

# Realistic Restoration of Streamflow in the Chipuxet Basin

---

## Principle Investigators

*Leon T. Thiem*

*Stanley Barnett*

*Vincent Rose*

## Problem and Research Objectives

The Chipuxet Basin is located in South Kingstown, RI, with smaller areas in Exeter and North Kingstown. The Chipuxet Aquifer is a source of drinking water for the University of Rhode Island (12,000 people) as well as the Kingston Water District (1,000 accounts). In addition to URI and KWD's withdrawals, United Water (a private company serving Wakefield, Narragansett and North Kingstown) owns a 27 acre parcel located along Plains Road which has been earmarked for future development. Currently, the annual average withdrawal from the aquifer is 1.1+ million gallons per day. This number is deceiving since it represents only an average demand over the entire year. During times of peak demands (summer for KWD, fall and spring for URI) the demands are considerably higher. Peak demands have exceeded the 7Q10 of the Chipuxet River. In fact, the demands are sufficient to dry up the Chipuxet River at times. Figure 1 serves to delineate the boundaries of the Chipauxet Basin. Figure 2 illustrates the low flows which occur in the Chipuxet River due to high water demands.

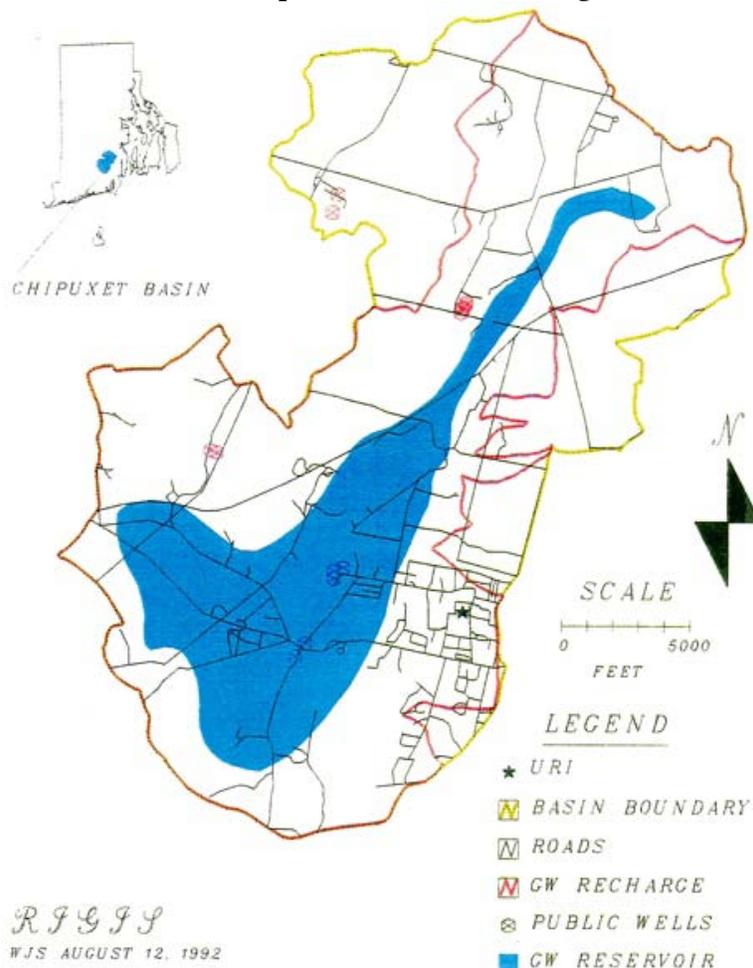


Figure 1 Chipuxet Basin Boundaries

# CHIPUXET RIVER

(USGS Station 01117350)

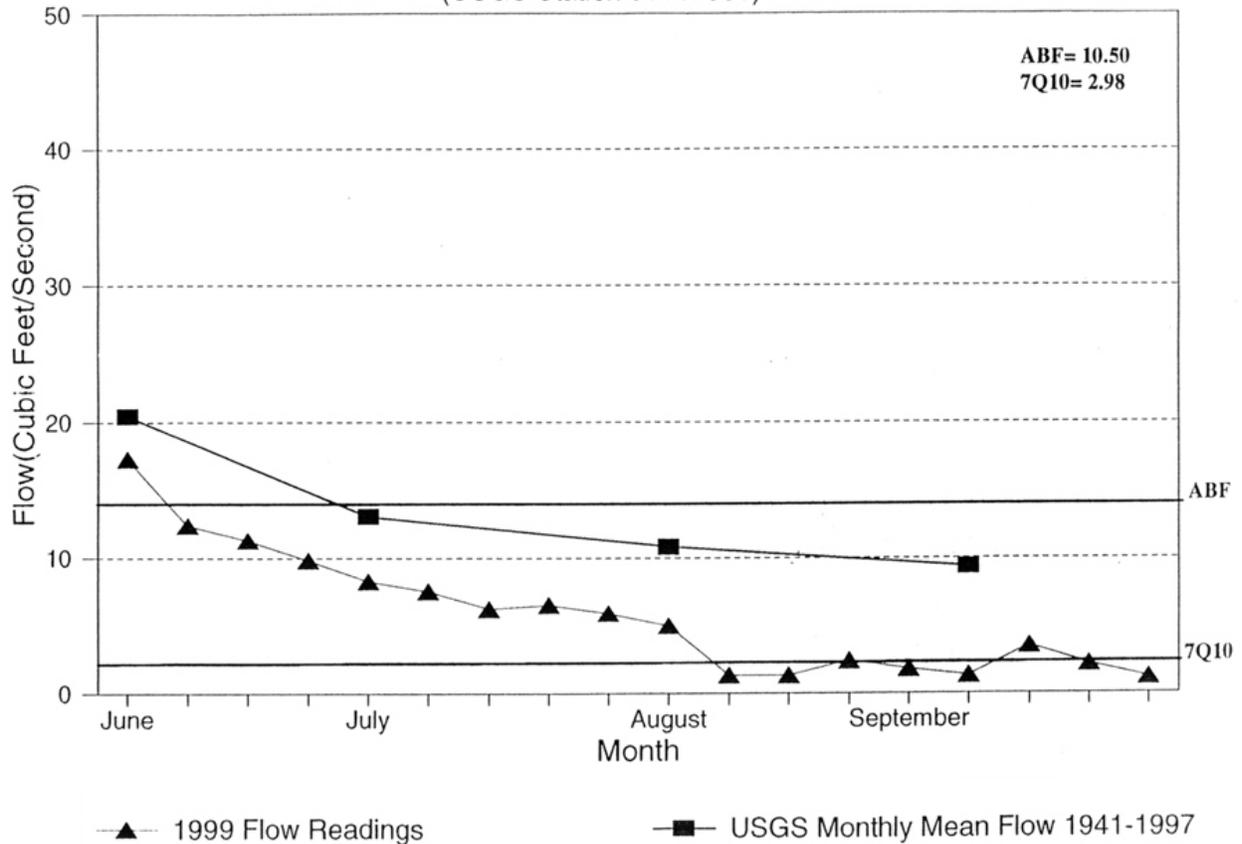


Figure 2 Chipuxet River Water Flows

Figure 2 illustrates the degree of depletion of the Chipuxet Basin. During the summer months the flow in the Chipuxet River can get below the 7Q10. Even this figure does not show the seriousness of the depletion because the gauging station that this flow is measured is above the location that water in the river is withdrawn for irrigation.

The objectives of this study included the following:

1. Quantify the water withdrawals from the Chipuxet Basin both spatially and temporally.
2. Estimate the water quality needs of the major withdrawers.
3. Characterize the quantity and quality of water discharges from the Chipuxet Basin.
4. Perform a feasibility study on conservation, wastewater separation and treatment with subsequent discharge within the Chipuxet Basin.

## **Methodology**

This project first quantifies the current water demands on the Chipuxet Aquifer by reviewing pertinent records including well records and irrigation demands. Special attention is given to the elimination of the exporting of water out of the Chipuxet Basin. Since the largest user of water is URI, efforts to reuse their water are emphasized. One potential option is to separate the wastewater that is used by URI into Grey Water (from showers and washing in the URI athletic and housing complexes) and use this water for irrigation. Black water (sewage) currently being pumped to the South Kingstown Wastewater Treatment Facility in Narragansett, RI, could be treated by conventional processes (activated sludge) or by new technology (membrane processes). This treated water could be returned to the aquifer by irrigation or by direct injection.

An extension of the previous data on water withdrawals from the Chipuxet Aquifer is conducted by contacting existing users. Where detailed data does not exist, the types of uses and quantities are estimated either from records or observation. Future needs are calculated by analyzing past data as well as reviewing long-range build-out plans for the Town and for URI. Potential practices that would be candidates for conservation are analyzed and the savings are estimated. Preliminary designs and estimated costs of constructing and operating the facility for each treatment option are determined.

## **Principal Findings and Significance**

Figure 3 illustrates the water usage in the Chipuxet Basin. The major users of the water are URI and the KWD. It is important to determine the water quality needs of the major withdrawers from the aquifer. Treated water could be utilized for agricultural irrigation since the major crop is turfgrass. Since turfgrass is not consumed, the degree of wastewater treatment is not as stringent as it would be for edible crops. Rather than sending the water out of the basin to the South Kingstown Wastewater Treatment Facility as is currently done the water can be treated on-site and remain within the basin.

Reverse Osmosis and Nano-filtration are being increasingly used in both drinking water and wastewater treatment. They can be used to provide water both for drinking purposes and for aquifer recharge. California is evaluating the reuse of wastewater to supplement surface potable supplies. A plant in Fountain valley, California produces high quality reclaimed water for direct injection in the aquifer. This plant has operated successfully and is scheduled for expansion. Several other communities in California and Oregon are investigating the use of reverse osmoses or nano-filtration for groundwater (aquifer) recharge. While the concept has gained

acceptance in arid area of the west it has not been applied in the more water abundant areas along the East Coast.

The Membrane Bioreactor process is a recent development in wastewater treatment. In this process a membrane is used to separate solids from liquids. The membrane can be used directly in activated Sludge reactor or separately in the effluent stream from the activated sludge reactor. This process offers three benefits. The facility has a smaller foot print than the conventional process since it can be operated at higher suspended solids levels. Since the settling tanks are not necessary, the frequency of sludge wasting and equipment needed is further reduced. This reduction in operation significantly reduces the need for constant monitoring and testing. The disadvantages include requiring the need for membrane monitoring and cleaning.

## CHIPUXET SYSTEM WATER USAGE 1990

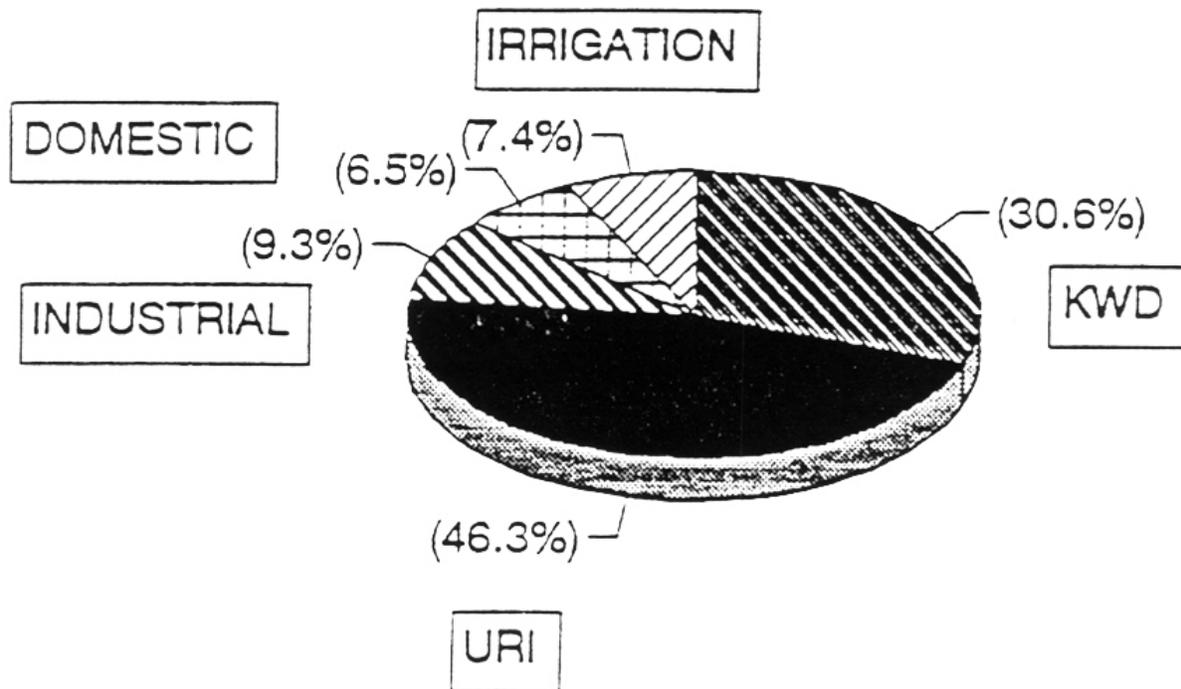


Figure 3 Water Usage in the Chipuxet Basin