ATTACHMENT 14

CWMP Alternatives Analysis,
Town of Bourne, December 7, 2022

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

ALTERNATIVES ANALYSIS

Town of Bourne, MA

December 7, 2022

ENVIRONMENTAL PARTNERS

— An Apex Company —

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Terms and Acronyms

208 Plan	The Section 208 Area Wide Water Quality Management Plan, developed under Section 208 of the Clean Water Act in 1978 and updated in 2015, is a framework to restore embayment water quality on Cape Cod. See also CCC.
303(d) List	Massachusetts' list of impaired and threatened waters per Clean Water Act Section 303(d).
ACEC	Areas of Critical Environmental Concern
BBC	Buzzards Bay Coalition
BGS	Below Ground Surface
BMP	Best Management Practice can be used to describe a stormwater treatment system or standard of care
BOD5	5-Day Biochemical Oxygen Demand measures the organic strength of wastewater
BOH	Board of Health
CCC	Cape Cod Commission is the regional land use planning, economic development, and regulatory agency created in 1990 to serve the citizens and 15 towns of Barnstable County, Massachusetts.
CEC	Contaminants of Emerging Concern
CFR	Code of Federal Regulation
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act
CWMP	Comprehensive Wastewater Management Plan; See Town Website "Frequently Asked Questions" Fact Sheet
DEIR	Draft Environmental Impact Report
DEP	Department of Environmental Protection
DO	Dissolved Oxygen
DRI	Development of Regional Impact
EIR	Environmental Impact Report
ENF	Environmental Notification Form
EOEEA	Executive Office of Energy and Environmental Affairs
EP or EPG	Environmental Partners Group, Inc.
FEIR	Final Environmental Impact Report
FEMA	Federal Emergency Management Agency
FIRM	Federal Insurance Rate Map
GIS	Geographic Information System
GWDP	Groundwater Discharge Permit
GPD or (gpd)	Gallons per Day
I/A	Innovative and Alternative Onsite System
IDDE	Illicit Discharge Detection and Elimination Program: detecting illegal accidental connections between the stormwater system and sewer system, detecting sources of human waste in a separated stormwater system.
I/I	Inflow and Infiltration, or uncontrolled flow sources into a sewer system. Typically from breaches in manholes, pipe joints, service connections or illegal connections.
IMA	Inter-municipal Agreement
IUP	Intended Use Plan

Terms and Acronyms

JBCC	Joint Base Cape Cod
LCP	Local Comprehensive Plan, completed in 2019 by Town of Bourne
LiDAR	Light Detection and Ranging; used for gathering terrain and elevation data, typically by drone or aircraft use.
MASSGIS	Massachusetts Office of Geographic Information Systems
MCL	Maximum Contaminant Level
MEP	Massachusetts Estuaries Project
MEPA	Massachusetts Environmental Policy Act is a public review of potential environmental impacts of projects.
MESA	Massachusetts Endangered Species Act
mg/L	Milligrams per Liter
MMA	Massachusetts Maritime Academy
MS4	Municipal Separate Stormwater System or exclusively stormwater pipes for drainage utilities.
NEIWPCC	New England Interstate Water Pollution Control Commission is a regional commission that helps the states of the Northeast preserve and advance water quality.
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NHESP	National Heritage and Endangered Species Program
NOAA	National Oceanic and Atmospheric Administration, a federal department of the U.S. Department of Commerce
NPC	Notice of Project Change
NRCS	National Resources Conservation Service: a federal agency which provides soil data and regional agricultural support
NPS	Non-point source; describes water runoff which is collected from several sources (ground, street, roof) as opposed to a point source or single outlet (effluent pipe or groundwater discharge wick)
NSA	Nitrogen Sensitive Areas as part of the future Title 5 Regulation proposed changes for areas with nitrogen impairments.
PPM	Parts Per Million; see also “mg/L”
PPY	Pounds per year; lbs./year
PRB	Permeable Reactive Barrier
RME	Responsible Management Entity is a public or private entity that provides oversight and maintenance for onsite systems
SAS	Soil Absorption System also known as a leach field
SBR	Sequencing Batch Reactor: a technology used for wastewater treatment
SCADA	Supervisory Control and Data Acquisition; A process control and monitoring system for Water and Wastewater Treatment Facilities
SMAST	School of Marine Science and Technology, University of Massachusetts Dartmouth
SNEP	Southeast New England Program: A partnership of government and non-government organizations all collaborating to innovatively improve water quality and habitats within New England’s coastal watersheds.
SRF	State Revolving Fund

Terms and Acronyms

SSO	Sanitary Sewer Overflow
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TR-16	Technical Report No. 16—Guides for the Design of Wastewater Treatment Works by NEIWPCC; Used as guide by engineers and operators for design criteria
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey; A federal agency responsible for soil, groundwater, stream and environmental data collection.
UV	Ultraviolet; A method for disinfection of wastewater effluent prior to discharge.
WPA	Wetlands Protection Act
WQS	Water Quality Standard
WWTF or WWTP	Wastewater Treatment Facility or Wastewater Treatment Plant.

EXECUTIVE SUMMARY

In 2021, the Town of Bourne embarked on the creation of a town-wide Comprehensive Wastewater Management Plan (CWMP) to be conducted in four successive phases. The first phase, the Needs Assessment, was completed in the first quarter of 2022. Phase II (this phase) consists of a screening of wastewater treatment technologies and management strategies for addressing the water quality concerns and infrastructure needs identified in the Needs Assessment. The remaining two phases, Phase III – Draft Recommended Plan and Phase IV – Regulatory Review are anticipated for completion in 2023.

Bourne has five nitrogen impaired watersheds that are identified as the priority watersheds in the Needs Assessment. Of these, two have been assigned a Total Maximum Daily Limit (TMDL) and three which have not yet received a TMDL but are under consideration for future study. The two TMDL watersheds are Phinney's Harbor and Megansett-Squeteague Harbor. The non-TMDL watersheds are Buttermilk Bay, Pocasset Harbor and Pocasset River, but are considered a priority for water quality needs, and are listed on the 2022 MassDEP/EPA Impaired Waters List. They are designated as second priority watersheds for nitrogen removal due to years of documented water quality concerns, including eutrophication and nitrogen loading.

Bourne completed their Needs Assessment in June 2022, which concluded that Bourne is to remove an estimated 8,100 kg of Nitrogen per year (kg N/year) to improve water quality across their priority watersheds. The primary source of nitrogen contamination in coastal communities, as identified by MassDEP, is from on-site septic systems.

All solutions for addressing TMDL goals and achieving the Town's water quality goals will need to be adaptive, meaning that the strategies will be adjusted over time as new technologies emerge and the Town's experience with individual strategies becomes known. This is consistent with the approach described in MassDEP's adaptive watershed management strategies. Table ES-1 presents a summary of the watersheds, their nitrogen impairment status, TMDL requirement status and the target nitrogen load to be removed annually.

Table ES-1: Summary of Bourne Watersheds

Embayment	Nitrogen Impaired?	TMDL Requirement?	Bourne Total Removal Goal (Kg-N/yr.)
Phinneys Harbor	Yes	Yes	1,706
Megansett-Squeteague Harbor*	Yes	Yes	564
Buttermilk Bay**	Yes	No	1,402
Pocasset Harbor	Yes	No	3,120
Pocasset River	Yes	No	1,289
Buzzards Bay	No	No	TBD
Cape Cod Canal	No	No	TBD
		Total	**8,072**

*Megansett-Harbor removal responsibility is shared with the Town of Falmouth.
**Buttermilk Bay removal responsibility with Town of Plymouth to be determined based on future MEP studies.

TECHNOLOGY OVERVIEW

The Board of Sewer Commissioners (BOSC) created a Wastewater Advisory Subcommittee (WAC) responsible for advising them in public policy and long-range planning as it related to the implementation of the CWMP. They participated in meetings and workshops to gain an understanding of nitrogen reduction alternatives. WAC members also visited sites to observe the installation and operation of innovative alternative treatment systems.

Environmental Partners (EP) and the WAC evaluated over 100 technologies, as provided by the Cape Cod Commission Technology Matrix. Categories include conventional (traditional), non-traditional, and policy alternatives. Examples of these nitrogen reduction strategies include tidal flushing, stormwater control and treatment, attenuation through wetlands and ponds, wastewater treatment (onsite treatment and disposal systems, innovative/alternative on site systems, cluster systems, community treatment plants and municipal treatment plants), water conservation and water reuse, land use planning and controls and nutrient trading. The preliminary screening of these alternatives performed as part of this CWMP Phase II selected the following priority technologies for Bourne.

- General Use Approved Innovative and Alternative (I/A) Onsite Systems
- Stormwater Best Management Practices

Conventional Sewering (either Centralized or Decentralized) is considered to be a backup alternative for each watershed, as needed. The CWMP is an adaptive management plan, which means that as conditions change over the coming years of the Recommended Plan, additional technologies (conventional and non-traditional) can be used by the Town at their discretion for use in particular watershed applications.

EVALUATION CRITERIA

The WAC, Town Staff, and EP developed the following evaluation criteria for screening the list of technologies for Bourne's recommended plan:

- Design flexibility for adding capacity
- Environmental Impacts
- Implementation Constraints and Risks
- Monitoring Requirements
- Nitrogen Removal
- Odor Emissions
- Land Area Requirements
- Maintenance/operation requirements
- Greenhouse Gas (GHG) Emissions
- Public Acceptance

- Alignment with Local Comprehensive Plan and Other Town Goals
- Resiliency to Climate Change

Each item was rated on a scale of 1 – 5 (1 being the least ideal, 5 being the most ideal) to help prioritize each technology in the recommended plan. This analysis resulted in the identification of highest-ranking alternatives for each watershed to be evaluated further.

ALTERNATIVES BY WATERSHED

Overall, the alternative utilizing conventional General Use Approved I/A onsite systems is able to meet the removal goal for most of the priority watersheds. Buttermilk Bay is the only nitrogen impaired watershed where a conventional centralized sewer alternative is also proposed. All watersheds included supplemental non-traditional stormwater best management practices as the secondary alternative. Table ES-2 below summarizes the alternatives proposed for each watershed and the expected removal range for the technologies.

Table ES-2: Summary of Alternatives and Total Estimated Nitrogen Removal

Embayment	Nitrogen Removal Goal (Kg-N/yr.)	Primary Alternative for Load Reduction	Estimated Nitrogen Removal Total (kg-N/yr.)
Megansett-Squeteague Harbor	564	General Use Approved I/A Onsite Systems	723 - 850
Phinneys Harbor	1,706	General Use Approved I/A Onsite Systems	2,384 – 2,565
Buttermilk Bay	1,402	Sewer Alternative 1	1,925
Pocasset Harbor	3,120	General Use Approved I/A Onsite Systems	3,292
Pocasset River	1,289	General Use Approved I/A Onsite Systems	1,363
Buzzards Bay	TBD	-	-
Cape Cod Canal	TBD	-	-
Total	**8,072**		**9,687 – 9,995**
		Additional Removal	*1,615 – 1,923*

Both Buzzards Bay and Cape Cod Canal do not have any Nitrogen impairments as identified by MassDEP and EPA on the 2022 Impaired Waters List and therefore have not had a nitrogen removal goal assigned to them. Recognizing that protection of both of these waterbodies regardless of their Impairment status remains a high priority for Bourne, long-term nitrogen reduction strategies are recommended for implementation in a phased approach over time.

CONCLUSION

The CWMP is rooted with the vision of "maximizing opportunities for the social and economic development while retaining an attractive, sustainable and secure coastline and environment for the enjoyment of residents and visitors," as described in Bourne's Local Comprehensive Plan. Creating a balanced recommended plan for achieving the water quality goals that the Town is committed to requires that a range of strategies be identified that are practical, achievable, and affordable for the community. The purpose of this screening analysis, Phase II of the CWMP, is to identify those broad strategies. The CWMP Phase III effort will develop the screened alternatives further, including their specific character in each watershed, the policy decision needed for their implementation, and their estimated costs.

SECTION 1 INTRODUCTION

In 2021, the Town of Bourne embarked on the creation of a town-wide Comprehensive Wastewater Management Plan (CWMP). The CWMP is rooted with the vision of "maximizing opportunities for the social and economic development while retaining an attractive, sustainable and secure coastline and environment for the enjoyment of residents and visitors," as described in Bourne's Local Comprehensive Plan. The CWMP Phase I - Needs Assessment was completed in the first quarter of 2022. Phase II (this phase) includes an analysis and screening of wastewater treatment technologies and management strategies for addressing the water quality concerns and infrastructure needs identified in the Needs Assessment. The remaining two phases, Phase III – Draft Recommended Plan and Phase IV – Regulatory Review are anticipated for completion in 2023.

Bourne completed their Needs Assessment in June 2022, which concluded that Bourne needs to remove an estimated 8,100 kg of Nitrogen per year (kg N/year) across their priority watersheds to achieve their water quality goals. The primary source of nitrogen contamination in coastal communities, as identified by MassDEP, is from on-site septic systems.

Bourne has five nitrogen impaired watersheds, which the Needs Assessment concluded are the priority watersheds. There are two types of priority watersheds: two with a Total Maximum Daily Limit (TMDL) and three which have not yet received a TMDL but are under consideration for future study.

The two TMDL watersheds within Bourne town limits are Phinney's Harbor and Megansett-Squeteague Harbor. The Phinney's Harbor watershed is located solely within Bourne, and therefore, is responsible for the entire TMDL reduction goal of 1,706 kg of Nitrogen per year established by MassDEP. Bourne and Falmouth share land within the Megansett-Squeteague Harbor watershed. Based on land area within the watershed, Bourne's nitrogen removal goal is estimated to be 564 kg per year. At the time of this study Falmouth has completed their CWMP for the South Coast Falmouth watersheds and the West Falmouth Watershed, however, a plan for addressing their nitrogen reduction requirement in Megansett-Squeteague has yet to be completed. Once both communities have individual watershed plans the two communities could engage in a shared watershed plan.

Buttermilk Bay, Pocasset Harbor and Pocasset River are non-TMDL watersheds, but they are considered a priority, as all three are listed on the 2022 MassDEP/EPA Impaired Waters List. They are designated as second priority watersheds for nitrogen removal due to documented water quality concerns, including eutrophication and nitrogen loading.

Both Buzzards Bay and Cape Cod Canal do not have any Nitrogen impairments as identified by MassDEP and EPA on the 2022 Impaired Waters List and therefore have not had a nitrogen removal goal assigned to them. Recognizing that protection of both of these waterbodies regardless of their Impairment status remains a high priority for Bourne, long-term nitrogen reduction strategies are recommended for implementation in a phased approach over time.

The CWMP is an adaptive management plan, which means that as conditions change over the coming years of the Recommended Plan, additional technologies (conventional and non-traditional) can be used by the Town at their discretion for use in particular watershed applications. Table 1 summarizes the watersheds, their nitrogen impairment status, TMDL requirement status and the target nitrogen load to be removed annually using technology/strategy alternatives.

Table 1: Summary of Bourne Watersheds

Embayment	Nitrogen Impaired?	TMDL Requirement?	Total Load to Remove kg-N/yr.	Bourne Total Removal Goal (Kg-N/yr.)
Phinneys Harbor	Yes	Yes	1,706	1,706
Megansett-Squeteague Harbor[1.]	Yes	Yes	1,446	564
Buttermilk Bay[2.]	Yes	No	1,402[3.]	1,402
Pocasset Harbor	Yes	No	3,120[3.]	3,120
Pocasset River	Yes	No	1,289[3.]	1,289
Buzzards Bay	No	No	4,208[3.]	TBD
Cape Cod Canal	No	No	41,007[3.]	TBD
			Total	8,072

1. Megansett-Harbor removal responsibility is shared with the Town of Falmouth.
2. Buttermilk Bay removal responsibility with Town of Plymouth to be determined based on future MEP studies.
3. Exact Loads to be removed are estimated based on Cape Cod Commission 208 Plan estimates from 2017; Massachusetts Estuaries Program (MEP) Studies have not been completed on these watersheds to determine the actual removal requirements and these are subject to change.

The Board of Sewer Commissioners (BOSC) created a Wastewater Advisory Subcommittee (WAC) responsible for advising them in public policy and long-range planning as it related to the implementation of the CWMP. They participated in meetings and workshops to gain an understanding of nitrogen reduction alternatives. WAC members also visited sites to observe the installation and operation of innovative alternative treatment systems.

Environmental Partners (EP) and the WAC evaluated over 100 technologies, as provided by the Cape Cod Commission Technology Matrix. Categories include conventional (traditional), non-traditional, and policy alternatives. Examples of these nitrogen reduction strategies include tidal flushing, stormwater control and treatment, attenuation through wetlands and ponds, wastewater treatment (onsite treatment and disposal systems, innovative/alternative on site systems, cluster systems, community treatment plants and municipal treatment plants), water conservation and water reuse, land use planning and controls and nutrient trading. The preliminary screening of these alternatives performed as part of this CWMP Phase II selected the following priority technologies for Bourne. The Phase II report is organized as follows:

- **Section 2 – Preliminary Screening of Technologies** presents a menu of technologies and strategies available for mitigating nitrogen discharges. They are categorized as conventional, non-traditional, and policy alternatives. These technologies include tidal flushing, stormwater control and treatment, attenuation through wetlands and ponds, wastewater

(onsite treatment and disposal systems, innovative/alternative on site systems, cluster systems, community treatment plants and municipal treatment plants), water conservation and water reuse, land use planning and controls and nutrient trading. Not all technologies are appropriate for incorporation in watershed nitrogen mitigation alternatives. The preliminary screening performed as part of this Phase II CWMP is intended to refine the technologies which the Town will further evaluate for consideration by the Town for inclusion into alternatives for each TMDL and impaired watersheds.

- **Section 3 – Evaluation Criteria** presents the evaluation criteria utilized for refining technologies chosen for each watershed. The criteria were selected by representatives of the community including the Board of Sewer Commissioners, Wastewater Advisory Committee and Town staff, and rely on MassDEP's guidelines of loading reduction rates for each technology. The criteria evaluation factors include nitrogen removal, design flexibility for handling varying loads and upgrades, environmental impacts and constraints, effluent quality, permit requirements, odor emissions, land requirements, ease of implementation, maintenance/operation requirements, greenhouse gas (GHG) emissions, public acceptance, conformance with the LCP, and climate change resiliency. This analysis resulted in the identification of the highest-ranking alternatives to be evaluated for each watershed.

- **Section 4 - Alternatives Evaluation** presents the alternatives evaluated for each watershed. The top-ranking alternatives were identified for further evaluation and included the following:
    - One conventional alternative as defined by MassDEP. In addition to conventional sewer/treatment plant approaches, the conventional alternative also includes General Use Approved Innovative/Alternative Onsite Systems.
    - Two alternatives comprised of decentralized and innovative/alternative technologies/strategies including enhancement of onsite systems with advanced treatment and innovative/alternative strategies such as shellfish aquaculture and permeable reactive barriers
    - Regional alternatives currently under discussion and development
        - For Buttermilk Bay, the Upper Bay Project led by the Buzzards Bay Coalition.
        - For Phinney's Harbor, Pocasset River, and Pocasset Harbor, the Joint Base Cape Cod Project led by Converge.

SECTION 2 PRELIMINARY SCREENING OF TECHNOLOGIES

The following sections describe the technologies considered for the Town's wastewater management alternatives. Several workshops were held with the Wastewater Advisory Committee, Town staff and EP to review the available technologies for wastewater treatment and nitrogen reduction. The screening of these technologies was based on an evaluation criterion matrix associated with individual watershed characteristics. The technologies are categorized according to the Cape Cod Commission 208 Plan 2015 update, including conventional, non-traditional, and policy alternatives.

SECTION 2.1 CONVENTIONAL

Based on guidance provided by MassDEP, a conventional alternative consists of any traditional wastewater management proven reduction strategy such as municipal sewering, package treatment facilities, or general use approved I/A systems. A sewered system consists of connections from individual homes that convey flow to a wastewater treatment plant with what is typically a centralized effluent discharge (either groundwater or surface water). For the purposes of the Preliminary Screening the conventional strategies are:

- General Use Approved, Innovative and Alternative Onsite Wastewater Systems, locally permitted under Title 5.
- Decentralized Wastewater Treatment Facilities (WWTFs) being a facility that provides treatment to a limited area such as a neighborhood. These facilities are often owned and operated by a private entity.
- Centralized WWTFs facility owned and operated by one municipality.
- Regional WWTFs owned and operated by multiple entities.

As part of the CWMP process, MassDEP requires that the community identify a conventional alternative for each watershed. EP highly recommends that the use of the General Use Approved I/A onsite system alternative is used with the creation of a Responsible Management Entity, or operation and maintenance utility, to oversee responsible management of the I/A onsite systems.

SECTION 2.2 NON-TRADITIONAL

The following are categories of non-traditional technologies, or technologies that do not employ traditional collection system, treatment, effluent disposal, and solids disposal processes. Based on guidance from MassDEP, if non-traditional strategies are targeted, the Town will have to identify a conventional alternative to be employed if the non-traditional alternative is unable to achieve the

water quality goals.[1] For some non-traditional technologies, the potential load reduction will also need to be supported by an MEP-equivalent linked embayment model to show that the proposed technology reduction will meet water quality goals at sentinel stations.

Green Infrastructure

- ***Phytoirrigation:*** Phytoirrigation utilizes plants to remove nutrients and other contaminants from irrigated WWTF effluent after secondary treatment. Phytoirrigation provides lower capital cost than tertiary treatment and a potential revenue from bio solids. The use of this technology requires ownership/control of large land areas and adherence to stringent and expensive implementation regulations. The resulting nitrogen removal is limited to growing season. For these reasons, this technology is not recommended for Bourne.
- ***Hydroponic Treatment:*** Photo Bioreactors or hydroponic treatment are natural systems that treat septic tank effluent. An aeration and a clarification chamber are employed to allow microbial communities and plants to engage with and treat the wastewater. Though pilot studies show that this technology has a high nitrogen removal rate, this technology is still in development and with high energy cost and low life span, it's not considered as a sustainable technology.
- ***Constructed Wetlands: Surface Flow, Sub-surface Flow, and Groundwater Treatment:*** Wastewater from a septic tank, WWTF secondary treatment unit or groundwater with high nitrogen levels is pumped to a constructed wetland consisting of plants with a constructed subsurface gravel bed. All constructed wetlands require an external carbon source to maintain effectiveness. This technology has proven to be very efficient in removing nitrate and nitrite with lower O&M costs. However, extensive monitoring and maintenance is needed the first few years of implementation. Maintenance issues typically noted for this type of construction include frequent clogging of the external carbon source, security and need for additional lining to prevent complete infiltration.

System Alterations

- ***Inlet/ Culvert Widening:*** Re-engineering and reconstruction of bridge or culvert openings increases the tidal flux through the culvert or inlet, thereby decreasing the nitrogen residence time. This is a restorative technology and does not remove the nitrogen from the estuary. To use inlet modeling as part of a non-traditional alternative, linked embayment modeling needs to be performed to confirm the confidence level of nitrogen removal from proposed improvements. Pre- and Post-modeling data confirms the confidence interval (or percent accuracy) that the proposed improvement will bring to the waterbodies of focus. Without the MEP-model equivalent data, inlet or culvert widening projects cannot be included in the Recommended Plan. For Bourne, only the Megansett Squeteague and Phinney's Harbor watersheds have these models developed. Due to modeling constraints, investigation of widening of inlet or culverts is not recommended for this iteration of

[1]Communication with MassDEP, September 22, 2022.

planning. Future adaptive management of this plan needs to accommodate appropriate time and effort for modeling if this alternative is planned for use.

- ***Coastal and Wetland Habitat Restoration:*** Restoration of coastal habitats includes establishing and/or enhancing native estuary salt marshes, eel grass beds, as well as shellfish and oyster beds together as an ecosystem to the local community. As a restorative sustainable technology, it returns the estuary to a more natural hydrologic regime and allows the growth of native species. Therefore, it's recommended as a non-conventional technology to watersheds with estuaries.
- ***Floating Constructed Wetlands:*** Manmade floating "islands" made of recycled materials serve as floating wetlands with exposed plant roots providing habitat for fish and microorganisms and treats waters within ponds and estuaries by reducing nitrogen and phosphorus levels. With limited nitrogen removal rates, resiliency, and site -specific restrictions, this technology is not recommended.
- ***Pond and Estuary Circulators:*** Electrically powered circulators installed in ponds and estuary increases the oxygen concentration in water while reducing nitrogen and/or phosphorus concentrations, while reducing odors, and enhancing fish habitat. The technology is still in initial stages of study and the percentage of nitrogen removal is still unclear. With additional site-specific restrictions and limited resiliency, it is not recommended to employ circulators.
- ***Pond and Estuary Dredging:*** Lakes, ponds, streams, and estuaries store nutrients within their sediments which accumulate over time. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. Dredging requires heavy permitting and can be disruptive to biological communities in sensitive ecosystems. More sediment data about Bourne's watersheds is needed to make a recommendation of this technology.
- ***Surface Water Remediation Wetlands***: Surface Water Remediation Wetlands are constructed to aid in water quality improvements to surface water bodies, usually streams or rivers, where water is pumped or allowed to flow naturally through treatment cells containing wetlands. Surface water remediation wetlands are used with free water surface (FWS) wetlands due to their larger size, and lower capital and O&M Costs. With a lot of regulatory work involved and large lands requirements, Surface Water Remediation Wetlands are not recommended.

On-Site Systems

- ***Innovative and Alternative Onsite Systems (Pilot and Provisional Status, per MassDEP):*** These onsite systems have denitrification components added to a traditional title 5 system that provide additional nitrogen removal. They can be adapted to retrofit existing systems and can accommodate a variety of existing conditions for new installations. Bourne already has some Pilot and Provisional IA systems in operation.
- ***Innovative and Alternative Onsite Enhanced Systems:*** Enhanced I/A systems have additional chemical treatment units that have the potential to achieve a 50% nitrogen removal rate, with a targeted nitrogen effluent concentration of 10 mg/L.

Decentralized Systems

- ***Cluster Treatment Systems:*** A single-stage cluster system is an I/A system treating wastewater flows greater than 2,000 gallons per day. Several homes or businesses discharge to and are treated by a shared I/A system. A two-stage cluster system requires a separate denitrifying process, chemical process, disinfection unit and an operator to run the system. With higher efficiency than individual systems, cluster treatment systems will be considered.
- ***Experimental On-site Treatment System:*** Next generation on-site systems utilize experimental technologies like Clear Pod, a bio-column for septic tanks; Applied Environmental Technologies and Enviro Utilities which use electrolytic reactors to remove nitrogen. These technologies are still in development with high potential to treat nitrogen and therefore is considered for units that have existing onsite systems.
- ***On-Site Grey Water Treatment:*** On-site grey water treatment processes include filtration and UV disinfection units. Treated grey water is recirculated for toilet flushing, lawn irrigation, and car washing. Because of high capital cost and maintenance requirements associated with this technology, it is not considered.

Innovative Resource Management

- ***Aquaculture- Shellfish and Mariculture:*** Shellfish, seaweed and other marine vegetation remove nitrogen from their environment. The cultivation and removal of the marine vegetation can remove nitrogen from an estuary, reducing the estuary's nitrogen load. This can serve as a dual-purpose project where shellfish can be harvested for market while there will be a local reduction in nitrogen in the overlying water column during the growth and maturation of the aquaculture. Estuaries within certain watersheds in Bourne can benefit from the implementation of aquaculture and help reduce the nitrogen load.
- ***Phytoremediation:*** Green plants with deep tap roots are planted as a buffer to intercept high nitrogen (nitrogen enriched) groundwater. The plants and microorganisms in their root zone reduce/use the nitrogen, removing it from the groundwater and watershed. Phytoremediation can be used to redirect a plume of nitrogen enriched groundwater or pull it up from deeper in the aquifer, allowing the plants to treat the plume. Lower capital and O&M cost, high nitrogen removal and ecological benefits are the reasons to recommend this technology.
- ***Fertigation Wells- Turf and Cranberry Bogs:*** Capturing nitrogen enriched groundwater using irrigation wells and using it to irrigate plants that use the nitrogen is called fertigation. Fertigation wells can capture nutrient enriched groundwater, typically from a concentrated source such as a WWTF discharge and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses and cranberry bogs. Due to the high removal of nitrogen and a potential revenue stream, fertigation wells in cranberry bogs are being considered.
- ***Permeable Reactive Barriers (PRBs):*** A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. Though with certain sitting requirement limitations,

PRBs have high efficiency and low overall cost and is considered as part of the alternatives evaluation.

Waste-Reduction Toilets

- ***Public Facility and Toilets- Urine Diverting:*** Urine diversion systems installed in public facilities diverts urine into a holding tank where the urine is stored and periodically collected by a servicing company which empties the tank for disposal or conversion to a fertilizer.
- ***Composting Toilets:*** A toilet system which separates human waste from shower, sink and other household water uses using minimal amounts of water. The human waste captured by the composting toilets is decomposed and turned into compost or fertilizer.
- ***Incinerating Toilets:*** Incinerating toilets are self-contained waterless systems that do not require being hooked-up to a sewer system or in-ground septic system (except to dispose of gray water). They rely on electric power or natural or propane gas to incinerate human waste to sterile clean ash.
- ***Packaging Toilets:*** A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

While there are compost toilets in use in Bourne, we do not recommend waste reduction toilets as an overall alternative strategy but something that individuals within the community can utilize in partnership with the watershed-based alternatives.

SECTION 2.3 POLICY-ORIENTED STRATEGIES

The following non-structural strategies, or policies, were considered as part of the Technology Matrix for Bourne.

- ***Fertilizer Management:*** Managing fertilizer application rates to lawns, golf courses, athletic facilities, and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally vegetated buffer strips on waterfront lots, and reducing application rates.
- ***Remediation of Existing Development:*** Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. High density existing developments near a WWTF with design capacity are eligible for this technology.
- ***Compact and Open Space Development:*** Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Small lots provide density that lowers wastewater

collection costs, and less lawn area reduces water and fertilizer use and is therefore recommended as a non-traditional alternative.

- ***Transfer of Development Rights:*** A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds. The protected parcels receive a deed restriction that limits the future level of development. Shifting the nitrogen load from more environmentally sensitive areas can benefit certain watersheds in Bourne and is therefore recommended.
- ***Stormwater BMPs:*** These strategies include street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and industrial/commercial reduction and control. Easily scalable and great efficiency, stormwater best management practices is highly recommended. According to the Cape Cod Commission technology Matrix, Stormwater BMPs have an estimated 25-50% removal of non-point sources of total nitrogen. 25% nitrogen removal was assumed at this stage of planning.

In February 2022, Environmental Partners completed a Mock Audit of Bourne's Municipal Separate Stormwater System (MS4) compliance with 2016 Massachusetts MS4 Permit and 2020 Permit Modifications. Based on EP's recommendation, the Town will update their Stormwater Management Plan (SWMP) within 4 years of the Permit effect date to include the reports assessing current street design and parking lot guidelines and the feasibility of allowing green infrastructure. The Town is also expanding upon and updating the following programs:

- Written Illicit Discharge Detection and Elimination (IDDE) Program
- Written procedures for site inspections and enforcement of sediment and erosion control procedures
- Listing of all interconnected MS4s and other separate storm sewer systems receiving a discharge from the permitted MS4;
- Written procedures to require submission of as-built drawings and ensure long term operation and maintenance
- Mapping of the separate storm sewer system, and
- An operation and maintenance plan

Continued coordination between the CWMP planning efforts and MS4 planning efforts will support the Town's efforts to achieve their watershed nitrogen removal goals.

SECTION 2.4 TECHNOLOGIES FOR EVALUATION

Table 2 summarizes those technologies that, on a preliminarily basis, were selected for detailed evaluation and analysis. The following technologies were determined to be technically feasible and that consist of primary (source removal) and secondary (remediation) technologies that are compatible with the Town's existing geography and growth characteristics of each Village.

Table 2: Bourne Non-Traditional Alternatives Engineering Feasibility Analysis

Technology Category	Expected Nitrogen Removal (%)	Technology by Watershed	Megansett Squeteague	Phinneys Harbor	Buttermilk Bay	Pocasset Harbor	Pocasset River	Buzzards Bay	Cape Cod Canal
Primary - Source Reduction									
Decentralized Systems	43-70%	Cluster Treatment System	X	X	X	X	X	X	X
	50-80%	Experimental On-site System Technologies							
	No Data	On-Site Grey Water Treatment							
Green Infrastructure	63%	Phytoirrigation							
	66%	Hydroponic Treatment							
	81%	Constructed Wetlands - Subsurface Flow							
	81%	Constructed Wetlands - Surface Flow							
Innovative Resource Management	12%	Aquaculture		X	X	X		X	
Non-Structural	50%	Fertilizer Management	X	X	X	X	X	X	X
	63%	Remediation of Existing Development	X	X	X	X	X	X	X
	100%	Compact and Open Space Development	X	X	X	X	X	X	X
	100%	Transfer of Development Rights	X	X	X	X	X	X	X
On-Site Systems	0%	Title 5 Septic System Replacement							
	28%	Innovative/Alternative (I/A) *	X	X	X	X	X	X	X
	Varied	I/A Hybrid Systems (2+ technologies) *	X	X	X	X	X	X	X
Waste Reduction Toilets	24%	Public Facility: Urine Diverting							
	24%	Toilets: Urine Diverting							
	62%	Toilets: Composting							
	62%	Toilets: Incinerating							
	62%	Toilets: Packaging							
Secondary - Restoration & Remediation									
System Alterations	12%	Inlet / Culvert Widening	X	X	X	X	X	X	X
	18%	Coastal Habitat Restoration	X	X	X	X	X	X	X
	25%	Floating Constructed Wetlands							
	83%	Surface Water Remediation Wetlands							
	88%	Pond and Estuary Dredging							
	No Data	Chemical Treatment of Ponds							
	No Data	Pond and Estuary Circulators							
Green Infrastructure	90%	Constructed Wetlands - Groundwater Treatment							
Innovative Resource Management	70%	Fertigation Wells - Cranberry Bogs							
	70%	Fertigation Wells - Turf							
	70%	Phytoremediation							
	73%	Permeable Reactive Barriers (PRBs)	X	X	X	X	X	X	X
Non-Structural	25-50%	Stormwater BMPs	X	X	X	X	X	X	X
		Total Alternatives Recommended	**11**	**12**	**12**	**12**	**11**	**12**	**11**

*I/A Systems assume use of Responsible Management Entity (RME) Utility Operation as part of Alternative Implementation.

SECTION 3 EVALUATION CRITERIA

The CWMP Plan of Study described a draft list of criteria to be used for evaluating the nitrogen reduction strategies described in Section 2. These criteria were reviewed and refined by the WAC and consist of the following:

- **Design Flexibility:** This category was rated in terms of how the technology assessed can be expanded or adapted to fit additional flows. If modules or components can be added to the treatment train over time to add on additional capacity for treatment, then it was rated more highly. More rigid treatment processes that have limited ability for expansion were rated lower.
- **Environmental Impacts**: including impacts on wetlands, water supply considerations, historical and archeological considerations. Biodiversity and conversation benefit, climate change resiliency, energy efficiency and flooding benefits were positive environmental impacts. Technologies with negative impacts on the environment with high greenhouse emissions were rated low on the evaluation criteria.
- **Institutional Considerations:** such as the need for changes in local by-laws and government organizations. Certain Non-structural source reduction technologies requires policy change within the community to effectively reduce nitrogen load in the Town of Bourne. Financial and regulatory limitations provide a disadvantage and therefore needs to be carefully evaluated. Legal ramifications and enforceability are other parameters to be considered.
- **Siting** considerations for any necessary pumping and/or treatment systems. Innovative technologies require specific siting requirements with frequent monitoring during the early implementation years. Land requirements above 10 acres were rated the lowest in the scoring criteria.
- **Reliability and flexibility**: Design flexibility with additional capacity, high nitrogen removal capacity and technology resilience were major factors in consideration for evaluation non-traditional technologies.
- **Outfalls to Surface Water**: Public acceptance was the major criteria utilized in evaluating this technology for discharge of treated wastewater. The Buzzards Bay Coalition has investigated a regional option of expanding treatment at the Wareham WWTF capacity and installing a larger outfall pipe at the current site of the Massachusetts Maritime outfall. At the Town meeting in November 2021, a warrant article was proposed to ban any new sewer outfalls into the Cape Cod Canal. It was approved unanimously at Town meeting. Therefore, surface water outfalls are considered the least acceptable option for the town of Bourne.

Each of these criteria were assigned a rating of 1 through 5, where a rating of 5 is the most preferable for the Town based on eh Technology's attributes of its cost benefit, high nitrogen removal, positive environmental impacts, and alignment with preservation. A summary of the rating categories for each criterion is provided in Table 3. Results from the evaluation of non-traditional alternatives is in Appendix A.

Table 3: Town of Bourne Evaluation Criteria

Criteria	Rating				
	1	2	3	4	5
Design flexibility for adding capacity	Not Scalable	Portions of Treatment only can be scaled up	Can only be scaled up for loads or flows	Portions of both can be scaled up	Can be scaled up for both flows and loads
Environmental Impacts	Negative Impacts	Some Negative impacts	No Impacts	Some positive impacts	Positive Impacts
Implementation Constraints	Constraints with no mitigation possible	Some constraints with equal mitigation	Some constraints	Few constraints	No constraints
Monitoring Requirements	Requires daily oversight	Requires monthly	Requires Quarterly	Requires semi annual	Requires annual
Nitrogen Removal	No Removal	0- 49% removal	50% Removal	50-75% Removal	Greater than 75% removal
Odor Emissions	High Odorous impact near waterfront	Odorous impact	Inland treatment with seasonal impact near waterfront	Some odors, mild	No odor impact, removed from villages completely
Land Area Requirements	>10 Acres	5-10 Acres	3-5 Acres	1-3 Acres	<1 Acre
Implementation Risk	High Risk, Technology Unapproved	Moderate Risk, Technology in Pilot	Mild Risk with mitigation for implementation	Some risk, low to mild impacts to implement	No Risk, No impact to implement
Maintenance/operation requirements	Daily Inspection, Daily Maintenance	Daily Inspection, Frequent maintenance	Monthly Inspection and Maintenance	Quarterly Inspection and Annual Maintenance	Annual or Bi Annual inspection and maintenance only as needed
Greenhouse Gas (GHG) Emissions	Permanent impacts and contribution	Construction with some permanent impacts	Temporary Construction Only (2-5 years)	Temporary Construction Only (1-2 years)	No permanent increase in GHG emissions
Public Acceptance	No	Maybe-No	Maybe	Maybe-Yes	Yes
Alignment with Local Comprehensive Plan and Other Town Goals	No	Maybe-No	Maybe	Maybe-Yes	Yes
Resiliency to Climate Change	No adaptation possible	Technology adaptation difficult	Technology not resilient, but some adaptation possible	Technology requires easy adaptation for resiliency	Technology is adaptable to climate changes

SECTION 4 ALTERNATIVES EVALUATION

After review of available structural and non-structural technologies and identification of evaluation criteria the WAC and Town Staff along with support from EP refined the alternatives to be applied to each of the watersheds for nitrogen removal. This Section describes the alternatives selected for each priority and non-priority watershed. The alternatives were applied in the following priority order:

1. **Conventional Alternatives**
   a. **General Use Approved, Innovative/Alternative Onsite Systems:** according to MassDEP, alternative systems with Certification for General Use will provide a level of environmental protection at least equivalent to that of a conventional on-site system designed in accordance with Title 5 and regulated by the Town Health Department. These systems can be used anywhere a conventional Title 5 system can be installed. The system owner is required to have inspection and testing performed as required by the approval on a regular schedule. The list of manufacturers and approved models is constantly being updated as new General Use Approvals are released. The most up to date list of approved technologies is found at the MassDEP Approved Title 5 Innovative/Alternative Technologies website at https://www.mass.gov/guides/approved-title-5-innovativealternative-technologies. A number of watersheds currently have I/A onsite systems already installed. The WAC and Town Staff have identified the desire to continue to utilize I/A onsite systems to the maximum extent possible for reduction of nitrogen in Bourne's watersheds.
   b. **Centralized Sewering:** Centralized sewering includes low pressure, gravity, or vacuum collection systems operated and maintained by the Town or Contract Operator on behalf of the Town. The wastewater is collected and conveyed (sometimes using pumping stations) to a wastewater treatment facility. The treatment facility can be Town-owned and operated or privately operated. Core sewer areas are not required for every watershed if suitable removal of nitrogen can be met using other conventional alternatives or sufficiently modeled non-traditional alternatives.
   c. **Decentralized Sewering:** Includes privately owned or publicly owned self-contained collection and treatment systems within a parcel or development of parcels. These types of facilities are typically found on large use properties such as condominium developments, large health facilities, schools, or hotels and resorts. This alternative includes the ability to upgrade onsite and neighborhood treatment facilities, especially in areas of densely developed neighborhoods.
   d. **Regional Sewering:** Centralized treatment alternatives, including expansion/upgrade of the existing WWTPs at the Wareham WWTF and the JBCC WWTF to improve nitrogen removal, and regional alternatives for treatment and/or disposal.

2. **Non-Traditional Technologies:**
    a. **Policy Based:** In addition the WAC selected stormwater best management practices (BMPs) will be used as the non-traditional technology across all watersheds, as applicable. Stormwater BMPs have an estimated 25-50% removal of non-point sources of total nitrogen, according to the Cape Cod Commission technology Matrix. An assumption of 25% nitrogen removal was assumed at this stage of planning.

The recommended alternatives for each watershed are described below, together with the estimated nitrogen removal associated with each alternative. Each alternative is accompanied with mapping that illustrates the assumed character of the scenario. The Watershed Multi-Variant Planning Tool (Watershed MVP) from the Cape Cod Commission was used to check calculations performed for each watershed and to provide an approximate cost per kg removed by watershed. The GIS-based program version 4.1 was used, accessible online using the following link: https://www.watershedmvp.org/login.

SECTION 4.1 MEGANSETT-SQUETEAGUE

Megansett-Squeteague Harbor has a TMDL which targets an annual Nitrogen loading removal of about 600 kg N/year. There are no decentralized nor centralized wastewater treatment facilities within the Megansett Squeteague watershed. Therefore to maintain existing village character and improve water quality, the Alternatives Analysis focused on onsite wastewater load reduction and stormwater best management practices.

Section 4.1.1 Conventional Alternatives

As part of the alternatives evaluation performed with the WAC, Innovative and Alternative (IA) onsite wastewater disposal systems was selected as the primary conventional alternative technology to be implemented in Megansett-Squeteague Harbor watershed.

4.1.1.1 General Use I/A Onsite Systems

A parcel-based mass balance calculation was used to estimate the nitrogen load reduction per parcel. Water use records by parcel were not available from the Bourne Water District, so the assumptions for each Land Use type are listed in Table 4.

Table 4: Parcel Water Use Assumptions by Land Use Code

Use Code	Average Water Use, GPD
Residential	183
Industrial	913
Commercial	548
Agricultural/Horticultural (Chap 61A)	1,827
Forest Property (Chap 61)	0
Multiple/Mixed Use	365
Exempt Property	0

Figure 1 (in Appendix B) shows the approximate location of the onsite systems to be converted to I/A General Use approved systems as well as the locations of existing I/A systems. Approximately 357 residential parcels were identified to be converted from Title 5 systems to I/A systems, removing approximately 630 kg N per year, or 100% of the total TMDL removal requirement for the Megansett-Squeteague Watershed. Loading calculations and assumptions are provided in Appendix C. Below is a summary of the parcel-based mass balance calculations showing predicted removal efficiency. Exempt properties were not included as part of the calculation.

Table 5: Megansett-Squeteague Conventional I/A Alternative

Parcels by Land Use	Number of Parcels	Septic Loading (kg N/year)	General Use I/A Loading (kg N/year)	Estimated Nitrogen Removal (kg N/year)
Commercial	21	376	272	104
Industrial	1	30	22	8
Multiple/Mixed Use	5	60	43	17
Residential	357	2,284	1,653	631
Total	**390**	**2,750**	**1,990**	**760**

For conservative planning purposes, only General Use MassDEP approved I/A system effluent concentrations that are recognized by MassDEP were modeled. The Town is interested in using a range of innovative technologies which may be able to meet a lower nitrogen effluent concentration, but for planning purposes, 19 mg/L was used as the effluent concentration for modeling I/A systems in Bourne's alternatives.

4.1.1.2 Centralized/Decentralized Sewering

There are no decentralized or existing wastewater treatment facilities within the Megansett-Squeteague Harbor watershed. Therefore, optimization of existing treatment facilities for decentralized treatment and construction of a sewer collection system is not recommended for this watershed. If sewering becomes available through partnership with Falmouth, then this plan can be adapted for future development of any centralized treatment alternatives.

4.1.1.3 Regional Sewering

Located at the southernmost part of Bourne, the closest geographic location available for a regional sewer is Falmouth or Mashpee. Falmouth has not identified any immediate plans to sewer this northern portion of town as of their latest CWMP Notice of Project Change (NPC) filing in 2020. Mashpee is focusing on their coastal embayments which are east of the region and are not considered feasible for Bourne to connect. Therefore, there is no regional sewering alternative proposed for Megansett-Squeteague embayment currently.

Section 4.1.2 Non-Traditional

Based on the non-traditional alternatives evaluation performed by EP and the WAC, there were no non-traditional structural alternatives selected for the Megansett Squeteague watershed. Based on

estimated nitrogen load removal calculations, it is expected that the Megansett Squeteague TMDL can be met using the conventional alternative alone. Stormwater BMPs were selected as suitable secondary alternative for removal of nitrogen from the Megansett Squeteague watershed. Using the Watershed MVP Scenario Mapping tool from the Cape Cod Commission, policy-based Stormwater BMPs will remove an estimated 219 kg of nitrogen per year. The model assumed a 25% reduction from Stormwater BMPs such as increasing public education on runoff and non-point source management, continuing parking lot sweeping and paved street sweeping, and modeling additional stormwater installations within the watershed.

Section 4.1.3 Megansett-Squeteague Summary

For Megansett-Squeteague, the majority of nitrogen source reduction will be achieved using I/A onsite wastewater systems by converting existing Title 5 systems to nitrogen-removing systems. Additional nitrogen removal will be supplemented through updating and implementing stormwater best management practices throughout the Town, including special attention to Megansett Squeteague as a priority TMDL watershed. Table 6 below shows a summary of the estimated nitrogen removal by Alternative Type.

Table 6: Megansett-Squeteague Alternative Summary

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg N/y)
Residential I/A General Use Onsite System Replacement	285 - 357	504 - 631
Stormwater BMP	-	219
Total Estimated Removal		**723-850**
TMDL Removal Requirement		*600*
Removal Goal Met?		**Yes**

The overall TMDL reduction goal is met with implementation of both conventional General Use I/A onsite system conversions and implementing updates to the Town wide Stormwater Management Practices. With this alternative the TMDL removal requirement is met and exceeded by approximately 125 – 150 kg-N per year. The use of a Responsible Management Entity is strongly recommended with the implementation of the General Use I/A onsite system alternative..

SECTION 4.2 PHINNEYS HARBOR

Phinney's Harbor has a TMDL, which requires that nitrogen loading to the harbor be reduced by 1,710 kg N/year.

Section 4.2.1 Conventional Alternatives

As part of the alternatives evaluation performed with the WAC, Innovative and Alternative (I/A) onsite wastewater disposal systems were selected as the main technology to be implemented in Phinney's Harbor watershed.

4.2.1.1 General Use I/A Onsite Systems

A parcel-based mass balance calculation was used to estimate nitrogen load reduction per parcel. Water use records by parcel were not provided by the Bourne Water District. Values for water use by land type from Table 4 in Section 4.1.1.1 were used. Figure 2 (in Appendix B) shows the approximate location of estimated onsite systems to be converted to I/A General Use approved systems as well as locations of existing I/A systems. Approximately 1,130 residential parcels were identified to be converted from Title 5 systems to I/A systems, removing approximately 2,000 kg N per year, or 100% of the total TMDL removal requirement for the Phinney's Harbor Watershed. Loading calculations and assumptions are provided in Appendix C. Below is a summary of the watershed loading calculation and predicted removal efficiency.

Table 7: Phinney's Harbor Conventional I/A Alternative

Parcels by Land Use	Number of Parcels	Septic Loading (kg N/year)	General Use I/A Loading (kg N/year)	Estimated Nitrogen Removal (kg N/year)
Residential	1,133 -1,235	7,900	5,246 – 5,718	2,001 – 2,182
Multiple/Mixed Use	11	131	95	36
Total	1,144 -1,246	8,031	5,341 – 5,813	2,037 – 2,218

Consistent with Megansett-Squeteague Harbor, General Use Approved I/A Onsite System nitrogen effluent concentration of 19 mg/L was used as the effluent concentration for modeling I/A systems in Bourne's alternatives.

4.2.1.2 Centralized/Decentralized Sewering

For conventional collection system and treatment alternatives, existing decentralized wastewater treatment facilities with existing groundwater discharge permits were prioritized for developing additional collection system capacity. There are two treatment plants in Phinney's Harbor watershed. Based on MassDEP daily monitoring report (DMR) data, available capacity was calculated using the average max daily flow observed during the last three years of permit data and subtracting from the capacity of the plant, dividing by a peaking factor of 2.4. In total, there is less than 19,000 GPD of existing decentralized treatment and discharge capacity available for residential flow.

Table 8: Phinney's Harbor Existing Decentralized WWTFs

Existing WWTF	Groundwater Discharge Permitted Flow (GPD)	Observed Max Day Flow (GPD)	Estimated Max Day Flow Available Capacity (GPD)
The Villages at Brookside (GWD Permit #415)	60,000	34,791	10,500
Residences at Canal Bluffs (GWD Permit #852)	31,994	13,400	7,800
		Total	**18,300**

Source: MassDEP Annual DMR Reports, 2019-2021

Using the existing decentralized wastewater treatment plants to meet the TMDL removal goal alone would require approximately 390 existing Title 5 systems to connect to a sewer collection system. In Phinney's Harbor, this is about 30% of Title 5 systems within the watershed. The estimated flow from 390 individual Title 5 systems is 68,800 gpd, using the average Bourne Water District water use of 196 gallons per day per account times the wastewater coefficient of 90% (196 gpd water use x 90% = 176 gpd of wastewater flow x 390). Based on the available capacity at existing decentralized treatment facilities of 18,300 gpd, the estimated flow need for sewering the TMDL load from Phinney's Harbor is 50,500 gpd.

In order to further develop this as an alternative for the community a comprehensive process evaluation should be conducted for each of the facilities. The assessments would be used to identify:

- Condition of collection system and treatment plant
- Required upgrades needed to support the additional flow to the plant
- Required additional infrastructure to transport sewage from the expanded service area to the WWTP
- Legal analysis to convert facility from private ownership and operations to municipal ownership and operations
- Approval from MassDEP for transfer of the Groundwater Discharge Permit to the town along with approval of the additional flow to the facility.

Since the General Use I/A onsite system approach for Phinneys Harbor effectively removes the required levels of nitrogen to meet the TMDL the WAC determined further expenditures to vet this option was not in the best interest of the community for the Alternatives Analysis phase of this study.

4.2.1.3 Regional Sewering

Five towns (Barnstable, Sandwich, Falmouth, Bourne and Mashpee) participated in a study completed by Wright- Pierce in 2019 to evaluate the existing Joint Base Cape Cod (JBCC) facilities as a potential future regional treatment facility. Phinney's Harbor is located within the collection radius of the JBCC regional wastewater collection and treatment alternative presented in the study.

The study recommended the transfer of ownership and operations of the facility from the Department of Defense to another entity. Over the last three years the Department of Defense began the process of investigating this option and has subsequently released military control of the wastewater treatment facility and collection system to Converge, an investment company. Converge as the new owner of the facilities has contracted with an operations firm, ASUS, to operate and maintain the existing collection, treatment, and disposal systems. Wright-Pierce is in the process of updating the 2019 study, to further examine the available flow capacity and project phasing under the new ownership of the facility. This study is expected to be completed in late 2023.

The conventional General Use I/A onsite system alternative meets the TMDL removal goal for Phinney's Harbor watershed, but if adaptive management reveals additional sewering is needed,

then the JBCC regional option can be considered for future uses. This alternative would require the planning, design and construction of a collection system from Phinneys Harbor residences to a pump station and a forcemain to convey the sewage to the regional facility.

Section 4.2.2 Non-Traditional

Based on the non-traditional alternatives evaluation performed by EP and the WAC, there were no non-traditional structural alternatives selected for the Phinney's Harbor watershed. Stormwater BMPs were selected as a suitable policy-based alternative for removal of nitrogen from the Phinney's Harbor watershed. Using the Watershed MVP Scenario Mapping tool from the Cape Cod Commission, policy-based Stormwater BMPs will remove an estimated 383 kg N per year spread over 1,384 parcels. The model assumed a 25% reduction from Stormwater Best Practices such as increasing public education on runoff and non-point source management, continuing parking lot sweeping and paved street sweeping, and modeling additional stormwater installations within the watershed. In coordination with Bourne's MS4 Program Requirements, outcomes from the Nitrogen Source Identification Report for Phinney's Harbor can include improvements to existing stormwater infrastructure and new device installations.

Based on estimated nitrogen load removal calculations, it is expected that the Phinney's Harbor TMDL can be met using the conventional alternative alone. If additional removal is needed in the future, Bourne can use its Technology Screening Matrix and Evaluation tools to assess new alternatives as part of an effective adaptive management strategy.

Section 4.2.3 Phinneys Harbor Summary

For Phinney's Harbor, the majority of nitrogen source reduction will be achieved by converting existing Title 5 systems to General Use Approved I/A Onsite Systems. Supplemental nitrogen removal will be achieved by updating and implementing stormwater best management practices, including ongoing stormwater improvements in Phinney's Harbor. Table 9 below shows a summary of the estimated nitrogen removal by Alternative Type.

Table 9: Phinney's Harbor Alternative Summary

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg-N/y)
Residential I/A General Use Onsite System Replacement	1,133 -1,235	2,001 – 2,182
Stormwater BMP	-	383
	Total	**2,384 – 2,565**
	TMDL Removal Goal	*1,706*
	Removal Goal Met?	**Yes**

The overall TMDL reduction goal is met with implementation of conventional General Use Approved I/A onsite system conversions, as well as updates to Town wide Stormwater Management Practices. The TMDL removal requirement is met with this alternative and is exceeded by approximately 650-850 kg-N per year. The implementation of the General Use I/A onsite system alternative will require the creation of a Responsible Management Entity.

SECTION 4.3 BUTTERMILK BAY

Buttermilk Bay is a non-TMDL watershed but has nitrogen impairments according to the MassDEP/EPA joint-approved Impaired Water List. Buttermilk Bay and Little Buttermilk Bay have documented water quality concerns associated with nitrogen loading and eutrophication. Buttermilk Bay is considered a priority watershed for determining solutions as part of the recommended plan. Based on the Needs Assessment, the estimated nitrogen removal need is 1,402 kg N per year, or 25% of the existing wastewater loading of the watershed based on existing onsite wastewater treatment.

Section 4.3.1 Conventional Alternatives

As part of the alternatives evaluation performed with the WAC, General Use approved Innovative and Alternative (I/A) onsite wastewater disposal systems were selected as the main conventional technology to be implemented in Buttermilk Bay watershed with supplemented removal from limited conventional centralized sewer and stormwater BMP improvements.

4.3.1.1 General Use I/A Onsite Systems

Figure 3 in Appendix B shows the approximate location of estimated onsite systems to be converted to I/A General Use approved systems as well as locations of existing I/A systems. Approximately 700 residential parcels were identified to be converted from Title 5 systems to I/A systems, removing approximately 1,120 kg N per year, or just about 80% of the total nitrogen removal goal for Buttermilk Bay. Loading calculations and assumptions are provided in Appendix C. Below is a summary of the watershed loading calculation and predicted removal efficiency.

Table 10: Buttermilk Bay Conventional I/A Alternative

Parcels by Land Use	Number of Parcels	Septic Loading) (kg N/year)	General Use I/A Loading (kg N/year)	Estimated Nitrogen Removal (kg N/year)
Agricultural/Horticultural	7	417	302	115
Commercial	1	18	13	5
Multiple/Mixed Use	7	83	60	23
Residential	713	4,057	2,936	1,120
Total	**728**	**4,575**	**3,311**	**1,264**

Consistent with the TMDL Watersheds, General Use Approved I/A onsite system nitrogen effluent concentration of 19 mg/L was used as the effluent concentration for modeling.

4.3.1.2 Centralized/Decentralized Sewering

There are no decentralized sewering opportunities for the Buttermilk Bay watershed. There is a centralized collection system close to the Buttermilk Bay watershed. Existing privately owned low-pressure collection system exist at the Hideaway Village community, a two and three season home

neighborhood on the North side of Buttermilk Bay. The Hideaway Village Pump Station collects flow and conveys directly to the Town of Wareham Sewer Collection System via the Red Brook Pump Station. Hideaway Village is not connected to the remaining Bourne municipal sewer system. The rest of the Buzzards Bay collection system includes properties along the Main Street Corridor, as well as neighborhoods such as Taylor's Point, and conveys flow by gravity and low-pressure systems to the Buzzards Bay Wastewater Treatment Facility (WWTF) at Queen Sewell Park or to the Wareham Collection System by forcemain.

The Town of Bourne owns and operates the Buzzards Bay WWTF. The Buzzards Bay WWTF is intended for economic development within the Buzzards Bay village corridor and existing collection system. It entered service in August 2021 and operates at a peak daily flow between 20,000 gpd and 60,000 gpd. Table 11 below shows the flow data to date.

Table 11: Buzzards Bay WWTF Flow Data

Effluent Flow Category	Gallons Per Day (GPD)
Groundwater Discharge Permitted Flow	100,000
Highest Recorded Peak Daily Flow	62,100
Average Peak Daily Flow	38,221

Source: Weston & Sampson Daily operating Records, Aug 2021– Sep 2022

One sewer alternative was developed for Buttermilk Bay, building from the limits of the existing Bourne owned and operated collection system down Main Street in Buzzards Bay. Approximately 330 residential parcels were selected along the southern portion of Buttermilk Bay, in densely developed neighborhoods. The Upper Bay Project reports have previously cited this area as a candidate for a low-pressure sewer collection system. Table12 below shows the one sewer alternative for this watershed and its approximate wastewater flow estimate. Existing I/A Systems within the sewer alternative area were not included as part of the sewer area calculations.

Table 12: Buttermilk Bay Conventional Sewer Alternative 1

Structural Alternative	Number of Residential Parcels	Peak Daily Flow Estimate (GPD)
Sewer Alternative 1	330	125,000

The Board of Sewer Commissioners (BOSC) manages capacity allocation to the existing wastewater collection system in Bourne. The BOSC considers the flow capacity of the collection system to be a combined total of 300,000 gpd; 200,000 gpd as an intermunicipal agreement with Wareham and 100,000 gpd at Bourne's Buzzards Bay WWTF. While the collection system in Bourne has additional capacity, any collection system expansion would need to be in accordance with the intermunicipal agreement with Wareham. Therefore, as of November 29, 2022, the BOSC has allocated all remaining capacity to the Buzzards Bay WWTF and any collection system expansion would likely send flow through the intermunicipal agreement to Wareham.

Based on a peak daily flow estimate total of 125,000 gpd from Sewer Alternative 1 and considering that the Buzzards Bay WWTF available capacity has already been allocated, Buttermilk Bay watershed has a 125,000 gpd wastewater treatment needs gap.

4.3.1.3 Regional Sewering

Wareham Wastewater Collection and Treatment System is considered a regional alternative. The Buzzards Bay Coalition conducted an Upper Bay Regional Wastewater Feasibility Assessment (known as the Upper Bay Project) over the course of a five-year period. The assessment took into consideration wastewater disposal needs for Wareham, Bourne, Marion, Plymouth and Massachusetts Maritime Academy. The report found that an expanded Wareham treatment facility with treatment to remove 90% of the nitrogen loading to the plant could meet the sewer needs of all the communities and reduce nitrogen pollution. The Buzzards Bay Coalition concluded that the use of the existing Massachusetts Maritime Academy (MMA) wastewater treatment plant outfall location would be the best new location of effluent disposal for the new Regional Wareham Wastewater Treatment Plant. The concept of using the MMA outfall, located in Bourne, for increased discharges into Buzzards Bay is not supported by Bourne's residents.

During November 2021, at a Special Town Meeting, the Town considered a non-binding article to restrict future effluent outfall projects from being constructed within the Town of Bourne. The Town Meeting Moderator told the audience that passage of Petitioner Warrant Article 11, a non-binding article, did not require a roll-call vote only a simple majority. The resulting voice vote was overwhelmingly in favor. It is clear that the Town of Bourne does not support this regional approach as an option if it is associated with an outfall along the Canal.

Section 4.3.2 Non-Traditional

For Buttermilk Bay, there are few remaining undeveloped parcels within the watershed boundaries. Therefore, the development potential within the watershed is limited under current zoning. Based on the non-traditional alternatives evaluation performed by EP and the Bourne WAC. Stormwater BMPs was selected as a suitable secondary alternative for removal of nitrogen from the Buttermilk Bay watershed. Using the Watershed MVP Scenario Mapping tool from the Cape Cod Commission, policy-based Stormwater BMPs will remove an estimated 177 kg N per year. The Watershed MVP model assumed a 25% reduction from stormwater BMPs such as increasing public education on runoff and non-point source management, continuing parking lot sweeping and paved street sweeping, and modeling additional stormwater installations within the watershed. In coordination with Bourne's MS4 Program Requirements, outcomes from the Nitrogen Source Identification Report for Buttermilk Bay and Little Buttermilk Bay can include improvements to existing stormwater infrastructure and new device installations.

Based on estimated nitrogen load removal calculations, it is expected that the Buttermilk Bay nitrogen removal goals can be met using the conventional General Use I/A alternative combined with Sewer Alternative No.1 for a portion of the watershed parcels If additional removal is needed in the future, Bourne can use its Technology Screening Matrix and Evaluation tools to assess new alternatives as part of an effective adaptive management strategy.

Section 4.3.3 Buttermilk Bay Summary

For Buttermilk Bay, the majority of nitrogen source reduction will be through converting existing Title 5 systems to General Use Approved I/A onsite systems and one sewer alternative. Additional nitrogen removal will be supplemented through updating and implementing stormwater BMPs throughout the Town, including ongoing stormwater improvements in Buttermilk Bay/Buzzards Bay Downtown District. Table 13 below shows a summary of the estimated nitrogen removal by Alternative Type.

Table 13: Buttermilk Bay Alternative Summary

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg-N/y)
Residential I/A General Use Onsite System Replacement	374	588
Sewer Alternative 1	330	1,160
Stormwater BMP	-	177
Total		**1,925**
Nitrogen Removal Goal		*1,402*
Removal Goal Met?		*Yes*

The overall nitrogen reduction goal is met with implementation of conventional sewer alternatives and I/A onsite system conversions, as well as updates to Town wide Stormwater Management Practices. The TMDL removal requirement is met and exceeded by approximately 500 kg-N per year. The implementation of the General Use I/A onsite system alternative will require the creation of a Responsible Management Entity.

SECTION 4.4 POCASSET HARBOR

Pocasset Harbor is a non-TMDL watershed but has nitrogen impairments according to the MassDEP/EPA joint-approved Impaired Water List. Pocasset Harbor has documented water quality concerns, including eutrophication and nitrogen loading concerns. Therefore, Pocasset Harbor is considered a priority watershed for determining solutions as part of the recommended plan. Based on the Needs Assessment, the estimated nitrogen removal need is 3,120 kg N per year, or 25% of the existing wastewater loading of the watershed based on existing onsite wastewater treatment.

Section 4.4.1 Conventional Alternatives

As part of the alternatives evaluation performed with the WAC, General Use Approved I/A onsite wastewater disposal systems were selected as the main conventional technology to be implemented in Pocasset Harbor watershed.

4.4.1.1 General Use I/A Onsite Systems

A parcel-based mass balance calculation was used to estimate nitrogen load reduction per parcel. Water use records by parcel were not provided by the Bourne Water District. Values for water use by land type from Table 4 in Section 4.1.1 were used. Figure 4 (in Appendix B) shows the approximate location of estimated onsite systems to be converted to I/A General Use approved systems as well as locations of existing I/A systems.

Table 14: Pocasset Harbor Conventional I/A Alternative

Parcels by Land Use	Number of Parcels	Septic Loading (kg N/year)	General Use I/A Loading (kg N/year)	Estimated Nitrogen Removal (kg N/year)
Residential	1,450	9,276	6,714	2,562
Commercial	53	948	686	262
Multiple/Mixed Use	13	155	112	43
Total	**1,516**	**10,379**	**7,512**	**2,877**

4.4.1.2 Centralized/Decentralized Sewering

Pocasset Harbor does not have any centralized collection or treatment facilities. There are several decentralized wastewater collection and treatment systems with groundwater discharges located throughout the watershed. After review of MassDEP DMR records, two existing decentralized treatment facilities have available capacity for future flow, if needed. Table 15 below shows the existing permitted flow, the maximum recorded flow at the facility and the approximate available capacity for future connections.

Table 15: Pocasset Harbor Existing Decentralized WWTFs

Existing WWTF	Permitted Flow (GPD)	Max Day Flow (GPD)	Available Capacity (GPD)
Pocasset Assisted Living (GWD Permit #778)	16,350	3,3000	5,200
Cataumet Harbor (GWD Permit #954)	32,430	4,018	11,800
		Total	**17,000**

Source: MassDEP Annual DMR Reports, 2019-2021

Using the existing decentralized wastewater treatment plants to meet the nitrogen removal goal alone would require approximately 710 existing Title 5 systems to connect to a sewer collection system. In Pocasset Harbor, this is about 40% of Title 5 systems within the watershed. The estimated flow from 710 individual Title 5 systems is 125,250 gpd, using the average Bourne Water District water use of 196 gallons per day per account times the wastewater coefficient of 90% (196 gpd water use x 90% = 176 gpd of wastewater flow x 710). Based on the available capacity at existing decentralized treatment facilities of 17,000 gpd, the estimated flow need for sewering the nitrogen removal goal from Pocasset Harbor is 108,250 gpd.

In order to further develop this as an alternative for the community a comprehensive process evaluation should be conducted for each of the facilities. The assessments would be used to identify:

- Condition of collection system and treatment plant
- Required upgrades needed to support the additional flow to the plant
- Required additional infrastructure to transport sewage from the expanded service area to the WWTP
- Legal analysis to convert facility from private ownership and operations to municipal ownership and operations
- Approval from MassDEP for transfer of the Groundwater Discharge Permit to the town along with approval of the additional flow to the facility.

Since the General Use I/A onsite system approach for Pocasset Harbor effectively removes the required levels of nitrogen to meet the TMDL the WAC determined further expenditures to vet this option was not in the best interest of the community for the Alternatives Analysis phase of this study.

4.4.1.3 Regional Sewering

Pocasset Harbor is located within a feasible sewering radius of the Joint Base Cape Cod (JBCC) regional wastewater collection and treatment alternative. As stated earlier, the five towns (Barnstable, Sandwich, Falmouth, Bourne and Mashpee) are participating in an update to the 2019 study, to further examine the available flow capacity and project phasing under the new ownership of the facility. This study is expected to be completed in late 2023.

The conventional General Use I/A onsite system alternative meets the nitrogen removal goal for Pocasset Harbor watershed, but if adaptive management reveals additional sewering is needed, then the JBCC regional option can be considered for future uses. This alternative would require the planning, design and construction of a collection system from Pocasset Harbor residences to a pump station and a forcemain to convey the sewage to the regional facility.

Section 4.4.2 Non-Traditional

Pocasset Harbor is densely populated throughout its watershed boundaries, but it is not a downtown district. Therefore, the development potential within the watershed is limited under current zoning. Based on the non-traditional alternatives evaluation performed by EP and WAC Stormwater Best Management Practices (BMPs) was selected as a suitable secondary alternative for removal of nitrogen from the Pocasset Harbor watershed. Using the Watershed MVP Scenario Mapping tool from the Cape Cod Commission, policy-based Stormwater BMPs will remove an estimated 470 kg N per year. The Watershed MVP model assumed a 25% reduction from Stormwater Best Practices such as increasing public education on runoff and non-point source management, continuing parking lot sweeping and paved street sweeping, and modeling additional stormwater installations within the watershed.

The WAC, Town Staff and Board of Sewer Commissioners have expressed interest in additional alternatives in this area such as Circuit Avenue Drainage Infrastructure Improvements, including the potential installation of stormwater devices to reduce nitrogen loading and potentially larger devices. The community is also interested in aquaculture, especially oysters, dependent upon funding and balancing other source reduction technologies as part of this plan.

In addition, the WAC, Town Staff and Board of Sewer Commissioners have expressed interest in additional alternatives in this area such as Hen Cove Dredging and Culvert Widening, restoration of coastal habitat, and drainage infrastructure improvements, including the potential installation of stormwater devices to reduce nitrogen loading and potentially larger devices. These alternatives will require additional modeling utilizing the MEP linked Culvert Widening and Linked embayment modeling or equivalent to justify the removal estimate.

Section 4.4.3 Pocasset Harbor Summary

For Pocasset Harbor, the majority of nitrogen source reduction will be replacement of existing Title 5 onsite systems with General Use Approved I/A onsite systems and updating and implementing stormwater best management practices throughout the Town. Table 16 below shows a summary of the estimated nitrogen removal by Alternative Type.

Table 16: Pocasset Harbor Alternative Summary

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg-N/y)
Residential I/A General Use Onsite System Replacement	1,450	2,562
Commercial I/A General Use Onsite System Replacement	53	262
Stormwater BMP	-	470
	Total	**3,292**
	Nitrogen Removal Goal	*3,129*
	Removal Goal Met?	*Yes*

The overall nitrogen reduction goal is met with implementation General Use Approved I/A onsite system conversions for residential and commercial properties, as well as updates to Town wide Stormwater Management Practices. There is an estimated additional nitrogen removal of approximately 200 kg-N per year after meeting the nitrogen removal goal. The implementation of the General Use I/A onsite system alternative will require the creation of a Responsible Management Entity.

SECTION 4.5 POCASSET RIVER

Pocasset River is a non-TMDL watershed but has nitrogen impairments according to the MassDEP/EPA joint-approved Impaired Water List. Pocasset River has documented water quality concerns, including eutrophication and nitrogen loading concerns. Therefore, Pocasset River is considered a priority watershed for determining solutions as part of the recommended plan. Based on the Needs Assessment, the estimated nitrogen removal need is 1,289 kg N per year, or 25% of the existing wastewater loading of the watershed based on parcel-based mass balance calculations.

Section 4.5.1 Conventional Alternatives

As part of the alternatives evaluation performed with the WAC, MassDEP General Use Approved Innovative and Alternative (I/A) onsite wastewater disposal systems were selected as the primary conventional alternative technology to be implemented in Pocasset River watershed.

4.5.1.1 General Use I/A Onsite Systems

A parcel-based mass balance calculation was used to estimate nitrogen load reduction per parcel. Water use records by parcel were not provided by the Bourne Water District. Values for water use by land type from Table 4 in Section 4.1.1 were used.

Table 17: Pocasset River Conventional I/A Alternative

Parcels by Land Use	Number of Parcels	Septic Loading (kg N/year)	General Use Approved I/A Loading (kg N/year)	Estimated Nitrogen Removal (kg N/year)
Commercial	48	859	621	237
Multiple/Mixed Use	6	72	52	20
Residential	650	4,158	3,010	1,148
Total	**704**	**5,088**	**3,683**	**1,405**

Figure 5 in Appendix B shows the approximate location of estimated onsite systems to be converted to I/A General Use approved systems as well as locations of existing I/A systems.

4.5.1.2 Centralized/Decentralized Sewering

Pocasset River does not have any centralized collection or treatment facilities. There is one decentralized wastewater collection and treatment system with a groundwater discharge in the watershed. After review of MassDEP DMR records, there is some capacity for future flow, if needed. Table 18 below shows the existing permitted flow, the maximum recorded flow at the facility and the approximate available capacity for future connections.

Table 18: Pocasset River Existing Decentralized WWTFs

Existing WWTF	Permitted Flow (GPD)	Max Day Flow (GPD)	Available Capacity (GPD)
The Park at Pocasset (GWD Permit #830)	38,605	10,314	11,200

Source: MassDEP Annual DMR Reports, 2019-2021

Using the existing decentralized wastewater treatment plants to meet the nitrogen removal goal alone would require approximately 300 existing Title 5 systems to connect to a sewer collection system. In Pocasset River, this is about 40% of Title 5 systems within the watershed. The estimated flow from 300 individual Title 5 systems is 52,920 gpd, using the average Bourne Water District water use of 196 gallons per day per account times the wastewater coefficient of 90% (196 gpd water use x 90% = 176 gpd of wastewater flow x 710). Based on the available capacity at the existing decentralized treatment facility of 11,200 gpd, the estimated flow need for sewering the nitrogen removal load from Pocasset River is 41,390 gpd.

In order to further develop this as an alternative for the community a comprehensive process evaluation should be conducted for each of the facilities. The assessments would be used to identify:

- Condition of collection system and treatment plant
- Required upgrades needed to support the additional flow to the plant

- Required additional infrastructure to transport sewage from the expanded service area to the WWTP
- Legal analysis to convert facility from private ownership and operations to municipal ownership and operations
- Approval from MassDEP for transfer of the Groundwater Discharge Permit to the town along with approval of the additional flow to the facility.

Since the General Use I/A onsite system approach for Pocasset River effectively removes the required levels of nitrogen to meet the TMDL the WAC determined further expenditures to vet this option was not in the best interest of the community for the Alternatives Analysis phase of this study.

4.5.1.3 Regional Sewering

Pocasset River is located within a feasible sewering radius of the Joint Base Cape Cod (JBCC) regional wastewater collection and treatment alternative. As stated earlier, the five towns (Barnstable, Sandwich, Falmouth, Bourne and Mashpee) are participating in an update to the 2019 study, to further examine the available flow capacity and project phasing under the new ownership of the facility. This study is expected to be completed in late 2023.

The conventional General Use I/A onsite system alternative meets the nitrogen removal goal for Pocasset River watershed, but if adaptive management reveals additional sewering is needed, then the JBCC regional option can be considered for future uses. This alternative would require the planning, design and construction of a collection system from Pocasset River residences to a pump station and a forcemain to convey the sewage to the regional facility.

Section 4.5.2 Non-Traditional Alternatives

Similar to Pocasset Harbor, Pocasset River is densely populated throughout its watershed boundaries, but it is not a downtown district. Therefore, the development potential within the watershed is limited under current zoning. Based on the non-traditional alternatives evaluation performed by EP and the WAC Stormwater Best Management Practices (BMPs) was selected as a suitable secondary alternative for removal of nitrogen from the Buttermilk Bay watershed. Using the Watershed MVP Scenario Mapping tool from the Cape Cod Commission, policy-based Stormwater BMPs will remove of 215 kg N per year. The Watershed MVP model calculates roadway nitrogen loading and assumes a 25% reduction from Stormwater Best Practices (BMPs). BMPs such as increasing public education on runoff and non-point source management, continuing parking lot sweeping and paved street sweeping, and modeling additional stormwater installations within the watershed.

Section 4.5.3 Pocasset River Summary

For Pocasset River, like Pocasset Harbor, the majority of nitrogen source reduction can be achieved through the sewer alternatives. Additional nitrogen removal will be supplemented through stormwater management best practices and adding some supplemental I/A onsite system

replacement. Table 19 below shows a summary of the estimated nitrogen removal by Alternative Type.

Table 19: Pocasset River Alternatives Summary

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg-N/y)
Residential I/A General Use Onsite System Replacement	650	1,148
Stormwater BMP	-	215
	Total	**1,363**
	Nitrogen Removal Goal	*1,289*
	Removal Goal Met?	*Yes*

The overall nitrogen reduction goal is met with replacement of Title 5 systems with conventional general use approved I/A onsite systems and stormwater best management practices. There is an estimated additional nitrogen removal of approximately 75 kg-N per year after meeting the nitrogen removal goal. The implementation of the General Use I/A onsite system alternative will require the creation of a Responsible Management Entity.

SECTION 4.6 BUZZARDS BAY

The direct discharge areas of Buzzards Bay Watershed are South of the Cape Cod Canal, between Phinney's Harbor and Pocasset River, and another small section at the end of Scraggy Neck peninsula in the Pocasset Harbor watershed. These two areas contain 593 parcels over 992 acres within the Town of Bourne and have an estimated wastewater flow of 41 MGD from existing septic systems and I/A systems. The Buzzards Bay direct discharge watershed has no Nitrogen impairments as identified by MassDEP and EPA in the most recent list of Impaired Waters.

Understanding that protection of the Bay regardless of Impairment status is highly prioritized by the Town of Bourne, EP recommends that long-term solutions be implemented in a phased approach. As stated in the Needs Assessment, EP expects that additional guidance and development of watershed specific plans will be made available after improvement is monitored and reported.

Section 4.6.1 Conventional Alternatives

The direct discharge watersheds were included as part of the alternatives evaluation performed with the WAC. Consistent with the other priority watersheds, General Use Approved Innovative and Alternative (I/A) onsite wastewater disposal systems were selected as the main conventional technology to be implemented town wide across all watersheds. However, Buzzards Bay direct discharge is not nitrogen impaired and not under a TMDL restriction, implementation of I/A onsite system retrofitting should be considered a part of the longer-term phasing, as the priority watersheds need to be implemented first.

4.6.1.1 General Use I/A Onsite Systems

Figure 6 in Appendix B shows an example of where estimated onsite systems could converted to I/A General Use approved systems as well as locations of existing I/A systems within the watershed. As stated in Section 1, there is no Total Nitrogen removal goal for this watershed, so removal goals to be met are not determined at this time.

4.6.1.2 Centralized/Decentralized Sewering

There are no decentralized wastewater treatment plant facilities within the Buzzards Bay direct discharge watershed. There are others nearby, and consideration of conveying wastewater to those facilities should be considered as part of future adaptations to this plan.

4.6.1.3 Regional Sewering

The regional wastewater facility closest to the Buzzards Bay direct discharge areas is the Joint Base Cape Cod Regional Wastewater Plant. As the Buzzards Bay direct discharge area is not considered nitrogen impaired nor is there a TMDL requirement for nitrogen removal, construction of a conventional sewer collection system is not prioritized at this time. There is the potential opportunity to expand conventional sewer services into the Buzzards Bay direct discharge watershed as needs evolve during the planning period and future time horizons.

Section 4.6.2 Non-Traditional Alternatives

Due to the existing buildout and overall size of the Buzzards Bay direct discharge watershed, stormwater BMPs are recommended as the non-structural, policy-based solution for this watershed. According to the Town's existing MS4 Permit, Buzzards Bay is not identified as a catchment in need of a nitrogen plan. Buzzards Bay does have a bacteria removal plan, and updating any stormwater BMPs for bacteria removal will also likely aid in nitrogen removal. We recommend prioritizing the TMDL and Nitrogen-impaired watersheds first, then addressing the direct discharge watersheds (Buzzards Bay and Cape Cod Canal).

SECTION 4.7 CAPE COD CANAL

Cape Cod Canal is a direct discharge watershed with no nitrogen impairments as identified by MassDEP and EPA in the most recent list of Impaired Waters. Understanding that protection of water quality within the Canal is a high priority for Bourne, EP recommends that long-term solutions be implemented in a phased approach.

Section 4.7.1 Conventional Alternatives

The direct discharge watersheds were included as part of the alternatives evaluation performed with the WAC. Consistent with the other priority watersheds, Innovative and Alternative (I/A) onsite wastewater disposal systems were selected as the main non-traditional technology to be implemented town wide across all watersheds. However, Cape Cod Canal direct discharge is not nitrogen impaired and not under a TMDL restriction, implementation of I/A onsite system retrofitting should be considered a part of the longer-term phasing, as the priority watersheds need to be implemented first.

4.7.1.1 General Use I/A Onsite Systems

Figures 7 and 8 in Appendix B show examples of where estimated onsite systems could converted to I/A General Use approved systems as well as locations of existing I/A systems within the watershed. As stated in Section 1, there is no Total Nitrogen removal goal for this watershed, so removal goals to be met are not determined at this time.

4.7.1.2 Centralized/Decentralized Sewering

In the Cape Cod Canal direct discharge watershed, there are several existing decentralized wastewater treatment facilities. The regional wastewater facility closest to the Cape Cod Canal direct discharge areas is the Joint Base Cape Cod Regional Wastewater Treatment Plant. As the Cape Cod Canal direct discharge area is not considered nitrogen impaired nor is there a TMDL requirement for nitrogen removal, construction of a new conventional sewer collection system (for treatment at the regional wastewater facility or a decentralized facility), is not prioritized at this time.

4.7.1.3 Regional Sewering

Both regional wastewater facilities are close to the Cape Cod Canal direct discharge areas, however, as the Canal is not considered nitrogen impaired nor is there a TMDL requirement for nitrogen removal, construction of a conventional sewer collection system is not prioritized at this time. There is the potential opportunity to expand conventional sewer services into the Cape Cod Canal direct discharge watershed as needs evolve during the planning period and future time horizons.

Section 4.7.2 Non-Traditional Alternatives

Due to the existing buildout and overall size of the Cape Cod Canal direct discharge watershed, stormwater BMPs are recommended as the non-structural, policy-based solution for this watershed. According to the Town's existing MS4 Permit, Cape Cod Canal is not identified as a catchment in need of a nitrogen plan. The Cape Cod Canal does have a bacteria removal plan, and updating any stormwater BMPs for bacteria removal will also likely aid in nitrogen removal. We recommend prioritizing the TMDL and Nitrogen-impaired watersheds first, then addressing the direct discharge watersheds (Buzzards Bay and Cape Cod Canal).

SECTION 4.8 TOWN WIDE SUMMARY

Based on the conventional, non-traditional, and policy-based alternatives summarized in each watershed, the overall town wide nitrogen removal alternatives estimate meeting the town wide nitrogen removal goal of 8,100 kg N per year, with an additional 1,600 – 2,000 kg N per year removal. Only priority watersheds were included in the total estimated nitrogen removal load calculations as Buzzards Bay and Cape Cod Canal load goals will be revisited when additional guidance on removal loading becomes available and as future iterations of Bourne's CWMP evolves. Table 20 below summarizes the estimated alternative removal compared to the total removal goal.

Table 20: Total Estimated Nitrogen Removal

Embayment	Nitrogen Removal Goal (Kg-N/yr.)	Estimated Nitrogen Removal Total (kg-N/yr.)
Megansett-Squeteague Harbor	564	723 - 850
Phinneys Harbor	1,706	2,384 – 2,565
Buttermilk Bay	1,402	1,925
Pocasset Harbor	3,120	3,292
Pocasset River	1,289	1,363
Buzzards Bay	TBD	-
Cape Cod Canal	TBD	-
Total	**8,072**	**9,687 – 9,995**
Additional Removal		*1,615 - 1,923*

SECTION 5 PHASE II PUBLIC PARTICIPATION

The goal of the CWMP public participation program is to provide an opportunity for public education, outreach, and response throughout the time that the CWMP is developed. During Phase II, EP continued to work with the Wastewater Advisory Committee, the Board of Sewer Commissioners, and Town staff for review and feedback. Based on discussions with the Board of Sewer Commissioners, the Commissioners will decide upon the recommended alternative strategies for detailed evaluation in Phase III.

At the conclusion of this phase, EP will submit an interim report summarizing the findings and recommendations of this Phase to MassDEP and will hold an informal review meeting to discuss any pre-review comments.

Public Participation was initiated at the start of the project and will continue throughout the development of the CWMP. Bourne actively seeks to create opportunities for public education, outreach, and participation throughout the project. The Town has a page on the Town's website specifically for the CWMP project, where information is regularly uploaded and shared with the public. This website information includes meeting and workshop agendas and minutes, presentations, deliverables, background documents, specific public information content related to the CWMP, and recordings of public meetings and hearings, and regular updates. Announcements related to public participation opportunities are posted on the town's CWMP website page (https://www.townofbourne.com/comprehensive-wastewater-management-plan-cwmp), and are also distributed by email to stakeholders using a list compiled by the Town Staff Working Group for the CWMP together with Environmental Partners. The list of Stakeholders is included in Appendix D.

Toward the end of Phase IV, when the comprehensive management strategy is drafted with the recommended plan, the Town plans to host three public hearings. The Recommended Plan and report will be presented. One public hearing will be with the Town and two with the Cape Cod Commission, to meet the requirements of the CWMP process. The Town will also prepare a summary report on the public participation activities of Phases I, II and III for inclusion in the final CWMP and Environmental Impact Report (FEIR). Table 21 shows an updated schedule with completed and planned public participation activities associated with Phase I, II III and IV.

Table 21: Updated Stakeholder Meeting Schedule

Scope of Work Task	*Town wide Meeting Date*
Phase I - Needs Assessment (Year 1)	
a. Wastewater Conditions	May 2021
b. Wastewater Needs and Problem Identification	December 2021
Phase II - Identification and Screening of Alternatives (Year 2)	
a. Proposed Criteria	April 2022 (WAC)
b. Refine criteria and matrix	April 2022 (WAC)
c. Present Refinement	July 2022 (WAC)
Phase III - Formulation of Plan (Year 2/3)	
a. Cost Allocation Discussion	One* (TBD)
b. Review the evaluation results and the plan	One (TBD)
c. Public Hearing	One (TBD)
Phase IV - MEPA & CCC DRI Reviews (Year 3)	One** (TBD)

*Presented with Board of Sewer Commissioners, a public meeting.
**Considered Public Hearings, in accordance with CWMP process requirements. Two meetings will be held with the Cape Cod Commission.

A summary of specific information to be shared during the course of the project is provided in Table 22.

Table 22: Public Participation Plan - Targeted Information Sharing Schedule

Scope of Work Task	Type of Document Shared			
	Public Notice and Agenda	**Workshop Findings**	**Summary Document**	**Other**
All Tasks				Monthly Progress Update
1. Project Startup & Plan Review				Project Introduction
4. Identification of Alternatives				
a. Proposed Criteria	One	One		
b. Refine criteria and matrix	One*			
c. Present Refinement	One	One	Alternatives Matrix	Task 5 Scope of Work
5. Formulation of Plan				
a. Cost Allocation Discussion	One*			
b. Review the evaluation results and the plan	One	One	Evaluation results	Plan Draft
c. Public Hearing	One	One	Response to Comment	Final Draft
6. Completion of MEPA & CCC DRI	Two		Final CWMP	

*Document will be part of regularly scheduled Board of Sewer Commissioners meeting.

SECTION 5.1 PUBLIC PRESENTATIONS AND HEARINGS PHASE II

The Phase II public participation included meetings with the BOSC and WAC. The WAC is responsible for advising the Board of Sewer Commissioners in the areas of public policy and long-range planning as it relates to the implementation of the CWMP. Members are residents of the Town of Bourne and adhere to regulations of the Open Meeting Laws of the Attorney General's Office. Committee membership includes seven voting members from the following Town representation:

- BOSC Representative
- Finance Committee/Capital Outlay Committee Representative
- Planning Board Representative
- Conservation Commission Representative
- Board of Health Representative
- Two At Large Member(s) of North of the Canal
- Two At Large Member(s) of South of the Canal

Ex-officio (non-voting) members include the following Town Staff and Stakeholders:

- Health Agent
- Engineering Department representative
- Conservation Agent
- Town Administrator
- DPW and/or Sewer Department representative
- Planning Department representative
- Water District Superintendents
    - Bourne Water District representative
    - Buzzards Bay Water District representative
    - Matt Sawicki, North Sagamore Water District
- Mass Maritime representative

At WAC meetings, a formal presentation was made by Environmental Partners to help guide discussion, inform the committee and receive feedback on the approach, plan and direction of the alternatives analysis. EP attended three WAC meetings, recorded by Bourne TV and materials posted to the Wastewater Advisory Committee website (https://www.townofbourne.com/wastewater-advisory-committee).

- April 4
- April 11
- July 13

Two Quarterly report outs were conducted for the Board of Sewer Commission during the Alternatives Analysis, March 29, 2022, and July 19, 2022. A final alternatives analysis workshop was presented to the public at an August 9, 2022, Board of Sewer Commission meeting. This presentation was followed by a discussion and feedback section to provide an opportunity for interaction and sharing of opinions and ideas from all attendees at the workshop. Presentation materials are included in Appendix D. All presentations were held in person with Bourne TV

coverage for virtual participants. There was no Zoom breakout participation as a part of meetings during this phase. All meetings were recorded and materials uploaded to the CWMP website (https://www.townofbourne.com/comprehensive-wastewater-management-plan-cwmp).

APPENDIX A: NON-TRADITIONAL EVALUATION

Criteria, Rev 2	**Score Criteria**				
	1	2	3	4	5
Design flexibility for adding capacity	Not Scalable	Portions of Treatment only can be scaled up	Can only be scaled up for loads or flows	Portions of both can be scaled up	Can be scaled up for both flows and loads
Environmental Impacts	Negative Impacts	Some Negative impacts	No Impacts	Some positive impacts	Positive Impacts
Implementation Constraints	Constraints with no mitigation possible	Some constraints with equal mitigation	Some contstraints	Few constraints	No Constraints
Nitrogen Removal	No Removal	0-49% removal	50% Removal	50-75% Removal	Greater than 75% removal
Monitoring Requirements	Requires daily oversight	Requires monthly oversight	Requires Quarterly oversight	Requires semi annual oversight	Requires annual oversight
Odor Emissions	High Odorous impact near waterfront	Odorous impact	Inland treatment with neighborhood impacts	Some odor, mild	No odor impact, removed from villages completely
Land Area Requirements	>10 Acres	5-10 Acres	3-5 Acres	1-3 Acres	<1 Acre
Implementation Risk	High Risk, Technology Unapproved	Moderate Risk, Technology in Pilot	Mild Risk with mitigation for implementation	Some risk, low to mild impacts to implement	No Risk, No impact to implement
Maintenance/operation requirements	Daily Inspection, Daily Mainteance	Daily Inspection, Frequent maintenance	Monthly Inspection and Mainteance	Quarterly Inspection and Annual Maintenance	Annual or Bi Annual inspection and maintenance only as needed
Greenhouse Gas (GHG) Emissions	Permanent impacts and contribution	Construction with some permanent impacts	Temporary Construction Only (2-5 years)	Temporary Construction Only (1-2 years)	No permanent increase in GHG emissions
Public Acceptance & Political Feasibility	No	Maybe-No	Maybe	Maybe-Yes	Yes
Alignment with Local Comprehensive Plan and Town Mission	No	Maybe-No	Maybe	Maybe-Yes	Yes
Resiliency to Climate Change	No adaptation possible	Technology adaptation difficult	Technology not resilient, but smome adaptation possible	Technology requires easy adaptation for resiliency	Technology is adaptable to climate changes

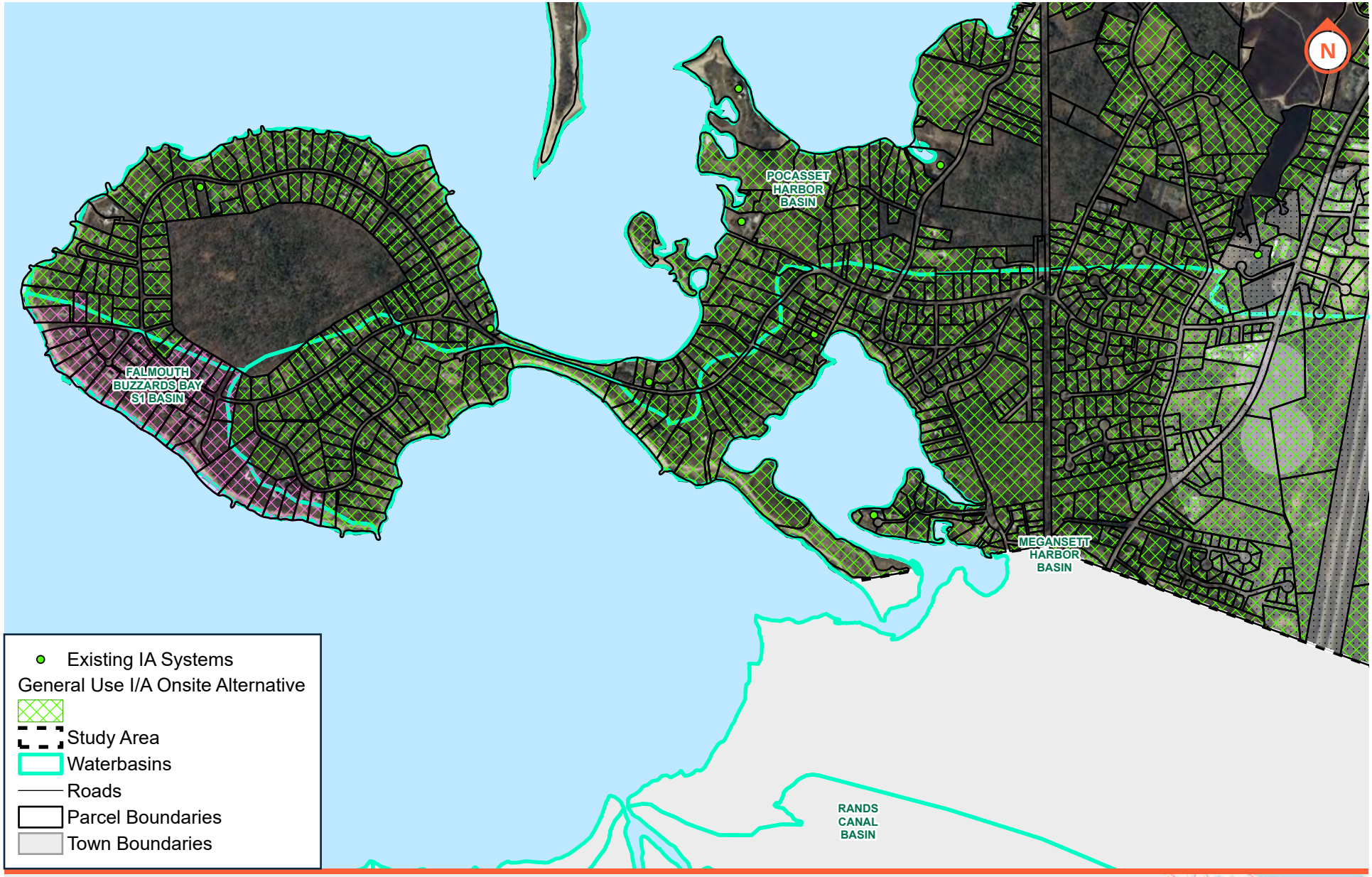
			Category Weight -->		*4%*	*3%*	*8%*
#	**Technology**	**Type**	**Raw Total (Unweighted)**	**Weighted Total**	**Design flexibility for adding capacity**	**Environmental Impacts**	**Implementation Constraints**
1	Cluster Treatment System	Source Reduction	✗ 40	! 3.48	4	4	3
2	Aquaculture	Source Reduction	✗ 40	✗ 3.07	2	5	2
3	Fertilizer Management	Source Reduction	✓ 53	! 4.06	5	4	5
4	*Remediation of Existing Development*	Source Reduction	✓ 52	! 4.34	5	5	3
5	*Compact and Open Space Development*	Source Reduction	✓ 58	✓ 4.64	5	5	2
6	*Transfer of Development Rights*	Source Reduction	! 48	✗ 3.42	5	5	1
7	Innovative/Alternative (I/A)*	Source Reduction	! 50	✓ 4.35	4	4	3
9	I/A Hybrid or Enhanced Systems (2+ technologies)*	Source Reduction	! 50	✓ 4.42	4	4	3
10	Coastal and Wetland Habitat Restoration	Restoration	! 46	! 3.85	3	5	2
11	Dredging and Maintenance	Restoration	✗ 44	! 3.95	4	4	3
12	Phytoremediation	Groundwater Remediation	! 47	! 4.12	2	5	3
13	Permeable Reactive Barriers (PRBs)	Groundwater Remediation	✗ 39	! 3.90	2	4	2
14	Stormwater BMPs	Groundwater Remediation	✓ 55	✓ 4.49	5	5	5

			Category Weight -->		*12%*	*7%*	*1%*
#	**Technology**	**Type**	**Raw Total (Unweighted)**	**Weighted Total**	**Nitrogen Removal**	**Monitoring Requirements**	**Odor Emissions**
1	Cluster Treatment System	Source Reduction	✗ 40	! 3.48	3	2	3
2	Aquaculture	Source Reduction	✗ 40	✗ 3.07	2	2	5
3	Fertilizer Management	Source Reduction	✓ 53	! 4.06	3	4	3
4	*Remediation of Existing Development*	Source Reduction	✓ 52	! 4.34	3	4	5
5	*Compact and Open Space Development*	Source Reduction	✓ 58	✓ 4.64	5	4	5
6	*Transfer of Development Rights*	Source Reduction	! 48	✗ 3.42	5	4	5
7	Innovative/Alternative (I/A)*	Source Reduction	! 50	✓ 4.35	3	4	3
9	I/A Hybrid or Enhanced Systems (2+ technologies)*	Source Reduction	! 50	✓ 4.42	4	4	3
10	Coastal and Wetland Habitat Restoration	Restoration	! 46	! 3.85	2	1	5
11	Dredging and Maintenance	Restoration	✗ 44	! 3.95	5	2	4
12	Phytoremediation	Groundwater Remediation	! 47	! 4.12	4	2	5
13	Permeable Reactive Barriers (PRBs)	Groundwater Remediation	✗ 39	! 3.90	4	2	3
14	Stormwater BMPs	Groundwater Remediation	✓ 55	✓ 4.49	4	1	4

			Category Weight -->		*2%*	*5%*	*5%*
#	**Technology**	**Type**	**Raw Total (Unweighted)**	**Weighted Total**	**Land Area Requirements**	**Implementation Risk**	**Maintenance/ Operation requirements**
1	Cluster Treatment System	Source Reduction	✗ 40	! 3.48	4	2	4
2	Aquaculture	Source Reduction	✗ 40	✗ 3.07	1	3	5
3	Fertilizer Management	Source Reduction	✓ 53	! 4.06	1	5	5
4	*Remediation of Existing Development*	Source Reduction	✓ 52	! 4.34	4	5	3
5	*Compact and Open Space Development*	Source Reduction	✓ 58	✓ 4.64	4	5	5
6	*Transfer of Development Rights*	Source Reduction	! 48	✗ 3.42	1	5	4
7	Innovative/Alternative (I/A)*	Source Reduction	! 50	✓ 4.35	4	5	5
9	I/A Hybrid or Enhanced Systems (2+ technologies)*	Source Reduction	! 50	✓ 4.42	4	4	5
10	Coastal and Wetland Habitat Restoration	Restoration	! 46	! 3.85	1	3	5
11	Dredging and Maintenance	Restoration	✗ 44	! 3.95	1	2	5
12	Phytoremediation	Groundwater Remediation	! 47	! 4.12	1	3	4
13	Permeable Reactive Barriers (PRBs)	Groundwater Remediation	✗ 39	! 3.90	2	2	4
14	Stormwater BMPs	Groundwater Remediation	✓ 55	✓ 4.49	5	5	4

			Category Weight -->		*1%*	*2%*	30%	20%
#	**Technology**	**Type**	**Raw Total (Unweighted)**	**Weighted Total**	**Greenhouse Gas (GHG) Emissions**	**Resiliency to Climate Change**	**Public Acceptance/ Political Feasibility**	**Alignment with Local Comprehensive Plan/Town Goals**
1	Cluster Treatment System	Source Reduction	✗ 40	! 3.48	1	2	4	4
2	Aquaculture	Source Reduction	✗ 40	✗ 3.07	4	2	3.5	3.5
3	Fertilizer Management	Source Reduction	✓ 53	! 4.06	5	5	4	4
4	*Remediation of Existing Development*	Source Reduction	✓ 52	! 4.34	2	3	5	5
5	*Compact and Open Space Development*	Source Reduction	✓ 58	✓ 4.64	4	4	5	5
6	*Transfer of Development Rights*	Source Reduction	! 48	✗ 3.42	5	2	3	3
7	Innovative/Alternative (I/A)*	Source Reduction	! 50	✓ 4.35	2	3	5	5
9	I/A Hybrid or Enhanced Systems (2+ technologies)*	Source Reduction	! 50	✓ 4.42	2	3	5	5
10	Coastal and Wetland Habitat Restoration	Restoration	! 46	! 3.85	4	5	5	5
11	Dredging and Maintenance	Restoration	✗ 44	! 3.95	2	3	4	5
12	Phytoremediation	Groundwater Remediation	! 47	! 4.12	5	3	5	5
13	Permeable Reactive Barriers (PRBs)	Groundwater Remediation	✗ 39	! 3.90	3	1	5	5
14	Stormwater BMPs	Groundwater Remediation	✓ 55	✓ 4.49	4	3	5	5

APPENDIX B: GIS FIGURES



ENVIRONMENTAL PARTNERS
— An Apex Company —

Figure 1

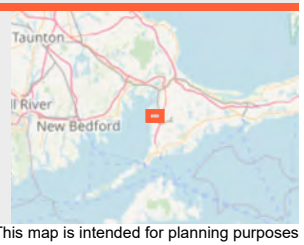
Megansett Squeteague Harbor

Bourne, MA

10/3/2022

0 750 1,500 3,000

1:1500 Feet



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Disclaimer: This map is intended for planning purposes

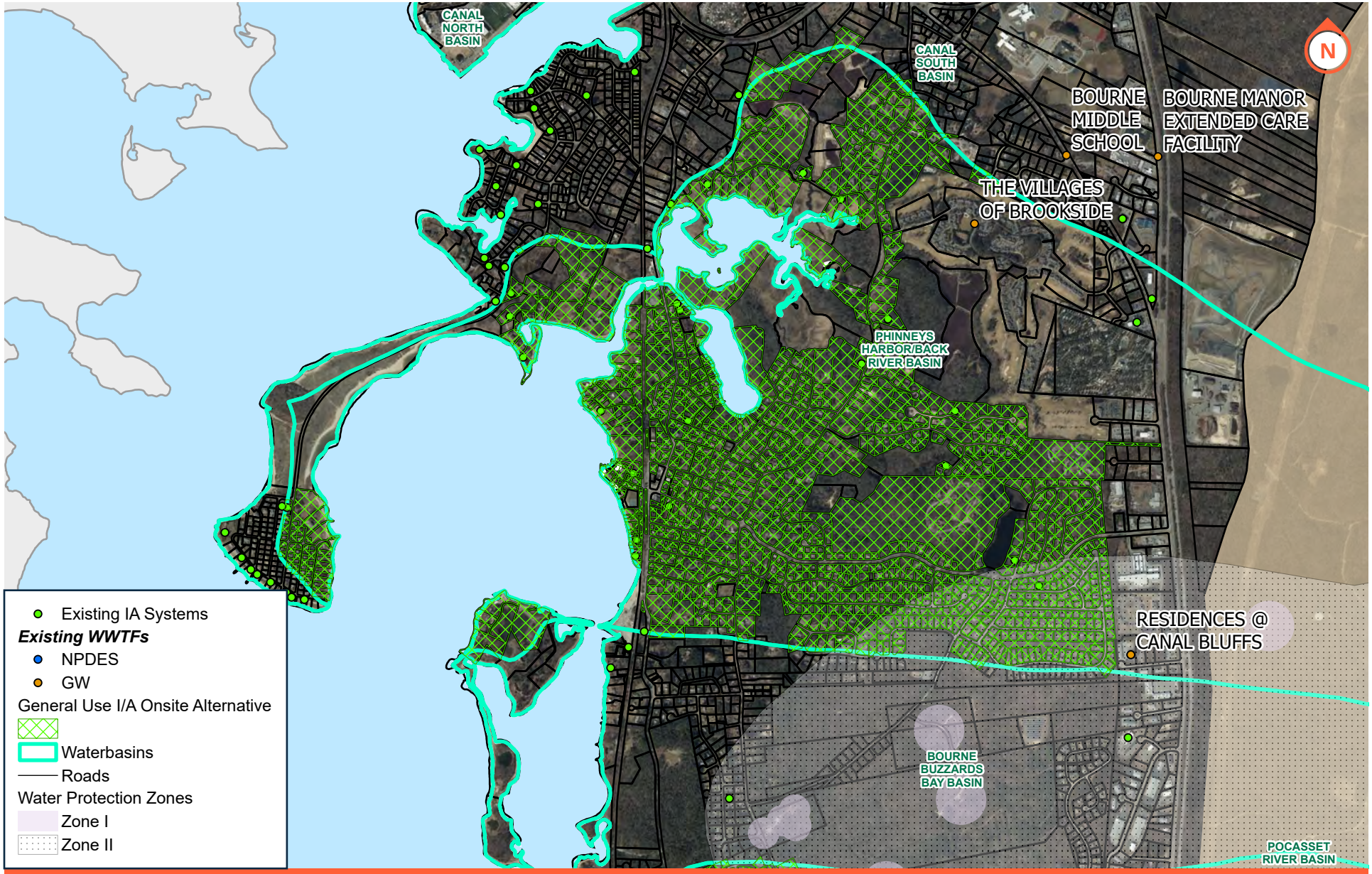

Figure 2

Phinney's Harbor

Bourne, MA

10/3/2022

0 1,000 2,000 4,000

1:2000 Feet

ENVIRONMENTAL PARTNERS

— An Apex Company —

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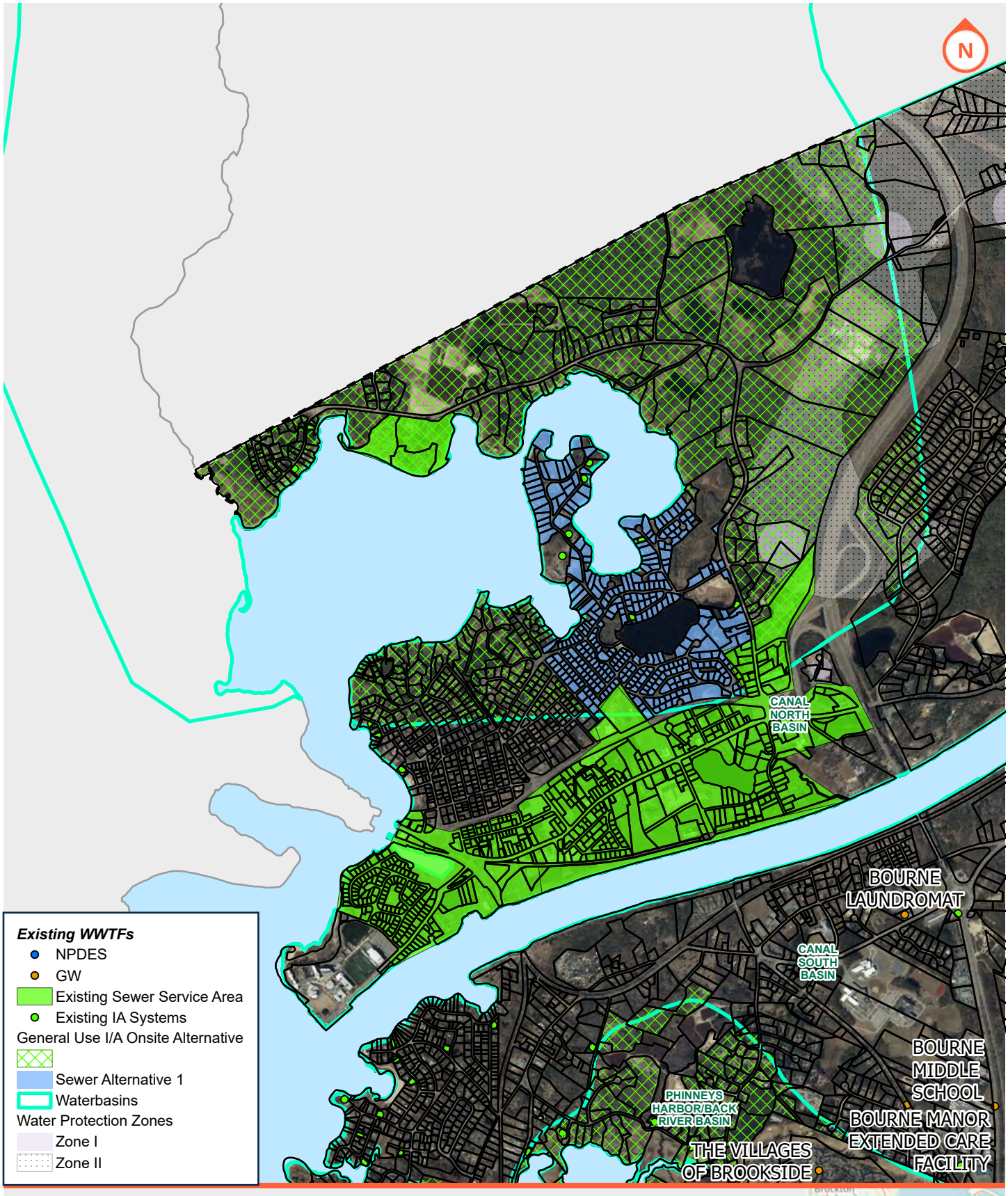
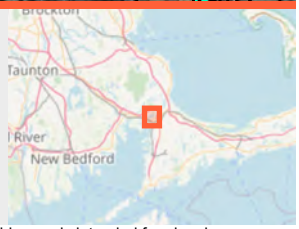


ENVIRONMENTAL PARTNERS
— An Apex Company —

Figure 3
Buttermilk Bay
Bourne, MA
10/3/2022

0 1,100 2,200 4,400
1:2200 Feet



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Disclaimer: This map is intended for planning purposes

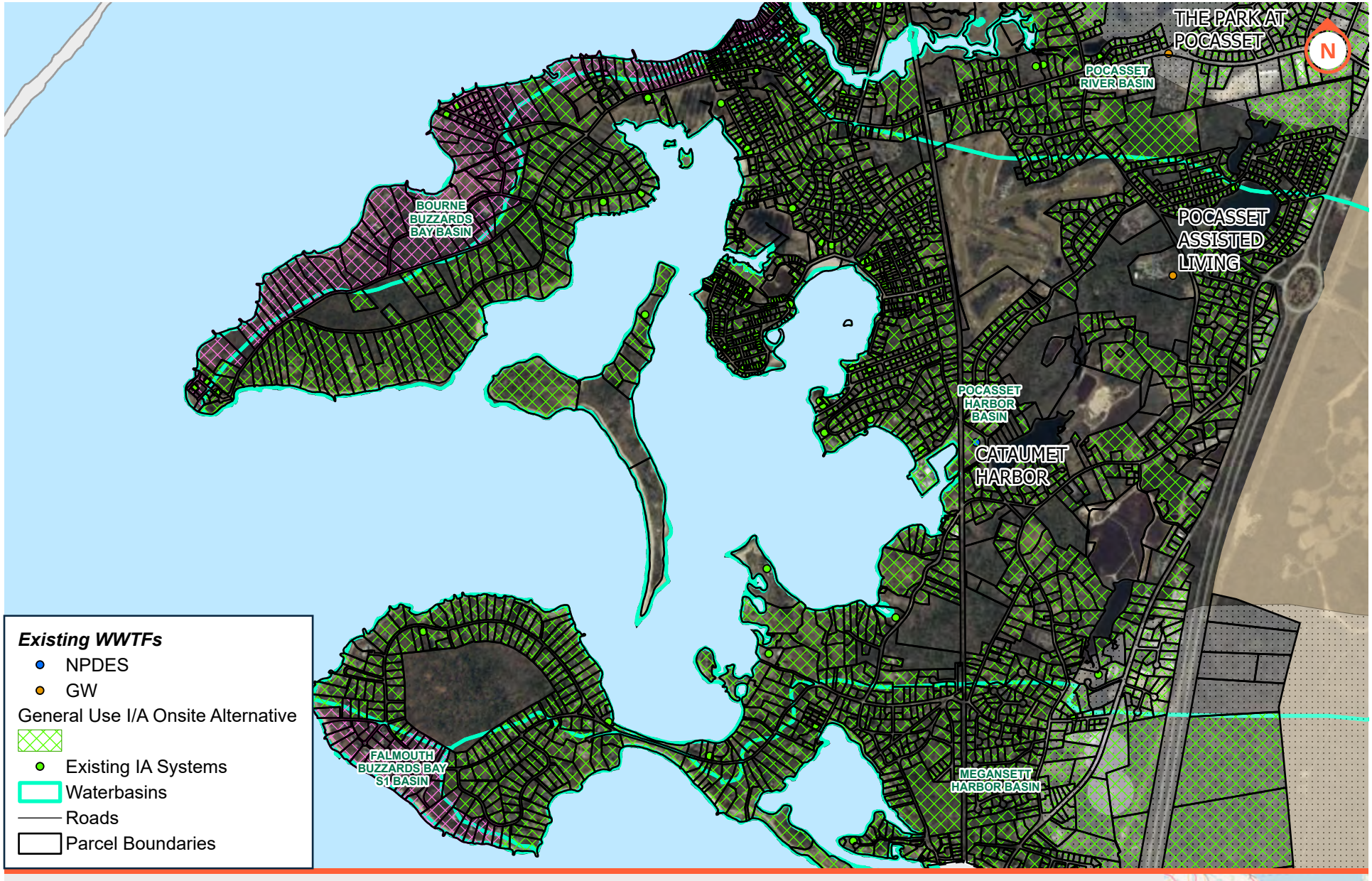


Figure 4

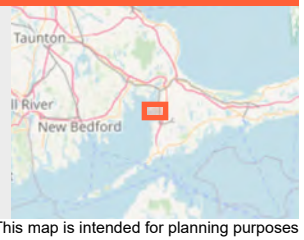
Pocasset Harbor

Bourne, MA

10/3/2022

0 1,175 2,350 4,700

1:2,350 Feet



ENVIRONMENTAL PARTNERS
— An Apex Company —

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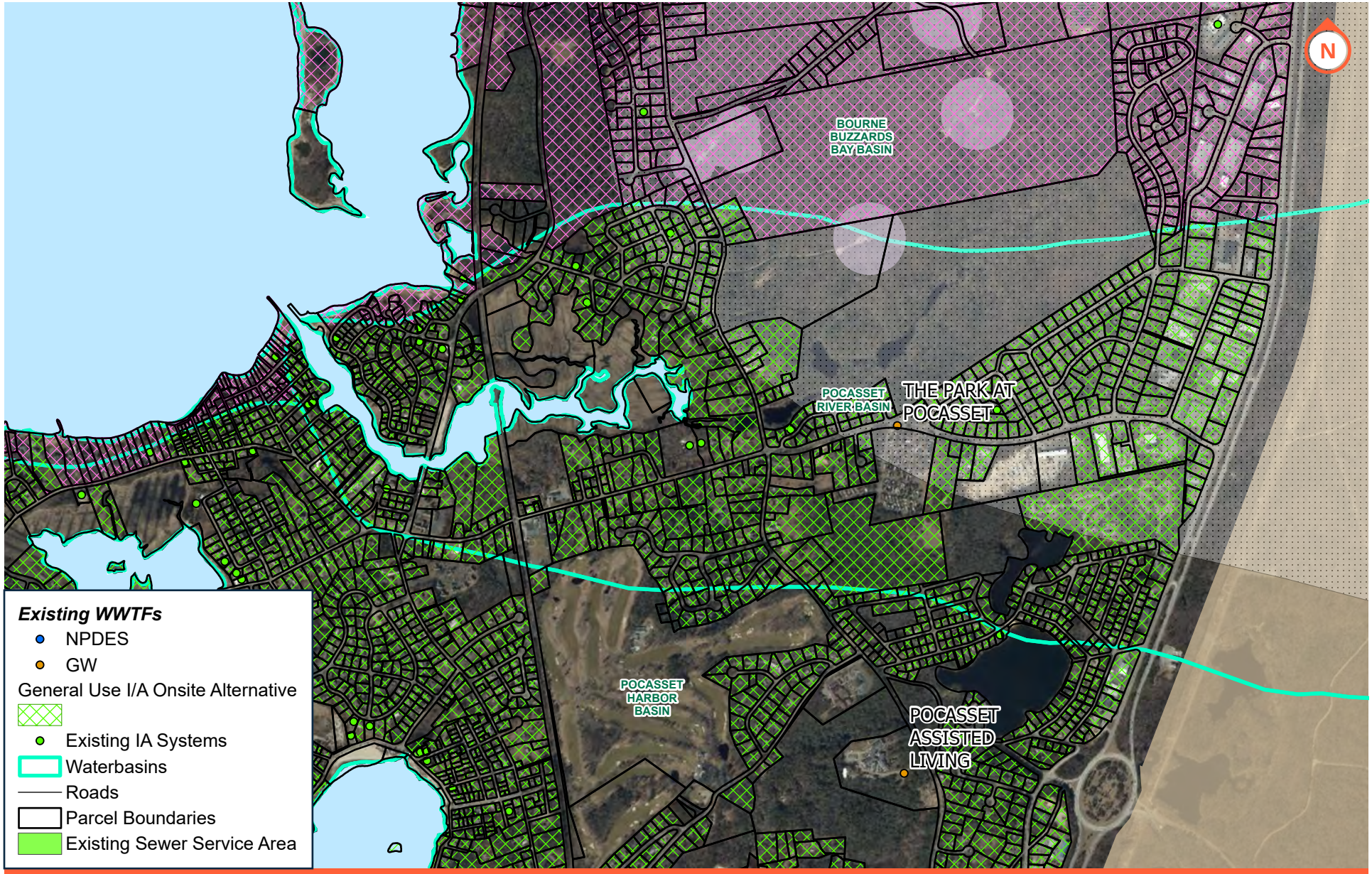


ENVIRONMENTAL PARTNERS
— An Apex Company —

Figure 5

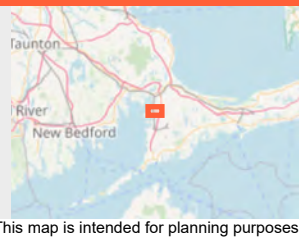
Pocasset River

Bourne, MA

10/4/2022

0 750 1,500 3,000

1:1500 Feet



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Disclaimer: This map is intended for planning purposes

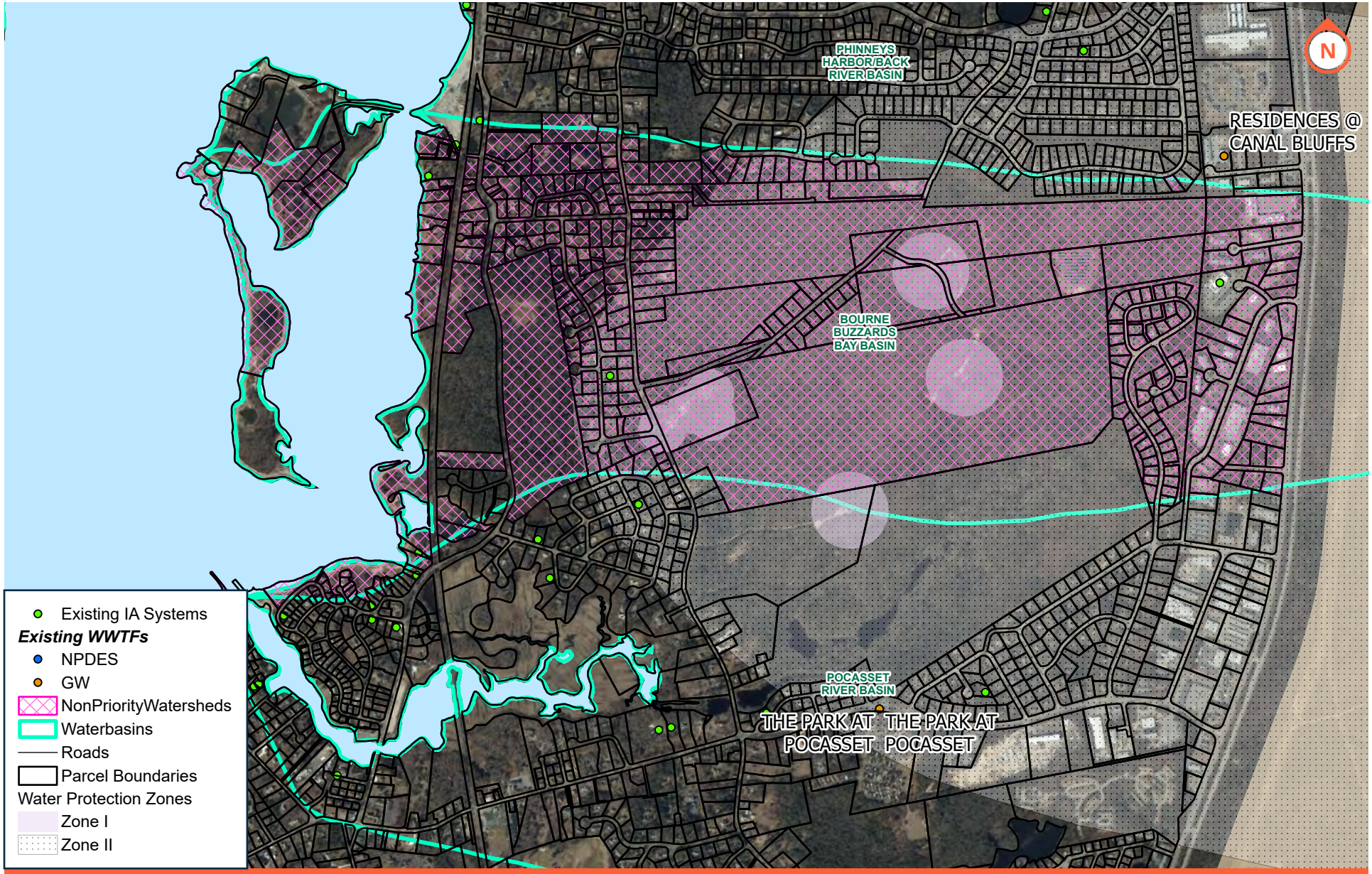


Figure 6

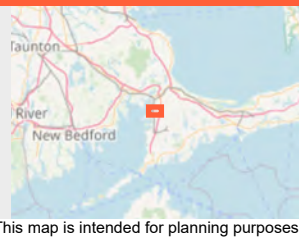
Buzzards Bay

Bourne, MA

10/3/2022

0 1,300 2,600 5,200 Feet

ENVIRONMENTAL PARTNERS
— An Apex Company —



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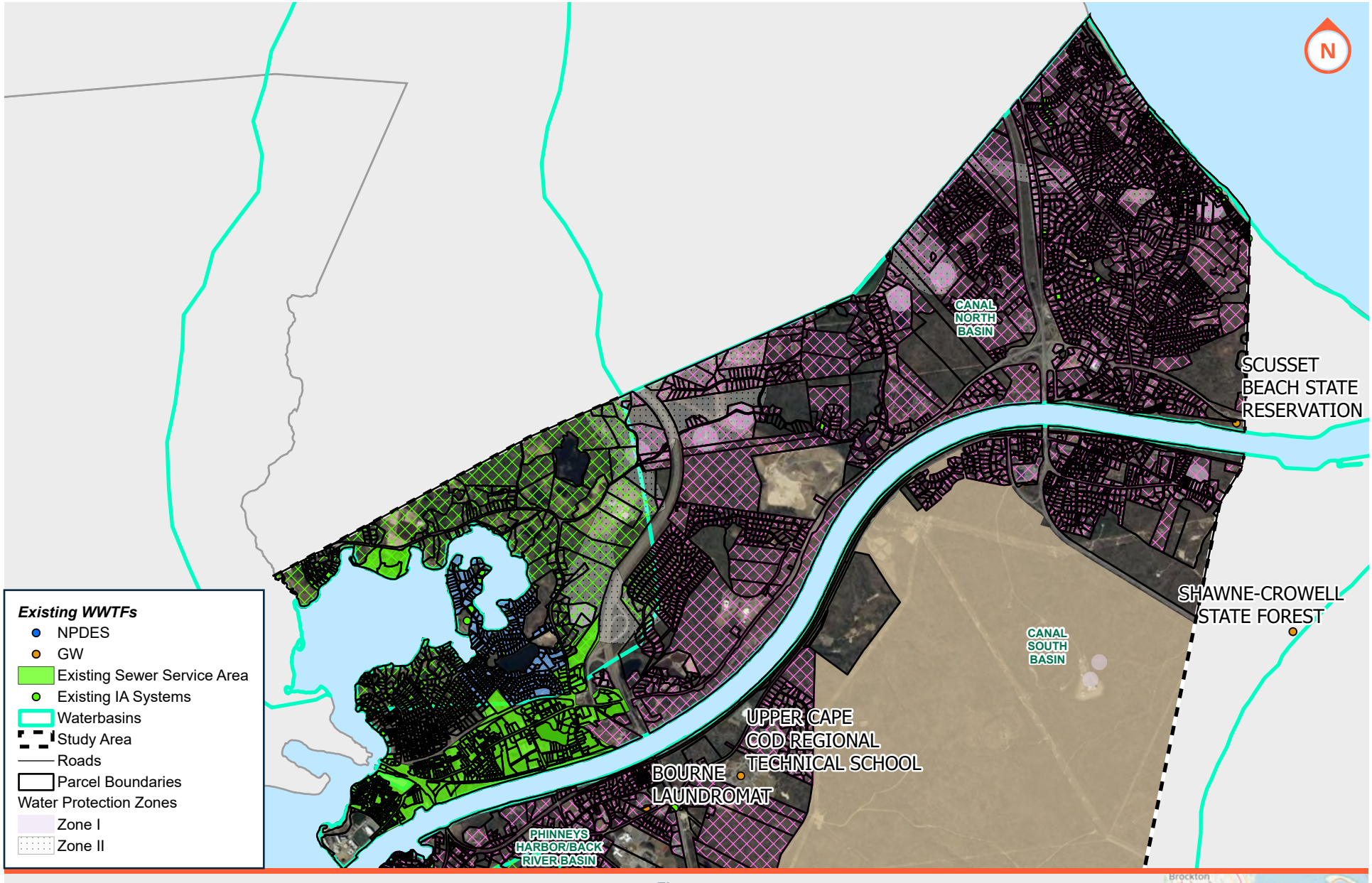
Disclaimer: This map is intended for planning purposes



ENVIRONMENTAL PARTNERS
— An Apex Company —

Figure 7

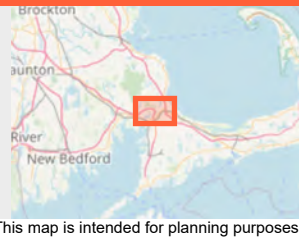
Canal North

Bourne, MA

10/3/2022

0 2,150 4,300 8,600

1:4300 Feet



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Disclaimer: This map is intended for planning purposes

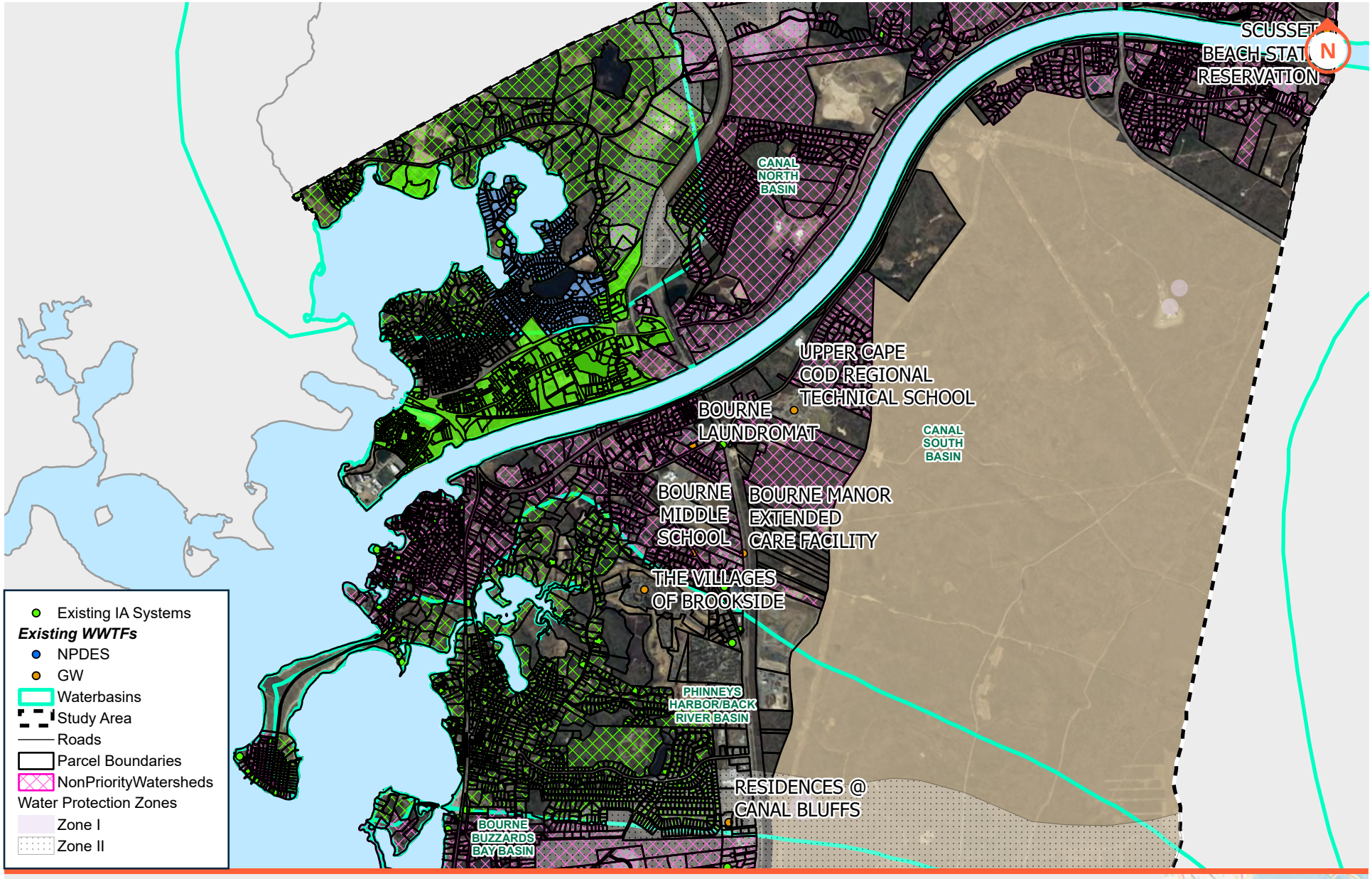

Figure 8

Canal South

Bourne, MA

10/3/2022

0 2,000 4,000 8,000 Feet 1:4000

ENVIRONMENTAL PARTNERS
— An Apex Company —

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Disclaimer: This map is intended for planning purposes

APPENDIX C: ALTERNATIVE PARCEL TABLES

APPENDIX D: PHASE II PUBLIC PARTICIPATION

Wastewater Advisory Committee

Agenda

Date	Time	Location
Monday, April 11, 2022	4:00 PM	Bourne High School – Library 75 Waterhouse Road, Bourne

Note this meeting is being televised, streamed or recorded by Bourne TV.

4:00 PM Call Public Session to Order in Open Session

All items on the agenda are subject to deliberation and votes.

1. Call to Order
   If anyone is audio or videotaping, they need to acknowledge it at this time.
2. Note excused/absent members
3. Workshop with Environmental Partners
   a. Review and discussion of Technology Matrix
   b. Review and discussion of Draft Evaluation Criteria.
4. Adjourn

Technology Matrix and Evaluation Criteria Review

Wastewater Advisory Committee
Comprehensive Wastewater Management Plan

ENVIRONMENTAL PARTNERS
— An Apex Company —

April 11, 2022

CWMP Status Update

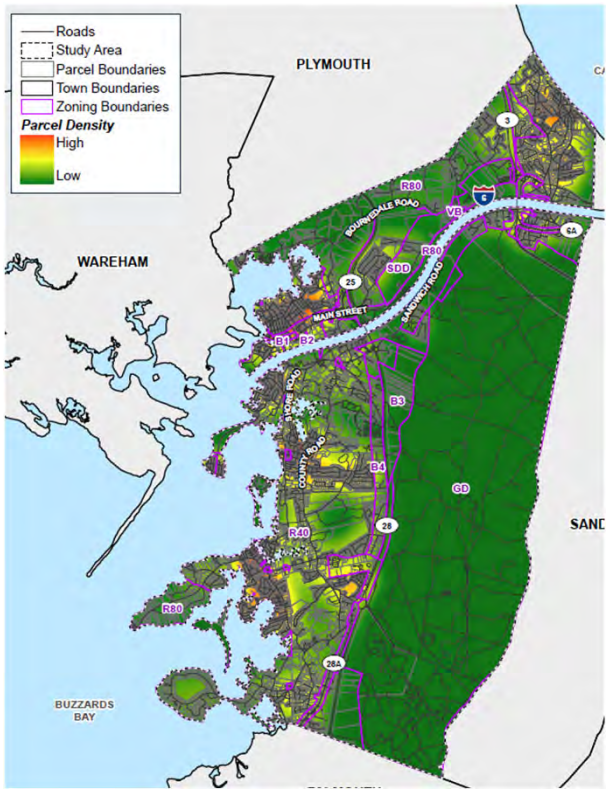
- Draft Needs Assessment Completed
- Kicked off Alternatives Analysis
  - Evaluating Technologies best suited for Bourne
  - Drafted Evaluation Criteria

Phase I: Needs Assessment Recap

- Study organized by watershed boundaries
- Analyzes current and future wastewater management needs using
  - Current zoning
  - Build-out based on current zoning
- Identifies nitrogen loading reduction requirements for all watersheds
  - With and without Nitrogen TMDLs

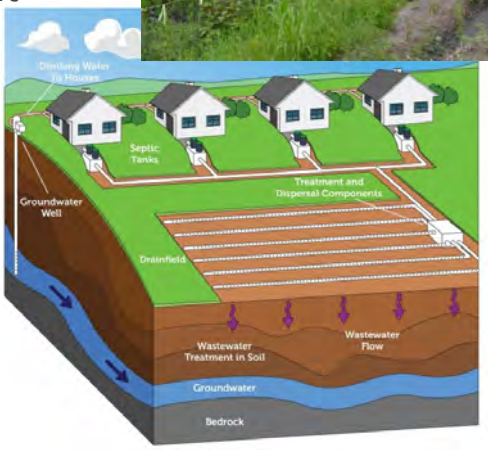
Embayment	Total Nitrogen Load Values, kg-N/year		Total Watershed Threshold kg-N/year	Total Load to Remove kg-N/yr.	Bourne's % Responsibility for Removal	Bourne Total Removal (kg-N/yr.)
	Wastewater	Total Load				
Megansett-Squeteague Harbor	7,611	11,658	1,446	1,446	39%	564
Phinneys Harbor	5,948	8,730	7,024	1,706	100%	1,706
Buttermilk Bay	4,058	5,610	4,208	1,402*	100%	1,402
Pocasset Harbor	7,958	12,479	9,359	3,120*	100%	3,120
Pocasset River	3,762	5,157	3,868	1,289*	100%	1,289
Buzzards Bay	16,830			4,208*	TBD	TBD
Cape Cod Canal	164,028			41,007*	TBD	TBD
					Total	8,072

*25% Removal assumed; Subject to change after MassDEP review



Phase II: Alternatives Analysis – Identifying Technologies

- Onsite Systems
  - Conventional Title 5 Systems
  - Innovative Alternative (IA) Onsite Systems
  - Cluster Systems
- Traditional Wastewater Treatment and Sewer Collection Systems
- Stormwater Controls
- Innovative & Alternative
  - Permeable Reactive Barriers
  - Aquaculture
  - Urine Recycling
- Policies & Bylaws



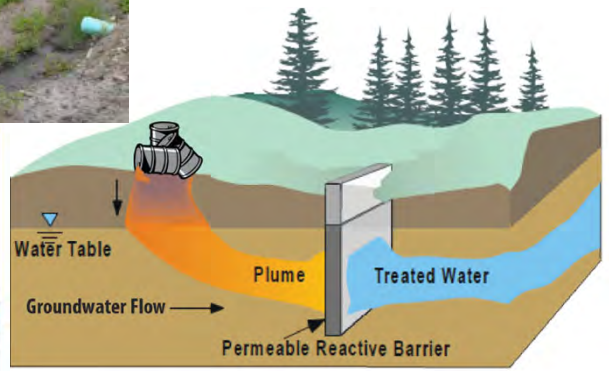
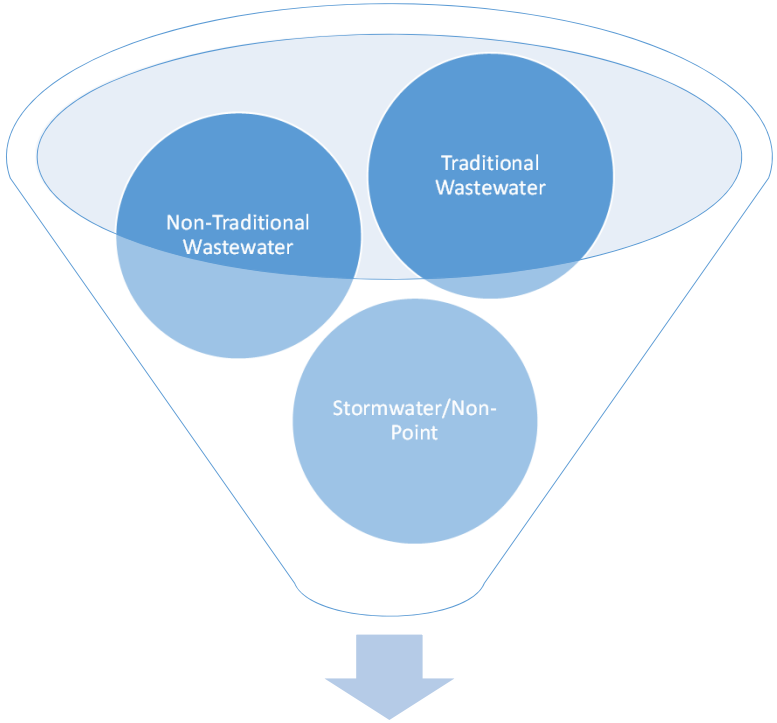


Image Sources: EPA, City of Cambridge MA

The Challenge:



Customized Solutions for Bourne

Review Draft Technology Matrix

Handout

Our Alternatives Analysis Will Be:

Community-Minded

- Transparent
- Offer Opportunities for Learning
- Adaptable

Innovative

- Boost our Blue Economy
- Best Practices
- Resilient to Climate Change
- Restore Habitats

Cost-Effective

- Funded by Grants
- Affordable
- Equitable

…are we missing anything?

Review Draft Evaluation Criteria

Handout

Next Steps:

Spring 2022	• Public Presentation of Alternatives Evaluation Criteria
Summer 2022	• Presentation of Alternatives Analysis • Town wide workshop
Fall 2022	• Draft Recommended Plan
Winter 2023	• Submit Final Recommended Plan

THANK YOU

ENVIRONMENTAL PARTNERS
— An Apex Company —

Draft Alternative Technology Matrix

Category	Expected Nitrogen Removal (%)	Technology by Watershed	Meganset Squeteague	Phinneys	Buttermilk Bay	Pocasset Harbor	Pocasset River	Buzzards Bay	Cape Cod Canal
PRIMARY									
Green Infrastructure	*63%*	*Phytoirrigation*							
	66%	*Hydroponic Treatment*							
	81%	*Constructed Wetlands - Surface Flow*							
	81%	*Constructed Wetlands - Subsurface Flow*							
	90%	*Constructed Wetlands - Groundwater Treatment*							
System Alterations	*12%*	*Inlet / Culvert Widening*							
	18%	*Coastal Habitat Restoration*						*X*	*X*
	25%	*Floating Constructed Wetlands*							
	No Data	*Pond and Estuary Circulators*							
	83%	*Surface Water Remediation Wetlands*							
	No Data	*Chemical Treatment of Ponds*							
	88%	*Pond and Estuary Dredging*							
On-Site Systems	*100%*	*Tight Tanks*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	0%	*Title 5 Septic System Replacement*						*X*	*X*
	28%	*Innovative/Alternative (I/A) Systems**	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	50%	*Innovative/Alternative (I/A) Enhanced Systems**			*X*	*X*	*X*	*X*	*X*
Decentralized Systems	*43-70%*	*Cluster Treatment System*		*X*	*X*	*X*	*X*	*X*	*X*
	50-80%	*Experimental On-site System Technologies*						*X*	*X*
	No Data	*On-Site Grey Water Treatment*		*X*	*X*	*X*	*X*	*X*	*X*
SECONDARY									
Innovative Resource-Management Technologies	*12%*	*Aquaculture*		*X*	*X*	*X*		*X*	
	70%	*Phytoremediation*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	70%	*Fertigation Wells - Turf*							
	70%	*Fertigation Wells - Cranberry Bogs*					*X*		*X*
	73%	*Permeable Reactive Barriers (PRBs)*				*X*	*X*		
Waste Reduction Toilets	*24%*	*Toilets: Urine Diverting*							
	24%	*Public Facility: Urine Diverting*					*X*	*X*	*X*
	62%	*Toilets: Composting*						*X*	*X*
	62%	*Toilets: Incinerating*							
	62%	*Toilets: Packaging*							
Non-Structural Technologies	*50%*	*Fertilizer Management*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	50%	*Stormwater BMPs*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	63%	*Remediation of Existing Development*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	100%	*Compact and Open Space Development*			*X*	*X*		*X*	*X*
	100%	*Transfer of Development Rights*							*X*
		Total Alternatives Recommended	**6**	**9**	**11**	**12**	**12**	**16**	**17**

*Responsible Management Entity (RME) Utility Operation Strongly Recommended if IA Systems are adopted as part of Plan

Helen Gordon

From: Mary Jane Mastrangelo <mjm@mrainc.org>
Sent: Wednesday, June 29, 2022 4:21 PM
To: mmccollem@townofbourne.com
Cc: Helen Gordon; Kate Roosa
Subject: [EXT] FW: Some thoughts on your June 22 WAC discussions
Attachments: 339C0596-B114-4DBE-BABC-949005C9A108.jpeg

FYI

From: Robert Dwyer <rdwyerphd@gmail.com>
Sent: Wednesday, June 29, 2022 9:37 AM
To: Kathy Fox Alfano <kfoxalfano@gmail.com>; Mary Jane Mastrangelo <mjm@mrainc.org>; Keith Barber <jkeithbarber@gmail.com>; Elmer Clegg <elmer.clegg@gmail.com>; Lydon, Timothy <Tlydon@townofbourne.com>
Subject: Some thoughts on your June 22 WAC discussions

Dear WAC members and meeting attendees,

I was able to watch the latter part of the Bourne Community TV replay of your WAC June 22 meeting Monday evening.

I thought your discussions were very fruitful, especially your review of different options that might be presented to the voters and to citizens. Like you, I was excited and encouraged to learn about the proposed Mass. regulation to require nitrogen-removing upgrades to existing and new septic systems.
I do have a few bits of information that I'd like to contribute to your ongoing discussions:

TMDLs:
I inferred from the conversations that some committee members thought that the TMDL listings of watersheds in Bourne by DEP were a "done deal". However, the process of identifying and improving impaired waters is actually very dynamic, both for the number of waterbodies/watersheds identified, and for future identification of WQ problems in ones that appear OK at present. . The state must update its list of impaired waters every two years, as specified in section 303(d) of the Clean Water Act. Once a water body is added on the list, the process is long and involved: first there is the notice that a TMDL is needed for each pollutant listed as impairing water quality. Next the TMDL process is executed, including identifying sources of the pollutant, monitoring, modeling and other activities to be included in a management plan that will put the watershed on a pollutant "diet". Following that, there's a long process of executing the management plan, and monitoring the reduction and eventual elimination of the impairment, restoring the body to its unimpaired "fishable-swimmable" designated use.

During term of the new Bourne CWMP, it's likely that other watersheds and water bodies (beyond Phinneys and Squeteague Harbors) will be identified as impaired, put on the 303(d) list and begin the TMDL process. The CWMP needs to include flexibility to deal with these changes.

Scope of coverage of the proposed DEP septic system upgrade regulation:

Please refer to the attached NASA sea surface chlorophyll photo from February 2020. Algal blooms are apparent in Buzzards Bay and around most of the shores of the Cape – suggesting that Nitrogen is coming from most of the shoreline. The only possible exceptions are the Cape Cod Bay beaches along Sandwich and Barnstable, and the beaches of the Outer Cape; most of these areas don't have much in terms of watershed discharge across the beaches in any case.

But Mass. DEP has not listed most of this shoreline as impaired. based on this photo and from a lot of other data, I think that the DEP is narrowly applying criteria to a small list of water bodies as impaired by nitrogen, thus requiring TMDLs. However, I think the new septic upgrade requirement should be applied by DEP and by the town boards of health very widely, not just to the watersheds and bays currently in the TMDL process for nitrogen.

I think the most egregious example of this is DEP's failure to recognize the clearly declining water quality of the main stem of Buzzards Bay, and list it on the impaired waters biennial list. The nitrogen fertilizing this algal growth is comeing from most or all of the bay's shoreline. The long-term consequences of not recognizing and working to correct this impairment from bay-wide over enrichment with nitrogen will be piece-meal application of nutrient reduction requirements. I think this narrow approach will ultimately fail to improve the water quality of the main stem of the bay. This failure may not be recognized for decades, and will require a costly revisiting of the whole process.

I think the state's proposed nitrogen removal regulations for new in existing septic systems should be applied to the whole town of Bourne, with a possible exception of some parts of Sagamore Beach where the surficial groundwater discharges into Cape Cod Bay. Further, these new requirements will have to be imposed in all of the other Cape and Southcoast towns that discharge surface water or groundwater flow into Buzzards Bay.

Focus on improving the septic systems of houses closer to the bay?

I respectfully disagree with Elmer Clegg's perspective that the focus septic improvements should be on houses that are closer to the bay than on houses and septic systems that are further inland. All of the water in the unconfined groundwater aquifer flows downhill towards Buzzards Bay, the Canal, Cape Cod Bay, etc. With regard to the nitrogen in septic system groundwater discharges, it will all eventually reach one of the marine water bodies. It's only a matter of time; these downgradient water flows are at the rate of 2 to 4 feet a day. A septic system discharging far inland, will take longer, but its nitrogen load will eventually reach Buzzards Bay. The nitrogen already in the ground water from inland septic systems (even after they have been improved) could still be discharging into the bay for decades.

Phosphorus, the pollutant that controls algal growth in freshwater bodies, is a bit different. Phosphorus actually adsorbs to soil particles, so it is attenuated as groundwater flow leaches towards freshwater ponds. Thus, a septic system located far from a freshwater body will contribute less phosphorus than one close to the perimeter of a pond. (For instance, I'm a bit skeptical about the effectiveness of the pilot tests of the NitROW removal system at a number of houses around freshwater Shubael pond in Marstons Mills.) I think Tim Lydon alluded to this N vs P difference a bit, but I couldn't hear all of his discussion.

My conclusion and recommendation:

1) I suggest that the CWMP be written with enough flexibility to expect, and respond to, future listings of additional watersheds as impaired on future iterations of DEP's 303(d) list, including the main stem of Buzzards Bay.

2) When DEP issues the draft regulation for public comment, I suggest that the WAC file Comments that recommend that the proposed septic system upgrades be widely and rapidly imposed, and that the regulation

also include a mechanism for financial assistance for homeowners to make these expensive upgrades, as well as funds for the towns to carry out in the many activities that they will need to undertake to implement these complicated regulations.

Note: I only emailed this to participants in the room on June 22 for whom I could quickly dig up email addresses. Feel free to forward to anybody else. I'm of course available to discuss any of these comments. I had hoped to be in the audience for more of your meetings, but I've had family issues to deal with.

Thanks to all members of the WAC for your continued hard work.

Bob Dwyer
917-403-5477

Board of Sewer Commissioners Meeting Agenda

Date	Time	Location
August 9, 2022	6:30 PM	Bourne Community Center 239 Main St., Buzzards Bay

Note this meeting is being televised, streamed or recorded by Bourne TV. All items within the meeting agenda are subject to deliberation and vote(s) by the Board of Sewer Commissioners.

6:30 P.M. Call Public Session to Order in Open Session

1. Moment of Silence to recognize our Troops and our public safety personnel
2. Salute to the Flag
3. Vision: Bourne is a proud community that embraces change while respecting the rich heritage of the town and its villages. It is a municipality based on strong fiscal government with a durable economy that recognizes the rights of all citizens, respects the environment, especially the coastal areas of the community and the amenities that it affords. Bourne embraces excellent education, and offers to citizens a healthy, active lifestyle.
4. Mission: Bourne will maximize opportunities for social and economic development while retaining an attractive, sustainable and secure coastline and environment for the enjoyment of residents and visitors. Through responsible and professional leadership and in partnership with others, Bourne will strive to improve the quality of life for all residents living and working in the larger community.
5. Public Comment on Non-Agenda Items: Public comments are allowed for up to a total of 12 minutes at the beginning of each meeting. Each speaker is limited to 3 minutes for comment. Based on past practice, members of the Board are not allowed to comment or respond.
6. Board of Sewer Commissioners Business
    a. Discuss and vote on FY23 sewer user rates
    b. CWMP – Public Meeting for Phase II – Alternatives Analysis
7. Adjourn

Town of Bourne
Comprehensive Wastewater Management Plan

Alternatives Analysis Public Presentation

ENVIRONMENTAL PARTNERS
— An Apex Company —

Agenda

- Review Workshop Goals
- Provide Technology Overview
- Review Evaluation Process and Results
- Present Alternatives by Watershed
- Review Next Steps & Schedule
- Discussion

Workshop Goals

- Provide Technology Overview
- Review Evaluation Criteria
- Discuss Recommended Technologies by Watershed

Refresher: What is a Comprehensive Wastewater Management Plan?

- Town-wide water quality assessment and solutions
- Aligns with 2019 Local Comprehensive Plan Goals for growth and development
- 20-year planning to meet water quality goals

What is the goal of our alternatives analysis?

- Remove nitrogen based on the goals set in our Needs Assessment
  - TMDLs
  - 25% Reduction across Nitrogen Impaired Watersheds
- Objectives
  - 208 Plan Compliant solutions
  - Alignment with Town Goals
- Process
  - Started with Cape Cod Commission Technology Matrix
  - Drafted evaluation criteria
  - Process of Elimination through Wastewater Advisory Committee

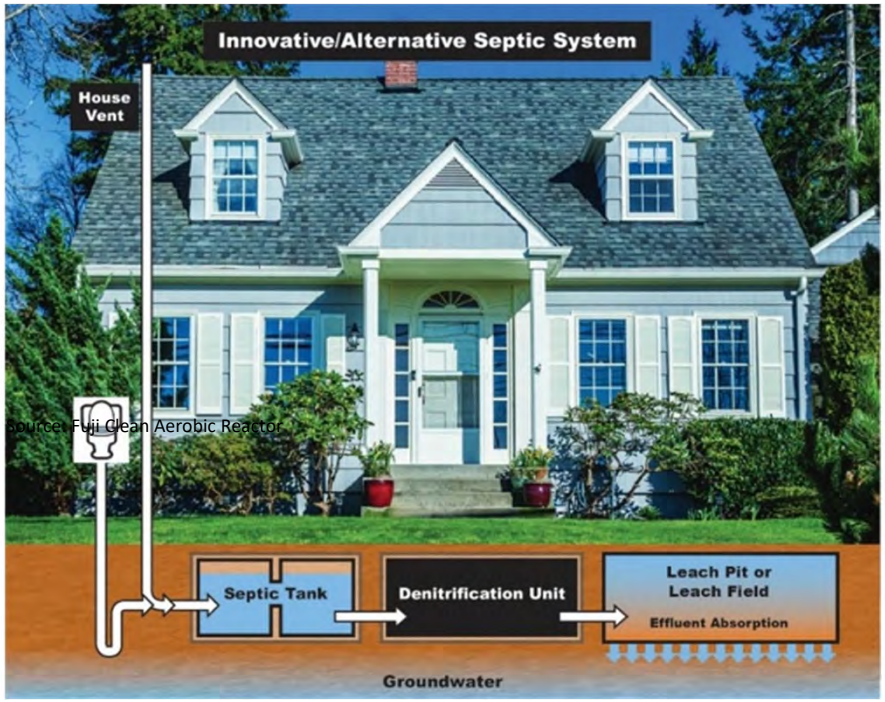
Watersheds	Total Nitrogen Load Values, kg-N/year		Bourne Total Removal (kg-N/yr.)
	Wastewater	Total	
Megansett-Squeteague Harbor	7,611	11,658	564
Phinneys Harbor	5,948	8,730	1,706
Buttermilk Bay	4,058	5,610	1,402
Pocasset Harbor	7,958	12,479	3,120
Pocasset River	3,762	5,157	1,289
Buzzards Bay	16,830		TBD
Cape Cod Canal	164,028		TBD
		Total	8,072

Alternatives Approach

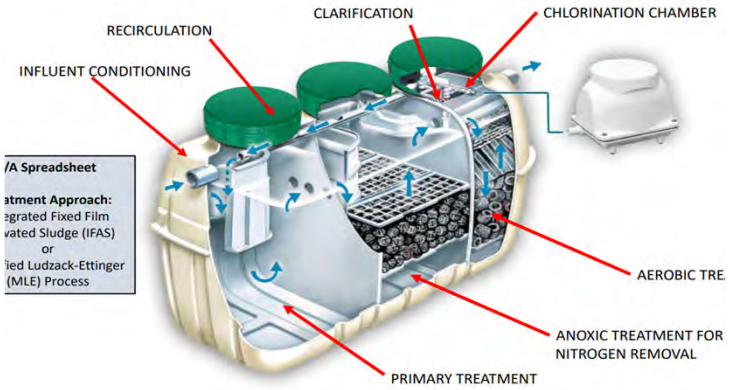
- Identifies management strategies for achieving the TMDL goal for each watershed
- Focuses on on-site and limited sewering approaches
- Does not consider a Buzzards Bay outfall
- Concept strategies to demonstrate that the TMDL goals can be achieved
  - Broad scale and conceptual at this point
  - Specific approaches to be developed in next CWMP phase
  - Will recognize existing I/A systems as part of the solution
- More detailed alternatives will develop costs (construction and O&M) and cost allocation strategies
- EP and the Town are aware and involved in the Title 5 regulation change process with MassDEP

Technology Toolbox

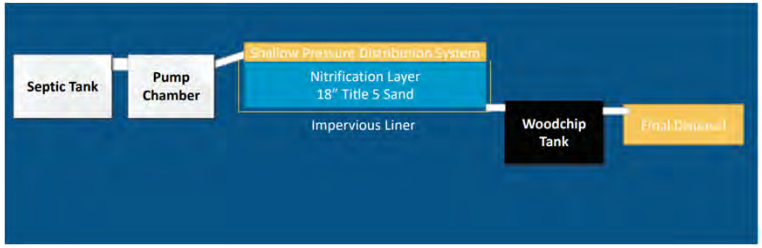
Innovative/Alternative Onsite Systems



Source: EPA



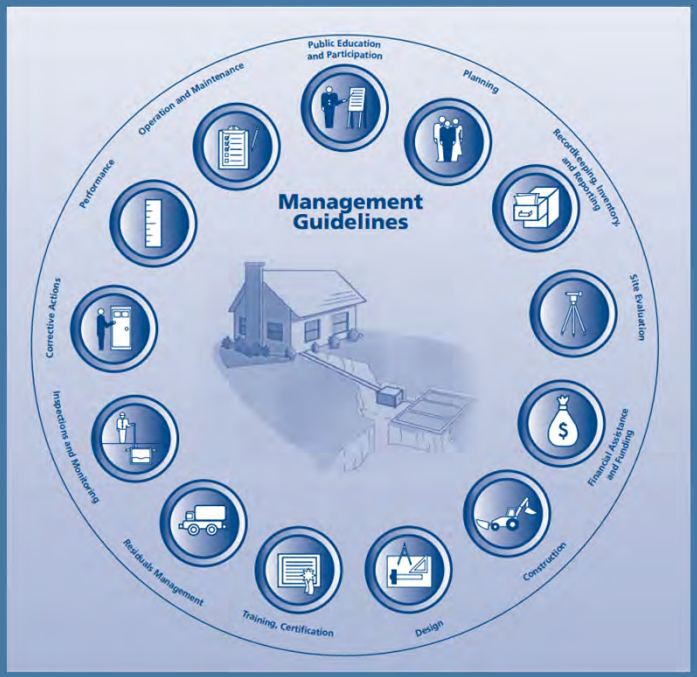
Source: Fuji Clean



Source: "Layer Cake" passive system

Responsible Management Entities (RMEs):

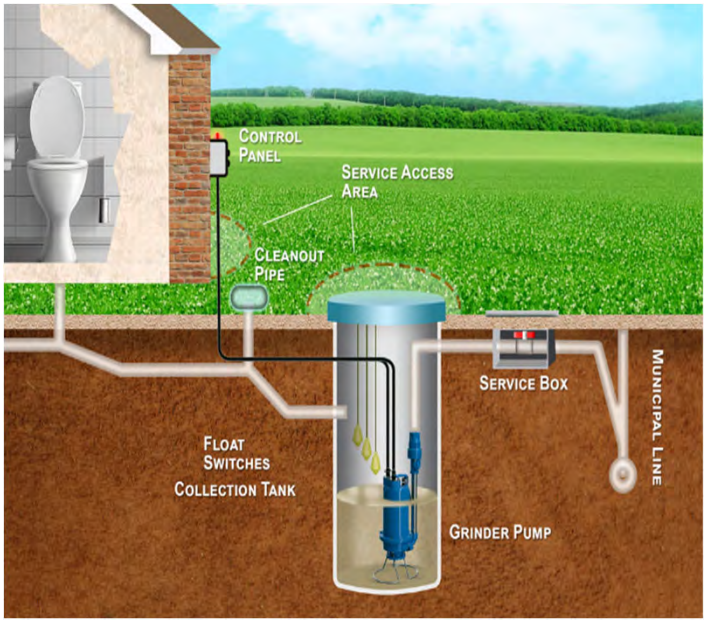
- Requires a regulatory agent/avenue for oversight
- Provides monitoring and oversight for each individual system
- MassDEP requires use of RMEs



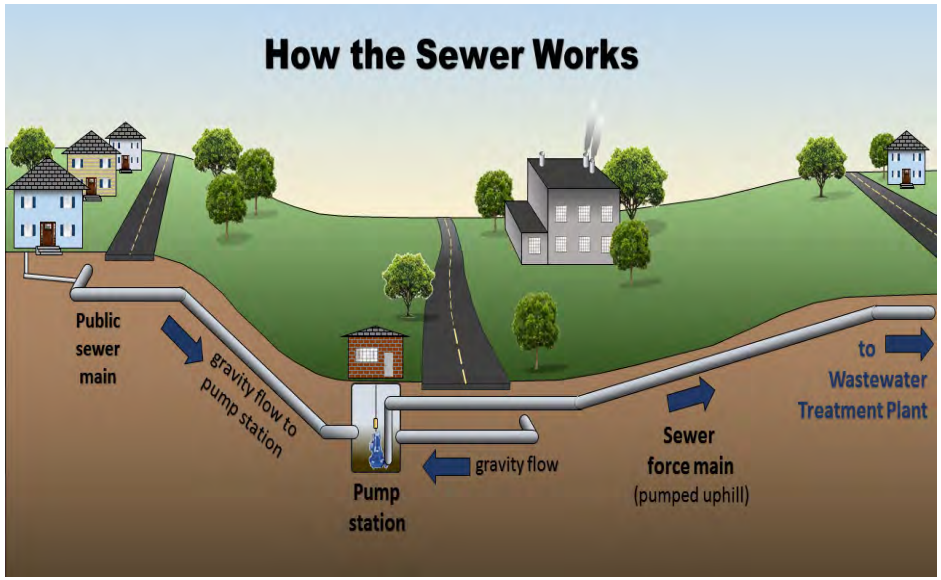
Stormwater Best Management Practices (BMPs)

Bioretention Areas & Rain Gardens

Collection Systems



Source: Empowering Pumps & Equipment



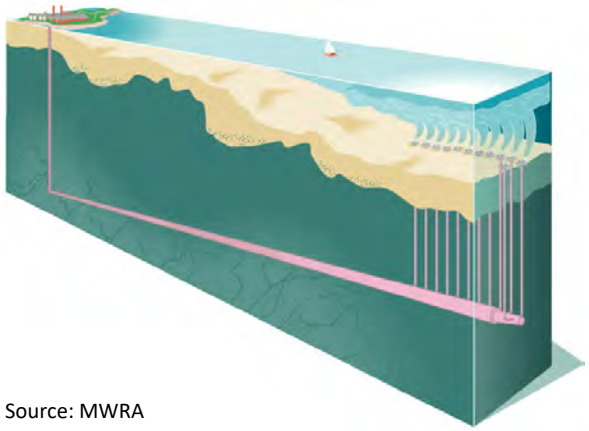
Source: City of Caldwell

Wastewater Treatment

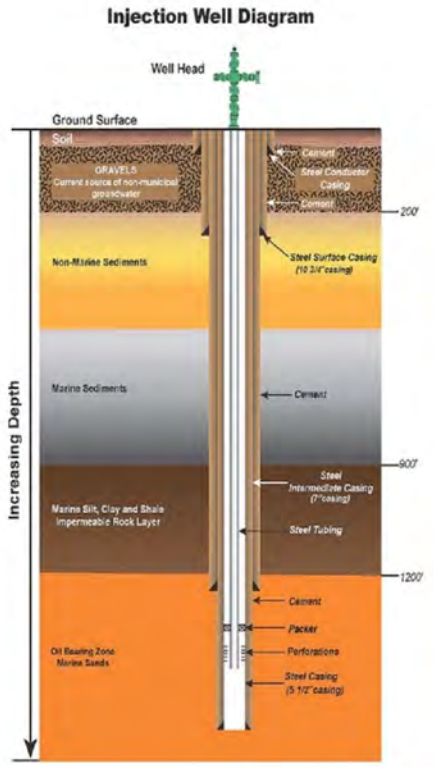
Source: Daniel Ackerman, CAI

Source: Carlin Contracting, Inc.

Effluent Disposal



Source: MWRA



Source: CA Department of Conservation

Alternatives by Watershed

Reminder

- Identifies management strategies for achieving the TMDL goal for each watershed
- Focuses on on-site and limited sewering approaches
- Does not consider a Buzzards Bay outfall
- Concept strategies to demonstrate that the TMDL goals can be achieved
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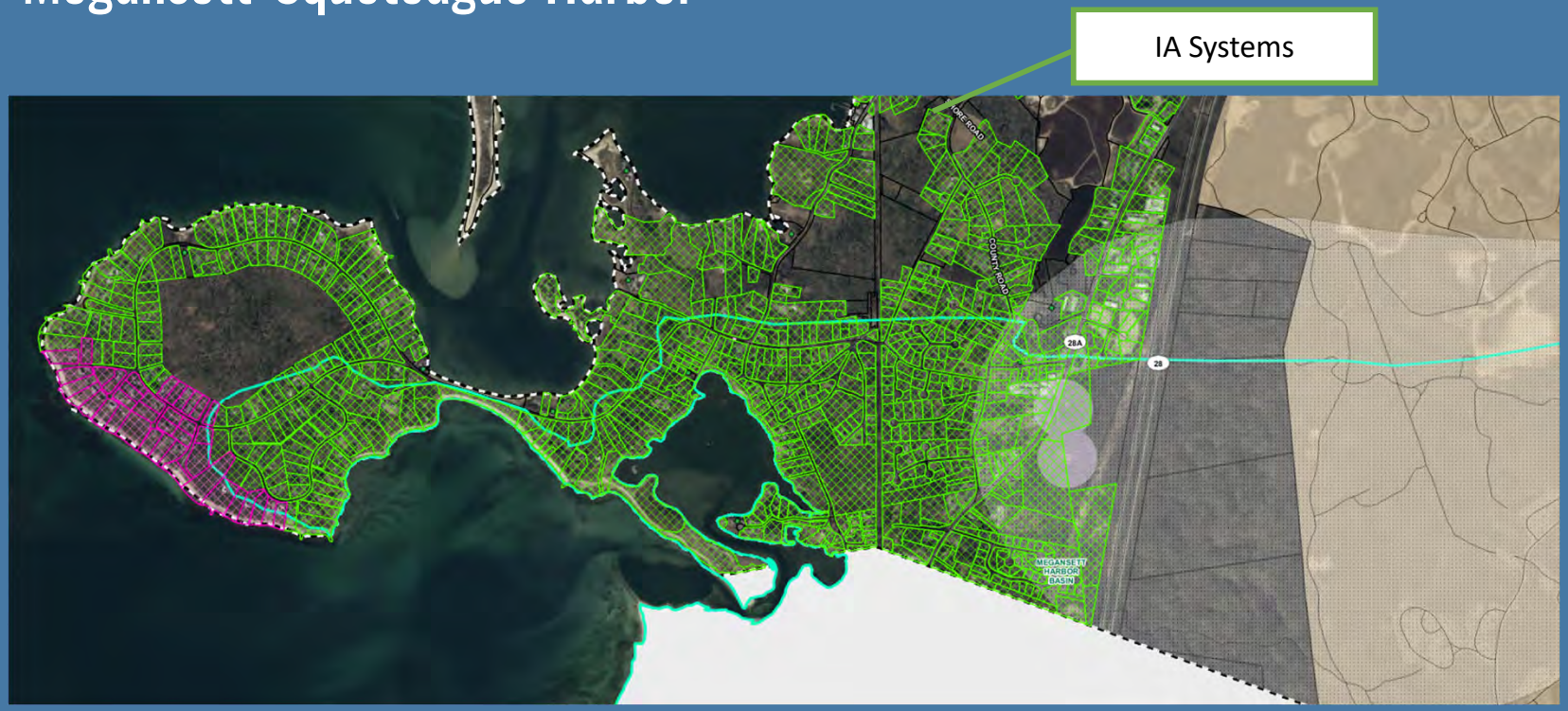
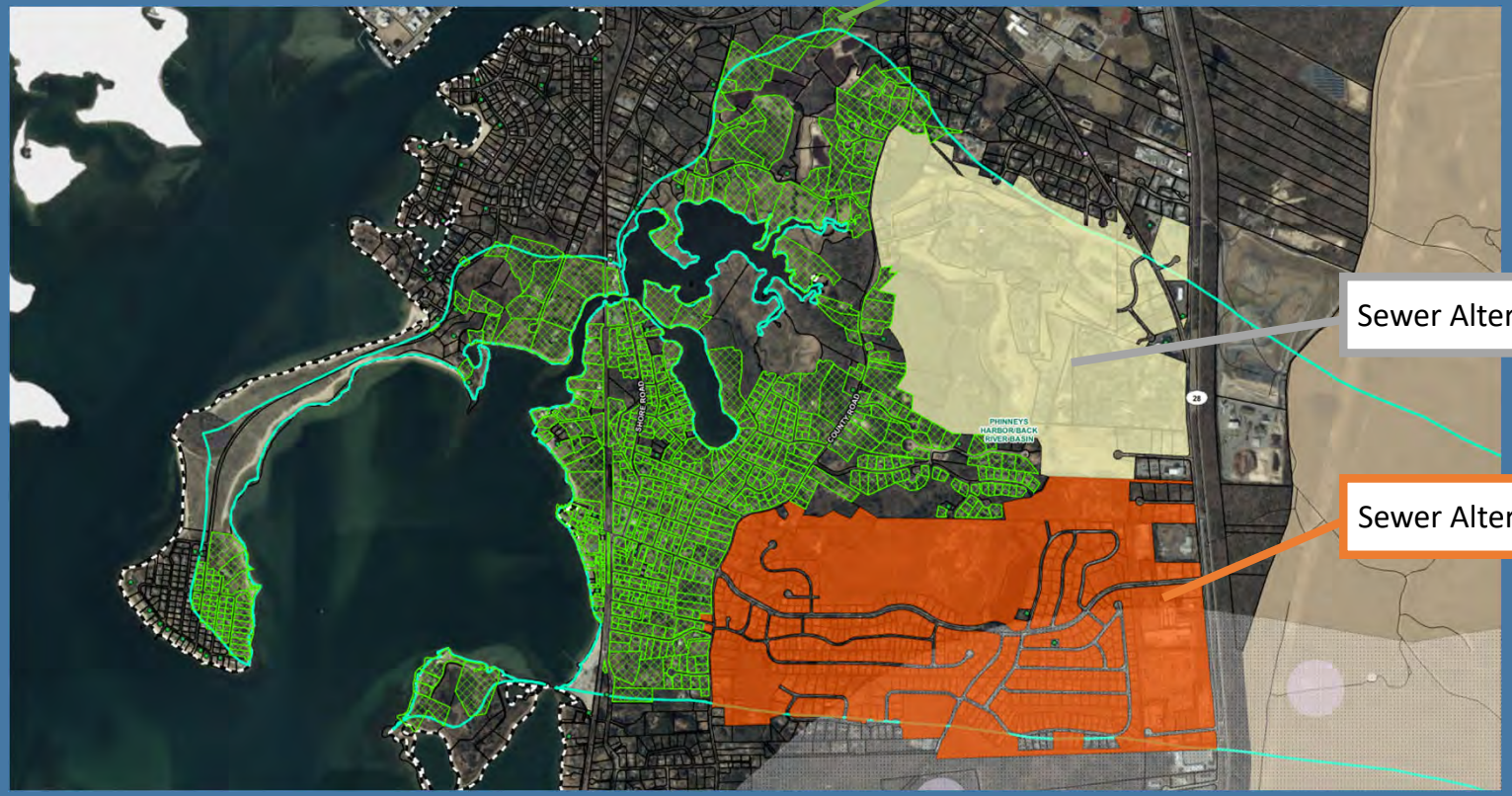
Megansett-Squeteague Harbor



Megansett-Squeteague Harbor

Alternative	Number of Parcels	Nitrogen Reduction Predicted (kg N/y)
I/A General Use System	483	545
Stormwater BMP	-	219
Total Estimated Removal		**764**
TMDL Removal Requirement		*600*
Removal Goal Met?		*Yes*

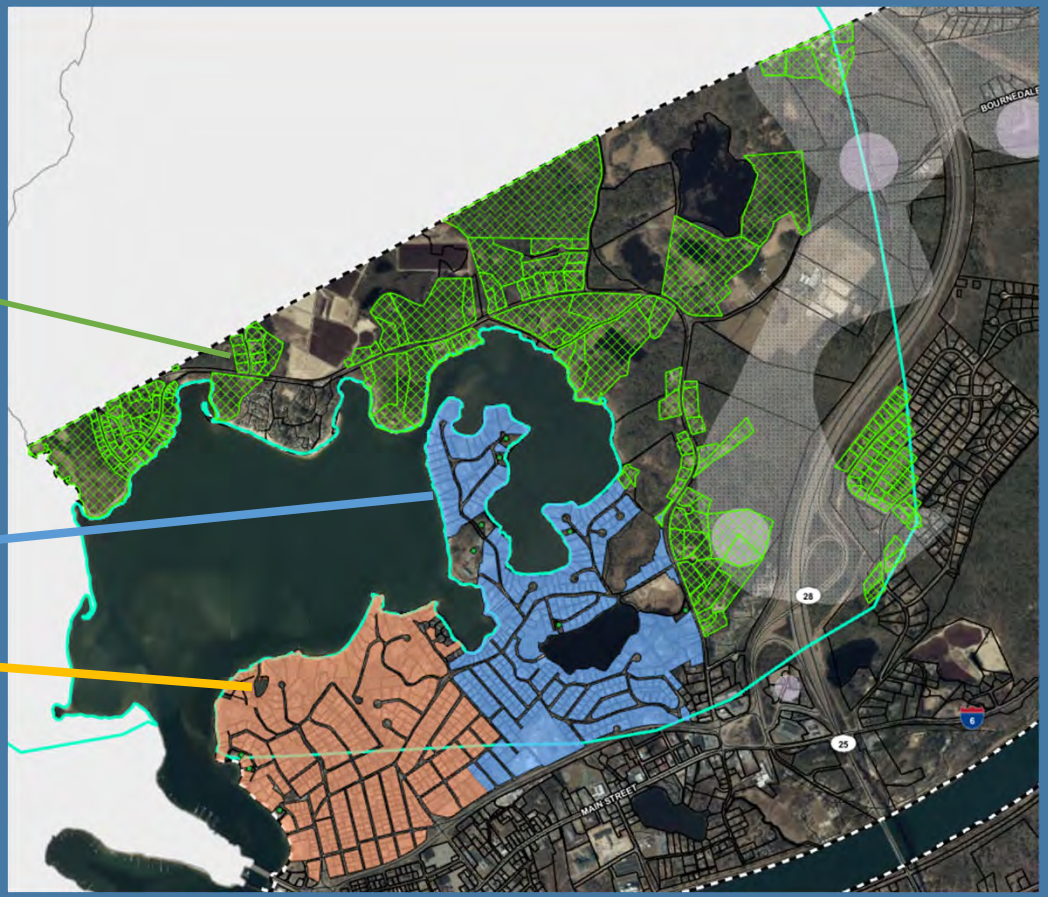
Phinney's Harbor



Phinney's Harbor

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg N/y)
I/A General Use System	646	729
Sewer Alternative 2A	18	60
Sewer Alternative 2B	481	1,598
Stormwater BMP	-	383
	Total	**2,770**
	TMDL Removal Goal	*1,706*
	Removal Goal Met?	*Yes*

Buttermilk Bay



Buttermilk Bay

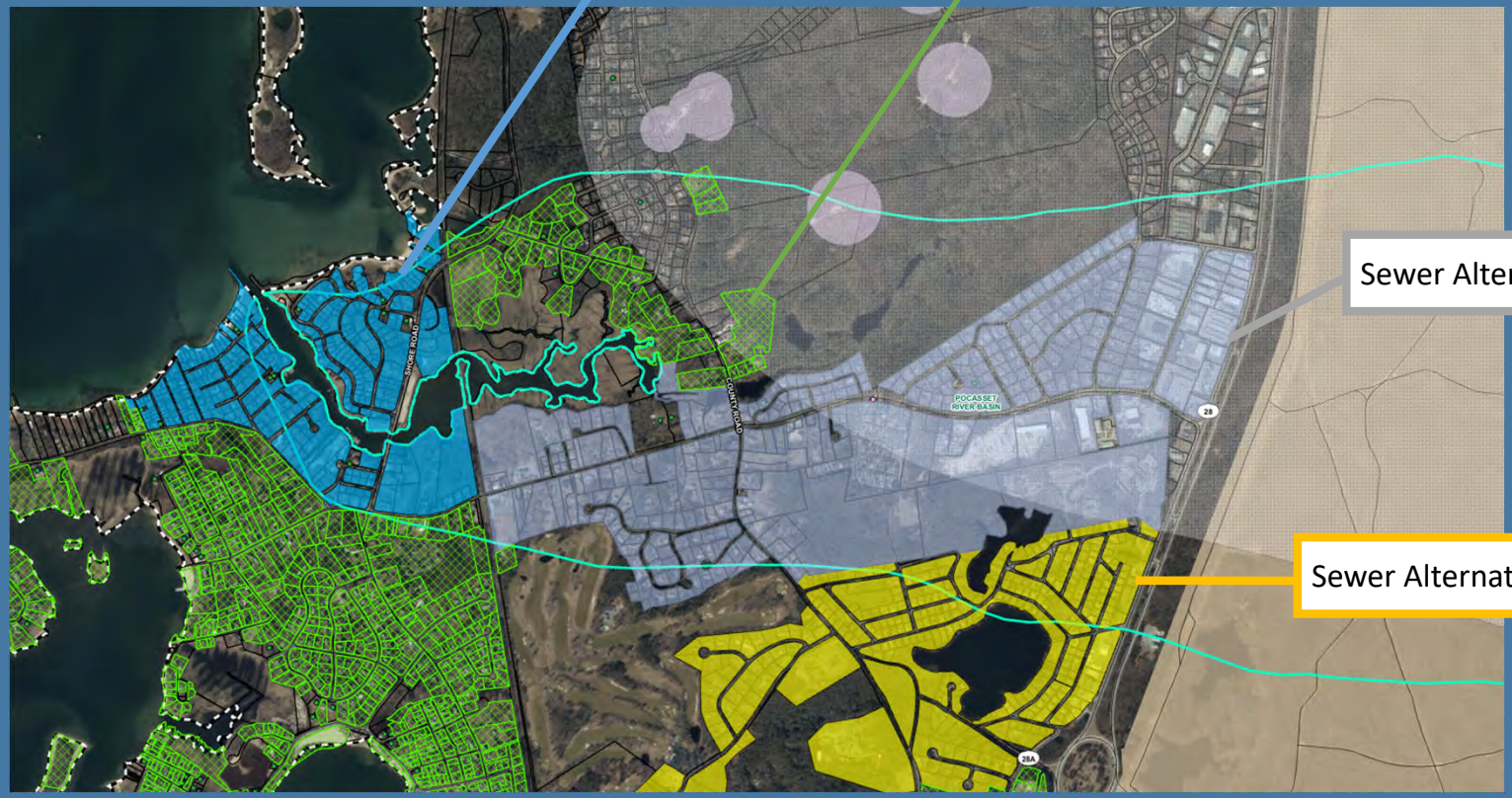
Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg-N/y)
I/A General Use System	266	266
Sewer Alternative 1A	349	1,029
Sewer Alternative 1B	187	551
Stormwater BMP	-	177
	Total	**2,023**
	Nitrogen Removal Goal	*1,402*
	Removal Goal Met?	*Yes*

Pocasset Harbor

Pocasset Harbor

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg-N/y)
I/A General Use System	1,107	1,249
Sewer Alternative 3A	12	40
Sewer Alternative 3B	70	232
Sewer Alternative 4A	359	1,192
Stormwater BMP	-	470
Total		**3,183**
Nitrogen Removal Goal		*3,129*
Removal Goal Met?		*Yes*

Pocasset River



Pocasset River

Alternative	Number of Parcels	Estimated Nitrogen Reduction (kg-N/y)
I/A General Use System	45	51
Sewer Alternative 3A	260	864
Sewer Alternative 3B	197	654
Sewer Alternative 4A	108	359
Stormwater BMP	-	215
	Total	**2,143**
	Nitrogen Removal Goal	*1,289*
	Removal Goal Met?	*Yes*

Next Steps

Project Schedule and Phase IV

Next Steps: Project Team

Summer 2022

- Public Presentation of Alternatives Evaluation
- Incorporate Public Feedback into Analysis

Fall 2022/ Winter 2023

- Quarterly Update to Sewer Commission
- Meet with Wastewater Advisory Committee
- Public Presentation of Draft Recommended Plan
- Incorporate Public Feedback into Plan

Spring/Fall 2023

- Quarterly Updates to Sewer Commission
- Finalization of Recommended Plan
- Town Meeting Action

Next Steps: Residents & Stakeholders

- Email questions and feedback
  - Bourne.CWMP@envpartners.com
    - Don't forget the dot!
- Visit the following Town Webpages
  - CWMP Page
    - https://www.townofbourne.com/comprehensive-wastewater-management-plan-cwmp
  - Wastewater Advisory Committee
    - https://www.townofbourne.com/wastewater-advisory-committee

THANK YOU

Questions or feedback?
Email the project team:
Bourne.CWMP@envpartners.com

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