IPSWICH RIVER BASIN WATER CONSERVATION REPORT CARD

Grading the Communities of the Ipswich River Basin on Water Conservation and Water Use Efficiency

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Summary and Background

The Ipswich River Watershed Association (IRWA) and the Massachusetts Audubon Society (Mass Audubon) have prepared this seventh annual Ipswich River Basin Water Conservation Report Card to highlight the need and opportunities for more efficient use of the water resources of the Ipswich River watershed.

The ongoing drought highlights the importance and value of water conservation and efficient water use to the Ipswich River and the communities that depend upon it for water supply. While the current drought is not severe by historical standards, several Ipswich watershed communities faced the prospects of water shortages this summer due to an inability to fill their water supply reservoirs. A failure to conserve limited water supplies during the summer of 2001 resulted in low reservoir levels when the drought began last fall. Below normal precipitation since that time left some reservoirs at unusually low levels in the early spring of 2002. During the drought, the Ipswich River has remained at relatively low flow levels for extended periods, and on several occasions during the fall of 2001 and the winter and early spring of 2002, record low flows for date were recorded.

Water withdrawals for public water supply are the major cause of unnaturally low and no flow conditions in the Ipswich River, according to studies by the United States Geological Survey (USGS). In the summers of 1995, 1997, and 1999, the upper half of the river ran dry or was reduced to isolated pools. In recent years the communities that have water supply sources in the Ipswich watershed have used an average of about 40 million gallons of water per day. About two thirds of this water comes directly from the Ipswich River or wells within the Ipswich watershed.

While public water supply withdrawals are the most significant cause of the river drying up, they are not the only factors causing the Ipswich River's flow problems. Twenty to 25 million gallons a day of the water supply is discharged out of the watershed, resulting in a major water deficit. Additional millions of gallons of stormwater and groundwater leak or flow into sewers, and that water is also removed from the watershed. The USGS studies found that diversions of wastewater out of the upper reaches of the Ipswich watershed also significantly contribute to low flow conditions.

The rapid pace of development in some portions of the watershed results in further disruption of the natural hydrology of the Ipswich watershed. Stormwater rushes across pavement, buildings, and other impervious surfaces, instead of soaking into the soil and recharging underground aquifers. The result is increased flooding in periods of high rainfall and snowmelt and decreased flow in dry periods. This deprives rivers and streams of the critical base flow that under natural conditions keeps them flowing and healthy in summer.

These problems must be addressed through comprehensive planning, resource protection measures, and more efficient use of the Ipswich watershed's limited water resources. In 1999, IRWA initiated two projects to meet this need. The first is a joint effort with the communities of Wilmington, Burlington, Reading and North Reading called ***"Planning for Growth and Watershed Protection,"*** which seeks long-term solutions to improve the water balance in our region, while protecting water quality and other resource values and providing the basis for a sustainable economy. The second, called ***"Communities Connected by Water,"*** is developing a watershed management plan to better manage and protect regional water resources, and has resulted in the

creation of the Ipswich River Watershed Management Council. These efforts are funded by the Massachusetts Executive Office of Environmental Affairs.

The Massachusetts Audubon Society is working to develop measures to address development pressures that threaten the Ipswich and many other Massachusetts watersheds. Mass Audubon's Endicott Regional Center in Wenham and The North Shore Alliance for Green Neighborhoods have developed a model bylaw and regulations for **Open Space Residential Design** (OSRD), also known as Conservation Subdivision Design. OSRD is an innovative tool communities can use to reduce stormwater runoff and outdoor water use and to protect their water supplies, aquatic wildlife habitat, and upland areas. In addition, Mass Audubon is working to educate individuals and communities across the state on measures they can implement to conserve water and protect the Ipswich and other rivers. This effort is funded by the Massachusetts Environmental Trust. Recently, Mass Audubon launched a river protection website that provides information on effective measures for conserving water. This site can be accessed at www.massaudubon.org/rivers.

Despite the serious low-flows in the Ipswich River, there are some noteworthy ***points of progress:***

- The **Town of Reading** achieved as A- overall grade – the highest overall grade obtained so far by any community in the watershed. Congratulations to Reading for the commitment they have made to improve water efficiency in their community!

- **IRWA** is developing a comprehensive water conservation program for the region, funded by the Executive Office of Environmental Affairs Massachusetts Watershed Initiative. This project will work with communities to establish realistic goals and standards for water conservation, to be applied consistently throughout the watershed. In addition, IRWA will provide technical assistance to municipalities and businesses, and will implement several pilot projects on water conservation.

- **The Towns of Reading and Wilmington** are negotiating to purchase water from the Massachusetts Water Resources Authority (MWRA). If implemented, this approach could reduce water withdrawals from the towns' wells adjacent to the Ipswich River during low-flow periods.

- The **Town of North Reading** is working to address its wastewater disposal needs with facilities that treat and return wastewater within the Ipswich basin, rather than approaches that would result in further transfers of water out of the Ipswich watershed. North Reading has also increased its purchases of water from Andover in summer, thus reducing the need to pump water from the wells adjacent to the Ipswich River.

- The **USGS**, with funding support from the **Massachusetts Executive Office of Environmental Affairs**, conducted additional modeling of management alternatives to improve streamflows. This modeling found that the low-flow problems of the Ipswich River can be solved by reducing the use of streamside wells, improving water conservation, and reducing the amount of water transferred out of the watershed.

- **USGS**, in collaboration with the **Massachusetts Division of Fisheries and Wildlife**, completed a study of how low-flows affect aquatic habitat in the Ipswich River. The study found that Ipswich River has excellent habitats when flows are adequate, but these habitats are lost during low-flow periods. As a result, the river's fish community has lost important species. A task force of fisheries experts convened by IRWA has developed recommendations for restoring a healthy fish community to the Ipswich River.

- In 2001, the **Massachusetts Water Resources Commission** designated the Ipswich a **Stressed Watershed**. While highlighting the impacts of low-flow conditions in the Ipswich River, this designation will help to ensure a high degree of review of proposals that might further reduce flows in the Ipswich River, and encourage restoration and water conservation efforts.

- ***"An Act Establishing a Water Resources Conservation and Efficiency Program,"*** (***S.2040/H.2212***) filed by Senator Bruce Tarr (Gloucester) and Representative Douglas Petersen (Marblehead) is currently before the Massachusetts legislature. This bill would provide funding, technical assistance and guidelines to improve water efficiency statewide and in the Ipswich River watershed. This bill is important to the protection of the Ipswich River and all rivers and watersheds in the Commonwealth.

- Over the past decade, **per capita water use in the watershed has declined slightly**, by about eight percent. Unfortunately, this good news is offset by an eight percent increase in population in Ipswich watershed communities. The combination of a slight improvement in water efficiency and an increased population resulted in overall annual water use remaining about the same over the past decade.

- A **Comprehensive Watershed Management Plan** is nearing completion, and will identify measures to restore flow while protecting water quality. The **Ipswich River Watershed Management Council**, which advises the state environmental agencies about regional issues and priorities, is working to identify priority actions. The Council invites participation of all those interested in working together toward protecting the Ipswich River.

Yet other projects threaten to worsen the flow situation in the Ipswich River. For example, if the Town of Wilmington moves forward with a proposal to expand its sewer system, it would result in further water losses from the critically stressed upper Ipswich watershed. Several communities have requested that the Massachusetts Department of Environmental Protection (DEP) consider reducing protection of the Ipswich River in response to the recent drought. A proposal for a new golf course in Ipswich has the potential to adversely impact the Ipswich River by pumping millions of gallons of irrigation water during low flow periods. In addition, the region's growth threatens to outstrip the progress in water conservation, especially with the trend toward large, water-demanding lawns. These potential projects and trends could undermine any progress being achieved to restore the Ipswich River to health.

Recommendations

1. ***Implement a strict "no net loss of water" (net gain) policy in the Ipswich River watershed.*** This approach would measure the effect of projects on the "water budget," and require that proposals that would result in further loss of water be mitigated by water imports, water efficiency or other practices to restore flow to the river.

2. ***Enact S.2040/H.2212, "An Act Establishing a Water Resources Conservation and Efficiency Program":*** This legislation will provide communities with the technical assistance and financial aid they need to reduce water demand region-wide. Rivers across the Commonwealth will receive more consistent protection against low-flow problems.

3. ***Adopt more effective water conservation standards throughout the region.***

    a. ***Revise rate structures to encourage water efficiency and discourage waste.*** Only five communities have inclining block water rates, where the price per gallon increases as water use increases. Most communities have rate structures that are flat (same cost per gallon regardless of use) *except for the lowest volume customers*, who are charged a minimum fee regardless of use. These customers, who may include elderly and single-person households, pay the most per gallon. This practice should be changed so that these low-volume customers are rewarded, rather than penalized.

    b. ***Implement more effective measures to reduce summer water use.*** Even-odd watering restrictions are generally not very effective, and in some cases are counterproductive, resulting in more watering. Requirements for hand-watering only, very restricted hours of outdoor water use (such as late evening/early morning), and of course watering bans, are much more effective. Whatever water use restrictions are used, they must be enforced to be effective. Automatic sprinkler systems should be better managed so that they operate only when soils are dry, and during restricted hours, if at all. Second meters, used in some communities with sewers to measure water used but not returned to the sewer system as wastewater, should be prohibited or billed at significantly higher rates. Communities should work with garden clubs to create demonstration water efficient lawns and landscapes and award programs for water-efficiency. Communities should implement seasonal rate structures that charge a premium for high summertime water use. These measures will not only assist communities in reducing summer use, which causes frequent drying up of portions of the river, but also may help to avoid costly water supply capacity expansions such as the construction of new wells and new or larger water treatment facilities.

    c. ***Implement comprehensive water efficiency programs in each community.*** Every community should develop and implement a comprehensive water efficiency program, with goals, timetables, budgets and accountability. Goals should include specific targets for reductions in water use in residential, commercial, industrial and municipal sectors, and plans for how to achieve these goals. Priorities should be set based on areas where most water savings can be achieved; however, no key area should be neglected. Water efficiency programs should include replacement of inefficient plumbing fixtures; replacement of inefficient and unreliable large meters with improved models; revision of

water rates to encourage water conservation and penalize water waste; leak detection and repair as part of routine operations; indoor and landscape water audit services to customers; year-round, effective education and outreach; improved drought/low-flow response and water restriction measures. **Every community should establish a goal of reducing per capita water use by at least 20 percent over the next decade.** This should include a special emphasis on reducing water use in summer when the Ipswich River is most severely stressed.

d. ***Improve the detail and accuracy of water system accounting.*** An important element of improving water system operational efficiency and water use efficiency is a comprehensive and accurate accounting of water use. Communities should increase their efforts to collect and compile accurate water use statistics. DEP should audit water supply statistics during the five year review of Water Management Act permits and require improved data collection and reporting where needed.

4. Adopt development controls that reduce outdoor water use and stormwater runoff. Communities should adopt the Open Space Residential Design bylaw and regulations being developed by the North Shore Green Neighborhoods Alliance to make new development more water efficient, reduce stormwater runoff, and protect important habitat.

5. Support and participate in the Ipswich River Watershed Management Council and Ipswich Basin Team. These groups are working to forge creative and effective solutions to the problems facing the region and the Ipswich River. Cooperation and coordination of efforts among all those who share this resource is essential to ensure its health and vitality as an environmental, economic and recreational resource for generations to come.

6. Everyone has a role to play. We all use water – none of us can live without it. Nor can businesses and the economy thrive without a dependable and clean source of water. The Ipswich River is truly the "lifeblood" of the region's economy *and* its ecology. We can all use water more efficiently in our homes, yards, schools and businesses. If every person in the region saved just three gallons a day, that would save a million gallons a day, or 365 million gallons a year! Given that the average water use in the region is 75 gallons per person per day, such a modest savings is truly achievable – in fact, people could realistically save much more water on a daily basis by installing water efficient plumbing fixtures and changing water wasting practices. We can let our local officials know how important it is to use the Ipswich River carefully and to protect it for our sustainable use now and in the future.

For more information about how to save water or how to protect the Ipswich River, please call the Ipswich River Watershed Association at 978-356-0418, or contact Richard Tomczyk, Ipswich River Basin Team Leader for the Executive Office of Environmental Affairs, at 978-661-7817.

For information on rivers, low flow, and water conservation on the Internet, visit www.massaudubon.org/rivers.

Introduction

In 1997, the Ipswich River was listed as one of the nation's most threatened rivers because of its severe low-flow problems. Much of the upper half of the river dried up or was reduced to isolated stagnant pools in the summers of 1995, 1997, and 1999. In 1999, the river experienced record low-flows in May, June, July and August. While the river did not experience extreme low flows during the summer of 2001, the drought that began in late summer of 2001 resulted in record low flows during late 2001 and early 2002, and extremely low flows continued into the spring season. This situation raises real concerns that the river will dry up again this summer.

For years, the Ipswich River has been recognized as severely stressed by water withdrawals by municipalities located within and outside of the Ipswich watershed. The Ipswich River basin provides all or part of the public water supply for 14 communities: Beverly, Danvers, Hamilton, Ipswich, Lynn, Lynnfield, Middleton, North Reading, Peabody, Reading, Salem, Topsfield, Wenham, and Wilmington. In early 2000, the USGS completed the development of a model of the hydrology of the Ipswich watershed that documented the magnitude of the impact of these water withdrawals on low flows in the Ipswich River. The USGS found that groundwater withdrawals in the upper reaches of the watershed are the main factor reducing summer flows by up to 90 percent. The diversion of wastewater to treatment plants outside the watershed also significantly reduces flow. The results of the USGS study highlight the need to increase water conservation and water efficiency efforts.

A companion study by USGS and the Massachusetts Division of Fisheries and Wildlife, completed in late 2001, found that the Ipswich River's fisheries have been seriously degraded by low-flow problems. The river's biodiversity has been diminished, with the loss of most "river dependent" species. The study identified several management objectives needed to restore the river to health. IRWA convened a workgroup of fisheries experts to develop a "target fish community," representing the fish species expected to be present in the Ipswich River were it not subject to excessive water withdrawals and diversions. In 2001, this workgroup developed recommendations for fisheries restoration goals for the Ipswich River.

The Ipswich River Watershed Association and the Massachusetts Audubon Society have prepared this seventh annual report card to assist communities in assessing their own water conservation efforts and identifying ways to improve water efficiency. A major goal of this evaluation is to point out where improved water conservation and more efficient operation of water supply systems could be implemented to reduce water withdrawals, and thereby to reduce stress on the Ipswich River and its tributary streams. The 2002 Report Card reviews water use in 2001, as reported by community water departments to the DEP in their Public Water Supply Annual Statistical Reports. The 2002 Report Card also reports on water efficiency trends in the Ipswich River basin over the past decade.

The Ipswich River Watershed Association and Massachusetts Audubon Society are committed to the protection and preservation of the Ipswich River. The Ipswich River Watershed Association serves as the voice of the Ipswich River and the ecosystems it supports by advocating for the protection, conservation, and sustainable management of the vibrant, vital natural resources within the river's watershed. IRWA works to ensure adequate stream flows, clean water, healthy natural habitats, necessary drinking water, and recreational opportunities for future generations. As the river's advocate, the Association is dedicated to using sound science and management tools to work with a variety of stakeholders to achieve a careful balance of human uses of the river with the needs of healthy terrestrial

and aquatic habitat, so that the riverine system is able to function as naturally as possible. Where the river has been compromised, IRWA seeks to restore it; where it remains pristine, IRWA seeks to protect it.

The Massachusetts Audubon Society is the largest conservation organization in New England, concentrating its efforts on protecting the nature of Massachusetts for people and wildlife. Mass Audubon protects more than 29,000 acres of conservation land, conducts educational programs for 250,000 children and adults annually, and advocates for sound environmental policies at the local, state, and federal levels. Established in 1896 and supported by 65,000 member households, Mass Audubon maintains 41 wildlife sanctuaries that are open to the public and serve as the base for its conservation, education, and advocacy work across the state. The Mass Audubon's largest sanctuary is the 2,800-acre Ipswich River Wildlife Sanctuary located in the Towns of Topsfield, Hamilton, and Wenham on the banks of the Ipswich River. Protecting and restoring the freshwater habitats of Massachusetts, including the Ipswich and other rivers and streams threatened by excessive water withdrawals, is a key conservation goal of the Massachusetts Audubon Society.

The Need for Water Conservation and Efficiency

Because the Ipswich River is so vulnerable to the impacts of water withdrawals, it is imperative that the communities using the basin as a source of water supply use water as efficiently as possible. Failure to do so threatens not only the ability of the river to support fish, wildlife and recreation, but also the region's economic viability and future.

Increased water demand in summertime is a particular problem, because it occurs at the same time the river is lowest, and can quickly result in pumping the river dry. Lawn watering is the chief reason for high summer water demand, which can be double or triple winter use. In recent years, many basin communities have experienced rapid residential growth, primarily in the form of single family homes with large lawns. Many of these lawns are watered frequently in an effort to keep them green, even during the hottest and driest part of the summer. The hotter and drier the summer, the more lawn watering. The water is taken up by lawn grasses or lost to evaporation. The result is very high summer water demand, driving water suppliers to pump more water at the very time that the river is at its lowest, and most vulnerable to water withdrawals. This peak summer water demand is also the motivation to build new wells or reservoirs, at great expense, which might be avoided if peak water demand were reduced.

Another reason the Ipswich River is so susceptible to low-flows is that 80% of the water which is taken for water supply is transported out of the watershed and discharged elsewhere. The communities of Beverly, Burlington, Danvers, Lynn, Reading, Peabody, Salem and parts of Andover and Wilmington transport their wastewater out of the basin for treatment and disposal. As a result, wastewater from these communities is not returned to the Ipswich basin to maintain streamflow. This results in a direct loss of about 20 to 25 million gallons of water per day, and a loss of additional millions of gallons daily due to "infiltration and inflow" – water which flows into the sewers through cracks and connections with storm drains. At times, infiltration and inflow can exceed the volume of wastewater in sewers, dramatically increasing the loss of water from the watershed.

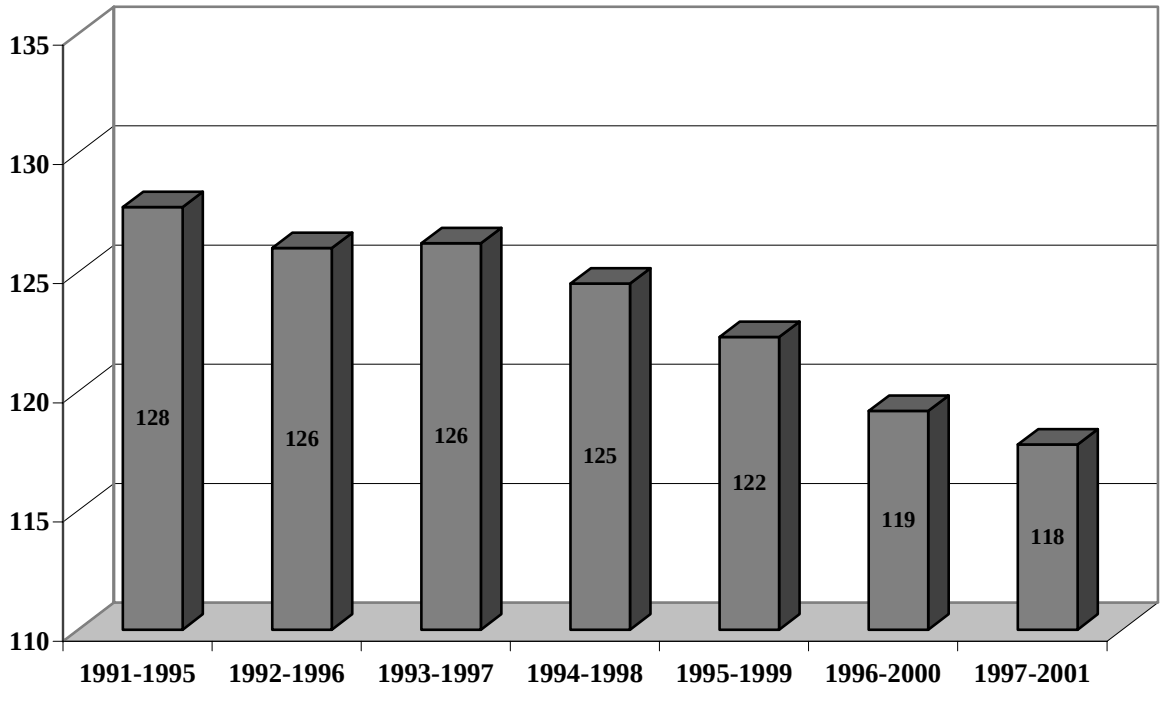
Accelerating watershed development in Ipswich River basin communities also threatens the river with increased pollution from stormwater runoff and disruption of the basin's hydrology that may increase

flooding and decrease groundwater reserves. Groundwater reserves are needed to provide summer streamflow and recharge municipal water supply wells during the summer. This threat is most pronounced in the upper and middle portions of the Ipswich River watershed. According to recent data from the 2000 U.S. Census, the population of the upper watershed communities of Wilmington and North Reading grew by 21% and 15% respectively over the past decade. The population of the mid-watershed community of Middleton grew by 57%. Threats associated with watershed development generally cannot be addressed by municipal water departments. These threats must be addressed through comprehensive planning and resource protection measures.

Water Use Trends in Ipswich Basin Communities

In preparing this annual report card over the past seven years, we have collected water use statistics for the communities that use the Ipswich River basin as a source of water supply. With data collected for the 11 year period from 1991 through 2001, this year we have analyzed the overall water use trend in the Ipswich watershed. To do this, we evaluated changes in per capita water use over the decade. We looked at five year averages of per capita water use to reduce the year-to-year variations that occur as the result of wet or dry summers. This provided us with per capita water use for seven, 5 year periods: 1991-1995, 1992-1996, 1993-1997, 1994-1998, 1995-1999, 1996-2000, and 1997-2001. The results of this analysis are presented in Figure 1.

Figure 1: Water use trend in the communities using the Ipswich Watershed as a source of water supply (in gallons per person per day).



Throughout the past decade, per capita water use in the Ipswich basin communities dropped by about eight percent, from an average of 128 gallons per capita per day (gpcd) during the period from 1991 through 1995, to 118 gpcd during the most recent five year period, 1997 through 2001. While this is good news, it does not mean that there has been a reduction in total water use of eight percent. The actual amount of water used has stayed about the same over the past decade due to a population increase of about eight percent, according to data from the 2000 U.S. Census. Due to the increased regional population, the total amount of water used by the communities that take water from the Ipswich River has remained about the same.

While it is indeed good news that water efficiency is improving in many of the communities that use the Ipswich River basin as a source of water supply, a much greater improvement could be achieved. Over the last decade, improvements in efficiency have only slightly outpaced the increase in water use due to growing populations. To meet future water needs and to restore the Ipswich River, increased water efficiency is needed.

The Report Card

To prepare the Report Card, IRWA and the Mass Audubon evaluate Public Water Supply Annual Statistical Reports, submitted by each water department to the Massachusetts DEP. The reports, filed on DEP forms, require information on total water use, disaggregated water use (water use broken down into categories such as residential, commercial, industrial, etc.), and information on water supply sources. **All information is self reported by water suppliers. There is no verification or audit process by DEP for the information provided by water suppliers.**

IRWA and the Massachusetts Audubon Society obtained copies of the water supply statistics filed by the communities that use the Ipswich River basin for all or a significant portion of their water supply for the years 1991 through 2001. This information was obtained from the files of the DEP in Boston. The data provided by water suppliers were then used to develop the report card.

Six factors were evaluated and graded: water use trend; residential water use; seasonal water use; non-account water; record keeping and reporting; and water rates. Each of these factors is described in detail in the methodology section of this report. Data for Middleton are included with Danvers, which provides water to Middleton. An overall water conservation grade for each community was also developed based on the average of their individual grades.

The Grades

Based on the grading criteria described in the section on methodology, the 14 communities that use the Ipswich River basin for all or a substantial portion of their water supply received the grades shown in the table below. Again, we wish to emphasize that the data on which these grades are based was supplied by the communities in their annual reports of water supply statistics to DEP.

2002 IPSWICH RIVER WATERSHED WATER CONSERVATION REPORT CARD
(covering water use for 2001)

Community	Overall Grade	Water Use Trend	Residential Water Use	Seasonal Water Use	Non-Account Water	Records & Reports	Water Rates
Beverly	**C+**	**D**	**B**	**B**	**D**	**A**	**D**
Danvers/Middleton[1]	**B**	**B**	**B+**	**C**	**A+**	**A**	**C**
Hamilton	**B+**	**A**	**B+**	**D**	**A+**	**A**	**B**
Ipswich	**B+**	**A**	**A+**	**B**	**B**	**A**	**C**
Lynn	**B-**	**A**	**B+**	**B**	**D-**	**A**	**D**
Lynnfield	**C+**	**B**	**B-**	**F**	**B+**	**A**	**C**
North Reading	**B-**	**B**	**D-**	**C**	**C+**	**A**	**B**
Peabody	**B-**	**A**	**B-**	**B**	**C+**	**C**	**C**
Reading	**A-**	**A+**	**A+**	**C**	**A+**	**A**	**C**
Salem	**B-**	**A**	**D-**	**B**	**B+**	**A**	**C**
Topsfield	**B**	**B**	**B-**	**B**	**A+**	**A**	**D**
Wenham	**C+**	**F**	**D-**	**A**	**B**	**A**	**B**
Wilmington	**B**	**A**	**B-**	**C**	**A+**	**B**	**C**

Since the Report Card was first issued in 1996, progress in implementing water efficiencies has been slow, despite the river drying up in 1995, 1997 and 1999. In general, grades for year 2001 water use were about the same as for year 2000. However, Reading achieved an A- overall – the highest overall grade achieved to date. Five communities improved their grades, six received lower grades, and two remained the same. Overall, the summer of 2001 was slightly warmer and considerably drier than the summer of 2000. This increased outdoor water use, resulting in higher grades for residential water use and seasonal water use in a number of communities. Although annual variations in the amount and distribution of rainfall make grades fluctuate somewhat from year to year, we do believe that improvement has occurred as a direct result of action by many communities to conserve water and achieve increased efficiency. This view is supported by the overall water use trend for the basin presented in Figure 1. We support and congratulate these successes, while recognizing that **much more could and should be done to conserve water to protect, preserve, and restore the Ipswich River and its tributaries**.

The dangerously low conditions of several area reservoirs and low groundwater levels in the Ipswich Watershed during the winter and spring of 2002 highlight the need for increased efforts to conserve water and use it efficiently. A failure to effectively conserve water during the summer of 2001 left water supply reservoirs at low levels by September, just as the drought began. Below normal precipitation since that time was insufficient to refill these reservoirs during the fall and winter months. Some relief occurred due to rains in March, April, and May, but total precipitation over the past year remains below normal, threatening the river and the sustainability of several water supplies during the coming peak demand season.

[1] The Town of Danvers provides water to the Town of Middleton. Reports filed with the DEP indicate that residential water use in Middleton is significantly higher than residential water use in Danvers. For this reason, Danvers grade for residential water use was adjusted upward. We note the need for Middleton to take immediate action to reduce high water use. Measures to increase water conservation and efficiency in Middleton are especially important given the very high rate of population growth in Middleton as indicated in the 2000 U.S. Census.

Methodology

The criteria used to assign grades are described below. **Wherever possible the grading criteria were based on Massachusetts standards or guidelines for water conservation and water system management as established by state water resource agencies and the Massachusetts Water Resources Commission. It should be noted, however, that because the Ipswich River is severely affected by municipal water withdrawals, all communities using the Ipswich basin as a source of water supply should be actively seeking to keep water use below state standards and to exceed state guidelines for efficient water system management.**

Overall Grades

Overall grades were given to each community by averaging grades for the six individual grade categories. As noted, the Town of Reading achieved an A-, the highest overall grade yet obtained. **Two communities achieved a "B+", the same number as last year.**

Water Use Trend

Water use trend shows whether a community's per capita water use is increasing or decreasing. Per capita water use should be decreasing because of water efficiency requirements and increased awareness of conservation needs and practices. As new homes are constructed and older ones renovated, the amount of water used by each person should decrease as modern, water-efficient plumbing fixtures are installed. Communities should also be saving water through leak detection and repair and other system improvements. In addition, as communities have become more aware of the stressed condition of the Ipswich River since 1995, they should have implemented public education efforts and other measures to encourage conservation and taken steps to reduce public water use, such as conservation and efficiency measures in schools and other public facilities.

Water use trend is calculated by comparing per capita water use in the most recent five years, 1997-2001 with per capita water use in the period 1991-1995. Grades were calculated based on the percentage change in water use between the periods 1991 to 1995 and 1997 to 2001.

Grade categories:

A+	=	Water use decreased > 20%
A	=	Water use decreased > 5%, ≤ 20%
B	=	Water use decreased ≤ 5%
C	=	Water use increased ≤ 5%
D	=	Water use increased > 5%, ≤ 10%
F	=	Water use increased > 10%, ≤ 20%
F-	=	Water use increased > 20%

Residential Water Use

This grade measures the average household water use by each person in a community each day. The current "state standard" is 65-70 gallons per capita per day (gpcd); however, a figure of 35 gpcd is now considered achievable. A recent study by the American Water Works Association found that typical single family indoor water use averages 73 gpcd in homes that do not practice water conservation, but less than 50 gpcd in homes using readily available measures such as high efficiency toilets and showerheads.[2]

[2] WaterWiser 1999. Residential Water Use Survey. American Water Works Association, Denver, CO. http://www.waterwiser.org.

In many municipalities around the nation, including New York City, Los Angeles, San Diego, Seattle, and Tampa, water utilities have established rebate programs and other incentives to encourage the replacement of old water-wasting plumbing fixtures with new water-efficient fixtures. These programs have been successful in reducing water use and avoiding the need for costly new water supply and wastewater infrastructure.

The residential water grade is calculated by dividing the average daily residential water use in the community by the number of people served by the public water system. The grades were based on residential water use levels reported for 2001. Letter grades were modified with a "+" if 2001 residential water use was below the average residential use for the community for the years 1991 through 1995 or with a "-" if 2001 residential water use was above the average residential water use for the community for the years 1991 through 1995.

Grade categories:

A	=	≤ 60 gpcd
B	=	> 60 gpcd but ≤ 70 gpcd
C	=	> 70 gpcd but ≤ 80 gpcd
D	=	> 80 gpcd but ≤ 90 gpcd
F	=	> 90 gpcd

Seasonal Use

Seasonal use is the increase in water use that typically occurs during summer when large quantities of water are used for lawn watering and other outdoor uses. This is an important measure because the Ipswich River is particularly vulnerable to the impacts of water withdrawals during the summer, when river water levels are naturally low. The grade for seasonal use reflects the progress each community has made in managing seasonal use. Each community is graded against its own historical seasonal water use, rather than against a single standard. This approach reflects the diverse nature of the communities that take water from the Ipswich River watershed, which range from urban areas like Lynn, Beverly, and Salem, to relatively rural communities such as Topsfield and Wenham.

Grades were developed by comparing seasonal water use from the period 1991-1995 with the period 1997-2001. For each year, the ratio of the highest month water use to the lowest month water use was calculated. Average ratios for each 5 year period were then developed for each community and grades were assigned as follows.

Grade categories:

A	=	Seasonal use reduced more than 5% since 1991-1995
B	=	Seasonal use no more than 5% higher than in 1991-1995
C	=	Seasonal use increased 5% to 15% since 1991-1995
D	=	Seasonal use increased 15% higher to 25% since 1991-1995
F	=	Seasonal use increased more than 25% since 1991-1995

Non-Account Water

Non-account water is that portion of the total amount of water used by a community in a year that was not sold to customers. Non-account water includes water lost through distribution system leaks and breaks, water that goes unmetered and unbilled due to meter slippage, water used for main flushing, water used for fighting fire, and other "unbilled" water. "Non-account water" does not include water classified as "municipal" on the Annual Statistical Reports. Non-account water provides an important indicator of how efficiently water is being used. For most water systems, a non-account water level of 10% of total water pumped is achievable.

Grade categories:

A	=	Non-account water ≤ 10%
B	=	Non-account water > 10%, ≤ 15%
C	=	Non-account water > 15%, ≤ 20%
D	=	Non-account water > 20%, ≤ 25%
F	=	Non-account water > 25% (or not reported)

Letter grades for non-account water have a "+" if 2001 non-account water was below the average for the community for 1991 through 1995, and with a "-" if greater than the average for the community for 1991 through 1995.

Record Keeping and Reporting

Record keeping and reporting is important because accurate information is needed to efficiently manage water supply systems. Disaggregated water use data (total water use broken down by the type of user) is particularly important since it provides information on how water is being used. Without this information, major problems such as excessive water loss through distribution system leakage may go undetected. When disaggregated water use is known, it is possible to target water conservation and efficiency efforts most effectively.

Two factors were evaluated to develop grades for record keeping and reporting: whether a community provided disaggregated water use information, and the consistency of the data provided. Data consistency was judged to be either good, fair, or poor. Grades were based on reports for 2001 only.

Grade categories:

A	=	Disaggregated data with good data consistency
B	=	Disaggregated data with fair data consistency
C	=	Disaggregated data with poor data consistency or disaggregated data estimated
D	=	Data not disaggregated
F	=	No report filed

Most water suppliers provided detailed information on water use in 2001; however, the accuracy of the information is not specified. We cannot assess the accuracy of the data provided since there is no independent audit or verification process. DEP should address the need for independent verification of municipal water supply statistics.

Water Rates

Water rates are important because the cost of water influences how much water people use. Three factors were used to grade water rates: *rate structure*, *billing frequency*, and the *marginal cost of water* for residential customers using relatively large amounts of water. The evaluation of rate structure considered both the actual rate structure (declining block, flat, or increasing block) and the progressivity of the rate structure if an increasing block structure is used. Individual grades for each of these three factors were developed and averaged to determine the final grade for water rates.

Rate Structure: All communities evaluated used either an increasing block or a flat rate structure. Under an increasing block rate structure, the cost of each gallon of water increases in steps as water use goes up. The first block is usually billed at a relatively low rate per thousand gallons or hundred cubic feet (approximately 750

gallons). In the next block each unit of water is billed at a higher rate. Increasing block rate structures may have many blocks with each block billed at a higher rate than the one preceding it. Because water becomes more expensive as more is used, there is an incentive to use less.

Under a true flat rate structure, all water use is billed at the same rate, no matter how much water is used. Flat rates provide less of an incentive to conserve. In a flat rate structure, customers who use water only for basic human needs such as drinking, cooking, waste disposal, and bathing may subsidize the cost of water for those who use much larger quantities of water for lawn watering or other non-essential uses. Some communities have a minimum charge per billing period, even if water use is below the assumed minimum. This minimum charge may penalize households that use very little water, by billing them at a higher rate per gallon than larger volume users.

Water rate progressivity (how quickly the unit cost of water increases as the amount used goes up) was assessed because an increasing block rate structure will only encourage conservation if the block rates are set at levels where most customers who use large quantities of water will begin to pay noticeably higher prices. If there is little difference between the cost of the first and subsequent blocks, or if the volume of water allowed under the first block is so high that most customers will never reach a higher block, the value of increasing block rates in encouraging water conservation will be reduced.

Rate progressivity was evaluated by comparing the cost of water for households using large quantities versus those using smaller amounts. The cost of water for two hypothetical households, one using 60,000 gallons per year and one using 150,000 gallons per year, were compared. In a flat rate structure, the household using 150,000 gallons per year would pay 2.5 times the amount the household using 60,000 gallons would pay. Costs for these two hypothetical households were calculated for each community with increasing block rates. To obtain a rate progressivity factor, the cost of water for the household using 150,000 gallons per year was first divided by 2.5 and then again divided by the cost of water for the household using 60,000 gallons per year. In communities with flat rates, this progressivity factor always equals 1; whereas in increasing block rate communities, the factor is always greater than 1 and becomes larger as rate progressivity increases.

Grades for rate structure were developed as follows.

A	=	Increasing block rate structure, progressivity factor > 1.50
B	=	Increasing block rate structure, progressivity factor > 1.25 to 1.50
C	=	Increasing block rate structure, progressivity factor > 1.00 to 1.25
D	=	Flat rate structure
F	=	Declining block rate structure

Billing Frequency: All communities bill for water at least semiannually or quarterly. When all other factors were equal, communities with quarterly billing were given higher grades than those with semiannual billing. Quarterly billing provides more rapid feedback on water costs to water users and thus tends to encourage conservation.

Grade categories:

A	=	Monthly billing
B	=	Monthly billing for large users/quarterly billing for small users
C	=	Quarterly billing
D	=	Semiannual billing
F	=	Annual billing

Marginal Cost of Water: Marginal cost of water was calculated by determining the water rate paid for the last thousand gallons (TG) by a residential customer using 150,000 gallons per year. This volume of use was selected to assess the marginal cost of water to a residential customer engaged in a high level of luxury water use, such as lawn watering or filling a swimming pool. Grades were assigned as followed

Grade categories:

A	=	> $7.50/TG
B	=	> $6.00/TG to $7.50/TG
C	=	> $4.50/TG to $6.00/TG
D	=	> $3.00/TG to $4.50/TG
F	=	≤ $3.00/TG

Following the calculation of grades for rate structure, billing frequency, and marginal cost of water, final water rate grades for each community were calculated by averaging these three individual grades.

An Important Note

It is not our intent to blame communities, or specific individuals, for inefficient use of the limited water resources of the Ipswich River basin. The residents of the communities that use the Ipswich basin for water supply may not realize that inefficient water use has extreme consequences for the Ipswich River and its tributaries. Water managers may wish to improve water system operations and efficiency, and may also wish to institute comprehensive water conservation programs, but are often constrained by limited budgets that are largely beyond their control. The intent of this report card is to draw public attention to the problem, to encourage support for water conservation, and by so doing to preserve and restore the Ipswich River.