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Environmental Notification Form

January 2020

BRIDGEWATER COMPREHENSIVE WASTEWATER MANAGEMENT PLAN (CWMP) RECOMMENDED PLAN

PREPARED FOR:
TOWN OF BRIDGEWATER

SUBMITTED TO:
Executive Office of Energy and Environmental Affairs

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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: Bridgewater Comprehensive Wastewater Management Plan – Recommended Plan			
Street Address: 100 Morris Ave., Additional Streets Described Below			
Municipality: Bridgewater		Watershed: Taunton River	
Universal Transverse Mercator Coordinates: 19 N 337061 4651123		Latitude: **41.995273** Longitude: **-70.967259**	
Estimated commencement date: 1/2021		Estimated completion date:1/2037	
Project Type: WWTF Upgrades and Sewer Extension		Status of project design: 10 %complete	
Proponent: Town of Bridgewater			
Street Address: 66 Central Square			
Municipality: Bridgewater		State: MA	Zip Code: 02324
Name of Contact Person: Jonas Kazlauskas, Superintendent Water and Sewer Dept.			
Firm/Agency: Town of Bridgewater		Street Address: 90 Cottage St.	
Municipality: Bridgewater		State: MA	Zip Code: 02324
Phone: 508-697-0910	Fax: N/A	E-mail: jkazlauskas@bridgewaterma.org	

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)?

State-Listed Species under M.G.L. c. 131A.: 11.03(2)(b)1. Alteration of designated significant habitat.

Wastewater: 11.03(5)(b)3.a. Construction of one or more new sewer mains five or more miles in length. The proposed sewer expansions will result in 7.2 miles of new sewer.

Which State Agency Permits will the project require?

NPDES Construction General Permit, DEP Wetland NOI (Order of Conditions), Possible MESA Conservation & Management Permit pending MESA Project Review

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:

MassDEP has provided a low interest loan for the completion of the CWMP. Though no other financial assistance has been sought for the implementation of the Recommended Plan in the CWMP, the Town intends to seek State Revolving Fund (SRF) funding.

Summary of Project Size & Environmental Impacts	Existing	Change	Total
LAND			
Total site acreage	2.9+		
New acres of land altered		7.2	
Acres of impervious area	8.9	0.3	9.2
Square feet of new bordering vegetated wetlands alteration		0	
Square feet of new other wetland alteration		0	
Acres of new non-water dependent use of tidelands or waterways		0	
STRUCTURES			
Gross square footage	21,500	16,340(1)	37,840
Number of housing units	0	0	0
Maximum height (feet)	20	0	20
TRANSPORTATION			
Vehicle trips per day	10	0	10
Parking spaces	10	0	10
WASTEWATER			
Water Use (Gallons per day)	N/A	0	N/A
Water withdrawal (GPD)	N/A	0	N/A
Wastewater generation/treatment (GPD)	1,001,000	384,000	1,385,000
Length of water mains (miles)	N/A	0	N/A
Length of sewer mains (miles)	50	7.2	57.2

Has this project been filed with MEPA before? ☐ Yes (EEA #___________) ☒ No
Has any project on this site been filed with MEPA before? ☒ Yes (EEA # 12085) ☐ No

(1). The increase in square footage includes structures at the WWTF and four pump stations located throughout the sewer extension needs areas.

GENERAL PROJECT INFORMATION – all proponents must fill out this section

PROJECT DESCRIPTION:
The project described in this ENF is that which is proposed as the recommended plan presented in Bridgewater's 2019 Comprehensive Wastewater Management Plan (with Water Resources) (CWMP). The CWMP was finalized in 2019 but was submitted to the Massachusetts Department of Environmental Protection for comments in 2017. Since that time, changes in existing wastewater management have occurred in Bridgewater that warranted additional review and analysis to provide the town with an updated planning document. Although the needs analysis was not redone as part of this effort, flows were re-examined and additional wastewater management alternatives were explored. Excerpts from the CWMP as referenced throughout and attached to this document as described.

Describe the existing conditions and land uses on the project site:
The CWMP's recommended plan includes two distinct project types: upgrades to Bridgewater's WWTF and sewer expansion to residential needs areas across town. Upgrades to the WWTF will be maintained within the boundary of the existing WWTF. Sewer extensions are proposed for residential areas and will be mainly limited to existing roadways. As the CWMP takes the entire Town into consideration, an excerpt from the CWMP is provided, describing existing conditions in the Town and the project planning area in Attachment B.

Describe the proposed project and its programmatic and physical elements:

NOTE: The project description should summarize both the project's direct and indirect impacts (including construction period impacts) in terms of their magnitude, geographic extent, duration and frequency, and reversibility, as applicable. It should also discuss the infrastructure requirements of the project and the capacity of the municipal and/or regional infrastructure to sustain these requirements into the future.

The proposed project, which involves both updates to Bridgewater's WWTF and sewer extensions, is described in detail as the recommended plan in the CWMP. Excerpts from the CWMP describing the project as well as its environmental impacts and infrastructure requirements are included in Attachment C.

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:

NOTE*: The purpose of the alternatives analysis is to consider what effect changing the parameters and/or siting of a project, or components thereof, will have on the environment, keeping in mind that the objective of the MEPA review process is to avoid or minimize damage to the environment to the greatest extent feasible. Examples of alternative projects include alternative site locations, alternative site uses, and alternative site configurations.*

Summarize the mitigation measures proposed to offset the impacts of the preferred alternative:

An alternatives analysis was performed as part of the CWMP effort. Excerpts from the CWMP describing the alternatives considered are included in Attachment C.

If the project is proposed to be constructed in phases, please describe each phase:

____

The recommended plan for upgrades to the WWTF includes provisions for a third secondary clarifier, to be constructed under a future contract as a phased approach, as there is a strong possibility that a third clarifier may not be needed in actual operating situations. Preliminary design of the WWTF improvements should confirm the need for additional clarification capacity, and include detailed recommendations for sizing, location and load conditions that would require the additional capacity. Similarly, effluent filtration may be deferred to a later construction phase to allow the ability to consider new or changed WWTF permit conditions and to allow the plant staff to best adapt the newly improved WWTF processes to achieve optimum treatment.

Securing funding and Town support for the sewer extensions will require additional effort and time from the Town. Construction on the sewer extensions, therefore, is unlikely to begin as soon as construction for WWTF upgrades, which already has an appropriation secured.

AREAS OF CRITICAL ENVIRONMENTAL CONCERN:

Is the project within or adjacent to an Area of Critical Environmental Concern?

☐ Yes (Specify__________________________________)

☒ No

if yes, does the ACEC have an approved Resource Management Plan? ___ Yes ___ No;

If yes, describe how the project complies with this plan.

____

Will there be stormwater runoff or discharge to the designated ACEC? ___ Yes ___ 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 ☐ No

NHESP Priority Habitat is located within the project area shown in Figure 5-1. The habitat borders the Lakeside Dr. and Goodwater Way Needs Areas.

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__________________________________) ☒ No

The Whitman Street project needs area does include the Spencer J. Leonard house located at 132 Whitman Street which has been designated an historic property by the Massachusetts Historical Commission. The Whitman Street needs areas is recommended to be sewered, though the construction is expected to remain in the existing roadway and not impact the specific property located at 132 Whitman St. Similarly, the Lakeside Drive and Goodwater Way needs area includes the Leonard – Stetson House located at 157 Lakeside Drive which has been designated an historic property by the Massachusetts Historical Commission. The Lakeside Drive and Goodwater Way needs areas is recommended to be sewered, though the construction is expected to remain in the existing roadway and not impact the specific property located at 157 Lakeside Drive.

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

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:
Lake Nippenicket: Non-Native Aquatic Plants, Mercury in Fish Tissue;
Matfield River: Aquatic Macroinvertibrate Bioassessments, Excess Algal Growth, Fecal Coliform, Dissolved Oxygen, Phosphorus (Total), Taste and Odor.

Is the project within a medium or high stress basin, as established by the Massachusetts Water Resources Commission? _X__Yes ___No
Based on the 2001 Water Resources Commission Stressed Basins Map, the project is located within an area of the Taunton River Basin that is medium stressed.

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:
Potential stormwater impacts resulting from the sewer extensions will be temporary, with the exception of the nominal increase of impervious area due to the construction of four pump stations. WWTF upgrades will include drainage improvements to meet site runoff control requirements. Both the sewer extensions and the WWTF upgrades may be subject to Bridgewater's *Stormwater Management Ordinance* (Article XIII of Bridgewater's Town Code) which designates a Stormwater Authority and requires the approval of Land Disturbance Review which must address control of wastes, erosion and sediment control, and operation and maintenance of permanent stormwater management measures for projects impacting greater than 5,000 square feet of land.

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 X___ No ___ ; if yes, please describe the current status of the site (including Release Tracking Number (RTN), cleanup phase, and Response Action Outcome classification):
There are two sites within the project area regulated by the Mass Contingency Plan. However, there will be no direct impact at these locations as all work will be completed in the paved right of ways in front of these properties. MCP properties within the project area and their status include:

151 Lakeside Dr. – RTN 4-0016492 – Phase II – RAO Class A2
150 Norlen Park – RTN 4-0015351 – RAO Class A3

Is there an Activity and Use Limitation (AUL) on any portion of the project site? Yes _X__ No ___;
if yes, describe which portion of the site and how the project will be consistent with the AUL:
150 Norlen Park - Although located within the project area, there will be no impact at this location as all work will be completed in the paved right of way in front of this property.

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:
Solid waste generated during construction will include asphalt pavement, which will be reclaimed, recycled, and reused on-site as backfill or road base.

(NOTE: Asphalt pavement, brick, concrete and metal are banned from disposal at Massachusetts landfills and waste combustion facilities and wood is banned from disposal at Massachusetts landfills. See 310 CMR 19.017 for the complete list of banned materials.)

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:
For this project, both Massachusetts General Law (MGL Chapter 90, Section 16A) and the Massachusetts Department of Environmental Protection (DEP) idling reduction regulation (310 CMR 7.11(1)(b)) will be adhered to. Both prohibit unnecessary vehicle idling by stating that the engine must be shut down if the vehicle will be stopped for more than five minutes. The only exemption will be if the vehicle's accessory equipment needs to be powered, such as a forklift or a truck's rear dump bed.

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.
   Attachment A - Figures
   Attachment B - Comprehensive Wastewater Management Plan (CWMP) Excerpts:
   - Section 1: Introduction & Project Background
   - Section 2: Existing Conditions

   Attachment C - Comprehensive Wastewater Management Plan (CWMP) Excerpts:
   - Section 5: Alternatives
   - Section 6: Recommended Plan

   Attachment D - ENF Distribution List

   All Figures are included in Attachment A and are referenced below.

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. Attachment A - Figures.

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. Attachment A - Figures

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. Attachment A - Figures.

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). Attachment A - Figures.

6. List of all agencies and persons to whom the proponent circulated the ENF, in accordance with 301 CMR 11.16(2). See Attachment D –ENF Distribution List.

7. List of municipal and federal permits and reviews required by the project, as applicable.
   NPDES Construction General Permit

DEP Wetlands NOI (Order of Conditions)
*MESA Conservation & Management Permit (possible upon results of MESA Project Review)

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	0.2	0.1	0.3
Internal roadways	0.6	0	0.6
Parking and other paved areas	0.2	0	0.2
Other altered areas	0	0	0
Undeveloped areas	0	0	0
Total: Project Site Acreage	2.9	0	2.9

The above quantities represent the characterization of the WWTF Site. The total project site acreage will remain unchanged as all upgrades will occur within the current boundaries of the WWTF. The characterization of the sewer extension project areas will remain unchanged for all pipe placed below roadway. Four pump stations are proposed to be built as part of the sewer extensions and are estimated to each occupy a space of 460 square feet.

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

Prior and ongoing planning efforts for the Town of Bridgewater and surrounding region were utilized in the production of the Town's CWMP. In addition to Bridgewater's Master Plan, several other planning efforts were undertaken including plans for Bridgewater State University and the Massachusetts

Correctional Institute, large contributors to the community. An excerpt from the CWMP describing the relevant planning efforts is included in Attachment B.

A. Identify the current municipal comprehensive land use plan
Title:__Bridgewater Master Plan___________ Date__2002 (Updates 2014 & Beyond)_____

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

1) economic development _______________________
2) adequacy of infrastructure _____________________
3) open space impacts ___________________________
4) compatibility with adjacent land uses_______________

An excerpt from the CWMP describing the relevant planning efforts is included in Attachment B.

C. Identify the current Regional Policy Plan of the applicable Regional Planning Agency (RPA)
RPA: Old Colony Regional Planning Council

Title: South Coast Rail Corridor Plan Update: Community Priority Areas of Regional Significance Date_2013__________________

D. Describe the project's consistency with that plan with regard to:
1) economic development ________________________
2) adequacy of infrastructure _______________________
3) open space impacts ____________________________

An excerpt from the CWMP describing the relevant planning efforts is included in Attachment B.

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))? _X_ Yes ___ 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**? _X_ Yes ___ 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.
Portions of the Lakeside Dr. and Goodwater Way needs areas for sewer extensions fall within Priority Habitat. These needs areas and the Priority Habitat is included as Figures 5-1 – Locus Map and 5-2 – Proposed Sewer Connection Layout for Lakeside Drive Area and Goodwater Way Area.

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
Previous determinations for sewer extension projects, where only existing roadway is to be altered for the installation of sewer pipe and then returned to its current state, have not resulted in a "take" of endangered, threatened, and/or species of concern. It is expected that this project will similarly not result in a "take." However, that determination will be made final only after consulting with the Division of Fisheries and Wildlife NHESP and filing a MESA Project Review.

3. Which rare species are known to occur within the Priority or Estimated Habitat?
The rare species which are known to occur within the Priority Habitat will be made known after consulting with the Division of Fisheries and Wildlife NHESP.

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 ___ 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:
Previous determinations for sewer extension projects, where only existing roadway is to be altered for the installation of sewer pipe and then returned to its current state, have not resulted in a "take" of endangered, threatened, and/or species of concern. It is expected that this project will similarly not result in a "take." However, that determination will be made final only after consulting with the Division of Fisheries and Wildlife NHESP and filing a MESA Project Review.

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))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

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:
Bridgewater has a non-zoning local wetlands protection ordinance (Chapter 320, Article I), which can prohibit alterations within 100 feet of a wetlands while the Wetland Protection Act (M.G.L. Ch131, S.40), requires filing a Notice of Intent to the Conservation Commission to work within 100 feet of a wetland but can only regulate work within the resource area or directly affecting it. Only the WWTF site is located within 100 ft of a wetland; the sewer extensions are not located close enough to wetlands to trigger protective measures.

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.
A Notice of Intent will need to be filed with DEP and the local conservation commission, in accordance with the Wetlands Protection Act, so that a local Order of Conditions can be obtained.

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 _X_ 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 ___ No.

B. Describe any proposed permanent or temporary impacts to wetland resource areas located on the project site:

The majority of the WWTF is located within the 100ft buffer zone of wooded swamp or open waters. No alterations at the WWTF will occur outside of the existing WWTF area neither during construction nor as a permanent alteration.

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	**0**	
Designated Port Areas	**0**	
Coastal Beaches	**0**	
Coastal Dunes	**0**	
Barrier Beaches	**0**	
Coastal Banks	**0**	
Rocky Intertidal Shores	**0**	
Salt Marshes	**0**	
Land Under Salt Ponds	**0**	
Land Containing Shellfish	**0**	
Fish Runs	**0**	
Land Subject to Coastal Storm Flowage	**0**	
Inland Wetlands		
Bank (lf)	**0**	
Bordering Vegetated Wetlands	**0**	
Isolated Vegetated Wetlands	**0**	
Land under Water	**0**	
Isolated Land Subject to Flooding	**0**	
Bordering Land Subject to Flooding	**0**	
Riverfront Area	**0**	

D. Is any part of the project:

1. proposed as a limited project? _X_ Yes __ No; if yes, what is the area (in sf)? **The entire sewer extension portion project area is considered a limited project as it includes the construction and extension of underground public utilities (sewer) per 310 CMR 10.53 (3)(d).**
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**? ___ Yes _X_ 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 ___ No; if yes, identify the area (in sf): **A wetlands restriction order search will be performed at the time of filing of the Notice of Intent.**
7. located in buffer zones? _X_ Yes ___No; if yes, how much: **59,400 square feet**

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:____________________
Area of filled tidelands covered by buildings:___________
For portions of site on filled tidelands, list ground floor uses and area of each use:
____
Does the project include new non-water-dependent uses located over flowed tidelands?
Yes ___ No ___
Height of building on filled tidelands_______________

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? ___ Yes _X__ No; if yes, describe these effects and the projects consistency with the policies of the Office of Coastal Zone Management:

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:
Per 301 CMR 11.03(5)(b)3.b., construction of one or more new sewer mains five or more miles in length. The 5-mile threshold is exceeded by extending sewer mains by 7.6 miles.

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

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	1,001,000	384,000	1,385,000
Discharge of industrial wastewater	0	0	0
TOTAL	1,001,000	384,000	1,385,000

	Existing	Change	Total
Discharge to groundwater	0	0	0
Discharge to outstanding resource water	0	0	0
Discharge to surface water	1,001,000	384,000	1,385,000
Discharge to municipal or regional wastewater facility	0	0	0
TOTAL	1,001,000	384,000	1,385,000

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:
Capacity improvements to the downstream collection system will be considered in detail when finalizing the design of the sewer extensions. As part of the preliminary design phase for the sewer extensions, as presented in Attachment C, it is recommended that a detailed downstream capacity analysis be completed for each area to be connection to the centralized system.

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:
In general, the existing capacity of the Bridgewater WWTF is nominally enough to meet existing and near future conditions in the town sewer service area. The future flow and load projections for the town system, including allowances for sewering the defined needs areas, provisions for infill connections and economic development within the sewer system, and provisions for future flows from Bridgewater State University, show that additional capacity at the WWTF may be needed in the future to meet all town and institutional wastewater needs. Additional hydraulic capacity could be created through elimination of excessive (or non-excessive) I/I.

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)	1,440,000	1,001,000	384,000	1,385,000

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?

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

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	>94,000 gal	0	>94,000 gal
Treatment	>1,380 tons/day	0	>1,380 tons/day
Processing	>1,380 tons/day	0	>1,380 tons/day
Combustion	0	0	0
Disposal	>1,380 tons/day	0	>1,380 tons/day

While an increase in flow to the plant is expected due to the sewer extensions and projected growth in Bridgewater, the capacity of the existing solids processing WWTF is not expected to be limiting. No expansion of solids processing is recommended at this time.

H. Describe the water conservation measures to be undertaken by the project, and other wastewater mitigation, such as infiltration and inflow removal.
Bridgewater has several opportunities for effluent reuse which is recommended to be considered, including reuse for toilet flushing at Bridgewater State University (BSU), heating and cooling makeup water at BSU, and irrigation. While I/I issues are not perceived to be excessive by the town, system review and rehabilitation efforts have been undertaken, and a program is currently underway to address I/I. In 2013, the Town authorized a bond for approximately $5 million in I/I investigation and system rehabilitation work. The work was recently completed.

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:
Local plans and policies were reviewed as noted in the "Land Section" of this ENF when preparing the recommended plan of the CWMP.

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:
The sewer extensions are included as a part of the recommended plan of the CWMP, excerpts of which are included as attachments to this ENF.

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**? ___Yes _X_ No; if yes, specify which permit:

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	_______	_______	_______
Number of vehicle trips per day	________	________	________
ITE Land Use Code(s):	________	________	________

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

Roadway	Existing	Change	Total
1. ___________________	________	________	________
2. ____________________	________	________	________
3. ____________________	________	________	________

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

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?

C. Is there a Transportation Management Association (TMA) that provides transportation demand management (TDM) services in the area of the project site? ____ Yes ____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 ____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)?

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:

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**? ___ Yes _X_ No; if yes, specify which permit:

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:

B. Will the project involve any

1. Alteration of bank or terrain (in linear feet)? ____________
2. Cutting of living public shade trees (number)? ____________
3. Elimination of stone wall (in linear feet)? ____________

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:

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 both questions A and B, proceed to the **Air Quality Section**. If you answered "Yes" to either 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 both questions A and B, proceed to the **Historical and Archaeological Resources Section**. If you answered "Yes" to either 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 _X_ 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:

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:

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:

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:

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)Journal-News Independent (Date)January 31, 2020

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

Signatures:

Date Signature of Responsible Officer or Proponent	1/16/2020 Date Signature of person preparing NPC (if different from above)
Michael Dutton, Town Manager	Kent M. Nichols
Name (print or type)	Name (print or type)
Town of Bridgewater	Weston & Sampson
Firm/Agency	Firm/Agency
66 Central Square	55 Walkers Brook Drive
Street	Street
Bridgewater, MA 02324	Reading, MA 01867
Municipality/State/Zip	Municipality/State/Zip
(508) 697-0910	(978) 532-1900 x2408
Phone	Phone

ATTACHMENT A

Figures

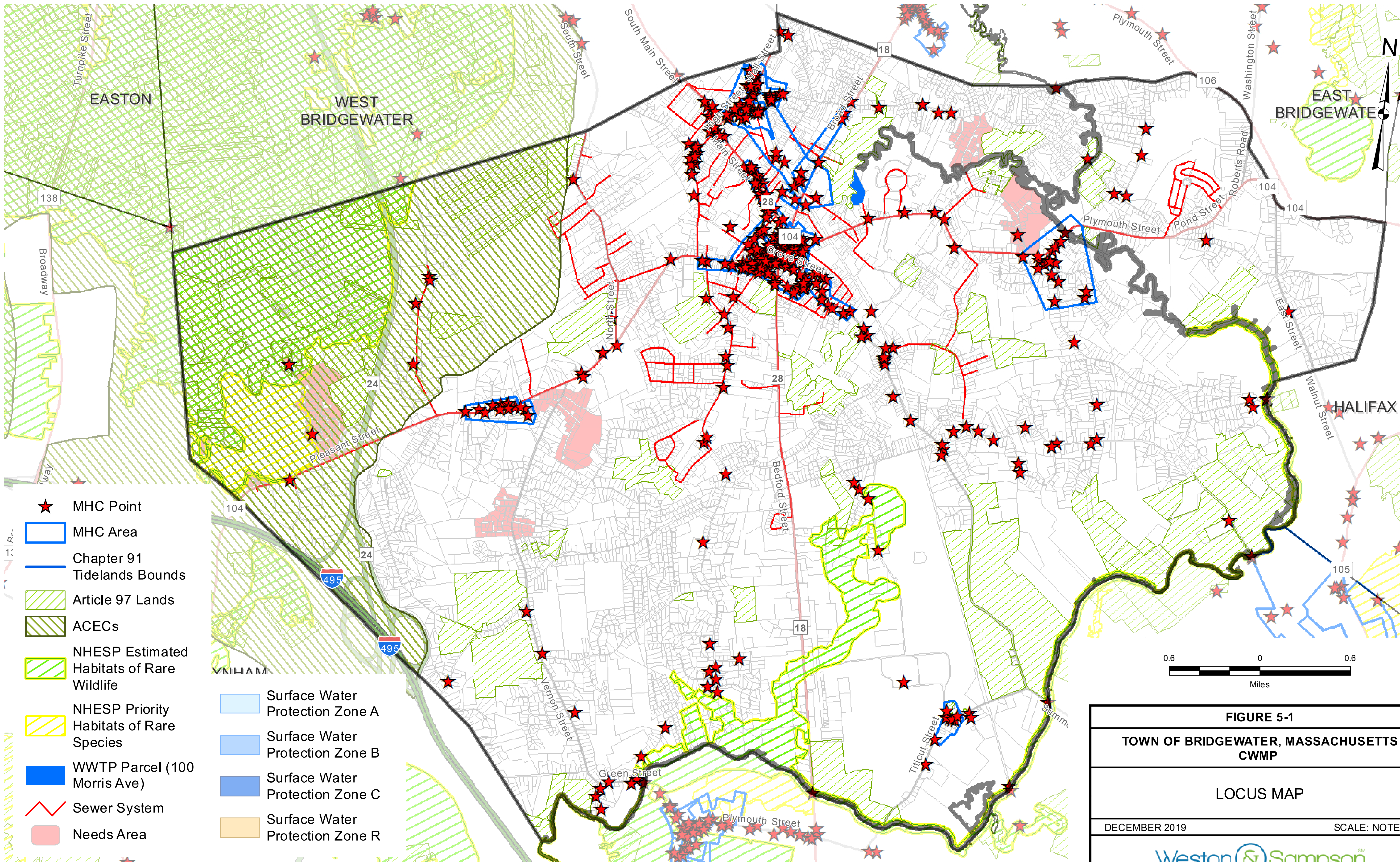


FIGURE 5-1

TOWN OF BRIDGEWATER, MASSACHUSETTS CWMP

LOCUS MAP

DECEMBER 2019 SCALE: NOTED

Weston & Sampson

Path: \\wse03.local\wse\Depts\GIS\data\Client\Bridgewater MA\Project\2130003.E\FIGURE 5-1 LOCUS11X17_20191219.mxd **User:** shinnickd **Saved:** 12/19/2019 5:12:54 PM **Opened:** 12/19/2019 5:13:38 PM

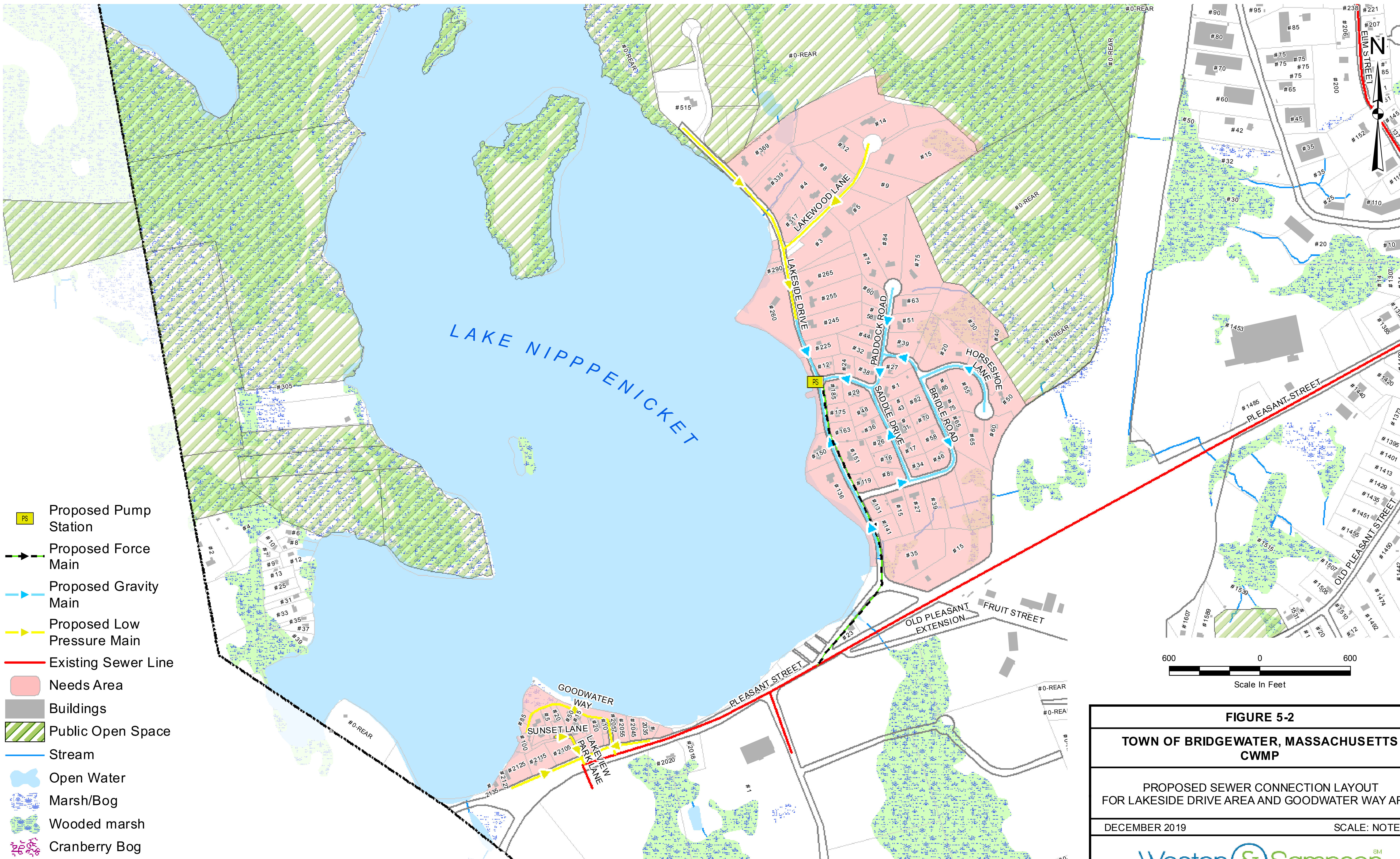


FIGURE 5-2

TOWN OF BRIDGEWATER, MASSACHUSETTS
CWMP

PROPOSED SEWER CONNECTION LAYOUT
FOR LAKESIDE DRIVE AREA AND GOODWATER WAY AREA

DECEMBER 2019 SCALE: NOTED

Weston & Sampson

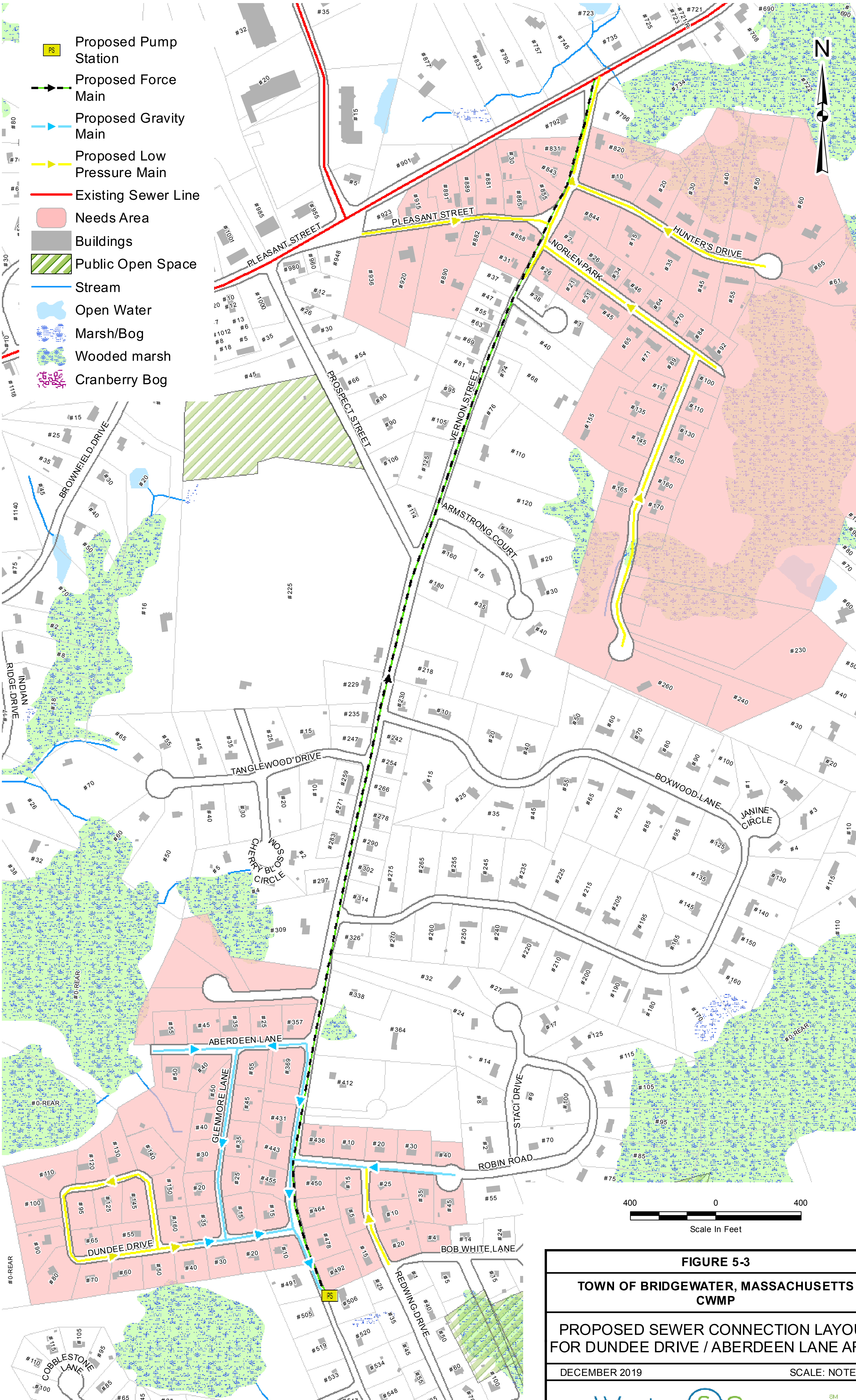


FIGURE 5-3

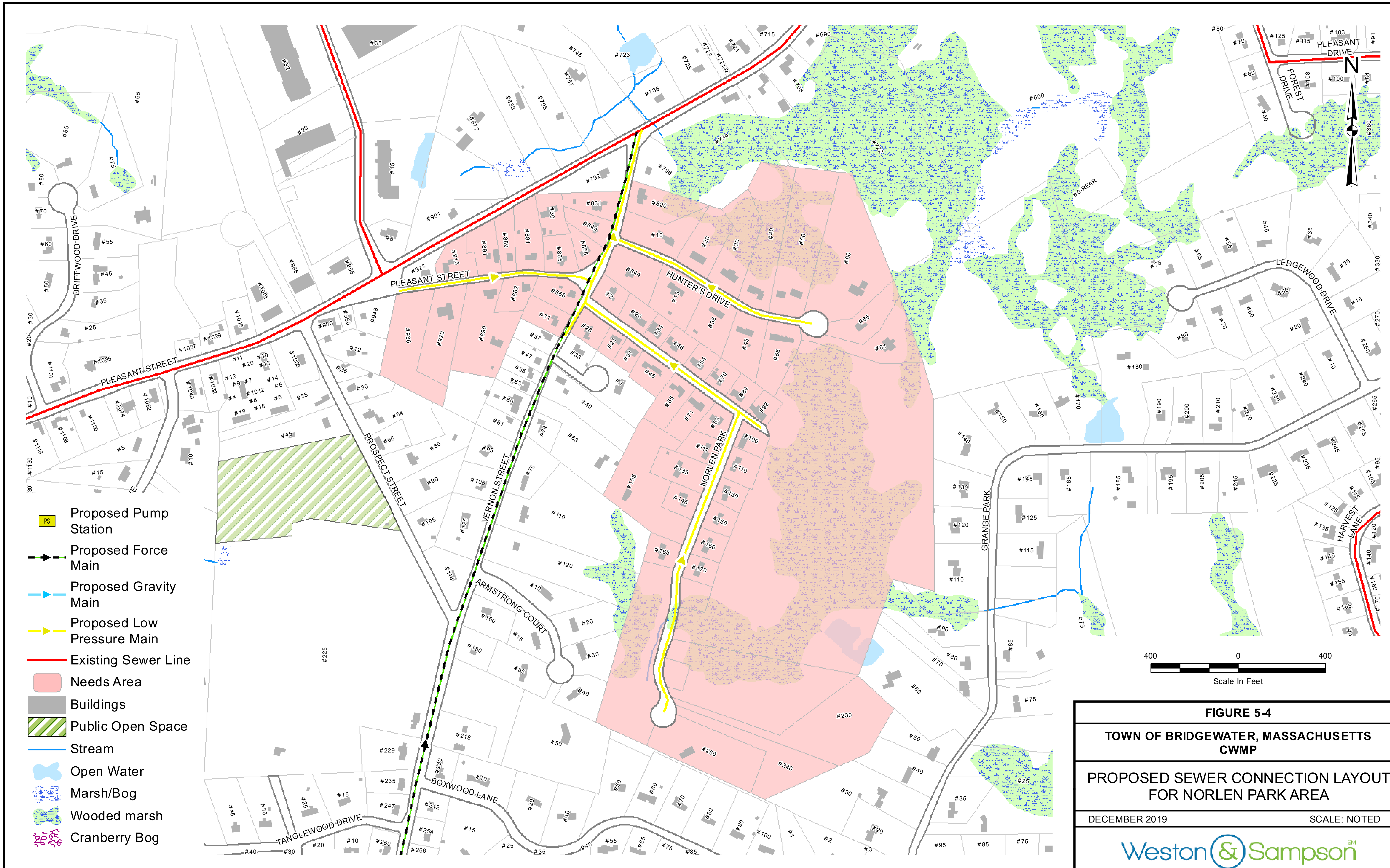
TOWN OF BRIDGEWATER, MASSACHUSETTS
CWMP

PROPOSED SEWER CONNECTION LAYOUT FOR DUNDEE DRIVE / ABERDEEN LANE AREA

DECEMBER 2019 SCALE: NOTED

Weston & Sampson

Path: \\wse03.local\WSE\Depts\GIS\data\Client\Bridgewater MA\Project\2130003.E\FIGURE 5-3 - 11 x 17 Landscape_20191219.mxd User: shinnickd Saved: 12/19/2019 2:33:05 PM Opened: 12/19/2019 2:43:12 PM



PLEASANT STREET
HUNTER'S DRIVE
NORLEN PARK
VERNON STREET
PROSPECT STREET
ARMSTRONG COURT
BOXWOOD LANE
TANGLEWOOD DRIVE
DRIFTWOOD DRIVE
GRANGE PARK
LEDGEWOOD DRIVE
HARVEST LANE
FOREST DRIVE
PLEASANT DRIVE
N
PS
Proposed Pump Station
Proposed Force Main
Proposed Gravity Main
Proposed Low Pressure Main
Existing Sewer Line
Needs Area
Buildings
Public Open Space
Stream
Open Water
Marsh/Bog
Wooded marsh
Cranberry Bog
400 0 400
Scale In Feet
FIGURE 5-4
TOWN OF BRIDGEWATER, MASSACHUSETTS
CWMP
PROPOSED SEWER CONNECTION LAYOUT FOR NORLEN PARK AREA
DECEMBER 2019
SCALE: NOTED
Weston & Sampson

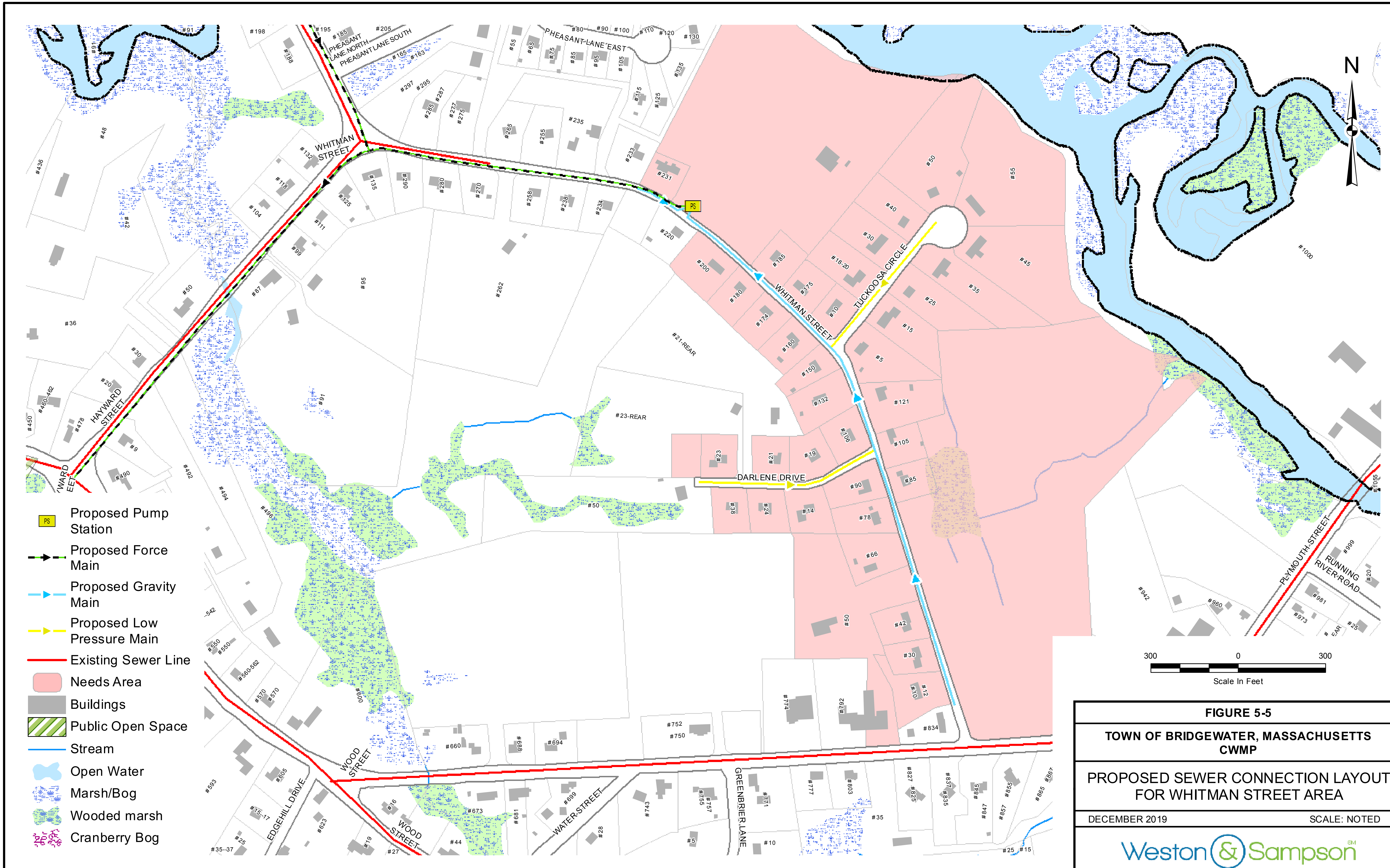


FIGURE 5-5
TOWN OF BRIDGEWATER, MASSACHUSETTS
CWMP
PROPOSED SEWER CONNECTION LAYOUT FOR WHITMAN STREET AREA
DECEMBER 2019
SCALE: NOTED
Weston & Sampson
N
300
0
300
Scale In Feet
Proposed Pump Station
Proposed Force Main
Proposed Gravity Main
Proposed Low Pressure Main
Existing Sewer Line
Needs Area
Buildings
Public Open Space
Stream
Open Water
Marsh/Bog
Wooded marsh
Cranberry Bog
PS
WHITMAN STREET
HAYWARD STREET
PHEASANT LANE NORTH
PHEASANT LANE SOUTH
PHEASANT LANE EAST
TUCKOOSA CIRCLE
DARLENE DRIVE
WOOD STREET
EDGEHILL DRIVE
WATER STREET
GREENBRIER LANE
PLYMOUTH STREET
RUNNING RIVER ROAD
#21-REAR
#23-REAR

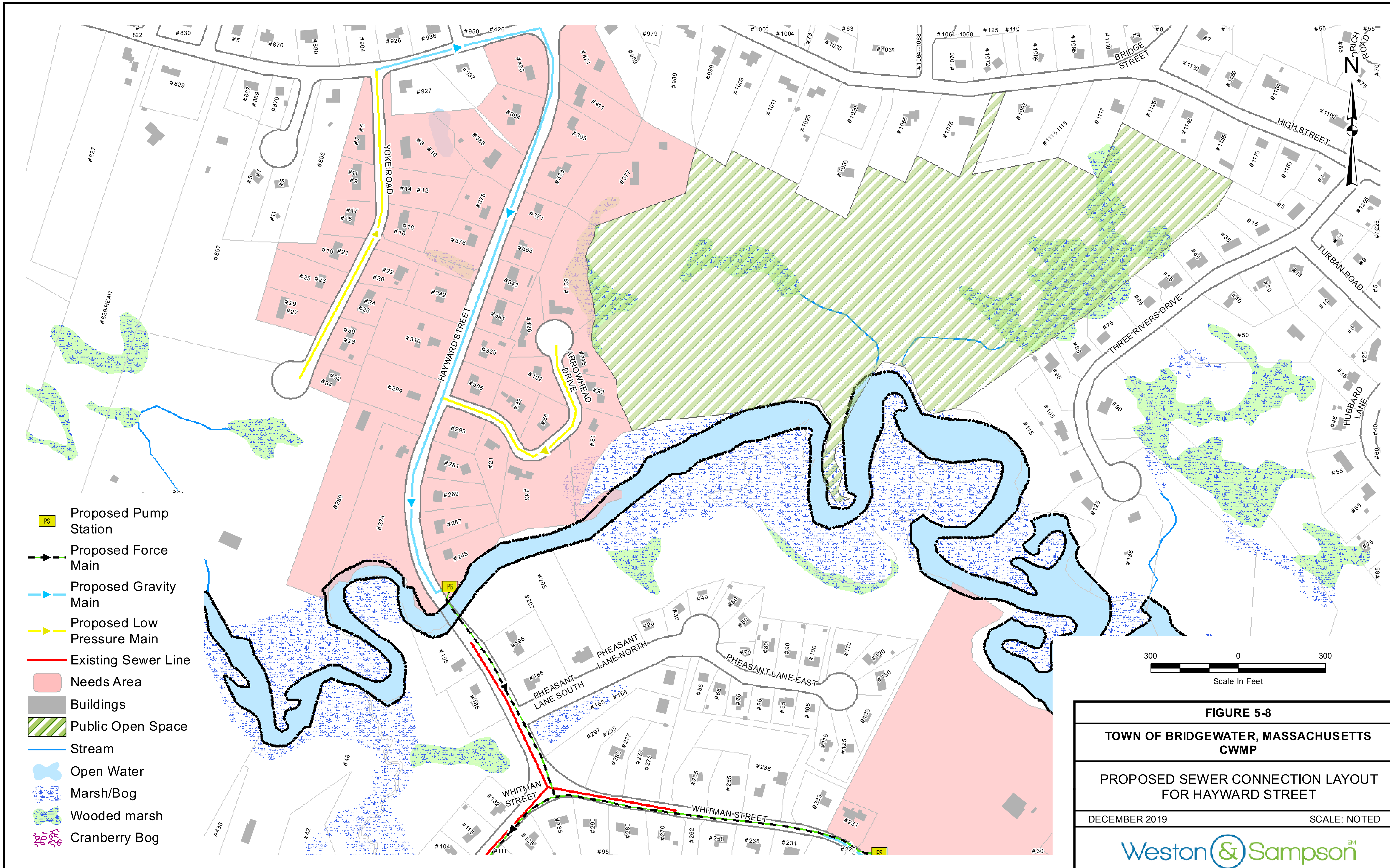


FIGURE 5-8

TOWN OF BRIDGEWATER, MASSACHUSETTS CWMP

PROPOSED SEWER CONNECTION LAYOUT FOR HAYWARD STREET

DECEMBER 2019 SCALE: NOTED

Weston & Sampson

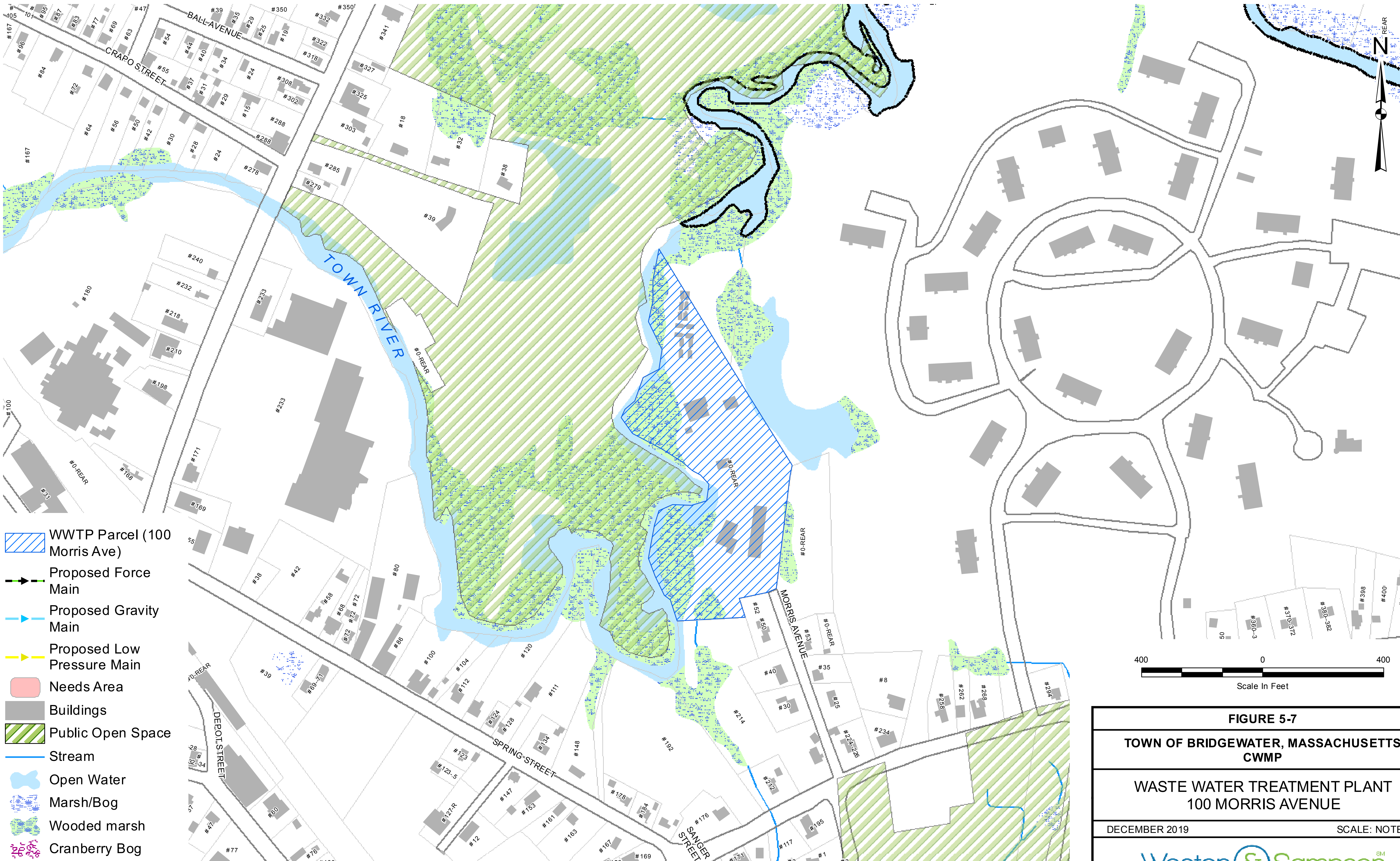


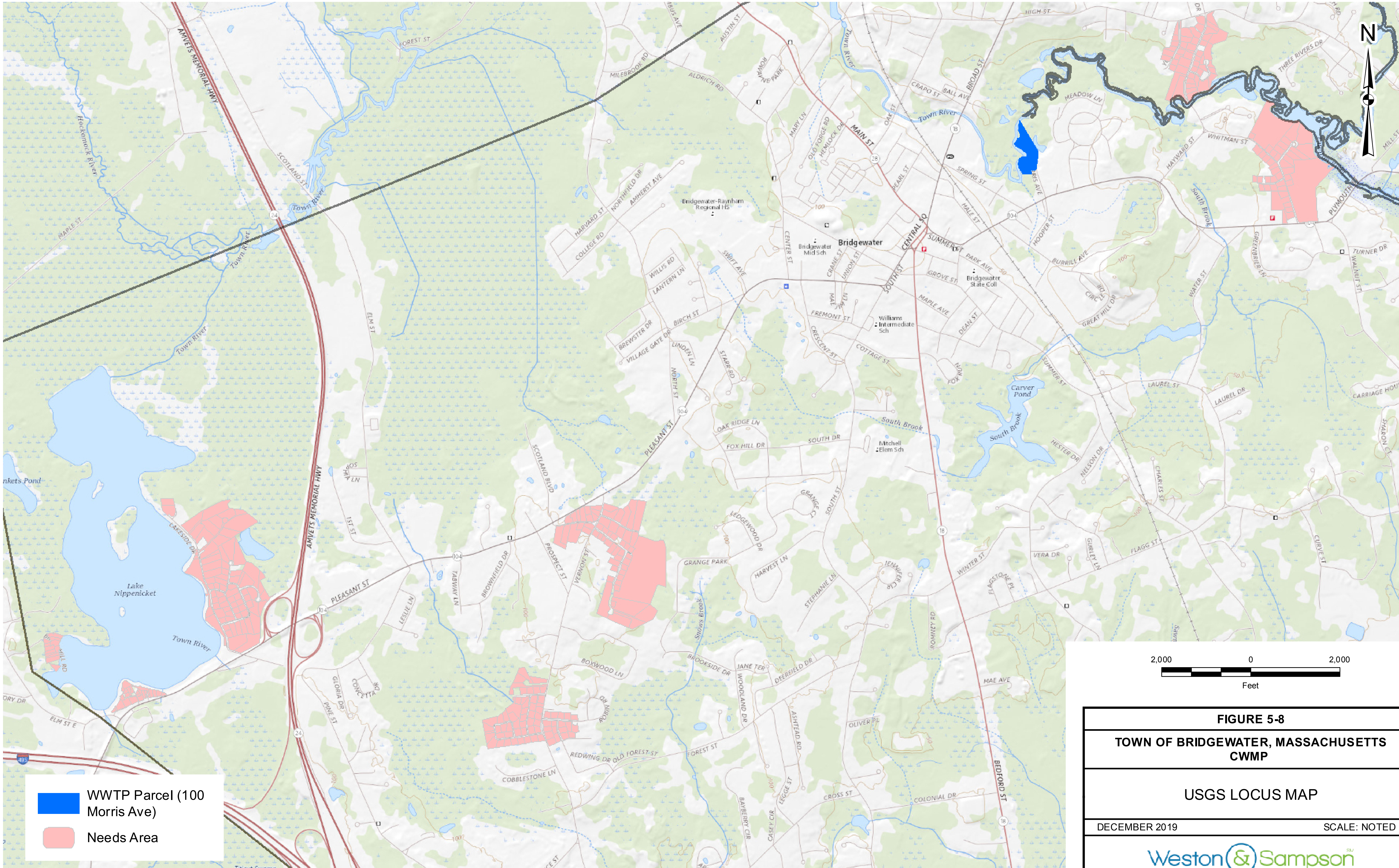
FIGURE 5-7

TOWN OF BRIDGEWATER, MASSACHUSETTS CWMP

WASTE WATER TREATMENT PLANT
100 MORRIS AVENUE

DECEMBER 2019 | SCALE: NOTED

Weston & Sampson



WWTP Parcel (100 Morris Ave)

Needs Area

FIGURE 5-8

TOWN OF BRIDGEWATER, MASSACHUSETTS CWMP

USGS LOCUS MAP

DECEMBER 2019 | SCALE: NOTED

Weston & Sampson

Path: \\wse03.local\wse\Depts\GIS\data\Client\Bridgewater MA\Project\2130003.E\FIGURE 5-8 USGS 11X17_20191219.mxd User: shinickd Saved: 12/19/2019 5:21:52 PM Opened: 12/19/2019 5:22:02 PM

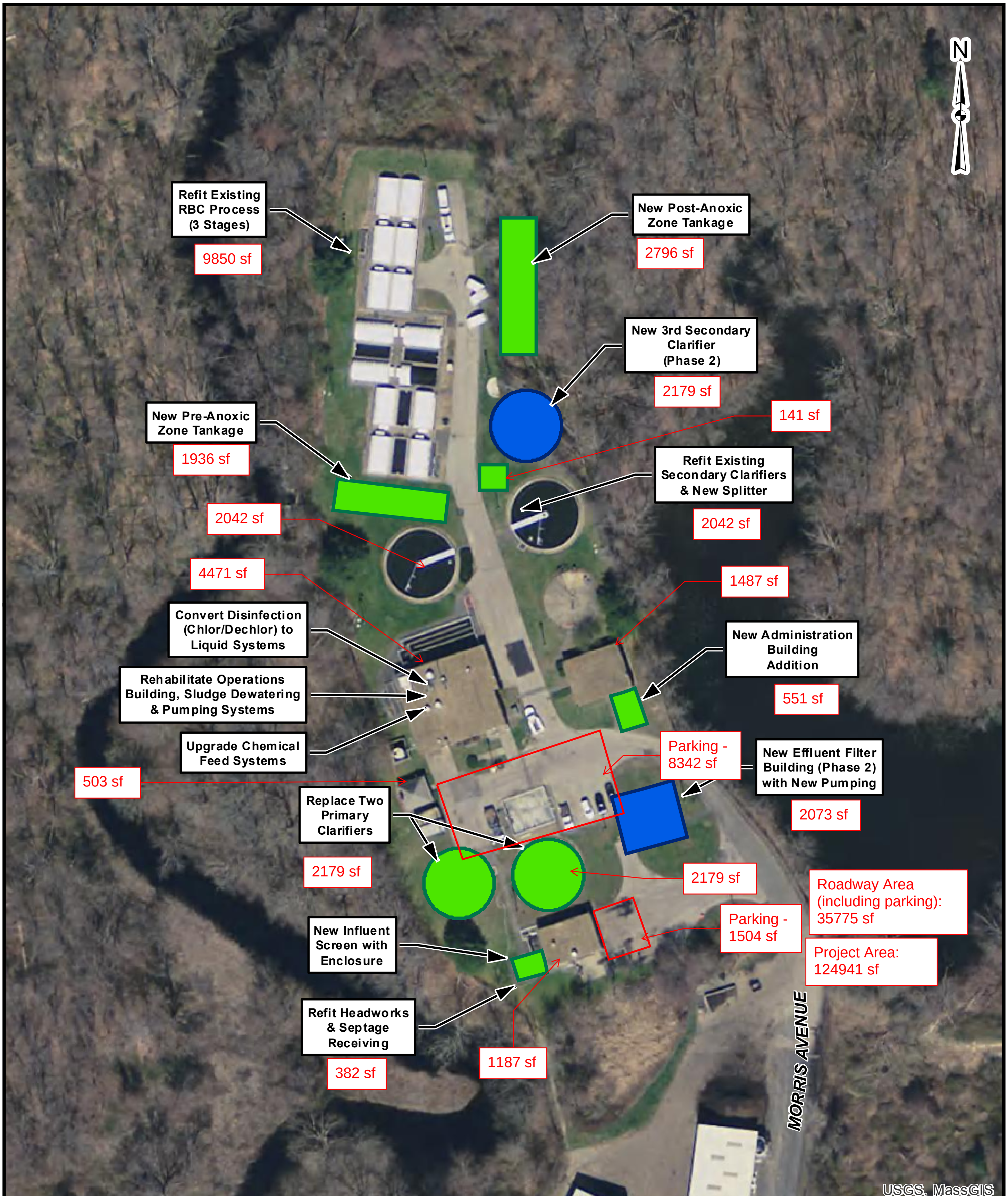


FIGURE 6-3
TOWN OF BRIDGEWATER, MASSACHUSETTS
PROPOSED WWTF MODIFICATIONS

Site Plan

Proposed Modifications

- Phase 1
- Phase 2

100 0 100
Scale In Feet

Weston & Sampson

ATTACHMENT B

Excerpts from Bridgewater CWMP:
Section 1: Introduction & Project Background;
Section 2: Existing Conditions

1.0 INTRODUCTION & PROJECT BACKGROUND

1.1 Project Description & Goals

The Town of Bridgewater is developing this 20- year plan for town-wide wastewater management for continued environmental protection and to be fiscally responsible with regard to future permit requirements. Bridgewater's Board of Water and Sewer Commissioners has been evaluating wastewater management needs and options for over 30 years and has supported the implementation projects to address much of the need previously identified. The last comprehensive study completed for the Town was the Sewerage Needs Analysis, December 2000. In March 2001, an Environmental Impact Report for Comprehensive Wastewater Management Plan was submitted for review under the Massachusetts Environmental Policy Act (MEPA) process. Since that time, many of the recommendations made in that study have been implemented to improve the level of wastewater treatment and disposal for more than a third of Bridgewater's developed properties.

In light of changes in the environmental, regulatory, and land use needs over the past 16-year period, it is time now to re-evaluate wastewater management needs and alternatives for the two-thirds of Bridgewater properties who continue to rely on individual on-site (septic) systems for wastewater treatment and disposal. Similarly, for the residents who rely on the centralized system and those who will in the future, evaluation and upgrade of the existing wastewater treatment plant is needed to meet more stringent discharge permit requirements from the Environmental Protection Agency (EPA). In addition, this CWMP process also includes integration of water management items as well as related stormwater management items for a more comprehensive water resources project perspective.

The re-evaluation process to develop this Comprehensive Wastewater Management Plan, or CWMP, as a guide for town-wide wastewater management for the next 20-years includes:

- Documentation of the Existing and Future Conditions in the Planning Area
- Needs Assessment
- Alternatives Analysis
- Recommended Plan Development
- Costs, Cost Allocation and Project Financing
- Implementation
- Public Participation

To find the most appropriate solutions to Bridgewater's wastewater management concerns, the following principles were emphasized throughout the planning process:

- Detailed, scientific-based wastewater needs information as a solid base for planning.
- Thorough and thoughtful review of appropriate alternatives.
- Recognition of the importance of maintaining local water balance when feasible.
- Selection of a recommended plan that benefits the entire Town.
- Public participation and stakeholder involvement.

1.2 Project Planning Area

The planning area for this comprehensive wastewater management plan (CWMP) is the entire Town of Bridgewater, Massachusetts. The initial goal of this project was to identify remaining areas of town that have challenges to using on-site systems so that later phases of the project could have a more focused project area for the alternatives analysis.

1.2.1 General Town Overview

The Town of Bridgewater is located in Plymouth County approximately 27 miles south of Boston. US Route 24 connects the town to the region's major highways, Interstate 495 and Route 128, providing easy highway access to Boston and to Providence, RI. Bridgewater is bounded by Raynham to the west; East Bridgewater and West Bridgewater to the north; Halifax to the East; and Middleborough to the south. See Figure 1-1: Locus Map (attached) for a depiction of the town's physical location.

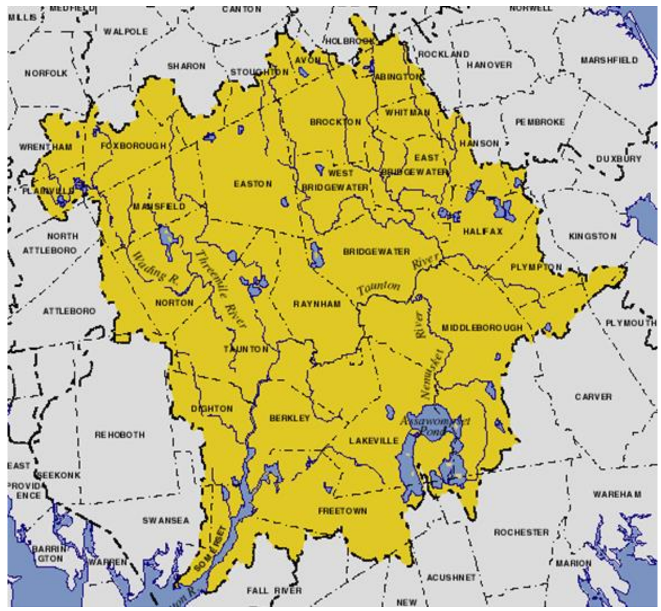
1.2.2 Town Water Resources

This section summarizes climate, hydrologic and geologic factors that relate to the Town's water supply.

1.2.3 River Basin

The Taunton River Basin is 562 square miles in area and empties into Mount Hope Bay near the City of Fall River. The basin overall is characterized by flat to gently rolling topography with elevations that range from sea level to 450 feet. The basin includes approximately 23 square miles of lakes and ponds and roughly 50 square miles of wetlands. Average monthly discharge at the MCI- Bridgewater stream gage ranges from 0.8 BG to 4.4 BG. Equivalent annual discharge, expressed in inches (compared to 44 inches annual average rainfall) ranges from 10.2 inches in 1966 to 36 inches in 1956.

Bridgewater lies entirely within the Boundaries of the Taunton River Basin and is fairly central in the basin. Bridgewater has many smaller brooks, streams and wetlands which drain into three major waterways; Town River, Matfield River, and Taunton River.



Taunton River Basin

1.2.4 Precipitation

Bridgewater is located in a temperate, inland area of Massachusetts. Long term precipitation records are available at Taunton and Blue Hill and used as the basis for the water supply sections of this CWMP. A graphical representation of this data is included as Figure 1-2: Annual Precipitation 1895 through 2012 Blue Hill, Massachusetts, below. Annual average precipitation at nearby Taunton is approximately 44" per year based on records starting in 1902. Significant variation occurs between dry years (28 inches in 1966) and the wettest year (64 inches in 1898). A second long period of record available (1895 through 2014) in the Bridgewater area is at Blue Hill 16 miles to the north: of note in both the Taunton and Blue Hill records is the exceptionally dry period from 1963 through 1966 during which the 4-year cumulative rainfall was approximately 40 inches below the average in Taunton and 50 inches at Blue Hill.

As shown below in Figure 1-3: Summary of monthly rainfall data, Taunton, Massachusetts, average monthly precipitation in Taunton is fairly uniform and ranges from 3.03 inches (February) to 4.24 inches (August). However the months of August and September show significant variation: August varies from 0.97 to 15.78 inches and September varies from 0.02 to 11.63 inches of precipitation.

Figure 1-2:
Annual Precipitation 1895 through 2012 Blue Hill, Massachusetts

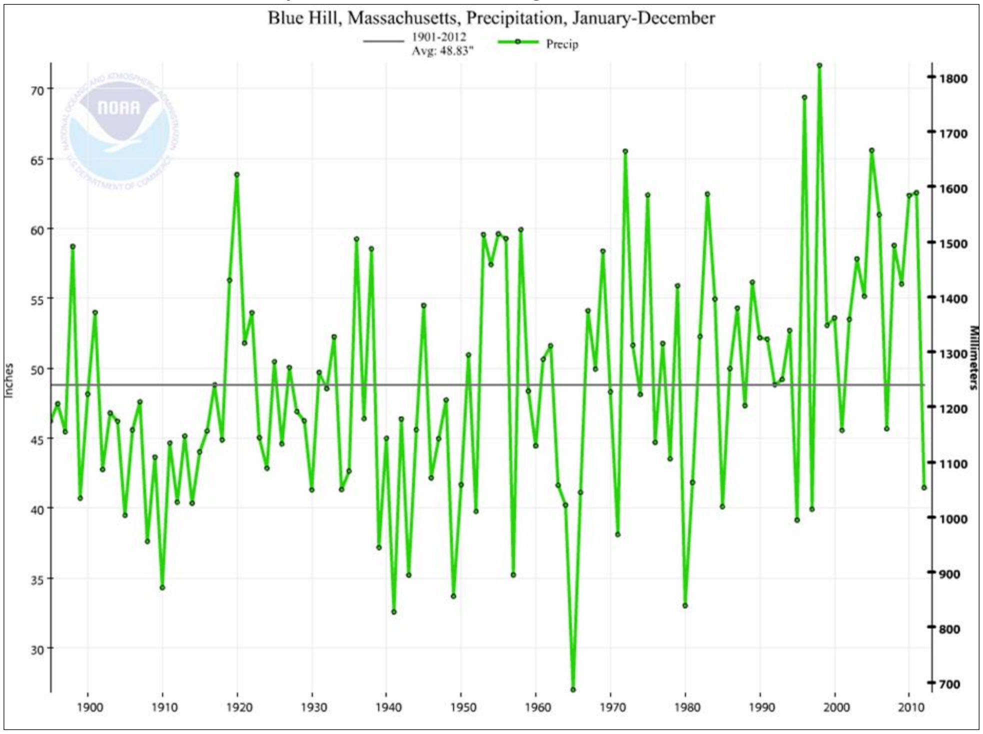


Figure 1-3:
Summary of monthly rainfall data, Taunton, Massachusetts (1875 to 1969)

Month	Minimum Monthly Precipitation, in Inches	Year of Occurrence	Average Monthly Precipitation, in Inches	Maximum Monthly Precipitation, in Inches	Year of Occurrence
Jan	0.68	1955	3.66	8.35	1958
Feb	.84	1947	3.03	5.89	1960
Mar	1.12	1949	3.60	7.18	1942
Apr	.85	1942	3.91	7.86	1958
May	.35	1964	3.38	10.39	1948
June	.05	1949	3.16	8.89	1938
July	.12	1952	3.39	5.88	1938
Aug	.97	1940	4.24	15.78	1955
Sept	.02	1941	3.84	11.63	1933
Oct	.60	1946	3.55	8.49	1955
Nov	1.01	1932	4.22	8.11	1941
Dec	.62	1955	3.49	8.96	1937

Minimum yearly precipitation: 27.31 inches (1965)
Maximum yearly precipitation: 56.57 inches (1933)
Average yearly precipitation: 43.52 inches

1.2.5 Surface Water

Bridgewater's surface water resources are shown on Figure 1-4: Water Resources (attached). According to the United States Census Bureau, the town has 0.7 square miles (2.62%) of surface water. The principal streams draining the Town of Bridgewater are Spring Brook, Matfield River and Town River which are tributary to the Taunton River. The confluence of Town River and the Matfield River form the Taunton River. Studies by the USGS and Massachusetts DEP have characterized the watersheds within the Town of Bridgewater on the basis of August streamflow depletion.

Main surface water bodies include Carver's Pond and Lake Nippenicket. Carver's Pond is formed by an earthen dam apparently built in the mid-1700s. Carver's pond occupies 28 acres in the central portion of Bridgewater and is in the center of a Town recreational area. Since several public water supply wells are located near the pond, 638 acres of the water shed are designated Zone II.

Lake Nippenicket occupies 354 acres in the northwest portion of the Town of Bridgewater and forms the headwaters of Town River. Neither the Lake nor the surrounding areas are developed as a Town of Bridgewater public water supply. However, a water supply source for the Town of Raynham is located to the west of Lake Nippenicket.

1.2.6 Aquifers

Bridgewater's water supplies are developed from two major groundwater sources. The first is an aquifer along the Matfield River tapped by four wells south of High Street and east of the river as well as 2 wells south of Plymouth Street along the Taunton River on the Wyman Meadow land. These wells were developed in soils mapped as glacial lake deposits (USGS GQ 127). This aquifer occupies the northeast corner of the town bracketing the Town River and Matfield River. Based on historic water quality data, this water supply appears to be influenced by recharge from the Matfield River.

The second group of wells is located adjacent to Carver's Pond. Four active wells are located along the southern portion of the pond. An inactive well is located along a different portion of shore to the north-west. Carver's Pond aquifer runs east and west of the Pond and then south, roughly west of Snow's Brook, to the Taunton River near the Middleboro line. These wells were developed in soils mapped as glaciofluvial materials (USGS GQ 127).

These aquifers are protected by delineation of Zone I and II recharge areas and associated land use restrictions in these areas. The Town owns the areas immediately adjacent to each well (Zone I). Zone II delineation is intended to identify recharge areas likely to be under the influence of the well during a six- month drought. The land use restrictions are established through Town ownership of land around the wells and by the town's Aquifer Protection District zoning. This protection district is mapped over the Zone I and II areas, which are shown on Figure 1-4: Water Resources (attached).

1.2.7 Surficial Geology & Soil Conditions

Glacial till containing layers of clay, gravel and other materials are common in Bridgewater and can be found throughout. The large, glacial lake, Lake Taunton, left behind thick silt and clay deposits in the southern and eastern sections of town and also along stream beds. Thin layers of organic soils are found in the northeastern section of town, mostly in the Hockomock Swamp. Figure 1-5. General Surficial Geology map of Bridgewater (attached).

The topography of Bridgewater is characterized as low-lying, with scattered wetlands and streams. Generally, elevation ranges from 100 to 175 feet above mean sea level (AMSL).

1.2.8 Organizational Context

Bridgewater's government consists of a Town Council and Town Manager. The Town Council consists of nine elected members who serve as the public representatives for the town's legislative and policymaking body. They approve budgets, establish community goals and strategize long term plans for the Town of Bridgewater. The Town Council is involved in all of town's projects. The Town Manager is hired by the Town Council and serves as the executive of Bridgewater's government. The two major governmental bodies involved in developing a wastewater management plan are the Board of Water and Sewer Commissioners and the Planning Board. Within these two bodies, there are board members and commissioners who have input on land use policy and regulations, and wastewater management.

The Bridgewater Board of Water and Sewer Commissioners is playing the lead role in this interdepartmental wastewater management planning effort. This commission is responsible for decision making to maintain the water supply system for the Town and to operate and maintain the central wastewater collection, treatment, and disposal system. The collection system has undergone numerous changes in the past several years, and the treatment system went through its most recent major upgrade in 1987. Bridgewater Water Department manages the Town's centralized water supply and treatment systems and Bridgewater Sewer Department manages the Town's sewer collection and treatment system. The Highway Department has also participated in this planning project. As part of their responsibility for maintenance and improvements to the Town's roadway network, stormwater management also falls under their jurisdiction.

The Planning Board and Zoning Board reviews development proposed for the Town, including issues relating to land use, flood plain and groundwater conservancy areas, zoning, and housing. 'Subdivision Rules and Regulations' set forth the Planning Board's procedures and standards to be followed in the subdivision of land and the construction of ways. The Planning Board is authorized under the General Laws of Massachusetts to regulate the laying out and construction of ways in subdivisions to insure the safety, convenience and welfare of present and future inhabitants of Bridgewater. Planning Board members maintain all planning-related information for the Town and make that data available for the general public.

The Board of Health is responsible for reviewing and permitting individual household and business wastewater disposal systems. These systems, commonly referred to as Title 5 systems, serve about seventy percent of Bridgewater's residents. The state's environmental code, Title 5, serves as the basis for regulating these systems.

Board of Health staff is playing a role in this wastewater planning effort, through involvement at the staff level. The Division's files have been vitally important in establishing the baseline of data for the analysis of the suitability of parcels in town for Title 5 systems.

The Conservation Commission is responsible for the administration of the State Wetlands Protection Act and overall stewardship of the natural resources of the Town, as well as the establishment of Town environmental policy in conjunction with the Town Council. Conservation Commission staff are also playing a role by involvement at the staff level, providing feedback and guidance on the environmental sensitivity and environmental data used in this study.

1.2.9 Town Development and Infrastructure

The Town of Bridgewater is predominantly developed with residential uses. Commercial and industrial development in the town has undergone limited growth over the years, in part to support the growing residential population. Setting Bridgewater apart from other Massachusetts communities is the presence of a growing state university- Bridgewater State University and a correctional institution- MCI Bridgewater. While occupying vast expanses of state owned and controlled land, those institutions provide little to no taxable property to support the towns financial obligations. Bridgewater is located within the Old Colony Planning Council (OCPC) Regional Planning District.

Town infrastructure includes a centralized sewer system, which provides wastewater collection, treatment and disposal for approximately 30% of the developed parcels in town. Wastewater that is collected by the centralized sewer system is transported to the Bridgewater Wastewater Treatment Plant (WWTP) for treatment and disposal to the Town River. That facility operates under a federal surface water discharge permit (NPDES Permit MA 0100641). The remaining 70% of the developed parcels in Bridgewater have an on-site (septic) system for wastewater management, with two known exceptions. These exceptions include the 1,500 acres of land in southeast Bridgewater occupied by the state's MCI Bridgewater Correctional Complex, which operates and maintains its own wastewater treatment facility. One street in town on the Raynham town line near Lake Nippenicket has a sewer connection to the Taunton WWTP through Raynham.

Nearly all developed parcels in Bridgewater receive municipal water service from the Bridgewater Water Department, so the town has a well-developed water supply, storage and distribution system.

Stormwater is managed with localized drainage collection systems that recharge the groundwater or flow to existing surface water via an outfall.

1.2.10 Project Focus Areas

While this CWMP has a town-wide planning area, to more consistently perform the wastewater needs analysis with prior efforts, the Town was divided into five study areas that were the main focus of this CWMP. These study areas are generally described as follows:

1. Plymouth Street/Whitman Street
2. Norlen Park/Scotland
3. Aberdeen/Dundee Area
4. Douglas/Atkinson/Fiske Area
5. South/Sunrise Area

1.3 Prior & Ongoing Planning Efforts

In addition to the ongoing wastewater planning, similar efforts have been undertaken by other town departments. Relevant findings from these planning efforts have been incorporated into this CWMP, as appropriate. Included below is a summary of the known planning efforts and their status as of the writing of this CWMP.

1.3.1 Town Master Plan & Regional Planning

A Master Plan was developed over the period of 2000 to 2002 to "provide the community with specific information and strategies to address growth issues and their impact on natural resources, economic development, municipal facilities and services, cultural and historic resources and the transportation system."

The 2002 Bridgewater Master Plan identified the following major areas for economic development in Bridgewater:

- Bridgewater Industrial Park on Elm Street off of Pleasant Street (Route 104), near the Route 24 interchange.
- Scotland Boulevard Industrial Park off of Pleasant Street (Route 104).
- Central Business District/Downtown at the convergence of routes 18, 28 and 104.

The Master Plan also included information on town resources and infrastructure.

The Town, with JM Goldson Community Preservation Planning as its consultant, is currently in the process of updating the 2002 Master Plan and has completed a few chapters of the updated report including the following:

- Chapter 1: Demographic Profile & Trends
- Chapter 2: Housing
- Chapter 3: Open Space & Natural Resources

Findings to date in the Bridgewater Master Plan Update 2014 & Beyond that may have an impact on the wastewater planning effort are related to population changes in the sewered areas (now and in the future) and housing increases that require public sewer service.

The Town, also with JM Goldson Community Preservation Planning as its consultant, completed its Housing Production Plan in 2012. The Housing Production Plan (HPP) utilizes current census data to determine the Town's existing affordable housing and its future affordable housing needs. The HPP shows that the Town as of the date of the plan currently has 220 units listed on the Subsidized

Housing Inventory. The Town needs 609 additional affordable housing units to meet the 10% minimum affordable housing component required by the Commonwealth. The plan illustrates several goals in order to achieve the required additional affordable housing in the Town.

The goals listed in the Housing Production Plan are as follows:

- Support incremental production of affordable housing until at least 10% of total year round housing units are affordable to households with incomes less than or equal to 80% of the area median income.

- Create new affordable housing downtown in multi-family and mixed use buildings.

- Create affordable housing in neighborhoods surrounding downtown – the "Bridgewater Village" – comparable with the scale, density, and design of these traditional neighborhoods.

- Promote a balance of residents across all age groups by creating affordable housing to attract young professionals and families.

- Create both rental and homeownership units affordable to low-income households

- Create affordable housing through adaptive reuse of existing buildings, including historic buildings, and redevelopment of previously developed properties.

- Strengthen the Town's capacity to support creation of affordable housing and preserve existing affordable units through both local and regional resources.

In late 2014, the Town worked with the Cecil Group and Nelson\Nygaard to develop Bridgewater Downtown Community Development Master Plan. This plan focuses on redevelopment and revitalization of the business district/downtown area.

The regional planning agency for Bridgewater is the Old Colony Planning Commission (OCPC). In August, 2013, the Old Colony Planning Council (OCPC) developed a South Coast Rail Community Priority Area (SCRCPA) plan for the Town of Bridgewater. The plan allowed for residents and the Town to determine which locations, within the town, should be deemed priority development areas based on elements of access, currently developed land, and the availability of municipal services in those locations. Along with selecting lands for development, Bridgewater also chose areas that should be preserved and protected based on their natural character and/or wildlife habitat. In that plan, residents expressed their support for two Priority Development Areas and five Priority Protection Areas. The two Priority Development Areas that were selected were the Interchange of 24 and 104 and the Downtown.

According to the plan, the following is a brief description of the two PDA's selected by the Town:

- The Route 24 and Route 104 Interchange PDA area is the Town's primary access to limited access highways including Routes 24 and Interstate 495. This area is supported by town water and town sewer and the western portion of the PDA is designated as an expedited permitting and priority development site by the state and the town.

- The Downtown PDA includes Bridgewater's traditional town center, where town offices, shops, banking and some older grandfathered residential uses exist. The downtown also includes Bridgewater State University; and Waterford Village (a state approved 40R zoning district). In addition, this PDA includes the Bridgewater Old Colony Commuter Rail Station and a mix of commercial and industrial properties.

1.3.2 Bridgewater State University Planning

In 2006-2007, Sasaki worked with the Commonwealth's Division of Capital and Asset Management (DCAM) to develop a Master Plan for Bridgewater State University (BSU). BSU spent the next several years working to achieve many of the goals listed in that 2006-2007 plan. In June, 2012, an update to the 2006-2007 Master Plan was developed.

A more detailed summary of the proposed components of the 2012 Master Plan Update is included in Appendix A, Bridgewater State University Information. The overall updated plan goals are as follows:

- Reinforce pedestrian connections between destinations
- Improve the interface between the campus and the community
- Provide spaces that enhance interaction between faculty, staff and students
- Move parking out of the center of campus
- Examine opportunities to capture swing space for renovation of aging facilities

A space needs assessment was included in the update. The faculty and administration members perceived the greatest space desire to be for additional classroom and office space, as well as student life space for resident and commuter students. Many campus stakeholders also mentioned the desire for additional space to accommodate conferences and community events.

In an effort to fully coordinate the Town's comprehensive wastewater planning with the ongoing development of BSU, the Town sent a letter to BSU documenting projections from the 2012 BSU Master Plan Update that were being incorporated to estimate future flow contributions. BSU sent a response letter, which suggested revision of the incorporated projections and requested a meeting to discuss the information. A meeting with BSU representatives was held on January 21, 2016 and existing sewer flow estimations and future flow projections were discussed. Discussions at the meeting resulted in a reduction in the future sewer flow projections for BSU due to a more limited planned student population increase and a less extensive space increase over the planning period. These revised projections are incorporated into the later Sections of the CWMP where applicable. Correspondence on this topic is also included in Appendix A, Bridgewater State University Information.

1.3.3 Massachusetts Correctional Institute (MCI) Bridgewater Planning

Bridgewater Correctional Complex, also known as MCI Bridgewater, is an institution owned and operated by the Commonwealth's Department of Corrections. The Bridgewater Correctional Complex consists of the Old Colony Correctional Center, Bridgewater State Hospital, the Massachusetts Alcohol and Substance Abuse Center and the Treatment Center. The Department of Corrections owns a total of 480 acres in the Town of Bridgewater, of which approximately 100 acres of that land is developed and in use. The remaining acreage is currently undeveloped and will be undeveloped in perpetuity as per Arcticle 97. The Old Colony Correctional Center covers approximately thirty acres of land within the complex and contains 10 cell blocks, seven consisting of sixty cells each, while the remaining three contain thirty cells each. This is a total of 510 cells, some of which have double occupancy because of a daily head count consistently above suggested capacity.

The institution has its own water supply connection to the City of Taunton and the facility operates their own sewer collection and treatment system, which runs at approximately 50% of its design capacity. Because the institution has its own system with capacity for future expansion, if desired, no future water resource impacts on the Town are anticipated from this facility.

1.3.4 Wastewater Planning

A Sewage Needs Analysis (SNA) was developed for the Town of Bridgewater and submitted to the Board of Water & Sewer Commissioners in 2000 by Dufresne-Henry, Inc. The needs analysis was initiated by collecting information from the Bridgewater Board of Health and Assessors' Office files. GIS data was also used in the analysis and limited field investigations were performed to confirm some information. The data collected was used to evaluate wastewater management needs considering lot sizes, soil types, groundwater limitations, wetland/floodplain proximity, history of failed on-site systems and protection of groundwater supplies. At that time, the Bridgewater Sewer Department also sent out wastewater surveys to residents that were not as yet sewered to further assess the desire and/or need for sewer extensions.

Of the 30 areas evaluated, 23 areas of wastewater need (9 of which were critical needs areas) were identified through this SNA analysis. Options for a solution included allowing variances to the conventional Title 5 system; communal wastewater treatment and disposal, local wastewater treatment and disposal; or wastewater collection, treatment and disposal. Map 1, Sewer System & Sewerage Needs Areas, December 2000 by Dufresne-Henry, Inc. (attached) was extracted from the SNA/EIR and depicts the wastewater needs areas and the recommended solutions.

A performance assessment of the Bridgewater WWTP was also conducted as part of the SNA. Findings of the WWTP performance assessment included:

- The WWTP consistently produces a high quality effluent.
- The facility is effectively treating the existing wastewater and septage loads with no problem.
- There is reserve capacity to treat additional flows and loads without compromising effluent quality and discharge permit limits.

Supplemental information was submitted in March 2001 as an Environmental Impact Report (EIR), EOEA No. 12085 for the SNA (which when combined with previous planning efforts constituted a Comprehensive Wastewater Management Plan, CWMP, of sorts). This was done so the town could proceed with the initial phases of the proposed multi-phase sewer extension project(s). Additional information included in this report contained updates from the previous analyses, information on growth management, information on water conservation and public comment responses. The current CWMP process will update the work done under the 2000 SNA and provide a similar roadmap for the next 20 years.

1.3.5 Water Planning

A water asset study (WAS) was conducted for the Town of Bridgewater through the Executive Office of Environmental Affairs (EOEA) in 2004. The goals of the study were to identify existing and future water supplies in order to provide planning that would afford protection of public water supplies.

The WAS reported that Bridgewater’s 5-year average daily demand was 1.73 million gallons per day (mgd), with a peak year average daily demand of 1.84 mgd. Bridgewater’s Water Management Act (WMA) permit regulates the annual withdrawal volume at 2.23 mgd. The WAS reported that Bridgewater’s build-out water demand, based on EOEA growth projections that include MCI Bridgewater (which has its own water supply source, i.e. the City of Taunton), was 5.62 mgd- a demand far exceeding current capacity. The Town believed EOEA’s growth projections to be overstated and had OCPC prepare a revised build-out analysis, which is not reflected in the high water demand projection.

Mapping conducted in conjunction with the WAS identified potential ‘water supply protection areas’ (WSPA). Approximately 17% (3,067 acres) of Bridgewater’s land area is a WSPA, which is broken down as follows:

- Approximately 47% of the WSPA area is currently developed.
- Approximately 26% of the WSPA area is potentially developable based on existing town zoning, and the majority of the potentially developable WSPA is zoned residential.
- Approximately 27% of the WSPA was classified as “protected or otherwise constrained.”

2.0 ASSESSMENT OF EXISTING CONDITIONS

A general overview of relevant background information including the project planning area, the organizational structure of Bridgewater and prior planning efforts was provided in Section 1. Section 2 of this Comprehensive Wastewater Management Plan provides more detail related to current demographics and land uses in the Town and on the Town's existing infrastructure.

2.1 Existing Conditions in the Planning Area

As discussed in Section 1, the Town of Bridgewater totals just over 27 square miles in size and is home to a mix of residential, commercial and industrial development along with Bridgewater State University (BSU) and a Massachusetts Correctional Institute (MCI) Facility.

2.1.1 Demographics

According to the 2010 census, the Town of Bridgewater has a population of 26,562. Bridgewater State University comprises approximately 272 acres of land area with a current population of almost 12,000 full-time and part-time undergraduate and graduate students. Similarly, MCI Bridgewater comprises approximately 100 acres of land housing a correctional facility, a hospital, a substance abuse center, and a treatment center.

In 2010, Bridgewater State College became Bridgewater State University. Not only did the name of the college change, but the number of students attending the college changed as well. There has been a substantial increase in the number of students enrolled in the University, as well as the number of students living on campus. The student population increased roughly 27% between 2000-2010 from about 8,800 total students to 11,200. Most recently, in 2013, overall enrollment increased to 11,267 students, with 3,180 resident students and 8,087 commuter students. As the University increased its student population, it also increased its population of students living on campus. The growth in resident students is attributed to construction of two new residence halls on the campus. (Source: Bridgewater State University Office of Institutional Research, October 2013.) Because of the similar increase in commuter students, Bridgewater has seen an increase in its college-age population throughout Town. According to the US Census, in 2000 there were 3,706 people between the ages of 18 and 24 living in Bridgewater, in 2010, there were 4,842. That is a 31% increase in the population of 18 to 24 year old persons over the 10 year period.

Bridgewater Correctional Complex, also known as MCI Bridgewater, is an institution owned and operated by the Commonwealth's Department of Corrections. The Bridgewater Correctional Complex consists of the Old Colony Correctional Center, Bridgewater State Hospital, the Massachusetts Alcohol and Substance Abuse Center and the Treatment Center. The Department of Corrections owns a total of 480 acres in the Town of Bridgewater, of which approximately 100 acres of that land is developed and in use. The remaining acreage is currently undeveloped and will be undeveloped in perpetuity as per Article 97. The Old Colony Correctional Center covers approximately thirty acres of land within the complex and contains 10 cell blocks, seven consisting of sixty cells each, while the remaining three contain thirty cells each. This is a total of 510 cells, some of which have double bunking because of a daily count consistently above suggested capacity.

2.1.2 Land Use & Current Development

The Town of Bridgewater's 27 square miles and is approximately 30% developed with various land uses. Table 2-1: Bridgewater 2005 Land Use Distribution, below, was developed from land use information from MassGIS and shows Bridgewater's 2005 land distribution by category.

Table 2-1: Bridgewater 2005 Land Use Distribution*

Land Use Category	2005 Use (acres)
Industrial	169
Junkyard	36
Low Density Residential	2196
Marina	1
Medium Density Residential	884
Mining	97
Multi-Family Residential	406
Non-Forested Wetland	960
Nursery	16
Open Land	513
Orchard	15
Participation Recreation	139
Pasture	327
Powerline/Utility	176
Transitional	141
Transportation	162
Urban Public/Institutional	354
Very Low Density Residential	229
Waste Disposal	21
Water	735
Water-Based Recreation	2
Total	**18,150**

*Information obtained from MassGIS

Figure 2-1: Existing Zoning (attached) depicts those areas where different land uses are targeted. In general, much of Bridgewater is zoned for residential use with business, industrial and mixed use being concentrated in central Bridgewater and along Route 104 near the Route 24 interchange corridor.

2.1.3 Existing Residential Development

As of the 2010 U.S. Census, there were 8,336 housing units in Bridgewater, an increase of 9% since 2000. Bridgewater's housing stock has grown steadily over the past 60 years, although growth has slowed in the past decade as seen by the decrease in residential building permits issued from a decade high of 91 in 2001 to a low of 20 in 2011 (US Census Bureau).

According to the draft 2014 Master Plan, building permit data provided by the Bridgewater Building and Planning Departments showed 68% of all residential permits for new construction issued between 2008 and 2012 were for single-family homes. In 2012 alone, 79% (22 units) of all residential permits issued for new construction were for single-family homes, 21% (6 units) for duplex units, and no permits were issued for units in multifamily buildings.

A comparison of housing types from the Town Assessors Department, as recorded in the Town's 2014 Draft Master Plan, shows that the Town's housing stock remains primarily single-family at just under 66% of total units. Based on Assessor's data from January 2012, condominiums make up about 12% of all units, two-families about 8.6%, and three-families 2.3%. Almost 3% of units are in 4-8 unit multifamily buildings and about 7.7% are in buildings with over eight units. These multi-family units include both rental and ownership units. The majority of the units in multifamily buildings with over eight units are located at Waterford Village (588 of 610 units).

According to the US Census, Bridgewater's vacant units increased from 2% of total units (126 vacant units) in 2000 to 4% of total units (341 vacant units) in 2010.

Furthermore, according to the US Census, the number of owner-occupied units has increased while rental units decreased since 2000. In the last decade, owner-occupied units, as a percent of total occupied housing units, saw an increase of 1.7% (increasing from 74.6% in 2000 to 76.3% in 2010, while rental occupied units saw a decrease of 1.8% (decreasing from 25.4% in 2000 to 23.6% in 2010). The vacancy rate could change in the future as the number of students looking for off campus housing grows assuming there is a continued increase in enrollment at Bridgewater State University.

2.1.4 Existing Commercial/Industrial Development

Figure 2-2: Existing Commercial/Industrial Land Use better defines the areas where businesses and industries exist in town. Much of Bridgewater's commercial development is concentrated in the Downtown area around Central Square and along the major routes that connect the town center to the Interstate 495 corridor in adjacent communities. Typical commercial development in these areas focuses on servicing the residential and university population. The Scotland Industrial Park area, off of Pleasant Street and the Elm Street Industrial area, near and parallel to Route 24, is where the majority of the town's industrial development has occurred.

2.1.5 Existing Zoning

Bridgewater's zoning requires a minimum lots size of 1 acre in the Residential A/B District and in the Planned Development (PD) District. The Residential C and D Districts require a minimum lot size of 18,500 square feet and the Central Business District (CBD) requires a minimum lots size of 10,000 square feet. Two-family and duplex units are permitted in the Residential C and D Districts by-right, while they are permitted only by special permit in the CBD. Multi-family housing is prohibited in all districts except for the Waterford Village Chapter 40R Smart Growth Overlay District. The Mobile Home Elderly Community District allows the highest densities in the Town at a minimum lot size of 7,000 square feet, with the exception of the 40R District.

The downtown is zoned CBD, while the Residential D District covers the largely sewered area around the downtown, with the Residential C District just outside of that area. Many of the undeveloped portions of the Town are in the Residential A/B Zoning District, which requires the lowest density. The PD District covers the area south of Lake Nippenicket.

2.1.6 Existing Water Resource Protection Measures

In addition to the delineation of Zone I and II discussed later in this report, a number of measures are in place to protect Bridgewater's water sources. As discussed below, they include regular sanitary surveys, an Aquifer protection District, protection of local wetlands and protection of the designated floodplains along surface water bodies.

2.1.7 Source Water Assessment Program

The BWD system is evaluated by the State DEP on a regular basis. The last evaluation completed in 2013, included several recommendations, the only issue found with the supply or distribution system was a recommendation to replace A/C +water mains. Other recommendations involved increased sampling and the required credentials for the distribution system operator(s), both of which have been addressed by the BWD.

2.1.8 Aquifer Protection District

Bridgewater's Aquifer Protection District is mapped over the town's main aquifers and over land (Zones I, II and III) significantly recharging the aquifer. It also prohibits or tightly regulates uses potentially contaminating the aquifer and requires special permits for dams, paved areas or other uses affecting storm water management and recharge, and sets standards for storm water management systems.

The District is mapped extensively over the environmentally sensitive areas, particularly in the northeastern section of the town, the area around the southern portion of Carver Pond, and a north-south strip of land west of Routes18/28. In addition, East Bridgewater's comparable district covers a small area east of Stump Pond, and the Raynham district covers much of the area southwest of Lake Nippenicket to the Raynham line. These provisions provide much protection, but town ownership is the greatest protection.

2.1.9 Local Wetlands Protection Bylaw Article XXXIII

In addition to its Aquifer Protection Zoning bylaw, the town has a non-zoning local wetlands protection bylaw. Such bylaws can regulate current activities as well as proposed activities regulated by zoning, and can go further than the Wetlands Protection Act (Ch.131, S. 40). Thus the bylaw can prohibit alterations within 100 feet of a wetland while the Act requires filing a Notice Intent to work within 100 feet of a wetland but can only regulate work within the resource area or directly affecting it. In addition, the bylaw may include protection of resources and values (e.g. aesthetics, recreation, and agricultural values) not covered under the Act. Further, decisions under the bylaw can be appealed only to Superior Court, while decisions under the Act may be appealed to the Department of Environmental Protection.

2.1.10 Floodplain District

The Flood Plain (overlay) District is to prevent residential use of land that floods seasonally or periodically, to protect and maintain the water table, and to ensure proper function of water courses to provide "adequate and safe floodwater storage capacity."

The District covers areas mapped as Zone A, A1-30 on the FEMA Flood Insurance Rate Maps and Flood Boundary and Floodway Maps. The Board of Appeals may allow development in the mapped flood plain if it can be done safely without causing problems elsewhere (e.g. by taking up needed flood storage and endangering downstream uses, or conversely, blocking flow and causing flooding upstream).

2.1.11 Sub-Basin Water Balance

As part of developing this CWMP, Weston & Sampson estimated the net water balance by sub-basin within the Town of Bridgewater. The purpose of this evaluation is to understand how human and natural influences are affecting the long-term ability of sub-basin to provide public and environmental benefits. In the context of the CWMP, this analysis helps the community understand which basins may be better for development of a new well (neutral or gaining water basins) or implementing/promoting groundwater discharge (losing water basins).

We utilized GIS data including sub-basin boundaries, impervious cover, surficial geology, wetlands, and water distribution and wastewater collection mapping, combined with available information on water withdrawals and wastewater discharges (groundwater and surface water) to estimate the water withdrawals and the recharge to groundwater (septic, permitted, and natural) within each sub-basin.

Based on this analysis, seven of the sub-basins are approximately neutral, one is losing water, and one is gaining water. Figure 2-3: Sub-basin Water Balance shows the net water balance in each sub-basin.

2.2 Existing Wastewater Systems

The existing wastewater management systems in Bridgewater include both a centralized sewer collection, transmission and treatment system that services roughly a third of the developed properties in town and individual on-site septic systems for the remaining two-thirds of the developed properties.

The town does not have a significant asset management system for its wastewater system. Physical system asset information is limited, and while a CAD map of the sewer system exists, there is not a well-defined GIS database and system map available for the town system.

2.2.1 Existing Collection System

According to the 2014 Draft Master Plan Update, The Town of Bridgewater has 2,264 households serviced by the Town sewer system, which is approximately 28% of all households.
The sewered areas include the Downtown and surrounding neighborhoods as well as along Route 104, part of Route 18, and part of Plymouth Street as well as some private sewer systems including the High Pond Drive development off of Pond Street. Bridgewater State University also connects to the municipal sewer system.

The system is comprised of approximately 35 miles of gravity sewer ranging in size from 5-inch diameter to 15-inch diameter and approximately 15 miles of low pressure sewer mains ranging in size from 2-inch diameter to 6-inch diameter. The original network is approaching 100 years in age and is located primarily in the downtown area and surrounding neighborhoods. These segments of pipe were constructed of vitrified clay and asbestos cement, with newer lines being cast iron or PVC. The sewer system is separated from the drainage system, though some sections of underdrains in the downtown area do exist. Figure 2-4, Existing Wastewater Collection System (attached) depicts the components and extents of the centralized system. Appendix B contains the Town's collection system mapping for the existing system as of April, 2004.

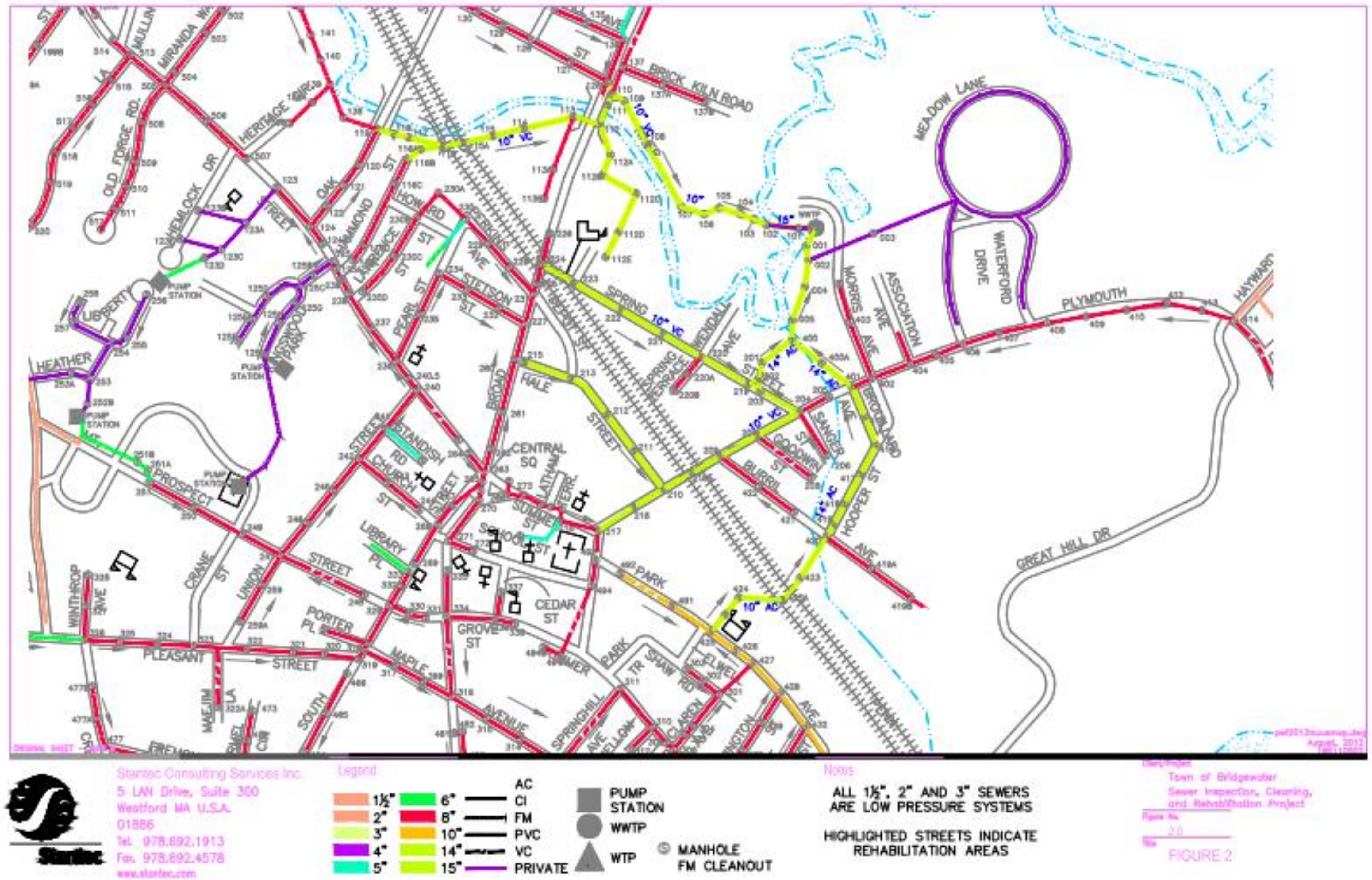
The existing collection system has experienced a handful of sanitary sewer overflow (SSO) events since 2004, which have all been reported as required. Of the five events since 2004, two have occurred on private property, one on Burrill Avenue, one at a manhole near the WWTF and one at a siphon. The events were not re-occurring and are not believed to indicate a permanent issue in the collection system.

MCI Bridgewater has its own sewer system and wastewater treatment facility, which currently operates at approximately 50% of its capacity. Because the facility has its own system, it does not contribute to the sewer flows or loading of the Town.

2.2.2 Infiltration & Inflow

As with any system of its age, the Bridgewater sewer collection system is subject to extraneous flows from infiltration and inflow (I/I). While I/I issues are not perceived to be excessive by the town, system review and rehabilitation efforts have been undertaken, and a program is currently underway to address system I/I. In 2013, the town authorized a bond for approximately $5 million in I/I investigation and system rehabilitation work. This work is currently ongoing, and is being designed by Stantec, Inc. The working plan for initial infiltration control includes a focus on system rehabilitation in areas where groundwater is high. Figure 2-5: Sewer System Infiltration Program Status shows the initial investigation and improvements status for the sewer system investigation and rehabilitation work.

Figure 2-5
Sewer System Infiltration Program Status

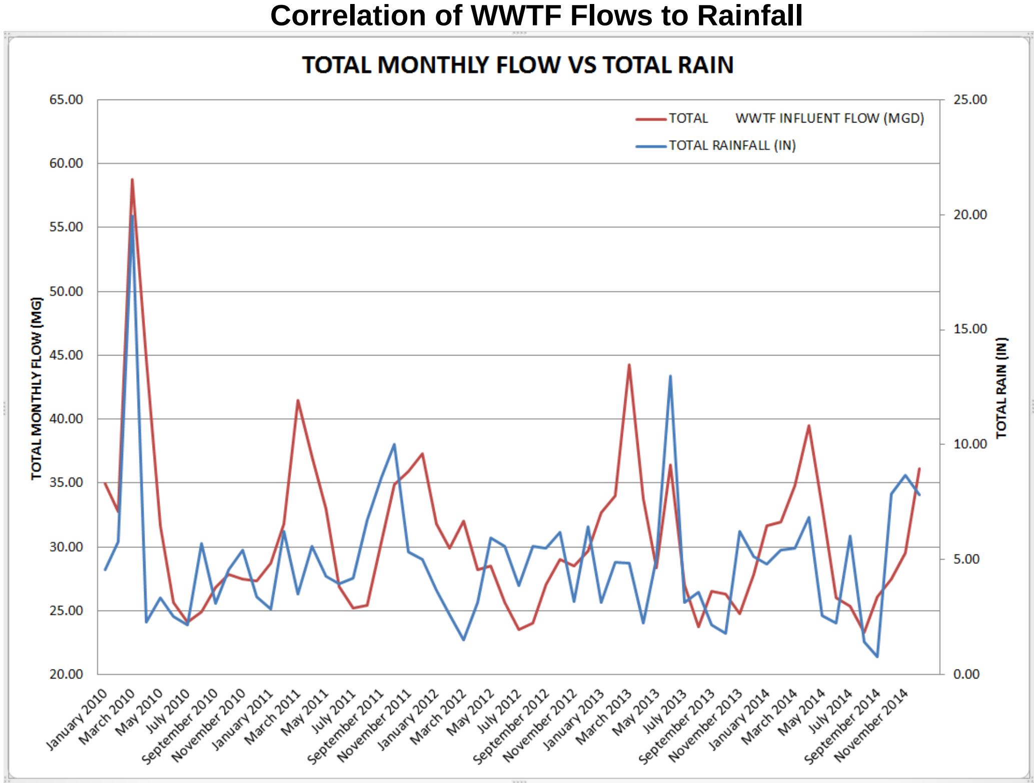


As part of the CWMP planning effort, Weston & Sampson prepared a limited desktop analysis of wastewater flow information relative to groundwater and rainfall conditions. The results, as expected, show correlation of higher wastewater flows with periods of high groundwater and rain events – as expected for systems with infiltration and inflow impacts. The results of this desktop analysis cannot be considered as reliable depictions of system flows and extraneous flow components but can be considered markers for areas worthy of investigation. These numbers also help to provide a general understanding of the nature of system flows.

The desktop analysis suggested that system flows over the analyzed period (generally 2010 through 2014) may include up to approximately 620,000 gpd of infiltration, and up to approximately 88,000 gpd of inflow (both of these numbers represent maximum monthly flow impacts, depicted as daily flow rates). The definition between infiltration and inflow is limited in systems like Bridgewater's due to the likely prevalence of private inflow sources – notably sump pumps. These extraneous flow quantities correlate to months with high groundwater and rainfall, and therefore relate to higher monthly flows – they are not relevant for consideration as fractions of average daily flows, nor to depict peak flow impacts from infiltration and inflow. Figure 2-6: Correlation of WWTF Flows to Rainfall and Figure 2-7: Correlation of Flow to Groundwater show the correlation of monthly WWTF flows with rainfall and groundwater, respectively. The spikes in monthly flows more often than not correlate with wet weather events.

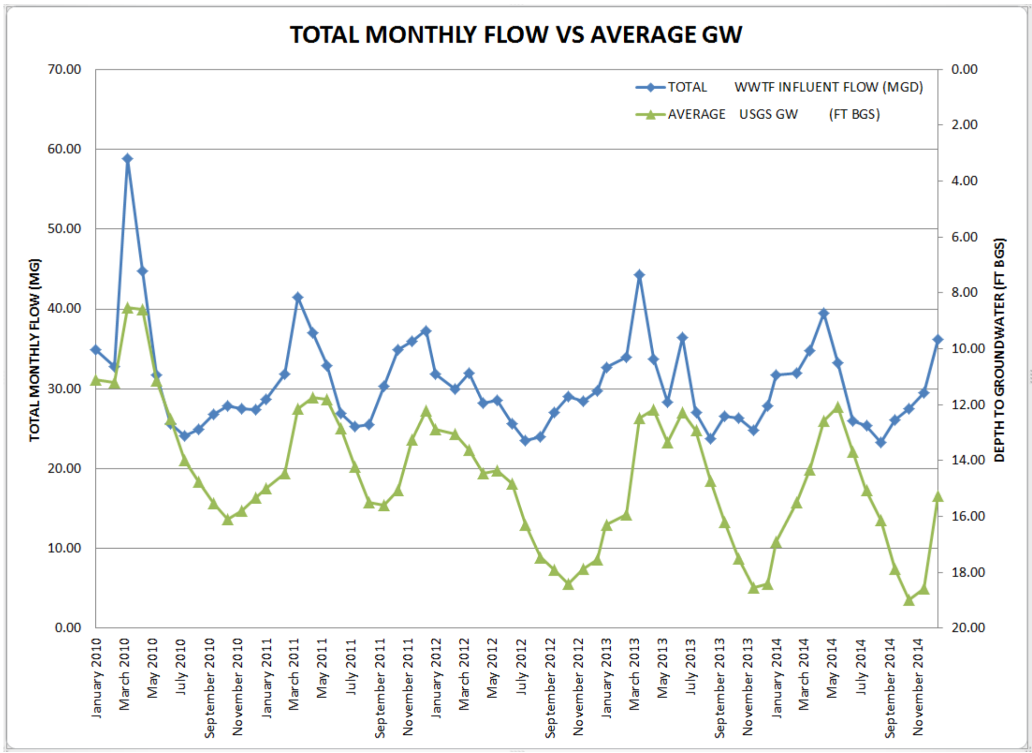
From a cursory review of individual rainfall events over the five years of flow data reviewed, even when groundwater levels are low, rainfall as low as 2 to 3 inches can result in plant flow increases of 0.3 to 0.5 million gallons in the day of (or day after) the storm event, more indicative of inflow than infiltration.

Figure 2-6
Correlation of WWTF Flows to Rainfall



From a review of existing flow contributions from residential, commercial, and institutional sewer users and the fairly consistent daily minimum flows over the five years of recorded flow data, it was concluded that there is a base line of approximately 50,000 gpd of infiltration in the Town's sewer system, regardless of wet weather or seasonal groundwater elevation fluctuations.

Figure 2-7
Correlation of Flows to Groundwater



A composite of these figures, along with further information from this desktop I/I review is included in Appendix D: Desktop Inflow & Infiltration Information.

2.2.3 Existing On-Site Septic Systems

The remaining 5,731 households (72%) are serviced by individual septic systems. Currently, none of the private wastewater treatment systems in operation require a groundwater discharge permit. Most of the on-site systems in Bridgewater are typical septic systems with a separate septic tank and subsurface leaching system. The leaching systems are trenches and fields, with many of the post 1980 systems constructed with concrete galleys, or flow diffusers. Newer systems have also utilized plastic infiltrator chambers. Some of the oldest systems prior to the 1950's are simple cesspools or have been modified to add overflow trenches to regain leaching potential. In these cases the existing cesspools, even if antiquated, provide some solids settling and decomposition although not sized appropriately. Many systems constructed in the 1960's and most in the 1970's utilized a 1,000 gallon septic tank and a leaching filed to infiltration leachate.

As of 2013, approximately sixty-five percent (755) of the on-site systems in Bridgewater had been built after 1995, when the state environmental code underwent its major revision. The remaining thirty-five percent of on-site systems were built sometime before that revision and therefore may not comply fully with current requirements.

The revisions to Title 5 in 1995 also required that sufficient land area be provided for each residential home site in nitrogen sensitive areas to ensure that the nitrogen loading was not excessive. The regulations require that a minimum of 10,000 square feet of land be provided for each bedroom within designated aquifer protection area. This requires new house lots with four bedroom designs to have a minimum lot size of 40,000 square feet or almost an acre. While this restriction has limited the expandability of some homes, those undersized properties in existence before 1995 are exempt from the limitations but cannot expand beyond the current number of bedrooms. Existing lots that do not have the land area to support the bedrooms can also install septic systems with advanced denitrification or place a development restriction on other land within the same aquifer district to alternatively meet the one bedroom per 10,000 square foot limit. These restrictions are recorded in the Plymouth County Registry of Deeds and benefit the property for perpetuity.

There currently are several Nitrogen Loading Restriction parcels in the Town of Bridgewater. The Bridgewater Zoning Regulations allow for several residential zones with different lot sizes. Residential A (one acre) which now includes areas once listed as Residential B (half acre). This zone (Residential A/B) now requires a full acre of land area, therefore, a four bedroom home is possible in nitrogen sensitive areas located within the Residential A/B zone. Many half acre house lots created when the Residential B zone was in effect are exempt from compliance with nitrogen loading regulations. The other residential zones (Residential C and D) allow for construction of single family houses on 18,500 square feet of land and duplexes on 30,000 square feet. In areas such as High Street, the Aquifer Protection District restricts construction to the zoning minimum unless a denitrification system or nitrogen credit is provided to meet the nitrogen loading limitation.

Further analysis of this compliance question was completed for the Needs Assessment, which is discussed in upcoming sections of this CWMP.

2.2.4 Existing Sewer Pump Stations

The Bridgewater Sewer Department operates eight (8) existing town-owned and operated pump stations that transmit the centralized wastewater from the sewered areas of town to the Wastewater Treatment Facility. These pump stations vary in design and age with the oldest station installed circa 1988. As the centralized system has expanded and development in more distant areas of town has occurred, the Sewer Department has incurred the responsibility for some stations that were constructed by private developers. There are also seven (7) privately owned and operated pump stations in the Town. Table 2-2 lists the existing wastewater pump stations.

Table 2-2
Existing Wastewater Pump Stations

Existing Wastewater Pump Stations	
Town-Owned	**Private**
Water Street Pump Station[1]	Lakeside Pump Station (private)
High Pond Estates Pump Station[1]	Bedford Street Pump Station (private)
Wally Kruger Pump Station[1]	Kingswood Park Pump Station (private)
Harvest Lane Pump Station[1]	Hemlock Drive Pump Station (private)
Dartmouth Road/College Park Pump Station[1]	Mt. Prospect Pump Station (private)

Route 104 Pleasant Street Pump Station[1]	Heather Lane Pump Station (private)
Elm Street Pump Station	Fireworks Circle Pump Station (private)
Elm St/Claremont Pump Station	

[1] Based on available information, these six of the existing wastewater pump stations were last evaluated in 2004 to document components of the stations and determine the estimated replacement value for property insurance purposes.

As part of this CWMP effort, the Town-owned pump stations were visited to document the current visual conditions. A description of each station with field observations is included in the full CWMP.

[Sections 2.2.4.1 – 2.2.4.6 not included in this excerpt for brevity. These sections detail the operations at current pump stations in Bridgewater.]

2.2.5 Existing Wastewater Treatment Facility

Existing Wastewater Treatment Facility

The Town of Bridgewater owns and operates a Wastewater Treatment Facility (WWTF) located on Morris Avenue in Bridgewater. This facility was most recently upgraded in 1987 and has an average daily flow (ADF) design capacity of 1.44 MGD of municipal wastewater. The WWTF is also designed to accept and treat up to 20,000 GPD of septage from Bridgewater. The WWTF is designed to provide secondary biological treatment with nitrification through attached growth process, and includes the following unit processes:

- Septage Receiving and Storage;
- Headworks with Preliminary Treatment, including Sewage Grinding and Grit Removal;
- Primary Settling;
- Secondary Treatment by Rotating Biological Contactors (RBCs);
- Secondary Clarification;
- Effluent Disinfection; and
- Sludge Storage, Dewatering, and Composting.

Wastewater influent enters the headworks, passes throw a comminutor (sewage grinder) to an aerated grit chamber. Flow is then split and enters two primary clarifiers to remove suspended solids and scum. Here, ferric chloride is added for phosphorus precipitation. The primary clarifier effluent is pumped to a series of 14 RBCs, arranged in three stages, to remove BOD and ammonia. Following this biological process, wastewater flows by gravity to the two secondary clarifiers for separation of biological solids from effluent. Finally, effluent passes through the chlorine contact chamber where chlorine gas is used for disinfection, followed by dechlorination with sulfur dioxide. Treated effluent is discharged via a 20-inch diameter outfall pipe to the Town River which runs along the western side of the WWTF site. The above figure shows an aerial view of the WWTF site.

Sludge (primary and secondary) produced in the treatment process is stored in the sludge storage tank and blended before it is dewatered on two belt filter presses (BFP). Filtrate from the dewatering process is returned to the biological treatment process, and dewatered biosolids are composted using the aerated static pile method. The final compost product is a high quality, Type 1 biosolid suitable for reuse and land application.

A series of excerpted drawings from the WWTF upgrade project, showing the locations of these processes, and a process flow diagram for the facility are included in Appendix C: Existing System Maps by Dufresne- Henry April, 2004.

2.2.6 NPDES Permit Limits

The Town of Bridgewater is authorized to discharge treated wastewater from the WWTF to the Town River under a National Pollutant Discharge Elimination System (NPDES) permit. The CWMP planning process was completed while the plant operated under an existing permit that was issued by EPA on December 30, 2003. This existing permit is included in Appendix E: Existing (2016) and Old NPDES Permit for WWTF (2003). This permit regulates flow, BOD_5, TSS, pH, Dissolved Oxygen, Settleable Solids, Fecal Coliform, Total Residual Chlorine, Total Phosphorus, Total Copper, three forms of nitrogen, and acute and chronic toxicity. Table 2-3: Original (2003) NPDES Permit Limits presents a summary of the monitoring requirements included in the former permit for the facility.

Table 2-3
Original (2003) Existing NPDES Permit Limits

Effluent Characteristic	**Discharge Limitation**			**Measurement Requirement**
	Average Monthly	**Average Weekly**	**Maximum Daily**	
Flow (MGD)	1.44		Report	Continuous Recorder
BOD_5 (mg/L) (lbs/day)	20 240	30 360	Report	2x/week, 24 hour composite
TSS (mg/L0 (lbs/day)	20 240	30 360	Report	2x/week, 24 hour composite
pH (S.U.)	6.0-8.3			1/Day, Grab
Dissolved Oxygen (mg/L)	>= 5.0			1/Day, Grab
Settleable Solids (ml/L)	0.1	0.1	0.3	1/Day, Grab
Total Copper (ug/L	11		15	1/Month, 24 hour composite
Whole Effluent Toxicity	Acute LC50 ≥ 100% Chronic C-NOEC ≥ 45%			4/year, 24 hour composite
Only from April 1 – October 31:				
Fecal Coliform (cfu/100)	200	400	400	2x/week, Grab
Total Residual Chlorine (ug/L)	24		42	1/day, Grab
Total Phosphorus (mg/L) (lbs/day)	1.0 12.0			1x/week, 24 hour composite
Ammonia Nitrogen (mg/L)	3.0 36.0			1x/week, 24 hour composite

Effluent Characteristic	Discharge Limitation			Measurement Requirement
	Average Monthly	**Average Weekly**	**Maximum Daily**	
(lbs/day)				
Total Kjeldahl Nitrogen (mg/L) (lbs/day)	Report		Report	2/x Month, 24 hour composite
NO_2/NO_3 (Nitrite/Nitrate) (mg/L) (lbs/day)	Report		Report	2x/Month, 24 hour composite
Only from November 1 – March 31:				
The permit requires monthly reporting only in the winter season for Total Phosphorus, Ammonia Nitrogen, Total Kjeldahl Nitrogen, and Nitrite/Nitrate.				

The existing permit also includes requirements to operate and maintain the collection system, including reducing infiltration and inflow, and statutory conditions for sludge quality.

2.2.6.1 WWTF Permit Limit Compliance

After reviewing the monthly DMR data for the years of 2010-2012, it was determined that there were only a few occasions where the discharge limits were exceeded. The reported exceedances are as follows:

- March 2010, BOD_5 exceeded the permissible limit of 20 mg/L by 1 mg/L
- April 2010, Ammonia Nitrogen exceeded the permissible limit of 3.0 mg/L by 3.2 mg/L
- December 2010, Copper exceeded the permissible limit of 35 ug/L by 8 ug/L
- December 2011, Copper exceeded the permissible limit of 35 ug/L by 3 ug/L

2.2.6.2 Newly Issued NPDES Permit for the WWTF

A preliminary draft NPDES permit was provided to the town for discussion during a site visit in 2013, and a new draft NPDES permit was issued to the facility in May of 2015. The new draft permit included significant changes – principally related to nitrogen and phosphorus limits, and these new requirements are discussed further in Section 4 of this report.

Following issuance of the draft of this CWMP to the Town, the EPA issued a new final permit for the WWTF, dated September 30, 2016. Table 2-4: New (2016) Existing NPDES Permit Limits, presents a summary of the monitoring requirements included in the newly issued permit for the facility. A copy of this new permit is also included in Appendix E: Existing (2016) and Old NPDES Permit for WWTF (2003).

Table 2-4
New (2016) Existing NPDES Permit Limits

Effluent Characteristic	Discharge Limitation			Measurement Requirement
	Average Monthly	Average Weekly	Maximum Daily	
Flow (MGD)	1.44		Report	Continuous Recorder
BOD_5 (mg/L) (lbs/day)	20 240	30 360	Report	2x/week, 24 hour composite
TSS (mg/L0 (lbs/day)	20 240	30 360	Report	2x/week, 24 hour composite
pH Range (S.U.)	6.5-8.3			1/Day, Grab
Total Residual Chlorine (ug/L)	24		42	1/day, Grab
Total Copper (ug/L)	35		46	1/Month, 24 hour composite
Whole Effluent Toxicity	Acute LC50 ≥ 100% Chronic C-NOEC ≥ 45%			4/year, 24 hour composite
Only from April 1 – October 31:				
Dissolved Oxygen (mg/L)	Not less than 6.0			1/Day, Grab
Escherichia Coli (cfu/100)	126		409	2x/week, Grab
Total Phosphorus (ug/L)	200		Report (mg/l)	1x/week, 24 hour composite
Ammonia Nitrogen (mg/L) (lbs/day)	3.0 36.0			3x/week, 24 hour composite
Total Nitrogen (mg/L) (lbs/day)	Report 60		Report	2/x week, 24 hour composite
NO_2/NO_3 (Nitrite/Nitrate) (mg/L) (lbs/day)	Report		Report	2x/week, 24 hour composite
Only from November 1 – March 31:				
The permit requires monthly reporting only in the winter season for Total Phosphorus, Ammonia Nitrogen, Total Kjeldahl Nitrogen, and Nitrite/Nitrate.				

Following issuance of the new NPDES permit in the fall of 2016, the Town of Bridgewater engaged in a formal appeal of the permit. The appeal process is ongoing.

[Sections 2.2.7 – 2.4 not included in this excerpt for brevity. These sections detail the existing conditions for the WWTF process areas, existing water system, and stormwater management practices.]

ATTACHMENT C

Excerpts from Bridgewater CWMP;
Section 5: Alternatives;
Section 6: Recommended Plan

5.0 ALTERNATIVES

This section of the CWMP discusses alternatives for addressing the various water resources management areas of need identified in Section 4 of the report. The discussion of alternatives is divided into several key areas for organization purposes.

5.1 Wastewater Management Alternatives

Building on prior planning studies, the needs analysis presented a general picture of which areas in the Town of Bridgewater may have challenges relying on on-site septic systems for wastewater disposal. There are several available alternatives for wastewater management that may be evaluated to minimize these potential challenges. Each alternative falls into one of two major categories – on-site solutions, and off-site solutions.

5.1.1 On-Site Wastewater Solutions

On-site systems include individual septic systems that treat and dispose of wastewater on the same parcel on which the wastewater is generated. These systems often consist of a septic tank to separate solids and a leaching field to treat the wastewater and re-distribute the discharge back to the ground. Some on-site systems require additional treatment components (for example, innovative/ alternative systems) or special construction (for example, mounded systems), which are discussed later in this Section.

Conventional Title 5 systems are not designed to achieve a high level of treatment of biochemical oxygen demand (BOD), total nitrogen removal or phosphorus removal. Title 5 septic tanks do not remove a high level of nutrients from the wastewater before it enters the soil absorption system. Properly designed, installed, and maintained systems still discharge pollutants into the groundwater. Unsaturated soils in a soil absorption system are effective at removing bacteria, viruses, and most nutrients (with the exception of some forms of nitrogen and high levels of phosphorus). Systems with saturated soils, an inadequate separation between the soil absorption system and the groundwater, rapidly percolating soils, an inadequately designed soil absorption system, or other limitations will contribute even higher levels of pollutants to the groundwater. Therefore, it is sometimes desirable, particularly in sensitive areas, to achieve a higher level of treatment than a conventional Title 5 system can provide.

Current Title 5 regulations allow for the use of innovative/alternative (I/A) technologies under the provisions of Sections 15.280 – 15.289 of the Code. Alternative systems provide substitutes or alternatives for one or more of the components of a conventional system while providing equal or greater environmental and health protection. The revised Title 5 regulations specifically identify the requirements for approval of I/A technologies, and classify the level of approval as remedial, piloting, provisional, and general. These alternatives are being used throughout the state for upgrades of systems on sites that cannot accommodate a conventional system. A list of approved I/A system technologies is maintained on the Massachusetts DEP web site.

5.1.2 Off-Site Wastewater Solutions

Off-site systems collect wastewater from a community or neighborhood and treat and dispose of the wastewater on a parcel separate from the wastewater generation point(s). Examples of off-site system solutions include:

a) Localized sewer systems (cluster) with a shared Title 5 treatment system;
b) Localized sewer systems (cluster) with a neighborhood treatment system;
c) Centralized sewer systems with a large-scale wastewater treatment plant (such as the

Bridgewater WWTF).

These off-site options are each generally described as follows.

5.1.2.1 Shared Title 5 Systems

Groups of homes or businesses that discharge a total of 10,000 gallons per day (gpd) or less of wastewater (on a maximum daily flow basis) can utilize Title 5 requirements to design their wastewater treatment and disposal site. This off-site alternative is the most similar to conventional on-site 'septic' systems. Typically, shared Title 5 systems are large on-site systems located on a vacant parcel or a vacant portion of a larger developed parcel in a neighborhood where individual lots have challenges in siting on-site systems. In most instances, shared systems are made up of a large septic tank and a larger leaching field. On occasion, however, in environmentally sensitive areas, these systems require additional components/equipment (I/A technology, as discussed in Section 5.1.1) to provide an increased level of treatment. These systems generally serve a collection area of less than thirty, average-size (3-bedroom) homes, and can be as small as just a few homes sharing a system on the property of one or several homeowners.

Shared Title 5 systems require special approval from DEP, as well as legal agreements and documentation regarding ownership, maintenance, and other issues. Shared systems must be pumped at least once per year. A conventional shared system for a particular area would include a localized collection system, a large septic tank, a dosing (pump) chamber, and a large soil absorption system. For design flows over 5,000 gpd, leaching trenches are the only type of soil absorption system allowed by DEP. Assuming the use of leaching trenches, the footprint for a 10,000 gpd soil absorption system could be approximately 1 acre or more, including sufficient reserve area. Availability of suitable land is therefore often a limiting factor in the application of shared systems. A second major factor is the administrative and legal constraints of having several property owners share the systems costs.

5.1.2.2 Small Decentralized Cluster or Neighborhood Treatment Systems (NTS)

This type of off-site system collects wastewater from a localized area that is larger than that allowed for a Title 5 system (i.e., will generate a flow greater than 10,000 gpd), and requires construction of a small, neighborhood treatment and groundwater disposal system. This type of off-site system is relatively new compared to centralized sewer systems but offers the benefit of groundwater recharge with higher quality effluent than individual on-site systems. Groundwater recharge is a term used for putting water back into the same general area from which it was taken, in order to replenish the groundwater.

A neighborhood treatment system generally includes below ground tankage and small-scale wastewater treatment components/equipment, which are often enclosed in a small above ground structure. Groundwater disposal systems are similar to leaching fields used in on-site systems, but they generally have a larger footprint designed to process greater flows of high-quality effluent. Groundwater discharges require a DEP permit to discharge the effluent to the ground. Siting a system can be challenging based on the need for a suitable discharge site.

This wastewater management alternative could generally be considered for areas in Bridgewater where groundwater recharge would be beneficial to:

- replenish base flow to area surface waters (lakes, ponds, brooks, streams or rivers);
- recharge the groundwater supply in drinking water aquifers; and
- maintain the water balance in sub-watershed basins.

The difficultly in analyzing and recommending this wastewater management alternative is public acceptance. Due mainly to the negative connotation associated with wastewater and the idea of having a 'treatment plant' in a neighborhood, there is often great resistance on the part of local residents to allow a municipality to locate a NTS. A good deal of public education on this wastewater management alternative would need to be conducted to prevent consideration of an alternative concept to which local residents are opposed.

Even after a potential site has passed the public acceptance test, the site must be technically analyzed to confirm that soils are appropriate to adequately filter the NTS effluent, that groundwater is deep enough to not cause a surcharge or excess mounding effect, and that sensitive receptors (like drinking water supplies, surface waters, wetlands, etc.) are not negatively impacted.

5.1.2.3 Centralized Sewer and Large-scale Wastewater Treatment Plant

The Town of Bridgewater has a limited system of sewers that collects wastewater flow from residences, businesses and institutions and transports this flow to a municipal wastewater treatment facility (WWTF) located off Morris Avenue. The sewer system currently receives flow predominantly from the Town Center area as well as from various developed portions of the town lying east and west of the town center. Flow is treated at the WWTF and discharged to the Town River, which flows to the Taunton River.

Since the Town has a centralized sewer system, extension of new sewer pipelines to serve needs areas and return flow to the WWTF is an appropriate alternative. Analysis of this alternative, however, required confirmation that both the existing sewer system and the existing WWTF have available capacity, and these issues are further discussed later in this section.

5.1.3 Evaluation of Wastewater Management Alternatives

Following up on information presented in the Needs Analysis, the applicability of on-site and off-site solutions for wastewater management to various areas of Bridgewater defines the best alternative for each area. In general, most of the un-sewered areas in Bridgewater were developed using on-site (Title 5) systems, and as such can be supported by such on-site solutions. The best solution for areas which can continue to be supported by on-site systems is obviously to maintain those systems, and to repair and reconstruct those systems, where and when necessary.

The cost to maintain a functional septic (Title 5) system for a single-family home is generally low, consisting primarily of the cost to monitor and periodically pump the septic tank. The costs for these systems are more challenging when the need arises to repair the system, to significantly upgrade, or replace the entire system. The capital costs for septic system replacement vary widely as these costs are a function of many factors. For single family homes, some repairs are reported to be possible for as low as several thousand dollars, and replacement costs as high as $100,000 have been reported. However, septic system replacement costs are likely to generally vary from $10,000 to $40,000 for a typical single-family home. Due to the variation in costs for system replacement, the financial comparison of on-site and off-site solutions for properties is subjective and site-specific.

Areas where significant needs for off-site solutions have been demonstrated are less suitable for long-term reliance on on-site systems. As such these areas need to be evaluated for the best possible off-site solution. Recognizing that there is remaining capacity in the town's WWTF, the primary focus for Bridgewater is to evaluate possible extension of sewers to these unsewered needs areas. Possible sewer extension solutions for identified needs areas, as well as possible sewering technologies, are presented in the following discussions.

5.2 Sewer Collection System Technology Alternatives

The collection portion of a centralized system can be developed using a variety of technologies for conveyance of the wastewater to the centralized treatment and disposal site. These technologies generally may include:

- Conventional gravity sewers, with pump stations and force mains,
- Individual grinder pumps and low-pressure sewers,
- Innovative and alternative (I/A) technologies such as septic tank effluent pump (STEP) systems, vacuum sewer systems, and small diameter variable slope (SDVS) gravity sewer systems,
- Some combination of these technologies (a hybrid system).

The existing wastewater collection system for the Town of Bridgewater is primarily a conventional system, consisting of conventional gravity sewer lines and pump stations, but also includes some limited low-pressure sewer lines serving some areas. Since more innovative and alternative (I/A) technologies have not been employed in Bridgewater's municipal system in the past, and since they do not lend themselves well to the proposed sewer extension areas, they may be less appropriate for future projects. We have, however, provided a limited discussion on these technologies for completeness.

5.2.1 Conventional Gravity Sewers with Pump Stations

A conventional gravity sewer system consists of sewer lines that allow residential, commercial, and industrial customers to discharge into a sanitary system consisting of gravity pipes, which flow downhill, and are not pressurized. Gravity sewer systems operate by collecting the wastewater via continuously sloped pipe, typically 8-inch minimum diameter, and transport the wastewater to the WWTF or to localized low points in the collection system. The design of a gravity sewer system is dependent on the velocity of the wastewater within the pipes. Minimum velocities of approximately 2 feet per second (fps) are recommended to assure that suspended matter does not settle out in the conduit. The industry standard minimum slope to achieve this velocity in an 8-inch pipe flowing full or half full is 0.0040. Maintaining this velocity is particularly challenging in end run pipes, where only a few homes contribute flow to the line. It is recommended that steeper slopes be employed in these areas. Maximum velocities (typically 8 to 10 fps) are set to prevent excessive scouring of the pipe, which can lead to structural failure of the system.

Extremely flat or hilly terrain poses a problem to gravity sewer installations since the gravity sewers must continually slope downward. This results in the sewer becoming increasingly deep or the need for a wastewater pumping station. Pump stations are located at low points to collect and pump the wastewater to the WWTF or to the nearest high point in the collection system, where the process of gravity flow continues. Pump stations may also be required where wastewater must be transported between drainage basins. Wastewater is pumped from the pump stations to the centralized treatment and disposal site (or to the closest gravity manhole that flows to the centralized treatment and disposal site) via a pressurized pipe called a force main. A discussion of pump station configuration alternatives is included later in this section of the report.

Conventional sewer systems are typically limited by topography and the higher cost that develops from installing pipelines in deep excavations. Higher costs for these systems can also result when multiple pump stations are needed to serve limited numbers of properties.

5.2.2 Low Pressure Sewers

Low-pressure sewer systems have proven to be a viable alternative where implementation of gravity sewer systems is impractical and/or uneconomical due to topography or other constraints. A low-pressure sewer system includes small diameter pressure sewers fed by individual grinder pumps at each source of flow. A pressure sewer system makes use of small diameter piping, buried at a relatively shallow depth (typically five feet deep) following the profile of the ground. The pressure main and service pipe are generally manufactured from polyvinyl chloride (PVC) or high-density polyethylene (HDPE). The pressure sewer mains and laterals are buried below the historical depth of frost penetration and should be located to avoid conflicts with other utilities.

The pressure sewer system is separated into branches of sewers of different sizes depending on the number of connections to each branch. Standard manholes are not required in a pressure sewer system. Instead, flushing connections/drain manholes are installed at the end of branches and where major changes in directions or size of pipe occur. Air relief/vacuum valve manholes are installed at high points in the system to allow trapped air to be removed from the pipes.

In a low-pressure sewer system, each customer will utilize an individual grinder pump for discharge of sewerage into the main. Each grinder pump unit is equipped with a grinder pump, check valve, tank, and necessary controls. The units can be located outdoors close to each customer's existing septic tank or cesspool so that the connection to the existing service pipe exiting the building can be made easily. The units can also be located inside the building if permissible under local plumbing codes. The grinder pump macerates the solids present in the wastewater to a slurry, in the manner of a kitchen sink garbage grinder, and discharges wastewater to the pressure sewer collection pipes. Apartment buildings, motels, and restaurants require larger pump units – often duplex pump systems are used for these properties. If a pump malfunction occurs, a high liquid alarm is activated. This alarm may be a light mounted on the outside of the building or an audible alarm that can be silenced by the customer or may include telemetry for remote response. The customer will then notify an approved technician or contractor to come and make necessary repairs.

A low-pressure sewer system collects and transports the wastewater from each customer located in low points to the nearest gravity sewer. Within the right-of-way, air relief manholes with air and vacuum valves would be installed at all high points and terminal flushing drain manholes would be installed at all low points. In addition, cleanouts would be installed approximately every 1,000 feet to provide access for periodic maintenance.

Low pressure sewers are limited by the ability of the individual pumps to overcome higher system pressures – this can result from very large pressure system networks. In the case of large service areas, a conventional pump station may be added to help transmit flows to a remote connection or treatment plant. Shallower excavations and smaller pipes make low pressure systems economical to install, though many property owners have concerns with the maintenance required for the individual pumps.

In communities like Bridgewater, where the costs for those portions of low-pressure sewer system's located on private property are borne entirely by the property owner, a low-pressure sewer system may be more publicly acceptable, given the lower municipal investment as compared to a conventional sewer system.

5.2.3 Hybrid Collection System (Conventional/Low Pressure)

A hybrid system is a combination of conventional wastewater collection system components and low pressure sewers (with individual grinder pumps). These combined systems are designed to maximize the use of gravity sewers and utilize grinder pumps and lower pressure sewers where the topography, subsurface conditions (ledge, groundwater, coastal areas, etc.), property spacing, or environmental or economic considerations warrant their use.

As discussed, the existing wastewater collection system in Bridgewater is primarily a conventional system, but the presence of low pressure components make the town's system a hybrid system. This approach offers balanced benefits of both system configurations and is appropriate to consider for most municipal service areas.

5.2.4 Septic Tank Effluent Pumping (STEP) System

Septic tank effluent pumping (STEP) systems are similar in overall construction, operation, and maintenance to grinder pumps and pressure sewers with the exception that solids and grease are removed from the wastewater at each residence or commercial/industrial establishment utilizing a conventional septic tank prior to pumping. This system employs a combination of on-site/off-site system technologies. Preliminary treatment takes place on each individual property and secondary treatment takes place at a centralized (or decentralized) facility.

STEP systems require the installation of watertight septic tanks at each home to remove solids and grease followed by an effluent pump that conveys the wastewater to a low pressure sewer system. A screen is typically installed between the septic tank and the effluent pump to prevent solids from entering the piping system. The STEP pressure sewer system requires the same integral components as the grinder pump pressure sewer system. Since a majority of the solids are removed in the septic tank, velocities of only 0.5 fps are required in the pipelines. Therefore, slightly longer mainline pressure sewers may be utilized as compared to grinder pump pressure sewers. Wastewater delivered to the treatment system from a STEP system typically has 30% lower biochemical oxygen demand (BOD) and can therefore be easier to treat. The STEP effluent wastewater tends to have a high ammonia (and therefore nitrogen) content. Unfortunately, this causes the septic wastewater to have a higher potential for generating odors and can cause corrosion in downstream collection system structures.

STEP systems require periodic pump outs to remove accumulated solids (septage) and grease from the septic tank to protect the effluent pumps. The septage is typically removed at an interval of approximately three to five years depending on system usage and must be conveyed for disposal to an approved facility. This interval is usually the same or more frequent as recommended for an on-site wastewater disposal system, to prevent clogging of the town's low pressure mains in the public way.

Due to the anaerobic nature of the effluent, STEP systems are not typically utilized where a conventional treatment facility is proposed to provide treatment. Also for this reason, STEP systems may tend to experience more odor nuisance problems.

5.2.5 Small Diameter Variable Slope Sewers

Small diameter gravity sewers - sometimes called small diameter variable slope (SDVS) gravity sewers, work on the same principle as conventional gravity sewers. That is, the wastewater is conveyed through the sewer pipeline by gravity. The small diameter gravity sewer does not, however, conform to a continuous downward sloping grade, instead generally following the ground contours with both upward and downward sloping sections. Actual flow in the small diameter gravity sewer therefore varies between pressurized conduit flow and open channel (gravity pipe) flow. The small diameter gravity sewer discharges into either a conventional gravity interceptor or a pump station.

Like STEP systems, the small diameter gravity sewer systems utilize a septic tank at each individual home to collect and retain solids, which could clog the small sewer lines. A screen is often place on the effluent (discharge) end of the septic tank to prevent the entrance of solids. The main design requirement for these systems is that each individual home septic tank discharge be located at an elevation sufficiently above the sewer outlet to induce gravity flow in the sewer line (i.e. above the hydraulic grade line for the sewer). For this reason, SDVS are dependent on the terrain in the area, although somewhat less so than conventional gravity sewers.

Small diameter gravity sewer systems have the pipeline cost advantages of pressure, STEP or vacuum sewer systems (i.e. small pipe, shallow installation depth and narrow trench widths). They have the additional advantage, however, of not requiring pumping for conveyance of the wastewater. Therefore, small diameter gravity sewer systems are less costly to construct, operate and maintain. Unfortunately, due to topography of the service area, small diameter gravity sewer systems are often not feasible where pressure, STEP and vacuum sewer systems would be. Also, in many areas where small diameter gravity sewers are feasible, conventional gravity sewers are also feasible, and are usually recommended.

5.2.6 Vacuum Sewer System

Similar to pressure sewers, vacuum sewers use small diameter sewer mains to collect wastewater from individual homes. The vacuum pipeline, however, is not continuously filled with wastewater as with pressure sewers. A central vacuum sewer collection station equipped with vacuum pumps provides a constant negative pressure (gauge) in the mains. Sufficient suction is generated to carry wastewater from individual building connection inlets through the vacuum main to the collection station. The collection station is typically equipped with conventional sewage pumps to transmit the collected wastewater to a nearby interceptor sewer or WWTF.

Building connections in a vacuum sewer system consist of a valve chamber, with a pneumatically controlled valve, which allows wastewater to enter the vacuum main as it accumulates in the valve chamber. A single valve chamber and service connection may be used to serve up to four individual homes. The service connection pipeline from the valve chamber to the main is typically 3 inches in diameter. Vacuum sewer mains vary from 4 inches to 8 or more inches in diameter. Mains are installed generally following ground surface contours, but allowable elevation changes are more limited than with pressure sewers.

The major advantage of vacuum sewers is the elimination of individual pumping systems for each home connected. The vacuum valve chamber requires no electrical connection and is less costly to install and maintain than a grinder or STEP pump unit. Since the sewer main is continuously evacuated of all wastewater, the possibility of wastewater leaking out of the pipeline is eliminated. The opportunity for groundwater infiltration into a vacuum sewer is greater than with a pressure sewer. Resulting loss of vacuum pressure in the main is monitored continuously, however, and leaks are quickly detectable. Vacuum sewers are less susceptible to grease accumulation since floatable wastes such as grease are accepted into the vacuum collection system as easily as the liquid wastes.

Vacuum sewers have been used in all climates, but recent installations in New England have experienced operational challenges in extreme cold winter periods, making the application of this technology challenging in areas like Bridgewater.

5.2.7 Sewer Installation Alternatives

The construction of conventional and alternative sewer systems typically requires significant excavation, which contributes to the significant costs of developing a system. Alternative methods of pipeline installation have been developed and should be considered for new system installation. These alternative systems increasingly include 'no-dig' (e.g. trenchless) and limited dig technologies. A few of the notable technologies that should be considered are discussed in this section, including pipe jacking, microtunneling, pipe ramming, and horizontal directional drilling.

Pipe Jacking

Pipe jacking is a trenchless method of installing a carrier pipe or casing by pushing it through the ground while excavating and removing the soil as the line advances. It is a sophisticated, non-disruptive, one-pass method of pipe installation for larger diameter pipelines.

The major advantages of the pipe jacking technology are as follows:

- Larger diameter pipe can be installed
- Accurate line and grade can be achieved
- No significant cost increase for greater pipe depths
- Excavation can be controlled
- In areas with soil and/or groundwater contamination, materials handling and disposal costs are minimized

The major disadvantages of the pipe jacking technology are as follows:

- Man entry into the jacking pit and into the pipe is required
- Boulders larger than pipe diameter pose a significant hindrance to the use of this technology
- Dewatering issues can be difficult
- Minimum recommended pipe diameter of 36 inches is required to allow for man entry
- Not always suitable in areas of solid bedrock
- Excavation of jacking and receiving pits is required

Microtunneling

Micro-tunneling is generally defined as remotely controlled pipe jacking that does not require personnel entry into the pipe. It is an accurate, laser-guided method for installing pipelines in varied soil conditions (i.e., from soft ground to hard rock). The installation of sewers and pipelines by microtunneling as a commercial alternative to open cut construction is fast becoming an accepted form of construction. It was first used in the United States in the early 1980's.

The major advantages of the microtunneling technology are as follows:

- Dewatering requirements are limited
- Extremely accurate line and grade can be achieved
- Operation is fully remote controlled, reducing the risk of accidents
- Wide range of pipe material (e.g., fiberglass, reinforced concrete, steel, polyvinyl chloride) and diameter options can be implemented

The major disadvantages of the microtunneling technology are as follows:

- Machines are expensive, therefore driving overall project costs up
- Contractors lack experience in this technology, especially in varying ground conditions
- Method is not cost-effective for smaller diameter installations

Pipe Ramming

Commonly used to cross roads, railways, and embankments, pipe ramming is a non-steerable method of forming a bore by driving a steel casing from a drive pit to an exit pit using a pneumatically operated percussion hammer. For smaller diameters the casing may be closed, but in larger sizes an open-ended casing is used. Upon completion of the bore, spoil is removed from the open ended casing using compressed air and water.

The major advantages of the pipe ramming technology are as follows:

- Set up is simplified resulting in reduced mobilization costs
- The bore pit is relatively small in size
- Provides ability to bore through cobbles and small boulders
- High groundwater table is easily dealt with
- Workers are not required to remain in the excavation during the operation

The major disadvantages of the pipe ramming technology are as follows:

- It is a non-steerable method
- It is only useful for shorter installations (i.e., maximum achievable length is 165 feet, with a diameter range of 8 to 36 inches)
- Intermittent stations are required for longer installations
- Unsuitable in areas of solid bedrock
- It is not recommended where line and grade are critical

Horizontal Directional Drilling (HDD)

Horizontal Directional Drilling (HDD) is a steerable method for the installation of pipelines. This trenchless technology method is performed by drilling a pilot hole, reaming the pilot hole to a larger diameter, and pulling back the product pipe. This technology was originally developed by the oil industry for river crossings of small diameter where a high degree of accuracy was not required. These systems are now widely used for installing underground pressure pipes where open excavations are not advisable.

The major advantages of the HDD technology are as follows:

- All of the equipment is on the surface
- No dewatering is required
- Long lengths can be achieved without requiring intermediate pits or stations
- Provides a powerful, steerable system
- Installations can be performed through a wide variety of geologic formations
- Allows for installation of a large range of pipe diameters
- Provides a predictable, short construction schedule
- Costs are typically lower than for other viable methods

The major disadvantages of the HDD technology are as follows:

- Utility crossings must be exposed where depths cannot be accurately determined using a non-destructive utility locator
- Costs and time of construction can vary significantly, depending upon size and length of pipe and soil conditions
- Not recommended if line and grade are critical (i.e., in the case of gravity sewers)
- Magnetic interference can affect the bearing sensors of the steering tool

Application of Alternative Technologies

Each of the technologies discussed has applicability for certain areas of new pipeline installation. The preliminary design of sewer extension projects in town should consider the use of alternative installation technologies to limit project impacts and control sewer extension costs.

5.3 Sewer Extension Alternative Analysis

Figure 5-1: Locus Map (attached) depicts the identified sewer needs areas from Section 4 and the approximate extents of the existing sewer system. Identified areas of need for an off-site wastewater solution were evaluated for the ability to connect, and best methodology for extending sewer to the existing Bridgewater sewer system. This analysis was conducted by reviewing the topography of the needs areas to determine the best technology for sewering – gravity sewers, low pressure sewers, and hybrid solutions. Where gravity sewer was appropriate, the plan identifies preliminary locations for pump stations at area low spots and provides for force mains to transmit proposed flow to the existing sewer system. The connection points are assumed to be at the nearest existing sewer system point possible.

5.3.1 Lakeside Drive Area

This subarea includes properties on Lakeside Drive, Lakewood Lane, Paddock Road, Bridle Road, Horseshoe Lane, and Saddle Drive. This subarea is fairly extensive with varied topography, lying on the east side of Lake Nippenicket. Therefore, sewering the area would require the use of gravity sewers, low pressure sewers with individual grinder pumps, force main, and a pump station. This area consists primarily of residential properties and includes 72 developed parcels and 9 vacant parcels.

The varied topography divides this area into two sections, lower-lying parcels that can be serviced by gravity sewer, and the more variable grade upland parcels that can be served with low pressure sewer. The proposed low pressure area begins at the northern most part of Lakeside Drive, extending halfway between Lakewood Lane and Saddle Drive. The low pressure sewer would be connected to proposed gravity sewer, which then would flow to a pump station located near the intersection of Lakeside Drive and Saddle Drive. The pump station would be connected via a new force main to the existing sewer force main on Pleasant Street, at the intersection of Pleasant and Lakeside. The lower section of this needs area will be serviced by gravity sewer that connects directly to the proposed pump station. Figure 5-2: Proposed Sewer Connection Layout for Lakeside Drive Area and Goodwater Way Area (attached) depicts the proposed sewer connection layout and the Table 5-1: Lakeside Drive Area Sewer Connection Summary, below, presents a summary of the approximate sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-1
Lakeside Drive Area Sewer Connection Summary

Component	Approx. Qty	Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	5,500 lf	$325	$1,787,500	59
Low Pressure Sewer	2,100 lf	$150	$315,000	22
Force Main	2,200 lf	$140	$308,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	**$2,910,500**	**81**

The sewer construction cost per lot served, based on the proposed layout, would be approximately

$36,000 per property for this area. Replacement of existing septic systems in this area is likely to be moderately difficult for many properties based on soil conditions and variable topography.

Considering the possible cost of septic system replacements, this unit cost suggests that sewering could be cost effective in comparison to keeping the area served by septic systems and would provide a higher degree of environmental protection to Lake Nippenicket.

5.3.2 Goodwater Way/ Pleasant Street Area

This subarea is nearly adjacent to the Lakeside Drive Area and includes properties on Goodwater Way, Lakeview Park Lane, and Sunset Lane. This area consists primarily of residential properties and includes 21 developed parcels and 7 vacant parcels. The proposed layout consists entirely of low pressure sewer, connecting to the existing Lakeside Pump Station on Lakeshore Center Street. Figure 5-2: Proposed Sewer Connection Layout for Lakeside Drive Area and Goodwater Way Area (attached) also depicts the proposed sewer connection layout for this area. Table 5-2: Goodwater Way/ Pleasant Street Area Sewer Connection Summary, below, presents a summary of the approximate sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-2
Goodwater Way/ Pleasant Street Area Sewer Connection Summary

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	0	$325	0	N/A
Low Pressure Sewer	1,500 lf	$150	$225,000	28
Force Main	0	$140	0	N/A
Pump Station	0	$500,000	0	N/A
		Total	**$225,000**	**28**

The cost per lot served, based on the proposed layout, would be approximately $8,000 per property. Replacement of existing septic systems in this area is likely to be moderately difficult for many properties based on small lots, soil conditions and variable topography.

Considering the possible cost of septic system replacements, this unit cost suggests that sewering would be cost effective in comparison to keeping the area served by septic systems and would provide a higher degree of environmental protection to Lake Nippenicket.

5.3.3 Dundee Drive/ Aberdeen Lane Area

This subarea includes properties on Dundee Drive, Aberdeen Lane, Glenmore Ln, Vernon Street, Robin Road, and Red Wing Drive. This subarea has varied topography and, therefore, requires the use of gravity sewers, low pressure sewers with individual grinder pumps, force main, and a pump station. This area consists primarily of residential properties and includes 57 developed parcels and 7 vacant parcels.

The proposed layout consists of low pressure sewer on the circle of Dundee Drive and the portion of Red Wing Drive depicted in the needs area. The remaining streets are proposed to be serviced by gravity sewer connecting to a pump station on a parcel at the southernmost part of Vernon Street within the needs area. Figure 5-3: Proposed Sewer Connection Layout for Dundee Drive/Aberdeen

Lane Area (attached) depicts the proposed sewer connection layout and Table 5-3: Dundee Drive/Aberdeen Lane Area Sewer Connection Summary, below, presents a summary of the sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-3 Dundee Drive/ Aberdeen Lane Area Sewer Connection Summary				
Component	**Approx. Qty**	**Approx. Unit Cost**	**Approx. Component Cost**	**Properties Served**
Gravity Sewer	4,400 lf	$325	$1,430,000	39
Low Pressure Sewer	1,800 lf	$150	$270,000	25
Force Main	5,600 lf	$140	$784,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	**$2,984,000**	**64**

The cost per lot served, based on the proposed layout, would be approximately $47,000 per property. Replacement of existing septic systems in this area is likely to be moderate to severely difficult for many properties based on soil conditions and high groundwater conditions.

Considering the possible cost of septic system replacements, this unit cost suggests that sewering could, but would likely not be cost effective in comparison to keeping the area served by septic systems and would provide a higher degree of environmental protection to adjacent wetland areas.

5.3.4 Norlen Park Area

This subarea includes properties on Norlen Park, Vernon Street, Pleasant Street, Hunters Drive, and Route 104. This area consists primarily of residential properties and includes 57 developed parcels and 6 vacant parcels. The proposed layout consists entirely of low pressure sewer, connecting to the existing force main from the Pleasant Street Pump Station. Figure 5-4: Proposed Sewer Connection Layout for Norlen Park Area (attached) depicts the proposed sewer connection layout and Table 5-4: Norlen Park Area Sewer Connection Summary, below, presents a summary of the sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-4 Norlen Park Area Sewer Connection Summary				
Component	**Approx. Qty**	**Approx. Unit Cost**	**Approx. Component Cost**	**Properties Served**
Gravity Sewer	0 lf	$325	$0	0
Low Pressure Sewer	5,700 lf	$150	$855,000	63
Force Main	0 lf	$140	$0	N/A
Pump Station	0	$500,000	$0	N/A
		Total	**$855,000**	**63**

The cost per lot served, based on the proposed layout, would be approximately $14,000 per property. Replacement of existing septic systems in this area is likely to be moderately difficult for many properties based on soil conditions.

Considering the possible cost of septic system replacements, this unit cost suggests that sewering could be cost effective in comparison to keeping the area served by septic systems and would provide a higher degree of environmental protection to adjacent wetland areas.

5.3.5 Bayberry Circle/ Ashtead Road Area

This subarea includes properties on Bayberry Circle, Ashtead Road, Bayberry Circle, Forest Street, and Cross Street. This area consists primarily of residential properties and includes 87 developed parcels and 22 vacant parcels. The proposed layout consists entirely of gravity sewer, connecting a proposed pump station on Cross Street. The pump station is connected by force main to an existing sewer at the intersection of Stephanie and South Street. Figure 5-5: Proposed Sewer Connection Layout for Bayberry Circle/Ashtead Road Area (attached) depicts the proposed sewer connection layout and Table 5-5: Bayberry Circle/Ashtead Road Area Sewer Connection Summary, below, presents a summary of the sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-5
Bayberry Circle/Ashtead Road Area Sewer Connection Summary

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	10,600 lf	$325	$3,445,000	109
Low Pressure Sewer	0 lf	$150	$0	N/A
Force Main	10,200 lf	$140	$1,428,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	**$5,373,000**	**109**

The cost per lot served, based on the proposed layout, would be approximately $49,000 per property. Replacement of existing septic systems in this area is likely to be moderate to severely difficult for many properties based on soil conditions.

Considering the possible cost of septic system replacements, this unit cost suggests that sewering could be cost effective in comparison to keeping the area served by septic systems.

5.3.6 Atkinson Drive Area

This subarea includes properties on Atkinson Drive, Fiske Drive, Sunrise Drive, Bridgewater Avenue, and South Street. This area consists primarily of residential properties and includes 79 developed parcels and 17 vacant parcels. This subarea is varied topography and, therefore, requires the use of gravity sewers, low pressure sewers with individual grinder pumps, force mains, and pump stations.

Fiske Drive and Atkinson Drive are proposed to be primarily gravity sewer with the exception of a small portion of Atkinson Drive that extends from house #97 to house #101. Sunrise Drive, Bridgewater Avenue and South Street (within the project area) are entirely serviced by low pressure sewer. The low pressure sewer connects to the gravity line at the intersection of South Street and Fiske Drive. The gravity flow then feeds into a proposed pump station on the cul de sac on Atkinson Drive. The proposed pump station then pumps through force main to the existing sewer at the intersection of Stephanie and South Street. Figure 5-6: Proposed Sewer Connection Layout for Atkinson Road Area (attached) depicts the proposed sewer connection layout and Table 5-6: Atkinson Drive Area Sewer Connection Summary, below, presents a summary of the sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-6
Atkinson Drive Area Sewer Connection Summary

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Sewer
Gravity Sewer	3,700 lf	$325	$1,202,500	55
Low Pressure Sewer	4,000 lf	$150	$600,000	41
Force Main	14,000 lf	$140	$1,960,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	**$4,262,500**	**96**

The cost per lot served, based on the proposed layout, would be approximately $44,000 per property. Replacement of existing septic systems in this area is likely to be moderate to severely difficult for many properties based on soil conditions and portions with high groundwater.

Based on this area's distance from the existing sewer system, previous planning efforts have evaluated siting a small wastewater treatment plant in this area to treat wastewater from this neighborhood locally. This alternative has been met with opposition from area residents regarding the use of low pressure sewers and the siting of a possible wastewater treatment plant. Though the acceptance of using low pressure sewer may be more prevalent now, wastewater treatment plant is likely to remain an issue for area residents.

Considering the possible cost of septic system replacements and the likely resistance of residents to site a wastewater treatment plant, this unit cost suggests that sewering could, but would likely not be cost effective in comparison to keeping the area served by septic systems.

5.3.7 Whitman Street Area

This subarea includes properties on Whitman Street, Tukoosa Circle, and Darlene Drive. This area consists primarily of residential properties and includes 38 developed parcels and 3 vacant parcels. This subarea is varied topography and, therefore, requires the use of gravity sewers, low pressure sewers with individual grinder pumps, force mains, and a pump station.

Whitman Street is proposed to be entirely serviced by gravity sewer. Tukoosa Circle and Darlene Drive are both connected by low pressure sewer to the gravity sewer on Whitman Street. The gravity sewer would flow to a proposed pump station in front of house #220 Whitman Street and new force main would be connected on Plymouth Street to the existing sewer at the intersection of Hayward Street. Figure 5-7: Proposed Sewer Connection Layout for Whitman Street Area (attached) depicts the proposed sewer connection layout and Table 5-5: Whitman Street Area Sewer Connection Summary, below, presents a summary of the sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-5 Whitman Street Area Sewer Connection Summary				
Component	**Approx. Qty**	**Approx. Unit Cost**	**Approx. Component Cost**	**Properties Served**
Gravity	3,000 lf	$325	$975,000	22
Low Pressure	1,100 lf	$150	$165,000	19
Force Main	2,500 lf	$140	$350,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	**$2,000,000**	**41**

The cost per lot served, based on the proposed layout, would be approximately $48,000 per property.

Replacement of existing septic systems in this area is likely to be moderate to severely difficult for many properties based on soil conditions and portions with high groundwater.

Considering the possible cost of septic system replacements, this unit cost suggests that sewering could, but would likely not be cost effective in comparison to keeping the area served by septic systems.

5.3.8 Hayward Street Area

This subarea includes properties on Hayward Street, Yoke Road, and Arrowhead Drive. This area consists primarily of residential properties and includes 48 developed parcels and 1 vacant parcel. This subarea is varied topography and, therefore, requires the use of gravity sewers, low pressure sewers with individual grinder pumps, force mains, and a pump station.

Hayward Street is proposed to be entirely serviced by gravity sewer. Arrowhead Drive and Yoke Drive are both connected by low pressure sewer to the gravity sewer on Hayward Street. The gravity sewer flows to a proposed pump station in front of house #245 Hayward Street and is connected by force main on Plymouth Street to the existing sewer at the intersection of Hayward Street. Figure 5-6: Proposed Sewer Connection Layout for Hayward Street Area (attached) depicts the proposed sewer connection layout and Table 5-6: Hayward Street Area Sewer Connection Summary, below, presents a summary of the sewer system construction components needed to serve this area, along with a planning level construction cost.

Table 5-6 Hayward Street Area Sewer Connection Summary				
Component	**Approx. Qty**	**Approx. Unit Cost**	**Approx. Component Cost**	**Properties Served**
Gravity	2,100 lf	$325	$682,500	25
Low Pressure	2,000 lf	$150	$300,000	24
Force Main	730 lf	$140	$102,000	N/A

Pump Station	1	$500,000	$500,000	N/A
		Total	**$1,584,500**	**49**

The cost per lot served, based on the proposed layout, would be approximately $32,000 per property. Replacement of existing septic systems in this area is likely to be moderate to severely difficult for many properties based on some small lot sizes, soil conditions and portions with high groundwater.

Considering the possible cost of septic system replacements, this unit cost suggests that sewering could be cost effective in comparison to keeping the area served by septic systems and would provide a higher degree of environmental protection to Town River.

5.4 Wastewater Treatment and Disposal Alternatives

Wastewater generated in the Town of Bridgewater is treated by various means and may be treated and disposed of by one of the following methods:

- Treatment and disposal to surface water
- Treatment and disposal to groundwater
- Treatment and disposal to regional facility (out of town)
- Treatment and beneficial reuse

Each of these treatment and disposal options have applicability and logistic limitations, which are presented briefly in this section.

5.4.1 Treatment and Disposal to Surface Water

The existing Bridgewater WWTF treats wastewater and disposes of treated effluent to the Town River, a tributary of the Taunton River. The facility has a permit to discharge treated effluent under the National Pollutant Discharge Elimination System (NPDES) program administered by the U.S. EPA under Section 402 of the Clean Water Act. Discharges to surface waters are also regulated by Massachusetts DEP under the Surface Water Discharge Permit Program (314 CMR 3.00) and the Massachusetts Clean Water Act (MGL c. 21, s. 26-53). EPA is the lead agency in NPDES permitting using compliance with water quality standards set under the DEP state Surface Water Discharge Permit Program (314 CMR 3.00). The DEP cosigns the issued permit, and if it is determined that water quality standards will be met, a Section 401 Water Quality Certificate is issued.

The Surface Water Discharge and NPDES Permit Programs have been established to limit or prohibit discharges of pollutants to surface waters to assure that surface water quality standards of receiving waters are protected, maintained or attained. The anti-degradation provision of the Surface Water Quality Standards (314 CMR 4.04) requires that in all cases existing uses (as a minimum) shall be maintained and protected.

As discussed in Section 2 of this report, the Bridgewater WWTF has gone through the process of getting a new NPDES permit, and the discharge criteria represent a concern to the town because of the extreme level of treatment needed to meet the proposed permit conditions. The Bridgewater WWTF currently has capacity remaining under its average daily flow permit limit of 1.44 mgd, but this available capacity is limited.

Increases to the existing permitted discharge limit or permitting for a new point discharge to a surface water would be difficult. Permit limits for surface water discharges are becoming more stringent with each round of permitting. Also, because there is recognition of the finite water supply available, DEP encourages the focus on water balance within municipalities and more importantly within watershed basins. The majority of the town's water supply is derived from groundwater wells and therefore, replenishing the groundwater supply with treated effluent may be appropriate for new (or increases to existing) discharge permits. Despite these conditions, the town should continue to discuss options for limited increase in discharge capacity with EPA and DEP.

The State of Massachusetts also owns and operates a WWTF with a surface water discharge permit – this facility serves the Massachusetts Correctional Institute (MCI Bridgewater) located off of Conant Street. The MCI Bridgewater WWTF has a permit capacity of 0.55 mgd (average daily flow), and discharges to the Sawmill Brook, a small tributary to the Taunton River. The facility currently treats average flows ranging from 300,000 gpd to 450,000 gpd.

In general, treatment and effluent disposal to surface water is an appropriate alternative for flows that can be transmitted to and treated at the Bridgewater WWTF within the facility's remaining capacity. This solution is appropriate for defined needs areas, and to support wastewater needs for planned and desired town growth.

5.4.2 Treatment and Disposal to Groundwater

Groundwater disposal of treated wastewater is the most commonly applied solution in rural areas, where individual 'septic' systems treat waste before discharging to the ground via infiltration systems. These discharges are covered under the Massachusetts Title 5 program for individual systems. This fully decentralized wastewater treatment and disposal method has proven effective for much of the Town of Bridgewater and continues to be a preferred wastewater management method for individual parcels, where options are not required based on defined needs.

Groundwater disposal is becoming more common in Massachusetts for collected wastewater from communities and significant developments. The groundwater disposal option involves the discharge of highly treated effluent from a wastewater treatment facility into an infiltration bed or subsurface distribution system, designed to handle the design year flows. For purposes of this discussion, the location of the discharge may be considered independent of the location of the treatment facility since the treated effluent could be transmitted by pressure main to the infiltration system.

The requirements for groundwater discharge of wastewater are outlined in the state laws pertaining to the Groundwater Discharge Permit Program (314 CMR 5.00 and 6.00) – this program generally covers discharges of 10,000 gpd or more to the ground. The principal constituents of concern for groundwater discharges are pathogens and nitrogen. Traditionally, the need to remove nitrogen has been a disadvantage for groundwater discharge options, but recent changes requiring low levels of effluent nitrogen and phosphorus in surface discharges make groundwater disposal a more reasonable alternative.

Potential sites for use as a groundwater disposal site must be comprised of sandy or gravely soils that exhibit moderate infiltration rates. Sites, which contain poor soil permeability, high groundwater levels, and ledge inhibit the downward flow of water and are generally unacceptable. Soil properties can be improved by excavation and amending the soils in the discharge area or mounding the infiltration beds. Soils with slight or moderate limitations for wastewater disposal are considered acceptable for effluent beds. The groundwater discharge option is also restricted by discharge standards, which prohibit anti-degradation of the groundwater and therefore require a strict level of treatment prior to discharge.

In general, groundwater discharge may be an option for Bridgewater if additional capacity is needed at the WWTF and an increase in the NPDES surface water discharge permit cannot be obtained.

This option also remains viable for individual properties and smaller developments in town.

5.4.3 Regional Treatment and Disposal

Several communities in the Bridgewater area have their own wastewater systems – the largest in the region are the Brockton and Taunton systems, neither of which are direct abutters to Bridgewater. The Town of Raynham is a member community in the Taunton wastewater system, and a very small number of properties in Bridgewater are connected to this system along the Raynham border. In addition, the Town of Middleborough has its own wastewater collection and treatment system, but the Middleboro sewer system is remote from areas of development in Bridgewater.

Regional disposal options are limited in town, as there are no other large systems with infrastructure near the town's needs areas. In general, this option should be reserved for small properties located along the Raynham border, where other options are not feasible.

5.4.4 Treatment and Disposal via Beneficial Reuse

Historically, treated effluent is discharged either to a surface water body or to the ground with percolation through the soil to the groundwater. Another option is to reuse the wastewater for non-potable needs. The State of Massachusetts and some communities have adopted policies on wastewater reuse in an effort to conserve valuable water resources and provide a means for the disposal of treated effluent. One common approach to beneficial reuse is to recharge aquifers through groundwater discharge – this practice is considered indirect reuse.

Direct reuse of highly treated effluent is also permissible in certain areas and is seeing more common application. Typical methods of reuse include outside watering applications in landscaping and agriculture and inside recycling for use as toilet water. Commercial and industrial facilities in Massachusetts have demonstrated the effectiveness of these systems.

A properly developed wastewater reclamation program can provide valuable benefits to both the municipality and the water/wastewater system users. With proper treatment, reclaimed wastewater demonstrates minimal health risks, while providing the community with a solution to their wastewater disposal problem.

Unfortunately in New England, systems that rely primarily on landscape watering for effluent reuse must often be supplemented with a permanent disposal option (such as surface or groundwater disposal) for use in winter months.

Effluent reuse options tend to present themselves with larger facilities which are industrial and institutional in nature. In these cases, controls on the water quality and use can be better implemented. Based on the more stringent effluent quality currently being required in the Bridgewater WWTF discharge permit, the town should keep the option of possible effluent reuse open for future discussion.

5.5 Wastewater Treatment Facility Alternatives

The discussion of alternatives to address the defined needs at the Bridgewater WWTF is separated into two primary parts – the overall process alternatives, focused on meeting the future permit conditions, and some individual process area discussions, needed to address specific issues with facilities or unit operations. The magnitude of the overall process considerations takes precedence over the options for individual areas and systems, and as such overall process alternatives are presented first in this discussion.

5.5.1 WWTF Process Alternatives Screening

The evaluation of the Bridgewater WWTF has identified needs in a number of areas that must be addressed. The major considerations for the WWTF relate to:

1. Condition, modernization and efficiency,
2. Treatment capacity (flows and loads), and
3. Ability to meet future permit limits.

As discussed in the needs development section of this report, major and minor changes to the permit are expected. By far, the most significant change is the stricter effluent nutrient limits. The new draft NPDES permit conditions proposed by EPA include a lower limit on effluent total phosphorus (P) of 0.2 mg/l, as compared to the current seasonal phosphorus limit 1.0 mg/l. The new permit also includes a new limit on effluent total nitrogen (TN) of 60 pounds per day, which is based on a concentration of 5.0 mg/l of total nitrogen at the plant design flow of 1.44 mgd. This compares to the current permit, which provides no total nitrogen limit, but includes a seasonal ammonia limit of 3.0 mg/l. As currently designed, the facility is not capable of meeting these new lower effluent nutrient limits. The existing WWTF process currently typically achieves effluent TN levels between 25 and 30 mg/l, but only has the ability to nitrify and therefore effluent inorganic nitrogen levels are not controllable.

The facility currently meets the seasonal (summer) phosphorus limit consistently by feeding ferric chloride (FeCl). Significant capital improvements will be required to allow the facility to meet the new nutrient limits as proposed by EPA.

There are a number of different processes available that can, when properly applied, provide increased nitrogen and/or phosphorus removal at the Bridgewater WWTP. These include both physical/chemical and biological treatment methods each having their own advantages and disadvantages depending on various site constraints such as available space, compatibility with existing processes and ability to meet the specified permit limits. This section provides a brief description of the available processes, preliminary thoughts on their possible implementation approach, and a qualitative discussion of both general and site specific advantages and disadvantages.

5.5.1.1 Phosphorus Removal Technologies

Phosphorus removal technologies generally fall into two basic process categories: physical/ chemical and suspended growth biological phosphorus removal. There are several variations of physical/chemical removal, while enhanced biological phosphorus removal is generally limited to the anaerobic selector process. These processes are not mutually exclusive and the various options are discussed further below.

Chemically Enhanced Primary Treatment (CEPT) Process

CEPT is a somewhat generic term that refers to the use of one or more chemical additions to the wastewater stream prior to the primary clarifiers. The chemicals can serve several functions depending on the overall treatment goals. In the case of Bridgewater, this includes enhancing solids capture and precipitation of soluble phosphorus providing removal of both particulate as well as soluble phosphorus in the raw waste stream.

The two most commonly used chemicals for precipitation of soluble orthophosphate are iron salts (typically ferric chloride) and aluminum sulfate (Alum). These chemicals combine with soluble orthophosphate in the wastewater to create the insoluble metal-orthophosphate precipitate. They also, however, form other precipitates most notably the associated metal-hydroxide. The formation of this ancillary precipitate increases the dose of the chemical required beyond that for orthophosphate precipitation alone, which in turn increases the amount of primary sludge produced. Chemical sludge production, increases in total sludge, typically ranges from 10% to as much as 30% of that without chemical addition. These chemicals also act to improve the coagulation, flocculation and removal of particulates in the wastewater in the primary clarifiers. This can significantly reduce the load not only of phosphorus but also solids, Biochemical Oxygen Demand (BOD) and particulate organic nitrogen on the downstream treatment process. The formation of the precipitates and enhanced capture of exiting particulates in the waste stream can significantly increase total primary sludge production and reduce total secondary sludge production. The resulting shift in sludge blend ratio and the nature of the chemicals themselves will have an effect on solids handling process including thickening, dewatering and composting. An increase in primary sludge fraction often improves dewaterability (as does ferric addition). Alum sludge, on the other hand, has a tendency to be less amenable to dewatering.

The incorporation of a small amount of polymer together with a metal salt can further improve solids capture providing as much as 60% BOD and 80% TSS removal with phosphorus removal potential in a similar range. In fact, in some instances phosphorus removal can be so effective as to result in a nutrient limitation in the downstream biological process, although this is not common and fairly easy to control. Typically CEPT is designed to provide a bulk reduction of phosphorus with polishing to effluent levels provided later in the process stream. Regardless, chemical precipitation alone may not reliably achieve the required effluent phosphorus limits proposed.

Capital improvements necessary to implement CEPT are generally rather modest requiring a fairly simple chemical storage and feed system with containment. Small chemical metering pumps would feed the chemical from liquid chemical storage tanks into a carrier water stream that is then injected into the wastewater flow upstream of the primary clarifiers. Alum can be obtained as an anhydrous powder that must then be mixed with water to provide the feed solution. The specific addition point is not too critical but should provide flash mixing followed by some flocculation/coagulation time to maximize effectiveness. Plant influent pumps or primary influent channels/piping can provide adequate mixing with flocculation and coagulation time provided in the primary clarifier influent stilling well. Polymer (when used) is typically injected in a dilute solution immediately prior the flocculation point. In the case of Bridgewater, with the current gravity influent flow to the primary clarifiers, chemical could be added to the influent manhole to provide mixing, with polymer (if needed) injected further downstream and coagulation/flocculation in the primary clarifiers. If influent flow pumping is moved ahead of the primary clarifiers (as is being considered), then these additions of chemicals could be done at the forward flow pump station.

Enhanced Biological Phosphorus Removal (BioP) Process

Enhanced Biological Phosphorus Removal is a suspended growth activated sludge process that incorporates an anaerobic selector zone ahead of the conventional aerobic activated sludge zone. The incorporation of this selector zone creates an alternating anaerobic-aerobic environment for the recycled activated sludge organisms that promotes the uptake and storage of phosphorus by the organisms in excess of that required for normal cell growth, referred to as “luxury uptake”. This biologically stored phosphorus is removed via the waste activated sludge. The viability and effectiveness of the process is dependent on (among other things) the amount of readily available soluble organic matter in the influent waste stream.

The BioP process is only applicable to suspended growth systems because fixed film systems cannot provide the anaerobic/anoxic cycles and sludge wasting in such a manner as to allow for wasting of phosphorus rich organisms. There are facilities that operate in a hybrid fixed-film/activated sludge configuration that can provide the requisite conditions for the suspended growth organisms to support BioP removal, but these processes are not common.

Because this process does not rely on chemical additional and precipitate formation, it does not significantly increase sludge production the way the CEPT or other chemical treatment options do. However, as a suspended growth process it typically will produce more sludge than the existing RBC process. Furthermore, even under the best of conditions the BioP process alone cannot be expected to reliably produce an effluent total phosphorus level significantly less than 1 mg/l. Therefore, a post biological treatment chemical addition polishing step would also be required to achieve the proposed effluent total P limit. As previously noted, chemical precipitation of phosphorus does increase sludge production, although when used as a polishing step for the BioP process the chemical requirements and sludge production are considerably less than that for a CEPT process.

Capital improvements necessary at Bridgewater to employ the BioP process would include at a minimum (if the RBC process were to be employed) the implementation of a hybrid fixed film/suspended growth activated sludge process. It is likely that it would also require additional secondary clarification capacity to capture the new suspended growth biomass as well as a return activated sludge pumping system to recycle the biomass to the treatment tanks. It is also likely that it would require additional process tankage to establish the anaerobic selector. Alternately, it is more probable that if BioP is to be employed, the secondary treatment RBC process would be replaced in its entirety with a suspended growth BioP process. In either case, a chemical addition polishing step would be required to achieve the proposed effluent limits. Regardless of the approach, employing a BioP process at Bridgewater would require major capital improvements to the existing facility.

Chemical Precipitation with Increased Dosage, using Current Secondary Treatment Process
The basic concept of chemical precipitation was discussed previously under the CEPT process discussion but can be employed in a variety of ways. In this approach chemical precipitation would be performed with addition of metal salts directly into the secondary treatment process influent. The RBCs would provide sufficient turbulence for good flocculation and coagulation of the precipitates, which would then be settled out in the secondary clarifiers. Initial chemical mixing could be provided by injection into the primary effluent lift pump suction lines.

Like any chemical precipitation approach this would increase the net sludge production and will alter the sludge characteristics and subsequent solids handling performance. This effect is likely to be less pronounced than that which would be expected in the CEPT process, as it would not impact primary sludge production or the overall primary sludge to secondary biological sludge ratio of the existing facility. The impact to solids handling would be limited to the increase in chemical sludge and the effects the chemicals themselves may have on the sludge thickening and dewatering characteristics.
In order to maximize phosphorus removal, excess chemical addition will be necessary due to the competing precipitation reaction with hydroxide previously mentioned. This will increase solids loads on the final clarifiers which may require additional clarification capacity.

This approach alone will likely not achieve the proposed effluent limits for total phosphorus without a post filtration step to maximize solids capture.

Multi-Point Chemical Addition Approach (CEPT and Chemical Precipitation in Secondary Clarifiers)
The multi-barrier chemical addition approach, as the name implies, relies on chemical precipitation with metal salts at several locations within the overall treatment system. As proposed here it would include both the CEPT process previously described and chemical addition in the secondary

treatment process with settling in the secondary clarifiers. As such the impacts of these processes previously discussed are applicable here, including chemical consumption, increased sludge production, changes in sludge handling characteristics, etc. However, with the CEPT process providing bulk reduction of phosphorus, as well as reducing BOD and TSS loads to the secondary system, the net chemical addition to the secondary system would be reduced over the option of chemical to the secondary system alone. This reduction may be sufficient to eliminate the need for additional secondary clarifier capacity. Regardless, as with these processes applied independently they may not reliably achieve the proposed effluent limits without some solids polishing step such as filtration. Other capital improvements however are limited to the addition of chemical storage and feed systems. As such, in relation to other options this alternative has a lower capital cost.

Chemical Precipitation with Added Ballasted Flocculation Process (e.g. CoMag or ActiFlo)
Chemical precipitation with Ballasted Flocculation is an enhancement of the chemical precipitation process which improves the level of phosphorus removal by incorporating a polymer or other coagulant aid in conjunction with a ballast material to improve the capture and settling of particulates (including the phosphorus precipitates). The ballast serves two functions, it creates surfaces on which small, less dense solids present in the wastewater can coagulate, and with its high density increases the net density of the coagulated particles (in effect like an anchor), speeding the settling and separation process. The ballast and captured solids are then collected and sent through a separate process (different for each proprietary process) where the ballast is separated from the waste solids.

There are several ballasted flocculation specific processes, all of which are proprietary. The difference between them is largely being the ballast material and method of ballast separation/recovery. These processes can achieve a high level of phosphorus removal with the right chemical doses and polymer. The improved settling reduces the settling area required. In the case of CoMag, the ballast is magnetite- a fine granular magnetic material that is separated in a side stream process that employs electromagnets to extract the ballast. The CoMag process typically applies a separate (tertiary) clarifier process. A modification of this process- the BioMag process- is combined into a secondary biological treatment. This allows it to be used in conjunction with existing process units like final clarifiers. The Actiflo process employs sand as the ballast, which is separated by specially designed cyclone separation equipment much like a grit separation cyclone. The ActiFlo process requires separate process tankage for proper flocculation and settling.

These processes require significant energy to operate due largely to the separation equipment and methods. Their footprint is small however, in comparison to conventional gravity settling tanks. In addition, the CoMag process with chemical addition for phosphorus removal has demonstrated the ability to achieve the proposed effluent phosphorus levels- although chemical requirements are quite high to achieve it. As for the other process impacts, they are essentially the same as that for any of the previously mentioned metal precipitation process discussed.

These processes would include new ballast separation equipment and facilities, and possibly new proprietary process tankage. As with any chemical feed scenario they would also require chemical storage and feed facilities.

Chemical Precipitation with Added Effluent Filtration (Cloth, Granular or other Filter Media) Process
This alternative employs chemical addition with metal salts followed by effluent filtration to provide higher levels of phosphorus removal than chemical addition alone. Several forms of effluent filters are available including cloth, single and multimedia granular bed media in varying physical configurations. All require periodic backwashing to remove the buildup of particulate on the media.

The backwash is typically returned to the raw influent for reprocessing. Filtration systems by nature have significant head loss through them and often require either additional influent or effluent pumping as a result. In addition, the backwash also requires pumping and a stored source of filtered water. Most systems therefore incorporate a backwash clear well which stores filtered water for the backwash cycles. In addition, to provide some backwash flow equalization some systems also provide a backwash mudwell.

Filtration following chemical addition for phosphorus precipitation and removal is capable of achieving the proposed effluent total phosphorus limits, and is typically used as a polishing step in concert with either a multipoint chemical feed approach or a treatment scheme incorporating the BioP process to achieve these levels and not overload the effluent filters. As a polishing, step the phosphorus load, and therefore chemical requirements, are typically lower than when chemical is employed earlier in the process train. Therefore the additional sludge produced is generally not significant in the overall process scheme.

In Bridgewater, influent pumping to the filter would likely be required with effluent discharged by gravity. Incorporating filtration into the Bridgewater facility under any scenario as a new process would require effectively the same level of capital improvements regardless of any other improvements with which it may be paired.

5.5.1.2 Nitrogen Removal Processes

Nitrogen removal in municipal waste applications is typically achieved by biological processes. There are a number of different specific process configurations employed depending on the nitrogen removal requirements, but all rely on two basic biological processes, nitrification and denitrification. Nitrification is the conversion of ammonia nitrogen to nitrite and then nitrate by a select group of bacteria that require oxygen (aerobic conditions) to do so. Alternately, denitrification is the conversion of nitrate and/or nitrite to nitrogen gas by a number of different bacteria and requires the absence of oxygen (or anoxic conditions). Nitrification must be achieved first before denitrification can take place. In nitrification, ammonia is effectively the “food” source for the bacteria with the dissolved oxygen necessary provided by mechanical means. In denitrification, the oxygen in the nitrate resulting from nitrification serves as the oxygen source which the bacteria use for consumption of other organic matter (food) in the wastewater. This basic process description is an oversimplification but sufficient for purposes of the subsequent process discussions. The source of food for denitrification can be the organics in the wastewater itself and/or chemical feed (such as methanol, acetic acid and others).

Denitrification can be achieved in anoxic zones virtually anywhere within the secondary process flow scheme - and there are a host of different biological nitrogen removal process configurations in use, depending on the treatment level required. However, to achieve the level of nitrogen removal required by the proposed permit a final post denitrification step will be necessary following the aerobic nitrification process. It may or may not require an external chemical feed for “food”, but providing for a readily degradable external source will speed the post denitrification biological process and reduce the treatment volume required (all else being equal).

In the following discussion of alternatives, the first several alternatives for nitrogen treatment focus on keeping the presently employed RBC process in use, while the latter options discussed include complete replacement of the biological process systems.

Modify Secondary RBC Process to Add Anoxic Stage (Submerged RBC) for Denitrification

This process alternative includes submerged RBCs to provide the anoxic conditions necessary for denitrification, with nitrification being provided by some or all of the existing RBCs. Submerged RBCs have the ability to achieve the nitrogen removal levels required but while technically feasible are not in widespread use for several reasons. Notably they require a sealed submerged bearing which complicates maintenance. In addition, other more efficient processes are available. Being a fixed film biological process the sludge production and character are essentially the same as the existing RBC process.

Implementation of submerged RBCs at Bridgewater would require either modification of existing excess RBC tankage or installation of new units. Using existing tankage presents several problems. First the existing tanks would need to be deeper, either by raising the sidewalls or increasing the depth by excavation. Raising the sidewalls (if feasible) is probably simpler than excavating and making them deeper. On the other hand, raising the side walls would require an intermediate lift station to get the flow into the raised units. An option to raise the primary clarifiers is the most likely solution for achieving this hydraulic profile change. Regardless of the implementation approach, the use of submerged RBCs does not in our opinion represent an option with benefits sufficiently significant to be worth pursuing.

Modify Secondary RBC Process to Add Anoxic Zone (MBBR Media Anoxic Reactor) for Denitrification
This alternative takes advantage of the existing RBC's capacity for nitrification and adds a separate anoxic zone for denitrification utilizing the Moving Bed Bio-Reactor (MBBR) process. This could be achieved with either a single post-denitrification zone or with both a pre- and post-denitrification zone. The MBBR process (like the RBCs) is a fixed film process- the difference is rather than employing a fixed mounted sheet media like that on the RBC shaft, the MBBR employs a loose "floating" media that is essentially suspended in the wastewater filled tank. There are many different media configurations but in all cases the basic purpose is the same, the media provide surface area on which the bacteria grow. The media and ancillary system components to protect it and retain it in the tank are typically proprietary, with each manufacturer having their own specific designs and equipment.

The basic advantages of this type of system are similar to that of other fixed film processes- reduced sludge production, low solids loads on the final clarifiers, biomass retention and density (as well as greater protection from shock loads and upsets relative to conventional suspended growth systems). They also can suffer from some of the same disadvantages of fixed film, systems such as the tendency to produce pin flock and potential for media clogging. In addition, these floating media type fixed film systems also require some significant measures to retain and protect the media from rags and stringy material that can cause problems for them, such as requiring fine screens on the influent and effluent of the tanks.

Recognizing these requirements, MBBR technology can achieve the proposed effluent nitrogen levels provided the process scheme includes a post denitrification zone. Further, as a fixed film process, MBBR may not require additional secondary clarifiers at Bridgewater.

Implementation at Bridgewater would at a minimum require the installation of new post anoxic MBBR reactor tanks with mixers, carbon feed systems, and (depending on the hydraulics) may require a lift station. Additional secondary clarification may not be necessary. It may be more advantageous to provide both pre- and post- anoxic MBBR reactors with an internal recycle from the end of the RBC nitrification stage, to take advantage of influent carbon and reduce the volume of the post denite MBBR reactors.

Modify Secondary RBC Process to Add Anoxic Zone (Liquid Phase) for Denitrification

This alternative combines the existing fixed film RBC process for nitrification with a suspended growth "activated sludge" process for denitrification. Suspended growth activated sludge systems, as the name implies, rely on biomass suspended in the wastewater as opposed to being attached to some fixed surface as in RBCs or MBBRs. The suspended biomass is referred to as mixed liquor suspended solids, or MLSS. All such systems require separation and return of the biomass to the reactors to maintain the biomass population on the process. This is typically achieved with secondary clarifiers and a sludge pump station to return the settled biomass from the clarifiers to the reactors. Less common is the use of membrane separation. This scenario assumes conventional secondary clarification with return sludge pumping is employed. Membranes are discussed later under another alternative.

Like the MBBR process, this option could be employed in two ways at Bridgewater, as a post-anoxic zone only following the RBCs, or as both a pre- and post-anoxic zone to take advantage of the available carbon in the influent for denitrification. A pre-anoxic zone alone would not achieve the proposed effluent total nitrogen limits. In either case a suspended growth anoxic zone may require additional secondary clarifiers at the plant due to the increased solids load resulting from the suspended biomass. In addition, a new activated sludge recycle pump system will be required to maintain the biomass levels in the reactor. The post anoxic zone would be most efficient using an external carbon source requiring the installation of a chemical storage and feed system. All applicable suspended growth activated sludge systems will also result in a significant increase in waste solids production over fixed film type systems that will increase thickening and dewatering capacity needs.

Modify Secondary RBC Process to Add New Effluent Denitrification Filter Process (Deep Bed Sand Filters)

Deep Bed denitrification filters are fixed film biological filters that provide both biological denitrification as well as solids filtration (although denitrification is their primary objective). There are a number of different physical configurations, including the more conventional intermittent backwash down flow type, and the continuously backwashed upflow type. Denitrification filters are very similarly to conventional solids filtration filters with three significant differences. They use a generally coarser sand media with a very high uniformity coefficient. The larger size and uniformity provide for growth of biomass on the media surface while limiting the rate of clogging that would result in finer media filters. Because they are employed following biological treatment for removal of BOD and the short hydraulic retention time they provide, they require addition of readily degradable carbon to ensure full denitrification. Finally, to provide sufficient surface area to support the necessary biomass and sufficient retention time to allow complete denitrification the media, depth (as much as 10 feet) is significantly greater than the 3 to 4 feet typical in sand filters for solids removal alone.

Deep bed denitrification filters can provide complete denitrification and when preceded by a fully nitrifying treatment process can consistently meet the proposed effluent total nitrogen goal. They also provide a very high level of solids removal. Denitrification filters are typically employed following a system that provides partial denitrification by way of a pre-anoxic reactor. Otherwise, the high filter influent nitrogen levels can result in frequent backwashing and high backwash recycle rates due to the resulting increased biological growth produced within the media bed. Because of their deep bed configuration and high head loss, denitrification filters typically require filter influent pumping in addition to the backwash pumps, wetwell and mudwell required by solids filters.

Implementation of effluent denitrification filters at Bridgewater would require a filter influent lift station as well as backwash pumps, backwash clear well and mudwell. It is also likely that a pre-denitrification step would be required to limit the nitrate loads to the filters. Adding complexity to the Bridgewater application is the need for effluent filtration to support meeting the low effluent phosphorus limits (as previously described). Using the deep-bed type denite filters for phosphorus removal as well presents a problem with conflicting filter design intent. Attempts to remove phosphorus precipitate flow on the denite filters typically create operational problems (e.g. the need for frequent backwash) and may compromise the plant's ability to meet both nutrient effluent limits.

Modify Secondary RBC Process to Add New Effluent Denitrification Filter Process (BlueWater Filter)
The BlueWater® denitrification filter technology is a proprietary deep bed granular media filter that employs an "upflow" design-in which wastewater is introduced through piping to the lower portion of the media bed and flows up through the media, exiting at the top of the unit. It also employs a continuous backwash rather than an intermittent backwash approach. The "dirty" media is lifted from a hopper at the bottom of the unit by a combination of air and water through a central riser pipe during which the turbulence causes a scrubbing action that washes the media as it rises. At the top of the filter the cleaned media settles by gravity back on to the discharge side of the media bed, while the removed solids are carried over a special backwash weir by the backwash water and (typically) sent to the plant drain for return to the head of the plant for reprocessing.

The application of continuous backwash upflow denitrification filters at Bridgewater would eliminate the need for the wash water clear well and the backwash water equalization tank (or "mudwell") required by the conventional intermittent down flow filters eliminating the tankage and pumping associated with these elements. The tradeoff relative to the intermittent backwash units is that the total daily backwash flow is higher for the continuously backwashed units. Intermittent systems backwash volumes typically range from 3 to 5% of forward flow, while continuous backwash units backwash volume can be from 5% to 7% of the forward flow.

Replace RBC Process with New Sequencing Batch Reactor (SBR) Secondary Process
This alternative abandons the existing RBC process completely in favor of a suspended growth or "activated sludge" biological treatment approach using the Sequencing Batch Reactor (SBR) configuration. Like all suspended growth activated sludge systems (as the name implies) and SBR relies on biomass suspended in the wastewater as opposed to being attached to some fixed surface. What make the sequencing batch reactor process unique is that it processes wastewater in batches, rather than in a continuous flow through process. The sequencing batch process creates, over time for a single batch, the same basic processes that a conventional flow through system creates in the space of a series of tanks through which the waste continuously flows. With current technology, this is all controlled through a preprogrammed PLC that allows preset operating cycles, as well as any number of alternate and or manual operations. Typical SBR conventional cycles include fill/react, react, settle and decant phases. The react phases may provide anaerobic, anoxic and or aerobic periods in almost any sequence. This flexibility provides the ability to achieve both biological nitrogen and phosphorus removal within the same reactor.

The batch mode of operation provides some distinct advantages and disadvantages relative to the continuous flow through approach. As a batch process, the SBR process does not require separate tanks to create the required nitrification, denitrification reactions, or clarification. This can be a significant advantage as it not only eliminates the secondary clarifier tanks and sludge collection mechanisms, but also the need for return sludge pumping. Alternately, the system typically requires influent pumping and often employs effluent equalization to avoid oversizing downstream processes like disinfection as a result of high batch discharge rates necessary to decant the batch volume in a relatively short period. The SBR process with proper cycling can achieve the proposed effluent nitrogen limits. However, as with all biological phosphorus removal processes, it cannot achieve the proposed phosphorus limits without the help of chemical polishing and filtration.

Implementation of an SBR system at Bridgewater would require modifications to the current primary effluent lift station, demolition of the existing RBCs and possibly demolition of the secondary clarifiers. It may be possible to use the existing secondary clarifiers as effluent equalization with the addition of pumping.

Replace RBC Process with New Membrane Bioreactor (MBR) Secondary Process

Membrane bioreactors are a variation of the conventional flow through suspended growth activated sludge process that employs membrane filters in lieu of conventional gravity clarifiers for solids separation. There are two basic membrane configurations: (1) the submerged type that has racks of membrane modules submerged directly in the activated sludge reactor tanks and draw effluent with the use of vacuum suction pumps (pulling a vacuum in the downstream side of the membranes), and (2) the external or closed vessel type where the membranes are contained in closed tubular modules with the activated sludge reactor tank effluent pumped through them.

Membrane systems are proprietary, with each manufacturer having their own specific differences, but all operate in one of these two configurations. As activated sludge suspended growth systems they can be designed to provide both biological nitrogen and phosphorus removal with the appropriate configuration of the activated sludge tankage. As such they can achieve the effluent total nitrogen levels proposed but would require chemical polishing to achieve the effluent phosphorus levels proposed.

Implementation at Bridgewater would require the demolition and replacement of the existing RBC system with new activated sludge process tanks. The existing secondary clarifiers may be able to be incorporated into such a system in some fashion (for example, as equalization tanks) but the existing RBC tanks are too shallow to provide either sufficient volume or aeration of an activated sludge system. In either case, effluent pumping (pressure or vacuum) is required as well as an internal recycle if a pre-anoxic zone is to be employed. If a closed vessel type system is used, the membrane system would require a building as well to house the membrane system and protect it from freezing.

Replace RBC Process with New Activated Sludge Secondary Process (MLE)

The Modified Ludzack-Ettinger MLE configuration of the activated sludge process includes a pre-anoxic zone for denitrification followed by an aerobic zone for nitrification. Aerobic zone effluent is returned to the pre-anoxic zone (referred to as Internal Mixed Liquor Recycle, or IMLR) to take advantage of the available influent carbon to support the denitrification process. Due to practical limitations of IMLR rates (which are typically between 100% to 300% of the influent flow) and influent carbon levels, the MLE process alone cannot achieve the effluent total nitrogen levels proposed. A post denitrification process would be required. The post denitrification process could be either a suspended growth process or a granular media filter (fixed film) process.

Implementation of an MLE process at Bridgewater would require demolition of the existing RBCs and construction of new tankage to provide the pre-anoxic and aerobic reactors, new internal mixed liquor recycle pumping system, additional final clarifiers and return sludge pumping system to handle the higher solids loading rates of a suspended growth system, and new mechanical aeration systems and anoxic zone mixers. Solids handling improvements may also be expected to handle the higher solids production.

Replace RBC Process with New 4-stage Denitrification Process (MLE with Post Denitrification Reactor)

This alternative is similar to the MLE process described above with the addition of new suspended growth post-anoxic zone reactors prior to secondary clarification. This process also typically requires the addition of a small reaeration zone prior to the secondary clarifiers to re-establish aerobic conditions in the sludge (which helps promote good settling characteristics). As noted earlier, the post-anoxic zone typically includes an external carbon source storage and feed system to optimize the post denitrification process. This process can meet the proposed nitrogen limits.

Implementation at Bridgewater would require demolition of the exiting RBCs and construction of new suspended growth process tankage in the MLE with post anoxic zone configuration, complete with new aeration systems, internal mixed liquor recycle and return sludge pumping, as well as additional finals clarifiers to handle the increased solids loads. Here again, solids handling improvements may be necessary to accommodate the additional waste solids.

5.5.1.3 Nitrogen and Phosphorus Removal Technologies

Various combination of the phosphorus and nitrogen removal technologies identified above can be employed together to achieve both phosphorus and nitrogen removal. In the case of the suspended growth activated sludge processes, there are three specific process configurations that are intended to do just that. The A2O and the 4- and 5-stage modified bardenpho processes. These are in effect modifications/combinations of several previously discussed processes. Each is discussed further below.

Replace RBC Process with New Activated Sludge Secondary Process (A20)

The A2O, or Anaerobic/Anoxic/Oxic, process is a suspended growth process that incorporates an anaerobic zone followed by an anoxic zone and then an aeration zone as the name implies. The anaerobic zone supports the BioP process development for phosphorus removal while the anoxic zone provides for denitrification of returned mixed liquor and the aeration zone provides nitrification. The latter two processes are effectively the same as the previously discussed MLE process. Like the MLE and BioP processes, this process may not consistently meet the proposed effluent limits for Nitrogen and Phosphorus.

Implementation of an A2O process at Bridgewater has all the same requirements as the BioP and MLE processes previously discussed.

Replace RBC Process with New 4 or 5-stage Bardenpho® Secondary Process

The 4-and 5-stage Bardenpho process are also variants of the previously discussed options. The 4-stage process includes a pre-anoxic selector followed by an aerobic zone for nitrification, an anoxic zone for denitrification and a reaeration zone. The 5 stage process adds a pre-anoxic zone between the anaerobic zone and the aeration zone and as such also requires an internal mixed liquor recycle (IMLR) pumping system. These processes can achieve the proposed effluent nitrogen limits but not the effluent phosphorus limits, unless combined with phosphorus polishing.

The improvements necessary at Bridgewater to implement any of these processes are similar to those previously mentioned for the nitrogen and BioP processes previously described, and include demolition of the existing RBCs, new process tankage for the processes described, new aeration systems, additional final clarification and return sludge pumping as for the pre-anoxic zones and IMLR pumping system. Also like the other suspended growth processes, improvements to solids handling are expected to be necessary to handle the increased sludge production from these processes.

5.5.1.4 Comparison of Screened Process Alternatives

The following Table 5-7: WWTF alternatives for Nutrient Removal presents a summary of the WTF process alternatives described above and some key qualitative advantages and disadvantages for each alternative.

Table 5-7 **WWTF Process Alternatives for Nutrient Removal**				
Alt. #	Description of Process Alternative	Target Nutrient	Advantages	Disadvantages
Phosphorus Removal Technologies				
A	Enhanced Biological Phosphorus Removal (BioP) Process	P	- Reduced chemical usage - Little increase in sludge production - No additional chemicals in sludge	- Cannot meet permit limit without additional processes - P can be re-released from sludge - Capital improvements required
B	Chemically Enhanced Primary Treatment (CEPT) Process	P	- Reduces overall load to biological process - P remains bound in sludge - Limited capital improvements required - Reduced load to secondary treatment	- Increased load on primary clarifiers - May not meet P permit limit alone - Can starve biological process for P - Additional chemicals in sludge - Potential negative impacts on solids handling performance
C	Chemical Precipitation with Increased Dosage, using Current Secondary Treatment Process	P	- Limited capital improvements required	- Increased load on secondary clarifiers - Higher chemical usage - May not meet permit limit alone - Increased sludge production - Additional chemicals in sludge - Potential negative impacts on solids handling performance
D	Multi-Barrier Approach, using CEPT and Chemical Precipitation in Secondary Clarifiers	P	- May be capable of meeting permit limit without major new process components - Reduced load to secondary treatment	- Requires multi-point chemical feed - Somewhat increased sludge production - Potential negative impacts on solids handling performance
E	Chemical Precipitation with Added Ballasted	P	- Demonstrated ability to meet lower P	- New additional secondary/tertiary

	Flocculation Process (e.g. CoMag or Actiflo)		permit limits	clarifiers needed - Proprietary process - Increased energy demands
F	Chemical Precipitation with Added Effluent Filtration (Cloth, Granular or other Filter Media) Process	P	- Ability to meet permit limits - Additional benefit in effluent solids removal	- New major process required - Forward flow pumping required to meet hydraulic requirements
	Nitrogen Removal Technologies			
G	Modify Secondary RBC Process to Add Anoxic Stage (Submerged RBC) for Denitrification	N	- Makes use of existing RBCs – Limits impacts during construction - Similarity to current process equipment	- Dated technology - Significant space requirement - May not meet permit limit alone
H	Modify Secondary RBC Process to Add Anoxic Zone (MBBR Media Anoxic Reactor) for Denitrification	N	- Makes use of existing RBCs – limits impacts during construction	- Significant space requirement - Limited successful applications available - May not meet permit limit alone
I	Modify Secondary RBC Process to Add Anoxic Zones (Liquid Phase) for Denitrification	N	- Makes use of existing RBCs – limits impacts during construction	- Significant space requirement - Limited successful applications available - May not meet lowest N permit limit alone
J	Modify Secondary RBC Process to Add New Effluent Denitrification Filter Process – Deep Bed Filter	N (and P)	- Makes use of existing RBCs – limits impacts during construction - May be used to address P removal - Additional benefit in effluent solids removal	- Significant space requirement - Forward flow pumping required to meet hydraulic requirements
K	Modify Secondary RBC Process to Add New Effluent Denitrification Filter Process – BlueWater Filter	N (and P)	- Makes use of existing RBCs – limits impacts during construction - May be used to address P removal - Additional benefit in effluent solids removal	- Significant space requirement - Forward flow pumping required to meet hydraulic requirements - New proprietary process
L	Replace RBC Process with New Sequencing Batch Reactor (SBR) Secondary Process	N	- Limited space for footprint required -Secondary clarifiers not required	- Requires demo of existing RBCs and major change in process operations - May not meet permit limit alone

				- Forward flow pumping required to meet hydraulic requirements
M	Replace RBC Process with New Membrane BioReactor (MBR) Secondary Process	N	- Produces very high quality/low solids effluent -Secondary clarifiers not required -Effluent filter not required	- Requires demo of existing RBCs and major change in process operations - Energy intensive process requires pumping for forward flow - May not meet permit limit alone
N	Replace RBC Process with New Activated Sludge Secondary Process (MLE)	N	- Less complex process	- Requires demo of existing RBCs and major change in process operations - May not meet permit limit alone
O	Replace RBC Process with New Activated Sludge Secondary Process (A_20)	N	- Less complex process	- Requires demo of existing RBCs and major change in process operations - May not meet permit limit alone
P	Replace RBC Process with New 4-stage Bardenpho Secondary Process	N	- Demonstrated ability to meet lower N permit limits	- Requires demo of existing RBCs and major change in process operations
Nitrogen and Phosphorus Removal Technologies				
Q	Replace RBC Process with New 5-stage Bardenpho Secondary Process	N and P	- Demonstrated ability to meet lower N permit limits - Enhanced biological P removal will reduce chemical requirements	- Requires demo of existing RBCs and major change in process operations

In order to consistently meet both the nitrogen and phosphorus permit limits, a combination of nitrogen and phosphorus removal alternatives described above will be required. Most of the nitrogen removal technologies can be combined with chemical precipitation of phosphorus using metal salts. The major differences include the mode of removal of precipitated floc – gravity methods (clarifiers, batch settling or ballasted settling) or physical barrier methods (filters or membranes).

Based on our review of the available processes, the advantages and disadvantages and the site specific characteristics including space and current processes (both wet and solids stream), we believe the following options should be considered further.

1. Alternative I - Refurbish the existing RBCs , add new suspended growth denite zones in either post only, pre- and post-anoxic, or step feed anoxic configuration, with multi-point

chemical feed for phosphorus removal and effluent polishing filters.

2. Alternative L - Replacement of the existing RBC process with and SBR activated sludge configuration, with multi-point chemical feed for phosphorus removal and effluent polishing filters.

3. Alternative Q - Replacement of the existing RBC process with a new five stage Bardenpho process, with multipoint chemical feed for phosphorus and polishing filters.

A more detailed discussion of the implementation requirements for these final three process alternatives is presented in the following section.

5.5.2 Detailed Conceptual Review of WWTF Process Alternatives

Each of the three WWTF process alternatives identified for further review in the screening discussion above were reviewed in further detail for implementation considerations. The following information and supporting figures provide details on how these options would be implemented at the Bridgewater WWTF.

5.5.2.1 Alternative I - Modify Secondary RBC Process to Add Anoxic Zones

Alternative I includes refurbishing the exiting RBC process, adding new suspended growth denite zones in either post-anoxic only, pre- and post-anoxic, or step feed anoxic configuration, combined with multipoint chemical feed for phosphorus removal and effluent polishing filters. This approach could be employed in two ways at Bridgewater, as a post-anoxic zone only, following the RBCs, or as both a pre- and post-anoxic zone, to take advantage of the available carbon in the influent for denitrification. A pre-anoxic zone (such as provided in an MLE process) alone would not achieve the proposed effluent total nitrogen limits. In either case, a suspended growth anoxic zone will require additional secondary clarifiers at the plant due to the increased solids load resulting from the suspended biomass. In addition, a new activated sludge recycle pump station will be required to maintain the biomass levels in the reactor. The post anoxic zone would be most efficient using an external carbon source requiring the installation of a chemical storage and feed system. All applicable suspended growth activated sludge system will also result in an increase in waste solids production over fixed film type systems that will increase thickening and dewatering capacity needs. It is expected, however, that this can be accommodated by extending processing time on exiting solids handling equipment such that solids handling expansion is not required.

Figure 5-9: Alternative I-Refurbish Existing RBC’s and add Anoxic Zones Final Configuration depicts the conceptual layout for this alternative.

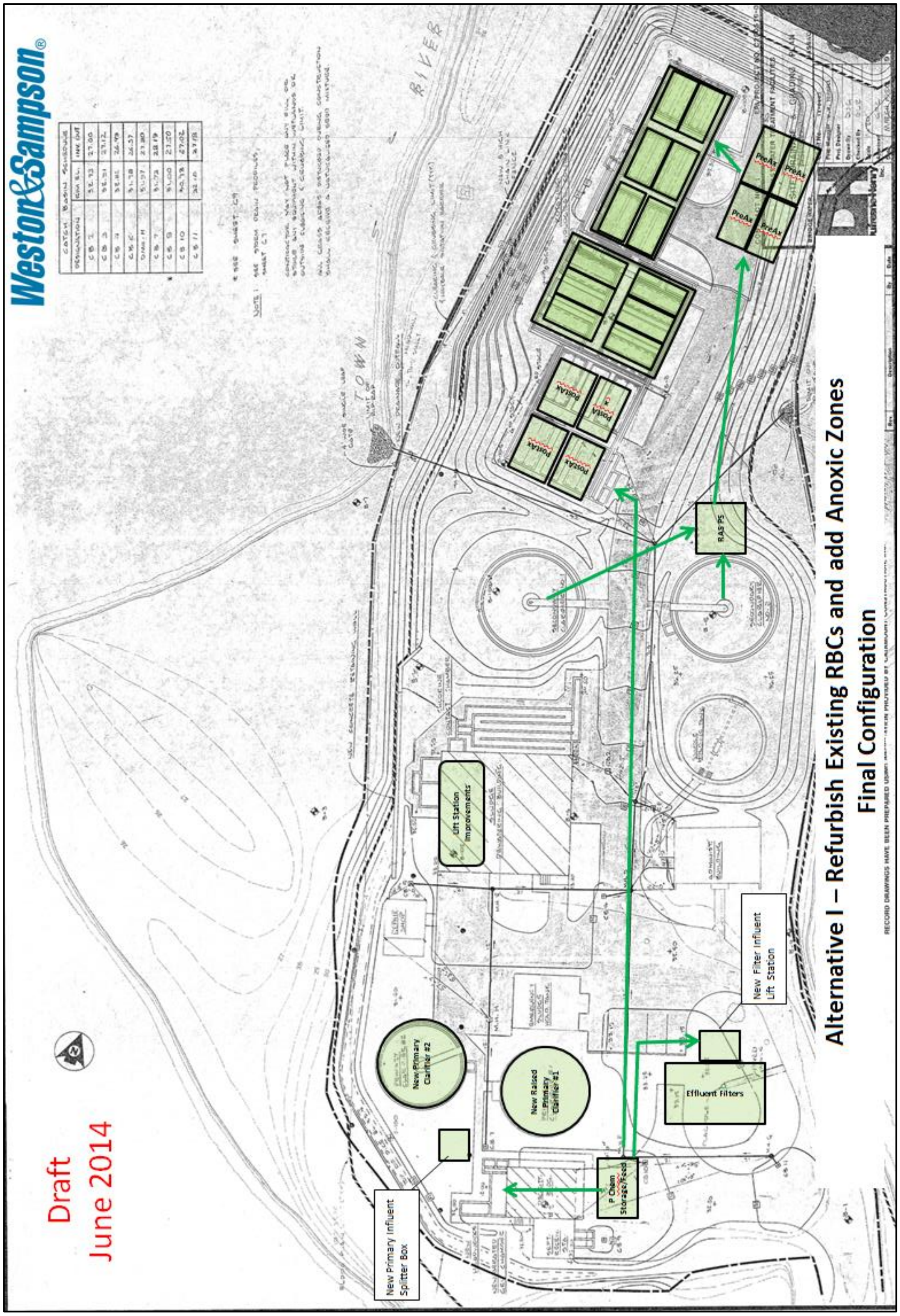


Figure 5-9 Alternative I- Refurbish Existing RBCs and add Anoxic Zones Final Configuration

Alternative I - Required Components/Staging:

Phase 1: Primary Clarifier, Chemical Feed and Influent Lift Station Reconstruction
Phase one improvements provide improved primary clarifier performance by providing a more conventional clarifier depth as well as coagulant addition capability (alum or Ferric). This improved primary clarifier performance will serve to offload the exiting secondary treatment system allowing for staged replacement with the new activated sludge tankage in subsequent phases.

1. Build New Phosphorus Chemical Storage and Feed Facility and Feed Lines to Influent prior to Primaries and to RBC effluent splitter to provide enhanced primary and secondary TSS removal.
2. Decommission and demo existing Clarifier #1 and rebuild as raised Clarifier #1
3. Modify Primary Effluent Lift Pumps and Piping to discharge 50% of flow to new raised primary and50% to remain to RBCs through existing FM
4. Decommission and demo existing Clarifier #2 and rebuild as raised Clarifier #2
5. Modify remaining Pumps in Primary Effluent Lift Station to discharge to New Primary #2
6. Bring new Enhanced Primary Clarification fully on line with Gravity flow to RBCs.

Phase 2: New Tertiary Effluent Filters
The filters provided in this phase will provide more reliable solids removal for the secondary effluent while the new secondary treatment systems are constructed.

1. Construct New Tertiary Sand Filters complete with filter influent lift station and Connect New Phosphorus Chemical Feed to Filters for effluent Polishing.

Phase 3: RBC Refurbishment
Under this upgrade approach the primary anoxic zones will provide some soluble BOD removal. This combined with the enhanced primary clarification reduces the total surface area of the RBC system required at design flows and loads. This approach reduces the current 14 RBC shafts by two (less than 10%). The BOD removal afforded by the new pre-anoxic zones together with the use of higher density media on the new RBC shafts will offset the reduction in the number of shafts. This eliminates the need for the third battery of RBC tanks which will be converted to the post anoxic zones in the subsequent stage limiting the additional footprint required for this option.

Due to access limitation for construction and maintenance of process performance during construction the proposed staging addresses the replacement of battery 1 and 2 of the RBC shafts before building the pre and post anoxic zones. Two refurbished batteries providing 12 shafts together with the enhanced primary and secondary clarification and the new effluent tertiary filters is sufficient to handle current plant flows. Beginning with the second battery minimizes the number of shafts out of service during construction. The first battery would follow.

1. Provide for bypass and or split of flow to batteries 1 and 3 of the RBC to allow the middle battery 9battery 2) to be removed from service.
2. Remove existing 4 RBC shafts and drives in Battery 2 and refurbish concrete tanks and install 6 new RBC shafts in the refurbished tanks.
3. Bring refurbished batter 2 on line and isolate Battery 1.
4. Remove Existing 6 RBC shafts in Battery 1, refurbish tanks and install 6 new RBC shafts in Battery 1 and bring on line.

Phase 4: Pre- and Post-Anoxic Zones and RAS PS

This phase provide the necessary pre and post anoxic zones needed to reduce the nitrate levels. Using a suspended sludge approach for these zones requires the establishment and maintenance of suspended biomass and a return sludge pump station. The pre-anoxic reactors and RAS Pump Station can be constructed essentially independent of the operation of the rest of the facility as upgraded in prior phases without compromising treatment and then being tied in once completed. Once this is complete, the post anoxic zones can be constructed in the existing RBC battery 3 tankage. The post anoxic carbon storage and feed system if required is expected to be installed on the ground floor of the RAS PS above the below grade RAS wet well and pump room.

1. Construct the new return sludge pump station, Pre-anoxic zones, reroute the influent to them and bring them on line.
2. Remove the third battery of existing RBC shafts from service and convert the tankage to post anoxic zones and install the carbon storage and feed equipment in the RAS PS and bring all on line.

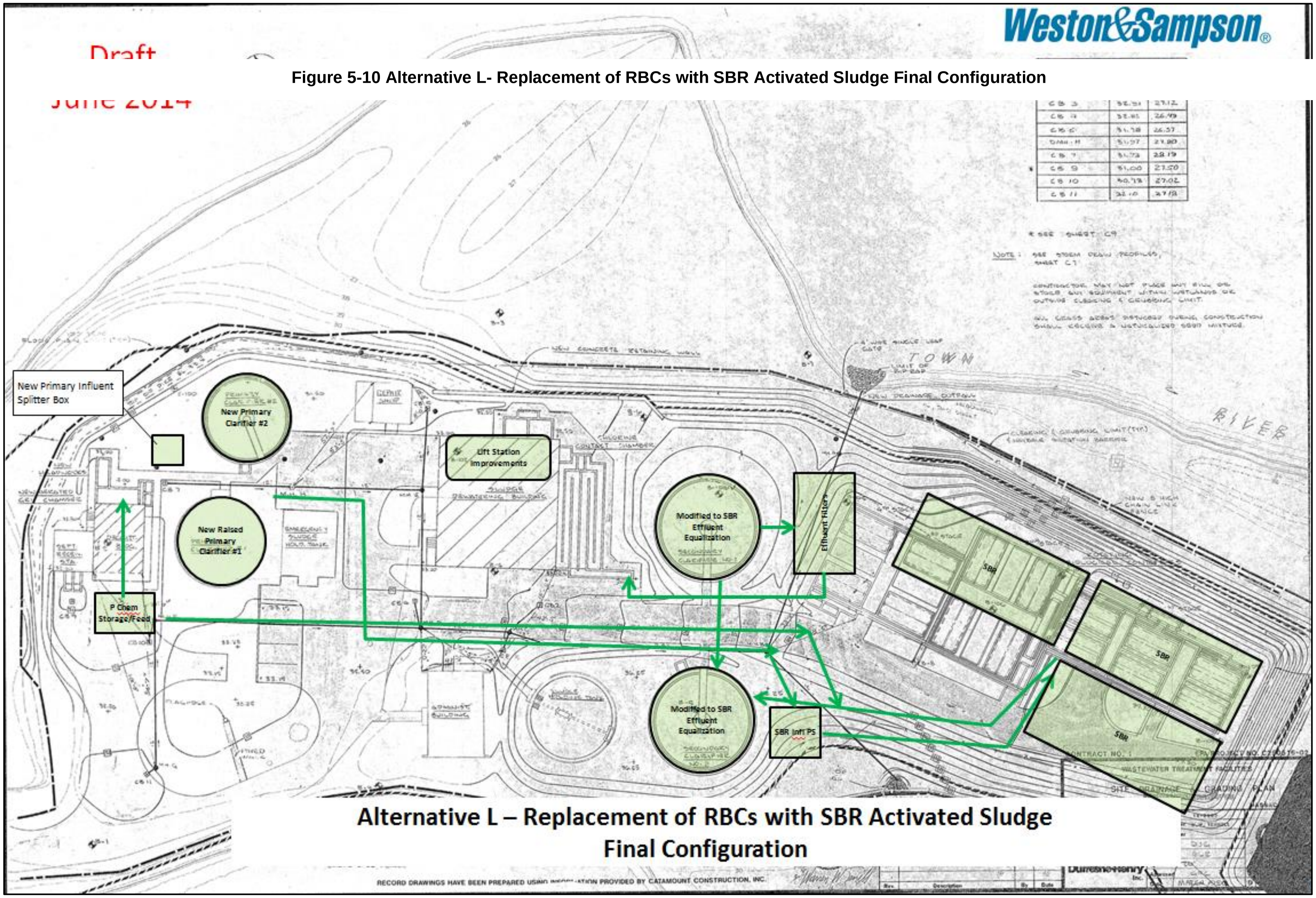
Construction sequencing figures supporting this alternative are included in Appendix G: WWTF Alternatives Construction Sequencing.

5.5.2.2 Alternative L – Replace RBC Process with New SBR

Alternative L includes replacement of the existing RBC process with an SBR activated sludge configuration, with multi point chemical feed for phosphorus removal, and effluent polishing filters. Due to their batch intermittent mode of operation, a minimum of two SBRs would need to be constructed and operated under a modified 4 hour operating cycle (2 hours fill/react, 2 hours settle decant or something similar) to allow continuous influent flow once in service. Splitting flow intermittently to one SBR and the existing RBCs is not practical for maintaining treatment during construction. The batch SBR operation will require either influent or effluent equalization. In this case because effluent filters and chlorination will be employed SBR effluent equalization will be required at a minimum. Because the SBRs will not require final clarifiers the existing final clarifies could be employed with modifications for equalization. In addition the tertiary filters will require equalization of influent flow and therefore in this option are constructed in the final phase with the last SBR.

Figure 5-10: Alternative L - Replacement of RBCs with SBR Activated Sludge Final Configuration depicts the conceptual layout for this alternative.

Figure 5-10 Alternative L- Replacement of RBCs with SBR Activated Sludge Final Configuration



Alternative L - Required Components/Staging:

Phase 1: Primary Clarifier, Chemical Feed and Influent Lift Station Reconstruction
Phase one improvements provide improved primary clarifier performance by providing a more conventional clarifier depth as well as coagulant addition capability (alum or Ferric). This improved primary clarifier performance will serve to offload the exiting secondary treatment system allowing for staged replacement with the new activated sludge tankage in subsequent phases.

1. Build New Phosphorus Chemical Storage and Feed Facility and Feed Lines to Influent prior to Primaries and to RBC effluent splitter to provide enhanced primary and secondary TSS removal.
2. Decommission and demo existing Clarifier #1 and rebuild as raised Clarifier #1.
3. Modify Primary Effluent Lift Pumps and Piping to discharge 50% of flow to new raised primary and50% to remain to RBCs through existing FM.
4. Decommission and demo existing Clarifier #2 and rebuild as raised Clarifier #2.
5. Modify remaining Pumps in Primary Effluent Lift Station to discharge to New Primary #2.
6. Bring new Enhanced Primary Clarification fully on line with Gravity flow to RBC battery 2 and 3.

Phase 2: SBR #1 and #2 Construction w/ Effluent Equalization
This phase provides for the construction of two SBR reactors and the requisite SBR influent lift station as well as conversion of one existing final clarifier to SBR effluent equalization.

1. Demolish RBC battery 1.
2. Construct New SBRs #1 and 2, new SBR influent lift station and convert Final Clarifier #2 to SBR Effluent Equalization.
3. Tap RBC influent line into lift station and connect SBR effluent to new equalization (Final Clarifier #2).
4. Bring New SBRs on Line with Equalization.

Phase 3: SBR #3 Construction w/ Additional Effluent Equalization and New Tertiary Filters

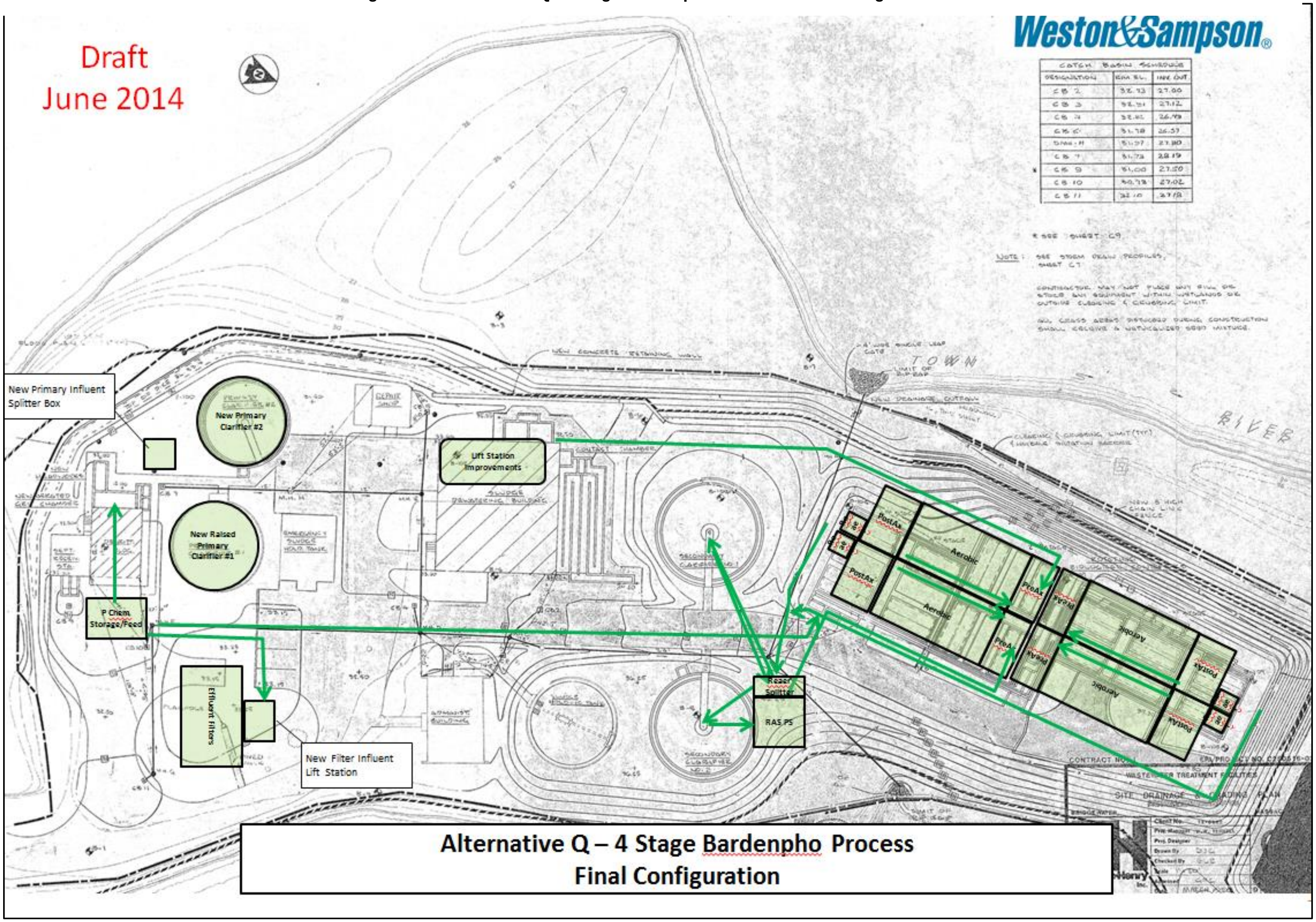
1. Demolish remaining RBC batteries.
2. Construct new SBR #3.
3. Convert Final Clarifier #1 to additional SBR Effluent Equalization.
4. Construct New Tertiary Filters using SBR effluent Equalization tanks as influent wet well.
5. Bring all elements on line.

Construction sequencing figures supporting this alternative are included in Appendix G: WWTF Alternatives Construction Sequencing.

5.5.2.3 Alternative Q – Replace RBC Process with New Bardenpho Process

Alternative Q includes replacing the existing RBC based secondary treatment with a new activated sludge based 4-Stage Bardenpho process. As with the prior option this alternative includes rebuilding and raising the primary clarifiers and new tertiary effluent filters. Figure 5-11: Alternative – Q 4 Stage Bardenpho Process Final Configuration depicts the conceptual layout for this alternative.

Figure 5-11 Alternative Q- 4 Stage Bardenpho Process Final Configuration



Alternative Q - Required Components/Staging:

Phase 1: Primary Clarifier, Chemical Feed and Influent Lift Station Reconstruction
Phase one improvements provide improved primary clarifier performance by providing a more conventional clarifier depth as well as coagulant addition capability (alum or Ferric). This improved primary clarifier performance will serve to offload the exiting secondary treatment system allowing for staged replacement with the new activated sludge tankage in subsequent phases.

1. Build New Phosphorus Chemical Storage and Feed Facility and Feed Lines to Influent prior to Primaries and to RBC effluent splitter to provide enhanced primary and secondary TSS removal.
2. Decommission and demo existing Clarifier #1 and rebuild as raised Clarifier #1
3. Modify Primary Effluent Lift Pumps and piping to discharge 50% of flow to new raised primary and 50% to remain to RBCs through existing FM.
4. Decommission and demo existing Clarifier #2 and rebuild as raised Clarifier #2.
5. Modify remaining Pumps in Primary Effluent Lift Station to discharge to New Primary #2.
6. Bring new Enhanced Primary Clarification fully on line with Gravity flow to RBCs.

Phase 2: New Tertiary Effluent Filters
The filters provided in this phase will provide more reliable solids removal for the secondary effluent while the new secondary treatment systems are constructed.

1. Construct New Tertiary Sand Filters complete with filter influent lift station and Connect New Phosphorus Chemical Feed to Filters for effluent Polishing.

Phase 3A: RBC Battery 1 Replacement with New Bardenpho Reactors
This phase will upgrade the secondary system in a stepwise fashion to a new activated sludge based Bardenpho process complete with new return sludge pump station. Phase 3A will provide two new trains of activated sludge based treatment which together with the enhancements provided in the prior phases will be capable of treating 100% of current flows. A minimum of one half of the existing RBC will remain in service with chemically enhanced final clarification followed by the new tertiary effluent filters as added contingency against washout during construction. The Bardenpho reactor design anticipated here would employ the newer invent style mixer aerators with deck mounted blowers located on the reactors themselves. This eliminates the need for a new blower structure and the additional space required for it on this tight sight and the associated aeration headers and diffusers.

1. Construct new Final Clarifier Splitter Box and Return Sludge Pump Station.
2. Demolish first of three existing batteries of RBCs (Battery 1) and construct two parallel trains of the Bardenpho process including connection of RAS pump station to new process train. Keeping the remaining RBCs and final clarifiers in service during construction.
3. Startup two new trains of secondary treatment process tanks and establish full treatment at current flows with the new system.

Phase 3B: RBC Batteries 2 and 3 Replacement with New Bardenpho Reactors

1. Demolish remaining RBCs and construct last two parallel trains of new secondary process tanks.

Upon completion of the upgrades the secondary process will have one redundant train at design flow of 1.44 MGD, while the primary and final clarifiers will not. The redundancy/capacity provided by the fourth train in the secondary treatment process tankage can be used to compensate for loss of either one primary or one final clarifier. The effluent filters provide for one redundant unit under average daily flow and load.

Construction sequencing figures supporting this alternative are included in Appendix G: WWTF Alternatives Construction Sequencing.

5.5.2.4 Cost Comparison of Final Process Alternatives

One of the primary challenges of reviewing and comparing process alternatives is appreciating the implications that each alternative has on the overall cost to upgrade the WWTF, while in parallel understanding the costs for WWTF improvements that are relatively independent of the selection of these alternatives. A key example of this is that each of the three key process alternatives will need to be supported by a chemical precipitation and multi-barrier system to meet the phosphorus effluent limits. All three options discussed above are therefore are assumed to include chemical feed systems and a new effluent filtration system - which is essentially the same for each alternative, and therefore can be omitted from the direct comparison. For the purpose of completeness, we generated planning level costs for the total WWTF facility improvement program needed for the Bridgewater plant aligned with each of the final three process alternatives. These fully developed WWTF improvement costs are included for side by side comparison in Appendix J: Bridgewater WWTF Planning Level Cost Estimate.

In this section, we present only the portions of the WWTF costs that are specific to the process alternative selection to allow a better appreciation for the difference in the capital cost to construct the improvements associated with each process alternative. Table 5-8: Comparison of Process Alternatives 'Partial Costs' includes the process alternative 'partial cost' comparison.

Table 5-8
Comparison of Process Alternatives 'Partial Costs'

Process Component	*Alternative I RBC with New Anoxic*	*Alternative L New SBR System*	*Alternative Q New Bardenpho System*
RBC Modifications	$1,300,000	$125,000	$125,000
New Process Systems	$1,350,000	$3,450,000	$4,200,000
Blowers & Support Systems	$250,000	$1,000,000	$1,200,000
Clarifier & Sludge Pumping Systems	$2,360,000	$2,360,000	$510,000
New Yard Piping	$225,000	$150,000	$150,000
Temporary Flow Handling & Bypass	$100,000	$150,000	$150,000
Subtotal	*$5,585,000*	*$7,235,000*	*$6,335,000*
Unscheduled Costs*	$280,000	$360,000	$320,000

Contractor Mark-up (BOHP)*	$840,000	$1,085,000	$955,000
Construction Cost Subtotal for Comparison of Costs	*$6,705,000*	*$8,680,000*	*$7,610,000*

* These cost/budget items are scaled to the partial costs for comparison, and are not total project costs.

Annual operation and maintenance cost impacts of the alternatives must also be considered in comparing alternatives that vary significantly. In general, the RBC process is very cost effective from an energy standpoint compared to the other processes that use pressurized air systems to aerate the process biology. The other two options tend to be somewhat more expensive from a process operation and maintenance (O&M) cost standpoint. The general cost profile of the three final alternatives is summary in Table 5-9: Process Alternatives Comparative Cost Profiles.

Table 5-9
Process Alternatives Comparative Cost Profiles

Cost Component	*Alternative I RBC with New Anoxic*	*Alternative L New SBR System*	*Alternative Q New Bardenpho System*
Capital Costs	Least Expensive	More Expensive	Most Expensive
Annual Costs	Least Expensive	More Expensive	Most Expensive
Net Comparative Cost Profile	**Least Expensive**	More Expensive	Most Expensive

As can be seen from the comparison, Alternative I, which includes continued use of the RBC process supplemented with the addition of anoxic zones, and the provisions of effluent filtration, offers the most desirable and cost-effective solution to the Town of Bridgewater.

5.5.2.7 Primary Clarifier Alternatives

The condition of the existing primary clarifiers warrants significant refurbishment, if not total replacement. Clarifiers with failing mechanisms can often be refit with new drives and mechanisms, which in the Bridgewater facility would address the identified mechanical issues. This approach does address the concerns with the condition of the structural concrete walls and floors of the clarifiers, which have appeared to exhibit signs of failure. Because the primary clarifiers will play a significant role in meeting the new permit limits – particularly based on the need for chemically enhanced primary treatment (CEPT), the investment in any changes to the clarifiers should be selected to best ensure long-term use of this system. As such, the plan should include clarifier modifications that will extend the service life of the systems to at least 20 years in the future.

In addition to condition concerns, the side water depth of the existing primaries is only seven (7) feet – significantly shallower than modern design standards would suggest. The least expensive option for complete clarifier rehabilitation could include in-situ structural repair and coating of the concrete, along with complete replacement of the mechanisms. This approach would avoid the need to change the hydraulic profile through the primaries. This approach would not address the shallow clarifier depth, but could extend the structures' useful lives. If this option is preferred, the preliminary design phase of improvements should include a detailed structural assessment of the concrete systems (possibly including coring the walls and analyzing the cores) - to ensure that rehabilitation would have a good chance of success.

The more significant cost option would be to completely rebuild new primary clarifiers in the current clarifier locations. This option would address the condition of equipment and structures and could work to improve the tank depth by raising the hydraulic grade line through the primaries. The hydraulic grade line change would include moving the forward flow pumping (currently primary effluent pumping) to before the primaries (to be primary influent pumping), and result in gravity flow from the primary effluent to the biological treatment process. This more extensive option eliminates some significant risk associated with the existing structures (which lie deep in the surrounding water table) and should provide a secure extended life for the primary clarification process.

5.5.2.6 WWTF Capacity Considerations

The overall anticipated costs to modernize the WWTF and to improve the WWTF processes to meet the new permit conditions will be very high based on the needs and alternatives developed. Based on the flows and loads presented for future conditions, including planned future development and sewer extensions, additional capacity at the WWTF should be considered. The incremental cost to provide a capacity increase as part of the overall WWTF improvements is expected to be nominal, as most existing process can be adjusted during the upgrades – essentially allowing a rerating of process components to remain in service, while designing new components for the ultimate design flow.

The controlling factor on system treatment capacity is more related to the permit limits – the former and new NPDES discharge permits limit the WWTF to an average daily flow of 1.44 mgd. Considering the significance of the new permit change impacts on capital and operating costs at the facility, requesting an increase in the NPDES permit to allow for additional capacity makes sense for Bridgewater, and the additional capacity should help to mitigate cost impacts by allowing for additional future system revenues.

The NPDES program generally allows for increases up to 10% of the capacity for the system to be considered 'deminimus' – essentially having limited impact on the receiving water. In addition, the Massachusetts Environmental Policy Act (MEPA) program allows for changes to surface water discharges from WWTFs up to 100,000 gpd without significant additional environmental assessment. For planning purposes, the plan for improvements to the Bridgewater WWTF should therefore move forward with a future design capacity to include a deminimus capacity increase, and the nominal future design capacity for the upgraded facility should be 1.54 mgd, ADF. Also, as stated earlier, elimination of excessive or non-excessive I/I could also help to provide additional plant hydraulic capacity needed to provide sewer service for existing development requiring off-site wastewater treatment and disposal or future desired commercial and industrial development in areas zoned for such uses,

5.5.3 Other Wastewater Management Alternatives

There are possible courses of action that the town can take to address the wastewater management needs that are not related to physical improvements to facilities. Some examples of these actions include management steps to help mitigate the needs – frequently these actions seek to reduce costs of compliance.

An example of a key management approach would be to appeal the new discharge permit conditions. The Town of Bridgewater had already begun a dialogue with EPA through the commentary on the draft NPDES permit (the most recent comment letter is included in Appendix F: New Draft of NPDES Permit for WWTF & Comment Letter). Other communities have engaged in formal appeals of permit conditions, which can include protracted legal battles. Where the permit conditions are unusually significant for Bridgewater, a permit appeal approach may be a reasonable step. The town must assess the likelihood of the success of an appeal, and also weigh the legal costs to pursue an appeal. Following the issuance of this CWMP report, EPA issued a final NPDES permit – and the Town has begun a formal appeal of the new permit.

A second approach that has been used in other regions is nutrient trading to address the new nutrient limits in the discharge permit. Nutrient trading for nitrogen impacts has been successfully employed in Connecticut to limit impacts to Long Island Sound. This program works by having the removal of total nutrient loads being non location specific – essentially a plant such as Bridgewater which is not readily adapted to nitrogen removal, could partner with a larger plant that can more efficiently remove nitrogen. The goal is to achieve the same load reduction on the receiving water, but to do so more economically and making best use of existing infrastructure (which varies greatly from plant to plant). Unfortunately, EPA and Massachusetts DEP have not positioned the Taunton River basin to employ nutrient trading methods. While this option could offer long-term benefits, and could help mitigate impacts on Bridgewater ratepayers, the implementation steps to engage such a program may be challenging – particularly the need to get DEP and EPA support.

5.6 Stormwater Management Alternatives

As discussed in Section 4.4, the permit for stormwater discharges from Small Municipal Separate Storm Sewer Systems (MS4 Permit) was re-issued by the Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP) on April 4, 2016 and becomes effective on July 1, 2017. The permit requires Bridgewater to implement best management practices for the six minimum control measures discussed in Section 4.4 to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. The MS4 Permit clearly defines the requirements and establishes timeframes for implementation. Since the MS4 Permit is a federally mandated permit, there is little opportunity for deviation from the established requirements, therefore an alternatives analysis was not performed in the context of stormwater management.

6.0 RECOMMENDED PLAN

The recommendations from the CWMP are presented in this section. The discussion is separated into information on the plan selection process, as well as specific components for the Recommended Plan for various water resource management systems and practices.

6.1 Plan Selection

This section of the comprehensive plan presents recommendations for water resource management in the Town of Bridgewater. The process of plan selection has included review of the existing and future conditions, review of needs for various system components, as well as overall programmatic needs, consideration of the findings of past planning efforts and studies, consideration of alternatives, and consideration to stakeholder and public input from public participation efforts. The recommended plan is intended to be consistent with the community's needs and best interests, but also to help establish a plan for regulatory compliance.

The most challenging component of the plan selection is the process change required to meet the new discharge permit conditions for the Bridgewater WWTF. The review of the final three process alternatives suggests that the Bardenpho process, which is the most proven process to meet the required 5 mg/l total nitrogen limit, is more invasive and disruptive to the site and existing WWTF systems to implement. The preferred alternative is the addition of new anoxic zones to be combined with continued use of the RBC process at the WWTF. While this process is expected to meet the new nitrogen limit, it is a less commonly applied solution (suspended growth biological denitrification with attached growth aerobic biological treatment and nitrification), and may require more significant modifications if EPA further lowers the effluent limit for total nitrogen to 3 mg/l (as they have proposed for the Taunton WWTF). The recommended process of modifying the RBC to include new anoxic zones for denitrification was selected for its lesser impact on the WWTF, lower total cost to construct and operate, and its favorability for the WWTF operations staff, who have demonstrated their effectiveness for operating the RBC process to achieve near complete nitrification.

The recommended plan presented herein is subject to further local review and approval, or modification, based on a continuing public participation effort. Local stakeholder support of the recommended plan is crucial considering the significant financial investment needed by the Town of Bridgewater to support the implementation of the recommendations.

6.2 Recommended Plan - General

The recommended plan presented herein has many components, which are organized generally into general management and programmatic recommendations, wastewater management and sewer extension recommendations, wastewater treatment and disposal recommendations, water supply recommendations, and stormwater management recommendations. Information on each of these components of the overall recommendations from the comprehensive planning effort is further presented in the following sections.

6.3 Management and Programmatic Recommendations

Over the course of planning, a number of observations have been made on overall management approaches and programs employed by the Town of Bridgewater, or ones that should be considered. A number of the general and programmatic recommendations are presented herein.

6.3.1 Water Reuse

As recent weather patterns in New England have reminded us, water is an increasingly scarce resource. This scarcity is true in the Bridgewater area – and throughout the Taunton River basin. Water resources need careful management and conservation to ensure the best future availability of water locally. One step that the community can take is to seek opportunities for reuse of treated effluent to supplement the need for clean public water. Effluent reuse is an appropriate step for communities where highly treated effluent can be generated that meets the Massachusetts water reuse standards, and where applications for safe reuse exist in the community. Notable reuse options include irrigation and landscape watering, industrial water uses (e.g. cooling water), institutional and commercial toilet flushing, and indirect reuse through aquifer recharge.

Bridgewater has effluent reuse opportunities in several of these areas, notably:

- Potential reuse for toilet flushing at Bridgewater State University (BSU) buildings could be feasible. This option presents reasonably strong opportunities, as the BSU campus has a number of major buildings and facilities located within one half mile of the Bridgewater WWTF.
- Potential reuse for heating/cooling makeup water at BSU could also be feasible based on the proximity of the BSU campus to the WWTF.
- Potential reuse for irrigation and landscape watering, in both general open spaces (greenspace) and at athletic fields and parks. Again, BSU's athletic complex and a number of its fields and open spaces lie within one half mile of the Bridgewater WWTF.

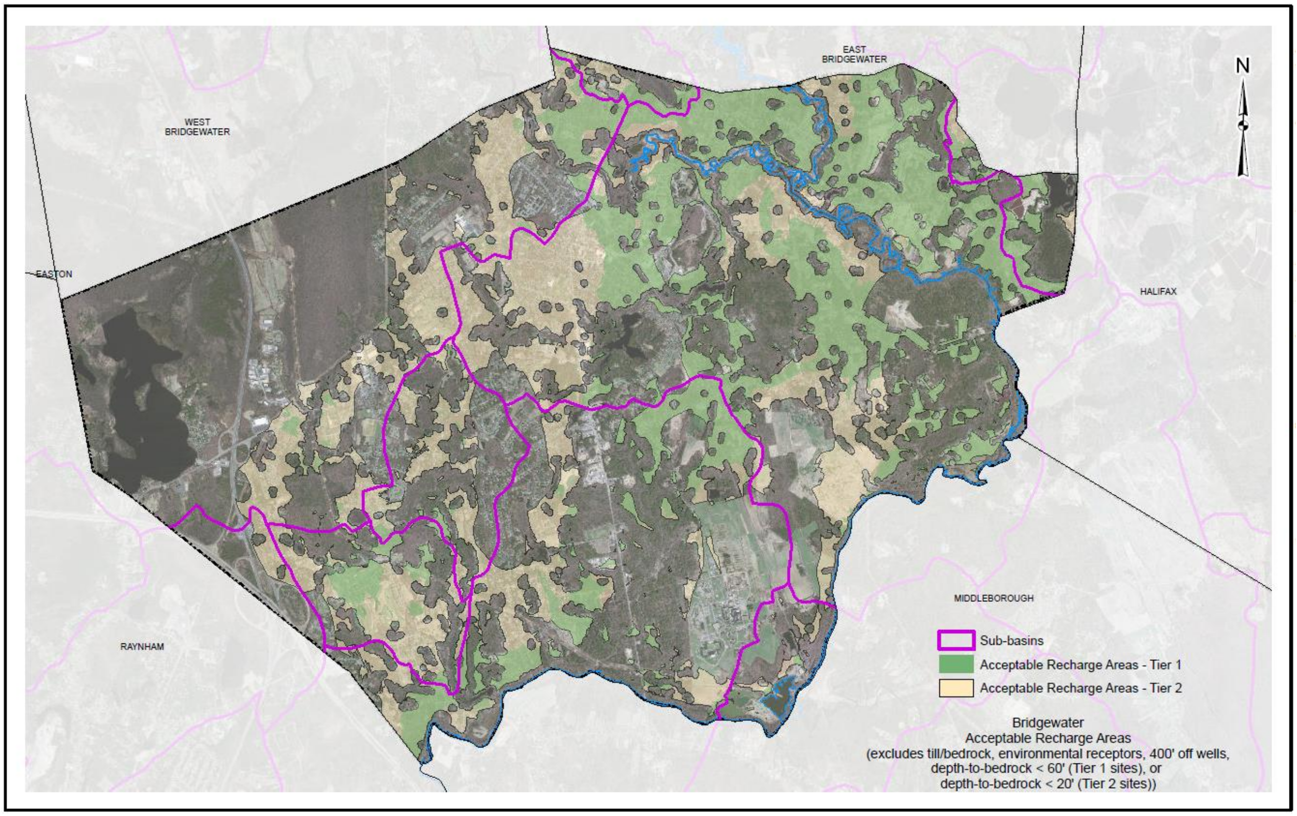
The reuse of highly treated effluent is a proven and safe water management practice, having been employed for many decades in other parts of the United States and overseas. This practice of reuse for landscape watering is now common in Florida and the southwest and is becoming more readily used in all regions. Treated effluent also can provide added benefits when used for landscape watering, as it contains nutrients (nitrogen and phosphorus), which are beneficial to support plant growth.

Reuse of treated effluent for irrigation and landscape watering would be a positive step for Bridgewater, and would help to reduce permitted discharges to the surface waters – As irrigation uses primarily occur during the dryer summer months, the contribution of these practices can limit demand on potable water supplies, while helping to protect groundwater levels and sustain local water balances.

6.3.2 Groundwater Recharge Considerations

The planning effort included performing a basic analysis of groundwater recharge considerations for possible future discharge of stormwater or wastewater effluent. The analysis was based on the key geo-physical conditions, includes depth and permeability conditions of soils. In the event that the town pursues stormwater management or alternative wastewater discharges – including effluent reuse for landscape watering as discussed earlier in this section of the CWMP, beneficial areas for recharge have been screened. These acceptable recharge areas are presented on Figure 6-1: Acceptable Recharge Areas.

Figure 6-1
Acceptable Recharge Areas



6.3.3 Regional Coordination

There are a number of properties in Bridgewater that are connected to sewer systems other than the town system, including a small number of properties connected through Raynham to the Taunton regional system. The town should continue to consider regional partnerships with neighboring communities, and with State owned facilities like the MCI Bridgewater facility, to address specific localized wastewater needs that may arise over the planning period. This may include negotiating to connect key properties with critically failing on-site systems to regional systems when they cannot otherwise be rehabilitated and cannot cost-effectively be connected to the Bridgewater system. Continued open communication with neighboring communities and systems should be maintained by appropriate Bridgewater town officials and staff.

6.4 Recommended Wastewater Management & Sewer System Extensions

The recommended plan for the majority of properties in Bridgewater that are presently not connected to sewers and are served by on-site (septic) systems is to continue to be served by these on-site solutions. On-site systems are a reliable and environmentally sound long-term solution for these properties, and no information has been found to suggest on-site solutions cannot provide appropriate wastewater management for these properties for the foreseeable future. There have been a number of specific needs areas identified in this report that require consideration of off-site solutions, and those are discussed further as follows.

Consistent with the findings of the town's previous planning reports, the future extension of sanitary sewers to various areas of identified need is warranted. The Recommended Plan for wastewater management was developed by compiling the specific recommendations for each subarea presented in Section 5.4 of this report. The subareas recommended for sewering include the following areas.

- Lakeside Drive Area
- Goodwater Way/ Pleasant Street Area
- Dundee Drive/ Aberdeen Lane Area
- Norlen Park Area
- Whitman Street Area
- Hayward Street Area

6.4.1 Lakeside Drive Area

This subarea consists primarily of residential properties. The varied topography divides this area into two sections. The lower-lying parcels may be served gravity sewer, and the more variable grade upland parcels should be served with low pressure sewer. A pump station will be connected to the existing sewer force main on Pleasant Street by a new force main at the intersection of Pleasant and Lakeside. Figure 5-2 (attached) depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 17,400 gpd and the peak flow estimate is 95,600 gpd.

Table 6-1
Lakeside Drive Area Sewer Connection

Component	Approx. Qty	Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	5,500 lf	$325	$1,787,500	59
Low Pressure Sewer	2,100 lf	$150	$315,000	22
Force Main	2,200 lf	$140	$308,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$2,910,500	81

6.4.2 Goodwater Way/ Pleasant Street Area

This area consists primarily of residential properties. The proposed layout consists entirely of low pressure sewer, connecting to the existing pump station on Pleasant Street. Figure 5-2 (attached) depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 6,200 gpd and the peak flow estimate is 33,900 gpd.

Table 6-2
Goodwater Way/ Pleasant Street Area Sewer Connection

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	0	$325	0	N/A

Low Pressure Sewer	1,500 lf	$150	$225,000	28
Force Main	0	$140	0	N/A
Pump Station	0	$500,000	0	N/A
		Total	$225,000	28

6.4.3 Dundee Drive/ Aberdeen Lane Area

This subarea has varied topography and therefore requires the use of gravity sewers and low pressure sewers with individual grinder pumps. This area consists primarily of residential properties. The proposed layout consists of low pressure sewer on the circle of Dundee Drive and the portion of Red Wing Drive depicted in the needs area. The remaining streets are proposed to be serviced by gravity sewer connecting to a pump station on a parcel at the southernmost part of Vernon Street within the needs area. Figure 5-3 (attached) depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 15,000 gpd and the peak flow estimate is 82,300 gpd.

Table 6-3
Dundee Drive/ Aberdeen Lane Area Sewer Connection

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	4,400 lf	$325	$1,430,000	39
Low Pressure Sewer	1,800 lf	$150	$270,000	25
Force Main	5,600 lf	$140	$784,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$2,984,000	64

6.4.4 Norlen Park Area

This area consists primarily of residential properties. The proposed layout consists entirely of low pressure sewer, connecting to the existing pump station on Pleasant Street. Figure 5-4 (attached) depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 13,900 gpd and the peak flow estimate is 76,200 gpd.

Table 6-4
Norlen Park Area Sewer Connection

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	0 lf	$325	$0	0

Low Pressure Sewer	5,700 lf	$150	$855,000	63
Force Main	0 lf	$140	$0	N/A
Pump Station	0	$500,000	$0	N/A
		Total	$855,000	63

The Douglas and Fiske Drive area has been the subject of recent past discussions for sewer extension locally, and the residents of the area were not supportive based on the high costs per residential property.

6.4.5 Whitman Street Area

This area consists primarily of residential properties. This subarea is varied topography and therefore requires the use of gravity sewers and low pressure sewers with individual grinder pumps, force mains, and pump stations. Whitman Street is proposed to be entirely serviced by gravity sewer. Tukoosa Circle and Darlene Drive are both connected by low pressure sewer to the gravity sewer on Whitman Street. The gravity sewer flows to a proposed pump station in front of parcel number 220 on Whitman Street and is connected on Wood Road to the existing sewer by force main. Figure 5-7 (attached) depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 9,000 gpd and the peak flow estimate is 49,600 gpd.

Table 6-5
Whitman Street Area Sewer Connection

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity	3,000 lf	$325	$975,000	22
Low Pressure	1,100 lf	$150	$165,000	19
Force Main	2,500 lf	$140	$350,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$1,990,000	41

6.4.6 Hayward Street Area

This area consists primarily of residential properties. This subarea is varied topography and therefore requires the use of gravity sewers, low pressure sewers with individual grinder pumps, force mains, and pump stations. Hayward Street is proposed to be entirely serviced by gravity sewer. Arrowhead Drive and Yoke Drive are both connected by low pressure sewer to the gravity sewer on Hayward Street. The gravity sewer flows to a proposed pump station in front of parcel number 245 on Hayward Street and is connected on Wood Road to the existing sewer by force main. Figure 5-8 (attached) depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 14,300 gpd and the peak flow estimate is 78,700 gpd

Table 6-6 Hayward Street Area Sewer Connection				
Component	**Approx. Qty**	**Approx. Unit Cost**	**Approx. Component Cost**	**Properties Served**
Gravity	2,100 lf	$325	$682,500	25
Low Pressure	2,000 lf	$150	$300,000	24
Force Main	730 lf	$140	$102,200	N/A
Pump Station	1	$500,000	$500,000	N/A
			$1,584,700	49

6.*4.7* *Summary of Sewer Extension Recommendations*

The recommendations for sewer system extensions are summarized in Table 6-7, which presents the planning level construction costs and the number of parcels served in each area.

Table 6-7 Summary of Planned Sewer Extension Areas		
Area	**Total Cost**	**Properties Served**
Lakeside Drive Area	$2,910,500	81
Goodwater Way/ Pleasant Street Area	$225,000	28
Dundee Drive/ Aberdeen Lane Area	$2,984,000	64
Norlen Park Area	$855,000	63
Whitman Street Area	$1,990,000	41
Hayward Street Area	$1,584,700	49
Total of All Sewer Areas	$10,549,000	326

The average construction cost per property served for all the areas taken together is approximately $32,400 per parcel. These are planning level costs for construction, and are intended to be somewhat conservative, but do not include allowances for engineering or contingencies. As with all planning level costs, many variables can affect the actual project costs – especially when excavation plays a major role in the proposed work.

Another component of the proposed sewer extension cost will be capacity improvements to the downstream collection system (existing pipeline and pump stations) that will be required for the additional flows. As part of the preliminary design phase for the proposed sewer extension project(s), it is recommended that a detailed downstream capacity analysis be completed for each area to be connected to the centralized system.

6.5 Wastewater Treatment and Disposal Recommendations

As detailed in the prior sections of this planning report, significant improvements are needed at the

Bridgewater WWTF. These improvements are driven by two major factors – the pending changes to the WWTF discharge permit conditions, as issued by the U.S. EPA, and the general need for modernization and capital restoration of the WWTF, resulting from age and condition of the WWTF systems. These needs are supplemented by opportunities for improvements in efficiency (including energy savings) and improvements in operability and reliability (substantially driven by technology changes over the life of the WWTF). The overall goal is to restore the facility to a condition and capability that will provide for Bridgewater's needs for the next 20 years.

As presented in the discussion of alternatives (included in Section 5 of this report), the magnitude of the needed improvements to the WWTF is significant – and will be costly. Notably, these improvements and higher costs to implement the recommendations are a result of:

- The fact that the current WWTF process (rotating biological contactors) was never planned to provide total nitrogen removal (which is more easily adapted into other treatment processes).
- The site limitations on the existing WWTF site, which is surrounded (along more than 80% of the site perimeter) by water and wetlands.

In general terms, the WWTF recommendation is to provide for capital improvements to the facility to allow the WWTF to meet future permit conditions and to generally restore the facility life. As discussed in the alternatives considerations, the recommended plan should include rerating the WWTF to increase the average daily flow treatment capacity to 1.54 mgd, and the permitting to support the improvements should include requesting a commensurate increase in the new NPDES discharge permit.

The recommended WWTF improvements are presented as follows, summarized by process area. For some recommendations, a discussion of possible phasing is presented to help improve the affordability of the recommended plan.

6.5.1 Headworks (Preliminary Treatment) and Septage Receiving

Improvements recommended to the WWTF headworks and preliminary treatment systems are generally required for modernization and operability. Recommended headworks improvements include:

- Replace the raw wastewater sewage grinder with a new influent screen. The screen will need to be located in the existing influent channel structure. A new enclosure will be needed to house a container for collection of screenings to be disposed of offsite. A screenings wash/press system will be needed to process raw screenings to reduce organic and water content of screenings, and to convey screenings from the new screen to the screenings storage container. The new screenings storage enclosure needs to be minimized in size, as the enclosed area will be subject to odors and humidity, and the cost to treat the air from this area can add significantly to the cost of the improvements.
- Rehabilitate the existing grit removal system to restore its useful service life. The grit chamber and collection screw system should be refitted and repaired, as needed. A new grit transfer pump should be provided to replace the existing grit pump in the headworks basement. The grit dewatering system (cyclone and degritter/classifier screw) should be rebuilt to restore its service life. The grit blowers and their controls should be replaced with a new energy efficient

blower and air control package.

- Rehabilitate the septage receiving tanks and septage transfer pump systems. The existing receiving tanks and the larger storage tanks should be drained, cleaned and inspected, and any defects in the tankage should be repaired. The mixer systems should be replaced or rehabilitated, and valving for the septage transfer pump systems should be refitted, as needed to restore their service life. Septage storage tank covers and hatches should be refitted and repaired, as needed.
- Rehabilitate the existing headworks building and its building systems to restore the facility service life. The headworks building needs roof replacement and building envelope (door, window and sealing system) improvements. The building mechanical system (heating and ventilating) also needs upgrade and should be replaced with more energy efficient equipment.

6.5.2 Forward Flow Pumping

The existing primary effluent pumping system located in the basement of the operations building lifts flow from the primary clarifier effluent box to the existing secondary biological process. The current hydraulic configuration of the WWTF leaves the primary clarifiers low in the ground, which made them initially difficult to construct with good quality, and subjects them to significant groundwater hydrostatic pressure, and impacts their accessibility for maintenance. In order to lift the primary clarifiers in the hydraulic profile of the WWTF, the following improvements are recommended:

- Provide modifications to yard piping to convey the effluent from the aerated grit chamber to the forward flow pumping system in the operations building basement. Provide new forward flow pumps, piping and valving in the operations building basement to function as primary influent pumps. While the new forward flow pumps will be subject to greater solids than the existing primary effluent pumps, the addition of screening to the preliminary treatment should mitigate any maintenance concerns with the new primary influent pumps. Provide modifications to the yard and process piping to convey flows from the new forward flows pumps to the primary clarifiers.

6.5.3 Primary Treatment

The primary clarifiers are in poor condition and are problematic from an operational viewpoint. The reconfiguration of the hydraulic profile and changes to the forward flow pumping system will allow for new primary clarifiers to be constructed with proper structural conditions and allow improved operator access for maintenance. The recommended improvements include:

- Demolish the two existing primary clarifiers and provide two new primary clarifiers in their place. The new primary clarifiers will be elevated in the hydraulic profile to allow the water surface to be at or above grade. The new clarifiers should be 45 feet or more in diameter, and the raised elevation should allow for improved clarifier sidewall depth. New clarifier mechanisms, drives, bridges, launders, and ancillary piping and valves should be provided as part of the work. Effluent from the raised primary clarifiers will flow by gravity to the secondary treatment process.

The new primary clarifiers should be designed to allow the continuation of co-settling, if the operators choose to continue that process. It is anticipated that flow split into the primary clarifiers will be addressed at the forward flow pumping by feeding each clarifier with a dedicated primary influent pump.

6.5.4 Secondary Treatment with Nitrification/Denitrification

The existing secondary biological treatment system at the Bridgewater WWTF is suffering from age and limited by the original process selection and facility design. The plant operations staff have been replacing RBC media and support systems actively as these aging systems continue to fail at the site. The secondary clarifiers were sized for the attached growth process, but the sizing leaves little capability to modify the process for enhancing treatment.

The biological treatment system improvements are the mechanism by which the Bridgewater WWTF will comply with the new discharge permit limits for total nitrogen and will provide part of the solution for phosphorus removal as well. The process for nitrogen removal includes a need for full nitrification – which is substantially achieved by the existing RBC system, as well as an effective denitrification process. The proposed process will provide new anoxic zones before and after the aerobic RBC treatment process to best support nitrogen removal in the process. The improvements to the biological treatment system will also address the hydraulic limitations of the existing RBC tanks and channels and provide for improved clarification. The recommended improvements include:

- Rehabilitate the existing RBC system to replace all media not recently replaced by the operations staff, and repair or replace all shaft support systems, drives and bearings. This work is intended to provide a rejuvenated biological treatment system to provide for the biological oxidation of organic loads and provide full nitirification of ammonia and organic nitrogen sources.
- Modify the RBC process tank to include the ability to supplement with diffused air to assist with aerobic treatment and to keep suspended biological growth in suspension. Add a new system of small blowers with piping, valves and controls to provide mixing/process air as needed. The new blowers are expected to require limited space and should be located in the operations building, or in outdoor enclosures.
- Modify the tanks and channels in the RBC process areas to add freeboard to accommodate peaks WWTF flows without overtopping. Constructing wall extensions on the existing tanks and channels is likely the most cost effective method of addressing this existing deficiency.
- Construct new pre-anoxic zone tankage, with ancillary systems to include mixers and recycle piping and valves, along with a flow splitter box to distribute flows. Based on our planning level calculations, the pre-anoxic tanks are currently proposed to be configured as four separate tanks with a total volume of approximately 220,000 gallons. The pre-anoxic tanks will receive influent flow from the primary clarifier effluent, and new return sludge flows from the secondary clarifiers and internal mixed liquor recycle pumping systems. Effluent from these tanks will flow by gravity to the RBC system for aerobic treatment.
- Construct new post-anoxic anoxic zone tankage, with ancillary systems to include mixers and recycle piping and valves, along with a flow splitter box to distribute flows. Provide new internal mixed liquor recycle (IMLR) pumping system to provide for internal biosolids returns. Based on our planning level calculations, the post-anoxic tanks are currently proposed to be configured as four separate tanks with a total volume of approximately 330,000 gallons. These post-anoxic zone tanks will receive flow by gravity from the RBC treatment process, and effluent from the post-anoxic zones will flow by gravity to the secondary clarifiers.
- Rehabilitate the two existing secondary clarifiers, including repairing the center columns,

sludge collector mechanisms, and bridges, and providing new drives. Construct a new secondary clarifier flow splitter structure, which will be useable for the initial two, and future three clarifier configuration.

- Modify the existing waste sludge pumping system, including pumps, valves and piping, to provide for return sludge capabilities to support the new treatment process. The improvements are expected to include refitting/rebuilding the existing pumps and adding two new return sludge pumps with appropriate controls. The sludge pumping system should be capable of delivering return sludge to the biological process or wasting sludge to either the sludge holding tanks or to the primary clarifiers for co-settling.
- If necessary based on actual plant loadings observed, construct a new third secondary clarifier. This recommendation is based on the projected loadings on the two existing clarifiers from the modified biological process, which exceed the preferred loadings under design conditions. The new clarifiers should be 50 feet or more in diameter, and should allow for improved clarifier sidewall depth, but actual sizing should be confirmed in design.

We have recommended provisions for a third secondary clarifier, to be constructed under a future contract as a phased approach, as there is a strong possibility that this third clarifier may not be needed in actual operating situations. Preliminary design of the WWTF improvements should confirm the need for additional clarification capacity, and include detailed recommendations for sizing, location and load conditions that would require the additional capacity.

6.5.5 Effluent Filtration

No effluent filtration is provided at the current WWTF, and no such process was envisioned during the initial facility planning. The phosphorus limits provided in the draft discharge permit by EPA are lower than facilities can traditionally meet by biological phosphorus removal (Bio-P) and chemical precipitation with gravity settling alone. In order to consistently meet the new phosphorus limits, effluent filtration should be included in the overall recommended plan. The recommended filtration improvements include:

- Construct a new effluent filtration system to treat effluent from the secondary clarifiers. The specific process selection should be refined through a preliminary design and piloting study, but the planning level recommendation would be for a packaged cloth media system to be provided.
- The filter system will require additional secondary effluent pumping to fit the filter into the hydraulic profile and allow for gravity return to the disinfection process. The new forward flow pumps could be located in the new filter building structure.
- The effluent filter system would require a new filter building be constructed at the site, located in front of (south of) the administration building.

Some facilities in New England have shown the ability to meet approximate limits of 0.2 mg/l total phosphorus using multi-barrier precipitation and settling approaches. Because of the high capital and operating cost of adding effluent filtration to the plant, and the possibility that the plant staff may be able to meet the new limit with the other proposed WWTF improvements, the recommendation for the Bridgewater WWTF is to initially defer the construction of the effluent filtration. Addressing the effluent filtration in a later WWTF improvements phase makes economic and environmental sense.

In addition, deferring the effluent filter to a later phase will allow the ability to consider any new or changed WWTF discharge permit conditions that may arise in the next round of permit renewals, and allow the plant staff to best adapt the newly improved WWTF processes to achieve optimum treatment.

The final selection of filtration technology is a critical and important step in the WWTF improvement design process. Before the final decision is made to incorporate a specific filter technology, we recommend shortlisting a number of filter technologies for final consideration (likely including cloth media filter, granular media filters, and coated media filters, as a minimum). Based on the level of secondary clarifier effluent to be filtered, and the permit limits for phosphorus (and metals), the town should require pilot/demonstration tests of several filter technology finalists before proceeding to design of these systems. These tests should be designed to address key seasonal differences in effluent limits and plant operations.

6.5.6 Disinfection

The disinfection process needs modernization and should be changed to provide a change from gas systems to liquid chlorination and dechlorination systems. The proposed changes also provide an opportunity to improve the efficiency of the disinfection system, which will help to control chemical costs over time. The recommended disinfection improvements include:

- Replace the existing gas chlorination system with a new liquid hypochlorite storage and feed system. System should include two new hypochlorite storage tanks, a system of pumps to allow chlorine feed to disinfection, as well as for process control, day tanks, a fill station, and ancillary systems to support the liquid feed process.
- Replace the existing sulfur dioxide gas de-chlorination system with a new liquid bisulfite dechlorination system. System should include new bisulfite storage tanks, at least two feed pumps, and ancillary systems to support the feed process. The bisulfite system requires design for a dedicated space with proper ventilation requirements due to the properties of the liquid chemical.
- Provide for enhanced mixing in the chlorination feed and dechlorination feed locations within the contact tank. Submersible mixers are the preliminary recommended option.

6.5.7 Solids Dewatering

Solids dewatering has not been a problem at the plant and the operators experience very good results from their dewatering and composting operations. However, the existing systems have essentially reached the end of their useful service life, and modernization of these systems is needed. The recommended improvements for solids dewatering include:

- Rehabilitate the sludge press feed pumping systems located in the operations building lower level. Existing sludge pumps will either be rebuilt or replaced with new positive displacement sludge feed pumps.
- Replace the existing belt filter press equipment with new dewatering presses. The need for different equipment is limited in this area because of the proximity to final composting operations. We anticipate that similar belt filter press equipment will be selected as replacement for the existing systems.
- Renovate and rebuild the sludge conveying systems that transport dewatered sludge from the

presses to the storage garage.

- Replacement of chemical feed systems and controls to support the solids dewatering. The plan includes providing for polymer (liquid) make-up, aging and feed systems, along with provisions for chemical feed for odor conditioning (permanganate), subject to the needs of the dewatering operators.
- Renovate the solids dewatering area and storage/receiving garage to improve air handling (heating and ventilating) systems.

6.5.8 Sludge Disposal Alternatives

The costs related to management, handling, processing and disposal of waste biosolids (sludge) are always among the most significant costs for a WWTF. These costs are driven greatly by:

1. The high cost of solids dewatering operations,
2. The high cost of trucking of solids to disposal,
3. The cost for ultimate disposal (e.g. tipping fees).

Most WWTFs face challenges in all three of these areas, and the final disposal options available typically drive the decisions as to processing and trucking. In the case of smaller facilities, operations often skip on-site dewatering to opt for liquid disposal – resulting in the costs being dominated by the latter two items (2 and 3 above). In the case of larger facilities, trucking and final disposal costs are large enough to drive the need for on-site dewatering to reduce volumes of sludge for disposal. The final disposal of the sludge typically controls, and for many facilities the choice is limited. While commercial composting facilities that create a reusable product are more common, landfilling options are now less common, and incineration options face continuing tighter regulation. The result is a future where final sludge disposal costs present a financial risk for all significant WWTFs.

The Bridgewater facility is somewhat unusual in that the town has had great success with its on-site composting operation. As confirmed by the operations staff, the final disposal of the composted bio-solids end product has not been a challenge for the facility. In fact, the staff has suggested that they have more end users seeking the compost product than they have product available. This beneficial disposal condition is likely due to the excellent quality of the composted final product produced by the Bridgewater composting operation. Considering the success of the composting operation and product distribution (disposal) at no cost to the facility, two of the three cost factors (2 and 3) cited above do not impact the consideration of alternatives for Bridgewater.

Based on the current success of the dewatering and composting operation, and the anticipated ability to continue in this regard in the future, the consideration of other final alternatives for sludge disposal at the Bridgewater WWTF are not warranted. Both liquid and solid disposal options off-site would result in greatly increased costs to the facility and would impact rate payers significantly. The current sludge disposal practices should therefore be continued and preserved for future operations.

6.5.9 Solids Composting

Improvements recommended to the solids (sludge) composting systems are generally limited to modernization needs. Recommended composting area improvements include:

- Provide limited repairs to the compost buildings, composting air blower systems, and compost screen system. Compost operations rolling stock – including trucks and loader, are expected to be updated through the WWTF operations budget, and are not included in the capital improvement recommendations.

6.5.10 Chemical Feed and Storage

Chemical feed and storage improvements are needed to support the new biological treatment processes. Critical chemical feed systems at the WWTF include metal salts for phosphorus precipitation (currently ferric chloride), soda for alkalinity and pH control, sludge conditioning chemicals (polymer and permanganate, or equivalent), and a carbon source to support denitrification. Chemicals for the disinfection (chlorination and dechlorination) process are included in the disinfection recommendations. Chemical storage and feed recommendations include:

- Modify the existing ferric chloride storage and secondary containment facility to include a covered enclosure (roof system) over the secondary containment area.
- Provide improvements to the pumping, piping and controls for ferric chloride to allow feed to multiple points. At least three feed points should be supported – to primary clarifier influent to allow chemically enhanced primary treatment (CEPT), to the back end of the biological treatment process to promote flocculation for settling in the secondary clarifiers, and at a third point in the sludge processing system (sludge holding or dewatering filtrate return) to allow side stream fixing of any phosphorus released from biological solids. A future ability to feed ahead of the effluent filter system may also be needed but should be phased for inclusion with the filter construction.

6.5.11 Instrumentation & Controls

Facilities constructed in the period when the Bridgewater WWTF was built generally have outdated or non-functional instrumentation and control (I&C) systems. In more complex treatment processes, reliable modern I&C systems are needed to monitor and assist operators in maintaining process control. These systems are more critical for plants with extremely challenging effluent limits, as have been required by the new permit for the Bridgewater WWTF. New I&C systems are needed as a key part of modernization, but also to support the new process changes. I&C recommendations include:

- Provide new process monitoring instrumentation for each new process and system added to the WWTF. Provide a new I&C system including system control and data acquisition (SCADA) capabilities to allow monitoring and appropriate level of control for each process and unit operation. The new I&C system should include a redundant head end system to be located in a dedicated plant control room. The system should also allow for remote access to plant operating information by operators via internet connection.

6.5.12 WWTF Buildings

The WWTF buildings need general modernization and also have some defined space needs. This section focuses on the administration and operations building needs. Headworks building needs and certain process area needs for heating and ventilating systems were discussed in other process areas. The recommended improvements include:

- Rehabilitate the existing operations building and its building systems to restore the facility service life. The operations building needs roof replacement and building envelope (door, window and sealing system) improvements. The building mechanical systems (heating and ventilating) also need upgrade and should be replaced with more energy efficient equipment.
- Provide an addition to the administration building to provide new dedicated (separate male and female) staff restrooms, and new dedicated (separate male and female) staff locker

rooms, and additional control and electrical room space to support new electrical systems and new I&C systems.
- Rehabilitate the existing operations building and its building systems to restore the facility service life. The operations building needs roof replacement and building envelope (door, window and sealing system) improvements. The building mechanical systems (heating and ventilating) also need upgrade and should be replaced with more energy efficient equipment.

6.5.13 Electrical Systems

As with instrumentation, plants of the age of the Bridgewater WWTF have outdated electrical systems. The electrical codes and industry practices have changed several times over the past few decades, and improvements to critical processes need to include modernization of electrical systems. Comprehensive electrical system improvements are typically refined in the final facility design, but for planning purposes, the electrical improvements should be expected to include:

- Replacement of critical electrical systems, including new primary transformer and secondaries, if needed, and new primary electrical switchgear to serve the facility.
- Replacement of outdated motor controls centers (MCCs), and provision of new MCCs to meet modern arc-flash and lock-out tag-out (LOTO) code requirements.
- Updating of raceways, conduits, pull boxes and handholds, and replacement of wiring where needed.
- New building lighting systems to meet modern energy codes.
- Refitting or replacement of the standby electrical generator and automatic transfer switch, to meet design standards for the upgraded plant.

The town should be sure to pursue utility rebates to support the costs of electrical system refitting (e.g. lighting or variable speed drive motor controls) that are eligible for local incentives.

6.5.14 WWTF Site Improvements

The WWTF site does not present any need for improvements in and of itself but will need to be improved to allow full access to all buildings and process areas following the completion of the new WWTF process changes. Site improvements will generally include the following:

- New yard piping, with appropriate valves and access pits/manholes, to support the process changes.
- General site grading to accommodate new buildings and tankage.
- New walkways to provide operator access to the process areas.
- New roadways/driveways to provide for service vehicle access throughout the site.
- New site lighting to provide for safe operations.
- Drainage improvements to meet new site runoff control requirements for industrial sites.

6.5.15 Temporary Provisions

In order to construct the recommended WWTF improvements on the existing site, a number of temporary provisions will be needed. These temporary provisions include staging, temporary construction support, flow handling and bypass facilities, and temporary electric and support systems. These challenges affect the construction budget both directly, by adding costs, and indirectly, by adding complexity to the project (which can dissuade contractors from bidding the construction work aggressively).

6.5.16 Summary of Recommended WWTF Improvements

The improvements recommended for the WWTF as presented above provide a comprehensive capital improvement program (CIP) for the facility. Such a comprehensive CIP typically has a significant capital cost to implement. Planning level costs were developed for the recommended capital improvements to the WWTF and are summarized by process area in the following Table 6-8: Summary of Recommended WWTF Improvements.

Table 6-8
Summary of Recommended WWTF Improvements

Process Area	*Recommended Improvements*	*Planning Level Cost*
Headworks & Septage Receiving	New influent screen with enclosure, refit grit removal system, refit septage pumping.	$1,010,000
Forward Flow Pumping	Relocate forward flow pumping ahead of primary clarifiers, and refit systems.	$450,000
Primary Treatment	Remove existing primary clarifiers and build two new clarifiers.	$2,050,000
Secondary Treatment with Nitrification & Denitrification	Refit RBC system, add new pre-anoxic and post-anoxic zone reactors, refit existing and add one new secondary clarifiers.	$5,260,000
Effluent Filtration	New effluent filtration system, with forward flow pumping, in new building.	$2,500,000
Disinfection	Refit disinfection to include new liquid hypochlorite and bisulfite feed systems.	$235,000
Solids Dewatering	Renovate solids dewatering system and support systems.	$1,275,000
Solids Composting	Minor equipment refit of solids composting facility.	$100,000
Chemical Feed & Storage	Upgrade existing and provide new chemical storage and feed (ferric, alkalinity, carbon).	$250,000
Instrumentation & Controls	Plant-wide instrumentation upgrade with new instruments and SCADA head end.	$700,000
WWTF Buildings	Refit operations and administration building, and new 1,000 sf building addition.	$960,000
Electrical Systems	Replace main plant switchgear and MCCs, and upgrade electrical systems.	$1,460,000
WWTF Site & Yard Piping	New and replacement yard piping, and general site improvements.	$795,000
Flow Handling & Bypass	Provide temporary flow handling and bypass systems during construction.	$100,000
Unscheduled Items (Budget)	Allowance for construction of items not specifically identified in planning process.	$860,000
Contractor & Sub Mark-ups (BOH&P)	Contractor and sub-contractor mark-up for bonds, insurance, overhead and profit.	$2,700,000
Subtotal		*$20,705,000*

Construction Contingency (20%)	Contingency to address unanticipated changes in costs.	$4,141,000
Engineering during Construction (14%)	Engineering services during construction, including administration and on-site efforts.	$2,900,000
Construction Total		*$27,746,000*
Admin., Legal and Management (2%)	Cost allowances for administrative, finance and legal costs, and project management.	$550,000
Engineering Design & Permitting (10%)	Engineering services for preliminary and final design, and project permitting.	$2,770,000
Total Planning Budget		*$31,100,000*

A process flow diagram for the proposed WWTF process and operational changes is included in Figure 6-2: Flow Diagram. A site plan showing the approximate locations for the planned additional buildings and tankage is included in Figure 6-3: Site Plan. Additional information and detail on costs for the recommended WWTF improvements is included in Appendix J: Bridgewater WWTF Planning Level Cost Estimate.

6.6 Energy Efficiency and Energy Management

The Bridgewater water and sewer systems include many components that are outdated and in need of modernization. As such, these systems offer opportunities to improve energy efficiency. As water and sewer systems (particularly pumping and treatment) are typically one of the largest energy consumers in a community, system changes could yield significant annual costs savings. In addition, system changes could be eligible for rebate assistance from the local utility, and possibly other incentive programs offered by the state. The most notable areas identified for possible energy savings through the planning work include the following:

- Bridgewater WWTF – Major process equipment uses significant energy resources on a continuous basis. The best opportunities for improvements include air blowers and pumps, where efficient motors and variable speed drives, combined with smart control logic can greatly mitigate major energy use. In addition, process selection can affect energy conservation – the recommendation to keep the RBC process in place recommends the lowest energy impact process at the WWTF, despite some risks that this could increase costs under future discharge permit actions. Also, building heating and ventilating systems, as well as lighting systems can be modernized, which can provide significant life-cycle energy savings.
- Sewer Pump Stations – Sewer pumping systems offer the same opportunities for improving efficiency of pumping equipment. Similarly, building heating, ventilating and lighting systems can be improved.
- Water Pump Stations – Water pumping systems (wells and booster stations) also offer the same opportunities for improving efficiency of pumping equipment. Where systems are housed in structures, building heating, ventilating and lighting systems can also be improved.

Additional opportunities for positive energy management steps may exist in Bridgewater, as well as opportunities to implement some renewable energy strategies. The town should continue to identify and pursue energy management as a means to control operational costs and conserve resources.

We recommend that the town include energy savings and management as specific goals in each of their public works projects going forward, including, as a minimum:

- Selection of processes that offer the best profile for long-term annual energy costs – as an example, treatment processes that are high energy consumers should be avoided, if possible. The selection of the RBC process to remain in place at the WWTF offers these types of benefits. The deferral of the effluent filter process until absolutely needed is a second key example of this recommendation.
- Unless technical reasons prohibit such an approach, providing for premium efficiency motors in all process equipment in the water and sewer systems. This would be incorporated into water pumping system projects, sewer pump station projects, and wastewater treatment projects.
- Unless technical reasons prohibit such an approach, providing for variable speed drives (a.k.a. variable frequency drives, or VFDs) in all process equipment in the water and sewer systems. This would be incorporated into water pumping system projects, sewer pump station projects, and wastewater treatment projects.
- Where applicable, improving building envelopes to provide for more energy efficient heating and cooling of structures, process areas and personnel space.
- Where applicable, improving building heating, ventilating and air conditioning (HVAC) systems to improve energy efficiency, including the use of modern climate control systems.
- Where applicable, refitting all buildings and sites with new energy efficient (LED or similar) lighting systems.

6.7 Water System Recommendations

The Town should continue with the implementation of the Capital Improvement Plan for their water distribution system, including the following upgrades: 1) increasing the size/capacity of undersized sections; 2) looping (additional water main connections) certain sections to improve reliability and circulation; and 3) replacing asbestos/concrete (AC) mains nearing the end of their service life.

The Bridgewater Water Department should continue replacement of water meters as needed to extend service life and improve data accuracy as a basis for billing. Installation of a cellular based data collection should be completed.

The Bridgewater Water Department should also evaluate the comprehensive water conservation program that they currently have in place and identify measures that may be augmented or added to meet likely conditions that will be attached to the WMA permit renewal for their sources.

The Bridgewater Water Department should evaluate town activities since 2005 that may qualify as potential mitigation of increased future water demand. Activities such as stormwater infiltration that increases groundwater recharge and land acquisition for conservation or watershed protection should be evaluated.

6.8 Stormwater Management Recommendations

Planning level costs were developed for compliance with the new MS4 Permit. Table 6-9: Summary of 2016 EPA MS4 Permit Requirements & Cost to Comply outlines the requirements of the MS4 Permit and provides an estimated compliance cost for the five year life of the permit and the 10-year timeframe allotted for implementation of the Town's illicit discharge detection and elimination program. The Town will need to invest an estimated $1.5 to $2.2 million over the next ten years to comply with the permit. Complying with the requirements related to impaired waters and implementing the Illicit Discharge Detection and Elimination Program will carry the largest financial burden.

The implementation and continued operation of a stormwater management program can have significant cost implications. In addition, changes in environmental focus and regulatory requirements dictating improved stormwater quality have significantly increased the cost of maintaining a stormwater program. It is recommended that the town consider alternative methods for raising the funds required to meet and sustain the additional financial demands of stormwater management. A wide variety of funding mechanisms are available including, but not limited to Stormwater Utilities, Revenue Bonds, Enterprise Funds, State Revolving Fund Loans, Impact Fees, Special Assessments, and System Development Charges.

6.9 Environmental Impacts

This section provides a discussion of the potential direct and indirect environmental impacts discussed in sections 6.4 and 6.5

6.9.1 Direct Impacts

Direct environmental impacts relate to the implementation of the wastewater management alternatives and occur either temporarily during construction or permanently as a result of the project. Direct impacts include disturbance of sensitive historical, archaeological, cultural or recreational areas, disturbance of wetlands and plant species habitats, impacts on surface water and groundwater quality, and impacts to normal traffic, business operations or other daily activities in the project area.

6.9.1.1 Historic, Archaeological, and Cultural Resources

Based on a review of the Massachusetts Cultural Resource Information System (MACRIS) from the Massachusetts Historical Commission, no portion of the project is likely to affect significant historic or archaeological resources. The majority of the work is in previously disturbed paved right-of-ways or the existing WWTF. There are two houses within the project needs areas, 157 Lakeside Drive and 132 Whitman Street, that are listed in the State Register of Historic Places, but these structures will not be impacted by the sewer expansion recommended in the roadways.

6.9.1.2 Recreation

Recreational impacts should be mostly temporary in nature, due to the construction noise, traffic access and air quality impacts. Since the work is being performed within existing roadways and the existing WWTF, recreational impacts are expected to be minimal. To the extent possible, construction near Bridgewater State University and the Swenson Athletic complex which is proximate to the WWTF, should be scheduled at a time that would be least disruptive, preferably during the summer months when school is out.

6.9.1.3 Wetlands and Floodplains

There are a number of wetlands within Bridgewater including those bordering the location of the existing WWTF. The impact of the recommended plan to sewer additional needs areas should be positive with regard to groundwater discharge once failing septic systems are removed from service. Wetlands areas provide valuable wildlife habitats. Excess nutrients leaching into wetlands from poorly functioning septic systems can cause water quality degradation and excessive plant growth, which can lead to reduced storage for floodwater retention and can cause floodwaters to overtop banks. Wetland wildlife, such as macro invertebrates, can be sensitive to nitrogen and dissolved oxygen levels. Additionally, wetlands are a natural filtering system for groundwater. The Town of Bridgewater relies solely on groundwater for its water supply and so protection of the wetland areas is a priority for the Town.

Temporary wetland impacts associated with construction will be considered during the final design. The only resource area anticipated to be impacted includes the 100-foot buffer zone of Bordering Vegetated Wetlands. All work will be identified in a Notice of Intent to be submitted to DEP and the local conservation commission for approval. As a minimum, siltation control measures will be used in these areas during construction to mitigate any potential impacts. With the exception of the proposed pump stations, a majority of the work for sewer extensions is within existing roadways and should not create any permanent impacts.

6.9.1.4 Groundwater

The presence of failing septic systems has a potential negative impact on the Town's groundwater resources. The recommended plan will improve groundwater quality by eliminating failing and inadequate on-site sewage disposal systems.

6.9.1.5 Surface Water

Implementation of the recommended plan for both WWTF upgrades and sewer extensions will provide protection of surface water quality. Recommended upgrades at the WWTF were driven by new permit conditions, requiring increased phosphorus and nitrogen removal from the WWTF effluent which discharges to the Town River, which itself flows to the Taunton River.

Sewer extensions will provide for the elimination of failing on-site wastewater disposal systems, and their nitrogen and phosphorous contributions in the project area. Conveying wastewater to the WWTF will help to eliminate untreated or partially treated sewage from entering surface water bodies. The project will result in improved surface water quality throughout Bridgewater including the Lake Nippenicket, Town River, and Taunton River. Lake Nippenicket and the Matfield River in Bridgewater are currently listed as having multiple impairments.

The project will remove or reduce potential sources of pollution in the form of nutrients (which feed noxious aquatic plants), turbidity, and bacteria/pathogen sources; and will thereby help protect the surface water resources in the project area. Once shoreline residences are tied into the sewer, phosphorus and nitrogen entering the reservoir, river and adjacent streams will be reduced. By reducing the (nutrient) pollutant loads to these waters, the project will help toward restoration of designated uses, and further protect the designated uses in the future.

6.9.1.6 Displacement of Traffic, Households, Businesses, and Services

Since the proposed sewer alignments are within existing roadways, there will be impacts on vehicular traffic patterns. Traffic impacts due to increased volume from construction vehicles will be seen and roadway construction may have some short-term effect on existing traffic patterns. To minimize these effects, construction documents should require, when and wherever possible, provisions that all work should include provisions for maintenance of at least a single lane of traffic. Adequate traffic controls shall also be provided. No work is proposed across state highways or commercial areas, limiting impacts on businesses and increased traffic volume areas.

6.9.1.7 Air Quality and Noise

The major impacts to air quality and noise would be short-term due to construction and equipment operation. Sensitive air quality and noise receptor sites, such as residential areas, schools and elderly housing will be identified and appropriate mitigation will be implemented prior to construction. There will be designated work hours to minimize noise and nuisance impacts on residents. Construction equipment will also be equipped with proper devices for noise reduction. In addition, watering of construction sites will be utilized to control the amount of dust generated. No long-term impacts are anticipated with respect to noise and air quality as the project area is already very densely developed. Several recommended improvements at the WWTF will improve odors on side including a new screenings storage area and odor conditioning in solids dewatering.

6.9.1.8 Vegetation and Wildlife

To minimize impacts to vegetation and wildlife habitats, the use of existing roadways for the installation of pipelines has been maximized. NHESP Priority Habitat of Rare Species is located within one needs area of the project area. This area may be temporarily impacted due to construction related activities; however, no permanent alteration of these habitats will occur. All work is within existing paved areas or the existing WWTF site, with the exception of the four (4) proposed pump stations.

6.9.1.9 Greenhouse Gases

Upgrades to WWTF include improvements in energy efficiency discussed in greater detail in Section 6.6. The sewers expansions are expected to reduce the number of septage hauler vehicles and thus decrease their emissions.

6.9.2 Indirect Impacts

Indirect environmental impacts result from induced changes in the patterns of land use and population growth. Specific indirect impacts of the recommended plan could include growth and development.

6.9.2.1 Growth

The main goal of the project is to extend sewer service to environmentally sensitive and susceptible areas and limited developed areas with failed and substandard on-site disposal systems. However, the installation of wastewater collection systems could result in limited induced growth. This growth would result from the development of a limited number of properties that were previously challenged due to site constraints that prevented the installation of an on-site wastewater disposal system. However, this problem will be mitigated with the installation of sewers in areas that have existing wastewater needs. These areas are already densely developed or have been targeted by the Town for further economic development. Therefore, it is not anticipated that negative impacts from unwanted growth will result from this project. Most of the residential areas are already nearly fully developed, with very few developable residential lots remaining in the project area. Overall, there are only a few developable lots or open land within the project area.

6.9.3 Summary of Environmental Considerations

Based on the above discussion, the recommended plan has been evaluated for its anticipated environmental impacts. Despite some temporary, construction-based, environmental impacts, the effects of upgrading the treatment capacity of the WWTF and expanding sewers to needs areas across Bridgewater will result in long-term benefits to the community by improving ground and surface water quality.

Attachment D
ENF DISTRIBUTION LIST

1. Secretary of Energy and Environmental Affairs (2 copies)
   Attn: MEPA Office
   100 Cambridge Street – 9th floor
   Boston, MA 02202

2. Department of Environmental Protection (DEP)
   Commissioner’s Office
   Attn: MEPA Coordinator
   One Winter Street
   Boston, MA 02108

3. DEP – Southeast Regional Office
   Attn: MEPA Coordinator
   20 Riverside Drive
   Lakeville, MA 02347

4. Massachusetts Department of Transportation
   Public/Private Development Unit
   10 Park Plaza
   Boston, MA 02116

5. Massachusetts DOT – District #5
   Attn: MEPA Coordinator
   Box 111
   1000 County Street
   Taunton, MA 02780

6. Massachusetts Historical Commission
   The MA Archives Building
   220 Morrissey Boulevard
   Boston, MA 02125

7. Old Colony Planning Council
   70 School St.
   Brockton, MA 02301

8. Bridgewater Town Council
   Municipal Office Building
   66 Central Square
   Bridgewater, MA 02324

9. Bridgewater Department of Community and Economic Development/ Planning
   Municipal Office Building
   66 Central Square
   Bridgewater, MA 02324

10. Bridgewater Conservation Commission
    Municipal Office Building
    66 Central Square
    Bridgewater, MA 02324

11. Bridgewater Board of Health
    Municipal Office Building
    66 Central Square
    Bridgewater, MA 02324

12. Bridgewater Public Library
    15 South Street
    Bridgewater, MA 02324

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