Town of Barnstable, Massachusetts

Comprehensive Wastewater Management Plan

Volume 1: Report Text, Tables and Figures

January, 2020

Comprehensive Wastewater Management Plan

Barnstable, Massachusetts

Prepared by:

Barnstable Department of Public Works

382 Falmouth Road

Hyannis, MA 02601

COMMONWEALTH OF MASSACHUSETTS
ROBERT R. STEEN
CIVIL
No. 48499
REGISTERED
PROFESSIONAL ENGINEER

14 JAN 2020

COMMONWEALTH OF MASSACHUSETTS
DANIEL W. SANTOS
CIVIL
No. 39223
REGISTERED
PROFESSIONAL ENGINEER

1-14-20

January, 2020

COMMONWEALTH OF MASSACHUSETTS
PHILIP GRIFFIN BEAUDOIN
CIVIL
No. 52237
REGISTERED
PROFESSIONAL ENGINEER

1/14/20

The Town of Barnstable
Department of Public Works
382 Falmouth Road, Hyannis, MA 02601
508.790.6400

Daniel W. Santos, P.E.
Director

Robert R. Steen, P.E.
Assistant Director

January 30, 2020

RE: Town of Barnstable Comprehensive Wastewater Management Plan
Revised Environmental Notification Form

Dear ENF Recipient:

As required by MEPA regulations, you recently received a copy of the Town of Barnstable's Environmental Notification Form for the Town's Comprehensive Wastewater Management Plan. On behalf of the Town of Barnstable we are pleased to submit the attached revised Environmental Notification Form. The revised form has been prepared to address comments on the Town's January 15, 2020 submission which we received from MEPA staff during a phone call on January 21, 2020.

This form should replace the previous form which you received. No changes have been made to any of the previous attachments. Please feel free to contact me with any questions regarding this document.

Sincerely,

Daniel W. Santos, P.E.

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Massachusetts Environmental Policy Act (MEPA) Office

Environmental Notification Form

For Office Use Only
EEA#: ________________
MEPA Analyst: ____________

The information requested on this form must be completed in order to submit a document electronically for review under the Massachusetts Environmental Policy Act, 301 CMR 11.00.

Project Name: Barnstable Comprehensive Wastewater Management Plan (CWMP)		
Street Address: Town-Wide		
Municipality: Barnstable	Watershed: Multiple (see report)	
Universal Transverse Mercator Coordinate	Latitude: Town-wide Longitude: Town-wide	
Estimated commencement date: 7/1/2020	Estimated completion date: 7/1/2050	
Project Type: Town-wide CWMP	Status of project design: 10 %complete	
Proponent: Town of Barnstable		
Street Address: 367 Main Street		
Municipality: Barnstable (Hyannis)	State: MA	Zip Code: 02601
Name of Contact Person: Daniel W. Santos, P.E.		
Firm/Agency: Barnstable DPW	Street Address: 382 Falmouth Road	
Municipality: Barnstable (Hyannis)	State: MA	Zip Code: 02601
Phone: 508-790-6400	Fax: 508-790-6406	E-mail: daniel.santos@town.barnstable.ma.us

Does this project meet or exceed a mandatory EIR threshold (see 301 CMR 11.03)?
☒Yes ☐No

If this is an Expanded Environmental Notification Form (ENF) (see 301 CMR 11.05(7)) or a Notice of Project Change (NPC), are you requesting:

a Single EIR? (see 301 CMR 11.06(8))	☒Yes ☐No
a Special Review Procedure? (see 301CMR 11.09)	☐Yes ☒No
a Waiver of mandatory EIR? (see 301 CMR 11.11)	☐Yes ☒No
a Phase I Waiver? (see 301 CMR 11.11)	☐Yes ☒No

(Note: Greenhouse Gas Emissions analysis must be included in the Expanded ENF.)

Which MEPA review threshold(s) does the project meet or exceed (see 301 CMR 11.03)?
11.03(3)(b)(1)(f): Alteration of one half or more acres of any other wetlands (For proposed sewer infrastructure within land subject to flooding and riverfront areas. Not anticipated to exceed 10 acres).
11.03(5)(a)(3): Construction of one or more new sewer mains ten or more miles

Which State Agency Permits will the project require?
1. ***Massachusetts Environmental Policy Act (MEPA) regulatory review and approval***
2. ***Massachusetts Department of Environmental Protection (MassDEP) regulatory review and approval***
3. ***MassDEP Plan Review for proposed traditional wastewater infrastructure (anticipated to be reviewed on a project-by-project basis)***

4. ***MassDEP Sewer Extension Permits for sewer system expansion (anticipated to be reviewed on a project-by-project basis)***
5. ***MassDEP WP68: Treatment Works Approval (anticipated as future Notice of Project change for future treatment plant upgrades)***
6. ***MassDEP Groundwater Discharge Permits (anticipated as future Notice of Project change for future proposed effluent disposal sites)***
7. ***MassDEP Site Assignment under MGL Chapter 83, Section 6 and 310 CMR 16.00 (anticipated as future Notice of Project change for future proposed effluent disposal sites)***
8. ***MassDOT State Highway Access Permit (anticipated to be prepared and applied for on a project-by-project basis)***
9. ***Orders of Conditions under the Massachusetts Wetland Protection Act (anticipated to be prepared and applied for on a project-by-project basis)***
10. ***Massachusetts Division of Fisheries & Wildlife NHESP review and approval***
11. ***Massachusetts Historical Commission review and approval***
12. ***MA Office of Coastal Zone Management – Federal Consistency Certification (if determined to be applicable)***

Identify any financial assistance or land transfer from an Agency of the Commonwealth, including the Agency name and the amount of funding or land area in acres:
Anticipate future applications for Clean Water SRF assistance. Applications will be submitted on a project-by-project basis. No land transfers with an Agency of the Commonwealth are proposed or anticipated at this time.

Summary of Project Size & Environmental Impacts	Existing	Change	Total
LAND			
Total site acreage	N/A		
New acres of land altered		+/- 5 acres	
Acres of impervious area	N/A	+/- 1 acres	N/A
Square feet of new bordering vegetated wetlands alteration		0	
Square feet of new other wetland alteration		+/- 400,000 sf	
Acres of new non-water dependent use of tidelands or waterways		0	
STRUCTURES			
Gross square footage	N/A	+/- 20,000 sf (estimated for pump stations)	N/A
Number of housing units	N/A	N/A	N/A
Maximum height (feet)	N/A	N/A	N/A
TRANSPORTATION			
Vehicle trips per day	N/A	N/A	N/A
Parking spaces	N/A	N/A	N/A
WASTEWATER			
Water Use (Gallons per day)	N/A	N/A	N/A
Water withdrawal (GPD)	N/A	N/A	N/A
Wastewater generation/treatment (GPD)	1,670,000 (average daily flow to BWPCF)	1,914,500 (existing average daily flow of parcels to be sewered)	3,584,500
Length of water mains (miles)	N/A	N/A	N/A
Length of sewer mains (miles)	85	190	275

Has this project been filed with MEPA before?
☐ Yes (EEA #__________) ☒No

Has any project on this site been filed with MEPA before?
☐ Yes (EEA #__________) ☒No

GENERAL PROJECT INFORMATION – all proponents must fill out this section

PROJECT DESCRIPTION:

Describe the existing conditions and land uses on the project site: ***The project site is the Town of Barnstable which is includes residential, commercial and limited industrial and agricultural land uses. The Project is a Town-wide Comprehensive Wastewater Management Plan which will expand wastewater infrastructure throughout the Town. The attached Comprehensive Wastewater Management Plan provides extensive detail on the Town's wastewater needs.***

Describe the proposed project and its programmatic and physical elements: ***The Project is a Town-wide Comprehensive Wastewater Management Plan which will expand wastewater infrastructure throughout the Town. The project is a thirty year plan, comprised of three, 10-year phases, predominantly focused on sewer expansion to achieve reduction in nutrients and address TMDL's in embayments, while also addressing water quality in ponds, drinking water source protection, targeted economic development and other wastewater needs of the community. The phases will be further broken up into individual projects, during which the Town anticipates that project specific permitting requirements (such as wetland resources, habitat, historical, etc.) will be reviewed in consultation with the appropriate agencies. The details of the plan are explained in extensive detail in the attached Comprehensive Wastewater Management Plan, specifically in Sections 5 and 6.***

Describe the on-site project alternatives (and alternative off-site locations, if applicable), considered by the proponent, including at least one feasible alternative that is allowed under current zoning, and the reasons(s) that they were not selected as the preferred alternative:
Section 8 of the attached Comprehensive Wastewater Management Plan describes the main project alternative, which would be a "No Action" alternative. The Town considers the "No Action" alternative to be highly undesirable, irresponsible and inconsistent with the Local Comprehensive Plan of the Town and the Cape Cod community at large. In addition, the "No Action" alternative would result in regulatory issues for the Town as well as potential legal challenges.
During the planning process the Town analyzed additional alternatives. However, these alternatives were determined to not be feasible alternatives for varying reasons, as described below:

- ***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 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). Additionally, this alternative would require 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 is still in discussions with neighboring communities about potential effluent disposal in neighboring communities. However, because the Town has an existing wastewater treatment facility, 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 the CWMP.***

As a result of the former, the Town has proposed the project described in the CWMP. This plan does include components of the alternatives which were analyzed, such as non-traditional projects and inter-municipal options.

Summarize the mitigation measures proposed to offset the impacts of the preferred alternative:
These mitigation measures are discussed in Section 8 of the attached Comprehensive Wastewater Management Plan.

If the project is proposed to be constructed in phases, please describe each phase:
The project is proposed to be constructed in three 10-year phases. These phases will be further broken out into individual projects to keep execution of the project manageable. This is described in detail in Section 5 and 6 of the attached Comprehensive Wastewater Management Plan.

AREAS OF CRITICAL ENVIRONMENTAL CONCERN:
Is the project within or adjacent to an Area of Critical Environmental Concern?
☒Yes (Specify: ***A small portions of Phase 2 is adjacent to the Sandy Neck Barrier Beach System ACEC***
☐No
if yes, does the ACEC have an approved Resource Management Plan? _X__ Yes ___ No;
If yes, describe how the project complies with this plan.
A small portion of Phase 2 is adjacent to the Sandy neck Barrier Beach System ACEC. No work is proposed by within the ACEC, however some properties to be sewered are located within the ACEC. The project will removed septic systems from the ACEC which will benefit the ACEC by improving water quality.
Will there be stormwater runoff or discharge to the designated ACEC? ___ Yes _X__ No;
If yes, describe and assess the potential impacts of such stormwater runoff/discharge to the designated ACEC.

RARE SPECIES:
Does the project site include Estimated and/or Priority Habitat of State-Listed Rare Species? (see http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/priority_habitat/priority_habitat_home.htm)
☒Yes (Specify: ***Species(s) unknown at this time.***) ☐No
The project involves multiple projects that include the installation of sewer infrastructure, which will generally within right-of-ways, some of which are adjacent to mapped habitats. The Town anticipates reviewing potential rare species impacts, in consultation with Natural Heritage, on a project-by-project basis, where applicable.

HISTORICAL /ARCHAEOLOGICAL RESOURCES:
Does the project site include any structure, site or district listed in the State Register of Historic Place or the inventory of Historic and Archaeological Assets of the Commonwealth?
☒Yes (Specify: ***The project proposes sewer infrastructure within multiple historic districts, specifically: Old King's Highway Historic District, Santuit Historic District, Cotuit Historic District, Craigville Historic District, Centerville Historic District, and Hyannis Port Historic District***) ☐No
The project is a Town-wide wastewater plan involving the installation of sewer infrastructure throughout the Town of Barnstable, which has numerous historic districts which are listed on the National Register Historic Districts. When in historic districts the projects, specifically above ground components such as pump stations, electrical equipment, etc., may be subject to review. It is anticipated that these reviews will be handled on a project-by-project basis, in consultation with the appropriate agency. Candidate sites

for these facilities will be reviewed against available mapping, in consultation with the appropriate agencies) during preliminary design to determine if there are any anticipated historical / archaeological impacts.

If yes, does the project involve any demolition or destruction of any listed or inventoried historic or archaeological resources? ☐Yes (Specify________________________________) ☒No

The Town does not anticipate the project to involve any demolition or destruction of inventoried historic or archaeological resources.

WATER RESOURCES:

Is there an Outstanding Resource Water (ORW) on or within a half-mile radius of the project site? ___Yes _**X**__No;

if yes, identify the ORW and its location. ________________________________

(NOTE: Outstanding Resource Waters include Class A public water supplies, their tributaries, and bordering wetlands; active and inactive reservoirs approved by MassDEP; certain waters within Areas of Critical Environmental Concern, and certified vernal pools. Outstanding resource waters are listed in the Surface Water Quality Standards, 314 CMR 4.00.)

Are there any impaired water bodies on or within a half-mile radius of the project site? _**X**__Yes ___No; if yes, identify the water body and pollutant(s) causing the impairment: ***See attached list of Impaired Water in the Town of Barnstable.***

Is the project within a medium or high stress basin, as established by the Massachusetts Water Resources Commission? ___Yes _**X**__No

STORMWATER MANAGEMENT:

Generally describe the project's stormwater impacts and measures that the project will take to comply with the standards found in MassDEP's Stormwater Management Regulations: ***The project will create minimal new impervious areas. Stormwater management BMPs will be incorporated as necessary for any new impervious surfaces. Additionally, erosion control devices and long-term O&M plans will be provided for each project.***

MASSACHUSETTS CONTINGENCY PLAN:

Has the project site been, or is it currently being, regulated under M.G.L.c.21E or the Massachusetts Contingency Plan? Yes ___ No _**X**__ ; if yes, please describe the current status of the site (including Release Tracking Number (RTN), cleanup phase, and Response Action Outcome classification):__________________

The project involves multiple projects that include the installation of sewer infrastructure, generally within right-of-ways. Any properties that work is proposed on will be screened during the preliminary design process.

Is there an Activity and Use Limitation (AUL) on any portion of the project site? Yes ___ No _**X**__; if yes, describe which portion of the site and how the project will be consistent with the AUL: ______________________.

Are you aware of any Reportable Conditions at the property that have not yet been assigned an RTN? Yes ___ No _**X**__ ; if yes, please describe:________________________________

SOLID AND HAZARDOUS WASTE:

If the project will generate solid waste during demolition or construction, describe alternatives considered for re-use, recycling, and disposal of, e.g., asphalt, brick, concrete, gypsum, metal, wood: ***Discussed in detail in Section 8.3.16 of the attached Comprehensive Wastewater Management Plan.***

Will your project disturb asbestos containing materials? Yes ___ No _**X**__ ;
if yes, please consult state asbestos requirements at http://mass.gov/MassDEP/air/asbhom01.htm

Describe anti-idling and other measures to limit emissions from construction equipment: ***Discussed in detail in***

Section 8.3.16 of the attached Comprehensive Wastewater Management Plan.

DESIGNATED WILD AND SCENIC RIVER:

Is this project site located wholly or partially within a defined river corridor of a federally designated Wild and Scenic River or a state designated Scenic River? Yes ___ No _X_ ;
if yes, specify name of river and designation:

If yes, does the project have the potential to impact any of the "outstandingly remarkable" resources of a federally Wild and Scenic River or the stated purpose of a state designated Scenic River?
Yes ___ No ___ ; if yes, specify name of river and designation: ____________;
if yes, will the project will result in any impacts to any of the designated "outstandingly remarkable" resources of the Wild and Scenic River or the stated purposes of a Scenic River.
Yes ___ No ___ ;
if yes,describe the potential impacts to one or more of the "outstandingly remarkable" resources or stated purposes and mitigation measures proposed.

ATTACHMENTS:

1. List of all attachments to this document.
   Town of Barnstable Comprehensive Wastewater Management Plan (CWMP).
2. U.S.G.S. map (good quality color copy, 8-½ x 11 inches or larger, at a scale of 1:24,000) indicating the project location and boundaries.
   See Figure 1-1 in attached CWMP for locus map and Figure 5-1 for Sewer Expansion Phasing Plan which shows the properties proposed to be connected to municipal sewer.
3.. Plan, at an appropriate scale, of existing conditions on the project site and its immediate environs, showing all known structures, roadways and parking lots, railroad rights-of-way, wetlands and water bodies, wooded areas, farmland, steep slopes, public open spaces, and major utilities.
   See Figures 2-1 through 2-14 and Figures 5-2 through 5-76 in attached CWMP.
4 Plan, at an appropriate scale, depicting environmental constraints on or adjacent to the project site such as Priority and/or Estimated Habitat of state-listed rare species, Areas of Critical Environmental Concern, Chapter 91 jurisdictional areas, Article 97 lands, wetland resource area delineations, water supply protection areas, and historic resources and/or districts.
   See Figures 2-1 through 2-14 and Figures 5-2 through 5-76 in attached CWMP.
5. Plan, at an appropriate scale, of proposed conditions upon completion of project (if construction of the project is proposed to be phased, there should be a site plan showing conditions upon the completion of each phase).
   See Figure 5-1 and 6-1 in attached CWMP.
6. List of all agencies and persons to whom the proponent circulated the ENF, in accordance with 301 CMR 11.16(2).
   Distribution list provided with the CWMP.
7. List of municipal and federal permits and reviews required by the project, as applicable.
   List provided in Section 8.4 of CWMP.
8. ***List of Impaired Waters in Town of Barnstable.***

LAND SECTION – all proponents must fill out this section

I. Thresholds / Permits

A. Does the project meet or exceed any review thresholds related to **land** (see 301 CMR 11.03(1)
___ Yes _**X**__ No; if yes, specify each threshold:

II. Impacts and Permits

A. Describe, in acres, the current and proposed character of the project site, as follows:

	Existing	Change	Total
Footprint of buildings			
Internal roadways			
Parking and other paved areas			
Other altered areas			
Undeveloped areas			
Total: Project Site Acreage			

Project is a Town-wide wastewater plan which will generate minimal new impervious surfaces. The Town estimates approximately 1 acre of new impervious surfaces as part of the project. New impervious surfaces will generally only be at the pump station sites (structures, driveways, etc.).

B. Has any part of the project site been in active agricultural use in the last five years?
___ Yes _**X**__ No; if yes, how many acres of land in agricultural use (with prime state or locally important agricultural soils) will be converted to nonagricultural use?

C. Is any part of the project site currently or proposed to be in active forestry use?
___ Yes _**X**__ No; if yes, please describe current and proposed forestry activities and indicate whether any part of the site is the subject of a forest management plan approved by the Department of Conservation and Recreation:

D. Does any part of the project involve conversion of land held for natural resources purposes in accordance with Article 97 of the Amendments to the Constitution of the Commonwealth to any purpose not in accordance with Article 97? ___ Yes _**X**__ No; if yes, describe:

E. Is any part of the project site currently subject to a conservation restriction, preservation restriction, agricultural preservation restriction or watershed preservation restriction? ___ Yes__**X**_ No; if yes, does the project involve the release or modification of such restriction? ___ Yes ___ No; if yes, describe:

F. Does the project require approval of a new urban redevelopment project or a fundamental change in an existing urban redevelopment project under M.G.L.c.121A? ___ Yes __**X**_ No; if yes, describe:

G. Does the project require approval of a new urban renewal plan or a major modification of an existing urban renewal plan under M.G.L.c.121B? Yes ___ No __**X**_; if yes, describe:

III. Consistency

A. Identify the current municipal comprehensive land use plan
Title: ***Town of Barnstable Comprehensive Plan 2010*** Date: ***2010***

B. Describe the project's consistency with that plan with regard to:

1) economic development :
Project will promote targeted economic development

2) adequacy of infrastructure:

Project will improve sewer infrastructure

3) open space impacts:
Project will have minimal impact on open space.

4) compatibility with adjacent land uses:
Not applicable

C. Identify the current Regional Policy Plan of the applicable Regional Planning Agency (RPA)
RPA: Cape Cod Commission

Title: ***Cape Cod Regional Policy Plan*** Date: ***February 22, 2019***

D. Describe the project's consistency with that plan with regard to:
1) economic development: ***Project will promote targeted economic development***
2) adequacy of infrastructure: ***Project will improve sewer infrastructure***
3) open space impacts: ***Project will have minimal impact on open space.***

RARE SPECIES SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **rare species or habitat** (see 301 CMR 11.03(2))? ___ Yes __X_ No; if yes, specify, in quantitative terms:

(NOTE: If you are uncertain, it is recommended that you consult with the Natural Heritage and Endangered Species Program (NHESP) prior to submitting the ENF.)

B. Does the project require any state permits related to **rare species or habitat**? __ Yes _X__ No

C. Does the project site fall within mapped rare species habitat (Priority or Estimated Habitat?) in the current Massachusetts Natural Heritage Atlas (attach relevant page)? __X_ Yes ___ No. ***Species are unknown at this time. The project is a Town-wide CWMP and portions of the sewer expansion plan are within mapped habitats. However, the majority of the work will be within existing roadways. Projects that are adjacent to mapped habitats will be reviewed on a project-by-project basis, in consultation with Natural Heritage, for habitat impacts.***

D. If you answered "No" to all questions A, B and C, proceed to the **Wetlands, Waterways, and Tidelands Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Rare Species section below.

II. Impacts and Permits

A. Does the project site fall within Priority or Estimated Habitat in the current Massachusetts Natural Heritage Atlas (attach relevant page)? __X_ Yes ___ No. If yes,

1. Have you consulted with the Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program (NHESP)? ___Yes _X__No; if yes, have you received a determination as to whether the project will result in the "take" of a rare species? ___ Yes ___ No; if yes, attach the letter of determination to this submission.

2. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? ___ Yes __X_ No; if yes, provide a summary of proposed measures to minimize and mitigate rare species impacts

3. Which rare species are known to occur within the Priority or Estimated Habitat? ***Species are unknown at this time. The project is a Town-wide CWMP and portions of the sewer expansion plan are within mapped habitats. However, the majority of the work will be within existing roadways. Projects that are adjacent to mapped habitats will be reviewed on a project-by-project basis, in consultation with Natural Heritage, for habitat impacts.***

4. Has the site been surveyed for rare species in accordance with the Massachusetts Endangered Species Act? ___ Yes _X__ No

4. If your project is within Estimated Habitat, have you filed a Notice of Intent or received an Order of Conditions for this project? ___ Yes __X_ No; if yes, did you send a copy of the Notice of Intent to the Natural Heritage and Endangered Species Program, in accordance with the Wetlands Protection Act regulations? ___ Yes ___ No

B. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? ___ Yes _X__ No; if yes, provide a summary of proposed measures to minimize and mitigate impacts to significant habitat:

WETLANDS, WATERWAYS, AND TIDELANDS SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **wetlands, waterways, and tidelands** (see 301 CMR 11.03(3))? _X__ Yes _ __ No; if yes, specify, in quantitative terms: ***The Project will exceed 11.03(3)(b)(1)(f): Alteration of one half or more acres of any other wetlands for proposed sewer infrastructure within land subject to flooding and riverfront areas.***

B. Does the project require any state permits (or a local Order of Conditions) related to **wetlands, waterways, or tidelands**? _X__ Yes ___ No; if yes, specify which permit: ***Certain portions of the project will require filing of a Notice of Intent for work within buffer zones, land subject to flooding and riverfront areas. This work will consist of installation of sewer infrastructure, generally within existing roadways. The Town anticipates handling these filings on a project-by-project basis in consultation with local Conservation staff.***

C. If you answered "No" to both questions A and B, proceed to the **Water Supply Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wetlands, Waterways, and Tidelands Section below.

II. Wetlands Impacts and Permits

A. Does the project require a new or amended Order of Conditions under the Wetlands Protection Act (M.G.L. c.131A)? _X__ Yes ___ No; if yes, has a Notice of Intent been filed? ___ Yes ___ No; if yes, list the date and MassDEP file number: ______; if yes, has a local Order of Conditions been issued? ___ Yes ___ No; Was the Order of Conditions appealed? ___ Yes ___ No. Will the project require a Variance from the Wetlands regulations? ___ Yes _X__ No.
Projects will be reviewed on a project-by-project basis in consultation with local Conservation staff and a Notice of Intent will be filed for each applicable project. It is anticipated that Notice of Intents will be needed for some of the projects for work within buffer zones, land subject to flooding and riverfront areas.

B. Describe any proposed permanent or temporary impacts to wetland resource areas located on the project site: ***Certain portions of the project will require work within land subject to flooding and riverfront areas. This work will consist of installation of sewer infrastructure, generally within existing roadways. The Town anticipates filing Notice of Intents on a project-by-project basis, where necessary, to address any wetland resource impacts.***

C. Estimate the extent and type of impact that the project will have on wetland resources, and indicate whether the impacts are temporary or permanent:

Coastal Wetlands	Area (square feet) or Length (linear feet)	Temporary or Permanent Impact?
Land Under the Ocean	________	________
Designated Port Areas	________	________
Coastal Beaches	________	________
Coastal Dunes	________	________
Barrier Beaches	________	________
Coastal Banks	________	________
Rocky Intertidal Shores	________	________
Salt Marshes	________	________
Land Under Salt Ponds	________	________
Land Containing Shellfish	________	________
Fish Runs	________	________
Land Subject to Coastal Storm Flowage	___***+/-300,000 SF***__	***Permanent (sewer infrastructure)***

Inland Wetlands

Bank (lf)	____________	____________
Bordering Vegetated Wetlands	____________	____________
Isolated Vegetated Wetlands	____________	____________
Land under Water	____________	____________
Isolated Land Subject to Flooding	____________	____________
Borderi ng Land Subject to Flooding	____________	____________
Riverfront Area	__*+/-100,000 SF*___	*Permanent (sewer infrastructure)*

D. Is any part of the project:

1. proposed as a **limited project**? ___ Yes _X__ No; if yes, what is the area (in sf)?____
2. the construction or alteration of a **dam**? ___ Yes _X__ No; if yes, describe:
3. fill or structure in a **velocity zone** or **regulatory floodway**? _ X __ Yes _ __ No
4. dredging or disposal of dredged material? ___ Yes _X__ No; if yes, describe the volume of dredged material and the proposed disposal site:
5. a discharge to an **Outstanding Resource Water (ORW)** or an **Area of Critical Environmental Concern (ACEC)**? ___ Yes _X__ No
6. subject to a wetlands restriction order? ___ Yes _X__ No; if yes, identify the area (in sf):
7. located in buffer zones? _X__Yes ___No; if yes, how much (in sf): ***Area unknown at this time as the project is a Town-wide project and is not completely designed. Areas will be determined and provided in Notice of Intent applications, where applicable.***

E. Will the project:

1. be subject to a local wetlands ordinance or bylaw? _X__ Yes ___ No
2. alter any federally-protected wetlands not regulated under state law? ___ Yes _X__ No; if yes, what is the area (sf)?

III. Waterways and Tidelands Impacts and Permits

A. Does the project site contain waterways or tidelands (including filled former tidelands) that are subject to the Waterways Act, M.G.L.c.91? ___ Yes _X_ No; if yes, is there a current Chapter 91 License or Permit affecting the project site? ___ Yes ___ No; if yes, list the date and license or permit number and provide a copy of the historic map used to determine extent of filled tidelands:

B. Does the project require a new or modified license or permit under M.G.L.c.91? ___ Yes X_ No; if yes, how many acres of the project site subject to M.G.L.c.91 will be for non-water-dependent use? Current ___ Change ___ Total ___
If yes, how many square feet of solid fill or pile-supported structures (in sf)?

C. For non-water-dependent use projects, indicate the following:
Area of filled tidelands on the site:___*N/A*__________________
Area of filled tidelands covered by buildings:__ *N/A* ___________
For portions of site on filled tidelands, list ground floor uses and area of each use:
____ *N/A* ___________
Does the project include new non-water-dependent uses located over flowed tidelands?
Yes ___ No _X__
Height of building on filled tidelands___*N/A*_____________

Also show the following on a site plan: Mean High Water, Mean Low Water, Water-dependent Use Zone, location of uses within buildings on tidelands, and interior and exterior areas and facilities dedicated for public use, and historic high and historic low water marks.

D. Is the project located on landlocked tidelands? ___ Yes _X_ No; if yes, describe the project's impact on the public's right to access, use and enjoy jurisdictional tidelands and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

E. Is the project located in an area where low groundwater levels have been identified by a municipality or by a state or federal agency as a threat to building foundations? ___Yes _X_ No; if yes, describe the project's impact on groundwater levels and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

F. Is the project non-water-dependent **and** located on landlocked tidelands **or** waterways or tidelands subject to the Waterways Act **and** subject to a mandatory EIR? ___ Yes _X__ No;
(NOTE: If yes, then the project will be subject to Public Benefit Review and Determination.)

G. Does the project include dredging? ___ Yes _X__ No; if yes, answer the following questions:
What type of dredging? Improvement ___ Maintenance ___ Both ____
What is the proposed dredge volume, in cubic yards (cys) _________
What is the proposed dredge footprint ____length (ft) ___width (ft)____depth (ft);
Will dredging impact the following resource areas?
Intertidal Yes__ No__; if yes, ___ sq ft
Outstanding Resource Waters Yes__ No__; if yes, ___ sq ft
Other resource area (i.e. shellfish beds, eel grass beds) Yes__ No__; if yes __ sq ft
If yes to any of the above, have you evaluated appropriate and practicable steps to: 1) avoidance; 2) if avoidance is not possible, minimization; 3) if either avoidance or minimize is not possible, mitigation?
If no to any of the above, what information or documentation was used to support this determination?
Provide a comprehensive analysis of practicable alternatives for improvement dredging in accordance with 314 CMR 9.07(1)(b). Physical and chemical data of the sediment shall be included in the comprehensive analysis.
Sediment Characterization
Existing gradation analysis results? __Yes ___No: if yes, provide results.
Existing chemical results for parameters listed in 314 CMR 9.07(2)(b)6? ___Yes ____No; if yes, provide results.
Do you have sufficient information to evaluate feasibility of the following management options for dredged sediment? If yes, check the appropriate option.

Beach Nourishment ___
Unconfined Ocean Disposal ___
Confined Disposal:
Confined Aquatic Disposal (CAD) ___
Confined Disposal Facility (CDF) ___
Landfill Reuse in accordance with COMM-97-001 ___
Shoreline Placement ___
Upland Material Reuse____
In-State landfill disposal____
Out-of-state landfill disposal ____
(NOTE: This information is required for a 401 Water Quality Certification.)

IV. Consistency:
A. Does the project have effects on the coastal resources or uses, and/or is the project located within the Coastal Zone? _*X*__ Yes ___ No; if yes, describe these effects and the projects consistency with the policies of the Office of Coastal Zone Management: ***Portions of the project may be within the Coastal Zone. The project intent is to improve the coastal water quality.***

B. Is the project located within an area subject to a Municipal Harbor Plan? ___ Yes _X__ No; if yes, identify the Municipal Harbor Plan and describe the project's consistency with that plan:

WATER SUPPLY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **water supply** (see 301 CMR 11.03(4))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **water supply**? ___ Yes _X__ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Wastewater Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Water Supply Section below.

II. Impacts and Permits

A. Describe, in gallons per day (gpd), the volume and source of water use for existing and proposed activities at the project site:

	Existing	Change	Total
Municipal or regional water supply	________	________	________
Withdrawal from groundwater	________	________	________
Withdrawal from surface water	________	________	________
Interbasin transfer	________	________	________

(NOTE: Interbasin Transfer approval will be required if the basin and community where the proposed water supply source is located is different from the basin and community where the wastewater from the source will be discharged.)

B. If the source is a municipal or regional supply, has the municipality or region indicated that there is adequate capacity in the system to accommodate the project? ___ Yes ___ No

C. If the project involves a new or expanded withdrawal from a groundwater or surface water source, has a pumping test been conducted? ___ Yes ___ No; if yes, attach a map of the drilling sites and a summary of the alternatives considered and the results. _______________

D. What is the currently permitted withdrawal at the proposed water supply source (in gallons per day)? ______Will the project require an increase in that withdrawal? ___Yes ___No; if yes, then how much of an increase (gpd)? ____________________

E. Does the project site currently contain a water supply well, a drinking water treatment facility, water main, or other water supply facility, or will the project involve construction of a new facility? ___ Yes ___No. If yes, describe existing and proposed water supply facilities at the project site:

	Permitted Flow	Existing Avg Daily Flow	Project Flow	Total
Capacity of water supply well(s) (gpd)	_______	________	________	________
Capacity of water treatment plant (gpd)	_______	________	________	________

F. If the project involves a new interbasin transfer of water, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or proposed?

G. Does the project involve:

1. new water service by the Massachusetts Water Resources Authority or other agency of the Commonwealth to a municipality or water district? ___ Yes ___ No
2. a Watershed Protection Act variance? ___ Yes ___ No; if yes, how many acres of alteration?
3. a non-bridged stream crossing 1,000 or less feet upstream of a public surface drinking

water supply for purpose of forest harvesting activities? ___ Yes ___ No

III. Consistency

Describe the project's consistency with water conservation plans or other plans to enhance water resources, quality, facilities and services:

WASTEWATER SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **wastewater** (see 301 CMR 11.03(5))? _X__ Yes ___ No; if yes, specify, in quantitative terms:
11.03(5)(a)(3): Construction of one or more new sewer mains ten or more miles
The project proposes the construction of approximately 190 miles of new sewer main over the three, 10-year phases.

B. Does the project require any state permits related to **wastewater**? _X__ Yes ___ No; if yes, specify which permit:

1. ***Massachusetts Environmental Policy Act (MEPA) regulatory review and approval***
2. ***Massachusetts Department of Environmental Protection (MassDEP) regulatory review and approval***
3. ***MassDEP Plan Review for proposed traditional wastewater infrastructure (anticipated to be reviewed on a project-by-project basis)***
4. ***MassDEP Sewer Extension Permits for sewer system expansion (anticipated to be reviewed on a project-by-project basis)***
5. ***MassDEP WP68: Treatment Works Approval (anticipated as future Notice of Project change for future treatment plant upgrades)***
6. ***MassDEP Groundwater Discharge Permits (anticipated as future Notice of Project change for future proposed effluent disposal sites)***
7. ***MassDEP Site Assignment under MGL Chapter 83, Section 6 and 310 CMR 16.00 (anticipated as future Notice of Project change for future proposed effluent disposal sites)***

C. If you answered "No" to both questions A and B, proceed to the **Transportation -- Traffic Generation Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wastewater Section below.

II. Impacts and Permits

A. Describe the volume (in gallons per day) and type of disposal of wastewater generation for existing and proposed activities at the project site (calculate according to 310 CMR 15.00 for septic systems or 314 CMR 7.00 for sewer systems):

	Existing	Change	Total
Discharge of sanitary wastewater	**1,670,000**	**1,914,500**	**3,584,500**
Discharge of industrial wastewater			
TOTAL	**1,670,000**	**1,914,500**	**3,584,500**

	Existing	Change	Total
Discharge to groundwater			
Discharge to outstanding resource water			
Discharge to surface water			
Discharge to municipal or regional wastewater facility	**1,670,000**	**1,914,500**	**3,584,500**
TOTAL	**1,670,000**	**1,914,500**	**3,584,500**

ABOVE FLOWS ARE AVERAGE DAILY FLOWS

B. Is the existing collection system at or near its capacity? ___ Yes _X__ No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:

C. Is the existing wastewater disposal facility at or near its permitted capacity? _X__ Yes___ No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows: ***Capacity restrictions of the existing wastewater disposal facility are discussed in Sections 2.2.3.1 and 5.3.2 of the CWMP. It is anticipated that future effluent disposal options will be presented and permitted as a Notice of Project Change.***

D. Does the project site currently contain a wastewater treatment facility, sewer main, or other wastewater disposal facility, or will the project involve construction of a new facility? _X__ Yes ___ No; if yes, describe as follows:

	Permitted	Existing Avg Daily Flow	Project Flow	Total
Wastewater treatment plant capacity (in gallons per day)	**2,700,000**	**1,670,000**	**1,914,500**	**3,584,500**

ABOVE FLOWS ARE AVERAGE DAILY FLOWS

E. If the project requires an interbasin transfer of wastewater, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or new? ***N/A***

F. Does the project involve new sewer service by the Massachusetts Water Resources Authority (MWRA) or other Agency of the Commonwealth to a municipality or sewer district? ___ Yes _X_ No

G. Is there an existing facility, or is a new facility proposed at the project site for the storage, treatment, processing, combustion or disposal of sewage sludge, sludge ash, grit, screenings, wastewater reuse (gray water) or other sewage residual materials? _X__ Yes ___ No; if yes, what is the capacity (tons per day):

	Existing	Change	Total
Storage			
Treatment			
Processing			
Combustion			
Disposal			

Unknown at this time. Currently being studied as part of the Town's Solids Handling project.

H. Describe the water conservation measures to be undertaken by the project, and other wastewater mitigation, such as infiltration and inflow removal. ***Projects that have been undertaken since the 2011 Needs Assessment Report are described in Section 2.2.2 of the CWMP. The Town's Water Pollution Control Division has a number of programs moving forward that will contribute to water conservation including the infiltration and inflow removal program, sewer pipe rehabilitation program, and pump station rehabilitation program.***

III. Consistency

A. Describe measures that the proponent will take to comply with applicable state, regional, and local plans and policies related to wastewater management: ***This project is the Town's Comprehensive Wastewater Management Plan and is intended to be an effort to comply with federal, state, and regional plans/policies related to wastewater management.***

B. If the project requires a sewer extension permit, is that extension included in a comprehensive wastewater management plan? _X__ Yes ___ No; if yes, indicate the EEA number for the plan and whether the project site is within a sewer service area recommended or approved in that plan: ***Project is the Town's Comprehensive Wastewater Management Plan.***

TRANSPORTATION SECTION (TRAFFIC GENERATION)

I. Thresholds / Permit

A. Will the project meet or exceed any review thresholds related to **traffic generation** (see 301 CMR 11.03(6))? ___ Yes __X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **state-controlled roadways**? __X_ Yes ___ No; if yes, specify which permit: ***State Highway Access Permit for proposed sewer infrastructure within state highways including Route 28, Route 132, and the state jurisdictional portions of Route 6A and Phinney's Lane .***

C. If you answered "No" to both questions A and B, proceed to the **Roadways and Other Transportation Facilities Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Traffic Generation Section below.

II. Traffic Impacts and Permits

A. Describe existing and proposed vehicular traffic generated by activities at the project site:

	Existing	Change	Total
Number of parking spaces	***N/A***	***0***	***N/A***
Number of vehicle trips per day	***N/A***	***0***	***N/A***
ITE Land Use Code(s):	***N/A***	***N/A***	***N/A***

B. What is the estimated average daily traffic on roadways serving the site?

Roadway	Existing	Change	Total
1. ______	______	______	______
2. ______	______	______	______
3. ______	______	______	______

Project is Town-wide.

C. If applicable, describe proposed mitigation measures on state-controlled roadways that the project proponent will implement: **N/A**

D. How will the project implement and/or promote the use of transit, pedestrian and bicycle facilities and services to provide access to and from the project site? **N/A**

C. Is there a Transportation Management Association (TMA) that provides transportation demand management (TDM) services in the area of the project site? ____ Yes __X__ No; if yes, describe if and how will the project will participate in the TMA:

D. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation facilities? ____ Yes __X__ No; if yes, generally describe:

E. If the project will penetrate approach airspace of a nearby airport, has the proponent filed a Massachusetts Aeronautics Commission Airspace Review Form (780 CMR 111.7) and a Notice of Proposed Construction or Alteration with the Federal Aviation Administration (FAA) (CFR Title 14 Part 77.13, forms 7460-1 and 7460-2)? **N/A**

III. Consistency

Describe measures that the proponent will take to comply with municipal, regional, state, and federal plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services: **N/A**

TRANSPORTATION SECTION (ROADWAYS AND OTHER TRANSPORTATION FACILITIES)

I. Thresholds

A. Will the project meet or exceed any review thresholds related to **roadways or other transportation facilities** (see 301 CMR 11.03(6))? ___ Yes _**X**__ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **roadways or other transportation facilities**? __X_ Yes ___ No; if yes, specify which permit: ***State Highway Access Permit for proposed sewer infrastructure within state highways including Route 28, Route 132, and the state jurisdictional portions of Route 6A and Phinney's Lane.***

C. If you answered "No" to both questions A and B, proceed to the **Energy Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Roadways Section below.

II. Transportation Facility Impacts

A. Describe existing and proposed transportation facilities in the immediate vicinity of the project site:
Project is Town-wide. Project involves construction of sewer infrastructure within existing roadways.

B. Will the project involve any
1. Alteration of bank or terrain (in linear feet)? _____**0**_______
2. Cutting of living public shade trees (number)? _____**0**_______
3. Elimination of stone wall (in linear feet)? ______**0**______

III. Consistency -- Describe the project's consistency with other federal, state, regional, and local plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services, including consistency with the applicable regional transportation plan and the Transportation Improvements Plan (TIP), the State Bicycle Plan, and the State Pedestrian Plan:
The project involves in the installation of sewer infrastructure and will not generate any traffic, except for temporary traffic delays during construction.

ENERGY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **energy** (see 301 CMR 11.03(7))? ___ Yes _X__ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **energy**? ___ Yes _X__ No; if yes, specify which permit:

C. If you answered "No" to <u>both</u> questions A and B, proceed to the **Air Quality Section**. If you answered "Yes" to <u>either</u> question A or question B, fill out the remainder of the Energy Section below.

II. Impacts and Permits

A. Describe existing and proposed energy generation and transmission facilities at the project site:

	Existing	Change	Total
Capacity of electric generating facility (megawatts)	________	________	________
Length of fuel line (in miles)	________	________	________
Length of transmission lines (in miles)	________	________	________
Capacity of transmission lines (in kilovolts)	________	________	________

B. If the project involves construction or expansion of an electric generating facility, what are:

1. the facility's current and proposed fuel source(s)?
2. the facility's current and proposed cooling source(s)?

C. If the project involves construction of an electrical transmission line, will it be located on a new, unused, or abandoned right of way? ___Yes ___No; if yes, please describe:

D. Describe the project's other impacts on energy facilities and services:

III. Consistency

Describe the project's consistency with state, municipal, regional, and federal plans and policies for enhancing energy facilities and services:

AIR QUALITY SECTION

I. Thresholds

A. Will the project meet or exceed any review thresholds related to **air quality** (see 301 CMR 11.03(8))? ___ Yes _X__ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **air quality**? ___ Yes _X__ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Solid and Hazardous Waste Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Air Quality Section below.

II. Impacts and Permits

A. Does the project involve construction or modification of a major stationary source (see 310 CMR 7.00, Appendix A)? ___ Yes ___ No; if yes, describe existing and proposed emissions (in tons per day) of:

	Existing	Change	Total
Particulate matter	______	______	______
Carbon monoxide	______	______	______
Sulfur dioxide	______	______	______
Volatile organic compounds	______	______	______
Oxides of nitrogen	______	______	______
Lead	______	______	______
Any hazardous air pollutant	______	______	______
Carbon dioxide	______	______	______

B. Describe the project's other impacts on air resources and air quality, including noise impacts:

III. Consistency

A. Describe the project's consistency with the State Implementation Plan:

B. Describe measures that the proponent will take to comply with other federal, state, regional, and local plans and policies related to air resources and air quality:

SOLID AND HAZARDOUS WASTE SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **solid or hazardous waste** (see 301 CMR 11.03(9))? ___ Yes _**X**__ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **solid and hazardous waste**? ___ Yes _**X**__ No; if yes, specify which permit:

C. If you answered "No" to <u>both</u> questions A and B, proceed to the **Historical and Archaeological Resources Section**. If you answered "Yes" to <u>either</u> question A or question B, fill out the remainder of the Solid and Hazardous Waste Section below.

II. Impacts and Permits

A. Is there any current or proposed facility at the project site for the storage, treatment, processing, combustion or disposal of solid waste? ___ Yes ___ No; if yes, what is the volume (in tons per day) of the capacity:

	Existing	Change	Total
Storage	___	___	___
Treatment, processing	___	___	___
Combustion	___	___	___
Disposal	___	___	___

B. Is there any current or proposed facility at the project site for the storage, recycling, treatment or disposal of hazardous waste? ___ Yes ___ No; if yes, what is the volume (in tons or gallons per day) of the capacity:

	Existing	Change	Total
Storage	___	___	___
Recycling	___	___	___
Treatment	___	___	___
Disposal	___	___	___

C. If the project will generate solid waste (for example, during demolition or construction), describe alternatives considered for re-use, recycling, and disposal:

D. If the project involves demolition, do any buildings to be demolished contain asbestos?
___ Yes ___ No

E. Describe the project's other solid and hazardous waste impacts (including indirect impacts):

III. Consistency

Describe measures that the proponent will take to comply with the State Solid Waste Master Plan:

HISTORICAL AND ARCHAEOLOGICAL RESOURCES SECTION

I. Thresholds / Impacts

A. Have you consulted with the Massachusetts Historical Commission? ___ Yes _X__ No; if yes, attach correspondence. For project sites involving lands under water, have you consulted with the Massachusetts Board of Underwater Archaeological Resources? ____Yes ____ No; if yes, attach correspondence

B. Is any part of the project site a historic structure, or a structure within a historic district, in either case listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? ___ Yes _X __ No; if yes, does the project involve the demolition of all or any exterior part of such historic structure? ___ Yes ___ No; if yes, please describe: ***The project is not anticipated to involve the demolition or alteration of any historic structures.***

C. Is any part of the project site an archaeological site listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? ___ Yes _X__ No; if yes, does the project involve the destruction of all or any part of such archaeological site? ___ Yes ___ No; if yes, please describe: ***See Item II below for discussion.***

D. If you answered "No" to all parts of both questions A, B and C, proceed to the **Attachments and Certifications** Sections. If you answered "Yes" to any part of either question A or question B, fill out the remainder of the Historical and Archaeological Resources Section below.

II. Impacts

Describe and assess the project's impacts, direct and indirect, on listed or inventoried historical and archaeological resources:
The project is a Town-wide wastewater plan involving the installation of sewer infrastructure throughout the Town of Barnstable, which has numerous historic districts that are listed on the National Register Historic Districts. The plan proposed work within the following historic districts: Old King's Highway Historic District, Santuit Historic District, Cotuit Historic District, Craigville Historic District, Centerville Historic District, and Hyannis Port Historic District. The majority of the project will involve the construction of sewer infrastructure, which will generally be below grade. Above ground components of the projects (pump stations, electrical equipment, etc.) may be subject to review, which is anticipated to be addressed on a project-by-project basis. Candidate sites for these facilities will be reviewed against available mapping and in consultation with the appropriate reviewing agency during preliminary design to determine if there are any anticipated historical / archaeological impacts.

III. Consistency

Describe measures that the proponent will take to comply with federal, state, regional, and local plans and policies related to preserving historical and archaeological resources: ***Candidate sites for these facilities will be reviewed against available mapping during preliminary design to determine, in consultation with the appropriate reviewing agency, if there are any anticipated historical / archaeological impacts.***

CERTIFICATIONS:

1. The Public Notice of Environmental Review has been/will be published in the following newspapers in accordance with 301 CMR 11.15(1):

   (Name) ***Cape Cod Times*** (Date) ***January 17, 2020***

2. This form has been circulated to Agencies and Persons in accordance with 301 CMR 11.16(2).

Signatures:

1/31/20

Date	Signature of Responsible Officer or Proponent	Date	Signature of person preparing ENF (if different from above)

Daniel W. Santos, P.E.	
Name (print or type)	Name (print or type)
Barnstable Department of Public Works	
Firm/Agency	Firm/Agency
382 Falmouth Road	
Street	Street
Hyannis/MA/02601	
Municipality/State/Zip	Municipality/State/Zip
508-790-6400	
Phone	Phone

Town of Barnstable Comprehensive Wastewater Management Plan

Distribution List

A copy of the CWMP/EENF has been sent to the following:

Secretary of Energy and Environmental Affairs
Executive Office of Energy and Environmental Affairs (EEA)
Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston MA 02114

Mass DEP- Boston
Commissioner's Office
One Winter Street, 2nd Floor
Boston, MA 02108

MassDEP Southeastern Regional Office
20 Riverside Drive Lakeville, MA 02347
Attention: MEPA Unit

Massachusetts Department of Transportation
Public/Private Development Unit 10 Park Plaza, Suite #4150 Boston, MA 02116

Massachusetts Department of Transportation
District #5
Box 111
1000 County Street
Taunton, MA 02780
Attn: MEPA Coordinator

Cape Cod Commission
3225 Main Street
P.O. Box 226
Barnstable, MA 02630

Massachusetts Historical Commission
The MA Archives Building
220 Morrissey Boulevard
Boston, MA 02125
Attn: Ms. Brona Simon

Coastal Zone Management
Attn: Project Review Coordinator
251 Causeway Street, Suite 800
Boston, MA 02114

Division of Marine Fisheries (South Shore)
Attn: Environmental Reviewer
836 South Rodney French BLVD
New Bedford, MA, 02744

Department of Agricultural Resources
Attn: MEPA Coordinator
138 Memorial Avenue, Suite 42
West Springfield, MA 01089

Natural Heritage and Endangered Species Program
Massachusetts Division of Fisheries & Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

Energy Facilities Siting Board
Attn: MEPA Coordinator
One South Station
Boston, MA 02110

Department of Energy Resources
Attn: MEPA Coordinator
100 Cambridge Street, 10th floor
Boston, MA 02114

Department of Public Health
Director of Environmental Health
250 Washington Street
Boston, MA 02115

DCR
Attn: MEPA Coordinator
251 Causeway St. Suite 600
Boston MA 02114

Town of Mashpee
Board of Selectmen
Mashpee Town Hall
16 Great Neck Road North
Mashpee, MA 02649

Town of Mashpee
Conservation
16 Great Neck Road North
Mashpee, MA 02649

Town of Mashpee
Board of Health
16 Great Neck Road North
Mashpee, MA 02649

Town of Mashpee
Planning Board
16 Great Neck Road North
Mashpee, MA 0264

Town of Sandwich
Planning and Development
16 Jan Sebastian Drive
Sandwich, MA 02563

Town of Sandwich
Conservation Commission
16 Jan Sebastian Drive
Sandwich, MA 02563

Town of Sandwich
Health Department
16 Jan Sebastian Drive
Sandwich, MA 02563

Town of Sandwich
Board of Selectman
130 Main Street
Sandwich, MA 02563

Town of Yarmouth
Board of Selectman
1146 Route 28
South Yarmouth, MA 02664

Town of Yarmouth
Planning Division
1146 Route 28
South Yarmouth, MA 02664

Town of Yarmouth
Conservation
1146 Route 28
South Yarmouth, MA 02664

Town of Yarmouth
Health Department
1146 Route 28
South Yarmouth, MA 02664

Town of Yarmouth
Department of Public Works
1146 Route 28
South Yarmouth, MA 02664

Town of Yarmouth
Town Administrator
1146 Route 28
South Yarmouth, MA 02664

Town of Barnstable
Town Council
367 Main St
Hyannis, MA 02601

Town of Barnstable
Planning and Development
367 Main St
Hyannis, MA 02601

Town of Barnstable
Conservation
200 Main St
Hyannis, MA 02601

Town of Barnstable
Health Division
200 Main St
Hyannis, MA 02601

Town of Barnstable, Massachusetts

Comprehensive Wastewater Management Plan

Volume 1: Report Text, Tables and Figures

January, 2020

Comprehensive Wastewater Management Plan

Barnstable, Massachusetts

Prepared by:

Barnstable Department of Public Works

382 Falmouth Road

Hyannis, MA 02601

COMMONWEALTH OF MASSACHUSETTS
ROBERT R. STEEN
CIVIL
No. 48499
REGISTERED
PROFESSIONAL ENGINEER

14 JAN 2020

COMMONWEALTH OF MASSACHUSETTS
DANIEL W. SANTOS
CIVIL
No. 39223
REGISTERED
PROFESSIONAL ENGINEER

1-14-20

COMMONWEALTH OF MASSACHUSETTS
PHILIP GRIFFIN BEAUDOIN
CIVIL
No. 52237
REGISTERED
PROFESSIONAL ENGINEER

1/14/20

January, 2020

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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

<table>
<tr><th>PHASE</th><th>TASKS</th></tr>
<tr><td>Phase I:
Needs
Assessment</td><td>
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
</td></tr>
<tr><td>Phase II:
Identification,
Screening, and
Evaluation of
Alternatives</td><td>
Using the CCC 208 Plan Chapter 4, identify all technically feasible options to address the wastewater needs
Traditional and non-traditional alternatives
Structural and non-structural alternatives
Compare alternatives with respect to the following factors:
Efficacy of the solution and probability of success
Proximity of the issue to existing infrastructure
Capital and operations and maintenance costs
</td></tr>
</table>

	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 DRI Reviews	• Prepare Environmental Notification Form and Environmental Impact Reports • File 208 Consistency application • 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 will submit this 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). This submittal will initiate the formal review and comment by local, regional, state and federal agencies, including the Cape Cod Commission's review of the CWMP for consistency with the 208 Plan. An EENF is subject to an extended 37-day review period by MEPA office, consisting of a 30-day public comment period and 7 days to issue a certificate. Upon receipt of the Secretary Certificate, the Town will respond to any comments from the various agencies and public comments, finalize the SEIR, and submit the SEIR to MEPA for final approval. Refer to Section 8 for the Environmental Impact Report.

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 subsequent volumes.

This Report is divided into 8 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.

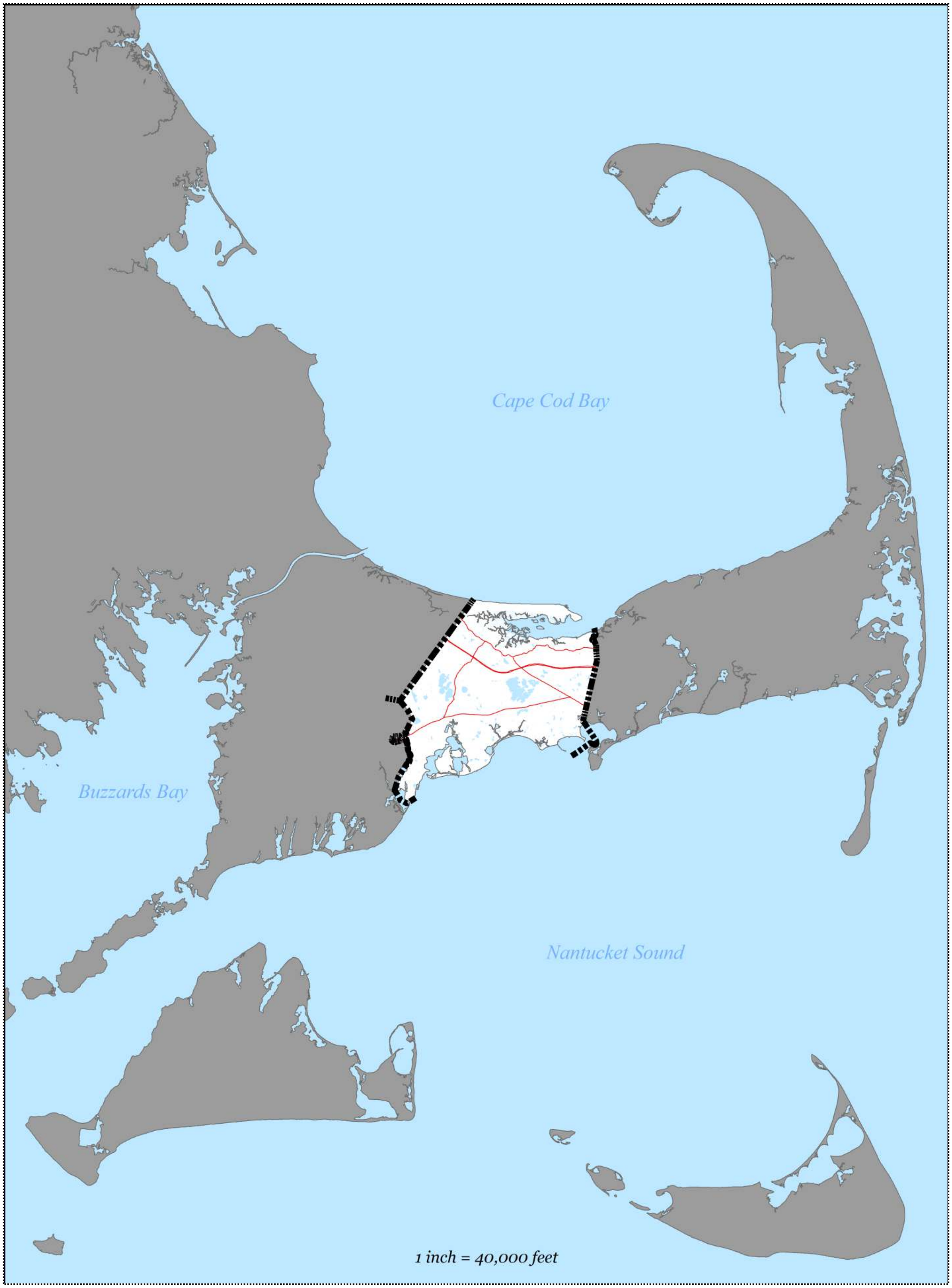

Figure 1-1: Location of the Town of Barnstable

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

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.

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.

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

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 Israels Pond	Coleman Pond Patty's Pond	
Eutrophic	Mill Pond Lamson Pond Fawcett's Pond Mill (Filenes) Pond Weathervane Pond Ben's Pond Fresh Hole Pond Flax Pond	Simmons 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		0.21[8]
Barnstable Harbor	**Barnstable Harbor Sentinel Station[2]**		TBD
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 available
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	Total attenuated controllable watershed N nitrogen load (kg/day)	Total attenuated controllable N load (from Barnstable) (kg/day)	Target (kg/day)	Total N load reduction targets (kg/day)	N Load reduction targets (by Barnstable) (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

Within the 208 Plan Update, the Three Bays area was identified as a watershed where stormwater has a significant impact, with approximately 23% of controllable nitrogen coming 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) placed in service or upgraded after 2017 in the Three Bays watershed.

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 precisely and definitively quantify the effluent discharge capacity of the BWPCF.

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 fall 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

As required by the 2018 permit update for the BWPCF, an effluent flow meter is to be designed prior to December 31, 2019 and installed at the facility prior to December 31, 2020. This project is discussed further in the permit update section.

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.

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. In addition to this project, the Town is in the preliminary planning phase for the construction of a new sewer running between Main Street and South Street on Old Colony Road, which will shed flow off of Pleasant Street and alleviate any remaining capacity constraints in the area.

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
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
Total	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 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

---

[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

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

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 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

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

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 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

[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

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 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.

---

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

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%
Total	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.

In anticipation of this effort the Town has appropriated 1.3 million dollars to install piping under the railroad tracks and along the length of Route 28 during the MassDOT project.

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
Total	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.

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 are scheduled to be 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)
653	94,200	9.4

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.

Table 2-20: Strawberry Hill Sewer Expansion Project Summary

Number of Parcels Connected	WW Captured (gpd)	N Removed (kg/day)
240	47,070	4.7

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)
130	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 is anticipated to be completed in the Fall of 2019.

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 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 Figure 2-24 and **Error! Reference source not found.**.

Table 2-22: Summary of the Needs

Watershed		Nitrogen Removal	Ponds & Well Protection	Economic Development	Other Sanitary Needs	Currently Sewered	Remain Unsewered	Total
Lewis Bay	Parcels	699	132	41	0	2,224	2,124	5,220
	WW (gpd)	131,238	22,603	28,024	0	1,062,378	284,135	1,528,378
Halls Creek	Parcels	0	86	0	266	328	688	1,368
	WW (gpd)	0	10,162	0	38,563	108,383	95,708	252,816
Centerville River	Parcels	2,636	1,809	6	0	46	3,501	7,998
	WW (gpd)	480,421	248,140	1,942	0	35,757	610,326	1,376,586
Three Bays	Parcels	3,112	482	22	0	0	2,009	5,625
	WW (gpd)	655,058	83,675	3,250	0	0	482,914	1,224,897
Rushy Marsh	Parcels	0	0	0	0	0	18	18
	(gpd)	0	0	0	0	0	3,779	3,779
Popponesset Bay	Parcels	505	8	0	0	0	430	943
	WW (gpd)	81,161	753	0	0	0	81,637	163,551
Barnstable Harbor	Parcels	364	304	74	0	443	3,471	4,656
	WW (gpd)	55,982	56,569	15,741	0	121,193	541,795	791,280
Undefined	Parcels	0	0	0	164	0	854	1,018
	WW (gpd)	0	0	0	44,840	0	208,980	253,820
Total	Parcels	7,316	2,821	143	430	3,041	13,095	26,846
	WW (gpd)	1,403,860	421,902	48,957	83,403	1,327,711	2,309,274	5,595,107

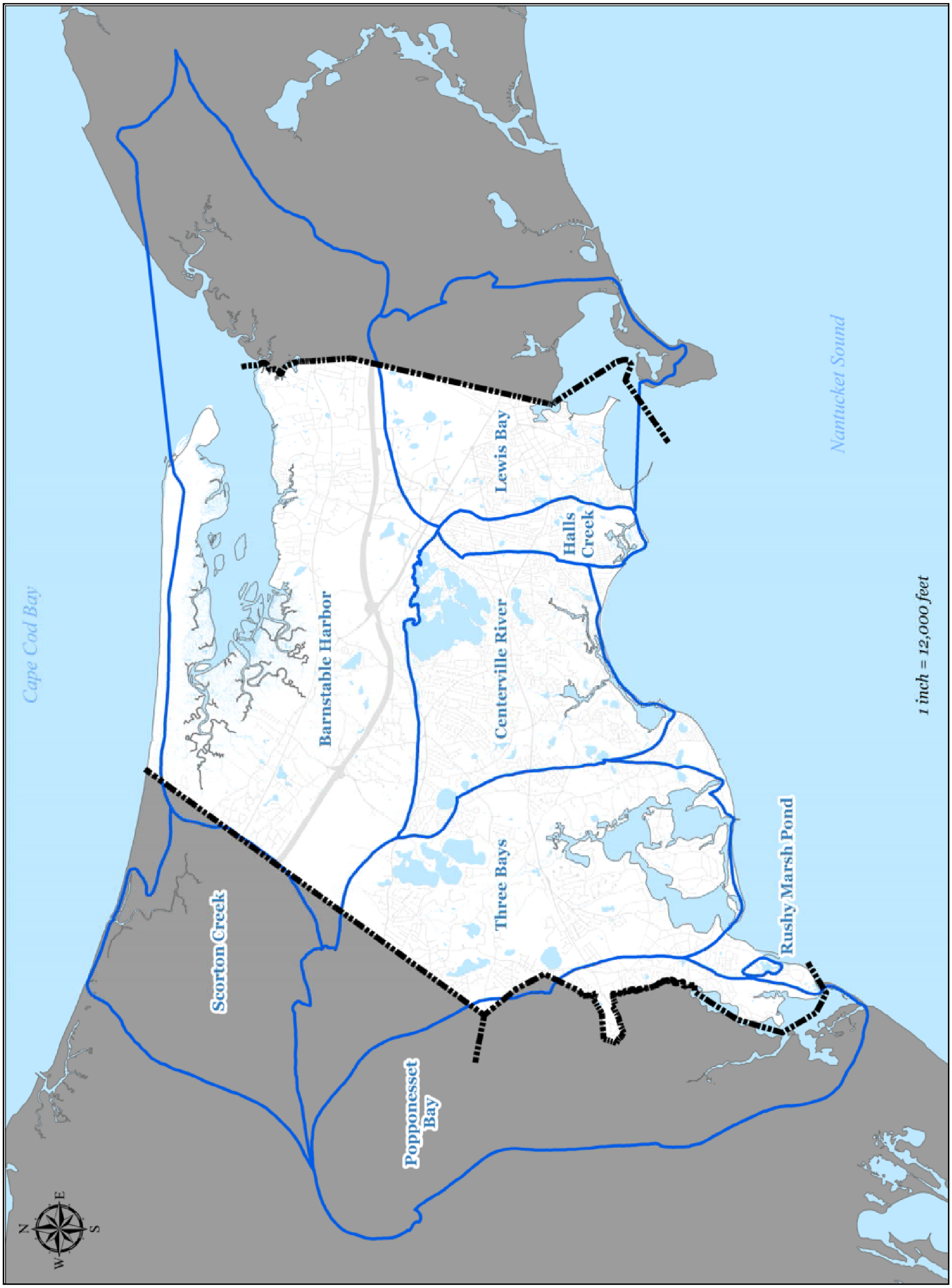

Figure 2-1: Watershed Boundaries

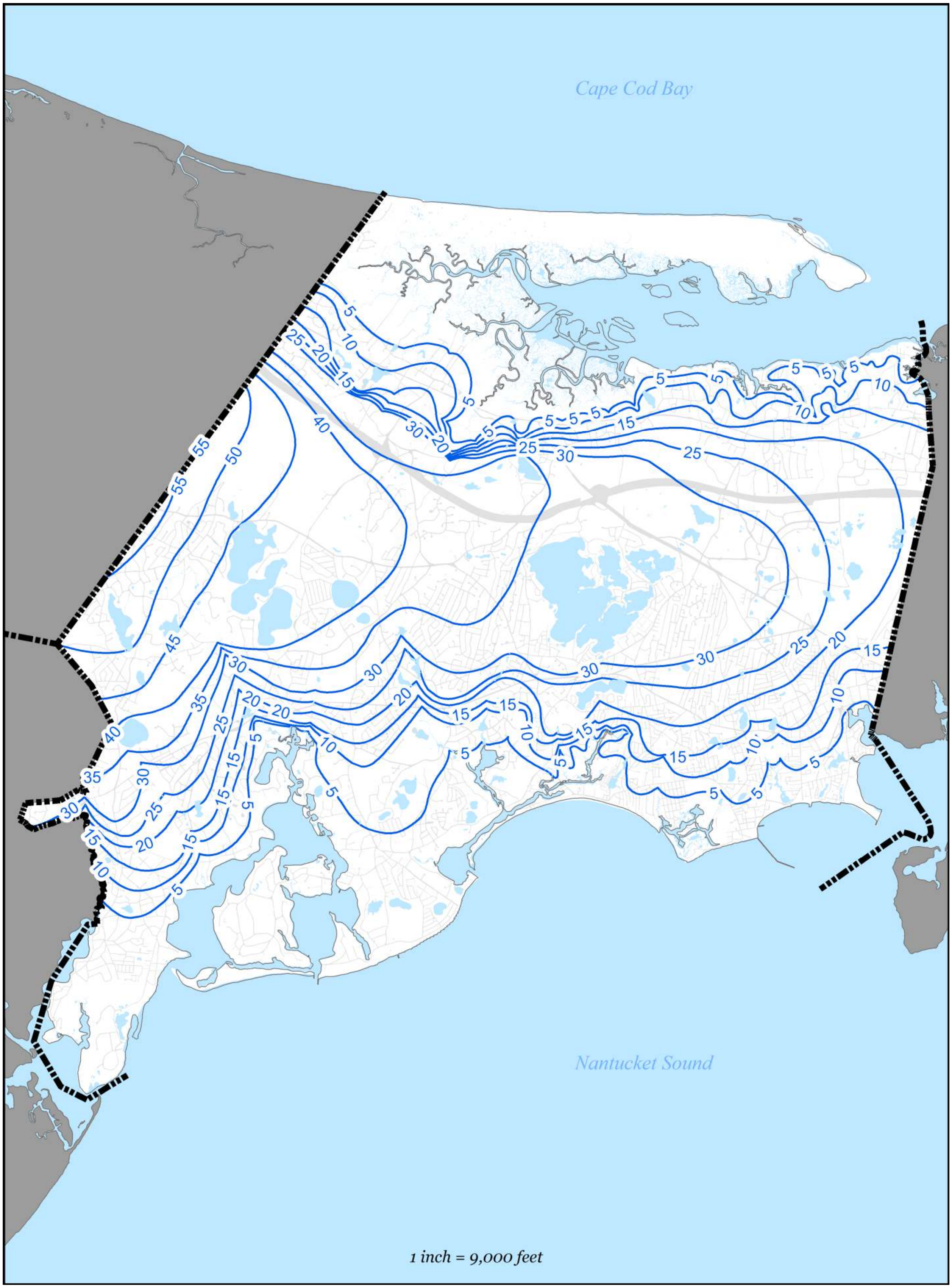

Figure 2-2: Groundwater Contours

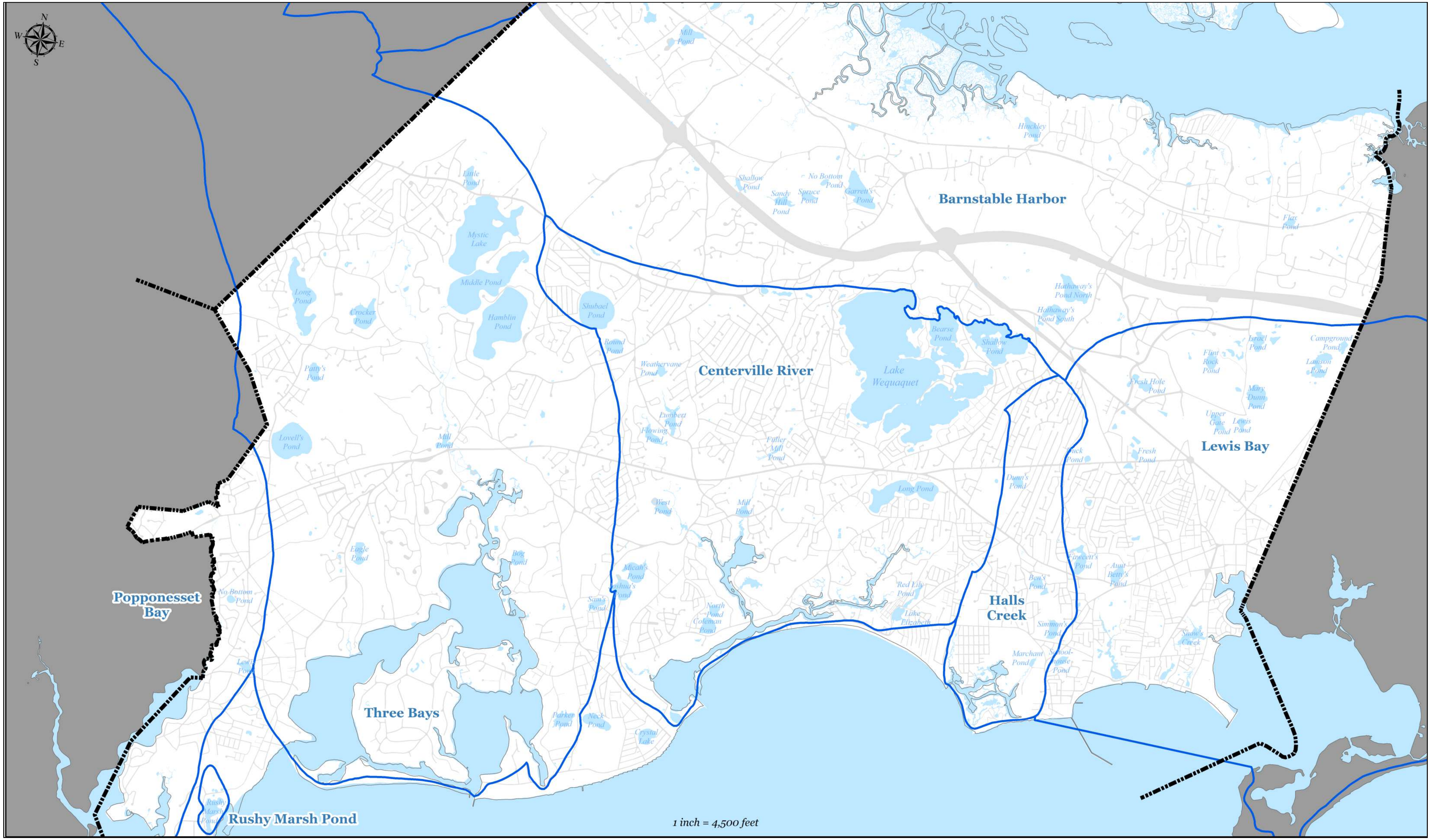

Figure 2-3: Named Freshwater Bodies

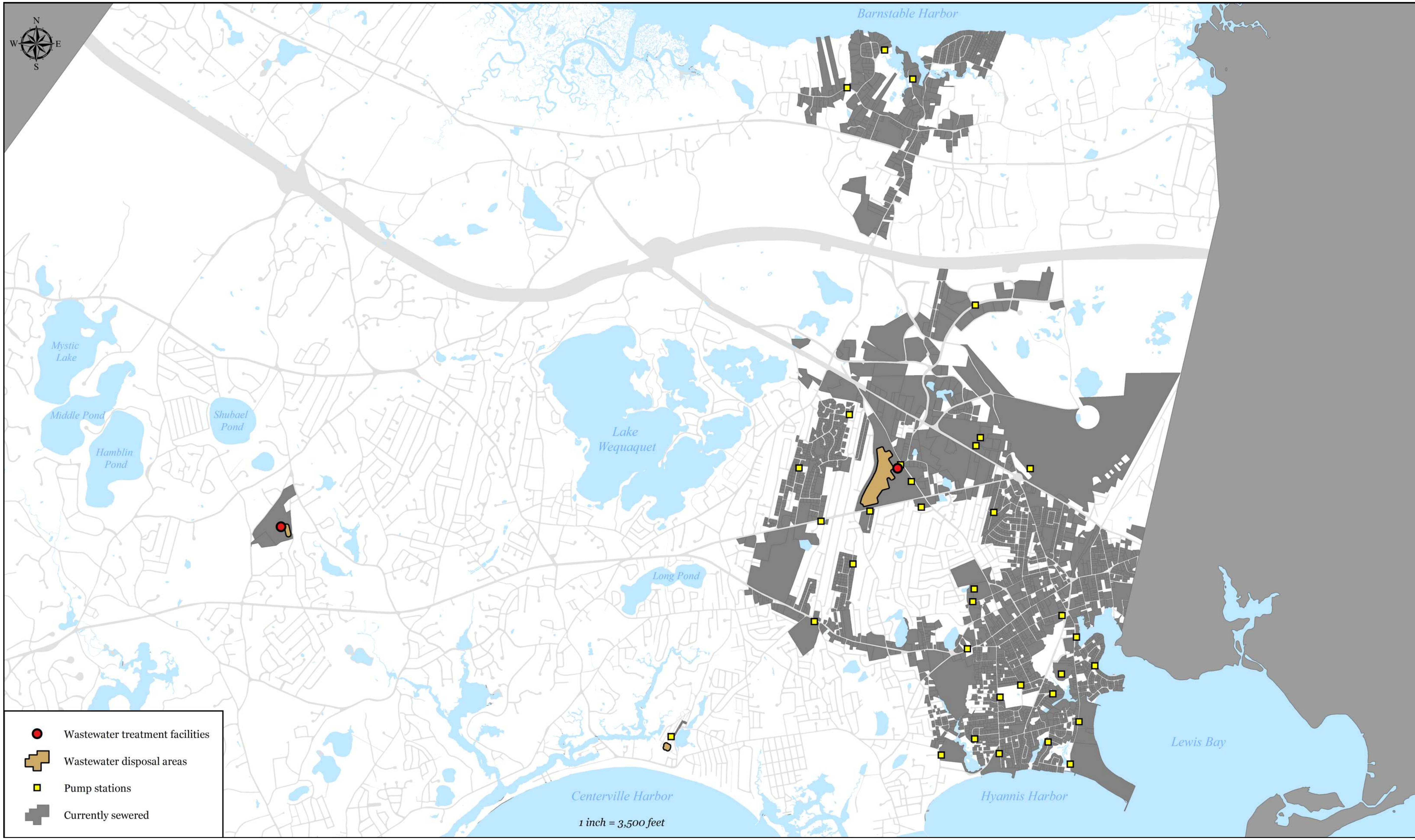

Figure 2-4: Present Sewer

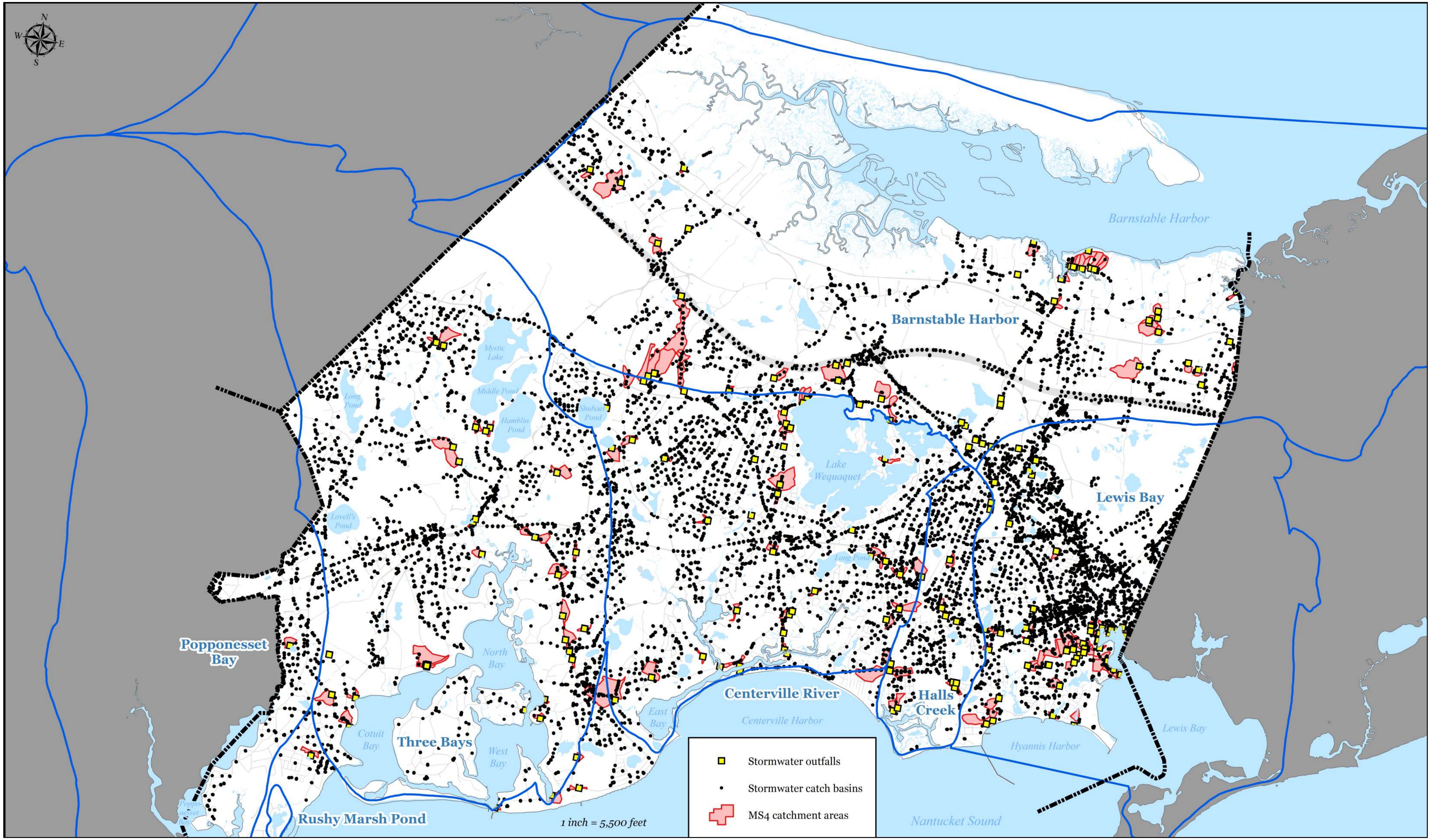

Figure 2-5: Storm Water Infrastructure

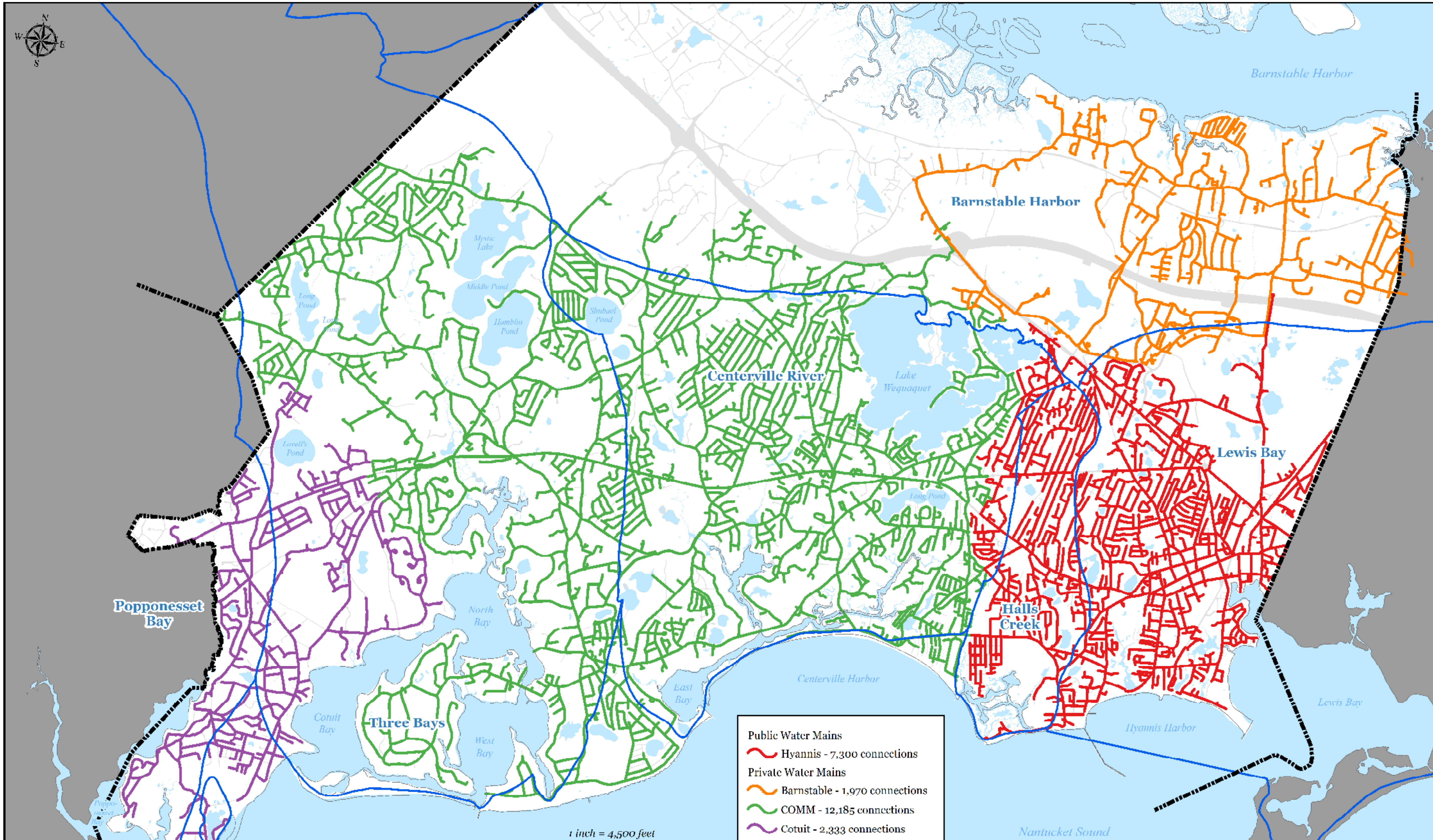

Figure 2-6: Water Supply

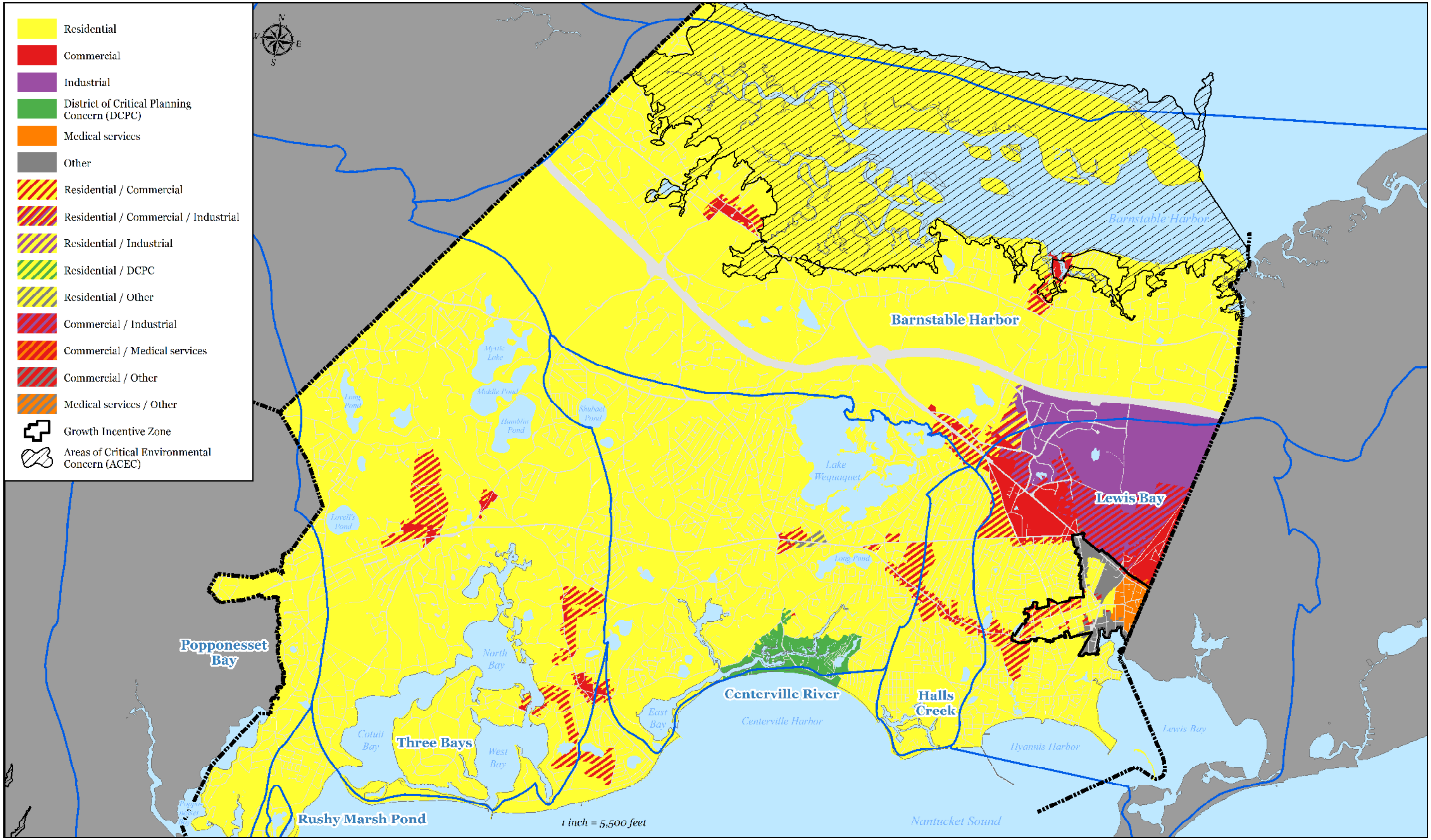

Figure 2-7: Zoning and ACEC

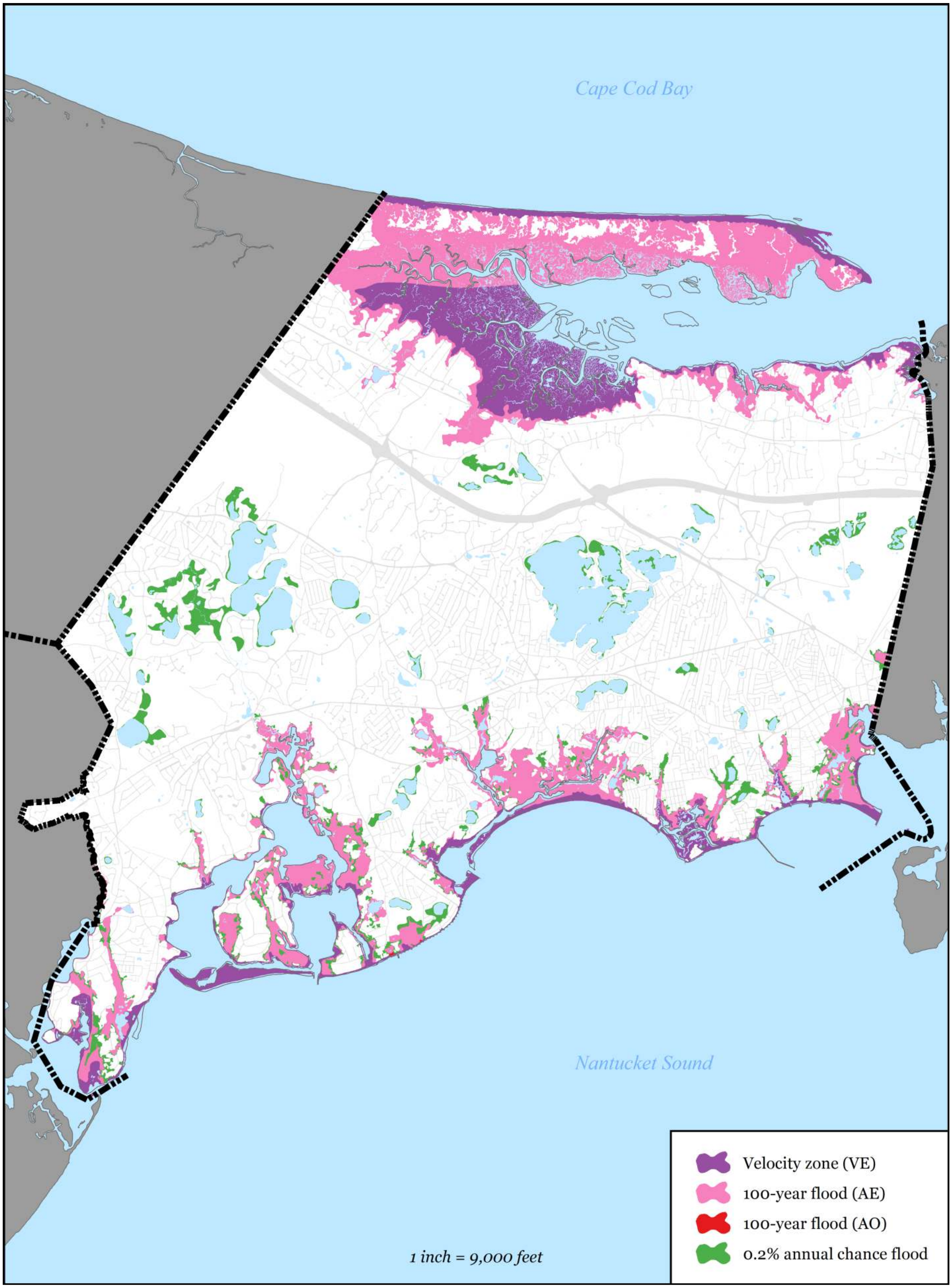

Figure 2-8: FEMA Flood Zones (2014)

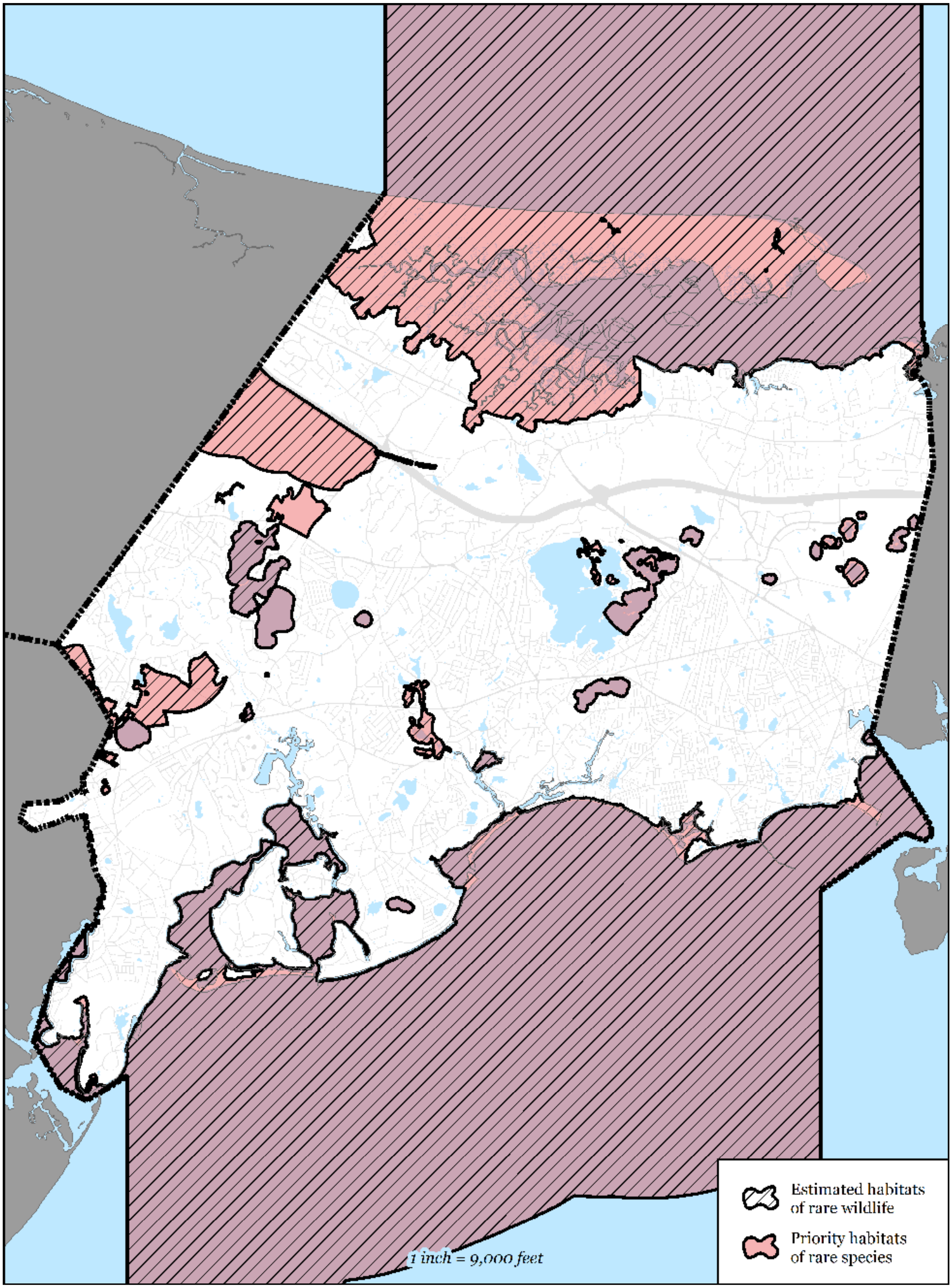

Figure 2-9: NHESP Priority Habitats and Estimated Habitats

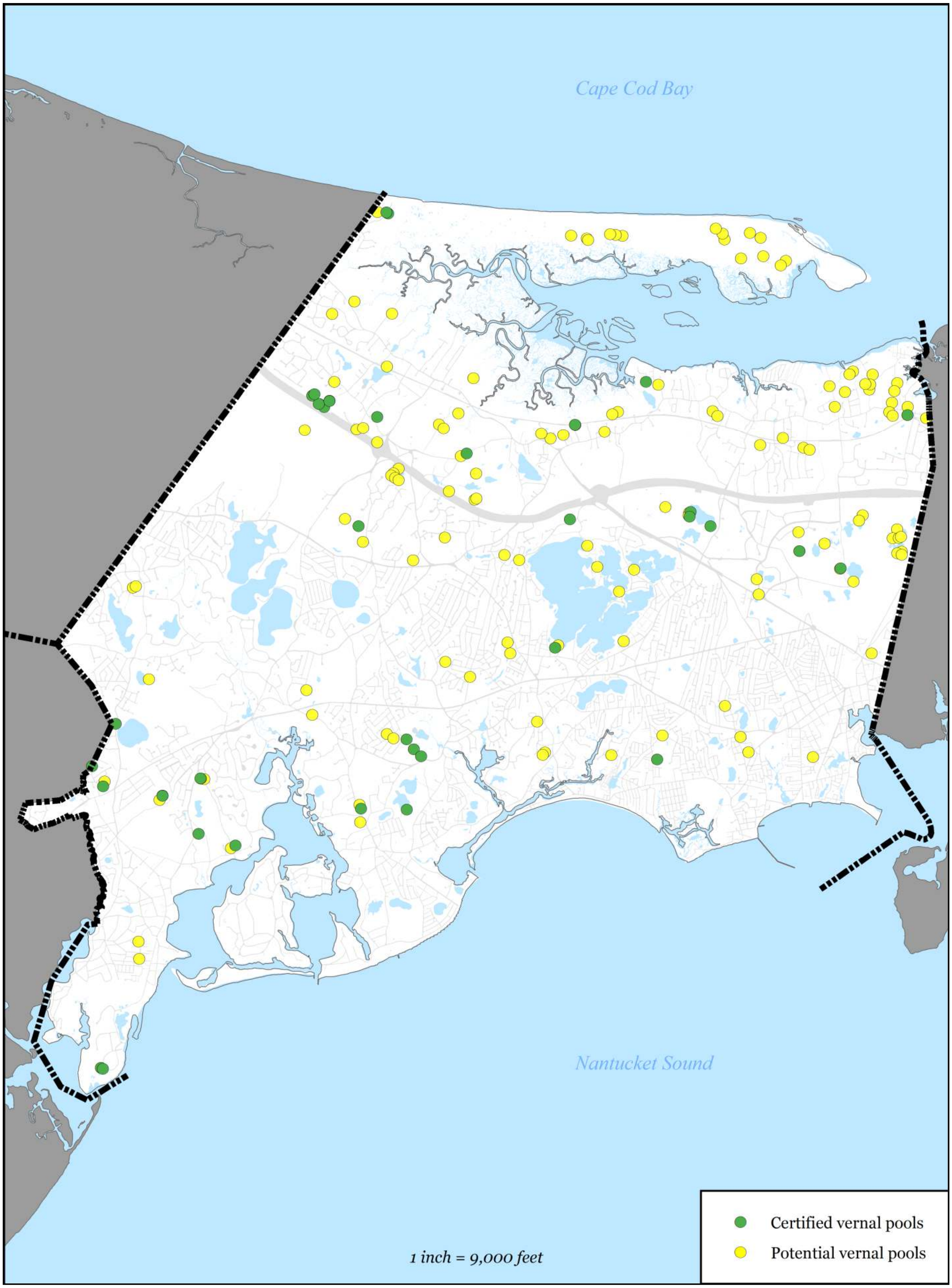

Figure 2-10: NHESP Certified Vernal Pools and Potential Vernal Pools

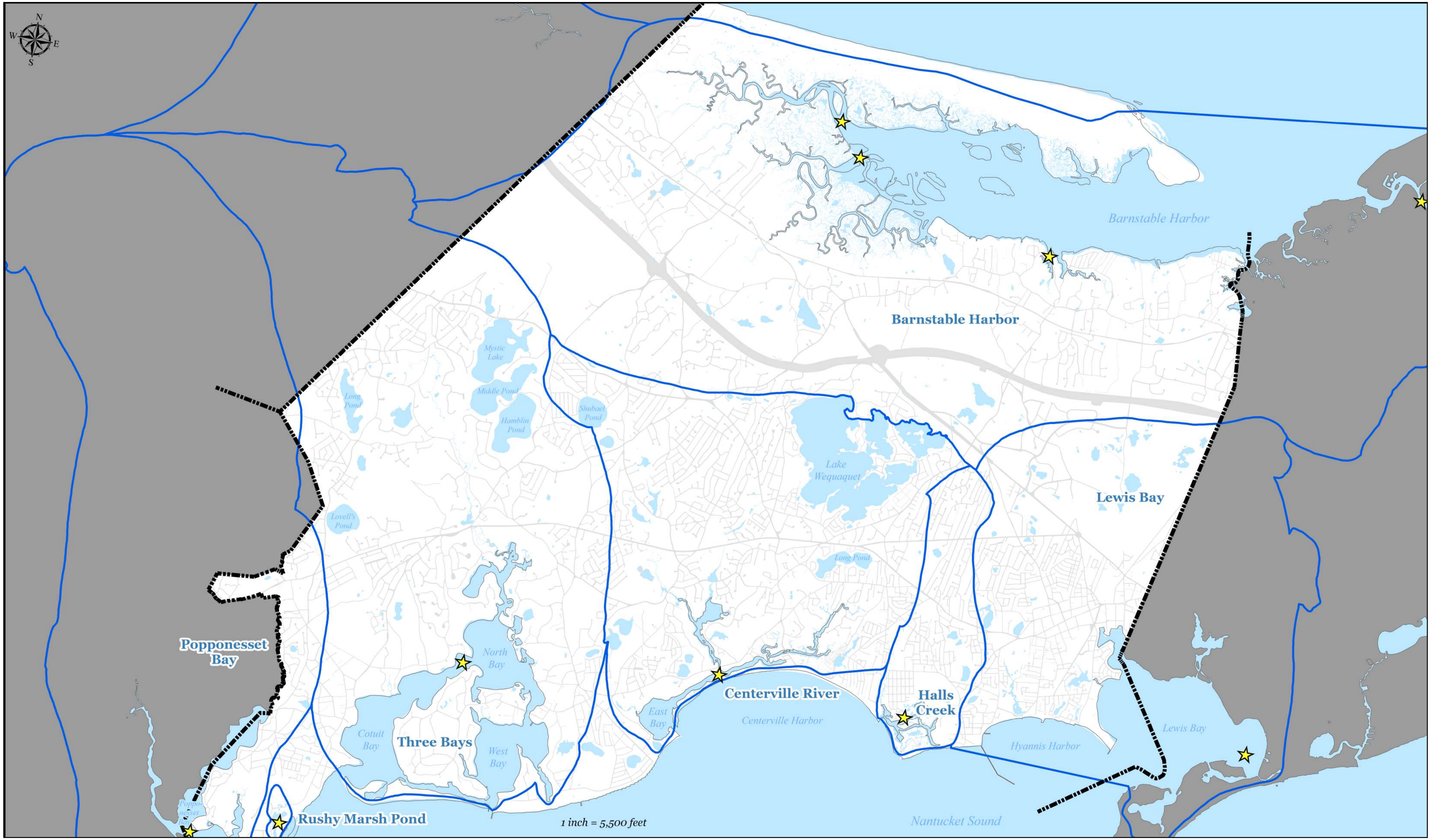

Figure 2-11: Sentinel Stations

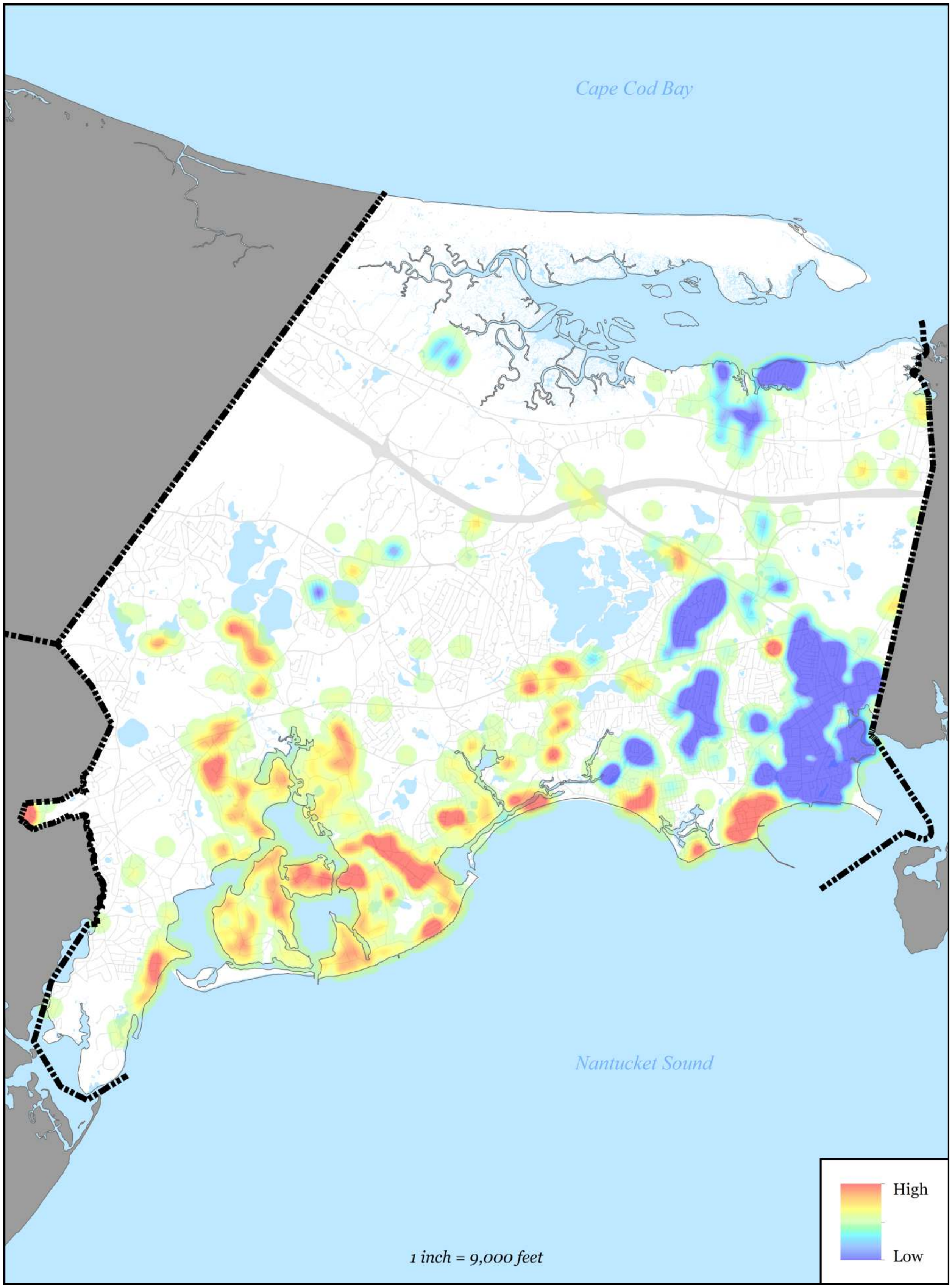

Figure 2-12: Nitrogen Loading Hotspots

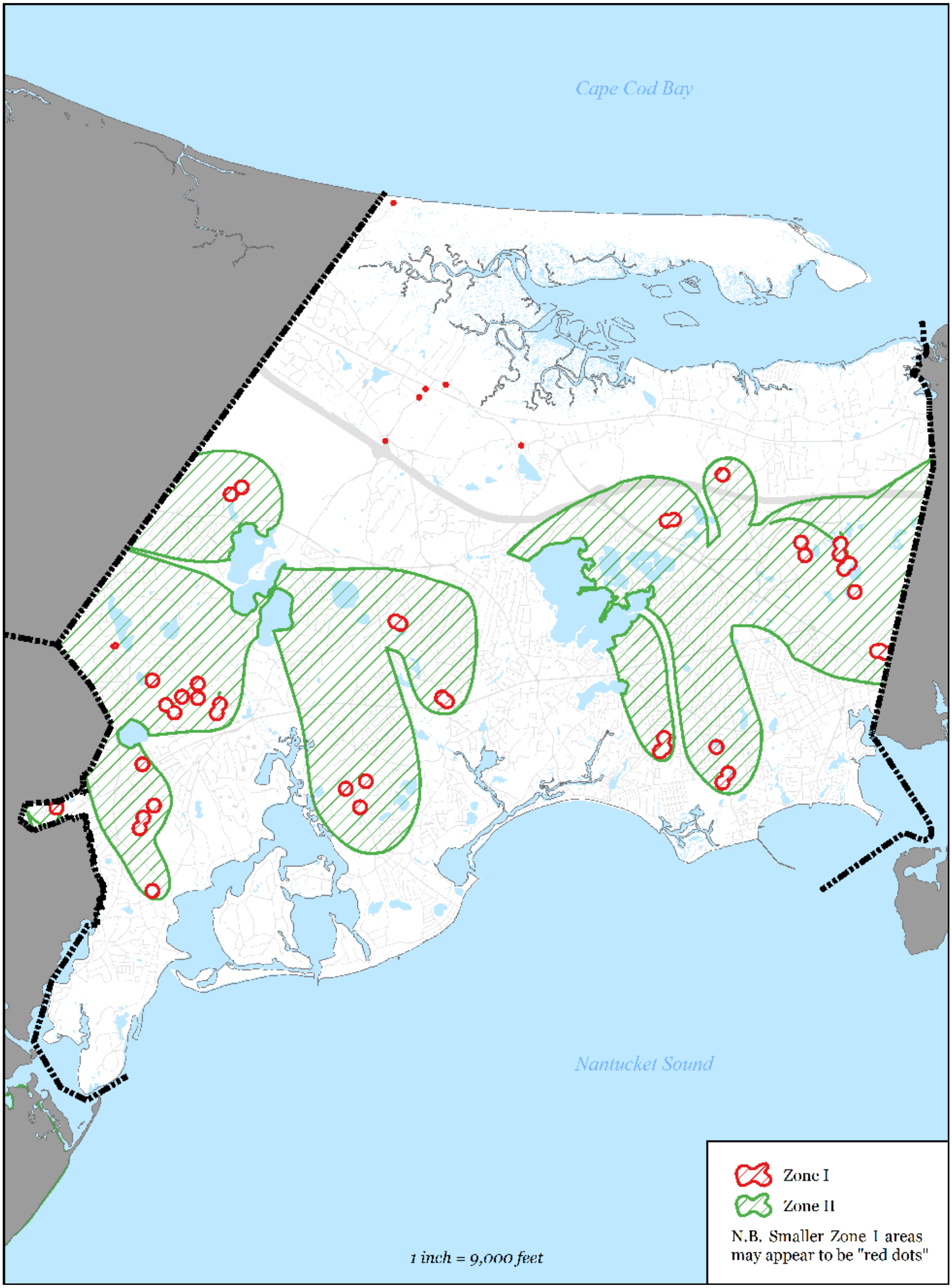

Figure 2-13: State-designated Wellhead Protection Areas

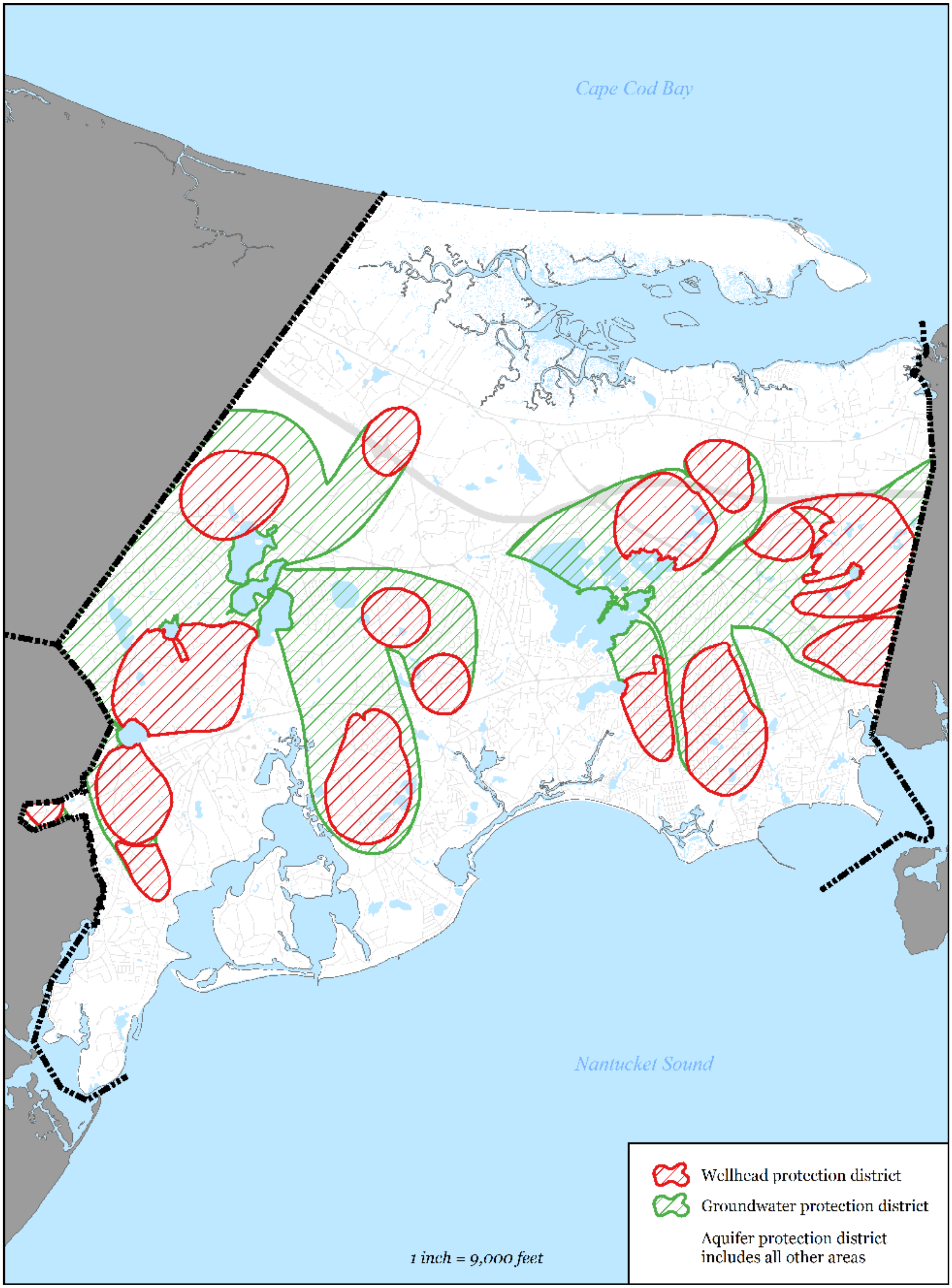

Figure 2-14: Town of Barnstable Groundwater Protection Overlay Districts

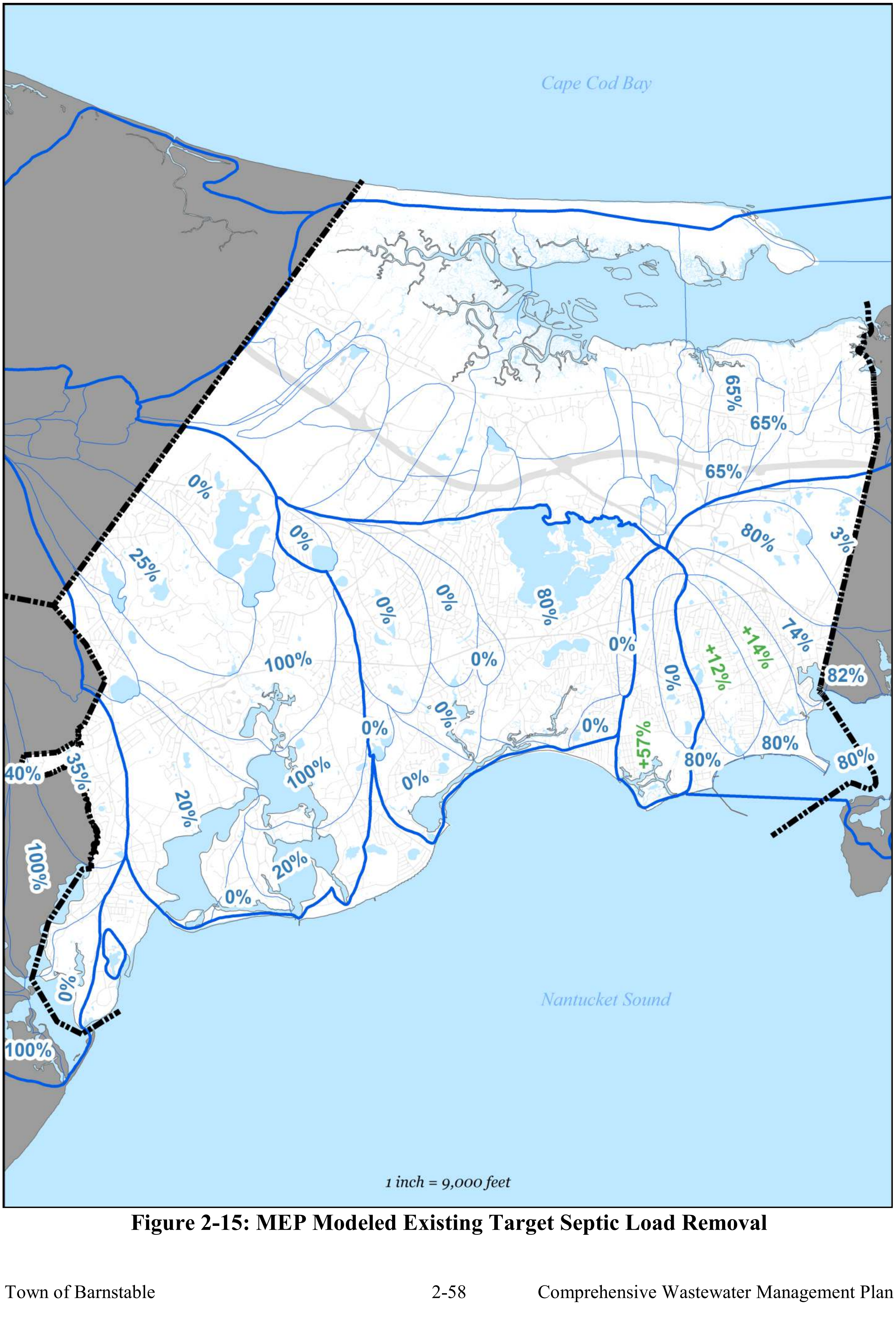

Figure 2-15: MEP Modeled Existing Target Septic Load Removal

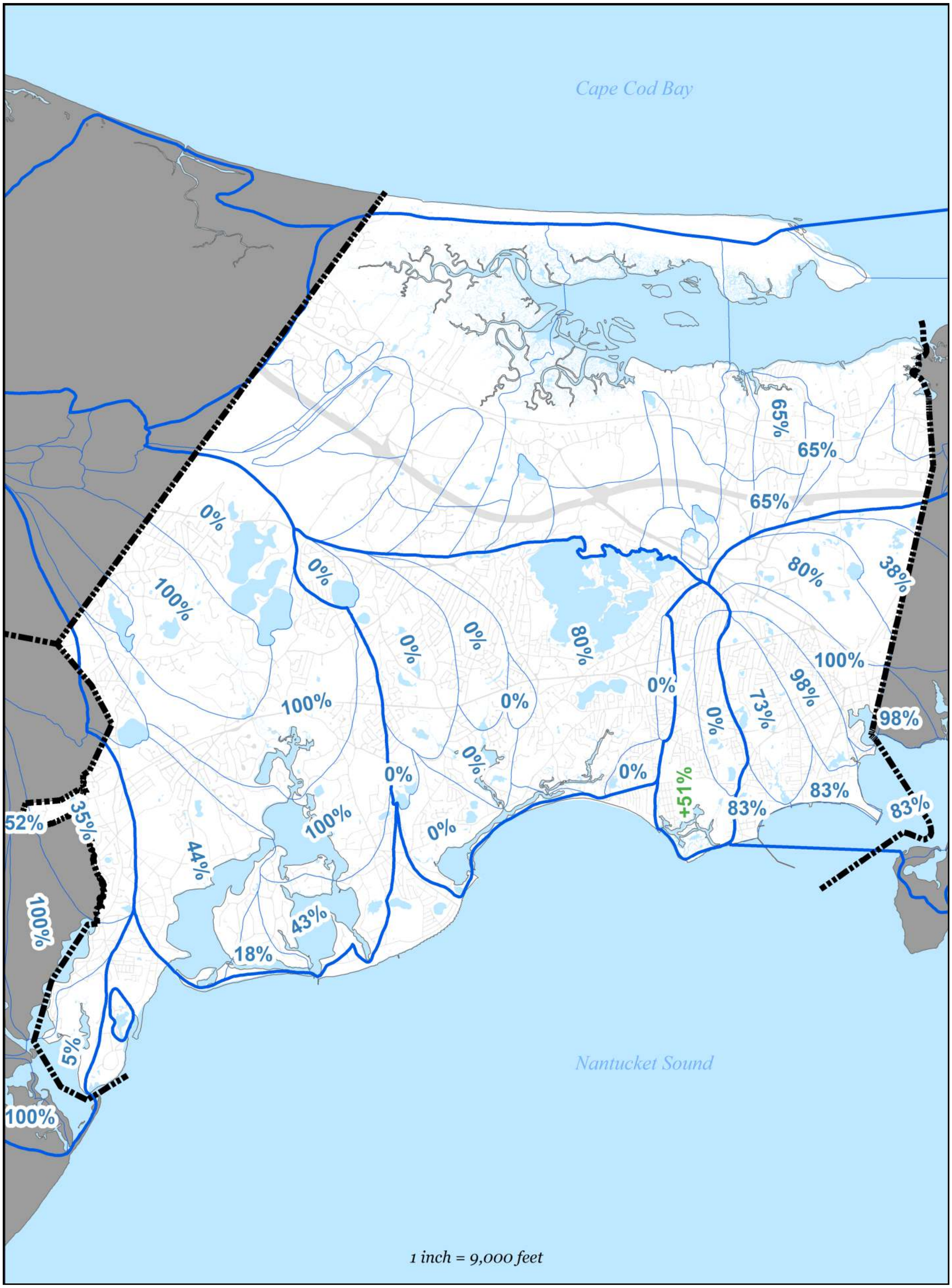

Figure 2-16: MEP Modeled Future Target Septic Load Removal

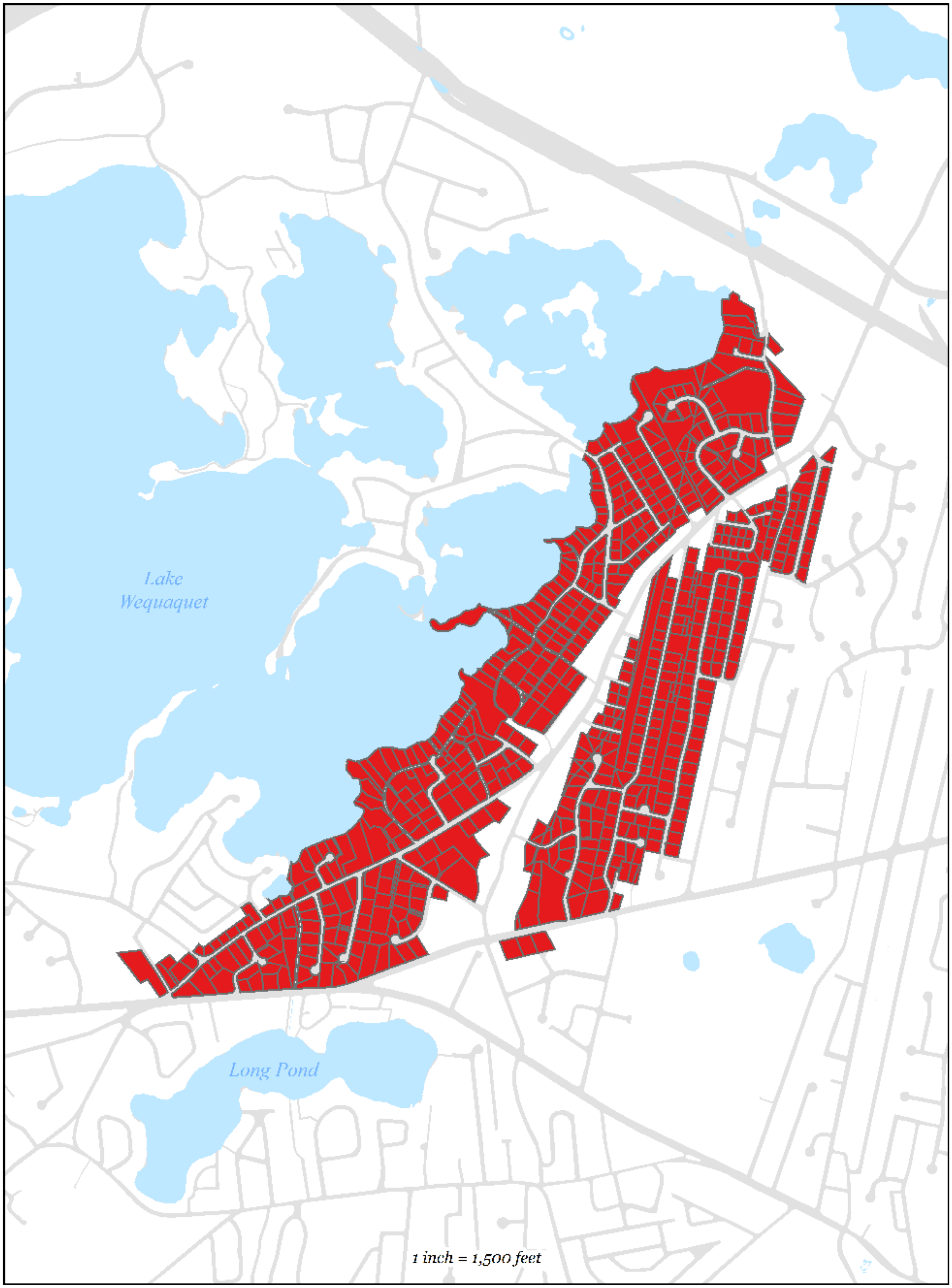

Figure 2-17: Phinney's Lane Sewer Expansion Project

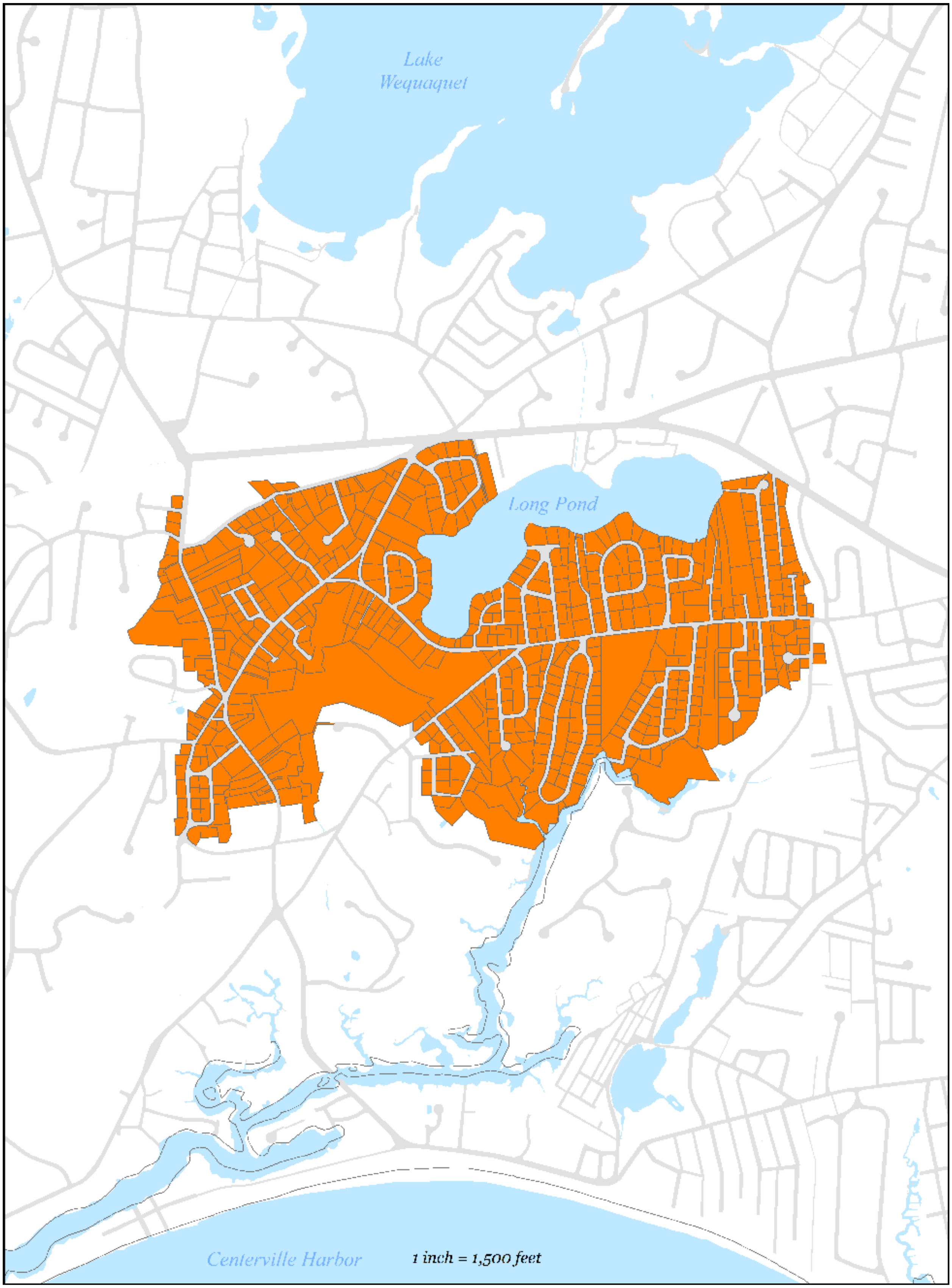

Figure 2-18: Long Pond Sewer Expansion Project

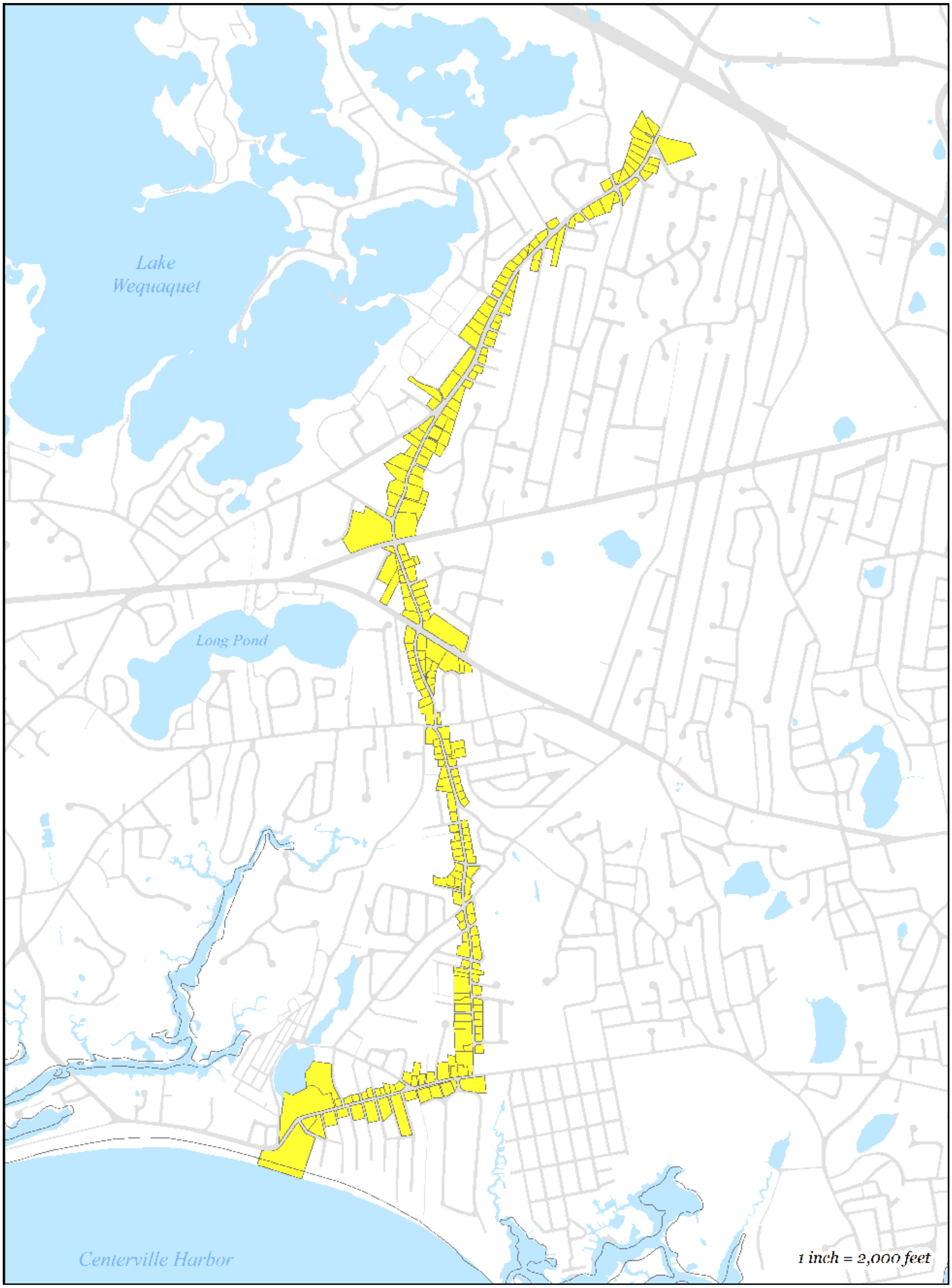

Figure 2-19: Strawberry Hill Road Sewer Expansion Project

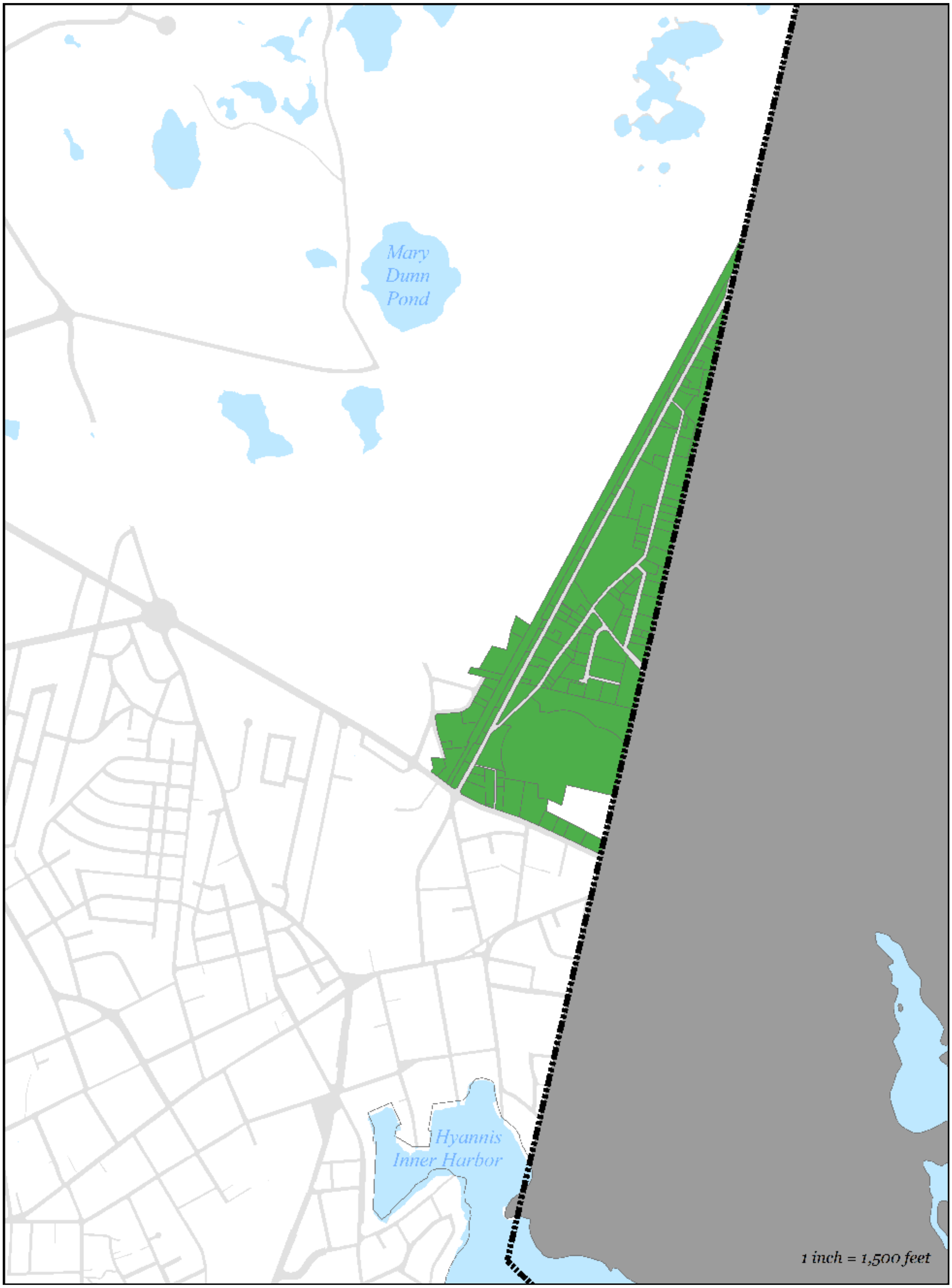

Figure 2-20: Old Yarmouth Road Sewer Expansion Project

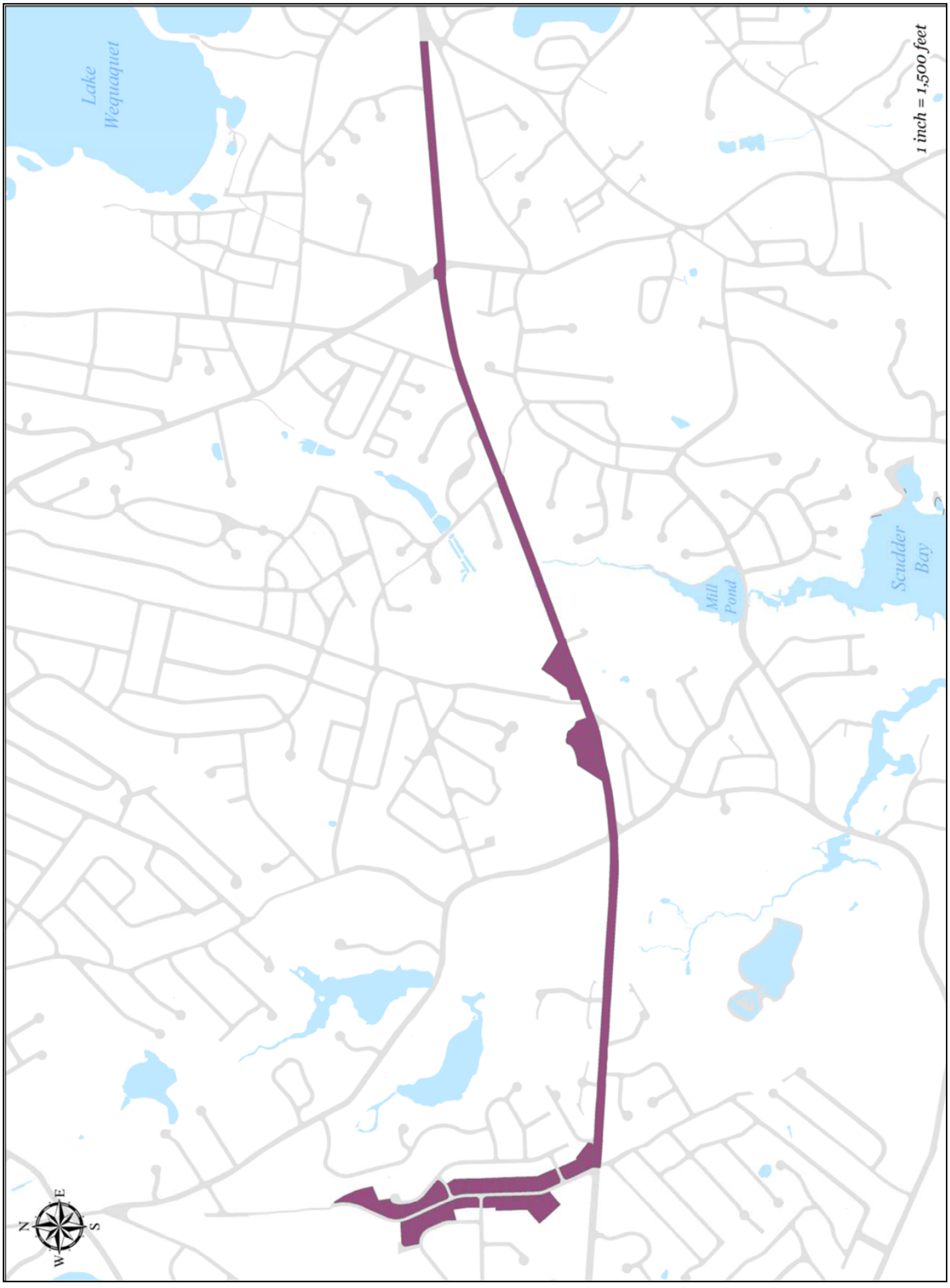

Figure 2-21: Route 28 Centerville (MMWWTF Transition) Project

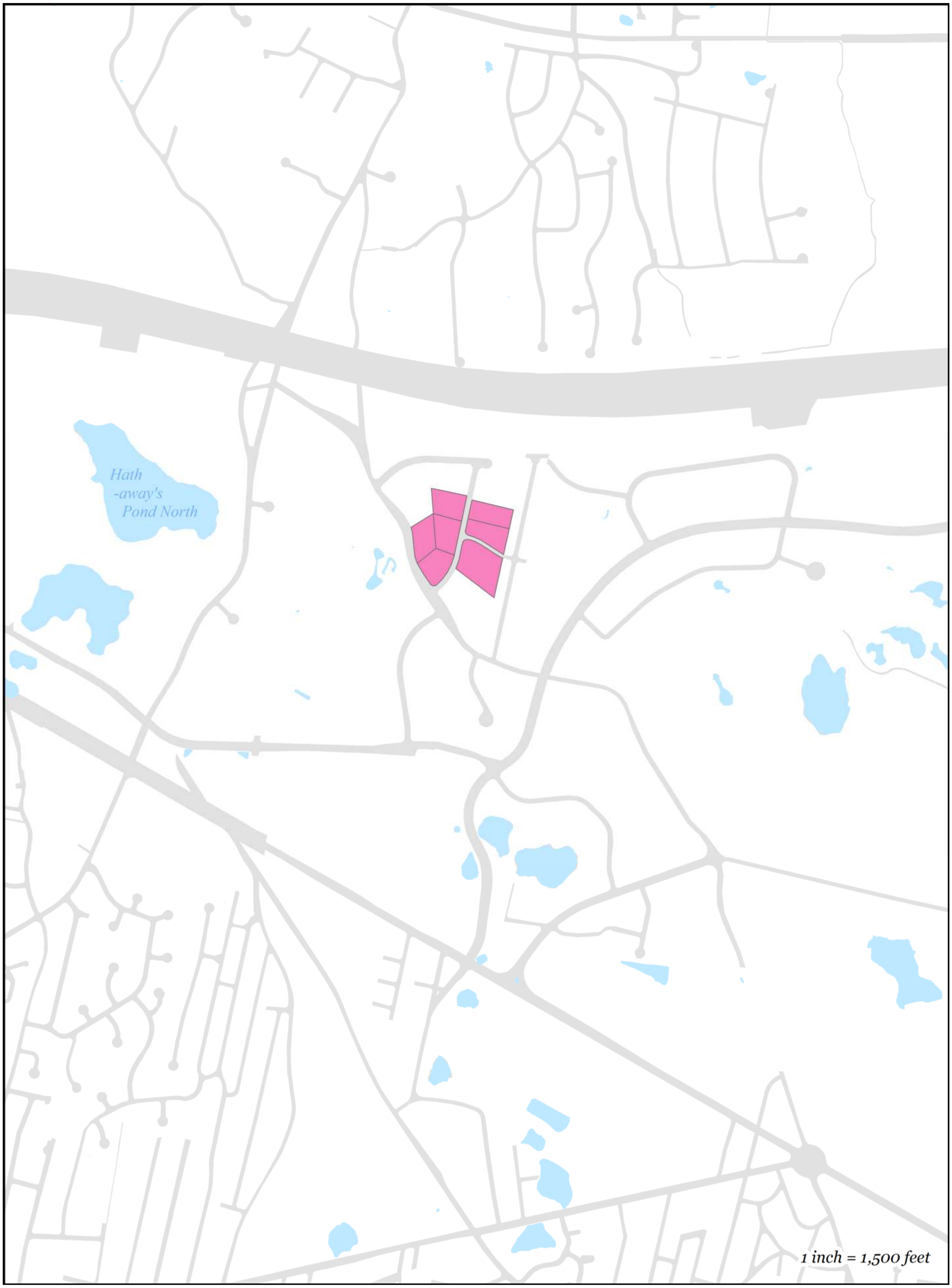

Figure 2-22: Merchant's Lane Sewer Expansion Project

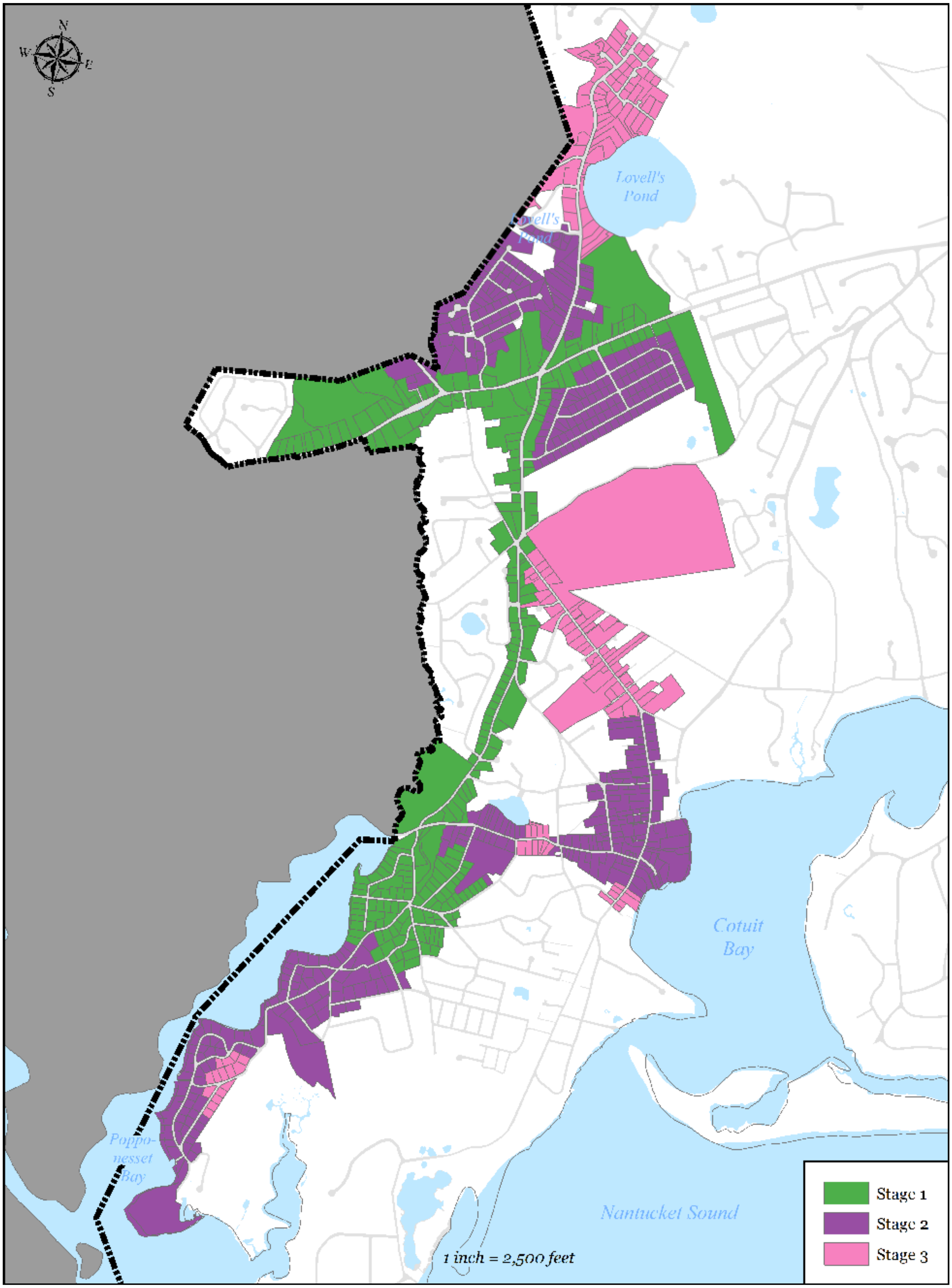

Figure 2-23: Cotuit Sewer Evaluation / Cotuit "Staging" Plan

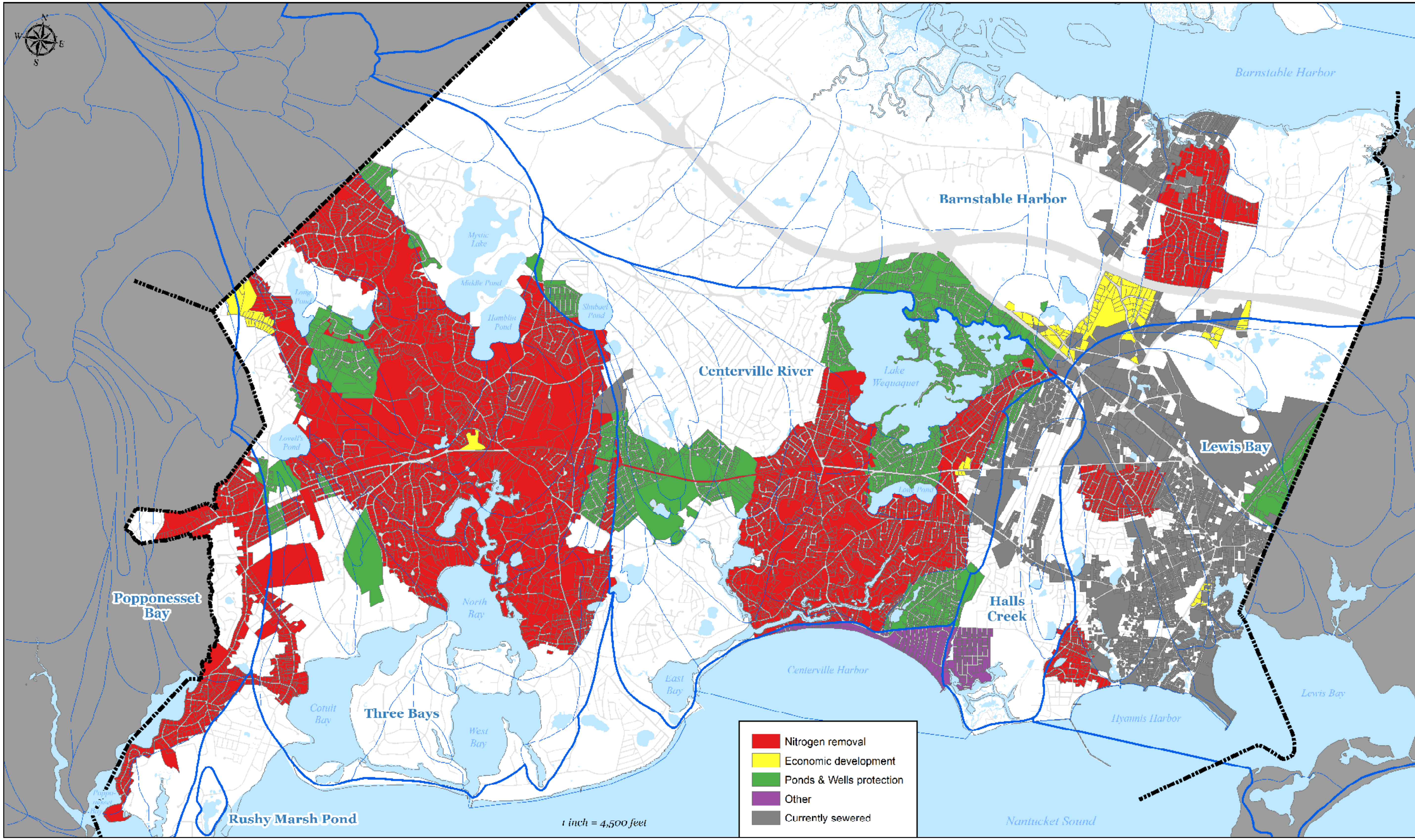

Figure 2-24: Wastewater Needs Areas

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 Asset 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.
- New effluent disposal should not occur in Zone IIs; and where possible, it should occur outside of 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 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.
- 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)	782,000	653,000	335,000	**1,770,000**
Load N Removed (kg/day)	78	65	33	**176**
Number of Parcels Affected	4,610	3,130	2,100	**9,870**
Approximate Road Miles	90	60	40	**190**
% of N Removed by Plan	44%	37%	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	250	480	160	**890**
Approximate Road Miles	6	9	3	**18**

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	1,770,000
Stages 1-3	144,500
Residential Buildout	211,300
Commercial Buildout	565,250
Total	**4,361,050**

1. Flows are average daily flows

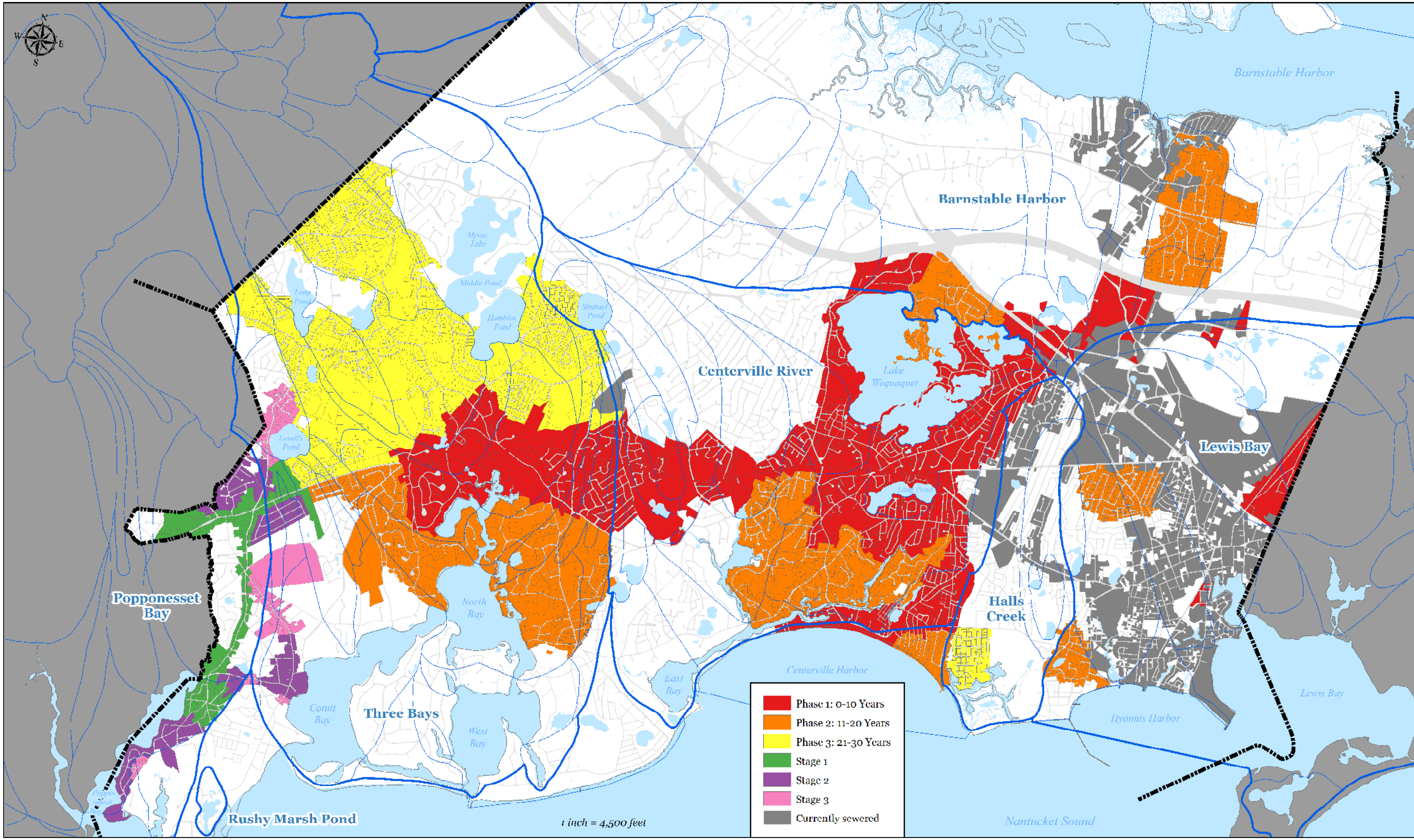

Figure 5-1: Sewer Expansion Phasing Plan

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.

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 which indicates that the TMDL will be met under this scenario (refer to Appendix OO). 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 attenuated nitrogen data):

- Total parcels within the Town of Barnstable within the Lewis Bay Watershed = 5,220
- Total parcels connected to existing municipal sewer = 2,256 (43%)
- Parcels with total area less than 0.25 acres = 2,315 (44%)
    - 1,119 (48%) already served by municipal sewer
    - 329 (14%) additional to be addressed with a traditional solution in the Plan
    - Total = 1,448 (62%)
- Parcels with average depth to groundwater less than four feet = 158 (3%)
    - 59 (37%) already served by municipal sewer
    - 20 (13%) additional to be addressed with a traditional solution in the Plan
    - Total = 79 (50%)
- Parcels with septic system variances = 27 (0.5%)
    - 3 (11%) will be addressed with a traditional solution in the Plan
- Parcels with known failed septic systems = 4 (0.08%)
    - 1 (25%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 2,498 (48%)
    - 842 (34%) already served by municipal sewer
    - 265 (11%) additional to be addressed with a traditional solution in the Plan
    - Total = 1,107 (44%)

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 = 5,220
- Parcels within FEMA mapped 100-year flood zone (AE/AO) or velocity zone (VE) = 601
    - 430 (71%) already served by municipal sewer
    - 23 (4%) that will be addressed with a traditional solution in the Plan
    - Total = 453 (75%)

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 265 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 wellfield. 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 9 ponds in the Lewis Bay Watershed. Pond classification of these ponds is shown in Table 5-4 and Table 5-5.

Table 5-4: 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 Campground Pond		
Mesotrophic	Aunt Betty's Pond Fawcett's		
Eutrophic			
Hypereutrophic		School House	

Table 5-5: Lewis Bay Watershed Pond Classification 2017

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

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

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
    - 2,256 of the 5,220 parcels (43%) 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).

- 840 parcels (16%) in the watershed are included in the proposed sewer expansion plan (14.4 kg/day-N, un-attenuated).
- Total proposed removal of (15.8 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 upgrades 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.
    - 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 6.4 for the Adaptive Management Plan and Section 6.3 for the Monitoring Plan.

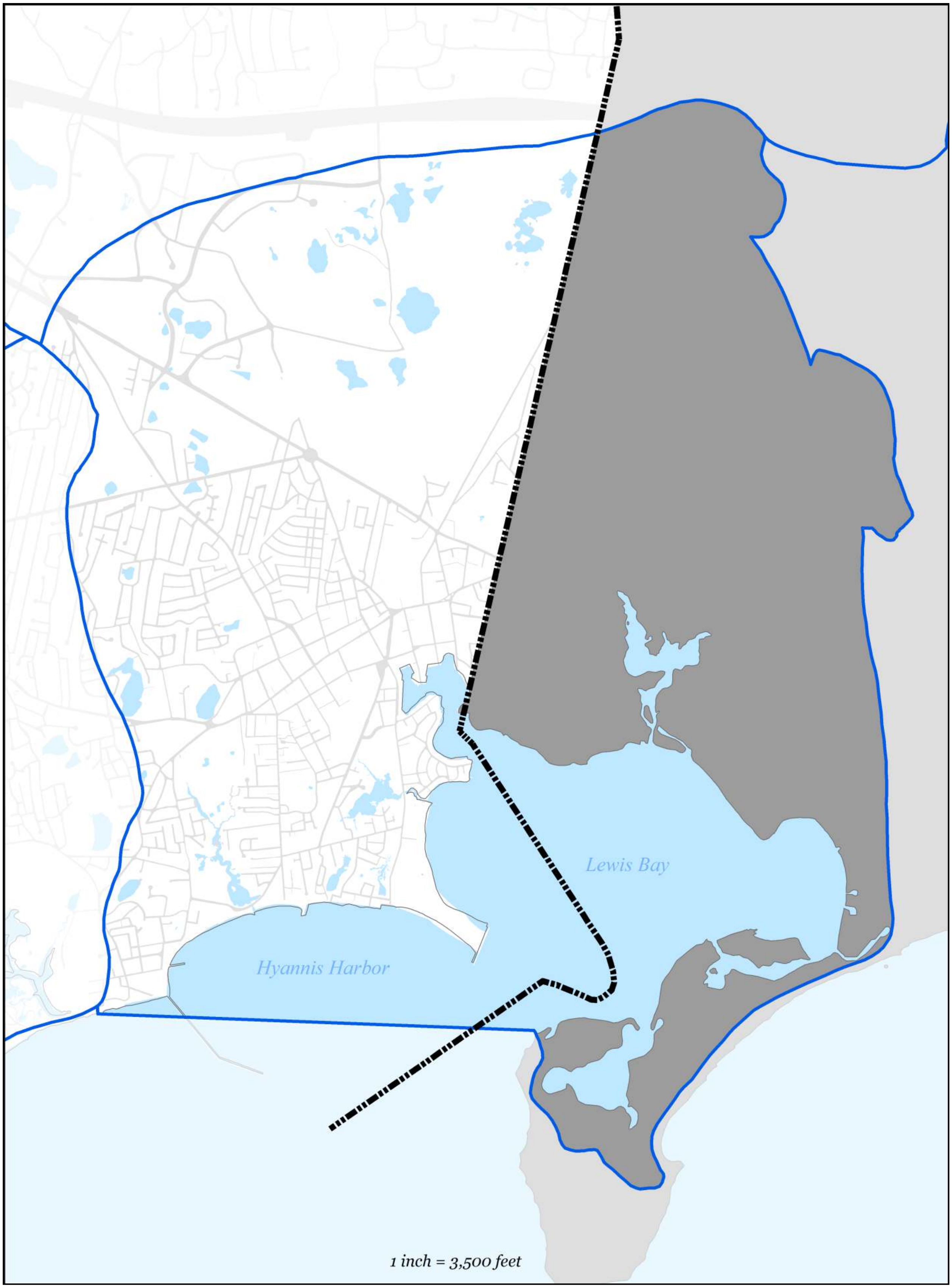

Figure 5-2: Lewis Bay Watershed

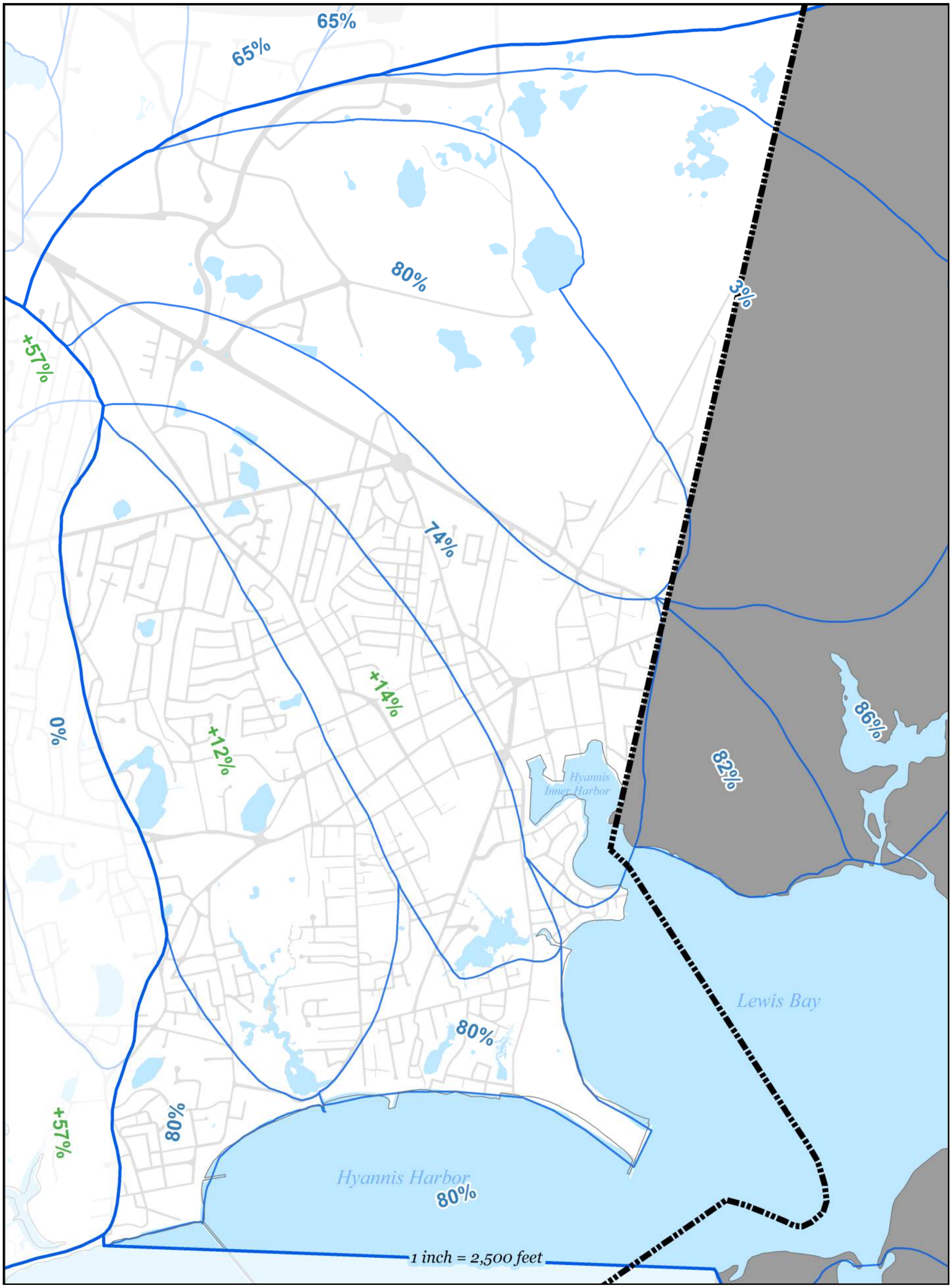

Figure 5-3: MEP-modeled Existing Septic Load Removal in Lewis Bay Watershed

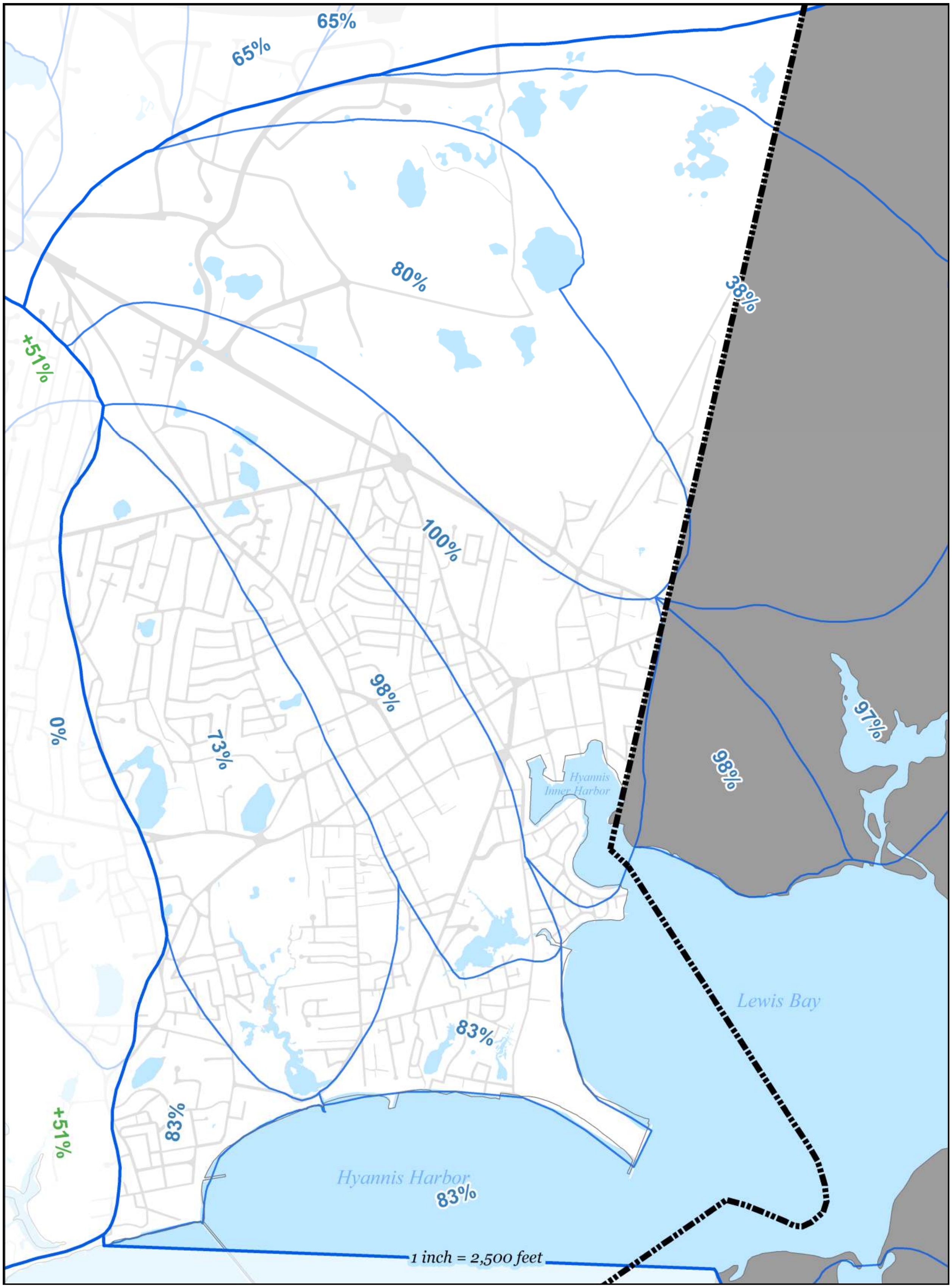

Figure 5-4: MEP-modeled Future Septic Load Removal in Lewis Bay Watershed

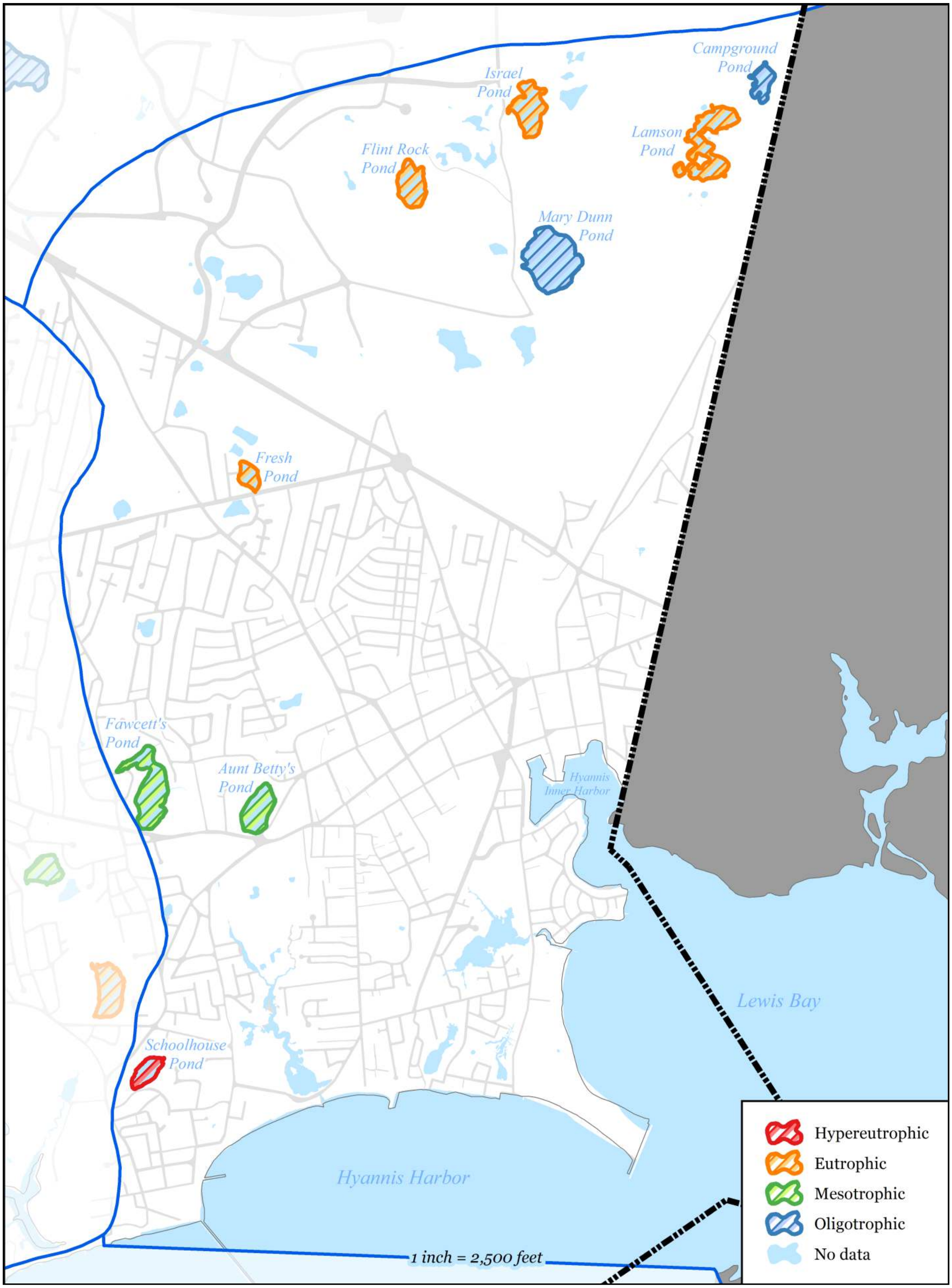

Figure 5-5: Impaired Ponds in Lewis Bay Watershed

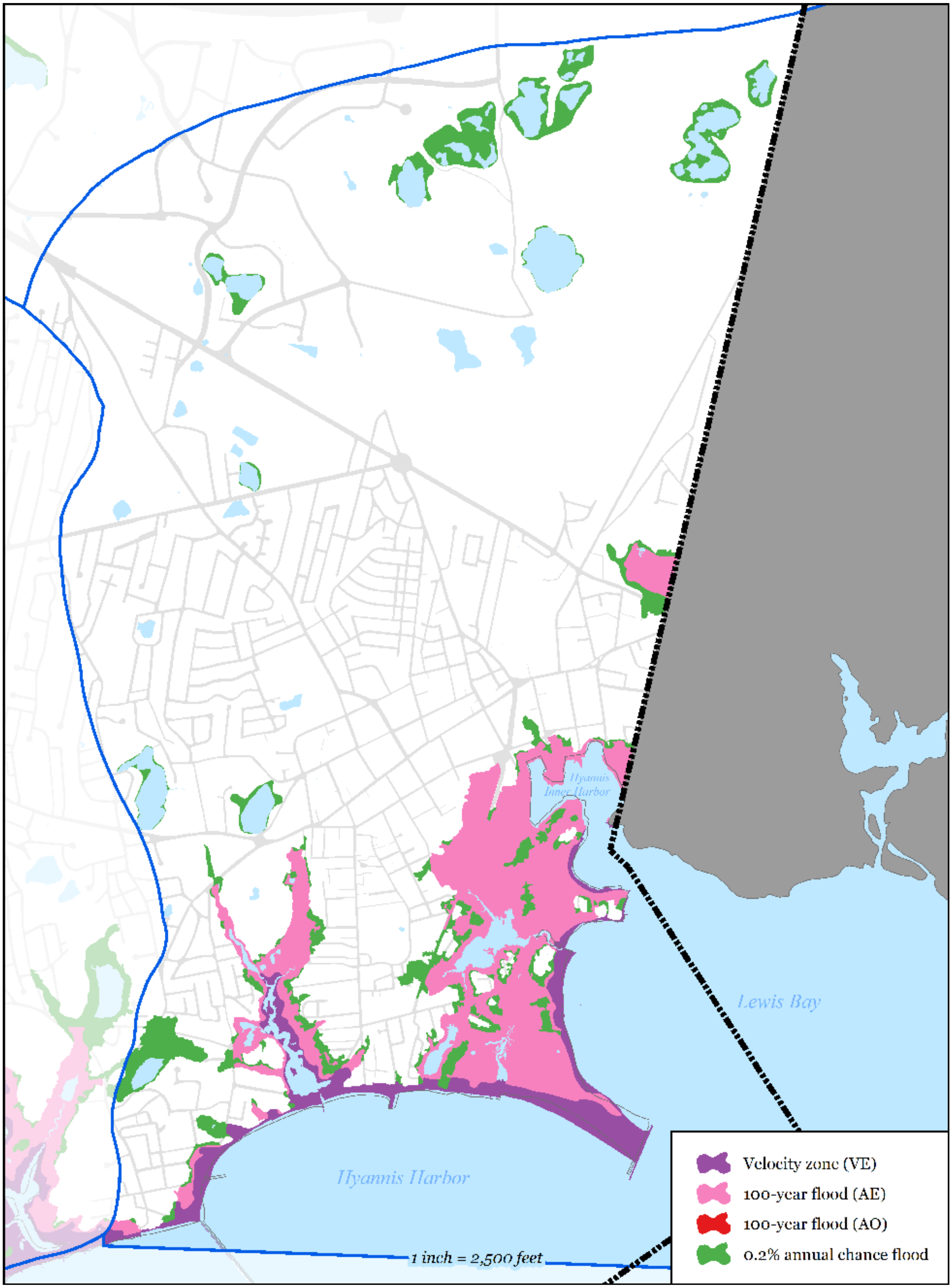

Figure 5-6: FEMA Flood Zones (2014) in Lewis Bay Watershed

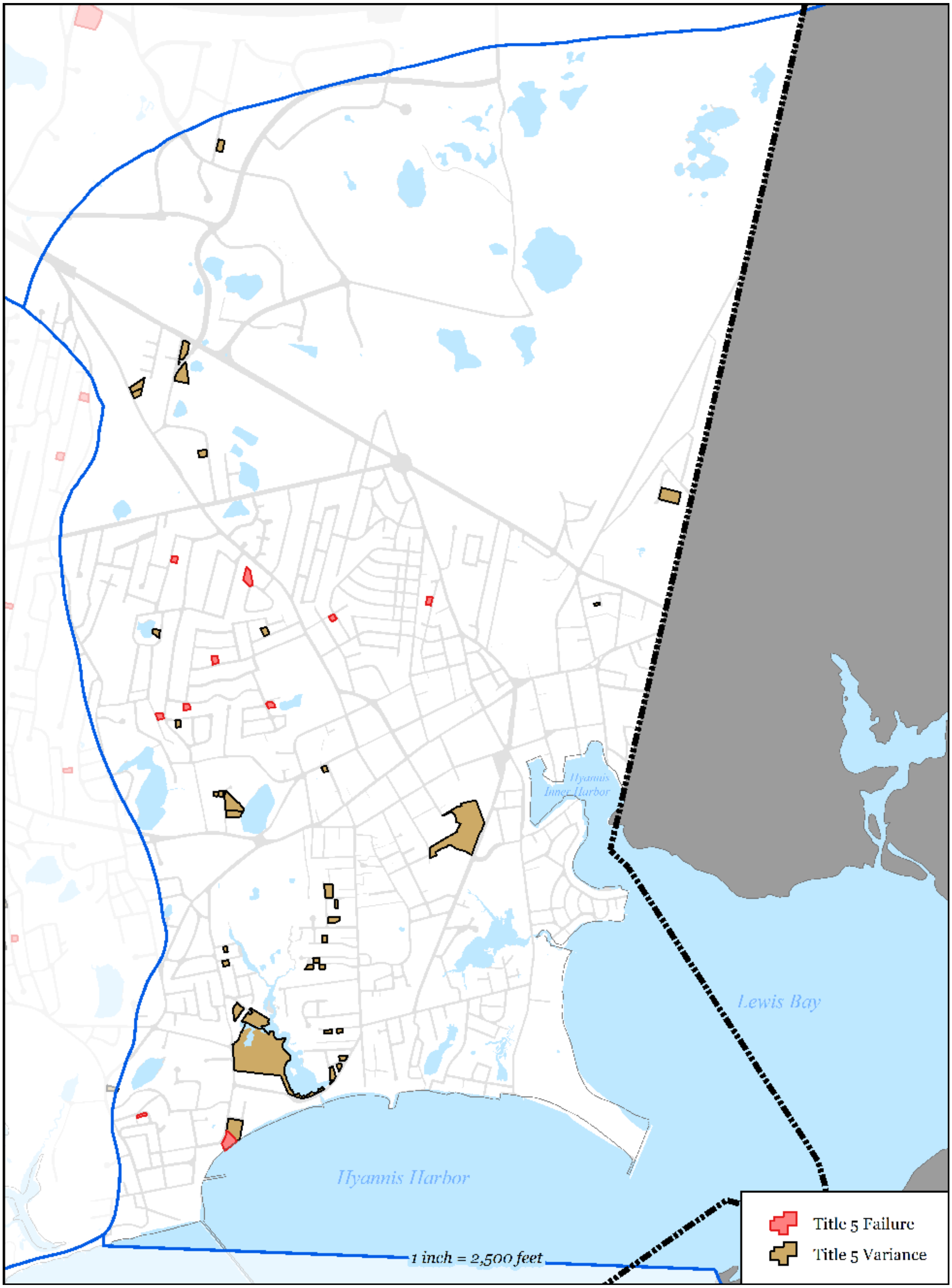

Figure 5-7: Parcels with Title 5 Septic Failures and Variances in Lewis Bay Watershed

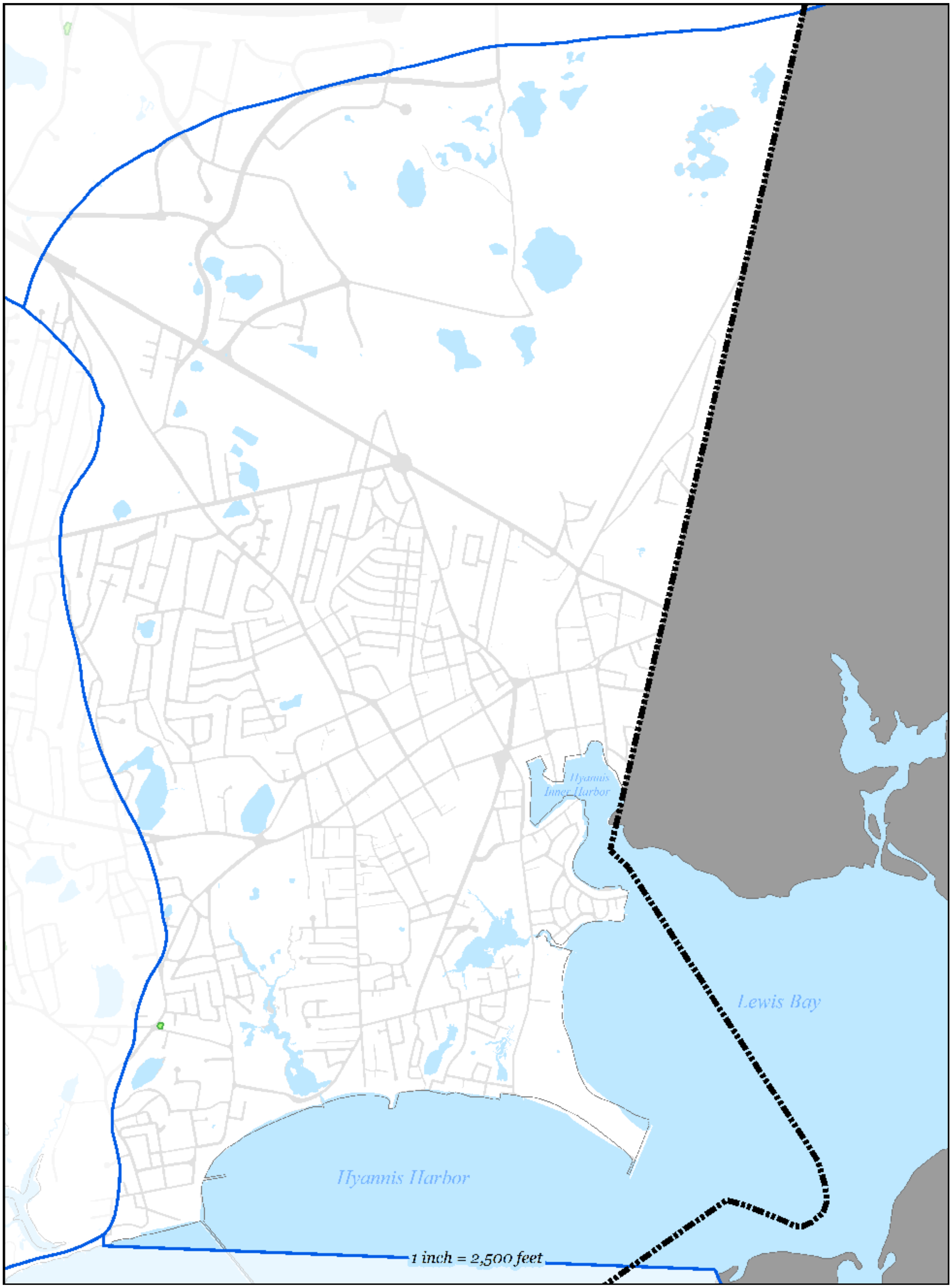

Figure 5-8: Parcels with I/A Septic Systems in Lewis Bay Watershed

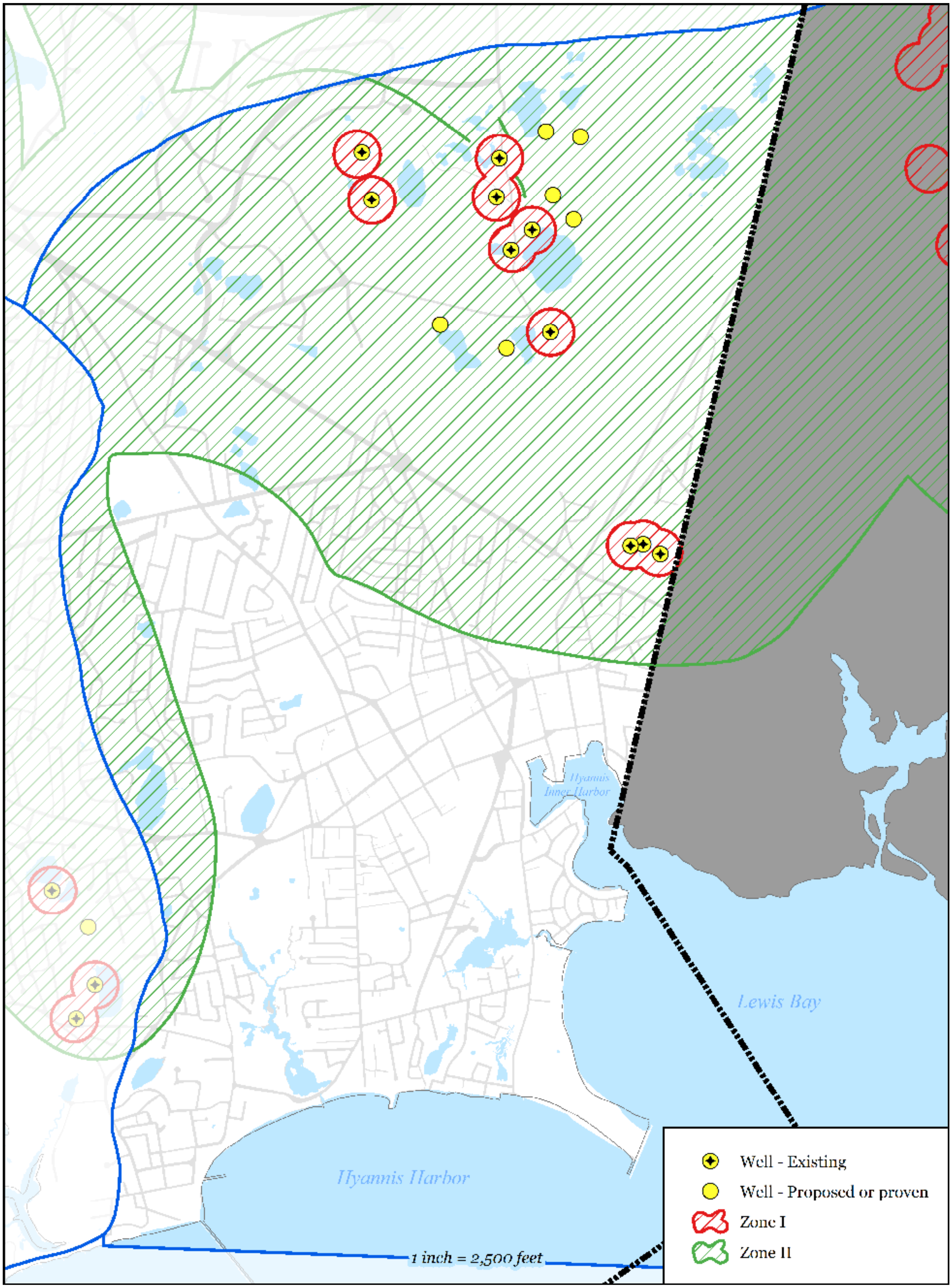

Figure 5-9: Public Water Supply Wells in Lewis Bay Watershed

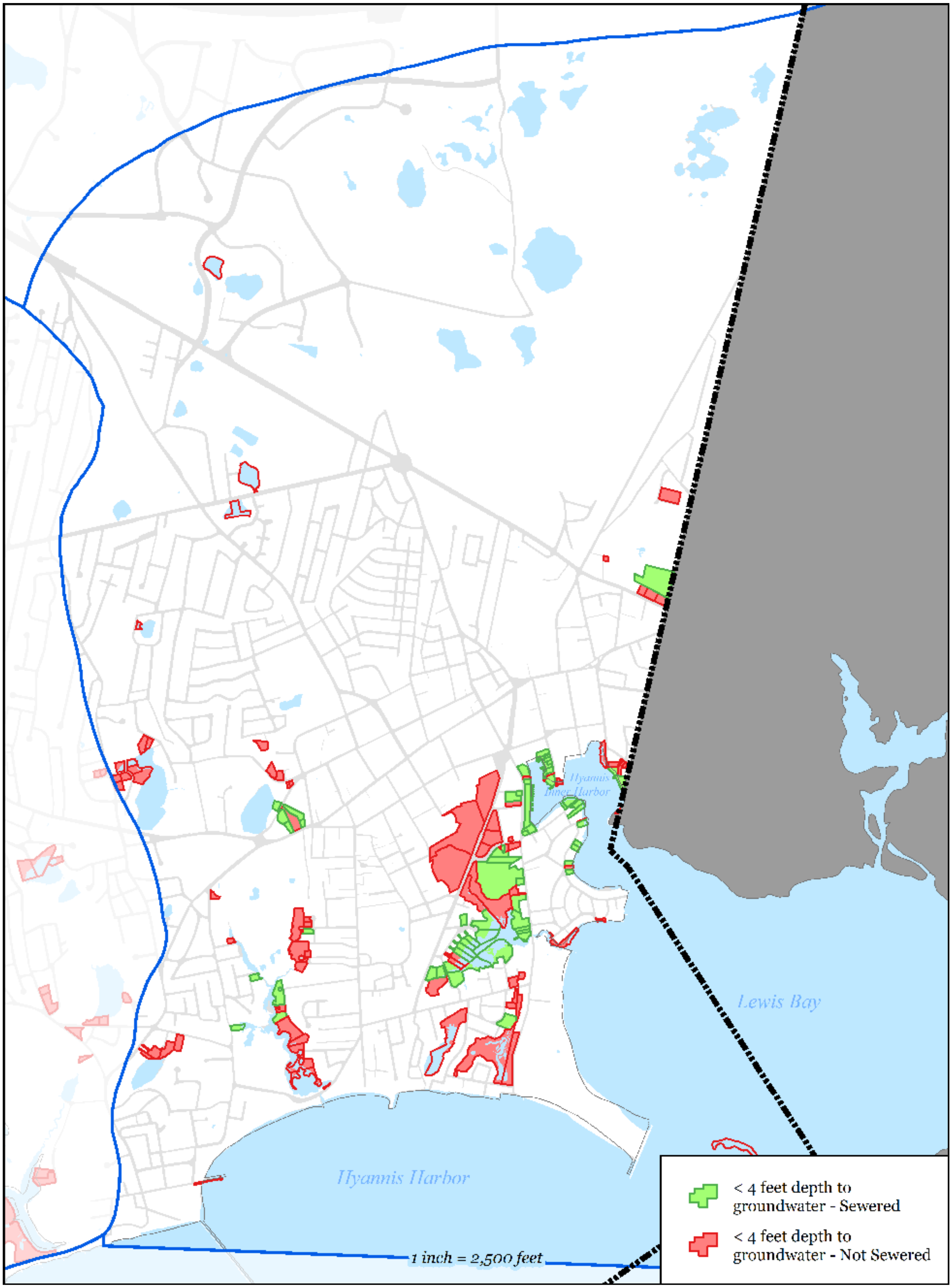

Figure 5-10: Parcels with Less than 4 feet Depth to Groundwater in Lewis Bay Watershed

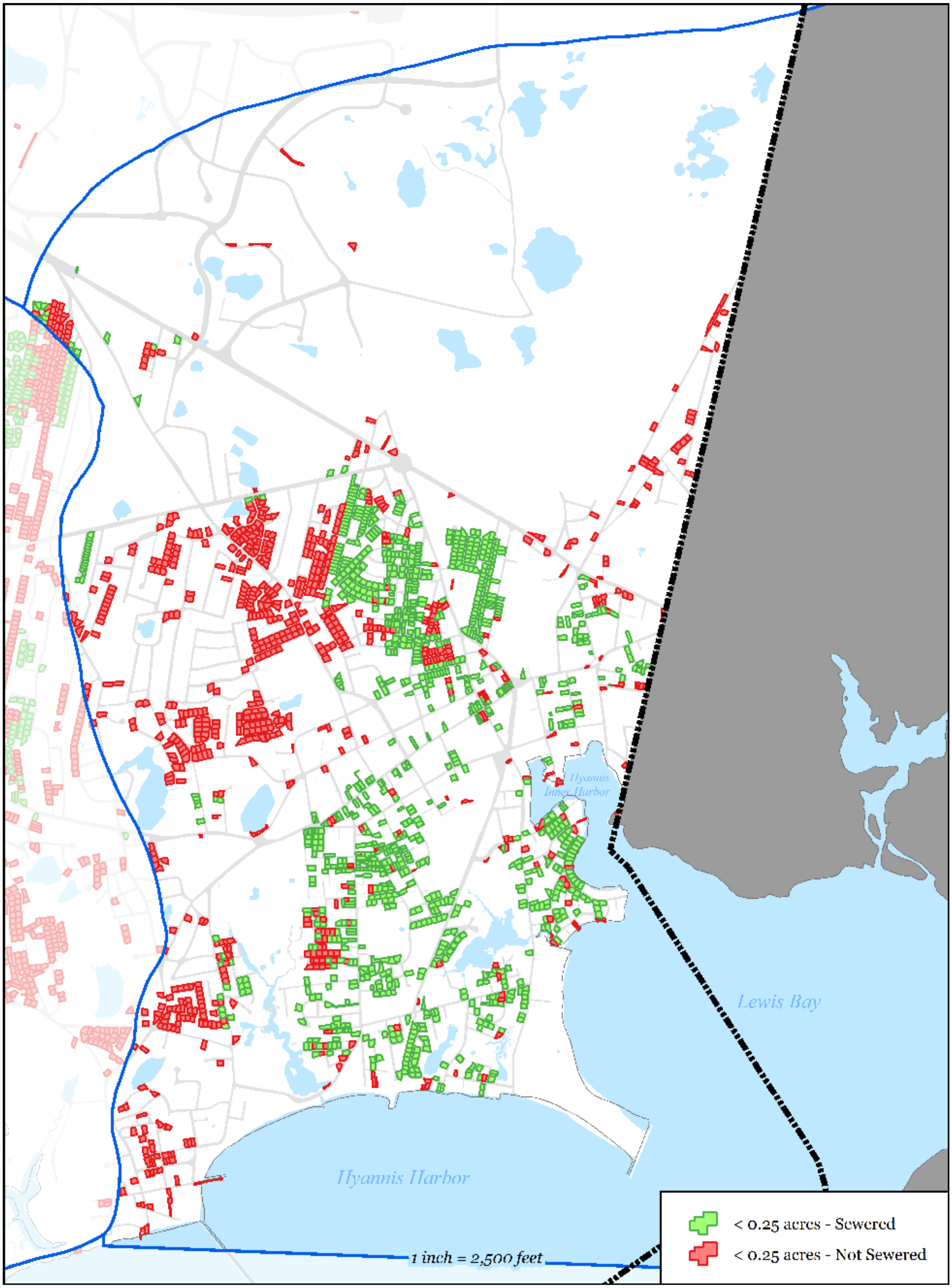

Figure 5-11: Parcels with Less than 0.25 acres in Lewis Bay Watershed

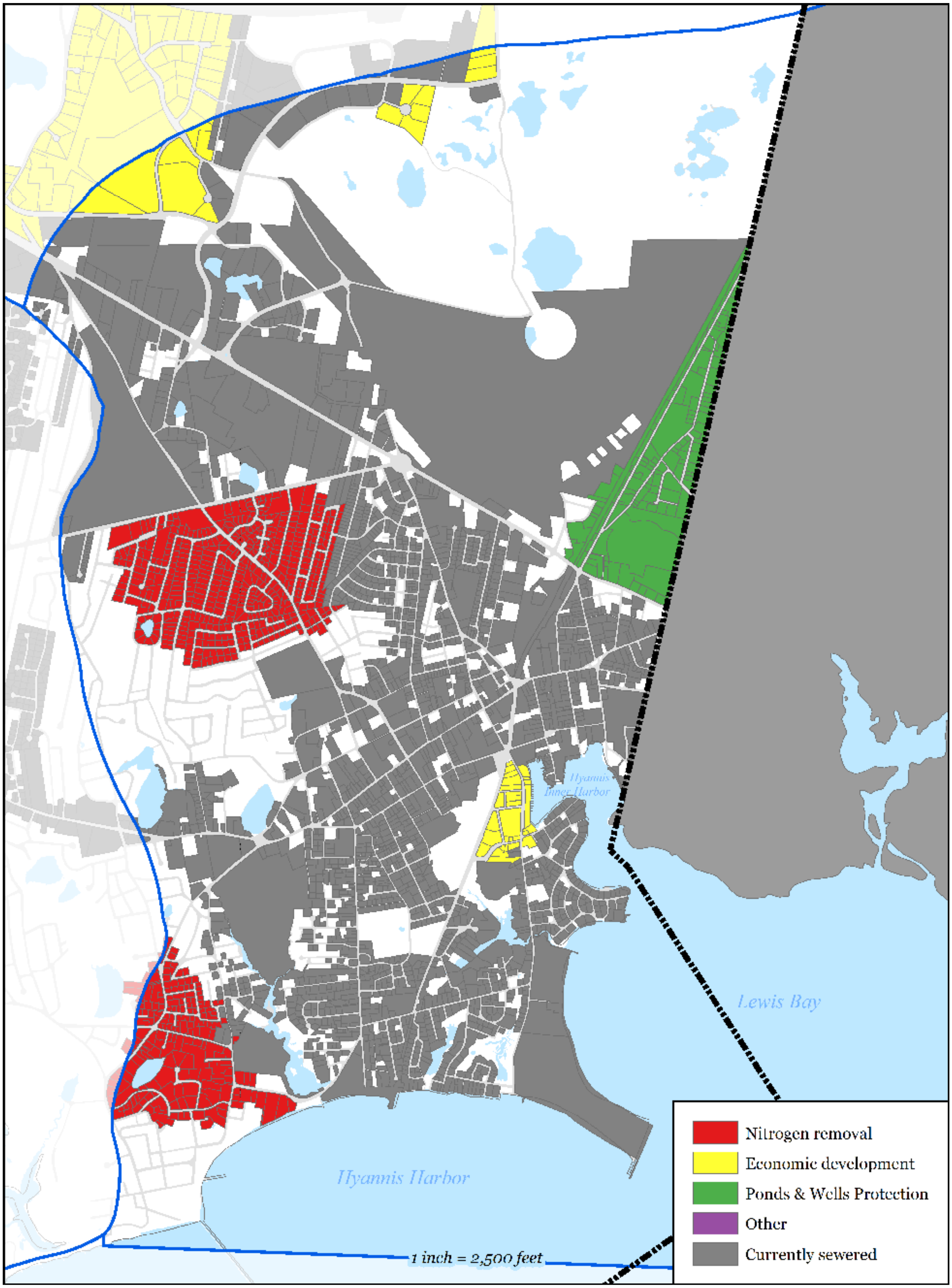

Figure 5-12: Needs Areas in Lewis Bay Watershed

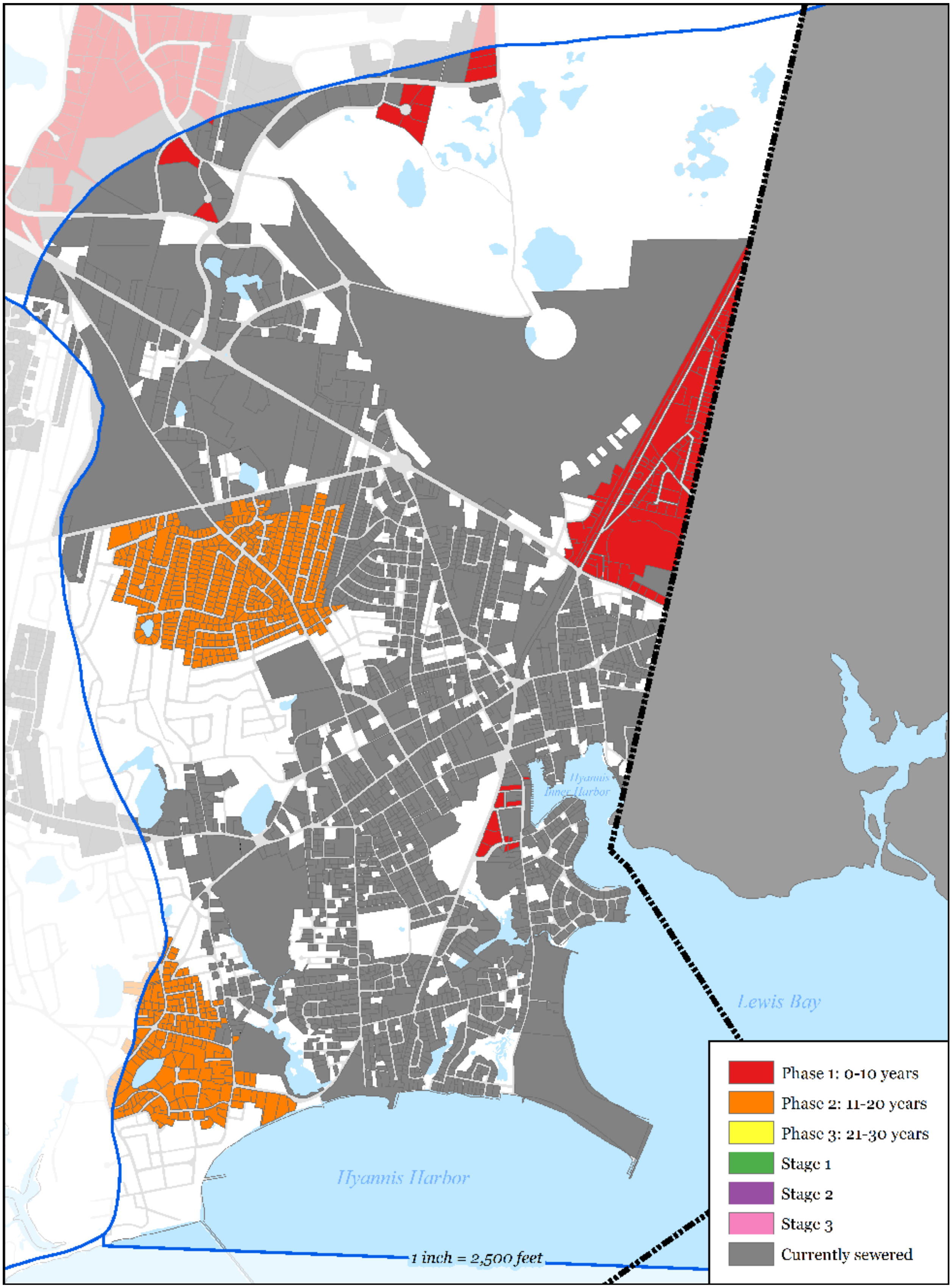

Figure 5-13: Sewer Expansion Plan in Lewis Bay Watershed

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 attenuated nitrogen data):

- Total parcels within the Halls Creek Watershed = 1,368
- Total parcels connected to existing municipal sewer = 329 (24%)
- Parcels with total area less than 0.25 acres = 642 (47%)
    - 164 (25%) already served by municipal sewer
    - 192 (30%) additional to be addressed with a traditional solution in the Plan
    - Total = 356 (55%)
- Parcels with average depth to groundwater less than four feet = 33 (2%)
    - 0 (0%) already served by municipal sewer
    - 23 (70%) additional to be addressed with a traditional solution in the Plan
    - Total = 23 (70%)
- Parcels with septic system variances = 5 (0.4%)
    - 3 (60%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 856 (63%)
    - 329 (38%) already served by municipal sewer
    - 71 (8%) additional to be addressed with a traditional solution in the Plan
    - Total = 400 (47%)

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 5-6 and Table 5-7.

Table 5-6: 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 5-7: 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		
Eutrophic	Simmons Pond		
Hypereutrophic			

Two ponds within the watershed have been identified as impaired; Dunn's Pond and Simmons 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 = 1,368
- Parcels within FEMA mapped 100-year flood zone (AE/AO) or velocity zone (VE) = 130
  - 0 (0%) already served by municipal sewer
  - 92 (71%) that will be addressed with a traditional solution in the Plan
  - Total = 92 (71%)

5.2.2.2 PROPOSED SOLUTIONS

The plan addresses the needs areas using the following techniques:

- Sewer Expansion
  - 329 of the 1,368 parcels (24%) located in the watershed are served by municipal sewer
  - 351 of the 1,368 parcels (26%) 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.
    - 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 6.4 for the Adaptive Management Plan and Section 6.3 for the Monitoring Plan.

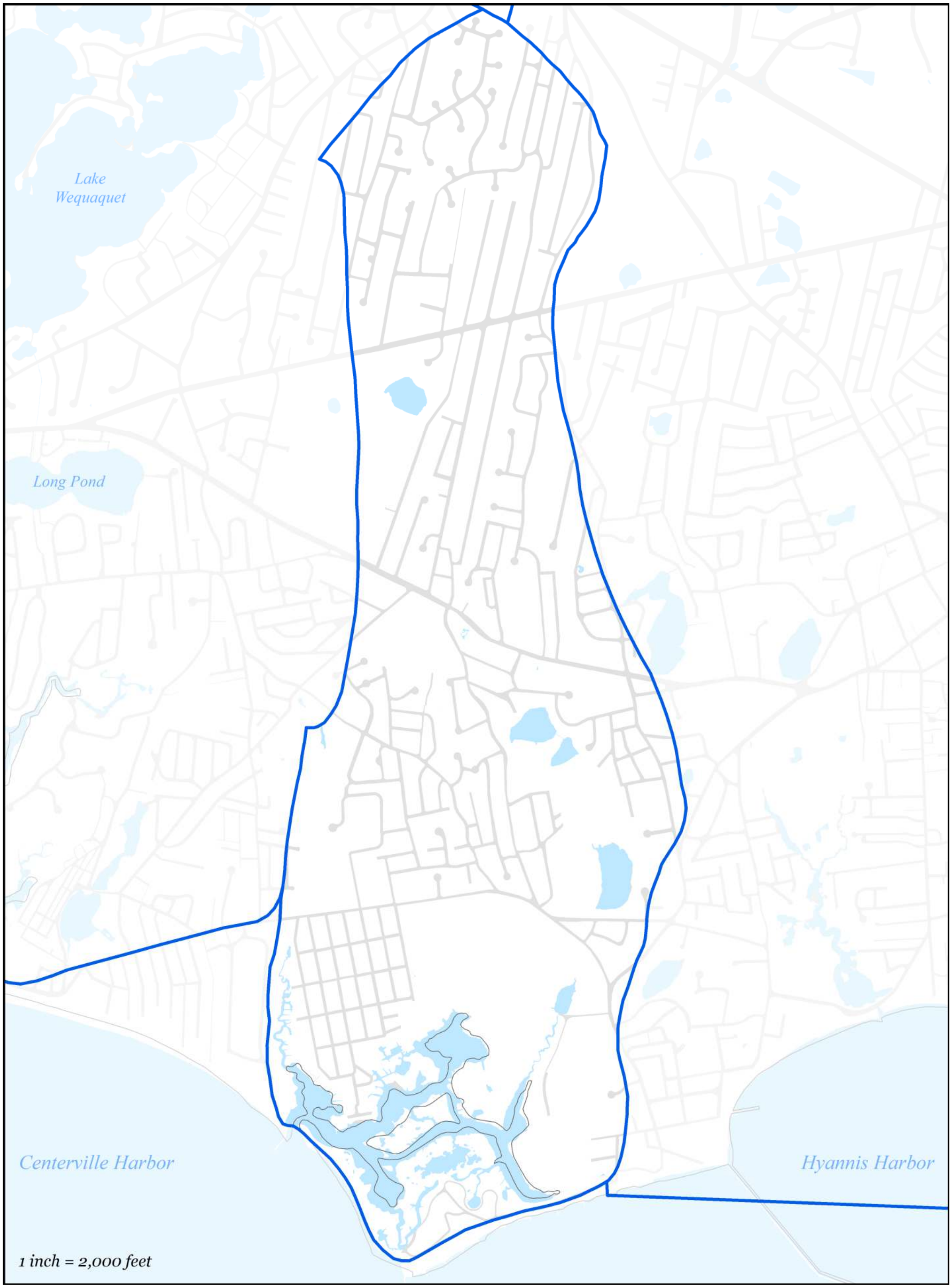

Figure 5-14: Halls Creek Watershed

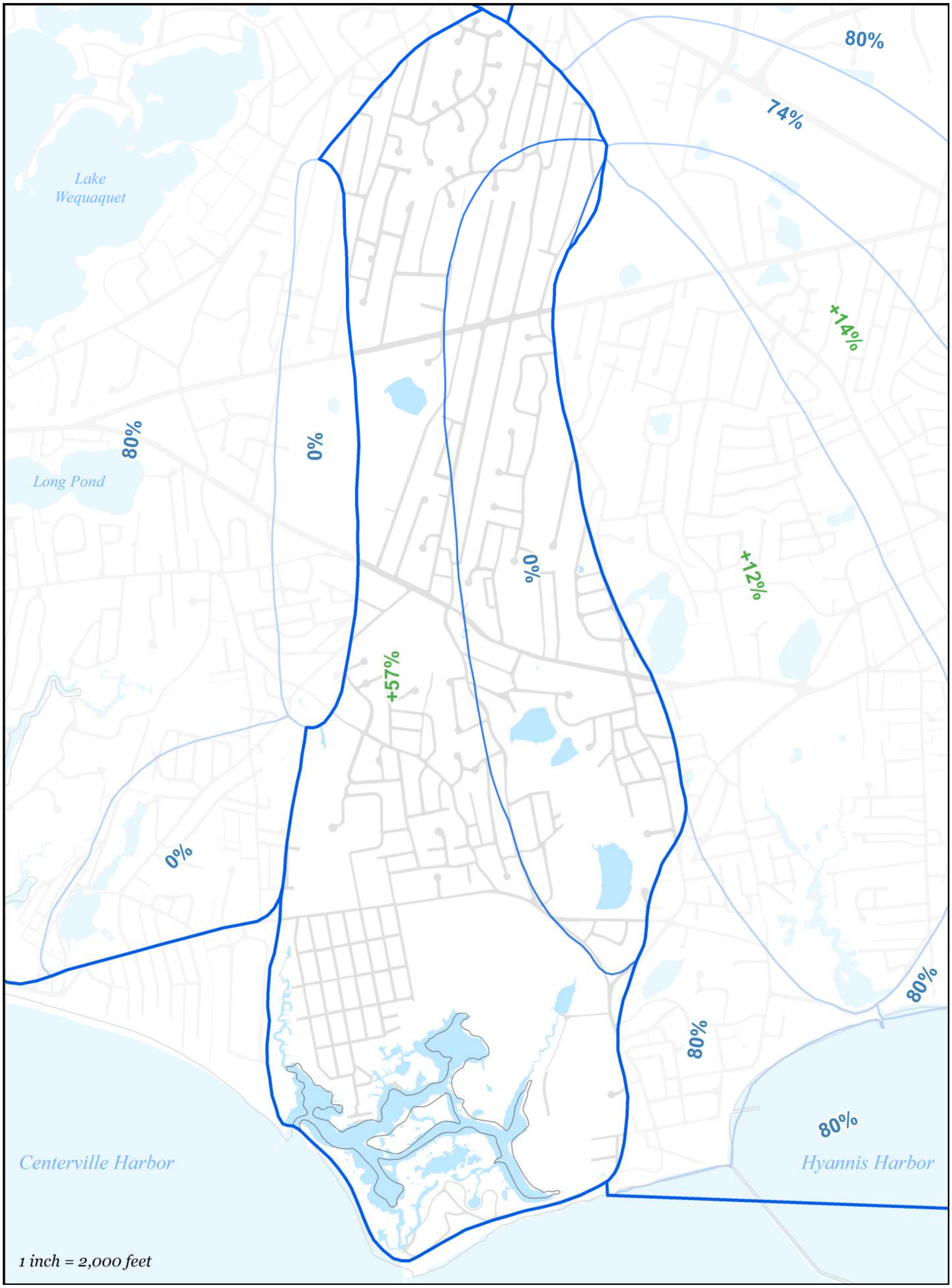

Figure 5-15: MEP-modeled Existing Septic Removal in Halls Creek Watershed

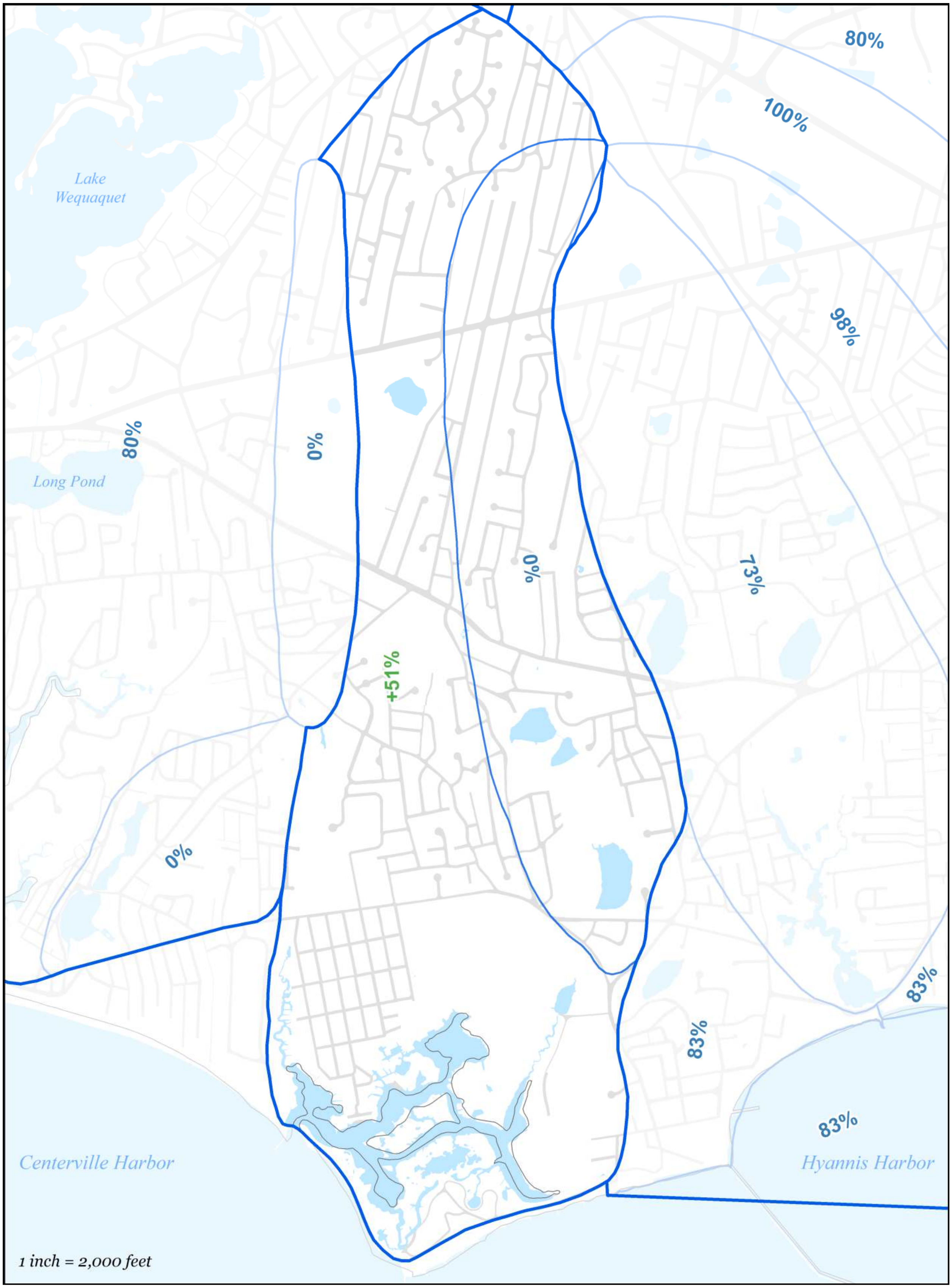

Figure 5-16: MEP-modeled Future Septic Removal in Halls Creek Watershed

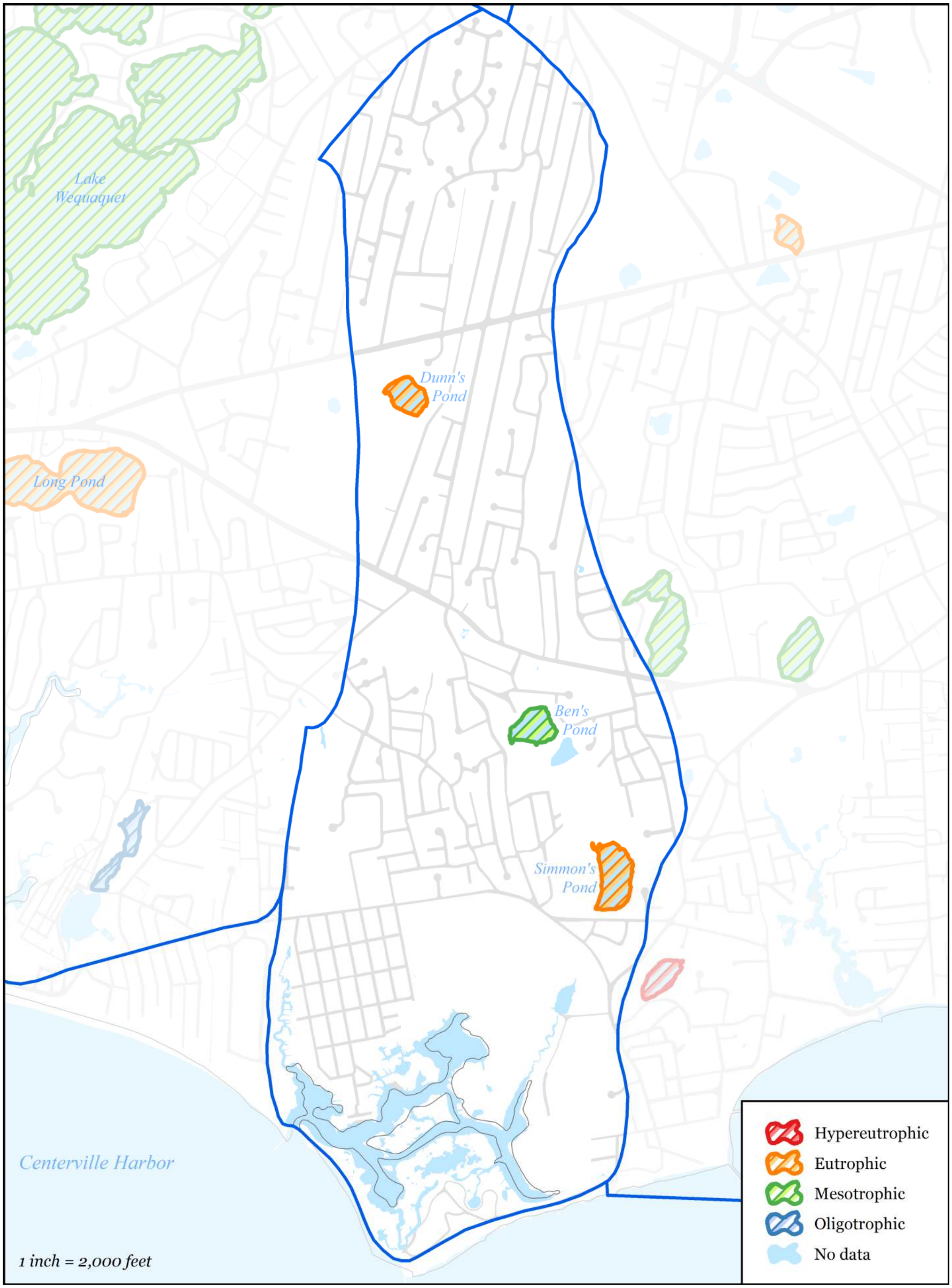

Figure 5-17: Impaired Ponds in Halls Creek Watershed

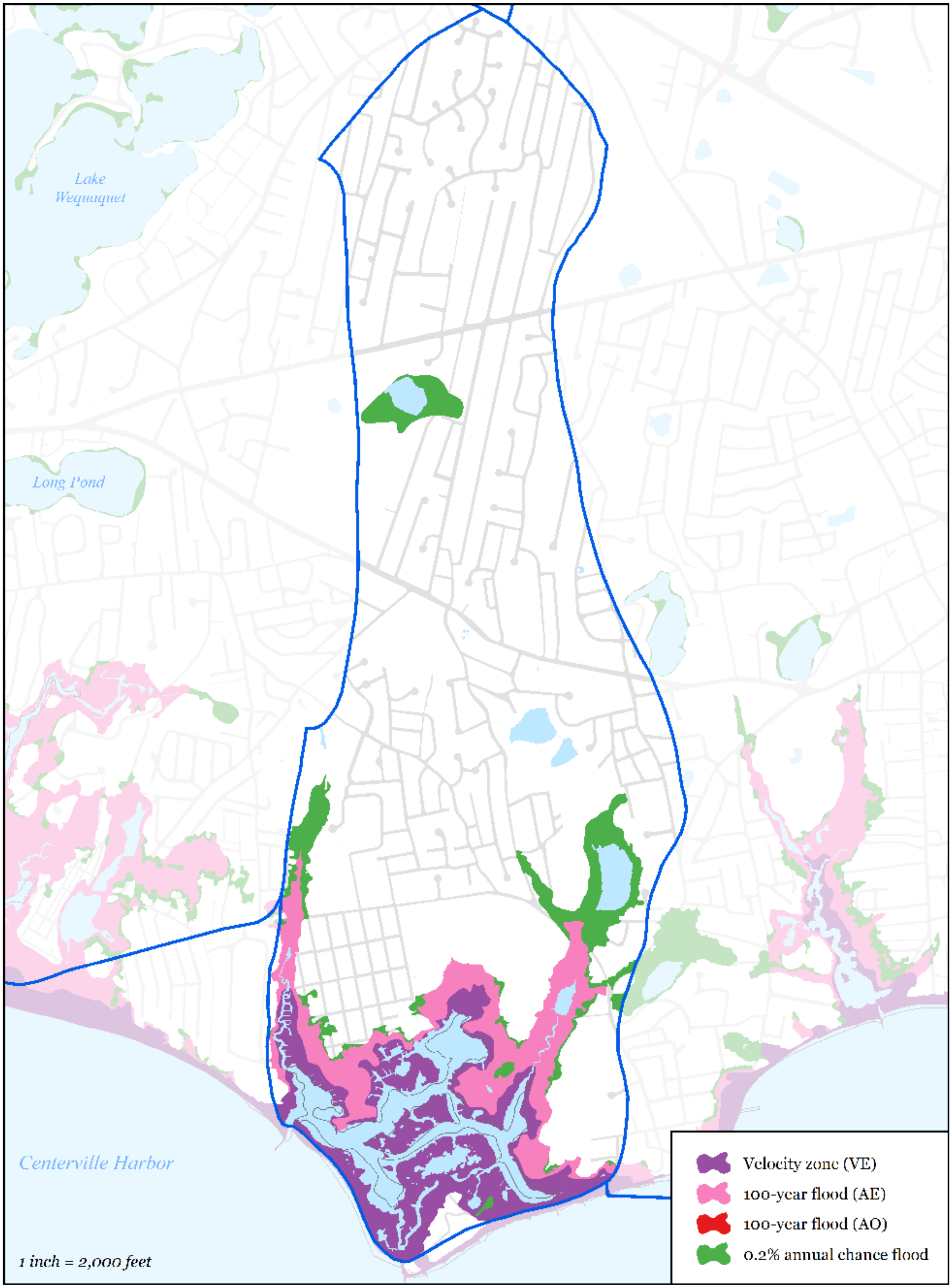

Figure 5-18: FEMA Flood Zones (2014) in Halls Creek Watershed

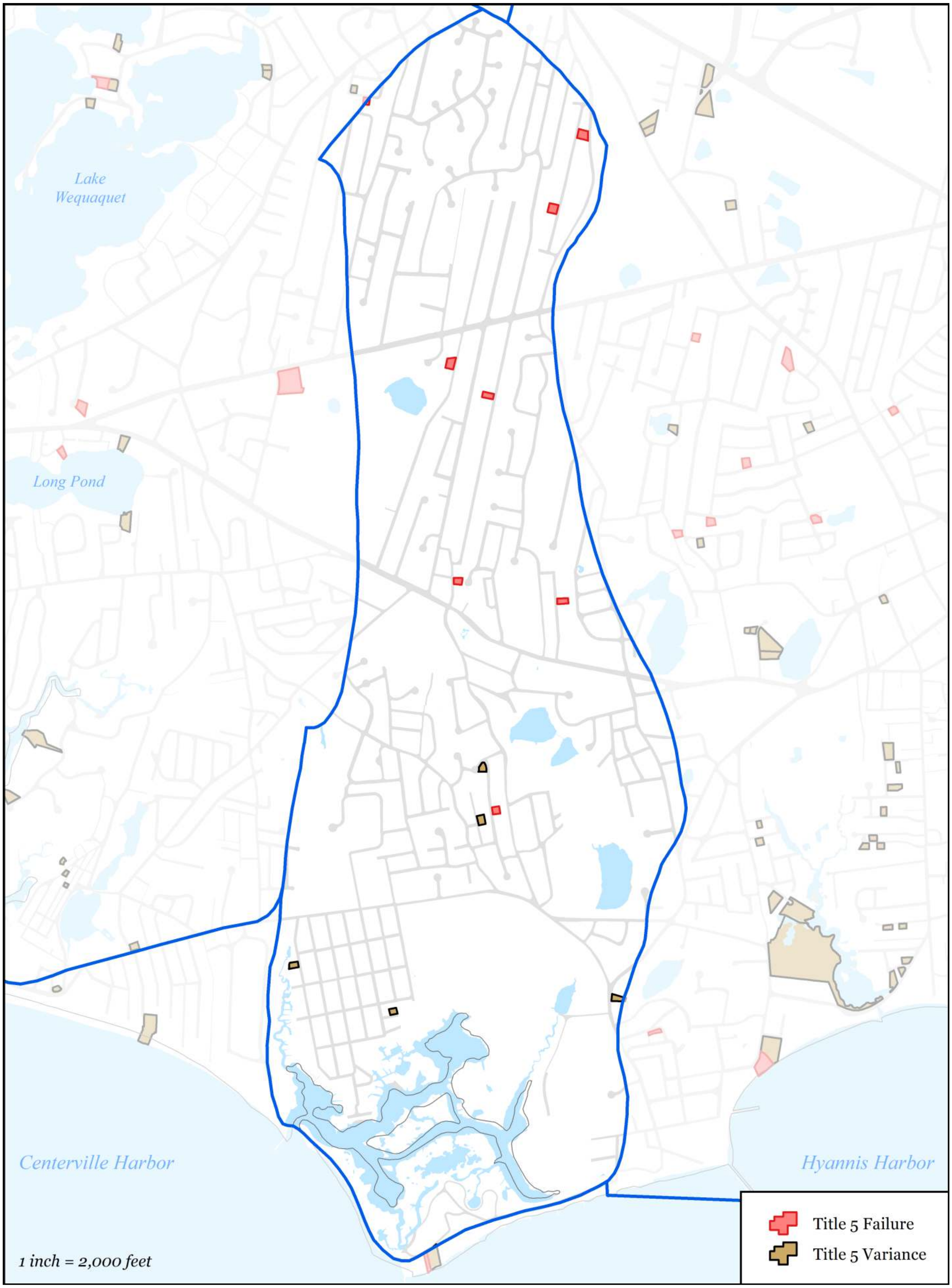

Figure 5-19: Parcels with Title 5 Septic Failures and Variances in Halls Creek Watershed

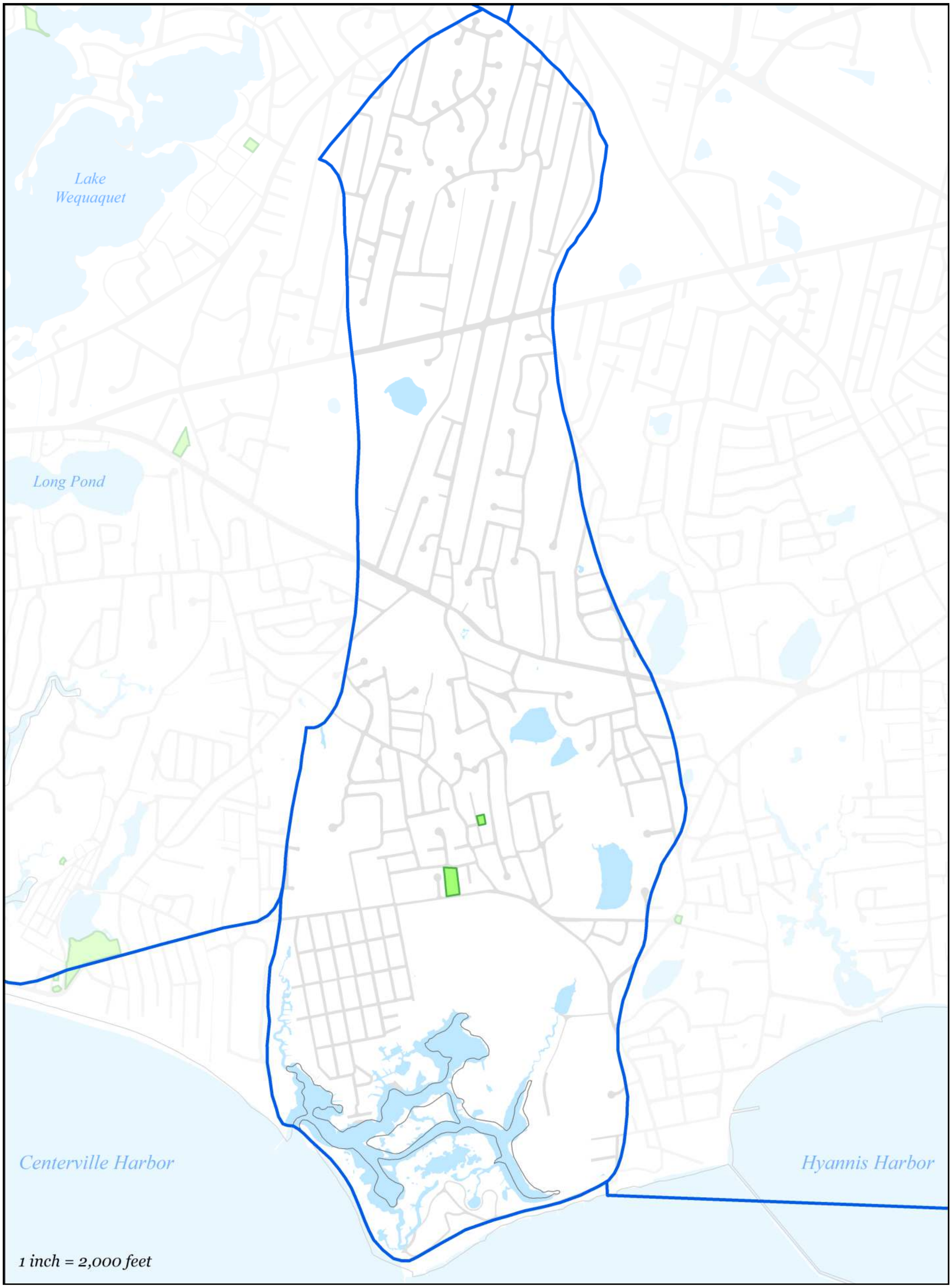

Figure 5-20: Parcels with I/A Septic Systems in Halls Creek Watershed

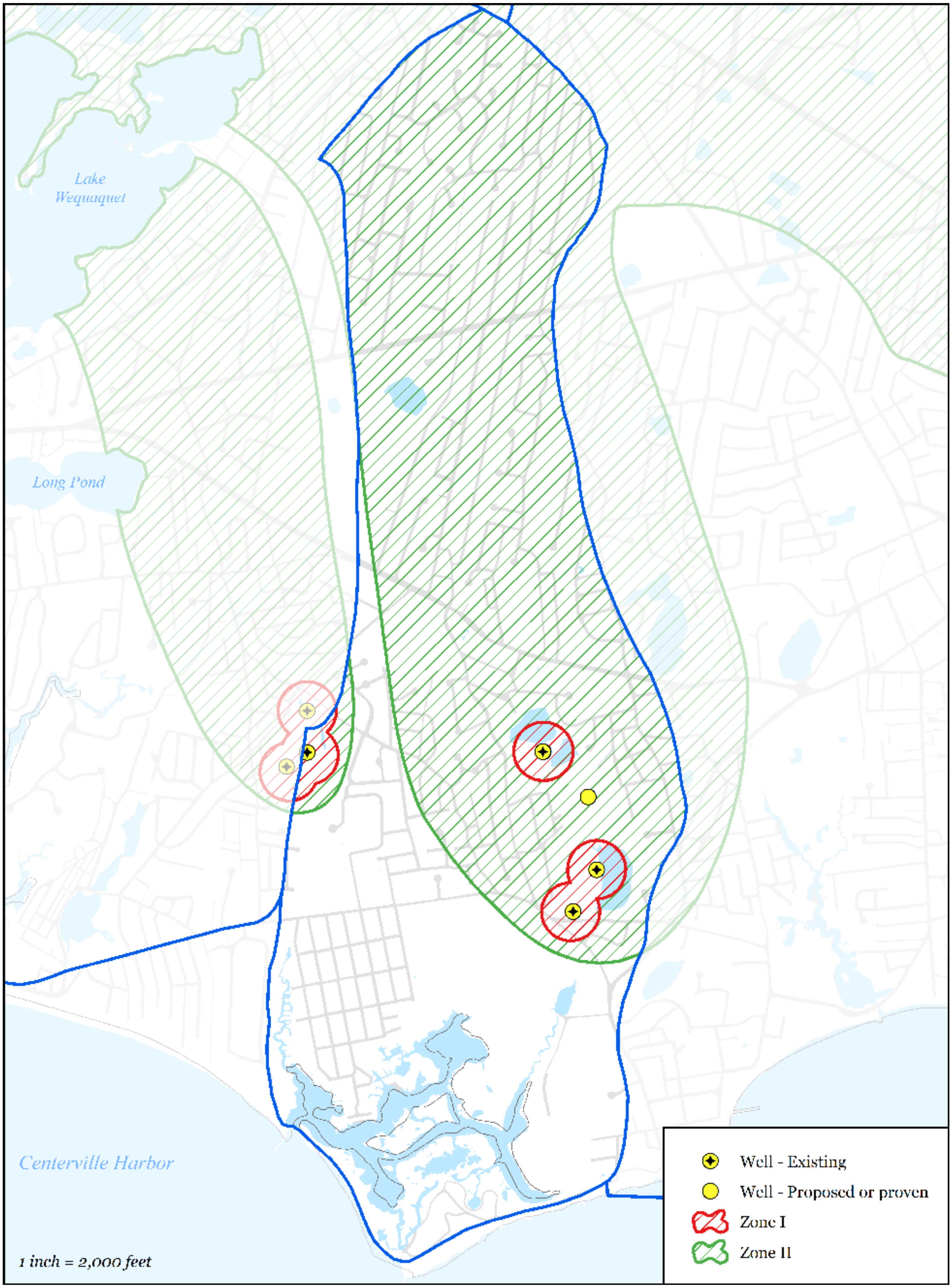

Figure 5-21: Public Water Supply Wells in Halls Creek Watershed

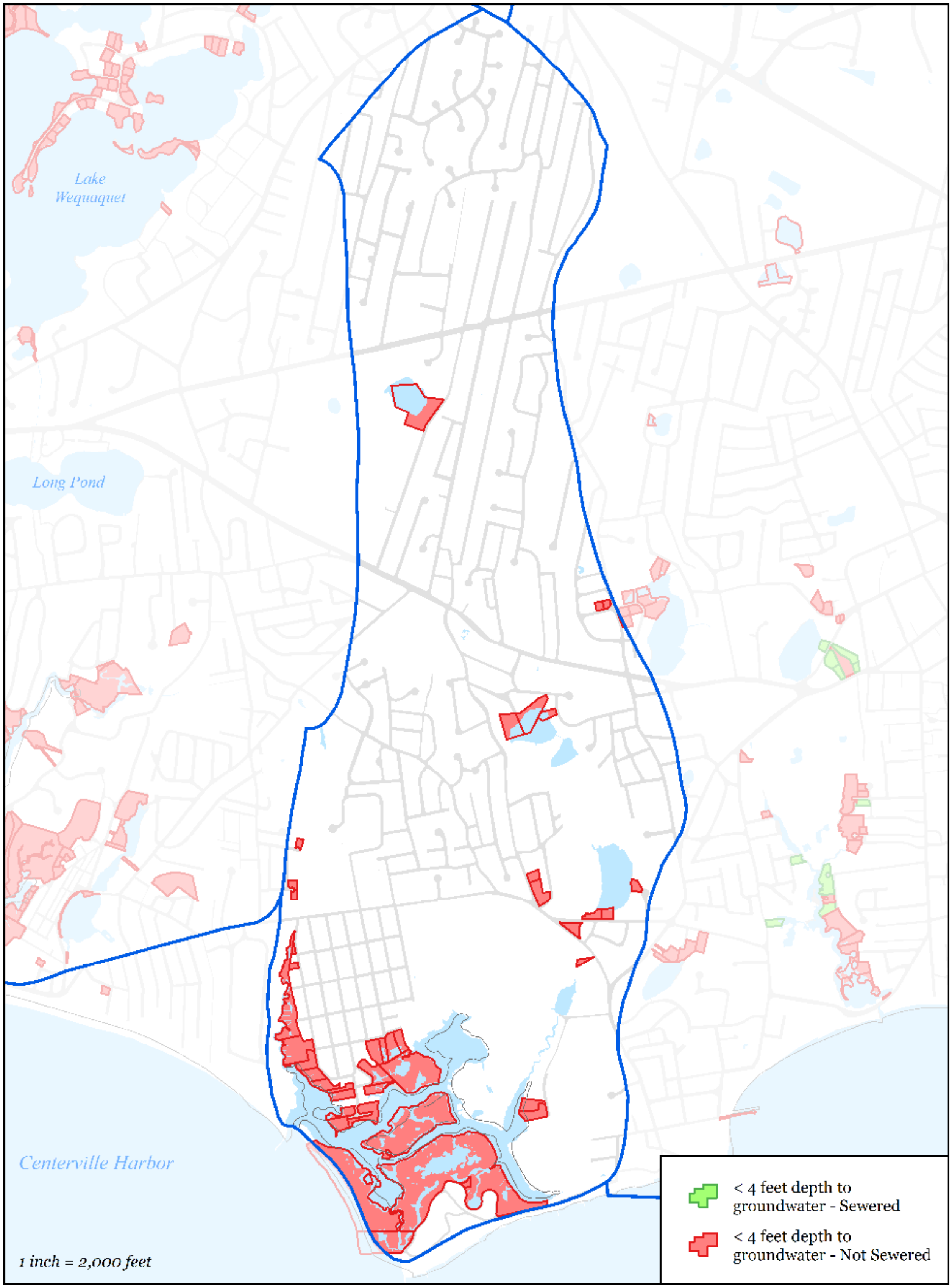

Figure 5-22: Parcels with Less than 4 feet Depth to Groundwater in Halls Creek Watershed

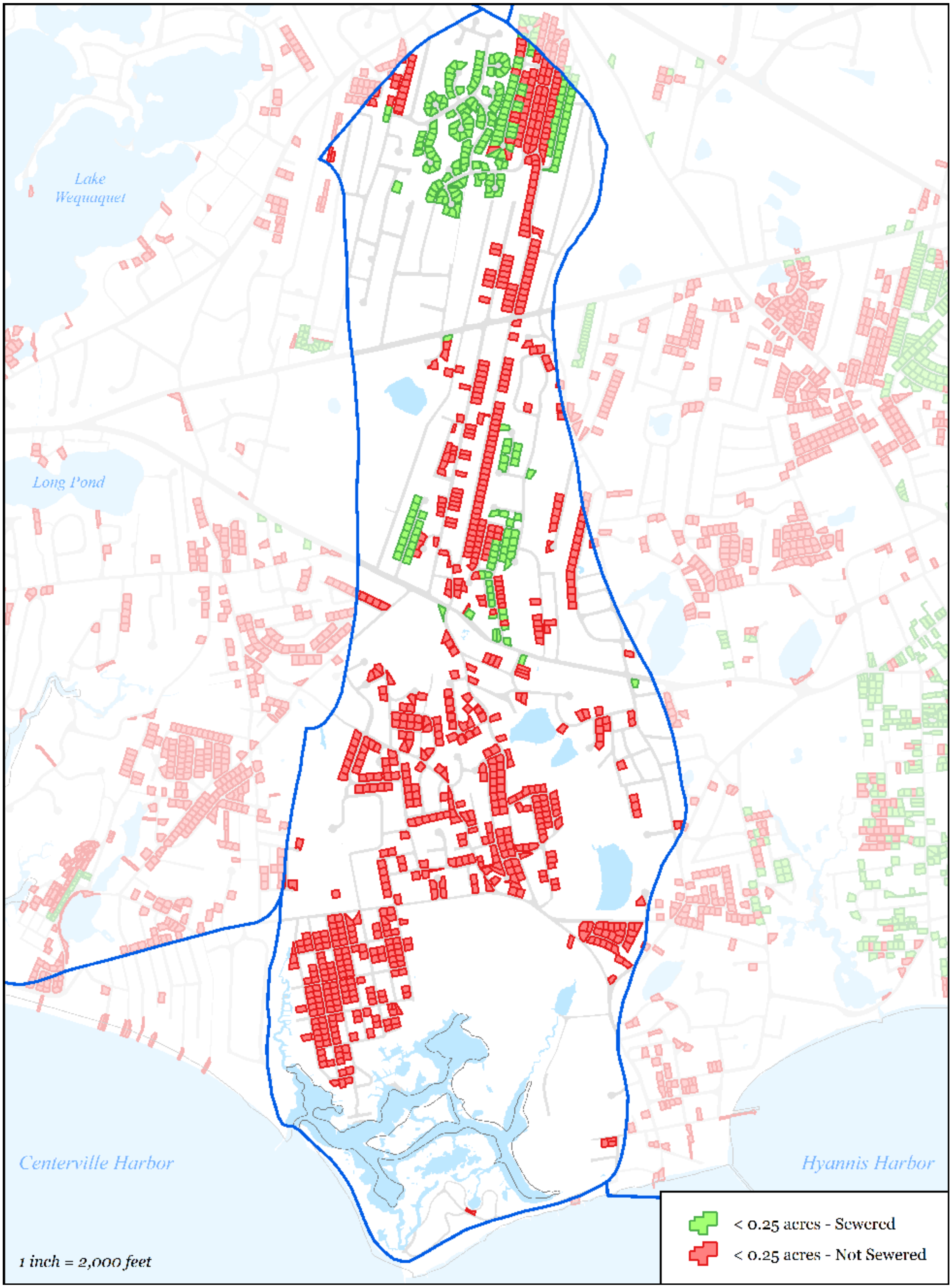

Figure 5-23: Parcels with Less than 0.25 acres in Halls Creek Watershed

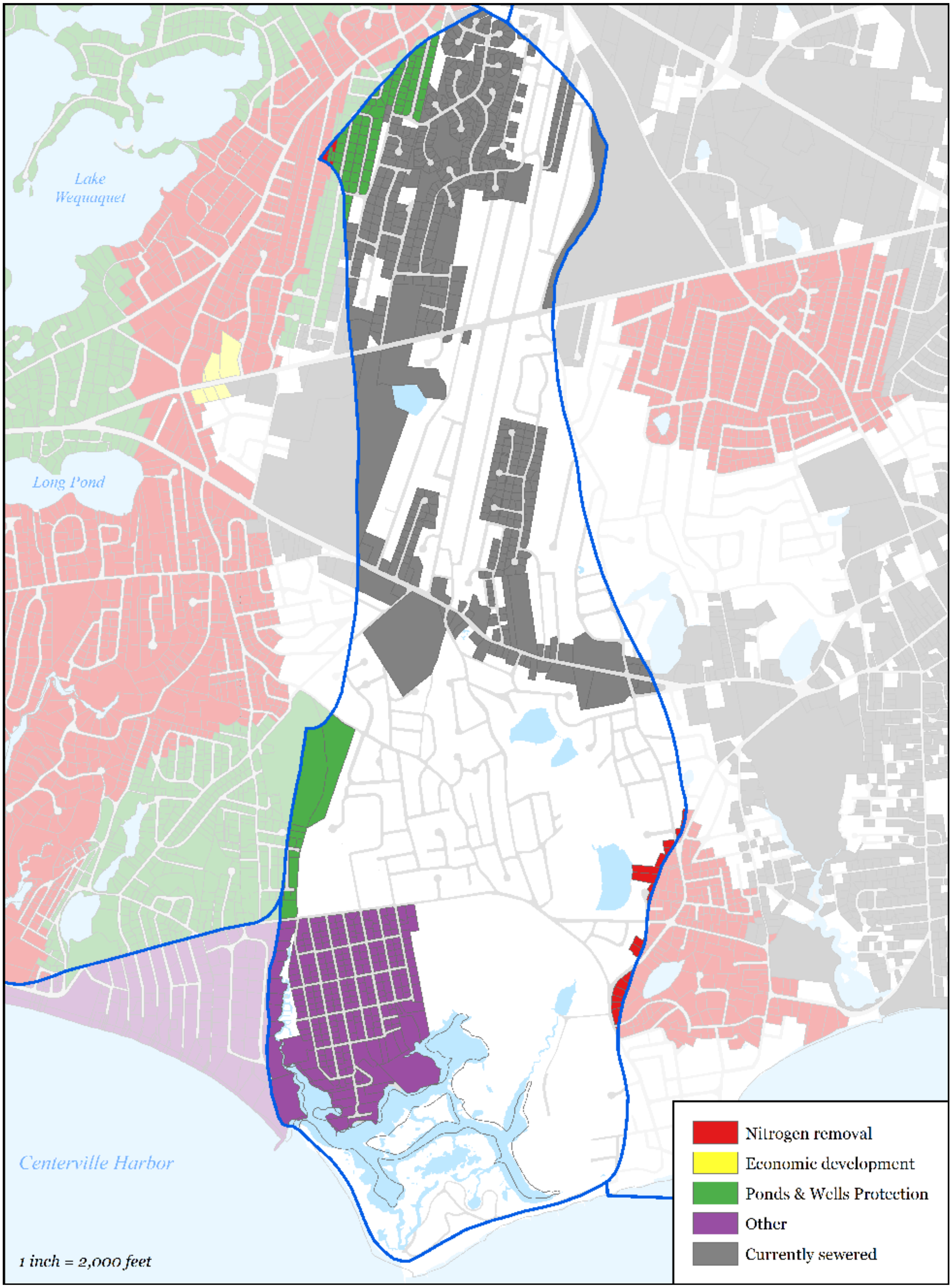

Figure 5-24: Needs Areas in Halls Creek Watershed

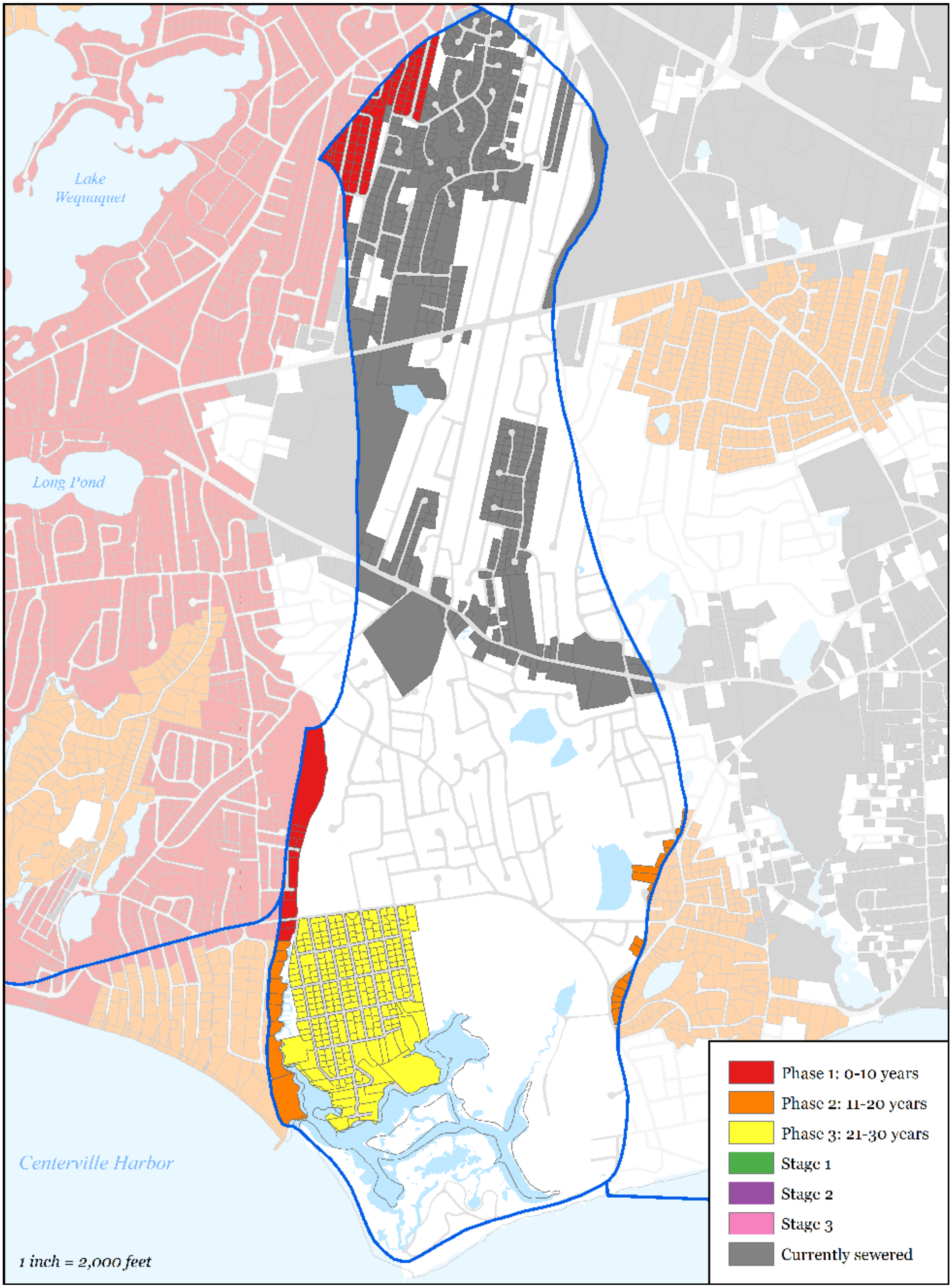

Figure 5-25: Sewer Expansion Plan in Halls Creek Watershed

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.

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, flood zone considerations, and economic development, via sewer expansion into Centerville River Watershed.

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 scenarios. Those scenarios modeled an 80% reduction in septic load (36.75 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 corresponds to a 34% overall average watershed septic reduction target.

The Town's wastewater plan includes removal of 86% of the total un-attenuated septic load within the Centerville River East sub-embayment via proposed sewer connections (2,056 properties 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 54% (71.6 kg/day N). Phase 1 of the plan will result in a total un-attenuated septic load reduction within the watershed of 40% (52.7 kg/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 attenuated nitrogen data):

- Total parcels within the Centerville River Watershed = 7998
- Parcels with total area less than 0.25 acres = 1,199
    - 1,019 (85%) will be addressed with a traditional solution in the Plan
- Parcels with average depth to groundwater less than four feet = 391
    - 336 (86%) will be addressed with a traditional solution in the Plan
- Parcels with septic system variances = 50
    - 42 (84%) will be addressed with a traditional solution in the Plan
- Parcels with known failed septic systems = 14
    - 10 (71%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 3,333
    - 1,700 (51%) 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. It should be noted that the parcels on the south side of Craigville Beach Road are generally outside of the Centerville River Watershed, but have been included in this section due to proximity to the watershed.

- Total parcels within the Centerville River Watershed = 7,998
- Parcels within 100 year flood plain and/or velocity zone = 822 (10%)
    - 652 (79%) 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 16 ponds in the Centerville River Watershed. Pond classification of these ponds is shown in Table 5-8 and Table 5-9.

Table 5-8: 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	Lake Wequaquet
Eutrophic		Round Pond Long Pond	
Hypereutrophic	Little Parker		

Table 5-9: 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			

Three ponds within the watershed have been identified as impaired: North Pond, Long 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, Red Lily Pond, Lake Elizabeth, and Filenes Pond.

5.2.3.1.4 Economic Development

Within the Centerville River, 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. 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
  - 4,434 parcels (55%) in the watershed are included in the sewer expansion plan
    - 3,348 parcels (76%) of which are in Phase 1.
  - Removal of 54% (71.6 kg/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 6.4 for the Adaptive Management Plan and Section 6.3 for the Monitoring Plan.

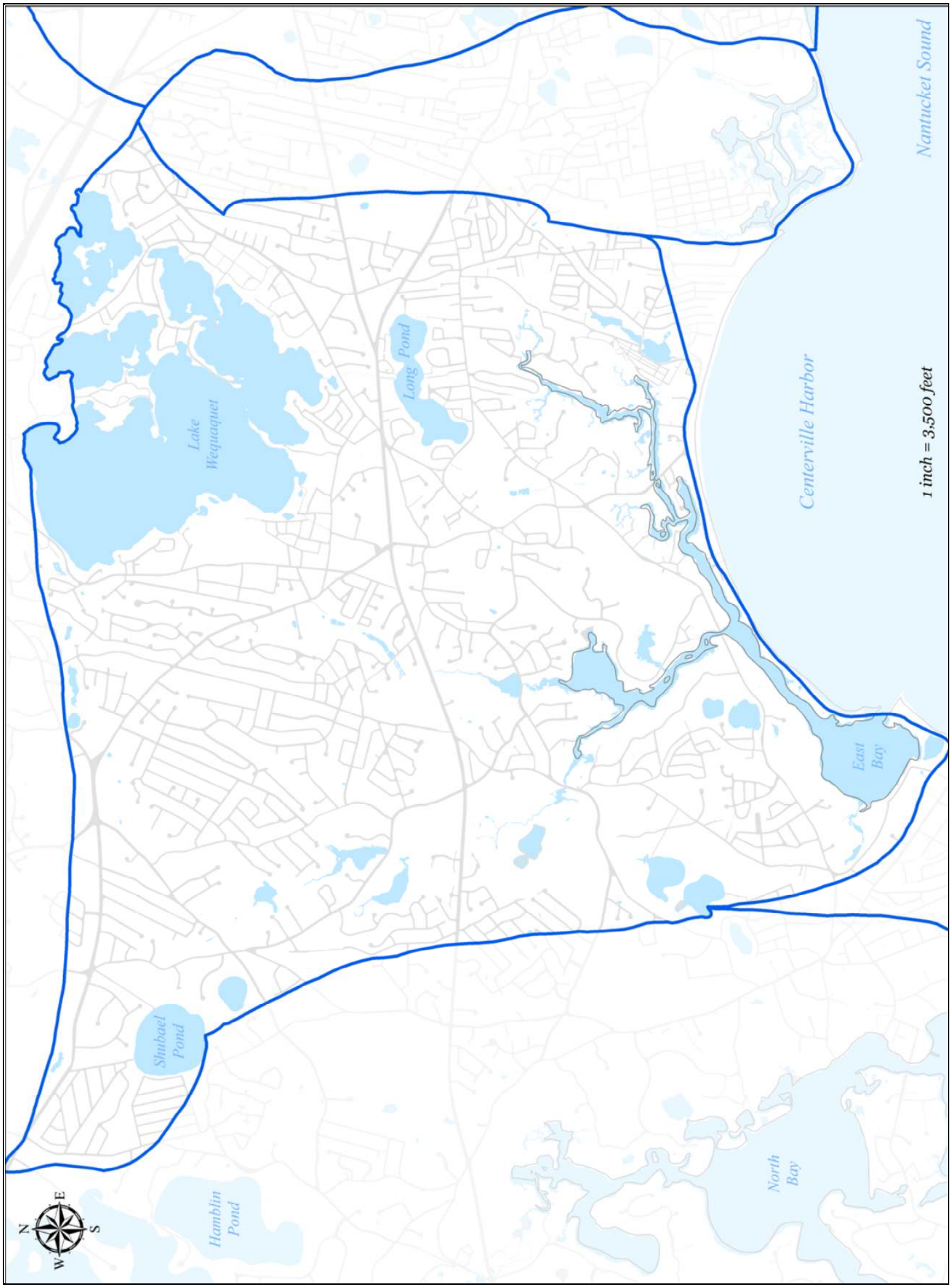

Figure 5-26: Centerville River Watershed

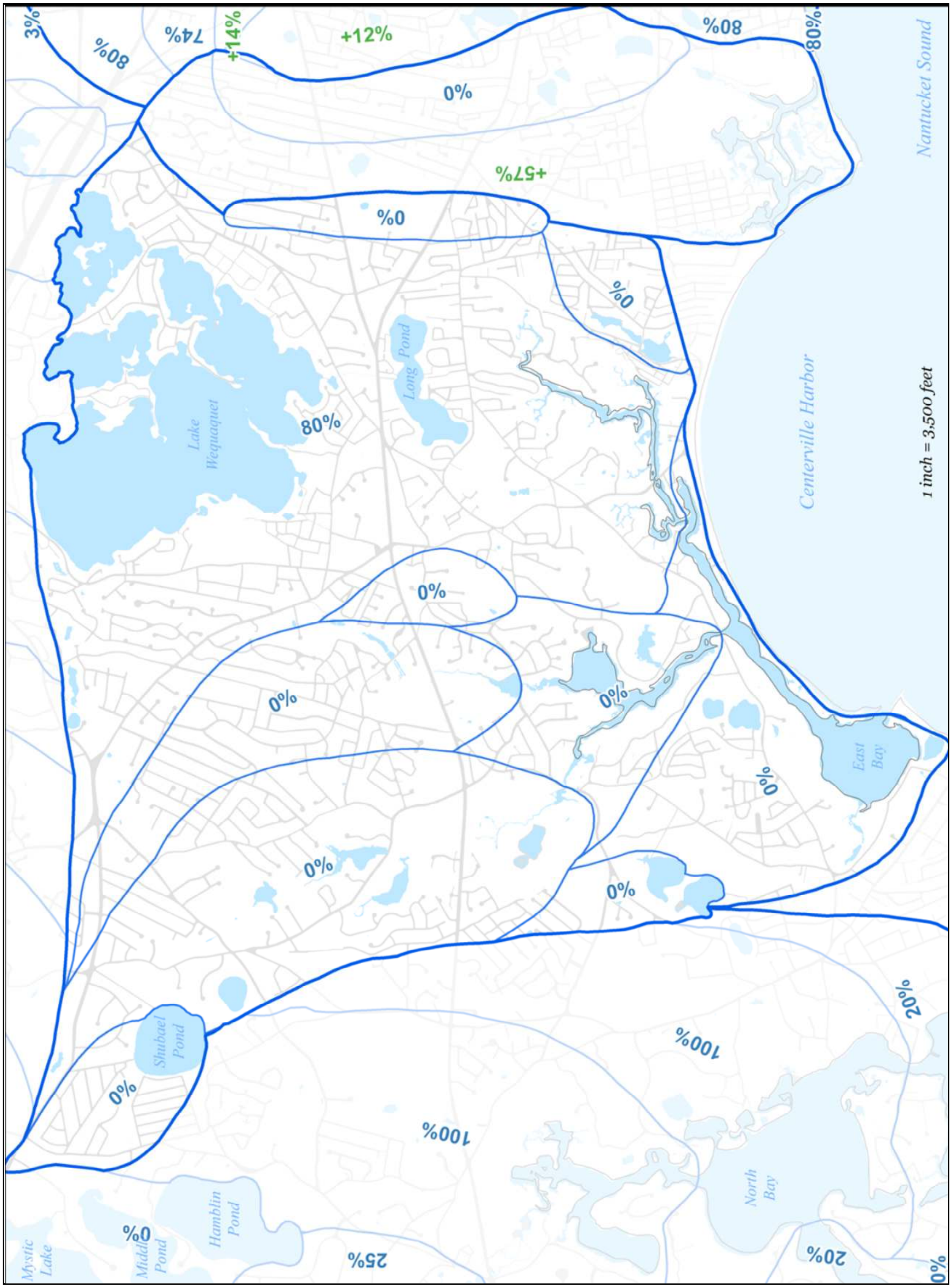

Figure 5-27: MEP-modeled Existing Septic Removal in Centerville River Watershed

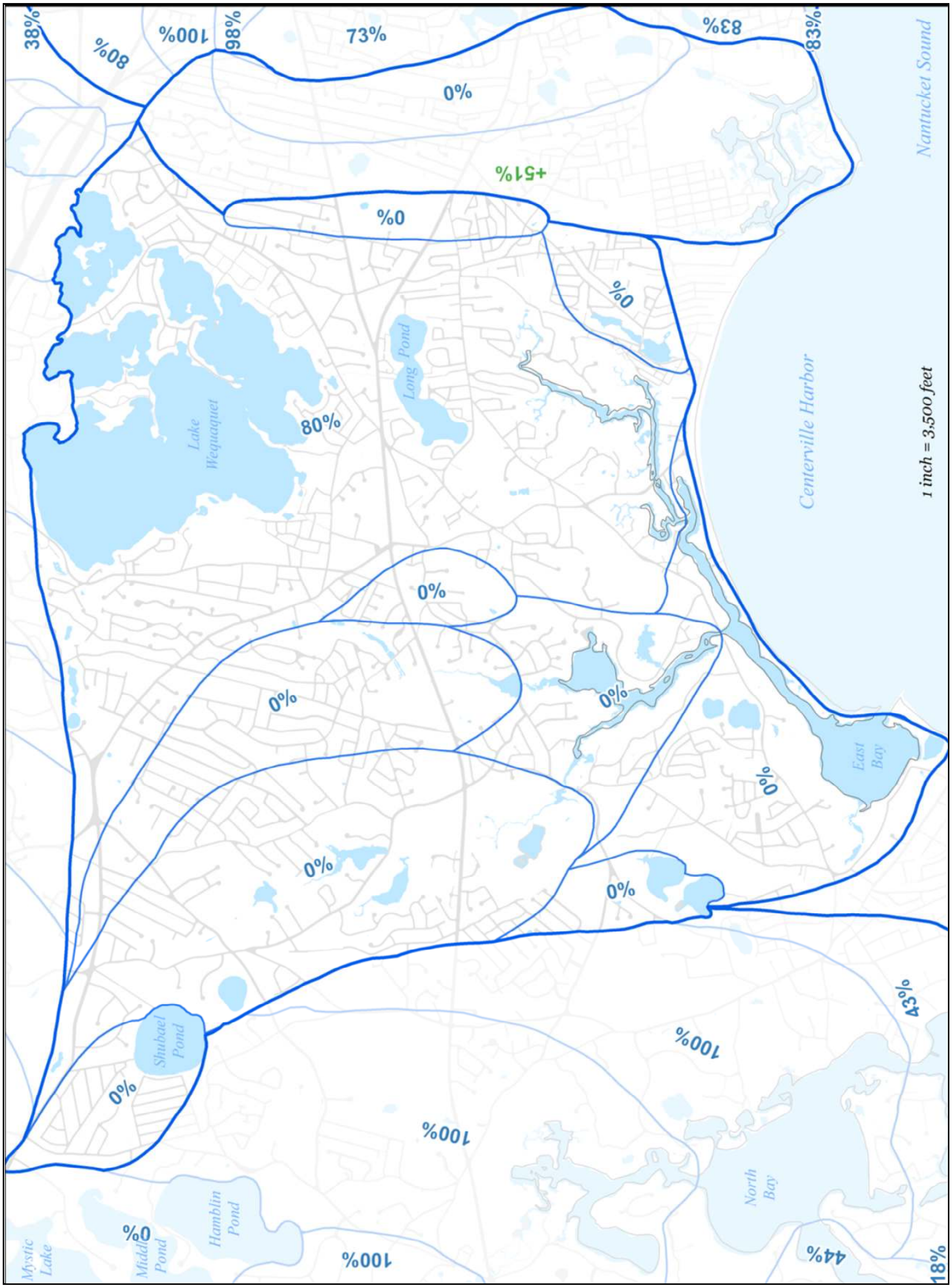

Figure 5-28: MEP-modeled Future Septic Removal in Centerville River Watershed

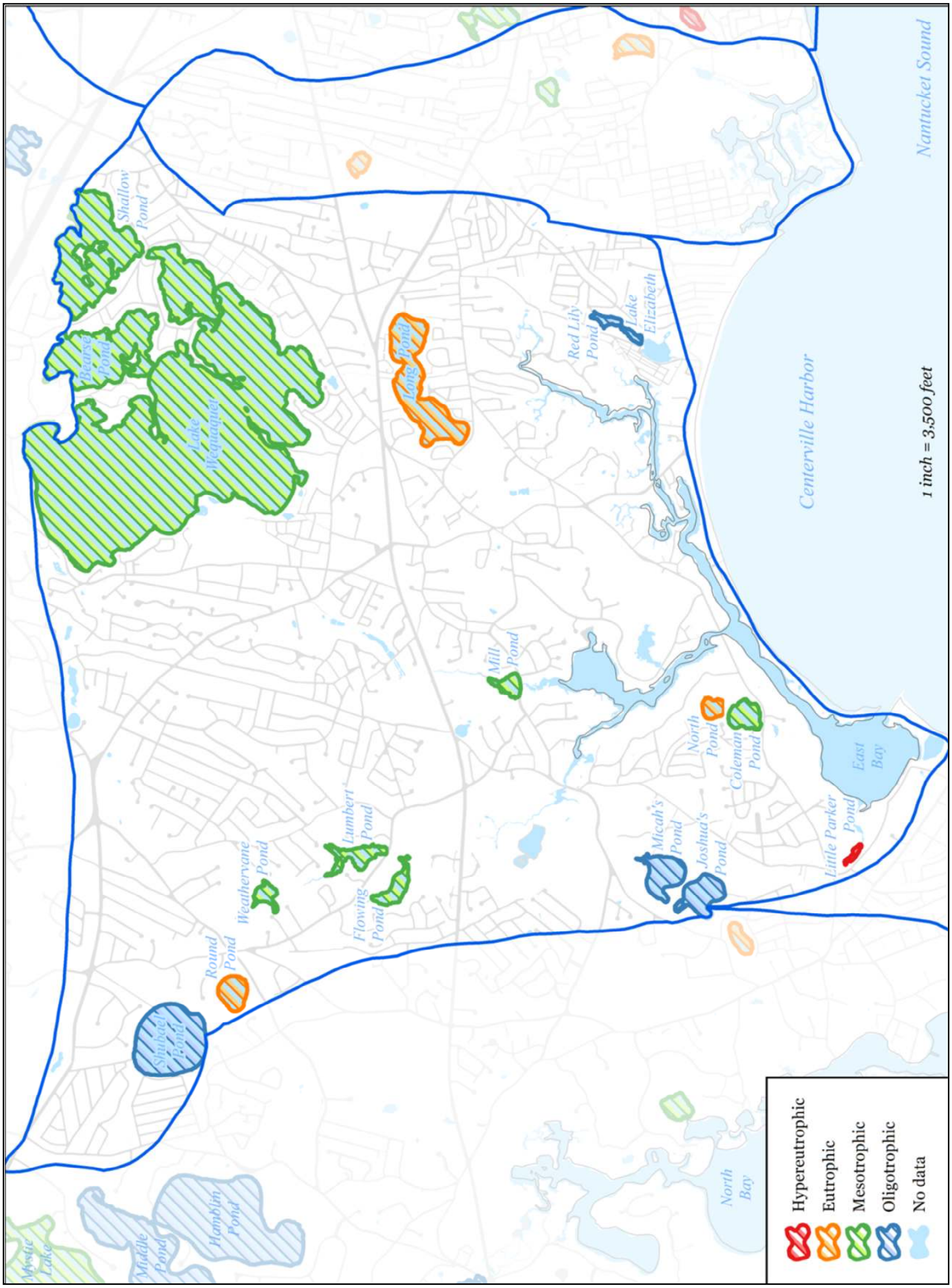

Figure 5-29: Impaired Ponds in Centerville River Watershed

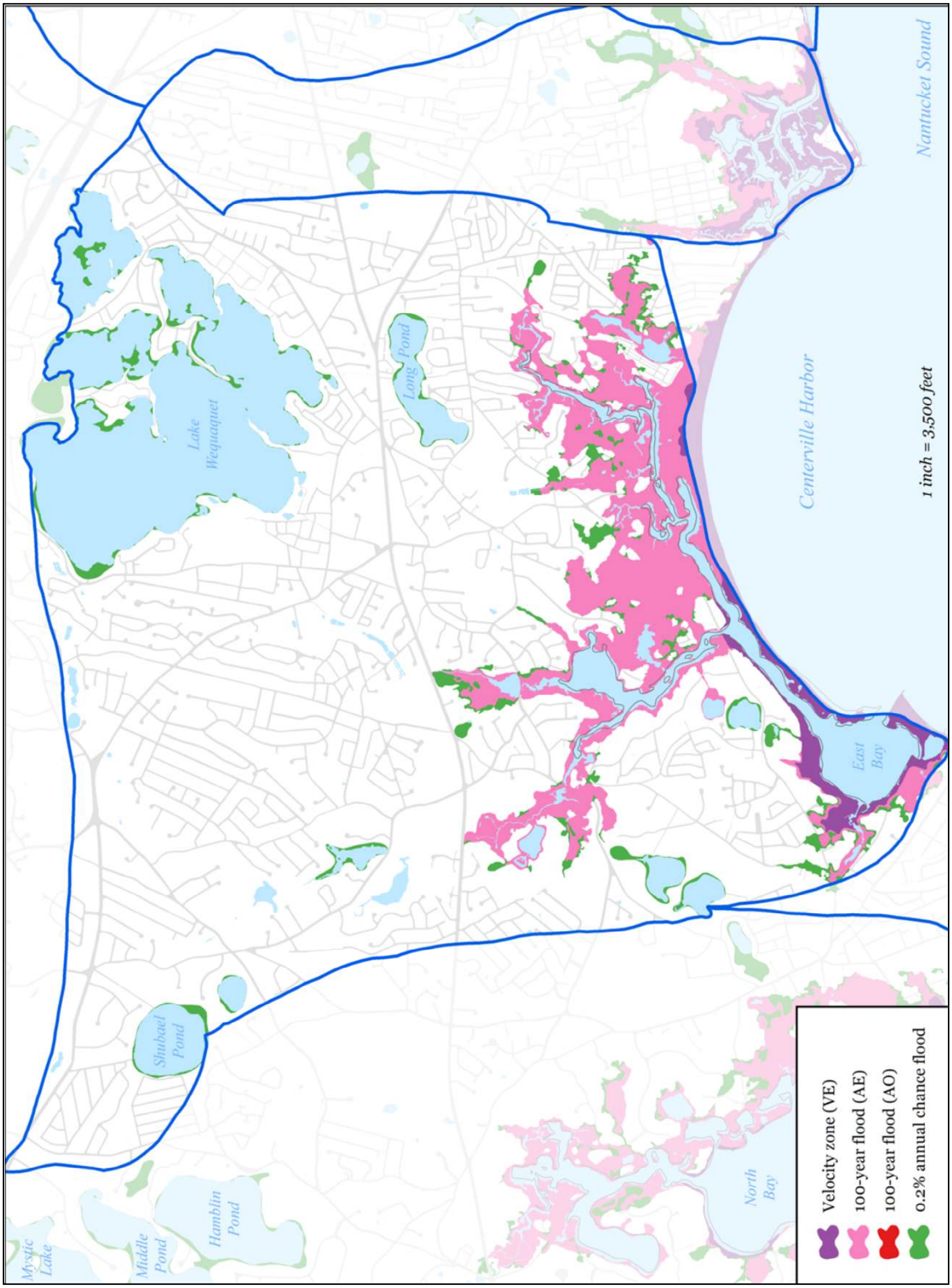

Figure 5-30: FEMA Flood Zones (2014) in Centerville River Watershed

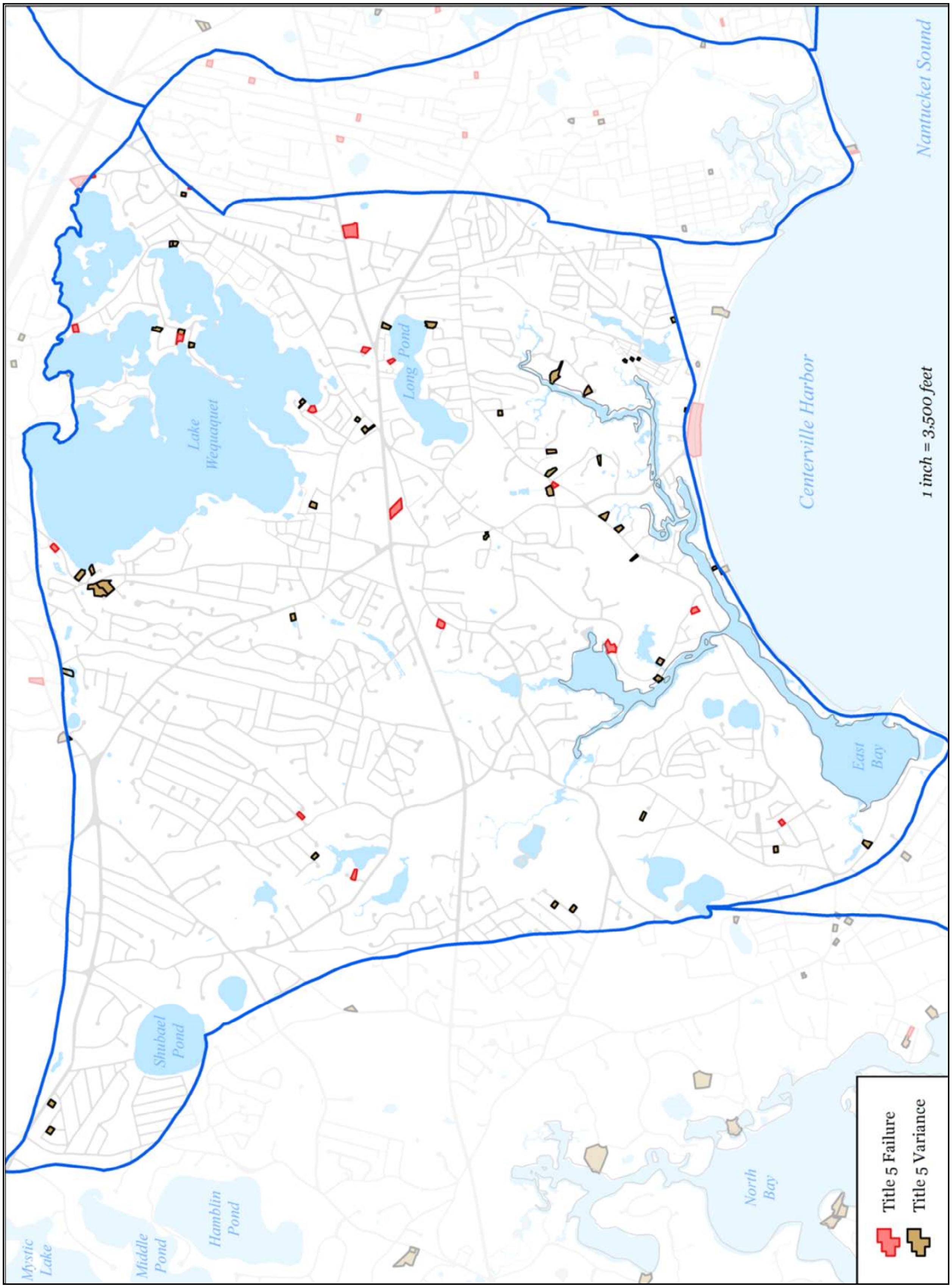

Figure 5-31: Parcels with Title 5 Septic Failures and Variances in Centerville River Watershed

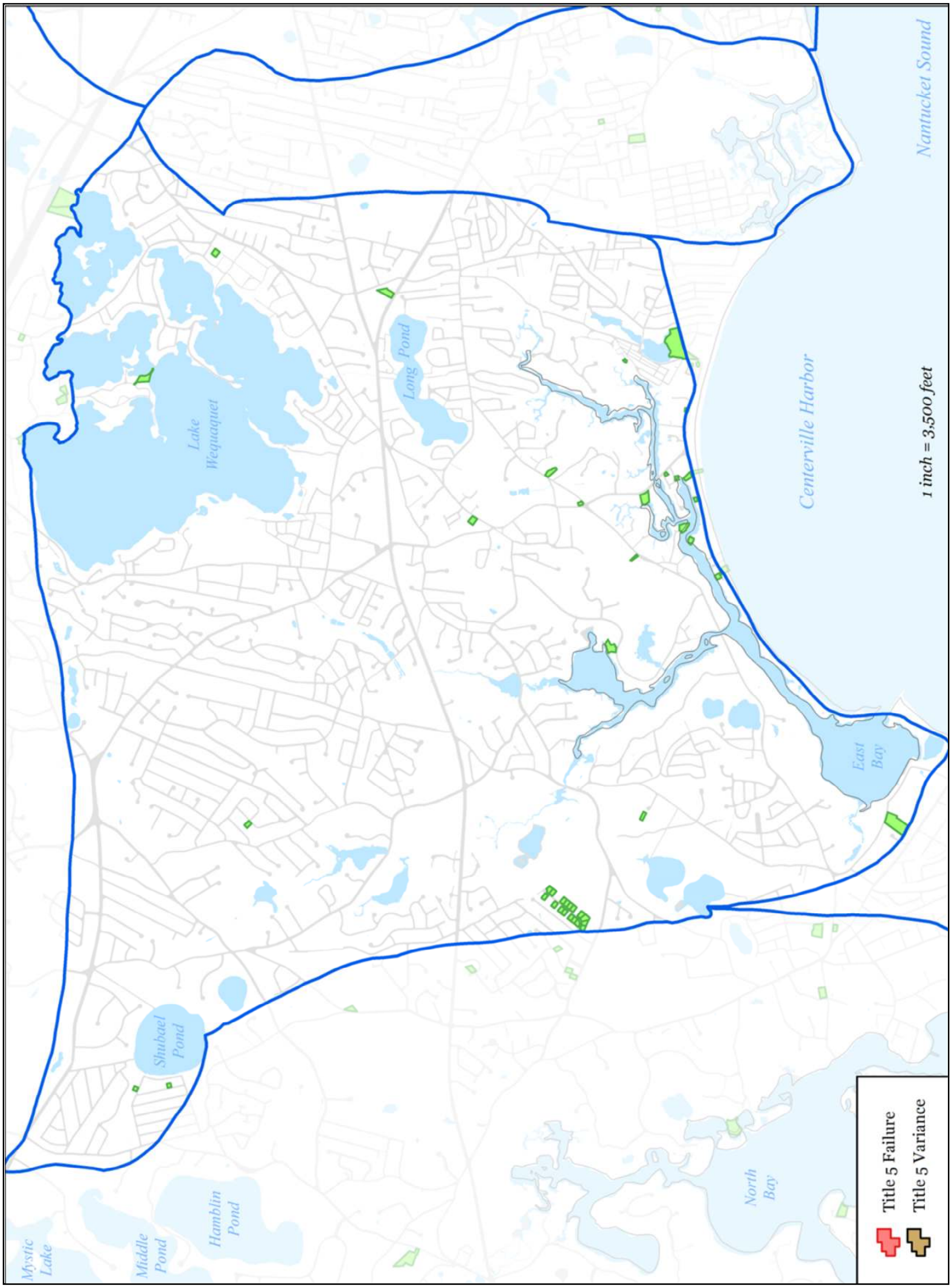

Figure 5-32: Parcels with I/A Septic Systems in Centerville River Watershed

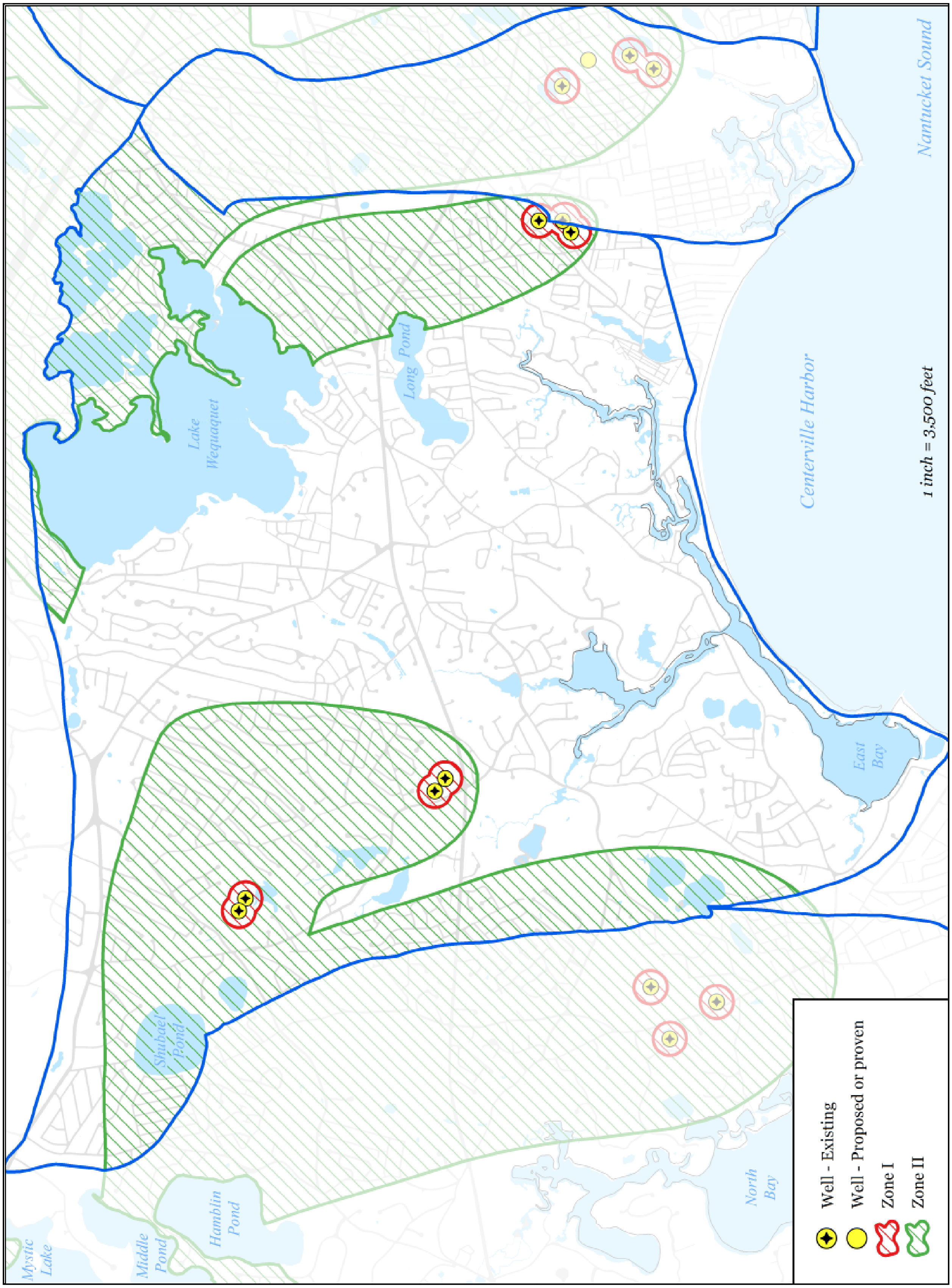

Figure 5-33: Public Water Supply Wells in Centerville River Watershed

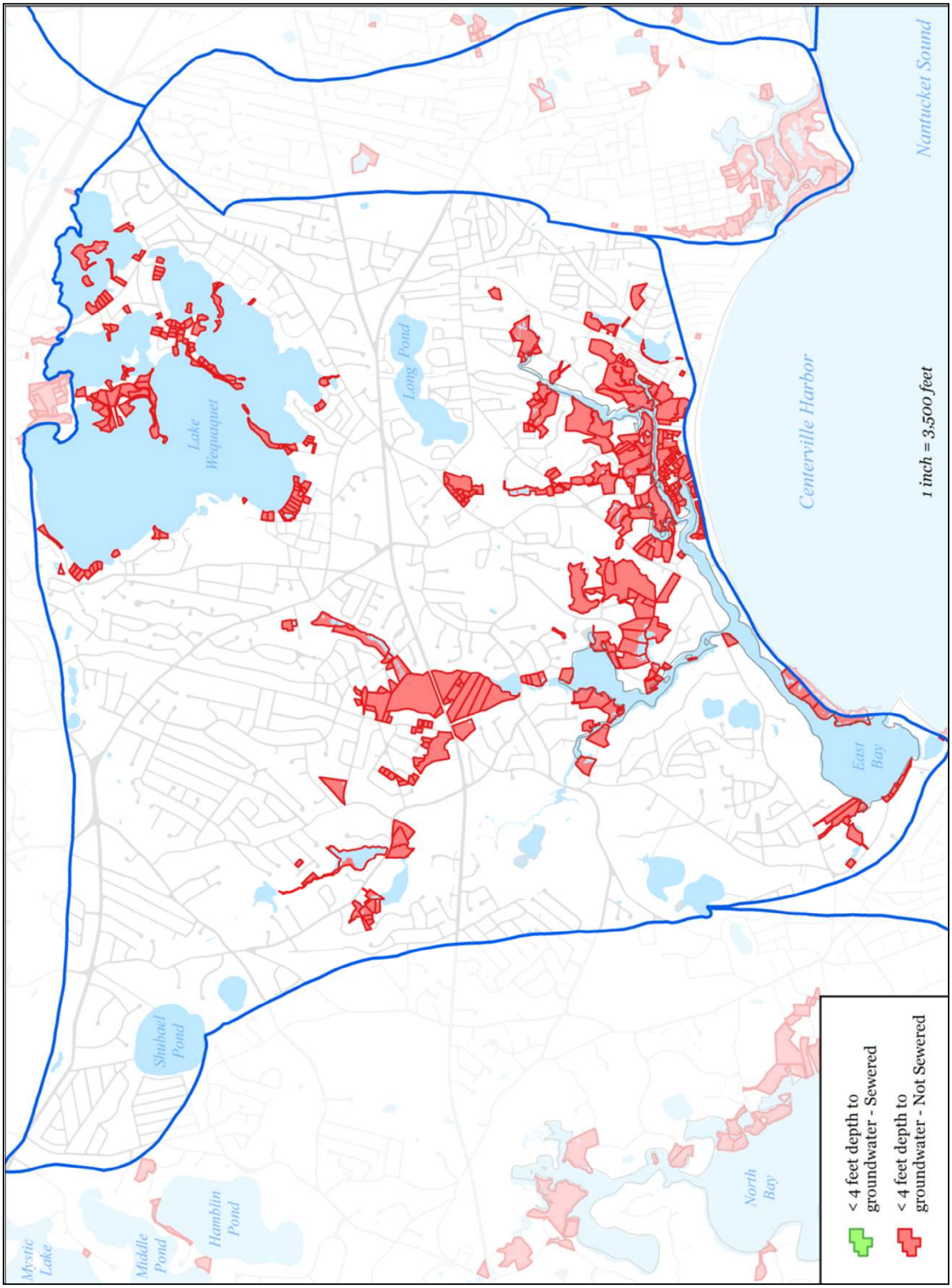

Figure 5-34: Parcels with Less than 4 feet Depth to Groundwater in Watershed

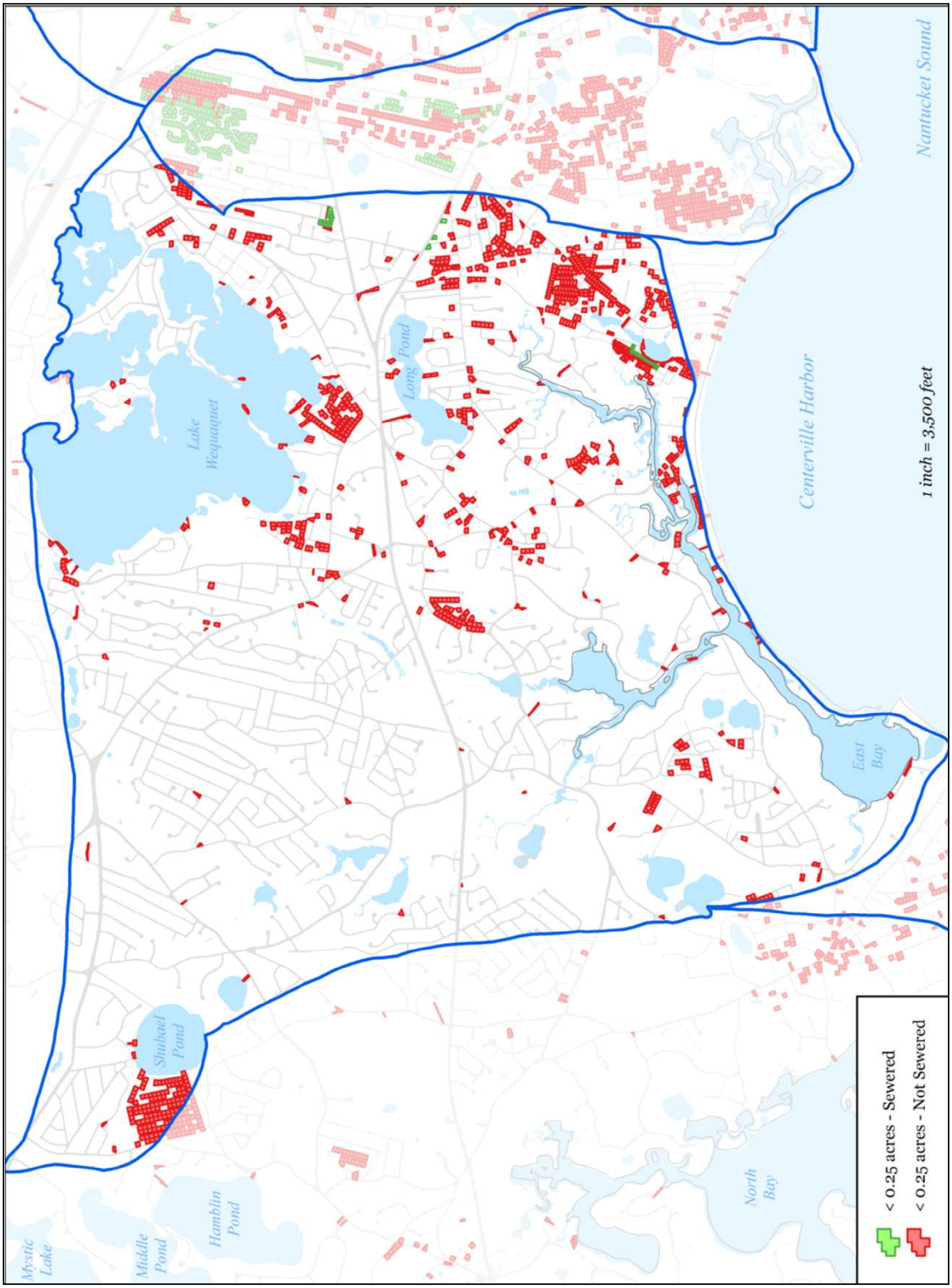

Figure 5-35: Parcels with Less than 0.25 acres in Centerville River Watershed

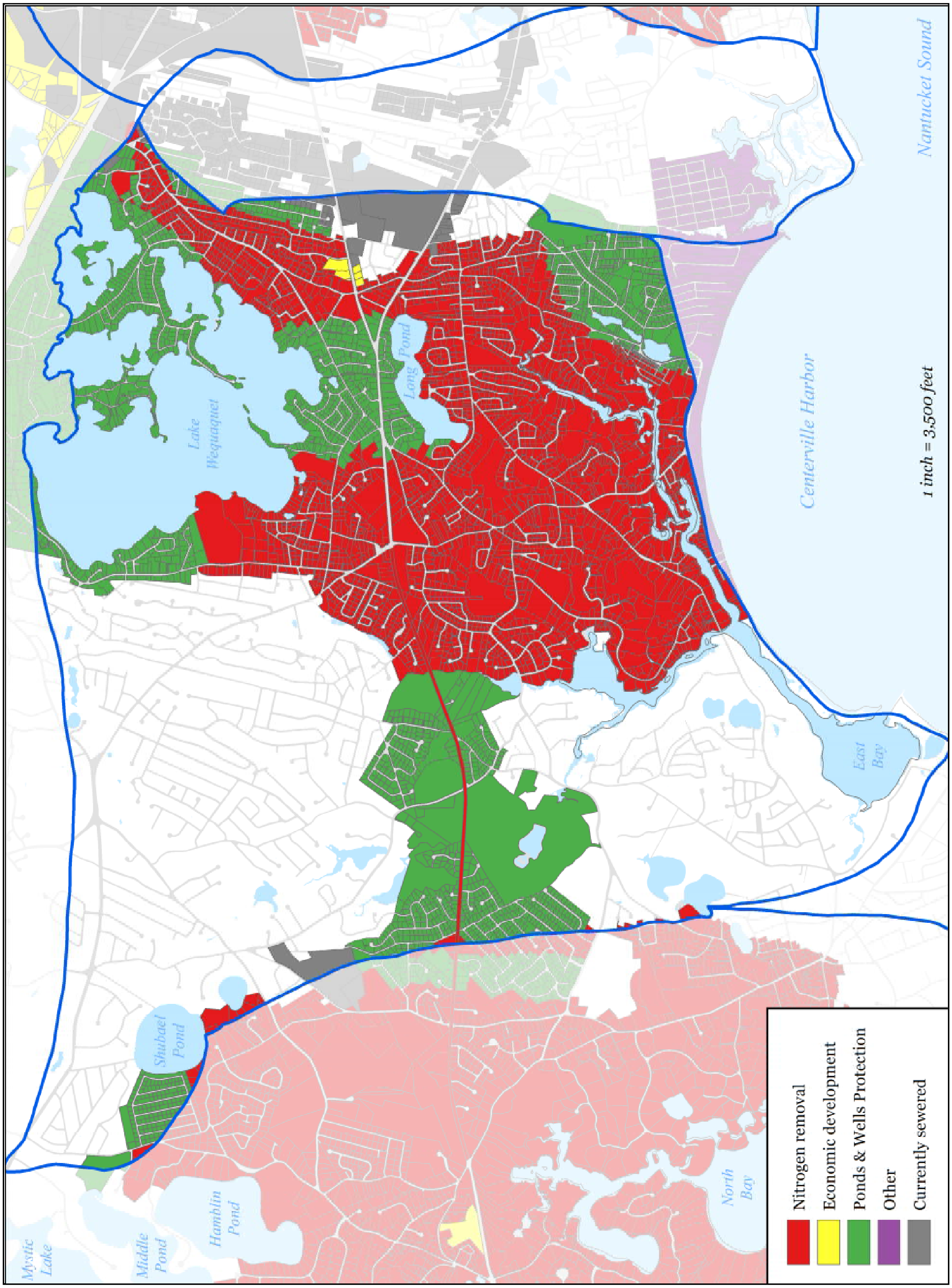

Figure 5-36: Needs Areas in Centerville River Watershed

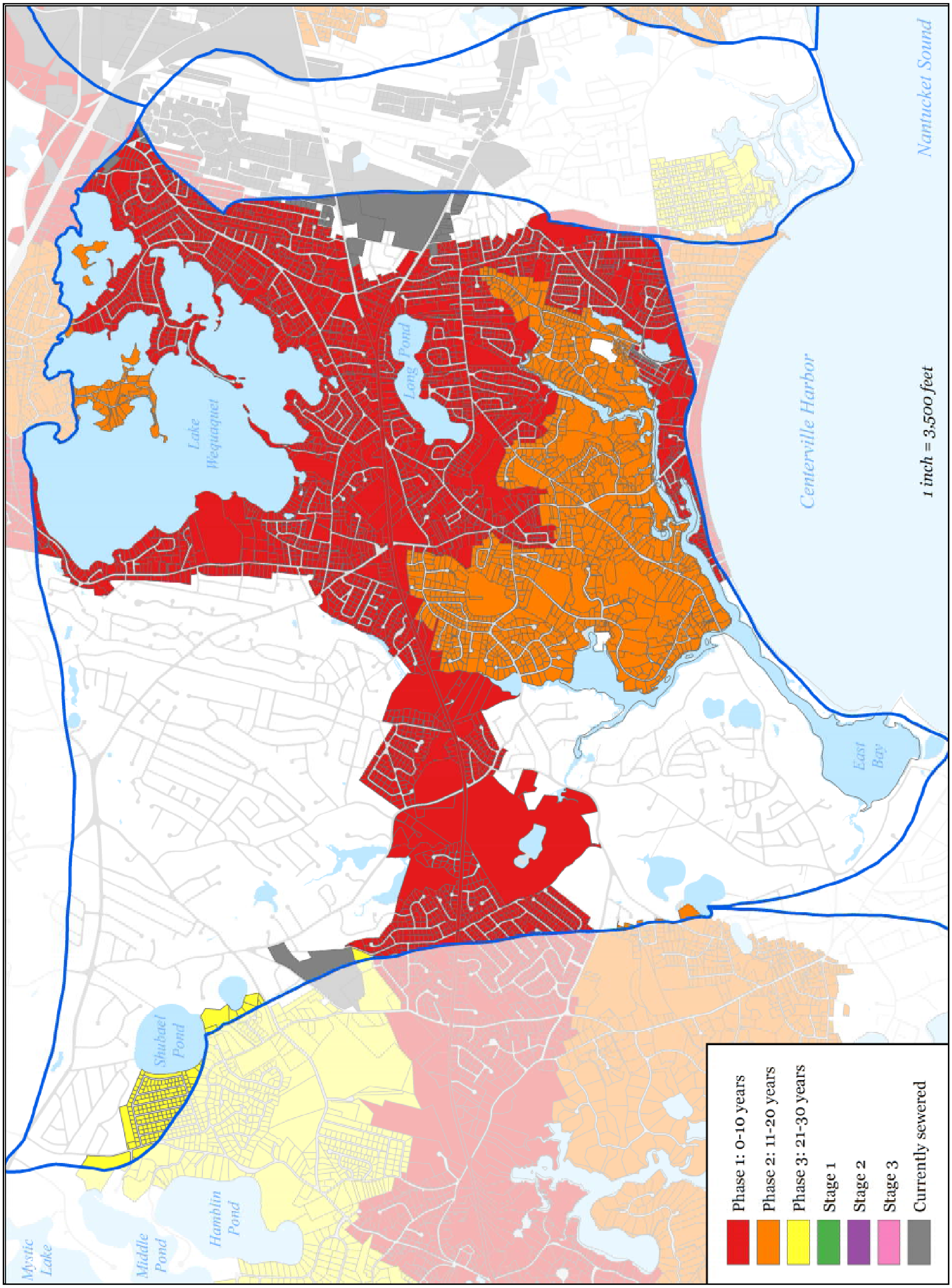

Figure 5-37: Sewer Expansion Plan in Centerville River Watershed

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 39 identified surface waters including 14 named freshwater ponds and 4 significant freshwater stream outlets (Skunknett River, Bumps River, Long Pond Stream, Lake Elizabeth). 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, 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 ask DEP for 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 5-10 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 5-10: MEP Threshold Septic Loading Modeling Scenario Summary

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 5-11, 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 5-11: 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	843	24.7	20.3%
3	1,708	28.4	23.4%
Subtotal	***3,356***	***69.1***	***56.9%***
Stage	**Parcels**	**Nitrogen (kg/day N)**	**% of Total Watershed Nitrogen Removed**
1	21	0.3	0.3%
2	216	3.8	3.1%
3	121	1.7	1.4%
Subtotal	***358***	***5.8***	***4.8%***
Total	***3,714***	***74.9***	***61.7%***

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 attenuated nitrogen data):

- Total parcels within the Three Bays Watershed = 5,625
- Parcels with total area less than 0.25 acres = 336
    - 208 (62%) will be addressed with a traditional solution in the Plan
- Parcels with average depth to groundwater less than four feet = 143
    - 62 (43%) will be addressed with a traditional solution in the Plan
- Parcels with septic system variances = 36
    - 12 (33%) will be addressed with a traditional solution in the Plan
- Parcels with known failed septic systems = 2
    - 2 (100%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 3,479
    - 2,671 (77%) 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 = 718 (13%)
    - 481 (67%) 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 12 ponds in the Three Bays Watershed. Pond classification of these ponds is shown in Table 5-12 and Table 5-13.

Table 5-12**:** Three Bays Watershed Pond classification 2009

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

Table 5-13**:** 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			

Seven ponds within the watershed have been identified as impaired: Pattys Pond, Parker Pond, Little Pond, Eagle Pond, Muddy Pond, Long Pond, and Sam's Pond.

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 Salt Water 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
    - 3,714 parcels (66%) in the watershed are included in the sewer expansion plan
    - Removal of 61.7% (74.9 kg/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.

- Alternative Septic Systems
  - Continue to support partners (BCWC and others) in evaluation of technologies and installation of pilot projects as discussed in Section 3.1.2.5.

- 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.

- 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 6.4 for the Adaptive Management Plan and Section 6.3 for the Monitoring Plan.

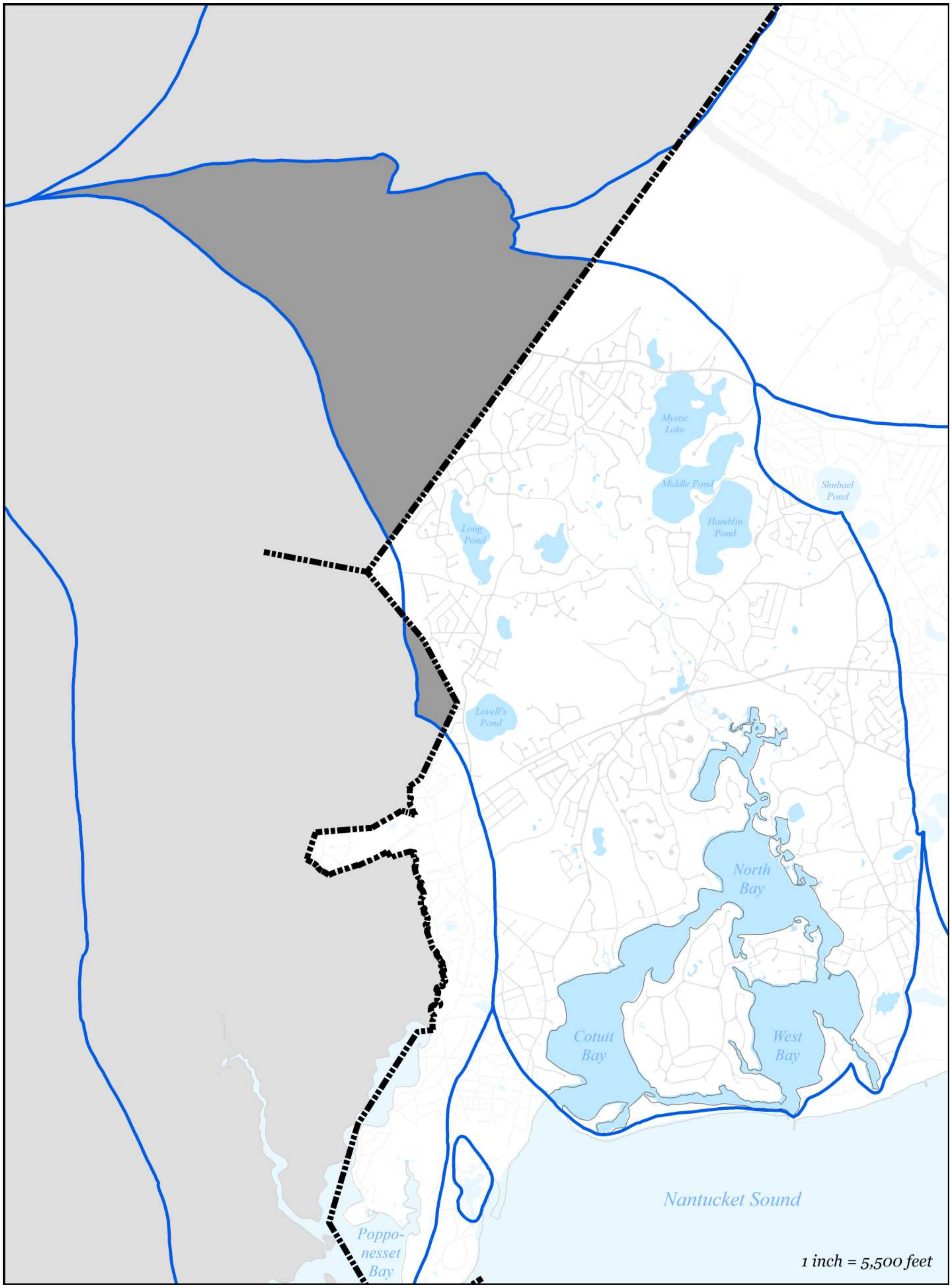

Figure 5-38: Three Bays Watershed

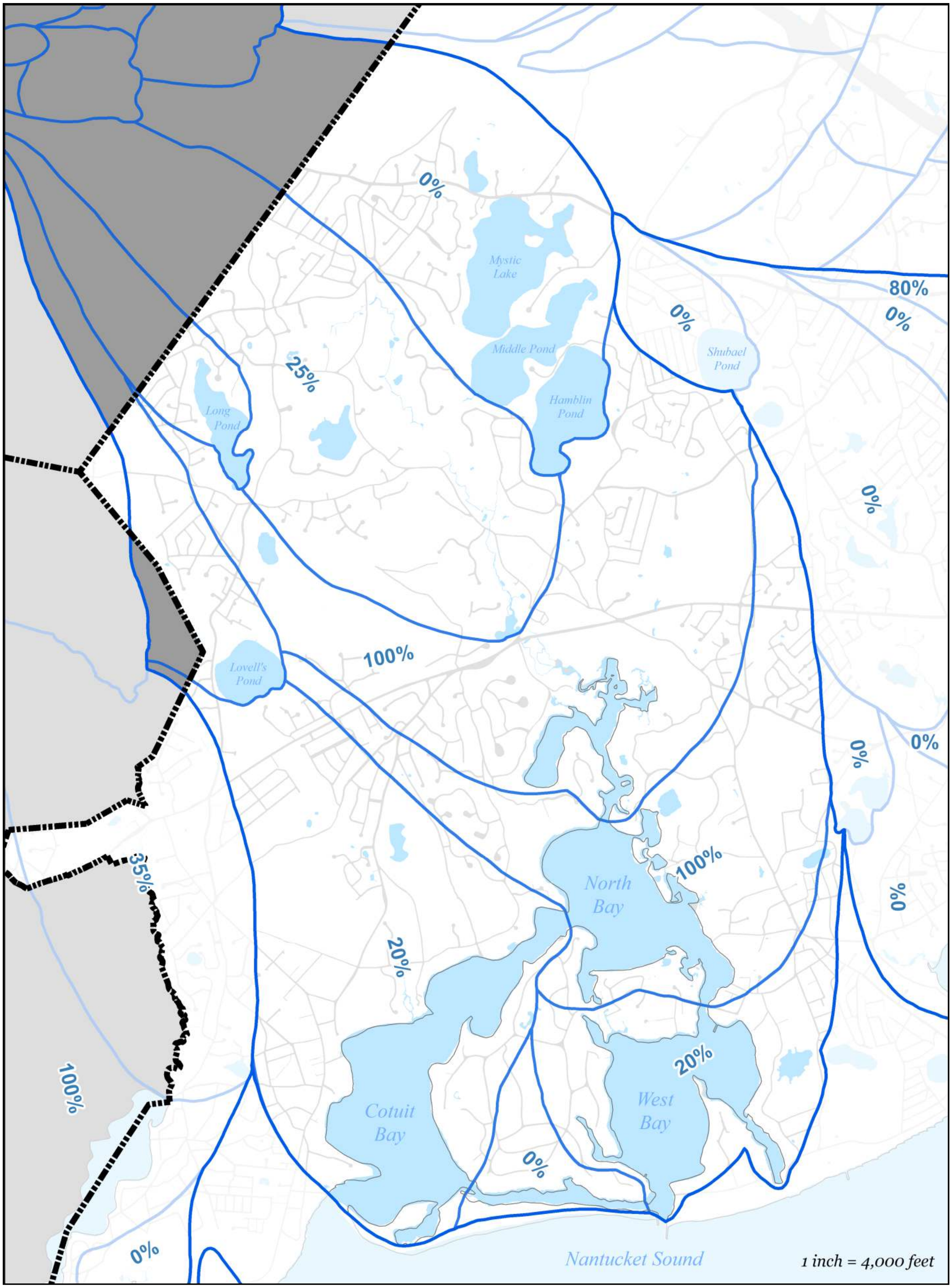

Figure 5-39: MEP-modeled Existing Septic Removal in Three Bays Watershed

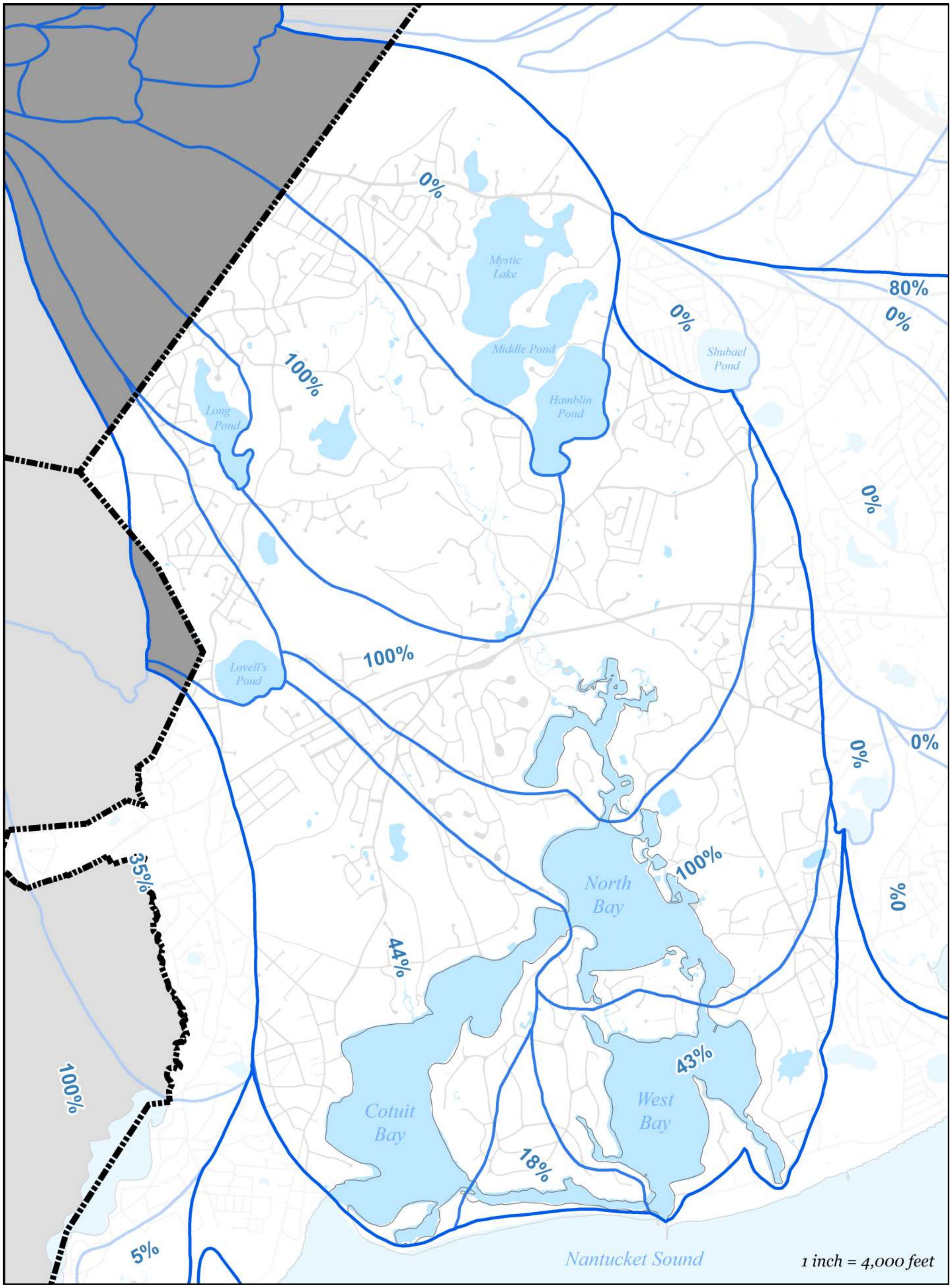

Figure 5-40: MEP-modeled Future Septic Removal in Three Bays Watershed

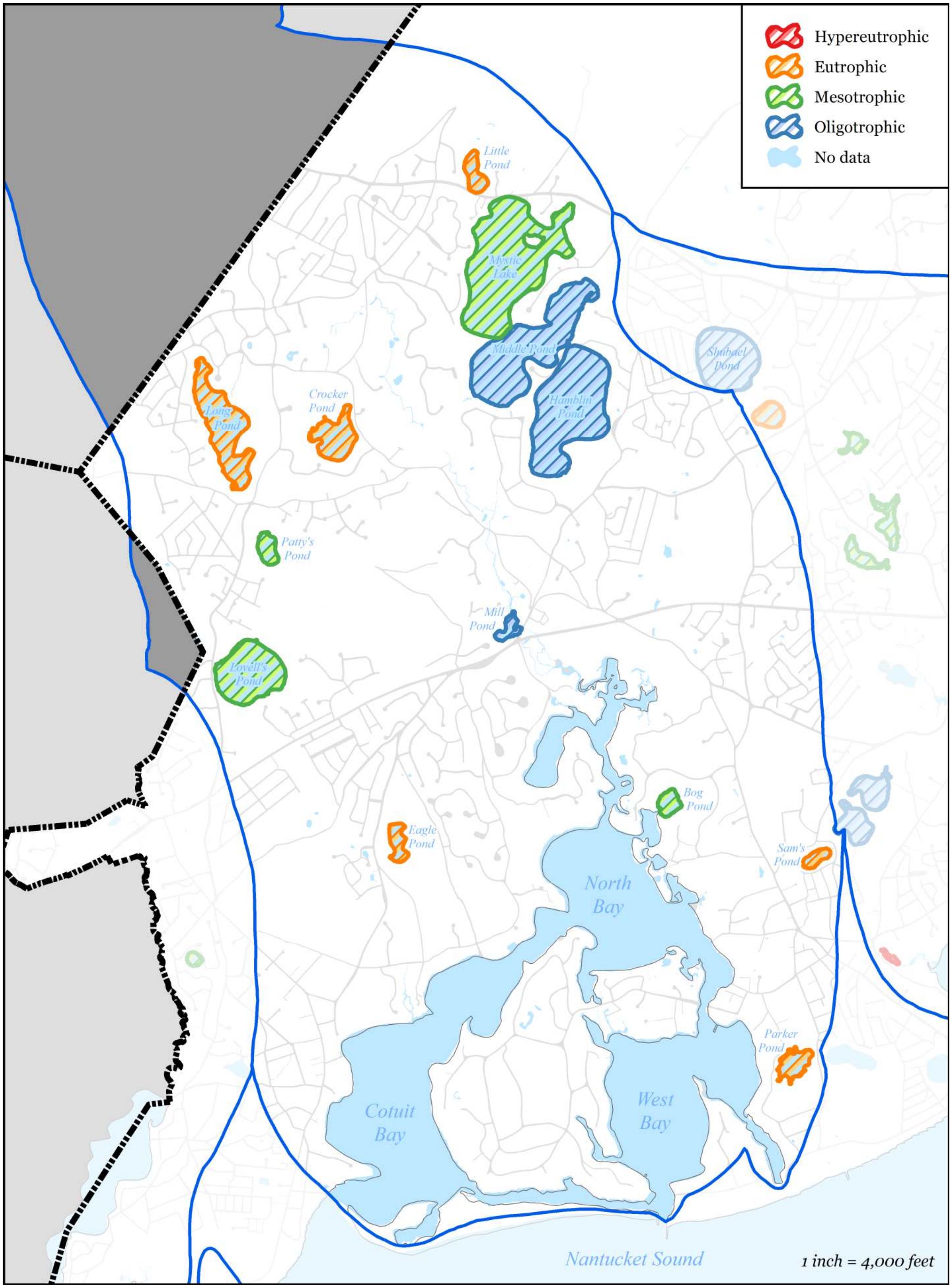

Figure 5-41: Impaired Ponds in Three Bays Watershed

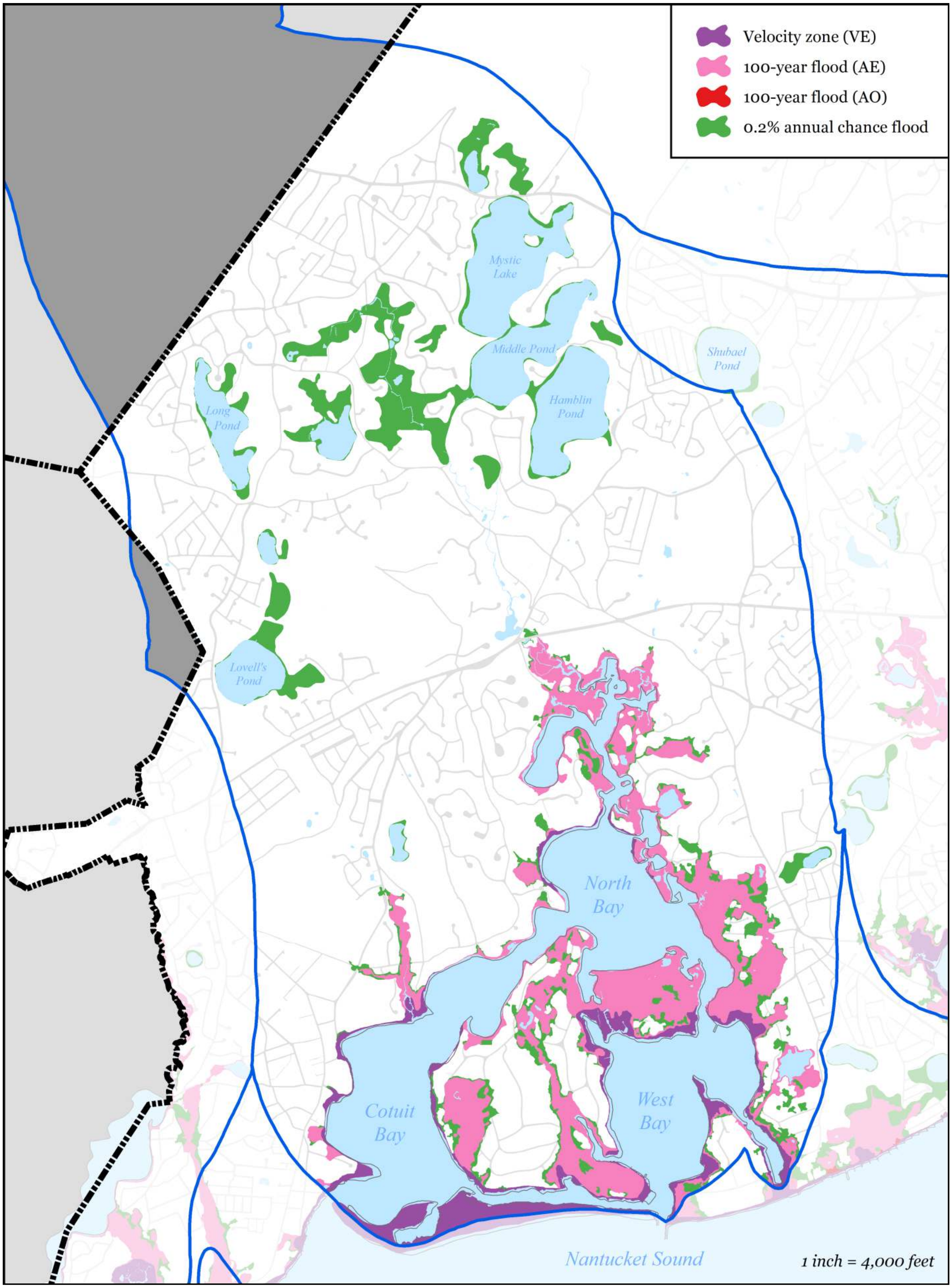

Figure 5-42: FEMA Flood Zones (2014) in Three Bays Watershed

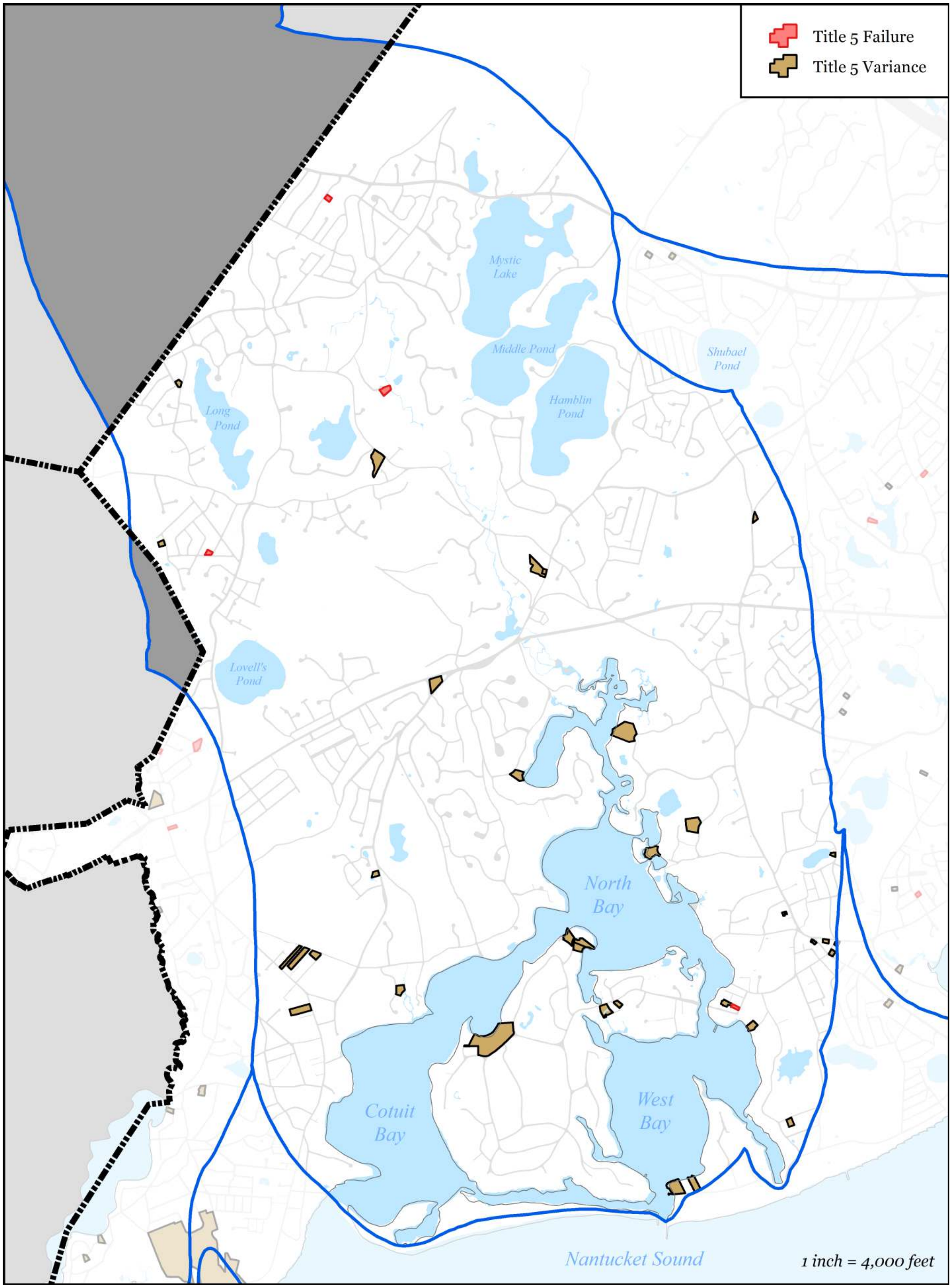

Figure 5-43: Parcels with Title 5 Septic Failures and Variances in Three Bays Watershed

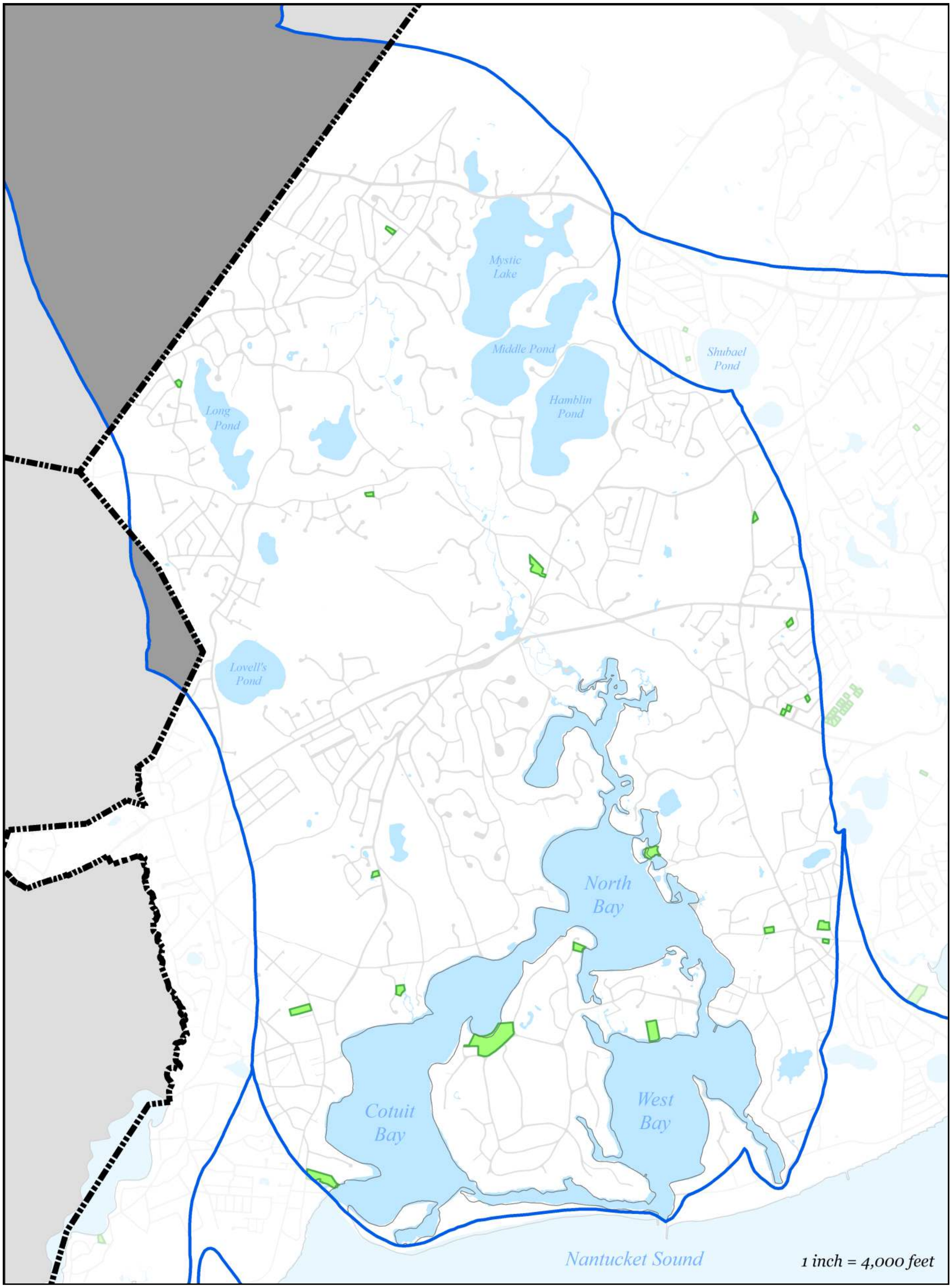

Figure 5-44: Parcels with I/A Septic Systems in Three Bays Watershed

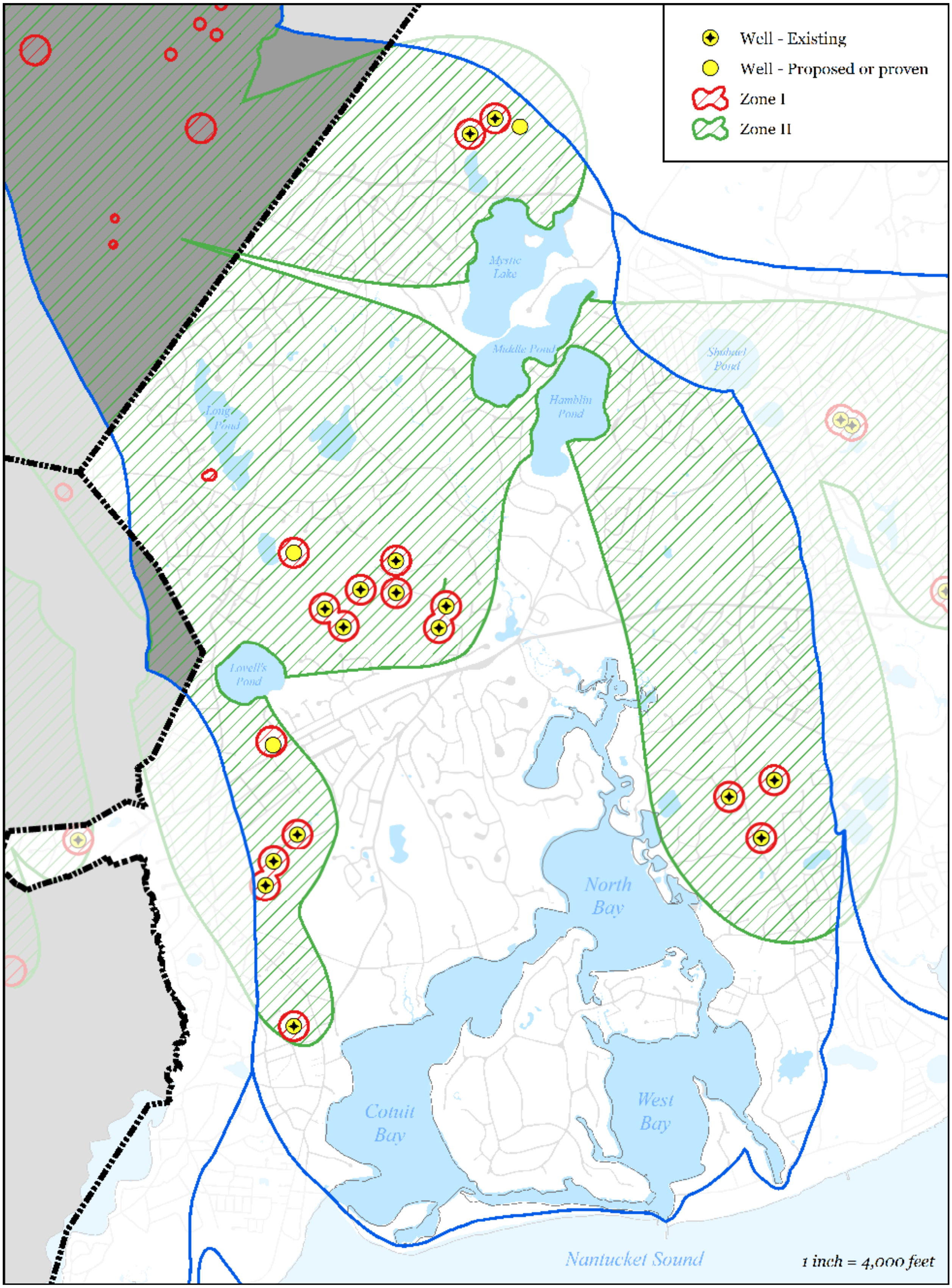

Figure 5-45: Public Water Supply Wells in Three Bays Watershed

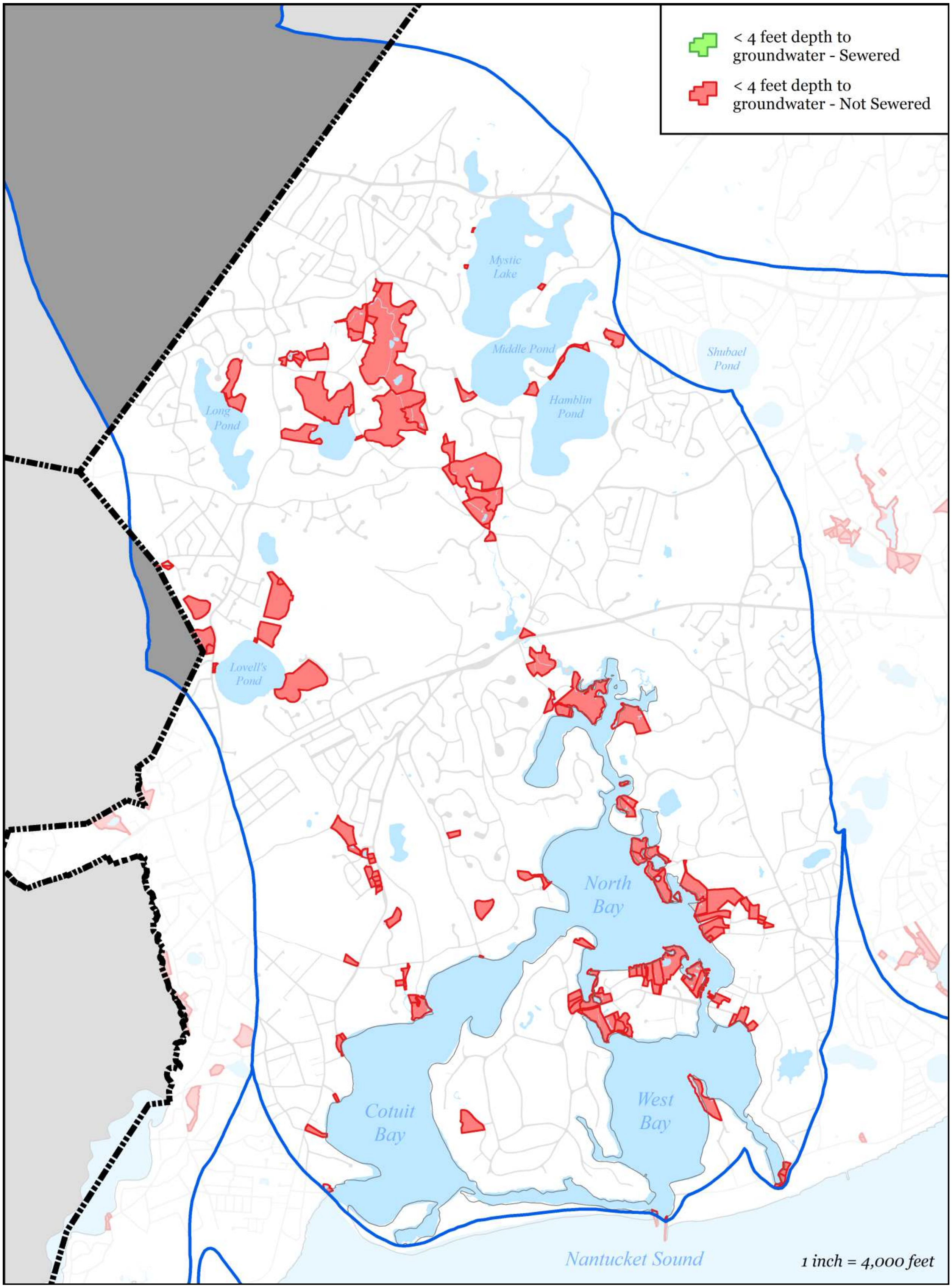

Figure 5-46: Parcels with Less than 4 feet Depth to Groundwater in Three Bays Watershed

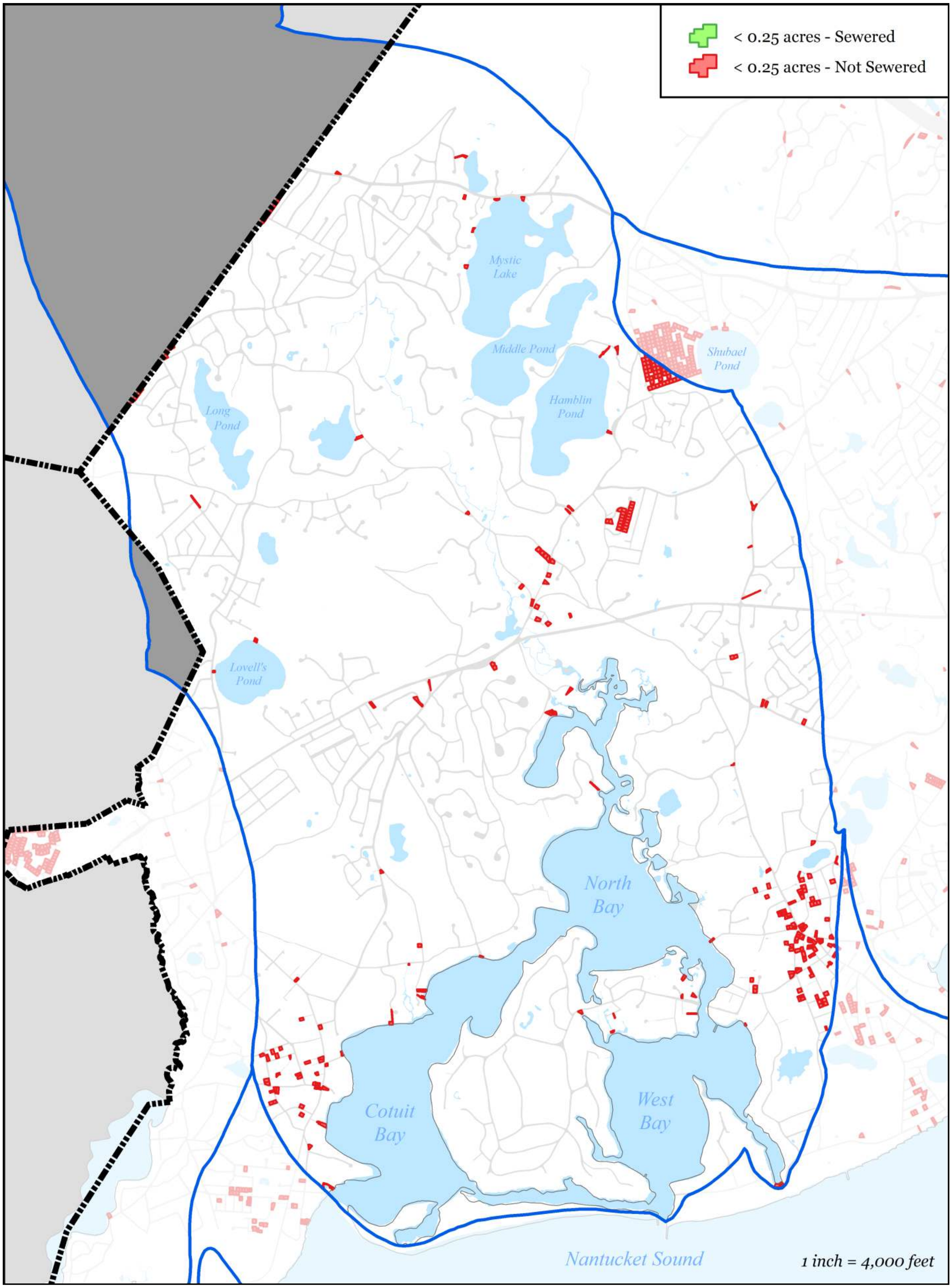

Figure 5-47: Parcels with Less than 0.25 acres in Three Bays Watershed

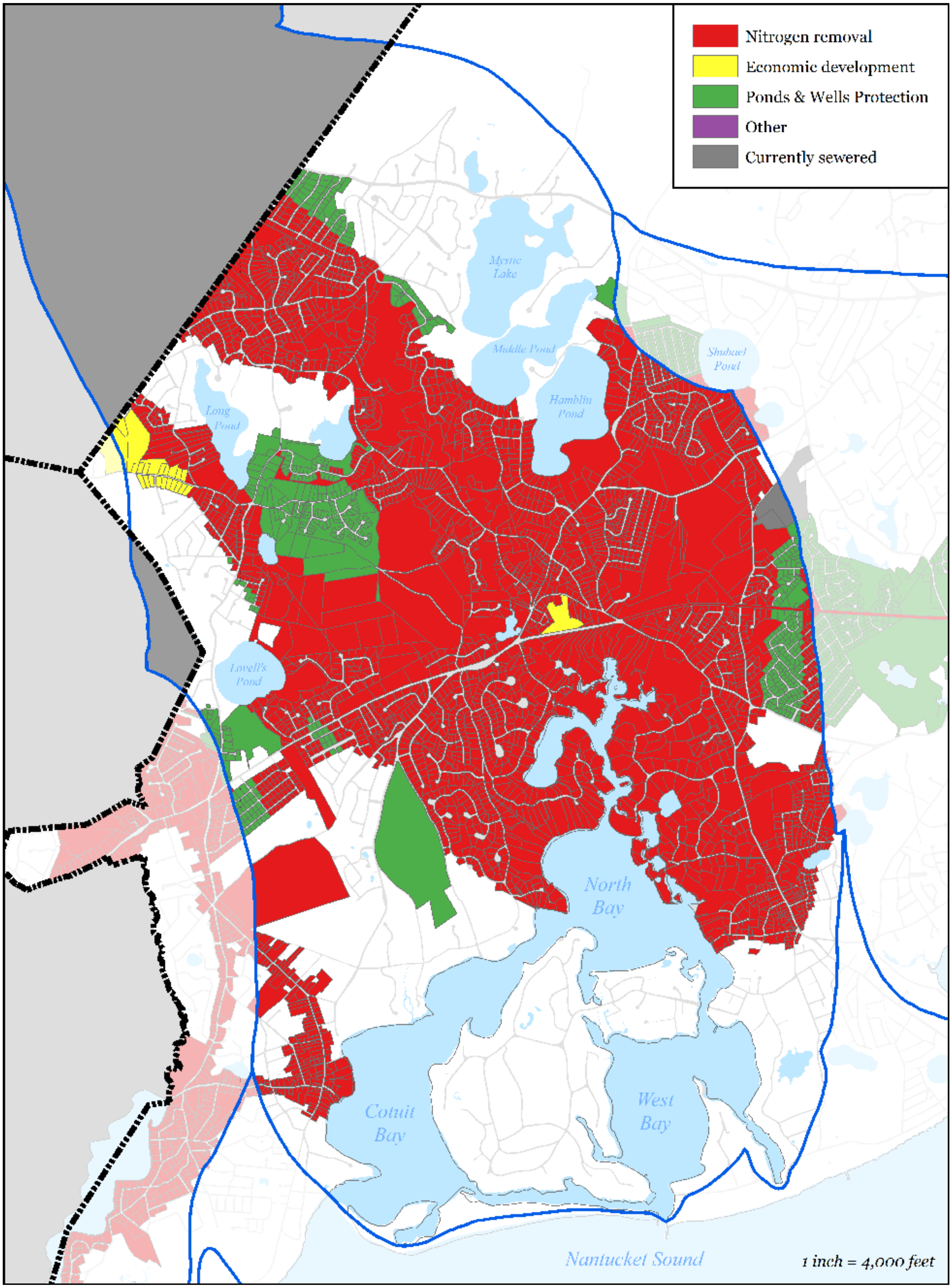

Figure 5-48: Needs Areas in Three Bays Watershed

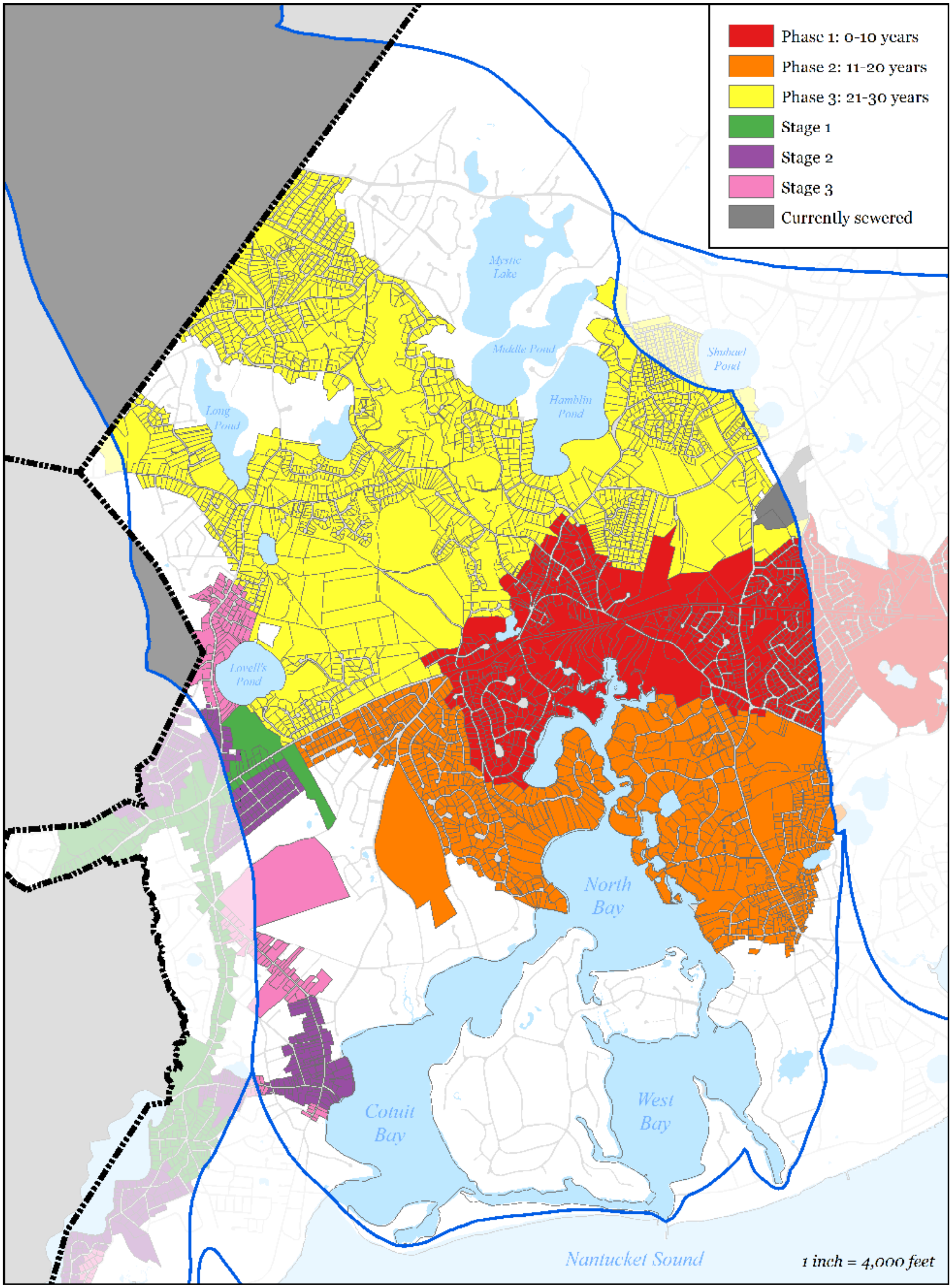

Figure 5-49: Sewer Expansion Plan in Three Bays Watershed

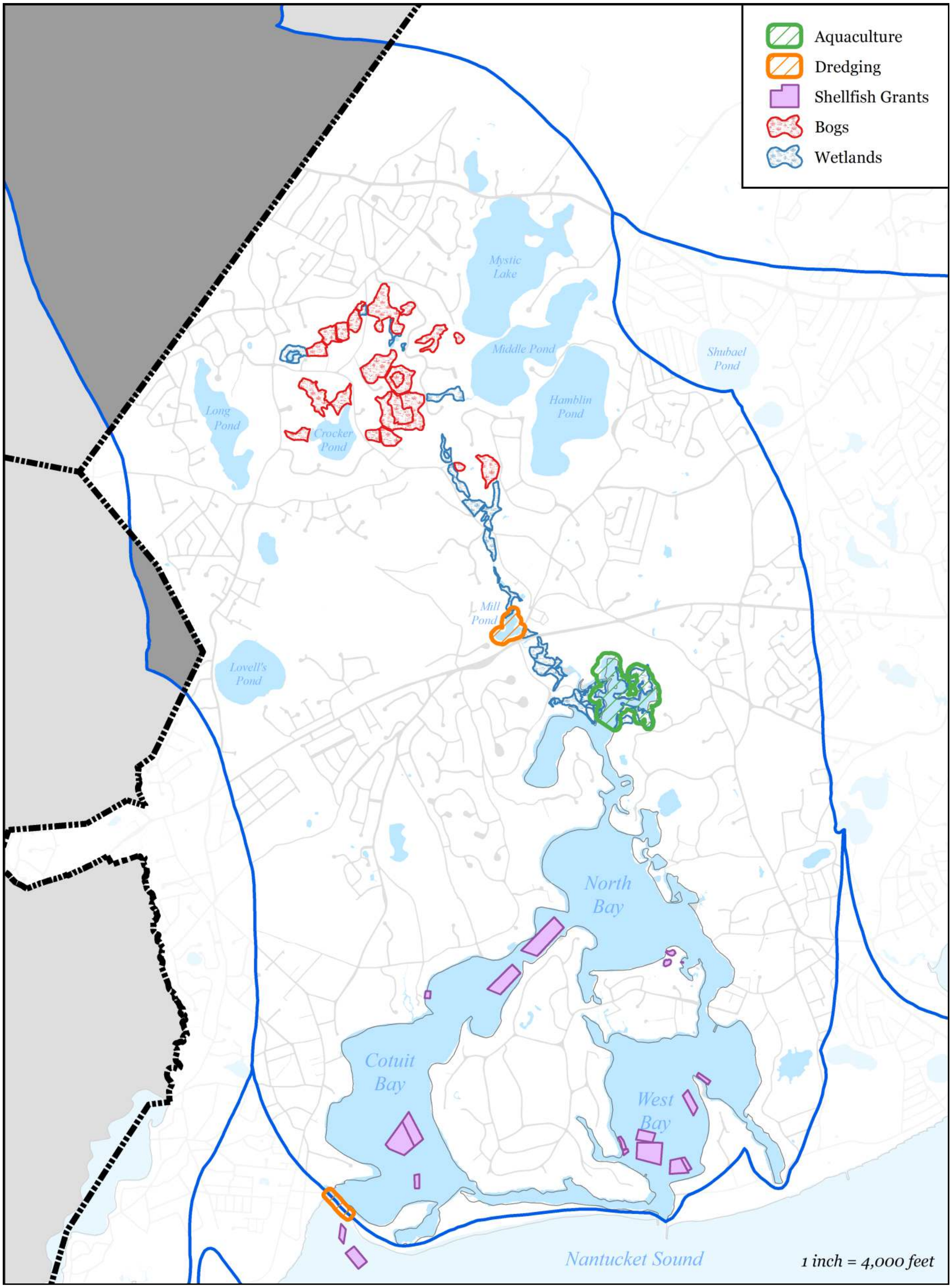

Figure 5-50: Non-Traditional Projects

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

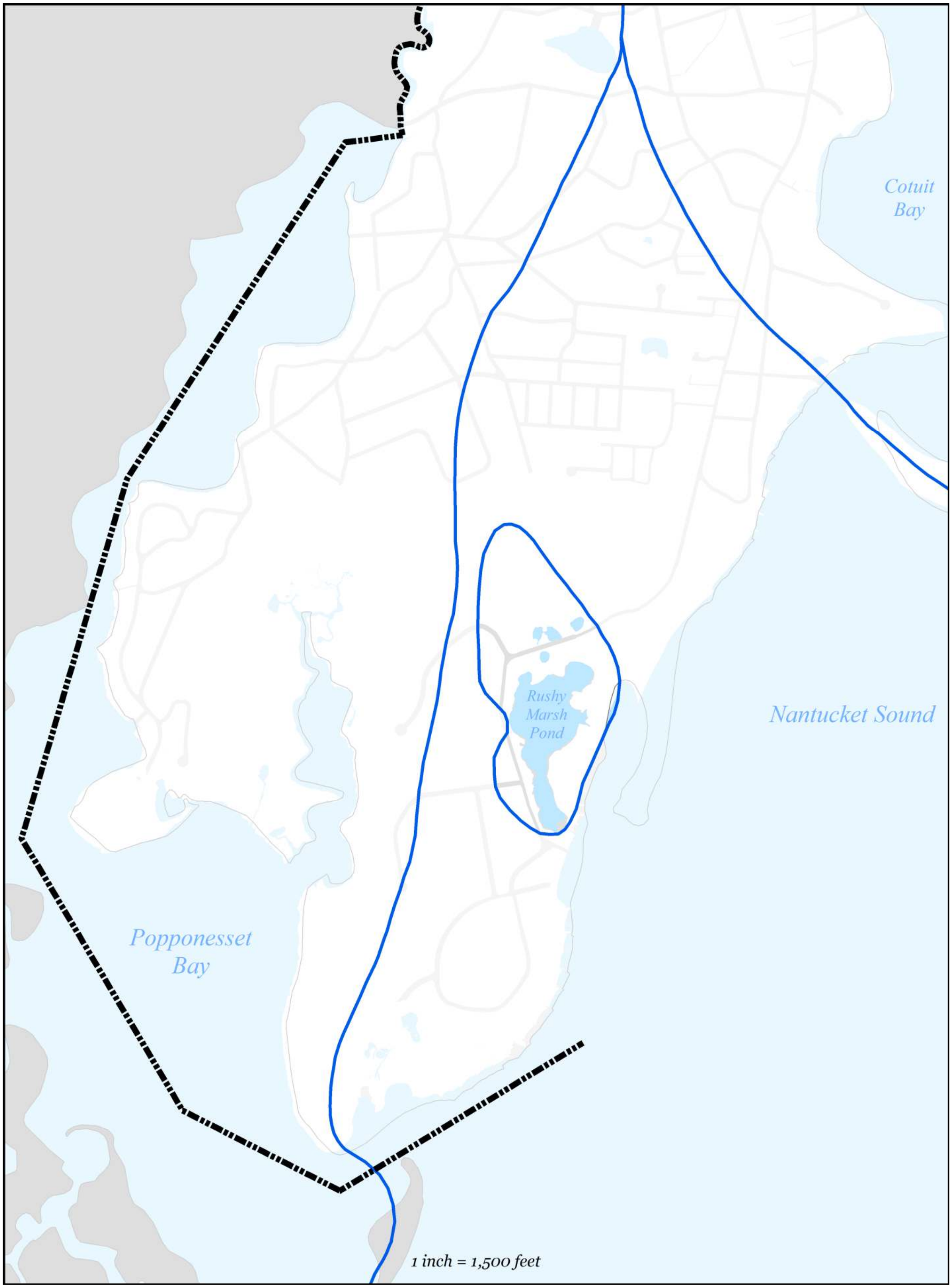

Figure 5-53: Rushy Marsh Watershed

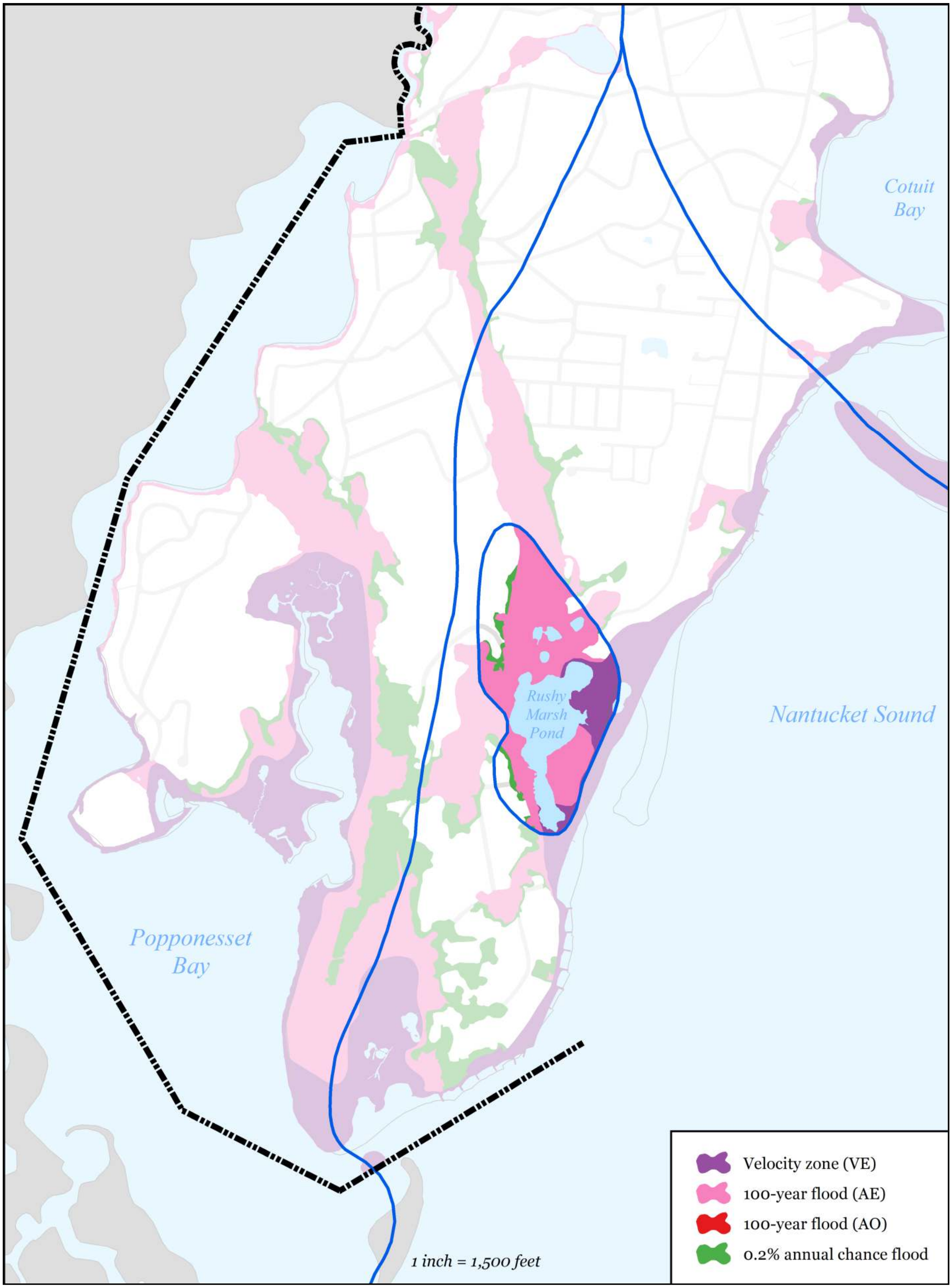

Figure 5-54: FEMA Flood Zones (2014) in Rushy Marsh Pond Watershed

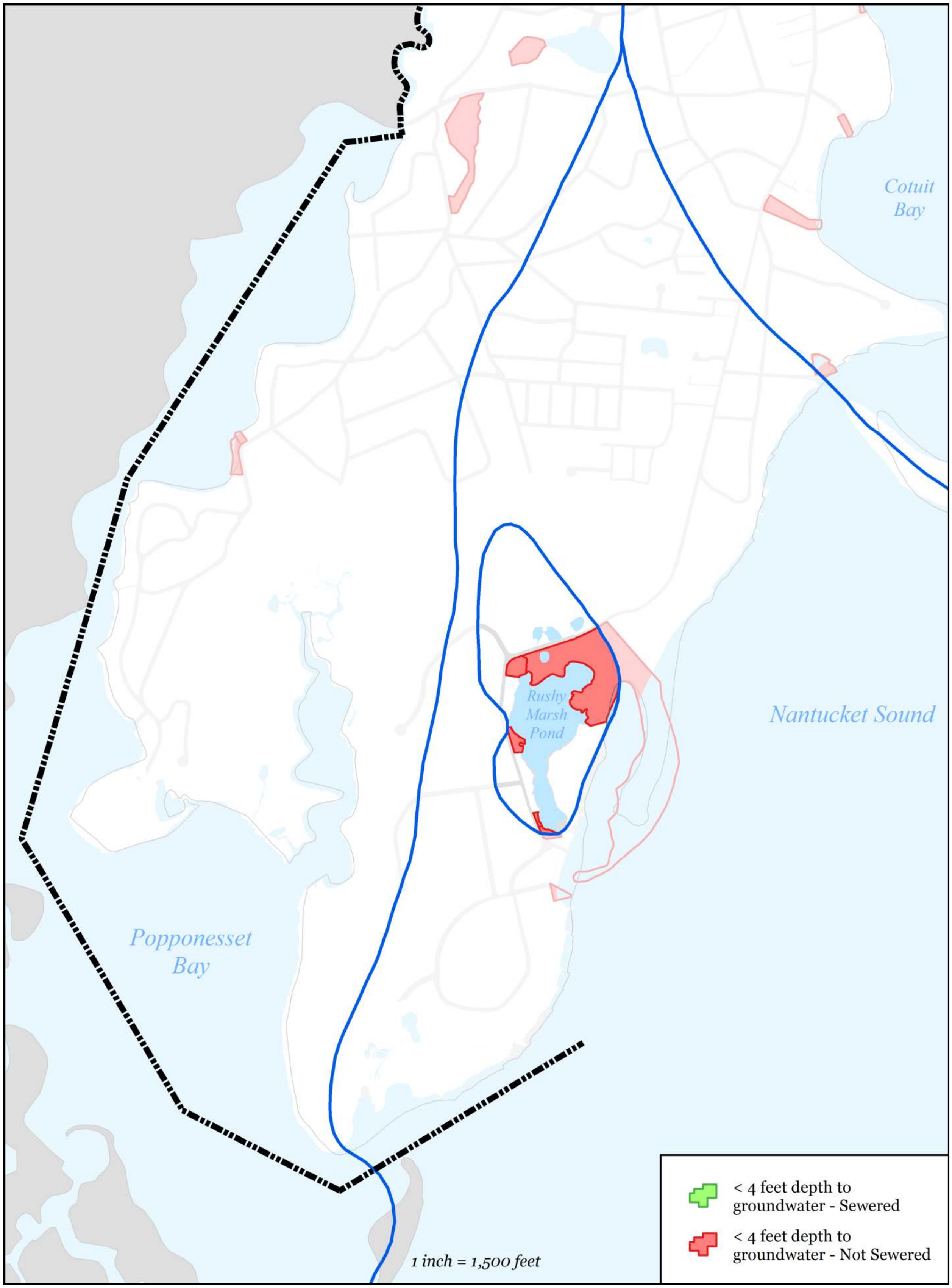

Figure 5-55: Parcels with Less than 4 feet Depth to Groundwater in Rushy Marsh Watershed

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. The 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.

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, flood zone considerations, and economic development, via sewer expansion into the Popponesset Bay Watershed.

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 5-14). 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 5-14: 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 watershed, specifically Shoestring Bay. Once 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 (4.1 kg/day-N), Shoestring Bay requires 100% septic load removal (6.9 kg/day-N) 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: 44%, (4.1 kg/day-N, un-attenuated)
- Shoestring Bay sub-watershed: 100% (3.4 kg/day-N, un-attenuated)
- Pinquickset Cove sub-watershed: 30% (0.6 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 (4.1 kg/day-N, un-attenuated) 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 attenuated nitrogen data):

- Total parcels located within the Popponesset Bay Watershed in the Town = 943
- Parcels with total area less than 0.25 acres = 92
  - 5 (5%) will be addressed with a traditional solution in the Staging Plan
- Parcels with average depth to groundwater less than four feet = 10
  - 5 (50%) will be addressed with a traditional solution in the Staging Plan
- Parcels with septic system variances = 6
  - 5 (83%) will be addressed with a traditional solution in the Staging Plan
- Parcels with known failed septic systems = 0
- Parcels located within a Zone II = 412
  - 219 (53%) 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 = 175
  - 114 (65%) 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 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 1 pond in the Popponesset Bay Watershed. Pond classification of these ponds is shown in Table 5-15.

Table 5-15:Popponesset Bay Watershed Pond classification 2009

	Ultra-Shallow 0 to 2.1m	Shallow 2.1 to 8.6m	Deep >8.6
Oligotrophic			
Mesotrophic		No Bottom	
Eutrophic			
Hypereutrophic			

5.2.6.1.4 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
  - 524 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 6.4 for the Adaptive Management Plan and Section 6.3 for the Monitoring Plan.

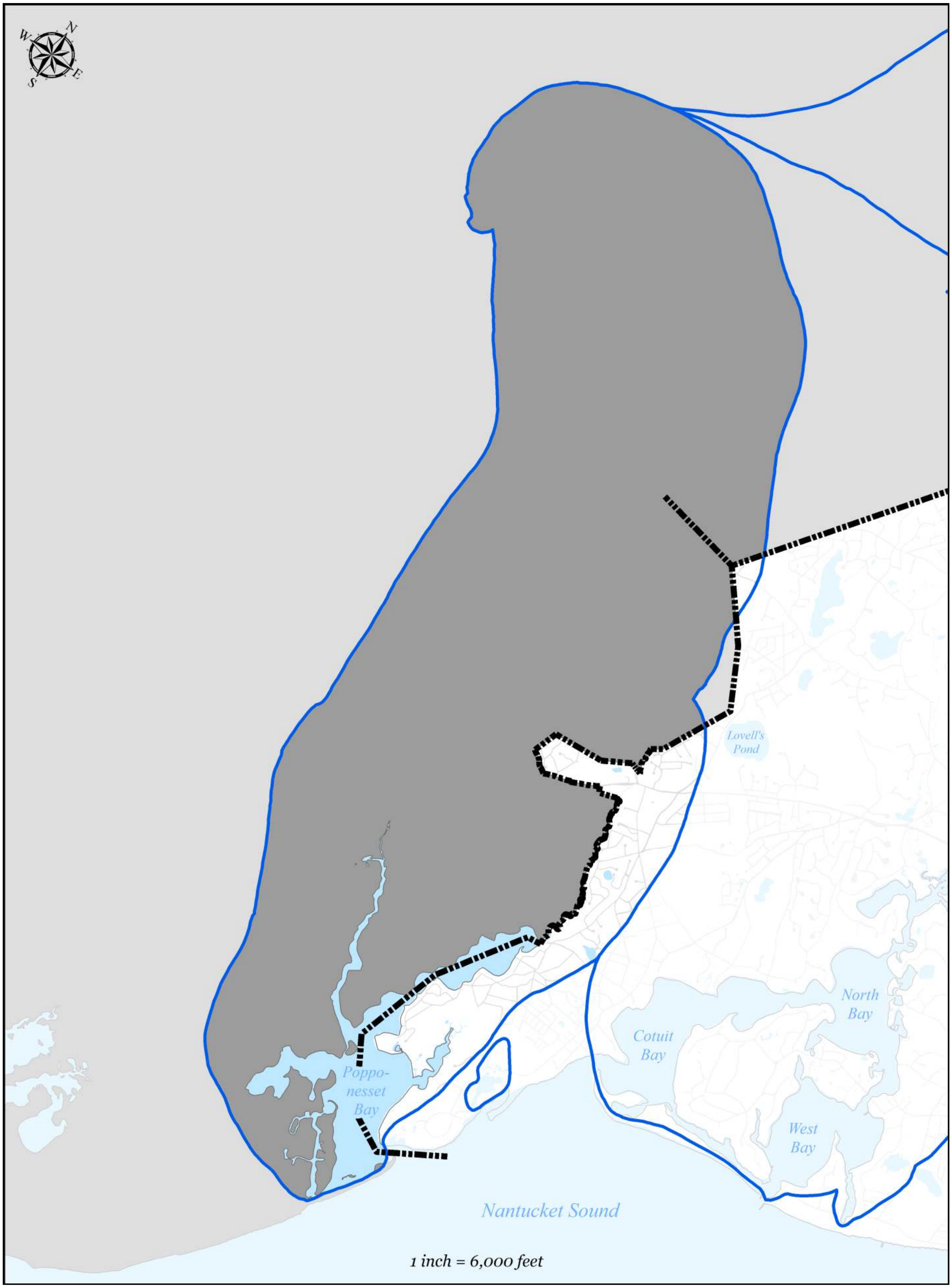

Figure 5-56: Popponesset Bay Watershed Boundary

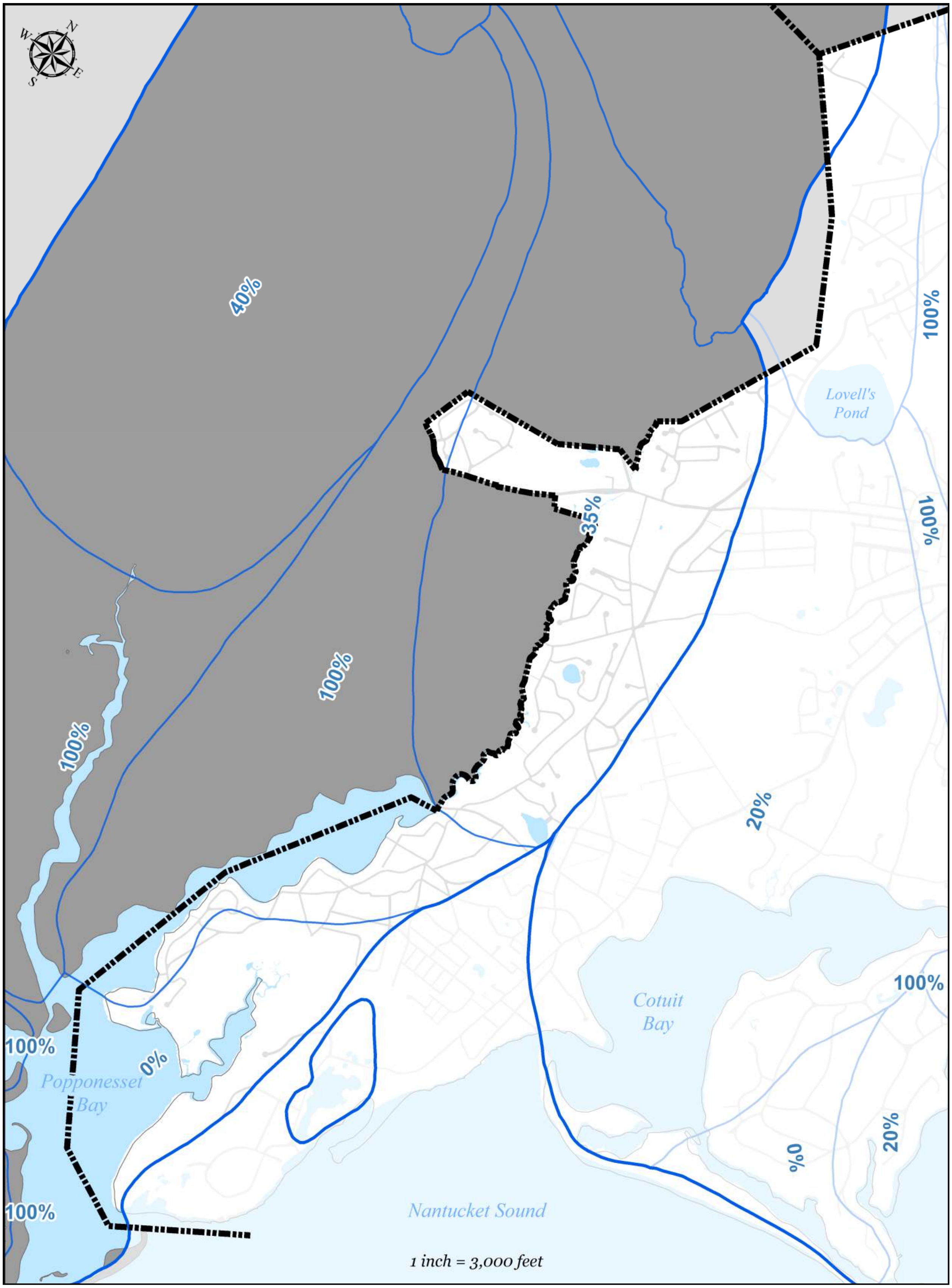

Figure 5-57: MEP-modeled Existing Septic Removal in Watershed

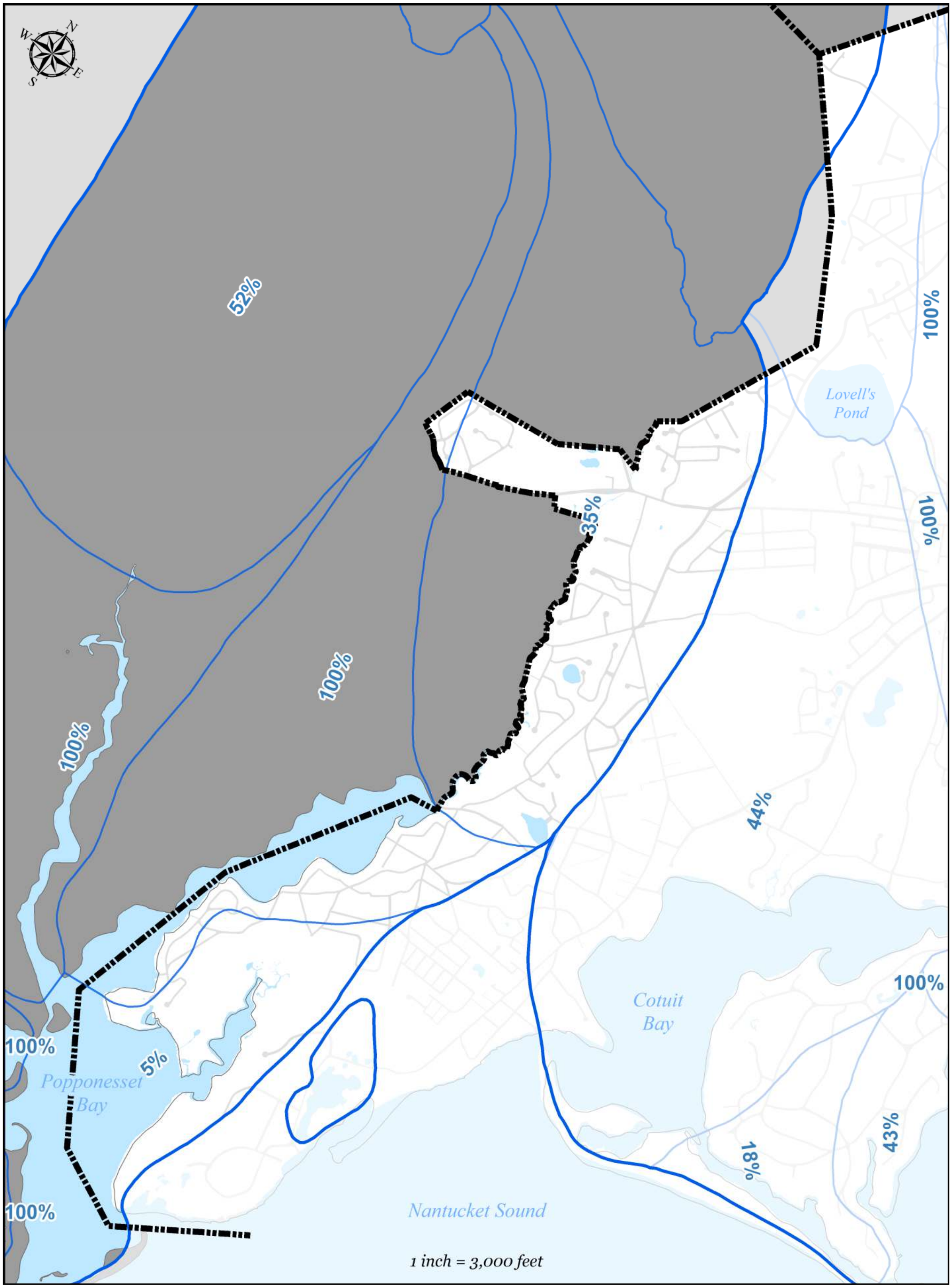

Figure 5-58: MEP-modeled Future Septic Removal in Watershed

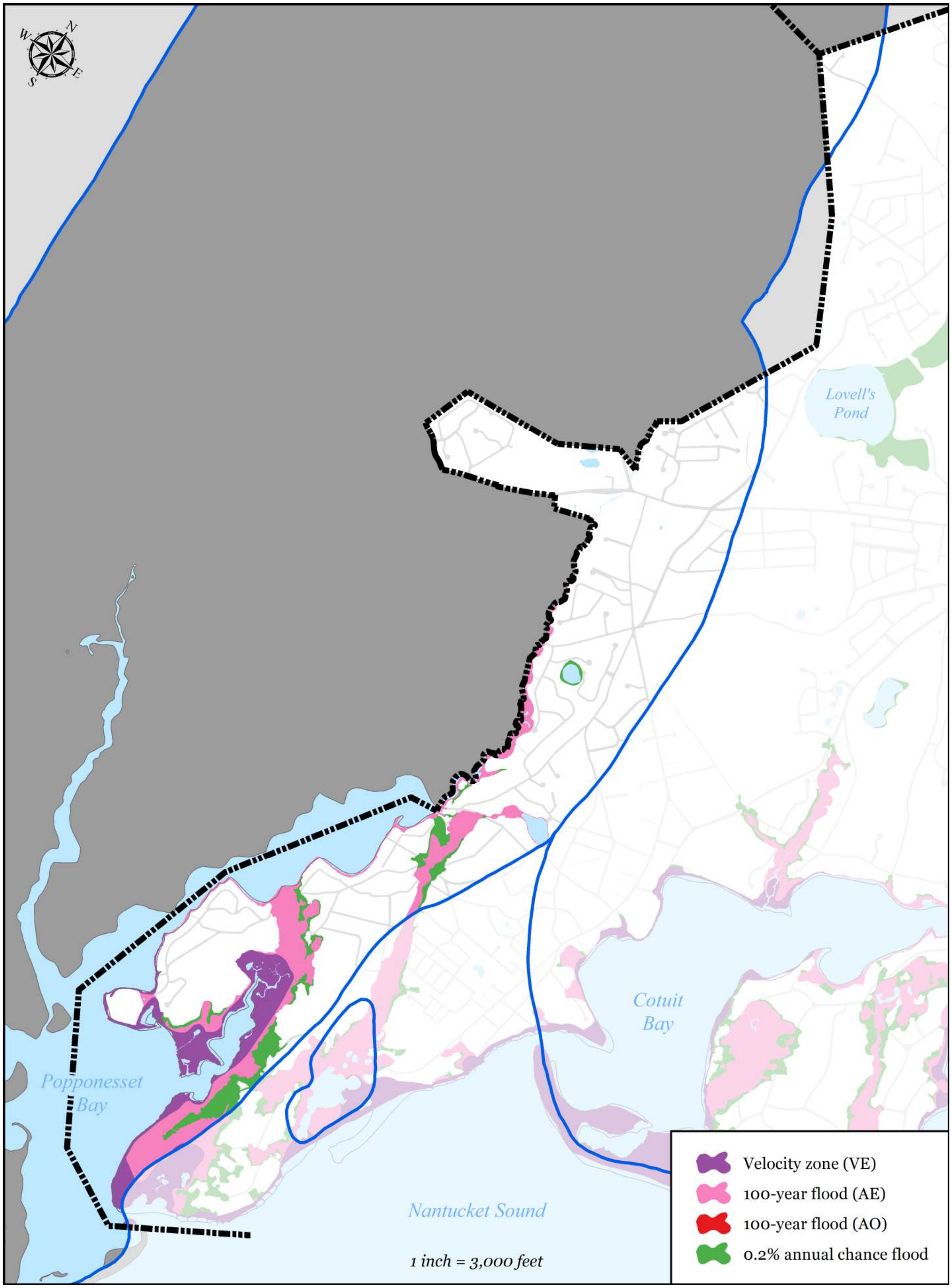

Figure 5-59: FEMA Flood Zones (2014) in Popponesset Bay Watershed

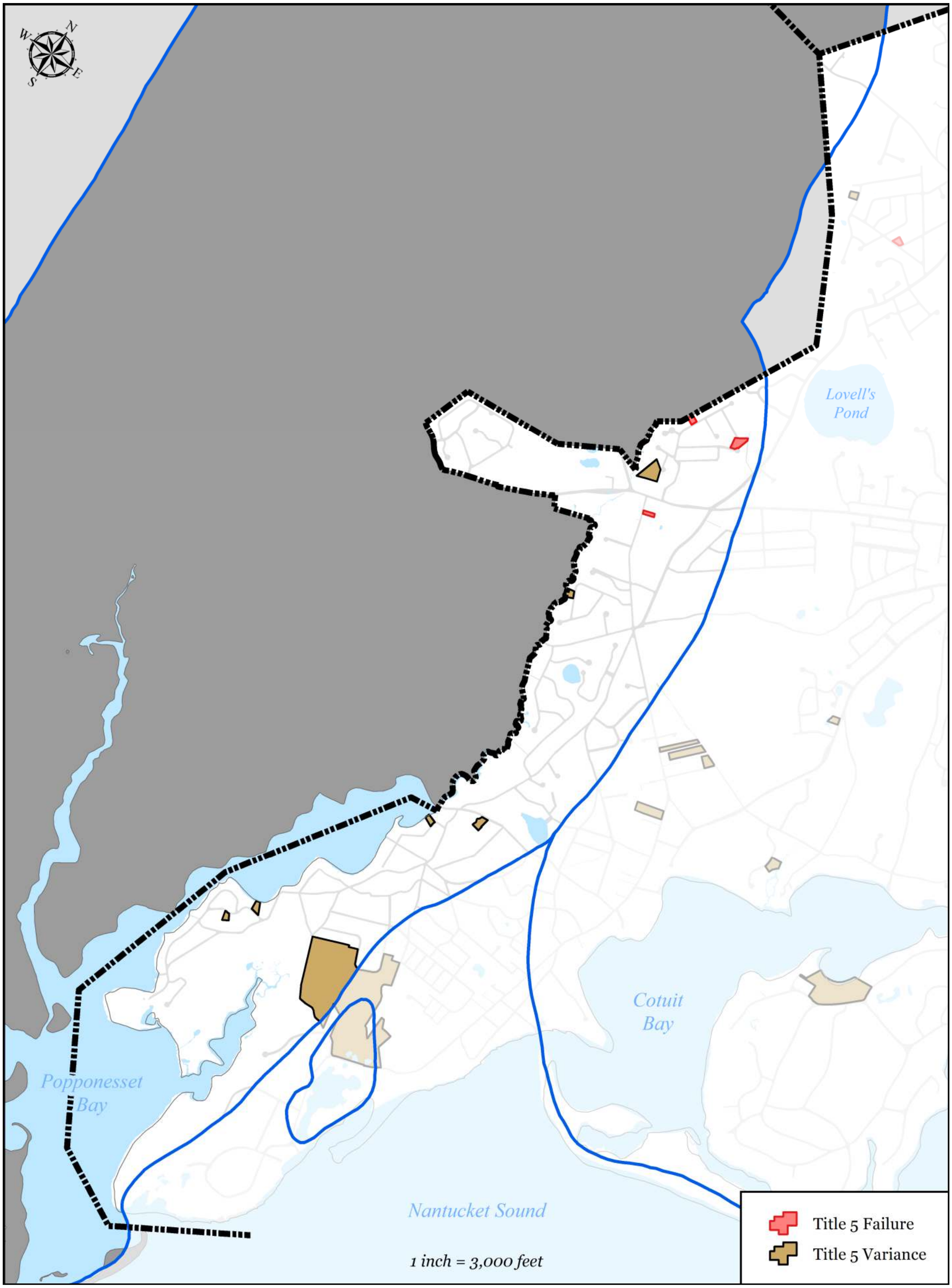

Figure 5-60: Parcels with Title 5 Septic Failures and Variances in Popponesset Bay Watershed

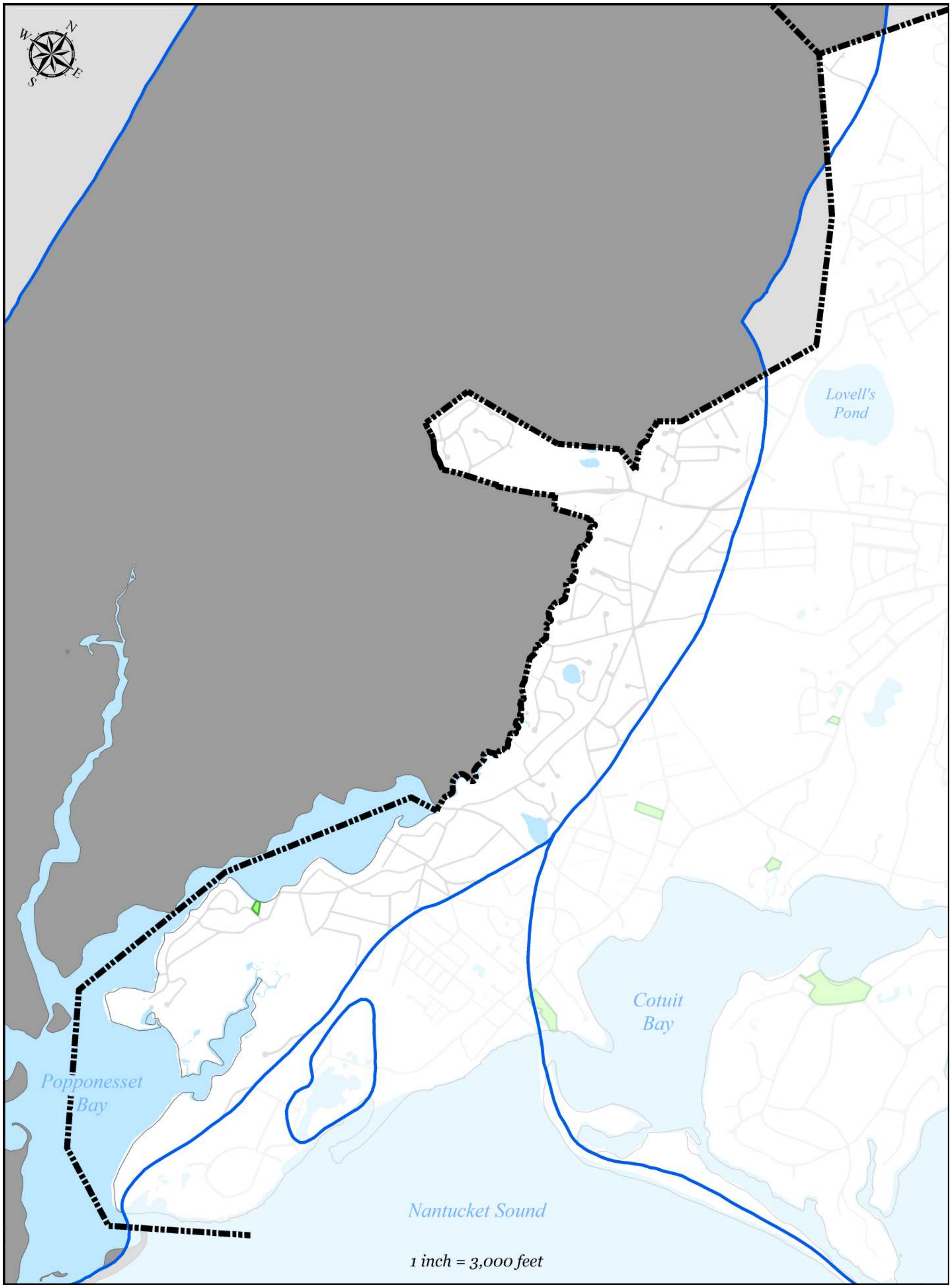

Figure 5-61: Parcels with I/A Septic Systems in Popponesset Bay Watershed

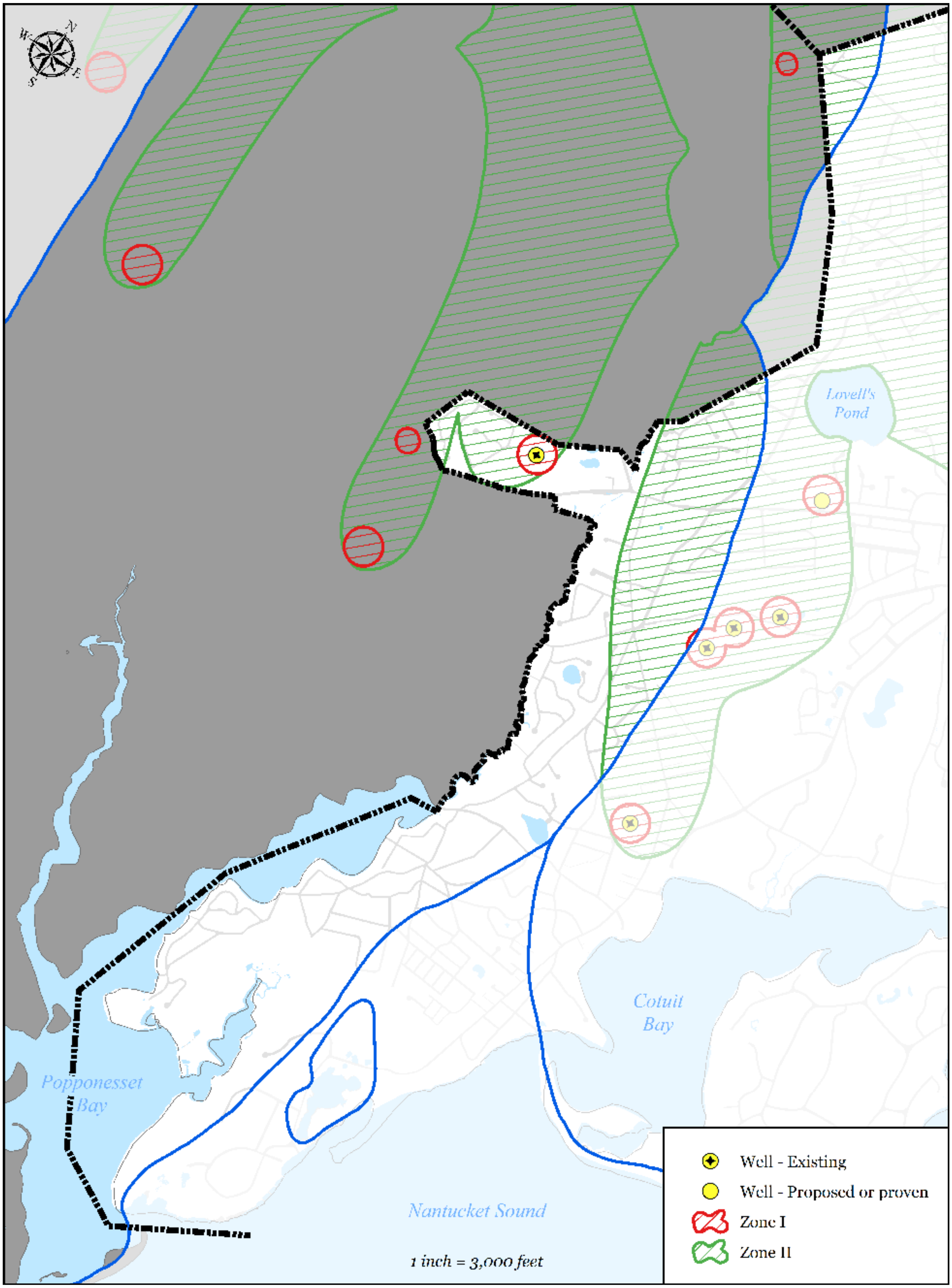

Figure 5-62: Public Water Supply Wells in Popponesset Bay Watershed

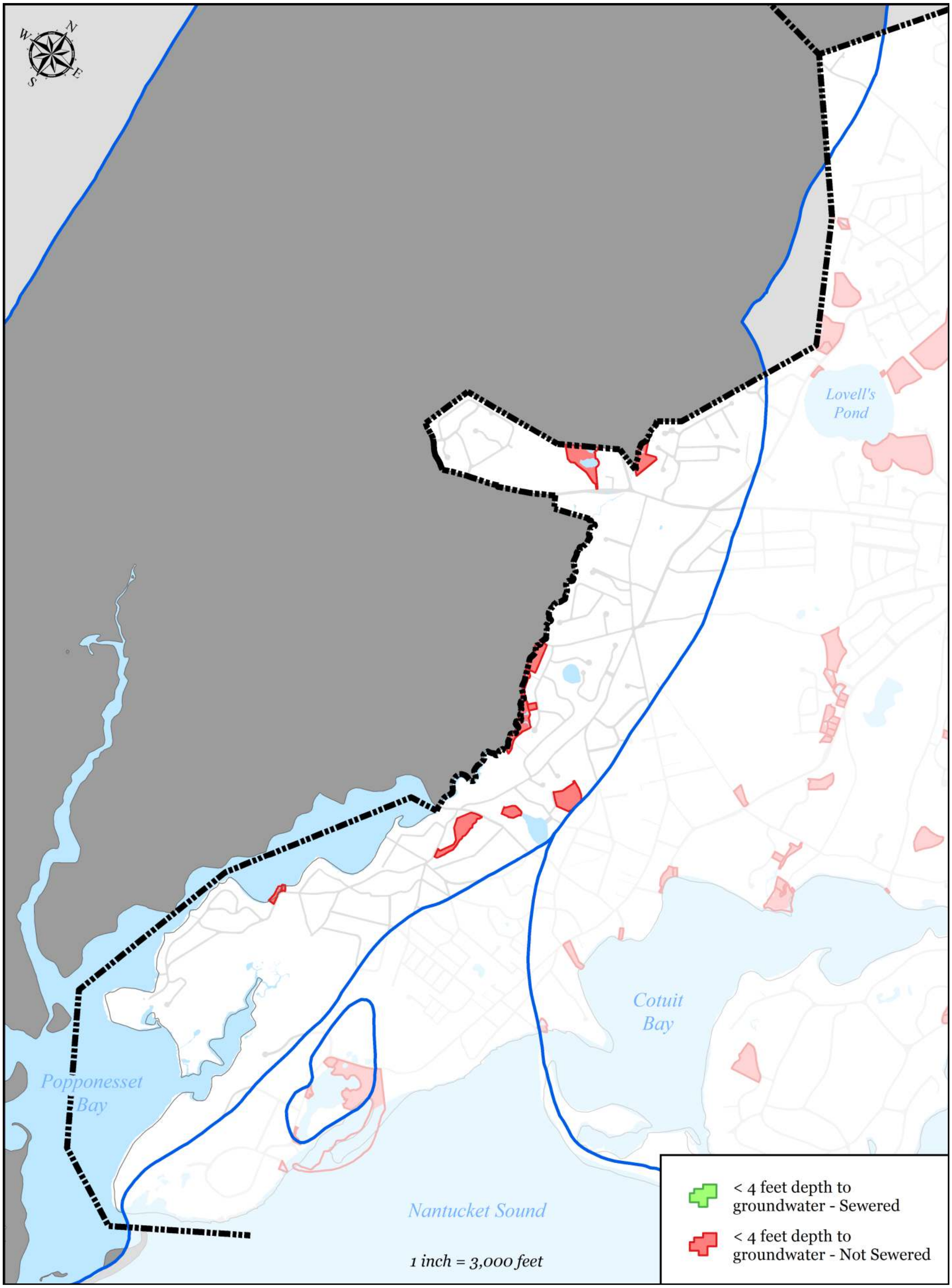

Figure 5-63: Parcels with Less than 4 feet Depth to Groundwater in Popponesset Bay Watershed

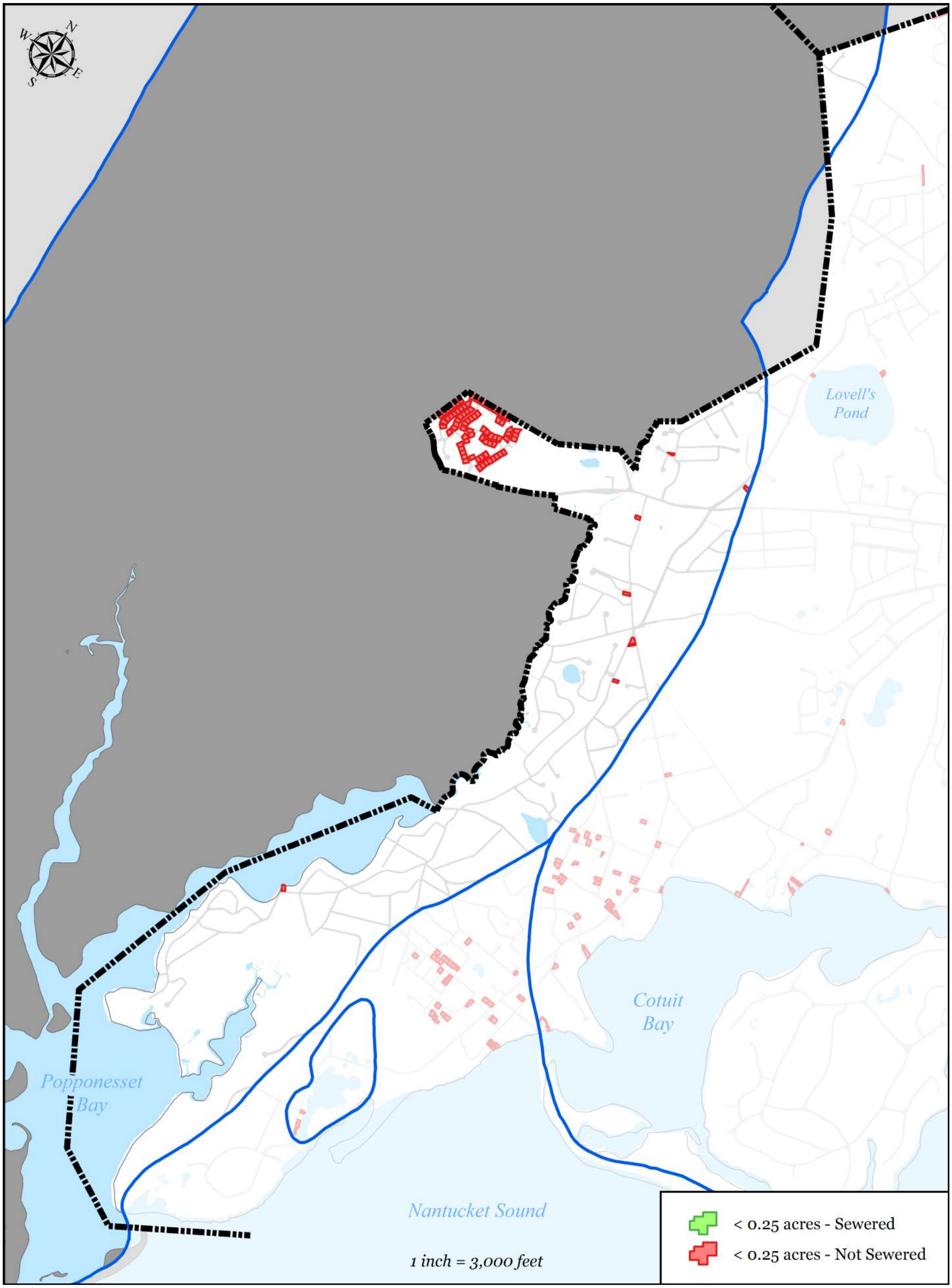

Figure 5-64: Parcels with Less than 0.25 acres in Popponesset Bay Watershed

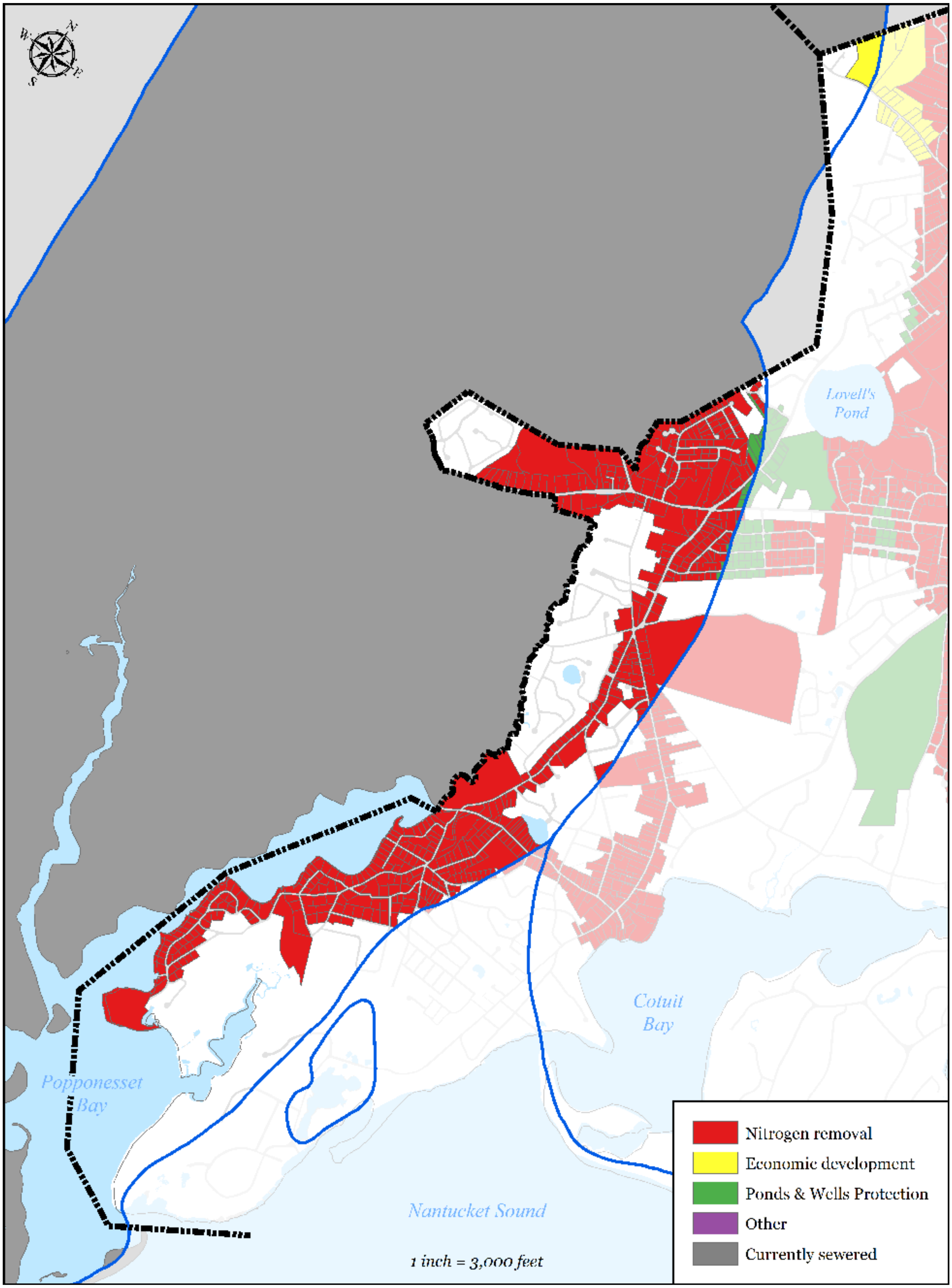

Figure 5-65: Needs Areas in Popponesset Bay Watershed

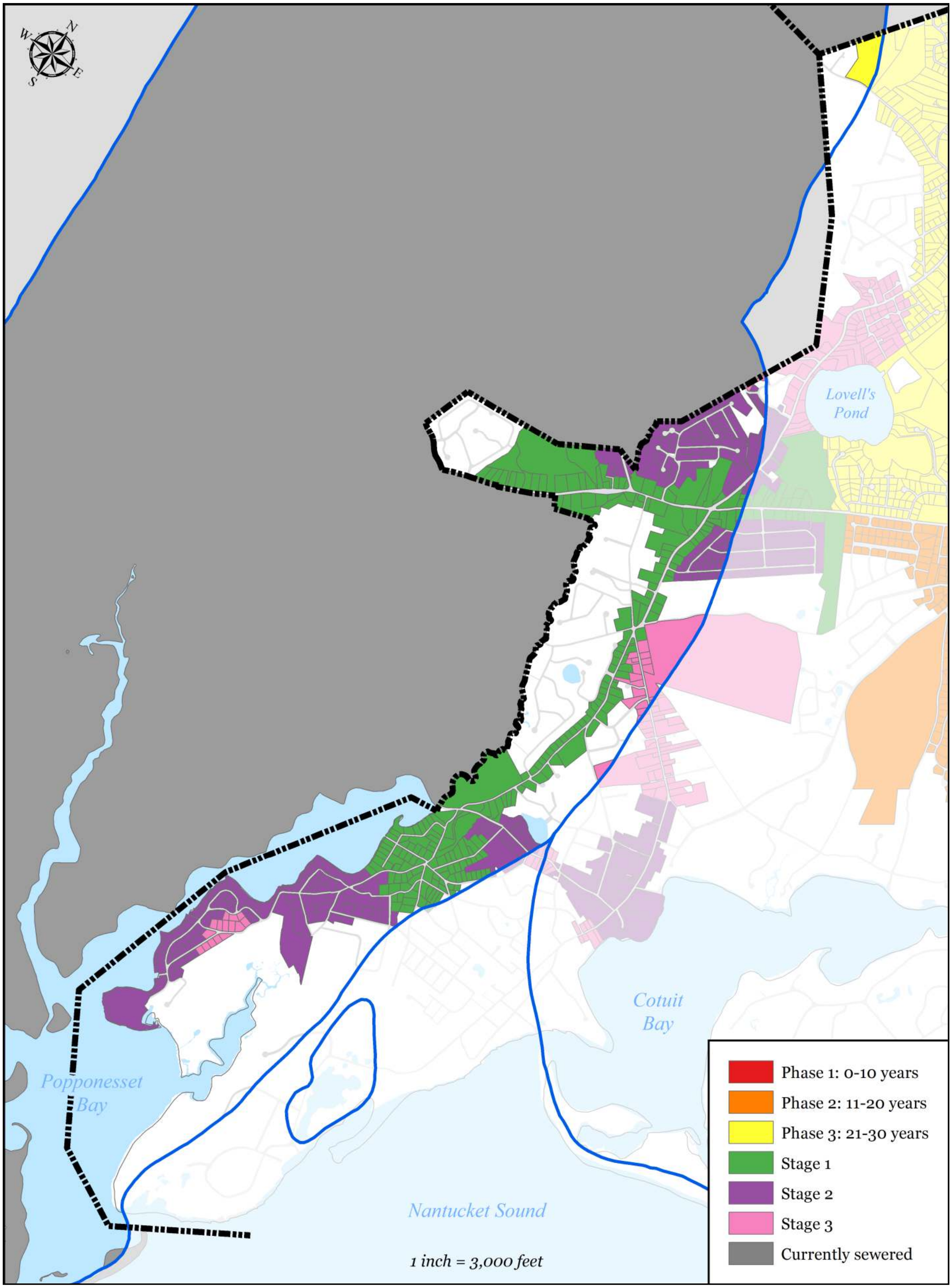

Figure 5-66: Sewer Expansion Plan in Popponesset Bay Watershed

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.

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 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 370 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 = 335 (7%)
    - 139 (41%) already served by municipal sewer
    - 38 (11%) additional to be addressed with a traditional solution in the Plan
    - Total = 177 (52%)
- Parcels with average depth to groundwater less than four feet = 267 (6%)

    - 29 (11%) already served by municipal sewer
    - 36 (13%) additional to be addressed with a traditional solution in the Plan
    - Total = 65 (24%)
- 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 = 2 (0.04%)
    - 1 (50%) will be addressed with a traditional solution in the Plan
- Parcels located within a Zone II = 669 (14%)
    - 40 (6%) already served by municipal sewer
    - 382 (57%) additional to be addressed with a traditional solution in the Plan
    - Total = 422 (63%)

Flood Zones

- Total parcels within the Barnstable Harbor Watershed = 5,220
- Parcels within FEMA mapped 100-year flood zone (AE/AO) or velocity zone (VE) = 833
    - 179 (21%) already served by municipal sewer
    - 24 (3%) that will be addressed with a traditional solution in the Plan
    - Total = 203 (24%)

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. Through those studies, there is extensive water data for 5 ponds in the Barnstable Harbor Watershed. Pond classification of these ponds is shown in Table 5-16 and Table 5-17. Two ponds within the watershed have been identified as impaired: Flax Pond and Mill Pond.

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			
Eutrophic	Mill 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		
Eutrophic	Flax Pond		
Hypereutrophic			

One pond within the watershed has been identified as impaired: Flax pond.

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
    - 370 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 6.4 for the Adaptive Management Plan and Section 6.3 for the Monitoring Plan.

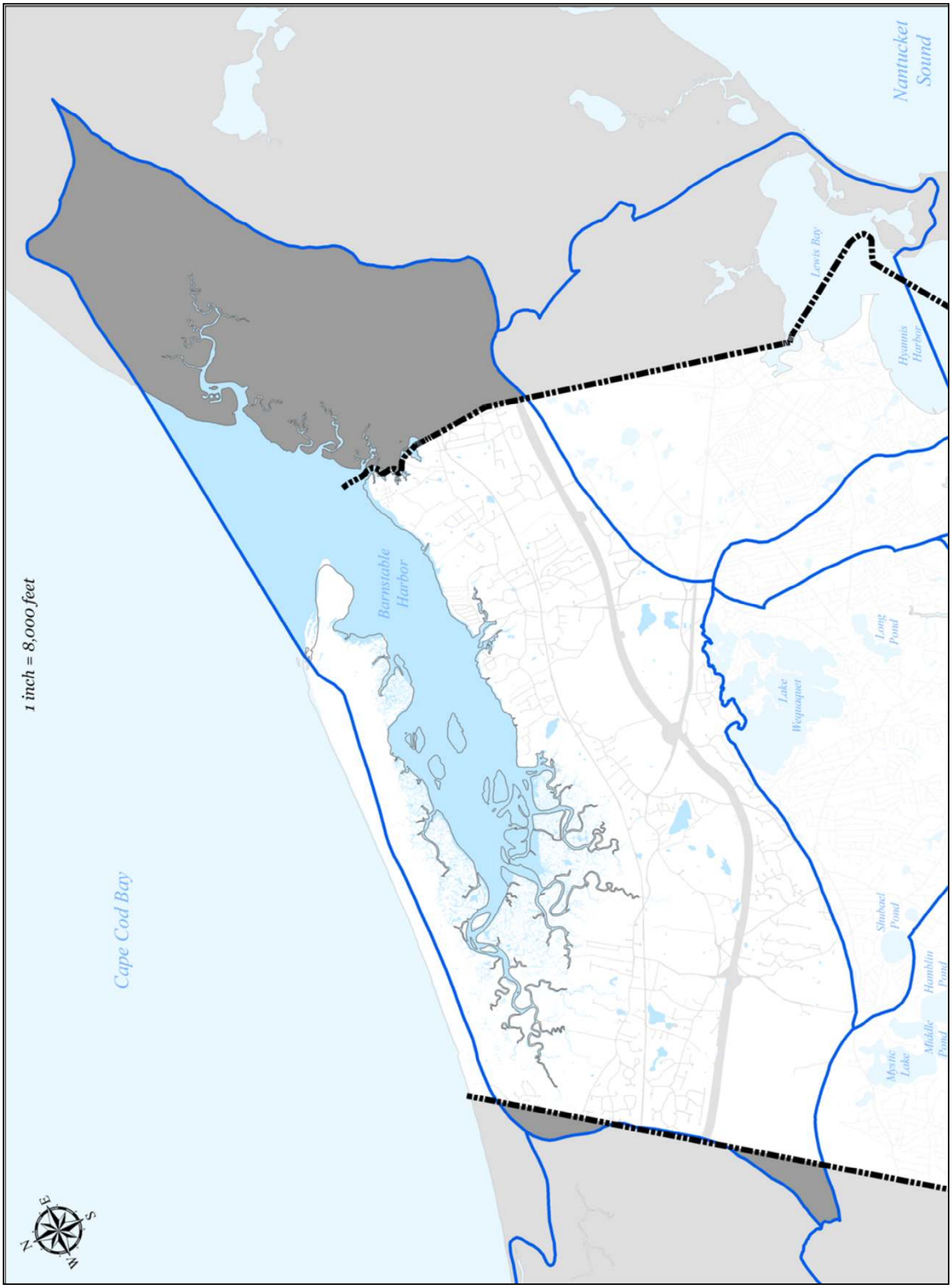

Figure 5-67: Barnstable Harbor Watershed

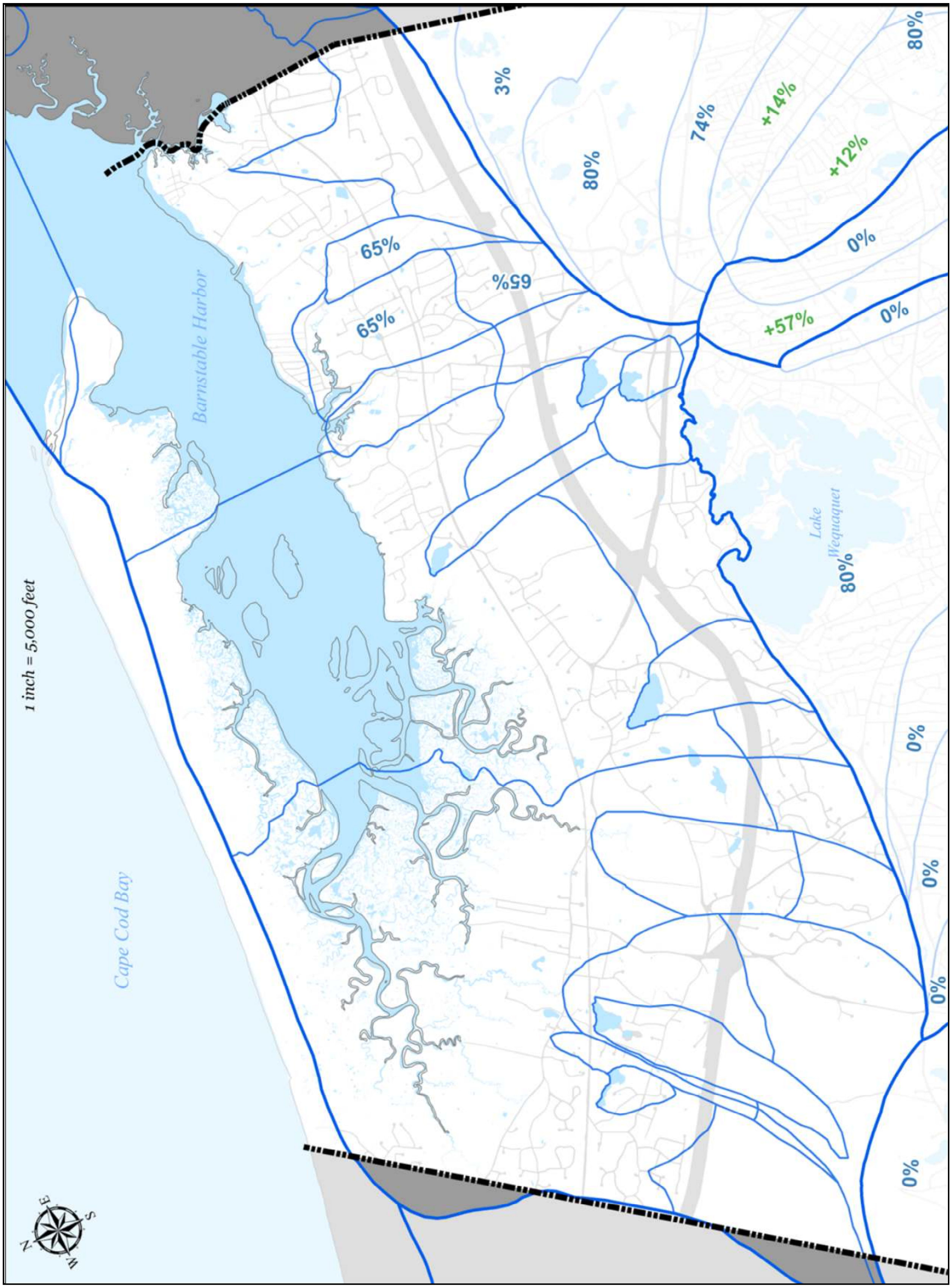

Figure 5-68: MEP-modeled Existing Septic Removal in Barnstable Harbor Watershed

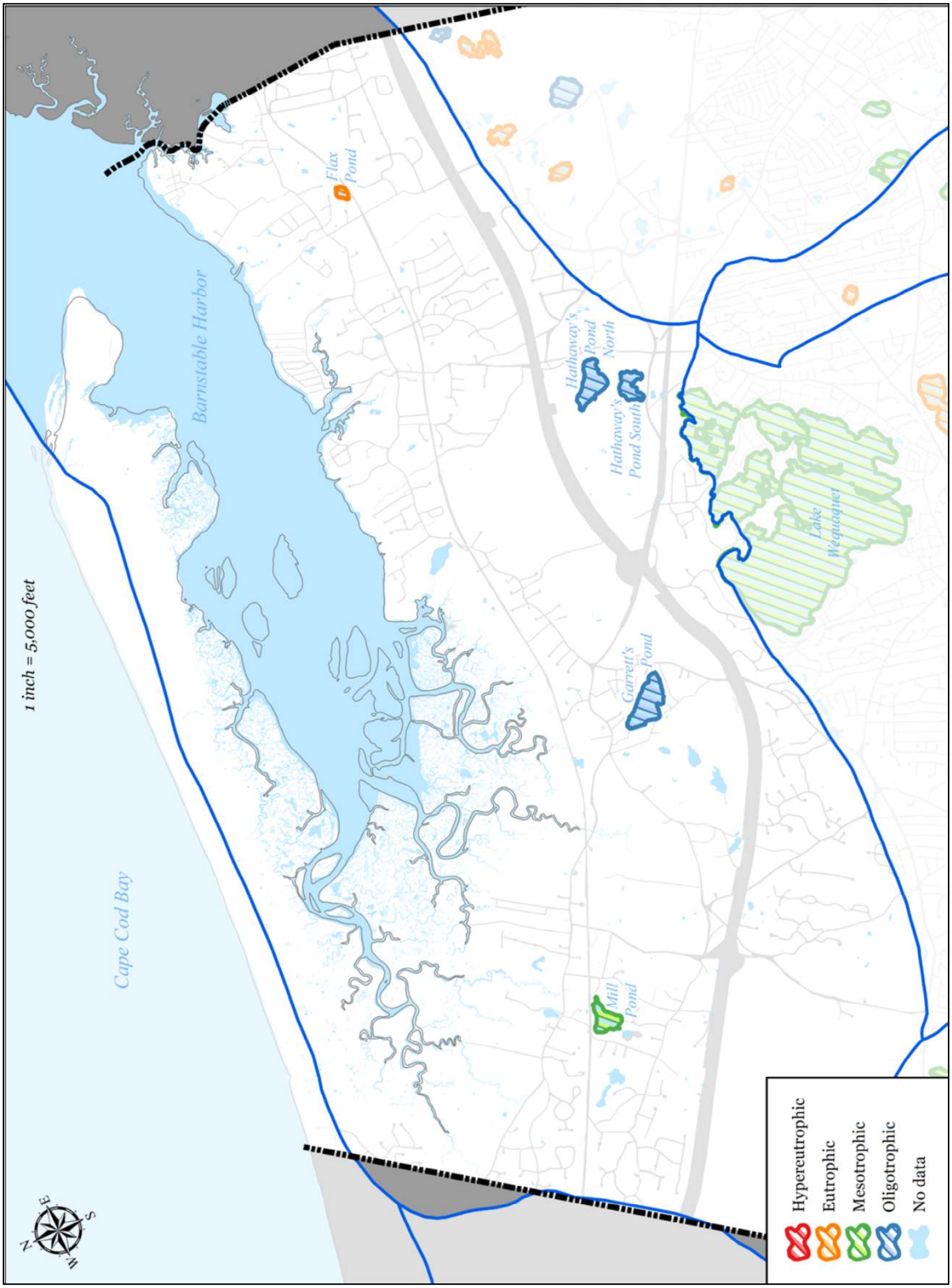

Figure 5-69: Impaired Ponds in Barnstable Harbor Watershed

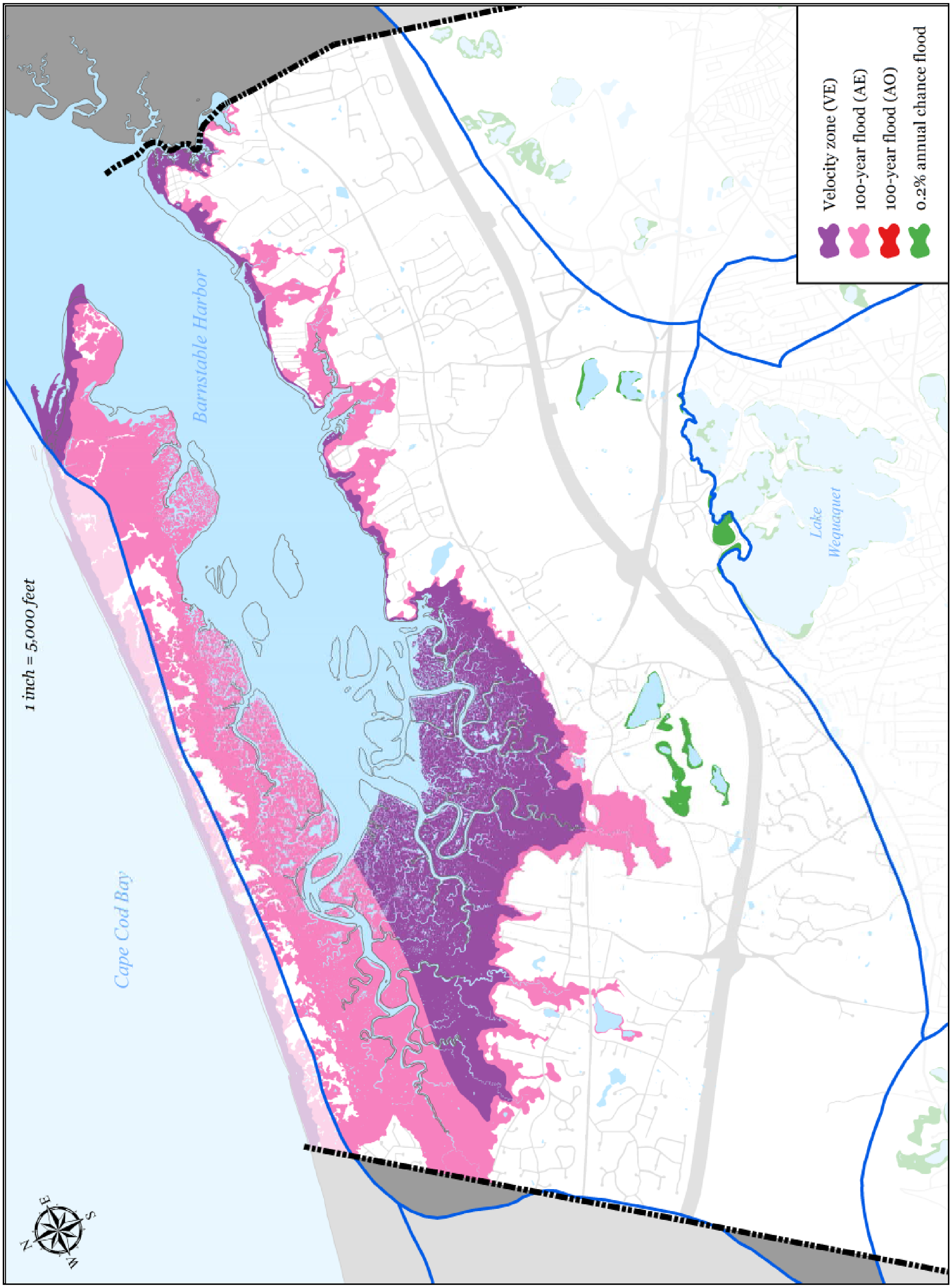

Figure 5-70: FEMA Flood Zones (2014) in Barnstable Harbor Watershed

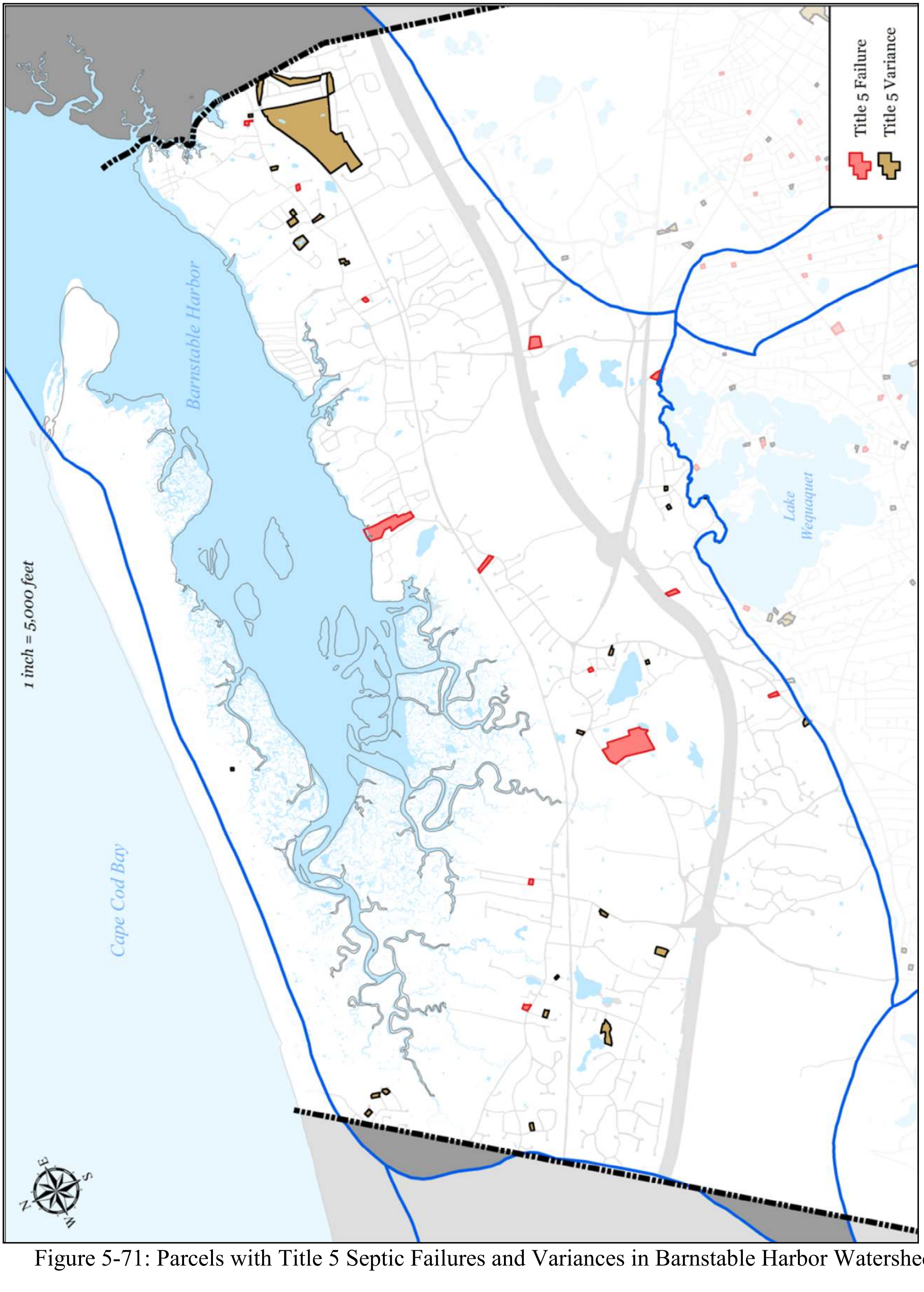

Figure 5-71: Parcels with Title 5 Septic Failures and Variances in Barnstable Harbor Watershed

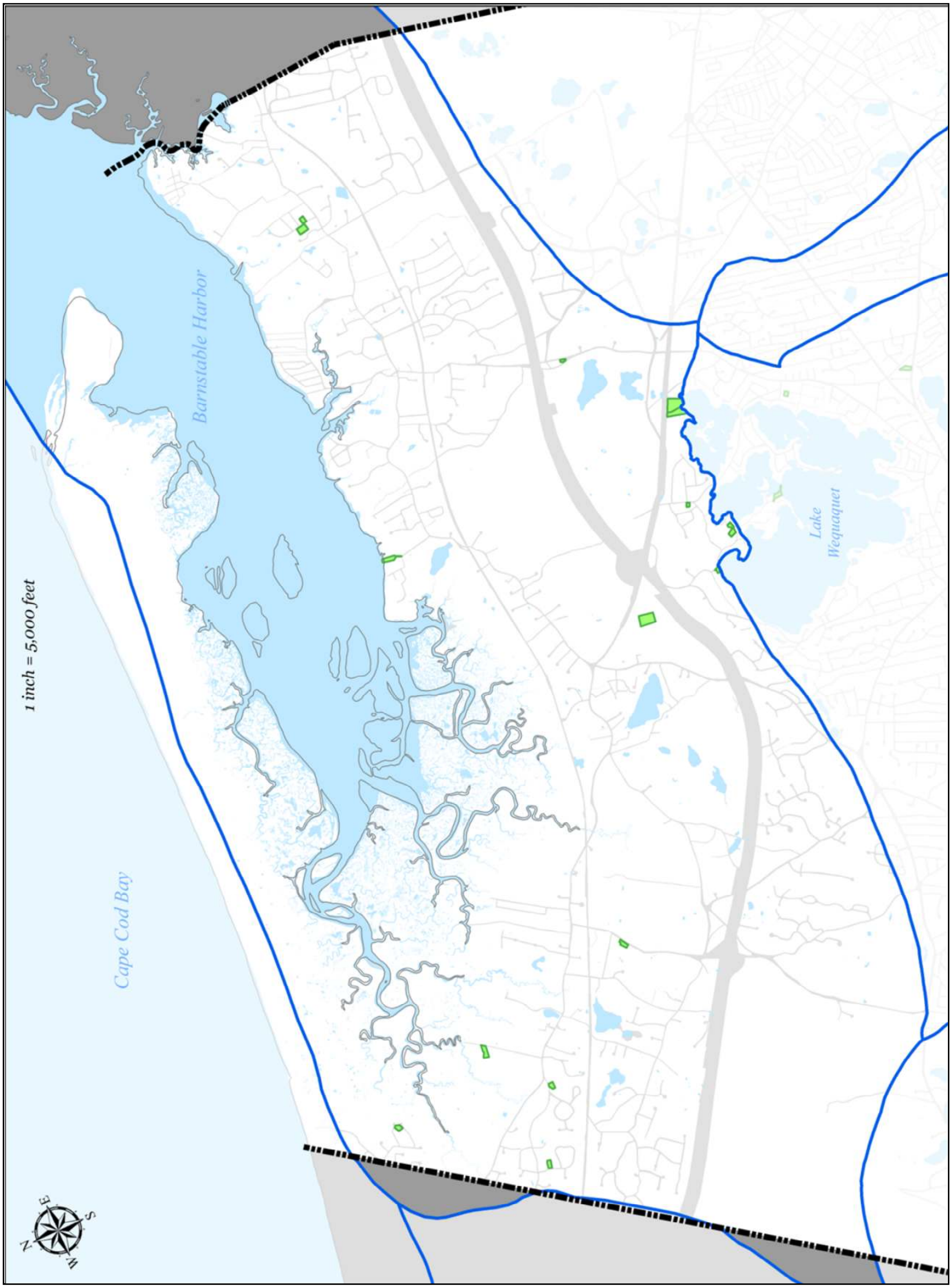

Figure 5-72: Parcels with I/A Septic Systems in Barnstable Harbor Watershed

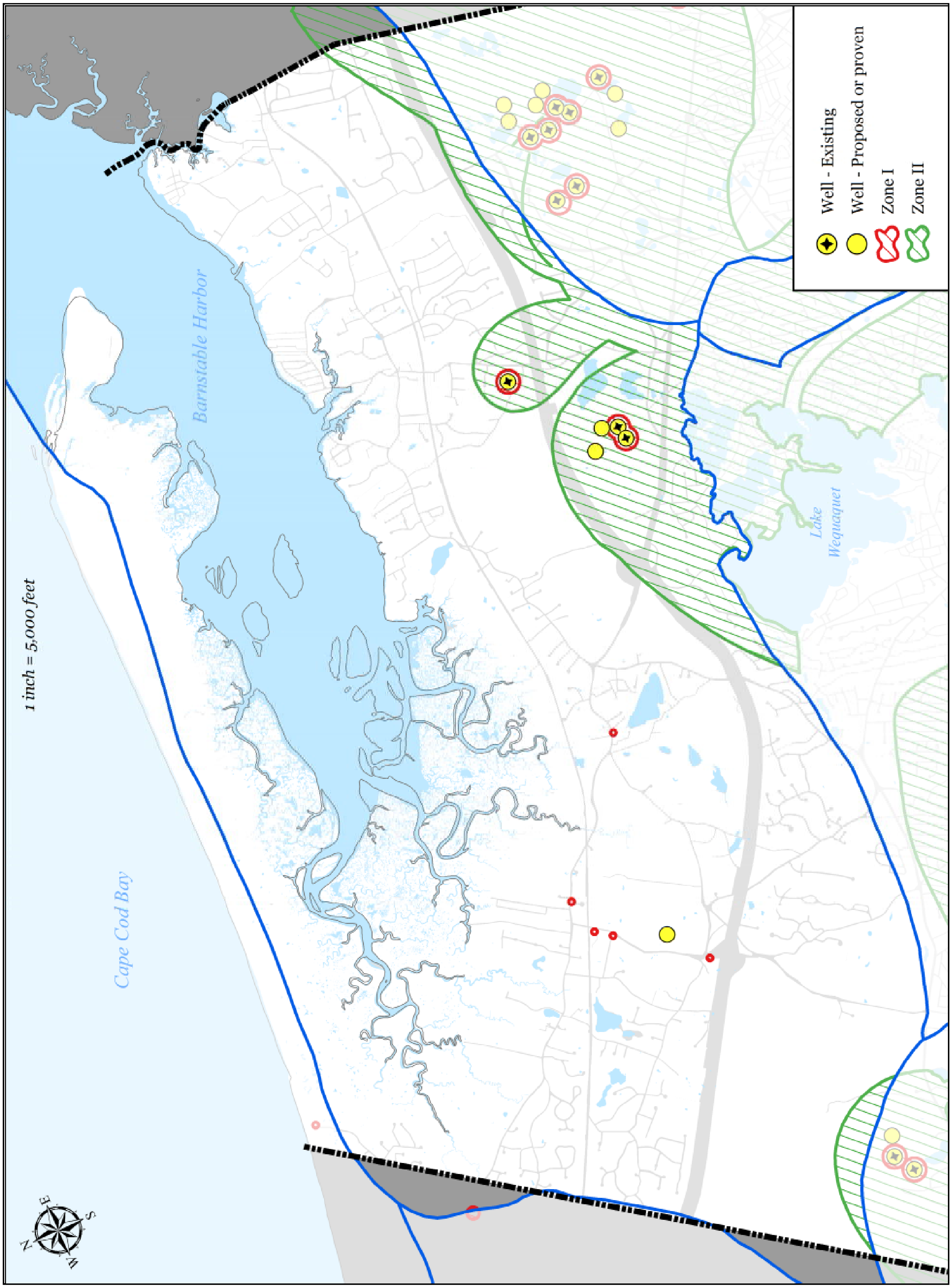

Figure 5-73: Public Water Supply Wells in Barnstable Harbor Watershed

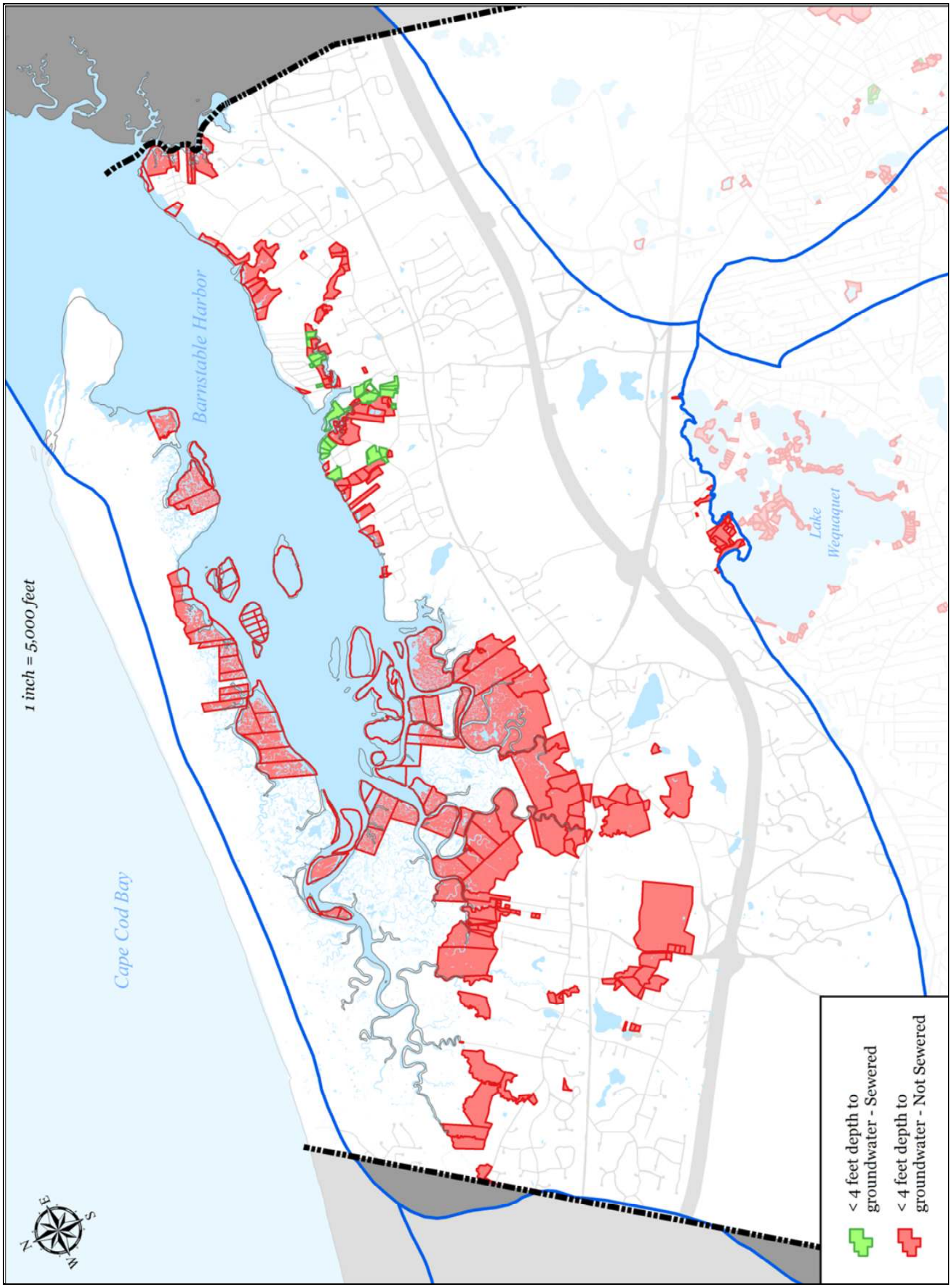

Figure 5-74: Parcels with Less than 4 feet Depth to Groundwater in Barnstable Harbor Watershed

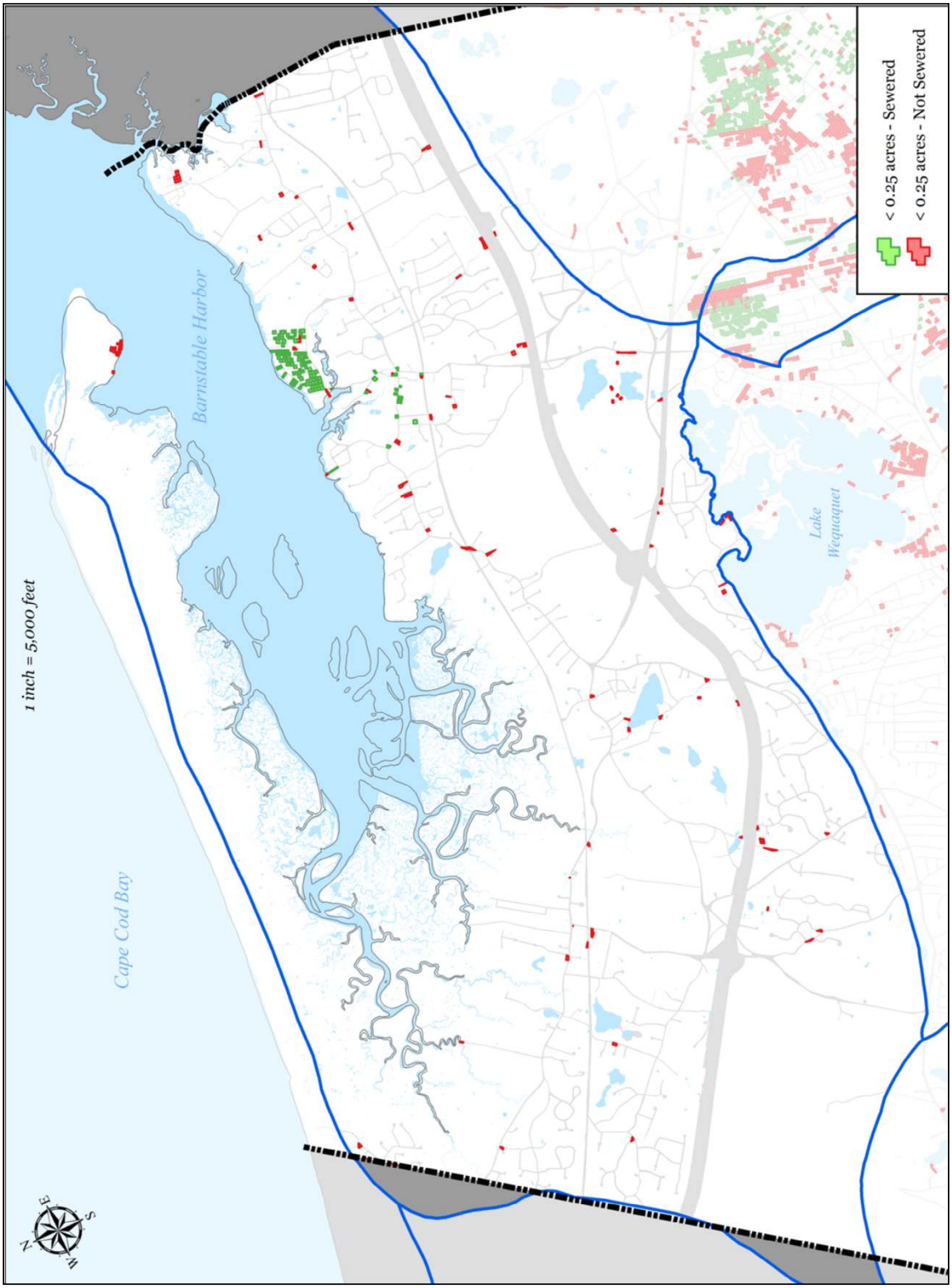

Figure 5-75: Parcels with Less than 0.25 acres in Barnstable Harbor Watershed

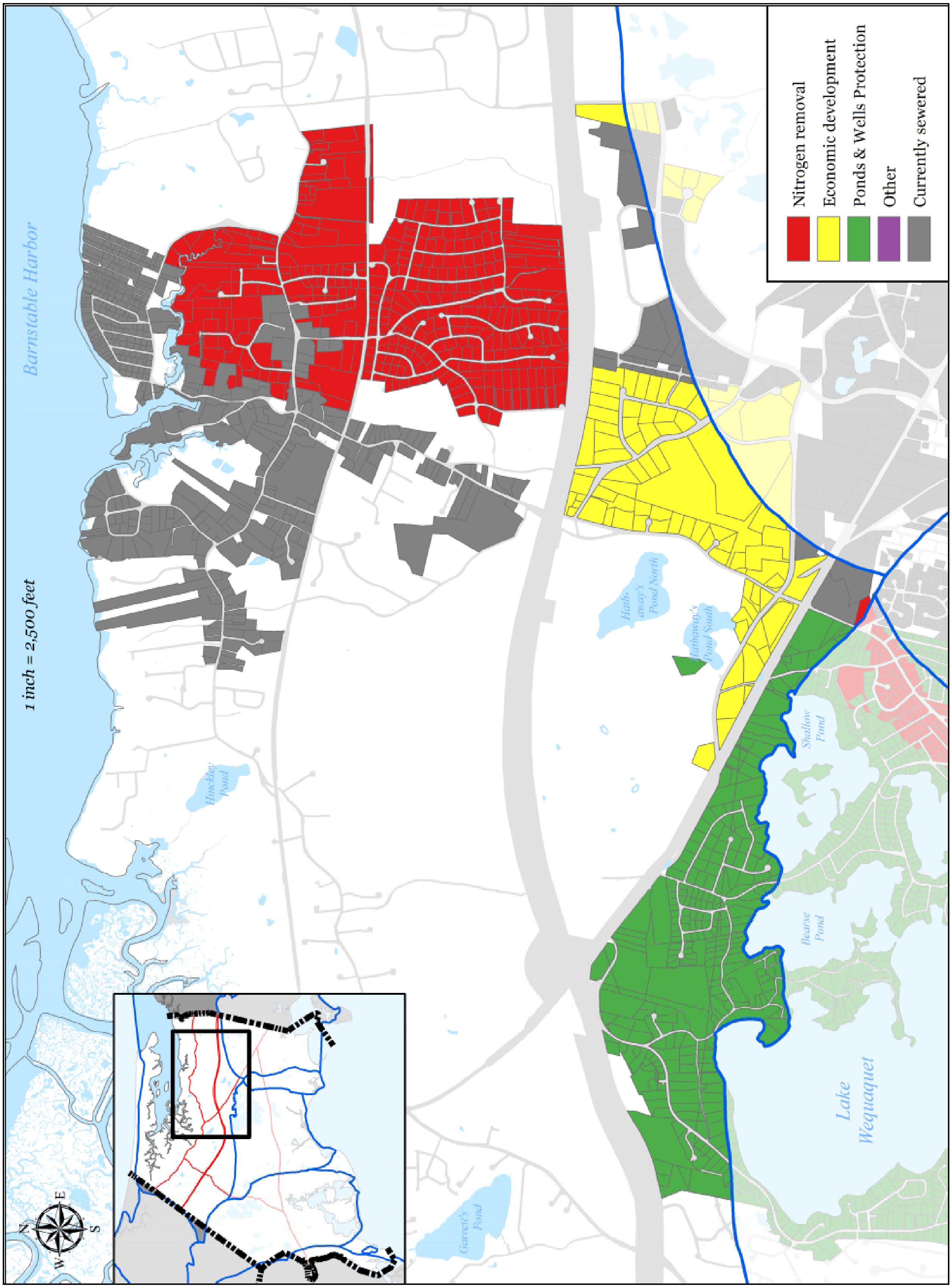

Figure 5-76: Needs Areas in Barnstable Harbor Watershed

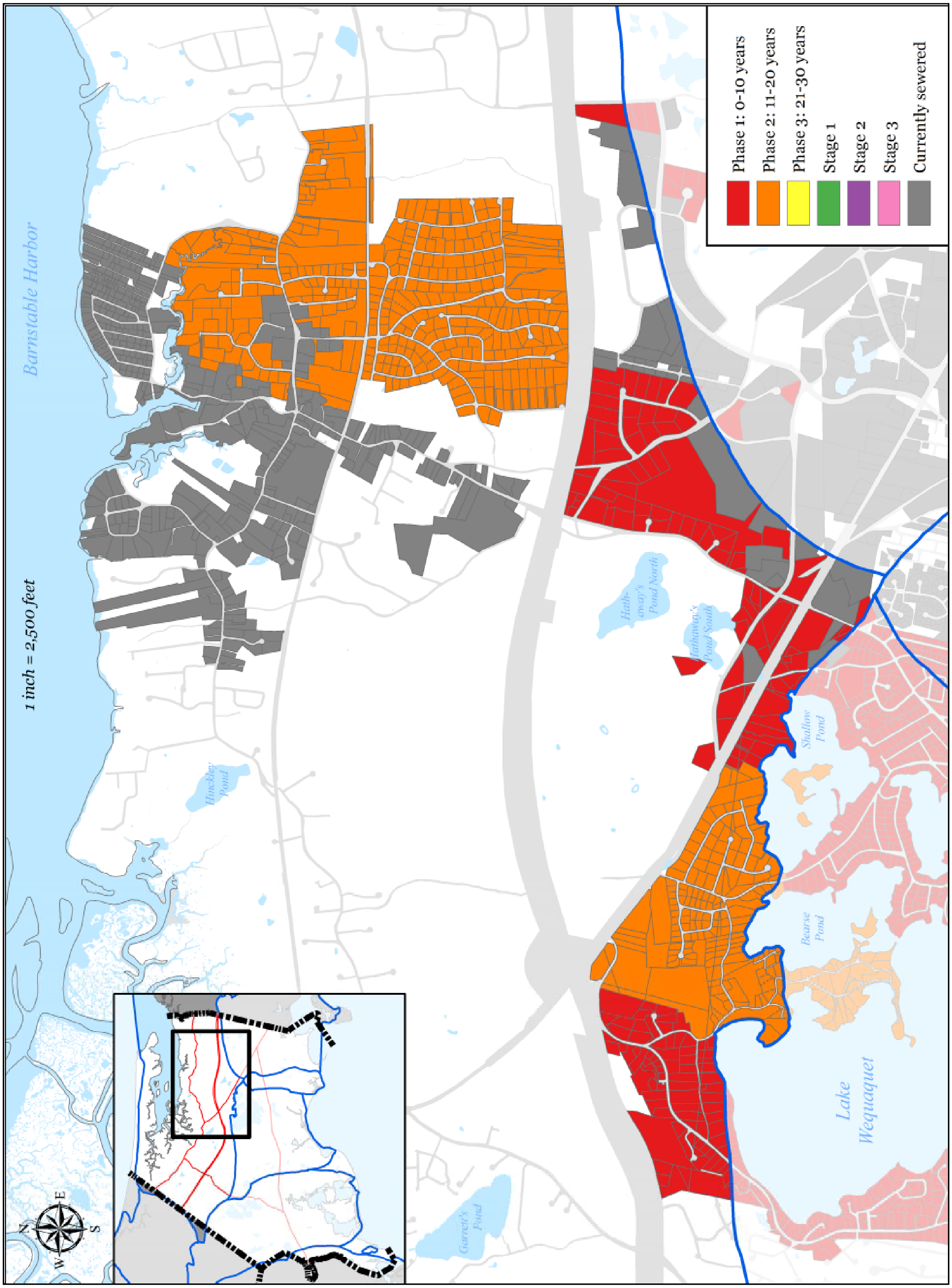

Figure 5-77: Sewer Expansion Plan in Barnstable Harbor Watershed

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 is 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 is 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 is 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

The effluent disposal capacity of the Barnstable Water Pollution Control Facility (BWPCF) has been studied for decades. The hydrogeology of the site was studied by Maravell et al., 1984; Cambareri, 1986; Geraghty and Miller, 1995; Stearns and Wheler, 2003; Stearns and Wheler, 2005; Stearns and Wheler, 2011; Watershed Hydrologic, Inc., 2014; GHD, 2017. This work indicated that there were concerns the effluent disposal capacity of the facility did not match its treatment capacity, and that the issue was not related to getting effluent into the ground, but rather the effect it had on groundwater levels downstream from the facility. However, those efforts were not rigorous enough to definitively say at what disposal level problems would start, how long it would last, which properties would be impacted, and exactly what would be the impact.

To better understand these issues the Town in 2019 hired CDM Smith to study effluent disposal. Their efforts, which were still underway as of the writing of this document, included field work (borings, slug testing, ground penetrating radar utilization, and groundwater monitoring) and the development of models (conceptual site models, and a numerical model) of the system. The numerical model was based on the 2016 steady-state USGS model with updates to reflect transient inputs near the BWPCF and the subsurface features identified as part of the field work. Additionally, though the base USGS model contained uniform grid cells of 400 by 400 feet, the CDM Smith model modified these for the area surrounding the BWPCF to 150 by 150 feet. This improved the resolution on the impacts of recharge at the individual effluent disposal beds.

What has been identified to date by these efforts is that the average monthly discharge at the BWPCF 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 are highest during the summer and lowest during the winter. Groundwater levels fluctuate several feet during any given year due to changes in monthly recharge from precipitation and septic and wastewater return flows. Recharge is highest in the winter and spring and lowest in the summer and fall. Average groundwater levels also fluctuate several feet from year to year. Depth to groundwater measurements taken between 1976 and 2019 at Well MAA1W 306, located at the Barnstable High School, have a range of almost 8 feet from 20.8 feet below ground surface (ft bgs) in 1998 to 28.5 ft bgs in 2002. Water levels are highest in late spring (April, May and June).

The geophysical survey and borings identified an extensive clay and silt layer under the BWPCF site. Testing indicated that this clay layer limits the vertical flow of groundwater. The depth of the clay/silt layer is variable from 55 to 107 feet below ground surface (ft bgs). Borings outside the BWPCF site suggest the clay extends beyond the BWPCF property, and generally is found at an elevation of approximately 0 to -40 ft NGVD29.

Initial modeling results have shown that BWPCF 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. Initial results have indicated that the estimated average annual site recharge capacity of the BWPCF is 2 MGD (with "capacity" being when the depth to groundwater is less than 8 feet at a "receptor". Additionally, the model predicted that a sea level rise of 2-ft will increase the baseline groundwater elevations at the BWPCF by approximately 0.8 ft (USGS 2016) further complicating the issue.

As noted this work is still on-going. Areas being actively investigated include the following.

- Is the criteria/threshold of 8-feet below ground level criteria a good indicator of impact on downstream dwellings?
- Exactly how many downstream receptors (dwellings, septic systems, etc.) are impacted, at what discharge levels, and what are the values of those properties? Is a viable solution purchasing those properties?

- What level of risk (impact and reoccurrence interval) is acceptable?
- The ramifications of the different seasonality of high groundwater and flow.
- What scenarios are there to mitigate the issue? One that is being modeled is the installations of downstream groundwater wells to withdraw the "surplus" water. Early indications are that this method can effectively lower groundwater levels, but more work is needed. Other scenarios will be identified and modeled.
- What other disposal options are there for the community? As noted in Section 4.4.3, discussions are underway with Yarmouth on trading treatment capacity in Barnstable for disposal capacity on Yarmouth.

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 6.4. The Town will submit adaptive management updates 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 6.3 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.

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. The draft memorandum from SMAST of this effort can be found in Appendix QQ. Below is a brief summary of the effort.

Updated Land Use Data

The original MEP assessments of Lewis Bay/Halls Creek, Centerville River, Three Bays and Branstable 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.
    - Sewer expansion in the western part of town (westerly of end of Phase 1 at Old Post Road) would 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. The proposed strategy for the Three Bays system of sewering as put forward in the 2019 Wastewater Plan will require implementation of further nitrogen management, currently being planned [non-traditional technologies], to attain the necessary nitrogen loading reductions to fully restore the water and habitat quality throughout the Three Bays Estuary." It should be noted that the Three Bays analysis did not account for any nitrogen mitigation within the Town of Sandwich, which is responsible for 7% of the contribution per the Cape Cod Commission Watershed Report.

Table 5-18: Summary of SMAST Watershed analysis.

<table>
<tr><th colspan="4">Centerville River: Whole System Watershed N Loads</th></tr>
<tr><td rowspan="2">Scenario</td><td rowspan="2">Description</td><td colspan="2">Total N Load (kg/yr)</td></tr>
<tr><td>Unatten</td><td>Atten</td></tr>
<tr><td>MEP</td><td>Baseline 2004</td><td>60,657</td><td>47,189</td></tr>
<tr><td>2019 Current</td><td>updated LU, WU, etc</td><td>62,054</td><td>49,692</td></tr>
<tr><td>MEP</td><td>Threshold (Allowable TN)</td><td></td><td>34,833</td></tr>
<tr><td>Proposed Sewer Plan</td><td>2019 update with sewer plan</td><td>37,682</td><td>29,323</td></tr>
<tr><td colspan="4"></td></tr>
<tr><th colspan="4">Lewis Bay: Whole System Watershed N Loads</th></tr>
<tr><td rowspan="2">Scenario</td><td rowspan="2">Description</td><td colspan="2">Total N Load (kg/yr)</td></tr>
<tr><td>Unatten</td><td>Atten</td></tr>
<tr><td>MEP</td><td>Baseline 2004</td><td>56,751</td><td>50,574</td></tr>
<tr><td>2019 Current</td><td>updated LU, WU, etc</td><td>60,538</td><td>54,838</td></tr>
<tr><td>MEP</td><td>Threshold (Allowable TN)</td><td></td><td>35,701</td></tr>
<tr><td>Proposed Sewer Plan</td><td>2019 update with sewer plan</td><td>35,565</td><td>31,501</td></tr>
<tr><td colspan="4"></td></tr>
<tr><th colspan="4">Barnstable Great Marshes: Whole System Watershed N Loads</th></tr>
<tr><td rowspan="2">Scenario</td><td rowspan="2">Description</td><td colspan="2">Total N Load (kg/yr)</td></tr>
<tr><td>Unatten</td><td>Atten</td></tr>
<tr><td>MEP</td><td>Baseline 2011-2012</td><td>73,613</td><td>66,221</td></tr>
<tr><td>2019 Current</td><td>updated LU, WU, etc</td><td>73,815</td><td>66,667</td></tr>
<tr><td>MEP</td><td>Threshold (Allowable TN)</td><td></td><td>92,433</td></tr>
<tr><td>Proposed Sewer Plan</td><td>2019 update with sewer plan</td><td>74,591</td><td>67,597</td></tr>
<tr><td colspan="4"></td></tr>
<tr><th colspan="4">Three Bays: Whole System Watershed N Loads</th></tr>
<tr><td rowspan="2">Scenario</td><td rowspan="2">Description</td><td colspan="2">Total N Load (kg/yr)</td></tr>
<tr><td>Unatten</td><td>Atten</td></tr>
<tr><td>MEP</td><td>Baseline 2000-2004</td><td>68,853</td><td>48,943</td></tr>
<tr><td>2019 Current</td><td>updated LU, WU, etc</td><td>69,372</td><td>51,643</td></tr>
<tr><td>MEP</td><td>Threshold (Allowable TN)</td><td></td><td>25,643</td></tr>
<tr><td>Proposed Sewer Plan</td><td>2019 update with sewer plan</td><td>42,545</td><td>29,039*</td></tr>
<tr><td colspan="4">* Does not include nitrogen mitigation for the Town of Sandwich, which contributes 7% of watershed load.</td></tr>
</table>

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	240	47,066	4.7	6.0%	CR
Route 28 East	49	9,440	0.9	1.2%	CR
Old Yarmouth Road	131	22,603	2.2	2.9%	LB
Phinneys Lane	653	94,200	9.4	12.0%	CR & HC
Long Beach	203	37,647	3.7	4.8%	CR & UN
Route 28 Centerville	41	5,534	0.6	0.7%	CR
Huckins Neck	148	21,506	2.1	2.8%	CR
Long Pond Area	606	114,599	11.4	14.7%	CR
Great Marsh Road	406	79,299	7.9	10.1%	CR
Old Craigville Road	397	41,512	4.1	5.3%	CR & HC
Route 28 Marstons Mills	157	36,429	3.6	4.7%	3B
Osterville Woods	328	59,571	5.9	7.6%	CR & 3B
Shootflying Hill Road	348	52,306	5.2	6.7%	CR & BH
Lumbert Mill	357	53,221	5.3	6.8%	CR
Osterville-West Barnstable Road & South County Road	153	32,787	3.3	4.2%	3B
Marstons Mills Main Street	144	24,123	2.4	3.1%	3B
Prince Cove	158	32,972	3.3	4.2%	3B
Attucks Lane/Kidds Hill Area	87	16,893	1.7	2.2%	BH
Total	**4,613**	**781,708**	**77.7**	**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 44% of the Plan.

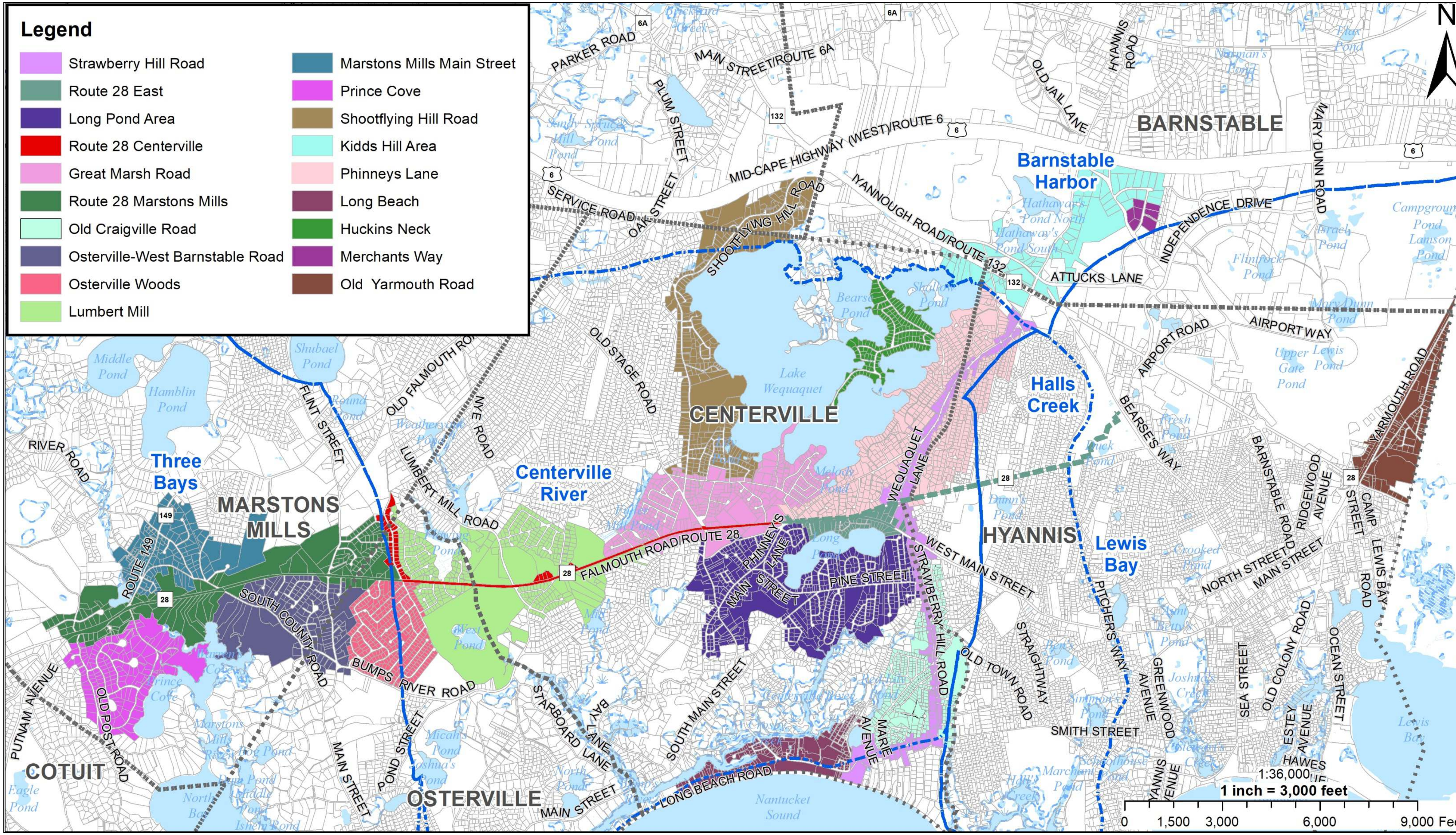

Figure 6-1: Phase 1 Implementation Plan

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

			Phase 1											
Project	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**FY30**	**FY31**	***TOTAL***
Merchants Way	***$50,000***	***$550,000***												**$600,000**
Strawberry Hill Road		***$835,000***	***$8,500,000***											**$9,335,000**
Route 28 East		***$800,000***		$12,000,000										**$12,800,000**
Old Yarmouth Road		***$750,000***	$600,000		$6,000,000									**$7,350,000**
Phinneys Lane	***$315,000***	***$735,000***			$20,000,000									**$21,050,000**
Long Beach				$300,000	$750,000		$7,500,000							**$8,550,000**
Route 28 Centerville		***$612,000***	$1,300,000			$14,000,000								**$15,912,000**
Huckins Neck					$250,000	$600,000		$5,000,000						**$5,850,000**
Long Pond Area	***$402,000***	***$938,000***					$28,000,000							**$29,340,000**
Great Marsh Road				$550,000		$1,250,000		$15,500,000						**$17,300,000**
Old Craigville Road					$500,000		$1,000,000		$15,000,000					**$16,500,000**
Route 28 Marstons Mills			$1,800,000						$13,500,000					**$15,300,000**
Osterville Woods							$450,000	$1,050,000		$13,500,000				**$15,000,000**
Shootflying Hill Road						$600,000		$1,350,000		$17,500,000				**$19,450,000**
Lumbert Mill								$450,000	$1,050,000		$13,500,000			**$15,000,000**
Osterville-West Barnstable Road & South County Road									$300,000	$675,000		$8,700,000		**$9,675,000**
Marstons Mills Main Street								$300,000		$650,000		$6,000,000		**$6,950,000**
Prince Cove									$350,000		$650,000		$8,000,000	**$9,000,000**
Attucks Lane / Kidds Hill Area	***$100,000***									$300,000	$650,000		$8,500,000	**$9,550,000**
TOTAL COSTS - COLLECTION SYSTEM	**$867,000**	**$5,220,000**	**$12,200,000**	**$12,850,000**	**$27,500,000**	**$16,450,000**	**$36,950,000**	**$23,650,000**	**$30,200,000**	**$32,625,000**	**$14,800,000**	**$14,700,000**	**$16,500,000**	**$244,512,000**
NEW PARCELS CONNECTED	**0**	**7**	**0**	**240**	**0**	**180**	**856**	**41**	**754**	**803**	**833**	**357**	**542**	**4,613**
COMBINED FLOW (GPD)	**1,670,000**	**1,670,000**	**1,670,000**	**1,717,000**	**1,717,000**	**1,749,000**	**1,881,000**	**1,887,000**	**2,023,000**	**2,144,000**	**2,292,000**	**2,345,000**	**2,452,000**	**782,000**

Legend	
Evaluation and/or Preliminary Design	(yellow)
Final Design	(blue)
Construction	(red)
Currently Funded Project	***$400,000***
Currently Unfunded Project	$500,000

Note: All costs are in 2017 dollars.

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

			Phase 1											
Project	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**FY30**	**FY31**	**TOTAL**
Aeration Upgrades			$100,000	$800,000		$15,000,000								**$15,900,000**
Effluent Flow Meter (Permit Requirement)		***$600,000***												**$600,000**
Denitrification		***$15,000***	$100,000		$1,500,000		$18,000,000							**$19,615,000**
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**
Solids Handling			$8,000,000											**$8,000,000**
Infiltration and Inflow (I/I) Program		***$380,000***		$400,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	**$3,030,000**
Pump Station Rehabilitation Program		***$1,160,000***	$1,000,000	$2,000,000	$500,000	$500,000	$1,200,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	**$7,860,000**
BWPCF Facility Study (Permit Requirement)				$150,000										**$150,000**
Headworks Modifications					$250,000									**$250,000**
Main Switch B Generator						$550,000								**$550,000**
Secondary Clarifier Upgrades											$300,000		$800,000	**$1,100,000**
TOTAL COSTS - WPCF UPGRADES	**$345,000**	**$3,455,000**	**$10,200,000**	**$3,350,000**	**$6,000,000**	**$16,300,000**	**$19,450,000**	**$35,500,000**	**$500,000**	**$500,000**	**$800,000**	**$500,000**	**$1,300,000**	**$94,400,000**

Legend	
Evaluation and/or Preliminary Design	(yellow)
Final Design	(blue)
Construction	(pink)

Note: All costs are in 2017 dollars.

6.2 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.

6.2.1 MASHPEE

Barnstable and Mashpee currently 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.

6.2.2 SANDWICH

Sandwich and Barnstable currently share Popponesset and Three Bays Watershed.

As discussed, Barnstable and Mashpee currently 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.

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.

6.2.3 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 during the writing of the CWMP. The study that was conducted can be found in Appendix JJ.

6.2.4 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 – such as this 20-year permit – necessary to address wastewater issues – instead of the traditional five-year permits; and
- 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.

6.3 MONITORING PLAN

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

6.3.1 EMBAYMENT MONITORING

The Town of Barnstable will continue its yearly embayment monitoring. This will include monitoring of water quality, eel grass coverage, and benthic infauna habitat, to verify that the sewer extension and nitrogen remediation efforts are effective.

The embayment monitoring will be a long-term effort and will need to be a team effort between the communities within the embayment watersheds and the Town.

The embayment monitoring program is divided into 5 sample events per summer season (2 in July, 2 in August, and 1 in September), at 2 to 8 sample locations per estuary, for the following parameters:

− Particulate Organic Nitrogen (PON)

− Dissolved Organic Nitrogen (DON)

− Dissolved Inorganic Nitrogen (DIN)

− Dissolved Oxygen (DO)

− Chlorophyll a

− Secchi Depth

− Salinity

− Total Suspended Solids (TSS)

6.3.2 NON-TRADITIONAL SOLUTIONS MONITORING

Monitoring plans for non-traditional solutions will be developed in consultation with DEP during the permitting phase of each project.

6.4 ADAPTIVE MANAGEMENT PLAN

The Town of Barnstable's CWMP focuses on implementation of a three phase and three stage sewer expansion plan occurring over 30 years. The CWMP also includes various non-traditional approaches and management solutions. The adaptive management approach allows for modifications to the plan after evaluation of the result from the earlier phases. Adaptive management also allows the Town to respond to changes environmental conditions, improved technologies and future unknowns. The Town will prepare an adaptive management plan update every five years which will provide an update on progress of the plan.

6.5 NEXT STEPS

The Town will submit this 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). This submittal will initiate the formal review and comment by local, regional, state and federal agencies, including the Cape Cod Commission's review of the CWMP for consistency with the 208 Plan. An EENF is subject to an extended 37-day review period by MEPA office, consisting of a 30-day public comment period and 7 days to issue a certificate. Upon receipt of the Secretary Certificate, the Town will respond to comments from various agencies and public comments, finalize the SEIR, and submit the SEIR to MEPA for final approval.

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.

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.

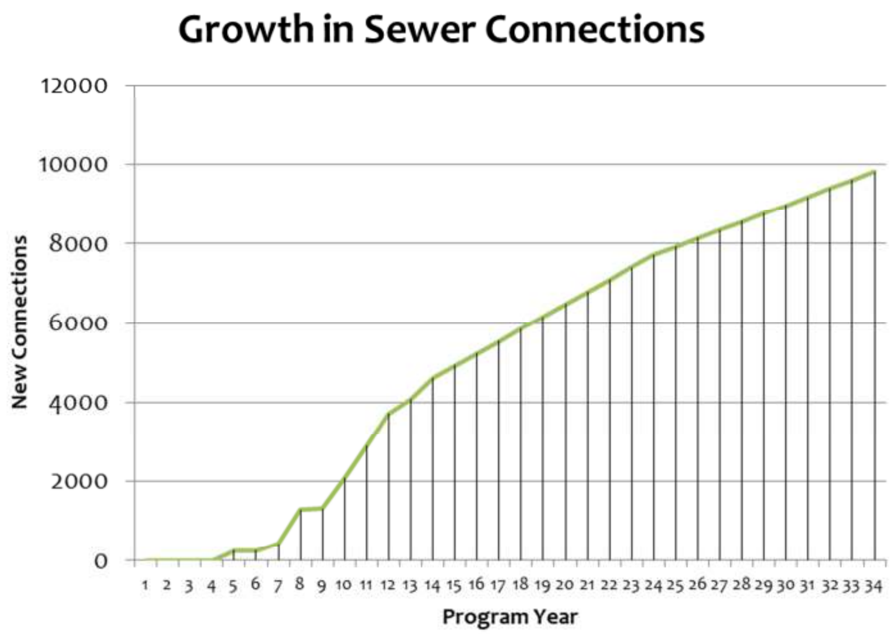

Figure 7-1: Growth in Sewer Connections

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.

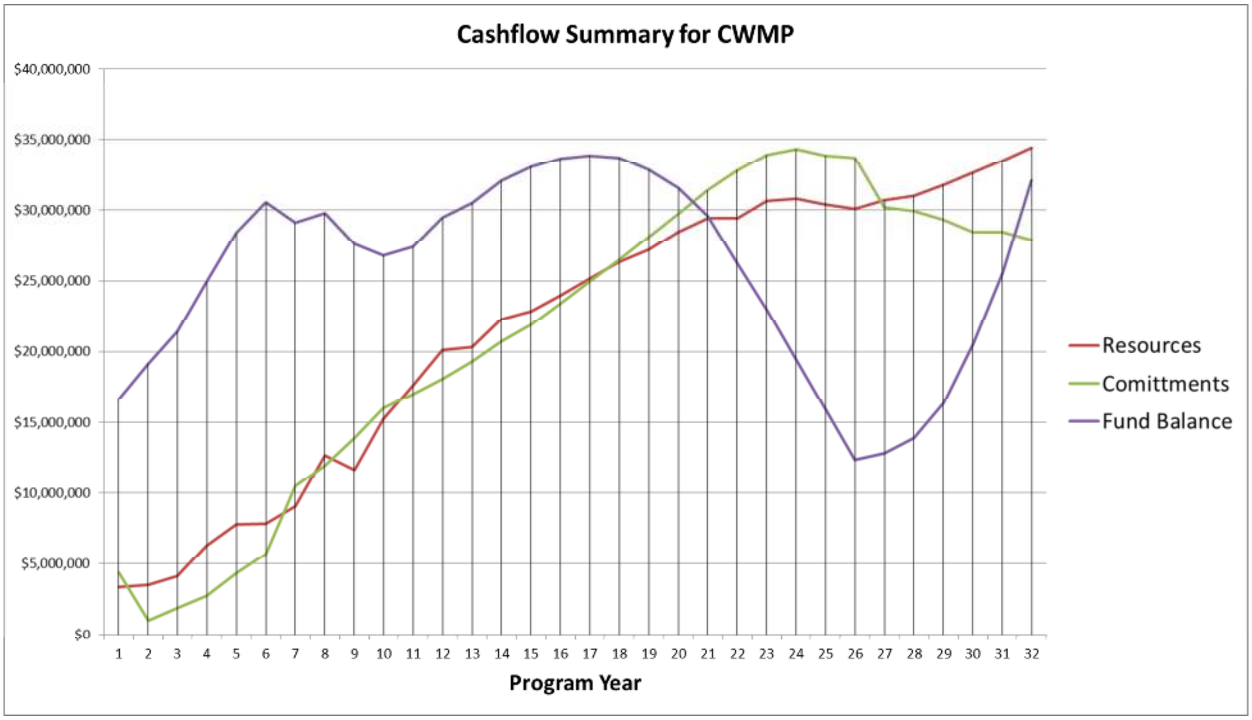

Figure 7-2: Cashflow Summary for CWMP

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

{ This page is intentionally left blank }

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) and the "No Action Plan". Impacts are considered for both initial project construction and long-term project operation.

8.2 ALTERNATIVES TO THE RECOMMENDED PLAN

The purpose of the CWMP is to address the wastewater management needs of the Town. One key element of the plan is 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.

The only alternative to the Recommended Plan identified by the Town is the No Action Plan. The No Action Plan 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.

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 SURFACE WATER QUALITY

No significant negative short-term impacts on surface water quality are expected as a result of the plan implementation. There is the possibility of erosion and sedimentation problems during the construction of sewers or the facilities for treatment and disposal, but those impacts will be closely controlled by requiring appropriate construction techniques and with close contractor oversight.

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 the Massachusetts Estuaries Project (MEP), 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-basin 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-basin 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.

8.3.2 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.

8.3.3 WETLANDS

There are mapped wetlands within the Town of Barnstable. The Town intends to locate its wastewater piping in public roadways, public rights-of-way or private roadways (with permission and easements) and intends to locate its wastewater pumping stations outside of wetlands. None of the project work identified to date is expected to impact wetlands directly; however, some of the improvements may encroach on buffers around regulated wetlands. The Conservation Commission will review these elements and address potential impacts by implementation of standard mitigation measures. No significant short-term or long-term wetland impacts are expected under the Recommended Plan.

8.3.4 FLOODPLAINS

Some of the properties in the Recommended Plan are located within the 100-year or 500-year floodplain. There may be a need to locate a few private and/or public pumping stations in floodplains, but those structures would be small, they would be flood-proofed, and they would pose little impact on potential floods. Any pumping station structures located in floodplains will consider the implications of sea level rise in terms of constructed elevations. The Town will consider limited use of low-pressure sewer systems in flood prone areas, or areas with very shallow groundwater, if necessary to avoid negative impacts to the public infrastructure. Neither of the plans is expected to have any significant short-term or long-term impacts on floodplains.

8.3.5 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.

8.3.6 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.

8.3.7 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 permission and easements) and intends to locate its wastewater pumping stations outside of wetlands and away from priority habitat, where feasible. The Town will conduct more detailed NHESP and MESA reviews prior to moving forward with permitting and preliminary design of Phase 1 projects.

8.3.8 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 permission and easements) 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.

8.3.9 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 and easements) 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 follow specific concepts:

- Segment the work to avoid disruption of lengthy stretches of principal roads at any one time.
- Consider night construction in areas of high traffic outside of residential areas.
- Consider locating wastewater piping with other utilities under bike paths when feasible and consistent with local planning.
- Have a well-developed public outreach approach for residents, businesses and visitors.
- 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.

There will be long-term traffic impacts as well. These long-term 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, however, these long-term impacts also include a significant increase in vehicles trips in the community due to additional growth through the planning period. The Town will need to assess the implications of growth on traffic in the permitting and design phase of projects.

8.3.10 AIR QUALITY

Construction vehicles can be the source of added air emissions and represent a direct short-term impact. Dust from construction sites is another common source of air quality concern. These impacts are generally mitigated by requiring appropriate construction techniques and with close contractor oversight.

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 odor control equipment.

8.3.11 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. Noise controls on construction equipment are available and are required to mitigate noise during construction. The Town will consider restricting work hours on construction sites near residential areas.

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.

8.3.12 EROSION CONTROL

During construction, temporary erosion control measures will be warranted to avoid sediment migration. This is commonly achieved with the use of hay bales, siltation fencing, and geotextile materials. Storm events and construction dewatering would warrant the use of these controls. During the design process, detailed drawings and specifications will outline the controls required to be used by the construction contractor. Drawings and specifications will meet with regulatory standards such as the National Pollution Discharge Elimination System (NPDES) and Storm Water Pollution Prevention Plans (SWPPP).

8.3.13 WASTE MATERIAL

During the construction process, waste materials will be generated including, brush, excess soil material and construction debris (e.g., scraps of wood, metal, and plastics). These materials will be collected and removed from the construction sites by the contractor at periodic intervals. Collection and removal of such material must be by authorized individuals.

8.3.14 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.

8.3.15 ENERGY AND GREENHOUSE GAS EMISSIONS

The Recommended Plan and the No Action Plan will result in continued and increased long-term electrical energy and fossil fuel use related to septic systems, I/A systems, sewer system conveyance pumping, wastewater treatment, effluent disposal and sludge disposal.

The "Revised MEPA Greenhouse Gas Emissions Policy and Protocol" (Massachusetts EOEEA, effective dated May 2010) outlines requirements for a detailed, site-specific greenhouse gas (GHG) emissions comparative analysis. However, given that there are several big-picture items that warrant further consideration (e.g., the number and location of pump stations, the number and location of effluent disposal facilities, the extent of regionalization with abutting municipalities in shared watersheds, etc.), it is premature to complete the type of GHG emissions analysis envisioned in the policy document at this time. Instead, a preliminary GHG emissions review was conducted.

The approach used in this preliminary GHG emissions analysis was to apply unit emission rates to the town-wide estimates of the number of septic system, the number of I/A systems and the number of sewer connections under two conditions: "pre-CWMP" and "post-CWMP". Under both conditions, growth and economic development were excluded. Said another way, this analysis identifies the change in GHG emissions associated with implementing the CWMP for the existing level of development. The unit emissions rates were developed based on a literature search. The town-wide GHG emissions estimates for the two conditions are as follows: Pre-CWMP at 10,900,000 kg CO2-eq/year; and Post-CWMP: 14,700,000 kg CO2-eq/year. This preliminary GHG emissions analysis indicates that implementation of the CWMP will result in an estimated 35% increase in GHG emissions. This is the net result of a 52% in emissions from septic systems and a 93% increase in emissions from centralized wastewater treatment. Refer to Appendix RR for supporting information.

Energy use during construction of the Recommended Plan is unavoidable.

The Recommended Plan will utilize energy-efficient processes to perform collection, treatment and disposal in a reliable manner to help mitigate increases GHG emissions. The following GHG emission reduction measures will be considered during the design and construction phases:

- Use the most current version of the Massachusetts State Building Code and Sustainable Development Principles during the design phase;
- Use Leadership in Energy and Environmental Design (LEED) and/or Envision principles as a guide during the design phase;
- Use high-efficiency treatment equipment and processes and minimize intermediate pumping systems;

- Use variable frequency drives and instrumentation systems to match process needs with process equipment delivery rates (e.g., liquid flow, aeration flow, ventilation rates);
- Implement water conservation strategies and potential effluent reuse strategies, if customers step forward, to offset needs to create an equivalent amount of potable water;
- Use design strategies to minimize the potential for infiltration/inflow to enter the collection system;
- Consider design strategies to minimize need for chemicals and odor control systems;
- Consider use of peak shaving and load shifting strategies;
- Minimize building footprints;
- Orient buildings to maximize natural lighting, to maximize the potential for shading (to minimize heat gain) and to maximize the potential for solar photovoltaic/ solar hot water systems opportunities;
- Use heat recovery systems to capture waste heat from the WWTF processes for ventilation systems;
- Use motion sensors for interior lighting and climate control;
- Use demand control ventilation strategies and energy efficient heating systems;
- Improve building envelopes including the potential for lower U-values windows and more insulation than required by the building code (e.g., walls, attics, windows; ductwork; hot water piping);
- Consider high albedo roofing systems/colors that are solar-ready;
- Consider use of additional on-site power generation (e.g., solar photovoltaic, wind turbine and combined heat and power), if economically viable;
- Consider requiring contractors to use of ultra-low sulfur diesel fuels and emissions controls for construction equipment; and
- Restrict idling for non-essential construction equipment.

8.3.16 GENERATION OF SOLID WASTE

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.

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.

8.3.17 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.

8.3.18 COMMUNITY GROWTH AND LAND USE

If the community does not take proacticve 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.

8.3.19 ADAPTATION TO CLIMATE CHANGE

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.

As it pertains to wastewater infrastructure, the Town will:

- Locate above-grade portions of septic systems and I/A systems, as applicable, outside of or above the flood elevation.
- Consider the use of low-pressure lift stations and low-pressure sewers in areas susceptible to sea level rise as this will minimize the public expenditure and require the pumping system to be directly associated with the private property.
- Give preference to pump station sites that are more than 3 feet above the 100-year flood elevation. Flood protect those pump stations that cannot meet this preference.
- Give preference to treatment and disposal sites that are more than 6 feet above the 100-year flood elevation. Flood protect those sites that cannot meet this preference.

8.4 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 require an Environmental Notification Form and likely an Environmental Impact Report.
- 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 are typically incorporated into the MEPA review process.
- DEP Groundwater Discharge Permits for 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.
- DEP Sewer Extension Permits for sewer system expansion after completion of the first phase.
- Department of Transportation (DOT) permits/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.

8.5 MITIGATION MEASURES

The Town will consider and implement the numerous mitigation measures outlined in this section of the CWMP during the permitting and design phases of projects.

8.6 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.