Marine Pollution Bulletin 60 (2010) 804–818

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Viewpoint

What history reveals about Forge River pollution on Long Island, New York's south shore

R. Lawrence Swanson *, B. Brownawell [1], Robert E. Wilson [2], Christine O'Connell [3]

School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY 11794-5000, USA

ARTICLE INFO

Keywords:
Duck farming
Sewage
Population growth
Ground water
Dredging
Oxygen depletion
Eutrophication
Development

ABSTRACT

Fifty years ago, the Forge River and Moriches Bay, of Long Island's south shore lagoonal system, achieved notoriety when their polluted conditions were alluded to in a report of the US President's Science Advisory Committee (1965). The Woods Hole Oceanographic Institution investigated the bay throughout the 1950s, identifying duck farming as the cause of "objectionable", "highly contaminated" conditions of these waters.

Much has changed: duck farming declined; the river was dredged to remove polluted sediments, improve navigation; and barrier island inlets stabilized. Yet, the river remains seasonally eutrophic.

Why? This paper reviews what occurred in the Forge River watershed. While governments aggressively curtailed the impacts of duck pollution, they failed to manage development and sewage pollution. The Forge experience indicates that watershed management is a continuing governmental responsibility as development accelerates. Otherwise, we will always be looking for that instantaneous remediation that is usually not affordable and is socially contentious.

1. Introduction

The Forge River is a small microtidal partially mixed estuary discharging into Moriches Bay (Fig. 1), a part of the Long Island south shore lagoonal system. The river is neither flood nor ebb dominated with a mean tide range of 0.59 m (1.9 ft) (Wilson et al., 2009). During recent summer months, the water in the Forge was noticeably polluted as evidenced by fish and crab kills, foul odors, and rotting algal debris in the water. Sections of the river have sporadically turned milky white. The problems were especially severe during the summer of 2005. Deteriorated conditions also occurred in the summers of 2006 and 2007. The river, particularly the upper reach, is often eutrophic during summer and has a documented history of being so. Wilson et al. (2009) measured anoxic conditions throughout the water column in the early morning of August 8, 2006. Bottom waters remained anoxic throughout the day while surface waters reached 12.8 mg 0_2/L (200% saturation). The sediments there are highly reduced, anoxic and devoid of macrofaunal organisms.

* Corresponding author. Tel.: +1 631 632 8704; fax: +1 631 632 8064.
E-mail addresses: lswanson@notes.cc.sunysb.edu (R.L. Swanson), bbrownawell@notes.cc.sunysb.edu (B. Brownawell), rwilson@notes.cc.sunysb.edu (R.E. Wilson), caoconne@ic.sunysb.edu (C. O'Connell).
[1] Tel.: +1 631 632 8658.
[2] Tel.: +1 631 632 8689.
[3] Tel.: +1 631 632 8641.

0025-326X/$ - see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.marpolbul.2010.03.007

2. Background

The polluted condition of the Forge River reflects the anthropogenic development of the area. It is an ecosystem that has been under stress for the better part of a century. The 4 km (2.2 nautical miles) tidal portion of the river has received the wastes from as many as eight duck farms and its watershed has experienced extensive population growth.

The tidal Forge ends abruptly at Montauk Highway, which serves as a dam, detaining freshwater flow in two ponds (East Pond and West Pond). The ponds discharge into the tidal river through separate box weirs, falling about 3.7 m (12 ft) to mean low water (MLW).

The Woods Hole Oceanographic Institution (WHOI), in the 1950s, referred to the tributaries of Moriches Bay (Forge and Terrell Rivers) as "objectionable" and "highly contaminated" (Redfield, 1952). The pollution problems of the bay were highlighted as a case study in a report of the Environmental Pollution Panel of the US President's Science Advisory Committee in 1965. Additionally, physical changes such as the natural and artificial opening and closing of breaches and inlets in the barrier beach of Moriches Bay have been especially influential in altering that ecosystem as well.

The Forge River (Fig. 1) has been known as Moriches Creek, as labeled on the Colton Map of 1836, and the Mastic River (Thompson, 1843). *The Atlas of Long Island, New York*, published by Beers, Comstock and Cline (1873) identifies the river as the Forge. It is a

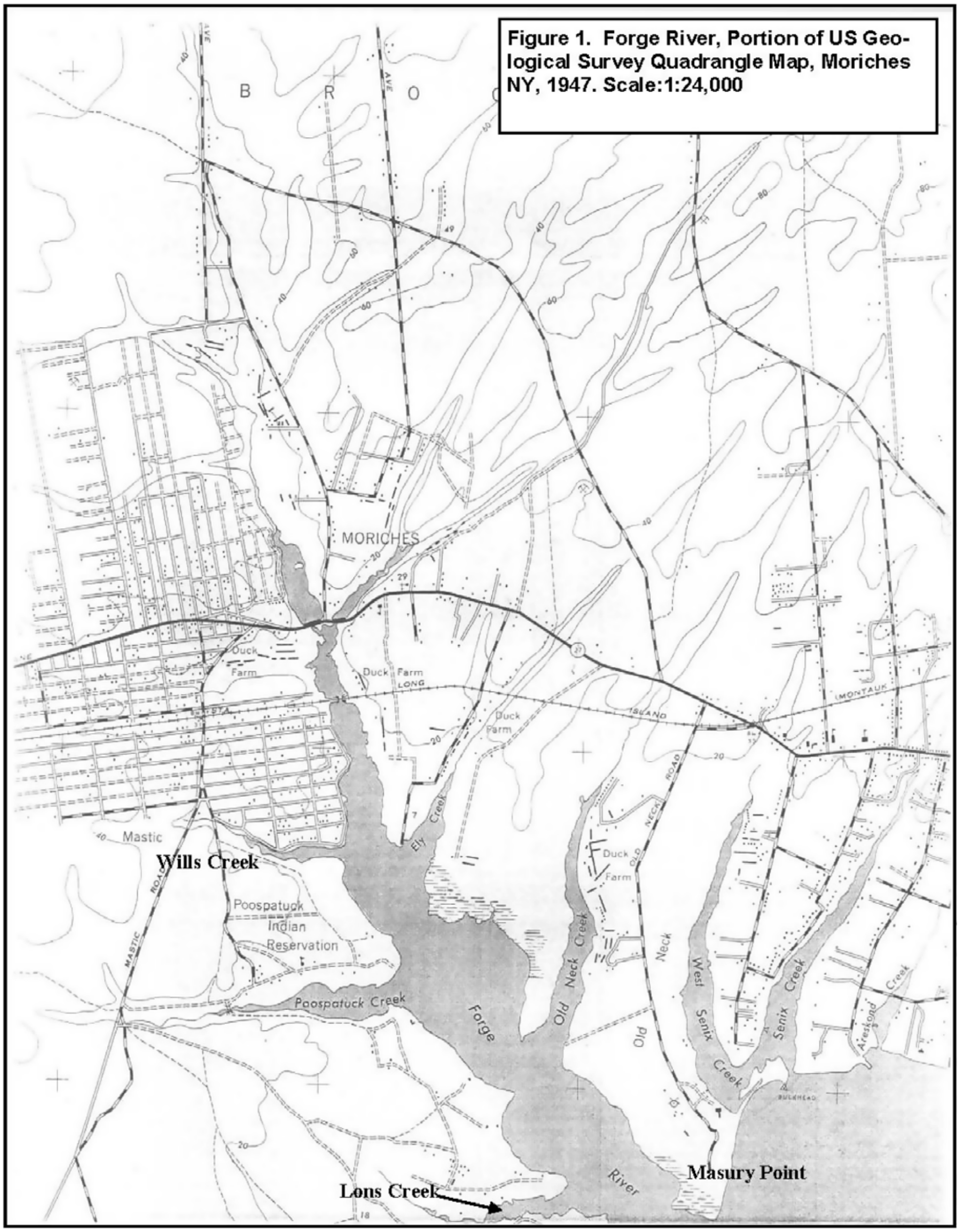

Fig. 1. Section of 1947 USGS Quadrangle map showing the Forge River. Note the duck farms.

remnant streambed that cut through the southerly sloping glacial outwash plain deposited during the Wisconsin glaciation that ended some 20,000 years ago. The stream valley flooded as sea level rose and it now functions as a small estuary torpidly flowing into the northwest portion of Moriches Bay, a coastal lagoon protected from the Atlantic Ocean by a barrier island system.

The river watershed, with the exception of the northeast corner (Zone III), falls within Hydrogeologic Zone VI of Long Island. This zone is on the south shore of Long Island and discharges to stream flow and underflow to Moriches Bay and Great South Bay (Koppelman et al., 1992). Generally, the Soil and Conservation Service classifies the soils of the Mastic, Shirley, Moriches area as part of the Riverhead–Plymouth–Carver association (Table 1; Warner et al., 1975). These soils are described as "deep, nearly level to gently sloping, well-drained and excessively drained, moderately coarse-textured and coarse-textured soils on the southern outwash plain". These largely unconsolidated soils allow for efficient transport of water through the relatively shallow vadose layer into the aquifer and thence the river and bay. Valiela and Kinney (2008) note this same condition for Great South Bay.

At the scale of the watershed, the river (Fig. 2) cuts through zones of Carver–Plymouth sands, Riverhead sandy loam, and Plymouth loamy sand (Warner et al., 1975). A key to the symbols on the map is indicated in Table 2. Note the land filled with dredge material near the entrance to Ely Creek. The surface soils throughout the drainage basin have been locally modified from those originally laid down as cut and fill techniques have been used for the extensive housing developments in the area. A description of the relevant soil types is shown in Table 1. Groundwater contamination from cesspools and septic tanks are generally associated with these soil types when the groundwater table is shallow (http://www.chipr.sunysb.edu/eserc/longis/geralsoilmap.html, downloaded 6 November, 2007) as is the case in this system. Munster et al. (2004) argued that the nitrate signal found in groundwater monitoring wells in Suffolk County is closely related to land use. Specifically, ground water near residentially developed areas using