IPSWICH BASIN WATER MANAGEMENT ACT PLANNING GRANT FY17

DRAFT REPORT

20173509.001A

JUNE 19, 2017

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TOWN OF TOPSFIELD
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A Report Prepared for:

The Town of Danvers, MA

In partnership with:

Town of Middleton, MA
Town of Hamilton, MA
Lynnfield Center Water District
Town of Topsfield, MA
Town of Wenham, MA

IPSWICH BASIN WATER MANAGEMENT ACT PLANNING GRANT FY17

DRAFT REPORT

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ACKNOWLEDGEMENTS to be added

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0 EXECUTIVE SUMMARY

The Ipswich River Basin (the Basin) includes all or part of 22 different communities in northeastern Massachusetts. The watershed has a population of approximately 160,000 people and supplies municipal water to approximately 350,000 people (EOEA, 2003). A significant amount (75%) of Basin water withdrawals are exported, either as wastewater flow, or for potable water use, outside of the Basin. Over the next 20 years, the Basin population is estimated to increase by about 5%. As the region's population continues to experience growth, increased water supply demands are likely.

Six community public water suppliers in the Basin conceived of this project in partnership: Danvers, Middleton, Hamilton, Lynnfield Center Water District, Topsfield and Wenham – in collaboration with the Massachusetts Water Works Association (MWWA); and with Kleinfelder providing technical and engineering consulting support. The purpose of this study was improve understanding of the current and future water supply constraints and challenges facing the Basin's municipal public water suppliers—particularly those who maintain groundwater sources—and, to identify potential regional solutions that could allow for improvement of resiliency and environmentally sustainable growth. Through an evaluation of existing information, this study examined the following questions:

- What are the constraints of the Ipswich Basin governing its hydrology?
- How are the Basin water resources being used?
- What opportunities are there to better manage water in the Basin?
- Is there enough water for future municipal public water supply needs?
- What are the Basin water supplier needs and challenges, particularly for Grant Partner communities?
- What are some solutions to improve resiliency for groundwater suppliers in the Basin?

Basin Characteristics and Water Usage Practices

Since the 1960s, the water resources challenges of the Ipswich Basin have been discussed and studied. The Basin's limited sand and gravel aquifers are situated primarily within river and stream valleys and so since the early 1900s, the primary locations for municipal groundwater wells have naturally been historically sited close to streams and rivers. The effect of municipal wells on streamflow in the upper reaches of the Basin has been anecdotally reported as far back as the 1960s, and modeled in recent years. In the last 10 years the use of some of the wells thought to be causing the most impact has ceased, yet low flows in the Ipswich River are still observed.

With its low lying topography, high groundwater table and humid climate, almost half of Basin rainfall is lost to evapotranspiration before it can recharge the groundwater and replenish stream baseflow. Recent studies have emphasized the powerful influence of evapotranspiration on the Basin's hydrology. **As climate change leads to longer periods of higher temperatures, the effect of natural processes on streamflow depletion is only expected to increase.**

Lack of available suitable aquifers in undeveloped areas away from headwater streams has led to very limited success by municipal suppliers in identifying new groundwater sources. As a result, use of surface water and purchase of water from outside of the Basin has been increasing as the use of groundwater sources has decreased. Whereas groundwater made up half of total water supply in 1960, **current groundwater withdrawals from the Basin have dropped to below 1960 volumes and surface water represents over 75% of the total water withdrawn from the Basin**. While overall Basin withdrawals more than doubled from 1960 to the late 1980s, and population has continued to increase, **total current withdrawals have remained steady at late 1980s rates. This appears to indicate that in general the Basin water users have made significant gains in demand reduction and are using water efficiently.** This is supported by statistics indicating that on average, Ipswich Basin water suppliers are meeting conservation standards.

Demand management

Water supply demand management best practices appear to be widely used amongst Basin groundwater suppliers. The seven municipal groundwater public suppliers responding to a survey reported that **almost all feasible enhanced conservation and demand management practices were in use and were rated as effective**. However, in terms of optimizing supplies with more advanced alternative strategies to minimize environmental impact, most groundwater suppliers responding indicated that most strategies were infeasible to implement, primarily due to physical constraints. The exceptions were suppliers who also had access to surface supply storage for moderating the use of wells during summer. Historic trends indicate that changes in water supply practices in the last several decades have resulted in a significant increase in the practice of seasonal 'flood skimming' or withdrawing large volumes of surface water during high streamflow months and storing them for summer use. For suppliers for whom this is an option, it is helping to moderate the effect of seasonal higher demand on groundwater supplies. All permitted groundwater suppliers in the Basin are subject to stringent permit restrictions intended to reduce summer seasonal impacts on surface water resources in order to improve aquatic habitat for stocked freshwater fish.

Almost all groundwater suppliers responding to a survey reported significant operational and administrative challenges in attempting to comply with all permit restrictions.
A 2010 USGS study scaled up water saving results from pilot programs that used four different water conservation techniques. Hypothetical water use reductions ranged from 1.4 to 8.5% but reductions in this range (less than 10%) had negligible effects on simulated low flows in the Basin

The physical / hydrologic dynamics of the Basin and recent modeling studies suggest that **as the climate warms, any incremental benefit to be gained by additionally stringent conservation or increasing restrictions on groundwater withdrawals are likely to be more than offset by evapotranspiration effects. Requiring water suppliers to chase these 'diminishing returns' may be increasingly costly and restrictive of economic growth**.

Wastewater and stormwater management

Other ways to improve Basin recharge and stream low flows through stormwater retrofit projects and low impact development have been explored and studied in the past decade. Results have shown that **while potentially beneficial in certain localized situations, and likely beneficial to water quality, on a Basin-wide scale low impact development and stormwater retrofits efforts will be volumetrically insignificant for improving stream low-flows.** Due to the large volume of wastewater export from the Basin, the capture and return of wastewater to the Basin would represent the best way to truly balance the hydrologic budget in the long term. However, due to the infrastructure already in place, and potential detriment to surface and groundwater quality, this solution is likely infeasible for the foreseeable future.

Future needs and potential solutions

Given that current municipal use (representing over 95% of total withdrawals) is about 22 MGD, and the established Basin Safe Yield is 29.4 MGD, usage would have to increase by over one-third to exceed the safe yield level. With population projections estimating on the order of 5% growth through the next twenty-five years, the answer **would appear to be that the Basin as a whole can supply foreseeable public water demands as well as accommodate limited growth.** It is clear that due to hydrogeologic and land use limitations alone, significant expansion of groundwater supplies in the Basin will not be a solution for the future. **Therefore, responsible expansion of regional supplies and of surface water options should be explored and permitted**. On the other hand, if regulators decide to adopt even more stringent protections with the goal of achieving the river flows as recommended by the Ipswich River Fisheries Restoration

Task Group, studies have indicated that reservoirs would fail to fill to capacity to meet demands for public water supply (USGS, Zarriello 2002).

The Grant Partner communities supplying groundwater have a number of specific challenges. Most of them are some of the smallest communities in the Basin with fewer sources and therefore reduced operational flexibility. Most are close to or projected to exceed baseline withdrawal limits and some have already been actively working on mitigation activities. Many are struggling to fund costly water treatment solutions while handling the administrative and operational burden of the permit conditions. The practice of maximizing surface water withdrawals during high flow and storing the water for summer use through the expansion of existing or construction of a new reservoir is one obvious choice for the long term water supply needs in the Basin. Another would be utilization of out of Basin sources such as those available via the Massachusetts Water Resources Authority (MWRA) Water System.

If communities can share resources, and be supported by regulators and environmental advocates, to implement one of these solutions, there is a better chance that Basin water resources can be managed in a way that balances current and future human needs with environmental protection.

1 BACKGROUND

1.1 INTRODUCTION AND PROJECT PURPOSE

The Ipswich River Basin (the Basin) covers an area of approximately 155 square miles and includes all or part of 22 different communities in northeastern Massachusetts. As the region's population continues to experience growth, increased water supply demands are inevitable. Six community public water suppliers in the Basin conceived of this project in partnership: Danvers, Middleton, Hamilton, Lynnfield Center Water District, Topsfield and Wenham – in collaboration with the Massachusetts Water Works Association (MWWA), and with Kleinfelder providing technical and engineering consulting support. These six Grant Partner suppliers desire to better understand current water supply constraints and projected future needs, while evaluating potential regional solutions that can ensure enough water for their respective communities' environmentally responsible future growth and development.

Currently, all of the Grant Partner suppliers are able to accommodate their individual water demands within their respective withdrawal volumes authorized under registrations and/or Water Management Act Permits. This constitutes a cumulative demand of about 5 million gallons per day (MGD). The communities' ability to meet individual water demands while reducing usage below historic 'baseline' levels (as defined in 310 CMR 36) suggests that they are already implementing effective conservation measures. However, recent projections indicate that most of the groundwater-based public suppliers in this Grant Partnership are expected to exceed their baseline volumes within 2 years. The maximum amount of dependable withdrawals that the Massachusetts Department of Environmental Protection (MassDEP) believes can be made continuously from the Basin (referred to as the "safe yield") according to the safe yield methodology adopted in November of 2014 is 29.4 MGD. The total annualized authorized withdrawal volumes allocated to all users (this includes golf courses, industrial/commercial, and municipal users) is 32.8 MGD, which is in excess of the defined safe yield. Therefore, this study sought to explore the following questions:

- How much water is actually being used in the Basin?
- Are there ways to better manage water in the Basin?, and

- How can public water suppliers (particularly those relying on groundwater) plan to meet long-term demand?

The Grant Partner groundwater suppliers in the Basin have indicated that substantial reliance on existing groundwater resources will continue to be a significant impediment to regional economic development as long as the principal strategy for meeting demand is to rely on individual permit holders to implement mitigation and minimization measures to reduce that demand. Instead, these public water suppliers recognize the need to be planning and implementing coordinated strategies to enhance, share, conserve and utilize their available resources—whether from within or outside the Basin or through the implementation of technological innovations.

1.2 IPSWICH BASIN

1.2.1 Topography, Hydrology and Wetlands

The Basin is located within an area of low relief known as the Atlantic coastal plain. Topography within the Basin is irregular on a local scale, with an average altitude of approximately 130 feet, ranging from sea level to 420 feet at Holt Hill in Andover. However, the topography of the Basin is uniform enough that it does not cause significant spatial variations in temperature and precipitation. The Ipswich River itself drops a total of only 115 feet in altitude along its 35 mile course from the northeastern corner of Burlington to Plum Island Sound in Ipswich. This is an average slope of only 0.06%. Surface water bodies and wetlands for the Ipswich Basin are shown on Figure 1-1.

As the river flows northeasterly towards the Atlantic, it passes through a large expanse of wetlands created by the low relief of the Basin. Swamps and marshes cover the valleys, flooding over 20% of the total land surface at times. Below Sylvania Dam in Ipswich, the river becomes an estuary bordered by tidal marshes for the remaining 3.5 miles of its course. A total of 77 small lakes and ponds fill depressions in the lowland areas of the Basin, 36 of which are greater than 10 acres in area. The largest lake in the Basin is Wenham Lake located in Wenham and Beverly, with an area of 224 acres.

0 0.75 1.5 3 4.5 6 Miles

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Ipswich Basin Surface Water Resources

Ipswich Basin FY17 Water Management Act (SWMI) Grant Project
Town of Danvers
Massachusetts

FIGURE
1-1

Two USGS gauging stations in the Ipswich River are used to collect and analyze streamflow data. The upstream station is located just below the South Middleton Dam in South Middleton (station number 01101500) and has a contributing drainage area of approximately 44.5 square miles. The period of record for the South Middleton station is October 1, 1937 to present. The mean annual streamflow over that period was 68 cubic feet per second (cfs). The downstream station (Ipswich Station) is located below the Willowdale Dam in Ipswich (station number 01102000) and has a contributing drainage area of approximately 125 square miles. The period of record for the Ipswich Station is October 1, 1929 to present. The mean annual streamflow at the Ipswich station was 194 cfs during that period.

Streamflow data collected over the period of record at the Ipswich station shows that the highest monthly mean streamflow occurs in March at a value of 456 cfs, while the lowest monthly mean streamflow at the station occurs in August at a value of 42 cfs. Streamflow data collected over the period of record at the South Middleton station shows that the highest monthly mean streamflow also occurs in March at 156 cfs. The lowest monthly mean at the upstream station is 15 cfs during August. In both cases there is approximately 90% reduction in streamflow between the highest and lowest months. The growing season in the Basin, as a part of USDA Zone 6, spans from roughly mid-April to mid-October. During this time large volumes of precipitation are captured by plants and evaporated before reaching the streams as baseflow.

The mean streamflow over the period of record for the growing season is 43 cfs and 128 cfs at the South Middleton and Ipswich stations, respectively. During the other half of the year, sometimes referred to as the recharge season, mean streamflow values are 92 cfs and 260 cfs at South Middleton and Ipswich stations, respectively. This is approximately twice the mean streamflow of the growing season. Figures 1-2 and 1-3 below show streamflow data for both the upstream and downstream stations for the period of record that was available electronically.

Zarriello and Reis (2000) created a precipitation and runoff model to analyze the effects of water withdrawals on streamflow within the Basin. Their model estimated median August ‘natural’ streamflow, with no water withdrawals or diversions for water supply. The estimated natural August median is 0.39 cubic feet per square mile (cfsm) at the South Middleton station and 0.25 cfsm at the Ipswich station.

FIGURE 1-2: STREAMFLOW DATA AT SOUTH MIDDLETON STATION (01101500 PERIOD OF RECORD (USGS)

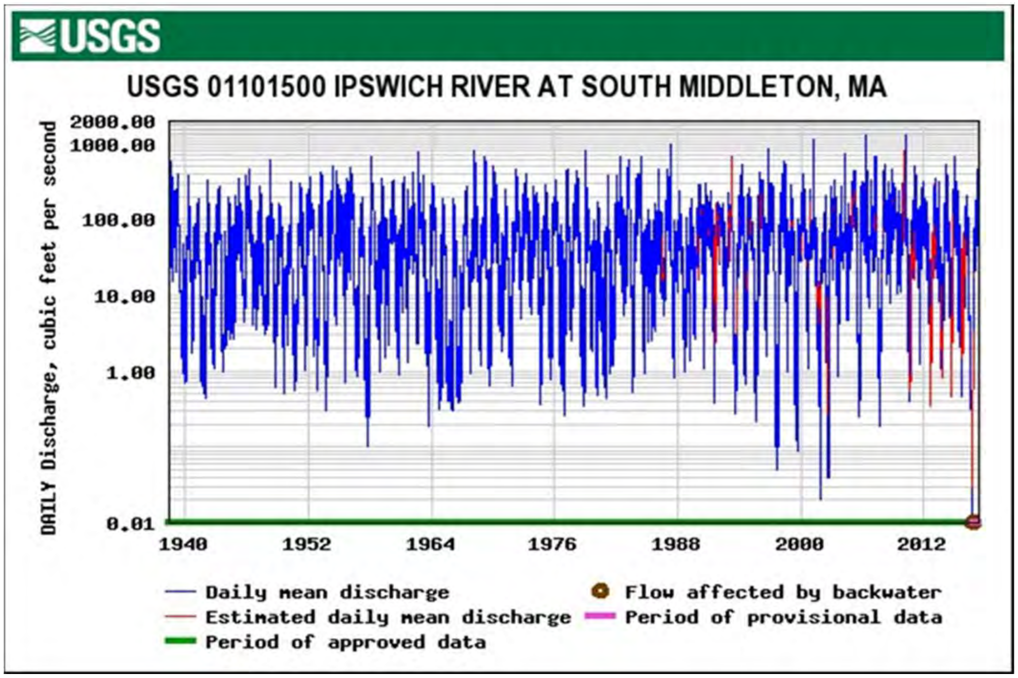
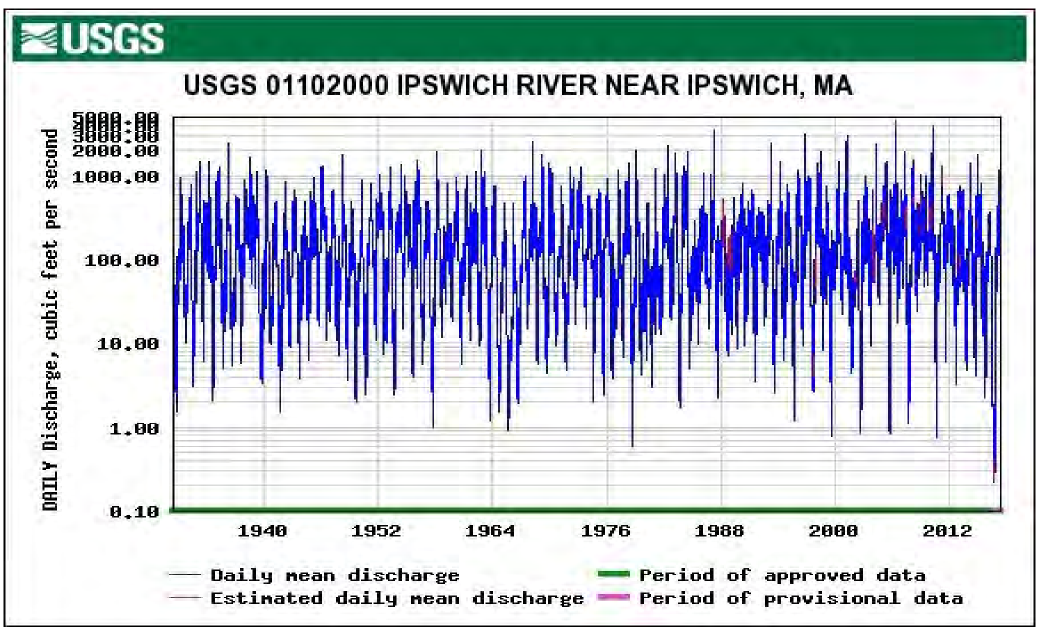


FIGURE 1-3: STREAMFLOW DATA AT IPSWICH STATION (01102000) PERIOD OF RECORD (USGS)



1.2.2 Climate and Precipitation

Located in northeastern Massachusetts, the climate of the Ipswich River Basin is typical of coastal New England regions. High temperatures during the summer months are limited by the region's proximity to the ocean, while precipitation extremes are effected by seasonal coastal storms.

The average annual air temperature in the Basin for the period of 1961-1995 was 49°F, with the lowest monthly mean of 25°F occurring in January and the highest monthly mean of 71°F occurring in July. The average annual precipitation in the Basin during this period was 45 inches, of which approximately 8% was snow (Zarriello and Ries, 2000). This total corresponds to approximately 121,100 million gallons (MG) of precipitation on an annual basis. Monthly totals show that precipitation generally falls uniformly throughout the year, with the difference between the wettest and driest month typically being around one inch. However, there are significant seasonal fluctuations in streamflow and recharge to deeper groundwater bodies, both of which are influenced by the annual temperature cycle.

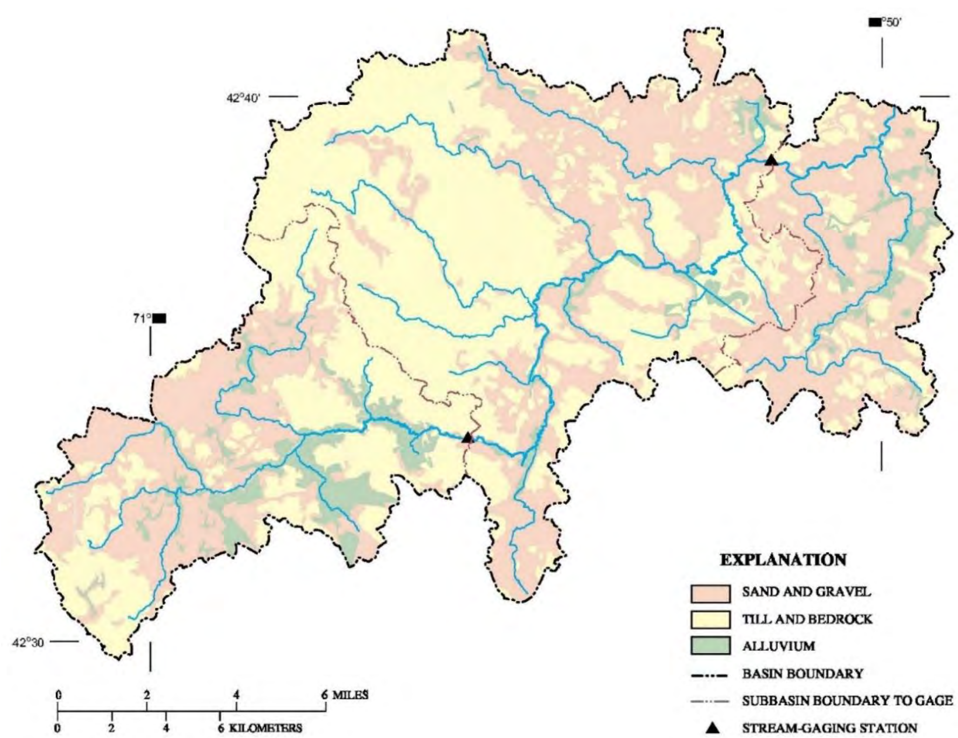
During the growing season, roughly mid-April to mid-October, little or no recharge reaches the deeper aquifers, as the majority of precipitation is lost to evapotranspiration. The average annual evapotranspiration (ET) is approximately 45% of precipitation. This amounts to 54,500 million gallons per year (MGY), or 149 million gallons per day (MGD). Evapotranspiration in the Basin is strongly seasonal, ranging from an average of 24 MGD in December to 352 MGD in July (Claessens et al, 2006). This results in lower groundwater levels and dramatic decreases in streamflow as the growing season progresses (Claessens et al, 2006; United States Geological Survey [USGS] 1966).

Current climate projections for coastal Massachusetts regions suggest that flooding due to precipitation is likely to increase in frequency, extent, and depth as the 21st century continues. The increase in flood conditions is not expected to result from an overall increase in precipitation totals, but rather an increase in the size and intensity of individual precipitation events. Along with an increase in the severity of precipitation events, an increase in the frequency, intensity, and duration of extreme heat events is also projected for the region. The higher likelihood of extended heat waves will further increase evapotranspiration rates in the Basin during the summer months, when recharge is already at a minimum, and water demands are highest.

1.2.3 Hydrogeology

Much like the climate and topography of the Ipswich River Basin, the underlying igneous and metamorphic bedrock units exhibit little spatial variation in terms of infiltration properties, storage capacities and water yield. Dominant rock types in the area include schist, syenite, diabase, and pegmatite of Precambrian to Triassic origin. Water is stored in joints and fractures within the bedrock and can produce a small but reliable source of water from drilled bedrock wells. However, the porosity, specific yield, and permeability of the bedrock are low and bedrock formations within the Basin do not form important or sizeable groundwater reservoirs (USGS, 1966) and are typically only suitable for domestic or small scale irrigation use. Unconsolidated deposits of the Basin show significant spatial variations in permeability and water storage capacity. These deposits can be generalized into three units consisting of: glacial till, stratified sand and gravel, and alluvium, covering approximately 54 percent, 43 percent, and 3 percent of the Basin, respectively (Zarriello and Ries, 2000); see Figure 1-4. The extensive presence of till limits the available deposits within the Basin that are suitable for municipal use as groundwater resources.

FIGURE 1-4: GENERALIZED SURFICIAL GEOLOGY OF THE IPSWICH RIVER BASIN (ZARIELLO AND RIES, 2000)



Glacial till in the Basin underlies most upland areas and can vary in content and compactness but as a unit has relatively low hydraulic conductivity. Precipitation that falls in the uplands runs off the semi-permeable glacial till, recharging very little to the underlying sediments and quickly reaching the permeable deposits of stratified sand and gravel that cover most of the lowland areas. These deposits, if allowed to recharge are theoretically able to store large quantities of precipitation and make up the Basin's major aquifers. Water stored in the aquifers is slowly released to streams throughout the year and is a major source of stream baseflow for the watershed. The fine-grained alluvial deposits of the Basin are generally located along stream channels and have a low to moderate permeability. In general, surficial soils of wetlands are of high porosity and low permeability, meaning they can store water well but do not facilitate its transfer to deeper aquifers. The large expanse of heavily vegetated wetlands in the Basin increases the potential for evapotranspiration during the summer growing season by holding water close to the land surface and inhibiting recharge (Zarriello and Ries, 2000).

1.2.4 History and Land Use

Land use within the Basin underwent drastic changes throughout the 20th century. From approximately 1900 to 1950 there was significant reforestation of the Basin. As agricultural land use declined during the first half of the 20th century, forests began to reclaim abandoned farmlands. Just after the turn of the century, agricultural land accounted for over 45 percent of the total land cover. By 1950 that percentage had dropped below 20 percent while forest cover increased from approximately 30 percent to over 50 percent during that same period. Residential land use increased slightly during the first half of the century but remained below 10 percent. Beginning in 1950 and continuing through the end of the century, there was a sharp increase in residential land use. The rapid urbanization of the Basin and increase in residential land use during the latter part of the 20th century was accompanied by deforestation. From 1951 to 1999 the ratio of forested to residential areas decreased from 5:1 to 1:1 (Claessens et al., 2006).

Impervious surfaces that prevent infiltration of water into the ground, such as building roofs and paved areas, have risen correspondingly with increased residential and commercial land use. Zarriello and Ries estimated the effective impervious cover in the Basin at approximately 6,725 acres in 1998. This value was obtained by estimating the percentage of impervious cover for various types of land uses such as commercial, high-density residential, and low-density residential. The impervious cover value presented by Zarriello and Ries also differentiates between impervious surfaces that drain directly to rivers and streams and those that drain to pervious surfaces. As a result the total area they present as effective impervious cover is lower than the total impervious cover in the Basin and cannot be compared directly to current impervious cover totals.

Estimates obtained using Massachusetts Geographic Information Systems (MassGIS), based on aerial photography for 2005, show a total of 11,025 acres of impervious cover. This accounts for approximately 11% of the total Basin area (Figure 1-5).

1.2.5 Population

The human population within the Ipswich River Basin steadily increased as the region was rapidly urbanized throughout the second half of the 20th century, almost quadrupling over the last 80 years of the century, with a population of approximately 120,000 in 1999 (Claessens, 2006). The Massachusetts Executive Office of Energy and Environmental Affairs (EOEA) has reported that the watershed has a population of approximately 160,000 people and supplies municipal water to approximately 350,000 people (EOEA, 2003).

For this study, population and population projections were estimated for the Basin by using Town population data for 16 Towns located in the Basin or partially within the Basin (Tewksbury, Rowley, Billerica, Woburn and Georgetown were not included) and multiplying the total Town population by the % of land area within the Basin. Population data and projections were obtained from the University of Massachusetts Donahue Institute (UMDI) Population Estimation Program. This data was used to produce population estimates for the Basin through 2035. For the period between 2015 and 2035, the data indicates that Basin population is projected to increase from approximately 147,600 to approximately 162,200, or by 4.6%. The population projections for the six Grant Partner communities are examined in further detail in Section 2.

0 1.25 2.5 5 7.5 10
Miles

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PROJECT NO. 20173509.001A	Ipswich Basin Impervious Cover		FIGURE
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FILE NAME: Ipswich Basin.mxd			

1.2.6 Streamflow Depletion

Precipitation and baseflow from sand and gravel aquifers are the two major contributors to streamflow in the watershed. In late winter and early spring, the Basin is inundated with water, and unconsolidated aquifers become saturated. As a result, snowmelt and precipitation runoff directly to the watershed's streams, and high stream flows are observed. This is in sharp contrast to conditions observed during the growing season (mid-April to mid-October), where increased rates of evapotranspiration result in the reduction by half of the volume of precipitation that is available to recharge deeper groundwater bodies.

Recent studies have emphasized the powerful influence of evapotranspiration on the Basin's hydrology. Long term simulations (1961-85) modeled by Zarriello and Reis (2000) evaluated scenarios with no water withdrawals and found that flow-duration curves for undeveloped land use and 1991 land use were similar, suggesting that land use has little effect on streamflow conditions in the Basin. Classens and others (2006) similarly concluded from their models that land use had a minimal effect on increased evapotranspiration rates in the Basin and therefore on Basin streamflow. Classens et. al. suggested that the increase in evapotranspiration could be attributed entirely to climate change. As climate change leads to increased temperatures, the effect of natural processes on streamflow depletion is only expected to increase.

The Basin's limited sand and gravel aquifers are situated primarily within river and stream valleys. Since the early 1900s, municipal groundwater wells have therefore naturally been historically sited close to streams and rivers. Figure 1-6 shows the locations of water supplies in the Ipswich Basin. The link between municipal wells and reduced streamflow in the upper reaches of the Basin has been reported anecdotally as far back as the 1960s (USGS, 1966), and the subject of modeling studies in recent years. However, no studies verifying a direct impact of pumping wells on streamflow have been conducted.

Zarriello and Reis (2000) created a precipitation and runoff model to analyze the effects of water withdrawals on streamflow within the Basin. Short term simulations (1989-93) included scenarios with no withdrawals, only surface water withdrawals, and only groundwater withdrawals. Flow-duration curves and hydrographs developed for the modeled scenarios predicted that surface water withdrawals had little or no effect on river low flows, but that groundwater withdrawals had the potential to effect modeled low flows. The model also predicted that groundwater withdrawals were most likely to impact streamflow between June and September and at headwater stream reaches with multiple pumped wells. It should be noted that the Zarriello and Reis model made the simplifying assumption that water withdrawn from groundwater wells was removed directly from the streamflow of the river.

Since the Zarriello and Reis (2000) study was published, however, **overall water withdrawals from the Basin have stayed essentially the same while groundwater withdrawals have declined by 44%** (see Section 2 for details) **to below 1960 levels**. In the last 10 years the use of some of the wells thought to be causing the most low streamflow impact has ceased. Lack of available suitable aquifers in undeveloped areas away from headwater streams has led to very limited success by municipal suppliers in identifying new groundwater sources. As a result, groundwater withdrawals from the Basin have dropped to below 1960 volumes and surface water currently represents over 75% of the total water withdrawn from the Basin. The dynamics of the Basin suggest however, that if continuing to reduce groundwater withdrawals has no discernable effect on improving stream low flows, the evapotranspiration effect is likely offsetting whatever incremental improvements, if any, are attributable to such reductions.

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Ipswich Basin Water Supply Withdrawals

Ipswich Basin FY17 Water Management Act (SWMI) Grant Project
Town of Danvers
Massachusetts

FIGURE
1-6

1.3 WATER MANAGEMENT ACT

1.3.1 History

Massachusetts General Law Chapter 21G, the Massachusetts Water Management Act, went into effect in 1986. The Water Management Act (WMA) was enacted with the intent to achieve a balance among the many and sometimes competing community water uses. The WMA also requires a determination of safe yield for each water source (defined as river basin in the current regulations) in the Commonwealth. The 1986 WMA regulations required new users with withdrawal volumes greater than 100,000 gallons per day (gpd) to undergo a withdrawal permitting process which would impose conditions on withdrawals based on hydrologic conditions of the particular basin. Permits were initially issued for 20 year periods with permit reviews scheduled every 5 years.

Registered public water suppliers (PWS), those with water withdrawals in place prior to the 1986 WMA, are required to maintain current registration statements but are not required to apply for WMA withdrawal permits, unless they intend to go above their registered volume by 100,000 gallons per day or install a new source. Public water suppliers with registered-only sources in the Basin include Ipswich, Lynn, Lynnfield Center Water District, Peabody, Wilmington, Reading, and North Reading. PWS with registered and permitted sources in the Basin include Danvers/Middleton, Hamilton, Topsfield, Salem/Beverly, and Wenham. Registrations are allowed a threshold volume above their registration amount, which the regulations in 310 CMR 36 currently define as “an average daily withdrawal volume less than 100,000 gpd for any period of 3 consecutive months from a total withdrawal of not less than 9 million gallons.

In 2001 the Ipswich River Basin was given the “stressed” designation by the Water Resources Commission. The Water Resources Commission defined a stressed basin as one in which the quantity of streamflow has been significantly reduced, the quality of streamflow is degraded, or the key habitat factors are impaired. It is important to note that the hydrologic stress was defined in relative terms by comparing Massachusetts basins to each other, not from a baseline assessments of each basin. In 2003 the MassDEP imposed additional conditions on permits being reviewed in an attempt to reduce the impacts of withdrawals on the Basin. Restrictions included seasonal restrictions on non-essential use, caps on residential gallons per capita per day (RGPCD), seasonal water use caps, water banks, and regulation of private wells. As a result, several permittees requested adjudicatory hearings; however, permit conditions imposed by the MassDEP were upheld.

In 2006, new permits were issued by MassDEP to permitted PWS in the Basin. At this time the Towns of Topsfield and Hamilton sued the MassDEP due to what they believed to be overly restrictive or unfair permit conditions. Ipswich Basin-specific conditions are discussed below in Section. In 2007 both permits were upheld by the court, however in the Hamilton case, the court remanded the MassDEP to re-determine the safe yield of the Basin. In August of 2009 Hamilton attempted to appeal the court's decision, however the appeal was determined to be premature until such time as MassDEP re-determined the safe yield.

In May of 2009, PWS' in the Basin filed permit renewal applications with the MassDEP and in April of 2010 Orders to Complete were submitted. Permit extensions were then allowed through the Permit Extension Act in 2010 and 2012, allowing withdrawals until 2014 under the existing permit conditions.

1.3.2 New Water Management Act Requirements

The Executive Office of Energy and Environmental Affairs (EOEA) convened a workgroup on sustainable water management that met from 2010 to 2014. New WMA regulations, 310 CMR 36.00, were promulgated in November of 2014 and included a new safe yield determination for the Basin, new baseline volumes for PWS', streamflow criteria, identification of cold-water fisheries resources, permit review categories, and minimization and mitigation requirements for permit holders.

The new safe yield determination of 29.4 MGD for the Ipswich Basin is less than both the current authorized (registered and permitted combined) withdrawal amount of 32.82 MGD and the registered-only withdrawal amount of 29.59 MGD. Baseline volumes were defined in 310 CMR 36 and calculated by MassDEP for each PWS by taking the volume of water withdrawn during the 2005 calendar year plus 5 percent, or the average annual volume withdrawn from 2003 to 2005 plus 5 percent, whichever is greater. However, baseline volumes cannot be less than a permittee's registered volume or greater than the authorized volume during 2005. In the event that during the 2003 to 2005 period, withdrawals were interrupted due to contamination of the source or construction of a treatment plant, the DEP used ''best available data" to establish baseline volumes for each PWS.

The new 2014 regulations also require that permit applicants with withdrawal points that impact a cold-water fish resource, as designated by the Massachusetts Department of Fisheries and Wildlife, must evaluate the feasibility of shifting such withdrawals to other withdrawal points if they exist. According to MassDEP, in the Ipswich Basin, cold-water fish resources are located in subbasins within the towns of Topsfield and Ipswich and withdrawals in those subbasins may require analysis to determine their impacts to the cold-water fish resources (see Figure 1-6). Additionally, PWS' with groundwater resources that are in subbasins with an August net groundwater depletion of 25% or more are required to develop and submit a plan to minimize the impacts of the requested groundwater withdrawal. Currently, 12 of the PWS in the Basin have groundwater resources in a subbasin with an August net groundwater depletion of 25% or more. Figure 1-6 displays the Ipswich River subbasins and water withdrawal points, along with net groundwater depletion ratings.

Permit applicants who seek withdrawal volumes above their baseline volumes are also required to submit a plan describing efforts that will be taken to mitigate such withdrawals to the greatest extent feasible. Plans are then reviewed and approved by the MassDEP as part of the permitting approval process. Details regarding minimization and mitigation requirements as well as newly defined permit tiers are described in the following sections. The reader is also referred to the MassDEP Water Management Act Guidance Document for detailed information on how MassDEP intends to implement the regulations during permit issuance and renewal: http://www.mass.gov/eea/docs/dep/water/laws/i-thru-z/wmaguide14.doc.

1.3.2.1 Permit Tiers

The November 2014 regulations define permit tiers for applicants. Permit tiers are determined based on the applicant's baseline withdrawal volume, any requested withdrawal above such baseline, and an evaluation of the potential change in biological category or groundwater withdrawal category during the late summer months (July- September) in the subbasin from which the water is withdrawn. Biological and groundwater withdrawal categories are defined in 310 CMR 36.14.

Biological categories 1-5 are assigned to each subbasin using fish data as a surrogate for aquatic health. Factors influencing the simulation include impervious cover, cumulative groundwater withdrawal as a portion of unimpacted August median flow, stream channel slope, and percent wetland in the stream buffer area. The groundwater withdrawal category for each subbasin is determined by looking at the ratio of the 2000-2004 groundwater withdrawal volume to the unimpacted median monthly flow for August, and is intended to be representative of conditions during the late summer (July-Sept) bioperiod. Seasonal groundwater withdrawal categories are also assigned for four other bioperiods using the ratio of the 2000-2004 groundwater withdrawal volume to the unimpacted mean median flow for the given period. The other bioperiods are defined as Fall (Oct-Nov), Winter (Dec-Feb), Spring (March-April), Early Summer (May-June).

Permit applications including a groundwater withdrawal or both a groundwater and surface water withdrawal are then assigned tiers based on the following criteria:

TABLE 1-1: WATER MANAGEMENT ACT WITHDRAWAL PERMIT TIERS

Tier	Description
Tier 1	The application does not request a withdrawal volume above the baseline volume
Tier 2	The application requests a withdrawal greater than the baseline volume, but it has been determined that the requested withdrawal will not change the biological category, groundwater withdrawal category, or seasonal groundwater withdrawal category of the subbasin from which the withdrawal is made.
Tier 3	The application requests a withdrawal greater than the baseline volume and it has been determined that the requested withdrawal will result in a change in the biological category, groundwater withdrawal category, or seasonal groundwater withdrawal category of the subbasin from which the withdrawal is made.

Withdrawals from surface water are divided into only two tiers, those that exceed baseline volume and those that do not. Tier 3 withdrawals are permitted by the MassDEP only if the permittee shows that there is no other feasible alternative to the requested withdrawal, and if the permittee undertakes mitigation commensurate with the impacts of the withdrawal to the greatest extent feasible.

1.3.2.2 Minimization Planning

Under the new 2014 WMA regulations, permit applicants with groundwater resources that are in subbasins with an August net groundwater depletion of 25% or more are required develop and submit a plan to minimize the impacts of the requested groundwater withdrawal. Of the 31 subbasins in the Ipswich River Basin, 13 have an August net groundwater depletion of 25% or greater. These include subbasins containing public water supply sources for Danvers, Hamilton, Ipswich, Lynn, Lynnfield Center Water District, North Reading, Peabody, Reading, Salem and

Beverly Water Supply Board, Topsfield, Wenham, and Wilmington. Minimization Plans must be submitted to the DEP for approval and all aspects of the plan must be approved prior to permit approval. The required minimization plan must include three analyses, with consideration given to cost, level of environmental improvement expected to result from minimization actions, available technology, and the applicants authority to implement the actions.

The first analysis that each minimization plan must include is referred to as a desktop optimization. This analysis is performed in order to evaluate whether there are any feasible operational changes that can be implemented in order to minimize the impacts of groundwater withdrawals on streamflow within the subbasin without significantly affecting the permittees ability to meet water demands. Operational changes that should be evaluated include modification of well withdrawal operations, including the timing of withdrawals from various sources, and the use of potential alternative sources including interconnections to adjacent systems. The desktop optimization must also consider existing system constraints such as infrastructure, pressure, water quality, operations, cost, regulatory issues, and societal needs. Results of the optimization analysis need to present the location and withdrawal schedules of the sources that will be used to meet the permittees water demands. For this study, Basin permittees were surveyed and interviewed about their current water management practices and the feasibility of implementing operational changes to minimize impacts on streamflow. Chapter 3 includes a qualitative evaluation and discussion of alternative sources and source optimization in the Basin.

The second analysis required in the minimization planning process looks at potential water releases and water returns in the subbasin. If a permit applicant has surface water impoundments located within, or upstream of the subbasin they must assess the feasibility of performing releases from such impoundments in a way that would improve the timing, magnitude, and duration of downstream flows in order to simulate natural conditions without significantly compromising other in-lake uses. In the event that such a release is possible, the permittee is required to develop and submit a plan for approval by the MassDEP. In addition to potential releases from surface water impoundments, permittees must also evaluate if there are any feasible opportunities to return water to the Basin in the form of stormwater recharge, infiltration/inflow (I/I) improvements, or wastewater discharges. Any such returns should aim to improve the quantity and timing of streamflow within the subbasin. Information from Basin permittees was collected to evaluate the feasibility of surface water releases, as well as wastewater and stormwater practices that could provide mitigation. These topics are discussed in Sections 3 and 4.

Lastly, each permittee submitting a minimization plan must adopt a specific set of nonessential outdoor water use restrictions designed by the MassDEP. Permittees must also evaluate all reasonable and cost-effective conservation measures beyond standard WMA water conservation requirements. Additional conservation measures should include, but are not limited to, rebate or incentive programs for residential customers that use WaterSense or Energy Star-labelled products, increases in water rates and evaluation of rate structure, increases in billing frequency, the listing of water consumption data on customers' bills, and comprehensive water system audits. Many of the Basin permittees are already employing many additional conservation measures. The water conservation practices of the Basin permittees are discussed further in Section 3.

1.3.2.3 Mitigation Planning

The 2014 WMA regulations specify that all applicants for Tier 2 and 3 permits must submit a formal plan detailing mitigation efforts that will be taken with regard to increased withdrawals. The plan must estimate the required volume of mitigation, identify feasible mitigation options, and include a timeline for the implementation of the selected mitigation options. Mitigation efforts are required to be commensurate with impacts, which are quantified volumetrically as the withdrawal volume above baseline. Impact is also characterized by changes in the biological or withdrawal category of the subbasin. Prior to beginning mitigation projects, permittees should exhaust all feasible options to reduce water demand below baseline.

Once it has been determined that water demands cannot be reduced below baseline using demand management, permittees are required to prioritize direct mitigation actions that are volumetrically quantifiable over indirect mitigation. Direct mitigation credits can be obtained through surface water releases, stormwater recharge efforts, wastewater returns, and infiltration and inflow removal and are based on a calculated rate of water returned. However, direct mitigation credits are subject to a location adjustment factor which adjusts the credited volume based on the area to which the water is returned. Water returns made outside of the major Basin will receive less credit than those which are returned within the major Basin.

Indirect mitigation efforts are defined in the WMA as those which are expected to offset the impacts of a withdrawal but are not quantifiable volumetrically. The MassDEP uses a qualitative credit system to assign credits based on the perceived benefits of a mitigation activity. The system aims to determine the effectiveness of an activity in augmenting base flow, improving habitat conditions, improving watershed protection, or providing other benefits that can offset withdrawal impacts. The MassDEP has assigned quantities of required indirect mitigation credits to permittees based on the indirect mitigation amount that the permittee must achieve. The Department has also assigned credit values for certain indirect mitigation activities such as the removal of dams, streambank restorations, installation of fish ladders, and the acquisition of property for natural resource protection. However, all indirect mitigation options are reviewed by the MassDEP on a case by case basis.

1.3.2.4 Ipswich River Basin Performance Standards and Streamflow Triggers

Upon issuing Permits in 2009 for the Ipswich Basin groundwater suppliers, MassDEP included a set of Ipswich Basin Performance Standards in the Permit Special Conditions:

- Unaccounted for Water: Unaccounted for Water shall not exceed 10%. This standard has since been applied to all public water suppliers.
- Residential Per Capita Water Use: Residential Per Capita Water Use shall not exceed 65 gallons per day.
- Seasonal Water Use: Water use between May 1st and September 30th is limited to a capped volume.
- Restriction of Unregulated Irrigation Wells: Restriction and enforcement regarding unregulated irrigation wells is required.

In the permits for the Grant Partner communities, MassDEP established restrictions on seasonal water use tied to Ipswich streamflow volume thresholds. Streamflow threshold triggers were derived from a USGS study (Armstrong et al, 2001), which assessed habitat and fish communities and streamflow requirements to protect habitat in the Ipswich River. The streamflow recommendations established by this study were based on the most sensitive freshwater fish species, which were stocked sport fish. The Permit streamflow triggers require mandatory water restrictions when flows drop below 0.42 cubic square feet per mile (cfsm). It is noted that 0.42 cfsm trigger is higher than the modeled 'natural' (i.e. zero water withdrawals) August median streamflows (Zarriello & Reis, 2000; see Section 1.2.2) for both the South Middleton Gauge (8% higher) and the Ipswich Gauge (68% higher). Danvers is additionally subject to (year-round) pumping restrictions, including alternate-day pumping at 0.67 cfsm and complete shut-down of pumping in Wells 1 and 2 triggered by the 0.42 cfsm threshold.

The water supply practices for communities falling within, or partly within, the Basin, are described below in Section 1.4.

1.4 WATER MANAGEMENT ACT AND WATER SUPPLIERS IN THE IPSWICH BASIN

There are 22 communities falling in or partly within the Ipswich Basin. The water use practices were summarized for the communities with substantial land area within the Basin; therefore Tewksbury, Rowley, Billerica, Woburn, Georgetown were not evaluated. The water suppliers, withdrawal source basin, and registered and permitted volumes under the WMA are shown below in Table 1-2. Some communities obtain supply from the Massachusetts Water Resources Authority (MWRA). A more detailed description of each water system is provided in Table 1-3. Water use data is discussed in detail in Section 2.

TABLE 1-2: IPSWICH BASIN WATER SUPPLIERS/COMMUNITIES, BASIN WMA VOLUMES AND AVERAGE USE

Town	Withdrawal Source Basin(s)	IPSWICH Registered Volume[1] (MGD)	IPSWICH Permitted Volume (MGD)	IPSWICH Registered + Permitted Volume (MGD)	IPSWICH Baseline[1] (MGD)	IPSWICH - Average Water Use 2009-2015[2] (MGD)
Andover	Merrimack; Shawsheen	n/a	n/a	n/a	n/a	n/a
Beverly	Ipswich	*see Salem and Beverly Water Supply Board (SBWSB)*				
Boxford	Ipswich (Private / Non Community wells)	n/a	n/a	n/a	n/a	n/a
Burlington	Shawsheen	n/a	n/a	n/a	n/a	1.89[3]
Danvers	Ipswich	3.14	0.58	3.72	3.35	3.26
Hamilton	Ipswich	0.92	0.11	1.03	0.92	0.62
Ipswich	Ipswich (25%); Parker (75%)	0.2		0.2		0.24
Lynn	Ipswich; North Coastal	2.62		2.62		1.25
Lynnfield Center [4]	Ipswich; North Coastal	0.29		0.29	0.29	0.38
Middleton	Ipswich	*see Danvers*				
North Andover	Merrimack	n/a	n/a	n/a	n/a	n/a
North Reading	Ipswich; Andover	0.96		0.96	0.96	0.51
Peabody	Ipswich; North Coastal	3.89		3.89		3.22
Reading	MWRA, Ipswich	2.57		2.57	2.57	

Town	Withdrawal Source Basin(s)	IPSWICH Registered Volume[1] (MGD)	IPSWICH Permitted Volume (MGD)	IPSWICH Registered + Permitted Volume (MGD)	IPSWICH Baseline[1] (MGD)	IPSWICH - Average Water Use 2009-2015[2] (MGD)
Salem	Ipswich	*see Salem and Beverly Water Supply Board*				
SBWSB	Ipswich	10.17	2.27	12.44	10.82	9.29
Topsfield	Ipswich	0.43	0.17	0.60	0.46	0.39
Wilmington	Ipswich; MWRA	2.91		2.91	2.91	1.92
Wenham	Ipswich	0.29	0.1	0.39	0.35	0.34
PWS Totals		28.39	3.23	31.62		23.31
Other non PWS, see Figure 1-6	Ipswich	1.2		1.2		
	TOTAL, IPSWICH	29.59	3.23	32.82		

Notes: Tewksbury, Rowley, Billerica, Woburn, Georgetown not evaluated

[1] Registered volumes from Final Permits for Danvers, Hamilton, Lynnfield Center, Salem-Beverly, Topsfield, Wilmington & Wenham. Otherwise baseline and registered volumes are those reported by the WMA Tool, http://www.mass.gov/eea/agencies/massdep/water/watersheds/sustainable-water-management-initiative-swmi.html

[2] Data from e-ASR database provided by MassDEP

[3] Burlington purchased water from MWRA in 2016 under an Emergency Declaration and via a wheeling arrangement.

[4]LCWD Registered limit of 0.61 = 0.29 Ipswich + 0.32 North Coastal. The District has been able to manage its demands so that the total withdrawal has not exceeded 0.81MGD (which includes registered plus threshold volumes of 0.1 MGD).

Grant Partner PWS

TABLE 1-3: SUMMARY OF WATER SYSTEM FOR IPSWICH BASIN WATER SUPPLIERS/COMMUNITIES

Town or PWS	Water System Summary
Andover	Obtains all municipal water supply from outside of the Ipswich River Basin (IRB). Water use: 7.18 vs 6.37 baseline
Beverly	Obtains water from Salem-Beverly Water Supply Board (SWWSB- see below); from 3 surface water supplies in the Ipswich: Putnamville Reservoir, Longham Reservoir, and Wenham Lake.
Boxford	Supplied 100% Private Wells
Burlington	Has a storage reservoir (Mill Pond Reservoir) at the headwaters of Maple Meadow Brook in the most upstream portion of the IRB. Water is pumped to the reservoir from outside of the Basin, stored, and released for use outside of the Basin. The portion of Burlington in the IRB is served by Town water and sewer, which discharges outside of the Basin.
Danvers	Supplied by 2 wells along the Ipswich and 3 reservoirs in the Ipswich Basin (Swan Pond, Middleton Pond, and Emerson Brook Reservoir; firm yield 3.51). Water is diverted from Swan Pond and Emerson Brook Reservoir into Middleton Pond and then into the system. Streamflow triggers at S. Mid Gage restrict Wells 1&2. Water use between May 1 and Sept 30 shall not exceed 587.52 for Danvers-Middleton (ADV 3.84 MGD).
Hamilton	Basin100% of supply is groundwater from 6 wells. Hamilton is subject to streamflow-triggered outside water use restrictions as well as a Seasonal Use Cap of 107.10MG from 5/1 to 9/30.
Ipswich	Supplied by five wells that withdraw from the Ipswich Basin including Fellows Rd. G.D. Well, Essex Rd. G.P. and G.D. Well, and the Winthrop G.D. Well #2. Currently, the town draws 55 percent of its water from reservoirs and 45 percent from wells.

Town or PWS	Water System Summary
Lynn	Maintains four primary water-supply reservoirs—Hawkes Pond, Walden Pond, Birch Pond, and Breeds Pond all of which are outside of the Ipswich River Basin. Water is diverted seasonally when conditions allow from the Ipswich River to Walden Pond and in some cases to Hawkes Pond, and from the Saugus River to Hawkes Pond. An emergency connection is maintained from the Town of Peabody Suntaug Lake Reservoir to Walden Pond. Water from Walden Pond can be gravity-fed to Birch Pond or pumped to Breeds Pond, then gravity-fed to the water-treatment facility. Under normal operations, water is pumped or gravity-fed through the reservoir-supply system to maintain optimal levels and water quality. Collectively, the four reservoirs and a small treated-water reservoir (low-service reservoir) have a usable storage capacity of about 3,940 MG. In addition to water obtained from the Ipswich and Saugus Rivers, Lynn is a member of the Massachusetts Water Resources Authority (MWRA) Water System and regularly purchases a small amount of water form MWRA.
Lynnfield (Lynnfield Center Water District)	Lynnfield has two public water suppliers, and wastewater is managed solely by onsite septic systems. The Town lies in two water Basins, the Ipswich River Basin, and the North Coastal Basin. The central portion of Lynnfield is most populous and obtains water from the Ipswich River Basin for consumption within the North Coastal Basin. There is a small part of Lynnfield, along the Peabody town line, in the area of Suntaug Lake and Winona Pond, which disposes of MWRA water in the Ipswich River Basin. Currently the Lynnfield Center Water District is operating under pumping restrictions and is exploring ways to increase the supply of water to support additional development and for an emergency. Currently, the two systems can support each other in the case of an emergency, but they are not able to provide full water supply.
Middleton	See Danvers.
North Andover	Obtains municipal water supply outside of the IRB. In areas that are sewered, wastewater is discharged outside of the Basin.
North Reading	Supplied by 7 wells in the Ipswich Basin (6 along Martins Brook and 1 on the Ipswich River) and purchases water from MWRA. Water purchase from Andover is subject to IBTA (Merrimack) up to 1.5MGD limit.
Peabody	Peabody maintains three primary supply reservoirs—Winona Pond, Suntaug Lake, and Spring Pond. Spring Pond is directly linked to two minor reservoirs—Long Basin and Fountain Pond. Spring Pond, Long Basin, and Fountain Pond are outside of the Ipswich River Basin. Water is pumped seasonally when conditions allow from the Ipswich River to Suntaug Lake, which then drains to Winona Pond or Fountain Pond. Two separate water-supply and treatment systems are operated by Peabody—(1) the Winona area system, and (2) the Coolidge area system. The Winona-system water is fed from Winona Pond and the Coolidge system water is fed through the Spring Pond reservoirs. A connection exists between the two systems. In addition, Peabody can purchase water from the MWRA. Since the two systems are interconnected, the firm-yield analysis can be calculated as a single system. The combined Peabody system has a usable storage capacity of about 1,230 MG.
Reading	Reading has 9 wells in the Ipswich Basin, near the River main stem, with a capacity of 1.96 MGD. They are registered, but since 2006, the wells are only maintained as emergency supply. Reading is purchasing all water from MWRA currently.
Salem	No land within Ipswich. Water supplied by Salem-Beverly Water Supply Board. See Salem-Beverly Water Supply Board.
Salem-Beverly Water Supply Board	The Salem–Beverly system supplies water to the towns of Salem, Beverly and occasionally Danvers. The Salem–Beverly system has three primary supply reservoirs—Longham Reservoir, Putnamville Reservoir, and Wenham Lake. All of the reservoirs and contributing drainage areas are within the Ipswich River Basin. Water from the Ipswich River is pumped from the Salem–Beverly Canal into Putnamville Reservoir or Wenham Lake. Water is gravity fed into Wenham Lake from Longham and Putnamville Reservoirs, then pumped to a water-treatment facility. Combined, the Salem–Beverly system has a usable storage capacity of about 3,540 MG.
Topsfield	Supplied by groundwater exclusively, from two tubular (vacuum) wellfields. Water banking is required above 0.60 MGD and streamflow-based outdoor use triggers are in place. Seasonal Use cap of 0.55 MGD 5/1 - 9/30.
Wilmington	Supplied by 5 wells adjacent to Maple Meadow Brook, 2 wells adjacent to Lubbers Brook and 3 wells adjacent to Martins Brook (all tributaries to the Ipswich). Wilmington also obtains water from MWRA (about 15% of supply on average). Currently only using 4 wells (1 Lubbers Brook, 3 adjacent to Martins Brook). The 5 wells adjacent to Maple Meadow Brook haven't been used since early 2000s due to possible contamination.
Wenham	Wenham gets its supply from two wells on Pleasant Street. If exceed 0.4 MGD water bank required. Streamflow-based outdoor use triggers in place. Ipswich Basin Performance Standards. Seasonal Use cap of 0.61 MGD 5/1 - 9/30.
Tewksbury, Rowley, Billerica, Woburn, Georgetown were not evaluated since their area of Town within Basin very small and/or no municipal withdrawals from or returns to the IRB	
Note: Shading indicates PWS is a Partner in this Grant Study	

2 WATER RESOURCES AND WATER USE DATA

The Basin water suppliers systems and WMA Permit limits were discussed in Section 1.4. In order to evaluate water use practices in the Basin, water use data was compiled for the 14 communities listed in Table 2-1.

TABLE 2-1: NUMBER AND SOURCE OF WATER SUPPLY FOR IPSWICH BASIN WATER SUPPLIERS/COMMUNITIES

Public Water Supplier (PWS) System Name	Groundwater Sources				Purchased Water					Surface Water Sources				
WATERSHED	**IP**	**NC**	**PK**	**SH**	**IP**	**MM**	**MWRA**	**NC**	**SH**	**IP**	**MM**	**NC**	**PK**	**SH**
BURLINGTON[1]				14			2			1				2
DANVERS	2				1					1				
HAMILTON	7													
IPSWICH	3		2										1	
LYNN							1			1		5		
LYNNFIELD CENTER	2	3												
MIDDLETON					1									
NORTH READING	4					1								
PEABODY	2						1	1		3				
READING (wells not used)	9						1							
SALEM BEVERLY WATER SUPPLY BOARD										4				
TOPSFIELD	2													
WENHAM	2													
WILMINGTON	5						1							
Total	**27**	**3**	**2**	**14**	**2**	**1**	**6**	**1**		**10**	**4**	**6**	**1**	**2**

IP = IPSWICH
NC = NORTH COASTAL
PK = PARKER
SH = SHAWSHEEN
MM = MERRIMACK
MWRA = MASS WATER RESOURCES AUTHORITY
[1] Burlington purchased water from MWRA in 2016 under an Emergency Declaration and via a wheeling arrangement.

2.1 RECENT WATER USEDATA 2009 - 2015

Water use data was evaluated for municipal PWS' with withdrawals from the Ipswich River Basin. The municipal suppliers represent over 95% of the total authorized withdrawals (Table 1-2), with the remaining withdrawals from industrial, agricultural, or golf course users. Monthly water withdrawal data from an electronic Annual Statistical Report (ASR) database, provided by MassDEP, was aggregated and summarized by source and PWS. The data represents reported groundwater, surface water, and purchased water withdrawals from registered and WMA permitted withdrawal sources from January 2009 through December 2015.

Before reporting usage and evaluating trends, the data went through a quality review process. Kleinfelder provided electronic records to the water suppliers for review. Kleinfelder conducted data clean-up of the MassDEP database, which consisted primarily of removing duplicate names for sources and correcting monthly totals from double-counting surface water source withdrawals (removing volumes of reservoir transfers). Data from other watersheds was also compiled in order to compare water efficiency statistics (unaccounted for water and residential per capita use) between the Ipswich and other Basins.

2.1.1 Summary of Data Gaps

ASR data was requested for 2016 but was not available in time to incorporate into this analysis.

2.1.2 Supplier – Reported Data

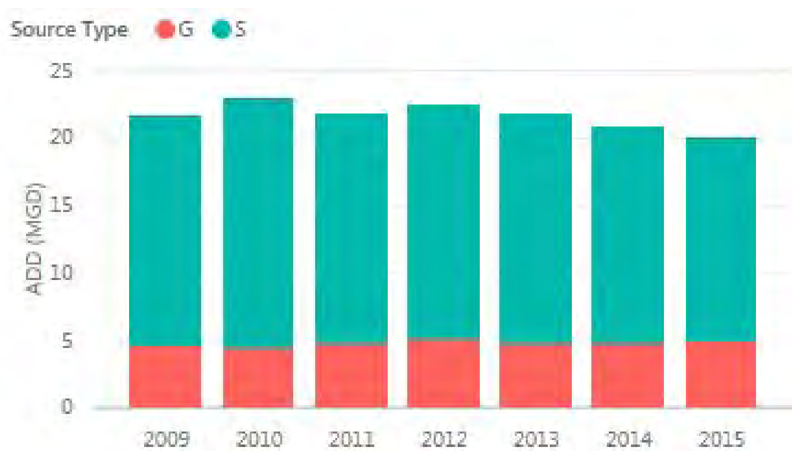
Monthly source withdrawals were summed for withdrawals from the Ipswich River Basin for each year from 2009 through 2015 and converted to an average day demand (ADD) in million gallons per day (MGD). For Ipswich Basin surface water and groundwater sources combined, total withdrawals averaged 21.7 MGD. The withdrawal volumes by supplier are shown below on Table 2-2. In the evaluated period, surface water (S) represented the largest portion of withdrawal volume, 78% on average, and ranging from 15.3 -18.6 MGD. Annual average demand for groundwater (G) ranged from 4.3-5.0 MGD, representing 22% on average (Figure 2-1).

TABLE 2-2: MUNICIPAL GROUNDWATER & SURFACE WATER WITHDRAWALS, IPSWICH BASIN 2009 - 2015

	Annual Average Withdrawal (MGD)							
Water Supplier	2009	2010	2011	2012	2013	2014	2015	AVERAGE
BURLINGTON		1.89						1.89
DANVERS	3.13	3.52	3.56	3.09	3.14	3.05	3.33	3.26
HAMILTON	0.60	0.60	0.61	0.66	0.62	0.64	0.64	0.62
IPSWICH	0.16	0.24	0.29	0.23	0.27	0.24	0.27	0.24

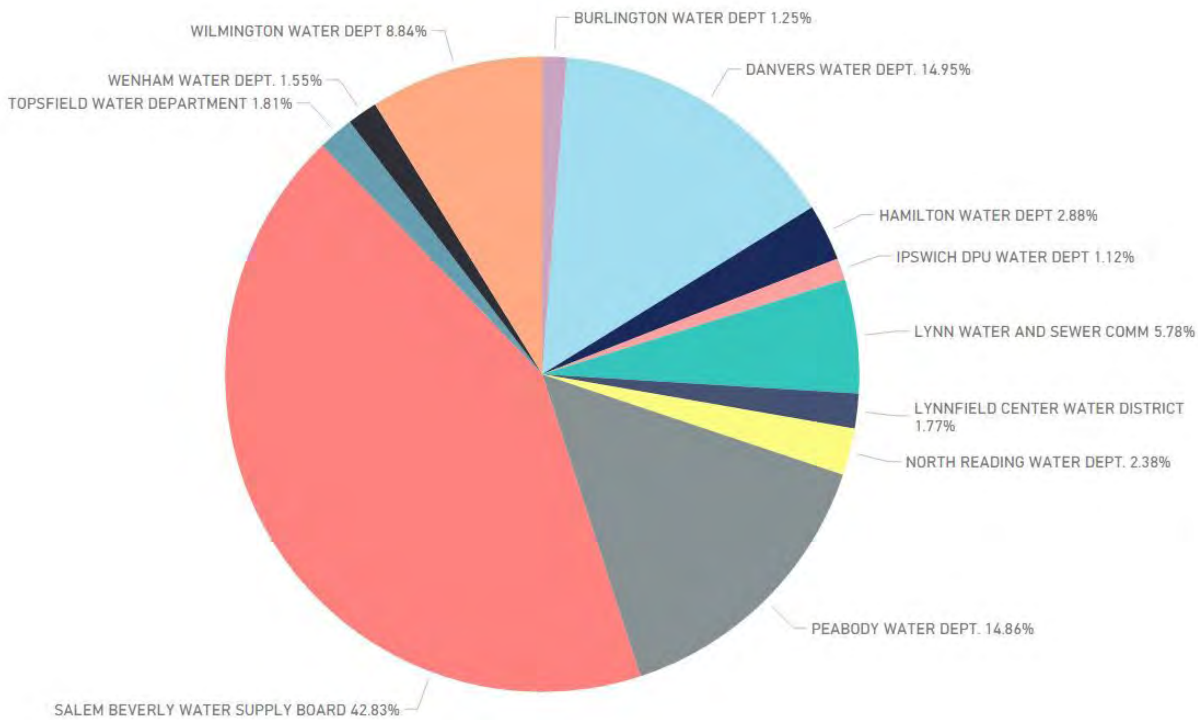
	Annual Average Withdrawal (MGD)							
Water Supplier	2009	2010	2011	2012	2013	2014	2015	AVERAGE
LYNN WATER AND SEWER	1.46	0.48	1.19	1.51	1.79	1.94	0.42	1.25
LYNNFIELD CENTER WD	0.38	0.41	0.39	0.41	0.46	0.33	0.31	0.38
MIDDLETON	*included in Danvers withdrawal*							
NORTH READING	0.47	0.50	0.54	0.58	0.51	0.50	0.50	0.51
PEABODY	2.66	3.08	3.30	3.67	3.31	3.31	3.22	3.22
READING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SALEM AND BEVERLY WATER SUPPLY BOARD (Salem, Beverly, occasionally Danvers)	10.07	9.84	9.38	9.61	9.11	8.23	8.76	9.29
TOPSFIELD	0.40	0.40	0.38	0.38	0.40	0.38	0.40	0.39
WENHAM	0.30	0.28	0.30	0.35	0.36	0.37	0.39	0.34
WILMINGTON	2.00	1.77	1.89	2.09	1.90	1.92	1.86	1.92
TOTALS	**21.62**	**23.01**	**21.83**	**22.57**	**21.87**	**20.90**	**20.09**	

FIGURE 2-1: GROUNDWATER (G) AND SURFACE WATER (S) WITHDRAWALS IPSWICH BASIN 2009 – 2015, as ADD



The percent breakdown of Basin withdrawals by supplier is shown in Figure 2-2; with Salem-Beverly as the largest municipal user, followed by Danvers, and Peabody.

FIGURE 2-2: IPSWICH BASIN WATER WITHDRAWALS (GROUNDWATER & SURFACE WATER) PERCENTAGE BY SUPPLIER

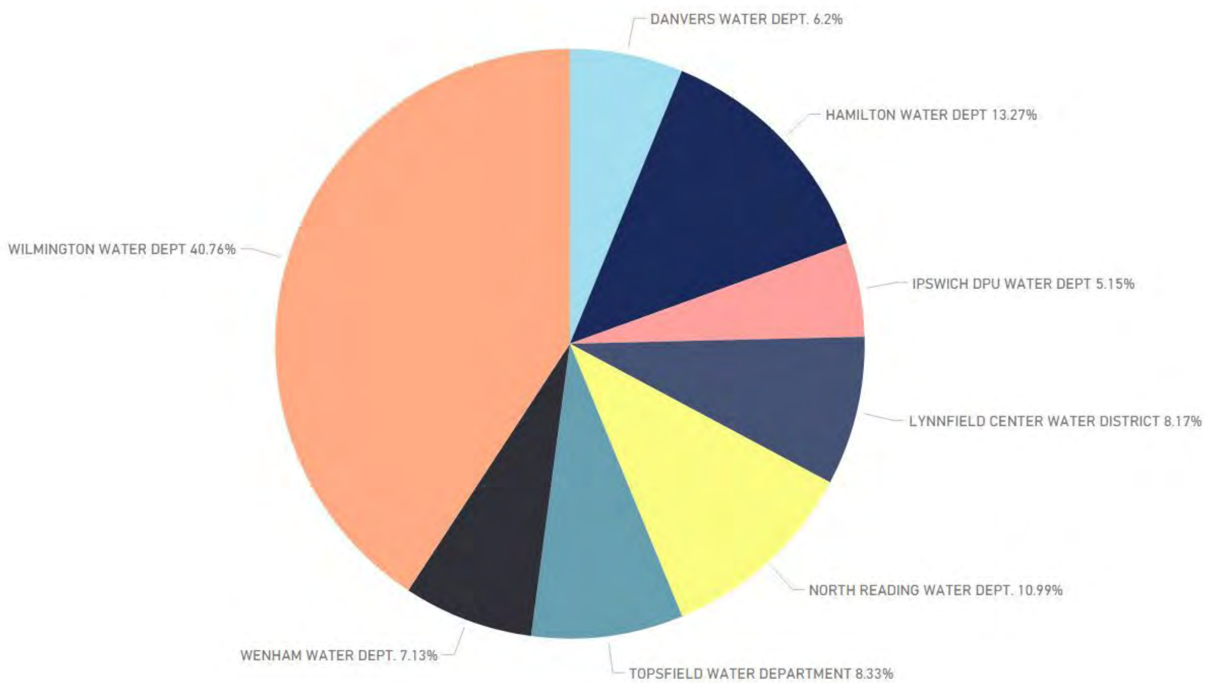


Groundwater withdrawals from the Ipswich Basin over the evaluation period averaged **4.7 MGD**, as shown on Table 2-3. Wilmington is the largest groundwater user in the Basin, followed by Hamilton. The breakdown of groundwater use percentage by supplier is shown in Figure 2-3.

TABLE 2-3: MUNICIPAL GROUNDWATER WITHDRAWALS IPSWICH BASIN 2009 – 2015

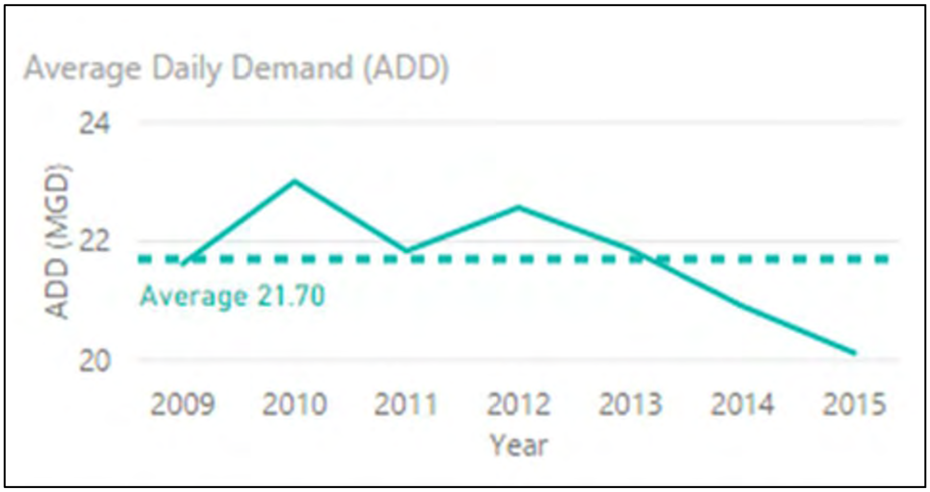
	Annual Average Withdrawal (MGD)							
Water Supplier	2009	2010	2011	2012	2013	2014	2015	AVERAGE
DANVERS	0.31	0.13	0.30	0.34	0.18	0.32	0.47	0.29
HAMILTON	0.60	0.60	0.60	0.66	0.62	0.64	0.64	0.62
IPSWICH	0.16	0.24	0.29	0.23	0.27	0.24	0.27	0.24
LYNNFIELD CENTER WATER DISTRICT	0.38	0.41	0.38	0.41	0.46	0.33	0.31	0.38
MIDDLETON	*included in Danvers withdrawal*							
NORTH READING	0.47	0.50	0.54	0.58	0.51	0.50	0.50	0.51
TOPSFIELD	0.40	0.40	0.38	0.38	0.40	0.38	0.40	0.39
WENHAM	0.30	0.28	0.30	0.35	0.36	0.37	0.39	0.34
WILMINGTON	2.00	1.77	1.89	2.09	1.90	1.92	1.86	1.92
TOTALS	4.62	4.33	4.68	5.04	4.70	4.70	4.84	

FIGURE 2-3: PERCENTAGE OF GROUNDWATER WITHDRAWALS BY SUPPLIER



Total withdrawals from the Basin sources have declined over the past seven years, with an 11% drop in withdrawal between 2012 and 2015 (Figure 2-4). This decline appears to be largely due to a decrease in withdrawal by Lynn and Salem-Beverly, accounting for 78% (2 MGD) of the decline in demand over this period.

FIGURE 2-4: TREND IN IPSWICH BASIN WATER TOTAL WITHDRAWALS ADD, 2009 – 2015

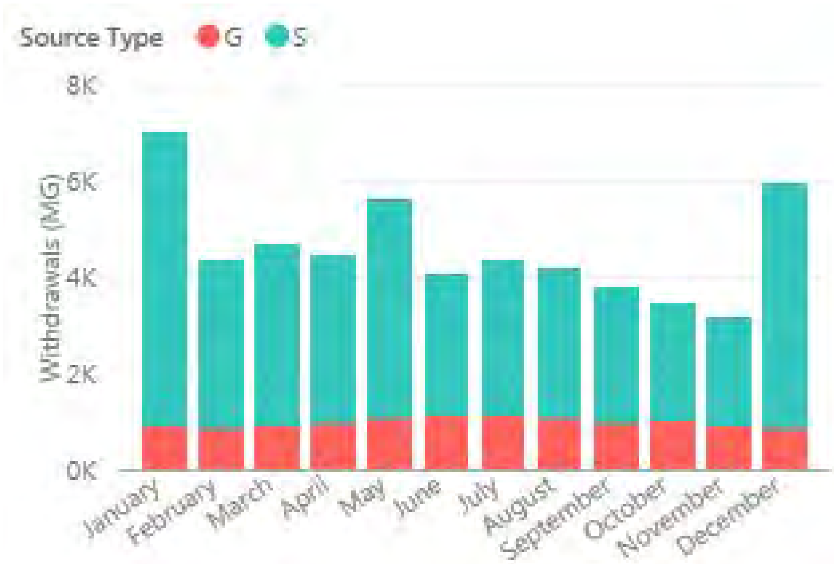


This is likely due to the Salem power plant, one of SBWSB's largest customers being off line for repairs during this time (personal communication, Tom Knowlton, SBWSB). Groundwater withdrawal trends were less clear, with use remaining fairly flat during the study period. Water purchased from MWRA helps make up for the remaining water supply needs of the Basin water suppliers. MWRA currently supplies water to Lynn, which is located out of Basin but maintains an intake supply on the Ipswich River, as well as to Lynnfield Water District, Reading, and Wilmington. Over the evaluation period, MWRA purchases by these suppliers totaled 7,046 MG or about 2.75 MGD.

2.1.3 Data Trends – Seasonal Water Use

Water use data was tabulated by source (well, surface water body, or purchased), on a monthly scale. The seasonal use trends shown below in Figure 2-5 reflect the practice of intensive surface water withdrawals during high river flow periods in January and December, when about 700 to 800 MG per month (about ¼ of the annual Basin supply needs) are drawn into surface reservoirs for use through the summer higher demand season. Surface water suppliers are limited to withdrawing water from the Ipswich River between December 1 and May 31, provided that a minimum flow is observed at the gaging stations. Flow at the South Middleton gaging station must be above 10 MGD for Lynn to withdraw and above 15 MGD for Peabody to withdraw. Flow at the Ipswich gaging station must be above 28 MGD for SBWSB to withdraw water (Zarriello, 2002).

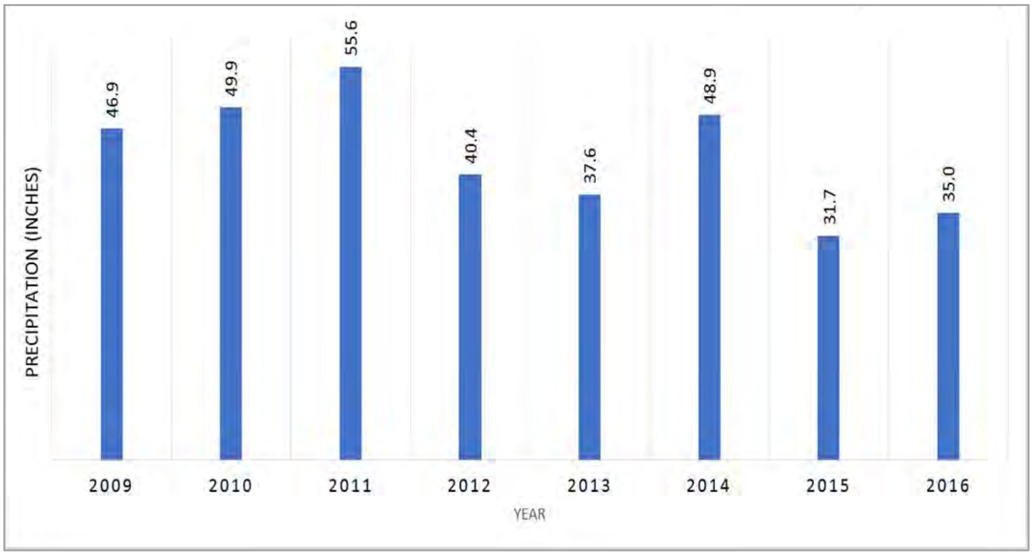
FIGURE 2-5: MONTHLY TOTAL WATER WITHDRAWAL TOTALS (MG), G+S 2009 – 2015



As seen below in Figure 2-6, there does not appear to be a summer trend over time for total withdrawals in the study period, and patterns do not appear to be well correlated with precipitation totals (Figure 2-7).

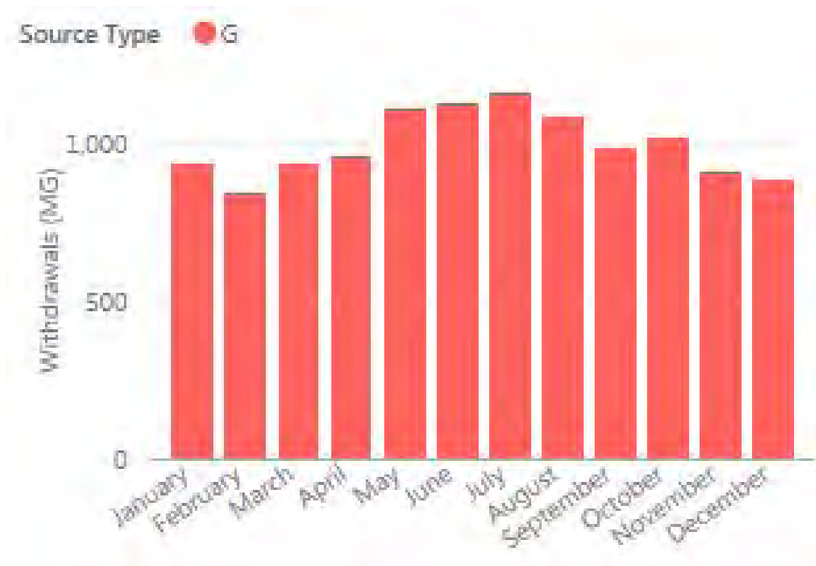
FIGURE 2-6: SUMMER (MAY – SEPTEMBER) TOTAL WITHDRAWALS G+S 2009 – 2015

FIGURE 2-7: ANNUAL PRECIPITATION (INCHES) MEASURED AT BEVERLY MUNICIPAL AIRPORT 2009 – 2016



Groundwater use reflects a pattern consistent with increased demand during summer months (Figure 2-8). Unfortunately, this increased demand coincides with the time period when evapotranspiration loss of stream baseflow is highest (Section 1). Most of the suppliers with groundwater sources in the Basin are exclusively reliant on those local groundwater sources. Danvers is the only supplier with a hybrid supply consisting of both surface and groundwater withdrawals in the Ipswich Basin. North Reading has four groundwater sources in the Ipswich Basin but makes up its increasing demand by purchasing water from Andover (Merrimack Basin).

FIGURE 2-8: MONTHLY GROUNDWATER WITHDRAWAL TOTALS (MG) OVER THE PERIOD 2009 – 2015

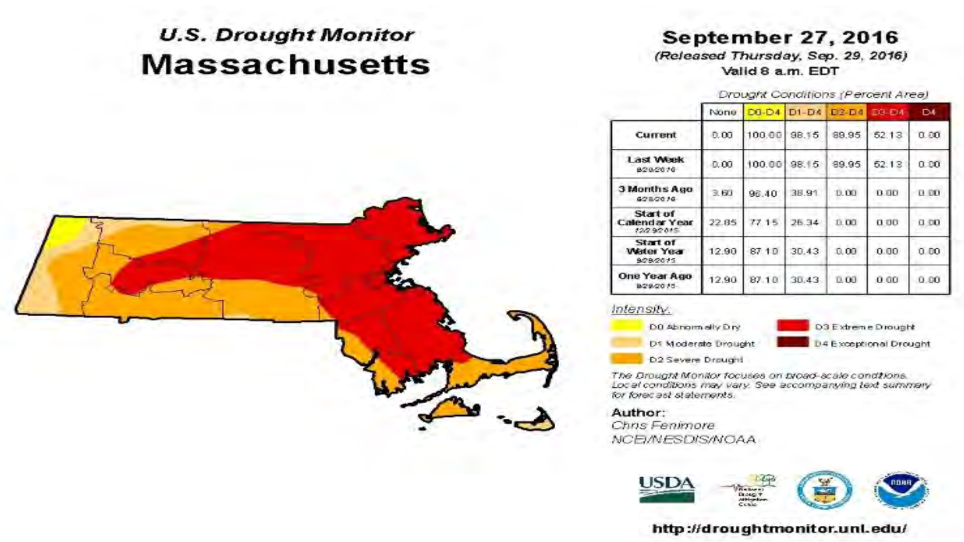


Stringent seasonal restrictions have been incorporated into the Ipswich groundwater supplier permits since 2009 (Section 1.4). Despite increased development in the Basin, summer groundwater withdrawals over the study period have remained fairly constant (Figure 2-9). This indicates that groundwater suppliers are using best practices in managing summer demand. Demand management practices within the Basin are discussed in detail in Section 3.

FIGURE 2-9: MAY THROUGH SEPTEMBER GROUNDWATER WITHDRAWALS (MGD) OVER THE PERIOD 2009 – 2015

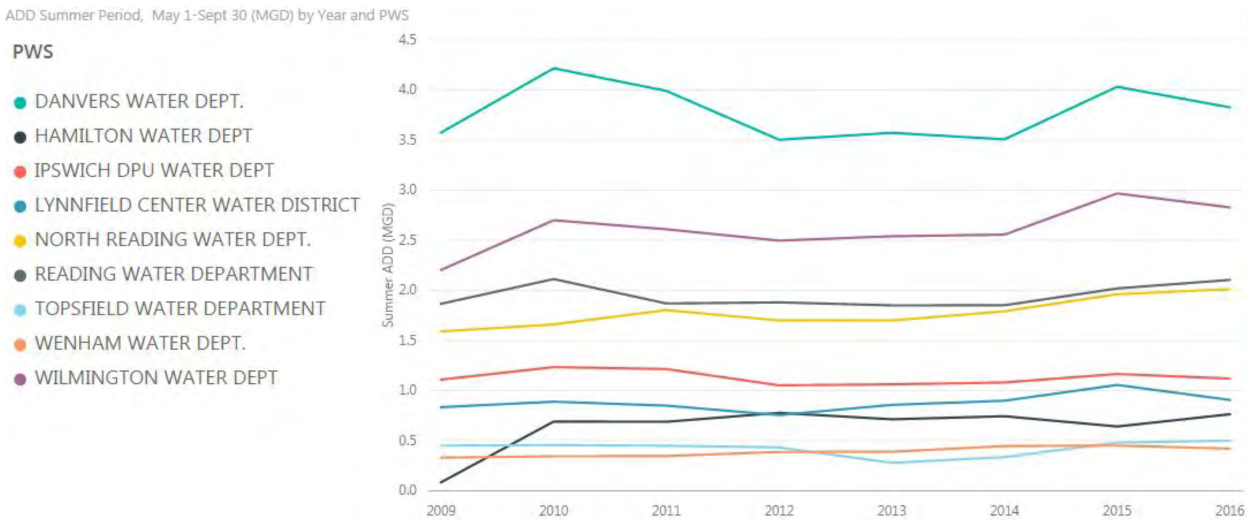
2.1.4 Drought of 2016 and Summer Usage Trends

In July of 2016, the Executive Office of Energy and Environmental Affairs (EOEA) activated the Massachusetts Drought Management Task Force to assess conditions after a prolonged period of precipitation deficit (essentially two-years of below normal precipitation). The Secretary of Energy and Environmental Affairs declared a Drought Watch for the Northeast region of the state as of July 1, 2016; this region included the Ipswich River Basin. By August of 2016, the Northeast region had been elevated to a Drought Warning. In a press conference in August, Governor Charles Baker urged greater water conservation measures be adopted by residents. In a letter dated August 15, 2016 to all public water systems with Water Management Act permits, MassDEP provided greater guidance on non-essential water use urging that outdoor water use should be banned in regions in a Drought Warning; this guidance went above the restrictions required per the Water Management Act permit conditions. While using slightly different indices than the Massachusetts Drought Plan to classify drought status, the US Drought Monitor had classified 52% of the state in an "Extreme Drought" as of September 27, 2016.



Although the Ipswich River Watershed Association has stated that during the summer of 2016, "*virtually all water suppliers saw a large increase in consumption over their recent summer averages"* (December 3, 2016 letter to Vandana Rao, Assistant Director of Water Policy for EEA), an examination of the drought usage data does not bear this out. Summer raw water withdrawal data for the communities for which data was readily available are presented in Figure 2-10, below. Some communities showed decreased withdrawals, while others showed moderate increases.

FIGURE 2-10: MAY THROUGH SEPTEMBER ADD (MGD) BY PWS OVER THE PERIOD 2009 – 2015



For the Grant Partner communities, Table 2-4 shows that raw water withdrawals in summer 2016 were an average of 5% lower than in 2015.

TABLE 2-4: MUNICIPAL ADD (MGD) SUMMER PERIOD, MAY 1-SEPT 30 2015 and 2016

Water Supplier	2015	2016	Percent Difference %
DANVERS	4.03	3.83	-5%
HAMILTON	0.77	0.76	-1%
LYNNFIELD CENTER WATER DISTRICT	1.06	0.91	-16%
TOPSFIELD	0.48	0.5	4%
WENHAM	0.45	0.42	-7%

Thirteen water suppliers in the Basin were surveyed (the suppliers listed in Table 2-2, with the exception of Burlington) and were asked to describe their experiences and techniques for dealing with the 2016 drought. The eight survey responses are provided below in Table 2-5. In general, the suppliers relying on groundwater were challenged with the administrative burden of applying strict outdoor watering restrictions and enforcing those restrictions. **All reported conducting enforcement measures, ranging from moderate to aggressive, including in some cases posting of offender addresses online and collecting fines.** For some suppliers, the challenges of the drought were reflected in degraded water quality and increased complaints and overall a general lack of flexibility and greatly increased operational challenges.

TABLE 2-5: BASIN WATER SUPPLIER 2016 DROUGHT SURVEY RESPONSES

Public Water Supplier	Difficulty meeting demand or other hardship during the 2015 - 2016 drought?	In what way(s)?	What techniques did you use to address these challenges?	Did you conduct enforcement related to water use restrictions? In what way?
Danvers	Yes	Reservoir levels were dropping; unable to balance this issue by using ground water sources.	The Town went to Level 5 water restrictions under the WMA Permit conditions	Verbal and Written Warnings were issued to those property owners when violations were observed.
Hamilton	Yes	Yes. Well levels were low and water quality suffered. Main well now needs redevelopment.	Issuing citations for illicit water use (sprinklers primarily), spreading the supply over other available sources with albeit lower quality water. Commissioned a peer review of the plant to determine longer term solutions to supply and plant processing issues.	Yes, issued citations. However, citations issued for private wells were dismissed in court.
Lynnfield Center	Yes	The District had to carefully monitor and modify normal operations in order to meet demands while adhering to individual restrictions pertaining to river basins	Outdoor watering ban.	Yes. Significant fines were issued.
Middleton	Yes	Labor cost to monitor outside water use after hours. Getting residents to understand and cooperate with the water restrictions.	Advertised in local papers, email blasts, electronic message boards to notify residents and had staff monitor outside water use after hours and write out violation tickets. We have also entered into a	Yes, we issued citations to residents who were violating our restrictions.

Public Water Supplier	Difficulty meeting demand or other hardship during the 2015 - 2016 drought?	In what way(s)?	What techniques did you use to address these challenges?	Did you conduct enforcement related to water use restrictions? In what way?
			pilot program with the Department of Fish and Game to educate residents.	
Reading	No	No. We were not heavily impacted by the drought.	Our Hydrant Flushing schedule was shortened.	No
Salem and Beverly WSB	No			
Topsfield	Not in meeting demand, but water quality was impacted.	Balancing our sources to get use of both but not exceed the new manganese regulations. We were unsuccessful.	Regular water testing to try and identify trends and alter source use to reverse unfavorable trends.	Yes, significant. Warning (1st offense; 2nd offense $50 fine); violations on website.
Wenham	Not in meeting demand.		Enforcement of the restriction bylaw.	Bylaw violation tickets were printed but not in time for the season.

2.1.5 Water Use Efficiency

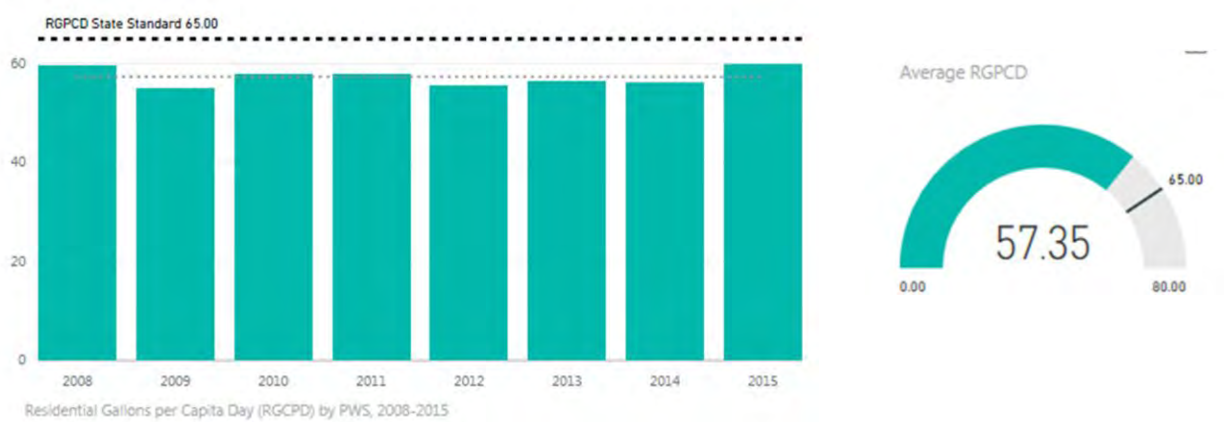
WMA Permits establish performance standards for Public Water suppliers, including Residential Gallons per Capita per Day (RGPCD) and Unaccounted for Water (UAW). RGPCD and UAW can be considered system efficiency metrics, which can be compared to an established State standard. Both of these efficiency metrics were evaluated over the period 2008-2015 for communities supplied by public water suppliers either in the Ipswich Basin or withdrawing water from within the Ipswich River Basin. Metrics were also compared to statewide averages.

2.1.5.1 Residential Per Capita Use

RGPCD measures average water use of residential customers for daily activities averaged over the calendar year. The Massachusetts standard is set at 65 RGPCD. In theory, if PWS are implementing a water conservation program in accordance with the Massachusetts Water Conservation Standards, which encourages water-saving behaviors, then the behavioral changes should be reflected in RGPCD values near the standard. Basin-wide trends from 2008-2015 are shown in Figure 2-11, below. The average for included suppliers is shown as a dotted grey line.

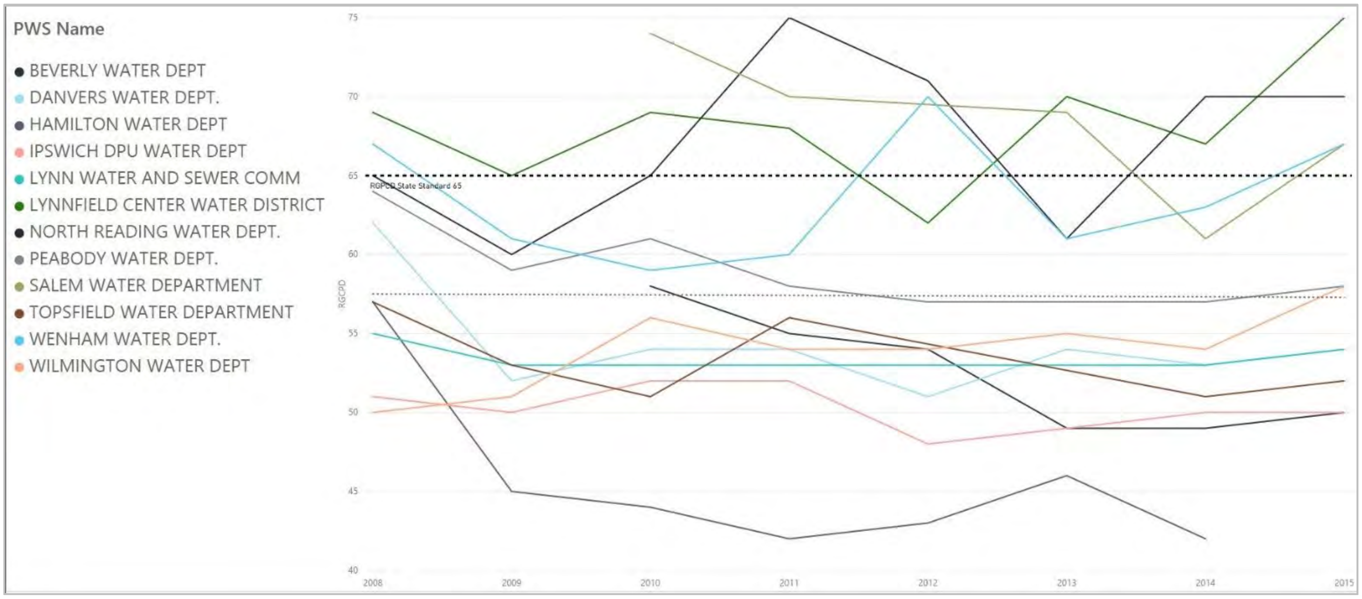
The Basin-wide average is approximately 57 RGPCD over this period, which is under the State standard of 65 and close to the statewide average of 59 RGPCD. In general, the average residential water use fluctuated over this period, with 2015 representing the highest year of residential water use per capital, with an average RGCPD of 62.7, and 2009 representing the lowest RGPCD, at 55.6. Variations in RGPCD values often correlate closely to periods of high or low precipitation, as this often changes the demand for residential outdoor water usage. Average RGPCD for these communities, in aggregate from 2010-2014, was relatively constant from 2010-2015.

FIGURE 2-11: AVERAGE RESIDENTIAL WATER USE FOR IPSWICH BASIN SUPPLIERS, 2008 - 2015



Rates for individual suppliers ranged more widely, however, from 49 to 70 RGPCD on average (Figure 2-12). Residential water suppliers with lowest residential water use include: Hamilton Water Dept., Ipswich DPU Water Dept., and Lynn Water Department.

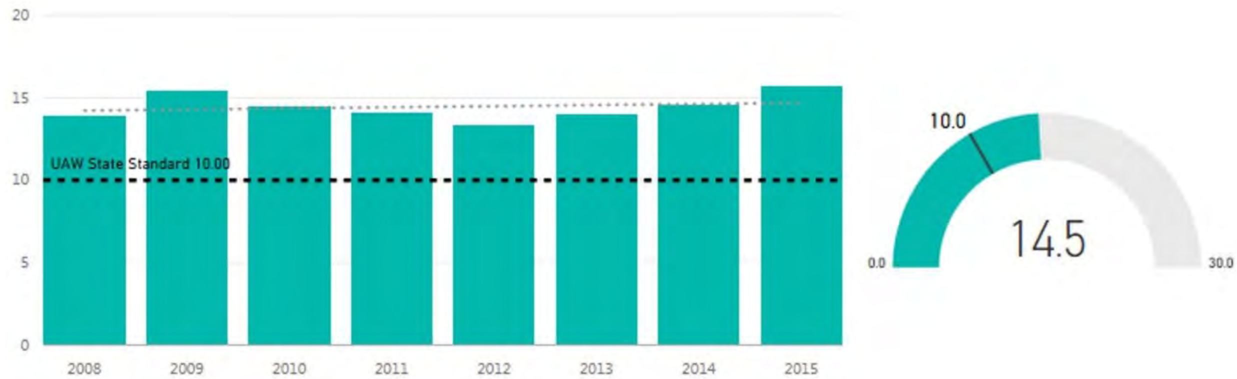
FIGURE 2-12: RESIDENTIAL USAGE RATES (RGPCD) FOR IPSWICH BASIN SUPPLIERS (2008-2015)



2.1.5.2 Unaccounted For Water

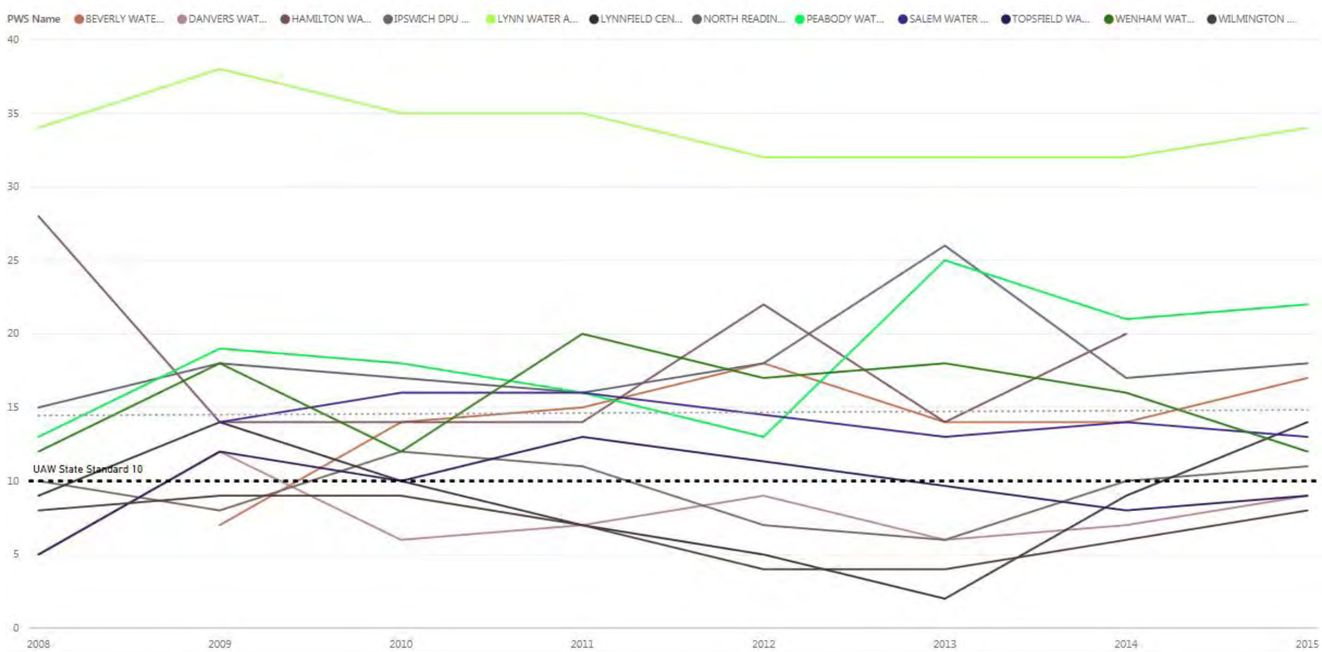
The State sets a standard for Unaccounted for Water at 10%. This metric is a calculation of the amount of water that enters the distribution system that is not accounted for from meter readings or municipal uses. In general, a large portion of UAW is from water lost through main breaks or leaks, inaccurate metering, or unmetered or undocumented water use. The Ipswich Basin-wide average (shown below in Figure 2-13 as a dotted grey line) is approximately 14.5% UAW over the period 2008-2015, which while above the State standard of 10%, is close to the state-wide average of 14.2%.

FIGURE 2-13: UNACCOUNTED FOR WATER FOR IPSWICH BASIN SUPPLIERS, 2008 - 2015



Similarly to RGPCD, UAW ranged widely between suppliers, from under 5% to over 30%. Over this period, Hamilton, Lynn, North Reading, Peabody, and Wenham each exceeded this standard. Reducing UAW remains a significant operational challenge for many suppliers in the Basin. Similar to numbers statewide, Basin-wide UAW is above 10%, at 14% and usually fluctuates year to year. This is not surprising, as the detection and repair of leaks is a continual challenge requiring consistent attention and investment.

FIGURE 2-14: UAW BY PWS FOR IPSWICH BASIN SUPPLIERS, 2009 – 2015



While the UAW metric was established to ensure that finished water is properly accounted for and conserved within a reasonable threshold, the industry is moving away from the term "Unaccounted for Water" and towards the American Water Works Association's M36 Water Loss Control Approach where utilities take a more comprehensive approach to looking at water that is lost due to leaks, breaks, meter inaccuracies and theft versus non-revenue water and what can be considered unavoidable real losses. Such an analysis gives utilities a much better management tool than simply a cursory calculation of water pumped versus water sold. It is anticipated that in the future, Water Management Act permits will incorporate the M36 Water Loss Approach as a functional equivalence measure for those utilities who want to pursue the M36 audit on their own or because they are unable to achieve the 10% UAW metric.

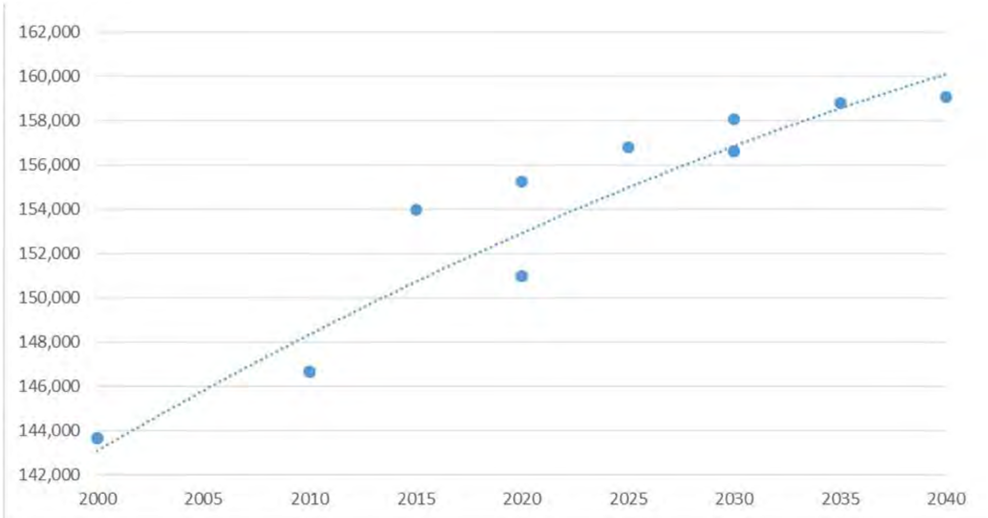
2.2 POPULATION PROJECTIONS AND WATER NEED FORECASTS

In 2015, the Massachusetts Department of Conservation and Recreation (DCR) has prepared Water Needs Forecasts for Salem-Beverly, Hamilton, Lynnfield Center Water District, Topsfield and Wenham. In June 2015, MassDCR informed Danvers that it was unable to develop water needs forecasts and recommended an interim allocation volume be used in the WMA Permit renewal process. Danvers had experienced atypical operating conditions during the 2010 to 2013 period in which it transitioned from chlorine to chloramines with its new water treatment facility. For this study, we compiled population projections from various sources for the communities served by these water suppliers (Section 2.2.1) and compiled the DCR forecasts for them (Section 2.2.2). In addition, we prepared a water needs forecast for Danvers using the Water Resources Commission methodology used by MassDCR.

2.2.1 Population Data and Growth

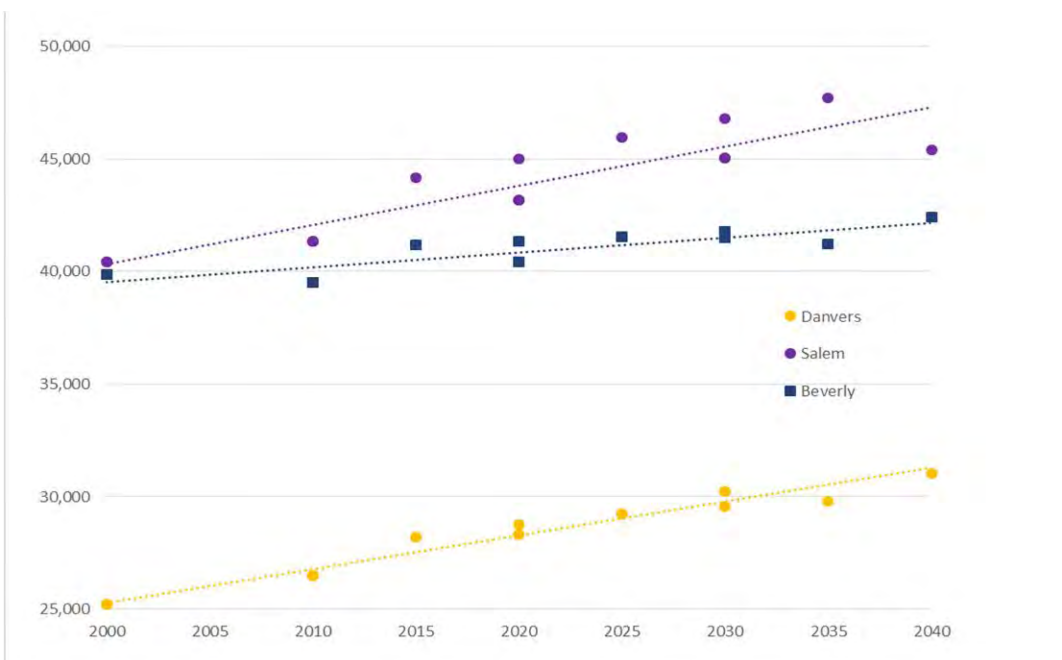
Available population data for the above mentioned water suppliers was compiled from all of the following sources: US Census for 2000 and 2010, and projections from 1) the UMass Donahue Institute database, 2) the Metropolitan Area Planning Commission (MAPC), and 3) the Massachusetts Department of Transportation (MassDOT). Population projections through 2040 are shown below on Figures 2-15, 2-16, and 2-17.

FIGURE 2-15: COMBINED POPULATION & PROJECTIONS: DANVERS, MIDDLETON, HAMILTON, LYNNFIELD, TOPSFIELD, WENHAM, SALEM & BEVERLY



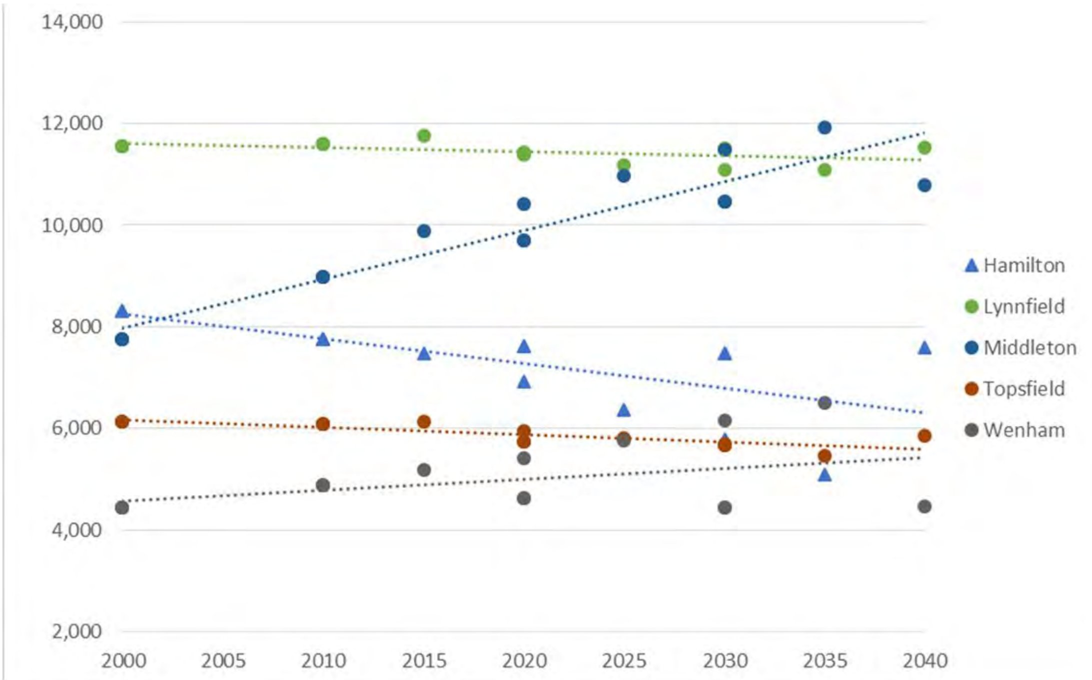
As a whole, these communities are projected to experience a **7-8%** increase in population from 2010 to 2035-2040 which is consistent across the three data sources. The three largest communities evaluated: Salem, Beverly, and Danvers, are all definitively projected to grow (Figure 2-16), by an average of 10%, 4%, and 14%, respectively. The SBWSB has also reported that it anticipates an increase in demand from future industrial growth in Salem and Beverly.

FIGURE 2-16: POPULATION AND PROJECTIONS: DANVERS, SALEM & BEVERLY



Population projections for the smaller communities are much more varied as seen in Figure 2-17. Middleton is the only community with a clear growth projection trend (25%).

FIGURE 2-17: POPULATION & PROJECTIONS: HAMILTON, LYNNFIELD, MIDDLETON, TOPSFIELD AND WENHAM



2.2.2 Water Needs Forecasts

Water needs forecasts, along with percent change in projected demand and in projected population are shown below on Table 2-6. Available water needs forecasts for Hamilton, Lynnfield Center Water District, Salem and Beverly, Topsfield and Wenham were compiled from information provided on MassDEP's 2015 'Permit Renewal 1-Pager' summary sheets. In most cases these forecasts include two 'scenarios': one based on current RGPCD and UAW values, and one based on those values being 65 and 10, respectively. MassDCR did not develop a water needs forecast for Danvers in 2015. The available 2009 water needs forecast for Danvers from MassDCR is presented.

Demands are projected to exceed WMA baseline values for all suppliers except Hamilton and Lynnfield Center Water District (no baseline established). For Lynnfield Center Water District, demands are projected to exceed total authorized volume (registered volume, Lynnfield Center has no permitted volume), although when considering the threshold amount, does not show exceedance until the furthest projection. Wenham's projections include one proposed development but excludes planned residential developments coming online within next 2 years including: Wenham Pines, Spring Hill/Dodge's Row, Maple Woods, and 213R Larch Row. MassDEP has requested that DCR re-forecast water demand for Wenham. It is noted that projected demand percentage increases are generally significantly lower than the projected population percentage increases for communities with projected growth.

TABLE 2-6: AVAILABLE WATER NEEDS FORECASTS AND PERCENT CHANGE IN DEMAND AND POPULATION

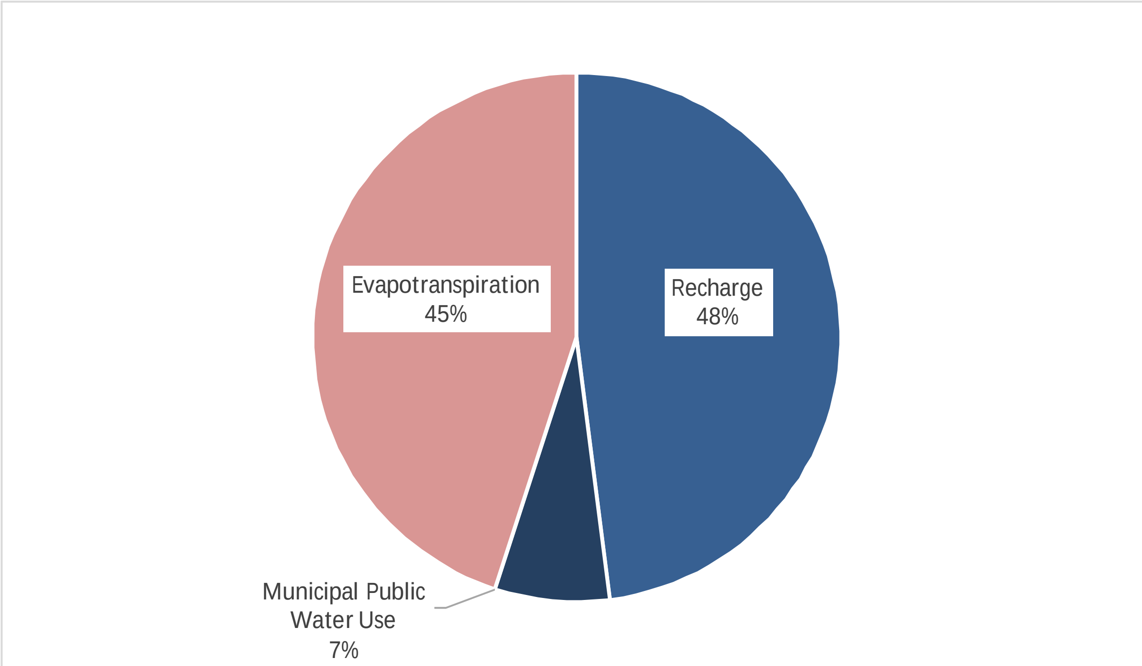
				Projected Demand (MGD)[1]				Projected % Change	
Supplier	Authorized Withdrawal (MGD)	Baseline (MGD)	Forecast Scenario Reported by MassDCR	2019	2024	2029	2029 + 5% buffer	Demand 2019-2029	Population 2015-2035
Danvers / Middleton	3.72	3.35	2009 DCR 65 / 10	3.76	3.83	3.88	4.07	+8	+17
Hamilton	1.03	0.92	65 / 10	0.74	0.75	0.76	0.80	+3	-15
			Current trends	0.69	0.70	0.71	0.75	+3	
Lynnfield[2] Center WD	0.81	n/a	65 / 10	0.69	0.70	0.71	0.75	+3	-2
			Current trends	0.74	0.76	0.77	0.81	+4	
Salem-Beverly	12.44	10.82	65 / 10	10.80	10.89	10.96	11.48	+1	+9
			65/10; Nanofiltration[3]	11.23	11.32	11.40	11.92	+2	
Topsfield	0.6	0.46	65 / 10	0.46	0.46	0.46	0.48	0	-7
			Current trends	0.42	0.42	0.42	0.44		
Wenham	0.39	0.35	65/10 + Mullen develop[4]	0.32	0.32	0.33	0.35	+3	+6
			Current trends	0.31	0.32	0.32	0.34		

1 Projections are provided in 2015 MassDEP Permit Summaries except for Danvers. Yellow shading indicates exceedance of baseline. Bold indicates exceedance of Authorized withdrawal
2 LCWD Registered limit of 0.61 = 0.29 Ipswich + 0.32 North Coastal. The District has been able to manage its demands so that the total withdrawal has not exceeded 0.81MGD (which includes both basins threshold volumes of 0.1 MGD).
3 Projection assumes Nanofiltration treatment will be implemented, which modifies the assumed water loss due to treatment processes.
4 Projection includes a proposed development, at the former Mullen estate, but excludes planned residential developments coming online within next 2 years including: Wenham Pines, Spring Hill/Dodge's Row, Maple Woods, and 213R Larch Row. MassDEP has requested that DCR re-forecast water demand.

2.3 WATER USE TRENDS OVER TIME

Municipal water use makes up a small portion of the annual Basin water budget. Approximately 45% of the precipitation falling in the Basin is lost to the atmosphere by evapotranspiration (Claessens, et.al, 2006). Currently about 7% of precipitation is used for municipal public water supply. In terms of groundwater withdrawals, this represents only 1% of annual precipitation.

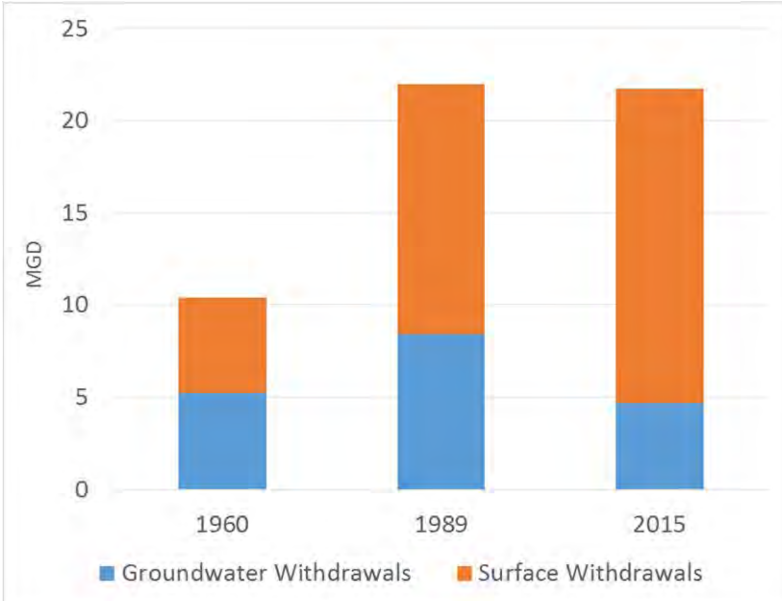
FIGURE 2-18: ESTIMATED FATE OF PRECIPITATION WITHIN IPSWICH RIVER BASIN



It is instructive to examine the recent and projected water use described in the sections above in an historic context. Water use in the Basin has been studied fairly extensively, and the literature indicates that uses of those resources have changed significantly over time. Claessens et.al (2006) reported on water use between 1930 and 1998: it increased dramatically during the 1960s and 1970s; with a slowing of the increase and leveling out from the 1980s through the 1990s. Although population has risen significantly both in the Basin– and in out of Basin communities supplied by its water (Sections 1.2.5; 2.2.1) — over the past several decades, water use has either stayed the same (all withdrawals) or decreased (groundwater).

Plotting the current withdrawals alongside the data of Sammels (1966) and Claessens et al. in Figure 2-19 below, we can see that groundwater and surface water were used in equal proportion in the 1960s. Since then, surface water use has expanded dramatically to make up increased Basin demand. While groundwater use increased from the 1960s to the 1990s, it has now dropped over 40% since the 1990s to the point where current use is lower than 1960 volumes.

FIGURE 2-19: IPSWICH BASIN, HISTORIC WATER USE, 1960 - 2015



3 WATER USE OPTIMIZATION AND ALTERNATIVE SOURCES

3.1 WATER CONSERVATION AND DEMAND MANAGEMENT BEST PRACTICES

The residential usage rates in the Basin (discussed in Section 2.1.5) indicate that on average, the Basin water users have made significant gains in demand reduction and are using water efficiently. An informational survey was sent to 13 Basin municipal water suppliers to inventory the use and effectiveness of water conservation and demand management practices. Table 3-1 presents a summary of the response ratings. PWS were asked to rate the relative effectiveness (E) of the practice, if in use, or a rating of the relative feasibility (F) of implementing the practice, if not in use as either Good, Fair or Poor. These ratings are reflected by color coding (green, blue, red, respectively) in the table below. A full table including detailed PWS response comments, is provided in Appendix A. Based on the survey responses shown below, water supply demand management best practices appear to be widely used, especially amongst groundwater suppliers in the Basin.

TABLE 3-1: WATER CONSERVATION AND DEMAND MANAGEMENT PRACTICES, RESPONSES TO PWS SURVEY

	Danvers		Hamilton		Ipswich		Lynnfield Center		Middleton		Topsfield		Wenham		Wilmington	
Water Conservation/ Demand Management Practice	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*
Source & Master Meters Calibrated Regularly?																
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?																
Meter Inspection / Testing / Replacement program?																
Method of meter reading?																
Data Management: Water Audits																
Leak Detection and Repair																

	Danvers		Hamilton		Ipswich		Lynnfield Center		Middleton		Topsfield		Wenham		Wilmington	
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)																
Rate and Billing Structures that promote conservation?																
Quarterly or greater billing frequency																
Water bills – Is consumption history provided? If so, is it reported in gallons?																
Seasonal rate structure with higher rates May 1- Sept 30																
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)																
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)																
Outdoor Demand Management – rain barrel / other incentive?																
Irrigation best available technology bylaw?																
Municipal Irrigation Alternatives																
Land Use Pattern Changes (Promotion / Incentives for Low impact development)																
Additional Plumbing Code Restrictions or Rigorous Enforcement																
Non-essential Outdoor Water use Mandatory Restrictions?																
Limit Non-Essential Outdoor Water Use to 2 days / week																
Limit Non-Essential Outdoor Water Use to 1 day / week																

	Danvers		Hamilton		Ipswich		Lynnfield Center		Middleton		Topsfield		Wenham		Wilmington	
Private Well Use Bylaw		Poor	Good			Good		Poor		Poor	Good			Fair		
Private Well Non-essential Outdoor Use Restrictions		Poor	Good			Good		Poor		Poor	Good		Good			
Public Education & Awareness Conservation Program	Good			Fair	Fair		Good		Good	Good		Good	Good		Good	
Other not listed above	Good										Good					

E (Effectiveness) or F (Feasibility) Rating:

Good	(green)
Fair	(blue)
Poor	(red)

As seen in the table above, the suppliers responding reported that almost all feasible enhanced conservation and demand management practices were in use and were effective. In 2010, the USGS published a study (Zimmerman et. al) that updated the 2000 Zarriello and Ries USGS model for the Ipswich Basin. One of the new model simulations included was a simulation to estimate the effectiveness of piloted enhanced water conservation programs applied across the Basin. The study scaled up water saving results from pilot programs that used four different methods. Hypothetical water use reductions ranged from 1.4 to 8.5% but reductions in this range (less than 10%) had negligible effects on simulated low flows in the Basin.

The physical / hydrologic dynamics of the Basin and the recent modeling studies suggest that as the climate warms, any incremental benefit to be gained by additionally stringent conservation or increasing restrictions on groundwater withdrawals are likely to be more than offset by ET effects and these ‘diminishing returns’ could become increasingly costly to achieve.

3.2 ALTERNATIVE WATER MANAGEMENT PRACTICES

An informational survey was sent to 13 municipal water suppliers to inventory the use and effectiveness of alternative water management or source optimization practices. PWS were asked to rate the relative effectiveness (E) of the practice, if in use, or a rating of the relative feasibility (F) of implementing the practice, if not in use, as either Good, Fair or Poor. These ratings are reflected below in Table 3-2 by color coding (green, blue, red, respectively). Table 3-2 presents a summary of the response ratings received. A full table, including detailed PWS comments, is provided in Appendix A.

Based on the survey responses shown below, In terms of optimizing supplies with alternative strategies to minimize environmental impact, most groundwater suppliers responding indicated that most strategies were infeasible to implement, primarily due to physical constraints. The exceptions were suppliers who also had access to surface supply storage for moderating the use of wells during summer.

TABLE 3-2: ALTERNATIVE WATER MANAGEMENT PRACTICES, RESPONSES TO PWS SURVEY

	DANVERS		HAMILTON		IPSWICH		LYNNFIELD CENTER		MIDDLETON		TOPSFIELD		WENHAM		WILMIN GTON	
	E	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*	*E*	*F*
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	Good			Poor		Poor		Poor	Good			Poor		Poor		Poor
Using Wells Up-gradient of Ponds & Lakes		Poor		Fair		Poor		Poor		Poor		Poor		Poor		Poor
Releases from Surface Water Impoundments to augment streamflow		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor
Process Water Infiltration		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor
High Flow or Flood Skimming	Good			Poor		Poor		Poor	Good			Poor		Poor		Poor
Aquifer Storage and Recovery		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor
Seasonal Transfer to Lakes or Ponds	Good			Poor		Poor		Poor	Good			Poor		Poor		Poor
Water Banking	Fair	Fair		Poor		Fair	Good		Fair	Fair		Fair		Poor		Poor

E (Effectiveness) or F (Feasibility) Rating:	Good	Fair	Poor

3.3 ALTERNATIVE WATER SOURCES

3.3.1 New Local Groundwater Sources

Exploration and test well investigation for new groundwater sources is performed in areas with good likelihood of containing medium to high yield aquifers, where land is available and ideally with compatible surrounding land use and no history of contamination. In general, the Ipswich River Basin has limited extents of medium and high-yielding aquifers (Figure 1-4, Surficial Geology). If potential well sites are discovered, then new wells can be installed to supplement existing local water supply. Some Ipswich Basin communities have conducted exploration for additional groundwater sources.

In 2013, Lynnfield Center Water District brought new bedrock wells in the North Coastal Basin online. The Lynnfield Center Water District is considering exploration for additional well options at existing sites. Last summer, the Town of Ipswich conducted a well investigation consisting of an 8 hour pump test and water quality analysis. This potential well site was identified to replace a well compromised by high manganese. It is estimated that four wells could produce approximately 300-400 gpm at this site. They are currently developing a scope for a master plan to evaluate expansion of surface water reservoirs, new well sources, and wastewater reuse.

The Town of Danvers performed bedrock well investigations in Danvers and Middleton in 2000 but did not locate a high volume bedrock well. The only area of Danvers with a high yielding aquifer is near Crane Brook in the North Coastal Basin; but it is one of the most densely developed parts of Town. The only area of open land is associated with an historic property site, the Rebecca Nurse Homestead. Topsfield searched for an additional source for many years. Finding very little water; high costs and permitting led Topsfield to abandon this search. In recent years, Wilmington has been investing in restoring lost yield to its existing small-diameter wellfields (Browns Crossing and Barrows) through installation of replacement wells. Hamilton is currently evaluating a potential new well site.

It is likely that implementation costs will vary from town to town depending on the ease with which well sites can be located or purchased, developed and permitted. If a town has mapped aquifers associated with available undeveloped land, it would be much more feasible and cheaper to implement than a town with little or no access to local aquifers. In general, however, it appears that the towns searching for new groundwater sources within the Ipswich Basin have not been able to easily identify any feasible sources. If water quality, or operational flexibility is the primary concern, as opposed to additional capacity, the installation of satellite and/or replacement wells could be considered, as appropriate.

3.3.2 Elevate Existing Reservoir

Two water suppliers in the Ipswich Basin operate surface water reservoirs located in the Basin: Salem-Beverly Water Supply Board and Danvers. The Town of Ipswich operates a reservoir located in the Parker River Basin. Salem-Beverly Water Supply Board diverts water from the Ipswich River into a system of three reservoirs which include the Putnamville Reservoir (located in Danvers), Longham Reservoir (located in Wenham), and Wenham Lake (located in Wenham and Beverly). Danvers operates a reservoir at Middleton Pond in Middleton. Danvers also owns a dam at Emerson Brook Reservoir, a short distance away from Middleton Pond.

An option to provide additional water supply would involve raising the spillway elevation of an existing dam to store more water. This option has been explored in detail on several occasions in the past for the Emerson Brook Reservoir in Middleton. There is sufficient area of undeveloped land at the Emerson Brook site to support a significantly sized reservoir. However, the area consists of wetland marsh. Regulatory agencies have strongly objected to the project on the grounds that a reservoir would be environmentally destructive by converting emergent marsh into open water. This issue was explored during the 1980s, again during the early 2000s and again discussed more recently. Each time, the regulatory authorities (MassDEP and the EPA) have objected on the basis of the change in wetland habitat. The only solution that has been offered is that a permit could be provided if 1:1 wetland replacement could be provided, which renders the project infeasible (personal communication, Richard Rodgers, Town of Danvers).

Middleton Pond appears to have an area of Town-owned undeveloped (forested) land at its northwesterly (upgradient) end and also bordering to the south. The potential for expansion of this reservoir into the forested upland has not yet been evaluated, but may be worth investigating.

None of the other towns reported looking into raising dams within their informational surveys or interviews. According to MassGIS (Figure 1-1, Surface Water Resources), Burlington, North Reading, Andover, North Andover, Middleton, Peabody, Danvers, Beverly, Boxford, Topsfield, Ipswich, and Hamilton all have existing dams. It is possible that if the existing conditions at these dams allow for it, their spillway elevations could be raised to allow for the storage of additional water that could be used for drinking water supply. There were no available examples of this being investigated within the Ipswich Basin other than at the Emerson Brook Dam.

The considerations for implementation make it a difficult alternative to implement. There are many potential environmental and regulatory complications involved in this approach as raising the spillway of a dam will increase the flooding footprint of the dam. There may be incompatible adjacent land uses, or great expense involved in acquiring land. Downstream hydraulic impacts would need to be evaluated. Furthermore, the emphasis on stream restoration for improving fish habitat in the Ipswich has aggressively promoted the practice of removing existing dams, rather than maintaining or elevating them. This would be another environmental and political hurdle for this option.

3.3.3 Construct New Reservoir

The creation of a new reservoir would provide a new source of water. This entails locating a suitable area and creating an impoundment to store water. Anecdotal information provided by basin suppliers reported that there was a study completed in the 1970's to investigate a potential new reservoir. Reportedly, the reservoir was not created due to environmental restrictions. A literature/regulatory search could not uncover a copy of this report. There were no other mentions within informational surveys about other attempts to pursue this practice.

The Quabbin Reservoir was created in the 1930's near Belchertown, MA. It was a significant engineering undertaking at enormous financial and social cost due to the relocation of four towns prior to the inundation of the valley. This is a much larger scale project than that which would be considered within the Ipswich Basin, but it is illustrative as to the complexities inherent in this option. New reservoir proposals will encounter resistance due to the need to flood large areas and potentially relocate residents as well as potentially displace existing wildlife species and habitat.

The Salem and Beverly Water Supply Board reported that a number of years ago they purchased a piece of property in Topsfield just north of their existing Putnamville Reservoir (Tom Knowlton, personal communication). This property has already been studied and found feasible for a new reservoir and is being held in reserve in the event of future needs. The SBWSB anticipates an increase in demand from future industrial /commercial growth in Salem and Beverly.

3.3.4 Municipal Interconnections

Water system interconnections allow for the distribution of water from water systems with available supply to water systems that require additional supply. Interconnections can be used for the purchase of water as well as for emergency purposes. Several members of the Ipswich Basin reported having interconnections in their Informational Survey responses.

Lynnfield Center Water District reported having an interconnection with Wakefield, one with North Reading, and three with the Lynnfield Water District but none of the interconnections have been used in the past five years according to their survey response. Figure 3-1 (with information provided by Massachusetts Water Resources Authority) also shows Lynnfield Center Water District as having an interconnection with Peabody. Wenham reported having no interconnections according to their informational survey, but the MWRA Map shows interconnections with Hamilton and Beverly. Topsfield reported having an interconnection with the Town of Danvers that was used in 2007 to supply one of their customers but not the whole town. The connection can feed Topsfield but cannot feed Danvers. Danvers reported having connections through Beverly with water provided by Salem and Beverly Water Supply Board. The MWRA Map shows Danvers as having a number of interconnections with Peabody as well. Ipswich reported having two interconnections that have not been tested in years according to their informational survey response. Hamilton reported having interconnections used only in the case of an emergency and not used as a supplemental supply. Wilmington has an MWRA connection and emergency interconnections to neighboring communities. The MWRA Map shows an interconnection between Middleton and North Reading. The MWRA Map also shows North Reading as having interconnections with Wilmington, Lynnfield Center Water District, Reading, and Andover.

Utilizing water system interconnections to solve supply deficiencies depends on several factors including: the available surplus supply, available permitted supply, system hydraulics, and water chemistry compatibility.

0 1.25 2.5 5 7.5 10 Miles

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PROJECT NO. 20173509.001A	Ipswich Basin MWRA Service Aera and Town Interconnections	FIGURE	
DRAWN: 5/30/2017		3-1	
DRAWN BY: JH	Ipswich Basin FY17 Water Management Act (SWMI) Grant Project Town of Danvers Massachusetts		
CHECKED BY: KR			
FILE NAME: Ipswich Basin.mxd			

3.3.5 Massachusetts Water Resources Authority (MWRA)

A potential source of water from outside of the Ipswich Basin would involve the MWRA Water System supplying one or more of the Basin communities, or supplying them jointly as a new governmental unit (see discussion of Joint Powers Agreement in Section 5). The MWRA has water available to supply to the Basin. According to service area information provided by MWRA (Figure 3-1), the Basin communities of Reading, Peabody, and Wilmington receive MWRA water. The following table lists MWRA usage rates for these communities. Other communities in adjacent basins receive water from MWRA, including Lynnfield Water District, Saugus, Lynn, Swampscott, and Marblehead.

TABLE 3-3: VOLUMES OF PURCHASED MWRA WATER BY BASIN SUPPLIERS (MGY)

Town	2009	2010	2011	2012	2013	2014	2015
Reading	621	642	599	591	595	584	606
Peabody	141	240	203	249	376	424	434
Wilmington	33	174	89	37	111	101	201

Although a detailed engineering analysis was not available, and was outside of the scope of this project, a planning-level analysis of town proximity and interconnections suggests that additional MWRA water could possibly be wheeled through the Reading, Wilmington, and Peabody distribution systems without construction of additional dedicated MWRA pipelines. Beyond that, system head losses would likely interfere with the ability to provide service. A new dedicated MWRA pipeline, for example, extending up Route 1 to Topsfield, would eliminate wheeling but would be costly to construct. In 2006, Wilmington constructed approximately 11,000 LF of transmission main to connect to the MWRA Water for approximately $3,500,000. It is possible that if multiple towns split the cost, a dedicated MWRA pipeline could be extended through Peabody to Middleton and then wheeled through Middleton/Danvers to neighboring towns. From the regulatory perspective, it is possible that MassDEP would support this solution as environmentally beneficial to the Ipswich Basin.

A number of questions need further examination to determine the feasibility and cost effectiveness including hydraulics, water chemistry mixing, and financial, legal, and political considerations.

The MWRA entrance fee is a significant one-time expense (currently $4.4M, with zero interest) per MGD planned to be purchased.

3.3.6 Other Out of Basin Supply

Water from sources north or west of the Ipswich Basin could also be considered to provide water supply by wheeling water through distribution systems or through a dedicated pipe. The Merrimack Basin is generally less stressed than the Ipswich, and both Andover and North Andover obtain supply from surface sources in the Merrimack Basin and are reportedly finalizing plans to bring additional inter-basin transfers into and out of the Basin. Hamilton is reported to be exploring a connection with Manchester, in the North Coastal Basin, which is in the process of evaluating its safe yield. Gloucester (also in the N. Coastal Basin) reportedly has excess supply but is rather distant from most communities with need in the Ipswich Basin. Implementation considerations for this option include InterBasin Transfer Act Approval, availability of supply, cost of construction and environmental impact.

3.3.7 Reclaimed Water

Reclaimed water is wastewater that has been processed with advanced treatment so that it can be safely reused for functions such as landscaping, irrigation, and toilet flushing. MassDEP has approved nearly a dozen reclaimed water projects, including Gillette Stadium, the Wrentham Village Premium Outlets, watering at golf courses, and reuse at manufacturing and office facilities. A list of other specific projects could not be located, but several are reported to be in operation within Massachusetts. Some may be located within the Ipswich Basin but there was no mention of such projects from survey respondents.

Cooling water, toilet and urinal flushing, boiler feed, industrial process water and irrigation to golf courses, parks, agricultural fields, landscaped areas and cemeteries are all allowed under 314 CMR 20.00. Uses in other states and that are being evaluated here include irrigation of parks and playgrounds, landscaping in nonresidential developments and cemeteries, highway landscaping, and cooling water. MassDEP has not yet made decisions on allowing additional uses.

The controlling factor in reclaimed water is the protection of public health. For this reason, the water to be reused must be virtually pathogen- and contaminant-free. An individual reclaimed water permit is required - Application Form BRP WP 84. If there is a discharge to the ground along with the reuse, then a groundwater discharge permit is required - Application Form BRP WP 79. Nevertheless, recent increased concern regarding the unknown risks of emerging contaminants (e.g. endocrine disruptors, PFOA/PFOS and others) make this a solution with potential or unknown level of risk. Furthermore this solution would not supply potable water needs under current regulations and the cost to pump treated water back from treatment facilities and to install separated reclaimed municipal water systems would likely be prohibitive. Reclaimed water is discussed further in Section 4.1.4.

3.4 SUMMARY OF FEASIBLE OPTIONS AND CONSIDERATIONS FOR IMPLEMENTATION

A variety of potential alternative supply options were examined and are summarized here and below on Table 3-4.

TABLE 3-4: POTENTIAL NEW OR ALTERNATIVE SOURCE OF WATER, RELATIVE FEASIBILITY, AND CONSIDERATIONS FOR IMPLEMENTATION

Potential New / Alternate Water Source	Feasibility Rating	Considerations
New local wells	Poor	Limited aquifers, land; cost, permitting
Elevate / Expand Existing Reservoir	Fair to Poor (varies)	Worth exploring if adjacent land use is compatible.
New Reservoir	Poor, except for Salem-Beverly	Available land; environmental, social, political impacts
MWRA	Fair to Good	Hydraulics, water chemistry, effects on rates
Municipal Wheeling / Interconnection	Fair to Good (varies)	Capacity, hydraulics, water chemistry, rate impact
Other Out of Basin Supply	Poor	Cost, permitting, inter-Basin transfer
Reclaimed Water	Poor	Cost, public health, regulations.

New local wells may be feasible in certain limited areas, but overall this option is rated as poor, since aquifers in undeveloped areas are limited, permit constraints would limit pumping, and many towns have been unsuccessful so far due to limited locations, high costs and permitting challenges. New reservoirs could create a significant new source of water, but were overall rated as having a poor feasibility due to environmental and political concerns and apparent lack of available land. However, one supplier (Salem-Beverly) has secured land suitable for a new reservoir near its existing Putnamville Reservoir. Elevating or expanding existing reservoirs could potentially be feasible depending on adjacent land use.

Numerous in-Basin interconnections currently exist and these could be used for the wheeling of water for purchase as well as for emergency purposes. In-Basin interconnections were rated as having a fair to good feasibility. An MWRA connection was rated as fair to good, depending on results of hydraulic, water chemistry mixing, connection costs and entrance fees. Other out of basin supply options are rated poor. Reclaimed water is probably not cost effective or practical since most of the wastewater is exported out of Basin. Several of these potential alternative water sources which rated fair or better are discussed in more detail in Section 5, Discussion and Long Term Planning Solutions.

4 WASTEWATER AND STORMWATER MANAGEMENT

4.1 WASTEWATER MANAGEMENT

An informational survey was sent to all of the thirteen communities that draw water from the Ipswich Basin requesting information on existing wastewater management practices and planned or potential changes in future practices. The information from the survey responses and other sources were used to describe practices in the sections below. The survey responses are compiled in Appendix A.

4.1.1 Existing Practices and Wastewater Export

Table 4-1 summarizes the wastewater management for all towns within or partially within the Ipswich River Basin. Several communities within the Basin rely entirely on private on-site septic systems to manage wastewater flows, including Boxford, Hamilton, Lynnfield, North Reading, Topsfield, and Reading. Approximately 95% of the Town of Middleton is served by private on-site septic systems.

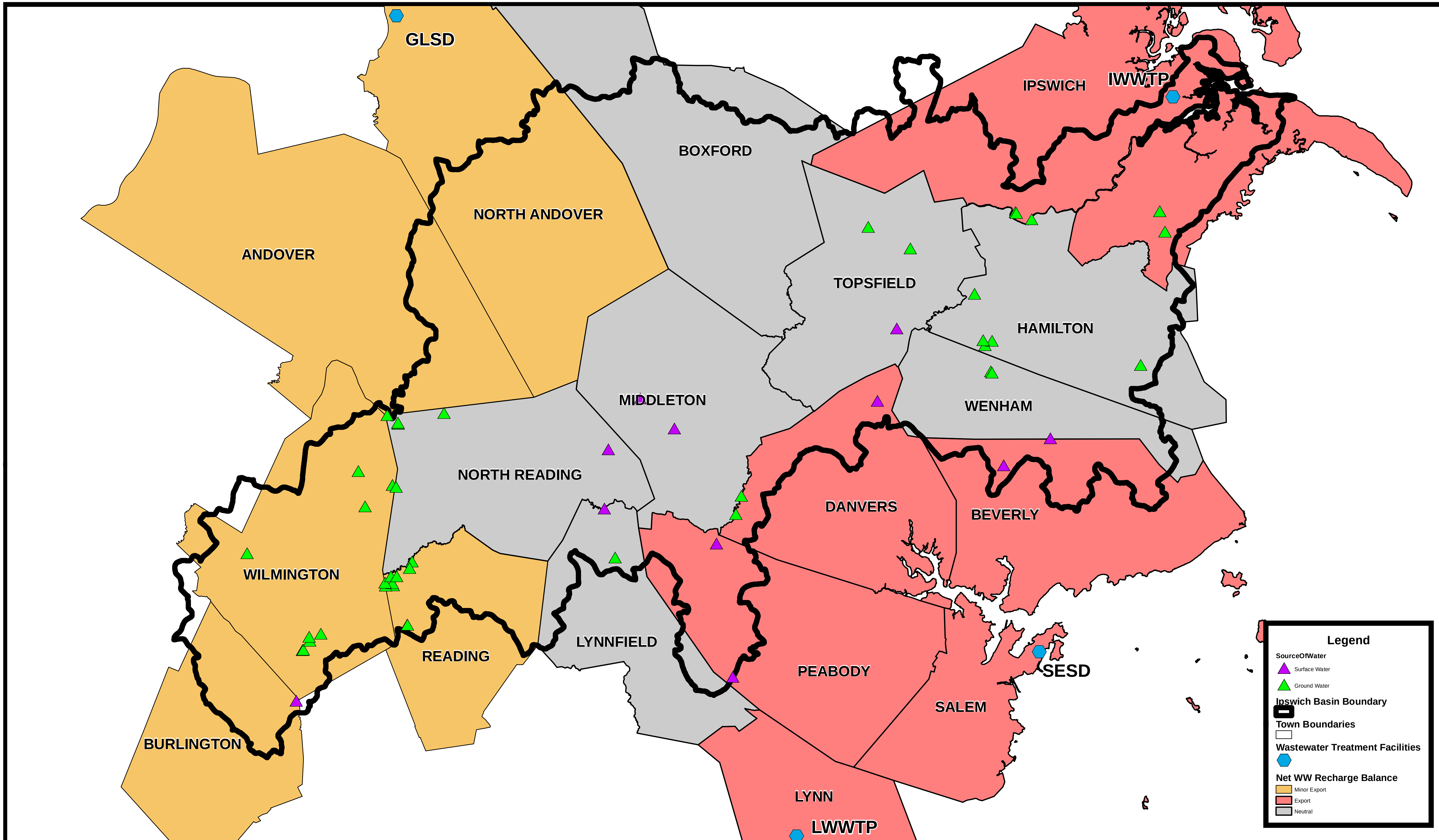
Alternatively, a number of communities are sewered and all of these effectively export water from the Basin via sewage discharge outside of the Basin. Danvers, Peabody and Salem/Beverly are almost entirely served by a sewer system. These systems flow to the South Essex Sewerage District (SESD). The SESD plant discharges to the Salem Sound in the northeast corner of the Town of Salem. Approximately half of the residents in the Town of Ipswich are served by the town sewer, although only 30% of the total area is on sewer. Their wastewater is treated at a local plant called the Ipswich Wastewater Treatment Facility, and discharged into Greenwood Creek located at the eastern edge of the town. While discharging technically within the Basin boundaries, Ipswich's facility is very close to the ocean and effectively does not recharge the Basin water supply.

TABLE 4-1: SUMMARY OF EXISTING WASTEWATER MANAGEMENT AND RECHARGE BALANCE, IPSWICH RIVER BASIN

	Average Annual Water Withdrawal from Basin (MGD)*	Percent of Town Sewered	Percent Town on Septic	% Area within Ipswich Basin	Sewer Discharge Location	Potential for Export via Sewer Infiltration?	Net WW Recharge Balance Ipswich Basin
Andover	0.00	50%	50%	17	GLSD	Y	Neutral
Beverly	3.83	100%	0%	24	SESD	Y	Export
Boxford	private	0%	100%	63	septic	N	Neutral
Burlington	1.89	100%	0%	29	sewer	Y	Minor Export
Danvers	3.26	95%	5%	28	SESD	Y	Export
Hamilton	0.62	0%	100%	85	septic	N	Neutral
Ipswich	0.24	50%	50%	52	IWWTP	Y	Export
Lynn	1.25	100%	0%	0	Lynn WWTP	N	Export
Lynnfield	0.38	0%	100%	32	septic	N	Neutral
Middleton	0.45	5%	95%	100	septic	N	Neutral
North Andover	0.00	75%	25%	59	GLSD	Y	Minor Export
North Reading	0.52	0%	100%	100	septic	N	Neutral
Peabody	3.22	100%	0%	27	SESD	Y	Export
Reading	0.00	100%	0%	48	MWRA	Y	Minor Export
Salem	5.11	100%	0%	0	SESD	N	Export
Salem/Beverly	9.29	n/a	n/a	n/a	n/a	n/a	Export
Topsfield	0.39	0%	100%	100	septic	N	Neutral
Wenham	0.34	0%	100%	92	septic	N	Neutral
Wilmington	1.92	20%	80%	83	septic (80%)	low	Minor Export

* Average from 2009 - 2015 as reported in MassDEP eASR; surface and groundwater combined

Approximately 50% of the Town of Andover is sewered, while North Andover is 75% served by sewer. These towns convey their wastewater flows to the Greater Lawrence Sanitary District (GLSD) located in in North Andover. The GLSD discharges into the Merrimack River at the Northern part of the town. Approximately 20% of the Town of Wilmington is on sewer. All of the Town of Reading is served by sewer. These two communities are serviced by the Massachusetts Water Resources Authority (MWRA) and their wastewater flows are treated at the Deer Island Treatment Plant. See the attached Figure 4-1, Wastewater Practices, for the locations of all wastewater treatment facilities that treat water from the Ipswich Basin, (excluding MWRA).



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PROJECT NO.	20173509.001A
DRAWN:	5/22/2017
DRAWN BY:	KJR
CHECKED BY:	KNR
FILE NAME:	Ipswich Basin.mxd

Wastewater Practices

Ipswich Basin FY17 Water Management Act
(SWMI) Grant Project
Town of Danvers
Massachusetts

FIGURE
4.1

Of the public water suppliers in the Basin, Danvers, Peabody, Ipswich, and Wilmington draw groundwater out of the Ipswich Basin and do not have systems in place to return wastewater to the Basin. Well #1 and Well #2 in Danvers, and the Johnson St. G.P. Well and Pine St. G.P Well in Peabody withdraw groundwater from the Ipswich Basin. The town of Middleton has some private sewer main that connects to the Town of Danvers' sewer system. Wilmington has four wells that withdraw from the Ipswich including Barrows Wellfield, Browns Crossing Wellfield, Salem St. Wellfield, and Shawsheen Ave. G.P. Well. The Town of Ipswich has three wells that withdraw from the Ipswich Basin including Fellows Rd., Essex Rd. and the Winthrop Well. It is also important to note that any water withdrawn from private wells in the towns of Reading, Andover, and North Andover that are within the limits of the Ipswich will not later recharge the Basin.

The net wastewater recharge balance for each town is listed on Table 4-1 and shown on Figure 4-1. A neutral impact indicates that wastewater is returned to the basin via septic system recharge. A net export indicates water is exported from the basin either as potable used out of Basin or as potable used in-Basin and exported as wastewater. Possible 'minor export' was indicated for towns where drinking water was not taken from the Basin, but where sewer lines in the Basin (discharging out of Basin) represented a potential for infiltration to have the effect of exporting groundwater. There is significant net export of water from the Basin, both as water and wastewater.

4.1.2 Potential Growth Plans

Boxford, Hamilton, Lynnfield, North Reading, Middleton, Topsfield, and Reading rely on private on-site septic systems to manage wastewater flows. These communities reportedly have no plans to implement a sewer system, and all new developments will utilize septic systems. The communities that currently are almost entirely on sewer include Peabody, Salem, Beverly, Danvers, and Reading. All new development in these communities will require expansion of the sewer collection systems. The Towns of North Andover, Wilmington and Ipswich are partially on sewer, however, they indicated that they have no plans to expand their sewer systems. Though no response was provided in the informational survey regarding expansions to Andover's sewer system, it was assumed that they will not be expanding their system.

4.1.3 Infiltration/Inflow

Groundwater infiltration into sewers can contribute to aquifer depletion. Available information regarding existing infiltration and inflow (I/I) removal programs was compiled to determine qualitatively if infiltration is a significant component of water export from the Basin. As listed in Table 4-1, there is potential for groundwater export via infiltration from a number of communities within the Basin. A detailed quantitative assessment of the overall contribution of I/I to Basin export was not part of the scope of this study, but could be evaluated further as information becomes available. The results of preliminary analyses are discussed below.

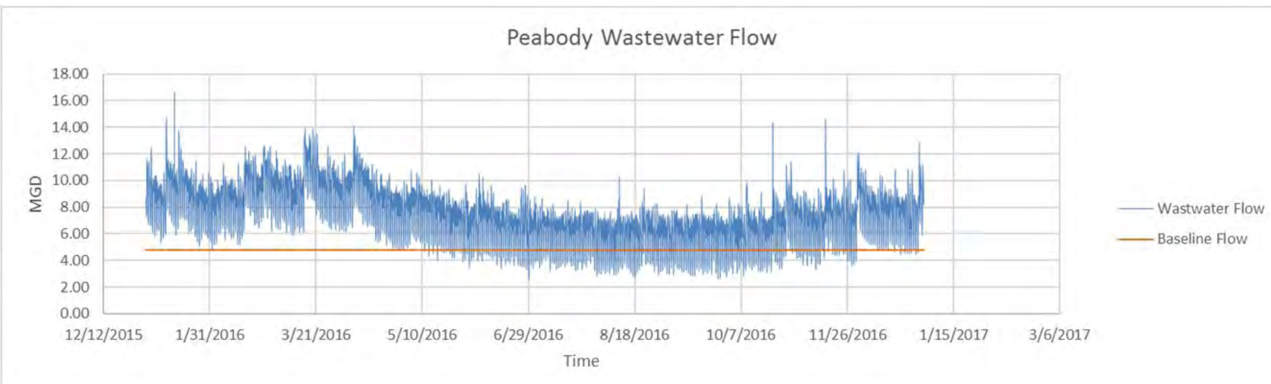
The Town of Reading is entirely served by MWRA sewer. Between 2013 and 2015, Reading averaged 1.32 MGD of infiltration and inflow each year in its 96 miles of sewer main. The most recent I/I report was produced in November 2012, with a supplement added in November 2014. In the past year, the Town inspected 25,487 LF of sewer main, replaced 310 LF of sewer main, cement lined 14 manholes, and inspected 153 manholes. Furthermore, funds were distributed for three projects including inspection of an additional 5,000 LF of sewer, cured-in-place pipelining (CIPPL) of 24,400 LF of sewer, and removing as many sources of private inflow within the designated amount of $53,000. The Town of Reading has also financed seven I/I reduction programs through the MWRA's funding assistance program.

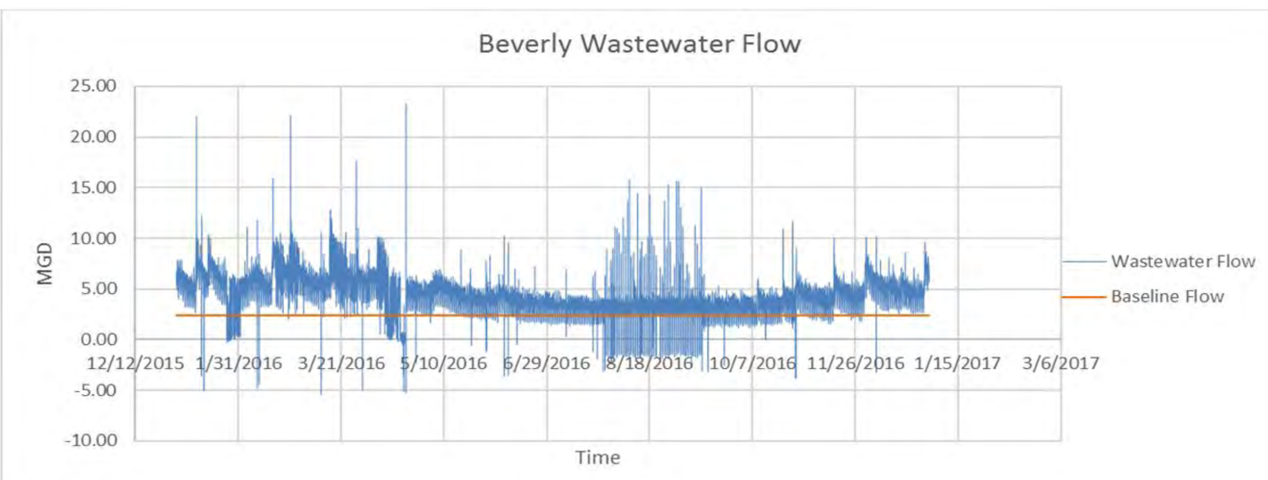
The Town of Danvers' most recently evaluated I/I in 2013, the results of which were reported in a Draft Technical Memorandum completed by CDM in June 2013. Under high groundwater table conditions, peak infiltration is approximately 3.9 MGD, and 2.1 MGD under low groundwater conditions. The sewer system was divided into 40 subareas; 10 of which exceeded MassDEP I/I Guideline of 4,000 GPD per inch-diameter mile (idm). Two of these subareas experiencing high levels of infiltration lie within the Ipswich Basin. Only one of these subareas was recommended for maintenance and repair in Phase Three.

The Towns of Peabody and Beverly did not provide any I/I reports, but a preliminary desktop I/I analysis was performed to determine an estimate of infiltration for planning purposes. Inflow will not affect the groundwater supply of the Basin, and therefore was not considered. The 15-minute wastewater flows were provided by the South Essex Sewerage District. A baseline flow was determined for each town by averaging the daily minimum 15-minute flows. This baseline flow is assumed to be infiltration, as sewers are not expected to be in use at all times. This analysis is limited by evaluating the sewer system as a whole. Infiltration will be averaged over the entire system, instead of targeted subareas (as in a typical I/I analysis). Additionally, we do not know if the infiltration occurs in the Basin or outside of it.

Figures 4-2A and Figure 4-2B below show a graph of the 15-minute wastewater flows for Peabody and Beverly for the year 2016, and their average baseline flows. According to this analysis, Peabody experiences approximately 4.76 MGD of infiltration. Beverly experiences approximately 2.40 MGD of infiltration on average. The extents of the sewer systems were not provided, so we were unable to determine if this is considered excessive according to MassDEP's Sewer System Evaluation Survey recommendation of 4,000 GPD/ idm.

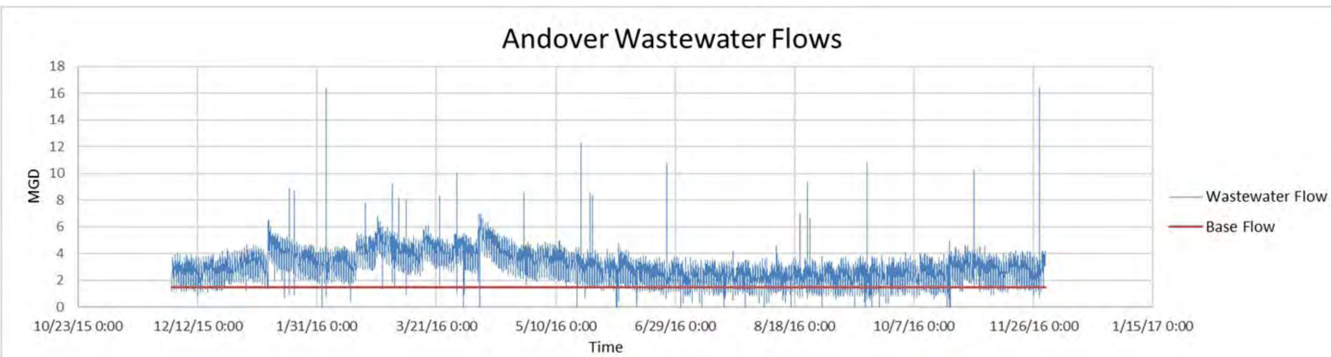
FIGURES 4-2A and 4-2B: BASELINE WASTEWATER FLOW (ASSUMED INFILTRATION) FOR PEABODY AND BEVERLY, MA





The same type of analysis was performed for the Towns of Andover and North Andover. The towns did not provide any I/I reports, but 15-minute wastewater flows were provided by the GLSD from December 2015 to November 2016. According to this analysis, the Town of Andover experiences 1.50 MGD of infiltration on average. Figure 4-3 below shows a graph of the 15-minute wastewater flows for Andover with the average baseline flow. The Town of North Andover provided the extent of their sewer system on their website, including the lengths for each size of pipe. Based off the average wastewater flow and the inch-diameter mile information, North Andover's infiltration and inflow equates to approximately 3,600 GPD/idm. This is relatively close to MassDEP's guideline of 4,000 GPD/idm.

FIGURE 4-3: BASELINE WASTEWATER FLOW (ASSUMED INFILTRATION) FOR ANDOVER, MA



The Town of Wilmington is served by MWRA sewer. Between 2013 and 2015, Wilmington averaged 0.45 MGD of infiltration and inflow each year in its 20 miles of sewer main which equates to roughly 2,500 GPD/idm which is below the MassDEP guideline. This is a conservative estimate, assuming all pipes are 8" to 10". The most recent I/I report was produced in 2003 with its most recent phase completed in 2005. Funding for an I/I analysis was approved in April 2016 and began in the Fall of 2016. Additionally, the Town of Wilmington has financed five I/I reduction projects through the MWRA's funding assistance program.

The Town of Ipswich is also partially served by sewer. They have indicated that they have no formal plan for I/I removal, but one will be developed within the next 2-3 years. The Town provided their daily wastewater flows, however, there was insufficient data to determine if the sewer system is experiencing any infiltration.

4.1.4 Potential Mitigation Options for Wastewater Practices

4.1.4.1 Wastewater Reuse

Wastewater reuse is the practice of providing advanced treatment to wastewater so that is can be reused for beneficial purposes, such as spray irrigation for golf courses, landscaping, artificial recharge of aquifers in certain situations, and toilet flushing. The Reclaimed Water Use Interim Guidance issued by DEP in 1999 (revised 2000) outlines the regulatory approach to these potential effluent reuse options. Public health is first priority with reuse applications. The wastewater must be treated to an exceptionally high level and be almost pathogen and contaminant free. Reuse projects must provide comprehensive monitoring of both the wastewater effluent and groundwater. Wastewater treatment plants must have redundant mechanical systems and backup power to ensure that standards are met. Also, redundant effluent disposal means are necessary since the water re-use application may be seasonal, suspended or eliminated. The feasibility of employing wastewater reuse is probably very low for the following reasons: unknown end-user or consumer, potential cost of upgrading wastewater treatment facilities to meet the reuse limits, cost of pumping the water to where it is needed, uncertainty and multiple permitting hurdles from various agencies, and public perception of risk.

4.1.4.2 Direct Mitigation

The sections below describe options that can be considered for mitigation credit for PWS' that are required to implement mitigation plans under a Water Management Act Permit. Once it has been determined that water demands cannot be reduced below baseline using demand management, permittees are required to provide mitigation and to prioritize direct mitigation actions that are volumetrically quantifiable over indirect mitigation.

Direct mitigation options are considered volumetric offsets that can be credibly quantified and have direct impact on streamflow by either replenishing groundwater recharge or increasing streamflow. Direct mitigation credits can be obtained through surface water releases, stormwater recharge efforts, wastewater returns, and infiltration and inflow removal and are based on a calculated rate of water returned. However, direct mitigation credits are subject to a location adjustment factor which adjusts the credited volume based on the area to which the water is returned. Water returns made outside of the major Basin will receive less credit than those which are returned within the major Basin.

Three primary options to being considered for credit include septic systems or wastewater returns located within the Basin and inflow / infiltration (I/I) removal.

4.1.4.2.1 Wastewater Returns

Per the WMA Permit Guidance Document, if a portion of the water withdrawn is returned to groundwater via septic systems, an 85% credit can be assessed for volume returned to the same major Basin. The credit for wastewater returns via septic systems can be subtracted from the total volume that must be mitigated. Based on available information, some parcels in the communities within the Ipswich Basin are not connected to the municipal sewer system and do have septic systems (Table 4-1) If the Towns needed to receive credit for current and future wastewater returns an analysis could be conducted to determine potential credit the Towns could receive for wastewater returns.

Currently, no towns serviced by sewer utilize wastewater treatment facilities that discharge into the Ipswich Basin. In order to optimize groundwater returns to enhance the water supply in the Ipswich Basin, communities that do not or only partially use sewer could limit future developments to septic systems exclusively. Additionally, in the long term, community septic tanks could be integrated into the wastewater systems, or local wastewater treatment facilities could be constructed that discharge within the Ipswich Basin.

4.1.4.2.2 I/I Program

The classification of I/I programs as direct verses indirect mitigation is a topic of ongoing discussion with MassDEP. I/I removal may be considered a direct mitigation strategy. As such, discussion of the Towns' I/I programs have been included under the Direct Mitigation section of this report. As funding sources become available, the Towns that are served by sewer will continue their efforts towards quantifying and removing I/I from their sewer systems. These efforts include conducting future I/I analyses, sewer system evaluation surveys and removal of extraneous I/I from the sewer system.

The cost of I/I programs is high, but the Towns may need to implement actions regardless of WMA requirements in order to free up wastewater capacity. Future credits for I/I would need to be negotiated with regulators as either indirect or direct mitigation. Recommended next steps for the Towns include identifying wastewater needs and alternatives, and I/I studies.

4.1.4.3 Indirect Mitigation

Under the Sustainable Water Management Initiative (SWMI) Framework, Indirect Mitigation options are those that are not easily quantifiable, but that provide a benefit to the environment by improving habitat, flow, water quality, stream continuity, or water supply protection. When a public water supplier's withdrawal request is above baseline, and the volume requested cannot be offset via demand management and direct mitigation, the required number of additional indirect credits must be determined. The number of credits required depends on whether the request above baseline is less or greater than 5% of August Median Flow and if it would cause a subbasin to drop to a lower category.

4.2 STORMWATER MANAGEMENT

4.2.1 Impact to Basin

The Ipswich Basin has 11,025 acres of impervious cover based on the MassGIS impervious cover raster data layer from 2005. This impervious area is approximately 11% of the Ipswich Basin. This is on the lower side of total impervious cover when compared to most neighboring Basins. The North Coastal, Shawsheen, Parker, and Boston Harbor Basins have approximately 23%, 21%, 7%, and 29% impervious cover respectively. It would be reasonable to expect that with population increase over time, continued development and urbanization could lead to an increase in impervious area which increases runoff and reduces opportunity for precipitation to recharge groundwater.

A 2010 USGS study of the Ipswich Basin (Zimmerman, et. al) examined the impact of low impact development (LID) techniques on streamflows. The study found that at a Basin-wide scale, changes in stormwater management did not have a significant impact on stream flows. This appears to be the case primarily because Basin-wide opportunities for impervious area reduction are too small to significantly affect stream flow as there is limited urbanized area in the Basin to begin with. An analysis of build-out conditions showed only minor effects, most likely because only 17% of land is available for development, and most is already zoned low-density residential. The 2010 study also simulated scaling up results from pilot LID retrofit projects to reduce effective impervious area in the subbasin above the South Middleton stream gage by 50%. These simulations also showed minimal effects.

Despite the limited effectiveness for mitigating volume of low streamflow conditions on a Basin-wide scale, Zimmerman et. al. did find that local scale simulations showed evidence of a greater effect especially in areas with smaller streams and higher percent impervious cover. These efforts are also promoted, and in some cases already mandated, by existing state and local stormwater regulations, as well as by the United States Environmental Protection Agency (USEPA) Municipal Small Storm Sewer System (MS4) Permit for Massachusetts. Certain efforts may also count as 'mitigation' under the Water Management Act. Where stormwater recharge projects can be implemented in these situations, and where they can provide mitigation under the WMA and / or help with compliance under the MS4, their benefit is multiplied. Several such specific structural improvements that can promote stormwater recharge are described in Section 4.2.3.

4.2.2 Existing Stormwater Management Practices

The existing stormwater practices of the towns within the Ipswich Basin were reported through informational surveys (provided in Appendix A). The new Massachusetts MS4 Permit, effective July 1, 2017, contains, among other elements, detailed new requirements for six different 'Minimum Control Measure' (MCM) permit elements: public education and outreach, public involvement and participation, illicit discharge and elimination, construction site stormwater runoff control, post-construction stormwater management in new developments and redevelopment, pollution prevention, and good housekeeping for municipal operations. Many towns are working on modifications to their existing practices to accommodate these changes.

The Town of Danvers reported that they currently have a Facilities Plan and a Stormwater Management Plan (SWMP) in draft form. The Town of Danvers High School has an installed water reuse system where rain water is collected through the turf field and held in a large tank underground. The collected water is used to water grass fields at the sports complex.

The Town of Hamilton does not have a SWMP yet, but they plan to develop one per Phase II of their MS4 Permit requirements. The Town of Middleton and the Town of Wenham reported that they do not currently have any structural stormwater best management practices (BMPs). The Town of Ipswich did not report any information related to stormwater management practices. The Town of Lynnfield is currently working on implementing its SWMP for the requirements of the MS4 regulations. The Town of Wilmington completed a SWMP in 2009 that details evaluations and recommended improvements to their stormwater system. Their SWMP also details their operation and maintenance practices including catch basin cleaning, street sweeping, structure and pipe inspections, outfall maintenance, illicit connection investigations, detention basin maintenance, culvert maintenance, and general maintenance permitting. The Town of Topsfield filed a SWMP in 2004 which details the elements of their stormwater practices such as public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention housekeeping of municipal operations. They have also reported completing several infiltration structure projects dating back to 2006.

4.2.3 Potential Stormwater Recharge Improvement Practices

There are many potential stormwater recharge improvement practices that can be implemented to improve stormwater recharge and help get runoff into the groundwater. Seven different practices are described below and summarized on Table 4-2. A number of these practices were evaluated in the Ipswich Basin during the Department of Conservation and Recreation's Ipswich Basin EPA Grant Demonstration Project (http://www.mass.gov/eea/agencies/dcr/water-res-protection/ipswich-river-watershed/).

Install Permeable Paving Materials:
Porous pavement is a paved surface with a higher than normal percentage of air voids to allow water to pass through it and infiltrate into the subsoil. This porous surface replaces traditional pavement, allowing parking lot, driveway, and roadway runoff to infiltrate directly into the soil and receive water quality treatment. This practice was studied as part of the Ipswich Basin EPA Demonstration Project and infiltration tests of the permeable paving materials at Silver Lake in Wilmington, conducted after construction, indicated that infiltration rates met or exceeded specifications and expectations. This practice is quite feasible, but efforts should be maintained to avoid sand and salt exposure during winter months. The sanding could clog the voids of the pavement, and the salt could contaminate infiltrated runoff. Relative cost and maintenance impacts are summarized in Table 4-2.

Construct Rain Gardens/Bio Retention Cells:
Bio retention cells (also called rain gardens in residential applications) are shallow depressions filled with sandy soil topped with a thick layer of mulch and planted with dense native vegetation. Stormwater runoff is directed into the cell via piped or sheet flow. The runoff percolates through the soil media that acts as a filter. This practice was studied as part of the Ipswich Basin EPA Demonstration Project. Monitoring on Silver Lake Avenue indicated that during 60% of storms that occur annually, the practice retained and reduced runoff volume, and reduced effective

impervious areas by about 50%. This practice can provide effective groundwater recharge, but it requires careful landscaping, and should only be sited in small drainage areas. Relative cost and maintenance impacts are summarized in Table 4-2.

Install Roof Drywells:

Dry wells are small excavated pits, backfilled with aggregate, and used to infiltrate uncontaminated runoff from non-metal roofs or metal roofs located outside the Zone II or Interim Wellhead Protection Area of a public water supply and outside an industrial site. This practice was studied as part of the Ipswich Basin EPA Demonstration Project. The increased recharge as provided by dry-wells was not specifically studied, however, the Partridgeberry Place LID subdivision did exhibit similar runoff characteristics to a normally forested site. This practice can be feasible for new development and retrofit projects in promoting groundwater recharge, but should only be sited for residential rooftops and in small drainage areas of one acre or less. It is important to make sure that local soils are conductive to infiltration, and source waters are not prone to conveyance of clogging materials. Relative cost and maintenance impacts are summarized in Table 4-2.

Install Leaching Catch Basins:

A leaching catch basin is pre-cast concrete barrel and riser with an open bottom that permits runoff to infiltrate into the ground. The basin is placed on a pad of free draining crushed stone, with the excavation around the basin back-filled with similar material. The base and barrel of the basin are perforated so that water entering the basin can enter the surrounding stone fill and infiltrate into the ground. This practice was not studied as part of the Ipswich Basin EPA Demonstration Project. However, consideration could be made into installing as a retrofit project to a site with existing catch basins. This practice can provide significant groundwater recharge, but requires adequate pre-treatment, such as traditional deep sump catch basins in-line. Relative cost and maintenance impacts are summarized in Table 4-2.

Construct Infiltration Basins or Trenches in Previously Impervious Areas:

Infiltration basins are stormwater runoff impoundments that are constructed over permeable soils. Runoff from impervious areas is stored until it exfiltrates through the soil of the basin floor and recharges to groundwater below. This practice was not studied as part of the Ipswich Basin EPA Demonstration Project. Infiltration basins or trenches can provide effective groundwater recharge when infiltration conducive soils are present, but requires frequent maintenance to remove captured sedimentation to maintain effectiveness. Relative cost and maintenance impacts are summarized in Table 4-2.

Subsurface Structures

Subsurface structures are underground systems that capture and gradually infiltrate runoff through a media of rock or gravel. Typical examples include pre-cast concrete or plastic pits, chambers, perforated pipes, or galleys. These structures are effective for recharge if surrounding soils are suitable and can often be used even if space is limited. They are useful in retrofit projects. Considerations must be made to prevent clogging the media with fines and avoiding system failure which could breed mosquitoes. Relative cost and maintenance impacts are summarized in Table 4-2.

Install Artificial Recharge or Injection Wells:

An artificial recharge, injection, or Class V well as it is referred to by USEPA, is used to inject non-hazardous fluids underground. Fluids are injected either into or above an underground source of drinking water. Most stormwater injection wells are sophisticated Class V wells which rely on pressure systems for fluid injection. This practice was not studied as part of the Ipswich Basin EPA Demonstration Project. Artificial recharge or injection wells are the most effective in terms of recharging groundwater, however it requires the most extensive pre-treatment measures to mitigate the contamination of groundwater sources. Relative cost and maintenance impacts are summarized in Table 4-2.

Control Inflow & Infiltration (I/I) into Sanitary Sewers:

There are several techniques available to controlling inflow and infiltration into sanitary sewers, whether it be into a sewer manhole structure, or into the sewer piping itself. By controlling this conveyance of stormwater runoff, or groundwater infiltration into sanitary sewers, the local groundwater source is given the ability to recharge appropriately, and the water is not directed through the sanitary sewer system to a distant source for treatment and discharge. This practice was not studied as part of the Ipswich Basin EPA Demonstration Project and is not a traditional method of groundwater conservation, and encouragement of recharge, but can be effective none-the-less. Generally, it is assumed that I/I projects result in a maximum of 50% infiltration removal. An Inflow reduction project typically results in the removal of 100% of the inflow to the sewer collection system from the identified sources. Relative cost and maintenance impacts are summarized in Table 4-2.

TABLE 4-2: POTENTIAL STORMWATER RECHARGE IMPROVEMENT TECHNIQUES

Stormwater Recharge Method[1]	Limitations	Relative Cost Impact Considerations[2,3]
Permeable Paving 	Clogging must be prevented	Low Capital Cost; Medium Construction Cost; Low Level of Maintenance
Rain Gardens/ Bio Retention Cells 	Requires careful landscaping; best for small drainage areas	Low Capital Cost; Medium Construction Cost; High Level of Maintenance
Roof Drywells 	Best for residential roofs; small drainage areas	Low Capital and Construction Cost; Low Level of Maintenance *Assuming local soils are conducive to infiltration, and source waters are not prone to conveyance of clogging materials.
Leaching Catch Basins 	Good for recharge; best if deep sumps are provided for pre-treatment	Low Capital Cost; Medium Construction Cost; Low Level of Maintenance if adequate level of pre-treatment is provided.

Stormwater Recharge Method[1]	**Limitations**	**Relative Cost Impact Considerations**[2,3]
Infiltration Basins or Infiltration Trenches 	Effective recharge; requires frequent maintenance	Low Capital Cost; Medium Construction Cost; High Level of Maintenance
Subsurface structures 	Effective recharge where soils are suitable and design prevents clogging	Medium Capital Cost; Medium Construction Cost; Low Level of Maintenance if adequate level of pre-treatment is provided.
Install Artificial Recharge or Injection Well 	Effective recharge; extensive pre-treatment required to avoid groundwater contamination	High Capital, Engineering, Permitting, and Construction Cost; Level of Maintenance – N/A

Stormwater Recharge Method[1]	Limitations	Relative Cost Impact Considerations[2,3]
Control Inflow & Infiltration (I/I) into Sanitary Sewers 	Does not promote recharge, but can conserve groundwater from export and theoretically prevent stormwater loss if that stormwater can be infiltrated instead of inflowing to sewers.	High Capital, Engineering, and Construction Cost; Low Level of Maintenance

[1]Massachusetts Stormwater Handbook Guidance Document, MassDEP, Volume 2, Chapter 2, 2008
[2]Preliminary Data Summary of Urban Stormwater Best Management Practices, USEPA, August 1999
[3]Comparison of Maintenance Cost, Labor Demands, and System Performance for LID and Conventional Stormwater Management, Journal of Environmental Engineering, July 2003

4.3 OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Through the use of informational surveys, the 13 water suppliers surveyed were asked if their communities had completed any other projects that would be environmentally beneficial and potentially eligible for Water Management Act mitigation credits. The responses are listed below:

- The Town of Danvers reported multiple environmentally beneficial policies and projects. These include: having a Stormwater Bylaw, a Wetlands Bylaw, completion of a dam removal at Curtis Pond, a stream restoration at Boston Brook, stream bank improvements at Frost Fish Brook to allow fish migration, the acquisition of property in Zone I or II of wells at Lobel's Grove, and the acquisition of property for natural resource protection at Choate Farm and Lobel's Grove.
- The Town of Wilmington reported having a Stormwater Bylaw, a Wetlands Bylaw, and a Water Quality Improvement Project at Silver Lake in 2003 (the Town participated in the EPA demonstration project).
- The Town of Ipswich reported having a Stormwater Bylaw, a Wetlands Bylaw, and a Water Use Bylaw, completion of a study to remove Mill's Dam, having actively pursued acquisition of property in Zone I and II and other open space properties, and a current project to improve water quality in Farley Brook, which discharges to the Ipswich River.
- The Town of Topsfield reported having a Stormwater Bylaw and a Wetlands Bylaw.

- The Towns of Wenham, Middleton, and Hamilton, and the Lynnfield Center Water District did not provide information on having completed any such projects.

4.4 SUMMARY OF WASTEWATER AND STORMWATER MANAGEMENT OPTIONS

Much of the drinking water pulled from the Basin eventually leaves it as exported wastewater. The most feasible options for minimizing the impact of wastewater practices include 1) minimizing extension of new sewer systems in favor of septic systems or localized groundwater discharging treatment systems, and 3) investigation and removal of infiltration and inflow to sewer systems. The degree to which I/I is a problem in the Ipswich Basin could not be determined within the scope of this study with the information provided.

Stormwater infiltration projects can be beneficial for improving water quality of receiving waters, and potentially beneficial locally or on a small scale for promoting recharge. However, due to the relatively low impervious cover of and overriding influence of evapotranspiration on the water budget (Section 1), large scale stormwater infiltration projects are unlikely to be a cost effective way to restore groundwater levels. However, further investigation into the potential localized benefit of such projects adjacent to particularly depleted streamflow reaches is worth considering for further evaluation, particularly in areas where the project would additionally help municipalities achieve mitigation credits under WMA and/or compliance with MS4.

5 DISCUSSION AND POTENTIAL LONG TERM PLANNING SOLUTIONS

The purpose of this study is to better understand the current and future water supply constraints and challenges facing the Basin's municipal public water suppliers—particularly those who maintain groundwater sources—and, to identify potential regional solutions that could allow for improvement of resiliency and environmentally sustainable growth. Through an evaluation of existing information, this study examined the following questions:

- What are the constraints of the Ipswich Basin governing its hydrology?
- How are the Basin water resources being used?
- What opportunities are there to better manage water in the Basin?
- Is there enough water for future needs?
- What are the Basin water supplier needs and challenges, particularly for Grant Partner communities?
- What are some solutions to improve resiliency for groundwater PWS in the Basin?

In this Section the key findings are summarized, potential solutions are discussed, outstanding questions are identified, and recommended next steps are presented.

5.1 SUMMARY OF KEY FINDINGS AND WATER SUPPLY CHALLENGES

Since the 1960s, the water resources challenges of the Ipswich Basin have been discussed and studied. With its low lying topography, high groundwater table and humid climate, almost half of Basin rainfall is lost to evapotranspiration before it can recharge the groundwater and replenish stream baseflow. Recent studies have emphasized the powerful influence of evapotranspiration on the Basin's hydrology. As climate change leads to longer periods of higher temperatures, the effect of natural processes on streamflow depletion is only expected to increase. The Basin's limited sand and gravel aquifers are situated primarily within river and stream valleys and so since the early 1900s, the primary locations for municipal groundwater wells have naturally been historically sited close to streams and rivers.

The effect of municipal wells on streamflow in the upper reaches of the Basin has been reported as far back as the 1960s, and modeled in recent years. In the last 10 years the use of some of the wells thought to be causing the most impact has ceased yet low flows in the Ipswich River are still observed. Lack of available suitable aquifers in undeveloped areas away from headwater streams has led to very limited success by municipal suppliers in identifying new groundwater sources. As a result, use of surface water and purchase of water from the MWRA has been increasing as the use of groundwater sources has decreased. Whereas groundwater made up half of total water supply in 1960, current groundwater withdrawals from the Basin have dropped to below 1960 volumes and surface water represents over 75% of the total water withdrawn from the Basin. A great deal of Basin water is exported, either as wastewater flow, or for potable water use, outside of the Basin. Basin water supplies about as many people inside as outside the Basin (EOEA, 2003) and about 17MGD or over 75% of total withdrawal is sold and/or sewered out of the Basin.

However, while overall Basin withdrawals more than doubled from 1960 to the late 1980s, and population has continued to increase, total current withdrawals have remained steady at late 1980s rates. This appears to indicate that in general the Basin water users have made significant gains in demand reduction and using water efficiently.

This is supported by statistics indicating that on average, Ipswich Basin water suppliers are meeting conservation standards, with residential per capita use (57) at well below the state standard of 65 RGPCD. A few communities remain above the standard while others are reporting even lower residential usage rates. Water supply demand management best practices appear to be widely used, especially amongst groundwater suppliers. Reducing unaccounted for water (UAW) remains a greater operational challenge for many suppliers in the Basin. Similar to numbers statewide, Basin-wide UAW is above 10%, at 14% and usually fluctuates year to year. This is not surprising, as the detection and repair of leaks is a continual challenge requiring consistent attention and investment.

The seven groundwater-using PWS responding to a survey reported that almost all feasible enhanced conservation and demand management practices were in use and were effective. In terms of optimizing supplies with alternative strategies to minimize environmental impact, most groundwater suppliers responding indicated that most strategies were infeasible to implement, primarily due to physical constraints. The exceptions were suppliers who also had access to surface supply storage for moderating the use of wells during summer.

Historic trends indicate that changes in water supply practices in the last several decades have resulted in a significant increase in the practice of seasonal ‘flood skimming’ or withdrawing large volumes of surface water during high streamflow months and storing them for summer use. For suppliers for whom this is an option, it is helping to moderate the effect of seasonal higher demand on groundwater supplies. All permitted groundwater suppliers in the Basin are subject to stringent permit restrictions intended to reduce summer seasonal impacts on surface water resources in order to improve aquatic habitat for fish. Almost all groundwater PWS responding reported significant challenges in attempting to comply with permit restrictions, most notably with the seasonal cap restriction.

The physical / hydrologic dynamics of the Basin and recent modeling studies (Claessens, 2006; Zimmerman 2010) suggest that as the climate warms, any incremental benefit to be gained by additionally stringent conservation or increasing restrictions on groundwater withdrawals are likely to be more than offset by ET effects and these 'diminishing returns' may become increasingly costly and restrictive of economic growth.

Other ways to improve Basin recharge and stream low flows through stormwater retrofit projects and low impact development have been explored and studied in the past decade. Results have shown that while potentially beneficial in certain localized situations, and likely beneficial to water quality, on a Basin-wide scale these efforts will be volumetrically insignificant. Due to the large volume of wastewater export from the Basin, the capture and return of wastewater to the Basin would represent the best way to balance the hydrologic budget in the long term. However, due to the infrastructure already in place, this solution would be a significant undertaking with vast financial, political, and environmental challenges to be overcome.

So, is there enough water for the future public water supply needs of the Basin? Given that current municipal use (representing over 95% of total withdrawals) is currently about 22 MGD, and that the established Basin Safe Yield is 29.4 MGD, usage would have to increase by over one-third to hit the safe yield level. With population projections estimating on the order of 5% growth through the next twenty-five years, the answer would appear to be that the Basin can supply foreseeable public water demands as well as accommodate limited growth. On the other hand, if regulators decide to adopt even more stringent protections with the goal of achieving the river flows as recommended by the Ipswich River Fisheries Restoration Task Group, studies have indicated that reservoirs would fail to fill to capacity to meet demands for public water supply (USGS, Zarriello 2002). It is clear that due to hydrogeologic and land use limitations alone, significant expansion of groundwater supplies in the Basin will not be a solution for the future. Therefore, responsible expansion of regional supplies and of surface water options should be explored and permitted.

During the grant workshops and in past meetings with MWWA, the Ipswich Basin groundwater-supplied communities have expressed that having adequate water allocations which will support future economic development and growth, while ensuring environmental sustainability, was highlighted as a major priority. The Water Management Act permitting process is complex and the new regulatory requirements introduce much uncertainty in terms of what will be required (and credited) for minimization and mitigation obligations in order to access volumes over baseline. The communities expressed concern that there are differing regulatory mandates within the Commonwealth's agencies which are in conflict. For example, there is a requirement to increase affordable housing opportunities, yet it appears from initial permitting discussions that future water withdrawal volumes may be curtailed. It is very difficult for communities to approve development if they are uncertain if they will have the permitted capacity to supply existing and future customers. The communities wish to maintain existing allocations to ensure that they have adequate supply to support required housing stock and so that they are not in a position of economic disadvantage should development wish to locate in their communities.

5.2 DISCUSSION OF POSSIBLE SOLUTIONS

The Grant Partner communities supplying groundwater have a number of specific challenges. Most of them are some of the smallest communities in the Basin with fewer sources and therefore reduced operational flexibility. Most are close to or projected to exceed baseline withdrawal limits and some have already been actively working on mitigation activities. Many are struggling to fund costly water treatment solutions while handling the administrative and operational burden of the permit conditions.

We explored possible solutions to help improve water supply resiliency and flexibility for these suppliers. Potential solutions were presented in Section 3, and then further discussed during workshops with the Grant Partners. The options with a fair to good feasibility rating are discussed below in terms of what the solution might entail, what potential challenges to implementation may arise, and what questions need to answered before pursuing the option further.

5.2.1 MWRA Purchase – Dedicated Supply

The purchase of water from MWRA should provide sufficient capacity for all interested suppliers and could be considered by individual suppliers or in collaboration, through a Joint Powers Agreement or Intermunicipal Agreement (discussed further in Section 6). For a dedicated MWRA supply, the most direct route appears to be extending a main north from the proposed MWRA connection at Suntaug Lake in Peabody, known as the Section 109 Pipeline Extension Project, up Route 1 through Danvers to Topsfield. Wenham would likely need to receive supply wheeled either from Danvers or from Topsfield. Hamilton would need to receive water from Wenham, presumably. The permitting and hydraulic requirements of such an arrangement would also need to be evaluated to fully assess feasibility. A more detailed evaluation of routes options and project requirements is outside of the scope of this study.

Another consideration needing evaluation is water chemistry compatibility. For systems that would be partially supplied MWRA communities, residual disinfectant and corrosion control should be examined for mixing zone impacts prior to implementation through a study, including in-field sampling, of water quality characteristics and treatment.

The effect of such a project on community rate payers would need to be examined if this option is explored further. Since individual suppliers may be seeking relatively small volumes, it would most likely be more cost effective to pursue this option by cost sharing under an intermunicipal agreement. As discussed in Section 3, there is an MWRA entrance fee of (currently) $4.4M per MG of supply. The MWRA entrance fee is payable over a 25 year period, interest free. There is a 1:1 matching grant fund program, subject to appropriation, for local government or regional governmental units wishing to join the MWRA. Funding options are discussed in more detail below in Section 5.3.

5.2.2 MWRA Individually Wheeled via Interconnection

MWRA currently supplies water to the following PWS in or near the Ipswich Basin: Reading, Peabody, Wilmington, and Lynnfield Water District. Although a detailed engineering analysis was not available, and is outside of the scope of this project, a planning level analysis of the current locations of municipal interconnections suggests that additional MWRA water could possibly be wheeled (water directed through one water supply community to another adjacent community) through Reading or Wilmington (and possibly Peabody) into Middleton or Danvers without construction of additional dedicated MWRA lines. Beyond that, system head losses may interfere with the ability to provide service. As with the MWRA dedicated supply option above, further evaluation of system hydraulics, water chemistry, and effects on rates would be required to further evaluate this option.

5.2.3 Other Municipal Supply Interconnection Purchase

As with the above MWRA options, successful implementation of purchase via interconnection depends on system hydraulics, water chemistry compatibility, and impact on rates. In addition, this option depends on the supply capacity and registered and/or permitted capacity of the selling PWS, and the willingness of the PWS to sell to the buyer.

In terms of available registered and permitted volumes, the PWS with available water appear to be limited those with surface water sources: Lynn, Peabody, and Salem-Beverly. While both Reading and Wilmington have un-utilized or under-utilized registered Ipswich volumes, it is unlikely that regulators would support the wheeling of groundwater supply from either of these communities, due to the reported impact of these wellfields on stream flows.

Lynn has an Ipswich registered volume of 5.31 MGD and is only using about 1.25 MGD from its Ipswich intake (Table 1-2). Peabody has a combined registered and permitted authorized withdrawal from the Ipswich Basin of 4.71 MGD and recent average use is 3.22 MGD. Salem-Beverly has a combined registered and permitted authorized Ipswich withdrawal of 12.44 MGD and average use of 9.29 MGD.

5.2.4 Middleton Pond or Other Reservoir Expansion

Of the Grant Partner communities, only Danvers has an existing surface water supply (Middleton Pond). As discussed in Section 3, attempts to pursue an expansion of the capacity of Emerson Brook Reservoir (also controlled by Danvers) have to date been infeasible due to unsuccessful negotiations with regulators regarding wetland impacts. Based on MassGIS mapping, Middleton Pond appears to have an area of Town-owned undeveloped land (mostly upland) at its northwesterly (upgradient) end and also bordering the Pond to the south. The potential for expansion of this reservoir into the forested upland has not yet been evaluated, but is worth investigating as a potential solution for Danvers / Middleton and possibly for a Grant Partners Joint Power Entity or individual community purchase.

5.2.5 Other Regional Solutions – Permit Bank / Credit System

A recurring theme in relation to the challenges faced by the Grant Partners is the challenge of meeting WMA permit requirements. One collaborative option worth exploring is if via joining into a regional Joint Power Entity, the suppliers could be permitted as a single PWS, thus expanding the flexibility to utilize their systems to meet demands and operations and maintenance needs while maintaining permit compliance in order to minimize environmental impact. Similar to nitrogen trading credits, this might involve, for example, the use of a withdrawal credit trading system based on withdrawals from or mitigation to subbasins with the same net groundwater depletion category. This would need to be further conceptualized amongst interested suppliers and discussed with MassDEP.

5.3 POTENTIAL FUNDING MECHANISMS

The investment of funds needed for construction of new infrastructure to implement many of the potential solutions listed above will be significant. There are some mechanisms that may help to partially offset these costs. In 2014, the Massachusetts Legislature passed into law comprehensive water infrastructure legislation. Chapter 259 of the Acts of 2014[1] provided several statutory mechanisms which can assist the communities in the Ipswich River Basin in looking toward regional solutions to address water supply issues. Listed below are the sections of the law that are likely applicable for the Ipswich River Basin. While these mechanisms are codified in statute, this funding will require appropriation by the legislature. The local legislative delegation should be made aware of the recommendations in this report and be asked to advocate for the funding necessary to explore and implement alternatives; without state assistance, the communities fear that the cost may be too much for ratepayers alone to bear.

<u>Section 31A of Chapter 21:</u> This is a matching grant program for communities who desire to join the Massachusetts Water Resources Authority or other regional system for wastewater, drinking water or for both wastewater and drinking water:

> *Subject to appropriation, the department of environmental protection shall administer a matching grant program for communities who desire to join the Massachusetts Water Resources Authority or any other regional system for wastewater, drinking water or for both wastewater and drinking water. Each grant shall match, on a 1:1 basis, money committed by a local government unit or a regional local governmental unit, as defined in section 1 of chapter 29C, to pay the entry fee established by the: Massachusetts Water Resources Authority, under section 8 of chapter 372 of the acts of 1984; or other fees required to join a regional system. The department shall award grants only to a local governmental unit or regional local governmental unit that satisfies the department that it has committed funds to join said Authority or regional system. Should the local*

[1] *https://malegislature.gov/Laws/SessionLaws/Acts/2014/Chapter259*

> *governmental unit or regional local governmental unit fail to join said Authority or regional system after receiving a grant under this section, the local governmental unit or regional local governmental unit shall return money granted under this section to the department.*
>
> *For the purpose of this section, the term "regional system" shall include any system established by mutual agreement of 2 or more municipalities or by a county in which all municipalities of said county have an agreement to provide drinking water or wastewater services, or both, through shared facilities, sources or distribution networks.*

Given the entrance fee of $4.4 million per MG; this matching grant program could cut the communities financial obligation in half; perhaps making it more advantageous to pursue. The on-going rate impact from wholesale purchases of MWRA water would still be an issue the communities would need to evaluate.

<u>MassDEP Drinking Water State Revolving Loan Fund regulations, 310 CMR 45.00</u>*:* The SRF regulations were amended to include language incorporating language from SECTION 23 of Chapter 259 of the Acts of 2014. *(e) The department shall promulgate regulations under section 7 establishing the types of eligible projects and criteria that the department shall use to evaluate applications for additional financial assistance, including principal forgiveness and additional financial incentives, consistent with the sustainability criteria as determined by the United States Environmental Protection Agency as required by the Water Resources Reform and Development Act of 2014. The financial assistance and financial incentives provided under these regulations shall be made available to projects appearing in the department's intended use plan the year following the release of regulations by the department and subsequent years. Such criteria may include, the following requirements, any 1 of which shall be sufficient to qualify the project for assistance: (i) the project is pursuant to a regional wastewater management plan that has been adopted by a regional planning agency with regulatory authority;* ***<u>(ii) the project is necessary to connect a local or regional local governmental unit to a facility of the Massachusetts Water Resources Authority, if the local or regional local governmental unit has paid or committed to pay the entry fee of that authority;</u>*** *(iii) the project is a green infrastructure project, as defined in section 26A of chapter 21, with consideration being given to projects that effectively combine green infrastructure with wastewater infrastructure and drinking water infrastructure projects;* ***<u>(iv) the project uses regional water resources to offset, by at least 100 per cent, the impact of water withdrawals on local water resources in the watershed Basin of the receiving community;</u>*** *(v) the project is a direct result of a disaster affecting the service area that is the subject of a declaration of emergency by the governor; (vi) the project is intended to provide public water supply to consumers whose groundwater or public or private wells are impacted by*

contamination; or (vii) the program is an innovative water project utilizing new technology, which improves environmental or treatment quality, reduces cost, increases access and availability of water, conserves water or energy or improves management, in the areas of drinking water, wastewater, stormwater, groundwater or coastal resources; provided, that the project has not been fully implemented, other than as a pilot project, previously in the commonwealth.

The above section of the law is intended to help communities defray the cost of the physical connection to the MWRA or other regional supplier. As discussed above, a new pipeline may be needed through Danvers to Topsfield; monies could be appropriated through the State Revolving Loan Fund to fund this project with principal forgiveness granted. Funding might also be secured to expand existing reservoirs if that expansion would allow for a community to offset their impact to the Basin.

Wastewater is a significant export from the Basin. For communities connected to the MWRA wastewater system, there is funding to address inflow and infiltration challenges which may contribute to the total volume of exported water. Reduction in I/I may help address water balance issues in the Basin, although the volume and degree to which it may be a problem should be assessed.

<u>Chapter 29, Section 2NNNN: Regional Water Entity Reimbursement Fund</u> *[Text of section added by 2014, 259, Sec. 17. See also, Section 2NNNN added by 2014, 286, Sec. 13, below.]*

Section 2NNNN. There shall be established and set up on the books of the commonwealth a separate fund to be known as the Regional Water Entity Reimbursement Fund, in this section called the fund. The fund shall be administered by the state treasurer and shall be funded by the commonwealth, by and through the state treasurer and subject to appropriation, to reimburse the Massachusetts Water Resources Authority for its costs: in providing cities and towns, within its sewer service area, financial assistance in the form of interest free grants and loans to rehabilitate collection systems in cities and towns; and to structurally reduce infiltration and inflow into the tributary to the treatment facilities owned by the authority. Such reimbursement shall be in addition to the contract assistance amounts in section 6 of chapter 29C, subject to the limit set forth in said chapter 29C, but shall not be greater than 10 per cent of the maximum amount set forth in said chapter 29C.

6 JOINT POWERS AGREEMENT

Pursuant to M.G.L. c.40, §4A1/2, added by Section 20 of the Municipal Modernization Act (Chapter 218 of the Acts of 2016), municipalities are authorized to enter into "joint powers agreements" for the joint exercise of any of their common powers and duties within a designated region. This authority is in addition to that conferred by M.G.L. c.40, §4A, which authorizes cities and towns to enter into Intermunicipal Agreements (IMAs) for the provision of joint municipal services.

The difference between an intermunicipal agreement executed pursuant to section 4A and one executed pursuant to section 4A1/2 is that a Joint Powers Agreement (JPA) typically involves the creation of a new legal entity (the "Joint Power Entity" or JPE), separate and distinct from the municipalities that create it. Entities created pursuant to a joint powers agreement are bodies politic and corporate with the power to, among other things, make, amend and repeal policies and procedures relative to the operation of the region, receive and expend funds, and to make and execute contracts necessary for the exercise of the powers of the region. Such entities are governed by a board of directors comprised of at least one member representing each participating municipality. No similar entity can be created under an IMA executed under the authority of section 4A.

Because section 4A1/2 authorizes communities to create new legal entities by Agreement, rather than forcing them to obtain legislative approval, it makes it far easier for Ipswich Basin groundwater permit holders to create a mechanism that can broker the acquisition of water from outside the watershed or otherwise provide for their customers' long-term water needs, should such an entity be needed.

In general, a JPE is an appropriate legal mechanism to consider when there is an on-going role for a separate, neutral entity in the management of water supply utilization and distribution. If there is no such need, however, a conventional IMA may likely provide sufficient arrangements. As the Grant Partners move toward implementing one or more of the conceptual solutions identified in Section 5.2 of this Report, the need (or lack of need) for a JPE will come into focus, as form follows function.

6.1 MWRA PURCHASE – DEDICATED SUPPLY

Traditionally, communities may join the MWRA only by Special Act, which typically requires a vote of the applicant city or town's legislative body, requesting that the Legislature adopt the necessary statutory provision. The MWRA then enters into an agreement with the municipality, setting the terms of its entry into the MWRA system. Each such agreement specifies the amount of water that is anticipated to be purchased, and the entry fee is thus computed (currently based on $4.4M per MG). Funding and financing mechanism for defraying this cost are described in section 5.3.

Any community that can construct a physical connection to MWRA distribution facilities is, at least in principle, eligible to pursue MWRA membership. Even though MWRA membership by Ipswich communities may have a beneficial impact on the ability of other water supplies in the Basin to obtain and utilize WMA permits, the decision to join the MWRA is conventionally understood as an individual one, based on the costs and benefits of membership to the particular community. At least in theory, however, cities and towns that cannot readily connect to MWRA water supply infrastructure could enter into IMAs with other communities where connections are more directly achievable, agreeing to assist with entry costs. However, if such an IMA were to provide directly for permits or registrations to be transferred from the joining community to another community, the MWRA takes the position that the remaining community would need to join the MWRA too.

6.2 MWRA INDIVIDUALLY WHEELED VIA INTERCONNECTION

Any community that can construct a physical connection to MWRA distribution facilities by "wheeling" an existing connection in a neighboring city or town is also eligible to join the MWRA. The entry fee and terms are no different from those available to communities directly connecting to MWRA facilities, but the infrastructure costs may be somewhat higher.

The MWRA requires communities that are wheeling MWRA connections to enter into IMAs setting forth the terms of the wheeling arrangement. Such IMAs must be approved by the MWRA. While it may make some sense for IMA signatory communities to coordinate efforts to involve more water suppliers, there does not appear to be an obvious need for on-going management of the MWRA relationship, requiring creation of a JPE, in order to establish MWRA memberships via interconnection. If potential community participants perceive a need for a "broker" to pull the necessary IMAs together, they may arrange for such a role through a preliminary MOA.

6.3 OTHER MUNICIPAL SUPPLY INTERCONNECTION PURCHASE

A conventional IMA seems well suited to implement a purchase of water by a community with increased needs from a water supplier with excess capacity.

6.4 EXISTING RESERVOIR EXPANSION

A more complicated agreement seems necessary to implement an expansion of Middleton Pond (or other existing Reservoir) for the benefit of Grant Partner communities. Presumably, such an agreement would allocate the cost of the reservoir expansion, and then establish rules for access to water withdrawals from the reservoir. While it may be possible to structure such an agreement without creating a JPE, there may also be good reasons for having an on-going management JPE to administer the relationship.

6.5 OTHER REGIONAL SOLUTIONS – PERMIT BANK / CREDIT SYSTEM

This category of solutions seem best suited to the use of a JPE, since they rely primarily on the on-going management of withdrawals from existing water sources and allocation among participating communities. A Joint Powers Agreement would, of course, need to continue and protect participating communities' registered and permitted authorizations. Its implementation would, therefore, depend on whether DEP will acquiesce in such continuance.

7 RECOMMENDATIONS AND NEXT STEPS

Given the physical and hydrogeological constraints of the Basin, increased groundwater withdrawal is probably not the solution; on that there is likely a rare point of agreement by both public water suppliers and Basin environmental advocates. Studies predict climate change will further exacerbate seasonal streamflow depletion by evapotranspiration in the Basin. There have been demonstrable achievements in water conservation efforts since the late 1980s, but there are unanswered questions:

- Are the WMA restrictions having any beneficial impact on improving low flow conditions?
- Will climate change overwhelm beneficial impacts, if any, of WMA restrictions on stream low flows?
- What are the impacts of WMA restrictions on the economics of the Basin?, and perhaps most importantly:
- How can suppliers, regulators, and watershed advocates work together on solutions that follow a "triple-bottom-line" approach that balances societal and environmental needs with healthy economic growth?

The practice of maximizing surface water withdrawals during high flow and storing the water for summer use is one obvious choice for sustaining long term growth in the Basin. Another would be utilization of out of Basin sources via MWRA. If communities can share resources, and be supported by regulators and environmental advocates, to implement one of these solutions, there is a better chance that Basin water resources can be managed in a way that balances current and future human needs with environmental protection.

In order to implement a solution that meets the water needs of public water suppliers in the Basin in balance with environmental stewardship, further investigation is needed into potential solution(s) feasibility, costs, benefits, and impacts. The Grant Partner communities recommend that a Phase II study be conducted to build upon the findings of this report. The study would consist of an alternatives analysis evaluating the top rated solutions and including conceptual design and planning level cost estimates, and identification of significant engineering, permitting, and legal requirements. The Phase II project would include additional focused workshops with Grant Partners to outline the components of a Joint Powers Agreement in order to proceed with the preferred alternative(s).

8 REFERENCES

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APPENDIX A

PUBLIC WATER SUPPLIER INFORMATIONAL SURVEY RESPONSES

IPSWICH BASIN FY17 WATER MANAGEMENT ACT (SWMI) GRANT PROJECT – INFORMATIONAL SURVEY

TOPSFIELD

KLEINFELDER
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Please respond to each of the questions about your water system and community in the spaces provided below. When complete, please submit this document via email to Agoldberg@kleinfelder.com and Kirsten Ryan at Kryan@kleinfelder.com.

Supporting documentation should be uploaded to the Ipswich Basin Project Sharepoint website: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx. To access this site, please follow the instructions included on the last page of this survey.

*The timeframe for completing this study is short and your input is critical to the project. We request that you endeavor to complete this survey by **March 10th**, if possible. If you have any questions please contact Andrew Goldberg Agoldberg@kleinfelder.com or Kirsten Ryan at Kryan@kleinfelder.com.* ***THANK YOU!!!***

SECTION 1: WATER MANAGEMENT & CONSERVATION PRACTICES

A. **Operational Constraints:** Are there operational (ie. Non-Permit related) issues with your system that restrict use of your water sources (eg. water quality treatment needs, declining yield; other?) Please describe.

We have manganese problems at both of our sources so we try to minimize the amount of manganese entering the system by favoring the one with the lowest concentration.

B. **Alternative Local Sources:** Have you explored the use or development of other local groundwater or surface water sources in your Town? What were the outcomes of those investigations? Please provide summary and upload any relevant technical reports to the Project Sharepoint site, if available.

We searched for another source for many years. Primarily we looked for sand/gravel sources by conducting informal test drilling in various spots around town. Towards the end we looked for a rock well. A site was identified and a test well installed but very little water was found. The search was abandoned due to costs and permit changes. We are regularly below our registered volume.

C. **Alternative Non-Local Sources:** Do you have interconnections with other water suppliers that you have utilized during the past 5 years? If so, please list them and volumes purchased. If not, have you studied the feasibility of connecting to another supplier and/or to the MWRA? Please describe the outcomes of those investigations and upload any supporting relevant technical reports to the Project Sharepoint site.

We have an interconnection with the Town of Danvers. It was used in 2007 to supply one of our customers but has not been used to supply the whole town. Currently the interconnection can feed Topsfield but we can't feed Danvers.

D. **Other Alternative Water Management Practices:** Do you employ or have you evaluated the use of any of the following strategies for minimizing environmental impacts of water withdrawals? If yes, please briefly describe and upload available documentation to the Project Sharepoint Site. If not current practice, please estimate the feasibility of potentially implementing and provide any comments.

Alternative Water Management Practices	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	N		Poor	Both sources are along stream channels.
Using Wells Up-gradient of Ponds & Lakes	N		Poor	Both sources are along stream channels that join the river in the southern part of town. Most septic infiltration is up-gradient of the streams.
Releases from Surface Water Impoundments to augment streamflow	N/A		Poor	We don't have any impoundments.
Process Water Infiltration	N/A		Poor	We currently use inline treatment.
High Flow or Flood Skimming	N/A		Poor	No reservoir.
Aquifer Storage and Recovery	N/A		Poor	
Seasonal Transfer to Lakes or Ponds	N/A		Poor	No reservoir.
Water Banking	N		Fair	

E. **Water Conservation / Demand Management Practices:** In the table below, briefly describe your current practices, if any, for each of the following elements. Note any significant changes in practices in the past 10 years and year the change was implemented. Rate the effectiveness of the practice and any comments to support the rating. If not current practice, rate the feasibility of implementing and provide any additional comments.

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Source & Master Meters Calibrated Regularly?	Y	Checked at least once per year. Good		
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?	Y	Good. No fines for theft.		
Meter Inspection / Testing / Replacement program?	Y	Good. Plan to replace 10% each year		
Method of meter reading?	Radio	Good. Archive all readings.		
Data Management: Water Audits (How Often? Date of Last Audit?)	Monthly	Good. Calculate UAW monthly.		
Leak Detection and Repair (How frequent? What method?)	Y	Good. Typically done annually. Done semi-annually last 2 years due to high UAW. Finding it difficult to locate leaks. May try comprehensive approach and listen to all services.		
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)	Y	Fair. We replace problematic mains as needed. Try to replace 1 mile every 2 years.		
Rate and Billing Structures that promote conservation? (Describe) How often are rates evaluated?	Y	Good. Increasing block rates evaluated every year.		
Quarterly or greater billing frequency	Y	Good. Switching some users with high Summer/Winter ratios to monthly.		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Water bills – Is consumption history provided? If so, is it reported in gallons?	Y	Good		
Seasonal rate structure with higher rates May 1- Sept 30	N		Fair	Would require monthly billing, higher costs.
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)	N		Fair	More likely if we were closer to exceeding annual limits. Still working on lowering UAW and outdoor use.
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)	N		Fair	
Outdoor Demand Management – rain barrel program or other incentive?	N		Fair	Had a rain barrel program for years until company went out of business.
Irrigation best available technology bylaw?	N		Fair	We have an irrigation bylaw requiring rain sensors. Water use restrictions make systems much less useful.
Municipal Irrigation Alternatives (e.g. rain gardens; cisterns; playing field irrigation systems with weather sensitive controls)	N		Poor	Water restrictions apply to public fields.
Land Use Pattern Changes (Promotion / Incentives for Low impact development)	N		Fair	

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Additional Plumbing Code Restrictions or Rigorous Enforcement	N		Fair	
Non-essential Outdoor Water use Mandatory Restrictions? (Describe)	Y	Good. Streamflow based restrictions that apply to all water uses including private wells. Hand watering only before 9 AM or after 5 PM. Irrigation system use prohibited.		
Limit Non-Essential Outdoor Water Use to 2 days / week	N/A		Poor	Streamflow based restrictions very strict and do not allow use of irrigation systems for large part of summer.
Limit Non-Essential Outdoor Water Use to 1 day / week	N/A		Poor	Streamflow based restrictions very strict and do not allow use of irrigation systems for large part of summer.
Private Well Use Bylaw	Y	Good. All private wells must follow steam flow based restrictions.		
Private Well Non-essential Outdoor Use Restrictions	Y	Good. All private wells must follow steam flow based restrictions.		
Public Education & Awareness Conservation Program	N		Good	Post information on line and use social media but not a 'program'

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Other / Not listed				Calculate UAW monthly. Archive all meter readings - use them for leak detection, UAW calculations, high use notices for customers. Use SCADA records to calculate hourly use, daily use, and early morning use to track leakage.

SECTION 2: WATER USE HISTORICAL DATA & PROJECTIONS

A. HISTORICAL WATER USE DATA:

Please review the Historical Water Use data we have compiled from the Annual Statistical Reports for your supply sources available on the Project Sharepoint Site in the WATER USE DATA FOLDER at this link: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx

- Please advise us of any inaccuracies; provide updated data if needed and note source of the updated data

*********DATA IS BEING COMPILED AND IS EXPECTED TO BE POSTED ON THE PROJECT WEBSITE FOR REVIEW BY 3/6 *********

B. PROJECTED WATER USE:

Please review the DCR Water Needs Forecast projections for your community in the WATER NEEDS FORECAST folder on the to the Project Sharepoint site.

*********At this time, the projection is available only for Grant Partner Communities*********

- Please provide any comments on the forecasts and any update to the assumptions upon which they were based.
- Please provide list of any more recent (since 2009) planning population projections and a compiled list of any new proposed developments and projected water demands.

SECTION 3: WASTEWATER MANAGEMENT

A. Please upload GIS data files as requested on the Project Data Checklist (sewer mains, pump stations, treatment / discharge locations; septic system database) to the Project Sharepoint site.
All septic systems but not on GIS. Lots of plans but they're all in paper files.
B. Approximately what percentage of town is sewered? Are there any plans to expand the sewer system? Do you have a wastewater facilities plan or Master Plan? Please describe and upload to the Project Sharepoint site.
0%
C. Where is the non-septic wastewater treated and discharged? Who can be contacted for further information?
D. What areas of the town are expected or planned to experience future development with on-site septic systems? What are the expected flows?
All future development, flows are unknown but will be a portion of water use forecast.
E. Does the Town have an Infiltration / Inflow removal program? Please describe and upload available documentation to the Project Sharepoint site.
No.

SECTION 4: STORMWATER MANAGEMENT

A. Does the Town have a Stormwater Master Plan or Stormwater Management Plan? Please describe and upload documentation, if available.

Yes, the Town has a Stormwater Management Plan and Bylaw. The bylaw applies to the whole town not just urbanized area.

B. Please upload stormwater GIS data if available: drain lines, outfalls, drainage catchment areas to the Project Sharepoint site.

C. Documentation of stormwater recharge projects may allow water suppliers to obtain credit towards permit mitigation requirements if needed. Credit can be sought for projects from 2005 to present. If available, please provide a list of stormwater management improvement projects or structural BMPs installed in your community that allow stormwater to infiltrate and recharge groundwater or disconnection / removal of impervious area. Information request is specific to installations within the Ipswich Basin.

Stormwater Recharge or Impervious Disconnection Projects

Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)
Hickory Beech	Infiltrators under pavement at circle	Ipswich River	2006	
Evergreen Lane	Infiltrators under pavement at circle	Ipswich River	2006	
High Street, 142	Roof drain infiltrators	Ipswich River	2015	
Wenham Rd., 51	Roof drain infiltrators	Wenham Swamp	2017	
Wenham Rd., 89	Roof drain infiltrators	Wenham Swamp	2016	
Wenham Rd., 103	Roof drain infiltrators	Wenham Swamp	2016	
Alderbrook Drive, 78	Roof drain infiltrators	Nichols Brook	2016	
Boston Street,	Roof drain infiltrators	Mile Brook	2007	

Stormwater Recharge or Impervious Disconnection Projects				
Address, Intersection, or Parcel	**Description & Size of Structure**	**Nearest Stormwater Outfall or Receiving Water**	**Year Installed**	**Area of Catchment Draining to Structure (if known)**
367				
Perkins Row, 67	Roof drain infiltrators	Mile Brook	2017	
Fox Run Rd., 51	Roof drain infiltrators	Ipswich River	2007	

Stormwater Recharge or Impervious Disconnection Projects (continued from above, if needed)				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 5: OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Have any of the following types of activities been implemented in your community? If yes, please describe location and activity and upload supporting documentation (summary or technical report) to the Project Sharepoint site.

- Dam removal
- stream restoration
- install / maintenance of fish passage
- acquisition of property in Zone I or II of well
- acquisition of other property for natural resource protection
- stormwater bylaw
- stormwater utility
- private well bylaw
- wetlands bylaw
- water quality improvement project
- Other

SECTION 6: ANY OTHER RELEVANT COMMENTS OR INFORMATION

We have a stormwater bylaw, wetlands bylaw and are designing a treatment plant.

Sharepoint Account Creation and Login Instructions

Step 1
We will be providing access to the Collaboration sites (SharePoint) by using Microsoft Live IDs. **Please follow these instructions to be granted access to this site.**

Site: *https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx*

If your work email address is registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), **please include that email address in a an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. You will be added to the site and you will NOT have to complete any of the remaining steps.

If you do NOT **have an Account registered with Microsoft** (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), please proceed to step 2.

Step 2
If you do not already have a Microsoft Live ID, you can register for one at this URL: https://signup.live.com/signup

Step 3

Once you have a Live ID, **please include that email address in an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. Once we receive your registered email address, you will receive an email invitation that includes login instructions and a link to the collaboration site.

Notes: **The email address that you enter as a username below should be your work email**, as it will be registered with Microsoft Live ID for access to be granted.

Please Note: You are the owner of this login information and you can update, modify or delete at any time.

Thank you again for your time.

IPSWICH BASIN FY17 WATER MANAGEMENT ACT (SWMI) GRANT PROJECT – INFORMATIONAL SURVEY

MIDDLETON

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Please respond to each of the questions about your water system and community in the spaces provided below. When complete, please submit this document via email to Agoldberg@kleinfelder.com and Kirsten Ryan at Kryan@kleinfelder.com.

Supporting documentation should be uploaded to the Ipswich Basin Project Sharepoint website: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx. To access this site, please follow the instructions included on the last page of this survey.

*The timeframe for completing this study is short and your input is critical to the project. We request that you endeavor to complete this survey by **March 10th**, if possible. If you have any questions please contact Andrew Goldberg Agoldberg@kleinfelder.com or Kirsten Ryan at Kryan@kleinfelder.com. **THANK YOU!!!***

SECTION 1: WATER MANAGEMENT & CONSERVATION PRACTICES

A. **Operational Constraints:** Are there operational (ie. Non-Permit related) issues with your system that restrict use of your water sources (eg. water quality treatment needs, declining yield; other?) Please describe.

Not applicable. The Town of Danvers treats the water that is sold to the Town of Middleton.

B. **Alternative Local Sources:** Have you explored the use or development of other local groundwater or surface water sources in your Town? What were the outcomes of those investigations? Please provide summary and upload any relevant technical reports to the Project Sharepoint site, if available.

Not applicable. The Town of Danvers treats the water that is sold to the Town of Middleton.

C. **Alternative Non-Local Sources:** Do you have interconnections with other water suppliers that you have utilized during the past 5 years? If so, please list them and volumes purchased. If not, have you studied the feasibility of connecting to another supplier and/or to the MWRA? Please describe the outcomes of those investigations and upload any supporting relevant technical reports to the Project Sharepoint site.

Not applicable. The Town of Danvers treats the water that is sold to the Town of Middleton.

D. Other Alternative Water Management Practices: Do you employ or have you evaluated the use of any of the following strategies for minimizing environmental impacts of water withdrawals? If yes, please briefly describe and upload available documentation to the Project Sharepoint Site. If not current practice, please estimate the feasibility of potentially implementing and provide any comments.

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Alternative Water Management Practices	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	N/A			
Using Wells Up-gradient of Ponds & Lakes	N/A			
Releases from Surface Water Impoundments to augment streamflow	N/A			
Process Water Infiltration	N/A			
High Flow or Flood Skimming	N/A			
Aquifer Storage and Recovery	N/A			
Seasonal Transfer to Lakes or Ponds	N/A			
Water Banking	N		Excellent	The Town of Middleton does not have any public sewer. 95% of the water is infiltrated into septic systems except a small percentage of private sewer near the Town Line.

E. **Water Conservation / Demand Management Practices:** In the table below, briefly describe your current practices, if any, for each of the following elements. Note any significant changes in practices in the past 10 years and year the change was implemented. Rate the effectiveness of the practice and any comments to support the rating. If not current practice, rate the feasibility of implementing and provide any additional comments.

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Source & Master Meters Calibrated Regularly?	N/A			Town of Danvers is responsible for supply, treatment, meters and billing.
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?	N/A			
Meter Inspection / Testing / Replacement program?	N/A			
Method of meter reading?	N/A			
Data Management: Water Audits (How Often? Date of Last Audit?)				
Leak Detection and Repair (How frequent? What method?)	Y	Excellent. The entire town is tested each year and a vendor is contracted by the Town of Danvers.		
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)	Y	Fair. Town system is fairly new. A small percentage of cast iron mains are to be replaced. Water main breaks are not common. Three in eleven years.		
Rate and Billing Structures that promote conservation? (Describe) How often are rates evaluated?	N/A			

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Quarterly or greater billing frequency	N/A			
Water bills – Is consumption history provided? If so, is it reported in gallons?	N/A			
Seasonal rate structure with higher rates May 1- Sept 30	N/A			
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)	N		Poor	The Town of Middleton has gone through a building boom in the last 20 years. We have placed more emphasis on outside irrigation.
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)	y	All municipals buildings have been outfitted with water conserving or waterless fixtures		
Outdoor Demand Management – rain barrel program or other incentive?	Y and N	We have had a barrel program in the past. Not a lot of demand	Good	We are open to trying the program again.
Irrigation best available technology bylaw?	y	Good. Bylaw for rain sensors has been in place for 12 plus years.		
Municipal Irrigation Alternatives (e.g. rain gardens; cisterns; playing field irrigation systems with weather sensitive controls)	y	All playing fields with irrigation has rain sensors. We try to emphasize rain garden and other alternatives with the planning board and ZBA		
Land Use Pattern Changes (Promotion / Incentives for Low impact development)	N		Fair	Have been trying to get the approving boards to amend their regulations.

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Additional Plumbing Code Restrictions or Rigorous Enforcement	N		Good	Open to suggestions
Non-essential Outdoor Water use Mandatory Restrictions? (Describe)	Y	Good. Middleton starts each year at Level 3 not matter what if the trigger levels are at level 2.		
Limit Non-Essential Outdoor Water Use to 2 days / week	Y			
Limit Non-Essential Outdoor Water Use to 1 day / week	Y	Level 4 7:00PM to 10 PM My opinion is that it should be two days a week from 7 PM to 8AM all the time.		
Private Well Use Bylaw	N		Poor	The Town passed a by-law in 2005 and a citizens partition had it revoked around 2010
Private Well Non-essential Outdoor Use Restrictions	N		Poor	The Town passed a by-law in 2005 and a citizens partition had it revoked around 2010
Public Education & Awareness Conservation Program	Y		Good	Signed onto a pilot program with Michelle Craddock of the Dept of Fish and Wildlife for an education program
Other / Not listed				

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SECTION 2: WATER USE HISTORICAL DATA & PROJECTIONS

A. HISTORICAL WATER USE DATA:

Please review the Historical Water Use data we have compiled from the Annual Statistical Reports for your supply sources available on the Project Sharepoint Site in the WATER USE DATA FOLDER at this link: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx

- Please advise us of any inaccuracies; provide updated data if needed and note source of the updated data

*********DATA IS BEING COMPILED AND IS EXPECTED TO BE POSTED ON THE PROJECT WEBSITE FOR REVIEW BY 3/6 *********

B. PROJECTED WATER USE:

Please review the DCR Water Needs Forecast projections for your community in the WATER NEEDS FORECAST folder on the to the Project Sharepoint site.

*********At this time, the projection is available only for Grant Partner Communities*********

- Please provide any comments on the forecasts and any update to the assumptions upon which they were based.
- Please provide list of any more recent (since 2009) planning population projections and a compiled list of any new proposed developments and projected water demands.

SECTION 3: WASTEWATER MANAGEMENT

A. Please upload GIS data files as requested on the Project Data Checklist (sewer mains, pump stations, treatment / discharge locations; septic system database) to the Project Sharepoint site.

The Town of Middleton does not have any

B. Approximately what percentage of town is sewered? Are there any plans to expand the sewer system? Do you have a wastewater facilities plan or Master Plan? Please describe and upload to the Project Sharepoint site.

C. Where is the non-septic wastewater treated and discharged? Who can be contacted for further information?

D. What areas of the town are expected or planned to experience future development with on-site septic systems? What are the expected flows?

E. Does the Town have an Infiltration / Inflow removal program? Please describe and upload available documentation to the Project Sharepoint site.

SECTION 4: STORMWATER MANAGEMENT

A. Does the Town have a Stormwater Master Plan or Stormwater Management Plan? Please describe and upload documentation, if available.

We have a stormwater by-law and permitting requirements

B. Please upload stormwater GIS data if available: drain lines, outfalls, drainage catchment areas to the Project Sharepoint site.

Do not have a GIS plan. It is in process.

C. Documentation of stormwater recharge projects may allow water suppliers to obtain credit towards permit mitigation requirements if needed. Credit can be sought for projects from 2005 to present. If available, please provide a list of stormwater management improvement projects or structural BMPs installed in your community that allow stormwater to infiltrate and recharge groundwater or disconnection / removal of impervious area. Information request is specific to installations within the Ipswich Basin.

Stormwater Recharge or Impervious Disconnection Projects				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

Stormwater Recharge or Impervious Disconnection Projects (continued from above, if needed)				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 5: OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Have any of the following types of activities been implemented in your community? If yes, please describe location and activity and upload supporting documentation (summary or technical report) to the Project Sharepoint site.

- Dam removal
- stream restoration
- install / maintenance of fish passage
- acquisition of property in Zone I or II of well
- acquisition of other property for natural resource protection
- stormwater bylaw
- stormwater utility
- private well bylaw
- wetlands bylaw
- water quality improvement project
- Other

SECTION 6: ANY OTHER RELEVANT COMMENTS OR INFORMATION

Sharepoint Account Creation and Login Instructions

Step 1
We will be providing access to the Collaboration sites (SharePoint) by using Microsoft Live IDs. **Please follow these instructions to be granted access to this site.**

Site: *https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx*

If your work email address is registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), **please include that email address in a an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. You will be added to the site and you will NOT have to complete any of the remaining steps.

If you do NOT have an Account registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), please proceed to step 2.

Step 2
If you do not already have a Microsoft Live ID, you can register for one at this URL: https://signup.live.com/signup

Step 3

Once you have a Live ID, **please include that email address in an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. Once we receive your registered email address, you will receive an email invitation that includes login instructions and a link to the collaboration site.

Notes: **The email address that you enter as a username below should be your work email**, as it will be registered with Microsoft Live ID for access to be granted.

Please Note: You are the owner of this login information and you can update, modify or delete at any time.

Thank you again for your time.

IPSWICH BASIN FY17 WATER MANAGEMENT ACT (SWMI) GRANT PROJECT – INFORMATIONAL SURVEY

IPSWICH

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Please respond to each of the questions about your water system and community in the spaces provided below. When complete, please submit this document via email to Agoldberg@kleinfelder.com and Kirsten Ryan at Kryan@kleinfelder.com.

Supporting documentation should be uploaded to the Ipswich Basin Project Sharepoint website: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx. To access this site, please follow the instructions included on the last page of this survey.

*The timeframe for completing this study is short and your input is critical to the project. We request that you endeavor to complete this survey by **March 10th**, if possible. If you have any questions please contact Andrew Goldberg Agoldberg@kleinfelder.com or Kirsten Ryan at Kryan@kleinfelder.com. **THANK YOU!!!***

SECTION 1: WATER MANAGEMENT & CONSERVATION PRACTICES

A. **Operational Constraints**: Are there operational (ie. Non-Permit related) issues with your system that restrict use of your water sources (eg. water quality treatment needs, declining yield; other?) Please describe.

Two of five wells have elevated Manganese levels and must be restricted. These are two of the larger capacity wells. Severely limited ability to manage drought conditions last summer.

B. **Alternative Local Sources:** Have you explored the use or development of other local groundwater or surface water sources in your Town? What were the outcomes of those investigations? Please provide summary and upload any relevant technical reports to the Project Sharepoint site, if available.

Conducted a test well investigation last summer. Identified a potential well site that would replace one of the high Manganese wells. Currently developing a scope for a master plan to evaluate expansion of surface water reservoirs, new well sources and wastewater reuse.

C. **Alternative Non-Local Sources:** Do you have interconnections with other water suppliers that you have utilized during the past 5 years? If so, please list them and volumes purchased. If not, have you studied the feasibility of connecting to another supplier and/or to the MWRA? Please describe the outcomes of those investigations and upload any supporting relevant technical reports to the Project Sharepoint site.

Have two interconnection that have not been exercised in years. No feasibility study has been completed for connection to another supplier.

D. **Other Alternative Water Management Practices:** Do you employ or have you evaluated the use of any of the following strategies for minimizing environmental impacts of water withdrawals? If yes, please briefly describe and upload available documentation to the Project Sharepoint Site. If not current practice, please estimate the feasibility of potentially implementing and provide any comments.

Alternative Water Management Practices	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	N		Poor	Our use of Ipswich Basin sources is registered at 0.2 gpd. Due to limited use – the alternatives in this section are not likely to be considered.
Using Wells Up-gradient of Ponds & Lakes	N		Poor	
Releases from Surface Water Impoundments to augment streamflow	N		Poor	
Process Water Infiltration	N		Poor	
High Flow or Flood Skimming	N		Poor	
Aquifer Storage and Recovery	N		Poor	
Seasonal Transfer to Lakes or Ponds	N		Poor	
Water Banking	N		Fair	

E. **Water Conservation / Demand Management Practices:** In the table below, briefly describe your current practices, if any, for each of the following elements. Note any significant changes in practices in the past 10 years and year the change was implemented. Rate the effectiveness of the practice and any comments to support the rating. If not current practice, rate the feasibility of implementing and provide any additional comments.

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Source & Master Meters Calibrated Regularly?	Y	Annual calibration. Good.		
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?	Y			
Meter Inspection / Testing / Replacement program?	Y			
Method of meter reading?	Y	Automatic meter reading system, monthly billing. Good.		
Data Management: Water Audits (How Often? Date of Last Audit?)	Y	Not done for several years, looking to restart program. Fair.		
Leak Detection and Repair (How frequent? What method?)	Y	Annual sonic leak detection. Good.		
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)	Y	Multimillion dollar main replacements over last 15 years. Currently developing master plan. Good.		
Rate and Billing Structures that promote conservation? (Describe) How often are rates evaluated?	Y	Residential seasonal rate structure since 2003. Rates increase 1.5X May-Sept. Has resulted in 20%+ drop in		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
		summer peak. Effective due to monthly billing. Good.		
Quarterly or greater billing frequency	Y	Monthly. Good.		
Water bills – Is consumption history provided? If so, is it reported in gallons?	Y	Not shown in gallons. Conversion is shown. Good.		
Seasonal rate structure with higher rates May 1- Sept 30	Y	Good.		
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)	Y	Provide giveaways during rain barrel events and at Utilities Office. Fair.		
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)	Y	New buildings have water saving fixtures. Fair.		
Outdoor Demand Management – rain barrel program or other incentive?	Y	Annual rain barrel program. Fair.		
Irrigation best available technology bylaw?	N	New by-law proposed for May town meeting includes ability to regulate irrigation systems.	Fair	By-law will grant authority, execution not expected in near future due to staffing limitations.
Municipal Irrigation Alternatives (e.g. rain gardens; cisterns; playing field irrigation systems with weather sensitive controls)	Y	Is considered for new municipal properties. Good.		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Land Use Pattern Changes (Promotion / Incentives for Low impact development)	Y	Good.		
Additional Plumbing Code Restrictions or Rigorous Enforcement				
Non-essential Outdoor Water use Mandatory Restrictions? (Describe)	Y	Limit watering to hand held hose only between 7PM and 6AM. Don't currently restrict number of days of watering.		
Limit Non-Essential Outdoor Water Use to 2 days / week	N			
Limit Non-Essential Outdoor Water Use to 1 day / week	N		Fair-Poor	
Private Well Use Bylaw	N	Proposed for May town meeting.	Good	
Private Well Non-essential Outdoor Use Restrictions	N	Proposed for May town meeting.	Good	
Public Education & Awareness Conservation Program	Y	Newsletter, website. Looking to enhance existing activities. Fair.		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Other / Not listed				

SECTION 2: WATER USE HISTORICAL DATA & PROJECTIONS

A. HISTORICAL WATER USE DATA:

Please review the Historical Water Use data we have compiled from the Annual Statistical Reports for your supply sources available on the Project Sharepoint Site in the WATER USE DATA FOLDER at this link: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx

- Please advise us of any inaccuracies; provide updated data if needed and note source of the updated data

*********DATA IS BEING COMPILED AND IS EXPECTED TO BE POSTED ON THE PROJECT WEBSITE FOR REVIEW BY 3/6 *********

B. PROJECTED WATER USE:

Please review the DCR Water Needs Forecast projections for your community in the WATER NEEDS FORECAST folder on the to the Project Sharepoint site.

*********At this time, the projection is available only for Grant Partner Communities*********

- Please provide any comments on the forecasts and any update to the assumptions upon which they were based.
- Please provide list of any more recent (since 2009) planning population projections and a compiled list of any new proposed developments and projected water demands.

SECTION 3: WASTEWATER MANAGEMENT

A. Please upload GIS data files as requested on the Project Data Checklist (sewer mains, pump stations, treatment / discharge locations; septic system database) to the Project Sharepoint site.

B. Approximately what percentage of town is sewered? Are there any plans to expand the sewer system? Do you have a wastewater facilities plan or Master Plan? Please describe and upload to the Project Sharepoint site.

Only 30% of the town by area is on sewer, but approximately 50% of the population is on sewer. There are no plans to expand the system. There has not been an update to the Master Plan since the 1980's.

C. Where is the non-septic wastewater treated and discharged? Who can be contacted for further information?

Wastewater is treated at the Plant located on Fowlers Lane. Effluent is discharged to Greenwood Creek.
Vicki Halmen, Water & Wastewater Director vhalmen@ipswichutilities.org, 978-356-6635 x2108.

D. What areas of the town are expected or planned to experience future development with on-site septic systems? What are the expected flows?

E. Does the Town have an Infiltration / Inflow removal program? Please describe and upload available documentation to the Project Sharepoint site.

No formal plan. Will be developed in the next 2-3 years.

SECTION 4: STORMWATER MANAGEMENT

A. Does the Town have a Stormwater Master Plan or Stormwater Management Plan? Please describe and upload documentation, if available.

B. Please upload stormwater GIS data if available: drain lines, outfalls, drainage catchment areas to the Project Sharepoint site.

C. Documentation of stormwater recharge projects may allow water suppliers to obtain credit towards permit mitigation requirements if needed. Credit can be sought for projects from 2005 to present. If available, please provide a list of stormwater management improvement projects or structural BMPs installed in your community that allow stormwater to infiltrate and recharge groundwater or disconnection / removal of impervious area. Information request is specific to installations within the Ipswich Basin.

Stormwater Recharge or Impervious Disconnection Projects				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 6: ANY OTHER RELEVANT COMMENTS OR INFORMATION

Ipswich Mills Dam removal has been studied; we actively pursue acquisition of property in Zone I and II and other open space properties; a stormwater bylaw was adopted in 2010; a water use bylaw including restriction on private water source use is proposed for May town meeting; wetlands bylaw was adopted and there is a current project to improve water quality in Farley Brook, which discharges to the Ipswich River.

Sharepoint Account Creation and Login Instructions

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Site: *https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx*

If your work email address is registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), **please include that email address in a an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. You will be added to the site and you will NOT have to complete any of the remaining steps.

If you do NOT have an Account registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), please proceed to step 2.

Step 2
If you do not already have a Microsoft Live ID, you can register for one at this URL: https://signup.live.com/signup

Step 3

Once you have a Live ID, **please include that email address in an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. Once we receive your registered email address, you will receive an email invitation that includes login instructions and a link to the collaboration site.

Notes: The email address that you enter as a username below should be your work email, as it will be registered with Microsoft Live ID for access to be granted.

Stormwater Recharge or Impervious Disconnection Projects (continued from above, if needed)				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 5: OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Have any of the following types of activities been implemented in your community? If yes, please describe location and activity and upload supporting documentation (summary or technical report) to the Project Sharepoint site.

- Dam removal
- stream restoration
- install / maintenance of fish passage
- acquisition of property in Zone I or II of well
- acquisition of other property for natural resource protection
- stormwater bylaw
- stormwater utility
- private well bylaw
- wetlands bylaw
- water quality improvement project
- Other

IPSWICH BASIN FY17 WATER MANAGEMENT ACT (SWMI) GRANT PROJECT – INFORMATIONAL SURVEY

Lynnfield Center

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Please respond to each of the questions about your water system and community in the spaces provided below. When complete, please submit this document via email to Agoldberg@kleinfelder.com and Kirsten Ryan at Kryan@kleinfelder.com.

Supporting documentation should be uploaded to the Ipswich Basin Project Sharepoint website: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx. To access this site, please follow the instructions included on the last page of this survey.

*The timeframe for completing this study is short and your input is critical to the project. We request that you endeavor to complete this survey by **March 10th**, if possible. If you have any questions please contact Andrew Goldberg Agoldberg@kleinfelder.com or Kirsten Ryan at Kryan@kleinfelder.com. **THANK YOU!!!***

SECTION 1: WATER MANAGEMENT & CONSERVATION PRACTICES

A. **Operational Constraints**: Are there operational (ie. Non-Permit related) issues with your system that restrict use of your water sources (eg. water quality treatment needs, declining yield; other?) Please describe.

The distribution system and mechanical equipment associated with drinking water treatment, storage and distribution do not exhibit any operational constraints. The District has sources in both the Ipswich and North Coastal Basins (see Attachment 1).
-1 of the 2 well sites in the Ipswich Basin experiences a declining yield greater than originally anticipated.
-1 of the 2 well sites in the North Coastal Basin experiences higher iron and manganese levels as wells are pumped down.
-1 of the 2 well sites in the Ipswich Basin experiences higher iron and manganese levels if the well is not in use for an extended period of time (~one day).

There have been past customer complaints regarding colored water coinciding with those wells' pump down or use after shut-down; which the District has remedied through respective lower pumping rates or continuous operation.

B. **Alternative Local Sources:** Have you explored the use or development of other local groundwater or surface water sources in your Town? What were the outcomes of those investigations? Please provide summary and upload any relevant technical reports to the Project Sharepoint site, if available.

-The District receives drinking water from two basins: the Ipswich River Basin, and the North Coastal Basin. Please see **Attachment 1** for a graph showing the volume of water used from each watershed between 2010 and 2016 per the District's Annual Statistical Reports.
- All sources are groundwater. The most recent source brought online was new bedrock wells in the North Coastal Basin (operational ~2013).
-The District is considering initial exploration for additional well options at existing wellfields/sites.

C. **Alternative Non-Local Sources:** Do you have interconnections with other water suppliers that you have utilized during the past 5 years? If so, please list them and volumes purchased. If not, have you studied the feasibility of connecting to another supplier and/or to the MWRA? Please describe the outcomes of those investigations and upload any supporting relevant technical reports to the Project Sharepoint site.

- None of the interconnections have been used within the past 5 years. The District has an interconnection with Wakefield, 1 with North Reading, and 3 with the Lynnfield Water District.
-Some consideration was given to evaluating the possibility of MWRA sources in the early 2000s. At that time, the cost of the necessary piping and connection fees was much higher than alternatives.

D. Other Alternative Water Management Practices: Do you employ or have you evaluated the use of any of the following strategies for minimizing environmental impacts of water withdrawals? If yes, please briefly describe and upload available documentation to the Project Sharepoint Site. If not current practice, please estimate the feasibility of potentially implementing and provide any comments.

Alternative Water Management Practices	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	N		poor	The District's well sites are not applicable to locational considerations.
Using Wells Up-gradient of Ponds & Lakes	N		poor	The District's well sites are not applicable to locational considerations.
Releases from Surface Water Impoundments to augment streamflow	N		Poor	No surface water impoundments are located such to augment streamflow.
Process Water Infiltration	N		Poor	No process discharges for Ipswich sources.
High Flow or Flood Skimming	N		Poor	District's sources are groundwater.

Aquifer Storage and Recovery	N		Poor	District's sources are groundwater.
Seasonal Transfer to Lakes or Ponds	N		Poor	District's sources are groundwater.
Water Banking	Y	New services pay $800 to join the District's water service, and that fee is placed in a water bank to fund water conservation education efforts and promote low-flow household fixtures and appliances.		

E. **Water Conservation / Demand Management Practices:** In the table below, briefly describe your current practices, if any, for each of the following elements. Note any significant changes in practices in the past 10 years and year the change was implemented. Rate the effectiveness of the practice and any comments to support the rating. If not current practice, rate the feasibility of implementing and provide any additional comments.

Water Conservation / Demand Management Practice	**Currently in Use? (Y/N)**	**Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)**	**If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)**	**Comment on Feasibility Rating**
Source & Master Meters Calibrated Regularly?	Y	Good – Outside Contractor is used to source and calibrate master meters Annually.		
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?	Y	Good - All uses are metered except for fire protection, fire training, hydrant flushing, treatment process monitoring and street sweeping. These sources of water use are estimated within the annual ASR (**see Attachment 2** for the 2015 ASR). Water theft appears negligible, no history of enforcement.		
Meter Inspection / Testing / Replacement program?	Y	Good – The District replaces approx. 150 of the oldest meters / year throughout the District. Meters are inspected when they are greater than 10 years old, and when a house is sold.		
Method of meter reading?	Y	Good – Drive by method (75% of District) and plug in reads (25% of District) twice per year		
Data Management: Water Audits (How Often? Date of Last Audit?)	Y	Good - Summarized as part of ASR (**Attachment 3**), confidentially estimated municipal use, miscellaneous losses and unaccounted for water.		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Leak Detection and Repair (How frequent? What method?)	Y	Good – Leak detection occurs on an annual basis. See attached 2015 ASR (**Attachment 2)**		
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)	Y	Good - the District has an ongoing Distribution System Study that will be finalized this spring, which will include a prioritized list of capital improvements.		
Rate and Billing Structures that promote conservation? (Describe) How often are rates evaluated?	Y	Good – see **Attachment 3** for the 2015 water rates. The District has a tiered water rate structure to encourage water conservation following the recommendations and policies of DEP. Statements are issued twice per year. The rates were most recently evaluated and updated in 2015 (the first increase in ten years).		
Quarterly or greater billing frequency	N		Poor	Current staffing does not support increasing the frequency of meter readings.
Water bills – Is consumption history provided? If so, is it reported in gallons?	N		Fair	Coordination efforts between billing and meter reading would have to be considered prior to including historical water usage on bills.
Seasonal rate structure with higher rates May 1- Sept 30	N		Poor	Would require much more frequent meter readings. Higher seasonal use (outdoor watering) are incorporated into the tiered

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
				rate structure for total annual volume.
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)	Y	Good - The District has a rebate program for residential water-savings devises. See **Attachment 4** for the 2015 CCR that discusses water conservation, and the rebate program.		
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)	Y	Good - Schools are relatively new (with standard conservation fixtures) and municipal buildings have virtually all been retrofitted with new fixtures.		
Outdoor Demand Management – rain barrel program or other incentive?	Y	Good - The District has a continuous policy of limited outdoor use (even calendar days between 5 and 9PM) In past years, the District has advertised the availability and demonstration of rain barrels at their offices, with almost zero participation.		
Irrigation best available technology bylaw?	Y	Good - Moisture sensor requirement for automatic sprinkler systems.		
Municipal Irrigation Alternatives (e.g. rain gardens; cisterns; playing field irrigation systems with weather sensitive controls)	Y	Good - The fields are relatively new/recently constructed or rehabilitated, with corresponding irrigation systems. Artificial turf has		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
		been used on some of the newer fields (no irrigation necessary).		
Land Use Pattern Changes (Promotion / Incentives for Low impact development)	Y	Good as the service area is mostly built-out. There is a Town bylaw limiting land clearing for creating lawns.		
Additional Plumbing Code Restrictions or Rigorous Enforcement	Y	Backflow prevention devices and annual testing (see ASR).		
Non-essential Outdoor Water use Mandatory Restrictions? (Describe)	Y	Good – Outside use of sprinklers is limited to even calendar days between 5PM and 9PM. See text in **Attachment 4**, 2015 CCR, and on the District's website.		
Limit Non-Essential Outdoor Water Use to 2 days / week	N		Fair	When DEP requires via streamflow triggers or other means, the District has further limited outdoor use, including total sprinkler bans (allowing hand-held only from 5 to 9PM).
Limit Non-Essential Outdoor Water Use to 1 day / week	N		Poor	Difficult for such change unless DEP imposed
Private Well Use Bylaw	N		Poor	The Town would have to establish that type of bylaw. Residents may have their own wells for watering

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
				their lawn. The District maintains a list of known private wells.
Private Well Non-essential Outdoor Use Restrictions	N		Poor	Similar to above, the Town would have to establish that type of bylaw.
Public Education & Awareness Conservation Program	Y	See **Attachment 4** for the 2015 CCR. The District uses the annual CCR and mailer inserts with water conservation information on them as means of educating the public on water conservation.		
Other / Not listed				

SECTION 2: WATER USE HISTORICAL DATA & PROJECTIONS

A. **HISTORICAL WATER USE DATA:**

Please review the Historical Water Use data we have compiled from the Annual Statistical Reports for your supply sources available on the Project Sharepoint Site in the WATER USE DATA FOLDER at this link: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx

- Please advise us of any inaccuracies; provide updated data if needed and note source of the updated data

*********DATA IS BEING COMPILED AND IS EXPECTED TO BE POSTED ON THE PROJECT WEBSITE FOR REVIEW BY 3/6 *********

B. **PROJECTED WATER USE:**

Please review the DCR Water Needs Forecast projections for your community in the WATER NEEDS FORECAST folder on the to the Project Sharepoint site.

*********At this time, the projection is available only for Grant Partner Communities*********

- Please provide any comments on the forecasts and any update to the assumptions upon which they were based.
- Please provide list of any more recent (since 2009) planning population projections and a compiled list of any new proposed developments and projected water demands.

Response to Section 2:

Historical water use is currently under review. Comments will be provided as applicable.

SECTION 3: WASTEWATER MANAGEMENT

A. Please upload GIS data files as requested on the Project Data Checklist (sewer mains, pump stations, treatment / discharge locations; septic system database) to the Project Sharepoint site.

No GIS of sewer / not applicable.

The LCWD is responsible for the drinking water distribution system, and associated treatment and storage facilitates. The Town of Lynnfield has only septic systems or other onsite treatment systems.

B. Approximately what percentage of town is sewered? Are there any plans to expand the sewer system? Do you have a wastewater facilities plan or Master Plan? Please describe and upload to the Project Sharepoint site.

0%, and no plans for sewer

C. Where is the non-septic wastewater treated and discharged? Who can be contacted for further information?

Not Applicable

D. What areas of the town are expected or planned to experience future development with on-site septic systems? What are the expected flows?

Limited to new construction / likely minimal residential.

E. Does the Town have an Infiltration / Inflow removal program? Please describe and upload available documentation to the Project Sharepoint site.

Not Applicable

SECTION 4: STORMWATER MANAGEMENT

A. Does the Town have a Stormwater Master Plan or Stormwater Management Plan? Please describe and upload documentation, if available.

This survey is completed based on the Lynnfield Center Water District.

The following paragraph regarding the Town of Lynnfield DPW summarizes information on their website :
http://www.town.lynnfield.ma.us/pages/LynnfieldMA_DPW/stormwater?textPage=1
The Town of Lynnfield, Department of Public Works Division, is currently working on implementing its Stormwater Management Program for the requirements of the MS4 (municipal separate storm sewer systems) and NPDES (National Pollutant Discharge Elimination System) regulations. The Town of Lynnfield's Stormwater Management Program consists of Public Education and Outreach, Public Involvement/Participation, Illicit Discharge and Elimination, Construction Site Stormwater Runoff Control, Post-Construction Stormwater Management in New Developments and Redevelopment, and Pollution Prevention/Good Housekeeping for Municipal Operations.

B. Please upload stormwater GIS data if available: drain lines, outfalls, drainage catchment areas to the Project Sharepoint site.

Not Available

C. Documentation of stormwater recharge projects may allow water suppliers to obtain credit towards permit mitigation requirements if needed. Credit can be sought for projects from 2005 to present. If available, please provide a list of stormwater management improvement projects or structural BMPs installed in your community that allow stormwater to infiltrate and recharge groundwater or disconnection / removal of impervious area. Information request is specific to installations within the Ipswich Basin.

Not available (would be coordinated with Town if applicable)

Stormwater Recharge or Impervious Disconnection Projects

Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

Stormwater Recharge or Impervious Disconnection Projects				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

Stormwater Recharge or Impervious Disconnection Projects (continued from above, if needed)				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 5: OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Have any of the following types of activities been implemented in your community? If yes, please describe location and activity and upload supporting documentation (summary or technical report) to the Project Sharepoint site.

- Dam removal

- stream restoration
- install / maintenance of fish passage
- acquisition of property in Zone I or II of well
- acquisition of other property for natural resource protection
- stormwater bylaw
- stormwater utility
- private well bylaw
- wetlands bylaw
- water quality improvement project
- Other

SECTION 6: ANY OTHER RELEVANT COMMENTS OR INFORMATION

Sharepoint Account Creation and Login Instructions

Step 1
We will be providing access to the Collaboration sites (SharePoint) by using Microsoft Live IDs. **Please follow these instructions to be granted access to this site.**

Site: *https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx*

If your work email address is registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), **please include that email address in a an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. You will be added to the site and you will NOT have to complete any of the remaining steps.

If you do NOT have an Account registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), please proceed to step 2.

Step 2
If you do not already have a Microsoft Live ID, you can register for one at this URL: https://signup.live.com/signup

Step 3

Once you have a Live ID, please include that email address in **an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. Once we receive your registered email address, you will receive an email invitation that includes login instructions and a link to the collaboration site.

Notes: The email address that you enter as a username below should be your work email, as it will be registered with Microsoft Live ID for access to be granted.

Please Note: You are the owner of this login information and you can update, modify or delete at any time.

Thank you again for your time.

IPSWICH BASIN FY17 WATER MANAGEMENT ACT (SWMI) GRANT PROJECT – INFORMATIONAL SURVEY

HAMILTON

KLEINFELDER
Bright People. Right Solutions.

Please respond to each of the questions about your water system and community in the spaces provided below. When complete, please submit this document via email to Agoldberg@kleinfelder.com and Kirsten Ryan at Kryan@kleinfelder.com.

Supporting documentation should be uploaded to the Ipswich Basin Project Sharepoint website: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx. To access this site, please follow the instructions included on the last page of this survey.

The timeframe for completing this study is short and your input is critical to the project. We request that you endeavor to complete this survey by ***March 10th****, if possible. If you have any questions please contact Andrew Goldberg Agoldberg@kleinfelder.com or Kirsten Ryan at Kryan@kleinfelder.com.* ***THANK YOU!!!***

SECTION 1: WATER MANAGEMENT & CONSERVATION PRACTICES

A. **Operational Constraints:** Are there operational (ie. Non-Permit related) issues with your system that restrict use of your water sources (eg. water quality treatment needs, declining yield; other?) Please describe.

Yes – Water quality treatment is an issue. WTP not performing up to standards. WTP cannot remove manganese as designed. Wells are declining in yield and quality from Idlewood well field.

B. **Alternative Local Sources:** Have you explored the use or development of other local groundwater or surface water sources in your Town? What were the outcomes of those investigations? Please provide summary and upload any relevant technical reports to the Project Sharepoint site, if available.

No exploration has been completed in over 10 years

C. **Alternative Non-Local Sources:** Do you have interconnections with other water suppliers that you have utilized during the past 5 years? If so, please list them and volumes purchased. If not, have you studied the feasibility of connecting to another supplier and/or to the MWRA? Please describe the outcomes of those investigations and upload any supporting relevant technical reports to the Project Sharepoint site.

We do have interconnections, but are only used in case of emergency and not as supplemental supply

D. **Other Alternative Water Management Practices:** Do you employ or have you evaluated the use of any of the following strategies for minimizing environmental impacts of water withdrawals? If yes, please briefly describe and upload available documentation to the Project Sharepoint Site. If not current practice, please estimate the feasibility of potentially implementing and provide any comments.

No

Alternative Water Management Practices	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	**N**		**Poor**	**Not possible**
Using Wells Up-gradient of Ponds & Lakes	**N**		**Fair**	**If new sources from well exploration are found in that location**
Releases from Surface Water Impoundments to augment streamflow	**N**		**Poor**	**Limited to no locations to release**
Process Water Infiltration	**N**		**Poor**	
High Flow or Flood Skimming	**N**		**Poor**	**Limited locations of possible surface waters**
Aquifer Storage and Recovery	**N**		**Poor**	**Would require infrastructure improvements and improvement in water quality**
Seasonal Transfer to Lakes or Ponds	**N**		**Poor**	**Limited locations to transfer**
Water Banking	**N**		**Poor**	**Infrastructure improvements could be costly**

E. **Water Conservation / Demand Management Practices:** In the table below, briefly describe your current practices, if any, for each of the following elements. Note any significant changes in practices in the past 10 years and year the change was implemented. Rate the effectiveness of the practice and any comments to support the rating. If not current practice, rate the feasibility of implementing and provide any additional comments.

Water Conservation / Demand Management Practice	**Currently in Use? (Y/N)**	**Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)**	**If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)**	**Comment on Feasibility Rating**
Source & Master Meters Calibrated Regularly?	**Y**	**Wells, RAW,and Finished annually calibrated**		
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?	**N**		**Fair**	**Policies would have to be adopted**
Meter Inspection / Testing / Replacement program?	**Y**	**Quarterly replacements as necessary, approximately 85% replaced**	**Good**	**Implement inspection program in workforce**
Method of meter reading?	**Y**	**Electronically/manually**		
Data Management: Water Audits (How Often? Date of Last Audit?)	**N**			
Leak Detection and Repair (How frequent? What method?)	**Y**	**Every 2 years, Ground mic and correlation**		
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)	**Y**	**Replacement Program, approx. 10 miles in the last 5 years**		
Rate and Billing Structures that promote conservation? (Describe) How often are rates evaluated?	**Y**	**Higher the consumption, the higher the rate (1996,1998,2001,2008,2015)**		
Quarterly or greater billing frequency	**Y**	**Quarterly**		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Water bills – Is consumption history provided? If so, is it reported in gallons?	Y	**Current history – in gallons, previous history - graphs**		
Seasonal rate structure with higher rates May 1- Sept 30	N		**Poor**	**Currently have tiered rates**
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)	N		**Fair**	**Implement program**
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)	N		**Fair**	**Implement program**
Outdoor Demand Management – rain barrel program or other incentive?	N	**Sold rain barrels a few years ago**	**Good**	**Re-instate program**
Irrigation best available technology bylaw?	Y	**Town By-Laws, Outdoor water use by-law, See Attached**		
Municipal Irrigation Alternatives (e.g. rain gardens; cisterns; playing field irrigation systems with weather sensitive controls)	N		**Fair**	**Infrastructure Improvements needed**
Land Use Pattern Changes (Promotion / Incentives for Low impact development)	N		**Fair**	**Coordination with Planning Board, Zoning**

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Additional Plumbing Code Restrictions or Rigorous Enforcement	N		Fair	Coordination with Building Department
Non-essential Outdoor Water use Mandatory Restrictions? (Describe)	Y	Good, stream flow triggers		
Limit Non-Essential Outdoor Water Use to 2 days / week	N	Handheld watering only (8am – 8pm) No mechanical devices	Good	Implement next phase in restrictions
Limit Non-Essential Outdoor Water Use to 1 day / week	N	Handheld watering only (8am – 8pm) No mechanical devices	Good	Implement next phase in restrictions
Private Well Use Bylaw	Y	Same as water customers		
Private Well Non-essential Outdoor Use Restrictions	Y	Same as water customers		
Public Education & Awareness Conservation Program	N		Fair	Other departments may have program
Other / Not listed				

SECTION 2: WATER USE HISTORICAL DATA & PROJECTIONS

A. HISTORICAL WATER USE DATA:

Please review the Historical Water Use data we have compiled from the Annual Statistical Reports for your supply sources available on the Project Sharepoint Site in the WATER USE DATA FOLDER at this link: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx

- Please advise us of any inaccuracies; provide updated data if needed and note source of the updated data

*********DATA IS BEING COMPILED AND IS EXPECTED TO BE POSTED ON THE PROJECT WEBSITE FOR REVIEW BY 3/6 *********

B. PROJECTED WATER USE:

Please review the DCR Water Needs Forecast projections for your community in the WATER NEEDS FORECAST folder on the to the Project Sharepoint site.

*********At this time, the projection is available only for Grant Partner Communities*********

- Please provide any comments on the forecasts and any update to the assumptions upon which they were based.
- Please provide list of any more recent (since 2009) planning population projections and a compiled list of any new proposed developments and projected water demands.

SECTION 3: WASTEWATER MANAGEMENT

A. Please upload GIS data files as requested on the Project Data Checklist (sewer mains, pump stations, treatment / discharge locations; septic system database) to the Project Sharepoint site.

Do not have any GIS data available

B. Approximately what percentage of town is sewered? Are there any plans to expand the sewer system? Do you have a wastewater facilities plan or Master Plan? Please describe and upload to the Project Sharepoint site.

None

C. Where is the non-septic wastewater treated and discharged? Who can be contacted for further information?

N/A

D. What areas of the town are expected or planned to experience future development with on-site septic systems? What are the expected flows?

All

E. Does the Town have an Infiltration / Inflow removal program? Please describe and upload available documentation to the Project Sharepoint site.

N/A

SECTION 4: STORMWATER MANAGEMENT

A. Does the Town have a Stormwater Master Plan or Stormwater Management Plan? Please describe and upload documentation, if available.

No. Planning to have plan per Phase II NPDES requirements

B. Please upload stormwater GIS data if available: drain lines, outfalls, drainage catchment areas to the Project Sharepoint site.

N/A

C. Documentation of stormwater recharge projects may allow water suppliers to obtain credit towards permit mitigation requirements if needed. Credit can be sought for projects from 2005 to present. If available, please provide a list of stormwater management improvement projects or structural BMPs installed in your community that allow stormwater to infiltrate and recharge groundwater or disconnection / removal of impervious area. Information request is specific to installations within the Ipswich Basin.

Stormwater Recharge or Impervious Disconnection Projects				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

Stormwater Recharge or Impervious Disconnection Projects (continued from above, if needed)

Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 5: OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Have any of the following types of activities been implemented in your community? If yes, please describe location and activity and upload supporting documentation (summary or technical report) to the Project Sharepoint site.

- Dam removal
- stream restoration
- install / maintenance of fish passage
- acquisition of property in Zone I or II of well
- acquisition of other property for natural resource protection
- stormwater bylaw
- stormwater utility
- private well bylaw
- wetlands bylaw
- water quality improvement project
- Other

SECTION 6: ANY OTHER RELEVANT COMMENTS OR INFORMATION

Sharepoint Account Creation and Login Instructions

Step 1
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Site: *https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx*

If your work email address is registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), **please include that email address in a an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. You will be added to the site and you will NOT have to complete any of the remaining steps.

If you do NOT have an Account registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), please proceed to step 2.

Step 2
If you do not already have a Microsoft Live ID, you can register for one at this URL: https://signup.live.com/signup

Step 3

Once you have a Live ID, **please include that email address in an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. Once we receive your registered email address, you will receive an email invitation that includes login instructions and a link to the collaboration site.

Notes: **The email address that you enter as a username below should be your work email**, as it will be registered with Microsoft Live ID for access to be granted.

Please Note: You are the owner of this login information and you can update, modify or delete at any time.

Thank you again for your time.

IPSWICH BASIN FY17 WATER MANAGEMENT ACT (SWMI) GRANT PROJECT – WENHAM INFORMATIONAL SURVEY

KLEINFELDER
Bright People. Right Solutions.

Please respond to each of the questions about your water system and community in the spaces provided below. When complete, please submit this document via email to Agoldberg@kleinfelder.com and Kirsten Ryan at Kryan@kleinfelder.com.

Supporting documentation should be uploaded to the Ipswich Basin Project Sharepoint website: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx. To access this site, please follow the instructions included on the last page of this survey.

*The timeframe for completing this study is short and your input is critical to the project. We request that you endeavor to complete this survey by **March 10th**, if possible. If you have any questions please contact Andrew Goldberg Agoldberg@kleinfelder.com or Kirsten Ryan at Kryan@kleinfelder.com. **THANK YOU!!!***

SECTION 1: WATER MANAGEMENT & CONSERVATION PRACTICES

A. **Operational Constraints:** Are there operational (ie. Non-Permit related) issues with your system that restrict use of your water sources (eg. water quality treatment needs, declining yield; other?) Please describe.

No

B. **Alternative Local Sources:** Have you explored the use or development of other local groundwater or surface water sources in your Town? What were the outcomes of those investigations? Please provide summary and upload any relevant technical reports to the Project Sharepoint site, if available.

No

C. **Alternative Non-Local Sources:** Do you have interconnections with other water suppliers that you have utilized during the past 5 years? If so, please list them and volumes purchased. If not, have you studied the feasibility of connecting to another supplier and/or to the MWRA? Please describe the outcomes of those investigations and upload any supporting relevant technical reports to the Project Sharepoint site.

Yes. Hamilton and Beverly. No water purchased in the last five years. Report on interconnection with Beverly to be uploaded. Since the report the Friend Ct water tower has been removed.

D. **Other Alternative Water Management Practices:** Do you employ or have you evaluated the use of any of the following strategies for minimizing environmental impacts of water withdrawals? If yes, please briefly describe and upload available documentation to the Project Sharepoint Site. If not current practice, please estimate the feasibility of potentially implementing and provide any comments.

No

Alternative Water Management Practices	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	N		Poor	Our only two wells are next to Pleasant Pond
Using Wells Up-gradient of Ponds & Lakes	N		Poor	Our only two wells are next to Pleasant Pond
Releases from Surface Water Impoundments to augment streamflow	N		Poor	Limited or no surface water impoundments available
Process Water Infiltration	N		Poor	N/A
High Flow or Flood Skimming	N		Poor	
Aquifer Storage and Recovery	N		Poor	
Seasonal Transfer to Lakes or Ponds	N		Poor	
Water Banking	N			

E. **Water Conservation / Demand Management Practices:** In the table below, briefly describe your current practices, if any, for each of the following elements. Note any significant changes in practices in the past 10 years and year the change was implemented. Rate the effectiveness of the practice and any comments to support the rating. If not current practice, rate the feasibility of implementing and provide any additional comments.

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Source & Master Meters Calibrated Regularly?	Y	Good. Two source meters calibrated yearly		
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?	Y/N,N	All except fire operations. Nothing in regulations about theft	Good	Working on updating regulations
Meter Inspection / Testing / Replacement program?	Y	Meter replacement ongoing 2/3 of Town complete		
Method of meter reading?		Radio and manual		
Data Management: Water Audits (How Often? Date of Last Audit?)	N			
Leak Detection and Repair (How frequent? What method?)	Y	In house leak detection yearly and contracted every three. Ground mic and correlation		
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)	N		Good	Starting in FY19 with yearly funding to a capital improvement account
Rate and Billing Structures that promote conservation? (Describe) How often are rates evaluated?	Y			
Quarterly or greater billing frequency	Y			
Water bills – Is consumption history provided? If so, is it reported in gallons?	Y,Y			

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Seasonal rate structure with higher rates May 1- Sept 30	N		Poor	Current rate structure with quarterly billing achieves same goal
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)	N		Good	Mitigation fee from new sub-divisions to be used for that purpose
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)	Y	Good. Replaced fixtures under a grant in 2008		
Outdoor Demand Management – rain barrel program or other incentive?	Y	Good. Rain barrel program offered yearly to residents		
Irrigation best available technology bylaw?	N		Fair	Could be considered
Municipal Irrigation Alternatives (e.g. rain gardens; cisterns; playing field irrigation systems with weather sensitive controls)	N			No municipal irrigation
Land Use Pattern Changes (Promotion / Incentives for Low impact development)	N		Fair	Will discuss with town planner
Additional Plumbing Code Restrictions or Rigorous Enforcement	N		Fair	Will discuss with permitting coodinator

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Non-essential Outdoor Water use Mandatory Restrictions? (Describe)	Y	Good. Steam flow triggers mandatory nonessential outdoor water restrictions.		
Limit Non-Essential Outdoor Water Use to 2 days / week	N			
Limit Non-Essential Outdoor Water Use to 1 day / week	N		Poor	
Private Well Use Bylaw	N		Fair	Could be discussed
Private Well Non-essential Outdoor Use Restrictions	Y	Good. Steam flow triggers mandatory nonessential outdoor water restrictions.		
Public Education & Awareness Conservation Program	Y	Good. Signs, bill stuffers and announcements at meetings		
Other / Not listed				

SECTION 2: WATER USE HISTORICAL DATA & PROJECTIONS

A. HISTORICAL WATER USE DATA:

Please review the Historical Water Use data we have compiled from the Annual Statistical Reports for your supply sources available on the Project Sharepoint Site in the WATER USE DATA FOLDER at this link: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx

- Please advise us of any inaccuracies; provide updated data if needed and note source of the updated data

*********DATA IS BEING COMPILED AND IS EXPECTED TO BE POSTED ON THE PROJECT WEBSITE FOR REVIEW BY 3/6 *********

B. PROJECTED WATER USE:

Please review the DCR Water Needs Forecast projections for your community in the WATER NEEDS FORECAST folder on the to the Project Sharepoint site.

*********At this time, the projection is available only for Grant Partner Communities*********

- Please provide any comments on the forecasts and any update to the assumptions upon which they were based.
- Please provide list of any more recent (since 2009) planning population projections and a compiled list of any new proposed developments and projected water demands.

SECTION 3: WASTEWATER MANAGEMENT

A. Please upload GIS data files as requested on the Project Data Checklist (sewer mains, pump stations, treatment / discharge locations; septic system database) to the Project Sharepoint site.

https://www.axisgis.com/WenhamMA/

B. Approximately what percentage of town is sewered? Are there any plans to expand the sewer system? Do you have a wastewater facilities plan or Master Plan? Please describe and upload to the Project Sharepoint site.

NONE

C. Where is the non-septic wastewater treated and discharged? Who can be contacted for further information?

N/A

D. What areas of the town are expected or planned to experience future development with on-site septic systems? What are the expected flows?

All.

E. Does the Town have an Infiltration / Inflow removal program? Please describe and upload available documentation to the Project Sharepoint site.

N/A

SECTION 4: STORMWATER MANAGEMENT

A. Does the Town have a Stormwater Master Plan or Stormwater Management Plan? Please describe and upload documentation, if available.

No. Stormwater management plan is being worked on at this time.

B. Please upload stormwater GIS data if available: drain lines, outfalls, drainage catchment areas to the Project Sharepoint site.

https://www.axisgis.com/WenhamMA/

C. Documentation of stormwater recharge projects may allow water suppliers to obtain credit towards permit mitigation requirements if needed. Credit can be sought for projects from 2005 to present. If available, please provide a list of stormwater management improvement projects or structural BMPs installed in your community that allow stormwater to infiltrate and recharge groundwater or disconnection / removal of impervious area. Information request is specific to installations within the Ipswich Basin.

Stormwater Recharge or Impervious Disconnection Projects				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

Stormwater Recharge or Impervious Disconnection Projects (continued from above, if needed)				
Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 5: OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Have any of the following types of activities been implemented in your community? If yes, please describe location and activity and upload supporting documentation (summary or technical report) to the Project Sharepoint site.

- Dam removal
- stream restoration
- install / maintenance of fish passage
- acquisition of property in Zone I or II of well
- acquisition of other property for natural resource protection
- stormwater bylaw
- stormwater utility
- private well bylaw
- wetlands bylaw
- water quality improvement project
- Other

SECTION 6: ANY OTHER RELEVANT COMMENTS OR INFORMATION

I am also uploading a water system study from 1990 and the same with the interconnection study the Friend Ct tank has been removed.

Sharepoint Account Creation and Login Instructions

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Site: *https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx*

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If you do NOT have an Account registered with Microsoft (Office 365, Microsoft Live ID, Outlook.com or Hotmail account), please proceed to step 2.

Step 2
If you do not already have a Microsoft Live ID, you can register for one at this URL: https://signup.live.com/signup

Step 3

Once you have a Live ID, **please include that email address in an email to Jason Seltenright** (jseltenright@kleinfelder.com) and that account will be used to access the site. Once we receive your registered email address, you will receive an email invitation that includes login instructions and a link to the collaboration site.

Notes: The email address that you enter as a username below should be your work email, as it will be registered with Microsoft Live ID for access to be granted.

Please Note: You are the owner of this login information and you can update, modify or delete at any time.

IPSWICH BASIN FY17 WATER MANAGEMENT ACT (SWMI) GRANT PROJECT – INFORMATIONAL SURVEY

DANVERS

KLEINFELDER
Bright People. Right Solutions.

Please respond to each of the questions about your water system and community in the spaces provided below. When complete, please submit this document via email to Agoldberg@kleinfelder.com and Kirsten Ryan at Kryan@kleinfelder.com.

Supporting documentation should be uploaded to the Ipswich Basin Project Sharepoint website: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx. To access this site, please follow the instructions included on the last page of this survey.

*The timeframe for completing this study is short and your input is critical to the project. We request that you endeavor to complete this survey by **March 10th**, if possible. If you have any questions please contact Andrew Goldberg Agoldberg@kleinfelder.com or Kirsten Ryan at Kryan@kleinfelder.com. **THANK YOU!!!***

SECTION 1: WATER MANAGEMENT & CONSERVATION PRACTICES

A. **Operational Constraints:** Are there operational (ie. Non-Permit related) issues with your system that restrict use of your water sources (eg. water quality treatment needs, declining yield; other?) Please describe.

Maximum daily demand without water restrictions.

B. **Alternative Local Sources:** Have you explored the use or development of other local groundwater or surface water sources in your Town? What were the outcomes of those investigations? Please provide summary and upload any relevant technical reports to the Project Sharepoint site, if available.

Yes, Bedrock well investigations were performed in Danvers and Middelton in 2000 and did not locate a high volume bedrock well.

C. **Alternative Non-Local Sources:** Do you have interconnections with other water suppliers that you have utilized during the past 5 years? If so, please list them and volumes purchased. If not, have you studied the feasibility of connecting to another supplier and/or to the MWRA? Please describe the outcomes of those investigations and upload any supporting relevant technical reports to the Project Sharepoint site.

Yes, the city of Beverly interconnection with water provided by Salem-Beverly water supply board.

D. Other Alternative Water Management Practices: Do you employ or have you evaluated the use of any of the following strategies for minimizing environmental impacts of water withdrawals? If yes, please briefly describe and upload available documentation to the Project Sharepoint Site. If not current practice, please estimate the feasibility of potentially implementing and provide any comments.

The Town of Danvers is required by the Massachusetts Water Management Act Agreement to institute and manage a **Water Use Mitigation Program** [WUMP]. This program requires the establishment and collection of a fee from any new development, commensurate with the calculated cost to remove two gallons of water use in the Danvers System for each gallon of additional water demand the project adds to the system. The Town's Water Withdrawal Permit requires the Town to expend these collected fees to reduce water system demand and to document these reductions to State Officials. As a result of this WUMP program, the Town has a specific fund set aside to provide rebates to its Danvers water account holders for replacing old inefficient fixtures with water conserving fixtures. This way our Danvers residents can save money and help conserve water.

Alternative Water Management Practices	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Shifting Use of Near-Stream Wells during Low Flow Periods; Seasonal Pumping Schemes	y	See Water Management Act permit restrictions		
Using Wells Up-gradient of Ponds & Lakes	N		Poor	Topography and Location Restrictions
Releases from Surface Water Impoundments to augment streamflow	N		Poor	Current land use and water demand does not have sufficient surface water to release
Process Water Infiltration	N		Poor	Only a small percentage of recycled water is not reintroduced into the plant but dispersed through sludge removal.
High Flow or Flood Skimming	Y	Water is transferred from Emerson Brook to Middelton Pond. Seasonal transfer from Oct-Jan.		
Aquifer Storage and Recovery	N		Poor	Aquifer Storage is unregulated. Restrictions on water withdrawal aid in aquifer recovery.
Seasonal Transfer to Lakes or Ponds	Y	See High Flow and Skimming		
Water Banking	N	However town uses WUMP program to offset new demand.	Fair	Restrictions and regulation are in place to help conserve water consumption during high demands and in new developments.

E. **Water Conservation / Demand Management Practices:** In the table below, briefly describe your current practices, if any, for each of the following elements. Note any significant changes in practices in the past 10 years and year the change was implemented. Rate the effectiveness of the practice and any comments to support the rating. If not current practice, rate the feasibility of implementing and provide any additional comments.

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Source & Master Meters Calibrated Regularly?	Y	Good, master raw water and finished water meters are tested annually.		
All Uses Metered and Authorized? Are there fines for water theft? Are they enforced?	Y	Fair-There are provisions for fines for water theft. It is a rare occurrence and yes they are enforced.		
Meter Inspection / Testing / Replacement program?	Y	Good- Yes completed in 2013		
Method of meter reading?	Y	Good-AMI, mesh network reading system		
Data Management: Water Audits (How Often? Date of Last Audit?)	Y	Fair- Regular Commercial Use water audits performed		
Leak Detection and Repair (How frequent? What method?)	Y	Good-Annual detection program with valve and hydrant inspections. Any leaks are repaired immediately.		
Distribution System Improvements (Water Main Replacement Program? Water Master Plan? Date?)	Y	Fair- There is a 2013 revision to the Capital Improvement plan to water distribution system. Improvements are dependent on available CIP funding.		
Rate and Billing Structures that promote conservation? (Describe)	Y	Fair -Tiered water rate Rates evaluated annually.		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
How often are rates evaluated?				
How often are rates evaluated ?	Y	Good - Annually		
Quarterly or greater billing frequency	Y	Good: Quarterly for residential and monthly for commercial.		
Water bills – Is consumption history provided? If so, is it reported in gallons?	Y	Good: Consumption history reported for last 12 months in Hundred Cubic Feet		
Seasonal rate structure with higher rates May 1- Sept 30	N		Fair	Rates are based on demand and usage, which can correlate to seasonal changes.
Residential Indoor Demand Management (water saving device giveaway or / incentive or rebate programs?)	Y	Fair: Danvers offers rebate programs for toilets, clothes washer, low flow showerheads, low flow faucet and lawn irrigation rain sensor. Replacement products must meet product specifications listed on rebate forms.		
Non-Residential Indoor Demand Management (e.g. Municipal building water saving fixtures?)	Y	Good: All bathroom toilets and faucets represent water saving products in all 7 public schools in town and other town buildings.		
Outdoor Demand Management – rain barrel program or other incentive?	Y	Good: Rain barrels are sold at discounted prices to resident's year round and at DPW events.		
Irrigation best available technology bylaw?	Y	Irrigation sensors with moisture controls		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Municipal Irrigation Alternatives (e.g. rain gardens; cisterns; playing field irrigation systems with weather sensitive controls)	Y	Fair: cisterns were recently installed at Danvers High School – athletic stadium – All systems have weather sensors-majority of field irrigation is supplied by wells		
Land Use Pattern Changes (Promotion / Incentives for Low impact development)	N			
Additional Plumbing Code Restrictions or Rigorous Enforcement	N		Fair	Building Enforcement utilizes state building and plumbing codes
Non-essential Outdoor Water use Mandatory Restrictions? (Describe)	Y	Good: Danvers has Outdoor Water Restriction ratings from Level 1 (none) to Level 6. For example, on May 1st, the Town of Danvers moves outdoor water restriction from Level 1 to a Level 2 which entails outdoor lawn & garden watering between the hours of 7:00 PM to 8:00 AM ONLY.		
Limit Non-Essential Outdoor Water Use to 2 days / week	Y	Good: Outdoor water restriction Level 4 set in drought conditions in summer months restricts outdoor watering to Tuesday & Thursday ONLY.		
Limit Non-Essential Outdoor Water Use to 1 day / week	Y	Good: Outdoor water restriction Level 5 set in extreme drought conditions restricts outdoor watering to hand held from 7:00 PM to 8:00 AM ONLY		

Water Conservation / Demand Management Practice	Currently in Use? (Y/N)	Describe Current Practices & Rate Effectiveness: (Good, Fair, Poor)	If NOT current practice, Rate Feasibility of Implementing (Good, Fair, Poor)	Comment on Feasibility Rating
Private Well Use Bylaw	N		Poor	A majority of private wells are not in the Ipswich River Basin watershed. Can't implement Town wide standard
Private Well Non-essential Outdoor Use Restrictions	N		Poor	See Private Well Bylaw Response
Public Education & Awareness Conservation Program	Y	Good: What's In the Works Newsletter that is sent to 10,000 households, web-site has a water conservation section @ danversma.gov, Outdoor Water Restriction signs throughout town, and brochures at DPW events. A water conservation PSA has been published by DCAT.		
Other / Not listed	Y	Good: Danvers DPW Facebook and Twitter posts for water conservation and Middle School calendar theme was Water Conservation this year Water Conservation will be the theme at the Public Works open House scheduled in May 2017.		

SECTION 2: WATER USE HISTORICAL DATA & PROJECTIONS

A. HISTORICAL WATER USE DATA:

Please review the Historical Water Use data we have compiled from the Annual Statistical Reports for your supply sources available on the Project Sharepoint Site in the WATER USE DATA FOLDER at this link: https://kleinfelder1.sharepoint.com/sites/ProjectsG/20173509/default.aspx

- Please advise us of any inaccuracies; provide updated data if needed and note source of the updated data

*********DATA IS BEING COMPILED AND IS EXPECTED TO BE POSTED ON THE PROJECT WEBSITE FOR REVIEW BY 3/6 *********

B. PROJECTED WATER USE:

Please review the DCR Water Needs Forecast projections for your community in the WATER NEEDS FORECAST folder on the to the Project Sharepoint site.

*********At this time, the projection is available only for Grant Partner Communities*********

- Please provide any comments on the forecasts and any update to the assumptions upon which they were based.
- Please provide list of any more recent (since 2009) planning population projections and a compiled list of any new proposed developments and projected water demands.

SECTION 3: WASTEWATER MANAGEMENT

A. Please upload GIS data files as requested on the Project Data Checklist (sewer mains, pump stations, treatment / discharge locations; septic system database) to the Project Sharepoint site.

B. Approximately what percentage of town is sewered? Are there any plans to expand the sewer system? Do you have a wastewater facilities plan or Master Plan? Please describe and upload to the Project Sharepoint site.

99.0 % less than 20 properties in Danvers that are not sewer

C. Where is the non-septic wastewater treated and discharged? Who can be contacted for further information?

Wastewater is conveyed to and treated at SESD in Salem

D. What areas of the town are expected or planned to experience future development with on-site septic systems? What are the expected flows?

None.

E. Does the Town have an Infiltration / Inflow removal program? Please describe and upload available documentation to the Project Sharepoint site.

Yes. The town has a 2013 facilities plan by CDM Smith which includes infiltration and inflow removal program, spot repairs, CIPP lining, sewer lateral lining, and sewer manhole rehabilitation. The report also lays out a schedule for the sewer pump stations.

SECTION 4: STORMWATER MANAGEMENT

A. Does the Town have a Stormwater Master Plan or Stormwater Management Plan? Please describe and upload documentation, if available.

Yes, Facilities Plan and SWMP is in draft form.

B. Please upload stormwater GIS data if available: drain lines, outfalls, drainage catchment areas to the Project Sharepoint site.

C. Documentation of stormwater recharge projects may allow water suppliers to obtain credit towards permit mitigation requirements if needed. Credit can be sought for projects from 2005 to present. If available, please provide a list of stormwater management improvement projects or structural BMPs installed in your community that allow stormwater to infiltrate and recharge groundwater or disconnection / removal of impervious area. Information request is specific to installations within the Ipswich Basin.

Over 80% of the town of Danvers lies outside the Ipswich River Basin and therefore the Town may not receive credits for groundwater credits.

Stormwater Recharge or Impervious Disconnection Projects				
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Address, Intersection, or Parcel	Description & Size of Structure	Nearest Stormwater Outfall or Receiving Water	Year Installed	Area of Catchment Draining to Structure (if known)

SECTION 5: OTHER ENVIRONMENTALLY BENEFICIAL PROJECTS

Have any of the following types of activities been implemented in your community? If yes, please describe location and activity and upload supporting documentation (summary or technical report) to the Project Sharepoint site.

- Dam removal – Curtis Pond dam removal
- stream restoration – Boston Brook
- install / maintenance of fish passage – yes, the stream bank improvements at Frost Fish Brook continues to allow fish migration
- acquisition of property in Zone I or II of well – yes, Lobel's Grove
- acquisition of other property for natural resource protection – Choate Farm, Lobel's Grove
- stormwater bylaw – Yes regulations for implementation
- stormwater utility - No
- private well bylaw - No
- wetlands bylaw - Yes
- water quality improvement project – Frost Fish Stream Bank stabilization project
- Other

SECTION 6: ANY OTHER RELEVANT COMMENTS OR INFORMATION

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