



## **WATER RESOURCES RESEARCH GRANT PROPOSAL**

**Title:** Bacterial and Nutrient Dynamics in Stormwater Control Systems in New Hampshire

**Duration:** September, 1997 to February 1999

**FY 1998 federal funds:** \$ 51,630

**FY 1998 non-federal funds** \$83,282

**Principal Investigator's Name(s) and University:**

Dr. Stephen H. Jones

University of New Hampshire

Jackson Estuarine Laboratory and Department of Natural Resources Durham, NH 03824

**Congressional District of University where research is to be conducted:** 01

**Statement of Critical Regional State Water Problems:**

Runoff from impervious surfaces in urban areas contains significant amounts of hazardous contaminants, including microbial pathogens/indicators, heavy metals, and toxic organic compounds like oils and hydrocarbons. Such contaminants pose threats to humans directly during recreation uses of surface waters and seafood consumption, and aquatic life through chronic and acute exposure to toxic concentrations. Contaminated stormwater is an important, documented problem nationwide as well as throughout the Northeast. The Casco Bay, New Hampshire and Massachusetts Bays National Estuaries Projects and associated research highlight stormwater control as a major issue relative to surface water contamination, especially for bacterial contaminants that restrict shellfishing. In New Hampshire, stormwater is recognized as a significant potential source of contaminants to surface waters throughout the state (NHDES, 1995). The threat of contaminants entering surface waters has been addressed by NHDES which requires the use of a variety of permanent stormwater control best management practices (BMPs) designed to capture, treat, or reduce the contaminant content of the runoff from large impervious areas (NHDES, 1996a). However, all shellfish beds in New Hampshire (Hampton, Rye and Little harbors; Great and Little bays and tributaries) are still subject to bacterial contamination following storm events to the extent that beds are closed. Based on numerous recent studies, most of the contamination appears to come from urbanized area runoff. A major effort by the state and the region is currently underway to reduce bacterial contamination and reopen more shellfish beds, and the causes of storm event contamination of surface waters need to be identified and BMPs installed.

The nature of stormwater as a pollution source is not well studied. Water quality in New Hampshire's coastal areas is negatively affected by stormwater, but the sources of contaminants are unknown, as are the mechanisms of transport of contaminants to surface waters. Suspected sources are inappropriately cross connected sanitary sewage lines, leaking lines, and non-human sources of non-enteric pathogens. In addition, nothing is known about the presence of actual pathogens or the relationship between monitored indicator bacteria and the public health risk of contaminated waters, either in New Hampshire or anywhere else (O'Shea and Field, 1992). Many of the runoff control systems used in New Hampshire are based on the findings of the National Urban Runoff Program (NURP) 1981-82 study in 22 different cities that lead to the design of many stormwater control facilities throughout the country to have resident or permanent pools (wet systems). However, there is an increasing body of data that indicates that wet stormwater control systems, catch basins and stormwater pipes may be enhancing microbial and dissolved contamination problems (Jones and Langan, 1996a; Ellis and Wu, 1995; Morrison et al., 1995; Center for Watershed Protection, personal communication). In wet systems, residual moisture or standing water combined with organic debris and solids provides a rich environment for growth of bacteria, especially during warm months. Jones and Langan (1996a) found bacterial levels in water flowing out of wet systems were often much higher than what was in the stormwater entering the system. An earlier study in New Hampshire (Oakland, 1983) found similar results for a vegetated swale system, and both studies indicated wet control systems were inconsistently effective for reducing nutrients. Thus, the use of systems found to be effective in national studies for treating urban runoff may not be effective for all contaminants of concern and may be ineffective for much of the year in NH. Progress is needed on these questions to provide a scientifically sound basis for decisions on resource allocation relative to reducing contamination in surface water. The timing of the proposed project is critical to take advantage of opportunities to collaborate with five other studies on stormwater in coastal New Hampshire that will only be available during the next year.

### **Expected Results and Benefits**

The most direct benefit of this project would be an increased understanding of the nature of one of the most important existing sources of bacterial contaminants to surface waters. Stormwater runoff consistently results in the closure of shellfish beds and non-attainment of classification standards for many water bodies. At present, the effects of stormwater are well documented, but the actual sources of contaminants are not identified. The results of this study will help to determine if permanent stormwater control systems are effective at removing bacteria and nutrients, or are actually sources. Even though bacterial contamination results in the closure of shellfish beds and restricts recreational uses of surface waters, the actual public health threat of contamination implied from elevated concentrations of indicator bacteria is unclear. This study will provide results on the presence of bacterial pathogens in addition to indicator bacteria to help put the public health question in perspective. This perspective will be useful for decisions that will need to be made for allocating resources to control contamination from different sources.

Better documentation of what happens to contaminants during passage through stormwater control systems during and between storm events is critical for determining whether presently accepted stormwater control systems are effective in New Hampshire. The results of a recent study showed existing systems may not be effective for many contaminants of concern, especially during colder months when significant stormwater events are apt to occur (Jones and Langan, 1996a). Proliferation of bacteria in stormwater pipes and control systems during dry weather periods may be a key cause of increased surface water contamination during storm events. The results of this project could provide unique and important findings on microbial contaminants that could also apply to any structure or system that contains stagnant water or moisture and is subject to intermittent flushing, i.e., municipal stormwater drains, drainage ditches, detention ponds, etc. Investigation of these biologically active environments may also reveal processing of nutrients that beneficial or benign, in addition to the unwanted proliferation of bacteria. The data would also provide the necessary information needed for development of new technologies for treating stormwater. The development of new innovative technologies is presently a high priority of a NOAA initiative at NH to promote prevention of contamination of estuaries.