1

throughout the permit term.

4.4.3 *Public Involvement and Participation*

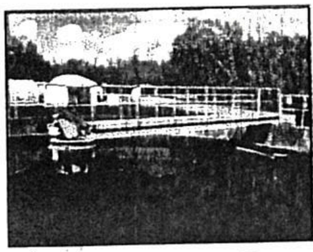
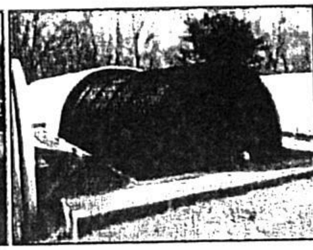
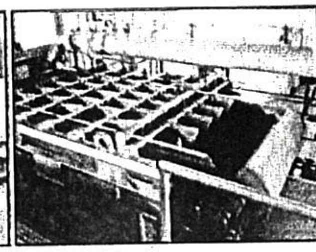
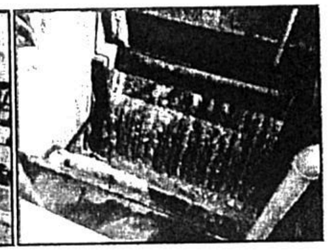
The permit requires the Town to provide opportunities on an annual basis for the public to participate in the review and implementation of the Town's Stormwater Management Program. Public participation activities may include, but are not limited to, posting stormwater information on the Town website, establishing a hotline where illicit discharges can be reported, organizing stream clean-up teams, and forming a Stormwater Advisory Committee.

4.4.4 *Illicit Discharge Detection and Elimination*

The new MS4 Permit requires the Town to implement an Illicit Discharge Detection and Elimination (IDDE) Program to locate and eliminate non-stormwater discharges from the municipal separate storm sewer system. The Town has already adopted an IDDE bylaw in accordance with the 2003 MS4 Permit, which prohibits illicit discharges, and gives the Town the authority to investigate suspected illicit discharges, eliminate illicit discharges and implement enforcement procedures. The new permit requires the Town to eliminate any illicit discharges within 60 days of becoming aware of the discharge. If elimination within 60 days is not feasible, the Town must establish an expedited schedule for elimination.

As part of the Town's implementation of their IDDE Program under the new permit, the Town must develop a more comprehensive drainage map than what was required under the 2003 MS4 Permit. The 2003 MS4 Permit required the Town to map 100% of their outfalls. To date, the Town has located, mapped and inspected an estimated 277 outfalls and 1,375 catch basins. The remaining estimated 213 outfalls have been identified on paper maps, and the Town has plans to incorporate those outfalls into the GIS. Under the new MS4 Permit, the Town is required to map open channel conveyances, interconnections with other MS4s, municipally-owned stormwater treatment structures, all water bodies within Town and their use impairments, and perform initial catchment delineations within two years of the permit effective date. The Town will be required to map all drainage pipes, drain manholes and their remaining catch basins, as well as provide updated catchment areas, within 10 years of the permit effective date. The Town is also required to integrate mapping of their sanitary sewer system with their drainage mapping where sanitary sewer mapping is available.

The Town will need to develop a written IDDE Plan, which details how catchments will be prioritized for investigation and outlines written procedures for how dry weather screening and sampling will be conducted, and how catchments will be investigated. Catchments associated with regulated outfalls and interconnections must be assessed and ranked based on their potential to have illicit discharges, and then investigated over a 10-year period. The sampling and catchment investigation requirements as identified in the MS4 Permit are some of the more extensive requirements outlined in the new permit having the greatest cost implications. The Town will be required to perform dry weather screening and sampling at all regulated outfalls and interconnections. In addition, wet weather sampling also needs to be performed at regulated outfalls and interconnections that have a minimum of one System Vulnerability Factor (SVFs) as identified in the permit. SVFs include, but are not limited to, areas with sanitary sewer overflows, areas with common trench construction serving both sanitary sewer and storm drain alignments, areas where the sanitary sewer and storm drain cross and the sanitary sewer is located above the storm drain, areas where sanitary sewer defects have been identified, etc. The Town must implement a comprehensive IDDE investigation program in all regulated catchments regardless of dry and wet weather sampling results. All key junction manholes within each catchment that have dry weather flow must be opened and sampled for ammonia, chlorine and surfactants at a

Weston & Sampson

westonandsampson.com

5 Centennial Drive
Peabody, MA 01960 (HQ)
tel: 978 532 1900

REPORT

September 2016 (DRAFT)

TOWN OF
Bridgewater
MASSACHUSETTS

Comprehensive Wastewater Management Plan (with Water Resources)

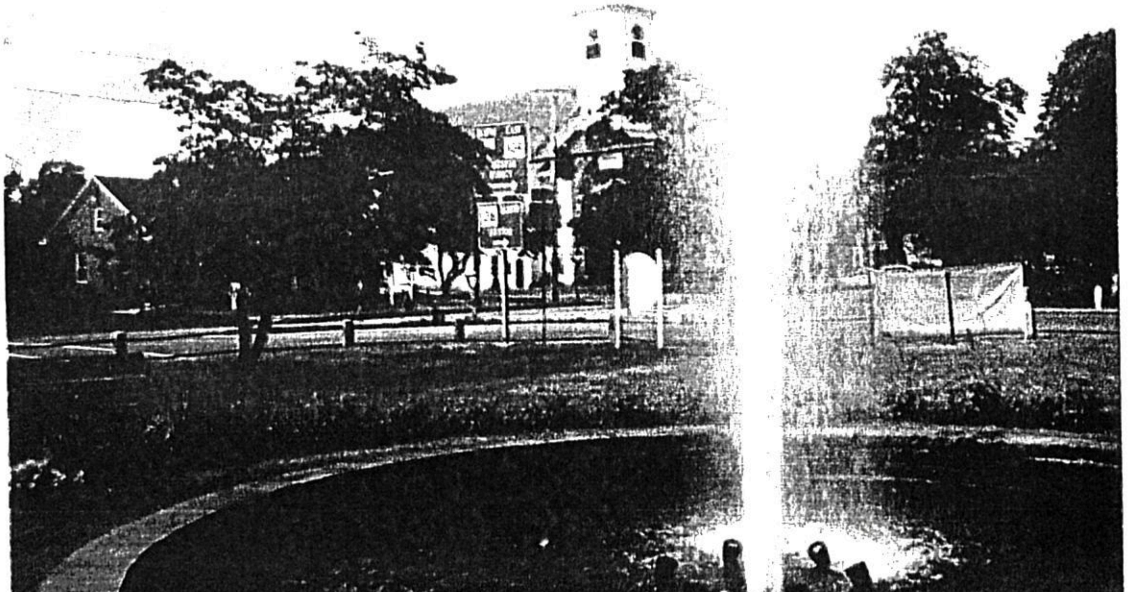


TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

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

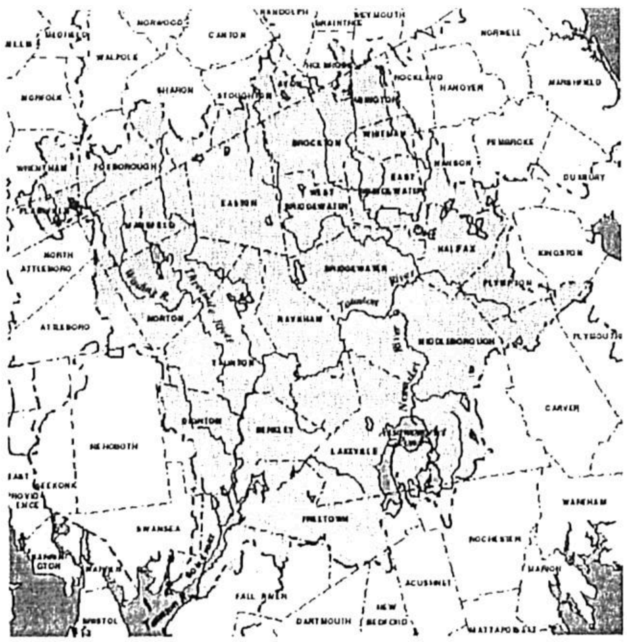
The Town of Bridgewater is located in Plymouth County approximately 27 miles south of Boston. US Route 24 connects the town to the region's major highways, Interstate 495 and Route 128, providing easy highway access to Boston and to Providence, RI. Bridgewater is bounded by Raynham to the west; East 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 State Farm 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.

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

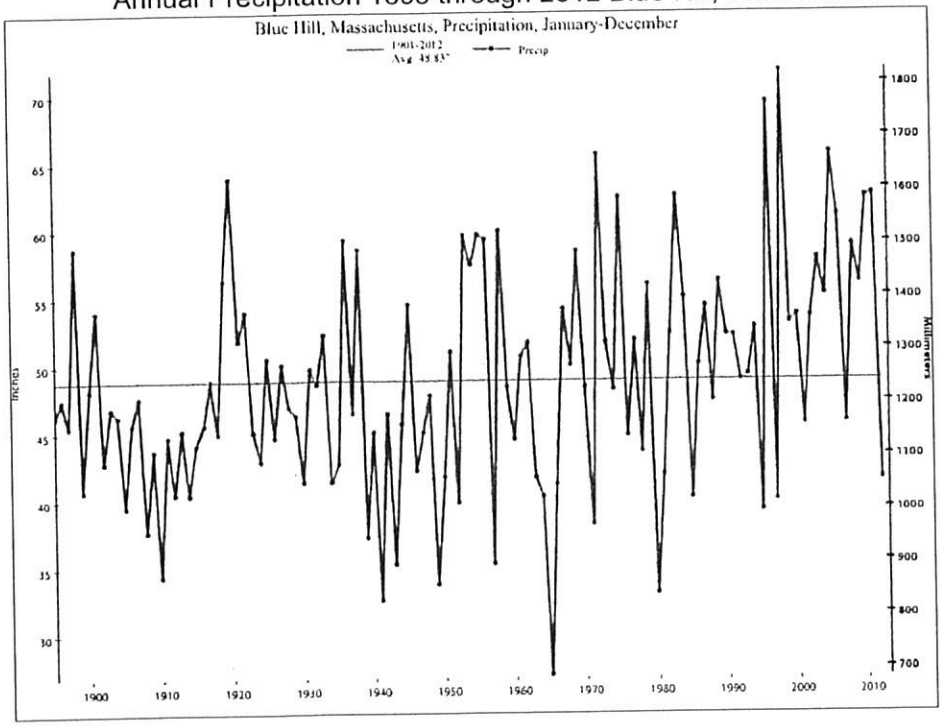


Figure 1-3:
Summary of monthly rainfall data, Taunton, Massachusetts (1875 to 1969)

	MINIMUM MONTHLY PRECIPITATION, IN INCHES AND YEAR OF OCCURRENCE		AVERAGE MONTHLY PRECIPITATION, IN INCHES	MAXIMUM MONTHLY PRECIPITATION, IN INCHES AND 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	3.56	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 public water supply.

1.2.6 Aquifers

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

The second group of wells is located adjacent to Carver's Pond. Four active well 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 develop materials mapped as glaciofluvial materials (USGS GQ 127).

These aquifers are protected by delineation of Zone I and II recharge areas and 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 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 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 BW

The topography of Bridgewater is characterized as low-lying, with scattered wetlands and streams. Generally, elevation ranges from 10 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 commissions that have input in 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 a 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 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. Like most residential communities, commercial and industrial development in town has grown over the years to support the growing residential population. Setting Bridgewater apart from other Massachusetts communities is the presence of a growing university- Bridgewater State University and a correctional institution- MCI Bridgewater. 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 in accordance with 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 line has a sewer connection to the Taunton WWTP through Raynham.

Nearly all developed parcels in Bridgewater receive municipal water service from 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. 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 Route 104 at the Route 24 interchange.
- Scotland Boulevard Industrial Park off of Pleasant Street.
- 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 a sewer connection.

The Town, also with JM Goldson Community Preservation Planning as its consultant, completed its Housing Production Plan in 2012. The Housing Production Plan 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 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.

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 off ce 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 bunking because of a daily count consistently above suggested capacity.

The institution has its own water supply connection to the Town of Taunton and the facility operates their own sewer collection and treatment system, which runs at approximately 50% of its 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 produces a high quality effluent consistently.
- The facility is effectively treating the existing loads with no problem.
- There is reserve capacity to treat additional flows and loads without compromising effluent 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 this 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 area 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 resident students living on campus increased by 86% from 1,520 students to 2,832 students. 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 last 10 years.

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 is comprised of approximately 27 square miles and, in terms of this land area, 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 show's 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 areas where different land uses are zoned to occur. In general, much of Bridgewater is zoned for residential use with business, industrial and mixed use being concentrated in central Bridgewater and along the Route 24 and Route 104 interchange.

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. This shows that the vacancy rate in the Town appears to remain steady over time.

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. Scotland Industrial Park area, just off of Pleasant Street and Elm Street, adjacent 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 zoned the Residential A/B District, which requires the lowest density and 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 designation 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 occurred in 2013. The Report made several recommendations the only issue found with the supply or distribution system was a recommendation to A/C water main be replaced. Other recommendations involved increased sampling and credentials for the distribution system operator both of which have been addressed.

2.1.8 Aquifer Protection District

Like most such provisions, 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 then 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 sensitive areas, particularly in the northeastern section of the town, the area around the southern portion of Carver Pond, and a north-south in a strip 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 area south of Lake Nippenicket to the Raynham line. These provisions provide much protection, but ownership is the greatest protection so being in the District should be an added factor supporting acquisition.

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 (attached) 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.

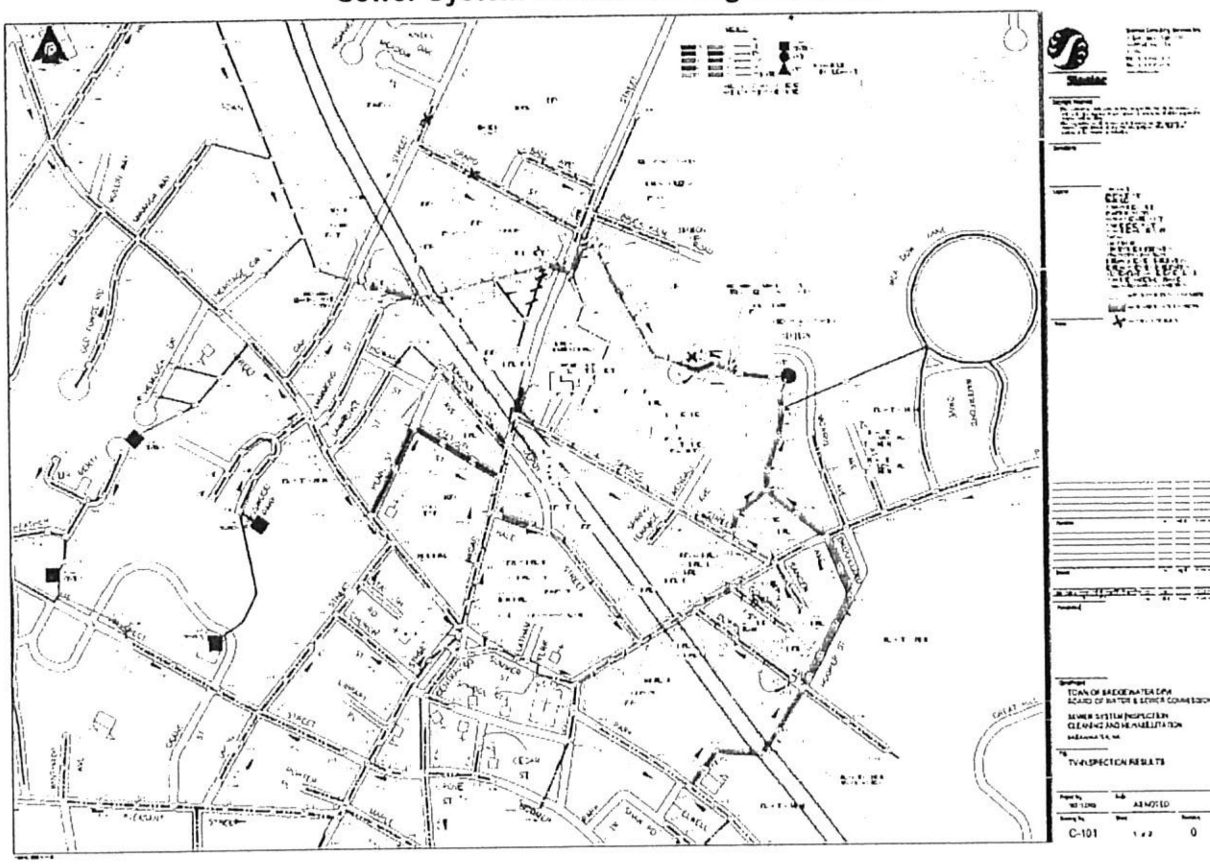
The system is comprised of approximately 35 miles of gravity sewer ranging in size from 5-inch diameter to 15-inch diameter and approximately 15 miles of low pressure sewer mains ranging in size from 2-inch diameter to 6-inch diameter. The oldest segments of pipe were constructed of vitrified clay and asbestos cement, with newer lines being cast iron or PVC. Figure 2-4, Existing Wastewater Collection System 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 MCI Bridgewater institution has its own sewer system and wastewater treatment facility, which currently operates at approximately 50% of its capacity. Because the institution 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 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) include may include up to approximately 620,000 gpd of infiltration, and up to approximately 88,000 gpd of inflow. These quantities correlate to days with high groundwater and rainfall, and therefore relate to higher daily flows – they are not relevant for consideration as fractions of average daily flows. Figures 2-6: Correlation of WWTF Flows to Rainfall and 2-7 Correlation of Flow to Groundwater show the correlation of WWTF flows with rainfall and groundwater, respectively.

Figure 2-6
Correlation of WWTF Flows to Rainfall

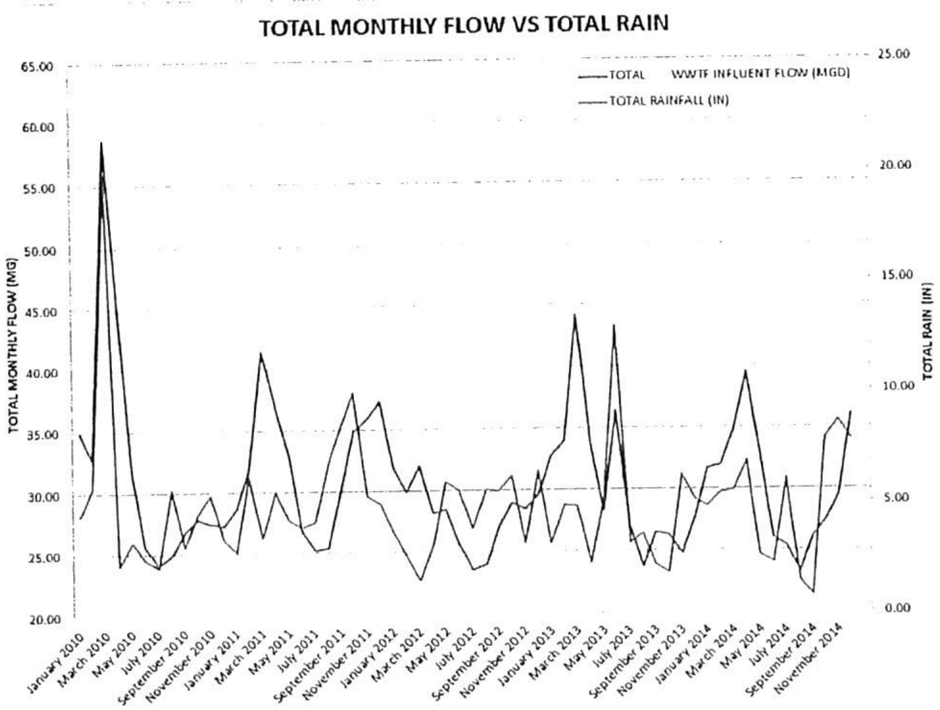
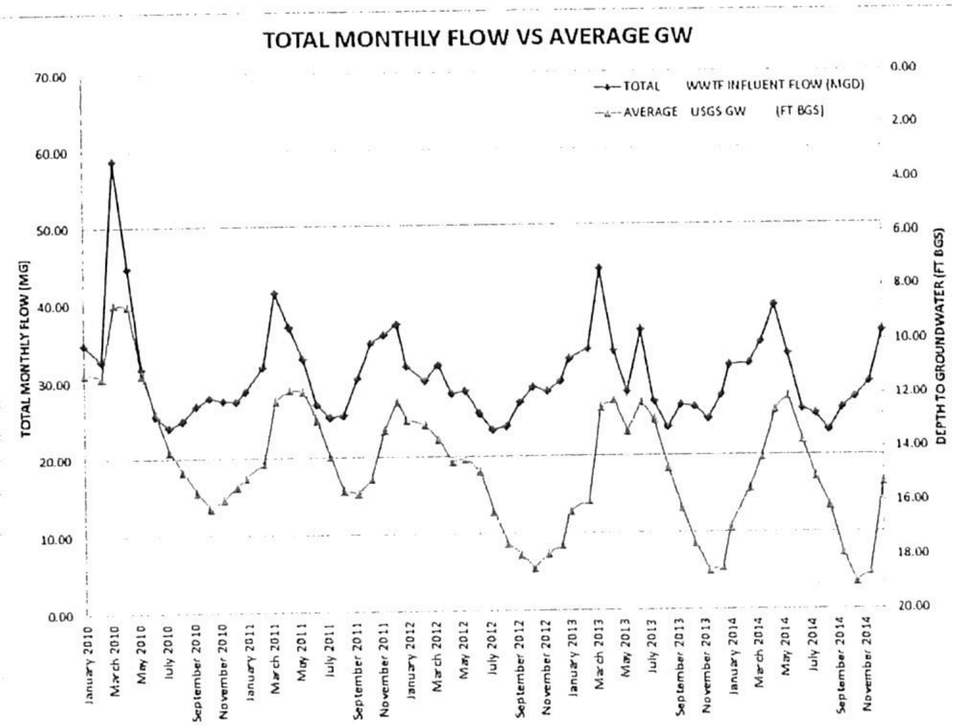


Figure 2-7
Correlation of Flows to Groundwater



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. Systems constructed in the 1960's and 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 last underwent its major revision. The remaining thirty-five percent of on-site systems were built sometime before the last code 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 and 20,000 square feet, respectively. In areas such as High Street, the Aquifer Protection District prevents construction to the zoning minimum unless a denitrification system or credit land 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 fourteen (14) existing 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 1994. 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.

High Pond only

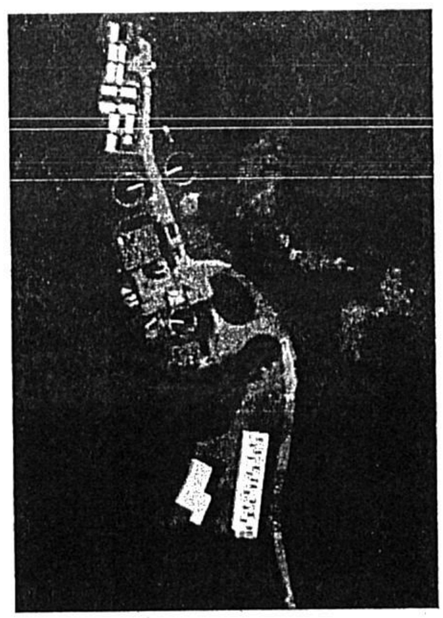
Existing Wastewater Pump Stations	
Water Street Pump Station	Lakeside Pump Station
High Pond Estates Pump Station	Bedford Street Pump Station (private)
Wally Kruger Pump Station	Kingswood Park Pump Station (private)
Harvest Lane Pump Station	Hemlock Drive Pump Station (private)
Dartmouth Road/College Park Pump Station	Mt. Prospect Pump Station (private)
Route 104 Pleasant Street Pump Station	Heather Lane Pump Station (private)
Elm Street Pump Station	Fireworks Circle Pump Station

Based on available information, six of the existing wastewater pump stations were last evaluated in 2004 to document components of the stations and determine the estimated replacement value.

2.2.5 *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 sodium hypochlorite 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 figure included in the text here shows an aerial view of the WWTF site.

Cl_2 gas

Table 2-3
Summary of WWTF Flows

Year	Annual Average Flow (MGD)	High Monthly Flow (MGD)	Low Monthly Flow (MGD)
2010	1.062	1.136	1.048
2011	1.064	1.064	0.974
2012	0.924	1.073	0.924
2013	1.020	1.045	0.927
2014	1.001	1.017	0.963
2015	0.974	1.006	0.974
2016	1.016	0.997	0.957
Overall	*1.009*	*1.136*	*0.924*

2.2.7.2 BSU Existing Flows

As a sub-set to the WWTF flows, specific flow contributions from the town's largest sewer user, Bridgewater State University, were reviewed to better capture the potential change in future conditions and to examine seasonal variation from this continuing flow source.

To estimate existing wastewater flows, we utilized data made available by BSU and flow estimates previously completed by Silva Engineering Associates. As stated in the Bridgewater State University Master Plan Update completed by the Division of Capital and Asset Management (DCAM) in June 2012, BSU has a total of approximately 10,800 students, of which 8,900 are undergraduates and 1,900 are graduate students. Roughly 400 faculty and 500 staff members serve this student population.

Early in the evaluation of existing flows, an attempt was made to show a significant season flow variation to the Town's wastewater treatment facility that could possibly warrant seasonal NPDES Permit limitations in the lower stream flow summer months. It was presumed that the flows in July and August were markedly lower due mostly to the lower water use (and wastewater flows) when the University was not fully occupied with full-time and commuting students. Based on Town water use records, in 2012, water use at the University between June and end of August was 2,800,000 gallons. Water use over the rest of the year was 20,800,000 gallons. Based on this comparison, while there is a marked difference in water use at the University, the actual difference in use (in gallons per day) is not significant enough to warrant "special" NPDES Permit concentrations over the summer months.

Based on recent (January 5, 2016) correspondence with BSU, for FY2014 approximately 30% of the students enrolled at the University live on campus, while the remaining students are considered commuters (70%). Total wastewater flows were estimated using these population numbers and unit flows calculated by Silva Engineering Associates in May 2005 in the Town of Bridgewater Stormwater and Sewerage Capacities analysis. The unit flow for resident students was adjusted for water conservation projects since 2005 based on metered flow for Weygand Hall which is believed to have the newest and most reliable meter on campus. Silva Engineering's analysis concluded that 32 gallons per day of wastewater is generated by each "resident" student and 7 gallons per day of wastewater is generated by each commuter student, faculty, or staff. Note that the unit numbers are consistent with average daily flows as deduced from the maximum daily flows of 65 gpcd presented in Title 5 for college and university type facilities. Adjustment for the resident student population flow contribution (based on the Weygand Hall metered flow) reduced the per capita flow from 32 gpd/capita to 26 gpd/capita. Commuter and staff per capita flow bases were not adjusted. Table 2-4: Bridgewater State University – Estimated Existing Wastewater Flows presents a summary of the expected existing BSU flows using these flow bases.

Table 2-4: Bridgewater State University – Estimated Existing Wastewater Flows

	People	Unit Flow (GPCD)	Wastewater Flow (Gallons Per Day)
Students (2014)			
Commuter [1]	7,830	7	54,810
Residents [1]	3,357	26	87,280
Staff/Faculty	1,060	7	7,420
Total	**12,247**		**149,510**

Notes:
[1] Assumes 70% of students are commuter, 30% are residents.

Weston & Sampson reviewed available Town of Bridgewater water use data for the BSU campus and determined the wastewater estimation method described above is more conservative than the recent water use data would predict. Table 2-5: BSU Per Capita Wastewater Flow based on Town Water Use Records presents the calculated unit flow, in gallons per capita per day using the existing water use data.

Table 2-5. BSU Per Capita Wastewater Flow based on Town Water Use Records

	Wastewater Flow (Gallons Per Day)	People	Unit Flow (GPCD)
Total	58,200	12,247	4.75

Note: Based on 2012 calendar year water use data

Weston & Sampson also compared these unit flow estimates to data available from a similarly sized fully residential New England college. Using wastewater flow data for that College from 2011 to 2014, during the school year flows average approximately 81,500 gallons per day, and for an entire 12 month period, flows are were approximately 61,500 gallons per day. Dividing these values by the student, faculty, and staff population of 2,100, per capita wastewater flows range between 39 and 29 gallons per capita per day.

Based the on the analysis completed by Silva Engineering Associates, unit flows for residential users are in this range, and therefore, to be conservative, estimates of future wastewater flows for BSU will be based on the prior estimates calculated by Silva Engineering Associates. Existing flows for BSU are already captured in the WWTF flows presented in the prior section, so the total existing wastewater flow value for BSU will be used to calculate the differential for estimated future flow at the WWTF.

The above existing flows should be looked at further with regard to the wide discrepancy between the existing recorded water use according to Town records, and the expected wastewater flows based on typical college water use and wastewater generation. Once the town has completed the town-wide Automatic Meter Reading (AMR) installation project, the BSU flows should be compared to historic information to gain a better understanding of these flows. In addition, we suggest that the seasonal variation in flows also be reviewed to determine the seasonal variation in wastewater flow generation from the University. At the higher wastewater flow, a wider flow variation (in gallons per day) would be expected.

2.2.7.3 WWTF Loads

Table 2-6: Existing Influent Loadings presents the average loading and concentrations in the raw sewage influent for biochemical oxygen demand (BOD_5) and total suspended solids (TSS), as reported in the Discharge Monitoring Reports. Both BOD and TSS are measured twice a week, using a 24-hour composite sampler. Over this period, reported influent BOD_5 concentrations ranged from 177 mg/l to 440 mg/l, with loads ranging from 1,541 lbs/day to 3,565 lbs/day. Over this period, the TSS concentrations ranged from 296 mg/l to 912 mg/l, with loads ranging from 2,974 lbs/dy to 7,419 lbs/day.

Table 2-6
Existing WWTF Influent Loadings

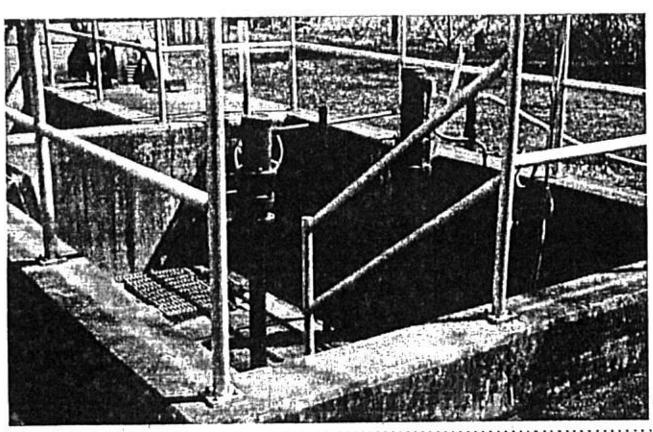
Year	BOD_5 mg/l	BOD_5 lbs/day	TSS mg/l	TSS lbs/day
2010	309	2,651	509	4,322
2011	261	2,328	594	5,219
2012	304	2,436	642	5,105
Avg.	*291*	*2,471*	*582*	*4,882*

The observed and reported BOD_5 influent loadings are consistent with moderately strong domestic wastewater. BSU had previously implemented water conservation measures, which is believed to resulted in a higher strength (not as dilute) discharge from the Town's largest flow contributor. Therefore, these numbers do not appear to need correction.

The TSS influent loadings are higher than expected for strong domestic wastewater. The TSS loadings appear to be influenced by the operational approach of returning waste sludge from the secondary clarifiers to the primary clarifiers for co-settling. This additional solids loading from biological solids reflects as a higher influent loading – but is not a true influent load. Based on secondary sludge volumes reported, the impact of co-settling on TSS would appear to be upwards of 20% of the reported TSS, on average. However, the actual impact on the individual reported numbers is difficult to gauge as sludge wasting is not coordinated with sampling. Lacking information on any strong TSS contributors to the collection system, the true influent TSS concentrations would be expected to be more on the order of 350 mg/l, consistent with a strong domestic wastewater.

2.2.8 WWTF Existing Process & Support Areas

2.2.8.1 Headworks and Septage Receiving/Storage

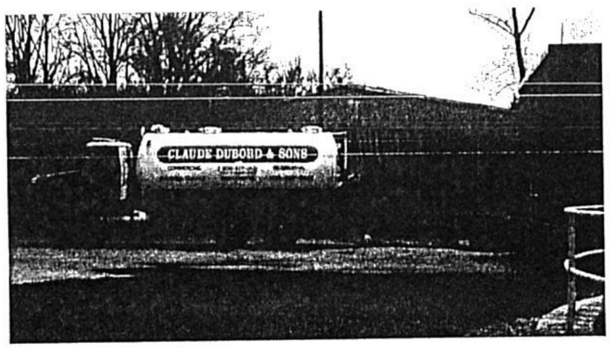


The headworks include a Channel Monster® sewage grinder, which replaced the original comminutor, and is located outside the headworks building. An aerated grit tank, with grit collector, is also outside, and associated grit pumps and a cyclone degritter are located in the headworks building. Septage pumps and blowers, and primary sludge pumps are also in the headworks building. The grinder cuts/shreds solids to 5/16" or smaller, to avoid damage of the treatment devices. Based on a site visit and discussions with Town staff, the current grinder has a design capacity of 5.2 MGD and has exceeded its useful life. A bypass channel with manual bar rack runs parallel with the grinder channel.

The Channel Monster® grinder requires excessive maintenance and is near the end of its useful life. Treatment plant staff would prefer this unit is replaced with screens, as the grinder has poor hydraulic properties and allows solids downstream, causing pump maintenance concerns.

The grit removal system consists of an aerated grit chamber, which removes large particles of grit/sand. Grit removal is necessary to prevent grit, such as sand, wood chips, coffee grounds, etc., from entering the treatment process and causing wear on equipment, and to avoid buildup in the Primary Clarifiers which results in loss of usable tank volume. The grit chamber has a design capacity of 90 cubic feet per minute (CFM) and a detention time of 3.3 minutes at peak design flow. Approximately 20 to 45 cubic feet per week of grit is removed from the system. The two 7.5 horsepower (hp) aerated grit chamber blowers (Spencer blowers) have exceeded their useful life. Based on site visits and discussions with WWTP staff, the effluent end of the grit tank has a poor configuration for splitting flow evenly between the Primary Clarifiers.

The grit removed is pumped into a cyclone degritter and washer to remove organic matter from the grit. The two five horsepower grit pumps have a capacity of 200 gallons per minute. The grit cyclone and washer has a capacity of 300 gallons per minute. In this facility, septage is also pumped directly through the grit cyclone.



The septage receiving station accepts septage from private haulers and stores it to allow for the waste to be added to the WWTF over an extended period. Septage is received into two 8,000 gallon tanks, and is then transferred to and stored in two 44,000 gallon tanks, from where it is distributed into the headworks (over a period of several days). Within the storage tanks, there are 7.5 hp submersible mixers that prevent the solids from settling while septage is being pumped. The original Carter plunger pump intended for transferring septage has been out of service since the 1990's. Septage is currently pumped into the system, through the grit cyclone, using the two Wemco pumps, with capacities of 17 gallons per minute.

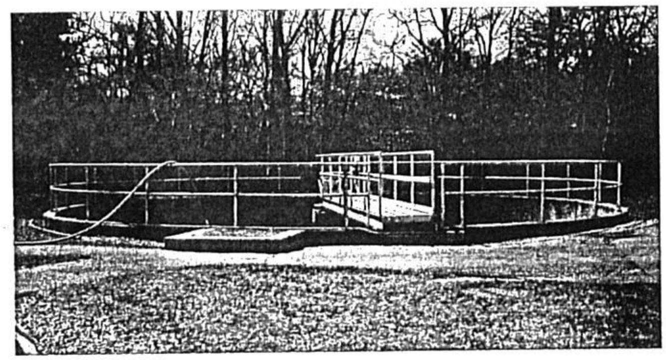
A combination of poor ventilation and no odor control in the headworks has resulted in corrosion due to hydrogen sulfide. The blowers are located in a separate room, adjacent to a mechanical/boiler room and a small storage room. An evaluation of the structure, including need for separate space uses and electrical updates, should be completed in the near future.

2.2.8.2 Primary Settling

There are two primary clarifiers that measure 40 feet diameter with a 7 feet deep side water depth. The clarifiers remove solids, scum and some organic load from the wastewater. Wastewater flows through the clarifiers at a low velocity, allow heavier particles to settle. Solids that float (scum) are removed by skimmers and deposited into a scum box, and then removed using one 3 hp Carter plunger pump, with a design capacity of 27 gpm. Settled primary sludge is removed using two 3 hp Carter plunger pumps, located in the basement of the headworks. These pumps have a rated capacity of 27 gpm. On average, the primary clarifier surface loading rate is 573 gallons per day per square foot.

The operations plan currently includes returning all secondary (waste sludge) to the headworks for co-settling in the primary clarifiers. This tends to increase the loading on the primary clarifiers, but also improves blending of sludge removed to the sludge holding tank. The operators are currently satisfied with this operation scheme.

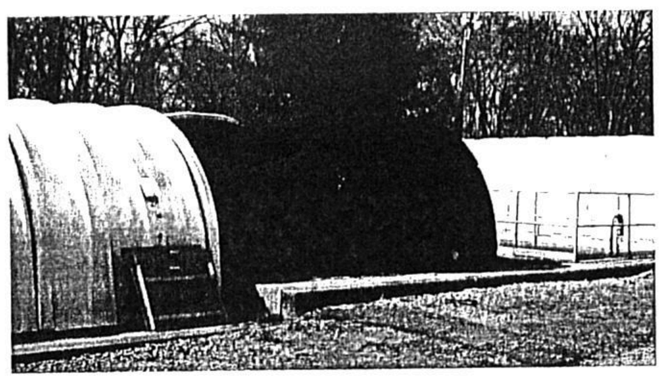
Ferric chloride ($FeCl_3$) is stored outdoors in a tank adjacent to the dewatering building, and is typically added to the clarifiers via a chemical feed system to precipitate phosphorus. This chemical should generally be protected from sunlight, and the storage area lacks a canopy or other structure. Overall, the ferric transfer system needs to be improved, including a dedicated feed area with secondary containment.



The primary clarifiers are set into the ground and the water surface is lower than the downstream biological treatment system, therefore requiring forward flow pumping. Primary effluent flows to a wetwell/tank adjacent to the dewatering building, and is pumped up to the biological treatment (RBCs) by a system of four centrifugal effluent pumps, designed to discharge at a rate of 400 gpm to 1,350 gpm.

The clarifiers are shallow, which limits their effectiveness, and their depth was likely limited by the fact that they sit low on the site and are submerged below the local groundwater table. Because of the configuration and being recessed into the ground, the clarifiers are difficult to operate and maintain. In addition, the site inspection showed the structures are at the end of their useful life, as metal needs replacement, and concrete is exhibiting signs of possible failure. The WWTF staff stated that the Amwell clarifier drives are becoming problematic to operate.

2.2.8.3 Rotating Biological Contractors

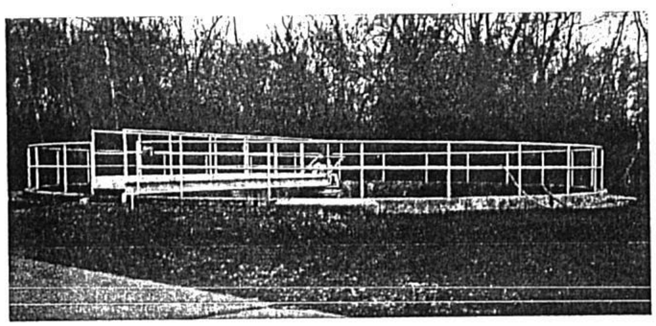


Wastewater is biologically treated through a three stage, 14-shaft RBC system, with a total media surface area of 1,600,000 square feet. The biological treatment process utilizes a concentrated mass of microorganisms to stabilize organic matter contained in the wastewater. The biological growth becomes attached to large-diameter corrugated plastic discs mounted on a horizontal shaft. These RBC media discs are submerged in the wastewater to approximately 40 percent of their diameter Spacing between the disks allows wastewater to enter, providing the microorganisms with food source. As these areas rotate out of the tank, air provides a source of oxygen to allow the microorganisms to consume the organic matter. Growth that sloughs off from the discs is separated from the flow in the secondary clarifiers.

Treatment occurs in three stages. Stage 1 utilizes six shafts with a total surface area of 600,000 square feet. Stage 2 utilizes four shafts and a total area of 400,000 square feet. Stage three consists of four shafts and a larger total area of 600,000 square feet to promote nitrification (conversion of ammonia to nitrite and nitrate). On average, the BOD load from the primary effluent is 1,957 lbs/day. The 1st stage loading is 3.26 lb/day per 1,000 square feet of RBC media, and the overall loading is 1.22 lbs/day per 1,000 square feet of media. Biological treatment has been generally effective, as expected with lower than design flow and loadings. The system historically has difficulty nitrifying in April – the early part of the nitrification season. In addition, much of the RBC media has been reaching the end of its useful life - media has been tearing, and the shaft bearings and support frames are failing. The original RBC media (Lyco) has been replaced on a number of shafts starting in 2012, and a number of frame and support repairs (welds and plates) have been completed by the staff.

The RBC tanks and associated channels were constructed with limited freeboard, which leads to hydraulic constraints. Based on discussions with WWTF staff, the RBCs start overflowing at wastewater flows of approximately 3.5 MGD. This hydraulic deficiency needs to be corrected to allow adequate hydraulic design flows to be processed through the plant.

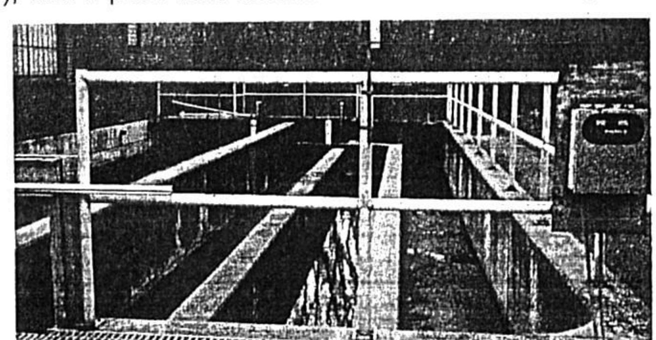
2.2.8.4 *Secondary Clarification*



Following the RBCs are two secondary clarifiers which are 48 feet in diameter and have a 10 foot sidewater depth, with a design hydraulic surface loading rate of 398 gpd/square foot (at average daily flow). These units remove scum and suspended solids, including biomass which sloughs off the RBC media. Low flow velocities allow solids to settle to the bottom, which are removed using two 24 gpm positive displacement pumps. As the biological treatment system is an attached growth process, no return activated sludge (RAS) is provided, so pumped sludge is considered waste activated sludge (WAS). This waste sludge is presently pumped backed to the plant headworks, to be co-settled in the primary clarifiers. Scum (floatable solids) that rises to the surface is collected by skimmers into the scum box, and then pumped using one 24 gpm positive displacement pump.

Precipitation of phosphorus using metal salts (such as FeCl) increases the solids loading on clarifiers. The design surface loading rate may be too high to properly remove phosphate and therefore should be reviewed. The operators noted that the clarifiers are operated without a sludge blanket inventory. The Amwell drives are aging, but the secondary clarifiers are in better structural condition than the primary clarifiers. In addition, the 10' sidewater depth of these units is less than desirable, and may be inadequate to support process modifications.

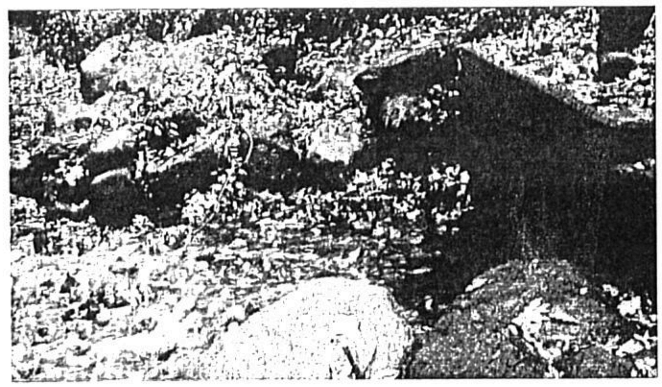
2.2.8.5 *Disinfection*



Two 32,900 gallon chlorine contact tanks (CCT), with a peak flow detention time of 18 minutes, are used to disinfect the wastewater before the effluent is discharge to the Town River. Disinfection is used to kill harmful organisms to protect public and environmental health by reduce spread of bacteria, viruses, and other waterborne pathogens. Chlorine is fed to the head end of the CCT, using two gas vacuum chlorinators which can dose chlorine at up to 300 lbs/day. The plant effluent flow meter is a parshall flume system, which sits at the upstream end of the CCT, and the flume velocity helps provide mixing for chlorine solution dosed just upstream. The chlorine gas supply is 150 pound cylinders, which are stored in a dedicated area. At the end of the contact tanks, dechlorination is accomplished by dosing sulfur dioxide (SO_2), again fed from 150 pound gas cylinders.

Staff reported they are having difficulty finding chlorine gas suppliers and would prefer a liquid hypochlorite and bisulfate system. Another concern is that there is no mechanical mixing at the head of the tanks, where chlorine is added, nor is there mixing at the back end of the CCT for dechlorination. According to operations staff, the efficiency of the disinfection system has generally been good at meeting permit requirements.

2.2.8.6 Outfall



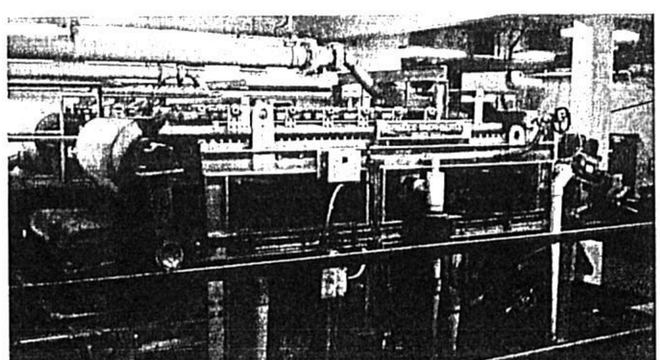
Following disinfection, effluent flows by gravity to an outfall on the bank of the Town River, a tributary to the Taunton River. The gravity outfall has not been problematic for the facility, and there are no known condition issues. End of pipe sampling access to the outfall is via the river bank, and no automatic river staging or other instrumentation is provided at the outfall.

2.2.8.7 Sludge, Production & Storage

Based on discussions with operators, approximately 1,380 lbs/day of sludge at 3.5% total solids is removed from the primary clarifiers (including both primary sludge and co-settled secondary waste sludge), and approximately 860 lbs/day of sludge (at approximately 1.5% solids) is generated from secondary clarification and phosphorus removal. Sludge is stored in a 40 foot diameter, 10 foot SWD storage tank that has a volume of 94,000 gallons. Sludge in the holding tank is mixed using two 7.5 horsepower submersible mixers. Sludge storage capacity has not proven to be a problem for the operations staff.

Because of the attached growth RBC process, there is no return activated sludge (RAS), and all secondary waste solids (equivalent to WAS) are pumped to the headworks where they are blended with raw sewage and co-settled with primary solids. These co-settled solids are dewatered together. This is an inefficient settling process, as it reincorporates phosphorus when the secondary flock is broken by headworks turbulence. Approximately 9,000 gallons per day from each secondary clarifier is returned to the headwork

2.2.8.8 Sludge Dewatering



Sludge is dewatered via belt filter press (BFP), in a dedicated space in the operations building. The plant has two one-meter presses, but typically only one is operating. Sludge is increasingly dewatered as it passes through three zones of operation (gravity drainage, medium pressure, and drum pressure zones). In the gravity drainage zone, water is removed by gravity. In the medium pressure zone, a heavy rubber "drag blanket" provides weight on the sludge mass, causing additional water to be removed. Finally, in the drum zone, the sludge is moved between two belts in a series of drums that squeeze and flex, resulting in creation of "cake". The dewatering system can handle 770 lbs/hour of solids. The system is operated approximately 20 hours a week, and typically produces 5.1 cubic yards per day of sludge "cake" - typically at 25% total solids (TS). Three positive displacement pumps, at 50 gallons per minute, feed sludge to the belt filter press. Polymer, used to coagulate the sludge to get better solids, is fed by two units at rates from 10 to 150 gallons per hour, as needed.

The production of the sludge dewatering system has been sufficient to meet the town's needs. The final product is composted on site, and disposal has not been an issue locally. The equipment (BFP and ancillary systems) is nearing the end of its useful service life, and replacement will be needed.

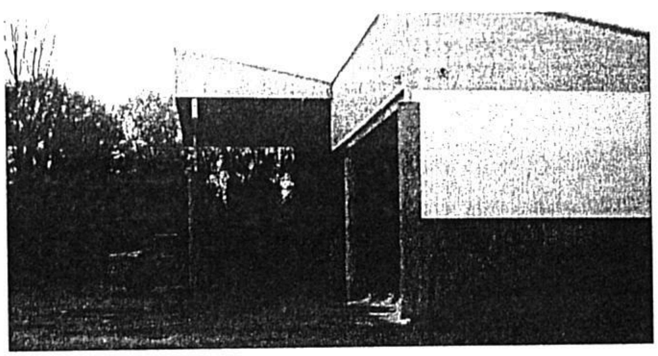
2.2.8.9 Sludge Composting

After sludge is dewatered, the "cake" is brought to the compost processing area and mixed with woodchips and sawdust. The facility has the capacity to process up to 10 piles, and typically mixes five piles a month. The mixture is stored in the drying shed for at least 21 days. The shed can have up to six piles at a time. For the compost to reduce pathogens, it the piles must have temperatures greater than 130 degrees F for three days and greater than 100 degrees F for 14 days.

After the compost has sat, it is screened through a trammel screen to recover loose woodchips and sawdust for re-use. The compost is then moved outdoors to cure for at least 30 days.

The compost area drains to the sewer and enters the headworks. Roof drains and stormwater runoff in this area enters the sewer, and should be re-directed to a stormwater system.

2.2.8.10 Buildings and Structures

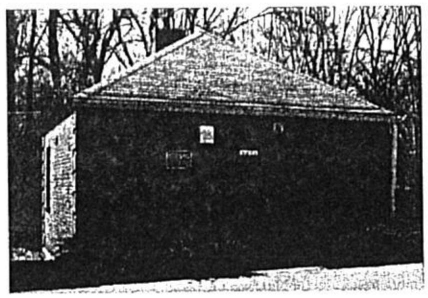


The WWTF has six buildings, in addition to the tankage and treatment structures located on site. Two of these buildings are open-type structures located in the composting area, dedicated to storage and processing for compost. These composting buildings provide protection from weather – primarily rainfall, for the compost processing. Building systems are therefore limited (e.g. no HVAC), and the structures are in serviceable condition. The four process buildings on site are all of brick and masonry block construction, with concrete foundations and subgrade areas. Three of these process building were built during the secondary WWTF upgrade, and th maintenance building pre-dates these newer buildings.

The headworks building has above and below grade levels – and houses septage transfer, grit and primary sludge pumps in the basement area, and grit dewatering and blowers above grade. The building is in fair condition, but needs architectural refit – for example the roofing will need replacement. The mechanical air handling/heating/ventilating systems need upgrade and modernization for efficiency and reliability.

The large main operations building also has a substantial above grade, and a large below grade space. This building primarily houses the sludge dewatering and related processes on the ground level, including a garage for sludge trucking/storage. The lower level includes process pumping, including sludge transfer, wasting and thickened sludge pumps, and forward flow pumps for primary effluent, located in a deeper basement level. The building is in fair condition, but needs architectural refit – for example the roofing will need replacement. The mechanical air handling/heating/ventilating systems need upgrade and modernization for efficiency and reliability.

The administration and laboratory building is a single story masonry building with no basement. Limited operations support space is provided in this building, but it lacks modern provisions for staff support (dedicated restrooms/locker areas, offices, break rooms and meeting space). The building has no below grade level. The building is in fair condition, but needs architectural refit – for example the roofing will need replacement. The mechanical air handling/heating/ventilating systems need upgrade and modernization for efficiency and reliability.



The small maintenance building was previously a process building and has a deep basement which formerly housed pumping. This ground level space is used as a maintenance shop, and doubles as a staff support (e.g. break-room) space. The lower level space is storage, but not especially useful. As with the other buildings, the building envelope is old and the systems need modernization.

2.2.8.11 Electrical Systems

The WWTF electrical systems are typical for the design standards used at the time of planning and construction. While the majority of systems are functional, they are consistently outdated and do not conform to current design standards. Many of the systems (e.g. motor control centers, MCCs) are spaced limited, and will create limitations to upgrade of the facility.

2.2.8.12 Instrumentation and Controls

The WWTF has an outdated master control board located in the Superintendent/Chief Operator's office space. The plant is generally manual in control, with localized control and monitoring by process area – no distributed control or SCADA system is in use. The existing systems are generally not expected to be compatible with modern instrumentation systems.

2.3 Existing Water Systems

This section provides an overview of the Town of Bridgewater's public water supply system including a description of the existing service area, a discussion of the sources and uses of water and an estimate of future demand. The Town operates a system through its Water Department (BWD) that serves approximately 90% of its population. Water is developed from groundwater sources pursuant to Registration # 42504201 issued in 2008 and WMA Permit # 9P-4-25-042.01 issued in 2007 (Table 1). Since 2008, the Commonwealth has developed new regulations that will apply to all new and reissued permits. The Town of Bridgewater's permit is scheduled for reissuance beginning in 2015.

Since the Town's permit will be subject to the new regulations when renewed in 2016, the implications of the new regulations are included in the discussion of the BWD public water supply. Specifically, Water Management Act permitting will incorporate regulations developed through the Sustainable Water Management Initiative (SWMI) that require that existing and new groundwater withdrawals be evaluated for impact to streamflow. Therefore the classification of the two source areas developed by Bridgewater and likelihood for future demand above the existing permitted withdrawals, or the 2005 utilization considered "baseline," is discussed.