# Submarine Groundwater Discharge along Fire Island, NY

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## Introduction

Submarine groundwater discharge (SGD) across the sea floor can be a significant source of freshwater, dissolved nutrients and dissolved contaminants to the coastal ocean. On the bayside of a barrier island SGD may also play an important role in salt marsh hydrology. On the ocean shore, coastal groundwater has the potential to influence beach processes. Beach morphology is at least partially controlled by beach groundwater-swash interactions. Beaches with high water tables tend to be characterized by shallow, erosive profiles, while beaches with low water tables usually exhibit steep, accretionary profiles. A correlation between groundwater levels in coastal dunes and shoreline movement has been demonstrated in other areas (e.g. Clarke and Eliot, 1987) where annual and biannual cycles in shoreline position corresponded to precipitation patterns. Understanding of these processes has led to the practical application of beach dewatering in the realm of coastal engineering as a mechanism to control erosion. By lowering the local water table, infiltration is increased, thereby decreasing sediment transport in the backwash. In the summer of 2004, SGD was measured at Talisman and Sailors Haven on Fire Island. Preliminary measurements had been made in 1980 at Talisman but no measurements had been made at Sailor's Haven.

The water table and freshwater lens at Talisman is about 7 m thick. It is underlain by saltwater connecting Great South Bay to the Atlantic in the Upper Glacial Aquifer between the freshwater lens and the Gardiners Clay at a depth of about 30m. The position of the saltwater-freshwater interface in the deeper aquifers is uncertain. However, deep wells into the Lloyd Aquifer show that it is fresh under Fire Island. Along a barrier island shoreline SGD can be driven by three mechanisms at the bay shoreline of Fire Island. First, groundwater can seep out of this lens across the bay floor. Second, there may be upward leakage of groundwater from the deeper aquifers. Third, there may be groundwater driven under the freshwater lens by the tides. The tide in the ocean is out of phase with the tide in the bay and has a larger range. At times, the ocean level is higher than the bay and can drive water from the ocean to the bay leading to SGD out across the Bay floor. At other times, the situation is reversed causing Bay water to be driven into the Bay floor and SGD at the ocean shore face

## Methods

It has become commonplace to measure SGD in semi-enclosed coastal bays and lagoons (Bokuniewicz and Zeitlin, 1980; Pavlik 1988). Seepage devices designed to measure SGD are benthic chambers that are vented to collection bags (Lee, 1977). They are made up of the top 20-centimeters of a 55-gallon steel drum. A valve at the top of the chamber allows the water being forced out of the chamber, due to SGD seeping up from the ground, to be collected in an attached collection bag. The change in volume of water in the collection bag is measured over a known time interval to determine flow rate.

## Results

At Talisman, both flow from the freshwater lens and flow driven under the lens by the tidal difference may be prevalent; there was a strong modulation with the tide (Figure 1). The highest rate was measured closest to shore as expected to be indicative of seepage from the freshwater lens. Flow rates also varied with the tide; low tide corresponding to a high SGD (up to 15 cm/day) and high tide to negative SGD (-5 cm/day; i.e. groundwater seepage from the bay to the ocean under the freshwater lens). At Sailors Haven the device closest to shore also show the highest upward seepage rate, and varied, as expected, with the tides. However, flow rates increased, unexpectedly offshore from values less than 8 cm/day to more than 15 cm/day. The high SDG offshore may reflect upward seepage from deeper aquifers.

**References**

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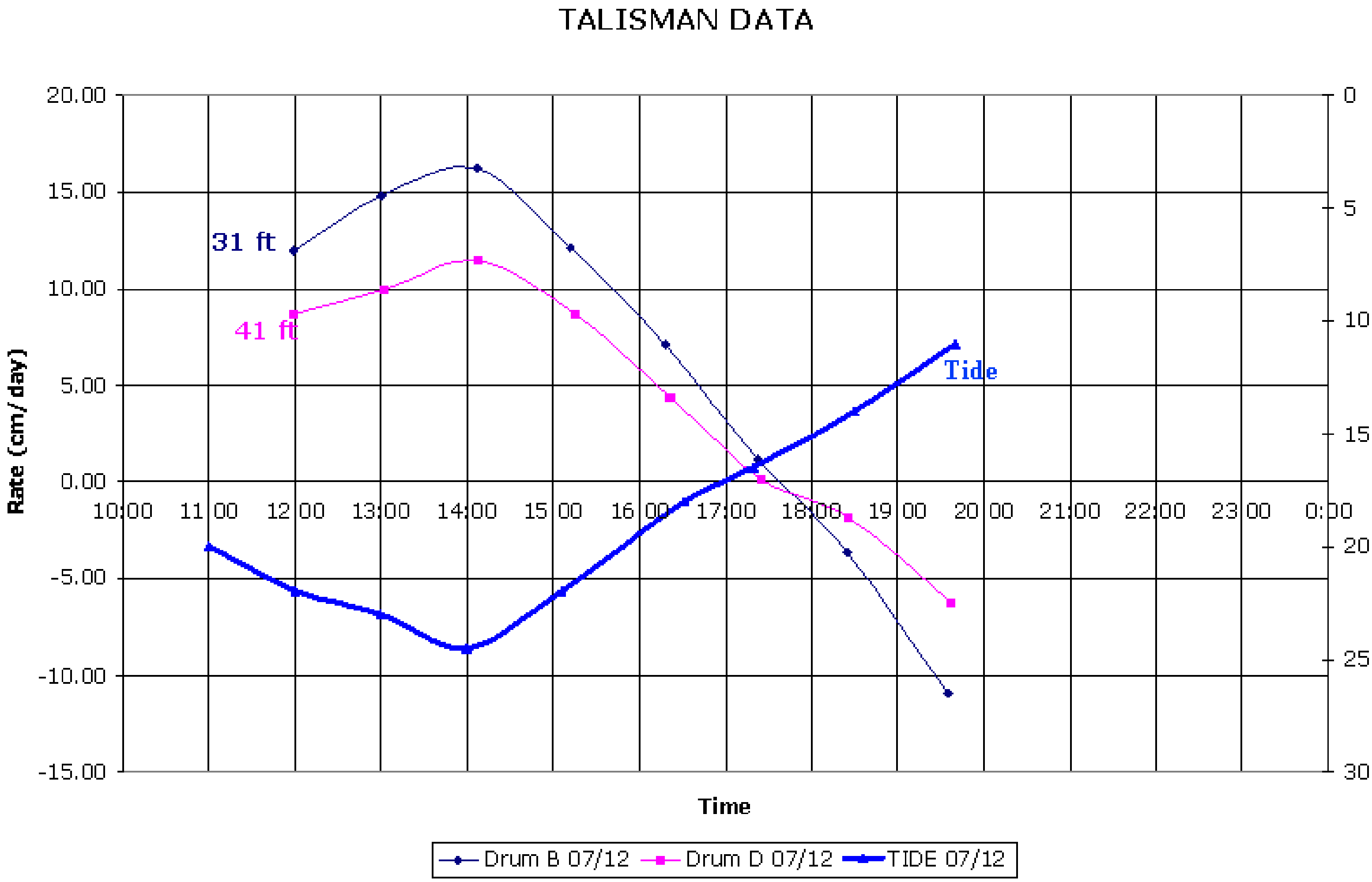


**Figure 1.** SGD at the bay shore of Talisman on July 12, 2004.