Town of Barnstable, Massachusetts

Comprehensive Wastewater Management Plan / Single Environmental Impact Report

Volume 1: Report Text, Tables and Figures

November, 2020

Comprehensive Wastewater Management Plan / Single Environmental Impact Report

Barnstable, Massachusetts

Prepared by:

Barnstable Department of Public Works

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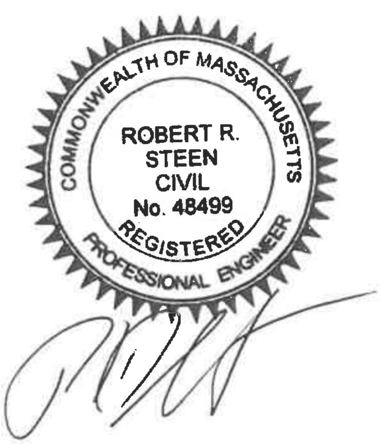

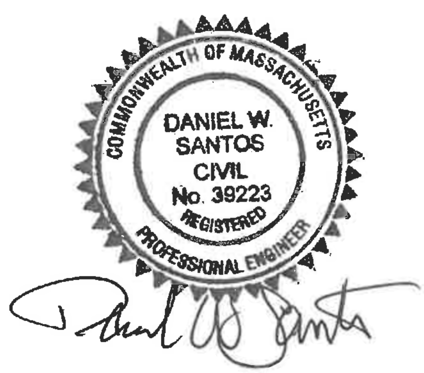

November, 2020

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November 13, 2020

Secretary Kathleen A Theoharides
Executive Office of Energy and Environmental Affairs (EEA)
Attn: MEPA Office
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RE: Town of Barnstable
Comprehensive Wastewater Management Plan / Single Environmental Impact Report

Dear Secretary Theoharides:

On behalf of the Town of Barnstable we are pleased to submit this Final Comprehensive Wastewater Management Plan (CWMP) and Single Environmental Impact Report (SEIR) in accordance with MEPA Regulations.

This CWMP/SEIR is the culmination of years of wastewater planning efforts within the Town. The recommended plan is a three-phase, 30-year plan, focused on traditional wastewater solutions (sewer collection, treatment and disposal). The plan also includes non-traditional projects which will be installed, monitored and the results presented to regulatory agencies for consideration. The Town undertook this effort in order to address the multiple wastewater needs of the community, specifically the reduction of nutrient loading to coastal embayments to meet total maximum daily loads (TMDLs), fresh water pond protection, and drinking water source protection.

In accordance with the April 3, 2020 Certificate on the Expanded Environmental Notification Form (EENF), the Town of Barnstable are please to submit this final document. We feel that this CWMP/SEIR addresses all of the comments raised in the certificate. Direct responses to all comments raised in the certificate can be found in Section 10 of the report.

Sincerely,

Daniel W. Santos, P.E.

Town of Barnstable Comprehensive Wastewater Management Plan

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0 EXECUTIVE SUMMARY

0.1 INTRODUCTION

The Town of Barnstable (Town) developed its Comprehensive Wastewater Management Plan (CWMP) to address various wastewater related issues within the community. The primary focus was nutrient removal, particularly nitrogen removal, as nitrogen has been shown to be causing eutrophication in coastal embayments. The prevalence of nitrogen has become an issue due to the widespread reliance on on-site septic systems as a means of addressing wastewater. The Cape Cod Commission (CCC), via its *Cape Cod Area-Wide Water Quality Management Plan Update*, or “208 Plan”, has been a strong proponent of wastewater planning for this reason. However, the Town also wanted to address other issues with this CWMP including nutrient contamination of ponds (principally via phosphorus), and Contaminants of Emerging Concern (CECs) such as like, 1,4-dioxane, perflorinated compounds (including Perfluorooctane sulfonate–PFOS, and Perfluorooctanoic acid-PFOA), etc. which has been affecting drinking water sources within the community.

To develop the CWMP, the Town appointed a Water Resources Advisory Committee (WRAC) comprised of 11 members including citizens and three Town Councilors, and was supported by the Department of Public Works (DPW) staff. Its purpose was “...to advise the Town of Barnstable on the completion and implementation of its Comprehensive Water Resource Management Planning Process, with the goal of protecting and restoring the Town’s fresh and saltwater bodies and it drinking water supplies, in compliance with the Cape Cod Commission’s Cape Cod Area-Wide Water Quality Management Plan Update of 2015 (the 208 Plan)”. The committee met via public meetings which were broadcast on the local public access television station, from January 2016 until August 2017 when it presented its findings to the Town Council. After the presentation to Town Council, Town staff continued to work on the plan as it evolved based on inputs from the community, and prepared it for submission to regulatory agencies.

The resulting plan summarizes and documents the Town’s wastewater planning efforts. These efforts have built on decades of prior wastewater planning as outlined in Section 1.3. This Report is divided into 10 Sections:

Section 1 introduces the CWMP and summarizes the purpose, project scope, previous relevant wastewater planning efforts, public review process, environmental review process, planning period and organization of the report.

Section 2 summarizes the Town’s 2011 Needs Assessment report, updates to Needs Assessment report, and projects already underway or completed since the Needs Assessment report.

Section 3 summarizes the evaluation of technological alternatives.

Section 4 summarizes the formulation and development of the Town's recommended wastewater plan.

Section 5 presents the Town's recommended wastewater plan on a watershed-by-watershed basis and contains the statement of consistency with the Cape Cod Commission's 208 Plan.

Section 6 presents the Town's proposed implementation plan and schedule.

Section 7 summarizes the financial considerations associated with the proposed plan.

Section 8 summarizes the environmental impact and benefits of the proposed plan.

Section 9 outlines the Draft Section 61 Findings.

Section 10 provides responses to comments received on the EENF.

0.2 EXISTING WASTEWATER NEEDS AND NITROGEN LEVELS

As discussed in Section 2, *Needs Assessment*, of the CWMP, the Town has within it eight watersheds. These include the:

- Popponesset Bay Watershed,
- Rushy Marsh Watershed,
- Three Bays System Watershed,
- Centerville River System Watershed,
- Halls Creek Watershed,
- Lewis Bay Watershed,
- Barnstable Harbor Watershed, and
- A very small portion of the Scorton Creek Watershed.

Of these watersheds, three are contained solely within the Town's borders (Centerville River System Watershed, Halls Creek Watershed and Rushy Marsh Watershed), while the rest are shared with neighboring communities. For five of the eight watersheds the United States Environmental Protection Agency (USEPA) in cooperation with the Department of Environmental Protection (DEP) has imposed a Total Maximum Daily Load (TMDL – effectively a nutrient budget) for nitrogen. This TMDL was based on modeling performed by the University of Massachusetts School of Marine Science and Technology (SMAST). The Town has TMDLs in place for Popponesset Bay, the Three Bay System, the Centerville River System, Halls Creek, and Lewis Bay. There is not a TMDL for Barnstable Harbor at this time, and a TMDL for Rushy Marsh is not anticipated due to its size.

The existing concentration of nitrogen in these watersheds can be found in Table 0-1. Note, watersheds are further subdivided into sub watersheds by the model, and nitrogen levels are monitored, and will be regulated, at “sentinel stations” within the watershed.

Nitrogen in these watersheds comes from many sources. The 208 Plan included a figure that delineated the sources Figure 0-1 shows the total sources of nitrogen, and those that are within our control.

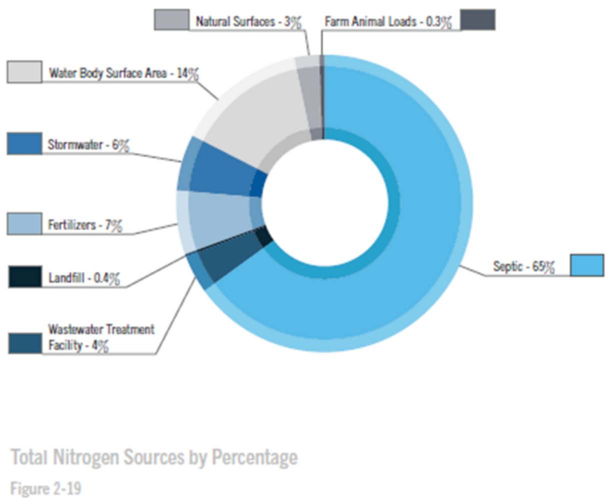

Figure 0-1: Sources of Nitrogen on Cape Cod (Source: 208 Plan)

As can be seen, by far the largest source of controllable nitrogen is coming from septic systems

Table 0-1: TN Concentrations in Watersheds

Watershed	Sub-embayment	Observed TN Concentration (mg/l)[1]	Threshold TN Concentration (mg/l)
Barnstable Harbor	Barnstable Harbor	0.072-0.111[8]	0.16[8]
Barnstable Harbor	Millway	0.266[8]	0.21[8]
Barnstable Harbor	**Barnstable Harbor Sentinel Station[2]**		0.16[8]
Centerville River	Centerville River East	0.43-0.75	
Centerville River	Centerville River West	0.43-0.75	
Centerville River	East Bay	0.41	
Centerville River	Scudder Bay	0.62	
Centerville River	**Centerville River Sentinel Station[3]**		0.37
Lewis Bay	Halls Creek	0.45	
Lewis Bay	Hyannis Inner Harbor	0.43 – 0.60	
Lewis Bay	Lewis Bay	0.41	
Lewis Bay	Mill Creek	0.52-0.56	
Lewis Bay	Snows Creek	1.57	
Lewis Bay	Stewart's Creek	1.25	
Lewis Bay	**Lewis Bay Sentinel Station[4]**		0.38
Popponesset Bay	Pinquickset Cove	0.527	
Popponesset Bay	Popponesset Bay	0.485-0.422	
Popponesset Bay	Shoestring Bay	0.690-0.520	
Popponesset Bay	**Popponesset Bay Sentinel Station[5]**		0.38
Three Bays	Cotuit Bay	0.39-0.44	
Three Bays	North Bay	0.38-0.48	
Three Bays	Princes Cove	0.32	
Three Bays	Princes Cove Channel	0.50-0.52	
Three Bays	Seapuit River	0.60-0.70	
Three Bays	Warren's Cove	0.64	
Three Bays	West Bay	0.64	
Three Bays	**Three Bay Sentinel Station[6]**		0.38
Rushy Marsh	**Rushy Marsh Sentinel Station[7]**	1.107	TBD

Notes:

1. Barnstable Harbor Based on Draft MEP report
- Centerville River Based on 2001-2005 data.
- Lewis Bay Based on 2001-2006 data
- Popponesset Bay Based on 1997-2003 data
- Three Bays Based on 1999-2004 data
- Rushy Marsh Based on MEP Report
2. Avereage of bioactive nitrogen at stations BM11, BM13, and BSH-4 based on the MEP Report. The Millway is a separate sentinel station with bioactive N threshold of 0.21 mg/L.
3. Located seaward of the mouth of the Bumps River. Additional threshold value of 0.50 mg/l applies to station BC-7 and station BC-3 for the protection of benthic habitat.
4. Located at the eastern end of Lewis Bay. Halls Creek had its own target threshold of 1.0 mg/l
5. Located at the mouth of Shoestring Bay
6. Located between Cotuit Bay and North Bay
7. TMDL not yet available
8. Bio active nitrogen concentrations
9. See Figure 2-11 for sentinel station locations

To establish the actual amount of nitrogen coming from septic systems within each watershed, the DPW developed a tool that compiled water data from 2010 to 2016 and calculated the average daily water usage of each parcel in Town. The tool then calculated the wastewater generated from each lot (assumed to be 90% of the calculated water usage) and the amount of nitrogen contributed (assumed a typical Title 5 septic system effluent concentration of 26.25 mg/L). A summary of the water use, wastewater generation, and associated nitrogen generation by watershed is provided in Table 0-2.

Table 0-2: Existing Wastewater Generation by Watershed

Watershed	Water Use (gpd)	Wastewater Generation (gpd)	Nitrogen Generation (kg/day)
Lewis Bay	1,518,042	1,366,238	31.7
Halls Creek	461,064	414,958	25.3
Centerville River	1,529,540	1,376,586	132.3
Three Bays	1,360,998	1,224,898	121.4
Rushy Marsh	4,198	3,779	0.4
Popponesset Bay	181,723	163,550	16.2
Barnstable Harbor	879,200	791,280	65.5
Undefined	282,021	252,819	25.2
Total	6,216,786	5,595,108	418.0

Other wastewater needs, in addition to nitrogen removal, for the community were also considered in Section 2. These included other pollutants/problematic nutrients affecting ponds and water supplies, protection of environmentally sensitive areas, residential buildout potential, commercial and industrial needs/buildout, etc. The result of all of this was summarized in Table 0-3.

Table 0-3: Summary of the Needs

Watershed		Nitrogen Removal	Ponds & Well Protection	Economic Development	Other Sanitary Needs	Total Needs Areas	Currently Sewered	Remain Unsewered	Total
Lewis Bay	Parcels	730	131	21	0	882	2,101	1,261	4,244
	WW (gpd)	125,774	22,603	2,737	0	151,114	1,047,053	168,070	1,366,237
Halls Creek	Parcels	39	80	0	266	385	483	1,475	2,343
	WW (gpd)	6,187	9,859	0	38,563	54,609	160,351	199,997	414,957
Centerville River	Parcels	2,770	1,980	6	0	4,756	65	3,177	7,998
	WW (gpd)	505,146	269,316	1,942	0	776,404	45,047	555,134	1,376,585
Three Bays	Parcels	3,543	772	1	0	4,316	1	1,308	5,625
	WW (gpd)	751,388	129,067	10	0	880,465	3,024	341,410	1,224,899
Rushy Marsh	Parcels	0	0	0	0	0	0	18	18
	WW (gpd)	0	0	0	0	0	0	3,779	3,779
Popponesset Bay	Parcels	518	8	0	0	526	0	417	943
	WW (gpd)	83,873	753	0	0	84,626	0	78,925	163,551
Barnstable Harbor	Parcels	362	305	68	0	735	452	3,469	4,656
	WW (gpd)	55,982	56,526	5,217	0	117,725	131,859	541,697	791,281
Undefined	Parcels	73	1	0	149	223	0	795	1,018
	WW (gpd)	18,974	28	0	43,124	62,126	0	191,693	253,819
Total	Parcels	8,035	3,277	96	415	11,823	3,102	11,920	26,845
	WW (gpd)	1,547,324	488,152	9,906	81,687	2,127,069	1,387,334	2,080,705	5,595,108

As can be seen, Table 0-3 provides the amount of wastewater that needs to be removed and corresponding number of parcels that have to be sewered for each watershed by broad need category.

0.3 HOW THE TOWN PROPOSED TO REMOVE THE NITROGEN

In considering how to address the need, the WRAC and Town staff considered a number of alternatives including traditional technologies, non-traditional technologies, and management approaches as discussed in Section 3, Evaluation of Technology Alternatives. Traditional technologies include collecting and conveying wastewater from homes to a treatment facility, treating it, and then disposing of the treated effluent. One of the big questions that committee worked on regarding traditional technologies, was should this be accomplished through one or two major plants (centralized), or via lots of smaller plants (decentralized). After careful consideration and reviewing the work that the Cape Cod Commission did on the topic, it was decided that the Town should leverage its existing facility and focus on a centralized approach. For non-traditional technologies, the committee considered a list of them, including but not limited to: aquaculture, fertigation, utilization of cranberry bogs, alternative toilets and septic systems, dredging, and permeable reactive barriers. The committee liked the promise of non-traditional technologies, but noted that at the time communities would have to negotiate with DEP for "credit" for each one. Additionally, it was understood that at least in the Three Bays Watershed, even the most optimistic understanding of the removal capability of non-traditional technologies would fall short of what was needed to meet the TMDLs. As such, the committee recommended a different approach. The Town would use both traditional and no traditional technologies in the CWMP. However, the plan would be designed such that all of the regulatory requirements could be met with traditional technologies alone. The plan would be structured in three 10-year phases. Non-traditional technologies would be installed in the first phase effectively "at risk". The Town would then monitor the performance/results of those solutions over the following 5-10 year period, thus establishing their true benefit. With that benefit firmly established, the Town would ask DEP for relief from that amount of traditional nitrogen removal (sewers) contained in the later phases of the plan. In that way the Town could assure DEP up front that the TMDLs will be met, while still maintaining its ability to leverage non-traditional technologies to their fullest extent.

As noted, the CWMP is structured as a three phase plan as outlined in Section 5, *Recommended Plan*, and listed below.

0.3.1 PHASE 1

- Construction of sewer infrastructure along Route 28 to address nutrient related issues within the Centerville River and Three Bays watershed. The Route 28 sewer infrastructure will be the major infrastructure to convey flow from westerly portions of the Town to the BWPCF.

- Sewer expansion adjacent to Wequaquet Lake, Bearses Pond, Shallow Pond, Long Pond, Red Lily Pond, Lake Elizabeth, and Filenes Pond to address deteriorating water quality.
- Sewer expansion to accommodate identified economic development areas including along the Route 28, Old Yarmouth Road, Attuck's Lane/Route 132, Kidd's Hill, Independence Park, and Hyannis Harbor.
- Sewer expansion within the flood zones in the Craigville and Long Beach region to address septic system issues in the area.
- Sewer expansion adjacent to Prince Cove and Warren's Cove (most impaired waterbodies in the Three Bays Watershed) and the Marstons Mills River.
- Modifications at BWPCF including upgraded/expanded aeration, denitrification upgrades, and upgrades to solids handling.
- Identification, permitting and construction of new effluent disposal site(s).
- Continuing to take the lead in pursuit of a regional sewer option at JBCC.
- Completion of Cotuit Cut/Sampson's Island dredging project to improve the flushing of Cotuit Bay (completed Fall 2020).
- Continued pursuit, construction and monitoring of non-traditional approaches along the Marstons Mills River System (Mill Pond Dredging, green stormwater projects, etc.).
- Continued embayment monitoring.

0.3.2 PHASE 2

- Continued westerly sewer expansion along Route 28.
- Continued sewer expansion within the Centerville River Watershed, specifically the Centerville River East subwatershed and expansion adjacent to Bumps River.
- Sewer expansion into the Nye's Neck region to complete sewer expansion surrounding all of Wequaquet Lake.
- Sewer Expansion to areas south of Craigville Beach Road east of Covell's Beach.
- Sewer expansion into the Millway subwatershed (the one sub-watershed within the Barnstable Harbor Watershed requiring septic load removal per the MEP report).
- Sewer expansion within the Lewis Bay Watershed in the General Patton area and northern Hyannis Port.
- Continued sewer expansion within the Three Bays Watershed, directly adjacent to sub-embayments requiring septic load removal (Prince Cove and North Bay), to address areas with shortest groundwater travel times.
- Sewer expansion into Osterville Village.
- Continued monitoring and analysis of non-traditional projects in the Three Bays Watershed.

- During this phase, it is the Town's intention to present the monitoring and analysis of the non-traditional approaches to the regulatory agencies.
  - If, as anticipated, the analysis of the monitoring program determines that the non-traditional approaches have improved conditions within the Three Bays Watershed, the Town would then enter discussions with regulatory agencies to pursue non-traditional "credits" in an effort to minimize the required sewer expansion proposed in Phase 3.
    - The Town is not proposing any non-traditional "credits" at this time and has designed the sewer expansion plan to achieve the required septic load removals by traditional approaches only.
- Continued embayment monitoring.

0.3.3 PHASE 3

- Continued sewer expansion into the northerly portion of the Three Bays Watershed.
- Continued sewer expansion within the Lewis Bay/Halls Creek Watershed.
- Continued monitoring and analysis of non-traditional projects and follow-up with regulatory agencies.
- Continued embayment monitoring.

The expected wastewater captured and nitrogen removed for each phase is listed below in Table 0-4.

Table 0-4: Sewer Expansion Plan - Phasing Statistics

	Phase 1 (0-10 Years)	**Phase 2 (10-20 Years)**	**Phase 3 (20-30 Years)**	**Total**
WW Captured (gpd)	798,900	810,700	372,900	**1,982,500**
Load N Removed (kg/day)	79	81	37	**197**
Number of Parcels Affected	4,735	3,820	2,377	**10,932**
Approximate Road Miles	75	60	38	**173**
% of N Removed by Plan	40%	41%	19%	**100%**

0.3.4 STAGES

In addition to the three phases, the sewer expansion plan also includes three separate "stages" of sewer expansion. The three stages are located in the Village of Cotuit and are focused on the Popponesset Bay Watershed and the Cotuit Bay subwatershed of the Three Bays Watershed. The term "stages" was used for these sewer expansion areas because they do not have a determined schedule, as it is assumed that these areas would be served by an undetermined western treatment and disposal solution to accommodate the sewer expansion. The original plan developed by the WRAC recommended approaching these areas via an inter-municipal agreement (IMA) with Mashpee and Sandwich, which was then executed between the communities. However, in order to address water quality concerns in Shoestring Bay and Cotuit Bay that would not be addressed via nitrogen sharing in an IMA, there is a desire for traditional wastewater solution in these areas. If a westerly solution becomes a reality, the Town intends to pursue sewer expansion within the areas identified in the stages.

Table 0-5: Sewer Expansion Plan - Staging Statistics

	Stage 1	Stage 2	Stage 3	Total
WW Captured (gpd)	37,200	84,500	22,800	**144,500**
Load N Removed (kg/day)	4	8	2	**14**
Number of Parcels Affected	253	483	155	**891**
Approximate Road Miles	5	8	3	**16**

0.4 WPCF UPGRADES

The CWMP will require upgrades to the Barnstable Water Pollution Control Facility (BWPCF). The anticipated WPCF upgrades include upgrades/rehabilitation projects addressing the aeration system, denitrification improvements, solids handling system, headworks, secondary clarifiers, and an expansion of effluent disposal capacity. All of these are anticipated to occur during Phase I of the CWMP. The most controversial of these will likely be the effluent disposal capacity expansion, as it will likely occur not on BWPCF lands. The others involve expansions/upgrades within the plants existing foot print. Each is discussed in Section 5.3 and the timing and costs of these upgrades can be found in Table 6-3 in Section 6.

0.5 SMAST MODEL RESULTS

To verify the CWMP would achieve the desired results, the Town had SMAST utilize the MEP model to confirm the plan will achieve the TMDLs. This effort determined that the plan, once fully implemented, will satisfy the nutrient removal targets and achieve the required TMDLs.

0.6 COSTS

Project capital costs are estimated by the Department of Public Works to be $663 million in today's dollars. Indexed for inflation at 2.0% will increase the total costs to over $863 million. These costs will come to Town Council not as one big project, but as a series of individual CIP projects over the next 30 years. Roughly 25% of these costs will be for upgrading the BWPCF, while the other 75% will be used for sewers and pump stations. Additionally there will be financing, legal, and project management costs to the project. With those also considered it is expected that the total cost of the CWMP will exceed one billion dollars.

0.7 IMPLEMENTATION SCHEDULE

As discussed above and in Section 6, the CWMP will be implemented with an aggressive 30-year plan, focused initially on traditional solutions that will be performed in three 10-year phases. The Town anticipates that as part of the CWMP process it will be updating the report every five years, with the first update occurring in 2025. This will allow the plan to adapt to new technologies, understanding of the environmental situation, and to react and adapt to the results from initial projects within the CWMP.

The Town has developed the implementation plan for the first 10-year phase (Phase 1) of the plan. Tables 6-1, 6-2, and 6-3 within Section 6 detail the impact of these projects, costs and expected timing of the work.

0.8 ENVIRONMENTAL IMPACTS AND MITIGATION

The project is, at its core, an environmental benefit, as it is being undertaken to positively restore the water quality of the impaired surface waters of the Town of Barnstable. Negative environmental impacts will generally only be temporary, associated with construction activities, and mitigation techniques will be employed in order to limit negative environmental impacts. Section 8 of the SEIR identifies environmental impacts of the project and Section 9 identifies Section 61 Findings and outlines mitigation measures.

1 INTRODUCTION

Communities undertake wastewater planning to address some, or all, of the following issues:

- Protection of surface waters, including nutrient loading
- Public health concerns
- Protection of groundwater and drinking water resources
- Addressing aesthetics and convenience concerns attributable to wastewater issues
- Support of sustainable, community aligned, economic development

The primary focus of recent wastewater plans on Cape Cod has been nutrient removal, particularly nitrogen removal, as nitrogen has been shown to be causing eutrophication in coastal embayments. The prevalence of nitrogen has become an issue due to the widespread reliance on on-site septic systems as a means of addressing wastewater. The Cape Cod Commission (CCC), via its *Cape Cod Area-Wide Water Quality Management Plan Update*, or "208 Plan", has been a strong proponent of wastewater planning for this reason. However, there are other important wastewater-related issues in the Town of Barnstable that also require attention. Those include, in no particular order: nutrient contamination of ponds (principally via phosphorus); Contaminants of Emerging Concern (CECs) affecting water resources and drinking water sources like, 1,4-dioxane, perflorinated compounds (including Perfluorooctane sulfonate–PFOS, and Perfluorooctanoic acid-PFOA), etc.; and desired economic development that is limited or restricted due to the lack of wastewater solutions. As a result, the Town of Barnstable's wastewater planning efforts address the required nitrogen issues, while at the same time also accounting for its other wastewater needs.

Comprehensive Wastewater Management Plans (CWMPs), and wastewater plans in general, are documents that provide the community guidance as it addresses wastewater challenges. CWMPs are often town-wide plans that identify water resource and water quality issues; suggest well thought out, efficient solutions to those issues; translates those solutions into the beginnings of projects; and recommends ways to fund and schedule those projects that makes sense for the community and solves the underlying problem.

The Town of Barnstable (Town) undertook the Comprehensive Wastewater Management Plan planning effort by appointing a Water Resources Advisory Committee (WRAC), which was comprised of 11 members including citizens and three Town Councilors, and was supported by the Department of Public Works (DPW) staff. Its purpose was "...to advise the Town of Barnstable on the completion and implementation of its Comprehensive Water Resource Management Planning Process, with the goal of protecting and restoring the Town's fresh and saltwater bodies and it drinking water supplies, in compliance with the Cape Cod Commission's

Cape Cod Area-Wide Water Quality Management Plan Update of 2015 (the 208 Plan)". The committee met from January 2016 until August 2017 when it presented its findings to the Town Council. During that time the committee:

- Assembled the data from previous planning efforts (wastewater and otherwise), and other available sources.
- Identified "holes" in the existing data, and then set about addressing those data gaps.
- Created a Geographic Information System (GIS)-based tool (The Tool) that allowed the WRAC and DPW to evaluate on a lot-by-lot basis.
    - Poor sanitary conditions and public health issues, such as:
        - excessively or poorly draining soils
        - high groundwater
        - failed septic systems
        - lot density
        - inadequate set-back from private wells/property lines
        - direct discharge of sanitary wastewater to a water body
    - Water Supply Protection issues including identifying "impaired" or endangered wells and the sources of the impairments that are likely impacting them
    - Properties/areas causing nutrient enrichment in surface waters (both marine estuaries and freshwater ponds)
    - Convenience and aesthetic issues including needing mounded septic systems, septic systems located in the Federal Emergency Management Agency (FEMA) Mapped velocity zones, systems that require excessive pumping, or are in areas where it is very expensive to install on-site wastewater solutions
    - Areas where economic development was desired, yet difficult due to the lack of viable wastewater options.
- Utilized the Tool to understand the various wastewater needs and requirements, and devise solutions for those needs.
- Met with regulators from both the Department of Environmental Protection (DEP) and Cape Cod Commission.
- Facilitated the meeting of Town Staff with adjoining town's staffs to find efficiencies and areas where common solutions could be used to address regional wastewater needs.
- Conducted public meetings, had staff create public outreach programs utilizing the Town's local government access television station, and public outreach meetings with the village associations that requested them.
- Complied with the Cape Cod Commission's 208 Plan process, including the submission of "Bookends" Plan.
- Presented its recommended plan to the Town Council.

The CWMP is intended to document the results of those efforts and present the Town's preferred approach for addressing its wastewater and water resource needs.

This CWMP is intended to be a working document. The Town is required to submit an adaptive management plan update every five years. The following is list of items that, among other unforeseen items, the Town anticipates the first adaptive management plan in 2025 will provide updates to:

- Progress towards effluent disposal solutions
- Financial plan updates
- Status of Route 28 sewer backbone to serve the western portion of the Town
- Project schedules and projects completed.
- Barnstable WPCF upgrades
- Continued improvements to existing collection system via pump station rehabilitation and infiltration/inflow programs
- Continued progress towards permitting, design and construction of non-traditional solutions
- Continued discussions with neighboring communities relative to potential inter-municipal partnerships and watershed permits within shared watersheds
- Continued discussions relative to Joint Base Cape Cod (JBCC) and other potential western solutions
- Status of sewer expansion "stages"
- Updates in build-out projections
- Monitoring and sampling update
- Policy decisions

1.1 BACKGROUND

The Town of Barnstable is located in the middle portion of Cape Cod as shown in Figure 1-1. Its year-round population is 45,193 (*US Census 2010*) while seasonal population can grow to more than three times that amount. It is organized into seven villages, and contains eight watersheds (no geographic relationship to the villages) including the Popponesset Bay Watershed, Rushy Marsh Watershed, Three Bays System Watershed, Centerville River System Watershed, Halls Creek Watershed, Lewis Bay Watershed, Barnstable Harbor Watershed and a very small portion of the Scorton Creek Watershed. Of these watersheds, three are contained solely within the Town's borders (Centerville River System Watershed, Halls Creek Watershed and Rushy Marsh Watershed), while the rest are shared with neighboring communities. Five of the eight watersheds have a Total Maximum Daily Load (TMDL) for nitrogen.

A TMDL is the maximum pollutant load a water body can receive and still meet water quality standards. TMDLs are created through a cooperative process involving multiple agencies. In the example of establishing TMDLs for nitrogen on Cape Cod, the process began with the Massachusetts Estuaries Project (MEP); a collaborative effort between DEP, University of Massachusetts School of Marine Science and Technology (SMAST), United States Geological Survey (USGS), and others. The MEP developed nitrogen thresholds for 70 estuaries in Southeast Massachusetts using a water quality model that predicts water quality changes resulting from land use decisions. The model is run with different watershed loading values to demonstrate the "nitrogen threshold" can be met, which is the upper limit of nitrogen loading that can enter the estuary and still meet water quality goals. Once MEP has established the nitrogen thresholds, DEP takes those numbers and prepares a draft TMDL for the water body. The draft TMDLs are then sent to the United States Environmental Protection Agency (USEPA) for approval, which once that happens, are enforceable. As of the writing of this CWMP, TMDLs are in place for Popponesset Bay, Scorton Creek, the Three Bays System, the Centerville River System, Halls Creek, and Lewis Bay. The Town is waiting for the determination of TMDLs for Barnstable Harbor and per discussions with MassDEP is not expecting one for Rushy Marsh.

The Town draws its public water supplies from groundwater which is part of Cape Cod's Sole Source Aquifer. This water is distributed to its citizens via one of four different water purveyors, or private wells. Those purveyors include the Hyannis Water System which provides water to the Village of Hyannis and has 12 supply wells; the Barnstable Fire District which provides water to the Village of Barnstable by means of four supply wells; the Cotuit Water District which uses five wells to provide water to the Village of Cotuit; and the Centerville-Osterville-Marstons Mills (C-O-MM) Water District which utilizes 19 wells to supply water to the Villages of Centerville, Osterville, and Marstons Mills. The Village of West Barnstable does not have a public water supply system, so properties there rely exclusively on private wells for their water. The Hyannis Water System is owned and operated by the Town, whereas the other three water purveyors are non-municipal water/fire districts.

The Town has 184 ponds, totaling 1,892 acres. Of these, 74 are named ponds and 25 are considered great ponds, which DEP defines as any pond or lake of 10 or more acres.

The Town's existing wastewater infrastructure includes the Barnstable Water Pollution Control Facility (BWPCF) located in Hyannis, a smaller wastewater plant in Marstons Mills referred to as the Marstons Mills Wastewater Treatment Plant (MMWWTP), the Red Lilly Pond cluster septic system, and their associated collection systems. The BWPCF treats an average daily flow of 1.67 million gallons per day (MGD) and has a maximum-month average daily flow of 1.97 MGD (2018 flow data). The BWPCF is permitted for a treatment capacity of 4.2 MGD and an effluent disposal capacity of 2.7 MGD. The Hyannis facility's collection system dates back to

1937, and includes approximately 55 miles of sewer, which collects flows from approximately 2,300 acres of catchment area. Within that 55 miles are 1.5 miles of vacuum sewer, and 1.2 miles of low pressure sewer, with the rest being gravity sewer. The collection system also includes 27 pump stations and an associated 25.5 miles of force mains. Contributors to the sewers include a mix of residential and commercial users within portions of the villages of Hyannis and Barnstable. The MMWWTP is a much smaller facility, which serves the Barnstable United Elementary School, West Villages Elementary School and a 30-unit housing trust development on an adjacent property. The facility is permitted to treat 42,900 gallons per day (gpd). Of this, the school is allotted 30,000 gpd while the Housing Trust is allotted 12,000 gpd. The Town also maintains the Red Lily pond cluster septic system in Centerville. The system consists of a network of 17 grinder pumps and approximately 1,300 linear feet of low pressure sewer serving 17 of homes feeding into a communal septic system.

1.2 WASTEWATER PLANNING SCOPE

Traditionally, CWMPs are developed for communities by consultants, and usually organized into four phases:

- Needs Assessment
- Identification, Screening and Evaluation of Alternatives
- Develop and Formalize Recommended Plan
- Environmental Notification and Form Filing (MEPA and Cape Cod Commission 208 Consistency processes)

A listing of the tasks found in each phase is included in Table 1-1.

The Town of Barnstable generally adopted this same approach, but diverged from it in the following key ways:

- The Town is fortunate to have a highly qualified technical staff, with a number of licensed engineers, many of whom have previously worked as consultants addressing wastewater issues for communities. As a result, the Town elected to utilize these resources and create the plan in-house versus hiring consultants.
- The Town had previously engaged in a number of wastewater planning efforts, some quite recently, that were leveraged to provide a strong foundation to this report.
- With the CCC development of the 208 Plan, much of the work that was traditionally required in the Identification and Evaluation of Alternatives Section was included in Chapter 4 of that document. As a result, the Town elected to leverage that work in its planning process and report development.
- The Town created its own GIS-based tool to evaluate, on a parcel-by-parcel basis, the various wastewater needs of the community**.** This was used to formulate the plan,

though ultimately the plan's results were review and confirmed by the SMAST MEP model.

Table 1-1: The Phases of the CWMP

PHASE	TASKS

Phase I:
Needs
Assessment
	• Document property type, seasonality, land use, soil conditions, watersheds and environmentally sensitive areas
	• Document existing water quality in each watershed
	• Identify the water use for each of the parcels
	• Formulate a GIS Tool for parcels that evaluates:
	    • Sanitary Conditions/Identified public health issues
	        • excessively or poorly draining soils
	        • high groundwater
	        • failed septic systems
	        • lot density
	        • inadequate set-back from private wells/property lines
	        • Title 5 variances
	        • Flood Zones
	    • Water Supply Protection
	        • Identified "impaired" or endangered wells and neighborhoods likely impacting them
	    • Surface Waters - Nutrient Enrichment
	        • Marine – SMAST Modeling and CCC 208
	        • Freshwater – Town sampling and study of ponds
	    • Convenience and Aesthetic Issues
	        • Identified Mounded septic systems, velocity zones, and excessive septage pumping
	    • Wastewater needs to allow Sustainable Economic Development
	• Identify existing municipal and private wastewater infrastructure
	• Identify requirements and collaboration potential with adjoining towns that share watersheds with Barnstable

Phase II:
Identification,
Screening, and
Evaluation of
Alternatives
	• Using the CCC 208 Plan Chapter 4, identify all technically feasible options to address the wastewater needs
	    o Traditional and non-traditional alternatives
	    o Structural and non-structural alternatives
	• Compare alternatives with respect to the following factors:
	    o Efficacy of the solution and probability of success
	    o Proximity of the issue to existing infrastructure
	    o Capital and operations and maintenance costs

	o Speed of impact on the problem o Ability of the solution to address more than one wastewater need o Perceived public and political perception and acceptance • Meet with adjoining towns that share watersheds with Barnstable to identify synergies
Phase III: Formulation of Plan	• Identify the best alternative or combinations of alternatives for each sub-watershed and watershed • Craft a plan and schedule for implementation • Prepare conceptual designs of traditional and nontraditional components • Develop capital cost estimates • Develop financial strategy and impacts on users and non-users • Consult with the public through workshops, hearings and reports • Submit Draft CWMP Table of Contents to DEP for review • Submit Draft CWMP to DEP for review
Phase IV: MEPA and CCC Reviews	• Prepare Environmental Notification Form and Environmental Impact Reports • File Request for Cape Cod Commission 208 Consistency • Respond to comments

1.3 SUMMARY OF PREVIOUS RELEVANT WASTEWATER PLANNING IN BARNSTABLE

1.3.1 INJECTION WELL PILOT TESTING EVALUATION MARCH; 2003

A pilot test was executed in 2003, to evaluate the feasibility of injecting treated wastewater into the subsurface using an injection well. The pilot test was conducted in two phases. Phase I used treated effluent, ending in 11 days as a result of well plugging of the injection zone. The plugging was attributed to the buildup of bacteria at the formation face of the injected zone. Phase II used potable water, where approximately 7 million gallons were injected and was sustained for approximately three months.

From the results, the study demonstrated that filtration and disinfection must be enhanced to levels greater than those used during the pilot test before it can be considered as an alternative for the Town. A copy of the report has been provided in Appendix H.

1.3.2 LAKE WEQUAQUET, LONG POND AND CAPE COD COMMUNITY COLLEGE SEWER EXTENSION PRELIMINARY DESIGN REPORT; SEPTEMBER 2003

In 2003, a sewer extension evaluation was performed for the neighborhoods surrounding Lake Wequaquet, Long Pond, Bearse Pond and Shallow Pond in the Town of Barnstable, as well as Cape Cod Community College. Four sewer extension alternatives were developed in order to determine the most economical preliminary sewer design to serve the area.

Alternative 3, a combination of gravity and low pressure sewers, was the recommended alternative. This alternative provided the lowest construction cost and lowest 50-year life cycle cost. In addition, this alternative was expected to have the least significant impact on the environment and the neighborhoods surrounding Lake Wequaquet and Long Pond. A copy of the report has been provided in Appendix I.

1.3.3 PRELIMINARY EVALUATION OF CAPE COD COMMUNITY COLLEGE FOR TREATED WATER RECHARGE; NOVEMBER 2003

An evaluation was completed in 2003, regarding the use of Cape Cod Community College for the recharge of treated municipal wastewater. After reviewing a few locations, it was decided a wooded area on the northeast side of the college property would be the site for the investigation.

The investigation resulted in the conclusion that the College has the potential to be a suitable site to discharge treated effluent. If open sand beds are utilized a recharge capacity of approximately one million gallons per day is possible. If leaching trenches are used, the recharge capacity is reduced to approximately 660,000 gallons per day. A copy of the report has been provided in Appendix J.

1.3.4 PRELIMINARY EVALUATION OF THE LORUSSO PROPERTY FOR TREATED WATER RECHARGE; NOVEMBER 2003

A preliminary evaluation was completed of the Lorusso Property, located along the power lines, just south of Route 6, for the recharge of treated effluent. The property is approximately 11 acres and is comprised of lightly vegetated, undulating terrain.

It was found the site contains soils that are finer grained but that the deeper subsurface soils would have the capacity to receive the recharged water. The report concluded the Lorusso Property had potential to be a site to discharge treated effluent. A copy of the report has been provided in Appendix K.

1.3.5 EFFLUENT MITIGATION INVESTIGATION PROJECT – CANDIDATE SITE EVALUATION AND COMPARISON; DECEMBER 2003

In 2003 a study was completed to identify specific sites for effluent discharge. The evaluation was completed on four sites. Out of the four sites two were chosen to be most favorable.

The sites chosen were the McManus site and the Cape Cod Community College site. Both were identified for the ability to support sand bed technology, which provides a low cost alternative on a dollar per flow basis. They also offered an estimated capacity of over 1.5 MGD. A copy of the report has been provided in Appendix L.

1.3.6 PRELIMINARY EVALUATION OF THE MCMANUS PROPERTY FOR TREATED WATER RECHARGE; MAY 2004

The Town of Barnstable consulted with Stearns & Wheler (now known as GHD) for an evaluation of the McManus site, located between 1860-1910 Iyannough Road (Route 132), to determine its suitability for wastewater reclamation through groundwater recharge.

The report found that the site has advantages due to its proximity to the WPCF, not being located in Barnstable Fire District Well #3 and of being comprised of relatively clean sand. It was reported that the site did have disadvantages of irregular topography, and the potentially low hydraulic conductivity in the deeper sand. It was concluded it should be considered a viable remote discharge site, despite the disadvantages identified. A copy of the report has been provided in Appendix M.

1.3.7 PRELIMINARY EVALUATION OF THE BARNSTABLE MUNICIPAL AIRPORT FOR TREATED WATER RECHARGE; MAY 2004

An evaluation was performed to see if the Barnstable Municipal Airport property would be an acceptable location for the recharge of treated effluent.

The evaluation concluded the Airport had potential to be an ideal site to discharge treated effluent. Soil type, topography, distance from sensitive receiving water, and proximity to the WPCF all contributed to this conclusion. A copy of the report has been provided in Appendix N.

1.3.8 BENCHMARK EVALUATION TO INVESTIGATE GROUNDWATER MOUNDING DOWNGRADIENT OF THE BARNSTABLE WPCF; FEBRUARY 2005

In 2005, an evaluation was performed to determine the Benchmark Elevation at which groundwater mounding may occur at parcels in the vicinity of the Barnstable Water Pollution Control Facility (WPCF). Its primary objective was to determine the amount of wastewater that could be discharged at the Barnstable WPCF without causing potential flooding to structures or septic systems due to resultant groundwater mounding.

The evaluation found that the Town of Barnstable should base its effluent management plans on criteria other than a specific defined Benchmark Elevation and the resultant limited flow rate. It was determined that the Town should pursue remote discharge sites for monthly flows greater than 2.5 MGD during periods of high groundwater to accommodate needed additional capacity. It was also recommended the Town carry out a monthly groundwater elevation monitoring program in the area surrounding the BWPCF so that potential impacts can be predicted. A copy of the report has been provided in Appendix O.

1.3.9 EFFLUENT DISPOSAL AND REUSE PLANNING GUIDANCE DOCUMENT AND CASE STUDY REPORT; FEBRUARY 2005

A case study was performed in 2005, with the purpose to assist communities in completing the process of finding suitable land for discharging treated wastewater and to determine which of the many disposal technologies best meets the community's needs. A copy of the report has been provided in Appendix P.

1.3.10 INFILTRATION LOADING TESTS, MCMANUS SITE; OCTOBER 2005

A preliminary evaluation was completed that determined the McManus Site to be a favorable location for treated wastewater recharge. It was determined that further testing was needed to evaluate the sites hydrogeologic suitability and infiltration capacity.

The Town determined that subsurface leaching trenches would be a preferred recharge technology for this site. It was estimated that if leaching trenches were laid out in 200-foot by 100-foot fields there would be room for 35 leaching fields. Based on that estimate it was determined that the site would have capacity of 1.6 MGD. A copy of the report has been provided in Appendix Q.

1.3.11 FINAL WASTEWATER FACILITIES PLAN AND FINAL ENVIRONMENTAL IMPACT REPORT FOR THE TOWN OF BARNSTABLE; MARCH 2007

The 2007 Wastewater Facilities Plan summarizes the technical evaluations, project decision-making, and recommended plan to address the wastewater needs in Barnstable that were identified in 1993. The plan was developed for the 20 year planning period of 1994 through 2014.

One recommendation was to extend sewers to the Wastewater Areas of Concern (AOC) in the eastern portion of the Town to address the water quality problems in these areas. There was also a recommendation to upgrade and expand the Barnstable Water Pollution Control Facility, which was undertaken and has been completed. A copy of the report can be found as Appendix 1-1 of the Needs Assessment Report in Appendix R.

1.3.12 NEEDS ASSESSMENT REPORT COMPREHENSIVE WASTEWATER MANAGEMENT PLANNING (CWMP) PROJECT TOWN OF BARNSTABLE, MA; MAY 2011

Refer to Section 2.1 for a summary of the Needs Assessment Report. The complete Needs Assessment Report is included in Appendix R.

1.4 PUBLIC REVIEW AND PUBLIC PARTICIPATION

As discussed, the plan was created via a public process. The WRAC's meetings and workshops were conducted in the Town Hall Hearing room and televised on Barnstable's government access channel 18 for the general public to be able to witness what was occurring. Additionally, those meetings were archived on the Town's website and available through video on demand allowing citizens to review them at a later time. The plan, and aspects of the plan, was presented to Town Council on a number of occasions, particularly August of 2017, and again in January 2019. The Town Manager also included in his Town Manager Communications to the Town Council monthly updates on the plan documentation during the calendar year 2019 meetings. These too were televised and archived. The DPW presented the plan to any organizations that requested such a briefing. As of the writing of this section, that included the Cotuit Village Association (twice), the Marstons Mills Village Association, the Hyannis Village Association, Wequaquet Lake Protective Association, and the Barnstable Clean Water Coalition (formerly known as the Three Bays Preservation). It is expected that public meetings such as these will continue for as long as the plan is being executed in the Town of Barnstable. The plan has also been briefed to Town Boards and Committees. To date, this has included the Board of Health and Comprehensive Financial Advisory Committee, though others are expected to occur during 2019. Finally, in concert with the local government access television station, Barnstable Channel 18, a video presentation is being created that will document the needs and the plan which will be aired on Channel 18, available on the Town's Website, and also able to be clipped into short segments that can be shared via social media to ensure the widest possible decimation of information regarding the plan. Refer to Section 4.

1.5 ENVIRONMENTAL REVIEW PROCESS

The Town submitted the plan to the Massachusetts Environmental Policy Act Office (MEPA) as an Expanded Environmental Notification Form (EENF) with request for a Single Environmental Impact Report (SEIR) in January of 2020. The Town received a Secretary's Certificate on April 3, 2020 which advised that "the Proponent should submit a Single EIR in accordance with the Scope included in this Certificate". During the EENF review process, MEPA and the Town agreed that the project, being a master planning document, warranted the consideration of a Special Review Procedure (SRP). The Certificate states "the Town has agreed to work with the MEPA Office to develop a SRP and submit a proposed framework prior to or together with the Single EIR". The Town has consulted with MEPA a number of times in the preparation of the SEIR and SRP and is submitting the SEIR and SRP simultaneously to MEPA for final approval of the plan. Upon receipt of MEPA approval, the Town will petition the Cape Cod Commission to undertake a 208 Consistency Review, which will be the last step in the approval of the plan.

1.6 ORGANIZATION OF CWMP

The Comprehensive Wastewater Management Plan has been prepared to summarize and document the Town's recent wastewater planning efforts. These efforts have built on decades of prior wastewater planning which have been summarized in Section 1.3. The report text, tables and figures are contained within Volume 1 of this document. All figures are provided at the end of the section in which they are referred to. The appendices are provided in Volume 2.

This Report is divided into 10 Sections:

1. Section 1 introduces the CWMP and summarizes the purpose, project scope, previous relevant wastewater planning efforts, public review process, environmental review process, planning period and organization of the report.
2. Section 2 summarizes the Town's 2011 Needs Assessment report, updates to Needs Assessment report, and projects already underway or completed since the Needs Assessment report.
3. Section 3 summarizes the evaluation of technological alternatives.
4. Section 4 summarizes the formulation and development of the Town's recommended wastewater plan.
5. Section 5 presents the Town's recommended wastewater plan on a watershed-by-watershed basis and contains the statement of consistency with the Cape Cod Commission's 208 Plan.
6. Section 6 presents the Town's proposed implementation plan and schedule.
7. Section 7 summarizes the financial considerations associated with the proposed plan.
8. Section 8 summarizes the environmental impact and benefits of the proposed plan.
9. Section 9 outlines the Draft Section 61 Findings.
10. Section 10 provides responses to comments received on the EENF.

Figure 1-1: Location of the Town of Barnstable

2 NEEDS ASSESSMENT

This section will identify the wastewater needs of the Town of Barnstable.

2.1 THE 2011 NEEDS ASSESSMENT REPORT

In 2011 a Needs Assessment Report was completed by GHD to clearly define the wastewater and nutrient-related needs of the Town. The complete Needs Assessment Report is provided in Appendix R.

2.2 UPDATES TO THE 2011 NEEDS ASSESSMENT REPORT

This section provides an overview of pertinent updates since the 2011 Needs Assessment Report.

2.2.1 UPDATE OF EXISTING ENVIRONMENTAL CONDITIONS

This section provides an overview of the existing environmental conditions within the Town of Barnstable.

2.2.1.1 SURFACE WATER

2.2.1.1.1 Ponds

The Pond and Lake Stewardship (PALS) sampling program was already underway as of the writing of the 2011 Needs Assessment Report. That program was developed in 2000 and conducted sampling of 38 ponds in the community. With the WRAC effort, it was identified that additional ponds should be sampled. A subcommittee was formed that developed the following criteria to select the additional ponds to be sampled.

This resulted in data for 17 additional ponds. The samples were taken using the PALS methodology, and measured for the same constituents. Data was calculated by using the Carlson Trophic State Index (TSI), shown in Table 2-1, relying on the chlorophyll-a as the primary indicator for TSI.

Specifically, samples were analyzed for total nitrogen, total phosphorous, chlorophyll a, and pH. Associated water quality data was collected at each site, and include dissolved oxygen, turbidity (water clarity), temperature, and depth. The results of this additional effort can be found in Table 2-2. It should be noted that these classifications are a preliminary finding, and additional monitoring is necessary to firmly establish the trophic state of these ponds.

The completed 2017 Pond Study and the 2009 Action Plan for the Ponds are provided in Appendix S and Appendix RR.

Table 2-1: Carlson Trophic State Index

Carlson Trophic State Index (TSI)					
TSI Calculations					
TSI(SD) = 60-14.41 In(SD)				SD = Secchi disk depth (meters)	
TSI(CHL) = 9.81 In(CHL) + 30.6				CHL= Chlorophyll a concentration (ug/L)	
TSI (TP) = 14.42 In(TP) + 4.15				TP = Total Phosphorus concentration (ug/L)	
TSI Values and likely pond attributes					
TSI Values	Chl a (ug/L)	SD (m)	TP (ug/L)	Attributes	Fisheries & Recreation
<30	<0.95	>8	<6	Oligotrophy: Clear Water, oxygen throughout the year in a hypolimnion	Salmonid fisheries dominate
30-40	0.95-2.6	8-4	6-12	Hypolimnia of shallower lakes may become anoxic	Salmonid fisheries in deep lakes only
40-50	2.6-7.3	4-2	12-24	Mesotrophy- Water moderately clear; increasing probability of hypolimnetic anoxia during summer	Hypolimnetic anoxia results in loss of salmonids
50-60	7.3-20	2-1	24-48	Eutrophy: Anoxic hypolimnia macrophyte problems possible	Warm-water fisheries only. Bass may dominate
60-70	20-56	0.5-1	48-96	Blue-green algae dominate, algal scums and macrophyte problems	Nuisance macrophytes, algal scums, and low transparency may discourage swimming and boating
70-80	56-155	0.25-0.5	96-192	Hyprteautrophy: (light limited productivity). Dense algae and macrophytes	
>80	>155	<0.25	192-384	Algal scums, few macrophytes	Rough fish dominate; summer fish kills possible

Table 2-2: 2017 Supplemental Ponds Water Quality Assessment

	Ultra-Shallow	Shallow 2.1 to 8.6m	Deep
Oligotrophic	Campground Pond		
Mesotrophic	Flowing Pond Mill Pond Fawcett's Pond Mill (Filenes) Pond Weathervane Pond Ben's Pond Fresh Hole Pond	Coleman Pond Patty's Pond Simmons Pond	
Eutrophic	Israels Pond Lamson Pond Flax Pond	Flintrock Pond Sam's Pond North Pond	
Hypereutrophic			

Coastal Embayments

The 2011 Needs Assessment Report discussed in detail why TMDLs are established for waters that are unable to meet state-established water quality standards, and that Barnstable had a number of embayments that required TMDLs for nitrogen. At that time, the Town had received the following reports (all of which are contained in the appendices) concerning these embayments:

- MEP Technical Report for Popponesset Bay; MEP, September 2004.
- MassDEP TMDL Report for Popponesset Bay; MassDEP, April 10, 2006.
- MEP Technical Report for Rushy Marsh; MEP, April 2006 (No TMDL Report expected).
- MEP Technical Report for Three Bays System; MEP, April 2006.
- MassDEP TMDL Report for Three Bays System; MassDEP, September 7, 2007.
- MEP Technical Report for Centerville River System; MEP, November 2006.
- MassDEP TMDL Report for Centerville River System; MassDEP, January 29, 2008.
- MEP Technical Report for Lewis Bay (and Halls Creek); MEP, December 2008.

However, at that time, the Town was still expecting TMDL for Lewis Bay (and Halls Creek), and the Technical and TMDL Reports for Barnstable Harbor. Since then, the following has been released:

- MassDEP TMDL Report for Lewis Bay System and Halls Creek, March 2015 (Appendix BB)
- MEP Draft Technical Report for Barnstable Harbor, June 2017 (Appendix CC)

The Town is still waiting on a final TMDL for Barnstable Harbor.

A summary of the projected threshold concentration of nitrogen that needs to be obtained in each watershed is included in Table 2-3.

Since the writing of the 2011 Needs Assessment, the Cape Cod Commission completed its update to the 1978 Water Quality Management Plan for Cape Cod, known as the “208 Plan” (found in Appendix A) in June 2015. The 1978 Plan had described the major water quality and wastewater management problems confronting the region at that time; and recommended land use controls, wastewater management, nonpoint source controls and institutional arrangements to improve water quality. The updated plan, in its own words, “recommends actions to streamline the regulatory process, make complex information more transparent and available to citizens, abate nitrogen-induced costs already impacting the region, provide more support to local community water quality efforts, and eliminate unnecessary costs” (*Cape Cod Area Wide Water Quality Management Plan*, June 2015, pg. S-xviii). Importantly Chapter 4 of the 208 Plan is a thorough look at technologies, both traditional and nontraditional, available to address wastewater issues. The Town used the Report to identify nitrogen removal requirements from each community that share watersheds. It also heavily utilized the 208 Plan’s Chapter 4 when assessing technologies to address wastewater needs. This CWMP will leverage that chapter for its Section 3, *Evaluation of Technology Alternatives*, versus creating one from scratch.

Table 2-3: TN Concentrations in Watersheds

Watershed	Sub-embayment	Observed TN Concentration (mg/l)[1]	Threshold TN Concentration (mg/l)
Barnstable Harbor	Barnstable Harbor	0.072-0.111[8]	0.16[8]
Barnstable Harbor	Millway	0.266[8]	0.21[8]
Barnstable Harbor	**Barnstable Harbor Sentinel Station[2]**		0.16[8]
Centerville River	Centerville River East	0.43-0.75	
Centerville River	Centerville River West	0.43-0.75	
Centerville River	East Bay	0.41	
Centerville River	Scudder Bay	0.62	
Centerville River	**Centerville River Sentinel Station[3]**		0.37
Lewis Bay	Halls Creek	0.45	
Lewis Bay	Hyannis Inner Harbor	0.43 – 0.60	
Lewis Bay	Lewis Bay	0.41	
Lewis Bay	Mill Creek	0.52-0.56	
Lewis Bay	Snows Creek	1.57	
Lewis Bay	Stewart's Creek	1.25	
Lewis Bay	**Lewis Bay Sentinel Station[4]**		0.38
Popponesset Bay	Pinquickset Cove	0.527	
Popponesset Bay	Popponesset Bay	0.485-0.422	
Popponesset Bay	Shoestring Bay	0.690-0.520	
Popponesset Bay	**Popponesset Bay Sentinel Station[5]**		0.38
Three Bays	Cotuit Bay	0.39-0.44	
Three Bays	North Bay	0.38-0.48	
Three Bays	Princes Cove	0.32	
Three Bays	Princes Cove Channel	0.50-0.52	
Three Bays	Seapuit River	0.60-0.70	
Three Bays	Warren's Cove	0.64	
Three Bays	West Bay	0.64	
Three Bays	**Three Bay Sentinel Station[6]**		0.38
Rushy Marsh	**Rushy Marsh Sentinel Station[7]**	1.107	TBD

Notes:
1. Barnstable Harbor Based on Draft MEP report
-Centerville River Based on 2001-2005 data.
-Lewis Bay Based on 2001-2006 data
-Popponesset Bay Based on 1997-2003 data
-Three Bays Based on 1999-2004 data
-Rushy Marsh Based on MEP Report
2. TMDL not yet availableAvereageAverage of bioactive nitrogen at stations BM11, BM13, and BSH-4 based on the MEP Report. The Millway is a separate sentinel station with bioactive N threshold of 0.21 mg/L.
3. Located seaward of the mouth of the Bumps River. Additional threshold value of 0.50 mg/l applies to station BC-7 and station BC-3 for the protection of benthic habitat.
4. Located at the eastern end of Lewis Bay. Halls Creek had its own target threshold of 1.0 mg/l
5. Located at the mouth of Shoestring Bay
6. Located between Cotuit Bay and North Bay
7. TMDL not yet available
8. Bio active nitrogen concentrations
9. See Figure 2 11for sentinel station locations

Table 2-4: Nitrogen Removal Targets by Watershed (Source: Cape Cod Commission, 2016)

Watershed	Attenuated controllable N load (Total area) (kg/day)	Attenuated controllable N load (Barnstable only) (kg/day)	Target (kg/day)	N load reduction targets (Total area) (kg/day)	N Load reduction target (Barnstable only) (kg/day)
Centerville River Watershed					
Centerville River East	52.7	52.7	24.7	28.0	28.0
Centerville River West	8.2	8.2	9.5	0.0	0.0
East Bay	7.8	7.8	8.6	0.0	0.0
Scudder Bay	44.5	44.5	52.6	0.0	0.0
Halls Creek Watershed					
Halls Creek	20.0	20.0	36.3	0.0	0.0
Lewis Bay Watershed					
Hyannis Inner Harbor	18.9	15.7	7.4	11.5	11.2
Lewis Bay	39.8	9.9	9.7	30.2	7.5
Mill Creek	32.7	5.7	22.3	10.3	1.8
Snows Creek	9.7	9.7	16.2	0.0	0.0
Stewarts Creek	51.3	51.3	41.6	0.0	0.0
Popponesset Bay Watershed					
Pinquickset Cove	0.9	0.9	0.8	0.2	0.2
Popponesset Bay	1.7	0.6	1.8	0.0	0.0
Shoestring Bay	35.5	11.3	19.7	15.8	5.0
Three Bays Watershed					
Cotuit Bay	22.1	21.0	22.3	0.0	0.0
North Bay	25.0	24.8	4.5	20.6	20.4
Princes Cove	11.7	10.8	2.2	9.5	8.8
Princes Cove Channel	5.7	5.7	0.8	5.0	5.0
Seapuit River	2.7	2.7	3.8	0.0	0.0
Warrens Cove	29.3	23.7	20.8	8.5	6.9
West Bay	15.0	15.0	16.0	0.0	0.0
Rushy Marsh Watershed					
Rushy Marsh Pond	0.2	0.2	0.1	0.1	0.1
Barnstable Harbor Watershed					
Barnstable Harbor*	100.2	82.1	75.1*	25.0*	20.5*

* Draft Barnstable Harbor MEP was not developed at the time of development of this table. This assumed a 25% reduction target as a placeholder. As discussed in Section 5, removal requirements per MEP are less.

2.2.1.2 STORMWATER

The Town has been implementing stormwater management solutions to help address nutrients, bacteria, and/or sediments impacting town waterways. Since the 2011 Needs Assessment Report, the Town, working with other organizations, has conducted the following projects, see Table 2-5.

Table 2-5: Special Stormwater Drainage Systems

Site Location	Village	Date Installed	Unit Type	Projected Removal Rates	Watershed
Cotuit Library	Cotuit	2020 (Projected)	Rain garden with sediment forebay and educational section		Three Bays
South County Road	Osterville	2020 (Projected)	Planted swales with sediment forebay	55% Nitrogen 70% Bacteria	Three Bays
Putnam Ave. at Little River crossing	Cotuit	2020 (Projected)	Bioretention with sediment forebay	55% Nitrogen 70% Bacteria	Three Bays
Cordwood Landing Phase 2	Cotuit	2020 (Projected)	Bioretention with sediment forebay	55% Nitrogen 70% Bacteria	Three Bays
Old Shore Road at Ropes Beach Phase 2	Cotuit	2019	Bioretention with sediment forebay	55% Nitrogen 70% Bacteria	Three Bays
Town Parking Lot Boat Ramp Prince Ave.	Marstons Mills	2019	Sand filter with rain garden and sediment forebay	55% Nitrogen 70% Bacteria	Three Bays
Cordwood Landing Phase 1	Cotuit	2009, upgraded 2019	Bioretention with sediment forebay	55% Nitrogen 70% Bacteria	Three Bays
Putnam Ave. at Old Shore Road / Ropes Beach & Boat Ramp	Cotuit	1999, upgraded 2019	Vortecnics/Wetland Pockets	55% Nitrogen 70% Bacteria	Three Bays
Osterville Library	Osterville	2018	Rain garden & educational section		Three Bays
Oyster Place Road / Town Dock	Cotuit	2017	Rain garden		Three Bays
Gateway Park	Hyannis	2015	Gravel wetland	47% Nitrogen	Lewis Bay
Bay Street / Boat Ramp	Osterville	2015	PERC CRETE Settling/Infiltrators		Three Bays

According to the updated land use and loading analysis completed by SMAST (Appendix QQ), approximately 11% of the controllable nitrogen load in the Three Bays watershed comes from stormwater runoff. The Town partnered with the Association to Preserve Cape Cod, the Barnstable Clean Water Coalition, the Horsley Witten Group and the Barnstable Land Trust on a five-year $1.2 million project for improving water quality through stormwater management. The project utilizes green infrastructure stormwater systems, which incorporate plants and soil media to remove nitrogen, bacteria, and other pollutants before the stormwater passes into the bays.

This approach accounts for Best Management Practices (BMP) vulnerabilities and incorporates projected impacts of climate change when considering siting, selection, and materials of practices. Design plans consider options for redundancy and flexibility to adapt to these impacts and emphasize the use of green infrastructure and low impact design. To ensure long-term effectiveness of the installed systems, O&M plans and training for town staff is provided and a permanent training video to support training of new staff in the future.

The overall nitrogen removal rate of green infrastructure, with normal maintenance, should be on the order of 55% for system(s) installed or upgraded after 2017 in the Three Bays watershed.

To the extent possible, the Town will continue to install green infrastructure in nitrogen sensitive watersheds, where appropriate, to reduce nutrient load. Acknowledging that traditional stormwater infrastructure (catch basins and leaching structures) do no remove significant amounts of nitrogen, the Town plans to test stormwater treatment inserts, to help remove excess nutrients in stormwater entering the catch basin. The Town intends to perform a handful of pilot tests of these inserts and monitor/sample them to determine efficacy (and potential negative effects), before implementing these inserts as a large scale.

2.2.1.3 SOILS

Soil data remains unchanged. Refer to Section 5-8 of the 2011 Needs Assessment.

2.2.1.4 DEPTH TO GROUNDWATER

The groundwater in Barnstable provides drinking water supplies and recharges the ponds, wetlands, and coastal estuaries. All groundwater in Barnstable is supplied by the Sagamore Lens which is shared by the towns of Bourne, Sandwich, Falmouth, Mashpee, and Yarmouth; the groundwater resources on Cape Cod as a whole are classified as a sole-source aquifer by USEPA. Groundwater contours in the Town of Barnstable are shown in Figure 2-2.

2.2.1.5 FLOOD ZONES AND VELOCITY AREAS

The FEMA flood zone maps were updated in July of 2014. The updated mapping added a substantial number of new properties to the various flood hazard zones. Figure 2-8 shows the updated FEMA flood zones.

2.2.1.6 GROUNDWATER AND DRINKING WATER PROTECTION AREAS

The Town draws its public water from the Sagamore Lens. Current discharges from individual septic systems and from wastewater treatment facilities have the potential to impact this drinking water supply. MassDEP has established regulations that must be met to protect this resource. Nitrogen discharges from septic systems previously were the main concern to the water supply, now concerns have been raised about a new category of water contaminant called Contaminants of Emerging Concern (CECs). This general category includes three subgroups – endocrine disrupting compounds, pharmaceuticals, and personal care products. These compounds and potential contaminants are not currently regulated by the federal government because their toxicity is not well understood.

Protection zones are put in place to protect the recharge area from contaminants around public water supply groundwater sources. DEP divides the wellhead protection recharge area into two zones called Zones I and II.

A Zone I is the protective 400 foot radius required around public water supply wells or well-fields that yield 100,000 gpd or greater. For wells of less than 100,000 gpd or greater than 10,000 gpd a 250-foot protective radius is used.

A Zone II is the area of the aquifer that contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated. This is traditionally modeled as 180 days of pumping at approved yield, with no recharge from precipitation. The Zone II must include the entire Zone I area. The existing state designated wellhead protection areas (Zone I and Zone II) are shown in Figure 2-13.

2.2.1.7 GROUNDWATER PROTECTION OVERLAY DISTRICTS

The Town's zoning has established three Groundwater Protection Overlay Districts to protect the public health, safety, and welfare by encouraging nonhazardous compatible land uses within groundwater recharge areas. The three overlay districts are shown in Figure 2-14. The overlay districts are defined as follows:

- The Groundwater Protection Overlay District (GP) is based on Zone II delineations to existing, proven future and proposed public water supply wells.
- The Well Protection Overlay District (WP) is based on a five-year time of travel zone to existing, proven future and potential future public supply wells.

- The Aquifer Protection Overlay District (AP) consists of all other areas of Town, except those located in the aforementioned GP or WP Overlay Districts.

The GP and WP districts restrict certain uses which could cause groundwater contamination, limit impervious coverage, site clearing, and sewage disposal. Refer to Appendix DD for the portion of the Zoning Code that establishes the Overlay District (Section 240-35 of the Town Code).

2.2.1.8 INTERIM SALTWATER ESTUARY REGULATION

In response to establishment of nitrogen TMDLs in a number of the Town's embayments, in March 2008 the Board of Health established an interim regulation (Section 360-45 of the Town Code) focused on limiting septic load within these watersheds. Septic loads within the watersheds of Popponesset Bay, Three Bays, and Centerville River are restricted by this regulation as follows:

"The maximum allowable discharge of sanitary sewage, based on the sewage design flow criteria listed in 310 CMR 15.203, Title 5, of the State Environmental Code, shall not exceed 440 gallons per 40,000 square feet of lot area, with the following exceptions:

(a) For approved building lots on which no building currently exists and that are less than 30,000 square feet in area, the maximum allowable sewage discharge shall be 330 gallons.

(b) For parcels with existing buildings, the maximum allowable flow shall be either 440 gallons per 40,000 square feet, except as described in Subsection B(1)(a) above or whatever is currently permitted, whichever is greater."

Refer to Appendix EE for the portion of the Town Code that establishes the Regulation.

2.2.1.9 SENSITIVE HABITATS

There are several regions within the Town of Barnstable that have been identified as combined habitats of rare species and wildlife by the Massachusetts Division of Fisheries, Natural Heritage and Endangered Species Program (NHESP). These are shown in Figure 2-9 and were updated in August 2017. NHESP has also identified vernal pools and potential vernal pools in the Town of Barnstable which were updated in December of 2018 and are shown in Figure 2-10.

2.2.2 UPDATES TO EXISTING WASTEWATER INFRASTRUCTURE

This section provides an overview of the existing wastewater infrastructure in the Town of Barnstable.

2.2.2.1 BARNSTABLE WATER POLLUTION CONTROL FACILITY (BWPCF)

The Barnstable Water Pollution Control Facility is comprised of septage handling, pretreatment, primary treatment, secondary treatment, and disinfection facilities. Treated effluent is disposed of on-site via rapid sand infiltration beds. The facility currently treats an average daily flow of 1.67 MGD, and has a maximum-month average daily flow of 1.97 MGD. The facility processes between 10 and 12 million gallons of septic and grease waste each year. The following sections outline the improvements that have been made to the BWPCF and sewer collection system since the completion of the 2011 Needs Assessment Report.

2.2.2.1.1 Underground Storage Tank Removal

A contract was completed in 2011 to remove two underground chemical storage tanks and replace them with pad mounted above-ground storage tanks. The existing 4,000 gallon fiberglass underground diesel storage tank feeding the emergency standby generator was removed and replaced with a 3,000 gallon double-walled steel storage tank and a new fuel delivery system. The existing 8,000 fiberglass underground sodium hypochlorite storage tank was removed and replaced with a new 6,650 gallon double-walled polyethylene storage tank with a new chemical delivery system.

2.2.2.1.2 Renewable Energy Facilities Construction

A construction contract was completed in 2012 for the installation of two 100 kW wind turbines and an 819 kW solar array. The $5,800,000 project cost was 100% grant funded through the American Recovery and Reinvestment Act (ARRA). The power produced from these facilities is fed into the electrical grid and the BWPCF is credited for the energy produced. This project, coupled with other energy efficiency improvements at the facility, has resulted in a nearly 75% reduction in net electrical usage at the WPCF.

2.2.2.1.3 Effluent Disposal Modeling

The BWPFC has continued to discharge 100% of its effluent on site. While several alternative disposal sites were located, the Town elected not to pursue those options for a variety of reasons, most notably due to their proximity to drinking water wells. The ultimate effluent disposal capacity of the rapid infiltration beds at the BWPCF remains uncertain. This is due to many site specific considerations that are independent of the BWPCF recharge such as seasonal and multi-year variations in the elevation of the groundwater table. In order to better understand the dynamics of the groundwater table in the area downgradient of the rapid infiltration beds, in 2014 the Town contracted the services of Watershed Hydrogeologic through its consultant GHD to develop a localized groundwater model for the area surrounding the BWPCF. The model, referred to as the Barnstable Groundwater Model (BGM), was utilized to delineate the fate and transport of the BWPCF effluent recharge.

Follow-up groundwater simulations were conducted in 2017 in order to provide the Town with a planning level analysis of the effects of various effluent discharge scenarios. While the inputs and assumptions used during these simulations were conservative, the analysis determined that the permitted discharge volume of 4.2 MGD for the BWPCF could potentially create groundwater mounding issues in the vicinity of the BWPCF rapid infiltration beds, and that a more detailed analysis should be carried out. As a result, the Town and Massachusetts DEP determined that the disposal capacity of the BWPCF should be lowered to 2.7 MGD with the issuance of the 2018 groundwater discharge permit, but that follow up studies would be necessary to determine the actual disposal capacity for the facility. In early 2019, a consultant was hired to quantify the effluent discharge capacity of the BWPCF. A summary of this effort is described in detail in Section 5.3.2.

2.2.2.1.4 Solids Handling Evaluation

In 2015, the Town initiated a solids handling evaluation and design in order to address the condition and capacity of the BWPCF solids handling facilities and to evaluate future sludge dewatering and disposal practices. The evaluation was put on hold until 2018 while wastewater planning efforts were completed. This allowed the consultant to gather design data for the volume of septic waste expected to be received and the amount of sludge expected to be produced at the BWPCF over the next 20 years. The design of these improvements is expected to be completed by the winter of 2020. It is expected that improvements will be constructed to the septage receiving station, grit removal system, sludge pumping equipment and pipework, odor control system, chemical delivery systems, and sludge thickening equipment.

2.2.2.1.5 Biowin Modeling

In 2017, in conjunction with the solids handling evaluation, the Town began the development of a Biowin computerized simulation model for the BWPCF. The model was used to establish future sludge production totals for the design of the BWPCF solids handling upgrades. The model can also act as a predictive tool to analyze the impact of varying flows and loads on the wastewater treatment process. While the data generated from the Biowin model will be used as a predictive tool for process control and assessing scenarios, it is not intended to be used as the basis for design or permitting.

2.2.2.1.6 Clarifier Rehabilitation

A construction contract completed in 2018 rehabilitated the BWPCF's two primary and three secondary clarifiers. The existing Primary Clarifiers Nos. 1 and 2 and Secondary Clarifiers Nos. 1 and 2 were built in 1980 and improvements were needed in order to address the condition of the process equipment and to improve the sludge removal efficiency of the clarifiers. Process equipment within Primary Clarifiers Nos. 1 and 2 and Secondary Clarifiers Nos. 1 and 2 was demolished and retrofitted with new spiral blade rake arms, baffles, algae sweeps, clarifier drives, catwalks, and sludge withdrawal mechanisms. Secondary Clarifier No. 3, constructed in 1996, was rehabilitated by sandblasting and recoating steel process equipment and installing a new clarifier drive. The concrete tank walls on all clarifiers were spot repaired and epoxy coated. Four 20-inch valves were replaced within the primary clarifier distribution box, and seven clarifier isolation valves were replaced within the Secondary pump room.

2.2.2.1.7 Standby Generator Installation

A construction contract completed in 2019 replaced the existing standby generator with a new 750kW pad-mounted diesel generator with a sound attenuated enclosure. The automatic transfer switch, main switchgear MSA, motor control center MCC-6, and all associated wiring was replaced as part of this project. The existing turbine generator, exhaust stack, main switchgear MSA, and motor control center MCC-6 were demolished and the electrical room ceiling and walls were repaired and repainted. While the new generator provides standby power for the entire wastewater treatment facility, future plans call for a second 450 kW generator to be installed at main switchgear MSB when future loads dictate. The 450 kW generator will provide additional redundancy to the BWPCF's existing standby power system.

2.2.2.1.8 Effluent Flow Meter Installation

With the 2018 permit update for the BWPCF, the DEP required the Town to install an effluent flow meter. Previously, the BWPCF used an influent flow meter to measure flows. The Town carried out a flow meter evaluation study in 2019 and selected the Teledyne Laser Flow Meter to be installed in the effluent channel after the chlorine contact chamber. Design plans were submitted to DEP in December of 2019. Those plans were approved and a construction contract for the installation of the flow meter began in the fall of 2020.

2.2.2.2 EXISTING COLLECTION SYSTEM STUDIES

The sewer collection system in the Town of Barnstable dates back to 1937 and consists of approximately 55 miles of gravity sewer, low pressure sewer, vacuum sewer, and force main. The Town owns, operates, and maintains a total of 27 pump stations. These range in size from very small stations serving private developments to larger stations which serve downtown areas while accepting flow from one or more smaller stations. The H-1 sewer expansion and Lincoln Road Pump Station construction projects outlined in the 2011 Needs Assessment report have been completed. The Town has assumed responsibility for the Hyannis Youth and Community Center pump station and the Settlers Landing private development pump station.

2.2.2.2.1 SewerCAD Modeling

In 2016, a contract was completed to expand the existing SewerCAD model for downtown Hyannis to incorporate the Town's entire collection system. The SewerCAD model, which is operated in-house by DPW engineers, is the most efficient way to evaluate capacity limitations as sewer extensions, new connections, or increases in flow are proposed. The updated model was loaded with existing water use data and a report was submitted outlining potential bottlenecks within the sewer system or capacity issues with pump stations under both existing and future flows. Several areas were identified as having capacity issues, and projects to address those deficiencies are discussed in detail in the localized collection system projects section of this report. See Appendix FF.

2.2.2.2.2 Infiltration and Inflow (I/I) Analysis

In 2017, as part of the Town's Capacity, Management, Operation and Maintenance (CMOM) efforts, a study was completed analyzing the amount of infiltration and inflow entering the Town's sewer system. Infiltration is the leakage of groundwater into the sewer through cracks and openings in sewer pipes and/or manholes. Inflow is the flow of surface water into the sewer through storm drains, roof leaders, and/or sump pumps in basements of buildings. Removal of infiltration and inflow from the Town's sewer system will free up pipe capacity and disposal capacity at the BWPCF. Sewer system authorities were required to submit an infiltration and inflow analysis to the DEP by December 31, 2017.

The 2017 study concluded that up to 0.44 MGD of infiltration could be entering the sewer system during high groundwater conditions. A 1988 infiltration and inflow study by Whitman and Howard estimated as much as 0.55 MGD was entering the sewer system. The study also found that there could be as much as 1.02 MGD of inflow entering the Town's collection system during a standard five-year twenty-four hour storm event. This conclusion represents a large increase of inflow over the 1988 study which found that inflow was negligible.

Based on the findings of this study, the Town has elected to follow up with Sewer System Evaluation Survey (SSES) work in order to locate the exact sources of infiltration and inflow noted in the 2017 Infiltration and Inflow Analysis. Sewers in the area of Enterprise Road and Route 132 will be evaluated for potential sources of infiltration and inflow while 8 other subsections of sewer will be evaluated for sources of inflow.

2.2.2.2.3 Pump Station Evaluation

In 2018, the Town hired a consultant to conduct evaluations for all of the 27 sewage pump stations it owns and maintains. The purpose of this project was to evaluate each of the pump stations with respect to the structural, architectural, electrical, mechanical, and process components and to make recommendations for improvements. Special consideration was given to coastal resiliency with shoreline pump stations. The consultant provided a twenty year capital improvement plan for improvements deemed necessary by this evaluation.

2.2.2.3 EXISTING COLLECTION SYSTEM IMPROVEMENTS

2.2.2.3.1 South Street Sewer Improvements

A consultant was hired in 2018 to complete an evaluation and design of sewer improvements in South Street in Hyannis. The purpose of the evaluation was to assess the condition and capacity of the sewers in South Street in order to support future buildout flows. The evaluation noted areas of capacity restrictions with both current and future flow scenarios. The consultant has recommended breaking this project into three construction phases. The first recommended phase is to replace the existing 12- and 15-inch clay sewers between High School Road and Old Colony Pump Station with a new 18-inch PVC sewer in order to address the capacity constraints that currently exist. Phase 2, would replace the existing 12- and 15-inch clay sewers between Old Colony Road and Lewis Bay Road with a new 18-inch PVC sewer line. By phasing this portion of the project, the Town has the benefit of waiting to see if future flows proposed in this area materialize, or if the sewers can simply be relined. Phase 3 of the project would replace the existing 10-inch clay sewers between Sea Street and High School Road if future buildout requires increased capacity in this area. The Town is currently evaluating alternate options, such as shedding flow, to address the capacity concerns.

2.2.2.3.2 Barnstable Road Evaluation

A consultant was hired in 2018 to complete an evaluation of the sewers in Barnstable Road in Hyannis. The purpose of this evaluation is to identify any conditional defects or capacity constraints within the Barnstable Road sewers so that these repairs can be made in conjunction with the Hyannis Water System's pipe rehabilitation program. This will allow the Town to save money on construction costs while minimizing disruption to residents and area businesses.

2.2.2.3.3 Pleasant Street Sewer Relining

In order to address capacity constraints identified in the 2016 SewerCAD report, in 2019 the Town hired a contractor to re-line the sewers on Pleasant Street in Hyannis. This project increased the capacity of the sewers by approximately 10% by reducing friction of the pipe and will improve the condition of the 1935 clay sewers within Pleasant Street. Additionally, in the spring of 2020, the Town undertook a small project to re-route a portion of the upstream sewer flow away from the Pleasant Street sewers to free up additional capacity. These projects were funded by a Housing Choice Grant.

2.2.2.3.4 Rendezvous Lane Pump Station Relocation

As recommended in the 2019 Pump Station Asset Management Plan, the Town is currently in the process of relocating the Rendezvous Lane Pump Station. The Rendezvous Lane Pump station is a pneumatic ejector style pump station, originally constructed in 1975. The pump station has exceeded its useful life, and system components are no longer manufactured and are difficult to obtain. In addition to the mechanical issues, the pump station is currently located inside the 100-year flood plain and Town wastewater staffs have reported several flooding incidents that have restricted access to the station during severe storm events. In 2020, the Town completed the design for the relocation of this pump station with a focus on improving coastal resiliency. The station is to be relocated approximately 500 feet inland, outside of the 100-year flood plain. An emergency backup generator will be installed and system components will be elevated to 3 feet above the 100-year flood plain. A construction contract was awarded in August of 2020, and the project is scheduled to be completed in the Spring of 2021.

2.2.3 UPDATES TO WASTEWATER TREATMENT FACILITY GROUNDWATER DISCHARGE PERMITS

2.2.3.1 BARNSTABLE WPCF

The Barnstable Water Pollution Control Facility was issued an updated Groundwater Discharge Permit (GPD) in November 2018. The permit expires in November 2023. The updated discharge permit limits the Town of Barnstable to 2.7 MGD maximum daily flow and requires the Town to submit an engineering report demonstrating adequate discharge capacity prior to accepting any flows in excess of 2.7 MGD. Table 2-6 summarizes the effluent limitations outlined in the 2018 discharge permit.

In addition to the discharge limitations, there are several new supplemental conditions required in the updated Groundwater Discharge Permit. The Town is required to submit a Comprehensive Wastewater Management Plan (CWMP) or equivalent to the Department for review and approval by December 31, 2021. By December 31, 2019, the Town must submit an engineering report and plans for DEP review for the installation of an effluent flow meter and have the meter installed by December 31, 2020. As part of the permit renewal in 2023, the Town must submit an engineering report outlining what modifications, if any, are required to insure that the facility can remain in compliance through the next 5-year permit term (year 2028) and beyond. See Appendix GG.

Table 2-6: BWPCF Effluent Discharge Limitations

Effluent Characteristics	Current Discharge Limitations	Expanded Discharge Limitations
Flow	2.7 MGD (maximum)	4.2 MGD (maximum)
Biochemical Oxygen Demand	30 mg/L	30 mg/L
Total Suspended Solids	30 mg/L	30 mg/L
Total Dissolved Solids	1000 mg/L	1000 mg/L

Effluent Characteristics	Current Discharge Limitations	Expanded Discharge Limitations
Nitrate Nitrogen	10 mg/L	10 mg/L
Total Nitrogen	10 mg/L and not to exceed 49,315 pounds per calendar year*	10 mg/L
Oil and Grease	15 mg/L	15 mg/L
Fecal Coliform	200 colonies/100 ml	200 colonies/100 ml
Total Chlorine	1 mg/L	1 mg/L

*49,315 pounds per year represents the mass load at a maximum daily flow of 2.7 MGD and an annual average Total Nitrogen concentration of 6 mg/L.

2.2.3.2 Marstons Mills Wastewater Treatment Plant (MMWWTP)

In February of 2019 the Marstons Mills Wastewater Treatment Plant (MMWWTP) was issued an updated Groundwater Discharge Permit. The permit expires in February 2024, see Appendix HH. Table 2-7 summarizes the effluent limitations outlined in the discharge permit.

Table 2-7: MMWWTP Effluent Discharge Limitations

Effluent Characteristics	Discharge Limitations
Flow	42,900 GPD
Biochemical Oxygen Demand	30 mg/L
Total Suspended Solids	10 mg/L
Nitrate- Nitrogen	10 mg/L
Total Nitrogen	10 mg/L
Oil and Grease	15 mg/L
Fecal Coliform	200 colonies/100ml
Turbidity	5 NTU

Note: As part of the permit renewal in 2023, the Town must submit an engineering report outlining what modifications are required to insure that the facility can remain in compliance through the next 5 year permit term (year 2028) and beyond.

2.2.4 EXISTING WASTEWATER GENERATION

The GIS-based tool compiles all water data and nitrogen removal requirements by watershed into one centralized location. The tool compiles water data from 2010 to 2016 and calculates the average daily water usage of each parcel in the Town. The tool then calculates wastewater generation of each lot as 90% of the calculated water usage. Nitrogen is calculated assuming a typical Title 5 septic system concentration of 26.25 mg/L. A summary of the water use, wastewater generation, and associated nitrogen generation by watershed is provided in Table 2-8.

Table 2-8: Existing Wastewater Generation by Watershed

Watershed	Water Use (gpd)	Wastewater Generation (gpd)	Nitrogen Generation (kg/day)
Lewis Bay	1,698,200	1,528,380	42.6
Halls Creek	280,910	252,810	14.4
Centerville River	1,529,540	1,376,590	132.3
Three Bays	1,361,000	1,224,900	121.4
Rushy Marsh	4,200	3,780	0.4
Popponesset Bay	181,720	163,550	16.2
Barnstable Harbor	879,200	791,280	65.5
Undefined	282,020	253,820	25.2
TOTALS:	6,216,790	5,595,110	418.0

2.2.5 UPDATE ECONOMIC DEVELOPMENT REQUIREMENTS

Aligning housing and economic development objectives with infrastructure planning is critical to the Town's economic future and environmental health, as well as the long-term fiscal stability of the municipality. The availability of infrastructure, specifically municipal wastewater, is a fundamental factor in business and housing development decisions. Available connections to municipal wastewater treatment allow for development at higher densities, therefore bringing down development costs and allowing for the most productive use of land.

Encouraging the development and redevelopment of land in areas appropriately supported by multi-modal transportation infrastructure, away from sensitive environmental or historic resource areas, and in proximity to community activity centers will support the growth of this community, while supporting community character and fiscal sustainability. The availability of sewer infrastructure in areas designated for growth is critical to their economic success.

2.2.5.1 ECONOMIC/HOUSING DEVELOPMENT PRIORITY AREAS

- Attucks/Independence: This area is zoned for commercial and industrial development and is well served by transportation infrastructure. The area contains a number of existing businesses and housing developments, and possesses the strong potential for future growth. Limited sewer expansion in this area has been funded by private developers in connection with new development projects and with the 2017 MassWorks Infrastructure Grant.
- Yarmouth Road Triangle: This built-out area contains many existing small businesses and several large auto dealerships. The immediate area contains limited development

potential, but potential future connections to the Barnstable Municipal Airport property could result in economic growth in connection with aviation purposes. The area also hosts several drinking water wells belonging to the Hyannis Water Division. Connecting the businesses in the area to municipal wastewater treatment would allow potential future economic expansion, as well as have long-term water quality benefits.

- The un-sewered portions of Route 28 corridor from Centerville to Marstons Mills include the auto-oriented commercial center in Centerville, as well as a number of commercial and multi-family residential uses outside of designated commercial zoning districts. The potential to intensify existing economic centers or infill/redevelop property along the corridor would be created with the addition of sewer infrastructure.
- There are a number of specific areas where the existing zoning does not reflect future development potential if there was expanded infrastructure availability. On account of current infrastructure constraints, as well as other factors, these areas are not designated economic or growth centers; however, with availability of wastewater infrastructure, these areas could support additional development. Such decisions would require regulatory changes, and thus appropriate community support. Further, policy decisions about infrastructure cost-sharing between the Town and potential developers where necessary may also have an influence.

  The areas are presented here for the purposes of identifying where this capacity for economic and housing growth could occur in the future.
    - Undeveloped parcels around the Route 132 & Attucks Lane intersection
    - Cape Cod Regional Transit Authority's Hyannis Transportation Center
    - Hyannis Resort & Conference Center and Golf Course
    - Bell Tower Mall, Centerville
    - Town of Barnstable, West Villages Elementary School and Barnstable United Elementary School

2.2.5.2 GROWTH INCENTIVE ZONE

The Growth Incentive Zone is an area encompassing downtown Hyannis Main Street, Hyannis Harbor, and commercial areas south of the Airport Rotary is designated as an area to support additional economic and housing growth and development. This designation was based on the availability of public wastewater infrastructure, along with historic and existing development patterns that could accept compact, walkable development. The area is the focus of planning efforts and development incentives to encourage new investment. The Growth Incentive Zone is currently zoned to encourage multi-family development and is the focus of regulatory efforts to further increase development potential.

Buildout of sewer infrastructure in Downtown Hyannis began in 1935. The system has been maintained and expanded over time; there are very few developed parcels within the Growth Incentive Zone that are not connected to public sewer. Planned infill development and redevelopment will rely on continued investment in improvement of the system. Further, policy decisions about infrastructure cost-sharing, where necessary and appropriate, may impact development.

Analysis of wastewater capacity completed at the time of the 2017 Growth Incentive Zone renewal supported that, overall, the existing infrastructure adequately supports existing development. The analysis highlighted the potential for deficiencies in the capacity of the South Street sewer main, which conveys flows from the majority of Hyannis to the South Street pump station. The sewers on South Street were installed in 1935 in three-foot sections of clay pipe and have recently shown signs of deterioration. Recent modeling efforts indicated that South Street sewers between High School Road and Old Colony Road are at full capacity under peak flow conditions, and will be over capacity under future conditions. The sewers between Old Colony Road and School Street are approaching capacity and will be over capacity under future conditions.

The Town has completed an evaluation of improvements necessary to upgrade the South Street Main and this project is in the design phase. In Fiscal Year 2020, a $4,019,000 CIP was approved under the Water Pollution Control Enterprise Fund for construction of the necessary improvements. Increasing sewer capacity on South Street will accommodate future growth and development for parcels feeding into South Street sewers.

Two other projects in the Growth Incentive Zone are also complete. One is a cleaning and lining of the sewers on Pleasant Street and surrounding areas to support additional capacity. This project was factored into the planning for the South Street sewer upgrades and funded by a Housing Choice Grant from the Commonwealth. An evaluation of the capacity of sewers on Barnstable Road is also currently underway.

2.2.6 FUTURE CONDITIONS

To fully understand the wastewater needs of the community, both existing flows and future flows must be considered. Existing flows are easier to quantify as they can be directly measured or calculated. Future flows are more difficult because it requires projections about what may yet occur in Town. Flows will increase as vacant lots are developed, existing lots are redeveloped, or commercial usages change. To help make these projections it is traditional to consider various predictions of "ultimate buildout", which is the maximum amount of growth that can occur given existing zoning, and then modify this to what is realistic, and from there to what could actually occur during the planning horizon of the project. To that end this document considers three forms of buildout as defined below:

- Ultimate Buildout – This is the maximum potential growth given existing zoning regardless of other conditions. This helps define the upper limit of flow that could ever occur, but is frankly not realistic.

- Realistic Buildout – This considers the ultimate buildout, but then also considers what realistically could occur. Factors that inform this are the history of growth, predicted economic cycles during the period, and an understanding of the community.
- Realistic Buildout within the planning period – This is the value that is most useful. It looks at realistic buildout and projects the extent of it that will occur either during the planning period for the project, or more importantly the design life of the infrastructure that is being installed.

2.2.6.1 POPULATION PROJECTIONS

2.2.6.1.1 Trends

The region experienced decades of growth through the 20th century, but the population saw a slight decline between 2000 and 2010. Population decline in Barnstable was more pronounced than in other Cape communities during this time period. Current population estimates for Barnstable are approximately 44,000-45,000 year-round residents. The current population is equivalent to that experienced in the late 1990s.

Table 2-9: Town of Barnstable Population Trends

	1980	1990	2000	2010	2015
Barnstable	30,898	40,958	47,821	45,193	44,331

Population projections are based on both natural change (births vs. deaths) and net migration. As a retirement destination, the Cape's population and economy is far more impacted by migration than by natural growth. The aging demographic profile of the Town, and of the region, predictably results in a declining natural growth rate. Barnstable County has the oldest median age in the Commonwealth (52.5 years) and has been experiencing a natural decrease in population since 1991.[1]

Positive in-migration was the contributing factor to population growth between 1970 and 2000. As the region's labor force, employment, and economic performance began to decline, so did rates of in-migration. In the decade of the 2000s, net migration was slightly positive (approx. 900 net in-migrants) while natural decrease was the dominant contributor to population decline. Thus

[1] Cape Cod 2020 Regional Transportation Plan, Cape Cod Metropolitan Planning Organization/Cape Cod Commission; Cape Cod Commission's Regional Housing Market Analysis and 10-year Forecast of Housing Supply and Demand by Crane Associates, Inc, June 30, 2017

far in the 2010s, natural decrease and net migration have nearly equaled each other; resulting in a slight decrease in population since 2010.

Analysis of the change in share the population amongst age cohorts shows expected "bell-shaped "trends over the past few decades in all except the 65 year and older group. Younger age cohorts increased until 2000 and have since declined. In Barnstable, the percentage of residents under the age of 18 has decreased from 19.1% in 2010 to 16.9% in 2017. This trend is reflected in changes in regional school enrollment, which declined 9.1% between 2010 (31,535) and 2017 (28,650). The share of persons aged 20-44 years also declined, likely as a result of residents moving off Cape for educational and job opportunities.

2.2.6.1.2 Forecasts and Projections

Data from the U.S. Census and Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning, provided to Metropolitan Planning Organizations, both indicate a continuation in population decline over the next three decades, with the regional population dipping below 200,000 in 2030. These projections, however, do not take into account factors such as the Cape's profile as a seasonal and retirement destination. The continued attractiveness of the Cape as a retirement destination amplifies the influence of future migration, as opposed to natural growth and may result in an underestimation in population.[2]

The Cape Cod Commission's Regional Housing Market Analysis and 10-year Forecast of Housing Supply and Demand by Crane Associates, Inc, dated June 30, 2017, forecasts population growth in Barnstable through 2025. Barnstable is predicted to increase its population by an average of 215 residents per year (0.51%). The Mid-Cape, specifically the Town of Barnstable, is predicted to show stronger population growth than other areas within the region. The Crane Report cites expected future job growth as a population driver. Other factors that support this determination may be the more even distribution of age and seasonal population in Barnstable than in other towns, as well as greater potential for new development based on recent growth, adopted land use policies, and infrastructure availability.

The Commission's Market Analysis by Crane Associates estimates the Mid-Cape will add approximately 3,790 jobs (0.59% annual average growth rate) between 2015 and 2025. The predicted trend is job growth presented in the Crane report is consistent with other sources that also forecast increases in employment within the Town. According to downscaled economic data by EMSI provided by the Cape & Islands Workforce Development Board, the Town of Barnstable hosted 33,488 jobs in 2018. Jobs grew by 1,602 over the last five years and were projected by that source to grow by 1,073 over the next 5 years (.63% average annual growth

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[2] Cape Cod 2020 Regional Transportation Plan, Cape Cod Metropolitan Planning Organization/Cape Cod Commission

rate).[3] The Town of Barnstable's designated role as a regional commercial center, the existing availability of infrastructure to support higher density development, and a trend toward encouraging future residential and commercial growth all support projections that residential and commercial infrastructure demands on infrastructure could increase.

Table 2-10: Town of Barnstable Building Permits

	2014	**2015**	**2016**	**2017**	**2018**
Residential					
New Dwellings	83	94	58	60	43
Additions/Alterations	1421	1562	1796	1609	1587
Demolitions	49	48	47	71	63
Rebuilds	26	28	24	29	25
Commercial					
New Buildings	17	5	17	16	19
Remodel	288	304	217	459	570

Building permit numbers continue to show strong patterns of redevelopment and reinvestment in both the single-family and commercial sectors, which reflect the limited supply of remaining vacant developable land available. The rate of issuance of building permits for single-family residential dwellings shows a trend towards decline of new construction over the past five years. The single-family construction numbers continue to stand in contrast to high rates of new growth in preceding decades; by comparison, the Town averaged 235 new single-family residential units per year in the late nineties. The above permit numbers, however, do not fully reflect the significant recent increases in multi-family units in Hyannis and Barnstable. Within the above time-frame, a total of 390 multi-family units in five projects were completely constructed; an estimated 100 additional units have completed the development review process and are anticipated to become available within the next one to two years. In the commercial sector, Barnstable has experienced significant investment in the form of redevelopment in the regional commercial center, including projects such as the Cape Cod Five headquarters and reinvestment in the large retail centers. A number of high profile projects, including redevelopment of Cape

[3] Emsi Q1 2019 Data Set for 10 Massachusetts Zip Codes within the Town of Barnstable

Town Plaza and Cape Cod Healthcare's planned six-story addition, are indicative of continued strong commercial investment.

These analyses and observations are largely consistent with the demand analysis presented in the *New Sources Alternatives Evaluation Report*, prepared for the Town by Weston & Sampson in March 2019. This report anticipated increases in Hyannis Water System projected average daily demand through 2023 based on economic and other factors.

When considering impacts on growth, population projections are an important determinant, but rates of household formation are also significant. Demographic data indicates that current and future population is concentrated in the upper age cohorts, a group which has already formed independent households and is not predicted to drive new household formation in the future. Overarching trends, both regionally and nationally, are towards declining household size (or fewer people per household), primarily driven by increases in single-person households and single-parent families. This trend, combined with an expected demand for smaller units by persons in upper age cohorts, could potentially drive demand for smaller housing units.[4]

Table 2-11: Town of Barnstable Households, 1990-2015

	1990	**1995**	**2000**	**2005**	**2010**	**2015**
Households	16,593	17,984	19,647	19,729	19,225	19,503

Finally, the impacts of Cape Cod's identity as a seasonal housing market and tourist destination must be considered. The Town's housing stock has always included a share of seasonal units. This share, however, was shown to have increased significantly during the Great Recession, which resulted in low real estate values on the Cape and opportunities for acquisition by people in strong regional markets (New York and Boston). The result Cape-wide was a decline in year-round housing units between 2010 and 2015. Because of aging demographics and the Cape's continued attractiveness as a retirement destination, the demand for seasonal housing units is expected to remain strong. Seasonal housing units are expected to increase at more than twice the rate of year-round units through 2025.[5]

2.2.6.1.3 Summary

In summary, a review of recent studies indicates that Barnstable can expect modest year-round population growth (±215 residents/year) over the next ten years as a result strong economic

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[4] Cape Cod Commission's Regional Housing Market Analysis and 10-year Forecast of Housing Supply and Demand by Crane Associates, Inc, June 30, 2017

[5] Seasonal housing units are expected to increase at more than twice the rate of year-round units through 2025.

prospects. Additionally, the attractiveness of Barnstable as a seasonal retirement community is expected to continue. These population forecasts should be paired with observed trends towards decreasing household size, diminishing single-family residential permit activity, and increases in multi-family housing production. Should these population and market demand trends continue, the Town can expect to see modest population growth, coupled with increased demand for smaller-scale housing units, and continued strong demand for seasonal housing.

2.2.6.2 BUILDOUT

Buildout studies first done for wastewater and comprehensive land use planning conducted in the late 2000s and then updated for MEP reports and the 2017 Water Resources Advisory Committee were used as a basis for this analysis. The prior buildout methodologies were reviewed and updated to reflect new development, regulatory changes, and current conditions. Projections were made on a parcel by parcel basis to estimate potential development that may occur at a future time of buildout. The number of residential dwelling units and non-residential building square footage were estimated for future buildout conditions.

This methodology produces a picture of the Town's "ultimate" buildout condition, with each parcel being subdivided or developed based on current zoning, or, for non-residential properties, floor-area ratio assumptions derived from current zoning. In a limited number of instances, additional buildout potential was assigned to a parcel based on the strong prospects of development potential notwithstanding current zoning.

Table 2-12: Future Residential Wastewater Generation – "Ultimate" Buildout

Watershed	Existing Residential Dwelling Units	Additional Dwelling Units at "Ultimate" Buildout	Additional Wastewater Flow at "Ultimate" Buildout (gpd)[1]
Centerville River	7,789	403	65,290
Three Bays	5,328	835	176,600
Rushy Marsh Pond	8	2	500
Popponesset Bay	858	120	21,280
Halls Creek	2,531	193	27,790
Lewis Bay (not including Halls Creek)	5,488	2,579	371,380
Scorton Creek	6	2	420
Barnstable Harbor	3,718	1,827	332,150
Uncategorized (outside all watersheds)	966	155	32,640
TOTALS:	26,692	6,116	1,028,050

1. Flows are based upon 90% of the Average Water Consumption per Dwelling Unit in each watershed as provided in Table 5-11 of the 2011 Needs Assessment Report (See Appendix R)

Table 2-13: Future Commercial Wastewater Generation – "Ultimate" Buildout

Watershed	Existing Commercial Building Square Footage	Additional Commercial Building Square Footage at "Ultimate" Buildout	Additional Wastewater Flow at "Ultimate" Buildout (gpd)[1]
Centerville River	1,559,488	732,439	38,090
Three Bays	1,164,866	1,325,995	79,560
Rushy Marsh Pond	0	0	0
Popponesset Bay	62,764	112,884	10,720
Halls Creek	428,089	347,762	27,470
Lewis Bay (not including Halls Creek)	9,066,887	18,309,511	1,446,450
Scorton Harbor	0	0	0
Barnstable Harbor	2,239,471	4,053,546	283,750
Uncategorized (outside all watersheds)	148,960	375,054	52,880
TOTALS:	14,670,525	25,257,190	1,938,920

1. Flows are based upon 90% of the Average Water Consumption per 1,000 SF of Non-Residential Use in each watershed as provided in Table 5-12 of the 2011 Needs Assessment Report (See Appendix R)

2.2.6.2.1 Future Wastewater Generation

As previously discussed, though ultimate buildout provides an upper limit of potential flows that could occur someday, it is not an accurate predictor of flows for specific projects and their associated infrastructure sizing. Other factors need to be considered to help arrive at a realistic buildout prediction for the projects design life. Areas where the greatest potential for near-term growth exists, based on both population/market demand analysis and buildout projections (under current regulations), include the Route 132 commercial center, the Hyannis/Barnstable industrial areas, and the Downtown Hyannis Growth Incentive Zone, all within the Lewis Bay Watershed. These areas are, for the most part, are already served by municipal wastewater infrastructure and potential increases in wastewater flows have been anticipated, planned for, and allocated. Additionally, new single-family home construction, typically reliant on Title 5 systems, are anticipated to continue only at the current modest rates of 68 new single-family dwellings annually, with the greatest potential for new single-family home construction occurring within the Barnstable Harbor watershed, which has been shown to have nitrogen assimilative capacity. Finally, the areas that do have significant potential for sewer-induced growth are areas where zoning permits more intensive development, but additional buildout has been constrained by Title 5. These areas include the Yarmouth Road triangle, a number of large parcels along Route

132, and non-residentially zoned parcels on the Route 28 corridor. For the most part, these are areas that are already developed in some fashion (vs being vacant lots) and as a result increase flows will be due to redevelopment vs all new growth. Considering all of this, it is believed that the realistic buildout prediction for the projects design life are considerably less than the ultimate buildout numbers listed in and Table 2-13.

To establish the realistic buildout prediction for the projects design life, the design life of the infrastructure being suggested in this CWMP should be understood. Generally, it is as follows:

- WPCF – 20 Years, though tanks may last longer
- Pump Stations – 20 Years, though tanks may last longer
- Sewer piping – 50 Years

Given the project's expected duration (30 years), and the design lives of the proposed infrastructure, it was felt that a conservative design life to compute realistic buildout would be 50 years.

Considering all of the above, it was assumed that realistic buildout over the design period (50 years) will be approximately 1/3rd of the residential and commercial ultimate buildout additional units numbers. Additionally, as was previously noted, not all watersheds are contributing to the proposed wastewater problems. With all of this considered Table 2-14 and Table 2-15 outlines the expected future wastewater generation.

One final note, the application of this flow will occur in infrastructure decisions, on a project by project basis. As a result, each project will readdress the issue of potential future flows for the relevant contributing areas. This will ensure that the latest view on growth is incorporated into the project thinking and that infrastructure is properly sized.

Table 2-14: Future Residential Wastewater Generation – "Realistic" Buildout

Watershed	Existing Residential Dwelling Units	Additional Dwelling Units at "Ultimate" Buildout	"Realistic" Additional Dwelling Units at 50 Years	"Realistic" Additional Dwelling Units In Watersheds that contribute to the Wastewater Issues	"Realistic" Future Wastewater Flow - Residential (gpd)[1]
Centerville River	7,789	403	134	134	21,740
Three Bays	5,328	835	278	278	58,810
Rushy Marsh Pond	8	2	1	0	0
Popponesset Bay	858	120	40	40	7,080
Halls Creek[2]	2,531	193	64	0	0
Lewis Bay (not including Halls Creek)	5,488	2,579	859	859	123,670
Scorton Creek	6	2	1	0	0
Barnstable Harbor[3]	3,718	1,827	608	0	0
Uncategorized (outside all watersheds)	966	155	52	0	0
TOTALS:	26,692	6,116	2,037	1,311	211,300

1. Flows are based upon 90% of the Average Water Consumption per Dwelling Unit in each watershed as provided in Table 5-11 of the 2011 Needs Assessment Report (See Appendix R)
2. It is assumed that the majority of additional residential dwelling units in the Halls Creek Watershed are going to occur in areas that are not within the sewer expansion plan or existing sewered areas as these areas are substantially built out with single family dwellings under existing conditions. Halls Creek has assimilative capacity to accept additional nitrogen.
3. It is assumed that the majority of additional residential dwelling units in the Barnstable Harbor Watershed are not going to be in the Millway Subwatershed as this subwatershed is substantially built out with single family dwellings under existing conditions. The remaining portions of the watershed, that are not already sewered, and which have been shown to have assimilative capacity to accept additional nitrogen, will remain unsewered under the plan.

Table 2-15: Future Commercial Wastewater Generation – "Realistic" Buildout

Watershed	Existing Commercial Building Square Footage	Additional Commercial Building Square Footage at "Ultimate" Buildout	"Realistic" Additional Commercial Square Footage at 50 Years	"Realistic" Additional Commercial Square Footage In Watersheds that contribute to the Wastewater Issues	"Realistic" Future Wastewater Flow - Commercial (gpd)[1]
Centerville River	1,559,488	732,439	243,902	243,902	11,420
Three Bays	1,164,866	1,325,995	441,556	441,556	23,850
Rushy Marsh Pond	0	0	0	0	0
Popponesset Bay	62,764	112,884	37,590	37,590	3,210
Halls Creek[2]	428,089	347,762	115,805	115,805	8,230
Lewis Bay (not including Halls Creek)	9,066,887	18,309,511	6,097,067	6,097,067	433,500
Scorton Harbor	0	0	0	0	0
Barnstable Harbor[3]	2,239,471	4,053,546	1,349,831	1,349,831	85,040
Uncategorized (outside all watersheds)	148,960	375,054	124,893	0	0
TOTALS:	14,670,525	25,257,191	8,410,645	8,285,752	565,250

1. Flows are based upon 90% of the Average Water Consumption per 1,000 SF of Commercial Units in each watershed as provided in Table 5-11 of the 2011 Needs Assessment Report (See Appendix R)
2. It is assumed that the additional commercial square footage in the Halls Creek Watershed will occur along existing sewer lines and thus is accounted for WPCF design purposes.
3 It is assumed that the additional commercial square footage in the Barnstable Harbor Watershed will occur in the Millway Subwatershed and other areas where there is existing sewer.

2.3 PROJECTS ALREADY UNDERWAY OR COMPLETED SINCE THE 2011 NEEDS ASSESSMENT

Since the writing of the 2011 Needs Assessment, the Town has engaged in a number of wastewater related projects that will/can affect the nutrient loads in its embayments. These range from actual infrastructure projects such as the Stewart's Creek Sewer Expansion, to evaluations of existing infrastructure to ensure capacity, to agreements regarding wastewater management with adjoining communities, to new and alternative approaches to nutrient management issues that are being pursued. This section is intended to update the reader on the most significant of those activities.

2.3.1 COOPERATIVE/INTER-MUNICIPAL INITIATIVES

This section provides an overview of the cooperative and inter-municipal initiatives to date.

2.3.1.1 POPPONESSET BAY THREE TOWN IMA

The Popponesset Bay Watershed is located in the Towns of Barnstable, Mashpee, and Sandwich. As a result, all three Towns share some responsibility for addressing the watershed's Total Nitrogen (TN) TMDL. To that end, from June 2016 until April 2017 the Towns met five times to develop an Inter-municipal Agreement (IMA), and begin discussions on a potential application for a Watershed Permit. The IMA was signed by all parties by the end of 2017. A full copy of the IMA can be found in Appendix II. Key components of the IMA included:

- The Towns agreed that it was in their best interests to apply jointly for a Watershed Permit.
- That each Town would develop and implement its own MassDEP approved CWMP or Targeted Watershed Management Plan, and the capital projects undertaken by the Town as a result of those plans will be the sole responsibility of that Town.
- The Town of Mashpee would serve as the fiscal agent under the IMA and, as such, will receive, hold, and expend any funds appropriated by the Parties for joint actions required in the implementation of the IMA, as well as any grant funds awarded to the Parties for the purpose of pursuing, securing, and implementing a Permit.
- The Towns would establish a Popponesset Bay Watershed Work Group, which would be comprised of three members from each Town (Town Manager, Selectman/Town Councilor, and a technical representative), and which will:
    - Administer this IMA and any amendments to it;
    - Administer the application and implementation of a Watershed Permit; but
    - The Work Group has no authority to bind one or more of the Parties.
- The Towns established a nitrogen allocation formula for the purpose of assigning costs (see Table within this bullet). They further agreed that the costs should be allocated on the basis of un-attenuated and attenuated nitrogen loadings.

- The un-attenuated loads for tracking and accounting of nitrogen reductions which result from implemented measures.
    - The attenuated loads to provide a benchmark for comparison of improvements to water quality based on implemented measures. Attenuated load is what is ‘received in the estuary’. See Table 2-16.
- The Towns agreed to develop a fair and practical methodology for nitrogen trading mechanism.
- The Towns agreed to work together to adopt a fair and practical methodology for monitoring the water quality of the watershed and funding said effort.

Table 2-16: Nitrogen Load Sharing by Town – Popponesset Bay Watershed IMA

	Unattenuated	**Attenuated**
Barnstable	12.6%	16.0%
Mashpee	65.4%	74.5%
Sandwich	22.0%	9.5%
TOTALS:	100%	100%

2.3.1.2 YARMOUTH/BARNSTABLE FEASIBILITY STUDY

The towns of Barnstable and Yarmouth share the impaired Lewis Bay Watershed. In 2018, Yarmouth was awarded an Efficiency and Regionalization Grant from the State’s Community Compact Program, a portion of which was used to fund an analysis of the potential to share wastewater treatment and effluent recharge between the two towns. As noted within this CWMP, Barnstable has an existing treatment facility, but may need to find additional disposal capacity. Yarmouth has additional disposal capacity at its Buck Island Road site, but does not have treatment facilities. The initial result of this effort is summarized in a memo which included in Appendix JJ. What was found was that sharing wastewater treatment and effluent recharge between communities is feasible, but the details regarding cost apportionment between the communities for the effort still needs to be negotiated and will ultimately dictate whether the effort moves forward.

2.3.1.3 JOINT BASE CAPE COD

Joint Base Cape Cod (JBCC) has a wastewater treatment and disposal system on its property that may be suited to serve as a potential regional wastewater system. The system provides service for on-base facilities, and was designed for 70,000 users, though currently only serves approximately 3,500 users. It is owned by the United States Air Force (USAF) and operated and maintained by the Massachusetts Air National Guard 102nd Intelligence Wing (ANG). The treatment plant (here after referred to as the WWTF) is an extended aeration activated sludge facility (biological nitrogen removal) that was constructed in 1995. The WWTF has a design capacity of 360,000 gpd (annual average) and a maximum day flow of 840,000 gpd. Treated effluent from the facility is piped via a 12-inch diameter ductile iron force main approximately 10.5 miles from the WWTF, through the Reserve, to a set of four Rapid Infiltration Basins (RIBs) that are located at the northwest edge of the JBCC near the Cape Cod Canal. The effluent force main has a design capacity of 1,400,000 gpd (peak hour) and could potentially be increased to 1,750,000 gpd on a peak hour basis with some modifications. The RIBs have a total surface area of 259,160 square feet, and are permitted for disposal of up to 360,000 gpd of effluent on a 12-month rolling average basis and up to a maximum of 840,000 gpd on any given day.

One of the concerns of using the JBCC system as a regional wastewater system is the condition of both the existing water and wastewater infrastructure. The Air Force has been clear that whatever entity takes over the wastewater system, will also have to take over the water system. These systems are extensive, and have not been maintained or had capital investments made to them to the same level as expected by municipalities. The wastewater collection system and water system are described below.

Wastewater Collection System

- Approximately 36 miles of sewer piping (161,000 LF) and 595 sewer manholes (SMHs):
    - 15% AC Pipe constructed in the 1960s (within 15 years of being at the end of design life).
    - 80% VC Pipe constructed in the 1940s and 1950s (at the end of design life).
    - 5% PVC Pipe constructed in the 1990s.
- 11 pump stations

Water System

- Two primary water supplies:
    - The interconnection with the Upper Cape Regional Water Supply Cooperative (UCRWSC).
    - The J-Well located on the JBCC, which is much more costly to treat and pump to the distribution system than wholesale purchase of bulk water from the UCRWSC
- Two 400,000-gallon elevated water storage tanks.
    - The tanks were constructed in 1942, dating back to the origin of the water system. Both tanks were refurbished in the early 1990s.
    - Both tanks are approaching 75 years old and both are constructed using an older, high maintenance technology for water storage.
- Serves approximately 380 customers.
- Does not use water meters to determine billing, rather water bills are generated based on a usage algorithm.

- Contains approximately 270 fire hydrants, many date back the original distribution system or were added with the expansion in the 1950s.
- The total length of water mains in the JBCC water distribution system is approximately 259,000 feet or 49 miles.
    - 144,000 LF of unlined cast iron water main ranging in size from 2-inch to 12-inch in diameter was installed in 1940 and 1941.
    - 112,000 LF of cement lined cast iron pipe installed between 1955 and 1960.
    - 32,900 feet of asbestos cement (transite) mains, also installed between 1955 and 1960, that are reported to be brittle and increasingly a problem.
    - 13,275 LF of copper pipe installed in the 1950s.
    - 3,020 LF of ductile iron pipe installed in the 1980s.

The costs of bringing these systems up to modern standards and operating them are significant. Massachusetts Development, and/or the four surrounding towns (Bourne, Falmouth, Mashpee, and Sandwich) have been investigating the possibility of making the WWTF a regional facility in one form or another for over a decade. During the winter of 2018/2019 Barnstable was approached by members of the aforementioned team and invited to join the four towns in their pursuit of the JBCC. Massachusetts Development was no longer a primary player, and the other towns felt Barnstable's participation would be beneficial. Barnstable agreed to join, and immediately contracted with a consultant to help come up-to-speed on the issues, opportunities, and challenges associated with facilities, and to "catch-up" with the other towns. The results of the consultant's efforts can be found in Appendices KK to NN.

2.3.2 NON-TRADITIONAL PROJECTS

This section provides an overview of non-traditional projects that the Town (and its various partners) are pursuing or have perused since the 2011 Needs Assessment Report. The Town's main effort relative to non-traditional projects is focused on the Three Bays Watershed, specifically the Marstons Mills River. A team of experts from science and government fields were formed to look at opportunities for nontraditional, in situ, approaches to nutrient reduction in the Marstons Mills River. The team was comprised of the following members: James Crocker, Town Councilor, Precinct 5; Dr. Brian Howes, Chancellor Professor, School of Marine Science and Technology, UMass Dartmouth; Zenas Crocker, Executive Director, Barnstable Clean Water Coalition; Scott Horsley, Water Resources Consultant; Dan Santos, Director, Barnstable DPW; and Rob Steen, Assistant Director, Barnstable DPW. The Team initially was focused on Mill Pond, and specifically the dredging of Mill Pond, which had been suggested as a nitrogen reduction effort in previous planning. However, it became apparent that a better approach would be to look at the Marstons Mills River, from its origins in cranberry bogs at its upper end to where it exists into North Bay, as a complete treatment system. To organize this approach, the nutrient removal from the river system was categorized into four efforts:

1. Utilization of the cranberry bogs at the upper end of the river
2. Mill Pond dredging
3. Innovative nutrient removing septic systems, and farming practices along its reaches
4. Warren's Cove dredging and aquaculture

It became apparent that items 1 and 3 were best pursued by the Barnstable Clean Water Coalition (BCWC), a 501 (c) (3) non-profit organization, while items 2 and 4 by the Town of Barnstable. In doing so the basis of a strong public-private partnership was formed between the Town and BCWC.

2.3.2.1 UPPER-END CRANBERRY BOGS

The headwaters of the Marstons Mills River contain approximately 150 acres of cranberry bogs. The BCWC has been collecting water quality data at the bogs, and found that more than 8,000kg of nitrogen flows out from them into the Marstons Mills River each year, or about 40% of the watershed's excess nitrogen load. Most of this nitrogen originates from septic systems that discharge to groundwater that then flows into the bogs as they are a collection area for the groundwater from much of the surrounding residential developments. The bogs contain wetlands and on old maps, the entire site was marked "ponds and wetlands". Interestingly, the farmers have stated that while they used to apply fertilizer, little is now needed since the crops do well without additional nitrogen. As a result, BCWC and the Town believe that the bogs could play a vital role in reducing the nitrogen load in our watershed. As of the writing of this report, BCWC is working closely with the farmers to examine a series of pilot programs that would allow for significant nitrogen attenuation to occur without negatively impacting their farming of the bogs.

2.3.2.2 MILL POND DREDGING

Mill Pond is a manmade pond at the mid-point of the river system, at the intersection of Routes 149 and 28. The pond has been progressively filling with silt and debris since its creation, to the point that it is less than 1-foot deep in many locations. Recent work by Dr. Brian L. Howes, Dr. David Schlezinger, and Dr. Roland Samimy of the University of Massachusetts – Dartmouth, School of Marine Science and Technology, documented in a technical memorandum dated October 25, 2017 titled *Fresh Pond Restoration and Management, Benthic Nutrient Flux of Mill Pond, Town of Barnstable, Quantifying the Rates of Nutrient Release/Uptake from Sediments in Mill Pond and Comparison to Historic Rates;(*see Appendix OO) concluded the following:

1. Sediment has been gradually filling Mill Pond over the past four centuries. This has resulted in very short hydraulic residence time (~1 day) in the pond, which likely results in a reduction in the retention of nitrogen by the pond, thus passing most of it down the Marstons Mills River to the Three Bays System.
2. Removal of watershed derived total nitrogen by Mill Pond appears to be approximately 25% annually, but only 7%-11% in the June–August period.

3. Nitrate entering Mill Pond is either removed (likely through denitrification - about 25% of the total nitrogen removed by Mill Pond in summer, a much lower fraction than other Cape Cod fresh ponds) or transformed to organic nitrogen forms (25% - 35%), although most is discharged to the downgradient estuary. The high level of nitrate discharged from Mill Pond (0.5 mg/L even in summer) indicates there is strong potential for additional nitrogen removal within this basin.
4. Enhancement of denitrification within Mill Pond should be possible in light of higher denitrification rates measured in other Cape Cod Ponds, the high nitrate remaining after passage through the pond and the low residence time."

The Group hypothesized that assuming that the nitrogen attenuation capacity of Mill Pond could be restored to 50% removal, then approximately 2,200 kg/year of additional nitrogen could be removed from the downstream system, or about 10% of the total nitrogen that needs to be removed from the Three Bays system. Additionally, the group identified other ecological benefits to restoring the pond to its original form. As an example, the sediments that had accumulated over the years in the pond are suspected to be acting as a source for nitrogen within the system. The pond is in a herring run, and it is believed that restoring the pond would be beneficial to the herring's passage. Finally, anecdotally it has been noted that the sediments within the pond pose a significant safety concern. Though they appear solid enough to wade on, they are reportedly too fluid to support human weight and would almost act as "quick sand". Given how shallow this pond has become, and the temptation to wade in it, this is a dangerous situation for the public at large.

2.3.2.3 SEPTIC SYSTEMS AND FARMING ALONG THE RIVERS REACHES

While in situ treatment of nitrogen is an important technique to achieving the Town goals, source reduction of nitrogen, whether it be residential or commercial wastewater treatment, is still the primary focus. There are new, and emerging septic system technologies that are being tested and which seem to be more effectively removing nitrogen. The Massachusetts Alternative Septic System Test Center (MASSTC) is a leading test site for innovative septic systems in the U.S. and is located on Cape Cod. MASSTC is currently testing individual alternative systems that perform as well as many municipal systems. BCWC is working closely with MASSTC, Mass Department of Environmental Protection (DEP), U.S. EPA and the Town to create a pilot program where they can monitor and track innovative/alternative (I/A) systems in a real-world environment in the Town's watersheds. In addition, they are working with The Nature Conservancy to develop a financing plan to create a roadmap for widespread replacement of Title 5 septic systems with these alternative technologies.

BCWC's water quality monitoring has also discovered several "hot spots" along the river. The most troubling is a horse farm with 8-10 horses. It is believed that a horse's liquid waste produces as much nitrogen as 20 to 40 people. During a heavy rain event, the monitoring just downstream from this farm revealed a nitrogen level six times the normal level recorded at this site, while the river flow was only three times higher than normal. Essentially, this one location may be contributing approximately one month's amount of nitrogen within hours. BCWC has been working with scientists and engineers from the U.S. EPA, UMass, and Horsley Witten Group to develop and install a simple, easily constructed, wood chip-based bioreactor (effectively a Permeable Reactive Barrier) that is designed to significantly reduce the nitrogen flow from stormwater on these types of farms.

2.3.2.4 WARREN'S COVE DREDGING

Warren's Cove is located at the exit of the river system as it empties into Prince Cove. Over time the cove has silted in due to poor tidal flushing and macro algae blooms. This has resulted in the cove becoming a "dead zone" full of silt and decaying matter. It was hypothesized that if the cove was dredged back to its sandy bottom, it would eliminate the nitrogen being contributed from the decaying silt and matter in its benthic layers, and could create an environment that could serve as a nursery for the local aquaculture farms, which would help further remove algae and nitrogen from the waterbody.

2.3.2.5 SAMPSON'S ISLAND DREDGING

Sampson's Island is a barrier beach on the south side of the Three Bays embayment. To the west of Sampson's Island, between the mainland of Cotuit, is a navigational channel which connects Cotuit Bay to Nantucket Sound. The eastern end of the island (known as Dead Neck) experiences significant erosion due to net littoral drift moving from east-to-west along this stretch of shoreline, which has resulted in an 800-foot sand spit forming on the western end of Sampson's Island. This spit has reduced the channel width which has reduced tidal flushing within Cotuit Bay. The Sampson's Island Dredging project is a three-phase, three-year project which will widen the channel width by approximately 400 feet in an effort to improve flushing in Cotuit Bay and improve navigation. The dredged material will be beneficially reused on-site for beach nourishment and bird habitat enhancement. The project is scheduled to be completed in the winter of 2020.

2.3.3 TRADITIONAL APPROACH

This section provides an overview of traditional (sewer collection, treatment and disposal) projects that the Town has completed or has underway.

2.3.3.1 STEWARTS CREEK SEWER EXPANSION

The Stewart's Creek Sewer Expansion was located in the southeast section of the Town of Barnstable in the Village of Hyannis. The sewer area is divided in two sections, east and west, by Stewart's Creek. The area was listed in the "Wastewater Facilities Plan Phase 1, Needs Assessment Report" dated December 1993, as an "Area of Concern". The area is plagued by high groundwater conditions, with wastewater discharged at groundwater level, near resource areas, with poor soils and small lots. The sewer extension was completed in 2012. Significant points of the project are:

- The Project also included updated stormwater structures and road improvements as needed.
- The sewer design included system resilience by removing a vulnerable sewer line crossing at the mouth of Stewart's Creek which opens to Hyannis Harbor/Nantucket Sound.
- Gravity and low pressure systems were combined to decrease the area of disturbance and cost.
- Policy: "Deadlines for Connections to Public Sewer Stewart's Creek Area Project" was adopted on February 12, 2013 by Barnstable Board of Health.
- First connection to the sewer was in October 2012.
- Total dwelling units to be connected is listed as 288, with one unit taken for taxes by the Town. Total number of parcels is 241 and the breakdown of unit types shown on Table 2-17.

Table 2-17: Stewart's Creek Sewer Extension

Unit Type	Parcels Total	Dwelling Units
Single Fam MDL-01*	178	178
Two Family	34	68
Multi Houses/Rooming MDL-01	3	3
Municipal MDL-00	6	NA
Undevelopable MDL-00	7	NA
Vacant Land MDL-00	3	3
Potentially Developable Land	1	1
Condo MDL-05	3	29
Bed & Breakfast	1	1
Accessory	1	1
Auto Repairs*	2	2
Charity Org MDL-01	1	1
Housing Auth MDL-01	1	1
TOTALS:	241	288

2.3.3.2 ROUTE 28 EAST SEWER EXPANSION PROJECT

The Route 28 East Sewer Expansion Project will install sewer infrastructure, including gravity sewer within Route 28 from Strawberry Hill Road to Phinney's Lane, a large pump station located at the intersection of Route 28 and Phinney's Lane, and sewer force mains which will convey flow from the proposed pump station to the BWPCF. The proposed pump station is anticipated to be utilized as a "booster" pump station for the sewer expansion into the Three Bays Watershed and the westerly portions of the Centerville River Watershed. As of the writing of this document, Town Council has appropriated $800,000 for preliminary and final design for this project and $283,900 to purchase a property located at the intersection of Route 28 and Phinney's Lane which is anticipated to be used to site the required pump station. In the summer of 2020, the Town selected Weston and Sampson to design the project. Design is anticipated to be completed in the summer of 2021.

2.3.3.3 ATTUCKS LANE SEWER EXPANSION PROJECT

The Attucks Lane Sewer Expansion Project will enable approximately 5,500 LF of sewer piping on portions of Attucks Lane, Iyannough Road (Route 132) and Old Strawberry Hill Road which will feed the new Attucks Lane Pump Station. This project will provide businesses and residences in the area a municipal solution to their wastewater needs. By doing so, the project will remove an estimated 500 kg/year of nitrogen from the Barnstable Harbor Watershed by removal of the existing septic systems. As of the writing of this document, Town Council has appropriated $100,000 for design and construction for this project.

Cape Cod Five Cents Savings Bank approached the Town about its desire to build a new state of the art headquarters at a 1500 Iyannough Road, which is a piece of property located between Attucks Lane and Iyannough Road (Route 132). Cape Cod Five offered to build a pump station on the site that would connect via a force main to the nearest point of the sewer collection system, approximately 250 feet east of the intersection of Phinney's Lane and Attucks Lane. As part of this work, Cape Cod Five installed necessary gravity sewer piping on-site for future tie-ins to the pump station. An agreement was reached between Cape Cod Five and the Town, where Cape Cod Five would construct the pump station and would gift it to the Town. The Town will then operate and maintain the pump station. Construction of the Attucks Lane Pump Station and associated gravity sewer and force main was completed in 2019.

2.3.3.4 PHINNEY'S LANE SEWER EXPANSION PROJECT

The Phinney's Lane Sewer Expansion Project will expand sewer to north of Route 28 along Phinney's Lane and the Wequaquet Lane area in Centerville to approximately Old Strawberry Hill Road. It will include gravity sewer and some low-pressure sewer. Residences in this area are completely dependent on on-site solutions to address their wastewater, which has had a negative effect on Lake Wequaquet, and to a lesser extent the Centerville River. As of the writing of this document, Town Council has appropriated $1,050,000 for preliminary and final design for this project.

Table 2-18: Phinney's Lane Sewer Expansion Project Summary

Number of Parcels Connected	WW Captured (gpd)	N Removed (kg/day)
591	85,100	8.5

2.3.3.5 LONG POND SEWER EXPANSION PROJECT

The Long Pond Project will expand sewer to south of Route 28 around Long Pond in Centerville. This will provide municipal wastewater collection to over 600 homes. It will include gravity sewer, low pressure sewer, one pump station on Main Street, Centerville, and one pump station at the south side of Long Pond. As of the writing of this document, Town Council has appropriated $1,340,000 for preliminary and final design for this project and $549,000 to purchase a property on Main Street, Centerville which may be used to site the required pump station.

Table 2-19: Long Pond Sewer Expansion Project Summary

Number of Parcels Connected	WW Captured (gpd)	N Removed (kg/day)
606	114,600	11.4

2.3.3.6 STRAWBERRY HILL ROAD SEWER EXPANSION PROJECT

Vineyard Wind reached an agreement with the Town to land submarine cables on the shore of Covell's Beach, and will use Town roads to lay the upland cables to the substation. While Vineyard Wind installs duct bank vaults up to the substation, the Town will be installing approximately 19,000 LF gravity sewer from Route 132 to Covell's Beach, approximately 9,300 LF of sewer force main, and one new sewer pump station. This provides a backbone for the eventual sewering of ±1,640 parcels which will remove 25.5 kg/day of total nitrogen. The Town will be saving an estimated $3,000,000 due to Vineyard Wind completing the paving, surveying, designing, etc. Design will be completed in the winter of 2020 with construction anticipated to begin in the spring of 2021.

Table 2-20: Strawberry Hill Sewer Expansion Project Summary

Number of Parcels Connected	WW Captured (gpd)	N Removed (kg/day)
237	46,500	4.6

2.3.3.7 OLD YARMOUTH ROAD SEWER EXPANSION

The Old Yarmouth Road project is a conceptual plan and is currently not funded. The plan includes installing gravity sewer in the Old Yarmouth Road “triangle” area. Just south of Old Yarmouth Road is the location of the Hyannis Water District’s Maher Wellfield. Sewering is needed to accommodate future economic development in the area and the protection of the Maher Wellfield from potential contaminants. MassDOT will be working on intersection improvements at Iyannough Road (Route 28) and Yarmouth Road which will consist of intersection reconstruction and traffic signal upgrades. During the improvements the Town will be installing sewer pipe within the project limits, taking advantage of the opened road. The Town is also working with property owners and developers in the area to establish a public/private partnership to install sewer infrastructure. As of the writing of this document, Town Council has appropriated $750,000 for the installation of the sewer infrastructure as part of the MassDOT Project.

Table 2-21: Old Yarmouth Road Sewer Expansion Project Summary

Number of Parcels Connected	WW Captured (gpd)	N Removed (kg/day)
131	22,600	2.2

2.3.3.8 ROUTE 28 CENTERVILLE (MARSTONS MILLS WWTP TRANSITION)

The proposed project would utilize an existing footprint of the Marstons Mills Wastewater Treatment Plant (MMWWTP) and convert it to a municipal wastewater pump station. This station would be designed to sewer the nearby properties and accommodate future sewering needs in the area. An intermediate pump station would also be included along Route 28 to convey the wastewater along Route 28 from this converted pump station to the aforementioned pump station at the intersection of Route 28 and Phinney’s Lane which will convey flows to WPCF.

2.3.3.9 MERCHANT’S WAY SEWER EXPANSION

Kidd’s Hill Sewer Expansion was developed after the receiving of a $3,753,000 MassWorks grant. The Grant funded sidewalks on Independence Drive and Kidd’s Hill Road, multiple intersection upgrades, drainage improvements and public utility extensions (sewer and water). The sewer improvements include installation of sewer on portions of Kidd’s Hill Road, Merchant’s Lane and Business Drive which would serve future developments (properties in this area are currently undeveloped). This project was completed in the Fall of 2020.

2.3.3.10 COTUIT SEWER EXPANSION EVALUATION

With the possibility of an interconnection with JBCC, there is discussion of installing sewer in Cotuit, and bringing it the JBCC plant. The JBCC would allow the Town to address nitrogen removal in the western part of the town, and could provide solutions to other sections of the Town as well. As of the writing of this document, Town Council has appropriated $250,000 for evaluation and preliminary design of sewer into Cotuit. The potential sewer extension into Cotuit has been shown as the three "stages" on the Town's phasing plan.

2.4 UPDATES SINCE FILING OF EENF

- Progressing the Effluent Disposal work (See Section 5.3.2)
    - Received the final CDM Smith Report and Addendum regarding existing effluent disposal capacity and risk factors associated with increasing effluent disposal at the BWPCF
    - Began the screening process to look of alternative effluent disposal locations within the Town of Barnstable
    - Received memos concerning the technical feasibility and potential costs for Ocean Outfall
    - Continued to work on potential partnerships on Joint Base Cape Cod
    - Began work on other "western solution" partnerships with Sandwich and Falmouth
- Continued design efforts and coordination with Vineyard Wind on the Strawberry Hill Road Sewer Expansion Project
- Contracted with an engineering firm and began survey and design for the Route 28 East Sewer Expansion Project
- Contracted with survey firms and commenced survey on the Phinney's Lane, Long Pond, Route 28 Centerville and Route 28 Marstons Mills Sewer Expansion Projects
- Completed the Merchant's Way Sewer Expansion
- Continued design efforts on the Solids Handling Facility Rehabilitation Project
- Completed design, bidding and contracting for Rendezvous Lane Pump Station Replacement Project.
- Continued working with Barnstable Clean Water Coalition in the investigation of non-traditional technologies (cranberry bog utilization and alternative septic's)
- Identified staffing needs and hiring plans to implement the CWMP
- Began discussion with the Board of Health and Town Manager's office on creating new rules for residences and businesses concerning their onsite septic systems.
- Began discussions with the Town Council on policy and financial decisions that are needed to implement the CWMP.

2.5 SUMMARY OF THE NEEDS

The previous sections have summarized the wastewater needs of the Town of Barnstable and the steps the Town has taken since the 2011 Needs Assessment to address these needs. The intent of the CWMP is to continue to identify and address the wastewater needs of the Town of Barnstable. The wastewater needs of the Town that are addressed by the CWMP are summarized in Table 2-22 (below) and Figure 2-24.

Table 2-22: Summary of the Needs

Watershed		Nitrogen Removal	Ponds & Well Protection	Economic Development	Other Sanitary Needs	Total Needs Areas	Currently Sewered	Remain Unsewered	Total
Lewis Bay	Parcels	730	131	21	0	882	2,101	1,261	4,244
	WW (gpd)	125,774	22,603	2,737	0	151,114	1,047,053	168,070	1,366,237
Halls Creek	Parcels	39	80	0	266	385	483	1,475	2,343
	WW (gpd)	6,187	9,859	0	38,563	54,609	160,351	199,997	414,957
Centerville River	Parcels	2,770	1,980	6	0	4,756	65	3,177	7,998
	WW (gpd)	505,146	269,316	1,942	0	776,404	45,047	555,134	1,376,585
Three Bays	Parcels	3,543	772	1	0	4,316	1	1,308	5,625
	WW (gpd)	751,388	129,067	10	0	880,465	3,024	341,410	1,224,899
Rushy Marsh	Parcels	0	0	0	0	0	0	18	18
	WW (gpd)	0	0	0	0	0	0	3,779	3,779
Popponesset Bay	Parcels	518	8	0	0	526	0	417	943
	WW (gpd)	83,873	753	0	0	84,626	0	78,925	163,551
Barnstable Harbor	Parcels	362	305	68	0	735	452	3,469	4,656
	WW (gpd)	55,982	56,526	5,217	0	117,725	131,859	541,697	791,281
Undefined	Parcels	73	1	0	149	223	0	795	1,018
	WW (gpd)	18,974	28	0	43,124	62,126	0	191,693	253,819
Total	Parcels	8,035	3,277	96	415	11,823	3,102	11,920	26,845
	WW (gpd)	1,547,324	488,152	9,906	81,687	2,127,069	1,387,334	2,080,705	5,595,108

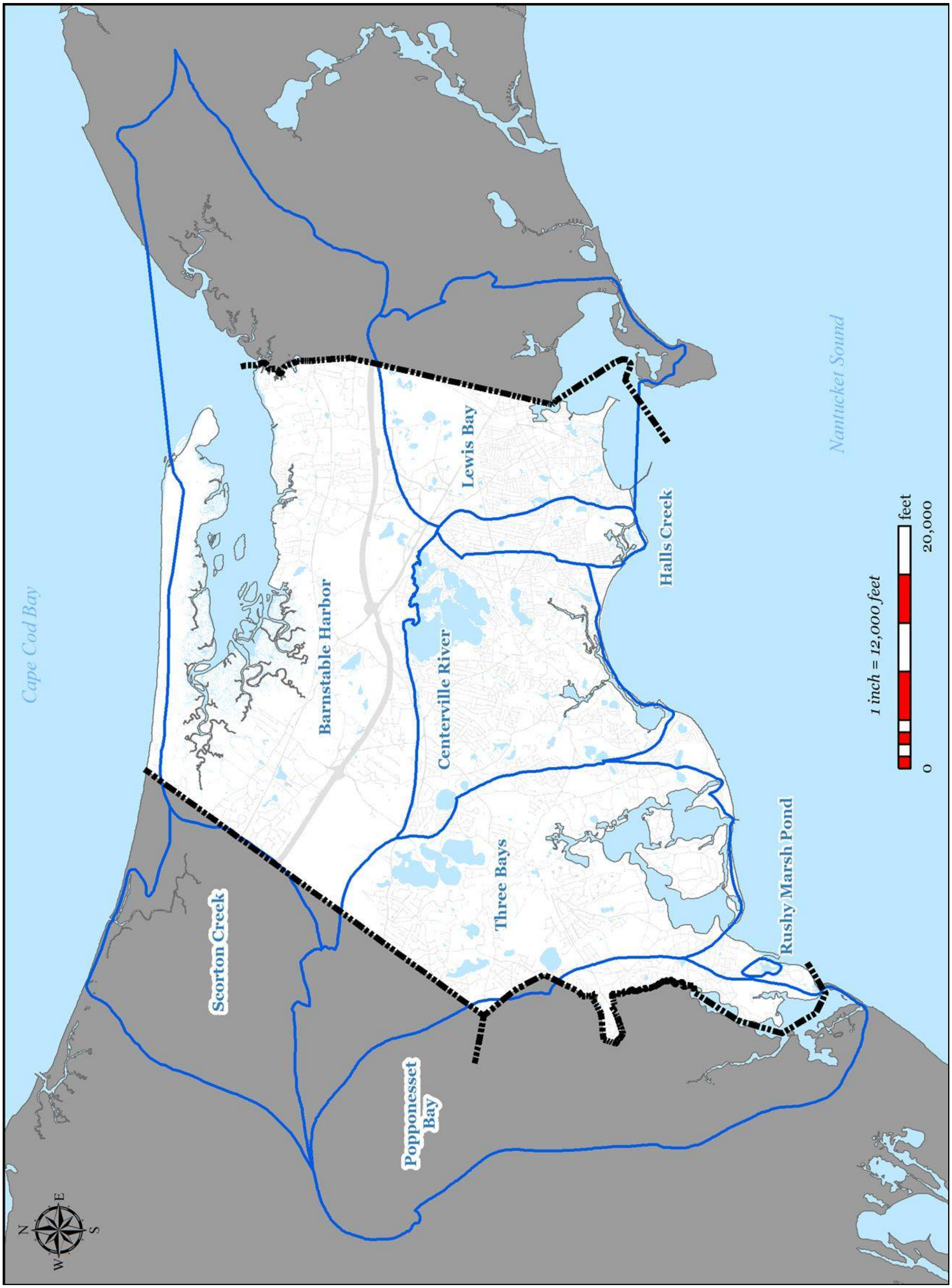

Figure 2-1: Watershed Boundaries

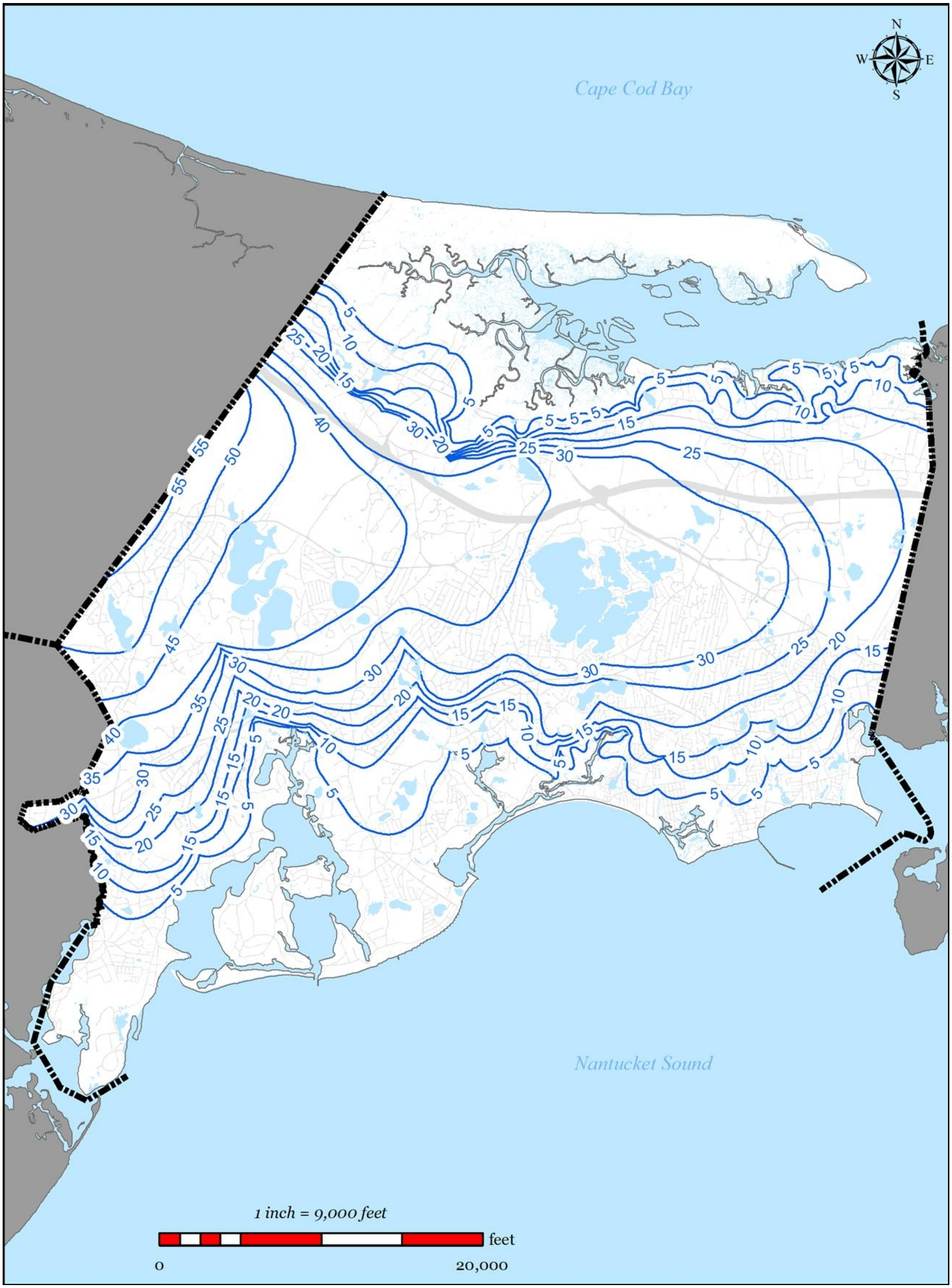

Figure 2-2: Groundwater Contours

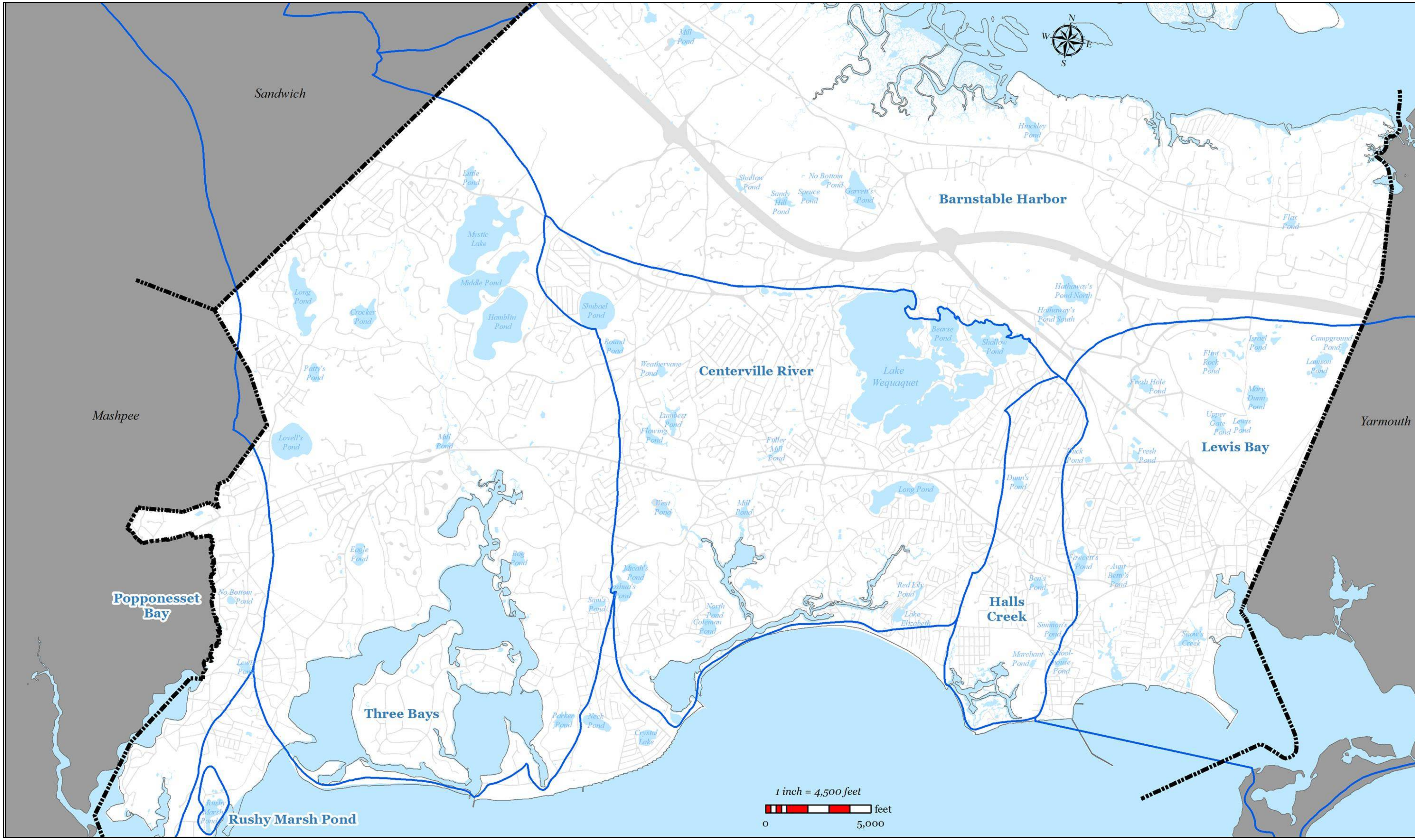

Figure 2-3: Named Freshwater Bodies

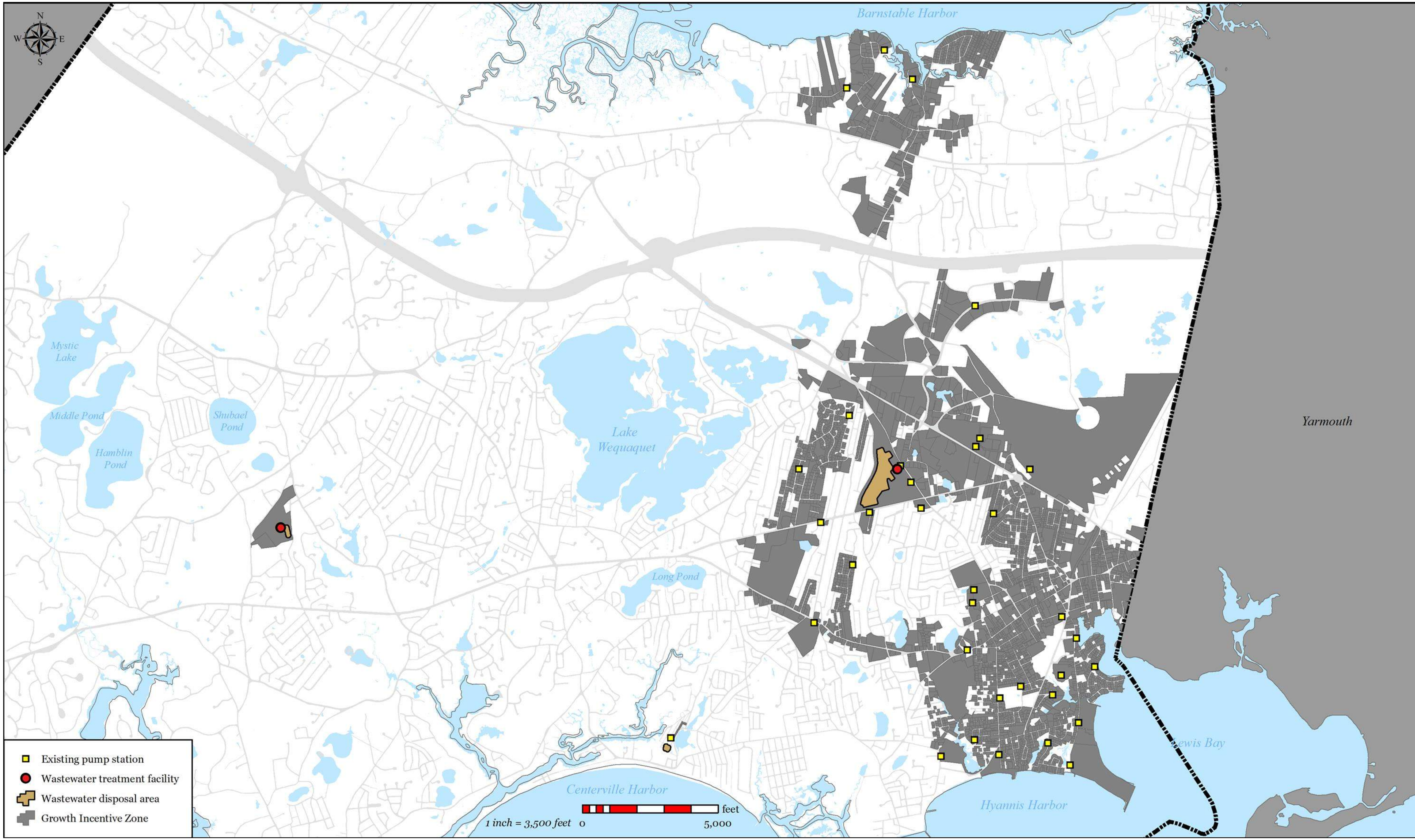

Figure 2-4: Present Sewer

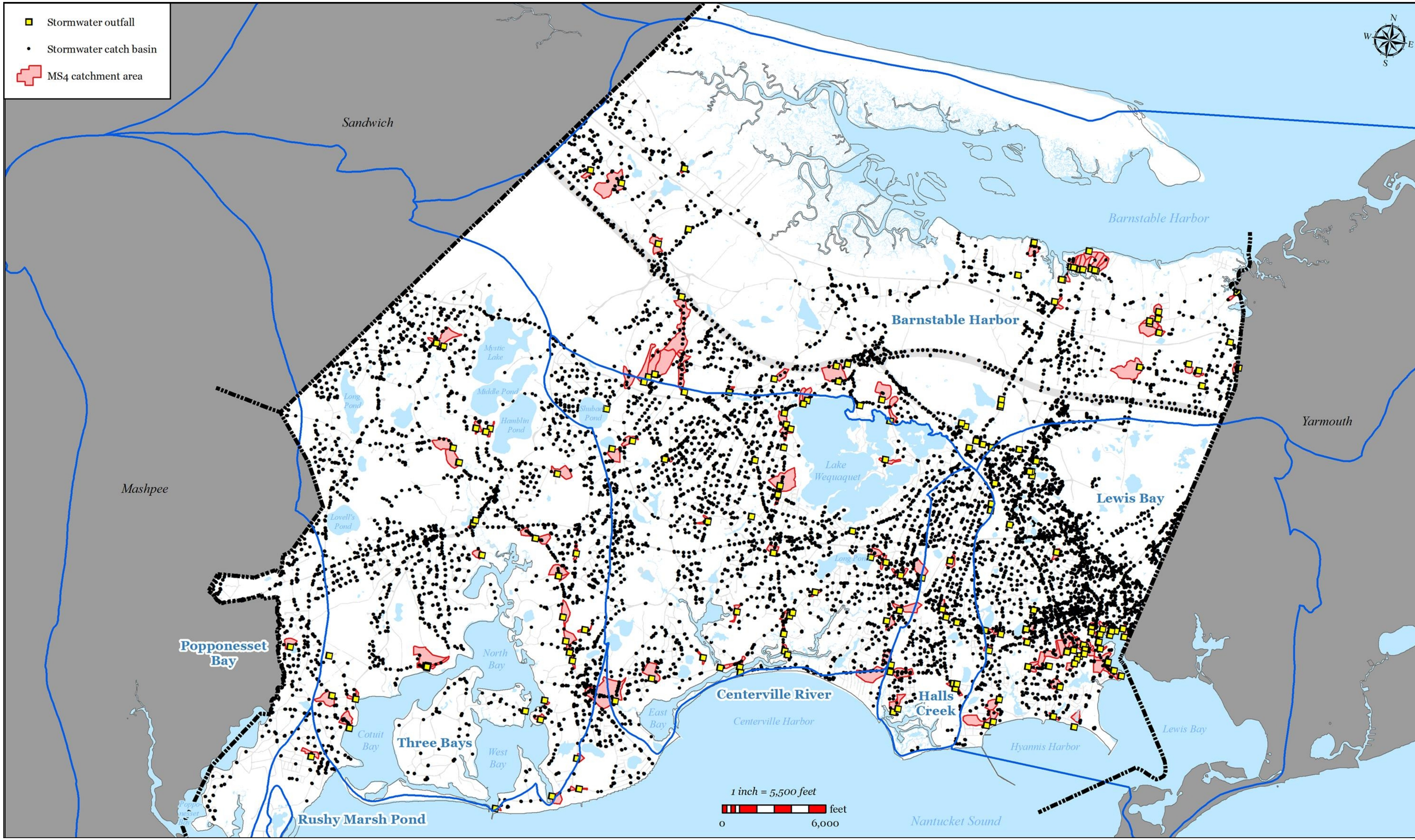

Figure 2-5: Storm Water Infrastructure

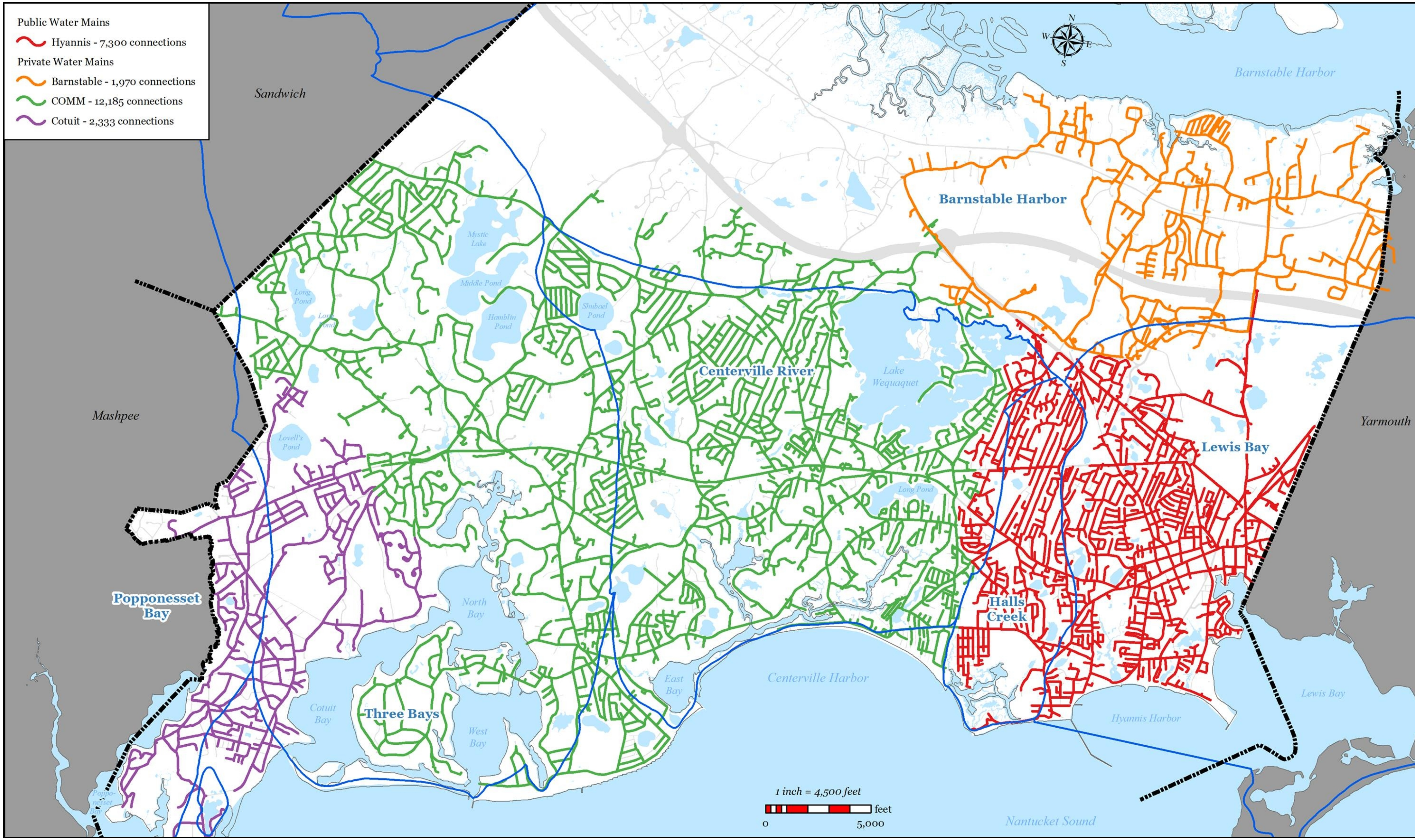

Figure 2-6: Water Supply

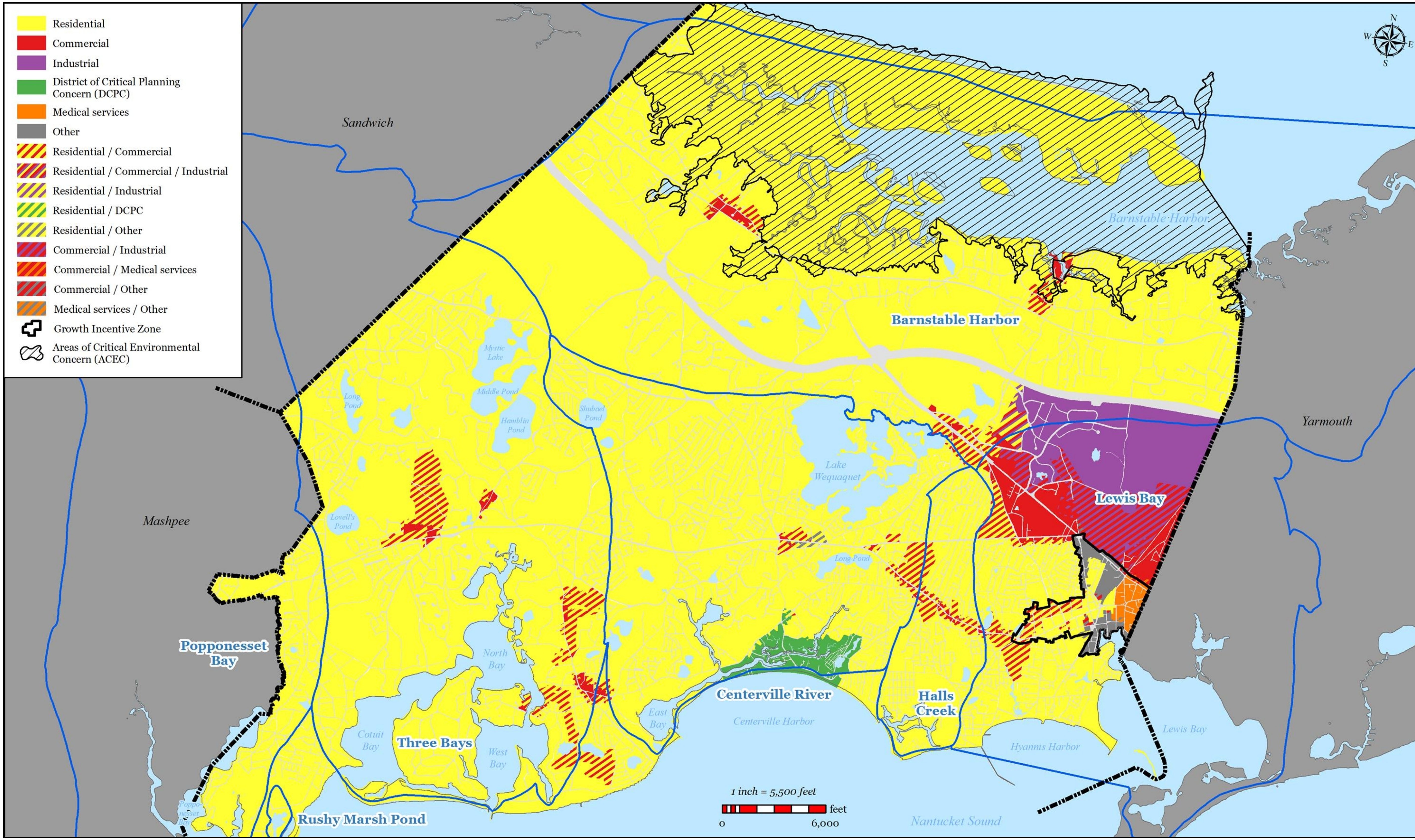

Figure 2-7: Zoning and ACEC

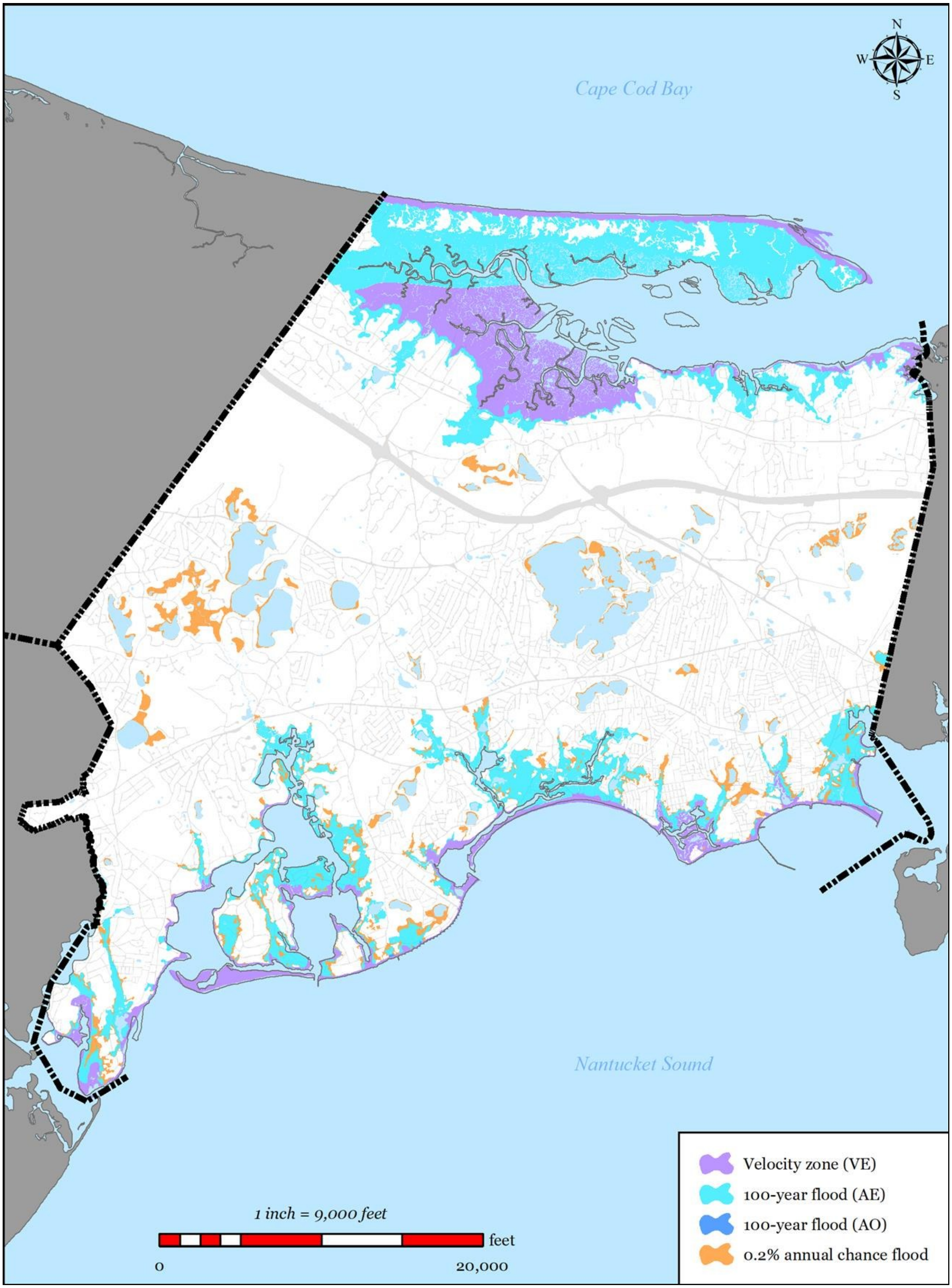

Figure 2-8: FEMA Flood Zones (2014)

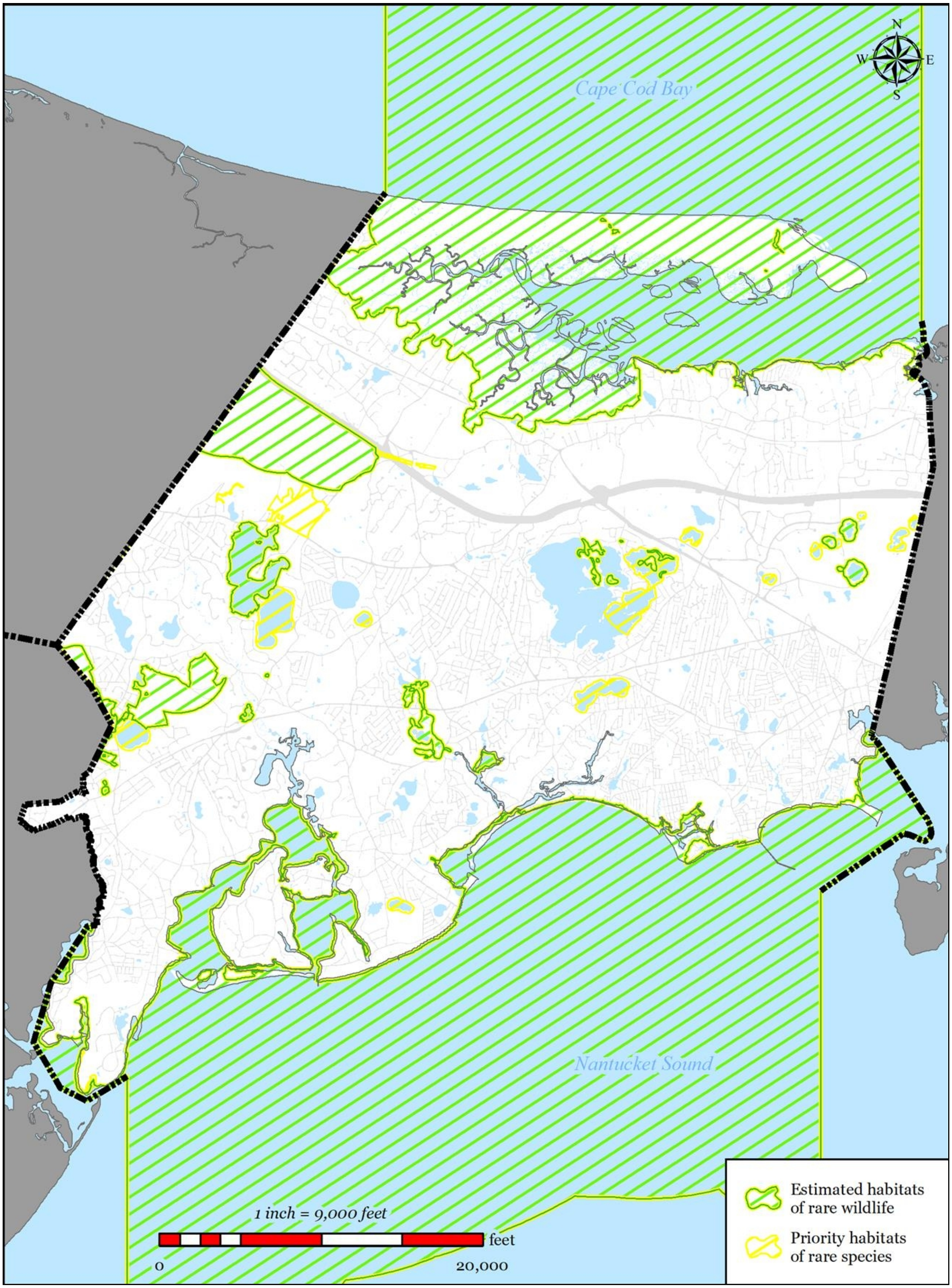

Figure 2-9: NHESP Priority Habitats and Estimated Habitats

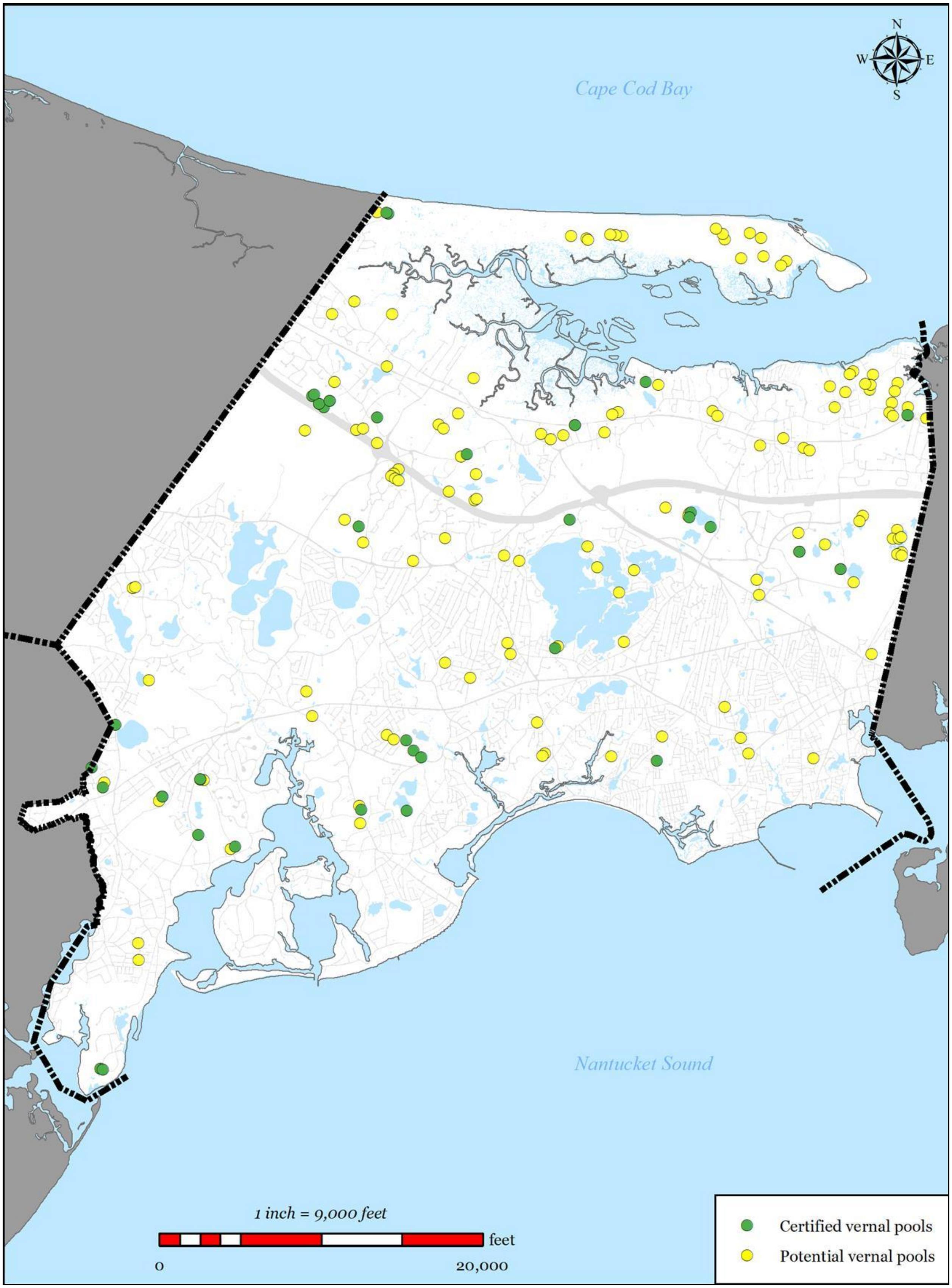

Figure 2-10: NHESP Certified Vernal Pools and Potential Vernal Pools

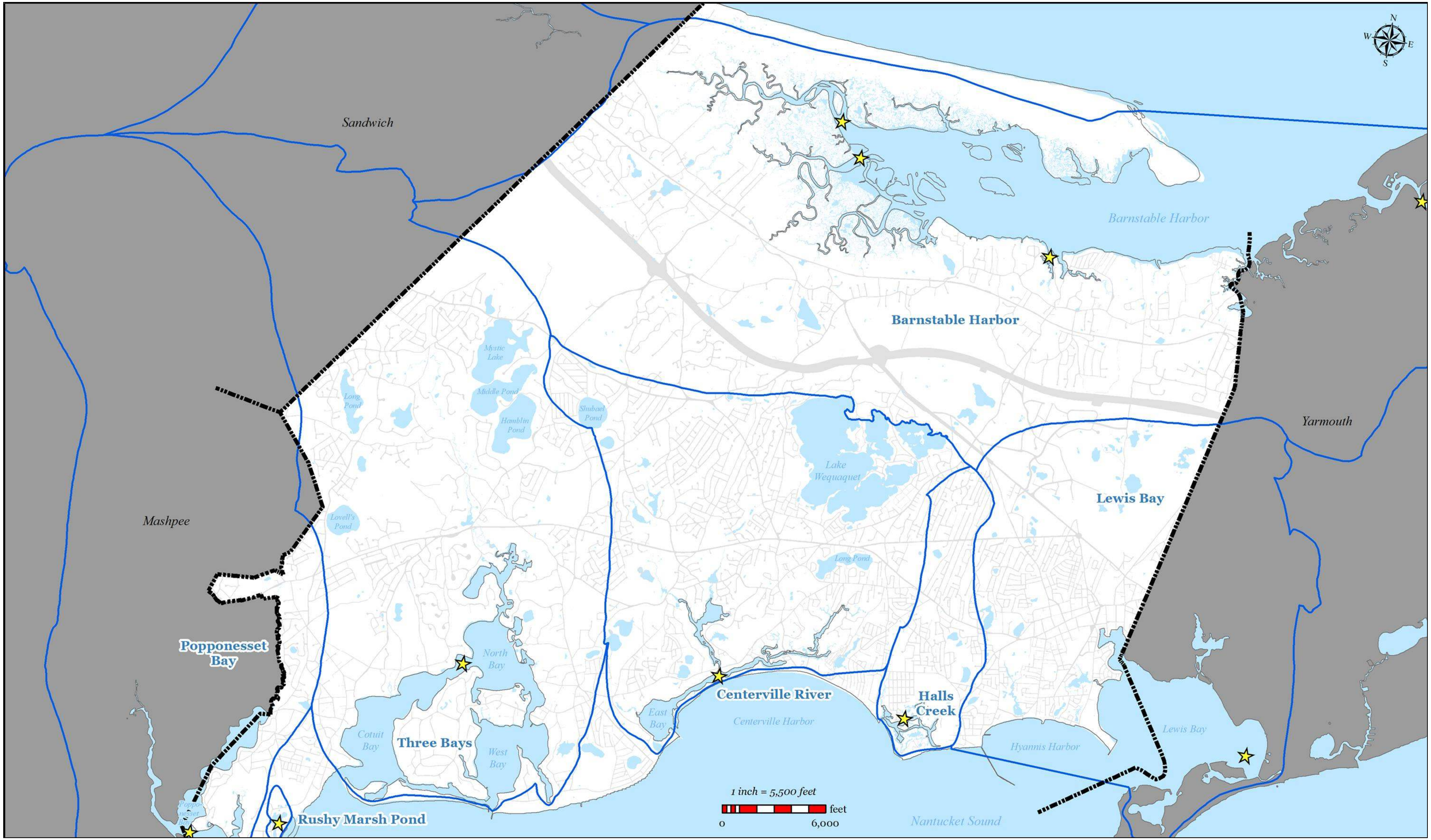

Figure 2-11: Sentinel Stations

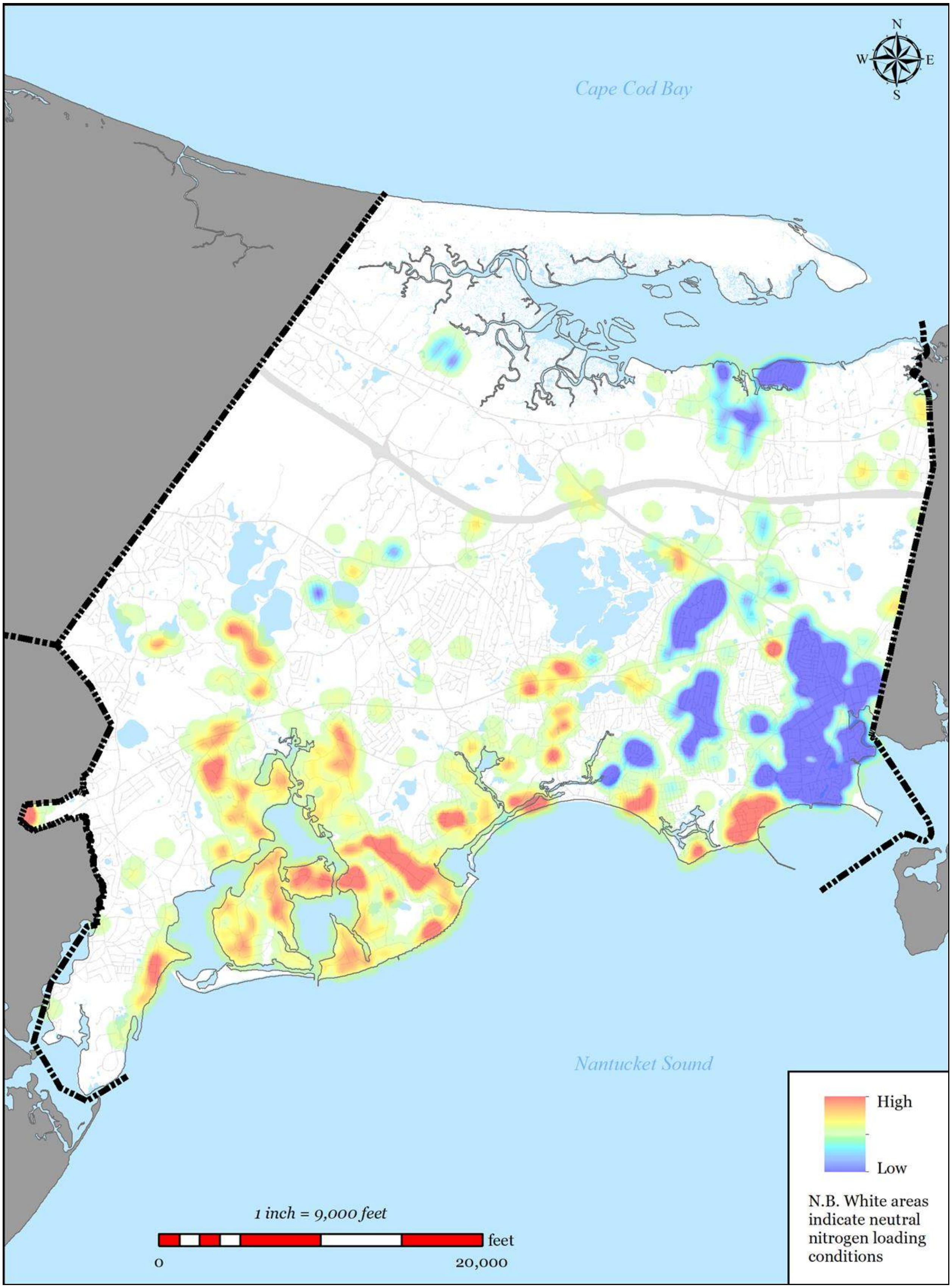

Figure 2-12: Nitrogen Loading Hotspots.

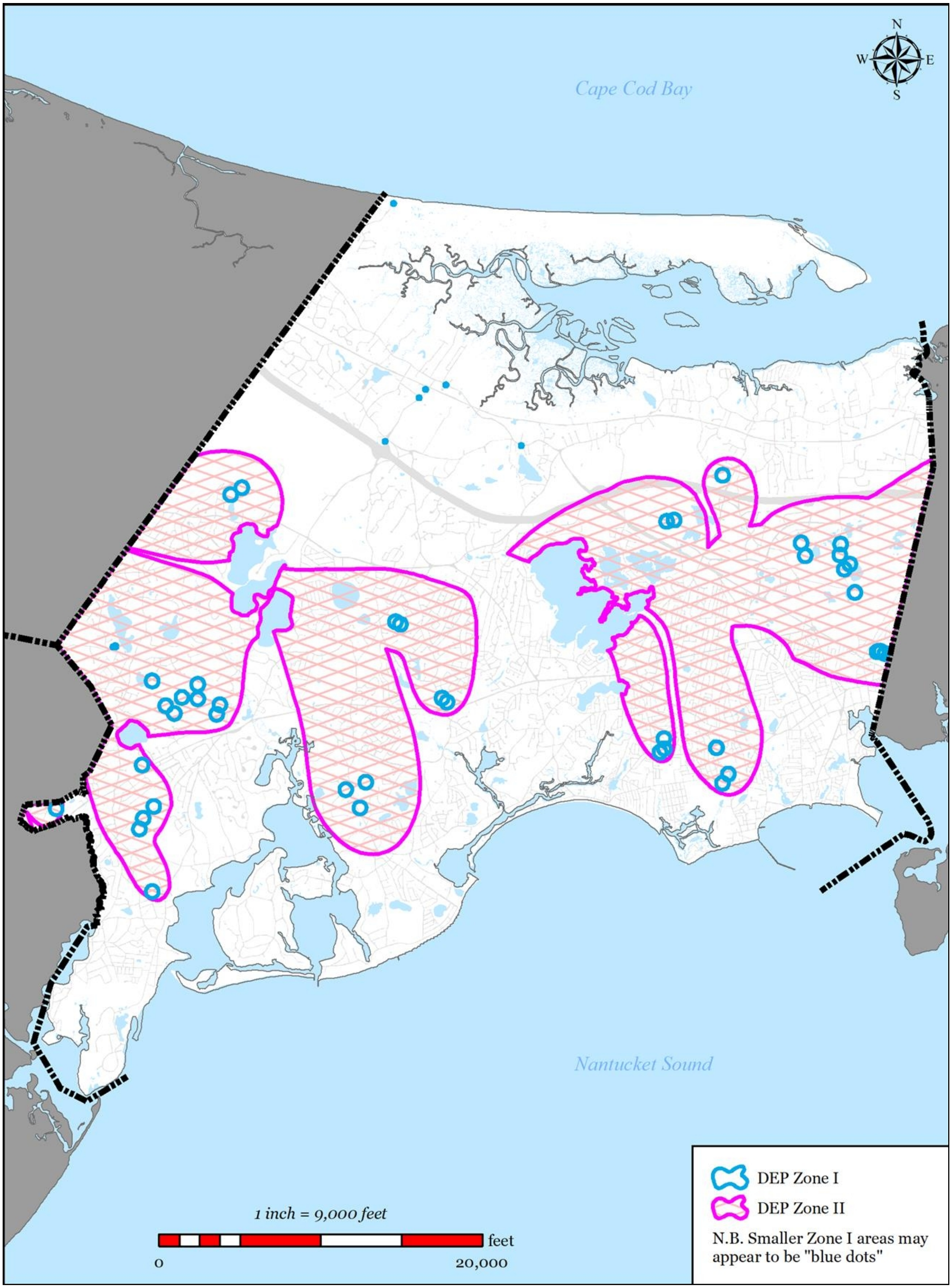

Figure 2-13: State-designated Wellhead Protection Areas

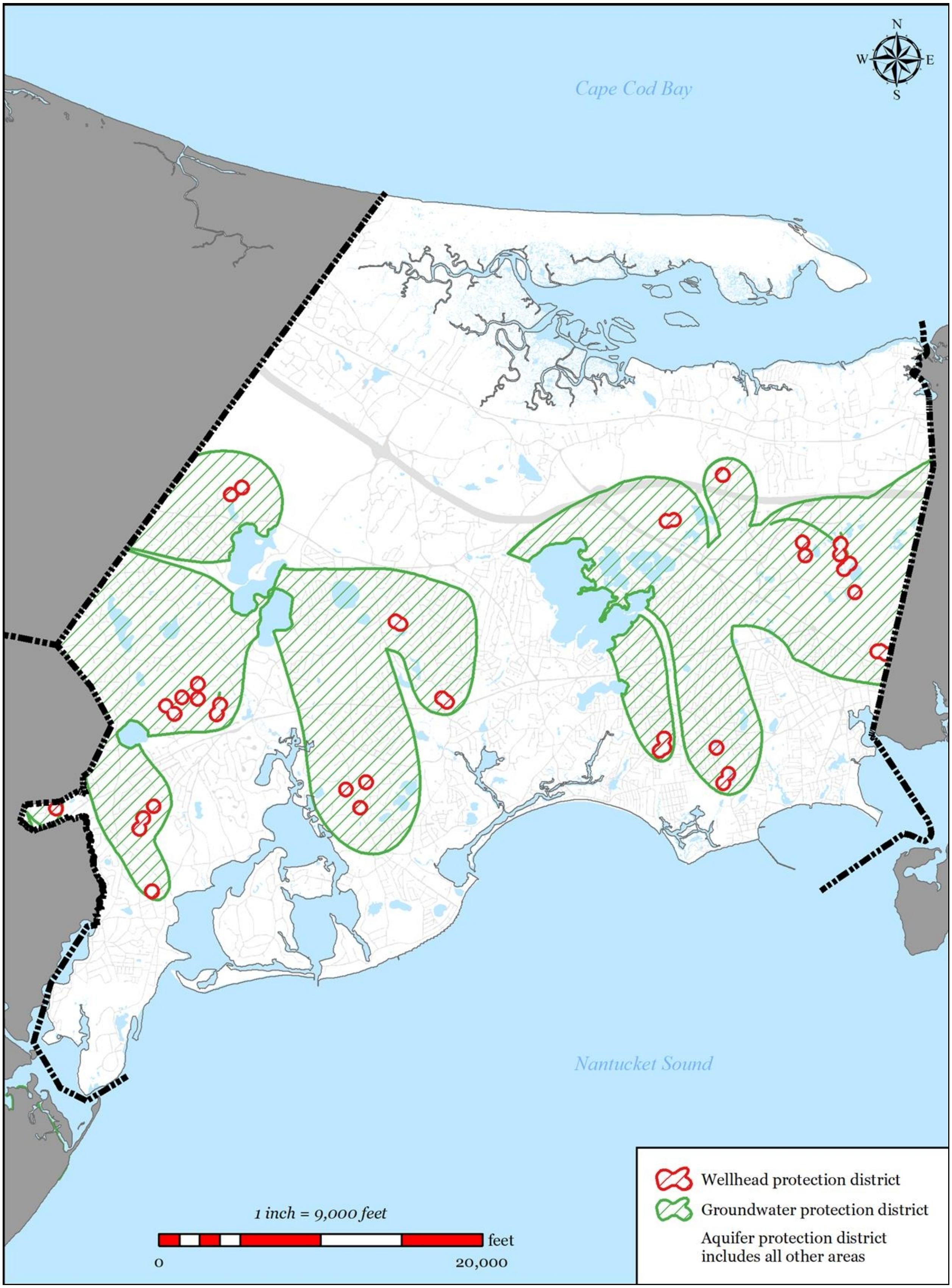

Figure 2-14: Town of Barnstable Groundwater Protection Overlay Districts

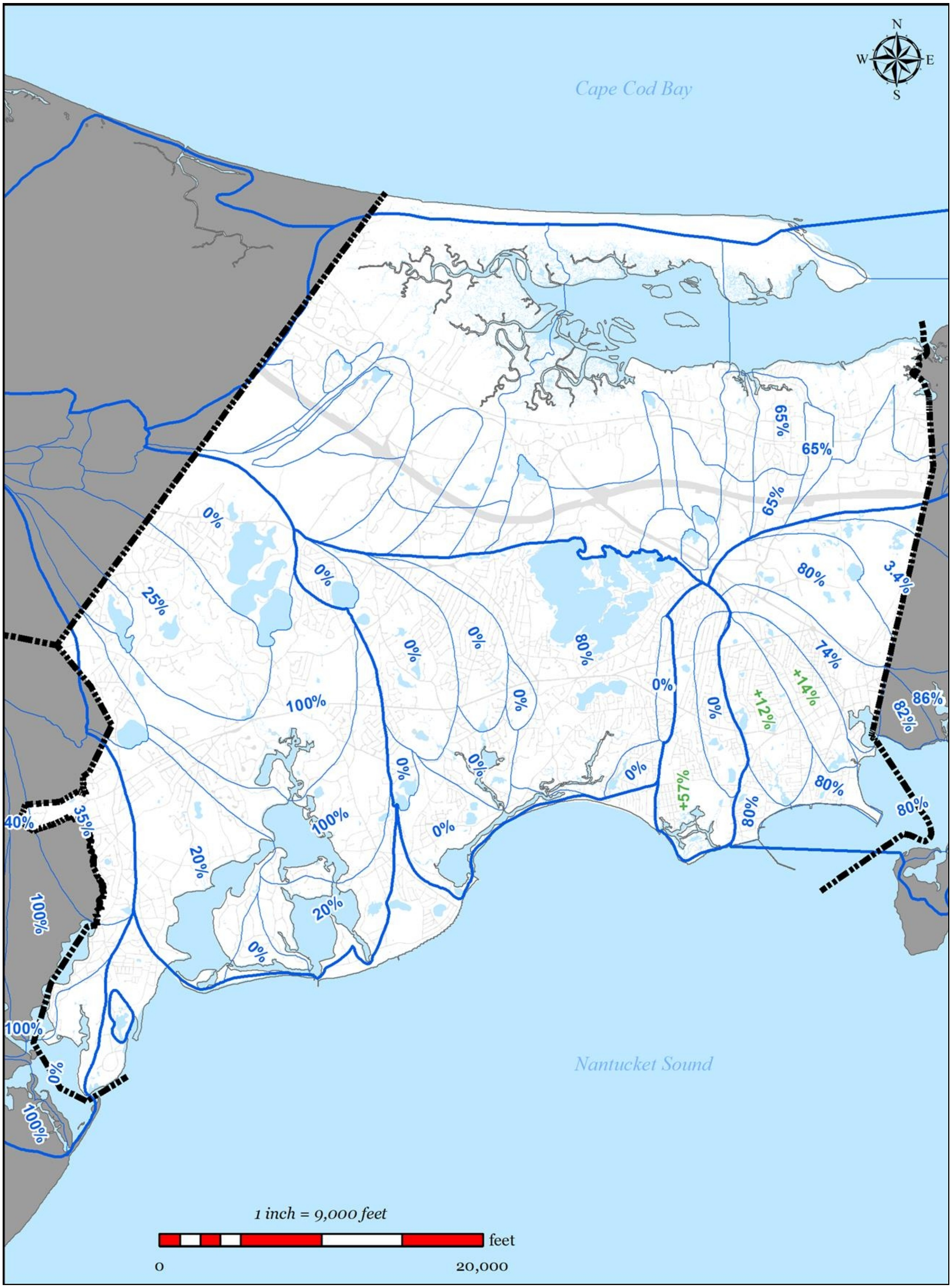

Figure 2-15: MEP Modeled Existing Target Septic Load Removal

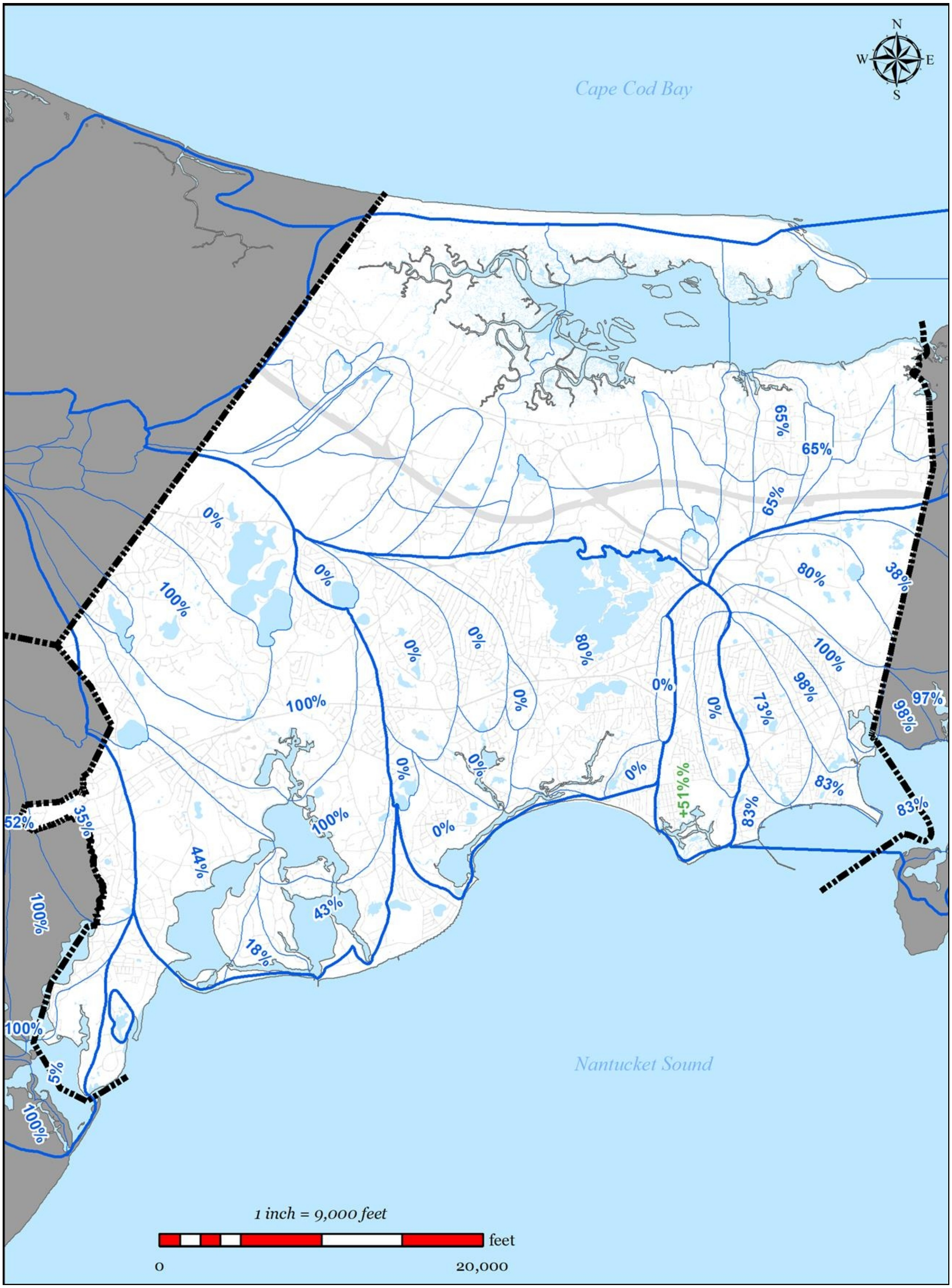

Figure 2-16: MEP Modeled Future Target Septic Load Removal

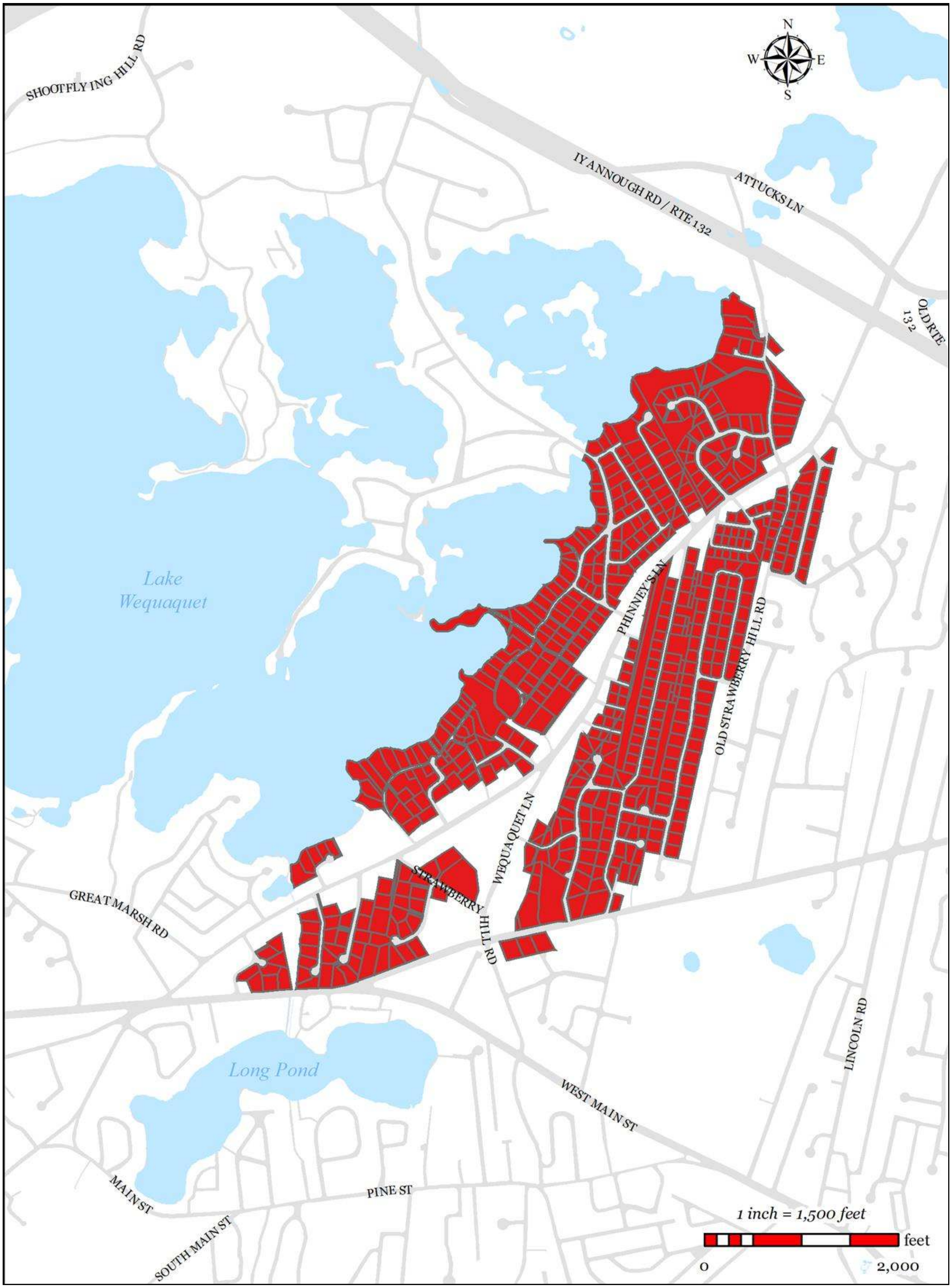

Figure 2-17: Phinney's Lane Sewer Expansion Project

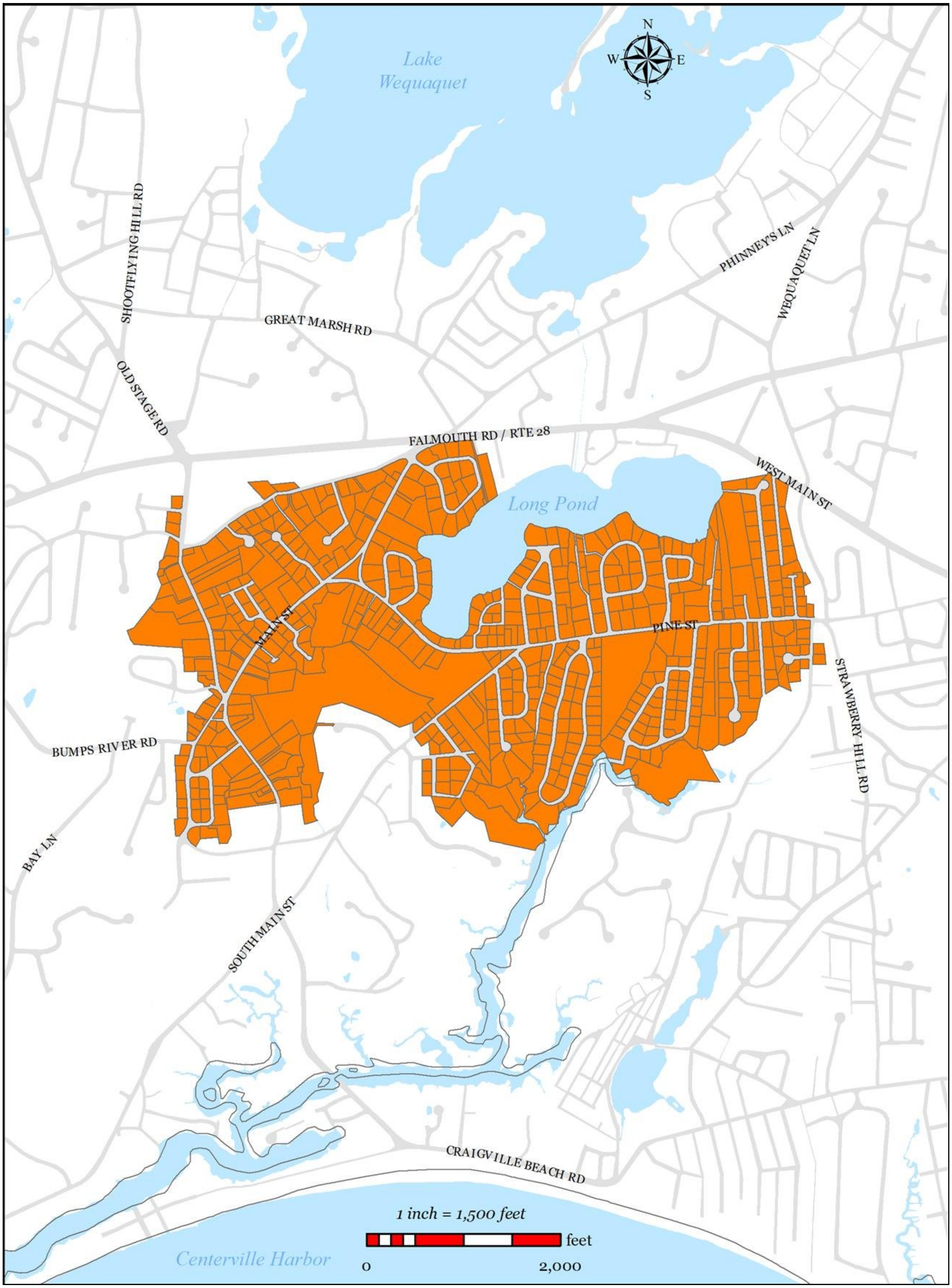

Figure 2-18: Long Pond Sewer Expansion Project

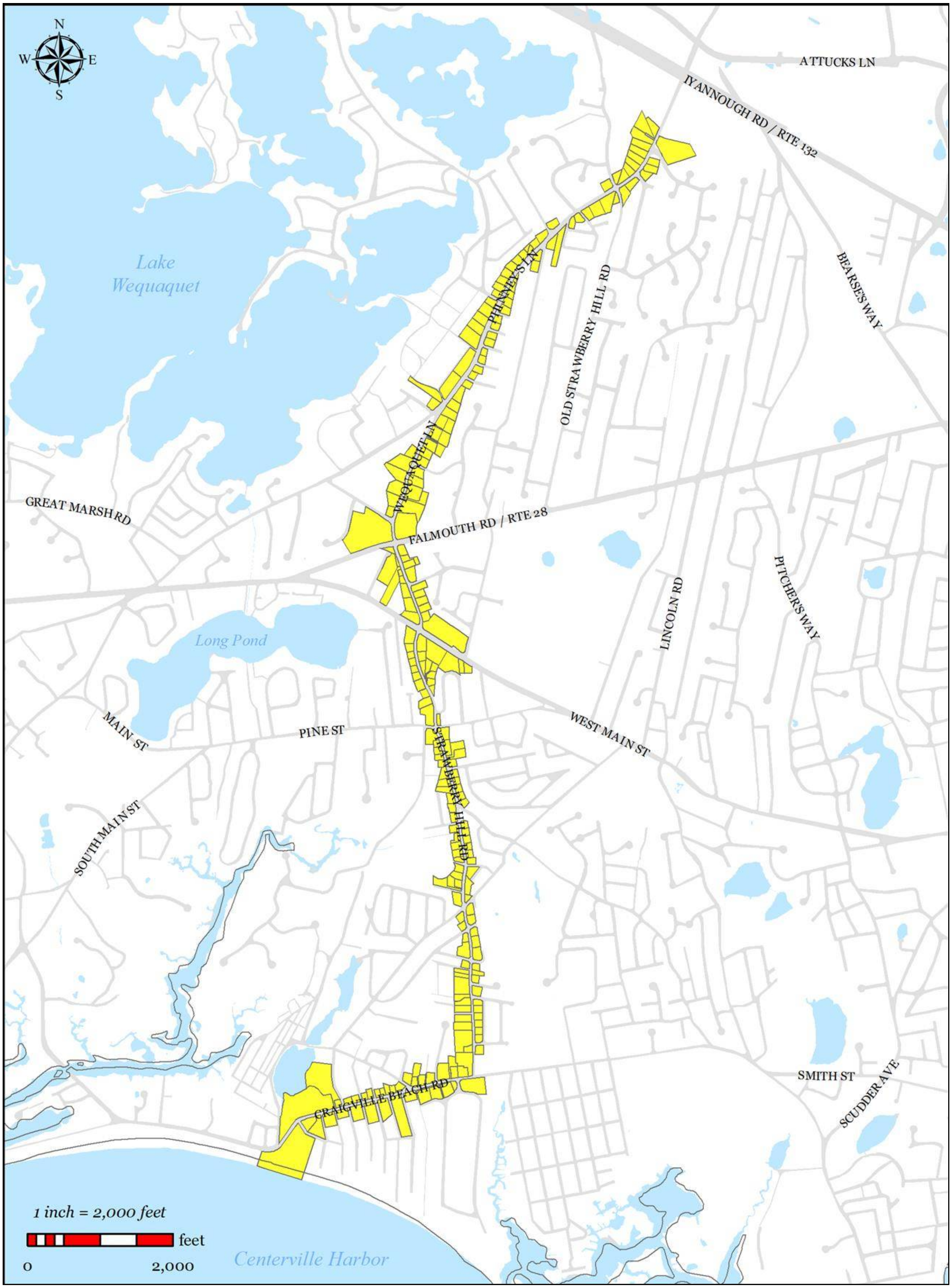

Figure 2-19: Strawberry Hill Road Sewer Expansion Project

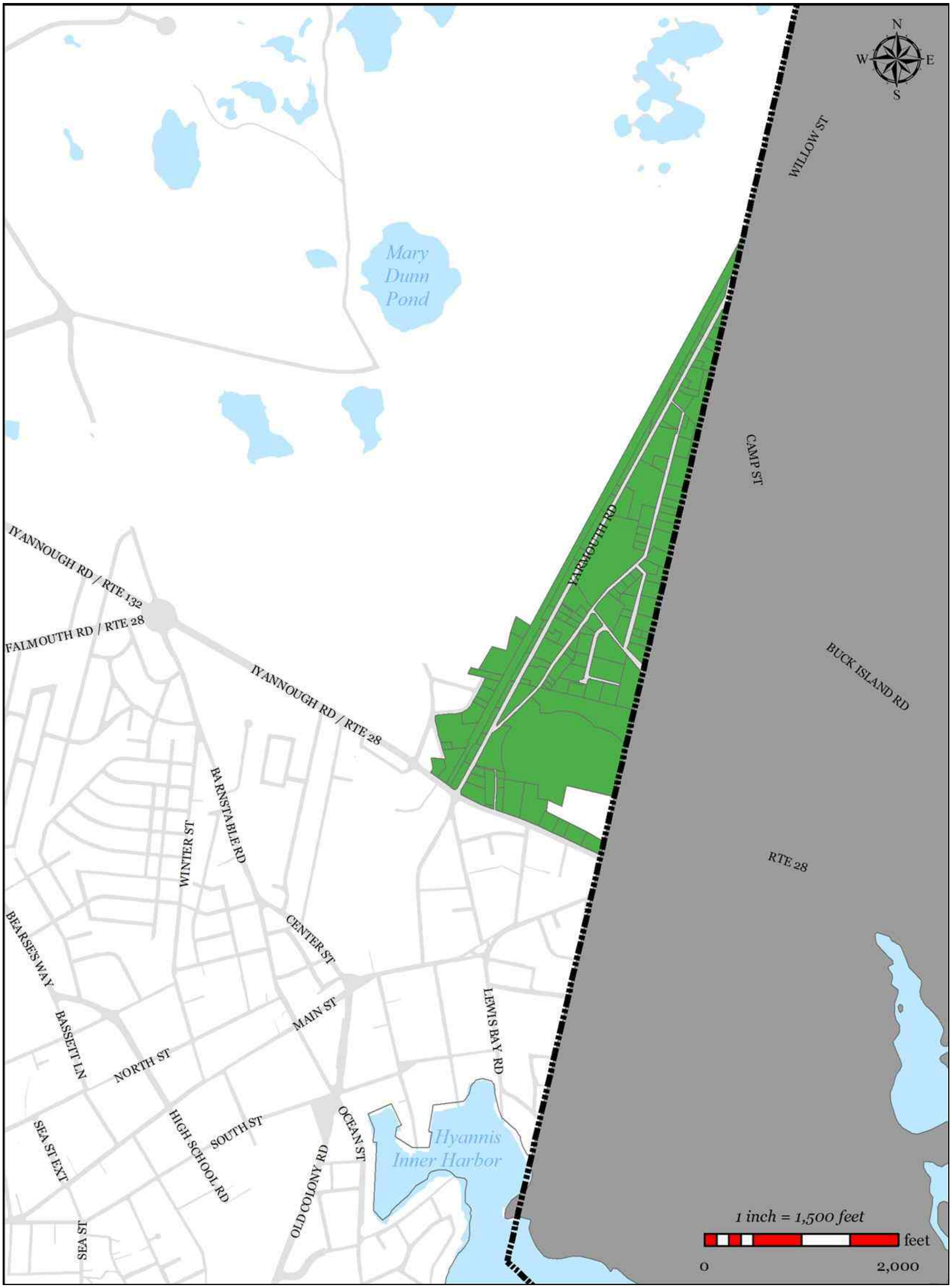

Figure 2-20: Old Yarmouth Road Sewer Expansion Project

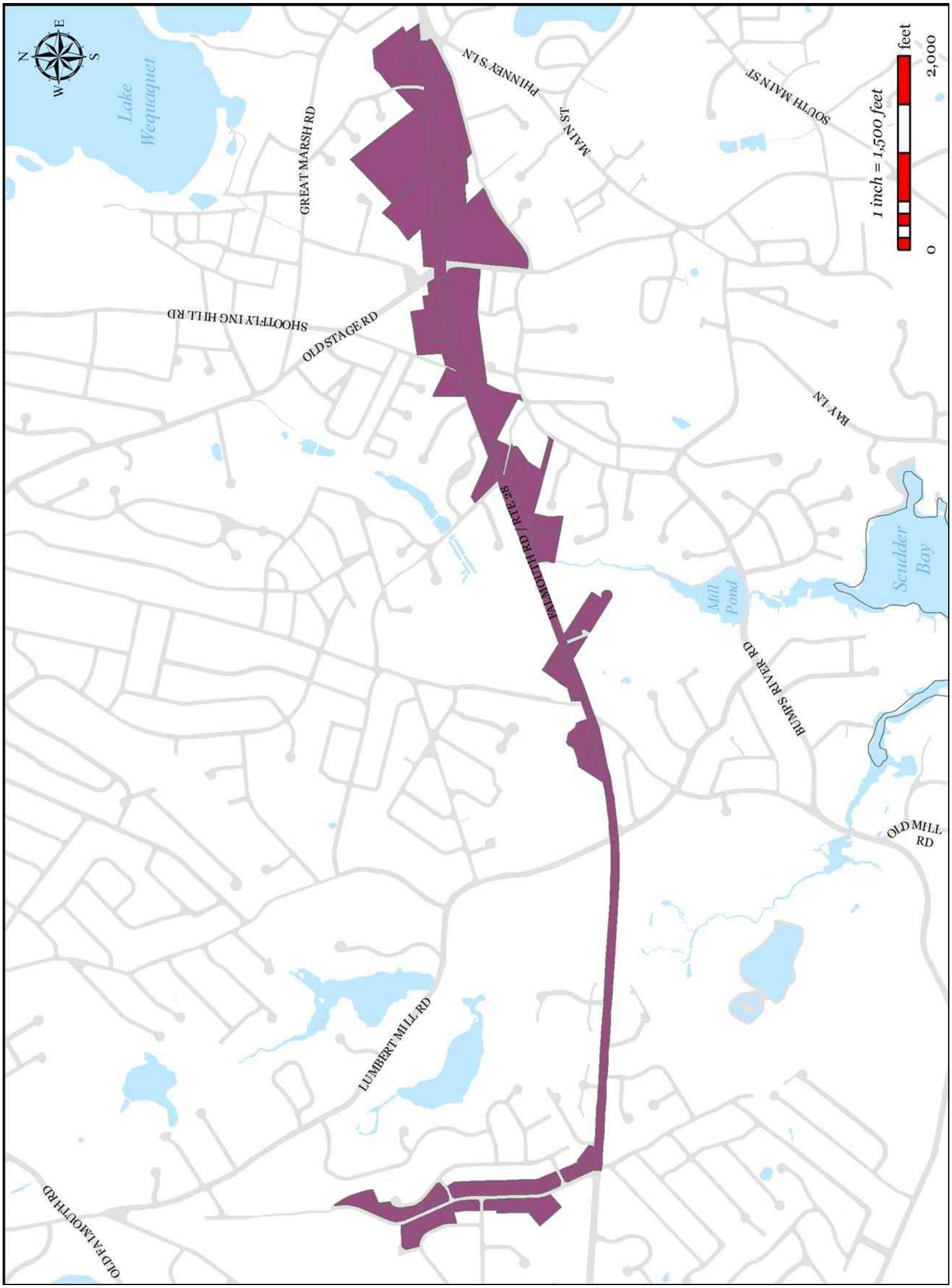

Figure 2-21: Route 28 Centerville (MMWWTF Transition) Project

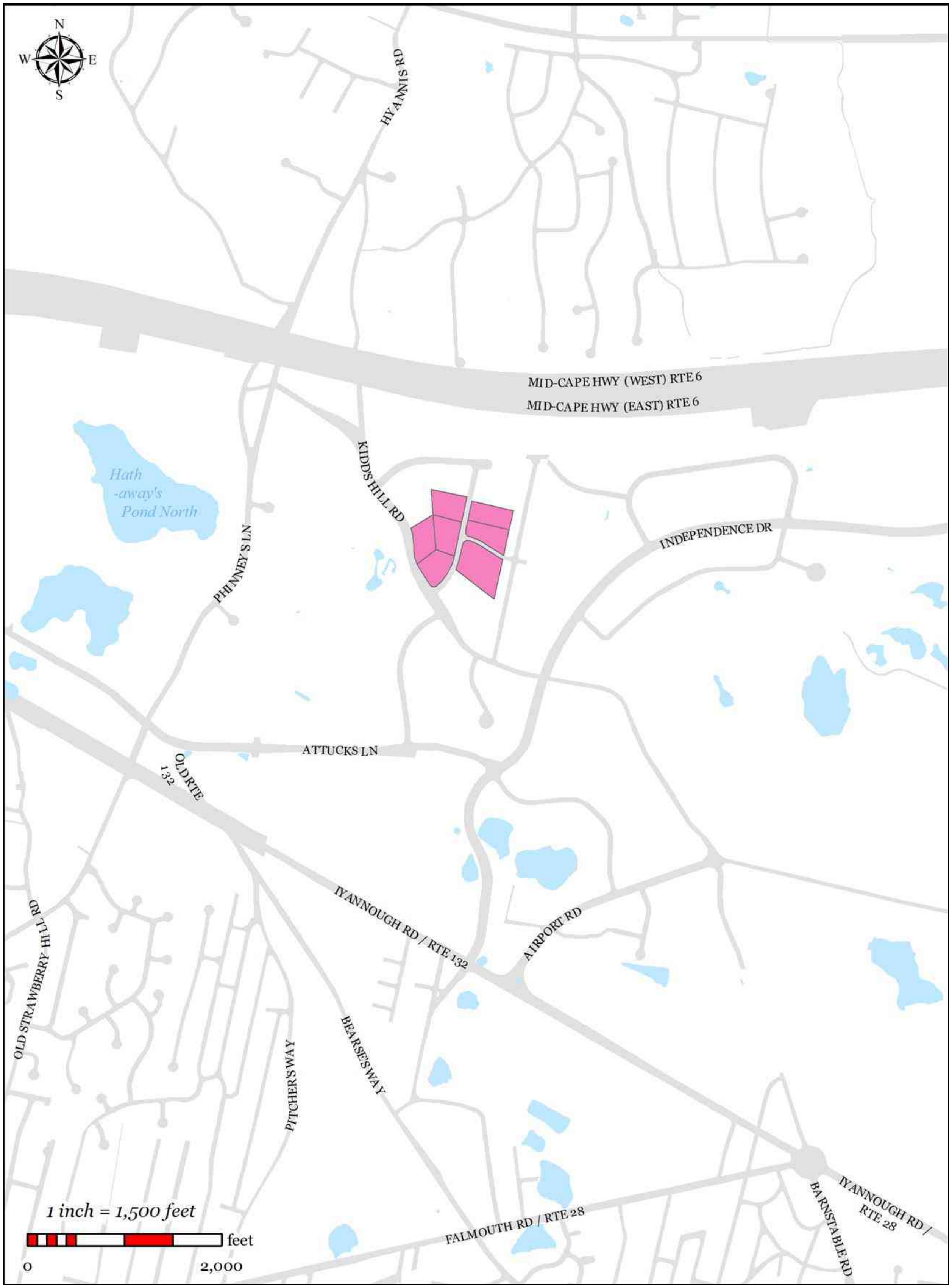

Figure 2-22: Merchant's Lane Sewer Expansion Project

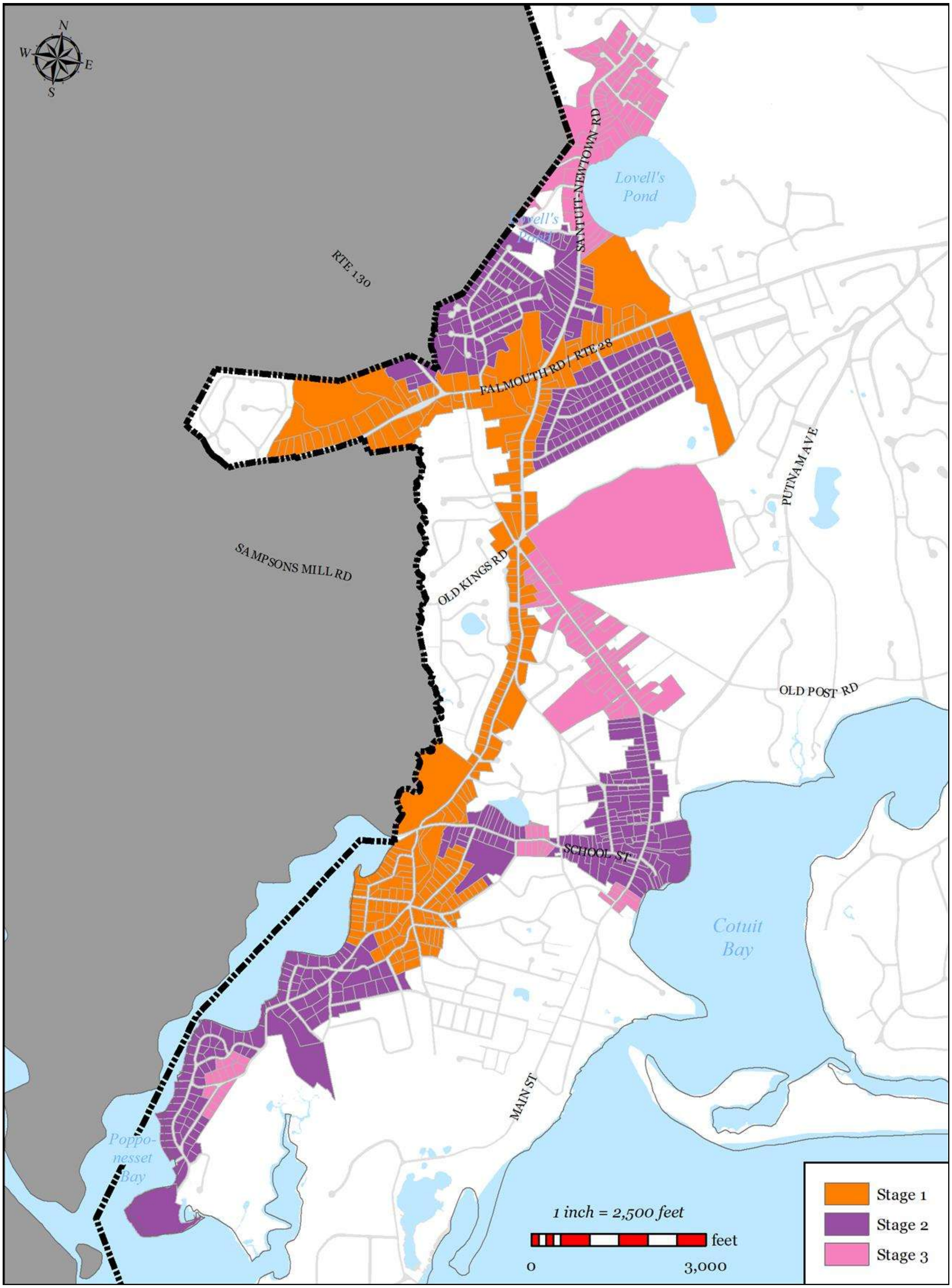

Figure 2-23: Cotuit Sewer Evaluation / Cotuit "Staging" Plan

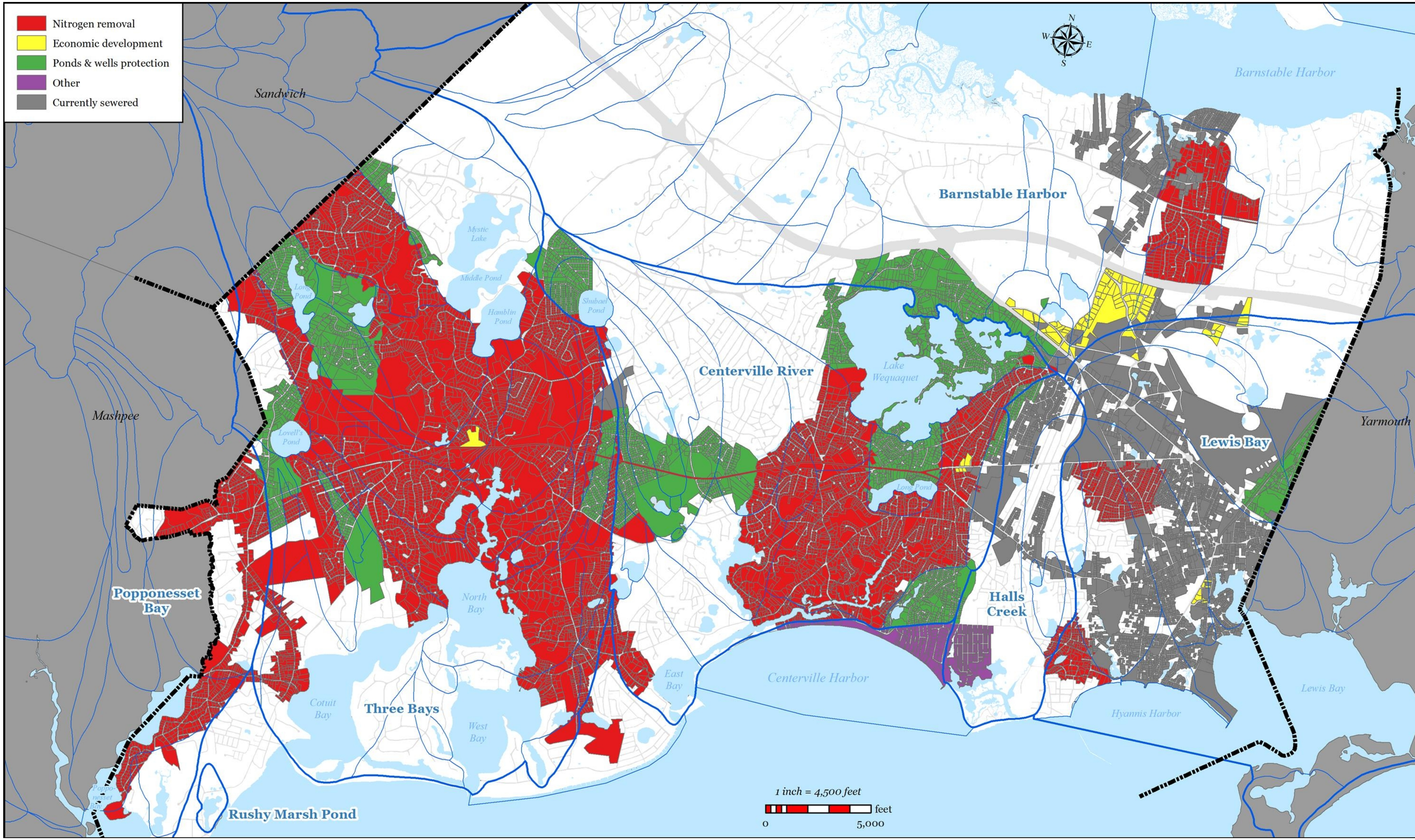

Figure 2-24: Wastewater Needs Areas

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3 EVALUATION OF TECHNOLOGY ALTERNATIVES

This section addresses the Identification, Screening, and Evaluation of Alternatives Phase of the CWMP process. As previously noted, Chapter 4 of the Cape Cod Commission's 208 Plan did a complete examination of the potential technologies, relevant to Cape Cod, that address wastewater needs. The chapter outlines expected nitrogen removals of the identified technology, their related costs, installation considerations, advantages, and disadvantages. The Town used that information during its planning to make decisions on its plan. As a result, rather than creating a new document on the subject, this section will refer to the 208 Plan (see Appendix A) and highlight some of the technologies that are incorporated in to the plan.

3.1 SUMMARY OF CAPE COD COMMISSION 208 PLAN CHAPTER 4

The 208 Plan is a watershed-based approach that deploys regulatory reforms, innovative strategies, and community-wide processes to mitigate nitrogen pollution. "Chapter 4: Nutrient Mitigation Technologies and Policies" of the 208 Plan, explains the different technologies, tools, policies, and approaches that can help restore water quality. The following sections describe the technologies that have been considered in the development of the plan.

3.2 TRADITIONAL TECHNOLOGIES

Traditional wastewater technology includes the following components:

- Collection of the wastewater from more than one property;
- Conveying that wastewater to a facility(s) that can treat it;
- Treating the wastewater to eliminate the aspects of it that will have negative effects on public health or the environment; and
- Disposing of that wastewater in an appropriate manner.

These components apply whether one is considering a multi-property septic system or the largest wastewater treatment facility. A quick discussion of each follows.

3.2.1.1 COLLECTION OF WASTEWATER

A wastewater collection system consists of a series of pipes which collect wastewater from individual properties. Wastewater flows from the home/business to the street via a sewer service connection. Usually these are the homeowner's responsibility at least to the edge of their right-of-way, but sometimes all the way to the sewer mains that are located in the street. The sewer mains are owned by the municipality, and are installed so the wastewater will be moved along by either gravity, under pressure (low pressure sewer which requires a small pump at every property), or via a vacuum. The Town of Barnstable has all three types of sewer main piping within its existing collection system, and as a result has formed a strong preference for gravity collection systems whenever possible. The Town experience is that the vacuum sewer is not reliable, and is limited in terms of expansion. Low pressure sewers are problematic as they too are limited in terms of expansion, and they require each property owner to have a small grinder pump on site. The responsibility for maintaining those pumps, particularly during power outages, has been the source of friction in the past. Gravity systems have the capability to be expanded, are relatively problem free, and do not require property owners to own mechanical equipment that could be argued are part of the collection system.

With a gravity system, when the collected wastewater reaches a low point in the neighborhood, it will need to be pumped up to where it can freely flow by gravity again. This is accomplished with pump stations. Pump stations range in size, but include an underground tank for the wastewater to collect in and pumps and controls that will push that wastewater uphill through pressurized pipes (force mains) to the next gravity section. There are multiple types of pump stations; each with its own niche, though there is some overlap between them. All will have multiple pumps (to ensure redundancy), control systems, and in Barnstable, backup power on site.

3.2.1.2 CONVEYING WASTEWATER

Once in the sewer mains, the wastewater must be transported from the neighborhood to the treatment facility. In the case of a communal septic system that may be within the same neighborhood, conveyance is effectively part of the collection process. However, in other situations – such as is planned for the neighborhoods in the Three Bays Watershed - treatment can be multiple miles away (over five miles in Three Bays case) from the neighborhood. Conveyance is generally accomplished using a series of pump stations and gravity mains which take up multiple neighborhoods collection systems flows and transport them to the wastewater treatment facility.

It is often believed that the largest expense in installing a wastewater system is in treatment, however typically collection and conveyance represents up to 75% of the total capital construction costs for the system.

3.2.1.3 TREATING WASTEWATER

Traditional wastewater treatment is used to eliminate the aspects of the wastewater that will have negative effects on public health or the environment. There are lots of options regarding wastewater treatment, with choices being informed based on the required size and scale and what one is trying to eliminate from the wastewater.

In Barnstable's case, the community already has a wastewater treatment facility, and it is the Town's intention to use that facility, expanding it as necessary, to treat as much of its wastewater as makes practical sense.

3.2.1.4 DISPOSING OF TREATED WASTEWATER (EFFLUENT DISPOSAL)

Once the wastewater is collected, conveyed to the wastewater treatment plant, and treated, it must then be disposed of or put to productive use (reuse). The Town's existing wastewater plant disposes of the wastewater via sand beds that are located on the same grounds as the plant. Though the plant is permitted to treat up to 4.2 MGD, it is currently limited in what is can dispose of to 2.7 MGD (max day) pending the outcome of the effluent disposal study discussed in Sections 2.2.2.1.3. Ultimately it is expected that mitigating measures will be found to allow the Town to dispose of all of its treated wastewater either at the wastewater treatment plant site or others.

3.2.2 NON-TRADITIONAL TECHNOLOGIES

The following sections describe non-traditional technologies that have been considered in the development of the plan. As discussed in Section 2.3.2, the focus area for the implementation of non-traditional technologies is the Three Bays Watershed.

3.2.2.1 AQUACULTURE

The growing and removal of mature shellfish can help remove nitrogen from an estuary. Shellfish do not absorb nitrogen directly from their environment; rather they feed on naturally-occurring phytoplankton, which use dissolved inorganic nitrogen to grow. Thus, shellfish incorporate nitrogen from their food into their tissues and shells. When shellfish is harvested, the accumulated nitrogen is removed from the water.

Shellfish also play an important role in the cycling of nutrients, including nitrogen. They release nitrogenous waste that can be used by phytoplankton as a source of nitrogen. In addition, some of the nitrogen filtered from the water by shellfish is deposited to the sediment as feces and pseudofeces (rejected food particles). These bio-deposits are decomposed by bacteria, which transform the nitrogen to a variety of other forms, including ammonium (NH4+), nitrate (NO3-), and nitrogen gas (N2).

In addition to contributing to water quality improvements, additional aquaculture could provide economic benefits to Cape Cod. The Town of Barnstable has 61.66 of shellfish grant acreage within Three Bays and Cotuit Bay. The Town is currently looking at Warrens Cove as a prospective aquaculture nursery. Warren’s Cove currently is not appropriate for aquaculture due to silt. Dredging Warren’s Cove back to a sandy bottom may allow the Town to establish aquaculture nurseries. The Cape Cod Commission estimates that aquaculture beds/floating racks can remove 8-15% of the nitrogen they encounter.

3.2.2.2 FERTIGATION

Fertigation consists of captivating nitrogen enriched groundwater with wells and using it to irrigate plants. Fertigation wells can capture nutrient enriched groundwater and recycle it back to irrigate and fertilize turf grass areas such as golf courses and athletic fields. Fertigation can reduce nutrient loads to down gradient surface waters while reducing fertilizer costs to irrigated areas.

3.2.2.3 CONVERSATION OF CRANBERRY BOGS

The headwaters of the Marstons Mills River contain approximately 150 acres of cranberry bogs. The Town believes that the abandoned bogs could play a vital role in reducing the nitrogen load in the Three Bays watershed. The following treatments of the bogs could help reduce the amount of nitrogen flowing into the Marstons Mills River:

- Conversion to ponds (Approx. 50%)
- Conversion to wetlands (TBD)
- Installation of floating wetlands (Approx. 8-15%)

3.2.2.4 ALTERNATIVE TOILETS

In any wastewater plan, one of the hardest items to quantify and address are the potential future flows from either new development, or redevelopment, of existing parcels. An approach to that issue is code changes that require alternative toilets (or I/A septic systems) for structures that are located in nitrogen sensitive areas that are not served by a sewer collection system. Alternative toilets (such as urine diverting (UD) toilets and composting toilets) are potential means of reducing both wastewater flows and pollutant loads. It has been hypothesized that human urine typically contributes about 80% of the nitrogen and 50% of the phosphorus in household wastewater, yet only around 1% of its volume. UD toilets are designed to capture these nutrients via urine, and segregate it from the remaining waste stream (which could facilitate resource recovery). Composting toilets collect all the waste (not just urine) rely on aerobic bacteria and fungi to naturally degrade and convert the wastes into compost. This generally happens in sealed units that are usually located in a structure's basement. While there are some significant benefits from these technologies, they have traditionally not gained enough public acceptability to be widely used. One of the significant stumbling issues has been that in existing properties they generally require significant re-plumbing, which can be expensive and disruptive. However, this issue is avoided on new construction where the systems are installed as the structure is being constructed.

3.2.2.5 ALTERNATIVE SEPTIC SYSTEMS

Innovative/alternative (I/A) septic systems may be used in areas where sewers are not anticipated, but where nitrogen reduction is warranted. Prior to being permitted for use, each type of system undergoes a three-phase approval process (Piloting Use, Provisional Use, General Use) to ensure performance at levels at least consistent with Title 5. During the approval process, limited numbers of each type of system may be installed under strict siting and flow conditions and extensive monitoring. Title 5 regulations include special requirements for installation, monitoring, and maintenance of these systems. Systems achieving Remedial Use approval are allowed solely to replace a failed system where a conventional system could not be sited and where there will be no increase in design flow.

3.2.2.6 DREDGING

Ponds and lakes naturally play an important role when it comes to decreasing the levels of nutrients in water. Freshwater and estuaries store nutrients within their sediments. As ponds age, they accumulate years of organic material, nutrients can be released into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and nutrients, helps reduce these nutrients from the water body and the watershed.

The Town is currently utilizing techniques like dredging for the rehabilitation of Mill Pond. Mill Pond is located between Route 28 and 149. Sediment has been gradually filling the pond over the past four centuries, and currently has up to 9 feet of silt and sand. Dredging the pond back to its original depth will give back its capacity to reduce the nitrogen concentrations.

Dredging of marine areas ensures safe access for navigators, as well as assisting in maintaining adequate tidal flushing. Tidal flushing maintains salinity levels, dissolved oxygen levels, and provides adequate nutrient exchange between embayments and the ocean. The Town is currently utilizing dredging to improve tidal flushing in the Three Bays (Sampson's Island Dredging Project) and has previously experienced modest improvements in water quality within the Centerville River after maintenance dredging.

3.2.2.7 PERMEABLE REACTIVE BARRIERS (PRBS)

An alternative to treating nitrogen on site or at an off-site treatment facility is to intercept nitrate in groundwater at the coastline before it enters an embayment. A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. As groundwater flows through the medium, microbes naturally occurring in the groundwater consume the carbon source, as well as oxygen, developing an anoxic environment. This process releases nitrogen gas to the atmosphere, reducing the groundwater nitrogen load before reaching the estuary.

3.2.3 MANAGEMENT SOLUTIONS

There is no one solution that addresses all the wastewater issues being experienced by Barnstable. Rather it will take a mix of solutions to achieve the Town's goals including traditional solutions, nontraditional solutions, and "management solutions". This last category, management solutions, includes a variety of approaches, all of which are related in their attempt to reduce the quantity and strength of the wastewater reaching the environment either by rules (zoning, ordinances, regulation, etc.) or by education and changing public behavior (flow and load reduction, storm water practices on private property, septic system improvements). In this section a number of those approaches will be introduced and discussed. Many of these are also discussed in Section 4 of the Cape Cod Commission's 208 Plan (see Appendix A).

3.2.3.1 REDUCTION OF FLOWS

One of the easiest and probably most cost effective ways to address wastewater is via reduction of the flows and loads that come from each of our homes, businesses, and municipal facilities. However, this also is a difficult approach to verify and enforce. Wastewater flows are the volumes of wastewater generated from our usage of toilets, sinks, showers, dishwashers, laundry units, etc. within our properties. It is generally measured as flow over a given time period, and usually expressed in units such as gallons per day (gpd). Wastewater loads are the quantities of pollutants (food waste, soaps, hormones, organic carbon, grease, human waste, etc.) contained in the wastewater. It usually is measured in mass-per-time units such as pounds per day. A brief summary of flow reduction strategies is provided below.

Reduction in water use can be implemented by requiring low-flow plumbing fixtures and/or progressive water pricing. While flow reduction does not reduce the nutrient load (or other contaminates of concern) within the wastewater, it does equate to less water that needs to be pumped, piped and treated; or that has to be addressed by a septic system. Additionally, it saves on source water having to be withdrawn from the ground in the first place. Low-flow plumbing fixtures (sinks, showers, toilets, and appliances) are available and can reduce water consumption without having to radically change behavior. Progressive water pricing charges fees based on the size of the service and quantity of water used - the larger the service connection, the higher the quarterly fee and the higher the water use, the higher incremental cost. This should be an incentive for property owner to reduce their water consumption, and its resulting wastewater flow. An additional progressive water pricing strategy would be to adjust rates seasonally, based on historic demand. As an example, during summer season when demand is highest, raise the rates which would provide economic incentives to reduce water consumption (and the associated wastewater generation).

3.2.3.2 LAND USE MANAGEMENT AND ZONING

Land use management and zoning is important as it can dictate the quantity of future flows that needs to be addressed by the wastewater plan. This is important as the proposed nitrogen removal percentages required in the watershed is the percentage of existing flows that needs to be removed. It is assumed that, 100% of all future flows must also be removed as well, which can be significant. Additionally, many communities have used the on-site wastewater restriction and rules as default zoning and growth regulations/restrictions; however, these are no longer applicable if sewers are provided to an area. Massachusetts State Sanitary Code, Title 5 (310 CMR 15.00) establishes maximum onsite flows based on residential bedroom count (110 gpd/bedroom), and different kinds of commercial uses. Title 5 also sets flow criteria for nitrogen-sensitive areas, limiting flow to 440 gallons per day per acre or four bedrooms on a one-acre lot. So, land use management and zoning needs to be considered in wastewater planning from two perspectives. Those two perspectives are:

1. Areas that are already developed, and which will now have sewers, will no longer have the check on growth that was provided by on-site system, and Title 5 regulations.
2. Areas that are not yet developed, where the Town does not want growth and wants to limit nutrient impact, can be zoned in such a way as to discourage that growth from occurring in the first place. This will prevent the need to provide future wastewater solutions and reduce total scope and cost of the Town's plan.

As such, the community may wish to install a variety of regulatory and land use planning tools to manage growth in the absence of Title 5. These include building regulations, zoning changes that direct growth to specific areas, and providing improved wastewater treatment methods when dealing with non-conformities. They also can include regulations that stipulate the amount of nutrients and flow allowed by on-site septic systems. Prudent use of these tools can help ensure that TMDLs can be met now and in the future, that sewer capacity is efficiently directed to those areas where greater intensity of land use is desirable, and that natural resource areas are protected.

3.2.3.3 FERTILIZER MANAGEMENT

By many accords, the second largest controllable nitrogen source impacting our environment is from the fertilizer used on lawns, golf courses, and recreational areas. The Massachusetts Estuaries Project estimated about 10% of the nitrogen harming our estuaries comes from fertilizer. To address this issue the Town of Barnstable implemented its own fertilizer control regulations. Chapter 78, of the Town Code, is titled *Fertilizer Nitrogen and Phosphorus Control*, outlines those regulations (see Appendix PP). The enforcement responsibility for this falls to the Town's Board of Health, through its Director of Public Health, with the exception of § 78-5B(4) and (8), which will be enforced by the Town's Conservation Commission.

3.2.3.4 SEPTIC SYSTEM MAINTENANCE

The Town should continue to encourage proper septic system maintenance with regard to septage pumping. While proper septage management will not reduce the nitrogen or phosphorus load to the watershed, it will preserve the life of an existing Title 5 system. This measure should be encouraged for all properties which continue to utilize on-site systems.

4 FORMULATION AND DEVELOPMENT OF THE RECOMMENDED PLAN

As discussed in the Department of Environmental Protection's (DEP), GUIDE TO COMPREHENSIVE WASTEWATER MANAGEMENT PLANNING, released in January 1996, "The comprehensive wastewater management planning process is the process whereby current and future wastewater needs are evaluated, wastewater management alternatives are developed which will meet these needs, and a final plan is chosen through careful comparison and evaluation of the alternatives. The process must include the necessary steps in ensuring that the planning effort results in the most cost effective, environmentally sound wastewater management plan." This section will describe how the Town of Barnstable developed its plan.

4.1 WATER RESOURCES ADVISORY COMMITTEE (WRAC), AND THE PLANNING PROCESS

As was previously discussed, the plan, which is documented in this report, was created by the Town's Town Council appointed Water Resources Advisory Committee (WRAC), the Department of Public Works (DPW), and other Town staff members. WRAC members included:

- Councilor Frederick Chirigotis
- Councilor John Norman
- Councilor John Flores
- Lindsey Counsell (served as the Committee Chair)
- Michael Moynihan (served as the Committee Vice Chair)
- Phillip Boudreau
- Casey Dannhauser
- Fred Dempsey
- Ed Eichner
- Farley Lewis
- George Zoto

The WRAC's work, and the subsequent planning efforts, was supported by a number of DPW and Town staff members. Those included:

- Mark Ells, Town Manager
- Andrew Clyburn, P.E., Assistant Town Manager
- Daniel Santos, P.E., DPW Director
- Mark Milne, Finance Director

- Elizabeth Jenkins, Planning and Development Director
- Rob Steen, P.E., DPW Assistant Director
- Griffin Beaudoin, P.E., Town Engineer
- Amanda Ruggiero, P.E., Assistant Town Engineer
- Andrew Boule, Water Pollution Control Supervisor
- Matthew Sumner, Engineering Records and Assets Manager
- Miroslav Jakubicka, Engineering Designer
- Dale Saad, Ph.D., Senior Project Manager – Special Projects
- Casey Scrima, Engineering Aide I
- Cynthia Lovell, Administrator to the Town Council
- Jim Benoit, GIS Manager

A number of guiding principles were utilized to steer the planning process. They included the following.

- The plan should be Town-wide and address all the categories of wastewater needs that are listed below. However, regulatory requirements (TMDLs) for nitrogen removal took priority.
  - Sanitary Needs
  - Convenience and Aesthetics
  - Protecting Groundwater and Water Supplies
  - Protecting Surface Waters
  - Enabling Sustainable Economic Growth
- Previous wastewater planning efforts, where applicable, should be used to inform the plan.
- The Cape Cod Commission 208 plan was a valuable resource for planning. It identified the portion of a watershed's nitrogen removal that was the Town's responsibility; and Section 4 (of the 208 Plan) identified potential treatment technologies and their associated removal percentages.
- The existing Water Pollution Control Facility, and collection system technologies, should be leveraged to the fullest extent possible.
- Regional solutions and potentially "nitrogen trading" could have benefits and should be fully explored and considered.
- To the extent possible, new effluent disposal should not be sited within Zone IIs or nitrogen sensitive watersheds.
- Appropriate phasing of the plan should facilitate adaptive management, sound fiscal policy, and allow for future technology/regulatory changes to be incorporated into the plan as they are encountered
- The plan should consider all types of solutions: Traditional (sewers, etc.), Nontraditional (UD toilets, fertilizer plans, aquaculture, dredging, etc.), and Management (Zoning, etc.).

- All regulatory requirements would be initially addressed via traditional technologies. However, nontraditional solutions should be incorporated into the initial phase of the plan, monitored, and, if effective, used to remove traditional approaches in the associated watershed in later phases of the plan.
- Management approach (zoning, etc.) would be considered for future growth/buildout for residential properties.

The WRAC met at least monthly, and at times more often, from January of 2016 until August 2017 when it presented its findings to the Town Council. During that time the committee:

- Assembled the data from previous planning efforts (wastewater and otherwise) and other viable sources.
- Identified "holes" in this data, and then set about addressing those data gaps.
- Created a GIS-based tool, that allowed the WRAC and DPW to evaluate on a lot-by-lot basis:
    - Poor sanitary conditions and public health issues, such as
        - bad soils/high groundwater,
        - effluent surfacing over leaching field,
        - inadequate set-back from private wells/property lines,
        - direct discharge of sanitary wastewater to a water body,
    - Water Supply Protection issues: and identify impaired or endangered wells and the sources of that impairment;
    - Properties/areas that were causing nutrient enrichment in surface waters (both marine estuaries and freshwater ponds).
    - Convenience and aesthetic issues including needing mounded septic systems, septic systems located in the flood mapping velocity zones, systems that require excessive pumping, or are in areas that where it is very expensive to install on-site wastewater solutions; and
    - Areas where economic development was desired, yet difficult due to the lack of good, viable, wastewater options.
- Utilized the GIS-based tool to understand the various wastewater needs and requirements, and devise solutions for those needs.
- Reviewed the CCC 208 Plan.
- Met with regulators from both the Department of Environmental Protection (DEP) and Cape Cod Commission.
- Facilitated the meeting of Town staff with adjoining towns' staffs to find efficiencies and areas where common solutions could be used to address regional wastewater needs.
- Conducted public meetings, had staff create public outreach programs utilizing the Town's local access television station, and did public outreach meetings with the village associations that requested them.

- Complied with the Cape Cod Commission's 208 Plan process, including the submission of "Bookends" Plan and a "Hybrid" Plan.
- Presented its recommended plan to the Town Council at which point the WRAC was disbanded.

After the presentation to Town Council in August of 2017, the plan continued to evolve. Three major events affected this evolution:

1. Town Council wanted to proceed with plan execution in areas that made sense and that could be considered traditional sewer expansion (that were adjacent to the existing collection system), but that also would start to address the nitrogen issues in our embayments. As a result three projects were submitted to Town Council as Capital Improvement Projects (CIPs). Town Council approved those projects for design. They are currently on-going. These are discussed in Section 2.3.3.
2. Vineyard Wind came to an agreement with the Town to land its power cables in Barnstable, and convey them through Barnstable roads. This presented an opportunity to leverage their road work and have sewer installed at the same time at a lower cost than would occur otherwise. As a result, some potential projects were pulled forward on the timeline.
3. Treatment and Effluent disposal at Joint Base Cape Cod (JBCC) WWTF. This was an opportunity that needed to be explored (see Section 2.3.1.3 and Appendices KK to NN). During the winter of 2018/2019 Barnstable joined the four upper Cape Towns of Mashpee, Falmouth, Sandwich, and Bourne in their pursuit of the wastewater assets on the JBCC. Utilizing JBCC would allow the Town to address more thoroughly the wastewater challenges in its western portion and possibly provide needed effluent disposal for other portions of the Town as well.

The plan is discussed in detail in Section 5, however, as is described above, it is continuing to evolve as more information comes available, and lessons are learned from earlier planning efforts.

4.2 APPROACH TO NON-TRADITIONAL SOLUTIONS

Using non-traditional approaches in wastewater planning has been difficult due to problems with quantifying their effect on nitrogen, gaining DEP approval for credit of the amount of nitrogen removal, and then documenting the effect once the approach has been installed (some items like fertilizer control are difficult to directly measure). To avoid all these issues, the Town made the decision to approach non-traditional solutions slightly differently. Rather than predicating the plan on them and having to ask for credit for these approaches up front, the Town instead decided to create a three 10-year phased plan that would address nitrogen requirements with traditional solutions. However, it would also, in the first phase of the plan, install non-traditional solutions "at risk" (see Marstons Mills River discussion). The Town would then monitor the performance/results of those solutions over a 5-10 year period, thus establishing their benefit. With that benefit firmly established, the Town would ask DEP for relief from that amount of traditional nitrogen removal (sewers) contained in the later phases of the plan.

4.3 PUBLIC CONSULTATION

Public consultation for this plan is a continuing activity. The development of the CWMP was a public process. The WRAC was formed from representatives of the community, the meetings were posted and open to the public, and the meetings were broadcast on the Town's government access channel and available through video on Demand. The Town Manager and DPW Director also presented progress on the plan, and then the plan itself, to the Town Council (also broadcast on the Town's government access channel and available through video on Demand) regularly. Toward the end of the planning process those updates became monthly. The Town's government access channel and available through Video on Demand also conducted interviews for broadcast from participants in the wastewater planning process, and is developing a standalone documentary broadcast on the plan.

The plan also was, and continues to be, presented to Village Associations, boards, and civic groups that request the presentation. As of the writing of this document, Cotuit Village Association, Marstons Mills Village Association, Greater Hyannis Civic Association, Barnstable Clean Water Coalition, Lake Wequaquet Association, the DPW Commissioners, and the Board of Health have all had presentations made to them. Additional groups that will have the plan presented to them include: Senior Managers Meeting (comprised of Town Departments Division Heads), the Conservation Commission, the Planning Board, the School Committee, the Economic Development Committee, and any other organization that requests it. Additionally, the Town held 4 advertised public presentations of the plan followed by questions and answers sessions in 4 of the villages in the Town in October of 2019:

- October 15, 2019: Barnstable County Complex, Barnstable Village
- October 21, 2019: Osterville Village Library, Osterville
- October 22, 2019: Barnstable Town Hall, Hyannis
- October 28, 2019: Liberty Hall, Marstons Mills

Additionally, the Town of Barnstable is unique in that three of its four public water purveyors are private entities that are not Town departments (the fourth one is a Town Department). To ensure appropriate communication with these organizations, the DPW initiated monthly meetings with the leaders of those organizations, where the plan was presented and discussed.

Finally, a website, that will be easily accessible from the Town's website, is being developed that will contain not only the plan, but links to the WRAC meetings and various televised presentations of the plan.

4.4 SHARED WATERSHEDS WITH ADJOINING COMMUNITIES

All but one of the impaired watersheds that Barnstable is responsible for is shared with at least one neighboring communities. Consequently, the Town needed to work with Mashpee, Sandwich, and Yarmouth in addressing the needs in these watersheds. As previously mentioned, one of the great benefits of the 208 plan was it apportioned the nitrogen removal requirements for a watershed between the communities that shared said watershed. This gave each community a clear understanding of their responsibility in the matter. What remained to be discussed between the communities was if there were collaborative approaches to the problem that would be more efficient than each community addressing it alone.

The Barnstable DPW met with each of the aforementioned community's wastewater planning teams multiple times. The solutions discussed with each were unique to that relationship, but the acknowledgement of a common problem was universal. Each is briefly synopsized below.

4.4.1 SANDWICH

Barnstable shares the watersheds of Three Bays, Popponesset Bay, and a small sliver of Barnstable Harbor with Sandwich. Joint items that were pursued included:

- Popponesset Bay IMA - The Town engaged with the towns of Sandwich and Mashpee in developing an inter-municipal agreement (IMA) regarding nutrient management in Popponesset Bay. As discussed in Section 2.3.1.1, the IMA provides a framework for collaboration by establishing a working group to develop an application for a Watershed Permit for Popponesset Bay, a formula for allocation of responsibility, establishing a "lead municipality" to serve as fiscal agent for common and agreed upon expenses (in this case, Mashpee) and the mutual assurance that each town will take affirmative steps toward water quality improvement.
- Three Bays Watershed – Coordination meetings and discussions were held with Sandwich. Each community is addressing its respective need for this watershed via their own CWMP. However, collaboration via the JBCC work may modify this approach.
- JBCC - The four upper cape towns (Bourne, Falmouth, Mashpee, and Sandwich) had been investigating the possibility of making the WWTF on JBCC a regional facility for over a decade. During the winter of 2018/2019 Barnstable was invited to join the four towns in that effort. Barnstable agreed to join, and immediately contracted with a consultant to help understand the issues, opportunities, and challenges associated with

managing and operating the JBCC facility. The results of the consultant's efforts can be found in Appendices KK to LL.

4.4.2 MASHPEE

Barnstable shares the Popponesset Bay watershed with Mashpee:

- Popponesset Bay IMA - The Town engaged with the towns of Sandwich and Mashpee in developing an inter-municipal agreement (IMA) regarding nutrient management in Popponesset Bay. As discussed in Section 2.3.1.1, the IMA provides a framework for collaboration by establishing a working group to develop an application for a Watershed Permit for Popponesset Bay, a formula for allocation of responsibility, establishing a "lead municipality" to serve as fiscal agent for common and agreed upon expenses (in this case, Mashpee) and the mutual assurance that each town will take affirmative steps toward water quality improvement.
- JBCC - The four upper cape towns (Bourne, Falmouth, Mashpee, and Sandwich) had been investigating the possibility of making the WWTF on JBCC a regional facility for over a decade. During the winter of 2018/2019 Barnstable was invited to join the four towns in that effort. Barnstable agreed to join, and immediately contracted with a consultant to help understand the issues, opportunities, and challenges associated with managing and operating the JBCC facility. The results of the consultant's efforts can be found in Appendices KK to LL.

4.4.3 YARMOUTH

Barnstable shares the Lewis Bay and Barnstable Harbor watersheds with Yarmouth:

- Treatment and disposal exchange – The towns share the Lewis Bay watershed and have begun discussions to see if shared wastewater treatment and effluent recharge between the towns was a viable and efficient solution. Talks were initiated and a study was conducted to better understand the opportunities related to having an exchange with Yarmouth. The basis of that exchange would be that Yarmouth would send its collected sewage to Barnstable for treatment, and Barnstable would send that effluent, plus additional effluent back to Yarmouth for disposal. The results of the study can be found in Appendix JJ. Those talks were still underway as of the writing of this plan.

4.5 MAPPING TOOLS

As discussed earlier, to help visualize wastewater needs, the Town created a GIS-based tool, which allowed the WRAC and DPW to evaluate the needs on a lot-by-lot basis. The tools captured issues such as:

- Poor sanitary conditions and public health issues, such as:

    - Poor soils/high groundwater,
    - Effluent surfacing over leaching field,
    - Non-conforming lots, and septic systems with variances,
    - Inadequate setback from private wells/property lines,
    - Direct discharge of sanitary wastewater to a water body;
- Water Supply Protection issues, and identify impaired or endangered wells and the sources of that impairment that are likely impacting them;
- Properties/areas that were causing nutrient enrichment in surface waters (both marine estuaries and freshwater ponds);
- Convenience and aesthetic issues including needing mounded septic systems, septic systems located in the FEMA mapping velocity zones, systems that require excessive pumping, or are in areas where it is very expensive to install on-site wastewater solutions; and
- Areas where economic development was desired, yet difficult due to the lack of viable wastewater options.

In addition, the tool quantified wastewater flow and nitrogen generation for every parcel in town which allowed Town staff to quantify nitrogen removal values while developing the sewer expansion plan to ensure they were meeting the projected removal requirements of the MEP models. To accomplish this, water data from 2011 to 2016 was gathered and a 5 year average, daily water use for all parcels in town was calculated. Projected daily wastewater flow was calculated assuming 90% of the water use becomes wastewater, similar to the MEP models. Nitrogen was then calculated assuming a standard Title 5 septic system Total N concentration of 26.25 mg/L, similar to the MEP models.

The tool proved to be extremely useful, and allowed team members to understand and visualize the various wastewater needs and requirements, and devise smart and efficient solutions for those needs.

5 RECOMMENDED PLAN

The following sections present the Town's recommended plan.

5.1.1 PHASING

The key component of the Town of Barnstable's Comprehensive Wastewater Management Plan (CWMP) is an aggressive 30-year plan focused on traditional solutions that will be performed in three 10-year phases. The plan has been designed to address multiple wastewater needs of the community, specifically: nutrient removal, pond protection, drinking water protection, economic development and other wastewater concerns. In addition to the traditional solutions, the Town simultaneously will be pursuing non-traditional approaches to nutrient reduction, which was discussed in Section 2.3.2 and Section 3.2.2.

The phases of the plan were developed to accomplish the following goals:

5.1.2 PHASE 1

- Construction of sewer infrastructure along Route 28 to address nutrient related issues within the Centerville River and Three Bays watershed. The Route 28 sewer infrastructure will be the major infrastructure to convey flow from westerly portions of the Town to the BWPCF.
- Sewer expansion adjacent to Wequaquet Lake, Bearses Pond, Shallow Pond, Long Pond, Red Lily Pond, Lake Elizabeth, and Filenes Pond to address deteriorating water quality.
- Sewer expansion to accommodate identified economic development areas including along the Route 28, Old Yarmouth Road, Attuck's Lane/Route 132, Kidd's Hill, Independence Park, and Hyannis Harbor.
- Sewer expansion within the flood zones in the Craigville Beach and Long Beach region to address septic system issues in the area.
- Sewer expansion adjacent to Prince Cove and Warren's Cove (most impaired water bodies in the Three Bays Watershed) and the Marstons Mills River.
- Modifications at BWPCF including upgraded/expanded aeration, denitrification upgrades, and upgrades to solids handling.
- Identification, permitting and construction of new effluent disposal site(s).
- Continuing to lead in pursuit of a regional sewer option at JBCC.
- Completion of Cotuit Cut/Sampson's Island dredging project to improve the flushing of Cotuit Bay.

- Continued pursuit, construction and monitoring of non-traditional approaches along the Marstons Mills River System (Mill Pond Dredging, green stormwater projects, etc.).
- Continued embayment monitoring.

5.1.3 PHASE 2

- Continued westerly sewer expansion along Route 28.
- Continued sewer expansion within the Centerville River Watershed, specifically the Centerville River East subwatershed and expansion adjacent to Bumps River.
- Sewer expansion into the Nye's Neck region to complete sewer expansion surrounding all of Wequaquet Lake.
- Sewer Expansion to areas south of Craigville Beach Road east of Covell's Beach.
- Sewer expansion into the Millway subwatershed (the one sub-watershed within the Barnstable Harbor Watershed requiring septic load removal per the MEP report).
- Sewer expansion within the Lewis Bay Watershed in the General Patton area and northern Hyannis Port.
- Continued sewer expansion within the Three Bays Watershed, directly adjacent to sub-embayments requiring septic load removal (Prince Cove and North Bay), to address areas with shortest groundwater travel times.
- Continued monitoring and analysis of non-traditional projects in the Three Bays Watershed.
    - During this phase, it is the Town's intention to present the monitoring and analysis of the non-traditional approaches to the regulatory agencies.
    - If, as anticipated, the analysis of the monitoring program determines that the non-traditional approaches have improved conditions within the Three Bays Watershed, the Town would then enter discussions with regulatory agencies to pursue non-traditional "credits" in an effort to minimize the required sewer expansion proposed in Phase 3.
        - The Town is not proposing any non-traditional "credits" at this time and has designed the sewer expansion plan to achieve the required septic load removals by traditional approaches only.
- Continued embayment monitoring.

5.1.4 PHASE 3

- Continued sewer expansion into the northerly portion of the Three Bays Watershed.
- Continued sewer expansion within the Lewis Bay/Halls Creek Watershed.
- Continued monitoring and analysis of non-traditional projects and follow-up with regulatory agencies.
- Continued embayment monitoring.

Table 5-1: Sewer Expansion Plan - Phasing Statistics

	Phase 1 (0-10 Years)	Phase 2 (10-20 Years)	Phase 3 (20-30 Years)	Total
WW Captured (gpd)	798,900	810,700	372,900	**1,982,500**
Load N Removed (kg/day)	79	81	37	**197**
Number of Parcels Affected	4,735	3,820	2,377	**10,932**
Approximate Road Miles	75	60	38	**173**
% of N Removed by Plan	40%	41%	19%	**100%**

5.1.5 STAGES

In addition to the three phases, the sewer expansion plan also includes three separate "stages" of sewer expansion. The three stages are located in the Village of Cotuit and are focused on the Popponesset Bay Watershed and the Cotuit Bay subwatershed of the Three Bays Watershed. The term "stages" was used for these sewer expansion areas because they do not have a determined schedule as it is assumed that these areas would be served by an undermined western treatment and disposal solution to accommodate the sewer expansion. The original plan developed by the WRAC recommended approaching these areas via an inter-municipal agreement (IMA) with Mashpee and Sandwich, which was then executed between the communities. However, in order to address water quality concerns in Shoestring Bay and Cotuit Bay that would not be addressed via nitrogen sharing in an IMA, there is a desire for traditional wastewater solution in these areas. If a westerly solution becomes a reality, the Town intends to pursue sewer expansion the areas identified in the stages.

Table 5-2: Sewer Expansion Plan - Staging Statistics

	Stage 1	Stage 2	Stage 3	Total
WW Captured (gpd)	37,200	84,500	22,800	**144,500**
Load N Removed (kg/day)	4	8	2	**14**
Number of Parcels Affected	253	483	155	**891**
Approximate Road Miles	5	8	3	**16**

Nitrogen removal data reported above in Table 5-1 and Table 5-2 is from the Town of Barnstable's wastewater planning GIS tool and reflects calculated existing un-attenuated nitrogen loading based upon existing water use data.

5.1.6 PLAN SUMMARY

The Town has developed a Comprehensive Wastewater Management Plan which will address the multiple wastewater needs of the Town. The Plan is primarily focused on an aggressive sewer expansion program which will be completed in three (3), 10-year phases, for a total of a 30 years program. The sewer expansion program also includes 3 “stages” as discussed in Section 5.1.5. In addition to the sewer expansion program, the CWMP will incorporate non-traditional projects where strategically appropriate. Assuming 20-year construction bonds, the program is envisioned to be a 50-year financial program. As such, the planning horizon for this project is 50 years, or 2070.

The following table summarizes the anticipated flows within the planning horizon:

Table 5-3: Sewer Expansion Plan Summary

Source	Flow (gpd)[1]
Existing Flow to BWPCF	1,670,000
Phase 1-3	1,982,500
Stages 1-3	144,500
Residential Buildout	211,300
Commercial Buildout	565,250
Total	4,573.550

1. Flows are average daily flows

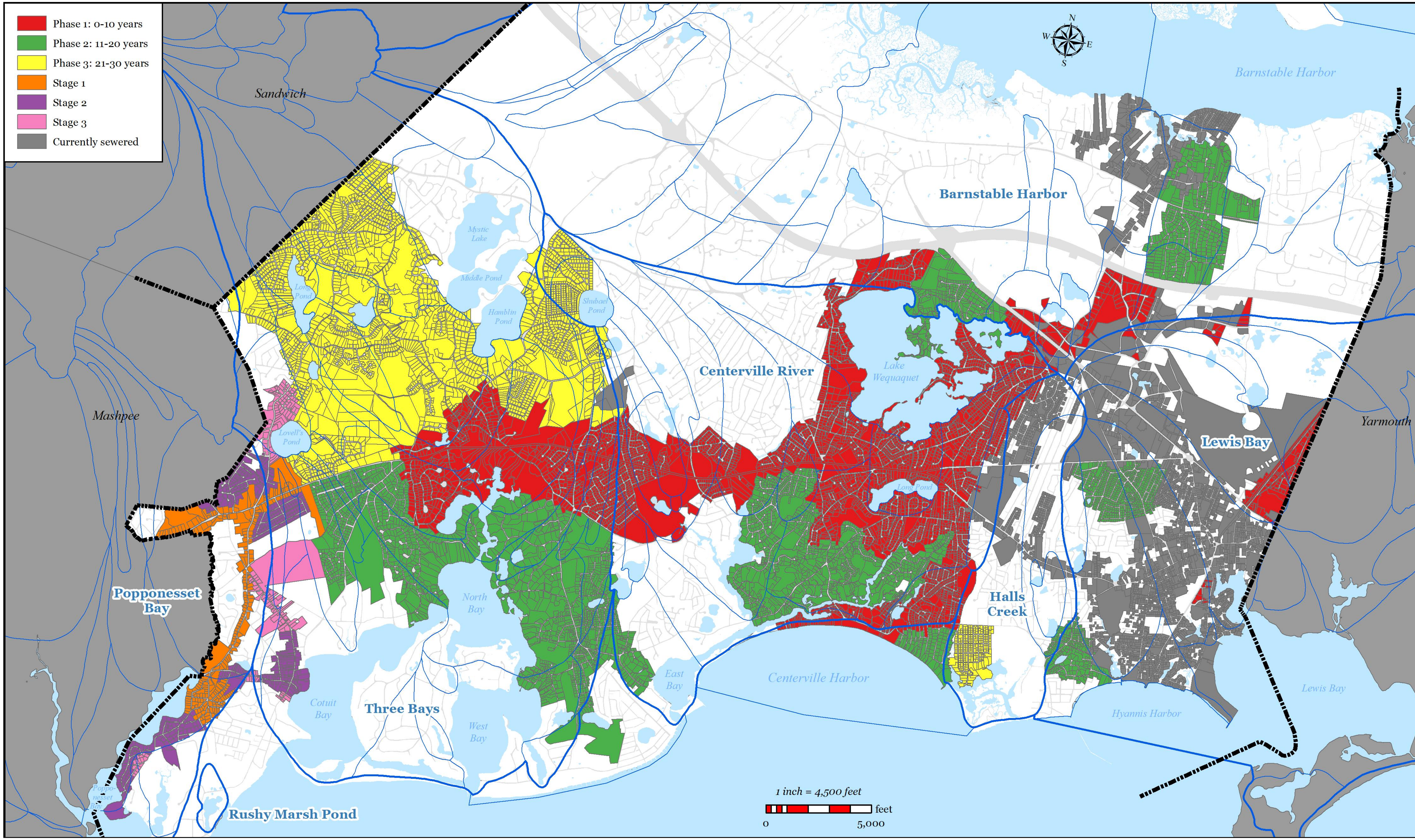

Figure 5-1: Sewer Expansion Phasing Plan

5.2 APPROACH BY WATERSHED

The plan has been developed utilizing a watershed-by-watershed approach to ensure the regulatory requirements of each watershed are met. The following sections will describe the needs and proposed solutions of each of the watershed located in the Town of Barnstable. All nitrogen data provided in this section were calculated using the Town's GIS tool and represent un-attenuated nitrogen totals.

Table 5-4: Summary of Plan by Watershed

Watershed	Parcels to be Sewered by Plan	WW to be collected by Plan (gpd)	Nitrogen to be removed by Plan (kg/day-N)
Lewis Bay	882	151,114	15.0
Halls Creek	385	54,609	5.4
Centerville River	4,756	776,404	77.1
Three Bays	4,316	880,465	87.5
Rushy Marsh	0	0	0
Popponesset Bay	526	84,626	8.4
Barnstable Harbor	735	117,725	11.7
Undefined	223	62,126	6.2
Total	**11,823**	**2,127,069**	**211.3**

5.2.1 LEWIS BAY WATERSHED

The Lewis Bay Embayment System is a complex estuary located in the Towns of Barnstable and Yarmouth with a southern shore bounded by Nantucket Sound. It is comprised of several primary segments that include Hyannis Inner Harbor, Mill Creek, Snow's Creek and Stewart's Creek. For a detailed description of the embayment system, refer to the 2006 MEP Report for the Lewis Bay Embayment (Appendix AA).

The Lewis Bay Watershed is the contributing area for the Lewis Bay Embayment System. The Lewis Bay Watershed is also located between the Towns of Barnstable and Yarmouth (see Figure 5-2). Within the watershed there are 71 identified surface waters including 8 named freshwater ponds and 6 significant freshwater stream outlets (Halls Creek, Stewarts Creek, Snow's Creek, Hospital Bog, Mill Pond and Chase Brook). Halls Creek Watershed is discussed separately in Section 5.2.2. There are 22 public drinking water wells located within the watershed, 10 of which are located in Barnstable (8 operated by Hyannis Water District, 2 operated by Barnstable Water District.) The Town of Barnstable Water Pollution Control Facility (BWPCF) is located within the watershed. Additionally, the BWPCF treats and discharges wastewater from portions of Hyannis Village and Barnstable Village. The BWPCF is permitted for maximum daily flow treatment of 4.2 MGD and disposal of 2.7 MGD and an annual mass nitrogen load limit of 49,315 pounds per year.

5.2.1.1 SUMMARY OF NEEDS

The Town of Barnstable's wastewater plan has been designed to address multiple needs areas within the Lewis Bay Watershed, including nutrient removal, pond protection, water supply protection, flood zone considerations, and economic development, via sewer expansion within the Lewis Bay Watershed.

5.2.1.1.1 Nutrient Removal

The 2008 MEP technical report for Lewis Bay indicates that the Lewis Bay system exceeds its critical threshold for nitrogen, resulting in impaired water quality. Based upon the findings of the MEP technical report, a TMDL for nitrogen has been developed and approved.

Barnstable has already taken significant action to address nitrogen removal within the watershed via the Stewart's Creek Sewer Expansion project (refer to Section 2.3.3.1) which connected 288 of residences to municipal sewer, resulting in a reduction of approximately 1.4 kg/day-N of un-attenuated septic load.

The Town's wastewater plan has been designed to exceed the existing septic load removals suggested in the 2008 MEP Report's threshold loading scenarios using traditional sewers. The Town also intends to pursue the feasibility in reducing nitrogen concentrations in the effluent of BWPCF by constructing denitrification filters.

The Town retained SMAST to re-model the watershed under a scenario that combines the proposed Town of Barnstable and Town of Yarmouth's wastewater plans to confirm that the TMDL will be met by the implementation of the two community's plans. The updated SMAST model indicates that the TMDL will be met under this scenario (refer to Appendix QQ). The Town of Barnstable anticipates that the two communities will pursue a watershed permit for the Lewis Bay Watershed.

5.2.1.1.2 Wastewater Needs (Other Needs)

Title 5 Issues

Integral to the planning process was the Town's development of a wastewater planning GIS tool which allowed Town staff to spatially map traditional Title 5 concerns such as small lot size, depth to groundwater, existing septic variances, existing known failed septic systems, and systems within Zone IIs. Parcels with area less than 0.25 acres were flagged because they were considered difficult to site a traditional septic system, likely to need septic variances, and increased density leading to increased nutrient loading. Parcels with an average depth of groundwater of less than four feet were flagged as likely to require raised systems which are costly and less desirable for community aesthetics. Existing septic variances and existing known failed septic systems were also mapped.

The tool allows the Town to overlay these layers to identify the "hot-spots" for traditional Title 5 concerns. These areas were then incorporated into the plan where practical. Many of these "hot-spots" overlaid other needs such as nutrients and pond protection. The Plan for the Lewis Bay Watershed significantly address traditional Title 5 concerns as shown in the data presented below which was calculated using the Town's wastewater planning GIS tool (this data does not account for nitrogen attenuation):

- Total parcels within the Town of Barnstable within the Lewis Bay Watershed = 4,244
- Total parcels connected to existing municipal sewer = 2,101 (50%)
- Parcels with total area less than 0.25 acres = 1,774 (42%)
  - 999 (56%) already served by municipal sewer
  - 311 (18%) additional to be addressed with a traditional solution in the Plan
  - Total = 1,310 (74%)
- Parcels with average depth to groundwater less than four feet = 147 (3%)
  - 59 40% already served by municipal sewer
  - 20 (14%) additional to be addressed with a traditional solution in the Plan
  - Total = 79 (54%)
- Parcels with septic system variances = 35 (0.8%)
  - 3 (9%) will be addressed with a traditional solution in the Plan
- Parcels with known failed septic systems = 10 (0.2%)
  - 3 (30%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 1,520 (36%)
  - 687 (45%) already served by municipal sewer
  - 273 (18%) additional to be addressed with a traditional solution in the Plan
  - Total = 960 (63%)

Please note that Hall's Creek Watershed is not included in this data. Refer to Section 5.2.2 for Hall's Creek Watershed data.

Flood Zones

The majority of the parcels within flood zones in the Lewis Bay Watershed in the Town of Barnstable are already served by municipal sewer.

- Total parcels within the Lewis Bay Watershed = 4,244
- Parcels within FEMA mapped 100-year flood zone (AE/AO) or velocity zone (VE) = 834 (20%)
    - 524 (63%) already served by municipal sewer
    - 82 (10%) that will be addressed with a traditional solution in the Plan
    - Total = 606 (73%)

5.2.1.1.3 Drinking Water Supply Protection and Contaminants of Emerging Concern (CEC's)

The Hyannis Water System (HWS) supplies drinking water to the majority of the parcels within the Lewis Bay Watershed. In recent years, the HWS has had significant issues with CEC's, specifically PFOS and 1,4-dioxane. The Town has been proactive in addressing this issue by investing significant capital to update treatment facilities for the HWS, specifically at the Mary Dunn Wells (activated carbon filters) and the Maher Wells (construction of $12 million treatment plant to treat for PFOS, 1,4 dioxane, iron, and manganese).

The Plan continues the effort of protection of the drinking waters source. The sewer expansion will connect 273 properties that are located within delineated Zone IIs to municipal sewer. Of particular concern is the "Old Yarmouth Road" project area which is directly adjacent to and up-gradient from the Maher well field. The existing land use within this area is predominantly commercial. The majority of the commercial uses are motor vehicle dealerships and repair facilities which are land uses susceptible to hazardous material release. The proposed Old Yarmouth Road Sewer Expansion project will connect the 131 properties within the project area to municipal sewer, thus reducing the risk of contamination from the commercial uses existing in this area.

5.2.1.1.4 Pond Protection

The Town's wastewater planning has included detailed studies of ponds 3 acres or larger throughout the Town. Through those studies, there is extensive water data for 10 ponds in the Lewis Bay Watershed. Pond classification of these ponds is shown in Table 5-5 and Table 5-6.

Table 5-5: Lewis Bay Watershed Pond Classification 2009

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6
Oligotrophic	Mary Dunn Pond		
Mesotrophic	Aunt Betty's PondFawcett's		
Eutrophic			
Hypereutrophic		School House	

Table 5-6: Lewis Bay Watershed Pond Classification 2017

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6
Oligotrophic	Campground Pond		
Mesotrophic	Fawcett's PondFresh Hole Pond		
Eutrophic	Lamson Pond Israels Pond BA-799	Flintrock Pond	
Hypereutrophic			

Five ponds within the watershed have been identified as impaired; Lamson Pond, Israels Pond, BA-799s, Flintrock Pond, and Schoolhouse Pond. Sewer expansion adjacent to the following ponds for protection from nutrients from septic systems has been proposed: Schoolhouse Pond.

5.2.1.1.5 Economic Development

The Town's Planning and Development Department (P&D) identified a number of areas within the Lewis Bay Watershed as needs areas for sewer expansion to promote economic development. These areas include:

- The "Old Yarmouth Road Sewer Expansion" project area located north of Route 28, east of Yarmouth Road and west of the Town Line.

- Parcels not served by municipal sewer in the area of Hyannis Harbor.
- Properties in the “Independence Park” area that have not been connected to municipal sewer to date or have not been developed to date.

5.2.1.2 PROPOSED SOLUTIONS

The plan addresses the needs areas using the following techniques:

- Sewer Expansion
    - 2,101 of the 4,244 parcels (50%) in the watershed within the Town of Barnstable are already connected to municipal sewer.
    - 241 parcels (5%) in the watershed within the Town of Barnstable were included in the Stewart’s Creek Sewer Expansion Project (1.4 kg/day–N, un-attenuated).
    - 882 (21%) in the watershed are included in the proposed sewer expansion plan (15.0 kg/day-N, un-attenuated).
    - Total proposed removal of (16.4 kg/day-N, un-attenuated, from watershed within the Town of Barnstable from proposed sewer expansion (including Stewart’s Creek Sewer Expansion Project).

- BWPCF Upgrades
    - Evaluate, design and construct denitrification improvements to decrease BWPCF total nitrogen (TN) from an existing average of 6 mg/L to a proposed average of 3 mg/L or lower.
        - At the BWPCF existing annual average daily flow of 1.67 MGD, 37.9 kg/day-N is discharge to the watershed.
        - A 50% reduction in the average effluent discharge TN concentration would remove 18.9 kg/day-N of existing (un-attenuated) nitrogen load from the watershed (approximately 35% of the total attenuated load to be removed per the Cape Cod Commission 208 Watershed Report).
    - Seek effluent discharge sites to accommodate additional flow being generated by the sewer expansion connections being treated at BWPCF.

- Stormwater upgrades
    - The Town’s MS4 program will identify and provide solutions to existing stormwater outfalls, where appropriate.
        - 59 of the Town’s 207 identified stormwater outfalls are located in the Lewis Bay Watershed.
    - The Town’s Public Road program invests on average $750,000 a year in stormwater improvements in the Town’s public roads. These improvements generally include replacement of failed catch basins and leaching structures.

- Fertilizer Regulation
    - In 2014 the Town adopted a Fertilizer Nitrogen and Phosphorus Control Regulation (see Appendix PP). The regulation includes the following:
        - Provides Best Management Practices and performance standards for noncertified fertilizer applicators.
        - Outlines education, certification, enforcement and penalties.

- Watershed Permit
    - Work with the Town of Yarmouth to seek a Watershed Permit for the Lewis Bay Watershed

5.2.1.3 FUTURE CONDITIONS

The plan accommodates future growth conditions as follows:

- Watershed is already densely developed.
- Hyannis Village is the main commercial center for Cape Cod. A Growth Incentive Zone (GIZ) has been established within Downtown Hyannis to promote re-development within the area.
    - The GIZ has existing sewer infrastructure, much of which dates back to the 1930s.
        - Studies are on-going (South Street, Barnstable Road, SewerCAD, etc.) to study the existing sewer collection system and determine where upgrades may be necessary to accommodate projected development within the GIZ.
        - Projects such as the Infiltration and Inflow Evaluation, Sewer System Evaluation Survey, and Pleasant Street Re-Lining project have addressed the aging infrastructure.
- Projected growth within the watershed is anticipated in areas that are either already served by municipal sewer or are included in the sewer expansion plan.
    - The sewer expansion plan has been designed to remove septic load than above and beyond what modeling required for existing conditions in order to accommodate projected growth within the watershed.
    - Sewer expansion projects will be designed to accommodate growth within the expansion areas (increased pipe sizes, appropriate pump station sizing, etc.).
- Adaptive management and monitoring
    - The Town will continue to monitor the embayment, review the Plan and provide formal updates as required.
    - Refer to Section 6.5 for the Adaptive Management Plan and Section 6.4 for the Monitoring Plan.

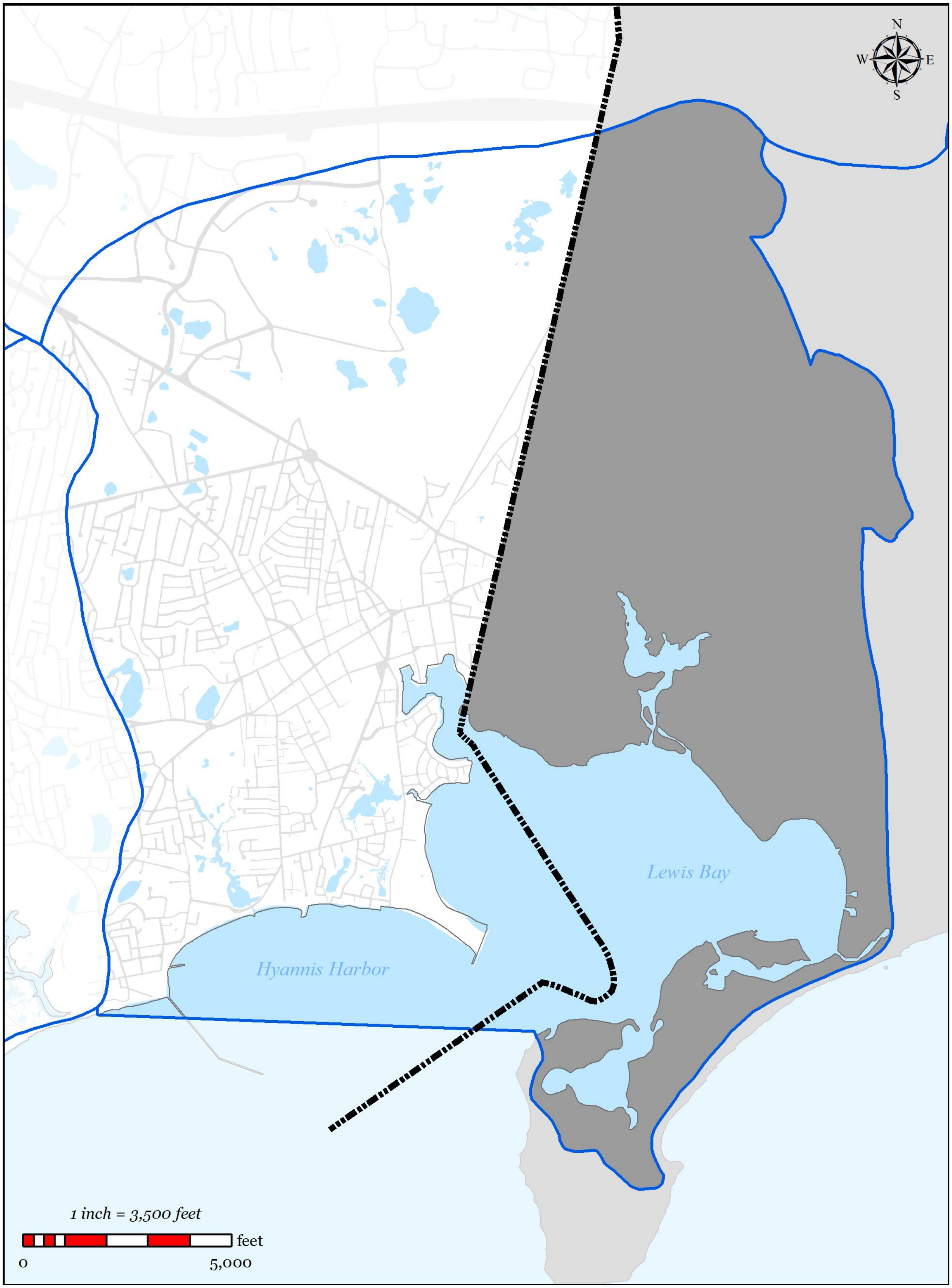

Figure 5-2: Lewis Bay Watershed

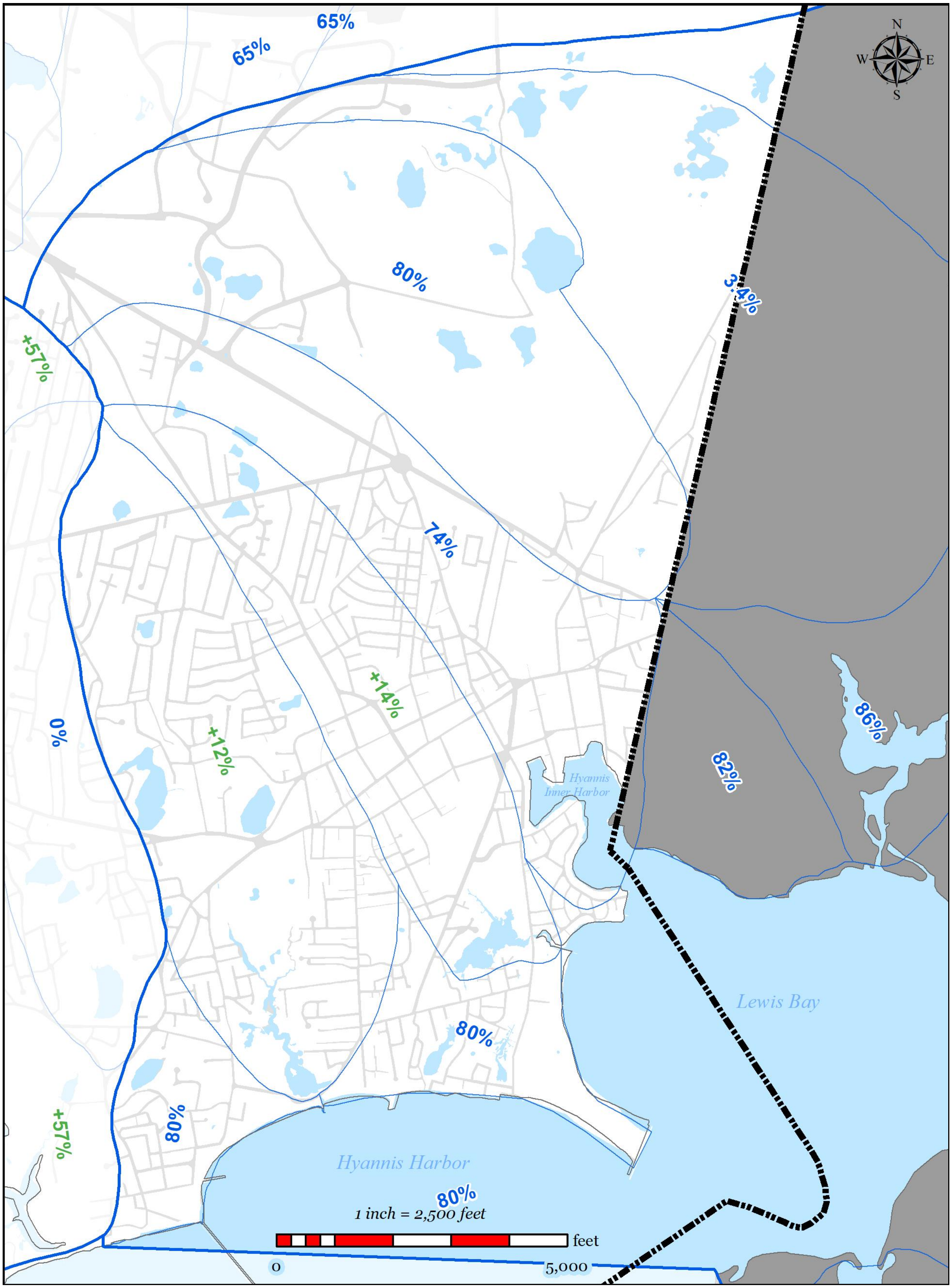

Figure 5-3: MEP-modeled Existing Septic Load Removal in Lewis Bay Watershed

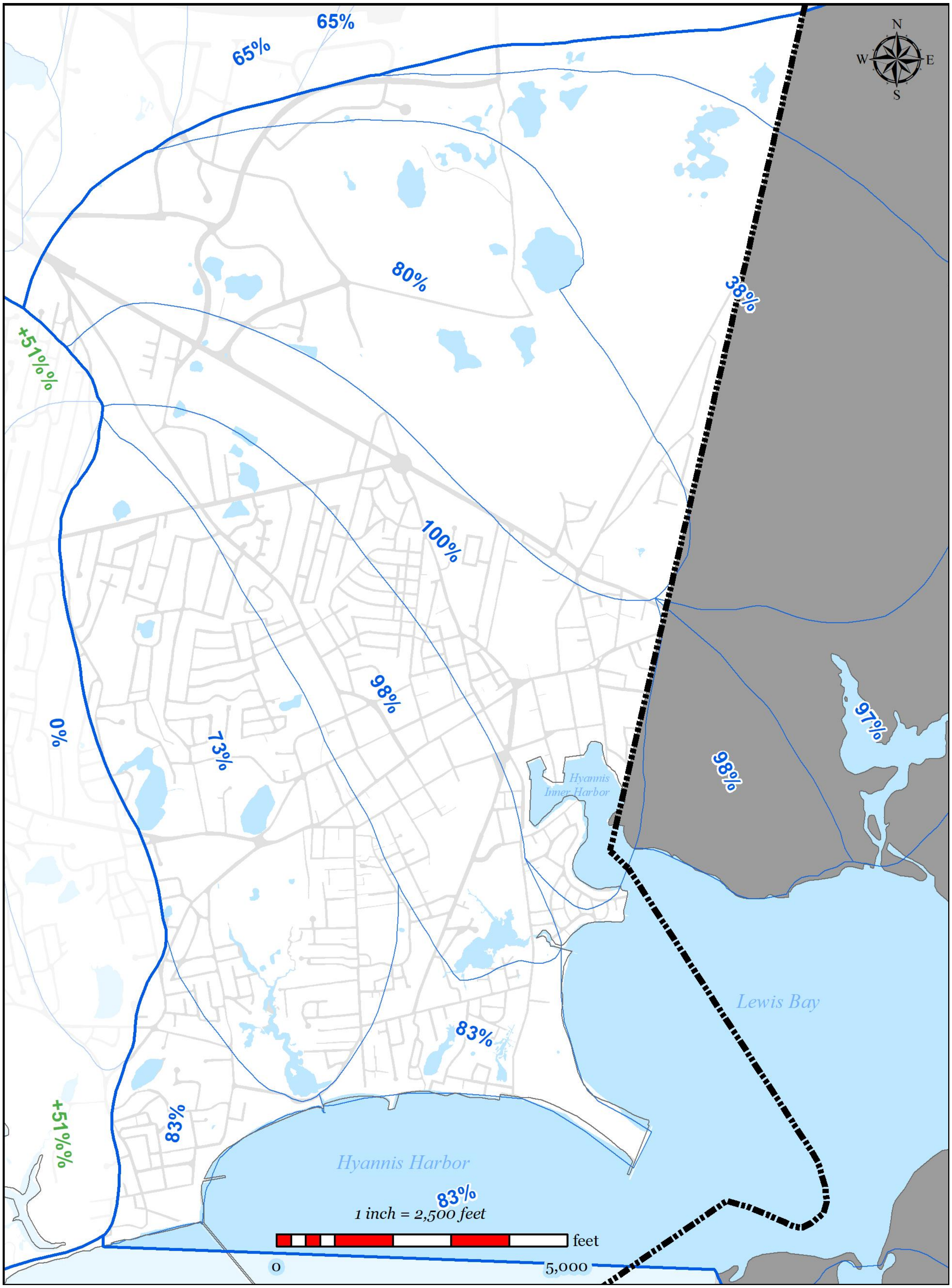

Figure 5-4: MEP-modeled Future Septic Load Removal in Lewis Bay Watershed

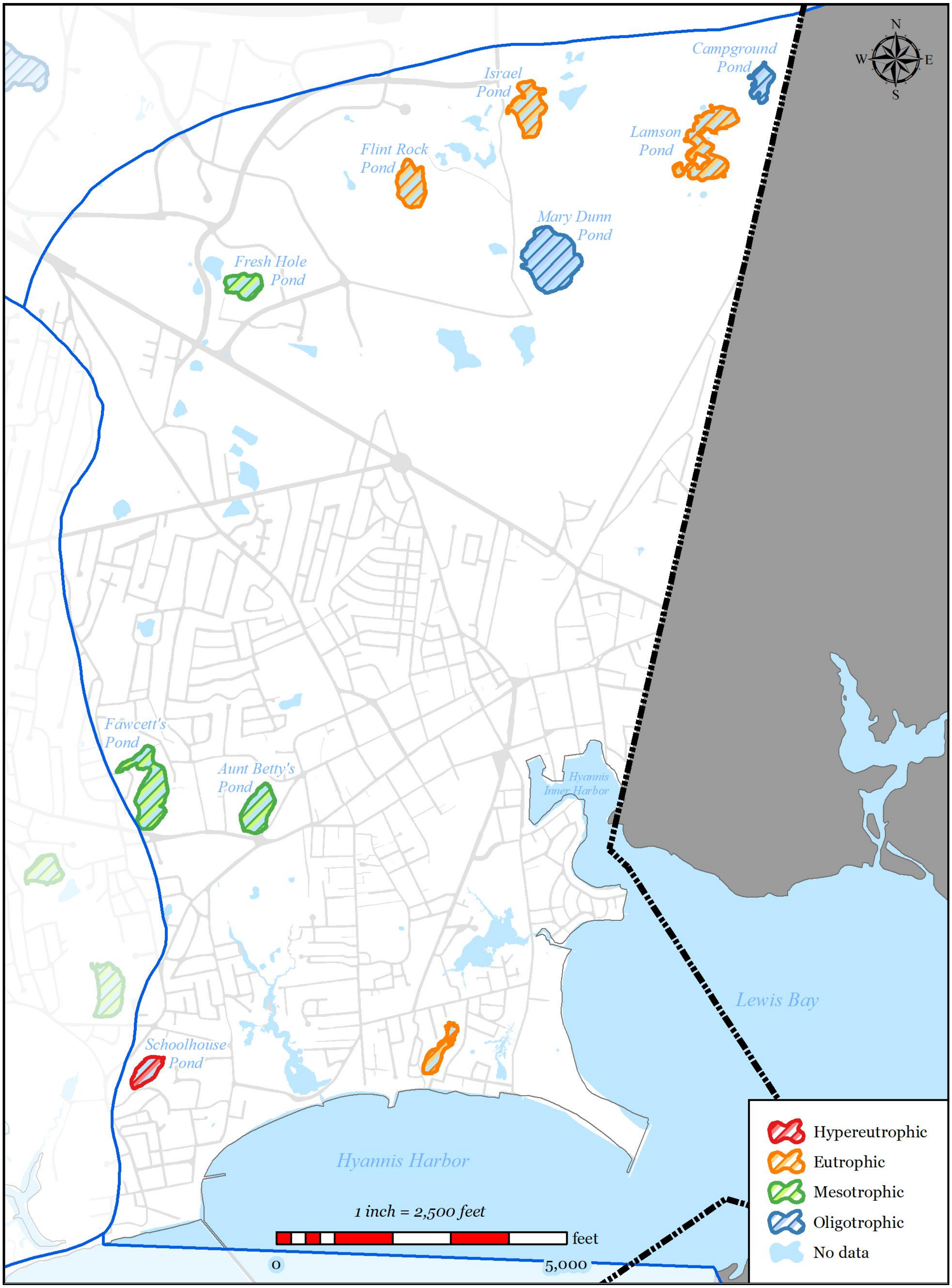

Figure 5-5: Trophic States of Ponds in Lewis Bay Watershed.

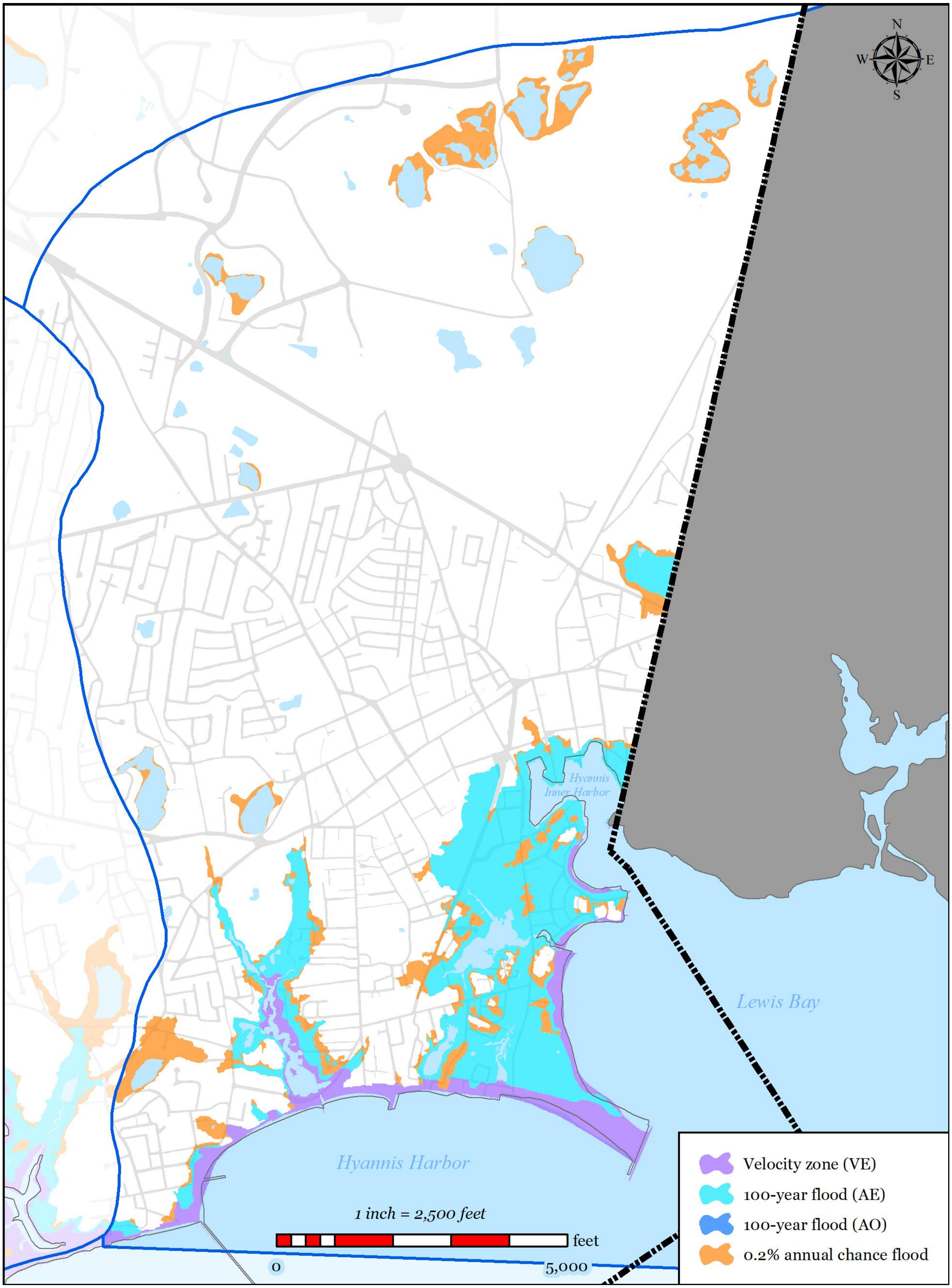

Figure 5-6: FEMA Flood Zones (2014) in Lewis Bay Watershed

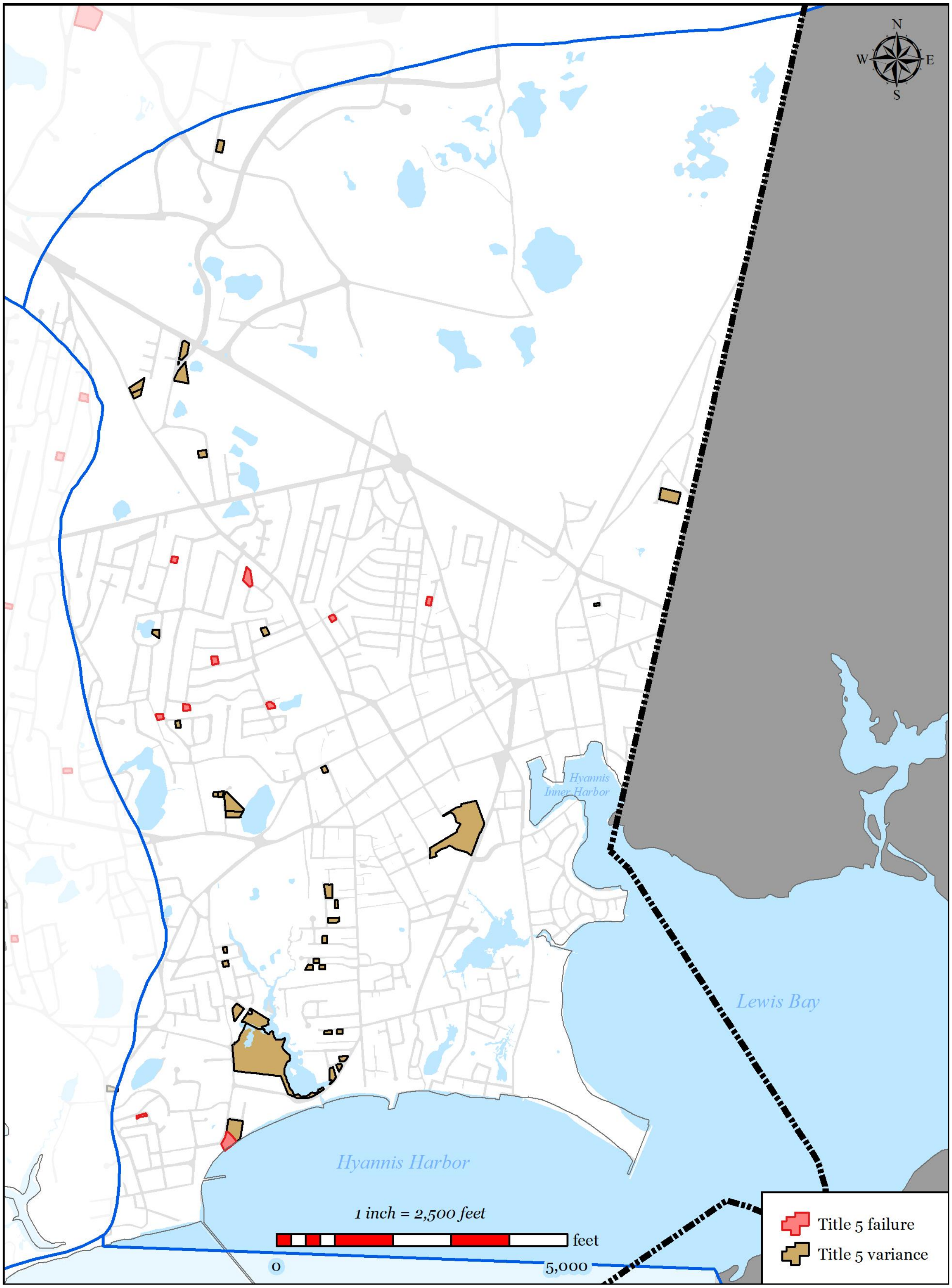

Figure 5-7: Parcels with Title 5 Septic Failures and Variances in Lewis Bay Watershed

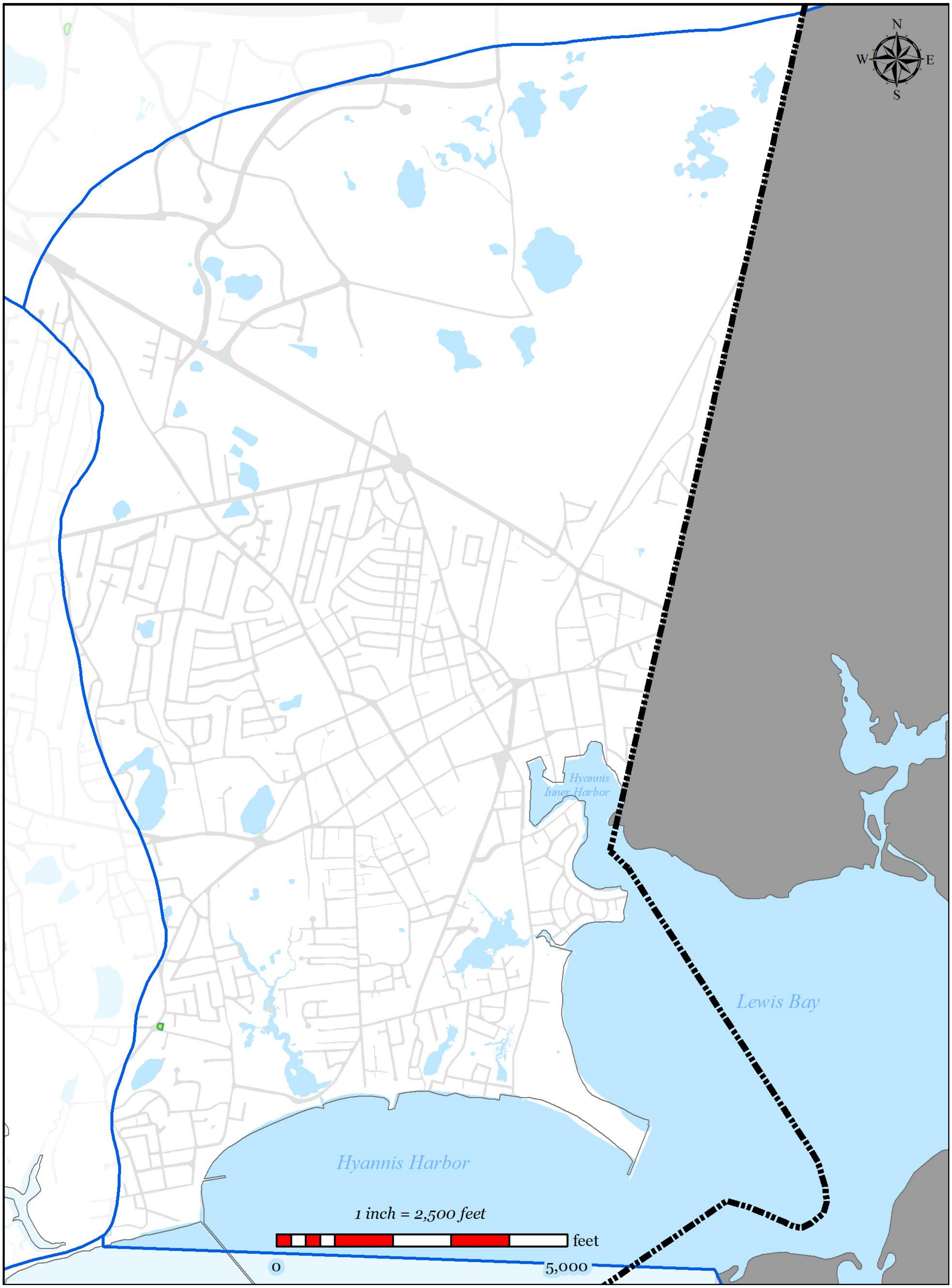

Figure 5-8: Parcels with I/A Septic Systems in Lewis Bay Watershed

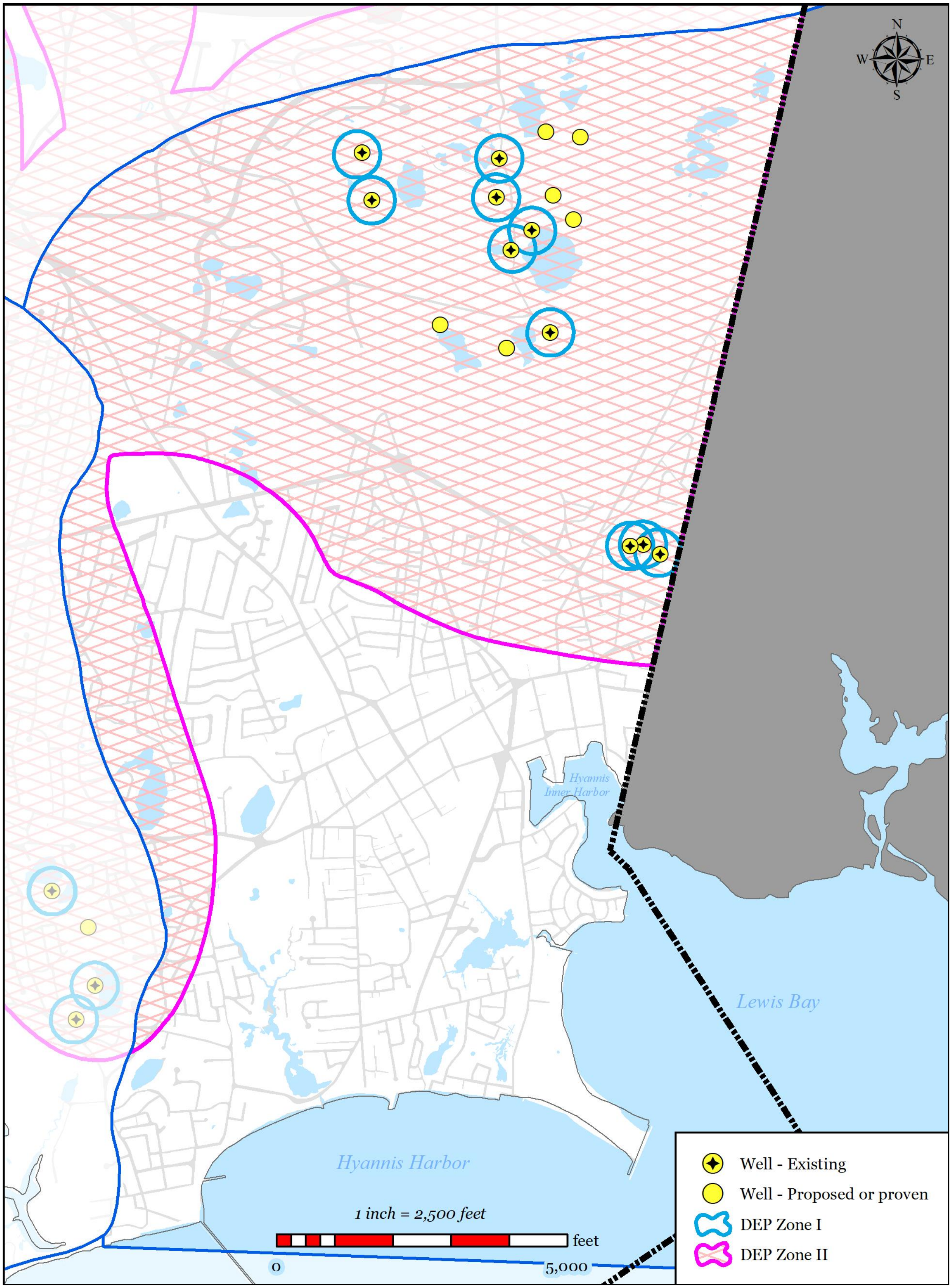

Figure 5-9: Public Water Supply Wells in Lewis Bay Watershed

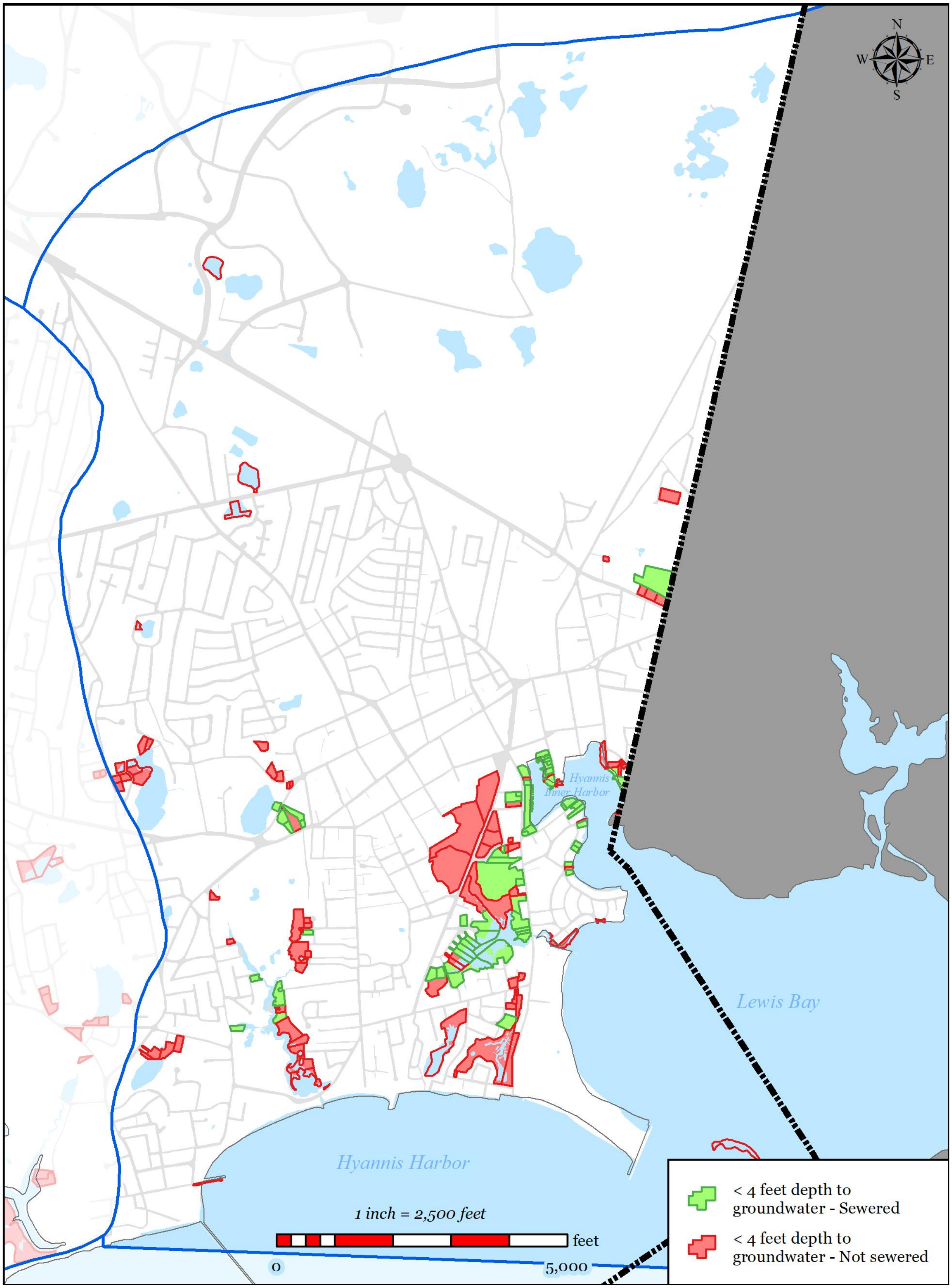

Figure 5-10: Parcels with Less than 4 feet Depth to Groundwater in Lewis Bay Watershed

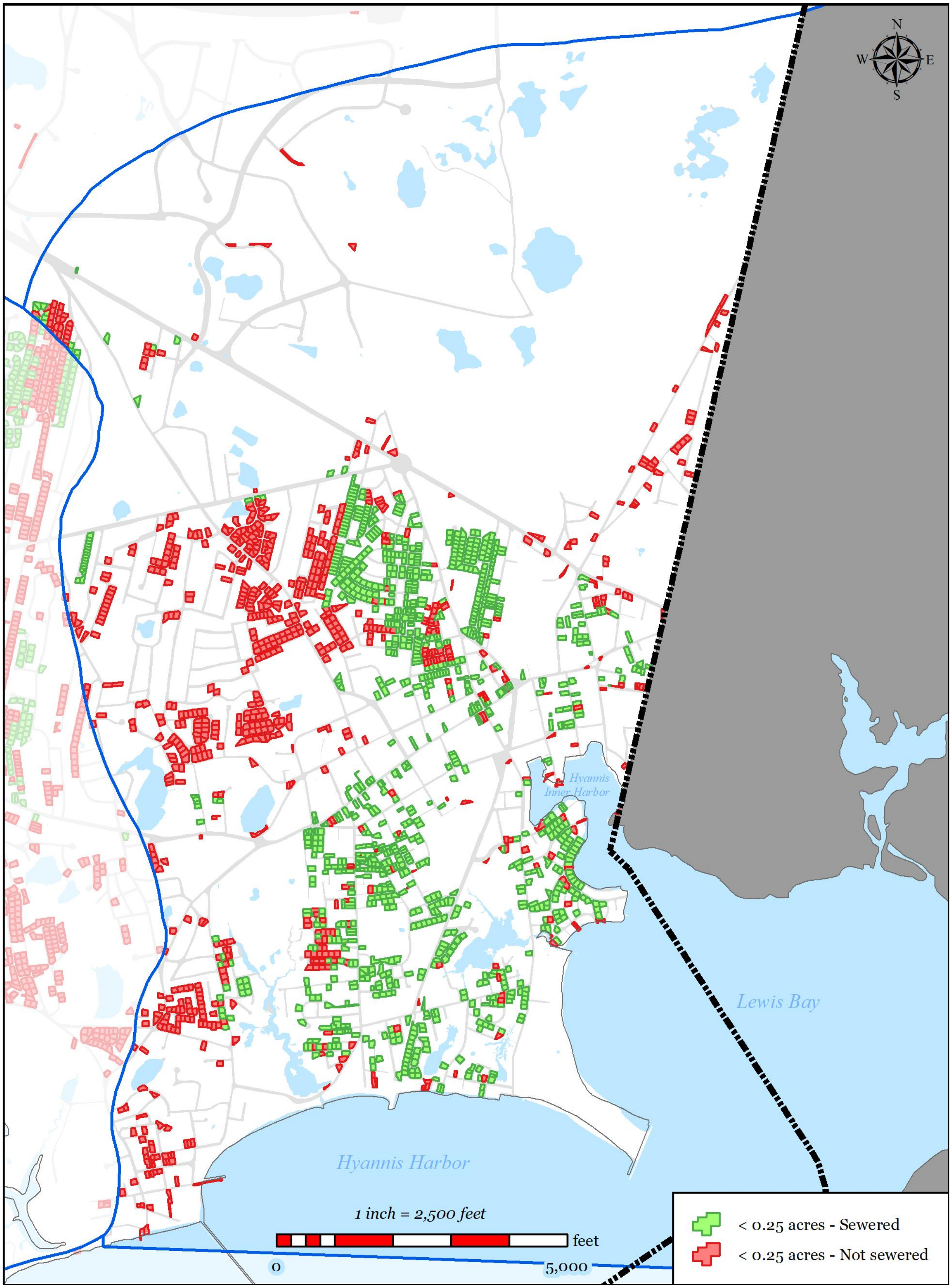

Figure 5-11: Parcels with Less than 0.25 acres in Lewis Bay Watershed

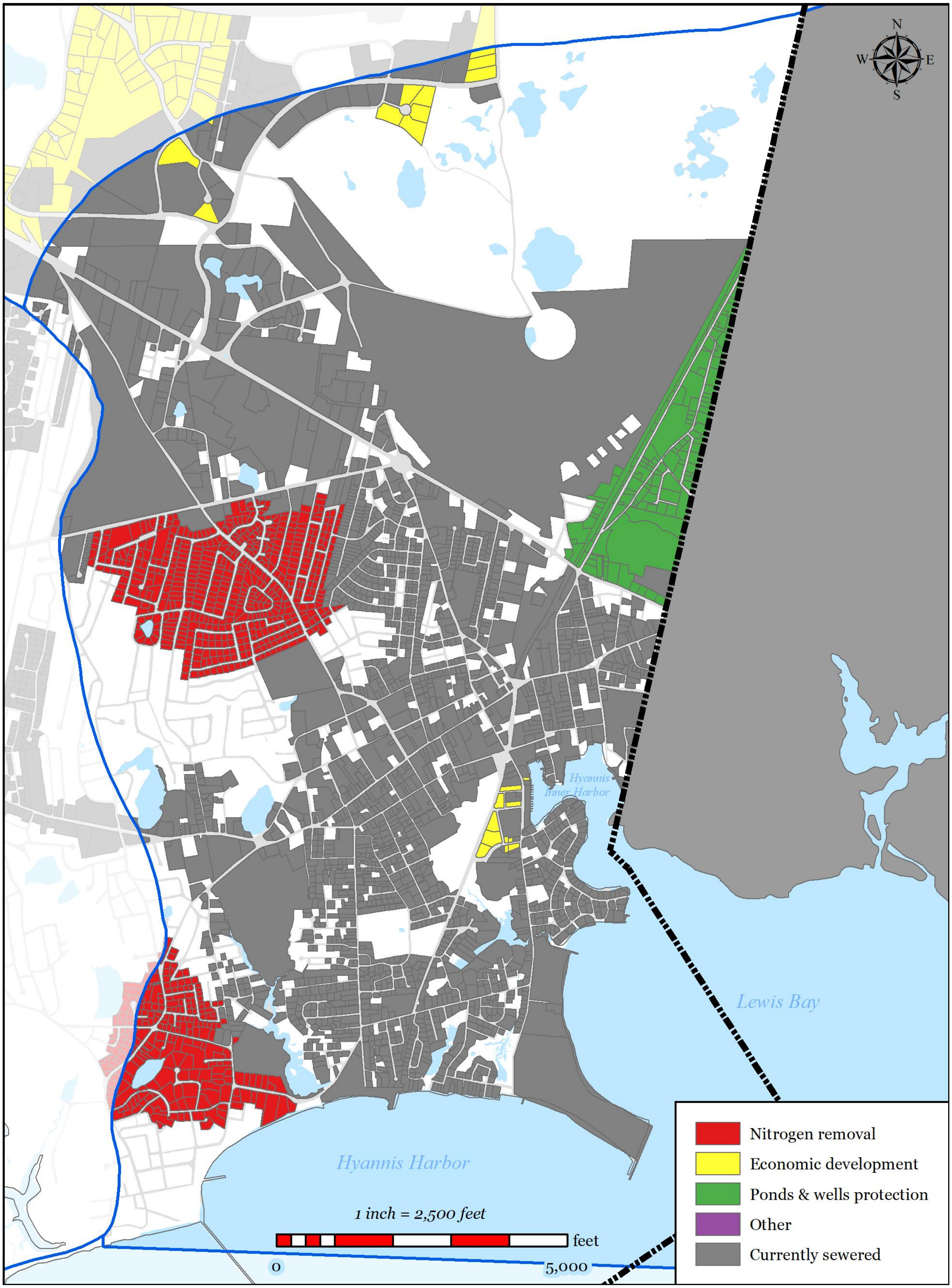

Figure 5-12: Needs Areas in Lewis Bay Watershed

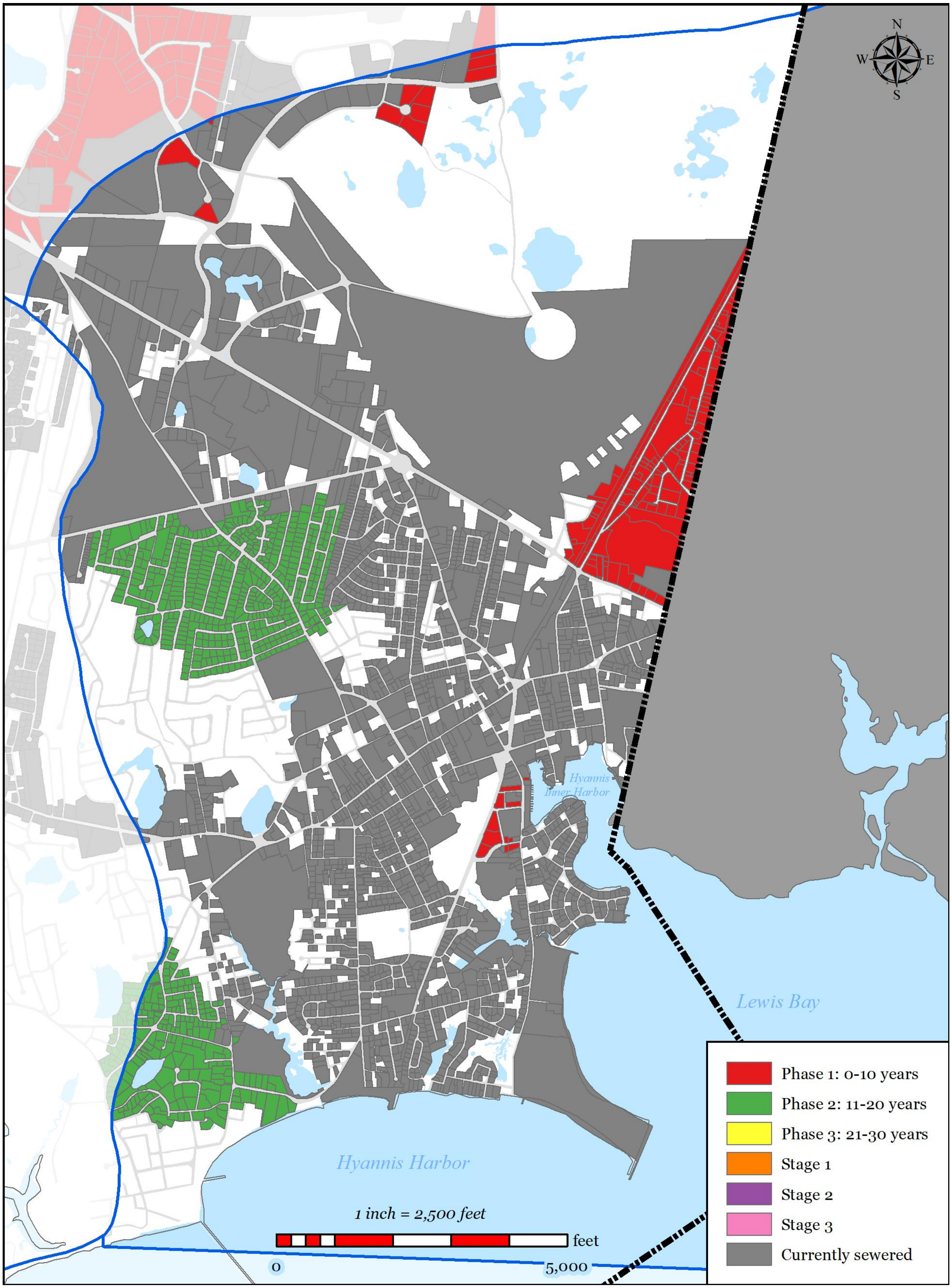

Figure 5-13: Sewer Expansion Plan in Lewis Bay Watershed

5.2.2 HALLS CREEK WATERSHED

The Halls Creek system is located within the Town of Barnstable with a southern shore bounded by Nantucket Sound. The Halls Creek estuary system is located to the west of the Lewis Bay embayment system. The 2008 Lewis Bay Embayment System MEP Report analyzes the Halls Creek system the nutrient capacity of the Halls Creek System. The estuarine system is separated from Nantucket Sound by Squaw Island and the system exchanges tidal water with Nantucket Sound through a single inlet. For a detailed description of the embayment system, refer to the 2008 MEP Report for the Lewis Bay Embayment System (Appendix AA).

The source water for the Halls Creek system is the Halls Creek Watershed. The Halls Creek Watershed is located entirely within the Town of Barnstable (see Figure 5-14). Within the watershed there are 4 named freshwater ponds (Marchant Pond, Simmons Pond, Ben’s Pond, and Dunn’s Pond). The Hyannis Water District operates three public drinking water wells that are located within the watershed and Centerville-Osterville-Marstons Mills (COMM) Water District operates one public drinking water well located on the western border of the watershed.

A large section of the upper reaches of the watershed is already served by municipal sewer. The 2008 MEP Model has shown that the Halls Creek system has an assimilative capacity to accept additional nitrogen, therefore it has not considered a needs area for nitrogen removal. As a result, significant municipal sewer extensions in the watershed are not proposed. However, there is one residential neighborhood located in the southwestern corner of the watershed that has been included in the sewer expansion plan to address other traditional wastewater needs as described below.

5.2.2.1 SUMMARY OF NEEDS

The Town of Barnstable’s wastewater plan has been designed to address multiple needs areas within the Halls Creek Watershed, including pond protection, water supply protection, flood zone considerations, and economic development, via sewer expansion within the Halls Creek Watershed.

5.2.2.1.1 Nutrient Removal

The 2008 MEP Model has shown that the Halls Creek system has an assimilative capacity to accept additional nitrogen, therefore it has not considered a needs area for nitrogen removal. As a result, significant municipal sewer extensions in the watershed are not proposed to address nitrogen. A large section of the upper reaches of the watershed is already served by municipal sewer.

5.2.2.1.2 Wastewater Needs (Other Needs)

Title 5 Issues

The plan has been designed to address traditional Title 5 concerns via traditional sewer expansion within the aforementioned residential neighborhood in the southwestern corner of the watershed. Utilizing the Town's wastewater planning GIS tool allowed Town staff to spatially map traditional Title 5 concerns such as small lot size, depth to groundwater, existing septic variances, existing known failed septic systems, and systems within Zone IIs. Parcels with area less than 0.25 acres were flagged because they were considered difficult to site a traditional septic system, likely to need septic variances, and increased density leading to increased nutrient loading. Parcels with an average depth of groundwater of less than four feet were flagged as likely to require raised systems which are costly and less desirable for community aesthetics. Existing septic variances and existing known failed septic systems were also mapped.

The tool allows the Town to overlay these layers to identify the "hot-spots" for traditional Title 5 concerns. These areas were then incorporated into the plan where practical. Many of these "hot-spots" overlaid other needs such as nutrients and pond protection. The Plan for the Halls Creek Watershed addresses traditional Title 5 concerns as shown in the data presented below (this data does not account for nitrogen attenuation):

- Total parcels within the Halls Creek Watershed = 2,343
- Total parcels connected to existing municipal sewer = 483 (21%)
- Parcels with total area less than 0.25 acres = 954 (41%)
    - 220 (23%) already served by municipal sewer
    - 199 (21%) additional to be addressed with a traditional solution in the Plan
    - Total = 419 (44%)
- Parcels with average depth to groundwater less than four feet = 43 (2%)
    - 0 (0%) already served by municipal sewer
    - 23 (53%) additional to be addressed with a traditional solution in the Plan
    - Total = 23 53%
- Parcels with septic system variances = 5 (0.2%)
    - 3 60% will be addressed with a traditional solution in the Plan
- Parcels with septic system failures = 7 (0.3%)
    - 0 (0%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 1,833 (78%)
    - 483 (26%) already served by municipal sewer
    - 104 (6%) additional to be addressed with a traditional solution in the Plan
    - Total = 587 (32%)

5.2.2.1.3 Pond Protection

The Town's wastewater planning has included detailed studies of ponds 3 acres or larger throughout the Town. Through those studies, there is extensive water data for 3 ponds in the Halls Creek Watershed. Pond classification of these ponds is shown in Table 5-7 and Table 5-8.

Table 5-7: Halls Creek Watershed Pond Classification 2009

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6
Oligotrophic			
Mesotrophic			
Eutrophic	Dunn's Pond		
Hypereutrophic			

Table 5-8: Halls Creek Watershed Pond Classification 2017

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6
Oligotrophic			
Mesotrophic	Ben's Pond	Simmons Pond	
Eutrophic			
Hypereutrophic			

One pond within the watershed has been identified as impaired; Dunn's Pond.

Flood Zones

Low lying areas within the aforementioned residential neighborhood in the southwestern corner of the watershed adjacent to the Halls Creek estuary system have been identified as needs areas for sewer expansion due to being within the 100 year floodplain and/or the velocity zone, and generally having shallow depth to groundwater. As a result of these conditions, traditional Title 5 septic systems are difficult and costly to site in these areas.

- Total parcels within the Halls Creek Watershed = 2,343
- Parcels within FEMA mapped 100-year flood zone (AE/AO) or velocity zone (VE) = 224 (10%)
    - 2 (0.9%) already served by municipal sewer
    - 130 (58%) that will be addressed with a traditional solution in the Plan
    - Total = 132 (59%)

5.2.2.2 PROPOSED SOLUTIONS

The plan addresses the needs areas using the following techniques:

- Sewer Expansion
    - 483 of the 2,343 parcels (21%) located in the watershed are served by municipal sewer
    - 385 of the 2,343 parcels (16%) located in the watershed in the Town are included in the sewer expansion plan

- Stormwater upgrades
    - The Town's MS4 program will identify and provide solutions to existing stormwater outfalls, where appropriate.
        - 15 of the Town's 207 identified stormwater outfalls are located in the Halls Creek Watershed.
    - The Town's Public Road program invests on average $750,000 a year in stormwater improvements in the Town's public roads. These improvements generally include replacement of failed catch basins and leaching structures.

- Fertilizer Regulation
    - In 2014 the Town adopted a Fertilizer Nitrogen and Phosphorus Control Regulation (see Appendix PP). The regulation includes the following:
        - Provides Best Management Practices and performance standards for noncertified fertilizer applicators.
        - Outlines education, certification, enforcement and penalties.

5.2.2.3 FUTURE CONDITIONS

The plan accommodates future growth conditions as follows:

- The watershed has significant assimilative capacity to accept additional nitrogen.
- The majority of the watershed is significantly built-out and there are not significant development potential areas identified in the watershed.
- Adaptive management and monitoring
  - The Town will continue to monitor the embayment, review the Plan and provide formal updates as required.
  - Refer to Section 6.5 for the Adaptive Management Plan and Section 6.4 for the Monitoring Plan.

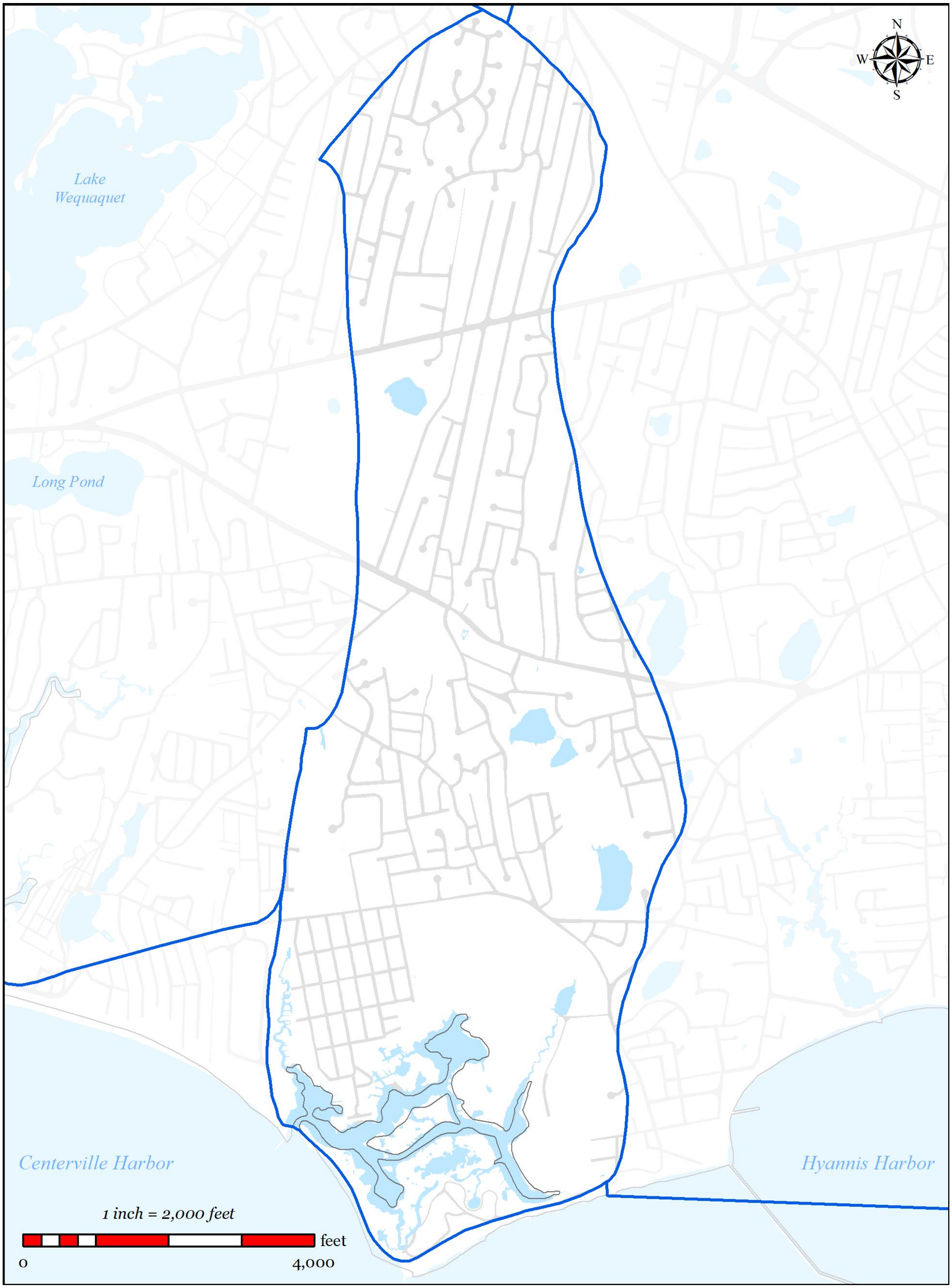

Figure 5-14: Halls Creek Watershed

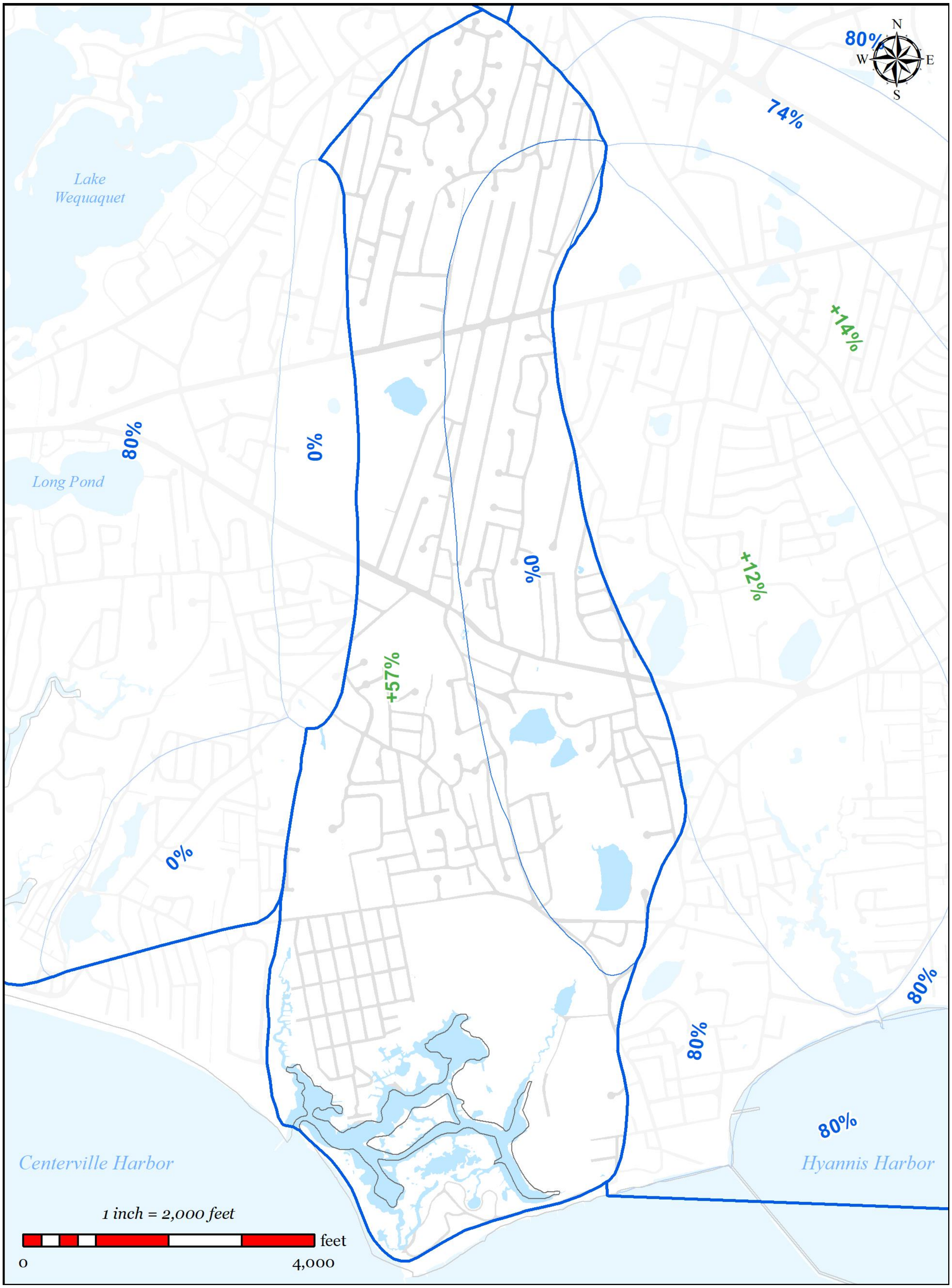

Figure 5-15: MEP-modeled Existing Septic Removal in Halls Creek Watershed

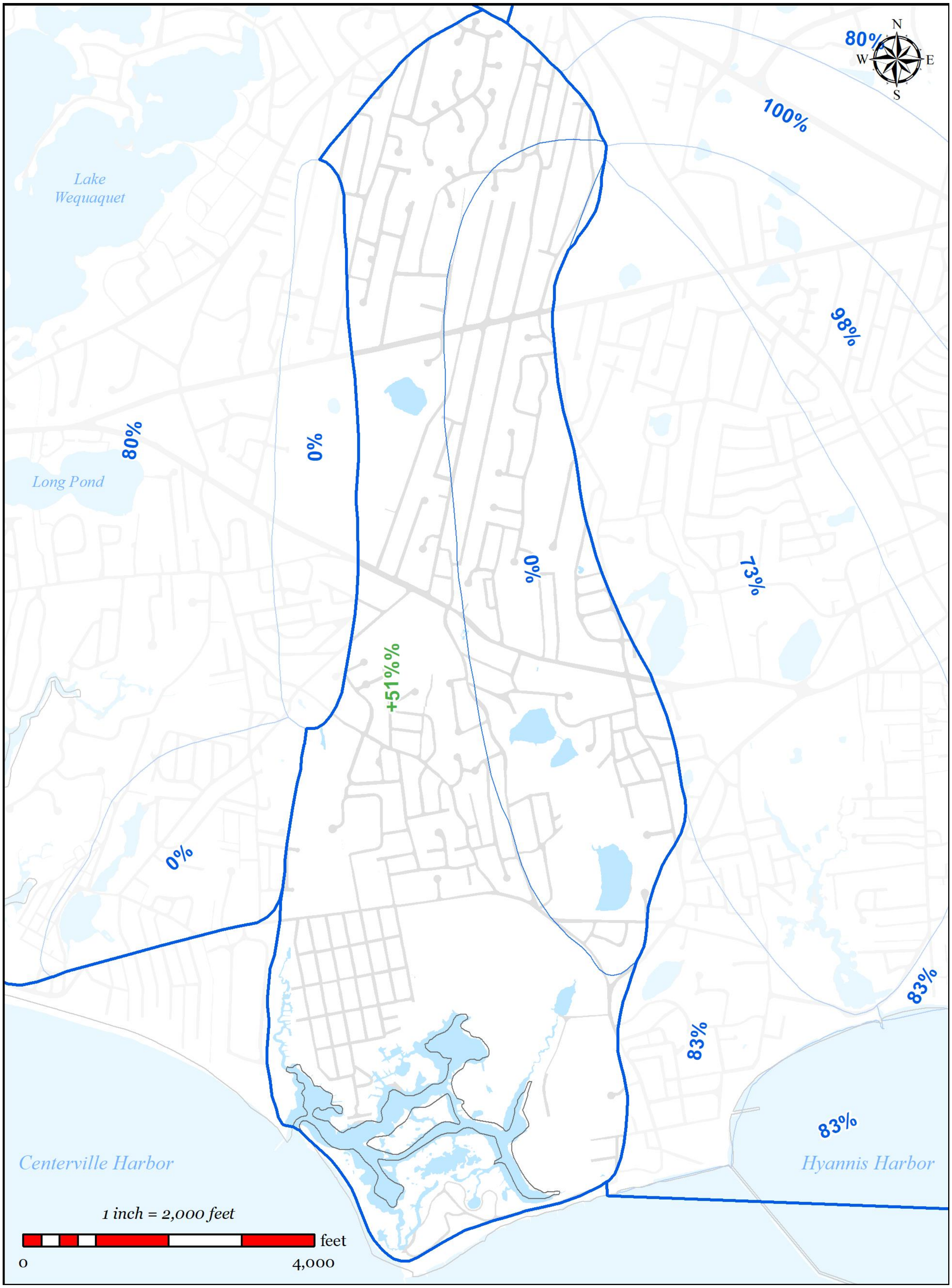

Figure 5-16: MEP-modeled Future Septic Removal in Halls Creek Watershed

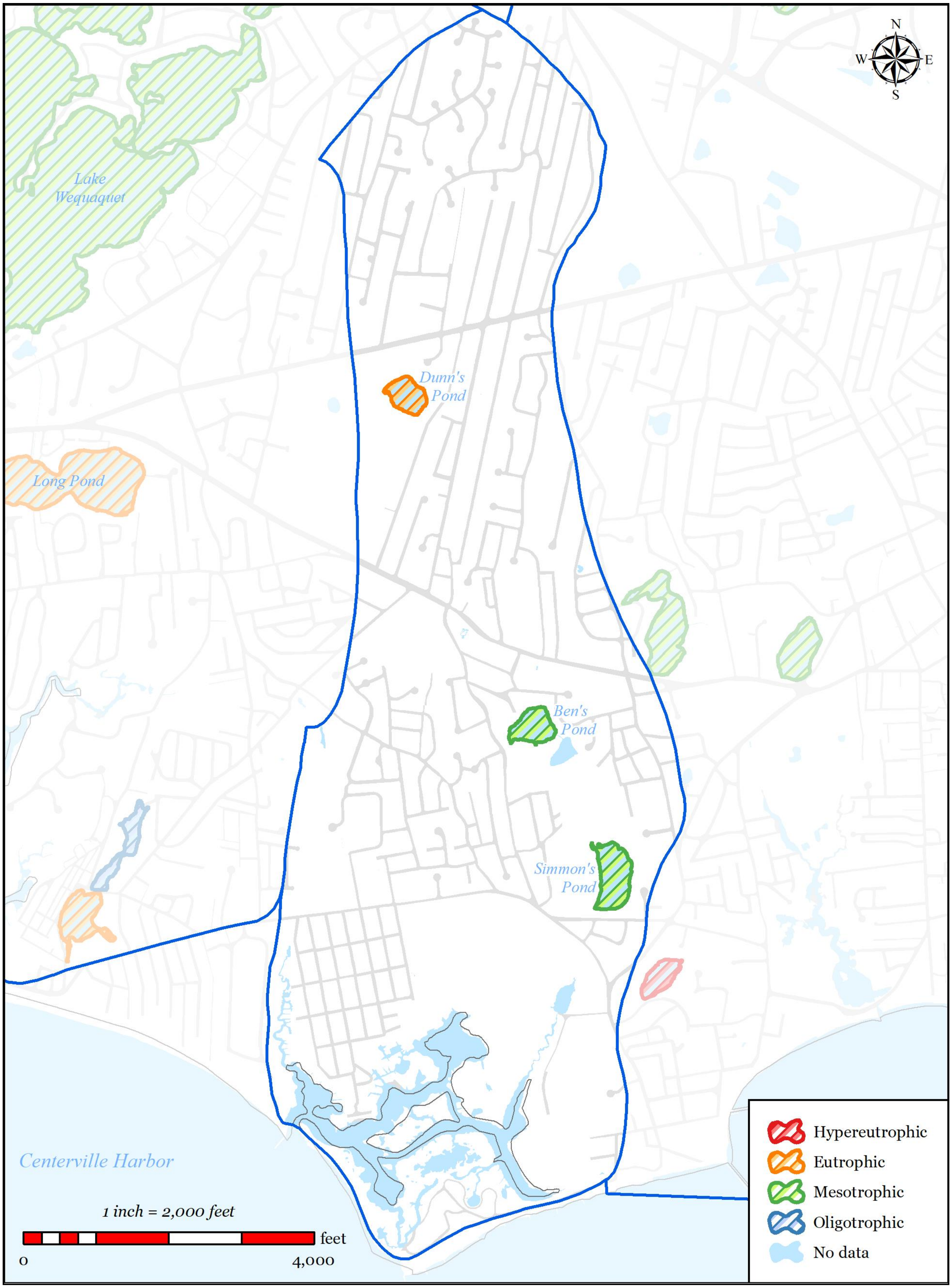

Figure 5-17: Trophic States of Pondsin Halls Creek Watershed.

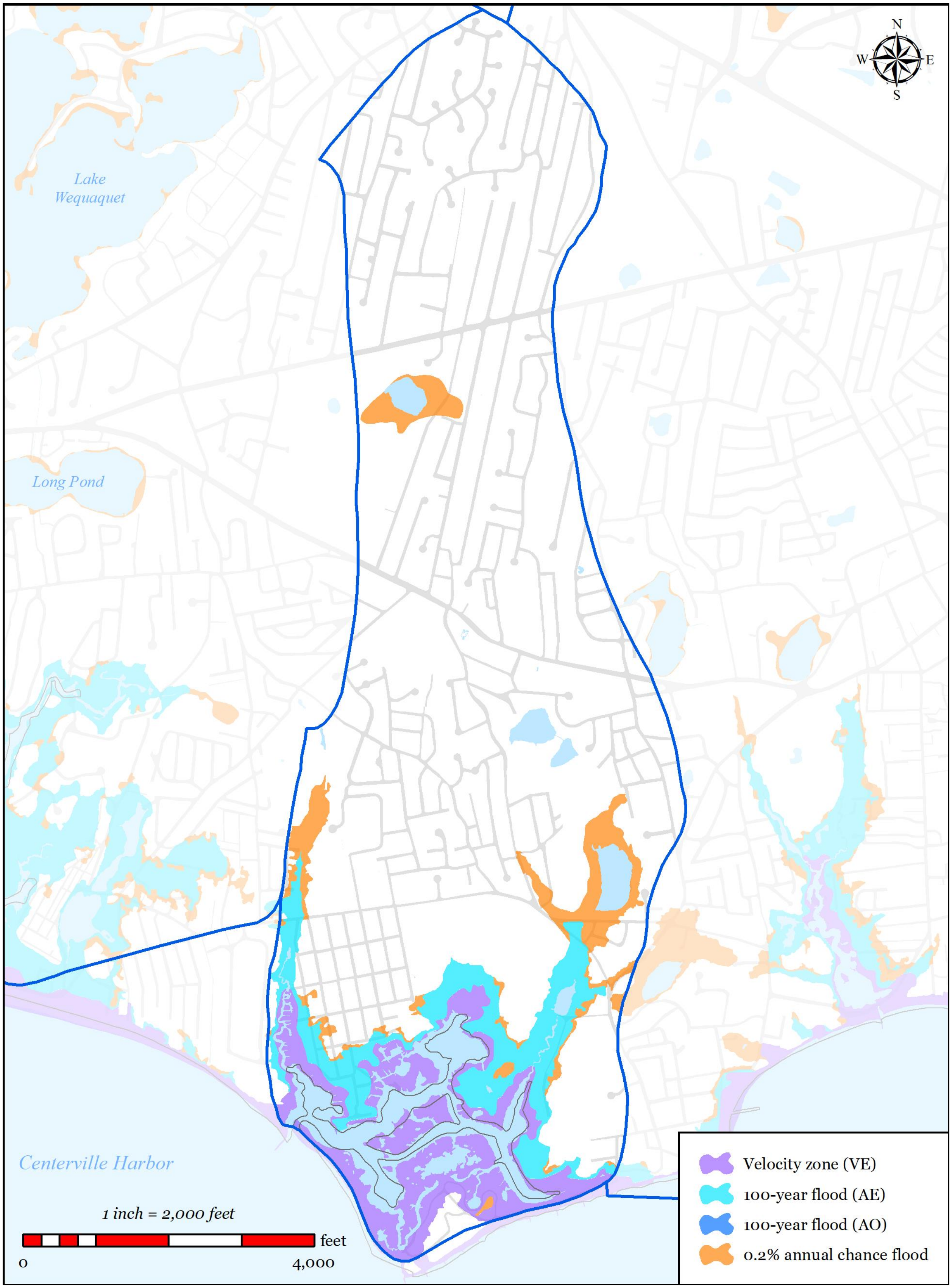

Figure 5-18: FEMA Flood Zones (2014) in Halls Creek Watershed

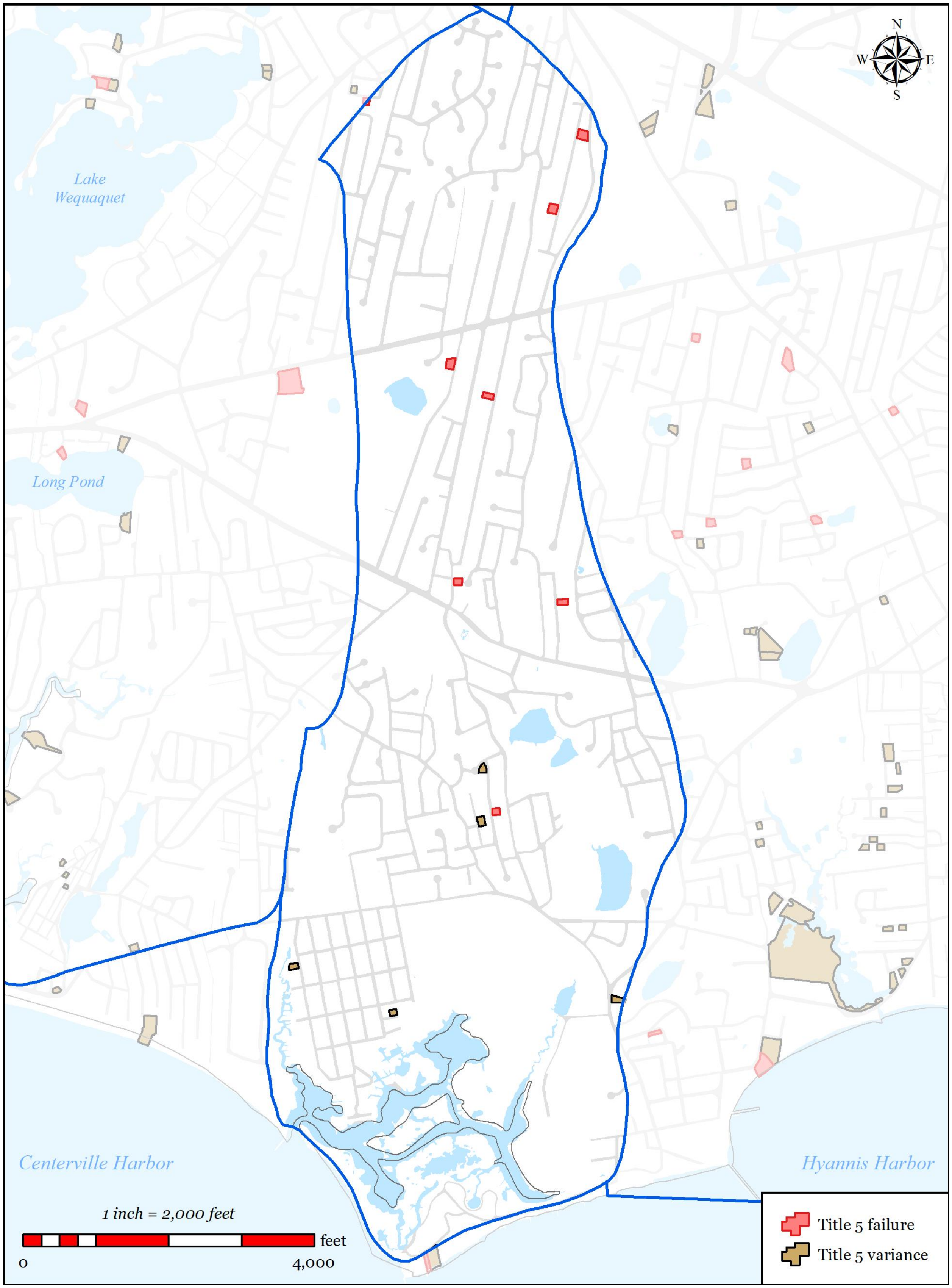

Figure 5-19: Parcels with Title 5 Septic Failures and Variances in Halls Creek Watershed

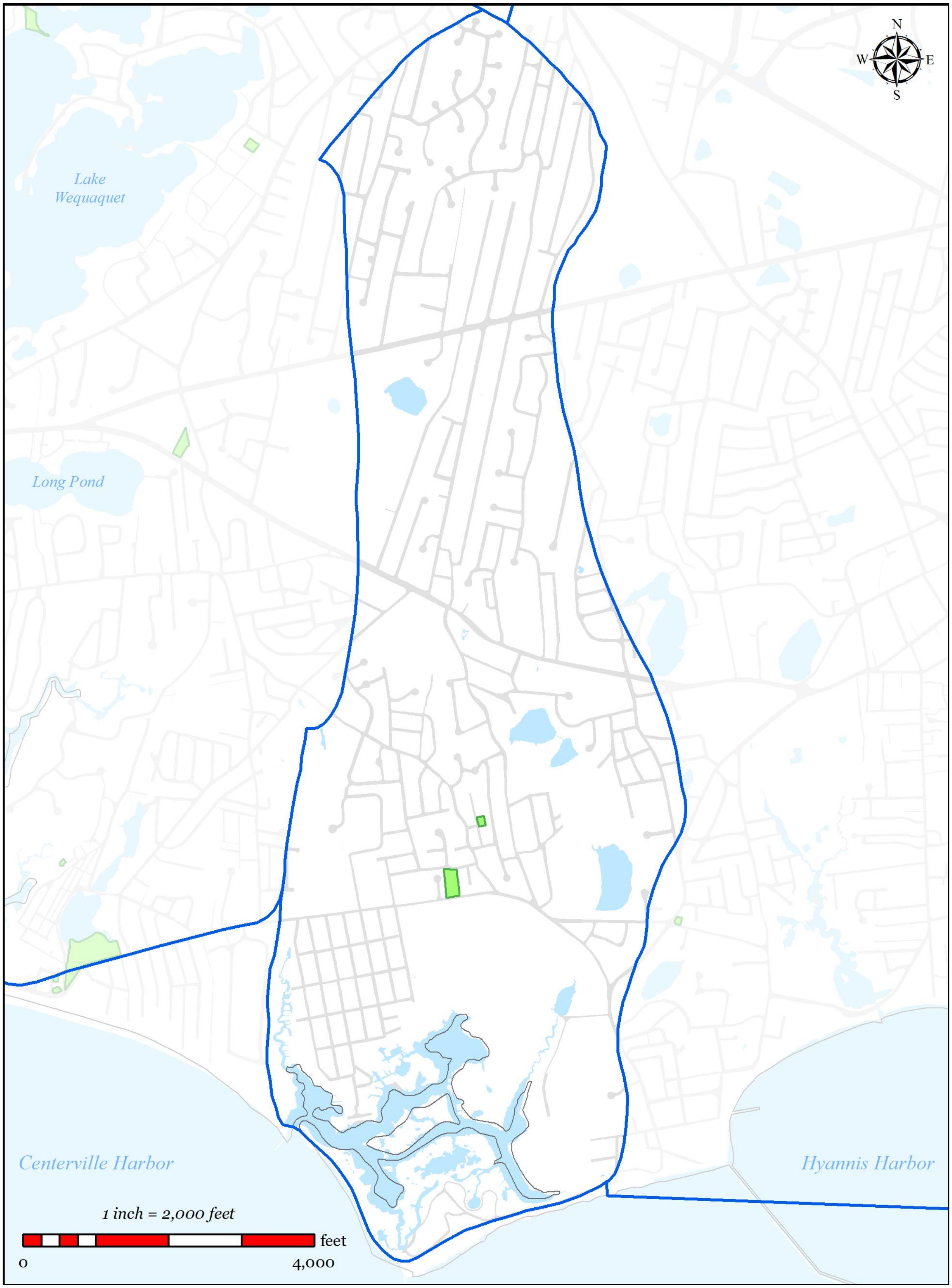

Figure 5-20: Parcels with I/A Septic Systems in Halls Creek Watershed

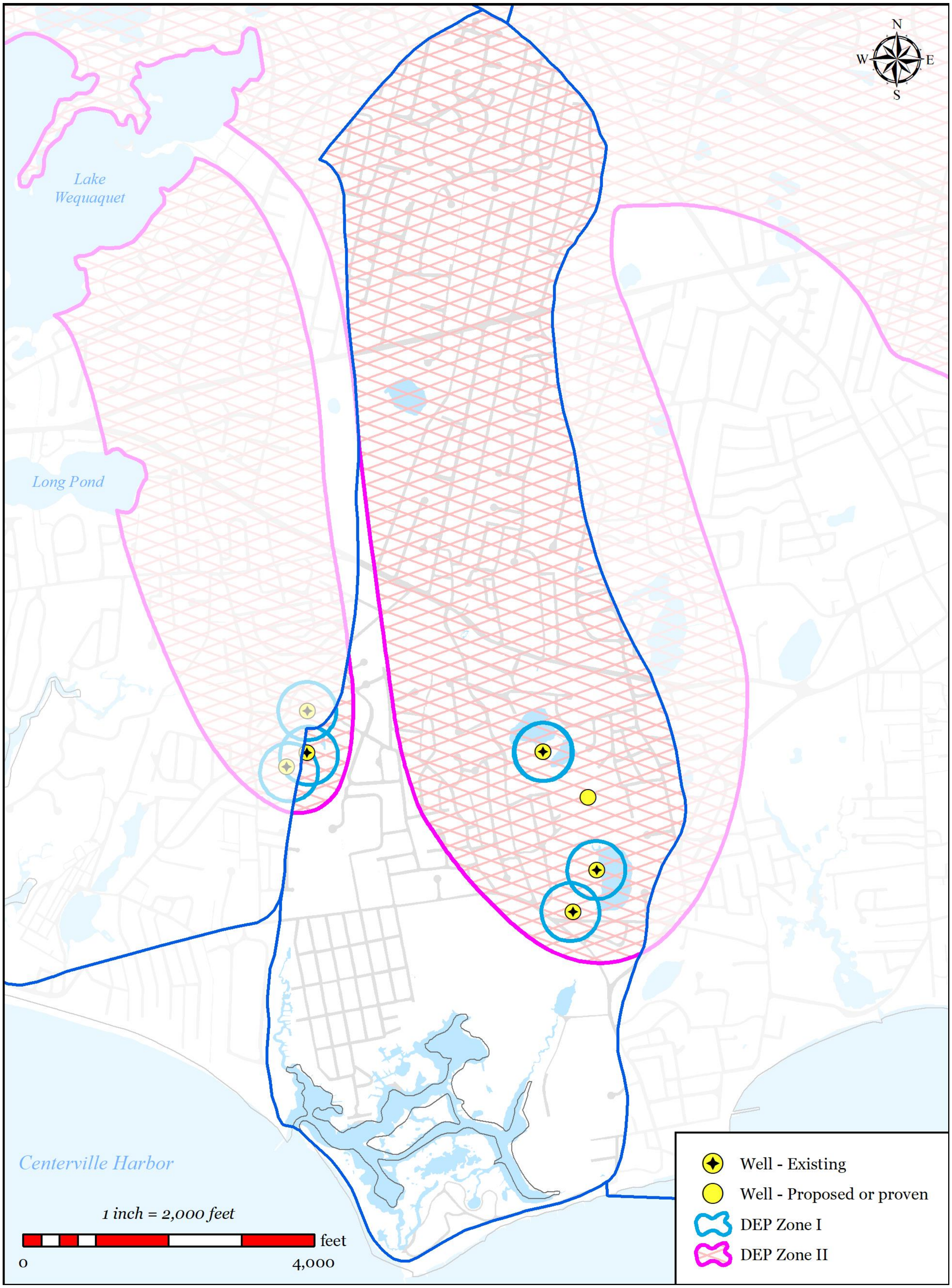

Figure 5-21: Public Water Supply Wells in Halls Creek Watershed

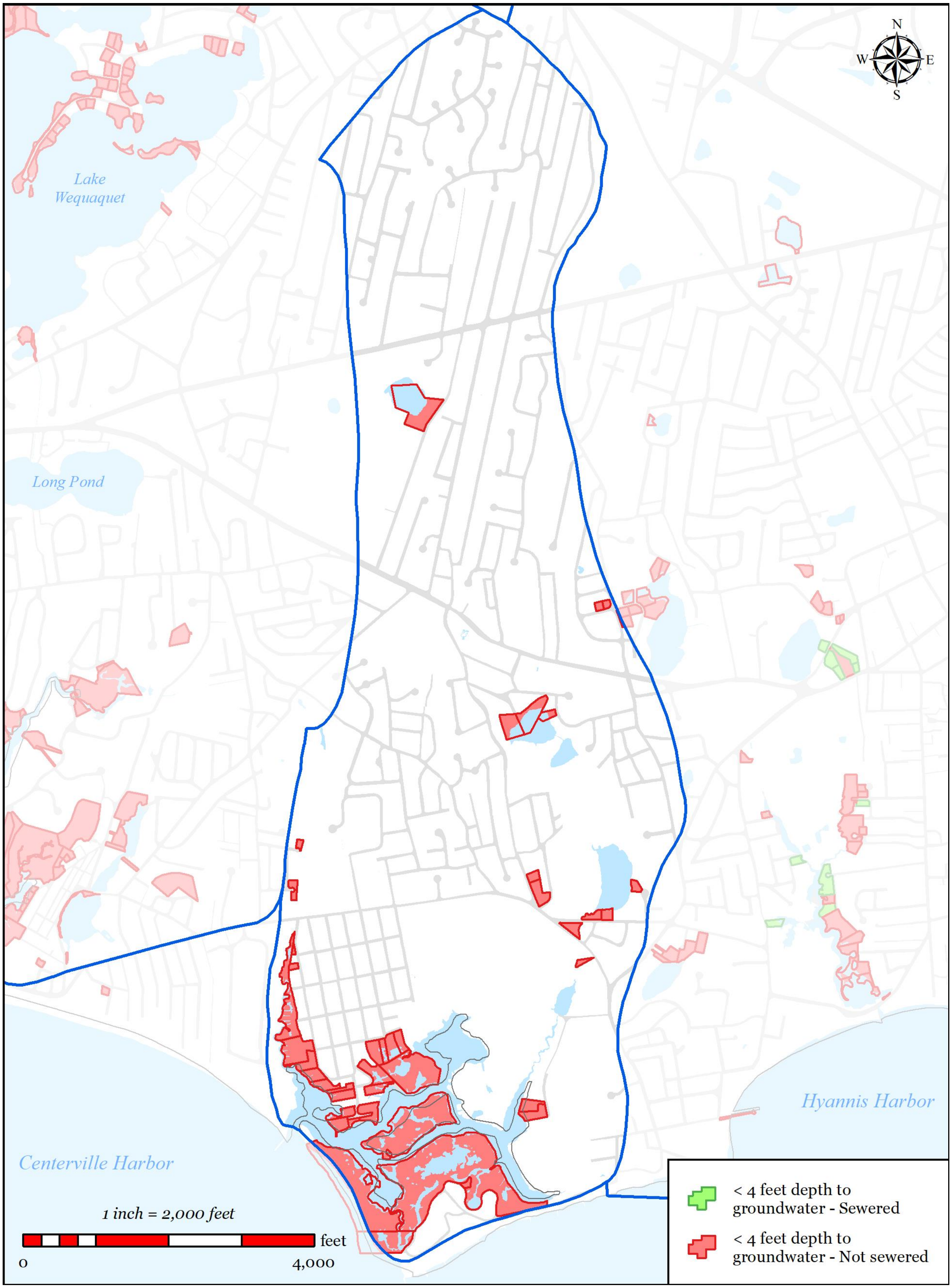

Figure 5-22: Parcels with Less than 4 feet Depth to Groundwater in Halls Creek Watershed

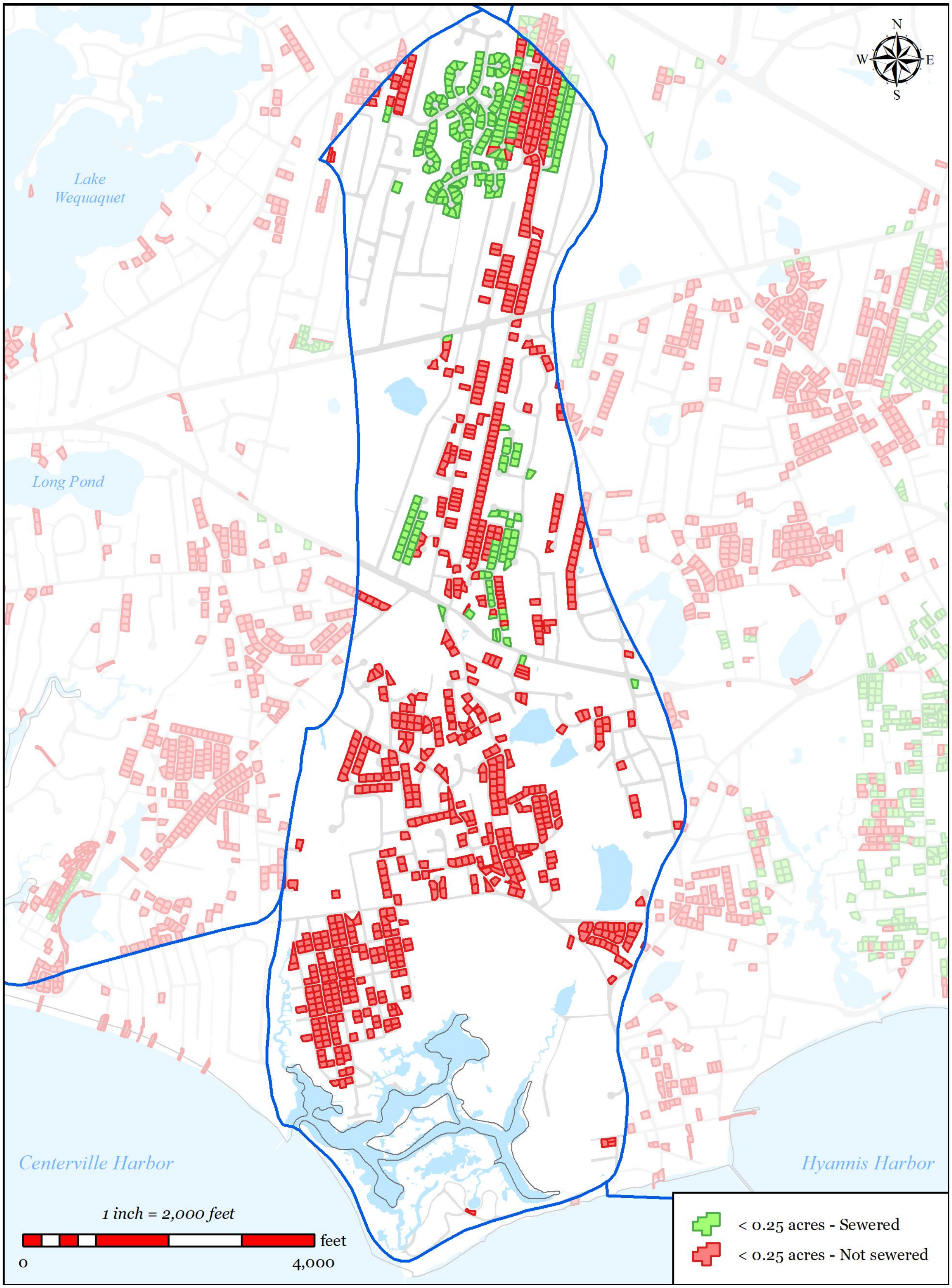

Figure 5-23: Parcels with Less than 0.25 acres in Halls Creek Watershed

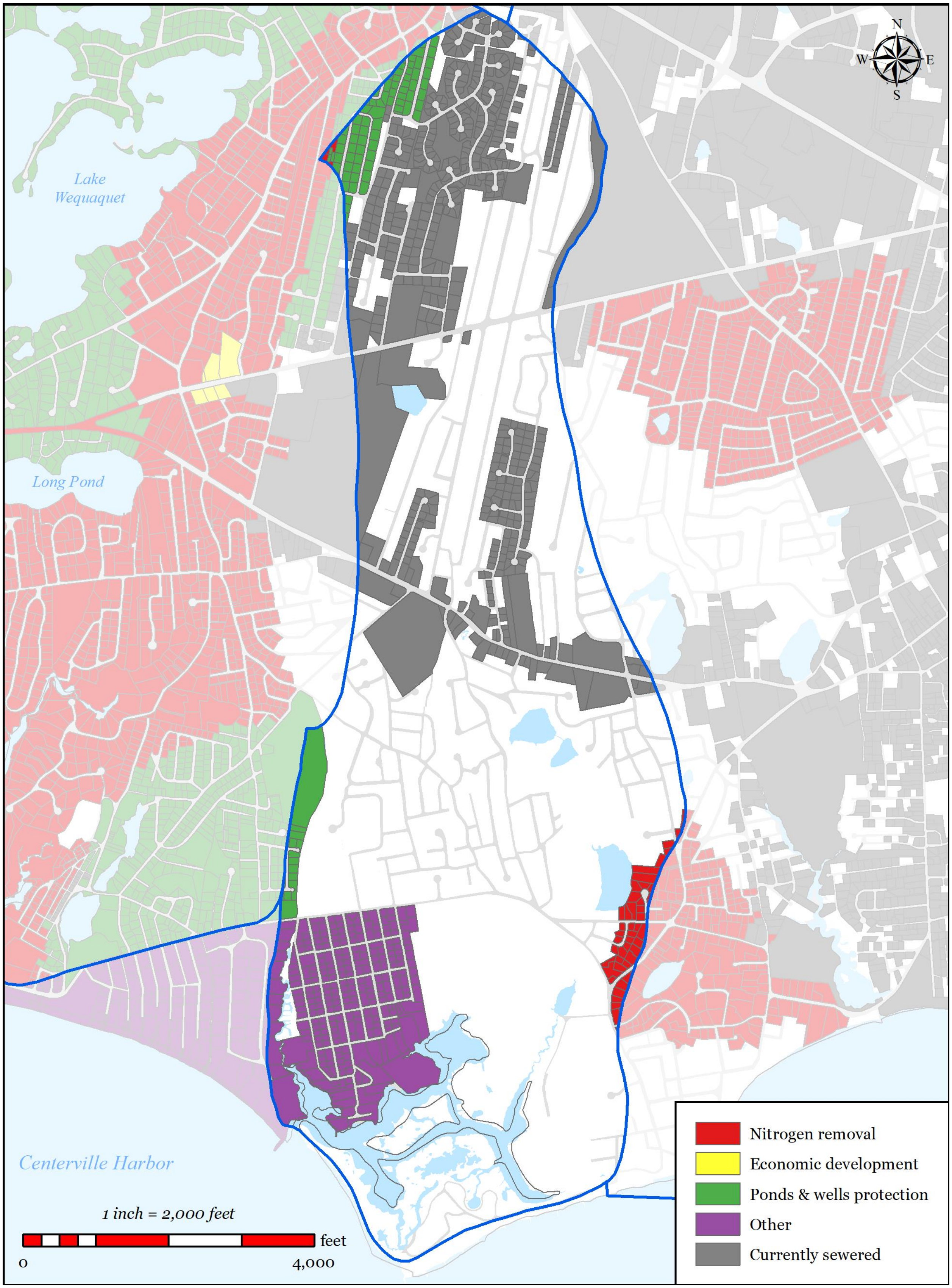

Figure 5-24: Needs Areas in Halls Creek Watershed

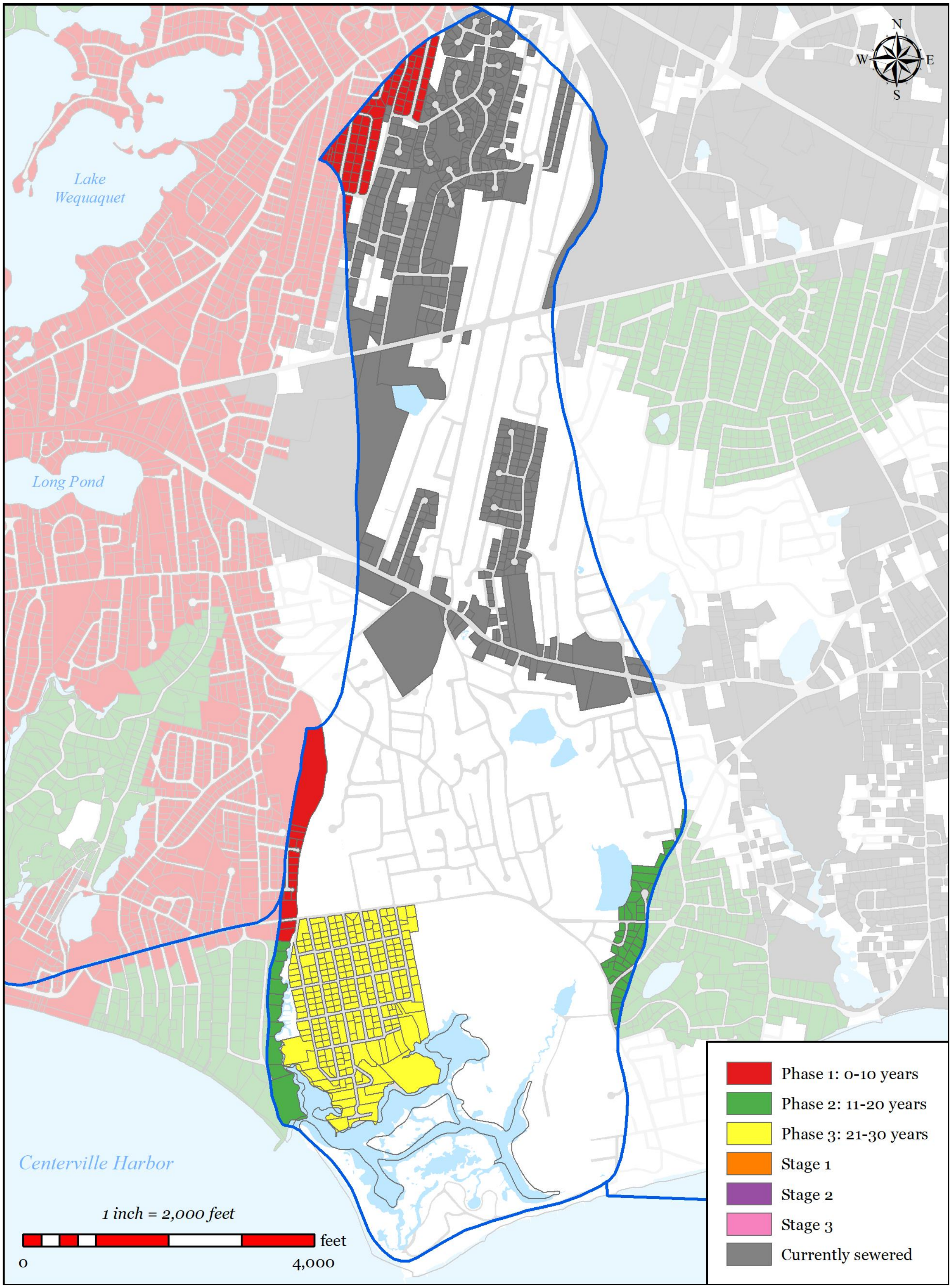

Figure 5-25: Sewer Expansion Plan in Halls Creek Watershed

5.2.3 CENTERVILLE RIVER WATERSHED

The Centerville River Embayment System is a complex embayment system located in the southern, central portion of the Town of Barnstable. The embayment has a lone inlet which connects Centerville Harbor to Nantucket Sound with a number of sub-embayments (East Bay, Centerville River, Bumps River, Scudder Bay, and Centerville River marshes). For a detailed description of the embayment system, refer to the 2006 MEP Report for the Centerville River Embayment (Appendix Y).

The source water for the Centerville River Embayment System is the Centerville River Watershed. The Centerville River Watershed is approximately 6,739 acres and is located entirely within the Town of Barnstable (See Figure 5-26). Within the watershed there are 39 identified surface waters including 14 named freshwater ponds (Wequaquet Lake, Bearses Pond, Shallow Pond, Long Pond, Red Lily Pond, Lake Elizabeth, Filenes Pond, Lumbert Pond, West Pond, North Pond, Skunknet Pond, Michah Pond, Joshua's Pond, Shubael Pond) and 4 significant freshwater stream outlets (Skunknett River, Bumps River, Long Pond Stream, Lake Elizabeth). COMM Water District operates 6 drinking water wells that are located within the watershed. The Town operates two smaller wastewater treatments facilities within the Centerville River Watershed; the Marstons Mills School Treatment Plant (permitted for 42,900 GPD) and the Red Lily Pond shared septic system.

5.2.3.1 SUMMARY OF NEEDS

The Town of Barnstable's wastewater plan has been designed to address multiple needs areas within the Centerville River Watershed, including nutrient removal, pond protection, water supply protection, flood zone considerations, and economic development, via sewer expansion within the Centerville River Watershed.

5.2.3.1.1 Nutrient Removal

The 2006 MEP technical report for the Centerville River system indicates that the system exceeds its critical threshold for nitrogen, resulting in impaired water quality. Based upon the findings of the MEP technical report, a TMDL for nitrogen has been developed and approved.

The Town's wastewater plan has been designed to exceed the septic load removals suggested in the 2006 MEP Report's threshold loading scenario. The MEP threshold scenario modeled an 80% reduction in septic load (41.1 kg/day-N) within the Centerville River East sub-embayment and no reduction in septic load in the other sub-embayments within the watershed. This corresponded to a 34% overall average watershed septic reduction target.

The Town's wastewater plan includes removal of 88% of the total un-attenuated septic load within the Centerville River East sub-embayment via proposed sewer connections (2,100 parcels within the sub-embayment). As can be seen in Figure 5-37, the majority of the sewer expansion within the sub-embayment is planned for Phase 1, which will remove 65% of the total un-attenuated septic load within the sub-embayment.

The proposed additional sewer expansion within the other sub-embayments only further contributes to the overall septic load removal within the watershed as a whole. The plan will result in a total un-attenuated septic load reduction across the watershed of 58% (77.1kg/day N). Phase 1 of the plan will result in a total un-attenuated septic load reduction within the watershed of 41% (54.1kg/day N).

Nitrogen removal data reported above is from the Town of Barnstable's wastewater planning GIS tool and reflects calculated existing, un-attenuated nitrogen loads based upon existing water use data.

5.2.3.1.2 Wastewater Needs (Other Needs)

Title 5 Issues

Integral to the planning process was the Town's development of a wastewater planning GIS tool which allowed Town staff to spatially map traditional Title 5 concerns such as small lot size, depth to groundwater, existing septic variances, existing known failed septic systems, and systems within Zone IIs. Parcels with area less than 0.25 acres were flagged because of they were considered difficult to site a traditional septic system, likely to need septic variances, and increased density leading to increased nutrient loading. Parcels with an average depth of groundwater of less than four feet were flagged as likely to require raised systems which are costly and less desirable for community aesthetics. Existing septic variances and existing known failed septic systems were also mapped.

The tool allows the Town to overlay these layers to identify the "hot-spots" for traditional sewering solutions. These areas were then incorporated into the plan where practical. Many of these "hot-spots" overlaid other needs such as nutrients and pond protection. The Plan for the Centerville River Watershed significantly address traditional Title 5 concerns as shown in the data presented below which was calculated using the Town's wastewater planning GIS tool (this data does not account for nitrogen attenuation):

- Total parcels within the Centerville River Watershed = 7,998
- Parcels with total area less than 0.25 acres = 1,064 (13%)
  - 925 (87%) will be addressed with a traditional solution in the Plan

- Parcels with average depth to groundwater less than four feet = 391 (5%)
    - 338 (86%) will be addressed with a traditional solution in the Plan
- Parcels with septic system variances = 48 (0.6%)
    - 43 (90%) will be addressed with a traditional solution in the Plan
- Parcels with known failed septic systems = 16 (0.2%)
    - 12 (75%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 3,333 (42%)
    - 1,844 (55%) will be addressed with a traditional solution in the Plan

Flood Zones

Low lying areas to the south of the Centerville River and on the south side of Craigville Beach Road have been identified as needs areas for sewer expansion due to being within the 100 year floodplain and/or the velocity zone, and generally having shallow depth to groundwater. As a result of these conditions, traditional Title 5 septic systems are difficult and costly to site in these areas.

- Total parcels within the Centerville River Watershed = 7,998
- Parcels within 100 year flood plain and/or velocity zone = 1,383 (17%)
    - 1,148 (83%) will be addressed with a traditional solution in the Plan
    - This data does not include the aforementioned parcels on the south side of Craigville Beach Road that are outside of the watershed.

Contaminants of Emerging Concern (CECs)

Contaminants of emerging concern (CECs) are increasingly being detected in surface water. (CECs) are made up of three general groups, endocrine disrupting compounds, pharmaceuticals, and personal care products. These compounds and potential contaminants are not currently regulated by the federal government because their toxicity is not well understood. Collecting wastewater with sewers and treating at a centralized treatment location allows the opportunity to treat wastewater for CECs as they are better understood and future treatment technologies are developed.

5.2.3.1.3 Pond Protection

The Town's wastewater planning has included detailed studies of ponds 3 acres or larger throughout the Town. Through those studies, there is extensive water data for 17 ponds in the Centerville River Watershed. Pond classification of these ponds is shown in Table 5-9 and Table 5-10.

Table 5-9: Centerville River Watershed Pond classification 2009

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6m
Oligotrophic	Red Lily Pond	Joshua's Pond	Micah's Pond Shubael Pond
Mesotrophic	Lumbert Pond	Coleman Pond Shallow Pond Bearse Pond	Wequaquet Lake
Eutrophic		Round Pond Long Pond (Cville) Lake Elizabeth	
Hypereutrophic	Little Parker		

Table 5-10: Centerville River Watershed Pond classification 2017

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6m
Oligotrophic			
Mesotrophic	Flowing Pond Mill (Filenes) Pond Weathervane Pond	Coleman Pond	
Eutrophic		North Pond	
Hypereutrophic			

Five ponds within the watershed have been identified as impaired: North Pond, Long Pond (Cville), Lake Elizabeth, Little Parker Pond, and Round Pond. Additionally, during the planning process there was significant public interest in sewer expansion around Lake Wequaquet. Sewer expansion adjacent to the following ponds for protection from nutrients from septic systems has been proposed: Wequaquet Lake, Bearses Pond, Shallow Pond, Long Pond (Cville), Red Lily Pond, Lake Elizabeth, Filenes Pond and Shubael Pond.

5.2.3.1.4 Economic Development

Within the Centerville River Waterhsed, the Route 28 corridor has also been identified by the Town as an area where a traditional solution is desired for economic development. Development within this corridor has historically been restricted by wastewater requirements (i.e. Title 5) and the Town's Saltwater Estuary's Regulation. The Town's wastewater plan has included sewer expansion along the entire Route 28 corridor to accommodate these goals. Sewer expansion is required within the Route 28 corridor to facilitate the sewer expansion needs of the western portion of the Town.

5.2.3.2 PROPOSED SOLUTIONS

The plan addresses the needs areas using the following techniques:

- Sewer Expansion
  - 4,756 parcels (59%) in the watershed are included in the sewer expansion plan
    - 3,428 parcels (72%) of which are in Phase 1.
  - Removal of 58% (77.1kg/day N) of the total existing un-attenuated septic load in the watershed.
    - Required removal per MEP = 34% (36.745 kg/day N).

- Stormwater upgrades
  - Stormwater runoff can contain nitrogen and phosphorus pollutants from fertilizers and pet and yard waste. Storm water will be managed by utilizing best management practices (BMPs) to mitigate the nutrients, and sediments, discharged by stormwater to the waterbodies and to their watersheds
  - The Town's MS4 program will identify and provide solutions to existing stormwater outfalls.
    - 40 of the Town's 207 identified stormwater outfalls are located in the Centerville River Watershed.
  - The Town's Public Road program invests on average $750,000 a year in stormwater improvements in the Town's public roads. These improvements generally include replacement of failed catch basins and leaching structures.

- Fertilizer Regulation
  - In 2014 the Town adopted a Fertilizer Nitrogen and Phosphorus Control Regulation (see Appendix PP). The regulations includes the following:
    - Provides Best Management Practices and performance standards for noncertified fertilizer applicators.
    - Outlines education, certification, enforcement, and penalties.

5.2.3.3 FUTURE CONDITIONS

The plan accommodates future growth conditions as follows:

- The majority of the watershed is significantly built-out.
- Projected growth within the watershed.
  - The projected growth within the watershed is focused on the Route 28 corridor which will be addressed with traditional solutions (i.e. sewer expansion).

Projected growth in these areas will be considered when sizing sewer infrastructure (pipes, pump stations, force mains, etc.).

- In order to address other needs within the watershed, the sewer expansion plan removes about 2 times the existing target septic load removal per MEP. This additional 34.8 kg/day N of removal can accommodate significant growth potential within the watershed while still meeting the nitrogen TMDL.
- Adaptive management and monitoring
  - The Town will continue to monitor the embayment, review the Plan and provide formal updates as required.
  - Refer to Section 6.5 for the Adaptive Management Plan and Section 6.4 for the Monitoring Plan.

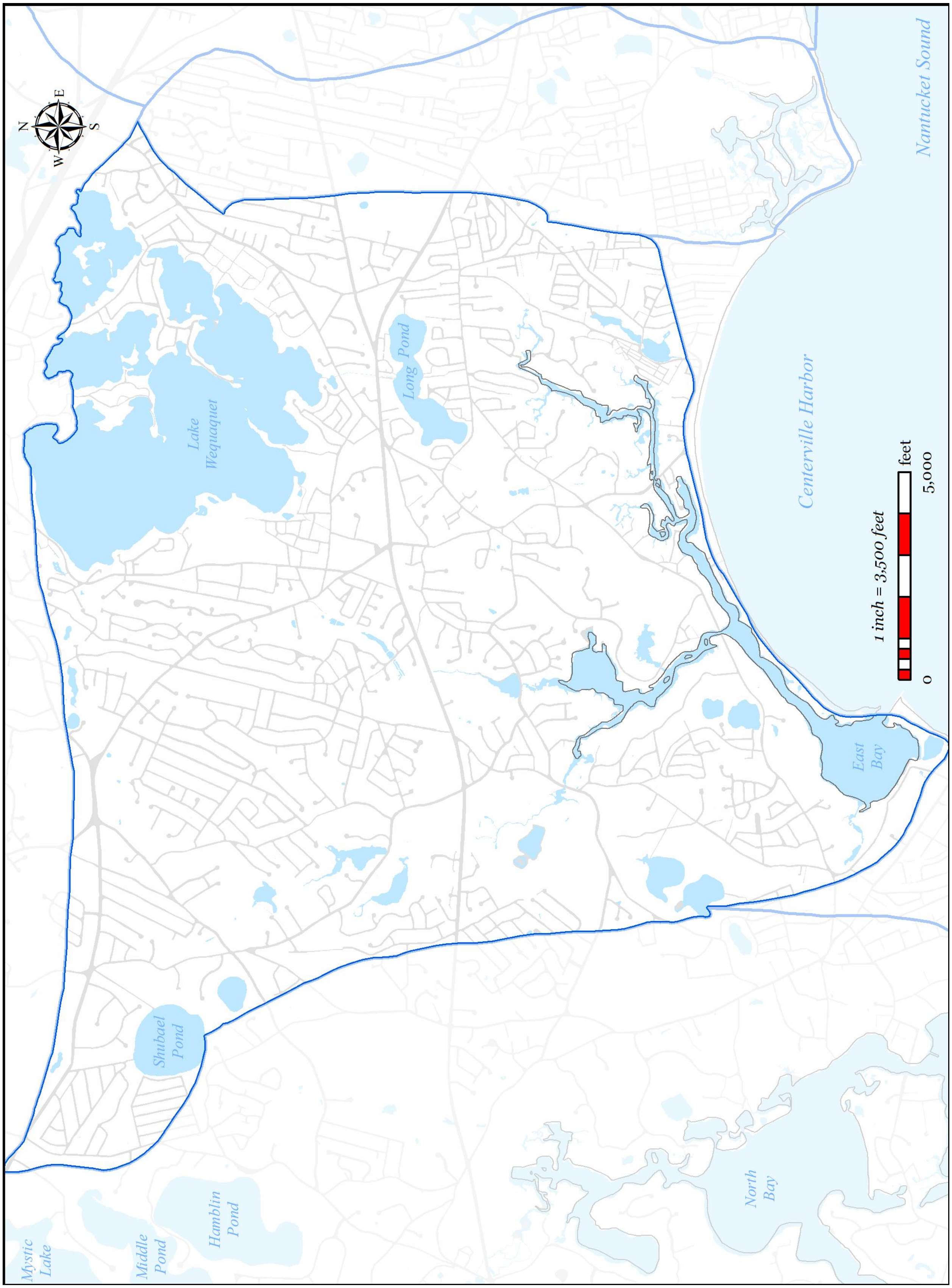

Figure 5-26: Centerville River Watershed

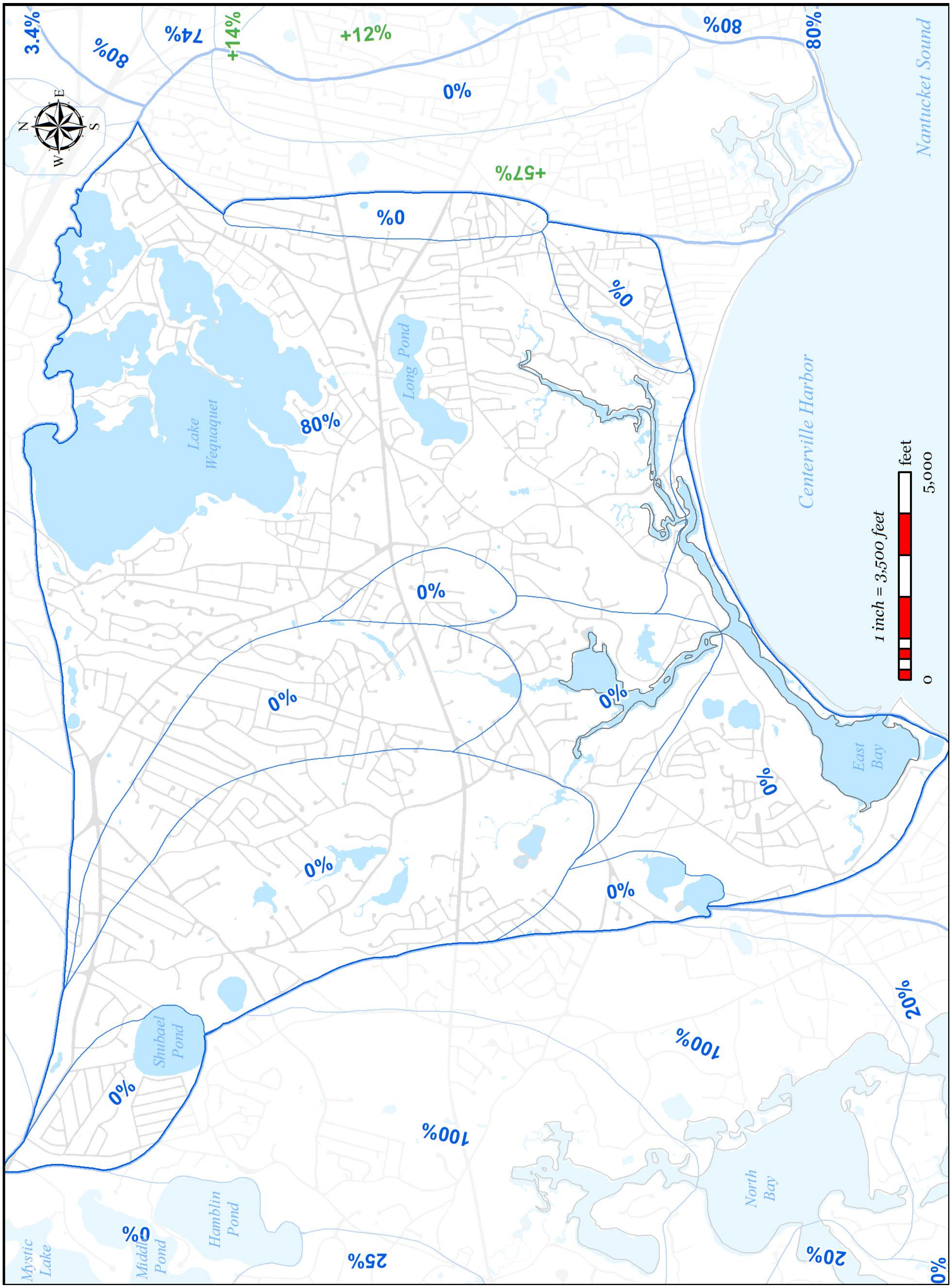

Figure 5-27: MEP-modeled Existing Septic Removal in Centerville River Watershed

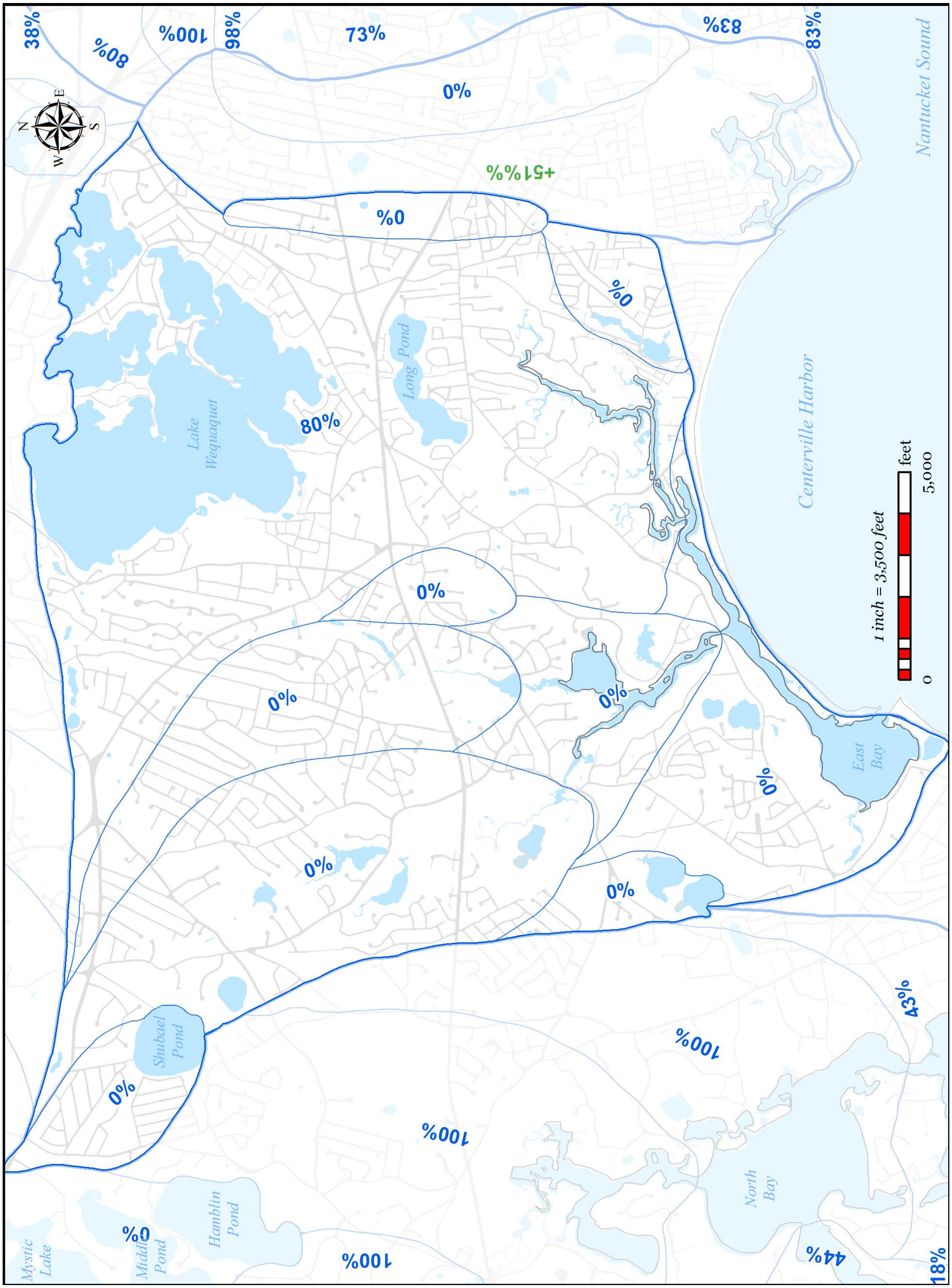

Figure 5-28: MEP-modeled Future Septic Removal in Centerville River Watershed

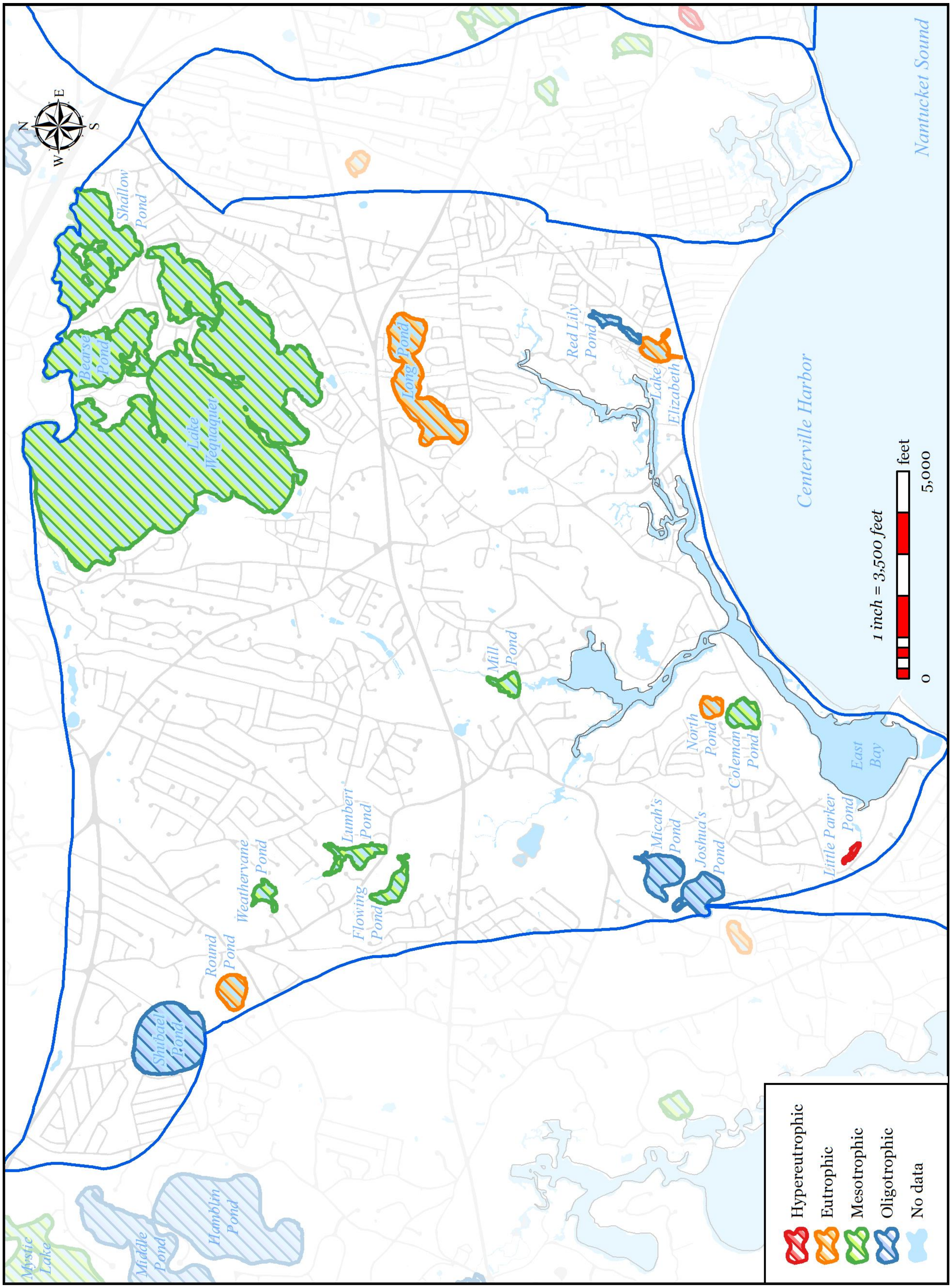

Figure 5-29: Trophic States of Pondsin Centerville River Watershed.

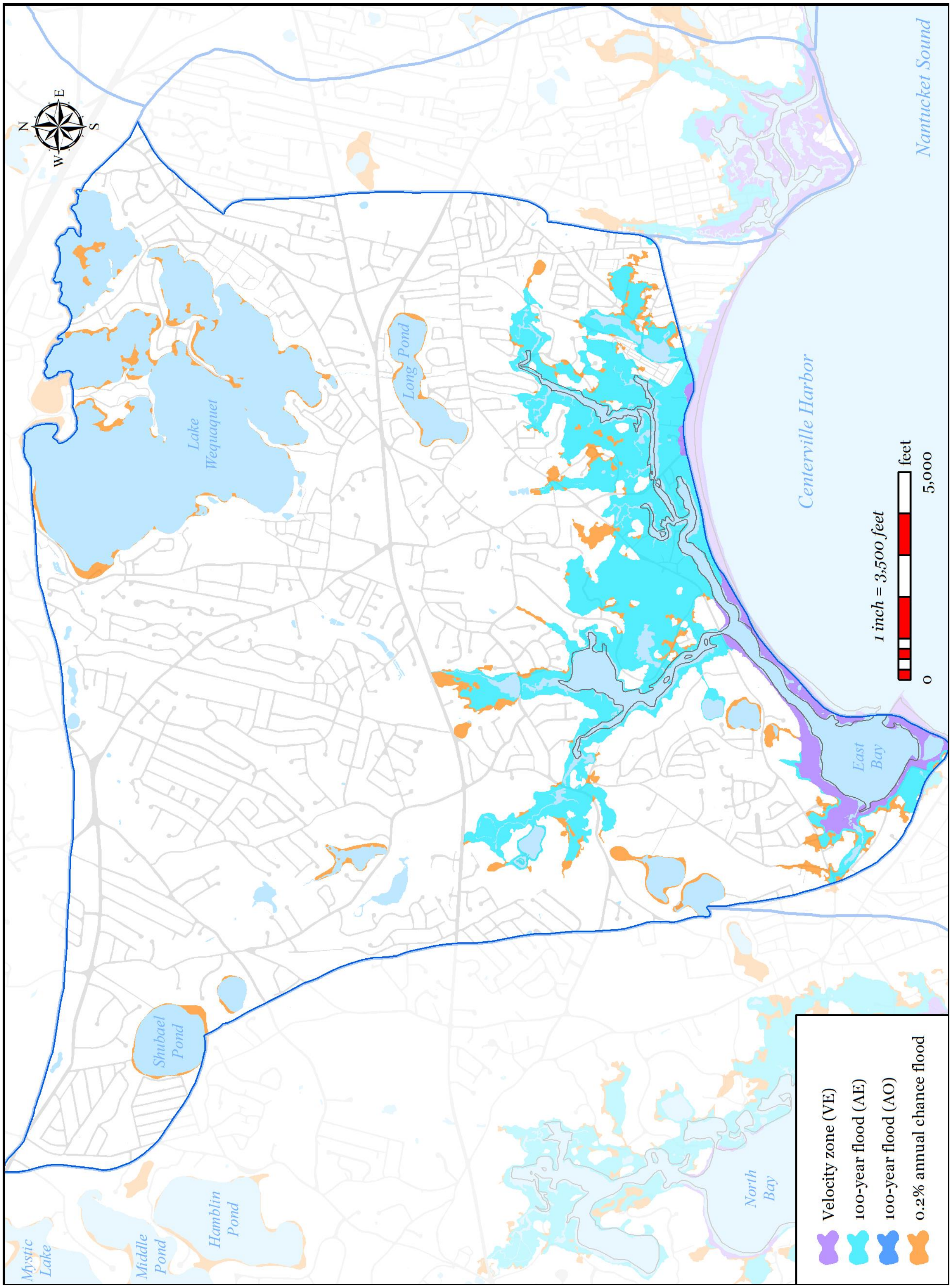

Figure 5-30: FEMA Flood Zones (2014) in Centerville River Watershed

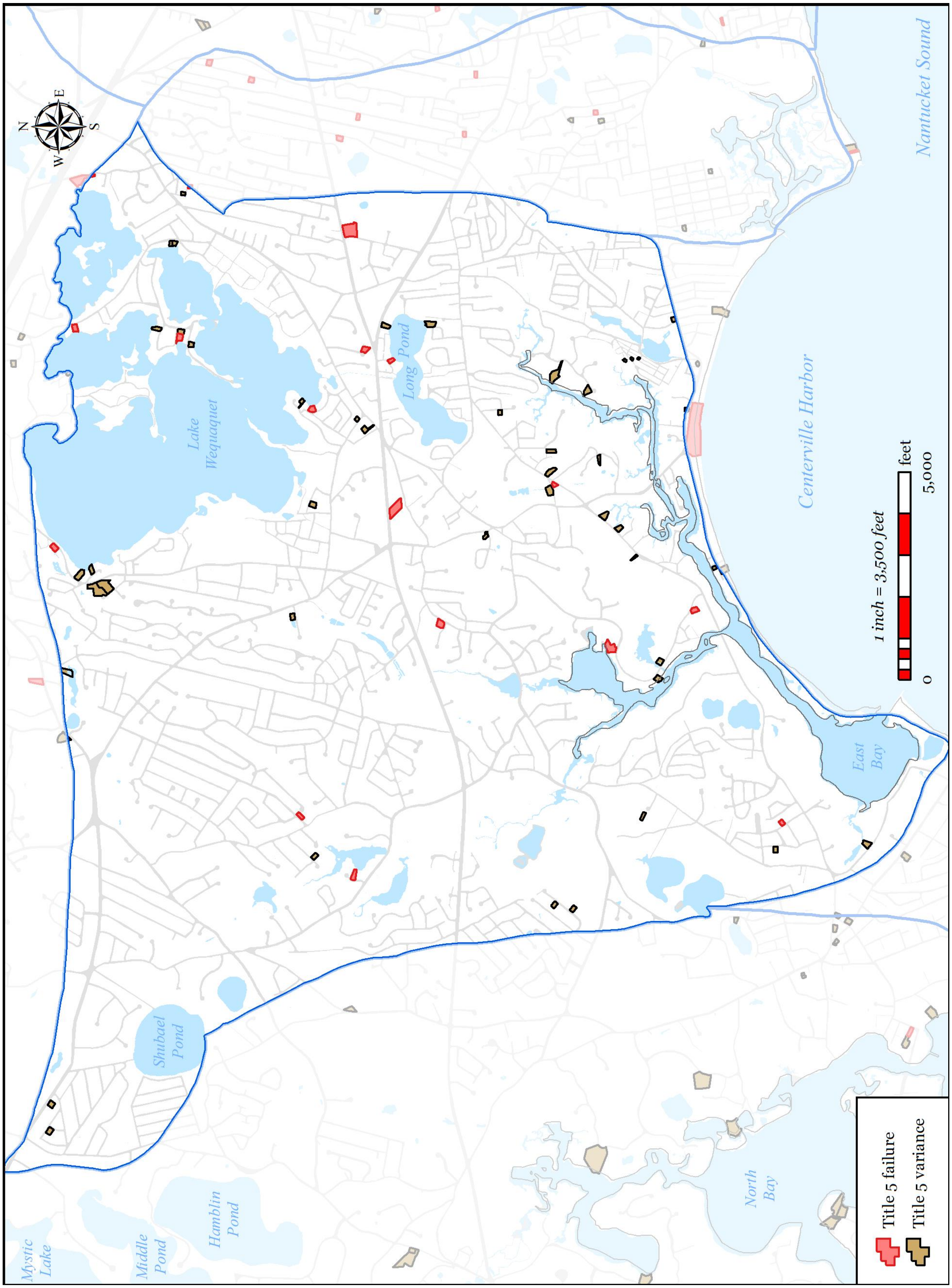

Figure 5-31: Parcels with Title 5 Septic Failures and Variances in Centerville River Watershed

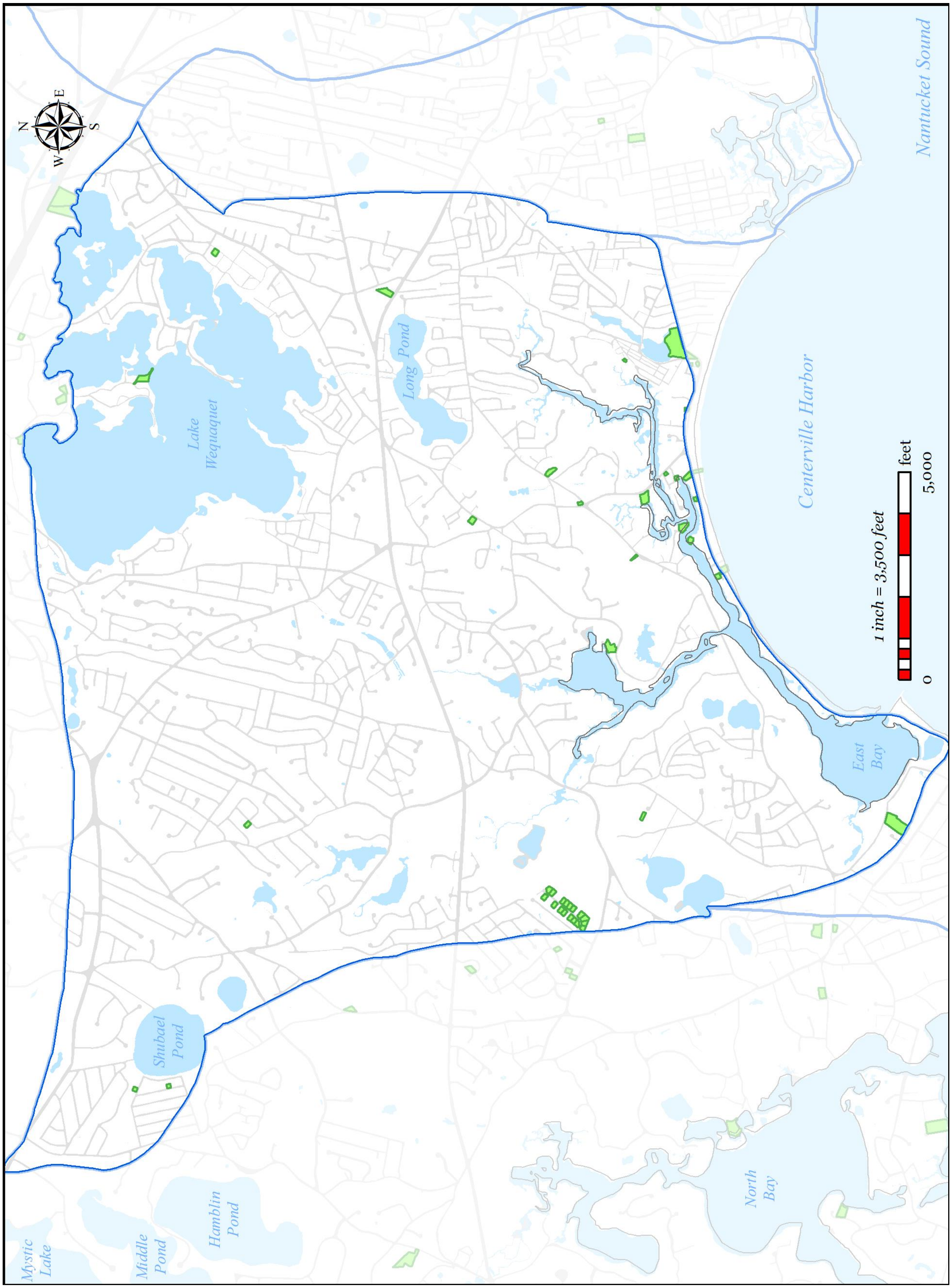

Figure 5-32: Parcels with I/A Septic Systems in Centerville River Watershed

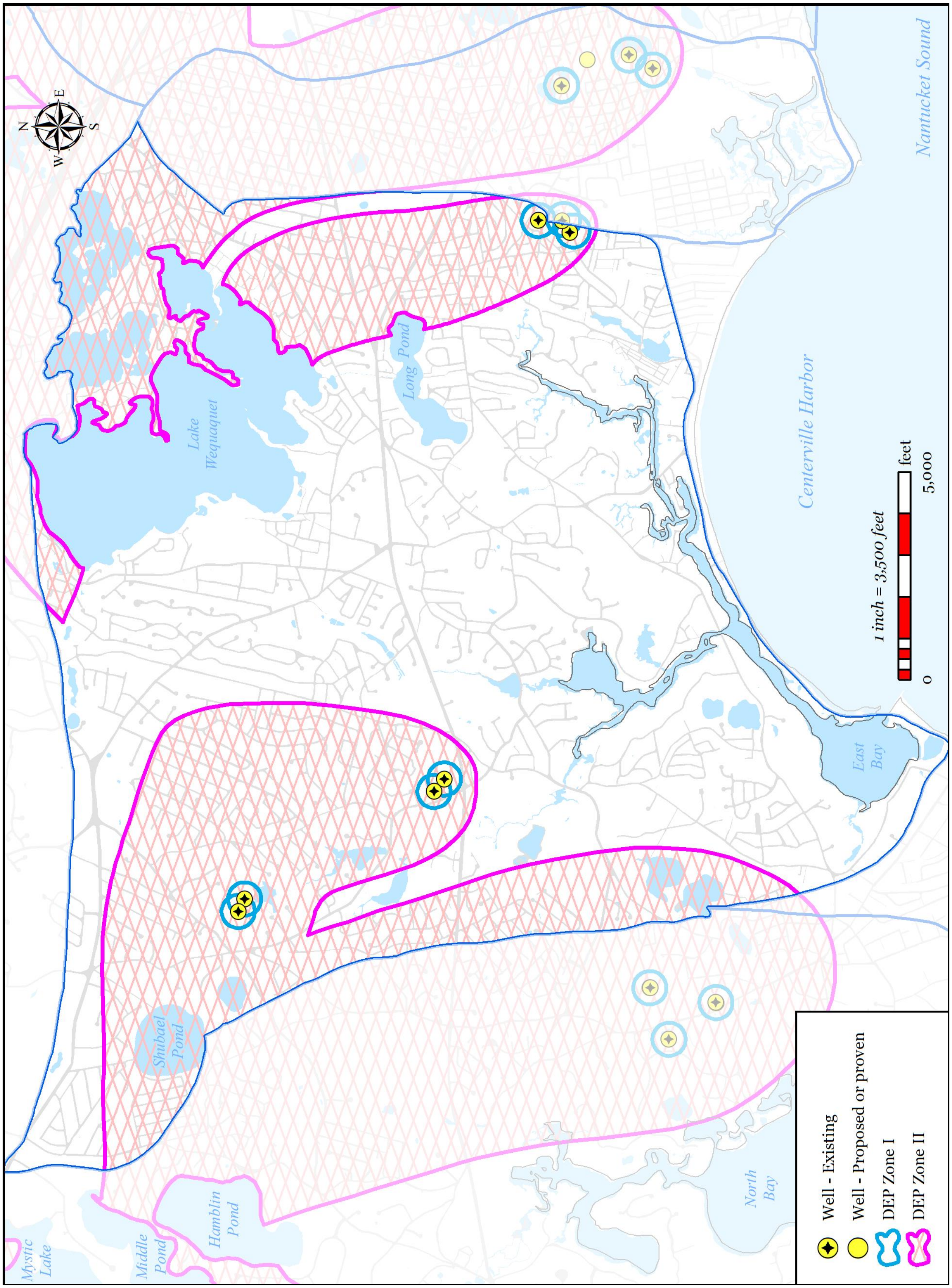

Figure 5-33: Public Water Supply Wells in Centerville River Watershed

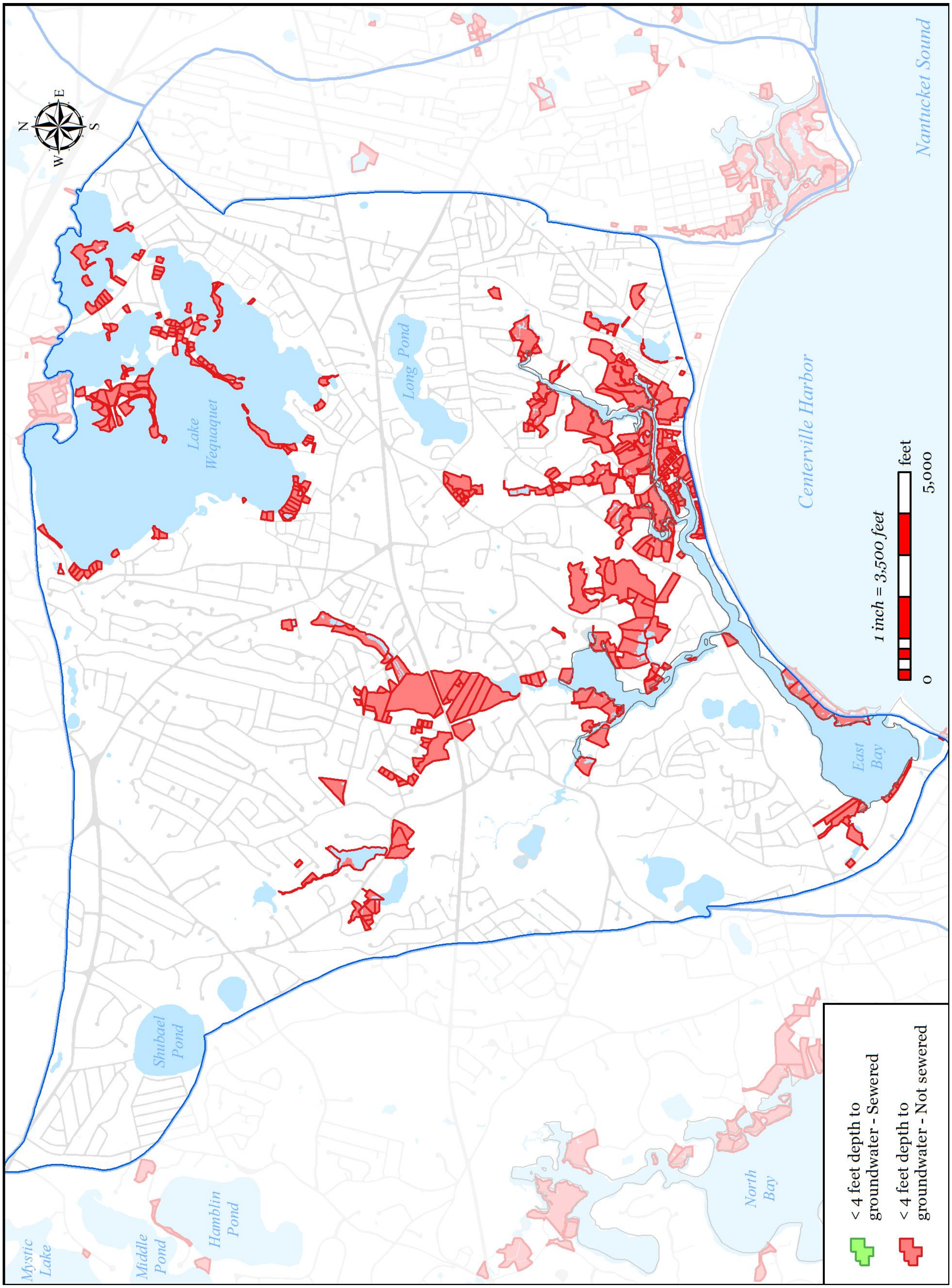

Figure 5-34: Parcels with Less than 4 feet Depth to Groundwater in Watershed

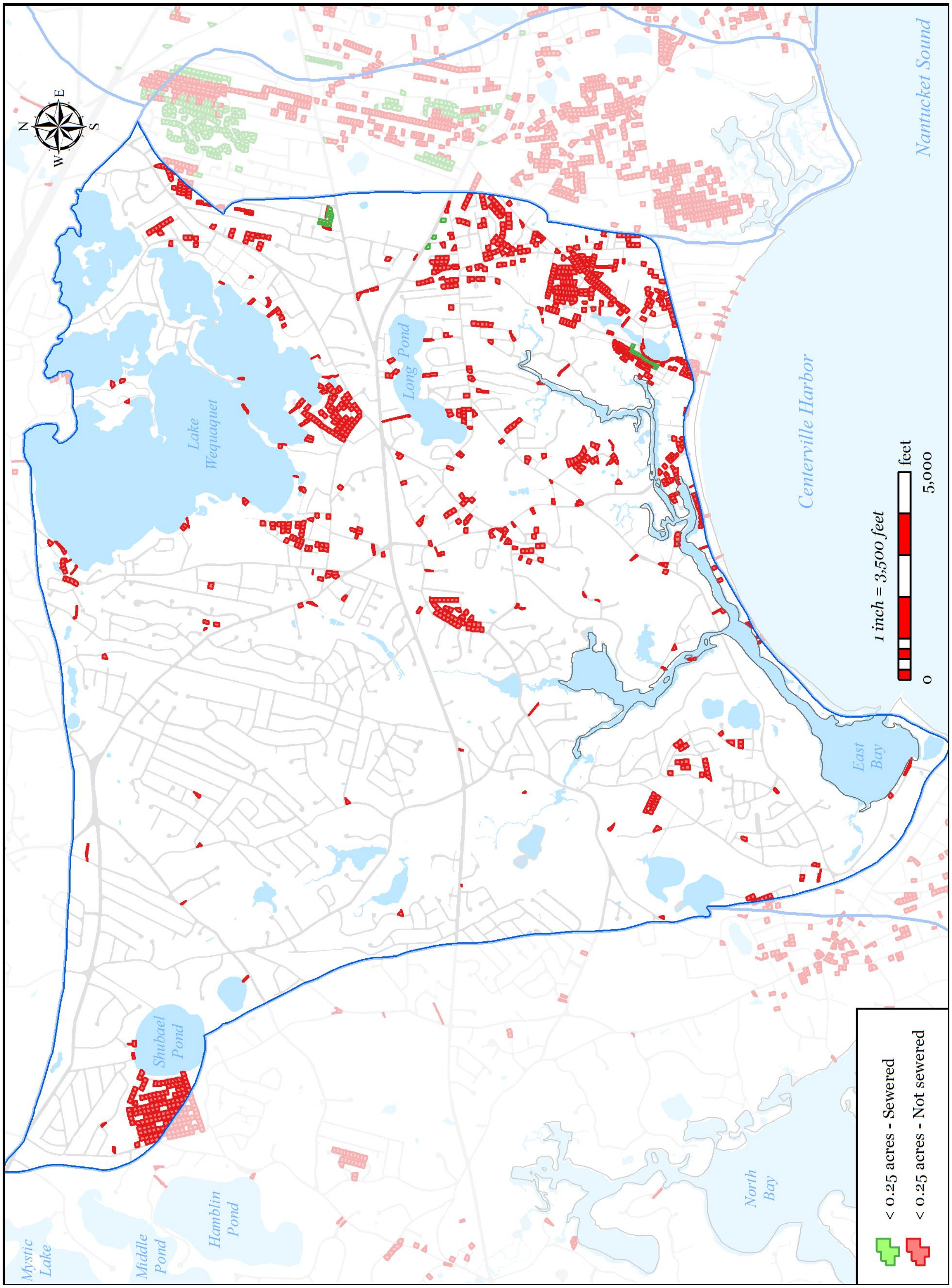

Figure 5-35: Parcels with Less than 0.25 acres in Centerville River Watershed

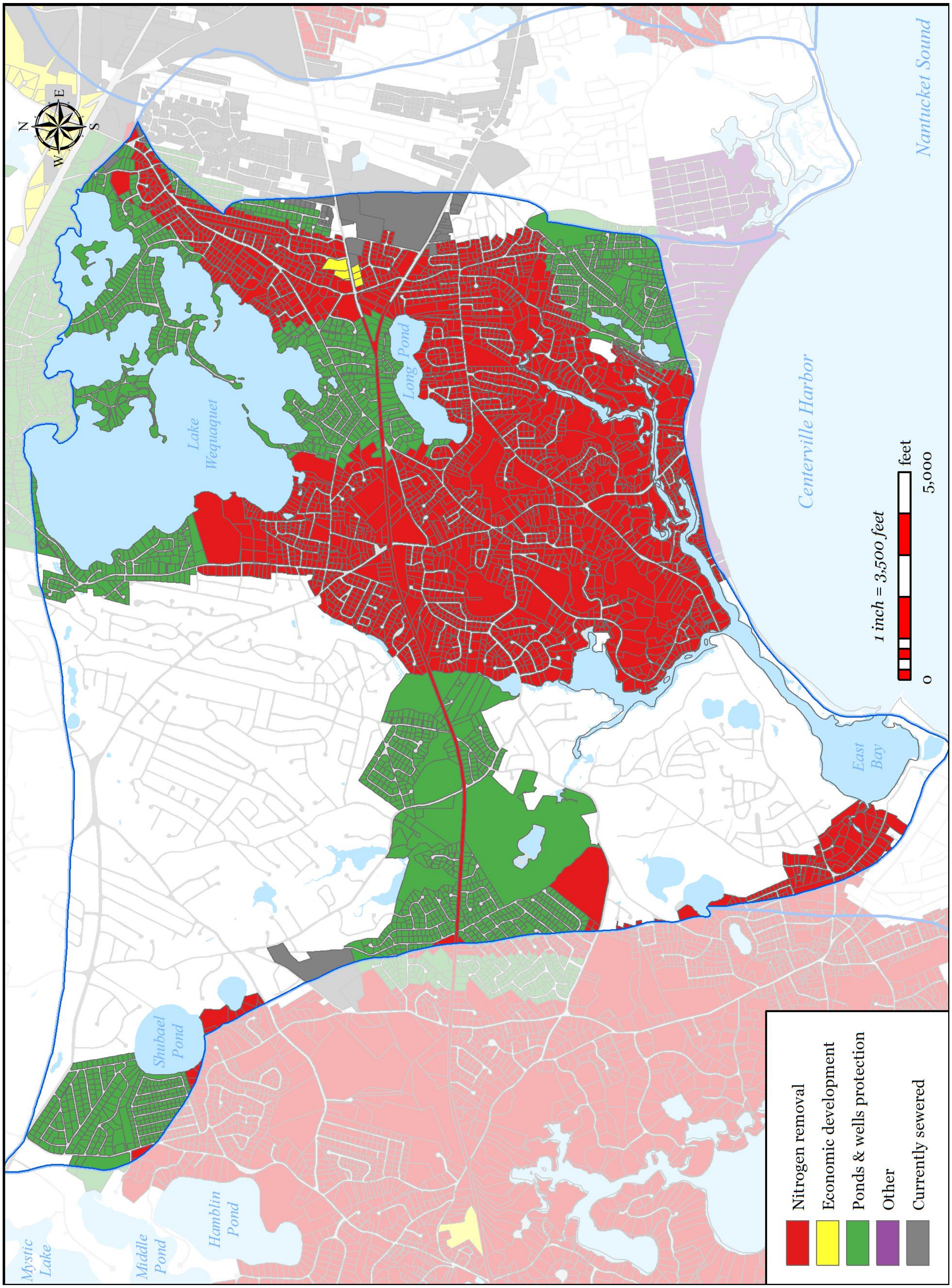

Figure 5-36: Needs Areas in Centerville River Watershed

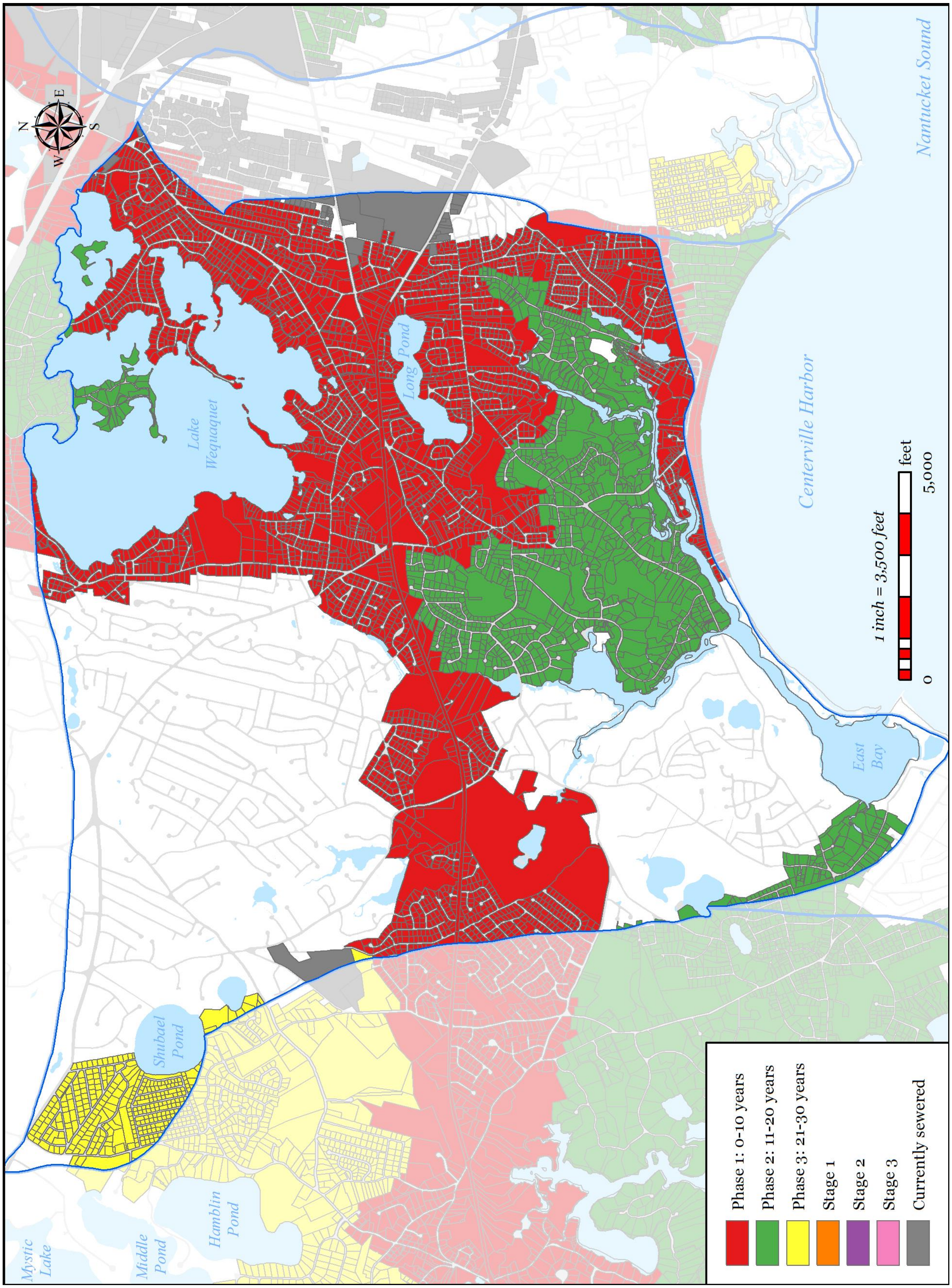

Figure 5-37: Sewer Expansion Plan in Centerville River Watershed

5.2.4 THREE BAYS WATERSHED

The Three Bays Embayment System is located in the southwestern portion of the Town of Barnstable. The embayment is a complex estuary with multiple inlets and sub-embayments (Cotuit Bay, West Bay, North Bay, Prince Cove, Warren's Cove). The estuary receives tidal waters from Nantucket Sound into its two large lower basins: Cotuit Bay to the west of Osterville Grand Island and West Bay to the east of Grand Island. For a detailed description of the embayment system, refer to the 2006 MEP Report for the Three Bays Embayment (Appendix W).

The Three Bays Watershed is approximately 6,739 acres and is located almost entirely within the Town of Barnstable (see Figure 5-38). Within the watershed there are 54 identified surface waters including 21 named freshwater ponds and 2 significant freshwater stream outlets (Marstons Mills River and Little River). Within the watershed, COMM Water District operates 9 drinking water wells and Cotuit Water District operates 4 drinking water wells. The Town does not operate any wastewater treatments facilities within the Three Bays Watershed.

The Town of Barnstable's wastewater plan has been designed to address multiple needs areas within the Three Bays Watershed, including nutrient removal, pond protection, traditional wastewater concerns and economic development, via sewer expansion into Three Bays Watershed. The Plan also includes non-traditional solutions, which will be installed in the first phase of the plan. The Town will not ask for "credit" up front for the non-traditional projects, but will be monitoring the results of those solutions over 5-10 years, thus establishing their benefit. With that benefit firmly established, the Town would then review with DEP to seek relief from that amount of traditional nitrogen removal (sewers) contained in the later phases of the plan.

5.2.4.1 SUMMARY OF NEEDS

The Town of Barnstable's wastewater plan has been designed to address multiple needs areas within the Three Bays Watershed, including nutrient removal, pond protection, water supply protection, flood zone considerations and economic development, via sewer expansion within the Three Bays Watershed.

5.2.4.1.1 Nutrient Removal

The Town's wastewater plan has been designed to exceed the septic load removals modeled in the 2006 MEP Report's threshold loading scenarios in order to meet the regulatory TMDLs. A summary of the modeled threshold septic loading scenario is provided in Table 5-11 and is shown graphically in Figure 5-39. The Town's sewer expansion plan has been designed to achieve the threshold septic load removal percentages in each sub-embayment.

Table 5-11: MEP Threshold Septic Loading Modeling Scenario Summary for Three Bays

Sub-Embayment	MEP Present Septic Load (kg/day)	MEP threshold septic load (kg/day)	MEP threshold Septic Load to Remove (kg/day)	MEP Threshold septic load % change
Cotuit Bay	17.022	13.618	3.404	-20.0%
West Bay	15.490	12.392	3.098	-20.0%
Seapuit River	2.921	2.921	0.000	0.0%
North Bay	24.978	0.000	24.978	-100.0%
Prince's Cove	11.192	0.000	11.192	-100.0%
Warren's Cove	6.975	0.000	6.975	-100.0%
Prince's Cove Channel	4.767	0.000	4.767	-100.0%
Marstons Mills Crescent	3.573	0.000	3.573	-100.0%
Surface Water Sources				
Marstons Mills River	10.071	7.553	2.518	-25.0%
Little River	3.203	3.203	0.000	0.0%
Total	**100.192**	**39.687**	**60.505**	**60.4%**

Nitrogen data reported below in Table 5-12, is from the Town of Barnstable's wastewater planning GIS tool and reflects calculated existing, un-attenuated nitrogen septic loads based upon existing water use data.

Table 5-12: Proposed Un-Attenuated Nitrogen Removal in the Three Bays Watershed by Traditional Solutions

	Parcels	Nitrogen (kg/day N)	% of Total Watershed Nitrogen Removed
Total Existing Watershed	5,625	121.4	N/A
Phase	**Parcels**	**Nitrogen (kg/day N)**	**% of Total Watershed Nitrogen Removed**
1	805	16.1	13.2%
2	1,320	35.4	29.2%
3	1,832	30.2	24.8%
Subtotal	*3,957*	*81.7*	*67.3%*
Stage	**Parcels**	**Nitrogen (kg/day N)**	**% of Total Watershed Nitrogen Removed**
1	21	0.3	0.3%
2	217	3.8	3.1%
3	121	1.7	1.4%
Subtotal	*359*	*5.8*	*4.8%*
Total	***4,316***	***87.5***	***72.1%***

5.2.4.1.2 Traditional Wastewater Needs (Other Needs)

Title 5 Issues

Integral to the planning process was the Town's development of a wastewater planning GIS tool which allowed Town staff to spatially map traditional Title 5 concerns such as small lot size, depth to groundwater, existing septic variances, existing known failed septic systems, and Zone IIs. Parcels with area less than 0.25 acres were flagged because of they were considered difficult to site a traditional septic system, likely to need septic variances, and increased density leading to increased nutrient loading. Parcels with an average depth of groundwater of less than four feet were flagged as likely to require raised systems which are costly and less desirable for community aesthetics. Existing septic variances and existing known failed septic systems were also mapped.

The tool allows the Town to overlay these layers to identify the "hot-spots" for traditional sewering solutions. These areas were then incorporated into the plan where practical. Many of these “hot-spots” overlaid other needs such as nutrients and pond protection. The Plan for the Three Bays Watershed significantly addresses traditional Title 5 concerns as shown in the data presented below which was calculated using the Town’s wastewater planning GIS tool (this data does not account for nitrogen attentuation):

- Total parcels within the Three Bays Watershed = 5,625
- Parcels with total area less than 0.25 acres = 308 (5%)
    - 244 (79%) will be addressed with a traditional solution in the Plan
- Parcels with average depth to groundwater less than four feet = 143 (3%)
    - 85 (59%) will be addressed with a traditional solution in the Plan
- Parcels with septic system variances = 35 (0.6%)
    - 21 (60%) will be addressed with a traditional solution in the Plan
- Parcels with known failed septic systems = 4 (0.1%)
    - 3 (75%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 3,479 (62%)
    - 2,886 (83%) will be addressed with a traditional solution in the Plan

Flood Zones

Low lying areas adjacent to the Three Bays system have been identified as needs areas for sewer expansion due to being within the 100-year floodplain and/or the velocity zone, and generally having shallow depth to groundwater. As a result of these conditions, traditional Title 5 septic systems are difficult and costly to site in these areas.

- Total parcels within the Three Bays Watershed = 5,625
- Parcels within 100 year flood plain and/or velocity zone = 1,157 (21%)
    - 628 (54%) will be addressed with a traditional solution in the Plan (including those portions of the plan that are located within the 3 “stages”).

Contaminants of Emerging Concern (CECs)

Contaminants of emerging concern (CECs) are increasingly being detected in surface water. (CECs) are made up of three general groups, endocrine disrupting compounds, pharmaceuticals, and personal care products. These compounds and potential contaminants are not currently regulated by the federal government because their toxicity is not well understood. Collecting wastewater with sewers and treating at a centralized treatment location allows the opportunity to treat wastewater for CECs as they are better understood and future treatment technologies are developed.

5.2.4.1.3 Pond Protection

The Town's wastewater planning has included detailed studies of ponds 3 acres or larger throughout the Town. Through those studies, there is extensive water data for 13 ponds in the Three Bays Watershed. Pond classification of these ponds is shown in Table 5-13 and Table 5-14.

Table 5-13: Three Bays Watershed Pond classification 2009

	Ultra-Shallow 0 to 2.1m	**Shallow 2.1 to 8.6m**	**Deep >8.6m**
Oligotrophic	Mill (MM)		Hamblin Pond Middle Pond
Mesotrophic	Bog Pond		Lovell's Pond Mystic Lake
Eutrophic	Little Pond	Parker Pond Eagle Pond Crocker Pond (formerly Muddy) Long Pond (MM)	
Hypereutrophic			

Table 5-14: Three Bays Watershed Pond classification 2017

	Ultra-Shallow 0 to 2.1m	**Shallow 2.1 to 8.6m**	**Deep >8.6m**
Oligotrophic			
Mesotrophic		Pattys Pond	
Eutrophic		Sam's Pond	
Hypereutrophic			

Six ponds within the watershed have been identified as impaired: Parker Pond, Little Pond, Eagle Pond, Crocker Pond, Long Pond (MM), and Sam's Pond. Sewer expansion adjacent to the following ponds for protection from nutrients from septic systems has been proposed: Sam Pond, Bog Pond, Eagle Pond, Mill Pond (MM), Hamblin Pond, Lovell's Pond, Crocker Pond, Patty's Pond, and Long Pond (MM).

5.2.4.1.4 Economic Development

Sewer expansion is required within the Route 28 corridor to facilitate the sewer expansion needs of the western portion of the Town. Additionally, the Route 28 corridor has also been identified by the Town as an area desired for economic development. Development within this corridor has historically been restricted by wastewater requirements (i.e. Title 5) and the Town's Saltwater Estuary's Regulation. The Town's wastewater plan has included sewer expansion of the entire Route 28 corridor to accommodate these goals.

5.2.4.2 PROPOSED SOLUTIONS

The Town's plan for the Three Bays Watershed incorporates both traditional solutions (sewer expansion) and non-traditional solutions (dredging, stormwater, etc.). The plan has been designed to meet the target septic removal via traditional sewer expansion alone. The sewer expansion is phased over three, 10-year phases, addressing the densest areas in the first two phases and the less dense (more expensive) areas in the third phase. During the first two phases, the Town intends to install non-traditional solutions, monitor them, and present the monitoring results to regulators. If the non-traditional solutions are effective, the Town's goal would be to reduce the amount of sewer expansion required in Phase 3. However, the Town is not seeking "credit" for these non-traditional projects at this time and has presented a plan that meets the Three Bays Watershed TMDL via traditional sewer expansion alone.
The plan addresses the needs areas using the following techniques:

- Sewer Expansion
    - 4,316 parcels (77%) in the watershed are included in the sewer expansion plan
    - Removal of 72.1% (87.5kg/day N) of the total existing un-attenuated septic load in the watershed.

- Stormwater upgrades
    - The Three Bay's Stormwater Project will continue. Refer to Section 2.2.1.2 for projects completed to date.
    - The Town's MS4 program will identify and provide solutions to existing stormwater outfalls.
        - 36 of the Town's 207 identified stormwater outfalls are located in the Three Bays Watershed.
    - The Town's Public Road program invests on average $750,000 a year in stormwater improvements in the Town's public roads. These improvements generally include replacement of failed catch basins and leaching structures.

- Mill Pond Dredging
    - Continue to evaluate, design, and permit the project as discussed in Section 2.3.2.2.

- Cranberry Bog Conversions
    - Continue to support partners (BCWC and others) in pursuit of projects to convert the cranberry bogs in the upper end of the Marstons Mills River system to nutrient removal practices as discussed in Section 2.3.2.1 and Section 3.2.2.3.

- Alternative Septic Systems
    - Continue to support partners (BCWC and others) in evaluation of technologies and installation of pilot projects as discussed in Section 3.2.2.5.

- Aquaculture
    - Existing commercial aquaculture grants in the Three Bays = 62 acres.
    - Continue to evaluate aquaculture opportunities in Warren's Cove as discussed in Section 2.3.2.4 and 3.2.2.1.

- Dredging of Cotuit Bay Cut
    - Three phase project anticipated to be completed in the winter of 2020.
    - Anticipated to improve flushing within Cotuit Bay.

- Fertilizer Regulation
    - In 2014 the Town adopted a Fertilizer Nitrogen and Phosphorus Control Regulation (see Appendix PP). The regulation includes the following:
        - Provides Best Management Practices and performance standards for noncertified fertilizer applicators.
        - Outlines education, certification, enforcement and penalties.

5.2.4.3 FUTURE CONDITIONS

- The majority of the watershed is significantly built-out.
- Projected growth within the watershed.
    - The projected growth within the watershed is focused on the Route 28 corridor which will be addressed with traditional solutions (i.e. sewer expansion). Projected growth in these areas will be considered when sizing sewer infrastructure (pipes, pump stations, force mains, etc.).
- Adaptive management and monitoring
    - The Town will continue to monitor the embayment, review the Plan and provide formal updates as required.

- Refer to Section 6.5 for the Adaptive Management Plan and Section 6.4 for the Monitoring Plan.

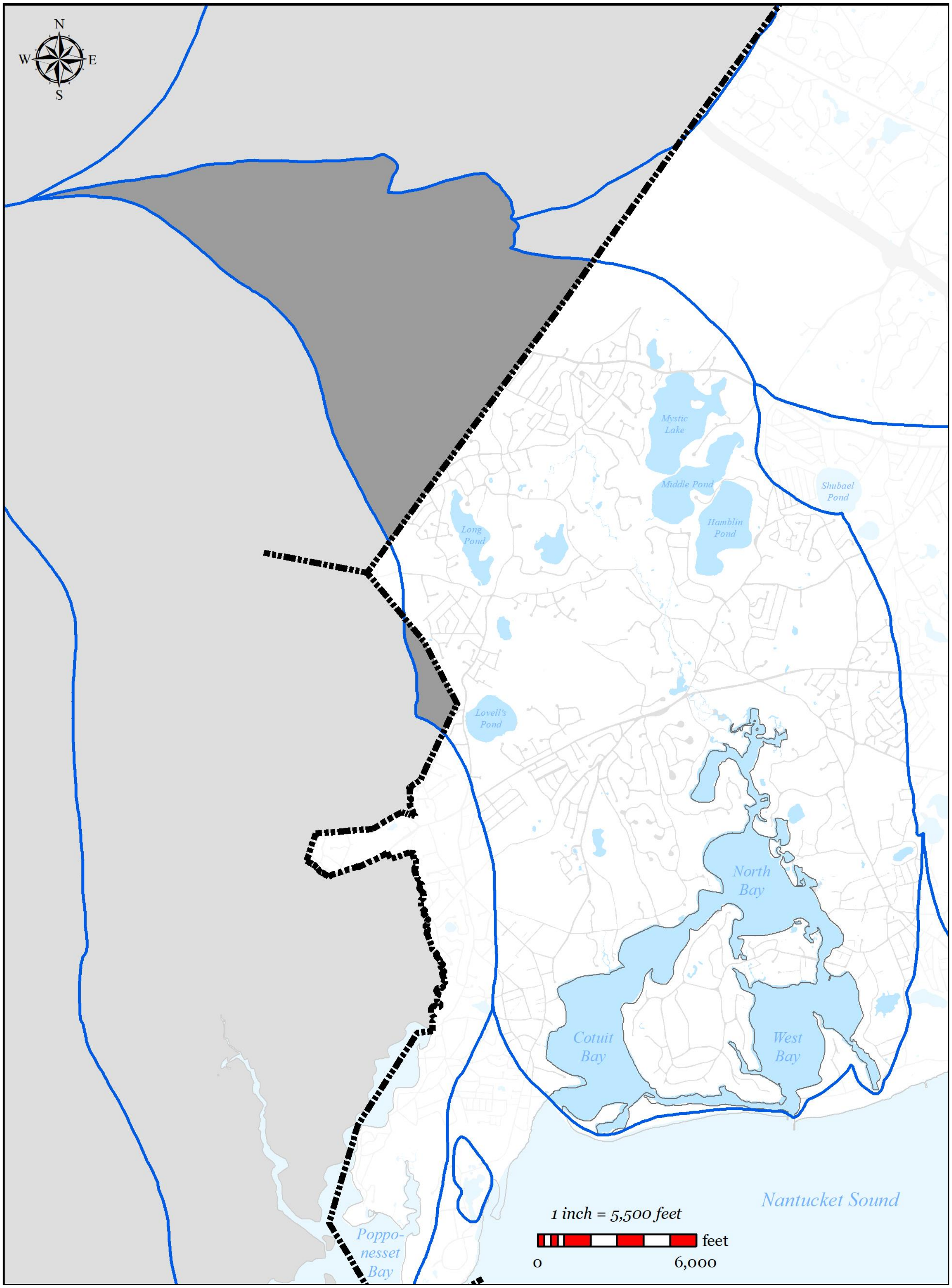

Figure 5-38: Three Bays Watershed

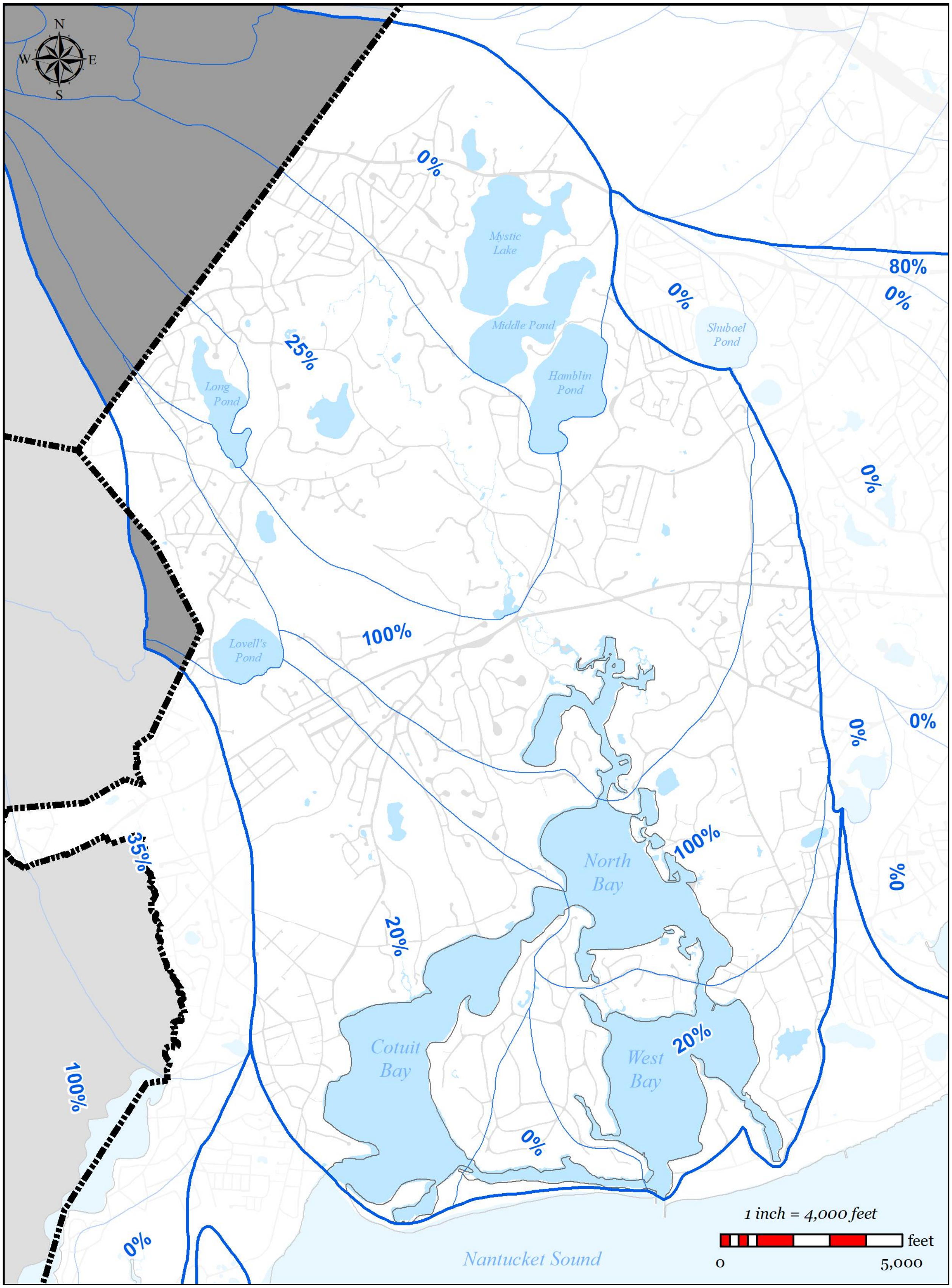

Figure 5-39: MEP-modeled Existing Septic Removal in Three Bays Watershed

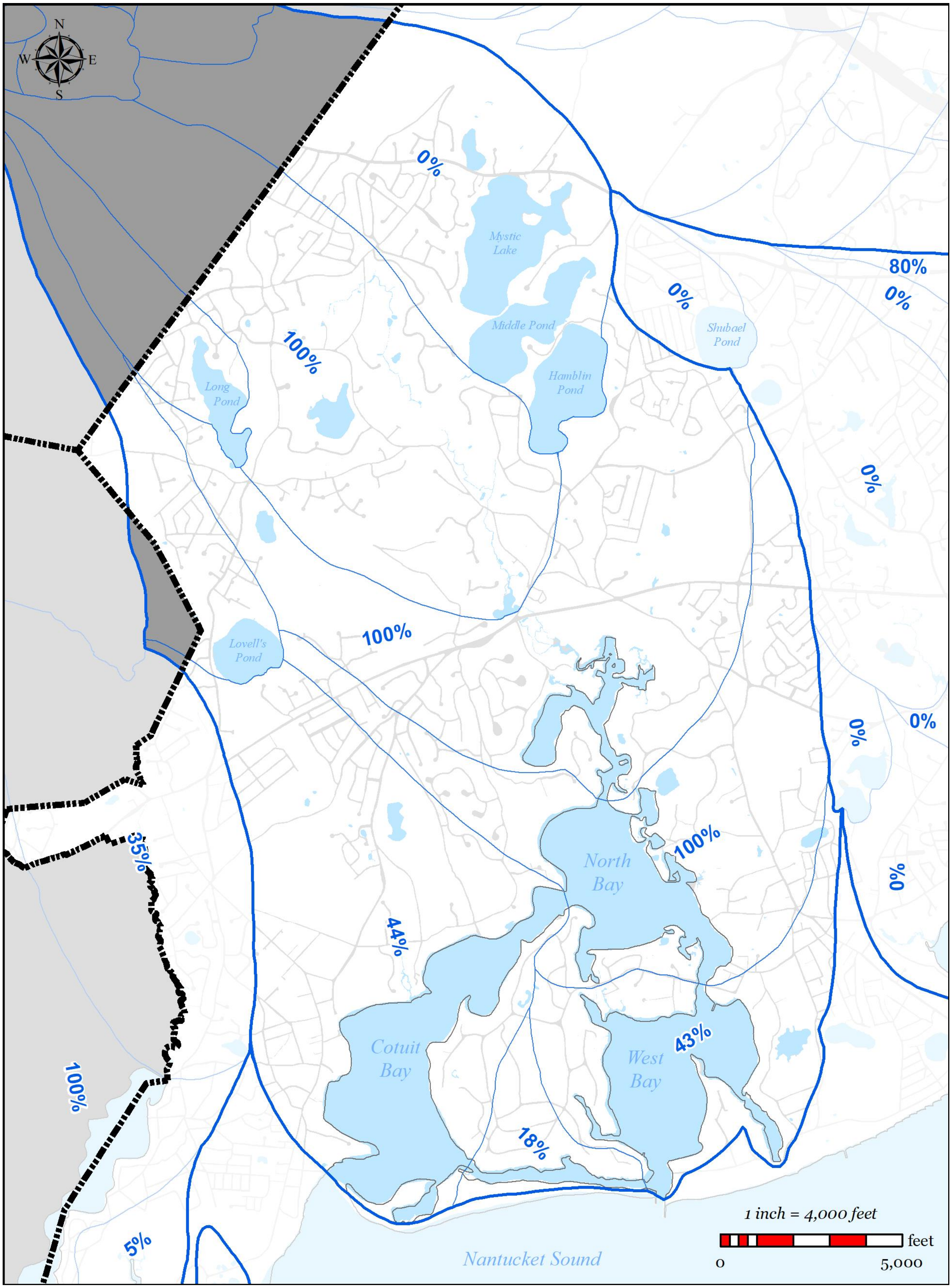

Figure 5-40: MEP-modeled Future Septic Removal in Three Bays Watershed

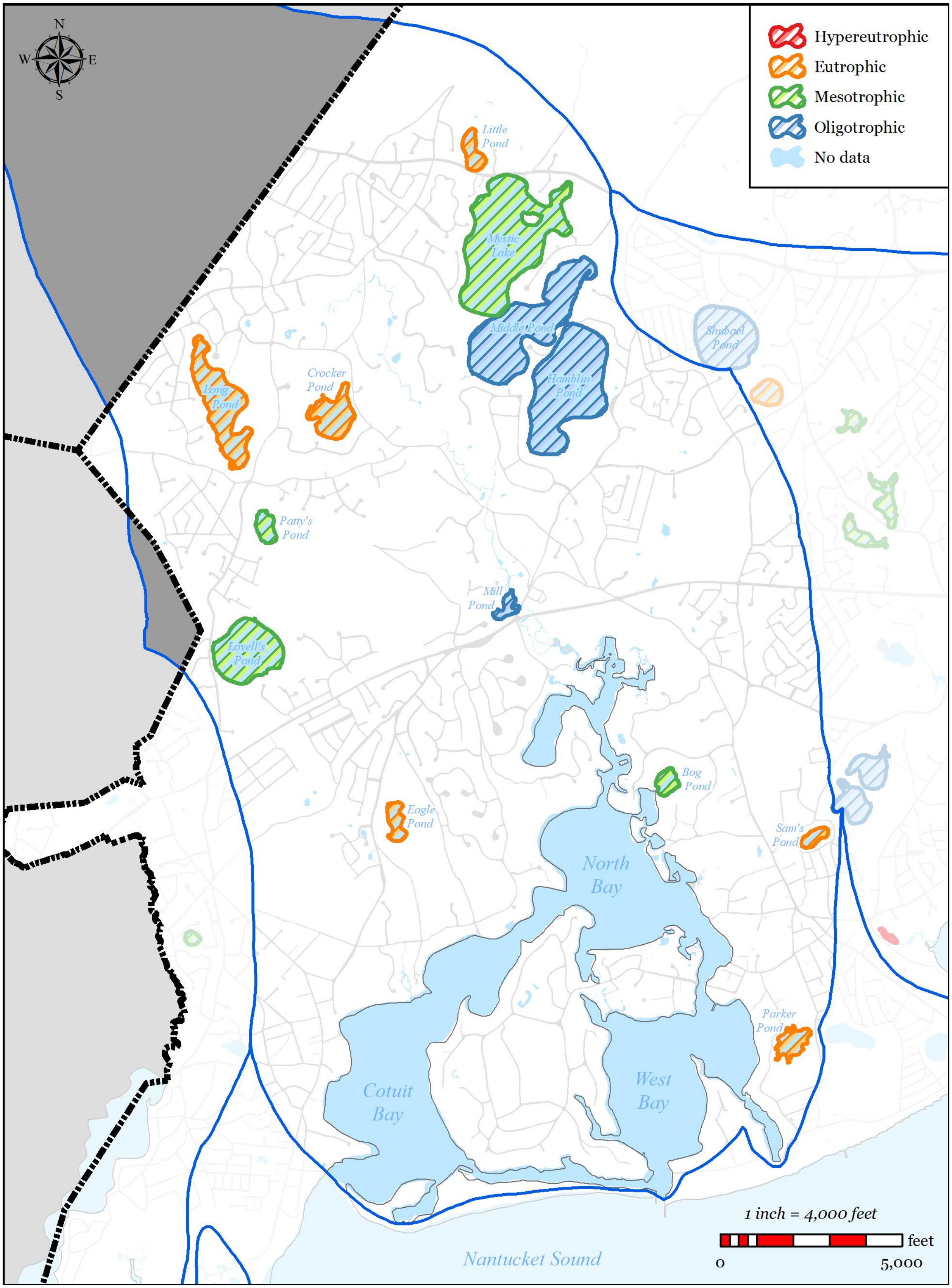

Figure 5-41: Trophic States of Pondsin Three Bays Watershed

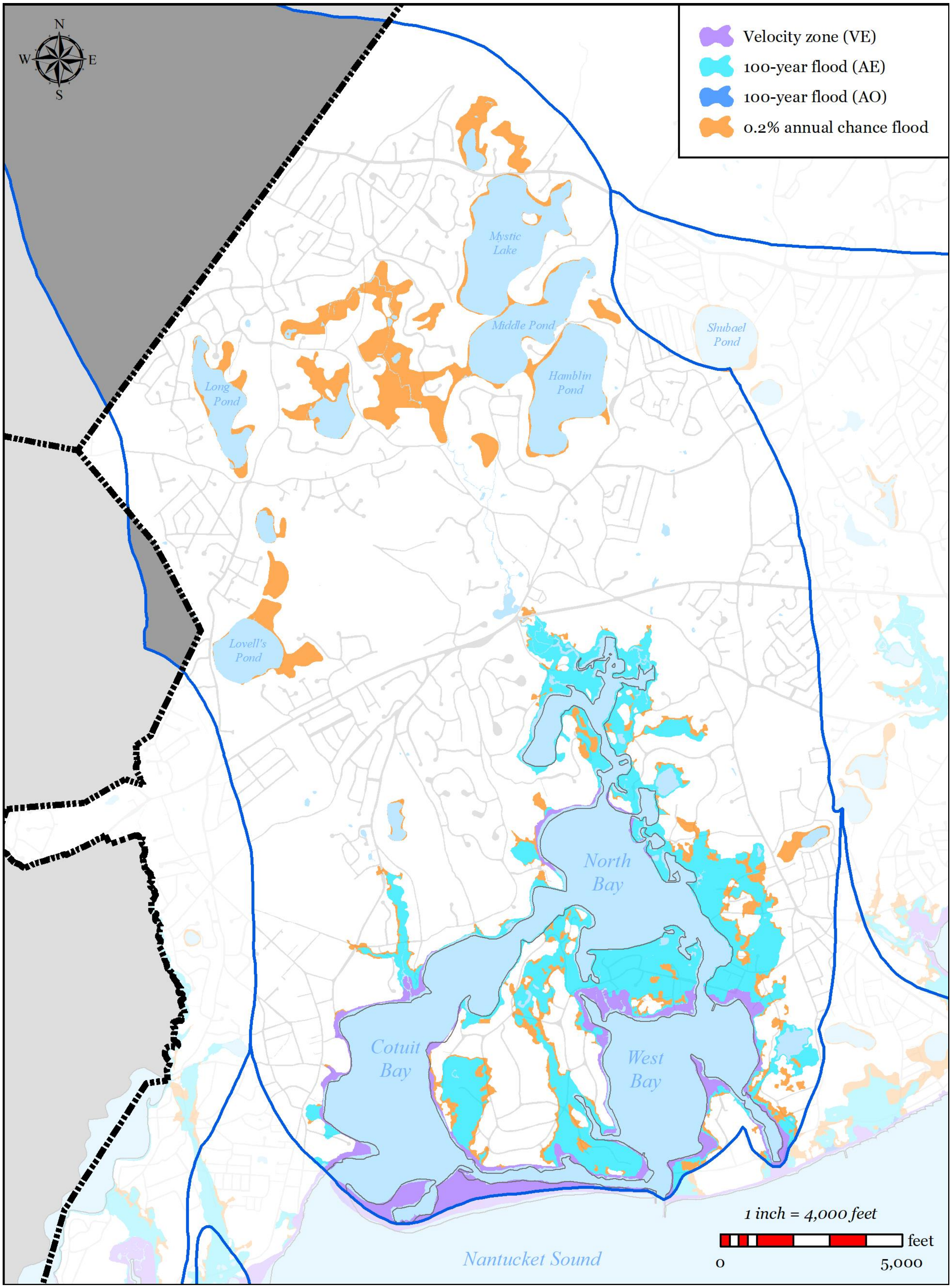

Figure 5-42: FEMA Flood Zones (2014) in Three Bays Watershed

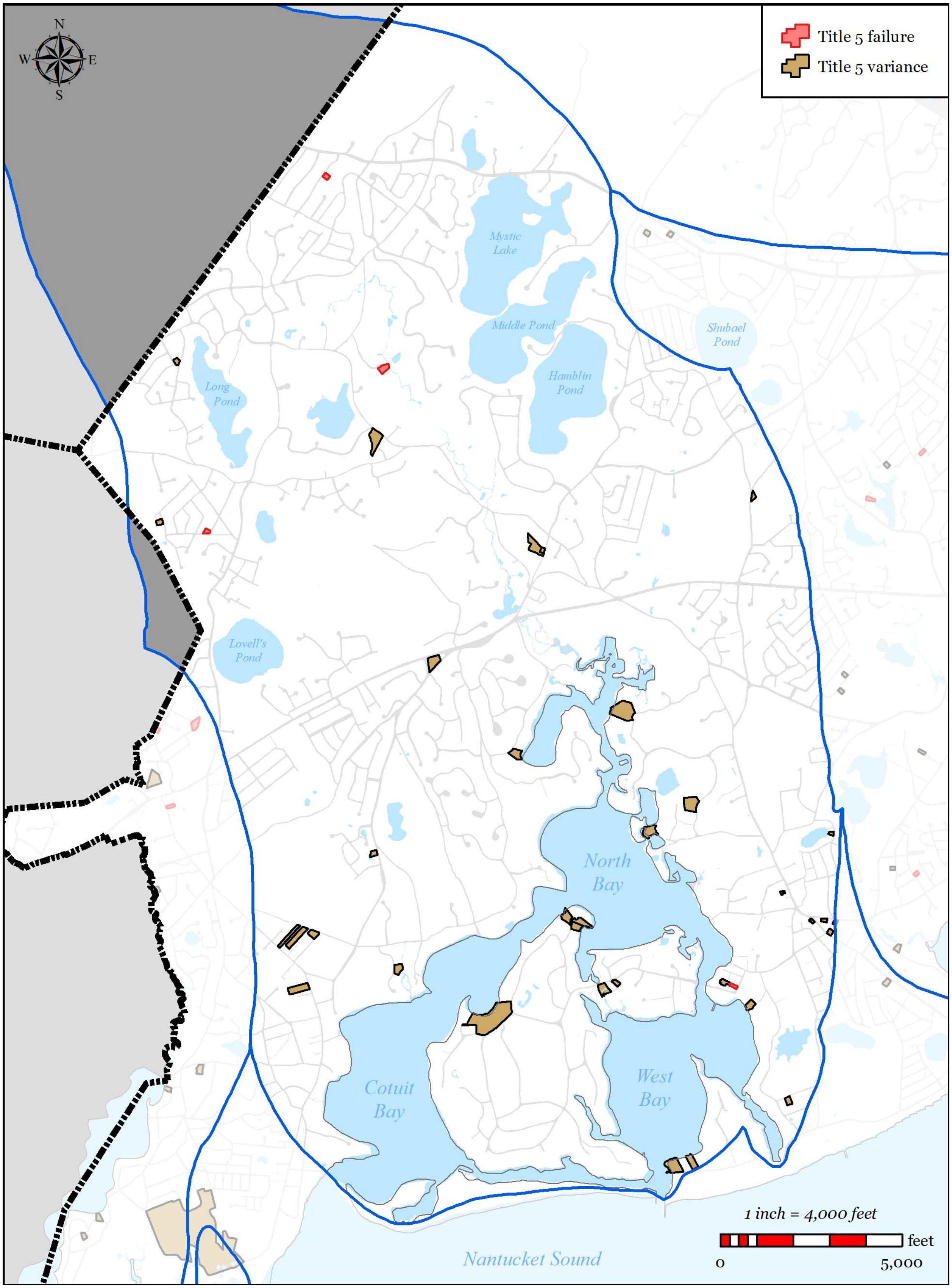

Figure 5-43: Parcels with Title 5 Septic Failures and Variances in Three Bays Watershed

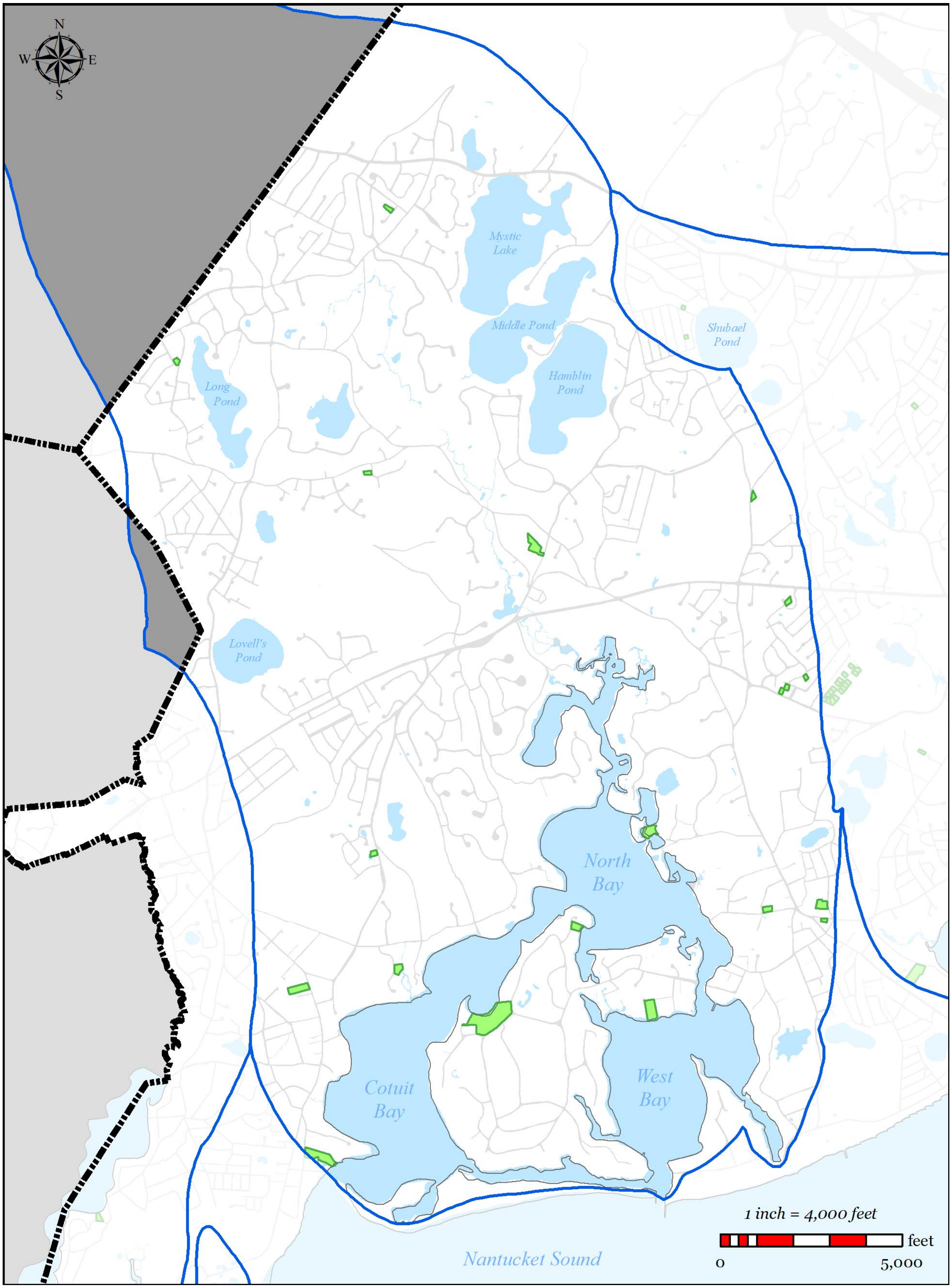

Figure 5-44: Parcels with I/A Septic Systems in Three Bays Watershed

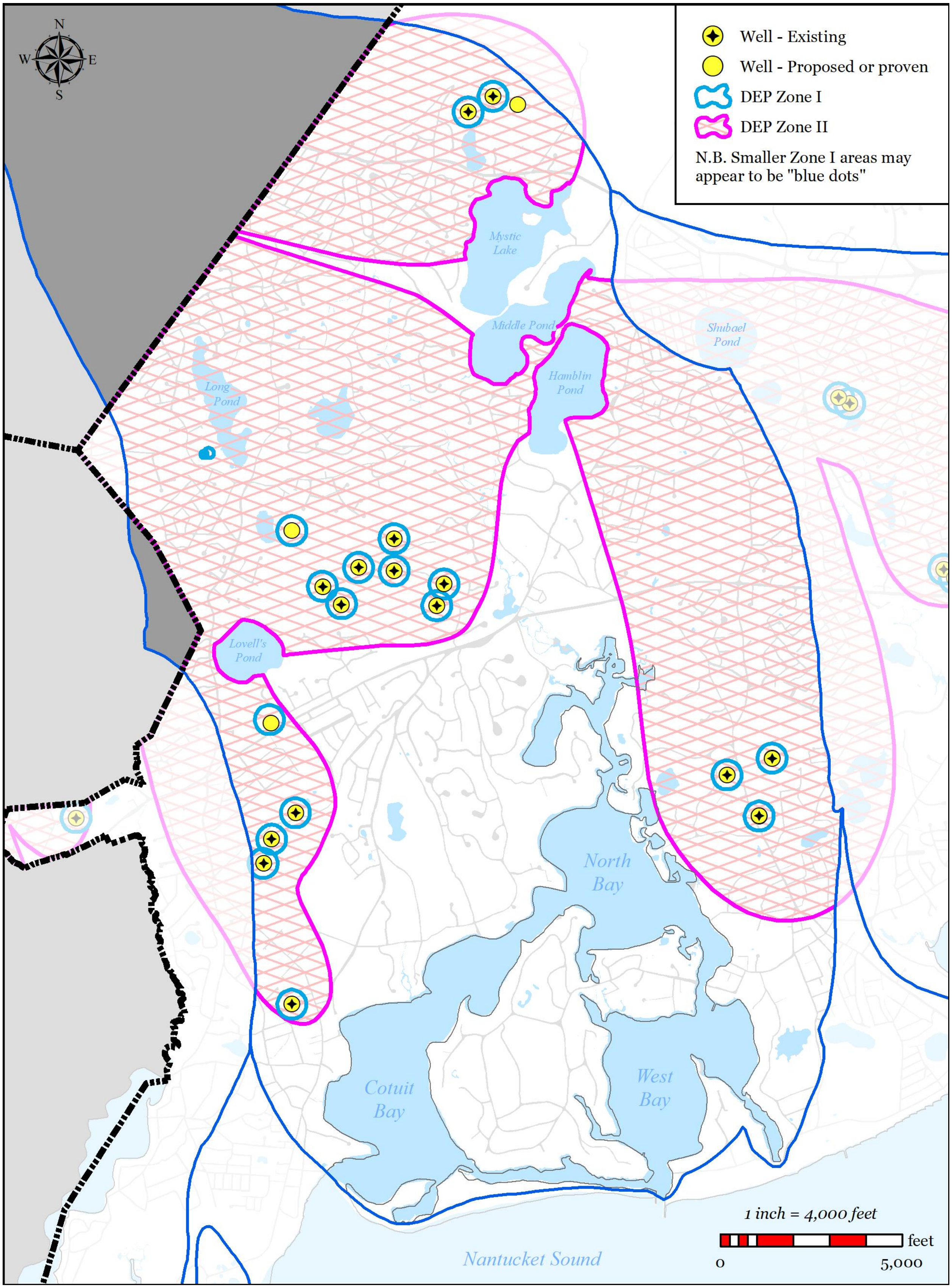

Figure 5-45: Public Water Supply Wells in Three Bays Watershed

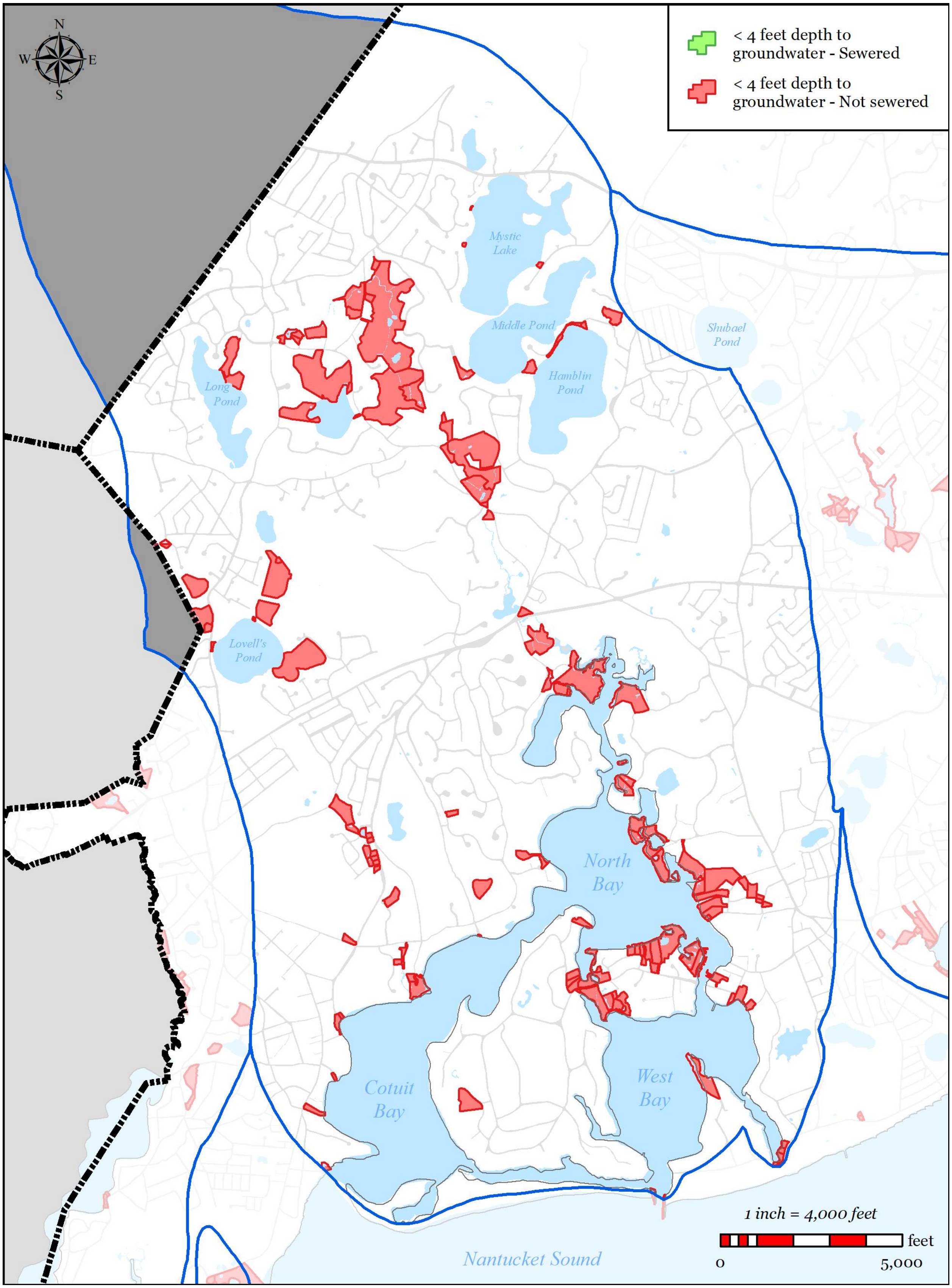

Figure 5-46: Parcels with Less than 4 feet Depth to Groundwater in Three Bays Watershed

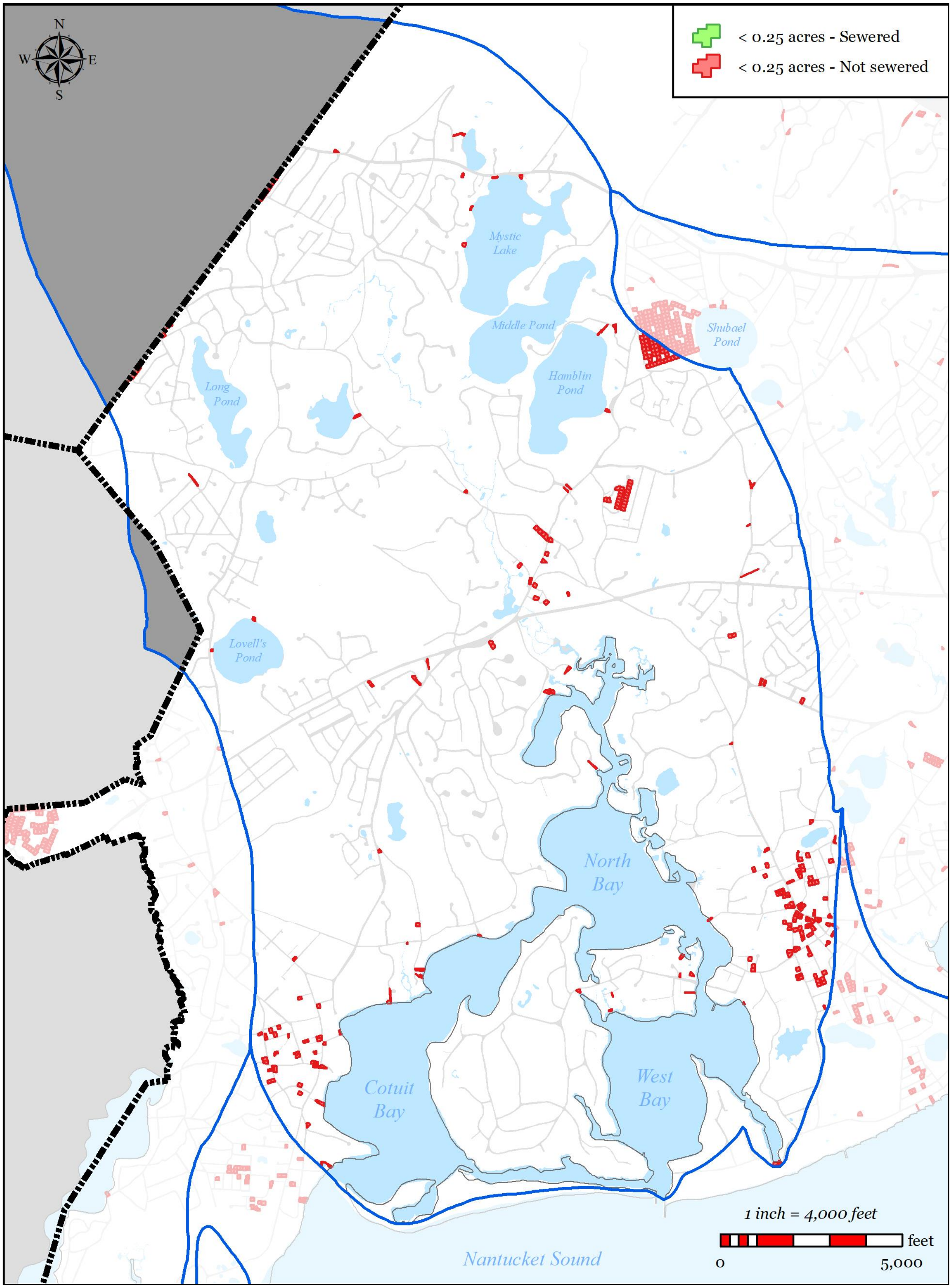

Figure 5-47: Parcels with Less than 0.25 acres in Three Bays Watershed

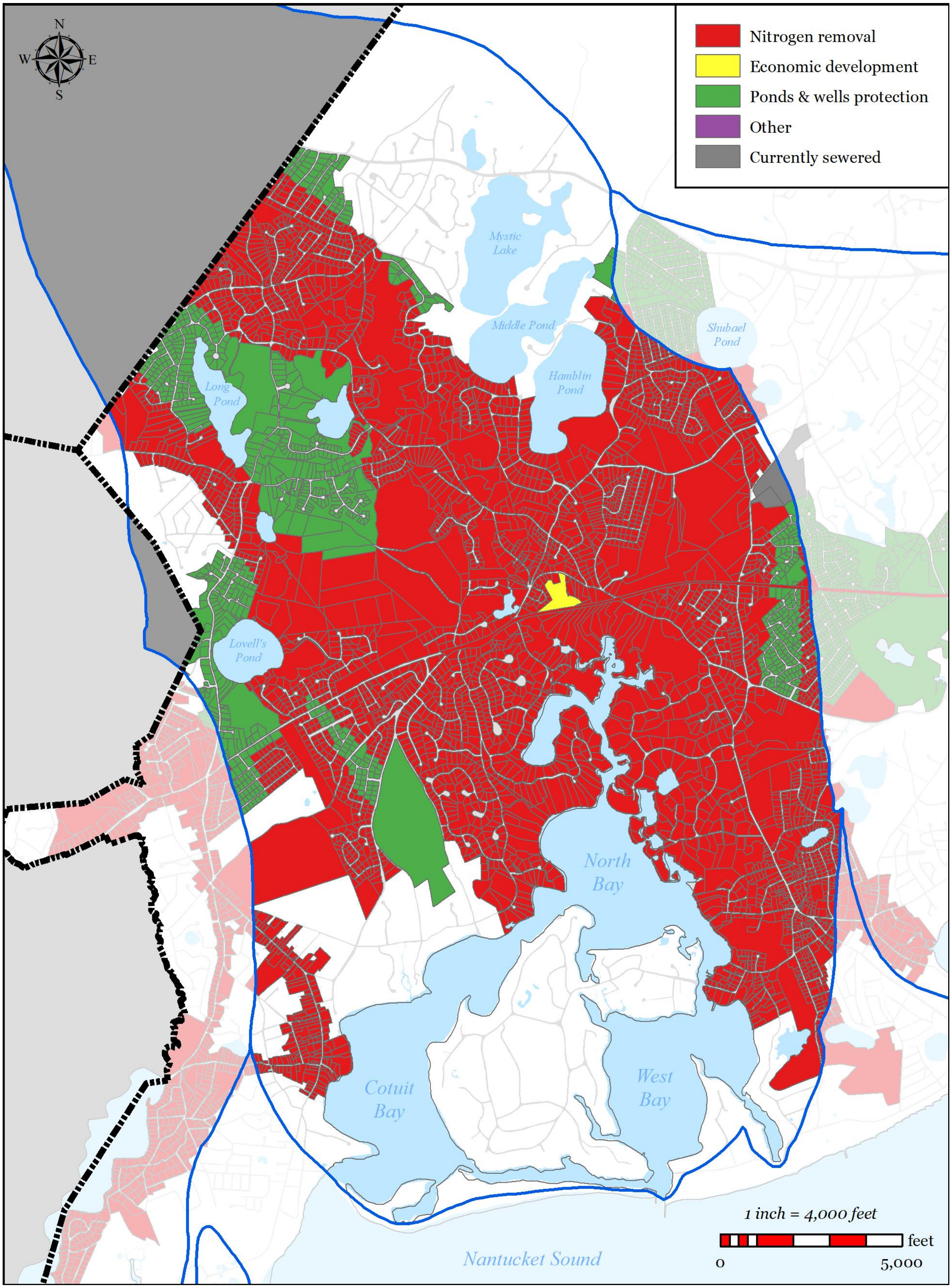

Figure 5-48: Needs Areas in Three Bays Watershed

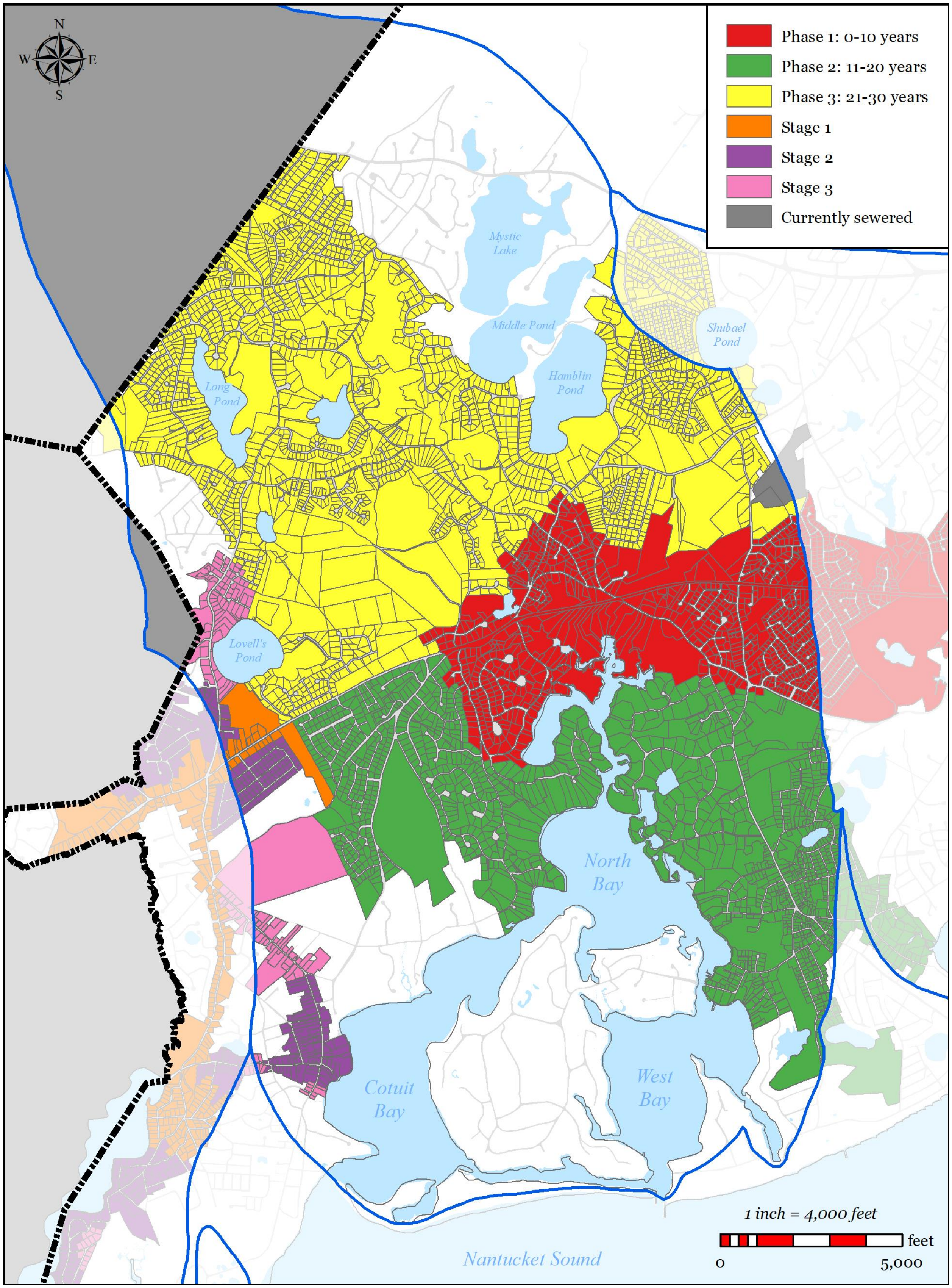

Figure 5-49: Sewer Expansion Plan in Three Bays Watershed

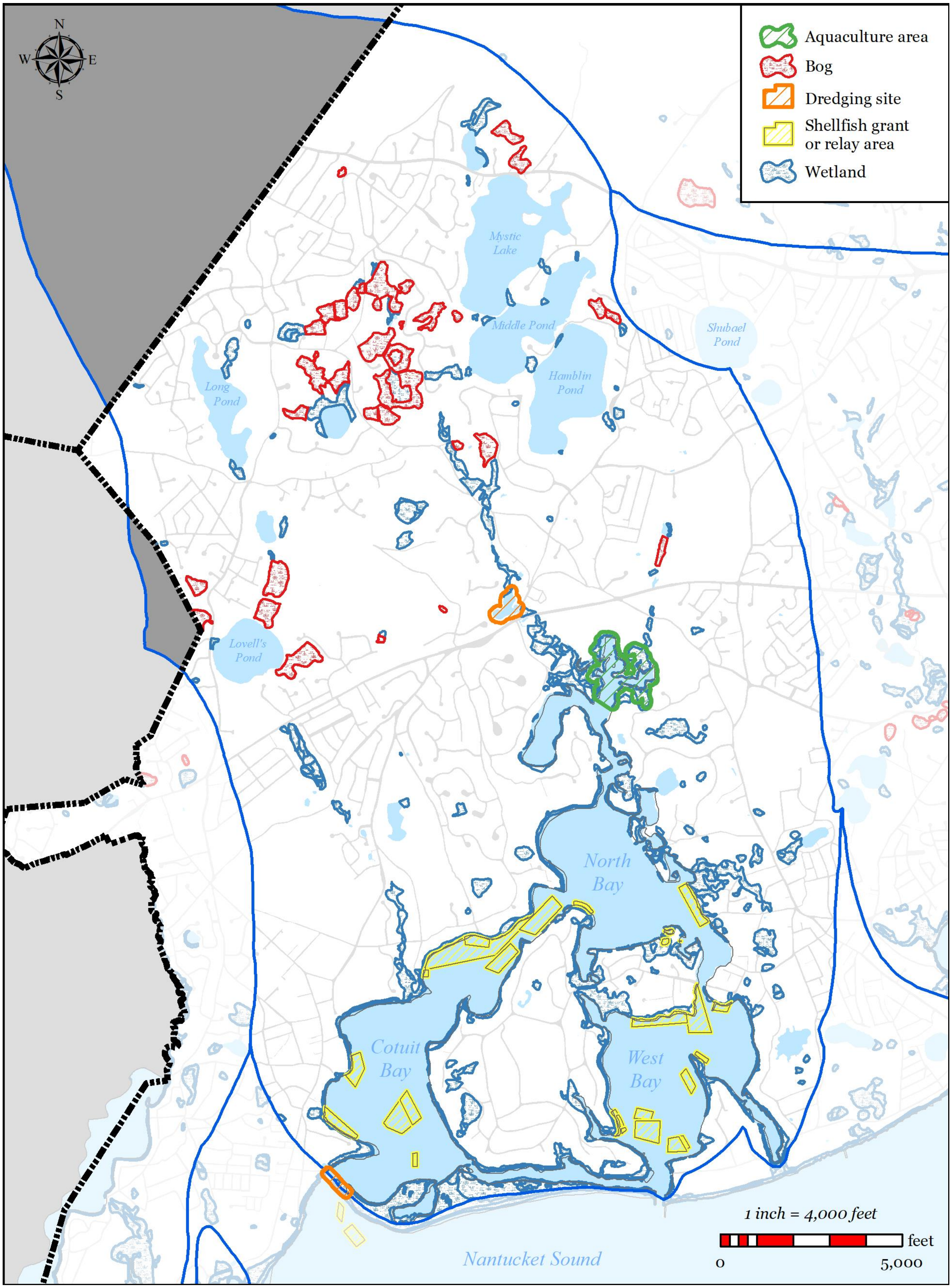

Figure 5-50: Non-Traditional Projects

5.2.5 RUSHY MARSH POND WATERSHED

The Rushy Marsh Embayment System is a small estuary located within the village of Cotuit. It is bounded by Main Street Cotuit on one side and Nantucket Sound on the other, and is located between the Popponesset Bay and Three Bays watersheds. According to the MEP report, virtually all the watershed's freshwater and nutrients enter Rushy Marsh via groundwater seepage, as there are no significant surface inflows to this system. Refer to Figure 5-53 for a figure showing the Rushy Marsh Embayment system. For a detailed description of the embayment system, refer to the 2006 MEP Report for the Rushy Marsh Embayment System (Appendix V).

The open water area of the marsh is approximately 15 acres, thus making it a great salt pond. USGS maps from 1893 show Rushy Marsh as a fully tidal estuary with salt marsh along its eastern and northern shores. During the 1900's the tidal inlet became restricted due to sedimentation deposits and the formation of a barrier beach. There were attempts to keep the system tidal with pipes and culverts, but ultimately the process of barrier beach formation resulted in a freshening of Rushy Marsh Pond. By the turn of the century, the system was a brackish salt pond.

The pond currently does not support eelgrass, and mapping from 1951 indicates it was not present then either. Given this lack of documentation of an eelgrass population, it is not clear that even when the system was much better flushed, it supported eelgrass beds. However, to the extent that conditions could be improved to the level required for eelgrass colonization, the acreage would likely range from 4-12 acres, most likely in the southern channel and the margins of the main basin.

5.2.5.1 SUMMARY OF NEEDS

5.2.5.1.1 Nutrient Removal

The 2006 MEP report states "While Rushy Marsh Pond presently has a relatively low nitrogen load from its watershed, due to its small size and proportionally large undeveloped areas, it is still significantly impaired by nitrogen enrichment and is clearly eutrophic. This apparent paradox results from its very low tidal exchange rate, resulting from barrier beach processes restricting the inlet to Nantucket Sound."

5.2.5.1.2 PROPOSED SOLUTIONS

The 2006 MEP report suggested that even if the Town removed 100% of the septic load that feeds into this pond, the pond would still be impaired due to its isolation from the sound. They went on to hypothesize that "…in order to meet the threshold concentrations in the system, alternative approaches beyond load reductions are required to increase circulation and water exchange with Nantucket Sound."

MEP went on to run some simple models on the system assuming the inlet was increased to 4 feet and again to 10 feet. What they found was the total nitrogen concentrations were significantly reduced with the modeled inlets, and that the reduction would be large to meet the threshold limits that they suggested for the marsh.

In response to these findings the Town, working with Applied Coastal Research and Engineering (ACRE), designed and installed a new inlet consisting of a 10-foot wide box culvert in the southern portion of the basin in 2012. However, within several months the new inlet had completely shoaled and filled with sand to the point that the new inlet was undistinguishable from the existing beach (see Figure 5-51, and Figure 5-52), which eliminated tidal flow and flushing.

In 2014, the Town had the Woods Hole Group conduct a forensic analysis of the project. What they found was that the tidal prism of Rushy Marsh was inadequate to maintain a stable inlet given the rate of littoral sand transport along the beach. In fact, they concluded that a stable inlet is not feasible for the as-built inlet without substantial maintenance and the addition of hard structures (jetties), or an extended large pipe well into the surf zone. Their initial calculations indicated that the jetty lengths would have to be between 122 ft and 145 ft long.

Given this finding, and the Town's understanding of the difficulty of permitting new hard structures such as these in the surf zone, it elected to forgo any further action on this watershed.

Figure 5-51: Rushy Marsh New Inlet, Newly Installed, Perspective Looking Toward Nantucket Sound

Figure 5-52: Rushy Marsh New Inlet, After Shoaling, Perspective from Nantucket Sound

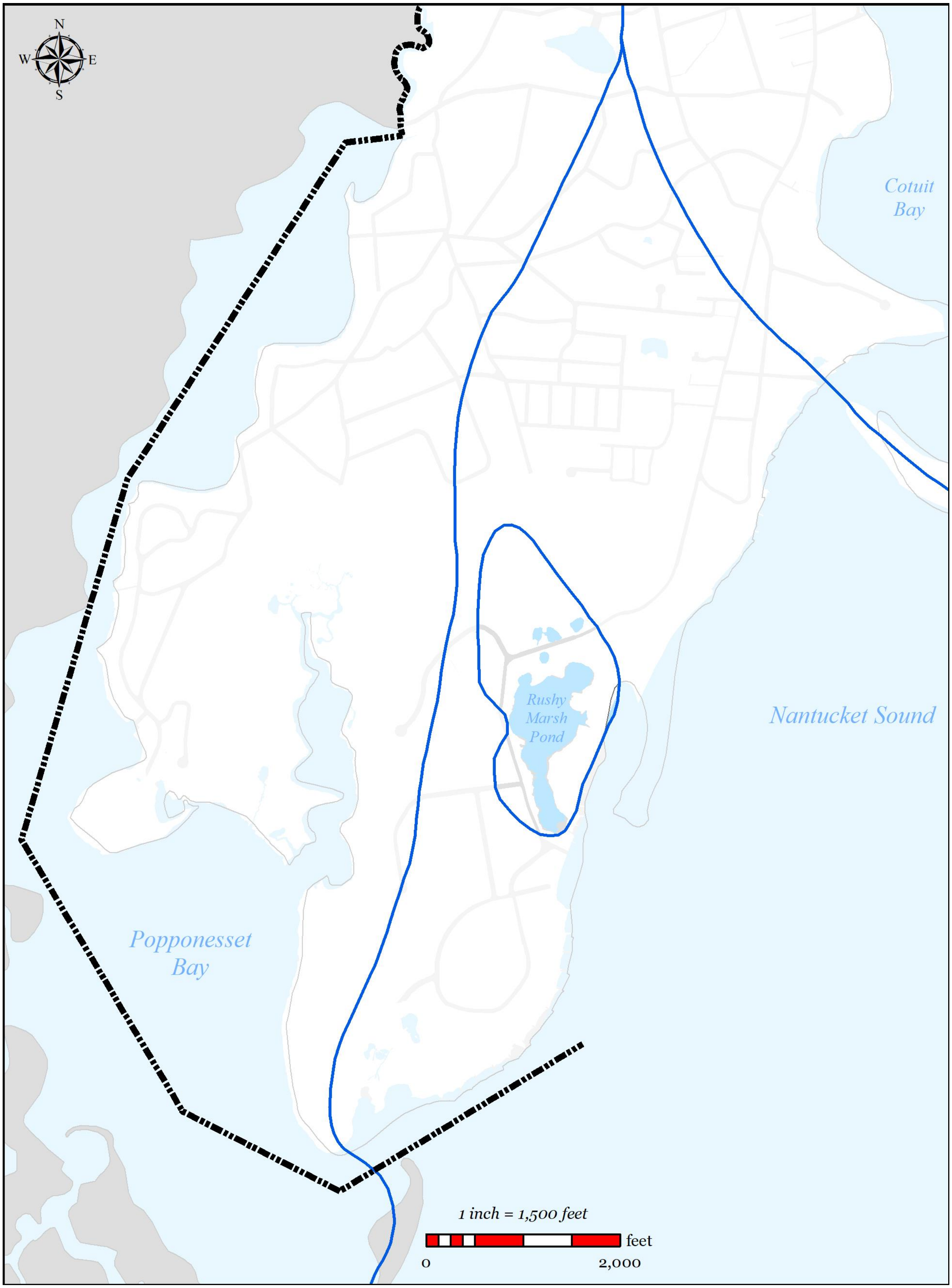

Figure 5-53: Rushy Marsh Watershed

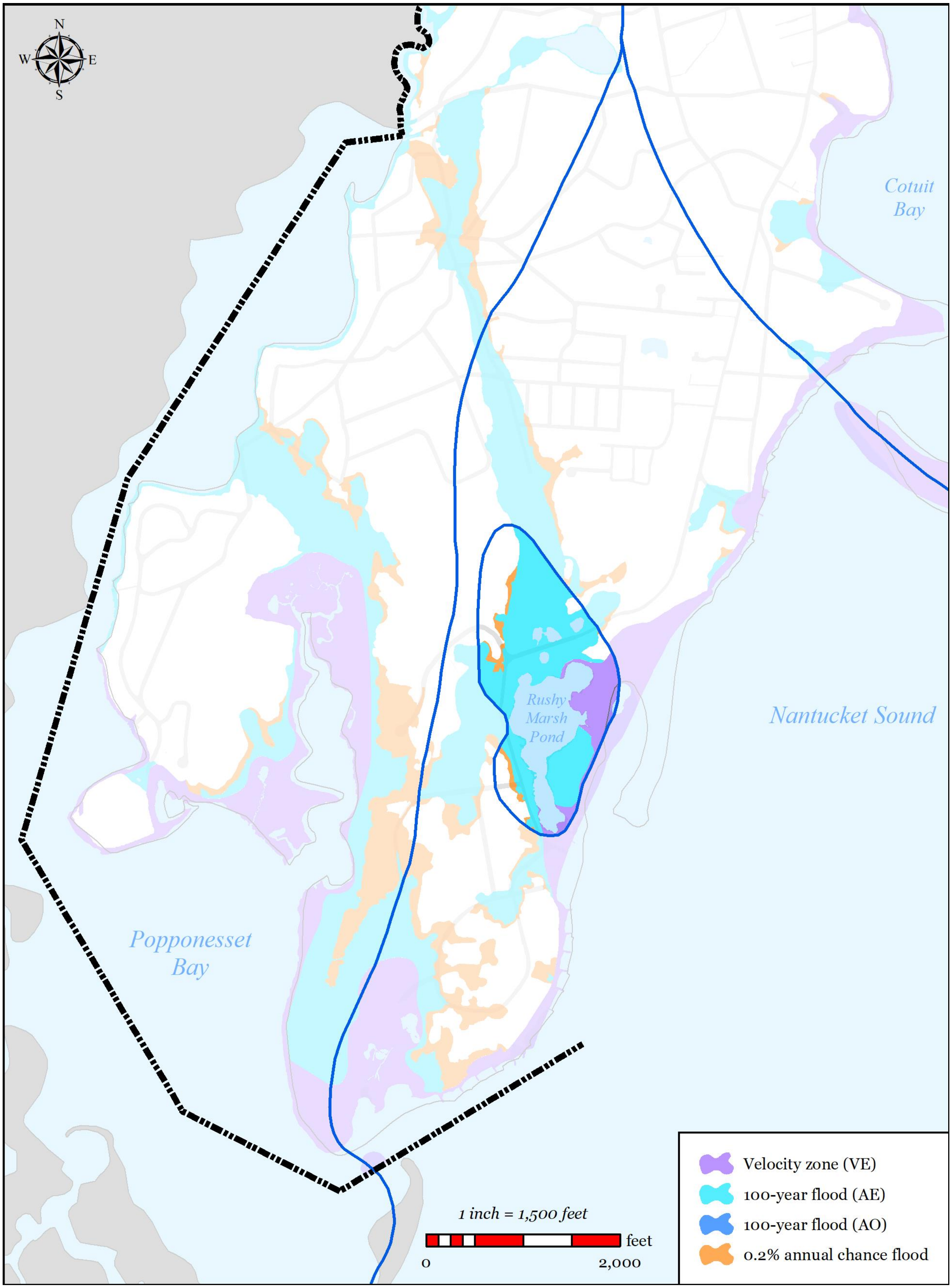

Figure 5-54: FEMA Flood Zones (2014) in Rushy Marsh Pond Watershed

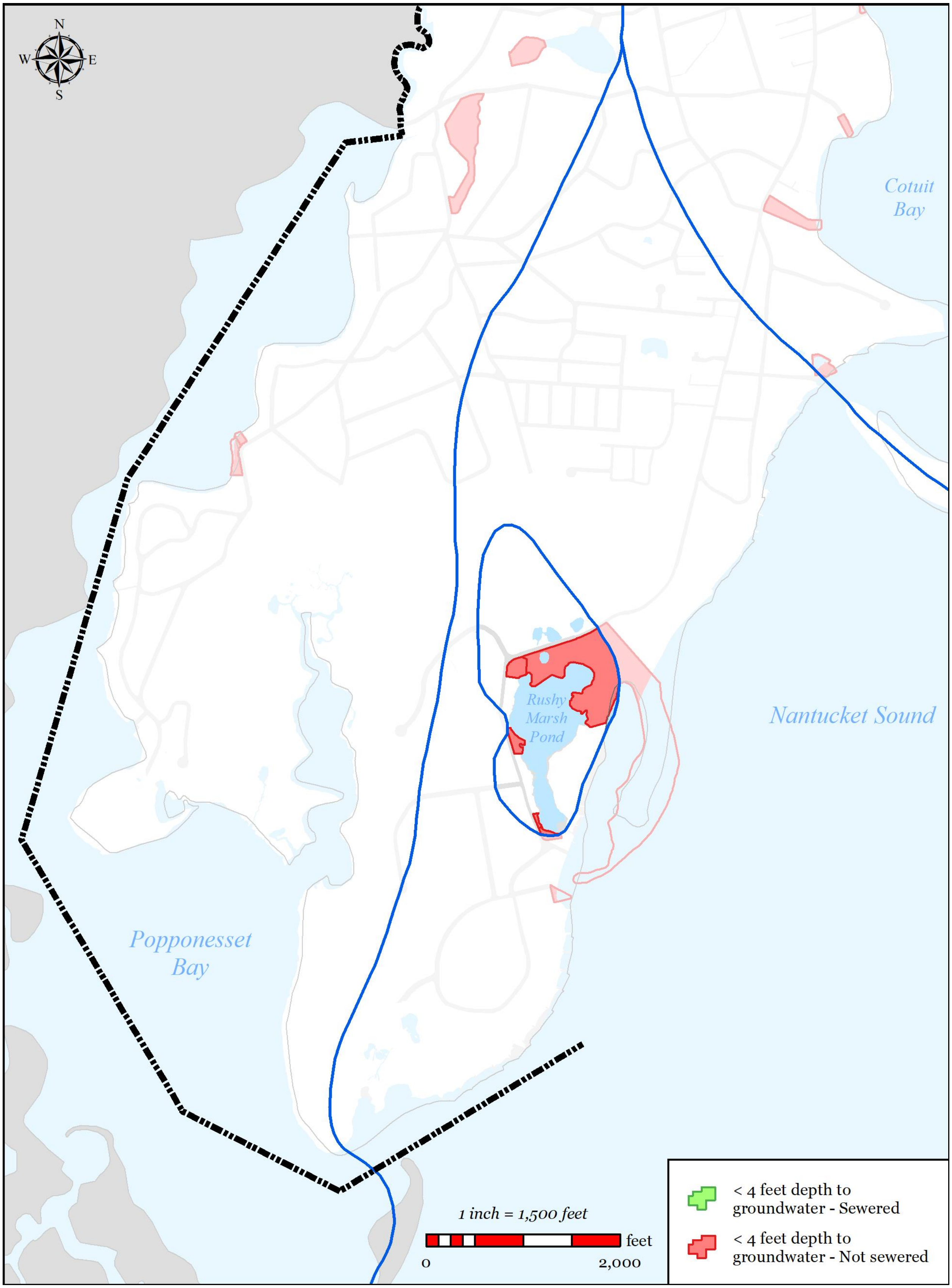

Figure 5-55: Parcels with Less than 4 feet Depth to Groundwater in Rushy Marsh Watershed

5.2.6 POPPONESSET BAY WATERSHED

The Popponesset Bay system is located within the Towns of Mashpee (north and west) and Barnstable (east), with a southern shore bounded by water from Nantucket Sound. The Bay is separated from Nantucket Sound by a barrier spit (Popponesset Beach), which grew from the southwestern shore. Popponesset Bay exchanges tidal water with Nantucket Sound through a single maintained inlet. Refer to Figure 5-56 for a figure showing the Popponesset Bay system. For a detailed description of the embayment system, refer to the 2004 MEP Report for the Popponesset Bay Embayment (Appendix T).

The source water for the Popponesset Bay Embayment System is the Popponesset Bay Watershed. The Popponesset Bay Watershed is approximately 13,082 acres and is distributed among the Towns of Mashpee, Barnstable and Sandwich (see Figure 5-56). Within the watershed there are 40 identified surface waters including 13 named freshwater ponds (including No Bottom Pond, Lewis Pond, Naomi Pond which are located in the Town of Barnstable) and 2 significant freshwater stream outlets (Mashpee River and Santuit River). The Cotuit Water District operates one public drinking water well located within the watershed within the limits of the Town of Barnstable.

5.2.6.1 SUMMARY OF NEEDS

The Town of Barnstable's wastewater plan has been designed to address multiple needs areas within the Popponesset Bay Watershed, including nutrient removal, pond protection, water supply protection, flood zone considerations, and economic development, via sewer expansion within the Popponesset Bay Watershed.

5.2.6.1.1 Nutrient Removal

The 2004 MEP technical report for the Popponesset Bay system indicates that the system exceeds its critical threshold for nitrogen, resulting in impaired water quality. Based upon the findings of the MEP technical report, a TMDL for nitrogen has been developed and approved.

As previously discussed in Section 2.3.1.1, the Town executed an IMA with its western neighbors (Mashpee and Sandwich) relative to addressing nitrogen removal (via nitrogen sharing or other similar methods) in the Popponesset Bay Watershed. Key components of the IMA include:

- The Towns agreed that it was in their best interests to apply jointly for a Watershed Permit.

- That each Town would develop and implement its own MassDEP approved CWMP or Targeted Watershed Management Plan, and the capital projects undertaken by the Town as a result of those plans will be the sole responsibility of that Town.
- The Town of Mashpee would serve as the fiscal agent under the IMA and, as such, will receive, hold, and expend any funds appropriated by the Parties for joint actions required in the implementation of the IMA, as well as any grant funds awarded to the Parties for the purpose of pursuing, securing, and implementing a Permit.
- The Towns would establish a Popponesset Bay Watershed Work Group, which would be comprised of three members from each Town (Town Manager, Selectman/Town Councilor, and a technical representative), and which will:
    - Administer this IMA and any amendments to it;
    - Administer the application and implementation of a Watershed Permit; but
    - The Work Group has no authority to bind one or more of the parties.
- The Towns established a nitrogen allocation formula for the purpose of assigning costs (see
  Table 5-15). They further agreed that the costs should be allocated on the basis of unattenuated and attenuated nitrogen loadings.
    - The unattenuated loads for tracking and accounting of nitrogen reductions which result from implemented measures.
    - The attenuated loads to provide a benchmark for comparison of improvements to water quality based on implemented measures. Attenuated load is what is received in the estuary.

Table 5-15: Nitrogen Allocation from Popponesset Bay Watershed IMA

	Unattenuated	**Attenuated**
Barnstable	12.6%	16.0%
Mashpee	65.4%	74.5%
Sandwich	22.0%	9.5%
Total	*100%*	*100%*

- The Towns agreed to develop a fair and practical methodology for nitrogen trading mechanism.
- The Towns agreed to work together to adopt a fair and practical methodology for monitoring the water quality of the watershed and funding said effort.

However, since the development of the IMA, concerns have been raised by the community that nitrogen trading would not adequately address deteriorating water quality in portions on the system, specifically Shoestring Bay. When a potential western wastewater treatment and disposal option presented itself (JBCC), the Town decided to fund the evaluation and preliminary design of a traditional solution in the Town's portion of the Popponesset Bay Watershed. As a result, the Town developed three "stages" of traditional sewer expansion in Cotuit which was designed to address the septic load removal requirements in the Town's portion of the watershed by traditional methods.

The Town's wastewater plan has been designed to exceed the septic load removals suggested in the 2004 MEP Report's threshold loading scenarios. The threshold septic loading scenario calls for a 61% reduction in total septic load within the watershed, which is further broken out into required septic load removals of the sub-watersheds that make up the total watershed. Portions of three of the sub-watershed areas are located within the Town: Santuit River requires 35% septic load removal, Shoestring Bay requires 100% septic load removal, and Pinquickset Cove requires 0% septic load removal. The aforementioned staging developed by the Town was designed to meet or exceed these percentages within the Town and removes the following total, un-attenuated septic load:

- Santuit River sub-watershed: 53% (5.1 kg/day-N, un-attenuated)
- Shoestring Bay sub-watershed: 99% (3.7 kg/day-N, un-attenuated)
- Pinquickset Cove sub-watershed: 30% (0.3 kg/day-N, un-attenuated)

It is important to note that the proposed staging sewer expansion plan as designed exceeds the threshold septic load to be removed within the Santuit River sub-watershed (53%) even though the Town makes up approximately half of the total sub-watershed area.

Nitrogen removal data reported above is from the Town of Barnstable's wastewater planning GIS tool and reflects calculated existing un-attenuated nitrogen loading based upon existing water use data.

5.2.6.1.2 Wastewater Needs (Other Needs)

Title 5 Issues

If the Town pursues the sewer expansion "stages" within the watershed, the plan will address traditional Title 5 concerns via traditional sewer expansion. Utilizing the Town's wastewater planning GIS tool allowed Town staff to spatially map traditional Title 5 concerns such as small lot size, depth to groundwater, existing septic variances, existing known failed septic systems, and systems within Zone IIs. Parcels with area less than 0.25 acres were flagged because of they were considered difficult to site a traditional septic system, likely to need septic variances, and increased density leading to increased nutrient loading. Parcels with an average depth of groundwater of less than four feet were flagged as likely to require raised systems which are costly and less desirable for community aesthetics. Existing septic variances and existing known failed septic systems were also mapped.

The tool allows the Town to overlay these layers to identify the "hot-spots" for traditional Title 5 concerns. These areas were then incorporated into the plan where practical. Many of these "hot-spots" overlaid other needs such as nutrients and pond protection. The Plan for the Popponesset Bay Watershed significantly address traditional Title 5 concerns as shown in the data presented below which was calculated using the Town's wastewater planning GIS tool (this data does not account for nitrogen attenuation):

- Total parcels located within the Popponesset Bay Watershed in the Town = 943
- Parcels with total area less than 0.25 acres = 87 (9%)
    - 6 (7%) will be addressed with a traditional solution in the Staging Plan
- Parcels with average depth to groundwater less than four feet = 10 (1%)
    - 5 (50%) will be addressed with a traditional solution in the Staging Plan
- Parcels with septic system variances = 6 (0.6%)
    - 5 (83%)will be addressed with a traditional solution in the Staging Plan
- Parcels with known failed septic systems = 3 (0.3%)
    - 2 (67%) will be addressed with a traditional solution in the Staging Plan
- Parcels located within a Zone II = 411 (44%)
    - 220 (54%) will be addressed with a traditional solution in the Staging Plan

Flood Zones

Low lying areas adjacent to Shoestring Bay, Pinquickset Cove, and Popponesset Bay proper have been identified as needs areas for sewer expansion due to being within the 100 year floodplain and/or the velocity zone, and generally having shallow depth to groundwater. As a result of these conditions, traditional Title 5 septic systems are difficult and costly to site in these areas.

- Total parcels within the Popponesset Bay Watershed = 943
- Parcels within 100 year flood plain and/or velocity zone = 197 (21%)
    - 122 (62%) will be addressed with a traditional solution in the Staging Plan

Contaminants of Emerging Concern (CECs)

Contaminants of emerging concern (CECs) are increasingly being detected in surface water. (CECs) are made up of three general groups, endocrine disrupting compounds, pharmaceuticals, and personal care products. These compounds and potential contaminants are not currently regulated by the federal government because their toxicity is not well understood. Collecting wastewater with sewers and treating at a centralized treatment location allows the opportunity to treat wastewater for CECs as they are better understood and future treatment technologies are developed.

5.2.6.1.3 Economic Development

Within the Popponesset Bay Watershed, the Route 28 corridor has also been identified by the Town as an area where a traditional solution is desired for economic development. Development within this corridor has historically been restricted by wastewater requirements (i.e. Title 5) and the Town's Salt Water Estuary's Regulation. The Town's wastewater plan has included sewer expansion along the entire Route 28 corridor to accommodate these goals.

5.2.6.2 PROPOSED SOLUTIONS

The plan addresses the needs areas using the following techniques:

- Sewer expansion
  - 526 of the 943 parcels (56%) located in the watershed in the Town are included in the sewer expansion plan
  - Removal of 52% (8.4 kg/day-N) of existing un-attenuated septic load within the portions of the watershed within the Town.

- Stormwater upgrades
  - The Town's MS4 program will identify and provide solutions to existing stormwater outfalls.
    - 1 of the Town's 207 identified stormwater outfalls is located in the Popponesset Bay Watershed.
  - The Town's Public Road program invests on average $750,000 a year in stormwater improvements in the Town's public roads. These improvements generally include replacement of failed catch basins and leaching structures.
    - As part of a project that, partnering with the Town of Mashpee, will replace the culvert which conveys Santuit River (a significant freshwater tributary to Popponesset Bay Watershed) under Old Kings Road, the Town will be installing new stormwater infrastructure which will address stormwater runoff that is discharging directly into the river. This new stormwater system will include deep sump catch basins and infiltration structures which will reduce total suspended solids, bacteria and to a lesser extent nutrients directly discharging to the River.

- Dredging

- The Town is not proposing any dredging within the Town's portion of the Popponesset Bay embayment. The majority of the navigational channels within Popponesset are located within the Town of Mashpee's jurisdiction. The Town of Mashpee performs on-going maintenance dredging within the embayment. The 2004 MEP report modeled a dredging alternative within the embayment which showed negligible impacts on nutrients in the embayment.

- Fertilizer Regulation
  - In 2014 the Town adopted a Fertilizer Nitrogen and Phosphorus Control Regulation (see Appendix PP). The regulation includes the following:
    - Provides Best Management Practices and performance standards for noncertified fertilizer applicators.
    - Outlines education, certification, enforcement and penalties.
- Watershed Permit
  - As stated in the executed IMA, Barnstable will work with the two other communities (Mashpee and Sandwich) that make up the Popponesset Bay Watershed, in the pursuit of a Watershed Permit.

5.2.6.3 FUTURE CONDITIONS

The plan accommodates future growth conditions as follows:

- The majority of the watershed is significantly built-out.
- Projected growth within the watershed.
  - The projected growth within the watershed is focused on the Route 28 corridor which will be addressed with traditional solutions (i.e. sewer expansion). Projected growth in these areas will be considered when sizing sewer infrastructure (pipes, pump stations, force mains, etc.).
  - New developments within the watershed would be required to connect to sewer.
- The sewer expansion staging plan removes more septic load than required within the watershed, specifically within the Santuit River sub-watershed and the Pinquickset Cove sub-watershed to substantially address any additional development that may be experienced in the watershed.
- Adaptive management and monitoring:
  - The Town will continue to monitor the embayment, review the Plan and provide formal updates as required.
  - Refer to Section 6.5 for the Adaptive Management Plan and Section 6.4 for the Monitoring Plan.

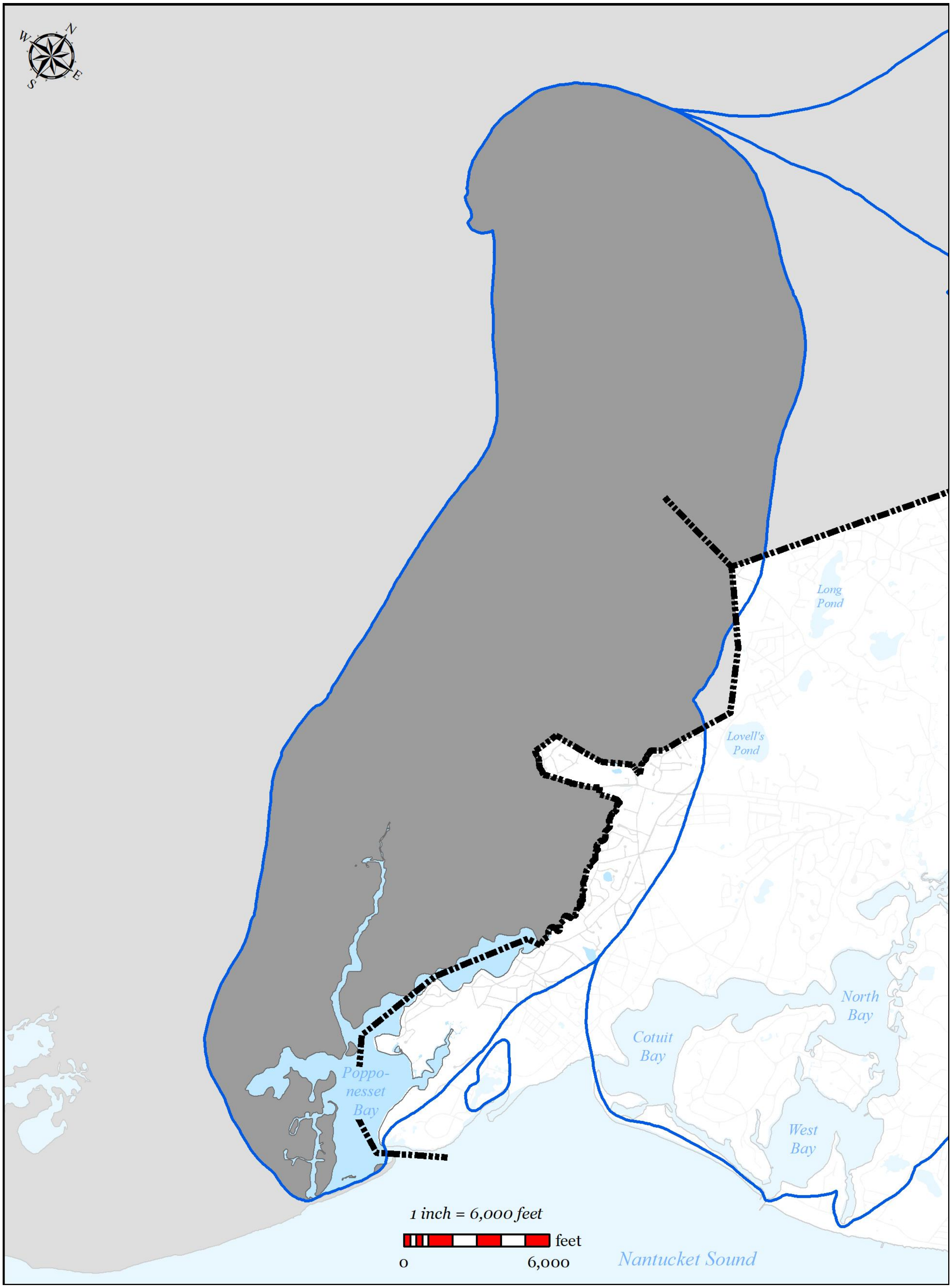

Figure 5-56: Popponesset Bay Watershed Boundary

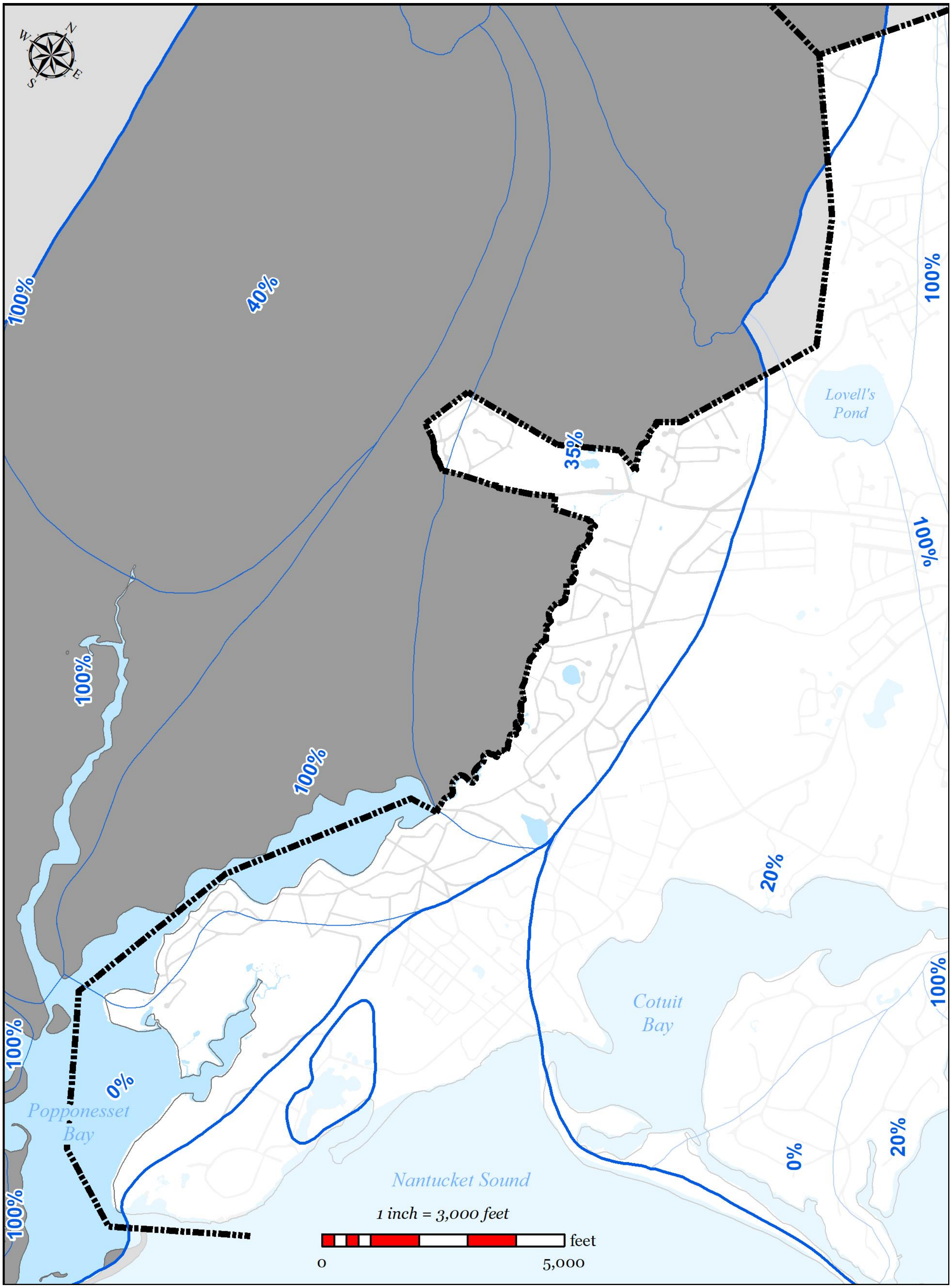

Figure 5-57: MEP-modeled Existing Septic Removal in Watershed

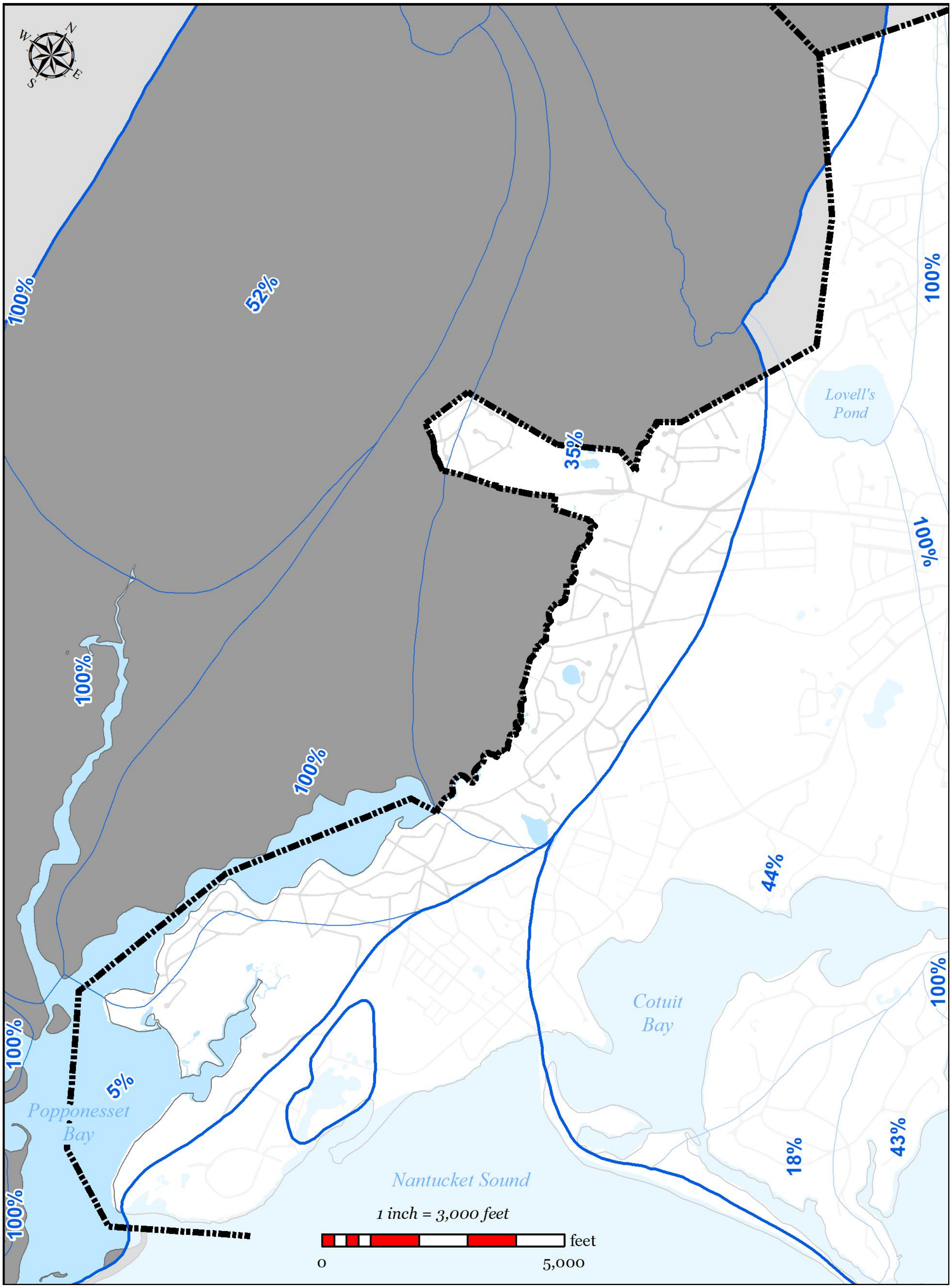

Figure 5-58: MEP-modeled Future Septic Removal in Watershed

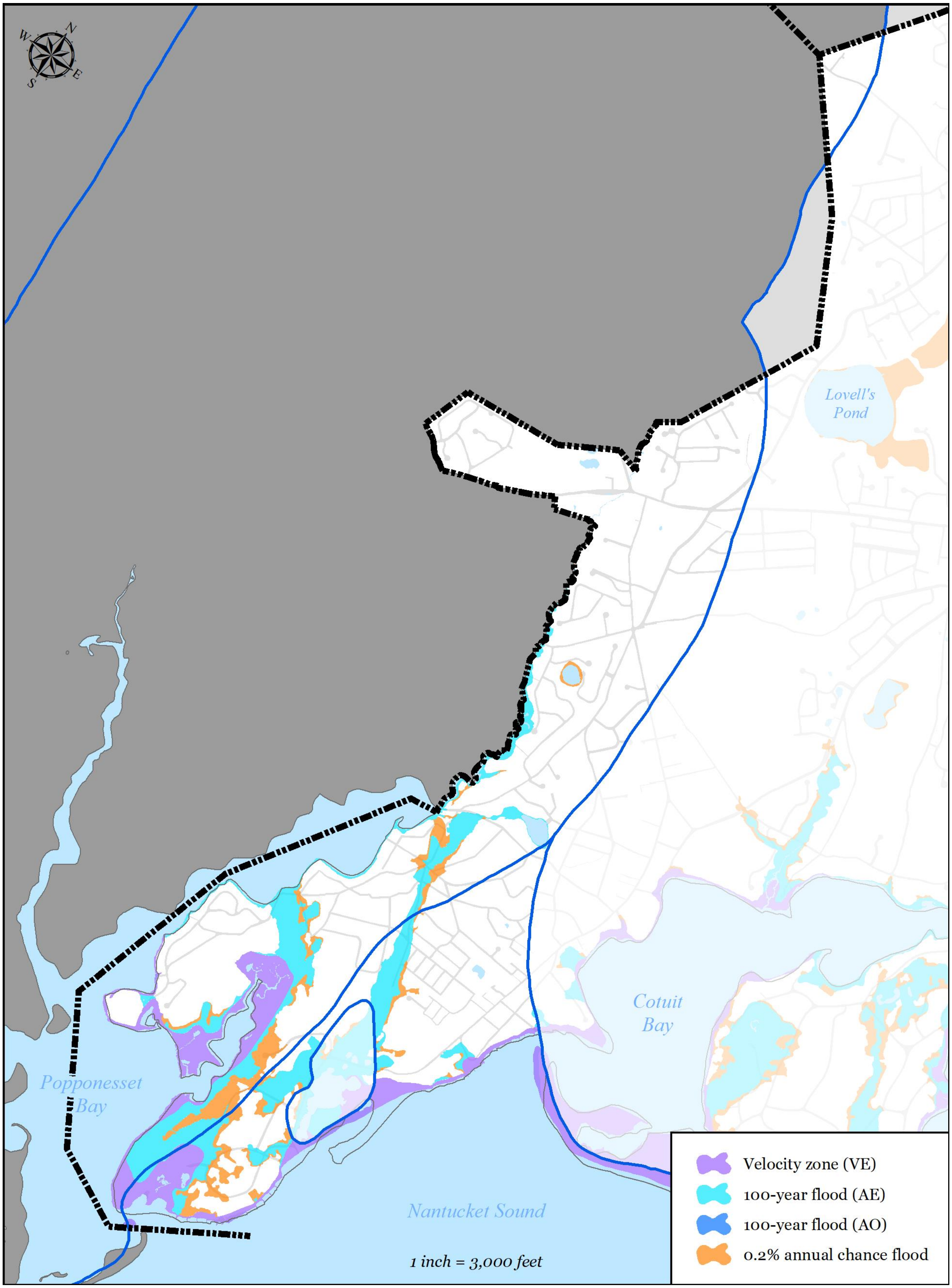

Figure 5-59: FEMA Flood Zones (2014) in Popponesset Bay Watershed

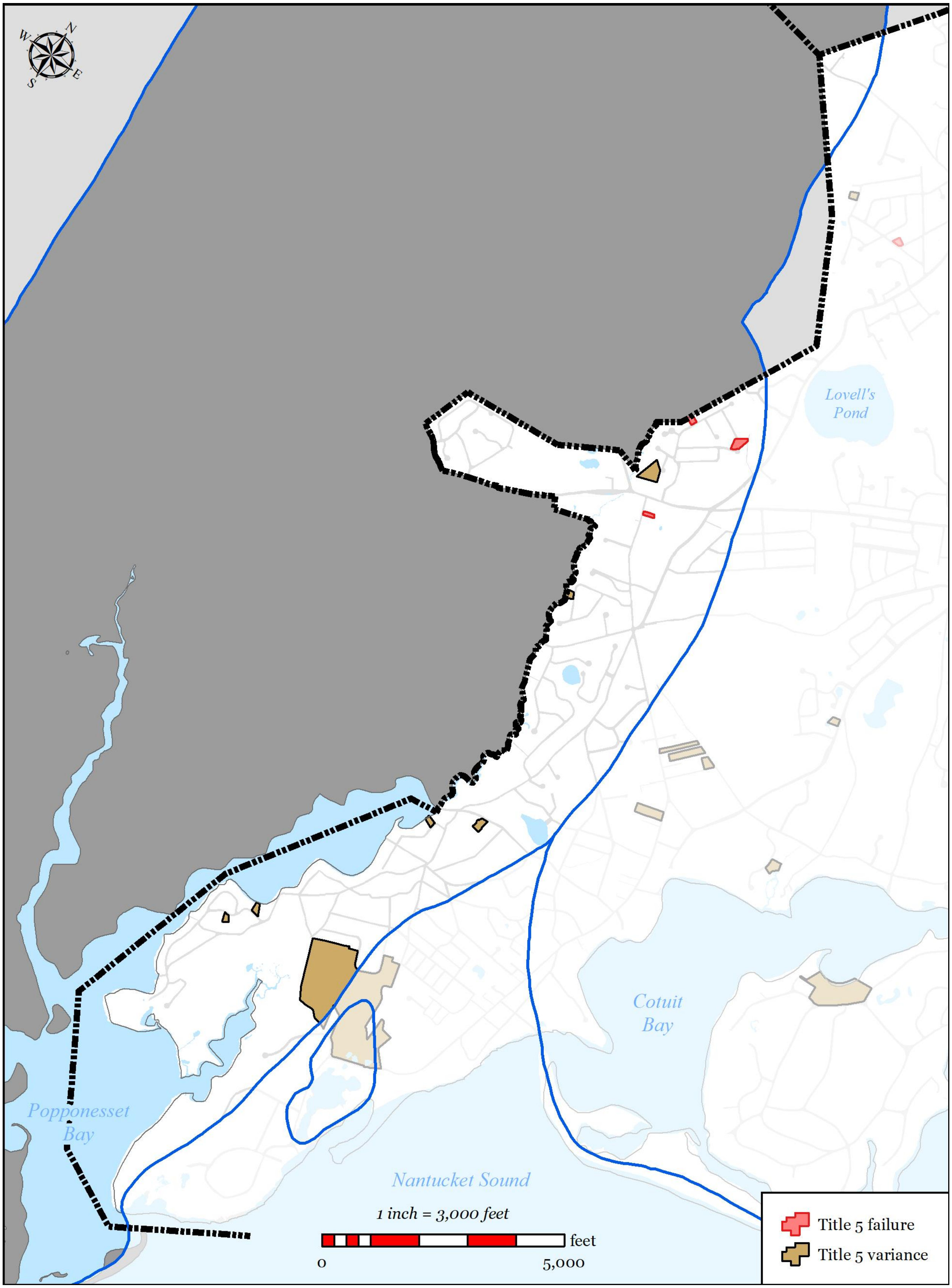

Figure 5-60: Parcels with Title 5 Septic Failures and Variances in Popponesset Bay Watershed

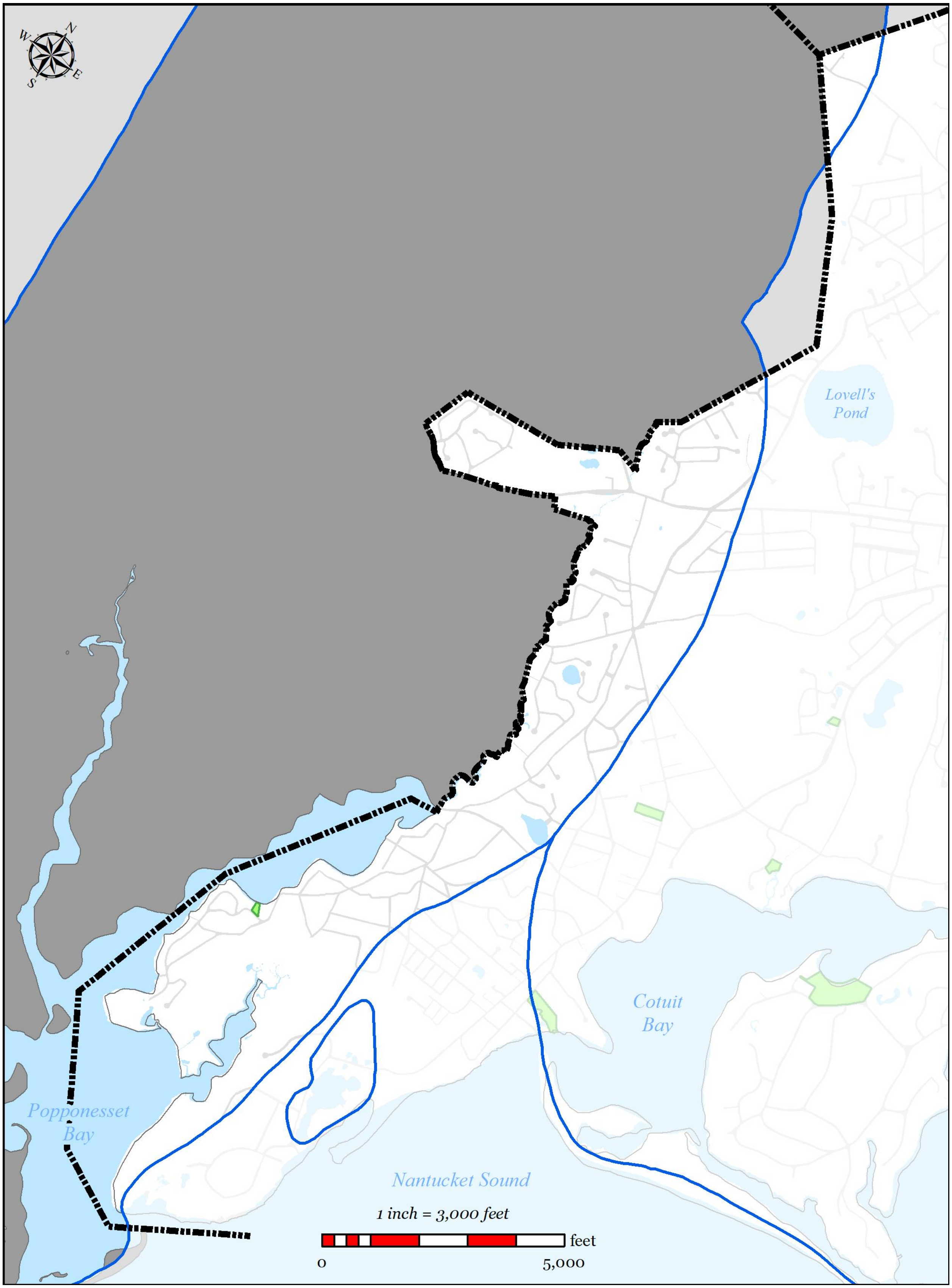

Figure 5-61: Parcels with I/A Septic Systems in Popponesset Bay Watershed

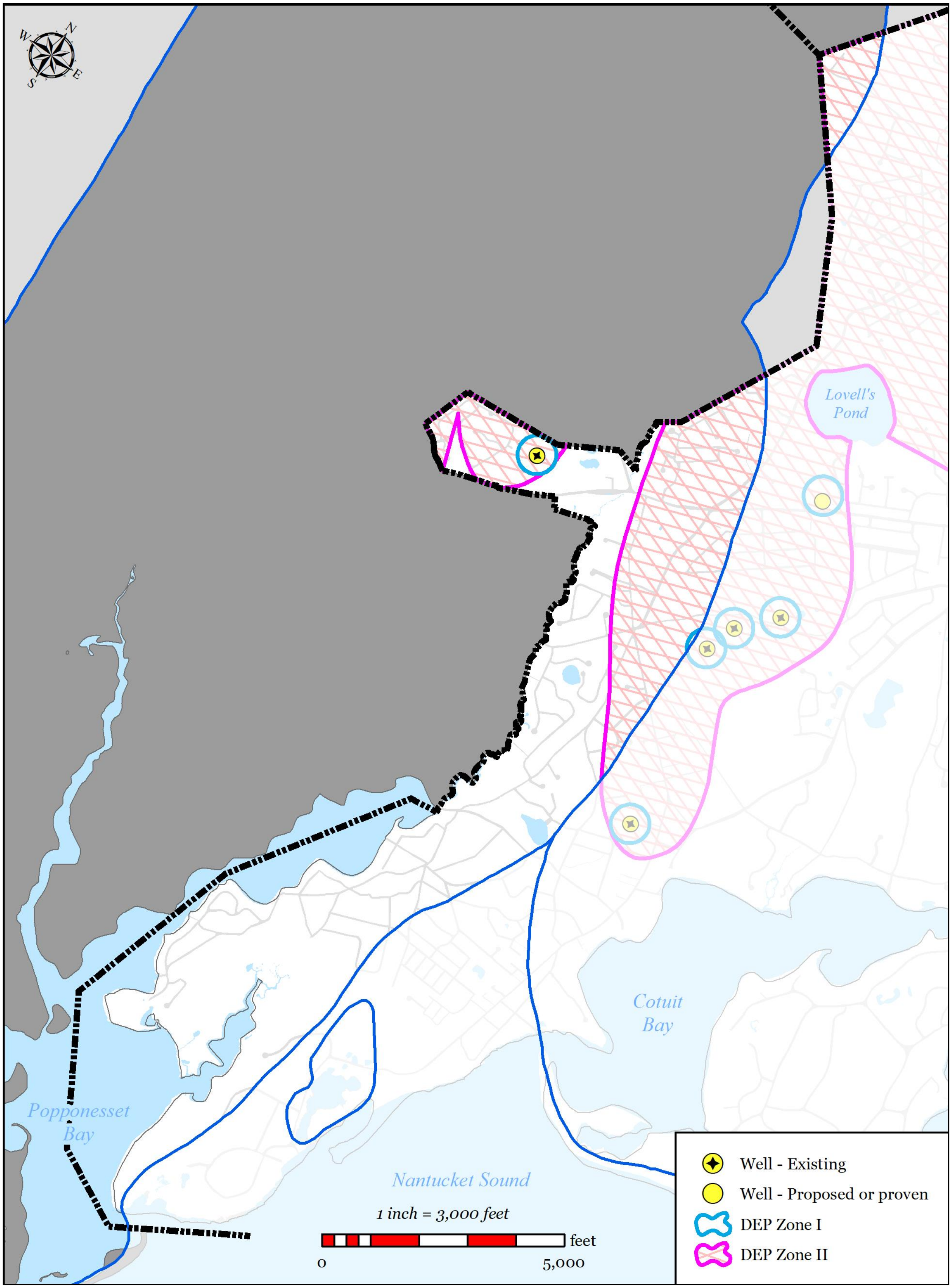

Figure 5-62: Public Water Supply Wells in Popponesset Bay Watershed

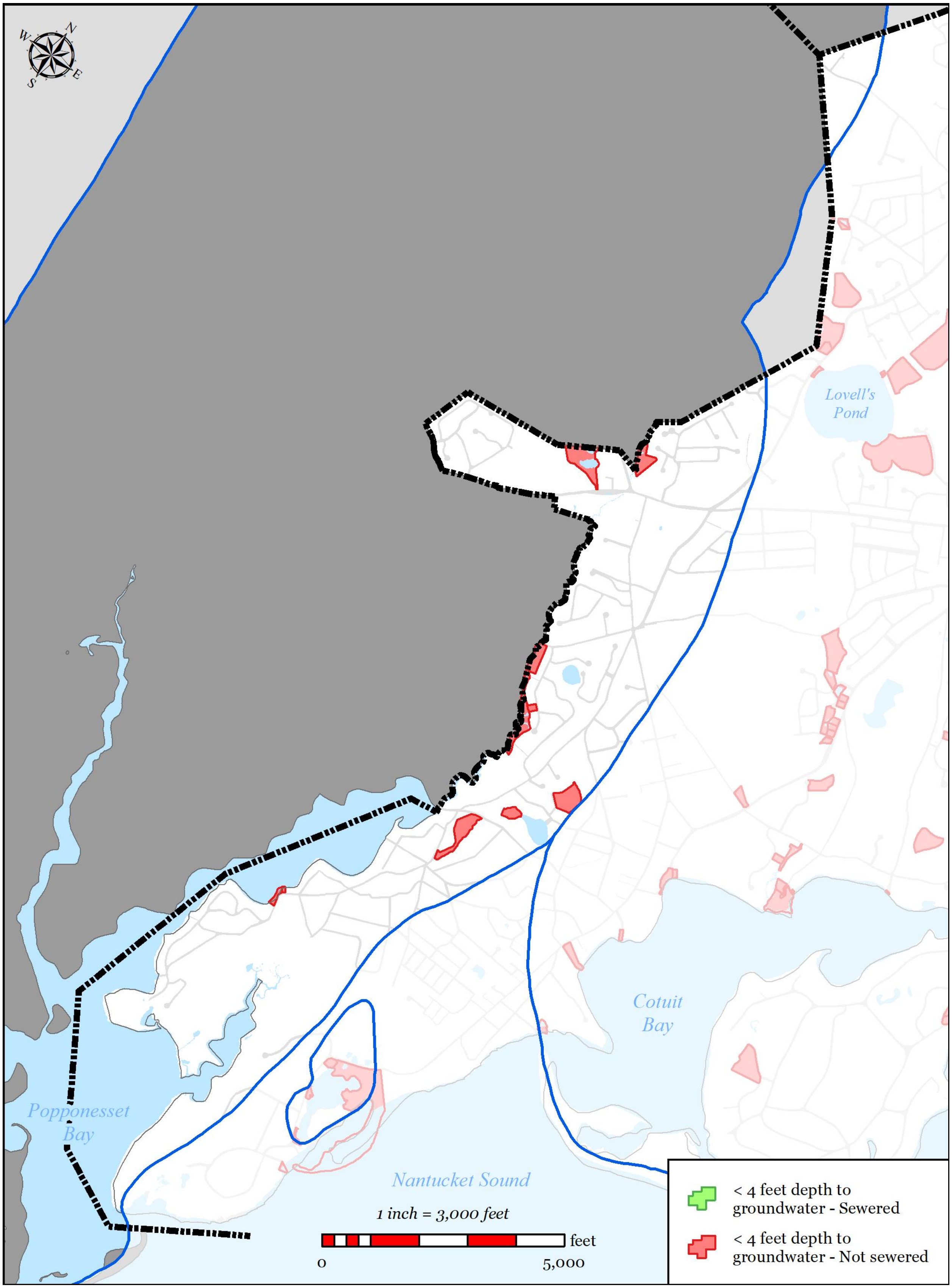

Figure 5-63: Parcels with Less than 4 feet Depth to Groundwater in Popponesset Bay Watershed

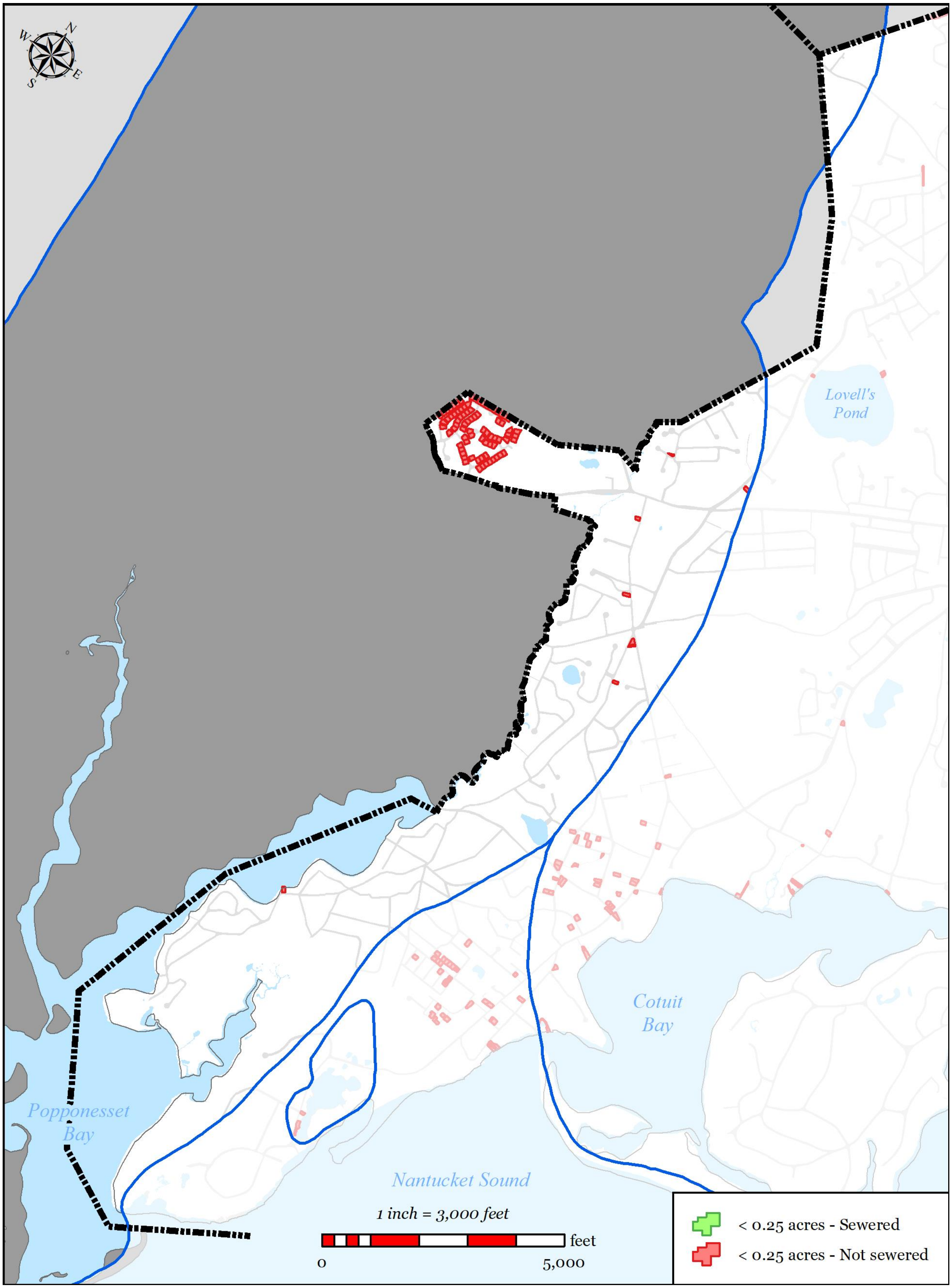

Figure 5-64: Parcels with Less than 0.25 acres in Popponesset Bay Watershed

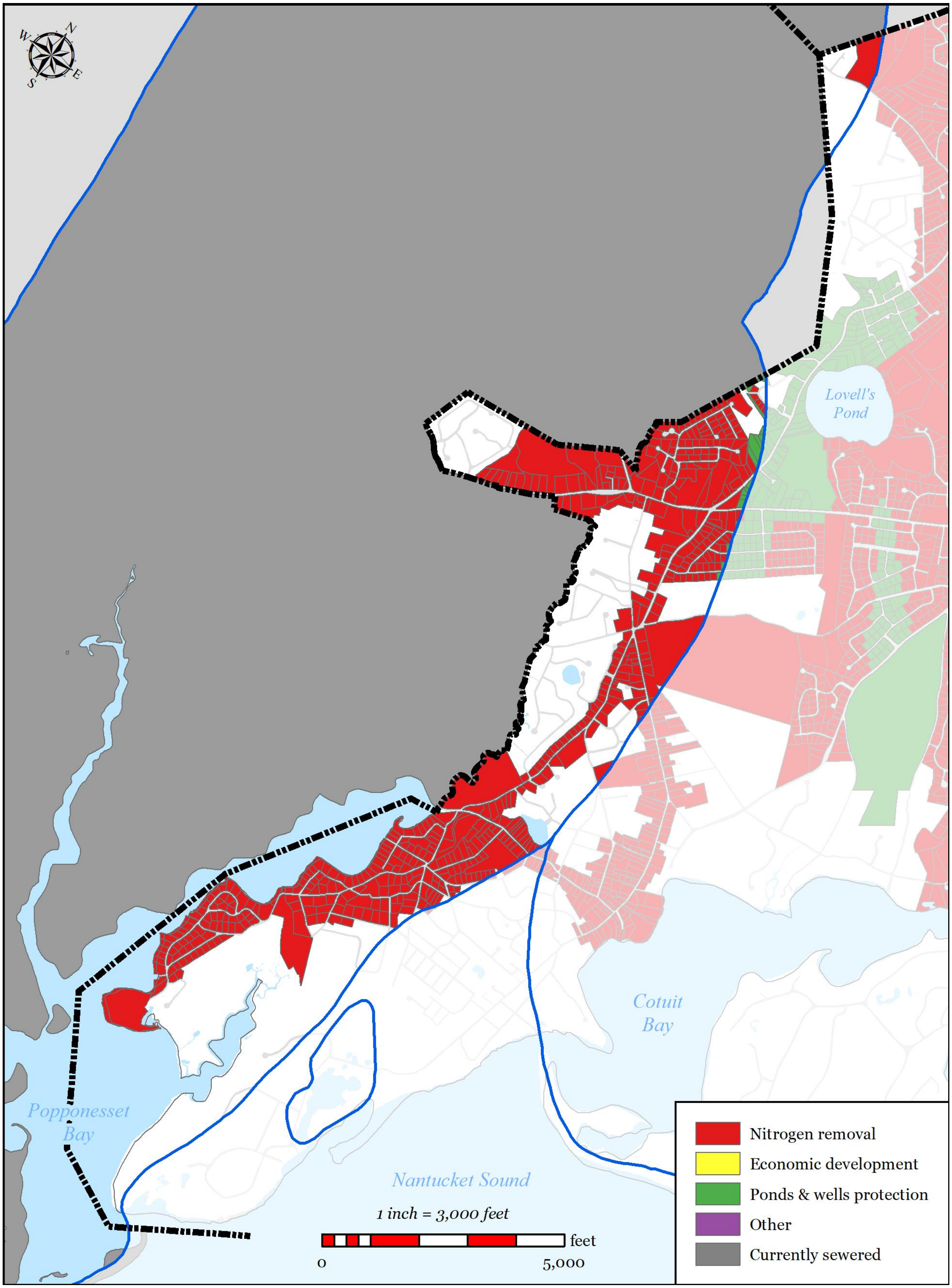

Figure 5-65: Needs Areas in Popponesset Bay Watershed

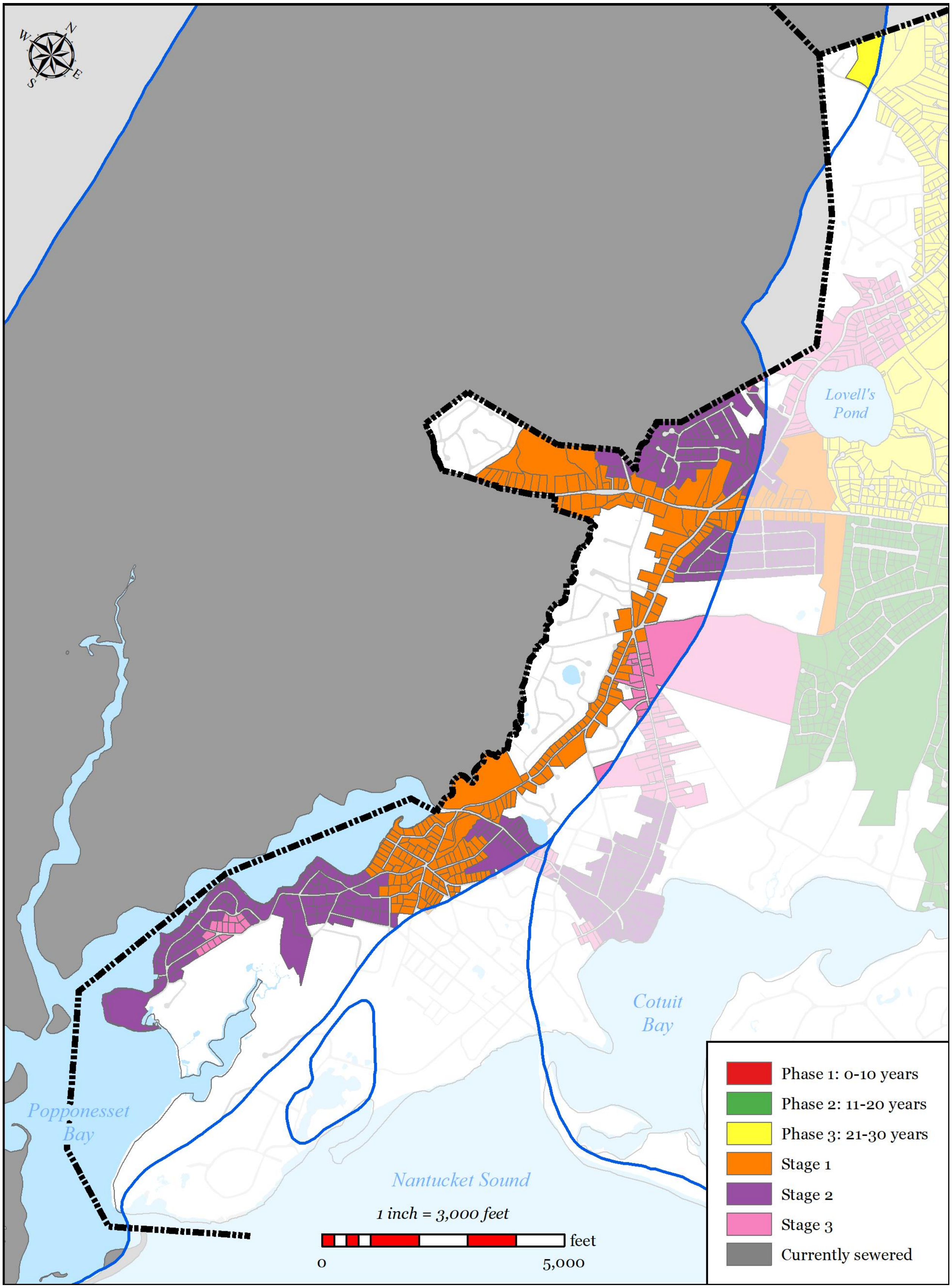

Figure 5-66: Sewer Expansion Plan in Popponesset Bay Watershed

5.2.7 BARNSTABLE HARBOR WATERSHED

The Barnstable Harbor Embayment System (also referred to as the Barnstable Great Marsh System) is located on the north side of the Town of Barnstable and extends into the towns of Sandwich, Yarmouth and Dennis. The system has a northern shore bounded by a narrow barrier beach, known as Sandy Neck, which separates the Harbor from Cape Cod Bay, with which it exchanges tidal waters. Due to the large tidal flow experienced in Barnstable Harbor, the embayment has been determined to have assimilative capacity with respect to nitrogen, except for the Millway sub-embayment (located in Barnstable Village). For a detailed description of the embayment system, refer to the 2017 Draft MEP Report (Appendix CC).

The Barnstable Harbor Watershed is the source water for the Barnstable Harbor Embayment System. The Barnstable Harbor Watershed is predominantly located within the Town of Barnstable but also extends into the towns of Yarmouth, Dennis and Sandwich (see Figure 5-67). Within the total watershed there are 63 identified surface waters including 18 named freshwater ponds and 3 significant freshwater stream outlets. The 2 significant freshwater stream outlets in the Barnstable Harbor Watershed that are located in the Town of Barnstable are: Bridge Creek and Brickyard Creek. There are 3 public drinking water wells operated by Barnstable Water District located within the watershed within the limits of the Town of Barnstable. Additionally, the Village of West Barnstable is located within the watershed and is predominantly serviced by private on-site drinking water wells. There are no municipally operated wastewater treatment facilities within the watershed.

5.2.7.1 SUMMARY OF NEEDS

The Town of Barnstable's wastewater plan has been designed to address multiple needs areas within the Barnstable Harbor Watershed, including nutrient removal, pond protection, water supply protection, flood zone considerations and economic development, via sewer expansion within the Barnstable Harbor Watershed.

5.2.7.1.1 Nutrient Removal

As of the writing of this report, the MEP technical report for the Barnstable Harbor system is in draft form and there is no approved nitrogen TMDL for the Barnstable Harbor system. The 2017 draft MEP technical report for the Barnstable Harbor system indicates that the system is not severely overloaded with respect to nitrogen and the majority of sub-embayments have assimilative capacity to accept more nitrogen. The one exception is the Millway sub-embayment which the modeling indicates is overloaded with respect to nitrogen and requires a 65% (4.7 kg/day-N) reduction in nitrogen septic load. The Town's wastewater plan has been designed to exceed the required septic load removal within the Millway sub-embayment by sewer expansion within the Millway sub-watersheds (Millway LT10, Millway GT10, and Maraspin Creek sub-watersheds). Utilizing the Town's wastewater planning GIS tool, the Town modeled the septic loading within the Millway sub-watersheds and developed a sewer expansion plan to reduce the septic loading to the Millway sub-embayment. The plan will extend sewer to 369 parcels within the Millway sub-watersheds which will result in an un-attenuated septic load removal of 5.3 kg/day-N, which exceeds the MEP required reduction of 4.7 kg/day-N.

5.2.7.1.2 Wastewater Needs (Other Needs)

Title 5 Issues

Integral to the planning process was the Town's development a wastewater planning GIS tool which allowed Town staff to spatially map traditional Title 5 concerns such as small lot size, depth to groundwater, existing septic variances, existing known failed septic systems, and systems within Zone IIs. Parcels with area less than 0.25 acres were flagged because they were considered difficult to site a traditional septic system, likely to need septic variances, and increased density leading to increased nutrient loading. Parcels with an average depth of groundwater of less than four feet were flagged as likely to require raised systems which are costly and less desirable for community aesthetics. Existing septic variances and existing known failed septic systems were also mapped.

The tool allows the Town to overlay these layers to identify the "hot-spots" for traditional Title 5 concerns. These areas were then incorporated into the plan where practical. Many of these "hot-spots" overlaid other needs such as nutrients and pond protection. The Plan for the Barnstable Harbor Watershed addresses traditional Title 5 concerns as shown in the data presented below which was calculated using the Town's wastewater planning GIS tool (this data does not account for attenuated nitrogen data):

- Total parcels within the Town of Barnstable within the Barnstable Harbor Watershed = 4,656
- Total parcels connected to municipal existing sewer = 452 (10%)
- Parcels with total area less than 0.25 acres = 302 (6%)
    - 132 (44%) already served by municipal sewer
    - 37 (12%) additional to be addressed with a traditional solution in the Plan
    - Total = 169 (56%)
- Parcels with average depth to groundwater less than four feet = 266 (6%)
    - 28 (11%) already served by municipal sewer
    - 30 (11%) additional to be addressed with a traditional solution in the Plan
    - Total = 58 (22%)
- Parcels with septic system variances = 26 (0.6%)
    - 5 (19%) will be addressed with a traditional solution in the Plan

- Parcels with known failed septic systems = 13 (0.3%)
    - 3 (23%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 669 (14%)
    - 39 (6%) already served by municipal sewer
    - 383 (57%) additional to be addressed with a traditional solution in the Plan
    - Total = 422 (63%)

Flood Zones

- Total parcels within the Barnstable Harbor Watershed = 4,656
- Parcels within FEMA mapped 100-year flood zone (AE/AO) or velocity zone (VE) = 962 (21%)
    - 178 (19%) already served by municipal sewer
    - 91 (9%) that will be addressed with a traditional solution in the Plan
    - Total = 269 (28%)

Contaminants of Emerging Concern (CECs)

Contaminants of emerging concern (CECs) are increasingly being detected in surface water. (CECs) are made up of three general groups, endocrine disrupting compounds, pharmaceuticals, and personal care products. These compounds and potential contaminants are not currently regulated by the federal government because their toxicity is not well understood. Collecting wastewater with sewers and treating at a centralized treatment location allows the opportunity to treat wastewater for CECs as they are better understood and future treatment technologies are developed.

5.2.7.1.3 Pond Protection

The Town's wastewater planning has included detailed studies of ponds 3 acres or larger throughout the Town, except for No Bottom Pond (1.7 acres). Through those studies, there is extensive water data for 7 ponds in the Barnstable Harbor Watershed. Pond classification of these ponds is shown in Table 5-16 and Table 5-17.

Table 5-16: Barnstable Harbor Watershed Pond Classification 2009 Study

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6m
Oligotrophic	Hathaway's Pond (South)	Garrett's Pond	Hathaway's Pond (North)
Mesotrophic		No Bottom Pond	
Eutrophic	Mill Pond (WB)	Hinckley Pond	
Hypereutrophic			

Table 5-17: Barnstable Harbor Watershed Pond Classification 2017 Study

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6m
Oligotrophic			
Mesotrophic	Mill Pond (WB)		
Eutrophic	Flax Pond		
Hypereutrophic			

Two ponds within the watershed have been identified as impaired: Flax pond and Hinckley Pond. Mill Pond (WB) was assessed recently during the 2017 study, revealing that the chlorophyll-a trophic state was more indicative of a mesotrophic system. However, this is only based on one sampling event, whereas the 2009 study was based on data from 2001-2007 and is more statistically significant. Sewer expansion adjacent to the following ponds for protection from nutrients from septic systems has been proposed: Hathaway's Pond (South).

5.2.7.1.4 Economic Development

The Town's Planning and Development Department (P&D) identified a number of areas within the Barnstable Watershed as needs areas for sewer expansion to promote economic development. These areas include:

- Properties along Route 132 from Attucks Lane to Phinney's Lane.
- Properties along Attucks Lane
- Properties along the west side of Phinney's Lane between Route 132 and the Mid-Cape Highway (Route 6).
- The Kidd's Hill Area (referred to in previous sections as the "Lorusso property").

- Properties in the "Independence Park" area that have not been connected to municipal sewer to date or have not been developed to date.

5.2.7.2 PROPOSED SOLUTIONS

The plan addresses the needs areas using the following techniques:

- Sewer Expansion
    - 452 of the 4,656 parcels (10%) in the watershed within the Town of Barnstable are connected to municipal sewer
    - 369 parcels in the Millway sub-watersheds will be are included in the proposed sewer expansion plan. The un-attenuated septic load removal is 5.3 kg/day-N, which exceeds the MEP required reduction of 4.7 kg/day-N.

- Stormwater upgrades
    - The Town's MS4 program will identify and provide solutions to existing stormwater outfalls.
        - 54 of the Town's 207 identified stormwater outfalls are located in the Barnstable Harbor Watershed.
    - The Town's Public Road program invests on average $750,000 a year in stormwater improvements in the Town's public roads. These improvements generally include replacement of failed catch basins and leaching structures.
    - In the Fall of 2019 and the Spring of 2020, the Town will be completing a streetscape project on Route 6A the center of Barnstable Village and on Mill Way which includes an upgrade to the stormwater management systems of these roadways. These upgrades will improve the water quality of the stormwater runoff generated on these roadways and collected in the stormwater system.

- Fertilizer Regulation
    - In 2014 the Town adopted a Fertilizer Nitrogen and Phosphorus Control Regulation (see Appendix PP). The regulation includes the following:
        - Provides Best Management Practices and performance standards for noncertified fertilizer applicators.
        - Outlines education, certification, enforcement and penalties.

5.2.7.3 FUTURE CONDITIONS

The plan accommodates future growth conditions as follows:

- The Millway sub-watershed is significantly developed with predominantly residential uses. It is not anticipated that there will be substantial growth within this sub-watershed. However, sewer expansion within this sub-watershed has been designed to remove 113%

of the required septic load to accommodate any unanticipated growth within this area. Sewer expansion projects will be designed to accommodate growth within the expansion areas (increased pipe sizes, appropriate pump station sizing, etc.).

- Downtown Barnstable Village is a densely developed business center and is also home to the Barnstable County complex. This area has been served by municipal sewer since the late 1970s.
  - The SewerCAD model indicates that the existing sewers in this area have sufficient capacity for existing and future conditions.
- Adaptive management and monitoring
  - The Town will continue to monitor the embayment, review the Plan and provide formal updates as required.
  - Refer to Section 6.5 for the Adaptive Management Plan and Section 6.4 for the Monitoring Plan.

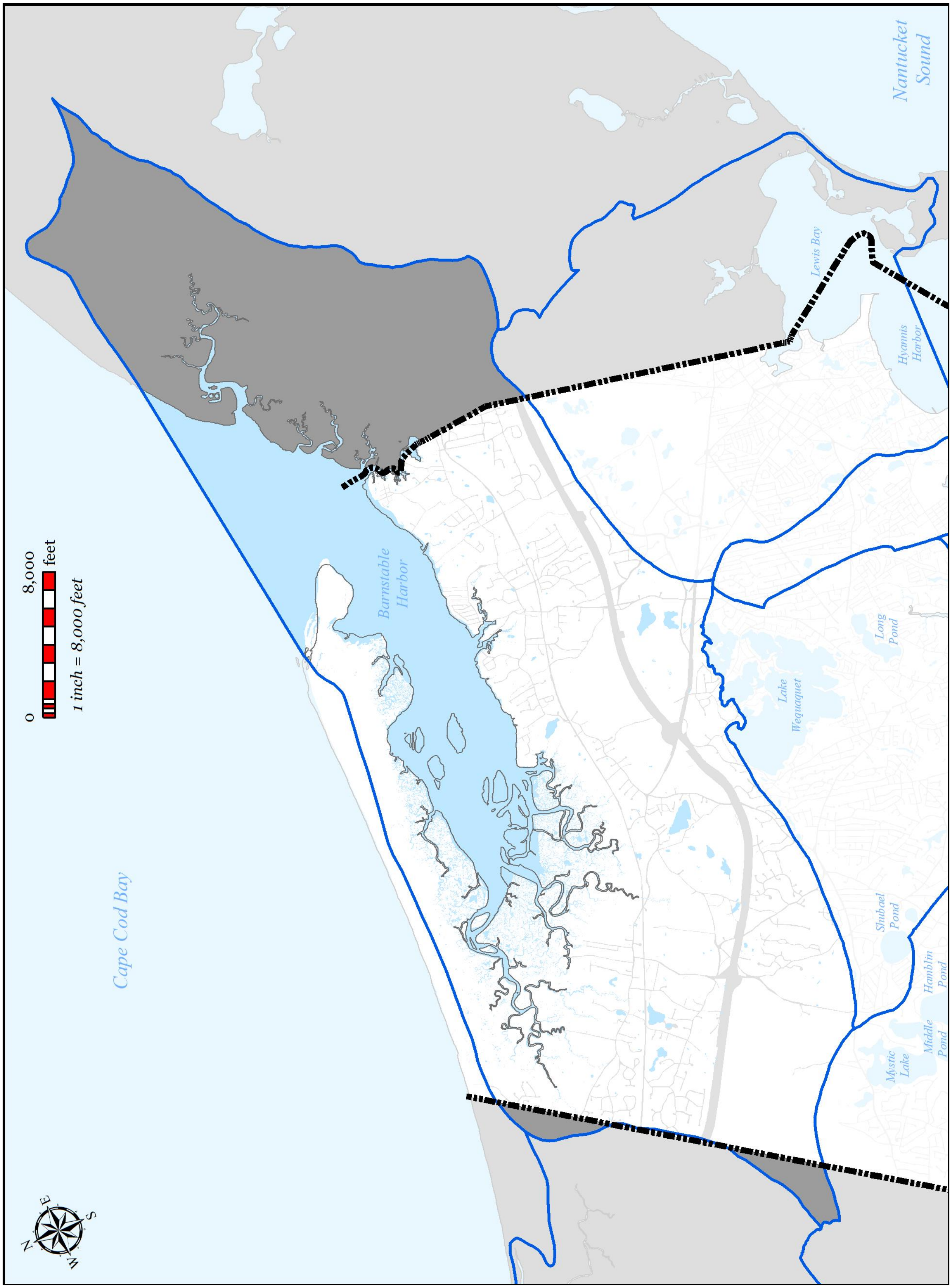

Figure 5-67: Barnstable Harbor Watershed

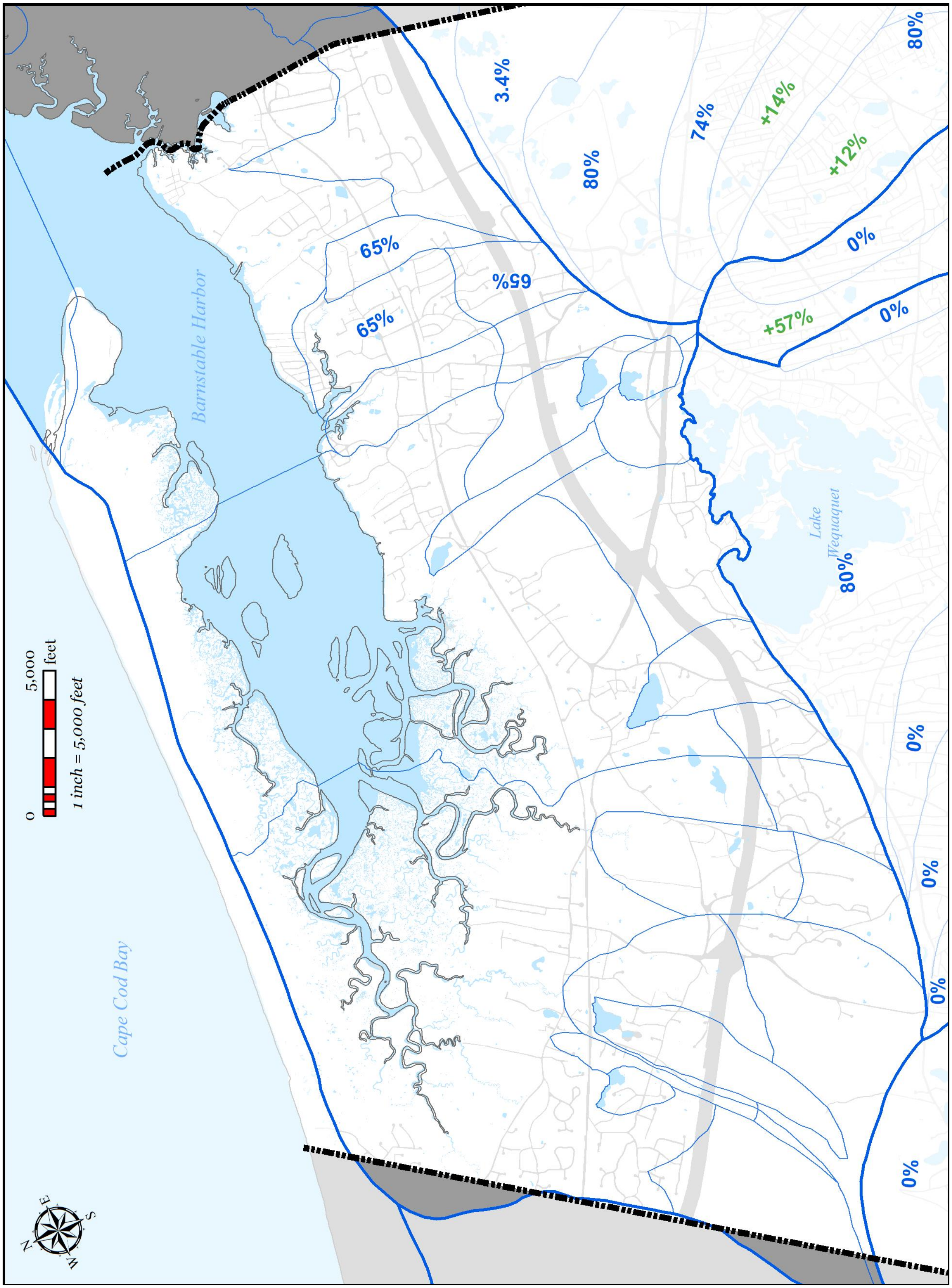

Figure 5-68: MEP-modeled Existing Septic Removal in Barnstable Harbor Watershed

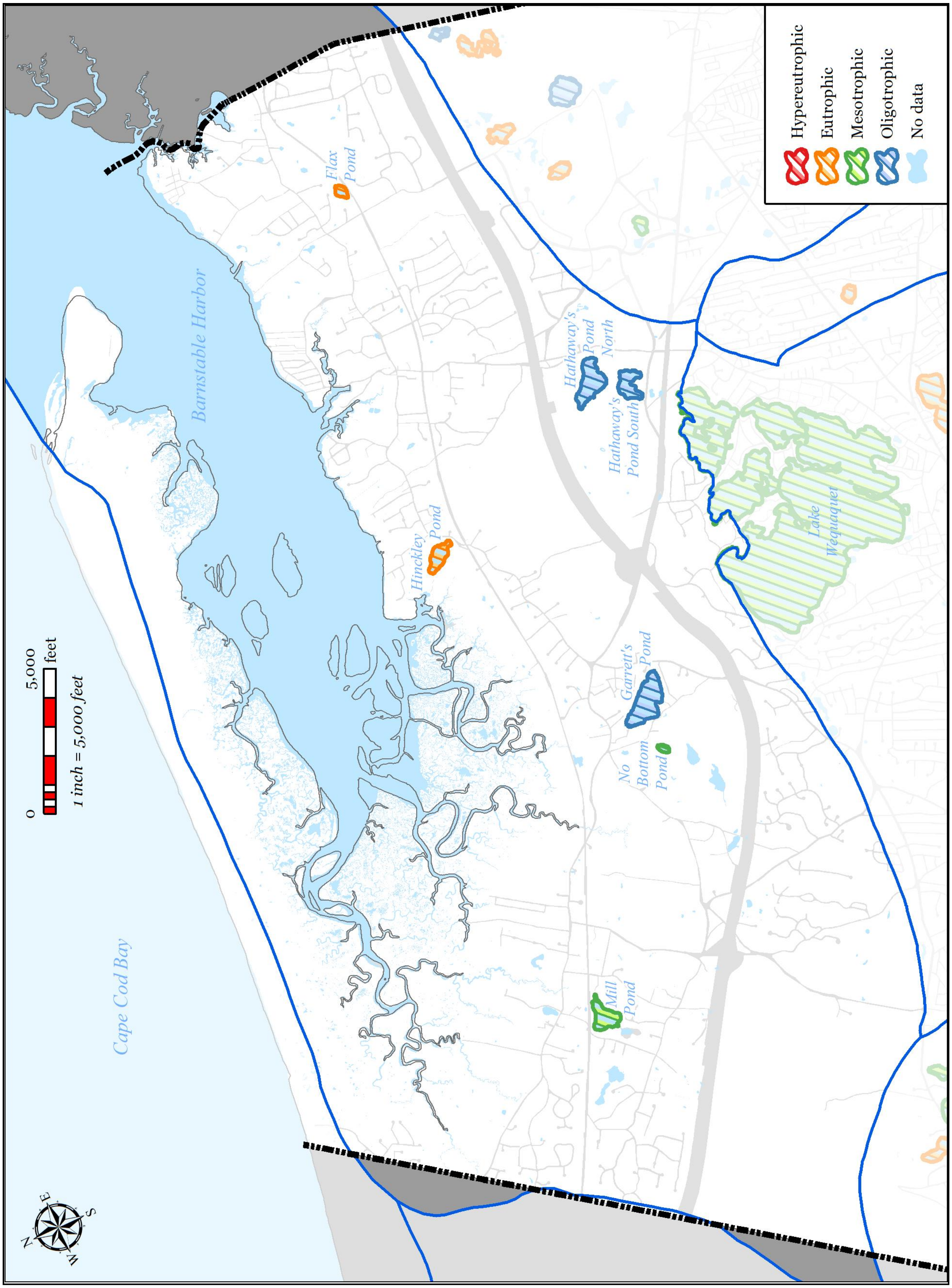

Figure 5-69: Trophic States of Ponds in Barnstable Harbor Watershed.

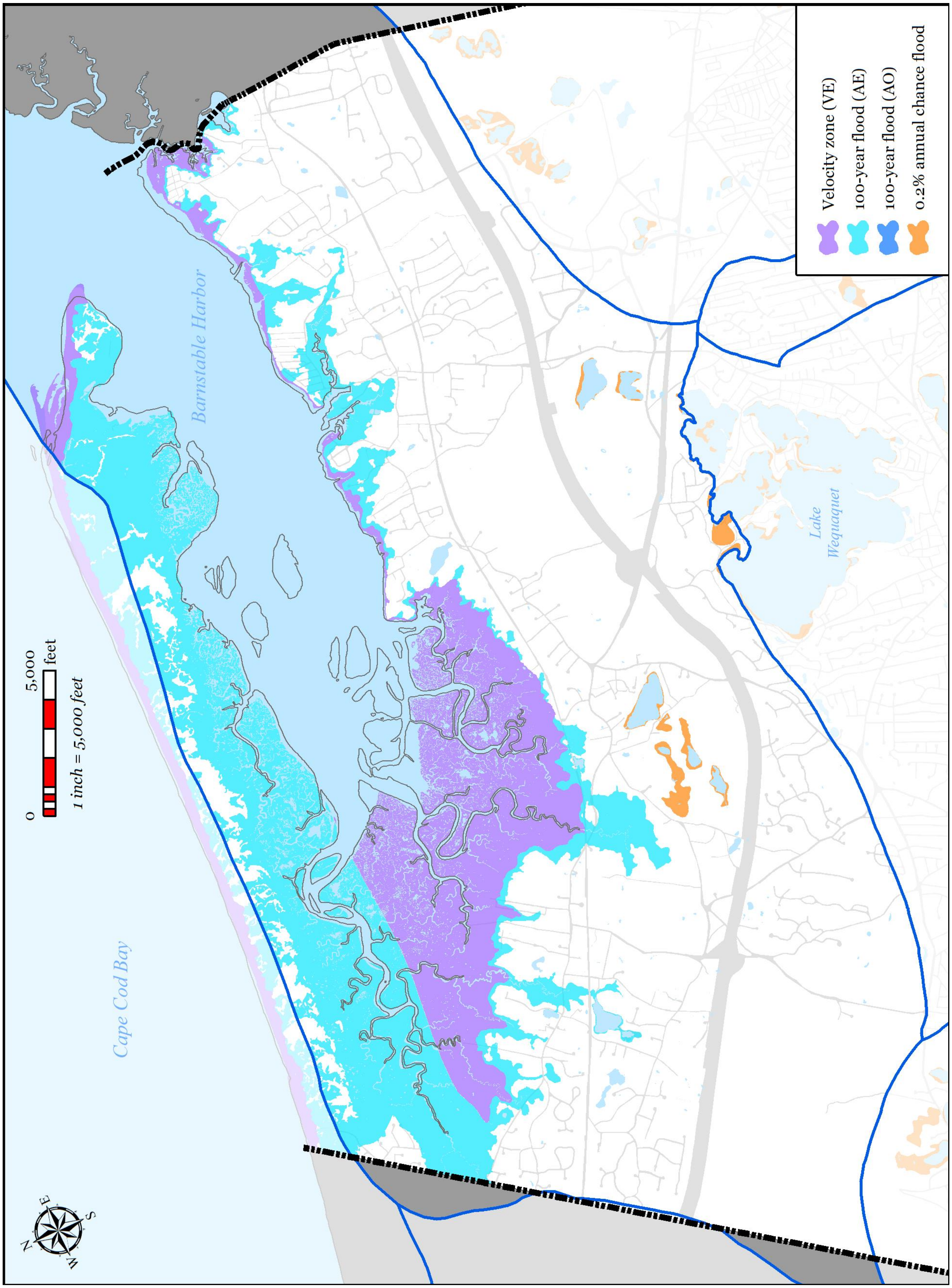

Figure 5-70: FEMA Flood Zones (2014) in Barnstable Harbor Watershed

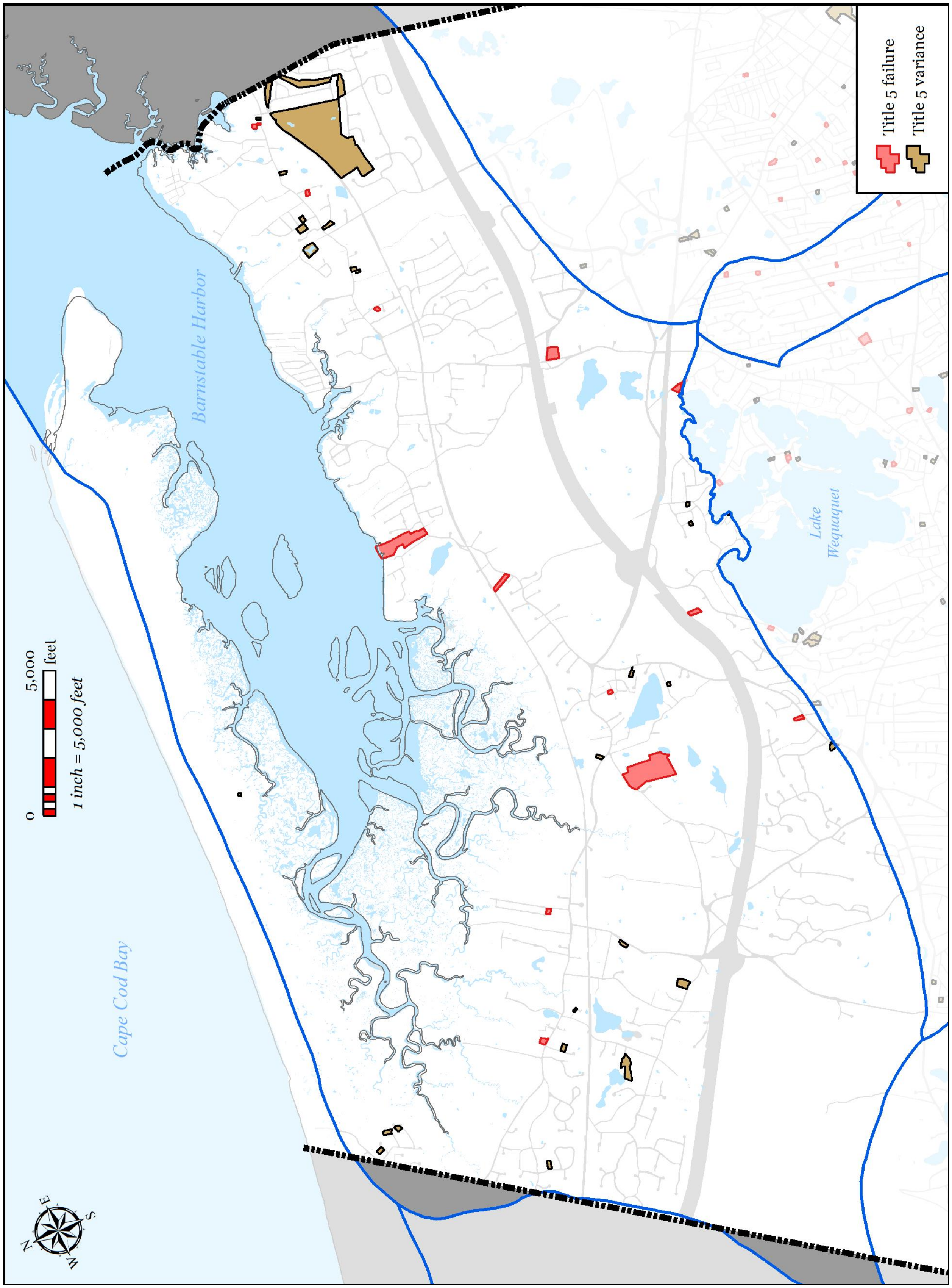

Figure 5-71: Parcels with Title 5 Septic Failures and Variances in Barnstable Harbor Watershed

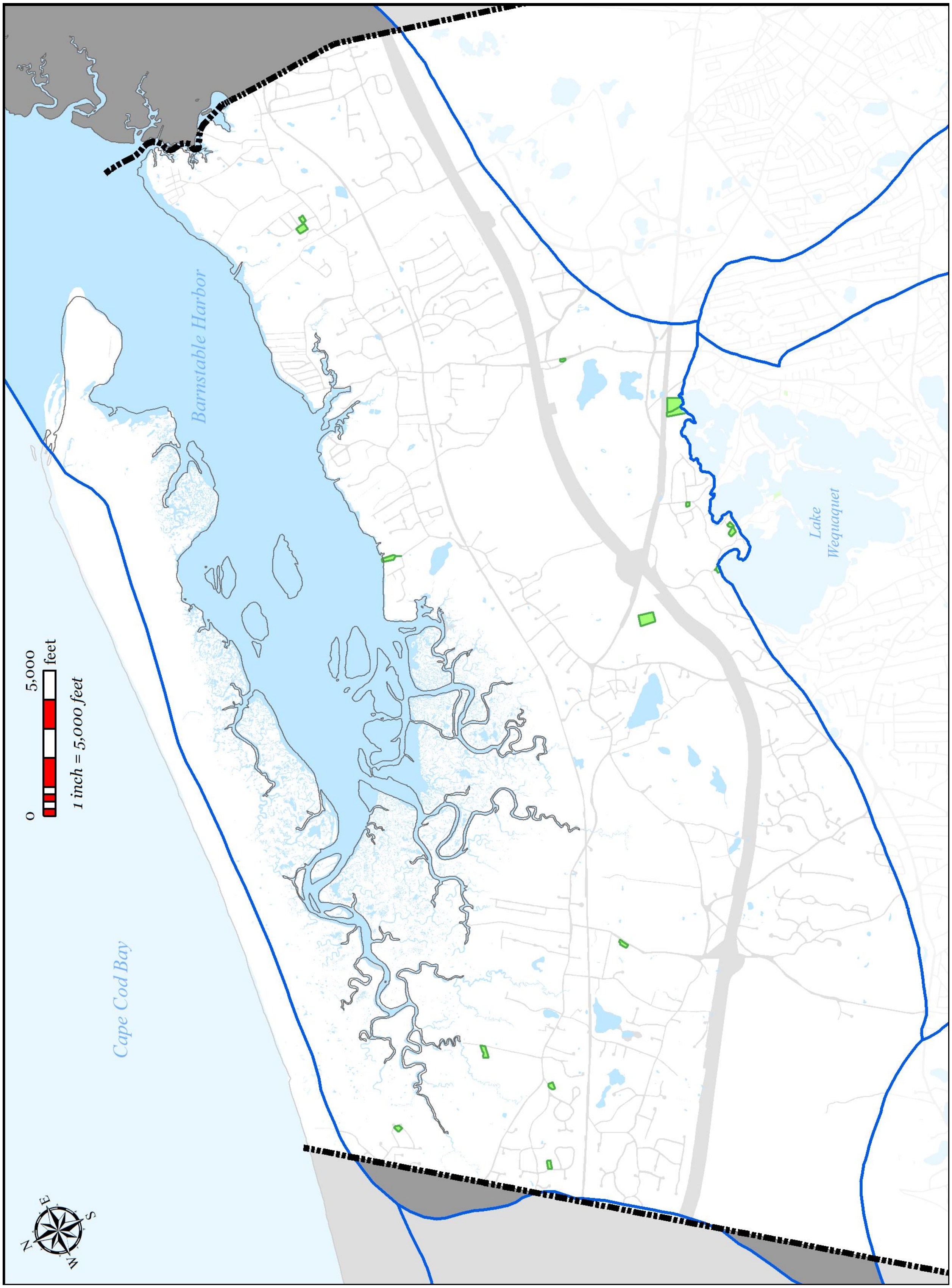

Figure 5-72: Parcels with I/A Septic Systems in Barnstable Harbor Watershed

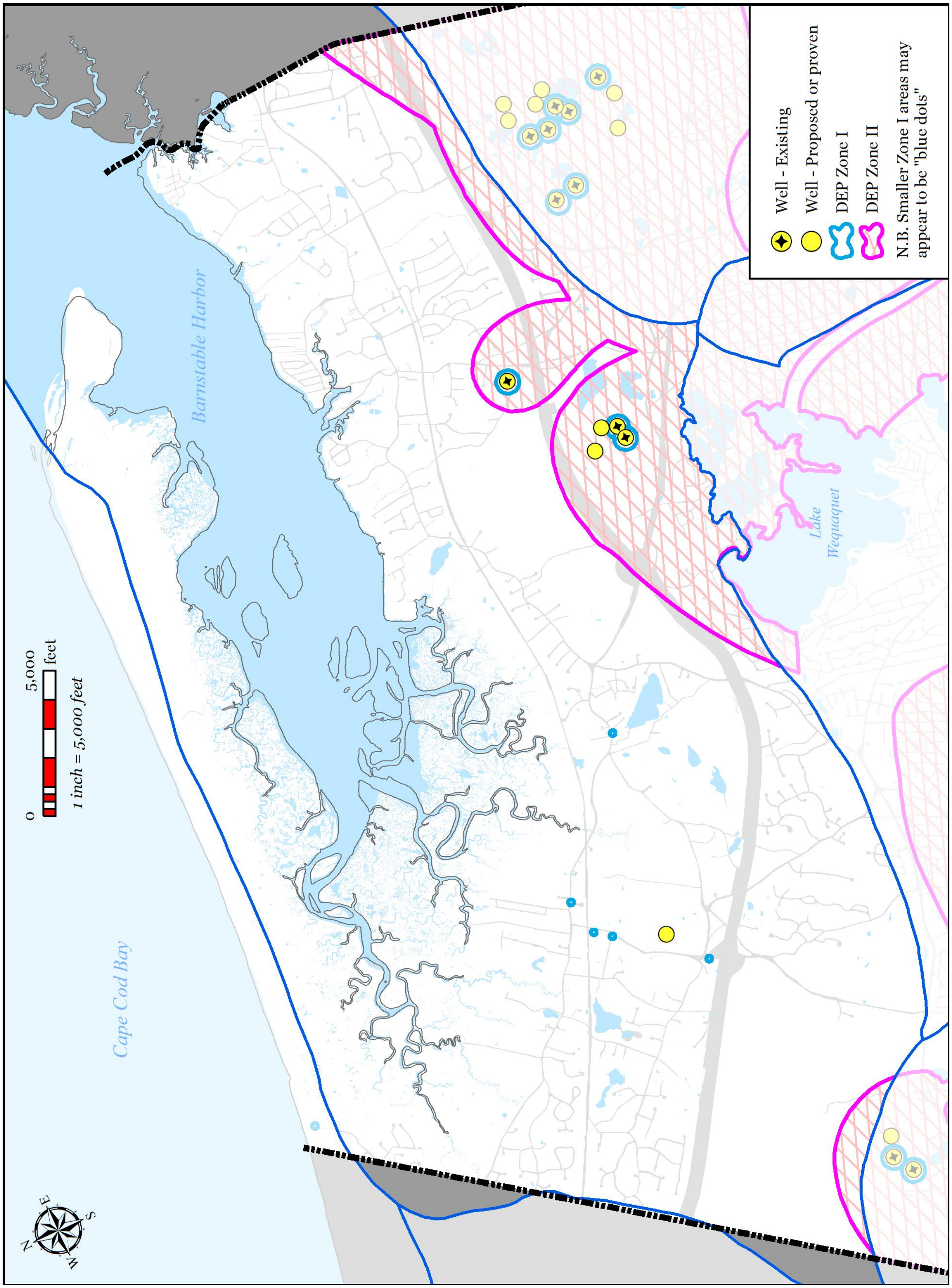

Figure 5-73: Public Water Supply Wells in Barnstable Harbor Watershed

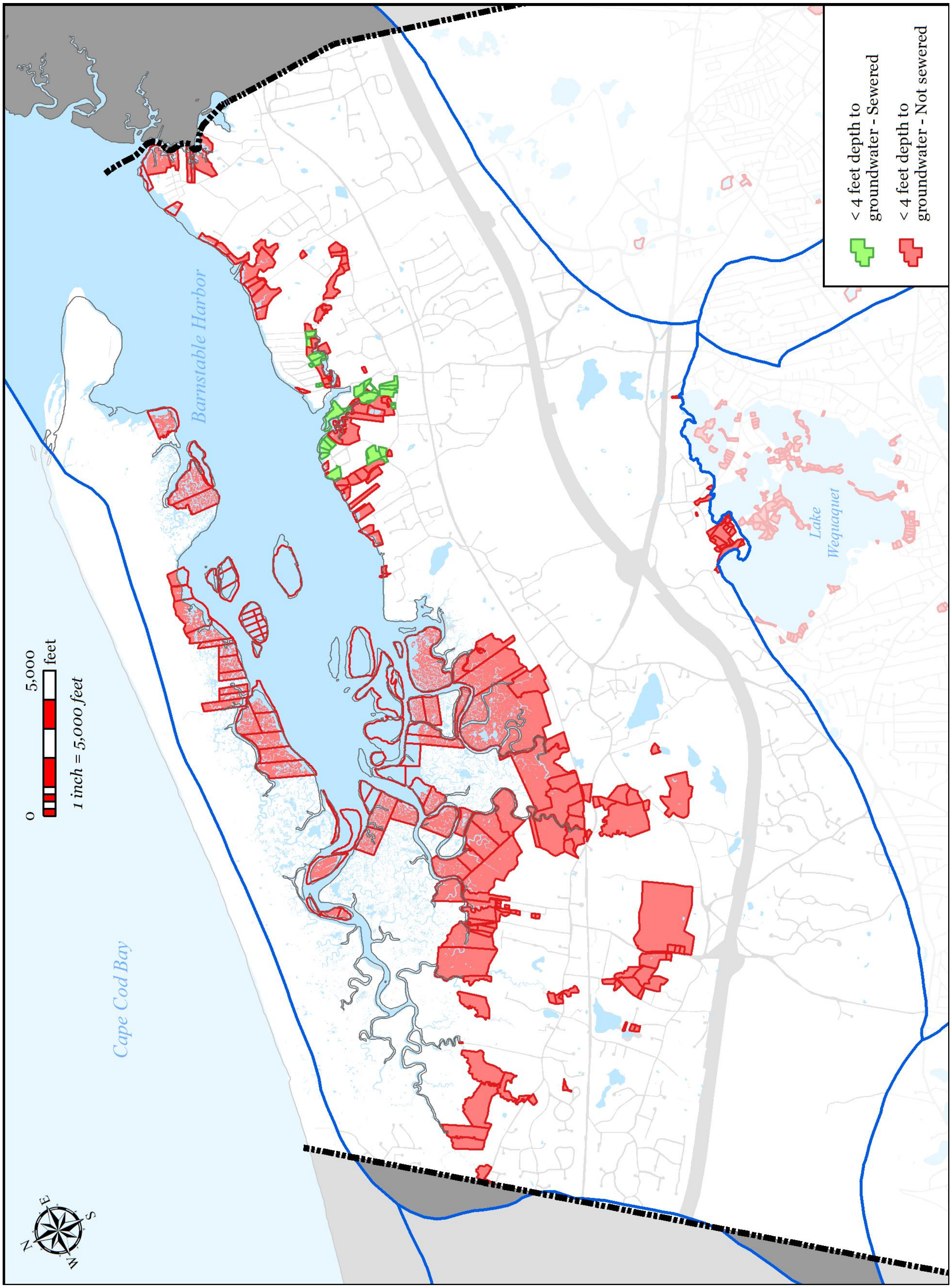

Figure 5-74: Parcels with Less than 4 feet Depth to Groundwater in Barnstable Harbor Watershed

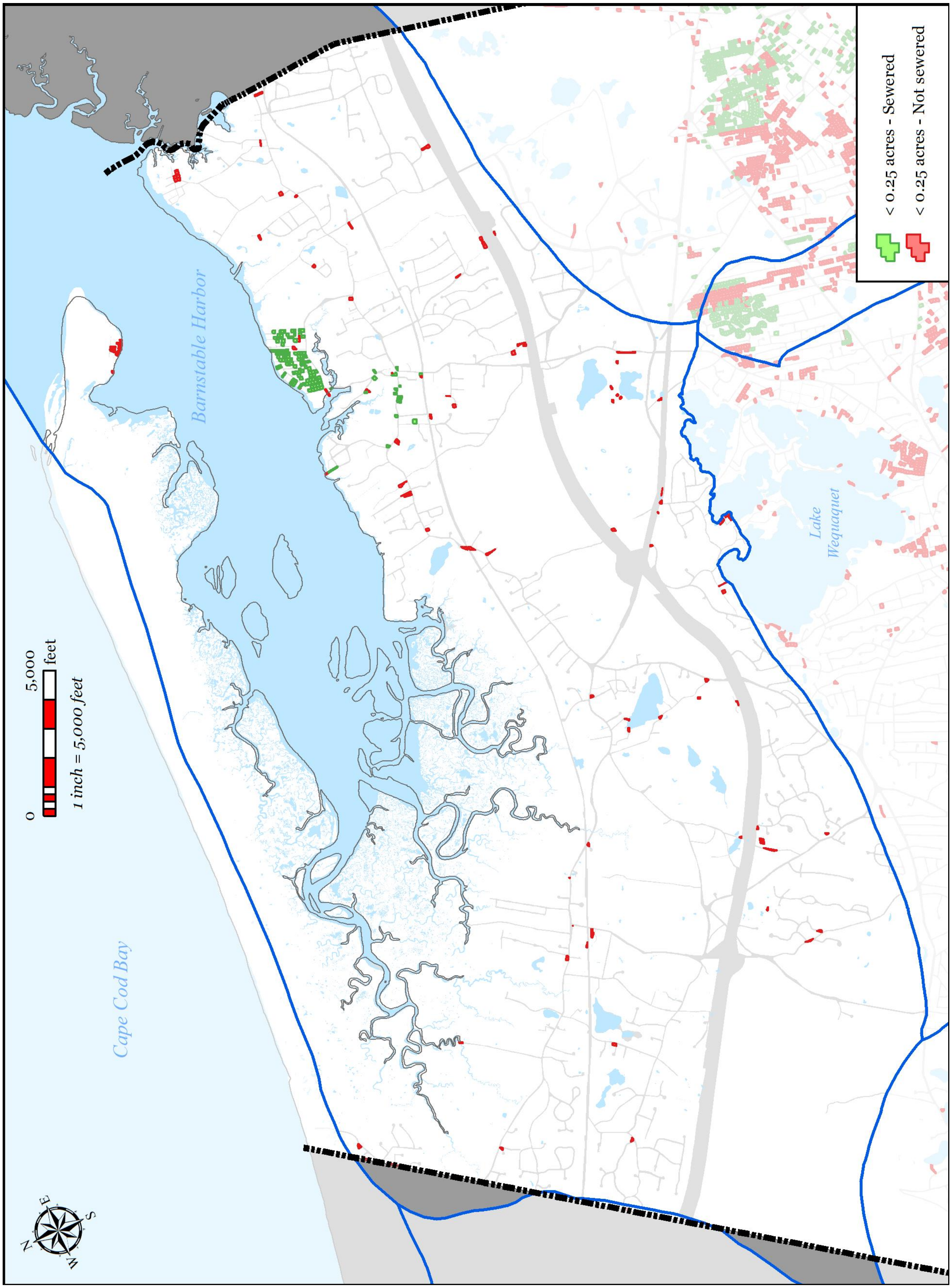

Figure 5-75: Parcels with Less than 0.25 acres in Barnstable Harbor Watershed

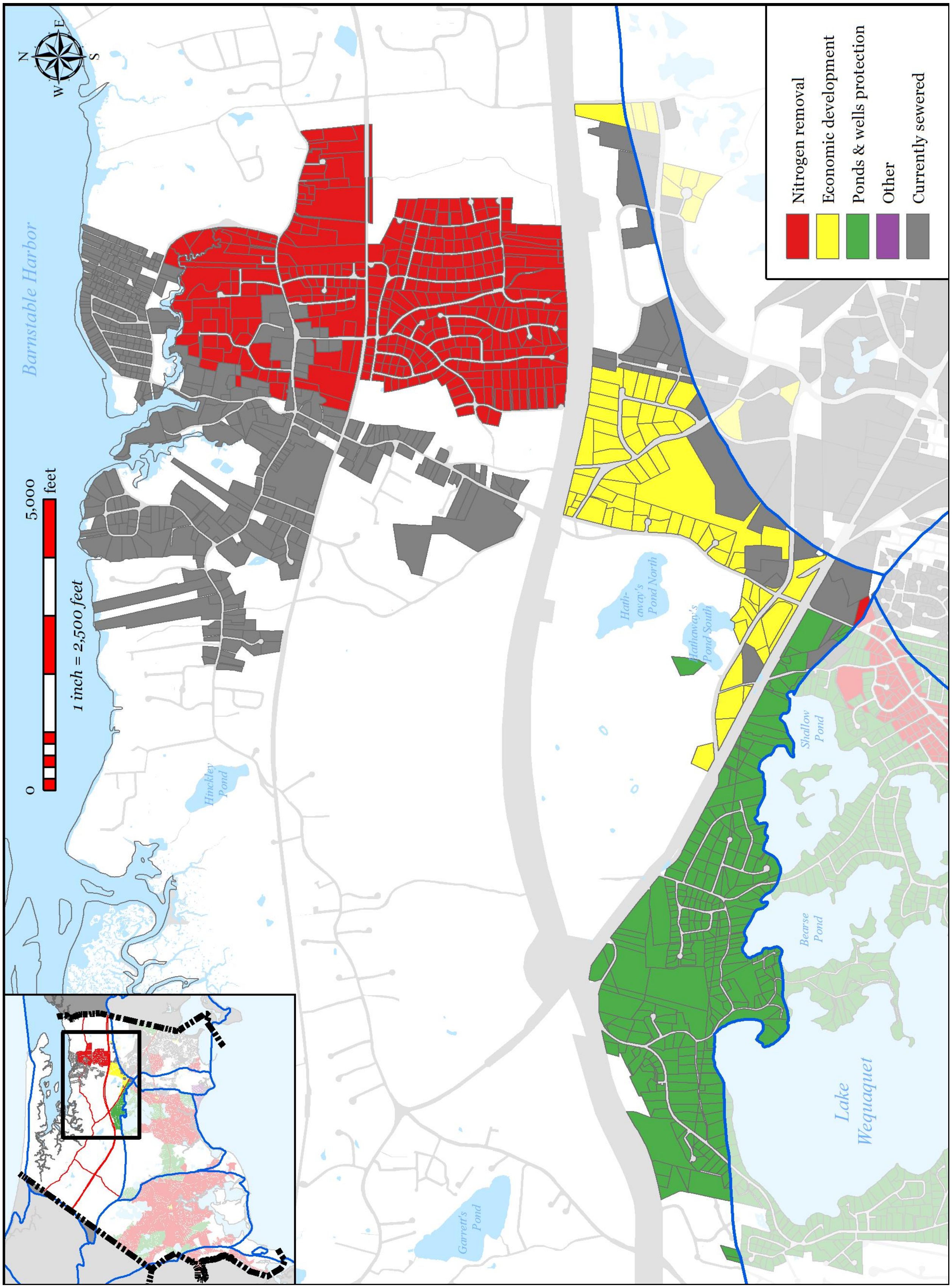

Figure 5-76: Needs Areas in Barnstable Harbor Watershed

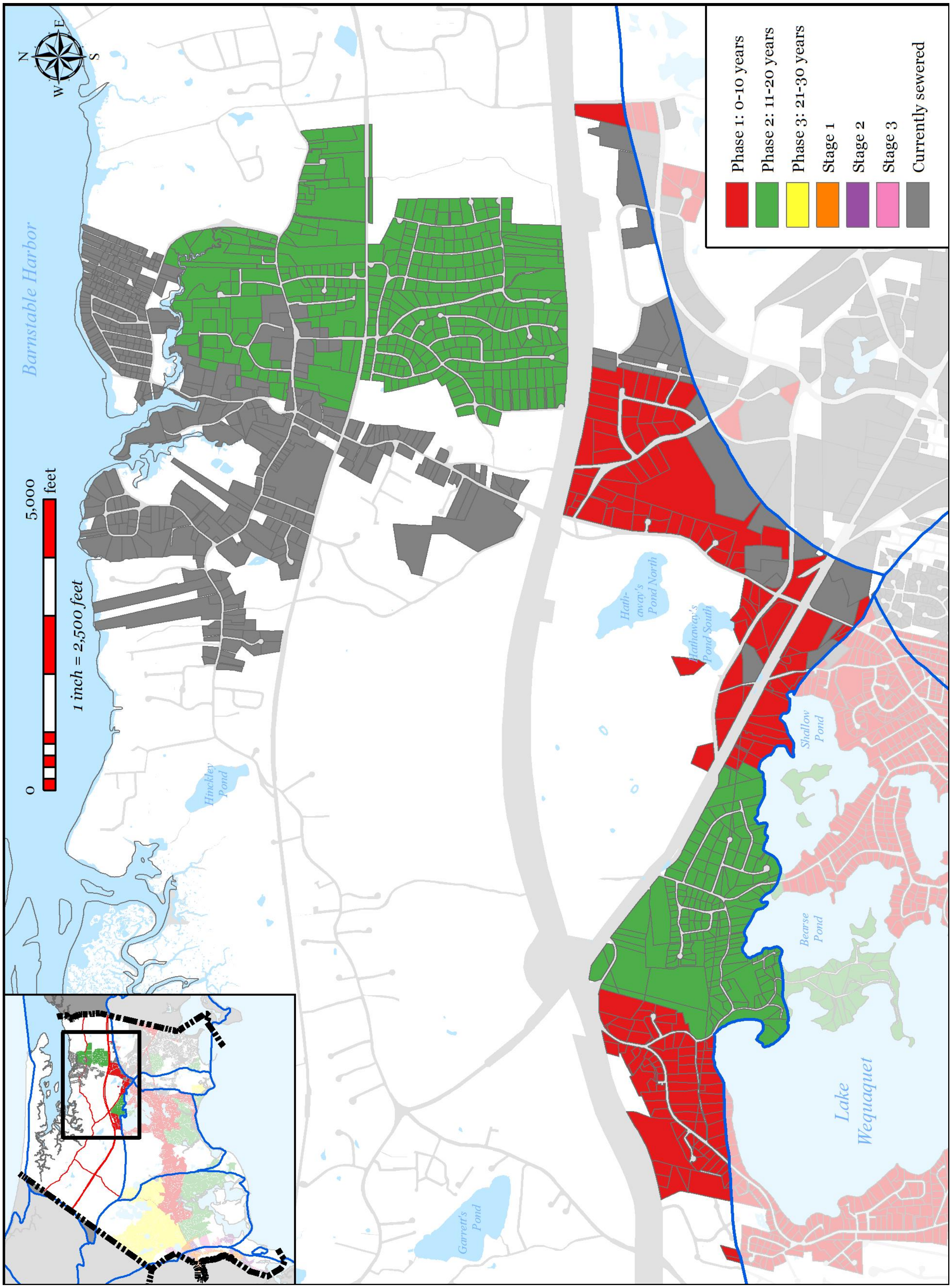

Figure 5-77: Sewer Expansion Plan in Barnstable Harbor Watershed

5.3 TREATMENT AND EFFLUENT DISPOSAL

To accommodate the proposed sewer expansion, aspects of the wastewater treatment facility will need to be upgraded. Additionally, as discussed in previous sections, effluent disposal options will have to be identified. The following two sections briefly discuss those requirements.

5.3.1 WATER POLLUTION CONTROL FACILITY

The Barnstable Water Pollution Control Facility (BWPCF) was initially constructed in 1935, though the majority of the plant as presently constituted was installed in 1980. The Town has been upgrading individual pieces of equipment at the facility as it has approached the end of its design life ever since. The majority of the additional flows and loads associated with sewer expansion will need to be treated at the plant which will require changes to the facility. These are discussed below. The timing and costs of these upgrades can be found in Table 6-3 in Section 6.

- Solids Handling Facility - The solids handling facility processes the residuals from septage receiving and the primary (two of them) and secondary (three of them) clarifiers. The residuals are thickened via two, 2-meter, gravity belt thickeners to approximately 5-6% solids, and trucked off Cape Cod to an incineration disposal facility. This system is nearing the end of its design life, and the additional flow from new sewers will further tax this equipment and necessitate expansion. This project is currently being designed and is expected to be constructed in FY21-23.
- Aeration Tanks/System – The aeration tanks are where biological activity reduces the organic carbon components of the wastewater. Properly configured, they can also reduce some of the nitrogen load as well. There are three parallel reactor trains, each with a volume of 170,000 cubic feet. The system was originally designed to treat 4.2 MGD for Biological Oxygen Demand (BOD) removal (without nitrogen removal). To achieve nitrogen removal tank volume is required for the nitrification and denitrification process, thus reducing the rated capacity of the aeration tanks. Based on treatment plant operation during July and August, and results of computer modeling, the estimated maximum month capacity of the aeration tanks is less than 2.5 MGD. Expansion of the aeration system to accommodate the new flows will be required within the first 3-5 years of the plan.
- Nutrient Removal Technologies – The existing facility reduces nitrogen concentrations to an annual average of approximately 6 mg/l of Total N. Though a relatively low concentration, in combination with the amount of flow being treated this can still equate to a significant nitrogen load entering the environment. The Town is limited to an annual mass nitrogen load limit of 49,315 pounds per year. Reducing the nitrogen concentration from 6 mg/l to 3 mg/l in the effluent would remove 18.9 kg/day-N of existing nitrogen load from the watershed (approximately 35% of the total attenuated load to be removed

per the Cape Cod Commission 208 Watershed Report), and would enable additional effluent discharge in the Town of Yarmouth if the Town elected to utilize that option (see Section 2.3.1.2). This evaluation, design and construction are expected to occur in years 1-5 of the plan.

- Headworks Facilities – The headworks is the portion of the plant that receives all the flows from the collections system and provides pretreatment of the wastewater. Pretreatment removes larger items for the wastewater and grit via a manual bar screen, an automated mechanically cleaned climber screen, and an aerated grit chamber. Though the headworks facilities are adequately sized for the projected flows from the sewer expansion, they do not have space to receive the new sewer piping, and the equipment is generally very dated technology that is beyond its design life. The evaluation, design and construction/upgrade of this facility are expected in years 3-8.
- Backup Power – With the expansion of the plant, there will be a need for additional backup power on site. As such the Town will need to design and install a second emergency backup generator in order to handle the increased electrical loads placed on the facility. The evaluation, design and construction/upgrade of this facility are expected in years 4-5.
- Secondary Clarifiers – Secondary clarifiers are the tanks that follow the aeration system, where the biological process ("bugs") are settled out from the wastewater prior to the treated water being disposed of. The Town currently has three secondary clarifiers (two are 70-foot diameter and one is 85-foot diameter). Between them is the capacity to treat up to 4.7 MGD (max day). To accommodate the full sewer expansion, additional secondary clarifier capacity will be needed. As such the Town will evaluate, design, and construct improvements to the secondary clarifiers at the BWPFC in order to increase treatment capacity. The evaluation, design and construction/upgrade of this facility is expected to occur at the end of Phase I and the beginning of Phase II.

5.3.2 EFFLUENT DISPOSAL

5.3.2.1 INTRODUCTION

As previously discussed in the CWMP, the BWPCF is permitted to treat 4.2 million gallons per day (MGD) max day flows, and dispose of 2.7 MGD max day flows via its adjacent rapid infiltration beds (RIBs). The facility is currently receiving 1.67 MGD average daily flow, with a measured max daily flow of 2.48 MGD (on July 7, 2017). As noted, it is estimated that the work associated with this CWMP will contribute an additional 2.1 MGD average daily flow to the facility over the next 30 years. After accounting for buildout in the existing collection system, the facility will ultimately need to be able to treat and dispose of about 4.5 MGD average daily flow. The BWPCF has adequate room to physically expand its treatment systems to address this additional flow. However, capacity for additional effluent disposal has been and remains a concern.

To address this issue the Town embarked on a two pronged approach. The first prong was to model and definitely determine if the RIBs could accommodate the projected additional flow, and if not, at what flow levels were downstream problems encountered. The second prong was to begin the search for alternative treated effluent disposal options. This section summarizes those efforts to date. It should be emphasized that this is ongoing work, and that no firm conclusions/recommendations have been reached as of the writing of this document.

5.3.2.2 BACKGROUND

The BWPCF, and its RIBs, are located in the triangular parcel of land between Bearses Way, Phinney's Lane, and Route 28 in the village of Hyannis. All of the BWPCF treated effluent is currently disposed of on-site via the RIBs. The BWPCF has 49 RIBs, but 12 are no longer in service.

The BWPCF staff measures the amount of discharge to each of the RIBs. For the period of time from 2014 through 2019 an average annual discharge to the beds of 1.6 MGD, a minimum daily discharge of 0.9 MGD and a maximum daily discharge of 3.0 MGD was measured. Flows to the RIBs were found to be highest in July and August and lowest in the winter months.

Understanding there were unanswered question/concerns with effluent disposal at the BWPCF, the Department of Public Works (DPW) proposed two different Capital Improvement Projects (CIPs) to Town Council. The first, titled *Effluent Disposal Capacity Study and Design* was intended to take a more rigorous look at this potential limitation of effluent disposal with the existing RIBs via sampling and modeling. The second CIP titled *Effluent Discharge Location Evaluation*, would conduct investigations and initial evaluations of alternative effluent disposal options/sites. Both were approved by Town Council.

Additionally, recognizing that there was likely a limit to effluent disposal capacity at the BWPCF, the DPW worked with DEP to address the issue while developing its new permit for the BWPCF. It was agreed that the permit should limit the effluent disposal capacity from 4.2 MGD to 2.7 MGD max daily flow based on the results of the studies to date, and require further updating of this figure as the results of the aforementioned CIPs (particularly the Disposal Capacity Study) were learned.

5.3.2.3 EFFLUENT DISPOSAL CAPACITY STUDY

In 2019, the DPW retained CDM Smith to conduct field work (borings, slug testing, ground penetrating radar utilization, and groundwater monitoring) and to develop models (conceptual site models, and a numerical model) of the effluent disposal system and surrounding hydrology.

A complete summary of their efforts can be found in their report that is attached to this memorandum. CDM Smith's numerical model used the 2016 steady-state USGS model as its basis, but updated it to reflect transient inputs near the BWPCF and the subsurface features that were identified as part of the field work. Additionally, they improved the resolution of the model in the vicinity of the BWPCF by reducing the typical grid size from 400 by 400 foot squares, to 150 by 150 foot.

Initial modeling results showed that BWPCF effluent disposal capacity was limited by the mounding of groundwater in low lying areas, and that capacity varied depending on the amount of recharge from precipitation received over the preceding three months. Baseline simulations showed that at the current average annual discharge rate of 1.6 MGD, the water table increased by 2 to 3 feet in the area of St. Francis Circle when compared to the zero recharge simulation. Additionally, mounding impacts of greater than 1-foot extend for over a mile radially from the site. Modeling estimated that average annual site recharge capacity at the BWPCF, without the potential for additional negative impacts downstream from the BWPCF is 2 MGD average daily flow (with the depth to groundwater of less than 8 feet at a "receptor" being used as the threshold of what is a negative impact) but ranges from a monthly average low of 0.96 MGD in April to as high as 3.1 MGD in August.

The next effort of the modelers was to evaluate the impact from various different disposal scenarios. To do this they conducted model runs for effluent disposal rates of 2.5 MGD, 3 MGD, 3.5 MGD, 4 MGD, and 4.5 MGD and used the following assumptions to evaluate the impacts of those flows.

- Evenly applied discharge to RIB beds 17, 18, 20 through 39 (beds in the southern portion of the site)
- The average annual recharge rate from precipitation was used for the simulation. Spring conditions (worst case scenario) were not used for this analysis because high water table and low effluent recharge rates in the spring would over-predict the potential impacts.
- The depth to groundwater was calculated by subtracting the model simulated heads from the digital elevation model of the ground surface.
- Depth to groundwater beneath buildings was identified by calculating the average depth to water beneath each building using the Massachusetts statewide data layer for structure rooftops based on 2011 imagery.
- Areas/properties were identified as being at risk where a simulated depth to groundwater was calculated to be less than 8 feet.

The DPW took the results of this effort and summarized it in Table 5-18 and Table 5-19 below. It should be noted that the number of potentially impacted structures in this table does not include a factor of safety.

Table 5-18: Number of Impacted Structures vs Average Daily Flow with Depth to Groundwater Less than 8 Feet

Area	0 MGD	1.6 MGD	2 MGD	2.5 MGD	3 MGD	3.5 MGD	4 MGD	4.5 MGD
Near Lake Wequaquet	211	240	250	255	267	270	280	285
St Francis Circle/Megan Road	0	4	12	18	19	26	26	30
Near St. Francis Circle	0	1	2	3	5	5	7	9
Barnstable Senior Center/High School	1	5	7	11	12	14	21	25
Enterprise Road/CC Mall	0	3	3	6	9	19	28	37
Fawcetts Pond	14	32	35	36	41	44	46	52
HYCC / Hamden Circle	1	2	3	3	5	8	9	9
General Patton Drive	0	1	1	1	1	2	4	5
Compass Circle	0	0	0	0	0	0	0	0
Indy Drive	0	0	0	0	0	0	0	0
Total	227	288	313	333	359	388	421	452
Difference at Each Flow Increment	**0**	**61**	**25**	**20**	**26**	**29**	**33**	**31**

Table 5-19: Number of Impacted Structures vs Average Daily Flow with Depth to Groundwater Less than 4 Feet

Area	0 MGD	1.6 MGD	2 MGD	2.5 MGD	3 MGD	3.5 MGD	4 MGD	4.5 MGD
Near Lake Wequaquet	61	81	89	92	95	100	102	110
St Francis Circle/Megan Road	0	0	0	1	2	6	14	17
Near St. Francis Circle	0	0	0	0	1	1	2	3
Barnstable Senior Center/High School	0	0	0	0	1	2	6	7
Enterprise Road/CC Mall	0	0	0	0	0	3	5	6
Fawcetts Pond	1	2	2	3	10	11	11	12
HYCC / Hamden Circle	0	0	0	0	1	1	1	1
General Patton Drive	0	0	0	0	0	0	0	1
Compass Circle	0	0	0	0	0	0	0	0
Indy Drive	0	0	0	0	0	0	0	0
Total	62	83	91	96	110	124	141	157
Difference at Each Flow Increment	**0**	**21**	**8**	**5**	**14**	**14**	**17**	**16**

It should be noted that the numbers in each column include the previous columns numbers (vs. being in addition to). As such, there are 225 (452 minus the 227 affected at the zero flow condition) total properties that have been identified as potentially affected by the BWPCF effluent (existing and future) in Table 5-18, and 95 (157 minus the 62 affected at the zero flow condition – again, existing and future) in Table 5-19.

5.3.2.4 IDENTIFICATION OF ALTERNATIVES

With confirmation of the BWPCF's disposal limitations, the DPW began looking at alternative disposal methods. These fell into four broad categories: Impact Mitigation, Land Based Treated Effluent Disposal Options, Ocean Outfall Effluent Disposal Options, and options outside of the Town of Barnstable. Additionally, there is yet another option that is briefly discussed where groundwater is extracted downstream of the WPCF and treated. This water then could potentially be considered a drinking water source.

5.3.2.4.1 Impact Mitigation

One approach to this issue is for the Town to either purchase all, or a portion of, the properties that are projected to be affected by additional effluent disposal (that above the current 1.6 MGD) at the BWPCF. To try and understand the impact of this, according to the website realator.com the average sold price of homes in Hyannis is $362,500.00. Assuming the Town was able to purchase all of the properties at that price, the cost for the properties where depth to groundwater is 8 feet or less (Table 1) would be $59,450,000 ((452-288)*$362,500,000). If the Town only elected to deal with properties where the depth to groundwater was 4 feet or less (Table 2) then the cost would be $26,825,000 ((157-83)*$362,500,000).

5.3.2.4.2 Land Based Treated Effluent Disposal Options

Another option would be to send the treated effluent above 2.0 MGD average daily discharge to other parcels in Town for disposal. To help identify potential sites to accomplish that, the DPW conducted a comprehensive review of all parcels in Town utilizing GIS. To help narrow this list of parcels, twelve criteria were identified, and a weighted score from 0 to 5 was applied to each criterion. Zeros were used as a "poison pill" to effectively eliminate parcels with highly undesirable characteristics. GIS was then used to apply these weighted criteria and prioritize the list of potential parcels by score.

The twelve criteria and their associated scoring values follow.

- Total area, or size of the parcel
    - 5=greater than 20 acres
    - 3=10 to 20 acres
    - 0=less than 10 acres
- Shape factor – to do this the square of each parcel perimeter was then divided by its area to calculate a shape factor value.
    - 5=22 or less
    - 3=22 to 44
    - 1=44 or more.
- Surface slope- the GIS Spatial Analyst extension was used to calculate slope from a surface digital elevation model (DEM).
    - 5=5 degrees or less
    - 3=5 to 10 degrees
    - 1=10 degrees or more
- Depth to groundwater - the Zonal Statistics tool was applied to a depth to groundwater DEM to calculate a mean depth to groundwater value for each parcel.
    - 5=30 feet or more
    - 3=20 to 30 feet

    - 1=10 to 20 feet
    - 0=10 feet or less
- Proximity to the wastewater treatment facility
    - 5=2 miles or less
    - 3=2 to 4 miles
    - 2=4 to 7 miles
    - 1=7 miles or more
- Proximity to neighboring structures - the distance from each parcel perimeter to the edge of its nearest neighboring building footprint.
    - 5=750 feet or more
    - 4=500 to 750 feet
    - 3=250 to 500 feet
    - 2=100 to 250 feet
    - 1=100 feet or less
- Groundcover class
    - 5=open land
    - 3=partially wooded
    - 1=wooded
- Soil drainage class
    - 5=type A
    - 3=type B
    - 2=type C
    - 1=type D
- Location within nitrogen-sensitive watersheds
    - 5=outside nitrogen sensitive watershed
    - 0=inside nitrogen sensitive watershed
- Location within Zone II wellhead protection areas
    - 5=unprotected
    - 1=Zone II protected
- Location within wetlands
    - 5=uplands
    - 0=wetlands
- Location within priority habitats.
    - 5=less than 2 acres protected
    - 1=2 acres or more protected

The twelve criteria scores for each parcel were then multiplied together to produce an effluent disposal site suitability index. Based on this methodology, higher scores were considered more desirable. 161 parcels produced a nonzero value. Scores ranged from a high of 7,812,500 to a low of 778. Table 5-20 lists the top 25 scores from this process. It should be noted, this is just a list produced by the process. It has yet to be vetted technically beyond that work, or socially or politically. There are parcels on the list that likely are not desirable, and ones not in Table 5-20 that may turn out to be very promising.

Table 5-20: Initial results, Top 25 scores from the GIS model

MAP & PAR ID	Owner	Address	Village	Suitability Index
236_005_W00	Commonwealth of Massachusetts (Cape Cod Community College)	2240 Iyannough Road/RT 132	WB	7,812,500
315_017	Barnstable County	0 Flint Rock Road	BA	5,859,375
299_024	Barnstable County(County Complex)	3195 Main Street Barnstable Villiage /RT6A	BA	2,695,078
104_003_W00	Town of Barnstable - Munip (Olde Barnstable Golf Course)	1500 Route 149	WB	1,952,344
256_005	Town of Barnstable - Conservation	0 Midcape Highway (West)/Rt 6	BA	1,933,594
254_016	Town of Barnstable - Land Bank (Hyannis Golf Course)	1800 Iyannough Road/Rt 132	BA	1,920,703
266_031	Hyannisport Golf Course	2 Irving Avenue	HY	1,660,156
256_001_001	Town of Barnstable - Conservation	0 Midcape Highway (West)/Rt 6	BA	1,594,922
333_012	Town of Barnstable - Hyannis Water	0 Mary Dunn Road	BA	1,530,078
236_005_B00	Commonwealth of Massachusetts (Cape Cod Community College)	2240 Iyannough Road/RT 132	BA	1,399,609
104_003_T00	Town of Barnstable - Munip (Olde Barnstable Golf Course)	1460 Route 149	MM	1,302,734
350_001	Cummaquid Golf Course	35 Marstons Lane	BA	1,301,953
314_036	GS BARNSTABLE LAND OWNER, LLC	160 Communication Way	BA	1,288,969
316_004	Barnstable County	0 Flint Rock Road	BA	1,237,109
318_025_004	MaGruder, Samuel, Mary, and Sarah	0 Indian Trail	BA	1,204,297
249_094	Town of Barnstable - Schools	744 West Main Street	HY	1,171,875
273_023	Hearth 'N Kettle Properties LP (Cape Codder Resort)	1225 Iyannough Road/RT 132	HY	1,171,875
293_001	Town of Barnstable - Munip (DPW)	382 Falmouth Road/Rt28	HY	1,171,875
296_047	Cape Cod Aggregates Corp	1550 Phinney's Lane	BA	1,171,875
269_002	Town of Barnstable - Schools (Hyannis West)	549 West Main Street	HY	1,152,422
276_002	Town of Barnstable - Conservation	0 Pond Lijah Road	BA	1,132,734
257_012	Town of Barnstable - Schools	2463 Main Street Barnstable Villiage /RT6A	BA	1,106,641
150_096	Town of Barnstable - Conservation	1350 Old Stage Road	MM	1,015,781
332_010_001	Villiage Green LLC	767 Independence Drive	BA	1,015,547
298_031	Town of Barnstable - Land Bank	0 Maraspin Road	BA	976,641

The parcels that are ultimately selected could be used for treated effluent disposal, either via RIBs or subsurface disposal; or for the disposal of pumped groundwater. Treated effluent is more difficult to permit than pumped groundwater, and as a result DPW asked CDM Smith to evaluate how much flow would need to be withdrawn downstream of the BWPCF at two different flow intervals to be protective of the vulnerable properties. What was found was that if the extraction wells (4 for a 4.2MGD scenario and 6 for a 10 MGD scenario) were located along Rt 28, in close proximity to the BWPCF, then nearly all the additional flow beyond 2 MGD would need to be pumped and discharged far enough away from the BWPCF area to avoid water table impacts. It is surmised, but not yet proven via model runs, that wells located closer to the vulnerable properties would potentially have to extract less flow to accomplish the same ends.

5.3.2.4.3 Ocean Outfall Treated Effluent Disposal Options

The Ocean Sanctuaries Act (OSA) was amended in 2014 to allow consideration of new or expanded ocean outfalls. This makes a disposal option that was not previously regulatory permitable, potentially feasible. However, it should be noted that there have been no new outfalls implemented since this change, and we are not aware of any completed application yet submitted to the MADEP for consideration. As a result there is no precedent/roadmap to follow that guarantees regulatory success for ocean outfalls. None the less, to be complete, the Town hired Wright-Pierce to conduct a very preliminary, technical study to evaluate if such an option was even technically feasible for the Town of Barnstable.

That effort concluded (memorandum attached) that treated effluent disposal via ocean outfall is potentially technically feasible on either the north or south side of the community (Cape Cod Bay or Nantucket Sound). Water depth is one of the key considerations for siting of an ocean outfall in order to achieve high initial dilution levels with the receiving water. As such, the bathymetry of Cape Cod Bay is more conducive to an outfall outlet being located closer to shore (4,000 feet from shore) vs. Nantucket Sound (12,000 feet from shore). This however must be juxtaposition against the fact that the BWPCF is located closer to the Nantucket Sound shore than the Cape Cod Bay shore. In the end both the land-based and water-based piping would need to be constructed and permitted, so the final cost may be comparable. As of the writing of this memorandum, Wright-Pierce is calculating initial budget estimates for both of these scenarios.

It needs to be emphasized that this work is in no way concluding that ocean outfalls are the best option for the BWPCF or even viable. What is does indicate is that the very first consideration, technical feasibility, looks like it may be possible. Significant additional study (including field survey; habitat review; subaqueous siting; piping alignments; hydrodynamics, particulate and pollutant modeling; long-term water quality data collection; precipitation recharge and water balance analysis; cost evaluations; NPDES permit applications to name a few) will be required to reach a conclusion regarding if this is truly a viable option; and then public discussion would have to occur at all levels of the community and with regulatory agencies to decide if it is the preferred option of the community. It is expected that these studies and subsequent regulatory application and review process could take up to a decade to complete.

5.3.2.4.4 Options Outside of the Town of Barnstable

In addition to looking at land based options in Town, the DPW also looked at options outside of the Town as well.

JBCC - The Joint Base Cape Cod (JBCC) has a wastewater treatment and disposal system on its property that may be suited to serve as a regional wastewater system. The system provides service for on-base facilities, and was designed for 70,000 users, though currently only serves approximately 3,500 users. The treatment plant (here after referred to as the WWTF) is an extended aeration activated sludge facility (biological nitrogen removal) that was constructed in 1995. The WWTF has a design capacity of 360,000 gpd (average daily flow) and a maximum day flow of 840,000 gpd. Treated effluent from the facility is piped via a 12-inch diameter ductile iron force main approximately 10.5 miles from the WWTF to a set of four Rapid Infiltration Basins (RIBs) that are located at the northwest edge of the JBCC near the canal. The effluent force main has a design capacity of 1,400,000 gpd (peak hour) and could potentially be increased to 1,750,000 gpd on a peak hour basis with some modifications. The RIBs have a total surface area of 259,160 square feet, and are permitted for disposal of up to 360,000 gpd of effluent on a 12-month rolling average basis and up to a maximum of 840,000 gpd on any given day.

Massachusetts Development and the Towns of Bourne, Falmouth, Mashpee, and Sandwich had previously begun investigating the possibility of making the WWTF a regional facility. During the winter of 2018/2019 they approached Barnstable to join that effort. Barnstable contracted with a consultant to inform it of the issues, opportunities, and challenges associated with a JBCC facility, and to "catch-up" with the other Towns. What was found was that were the Town to send its logical flows to JBCC (those west of Route 149) it would ultimately equate to 1.2MGD average daily flow. With those flows added to the other four towns flow and that of the JBCC itself, the WWTF and disposal beds would need to be expanded to accommodate approximately 4.6 MGD average daily flow. Estimated capital cost to do this ranged from approximately $220,000,000 to $257,000,000 (2019 dollars) depending on the method of effluent disposal selected. Cost sharing between the communities were this to happen have not been established, but Barnstable's share would likely range from $75,000,000 to $100,000,000. It should be noted, that these costs are to convey the wastewater from Barnstable's boarders treat and dispose of it on JBCC. They do not include the costs to provide the sewers and pump stations within the Town to collect this flow. They also do not include Barnstable's share of the annual O&M costs that would be needed to run such a facility.

Sandwich & Mashpee Partnership – In addition to the JBCC efforts, the towns of Barnstable, Sandwich and Mashpee agreed to look at cooperative options not on JBCC. It was felt this would be useful if for no other reason as to better understand the value of the JBCC opportunities. Titled the "3 Town Regional" (3TR) solution, Barnstable hired Wright-Pierce to outline the key components and costs of the 3TR wastewater conveyance, treatment and disposal systems. For this analysis the Towns elected to use the same flows as were used in the JBCC so as to be able to make a "apples to apples" cost comparison between the two options.

The technical team identified a potential new wastewater facility that could be constructed at the east end of Jan Sebastian Drive, in Sandwich. It would treat an eventual flow of 1.74 MGD average daily flow (3.83 MGD 3-day max flow), and would dispose of the treated effluent on a parcel north east of the proposed facility, utilizing subsurface disposal instead of RIBs (a Town of Sandwich requirement).

Total capital costs of this option was estimated at approximately $153,000,000. As with the JBCC evaluation, cost sharing between the communities has not been established, but Barnstable's share could be approximately $101,000,000. As with JBCC, these costs do not include the costs to provide the sewers and pump stations within the Town to collect this flow. They also do not include Barnstable's share of the annual O&M costs that would be needed to run such a facility.

Yarmouth Partnership – A potential partnership between Barnstable and the Town of Yarmouth was identified. The Town of Yarmouth, which does not have an existing wastewater treatment facility, was in need of wastewater treatment capacity while having excess effluent disposal capacity. The Town of Barnstable, on the other hand, was in need of disposal capacity and had an existing wastewater treatment facility. To understand the possibilities and limitations of this partnership, the Town of Yarmouth hired CDM Smith to analyze the possibilities.

CDM Smiths findings are attached. What they found was that the Town of Yarmouth needed approximately 365,000 gpd of treatment capacity. In return they could offer approximately 500,000 gpd of effluent disposal to Barnstable (on top of the 365,000 they needed) assuming an effluent TN discharge of 6mg/l. It was also noted that if the BWPCF could improve the TN discharge to 3mg/l then over 800,000 gpd could be available. Capital costs to convey wastewater from Yarmouth to Barnstable, treat it, and return it with additional effluent to Yarmouth were estimated to be between $35,000,000 and $45,000,000 million dollars depending on particular scenarios.

5.3.2.4.5 Pump and Treat

As was discussed above, CDM Smith's modeling indicates that wells could be installed downstream from the BWPCF to protect the low lying properties that are affected by the effluent mound. Initially, it was thought that such water could then be used as fertigation on golf courses, or just disposed of via subsurface disposal in an area that will not affect the water table local to BWPCF. However, another option exists as well. This water could be treated to a high level, potentially to drinking water standards, and if that were the case, then two issues could potentially be resolved at once. The groundwater mounding issue, and the additional flows/water sources that the Hyannis Water Departments needs to find for its system.

5.3.2.4.5 Results

As identified above, the average monthly discharge at the WPCF ranges from 1.4 MGD to 1.9 MGD (based on 2014 through 2018 BWPCF records), with an annual average discharge of 1.6 MGD. Due to the seasonal population, wastewater flows to the facility are highest during the summer and lowest during the winter months. Groundwater levels fluctuate several feet during any given year due to changes in monthly recharge from precipitation, but generally recharge is highest in the winter and spring and lowest in the summer and fall. Average groundwater levels were found to fluctuate several feet from year to year.

Initial modeling results have shown that WPCF effluent disposal capacity is in fact limited by the depth to groundwater in low lying areas, and that capacity varies depending on the amount of recharge from precipitation over the preceding three months. The estimated average annual site recharge capacity of the BWPCF is 2.0 MGD (with depth to groundwater of less than 8 feet at the "receptor" being used as the threshold of what is bad), but ranges from a monthly average low of 0.96 MGD in April to as high as 3.1 MGD in August. It is expected that the BWPCF will not reach the 2.0 MGD annual average discharge point until 2027.

To help frame the discussion moving forward, Table 4 attempts to compare the various options discussed above. As can be seen, there is still work to be done to completely flesh out each option, but this is likely the universe of opportunities the Town will have to select from to increase it treated effluent disposal capacity.

As noted above, based on current planning, a solution (or a part of a solution) is predicted to be needed by 2027. If it is assumed that a selected option will need 24 months to construct and an additional 24 months to design and permit, based on these assumptions the Town will need to have selected its approach by the end of 2022, ideally sooner.

The DPW will continue to develop these options technically, and come up with costs estimates for those options that are missing them. It is important that the process of politically vetting these options is simultaneously started, soon to be followed by socially vetting the options within the community. To help with this, the DPW is recommending that the Town Council reconstitute the Water Resources Advisory Committee (WRAC).

Table 5-21: Comparison of Effluent Options

Effluent Disposal Method	Technical Difficulty (Low, Med, High)	Regulatory Difficulty (Low, Med, High)	Social Difficulty(Low, Med, High)	Flow (Average Daily Flow)	Potential Costs ($)
Purchase affected structures where groundwater is expected to be within 8 feet of the ground surface	Low	Low	Low	2.5 MGD	>$82M
Purchase affected structures where groundwater is expected to be within 4 feet of the ground surface	Low	Low	Low	2.5 MGD	>$34M
Site additional effluent disposal RIBs in TOB	Low	Med	High	2.5 MGD	TBD
Site pumped groundwater disposal RIBs in TOB	Low	Low	Med	2.5 MGD	TBD
Site additional effluent disposal subsurface discharge in TOB	Med	Med	High	2.5 MGD	TBD
Site pumped groundwater disposal subsurface in TOB	Low	Low	Med	2.5 MGD	TBD
Ocean Outfall	High	High	High	2.5 MGD	TBD
JBCC	High	High	Med	1.2 MGD	$75-$100M
3TR	Med	Med	Med	1.2 MGD	$101M
Yarmouth @ 6mg/l nitrogen	Low	Med	Med	0.5MGD	$35-45M
Yarmouth @ 3mg/l nitrogen	Low	Med	Med	0.84 MGD	$35-45M + $20M for BWPCF upgrade
Pump and Treat	High	High	High	2.5 MGD	TBD

Notes: 1. 2.5 MGD is ultimately needed by the BWPCF to be able to treat and dispose of the predicted 4.5 MGD Average Daily Flow
2. JBCC and 3TR mostly address flows from what is currently planned to be Phase III sewers.

One final point, as per Table 6-2, average daily flows at the BWPCF are not expected to reach 2 MGD until 2027. An update on the work described above will be included in the five year adaptive management plan update, which will be prepared by the Town in 2025.

5.4 STATEMENT OF CONSISTENCY WITH 208

Waste Treatment Management Agency (WMA) assumes responsibility for controllable nitrogen for any part of the watershed within its jurisdiction.

In the Comprehensive Water Management Plan (CWMP), the Town of Barnstable commits to addressing its share of controllable nitrogen load in all of the watersheds within the Town's jurisdiction.

Future Action: Nitrogen loading information should be revisited during development of annual updates and adaptive management reports, using up-to-date population and water use data.

Plan meets applicable nutrient targets.

The CWMP is designed to reduce nutrient loads to meet the nutrient targets (TMDL's or otherwise) within the jurisdictional limits of the Town of Barnstable. The University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST) has reviewed the plan via the MEP model and determined that the plan, once fully implemented, will satisfy the nutrient removal targets to achieve the TMDLs in the Town's embayments.

Planning occurs at a watershed level with consideration of a hybrid approach.

The CWMP is designed to meet the nutrient targets developed for each of the watersheds addressed in the plan with traditional solutions. However, the plan includes a hybrid approach by also utilizing non-traditional solutions such as dredging, aquaculture, alternative septic systems, cranberry bog conversions, and storm water treatment.

Future Action: The Town will continue to progress towards required nitrogen reductions, using tradition and non-traditional solutions.

Public was engaged to gain plan consensus.

The Town has involved the public during the process of drafting the CWMP, with a committee named the WRAC, which was staffed by eight citizens and three Town Councilors. Their meetings and workshops were conducted in the Town Council Meeting room and televised and available on video on demand, for the general public to be able to witness what was occurring. Further public engagement in the planning process is discussed in detail in Section 4.

Future Action: The Town will continue to involve the public in the process of finalizing the plan and pursuing its implementation.

Plan includes proposed strategies to manage nitrogen loading from new growth.

The CWMP includes addresses future development and its wastewater flows and nitrogen loads. Please refer to Sections 2.2.6 for discussion of future conditions in the Town and Section 5.3 for discussion relative to how the plan addresses future conditions on a watershed by watershed basis.

Future Action: The Town of Barnstable will continue to progress with future growth conditions. The town will continue creating updates to the plan every five years to accommodate future growth.

Plan includes adaptive management approach

Refer to the adaptive management plan in Section 6.5. The Town will submit adaptive management updates to the Cape Cod Commission and MassDEP every 5 years.

Plan included pre- and post- implementation monitoring program

The Town has completed 20+ seasons of embayment monitoring, with monitoring locations selected and approved under MassDEP, to track compliance with total maximum daily load. Refer to Section 6.4 for further discussion of the Town's monitoring plan.

Future Action:

The Town will continue to perform embayment monitoring to comply with the MassDEP standards, as well as continue private monitoring of the Marstons Mills River carried out by the Barnstable Clean Water Coalition.

Plan includes a description and assessment of the towns proposed funding strategy

Refer to Section 7 of the CWMP for the Town's financial strategy.

WMA commits to regular 208 Plan update consistency reviews until water quality goals are achieved, generally to occur at least every five years

The Town of Barnstable plans to formally review the CWMP every five years via an adaptive management update which will be submitted to the Cape Cod Commission and MassDEP.

In shared watersheds, WMA seeking 208 Consistency Review collaborates with neighboring WMA(s) on nitrogen allocation, shared solutions, and cost saving measures

Refer to Sections 2.3.1 and 6.2 for discussion relative to the Town's collaborative work with neighboring communities relative to nitrogen allocation, shared solutions and cost saving measures.

5.5 UPDATED MEP MODELING

In order to verify that the proposed sewer expansion plan would achieve the TMDL's in the impaired embayments, the Town retained the University of Massachusetts School for Marine Science and Technology (SMAST) to review the plan via the MEP model. The plan was reviewed for the four embayments where the majority of the watershed is within the Town of Barnstable: Three Bays, Centerville River, Lewis Bay, and Barnstable Harbor (referred to as Barnstable Great Marshes by SMAST). This effort determined that the plan, once fully implemented will satisfy the nutrient removal targets to achieve the TMDLs in these embayments, except for Three Bays (Appendix QQ). As described in Appendix QQ, the Three Bays estuary required further nitrogen management to meet the TMDLs/MEP thresholds through tradition solutions only.

The Town's intent has always been to present a plan that attains the TMDLs/MEP thresholds through traditional solutions (sewers), and does not rely on non-traditional solutions to meet these thresholds. Therefore, the Town added additional sewer parcels within the Three Bays Watershed and requested SMAST review the updated sewer plan. This additional model run resulted in the TMDL threshold being attained via traditional solutions alone (Appendix SS). Below is a brief summary of both efforts.

Updated Land Use Data

The original MEP assessments of Lewis Bay/Halls Creek, Centerville River, Three Bays and Barnstable Harbor were completed in different years, some of which were approaching 2 decades ago, the impact of changes in the land use and water use information obtained from the Town for each assessment were different. As a result, SMAST, working with Town staff, updated each watershed model was updated with current land use and water use data.

Sewer Expansion Plan: Wastewater Treatment and Effluent Discharge Locations

After updating the models to reflect current conditions, SMAST modeled the impact of the Town's sewer expansion plan to confirm that TMDL's would be met. To do this, Town staff had to project where collected wastewater would be treated and discharged. The following treatment and disposal assumptions were made:

- Majority of sewer expansion would be treated at BWPCF.
    - It was assumed that 2.0 MGD average daily flow would be disposed at BWPCF via the existing rapid infiltration beds. The modeling assumed a Total Nitrogen concentration of 3 mg/L which accounts for anticipated denitrification upgrades at the facility.

    - For modeling purposes, sewer expansion in the western part of town (westerly of end of Phase 1 at Old Post Road) was assumed to be treated and disposed of at an as-yet-undetermined wastewater treatment facility outside of the Town boundaries, i.e. a "western solution" (JBCC, or otherwise).
- The remainder of effluent was assumed to be discharged in the Barnstable Harbor Watershed at an as-yet-undetermined effluent disposal location. This was done to ensure there is sufficient assimilative capacity to accept additional nitrogen in the watershed if other options (increased disposal capacity rating at BWPCF, potential Yarmouth partnership, pumping of groundwater, etc.) are not realized.

Conclusion

The following is SMAST's conclusion of the effort:

"The Town has proposed a 30-year, three-phased wastewater plan that uses and builds on the existing wastewater infrastructure, including the municipal Hyannis WPCF. Using the updated 2019 land uses, project staff also reviewed the impact of the proposed 2019 wastewater plan when fully implemented on the watershed nitrogen loads and the associated nitrogen concentrations in the Town's major estuaries. These scenarios incorporated the proposed sewering in each of the watersheds, along with the proposed distribution of treated effluent from the Hyannis WPCF. These scenarios also utilized the existing MEP hydrodynamic/water quality models without any updates to tidal measurements, sediment nitrogen regeneration or bathymetry. In most of the systems, the proposed Town wastewater plan resulted in the TMDLs/MEP thresholds being attained".

Table 5-22: Summary of SMAST Watershed analysis.

Centerville River: Whole System Watershed N Loads			
Scenario	Description	Total N Load (kg/yr)	
		Unatten	Atten
MEP	Baseline 2004	60,657	47,189
2019 Current	updated LU, WU, etc	62,054	49,692
MEP	Threshold (Allowable TN)		34,833
Proposed Sewer Plan	2019 update with sewer plan	37,682	29,323
Lewis Bay: Whole System Watershed N Loads			
Scenario	**Description**	**Total N Load (kg/yr)**	
		Unatten	**Atten**
MEP	Baseline 2004	56,751	50,574
2019 Current	updated LU, WU, etc	60,538	54,838
MEP	Threshold (Allowable TN)		35,701
Proposed Sewer Plan	2019 update with sewer plan	35,565	31,501
Barnstable Great Marshes: Whole System Watershed N Loads			
Scenario	**Description**	**Total N Load (kg/yr)**	
		Unatten	**Atten**
MEP	Baseline 2011-2012	73,613	66,221
2019 Current	updated LU, WU, etc	73,815	66,667
MEP	Threshold (Allowable TN)		92,433
Proposed Sewer Plan	2019 update with sewer plan	74,591	67,597

Three Bays: Whole System Watershed N Loads			
Scenario	**Description**	**Total N Load (kg/yr)**	
		Unatten	**Atten**
MEP	Baseline 2000-2004	68,853	48,943
2019 Current	updated LU, WU, etc	69,372	51,643
MEP	Threshold (Allowable TN)		25,643
Proposed Sewer Plan	2019 update with sewer plan	42,545	29,039
Revised Proposed Sewer Plan	2020 update with proposed sewer plan plus four additional sewer areas	36,202	23,714

6 IMPLEMENTATION PLAN/SCHEDULE

6.1 PROPOSED IMPLEMENTATION PLAN AND RECOMMENDED CAPITAL IMPROVEMENT SCHEDULE

The Plan includes an aggressive 30-year plan focused on traditional solutions that will be performed in three 10-year phases. The Town has developed a recommended implementation plan for the first 10-year phase (Phase 1) of the plan. The Town anticipates that the first adaptive management update (2025) include an update on this implementation plan as well as a similar detailed implementation plan for Phase 2. The followings table and figure graphically show the effectiveness of the Phase 1 Implementation Plan.

Table 6-1: Phase 1 Traditional Project Statistics

Project	Number of Parcels	Wastewater Captured (gpd)	Total N Removed (kg/day)	% of Total N Removed in Phase 1	Watershed[1]
Merchants Way[2]	7	0	0.0	0.0%	BH
Strawberry Hill Road	237	46,467	4.6	5.8%	CR
Route 28 East	120	19,102	1.9	2.4%	CR
Old Yarmouth Road	131	22,603	2.2	2.8%	LB
Phinneys Lane	591	85,138	8.5	10.7%	CR & HC
Long Beach	203	37,647	3.7	4.7%	CR & UN
Route 28 Centerville	80	36,324	3.6	4.5%	CR
Huckins Neck	148	21,506	2.1	2.6%	CR
Long Pond Area	606	114,599	11.4	14.4%	CR
Great Marsh Road	378	51,355	5.1	6.4%	CR
Old Craigville Road	441	49,234	4.9	6.2%	CR & HC
Route 28 Marstons Mills	161	36,429	3.6	4.5%	3B
Osterville Woods	331	60,719	6.0	7.6%	CR & 3B
Shootflying Hill Road	383	57,583	5.7	7.2%	CR & BH
Lumbert Mill	350	50,374	5.0	6.3%	CR
Osterville-West Barnstable Road	154	32,787	3.3	4.2%	3B

Project	Number of Parcels	Wastewater Captured (gpd)	Total N Removed (kg/day)	% of Total N Removed in Phase 1	Watershed[1]
Main Street Marstons Mills	144	24,123	2.4	3.0%	3B
Prince Cove	158	32,972	3.3	4.2%	3B
Kidds Hill Area	97	18,354	1.8	2.3%	BH
Unassigned	14	1,613	0.2	0.3%	LB
Total	**4,734**	**798,929**	**79.3**	**100.0%**[3]	

1.BH=Barnstable Harbor, CR=Centerville River, LB=Lewis Bay, HC=Halls Creek, 3B=Three Bays, UN=Undefined
2. Parcels to be served by this project are currently undeveloped.
3. Phase 1 is 40% of the Plan.

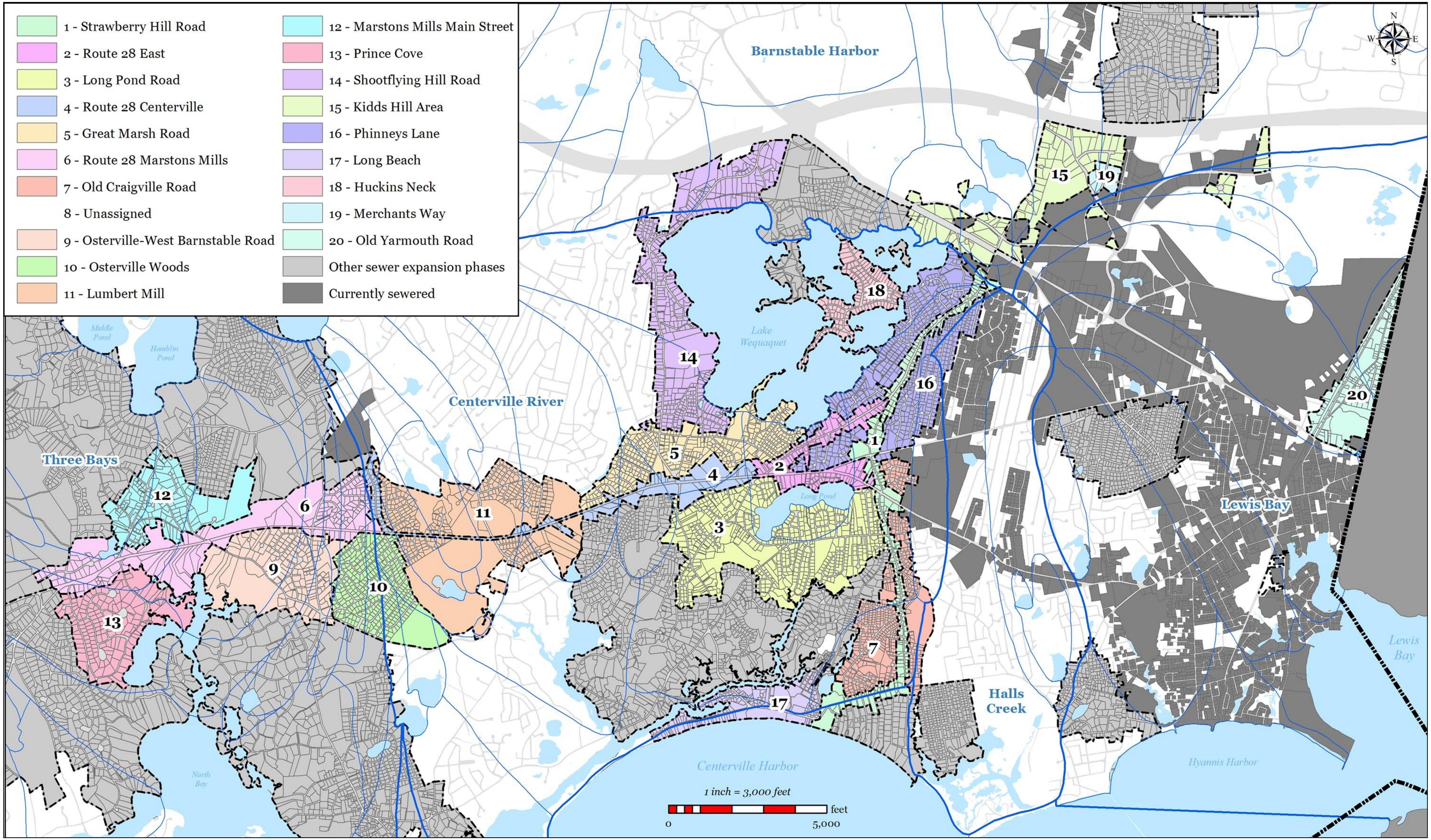

Figure 6-1: Phase 1 Implementation Plan

Table 6-2: Phase 1 Sewer Collection System Expansion CIP Schedule

Sewer Expansion Collection System Projects - Phase 1															
				Phase 1											
Project	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**FY30**	**FY31**	**FY32**	***TOTAL***
Merchants Way	***$50,000***	***$550,000***													***$600,000***
Strawberry Hill Road		***$835,000***	$12,720,000												**$13,555,000**
Route 28 East		***$800,000***		$13,740,000											**$14,540,000**
Long Beach				$290,000	$690,000	$8,820,000									**$9,800,000**
Phinneys Lane	***$315,000***	***$735,000***				$21,540,000									**$22,590,000**
Old Yarmouth Road		***$750,000***		$240,000	$560,000		$6,420,000								**$7,970,000**
Route 28 Centerville		***$612,000***		$790,000			$9,898,000								**$11,300,000**
Long Pond Area	***$402,000***	***$938,000***						$31,905,000							**$33,245,000**
Old Craigville Road					$570,000		$1,340,000		$17,180,000						**$19,090,000**
Great Marsh Road					$460,000		$1,080,000		$13,840,000						**$15,380,000**
Route 28 Marstons Mills				$1,770,000						$15,975,000					**$17,745,000**
Osterville Woods							$500,000	$1,180,000		$15,150,000					**$16,830,000**
Huckins Neck							$260,000		$620,000		$7,945,000				**$8,825,000**
Lumbert Mill								$400,000	$940,000		$12,045,000				**$13,385,000**
Shootflying Hill Road								$650,000		$1,520,000		$19,510,000			**$21,680,000**
Osterville-West Barnstable Road									$300,000	$700,000		$8,975,000			**$9,975,000**
Marstons Mills Main Street										$220,000	$520,000		$6,620,000		**$7,360,000**
Prince Cove										$270,000	$620,000		$7,980,000		**$8,870,000**
Kidds Hill Area	***$100,000***										$230,000	$540,000		$6,800,000	**$7,670,000**
TOTAL COSTS - COLLECTION SYSTEM	**$867,000**	**$5,220,000**	**$12,720,000**	**$16,830,000**	**$2,280,000**	**$30,360,000**	**$19,498,000**	**$34,135,000**	**$32,880,000**	**$33,835,000**	**$21,360,000**	**$29,025,000**	**$14,600,000**	**$6,800,000**	**$260,410,000**
NEW PARCELS CONNECTED	**0**	**7**	**0**	**0**	**237**	**120**	**203**	**736**	**80**	**0**	**1,425**	**640**	**887**	**399**	**4,734**
COMBINED FLOW (GPD)	**1,670,000**	**1,670,000**	**1,670,000**	**1,670,000**	**1,716,000**	**1,735,000**	**1,773,000**	**1,882,000**	**1,918,000**	**1,918,000**	**2,133,000**	**2,252,000**	**2,393,000**	**2,468,000**	**798,000**

Legend	
Evaluation and/or Preliminary Design	
Final Design	
Construction	
Currently Funded Project	***$400,000***
Currently Unfunded Project	$500,000

Note: All Costs are in 2020 Dollars

Table 6-3: Phase 1 Treatment Plant Upgrades CIP Schedule

WPCF Sewer Expansion Related Upgrades - Phase 1															
				Phase 1											
Project	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**FY30**	**FY31**	**FY32**	**TOTAL**
Aeration Upgrades			$200,000	$200,000		$5,500,000									**$5,900,000**
Effluent Flow Meter (Permit Requirement)		***$600,000***													**$600,000**
Denitrification		***$15,000***		$200,000		$2,000,000		$18,000,000							**$20,215,000**
BWPCF Effluent Disposal Capacity	***$195,000***														**$195,000**
Effluent Disposal Location	***$150,000***			$1,000,000		$3,500,000			$35,000,000						**$39,650,000**
Future Pipes for Potential Yarmouth Connection		***$1,300,000***													**$1,300,000**
Secondary Clarifier Upgrades											$300,000		$800,000	$800,000	**$1,900,000**
Solids Handling Rehabilitation			$8,500,000												**$8,500,000**
Infiltration and Inflow (I/I) Program		$380,000			$600,000										**$980,000**
Pump Station Rehabilitation Program		$1,160,000	$1,200,000	$2,200,000	$650,000	$350,000	$1,200,000	$1,200,000	$1,300,000	$1,400,000	$1,500,000	$1,600,000	$1,700,000	$1,800,000	**$17,260,000**
BWPCF Facility Study (Permit Requirement)				$250,000											**$250,000**
Headworks Modifications					$350,000		$5,000,000								**$5,350,000**
Main Switch B Generator						$550,000									**$550,000**
TOTAL COSTS - WPCF UPGRADES - CWMP	**$345,000**	**$1,915,000**	**$200,000**	**$1,400,000**	**$0**	**$11,000,000**	**$0**	**$18,000,000**	**$35,000,000**	**$0**	**$300,000**	**$0**	**$800,000**	**$800,000**	**$69,760,000**
TOTAL COSTS - WPCF UPGRADES- Enterprise	**$0**	**$1,540,000**	**$9,700,000**	**$2,450,000**	**$1,600,000**	**$900,000**	**$6,200,000**	**$1,200,000**	**$1,300,000**	**$1,400,000**	**$1,500,000**	**$1,600,000**	**$1,700,000**	**$1,800,000**	**$32,890,000**
TOTAL COSTS - WPCF UPGRADES- CWMP + Enterprise	**$345,000**	**$3,455,000**	**$9,900,000**	**$3,850,000**	**$1,600,000**	**$11,900,000**	**$6,200,000**	**$19,200,000**	**$36,300,000**	**$1,400,000**	**$1,800,000**	**$1,600,000**	**$2,500,000**	**$2,600,000**	**$102,650,000**

Legend	
Evaluation and/or Preliminary Design	
Final Design	
Construction	
Currently Funded Project	***$400,000***
Currently Unfunded Project	$500,000

6.2 SPECIAL REVIEW PROCEDURES

At an estimated cost greater than $1 Billion, the Town's Comprehensive Wastewater Management Plan is likely to be the largest infrastructure project the Town will ever undertake. As a result, the program will be executed as dozens of smaller, more manageable projects. There are five different types of projects that that have been identified as part of the program: sewer system expansion projects, treatment plant improvements, effluent disposal expansion, non-traditional solutions, and inter-municipal partnerships. The intent of this section is to outline how the Town will execute each type of project, and identify the regulatory review procedures required for each type of project.

6.2.1 SEWER SYSTEM EXPANSION PROJECTS

The sewer system expansion program is the core of the Town's Comprehensive Wastewater Management Plan and will consist of the installation of ±190 miles of new sewer infrastructure, serving ±11,816 properties and collecting ±2.1 MGD of new flow (±4.6 MGD total including existing flow and buildout projections).

Due to the massive size of this program, it will be necessary to execute the program as dozens of smaller, more manageable projects over the course of 30 years, which are defined by logical project boundaries (i.e. topography/sewershed, neighborhoods, etc.). Per discussions with MEPA staff, additional MEPA review will not be necessary for these sewer expansion projects, unless the proposed sewer expansion areas expand outside of those identified in this document. It is acknowledged that each of these projects will have their own unique permitting requirements.

The following is the typical approach that the Town anticipates for the development, design, review, permitting (where necessary), bidding and construction of the sewer expansion projects. This section is more detailed than the other four project types as it is not anticipated that further MEPA review will be required, whereas the other four project types are anticipated to require additional MEPA review.

- Town staff defines the general project service area and develops a schematic design for the project based upon existing GIS data.
- Town staff requests funding for the preliminary design of the sewer expansion project from Town Council.
- When funding is appropriated, the Town will prepare an RFP for survey/detailed mapping of the project service areas.
- Upon receipt of the survey data, it is anticipated that Town staff will develop a preliminary design (30% design) of the sewer infrastructure. Alternatively, this phase

of work may be contracted, but at this time it is anticipated that Town staff will perform this phase of work. The following activities are part of preliminary design:

- Review and identify the sewer alignments necessary to serve the target parcels. Identify locations of sewerage infrastructure. Review and select appropriate climate adaptation measures and appropriate greenhouse gas (GHG) emission reduction measures for the infrastructure.
- Town staff will review and identify any project specific regulatory requirements and develop a permit matrix. Town staff may arrange a pre-application meeting with certain regulatory agencies in order to confirm the regulatory requirements. Document all regulatory meetings with meeting minutes.
- It is anticipated that the following regulatory agencies may have jurisdiction over certain portions of the sewer expansion program which will require regulatory review and potentially permits:
    - Conservation Commission: For construction within buffer zones, riverfront areas, and flood zones.
        - Wetland resource areas will be identified during the survey/mapping phase and a wetland resources report will be prepared. Town staff will review these findings with Conservation staff to determine if a Notice of Intent will be necessary for the project.
    - Division of Fisheries & Wildlife: For construction within mapped Priority Habitats for state-listed rare species.
        - The majority of the infrastructure installed during the sewer expansion program will be within roadways and thus will be exempt from MESA review pursuant to 321 CMR 10.14 (6) and (10).
        - Certain components of the program may not meet the exemption as they will be outside of roadways and thus may require review, such as pump stations, cross country sewers (not anticipated at this time), etc.
    - MassDOT: For construction within State Highways.
        - A pre-application meeting will be held with MassDOT staff for projects that involve work within a State Highway layout.
    - Massachusetts Historical Commission
        - As per page 16 of the EENF Certificate, the Town will submit a US Geological Survey topographical map that clearly locates the proposed project area, as well as the preliminary designs, for review by MHC to determine if the project will have any "adverse effects" on historic or archaeological resources.

        - If MHC determines that the project may have "adverse effects", the Town will begin discussions with MHC on mitigation measures that the Town will undertake to address the adverse effects and secure necessary permits.
    - Local Historic Commissions
        - Town Staff will review if the project area is within any local historic commission jurisdictions.
  - Town staff will identify any roadways or properties that may require easements, takings, purchases, etc. for sewers, force mains, pump stations and appurtenant work.
    - There are over 200 miles of private roadways in the Town of Barnstable. The sewer expansion program proposed sewer within approximately 75 miles of private roadways. It is anticipated that easements and/or takings will be necessary to complete construction within the private roads.
    - Proposed pump station sites will be identified during this phase. Some sites may require easements, purchases, etc.
  - Cost estimating (construction, contingency, technical services, fiscal/legal, etc.) and preliminary cost allocation to sewer users.
  - Evaluate grant funding opportunities
  - Identify construction schedule and work hours appropriate for the project
  - Public consultation
  - Document the results of the preliminary design in a standardized Preliminary Design Report, including each of the items listed above.
  - Town Staff will prepare and submit Performance Evaluation Forms (PEFs) to seek State Revolving Fund (SRF) funding for the project. All other potential funding sources will be evaluated/applied for at this time.
- Town staff requests funding for the final design and permitting of the sewer expansion project from Town Council.
- The Town will prepare an RFP to retain an engineering consultant to complete the final design/permitting services. It is anticipated that the sequence of work will be as follows:
  - Consultant reviews the Town's PEF and Preliminary Design Report. Consultant to confirm permitting requirements and advise the Town accordingly.
  - Consultant will prepare a 75% design submission.
    - This submission will be used for submission to regulatory agencies if permits are required for the project. The following is a summary of the expected submissions to regulatory agencies, when applicable:
        - Conservation Commission: Notice of Intent Application

        - Division of Fisheries & Wildlife: MESA Review
        - MassDOT: State Highway Access Permit
        - Massachusetts Historical Commission: Project Notification Form
        - Local Historic Commissions: Varies by Commission
      - It is also expected that a publicly noticed informational session will be held at this time to present project details with the community and stakeholders.
      - This submission will include the preparation of documentation for any necessary property purchase, easements, takings, etc.
  - Town Staff requests funding for the construction of the sewer expansion project from Town Council.
  - Consultant will prepare a 90% design submission (plans, specifications, and cost estimate) which will address comments from Town Staff and regulatory agencies.
      - This submission will be used for the SRF Application for projects that are listed on the SRF Intended Use Plan.
      - It is expected that a second publicly noticed informational session will be held at this time.
  - Consultant will prepare a 100% design submission (plans, specifications and cost estimate) which will address comments from Town Staff and SRF review, when applicable.
      - For SRF eligible projects, all necessary documentation is submitted to SRF. SRF issues a Project Approval Certificate (PAC), allowing the Town to advertise the construction bid.
  - Bid for construction of the project is advertised.
  - Bids are opened and reviewed by Town Staff. A recommendation to award will be prepared for the Town Manager's approval.
      - For SRF eligible projects, the recommendation to award will be submitted to SRF. SRF issues an Approval to Award, allowing the Town to award the project.
  - Construction commences.
  - Construction is completed. Permit closeout documents are prepared and submitted. SRF closeout documents are prepared and submitted.

6.2.2 TREATMENT PLANT IMPROVEMENTS

Section 5.3.1 identifies the anticipated treatment plant improvements that will be necessary at the Barnstable WPCF in order to accommodate the increase in flow from the sewer expansion program. Treatment plant improvement projects fall into two different sub-categories:

rehabilitation or capacity expansion. The following is the typical approach that the Town anticipates for the review of the two sub-categories of treatment plant improvements. Please note that the anticipated approach for effluent disposal expansion projects are addressed in Section 6.2.3.

6.2.2.1 Treatment Plant Rehabilitation Projects

The projects that fall into the rehabilitation sub-category will improve existing facilities that need rehabilitation due to age of the infrastructure and include the following projects: Solids Handling Facility, Headworks Facilities, and Backup Power. The main goal of these projects are to rehabilitate existing aging infrastructure. These projects will consider the increased flow as a result of the sewer expansion program, but will not result in an application to increase the permitted treatment capacity of the Barnstable WPCF Groundwater Discharge Permit and therefore will not trigger any MEPA review thresholds. As a result, it is anticipated that these projects will not require further MEPA review or a Notice of Project change to this project. These projects will require a Treatment Works Plan Approval by MassDEP. The WPCF is not within a mapped priority habitat so MESA review will not be required. There are no wetland resource areas near the treatment processes at the WPCF, so Conservation Commission review will not be required. The Town anticipates seeking SRF funding for these projects, which will trigger additional review.

6.2.2.2 Treatment Plant Capacity Expansion Projects

The projects that fall into the treatment plant capacity expansion sub-category are projects required to increase the permitted expansion of the treatment capacity at the WPCF in order to accommodate the increase in flow from the sewer expansion program. The treatment plant capacity expansion projects include: Aeration Tanks/System, Nutrient Removal Technologies, and Secondary Clarifiers. As these projects are intended to increase the treatment capacity of the WPCF, they may require MEPA review due to exceeding the following review threshold: *11.03(5)(b)(2) Expansion of an existing wastewater treatment and/or disposal facility by the greater of 100,000 gpd or 10% of existing capacity.* Since MEPA review may be required for these projects and because these projects have not been designed at the time of the preparation of this report, the Town will hold a pre-application meeting with MEPA staff to review if the project requires the submission of a Notice of Project Change to this project.

6.2.3 EFFLUENT DISPOSAL EXPANSION

As discussed in Section 5.3.2, the sewer expansion program will require an expansion of the effluent disposal capacity for the WPCF. The Town is actively evaluating options for effluent disposal expansion. The expansion of the effluent disposal capacity will require MEPA review as one of the following review thresholds will be exceeded (depending upon the design capacity and location of the effluent disposal expansion facility):

- *11.03(5)(a)(1) Construction of a new wastewater treatment and/or disposal facility with a capacity of 2,500,000 or more gpd;*
- *11.03(5)(b)(1) Construction of a new wastewater treatment and/or disposal facility by the greater of 100,000 or more gpd;*
- *11.03(5)(b)(2) Expansion of an existing wastewater treatment and/or disposal facility by the greater of 100,000 gpd or 10% of existing capacity.*

Since MEPA review will be required for any effluent disposal expansion project(s) and because these project(s) have not been designed at the time of the preparation of this report, effluent disposal expansion projects will be submitted as a Notice of Project Change to this project.

6.2.4 NON-TRADITIONAL SOLUTIONS

As discussed in earlier sections of the SEIR, the Town's CWMP includes the implementation of non-traditional solutions to supplement the sewer expansion program. The sewer expansion program has been designed, and confirmed by SMAST, to meet the nitrogen TMDLs in the estuaries, thus achieving the regulatory requirement without the use of non-traditional projects. The non-traditional projects are intended to be implemented in the first phase of the Project and then, monitored, and reported to MassDEP, with the goal of potentially reducing the need for Phase 3 sewer expansion projects in certain areas. As the non-traditional projects are supplementary to the sewer expansion program, and are not necessary to achieve the regulatory TMDL requirements, it is not intended that these projects would be "permitted" via this application. Each non-traditional solution will require unique regulatory review, which will be further understood through discussions with regulatory agencies, as the projects are developed. It is unclear at this time whether any of the non-traditional solutions will exceed any MEPA thresholds. If a non-traditional project exceeds a MEPA review threshold, they will be reviewed as a Notice of Project Change to this project.

Below is a summary of the non-traditional solutions, that have been identified to date, that are anticipated to be further investigated within the Three Bays Watershed, including potential environmental impacts, mitigation measures, and permitting requirements to the extent they are understood at the time of the preparation of this report:

- Improving nutrient attenuation in the cranberry bogs in the upper end of the Marston's Mills River.
    - Potential environmental impacts, mitigation measures and potential MEPA triggers are unknown at this time and will be dependent upon the recommended nutrient attenuation technique to be implemented in the bogs.
    - The Town anticipates that this project will be submitted to MEPA as a Notice of Project Change to the CWMP and will require review/permits from numerous regulatory agencies.
- Dredging of Mill Pond.

- Environmental impacts, mitigation measures and potential MEPA triggers will be further studied and evaluated during design development and permitting of the project.
- Of particular interest, and requiring further vetting, will be ecological impacts of the project, including impacts on a mapped priority habit and maintaining/improving fish passage (herring).
- The Town anticipates that this project will be submitted to MEPA as a Notice of Project Change to the CWMP and will require review/permits from numerous regulatory agencies.

- Innovative/alternative (I/A) septic system technologies focused on nutrient removal.
  - Negative environmental impacts from I/A septic system technologies are not anticipated.
  - No permitting is anticipated to be required for the installation of I/A systems (other than local approvals) as it is assumed that the I/A septic systems that would be utilized will be approved for general use by MassDEP.
- Nutrient reduction BMPs at horse farms.
  - Potential environmental impacts, mitigation measures and potential MEPA triggers are unknown at this time and will be dependent upon the recommended nutrient reduction technology that is implemented.
  - Permitting requirements are unknown at this time.
- Dredging and establishment of an aquaculture nursery in Warren's Cove.
  - Environmental impacts, mitigation measures and potential MEPA triggers will be further studied and evaluated during design development and permitting of the project.
  - The Town anticipates that this project will be submitted to MEPA as a Notice of Project Change to the CWMP and will require review/permits from numerous regulatory agencies.
- Dredging and inlet widening of Sampson's Island to improve flushing within the Three Bays.
  - This project was subject to a prior MEPA review which studied and identified the environmental impacts and mitigation measures. Implementation of the project began in 2018 and will be completed in the winter of 2020.
  - No further permitting is required and the Town is currently working with MassDEP to develop a monitoring plan for the project.
- Installation of Stormwater BMPs focused on nutrient reduction.
  - Negative environmental impacts from the installation of stormwater BMPs focused on nutrient reduction are not anticipated. These BMPs will generally be replacing and/or supplementing existing traditional stormwater infrastructure which is less effective at removing nutrients from stormwater runoff.

- No permitting is anticipated to be necessary for the installation of Stormwater BMPs, except when the BMPs are within areas subject to the Wetlands Protection Act which will require Conservation Commission approval.

6.2.5 INTER-MUNICIPAL PARTNERSHIPS

As discussed in Sections 2.3.1 and Section 6.3, the Town has been actively engaging with neighboring communities to explore the potential of inter-municipal partnerships to address wastewater needs. The Town anticipates that these discussions will continue. Should an inter-municipal wastewater partnership materialize in the future, it would require MEPA review due to exceeding the following review threshold: *11.03(5)(a)(4) Provided that the Project is undertaken by an Agency, New sewer service to a municipality or sewer district across a municipal boundary through new or existing pipelines, unless an emergency is declared in accordance with applicable statues and regulations.* If an inter-municipal wastewater partnership is proposed to move forward, the Town will submit a Notice of Project Change to this project.

6.3 COORDINATION WITH NEIGHBORING COMMUNITIES

Barnstable shares watersheds with the towns of Mashpee, Sandwich, and Yarmouth. The Town will continue to work with neighboring communities to address the needs for each watershed.

6.3.1 MASHPEE

Barnstable and Mashpee share the Popponesset Bay Watershed. Barnstable has worked with Mashpee and Sandwich in developing an inter-municipal agreement (IMA) regarding nutrient management in Popponesset Bay. Please refer to Section 2.3.1.1 for more detail about this IMA agreement.

JBCC – The towns of Bourne, Falmouth, Mashpee, and Sandwich have discussed the possibility of utilizing the waste water treatment facility on JBCC as a regional facility. During the winter of 2018/2019 Barnstable was invited to join the four towns. Barnstable joined and contracted a consultant to study the feasibility of further expanding the Joint Base Cape Cod wastewater treatment facility, to accommodate additional flows from the western portion of the Town. The results of the consultant's efforts can be found in Appendices KK to NN.

6.3.2 SANDWICH

As discussed, Barnstable and Mashpee share the Popponesset Bay Watershed. Barnstable has worked with Sandwich and Mashpee in developing an inter-municipal agreement (IMA) regarding nutrient management in Popponesset Bay. Please refer to Section 2.3.1.1 for more detail about this IMA agreement.

Three Bays Watershed – Coordination meetings and discussions were held with Sandwich. Each community is addressing its respective need for this watershed via their own CWMP.

JBCC - As discussed the towns of Bourne, Falmouth, Mashpee, and Sandwich have discussed the possibility of utilizing the waste water treatment facility on JBCC as a regional facility. During the winter of 2018/2019 Barnstable was invited to join the four towns. Barnstable joined and contracted a consultant to study the feasibility of further expanding the Joint Base Cape Cod wastewater treatment facility to accommodate additional flows from the western portion of the Town. The results of the consultant's efforts can be found in Appendices KK to NN.

6.3.3 YARMOUTH

Yarmouth and Barnstable share the Lewis Bay and Barnstable Harbor watershed. After discussion of treatment options a study was conducted to better understand the opportunities related to having an exchange with Yarmouth. The basis of that exchange would be that Yarmouth would send its collected sewage to Barnstable for treatment, and Barnstable would send that effluent, plus additional effluent back to Yarmouth for disposal. Barnstable and Yarmouth are currently still discussing treatment options as of the writing of the CWMP. The study that was conducted can be found in Appendix JJ.

6.3.4 WATERSHED PERMITS

Massachusetts DEP has formulated a watershed permitting program to provide a permitting structure that transcends municipal boundaries and focuses on nitrogen management solutions across an entire watershed. Within the Town's shared watersheds with approved TMDL's (Popponesset Bay, Three Bays, and Lewis Bay) the Town anticipates engaging neighboring communities, working with MassDEP and the Cape Cod Commission, to seek watershed permits. A watershed permit for these impaired watersheds will:

- Provide the communities an opportunity to employ a greater range of solutions to address their water quality needs. The permit covers not just traditional wastewater systems, but also alternative approaches, such as fertilizer reduction, inlet restoration, aquaculture or permeable reactive barriers;
- Allow communities to get credit for the nitrogen reductions stemming from non-traditional approaches and/or non-traditional technologies, credit they would not receive through traditional permitting;
- Account for the need for long-term strategies necessary to address wastewater issues;
- Employ an adaptive management approach, acknowledging the uncertainties that may be associated with some projects, and carefully monitoring performance and assessing progress in a transparent fashion – and if necessary, making changes in the approach that may be needed to achieve water quality goals in a timely manner.

6.4 MONITORING PLAN

The following sections describe the Town's approach to monitoring the effectiveness of the plan.

6.4.1 TRACKING OF TRADITIONAL SOLUTION

As the Town moves forward with the sewer expansions as described in the CWMP, sewer connections will be made and wastewater and associated nutrients will be collected and treated at the Barnstable Water Pollution Control Factility (BWPCF). These connections will result the reduction of nutrients entering the groundwater of the respective watershed and an increase in wastewater flow treated by the BWPCF. Due to the fact that the groundwater travel time may take several months to years to reach the estuaries (depending upon distance from the source), completion of sewer connections will not immediately result in a reduction of nitrogen concentrations in the embayment. In order to track progress of the sewer expansion program, the Town will utilize the Town's GIS-based tool to track sewer connections. This information will be utilized to determine the calculated nitrogen septic load reduction within the watersheds and will be reported in the Adapative Management Plan updates.

6.4.2 EMBAYMENT MONITORING

The Town of Banrstable has been performing water quality embayment monitoring at long-term stations since they were established (between 1999 – 2002) during the Massachusetts Estuaries Project (MEP). The long-term monitoring stations are shown in Figure 6-2- Figure 6-6. The monitoring program includes all sentinel stations developed by the MEP as well as numerous other monitoring stations within each embayment. The Town is committed to continuing its yearly embayment monitoring of Lewis Bay, Halls Creek, Centerville River, Three-Bays, Rushy Marsh, and Barnstable Harbor. This will include monitoring of water quality, eelgrass coverage, and benthic infauna habitat, and will be the tool by which the effictiveness of the CWMP will be verified.

The embayment monitoring is a long-term, team effort between the Town, SMAST, citizen volunteers and non-profit partners (notably BCWC). Training is performed annually with SMAST staff to ensure all samplers are familiar with sampling protocols, equipment, and techniques.

The embayment monitoring program is a coordinated effort that is conducted on four dates per summer season between July and September, on a mid-ebb tide between 6-9 AM. Field data collection will include:

- Beaufort Force and Wind Direction
- Total Water Depth
- Secchi Depth

- Temperature
- Dissolved Oxygen (DO)
- 24-hour Precipitation
- Other in-field observations (birds, shell fishing, moorings, swimming)

Samples are analyzed at a MA DEP certified laboratory for the following parameters:

- Ammonium (NH_4^+)
- Nitrate + Nitrite (NO_x^-)
- Particulate Organic Nitrogen and Carbon (PON / POC)
- Dissolved Organic Nitrogen (DON)
- Ortho-Phosphate (PO_4^+)

Results of the water quality monitoring will be compiled annually to assess trends in water quality data as the CWMP is implemented. The results of the monitoring program will provide information on changes in watercolumn nutrient concentrations, dissolved oxygen conditions, and associated habitat restoration. A summary of the results will be included in the 5-year adaptive management updates.

6.4.3 NON-TRADITIONAL SOLUTIONS MONITORING

The Town of Barnstable intends to implement several non-traditional solutions (described in Section 2.3.2). The approach for implementing, monitoring, and seeking relief from the amount of traditional nitrogen removal (sewers) proposed in the later phases of the plan is described in Section 4.2 and 6.2.4. Monitoring plans for non-traditional solutions will be developed in consultation with DEP during the permitting phase of each project and will be designed to evaluate the effectiveness of the non-traditioanl treatment option. Monitoring plans will be long-term (likely 5-10 years) to firmly establish the nutrient removal before seeking relief of traditional nitrogen removal (sewers). Many of these non-traditional solutions will depend on adequate background data from either long term water quality monitoring MEP stations and/or new stations. Evaluation of the non-traditional solutions will specifically relate to the site of the non-traditional solution to evaluate nutrient removal effectiveness and sustainability of the solution. An update on non-traditinal soluntions monitoring will be provided in the 5-year adaptive management updates.

6.5 ADAPTIVE MANAGEMENT PLAN

The Town proposes an adaptive managemet approach to achieving the nutrient reduction goals. The Town of Barnstable's CWMP proposes to achieve the nitrogen reduction goals for all estuaries through implementation of a 30-year sewer expansion program consisting of three, 10-year phases and three separate stages. The CWMP also includes various non-traditional approaches to be implemented by the Town for potential relief of traditional nitrogen removal (sewers). The adaptive management approach allows the Town to move forward with the plan described within this CWMP and make modifications to the plan after evaluation of the results of implemented projects. An adaptive management approach also allows the Town to respond to changing environmental conditions, landuse updates, improved technologies and future opportunities and unknowns. The Town will prepare an adaptive management plan update every five years which will provide an update on progress of the plan.

In order to ensure the Town is on track with the implementation of the CWMP and working toward TMDL compliance, the Town will maintain regular communication with the regulatory agencies and document progress in an Adaptive Management Plan update report every five years. This report will provide updates to:

- Progress towards effluent disposal solutions
- Financial plan updates
- Status of sewer expansion using the GIS-tool to quantify the amount of nitrogen removed from the watershed
- Status of Route 28 sewer backbone to serve the western portion of the Town
- Project schedules and projects completed
- Barnstable WPCF upgrades
- Continued improvements to eixisting collection sustem via pump staion rehabilitation and infiltration/inflow programs
- Continued progress towards permitting, design and construction of non-traditional solutions
- Continued discussions with neighboring communities relative to potential inter-municipal partnerships and western permits within shared watersheds
- Continued discussions relative to Joint Base Cape Cod (JBCC) and other potential western solutions
- Status of sewer expansion “stages”
- Updates in build-out projections
- Monitoring and sampling update
- Policy decisionsChanges in nitrogen loading associated with development/redevelopment and sewering
- Wastewater treatment volumes and nutrient concentrations of influent and effluent
- Status of potential inter-municipal partnerships
- Assessment of non-traditional solutions on nutrient removal effectiveness
- Analysis of water quality trends in estuaries, ponds, and groundwater
- Response of eelgrass and benthic communities to reduced nitrogen loading
- Proposed changes in the implementation of traditional and non-traditional solutions in future phases to meet the TMDL

Through this report, Town will document progress of implementing traditional and non-traditional solutions and document the point at which the Town reaches the TMDLs for its estuaries and the associated ecosystem restoration. The ultimate goal is for TMDL compliance will be habitat restoration for eelgrass or bottom fauna.

6.6 NEXT STEPS

The Town submitted the CWMP to the Massachusetts Environmental Policy Act Office (MEPA) as an Expanded Environmental Notification Form (EENF) with a request for a Single Environmental Impact Report (SEIR) in January of 2020. The Town received a Secretary's Certificate on April 3, 2020 which advised that "the Proponent should submit a Single EIR in accordance with the Scope included in this Certificate". During the EENF review process, MEPA and the Town agreed that the project, being a master planning document, warranted the consideration of a Special Review Procedure (SRP). The Certificate states "the Town has agreed to work with the MEPA Office to develop a SRP and submit a proposed framework prior to or together with the Single EIR". The Town has consulted with MEPA a number of times in the preparation of the SEIR and SRP and is submitting the SEIR and SRP simultaneously to MEPA for final approval of the plan. Upon receipt of MEPA approval, the Town will petition the Cape Cod Commission to undertake a 208 Consistency Review, which will be the last step in the approval of the plan.

After the CWMP permitting process, the Town anticipates next steps to include:

- Continue public outreach process.
- Continue discussions relative to financial plan and other policy decisions.
- Continue efforts towards effluent disposal solution(s).
- Continue planning, design and begin construction of sewer expansion projects including Route 28 sewer backbone to serve the western portion of the Town.
- Continue planning, design and begin construction of Barnstable WPCF upgrades.
- Continue planning, permitting, design and begin construction of non-traditional solutions.
    - The Town anticipates submitting Notice of Project Change's for future non-traditional projects.
- Continue discussions with neighboring communities relative to potential inter-municipal partnerships and watershed permits within shared watersheds.
- Continue discussions relative to Joint Base Cape Cod (JBCC) and other potential western solutions.
- Continue environmental monitoring and sampling.

The first 5-year adaptive management plan update, anticipated to be submitted in 2025, will provide updates on progress the Comprehensive Wastewater Management Plan effort.

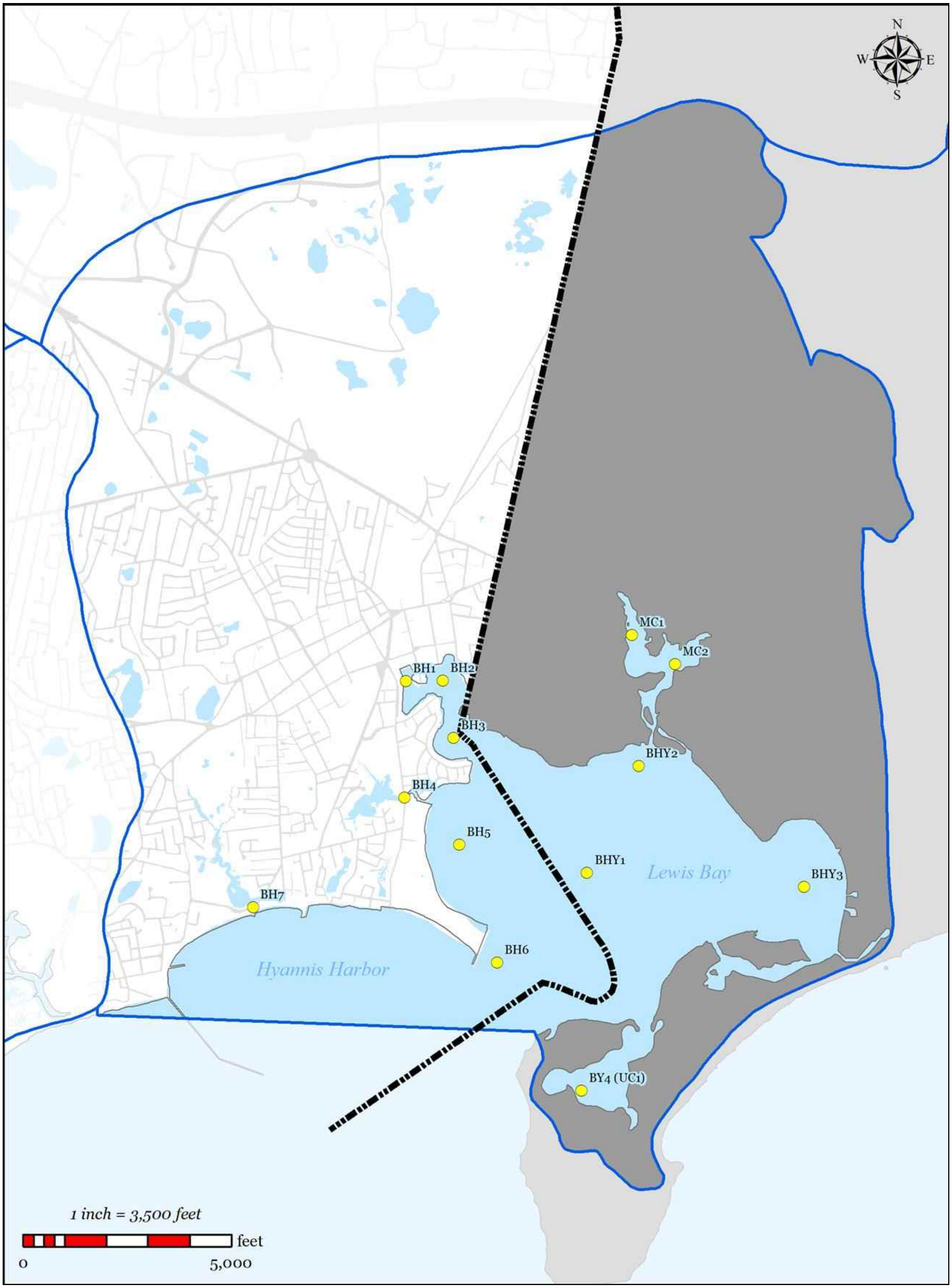

Figure 6-2: MEP Water Quality Stations in Lewis Bay Watershed

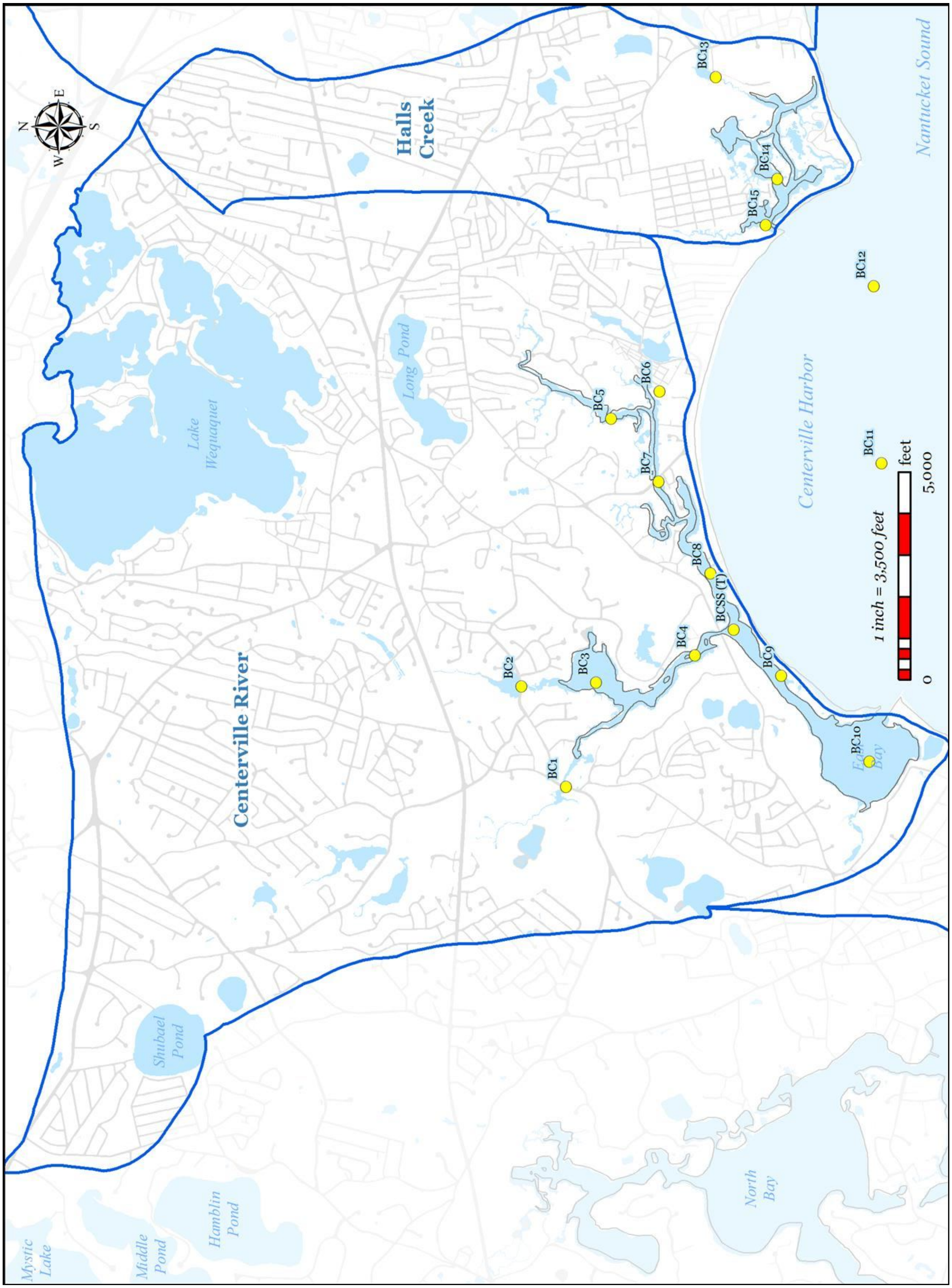

Figure 6-3:MEP Water Quality Stations in Halls Creek and Centerville River Watersheds

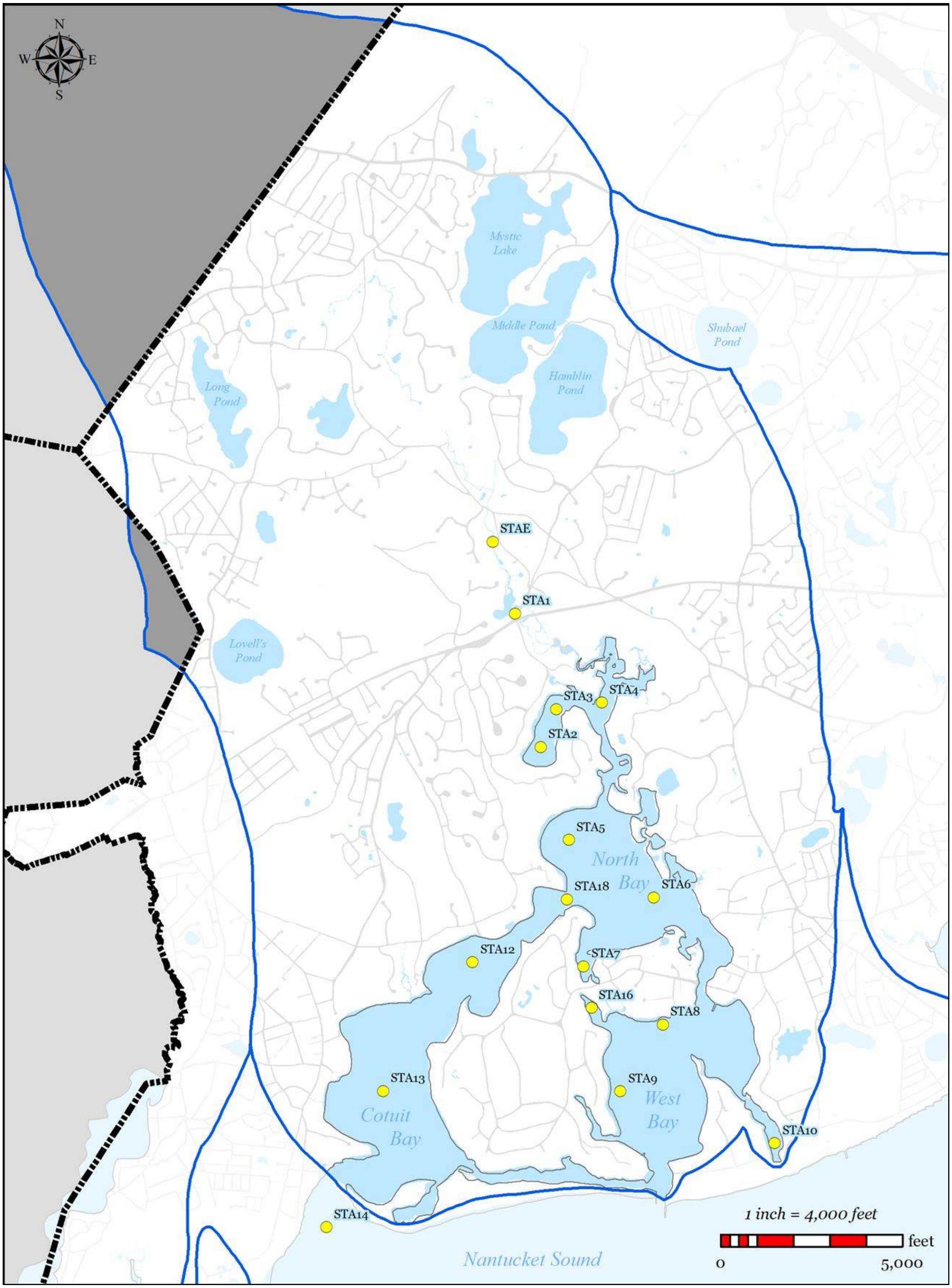

Figure 6-4: MEP Water Quality Stations in Three Bays Watershed

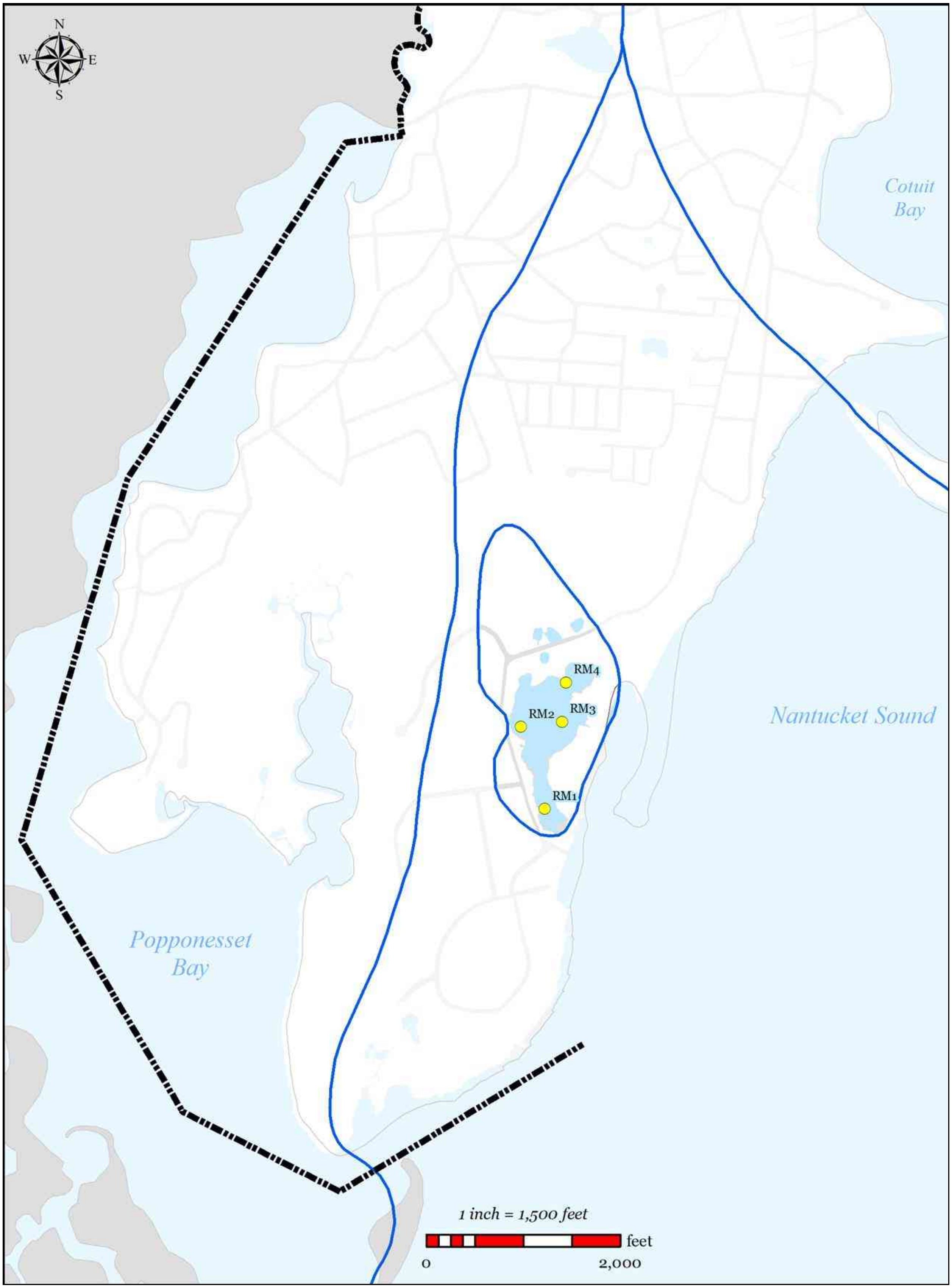

Figure 6-5: MEP Water Quality Stations in Rushy Marsh Pond Watershed

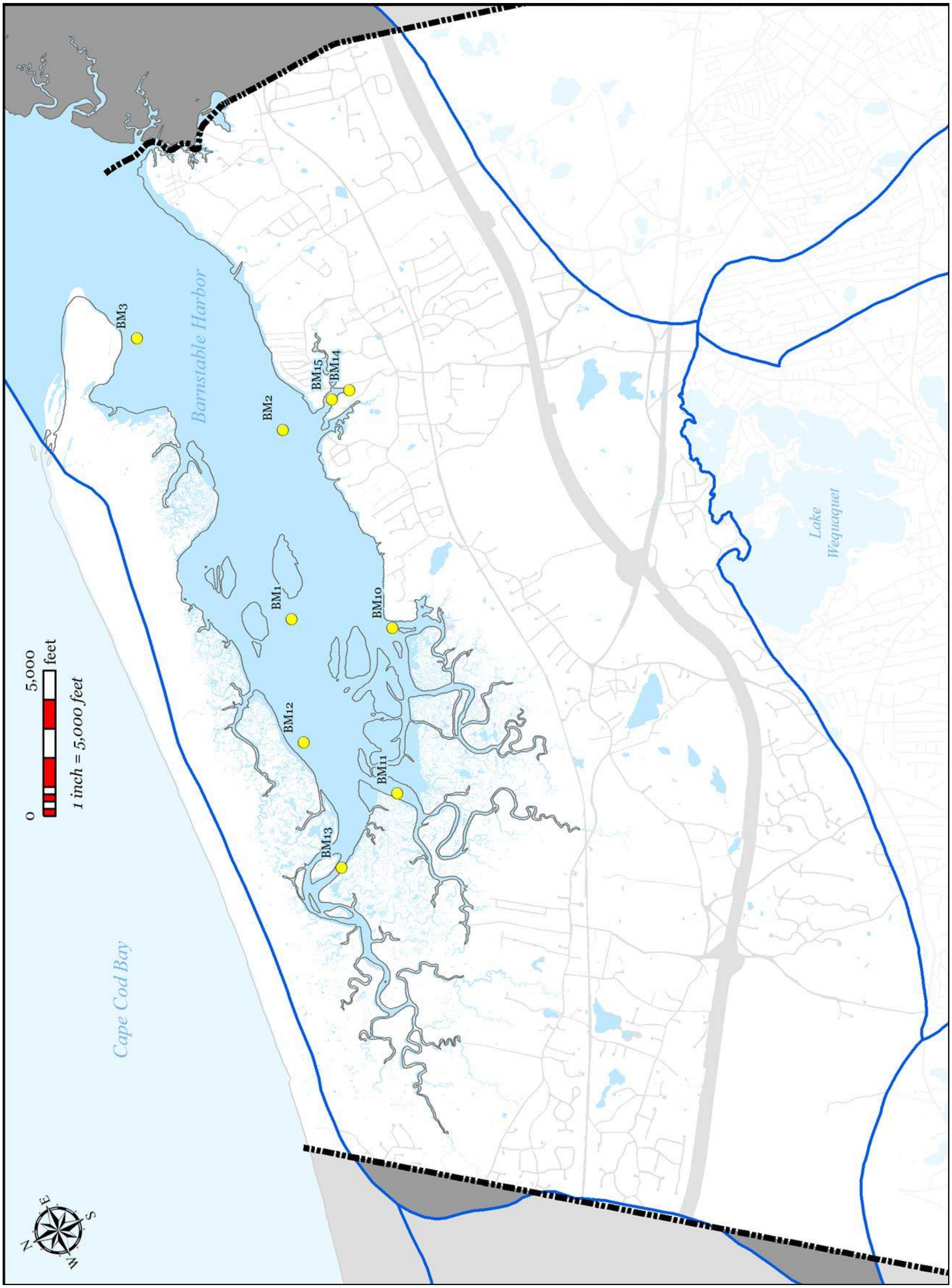

Figure 6-6:MEP Water Quality Stations in Barnstable Harbor Watershed

7 FINANCIAL PLAN

7.1 FUNDING SOURCES

7.1.1 MEALS AND ROOMS TAX.

Chapter 248 of the Acts of 2012 authorized the town of Barnstable to establish a Sewer Construction Fund. The amount of local meals excise tax collected under section 2 of chapter 64L of the General Laws shall be credited to the fund without further appropriation. In addition, the amount of local rooms excise based on rates in excess of four percent (4%) collected under section 3A of chapter 64G of the General Laws are credited to the fund without further appropriation. The town's local rooms excise tax rate is currently six percent (6%) providing one-third of all rooms tax to be credited to this fund. Any interest earned on the assets of the fund are credited to the fund and not the General Fund.

This legislation was amended by Chapter 355 of the Acts of 2014 which expanded the use of the fund allowing the town to appropriate monies in the Fund for sewer construction and maintenance and improvements to certain private ways.

The legislation was amended a second time with Chapter 32 of the Acts of 2018 which allows for the town to appropriate monies in the fund for planning, designing and construction of sewers and other means of comprehensive wastewater management and maintenance and improvement of private ways. The legislation refers to this Special Revenue Fund as *the Sewer Construction and Private Way*

7.1.2 MAINTENANCE AND IMPROVEMENT FUND

At the close of fiscal year 2019, this fund had an unreserved fund balance of $14.1 million available for appropriation and the annual revenue generated from the meals and rooms tax has averaged $2.42 million and has grown by an average annual rate of 3.8%.

7.1.3 SHORT-TERM RENTAL TAX

Legislation was signed into law in December, 2018 which expands the room occupancy excise, G.L. c. 64G, to short-term rentals of property for more than 14 days in a calendar year, starting July 1, 2019 for which a rental contract was entered into on or after January 1, 2019. It is estimated that the additional rooms tax generated from this category of rental property will eventually provide an additional $1 million per year to the town's dedicated special revenue fund once compliance when the new law matures.

7.1.4 STABILIZATION FUND

The Town's General Fund would have been the beneficiary of an estimated $1.25 million annually from the expansion of the rooms excise tax on short-term rentals. A new Stabilization Fund has been approved to dedicate this new revenue stream to the comprehensive management of the town's water and wastewater needs and none of the revenue will be credited to the General Fund.

7.1.5 CAPE COD & ISLANDS WATER PROTECTION FUND

Preliminary projections for revenue to be generated by the Cape Cod & Islands Water Protection Fund (CCIWPF) amount to $18 million annually. A tax rate of 2.75% is applied to stays in hotels, motels, B&B's, other lodging establishments as well as short-term rental properties rented in excess of 14 days in a calendar year. The revenue will be awarded to communities in the form of principal subsidies on loans issued through the State Revolving Loan Program. It is estimated that lodging establishments in the town of Barnstable could contribute in excess of $2.5 million annually to this fund once it matures. Over the next 30 years it is estimated this fund could generate in excess of $800 million.

7.1.6 SEWER ASSESSMENTS

Chapter 83 of the General Laws allows for the issuance of assessments to property abutters for a proportional share of the cost for a common sewer. The town will make every effort to maximize the number of property abutters on a specific sewer project to keep the proportional share of the costs to the least amount possible. The town could set an upper limit on the sewer assessments and subsidize them depending upon the amount of principal subsidies received from the CCIWPF and tax revenue generated from meals and rooms taxes. A reasonable upper limit may be defined as the average cost to replace a septic system.

Property owners have the option to pay the sewer assessment in full or apportion the cost to future tax bills for up to 30 years under Chapter 83 of the General Laws. The interest rate applied to the apportioned assessments is either 5%, or by vote of the Town Council, can be at a rate up to 2% above the net rate of interest chargeable to the town for the project to which the assessment relates.

7.1.7 SYSTEM DEVELOPMENT CHARGES

This is a fee in the utility industry that is charged to new customers of a utility system to pay for the investments made into the "backbone" of a system. There are three (3) methods that could be used to calculate the charge:

- Historical buy-in method – typically used when the existing system has sufficient capacity to serve new development now and into the future
- Incremental cost method – typically used when the existing system has limited or no capacity to serve new development and new facilities are needed to serve the next increment of new development
- Combined approach – typically used where some capacity is available in parts of the existing system, but new or incremental capacity will need to be built in other parts to serve new development in the near future

The financing plan includes a system development charge that would be paid at the time of connection to the sewer system

7.1.8 DEBT ISSUANCE

When debt is necessary to finance capital improvements, the town either issues General Obligation Bonds through the capital markets or obtains loans through state agencies such as the Department of Environmental Protection's Massachusetts Clean Water Trust (MCWT) that offers municipal infrastructure financing programs at low interest rates, occasional principal subsidies, and with attractive repayment terms.

The MCWT offers 0% loans for projects that contribute to nutrient enrichment reduction; 1.5% loans for Housing Choice Communities and 2% loans as a standard option. The loans can be amortized for up to 30 years provided the asset has a useful life exceeding that time period.

Project costs that are not financed through the MCWT will be financed with a General Obligation Bond issue in the capital market. The town's current bond rating is AAA and should result in 20 year loan rates of approximately in the 4% to 6% range under current market conditions.

7.1.9 FEDERAL & STATE GRANTS

Most grants available from state and federal agencies for sewer infrastructure require target pilot projects and innovative or "green" projects. Grants are typically not available for standard utility infrastructure needs such as replacing sewer mains or building of pump stations to meet on-going demand. Federal and State assistance has been directed to the MCWT to date which has allowed for the favorable borrowing conditions mentioned previously. This financing plan assumes this method of assistance will continue.

7.1.10 PROPERTY TAXES

The financial plan includes property taxes as a funding source for the program. It may be in the form of an operating override dedicated for sewer expansion, a capital or debt exclusion to cover some or all of a project's cost, or a reprioritization of the existing tax levy for this purpose.

7.2 FINANCIAL ACCOUNTING FOR THE COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

7.2.1 SEWER ENTERPRISE FUND

A separate enterprise fund already exists that accounts for all sewer related operations including the collection, treatment, and disposal of effluent. As sewer expansion projects are completed and properties are tied into the sewer system, property owners will begin to be billed the user charge rates in existence for being part of the collection and treatment system. Capital expenditures made to improve the existing treatment and collection system are built into the user fee rate structure and will be accounted for in the enterprise fund.

The operating budget of the Sewer Enterprise Fund will include the debt service payments required on all loans issued to finance the sewer expansion program. On an annual basis, the fund will receive a transfer from the town's Sewer Construction and Private Way Maintenance and Improvement Fund (CWMPWIF) to pay for the annual debt service. It may also receive a transfer from the new Stabilization Fund to help offset project costs or debt service as well as the General Fund if property taxes are approved to cover any portion of the program.

7.2.2 SEWER CAPITAL FUND

A separate fund will be created within the enterprise fund structure to track all sewer expansion project activity. This includes all appropriations made for sewer expansion projects and the proceeds from the associated debt issuances to finance the project. As projects are completed the assets become part of the Sewer Enterprise Fund's fixed asset listing and future costs to operate and maintain the assets will be incorporated into the user fee rate structure.

7.2.3 SEWER ASSESSMENT FUND

A separate fund will be created within the enterprise fund structure to track all sewer assessments receivable and sewer assessments collected. The annual operating budget of the Sewer Enterprise Fund will receive a transfer from this fund to pay for the debt service issued to construct a sewer collection expansion project.

7.2.4 SEWER CONSTRUCTION & PRIVATE WAY MAINTENANCE AND IMPROVEMENT FUND

This is an existing fund within the town's Special Revenue Fund structure. Revenue generated from meals and rooms taxes and investment earnings on cash deposits are credited to this fund. Project management costs incurred by the Department of Public Works and transfers to the Sewer Enterprise Fund covering debt obligations will be appropriated from this fund on an annual basis. The annual debt service associated with bond issues to finance the sewer expansion program will be part of the Sewer Enterprise Fund requiring the transfer from this fund.

7.2.5 STABILIZATION FUND

The new Stabilization Fund will be used to supplement the funding for the CWMP either in the form of a cash appropriation or an annual transfer to the Sewer Enterprise Fund to pay for a portion of the debt service on loans issued to finance sewer expansion projects.

7.3 FINANCIAL PLAN ASSUMPTIONS AND FINANCIAL PROFORMA

7.3.1 FINANCING THE CONSTRUCTION COST

The total construction costs for collection, conveyance, treatment, and disposal are projected to be $863 million over a 30 year period. An estimated 9,812 new properties are expected to be connected to the sewer system. This equates to an average parcel cost of $87,953. Recognizing that this would be a financial hardship for property owners the town has created several funding sources to offset the sewer assessments that will need to be issued to fund a portion of this plan.

The town will issue General Obligations Bonds to fund the construction on an annual basis over the next 30 years. Bonds will be issued using a 20 year amortization period to save on borrowing costs when cash flow allows. It is estimated the principal subsidies from the MCWT and the CCIWPF could total $112 million over the next 30 years.

The MCWT offers loan rates of 0% on projects that address nutrient enrichment reduction; loan rates of 1.5% for Housing Choice Communities (Barnstable qualifies), and standard loan rates of 2%. Additionally, the town has access the capital markets every year for the past several years averaging a net interest rate of approximately 2.5%. The financial plan assumes bonds will be issued with an average interest rate of 2%, amortized over 20 years using a level payment amortization method.

7.3.2 SEWER CONSTRUCTION AND PRIVATE WAY MAINTENANCE & IMPROVEMENT SPECIAL REVENUE FUND

The unreserved balance in this fund at the close of fiscal year 2019 was $14 million. The fund currently generates $3.1 million in revenue with a current $500,000 per year obligation to debt service for the Stewart's Creek project. The annual net revenue capacity remaining ($2.6 million), along with the fund balance ($14 million), will allow the town to leverage a long-term borrowing program of approximately $8 million per year with no sewer assessments.

7.3.3 CURRENT ROOMS AND MEALS TAX REVENUE

Currently, one-third of all rooms tax generated by the town and 100% of the local meals tax is dedicated to this program and credited to the town's Special Revenue Fund for Sewer Construction and Private Way Maintenance & Improvements. Meals and rooms taxes are projected to grow on average at 4% and 3% respectively per year. Below is the average rate of growth over the past several years.

Table 7-1: Meals and Rooms Tax Projection

FY	Meals Tax	Change		Rooms Tax	Change
2012	$1,197,380			$822,891	
2013	$1,255,113	4.82%		$845,682	2.77%
2014	$1,302,329	3.76%		$905,256	7.04%
2015	$1,369,762	5.18%		$894,092	-1.23%
2016	$1,465,624	7.00%		$933,975	4.46%
2017	$1,485,589	1.36%		$975,535	4.45%
2018	$1,550,284	4.35%		$991,379	1.62%
2019	$1,620,727	4.54%		$1,017,522	2.64%
	Average	**4.43%**		**Average**	**3.11%**

7.3.4 NEW – LOCAL ROOMS TAX ON SHORT-TERM RENTALS

It is estimated that the new local rooms tax on short-term rentals will take 4 years to mature and it has been suggested by outside sources, that the tax will eventually approximate the rooms tax generated on hotels, motels, B&B, and other lodging houses. By law, one-third of this revenue will be credited to the town's Special Revenue Fund for Sewer Construction and Private Way Maintenance and Improvements and two-thirds is credited to the new Stabilization Fund dedicated for the management of sewer and water. Once this revenue source matures it is projected to grow at an average rate of 3% per year. The projected revenue from this source is as follows:

Table 7-2: Short-term Rental Tax Projection

Short-term Rental Tax Projection			
Year	Stabilization Fund	Sewer construction & Private Way Maintenance & Improvement Fund	Total
1	$ 500,000	$ 250,000	$ 750,000
2	$ 700,000	$ 350,000	$ 1,050,000
3	$ 1,000,000	$ 500,000	$ 1,500,000
4	$ 1,500,000	$ 750,000	$ 2,250,000
5	$ 1,515,000	$ 757,500	$ 2,272,500
Year 6 and after - 1% greater than the previous year			

7.3.5 CAPE COD & ISLANDS WATER PROTECTION FUND

A tax rate of 2.75% is applied to stays in hotels, motels, B&B's, other lodging establishments as well as short-term rental properties rented in excess of 14 days in a calendar year. The financial plan assumes the short-term rental market could be as much as 75% of the current hotel/motel market, which would result in a combined annual tax base of $483 million as illustrated below. This would result in over $13 million annually for the CCIWPF and a projected $600 million over 30 years. The financial plan assumes Barnstable would receive $112 million over a 30 year period or 19%. This approximates what Barnstable is estimated to contribute to the CCIWPF from lodging rentals within the town.

Table 7-3: CCIWPF Projection

Total Hotel/Motel room sales	$276,355,504
Estimated STR market (75% of H/M)	$207,266,628
Total subject to CCIWPF Tax	$483,622,132
CCIWPF Rate	2.75%
Annual Projected Tax	$13,299,609
Projected tax over 30 years	$601,393,010
Barnstable principal subsidies	$112,229,437
Barnstable's share of CCIWPF	19%

7.3.6 INVESTMENT EARNINGS

Earnings on invested cash balances will average 1.5% per year. A mix of investment maturities and types will be utilized offering the potential for higher yields based on current market conditions. Security of principal will remain the number one priority, followed by liquidity and yield.

7.3.7 SEWER ASSESSMENTS

Construction costs are estimated to be $863 million and include an estimated 9,812 parcels resulting in an average per parcel cost of $87,953. This includes the cost of sewer mains, pumps and collector lines as well as bringing roads back to their original condition. 13% of the project costs are estimated to be covered by the CCIWPF resulting in the average per parcel costs decreasing to $76,538. If the decision is to cap the sewer assessments at a predetermined level such as the average cost to replace a septic system then a subsidy will be necessary. The subsidy would come in the form of meals and rooms taxes contributed to funding the program, subsidies from the CCIWPF and a contribution to the program from property taxes. The proforma includes the assumption that sewer assessments would average $18,000; indexed for inflation, this would increase to $31,965 by year 30 of the program.

Property owners would have the option to apportion this cost over future tax bills for up to 30 years. The proforma includes the assumption that the entire assessment amount will be collected over a 15 year period as it is more likely that most liens will be paid off in a shorter time period due to refinancing activity and the transfer of ownership. This will reduce the amount of interest collected on the assessments but improve the cash flow under the program. The fiscal impact on a property owner who chooses to apportion the assessment of $18,000 over 30 years is $660 annually using a 2.5% interest rate; or $55 per month.

7.3.8 INTEREST RATE ON SEWER ASSESSMENTS AND AMORTIZATION PERIOD

A property owner can pay a sewer assessment in full at the time it is billed or elect to apportion it to future tax bills for up to 30 years if sewer assessments are conducted under chapter 83. If apportioned, a lien is recorded against the property and interest is charged against the outstanding balance of the assessment. The interest rate on the betterment defaults to 5% unless legislative action is taken to establish it at a different rate. The Town Council can elect to set the interest rate up to 2% more than the town’s interest rate it incurs on the borrowing to finance the project. If the town receives a 2% loan from the MA Clean Water Trust the interest rate on the assessment could be set anywhere from 2% to 4%.

Upon the sale of a property, usually all outstanding liens recorded are settled and paid in full. Therefore, all interest that could have been earned on the assessment to offset any borrowing costs the town incurs will not be realized. The proforma includes an assumption that the town will collect interest on the first 15 years on sewer assessments. In most cases, a sale or refinancing will most likely occur paying off any outstanding principal balance on a betterment/sewer assessment. An estimated interest rate of 2.5% is used on the sewer assessments.

7.3.9 FEDERAL AND STATE GRANTS AND OTHER SOURCES

No direct federal or state grants to the town are included in the proforma. It is more likely that any such aid will be directed to the MCWT and will be used to issue low interest loans and possible principal subsidies. Any subsidies or direct aid will improve the bottom line in the proforma.

7.3.10 PROJECT COSTS

Project costs are estimated by the Department of Public Works to be $663 million in today's dollars. Indexed for inflation at 2.0% will increase the total costs to over $863 million. Project costs will be separated between General Benefit Facilities (GBF) and Special Benefit Facilities (SBF). The financial plan assumes the town will pay for GBF costs and only assess SBF costs to property abutters. GBFs include, but are not limited to, pumping stations, trunk and force mains, land acquisition, easements, and are assessed on all areas to receive benefits within the pumping district or combination of districts. SBFs include, but are not limited to, the sewer mains serving adjacent properties and are assessed only to the adjacent properties.

7.3.11 INTEREST RATES ON LONG-TERM BORROWING

Borrowing rates on bonds will average 2.0% assuming a mix of 0%, 1.5% and 2% SRF loans and 4% to 6% General Obligation Bonds (GOB) in the capital markets. If the town adopts Chapter 83; Section 1A it will be eligible for 0% financing from the MA Clean Water Trust and could borrow and assess betterments for a term of up to 50 years or the useful life of the project, whichever is shorter. Limited resources in the Trust could require the town to finance a portion of the program with a General Obligation Bond (GOB) at an estimated interest rate of 4-6%. The town's last five GOB's averaged a net interest cost of 2.25% which includes a mix of 5 to 20 year maturities. This program assumes all GOB's will be comprised of 20 year maturities. Longer amortization periods will result in higher interest rates on GOB borrowings so the 4-6% range is used.

The town's annual debt service costs will increase as a new bond issue is introduced every year to cover the project costs not provided for with a grant from the CCIWPF.

7.3.12 OTHER COSTS

DPW will need staff to manage the implementation of a comprehensive sewer expansion program. The town will also need a budget for other costs such as legal expenses and for possible land acquisitions needed and other activities associated with implementing the plan. A provision for these costs has been included in the proforma. No provision has been made for the taking of private ways as public roads.

7.3.13 CONNECTION COSTS AND CONNECTION REQUIREMENT.

The cost to connect a property to the town's sewer system would be paid by the homeowner. It may be possible for the town to cover the cost of the connection and place a lien on the property similar to the assessment process. This option will be explored as well as an option to create a revolving loan fund that property owners could access to amortize the connection cost over multiple years.

7.3.14 LOW INCOME ASSISTANCE

There is no provision in this profroma to provide financial assistance to low income property owners.

7.3.15 SYSTEM DEVELOPMENT CHARGE

A system development charge (SDC) is a fee in the utility industry that is charged to new customers of a utility system to pay for the investments made into the “backbone” of a system. There are three (3) methods to calculate one;

- Historical buy-in method – typically used when the existing system has sufficient capacity to serve new development now and into the future
- Incremental cost method – typically used when the existing system has limited or no capacity to serve new development and new facilities are needed to serve the next increment of new development
- Combined approach – typically used where some capacity is available in parts of the existing system, but new or incremental capacity will need to be built in other parts to serve new development in the near future

The CWMP Financing Plans includes a $2,000 SDC that would be paid at the time of connection to the sewer system. It is projected that this will raise over $19 million to offset a portion of the investment in the collection and treatment facilities

7.3.16 SEWER UTILITY CHARGES

Over the next 30 years it is estimated that over 9,800 new customers will be tied into the public sewer system creating a more robust customer base. This will result in an increase in the annual revenue generated by the Sewer Enterprise Fund that can be used to finance a portion of the treatment and disposal facility expansion. The current average residential bill is around $400. At full buildout this would generate an additional $10 million annually to offset the cost of operations and capital improvements.

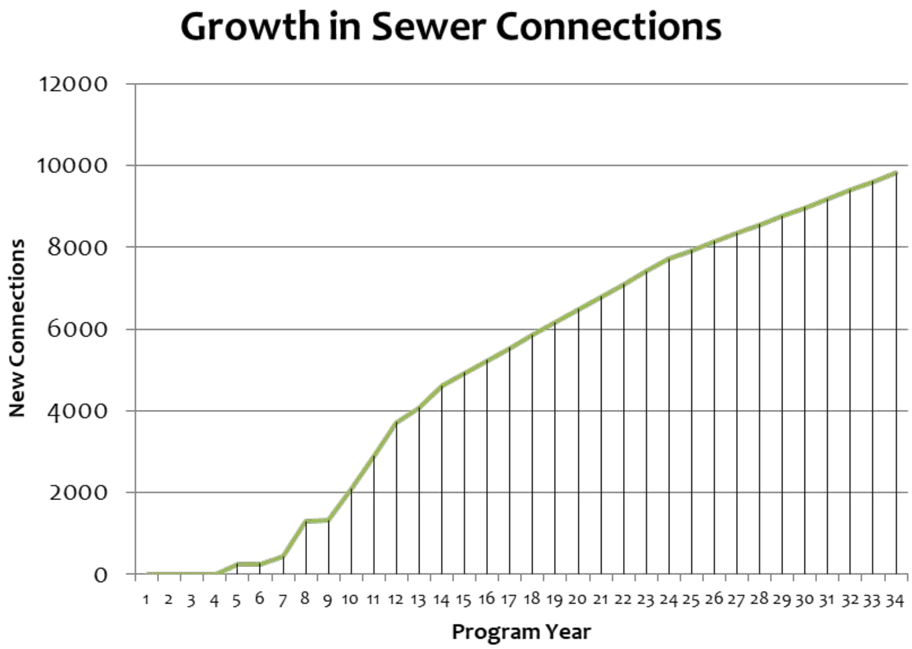

Figure 7-1: Growth in Sewer Connections

7.3.17 PROPERTY TAX CONTRIBUTION

This program will improve the town's water resources and provide benefits for all property owners in some way. A contribution from property taxes could be made to recognize this benefit. It can either be from the existing tax levy base or from an increase in the levy approved by the voters. The financial plan includes an assumption that an annual investment of $3,000,000 will be needed on an annual basis by the second 10 year phase of the program. This investment will begin in FY 2022 with a contribution of $300,000; increasing $300,000 per year until it reaches $3 million by FY 2031.

The tax rate would be one cent ($0.01) for every $142,574 in property tax support. This is arrived at by taking the current tax levy of $122,755,923.63 and dividing it by 861 (the current single tax rate is $8.61). The creation of a stabilization fund with a ten (10) cent impact on the tax rate would generate $1,425,737 in the first year and $36.4 million over a 20 year period. The tax bill impact for this level of increase is $10 per year for every $100,000 in taxable assessed value. The median value property in FY 2019 is $351,800. This would result in an annual tax increase of $35.18 and $25.35 for a property qualifying for the residential exemption.

7.3.18 DEBT LIMITATIONS

Except as otherwise provided by law, the town shall not authorize indebtedness to an amount exceeding 5 per cent of the equalized valuation of the town. The town may authorize indebtedness in excess of 5 per cent but not in excess of 10 per cent, of the aforesaid equalized valuation; provided, however, that the amount of indebtedness so authorized shall be subject to the approval of the members of the municipal finance oversight board, which approval may be given either before or after such authorization. All authorized debts, except those expressly authorized by law to be incurred outside the debt limit, shall be reckoned in determining the limit of indebtedness under state law.

The town's current equalized valuation for applying this test is $14,932,044,600. Five percent of the EQV is $746,602,230. At no point in time does the town approach this level of outstanding debt within this program.

7.4 SUMMARY

Based on the set of assumptions previously listed, the financial plan for the CWMP remains in a positive fund balance position throughout the program. Steps taken by the town to date in creating multiple funding sources results in those resources exceeding commitments for several years and allows the town to grow its fund balance for this program. As the program is implemented and construction bonds are issued the annual commitments for debt service and project management will eventually exceed annual resources resulting in the use of fund balance to offset the costs. This begins to happen in year 18 of the program and continues through year 25 until fund balance reaches its lowest level of approximately $12.5 million in year 26. At this point, resources begin to outpace commitments again.

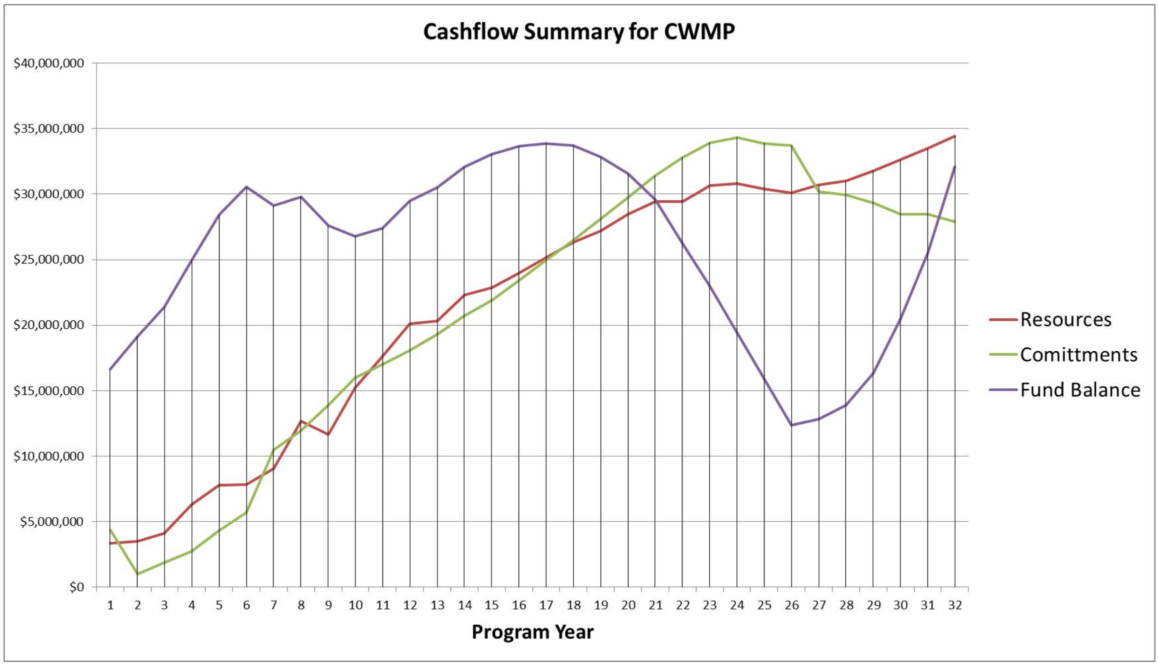

Figure 7-2: Cashflow Summary for CWMP

Table 7-4: Funding Sources

Funding Sources		
Estimated Principal Subsidies on Bond Issues	$112,229,437	11%
Sewer Assessments	$255,764,639	24%
Investment Earnings	$11,397,346	1%
Property taxes	$70,500,000	7%
System Development Charges	$19,624,000	2%
User Rate Revenue	$128,524,045	12%
Rooms and Meals Taxes including STR	$463,211,220	44%
Total funding sources	**$1,061,250,687**	**100%**

7.4.1 SUMMARY OF ASSUMPTIONS

Table 7-5: Inputs

INPUTS	
Program Implementation Year	**2020**
Program Ending Year	**2049**
Years to Implement	**30**
Average Principal Subsidy on Debt Issues	**13.00%**
Average Interest Rate on Bonds	**2.00%**
Collection System Bond Amortization Period in Years	**20**
Treatment System Bond Amortization Period in Years	**20**
Average Sewer Assessment Charge	**$18,000**
Inflation Factor on Sewer Assessment Charge	**2.00%**
Interest Rate on Sewer Assessments	**2.50%**
Sewer Assessment Amortization Period in Years	**30**
Sewer Assessments Maturity in Years	**15**
Growth Rate on Rooms Tax Revenue	**3.00%**
Growth Rate on Meals Tax Revenue	**4.00%**
Rate of Return on Investments	**1.50%**
Construction Cost Inflation Factor	**2.00%**
Project Management Inflation Factor	**4.00%**
New Short-term Rental Tax Revenue Estimate	**$2,250,000**
Property Tax Contribution Ceiling	**$3,000,000**
Annual Growth in Property Tax Contribution	**$300,000**
Fiscal Year Property Tax Contribution Begins	**2022**
Fiscal Year Property Tax Contribution Ends	**2056**
System Development Charge	**$2,000**
Average Residential Sewer Bill - Year 1	**$400**
Annual Increase in Sewer Rates	**3.00%**

Table 7-6: Comprehensive Wastewater Management Plan Funding Proforma

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN										
FUNDING PROFORMA										
Years	1	2	3	4	5	6	7	8	9	10
Fiscal Year	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Beginning Fund Balance	$ 17,647,010	$ 16,641,755	$ 19,163,139	$ 21,403,226	$ 24,973,883	$ 28,405,802	$ 30,533,731	$ 29,112,981	$ 29,817,415	$ 27,596,542
Resources:										
Hotel/Motel Rooms Tax 1/3	1,048,048	1,079,489	1,111,874	1,145,230	1,179,587	1,214,974	1,251,424	1,288,966	1,327,635	1,367,464
Meals Tax	1,685,556	1,752,978	1,823,097	1,896,021	1,971,862	2,050,737	2,132,766	2,218,077	2,306,800	2,399,072
Short-term Rental Tax	250,000	350,000	500,000	2,250,000	2,317,500	2,387,025	2,458,636	2,532,395	2,608,367	2,686,618
Property Tax Contribution	-	-	300,000	600,000	900,000	1,200,000	1,500,000	1,800,000	2,100,000	2,400,000
Earnings on Investments	264,705	249,626	287,447	321,048	374,608	426,087	458,006	436,695	447,261	413,948
Existing Sewer Assessments	95,014	92,509	88,335	85,917	77,803	75,685	72,974	70,888	68,801	66,715
Assessments	-	-	-	-	355,889	355,889	633,590	1,980,622	2,046,431	3,280,888
User Charge Revenue	-	-	2,971	3,060	111,200	114,536	203,944	631,171	670,881	1,084,527
Systems Development Charge	-	-	14,000	-	480,000	-	360,000	1,712,000	82,000	1,508,000
Total Resources	3,343,323	3,524,603	4,127,723	6,301,276	7,768,450	7,824,934	9,071,339	12,670,814	11,658,177	15,207,233
Commitments:										
Staffing	200,000	208,000	316,320	428,973	446,132	463,977	582,536	605,838	630,071	655,274
Operating expenses	-	10,000	10,400	10,816	11,249	11,699	12,167	12,653	13,159	13,686
Other costs	-	-	100,000	104,000	108,160	112,486	116,986	121,665	126,532	131,593
Existing Debt Service Payments	501,578	501,926	502,283	502,647	503,019	503,400	503,788	504,185	504,591	505,006
Estimated Debt Service on Collection System	-	283,292	958,634	1,684,184	3,267,971	4,234,311	6,448,318	7,893,744	9,776,403	11,850,913
Estimated Debt Service on Treatment System	-	-	-	-	-	371,132	2,828,294	2,828,294	2,828,294	2,852,013
Other Cash Program Commitments	3,647,000	-	-	-	-	-	-	-	-	-
Total Current Year Commitments	4,348,578	1,003,218	1,887,637	2,730,620	4,336,530	5,697,005	10,492,089	11,966,380	13,879,050	16,008,484
Increase (Decrease) in Trust Fund Balance	(1,005,255)	2,521,384	2,240,087	3,570,657	3,431,919	2,127,929	(1,420,750)	704,434	(2,220,873)	(801,252)
Ending Trust Fund Balance	$ 16,641,755	$ 19,163,139	$ 21,403,226	$ 24,973,883	$ 28,405,802	$ 30,533,731	$ 29,112,981	$ 29,817,415	$ 27,596,542	$ 26,795,291
Project Costs	$7,316,766	$ 22,867,742	$ 13,805,447	$ 41,307,729	$ 18,832,576	$ 48,587,031	$ 73,348,173	$ 35,384,113	$ 38,989,895	$ 18,486,901
Cape cod & Islands Water Protection Fund subsidies	($951,180)	($2,972,806)	($1,794,708)	($5,370,005)	($2,448,235)	($6,316,314)	($9,535,262)	($4,599,935)	($5,068,686)	($2,403,297)
Net Bond Issue	$6,365,586	$19,894,936	$12,010,739	$35,937,724	$16,384,341	$42,270,717	$63,812,911	$30,784,178	$33,921,209	$16,083,604

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN
FUNDING PROFORMA

Years	11	12	13	14	15	16	17	18	19	20
Fiscal Year	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Beginning Fund Balance	$ 26,795,291	$ 27,408,347	$ 29,479,965	$ 30,516,735	$ 32,084,590	$ 33,062,227	$ 33,663,186	$ 33,885,576	$ 33,727,974	$ 32,833,569
Resources:										
Hotel/Motel Rooms Tax 1/3	1,408,488	1,450,743	1,494,265	1,539,093	1,585,266	1,632,824	1,681,809	1,732,263	1,784,231	1,837,758
Meals Tax	2,495,035	2,594,836	2,698,630	2,806,575	2,918,838	3,035,591	3,157,015	3,283,296	3,414,627	3,551,212
Short-term Rental Tax	2,767,216	2,850,233	2,935,740	3,023,812	3,114,526	3,207,962	3,304,201	3,403,327	3,505,427	3,610,589
Property Tax Contribution	2,700,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Earnings on Investments	401,929	411,125	442,199	457,751	481,269	495,933	504,948	508,284	505,920	492,504
Existing Sewer Assessments	64,628	62,542	62,542	62,542	-	-	-	-	-	-
Assessments	4,621,862	6,040,756	6,661,015	7,621,531	8,181,891	8,753,458	9,336,457	9,931,115	10,181,778	10,800,460
User Charge Revenue	1,548,729	2,056,418	2,321,709	2,709,738	2,978,592	3,261,137	3,557,955	3,869,647	4,196,838	4,540,178
Systems Development Charge	1,606,000	1,666,000	714,000	1,084,000	620,000	620,000	620,000	620,000	620,000	620,000
Total Resources	17,613,888	20,132,653	20,330,100	22,305,042	22,880,382	24,006,906	25,162,384	26,347,931	27,208,820	28,452,702
Commitments:										
Staffing	681,485	708,744	737,094	766,578	797,241	829,130	862,296	896,788	932,659	969,965
Operating expenses	14,233	14,802	15,395	16,010	16,651	17,317	18,009	18,730	19,479	20,258
Other costs	136,857	142,331	148,024	153,945	160,103	166,507	173,168	180,094	187,298	194,790
Existing Debt Service Payments	505,430	505,862	306,986	307,438	-	-	-	-	-	-
Estimated Debt Service on Collection System	12,810,815	13,783,299	14,896,694	16,015,276	17,156,229	18,320,001	19,507,049	20,717,838	21,952,843	23,212,548
Estimated Debt Service on Treatment System	2,852,013	2,905,996	3,189,137	3,477,941	3,772,520	4,072,992	4,379,473	4,692,083	5,010,946	5,336,186
Other Cash Program Commitments	-	-	-	-	-	-	-	-	-	-
Total Current Year Commitments	17,000,832	18,061,035	19,293,330	20,737,187	21,902,744	23,405,947	24,939,995	26,505,533	28,103,225	29,733,748
Increase (Decrease) in Trust Fund Balance	613,056	2,071,618	1,036,770	1,567,855	977,637	600,959	222,390	(157,602)	(894,405)	(1,281,046)
Ending Trust Fund Balance	$ 27,408,347	$ 29,479,965	$ 30,516,735	$ 32,084,590	$ 33,062,227	$ 33,663,186	$ 33,885,576	$ 33,727,974	$ 32,833,569	$ 31,552,523
Project Costs	$ 18,277,602	$ 21,940,583	$ 26,345,028	$ 26,871,929	$ 27,409,368	$ 27,957,555	$ 28,516,705	$ 29,087,039	$ 29,668,780	$ 30,262,156
Cape cod & Islands Water Protection Fund subsidies	($2,376,088)	($2,852,276)	($3,424,853)	($3,493,350)	($3,563,218)	($3,634,482)	($3,707,171)	($3,781,315)	($3,856,941)	($3,934,081)
Net Bond Issue	$15,901,514	$19,088,307	$22,920,175	$23,378,579	$23,846,150	$24,323,073	$24,809,534	$25,305,724	$25,811,839	$26,328,075

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN
FUNDING PROFORMA

Years	21	22	23	24	25	26	27	28	29	30
Fiscal Year	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**
Beginning Fund Balance	$ 31,552,523	$ 29,607,235	$ 26,208,202	$ 22,940,314	$ 19,422,811	$ 15,930,608	$ 12,351,226	$ 12,829,787	$ 13,876,010	$ 16,351,435
Resources:										
Hotel/Motel Rooms Tax 1/3	1,892,891	1,949,677	2,008,168	2,068,413	2,130,465	2,194,379	2,260,210	2,328,017	2,397,857	2,469,793
Meals Tax	3,693,261	3,840,991	3,994,631	4,154,416	4,320,593	4,493,417	4,673,153	4,860,079	5,054,483	5,256,662
Short-term Rental Tax	3,718,907	3,830,474	3,945,389	4,063,750	4,185,663	4,311,233	4,440,570	4,573,787	4,711,000	4,852,330
Property Tax Contribution	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Earnings on Investments	473,288	444,109	393,123	344,105	291,342	238,959	185,268	192,447	208,140	245,272
Existing Sewer Assessments	-	-	-	-	-	-	-	-	-	-
Assessments	11,153,816	10,450,461	11,041,203	10,474,268	9,596,023	8,649,112	8,510,276	8,040,812	7,981,324	7,920,647
User Charge Revenue	4,900,341	5,278,028	5,673,965	6,088,120	6,441,518	6,810,641	7,196,114	7,598,585	8,018,729	8,457,242
Systems Development Charge	620,000	620,000	620,000	618,000	420,000	420,000	420,000	420,000	420,000	420,000
Total Resources	29,452,504	29,413,741	30,676,479	30,811,072	30,385,604	30,117,741	30,685,592	31,013,727	31,791,533	32,621,946
Commitments:										
Staffing	1,008,764	1,049,115	1,091,079	1,134,722	1,180,111	1,227,316	1,276,408	1,327,465	1,380,563	1,435,786
Operating expenses	21,068	21,911	22,788	23,699	24,647	25,633	26,658	27,725	28,834	29,987
Other costs	202,582	210,685	219,112	227,877	236,992	246,472	256,330	266,584	277,247	288,337
Existing Debt Service Payments	-	-	-	-	-	-	-	-	-	-
Estimated Debt Service on Collection System	24,497,447	25,524,752	26,186,219	26,089,871	25,147,870	24,836,152	23,289,859	22,525,502	21,337,533	19,971,607
Estimated Debt Service on Treatment System	5,667,931	6,006,311	6,425,169	6,852,405	7,288,186	7,361,551	5,357,775	5,820,229	6,291,932	6,749,350
Other Cash Program Commitments	-	-	-	-	-	-	-	-	-	-
Total Current Year Commitments	31,397,792	32,812,773	33,944,368	34,328,575	33,877,806	33,697,123	30,207,031	29,967,503	29,316,109	28,475,067
Increase (Decrease) in Trust Fund Balance	(1,945,288)	(3,399,032)	(3,267,889)	(3,517,503)	(3,492,203)	(3,579,382)	478,561	1,046,223	2,475,425	4,146,879
Ending Trust Fund Balance	$ 29,607,235	$ 26,208,202	$ 22,940,314	$ 19,422,811	$ 15,930,608	$ 12,351,226	$ 12,829,787	$ 13,876,010	$ 16,351,435	$ 20,498,313
Project Costs	$ 30,867,399	$ 31,484,747	$ 19,698,047	$ 20,092,008	$ 20,493,848	$ 20,903,724	$ 21,321,799	$ 21,748,235	$ 22,183,200	$ 22,626,864
Cape cod & Islands Water Protection Fund subsidies	($4,012,762)	($4,093,017)	($2,560,746)	($2,611,961)	($2,664,200)	($2,717,484)	($2,771,834)	($2,827,271)	($2,883,816)	($2,941,492)
Net Bond Issue	$26,854,637	$27,391,730	$17,137,301	$17,480,047	$17,829,648	$18,186,240	$18,549,965	$18,920,964	$19,299,384	$19,685,372

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8 ENVIRONMENTAL IMPACT STATEMENT

8.1 INTRODUCTION

The purpose of this section of the report is to identify the environmental impacts of the "Recommended Plan" (as described in Sections 5 and 6). Impacts are considered for both initial project construction and long-term project operation.

The purpose of the CWMP is to address the wastewater management needs of the Town, specifically meeting the nitrogen-based TMDL regulatory requirements outlined for the Lewis Bay Watershed, Centerville River Watershed, Three Bays Watershed, Popponesset Bay Watershed and the Millway subwatershed of the Barnstable Harbor Watershed. Additional wastewater management elements considered in the Recommended Plan include protection of drinking water supplies (public and private), protection of freshwater ponds, and maintaining sanitary conditions and aesthetics. The Town has considered its wastewater management needs on a watershed-by-watershed basis and has compiled these needs into the Recommended Plan, as described in other sections of this report. Refinements to the Recommended Plan (e.g., additional effluent disposal locations, regional partnerships, etc.) will be ongoing and reported in subsequent plan updates, the first of which will be submitted in 2025.

8.2 ALTERNATIVES TO THE RECOMMENDED PLAN

The Town considered multiple alternatives to the Recommended Plan which are identified below:

- The Town considered a No Action Alternative. This alternative involves the continued reliance on private on-lot wastewater disposal systems (e.g., standard Title 5 systems which do not address nitrogen removal, surface water protection or drinking water supply protection from contaminants of emerging concern) for large areas of town and the continued reliance on the existing Barnstable Water Pollution Control Facility (BWPCF) without additional nutrient removal upgrades.
- The Town considered an alternative which would consist of all "non-traditional" projects. However, due to the high required nitrogen removal in certain watersheds it was determined that this alternative would not be able to meet the regulatory requirements (TMDLs) and therefore the Town did not proceed with this alternative. However, the Town has incorporated "non-traditional" projects in the plan to supplement the proposed sewer expansion plan.

- The Town considered an alternative which would construct multiple wastewater treatment facilities and/or “package plants” in various locations throughout the Town. However, due to the size of the Town and the high required nitrogen removal in certain watersheds, it was determined that centralized treatment would be significantly more cost effective because the Town has an existing wastewater treatment plant with sufficient physical room for expansion. Additionally, it was also determined that this alternative would not meet the regulatory requirements (TMDLs) in all watersheds without removing the nitrogen from the system (via discharge of treated effluent outside of the watershed). This alternative would also result in significantly more long term O&M costs and would require significantly more land acquisitions and/or land disturbance by the Town to build the multiple plants. For these reasons, the Town did not proceed with this alternative.
- The Town considered an alternative where all septic systems would be replaced with Innovative/Alternative (I/A) septic systems. However, it was also determined that this alternative would not meet the regulatory requirements (TMDLs) because currently approved I/A systems alone do not remove as much nitrogen as centralized treatment.
- The Town has considered inter-municipal alternatives and intends to continue discussions with neighboring communities about potential inter-municipal partnerships, specifically relative to effluent disposal options in neighboring communities. The Town has an existing wastewater treatment facility, so treatment outside of the Town limits was determined to not be cost effective, except for potentially the westernmost portion of the Town which may be treated at a future “western solution” as described in earlier sections of this report.

8.3 ASSESSMENT OF ENVIRONMENTAL IMPACTS

Impacts of the plans under consideration fall in the general categories of "direct", "indirect" and "cumulative". The direct impacts are those that occur as a direct result of either the construction of the proposed wastewater facilities, or their ongoing operation. The indirect impacts are those land use or demographic changes that eventually occur as a result of implementation of the plans, or as a consequence of taking no action. Cumulative effects result from the incremental impact of the proposed project when added to other past, present, or future actions, regardless of who undertakes those other actions.

This section of the report identifies impacts for a wide range of environmental issues. Impacts are discussed as either "short-term" (generally related to project construction) or "long-term" (generally related to on-going operations of the completed plan).

8.3.1 LAND ALTERATION

The Recommended Plan is planned, so as to limit the amount of previously undisturbed areas to be altered during construction. The majority of work proposed will be within existing disturbed areas (i.e. public roadways, private roadways, etc.) and will be reconstructed to match existing conditions. In previously undisturbed areas that will be altered (i.e. new pump stations) the projects will each be designed to limit the amount of impervious areas, while maintaining functionality. These will be planned, designed and reviewed on a per project basis. To better estimate the total previously undisturbed area to be altered, the Town has broken out the proposed pump stations by approximate size (i.e. Small, Medium, and Large) and established an estimated square footage of impervious area associated with each size. The total project anticipates five (5) "large" pump stations, nineteen (19) "medium" pump stations and sixty-two (62) "small" pump stations.

The total previously undisturbed area to be altered is calculated based on the following table:

Table 8-1: Alteration of Previously Undisturbed Area

Pump Station Size	Total Number	Impervious Area/Pump Station (SF)	Total Alteration of Previously Undisturbed area (SF)
SMALL	62	500	31,000
MEDIUM	19	1,000	19,000
LARGE	5	2,000	10,000
		TOTAL SF:	**60,000 SF or 1.4 Acres**

In addition to new pump stations, the Recommended Plan proposes the installation of 190 miles of gravity mains and forcemains throughout the Town. The estimated alteration of existing disturbed areas for the sewer main installation is broken down as follows:

Table 8-2: Alteration of Existing Disturbed Area

Total Roadway (Miles)	Avg. Road Width (ft)	Total Area of Alteration (Acres)
190	24	553

8.3.2 SURFACE WATER QUALITY

No significant negative short-term impacts on surface water quality are expected as a result of the plan implementation. Measures to mitigate erosion and sedimentation will need to be implemented during the construction of sewers or the facilities for treatment and disposal.

There are significant long-term benefits for surface water quality associated with the Recommended Plan and there are major detriments to the No Action Plan. The major driving force behind this project is the current and expected future overloading of coastal waters from wastewater-related nitrogen and the analogous wastewater-related phosphorus loading problems in selected freshwater ponds. Based on confirmatory model runs conducted by SMAST using the MEP model, the Recommended Plan will result in compliance with nitrogen-based TMDLs and will result in reduced phosphorus loadings where important to pond quality.

Additional long-term benefits of water quality improvements include improved swimming, fishing and boating activities; better environmental health with respect to eelgrass and bottom fauna; and preservation of tourism, fisheries and property values.

A potential long-term impact includes differential inter-/intra-watershed transfer. Under the proposed plan, water will be removed from some watersheds and disposed of in the same or different watersheds based on the applicable effluent disposal method (septic vs Barnstable Water Pollution Control Facility (BWPCF)) and location (BWPCF). Generally, this inter-/intra-watershed transfer volume is a relatively small percentage of the total recharge volume. Being that there are multiple water purveyors in the Town, the potential impacts on water purveyors will need to be confirmed as effluent disposal scenarios are further developed.

8.3.3 GROUNDWATER QUALITY

No short-term impacts on groundwater quality are expected as a result of the plan implementation.

The elimination of septic systems that will occur under the Recommended Plan will result in long-term improvements in groundwater quality. It is that improvement in groundwater quality that will eventually lead to better surface water quality, as groundwater moves from inland areas to coastal discharge areas, or toward ponds from tributary areas. The plan provides for sewering in Zone II water supply protection areas of several public water supply wells which will reduce threats to groundwater quality associated with nitrogen and contaminants of emerging concerns within the Zone II areas. These threats continue in a No Action Plan.

8.3.4 WETLANDS

There are mapped wetland resources within the Town of Barnstable that are adjacent to work identified in the Recommended Plan. The Town intends to locate its wastewater piping in public roadways, public rights-of-way or private roadways (with appropriate permissions, easements and/or takings) and intends to locate its wastewater pumping stations as far from wetland resource areas as feasible. None of the project work identified to date is expected to impact wetland resources directly (except for floodplains which are discussed in Section 8.3.5); however, some of the improvements may encroach on buffers around regulated wetlands. It should be noted that the majority of the proposed work (i.e. sewer gravity mains and force mains within roadways) is anticipated to be exempt from 310 CMR 10.0 per 310 CMR 10.02(2)(b) 1. & 2.j. Where projects impact wetland resource buffers, and are determined to not be exempt, the Conservation Commission will review these elements, through the submission of a Request for Determination of Applicability (RDA) or a Notice of Intent (NOI) filing. These filings will address potential impacts of the proposed work by implementation and identify any necessary mitigation measures, where appropriate. No significant short-term or long-term wetland impacts are expected under the Recommended Plan.

8.3.5 FLOODPLAINS

Portions of the Recommended Plan are located within mapped floodplains. Sewer piping will be located below grade and will be equipped with watertight covers, when within floodplains. There will be a need to locate a few private and/or public pumping stations in floodplains. However, those structures are anticipated to be small, will be designed to be flood-proofed, would pose little impact on potential floods and will not result in a significant alteration to the flood zones. Any pumping station structures located in floodplains will consider the implications of sea level rise in terms of constructed elevations. Electrical equipment and standby generators will be designed to be three feet above the 100-year flood elevation. The Town will consider limited use of low-pressure sewer systems in flood prone areas, or areas with very shallow groundwater, but intends to limit the use of low-pressure sewers to reduce the maintenance concerns to residents associated with low-pressure sewers. The Recommended Plan is not expected to have any significant short-term or long-term impacts on floodplains.

8.3.6 COASTAL RESOURCES

Coastal resources include beaches and other swimming areas, commercial/recreational shellfishing areas, and marine/estuarine habitat. Barnstable has one Area of Critical Environmental Concern (the Sandy Neck/Barnstable Harbor ACEC). No construction is anticipated in the coastal resources, although sewer construction to address nutrient loading to the Millway subwatershed in the Barnstable Harbor watershed will be close to the ACEC area.

The Recommended Plan provides protection for these resources, primarily through improved water quality. Conversely, the No Action Plan allows current water quality degradation to continue.

8.3.7 OPEN SPACE AND RECREATION

The Recommended Plan is not expected to have any direct short-term or long-term impacts on designated open space and recreation.

8.3.8 RARE AND ENDANGERED SPECIES

The Recommended Plan will include work that crosses areas that are identified as Natural Heritage and Endangered Species (NHESP) Priority and Estimated Habitats. No assessment of Massachusetts Endangered Species Act (MESA) regulatory implications has been completed to date. As noted above, the Town intends to locate its wastewater piping in public roadways, public rights-of-way or private roadways (with permissions, easements and/or takings) and intends to locate its wastewater pumping stations outside of wetlands and away from priority habitat, where feasible. The Town expects that the majority of the sewer work will be exempt from MESA review, pursuant to 321 CMR 10.14, as it will be located within existing roadways. However, the Town will conduct more detailed NHESP and MESA reviews prior to moving forward with permitting and preliminary design of Phase 1 projects as described in Section 6.2.

A copy of the SEIR will be provided to the Division of Fisheries and Wildlife.

8.3.9 ARCHAEOLOGICAL AND HISTORIC RESOURCES

As noted above, the Town intends to locate its wastewater piping in public roadways, public rights-of-way or private roadways (with permissions, easements and/or takings) and intends to locate its wastewater pumping stations directly adjacent to rights-of-ways, where feasible. The candidate project sites for sewers, pump stations, forcemains, treatment facilities and disposal sites will be reviewed against available mapping of such resources at the Massachusetts Historical Commission (MHC) prior to initiating permitting and preliminary design activities.

Areas north of Route 6 in Sandwich are within the Old Kings Highway Regional Historic District. A small portion of the sewer service area is located in this District. Above-grade structures that are to be located within the District will be designed with architectural features consistent with District standards and will be subject to the review of the Barnstable Old King's Highway Historic District Committee. The town was in contract with MHC on October 15, 2020 and confirmed that each project will be reviewed on a project-by-project basis. If there is a project component of the Town's CWMP that is deemed to have an "adverse effect", the Town will consult with MHC and the other project proponents and, as warranted, other government agencies and other interested parties. The end result of the consultation process is the developing and signing of a Memorandum of Agreement (MOA) between the Town, MHC, the state or federal funding, permitting, or licensing agency, and other participating parties as warranted. An MOA is a written agreement signed by the consulting parties. It stipulates the measures that will be taken to avoid, minimize and/or mitigate the adverse effects and states that the signatories agree to these measures. Once the stipulations of the MOA are fulfilled, MHC review is complete.

A copy of the SEIR will be provided to MHC.

8.3.10 TRAFFIC

One of the most significant direct short-term impacts of any infrastructure project is the traffic congestion resulting from construction activities in or near public and private roadways. As noted above, the Town intends to locate its wastewater piping in public roadways, public rights-of-way or private roadways (with permission, easements and/or takings) and intends to locate its wastewater pumping stations adjacent to rights-of-way, whenever possible. The Town will take a proactive approach to mitigating construction-related traffic, including the following specific concepts:

- Segment the work to avoid disruption of lengthy stretches of principal roads at any one time.
- In order to expedite the length of project disturbances, the Town will consider work during the summer construction moratorium; as long as it is determined by the Director of Public Works that doing so will not result in a significant negative impact to traffic.
- Consider night construction in areas of high traffic outside of residential areas.
- Work will be restricted on holidays and on the Friday before and the Tuesday after Monday (or Monday observed) holidays
- Consider locating wastewater piping under shared use paths or sidewalks when feasible and consistent with local planning.
- Establish a well-developed public outreach approach for residents, businesses and visitors to advise the public of anticipated traffic delays and/or detours due to construction.
- Have a focused public input approach, including the potential for weekly construction meetings, for those residents, businesses and visitors directly impacted by construction.
- Generally schedule work when traffic is less intense, when possible.

Long-term traffic impacts include the relatively small increase in vehicles trips to/from the BWPCF for normal operation and maintenance activities as well as chemical deliveries and sludge removal. Economic development needs areas may result in increased traffic due to growth in the area, which the Town will have to plan appropriate for.

8.3.11 AIR QUALITY AND DUST

Construction vehicles can be the source of added air emissions and represent a direct short-term impact. During construction, vehicles and equipment will generate emissions. The EENF Certificate recommends compliance with MassDEP's Clean Air Construction Initiative and the Massachusetts Diesel Retrofit Program (MDRP). The 2008 MDRP guidance document defines measures to mitigate construction vehicle impacts, with requirements specific to the SRF program and recommendations for those projects reviewed by MEPA. As stated in this guidance document, project construction contracts must:

- Require contractors to install an emission control device on each piece of diesel construction equipment to reduce emissions, including a diesel oxidation catalyst (DOC) or diesel particulate filter (DPF). MassDEP's SRF program specifically requires that a verified DOC be installed on the equipment, meaning the device is proven to reduce emissions via standardized testing consistent with an EPA or California Air Resources Board (CARB) program;
- As of January 2010, require the use of ultra-low sulfur diesel (ULSD) fuel [sulfur content less than 15 parts per million (ppm)] in all diesel-fired construction equipment used on MEPA reviewed projects; and
- Prohibit motor vehicle engines from idling more than five minutes (in compliance with the Massachusetts 5-minute idle law, 310 CMR 7.11), unless the engine is being used to operate a lift or refrigeration unit.

It should be noted that as of January 1, 2008, MDRP retrofit requirements for the SRF program are applicable only for construction engines 50 or more horsepower (hp) and that will be used at least 30 days on the project site; however, retrofit recommendations for projects reviewed by MEPA are not limited to engines of a particular size. The SRF program requires that contractors fill out and file with MassDEP a formal Certification of equipment retrofits.

Consistent with these requirements, the contract documents will recommend that the Contractor comply with the MDRP by having all of the Contractor's off-road (non-registered) diesel vehicles and equipment used during construction equipped, or retrofitted, with after-engine emission controls that are EPA certified or their equivalent. Additionally, the Contractor will be required to use ULSD fuel in all off-road construction equipment, and the anti-idling law will be enforced at the construction sites.

Dust from construction sites is another common source of air quality concern. The Contractor will perform dust control operations, in an approved manner, whenever a nuisance or hazard occurs or when directed by the Town or its representative, even though other work on the project may be suspended. Methods of controlling dust will meet all air pollutant standards as set forth by federal and state regulatory agencies.

- Dump trucks will be covered with tarpaulins and have tightly fitting tailgates.
- The Contractor will be required to maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.
- Dust control will be generally accomplished by the use of water. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted. Calcium chloride may be used if permitted by the Town. The use of petroleum products is prohibited.
- Sprinkling will be repeated at such intervals as to keep all parts of the disturbed area at least damp, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used.

Long-term impacts include the potential from odor releases from treatment plants and pump stations as well as air emissions from vehicles accessing any of the treatment plant and pump station sites for normal operations. None of these sources of air emissions is considered significant, since all can be subject to routine maintenance of odor control equipment.

8.3.12 NOISE

Much like air quality, noise impacts can occur both during construction and as a result of routine operation. As a direct short-term impact, construction noise is unavoidable. The Town will consider restricting work hours on construction sites near residential areas, where appropriate. The Contractors performing the work will be required to make every effort to minimize noises caused by the operations. Equipment will be recommended to be equipped with silencers or mufflers designed to operate with the least possible noise level in compliance with state and federal regulations and Town of Barnstable regulations, whichever are more stringent.

During construction, the following measures will be used to control noise: 1) loud pieces of equipment will be substituted with quieter equipment, 2) effective intake and exhaust mufflers will be used on internal combustion engines, and 3) truck loading, unloading, and hauling operations will be conducted in a manner that keeps noise and vibration to a minimum.

Pumps, blowers, standby generators, ventilation systems and other equipment emit noise at treatment plants and pump stations. All can be fitted with noise control devices that are largely successful in avoiding nuisance noise conditions. The use of earthen berms and vegetated buffers can help limit off-site noise impacts. Noise mitigation will be considered in the design phase with input from the Town.

8.3.13 STORMWATER MANAGEMENT AND EROSION CONTROL

8.3.13.1 Stormwater Management

Implementation of the Recommended Plan will result in the addition of approximately 1.4 acres of new impervious areas. Each project component will be designed to minimize the amount of impervious area required to provide functional, operational infrastructure for the Towns municipal sewer system. The majority of the new impervious area will be due to construction of the required pump stations to convey wastewater to the WPCF. Any new impervious area will be treated on-site and will not flow/connect into the Town's stormwater system (or municipal sewer system) and will be designed in accordance with the latest editions of the Massachusetts Stormwater Management Standards.

8.3.13.2 Erosion Control

During construction, temporary erosion control measures will be warranted to avoid sediment migration and impact to water quality and nearby wetlands. The Contractor's responsibilities as defined in the specifications for each construction contract will include the following items, broken down into regulatory and pre-construction provisions and other water quality and sedimentation/erosion prevention provisions.

8.3.13.3 Regulatory and Pre-construction Provisions

- Necessary permits required for proper execution of the project will be obtained prior to commencement of work. A copy of each permit will be submitted to the Town and the Town will maintain records of all permits.
- The Contractor will apply for and obtain a Construction General Permit from EPA pursuant to the National Pollutant Discharge Elimination System (NPDES) program, when necessary. The permit requires preparing and submitting a Notice of Intent (NOI) for Storm Water Discharges and Notice of Termination Form and preparation of a Storm Water Pollution Prevention Plan (SWPPP).
- The Contractor will prepare an Erosion and Sedimentation Control Plan and submit to the Engineer for review and approval. Once approved by the Town, the Contractor will incorporate the Erosion and Sedimentation Control Plan into the SWPPP.
- The Contractor will update the Erosion and Sedimentation Control Plan and the SWPPP as necessary so that the documents are always current in accordance with the NPDES regulations and describe erosion and sediment control and storm water pollution prevention at all locations of construction and for all activities of construction.The Contractor will submit a dewatering plan for review and approval by Town Staff and

Conservation Commission (where appropriate) prior to the start of work. The plan will include the methods and discharge points proposed to be used by the Contractor. The Contractor will be required to retain the services of a Professional Engineer registered in Massachusetts to prepare dewatering and drainage system designs and submittals.

- The Contractor will submit the location of proposed stockpile areas to Town Staff and the Conservation Commission (where appropriate) for approval prior to the start of work.
- When applicable, the requirements of any applicable Barnstable Conservation Commission Order of Conditions will be followed.
- When applicable, the Contractor will have a copy of the Order of Conditions and the approved SWPPP and Erosion and Sedimentation Control Plan on-site at all times.

8.3.13.4 Other Water Quality and Sedimentation/Erosion Prevention Provisions

- The Contractor will take sufficient precautions during construction to mitigate the run off of polluting substances such as silt, clay, fuels, oils, bitumen and calcium chloride into the supplies and surface waters of the state. Special precautions will be taken in the use of construction equipment to prevent operations which promote erosion.
- Disposal of drainage will be in an area approved by the Town. Drainage will not be disposed of until silt and other sedimentary materials have been removed. Particular care will be taken to prevent the discharge of unsuitable drainage to a water supply, surface water body, or other resource area.
- When excavating in adjacent to wetlands or floodplain, where no temporary diversion structure is required, excavated material will be placed on the uphill side of the trench so that the trench serves as a barrier between the excavated material and the wetland or floodplain.
- Erosion and sedimentation control will be installed prior to site preparation activities. The Contractor will be required to contact the Town to inspect siltation controls prior to excavation.
- All work will be scheduled and conducted in a manner that will minimize the erosion of soils in the area of the work. Erosion control measures will be provided as required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc.
- Offsite surface water will be diverted around the site, to a downstream channel ahead of siltation barriers. Ditches around construction areas will also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches will be backfilled and the ground surface restored to original condition.
- Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in a surface water body, will not be directly returned to the water body. Such waters will be diverted through a settling basin or filter before being directed into water bodies.

- The Contractor will not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm water. Water from dewatering operations will be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels. Dewatering hose intakes will be kept off the bottom of the trench to minimize the pumping of silt.
- The Contractor will be required to repair any damage caused by dewatering and drainage system operations.
- Existing or new sanitary sewers will not be used to dispose of drainage.
- Crushed stone for sediment filtration devices, access ways and staging areas will conform to Mass Highway Department "Standards and Specifications for Highways and Bridges" Section M2.01.3.
- Erosion control measures will be placed in/around catch basins that discharge into wetlands, water supply or surface water bodies.
- Straw mulch will be utilized on all newly graded areas to protect areas against washouts and erosion.
- Staging areas and access ways, which in the opinion of the Town will erode due to truck traffic, will be surfaced with a minimum depth of 4 in of crushed stone.
- The Contractor will visually inspect all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, the Contractor will promptly install additional devices as needed. Sediment controls in need of maintenance will be repaired promptly.
- Where silt fence is used, accumulated sediment will be removed once it builds up to 1/2 of the height of the fabric. Damaged fabric will be replaced or patched with a 2 feet minimum overlap. Other repairs will be made as necessary to ensure that the fence is filtering all runoff directed to the fence.
- In cross country areas, if applicable, brush and stumps will not be removed and the ground surface will not be disturbed until no more than one week prior to the start of pipe laying in that area.
- Loaming and seeding or mulching of cross-country areas will take place as soon after laying the pipeline as practicable.
- Temporary mulch will be applied to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days.
- Once the site has been fully stabilized against erosion, sediment control devices and all accumulated silt will be removed and disposed of in a proper manner.
- All preventative measures will be taken to avoid the spillage of petroleum products and other pollutants. Routine vehicle and equipment maintenance and refueling will only occur in designated areas located more than 100-feet from wetland resource areas. At

each staging area, spill clean-up equipment (shovels, brooms, absorbent pads and materials) will be maintained for use in the event of an accidental spill.

- All fuel, oil, solvents, etc. will be stored in original containers or in containers manufactured for storing such material that are clearly labeled as to the contents of the container. Fuel, oil and other potentially hazardous materials will be kept secured in a locked storage locker designed and properly vented for storing such material. Copies of Safety Data Sheets (formerly "MSDSs") for all applicable materials will be maintained at the construction site and will be readily accessible for employees or inspection officials.
- The Contractor will immediately clean up any and all spills of fuel, oil, or other potentially hazardous materials. Any and all reportable spills will be reported to the proper authorities (Local Fire Department, Board of Health, MassDEP, and others as applicable).

8.3.14 WASTE MATERIAL

8.3.14.1 Materials Management, Construction Debris, Solid Waste and Recycling

Since the proposed project primarily involves the construction of new pipelines and facilities, limited demolition will be involved. The following requirements will be included in the specifications with regards to materials handling, storage, cleanup, and disposal, to mitigate environmental impacts:

- Provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter.
- During the course of the work, keep the site of operations in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.
- Excavated material will be segregated for use in backfilling provided the material meets the requirements for its intended use.
- It is expressly understood that no excavated material will be removed from the site of the work or disposed of, except as directed by the Engineer. When removal of surplus materials has been approved by the Engineer, dispose of such surplus material in approved designated areas.
- Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material will be hauled and stored at a location provided. When required, it will be re handled and used in backfilling the trench.
- All debris and excess material will be disposed of in an environmentally sound manner. Dumping or disposal of debris or excess material in any stream corridors, any wetlands,

any surface waters, any floodplains or at unspecified locations is prohibited. Discharging of solid waste deleterious to any public or private property not specified for said purpose is prohibited.

- Storing construction equipment and vehicles and/or stockpiling construction materials at locations not previously specified and approved by the Town for said purposes is prohibited.
- Dumping, disposing, or stockpiling of any material at any location within the Town of Barnstable without approval of the Town is prohibited.
- Burning at the project site for the disposal of refuse and debris or cleared and grubbed materials will not be permitted.
- All pieces of ledge and boulders which are not suitable for use in other parts of the work will be removed and disposed of in an approved manner.
- Surplus imported fill will be removed and disposed off-site.
- The Contractor will either be, or employ the services of a Subcontractor, who is licensed in the Commonwealth of Massachusetts to perform asbestos abatement where applicable. All work associated with the handling of asbestos cement pipe will be conducted only by the licensed party.

8.3.14.2 Management of Hazardous Materials

The following mitigation measures will be employed to address potential impacts associated with subsurface contamination throughout the project area and will be included in the contract specifications:

- Excavated materials will be managed in accordance with applicable Massachusetts Contingency Plan (MCP) requirements. These provisions include identification of contaminated materials, segregation, proper stockpiling or containment, and sampling and analysis to determine the appropriate facility for reuse, recycling, or disposal of these materials.
- Dewatering discharges will be managed in accordance with MCP requirements, including identification of contaminated groundwater, proper containment and pretreatment, and required sampling and analysis.
- The Contractor will submit a Hazardous Material Health and Safety Plan detailing procedures and protocols to protect workers and the general public from potential hazards during the construction work.
- The Contractor will submit an Emergency Response Plan detailing procedures to address the discovery of hazardous materials that could pose an imminent hazard to workers and the public, and procedures to address emergencies that involve fires and/or explosions.

- Hazardous materials management activities will be conducted under the supervision of a Licensed Site Professional (LSP) in accordance with MCP Utility-Related Abatement Measure or Immediate Response Action provisions, as appropriate.

8.3.15 EXISTING VEGETATION

During the construction process, clearing of existing vegetation will be required to make room for some of the wastewater treatment and/or pumping structures. The extent of clearing will be minimized to that required to construct and permanently operate the facility; areas outside of this limit of construction will be preserved in their natural state. Disturbed areas will be re-vegetated with the same or similar species as were initially present except in cases where supplemental vegetation is desired for visual or noise buffers for adjacent properties. Protecting existing vegetation will be given careful consideration during the permitting and design phase of specific projects.

8.3.16 ENERGY AND GREENHOUSE GAS EMISSIONS

Refer to Appendix UU for the Greenhouse Gas Emission Analysis.

8.3.17 GENERATION OF SOLID WASTE FROM WASTEWATER

All treatment plants, regardless of size and location, generate solid wastes in the form of grit, screenings and excess biosolids. These solids wastes will be disposed of in accordance with local, state and federal laws.

All properties that continue to be served by on-site septic system will continue to have septage pumped and disposed of off-site in accordance with local, state and federal laws. The WPCF will continue to accept septage.

Both the Recommended Plan and the No Action Plan will result in the continued and increased transport and treatment of septage sludges. While there will be a decrease in the volume of septage sludge under the Recommended Plan, there will be an increase in the volume of wastewater treatment sludge. Generation of solid waste is considered neutral between the Recommended Plan and the No Action Plan. It should be noted that the WPCF's Solids Handling Facility is being rehabilitated in Phase 1 of the Plan in order to allow the Town to continue to manage the solids waste generated at the WPCF and from septic system pumping trucks.

8.3.18 PUBLIC HEALTH

All properties that continue to be served via on-site septic systems will be managed in accordance with Massachusetts Title 5. Public health issues are considered neutral between the Recommended Plan and the No Action Plan.

8.3.19 COMMUNITY GROWTH AND LAND USE

If the community does not take proactive actions, the construction of public sewers could allow for unintended growth. The Town intends to mitigate the potential for unintended growth through the implementation of smart zoning. That will require closely coordinating growth and wastewater flow projections with the Local Comprehensive Plan, which is currently being updated (last published in 2010). In certain areas, this may include the implementation of flow-neutral, or net-flow-neutral, regulations consistent with the requirements of the DEP 0% SRF loan requirements. Given this approach, no significant indirect impacts are expected related to community growth or development of land beyond what would occur under the No Action Plan.

8.3.20 ADAPTATION TO CLIMATE CHANGE

Refer to Appendix TT for a detailed discussion on the approach to climate change adaptation.

The Town's beaches and coastal marshes represent a significant component of the town's character. The Town will need to continue to monitor climate science and climate change guidance issued by the Commonwealth. The Town will need to continue activities such as long-term beach and marsh monitoring, and long-term beach nourishment. The Town will consider the following modifications to the planning and permitting processes to manage development is vulnerable areas. The Town is actively studying the implications of sea level rise on the discharge capacity of the Barnstable WPCF rapid infiltration basins.

8.4 IMPLICATIONS OF A "NO ACTION PLAN"

In addition to significant regulatory issues, and potential legal challenges, the No Action Plan will result in continued deterioration of surface water quality (coastal estuarine and freshwater ponds), continued reliance on septic system discharges within Zone II public water supply protection areas and other sensitive areas, restrictions on targeted economic development in planned growth areas, and the potential for reductions in property values in the long-term. The economy of Town of Barnstable, like the rest of Cape Cod, is heavily reliant on seasonal tourism, which is attracted to the community to enjoy the picturesque natural water bodies. Continued degradation to these natural resources would have a crippling long-term impact on the community. The Town of Barnstable considers the "No Action Plan" highly undesirable, irresponsible and certainly inconsistent with the Local Comprehensive Plan of the Town and the Cape Cod community at large.

9 DRAFT SECTION 61 FINDINGS

The purpose of this Section is to identify and present Draft Section 61 Findings and mitigation measures for the CWMP/SEIR. The SEIR is required as part of the Certificate of the Secretary of Energy and Environmental Affairs to include a separate chapter summarizing proposed mitigation measures and Draft Section 61 Findings for each permit or other approval to be issued by State Agencies. The Draft Section 61 Findings need to contain a clear commitment to implement mitigation, and identification of the parties responsible for implementing the mitigation and a schedule for implementation.

9.1 PERMITTING AND APPROVALS

There are numerous regulatory programs with permitting and approval requirements that apply to the planning, design and implementation of the Recommended Plan. These include:

- Department of Environmental Protection (DEP) regulatory review and approval of the CWMP.
- Massachusetts Environmental Policy Act (MEPA) review, which requires an Environmental Notification Form (previously submitted) and an Environmental Impact Report (this document).
- Cape Cod Commission (CCC) review under the 208 Plan Consistency Review requirements.
- Massachusetts Natural Heritage and Endangered Species Program (pursuant to the Massachusetts Endangered Species Act), Massachusetts Division of Fisheries and Wildlife, Massachusetts Wetland Protection Act, and Massachusetts Historical Commission reviews need to be conducted. These reviews will be conducted on a project-by-project basis.
- DEP Groundwater Discharge Permits for the existing WPCF facility and new treatment and disposal sites under 314 CMR 5.0. A groundwater discharge permit is required for each treatment facility and its associated effluent disposal site(s).
- DEP Reclaimed Water Permit for potential effluent reuse site(s) under 314 CMR 20.0. Reclaimed water permits are required for treatment facility(s) and associated effluent reuse site(s).
- Potential DEP Watershed Permits for watersheds with TMDLs, if determined to be necessary by DEP to ensure compliance with the TMDL reports.
- DEP Plan Review for proposed traditional wastewater infrastructure, once plans and specifications have been prepared.

- DEP Site Assignment under MGL Chapter 83, Section 6 and 310 CMR 16.00 for any new publicly-owned wastewater treatment and disposal site.
- Massachusetts Department of Transportation (DOT) Highway Access Permit approvals for construction in State roads.
- Activities must be consistent with the Area of Critical Environmental Concern (Sandy Neck/ Barnstable Harbor ACEC), where applicable.
- Activities must be consistent with the requirements of the Old Kings Highway Regional Historic District, where applicable.
- Activities must be consistent with the permits and requirements of the Town's Planning Board, Conservation Commission and Historic District Commission.
- The Town must issue building permits for treatment facilities and pumping stations after compliance with the State Building Code is demonstrated.

Compliance with these programs must be demonstrated at various stages of project development, and will be evaluated on a project-by-project basis as described in the Special Review Procedures in Section 6.2.

The assessment of impacts to the environment as they pertain to the Recommended Plan are discussed in Section 8 of this CWMP/SEIR and the resulting planned mitigation measures are discussed below in Section 9.2. The following section outlines the mitigation commitments, and may be used as the basis of development of Section 61 Findings for Federal and/or State permits necessary for construction and operation of the Recommended Plan.

All mitigation measures will be funded and implemented by the Town of Barnstable, its agents, representatives and/or contractors. Any State agency actions required above will be coordinated and implemented by the Town of Barnstable or its agents. The program, including implementation of mitigation measures, will be managed and overseen by the Town of Barnstable Department of Public Works.

9.2 MITIGATION MEASURES

As part of the EIR process outlined in the MEPA regulation (301 CMR 11.07), the following mitigation measures were identified. These measures were identified to limit negative environmental impacts and/or create positive environmental impacts during development and operation of the preferred plan. Project specific mitigation measures and associated costs are anticipated to be identified and implemented on a project-by-project basis. However, general mitigation measures that will be implemented for each type of project are described below.

9.2.1 Sewer Expansion Project Mitigation Measures

The sewer expansion program is, at its core, a mitigation measure which the Town will implement to improve the water quality within the impaired embayments of the Town. This section identifies construction phase mitigation measures which will be employed in order to mitigate potential temporary environmental impacts related to construction.

- General Regulatory Considerations
  - For each project, Town staff and/or consultant will meet with regulatory agencies early in the design phase to identify appropriate permitting requirements and mitigation measures. Regulatory agencies that will be met with to discuss appropriate permitting requirements and mitigation measures include, but are not limited to: Conservation Commission, Division of Fisheries & Wildlife (including NHESP review), MassDOT, Massachusetts Historical Commission, Local Historical Commissions, and MassDEP.
  - Sewer infrastructure will be designed to minimize impacts to environmental resources as described in Section 8.3.
- Traffic
  - Detailed traffic management plans will be developed for each project.
  - In order to reduce the duration of construction and associated traffic disturbances, the Town will consider work during the summer construction moratorium; as long as it is determined by the Director of Public Works that doing so will not result in a significant negative traffic impacts for residential and commercial areas.
  - Consider night construction in areas of high traffic outside of residential areas, subject to approval of the Director of Public Works.
  - Work will be restricted on holidays and on the Friday before and the Tuesday after Monday (or Monday observed) holidays, unless otherwise approved by the Director of Public Works.
  - Establish a well-developed public outreach approach for residents, businesses and visitors to advise the public of anticipated traffic delays and/or detours due to construction.
- Land Disturbances
  - Sewer infrastructure will be designed to be within existing roadways or disturbed/developed areas to the extent practical.
  - Pump station sites, will be designed to minimize new land disturbance and impervious areas.
  - Stormwater BMPs will be installed to mitigate any new impervious surfaces. BMPs will be designed in accordance with the Massachusetts Stormwater Management Standards and applicable Town Regulations.
  - Additionally, the Town will consider stormwater BMPs at existing wastewater facilities, where land and funds are available, in order to mitigate the existing impervious surfaces.
- Greenhouse Gas Emissions (GHG), Air Quality and Dust Control

- Pump station will be designed to consider the implementation of energy efficient design features to reduce energy use and minimize GHG release.
- Designs will consider opportunities for on-site energy generation, such as solar photovoltaic (PV) systems, where appropriate.
- Project specifications will be developed to require the contractors to perform work consistent with MassDEP's Clear Air Construction Initiative and the Massachusetts Diesel Retrofit Program and will incorporate limitations on contractor equipment idling.
- Project specifications will be developed to require the contractor to control dust during construction.

- Aesthetics
  - Above grade wastewater infrastructure, specifically pump stations, will be designed to be consistent with the neighborhood aesthetics. Vegetative screes will be employed if necessary for aesthetic purposes.

- Noise
  - The Town will restrict work hours to "normal working hours" on construction sites near residential areas, except under unusual or emergency situations.
  - Project specifications will recommend that the contractor's equipment be equipped with silencers or mufflers designed to operate with the least possible noise level in compliance with state and federal regulations and Town of Barnstable regulations, whichever are more stringent.
  - Contractor's truck loading, unloading, and hauling operations will be conducted in a manner that keeps noise and vibration to a minimum.
  - Pump stations will be designed with noise prevention measures to minimize noise from pumps, blowers, standby generators, ventilation systems and other equipment that has the potential to emit noise.

- Wetland Resource Areas and Floodplains
  - No direct impact to wetland resource areas are anticipated, except for floodplains.
  - The majority of the proposed work (i.e. sewer gravity mains and force mains within roadways) is anticipated to be exempt from 310 CMR 10.0 per 310 CMR 10.02(2)(b) 1. & 2.j.
  - Where projects impact wetland resource buffers, and are not exempt, the Conservation Commission will review these elements, through the submission of a Request for Determination of Applicability (RDA) or Notice of Intent (NOI) filing, and address potential impacts by implementation of standard mitigation measures.
  - Sewer piping will be located below grade, within previously disturbed roadways, and will be equipped with watertight covers, when within floodplains.

    - Pump stations located in floodplains will be designed to be flood-proofed, would pose little impact on potential floods and will not result in a significant alteration to the flood zones. Any pumping station structures located in floodplains will consider the implications of sea level rise in terms of constructed elevations. Electrical equipment and standby generators will be designed to be three feet above the 100-year flood elevation.

- Resiliency and Climate Change
    - Project designs will consider resiliency and climate change as described in Appendix TT.

- Stormwater and Erosion Controls
    - Necessary permits required for proper execution of the project will be obtained prior to commencement of work. A copy of each permit will be submitted to the Town and the Town will maintain records of all permits.
    - Any new impervious area will be treated on-site and will not flow/connect into the Town's stormwater system (or municipal sewer system) and will be designed in accordance with the latest editions of the Massachusetts Stormwater Management Standards.
    - The Contractor will apply for and obtain a Construction General Permit from EPA pursuant to the National Pollutant Discharge Elimination System (NPDES) program, when necessary. The permit requires preparing and submitting a Notice of Intent (NOI) for Storm Water Discharges and Notice of Termination Form and preparation of a Storm Water Pollution Prevention Plan (SWPPP).
    - The Contractor will prepare an Erosion and Sedimentation Control Plan and submit to the Engineer for review and approval. Once approved by the Town, the Contractor will incorporate the Erosion and Sedimentation Control Plan into the SWPPP.
    - The Contractor will update the Erosion and Sedimentation Control Plan and the SWPPP as necessary so that the documents are always current in accordance with the NPDES regulations and describe erosion and sediment control and storm water pollution prevention at all locations of construction and for all activities of construction. The Contractor will submit a dewatering plan for review and approval by Town Staff and Conservation Commission (where appropriate) prior to the start of work. The plan will include the methods and discharge points proposed to be used by the Contractor. The Contractor will be required to retain the services of a Professional Engineer registered in Massachusetts to prepare dewatering and drainage system designs and submittals.
    - The Contractor will submit the location of proposed stockpile areas to Town Staff and the Conservation Commission (where appropriate) for approval prior to the start of work.

- When applicable, the requirements of any applicable Barnstable Conservation Commission Order of Conditions will be followed.
- When applicable, the Contractor will have a copy of the Order of Conditions and the approved SWPPP and Erosion and Sedimentation Control Plan on-site at all times.
- The Contractor will take sufficient precautions during construction to mitigate the run off of polluting substances such as silt, clay, fuels, oils, bitumen and calcium chloride into the supplies and surface waters of the state. Special precautions will be taken in the use of construction equipment to prevent operations which promote erosion.
- Disposal of drainage will be in an area approved by the Town. Drainage will not be disposed of until silt and other sedimentary materials have been removed. Particular care will be taken to prevent the discharge of unsuitable drainage to a water supply, surface water body, or other resource area.
- When excavating in adjacent to wetlands or floodplain, where no temporary diversion structure is required, excavated material will be placed on the uphill side of the trench so that the trench serves as a barrier between the excavated material and the wetland or floodplain.
- Erosion and sedimentation control will be installed prior to site preparation activities. The Contractor will be required to contact the Town to inspect siltation controls prior to excavation.
- All work will be scheduled and conducted in a manner that will minimize the erosion of soils in the area of the work. Erosion control measures will be provided as required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc.
- Offsite surface water will be diverted around the site, to a downstream channel ahead of siltation barriers. Ditches around construction areas will also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches will be backfilled and the ground surface restored to original condition.
- Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in a surface water body, will not be directly returned to the water body. Such waters will be diverted through a settling basin or filter before being directed into water bodies.
- The Contractor will not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm water. Water from dewatering operations will be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels. Dewatering hose intakes will be kept off the bottom of the trench to minimize the pumping of silt.

- The Contractor will be required to repair any damage caused by dewatering and drainage system operations.
- Existing or new sanitary sewers will not be used to dispose of drainage.
- Crushed stone for sediment filtration devices, access ways and staging areas will conform to Mass Highway Department "Standards and Specifications for Highways and Bridges" Section M2.01.3.
- Erosion control measures will be placed in/around catch basins that discharge into wetlands, water supply or surface water bodies.
- Straw mulch will be utilized on all newly graded areas to protect areas against washouts and erosion.
- Staging areas and access ways, which in the opinion of the Town will erode due to truck traffic, will be surfaced with a minimum depth of 4 in of crushed stone.
- The Contractor will visually inspect all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, the Contractor will promptly install additional devices as needed. Sediment controls in need of maintenance will be repaired promptly.
- Where silt fence is used, accumulated sediment will be removed once it builds up to 1/2 of the height of the fabric. Damaged fabric will be replaced or patched with a 2 feet minimum overlap. Other repairs will be made as necessary to ensure that the fence is filtering all runoff directed to the fence.
- In cross country areas, if applicable, brush and stumps will not be removed and the ground surface will not be disturbed until no more than one week prior to the start of pipe laying in that area.
- Loaming and seeding or mulching of cross-country areas will take place as soon after laying the pipeline as practicable.
- Temporary mulch will be applied to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days.
- Once the site has been fully stabilized against erosion, sediment control devices and all accumulated silt will be removed and disposed of in a proper manner.
- All preventative measures will be taken to avoid the spillage of petroleum products and other pollutants. Routine vehicle and equipment maintenance and refueling will only occur in designated areas located more than 100-feet from wetland resource areas. At each staging area, spill clean-up equipment (shovels, brooms, absorbent pads and materials) will be maintained for use in the event of an accidental spill.
- All fuel, oil, solvents, etc. will be stored in original containers or in containers manufactured for storing such material that are clearly labeled as to the contents of the container. Fuel, oil and other potentially hazardous materials will be kept secured in a locked storage locker designed and properly vented for storing such

material. Copies of Safety Data Sheets (formerly "MSDSs") for all applicable materials will be maintained at the construction site and will be readily accessible for employees or inspection officials.
    - The Contractor will immediately clean up any and all spills of fuel, oil, or other potentially hazardous materials. Any and all reportable spills will be reported to the proper authorities (Local Fire Department, Board of Health, MassDEP, and others as applicable).

- Waste Management
    - Provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter.
    - During the course of the work, keep the site of operations in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.
    - Excavated material will be segregated for use in backfilling, provided the material meets the requirements for its intended use.
    - All debris and excess material will be disposed of in an environmentally sound manner. Dumping or disposal of debris or excess material in any stream corridors, any wetlands, any surface waters, any floodplains or at unspecified locations is prohibited. Discharging of solid waste deleterious to any public or private property not specified for said purpose is prohibited.
    - Storing construction equipment and vehicles and/or stockpiling construction materials at locations not previously specified and approved by the Town for said purposes is prohibited.
    - Dumping, disposing, or stockpiling of any material at any location within the Town of Barnstable without approval of the Town is prohibited.
    - Burning at the project site for the disposal of refuse and debris or cleared and grubbed materials will not be permitted.
    - All pieces of ledge and boulders which are not suitable for use in other parts of the work will be removed and disposed of in an approved manner.
    - Surplus imported fill will be removed and disposed off-site.
    - The Contractor will either be, or employ the services of a Subcontractor, who is licensed in the Commonwealth of Massachusetts to perform asbestos abatement where applicable. All work associated with the handling of asbestos cement pipe will be conducted only by the licensed party.
    - Dewatering discharges will be managed in accordance with MCP requirements, including identification of contaminated groundwater, proper containment and pretreatment, and required sampling and analysis.

- The Contractor will submit a Hazardous Material Health and Safety Plan detailing procedures and protocols to protect workers and the general public from potential hazards during the construction work.
- The Contractor will submit an Emergency Response Plan detailing procedures to address the discovery of hazardous materials that could pose an imminent hazard to workers and the public, and procedures to address emergencies that involve fires and/or explosions.
- Hazardous materials management activities will be conducted under the supervision of a Licensed Site Professional (LSP) in accordance with MCP Utility-Related Abatement Measure or Immediate Response Action provisions, as appropriate.

9.2.2 Treatment Plant Project Mitigation Measures

- Perhaps the most significant mitigation measure that will be undertaken at the WPCF is the planned denitrification improvements which will reduce the nitrogen concentrations in the treated effluent to an anticipated concentration of 3 mg/L.
- All improvements at the WPCF will take place on previously developed areas within the WPCF property.
- All improvements at the WPCF will consider the implementation of energy efficient design features to minimize GHG release, as discussed in the GHG evaluation in Appendix UU.
- Projects will consider opportunities for further on-site energy generation, such as PV systems, where appropriate.
  - It should be noted that the WPCF already implements on-site energy generation including an 819 kW PV array and two 100 kW wind turbines.
- The WPCF's Solids Handling Facility is being rehabilitated in Phase 1 of the plan in order to allow the Town to continue to manage the biosolids waste generated at the WPCF and from off-site residential and commercial septic systems in Barnstable (via pumper trucks).
- As described in the Special Review Procedures in Section 6.2.2, the Town is actively evaluation WPCF expansion options. WPCF expansion projects will be submitted for review as a Notice of Project Change to this CWMP. Mitigation measures will be identified during the Notice of Project Change process.

9.2.3 Effluent Disposal Expansion Mitigation Measures

- As described in the Review Procedures in Section 6.2.3, the Town is actively evaluating options for effluent disposal expansion. Effluent disposal expansion will be submitted for review as a Notice of Project Change to this CWMP. Mitigation measures will be identified during the Notice of Project Change process to reflect the proposed effluent disposal expansion technique/technology and site specific concerns.

9.2.4 Non-Traditional Projects Mitigation Measures

- As described in the Review Procedures in Section 6.2.4, the Town is actively considering non-traditional projects as a means to potentially refine future phases of this CWMP. Non-traditional measures and/or modifications to the CWMP resulting from the non-traditional measures will be submitted for review as a Notice of Project Change to this CWMP. Mitigation measures will be identified during the Notice of Project Change process to address the unique impacts of the particular non-traditional project.

10 RESPONSE TO COMMENTS

This section addresses comments received on the January 2020 Barnstable Comprehensive Wastewater Management Plan Expanded Environmental Notification Form. The first section of comments addressed are those contained in the April 3, 2020 Certificate issued by MEPA. The following sections include responses to comments contained in the comment letters received from various regulatory agencies during the EENF review period.

Each comment is presented below in italics and is a direct quote from the Certificate or the applicable comment letter. Responses are provided below each comment in bold font. Most comments concerns are addressed in the body of this CWMP/SEIR in more detail, and reference is made below to the applicable sections where supplemental information can be found.

10.1 MEPA EENF CERTIFICATE – APRIL 3, 2020

1. *The Single EIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this Scope.*

   The Single EIR (SEIR) has been prepared per Section 11.07 of the MEPA regulations as modified by the scope in the April 3, 2020 Certificate.

2. *The Single EIR should identify and describe any changes to the project since the filing of the EENF and provide an update on State, local and federal permitting.*

   Section 2.4 identifies and describes the changes to the project since the filing of the EENF as well as progress that has been made in the planning and design of certain aspects of the project. There has been no update regarding State, local and federal permitting for this project since the filing of the EENF.

3. *The Single EIR should include an executive summary, it should identify significant environmental benefits and impacts, and measures that will be taken to avoid, minimize and mitigate adverse impacts.*

   An executive summary has been provided.

4. *The Single EIR should describe the planning process that has occurred to date, and the proposed schedule for the remaining phases of planning, design, environmental permitting and review, and construction.*

   Section 4 of the SEIR describes the planning process that has occurred to date that led to the formulation and development of the CWMP/SEIR. The program is a three phase, 30 year plan which will include the planning, design, environmental permitting/review and construction of dozens of projects. The approach to how each type of project will be planned, designed, permitted and constructed is

described in the Special Review Procedures in Section 6.2. Furthermore, the Implementation Plan/Schedule for Phase 1 (first ten years) of the program is described in detail in Section 6.

5. *Include maps that show where sewer lines, cross-country easements, pumping stations, and other facilities will be located, to the extent it is available when the Single EIR is submitted.*

   Figures depicting a conceptual schematic design of the proposed sewer collection system expansion have been provided in Appendix VV and WW. These figures are planning level figures, developed from Town GIS data, and depict a conceptual layout of sewer piping (with anticipated flow directions) and approximate pump station locations. Sewer collection system design and final pump station sites will be further vetted during the design development of each project.

6. *The Single EIR should discuss the state permitting process for this project and describe how it will meet all applicable performance standards*

   The first step in the state permitting process for the Town's CWMP is MEPA approval of this SEIR, which will allow the Town to begin executing the projects that make up the program. Each project that will be executed as part of this program will present unique permitting requirements. Section 6.2 of the SEIR describes the state and local permitting process for each type of project which will be executed through this program.

7. *Early coordination with MassDEP during preparation of the Single EIR as requested in the agency's comments.*

   The Town met with MassDEP Southeast Regional Office staff a number of times during the development of the recommended plan and prior to the submission of the EENF. The Town met remotely with Brian Dudley and Andrew Osei from MassDEP Southeast Regional Office on August 13, 2020 to review MassDEP's comments to the EENF and to discuss, in detail, the preparation of the SEIR. The Town will continue to regularly meet with MassDEP staff during the execution of the program and will submit an adaptive management plan update every five years to MassDEP, which will document the project's progress.

8. *The Single EIR should provide a conceptual description of non-traditional nitrogen reduction measures that it intends to implement through demonstration projects assist to achieve the nitrogen removal, including, in addition to water quality benefits, a conceptual description of environmental impacts and mitigation measures to the extent this can be identified at this stage.*

   Non-traditional solutions are discussed in several sections throughout the CWMP. The locations of the information are provided in the following list:

   - **The description of non-traditional solutions is provided in Section 2.3.2;**
   - **Discussion of the anticipated efficacy of non-traditional technologies is included in Section 3.2.2;**

- **Approach to non-traditional technologies as it pertains to the CWMP Adaptive Management is provided in Section 4.2;**
- **Implementation of non-traditional solutions through the phased sewer expansion of the Three Bays watershed is provided in Section 5.2.4.2;**
- **Non-traditional solution monitoring is described in Section 6.4.3;**
- **Permitting approach for non-traditional solutions is described in Section 6.2.4.**

The Town has presented a CWMP that addresses nutrient removal requirements (TMDLs) with traditional solutions alone. However, the Town does intend to incorporate various non-traditional solutions. These non-traditional solutions are expected to be implemented in Phase 1 of the program. The Town will then monitor the performance/results of these solutions over a 5-10 year period, thus establishing their benefit. With the benefits firmly established, the Town anticipates seeking relief from MassDEP from an equivalent amount of traditional nitrogen removal (sewers) contained in the later phases (Phase 3) of the plan.

The Town's CWMP anticipates implementation of non-traditional solutions to be focused primarily within the Three Bays Watershed, with a major focus on reducing the nitrogen load within the Marston's Mills River system. The report provides a summary of the non-traditional solutions anticipated to be further evaluated within the Three Bays Watershed, potential environmental impacts, mitigation measures, and permitting requirements to the extent they are understood at the time of the preparation of this report.

The Town will provide an update on non-traditional solution projects in the 5-year Adaptive Management Plan update, detailing any development of initial monitoring, permitting, environmental impacts, and mitigation measures realized at that time. Generally, the non-traditional solutions monitoring plans will be long-term (5-10 years) to firmly establish the nutrient removal before requesting nitrogen credit (sewers) from the DEP. Many of these non-traditional solutions will depend on long term water quality monitoring stations that were established during the Massachusetts Estuaries Project, as well as new stations, as necessary. Evaluation of the non-traditional solutions will specifically relate to the site of the non-traditional solution to evaluate nutrient removal effectiveness and sustainability of the solution.

9. *The Single EIR should provide more detail about the water quality embayment monitoring program described under the Preferred Alternative, including the general approach to be used, how it will be implemented, monitoring locations, and water quality parameters to be measured.*

   Section 6.4 has been revised to provide more detail about the water quality embayment monitoring program, including the general approach utilized, how the monitoring program will be implemented, monitoring locations and water quality parameters to be measured.

10. *The Single EIR should address how the monitoring program will be designed to evaluate the effectiveness of non-traditional treatment options.*

Section 6.4.3 of the SEIR addresses how the monitoring program will be designed to evaluate the effectiveness of the non-traditional treatment solutions.

11. *The Single EIR should provide updates on opportunities for wastewater planning on a regional scale identified in the EENF, including its coordination with Bourne, Falmouth, Mashpee and Sandwich to establish nutrient loadings and discussions related to the potential use of the JBCC wastewater facility.*

There have been no significant updates relative to opportunities for wastewater planning on a regional scale since the submission of the EENF.

12. *Any projects or activities within the Camp Edwards Wildlife Management Area, including but not limited to any potential upgrades to or expansion of existing wastewater treatment facilities, would require review and approval by the NHESP.*

The Town acknowledges that any potential projects or activities within the Camp Edwards Wildlife Management Area, included but not limited to any potential upgrades to or expansion of existing wastewater treatment facilities, would require review and approval by NHESP.

13. *The Single EIR should provide a detailed description of the Town's proposed Adaptive Management Plan (AMP) and its water quality monitoring program in the Town of Barnstable.*

The Town's proposed Adaptive Management Plan is described in Section 6.5. The Town's water quality monitoring program is described in Section 6.4.

14. *The Single EIR should provide an estimate of the total amount of alteration associated with the proposed project in greater detail than what was provided in the EENF (including areas to be altered for sewer mains, pump station impacts, and other project components).*

Section 8.3.1 estimates the total amount of alteration associated with the proposed CWMP.

15. *The Single EIR should include a breakdown showing the amount of alteration for different project elements.*

Subsection 8.3.1 provides a breakdown of the amount of alteration for the construction of proposed pump station as well as proposed sewer mains (i.e. gravity and force mains).

16. *The Single EIR should clarify the location, type and amount of alteration in previously undisturbed areas.*

See response to Comment #15.

17. *The Single EIR should clarify the amount of new impervious area associated with the construction of the components of the Town's CWMP.*

See response to Comment #15.

18. *The Single EIR should describe how the Town's proposed stormwater management system will be designed and constructed to be consistent with MassDEP's stormwater management regulations and policy standards and avoid and minimize adverse impacts associated with any new impervious area.*

Section 8.3.13 discusses how projects will be designed in accordance with the latest edition of the Massachusetts Stormwater Standards.

19. *The Single EIR should describe proposed measures to manage stormwater during project construction.*

Section 8.3.13 addresses how stormwater will be managed during project construction.

20. *The Single EIR should identify parcels located within the proposed sewer service areas that are undeveloped or that have development constraints due to the lack of sewers, and compare the potential secondary growth impacts that may be induced by public sewers with local and regional growth management policies and zoning.*

The demand and potential for additional growth is addressed is Sections 2.2.5 and 2.2.6 of the CWMP. The Town of Barnstable has a long and progressive history of aligned efforts to plan for responsible growth, sustainable economic development, and preservation and protection of our natural, cultural, and historic resources. These efforts continue today, including a planned effort to update the Town's Local Comprehensive Plan over the next two years.

Residentially zoned properties outside of Hyannis and Barnstable Villages are subject to the Town's "Resource Protection Overlay District" a zoning overlay that imposes a two acre minimum lot area requirement for newly created lots. The rate of development for lots at this density is unlikely to be impacted by the presence of sewers versus Title V. In general, the lack of sewers is not a primary development constraint in these areas, with the rare exception of lots that are unable to support a Title V system as a result of high groundwater or other factors. Further, residential growth is controlled by a Town-wide growth management ordinance, which caps the number of building permits issued annually to 96 market-rate residential dwelling units.

Properties within the proposed sewer service areas for which the lack of sewers is a more prominent development constraint are those areas which are non-residentially zoned. Such parcels (see Figure 10-1), if served by public sewers, may have the potential under current zoning to assume additional growth. These areas include:

- **Areas including the Yarmouth Road triangle, Hyannis Harbor lots, and areas on Route 132 and the Industrial Park are included in the proposed service areas in support of additional development. Additional development in these areas is contemplated by local and regional land use plans and**

economic development objectives. Other supporting infrastructure, including water, roadway, and transit infrastructure is available to support additional growth.

- **Some commercial areas, including those in Centerville Village and the western part of town along Route 132 have restrictive commercial zoning and are largely built-out. The potential for additional growth in these areas is limited.**
- **Non-residentially zoned areas on Route 28 in Centerville and in Osterville are more likely to see development interest. The Centerville commercial zoning was recently amended to allow for multi-family housing and a broader range of commercial uses. These areas are also served by other infrastructure. Recent proposals to expand commercial areas beyond the current boundaries were rejected, citing the need for additional planning. Downtown Osterville has a permissive regulatory environment; however the area is small in geographic scope, already significantly developed, characterized by small lots, and does not allow multi-family development. These factors highly limit overall development potential, making any potential sewer induced growth limited in the scope of the overall plan.**

21. *The Single EIR should examine what regulatory or physical constraints would remain on home expansions after sewers are constructed, and whether such expansions might have unanticipated impacts on estimated wastewater flows and water use.*

All residential development is constrained by current bulk, dimensional, and in some cases coverage requirements that limit individual home expansions. Residential development on small lots (less than 10,000 sq.ft) is further constrained by zoning limitations. Development and redevelopment in sensitive areas, specifically the Craigville Beach District of Regional Planning Concern, is also highly limited.

In general, the average single-family home size is 3 bedrooms. The opportunity for sewer induced home expansions does exist within some portions of the sewer expansion areas. Overall, however, the cumulative impact of these expansions in comparison to the scope of the plan is anticipated to be minimal.

22. *The Single EIR should identify areas of impacts to wetland resource areas and describe mitigation measures. It should address the project's compliance with appropriate standards of the Wetlands Regulations (310 CMR 10.00).*

Section 8.3.4 addresses impacts on wetland resource areas, describes mitigation measures and compliance with standards of 310 CMR 10.00.

23. *The Single EIR should also delineate on a plan of reasonable scale all environmental resources areas located within areas proposed for sewering, including wetlands, drinking water supplies, sensitive habitats, fisheries, designated Areas of Critical Environmental Concern (ACEC), Article 97 lands, historic resources, and agricultural lands.*

Refer to Appendix VV and WW for 500 scale figures showing the conceptual sewer overlaid on the various resource areas discussed above.

24. *Where it has been demonstrated that impacts are unavoidable, the Single EIR should demonstrate that the impacts have been minimized, and that adequate mitigation will be pursued.*

    Refer to Section 8.3 for the assessment of environmental impacts and mitigation measures.

25. *The Single EIR should include information on which future phases of the CWMP are located in Chapter 91 jurisdictional areas or landlocked tidelands subject to a Public Benefits Determination by the Secretary of EEA.*

    Based on review of MassGIS layers for Chapter 91 jurisdictional areas and landlocked tidelands subject to Public Benefits Determination by the Secretary of EEA, it does not appear that any of the proposed sewer expansion projects will involve work within these areas.

26. *I ask that the Town continue to work closely with NHESP and consult with the Barnstable Conservation Commission during the preparation of this section of the Single EIR.*

    The Town met remotely with Jesse Leddick, Chief of Regulatory Review for Massachusetts Division of Fisheries & Wildlife on August 28, 2020 to review the comments provided by the Division on the EENF. Other topics discussed during this meeting were the preparation of the SEIR, approach towards permitting of the various types of project contained in the CWMP, and progress on prior discussions with Division staff regarding the Mill Pond Dredge project.

27. *The Single EIR should identify necessary project construction and post-construction conditions and commitments to avoid an adverse impact to resource area habitats of state-listed species located within and adjacent to the project areas.*

    Due to the vastness of the project, it will be necessary to review necessary project construction and post-construction conditions and commitments on a project by project basis. It is anticipated that the majority of the sewer expansion projects will be exempt from MESA review as the work will be contained within existing disturbed roadways. However, certain aspects of the sewer expansion projects may be subject to MESA review and Section 6.2 describes the review procedures that will be undertaken to determine if projects are subject to MESA review. Non-traditional projects will be reviewed with MESA staff early in the project planning in order to determine permitting requirements and discussion commitments to avoid adverse impacts to resource habitats of state-listed species, where applicable.

28. *The Single EIR should report on the results of the Town's consultations with NHESP.*

    Discussions with Massachusetts Division of Fisheries & Wildlife during the preparation of the SEIR are described above in the response to Comment #26.

29. *If sufficient detail is not available to conduct a full evaluation of all phases, the Town should propose procedures in the SRP to enable a review of rare species impacts as appropriate during future phases of the CWMP buildout plan.*

    Section 6.2 outlines the Special Review Procedures that will be taken for each type of project to ensure a review of rare species impacts, as appropriate, during future projects included in the CWMP. These procedures were discussed with NHESP staff during the remote meeting held on August 28, 2020 as discussed above in the response to Comment #26.

30. *Any proposed upgrades to or expansions of the wastewater treatment facilities would require review by the NHESP for compliance with the MESA that because they are located within Priority Habitat. The Single EIR should address applicability of any permitting requirements by NHESP.*

    The Barnstable WPCF is not located within a mapped Priority Habitat and therefore upgrades to treatment facilities at the facility are not expected to require NHESP review. Proposed effluent disposal facilities may require NHESP review if the selected sites are located within a mapped Priority Habitat. At this time, proposed effluent disposal facilities have not been identified.

31. *MassDEP also requests that the Town investigate and permit additional wastewater sites in parallel with the wastewater treatment upgrades planned Phase 1.*

    Section 5.3.2 describes the Town's progress the date relative to securing expanded effluent disposal facilities. The Town understands that expansion of treatment capacity at the WPCF cannot occur without expansion of effluent disposal capacity.

32. *The Town should continue consulting with MassDEP and present the results of the discussion in the Single EIR.*

    Refer to the response to Comment #7.

33. *The Single EIR should include any identified upgrades and or modifications of the wastewater treatment facilities through Phase 1, and, to the extent future upgrades are anticipated, either provide details on those upgrades or a process by which they could be reviewed through the SRP if relevant thresholds are met or exceeded***.**

    Section 5.3.1 identifies required upgrades/modifications to treatment processes at the Barnstable WPCF to support the sewer expansion plan. In addition, Section 6.2 identifies the anticipated special review procedures for upgrades/modifications to treatment processes that are anticipated to be completed to support the program.

34. *The Single EIR should review alternative locations for system components, such as pump stations, including locations outside the floodplain.*

    The sewer expansion plan will require the installation of infrastructure within floodplains in order to serve properties within these areas. To the extent possible, the Town will make efforts to locate critical infrastructure such as pump stations, outside (above) floodplains. However, it will not feasible to locate all infrastructure outside of floodplains. Design techniques that the Town will employ in order to

maximize resiliency of infrastructure required to be located within floodplains are further described in Section 8.3.5 and Appendix TT.

In 2019 the Town retained Wright Pierce to perform a comprehensive Pump Station Evaluation of the 27 existing pump stations in the collection system. The evaluation identifies a number of resiliency improvements for the existing pump stations. One of the identified projects is the relocation of the existing Rendezvous Lane Pump Station, which is located adjacent to Barnstable Harbor, within the floodplain, and has experienced flooding during coastal storm events in recent years. The Town is currently under contract for the construction of a relocation of the existing Rendezvous Lane Pump Station, which will move the station and associated infrastructure away from Barnstable Harbor and 3 feet above the 100-year flood elevation. The project also includes adding a standby generator to the station. The project is scheduled to be completed in the Spring of 2021.

35. *The Single EIR should identify design features that could increase the resiliency of the proposed infrastructure under future sea level conditions.*

    Section 8.3.5 and Appendix TT identifies design features that will increase the resiliency of the proposed infrastructure under future sea level conditions.

36. *The Single EIR should discuss climate resiliency considerations made in designing and implementing other components of the CWMP, including the siting and construction of new sewer mains.*

    Appendix TT discusses climate resiliency considerations that will be made in the design and implementation of all components of the CWMP, including the siting and construction of new sewer mains.

37. *The Single EIR should include a more project-specific GHG evaluation of emissions associated with modification to the WWTF and any other facilities, such as pump stations, that may emit GHG.*

    Appendix UU includes a project-specific GHG evaluation of emissions associated with modifications to the WWTF and the construction of facilities which may emit GHG. The Town met with MEPA staff on August 13, 2020 to review the scope of the GHG evaluation. Based upon this discussion, on August 14, 2020 the Town's consultant (Wright Pierce), presented a proposed scope to MEPA staff via email. On August 21, 2020, MEPA staff approved the scope of the GHG evaluation via email. The GHG evaluation has been prepared based upon this approved scope.

38. *It should establish a Base Case and an as-proposed Preferred Alternative Case along with providing the other information required by the Policy*.

    The GHG evaluation provided in Appendix UU presents a Base Case and a Preferred Alternative Case. As discussed above in the response to Comment #37, the GHG evaluation scope was reviewed and approved by MEPA staff prior to preparation.

39. *The Single EIR should review energy-efficient alternatives identified in the reports cited above and indicate whether the Town will adopt the measure or not, and provide a rationale for the decision.*

    Refer to the GHG evaluation in Appendix UU.

40. *The Single EIR should review opportunities for onsite energy generation, including biogas and solar photovoltaic (PV) systems. The Town should consult with MEPA staff before completing this analysis.*

    Refer to the GHG evaluation in Appendix UU.

41. *The Town should provide MHC with a US Geological Survey topographical map that clearly locates the phased project areas and scaled project plans showing existing and proposed conditions. These plans should be submitted to MHC as early as possible during the design phase corresponding to each of the proposed project development phases.*

    The Town was in contact with John Patton with MHC on October 15, 2020. Mr. Patton is the assigned reviewer for the Town's CWMP. He confirmed that MHC will review each project on a "per project" basis. The Town will submit a project notification form to MHC for each project.

42. *The Town should continue to coordinate with MHC to ensure review of any potential historic impacts from the project and the Single EIR should provide an update on the status of these discussions.*

    See response to comment #41.

43. *If MHC deems the project to have an "adverse effect" on historic or archaeological resources, the Single EIR should include a discussion of mitigation measures that the Town will undertake to address the adverse effect.*

    Section 8.3.9 discusses the process the town will take on projects deemed to have an "adverse effect" on historic or archeological resources.

44. *The Town should consult with MassDOT to confirm what elements of the project will require approval.*

    The Town met virtually with MassDOT District 5 Staff on August 24, 2020 to review the project. The Town understands that the portions of the project that are within State Highways will require a State Highway Access Permit. The sewer expansion plan proposes sewer infrastructure in portions of the roadways under State jurisdiction: Route 28, Route 132 and portion of Phinney's Lane immediately south of Route 132.

45. *The Single EIR should identify areas subject to MassDOT review, describe potential project impacts in those areas, and identify mitigation measures.*

    Refer to response to Comment #44.

46. *Construction period impacts and mitigation measures should be described in the Single EIR***.**

Section 8.0 discusses both "direct" and "indirect" impact that the construction of the CWMP will have as well as mitigation measures that the town intends to implement to minimize these potential impacts.

47. *The Single EIR should describe impervious areas to be created by the project and review alternatives for minimizing new impervious surfaces.*

Section 8.3.1 breaks down the impervious areas to be created by the proposed CWMP. These new impervious areas are generally associated with new pump stations as described in SEIR. With each proposed project, the Town will review each site to allow for the minimum amount of impervious surface required to construct a functional site. In addition, the Town will consider surfacing options for site access in lieu of paved driveways, where appropriate.

48. *The Single EIR should identify sedimentation and erosion control measures to be used during construction.*

As noted in Section 8.3.13, construction project will incorporate sedimentation and erosion control measures to minimize erosion during construction activities. This will be accomplished by use of erosion controls (i.e. straw wattles, silt fence, silt sacks, etc.) as well temporary seeding for stabilization, and stabilization fabric if necessary. Most of the work proposed as part of the CWMP will be completed within the roadway layout and disturbance of undeveloped land will be minimal. The Town of Barnstable Town Code, Article VII, Section 801-40 Erosion Control Measures, will be adhered to on each project, as well as erosion control standards for NPDES and each project will have individual Stormwater Pollution Prevention Plans (SWPPS) prepared on a project by project basis.

49. *The Single EIR should describe any stormwater best management practices (BMPs) to be constructed to offset new impervious area.*

As noted in Section 8.3.1 it is anticipated that the overall increase in new impervious area for the full build-out of the Town's CWMP will be approximately 1.4 acres of new impervious area. To offset any new impervious area, the Town will design BMP's to assure that there will be no net increase in offsite peak flow rates or volumes. The BMP's will be designed to increase groundwater infiltration as well pretreatment technologies as required by the current Massachusetts Stormwater Regulations.

50. *The Single EIR should include a separate chapter summarizing proposed mitigation measures. This chapter should also include draft Section 61 Findings for each permit or other approval to be issued by State Agencies.*

See Section 9 for proposed mitigation measures and draft Section 61 Findings.

51. *The Single EIR should contain clear commitments to implement these mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and a schedule for implementation.*

    Refer to Section 9.

52. *The Single EIR should clearly indicate which mitigation measures will be constructed or implemented based upon project phasing to ensure that adequate measures are in place to mitigate impacts associated with each phase.*

    Refer to Section 9.

53. *The Single EIR should contain a copy of this Certificate and a copy of each comment letter received.*

    A copy of the Secretary's Certificate and a copy of each comment letter received for the EENF are provided in Appendix AAA.

54. *The Single EIR should include direct responses to comments to the extent that they are within MEPA jurisdiction.*

    This Section provides direct responses to comments and/or reference to the section of the SEIR where the appropriate information to address the comments can be found.

55. *The Proponent should circulate the Single EIR to those parties who commented on the EENF, to any State Agencies from which the Proponent will seek permits or approvals, and to any parties specified in section 11.16 of the MEPA regulations.*

    The Town has submitted a copy of the SEIR to all parties who have comments on the EENF, to all State agencies that the Town will seek permits or approvals from, and to all parties specified in Section 11.16 of the MEPA regulations. A list of parties who the SEIR has been submitted to is provided in the SEIR.

56. *A copy of the Single EIR should be made available for review at the Barnstable public library.*

    A copy of the SEIR will be made available for review at the Osterville Library.

10.2 COMMENT LETTER FROM MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

1. *The Project Proponent should review 310 CMR 10.02(2)(b) 1. & 2.j. prior to preparing and submitting any Notices of Intent.*

    The Town will review 310 CMR 10.02(2)(b) 1 & 2.j during the design development of each portion of the program in order to determine applicability of 310 CMR, prior to preparing and submitting any Notices of Intent. As described in Section 6.2, the Town will consult with the Town's Conservation Department, as necessary, to confirm determinations of applicability of 310 CMR to the proposed work.

2. *For the engineering report, rather than Projecting required upgrades through the next 5-year permit term, MassDEP advises the Town to include any identified upgrades and or modifications of the facility through Phase 1 in accordance with Barnstable's DCWMP.*

   The engineering report that is required to be prepared prior to the renewal of the Groundwater Discharge Permit for the Barnstable WPCF will evaluate and identify any required upgrades or modifications of the facility through Phase 1, rather than the next 5-year permit term.

3. *"Depending on the timing of the design and permitting of critical upgrades or modifications that could expand discharge capacity, the Town should consider submission of a WP11 in lieu of a WP12 permit application. MassDEP can be flexible with the submission date of the permit renewal, within reason, to simplify permit renewal and potential plan approval reviews."*

   The Town will work in close consultation with MassDEP during the design and permitting of critical upgrades or modification that could expand discharge capacity and will consider submission of a WP11 in lieu of a WP12 permit application as appropriate.

4. *MassDEP considers it imperative that the Town's plan prioritize its stated intent to investigate and permit additional wastewater sites in parallel with the wastewater treatment upgrades planned Phase 1.*

   The Town agrees that the successful resolution of expanded effluent disposal facilities is critical to the successful completion of the Plan. Section 5.3.2 describes the work done to date relative to this issue.

5. *The Town should continue to work towards a "western solution" to address the respective needs of Popponesset Bay and the Three Bays embayments. The Town should continue to consider alternative partnerships and solutions to assure the Town meets the TMDLs and water quality needs in those embayments.*

   The Town intends to continue to work towards a "western solution" and to continue to consider alternative partnerships and solutions to assure that the Town will meet the TMDLs and water quality needs in the Three Bays and Popponesset Bay embayments. Updates on these efforts will be described in the 5-year adaptive management plan.

6. *The CWMP states that the remaining load (in the Three Bays Watershed) can be addressed through non-traditional approaches; however, there should be a conventional contingency plan provided in the event that the non-traditional approaches do not produce the desired results.*

   The Town has expanded the proposed sewer expansion area in the Three Bays Watershed. SMAST has verified, using the MEP model, that this expanded proposed sewer expansion area in the Three Bays Watershed will achieve the TMDL requirements within the Three Bays. Refer to Appendix SS for the memorandum summarizing the model update.

7. *The Town should work with MassDEP to form a water quality-monitoring plans and discuss the sustainability of the proposed water quality effects. At the minimum, monitoring plans should consider use of nearby monitoring station locations used for the MEP.*

   Refer to Section 6.4 for discussion on the Town's monitoring plan.

8. *The Town should develop a monitoring plan for MassDEP approval for the Sampson's Island Dredging Project to estimate the nitrogen attenuation impact of the Project moving forward.*

   As of the writing of this report, the Town is working with MassDEP to develop an agreed upon monitoring plan for the Sampson's Island dredging project.

9. *Table 2-3 indicates that Threshold TN Concentrations for the Barnstable Harbor Sentinel Station is "To Be Determined". The MEP Report indicates that the threshold concentration is the average of the bioactive nitrogen concentrations at Stations BM-11, BM-13, and BSH-4 and is set at 0.16 mg/L. The additional sentinel station in the Millway (as shown in Figure VIII-3 of the MEP Report) has a threshold concentration of 0.21 mg/L.*

   The table has been corrected.

10. *In Section 2.2.1.2, it mentions that the 208 Plan Update identifies stormwater contributing 23% of the controllable nitrogen load to the Three Bays watershed. This is a significantly higher figure than identified in the MEP report for this watershed. The difference in the numbers should be explained or reconciled.*

    The text has been corrected.

11. *In general, the discussion about stormwater should discuss how stormwater improvements, particularly in leaching catch basins, may or may not treat for total nitrogen.*

    Text in the report has been updated.

12. *The Town should consult with MassDEP's Air Quality section to determine if there are any permitting requirements for the proposed replacement and additional generators.*

    The Town reached out via email to Thomas Cushing of the MassDEP Air Quality Section on August 25, October 28, and November 2, 2020 but was unable to schedule a meeting prior to the submission of this report.

13. *On Page 2-23 there is a typographical error in the last line of the first paragraph stating "Error! Reference Source not found".*

    This typographical error has been corrected.

14. *On Figure 2-12: Nitrogen Hot Spots, most of the Town is not color coded. Perhaps this figure could be better described.*

Additional text has been added to Figure 2-12 indicating white areas represent average nitrogen loading conditions. A more detailed explanation is provided below:

Nitrogen loading (grams per day) for each parcel centerpoint were calculated from water usage data from 2011 to 2016. The ArcGIS Spatial Analyst "Optimized Hot Spot Analysis" tool was then used to identify statistically significant high and low values. This output was then converted into a raster image using the ArcGIS Spatial Analyst "Kernel Density" tool, which is symbolized by standard deviations (n=2.5.) from red (hot) to white (neutral) to blue (cold). Large areas without coloring should be interpreted as white, neither a hot or a cold spot.

The figure functions just like a temperature map on a news broadcast, though it highlights statistically significant high and low value areas within the sample (not relative to some established standard value). The interpolation tools mentioned above produce numeric outputs for each raster grid cell, but those values become effectively unit-less in the process.

15. *In Section 5.2.1.1.1 Nutrient Removal, the reference should be to Appendix QQ.*

    The reference has been corrected.

16. *In Table 5-5, is there an update on the status of Mary Dunn, Campground and Aunt Betty's Ponds?*

    Table 5-5 refers to work completed in the ponds study report by SMAST in 2017. This study of additional ponds in Barnstable did not include an analysis on Mary Dunn, Campground, and Aunt Betty's Ponds.

17. *MassDEP requests that all non-road diesel equipment rated 50 horsepower or greater meet EPA's Tier 4 emission limits, which are the most stringent emission standards currently available for offroad engines. If a piece of equipment is not available in the Tier 4 configuration, then the Proponent should use construction equipment that has been retrofitted with appropriate emissions reduction equipment. Emission reduction equipment includes EPA-verified, CARB-verified, or MassDEP approved diesel oxidation catalysts (DOCs) or Diesel Particulate Filters (DPFs). The Proponent should maintain a list of the engines, their emission tiers, and, if applicable, the best available control technology installed on each piece of equipment on file for Departmental review.*

    Section 8.3.11 discusses measures that will be implemented throughout the CWMP construction projects to address emissions from construction equipment.

18. *MassDEP requests that the Proponent install permanent signs limiting idling to five minutes or less on-site.*

    Section 8.3.11 discusses measures that will be implemented to address idling during construction. Permanent signs will be challenging as each project will included miles of sewer infrastructure, however the anti-idling will be enforced at each construction site.

19. *MassDEP recommends that the Proponent review the data and recommendations in the 2011 Massachusetts Climate Change Adaptation Report issued by the Executive Office of Energy and Environmental Affairs (EEA) (http://www.mass.gov/eea/docs/eea/energy/cca/eea-climate-adaptation-report.pdf), the 2014 National Climate Assessment, specifically the Northeast region section, (https://nca2014.globalchange.gov/) and the 2017 U.S. Global Change Research Program Climate Science Special Report (https://science2017.globalchange.gov/) to address potential climate change impacts and adaptation measures feasible for implementation on the Project site. MassDEP also recommends that you check the following link for updates to the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (https://resilientma.com/updates/).*

    These documents have been reviewed and have been considered in the preparation of the SEIR. Refer to Appendix TT for detailed discussion on these topic of climate adaptation and resiliency.

20. *The Proponent should consider the potential impacts of climate change as part of the planning, design and operation of the proposed expansion of the Headworks Facilities and upgrade of the WWTF.*

    The Town will consider potential impacts of climate change for all project components, including the WPCF upgrades.

10.3 COMMENT LETTER FROM MASSACHUSETTS DIVISION OF FISHERIES AND WILDLIFE

1. *Construction of New Sewer Infrastructure*

    The Division notes that wastewater collection systems proposed within Priority Habitat may be exempt from MESA review pursuant to 321 CMR 10.14 (6) and (10), which state that "the following Projects and Activities shall be exempt from the requirements of 321 CMR 10.18 through 10.23…"

    [6] construction, repair, replacement or maintenance of septic systems, private sewage treatment facilities, utility lines, sewer lines or residential water supply wells within existing paved areas and lawfully developed and maintained lawns or landscaped areas, provided there is not expansion of such existing paved, lawn and landscaped areas;

    [10] installation, repair, replacement, and maintenance of utility lines (gas, water sewer, phone, electrical) for which all associated work is within ten feet from the edge of existing paved roads…

    The complete list of MESA filing exemptions may be found on the Division's website. We would encourage the Town to examine design alternatives which avoid and minimize impacts to Priority Habitat, including re-use of existing paved, developed and/or landscaped areas wherever possible. For any proposed work within Priority Habitat, the Town should proactively consult with the Division to confirm whether proposed work is exempt from MESA review or will require review through a direct filing with the Division.

The Town anticipates that the majority of the sewer expansion program will be exempt from MESA review as the Town intends to install the sewer infrastructure within existing roadways. As discussed in the special review procedures outlined in Section 6.2, Town staff will proactively consult with Division of Fisheries and Wildlife Staff during the early design stages of each project that is adjacent to mapped Priority Habitats to confirm if the proposed work is exempt from MESA review or will require review through a direct filing with the Division.

2. *Modifications to Existing Barnstable Water Pollution Control Facility (BWPCF)*

   The Division notes that the Town's existing wastewater treatment facility does not appear to be located within the Priority Habitat of state-listed rare species, as indicated in the Massachusetts Natural Heritage Atlas (14th Edition). Therefore, the Division anticipates that any proposed upgrades to the BWPCF would not require review for compliance with MESA.

   This is the Town's understanding as well.

3. *New Discharge Sites*

   The ENF states that a new effluent disposal site(s) will need to be identified, permitted and constructed to accommodate flows from proposed sewer areas. As provided above, any new effluent disposal site(s) proposed within Priority Habitat would require review for compliance with the MESA. The Division encourages the Town to examine alternative locations for the proposed disposal site(s) that are located outside of, or that otherwise avoid and minimize disturbance within, Priority Habitat. For any proposed work within Priority Habitat, the Division would encourage the Town to contact the Division in advance of a formal filing to proactively address any rare species concerns and discuss potential MESA permitting pathways.

   The Town will consult with MESA prior to commencing the permitting process of any proposed work described within the CWMP that is within a Priority Habitat.

4. *Joint Base Cape Cod*

   The ENF states that Barnstable, Bourne, Falmouth, Mashpee and Sandwich are conducting a regional evaluation of wastewater discharge options on Joint Base Cape Cod (JBCC). Specifically, the ENF also states that the Towns are discussing the possibility of utilizing the existing wastewater treatment facility at JBCC – which currently consists of a treatment plant and four infiltration basins northwest near the Cape Cod Canal – as regional facility.

   The Division notes that, with the exception of the treatment plant itself, the existing JBCC wastewater treatment facilities and their surrounds appear to be located within Priority Habitat. Any proposed upgrades to or expansions of these facilities would require review by the Division for compliance with the MESA.

   In addition, the Division notes that the four existing infiltration basins at JBCC near the Cape Cod Canal are located within the Camp Edwards Wildlife Management Area. Chapter 47 of the Acts of 2002 transferred the care, custody and control of the norther 15,000 acres of JBCC to the Division as the Camp Edwards Wildlife Management Area *to conserve fish and wildlife resources for the benefit of the citizens of the Commonwealth. Any proposed projects or activities within the Camp Edwards Wildlife Management Area, including but not limited to any potential upgrades to or expansion of the existing wastewater treatment facilities, would require review and approval by the Division.*

The Town should contact the Division as soon as possible to discuss this proposal. In advance, we request that the Town provide more detailed information about this proposal to the Division for review, including but not limited to whether it would include upgrades to or expansion of existing JBCC effluent disposal facilities. In advance, we request that the Towns evaluate alternative locations for this proposal that avoid and minimize work within Priority Habitat.

If this proposal advances further, the Town and/or project partners will contact the Massachusetts Division of Fisheries and Wildlife to discuss the proposal.

5. *Cotuit Cut / Sampson's Island Dredging*

   The Division reviewed and determined (October 6, 2009) that this project, as proposed, would not result in a Take of state-listed species. Therefore, the Division has no additional comments on this project at this time.

   No response necessary

6. *Non-Traditional Approaches for Marstons Mills River System: Mill Pond Dredging*

   The ENF states that the Town will pursue dredging of Mill Pond as a component of its non-traditional approaches to nutrient management. The Division notes that Mill Pond is mapped as Priority Habitat for a state-listed fish species. Based on a review of information submitted to the Division to date and information currently contained in our database, the Division anticipates that the project, as proposed, will likely result in a Take (321 CMR 10.18 (2)(b)) of state-listed species. Projects resulting in a Take of state-listed species may only be permitted if they meet the performance standards for a Conservation and Management Permit (CMP; 321 CMR 10.23). In order for a project to quality for a CMP, the applicant must demonstrate that the project has avoided, minimized and mitigated impacts to state-listed species consistent with the following performance standards: (a) adequately assess alternatives to both temporary and permanent impacts to the state-listed species; (b) demonstrate that an insignificant portion of the local population will be impacted; and (c) develop and agree to carry out a conservation and management plan that proves a long-term net benefit to the conservation of the state-listed species.

   The Town has been consulting with the Division to proactively address state-listed species concerns and MESA permitting associated with this project. Coordination and consultant with the Division remain ongoing at this time. As the MESA review process for this project remains ongoing, no work or activities associated with this project may occur until the Division has made a final decision relative to the CMP.

   The Town will continue to consult with Division of Fisheries and Wildlife staff to proactively address state-listed species concerns and MESA permitting associated with the Mill Pond Dredging Project. The Town understands and acknowledges

that no work or activities associated with this project may occur until the Division has made a final decision relative to the CMP.

10.4 COMMENT LETTER FROM MASSACHUSETTS DEPARTMENT OF TRANSPORTATION

1. *The Public/Private Development Unit (PPDU) has reviewed the Expanded Environmental Notification Form (EENF) for the Barnstable Comprehensive Wastewater Management Plan in Barnstable. The town-wide sewer expansion project consists of adding 190 miles of new sewer main and several above-ground pump station structures.*

   The project will require a Non-Vehicular Access Permit from MassDOT. The new sewer lines will run along and cross state highways Route 132 and Route 28, and the state jurisdictional portions of Route 6A and Phinney's Lane. Though the new sewer lines will not generate traffic, temporary traffic impacts related to the construction of the project may occur. Accordingly, the proponent should develop a Traffic Management Plan (TMP) to be reviewed and approved by MassDOT. The proponent may also with to adopt a Temporary Traffic Control Plan (TTCP), to be developed consistent with FHWA and MassDOT guidelines.

   MassDOT recommends that no further environmental review be required based on transportation issues. The details of the above and any other access-related issues can be addressed during the permitting process for the project

   The Town understands and acknowledges that any work within State Highway Layouts will require a Non-Vehicular Access Permit from MassDOT.

10.5 COMMENT LETTER FROM CAPE COD COMMISSION

Commission staff believes the ENF sufficiently details the scope of the Town's Plan and addresses the appropriate environmental issues that will be addressed through subsequent MEPA review. Further, staff supports the Town's request for and the Secretary's grant of a Single EIR, as the ENF describes and analyzes a wide variety of alternatives, provides sufficient environmental baseline information, and includes planning and design to avoid environmental impacts. The overall purpose of the Plan is to protect or improve a variety of natural resources from environmental degradation: coastal waters, freshwater ponds and drinking water supplies.

The Cape Cod Commission reserves further substantive comments for later stages of MEPA review. Commission staff have consulted with and provided comments to the Town as the Town has developed the Plan. Ultimately, after MEPA review concludes, the Cape Cod Commission will review the Plan to determine its consistency with Section 208 Area-wide Water Quality Plan for Cape Cod.

The Town will seek a 208 Consistency Determination from the Cape Cod Commission after the completion of MEPA review.

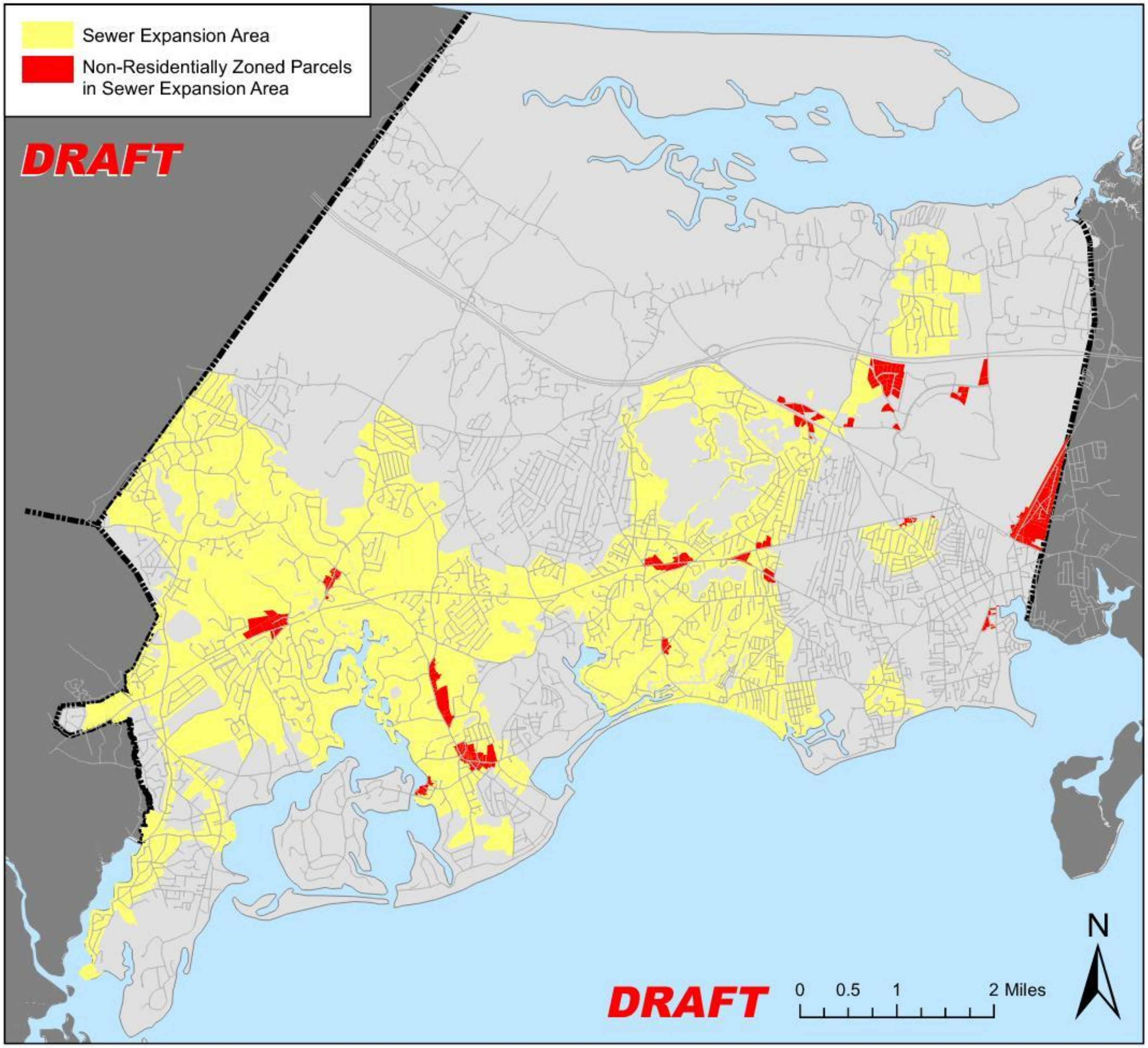

Figure 10-1: Sewer Phases- Non Residential Zoning

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