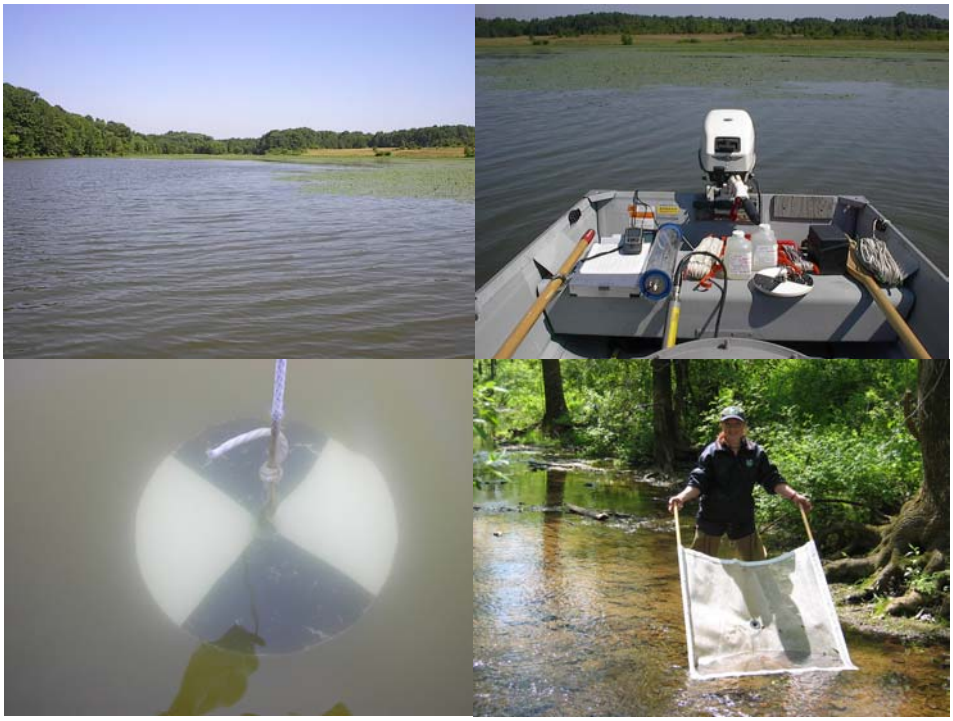
FINAL REPORT

Little Neshaminy Creek & Bradford Lake Watershed Assessment



June 30, 2005

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Prepared for:

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Photographs (from left to right): Bradford (Warrington Lake) on a calm summer morning in 2002. Boat with monitoring equipment at Bradford Lake. Measuring Secchi disk transparency (water clarity) during a survey of Bradford Lake. Gretchen Schatschneider, Watershed Specialist of the Bucks County Conservation District, collecting macroinvertebrates (aquatic organism) in the Little Neshaminy Creek in 2004. All photographs taken by Ed Molesky of Aqua Link, Inc.

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Acknowledgements

The Little Neshaminy Creek and Bradford Lake Watershed Assessment would not be possible without the financial support of the Pennsylvania Department of Environmental Protection. Funding for this assessment was provided through the state's Growing Greener Grant Program.

Aqua Link, Inc. and the Bucks County Conservation District would like to thank the County Commissioners and the District Board of Directors for their support of the Little Neshaminy Creek and Bradford Lake Watershed Assessment Project, thereby allowing the District to serve as the Project Sponsor. Aqua Link commends their strong commitment for protecting and restoring the water resources of Bucks County.

Special thanks are extended to the Bucks County Department of Parks and Recreation, Warrington Township and their Environmental Advisory Council, Aqua Pennsylvania, the Montgomery County Conservation District and U.S. Department of Agriculture Natural Resources and Conservation Service (NRCS) for their support of this most noteworthy project.

Aqua Link also would like to thank Mr. John Thomas and Mr. Frederick Groshens, District Manager and Former District Manager, and Ms. Gretchen Schatschneider, Watershed Specialist, of the Bucks County Conservation District for all their hard work and assistance through the entire duration of this project. Lastly, special thanks are extended to Reggie Pena of Warminster for assisting the District in implementing the stream monitoring program for this assessment project.

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Executive Summary

Bradford Lake, also known as Warrington Lake and Floodwater Retarding Dam PA-611, is a 22-acre impoundment located off of County Line Road in Warrington Township, Bucks County, Pennsylvania. The impoundment was created in 1975 by constructing an earthen dam across the Little Neshaminy Creek. Bradford Lake was primarily built to alleviate flooding along the Little Neshaminy and the Neshaminy Creeks. Secondary uses of this lake include fishing and aesthetics. In addition, visitors use the surrounding 280-acre parkland for walking, hiking and nature watching.

The Bradford Lake watershed, which is the focus of this assessment, is the portion of the Little Neshaminy Creek that drains into the lake. From the lake, the Little Neshaminy Creek travels easterly and eventually discharges into the Neshaminy Creek near Rushland and Wrightstown. The majority of the Bradford Lake watershed lies within Warrington Township in Bucks County and Horsham and Montgomery Townships in Montgomery County.

This report describes the findings of a comprehensive assessment of the Bradford Lake watershed, which includes Bradford Lake and its major tributaries. The lake receives streamflow via the Little Neshaminy Creek and two unnamed tributaries. Aqua Link, Inc. prepared this report for the Bucks County Conservation District. The District served as the project sponsor for this assessment and funding for the project was provided by the Pennsylvania Department of Environmental Protection (PA DEP) through the Growing Greener Grant Program. As part of this assessment, a lake and watershed management plan was developed to improve and further protect the water quality of Bradford Lake and its tributaries.

The lake and watershed management plan was developed using watershed-specific data and information. Watershed data and information were compiled, analyzed and mapped using GIS (Geographical Information System) software. Stream and lake data were collected from April 2002 through May 2005 and subsequently analyzed. Hydrologic and pollutant (nutrients and sediment) budgets were determined for the lake and field investigations were performed in order to identify major sources of nonpoint pollution throughout the entire watershed.

By way of this assessment, Bradford Lake is classified as a very shallow, hypereutrophic impoundment or reservoir. The summer mean Carlson TSI values for total phosphorus, chlorophyll-a and Secchi disk transparency were 73, 58 and 65, respectively. During the study period, the lake contained high concentrations of nutrients, which resulted in large algal blooms (high levels of phytoplankton biomass) and the depletion of dissolved oxygen. In turn, these algal blooms significantly decreased water clarity (Secchi disk transparency) and apparently reportedly resulted in taste and odor problems for a water treatment facility near Langhorne. In addition, low dissolved oxygen levels allowed for the buildup of potentially toxic ammonia nitrogen and exacerbated the internal release of nutrients from in-lake sediments. Low levels of dissolved oxygen in conjunction

with elevated ammonia nitrogen concentrations likely impaired the aquatic biota including the lake's fishery.

Bradford Lake also contains very dense stands of aquatic vegetation that are adversely impairing its recreational uses. By far, the most dominant aquatic plant is water chestnut (*Trapa natans*). Water chestnut is a highly aggressive and invasive exotic plant that has little value as a food source and habitat for native wildlife. Dense mats of water chestnut shade out native plant species, reduce biodiversity, and can impact threatened and endangered species. Decomposition of dying plants in the fall causes low dissolved oxygen levels and can further stress the aquatic environment.

The pollutant budgets determined that the major sources of pollution to the lake are classified as nonpoint source (NPS) pollution. By far, most of the nutrients and suspended solids (sediments) to the lake are derived from urban lands that are used for residential housing, commercial shopping centers and manufacturing. Overall, urban lands (the combination residential, commercial, manufacturing and parking) accounted for 65, 50 and 64 percent of all of the phosphorus, nitrogen and sediment loadings to Bradford Lake.

On a subwatershed basis, the pollutant budgets illustrate that the Little Neshaminy Creek subwatershed contributes the highest nutrient and sediment loadings to the lake. The most significant source of nutrients and sediments to Bradford Lake is the Little Neshaminy Creek. This stream and its surrounding subwatershed contribute 74, 76 and 82 percent of the phosphorus, nitrogen and suspended solids to the lake. A significant portion of the nutrient loadings to the Little Neshaminy Creek are attributed to three, upstream wastewater treatment facilities. These three facilities represent about 23 and 14 percent of the phosphorus and nitrogen loadings to the Little Neshaminy Creek.

Stream water quality and hydrologic data strongly indicate that the concentrations and loadings for both nutrients and suspended solids (sediments) increased dramatically during storm events. During storm events, the Little Neshaminy Creek subwatershed contributes significantly more nutrients and sediment (suspended solids) to the lake than the other subwatersheds combined.

The Bradford Lake watershed largely consists of medium density residential lands with some commercial lands that are intermixed with woodlots, fields and agriculture. The majority of the residential homes are located within housing developments and agriculture is generally limited to crop production. The watershed investigation revealed that the most serious threat to lake water quality is land development (active and post construction). Overall, pollutant export during the construction phase can be significant. Pollutant export (sediments with attached nutrients) increases dramatically both during and shortly after construction. Initial clearing and grading operations during construction expose much of the surface soils. Unless adequate erosion controls are installed and maintained at the site, enormous quantities of sediment along with attached nutrients and organic matter are delivered to streams. After construction has been completed, increased stormwater volumes enriched with nutrients are quickly delivered to surface waters from impervious

areas, which can result in scouring of streambeds and increased sediment loadings to surface waters.

The primary goal of the lake and watershed management plan is to reduce nonpoint source pollutants, namely nutrients and sediments, to streams and subsequently the lake itself. This plan consists of key recommendations (in-lake, watershed and institutional best management practices) to improve and further protect stream and lake water quality. Recommended in-lake restoration techniques include sediment dredging, diffused-air aeration, the use of aquatic algaecides and herbicides to control nuisance levels of algae and aquatic vegetation, and mechanical weed harvesting. Recommended watershed best management practices include streambank stabilization; establishing riparian buffers; performing a stormwater retrofit assessment and preparing conservation and nutrient management plans for active farms. Lastly, recommended institutional best management practices include establishing a watershed organization, land acquisition and protection, adopting ordinances for water quality protection, establishing lower phosphorus limits for NPDES point source discharges, environmental education and water quality monitoring of the lake and its tributaries.