SECTION 7

CONCLUSIONS AND ADDITIONAL COMMENTS

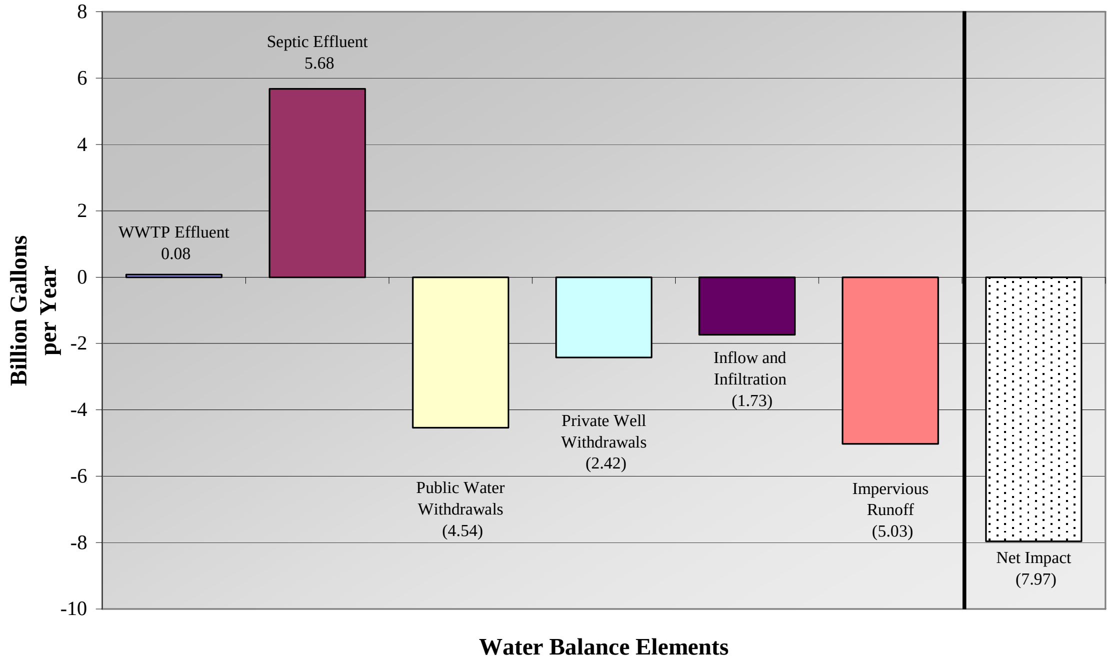
The results of the Phase I efforts include significant data collection, habitat and hydrologic analyses, a public outreach program, a smart growth case study and the development of recommendations for future phases of the Watershed Plan. As a product of this work, a number of conclusions were developed and are summarized and discussed below.

1.0 CONCLUSIONS

1. Water Balance (Entire Watershed)

Based on the data collected to date (see Section 2), and on a number of modeling assumptions (see Section 4 and Appendix A), the water balance analysis shows that urbanization had resulted in hydrologic shifts throughout the Taunton watershed. Specific conclusions and illustrations of some of these shifts at the sub-watershed scale are provided in Section 4 of this report. Groundwater recharge provides the primary source of baseflow to streams and wetland systems and replenishes aquifers. When anthropogenic groundwater withdrawals and discharges are accounted for across the watershed, and the effects of impervious surfaces are accounted for, the analysis shows that urbanization and water transfers have resulted in net losses in groundwater recharge of – 7.97 billion gallons per year (-6.2%). A graphical representation of the various water withdrawal and recharge categories and quantities, excluding surface water withdrawals and discharges, is provided for the Taunton watershed in Figure 7.1.

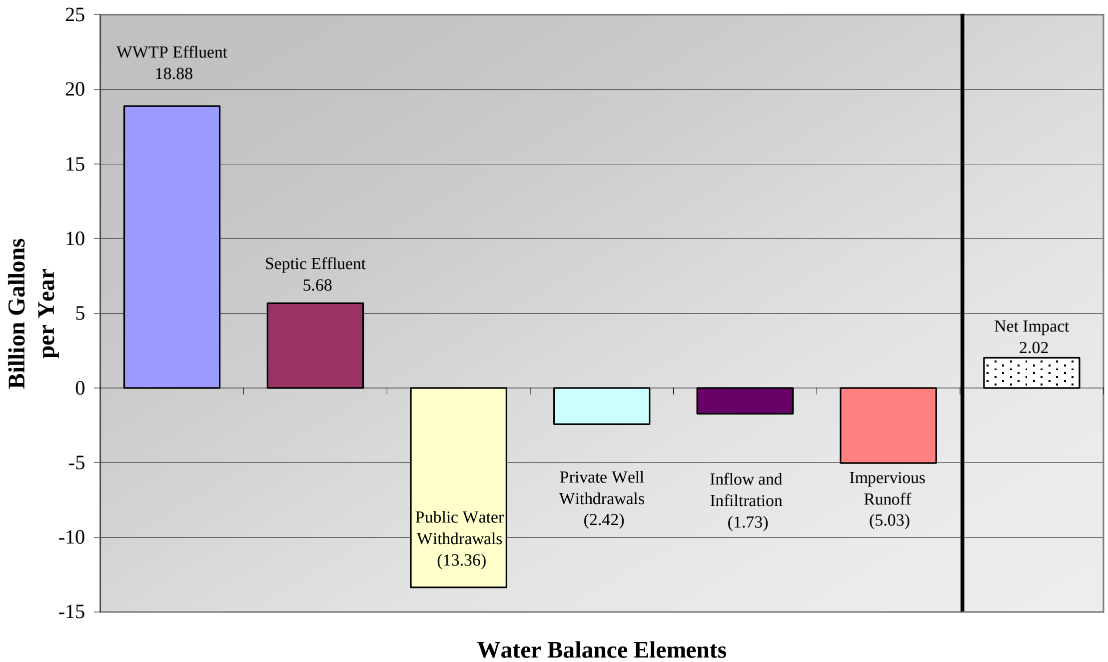
Figure 7-1 - Taunton Watershed Balance, Excluding Surface Water Withdrawals and NPDES (Natural Recharge = 131 Billion Gallons per Year)



These findings are consistent with a report issued in 2001 by the Massachusetts Water Resources Commission that indicates that 50% of the Taunton River Watershed is classified as “medium-stressed” (flow deficit), 10% of the basin as “highly-stressed” and the remainder of the basin is designated as “unassessed” due to lack of data.

A significant portion of the recharge deficit is, however, returned to streams via surface discharges of wastewater regulated by NPDES permit program. When accounting for NPDES discharges as well as surface water withdrawals (usually from larger water systems, such as the Attleboro system withdrawing from the Wading River and the Brockton System withdrawing from Brockton Reservoir and Monponsett Pond), the watershed-wide analysis shows a net increase in total watershed baseflow of approximately 2%. In other words, at the full watershed scale, anthropogenic losses of natural baseflow that had previously been provided by precipitation-derived recharge have been compensated for the discharge of treated wastewater from sources located outside the watershed. Our work suggests that approximately 19 billion gallons per year (GPY) of wastewater discharges now comprise almost 15% of the total estimated baseflow (131 billion GPY) throughout the Taunton River Watershed. A graphical representation of the various recharge categories and quantities, including surface water withdrawals and discharges, is provided for the Taunton Watershed in Figure 7.2.

Figure 7-2 - Taunton Watershed Balance, Including Surface Water Withdrawals and NPDES (Natural Recharge = 131 Billion Gallons per Year)



2. Water Balance (Sub-Watersheds)

While the watershed as a whole is in relative balance, the picture is often very different when looking at the sub-watershed scale. The water balance analysis excluding surface water withdrawals and NPDES discharges shows that of the 108 sub-watersheds, 27 % (29) have surplus water and 73% (79) have water deficits under current conditions compared to natural conditions. They range from a surplus of 9% in one sub-watershed to a deficit of 231% in a small sub-watershed with several significant major water withdrawals. A total of 25 sub-watersheds have a water deficit of greater than 10%, and eight (8) sub-watersheds have a surplus of greater than 5%. As discussed earlier, across the entire Taunton Watershed, the water balance tool indicates a total net recharge of 122,900 mgy under existing conditions compared to an estimated natural recharge rate of 131,000 mgy. This represents a 6.2% water deficit throughout the entire Taunton watershed. In other words, the volume of water in the ground within the watershed is 6.2% less than it would be under natural conditions.

When the same analysis was performed incorporating surface water withdrawals and NPDES discharges, 31 % (34) of the 108 sub-watersheds have surplus water compared to natural conditions and 69% (74) have water deficits. They range from a surplus of 259% in one sub-watershed to a deficit of 1,225% in a small sub-watershed with several significant major water withdrawals. A total of 29 sub-watersheds have a water deficit of greater than 10%, and 15 sub-watersheds have a surplus of greater than 5 percent. Overall for the entire Taunton Watershed, the analysis shows a total existing net recharge of 132,983 mgy compared to an estimated natural recharge rate of 130,962 mgy. This represents a 1.5% water surplus throughout the entire Taunton watershed. In other words, when surface withdrawals and discharges are included in the analysis, the overall volume of water in the Taunton Watershed is greater now than under natural conditions. However, when these results are compared to the analysis that looks at recharge only, the extent to which individual sub-watersheds differ from natural conditions (both surpluses and deficits) is amplified significantly.

However, when these two analyses are compared side by side (with and without surface water withdrawals and discharges), it is clear that the surface water withdrawals and discharges shift water more significantly between sub-watersheds than the groundwater withdrawals and discharges alone. The range of deficits and surpluses among sub-watersheds is significantly increased when surface water is considered in the analysis. In general, groundwater effects are felt over the long term, as groundwater moves relatively slowly through the watershed, and surface water impacts are felt over the shorter term, as surface waters generally flow more rapidly through the streams and rivers of the watershed. Therefore, while groundwater withdrawals and discharges are clearly impacting the Taunton Watershed over the long term (groundwater moves relatively slowly), the surface water withdrawals and discharges are likely affecting different sub-watersheds of the watershed over the short term.

Clearly, this shows that the use and movement of water in the watershed is altering the natural hydrology of the watershed on a macro and a micro scale. At the sub-watershed scale, where the small headwater streams occur, and where critical aquatic and riparian habitats exist, the effects of urbanization n the water balance have significant and measurable impacts. Subsequent phases of this watershed plan must focus on reversing this trend at the sub-watershed scale. The sub-watershed analysis is an important tool in such a large watershed because it helps to break down the big picture into smaller areas that can be addressed through individual management techniques. Evaluation of groundwater impacts alone versus surface and groundwater impacts is helpful to direct the recommended management tools in Phase II of this watershed plan.

3. Stream Buffer and Habitat Analysis

A GIS-based analysis was performed to begin to understand the current land development and land protection patterns in the watershed, as an indicator of watershed health. This analysis, like the water balance analysis, was performed at the sub-watershed scale in order to help prioritize future watershed management actions. Specifically, the following two questions were posed:

1. *How well protected are stream buffers throughout the Taunton River Watershed?*
2. *How well protected are the most ecologically critical areas of the watershed?*

The key results of the analysis are summarized as follows:

Stream Buffer Protection

- Approximately 10.9% of the Taunton River Watershed is located within 200 feet to a stream, lake or pond, and approximately 26% of lands within a 200-foot stream buffer are developed.

- The 200-foot buffer is less than 50 percent developed in the vast majority (91%) of sub-watersheds in the Watershed. In general, the sub-watersheds with the most developed land in the 200-foot buffer are those with the highest percentage of impervious cover.
- On average, the 200-foot stream buffers within the Taunton River Watershed contain approximately 6.3% impervious cover. As shown in Figure 5.12, the 200-foot stream buffers in 82% of the sub-watersheds contain 10% or less impervious cover. The sub-watersheds with the highest percentage of impervious cover are located in Brockton, Avon, Mansfield and Foxborough.
- Forty three (43) percent of all sub-watersheds (45 sub-watersheds) in the Watershed have between 0-10% protected land within the 200-foot stream buffer.

Protection of Ecologically-Critical Areas

- Conservation lands and protected open space comprise 12.5% of the Taunton River Watershed. Fifty six (56) percent of all sub-watersheds are comprised of less than 10% conservation lands or open space. Only 23% of sub-watersheds in the Watershed are composed of greater than 20% conservation lands or protected open space. This indicates that the majority of the remaining land in each sub-watersheds is either already developed or vulnerable to future development.
- In general, sub-watersheds in the south-central portion of the watershed have the highest percentage of unprotected Priority Habitat Area. This area, which includes significant portions of Dighton Taunton, Raynham, Berkeley, Bridgewater, Lakeville and Middleborough, is characterized by having between 70-100% of TNC Priority Habitat Area unprotected.

4. Public Outreach and Participation

According to participants at four public workshops held throughout the watershed, public education training of local government officials was deemed to be of the highest priority. An estimated 300 new local officials are elected or appointed each year in the watershed. These volunteer officials assume major responsibilities for making decisions that have long-term impacts on the sustainability of natural resources in their communities. These individuals could better fulfill their responsibilities with additional training in land use, smart growth, habitat, water conservation, and related topics. An organized training program is needed for local officials on these topics.

Another issue that was raised at the public workshops and observed throughout the watershed during our study is the presence of "sprawl"-type growth, characterized by relatively low density, high imperviousness and segregated uses (residential separated from commercial shopping and job centers). This land use pattern results in large expanses of land used at a relatively low density, loss of naturally-vegetated open space, expensive wastewater solutions and the heavy reliance on the automobile with the subsequent generation of auto-related stormwater pollution. There is a need to re-think development patterns that are largely controlled by the local land use codes of the 43 member communities. Smart growth techniques provide a viable option for the future and need to be fully executed in future phases of this project.

The buffer zone analysis suggests that this sprawl-type development is encroaching on the Riverfront Area, a 200-foot buffer zone to the Taunton River and its tributaries. This encroachment compromises the inherent values of the riparian buffers that include attenuation of pollutants, and maintenance of the natural hydrologic regime and habitat. In addition to Riverfront Areas, future land protection efforts should prioritize acquisition and conservation easements to preserve a contiguous mosaic of protected priority habitat areas throughout the watershed. Such efforts will be particularly critical in the south-central portion of the watershed, where critical habitat areas have the highest overall threat of future development impacts.

5. Data Collection

It is increasingly important that watershed data is collected and maintained in an organized and readily available format. Effective planning depends on an accurate understanding of baseline (current) conditions, historical trends and a mechanism for monitoring future changes. While the data collection and verification effort during Phase I was very thorough, some data gaps remain. Based on the level of effort required to compile this information, it is clear that a better electronic data management system would facilitate better decision making and planning on the part of permitting agencies, municipalities and other interested parties to make informed decisions. A summary of the Phase I data collection effort is provided below.

- Water and sewer service area maps were created for all communities in the Taunton River Watershed except for the two communities without any water or sewer infrastructure (Rehoboth and Rochester), as well as the three communities with minimal areas within the boundaries of the Taunton River Watershed (Dartmouth, Norfolk, and Walpole).
- A total of 355 Water Management Act (WMA) permitted and registered sources were identified within the Taunton River Watershed, including 195 cranberry facilities.
- Average daily flow and exact geographical coordinates were obtained for all 22 groundwater discharge permits within the Taunton River Watershed.
- Latitude and longitude information was obtained for all 18 NPDES discharge locations within the Taunton River Watershed. Reported average monthly discharge volumes were available for 13 of the 18 facilities, and volumes were approximated for the remaining five facilities based on permitted volumes.

2.0 ADDITIONAL COMMENTS

The implications of water balance shifts can be significant ecologically. As less water enters the subsurface as recharge, groundwater levels decline, thus reducing the aquifer storage volumes. Declining groundwater levels also affect surface water features. In the very flat terrain of the Taunton basin even minor declines in water table can represent significant horizontal shifts in wetland systems that are highly-dependent upon shallow water tables within the root zone. Decreases in recharge-derived baseflow can also affect aquatic ecosystems, and can result in shifts in species composition. This is illustrated in the preliminary results of a recent study by the US Geological Survey (USGS) of the Ipswich, Blackstone and SuAsCo basins, which examined the water balance (withdrawals versus return flows) and its impact on fisheries (Armstrong et al., 2008). This study examined four classifications of sub-watersheds (natural, depleted, surcharged, and churned). Depleted sub-watersheds are those where water withdrawals exceed return flows. Surcharged sub-watersheds are those where return flows exceed withdrawals. Churned sub-watersheds refer to those where both withdrawals and return flows occur and are balanced. This study indicates that in some cases, even very mild shifts in the water balance can have a measurable effect on the species composition.

Other related ecological impacts associated with changes in the streamflow regime can include wetlands losses and/or modifications and the associated effects on ecosystem composition including species diversity. Such impacts are caused by lowered water table elevations and/or modified flood durations during and following storm events.

The effects of climate change are also important to be considered in a long-term watershed management strategy. Higher intensity rainfall events coupled with lengthier drought periods will affect the hydrologic regime of the watershed. Rising temperatures and sea levels will result in ecological impacts.

A comprehensive wastewater management approach is needed throughout the watershed. The Upper Taunton Wastewater Study currently underway will examine some potential regional solutions, largely related to the urban centers and the existing wastewater treatment facilities of Brockton, Mansfield and Taunton in the northern part of the watershed. As presented in the water and sewer service area mapping produced in Phase I , the vast majority of the watershed is currently served by on-site septic systems, and many of these are located in soils that have “severe limitations” for sewage disposal (according to the USDA Natural Resources Conservation Service Soil Surveys). Low-density land use patterns (sometimes described as sprawl) result in the consumption of large land areas for relatively little housing and job production. This results in the loss or under- utilization of limited “good soils” for sewage disposal and high costs associated with extending and connecting sewers to this widely dispersed development. Innovative and alternative sewage treatment technologies are available on both an individual home and village-scale basis, and, in conjunction with smart growth land use codes, will offer more effective and affordable wastewater solutions. A comprehensive analysis of viable recharge areas, future land use planning, project permitting, and open space acquisition programs can preserve natural areas, and good soil locations.

Stormwater management is an important piece of the water balance and watershed health puzzle in the Taunton Watershed. A water quality evaluation known as a Total Maximum Daily Load (TMDL) analysis for the Taunton River suggests that pathogens (bacteria, viruses, and other microorganisms) are the primary water quality impact and that the primary source of these pollutants is stormwater runoff. In addition, as shown in Section 5 of this report, there are significant areas of the watershed that are impervious, particularly within the 200 –foot buffer to surface waters. Application of the 2008 Massachusetts Department of Environmental Protection Stormwater Standards and DEP’s pending Stormwater General Permit will help in minimizing additional future stormwater impacts for new developments within the 100-foot jurisdictional buffer zone to wetlands and large impervious areas beyond the jurisdiction of the Wetlands Protection Act. However, progressive amendments to local land use codes, particularly Subdivision Rules and Regulations and wetlands protection and stormwater management codes, are needed to expand and strengthen these stormwater controls throughout the watershed. Stormwater retrofit projects are also needed to address the many existing untreated stormwater discharges.

3.0 REFERENCES

Armstrong, David et al. United States Geological Survey: Presentation to the Massachusetts Water Resources Commission. April 10, 2008 (Publication in Preparation).