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Study on Investment in Water and Wastewater Infrastructure and Economic Development

January 2014

Edward J. Collins, Jr. Center for Public Management

McCORMACK GRADUATE SCHOOL OF POLICY AND GLOBAL STUDIES

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EXECUTIVE SUMMARY

Purpose & Methodology

The Edward J. Collins, Jr. Center for Public Management in the John W. McCormack Graduate School of Policy and Global Studies at the University of Massachusetts Boston was tasked by the Massachusetts Water Resources Authority Advisory Board (MWRAAB) with asking and answering a very fundamental question relating to public infrastructure: "What is the relationship between investment in water and wastewater infrastructure and economic growth?" To do so, Center staff not only researched the positive results of investing in infrastructure, but also took time to consider what failing to invest in adequate water and wastewater infrastructure might mean. Additionally, the Center sought to identify some of the challenges facing Massachusetts today and in the future. The Center divided the task into four components: 1) review of academic research on the topic of infrastructure investment; 2) preparation of Massachusetts case studies illustrative of different successes and challenges; 3) documentation of the state of water and wastewater infrastructure in the Commonwealth today; and, 4) identification of challenges that presently exist and those that are not too far over the horizon.

Where possible, the Center attempted to quantify the financial implications of investing or failing to invest, but it should be understood that these are only order of magnitude figures; significantly more detailed analysis would be needed to determine the true cost. One of the hoped for outcomes of this report is that it will prompt more detailed assessment at the municipal, regional, and state level into the infrastructure issues identified herein.

Summary

Chapter 1: Academic Research

Academic research into the relationship between investment in infrastructure and economic development began in the 1980s and, over time, the earliest findings have been refined and enhanced. These studies used national level data sets to make findings applicable to the nation as a whole. After initially finding that a positive relationship exists between investment in infrastructure and economic opportunity, more recent analysis has gone so far as to attempt to quantify the return on infrastructure investment. Some studies analyzed investment in water and sewer infrastructure specifically and found a particularly positive relationship in this area. Important study findings include:

- *A correlation exists between investment in infrastructure and increases in the Gross Domestic Product.*

In particular, the massive infrastructure investment that occurred after the end of World War II not only positively correlated with economic growth, it showed a relationship to worker productivity which grew dramatically at the time. Not only was infrastructure investment found to be an essential component to

the "'golden age' of the 1950s and 1960s,"[1] a correlation was separately found between the decline in labor productivity of the 1970s and 1980s and the decline in the level of public investment in infrastructure at the same time.[2]

- *Government investment in infrastructure has a far greater impact on private investment decisions than any other type of government expenditure.*[3]

Although federal investment has the greatest influence, state level investment "has a positive impact on several measures of state-level economic activity: output, investment, and employment growth."[4] Investment in water and sewer was actually found to have a greater impact on economic growth than investment in transportation. As one study found, "aggregate public capital and two of its components (highways, water and sewer) make a positive contribution to state output. Water and sewer systems have a much larger effect on state output than highways and 'other' public capital stock."[5]

- *Investment in water and wastewater infrastructure can stimulate private investment, which in turn, generates municipal and state revenue.*

One study of rural development in particular found that "[e]very dollar spent in constructing an average water/sewer project generated almost $15 of private investment, leveraged $2 of public funds, and added $14 to the local property tax base."[6] Another study found that "a $1 investment in water and sewer would generate $2.03 in new taxes over the same period (20 years), on average, of which $0.68 is new state and local tax revenue."[7]

Authors of the studies do caution that while their findings are positive, this does not mean that every investment will produce the results found in the aggregate. The effects of infrastructure investment vary by location, type, and scale, and only project-specific analysis can reveal if a positive return will be generated by a particular expenditure of public funds. One of the more prolific authors on this topic, Alicia Munnell, Senior Economist at the Federal Reserve Bank of Boston underscored this point when she wrote, "Aggregate results, however, cannot be used to guide actual investment spending. Only cost-benefit studies can determine which projects should be implemented."[8]

Chapter 2: Case Studies

The Center prepared five case studies to look at how the national research findings might apply locally. What was found was the same – investment in water and sewer infrastructure can unlock economic potential in an area. The converse was also found – the lack of infrastructure or uncertainty about

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[1] Aschauer, David A., 1990. "Why is infrastructure important?," Conference Series ; [Proceedings], Federal Reserve Bank of Boston, pages 21-68

[2] Munnell, Alicia H., 1990, "Why has Productivity Growth Declined? Productivity and Public Investment," *New England Economic Review*, (January/February), pp. 3-22

[3] Ibid.

[4] Munnell, Alicia H., 1992, "Policy Watch: Infrastructure Investment and Economic Growth," *Journal of Economic Perspectives*- Volume 6, Number 4, Fall, pp. 189-198

[5] Moomaw, Ronald L., Mullen, John K. and Williams, Martin, 1995, "The Interregional Impact of Infrastructure Capital," *Southern Economic Journal*, Vol. 61, No. 3 (January), pp. 830-845

[6] Bagi, Faqir S., 2002, "Economic Impact of Water/Sewer Facilities on Rural and Urban Communities," *Rural America*, Volume 17, Issue 4/Winter

[7] Cohen, Isabelle, Freiling, Thomas, and Robinson, Eric, 2012, "The Economic Impact and Financing of Infrastructure Spending," Thomas Jefferson Program in Public Policy, College of William & Mary, for Associated Equipment Dealers

[8] Ibid

water availability can delay, if not outright halt, development projects. The cases selected represent a cross section of Massachusetts communities, from urban redevelopment sites in Boston and Somerville to land being transformed from agriculture to mixed use in Stoughton. The cases also capture two projects that are transforming previous military or institutional campuses in Taunton and Weymouth. Although these are just snapshots of the issues faced in communities across the Commonwealth, significant lessons can be learned from each.

Among the case studies, the largest scale and most successful projects occurred where water, wastewater, and transportation infrastructure was already in place. These were found in Boston and Taunton, where sites were made development-ready by the provision of roadways, and water and sewer infrastructure, as well as transit, in the case of Boston.

In **Boston**, the 1,000-acre Seaport District (aka, Innovation District) is being transformed, at an unanticipated pace, from surface parking lots and outdoor storage into a dynamic mixed use innovation district. As recently as the 1990s, prior to the expansion and upgrade of the Deer Island treatment plant, the Boston waterfront was heavily impacted by inadequately treated wastewater. Partially treated waste was regularly released into the harbor and relied on tidal action to move the discharged material into Massachusetts Bay, tidal action that was not always successful. In addition, during heavy rainfall, combined wastewater and stormwater would often be discharged directly into the harbor or one of its tributaries via 84 combined sewer overflows. Successful litigation by the U.S. EPA, the Conservation Law Foundation, and the City of Quincy resulted in the creation of the MWRA and a multi-billion dollar investment to clean up the harbor, opening up the Boston Seaport District, and other areas, to new investment and development. The harbor clean up paved the way for additional public investment, including construction of the MBTA Silver Line, completion of the Central Artery/Tunnel Project, marine terminal space optimization, and construction of the Boston Convention & Exhibition Center. Collectively, these investments set the stage for development, and they are showing results today. Between 2010 and 2013, 200 new businesses, including Brightcove, Fort Point Legal, Next Step Living, Rethinking Robotics, and others moved to the Seaport District, bringing 4,000 jobs with them.[9] At present, approximately 30 million square feet of development has been built or permitted within the District, a figure not anticipated until 2025, and an additional 6,300 employees will be moving to the district over the next three years.[10] Estimates are that $2.2 billion was invested by private entities in the area between 1987 and 2004.[11] This amount is projected to increase up to $8.4 billion, based on planned and permitted projects.[12] Development to date is estimated to produce $75 million in local property tax revenues, a figure that will increase in the near future.

Taunton's Myles Standish Industrial Park (MSIP) offers a suburban example of the lesson seen in Boston, which is that readily available infrastructure offers an incentive for businesses to locate to an area. Formerly Camp Myles Standish and the Paul A. Dever State School, the 1,000-acre site currently hosts 5.8 million square feet of development and is home to 100 companies with 7,400 employees. The reuse of the site began in the 1970s with the construction of the 495 beltway, located only 100 yards from the site. The City of Taunton invested over $1.5 million in water and wastewater infrastructure to bring Phase I on line. This investment funded the construction of 20,000 linear feet of 12-inch water main and

[9] Boston Redevelopment Authority, "Boston Innovation District: 3 Years and Counting", February 28, 2013
[10] Leung, Shirley, "Heavy traffic has planners scrambling", Boston Globe, August 16, 2013.
[11] Save the Harbor/Save the Bay, The Leading Edge: Boston Harbor's New Role in the City's Economy, 2004. p. 5
[12] Ibid, p. 6.

15,000 linear feet of sanitary sewer, which connected the individual development parcels to the City's municipal systems. Over time, the private sector has acquired hundreds of acres of land from the Taunton Development Corporations and constructed new buildings. Today, the park generates $6.0 million in local property taxes annually, a figure that is expected to increase to $7.8 million when the final phase of development is complete.

In three other case studies, delays in securing potable water resources or building adequate infrastructure have slowed or even halted economic development. Stoughton overcame a water moratorium, while the Southfield project in Weymouth is still seeking a permanent water source for the later phases of development. In Somerville, plans are being made to grapple with significant stormwater issues.

By joining the MWRA, **Stoughton** was able to end a 20-year moratorium on new water connections that impeded development from 1983 to 2003. In the early 1980s, it had become apparent that the local aquifer could not adequately supply the town and by 1983 the Board of Selectmen put a moratorium on new water connections in place to preserve this dwindling source of water. Despite the Town's best efforts, including bringing two new wells into production, the water situation was not alleviated and in 2000 the Massachusetts Department of Environmental Protection (MassDEP) issued an Administrative Consent Order requiring the Town to find another source of drinking water. During this time period, the town lost jobs, and its commercial tax base was in decline. However, soon after making a decision on a permanent source of water and investing $1.8 million in a new water main, Stoughton's commercial tax base began to grow rapidly. Between 2003, when the moratorium was lifted, and 2009, annual commercial tax revenues grew by $4.5 million (nearly 50%), and the town has become recognized as a retail center with its IKEA, Kohl's, and Target stores.

At the Southfield development in **Weymouth**, the decision on a permanent water source has not yet been made, and the project cannot move into Phase II or Phase III of construction without one. While the Town of Weymouth has adequate water to support Phase I of the development, the water supply is not sufficient for the later phases, even though those are the ones where a greater share of the commercial development will be built. Still under consideration after many years are Brockton's desalination facility on the Taunton River in Dighton and the MWRA as potential sources of water. Perhaps adding more complexity is the fact that Weymouth-Weir Basin is approaching the allowable "safe yield" under the Executive Office of Energy and the Environment's (EOEEA) framework for implementing the Sustainable Water Management Initiative (SWMI). This initiative, which attempts to balance the water needs of consumers and the natural environment, has the potential to impact the amount of permitted water available to communities in the future. Per the project's development plan application, Phase I consists of 500 units of housing and 150,000 square feet of commercial development, leaving up to 2,355 units and 1.85 million square feet of commercial development for future phases. Estimates are that at full build out, the project will generate $11.1 million in annual property taxes combined for the three communities that span the 1,400-acre site, Abington, Rockland, and Weymouth.

In **Somerville**, the City has put plans in place to allow the construction of significant transit-oriented development around the new MBTA Green Line Station that will be built in Union Square, ultimately supporting an estimated 4,300 new jobs and 850 new housing units. However, it faces a very real challenge in addressing existing stormwater issues that have led to flooding in the area in recent years. The issue is twofold. First, across most of the Somerville, stormwater flows into a combined sewer-stormwater system, sending excess water to Deer Island for processing and leading to combined sewer

overflows during storms. Second, the "Old Stone Culvert," which was built to release stormwater from the east Somerville area into the Charles River, has been blocked for decades. As a result, during heavy storms the water has nowhere to go and it comes to the surface. In July 2010, water flooded the City's police station, an adjacent fire department substation, and the public safety building parking lot, damaging or destroying 26 police vehicles. Resolving the infrastructure situation is estimated to cost on the order of $40-50 million, a steep price that will influence how quickly and readily the private sector will be willing to invest in the area.

See Appendix F for two additional case studies prepared by the MWRA Advisory Board for Framingham and Lynnfield.

Chapter 3: Potable Water

Cities and towns in Massachusetts get their water supply in many different ways. Some purchase water from the MWRA, some operate their own municipal public water service (PWS), others participate in a regional water system, either as an operator of the system or a purchaser, still others buy from another municipal public water service or have an independent water district, and some have private water (i.e., wells). Some municipalities may have a combination of the above. Adding to the complexity of this "system" is the fact that water may come from surface water sources, such as rivers, ponds, and reservoirs, or it may be groundwater that is stored naturally in an aquifer.

Even though potable water sources may differ, one overarching challenge that nearly all, if not all, face is the limited funding to maintain, repair, or replace their aging systems. In fact, the Massachusetts Water Infrastructure Finance Commission (WIFC) estimates that a funding gap of $10.2 billion exists between water infrastructure investment needed and funding available in the Commonwealth through 2030.[13] Costs are rising, driven by aging systems and environmental and public health concerns, while funding at the federal and state level is declining, and user rates oftentimes do not reflect the true cost of service, collectively fueling the growing gap. In Boston alone, the estimated cost for repair or replacement of pipes due to wear-out will exceed $60 million through 2030 and $200 million through 2050.[14] As communities struggle to fund system repair and enhancement through loans or general funds, other needed projects are put on hold and the debt burden rises.

In addition, although Massachusetts receives 44 inches of precipitation in the form of snow and rain per year on average, the amount of precipitation across the state's 27 water basins varies over time, with extreme precipitation events causing flooding in some areas and long periods of drought or low rainfall contributing to shortages in others. Water shortages can be further exacerbated by inefficient use and inequitable distribution. The Sustainable Water Management Initiative (SWMI) represents the Executive Office of Energy and Environmental Affairs' (EOEEA) effort to implement the State's Water Management Act (WMA) (WMA, 310 CMR 36.03) by developing a system that evaluates and classifies water sources, and defines the maximum amount of water that can be dependably withdrawn from a basin during

[13] Water Infrastructure Finance Commission (WIFC), Massachusetts's Water Infrastructure: Toward Financial Sustainability, February 7, 2012, p. 4
[14] WIFC, p. 36. Cost estimate start CY 2010 and run through stated period.

Summary of Case Study Financial Projections (estimates only)

Location	Project	Local Property Tax	Projected Population Growth	Projected Job Growth	Increased Local Buying Power (est.)	Increased Annual State Revenue (from jobs only) (est.)
Boston	Seaport District	$75 m (current)	8,123	16,000	$110,086,004	$12,264,486
Somerville	Union Square & Boynton Yards	$45 m (projected)	1,947	4,300	$26,380,915	$3,296,081
Stoughton	Entire town connected to MWRA (2003)	$4.5 m (increase in commercial tax levy)	4,614	753	$62,533,542	$577,197
Taunton	Miles Standish Industrial Park	$7.8 m (projected)	0	2,500	$0	$1,916,326
Weymouth	Southfield	$11.2 m (projected)	6,766	2,533	$91,704,342	$1,941,621
			21,449	**26,086**	**$290,704,802**	**$19,995,712**

Assumptions:

1. The figure for Stoughton's local tax property represents the increase in the annual tax levy fromcommercial property between 2003 and 2009; it does not include all property tax revenues.
2. The Boston Seaport District has 4,000 jobs today, 20,000 projected overall.
3. Seaport District population growth includes existing units, units under construction, and permitted; is not a build out figure.
4. Boston and Somerville had 2.29 persons per household and Stoughton had 2.37 persons per household per 2010 census.
5. The calculations for state revenue from new jobs used the existing distribution of jobs by employment sector for the State, no distinction was made for local conditions.
6. The average retail expenditure per Massachusetts resident per year is $13,553. (Census 2007 Quick Facts).
7. State revenue estimates are for all jobs, not "net new" jobs.

(*This table provides only rough estimates of the financial implications of the five case studies based upon information available; project specific fiscal analysis would need to be done to ascertain the actual revenues to be generated by each.)*

drought conditions.[15] Starting in 2014, the established framework will guide the MassDEP's permitting of water withdrawals.[16] This framework is intended to provide for the continued withdrawal of water for public consumption, but in a manner that will maintain healthy streams and gradually improve degraded ones over time. At the same time, its conservative approach will help ensure that adequate potable water is available in each watershed, even in drought conditions.

Although the initiative is not fully in effect today, this analysis could affect the amount of water authorized for withdrawal from surface and groundwater sources in the future when permits come up for renewal. To preliminarily consider the potential implications of the SWMI framework, employment projections generated by the Metropolitan Area Planning Council (MAPC) as part of its MetroFuture Plan were compared with the communities identified in this report as potentially constrained. This revealed that as many as 44,200 of the 230,000 jobs (approximately 19%) projected to be added to the Boston metro region by 2035 are located in communities with potential water resource constraints. This is based upon a high-level analysis that cannot take the place of detailed local study, but it does point to areas where more study may be warranted. The EOEEA is promoting water conservation and reducing the amount of unaccounted for water as preliminary steps to address potential water constraints, but depending on the community this may not be enough to offset the increased water needs generated by new development. Given that MetroFuture-projected jobs may generate up to $176 million in State revenues each year, if attention is not be paid to the potentially constrained communities, State revenues may remain unrealized.

Chapter 4: Wastewater Treatment

As with potable water, Massachusetts is home to many different models of managing wastewater and stormwater. Some municipalities send their wastewater to MWRA, others operate their own wastewater treatment plant(s), or send the water to a regional treatment plant or an independent water district. In some communities, property owners maintain their own on-site septic systems. In most instances, these only serve one household or business, but in case of the Town of Hamilton, a shared septic system serves multiple businesses in the town center. In terms of stormwater, outside of the older urban cities, most communities have their stormwater and wastewater separated into two different pipe systems. However, in Boston, Cambridge, Somerville, Springfield, Worcester, and a few others, the pipes are combined and during a storm, the amount of water sent to the treatment plant increases substantially, leading to combined sewer overflows (CSOs) at times.

What is common among most Massachusetts communities is the need for additional funding for repair and renovation of their wastewater treatment systems. From the 1970s to 1980s in an effort to comply with the Clean Water Act of 1972, the federal government provided 75% of the cost for sewer projects. As a result, many facilities across the Commonwealth were built at that time and today have either passed or are approaching their 30- to 40-year anticipated lifespan. In fact, the WIFC estimates that up to $18 billion may be needed over the next 20 years for wastewater infrastructure in Massachusetts alone, depending on regulatory requirements.[17]

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[15] Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Sustainable Water Management Initiative: Framework Appendices, November 28, 2012, p. 1
[16] Ibid. p. 4
[17] WIFC, p. 4

Public wastewater distribution systems are also regularly subject to changes in environmental regulations, often times requiring multi-million dollar upgrades to the treatment plants or their associated distribution systems. For larger service areas such as the MWRA or regional districts, the capital costs of these improvements can be spread across large numbers of rate-payers, but for smaller municipal districts, they must rely upon local residents or businesses to fund large portions of the upgrade costs. Municipalities must also keep current on the regulations in order to avoid fines or penalties.

In terms of implications for economic opportunity, most municipal and regional WWTPs appear equipped to accommodate future growth, even though heavy water events do infrequently overwhelm plants causing flooding or overflows. However, at four Massachusetts wastewater treatment plants (Concord, Lynn, Marlborough, and Rockland), current demand for wastewater processing exceeds 85% of permissible average flow, a situation that may affect future growth in these communities if not addressed. In two other locations, Brockton and the Charles River Pollution Control District (CRPCD), when population and employment projections are taken into account, the resulting wastewater volume approaches, if not exceeds, the capacity of the existing systems. The CRPCD serves the towns of Bellingham, Medway, Millis, and Franklin. Interestingly, four of these communities (Bellingham, Medway, Millis, and Rockland) are projecting a reduction of 686 jobs by 2035, while the remaining four (Concord, Franklin, Lynn, and Marlborough) are projecting increases of nearly 7,300 jobs. In addition, all eight communities have a combined population growth projection of nearly 100,000 new residents by 2035. The number of employees and residents taken together will contribute to an increase in waste-water processing needs that will tax those treatment facilities that have limited excess capacity today.

Conclusion

Although the Commonwealth's water, wastewater, and stormwater infrastructure systems are typically hidden from view, and therefore less in the forefront of the minds of the public than other forms of infrastructure, such as transportation systems, they have a direct impact on the economic vitality of the state. What can be seen through academic research is that a relationship exists between economic growth and investment in public infrastructure, particularly water and wastewater infrastructure. The Massachusetts-specific case studies made the same finding, showing that where adequate infrastructure is already in place, economic development can occur quite expeditiously, but where infrastructure is inadequate or water availability in question, projects can be delayed for years, if not halted entirely. Although Massachusetts appears to have come out of the Great Recession more rapidly than other states, its hallmark industries of biotechnology, technology, medical services, and education are being sought by states across the country. Infrastructure availability, capacity, and reliability constitute one dimension upon which other states may wish to compete for these attractive business sectors.

Impacting communities' ability to meet the needs of new and growing businesses are their rapidly aging infrastructure, changing regulatory requirements, and increasingly constrained funding resources. In few instances do local ratepayers have the capacity to absorb the rising costs for maintenance and improvements by themselves, particularly given the Massachusetts Water Infrastructure Finance Commission's estimates of funding gaps of $10.2 billion and $18 billion for water and wastewater infrastructure, respectively, through 2030. Nevertheless, significant state revenues, current and future, may be at risk if something is not done.

Although the Center cannot make a specific recommendation as to the amount of funding needed to address these issues in the same way that the WIFC has done, it is clear that additional resources are needed for cities, towns, and water districts across the state. In addition, particular attention should be paid to those communities that have been identified under the SWMI framework as being potentially constrained, for approximately 19% of the new jobs projected in the Boston metro area by 2035 are located in those communities.

Data Sources and Study Area

As can be seen in the bibliography, the Center used an array of sources, including academic papers, Massachusetts-specific studies. Of particular relevance and significance was the invaluable work performed by the Massachusetts Water Infrastructure Finance Commission (WIFC) on the cost of infrastructure and the Executive Office of Energy and Environmental Affairs (EOEEA) as it relates to implementation of the State's Water Management Act. Center staff also contacted many communities directly and found them to be forthcoming with data and insights about their particular systems and circumstances. One important resource used in considering the implications of future growth was the Metropolitan Area Planning Commission's (MAPC) 2008 plan entitled *MetroFuture Making A Greater Boston Region*. In this plan, MAPC provides detailed projections for population and employment growth for municipalities in the Boston metro region through 2035. The Center had the benefit of receiving updated MetroFuture projections directly from MAPC in Spring 2013. A more detailed description of the MetroFuture plan and some of its data is included in Appendix C.

While the Center's report is comprehensive in nature and discusses many issues facing the Commonwealth as a whole, it was beyond the capacity of the report to address all municipalities and all circumstances. As a result, the geographic focus had to be somewhat narrowed at times. Specifically, unless otherwise noted, Cape Cod, the islands, and the Berkshires are not included in the maps and tables. The chapter on wastewater treatment (Chapter 4) further reduces the study area to focus on eastern Massachusetts where a greater proportion of communities are served by public wastewater treatment facilities. In addition, analysis of the implications of future growth concentrates exclusively on the Boston metro region using the data provided by MAPC.

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STUDIES ON INVESTMENT IN INFRASTRUCTURE

OVERVIEW

Academic research into the relationship between investment in infrastructure and economic development began in the 1980s. Over time, the earliest findings have been refined and enhanced. Initially, researchers began by asking whether public investment in infrastructure had any connection to economic growth. Other researchers built upon the earliest efforts and sought to understand the relationship between public investment in infrastructure and private investment. More recently, researchers have gone so far as to attempt to quantify the return, in terms of economic growth and tax revenues, on the public investment, and some studies have looked specifically at investment in water and sewer infrastructure.

Important study findings include:

- A correlation exists between investment in infrastructure and increases in the Gross Domestic Product.
- Government investment in infrastructure has a far greater impact on private investment decisions than any other type of government expenditure.
- Investment in waste disposal and water systems offers a greater stimulant to the regional economy than increased public funding for highways.

However, authors of the studies caution that their findings, which use data collected for the U.S. as a whole, do not mean that every investment will produce the results found in the aggregate. The effects of infrastructure investment vary by location, type, and size of the investment, and *only project-specific analysis can reveal if a positive return will be generated by a public expenditure*. One of the more prolific authors on this topic, Alicia Munnell, Senior Economist at the Federal Reserve Bank of Boston underscored this point when she wrote, "Aggregate results, however, cannot be used to guide actual investment spending. Only cost-benefit studies can determine which projects should be implemented."[18]

[18] Munnell, Alicia H., 1992, "Policy Watch: Infrastructure Investment and Economic Growth," Journal of Economic Perspectives- Volume 6, Number 4, Fall, pp. 189-198

ANSWERS TO KEY RESEARCH QUESTIONS

Following is a brief synopsis of answers to four key research questions; more detailed summaries of relevant studies can be found in Appendix A:

- *Does investment in public infrastructure have an impact on economic growth?*

David Alan Aschauer (University of Michigan) and Jeremy Greenwood (University of Western Ontario, Canada, and Rochester Center for Economic Research, New York) were the first to study the connection between infrastructure investment and economic growth. Prior to their work, researchers focused on the impacts private investment had on the gross domestic product, leaving unasked the question of the role of public investment. By using macroeconomic data, the researchers found a strong correlation between infrastructure investment and growth in Gross Domestic Product.[19] In particular, they found that the massive infrastructure investments that occurred after the end of World War II not only positively correlated with economic growth, they also showed a relationship to worker productivity which grew dramatically at the time. A study by Aschauer published in 1989, "presents time series evidence for the post-World War II period in the United States that a 'core infrastructure' of streets and highways, mass transit, airports, water and sewer systems, and electrical and gas facilities bears a substantially positive and statistically significant relationship to both labor and multifactor productivity."[20] Similar results were derived by Douglas Holz-Eakin[21] of Columbia University.

Building upon the initial findings was a study that found the opposite to be true – lack of investment in public infrastructure can be correlated with lowered labor productivity. In 1990, Alicia Munnell, Senior Economist at the Federal Reserve Bank of Boston, published a report finding a relationship between the decline in labor productivity of the 1970s and 1980s and the decline in the level of public investment in infrastructure. While the decline in public investment was not the sole cause of the decline in productivity, Munnell concluded that, "The public capital-labor ratio, however, continues to decline, acting as a drag on the growth in labor productivity." [22]

- *What is the relationship between public investment in infrastructure and private investment?*

Researchers have found a substantial positive relationship between public investment in infrastructure and private investment. In his 1990 report entitled "Why is infrastructure important?" David Alan Aschauer sought to determine the magnitude of impact that investment in infrastructure had on economic output and found that government investment in infrastructure has a far greater impact on private investment decisions than any other type of government expenditure. "Given that public capital

[19] Aschauer, David Alan & Greenwood, Jeremy, 1985. "Macroeconomic effects of fiscal policy," *Carnegie-Rochester Conference Series on Public Policy*, Elsevier, vol. 23(1), pages 91-138, January

[20] Aschauer, David Alan, 1990. "Why is infrastructure important?," Conference Series ; [Proceedings], Federal Reserve Bank of Boston, pages 21-68

[21] Holz-Eakin, Douglas, "Private Output, Government Capital, and the Infrastructure Crisis," *Discussion Paper* Series No. 394, New York: Columbia University, May 1988

[22] Munnell, Alicia H., 1990, "Why has Productivity Growth Declined? Productivity and Public Investment," *New England Economic Review*, (January/February), pp. 3-22

complements private capital, an increase in the public capital stock can be expected to stimulate private capital accumulation through its effect on the profitability of private capital."[23]

Up to this point in time, research had predominantly used national-level data to understand the effects of public investment in infrastructure. However, in 1992, Alicia Munnell took the analysis further and began to look at the data at the state level, finding that state level investment also had a positive correlation with private investment albeit on a smaller scale. "Taken together, these three analyses indicate that public capital has a positive impact on several measures of state-level economic activity: output, investment, and employment growth. The magnitudes of these effects are considerably smaller than those found at the national level; for instance, the elasticity of public capital with respect to output was .15, roughly half the estimate at the national level."[24]

- *What is the return on investment in public infrastructure?*

In 2012, Isabelle Cohen, Thomas Freiling, and Eric Robinson at the College of William and Mary published a paper that attempted to understand the short- and long-term financial return generated by infrastructure investment. They found that, "In the short-run, spending on infrastructure produces twice as much economic activity as the level of initial spending. These effects are most heavily concentrated in the manufacturing and professional and business services sectors, but also accrue to smaller sectors like agriculture. In the long-run, spending on all types of infrastructure generates substantial permanent positive effects across the economy as a whole. Money spent now will produce significant tax revenue returns to the government's budget over twenty years." [25]

Over the long term, they found that the results of public investment are amplified. In particular, the group determined that every $1 invested at the beginning of a 20 year period would yield $3.21 in GDP growth at the conclusion of the period. In addition, in the aggregate, $1 invested in infrastructure would generate almost $0.96 in new taxes over 20 years.

- *What impact does investment in water and sewer infrastructure have?*

In 1995, researchers from the University of Oklahoma, Clarkson University, and Northern Illinois University analyzed the effects of investment in different infrastructure components individually and found a greater impact resulting from investment in water and sewer infrastructure than other types of infrastructure. Their report concluded that "aggregate public capital and two of its components (highways, water and sewer) make a positive contribution to state output. Water and sewer systems have a much larger effect on state output then highways and 'other' public capital stock." [26] They further found that, "The implication is that additional investment in waste disposal and water systems offers a greater stimulant to the regional economy than increased public funding for highways. Also, willingness to facilitate the building of water and sewer infrastructure may allow states to maintain or

[23] Aschauer, David Alan, 1990. "Why is infrastructure important?," Conference Series ; [Proceedings], Federal Reserve Bank of Boston, pages 21-68

[24] Munnell, Alicia H., 1992, "Policy Watch: Infrastructure Investment and Economic Growth," *Journal of Economic Perspectives*- Volume 6, Number 4, Fall, pp. 189-198

[25] Cohen, Isabelle, Freiling, Thomas, and Robinson, Eric, 2012, "The Economic Impact and Financing of Infrastructure Spending," Thomas Jefferson Program in Public Policy, College of William & Mary, for Associated Equipment Dealers

[26] Moomaw, Ronald L., Mullen, John K. and Williams, Martin, 1995, "The Interregional Impact of Infrastructure Capital," *Southern Economic Journal*, Vol. 61, No. 3 (January), pp. 830-845

enhance their competitive advantage in attracting new facilities and jobs." [27] The authors warned, however, that these findings differ substantially based upon local conditions and may be due, in part, to the significant roadway networks already existing in many communities.

A study by the U.S. Department of Agriculture looked at the impact of specific infrastructure investments made by the U.S. Department of Commerce, Economic Development Administration (EDA) in 1989 and 1990 and found positive benefits from investment in water and sewer infrastructure where it helped businesses expand or locate in a community. "Water/sewer projects can save and/or create jobs, spur private sector investment, attract government funds, and enlarge the property tax base. The 87 water/sewer projects studied, on average, created 16 full-time-equivalent construction jobs. Direct beneficiaries (businesses) saved, on average, 212 permanent jobs, created 402 new permanent jobs, made private investments of $17.8 million, leveraged $2.1 million of public funds, and added $17.0 million to the local property tax base. Indirect beneficiaries saved, on average, 31 permanent jobs, created 172 new permanent jobs, attracted $3.34 million in private-sector investment, leveraged $905,000 of public funds, and added $3.0 million to the local property tax base. This enlarged property tax base, at a mere 1-percent tax rate, would yield $200,000 in annual property tax to the community." [28]

In their work attempting to quantify the effects of financial investment in infrastructure, Cohen, Freiling, and Robinson at the College of William and Mary found that a $1 investment in a water and sewer project would yield $6.77 in GDP growth over a 20 year period. The same $1 would also generate $2.03 in new taxes over the same period, on average, of which $0.68 is new state and local tax revenue.[29]

A Cautionary Note

Even though the reports referenced above found a positive link between public infrastructure investment and private investment, economic growth, and tax generation, none of the authors could state that a causal relationship exists.

Further, the analyses predominately utilized aggregate data collected for the U.S. as a whole, at the state level, or by region. As a result, as the authors make this clear, not every investment will produce the results found in the aggregate. The effects of infrastructure investment vary by location, type and size of the investment and detailed analysis of each project is needed to determine if a positive return will be generated by the public expenditure. Alicia Munnell underscored this point when she wrote, "Aggregate results, however, cannot be used to guide actual investment spending. Only cost-benefit studies can determine which projects should be implemented." [30]

Of particular importance is the fact that one component of public infrastructure cannot be evaluated in isolation of others, e.g., a project that might generate a positive returned based upon the water and sewer investment might generate significant costs in terms of transportation infrastructure or environmental conditions, or vice versa.

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[27] Ibid.

[28] Bagi, Faqir S., 2002, "Economic Impact of Water/Sewer Facilities on Rural and Urban Communities," *Rural America*, Volume 17, Issue 4/Winter

[29] Cohen, Isabelle, Freiling, Thomas, and Robinson, Eric, 2012, "The Economic Impact and Financing of Infrastructure Spending," Thomas Jefferson Program in Public Policy, College of William & Mary, for Associated Equipment Dealers

[30] Munnell, Alicia H., 1992, "Policy Watch: Infrastructure Investment and Economic Growth," Journal of Economic Perspectives - Volume 6, Number 4, Fall, pp. 189-198

MASSACHUSETTS CASE STUDIES

(Boston, Somerville, Stoughton, Taunton, and Weymouth)

OVERVIEW

While academic research indicates that investment in water and sewer infrastructure can generate a positive return on the investment, five case studies within Massachusetts serve as illustrative examples of the interrelationship between the availability of infrastructure and economic opportunity. They additionally show how inadequate infrastructure can slow or potentially halt development. The cases selected represent a cross section of Massachusetts communities, from urban sites in Boston and Somerville being redeveloped to land being transformed from agriculture to mixed use in Stoughton. The cases also capture two projects that transform previous military or institutional campuses in Taunton and Weymouth. From each, significant lessons can be learned.

- Urban Redevelopment: Seaport District, Boston, MA

Project Impacts at Build Out
20,000 new jobs
Est. $75 million in annual local tax revenue

Considerable effort has gone into cleaning up the Boston Harbor to bring it into compliance with the Federal Clean Water Act of 1972. While the impetus for the improvement was federal legislation and litigation by the City of Quincy, the Conservation Law Foundation, and the U.S. Environmental Protection Agency (EPA), the results have transformed South Boston and the Boston waterfront, bringing thousands of new jobs to the city. Although billions of dollars in public funds were invested to construct primary and secondary treatment facilities and new pipes to bring the wastewater to the plants, they are projected to leverage up to $8.4 billion in private investment based on planned and permitted projects.[31] ($2.2 billion in private investment already was made between 1987 and 2004[32].) Between 2010 and 2013, 200 new businesses, including Brightcove, Fort Point Legal, Next Step Living, Rethinking Robotics, and others moved to the district bringing 4,000 jobs with them.[33] At present, approximate 30 million square feet of development has been built or permitted within the District, a transformation not anticipated until 2025 and an additional 6,300 employees will be moving to the district over the next three years.[34]

- Land Reuse: Myles Standish Industrial Park, Taunton, MA

Project Impacts to Date
7,400 new jobs
$6 million in annual local tax revenue

The transformation of the 1,000 or so acre site that was formerly Camp Myles Standish and the Paul A. Dever State School, into the Myles Standish Industrial Park (MSIP) has taken several decades and considerable investment in water and sewer infrastructure. The site has access to water provided by the Town of Taunton in addition to several on-site wells. The Town also treats the site's wastewater at its local wastewater treatment facility, where it also treats flows from portions of the towns of Dighton,

[31] Ibid, p. 6.
[32] Save the Harbor/Save the Bay, The Leading Edge: Boston Harbor's New Role in the City's Economy, 2004. p. 5
[33] Boston Redevelopment Authority, "Boston Innovation District: 3 Years and Counting", February 28, 2013
[34] Leung, Shirley, "Heavy traffic has planners scrambling", Boston Globe, August 16, 2013.

Norton, and Raynham. As development of the remaining 220 acres of the site is underway, potable water demand is anticipated to grow and the site will generate additional wastewater, impacting the Town's water availability and treatment plant capacity. The developers will be offsetting the projected increase in sewer flow by undertaking efforts to reduce the amount of stormwater entering the wastewater system. Even with relatively limited challenges, infrastructure costs for the final phase are estimated to cost $10 million, as compared to land acquisition costs of $1. Since the projected development cost exceeds the expected $17.2 million in land sales proceeds, additional financing is needed. This additional funding will come from a $3.1 million MassWorks grant, a $1.5 million U.S. Economic Development Administration grant, and the use of District Improvement Financing (DIF) which captures the incremental change in property value to finance development projects. Absent these public resources, the site development potential may not have been realized.

- Community-wide Water Moratorium: Stoughton, MA

Project Impacts
$4.5 million increase in annual local tax revenue (2003-2009)

The Town of Stoughton, a former mill town with a population of approximately 27,000, experienced little or no growth over a 20+ year period due to the lack of potable water. For much of its history, Stoughton relied on ground water and the Town operated a Public Water System (PWS) fed by five ground water wells, which ultimately were not adequate to meet demand. In 1983, the Board of Selectmen established a moratorium on new water connections to preserve their dwindling source of water. By 2000, MassDEP issued an Administrative Consent Order requiring the Town to find another source of drinking water. During the moratorium period, the number of local jobs declined by over 17% due to an array of reasons, and local tax revenues were adversely impacted. However, after the Board of Selectmen voted to purchase water from the MWRA and invest $1.8 million in a new water main, the water shortfall ended and commercial development began again, including an IKEA store and other retail. As a result, between 2003, when the water main was completed, and 2009, commercial tax revenues increased by nearly $4.5 million or 49%. In contrast, in the equivalent number years before the pipeline opened and when the moratorium was in still effect (1997-2003), commercial property taxes only increased by $1.1 million or 14%.

- SWMI Impacted Community: Naval Air Station South Weymouth, Weymouth, MA

Project Impacts at Build Out
2,533 new jobs
Ext. $11.2 million in local tax revenue

Now called the "Village Center," plans for the reuse of the Naval Air Station South Weymouth include 900 thousand to 2 million square feet of commercial development and up to 2,855 residential units. Although reaching community agreement on a preferred development plan has taken considerable time, the preferred plan was approved in 2007. Identifying a viable water supply for the property has taken considerable time and study and has been made more complex due to the fact that the Town of Weymouth does not have adequate potable water available to supply future phases of the project. After studying 11 potential water sources, at present, only the MWRA and the City of Brockton's Taunton River Desalination Project remain under consideration for future phases of the project. Upon completion, the project is anticipated to generate millions of dollars of annual net tax revenues to the towns of Abington ($1.3 million), Rockland ($4.7 million), and Weymouth ($5.1 million).

- Unrealized Opportunity: Union Square & Boynton Yards, Somerville, MA

Project Impacts at Build Out
4,300 new jobs
Ext. $45 million in annual local tax revenue

In contrast to the Boston Seaport, the Union Square and Boynton Yards areas of Somerville remain underutilized, at least in part due to infrastructure issues. In recent years, the City has rezoned the area, which is less than 2 ½ miles from Kendall Square, to allow for 4,300 new jobs and 850 additional housing units[35]. These plans were made to facilitate transit oriented development located near the new Union Square MBTA Green Line station. However, a high water table coupled with a combined wastewater and stormwater system and a blocked downstream outfall has resulted in significant flooding in the area on multiple occasions. The most significant recent occurance was in July 2010 when 3 ½ inches of rain fell on the city in one hour, flooding the police station, a fire station, the MBTA commuter rail tracks, and many businesses and private properties. Early estimates of the cost to address the stormwater issues are on the order of $40 to $50 million, a cost that will be difficult for the private sector to absorb in its entirety. Absent some level of public investment in infrastructure, portions of the area may remain underutilized, and local property tax revenues and state revenues will remain unrealized.

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Although circumstances vary in different communities and with differing development projects, the case studies indicate that the adequacy of water and wastewater infrastructure can influence how rapidly economic development occurs, and if it occurs at all. In locations such as the Boston Seaport District where water and sewer infrastructure is newly built and the surrounding environment is attractive and welcoming, investment and job growth can happen at a pace much quicker than initially planned for. However, in other locations subject to water moratoriums, flooding, or uncertain water supply, development can languish for years until such issues are addressed.

[35] City of Somerville, Union Square Revitalization Plan, August 2012, p. 12.

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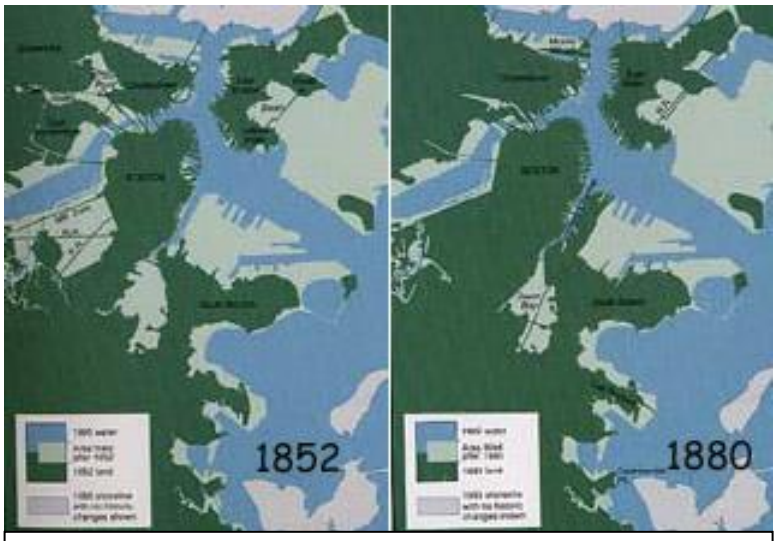
URBAN REDEVELOPMENT: SEAPORT DISTRICT, BOSTON, MA

Background

South Boston's Fort Point Channel area

The redevelopment of the South Boston waterfront has been one of the most ambitious and challenging urban redevelopment projects in the Northeast. Critical to its success was the Boston Harbor Project, the largest court-ordered compliance action in the history of the Clean Water Act. Improvements to sewage treatment and the clean-up of Boston Harbor, a 50 square mile expanse of water, have played a part in the area's redevelopment which began in the late 1990s and continues today.

The South Boston waterfront had long been a host to industrial, rail, and maritime uses. As industry and the railroads departed, large sections of formerly job producing land gave way to parking, outdoor storage uses, and vacant lots. Prior to the expansion and upgrade of the Deer Island treatment plant, the area was heavily impacted by inadequately treated waste and untreated overflow sewage that flowed into the Harbor. At the time, the Metropolitan District Commission (MDC), a state agency tasked with, among other things, the collection and treatment of wastewater from the 43 communities that make up the Boston metropolitan region, operated two primary wastewater treatment plants, one at Deer Island and the other at Nut Island. Primary treatment at these plants allowed for the settling of suspended solids from the wastewater but not for the screening of oil, grease, and other materials that float; it also did not address phosphates and other compounds. Both plants discharged their "treated" water into Boston Harbor. Additionally, the sludge that was generated when separating the solids from the wastewater was openly dumped into the harbor. Further, most of the development in the Boston metro area was supported by combined sanitary and stormwater collection systems. As a result, during a heavy rainfall, the flow could overwhelm the system's capacity. It would then be discharged, usually untreated, directly into the harbor or one of its tributaries through 84 combined sewer overflows.



Boston's shoreline infill: 1852 vs. 1880

In 1982, as a result of the failure to comply with the Federal Clean Water Act, which mandated primary and secondary treatment of all municipal sewer systems by 1977, the City of Quincy, the Conservation Law Foundation (CLF), and EPA filed suit in state and federal court to compel the clean-up of the Boston Harbor.

Previous Site Use

In 1836, the Boston Wharf Company began filling the tidal mud flats along the Fort Point Channel to form a strip of land some 600 feet wide and 4,000 feet long for the construction of new wharf and industrial space with "A" Street providing access along the eastern edge of the wharf. By 1880, additional land east of A Street was being filled, overseen by the Boston Harbor Commission, to provide rail access. The shoreline in existence today was established by 1927 with the filling of the remaining South Boston flats.

Industrial and warehouse activity was predominant on either side of A Street, with Standard Sugar Refining as the area's largest business operation. The vast majority of the new land created east of A Street was dedicated to railroad yards which served the various finger piers jutting into Boston Harbor. Commonwealth Pier, the largest of the finger piers on Boston Harbor, was completed in 1911 and birthed passenger liners as well and freight ships.

In the years that followed, the transformation of shipping from bulk cargo to containerization led to the general demise of a working South Boston waterfront. The railroads abandoned most of their property and the few industrial buildings left were located along the Channel, with Gillette at the southern end of the Channel and a large clustering of historic wharf buildings north of Summer Street.

Aerial view of South Boston, 2012

Unlocking the Economic Development Potential

In 1982, the City of Quincy filed suit in Massachusetts Superior Court against the MDC. The Conservation Law Foundation (CLF), with the help of some financial support from the Boston Foundation, filed its own suit in 1983 in federal court against MDC and the EPA for its failure to enforce the Clean Water Act. By 1984, the Quincy case had progressed to a point where Superior Court Judge Paul Garrity issued an order banning any additional connections to the MDC system, effectively derailing any real estate development in Boston during one of the greatest real estate boom markets in the U.S.[36] The order galvanized the business community and effectively forced the Commonwealth to create a new agency, the Massachusetts Water Resources Authority (MWRA), to replace the MDC. When this order was overturned by the Massachusetts Supreme Judiciary Court, Federal Judge David A. Mazzone lifted his stay on the CLF case, (the case was stayed while the Quincy law suit proceeded in state court)

[36] Alonso, Enrique, Recarte, Ana, "The Boston Harbor Project," Friends of Thoreau Environmental Program, Research Institute of North American Studies, University of Alcalá, Spain

with the US EPA now as a litigant rather than a defendant. In that same year, Judge Mazzone found the MWRA as successor to the MDC was in violation of the Clean Water Act and ordered the clean-up of Boston Harbor. It was recognized by many that, "The combined discharge of marginally treated primary effluent and sludge into the shallow waters of Boston Harbor imposed a significant burden on the marine ecology and resulted in serious deterioration of the aesthetic, commercial and recreational qualities of this vital resource."[37]

Investment in Water/Sewer Infrastructure

Deer Island, one of Boston's two primary wastewater treatment plant sites, was chosen as the location for a massive undertaking, and the MWRA commenced a sizeable public works project that included increasing capacity of Deer Island's existing primary treatment facility, creating a new secondary treatment facility, and building a new outfall for discharge of fully treated water nine miles beyond Boston Harbor in Massachusetts Bay. Nut Island, Boston's other primary treatment plant, which served communities south of the city, was closed in 1998. Total cost for construction of the treatment plant was $3.8 billion and the project is hailed as one of the most "advanced pollution management programs in America."[38]

Work began in 1990 and continued through 2001. Major highlights include:

- 1990: MWRA initiates construction on Deer Island.
- 1991: Discharge of sewage from Nut and Deer Island into Boston Harbor ends in December. Sludge-to-fertilizer pelletization begins at Fore River Plant.
- 1995: New improved primary treatment facility beings operating at Deer Island.
- 1997: Secondary treatment facilities begin to open at Deer Island.
- 1998: The Nut Island to Deer Island sewage transport tunnel is completed and the Nut Island plant is closed.
- 2000: Outfall tunnel opens, allowing for the safe transport of treated waste 9.5 miles out into the Massachusetts Bay.
- 2001: Final battery of secondary treatment is in operation on Deer Island.

Construction was completed by 3,000 to 4,000 workers who worked under a single collective labor agreement bargained with multiple unions. Specific design elements with their associated costs (as available) include:

- Building a concrete plant to avoid transportation from the mainland;
- Building five miles of rock tunnel to transport the sewage from Nut Island to Deer Island, at a cost of $159 million;
- Expanding primary treatment operations consisting of three batteries of primary clarifiers, at a cost of $482 million. [In dry weather, the primary plant handles approximately 350 million

[37] Construction Management eJournal, A Case Study of the Construction Management on the Boston Harbor Project, Reflections at Project Completion, Armstrong, W, and Wallace, R, January, 2001 accessed at http://cmaanet.org/files/boston_harbor_project.pdf, May 19, 2013

[38] The Meeting of City and Sea: A Guide to the John Joseph Moakley United States Courthouse, Discovering Justice, James D. St. Clair Court Public Education Project

gallons per day (MGD)], but can handle up to 1,270 MGD in peak wet weather);

- Building the secondary treatment plant on Deer Island, consisting of three batteries of activated sludge secondary reactors and clarifiers, which are supported by a cryogenic oxygen plant, at a cost of $506 million. (Secondary batteries are capable of treating up to 780 MGD);
- Constructing an odor control facility;
- Constructing a thermal power plant capable of generating electricity;
- Creating additional recycling facilities such as to prepare sludge for pelletization;
- Constructing sludge thickening and anaerobic digestion facilities, at a cost of $312 million;
- Constructing a mini-hydroelectric plant allowing the final water to circulate through a turbine prior to transport through the outfall, at a cost of $85 million;
- Constructing a fertilizer manufacturing plant for pelletization, which converts sludge into 33,000 dry tons of fertilizer annually;
- Procuring off-island landfill space;
- Building a 9.5 mile effluent outfall tunnel to transport treated sludge to the deeper, stronger currents of Massachusetts Bay, at a cost of $260 million. The tunnel includes 55 diffusers along the last 1.5 miles; and,
- Setting up and maintaining on and off-island utilities for plant operations; and on and off island transport for workers.

Between 1989 and 1998, the Boston's pumping capacity increased from 700 to 900 MGD. Prior to that, the capacity of the wastewater collection system had not been increased for 40 years, at the same time leaks in pipes compromised the system's efficiency.

The digester eggs responsible for sewage treatment are 110 feet tall and hold 3 million gallons of liquid sewage each. The liquid sewage decomposes for 10-22 days, after which the sludge is heated to 95 degrees to create methane gas that fuels a power plant. The remaining sludge is shipped to Quincy, heat dried, and turned into fertilizer pellets to be sold and shipped. Since completing the Boston Harbor Project, bacteria levels have dropped significantly.

The Metropolitan District Commission (MDC) failed to apply for federal money available under the Clean Water Act to assist with compliance that was available until 1997. Part of the hesitation was the magnitude of the project, lack of clear accountability, and lack of local matching funds.[39] Based on the water usage rates charged by MDC at the time, and its lack of authority to raise funds, financing a wastewater treatment project would have been impossible.[40]

While MWRA did receive a $100 million grant from the Commonwealth as a result of the 1987 Massachusetts Water Quality Act, the bulk of financing came from the customers themselves. The judge presiding over the federal lawsuits, Judge Mazzone, was strict in binding all 43 communities who were served by Deer Island (and formerly Nut Island) to the operations and financing of the entire venture, and was successful in pushing the project's continuance despite several consumer protests and uprisings. Shortly following a 1993 protest, the Legislature created a debt service assistance program to help mitigate the annual increases in sewer bills and the Massachusetts legislative delegation was successful in securing federal aid, which ultimately funded approximately 20% of the cost of the Boston Harbor Project.

[39] Scott Kohler, Cleaning up Boston's Harbor and Waterfront, The Boston Foundation, 1986
[40] Boston Sewer and Water Commission, Capital Improvements Program, 2011-2013

To prepare for development of the South Waterfront, the City of Boston constructed a new network of separate sanitary and stormwater sewers. The $31 million investment also eliminated the combined sewer overflow into Fort Point Channel.[41]

Planning for the Future

Anticipating the clean-up of Boston Harbor and leveraging the new access resulting from the extension of the Massachusetts Turnpike to Logan Airport via a third harbor tunnel, the Boston Redevelopment Authority (BRA) began updating its comprehensive development plans for the 900 acre South Boston Waterfront, aka, the "Fort Point District" in the late 1980s. The first studies were prepared in the early 1970s when BRA Director Robert T. Kennedy outlined conceptual plans for the waterfront and Fort Point Channel. Richard Beatty, director for downtown planning said that "the plan calls for retaining Fort Point Channel, cleared of is present pollution, as an aesthetic complement to development."[42]

The District is divided into four smaller sub-districts which include the Fort Point Waterfront District, Central Manufacturing / Seaport, St. Vincent's neighborhood, and the Boston Wharf area. The BRA's report, published in 1990, concentrated most of its redevelopment vision for the 175 acre Fort Point Waterfront, and found that "more than half of the land in the Fort Point Waterfront, north of Summer Street between the Boston Wharf and the Fish Pier, is vacant or underutilized," and that "more than 53% of the district is in public ownership."[43]

The 1990 plan established seven major goals:

- A diversified economy with 10,000 construction and 32,000 permanent jobs;
- A new transportation [and infrastructure] network;
- New housing opportunities with 2,500 units;
- 45 acres of public open space;
- Strengthen the remaining Working Harbor;
- Protecting the industrial and manufacturing base; and,
- Managing balanced growth.

South Boston's Fan Pier

The BRA plan paralleled the planning efforts of Massport, which released its plan that same year for World Trade Center Boston, the 1.3 million square foot development of Commonwealth Flats adjacent to Commonwealth Pier. Massport's plan called for the development of three high-rise buildings, one 375 room hotel and two office towers (460,000 and 560,000 square feet, respectively) on eight acres of land. Commonwealth Pier was redeveloped by Massport in the mid-1980s as exhibition space.

[41] Stephen Shea, Director of Engineering Design at the Boston Water and Sewer Commission, email to Shelley Ayervais, April 19, 2013
[42] Boston Herald, "Channel Area Plans Develop," March 3, 1972
[43] Boston Redevelopment Authority, "Fort Point District Plan," 1990

Later plans, like Seaport Square, Boston Convention and Exhibition Center, and Fort Point Channel 100 acres plan, would expand the redevelopment to large portions of the Central Manufacturing sub-district from the Channel to D Street.

Current Site Use

Master Site Plan: The Residences at Fan Pier

The Boston Harbor Project was integral in the economic and recreational growth of the area.[44] In the past several decades, the waterfront has been 'reborn', with $2.2 billion[45] in private investment (as of 2004) which has outpaced growth in other areas of the city. However, based upon planned and permitted projects, estimates of private investment rise to $8.8 billion[46] at built out. New development includes office, retail, industrial space, research space, and residential. Between 2010 and 2013, 200 new businesses, including Brightcove, Fort Point Legal, Next Step Living, Rethinking Robotics, and others moved to the district bringing 4,000 jobs with them.[47] At present, approximate 30 million square feet of development has been built or permitted within the District, a transformation not anticipated until 2025 and an additional 6,300 employees will be moving to the district over the next three years.[48] Over 1,000 housing units have been built since 2010, another 1,047 are currently under construction, and an additional approximately 2,500 units have been permitted as of summer 2013.[49]

Courthouse on Fan Pier:

The 760,000 square foot John Joseph Moakley Federal Courthouse was completed in 1999 and sits on 4.6 acres at Fan Pier. Construction costs totaled $170 million. Over half of the site is dedicated to public open space, including the Fan Pier Plaza, which occupies the site's entire 850 foot-long waterfront.

Fan Pier:

In 2005, the Fallon Company, a partnership between Joseph Fallon and Mutual Life Insurance Co., purchased 21 acres of waterfront property at a price of $115 million, after two previous deals fell through with other buyers. "Cost of building on waterfront land and the public amenities any new owner would be required to provide have made potential buyers leery of paying too much for the property."[50]

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[44] Susan Diesenhouse, "Spurring Growth on Boston's Waterfront," *New York Times*, November 1, 2011
[45] Save the Harbor/Save the Bay, The Leading Edge: Boston Harbor's New Role in the City's Economy, 2004. p. 5
[46] Ibid. p. 6
[47] Boston Redevelopment Authority, "Boston Innovation District: 3 Years and Counting", February 28, 2013
[48] Leung, Shirley, "Heavy traffic has planners scrambling", Boston Globe, August 16, 2013
[49] Boston Redevelopment Authority, "South Boston Waterfront: Home of the Innovation District", July 2013
[50] Chris Reidy, "Partnership to purchase Fan Pier," Boston Globe, August 17, 2005

Development plans for the area span nine blocks and are estimated at $1.2 billion. Eight new buildings will consist of 1.1 million square feet of residential use (8,000 units), 1.2 million square feet of office space, 300,000 square feet of retail, 107,000 square feet of civic and cultural space, 175 hotel rooms, and restaurants and cafes. Additionally, plans include a six acre marina to be built. LEED certification will be standard for much of the development.

The first building, a 500,000 square foot office building, was completed in 2010. Future area tenants include Vertex Pharmaceuticals whose 1,800 employees will occupy 1.1 million square feet in two buildings, and law firm of Goodwin Procter as the anchor tenant of another building (260,000 square feet out of 500,000 square feet) which is slated to begin development in 2013 and be occupied by 2016. "Goodwin Procter will bring another 860 employees to the building, advancing Mayor Thomas M. Menino's effort to transform the waterfront into a new business district that will also attract retail stores, restaurants, civic spaces, and homes. The mayor has renamed the area Boston's Innovation District."[51] A residential condo building currently underway is the first ownership building constructed in the seaport district in years, and will provide 130 new units next to the courthouse. Fan Pier's development will bring an estimated 2,000 new jobs to Boston, and $10 million annually in tax revenue for the City.

Seaport Square:

South Boston's Seaport Square

Seaport Square, 23 acres of planned mixed-use development, began construction in 2012 by breaking ground on the $5.5 million, 12,000 square foot Boston Innovation Center. Ultimately, Seaport Square will create a "24/7 vibrant neighborhood" scheduled for completion in 2019, according to the draft EIR filed in June 2010 by developer MS Boston Seaport, LLC.[52] Plans call for creation of five public spaces along with the 6.5 million square feet of development that will be comprised of 2.8 million square feet of residential space, 1.3 million square feet of office space, 1.3 million square feet of retail and entertainment space, 600,000 square feet of cultural and educational space, 500,000 square feet of hotel space, and 6,500 underground parking spaces.

Public benefits include:

- An estimated $32 million in property tax revenue, $31 million in state sales tax, $2.6 million in state hotel tax, and $1.2 million toward the convention center financing fee;
- $35 million in Affordable Housing linkage to City of Boston;
- An estimated 10,000 construction jobs and 20,000 permanent jobs;
- 2,500 new housing units including at least 15% affordable housing units and another 15% for workforce housing;
- Target LEED standards at the Silver level or higher for entire site;

[51] Casey Ross, "Boston law firm, developer in waterfront deal Goodwin Procter to anchor FanPier site," Boston Globe, December 19, 2012

[52] Seaport Square, Final Environmental Impact Report, Gale International, EOEA #: 14255, 2008

- Smart growth/TOD; and,
- Public infrastructure improvements.

Boston's Harbor Islands:

Boston's Harbor Islands, 34 islands in total spanning over 50 square miles of bays, harbors and rivers, became a unit of the National Parks System in 1996 by an act of Congress. The Commonwealth began acquiring the islands in 1970s on behalf of the public. An important natural, cultural, and geologic resource, the Islands currently offer the public, "a place where you can walk a Civil War-era fort, visit historic lighthouses, explore tide pools, hike lush trails, camp under the stars, or relax while fishing, picnicking or swimming - all within reach of downtown Boston."[53] The Massachusetts Department of Conservation and Recreation (DCR) is one of twelve managing partners and owns and manages more than half of the islands in the park.

Additional direct benefits of the Harbor clean-up effort include the return of wildlife to the harbor area, both above and below the waters. Fisheries have started to recover, and the shellfish and lobster industry now contributes $10 million annually to the local economy.

Fort Point Channel

The Fort Point Channel Plan provides the framework for growth on the 100 acre area for the next 20 years. The vision for the area is to create an active mixed-use neighborhood that protects and encourages the expansion of appropriate existing industrial uses and employment and builds on the residential base to support a greater variety of uses and people. This plan calls for a 24-hour community that incorporates a variety of land uses. The City's policy for the district requires that a minimum of one third of its total new development be devoted to residential use. Other uses, may not occupy more than two thirds of the district.

At completion it is anticipated to generate an additional $47 million dollars annually in property tax and will create more than 12 thousand permanent jobs. The area will support approximately 2,300 residential units, of which at least 15% (350 units) must be affordable.

Findings

1. The billions of dollars invested in the infrastructure that cleaned up the Boston Harbor, while initially undertaken as a result of litigation, have and continue to positively transform the land adjacent to the waterfront from an underutilized industrial area to an active mixed-use employment center projected to generate over 20 thousand permanent new jobs, at least 10 thousand construction jobs, and $75 million in annual local property tax revenue.
2. Infrastructure investments that meet an environmental need may also stimulate economic opportunity as employers are increasingly looking for attractive, mixed-use environments in which to locate their operations.

[53] DCR website, http://www.mass.gov/dcr/parks/metroboston/harbor.htm

LANDREUSE: MYLES STANDISH INDUSTRIAL PARK, TAUNTON, MA

Camp Myles Standish: U.S. Army Facility used during WWII

Background

The Myles Standish Industrial Park (MSIP), "one of the largest and most successful public industrial parks in New England,"[54] sits on over 1,000 acres of land located in the northwest portion of the city of Taunton, Massachusetts just off of I-495. The park features all underground utilities, municipal water, up to 100 acres of land with access to adjacent CSX freight rail lines, and is located roughly 10 minutes from I-95 and 20 minutes from I-90, the Massachusetts Turnpike. Investment in water and sewer infrastructure aided in the conversion of vacant, contaminated land into an industrial park, attracting businesses, creating thousands of jobs, and generating millions of dollars in tax revenue. The first three phases of development have produced 5.8 million square feet of space, housing 7,500 jobs, and generating over $6.0 million in local tax revenues. The current phase is anticipated to add 1,000 to 1,500 additional jobs and $1.8 million in revenue to that total.

Land transformation began in 1974, when construction of Phase I (approximately 117 acres) was initiated; the phased development continues to the present day. Tenants include Agar Foods, Pepsi Cola, and General Dynamics. The latest phase of development focuses on life sciences, with Taunton being designated a Platinum "BioReady" Community by the Massachusetts Biotechnology Council.

Previous Site Use

The site that now houses the MSIP was once a U.S. Army facility called Camp Myles Standish. It consisted of 1,642 acres acquired by the federal government in 1942 as an Army embarkation point and prisoner of war camp. The camp had over 1,200 buildings, and more than 1.5 million solders, including Canadian and Australian troops, passed through its gates. Approximately 4,000 Italians and 5,000 German soldiers were confined at the camp during and, for a brief period, after the war. In 1948, when the site was no longer needed after the end of WWII, the federal government deeded 1,200 acres of land to the Massachusetts Department of Mental Health under the condition that the land would be used to help the mentally disabled for a minimum of 25 years. Other portions of the camp were dedicated to open space including Watson Pond and Watson Pond State Park.

The site became the Paul A. Dever State School (formerly Myles Standish School for the Mentally Retarded), which opened in 1952 as a place to treat and house mentally disabled residents as well as a state mental hospital. The campus consisted of 15 buildings (12 L-shaped dormitories, an infirmary,

[54] 'Taunton Priority Protection & Development Areas', City of Taunton, 2008. Available at http://www.srpedd.org/scr/ppa-pda/taunton-report.pdf.

cafeteria, and power plant) connected by about 1.5 miles of underground tunnels, along with other structures. At some time, a sewage treatment plant was constructed to serve the complex. The grounds also included a farm where the pupils grew vegetables and raised pigs, turkeys, and chickens. The four story hospital was constructed in 1966 and substantially expanded in the 1980s. Between the school and hospital roughly 3,000 patients lived on the site. Much of the facility closed in 1991; it was completely closed in 2002.

Unlocking the Economic Development Potential

In the years after WWII, suburban growth created demand for new commercial and industrial development throughout eastern Massachusetts. At same time, as the footprint of the school contracted, large portions of the campus were vacated and by 1974, the City of Taunton, through its Industrial Development Commission, acquired 437 acres for redevelopment. The newly formed Taunton Industrial Development Corporation, a private nonprofit corporation, was tasked with the responsibility of managing and marketing the new industrial park.

Abandoned Paul A. Dever State School

State transportation plans supported development of the site as the design for the much-anticipated I-495 Belt-way were completed. In 1976, Governor Michael Dukakis approved the first phase of highway construction that would connect I-95 to the Massachusetts Turnpike and would result in a full interchange at Bay Street, just 100 yards from the site, thereby putting Taunton and the Dever School site in a prime location for development.

In 1977, the first phase of development (approximately 177 acres) was completed and lots were offered for sale.[55] The Commission acquired an additional 218 acres in 1995, 154 acres in 2000, and 220 acres in 2011. There was no master plan for the entirety of the site, but rather, plans were prepared for each section of land as it became available.

The City of Taunton invested over $1.5 million to bring Phase I on line. This investment included 20,000 linear feet of 12-inch water main and 15,000 linear feet of sanitary sewer to connect the individual development parcels to the City's municipal systems. "The fact that the water was available and economical was a big selling point when (MSIP) opened,"[56] according to Mr. O'Brien, Taunton Water Division Supervisor. As additional acreage became available, the process repeated itself, providing shovel-ready sites with utilities at the curb. It can be said that planning and speculative investment in infrastructure, particular water and sewer utilities, led to the early and continued successes of the park.

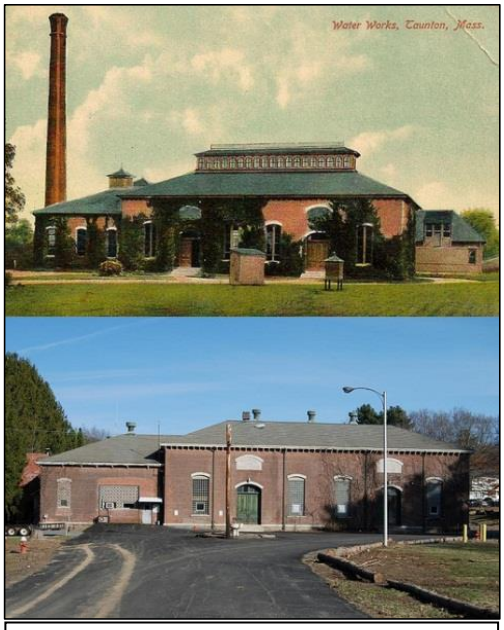
[55] Taunton Development Corporation website, "Taunton Development Corporation History" retrieved at http://www.tauntondevelopment.org/history.htm, September 15, 2013

[56] Cathal O'Brien, Division Supervisor, Taunton Public Works Department, interview with W. Rob May, March 2013.

Investment in Water/Sewer Infrastructure

Potable Water

The City of Taunton draws its water from Elders Pond and the Assawompset Pond Complex, a series of five interconnected ponds comprising the Assawompset, Pocksha, Great Quittacus, Little Quittacus, and Long ponds. The six reservoirs are located in parts of Freetown, Lakeville, Middleboro, and Rochester, Massachusetts, and are over 7 miles from the city center and 10 miles from MSIP.



Taunton Water Works: then and now

Water from these ponds is first treated at the Charles J. Rocheleau Water Filtration Plant located in Lakeville. The treated water is then pumped to the distribution system where it is either delivered to a customer or sent to one of five storage facilities around the city. The Prospect Hill Reservoir (22.5 million gallons), the Myles Standish Industrial Park Standpipe (2.1 million gallons), the Westville Elevated Storage Tank (0.3 million gallons), the Oakland Elevated Storage Tank (0.75 million gallons), and the East Taunton Elevated Storage Tank (1 million gallons) combined provide more than 26 million gallons of distribution storage. The Industrial Park Standpipe was constructed in 1977 to stabilize water pressure in the Park.

The system has two interconnections to supply both the Village of North Dighton Water District and the Bridgewater Correctional Complex with potable water. The City also supplies potable water services in parts of Berkley, Lakeville, Middleboro, Norton, and Raynham. The system also has two interconnections to supply the Town of Raynham Center Water District and the Town of Dighton in the event that they need potable water in an emergency.

The Taunton water system uses 2.21 billion gallons per year (bgy). The City of New Bedford water system, which supplies water to Acushnet, Dartmouth, and Freetown, also accesses water from the Assawompset Complex, drawing approximately 3.71 bgy for a combined withdrawal from the source of 5.92 bgy. Water withdraws are classified as either "registered," meaning a historic or grandfathered withdrawal level that predates the 1986 Water Management Act, or "permitted" which are withdrawals that are regulated by MassDEP. Taunton has a registered volume of 2.142 bgy and a permitted volume of 0.591 bgy, and New Bedford has a registered volume of 6.668 bgy and permitted volume of 0.919 bgy for a total registered volume of 8.81 bgy and permitted volume of 1.510 bgy (total Registered/Permitted volume of 10.32 bgy) combined. Allowable water withdrawals across both jurisdictions totals 10.32 byg.

Table 1: Allowed Draws from Assawompset Complex (MGY)				
	Registered	Permitted	Grand Total	Actual Draw
Taunton	2,142	591	2,733	2,210
New Bedford	6,668	919	7,587	3,712
Total	8,810	1,510	10,320	5,922

When attempting to calculate a "Safe Yield" for the Assawompset Complex under the Sustainable Water Management Imitative (SWMI), the Executive Office of Energy and Environmental Affairs found that that reservoir storage capacity is less than the drought year inflow plus annual use, therefore a Safe Yield could not be achieved. Safe Yield is maximum amount of water that can be withdrawn from a source for human use during drought conditions and still protect the environment. This finding has the potential to impact growth of those communities dependent on the Assawompset Complex when it comes time for MassDEP to review and renew the Permitted Withdrawal Volumes.

In addition to access to the surface water described above, the site also has some well water available. Prior to closing, the Dever State School had three wells on site. As reported in a 2004 Source Water Assessment and Protection (SWAP) Report, three (3) groundwater sources tap the Canoe River Aquifer; all are 8 inches in diameter. The primary source of water was Well #1, which was drilled to a depth of 43 feet. Well #2 has been inactive for at least 20 years due to casing and screen failure. Well #3 was also drilled to a depth of 50 feet and served primarily as an emergency back-up source. The Canoe River Aquifer is a sand and gravel aquifer. Well #1 is currently being used by BJ's Wholesale Club as its primary source of potable water.

Wastewater

The City of Taunton's existing wastewater collection system consists of approximately 100 miles of sewer and a wastewater treatment facility (WWTF) that provides advanced secondary treatment. Treated water is discharged to the Taunton River. The treatment plant is just over 2 miles from the city center and 5 miles from MSIP. The Taunton WWTF also presently treats flows from portions of the towns of Raynham, Dighton, and Norton.

Taunton's Wastewater Management Facility

In 2005, the City became the subject of a U.S. EPA and MassDEP Administrative Consent Order. The environmental agencies found that the existing WWTF was under capacity and wet weather often caused the discharge of untreated raw sewage into the river. As a result of the Order, Taunton engaged Veolia Water, a division of the internationally known Veolia Environmental group, in 2006 to manage its wastewater collection and treatment systems.

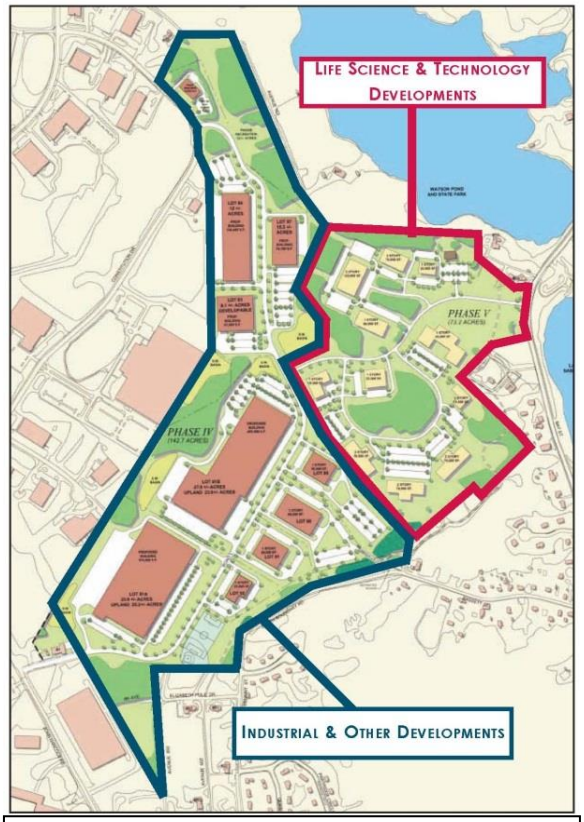
Veolia prepared a wastewater management plan that includes constructing sewers within 14 wastewater priority needs areas throughout the city that are currently served by on-site wastewater disposal systems and expanding the existing WWTF to handle additional flow from these needs areas, as well as from projected infilling within existing serviced areas and projected additional intermunicipal flow. The plan was approved by MassDEP in 2006.

In November 2006, the City filed a MEPA Environmental Notification Form for the implementation of Taunton's Comprehensive Wastewater Management Plan; at the time of the filing Taunton's discharge rate was 8.25 MGD, which include intermunicipal flows. The plan would expand the City's treatment facility to 10.7 MGD to accommodate 1.02 MGD from infill development within the city and 1.43 MGD from development within the inter-municipal areas. The project would also eliminate a Combined Sewer Outfall and greatly reduce Inflow and Infiltration (I&I) to address capacity issues. The plan was approved by MassDEP in 2009.

The Taunton Wastewater Treatment Plant has a 2007 National Pollution Discharge Elimination System (NPDES) permit to discharge 8.4 MGD of treated wastewater into the Taunton River. The Town of Mansfield owns and operates a Wastewater Treatment Plant in the town of Norton, approximately three tenths of a mile north of the Industrial Park.

The Next Phases of Development

In 2009, the Taunton Development Corporation, now in partnership with MassDevelopment, a semi-independent agency of the Commonwealth, began planning for the expansion of the park. These next phases would result in the redevelopment of an additional 220 acres and demolition of 45 free-standing buildings that formed the core campus of the Dever School. The plans call for an 8,700 linear foot extension of the existing road and utility network, stormwater management systems, and the creation of 24 buildable lots to support 1.45 million square feet of commercial/industrial space in a 145 acre expansion of the existing park and 500,000 square feet of mid-rise laboratory and flex technology space in a new Life Science Campus. Anchoring the Life Science Campus will be a $5 million, state-funded, Life Science Center with classroom, training laboratory, and administrative office space When completed these two phases are projected to increase potable water demand by 169,850 gallons and to generate 145,500 gallons of wastewater per day.[57] To mitigate the increase in sewer flow, the development team has committed to a "5 to 1" inflow and Infiltration mitigation effort which that reduce I&I by 727,500 gallons per day for a net reduction of 582,500 gallons per day.



Myles Standish Industrial Park development

Groundbreaking for the development of the final 220 acres took place in June 2012.

[57] Taunton Development Corporation, "Myles Standish Industrial Park Expansion and Life Science Center: Final Environmental Impact Report," December, 2009

Project Costs and Funding

Total cost, prior to beginning private development, for the current 220 acre development is projected at $25.5 million ($15.5 million for demolition and remediation and $10 million for infrastructure improvement). The site was acquired from the Commonwealth as surplus property for $1. Since the projected development cost exceeds the expected $17.2 million in revenue from the sale of the shovel-ready sites, additional financing will be needed to deliver the project. This additional funding will come from a $3.1 million MassWorks grant, a $1.5 million U.S. Economic Development Administration grant, and the use of District Improvement Financing (DIF), which captures the incremental change in property value finance development projects.

Current Site Use

Today, MSIP is a 'premier' industrial park and is described as an economic engine, bringing new businesses and jobs into Taunton. MSIP contains a total of 1,029 acres, 807 of which have been developed and presently provide 5.8 million square feet of space, 7,500 jobs, and over $6.0 million in local tax revenues. Business uses within the park include office space, high tech, manufacturing, and warehousing and distribution centers. Individual lots range from 20,000 to 1 million square feet, and cost anywhere from $125,000 to $150,000 per acre. Land is zoned as industrial, and has been approved by the Commonwealth as a 43D priority development site, which expedites the local permitting process. Economic Development Incentives from the City of Taunton and the Commonwealth are available for businesses choosing to locate on this site.

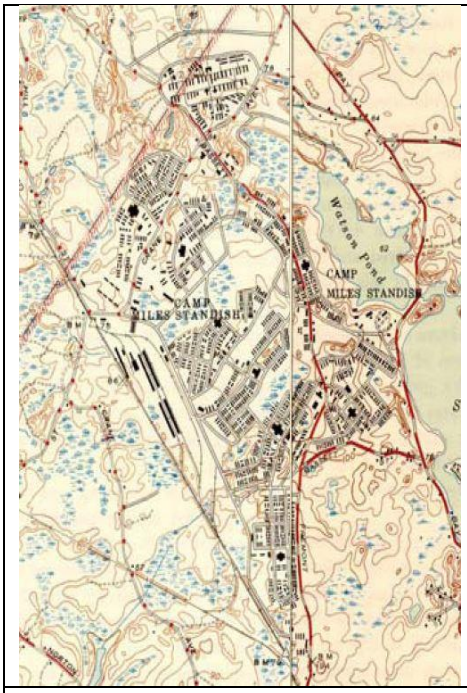
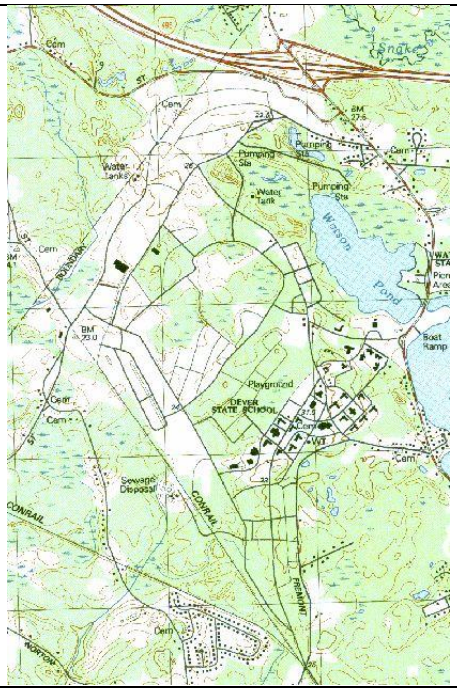
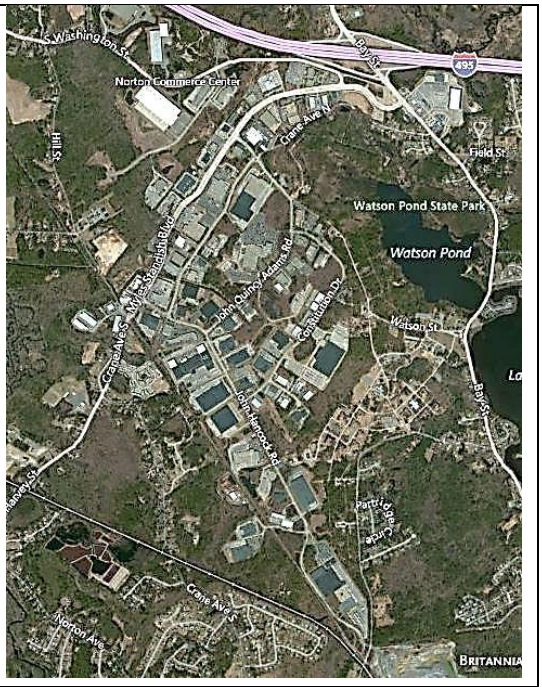
Groundbreaking for the development of the final 220 acres took place in June 2012. The final phases of the park will create an additional 1.85 million square feet of commercial/industrial space including 550,000 square feet of life science space. A total of 1,300 construction jobs are expected to be created, with 2,414 permanent jobs to be located on site after occupancy. The project will also provide an additional $1.8 million of new tax revenue to the City of Taunton each year. Plans include the provision of an additional 2.3 million square feet of space across an expansion of the MSIP and a Life Science Center. The Life Science Center will consist of classroom training, laboratory and administrative office space. Extended roadways and open recreation space round out the development plans.

Table 2: Development Budget for 1.85M SF of New Development	
Total Project Costs	$27.3M
Land Sale Revenue	$17.2M
Property Value	(-$10.1M)
Municipal Impacts	
Projected Annual Tax Revenue	$1.8M
Estimated Construction Jobs	1,330
Estimated New Jobs	2,414

Source: Taunton Development Corporation & MassDevelopment

Findings

1. While transportation improvements made the site accessible, absent sizeable investment in water and sewer infrastructure, the formerly underutilized site would not have been transformed into a large-scale industrial park, housing almost 4 thousand permanent and temporary jobs, and generating $6 million in annual property tax today, a figure projected to increase to $7.8 million upon completion of the last phase of development.
2. In an era of changing environmental regulation, such as SWMI, communities will need to ensure that their water resources are adequate to meet demand of growing commercial sites.

		
Camp Myles Standish (1945)	Dever School (c. 1978)	Myles Standish Industrial Park (2012)

Myles Standish Industrial Park
Business Directory

7-Eleven, Inc.
A ESCO Electronics, Inc.
A.C.E. International
AGAR Supply Co. Inc.
American Insulated Panel
American Lighting Fixtures
Applied Control Eng. Co.
Argos Corporation
Atlantic Broom Co.
Automatic Machine Produces
B & J Manufacturing
Bank of America Home Loans
BBA Remanufaturing Inc.
Beavex, Inc.
Best Foods
Biodirect, Inc.
BioLine
BISCO Environmental
Boston Apparel Group
Braver Technology Solutions
Bureau Veritas Products
C.R. Laurence Company
Callico Distributors
Carolina Logistics
CBM Industrial Electronics
Chase Corporation
Circuit Design
Comcast Cable
Compurex
Consulting & Technical Services
Crescent Credit Union
Customized Transportation Solutions
Eastern Diagnostic Imaging, Inc.
Electronic Contract Services
Emagine Communications
Empire Auto Parts, Inc
Energy USA
F. H. Chase
Floor Works, Inc.
Florence Electric
Forte Technology, Inc.
Future Fuel
G. Brouillette & Sons
General Dynamics
GKI Bethlehem Lighting
Graybar Electric Company
Hallam, ICS
Harmony ADHC
HARPACK-ULMA Packaging, LLC
Holday Inn
Huttig Building Supplies
Keystone Automotive
Kopin Corporation
Loomis Fargo
Madison Avenue Design
McMahon Associates, Inc.
MD Com
Medical Scientific, Inc.
Mentor Network
National Weather Service
NAVIX Diagnostix
New England Ice Cream
Northeast River Forecast Center
Ohlson Packaging
Organogensis
Patio Enclosures
Pepsi Cola
Perkins Paper, Inc
Petco Distribution Center Phase III
Princess House
Professional Contract Sterilization
Progeny Systems
Pumpernickel Express
Quality Beverage, Inc.
Quebecor World RPC
Quinn Child Care Center
Redhawk Industries
Rich's Transportation
Rich's Transportation Services
RPC Packaging Supply
Schein Dental
Service Sleuth
Shaw Distributor Co.
Silver City Canine Training
SmartCo Services LLC
Special Olympics
Supreme Industrial Products
Taco Metals
TCI Tires, Inc.
Terminix
The Ryan Company, Inc.
Tribe, Inc.
Tropicana
United Refrigeration
United States Post Office
V & S Taunton Galvanizing
Verizon
Verizon Maintenance
Verizon Wireless
VersaCold
W.W. Grainger
Waters Corporation
Westerbeke Corporation

COMMUNITY-WIDE WATER MORATORIUM: STOUGHTON, MA

Background

Stoughton Welcome Sign

The Town of Stoughton, a former mill town with a population of approximately 27,000,[58] experienced limited population and economic growth over a twenty-year period from the early 1980s to the early 2000s due to water shortage. Historically, the served an active manufacturing center, but as this business sector has declined, the town has emerged as a regional retail destination. The major commercial and industrial areas in town are located adjacent to Route 24, which is accessed by three interchanges, and along routes 138, 139 and 27. Stoughton also has access to regional transit, being served by bus from Brockton and MBTA Commuter Rail at the station in Stoughton Center.

Prior to 2003, Stoughton relied on ground water from the Steep Hill Brook and Upper Quesit Brook aquifers as its source of drinking water. The Town operated a Public Water System (PWS) fed by five ground water wells, with an emergency water interconnection available through the Town of Canton, allowing it to access water from the Massachusetts Water Resources Authority (MWRA), if needed. By the early 1980s, it had become apparent that the aquifer could not adequately supply the town and in 1983, the Board of Selectmen established a moratorium on new water connections to preserve this dwindling source of water. Despite the Town's best efforts, including bringing two new wells into production, the water situation was not alleviated. In 2000, the Massachusetts Department of Environmental Protection (MassDEP) issued an Administrative Consent Order requiring the Town to find another source of drinking water.

Previous Site Use

In the early 2000s, the Town of Stoughton had not completely rebounded from the closings of local manufacturing plants and the relocation of Reebok's corporate headquarters. As a result, the number of jobs in town, which had peaked at almost 14,000 in 1995, declined to about 12,500 by 2001.[59] Despite having 0.46 jobs per resident, just over 80% of Stoughton's working residents commuted to other communities in 2000.[60]\

[58] U.S. Census, 2010 Quickfacts.
[59] Metropolitan Area Planning Council, "Stoughton Community Development Plan," June 2004
[60] ibid

Assessed Value and Tax Levy

In 1992, the first full year after the recession of the early 1990s, the assessed value of commercial and industrial property in Stoughton dropped dramatically, and the assessed value of those parcels combined did not see positive growth again until 1999. At the same time, the percentage of total assessed value generated by Residential and Open Space uses (columns 1 and 2) grew from 74.7% to 77.8%. Since residential property assessments were relatively flat, this shift in percent of total assessed value was actually the result of the loss in value of commercial, industrial and personal property (CIP). By 1999, the total value of real estate was $1.6 billion with residential property making up 78% the total valuation. Over the same period, the assessed value of commercial and industrial property declined sharply, by 24% and 11.5% respectively.

Table 3: Assessed Value of Land by Class (1990-1999)[61]

FY	Residential	Open Space	Commercial	Industrial	Personal Property	Total	Res/OS as % of Total	CIP as % of Total
1990	$1,262,441,500	$109,700	$277,926,185	$120,442,400	$30,179,500	$1,691,099,285	74.7	25.3
1991	$1,268,156,850	$109,700	$298,208,185	$120,968,200	$29,345,000	$1,716,787,935	73.9	26.1
1992	$1,152,774,700	$98,700	$269,535,185	$108,468,500	$29,812,800	$1,560,689,885	73.9	26.1
1993	$1,052,396,000	$94,100	$201,202,730	$67,015,500	$30,410,904	$1,351,119,234	77.9	22.1
1994	$1,060,505,600	$94,100	$198,142,100	$66,804,800	$31,237,280	$1,356,783,880	78.2	21.8
1995	$1,057,137,900	$93,600	$199,032,900	$66,323,000	$31,590,780	$1,354,178,180	78.1	21.9
1996	$1,099,587,500		$212,236,400	$67,096,900	$37,807,700	$1,416,728,500	77.6	22.4
1997	$1,110,685,200		$214,606,400	$66,408,800	$38,182,700	$1,429,883,100	77.7	22.3
1998	$1,125,624,700		$225,947,800	$65,913,700	$38,354,400	$1,455,840,600	77.3	22.7
1999	$1,250,008,773		$210,707,071	$106,557,851	$38,727,420	$1,606,001,115	77.8	22.2

In contrast, the tax levy (i.e., assessed property taxes) for four major real estate classes - residential, commercial, industrial, and personal property (i.e., goods and equipment owned by businesses) - trended upwards throughout the 1990s, despite a dip in the industrial levy in 1993. The steady rise in Commercial, Industrial, and Personal Property (CIP) as a percent of the total tax levy shows a shifting of the tax burden from residential to nonresidential property owners, at the same time that the actual assessed value of commercial property was declining.

Table 4: Tax Levy by Class (1990-1999)[62]

FY	Residential	Open Space	Commercial	Industrial	Personal Property	Total	Res/OS as % of Total	CIP as % of Total
1990	$14,215,091	$1,235	$3,699,198	$1,603,088	$401,689	$19,920,301	71.37	28.63
1991	$14,850,117	$1,285	$4,136,148	$1,677,829	$407,015	$21,072,394	70.48	29.52
1992	$15,470,236	$1,325	$4,285,609	$1,724,649	$474,024	$21,955,843	70.47	29.53
1993	$16,112,183	$1,441	$4,569,314	$1,521,922	$690,632	$22,895,492	70.38	29.62
1994	$16,766,594	$1,488	$4,638,507	$1,563,900	$731,265	$23,701,753	70.75	29.25

[61] Commonwealth of Massachusetts, Departent of Revenue, Municipal Data and Financial Management, Databank Reports, http://www.mass.gov/dor/local-officials/municipal-data-and-financial-management/data-bank-reports/property-tax-information.html
[62] Ibid

1995	$17,294,776	$1,531	$4,824,558	$1,607,670	$765,761	$24,494,295	70.61	29.39
1996	$18,044,231		$5,174,323	$1,635,822	$921,752	$25,776,128	70.0	30.0
1997	$18,748,366		$5,380,182	$1,664,869	$957,240	$26,750,658	70.1	29.9
1998	$19,563,357		$5,782,004	$1,686,732	$981,489	$28,013,582	69.8	30.2
1999	$20,575,144		$5,309,818	$2,685,258	$975,931	$29,546,151	69.6	30.4

Employment

In the 2002, annual industry-level job data from the Executive Office of Labor and Workforce Development reported that health care emerged as the largest private sector employer in Stoughton with over 1,800 jobs in medical and dental offices, nursing homes, etc. Retailing was the second largest employer in Stoughton with 1,600 jobs while manufacturing took third place with 1,500 jobs. The represents the last year that Stoughton was totally dependent upon local ground water resources.

Planning for the Future

The water connection moratorium and MassDEP's declaration of a water emergency proved to be a clarion moment as the Town's policy makers realized that action needed to be taken if Stoughton was to continue to grow. A series of studies, beginning with a 1985 Water Supply Allocation Report set the stage for Stoughton's future. These studies included:

Water Supply Allocation Report - Old Colony Planning Council (OCPC) - 1985
This report proposed an overall allocation of increased water supplies to be provided by new wells and access to emergency water supplies to be provided by the MWRA to begin to ease Stoughton away from its water connection moratorium of 1983.

Stoughton Strategic Planning Study - OCPC - 1987
While this master planning study emphasized housing and open space, it did include discussion of commercial and industrial uses focused on Stoughton Center.

Stoughton Community Development Plan - Metropolitan Area Planning Council (MAPC) - 2004
The Stoughton Community Development Plan was prepared pursuant to Executive Order 418, which provided community development planning funds to help communities proactively plan for the future. Stoughton's plan addressed housing, economic development, natural resources, open space, and transportation.

Stoughton Central Business District Study - OCPC - 2005
This study examined a potential Transit Oriented Development (TOD) project in Stoughton Center and drafted a proposed TOD zoning bylaw. It made no explicit recommendations regarding the study area; however, it stressed the idea of intensifying development in the Center as opposed to scattering it along Route 27. This also supported the complementary idea of concentrating other growth in a node at the southern end of the corridor. Combined, this could minimize sprawl, sewer service demands, and potential land use conflicts along the intervening sections of Park Street.

North Stoughton Overlay District Study - Cecil Group - 2006
This study identified alternative development scenarios, and developed a draft zoning bylaw for the area. A report entitled Findings on Existing Conditions was provided to the Town in May 2006. A

draft Mixed-Use Overlay District Bylaw and Design Guideline document was prepared in February 2007.

Stoughton has zoned a large amount of land for commercial use including 777 acres for retail and general business use and 1,315 acres for industrial use. MAPC's buildout analysis in 2000 calculated that over 12 million square feet of commercial development could take place in the town, provided that an adequate source of water could be secured. This included 5 million square feet of development on vacant land and 6.6 million in two redevelopment areas, most of it around Turnpike Street in northeast Stoughton. As a result of the Town's focus on advanced planning, once outstanding infrastructure needs were addressed, the stage was set for large scale economic development in Stoughton.

Investment in Water/Sewer Infrastructure

In the 1980s, five of the six wells for Stoughton Water Division were located along the western town boundary. The other well was located west of Sumner Street and Goddard Memorial Hospital. Each well had a Zone I of 400 feet. However, the wells were located in an aquifer with a high vulnerability to contamination due to the absence of hydrogeologic barriers (i.e. clay) that can prevent contaminant migration.[63] Two new wells were brought on line in 1984 and 1998, but did not generate sufficient yields to reduce the existing and anticipated water shortfall. In fact, by 2001, while the Stoughton PWS produced a maximum average annual production capacity of 1.9 MGD, the Town still faced a projected deficiency of 1.15 MGD by 2020.

After rejecting a proposal to join the City of Brockton's Taunton River Desalination Project, an ultrafiltration and reverse osmosis plant with a 5 MGD processing capacity in Dighton, Massachusetts, the Stoughton Board of Selectmen approved funding for the construction of a new 4.5 mile long, 16-inch water main through the town of Canton to connect with MWRA's Southern Extra High Pressure Zone.
The $1.8 million project began construction in 2002 and was completed in 2003. The main joins the Stoughton PWS at Island Road where it connects to a network of 76,000 linear feet of mains with 4 storage tanks and 10 pumping stations. This provided the town with access to MWRA's extensive water resources, thereby alleviating the existing water shortfall and allowing the town to engage in commercial growth for the first time in two decades.

Current Site Use

Two large commercial developments have had a significant impact on Stoughton. First, the IKEA Swedish furniture and housewares retailer opened a 230,000 square foot store, together with a 135,000 square foot parking deck in 2005. In addition to 10,000 exclusively designed items, IKEA Stoughton presents 50 different room-settings, three model home interiors, a supervised children's play area,

Stoughton IKEA

[63] Massachusetts Department of Environmental Protection, "Source Water Assessment and Protection (SWAP) Report," 2003

and a 350-seat restaurant. IKEA recently announced that, after dropping its plans to open a store north of Boston in Somerville, it would be expanding its Stoughton facility by nearly 60,000 square feet. Construction is expected to begin in the fall of 2013 with the addition opening in 2014.

Second, Target, the Minneapolis based discount retailer, opened a 143,000 square foot store with below grade parking in 2008. Shoppers access the store from the parking deck by means of escalators and Vermaport, a vertical transportation system that allows customers to move shopping carts between the sales floor and the parking lot.

Stoughton Target

Stoughton is experiencing renewed development interest, particularly along the Turnpike Street corridor says Noreen O'Toole, Director of Community Development. O'Toole confirms that the Town continues to seek funding for a sewer study and engineering design services for an extension of sewer service around the Campanelli Industrial Park.

Assessed Value & Tax Levy

Between 2003 and 2009, the assessed value of commercial property in Stoughton doubled from $254 million to $432 million. The single year jump of $50 million in 2005 reflects the IKEA development and other projects being completed after potable water was secured from MWRA. While the value of industrial property also rose, it did not do so at the dramatic rate that commercial property did.

Table 5: Assessed Value of Land by Class (2000-2009)[64]

FY	Residential	Open Space	Commercial	Industrial	Personal Property	Total	Res/OS as % of Total	CIP as % of Total
2000	$1,285,207,063		$212,079,238	$105,911,351	$40,013,960	$1,643,211,612	78.2	21.8
2001	$1,401,099,708		$224,689,747	$109,460,700	$44,690,440	$1,779,940,595	78.7	21.3
2002	$1,766,920,175		$249,898,850	$125,699,715	$37,679,460	$2,180,198,200	81.0	19.0
2003	$1,916,844,559		$254,459,066	$124,233,115	$38,105,250	$2,333,641,990	82.1	17.9
2004	$2,079,339,943		$256,679,260	$124,394,637	$37,757,920	$2,498,171,760	83.2	16.8
2005	$2,577,300,284		$305,509,752	$153,891,650	$36,416,710	$3,073,118,396	83.9	16.1
2006	$2,825,419,841	$0	$332,899,642	$157,498,866	$38,953,850	$3,354,772,199	84.2	15.8
2007	$2,989,073,830	$0	$385,534,287	$163,347,171	$41,756,660	$3,579,711,948	83.5	16.5
2008	$3,076,942,018	$0	$426,497,703	$181,788,942	$64,361,920	$3,749,590,583	82.1	17.9
2009	$2,832,466,011	$0	$432,618,639	$175,394,540	$80,031,260	$3,520,510,450	80.5	19.5

The taxes generated by all categories of real estate continued the same upward trend, with the total levy growing from $33.6 million in 2003 to $44 million in 2009. At the same time, the percentage of tax burden continued to shift away from the residential taxpayer to commercial and industrial property

[64] Commonwealth of Massachusetts, Department of Revenue, Municipal Data and Financial Management, Databank Reports, http://www.mass.gov/dor/local-officials/municipal-data-and-financial-management/data-bank-reports/property-tax-information.html

owners and by 2009, Commercial, Industrial and Personal Property accounted for 30% of the total levy as compared to 1999 when the same class of property only accounted for 22.2% of the tax levy.

Table 6: Levy by Land Class[65]

FY	Residential	Open Space	Commercial	Industrial	Personal Property	Total	Res/OS as % of Total	CIP as % of Total
2000	$21,694,295		$5,467,403	$2,730,395	$1,031,560	$30,923,653	70.15	29.85
2001	$22,487,650		$5,659,935	$2,757,315	$1,125,752	$32,030,652	70.21	29.79
2002	$23,906,430		$5,690,197	$2,862,183	$857,961	$33,316,771	71.75	28.25
2003	$24,478,105	$0	$5,570,109	$2,719,463	$834,124	$33,601,801	72.85	27.15
2004	$26,303,650	$0	$5,859,988	$2,839,930	$862,013	$35,865,581	73.34	26.66
2005	$27,628,659	$0	$6,177,407	$3,111,689	$736,346	$37,654,101	73.37	26.63
2006	$28,225,944	$0	$6,611,387	$3,127,927	$773,623	$38,738,881	72.86	27.14
2007	$28,994,016	$0	$7,683,698	$3,255,509	$832,210	$40,765,433	71.12	28.88
2008	$30,123,262	$0	$8,329,500	$3,550,338	$1,256,988	$43,260,088	69.63	30.37
2009	$31,185,451	$0	$8,552,870	$3,467,550	$1,582,218	$44,788,089	69.63	30.37

Between 2003, when the $1.8 million pipeline accessing the MWRA water resources was completed and 2009, the Stoughton tax revenues generated by CIP properties increased by nearly $4.5 million or 49%. In contrast, in the equivalent number years before the pipeline opened and when the moratorium was in effect (1997-2003), commercial property taxes only increased by $1.1 million or 14%.

Employment

In the 2011, annual job data from the Executive Office of Labor and Workforce Development indicated that retail employment had overtaken health care to become the largest private employment sector in Stoughton with over 2,100 jobs. Heath care remains the second leading employer with just over 2,000 jobs, while business and professional services replaced manufacturing in third place with 1,330 jobs. Manufacturing plays a dwindling but still important role in Stoughton by providing over 1,000 jobs.

Findings

1. Comprehensive planning for land use and infrastructure, including the provision of adequate access to potable water, can generate positive property tax returns for a municipality. In the case of Stoughton, after the water connection moratorium was lifted, annual commercial tax revenues grew by $4.5 million between 2003 and 2009, an increase of almost 50%.
2. In Stoughton, the funds required to alleviate the moratorium on new water connections were more than recovered by property tax revenues in the years that immediately followed.

[65] Ibid

SWMI Impacted Community: Naval Air Station South Weymouth, Weymouth, MA

Background

Naval Air Station South Weymouth, the last military facility on the south shore of Massachusetts, closed in 1997. Located 11 miles south of downtown Boston on the Old Colony MBTA Commuter Rail Line, the 1,390 acre base has become one of the largest redevelopment opportunities in New England. However, for over 18 years, developers, municipal officials, state leaders and local residents have wrestled with what form that redevelopment would take and how infrastructure needs would be met.

In September 1941, construction began on a new, 1,257 acre[66] Naval Air Station (NAS) that included portions of the towns of Weymouth, Abington, and Rockland in response to President Roosevelt's extension of the Pan-American Security Zone the prior April. The Security Zone obligated American forces to protect civilian shipping on the North Atlantic Sea Lanes between the US coast and Iceland, which the UK had occupied after the fall of Denmark in 1940. NAS South Weymouth would provide important anti-submarine warfare support as the northern-most base for the Navy's fleet of lighter-than-air ships (blimps). The base was constructed with several mooring masts, airship hangers, and a cinder covered turf runway for light aircraft. Four years later in August 1945, after WWII ended in Europe, the base was downgraded from a Naval Air Station to a Naval Air Facility. The base was further downgraded in June 1949 to an Axillary Landing Field, one step away from decommissioning.

In 1950, the base was reactivated and restored to its NAS designation following the Navy's decision to close NAS Squantum on Dorchester Bay in Quincy because of growing air space conflicts with Logan Airport in East Boston. Between 1952 and 1953, the base was rebuilt to support jet aircraft to include a main 7,000 foot north-south runway, a 2,000 foot east-west runway, and a 5,000 foot diagonal runway. In 1959, the east-west runway was lengthened to 6,000 feet, which required the permanent closure of Union Street, which previously connected the towns of Weymouth and Rockland. An additional 143 acres of land was also added to the base.

Weymouth Naval Air Station South

[66] Instillation Fact Sheet, United States Navy, Base Realignment and Closure Program Management Office, http://www.bracpmo.navy.mil/Default.aspx, 2013

Previous Site Use

Two control towers, old and new

At the height of its post-WWII activity, the base housed 750 Navy and 160 Marine Corps active duty troops, in addition to over 2,500 reservists. The base also housed a small contingent of Coast Guard personnel and their families. According to the Massachusetts Historical Commission's "Form A" for the property, "there are 201 buildings and 54 structures, ranging from aircraft hangars to utility sheds, presently located at South Weymouth Naval Air Station."[67] By 1995, the total area under the jurisdiction of Commanding Officer, NAS South Weymouth was 2,120 acres[68] across several communities south of Boston, with approximately 1,390 acres being located in Weymouth, Abington and Rockland. Of that, 390 acres were part of the base development (hangers, runways, and buildings) and the remaining 1,000 acres was open space.

Water service to the base has been historically provided by the Town of Weymouth's municipal water supply and distribution system. During its full operation, the base water demand was as much as 150,000 GPD.[69]

Planning for the Future

In 1995, NAS South Weymouth was selected by the Base Realignment and Closure (BRAC) program for closure. Through an Executive Order, Governor William Weld established a Naval Air Station Planning Committee (NASPC) with representatives from local, state and federal government as well as private sector and organized labor. The 33-member body began a series of planning exercises and forums to create a master plan for the reuse of the base and allow the communities of Weymouth, Abington, and Rockland to apply for conveyance of portions of the former base. The base officially closed on September 30, 1997 with the departure of the last C-130 Hercules Transport.

After two years of work, the NASPC adopted a reuse plan on January 27, 1998. The 1998 Reuse Plan envisioned approximately 3.5 million square feet of development, including 2.1 million square feet of retail, 1.4 million square feet of office, research and development and light manufacturing, and 500-700 units of senior housing. The retail square footage was intended to accommodate a large retail/entertainment center proposed by a national retail mall developer and the plan set aside a significant portion of land (approximately 200 acres or over 51% of the previously developed base) for

[67] Massachusetts Historical Commission, Form "A" Area Inventory, WEY.G (c1990*)*

[68] Instillation Fact Sheet, United States Navy, Base Realignment and Closure Program Management Office, http://www.bracpmo.navy.mil/Default.aspx, 2013

[69] Naval Air Station Development Project, Final Environmental Impact Report, EOEA# 110542R, SSTTDC and LNR South Shore LLC, 2007

this purpose.[70] That same year, the NASPC selected Mills Corporation, the Virginia-based developer, owner/operator of some of the largest outlet malls in the country, as the master developer for the retail/entertainment center.

Later in 1998, special legislation (Chapter 301 of the Acts of 1998) created the South Shore Tri Town Development Corporation (SSTTDC), with the powers and authority to carry out the Reuse Plan. As a body politic, the SSTTDC is a special purpose municipality, governed by a board of directors rather than an elected legislative body, with all the powers of a town, including the authority to levy and collect taxes. Unlike other municipalities, the SSTTDC had a sunset provision on the last day of the twelfth year following the effective date of the enabling act, upon which date the corporation would dissolve.

Local opposition to the plan, particularly objection to increases in traffic that a major mall would attrack caused the SSTTDC to cancel its agreement with Mills in 2000. After this, the SSTTDC set out to revise the 1998 Plan. The interim plan shifted the focus from a retail/entertainment center to a business campus with 2.5 million square feet of high technology, office, and research and development uses. The retail component was downsized away from large format retail to 300,000 square feet of retail that would support an office complex, with such elements as specialty stores, hotel, restaurants and a conference/convention center. The plan also included 100,000 square feet of institutional uses, 700 housing units, and 32 recreational fields. It is this interim plan that served as the basis for the SSTTDC's application for an Economic Development Conveyance to the Navy to acquire the former NAS.

The revised plan continued to face significant opposition, both locally and from state and regional permitting authorities. The Secretary of Environmental Affairs, in the August 2002 Environmental Certificate issued in response to the Draft Environmental Impact Report (DEIR), ordered the SSTTDC to incorporate the principles of Smart Growth and mixed-use in subsequent reuse proposals. Similarly, the U.S. EPA's comments on the DEIR emphasized the need for consistency with Smart Growth principles and called for a further revision of the Reuse Plan.

Rendering of Southfield Highlands neighborhood

In October 2002, the SSTTDC selected LNR Properties, a spin-off of national homebuilder Lennar Corporation, as the Master Developer of the base. LNR is a Miami, Florida-based diversified real estate investment, finance, management, and development company. LNR spent the next two years creating its own master plan for the property. LNR released its "Village Center" plan in March 2005. The mixed-use, smart growth reuse plan would create a community-focused setting built around a village center, with a street layout that would encourage a safe environment for walking, biking, and transit with narrow streets, short blocks, and a route for shuttles that connect the project to the MBTA commuter rail station.[71] The 2005 Reuse Plan caps the number of residential units at 2,855 but still provides for diverse housing types and options, including senior housing, apartments, condominiums, townhouses, and single- family homes distributed between five nodes.

[70] Reuse Plan for Naval Air Station South Weymouth, SSTTDC, 2005
[71] Village Center Master Plan, LNR Property Corporation, 2005

Southfield welcome sign

The Village Center plan includes 900,000 to 2.0 million square feet of commercial development, of which no more than 500,000 will be for retail uses. The majority of the commercial development is to be located in the Shea Science Park, an area of approximately 81 acres with up to 1.5 million square feet of commercial space that will be zoned to allow for maximum flexibility so that different commercial uses can be built in response to changing market conditions.[72] An additional 1,000 acres of land will be publicly accessible and permanently preserved open space and recreational facilities, including a golf course, passive recreation areas, biking and walking trails, outdoor and indoor active recreation facilities and formal open spaces areas.[73]

The Village Center plan was adopted by SSTTDC and the Final Environmental Impact Report was approved in 2007. Special legislation (Section 37, Chapter 303 of the Acts of 2008) revised and reaffirmed the powers and duties of SSTTDC, and also extended the date of termination to no earlier than August 13, 2018, provided that all bonds had been retired and the approval of a dissolution and administrative agreement with the three towns had been adopted.

Phasing Plan

To address local concerns, the residential components and the commercial components shall be built proportionately. In Phase I, for each 500 units of residential development, at least 150,000 square feet of commercial development will be built. In Phase II, for each 1,000 units of residential development, at least 300,000 square feet of commercial development will be added. Finally, in Phase III of the Development Program, for each 425 units of residential development, at least 150,000 feet of commercial development is required.[74] With each phase come specific infrastructure improvements as described below.

Housing under construction, Southfield

[72] Ibid
[73] Ibid
[74] Reuse Plan for Naval Air Station South Weymouth, SSTTDC, 2005

Table 7: Southfield Weymouth Village Center Phasing Plan & Infrastructure Improvements			
Phase	**Transportation Improvements**	**Water Supply and Distribution Improvements**	**Wastewater Collection and Treatment Improvements**
Phase I	• Route 18 intersection improvements (five locations) • Route 18 widening from Route 3 to Shea Memorial Drive [approximately 2 linear miles] • Route 18 widening from Shea Memorial Drive to Route 139 [approximately 2.5 linear miles] • Trotter Road improvements • Temporary access to Route 3 • East-West Parkway from Route 18 to Route 3 under construction [approximately 1.5 linear miles]	• Construct offsite line (assumes MWRA alternative) • Construct new on-site lines to serve Phase I • Develop on-site well to meet irrigation and other needs	• Construct wastewater treatment facility • Construct backbone + Phase I stormwater management facilities • Construct on-site wastewater collection lines to serve Phase I
Phase II	• Completion of East-West parkway from Route 18 to Route 3 [approximately 2.5 linear miles] and improvements to local streets • Activation of on-site transit system	• Construct new on-site lines to serve Phase II	• Construct on-site wastewater collection lines to serve Phase II • Construct Phase II stormwater management facilities
Phase III		• Construct new on-site lines to serve Phase III	• Expand wastewater treatment facility to build-out capacity • Construct on-site wastewater collection lines to serve Phase III • Construct Phase III stormwater management facilities

Accessing the Economic Development Potential

If built as planned, the anticipated commercial land use will create significant numbers of jobs and provide a tax base that would enhance the financial means of the towns. Current projections indicate that the Reuse Plan will result in an estimated 6,000 to 12,000 construction jobs and 2,000-3,000 permanent jobs.[75]

Table 8: Southfield Employment Projections[76]		
Job Projections	Southfield	Within 7 Mile Radius (includes Southfield)
Retail	444	592
Biotech	1,394	4,404
Office	462	924
Hotel	200	250
Golf	33	33
Total	2,533	6,203

[75] Reuse Plan for Naval Air Station South Weymouth, SSTTDC, 2005
[76] Mark Fontecchio, "Air Base Plan: Lots of Housing," Patriot Ledger, September 24, 2004

All fiscal analyses performed to date indicate that the project will generate substantial net revenues to the towns, with projections ranging from as much as $11 million per year to the most conservative estimate of $6.2 million per year.[77]

Projected net tax revenue to host communities (after Southfield expenses):[78]

- Weymouth: $5.1 million
- Rockland: $4.7 million
- Abington: $1.3 million

In 2008, Governor Deval Patrick designated Southfield as a Growth District to in order to provide access to State infrastructure funding to help the project achieve fruition.

Investment in Water/Sewer Infrastructure

In order for the base to be redeveloped, substantial public and private investment was and continues to be needed to lay the infrastructure foundation, including roads, water systems, wastewater systems, and other infrastructure.[79] Estimates indicate that the average daily demand for water under the Village Center plan will be up to 1.4 MGD, with an estimated maximum daily demand of 1.8 MGD.[80] In contrast, during its full operation, South Weymouth Naval Air Station's water demand was only 150,000 gallons per day (GPD), an amount that was purchased from the Town of Weymouth. By 2012, prior to the construction of new residential units, water demand for the remaining uses on the base had declined to a low of 35,000 GPD. A portion of this existing demand, (5,500 GPD), is generated by the Coast Guard housing which is not part of the redevelopment plan. The SSTTDC is, however, obligated by its agreement with the Navy to continue to supply water to the Coast Guard facilities.

Today, the Town of Weymouth obtains its public drinking water supply from a combination of surface and groundwater sources. Surface water sources include the Great Pond in the Great Pond Drainage Basin and, Whitman's Pond in the Old Swamp River Drainage Basin, which is to be used only during a severe drought[81]. Groundwater sources consist of five wells – one well is located adjacent to the South Cove of Whitman's Pond in the Old Swamp River Drainage Basin and four wells are located in the Mill River Drainage Basin. There are four gravel wells in the Mill River Basin, each having a design capacity of 1.0 MGD, although the actual pumping rate is less than this amount.[82] All told, the Town of Weymouth is currently able to withdraw 4.94 MGD[83] from its local water sources, leaving excess capacity of only

[77] Reuse Plan for Naval Air Station South Weymouth, SSTTDC, 2005
[78] Mark Fontecchio, "Air Base Plan: Lots of Housing," Patriot Ledger, September 24, 2004
[79] Reuse Plan for Naval Air Station South Weymouth, SSTTDC, 2005
[80] Naval Air Station Development Project, Final Environmental Impact Report, EOEA# 110542R, SSTTDC and LNR South Shore LLC, 2007
[81] Department of Public Works associate, Town of Weymouth, phone interview with Shelley Ayervais, September 12, 2013.
[82] Naval Air Station Development Project, Final Environmental Impact Report, EOEA# 110542R, SSTTDC and LNR South Shore LLC, 2007
[83] Department of Public Works page on Weymouth, MA website. Accessed on September 12, 2013 at http://www.weymouth.ma.us/index.php/departments/dpw/water-sewer/.

approximately 380,000 GPD[84] after factoring in local growth. As such, existing water resources are not adequate for full build-out of the Village Center development plan. To date, the Town of Weymouth has committed to supply SouthField with 240,000 GPD[85], which is adequate to meet the needs of the first phase of development only. Using Weymouth water to supply the project during Phase 1 will allow this phase to be built while a new source of water can be identified and secured.[86]

A further complication is the fact that the amount of potable water available to Weymouth from its existing water sources may be impacted by new State standards in the form of the Sustainable Water Management Initiative (SWMI). The Water Management Act of 1986 (M.G.L. c. 21G) authorizes the Massachusetts Department of Environmental Protection (MassDEP) to regulate the quantity of water withdrawn from both surface and groundwater supplies. The SWMI framework establishes a methodology for defining what is entitled the "Safe Yield" in each of the Massachusetts' 27 watersheds. Safe Yield is defined by the Act as "the maximum dependable withdrawals that can be made continuously from a water source, including ground or surface water, during a period of years in which the probable driest period or period of greatest water deficiency is likely to occur; provided however, that such dependability is relative and is a function of storage and drought probability."[87] Starting in 2014, the SWMI framework will guide MassDEP's permitting of water withdrawals under the Act. Water withdraws are classified as either "registered," meaning a historic or grandfathered withdrawal level that predates the 1986 Water Management Act, or "permitted" which are withdrawals that are regulated by MassDEP. In 2012, Weymouth used 4.09 MGD which represents 82% of its total authorized withdrawal. If the Town seeks to increase its permitted withdrawal in the future, the request will likely be reviewed closely to see if water conservation or other efforts can offset the requested increase.

To address the potential water shortfall, eleven water supplies were identified and investigated in the Draft Environmental Impact Report as potentially being able to provide part or all of the 1.4 - 1.8 MGD of water needed to supply the project. Of these, only the MWRA and the City of Brockton were found to have a permitted capacity to meet demands of the project.[88] MWRA's combined system has a long-term safe yield of 300 MGD and a Water Management Act Permit Safe Yield of 312 MGD. A *Long Range Water Supply Study* commissioned by MWRA in 2005 concluded that the existing supply system has an excess capacity beyond the 2025 future demand estimate of 33-45 MGD. Brockton has the right to purchase an additional 4.07 MGD of water from a newly constructed regional desalination facility on the Taunton River in Dighton. The privately owned facility can expand its capacity to 7.57 MGD, which is more than enough to supply SouthField. Regardless of the source ultimately selected, construction of a new dedicated water main to serve the project will be required, among other improvements. The estimated cost of bringing water to the site and constructing the required distribution backbone are below.

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[84] Naval Air Station Development Project, Final Environmental Impact Report, EOEA# 110542R, SSTTDC and LNR South Shore LLC, 2007

[85] Certificate of the Secretary of Energy and Environmental Affairs on the Notice of Project Change, Naval Air Station Development Project, April 11, 2008

[86] Naval Air Station Development Project, Final Environmental Impact Report, EOEA# 110542R, SSTTDC and LNR South Shore LLC, 2007

[87] Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) Sustainable Water Management Initiative: Framework Summary, November 28, 2012

[88] Naval Air Station Development Project, Final Environmental Impact Report, EOEA# 110542R, SSTTDC, 2002

Table 9: Cost of Enhanced Water Supply Southfield Development, Weymouth, MA[89]		
Description	**MWRA**	**Brockton**
MWRA Admission Fee[90]	$7,350,000	$0
Water Transmission Main	$11,661,570	$10,160,950
Intermediate Booster Pump Station	$442,500	$422,500
Ground Level Water Tank	$934,375	$934,375
Booster Pump Station	$292,500	$292,500
Elevated Water Tank	$970,125	$970,125
Total Capital Cost:	$21,651,070	$12,780,450
Capital Cost Present Worth($/kgal)	$1.39	$2.35
Wholesale Rate($/kgal)	$1.81	$6.20
Operation, Maintenance and Management($/kgal)	$1.20	$1.20
Total Present Worth Cost($/kgal):	$5.36	$8.79

The plan calls for all wastewater to be treated on site in a new wastewater treatment facility with the effluent being reused, for irrigation and process water, and/or discharged to the French's Stream to recharge the local aquifer.

The total cost of roads, utility systems, civic, recreational and transportation facilities, and the mitigation of impacts could exceed $240 million.[91]

Current Site Use

In 2006, the first 324 acres were transferred from the SSTTDC to LNR. This transaction is known as Finding of Suitability to Transfer (FOST) 1 & 2. This includes the development parcels that will become the 81 acre Shea Science Park and North Village (now renamed SouthField Highlands). Also in 2006, construction began on Memorial Grove Avenue, a new access road that forms the backbone of the Science Park and connecting Shea Memorial Drive to the neighborhood roads of SouthField Highlands. In 2007, LNR's Phase IA Plan was approved by the SSTTDC and construction of the SouthField Highlands' local road network began upon the completion of Memorial Grove Avenue.

In 2011, an additional 882 acres were transferred to LNR, collectively known as FOST 3, 4, and 5A. This acreage includes what will become the Transit Village (now known as SouthField Crossing), Village Center (SouthField Square), East Village (SouthField Village) and Golf Village (The Estates at SouthField).

[89] Naval Air Station Development Project, Final Environmental Impact Report, EOEA# 110542R, SSTTDC and LNR South Shore LLC, 2007

[90] Admission may be phased with development. Initial Admission Fee may be less depending on initial water demand.

[91] Village Center Master Plan, LNR Property Corporation, 2005

Groundbreaking for the first residential units located in the SouthField Highlands also occurred in 2011, and today there are currently 500 units on site. Construction of the first phase of the East-West access road was also completed with the assistance of federal and state funding.

Findings

1. In order to access the potential jobs and property tax revenues that could be generated by the SouthField development, the Town of Weymouth will need to gain access to a sizeable and reliable source of potable water. In jeopardy is the potential of up to $11 million in tax revenue to host communities, and over 6 thousand local jobs.
2. Failure to address current water availability and identify and secure new water resources will adversely impact later phases of SouthField redevelopment and impede general development in Weymouth.

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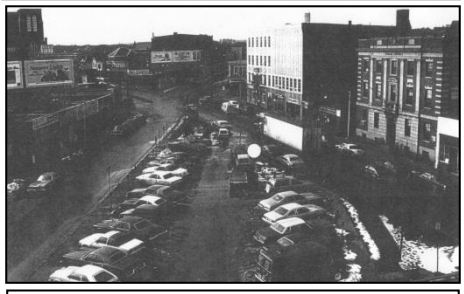
UNREALIZED OPPORTUNITY: UNION SQUARE & BOYNTON YARDS, SOMERVILLE, MA

Background

Located approximately 2 ½ miles from the Kendall Square in Cambridge, Somerville's Union Square already serves as a strong center of community activity. Additionally, Union Square and nearby Boynton Yards are anticipated to become strong regional-serving economic centers in the near future, provided that area infrastructure is successfully upgraded to support the ambitious plans that are underway. In preparation for the extension of the MBTA Green Line into Union Square, the City of Somerville rezoned the Union Square and Boynton Yards areas to promote transit-oriented development; land use policy changes that will result in an estimated 4,300 new jobs and 850 new housing units.[92] While progress on securing the needed transit investment is underway, as a result of years of advocacy by local and state officials, residents, and businesspersons, additional infrastructure challenges must be overcome before the full potential of the area can be realized.

Previous Site Use

According to the City, "Union Square is the city's oldest and largest commercial district. The area was originally referred to as Milk Row because of the small family farms that supplied milk and produce to Boston. The nineteenth century saw the establishment of brickyards, slaughterhouses, and the Union Glass Company. In 1835, a passenger railroad station opened near Union Square. By 1845, horse car services provided transport between Union Square and Harvard Square. Union Square became a hub of activity with streetcars making over 80 stops each day by 1900."[93] However, after passenger service to Somerville was discontinued in 1958, the area became less vibrant. A core of ground floor retail businesses remained, but many of the upper floors that previously held commercial businesses were vacated. Some buildings were torn down and at least one was reduced in height as its property owner found the upper stories not to be financially viable. Efforts in recent years have brought more people into the square for a weekly farmers market and events, but financial investment by property owners has been limited.



Historic Union Square

[92] City of Somerville, Union Square Revitalization Plan, August 2012, p. 12
[93] http://www.somervillema.gov/departments/ospcd/squares-and-neighborhoods/union-square, retrieved June 6, 2013

Boynton Yards lies across the commuter rail tracks immediately to the south of Union Square. "A majority of the Boynton Yards area was a tidal estuary of the Boston Harbor known as Millers River that showed little promise for development. In 1836, the opening of the Fitchburg Railroad saw the beginning of its industrial character as portions of the river were filled for right of way."[94] By the 1850s, the area was home to several meat packing and rendering businesses, among other industrial uses, leading to increasingly noxious environmental conditions. In 1872, Joint Commission for the Abatement of the Millers River filed a report recommending that the river be filled. The third finding of their report is as follows:

> From the fact that the slaughtering establishments from below Prospect Street, have used the basins of the Miller's River to cast into their waters not only blood in large amounts, but the animal filth from without and within the bodies of over half a million hogs a year, slaughtered in these establishments, and dressed by a process in which each slaughtered hog, while still bleeding is plunged into scalding water, and there kept until the epidermis, and all attached dirt are so softened that they can be scraped off. And the Commission further find this cause to be the main cause of the foul and putrid mass of animal corruption concentrated in these basins, and constituting the nuisance to be abated.[95]

The Commission also found that the water flow on the Millers River was insufficiently strong to move the "animal filth" into deeper waters where it could be carried away out to sea. This was the case even though the associated engineer's report found that 42% of the total land area of Somerville at the time (1,130 out of 2,694 acres) naturally drained into the Millers River.[96] The Commission and engineer recommended that Somerville's stormwater be rerouted to the north into the Mystic River, while stormwater from the area of east Cambridge, which drained into Millers River, would be routed to the Charles River. The group recommended filling the land, as opposed to other solutions such as removing the industrial waste material, in part, because the newly created parcels could be sold to offset the costs. The Commission was correct in anticipating that this land would be in demand, and the filled land area quickly became occupied by railroad tracks and other industrial uses.

By 1992, the last rendering plant had closed, and in 1998, the area became the subject of an urban renewal plan. Soil remediation efforts and upgrades to infrastructure facilitated the conversion of the area from heavy industry to light industry, but the area remains underutilized today. Uses in the area include auto salvage, outdoor storage of scaffolding materials, an industrial scale linen cleaning business, and a local cab company among others. One multi-story industrial building has become home to an array of small and medium sized businesses including Taza Chocolate, which roasts cocoa and prepares chocolate on site.

The Union Square and Boynton Yards areas have seen limited private investment in recent years and a City study found that only 4% of the buildings (10 structures) in the Union Square / Boynton Yards area

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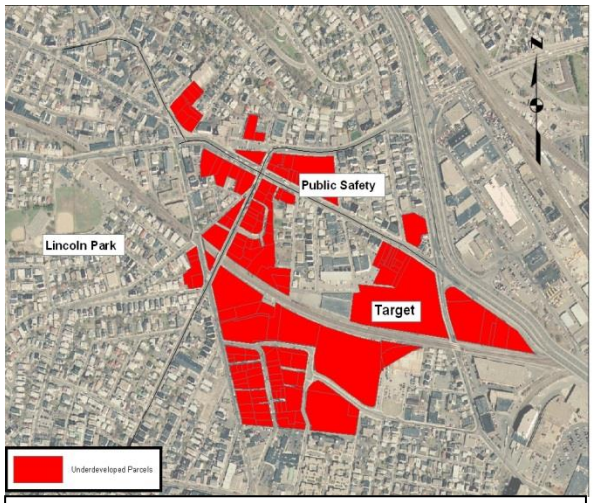
[94] Application for the Massachusetts District Improvement Financing Program (DRAFT), July 10, 2010, http://www.somervillema.gov/sites/default/files/documents/Section%203.1%20to%203.6%20and%203.9.pdf, p. 35

[95] Joint Commission on the abatement of the Miller's river nuisance report, 1872

[96] Ibid, p. 15

were constructed after 1981.[97] As can be seen, across both areas, the vast majority of non-residential properties can be categorized as underutilized, i.e., having a building value that is less than ½ of the value of the accompanying land. Recent study found that 164 of 482 parcels in the area (34%) were in "moderate" or "severe" disrepair and an additional 170 parcels (35%) had "moderate" or "severe" disrepair in one or more categories of building evaluation.[98]



Underutilized properties

Planning for the Future

In order to best capture the benefits of the anticipated investment in transit, the City of Somerville has undertaken multiple planning efforts for the Union Square / Boynton Yards areas. These include a master plan (2003), rezoning (2009), a city-wide comprehensive plan (2012), and an area-specific revitalization plan (2012). Together, these paint a vision of urban, mixed-use transit oriented neighborhoods with active street level retail uses and foot traffic, and upper story residences or office uses. In particular, the 2009 rezoning dramatically increased the development potential of the area. This includes heights ranging from 50 feet (with a floor area ratio of 3.0) to up to 135 feet (with a floor area ratio of 5.5 for a green building) in portions of Boynton Yards, while at the same time requiring substantial areas of publicly accessible open space and set asides for arts-related uses, a key land use theme for the area.

According to the City, the full build out potential of the two development areas is over 2.3 million square feet, of which 1.5 million square feet[99] would be used for commercial development under "Scenario 1 Mixed Development." This figure would increase to nearly 2 million square feet under "Scenario 3 Commercial Development" and would remain at a sizeable 600,000 square feet even under "Scenario 2 Residential Development."[100] Estimates are that at build-out, the total value of the properties as anticipated in the Somervision Plan would be $636 million. Together, they would generate $12.6 million in property taxes annually, based upon the current tax rates.

Accessing the Economic Development Potential

The City has taken multiple steps to unlock the economic development potential of the area. Most recently, in August 2012, the City adopted the Union Square Revitalization Plan which will allow the Somerville Redevelopment Authority to acquire and dispose of designated property. In addition, a plan to realign the roadways in Boynton Yards in order to create a strong street pattern that would allow for

[97] City of Somerville, Union Square Revitalization Plan, August 2012, p. 41
[98] Ibid, p. 41
[99] The Somervision comprehensive plan suggests that slightly more housing would be built at 930,000 s.f., as opposed to 805,000 s.f. in the revitalization plan, but both plans have the same amount of commercial development anticipated. Somervision Comprehensive Plan, April 19, 2012, p. 145
[100] Ibid, p. 128

an easy walk from the MBTA station, while also meeting vehicular needs is underway. Part of this analysis is an assessment of the investment needed in infrastructure.

Flooding impacts, July 2010

Investment in Water/Sewer Infrastructure

Since the Miller's River was first filled in 1872, the area has had a very high water table and flooding has occurred periodically. As an older community, Somerville retains miles of combined sewers, where the water from the sanitary sewer and stormwater systems are comingled. On a dry day, the local infrastructure system is able to accommodate all of the flow, and the water is sent to the MWRA facility at Deer Island where it is processed. However, on days of significant rainfall, the system cannot handle all of the water and combined sewer overflows (CSO) takes place.[101]

The City has made progress on improving the sanitary sewer and stormwater system capacity through infrastructure upgrades made along Somerville Avenue and construction of stormwater detention tanks located in Beacon Street in recent years. The stormwater detention tanks under Beacon Street were constructed through a joint partnership with the City of Cambridge and had a cost of approximately $10 million. Work on Somerville Avenue was partially funded utilizing grants and loans provided by the MWRA totaling approximately $1.2 million. The remaining funds came from the City of Somerville and MassDOT. The project covered a distance of approximately one mile with a total project cost of approximately $25 million.

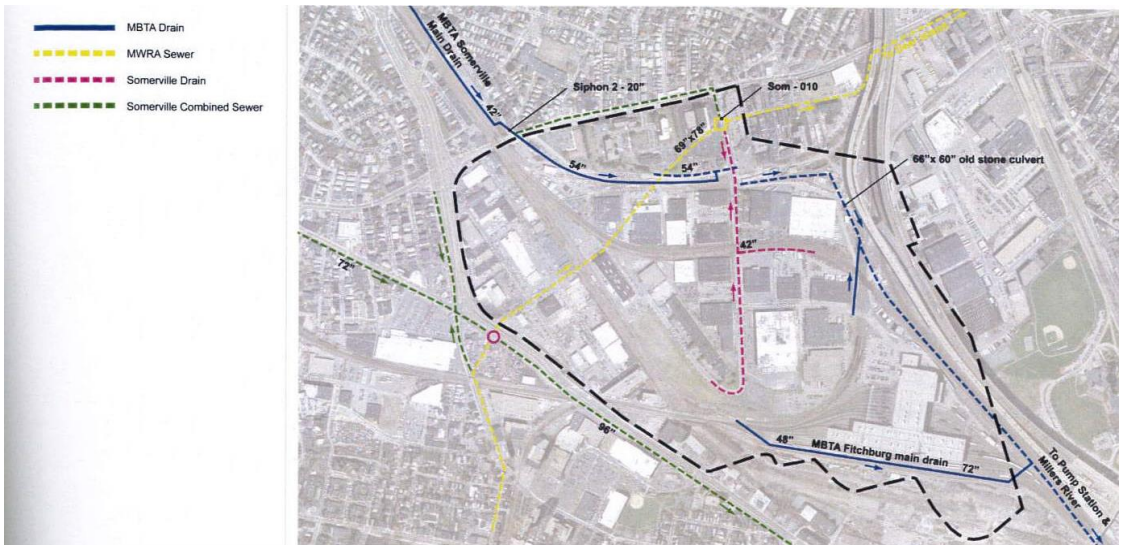
However, since both streets drain into Union Square and the only pipe leaving Union Square carries combined flow, the separated water from Somerville Avenue and Beacon Street is currently channeled into an underground cistern where it is recombined. In addition, the lines down those side streets that connect into Somerville Avenue and Beacon Street have not yet been separated and that water also flows into the same cistern, i.e., both streets have a combined sewer line running down the center of the streets and separated lines running parallel at the outside edges of the rights-of-way. When the combined sewer / stormwater leaves Union Square, it heads eastward toward Charlestown where it connects to an MWRA sewer interceptor leading to Deer Island at one of two locations: on McGrath Highway, near Somerville Avenue or on Inner Belt Road between Washington Street and New Washington Street. At Inner Belt Road, the MWRA line is a box interceptor with dimensions of 69 inches by 78 inches (equivalent to an area of 37.38 square feet).

In years past, during storm events when the water flow exceeded the capacity of the MWRA interceptor, the excess water or "CSO" would be released into the Charles River in one of two locations – the Prison Point CSO facility (near the Museum of Science) and the Millers River outfall (underneath the Leonard P.

[101] Somerville currently has two CSOs within its borders at Alewife Brook and the Mystic River, and contributes to a CSO in Cambridge that flows into the Charles River.

Zakim Bridge). The Prison Point CSO, being farther to the west, would accommodate overflow from the western part of Somerville, Union Square, Boynton Yards, and parts of Cambridge. The Millers River Outfall would handle overflow from East Somerville, the Inner Belt/Brickbottom section of Somerville, and the nearby MBTA lines and commuter rail maintenance facility.

However, the Millers River Outfall is no longer operational and has not been for over 20 years. The problem began in 1978, when the New Charles River Dam was built. This dam, which was designed to prevent high water levels in the Boston Harbor from flowing upriver into the Charles River and causing upstream flooding, had a secondary effect of halting the tidal action that previously kept the Millers River outfall free from silt and debris, since the dam was built below the Millers River outfall. Today, the Old Stone Culvert, a 66-inch by 60-inch culvert, which runs parallel to I-93 and leads to the Charles River is blocked. This became apparent in the early 1990s when the City found that "the culvert did not have capacity to provide relief for all of its connections and as a result, flows traveled upstream and relied on the City's connection with the MWRA interceptor"[102], i.e., water from the MBTA facilities was backing up into Somerville while, at the same time, preventing water from Somerville to flow into the Charles River. In response, the City then closed its connection to the Millers River outfall. While this addressed the surcharge of downstream water back into City system, it also reduced the number of outfalls available to process the area's stormwater in half. As a result, stormwater backs up in East Somerville and the Inner Belt / Brickbottom with some regularity, and also in Union Square and Boynton Yards during particularly strong storm events. (The Prison Point CSO remains operational and the MWRA facility there screens the water for debris, chlorinates it for public health purposes, and then de-chlorinates it before releasing the water into the Charles River.)



Sewer Lines in Inner Belt / Brickbottom, Somerville, MA

In July 2010, flooding in Somerville caused millions of dollars in damage to private and public property. In Union Square, water flowed into the City's police station, an adjacent fire department substation, and the public safety building parking lot. As a result, 26 police vehicles were either damaged or destroyed, offices had to be temporarily vacated, nearby businesses and homes were flooded, and the

[102] Letter to Kevin Brander, DEP/NERO, from Robert T. King, City of Somerville, February 28, 2013

Fitchburg/Lowell commuter rail lines had to be shut down for a period of time due to the depth of the water on the tracks. While the cause of this flooding was the unusual downpour of 3 ½ inches of rain in less than one hour, it is representative of the stormwater challenges facing the area.

In 1990, the MBTA, on whose property the Old Stone Culvert is located, proposed replacing the existing system with a new system that would not only handle the upstream flows, but would also capture the stormwater from the MBTA commuter rail maintenance facility located nearby. However, this was not implemented.

Prospect Street Bridge (before/after)

In 2009, CDM Engineering prepared a Sewer Assessment Report which was required by the MassDEP in response to the City's request for an extension on their variance for combined sewer overflows. This report analyzed the three remaining overflows, including the Millers River overflow. The report found that a relatively small area of the city natural drained into the Millers River and in part of this area, the sewer and storm drains were already separated, thereby theoretically reducing a portion any potential CSO. The firm estimated that the cost of fully separating the area would be approximately $15 million[103], a figure which does not include the cost to rehabilitate or replace the Millers River outfall. The impact of this expense, in their estimation would be a reduction of 4 Mgal per year at the Prison Point CSO, from 191 Mgal/year to 187 Mgal per year. In evaluating the cost to separate the remaining areas of Somerville that overflow to the Prison Point CSO, the report provided a full estimate of $100 million for full separation. The study further concludes that it does not recommend full separation as a solution for the existing overflow due to the cost.

The City continues to explore other alternatives in order to unlock the potential economic opportunity in the Union Square and Boynton Yards areas, as well as the Inner Belt / Brickbottom area. To resolve the situation, at least three options are available: 1) implement storage solutions that will delay stormwater surges through the system during storm events. Infiltration systems could allow the stormwater the opportunity to drain back into the surrounding soils, where appropriate; 2) explore opportunities to create a new stormwater outfall for the City; 3) specifically explore reopening the Millers River outfall. Under alternatives 2 and 3, additional efforts would need to be undertaken to increasingly separate stormwater from the sanitary sewer system so the new outfall is used to its capacity and the maximum separation occurs to reduce the potential for future flooding.[104] Regardless of the alternative chosen, a substantial investment in sewer and stormwater infrastructure will be needed.

The Union Square Revitalization Plan recognizes the need to address the flooding in the square as one of

[103] CDM, Somerville Sewer Assessment Report, February 2009 (Draft Report), p. 6-6
[104] Email correspondence from Robert T. King, Director of Engineering, City of Somerville, to Monica Lamboy, June 25, 2013

its key infrastructure issues. To resolve the local issue, the preliminary plan proposes to increase the size of the combined sewer / stormwater pipe leaving the square from 72-inches to 96 inches while also separating the Somerville Avenue water flow from the Beacon Street water flow and placing the Beacon Street/Washington water in a second 72 inch pipe.[105] Additional projects will look for opportunities to retain, detain or infiltrate stormwater upstream of the Union Square area to increase capacity in that system during large storm events. All told, the Union Square infrastructure and streetscape work could approach $40-50 million prior to completion.

Although this investment will move the water beyond Union Square, it does not address the downstream issues that remain due to the blockage of the Old Stone Culvert. Other options include installing additional underground stormwater tanks to retain the water, which could then be infiltrated back into the soil or released into the combined sewer system once water levels had fallen low enough to accommodate additional flow. The downstream Inner Belt and Brickbottom areas, which are both impacted by the same stormwater issues, combined represent 180 acres of potential new development, as compared to Union Square and Boynton Yards which total 70 acres. Although planning is not as advanced in these areas as Union Square and Brickbottom, the Somervision comprehensive plan anticipates 4.4 million square feet of commercial development and 1.92 million square feet of residential development at build out. This could potentially result in $1.7 billion in property value and nearly $35 million in annual property tax revenue.

Current Site Use

Although efforts to address the infrastructure issues in Union Square and Boynton Yards in Somerville are still underway, the community has come together to promote improved transportation access into the square and to articulate its vision of vibrant mixed use neighborhood that supports increased commercial development and new jobs, while also allowing for a mix of uses such as market rate and affordable housing.

Findings

1. While improving access to transit has been a high priority, water, sewer, and stormwater infrastructure will need to be addressed before the economic development potential of the area can be realized, including an estimated 4,300 jobs and approximately $45 million in local property tax revenues annually.
2. Early estimates of infrastructure costs in the Union Square / Boynton Yards areas are on the order of $40 to $50 million, a cost that will be difficult for the private sector to absorb in its entirety. Absent some level of public investment in infrastructure, portions of the area may remain underutilized, and local property tax revenues and state revenues will remain unrealized.

[105] City of Somerville, Union Square Revitalization Study, August 2012, p. 80-81

Table 10: Summary of Case Study Financial Projections (estimates only)

Location	Project	Local Property Tax	Projected Population Growth	Projected Job Growth	Increased Local Buying Power (est.)	Increased Annual State Revenue (from jobs only) (est.)
Boston	Seaport District	$75 m (current)	8,123	16,000	$110,086,004	$12,264,486
Somerville	Union Square & Boynton Yards	$45 m (projected)	1,947	4,300	$26,380,915	$3,296,081
Stoughton	Entire town connected to MWRA (2003)	$4.5 m (increase in commercial tax levy)	4,614	753	$62,533,542	$577,197
Taunton	Miles Standish Industrial Park	$7.8 m (projected)	0	2,500	$0	$1,916,326
Weymouth	Southfield	$11.2 m (projected)	6,766	2,533	$91,704,342	$1,941,621
			21,449	**26,086**	**$290,704,802**	**$19,995,712**

Assumptions:

1. The figure for Stoughton's local tax property represents the increase in the annual tax levy fromcommercial property between 2003 and 2009; it does not include all property tax revenues.
2. The Boston Seaport District has 4,000 jobs today, 20,000 projected overall.
3. Seaport District population growth includes existing units, units under construction, and permitted; is not a build out figure.
4. Boston and Somerville had 2.29 persons per household and Stoughton had 2.37 persons per household per 2010 census.
5. The calculations for state revenue from new jobs used the existing distribution of jobs by employment sector for the State, no distinction was made for local conditions.
6. The average retail expenditure per Massachusetts resident per year is $13,553. (Census 2007 Quick Facts).
7. State revenue estimates are for all jobs, not "net new" jobs.

(*This table provides only rough estimates of the financial implications of the five case studies based upon information available; project specific fiscal analysis would need to be done to ascertain the actual revenues to be generated by each.)*

POTABLE WATER RESOURCES

OVERVIEW

Although to consumers, water may seem to be a limitless commodity because they simply turn the spigot and water is immediately there, water is not evenly distributed across Massachusetts. In fact, some regions face potential shortfalls today and others may find themselves with a shortfall in the future. All told, across its 27 water basins, Massachusetts receives 44 inches of precipitation in the form of snow and rain per year on average, which provides an adequate supply of water for people and the environment. However, the amount of precipitation varies over time, with extreme precipitation events causing flooding in some areas and long periods of drought or low rainfall contributing to shortages in others. Water shortages can be further exacerbated by inefficient use and inequitable distribution. (See Appendix B for "How Water is Collected in Massachusetts".)

The availability of water is of importance because it has a direct impact on the Commonwealth's attractiveness to new businesses, as with each job is added, local water demand increases. Given that estimates are that 57,000 jobs are created for every $1 billion spent on drinking water infrastructure, and the state's fishing and agricultural industries depend on sustainable water sources,[106] the provision of adequate potable water is an economic imperative. Despite this, challenges still remain in Massachusetts.

These challenges include:

- Aging potable water infrastructure system

Within the study area[107] today, 51 communities are part of the MWRA water system (15 of which receive partial service and 3 receive emergency service only), 120 communities use surface water supplied by a Public Water Service (PWS) other than or in addition to water provided by the MWRA, 117 use groundwater supplied by a PWS, and 17 do not have a PWS, instead relying on private well water. As a result, the state is home to an array of water suppliers of varying size who secure their water from multiple different sources.

As will be seen with the State's wastewater systems, considerable investment is needed to keep existing water systems, including pipes, reservoirs, and treatment plants in safe and functioning condition. The Massachusetts Water Infrastructure Finance Commission (WIFC) has identified an estimated $10.2 billion funding gap across the Commonwealth through 2030.[108] This gap represents the difference

[106] Water Infrastructure Finance Commission (WIFC), Massachusetts's Water Infrastructure: Toward Financial Sustainability, February 7, 2012. p. 22
[107] Note: Barnstable, Berkshire, Dukes, and Nantucket Counties were excluded from the water analysis due to their unique environments and distance from the MWRA assets and resources.
[108] WIFC, p.4

between current funding and estimated needs including capital investment, repair and replacement, operations, maintenance, and debt service. Costs stemming from changes in regulatory requirements and economic growth will only add to this gap. Costs are rising, driven by aging systems and environmental and public health concerns, while funding at the state and federal level is decreasing. In addition, user rates oftentimes do not reflect the true cost of service, collectively fueling the growing gap. In Boston alone, estimated cost for repair or replacement of pipes due to wear-out will exceed $60 million through 2030 and $200 million through 2050.[109] As communities struggle to fund system repair and enhancement through loans or general funds, other needed projects are put on hold and debt burden rises.

- Existing constrained water basins

In 2001, the Massachusetts Water Resource Commission (WRC) published the results of a multi-year study identifying which of the state's 27 river basins (also known as watersheds) are "stressed". The Commission defined a "stressed basin" as a basin or sub-basin in which the quantity of streamflow had been significantly reduced, the quality of the streamflow degraded, and/or key habitat factors impaired. As a result of their work, the entire Ipswich River was identified as high stress, along with 11 sub-basins, including the Seven Mile River near Spencer, the Quinsigmond River at North Grafton, and the Wading River at Mansfield. Challenges along the Ipswich River are long-standing, beginning with a legislative decision in the late 1800s that allowed multiple communities to draw water from the river. Until recently, 14 communities either drew water from the river via reservoir (Beverly, Danvers, Lynn, Middleton, Salem, Peabody), or from wells along the river (Hamilton, Ipswich, Lynfield, North Reading, Reading, Topsfield, Wenham, Wilmington). However, in 2006, the Town of Reading decided to acquire water from the MWRA instead of using its wells. Nevertheless, the basin continues to be defined as constrained. [The WRC effort has been superseded by more recent analysis performed by the Executive Office of Energy and the Environment (EOEEA) described below.]

- Future Constraints: Sustainable Water Management Initiative

The Sustainable Water Management Initiative (SWMI) represents the Massachusetts Executive Office of Energy and Environmental Affairs' (EOEEA) effort to implement the State's Water Management Act (WMA) (WMA, 310 CMR 36.03) by developing a system that evaluates and classifies water sources, and defines the maximum amount of water that can be dependably withdrawn from a basin during drought conditions.[110] Starting in 2014, the established framework will guide the MassDEP's permitting of water withdrawals.[111] It is intended to provide for the continued withdrawal of water for public consumption, but in a manner that will maintain healthy streams and gradually improve degraded ones over time. At the same time, its conservative approach will help ensure that adequate potable water is available in each watershed, even in drought conditions.

In preparation for implementation of the initiative, EOEEA has analyzed all of Massachusetts water basins to determine which will have adequate water flow or "safe yield" to address consumer needs and the needs of the downstream environment. Although the initiative is not fully in effect today, this

[109] WIFC, p. 36. Cost estimate start CY 2010 and run through stated period.
[110] Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Sustainable Water Management Initiative: Framework Appendices, November 28, 2012, p. 1
[111] Ibid. p. 4

analysis could affect the amount of water permitted for withdrawal from surface and groundwater sources in the future when permits come up for renewal. At present, the EOEEA is reaching out to communities to engage them in thinking of ways to prepare for implementation. Local efforts could include everything from water conservation, engaging in leak detection, using other water sources already available to the communities, or securing new water sources, among other activities.

- Implications for Employment and Population Growth

In terms of economic growth, Massachusetts' abundant water supply is more than adequate to accommodate increased job growth. However, water supply in those communities planning for substantial employment growth will need to be analyzed to determine if it is adequate at the local level to meet the new demand, or if infrastructure improvements are needed before the growth occurs.

Focusing in on the metro-Boston region, which is projected to add 230,000 new jobs by 2035[112], rough estimates indicate that this new job growth will increase demand for water by approximately 5 million gallons per day. At the same time, the resident population is expected to increase by 484,000, thereby increasing water demand by an additional 31.4 to 32.4 million gallons per day. At the same time, the new jobs increase the demand for water, estimates are that they may contribute up to $176 million in state revenue each year.

When looking at where the new growth is anticipated to occur, it becomes clear that some of the significant contributors to the growth are also communities potentially being affected by the new SWMI framework. These include Lynn, Plymouth, Westborough, and Weymouth, among others. In fact, over 44,200 (approximately 19%) of the prospective jobs in the Boston metro region are anticipated to be located in communities with water withdrawals that could be affected by SWMI. Although the implementing regulations have not yet been finalized and EOEEA has worked with communities via a pilot program to make the transition as successful as possible, change in how much potable water can be taken from various bodies of water is on the horizon. Given that developers prefer projects where infrastructure connections are already in place or where funding for infrastructure improvements has been committed, it will be important for Massachusetts communities to learn how the SWMI framework will affect them now and in the future and plan accordingly.

**

In order to fully capitalize on potential new employment and population growth, having a readily available source of potable water is a must. In parts of the Commonwealth, the MWRA and municipalities have been so successful in providing water in abundance to their residents and businesses, that the average customer may not be aware that any challenges exist. However, changes in consumption, investment in local and regional infrastructure, and potentially in some instances, the acquisition of water from new suppliers may be required to meet future water needs in a regulatory system that is trying to increasingly balance the needs of customers with the natural environment. These challenges exist while municipalities and regional water districts are grappling with the cost of maintaining what infrastructure is already in place amidst a state-wide funding gap of $10.2 billion.

[112] Metropolitan Area Planning Council (MAPC), MetroFuture: Making A Greater Boston Region, May 2008, updated projections provided by Timothy G. Reardon, Manager of Planning Research, MAPC, to W. Rob May, March 2013.

This chapter identifies where stressed water basins exist today, describes the implications of new policies affecting the future draw of water from surface and groundwater sources, and then describes locations where water shortages may potentially impact community plans for economic development.

MWRA POTABLE WATER SYSTEM

Potable Water System History

The Massachusetts Water Resources Authority (MWRA) is a quasi-independent public authority that was established by the State Legislature in 1984. In 1985, the MWRA Water Division assumed responsibility for the delivery and distribution of potable water to 46 communities[113], taking over this charge from the Metropolitan District Commission (MDC). Over time, the number of member communities has grown, and today there are currently 51 communities that receive all or a portion of their water service through the MWRA water supply system.

The original 46 communities are identified below[114]:

Table 11: Communities Originally Served by MWRA Water (1985)					
Arlington	Belmont	Boston	Brookline	Cambridge*	Canton**
Chelsea	Chicopee	Clinton●	Dedham**	Everett	Framingham
Leominster*	Lexington	Lynn***	Lynnfield**	Malden	Marblehead
Marlborough**	Medford	Melrose	Milton	Nahant	Needham**
Newton	Northborough**	Norwood	Peabody**	Quincy	Revere
Saugus	Somerville	Southborough	South Hadley Water Dist No. 1	Stoneham	Swampscott
Wakefield**	Waltham	Watertown	Wellesley**	Weston	Wilbraham
Winchester**	Winthrop	Woburn**	Worcester*		
* Emergency back up only		** Partial water service		*** GE plant only	
● Per an 1898 agreement, Clinton receives 800 MGY directly from the Wachusett Reservoir in exchange for flooding a large portion of the town. The Town treats and pumps the water.					

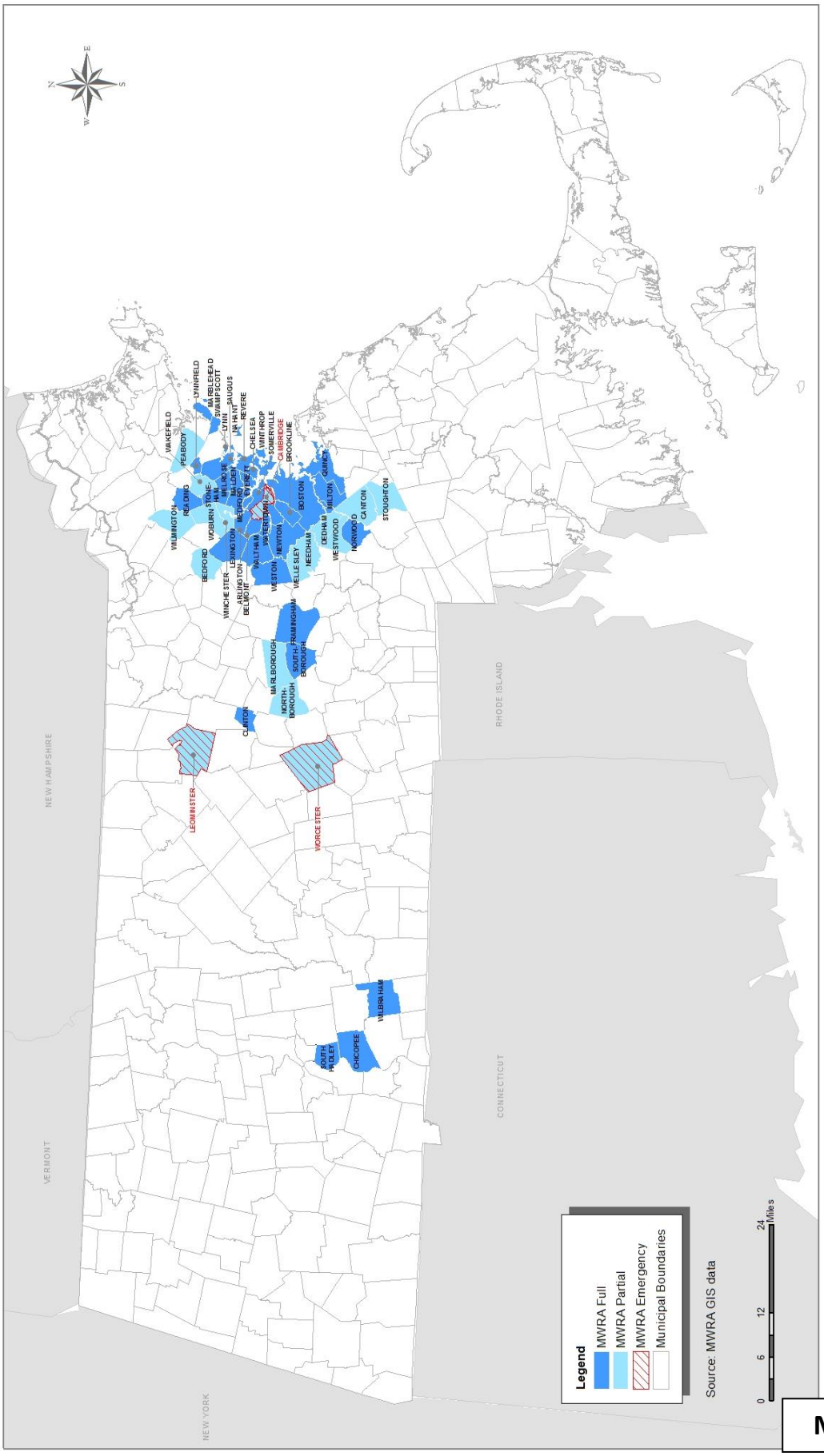
The five communities that have joined the MWRA water supply system since 1985 are:

Table 12: Communities Added After 1985				
Bedford**	Reading	Stoughton**	Westwood**	Wilmington**
* Emergency back up only		** Partial water service		

Thirty-three (33) of these communities receive all of their potable water from the MWRA, while 18 receive partial or emergency backup service. Communities with partial MWRA service may supplement this through municipal Public Water Systems (PWS), private water systems, or they may allow individual users to tap their own surface water or groundwater sources.

[113] Massachusetts Water Resource Authority (MWRA), Water System Master Plan, 2006
[114] Massachusetts General Laws (MGL) Chapter 372, Section 8 (d), Acts of 1984

MWRA Water Communities

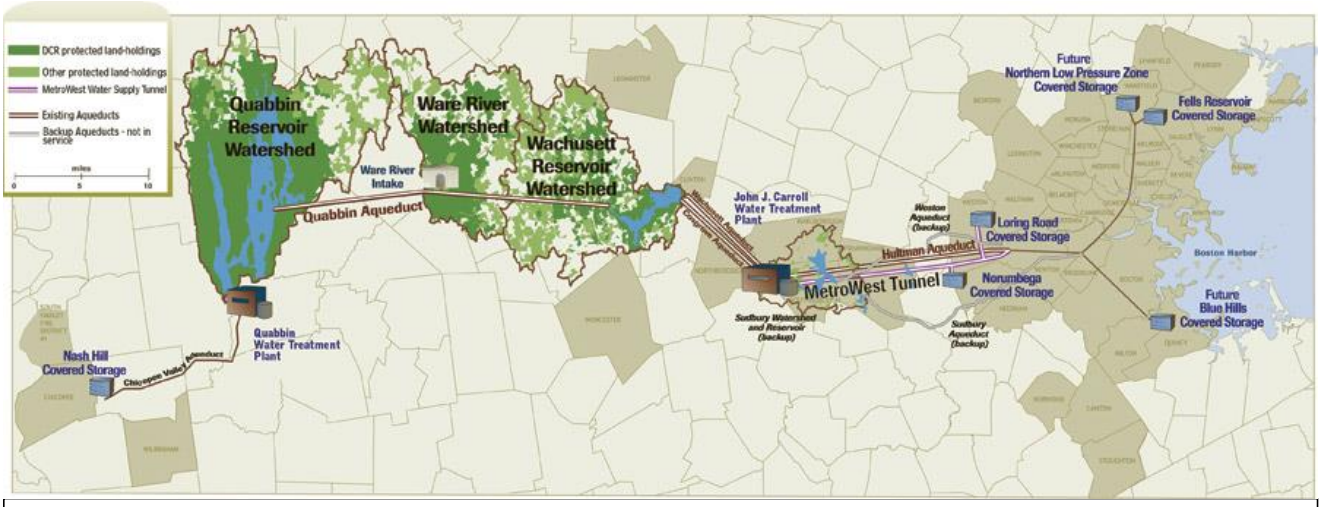


Map 1

MWRA Water System Today

The water system that MWRA inherited from the MDC received its water from a series of interconnected watersheds and reservoirs managed by the Massachusetts Department of Conservation and Recreation (DCR). According to the MWRA, "MWRA's water comes from the Quabbin Reservoir, about 65 miles west of Boston, and the Wachusett Reservoir, about 35 miles west of Boston. The two reservoirs combined supplied an average of 214.21 million gallons per day to consumers in 2007. The Quabbin alone can hold a 4-year supply of water."[115] The Quabbin Reservoir (412 billion gallons) receives water from the East Branch and West Branch of the Swift River year-round and, for eight months of the year, the MWRA has the ability to withdraw water from the Ware River (when flow exceeds 85 MGD) to add to this. The Wachusett Reservoir (65 billion gallons) receives water from the Nashua River.

To provide water for the Boston metropolitan region, the two reservoirs are interconnected via the Quabbin Aqueduct and then water is moved through a series of additional aqueducts including the Cosgrove Aqueduct, Hultman Acqueduct, Metrowest Tunnel, City Tunnel, City Tunnel Extension, and the Dorcester Tunnel. Water is stored in several covered storage tanks across the region including the Norumbega (Weston), Loring Road (Weston), Blue Hills (Quincy), and Fells (Stoneham) Covered Storage Facilities. The Spot Pond Covered Storage facility in Stoneham is currently under construction. Water for the western communities (Chicopee, Wilbraham, and South Hadley Water District No. 1) is drawn directly from the Quabbin reservoir, treated at the Ware Disinfection Facility, and delivered via the Chicopee Valley Aqueduct to the Nash Hill Covered Storage facility (Ludlow) for distribution. Additional storage tanks include: Arlington, Bear Hill in Stoneham, Bellevue in West Roxbury, Deer Island, Turkey Hill in Arlington, Walnut Hill in Lexington. "In total, MWRA's storage tanks hold approximately 180



MWRA Water Supply System (2013)

[115] "How the MWRA System Works", http://www.mwra.state.ma.us/04water/html/watsys.htm, retrieved on June 10, 2013.

million gallons of treated water. The water is continuously used and replenished."[116]

Shortly after its creation, the MWRA began a massive upgrade of its distribution system. The highlight of this investment was the construction of MWRA's first modern water treatment plant and the Metro West Tunnel. The John J. Carroll Water Treatment Plant, completed in 2005, treats drinking water for the majority of MWRA customers, residents and businesses in MetroWest and Metro Boston communities. The plant has the capacity to treat up to 405 million gallons of water (MGD) from the Wachusett reservoir on a maximum day, although daily use does not approach this figure.[117] The plant is located at the end of the Cosgrove Tunnel and Wachusetts Aqueduct and at the beginning of the Hultman Aqueduct and MetroWest Tunnel.

Today, the MWRA operates an elaborate system of over 400 miles of water tunnels and distribution mains, which in turn feed another 6,700 miles of locally-owned water distribution pipes.[118] Water demand now averages approximately 200 million gallons per day (MGD)[119], significantly less than the 1980 peak of 342 MGD.[120]

[116] "Covered Drinking Water Storage", http://www.mwra.state.ma.us/04water/html/cov.htm, retrieved on June 10, 2013.
[117] MWRA, Water System Master Plan, 2006, p. 3-6.
[118] Ibid, p. 3-5.
[119] Estes, Stephen, "Report to MWRA Board of Directors on 2012 Water Use Trends", January 13, 2013.
[120] MWRA, Water System Master Plan, p. 4-4.

NON-MWRA WATER SYSTEMS AND SOURCES

Surface Water Systems

The U.S. EPA has identified 120 communities in Bristol, Essex, Franklin, Hampshire, Hampton, Norfolk, Plymouth, Suffolk, and Worcester Counties [121] that use surface water supplied by a Public Water Service (PWS) other than or in addition to water provided by the MWRA.[122] Surface water refers to water captured directly from a river or retained in a reservoir. In a typical municipal surface water system, water is collected from a running river, lake, or other body of water through an intake pipe for treatment. The treatment process starts with screenings, which removes large debris. The screened water is then transferred to mixing tanks where compounds are added to the water to cause coagulation and flocculation. The mixed water flows into large settling tanks to allow particulate, small suspended solids, to either sink to the bottom or float to the top. The settled water is then allowed to flow through a series of fine filters like sand and activated coal before it is disinfected with chlorine or ozone to kill any pathogens. The clean water is then pumped under pressure to customers around the system. (See Appendix B: How Water is Collected in Massachusetts for additional information.)

An example of a larger surface water system is operated by the City of Worcester. It not only provides water for city residents and businesses, it also sells water to the towns of Auburn, Holden, and Paxton, with an annual production of 8.4 billion gallons of water (23.3 MGD) in 2012. The system has 18 employees and an annual budget of $2.2 million.[123] Water for Worcester is treated by a 50 MGD plant in Holden. A significantly smaller water system is one operated by Taunton, which produces 7 MGD. It has 10 employees and a budget of $1.7 million.[124] Its water is treated at the Rocheleau Water Filtration Plant in Lakeville which has a capacity of 14 MGD. The City of Cambridge operates another type of system where city residents and businesses receive their potable water from the Cambridge Water Department on a daily basis, yet the City maintains a standby connection to the MWRA system in the event of an emergency. Since the physical connection already exists, transferring its customers onto MWRA water can happen expeditiously, when needed. The Broadway water main break of February 2005 is an example of why this relationship exists. When the 30-inch main ruptured, Cambridge turned to MWRA, which provided it with 2.744 million gallons to keep the water flowing throughout the city.

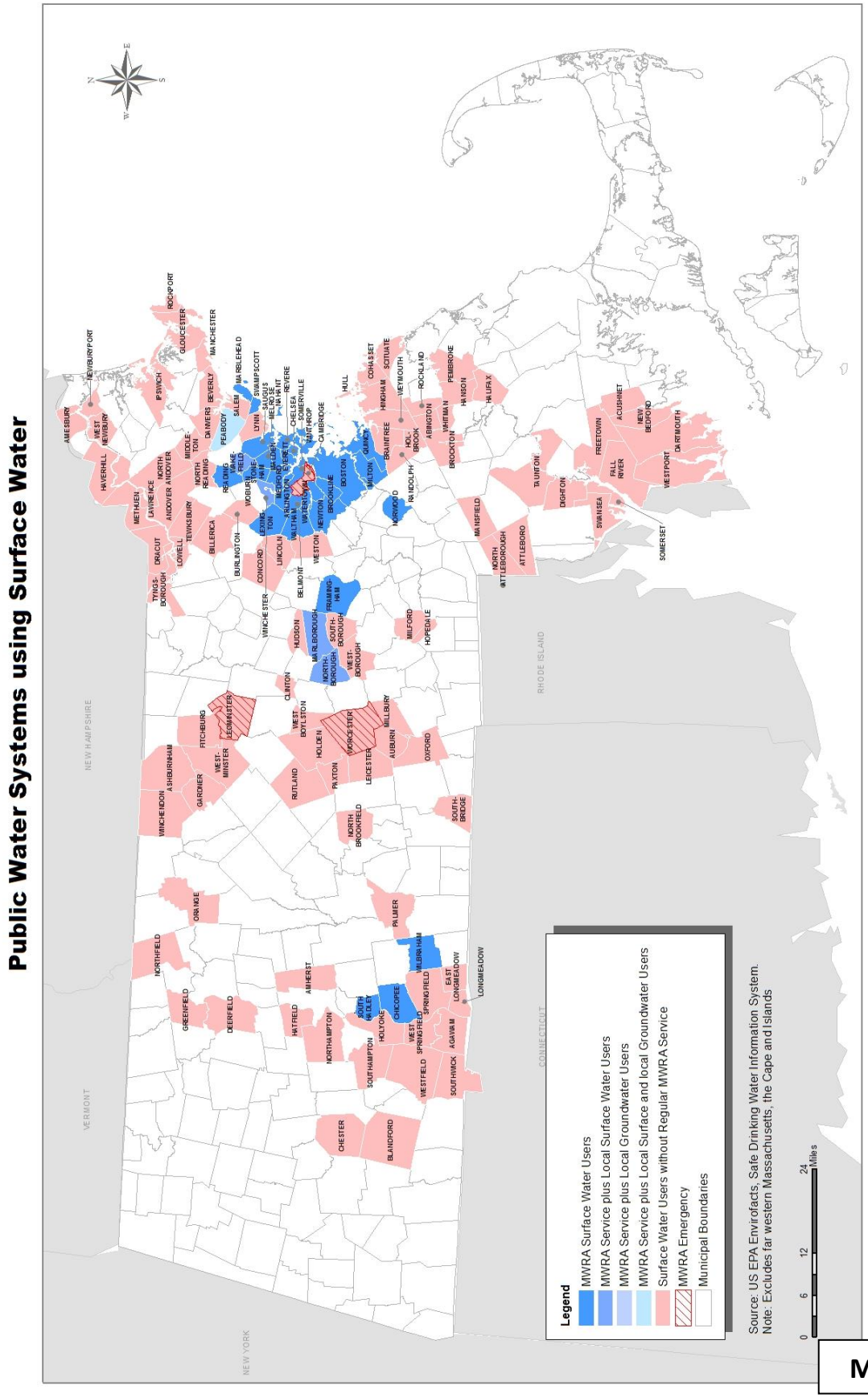
Surface water users are identified below and on Map 2.

[121] Note: Berkshire, Dukes, Barnstable, and Nantucket Counties were excluded from this analysis due their distance from the MWRA assets and resources.
[122] U.S. EPA Envirofacts, Safe Drinking Water Information System
[123] Robert Hoyt, Filtration Plant Manager, Worcester Water Department
[124] John Chase, Supervisor, Taunton Water Department

Table 13: Non-MWRA Water System Users (Surface Water)					
Abington	Acushnet	Agawam	Amesbury	Amherst	Andover
Ashburnham	Attleboro	Auburn	Beverly	Billerica	Blandford
Braintree	Brockton	Burlington	Cambridge*	Chester	Clinton●
Cohasset	Concord	Danvers	Dartmouth	Deerfield	Dighton
Dracut	E. Longmeadow	Fall River	Fitchburg	Freetown	Gardner
Gloucester	Greenfield	Halifax	Hanson	Hatfield	Haverhill
Hingham	Holbrook	Holden	Holyoke	Hopedale	Hudson
Hull	Ipswich	Lawrence	Leicester	Leominster*	Lincoln
Longmeadow	Lowell	Lynn**	Manchester	Mansfield	Marlborough**
Methuen	Middleton	Milford	Millbury	Monroe	New Bedford
Newburyport	North Andover	N Attleborough	North Brookfield	North Reading	Northfield
Northampton	Orange	Oxford	Palmer	Paxton	Peabody**
Pembroke	Randolph	Rockland	Rockport	Rutland	Salem
Scituate	Somerset	Southampton	Southbridge	Southwick	Springfield
Swansea	Taunton	Tewksbury	Tyngsborough	Wakefield**	West Boylston
West Newbury	West Springfield	Westborough	Westfield	Westminster	Westport
Weymouth	Whitman	Winchendon	Winchester**	Worcester*	
* Emergency back up only from MWRA			** Partial water service from MWRA		
● Under an 1898 agreement, Clinton receives 800 MGY directly from the Wachusett Reservoir in exchange for flooding a large portion of the town. The Town treats and pumps the water.					

Of the surface water users, a number of them purchase water from another community.

Table 14: Non-MWRA Water Users (Surface Water) (Purchase from other community)					
Acushnet	Agawam	Auburn	Bedford**	Dartmouth	Dighton
Dracut	E. Longmeadow	Freetown	Halifax	Hanson	Holbrook
Holden	Hopedale	Longmeadow	Mansfield	Middleton	Millbury
North Attleboro	North Reading	Northborough	Orange	Paxton	Pembroke
Randolph	Southampton	Southwick	Tyngsborough	West Boylston	West Newbury
Westminster	Westport	Whitman	Winchendon		


Public Water Systems using Surface Water
Legend
MWRA Surface Water Users
MWRA Service plus Local Surface Water Users
MWRA Service plus Local Groundwater Users
MWRA Service plus Local Surface and local Groundwater Users
Surface Water Users without Regular MWRA Service
MWRA Emergency
Municipal Boundaries
Source: US EPA Envirofacts, Safe Drinking Water Information System.
Note: Excludes far western Massachusetts, the Cape and Islands
0 6 12 24 Miles
NEW HAMPSHIRE
VERMONT
NEW YORK
CONNECTICUT
RHODE ISLAND

Map 2

Groundwater Systems

The U.S. EPA has identified 117 communities in those same counties that use groundwater supplied by a Public Water Service (PWS), two of which have partial surface water service from MWRA. Groundwater consists of water that is naturally stored in sand and gravel aquifers and is accessed by wells. (See Appendix B: How Water is Collected in Massachusetts for additional information.)

The Town of Plymouth, which provides approximately two-thirds of its population with water, is supplied by twelve gravel packed wells that draw water from the Plymouth-Carver aquifer. The water, filtered by the gravel packing, is disinfected at each well and treated to balance its pH before being pumped into the municipal supply system. Plymouth is unable to provide employment and production costs for water treatment as it does not separate treatment from delivery costs in its budget.[125] A larger system is that of Natick, which operates 10 wells. Eight of the wells, known as the Springvale, Evergreen, Pine Oaks, and Morse Pond wells, are located in Natick and draw water from the Sudbury/Assabet/Concord (SuAsCo) watershed. The Elm Bank wells are located in Dover and draw water from the Charles River watershed. The Springvale, Evergreen, and Elm Bank wells are the primary sources for the town, with water from the Springvale and Evergreen wells being treated at Springvale Water Treatment Plant before distribution. The treatment plant was recently expanded to provide capacity of 8 MGD and employs 7 FTE's and employs 2 PTE's with a budget (operating and treatment personnel) of $1,264,690 per year..[126]

Groundwater users can be found in the table below and on Map 3.

Table 15: Non-MWRA Water System Users (Groundwater)

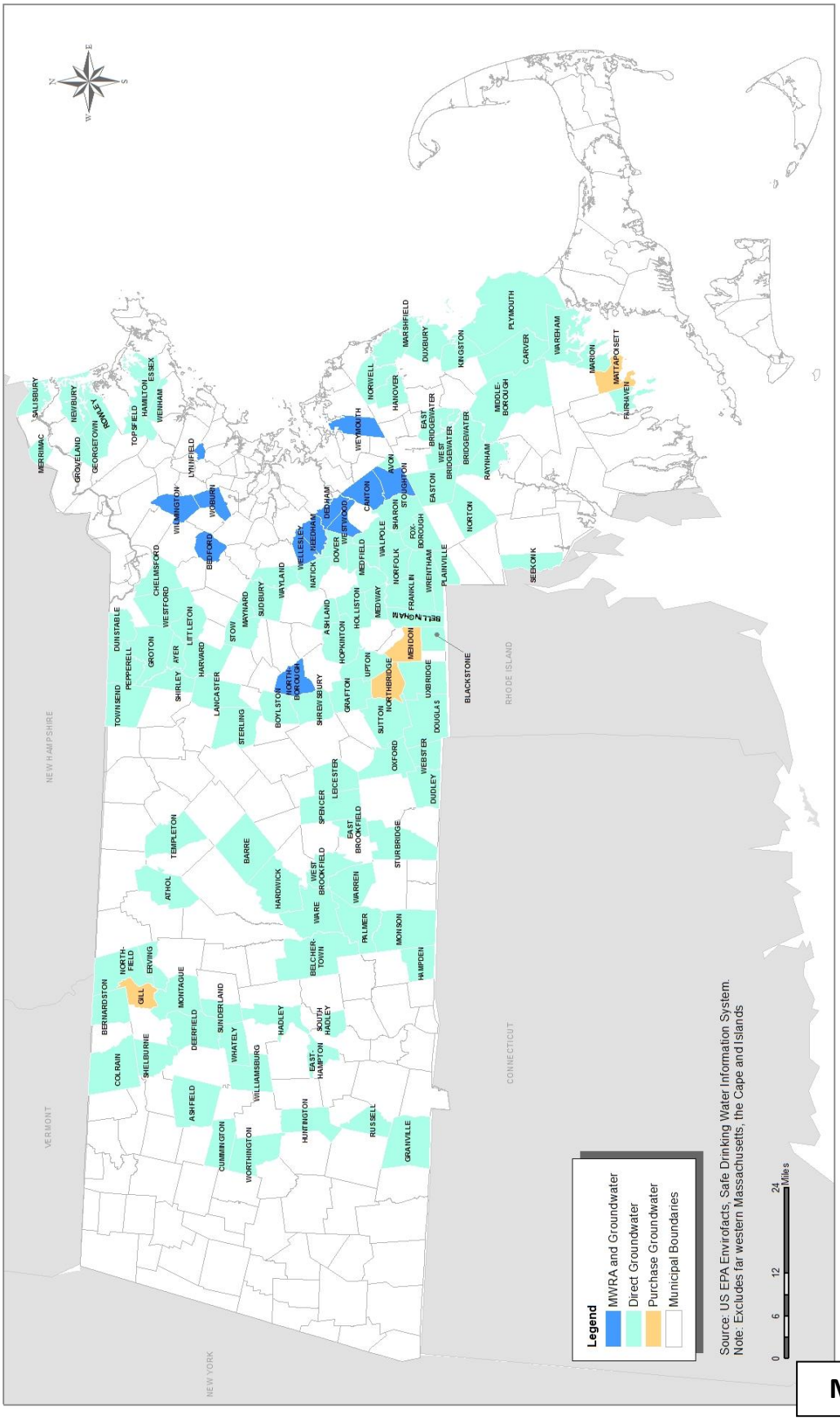
Acton	Ashfield	Ashland	Athol	Avon	Ayer
Barre	Bedford**	Belchertown	Bellingham	Bernardston	Blackstone
Boylston	Bridgewater	Canton**	Carver	Chelmsford	Colrain
Cummington	Dedham**	Deerfield	Douglas	Dover	Dudley
Dunstable	Duxbury	E. Bridgewater	East Brookfield	Easthampton	Easton
Erving	Essex	Fairhaven	Foxborough	Franklin	Georgetown
Gill	Grafton	Granville	Groton	Groveland	Hadley
Hamilton	Hampden	Hanover	Hardwick	Harvard	Holliston
Hopkinton	Huntington	Kingston	Lancaster	Leicester	Littleton
Lunenburg	Lynnfield**	Marion	Marshfield	Mattapoisett	Maynard
Medfield	Medway	Mendon	Merrimac	Middleborough	Millis
Monson	Montague	Natick	Needham**	Newbury	Norfolk
Northborough**	Northbridge	Northfield	Norton	Norwell	Oxford
Palmer	Pepperell	Plainville	Plymouth	Raynham	Rowley
Russell	Salisbury	Seekonk	Sharon	Shelburne	Shirley
Shrewsbury	South Hadley	Spencer	Sterling	Stoughton**	Stow
Sturbridge	Sudbury	Sunderland	Sutton	Templeton	Topsfield
Townsend	Upton	Uxbridge	Walpole	Ware	Wareham

[125] Rich Tierney, Water Quality Engineer, Plymouth Water Department
[126] Anthony Comeau, Interim Water/Sewer Commissioner, and Bill Chenard, Natick Water & Sewer Division

Warren	Wayland	Webster	Wellesley**	Wenham	W. Bridgewater
West Brookfield	Westford	Westwood**	Weymouth	Whately	Williamsburg
Wilmington**	Woburn**	Worthington	Wrentham		
** Partial water service from MWRA					

Of those groundwater users, five (5) communities purchase groundwater from another community.

Table 16: Non-MWRA Water Users (Groundwater) (Purchase from other community)				
Gill	Mattapoisett	Mendon	Northbridge	Palmer


Public Water Systems using Groundwater
Legend
MWRA and Groundwater
Direct Groundwater
Purchase Groundwater
Municipal Boundaries
Source: US EPA Envirofacts, Safe Drinking Water Information System.
Note: Excludes far western Massachusetts, the Cape and Islands
0
6
12
24
Miles
VERMONT
NEW HAMPSHIRE
NEW YORK
CONNECTICUT
RHODE ISLAND
SALISBURY
MERRIMAC
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
TOPSFIELD
HAMILTON
ESSEX
WENHAM
LYNNFIELD
WILMINGTON
WOBURN
BEDFORD
CHELMSFORD
WESTFORD
LITTLETON
AYER
SHIRLEY
HARVARD
LANCASTER
STOW
MAYNARD
SUDBURY
WAYLAND
WELLESLEY
NEEDHAM
NATICK
DEDHAM
WESTWOOD
DOVER
MEDFIELD
WALPOLE
CANTON
AVON
STOUGHTON
SHARON
FOXBOROUGH
NORFOLK
FRANKLIN
WRENTHAM
PLAINVILLE
MEDWAY
HOLLISTON
ASHLAND
HOPKINTON
BELLINGHAM
MENDON
UPTON
NORTHBRIDGE
SUTTON
GRAFTON
SHREWSBURY
NORTHBOROUGH
BOYLSTON
UXBRIDGE
DOUGLAS
WEBSTER
OXFORD
DUDLEY
STURBRIDGE
EAST BROOKFIELD
LEICESTER
SPENCER
WEST BROOKFIELD
WARREN
PALMER
MONSON
HAMPDEN
WARE
BELCHERTOWN
HADLEY
SOUTH HADLEY
EAST HAMPTON
HUNTINGTON
RUSSELL
GRANVILLE
WORTHINGTON
CUMMINGTON
WHATELY
WILLIAMSBURG
ASHFIELD
DEERFIELD
SUNDERLAND
MONTAGUE
GILL
NORTHFIELD
ERVING
BERNARDSTON
SHELBURNE
COLRAIN
ATHOL
TEMPLETON
BARRE
HARDWICK
TOWNSEND
PEPPERELL
DUNSTABLE
GROTON
STERLING
BLACKSTONE
WEYMOUTH
NORWELL
HANOVER
MARSHFIELD
DUXBURY
KINGSTON
PLYMOUTH
CARVER
WAREHAM
MARION
MATTAPOISETT
FAIRHAVEN
EAST BRIDGEWATER
WEST BRIDGEWATER
BRIDGEWATER
RAYNHAM
MIDDLEBOROUGH
EASTON
HORTON
SEEKONK

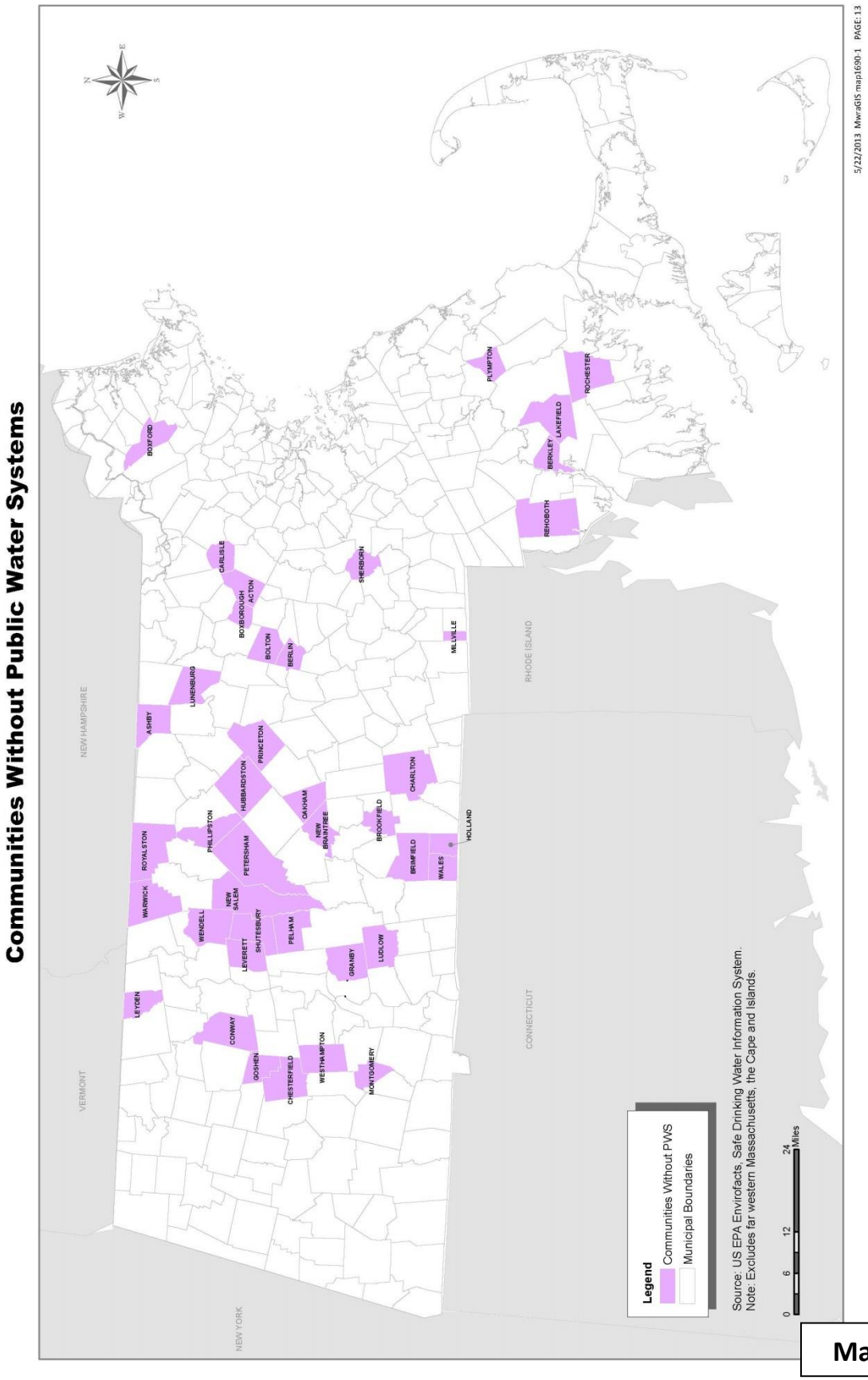
Map 3

Communities without Public Water Systems

The 16 communities listed below are not served by a PWS. Instead, residents and businesses secure potable water via individual wells. The residential population of these communities ranges from 990 (New Salem) to 6,240 (Granby). One of the challenges these community face is ensuring that the water supply remains adequate and is not drawn down so low that the concentration of undesirable chemicals or metals gets too high. Massachusetts General Law Chapter 111 Section 122 gives local boards of health jurisdiction over private groundwater wells. Each board may adopt a Private Well Regulation that establishes criteria for private well siting, construction, water quality and quantity.

Table 17: Communities Without a Public Water Supply

Ashby	Berlin	Bolton	Boxford	Carlisle	Granby
Hubbardston	New Braintree	New Salem	Oakham	Pelham	Petersham
Phillipston	Princeton	Stow	Plympton		


Communities Without Public Water Systems
NEW HAMPSHIRE
VERMONT
NEW YORK
CONNECTICUT
RHODE ISLAND
BOXFORD
CARLISLE
BOXBOROUGH
ACTON
SHERBORN
BOLTON
BERLIN
MILLVILLE
LUNENBURG
ASHBY
PRINCETON
HUBBARDSTON
PHILLIPSTON
OAKHAM
NEW BRAINTREE
BROOKFIELD
CHARLTON
HOLLAND
ROYALSTON
PETERSHAM
BRIMFIELD
WALES
WARWICK
NEW SALEM
WENDELL
SHUTESBURY
PELHAM
LEVERETT
GRANBY
LUDLOW
LEYDEN
CONWAY
GOSHEN
CHESTERFIELD
WESTHAMPTON
MONTGOMERY
PLYMPTON
ROCHESTER
LAKEFIELD
BERKLEY
REHOBOTH
Legend
Communities Without PWS
Municipal Boundaries
Source: US EPA Envirofacts, Safe Drinking Water Information System.
Note: Excludes far western Massachusetts, the Cape and Islands.
0 6 12 24 Miles
5/22/2013 MwraGIS map1690-1 PAGE 13

Map 4

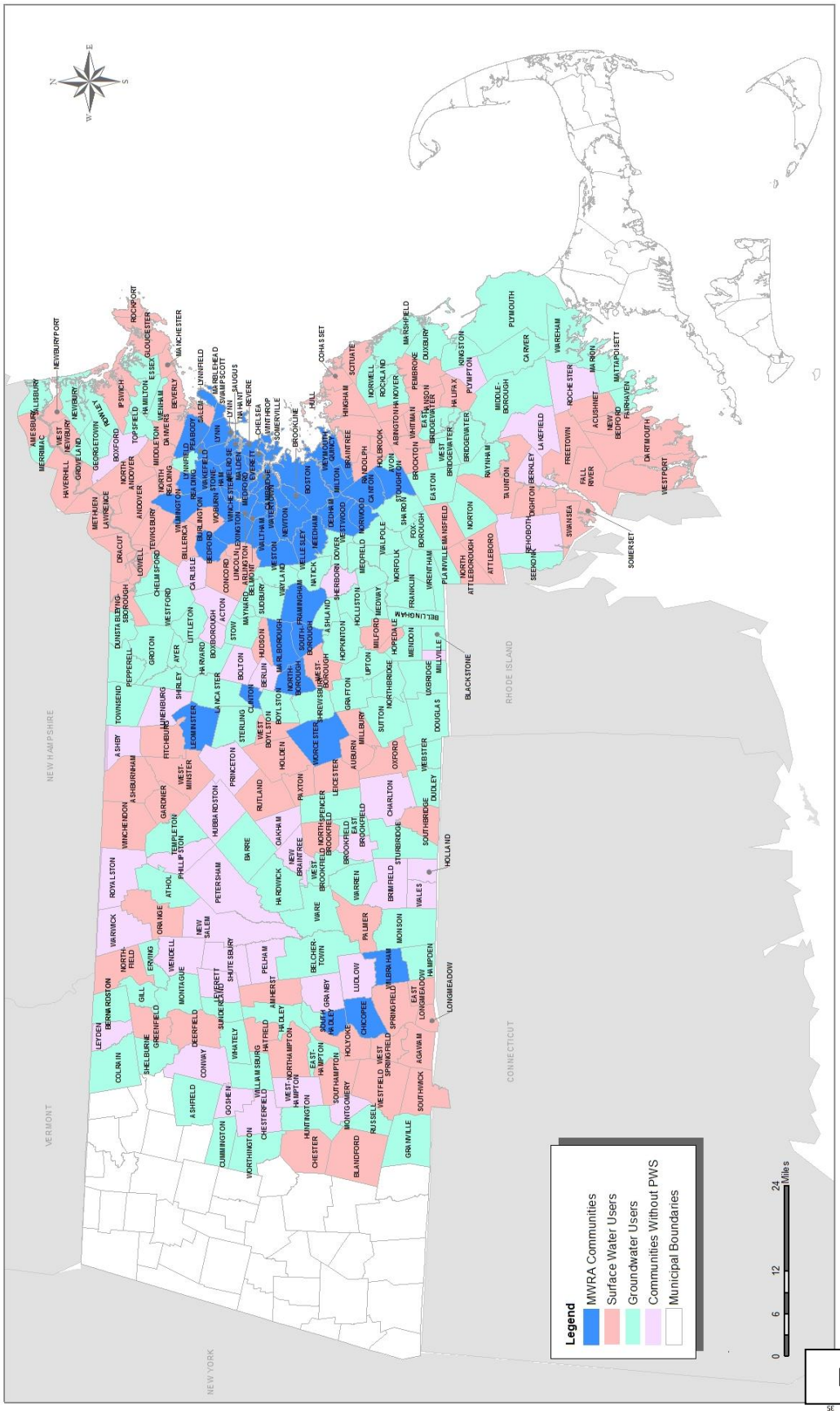
POTABLE WATER SYSTEMS SUMMARY

As can be seen from Map 5, the means by which communities in eastern and central Massachusetts receive their potable water supply varies, often on a community by community basis. A sizable portion of the study area (approximately 10.4% of the land area) receives its water either exclusively or in part from the MWRA with a total population of over 2.2 million served by MWRA water. However, the greatest number of residents live in communities served by non-MWRA surface water (2.86 million), while communities served by groundwater constitute the largest portion of the study area (2,865 square miles). However, as can be seen below although the land area served by surface and groundwater resources is greater than that served by the MWRA, the number of customers per square mile is far greater for the MWRA-served communities (3,860 persons per square mile versus 1,270 for surface water and 546 for groundwater).

Table 18: Land Area & Population by Service Type

Predominant Water Source	Land Area (sq. mi.)	Population
MWRA (excluding emergency service)	585	2,258,000
Public Surface Water (non-MWRA)	2,247	2,855,000
Public Groundwater	2,865	1,565,000
No Public Water System	457	55,000

(Note that municipalities served by more than one type of water source were included in the sums for each type, i.e., some communities are counted more than one time in the table above as there was no efficient way to determine how much land area was served by the different system types.)


Water Supply
Legend
MWRA Communities
Surface Water Users
Groundwater Users
Communities Without PWS
Municipal Boundaries
0
6
12
24
Miles
NEW HAMPSHIRE
VERMONT
NEW YORK
CONNECTICUT
RHODE ISLAND

Map 5

CURRENT AND FUTURE CHALLENGES IN WATER AVAILABILITY

Although Massachusetts does not face an overall shortage of water, as other states and regions do, there are challenges in getting the water to the consumer in a safe and cost effective way, while also balancing the needs of residents and businesses with that of the natural environment, an important priority of the State. Three significant challenges presently exist, although their impacts vary from community to community. These include:

- Cost of infrastructure maintenance and enhancement;
- Stressed water basins; and,
- Changing regulatory environment (SWMI).

These challenges have implications for how well communities are equipped for new job and population growth; growth that can improve the state and local financial outlook through increased property taxes and the buying power of new households.

Cost of Infrastructure Maintenance and Enhancement

The WIFC found that a funding gap of $10.2 billion for necessary water infrastructure investments exists in Massachusetts through 2030.[127] As water systems age, communities in Massachusetts and across the country are overwhelmed by the cost for upkeep and replacement. Much of the needed investment lies in the basic assets including power equipment, pipes, manholes, pumps, treatment plants, filter beds along with other system components.[128]

An estimated 21,000 miles of pipes in Massachusetts are in need of repair or replacement. In Boston alone, expenditures due to pipe wear out will exceed $60 million through 2030 and $200 million through 2050.[129] The industry suggests a reasonable guideline is to repair or replace 1% of the water distribution system each year to reduce the risk of failures, leakage and water quality issues; as well as to improve system efficiency and public safety.[130] In the town of Holliston, the average cost for replacing 1 mile of pipe was estimated at $800,000.[131] If the costs in Holliston are used as a proxy for the rest of the state, the cost of replacing 1% of pipes across the state requires a $168 million investment each year.

In Milford, served by the Milford Water Company, water infrastructure improvements related to storage, supply, and distribution were estimated at a total cost of over $22 million in 2010.[132] This

[127] WIFC, p. 4
[128] Ibid. p. 35
[129] Ibid. p. 26
[130] Tata & Howard, Water and Wastewater Consultants, Master Plan and Capital Improvement Plan for Milford Water Company, December 29, 2010. Retrieved September 9, 2013 at http://www.milfordwater.com/download/public_files/Milford%20Master%20Plan%20FINAL.pdf, p. 37
[131] WIFC, p. 48
[132] Tata & Howard, p. 46-57

estimate excludes the water company's $16.8 million new treatment plant that went online in 2013, mandated by the MassDEP after the town experienced an almost 2-week long boil water order in 2009. For much of 2011, (prior to construction of the new plant), the town's drinking water quality was compromised as the Milford Water Company repeatedly violated the trihalomethane drinking water standard. (Trihalomethan is a byproduct of chlorine treatment suspected of causing cancer). The new plant was funded through a bank loan, and the company requested an 83% increase among rate payers. "In September 2013, the DPU [Massachusetts Department of Public Utilities] turned down this request after a 10 month investigation. DPU allowed an increase of 53%, which follows last year's increase of 33%."[133] The existing treatment infrastructure (an existing filter plant and slow sand filters) were in service for over 130 years.[134] As a private utility, state revolving fund disbursements are limited to $5 million per project,[135] so the majority of funding comes from the rate payers.

Sources of revenue to pay for drinking water infrastructure investments are on decline at the federal, state, and municipal level.[136] State and federal earmarks have been "virtually eliminated",[137] and the Drinking Water State Revolving Fund (offering low interest loans since 1989, in lieu of prior grant assistance) is currently the most important funding stream. Between 1997 and 2011, an average of $33 million has been distributed to Massachusetts through this fund each year. The Commonwealth's Water Pollution Abatement Trust leverages federal funds in the bond market at a rate of approximately 2.4 for project financing.[138] At the municipal level, rate payers contributed a statewide average of 0.52% of median household income (MHI) for drinking water in 2010, far below the 1.25 percent recommendation in 2012 from the WIFC.[139]

Infrastructure that is left in service past its useful life, or is otherwise compromised can generate significant costs. "When older infrastructure goes without necessary maintenance, failures become more likely."[140] Direct costs of water main failures may include design, labor and materials, cost for public safety assistance, utility damage costs, landscaping restoration costs, laboratory costs, and debt service, among others. Costs to the public include traffic impacts, business customer outage impacts, public health impacts, property damage and stress on public safety departments who may not be able to respond as effectively to emergencies during the failure event.[141] Delaying repair until emergency situations arise is often more costly than scheduling maintenance as needed.

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[133] Baskin, Kathy, Director of Water Policy, EOEEA, email correspondence to Matthew Romero, MWRA, September 20, 2013

[134] Corcoran, Lindsay, "New water treatment plant comes online in Milford", milforddailynews.com, June 5, 1023. Retrieved September 9, 2013 at http://www.milforddailynews.com/news/x1528536624/New-water-treatment-plant-comes-online-in-Milford

[135] David Condrey, Manager, Milford Water Company, Phone interview with Shelley Ayervais, September 11, 2013

[136] Metzger, Andy, Statehouse News Service, "Sullivan Pledges to 'Doubledown' on State Conservation Efforts", September 4, 2013.

[137] Tata & Howard. p. 52

[138] Ibid. p. 54

[139] Ibid. p. 58

[140] Ibid. p. 36

[141] Ibid. p. 37

Stressed Basins

In 1999, the WRC began a multi-year study to define and identify stressed water basins in an effort to provide additional information to regulators evaluating the environmental impact of development

Stressed Basin Impacts

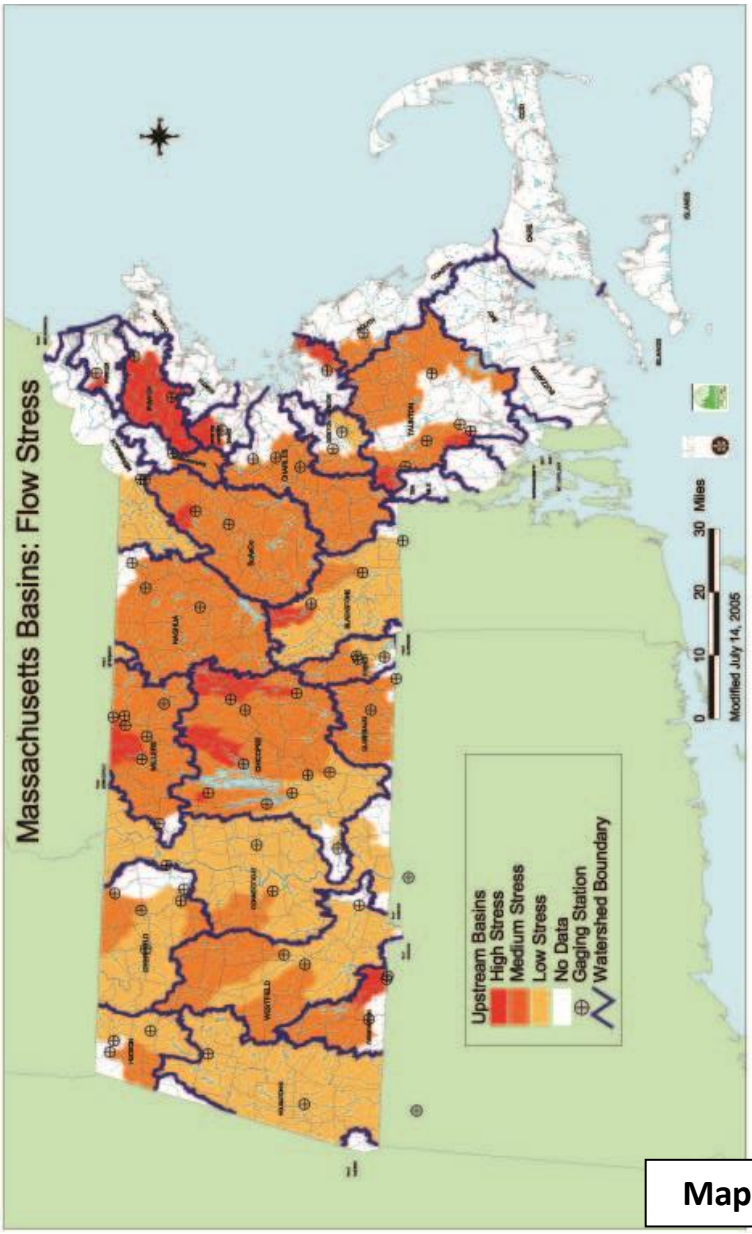
projects. Publishing their findings in 2001[142], the WRC defined a "stressed basin" as a basin or sub-basin in which the quantity of streamflow had been significantly reduced, the quality of the streamflow degraded, and/or key habitat factors impaired. The stressed basin classification was intended to identify areas that would require a more comprehensive and detailed review of environmental impacts, and that might require additional mitigation. It should be noted that this report did not address standing surface water (lakes and ponds) or groundwater except where the groundwater provides the base level flow to rivers and streams. In addition, while this report ranked watersheds based on their streamflow relative to their land areas, the reason(s) for a river's low flow was not provided. Those rivers with naturally occurring low flows were not distinguished from those with low flows due to water withdrawals. The WRC's definition of stress included:

High Stress:	net outflow of water equals or exceeds the estimated natural August median flow;
Medium Stress:	net outflow of water equals or exceeds estimated natural 7Q10 flow (i.e., the lowest 7-day average flow that occurs (on average) once every 10 years[143]); and,
Low:	no net loss to the basin.

The report also produced the map below identifying high and medium stressed basins. As can be seen, the entire Ipswich River was identified as high stress, along with 11 sub-basins, including the Seven Mile River near Spencer, the Quinsigmond River at North Grafton, and the Wading River at Mansfield. The Cape and Islands were not included in the analysis and, as a result, are shown in white. (See Appendix D for a list of high and medium stress basins in Massachusetts according to the WRC.) The WRC's work led to the 2004 Water Management Policy which recommended the development of a pilot watershed process that would take into consideration the cumulative effects of permitting on the system as a whole[144], and eventually to the Sustainable Water Management Initiative (SWMI) of 2012 (described

[142] Massachusetts Water Resources Commission (WRC), Stressed Basins in Massachusetts, December 13, 2001.
[143] U.S. EPA, "Flow 101", retrieved at http://water.epa.gov/scitech/datait/models/dflow/flow101.cfm#1Q10, July 9, 2013
[144] Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Massachusetts Water Policy, 2004, p. 29

below). Although the WRC report was illustrative at the time written, the more recent SWMI analysis on safe yield has also superseded this earlier work.



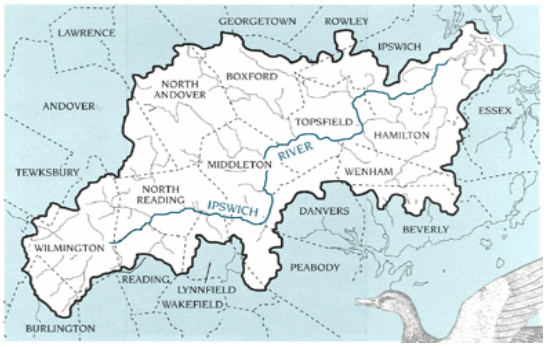
Map 6

(*It should be noted that this map does not reflect current understanding of where stressed basins are located. It is included for historical reference.)*

Water, Water Everywhere

Further attention was called to areas of Massachusetts with water constraints via the publication of "Water, Water Everywhere: Dare I Drink a Drop?" published by the Federal Reserve Bank in 2005. This report called particular attention to the Ipswich River, which ranked third on the American River Association's list of "America's Most Endangered Rivers of 2003."[145] The report found that the stresses on the Ipswich River began some time ago:

> This conflict originated in the late 1800s, when the towns of Beverly, Salem, Lynn, and Peabody were given legislative authority to pump water out of the river. By the early 1900s, Salem and Beverly created a water board and began withdrawing 25 million gallons a day from the Ipswich, diverting it to a reservoir. The town of Lynn quickly followed suit. In 1972, Peabody also erected a pumping station, taking water from the river and placing it in reservoirs for town water consumption. While this was occurring, other towns, among them rapidly developing Hamilton, Wenham, Ipswich, Reading, North Reading, Wilmington, Topsfield, and Lynnfield, all dug wells along the river. In addition, two other towns, Danvers and Middleton, have reservoirs that capture water from the Ipswich naturally (Kirk 1998). As a result of these sharp increases in water withdrawal, the river has run dry in several upstream locations over 300 times in the last few years (Cole 2001). Consequently, the river ranked third on American Rivers' list of "America's Most Endangered Rivers of 2003.[146]



Stressed Basins

New Regulatory Framework: Sustainable Water Management Initiative

The Sustainable Water Management Initiative (SWMI) represents the EOEEA's effort to develop a system that evaluates and classifies water sources, and defines the maximum amount of water that can be dependably withdrawn from a basin during drought conditions.[147] In Massachusetts, water

[145] Robert Tannenwald and Nicholas Turner, Water, Water Everywhere: Dare I Drink a Drop?", New England Public Policy Center, Federal Reserve Bank of Boston, May, 2005, p. 12
[146] Ibid, p. 12
[147] EOEEA, SWMI Framework Appendices, p. 1

withdraws are classified as either "registered," meaning the historic or grandfathered withdrawal level that predates the 1986 Water Management Act, or "permitted," which are increases authorized since the Water Management Act was passed. The total authorized withdrawal is the sum of registered plus permitted withdrawals. Both registrations and permits are regulated by MassDEP.

Beginning in 2014, the established framework will guide the MassDEP's[148] permitting of water withdrawals under the Water Management Act (WMA).[149] It is intended to provide for the continued withdrawal of water for public consumption but in a manner that will maintain healthy streams and gradually improve degraded ones over time. At the same time, its conservative approach will help ensure that adequate potable (surface) water is available in each watershed, even in drought conditions. A draft of proposed SWMI regulations, the product of a three-year stakeholder process, will likely be available for public comment in fall 2013.[150] According to MassDEP, compliance with SWMI regulations will be a collaborative process, with a steady stream of guidance provided to communities by MassDEP. Communities will be subject to new regulations either at expiration of their 20-year permit, during the permit's five-year review, or when water increases are requested.[151] The agency has further signaled its intent to only address permitted water withdrawals and not undertake actions affecting historic or registered withdrawal rates at the present time.

The EOEEA established the following principles as guiding the SWMI program:

- Acknowledge and preserve critical existing water supply areas and legitimate future need;
- Minimize existing water withdrawal impacts in already impacted areas , taking into account cost and feasibility;
- Mitigate increased withdrawals commensurate with impact, taking into account cost and feasibility; and,
- Protect quality habitats and avoid further degrading unhealthy aquatic habitats.[152]

Calculations were made for each of Massachusetts's 27 major watersheds. A watershed contains surface water, in the form of ponds, reservoirs and rivers, and groundwater captured in an aquifer. At times, multiple users will access the same water basin, via reservoir, well, or other means. If the total withdrawal from a watershed is not monitored comprehensively, potential exists for a "tragedy of the commons" where users take what they need without regard for the overall health of the system, leading to its potential deterioration. The amount that may be withdrawn pursuant to SMWI is called the "safe yield".

Pursuant to the Water Management Act, "Safe Yield means the maximum dependable withdrawals that can be made continuously from a water source, including ground or surface water, during a period of years in which the probable driest period or period of greatest water deficiency is likely to occur; provided however, that such dependability is relative and is a function of storage and drought Probability."[153] Therefore, the Safe Yield will be the maximum withdrawal that will ultimately be allowed

[148] MassDEP is an agency within EOEEA.
[149] Ibid. p. 4.
[150] Bethany Card, Assistant Commissioner, MassDEP Bureau of Resource Protection, phone interview with Shelley Ayervais, August 28, 2013
[151] Ibid.
[152] EOEEA, SWMI Framework Appendices, p. 5.
[153] Water Management Act, 310 CMR 36.03

as the SWMI program moves into implementation. MassDEP will use a two stage process to determine if permitted withdrawals should be allowed as requested, or whether mitigation will be needed. These steps include determining: a) if the existing or requested withdrawal exceeds the safe yield; or, b) if the existing or requested withdrawal could potentially move the watershed from one "groundwater withdrawal category" into another. Each will be described separately below, although in practice, they will be reviewed at the same time when considering permitted withdrawals.

Calculation of Basin Safe Yield

Safe Yield has been calculated by the DEP at the water basin level, in other words, they have performed an analysis to determine the amount of water that can be taken for the basin as a whole, an amount that will then be allocated to various municipalities and water districts drawing from that basin. Safe Yield consists of two components: the amount of water that can be withdrawn from a water basin streams and rivers during a drought year, plus credit for existing reservoir storage where that the reservoir capacity meets certain defined criteria (i.e., "Reservoir Storage Volume").

To establish the amount allowed to be taken from the combined waterways, the DEP determined the natural flow rate for each basin that was exceeded 90% of the time for each month over the past 44 years, considering the remaining 10% as periods with water constraints. They then annualized these figures, thereby taking into account seasonal variations, by averaging the monthly streamflows. This methodology, the DEP found was "equal to, or lower than, the drought of record flows (generally the year of 1965)."[154] After determining the 90% figure, the DEP then factored in the influence the water flow has on the aquatic habitat and determined that a maximum of 55% of the water volume could be removed, leaving "45% of the flow in the river as protection against a drought condition on an annualized basis, so as to meet the statutory requirement that withdrawals not exceed the amount of water that can dependably be withdrawn."[155]

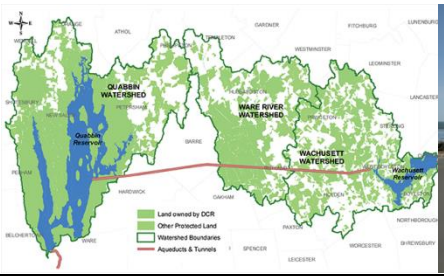
To this figure, called "55% of Q90", the DEP added credit for reservoirs whose storage capacity met a series of four different criteria relating to streamflow, storage capacity, and system use. Of the 40 reservoirs analyzed, 32 (80%) of them did not receive additional credit for their existing storage and within the seven that received additional credit, the volume of water credited varies extensively from 0.4 MGD in Southbridge (Quinebaug Basin) to 214 MGD from the Quabbin Reservoir (Chicopee Basin). Each reservoir's influence on the total authorized withdrawals within its basin also varies, with four reservoirs contributing less than 10% of the basin's authorized withdrawal and one reservoir contributing 26.6%. In three cases, however, the reservoir storage makes a very meaningful difference to the amount of water allowed for withdrawal – the Quabbin Reservoir, the Wachusett Reservoir, and the two reservoirs in Fall River contribute 77% or more of the total allowable water withdrawal in their respective basins. This shows the relative significance of each of these reservoirs to their respective water basins.

[154] Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Sustainable Water Management Initiative: Framework Summary, November 28, 2012, p. 9.
[155] Ibid., p. 10.

Table 19: Contribution of Reservoir Storage Volumes				
Basin Name	**System Name**	**Draft Reservoir Storage Volumes (MGD)**	**Total Annualized Authorized Withdrawals (MGD)**	**% of total authorized**
Charles	Lincoln	0.5	46.5	1.1%
Quinebaug	Southbridge	0.4	5.6	7.1%
Boston Harbor (Mystic)	Winchester	0.6	6.6	9.1%
Westfield	Springfield	14.9	56.1	26.6%
Nashua	MWRA	138.8	180.6	76.9%
Narr-Mt. Hope Bay	Fall River	12.6	13.4	94.0%
Chicopee	MWRA	214.0[156]	205	104.4%

Only the MWRA system, with the Quabbin Reservoir, the Ware River diversion[157] in the Chicopee Basin, and the Wachusett Reservoir in the Nashua Basin, was found to achieve a specific classification of "maximum safe yield level", in which reservoir storage is a minimum of 200,000 mg and drought year inflow is at least 50,000 mg.[158] Under the SWMI framework, the MWRA is credited with a combined 348.5 MGD in draft reservoir storage volume. This will be added to the "55% of Q90" figure to determine safe yield. In testimony to the conservative nature of the SWMI program, the actual storage capacity of the Quabbin Reservoir alone is 412 billion gallons and Wachusett Reservoir has a capacity of 65 billion gallons for a total 477 billion gallons. To put that into perspective, it would take almost five years to drain the reservoirs empty (if filled to capacity) if no new water was added from the Ware River or through precipitation, and the MWRA users continued at their 2012 average daily water usage rate of 194.75 MGD. [159] As noted by EOEEA, "At the end of a severe one-year drought, the MWRA system would have multiple years of usable water remaining in storage".[160]

Ware River Diversion



MWRA Watershed

Windsor Dam Monument

[156] 209.7 mgd of this amount is from the Quabbin/Ware reservoirs; an additional 1.1 mgd is generated by the Bickford Reservoir and 3.2 mgd from the Mare Meadow Reservoir; both of which are located in Fitchburg.
[157] The MWRA is allowed to divert flows in excess of 85 million of gallons water per day from the Ware River between October 15 and June 15 each year to be stored in the Quabbin Reservoir, if needed.
[158] EOEEA, SWMI Framework Appendices, p. 3
[159] Estes-Smargiassi, Stephen, MWRA Director of Planning
[160] EOEEA, SWMI Framework Appendices, p. 1

Within the Westfield Basin, which offers 14.9 MGD in reservoir storage volume, several reservoirs can be found. The Cobble Mountain Reservoir has a capacity of 22.8 billion gallons and the Borden Brook Reservoir has a capacity of 2.5 billion gallons. The two are interconnected in that the Borden Brook Reservoir feeds into the Cobble Mountain Reservoir. A third reservoir, the Ludlow Reservoir, with a capacity of 1.71 billion gallons, serves as an emergency supply. Drinking water is treated at the West Parish Water Filtration Plant in Westfield, before being sent to one of four storage tanks (60 million gallon total capacity) on Provin Mountain in Agaway.[161]

The 0.5 MGD credited within the Charles River Basin is generated by Flints Pond (also known as Sandy Pond) Reservoir. The reservoir was completed in 1900 and today is owned by the Town of Lincoln. It consists of an earthen construction gravity dam and it has a capacity of 930 acre feet, but its normal water storage is 730 acre feet. The DeCordova Museum and Sculpture Park overlooks this scenic pond.

Constrained Water Basins

When comparing safe yield and authorized withdrawals at the water basin level, two basins stand out as particularly constrained: the Ipswich River Basin and the Ten Mile Basin. In both instances, the Total Authorized Withdrawal exceeds the Draft Safe Yield. In addition, in the case of Ipswich, even the Total Registered Volume exceeds the Draft Safe Yield which means that not only does the currently authorized level of water withdrawal exceed the Safe Yield, the historic withdrawal does so, as well. It should be noted that in both instances, the actual water use as of 2008 did <u>not</u> exceed the identified Safe Yield.[162]

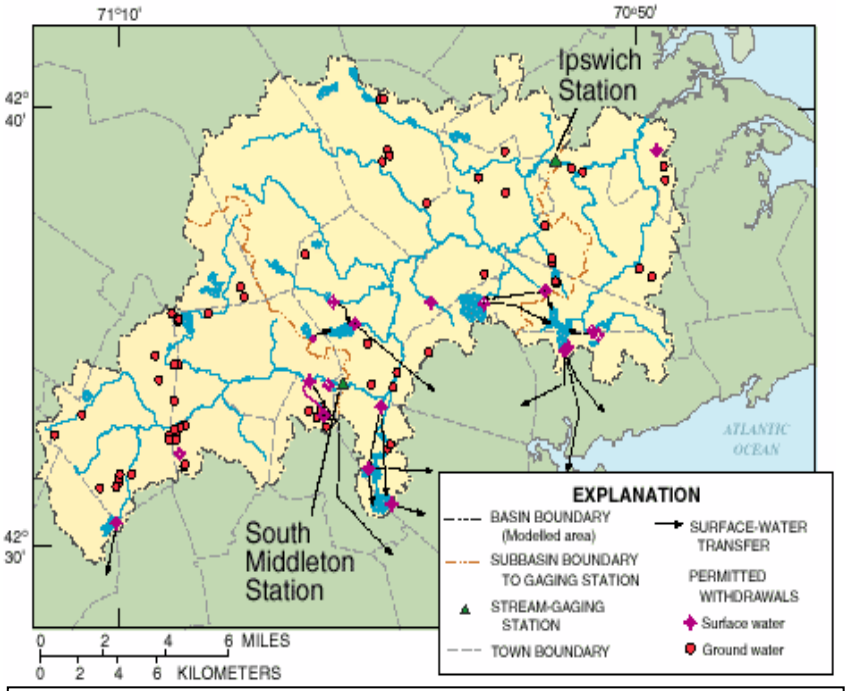
[161] Springfield Water & Sewer Commission website, Water System History and Description page. Accessed on October 15, 2013 at http://www.waterandsewer.org/about_us/water_system_history.html.

[162] One other basin – the Narragansett Mt. Hope Bay Basin – stands out because its reported water use (14.3 mgd) exceeded the authorized withdrawal (13.4 mgd). However, it did not exceed the Draft Safe Yield.

Table 20: Massachusetts Water Basin Data[163]							
Basin Name	**Drainage Area sq mi**	**Annualized Basin Yield Q90 (MGD)**	**Draft Reservoir Storage Volumes (MGD)**	**Draft Safe Yield: 55% of Q90 +Storage (MGD)**	**Total Annualized Authorized Withdrawals (MGD)**	**Total Annualized Registered Volume (MGD)**	**2008 Reported Use (MGD)**
Blackstone	357.8	135.6	0	74.6	36.0	25.4	29.0
Boston Harbor Total	291.6	99.1	0.6	see sub-basins	38.6	31.62	28.7
- 19c BH Wey-mouth & Weir	106.6	33.8	0.0	18.6	16.6	15.48	16.1
- 19b BH Neponset	108.9	39.4	0.0	21.7	15.4	9.95	8.3
- 19a BH Mystic	76.1	25.9	0.6	14.8	6.6	6.19	4.2
Buzzards Bay	374.3	177.5	0	148.0	85.1	74.01	73.7
Cape Cod	394.8	261.1	0	261.1	52.5	33.47	39.9
Charles	310.8	116.9	0.5	64.8	46.5	34.12	34.7
Chicopee	722.2	253.1	214.0	353.2	205.0	201.76	124.1
Concord	399.6	158.9	0	87.4	36.4	28.64	27.1
Connecticut	7,368.6	3,393.5	0	1,866.4	149.2	144.56	115.7
Deerfield	663.5	236.4	0	130.0	3.9	3.77	2.6
Farmington	151.9	46.0	0	25.3	0.0	0	0.0
French	94.7	35.8	0	19.7	4.3	4.22	2.7
Housatonic	500.2	159.2	0.12	87.7	35.6	29.35	18.4
Hudson	219.9	67.2	0	37.0	14.1	10.69	8.6
Ipswich	155.3	53.4	0	29.4	32.8	29.59	24.3
Islands	142.1	94.0	0	94.0	7.4	5.2	6.4
Merrimack	3,902.0	1,667.5	0	917.1	82.3	56.91	57.4
Millers	389.1	120.1	0	66.1	10.9	8.73	7.7
Narr-Mt. Hope Bay	111.9	44.3	12.6	37.0	13.4	12.69	14.3
Nashua	507.8	212.3	138.8	255.6	180.6	167.46	146.4
North Coastal	170.4	46.1	0	25.4	21.9	20.8	18.4
Parker	81.8	26.9	0	14.8	2.5	1.63	2.3
Quinebaug	153.8	57.2	0.4	31.9	5.6	2.69	2.8
Shawsheen	78.1	26.4	0	14.5	5.0	5.01	3.8
South Coastal	240.4	92.9	0	see sub-basins	see sub-basins	see sub-basins	see sub-basins
- 21a North & South Rivers	120.6	42.2	0	23.2	14.4	12.71	13.8
- 1b South Coastal Shore	119.8	N. A.	0	50.1	33.9	23.97	19.0
Taunton	529.8	244.2	0	134.3	94.2	67.55	67.9
Ten Mile	48.6	19.3	0	10.6	12.9	9.99	8.9
Westfield	516.5	152.5	14.9	98.8	56.1	51.1	44.3

[163] Ibid, p. 12.

The Ipswich basin encompasses approximately 155 square miles of land (74% of which is forest land and 10% made up of lakes, ponds and marshes) and includes all or a part of 21 communities with a combined population of 160,000. The Ipswich basin has historically provided water to 14 communities as described above (see page 81), but that was reduced to 13 after the Town of Reading began to purchase its water from the MWRA. Prior to 2006, the Town of Reading secured its drinking water from groundwater wells in the Ipswich River Basin. In 1999, although average daily demand did not exceed the Town's registered water volume, the Town began to develop a long-term water supply strategy in recognition that the Ipswich River was experiencing significant periods of flow below natural conditions. In October 2005, the MWRA Advisory Board approved the purchase of 219 MGD annually between May and October of each year (1.2 MGD on average), while allowing the Town to supplement this by drawing up to 1 MGD from the river daily. However, soon thereafter, the Town requested a project change in order to purchase all of its water supply from the MWRA, and by mid-2006, the MWRA Advisory Board approved the purchase of up to 829 million gallons per year by the Town of Reading, after review by MassDEP and Town Meeting voted to become an MWRA member. At present, the Town no longer draws water from the Ipswich River Basin, although that remains an option in event of an emergency. The Town of Wilmington also currently purchases a portion of its water from the MWRA, which also helps to reduce water demand on the watershed.



Ipswich River Basin

Today, the Ipswich River basin continues to provide drinking water to approximately 350,000 people.[164] Factors that affect the amount of water withdrawn from the basin include the daily withdrawal of 20-25 MGD supply out of the watershed, leakage of stormwater and groundwater into sewers, and the diversion of wastewater out of the upper reaches of the watershed. [165] Despite an 8% decrease in per capita water usage that took place in the 1990s, population growth in the area caused total water usage to remain stable.[166]

The Ten Mile basin, located in Southeastern Massachusetts and a small portion of North East Rhode Island, provides water to Attleboro, Foxborough, Mansfield, North Attleboro, Plainville, and Seekonk. It

[164] Ipswich River Watershed, EOEEA website retrieved September 6, 2013 at http://www.mass.gov/eea/air-water-climate-change/preserving-water-resources/mass-watersheds/ipswich-river-watershed.html
[165] Ipswich River Basin Water Conservation Report Card, Ipswich River Basis Association, Mass Audubon Society, August, 2002. Retrieved September 6, 2013 at http://ipswich-river.org/wp-content/uploads/2010/03/ipswich_riv_rep.pdf. P.2.
[166] Ibid. p. 10.

is the smallest of Massachusetts's 27 watersheds, with approximately 54 miles of total drainage area, and it picks up flow from two major tributaries located in Attleboro. The Ten Mile River begins at its headwaters in the Town of Plainville, flows south along the Massachusetts and Rhode Island border and empties into the Seekonk and Providence Rivers of Narragansett Bay. The river captures its flow from the Seven Mile River and the Bungay River, both located in Attleboro.[167] Four Massachusetts communities within the Ten Mile Watershed have water permits (Attleboro, Foxborough, Mansfield, and Seekonk) that will expire on November 30, 2015 at which point the new SMWI regulations will be enforced. MassDEP has begun outreach to these communities and plans to work more closely with them as the permit expiration date approaches to help them plan for the implementation of SWMI.[168]

At present, it is anticipated that SWMI will only apply to permitted withdrawals, as opposed to historic registered volumes. However, it remains to be seen whether the Commonwealth will also address registered volumes at some point in the future in those basins that exceed the Safe Yield needed to protect the environment.

Prospective Basin Constraints

Although the Ipswich and Ten Mile basins are acknowledged because their authorized water withdrawals exceeds their Safe Yield, they also belong to a group of four basins where the actual water withdrawals are approaching the Safe Yield. Combined, these four watersheds encompass many municipalities and hundreds of thousands of residents.

Table 21: Basins where Use vs. Safe Yield is > .70 (2012)

Basin	Ratio
Boston Harbor Weymouth-Weir	86.6%
Ipswich	82.7%
North Coastal	72.4%
Ten Mile	84.0%

Other studies have acknowledged that water constraints exist in the North Coastal Watershed and the Weymouth Weir watershed and attempted to identify actions to address. As three reports indicate:

> The North Coastal Watershed has a total drainage area of approximately 168 square miles. It encompasses all or part of five river sub-basins, including the Danvers, Essex, Saugus, Pines, and Annisquam Rivers. There are approximately 2,428 acres of lakes and ponds in the watershed. The North Coastal encompasses all or part of 26 Massachusetts municipalities, and supports a population of approximately 500,000 people.[169,170]

[167] EOEEA 'Ten Mile River' webpage on website accessed on September 6, 2013 at http://www.mass.gov/eea/air-water-climate-change/preserving-water-resources/mass-watersheds/ten-mile-river.html.
[168] Bethany Card, Assistant Commissioner, Bureau of Resource Protection, Email received by Shelley Ayervais, August 29, 2013.
[169] Only eight of the 26 operate their own public water supply monitored by the DEP; the remainder either use less than 0.1 mgd or buy their water from another supplier.
[170] EOEEA, "North Coastal Watershed", retrieved from http://www.mass.gov/eea/air-water-climate-change/preserving-water-resources/mass-watersheds/north-coastal-watershed.html on October 11,2013.

> The high population density places demand on the water supply resources in the (North Coastal) drainage basin, even though several municipalities actually derive their water supply from surface or groundwater sources outside of the North Coastal Watershed. Projected water demand at buildout for municipalities will exceed presently permitted supply by 12,600,000 gallons per day (GPD). Data compiled from (EOEA 2002A Special Report on Community Preservation and the Future of our Commonwealth). An area of significant concern is the Saugus River, a system that is affected by low flow conditions caused in part by registered and permitted water withdrawals by the Lynn Water and Sewer Commission. Water is diverted from the Saugus River mainstem into Hawks Pond, part of the LWSC Water Supply Reservoir system. Permitted and registered withdrawals of 10.21 MGD by the City of Lynn and a permitted withdrawal of 0.28 MGD by the Colonial Golf Course in Lynnfield contribute to a section of the Saugus River being dry (Cashins 1997). The town of Rockport is seeking to expand its water supply by the establishment of a new reservoir and the diversion of three intermittent streams. Salisbury officials are concerned that large scale withdrawals by neighboring Seabrook NH maybe impacting Salisbury wellfields.[171]

In the Boston Weymouth-Weir Watershed, "the communities of Weymouth, Braintree, Holbrook, Randolph, and Hingham obtain their water from within the watershed. These communities are virtually at the capacity or above the capacity of their existing water supply sources (Chretien 2002)".[172] Municipalities within the basins that have rates of water withdrawal approaching Safe Yield are identified below.

Table 22: Communities in Potentially Constrained Basins

Ipswich	North Coastal	Ten Mile	Wenham-Weir
Beverly	Essex	Attleboro	Braintree
Danvers	Gloucester	Foxborough	Hingham
Hamilton	Lynn	Mansfield	Holbrook
Ipswich	Lynnfield**	North Attleboro	Hull
Lynn	Peabody	Plainville	Medfield
Lynnfield**	Rockport	Seekonk	Randolph
Middleton	Salisbury		
North Reading	Wakefield**		
Peabody			
Reading			
Salem/Beverly			
Topsfield			
Wenham			
Wilmington**			

** Receives partial MWRA service.

[171] Gordon, Jesse, North Coastal Watershed Five-Year Action Plan, June 30, 2004, p. 13.
[172] EOEEA, Weymouth-Weir Subwatershed – River and Estuary Segment Assessments, p. 190, retrieved from http://www.mass.gov/dep/water/resources/70wqar3c.pdf , October 11, 2013

Sub-Basin Constraints

In addition to its analysis of Safe Yield at the basin level, as part of the SWMI framework MassDEP has also analyzed environmental conditions at the sub-basin level which will further influence future water permits. At the sub-basin level the agency has established biological categories that reflect the relative health of the aquatic environment. These range from Category 1 sub-basins which are "relatively un-impacted by human alteration (as expressed by impervious cover and flow alteration)" and have 0 to 5% alteration to Category 5 sub-basins which "represent fish communities that have undergone severe changes to their structure and function" and have 65% or greater levels of alteration.[173] Most of the Commonwealth has been analyzed for these categories with the exception of the Cape and islands as they are unique environments that will be considered separately. Overall, it can be seen that more than half of the state's sub-basins fall into categories 1 and 2, while less than 9% fall into the most severely disturbed categories.

Table 23: Sub-basins by Groundwater Withdrawal Levels

Category	Number	% of total
Category 1 (<5%)	446	29.5%
Category 2 (5 to <15%)	384	25.4%
Category 3 (15 to ≤ 35%)	233	15.4%
Category 4 (35 to < 65%)	175	11.6%
Category 5 (>65%)	135	8.9%
Undetermined	137	9.1%
Total	**1,510**	**100%**

The biological categories, also known as "Groundwater Withdrawal Levels", will be used when water permits are renewed or increases to permitted withdrawals are requested. The test in most instances will be whether the requested withdrawal/increase will move the basin from one category to another. This may have particular significance for categories 1 and 2 which are in their most natural conditions and have narrow bands, 5% and 10%, respectively, as compared to category 4 which has a rather wide band of impact, 30%. This means that those sub-basins with very healthy environments will need to ensure their maintenance and protection by not withdrawing water in amounts that can generate adverse impacts.

Potential Constraints at the Municipal Level

In addition to those municipalities whose water availability is influenced by basin-level water availability, others are potentially constrained due to local conditions, such as existing water use and potential growth. Today, a significant number of municipalities have withdrawal levels that are equal to or exceed their total authorized limits. In 2012, a total of 33 communities ranging from Abington to Winchendon reached their authorized levels of withdrawal and, while the majority of them were located in basins that had remaining capacity and did not approach Safe Yield, if the municipalities request increases to

[173] EOEEA, SWMI Framework, p. 14.

their water permits, those requests will be evaluated under the new SMWI framework and will also take into account the sub-basin environmental conditions.

The communities whose actual water use in 2012 equaled or exceeded their authorized withdrawal are listed below.

Table 24: Ratio of Daily Use to Authorized Withdrawal (2012)

Municipality	Authorized Withdrawal (MGD)	Average Daily Use (2012) (MGD)	Basin	Avg Daily v. Authorized
Abington/Rockland	2.21	2.6	South Coastal	118%
Ashburnham	0.18	0.46	Millers	256%
Attleboro	3.85	3.89	Ten Mile	101%
Brookfield	0.09	0.09	Chicopee	100%
Byfield	0.17	0.18	Parker	106%
Clinton	2	2.04	Nashua	102%
Deerfield	0.1	0.1	Deerfield	100%
East Brookfield	0.11	0.97	Chicopee	882%
Essex	0.22	0.25	North Coastal	114%
Fitchburg	0.78	1.71	Chicopee	219%
Hanover	1.38	1.4	South Coastal	101%
Hopedale	0.41	0.42	Blackstone	102%
Hopkinton	0.98	0.98	Concord	100%
Ipswich	0.2	0.23	Ipswich	115%
Lancaster	0.53	0.62	Nashua	117%
Lanesborough	0.21	0.21	Housatonic	100%
Leicester	0.19	0.19	Blackstone	100%
Lynnfield **	0.29	0.41	Ipswich	141%
Medway	0.91	0.91	Charles	100%
North Raynham	0.32	0.37	Taunton	116%
Peabody	3.89	4.64	Ipswich	119%
Pembroke	1.26	1.32	South Coastal	105%
Plainville	0.23	0.32	Ten Mile	139%
Plainville	0.39	0.46	Taunton	118%
Plymouth	0.22	0.25	Buzzards Bay	114%
Randolph/Holbrook	3.27	3.47	Weymouth-Weir	106%
Raynham	0.82	0.95	Taunton	116%
Rutland	0.37	0.38	Nashua	103%
Salisbury	0.25	0.28	Merrimack	112%
Sheffield	0.13	0.14	Housatonic	108%
Shirley	0.31	0.4	Nashua	129%
Sunderland	0.24	0.27	Connecticut	113%
Winchendon	0.67	0.67	Millers	100%
Winchester**	1.06	1.12	Mystic	106%

** Receives partial MWRA service.

Of these, at least five are located within the constrained Ipswich and Ten Rivers basins, including the towns of Ipswich, Lynnfield, and Peabody, and Attleboro and Plainville, respectively. One community,

Essex, is in the North Coastal basin which as of 2012 was using over 70% of the total Safe Yield and two communities, Holbrook and Randolph - are in the Weymouth-Weir basin which was at 86.6% of Safe Yield.

Further, economic development studies that consider future population and employment growth have identified other potentially constrained communities. In particular, two planning studies prepared by the Executive Office of Housing and Economic Development (EOHED) and the Executive Office of Energy and Environmental Affairs (EOEEA) have projected that growth in the I-495/Metrowest region and in the Merrimack Valley could exceed existing water allocations. The I-495 report found 21 communities in which water demand under the preferred growth scenario would exceed current authorization. As the report states, "Overall growth projections…will put increasing pressure on local water systems…Of the communities in the Compact Region, all but two are projected to increase their water use. In some cases, demand is projected to double."[174] In the Merrimack Valley, EOHED found that "14 (of 15) communities expect to see an increase in water use for a total increase of 6.403 MGD in the region (an increase of 18.40%)" and in seven communities, projected demand will exceed current allocations.[175]

The communities identified in the two planning reports can be found below.

Table 25: Communities Identified in EOHED Studies with Potential Water Constraints

I-495 / Metrowest		Merrimack Valley
Acton	Medfield	Amesbury
Ashland	Milford	Georgetown
Bellingham	Millis	Groveland
Grafton	Norfolk	Merrimack
Holliston	Northborough	Newbury: Byfield Water District
Hopedale	Shrewsbury	Rowley
Hopkinton	Sudbury	West Newbury
Hudson	Wayland	
Littleton	Westborough	
Marlborough**	Westford	
Maynard		

** Receives partial MWRA service.

All told, 81 municipalities have been identified in this report as potentially constrained based on one or more of the following factors:

- Located in existing constrained basin;
- Located in basin where use in 2012 approached Safe Yield;
- Community where use in 2012 approached authorized withdrawal;
- Studies by EOHED or EOEEA indicate that future growth approaches or exceeds authorized withdrawal.

[174] Executive Office of Housing and Economic Development (EOHED), I-495/Metrowest Development Compact Plan, March 2012, p. 58.
[175] EOEEA, "Merrimack Valley: Projected Growth Impact on Water Demand" powerpoint presentation.

Means to Address Potential Water Constraints

Although the number of municipalities identified as having potential constraints is significant, options do exist to address these existing or potential constraints. Water conservation efforts are most often the first and least costly means to reduce water use. Reductions can be made at the household level, in business locations, and in public buildings by replacing fixtures such as toilets, faucets, and showerheads low flow alternatives. In addition, developments can capture stormwater runoff from roofs and parking lots for reuse to water landscaping. Significant progress can also be made when communities reduce the amount unaccounted for water. "Unaccounted-for Water (UFW) is the difference between the quantity of water supplied to a city's network and the metered quantity of water used by the customers. UFW has two components: (a) physical losses due to leakage from pipes, and (b) administrative losses due to illegal connections and under registration of water meters."[176] As can be seen below, in 2012 the percentage of water that was unaccounted for exceeded 25% of total use in nine (9) potentially constrained communities listed below. In another 14 communities, the rates exceeded 15% of water use.

Table 26: Unaccounted for Water in Potentially Constrained Communities

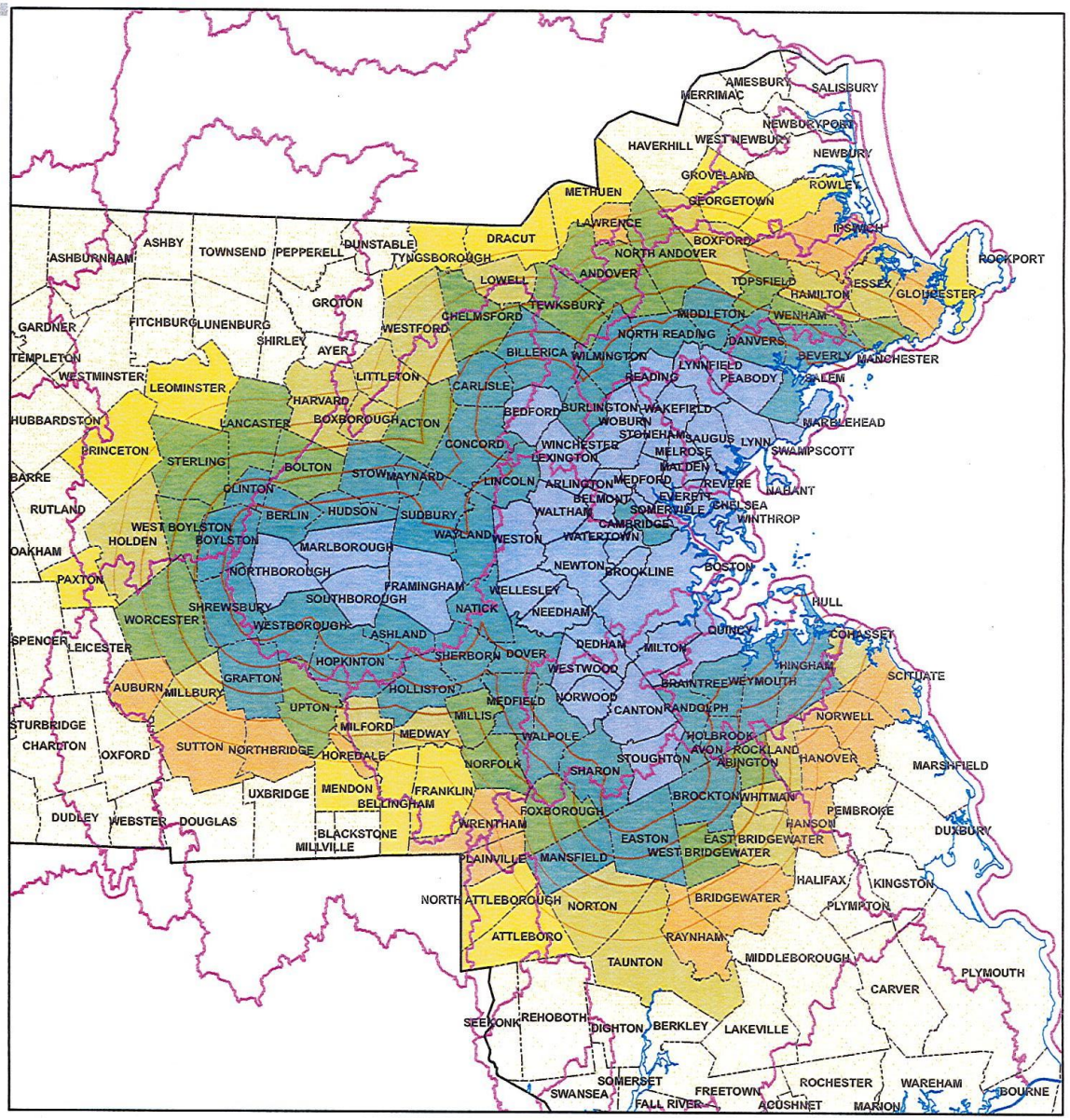
Municipality	Basin	Authorized Withdrawal (MGD)	Avg Daily Use (2012) (MGD)	Avg Daily v. Authorized	UAW*
Lancaster	Nashua	0.53	0.62	117%	39.7%
Norfolk	Charles	0.53	0.44	83%	37.2%
Maynard	Concord	1.09	0.81	74%	36.5%
Winchendon	Millers	0.67	0.67	100%	36.4%
North Reading	Ipswich	0.96	0.58	60%	31.1%
Lynn	Ipswich	5.31	1.5	28%	30.8%
Lynn	North Coastal	8.93	8.62	97%	30.8%
Clinton	Nashua	2	2.04	102%	29.8%
Medfield	Charles	1.5	0.86	57%	27.0%
Medfield	Weymouth-Weir	0.92	0.44	48%	27.0%
Gloucester	North Coastal	3.75	3.01	80%	25.5%

Another option in some locations may be to purchase water from communities or water systems that are not close to their safe yield. Of the potentially constrained communities, six already receive partial service from the MWRA so they have some form of direct connection into the MWRA system whether this be for emergency purposes, for a portion of the community, or for a single property in the case of the GE Plant in Lynn. These include Lynn, Lynnfield, Marlborough, Wakefield, Wilmington, and Winchester. Many others are located in proximity to those that are served by the MWRA (see Map 7 below). This may allow for opportunity to draw from this larger regional system in the future, as the

[176] The World Bank, retrieved November 13, 2013 from http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMNAREGTOPWATRES/0,,contentMDK:22356658~pagePK:34004173~piPK:34003707~theSitePK:497164~isCURL:Y,00.html

MWRA reservoirs have adequate Safe Yield available to serve additional consumers. Other communities are proximate to the Springfield (Chicopee and Connecticut basins) system or other systems which have significant water availability.

TOWN	distance	TOWN	distance
ABINGTON	4	LEOMINSTER	10
ACTON	4	LINCOLN	2
ANDOVER	4	LITTLETON	6
ASHLAND	2	LOWELL	6
ATTLEBORO	10	MANCHESTER	4
AUBURN	8	MANSFIELD	2
AVON	2	MAYNARD	2
BELLINGHAM	10	MEDFIELD	2
BERLIN	2	MEDWAY	6
BEVERLY	4	MENDON	10
BILLERICA	2	METHUEN	10
BOLTON	4	MIDDLETON	2
BOXBOROUGH	6	MILFORD	6
BOXFORD	6	MILLBURY	6
BOYLSTON	2	MILLIS	4
BRAINTREE	2	NATICK	2
BRIDGEWATER	8	NORFOLK	4
BROCKTON	2	NORTH ANDOVER	4
BURLINGTON	2	NORTH ATTLEBOROUGH	10
CAMBRIDGE	2	NORTH READING	2
CARLISLE	2	NORTHBRIDGE	8
CHELMSFORD	4	NORTON	6
CLINTON	2	NORWELL	8
COHASSET	8	PAXTON	10
CONCORD	2	PLAINVILLE	8
DANVERS	2	PRINCETON	10
DOVER	2	RANDOLPH	2
DRACUT	10	RAYNHAM	8
EAST BRIDGEWATER	6	ROCKLAND	6
EASTON	2	ROWLEY	10
ESSEX	6	SALEM	2
FOXBOROUGH	4	SCITUATE	8
FRANKLIN	10	SHARON	2
GEORGETOWN	10	SHERBORN	2
GLOUCESTER	8	SHREWSBURY	2
GRAFTON	2	STERLING	4
GROVELAND	10	STOW	2
HAMILTON	6	SUDBURY	2
HANOVER	8	SUTTON	8
HANSON	8	TAUNTON	6
HARVARD	6	TEWKSBURY	4
HINGHAM	2	TOPSFIELD	4
HOLBROOK	2	TYNGSBOROUGH	10
HOLDEN	6	UPTON	4
HOLLISTON	2	WALPOLE	2
HOPEDALE	8	WAYLAND	2
HOPKINTON	2	WENHAM	4
HUDSON	2	WEST BOYLSTON	4
HULL	2	WEST BRIDGEWATER	4
IPSWICH	8	WESTBOROUGH	2
LANCASTER	4	WESTFORD	6
LAWRENCE	8	WEYMOUTH	2
		WHITMAN	6
		WILMINGTON	2
		WORCESTER	4
		WRENTHAM	8



Legend

distance from selected MWRA municipalities

- within 2 miles
- within 4 miles
- within 6 miles
- within 8 miles
- within 10 miles

Map 7

SWMI Pilot Program

In 2012, to better understand the implications of the SWMI framework and guide the development of implementing regulations, EOEEA commissioned a pilot project that engaged four public water suppliers: Amherst, Danvers-Middleton, Dedham-Westwood, and Shrewsbury. Phase I focused on "the evaluation of minimization and mitigation options to reduce the impacts of groundwater withdrawals on streamflows"[177] and Phase II involved testing the permitting process under SWMI. Among the pilot's recommendations were to provide guidance for addressing proposed mitigation actions other than those included the SWMI mitigation table and consider providing some flexibility in the timing of implementation, and provide a methodology to be used for site specific studies, as opposed to the using the overall framework analysis.[178]

Table 2-1. Minimization and Mitigation Options

Minimization	Mitigation
1. Optimization of existing resources; 2. Use of alternative sources; 3. Interconnections with other communities or suppliers; 4. Releases from surface water impoundments; 5. Outdoor water restrictions tied to streamflow triggers (e.g., greater restrictions on outdoor watering than is currently applied); 6. Implementation of reasonable conservation measures; 7. New England Water Works Association Best Management Practice (BMP) toolbox; 8. Other measures that return water to the subbasin.	1. Instream flow improvements through release of surface waters; 2. Wastewater improvements including additional septic or treated groundwater discharge and I/I removal; 3. Stormwater/impervious cover improvements including recharge, adoption of a stormwater utility, adoption/implementation of MS4 requirements, reduction of impervious cover; 4. Water supply management including adoption of an enterprise account; 5. Habitat improvement including improving habitat connectivity, restoration of stream buffers; 6. Demand management to reduce water withdrawals.

Source: Table 5 and Table 6 of the Final SWMI Framework

In at least one instance, significant challenges were identified. The Town of Shrewsbury, one of the pilot communities, "[was] unable to develop a mitigation list commensurate with impact from increased withdrawals utilizing the proposed SWMI methodology."[179] Shrewsbury was selected as a pilot community as, "[the town was] in discussions with Secretary Bialecki of the Office of Housing and Economic Development relative to the need for increase[d] water supply for economic development. The impetus for the meeting was that we could not meet the water demands of a significant business that wanted to locate in Shrewsbury on a Town-owned piece of industrial land that is zoned for the proposed use. That need for the additional water supply and for economic development still exists."[180]

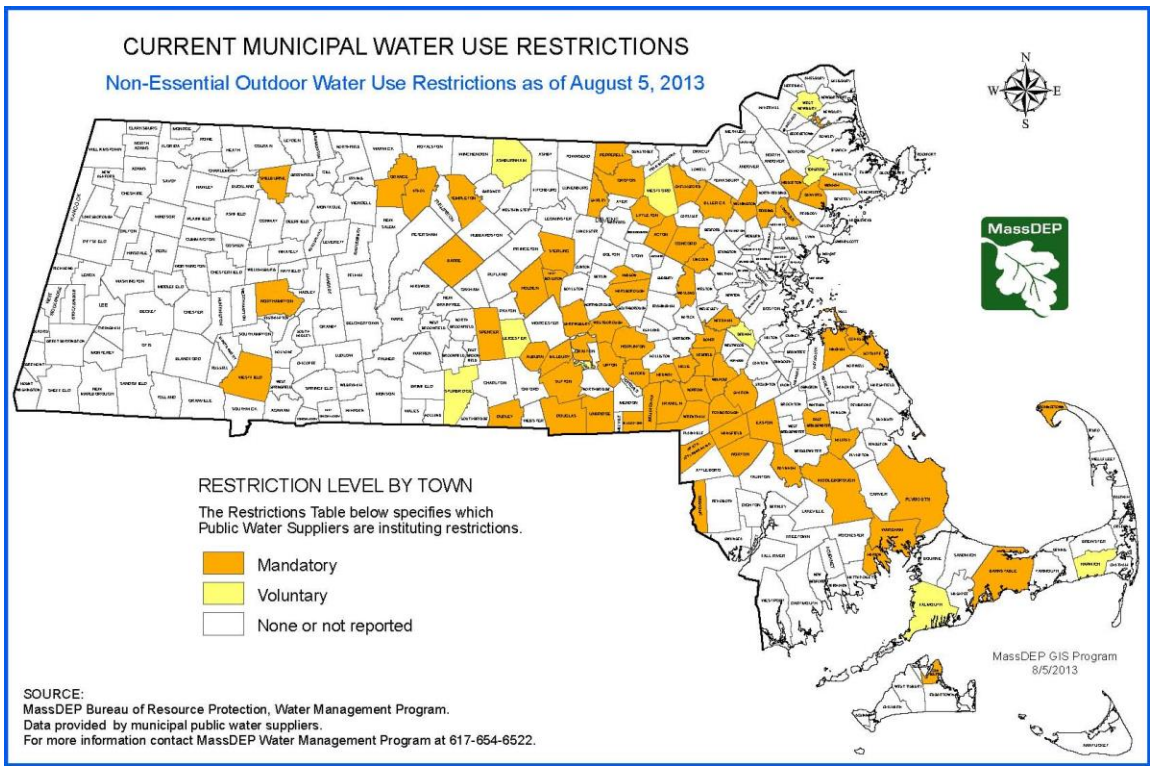
As can be seen, many of the SWMI-impacted communities are located in proximity to those that are served by the MWRA. This may allow for opportunity to draw from this larger regional system in the future, as the MWRA reservoirs have adequate Safe Yield available to serve additional consumers.

[177] Tighe & Bond, Comprehensive Environmental, Inc., Sustainable Water Management Initiative Pilot Project Phase 2 Summary Report, Appendix A, Comments from the Town of Shrewsbury, June 7, 2013, p. 2-1
[178] Ibid. p. 2-4
[179] Ibid.
[180] Ibid.

Municipal Water Use Restrictions

The Massachusetts Department of Environmental Protection keeps a list of communities that have implemented outdoor water use restrictions. Despite normal to above normal precipitation in most of the Commonwealth, and the third wettest June on record,[181] over 80 communities and water systems have enacted mandatory or voluntary water-use restrictions.

The map below identifies those communities that, as of August 5, 2013 have implemented outdoor use restrictions. (See Appendix E for the water district, implementation date, and level of restriction.)



[181] Lauren Dezenski, "June has been third wettest on record in Boston," Boston Globe, June 28, 2013

Implications for Economic Growth

A readily available source of water is needed for vibrant economic growth, because as each new job is added, demand for potable water increases unless otherwise offset by conservation measures. This section shows the connection between water availability and different industry sectors, identifies the potential growth possible in the Boston Metro region, and then preliminarily identifies locations where potential water constraints may not align with anticipated job growth. While this analysis will focus on the Boston metropolitan area, it can similarly be applied to other areas of Massachusetts and across the state.

Water Use by Industry Sector

MassDEP provides a detailed list of water use by different job type in Massachusetts, acknowledging that with each new job, water consumption grows. Water consumption increases can be generated by the employee, customers, landscaping or grounds maintenance, or food processing or dishwashing in the case of a restaurant. A sampling of water needs by use can be found below.

Table 27: Water Use by Industry Type[182]

Industry	Unit	Gallons Per Day
Retail Store (except supermarket)	Per 1,000 s.f.	50
Restaurant/Food Service	Per seat	35
Office	Per 1,000 s.f.	75
Factory, Industrial Plant, Warehouse or Dry Storage (w/o cafeteria)	Per person	15
Hospital	Per bed	200
Boarding Schools, Colleges	Per person	65

Potential Employment and Revenue Growth

As of June 2013, the Boston metro area contained nearly 1.8 million jobs. As is well known and is evidenced in the table below, the region contains many jobs in the education and health, and professional and business sectors.

Table 28: Boston Metro Jobs by Sector (June 2013)[183]

Sector	Jobs (2013)	% of Total
Construction	62,600	3.5%
Education and Health Services	388,800	21.8%
Financial Activities	144,200	8.1%
Government	202,500	11.4%

[182] 310 CMR Department of Environmental Protection, section 15.203, subsections 2-5.
[183] U.S. Department of Labor, Bureau of Labor Statistics, Economy at a Glance retrieved from http://www.bls.gov/eag/eag.ma_boston_nd.htm#eag_ma_boston_nd.f.3, September 6, 2013.

Information	62,800	3.5%
Leisure and Hospitality	180,900	10.2%
Manufacturing	92,400	5.2%
Mining and Logging	300	0.0%
Other Services	70,700	4.0%
Professional and Business Services	329,600	18.5%
Trade, Transportation, and Utilities	246,900	13.9%
Total Nonfarm	**1,781,700**	

Added to this number, the Metropolitan Area Planning Council's (MAPC) MetroFuture Plan projects an increase of 230,000 jobs by 2035, or a nearly 13% increase in employment across the metro-Boston area. (See Appendix C "A Guide to MetroFuture" for a more detailed explanation of MAPC's planning in addition to population and employment data.) Each of these new jobs will have implications for water demand in the region.

A crude measurement of the potential increase in water demand generated by this growth can be calculated by assuming that the distribution of the new jobs by job sector remains the same as the State as a whole and then applying MassDEP's water requirements to each new job by sector. A conservative estimate using this methodology reveals a potential increase in water demand of 5 million gallons per day or 1,825 mg annually. That said, given the Commonwealth's investment in biotech and health sciences, it would not be unexpected to see the distribution shift to favor those industries, both of which are heavy water users and would increase the above estimate.

Table 29: Job Growth and Water Demand by Sector (estimates only)

Sector	Jobs (2013)	% of Total	Change in Jobs (2010-2035)	Proj. Water Use (gpd) (est.)[184]
Construction	62,600	3.5%	8,081	121,216
Education and Health Services	388,800	21.8%	50,190	953,615
Financial Activities	144,200	8.1%	18,615	465,370
Government	202,500	11.4%	26,141	653,519
Information	62,800	3.5%	8,107	202,672
Leisure and Hospitality	180,900	10.2%	23,352	583,810
Manufacturing	92,400	5.2%	11,928	178,919
Mining and Logging	300	0.0%	39	581
Other Services	70,700	4.0%	9,127	68,450
Professional and Business Services	329,600	18.5%	42,548	1,063,703
Trade, Transportation, and Utilities	246,900	13.9%	31,872	796,809
Total Nonfarm	**1,781,700**		**230,000**	**5,088,664**

However, each of these will also generate income for the state, municipalities, and Massachusetts households which can similarly be quantified. As part of the Commonwealth's Infrastructure Investment Incentive Program (I-Cubed), the State worked to quantify the revenue to be collected by job type for

[184] Assumptions include: For education and health: students were not added, only jobs, used an average of 19 gallons per day per person; Office uses (financial activities, government, information, professional and business) were estimated at 3 jobs per 1,000 s.f.; trade, Transportation and utilities was calculated as office jobs; Leisure and hospitality and other services were calculated equivalent to retail jobs with 2 jobs per 1,000 s.f.

newly created jobs. These analyses are quite enlightening as they not only provide information on the wages by job and resulting income tax revenues to be generated, they apply conservative discount factors that take into account the likelihood that a job is truly "new", i.e., is being created as a result of the project and not just being transferred from elsewhere in the state. For example, the 2009 analysis for the Somerville Assembly Row project found that a retail job had a projected income of just over $26,000 while an office job was projected at over $72,500.[185] Overall each new office job was expected to contribute approximately $806 in new State income tax each year. Retail jobs were expected to generate approximately $240 in income tax, but an additional $800 in sales tax income, for a total of $1,040 each. A displacement factor was calculated to determine how many jobs would be net new. An office job was more likely to be new (26% of total office jobs locating in a new development) as opposed to retail (15% of total retail jobs locating in an area). The revenue figures were calculated for State taxes only. Municipal revenue increase would occur through property taxes and hotels and meals taxes, if adopted.

If the same methodology is applied to the 230,000 new jobs projected by the MetroFuture plan, a rough estimate of annual State revenues can be derived. A highly conservative estimate of revenues, just including those job sectors that are most closely equivalent to office or retail jobs and applying a substantial discount factor to identify net new jobs reveals that over $42 million in state revenue would be generated each year by the new jobs projected by MetroFuture. (If the discount factor was not applied, projected revenue would exceed $176 million per year.)

Table 30: Projected State Revenue Growth by Sector (estimated)

Sector	Jobs	% of Total	Change in Jobs (2010-2035)	Net New Jobs (2035)	Proj. State Rev ($)
Construction	62,600	3.5%	8,081		
Education and Health Services	388,800	21.8%	50,190	13,049	10,517,873
Financial Activities	144,200	8.1%	18,615	4,840	3,900,919
Government	202,500	11.4%	26,141	6,797	5,478,059
Information	62,800	3.5%	8,107	2,108	1,698,874
Leisure and Hospitality	180,900	10.2%	23,352	3,503	3,586,931
Manufacturing	92,400	5.2%	11,928		
Mining and Logging	300	0.0%	39		
Other Services	70,700	4.0%	9,127	1,369	1,401,858
Professional and Business Services	329,600	18.5%	42,548	11,063	8,916,386
Trade, Transport, and Utilities	246,900	13.9%	31,872	8,287	6,679,174
Total Nonfarm	**1,781,700**		**230,000**		**42,180,072**

Employment Growth & Potentially Constrained Communities

As noted above, at least four factors influence water availability in communities in Massachusetts today. These include the new SWMI framework's water basin Safe Yield, the sub-basin Groundwater Withdrawal Levels, existing water use relative to authorized withdrawal, and potential growth.

[185] Assembly on the Mystic, Federal Realty Investment Trust & City of Somerville, October 27, 2009, p. 73. Accessed on September 13, 2013 at //www.somervillema.gov/sites/default/files/documents/FULL-PACKAGE-EconomicDevelopmentProposal.pdf

Collectively, this has potential implications for employment growth in Massachusetts and in the Boston metro region.

Although the MetroFuture plan anticipates 230,000 to be added to the Boston metro area by 2035, growth is not anticipated to be evenly distributed across all communities. In fact, of the 164 communities included in the planning area, 130 of them (79.3%) are expected to experience job growth, 32 will experience some level of decline (17.9%), and two will experience no change (1.2%). A total of 15 communities are expected to see employment growth in excess of 3,000 jobs and an additional 11 are expected to grow between 2,000 and 3,000 jobs by 2035. (See Appendix C "A Guide to MetroFuture" for detail on employment projections).

Table 31: MAPC Employment Projections (Communities with Greatest Job Growth) (2010 – 2035)

Location	2010 Jobs	Change in Jobs	2035 Jobs
Boston	545,079	58,314	603,393
Cambridge	103,015	16,938	119,953
Somerville	20,435	15,130	35,564
Andover	32,011	9,997	42,008
Brockton	36,800	5,240	42,040
Lowell	33,204	4,759	37,963
Weymouth	18,275	4,377	22,652
Taunton	24,118	4,342	28,460
Westborough	23,610	4,080	27,690
Plymouth	22,869	3,890	26,759
Quincy	48,046	3,814	51,860
Westford	11,681	3,464	15,145
Tewksbury	15,213	3,190	18,403
Chelmsford	20,736	3,183	23,919
Framingham	43,809	3,020	46,829

Of course, for the projected job growth to occur, those communities must have adequate infrastructure that can accommodate the new jobs and three out of the top 15 growth communities have been identified as having potential constraints. These include Weymouth (4,080 jobs) (see Weymouth case study on the page 41), Westborough (4,080 jobs), Plymouth (3,890 jobs), and Lynn (2,253). Each has unique plans for economic growth and infrastructure challenges.

Located at the junction of I-90 and I-495 in central Massachusetts, **Westborough** has over 1,000 acres of vacant land zoned for commercial and industrial development. The epicenter of development is located along Route 9 where it intersects with I-495, including the Westborough Technology Park, Westborough Office Park and the Westborough Business Park. Just south of this area, the Commonwealth and CSX Railroad have recently invested over $20 million to repurpose a vacant Automotive Terminal into a bulk commodity transfer facility. The state-of-the-art TRANSFLO facility receives bulk shipments of commodities like corn syrup, plastic pellets and industrial commodities by rail and transfers them to trucks for delivery to businesses in the Commonwealth and New England that do not have a direct rail connection. Westborough has also targeted two redevelopment sites for new uses. The former Lyman School has become a small but important node of business activity in town. The property now houses

the Massachusetts Technology Collaborative, and plans are in the works to develop 120,000 square feet of commercial space on a Town-controlled portion of the site adjacent to Route 9 between Park and Milk streets. The other site is the Westborough State Hospital Property while currently used by numerous state agencies could be replaced with other uses through redevelopment of the property.

Plan for Seaport at Cordage

The town of **Plymouth** has seen significant population growth in the past three decades and has become the second largest employment base on the South Shore with over 23,000 jobs according to the 2010 census. Plymouth has designated five priority development areas including: Seaport at Cordage, River Run, and the "1,000 Acres" off Bourne Road. Cordage Park is home to the former Plymouth Cordage Company, which at one time was the largest rope maker in the world. Seaport at Cordage, situated on Plymouth Bay, is a 45 acre mixed-use redevelopment project. The plan opens the shoreline to the public and promotes economic activity in the region. Phase I saw the redevelopment of a vacant mill building into the Cordage Commerce Center that is home to the Jordan Hospital Rehabilitation Center, Quincy College's Plymouth Campus, and the University of Massachusetts-Boston satellite campus. Phase II will include a variety of residential (675 units), retail, restaurant and marina uses. River Run is a development in South Plymouth that will contain approximately 1,175 homes and up to 90,000 square feet of commercial space on 1,320 acres, constructed over 12 years. The first phase is being facilitated by the construction of an access roads and infrastructure improvements financed with a $950,000 Massachusetts Opportunity Relocation and Expansion (MORE) Jobs Capital Program grant. The "1,000 Acre" site, also in South Plymouth is an undeveloped parcel owned by the town. Mass Development has said that approximately one half of the "1,000 Acres" site is developable. At present, development is limited due to significant title issues and the need for water, wastewater and roadway infrastructure improvements.

In addition, the City of **Lynn**, which is in the top 25 growth communities, has an ambitious vision for its 305 acre waterfront development area. Located 10 miles from downtown Boston, the project seeks to transform the city's underutilized industrial waterfront into a regional economic engine. The Master Plan, completed in 2007, calls for the construction of over 1 million square feet of commercial/retail space, 400,000 square feet of office, 300,000 square feet of hotel use, 3,100 residential units in a mix of multifamily housing types, 220,000 square feet of light industrial development, with 24 acres of new open space including a new mixed use marina.[186] Transportation improvements include expanding MBTA Commuter Rail service at the River Works and Lynn Stations, and transforming Massachusetts Route 1A (the Lynnway) into a people- and development-friendly arterial. The project is expected to create close to 5,000 permanent jobs and 9,500 construction jobs. Estimated value of the project at build out is $1.8 billion in current dollars. Currently, the Lynn Water and Sewer Commission provides its own water treatment with water sourced from the Saugus (primary) and Ipswich (secondary) Rivers and the Commission's Waste Water Treatment Plant is located in the center of the redevelopment project

[186] City of Lynn, Massachusetts, Waterfront Master Plan Report, 2007

area. Each of these jobs will add to potable water demand within this already stressed water basin. Given that the GE Aviation Plant in Lynn already receives water from the MWRA and an emergency water connection is in place, potential exists to find an alternate water resource, in addition to undertaking conservation efforts, to facilitate the anticipated 10% growth rate in Lynn.

Lynn Waterfront Redevelopment Plan

Perhaps of greater significance is when all of the potentially constrained communities are considered in the aggregate, including large and small growth communities. Of the 81 communities identified as potentially constrained below, 65 of them are located within MAPC's MetroFuture boundary. Together, they total over 44,200 potential new jobs, over 19% of all jobs projected in the Boston metro region until 2035.

Table 32: Job Growth in Potentially Constrained Communities (Growth figures for Boston Metro Area only)

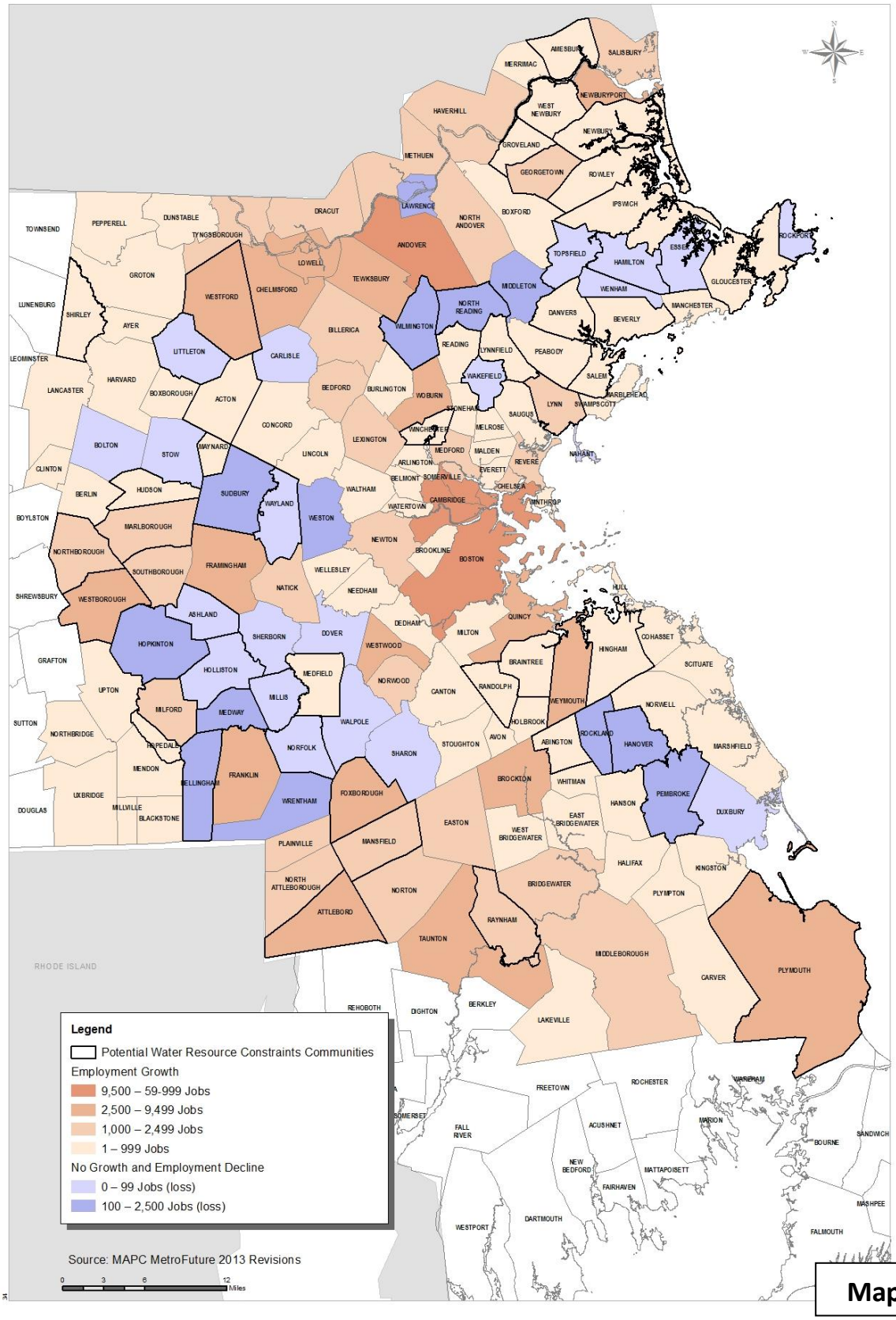
Municipality	Basin	Authorized Withdrawal (MGD)	Avg Daily Use (2012) (MGD)	Avg Daily v. Authorized	Change in Jobs	2035 Jobs
Abington/Rockland	South Coastal	2.21	2.6	118%	628	4,440
Acton	Concord	1.94	1.68	87%	609	10,259
Amesbury	Merrimack	1.88	1.28	68%	260	4,872
Ashburnham	Millers	0.18	0.46	256%		
Ashland	Concord	2.18	1.91	88%	-34	4,962
Attleboro	Ten Mile	3.85	3.89	101%	2,825	19,423
Bellingham	Blackstone	1.41	0.6	43%	-225	5,161
Bellingham	Charles	1.36	0.87	64%		
Beverly	Ipswich	(see Salem/Beverly)			483	22,052
Braintree	Weymouth-Weir	3.87	3.54	91%	986	27,207
Brookfield	Chicopee	0.09	0.09	100%		
Clinton	Nashua	2	2.04	102%	300	4,660
Danvers	Ipswich	3.72	3.14	84%	117	25,107
Deerfield	Deerfield	0.1	0.1	100%		
East Brookfield	Chicopee	0.11	0.97	882%		

Table 32: Job Growth in Potentially Constrained Communities (Growth figures for Boston Metro Area only)						
Municipality	**Basin**	**Authorized Withdrawal (MGD)**	**Avg Daily Use (2012) (MGD)**	**Avg Daily v. Authorized**	**Change in Jobs**	**2035 Jobs**
Essex	North Coastal	0.22	0.25	114%	-26	1,080
Fitchburg	Chicopee	0.78	1.71	219%		
Foxborough	Ten Mile	0	0.19		2,827	13,706
Georgetown	Parker	0.76	0.68	89%	1,105	3,317
Gloucester	North Coastal	3.75	3.01	80%	768	10,633
Grafton	Blackstone	1.47	1.12	76%		
Groveland	Merrimack	0.41	0.37	90%	747	1,861
Hamilton	Ipswich	1.03	0.66	64%	0	1,481
Hanover	South Coastal	1.38	1.4	101%	-160	6,560
Hingham/Hull	Weymouth-Weir	3.51	3.21	91%	443	12,233
Holbrook	Weymouth-Weir	(see Randolph/Holbrook)			155	2,783
Holliston	Charles	1.14	0.92	81%	-1	5,233
Hopedale	Blackstone	0.41	0.42	102%	50	1,670
Hopkinton	Concord	0.98	0.98	100%	-158	9,116
Hudson	Concord	2.95	2.13	72%	599	10,419
Hull	Weymouth-Weir	(see Hingham/Hull)			44	1,169
Ipswich	Ipswich	0.2	0.23	115%	30	4,697
Lancaster	Nashua	0.53	0.62	117%	150	2,270
Lanesborough	Housatonic	0.21	0.21	100%		
Leicester	Blackstone	0.19	0.19	100%		
Littleton	Merrimack	1.46	1.1	75%	-29	5,219
Lynn**	Ipswich	5.31	1.5	28%	2,253	24,810
Lynn**	North Coastal	8.93	8.62	97%		
Lynnfield **	Ipswich	0.29	0.41	141%	671	6,163
Lynnfield **	North Coastal	0.32	0.16	50%		
Mansfield	Ten Mile	1.58	0.51	32%	1,819	12,811
Marlborough**	Concord	2	1.67	84%	1,463	34,178
Maynard	Concord	1.09	0.81	74%	185	4,585
Medfield	Weymouth-Weir	0.92	0.44	48%	113	2,874
Medfield	Charles	1.5	0.86	57%		
Medway	Charles	0.91	0.91	100%	-177	3,336
Merrimack	Merrimack	0.36	0.35	97%	217	983
Middleton	Ipswich	(purchase from Danvers)			-112	4,176
Milford	Charles	3.3	2.59	78%	1,385	16,166
Millis	Charles	0.8	0.59	74%	-53	1,930
Newbury(Byfield)	Parker	0.17	0.18	106%	790	2,249
Norfolk	Charles	0.53	0.44	83%	-48	3,164
North Attleboro	Ten Mile	2.1	1.2	57%	1,799	12,974
North Raynham	Taunton	0.32	0.37	116%		
North Reading	Ipswich	0.96	0.58	60%	-795	7,623
Northborough	Concord	0.74	0	0%	1,840	7,640
Peabody	Ipswich	3.89	4.64	119%	203	23,231
Peabody	North Coastal	1.89	1.33	70%		
Pembroke	South Coastal	1.26	1.32	105%	-113	6,226

Table 32: Job Growth in Potentially Constrained Communities (Growth figures for Boston Metro Area only)						
Municipality	**Basin**	**Authorized Withdrawal (MGD)**	**Avg Daily Use (2012) (MGD)**	**Avg Daily v. Authorized**	**Change in Jobs**	**2035 Jobs**
Plainville	Taunton	0.39	0.46	118%	1,336	4,910
Plainville	Ten Mile	0.23	0.32	139%		
Plymouth	Buzzards Bay	0.22	0.25	114%	3,890	26,759
Randolph/Holbrook	Weymouth-Weir	3.27	3.47	106%	694	8,429
Raynham	Taunton	0.82	0.95	116%	1,263	9,868
Rockland	South Coastal	(see Abington/Rockland)			-231	7,773
Rockport	North Coastal	0.72	0.53	74%	-12	903
Rowley	Parker	0.55	0.40	73%	583	3,232
Rutland	Nashua	0.37	0.38	103%		
Salem/Beverly	Ipswich	12.44	9.61	77%	142	18,521
Salisbury	Merrimack	0.25	0.28	112%	1,242	4,037
Salisbury	North Coastal	0.84	0.53	63%		
Seekonk	Ten Mile	1.71	1.21	71%		
Sheffield	Housatonic	0.13	0.14	108%		
Shirley	Nashua	0.31	0.4	129%	150	2,290
Shrewsbury	Blackstone	3.91	3.66	94%		
Sudbury	Concord	2.08	1.74	84%	-167	7,663
Sunderland	Connecticut	0.24	0.27	113%		
Topsfield	Ipswich	0.6	0.38	63%	-87	1,848
Wakefield**	North Coastal	0.48	0.34	71%	-37	14,054
Wayland	Concord	1.77	1.21	68%	-66	2,813
Wenham	Ipswich	0.39	0.35	90%	-15	1,478
Westborough	Concord	3.1	2.23	72%	4,080	27,690
Westford	Merrimack	2.44	1.41	58%	3,464	15,145
West Newbury	Merrimack	0.16	0.13	81%	65	804
Weymouth	Weymouth-Weir	5.00	4.09	82%	4,377	22,652
Wilmington**	Ipswich	2.91	2.09	72%	-777	18,162
Winchendon	Millers	0.67	0.67	100%		
Winchester**	Mystic	1.06	1.12	106%	396	8,805
TOTAL					**44,223**	**604,545**
**Receive partial water service from MWRA.						

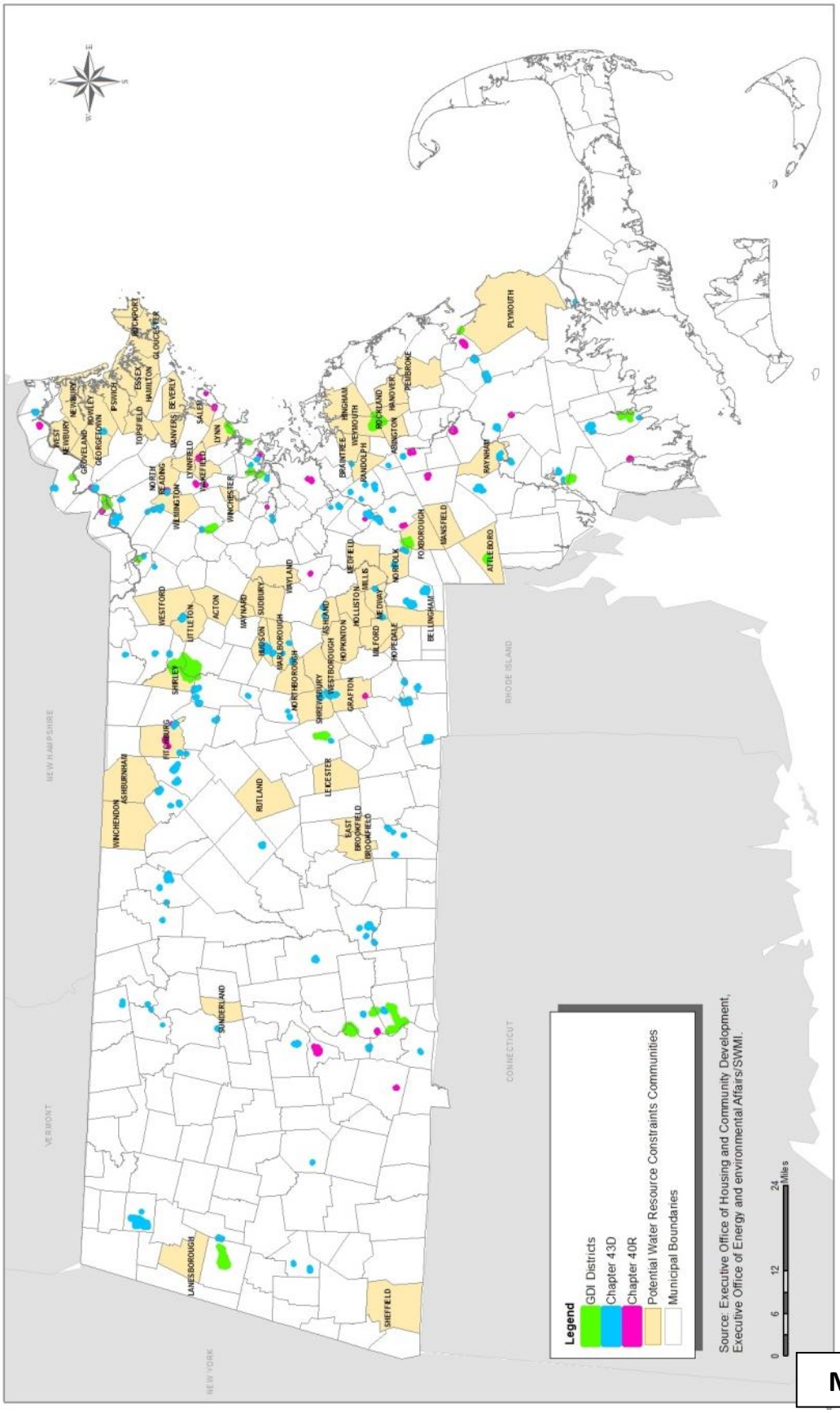
Several of these communities have been formally identified by the Commonwealth as growth opportunity areas. For example, Attleboro, Foxborough, Lynn, and Wakefield, have either established Growth District Incentive (GDI) areas or expedited permitting areas (43D). In each of these programs, the anticipation is that new development will be facilitated expeditiously, but for this to occur, potential water constraints will need to be addressed. Map 9 below shows the potentially communities in relation to the Commonwealth's targeted investment zones (Growth District Initiative, Chapter 43D Priority Development Sites/Local Permit Expediting, and Chapter 40R Smart Growth Sites), indicating where areas of potential job growth are located relative to areas with existing or potential future water constraints. A map of MetroFuture employment projections can be found Appendix C.

Employment Growth 2010-2035 with Potential Water Resource Constraints Communities



Map 8

State Targeted Investment Zone and Communities with Potential Water Resource Constraints



Map 9

Implications for Future Population Growth

Many of the same communities anticipating significant economic growth are also anticipating growth in the residential population. Across the MetroBoston study area, MetroFuture projects the population to grow by 484,000 people by 2035. At an average daily residential water use of 65-67 gallons per person per day, that is equal to 31.4 million to 32.4 million gallons of new water use per day. However, each new resident brings with them financial resources that can help offset the water they use. In addition to paying for the water they use via local water rates, new residents actually increase the retail buying power of a community when they move in. In fact, Census data reveals that the average retail expenditure in Massachusetts is $13,553[187] per person per year which can be of benefit to the community in which they move.

As with employment growth, population growth will vary from community to community, even within those as potentially constrained. A high level of growth is projected for the communities of Lynn, North Attleboro, Plymouth,Westford, and Weymouth. Plymouth, in particular is projected to grow to nearly 100,000 residents, adding over 18,000 between 2010 and 2035, while Weymouth and Lynn are anticipated to add over 15,700 and 12,400 residents, respectively.

The City of Weymouth and the towns of Abington and Rockland are host to the redevelopment of the South Weymouth Naval Air Station. Rebranded as South Field, the 1,400 acres base will create a variety of housing options from 1 acre estate homes to multi-family above retail in a traditional village center. Additionally, a 78 acre corporate park will accommodate approximately 2 million square feet of office and R&D lab space.

The City of Peabody announced in early 2013 that it would revise its comprehensive master plan, last updated in 2002. With the assistance of the Salem State University Center for Economic Development and Sustainability, the master plan will review and make recommendations to amend land use, zoning, business mix and architectural/development patterns in the community. [188] This follows efforts by the City of Salem and the Metropolitan Area Planning Council in 2009/2010 to create the Peabody-Salem Corridor Concept Action Plan for the Main Street/Boston Street Corridor. Although well established, the community has a potential to concentrate on infill and redevelopment activities along I-95, and Massachusetts Routes, 1, and 128 where a large portion of its commercial tax base is located.

Detailed population estimates by constrained community can be found in Table 33 below and a map of the MetroFuture population projections is on page 112.

Table 33: Population Growth in Potentially Constrained Communities (Growth figures for Boston Metro Area only)

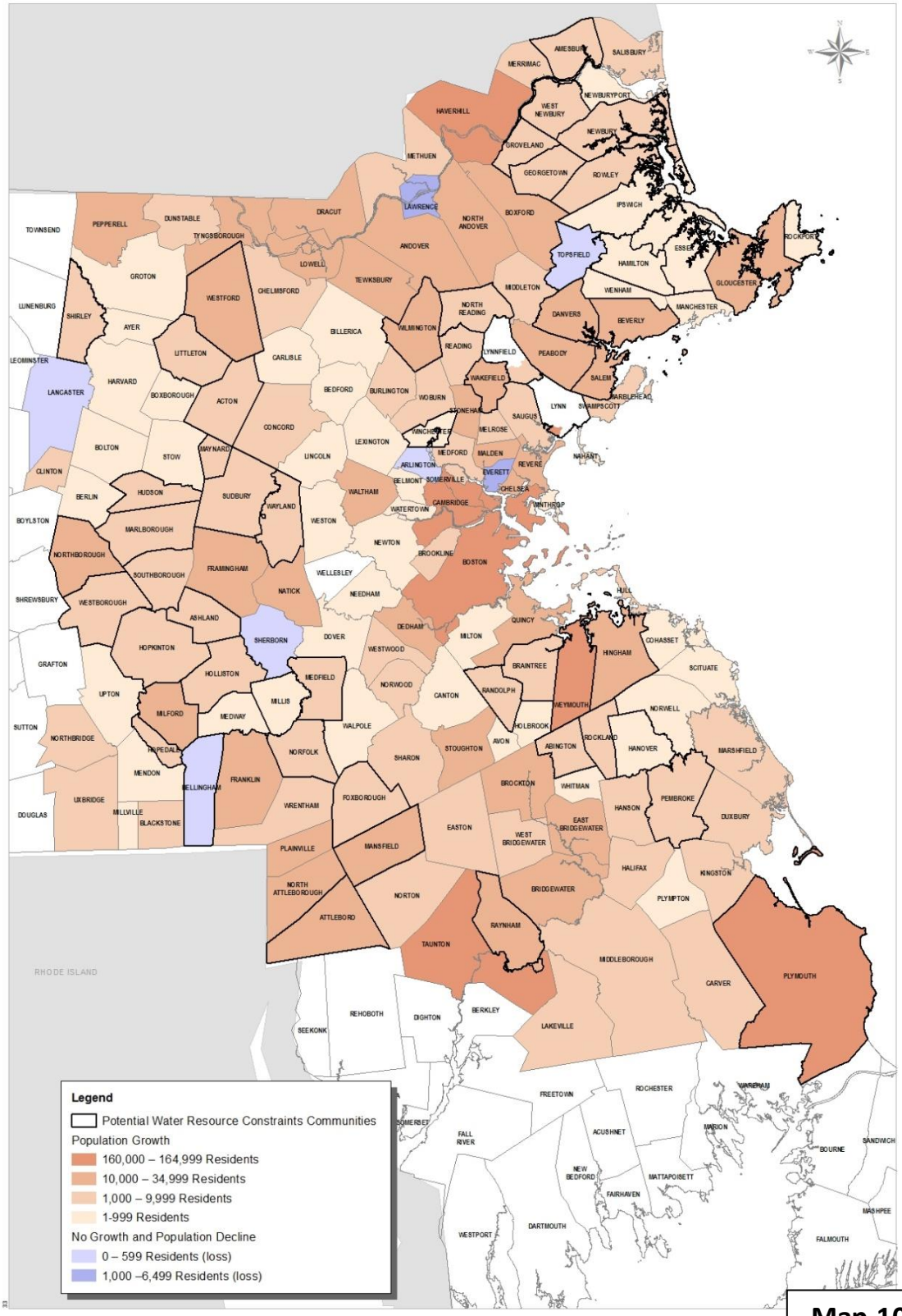
Municipality	Basin	Authorized Withdrawal (MGD)	Avg Daily Use (2012) (MGD)	Avg Daily v. Authorized	Change in Pop	2035 Pop
Abington/Rockland	South Coastal	2.21	2.6	118%	3,193	22,991
Acton	Concord	1.94	1.68	87%	2,383	33,957

[187] US Census Quick Facts 2007
[188] Alan Burke, "Peabody to Create Master Plan," The Salem News, February 8, 2013

Table 33: Population Growth in Potentially Constrained Communities (Growth figures for Boston Metro Area only)						
Municipality	**Basin**	**Authorized Withdrawal (MGD)**	**Avg Daily Use (2012) (MGD)**	**Avg Daily v. Authorized**	**Change in Pop**	**2035 Pop**
Amesbury	Merrimack	1.88	1.28	68%	2,785	23,680
Ashburnham	Millers	0.18	0.46	256%		
Ashland	Concord	2.18	1.91	88%	2,258	23,847
Attleboro	Ten Mile	3.85	3.89	101%	6,457	66,649
Bellingham	Blackstone	1.41	0.6	43%	-543	21,176
Bellingham	Charles	1.36	0.87	64%		
Beverly	Ipswich	(see Salem/Beverly)			483	22,052
Braintree	Weymouth-Weir	3.87	3.54	91%	3,368	65,334
Brookfield	Chicopee	0.09	0.09	100%		
Clinton	Nashua	2	2.04	102%	1,884	19,850
Danvers	Ipswich	3.72	3.14	84%	3,334	54,817
Deerfield	Deerfield	0.1	0.1	100%		
East Brookfield	Chicopee	0.11	0.97	882%		
Essex	North Coastal	0.22	0.25	114%	204	4,814
Fitchburg	Chicopee	0.78	1.71	219%		
Foxborough	Ten Mile	0	0.19		4,051	31,795
Georgetown	Parker	0.76	0.68	89%	3,313	13,708
Gloucester	North Coastal	3.75	3.01	80%	4,311	42,965
Grafton	Blackstone	1.47	1.12	76%		
Groveland	Merrimack	0.41	0.37	90%	3,070	10,643
Hamilton	Ipswich	1.03	0.66	64%	586	9,831
Hanover	South Coastal	1.38	1.4	101%	119	20,718
Hingham/Hull	Weymouth-Weir	3.51	3.21	91%	3,979	37,998
Holbrook	Weymouth-Weir	(see Randolph/Holbrook)			155	2,783
Holliston	Charles	1.14	0.92	81%	1,830	20,611
Hopedale	Blackstone	0.41	0.42	102%	1,118	8,649
Hopkinton	Concord	0.98	0.98	100%	2,159	26,358
Hudson	Concord	2.95	2.13	72%	1,934	30,817
Hull	Weymouth-Weir	(see Hingham/Hull)			44	1,169
Ipswich	Ipswich	0.2	0.23	115%	440	18,282
Lancaster	Nashua	0.53	0.62	117%	-375	9,800
Lanesborough	Housatonic	0.21	0.21	100%		
Leicester	Blackstone	0.19	0.19	100%		
Littleton	Merrimack	1.46	1.1	75%	1,748	15,921
Lynn**	Ipswich	5.31	1.5	28%	12,439	125,326
Lynn**	North Coastal	8.93	8.62	97%		
Lynnfield**	Ipswich	0.29	0.41	141%	1,797	18,884
Lynnfield **	North Coastal	0.32	0.16	50%		
Mansfield	Ten Mile	1.58	0.51	32%	5,646	39,822
Marlborough**	Concord	2	1.67	84%	3,625	74,839
Maynard	Concord	1.09	0.81	74%	1,432	15,938
Medfield	Weymouth-Weir	0.92	0.44	48%	1,285	16,070
Medfield	Charles	1.5	0.86	57%		
Medway	Charles	0.91	0.91	100%	479	16,744

Table 33: Population Growth in Potentially Constrained Communities (Growth figures for Boston Metro Area only)						
Municipality	**Basin**	**Authorized Withdrawal (MGD)**	**Avg Daily Use (2012) (MGD)**	**Avg Daily v. Authorized**	**Change in Pop**	**2035 Pop**
Merrimack	Merrimack	0.36	0.35	97%	1,653	8,757
Middleton	Ipswich	(purchase from Danvers)			-112	4,176
Milford	Charles	3.3	2.59	78%	4,780	47,707
Millis	Charles	0.8	0.59	74%	200	10,074
Newbury(Byfield)	Parker	0.17	0.18	106%	3,299	11,424
Norfolk	Charles	0.53	0.44	83%	978	15,417
North Attleboro	Ten Mile	2.1	1.2	57%	8,415	48,304
North Raynham	Taunton	0.32	0.37	116%		
North Reading	Ipswich	0.96	0.58	60%	371	23,681
Northborough	Concord	0.74	0	0%	5,495	25,450
Peabody	Ipswich	3.89	4.64	119%	3,999	78,379
Peabody	North Coastal	1.89	1.33	70%		
Pembroke	South Coastal	1.26	1.32	105%	2,015	26,191
Plainville	Taunton	0.39	0.46	118%	4,358	16,196
Plainville	Ten Mile	0.23	0.32	139%		
Plymouth	Buzzards Bay	0.22	0.25	114%	18,410	97,748
Randolph/Holbrook	Weymouth-Weir	3.27	3.47	106%	2,829	42,676
Raynham	Taunton	0.82	0.95	116%	5,022	27,009
Rockland	South Coastal	(see Abington/Rockland)			-231	7,773
Rockport	North Coastal	0.72	0.53	74%	728	8,595
Rowley	Parker	0.55	0.4	73%	2,302	10,807
Rutland	Nashua	0.37	0.38	103%		
Salem/Beverly	Ipswich	12.44	9.61	77%	3,982	63,701
Salisbury	Merrimack	0.25	0.28	112%	3,580	14,658
Salisbury	North Coastal	0.84	0.53	63%		
Seekonk	Ten Mile	1.71	1.21	71%		
Sheffield	Housatonic	0.13	0.14	108%		
Shirley	Nashua	0.31	0.4	129%	1,619	10,970
Shrewsbury	Blackstone	3.91	3.66	94%		
Sudbury	Concord	2.08	1.74	84%	1,438	26,927
Sunderland	Connecticut	0.24	0.27	113%		
Topsfield	Ipswich	0.6	0.38	63%	-161	7,859
Wakefield**	North Coastal	0.48	0.34	71%	3,065	42,087
Wayland	Concord	1.77	1.21	68%	2,001	17,874
Wenham	Ipswich	0.39	0.35	90%	147	6,515
Westborough	Concord	3.1	2.23	72%	6,917	48,800
Westford	Merrimack	2.44	1.41	58%	8,560	42,192
West Newbury	Merrimack	0.16	0.13	81%	1,657	6,631
Weymouth	Weymouth-Weir	5.00	4.09	82%	15,701	87,720
Wilmington**	Ipswich	2.91	2.09	72%	2,354	43,617
Winchendon	Millers	0.67	0.67	100%		
Winchester**	Mystic	1.06	1.12	106%	551	30,334
TOTAL					**203,526**	**2,009,488**
**Receive partial MWRA service.						

Population Growth 2010-2035 with Potential Water Resource Constraints Communities



Source: MAPC MetroFuture 2013 Revisions

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Map 10

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WASTEWATER TREATMENT SYSTEMS

OVERVIEW

> *"A well maintained, reliable water infrastructure system is vital to the Commonwealth's health, economy, environment, and cultural vitality."*[189]

Wastewater treatment in the Greater Boston area has improved dramatically since the Federal Clean Water Act was passed in the early 1970s; however, in many cases what was once state-of-the-art is now in need of upgrade, repair, or replacement at a time when funding is less abundant. Adding complexity to this challenge is the fact that wastewater treatment systems seemingly vary from community to community. While 43 communities in eastern Massachusetts are served by the MRWA, many others operate local- or regional-serving wastewater treatment plants, and still others do not have public treatment services at all, instead relying on individual or shared septic systems. Even where communities are served by MWRA facilities, municipalities and the MWRA have shared responsibility for maintenance of the lines that bring the effluent to the treatment plant.

While it is recognized that effective wastewater management is essential to public health and safety, national security, the environment, tourism, and economic development,[190] significant wastewater treatment challenges presently affect area municipalities, businesses, and residents; challenges that are on track to become more critical in the future. These challenges include:

- Aging wastewater treatment plants

Following passage of the Clean Water Act in 1972, federal funds provided 75% of the cost for sewer projects, with state funds contributing an additional 15%. As a result, many municipal primary and secondary wastewater treatment plants (WWTPs) were built in 1970s and 1980s. With an expected 30 or 40-year effective service life, many facilities are at or nearing the end of their lifespan. Renovation costs can total $100 million or more, while the cost of constructing a new plant is estimated at $17 million[191] per MGD of capacity.[192] However, today municipal WWTPs rely predominantly on local user fees and tax revenue to pay for plant operation, maintenance, and upgrades or construction of new facilities, which can represent a significant financial burden.

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[189] Water Infrastructure Finance Commission, '*Massachusetts's Water infrastructure: Toward Financial Sustainability*', February 7, 2012. p.3.
[190] Ibid.
[191] '*Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod*', Barnstable County Wastewater Cost Task Force, April, 2010. p. 2.
[192] As an example, Concord, Scituate, and Uxbridge currently treat 1.0 million gallons per day, but any plant must be oversized to accommodate new growth and storm-related surges.

- Aged or inadequate sewer lines

Throughout the Boston metro area, stormwater routinely enters the wastewater treatment system, resulting in the costly treatment of more water than is necessary and storm surges that can overwhelm a facility's capacity. In some of the area's oldest communities, this occurs because the stormwater and wastewater systems are one in the same (e.g., Boston, Cambridge, Somerville, for example); and even in communities with separated systems, stormwater can enter the wastewater system via cracks in the pipes. Combined sewer overflows (CSOs) occur when a system is overloaded by wastewater and stormwater and untreated or partially treated water is released into a nearby body of water. Addressing this situation is costly and the U.S. EPA estimates that the nation capital costs of future CSO control over the next 20 years will exceed $50 billion.[193] MWRA's plan to reduce annual overflow volume from 3.3 billion gallons (in 1988) to 0.1 billion gallons (by 2016) alone is estimated to cost $867 million. In addition to making the changes needed to separate the flows, facilities must be built or expanded in order to pre-treat the separated stormwater before releasing it into a nearby river or stream.

- Capacity limitations that threaten to stifle regional growth

Across Massachusetts, most municipal and regional WWTPs appear equipped to accommodate future growth, although heavy water events do infrequently overwhelm plants causing flooding or overflows. The amount of available capacity used by municipal plants is on the order of 67% (median), meaning that flow could increase by approximately 1/3 and the plants would be within their available permitted average capacity.[194] However, at four Massachusetts wastewater treatment plants (Concord, Lynn, Marlborough, and Rockland), current demand for wastewater processing exceeds 85% of permissible average flow, a situation that may affect future growth in these communities if not addressed. Lynn, in particular, is projecting 2,000 new jobs and 10,000 new residents, which would require treatment of at least an additional 1.1 MGD of wastewater[195], bringing the existing facility's average operations up to 92% of total capacity. In addition, when employment and population growth estimates included in MAPC's MetroFuture plan are taken into account, at least two additional Boston area municipal plants (Brockton and the Charles River Pollution Control District) may approach or exceed capacity limitations by 2035.

- Increasingly stringent EPA regulations

Public wastewater distribution systems are regularly subject to changes in environmental regulations, often times requiring multi-million dollar upgrades to the treatment plants or their associated distribution systems. In recent years, the EPA has become increasingly restrictive in its requirements relating to treated wastewater discharge, nutrient removal, and stormwater discharge. Communities across the state have had to grapple with these new requirements or run the risk of being fined for failing to comply.

[193] Ibid. p. 10.
[194] Conversations with WWTP personnel by Shelley Ayervais, May 2013, and NSPED issued permits.
[195] Using estimate of 75GPD of wastewater produced per residents and 20GPD per employee

- Diminished funding

Federal funding for wastewater treatment has consistently declined since its peak in the late 1970s and what funding remains has been converted from grants into loans. The Commonwealth augments federal grants with a 20% matching state appropriation (through a budget category called "Contract Assistance"). Since 1991, over 75% of this financial assistance has benefited secondary treatment projects (37%), CSO correction projects (22%), and new collector sewer projects (17%) through pass-through and linked-deposit loans. In addition, the Commonwealth's Sewer Rate Relief Fund was created in 1993 to address the escalating debt from rising water and sewer expenses at a time when sewer rate increases were in the double digits for many communities. At its peak, the Sewer Rate Relief Fund received $62 million per year; however, the program went unfunded in FY09 - FY11, and was funded at $500,000 in FY12. Unfortunately, at a time where trends in funding are declining, projections for the investment needed to maintain the State's wastewater treatment infrastructure is increasing. In fact, a 2011 Water Infrastructure Finance Commission analysis calculated a statewide funding gap of $11.2 billion to pay for wastewater systems improvements expected over next 20 years.[196]

**

From the research performed, it is clear that crafting a workable solution to Massachusetts' wastewater infrastructure needs poses a significant challenge to environmental regulators, municipalities, regional agencies, and the Commonwealth itself. If one of the Commonwealth's goals is to fully benefit from anticipated growth in jobs and business, its wastewater infrastructure must be right-sized for the new growth, in compliance with changing regulations, and cost effective.

[196] Water Infrastructure Finance Commission, p.4.

MWRA WASTEWATER TREATMENT SYSTEM

Wastewater Treatment History

Boston's original sewer system came into operation in 1884, with the completion of the Boston Main Drainage Works (BMDW). BMDW served 18 communities within a 13 square mile area of central Boston. (17 of the 18 communities, the exception being Brookline, have since been annexed become part of the City of Boston.) The system provided no treatment, but merely diverted sewerage to Moon Island, located in Quincy Bay within the Boston Harbor, where it was temporarily held before being released with the outgoing tide.

Construction of a regional system commenced in 1889 under management of the newly created Metropolitan Sewerage District (MSD). By 1909, four major systems and system expansions had come online: the North Metropolitan Sewer District (discharging to Deer Island), the South Metropolitan Sewer District (discharging to Nut Island), Neponset Valley Sewer System (discharging to Nut Island) and the Charles River Valley Sewer System (discharging to Moon Island).[197] The Metropolitan District Commission (MDC) was created by state legislature in 1919 to oversee the MSD and the water system.

Despite having one of the greatest early sewer systems in the country, wastewater treatment did not begin until the mid-1900s, in an attempt to reverse the deterioration of water quality in Boston Harbor. Two primary treatment plants were constructed: the Nut Island Primary Wastewater Treatment Plant in 1952 to treat the southern collection system and the Deer Island Primary Wastewater Treatment Plant in 1968 to treat sewerage from the northern collection system. (The discharge facility at Moon Island was put on emergency stand-by status.) Primary treatment includes the removal of up to 60% of the solids in the waste stream, as they settle as a mixture of sludge and water. However, primary treatment removes very few toxic chemicals. The new treatment facilities continued to rely on tidal action to move the discharged material out of Boston Harbor. Unfortunately, this tidal action was not always

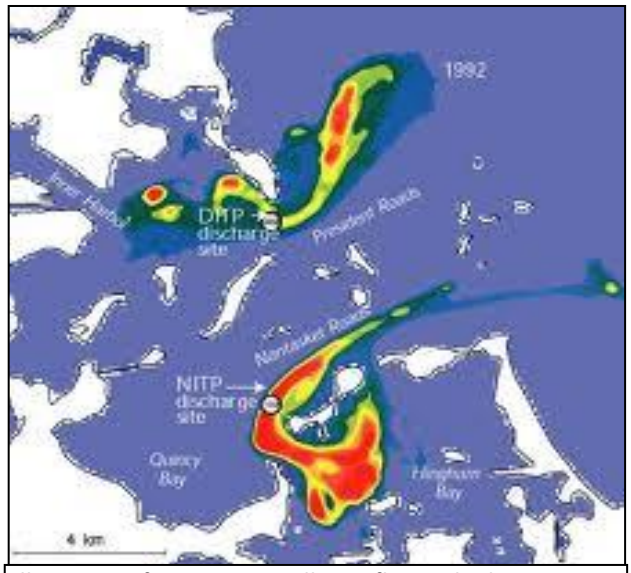


Illustration of wastewater pollution flowing back into Boston Harbor prior to Clean Water Act (Source: MWRA)

[197] Ibid. North Metropolitan Sewer served parts of Boston and as well as Winthrop, Chelsea, Everett, Malden, Melrose, Cambridge, Somerville, Medford, Winchester, Woburn, Stoneham, Arlington, Belmont, Wakefield, Lexington, and Revere. South Metropolitan Sewer served parts of Boston and Brookline, Newton, Watertown, Waltham, Milton, Hyde Park, Dedham, Quincy. The Neponset service area included West Roxbury, Germantown, and other communities along the Neponset River. The Charles River Valley Sewer System served Brighton, Alston, and the Fenway community.

successful. The computer model graphic above shows how plumes often flowed back into the Harbor[198].

In 1972, the Federal Clean Water Act mandated primary and secondary treatment for all municipal sewer systems, sparking the eventual successful clean-up of the Boston Harbor. While failing to meet the Act's 1977 federal deadline, by the late 1990s, and at a cost of $3.8 billion[199],the MWRA came into compliance with federal regulations. (See South Boston Waterfront and Boston Harbor case study for details.)

MWRA Wastewater Treatment System Today – Deer Island Treatment Plant

In 1985, the Massachusetts Water Resources Authority (MWRA), created by state legislature in 1984, assumed responsibility from the Metropolitan District Commission (MDC) for sewage collection and treatment for 43 MA municipalities.

The original MWRA wastewater communities include: Arlington, Ashland, Bedford, Belmont, Boston, Braintree, Brookline, Burlington, Cambridge, Canton, Chelsea, Dedham, Everett, Framingham, the north sewer district of Hingham, Holbrook, Lexington, Malden, Medford, Melrose, Milton, Natick, Needham, Newton, Norwood, Quincy, Randolph, Reading, Revere, Somerville, Stoneham, Stoughton, Wakefield, Walpole, Waltham, Watertown, Wellesley, Westwood, Weymouth, Wilmington, Winchester, Winthrop and Woburn.

Deer Island was chosen as the location for a massive investment that included (among other things) a secondary treatment facility and new nine-mile outfall tunnel to transport the discharge of fully treated water beyond the Boston Harbor and into the Massachusetts Bay. Secondary treatment removes 80% to 90% of human wastes and other solids by adding oxygen to the wastewater to speed up growth of micro-organisms, which then consume the wastes and settle to the bottom of a secondary settling tank. Secondary treatment also removes a significant portion of toxic chemicals. The obsolete Nut Island facility was allowed to close, with all flow previously processed at Nut Island piped under the harbor to Deer Island for treatment.

Deer Island Treatment Plant (Source: MWRA)

The MWRA system is divided into a North System and South System, with the North System serving approximately 1.3 million people and the South System approximately 700,000 people.

[198] http://www.mwra.state.ma.us/harbor/html/modeled_dilution.htm
[199] Ibid.

The North System

MWRA's North System covers an area of approximately 168 square miles and serves the following communities:[200]

Table 34: MWRA North System Communities					
Arlington	Bedford	Belmont	Boston*	Brookline*	Burlington
Cambridge	Chelsea	Everett	Lexington	Malden	Medford
Melrose	Milton*	Newton*	Reading	Revere	Somerville
Stoneham	Wakefield	Waltham	Watertown	Wilmington	Winchester
Winthrop	Woburn				
**community served by both north and south system*					

Approximately 80% of MWRA's North System is a separate system, whereby wastewater and stormwater are separated. However, portions of Boston, Cambridge, Somerville and Chelsea (approximately 20% of the north service area) still have combined systems; older systems designed so that wastewater and stormwater flow into the same pipe system.

Three remote headworks, where bricks, logs and other large objects are screened out before it is sent on to be treated, connect to the North Main Pump Station on Deer Island by two deep rock tunnels: the Boston Main Drainage Tunnel and the North Facilities Metro Relief. The North Metro Trunk Sewer delivers water to a fourth headworks, Winthrop Terminal Headworks, located on Deer Island and receiving flow from Winthrop and the East Boston Pump Station. The North System includes four main pumping stations that allow the conveyance of wastewater to headworks facilities, in areas where gravity flow is not adequate.

North System Headworks include:
- Ward Street Headworks located in Roxbury (256 MGD capacity)
- Columbus Park Headworks located in South Boston (182 MGD)
- Chelsea Creek Headworks located in Chelsea (350 MGD)
- Winthrop Terminal Headworks located at Deer Island (125 MGD)

North System Pump Stations include:
- Alewife Brook Pump Station (64 MGD capacity)
- Caruso (East Boston) Pump Station (110 MGD)
- DeLauri Pump Station (11 MGD)
- Allison Hayes (11 MGD)

The South System

MWRA's South System services an area of approximately 237 square miles to the south and southwest

[200] '*Appendix I: An Overview of the MWRA Sewerage System and Facilities*.' Available on MWRA website at http://www.mwra.state.ma.us/harbor/enquad/pdf/2001-04_overview.pdf

of Boston.[201] A 4.7 mile inter-island tunnel conveys wastewater from Nut Island for treatment at Deer Island Treatment Plant.

The South System serves the following communities:[202]

Table 35: MWRA South System Communities					
Ashland	Boston*	Braintree	Brookline*	Canton	Dedham
Framingham	Hingham	Holbrook	Milton*	Natick	Needham
Newton*	Norwood	Quincy	Randolph	Stoughton	Walpole
Wellesley	Westwood	Weymouth			
**community served by both north and south system*					

The South System includes seven pumping stations to move wastewater from low-lying areas to the Nut Island Headworks (the South System's only headworks facility, located in Quincy) for treatment.

South System Pump Stations include:

- Hingham Pump Station (16.5 MGD)
- Braintree-Weymouth Pump Station (60 MGD)
- Squantum Pump Station (12 MGD)
- Houghs Neck Lift Station (2.8 MGD)
- Neponset Pump Station (90 MGD)
- Framingham Pump Station (48 MGD)
- Quincy Pump Station (52 MGD)

Complete System

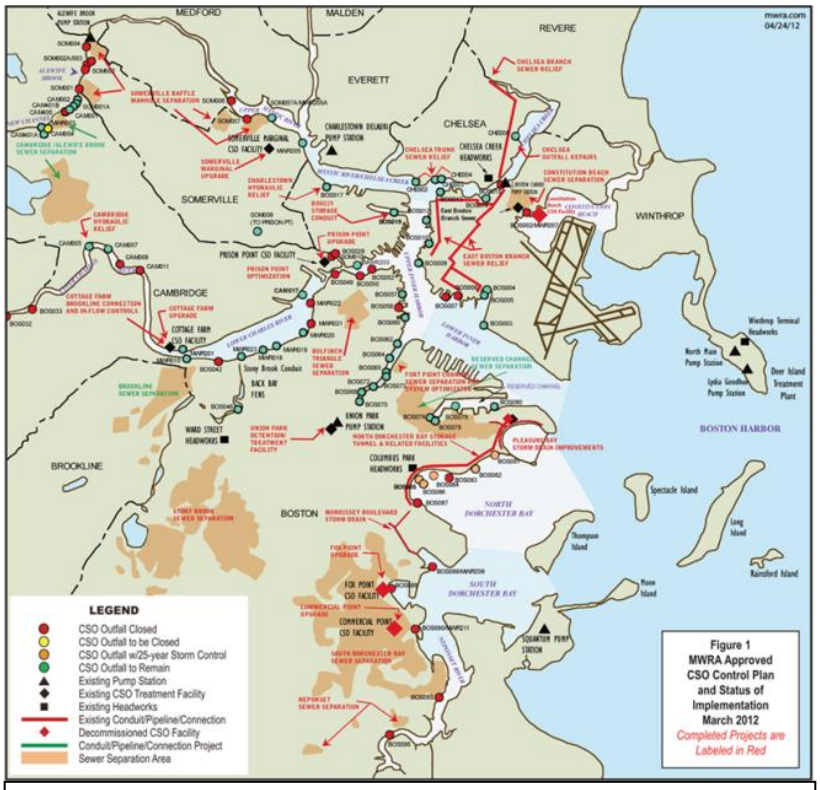
The combined MWRA system contains over 230 miles of interceptor sewers connecting to more than 5,400 miles of town and municipally-owned local sewers. Interceptor sewers pipe sewage from MWRA communities to one of MWRA's five headworks. From the headworks, pumps draw the sewage through deep-rock tunnels under the harbor to Deer Island where the sewage receives preliminary treatment - mud and sand are separated in a grit chamber, primary and secondary treatment. Deer Island is designed to handle a maximum of 1,270 million gallons per day (MGD): 910 MGD from the north system, and 360 MGD from the south system. The average combined treatment flow is 350 MGD, with a peak flow of 1.27 trillion gallons per day. The facility includes four permitted outfall pipes; however, only two are regularly in use, with the other two available for activation during high flow or emergency situations. All discharge flows into the Boston Harbor. Deer Island is in compliance with all federal and state environmental standards and is subject to a precedent-setting discharge permit issued by the EPA and the MA DEP.

MWRA's annual maintenance budget for just its wastewater treatment operation is $66.5 million for FY 2014.. This figure includes salaries, overtime and benefits, ongoing maintenance, chemicals, utilities,

[201] Ibid.
[202] Ibid.

staff trainings, and professional services, among other things.[203]

Presently, the MWRA wastewater service area includes 51 combined sewer overflow (CSO) outfalls, 46 of which discharge untreated combined flows into the Boston Harbor, Alewife Brook, Mystic River, Charles River, and Neponset River.[204] The number of outfalls is down from 84 in 1987, in accordance with MWRA's Long-Term CSO Control Plan, which anticipates the closing of one additional outfall by 2015. Combined sewer overflows occur during storm events when a combined sewer reaches capacity due to the influx of stormwater which may cause an "assault on (the state's) waterways."[205] In 2011, approximately 2.8 billion gallons of sewage water was released through CSO pipes throughout the state, untreated.[206] Within the MWRA district, untreated annual CSO discharge has been reduced from 3.3 billion gallons in 1988 to 0.5 billion gallons in 2012, 88% of which is treated at one of four CSO outfalls discharging from CSO treatment facilities (2 others were decommissioned in 2007 as part of the CSO Control Plan).[207]



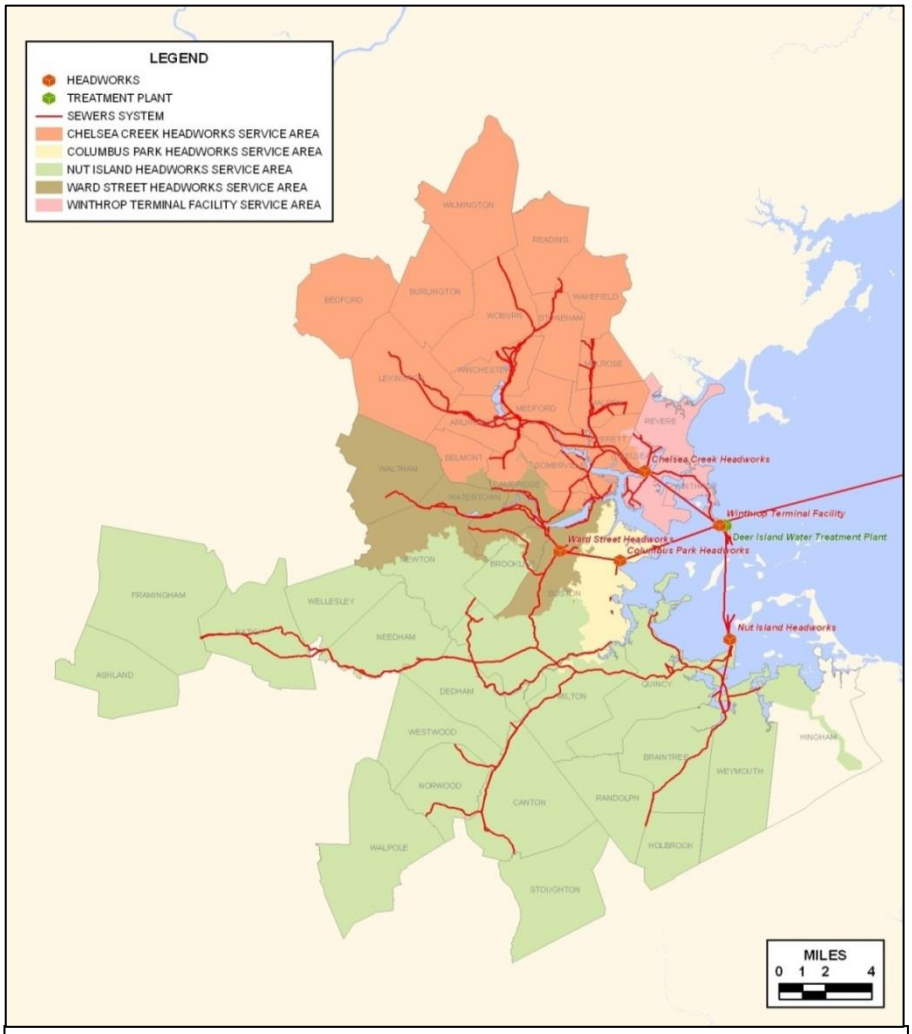
MWRA's CSO outfalls

CSO treatment facilities provide treatment that may include screening, disinfection / chlorination, and detention for 100% of volume in accordance with MWRA's National Pollutant Discharge Elimination System (NPDES) permitting process. In extreme storms, facility capacity can be exceeded causing untreated overflows at other CSO outfalls. MWRA's four CSO activation facilities include Cottage Farm and Prison Point in Cambridge, Somerville Marginal in Somerville, and Union Park in the South End, Boston.

[203] MWRA Fiscal Year 14 Proposed Budget available on MWRA webpage. Accessed September 12, 2013 at http://www.mwra.state.ma.us/finance/ceb/fy2014proposed/divisionsections.pdf.
[204] '*Combined Sewer Overflows*,' Available on MWRA website at http://www.mwra.state.ma.us/03sewer/html/sewcso.htm.
[205] New England Center for Investigative Reporting, Springfield Republican, April 28, 2013.
[206] Ibid.
[207] MWRA Combined Sewer Overflow Control Plan Annual Progress Report, 2012, p. 4.

MWRA Clinton Wastewater Treatment Plant

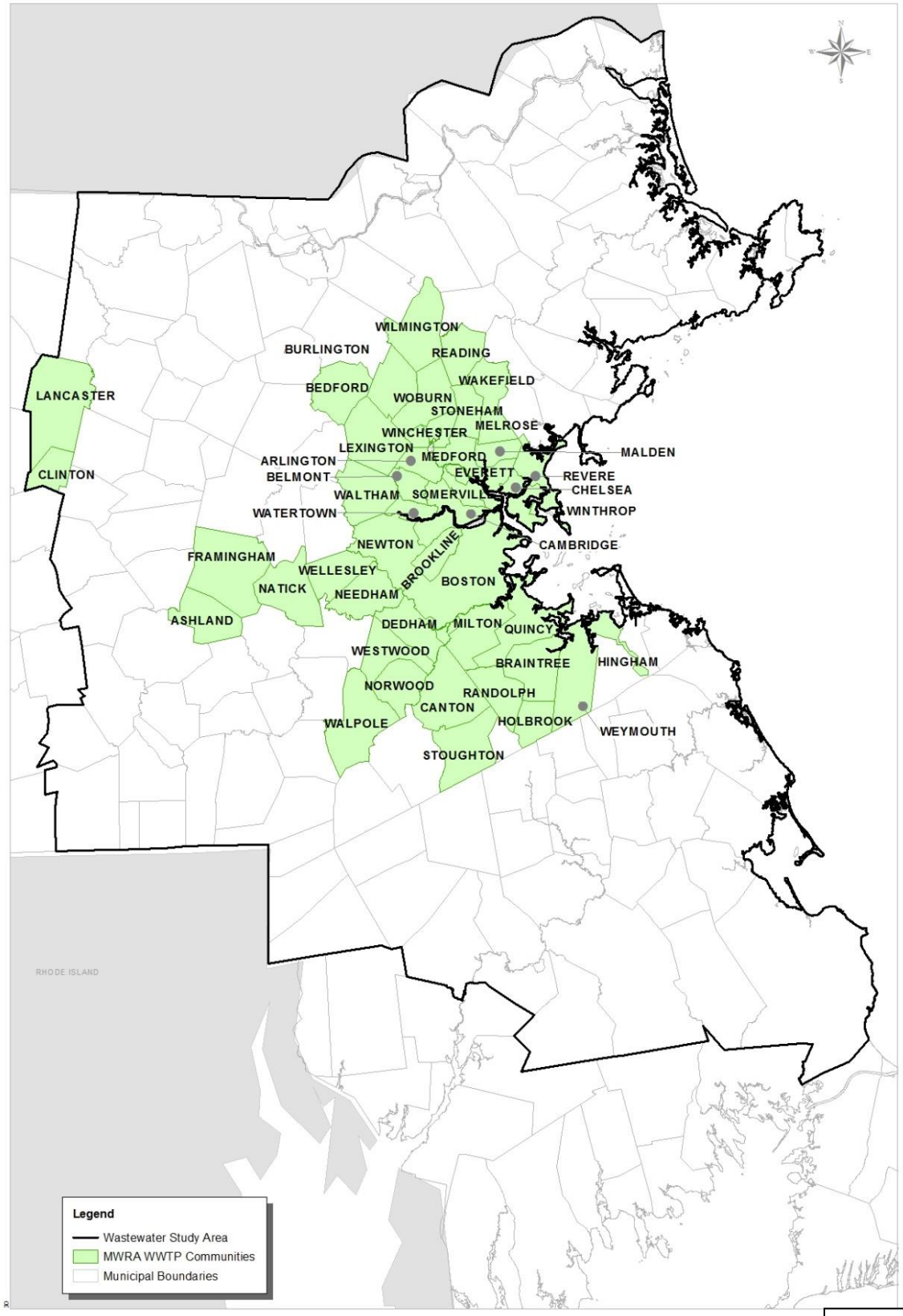
The MWRA serves the town of Clinton and the Lancaster Sewer District with wastewater treatment under special arrangements that originated when the Metropolitan District Commission (MDC) acquired land in Clinton to be flooded for the Wachusett Reservoir. In 1987, the MWRA assumed control of the Clinton WWTP which discharges treated wastewater into the South Nashua River below the Wachusett reservoir (the South Nashua River flows north from the reservoir). The town of Clinton and the Lancaster Sewer District own and operate the collection system, aside from approximately one mile of MWRA intercepting sewers that transport wastewater to the facility. After assuming control, MWRA constructed new primary, secondary, and advanced treatment facilities at the plant, which were completed in 1992. The Clinton Treatment Plant operates under a separate discharge permit from the Boston NPDES. Plant capacity is 3 MGD on average, with the capacity to process 6 MGD at peak.[208]



MWRA Wastewater Treatment System

[208] 'The Clinton Wastewater Treatment Plant,' at MWRA website. Available at http://www.mwra.state.ma.us/03sewer/html/clintonwwtp.htm

MWRA Wastewater Communities



Map 11

NON-MWRA WASTEWATER TREATMENT FACILITIES

Municipal Wastewater Treatment Facilities

Approximately 435 million gallons of wastewater is treated each day by non-MWRA state and federally permitted wastewater treatment facilities in Massachusetts[209], in addition to what is treated by MWRA at Deer Island. Within the Boston metropolitan area, over 60 communities are served all or in part by non-MWRA regional or municipal wastewater treatment plants, with some communities served by more than one plant. (It is not uncommon for communities served by a treatment facility to also have a portion of the community on septic.)

Each wastewater treatment facility that discharges directly from a point source into a receiving water body must obtain a National Pollutant Discharge Elimination System (NPDES) Water Permit issued by EPA New England. This includes the two MWRA facilities as well as the dozens of Boston area non-MWRA facilities. NPDES was created in 1972 as part of the Clean Water Act. The permit issuer determines the allowable volume of effluent that may be discharged without compromising water quality, specified as the maximum average monthly flow in millions of gallons/day. Total average permitted flow among all municipal plants serving Metro Boston communities is approximately 280MGD.[210] Actual average flow is almost 200MGD[211], with treated effluent discharged into various surface waters (rivers, coastal waters, streams, etc.). In addition to NPDES permitting, municipal wastewater management plans are subject to MEPA regulations, which guide the planning process with the goal of uncovering all direct and indirect environmental impacts of wastewater alternatives.

Metro-Boston's non-MWRA regional or multi-community wastewater treatment facilities include:

[209] Infrastructure Status Report: Massachusetts Wastewater Facilities, Massachusetts Infrastructure Investment Coalition, May 2007.
[210] Interviews with WWTP operators, and EPA NPDES permits.
[211] Ibid.

Table 36: Regional Wastewater Treatment Facilities	
TREATMENT FACILITY	**COMMUNITIES SERVED (entirely or in part)**
Attleboro Water Pollution Control Facility	Attleboro, Plainville
Brockton WWTP	Brockton, Abington, Whitman
Charles River Pollution Control District	Bellingham, Medway, Millis, Franklin
Greater Lawrence Sanitary District	Dracut, Lawrence, Andover, North Andover, Methuen
Haverhill WWTF	Haverhill, Groveland
Lowell WWTF	Lowell, Dracut, Chelmsford, Tyngsboro, Tewksbury
Lynn Regional WWTF	Lynn, Saugus, Swampscott, Nahant
Mansfield WWTP	Mansfield, Foxboro, Northborough
Marlborough West WWTP	Marlborough[212], Northborough
Marshfield WWTP	Marshfield, Duxbury
Medway WWTP	Medway, Franklin
Milford WWTP	Milford, Hopkinton, Hopedale
Newburyport WWTF	Newburyport, Newbury
Pepperell WWTF	Pepperell, Groton
Rockland WWTF	Rockland, Abington
South Essex Sewerage District System	Beverly, Danvers, Peabody, Salem, Marblehead
Taunton WWTF	Taunton, Dighton, Raynham, Norton
Westborough WWTP	Hopkinton, Shrewsbury, Westborough

Metro-Boston's non-MWRA single community wastewater treatment facilities include:

Table 37: Municipal Wastewater Treatment Facilities Serving Only One Community (entirely or in part)					
Amesbury	Athol	Ayer	Billerica	Bridgewater	Cohasset
Concord	Gloucester	Hopedale	Hopkinton	Hudson	Hull
Ipswich	Kingston	Manchester	Maynard	Medfield	Merrimac
Middleboro	No. Attleboro	Northbridge	Rockport	Salisbury	Scituate
Upton	Uxbridge				

Labor, electricity, operation of pumping stations, and plant system maintenance and repairs contribute to the cost of plant operation. Some plants are also responsible for the collection system (sewers, drain lines, manholes, etc.) as dictated by the city or town. The chart below provides an example of annual costs for operating a small, medium, and larger facility

[212] A portion of Marlborough is served by the Marlborough Easterly WWTP.

Table 38: Annual Municipal Operating Costs (Examples Only)			
Facility	**Amesbury WW Pollution Abatement Facility**	**Taunton WWTF**	**Lowell WWTF**
Permitted Flow	2.4MGD	8.4MGD	32.0MGD
FTEs	6	15 at plant; additional 5 to maintain sewer lines	48
Annual operating budget	$2.7 million	$2.5 mill (not including additional 5 'sewer' employees)	$10 million: incl.; maintenance of plant and collection system (sewers, drain lines, manholes, etc) 230 miles of sewer
Year built	1970s	1960s	Late 70s; went online in 1980
Cost to build	$3.5 million	N/A	CSO/pump stations /plant $130 million
Cost of recent renovations / upgrades	2003 - $8.6 million	1998 – most recent upgrade to add on basins, improving treatment, upgraded pump to increase capacity; $11.5 million; Decrease total nitrogen removal- imminent	Over $100 million to upgrade plant and in collection system.

Basic components of both large and small wastewater treatment plants include the sewer pipes necessary to collect the wastewater from homes and businesses and carry it to the plant, a primary treatment settling tank(s), and secondary tank(s). A minority of the state's treatment plants (18% based on population served vs. 37% of facilities nationwide[213]) also provide tertiary treatment; the process by which very fine particles, residual toxins, or high levels of nutrients like nitrogen and phosphorus are removed before waste is discharged.

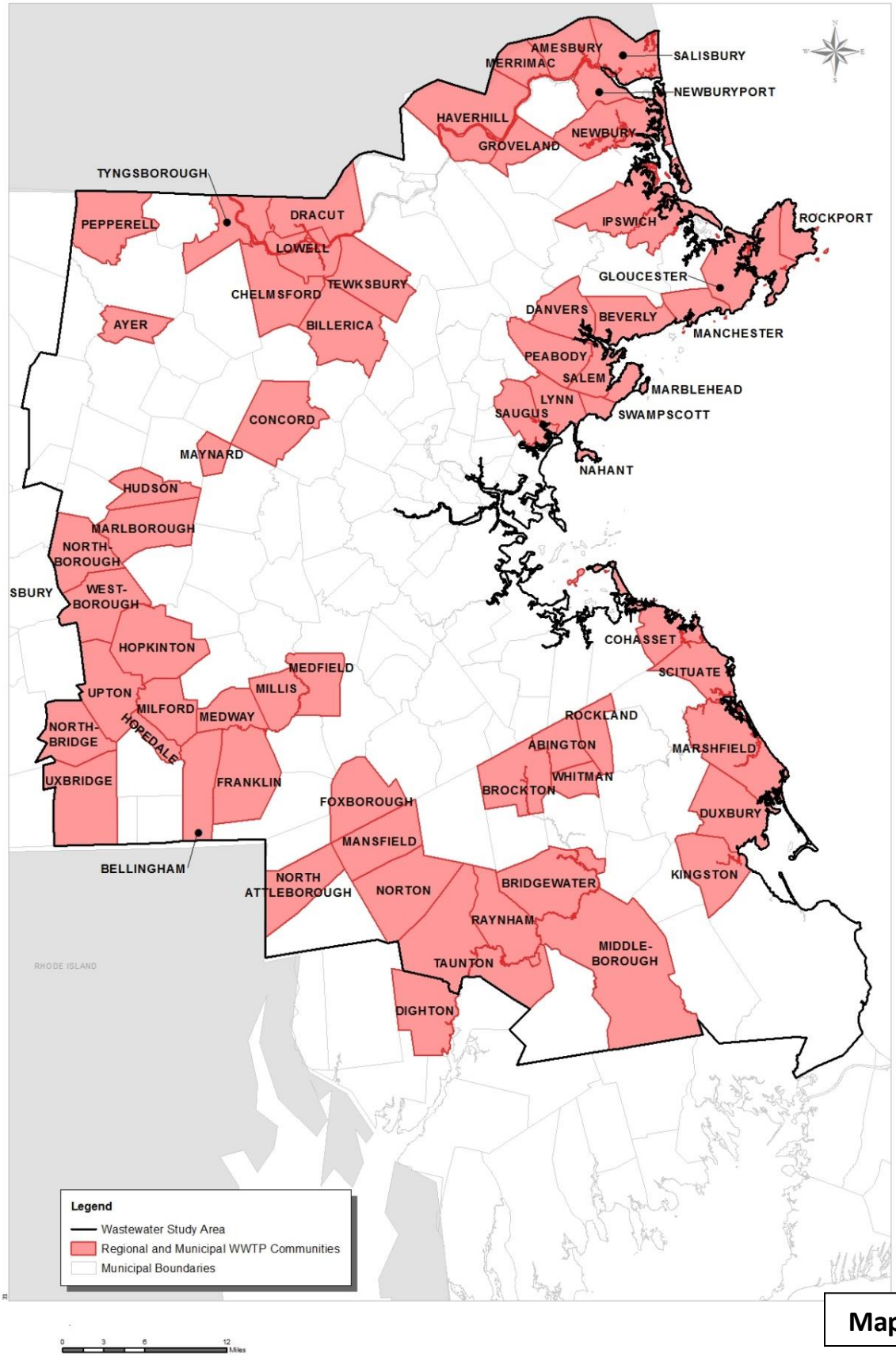
Wastewater Delivery System

In Massachusetts, installation of sewer pipes began in the late 1800s, with a second boom in the 1920s, a third after WWII, and a final thrust in the 70s and 80s. Presently, Massachusetts is home to over 20,000 miles of sewer pipe. The expected service life of a sewer pipe can range from 50-75 years, at which point pipe deterioration can cause cracks or loosen joints, allowing for seepage of sewage into the groundwater, and seepage of groundwater into the pipes, (inflow and infiltration) inflating the volume of sewage carried to plants which may cause undo strain on plant equipment and increase cost of operation.

Many of the state's treatment facilities were constructed in the 70s and 80s, when federal construction grant funding and low interest financing (available beginning in 1987 under the Clean Water State

[213] Infrastructure Status Report: Massachusetts Wastewater Facilities, Massachusetts Infrastructure Investment Coalition, May 2007. p.2.

Regional and Municipal WWTP Communities



Map 12

Revolving Fund – CWSRF) was widely available. The average life of a treatment plant is 30-40 years; however, service life is often shorter for plant equipment, ranging from 10-25 years.[214]

Municipalities, ultimately responsible for wastewater pollution control, vary in their approach to system upkeep, with some developing asset management programs that work to maximize the service life of pipes and plant equipment by using predictive and preventive maintenance techniques. Others correct problems as they arise, which can lead to a reduction in the service life of materials, and higher maintenance costs. CWSRF funding is still available and administered by the Massachusetts Water Pollution Abatement Trust; however, in recent years request for CWSRF funding was anywhere from 3 to 5 times greater than available funds.[215]

The attached table lists municipal treatment plants along with their permitted and average MGD flow, permit number, and receiving body of water.[216] The majority of plants are not operating at capacity based on average daily flow, though, wet weather events can affect facility functioning; whether altering speed of treatment, or resulting in sub-optimal wastewater treatment.[217] One recent extreme example occurred in Hull, MA earlier in 2013 when a high volume of wastewater caused by heavy rains and melting snow overwhelmed the town's wastewater treatment facility, causing the plant to go off-line for 2 ½ days. Roughly 10 million gallons[218] of raw sewage were diverted through temporary pumps and pipes and pumped into the ocean, and the town's three schools had to be closed. According to the MWRA, during peak times (typically occurring in the spring), I/I can represent 50% - 55% of flow to treatment facilities.

Table 39: Wastewater Discharge as Percentage of Permitted

Facility	Permit #	Permitted MGD	Average Actual MGD	Actual MGD as a % of Permitted	Receiving water
Amesbury WW pollution abatement facility	MA0101745	2.40	1.60	67%	Merrimac River
Athol WWTP	MA0100005	1.75	0.75	43%	Millers River
Attleboro Water Pollution Control Facility	MA0100595	8.60	3.75	44%	Ten Mile River
Ayer WWTP	MA0100013	1.79	1.20	67%	Nashua River
Billerica WWTP	MA0101711	5.50	3.00	55%	Concord River
Bridgewater WWTP	MA0100641	1.44	1.00	69%	Town River
Brockton WWTP	MA0101010	18.00	14.80	82%	Salisbury plain
Charles River Pollution Control District	MA0102598	5.70	4.65	82%	Charles River
Cohasset WWTP	MA0100285	0.72	0.25	35%	Cohasset Harbor
Concord Wastewater Treatment Facility	MA0100668	1.20	1.00	83%	Concord River
Gloucester WW Pollution Control Facility	MA0100625	5.15	3.69	72%	Gloucester Harbor (Atlantic Ocean)
Greater Lawrence Sanitary District	MA0100447	52.00	30.00	58%	Merrimack River, Spicket River

[214] Ibid. p. 1.
[215] Ibid. p. 3.
[216] Data on WWTP average flow collected in phone interviews with municipal plants by Shelley Ayervais, May 2013. Data on flow capacity, county, permit # and receiving water collected from US EPA Discharge to River Permits, at EPA website. Available at http://www.epa.gov/region1/npdes/permits_listing_ma.html.
[217] Data collected in phone interviews with municipal plants by Shelley Ayervais, May 2013.
[218] Lauren Dezenski, "Hull water treatment plant reopened, ending dumping of raw sewage into the Atlantic Ocean," The Boston Globe, March 4, 2013. Retrieved June 14, 2013 at http://www.boston.com/metrodesk/2013/03/04/hull-water-treatment-plant-reopened-ending-dumping-raw-sewage-into-the-atlantic-ocean/pd4K8QUr32l55OnV7pZeQI/story.html.

Table 39: Wastewater Discharge as Percentage of Permitted					
Facility	**Permit #**	**Permitted MGD**	**Average Actual MGD**	**Actual MGD as a % of Permitted**	**Receiving water**
Haverhill WWTF	MA0101621	18.10	10.00	55%	Merrimac River & Little River
Hopedale WWTP	MA0102202	0.59			Mill River
Hopkinton WWTP		0.10	0.08	80%	Leach field discharge
Hudson Sewage Treatment Plant	MA0101788	2.65			Assabet River
Hull WW Pollution Control Facility	MA0101231	3.07	1.60	52%	Atlantic Ocean/Hingham Bay
Ipswich WWTP	MA0100609	1.80	1.20	67%	Greenwood Creek (tributary of Ipswich River)
Kingston WWTF	SE 659-3	0.38	0.30	80%	Leaching field under Indian Pond Country Club
Lowell WWTF	MA0100633	32.00	25.00	78%	Merrimack River, Concord River, Beaver Brook
Lynn Regional WWTF	MA0100552	25.80	22.81	88%	Lynn Harbor
Manchester WWTF	MA0100871	1.20	0.30	25%	Manchester Bay
Mansfield WWTP	MA0101702	3.14	2.10	67%	Three Mile River
Marlborough Easterly WWTP	MA0100498	5.50	3.50	64%	Hop Brook to Sudbury River
Marlborough West WWTP	MA0100480	2.89	2.25	78%	Assabet River
Marshfield WWTP	MA0101737	2.10	1.25	60%	Massachusetts Bay
Maynard WWTP	MA0101001	1.45	0.80	55%	Assabet River
Medfield WWTF	MA0100978	1.52	0.80	53%	Charles River
Merrimac WWTF	MA0101150	0.45	0.39	87%	Merrimac River
Middleborough WWTP	MA0101591	2.16	1.25	58%	Nemasket to Mount Hope Bay
Milford	MA0100579	4.30	3.50	81%	Charles River
Newburyport WWTF	MA0101427	3.40	1.77	52%	Tidal Creek, Merimack River Estuary
North Attleboro WWTP	MA0101036	4.60	3.10	67%	Ten Mile River
Northbridge WWTP	MA0100722	1.80	0.95	53%	Unnamed brook to Blackstone River
Pepperhill WWTP	MA0100064	1.10	0.51	46%	Nashua River
Rockland WWTF	MA0101923	2.50	2.30	92%	French Stream
Rockport WWTF	MA0100145	0.80	0.70	88%	Sandy Bay (Atlantic Ocean)
Salisbury WWTF	MA0102873	1.30	0.70	54%	Tidal creek to Merrimack River
Scituate WW Pollution Control Facility	MA0102695	1.60	1.00	63%	Tidal ditch flows into Herring River
South Essex Sewerage District System	MA0100501	29.71	20.00	67%	Salem Harbor
Taunton WWTF	MA0100897	8.40	6.00	71%	Taunton River
Upton WWTP	MA0100196	0.40	0.26	65%	Unnamed stream to West River to Blackstone
Uxbridge WWTF	MA0102440	2.48	1.00	40%	Blackstone River
Wayland WWTP	MA0039853	0.05	0.02	38%	Sudbury River, or wetlands adjacent to
Westborough WWTP	MA0100412	7.70	5.40	70%	Assabet River

No Public Wastewater Treatment System

Homes and businesses not connected to a sewer system must use septic systems or cesspools to manage wastewater. Both are regulated by the DEP and local boards of health. Title V (Massachusetts Septic System Inspection Regulation, 310-CMR-15.0) requires system inspection prior to home/facility enlargement, or the sale or transfer of ownership. If a system fails, the present owner is required to repair or replace the system within 2 years regardless of whether the property is sold. Financial assistance is available to homeowners in the form of a Title V tax credit, (maximum credit of $6,000 over 4 years).

A septic system is a self-contained, underground wastewater treatment system comprised of a water-tight tank usually made of concrete or fiberglass, with an inlet and outlet pipe; and a drainfield, a.k.a. "leach field", "disposal field", or "soil absorption system." Facilities may share septic systems. In a septic system, a sewer pipe carries wastewater from the home or facility to the tank, where the wastewater naturally settles overtime into scum (the top layer, containing solids lighter than water – such as oil and grease), sludge (the bottom layer, containing solids heavier than water), and a middle layer of partially clarified water. Naturally occurring bacteria in the tank slowly break down the scum and sludge until it is pumped out of the tank. The clarified water flows from the tank and is distributed into a drainfield; a series of trenches or a bed lined with gravel or course sand acting as a biological filter and buried one to three feet below the ground surface. The pumping of private residential septic systems is recommended every 1-3 years depending on usage, and typically costs between $150 and $250. Private system replacement could cost up to $40,000.[219]

A cesspool is a pit which acts as both a settling chamber for solids and leaching system for liquids. Title V only requires replacement of cesspools for those that are posing a threat to public health driven by operating failure or location near to drinking supplies.

The following communities are presently without any publicly managed residential wastewater treatment; though in some communities, treatment plants exist for specific industrial facilities.

Table 40: Communities without Public Wastewater Treatment Facilities

Acton	Berlin	Blackstone	Bolton	Boxborough	Boxford
Carlisle	Carver	Dover	Dunstable	E Bridgewater	Easton
Essex	Georgetown	Groton	Halifax	Hamilton	Hanover
Harvard	Holliston	Lakeville	Lincoln	Littleton	Lynnfield
Mendon	Middleton	Millville	Norfolk	N Reading	Norwell
Pembroke	Plymouth	Plympton	Rowley	Sharon	Sherborn
Shirley	Southborough	Stow	Sudbury	Topsfield	Wenham
W Bridgewater	W Newbury	Westford	Weston	Wrentham	

Treatment plants serving non-residential facilities (such as commercial, industrial, or correctional facilities) operate within some of these communities in accordance with EPA discharge permits.

Within rural communities where homes and business are more widely-spaced, private systems may be more economical than sewer centralized sewer systems; however, similar to treatment facilities, capacity is not infinite.

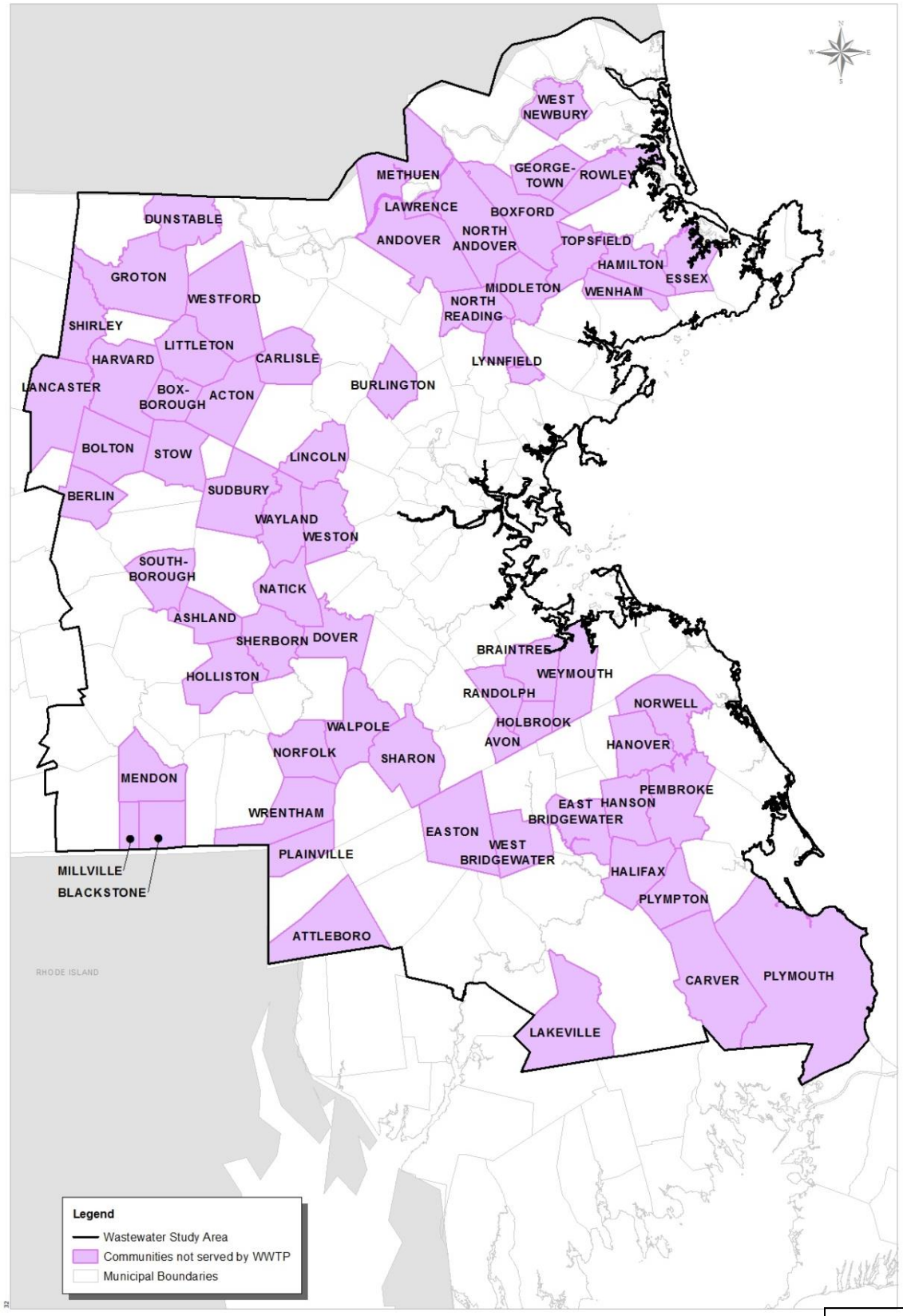
One community presently operating entirely on septic and dealing with capacity issues is the Town of Hamilton. Hamilton is a community of 7,758 residents[220]; a population that increased by 6.5% since 1990. [221] Hamilton is situated on 15 square miles, with no manufacturing industry or industrial-zoned land in the town. Still, in 1980, a town-commissioned study exploring downtown development recommended the town invest in a WWTF. More than two decades later, in the absence of any action,

[219] MassDEP, Septic System Maintenance: FAQs
[220] U.S. Census Bureau, 2010 Federal Census
[221] http://www.hamiltonma.gov/Pages/HamiltonMA_BComm/HousingPartnership/HousingPlanNov07.pdf

the town's 2004 Master Plan still sites wastewater management as a "long-standing need (and…) one of Downtown Hamilton's development constraints."[222] There is no room left for wastewater holding tanks within the downtown area.

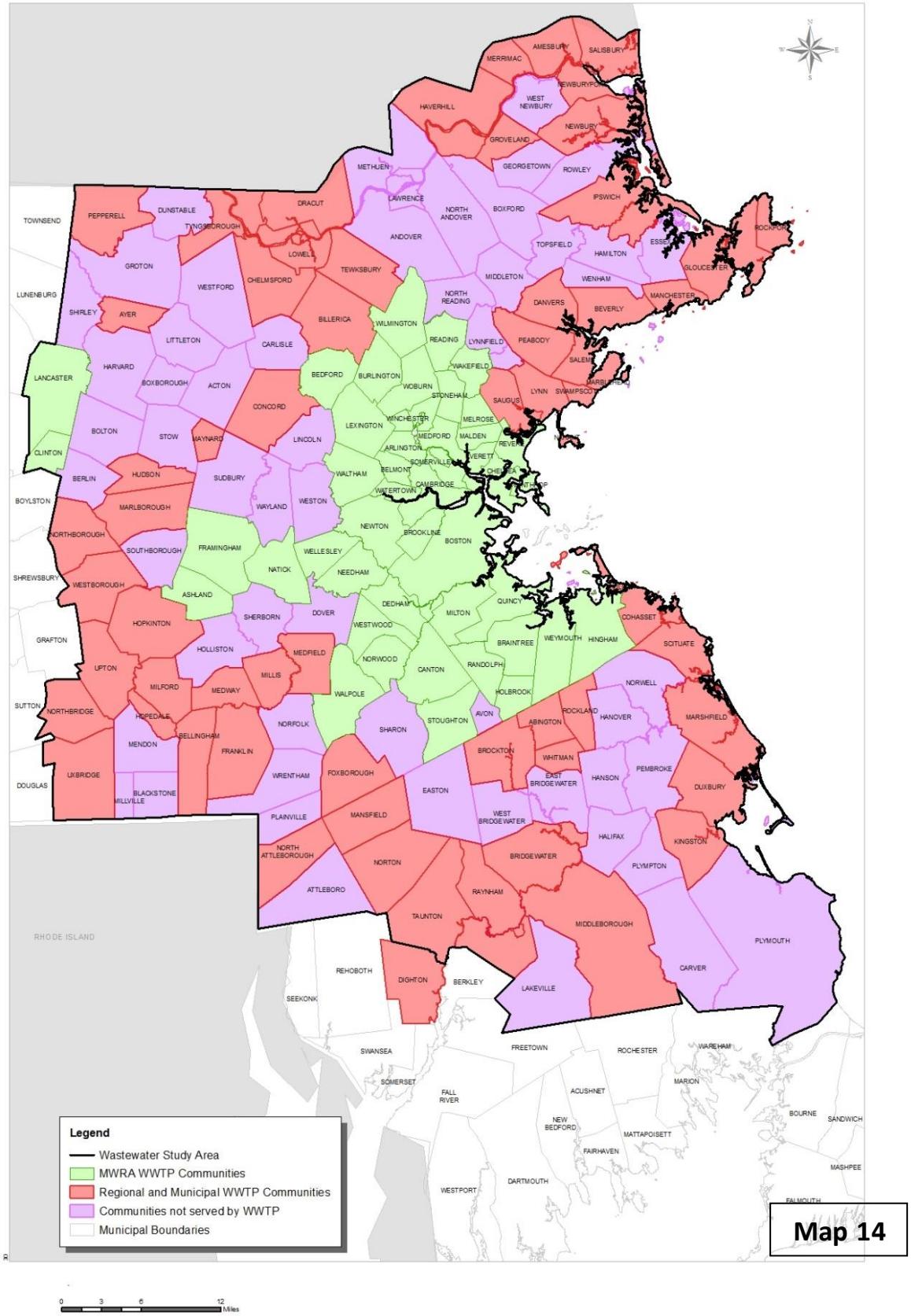
[222] Hamilton Master Plan, Agriculture and Economic Development, 2004. P.61. Available at http://www.hamiltonma.gov/pages/HamiltonMA_Planning/masterplan/ch3.pdf.

Communities not served by WWTP



Map 13

Communities by Type of Wastewater Treatment System (2013)



CURRENT AND FUTURE CHALLENGES IN WASTEWATER TREATMENT

Although each wastewater treatment system faces its own unique challenges, systems across Massachusetts are currently faced with several substantial overarching challenges including:

- Aging wastewater treatment plants;
- Aged or inadequate sewer lines;
- Capacity limitations that threaten to stifle regional growth;
- More stringent EPA regulations; and,
- Diminished funding resources.

Aging Infrastructure

Wastewater Treatment Plants

Many Boston area wastewater treatment plants (WWTPs) were first built in the 1970-80s, including Deer Island, driven by major federal investments for the construction of wastewater treatment facilities authorized in the federal Clean Water Act of 1972. Since then, authorizations and appropriations under the Act have totaled $65 billion and $85 billion nationwide, respectively, representing 25%-30% of the total funds appropriated to the EPA during this time frame[223]. In Massachusetts, total federal investment in wastewater infrastructure was over $3.5 billion.[224] As WWTPs approach their 30- or 40-year mark, the end of their effective service life draws near[225]. The expected life span for most equipment within the facilities (e.g., pumps, valves, electrical equipment, computer systems, etc.), is even shorter, varying from 10-25 years.[226] Replacement of aerators, digesters, settling and clarifying tanks represent significant investments necessary to maintain a facility.[227] Although recent investments have been made at many area plants, many more plants remain in need. WWTPs that serve only one community are owned and often operated by that municipality; they rely on local user fees and tax revenue to pay for upgrades, plant operation, and maintenance. Communities served by regional plants contribute to capital improvements, maintenance, and operations based upon their actual flow (usage), and/or loading (e.g., make up of wastewater), and/or maximum flow capacity.

When necessary maintenance is not completed, failures become more likely, causing emergency situations that can be harmful to the local economy, public health, and the environment. Detailed

[223] Claudia Copeland, '*Water Infrastructure Financing: History of EPA Appropriations*,' Congressional Research Service, April 5, 2012.
[224] Drinking Water SRF Program Information for the State of Massachusetts, November 2, 2012, and federal grant data provided to Shelley Ayervais by Steve McCurdy, MassDEP Director of Community Services, July 31, 2013.
[225] Massachusetts Infrastructure Investment Coalition, *Infrastructure Status Report: Massachusetts Wastewater Facilities*, May 2007.
[226] Ibid.
[227] John Loughlin, Superintendent of Rockland, MA, phone interview with Shelley Ayervais, July 25, 2013.

earlier, the wastewater treatment plant closure in the Town of Hull in winter 2013 (due to a clogged pump caused by a 2x4 which made it through a screening process) during heavy rains exemplifies the price a community can pay when systems malfunction. To date, Hull has had to borrow approximately $2.4 million to cover costs related to the disaster.[228] In addition, schools were closed and approximately 10 million gallons of raw sewage flowed into the Atlantic. While the incident was a freak occurrence, staff are currently investigating how to modify the screening process to prevent future catastrophes.

Some communities have developed asset management programs to proactively plan for required maintenance, maximizing the service life of sewer pipes and plant equipment. However, others currently operate with no such plan and risk facing emergency situations that are often more costly than scheduled maintenance. The Town of Chatham instituted a 20-year asset management plan to identify system work necessary to comply with town planning efforts and environmental regulations. Working together, six entities (i.e., a wastewater planning technical advisory group, citizen's advisory group, town manager, town finance director, board of selectmen, and MA Estuary Project) calculated a total cost of $210 million for plant upgrades and expansion, and collection system expansion; and identified financing strategies include securing financial commitments from the USDA rural development program and state revolving fund, utilizing federal stimulus funds, and paying the town's General Fund.

Municipal or regional plant renovations can total upwards of $100 million, while the cost of constructing a new plant is estimated at $17 million per MGD of capacity, with operations and maintenance totaling another $2 million annually per MGD of actual flow.[229] When major upgrade or construction of a new facility, there needs to be a plan in place for sequencing events so as to be most effective and cost efficient and educating plant operators on operational adjustments. Care must also be paid to ensure that the system continues functioning during construction, or alternative treatment must be provided.

On a grander scale, MWRA's Deer Island Treatment Plant (DITP) alone contains over 70,000 equipment and instrumental components, requiring regularly scheduled maintenance and replacement cycles, which will become costlier as the facility ages. According to MWRA's *Wastewater Master Plan (2006)*, MWRA's wastewater needs will total $2 billion for projects between FY07 and FY48[230], with over 70% of expenditures to rehabilitate or replace facility equipment and structural components at the Deer Island Treatment Plant.[231] (Note that the 2006 Master Plan includes a budget of only $461 million to implement the Long-Term CSO Plan; however, actual spending will exceed $800 million.)

Sanitary Sewer System

> "Our aging water infrastructure system suffers from a lack of investment, delayed maintenance and insufficient resources"[232]

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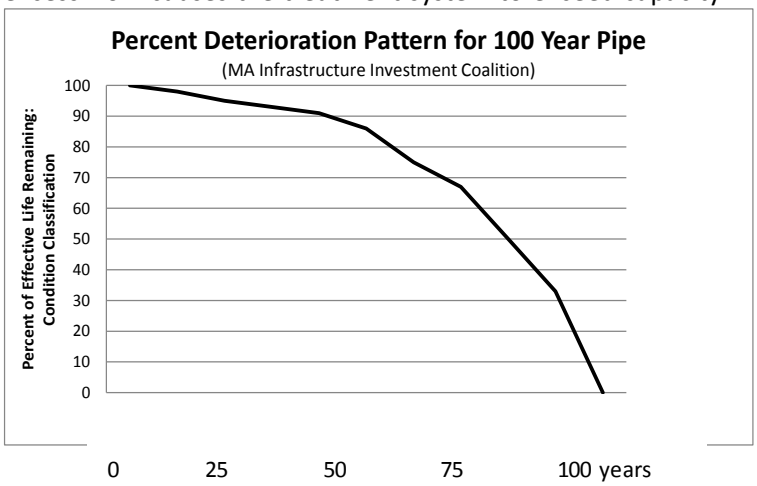
[228] Catherine Goldhammer, *'Errant 2x4 caused multi-million-dollar sewer plant damage'* Hull Times, July 25, 2013. Retrieved on August 2, 2013.
[229] '*Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod'*, Barnstable County Wastewater Cost Task Force, April, 2010. p. 2.
[230] MWRA 2006 Master Plan, p. 3.
[231] Ibid. p. 4.
[232] Water Infrastructure Finance Commission, 2007, p. 3.

Since portions of Greater Boston's sewer system (i.e., system of pipes through which wastewater travels), were installed as long ago as the late 1800s, miles of pipe in the region are presently beyond their effective service life, estimated at 50-75 years depending on the piping material, soil conditions, and character of wastewater flowing through them.[233] The chart below illustrates how quickly pipes can deteriorate when left to perform beyond estimated service life without repair or replacement.

Deteriorating pipes are at best an expense to wastewater treatment facilities and at worst a threat to public health, recreation and tourism, and the economy. Cracks and leaks in the pipes allow rainwater (inflow) and groundwater (infiltration) to enter the sewer system through drains, downspouts, pumps and streams. "I/I" can dramatically increase wastewater flow, contributing to combined sewer overflows (CSO) or sanitary sewer overflows (SSO), as excess flow causes the treatment system to exceed capacity and ultimately release combined stormwater and untreated wastewater. According the MWRA, I/I represents 50% of DITP's annual average flow.[234] Communities are typically responsible for maintaining their own sewer distribution systems; however, the MWRA is responsible for improving portions of some systems as part of its CSO control plan.



Combined Sewer Systems

Communities with combined sewer systems are required to implement mitigation measures as a component of the National Pollutant Discharge Elimination System (NPDES) permitting process. CSO mitigation measures include infrastructure upgrades to increase system capacity (e.g., storage) and stormwater management to reduce the volume of runoff entering CSSs. Communities must also draft a Long-Term Control Plan (LTCP) to ultimately bring the community in compliance with the requirements of the Clean Water Act.

Infrastructure investments made to implement LTCPs are expected to have life expectancies of several decades, and the costs will be considerable. While total expenditures incurred by municipalities engaged in CSO control is unknown, when the U.S. EPA compiled expenditures for 48 communities, roughly 6% of the nation's total, they found expenditures totaling $6 billion and ranging from $134,000 to $2.2 billion per community.[235] The U.S. EPA estimates that the nation capital costs of future CSO control over the next 20 years will exceed $50 billion.[236]

Whether CSO separation makes sense depends on existing conditions including: whether most sewers

[233] Massachusetts Infrastructure Investment Coalition, *Infrastructure Status Report: Massachusetts Wastewater Facilities*, May 2007.
[234] David Kubiak, MWRA, Phone interview with Shelley Ayervais, August 2, 2013.
[235] 'A Screening Assessment of the Potential Impacts of Climate Change on Combined Sewer Overflows (CSO) Mitigation in the Great Lakes and New England Region, U.S. EPA, February, 2008. p. 10.
[236] Ibid. p. 10.

are already separated, siting constraints, whether other CSO strategies are feasible/permitted, whether other infrastructure improvements are required, and current utilization of the combined system. To separate a system, existing pipes are used for either sanitary flow or stormwater, depending on diameter and slope, and new storm or sanitary sewers are installed to operate in parallel. Costs of sewer separation projects included in MWRA's CSO control plan have totaled $44 million (Stony Brook Sewer Separation) and $119 million (South Dorchester Bay Sewer Separation).[237] Potential negative impacts from separating systems include the release of additional loads of stormwater pollutants into receiving waters, roadway disruption, and the need to disconnect private stormwater drainage structures, sump pumps and roof footer drains. Boston, Cambridge, Chelsea, and Somerville presently are served in part by combined sewers and they are grappling with the challenges through MWRA and municipal efforts.

The City of Gloucester was recently been disrupted by I/I. In June 2013, beach closures were required when a CSO event that overwhelmed the system with stormwater caused the release of the stormwater and untreated sewage into the harbor. Under prior state and federal mandates, the City has been addressing the issue of CSOs, planning for a $40 million project to expand the system's capacity. The community is served by a municipal WWTP that went online in 1984 after Gloucester was sued by the U.S. EPA and MDEP.

Table 41: CSO Permittees in MA

NPDES Permit No.	Region/District
MA0101192	BOSTON WATER & SEWER COMMISSION
MA0101974	CAMBRIDGE, CITY OF
MA0101877	CHELSEA, CITY OF
MA0101508	CHICOPEE WPC
MA0100986	EAST FITCHBURG WWTF
MA0100382	FALL RIVER WWTP
MA0100625	GLOUCESTER
MA0100447	GREATER LAWRENCE SANITARY DISTRICT
MA0101621	HAVERHILL WPAF
MA0101630	HOLYOKE WPCF
MA0100633	LOWELL REGION W&WW UTILITY
MA0100552	LYNN REGIONAL WPCF
MA0100137	MONTAGUE WPCF
MA0102351	MWRA
MA0100781	NEW BEDFORD WWTF
MA0101168	PALMER WPCF
MA0101982	SOMERVILLE, CITY OF
MA0100455	SOUTH HADLEY WWTP
MA0103331	SPRINGFIELD, CITY OF
MA0100897	TAUNTON WWTP
MA0102997	WORCESTER, CITY OF

In 1994, mandated by a 1987 court order, the MWRA drafted a CSO Control Plan to address the discharges from all CSO's connected to the their sewer system, including outfalls owned by member communities. The plan will reduce annual overflow volume from 3.3 billion gallons (in 1988) to 0.1

[237] MWRA Combined Sewer Overflow Control Plan: Annual Progress Report 2011, prepared March, 2012, p. 54.

billion gallons (by 2016), and will cost an estimated $867 million, more than double the initial estimates, which anticipated in MWRA's 2006 Master Plan. The MWRA, funded by its ratepayers, is responsible for covering all planning and project costs and does so by floating its own bonds or taking advantage of low interest financing available through the State Revolving Fund. Thirty-one of the 35 planned projects, which include sewer separation, existing CSO treatment facility upgrades, CSO consolidation/storage conduits, new CSO treatment facility construction, relief sewers, localized hydraulic relief, outfall repair, region wide floatables control, and system optimization, have been completed.[238]

One of MWRA's CSO projects, the South Boston CSO Storage Tunnel project, including construction of the North Dorchester Bay CSO Storage Tunnel (a 10,832 foot long 17-foot-diameter combined-sewer overflow tunnel) and related facilities constructed in South Boston came on line in May 2011, at a capital cost of $237 million. The tunnel nearly eliminates CSOs and separate stormwater discharge events into North Dorchester Bay, making the beaches of South Boston among the cleanest in the nation by protecting them from large volumes of bacteria previously released during CSO events.[239]

According to Save the Harbor Save the Bay, a non-profit public interest advocacy organization, "The North Dorchester CSO Tunnel Project restores critical recreational opportunities to the residents of South Boston and Dorchester - and to the more than 1 million people who live within a short commute of these important public swimming beaches. (The Project) provides important environmental benefits to the marine environment at a substantial savings of more than $100 million to the region's ratepayers over the previous proposed solutions."[240] In 2011 and 2012 respectively, swimming was prohibited on only 4 and 3 days (due to unknown causes of bacteria), as compared to an average of 17 days annually from 2008-2010.

Separated Sewer Systems

Overflows can also be problematic in communities served by separated systems (i.e., where sewage is separated from stormwater), as stormwater can still enter an older or unmaintained sanitary sewer line via I/I, thereby sending excess water to a plant for treatment. Two issues stemming from an aging system caused the City of Revere (an MWRA sewer customer) to come into violation of the Clean Water Act in 2010. First, Revere had been discharging storm drain overflows (which often contained sewage "leaked into the stormwater system due to weaknesses in the drainage pipes"[241]) without an NPDES permit. Second, the City experienced hundreds (over 700 since 2000) of sewer blockages or capacity limitations that "resulted in basement backups in its wastewater collection system and….(on over 50 occasions) surcharges that discharged raw sewage to surface waters."[242] The 2010 Consent Decree mandated that the City detect and eliminate illegal wastewater overflows coming from its sewer and stormwater systems over the next 10 years. Cost for targeting these sources of I/I are expected to total

[238] MWRA CSO Control Plan Annual Progress Report 2005, p.3.
[239] "*The Cleanest Urban Beaches In America*," Accessed on August 25, 2013 on the Save the Harbor Save the Bay website at http://www.savetheharbor.org/splash/summer-2011/articles/cleanest-urban-beaches-america.html
[240] Ibid.
[241] "*Council approves funds for sewer and drainage work*." Revere News, July 25, 2102
[242] City of Revere, MA Clean Water Act Settlement, EPA, Retrieved August 8, 2013 at http://www.epa.gov/compliance/resources/cases/civil/cwa/cityofrevere.html.

more than $100 million.[243] The City has issued bonds for $50 million in repairs over a 10 year period and is trying to get funding from MWRA's Local Water System Assistance Program (LWSAP), though less than $1 million of the LWSAP's $6.4 million allocation for Revere remains available. Most recently, in FY13, the Revere City Council approved $7.55 million in CWSRF (Clean Water State Revolving Fund) loans to help pay for continued work to improve the City's sewage and drainage systems.[244]

Mayor Rizzo hopes to extend the time deadline by approaching the federal government to explain that the shorter time frame poses too much of a financial burden. Meanwhile, user rates continue to rise, up by 6.19% for residential and 9.85% for commercial users in the past year[245], to help offset municipal costs. Overall, the required work will replace 98 miles of sewer pipe, ultimately removing sources of stormwater from its sewage system, and reducing discharges of untreated sewage to rivers and their tributaries that flow into Boston Harbor and Mass Bay. [246]

Fixing Broken Pipelines

"In 2011, approximately 2.8 billion gallons of sewage water spilled through 181 pipes throughout (Massachusetts),"[247] and public swimming beaches were closed 915 times.[248] While conditions have improved in great strides since passage of the Clean Water Act, according to Denny Dart, Chief of Water Enforcement for the New England Region, "there is still much to do… In New England, where the pipes are a century old, it's time to replace much of it."[249] The MWRA reported in their 2006 Master Plan that 18 miles of their 240 miles of gravity sewer interceptors are in need of repair and replacement, scheduled in MWRA's Capital Improvement Plan.[250]

Several options exist for pipe repair or replacement. Cast-in-place pipelining (CIPP) and sliplining are less intrusive repair strategies that do not involve excavation. Slip lining may provide a life span near that of a new pipe (50-100 years), while CIPP can range from 25-50 years. Chemical grouting of joints provides a shorter-term solution that may last 10-20 years.[251] Pipe bursting is a replacement strategy whereby pipes are replaced via insertion and receiving pits rather than conventional trenches. These solutions are often less expensive, saving 10% - 40%, as compared to the conventional 'dig and replace' in urban areas where traffic, utilities, slow construction, railroad crossings, etc., increase project costs. However, dig and replace may be a most cost-effective solution where trench digging is not an issue, or if there are a lot of service connections to make. Regardless of chosen solution, bypass pumping of existing flows can be a costly challenge. Cost for replacing or repairing larger sewer pipes (like MWRAs) is estimated at

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[243] "*Mayor Rizzo to hold a public meeting on ongoing water and sewer infrastructure improvements*," City of Revere, May 7, 2013. Available at http://www.revere.org/news/post/mayor-rizzo-to-hold-a-public-meeting-on-ongoing-water-and-sewer-infrastructure-improvements.
[244] "*Council Approves funds for sewer and drainage work*," Revere News, July 25, 2012. Accessed on August 29, 2013 at http://advocatenews.net/news/council-approves-funds-sewer-drainage-work/1639/.
[245] *"Life in the MWRA Water District*," Revere News, June 13, 2013.
[246] EPA Settlement with Revere
[247] Doug Struck, New England Center for Investigative Reporting, Springfield Republican, April 28, 2013.
[248] Ibid.
[249] Ibid.
[250] MWRA 2006 Master Plan
[251] Carl Leone, Senior Program Manager, MWRA Community Support Program, Email sent to Shelley Ayervais July 17, 2013.

$1,000 to $2,000 per foot.

System Capacity

While oversizing a wastewater treatment facility beyond what it can be used for in the near future is not an efficient use of public funds, undersized facilities can adversely impact plans for economic development. Given the time needed to design, fund, and construct new or expanded facilities, if economic development plans are not taken into account early, new construction can be impacted for long periods of time.

Wastewater Treatment Capacity Today

> *"The state faces critical environmental or growth issues that may require new infrastructure or a new paradigm for water, wastewater, and stormwater services."*[252]

MWRA's Deer Island treatment plant is poised to handle projected population and employment growth in the next decades, with plant capacity of 1.3 billion GPD, permitted average daily flow of 436 MGD, and current actual 5 year average flow (2012) of 342 MGD.[253] In their 2006 Master Plan, the MWRA projected a total increase of 4%, or 14MGD, in wastewater flow between 2000 and 2030.[254] Across the state, most municipal and regional WWTPs appear equipped to accommodate future growth. Importantly, the amount of available capacity used by municipal plants is between 63% (mean) and 67% (median), meaning that flow could increase by over one-third and they would still have additional capacity remaining.[255] However, at four Massachusetts wastewater treatment plants, current demand for wastewater processing exceeds 85% of permissible average flow. These include facilities in Concord, Lynn, Marlborough, and Rockland.

Concord's WWTP, which provides secondary treatment to approximately 30% of the town's developed parcels, was completed in the mid-1980s and funded predominantly by state and federal funds (90% of total cost). In 1999, the EPA required the Town to develop a wastewater management program (CWMP) in response to reported average 12-month flows that exceeded 80% of the plant's permitted capacity of 1.2MGD. Despite best efforts, as of 2007 the Town anticipated that projected flows from current and future sewered properties would exceed permitted flow capacity, and wastewater treatment has been named the #1 constraint for town growth. While a consent order has not been issued, restaurants cannot add seats, downtown growth is stunted, and smart growth efforts are on hold.[256] To attempt to address the problem, the Town employs and aggressive conservation program that includes I/I investments.[257]

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[252] Water Infrastructure Finance Commission, p. 44.
[253] Inflow/Infiltration Local Financial Assistance Program Annual Update, Staff Summary prepared by Frederick A Laskey, Exec Dir, March 13, 2013,. p. 7.
[254] MWRA 2006 Master Plan, Section 5-1.
[255] Phone interviews with WWTP personnel; Review of NSPED permits issued by the EPA and available online.
[256] Allen Cathcart, Concord Water/Sewer Superintendent, phone conversation with Shelley Ayervais, July 5, 2013.
[257] Ibid.

Table 42: Average MGD relative to Permitted Capacity (2035)						
WWTF	Communities Served	Other WWT service?	Permitted mgd (plant)	Current avg mgd (plant)	Current avg + proj growth mgd	% pmtd capacity 2035
Lynn WWTF	Concord	Septic	1.2	1	1.21	101%
	Lynn	No	25.8	22.81	23.9	93%
	Saugus	No				
	Swampscott	No				
	Nahant	No				
Marlborough West	Marlborough	Marlborough Easterly WWTF	2.89	2.25	2.75	95%
	Northborough	Septic				
Rockland	Rockland		2.5	2.3	2.4	97%
	Abington	95% served by Brockton WWTP				

In 2008, Concord created a Wastewater Task Force at the request of its Board of Selectmen to identify ways to bridge the capacity gap. Options noted in the Task Force's final report include: constructing a new WWTP with a groundwater discharge system; constructing several smaller, localized Town-owned-and-operated treatment systems which would provide a short-term solution to allow flows to increase to hydraulic plant capacity of 1.36; or seeking EPA and DEP approval to permanently increase current WWTP flow beyond 1.2MGD (not favored by EPA and DEP). The Town has yet to select a long term solution.[258] As an interim solution, a partial groundwater discharge system was installed at a cost of $3+ million to increase plant capacity by 150,000 gallons/day. Other recent plant expenditures include a $9.7 million upgrade to bring the plant into compliance with the EPAs required reduction phosphorous discharge stipulated in the Town's 2006 NPDES permit, among other things.

The Lynn Regional WWTF serves all of Lynn, Saugus, Swampscott, and Nahant, and treated discharges flow into the Lynn Harbor (Broad Sound), Saugus River, Strawberry Brook, and Nahant Bay. Construction of the primary and secondary treatment facility took place in the early-mid 1980s and mid-late 1980s, respectively, at a combined cost of approximately $110 million.[259] Average actual flow of 22.8 MGD represents 88% of permitted flow capacity (25.8MGD), though the facility is capable of managing flows in excess of 110 MGD for short periods of time, if necessary. According to plant personnel, there is little room for adding capacity. The plant is presently awaiting a new NPDES permit (to replace an expired one) so will find out if any upgrades are required.

The Marlborough Westerly WWTP serves the portion of Marlborough that lies west of Route 495 (Marlborough Easterly WWTP serves the community east of Route 495), and serves part of Northborough under municipal agreement. Northborough is also served by septic systems. Currently, Marlborough Westerly's actual average plant flow is 78% of that permitted (2.25 MGD vs. 2.89 MGD). As a result, flow from western Marlborough is "currently at its available capacity and will require an increase in the design flow of the facility in order to accommodate expected growth."[260] However, the plant's renewed NPDES permit does not allow for additional capacity and an anti-degradation study may be performed to study whether increasing flows will negatively affect the receiving water, the Assabet River.[261] In 2011, Marlborough's City Council approved a study required by the EPA to find major

[258] Ibid.
[259] Interview with Lynn Wastewater Treatment Plant personnel by Shelley Ayervais, July, 2013.
[260] Marlborough Westerly WWTP website. Retrieved July, 2013 at http://www.Marlborough-ma.gov.
[261] Ibid.

sources of leaks within its sewer system (I/I), at a cost of a quarter of a million dollars. Unrelated to capacity issues, new NPDES permits for Marlborough's Westerly and Easterly plants both require enhanced treatment of phosphorous; a costly plant upgrade (costs for each plant are estimated at $40 million) that will result in "a significant increase to the city's sewer user fees."[262]

Rockland's WWTP was first built in 1964 and then upgraded in 1982 to add secondary treatment. (The $14.2 million upgrade was funded 90% by federal and state funds.) In 2005, the average flow was 3.0 MGD, exceeding the permitted limit of 2.5 MGD and resulting in an administrative order that mandated Rockland to submit a 5-year plan to reduce flow. Through roughly $2 million in I/I reduction efforts, Rockland has been able reduce average daily flow to 2.2 or 2.3 MGD while also allowing construction of a number of new large residential developments. In Rockland, I/I efforts are funded by a Sewer Development Fund which is mainly funded by developers pursuant to a moratorium established by the Town. (To date, no developer has balked at having to contribute to the Fund.) According to John Loughlin, Rockland's Sewer Superintendent, the EPA is unlikely to increase permitted flow unless petitioned by developers of a new residential and commercial redevelopment being constructed in South Weymouth (see South Weymouth Southfield case study). New development is expected to generate 6,000 – 12,000 construction jobs, 2,000 – 3,000 permanent jobs, and $6 million - $11 million in combined municipal revenues for Rockland, Abington, and Weymouth. While the 2007 master plan called for wastewater to be treated on-site, developers are currently assessing options for wastewater treatment, which include hooking in to Rockland's WWTP or sending effluent to MRWA's Deer Island facility via Weymouth's sewer system.[263]

Capacity issues are not limited to communities served by centralized WWTPs. In the Town of Hamilton, a community served by septic systems, "lack of adequate wastewater disposal facilities to support a larger variety of business establishments, notably restaurants…"[264] is noted as a development constraint for its downtown. Moreover, there is a lack of space to build additional holding tanks, as reported by Hamilton's Board of Health in 1994. The Town's master plan recommends exploration of constructing a wastewater treatment facility to serve all of Downtown Hamilton's current and future investments. Conceivably, the plant could be co-financed by the Town and private property owners and take advantage of low-interest financing available through the state.

Implications of Future Employment and Population Growth on Treatment Capacity

MAPC's MetroFuture projections anticipate 544,000 new residents (+11%) and 251,000 new jobs (+10%) across all MAPC communities through 2035. These increases in the Greater Boston region have implications for the MWRA, municipal/regional wastewater treatment plants, and areas served by decentralized wastewater systems (e.g., septics and cesspools). Using a rate of 75 gallons of wastewater generated per person per day for residents and 20 gallons per person per day for employees[265], the

[262] Marlborough Easterly WWTP website. Retrieved July, 2013 at http://www.marlborough-ma.gov/Gen/MarlboroughMA_PublicWrks/MarlboroughMA_DPWUtility/MarlboroughMA_WaterSewer/MarlboroughMA_EastlyPlnt/index.
[263] John Loughlin, Sewer Superintendent, Rockland, Interview with Shelley Ayervais, July 25, 2013.
[264] Hamilton, MA Master Plan, February, 2004. p. 61.
[265] 75GPD and 20GPD estimates based upon Department of Environmental Protection, 310 CMR; U.S. Geological Survey, Estimated Use of Water in the United States in 1995, U.S. Geological Survey Circular 1200. Denver, Colorado. 1995; Timothy G. Ellis, 'Chemistry of Wastewater', Department of Civil, Construction & Environmental

approximate additional wastewater in need of treatment will be 40.9 MGD, (36.4 MGD from residents and 4.6 MGD from employees). Additional wastewater will be generated by particularly water-intensive uses, such as: biotechnology, other industrial facilities, new schools, and other services and amenities to accommodate population increase. New primary and secondary schools, for example, must plan for between 8-20 gallons per day per student.[266] The table below projects the additional wastewater that will need to be treated by type of wastewater treatment system.

Table 43: Projected Population & Employment Growth (through 2035)

Type of WW system	# of communities	Pop (2010) (000)	Projected Pop Growth	Jobs (2010) (000)	Projected Job Growth	Wastewater Added (mgd)
Municipal*	68	1,676	11%	694	12%	14.8
MWRA	45	2,225	10%	1,399	9%	19.5
Unknown/other	51	558	15%	206	10%	6.6
TOTAL	164	4,459	11%	229	10%	40.9

Source: MAPC, MetroFuture

Based upon these growth projections, at least 2 Boston-area municipal plants (Brockton and the Charles River Pollution Control District) will approach or exceed capacity limitations by 2035; however, more may be at risk when factoring in wastewater produced by new industries, businesses, services, and amenities (in addition to that just from residents and employees). Further investigation will be necessary to get a complete picture of all wastewater treatment systems currently serving these communities, and any plans for increasing capacity through repair (I/I) or enhancements of current systems. Furthermore, actual wastewater generation will depend upon the type of residences built (luxury vs. smaller homes) and job growth (heavy industry vs. offices or shops). Nevertheless, the Brockton and Charles River Control District warrant attention even based on this study's conservative analysis.

Brockton's WWTP serves all of Brockton, and almost all of Abington and Whitman, each permitted for roughly 1 MGD. The plant was first constructed in the 1960s, with upgrades taking place over time, most recently in 2007-2008 at a cost of roughly $804 million[267], driven by Consent Decree. An additional $28 million was spent on reducing flow through extensive I/I work on the city's collection system.[268] All costs are born by the city, with funds made available thru SRF loans. Growth projections may produce additional wastewater that will bring the facility to 85% capacity or greater. According to the old Colony Planning Council, job growth will be generated building upon Brockton's core financial, government and office functions, as well as revitalizing its downtown.[269] The Commonwealth is presently evaluating regional wastewaters solutions for the Upper Taunton River Watershed, including roughly 25 communities along I-95, I-495 and Rt. 24 between Boston and Providence.

Engineering, Iowa State University. Available at http://www.eolss.net/EolssSampleChapters/C06/E6-13-04-05/E6-13-04-05-TXT-05.aspx.

[266] 310 CMR, Department of Environmental Protection

[267] Dave Norton, Brockton's Contract Administrator, phone interview with Shelley Ayervais, August 8, 2013.

[268] Ibid.

[269] Old Colony Planning Council Guide for Shaping Our Communities and the OCPC Region, 2000

Table 44: Average MGD relative to Permitted Capacity (2035)						
WWTF	Communities Served	Other WWT service?	Permitted mgd (plant)	Current avg mgd (plant)	Current avg + proj growth mgd	% pmtd capacity 2035
Brockton	Brockton		18	14.8	15.2	85%
	Abington	Rockland serves 5%				
	Whitman	Septic serves 7%				
Charles River Pollution Control District	Bellingham		5.7	4.65	5	88%
	Medway					
	Millis					
	Franklin					

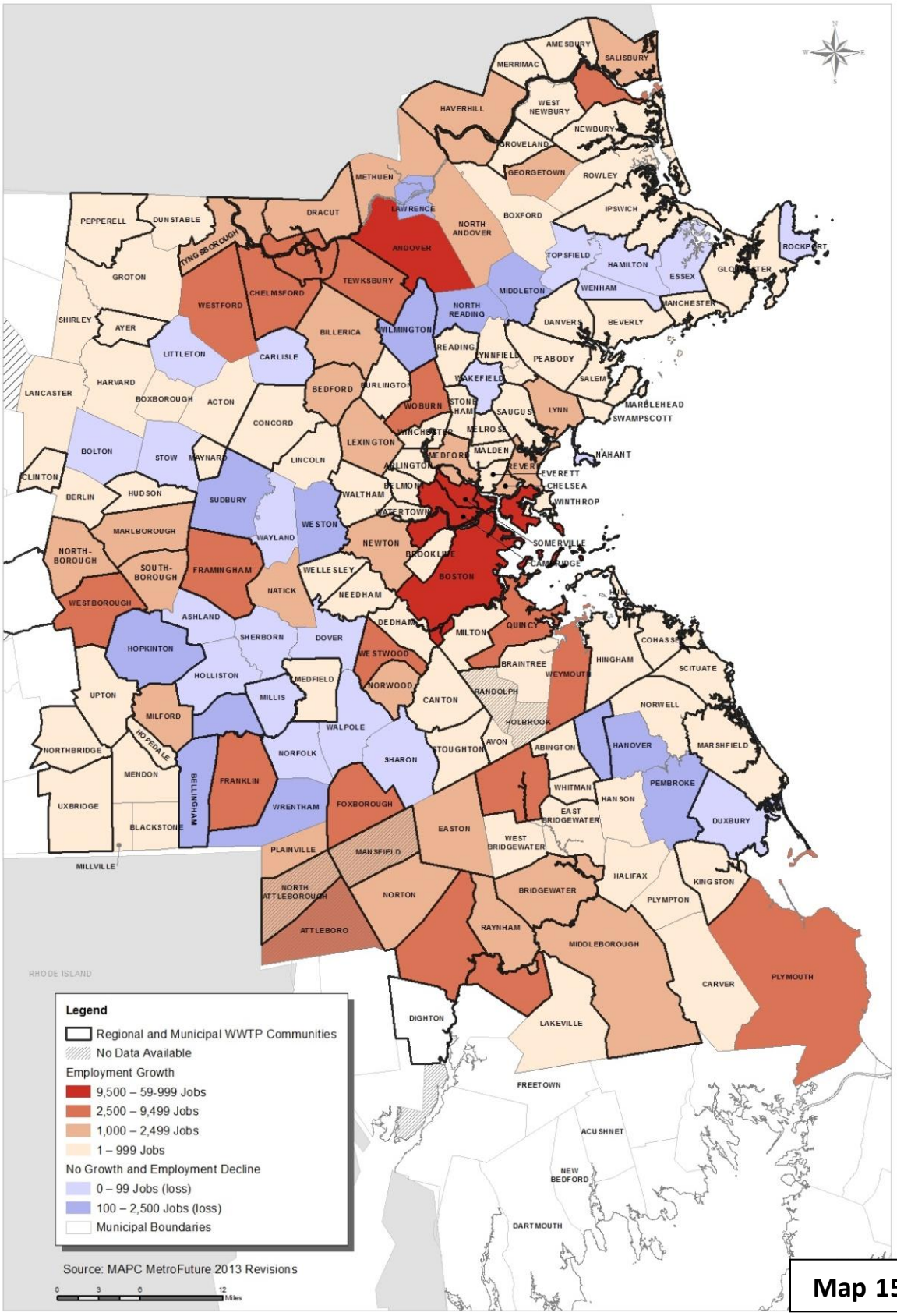
The Charles River Pollution Control District began operation in 1980 to serve the towns of Medway, Millis, Franklin, and the northern portion of Bellingham. In 1998, permitted plant capacity was increased from 4.5 MGD to 5.7 MGD; however, permission to expand plant capacity beyond that, as requested neighboring Holliston (currently decentralized treatment) in the late 1990s was not granted.[270] Presently, average plant flow is at 82% of capacity, and is projected to grow to at least 88% by 2035 when taking into account MetroFuture projections. In addition to capacity issues, the plant's recent NPDES draft permit requires significant system upgrades to prevent overflows caused by malfunctions and failures, in addition to implementation of an I/I reduction program. A 20-year capital improvement plan was recently prepared to meet the more stringent EPA regulations and improve plant reliability at its current capacity. Costs for planning and project completion will be close to $30 million and include equipment replacement, reducing phosphorous, improving the disinfection system, and extending the life of the plant for an additional 20 years. The plant was fined back in 2011 for exceeding its discharge limits of phosphorous and suspended solids.

In addition, growth in the four districts that have existing capacity issues – Concord, Lynn, Marlborough, and Rockland will only exacerbate current problems. Lynn, in particular, is projecting 2,000 new jobs and 10,000 new residents, which would require treatment of at least an additional 1.1 MGD of wastewater[271], bringing the existing facility's average operations up to 92% of total capacity. Marlborough is projecting a 5% increase in resident population which will also increase the amount of wastewater requiring treatment.

One potential opportunity is the fact that some of the areas that are facing particular significant challenges are relatively proximate to other communities that currently receive wastewater treatment from the MWRA or by other regional treatment systems. Of course, due to the many interwoven challenges that face wastewater systems, including aging pipes and I/I, even the larger treatment systems have capacity issues during storm events and additional improvements may be needed before a new member can be added.

[270] Charles River Watershed Association, Streamer Newsletter, Winter 1997, accessed on June 28, 2013 at http://www.crwa.org/streamers/winter97/strmw97p7.html.
[271] Using estimate of 75GPD of wastewater produced per residents and 20GPD per employee.

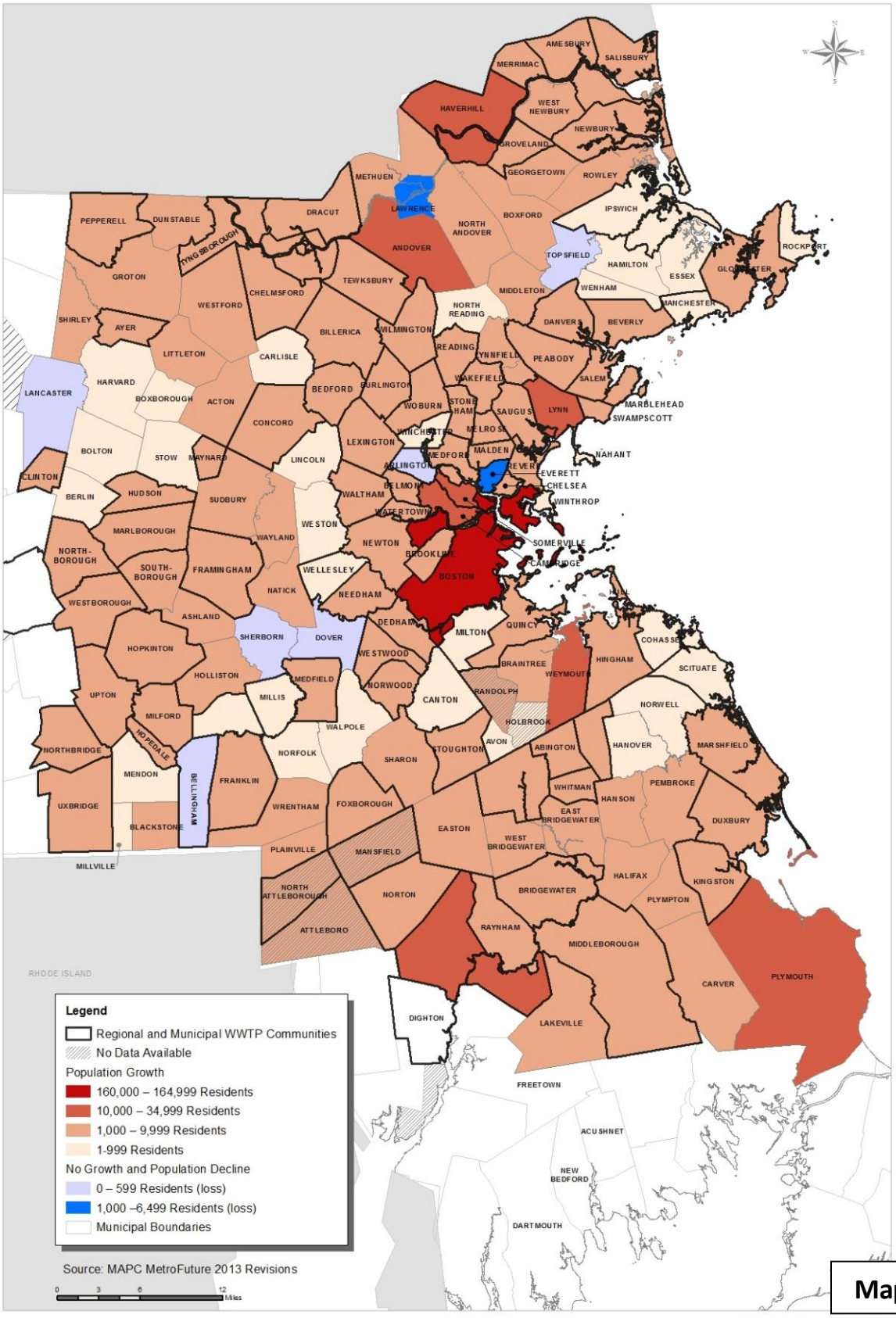
Employment Growth 2010-2035 with WWTP Communities



Map 15

9/13/2013 MwraGIS map1690-2 PAGE: 34

Population Growth 2010-2035 with WWTP Communities



Map 16

9/13/2013 MwraGIS map1690-2 PAGE: 33

Increasingly Stringent Regulations

Public wastewater distribution systems are regularly subject to changes in environmental regulations, often times requiring multi-million dollar upgrades to the treatment plants or their associated distribution systems. For larger service areas such as the MWRA or regional districts, the capital costs of these improvements can be spread across large numbers of rate-payers, but for smaller municipal districts, they must rely upon local residences or businesses to fund large portions of the upgrade costs. Municipalities must also keep current on the regulations in order to avoid fines or penalties. Regulatory changes affecting Massachusetts treatment facilities include:

Treated Wastewater Discharge

The EPA has tightened the regulations surrounding the quality of treated wastewater discharge as its effect on receiving waters has become better understood. Once established, new regulations come in to effect as treatment plant permits are renewed, often requiring costly facility upgrades.

Nutrient Removal

In recognition that nitrogen and phosphorus can ultimately destroy fish populations[272], the EPA sets limits for each public treatment plant using site-specific water quality data. This is because the EPA is sensitive to the fact that for some site's water quality is not compromised by current discharge levels, and the cost for upgrades at smaller plants can be proportionately higher than plants serving larger populations. Although the EPA has denied requests to set national limits for nitrogen and phosphorus removal (most recently denying the National Resources Defense Council's 2007 request, in 2012), "Environmental engineers expect the EPA to push for even lower nutrient levels in the years ahead."[273] Currently, 18% of the state's WWTPs offer advanced treatment (beyond secondary), as compared to 37% nationally.

In 2005, the EPA imposed stricter nutrient discharge standards for plants discharging into the Assabet River, which had been labeled a 'distressed' waterway. The following plants were among those required to perform upgrades:

- *Marlborough Easterly WWTP - $40 million planned upgrade*
- *Marlborough Westerly WWPT - $40 million planned upgrade*
- *Westborough WWTP - $54 million total for upgrades related to nutrient removal as well as other upgrades.*
- *Maynard WWTPs - $9 million upgrade*

Worcester is one community that has struggled to finance mandated plant upgrades. A member of the Upper Blackstone Treatment Facility, which serves 6 communities and portions of another 4, Worcester had spent approximately $180 million since 2004 on EPA-mandated plant improvements, and expects to

[272] Plants fed by these nutrients attract microbes that break down vegetation and consume the dissolved oxygen needed by fish.

[273] Lisa Eckelbecker, "Blackstone debate goes beyond dollars: the cost of clean – Part 2," Telegram.com, December 6, 2012. Retrieved on August 8, 2013 at http://www.telegram.com/article/20121206/NEWS/121209785/1116&Template=printart.

spend another $200 million[274] to come into compliance with new regulations, which, though disputed by the Upper Blackstone Water Pollution Abatement District, were held up in court in May 2013. Required improvements have been viewed as "overly restrictive and burdensome… for businesses homeowners and the city… There are businesses that will make decisions about not hiring because of these costs with no predictability."[275] Increases in sewer rates have and will continue to be needed in order to help fund upgrades, barring federal or state funding. Impending rate changes could add anywhere from $60 to $250 in annual fees to the average household, depending on whether actual costs are closer to EPA's lower estimates or the District's higher estimates. In 2010, the average household in Worcester paid $486 in sewer fees, so even low range estimates would pose a significant increase. At present, the fees remain substantially below the state average of $638 year.[276] Required work, pursuant to the facility's 2008 renewed permit, includes removing contaminated soil, building 2 new wastewater treatment tanks, modify four existing tanks, adding a pump station, constructing a phosphorus removal facility, and working on the water disinfection process on the grounds of the existing facility.[277] The Conservation Law Foundation is opposing the MA DEP's attempt to delay implementation of more protective limits.

MWRA's Deer Island Treatment Plant currently operates under an NPDES permit that expired in 2005 but has been administratively continued while the EPA prepares the new permit. Permitting requires the submission of effluent discharge monitoring reports, implementation of CSO controls and the CSO long-term control plan, and submittal of reports on staffing, best management practices, and ambient monitoring thresholds among other reports. It should be noted that the Deer Island facility has been the recipient of numerous awards from the National Associate of Clean Water Agencies for operating continuously without violations.

MWRA's Clinton Plant operates under an NPDES draft permit (2010) that imposes stricter limits on phosphorus, and which will require the plant to construct a new phosphorus removal treatment facility estimated at a cost of $3.5 million[278]. Future permit revisions may include more stringent aluminum limits, which has driven a shift from alum to a different chemical to treat phosphorous.

Stormwater Runoff

Stormwater runoff is ranked as the leading cause of pollutants that deteriorate water quality along coastlines, and the second leading cause of pollutants in estuaries nationwide.[279] Common pollutants include chemicals and nutrients, oil and grease from roadways, lawn pesticides, sediment from construction sites, and trash. In addition, waterways capturing stormwater runoff typically have higher peak flow rates, and are subject to flooding, erosion, and other issues.

As the negative effects of stormwater become increasingly understood in the coming decades, "there is

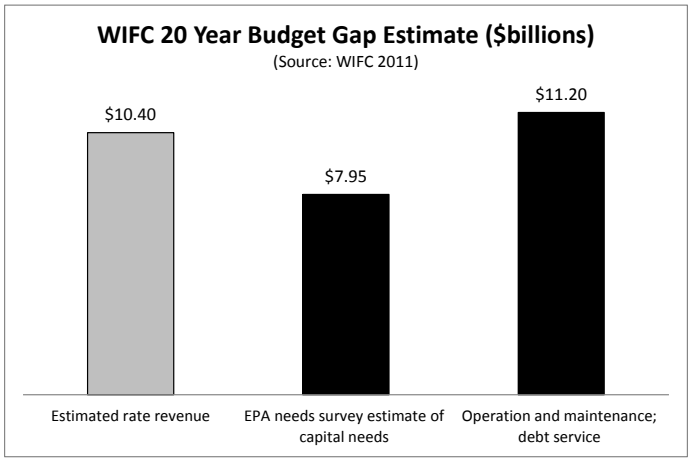
[274] Matt Pilon, "Murray Blasts 'Budget Buster' Water Quality Regs," Worcester Business Journal Online, June 19, 2013. Retrieved August 8, 2013 at http://www.wbjournal.com/article/20130619/NEWS01/130619936/murray-blasts-budget-buster-water-quality-regs
[275] Quote from Tim Murray, Executive Director of Worcester Regional Chamber of Commerce, "Murray Blasts 'Budget Buster, Water Quality Regs," June 19, 2013.
[276] Tighe & Bond 2012 MA Sewer Rate Survey
[277] Eckelbecker, "Blackstone debate goes beyond dollars: the cost of clean – Part 2," December 6, 2012.
[278] MWRA 2006 Wastewater System Master Plan, p 4-2
[279] Water Infrastructure Finance Commission, p 27.

expected to be a dramatic increase in regulation and therefore, costs for stormwater management."[280] Presently, an MS4 (municipal separated storm sewer systems) permit is required in 255 Massachusetts municipalities (roughly 73%). MS4 permits require communities to develop stormwater management programs to address uncontrolled runoff and introduce ordinances and bylaws to regulate illegal connections and discharges into the municipal storm drain system. Future costs for stormwater management are unknown as federal requirements for stormwater mitigation are only pending; however, the MA WIFC (Water Infrastructure Finance Commission) estimates that up to $18 billion may be needed over the next 20 years, depending on regulatory requirements[281]. Presently, very few MA communities have stormwater utilities to raise revenues earmarked for stormwater mitigation (fees may be based on a formula relating to impervious surface). Federal or state resources specifically allocated to address the cost of future stormwater compliance measures do not yet exist.

The Town of Reading is one example of a community that is proactively managing its stormwater. In 2007, Reading Town Meeting voted to create an Enterprise Fund for stormwater operation and maintenance, at the recommendation of a stormwater advisory committee. Roughly $430,000 is raised annually from residential fees ($40 per year per single- or 2-family) and other development ($40 per year per 3,210 square feet of development). Revenue is used for labor and maintenance on stream and detention basins, capital expenses, drainage mapping, identification of illicit connections, and drainage infrastructure improvements. Leftover money is rolled over into the following year's Enterprise Fund budget.[282]

Limited Funding Resources

"Our drinking water, wastewater and stormwater infrastructure need increased investment if they are going to continue to deliver reliable clean water and keep wastes and toxic chemicals out of our environment without service interruptions."[283]



The volume of system upgrades and repair driven by aging infrastructure and impending environmental regulation comes in the face of reduced levels of funding available to assist municipalities (and rate payers) with costs. The Massachusetts legislature and US EPA[284] have both recognized the financing gap driven by the lack of available funding needed to maintain and replace wastewater systems as systems age. In lieu of state or federal funding, many municipalities are taking on increasing levels of debt to maintain infrastructure and meet applicable requirements.

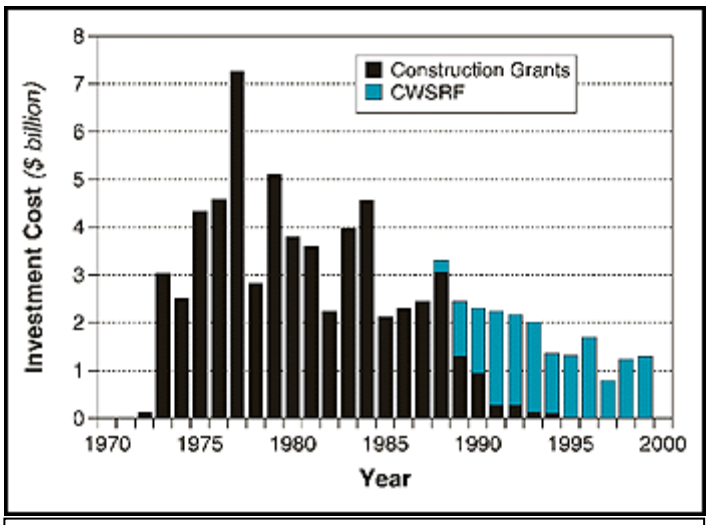
[280] Ibid, p. 42.
[281] Ibid, p. 4.
[282] Water Infrastructure Finance Commission, p. 43.
[283] Ibid. p. 3.
[284] Ibid. p. 7.

A 2011 Water Infrastructure Finance Commission[285] analysis calculated a statewide funding gap of $11.2 billion to pay for wastewater systems improvements expected over next 20 years. This is far greater than a 2004 EPA estimate of roughly $3 billion for all of New England.[286]

WIFC's estimated gap takes into account capital investments, repair and replacement, operations, and maintenance and debt service, but excluded cost of new regulatory requirements or investment needed to accommodate economic growth.

Federal Funds

Following passage of the Clean Water Act, federal funds were disbursed as grants to cover 75% of the cost for sewer projects, while the state pitched in another 15%. Between 1970-1995, $61.1 billion[287] was distributed in federal grants through the EPA's Federal Construction Grant Program, with at least $2.1 billion[288] flowing to Massachusetts, which proved critical to the construction of primary and secondary wastewater treatment facilities within communities.



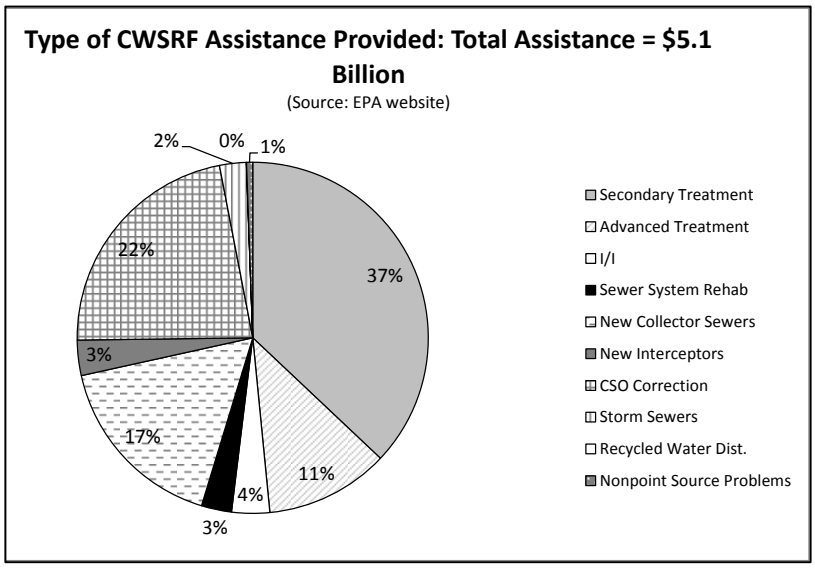
(Source: EPA Progress In Water Quality)

In a major shift, the federal grants once offered were gradually replaced by loans, with grant disbursements dwindling until 1995 when they ended altogether. The Clean Water State Revolving Fund (SRF) began in 1988, using federal dollars from the EPA along with a state match of 20% to finance low-interest loans available to municipalities, water and wastewater districts and public water suppliers for drinking water and wastewater infrastructure projects. An estimated 27% of project costs are saved through the reduced-interest loan, which is repaid over 20-30 years. In Massachusetts, the current SRF loan interest rate is 2%; however, the O'Leary Provision passed by the legislature in 2008 may reduce SRF interest rates down to 0% provided projects meet certain criteria including a reduction in nutrient discharge levels.

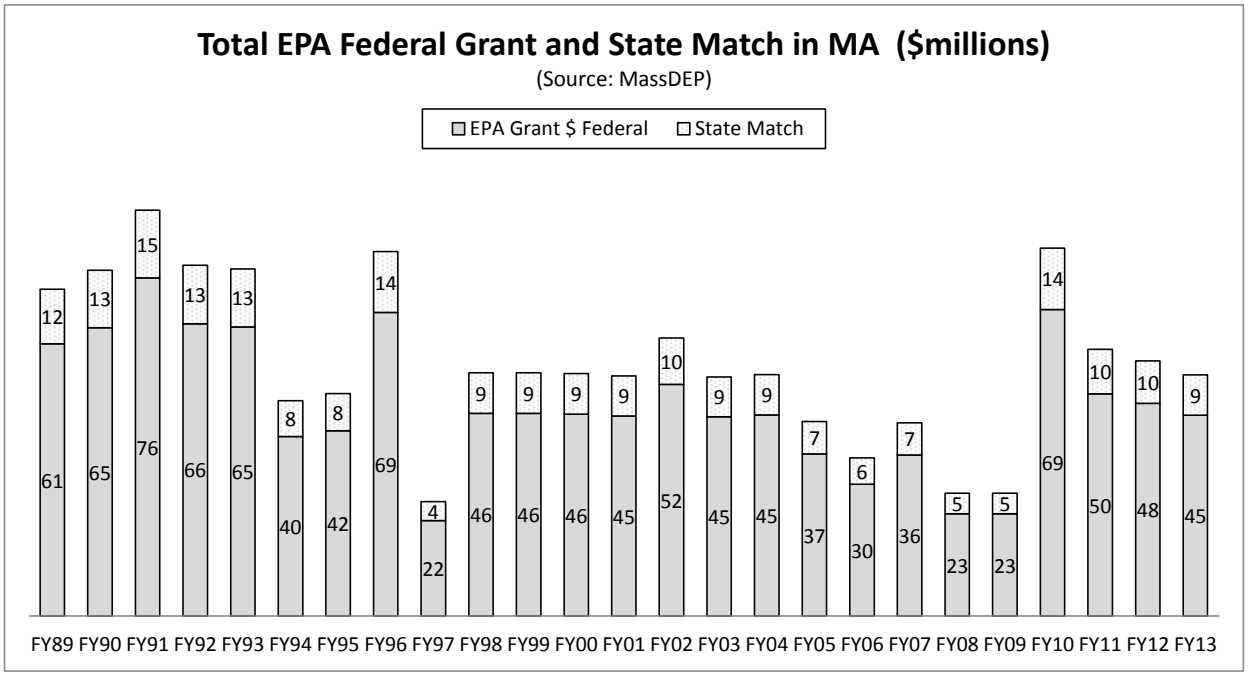
The Massachusetts SRF is managed by the Water Pollution Abatement Trust (MWPAT) in the Treasurer's office. Total amount of federal capitalization grants provided to the state through FY12 is $1.3 billion (including funds from the American Recovery and Reinvestment Act in 2009), which have translated into $5.12 billion[289] in clean water project financing, or an average of $236 million annually. (The MWPAT

[285] The Water Infrastructure Finance Commission was created in 2009 by MA Legislature to analyze the state's water infrastructure funding needs and recommend how to finance these needs.
[286] Water infrastructure Funding Options for A Sustainable Future,, U.S, EPA, p. 1. Available at http://www.epa.gov/region1/eco/drinkwater/pdfs/waterfundletterweb.pdf.
[287] EPA Progress In Water Quality. Available at http://water.epa.gov/polwaste/wastewater/treatment/upload/2002_06_28_wquality_execsum.pdf.
[288] MassDEP spreadsheet listing annual federal grant amounts for state of MA, received in email from Steve McCurdy, Director, MassDEP Municipal Services, by Shelley Ayervais, July 31, 2013.
[289] Clean Water State Revolving Fund Program Information for the State of Massachusetts, November 2, 2012.

leverages federal grants in the bond market.) Federal award amounts are appropriated annually by Congress and have fluctuated in Massachusetts from a low of $22 million in FY97 to almost $160 million in 2009 thanks to $133 million from the American Recovery and Reinvestment Act (ARRA). Excluding ARRA funding, the annual state average is $47.8 million in funding.[290] The Commonwealth augments federal grants with a 20% matching state appropriation (through a budget category called "Contract Assistance"). Since 1991, over 75% of SRF financial assistance has benefited secondary treatment projects (37%), CSO correction projects (22%), and new collector sewer projects (17%) through pass-through and linked-deposit loans.



97% of Massachusetts residents live in communities that have benefitted from projects financed by money borrowed from the Trust. Top borrowers of MWPAT's SRF program includes: MWRA, Fall River,

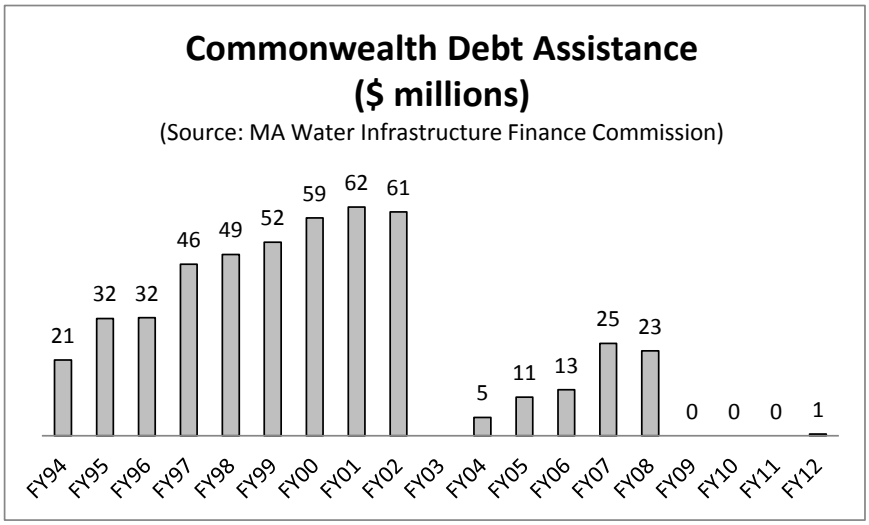


the Upper Blackstone Pollution Abatement District, New Bedford, Brockton, Lowell, South Essex Sewer District, Taunton, Nantucket, Lynn Water & Sewer, Chicopee, Gloucester, Chelmsford, Springfield Water & Sewer, and Fitchburg.[291]

[290] Ibid.
[291] Water Infrastructure Finance Commission, p. 54.

Other sources of federal funds include the Rural Development Insurance Fund, created in 1972 under the Rural Development Act, providing grants and loans for drinking water and clean water projects to rural areas and small cities and towns (population < 10,000). The fund provided almost $87 million to New England communities in FY07. Additionally, the Community Development Block Grant (CDBG) Program under the US Department of Housing and Urban Development has been used as another more modest source of funding, with 10-20% of grants utilized on water and wastewater infrastructure

State Funds



Unlike other states in New England, Massachusetts does not offer grant programs for wastewater infrastructure; however, in addition to the state's mandatory 20% SRF contribution, "the state appropriates funding each year to subsidize market interest rates down to 2% on all CWSRF loans,"[292] and, in certain years, funds the Commonwealth Sewer Rate Relief Fund. The Commonwealth Sewer Rate Relief Fund was created in 1993 to address the escalating debt from rising water and sewer expenses at a time when sewer rate increases were in the double digits for many communities. At its peak, the Sewer Rate Relief Fund received $62 million per year; however, the program went unfunded in FY09 - FY11, and was funded at only $500,000 in FY12. For the MWRA, the lower funding levels have led to rate hikes, increased drawing from reserves, and layoffs.[293] After funding dropped to $0 for the first time in FY03, the MWRA, which had over the years received the highest share of support, increased rates by 2.9% to 6.9% mid-year and cut $420 million from its capital improvement program and $47.2 million from its current expense budget.[294]

MWRA's Inflow/Infiltration Local Financial Assistance Program was also created in 1993; however, this program is funded by MWRA's 43 sewer member communities rather than by state or federal distributions. The Local Financial Assistance Program is a grant/loan program to help fund I/I reduction and sewer system rehabilitation projects among member communities, with the goal of reducing I/I by improving local sewer system conditions and ensuring ongoing repair/replacement of the collection system. The program is a critical component of MWRA's Regional I/I Reduction Plan. Approved projects receive grant funding equivalent to 45% of project cost and 0% financing loan to be repaid over 5 years for the balance. To date, total funding equals $300.75 million, with all funds either already distributed ($246 million) or allocated for future projects approved through FY21. Funds may be used to cover project planning/study, design, construction, and engineering services, and are allocated to each MWRA community based on their respective share of MWRA sewer charges. (The MWRA anticipates discussing

[292] Water Infrastructure Funding Options for A Sustainable Future, U.S. EPA New England. Available at http://www.epa.gov/region1/eco/drinkwater/pdfs/waterfundletterweb.pdf.
[293] Water Infrastructure Finance Commission, p. 50.
[294] Ibid.

what additional funds may be pledged to the program, during its FY15 Capital Improvement Program (CIP) budget cycle.[295]) On average, estimated daily flow reduction associated with completed I/I projects funded by the Financial Assistance Program is about 80 MGD. However, reductions in I/I may be offset by increases elsewhere in the system as further deterioration takes place. [296]

Municipal Funds

For those communities operating their own wastewater treatment plants, they must not only budget for ongoing annual operating costs, but also the cost of maintenance and eventual replacement of the plant itself. They must also be prepared to cover the costs of improvements resulting from changing regulatory requirements. To be equipped to address short-term and long-term costs, the Massachusetts Water Infrastructure Finance Commission (MWIFC) recommends the establishment of sewer fees equivalent to 1.25% of median household income (MHI). The EPA actually suggests a higher rate of 2.5% of MHI. However, Data shows are that most municipalities do not set rates at the recommended level. "Unlike other utilities…. Municipal water and sewer rates do not come close to covering the full cost of providing clean water and eliminating waste."[297]

When applying the MWIFC recommended rate to the 2010 Census, it can be seen that the average household sewer rate in Massachusetts should have been $824 per year, based on a median household income of $65,981.[298] However, the actual average household payment was $638, or 0.97% of MHI.[299] While a $186 per year shortfall may not seem significant, across the approximate 2.5 million households in the state, it translates into a $465 million deficit. Using the EPA recommendation, the shortfall translates into over $1,000 per household or $2.5 trillion.

The City of Newton is one community that is being more proactive about infrastructure costs. A 7.7% rate increase (an average of $94/household) in 2012 and a 3.9% increase in 2013 will be followed by continued rate changes over the next 10 years in order to address existing problems, of which I/I alone is anticipated to cost up to $10 million per year. Debate continues within the community as to whether recent and future planned hikes are enough to cover MWRA fees (i.e., 74% of the annual sewer budget) and fix the infrastructure for which an 11-year ($49 million) and 20-year plan have been drafted. Even so, in 2012, Newton's average sewer charge per household was $1,060[300], or just 0.96% of local MHI[301]. One incentive to invest in infrastructure is the recognition that Newton stands to save an estimated $3

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[295] Carl Leone, Senior Program Manager MWRA Community Support Program, email received by Shelley Ayervais, July 18, 2013.
[296] MWRA NPDES Permit # MA0103284 MWRA Annual Inflow and Infiltration Reduction Report for FY 2012, August 24, 2012, p. 5. Available at http://www.mwra.state.ma.us/harbor/pdf/infinf.pdf.
[297] Water Infrastructure Finance Commission, p..6.
[298] United States Census Bureau State and County Quickfacts, 2012. Average median household income between 2007-2011 of $65,981.
[299] Tighe & Bond 2012 Massachusetts Sewer Rate Survey. Available at http://rates.tighebond.com/(S(qqpk5xfbuke3lx45jszjweir))/Downloads/2012MASEWERFINAL.pdf .
[300] 2012 Water & Sewer Retail Rate Survey, MWRA Advisory Board, p.5.
[301] U.S. Census Bureau, State and County Quickfacts 2012.

million annually if 50% of inflow is stopped.[302]

In 2012, MWRA communities paid an average of $879 per household, up 3.8% from prior year.[303] MWRA calculates fees for each municipality based upon that community's population, average wastewater flow and maximum wastewater flow, and composition of wastewater. Fees cover capital costs, including debt service, as well as costs for operation and maintenance.

Debt burden for municipalities and the MWRA

To maintain water infrastructure and comply with federal mandates, many municipalities have taking on higher debt and, subsequently, debt service represents a growing portion of their budget.

In the Town of Holliston, debt service on previous capital expenditures currently accounts for 40% of the water department's budget. "Town officials testified (as to) the impact of debt on its ability to deal with current issues."[304] The Town is mandated to repair an existing well site at a cost of $1.5 million, and maintains about 100 miles of pipe, some of which is nearing the end if its service life and will cost roughly $800,000 per mile to replace. The City of Fall River currently has a debt burden representing 45% of its sewer division budget.

For the MWRA, capital debt service of $398 million represents 60% of its FY14 operating budget. Since 1984, the MWRA has spent $7.4 billion in capital improvements, 80% of which were mandated by state or fed regulations (including the Boston Harbor Project). The agency estimates that without additional financial assistance, debt service will peak in FY22 at $550 million[305], or 83% of the FY14 budget.[306]

[302] Melanie Graham, "Average Newton Home to See $51 increase to Water/Sewer Bill," Newton, MA Patch, May 8, 2012. Retrieved July 31,2013 at http://newton.patch.com/groups/politics-and-elections/p/average-newton-home-to-see-51-increase-to-water-sewer-bill.
[303] 2012 Water & Sewer Retail Rate Survey.p.5.
[304] Water Infrastructure Finance Commission, p. 48.
[305] Ibid. p. 46.
[306] MWRA FY 2014 Proposed Capital Improvement and Capital Expense Budget, MWRA Water Advisory Committee, April 5, 2013.. Available at http://www.mwra.state.ma.us/monthly/wac/presentations/2013/040513-cipceb.pdf.

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CONCLUSION

Municipalities large and small, along with regional and state agencies across Massachusetts and the U.S., are grappling with the high cost of building, maintaining, repairing, and renovating water and sewer infrastructure in an era of diminished funding. A decline in infrastructure investment has been happening across the country over several decades, even though multiple studies document that infrastructure investment is linked to increased economic opportunity in the form of increased worker productivity and new jobs. Closer to home, examples can be found in Massachusetts where access to infrastructure helped unlock the development potential of a site, and others where development has been delayed due to infrastructure limitations.

As officials across the Commonwealth consider how to plan for water and wastewater infrastructure needs going forward, a few key findings can be made:

1. The magnitude of need is substantial. According to the Massachusetts Water Infrastructure Finance Commission, a $28 billion gap exists between the amount of funding available for water and wastewater infrastructure and need over the next 20 years. As maintenance and replacement activities are delayed, costs can rise, not only because construction costs regularly increase, but also because the potential for emergency situations grows, often requiring more costly responses than if the equipment and facilities were maintained in the first place;
2. Economic development occurs much more expeditiously on properties with ready access to water and wastewater infrastructure. Where infrastructure does not exist or water supply is inadequate, development can be delayed for years;
3. The provision of potable water and wastewater treatment services in Massachusetts is highly fragmented. Where public services are provided, municipalities either: a) operate their own public water supply and/or wastewater treatment plant(s); b) purchase water/sanitation services from a nearby community with excess capacity; and/or, c) purchase water/sanitation services from a large regional provider such as the MWRA. Elsewhere in the state, residents and businesses draw water from private wells and/or operate their own septic systems. As such, any comprehensive effort to improve water and wastewater infrastructure will need to work with multiple providers and take into account the unique circumstances of each community;
4. Municipalities across the state are facing significant challenges with major infrastructure systems reaching their reasonable useful lifetime at the same time as state and federal regulatory requirements are becoming increasingly stringent;
5. Delayed or stalled economic development projects have a real financial impact on local communities seeking to increase their commercial property tax base. The same is true for the Commonwealth, which derives considerable income from new development via income taxes from the new workers on site, sales taxes, etc. When jobs are not added as anticipated, state and municipal governments feel the negative impacts of delayed or lost revenues;
6. As noted in various national studies, not all infrastructure investments generate the same return, and only robust cost-benefit analysis can determine whether a proposed project will produce the jobs and revenues that can help offset costs at a local and/or state level. Comprehensive cost-

benefit analyses would need to take into account the costs of all forms of infrastructure, including transportation, in addition to environmental impacts, and would not solely evaluate a project through the lens of water and wastewater infrastructure. Nevertheless, multiple examples can be found today where access to adequate water and wastewater infrastructure has made the difference between economic development projects that quickly generate thousands of new jobs and those that have been delayed for years.

Ensuring that adequate water and wastewater infrastructure and capacity exist in Massachusetts will be essential to ensuring that the Commonwealth's goals for job growth and housing construction can be met.

APPENDIX A
SUMMARY OF STUDIES ON INFRASTRUCTURE INVESTMENT

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APPENDIX A: SUMMARY OF STUDIES ON INFRASTRUCTURE INVESTMENT

Study: "Macroeconomic Effects of Fiscal Policy"

David Alan Aschauer, University of Michigan, and Jeremy Greenwood, University of Western Ontario, Canada, and Rochester Center for Economic Research, New York, were the first to study the connection between infrastructure investment and economic growth. In their paper, "Macroeconomic Effects of Fiscal Policy,"[307] published in the *Carnegie-Rochester Conference Series on Public Policy*, January, 1985, Aschauer and Greenwood expanded the classical Production Function, where Gross Domestic Product is a function of Private Capital and Labor, to include public infrastructure. Their analysis provided empirical evidence that suggested that the public investment in infrastructure was an important factor in private sector output. "On the expenditure side of fiscal policy, government services were modeled as yielding consumption and production benefits for the private sector, while government investment in public capital augmented society's future production possibilities."

> While the model employed is simple, it still allows for government services to yield consumption benefits for individuals and production benefits for firms
> - David Aschauer and Jeremy Greenwood

This theory was further borne out in Aschauer's continuing work. As Senior Economist of the Federal Reserve Bank of Chicago, he writes "Is Public Expenditure Productive?"[308] published in the *Journal of Monetary Economics*, 1989, in which he "presents time series evidence for the post-World War II period in the United States that a 'core infrastructure' of streets and highways, mass transit, airports, water and sewer systems, and electrical and gas facilities bears a substantially positive and statistically significant relationship to both labor and multifactor productivity."[309]

> Given that public capital complements private capital, an increase in the public capital stock can be expected to stimulate private capital accumulation through its effect on the profitability of private capital.
> – David Aschauer

Study: "Why is Infrastructure Important?"

Having further refined his work, Aschauer, as the Elmer W. Campbell Professor of Economics at Bates College, presented the paper, "Why Is Infrastructure Important?" at a Federal Reserve Bank of Boston

[307] Aschauer, David Alan & Greenwood, Jeremy, 1985. "Macroeconomic effects of fiscal policy," *Carnegie-Rochester Conference Series on Public Policy*, Elsevier, vol. 23(1), pages 91-138, January
[308] Aschauer, David Alan, 1989. "Is public expenditure productive?," *Journal of Monetary Economics*, Elsevier, vol. 23(2), pages 177-200, March
[309] Aschauer, David Alan, 1990. "Why is infrastructure important?," Conference Series ; [Proceedings], Federal Reserve Bank of Boston, pages 21-68

conference entitled "Is There a Shortfall in Public Capital Investment?,"[310] the author revisited his earlier work to determine the marginal product for core infrastructure investments. Marginal Product is a measure of how a change in an input, here public infrastructure investment, affects the change in output. Aschauer found that "The estimate of the marginal product of core infrastructure spending is 2.226 (standard error = 0.389), while that of all other government expenditure combined is 0.250 (standard error = 0.160). Thus, the level of per capita output is positively and significantly related to core infrastructure and negatively though insignificantly related to other government spending."[311] "Given that public capital complements private capital, an increase in the public capital stock can be expected to stimulate private capital accumulation through its effect on the profitability of private capital."[312]

The paper concluded that "recent empirical evidence, as well as that established in the preceding section of this paper, suggests that infrastructure expenditures may well have been a key ingredient to the robust performance of the economy in the "golden age" of the 1950s and 1960s."[313]

> For the evidence suggests that, in addition to providing immediate economic stimulus, public infrastructure investment has a significant, positive effect on output and growth.
> - Alicia Munnell

Study: "Why has Productivity Growth Declined?"

Further support for the theory that investment in public infrastructure supports economic growth was presented by Alicia Munnell, Senior Economist at the Federal Reserve Bank of Boston in "Why has Productivity Growth Declined? Productivity and Public Investment," published in *New England Economic Review*[314] in which the author found a correlation between the decline in labor productivity of the 1970s and 1980s and the decline in the level of public investment in infrastructure. While the decline in public investment is not the sole cause of the decline in productivity, it did support Aschauer's earlier findings. Munnell concluded that, "The public capital-labor ratio, however, continues to decline, acting as a drag on the growth in labor productivity. The public capital-labor ratio, which had been increasing until 1973, fell by an average annual rate of 0.5 percent over the period 1973-79 and continued to fall by 0.4 percent annually over 1979-87."[315]

Study: Policy Watch: Infrastructure Investment and Economic Growth

While much of the early work in this field of study was considered controversial, particularly to weight given to investment in public infrastructure and its effect on output, Munnell sought to address the critics and reworked her previous analysis in a new 1992 report entitled "Policy Watch: Infrastructure Investment and Economic Growth," published in the *Journal of Economic Perspectives.*[316] To support this theory Munnell conducted three exercises. In the first exercise, the author developed estimates for the production functions for the individual states and found that they, like the nation-wide data, had a positive impact on output. The second exercise analyzed the relationship between public and private

[310] ibid
[311] ibid
[312] ibid
[313] ibid
[314] Munnell, Alicia H., 1990, "Why has Productivity Growth Declined? Productivity and Public Investment," *New England Economic Review*, (January/February), pp. 3-22
[315] ibid
[316] Munnell, Alicia H., 1992, "Policy Watch: Infrastructure Investment and Economic Growth," *Journal of Economic Perspectives*- Volume 6, Number 4, Fall, pp. 189-198

investment, which were portrayed as two opposing forces. Munnell found that "on balance, public capital investment stimulates private investment."[317] The third exercise looked at the relationship between employment growth and infrastructure investment using a business location model.

The results showed a statistically significant relationship between investments in infrastructure and positive employment growth. Munnell concluded that, "Taken together, these three analyses indicate that public capital has a positive impact on several measures of state-level economic activity: output, investment, and employment growth. The magnitudes of these effects are considerably smaller than those found at the national level; for instance, the elasticity of public capital with respect to output was .15, roughly half the estimate at the national level."[318]

> Our third conclusion is that, in general, states get greater returns from investing in water and sewer systems than from investing in highways.
> - Moomaw, et al.

Study: "The Interregional Impact of Infrastructure Capital"

Ronald L. Moomaw, University of Oklahoma, John K. Mullen, Clarkson University, and Martin Williams, Northern Illinois University continued to drill down from national to state level analysis. Their study, "The Interregional Impact of Infrastructure Capital" published in *Southern Economic Journal,*[319] 1995, concluded that "aggregate public capital and two of its components (highways, water, and sewer) make a positive contribution to state output. Water and sewer systems have a much larger effect on state output than highways and 'other' public capital stock." "The implication is that additional investment in waste disposal and water systems offers a greater stimulant to the regional economy than increased public funding for highways. Also, willingness to facilitate the building of water and sewer infrastructure may allow states to maintain or enhance their competitive advantage in attracting new facilities and jobs."

The authors warned however, that there was substantial variation in the magnitudes in output elasticity for infrastructure investment across the states. Their research shows that many New England states had exhausted their benefit from additional investment. Fortunately this was not the case with water and sewer capital in Massachusetts.

> Every dollar spent in constructing an average water/sewer project generated almost $15 of private investment, leveraged $2 of public funds, and added $14 to the local property tax base.
> - Fagir S. Bagi

Study: "Economic Impact of Water/Sewer Facilities on Rural and Urban Communities"

Fagir S. Bagi, an economist at the Economic Research Service of the United States Department of Agriculture, studied the impact of investments made by the United States Department of Commerce, Economic Development Administration (EDA) in 1989 and 1990. The Economic Research Services provides *economic* analysis on efficiency, efficacy, and equity issues relating to agriculture, food, the environment, and rural development to improve public and private decision making on economic and policy issues related to agriculture and rural America. EDA generally invests in projects that are in response to a specific request or need of an end-user. Bagi noted that "Many communities invest in

[317] ibid
[318] ibid
[319] Moomaw, Ronald L., Mullen, John K. and Williams, Martin, 1995, "The Interregional Impact of Infrastructure Capital," *Southern Economic Journal*, Vol. 61, No. 3 (January), pp. 830-845

water/sewer facilities to encourage economic growth by facilitating the expansion of existing businesses as well as attracting new ones."

Bagi's research, published in *Rural America,*[320] winter 2002, documented the direct and indirect effects on local economies, measured as the number of commercial and industrial business attracted and retained, jobs created or retained, and local taxes. The study found that; "Water/sewer projects can save and/or create jobs, spur private sector investment, attract government funds, and enlarge the property tax base. The 87 water/sewer projects studied, on average, created 16 full-time-equivalent construction jobs. Direct beneficiaries (businesses) saved, on average, 212 permanent jobs, created 402 new permanent jobs, made private investments of $17.8 million, leveraged $2.1 million of public funds, and added $17.0 million to the local property tax base. Indirect beneficiaries saved, on average, 31 permanent jobs, created 172 new permanent jobs, attracted $3.34 million in private-sector investment, leveraged $905,000 of public funds, and added $3.0 million to the local property tax base. This enlarged property tax base, at a mere 1-percent tax rate, would yield $200,000 in annual property tax to the community."

Furthermore; "the average urban water/sewer facility, which costs only about one-third more than the average rural facility, creates about twice the amount of permanent jobs, induces three times more private investment, leverages twice as much in public funds, and adds three times more to the local property tax base."

Study: "Local Government Investment in Municipal Water and Sewer Infrastructure: Adding Value to the National Economy"

In 2008, Richard A. Krop, Ph.D., Charles Hernick and Christopher Frantz prepare a briefing paper for the U. S. Council of Mayors entitled, "Local Government Investment in Municipal Water and Sewer Infrastructure: Adding Value to the National Economy."[321] Their work highlighted an evolution in the statistical technique used to analyze the relationship between infrastructure investment and economic growth. The authors documented this evolution with:

- Moomaw, et al. (1995), "The Interregional Impact of Infrastructure Capital,[322]"
- Evans & Karras (1994), "Are Government Activities Productive? Evidence from a Panel of U.S. States,"[323]
- Batina (1998) "On the long run effects of public capital and disaggregated public capital on aggregate output," [324]
- Pereira (2000), "Is All Public Capital Created Equal?;" [325] and

[320] Bagi, Faqir S., 2002, "Economic Impact of Water/Sewer Facilities on Rural and Urban Communities," *Rural America*, Volume 17, Issue 4/Winter

[321] Krop, Ph.D., Richard A., Hernick, Charles, Frantz, Christopher, 2008, "Local Government Investment in Municipal Water and Sewer Infrastructure: Adding Value to the National Economy," The Cadmus Group, Inc. for the United States Conference of Mayors

[322] Moomaw, Ronald L., Mullen, John K. and Williams, Martin, 1995, *Southern Economic Journal*, Vol. 61, No. 3 (January), pp. 830-845

[323] Evans, Paul & Karras, Georgios, 1994, "Are Government Activities Productive? Evidence from a Panel of U.S. States," *The Review of Economics and Statistics*, MIT Press, vol. 76(1), pages 1-11, February

[324] Batina, R.G." On the long run effects of public capital and disaggregated public capital on aggregate output," *International Tax and Public Finance*, 5:3 (1998): 263-281

[325] Pereira, Alfredo M., 2000. "Is All Public Capital Created Equal?," *The Review of Economics and Statistics*, MIT Press, vol. 82(3), pages 513-518, August

- Pereira (2001), "On the Effects of Public Investment on Private Investment: What Crowds in What?" [326]

The analysis showed that "Measures of the return on public infrastructure investment vary geographically and are affected by past investment. For example, if public water and sewer infrastructure is adequate and of high quality, the rates of return on further investment may be lower than it would be if infrastructure were inadequate. Optimal levels of investment also depend on the method used to generate additional funding." It should be noted that the study defined infrastructure investment as both the reinvestment and replacement of existing infrastructure (existing assets), and investment in new infrastructure (adding assets at the margin). Replacement of existing infrastructure may have less of an economic impact than system expansions, which open up undeveloped land to commercial and industrial activity.

> Public infrastructure is the foundation for economic development. Access to roads, water, sewer, communication technologies, and electricity are all essential to the economy.
> - U. S. Council of Mayors

Having reviewed these newer studies, the authors concluded the following: "First, although not all studies find a growth-enhancing effect, there is a general consensus in the literature that spending often displays positive economic returns. Second, according to most studies the impact is much lower than the findings of earlier studies (e.g., Aschauer 1989). Third, both the average return and the range of return vary based on the type of infrastructure and the amount of infrastructure already in place."

Study: "The Economic Impact and Financing of Infrastructure Spending"

The most recent study was Isabelle Cohen, Thomas Freiling, and Eric Robinson paper, "The Economic Impact and Financing of Infrastructure Spending"[327] published in 2012. Their work attempted to understand the short- and long-run implications of infrastructure investment. To analyze the short-run effect, the authors created an input-output model, using nonresidential construction as a proxy for public infrastructure investment. They found that the direct and indirect impact from nonresidential construction as $1.92 for every $1 invested.

> These investments return some portion of the money initially outlaid by the government over a twenty-year time horizon, and, in several cases, more than pay for themselves.
> - Cohen et al.

For long-run effect they used the vector auto- regression method pioneered by Pereira. The vectors are GDP and Infrastructure investment (by category) over a 20-year period. The regression found a Marginal Product of $3.21. Therefore, $1 invested at the beginning of the 20-year period would yield $3.21 in GDP growth at the conclusion of the period. More important was the analysis of different infrastructure categories. Here they found that a $1 investment in a Water and Sewer project would yield $6.77 over the same 20-year period.

[326] Pereira, Alfredo M., 2001. "On the Effects of Public Investment on Private Investment: What Crowds in What?", *Public Finance Review*, vol. 29(1), pages 3-25, January

[327] Cohen, Isabelle, Freiling, Thomas, and Robinson, Eric, 2012, "The Economic Impact and Financing of Infrastructure Spending," Thomas Jefferson Program in Public Policy, College of William & Mary, for Associated Equipment Dealers

Their analysis continued to explore the federal, state and local tax implications for infrastructure investment. They found that in the aggregate, $1 invested in infrastructure generates almost $0.96 in new taxes over 20 years. And that Water and Sewer investments generated on average $2.03 in new taxes over the same period, of which $0.68 is new state and local tax revenue.

Conclusion

The Collins Center undertook a review of scholarly research and related articles to provide the Massachusetts Water Resources Authority Advisory Board with an independent analysis for a linkage between investments in Water and Sewer Infrastructure and Economic Development. The authors collected and analyzed a considerable amount of data that reflected infrastructure investment, employment and Gross Domestic Project over the past 50 years. The studies sited here, along with additional sources listed in the bibliography, find:

- A positive correlation between public investment and private development;
- The effect varies by location, type and size of the investment;
- Additional research, including cost/benefit analysis of individual future projects is required to determine the best public investment returns.

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APPENDIX B
HOW WATER IS COLLECTED IN MASSACHUSETTS

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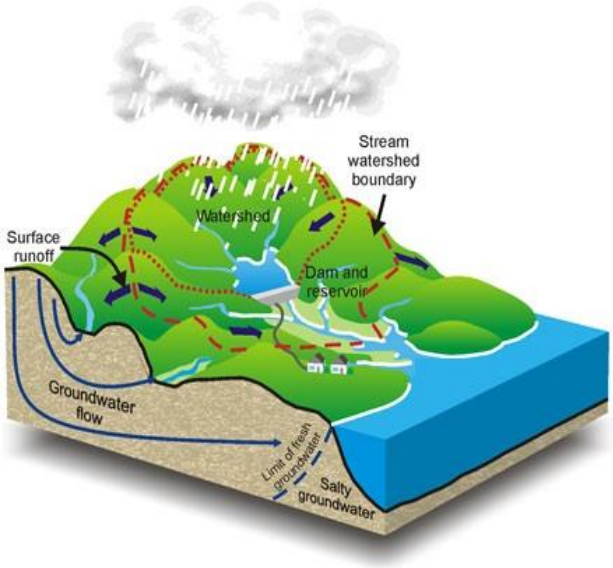
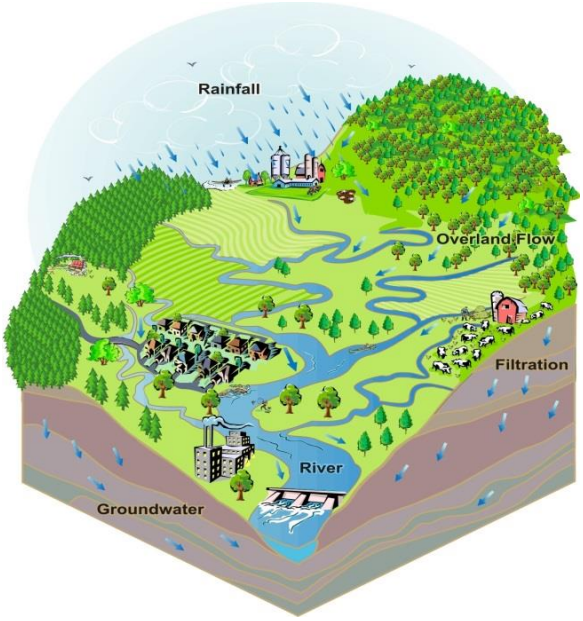
APPENDIX B: HOW WATER IS COLLECTED IN MASSACHUSETTS

Rainwater in Massachusetts falls into an array of different environments across the state, from the coastal regions on the east to the Berkshires on the west. As it falls, it may remain at the surface and be channeled into a stream, river, or reservoir, or it may seep through the earth and be collected in an underground aquifer.

Watershed

The United States Geological Survey defines a watershed as "an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel."[328] It includes all the surface water (rivers, streams, wetlands, ponds, and reservoirs) and groundwater within its boundary. While the term comes from the concept that all the water that falls as precipitation in a geographic area 'sheds' to a particular exit point, it is important to recognize that a watershed also includes groundwater, i.e., not all precipitation that falls in a watershed flows out. While some rainfall and snowmelt soaks into the soil and gradually flows downhill within the watershed to feed wetlands or streams and rivers, other precipitation infiltrates deep into the ground to form ground-water aquifers. In Massachusetts, the term "River Basin" is often interchanged with watershed. Massachusetts has 27 watersheds[329] shown in the table and map below.



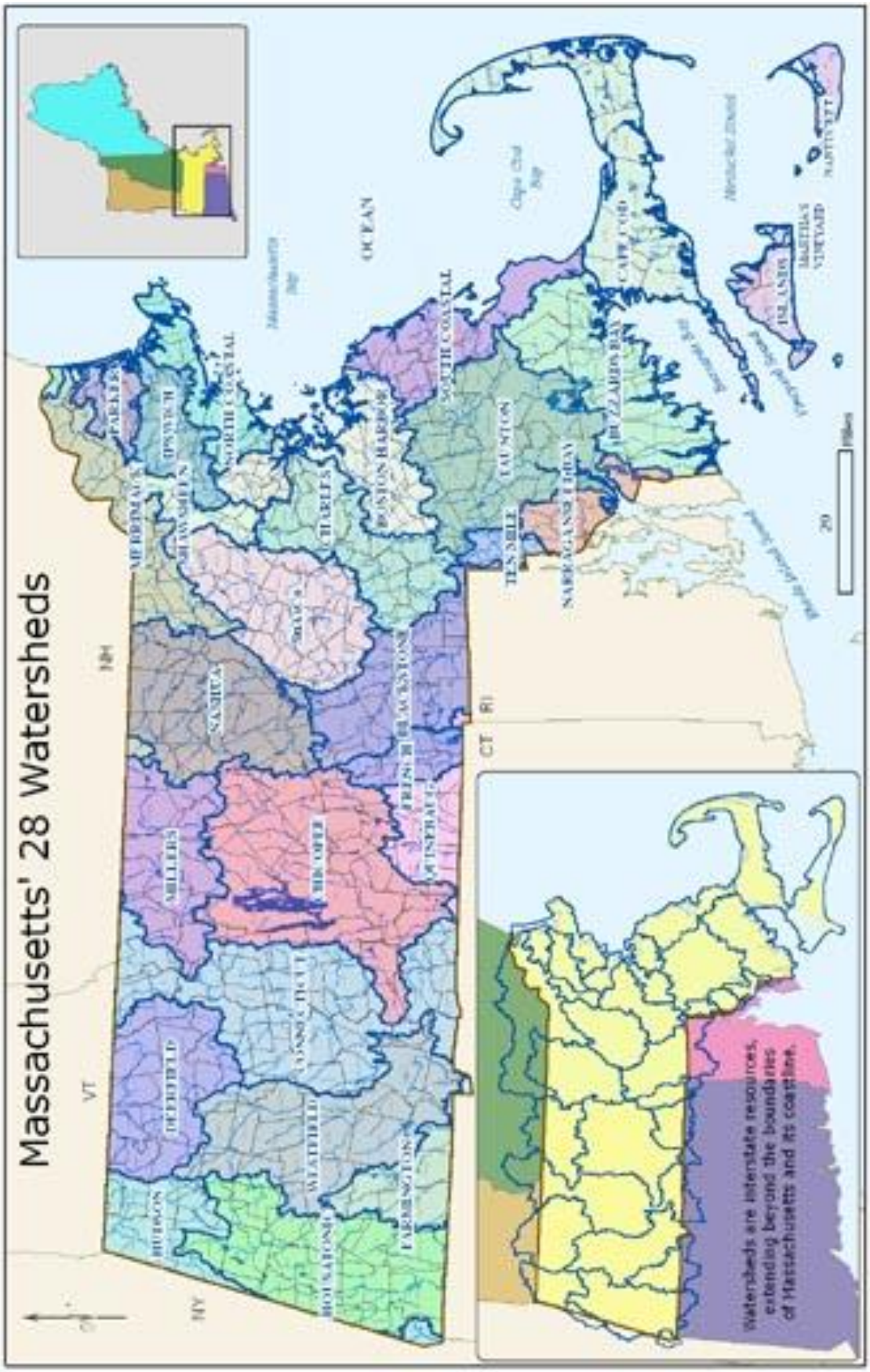


Watershed discharging to the Ocean	Watershed discharging to another river system.

[328] U.S. Geological Survey, "What is a watershed?", retrieved from http://ga.water.usgs.gov/edu/watershed.html. .
[329] MassDEP website http://www.mass.gov/eea/air-water-climate-change/preserving-water-resources/mass-watersheds/view-watersheds-by-region.html

Massachusetts Land-Based Watersheds	
Watershed	**Major Cities within each Watershed**
Blackstone River	Attleboro, Grafton
Boston Harbor (Mystic)	Woburn, Somerville, Medford, Arlington, Everett
Boston Harbor (Neponset)	Boston, Quincy, Stoughton, Dedham
Buzzards Bay	Fall River, New Bedford
Cape Cod	Barnstable, Dennis, Provincetown
Charles River	Boston, Cambridge, Brookline, Lexington, Natick
Chicopee River	Chicopee, Springfield, Palmer
Connecticut River	Amherst, Northhampton, Springfield
Deerfield River	Greenfield, Charlesmont
Farmington River	Otis, Sandisfield
French and Quinebaug Rivers	Sturbridge, Southbridge, Charlton
Housatonic	Pittsfield, Lee
Hudson (Hoosic) River	Adams, North Adams, Williamstown
Ipswich River	Andover, Beverly, Danvers, Ipswich, Peabody
Martha's Vineyard Island	Tisbury, West Tisbury, Edgartown
Merrimack River	Haverhill, Lowell, Lawrence, Newbury, Methuen
Millers River	Orange, Winchendon, Athol
Nantucket Island	Nantucket
Mount Hope/Narragansett Bay	Fall River, Dighton, Swansea
Nashua River	Fitchburg, Leominster, Townsend
North Coastal	Gloucester, Saugus, Lynn
Parker River	Newbury, Ipswich, Boxford
Shawsheen River	Andover, Tewksbury, Billerica
South Coastal	Plymouth, Duxbury, Marshfield
SuAuCo (Sudbury-Assabet-Concord) River System	Concord, Framingham, Marlborough, Sudbury
Taunton River	Taunton, Middleborough, Freetown, Brockton
Ten Mile River	Attleboro, North Attleboro
Westfield River	Blandford, Westfield, Chester

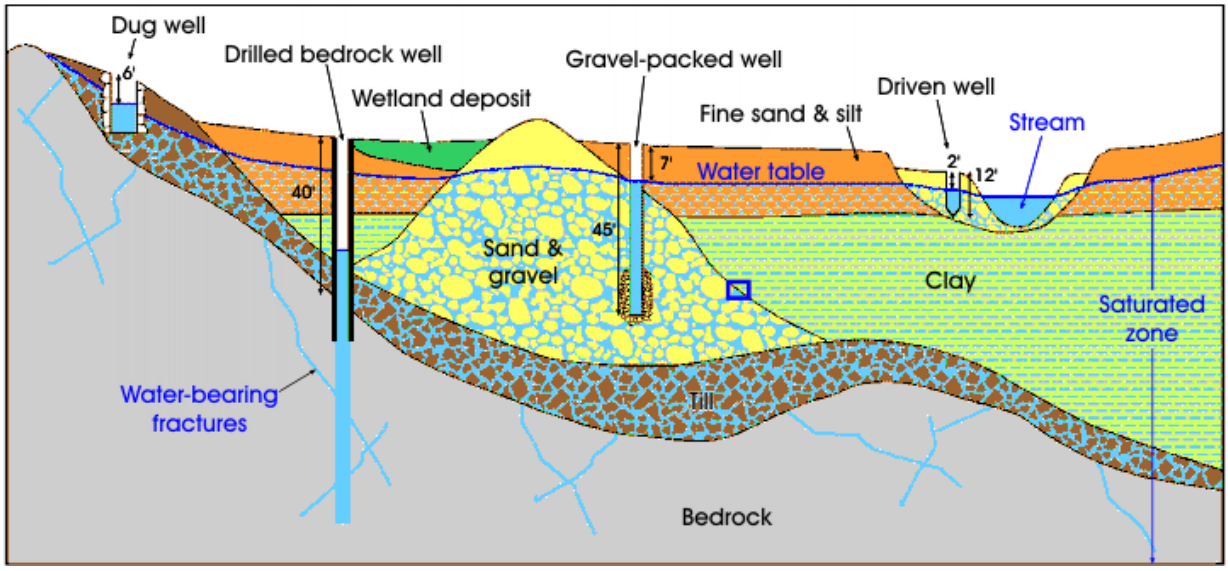
The 28th watershed serving Massachusetts is the Atlantic Ocean.


Massachusetts' 28 Watersheds
VT
NH
NY
CT
RI
OCEAN
Waterbeds are interstate resources, extending beyond the boundaries of Massachusetts and its coastline.

Groundwater in Massachusetts

The main water-bearing subterranean structures in Massachusetts can be classified by its rock type and ability to yield water. During the Ice-Age, glaciers advanced and retreated many times leaving layers (strata) of well-sorted sand, gravel, clay, and till (drift) above a layer of fractured bedrock formed in when the supercontinent Pangaea first formed and then broke apart. Early in the Commonwealth's settlement history, wells were dug into the shallow glacial drift to tap the groundwater close to the surface. This practice continues today despite the fact that many of these wells can experience decreased production or go dry during drought conditions. In some areas these shallow wells have become contaminated from infiltration of polluted surface water. As drilling technology improved, wells could be dug into the fractured bedrock, which can be found across the state. This is an option for many communities, except for those in the Cape and Islands region where it is buried deep and often mixed with sea water.

The illustration below is from the Maine Geological Survey.[330]



Stratified-Drift Aquifers

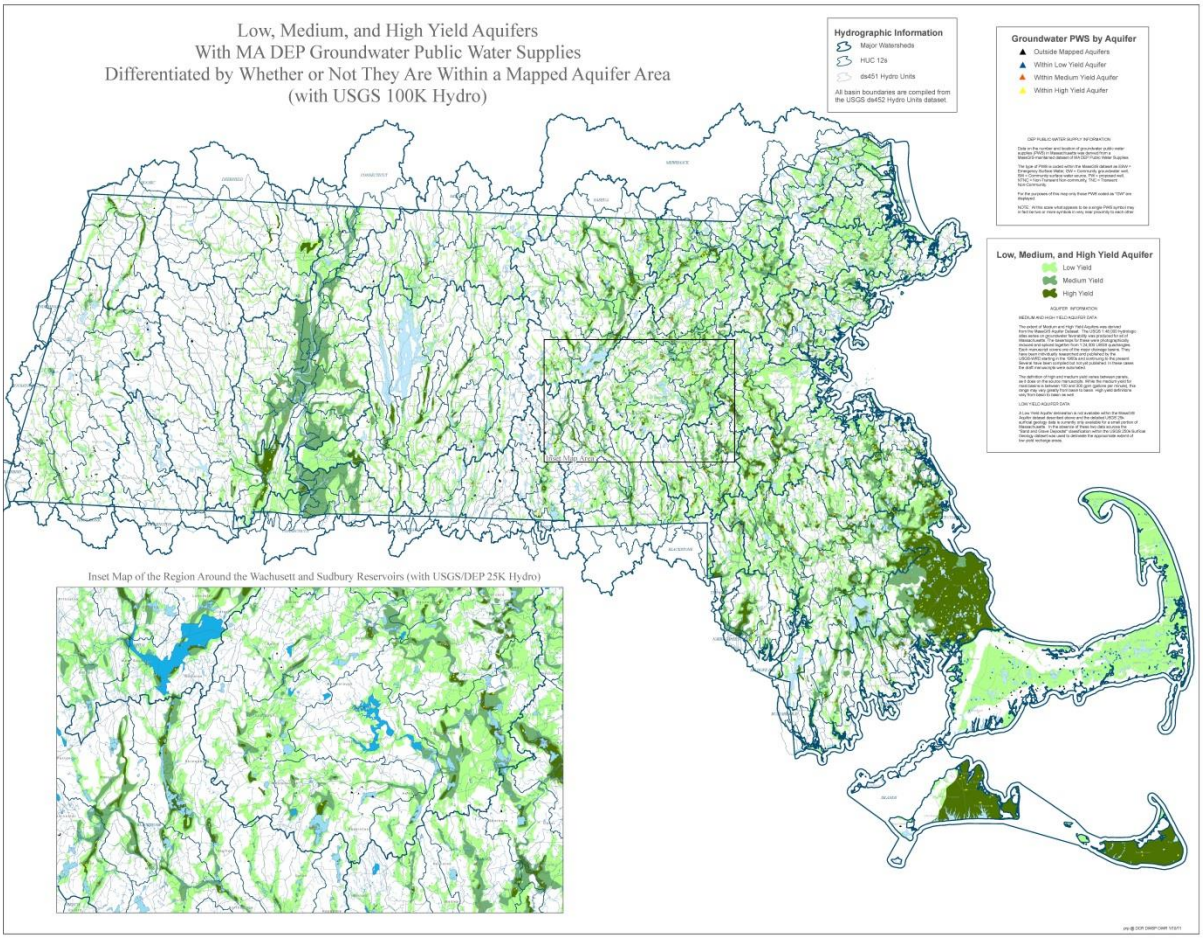
The most productive sources of groundwater in Massachusetts are unconfined stratified-drift aquifers.[331] The upper boundary of these aquifers consists of permeable deposits of sand and gravel known as the water table, and the lower edge is a layer composed of water trapping material such as clay or bedrock. Throughout the state, stratified-drift deposits form thin and narrow, but very productive aquifers within the 27 watersheds. In Plymouth County, Cape Cod, Martha's Vineyard and Nantucket there are no natural watershed dividers and the drift forms one continues layer over the bedrock. The higher water yields come from sand and gravel deposits with highest yields coming from

[330] State of Maine webpage http://www.maine.gov/doc/nrimc/mgs/explore/water/facts/water-1.htm
[331] Alison C. Simcox, "Water Resources of Massachusetts," Water-Resources Investigations Report 90-4144, U.S. Geological Survey, 1992

well near rivers or wetlands. Stratified-drift aquifers can quickly recharge if precipitation is allowed to soak into the ground. However, spreading suburbanization with packed soil and paving will continue to reduce the recharge rate and lower the yield.

Bedrock Aquifers

The three principal types of bedrock aquifers in the Commonwealth are crystalline (igneous and non-carbonate metamorphic), sedimentary, and carbonate.[332] Crystalline aquifers are the most common and can be found across the State. Sedimentary aquifers are found in west-central Massachusetts, with Carbonate aquifers primarily located in the Berkshires. The yield of a well in bedrock depends on the presence of fragmentation. Bedrock aquifers are generally less productive than stratified aquifers and take longer to recharge.



[332] Alison C. Simcox, "Water Resources of Massachusetts," Water-Resources Investigations Report 90-4144, U.S. Geological Survey, 1992

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APPENDIX C
A GUIDE TO METROFUTURE

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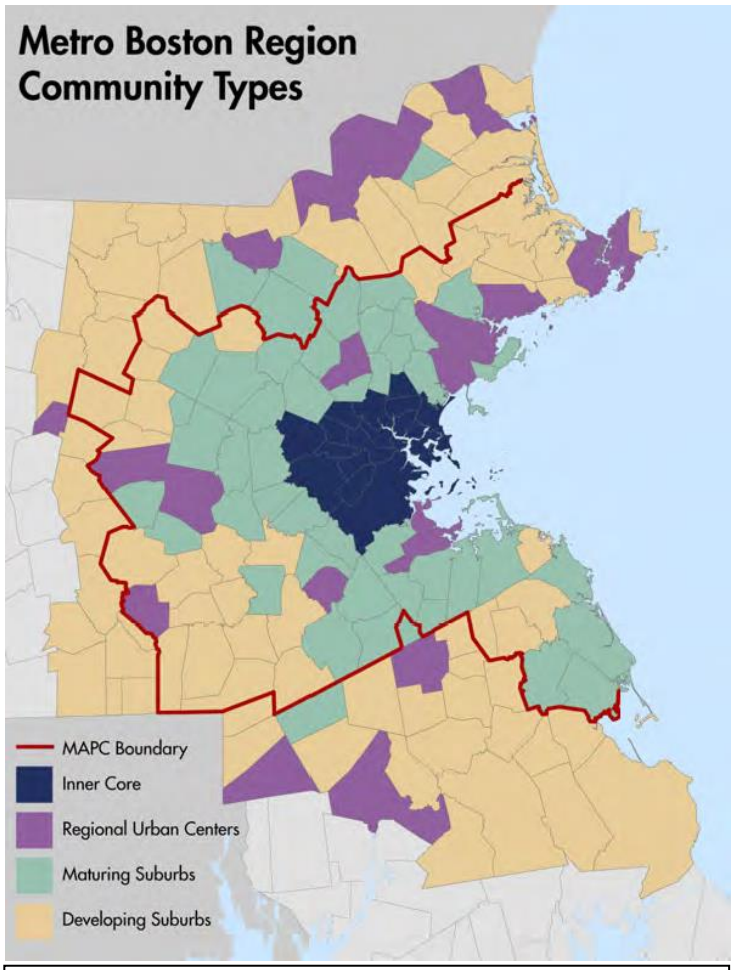
APPENDIX C: A GUIDE TO METROFUTURE

The Metropolitan Area Planning Council (MAPC) is the regional planning agency that covers the Boston metropolitan region, including 101 cities and towns. It was established in 1963 and was created as a public agency under Massachusetts General Law Chapter 40B Section 24. MAPC is one of 14 state agencies created by the Commonwealth at that time to respond to the need for a regional planning perspective. The agency works toward, "sound municipal management, sustainable land use, protection of natural resources, efficient and affordable transportation, a diverse housing stock, public safety, economic development, an informed public, and equity and opportunity among people of all backgrounds."[333]

Among MAPC's many initiatives is the MetroFuture Plan, which is a 30-year plan for the region adopted in 2008 after substantial public participation. In preparation of the plan, MAPC analyzed regional trends for a broader 164-municipality area.

The map below identifies the MetroFuture Communities classified by Community Type, which is based upon land-use and housing patterns, recent growth trends, and projected development patterns.



Metro Boston MetroFuture Study Area, MAPC

MetroFuture Data Analysis

A computer model of development was used as part of the MetroFuture planning effort to quantitatively analyze alternative patterns of future growth. This model linked population, housing, employment, land-use, water demand, and many other variables. According to MAPC, "key variables of the model included:

- Demographic projections based on birth and death rates (by age and race) and in- and out-migration rates (including international immigration.)

[333] MAPC, Mission Statement, retrieved from http://www.mapc.org/about-mapc, June 25, 2013.

- Employment projections based on national growth projections by employment sector and capture rate estimates for Eastern Massachusetts, as well as each community's share of our recent growth. Labor demand was estimated based on current region-specific staffing patterns for each sector.
- Labor supply, modeled on a regional basis by applying age, race, and gender-specific educational attainment, and labor force participation rates to the projected population.
- Land use projections based on local land-use trends, vacant developable land (accounting for wetlands and other constraints), and redevelopment opportunities.
- Open space resources.
- Housing supply, projected in eight basic housing types.
- Water demand, based on existing "baseline" demand and standard assumptions about the per-capita and per-employee (by sector) consumption for new growth.
- Municipal Finance, based on recent trends in revenue and per-capita expenditures.
- Transportation modeling using estimates trip generation, mode split, vehicle miles travel, congestion, and air quality indicators.
- Energy Consumption, based on per unit energy consumption for heating, water heating, appliances, lighting, and other uses for various housing types."[334]

Projections for 2035[335]

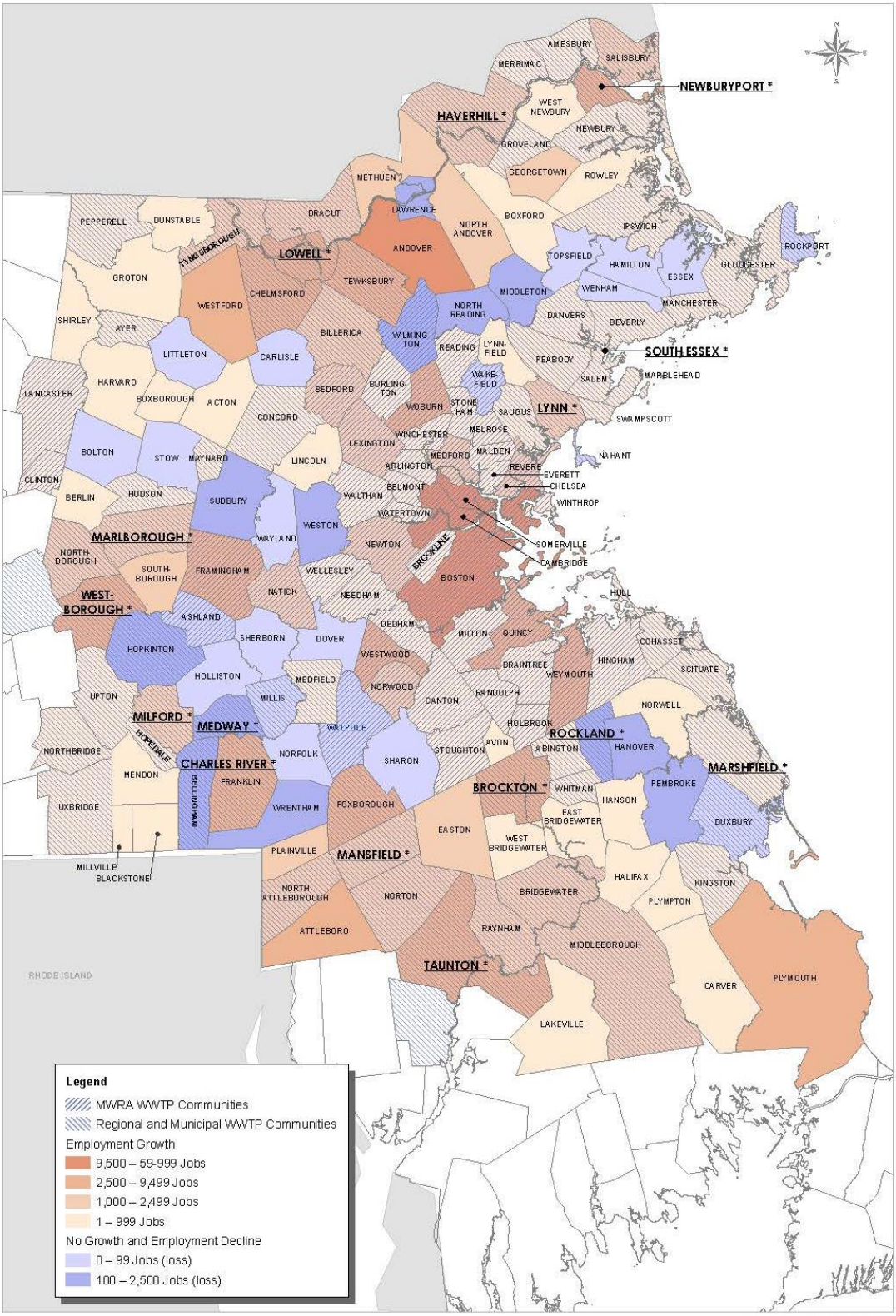
Three data sets are particularly relevant to this report: population, employment and water demand. Following the 2010 federal census, MAPC has been working to update the projections they previously developed. The first numbers to be released were the population and employment figures. MAPC expects to release new water demand projections later in 2013. Key findings include:

- The region is expected grow by an additional 713,000 residents to a total population of approximately 7.5 million. This population growth, however, is not evenly distributed across the metro region. MAPC's data reflects growth or loss by community.

- The metro Boston region is expected to add almost 230,000 new jobs for a total employment level of just over 2.5 million. Employment is also not evenly distributed across the region.

[334] MAPC, MetroFuture Making A Greater Boston Region, 2008, p. 7.
[335] Metropolitan Area Planning Council (MAPC), MetroFuture: Making A Greater Boston Region, May 2008, updated projections provided by Timothy G. Reardon, Manager of Planning Research, MAPC, to W. Rob May, March 2013.

Employment Growth 2010-2035



Source: MAPC MetroFuture 2013 Revisions

0 3 6 12 Miles

MAPC EMPLOYMENT PROJECTIONS (2010 – 2035)			
Location	**2010 Jobs**	**Change in Jobs**	**2035 Jobs**
Abington	3,812	628	4,440
Acton	9,650	609	10,259
Amesbury	4,612	260	4,872
Andover	32,011	9,997	42,008
Arlington	7,797	238	8,035
Ashland	4,996	-34	4,962
Attleboro	16,598	2,825	19,423
Avon	5,080	660	5,740
Ayer	8,410	580	8,990
Bedford	21,564	1,133	22,697
Bellingham	5,386	-225	5,161
Belmont	6,263	174	6,437
Berlin	480	150	630
Beverly	21,569	483	22,052
Billerica	20,583	2,226	22,809
Blackstone	1,030	30	1,060
Bolton	1,457	-56	1,400
Boston	545,079	58,314	603,393
Boxborough	3,881	63	3,944
Boxford	1,018	26	1,044
Braintree	26,221	986	27,207
Bridgewater	7,780	1,260	9,040
Brockton	36,800	5,240	42,040
Brookline	17,164	419	17,584
Burlington	37,223	881	38,104
Cambridge	103,015	16,938	119,953
Canton	23,146	171	23,316
Carlisle	583	-50	534
Carver	2,665	641	3,306
Chelmsford	20,736	3,183	23,919
Chelsea	13,393	1,579	14,973
Clinton	4,360	300	4,660
Cohasset	2,470	9	2,480
Concord	11,528	920	12,448
Danvers	24,990	117	25,107
Dedham	14,433	286	14,719
Dover	737	-84	652
Dracut	4,826	1,592	6,418
Dunstable	255	139	394
Duxbury	2,725	-12	2,713

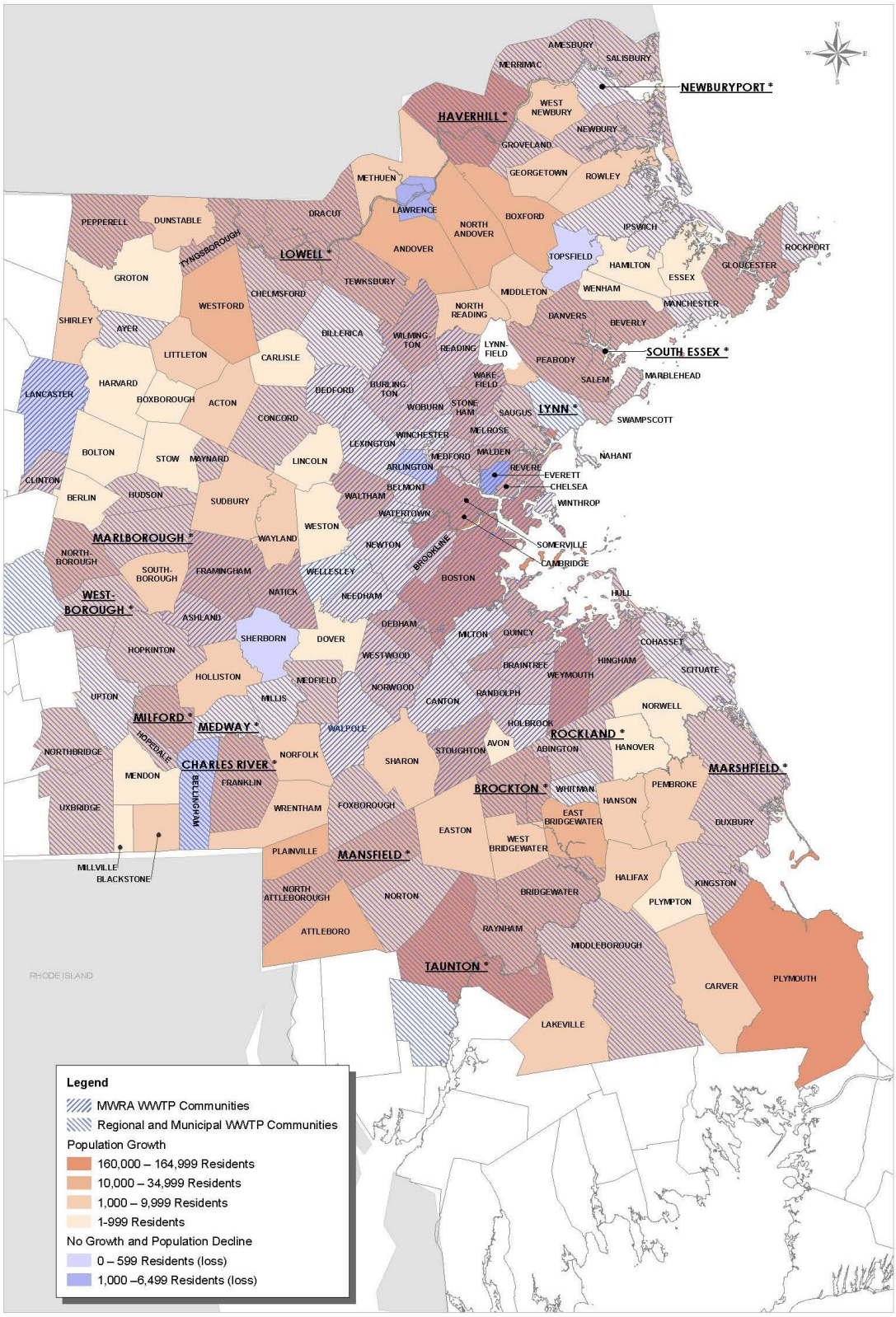
MAPC EMPLOYMENT PROJECTIONS (2010 – 2035)			
Location	**2010 Jobs**	**Change in Jobs**	**2035 Jobs**
East Bridgewater	2,540	411	2,951
Easton	9,330	1,485	10,815
Essex	1,106	-26	1,080
Everett	12,771	122	12,894
Foxborough	10,879	2,827	13,706
Framingham	43,809	3,020	46,829
Franklin	13,684	2,636	16,320
Georgetown	2,212	1,105	3,317
Gloucester	9,865	768	10,633
Groton	3,280	230	3,510
Groveland	1,114	747	1,861
Halifax	1,175	209	1,384
Hamilton	1,481	0	1,481
Hanover	6,721	-160	6,560
Hanson	1,512	254	1,766
Harvard	910	70	980
Haverhill	18,008	1,893	19,901
Hingham	11,790	443	12,233
Holbrook	2,628	155	2,783
Holliston	5,235	-1	5,233
Hopedale	1,620	50	1,670
Hopkinton	9,274	-158	9,116
Hudson	9,820	599	10,419
Hull	1,125	44	1,169
Ipswich	4,667	30	4,697
Kingston	5,100	690	5,790
Lakeville	2,990	828	3,818
Lancaster	2,120	150	2,270
Lawrence	23,039	-2,239	20,800
Lexington	19,287	2,410	21,696
Lincoln	1,681	112	1,793
Littleton	5,247	-29	5,219
Lowell	33,204	4,759	37,963
Lynn	22,557	2,253	24,810
Lynnfield	5,493	671	6,163
Malden	15,031	103	15,133
Manchester	1,698	81	1,779
Mansfield	10,992	1,819	12,811
Marblehead	4,619	172	4,791
Marlborough	32,715	1,463	34,178

MAPC EMPLOYMENT PROJECTIONS (2010 – 2035)			
Location	**2010 Jobs**	**Change in Jobs**	**2035 Jobs**
Marshfield	5,225	283	5,507
Maynard	4,400	185	4,585
Medfield	2,761	113	2,874
Medford	17,906	1,421	19,327
Medway	3,513	-177	3,336
Melrose	6,273	194	6,468
Mendon	1,280	40	1,320
Merrimac	766	217	983
Methuen	14,684	2,349	17,033
Middleborough	8,169	1,874	10,043
Middleton	4,288	-112	4,176
Milford	14,781	1,385	16,166
Millis	1,983	-53	1,930
Millville	270	10	280
Milton	4,988	1	4,990
Nahant	412	0	412
Natick	24,218	1,182	25,401
Needham	20,260	773	21,033
Newbury	1,459	790	2,249
Newburyport	10,445	2,855	13,300
Newton	47,779	2,184	49,962
Norfolk	3,212	-48	3,164
North Andover	13,149	1,410	14,559
North Attleboro	11,175	1,799	12,974
North Reading	8,418	-795	7,623
Northborough	5,800	1,840	7,640
Northbridge	5,320	630	5,950
Norton	5,971	1,087	7,058
Norwell	8,344	78	8,422
Norwood	23,811	1,315	25,126
Peabody	23,028	203	23,231
Pembroke	6,340	-113	6,226
Pepperell	1,379	921	2,300
Plainville	3,574	1,336	4,910
Plymouth	22,869	3,890	26,759
Plympton	384	856	1,240
Quincy	48,046	3,814	51,860
Randolph	7,734	694	8,429
Raynham	8,605	1,263	9,868
Reading	6,417	233	6,649

MAPC EMPLOYMENT PROJECTIONS (2010 – 2035)			
Location	**2010 Jobs**	**Change in Jobs**	**2035 Jobs**
Revere	8,873	1,158	10,031
Rockland	8,003	-231	7,773
Rockport	915	-12	903
Rowley	2,649	583	3,232
Salem	18,379	142	18,521
Salisbury	2,795	1,242	4,037
Saugus	10,079	513	10,592
Scituate	3,152	63	3,215
Sharon	3,349	-22	3,328
Sherborn	637	-28	608
Shirley	2,140	150	2,290
Somerville	20,435	15,130	35,564
Southborough	6,527	1,161	7,688
Stoneham	7,757	495	8,252
Stoughton	12,691	753	13,444
Stow	2,005	-97	1,908
Sudbury	7,830	-167	7,663
Swampscott	3,549	5	3,554
Taunton	24,118	4,342	28,460
Tewksbury	15,213	3,190	18,403
Topsfield	1,934	-87	1,848
Tyngsborough	4,123	1,526	5,649
Upton	1,010	30	1,040
Uxbridge	3,080	120	3,200
Wakefield	14,091	-37	14,054
Walpole	10,376	-68	10,308
Waltham	54,248	993	55,241
Watertown	18,334	738	19,072
Wayland	2,880	-66	2,813
Wellesley	16,735	893	17,629
Wenham	1,494	-15	1,478
West Bridgewater	5,860	900	6,760
West Newbury	739	65	804
Westborough	23,610	4,080	27,690
Westford	11,681	3,464	15,145
Weston	4,149	-203	3,946
Westwood	9,796	2,875	12,671
Weymouth	18,275	4,377	22,652
Whitman	3,126	482	3,608
Wilmington	18,939	-777	18,162

MAPC EMPLOYMENT PROJECTIONS (2010 – 2035)			
Location	**2010 Jobs**	**Change in Jobs**	**2035 Jobs**
Winchester	8,409	396	8,805
Winthrop	1,885	13	1,898
Woburn	38,807	2,688	41,495
Wrentham	6,275	-134	6,142
Grand Total	**2,299,045**	**229,139**	**2,528,184**

Population Growth 2010-2035



Source: MAPC MetroFuture 2013 Revisions

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MAPC POPULATION PROJECTIONS (2010 – 2035)			
Location	**2010 Population**	**Change in Population**	**2035 Population**
Abington	19,798	3,193	22,991
Acton	31,574	2,383	33,957
Amesbury	20,895	2,785	23,680
Andover	65,212	15,035	80,247
Arlington	50,642	-483	50,159
Ashland	21,589	2,258	23,847
Attleboro	60,192	6,457	66,649
Avon	9,436	940	10,376
Ayer	15,948	1,443	17,391
Bedford	34,884	1,567	36,451
Bellingham	21,719	-543	21,176
Belmont	30,992	1,158	32,150
Berlin	3,346	884	4,230
Beverly	61,071	3,773	64,844
Billerica	60,826	2,717	63,543
Blackstone	10,056	2,204	12,260
Bolton	6,354	814	7,167
Boston	1,162,721	162,435	1,325,156
Boxborough	8,877	978	9,855
Boxford	8,983	3,363	12,346
Braintree	61,966	3,368	65,334
Bridgewater	34,343	4,898	39,241
Brockton	130,611	9,479	140,090
Brookline	75,897	1,919	77,817
Burlington	61,721	3,294	65,015
Cambridge	208,627	33,462	242,089
Canton	44,707	809	45,515
Carlisle	5,435	363	5,799
Carver	14,174	3,553	17,727
Chelmsford	54,371	5,831	60,202
Chelsea	48,570	8,269	56,840
Clinton	17,966	1,884	19,850
Cohasset	10,012	733	10,746
Concord	29,196	3,421	32,617
Danvers	51,483	3,334	54,817
Dedham	39,162	4,585	43,747
Dover	6,326	-12	6,313
Dracut	34,283	8,207	42,490

MAPC POPULATION PROJECTIONS (2010 – 2035)			
Location	**2010 Population**	**Change in Population**	**2035 Population**
Dunstable	3,434	1,780	5,214
Duxbury	17,784	1,060	18,844
East Bridgewater	16,334	3,442	19,776
Easton	32,443	3,672	36,115
Essex	4,610	204	4,814
Everett	54,438	-1,753	52,686
Foxborough	27,744	4,051	31,795
Framingham	112,131	6,199	118,330
Franklin	45,319	6,072	51,391
Georgetown	10,395	3,313	13,708
Gloucester	38,654	4,311	42,965
Groton	13,926	1,124	15,050
Groveland	7,573	3,070	10,643
Halifax	8,693	1,691	10,384
Hamilton	9,245	586	9,831
Hanover	20,600	119	20,718
Hanson	11,723	2,543	14,266
Harvard	7,431	139	7,570
Haverhill	78,887	11,422	90,309
Hingham	34,019	3,979	37,998
Holbrook	13,420	534	13,954
Holliston	18,782	1,830	20,611
Hopedale	7,531	1,118	8,649
Hopkinton	24,199	2,159	26,358
Hudson	28,883	1,934	30,817
Hull	11,418	1,136	12,554
Ipswich	17,842	440	18,282
Kingston	17,729	2,261	19,990
Lakeville	13,593	3,223	16,816
Lancaster	10,175	-375	9,800
Lawrence	99,506	-6,099	93,407
Lexington	50,685	3,176	53,860
Lincoln	8,043	922	8,965
Littleton	14,172	1,748	15,921
Lowell	139,935	8,093	148,028
Lynn	112,887	12,439	125,326
Lynnfield	17,088	1,797	18,884
Malden	74,482	4,348	78,829
Manchester	6,834	147	6,981
Mansfield	34,176	5,646	39,822

MAPC POPULATION PROJECTIONS (2010 – 2035)			
Location	**2010 Population**	**Change in Population**	**2035 Population**
Marblehead	24,428	1,187	25,615
Marlborough	71,214	3,625	74,839
Marshfield	30,357	3,096	33,452
Maynard	14,506	1,432	15,938
Medfield	14,785	1,285	16,070
Medford	74,079	4,134	78,213
Medway	16,265	479	16,744
Melrose	33,256	1,723	34,980
Mendon	7,119	761	7,880
Merrimac	7,104	1,653	8,757
Methuen	61,938	3,463	65,401
Middleborough	31,286	3,391	34,677
Middleton	13,276	2,020	15,296
Milford	42,927	4,780	47,707
Millis	9,874	200	10,074
Millville	3,460	230	3,690
Milton	31,990	858	32,849
Nahant	3,822	236	4,058
Natick	57,333	4,375	61,709
Needham	49,146	1,605	50,751
Newbury	8,125	3,299	11,424
Newburyport	27,861	3,528	31,389
Newton	132,867	2,887	135,753
Norfolk	14,439	978	15,417
North Andover	41,501	7,089	48,590
North Attleboro	39,889	8,415	48,304
North Reading	23,310	371	23,681
Northborough	19,955	5,495	25,450
Northbridge	21,027	2,563	23,590
Norton	24,971	3,641	28,612
Norwell	18,851	230	19,081
Norwood	52,414	3,171	55,585
Peabody	74,380	3,999	78,379
Pembroke	24,177	2,015	26,191
Pepperell	12,876	7,134	20,010
Plainville	11,838	4,358	16,196
Plymouth	79,338	18,410	97,748
Plympton	3,204	1,836	5,040
Quincy	140,383	8,436	148,819
Randolph	39,846	2,829	42,676

MAPC POPULATION PROJECTIONS (2010 – 2035)			
Location	**2010 Population**	**Change in Population**	**2035 Population**
Raynham	21,987	5,022	27,009
Reading	31,147	2,788	33,934
Revere	60,628	4,488	65,116
Rockland	25,492	1,509	27,002
Rockport	7,867	728	8,595
Rowley	8,505	2,302	10,807
Salem	59,719	3,982	63,701
Salisbury	11,078	3,580	14,658
Saugus	36,707	2,631	39,338
Scituate	21,284	174	21,458
Sharon	20,961	1,581	22,543
Sherborn	4,756	-40	4,715
Shirley	9,351	1,619	10,970
Somerville	96,233	29,627	125,859
Southborough	16,294	2,580	18,874
Stoneham	29,194	3,586	32,780
Stoughton	39,654	4,614	44,268
Stow	8,595	439	9,034
Sudbury	25,489	1,438	26,927
Swampscott	17,336	1,066	18,402
Taunton	80,045	13,958	94,003
Tewksbury	44,174	8,360	52,534
Topsfield	8,019	-161	7,859
Tyngsborough	15,415	5,368	20,783
Upton	8,552	1,028	9,580
Uxbridge	16,537	2,284	18,821
Wakefield	39,022	3,065	42,087
Walpole	34,447	781	35,228
Waltham	114,880	4,839	119,719
Watertown	50,391	1,145	51,536
Wayland	15,874	2,001	17,874
Wellesley	44,719	720	45,440
Wenham	6,369	147	6,515
West Bridgewater	12,776	1,982	14,758
West Newbury	4,974	1,657	6,631
Westborough	41,883	6,917	48,800
Westford	33,632	8,560	42,192
Weston	15,410	566	15,976
Westwood	24,414	4,775	29,189
Weymouth	72,019	15,701	87,720

MAPC POPULATION PROJECTIONS (2010 – 2035)			
Location	**2010 Population**	**Change in Population**	**2035 Population**
Whitman	17,614	1,044	18,658
Wilmington	41,263	2,354	43,617
Winchester	29,783	551	30,334
Winthrop	19,382	152	19,534
Woburn	76,927	4,561	81,488
Wrentham	17,230	2,108	19,339
Grand Total	**6,758,175**	**713,650**	**7,471,825**

APPENDIX D
HIGH AND MEDIUM STRESSED WATER BASINS

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APPENDIX D: HIGH AND MEDIUM STRESS BASINS

The table below identifies the High Stress and Medium Stress River Basin and Sub-Basins in Massachusetts[336].

High and Medium Stress River Basins and Sub-Basins in MA		
Station Name	**Station #**	**FINAL STRESS LEVEL**
Aberjona at Winchester	01102500	HIGH
East Branch Swift near Hardwick	01174500	HIGH
East Branch Tully River near Athol	01165000	HIGH
Hop Brook near New Salem	01174000	HIGH
Hubbard River near West Hartland, CT	01187300	HIGH
Ipswich River at S. Middleton	01101500	HIGH
Ipswich River at Ipswich	01102000	HIGH
Nashoba Brook near Acton	01097300	HIGH
Parker River at Byfield	01101000	HIGH
Priest Brook near Winchendon	01162500	HIGH
Quinsigmond River at North Grafton	01110000	HIGH
Segreganset River near Dighton	01109070	HIGH
Seven Mile River near Spencer, MA	01175670	HIGH
Valley Brook near West Hartland, CT	01187400	HIGH
Wading River at Mansfield	01108500	HIGH
Ware River near Barre	01172500	HIGH
Assabet at Maynard	01097000	MEDIUM
Cadwell Creek near Belchertown	01174900	MEDIUM
Charles River at Dover	01103500	MEDIUM
Charles River at Waltham	01104500	MEDIUM
Charles River at Wellesley	01104200	MEDIUM
Concord below River Meadow Brook at Lowell	01099500	MEDIUM
French River at Hodges Village	01124350	MEDIUM
Green River at Williamstown	01333000	MEDIUM
Green River near Colrain	01170100	MEDIUM
Indian Head River at Hanover	01105730	MEDIUM
Little River near Oxford	01124500	MEDIUM
Mill River at Northampton	01171500	MEDIUM
Millers River at Erving	01166500	MEDIUM
Millers River at South Royalston	01164000	MEDIUM
Millers River near Winchendon	01162000	MEDIUM
Nashua at East Pepperell	01096500	MEDIUM
Neponset River at Norwood	01105000	MEDIUM
North River at Shattuckville	01169000	MEDIUM
Old Swamp River near South Weymouth	01105600	MEDIUM
Quaboag near West Brimfield	01176000	MEDIUM

[336] Massachusetts Water Resources Commission, Stressed Basins in Massachusetts, December 13, 2001, p.20.

High and Medium Stress River Basins and Sub-Basins in MA		
Station Name	**Station #**	**FINAL STRESS LEVEL**
Quinebaug River at Quinebaug, CT	01124000	MEDIUM
Quinebaug River nr Southbridge	01123600	MEDIUM
Shawsheen River near Wilmington	01100600	MEDIUM
South River near Conway	01169900	MEDIUM
Squannacook near West Groton	01096000	MEDIUM
Swift River at West Ware	01175500	MEDIUM
Tarbell Brook near Winchendon	01161500	MEDIUM
Taunton River near Bridgewater	01108000	MEDIUM
Threemile River at North Dighton	01109060	MEDIUM
West Branch Farmington nr New Boston	01185500	MEDIUM
West Branch Westfield at Huntington	01181000	MEDIUM
Wading River near Norton	01109000	MEDIUM
Ware River at Gibbs Crossing	01173500	MEDIUM
Ware River at Intake Works near Barre	01173000	MEDIUM
West River near Uxbridge	01111200	MEDIUM
Westfield River at Knightville	01179500	MEDIUM
North Nashua near Leominster	01094500	MEDIUM*
Otter River at Otter River	01163200	MEDIUM*

*Data for the Otter River and the North Nashua River watersheds indicate a low stress classification, however they are classified as Medium stress due to a medium stress classification down gradient.

APPENDIX E
MUNICIPAL WATER RESTRICTIONS (AUGUST 5, 2013)

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APPENDIX E: MUNICIPAL WATER USE RESTRUCTIONS
(August 5, 2013)

Massachusetts Municipal Water Use Restrictions as of August 5, 2013[337]			
Town	**Public Water Supplier**	**Implementation Date**	**Restriction Level**
Acton	Acton Water District	5/1/2013	Mandatory
Ashburnham	Ashburnham Water Dept.	5/1/2013	Voluntary
Athol	Athol Water Dept.	7/21/2013	Mandatory
Auburn	Auburn Water District	5/1/2013	Mandatory
Barnstable	Centerville-Osterville Marston Mills Water Dept.	5/21/2013	Mandatory
Barre	Barre Water Dept.	5/1/2013	Mandatory
Bellingham	Bellingham Water Dept.	5/7/2013	Mandatory
Billerica	Billerica Water Works	5/1/2013	Mandatory
Blackstone	Blackstone Water Dept.	7/22/2013	Mandatory
Byfield	Byfield Water District	5/1/2013	Mandatory
Chelmsford	Chelmsford Water District	5/1/2013	Mandatory
Chelmsford	North Chelmsford Water District	5/1/2013	Mandatory
Cohasset	Aquarion Water Co.	7/17/2013	Mandatory
Concord	Concord Water Dept.	7/18/2013	Mandatory
Danvers	Danvers Water Division	5/1/2013	Mandatory
Dedham	Dedham-Westwood Water District	6/1/2013	Voluntary
Douglas	Douglas Water Dept.	5/1/2013	Mandatory
Dover	Colonial Water Co.	5/1/2013	Mandatory
Dudley	Dudley Water Dept.	5/1/2013	Mandatory
Easton	Easton Water Division	5/1/2013	Mandatory
East Bridgewater	East Bridgewater DPW	5/20/2013	Mandatory
Falmouth	Falmouth Water Dept.	4/22/2013	Voluntary
Foxborough	Foxborough Water and Sewer Comm.	5/1/2013	Mandatory
Franklin	Franklin Water Dept.	6/3/2013	Mandatory
Grafton	Grafton Water District	1/1/2013	Mandatory
Grafton	South Grafton Water District	6/1/2013	Voluntary
Groton	Groton Water Dept.	6/1/2013	Mandatory
Groton	West Groton Water Supply District	5/1/2013	Mandatory
Halifax	Halifax Water Dept.	7/1/2013	Mandatory
Harwich	Harwich Water Dept.	6/1/2013	Voluntary
Hingham	Aquarion Water Co.	7/17/2013	Mandatory
Holden	Holden DPW	5/1/2013	Mandatory
Hopkinton	Hopkinton Water Dept.	5/1/2013	Mandatory
Hudson	Hudson Water Dept.	5/1/2013	Mandatory
Hull	Aquarion Water Co.	7/17/2013	Mandatory
Leicester	Cherry Valley and Rochdale Water District	5/1/2013	Voluntary

[337] Massachusetts Executive Office of Energy and Environmental Affairs, Department of Environmental Protection, Water Resources web page http://www.mass.gov/eea/agencies/massdep/water/watersheds/municipal-water-use-restrictions.html.

Massachusetts Municipal Water Use Restrictions as of August 5, 2013[337]			
Town	**Public Water Supplier**	**Implementation Date**	**Restriction Level**
Lincoln	Lincoln Water Dept.	5/1/2013	Mandatory
Littleton	Littleton Water Dept.	5/1/2013	Mandatory
Lynnfield	Lynnfield Center Water District	5/1/2013	Mandatory
Mansfield	Mansfield Water Dept.	5/24/2013	Mandatory
Marion	Marion Water Division	6/15/2013	Mandatory
Marlborough	Marlborough DPW Water Division	5/6/2013	Mandatory
Medfield	Medfield Water Dept.	7/25/2013	Mandatory
Medway	Medway Water Dept.	5/1/2013	Mandatory
Middleborough	Middleborough Water Dept.	5/1/2013	Mandatory
Middleton	Middleton Water Dept.	7/22/2013	Mandatory
Milford	Milford Water Co.	7/8/2010	Mandatory
Millbury	Aquarion Water Co.	5/1/2013	Mandatory
Millis	Millis Water Dept.	5/1/2013	Mandatory
Needham	Needham Water Dept.	6/26/2013	Mandatory
Norfolk	Norfolk Dept. of Public Works	1/1/2013	Mandatory
North Attleborough	North Attleborough Water Dept.	5/1/2013	Mandatory
Northampton	Northampton DPW	7/23/2013	Mandatory
Norton	Norton Water Dept.	1/1/2013	Mandatory
Oak Bluffs	Oak Bluffs Water District	5/1/2013	Mandatory
Orange	Orange Water Dept.	7/21/2013	Mandatory
Pepperell	Pepperell Water Division	5/1/2013	Mandatory
Plymouth	Plymouth Water Co.	5/1/2013	Mandatory
Provincetown	Provincetown Water Dept.	6/1/2013	Mandatory
Raynham	Raynham Center Water District	5/1/2013	Mandatory
Raynham	North Raynham Water District	6/1/2013	Mandatory
Reading	Reading Water Dept.	3/1/2013	Mandatory
Scituate	Scituate Water Dept.	5/27/2013	Mandatory
Seekonk	Seekonk Water District	5/1/2013	Mandatory
Shirley	Shirley Water District	5/1/2013	Mandatory
Sharon	Sharon Water Dept.	5/1/2013	Mandatory
Shelburne	Shelburne Falls Fire District	7/31/2013	Mandatory
Shrewsbury	Shrewsbury Water Dept.	5/1/2013	Mandatory
Spencer	Spencer Water Dept.	5/1/2013	Mandatory
Sterling	Sterling Water Dept.	5/1/2013	Mandatory
Sturbridge	Sturbridge Water Dept.	5/29/2013	Voluntary
Sutton	Wilkinsonville Water District	5/1/2013	Mandatory
Templeton	Templeton Light and Water	5/23/2013	Mandatory
Topsfield	Topsfield Water Dept.	5/9/2013	Voluntary
Upton	Upton Water Dept.	5/1/2013	Mandatory
Uxbridge	Uxbridge Water Dept.	5/1/2013	Mandatory
Walpole	Walpole Water Dept.	5/6/2013	Mandatory
Wareham	Onset Fire and Water District	5/1/2013	Mandatory
Wareham	Wareham Fire District	5/1/2013	Mandatory
Wayland	Wayland Water Division	6/23/2013	Mandatory

APPENDIX F
CASE STUDIES FOR FRAMINGHAM & LYNNFIELD
Prepared by the MWRAAB

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APPENDIX F: CASE STUDIES FOR FRAMINGHAM & LYNNFIELD

(Prepared by the MWRAAB)

In addition to the case studies presented in the main body of the report, Advisory Board staff reached out to communities and entities related to two additional projects: Genzyme in Framingham, and the MarketStreet Lynnfield open air shopping center.

Genzyme, Framingham

The Massachusetts Life Sciences Center (MLSC) describes itself as "an investment agency that supports life sciences innovation, research, development, and commercialization."[338] More specifically, it is charged with dispersing $1 billion in state funds over ten years aimed at "innovation-driven economic development initiatives in the Massachusetts life sciences ecosystem."[339]

In 2008, MLSC dispersed $12.9 million in the form of a direct grant to the town of Framingham to help make possible the expansion of Genzyme's presence.[340] A major reason Genzyme was able to expand at the site was due to the investment of these public funds to "upgrade sewer infrastructure in and around the technology park."[341]

After this public investment in the local infrastructure was made, it leveraged $315 million in additional private funds from Genzyme to complete the project. This project allowed for the creation of 230,000 square feet of new life science space, as well as an increase in local property tax revenue of $1 million/year. In addition to saving the 2,300 existing jobs, this project created 389 full-time equivalent jobs and 183 trade jobs.[342] Additionally, these new jobs contribute an estimated $315 thousand in annual state revenue. Between 2015 and 2018, Genzyme intends to expand over 760,000 square feet – 400,000 square feet of research-related space, as well as 360,000 square feet to be used by some combination of manufacturing, office, and parking – which will significantly add to the local revenues.
The success of this project further demonstrates the relationship between the investment in infrastructure and the resulting job creation and potential economic development opportunities.

600 Market Street, Lynnfield

600 Market Street in Lynnfield was a prime location for development. The project was to encompass a 203-acre parcel featuring 395,000 square feet of retail space, 80,000 square feet of office space, and 180 units of housing. It would eventually become "the North Shore's largest open air shopping center."[343] However, before the site could be developed wastewater capacity issues had to be addressed.

[338] http://www.masslifesciences.com
[339] http://www.masslifesciences.com/about/mission/
[340] Source: Email dated September 19, 2013 from Colin Donnelly of MLSC.
[341] http://www.metrowestdailynews.com/news/x1272743103/Genzyme-celebrates-opening-of-new-Framingham-plant
[342] Source: Email dated September 19, 2013 from Colin Donnelly of MLSC.
[343] http://www.marketstreetlynnfield.com

The site was already statutorily permitted to utilize the MWRA wastewater system; however, without significant investment in the local infrastructure, the additional capacity needed for this development would not have been possible. This investment totaled approximately $3.3 million, and upgraded the wastewater collection systems in the communities of Melrose and Wakefield to allow for a connection into Wakefield.

When completed, the development will create 1,000 permanent jobs and will generate an estimated $1.75 million/year in tax revenue for Lynnfield.[344] Increased state revenue from these new jobs is estimated at $806 thousand annually.

The Market Street example demonstrates that insufficient infrastructure limits a project's ability to develop or expand; however, it also shows the potential economic and financial benefit, both to the municipality and to the Commonwealth, when a sufficient investment is made to upgrade the infrastructure appropriately.

Genzyme and Market Street at a Glance							
Location	**Project**	**Investment Made**	**Local Property Tax**	**Projected Pop Growth**	**Increased Local Buying Power**	**Projected Job Growth**	**Increased Annual State Revenue (from jobs only)**
Framingham	Genzyme Expansion	$12.9 m MA Life Science Grant for Infrastructure Improvements	$1 m	0	0	Saved 2,300 jobs; Added 389 FTE and 183 trade jobs	$315,000
Lynnfield	Colonial Lynnfield Development	$3.3 m for Wastewater Improvements to Wakefield and Melrose	$1.75 m	0	0	1,000	$806,000

[344] http://www.bostonglobe.com/metro/regionals/north/2013/02/21/lynnfield-development-set-open-august-owners-eye-cinema/em23iowA9ZTKGfHs212sPK/story.html

APPENDIX G
MASSWORKS FUNDED PROJECTS (2011-2013)
Prepared by the MWRAAB

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APPENDIX G: MASSWORKS FUNDED PROJECTS (2011-2013)

(Prepared by the MWRAAB)

The MassWorks Infrastructure Program has also demonstrated the importance of water and wastewater infrastructure for the economic development and growth for municipalities. According to the MassWorks website:[345]

The MassWorks Infrastructure Program provides a one-stop shop for municipalities and other eligible public entities seeking public infrastructure funding to support:

- Economic development and job creation and retention;
- Housing development at density of at least 4 units to the acre (both market and affordable units); and,
- Transportation improvements to enhancing safety in small, rural communities

The MassWorks Infrastructure Program is administered by the Executive Office of Housing and Economic Development, in cooperation with the Department of Transportation and Executive Office for Administration & Finance.

Water and Wastewater Projects Receiving MassWorks Funds from 2011 – 2013

Chelsea: The City of Chelsea was awarded a $3 million grant to support Phase III of the Gateway Center Improvement Project, which will include the replacement of water mains, sewer separation, and roadway and sidewalk repairs. These upgrades will help support the long-term redevelopment efforts in the City's Urban Renewal District and will support the construction of a new 152-room hotel, a 250,000 square foot corporate center, and the construction of the second phase of the One North housing project, which will include 230 market-rate rental units. This latest grant will complement the $2.5 million the City has received in MassWorks funding since 2011 to support the revitalization of the area. This project is supported by the Metropolitan's Area Planning Council's Metrofuture Plan. Click here for the press release and more information

Ashland: Cold Spring Brook Infrastructure Improvement Project – $365,000 for increasing the Cold Spring Brook sewer pipeline and connecting it to the Chestnut Street Pump Station. The improvements support future growth within the Rail Transit District, which is located within a quarter-mile of the Ashland commuter rail station and was identified as a State Priority Development Area in the 495/MetroWest Development Compact.

Ware: Industrial Sewer Treatment Expansion – $2.5 million in MassWorks support will complement $1 million committed by the Town of Ware and an additional $2.5 million by Kanzaki Specialty Paper (KSP) for upgrades and improvements to Ware's Waste Water Treatment Plant. The project represents a

[345] http://www.mass.gov/hed/economic/eohed/pro/infrastructure/massworks/

Public-Private partnership which will increase sewer capacity by mitigating current treatment issues generated by KSP and allow KSP to expand production at their facility.

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The Edward J. Collins, Jr. Center for Public Management in the McCormack Graduate School of Policy and Global Studies at the University of Massachusetts Boston was established in 2008 to improve the efficiency and effectiveness of all levels of government. The Center is funded by the Commonwealth and through fees charged for its services.

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