

## EXECUTIVE SUMMARY

The 23.4 square-mile Weir River watershed study area is located in the Weymouth and Weir River Sub-basin of the Boston Harbor Basin in eastern Massachusetts. The contributing drainage area to the Weir River is about 19.5 square miles of which the non-tidal portion of the watershed covers about 14.8 square-miles to Foundry Pond Dam in Hingham. The watershed is divided into six subbasins which contribute to the major streams and rivers --- Accord Pond, Plymouth River, Accord Brook, Crooked Meadow River, Fulling Mill Brook, and the Weir River itself. A seventh subbasin includes Hull and other tidally influenced areas.

The watershed provides water for approximately 38,000 persons living in the suburban communities of Hingham, Hull, Cohasset, and Norwell. Small portions of Rockland and Weymouth are within the watershed, but these two towns withdraw virtually no water from the watershed. The Town of Norwell pumps water from four wells which are within the upper portion of the watershed. The Aquarion Water Company (AWC – formerly the Massachusetts American Water Company), which supplies nearly all of Hingham and Hull and a small portion of Cohasset, withdraws water exclusively from the Weir River watershed. AWC accounts for the bulk (over 85 percent) of water withdrawals from the watershed.

The Commonwealth of Massachusetts regulates water withdrawals of over 100,000 gallons per day under the Water Management Act. **Table E-1** lists the amounts of water registered or permitted for withdrawal from the Weir River watershed. The table also lists the actual Average Daily Demand for water from the watershed averaged over the five year period between 1996 through 2000. Withdrawal rates are stated in million gallons per day (MGD).

Water Producer / Consumer	Actual Average Daily Demand (5-yr ave.) (MGD)	Registered and Permitted Withdrawal Rates (MGD)
Aquarion Water Company	3.57	3.51
Norwell Water Department	0.46	0.56 (1998) 0.67 (2000)
Self Supply & Golf Courses	0.08	---
Watershed Total	4.12	4.07 (1998) 4.18 (2000)

**TABLE E-1: Actual and Registered plus Permitted Withdrawal Rates**

The water resources of the Weir River watershed are taxed in terms of both their capacity to provide a stable public water supply and their ability to maintain adequate habitat for aquatic wildlife. In the summer of 1999 and spring of 2002,

during which precipitation was well below seasonal averages, outdoor water use restrictions were implemented in Hingham and Hull. During this period pond levels were low and Accord Brook was dry in some reaches.

To evaluate the interaction of water supply demand and the natural aquatic environment, a water budget model was created by GZA for the watershed. The water budget model was used to estimate the in-stream flows which would have been expected to occur in the watershed under virgin, pre-development conditions. The water budget was also used to evaluate flows under current and potential future water demand conditions. Low flow conditions typically occur, as would be expected, in the summer months. Estimates of average summer streamflow (per square mile of subbasin) for three of the streams of the watershed are shown in **Table E-2**.

Stream	Pre-Development (cfs per sq. mile)	Current Conditions (cfs per sq. mile)	Future Conditions (cfs per sq. mile)
Accord Brook	0.68	0.37	0.37
Plymouth River	0.68	0.68	0.68
Weir River	0.67	0.39	0.36

**TABLE E-2: Water Balance Derived Estimates of Mean August Streamflow**

The streamflow data indicate that water withdrawals and development have significantly reduced streamflow during the summer in Accord Brook and the Weir River. The Plymouth River is currently much less affected by water withdrawals. The Future Conditions scenario represents an increase in demand forecast using Massachusetts Department of Environmental Management methods and assuming continued utilization of current supply sources. The impacts of proposed major developments in the Plymouth River subbasin and elsewhere in Hingham are not included in the future conditions scenario presented above.

The predicted streamflow quantities represent both the contribution of surface runoff and baseflow. Baseflow is water that discharges into a stream from groundwater storage and is important because it is a constant source of flow, unlike surface water runoff, which may not be continuous during the summer in a watershed as small as the Weir River basin. Under current conditions, the water balance model predicts that baseflow in a typical summer is completely eliminated from Accord Brook and is reduced by up to 62 percent in the Weir River.

Concurrent with development of the water balance model, the selected streams and rivers of the watershed were studied to evaluate the relationship between the amount and quantity of in-stream flow and the quality of aquatic habitat. Several indicator aquatic species were identified and existing habitat suitability index curves were applied to data collected within the study area. The indicator aquatic species include brown trout, white sucker, tessellated darter, and

caddisfly/mayfly. Stream-specific data gathered in the field was then used to develop hydraulic rating curves which relate aquatic habitat to flow.

The United States Fish and Wildlife Service New England Flow Policy (1991) states, “Low flow conditions in August typically result in the most metabolic stress to aquatic organisms, due to high water temperatures and diminished living space, dissolved oxygen, and food supply. Over the long term, stream flora and fauna have evolved to survive these periodic adversities without major population changes.” Pre-development summer and early fall low flow conditions were therefore used establish minimum acceptable streamflow thresholds.

Based on our understanding of stream management objectives in the Weir River watershed, the summertime minimum instantaneous streamflow recommendation was established to conserve at least 50 percent of the aquatic habitat which would have been present based on typical pre-development streamflows in August. The 50 percent criterion is proposed as a way of balancing the various environmental and stakeholder interests in the watershed.

**Recommended Minimum**

**Instantaneous Summer Streamflow: 0.14 cfs per sq. mile**

While this recommendation has been developed specifically for the summer, it is appropriate to apply it during all seasons to insure that at no time is all streamflow depleted, diverted, or impounded. By comparison, the minimum summer flow threshold for the Weymouth and Weir Basin proposed by DEM to the Water Resources Commission in 1991 is 0.15 cfs per square mile (cfs/m). The U.S. Fish and Wildlife Service recommended a more conservative New England Regional Aquatic Base Flow value of 0.5 cfs/m.

Additional seasonal minimum average streamflow recommendations have been made to account for normal variability and possible fisheries spawning and incubation needs. **Table E-3** summarizes the recommended minimum seasonal streamflows for the Weir River watershed. These recommendations, like the minimum instantaneous streamflow value, were developed based on average annual precipitation within the watershed. The seasonal recommendations are intended to be compared to the mean streamflow throughout each season as developed from a set of multiple streamflow measurements.

Season	Minimum Flow (cfs per sq. mile)
Summer: (July 1 through September 30)	0.58
Fall / Winter: (October 1 through February 28)	1.07
Early Spring: (March 1 through April 30)	3.11
Late Spring: (May 1 through June 30)	1.36

**TABLE E-3: Recommended Instantaneous Minimum In-stream Flows**

Maintenance of the recommended minimum seasonal streamflows requires that total water withdrawals be limited to a rate that does not cause excessive depletion of the rivers and streams. The average daily demand which may be sustained without causing flows in any season to fall below the minimum acceptable threshold has been termed by GZA the *Aquatic Habitat Safe Yield*. Using the water balance model, the Aquatic Habitat Safe Yield has been estimated for each subbasin of the Weir River Basin for each season, and is presented below in **Table E-4**. Actual average seasonal water withdrawals from the Weir River watershed during the period between 1996 through 2000 are listed for comparison.

Season	Aquatic Habitat Safe Yield (MGD)	Average Seasonal Water Withdrawals (MGD)
Summer: (July 1 through September 30)	0.72	4.94
Fall / Winter: (October 1 through February 28)	11.48	3.61
Early Spring: (March 1 through April 30)	2.94	3.55
Late Spring: (May 1 through June 30)	3.31	4.71
Annual	5.99	4.12

**TABLE E-4: Estimated Seasonal Aquatic Habitat Safe Yields**

The Aquatic Habitat Safe Yield estimates were developed based on the full utilization of streamflow in excess of the recommended minimums during each season, in each subbasin, assuming average precipitation. The Aquatic Habitat Safe Yield development methodology did not attempt to model the specific configurations of the water supply sources within the Weir River watershed.

On an annual basis, current average water withdrawals from the Weir River watershed do not exceed the estimated annual Aquatic Habitat Safe Yield. However, when viewed on a seasonal basis, water withdrawals exceed the estimated Aquatic Habitat Safe Yield from March through September. Excess withdrawals are particularly pronounced in the Summer when demand is highest and streamflows are the lowest.

The Aquatic Habitat Safe Yield estimates developed in this study are a function of the recommended seasonal minimum streamflows rates. The recommended minimum seasonal streamflows developed in this report are in turn dependent, in part, on the choice of the level of acceptable habitat conservation. In this study, the flow required to preserve 50 percent of the habitat provided by typical August streamflows was established as the recommended minimum instantaneous streamflow. The amount of water which should be allocated to habitat is actually dependent on the values and needs of the various stakeholders within the watershed. The Aquatic Habitat Safe Yield estimates provided in this report are intended to provide an indication of the availability of water resources in the

watershed and to identify where conflicts between uses may occur. This information is provided to the stakeholders and other interested parties in the watershed to spur discussion and assist with future decision-making regarding the allocation of the finite water resources of the Weir River watershed. The conclusions made regarding Aquatic Habitat Safe Yield are in no way meant to imply a recommendation of limiting the existing rights to public water sources presently utilized.

The Weir River Watershed Study effort was managed by the Massachusetts Department of Environmental Management's Office of Water Resources. The Study was completed for and funded by the Executive Office of Environmental Affairs and the Boston Harbor basin team. Public and agency comments provided to the DEM regarding the draft report have been considered and addressed in the final report.