Proposed Scope of Work: Continuation of Stream Runoff Stations to Monitor and Evaluate the Impact of Runoff on the Hydrology of the Lake George Drainage Basin

A Project to Quantify the Impacts of Land Use on
Stormwater Runoff

Submitted for consideration to:

The Lake George Water Conference
New York State Department of State
Albany, New York

Submitted By:

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In Collaboration with:
NYS Department of Environmental Conservation
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Project Scope Period: 2 Years
Fundable in 1 year increments
2010 application

Executive Summary

We propose to continue operation of gaging stations and equipment on 8 streams in the Lake George basin and the LaChute River, which is the outlet of Lake George. The current proposal represents year 4 of a 4 year effort. The objective of the proposed project is to monitor and evaluate the relative contribution of surface discharge to Lake George in a group of major streams, which contribute approximately 55% of the annual hydrologic discharge into the lake, during an extended period of time (4 years) under a variety of climatic, seasonal and land-use conditions. Discharge will be recorded continuously at each site. Bi-weekly samples during the ice-free period and four to six storm event sample series will be collected for analysis of chemical parameters of interest to the nutrient loading to Lake George including phosphorus, nitrogen, sulfate, chloride, and calcium. Conductivity, pH and total suspended solids also will be measured. Additional analytes may be included for selected samples. The data collected for this project, in conjunction with similar data collected on these same streams during the past several decades will allow a current and accurate evaluation of the influence of development on the water quality of Lake George and provide essential information for the implementation of stormwater management remediation practices and structures within selected watersheds.

Section 1. Introduction.

Stormwater runoff has been identified as the primary source of nutrient, bacterial contaminant and pollutant loading to Lake George (Sutherland et al, 1983; Hyatt et al, 1992; Stearns and Wheler, 2001). Surface runoff contributes 83% of the phosphorus loading to the lake, with developed watersheds contributing 46% of the loading while comprising only 5% of the land area. Surface runoff also contributes large amounts of erosion-derived sediments to the lake. The rapid growth of deltas at the outflow of major tributaries alter habitats for native plant and animal species, hinders navigation, and encourages the establishment of exotic invasive species including Eurasian watermilfoil and zebra mussels. A generic environmental impact statement has been developed for Lake George to address these issues and to consider options for remediation.

Numerous stormwater remediation projects have been implemented in the basin surrounding Lake George over the past decade, with sediment capture a primary goal. These projects have focused on detention and infiltration of stormwaters, stabilization of upland slopes with vegetative cover and control of stormwater runoff from new construction. A major shortfall of all these remediation efforts is the lack of assessment of the impact of human activities on sub-catchments within the Lake George basin. Little or no information exists on the effects of changing land use, urbanization, silvaculture, remedial activities, and infrastructure changes within individual sub-catchments.

As with issues of water quality, the Lake George community – both private citizens and elected public officials - embraces the supposition that the lack of stormwater controls and extensive development exacerbate erosion and runoff from the lake's basin and bring nutrients into the lake at ever-increasing rates of loading. Intuitively, the broader lake community connects the changes in land use occurring in the Lake George watershed as deleterious to lake water quality. However, two primary questions remain:

1. Do we have basic flow and runoff chemistry data to support the beliefs that stormwater has a negative effect on the water quality of Lake George?
2. Do we have current basinwide stream flow and chemical data that can be used to quantify the impacts of changing land use on various portions of the Lake George watershed, particularly the upland area?

We can answer Question #1 with a qualified 'yes'. Basic stormwater runoff data has been and continues to be collected for a number of subcatchments within the Lake George basin. The link between development, runoff and water quality decline was documented in the early 1980's when the New York State Department of Environmental Conservation (NYS DEC) conducted the Lake George Urban Runoff Study. The study focused on six major watersheds in the area south of Tea Island, which comprises about 12% of the total Lake George drainage basin. More than forty storm events were sampled during a two-year period at the six stream sampling stations to assess the loading of nutrients and contaminants from developed and undeveloped areas to the open waters of the Lake. Additionally, the nearshore and open waters of Lake George were sampled during storm and non-storm periods to assess the impact of stormwater runoff on the trophic conditions of the Lake. Major findings from this study were (1) that

approximately 75 percent of the annual phosphorus loading to the Lake occurs between February and June, indicating the dominant effect of snowmelt on the hydrology, and (2) the areal phosphorus load (in grams of P/ha/day) of any catchment could be directly related to the percentage of its developed area. Given the limited geographical area of this study, only a limited number of soil types, slopes, and levels of urbanization were evaluated. The majority of development at the southern terminus of the lake was also concentrated near the lakeshore with limited impacts in the more sensitive upland areas. In the past 20 years, housing construction and the infrastructure to support it has moved to the higher elevations within the watershed. Thin soils, steep slopes and exposed bedrock make these areas particularly sensitive to soil erosion. Upland development in the headwaters simply exacerbates problems with stormwater runoff management already being experienced in the lower reaches of these subwatersheds.

Both scientifically and from a management perspective, there are insufficient current data to quantify the impacts of changing land use around the Lake George basin (Question #2). Much of the lake's stream and stormwater data has been collected in a fragmentary manner around the lake – often focused on a single stream or sub-basin and only collected for short periods of time. In addition, much of the historical data that does exist is not useful or applicable for current lake-wide projections of water quality impacts from land use and stormwater, or for the development of stormwater remediation structures or practices.

Section 2. Background Information.

The Lake George watershed is dissected by more than 141 streams. Many of these streams are small with only seasonal (intermittent) flow reported during wet periods of the year, such as runoff during spring snowmelt. A total of 92 streams are large enough to be mapped on the USGS 7.5 minute topographic maps. The largest tributary to Lake George is Northwest Bay Brook, with a catchment area of 28.1 square miles. Other major tributaries include Hague Brook in the town of Hague, West, East and English Brooks in the town of Lake George, Shelving Rock Brook in the town of Fort Ann, Finkle, Stewart and Indian Brooks in the Town of Bolton, Gull Bay and Sucker Brooks in the Town of Putnam and Foster Brook in the Town of Dresden.

Early investigators (Sherman, 1945) supported the contention that underground springs were the principal source of water to Lake George. More recent investigators (Colon, 1972) have divided the water sources more equitably between the three primary components of the water budget, direct precipitation to the lake surface, stream flow from the watershed and groundwater inputs. The most recent data on the hydrology of the Lake George basin was developed by Shuster (1994). His studies (Table1) suggest that prior investigators overestimated the contribution of groundwater (springs), which he calculated produce only 18% of the total water budget. The principal source of water to Lake George is via its many permanent and seasonal streams. Streamflow contributes 55 to 57% of the annual hydrologic budget of Lake George. Of this, approximately half is derived from deep sustaining aquifers, 10-15% comes from rapid, transient surface runoff events and the remainder from shallow groundwaters (Shuster 1994).

The chemical characterization of stormwater runoff in selected Lake George streams has been the subject of a number of studies including the International Biological Program (IBP) in the late 1960's and 1970's, the synoptic work of Fuhs (1972), and the Lake George Urban Runoff

Program (NURP) in the early 1980's (Sutherland et al. 1983). During the 1990's, a NYS DEC Program monitored flow and water chemistry at five stream locations including Finkle Brook,

Table 1. Hydrologic budget for Lake George, New York.

Source	% of Budget
Stream Flow	55
Precipitation on lake surface	27
Groundwater	18
Shallow	11.5
Deep	6.5

Table extracted from Shuster, 1994

Marine Village, Sheriff's Dock Culvert, West Brook and Hague Brook, which represent urbanized watersheds within the Lake George basin. During 2000, Sutherland et al. conducted a synoptic survey of all Lake George tributaries to determine flow, calcium (in relation to the potential for zebra mussel colonization) and chloride (in relation to the long-term use of road salt as a winter deicing compound) characteristics in the basin. A long-term (40 year) stream flow monitoring site within the Lake George basin (NW Bay Brook) was marked for elimination in 1998. Operation of this largely forested watershed site was assumed by the Darrin Fresh Water Institute in 1997, with both flow and water chemistry recorded through 2004. From 2004 through 2006, only flow data was collected. With funding via the Lake George Watershed Coalition in 2007, chemistry data for baseflow and storm events were once again collected.

In 2006, a cooperative project of the Lake George Land Conservancy, FUND for Lake George, NYS DEC and the Darrin Fresh Water Institute sought to characterize three subcatchments; Northwest Bay Brook, Indian Brook and Finkle Brook, based on upland development pressures. This project focuses on the relationship between stream chemistry and stream biological productivity (algal, bacterial and fungal). Water samples for chemistries are taken in conjunction with the biotic sampling. This study is being done on three streams in the basin and is not connected to overall base or episodic stream flow.

Section 3. Description of the Proposed Project.

Funds requested for this project will be utilized to:

- maintain functional and continuous flow monitoring capability on 8 streams, and the LaChute River (Lake George outlet),
- monitor baseflow and storm flow through the 2010 calendar year,
- collect basic chemistry samples for key nutrients and pollutants entering the lake and evaluate the relative contribution of streams and stormsewers, basin-wide, to the loading of nutrients into Lake George under ambient, baseflow conditions and storm conditions.

This project will be a joint collaboration between the DFWI and NYS DEC. The Investigators propose to establish and maintain a basin-wide network of stations that will collect discharge

data from major streams during a 4 year period (minimum), in order to elucidate important hydrologic information concerning Lake George. A 4 year study is considered to be the minimum duration necessary to separate the effects of climatic variability on the hydrologic cycle of the drainage basin. The objectives of the proposed project are to:

- evaluate the relative contribution of surface discharge to Lake George in a group of major streams during an extended period of time and under a variety of climatic, seasonal and land-use conditions, and

- evaluate the relative contribution of these major streams to the loading of key nutrient chemistries including phosphorus, nitrogen, silica, calcium and chloride to Lake George, and

- relate current findings to historical information for a number of subcatchments with a focus on changes in loading estimates relative to changing land use and

- provide the findings to local and regional regulatory agencies in a form suitable to aid in the development or improvement of stormwater regulations.

The project proposed herein has been designed as a continuation of a recent project conducted by the NYSDEC for the FUND for Lake George between 2002 and 2006 in an effort to address some of the major information gaps that exist in the current hydrology and stream chemistry database available for Lake George (Sutherland, personal communication). This effort is now completed and no further FUND support is anticipated for continuing this work. The recent NYS DEC project established continuous flow measurement and chemistry sampling on eight (8) major Lake George streams that, collectively, comprise about 52 percent of the total annual hydrologic budget of Lake George. Chemistry sampling occurred primary during the ice-free period in the basin (May through October) and samples were analyzed for calcium, chloride, sulfate, nitrate, total suspended sediment, pH, and specific conductance.

The current status of the Lake George stream monitoring stations in the Lake George basin and the period of record at each station is summarized in Table 2.

Table 2. Summary of NYS DEC stream stations and period of record.

Stream Name	Level Recorder	Staff Gage	Shelter	Sampler	Period of Record	Comment
East	Telog 2109e	Yes	No	No	since June 2002	
West	Telog 31	Yes	Yes	No	since August 1997	
English	Telog 2109e	Yes	No	No	since June 2002	
Finkle	Telog 2109	Yes	Yes	No	since August 1991	
Shelving Rock	Telog 2109e	Yes	No	No	since June 2002	
Indian	Telog 31	Yes	No	No	since June 2002	
Northwest Bay	Isco 720	Yes	Yes	Yes	since June 1965, DFWI July 1997	Replace with Telog 31
Hague	Telog 2109e	Yes	No	No	since June 1992	
LaChute	Telog 2109e	Yes	No	No	since June 2002	

Section 4. Scope of Work, Schedule and Deliverables.

Each station will be visited on a bi-weekly basis during the period from May through October, and monthly during the remainder of the year. Each site visit will include the collection of a sample for analysis of water chemistry and a check of equipment for proper functioning. Stream gaging will occur at least monthly to verify the rating curve established at each site. In addition to the regular bi-weekly sampling effort, a total of 3-5 storm events will be sampled during the year including spring runoff, one or two high intensity, short duration summer storms and one or two longer duration events that occur in the spring or fall.

With the exception of the usual prolonged period of spring runoff, which could require a total of 20-30 samples at each station, it is estimated that a total of 5-8 samples will be collected at each station for each of the other 3-5 events described. It will not be necessary to sample each of the nine (9) stations with the frequency of storm events sampling described above. The outflow of Lake George, the La Chute River, does not need to be sampled during storm events. In addition, due to the limited number of automatic samplers and the tremendous workload created when collecting stormwater samples, not every storm event selected for sampling will be sampled at each station.

The DFWI is requesting funds for year 4 of a 4-year study to establish functional stream gaging capabilities on the streams of interest (Table 2) and to initiate a basin-wide stream chemistry monitoring program. These funds will be used to compensate staff time for approximately 250 site visits that will occur annually in conjunction with the bi-weekly, monthly and storm event sampling. Funds also are required for supplies such as batteries for the level recorders, bottles for processing and storage of samples prior to analysis, and chemicals for the processing of samples in the laboratory. Finally, there is the cost associated with approximately 650 samples that will be collected for chemical analyses carried out by the DFWI Keck Water Lab in Troy, NY, as well as, for transportation to collect samples.

The DFWI (with assistance from the NYS DEC) will issue a report at the end of each calendar year, or as soon thereafter as possible, summarizing the project results during that period. A final report will be prepared within six months following completion of the project.

Section 5. Project Outreach and Value to the Lake George Community.

The negative effects of stormwater runoff on the water quality of Lake George were elucidated nearly 30 years ago (Sutherland et al. 1983). In spite of this historical base of knowledge, continued development and prolonged environmental exposure to deleterious conditions further exacerbates the effects observed in the past and furthers our understanding of anthropogenic influence on the Lake George watershed and subsequently Lake George itself. Continuously educating the Lake George community about the cause-and-effect link between the watershed and the lake keeps this pertinent issue at the forefront of community awareness. An active, basin-wide monitoring program provides real-time data and findings that can be communicated to the public as part of the educational process through newspaper articles, Town meetings,

special presentations, etc. It also is critically important, where possible, that the scientific community provide current information that addresses the important stormwater runoff issues, particularly in watersheds where rapid development is occurring so that planning decisions are based on data and not supposition. Understanding the effect of land use on the quality of runoff waters, and the changing nature of runoff waters from developed areas is critical for local legislators responsible for regulation of land usage. Quantifying the effect of new construction on the quality of runoff waters is a first step toward wise stewardship. The runoff data become even more important when decisions are required regarding the implementation and design of stormwater management practices and structures, respectively, which are costly and often not appreciated by the general public if not well understood in terms of the stormwater problems that are being remediated.

Section 6. Bibliography.

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Fuhs, G.W. 1972. The chemistry of streams tributary to Lake George, New York. Environmental Health Report No. 1, New York State Department of Health, Albany, New York. 51 pp. + Appendices.

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West, T.A., J.W. Sutherland, J.A. Bloomfield and D.W. Lake, Jr. 2001. Final Report: A study of the effectiveness of a Vortechs ^{TM} stormwater treatment system for removal of total suspended solids and other pollutants in the Marine Village watershed, Village of Lake George, New York. New York State Department of Environmental Conservation, Division of Water, Albany, New York. 21 pp. + Appendices.

Lake George Hydrology Program
Budget for 2010

Lake George Stormwater Runoff Study

Personnel		$42,750
	Fringe (40.765%)	$17,427
	Total Personnel	$60,177
Equipment		$4,000
Subcontract		
Analytical Chemistry - DFWI Bolton Laboratory		$9,000
Analytical Chemistry - Keck Water Laboratory		$16,000
Vehicles		$2,250
Supplies		
Fuel		$1,540
Misc. supplies		$3,150
Travel & Meeting Attendance		$950
Report Prep, Clerical Supplies, etc.		$1,750
Indirect costs (excluding equipment) - 26%		$24,652
	TOTAL	$123,469

Notes:
Contract Period -1/1/2010 thru 12/31/2010