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Thomas P. Ballestero
University of New Hampshire, tom.ballestero@unh.edu

Robert Roseen
University of New Hampshire

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CHARACTERIZATION OF GROUNDWATER DISCHARGE TO HAMPTON HARBOR

Principal Investigators: Dr. Thomas Ballestero, Dr. Robert Roseen, University of New Hampshire

Descriptors: thermal infrared, groundwater discharge, nutrients, pollution, coastal management, coastal, estuary

Problem and Research Objectives:

Contamination of coastal waters from groundwater discharge is a considerable problem that historically is very difficult to quantify. Coastal Managers across the nation recognize nutrient enrichment as one of the most serious problems in coastal areas. In estuarine environments such as these, nitrogen is the main contaminant of concern. Previous efforts have focused on dissolved inorganic nitrogen (DIN) and potentially missed dissolved organic nitrogen (DON). DON and DIN may be necessary to evaluate total nitrogen loading. Analyses for dissolved organic carbon (DOC) will also help ascertain the potential for DON. Recent research within the Great Bay Estuarine System indicates that groundwater discharge to the bay is extensive and in many cases carries a significant DIN load. This is consistent with other researchers that have identified groundwater inflow to coastal areas as a very significant fraction of the total fresh water flow to coastal waters, and in some cases even exceeding contamination from surface waters. Perhaps more importantly, this nitrate-rich groundwater may be the dominant freshwater source to an estuary during the low flow summer months when oxygen-depletion is most critical. Oxygen-depleted waters have been observed in some of the tributaries of the Great Bay Estuary. Oxygen-depleting substances and nutrients are the leading stressors upon estuarine ecosystems, as reported by the USEPA.

The funds requested will support further breadth of analysis of nitrogen contamination. Specifically, the requested funds address dissolved organic nitrogen and dissolved organic carbon to complement existing efforts analyzing dissolved inorganic nitrogen. The combination of DON and DIN should enable a clearer understanding of the total nitrogen loading. Furthermore, the proposed research will further test and evaluate a developing methodology for assessing estuarine contaminant loading from groundwater. Contaminant loading estimates are an integral part of effective resource management. Unregulated non-point sources, such as groundwater, are difficult to estimate, as they are typically not monitored. These estimates are the foundation of current regulatory approaches including the determination of Total Maximum Annual Loads. In order for coastal managers to protect and preserve coastal areas, an accurate assessment of contaminant sources is needed including knowledge of the magnitude and water quality characteristics of ground water flowing into the coastal system. Thus, effective management, mitigation strategies, and development of Best Management Plans requires a thorough understanding of the issues and processes that affect an ecosystem.

Recent research in thermal infrared imagery coupled with field verification has been shown to be an effective and affordable means to assess groundwater discharge. A direct assessment of groundwater discharge to coastal waters may be more reliable than conventional methods in that it evaluates the groundwater at the point of discharge into surface waters. Comparative means rely upon forecasting to predict the flow and the rate of transport. Errors in subsurface characterization, non-point source load budgets, as well as potential unknown contaminant sources will contribute to errors in loading and discharge estimates. Many of these errors may be unavoidable due to limited budgets that restrict thorough site characterizations. However, thermal infrared imagery obviates the need to address the upgradient factors as point-of-discharge observations inherently include these influences. Only after

contamination has been observed and mitigation is chosen is it necessary to address these issues of land use impacts.