

Contract #07-16

2010

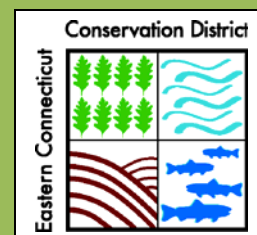
Spaulding Pond Watershed Management Plan



Photo by Sarah Lamagna/ECCD

This project is funded in part by the CT DEP through the US EPA Nonpoint Source grant under § 319 of the Clean Water Act.

Prepared by the Eastern Connecticut Conservation District, Inc.



www.ConserveCT.org/eastern

Acknowledgements

The Eastern Connecticut Conservation District would like to thank the following for their contribution of time and effort to the development of this plan:

Joseph Loyacano, Director (retired), City of Norwich Department of Public Works
Barry Ellison, Director, City of Norwich Department of Public Works
Luis DePina, Director, City of Norwich Recreation Department
Thomas Doherty, City of Norwich Recreation Department
Michelle Kellough, Norwich Animal Control Official
Christopher LaRose, Assistant General Manager, Norwich Public Utilities
David Coughlin, Uncas Health District

Stan Zaremba, CT Department of Environmental Protection
Eric Thomas, CT Department of Environmental Protection

Aristea Kinney, CT Department of Public Health

Peter Popinchalk, Kelly Middle School
2009 Kelly Middle School Eighth Grade Science Students
Park visitors and volunteers who participated in outreach activities.

Eastern Connecticut Conservation District Staff

Scott Gravatt, Executive Director
Kate Johnson, Office Administrator
Judy Rondeau, Natural Resource Specialist
Jean Pillo, Watershed Conservation Coordinator
Sarah Lamagna, Natural Resource Specialist
Pat Young, Natural Resource Specialist

Table of Contents

- I. Executive Summary
- II. Introduction
- III. Watershed Management Plan Purpose and Procedure
- IV. Watershed Description
- V. Nine Element Watershed Based Plan
 - A. Identification of Pollutant Causes and Sources
 - B. Pollutant Load Reduction Estimates
 - C. Watershed Best Management Practices
 - D. Financial and Technical Assistance Needed
 - E. Education/Outreach Component
 - F. Implementation Schedule
 - G. Interim Milestones
 - H. Monitoring and Assessment Component
 - I. Implementation Effectiveness

APPENDICES

- Appendix A – Geese Counting Data Sheet
- Appendix B – Results of Waterfowl Tallies
- Appendix C – Results of Bacteria Sampling by Uncas Health District
- Appendix D – Stream Bacteria Test Results
- Appendix E – Rainfall Data from Norwich Public Utilities
- Appendix F – Comparison of Bacteria Data to Rainfall Data
- Appendix G – Location Map of Animal Control Facility
- Appendix H – Location Map of Optical Brightener Pad and Drainage Pipes
on Ox Hill Rd

I. Executive Summary

The Eastern Connecticut Conservation District (ECCD) conducted a thorough investigation and evaluation of the Spaulding Pond watershed in Norwich, Connecticut. Spaulding Pond, a city-owned waterbody located in Mohegan Park, does not meet the water quality standards for its designated use of recreation due to periodic bacterial exceedances. Although there has been a considerable investment of funding and energies by several government agencies and other parties over the years, water quality problems have persisted.

The project included an in-depth review of all available existing water quality data and information. Water sampling data from several sources was obtained and evaluated with the goal of finding indicators that would help identify or confirm sources of NPS pollution. Land uses were examined, and detailed field surveys were conducted, including an inspection of storm drains and outfalls, documentation of resident waterfowl populations and an evaluation of park use by park visitors.

This project was pursued with the intent of developing a Watershed Based Plan for the Spaulding Pond watershed. Therefore, it is by design that ECCD's evaluation contains information that addresses the nine elements required by the US Environmental Protection Agency (US EPA) for a Watershed Based Plan. The Watershed Based Plan identifies specific management measures that are necessary for water quality assessment and improvement, enabling Spaulding Pond to meet the standards for its designated use, and be eligible for delisting.

One of the most valuable products contained in this evaluation is a comprehensive list of recommended implementation actions for improving the water quality throughout the watershed. The recommendations are consolidated and organized in one of the latter sections of the report.

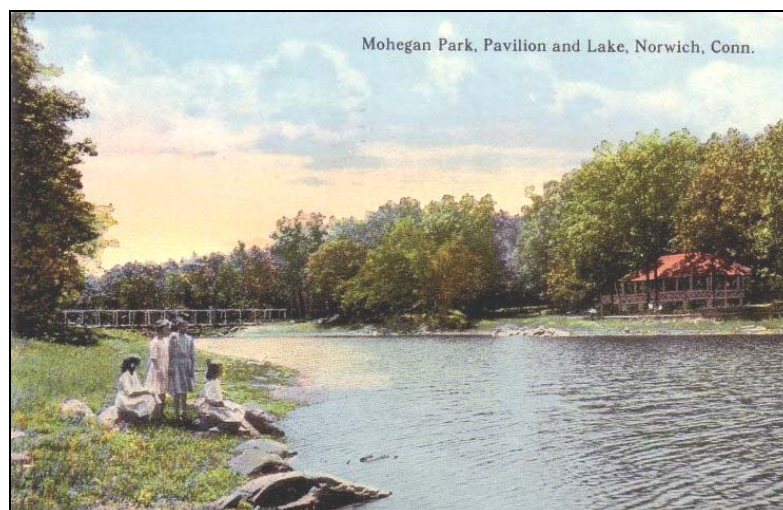


Figure 1: Postcard of Spaulding Pond at Mohegan Park dated 1912. The view is south towards the dam.

II. Introduction

Spaulding Pond (Water body Segment ID CT3800-00-6+L3_01), is a 14-acre impoundment of an unnamed stream located within the City of Norwich-owned Mohegan Park, and is a popular destination for recreational activities such as swimming and fishing. However, Spaulding Pond is listed as impaired by the State of Connecticut for one of its designated uses, which is water contact recreation. The cause of the impairment is elevated *Escherichia coli* (*E. coli*) levels, suspected by the CT DEP to be attributed to the presence of waterfowl. *E. coli* originates in the intestinal tracts of warm-blooded animals (including humans). When found in a water body, *E. coli* is indicative of the presence of human or animal waste. While *E. coli* itself is not generally considered harmful, it is an indicator that other disease-causing organisms, which may present a health risk, may be present in the waterbody. A public swimming area located on the eastern shore of Spaulding Pond must be closed when *E. coli* levels exceed the established Connecticut Department of Public Health (CT DPH) water quality standard for recreational contact of 235 colony forming units (cfu) per 100 milliliters of water for a single sample. A geometric mean of 126 cfus/100 milliliters of water for any set of samples will also trigger designation of a water body as impaired for recreation.

The Eastern Connecticut Conservation District, in partnership with the City of Norwich, the Uncas Health District and the CT DEP, has conducted a watershed investigation that identifies the causes of the impairment and makes recommendations to address this periodic bacterial contamination. The project also supports State efforts to develop a TMDL (total maximum daily load) for indicator bacteria (*E. coli*) for Spaulding Pond. The information gathered as part of the Spaulding Pond water quality improvement project has been used to develop an abbreviated form of the US EPA nine-element watershed-based plan, which identifies the sources of impairments and provides non-point source pollution best management practices (BMPs) to address them.



Figure 2: Similar view of Spaulding Pond, 98 years later.

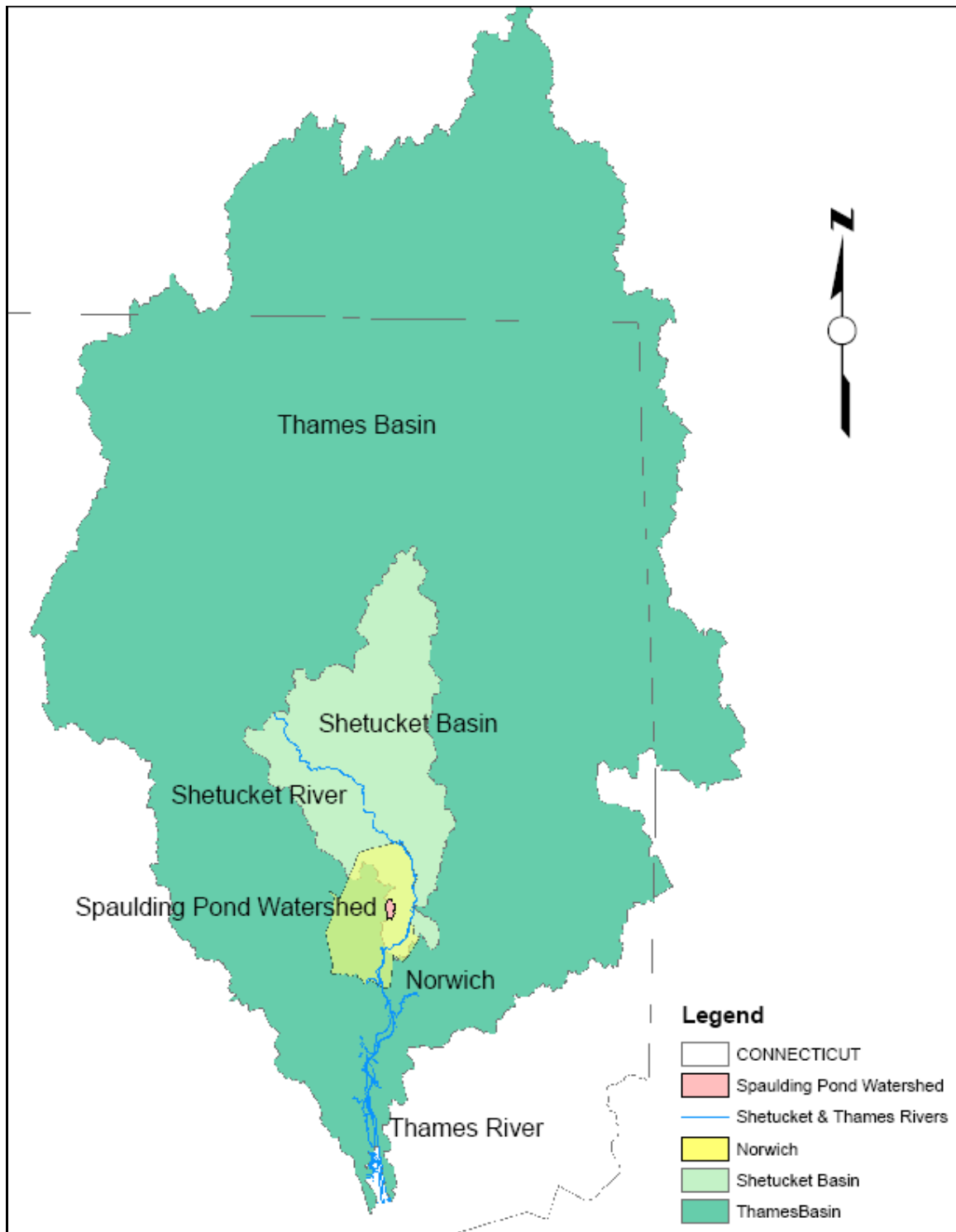


Figure 3: Spaulding Pond Watershed and City of Norwich within the Shetucket and Thames Basins.

III. Watershed Management Plan Purpose and Procedure

A. Purpose

The purpose of the Spaulding Pond Watershed Management Plan is to identify the sources of bacterial contamination in Spaulding Pond and to recommend non-point source (NPS) pollution management measures to address those sources. The primary objective of this watershed management plan is provide decision-makers with a list of specific actions which, when implemented, will reduce bacteria loading in Spaulding Pond to levels that meet State standards. The most visible benefit of such a reduction will be the elimination of beach closures at Mohegan Park due to high levels of *E. coli*, through the implementation of the management strategies identified in Section 5C of this document.

B. Procedure

The following headings provide a summary of topics that were investigated. Results of the investigation are provided in Section V, Part A of this report.

1. Watershed Team

The success of a watershed based plan depends on implementation. Therefore it is essential for the plan to be accepted by those who will be implementing the recommendations. This is best done by including those who will be responsible for implementation in the creation of the plan. To that end, a watershed management team was assembled, comprised of ECCD, the City of Norwich Department of Public Works, the Norwich Recreation Department, the Uncas Health District, and the CT DEP. ECCD met with representatives from these key stakeholder entities to discuss the water quality problem and to gather information regarding possible sources of bacterial contamination, and also to solicit information regarding measures currently being taken to mitigate the problem.

ECCD also discussed potential waterfowl management issues with CT DEP wildlife division staff, and provided water testing data to CT DEP TMDL staff for use in the development of a bacteria total maximum daily load (TMDL) for Spaulding Pond.

Table 1: Watershed Management Team

Team Member	Responsibility/Area of Expertise
CT DEP	TMDL, Flock Evaluation
ECCD	Water Quality Investigation
Norwich DPW	Park Maintenance
Norwich Public Utilities	Sewer Line Installation, Rainfall Data
Norwich Recreation Dept	Swim Beach Maintenance
Uncas Health Department	Water Testing

2. Management Activities Already Undertaken By Team Members

Management activities already undertaken by the City of Norwich include implementation of swimming beach maintenance strategies by Recreation Department employees, posting of signs to ban dog walking in the park, and the installation of aerator units in Spaulding Pond to increase water oxygenation and circulation.

Over a several year period, the Norwich Department of Public Works installed three aerating fountains in Spaulding Pond. Although there is no scientific data to confirm that these aerators can help reduce the levels of bacteria, there are indications that the aerators may help. It is possible the aerators help reduce levels of bacteria as a result of increased water circulation. Therefore, ECCD has included aerators and/or circulators at Spaulding Pond as a BMP recommendation.

3. Information Collection and Review

Over the course of ECCD's investigation, data was gathered from the City of Norwich, Uncas Health District and Mohegan Park visitors, and through field studies conducted by ECCD. Other available resource data utilized includes land cover/land use data from the University of Connecticut's Center for Landuse Education and Research (CLEAR), and generally available GIS data layers from CT DEP, USDA, USGS and others. This data was used to develop the abbreviated watershed-based plan for the Spaulding Pond watershed. The plan identifies the most likely sources of the bacterial contamination, and provides NPS management recommendations which will be implemented by local stakeholders.

4. Land Use and Land Cover

ECCD evaluated land use and land cover in the Spaulding Pond watershed, particularly in the highly developed northern portion of the watershed, which contains the headwaters of the intermittent stream that flows to Spaulding Pond. Of particular importance was the possibility of inputs to the stream from developed areas that could be causing or contributing to bacteria loads, including failing septic systems or illicit discharges. In addition to land use/land cover data, Natural Resources Conservation Services (NRCS) soils data was reviewed to determine suitability of local soils for subsurface sewage disposal.

5. Septic System Failures/Illicit Discharges

In order to determine if septic system effluent or contamination from illicit discharges was present in the stream flowing to Spaulding Pond, optical brightener pads (untreated cotton pads which fluoresce under ultraviolet light if they absorb optical brighteners - a common laundry detergent additive) were placed in the stream just upstream of Ox Hill Road (see location map in Appendix G). In addition to utilizing the optical brightener pad method, Uncas Health District sampled the water for bacteria at both Ox Hill Road and downstream at the pond inlet on the days the optical brightener pad was placed and removed, to provide additional bacterial data.

6. Water Quality Sampling

Data from water quality sampling conducted by Uncas Health District, which sampled bi-weekly at the swimming beach from Memorial Day through Labor Day

in 2010, was obtained and analyzed. Rainfall data for the same time period was obtained from Norwich Public Utilities, and compared to the water quality data to determine if a relationship between rainfall and elevated bacteria levels in Spaulding Pond was apparent.



Figure 4: Optical brightener pad in stream north of Ox Hill Road culvert.

An analysis of graphs depicting rainfall and bacteria levels for each monitoring year from 2007 to 2010 (Appendix E) indicates that there may be an association between rainfall and elevated bacteria levels in Spaulding Pond. However, since water sampling is conducted on a bi-weekly schedule independent of rain events, a direct causal relationship cannot be established.

7. Storm Drain System

The storm drain system located in Mohegan Park was evaluated for potential bacteria contributions from the adjacent upland areas, with special focus on the storm pipes that outlet directly into Spaulding Pond. The evaluation included consideration of possible bacteria contributions from such sources as latrine areas established by animals frequenting trash bins and other food sources.

8. Waterfowl Information

Students from a nearby middle school gathered information regarding geese and duck populations in the spring of 2010, including information on the number of nesting pairs and goslings observed. They also documented activities such as the number of park visitors observed fishing, swimming, walking dogs or feeding the waterfowl.

9. Park Use Information

ECCD staff and volunteers visited Mohegan Park on several occasions to elicit information from park visitors. Both weekday and weekend park visitors were surveyed to determine when and how they use the park, and what activities they typically enjoy. The survey included questions regarding park visitor's attitudes toward feeding the resident waterfowl. The results of the survey are summarized in Table 2. Public participation will be critical in the implementation of the WBP, since it is a change in public behavior that will drive many of the water quality improvements at Spaulding Pond. Activities such as dog walking and the feeding of ducks and geese at the Park (as well as other types of wildlife) have been traditional park activities, so public education, acceptance and support will be needed in order to create the behavioral changes necessary to discontinue these practices.

Table 2: Park Visitor Survey Results

- Roughly as many visitors live in Norwich as come from out of town (54% vs. 46%)
- 54% visit at least once a week
- 89% like to walk and 43% enjoy wildlife
- 81% say park is an important link to nature
- 24% say the swim area is important to them
- 37% feed the waterfowl. Of those:
 - 75% would not feed if they knew feeding could increase bacteria
 - 100% would not feed if they knew feeding was unhealthy for birds

IV. Watershed Description

The Spaulding Pond watershed is part of the Shetucket River regional drainage basin and the Thames River major drainage basin (see Figure 3). The local watershed contributing to Spaulding Pond is 275 acres (0.43 square miles) and is located entirely within the City of Norwich. The Spaulding Pond watershed is typical of eastern Connecticut with rolling hills and stream valleys as depicted in the USGS topographic map in Figure 5. The maximum elevation is approximately 290 feet and the minimum elevation is approximately 244 feet at Spaulding Pond, an elevation differential of 146 feet. The Norwich area is underlain by glacial soils, including lodgment and melt-out tills, deposited by the Laurentide ice sheet approximately 18,000 years ago. These soils are overlain by more recent soils as depicted in Figure 6.

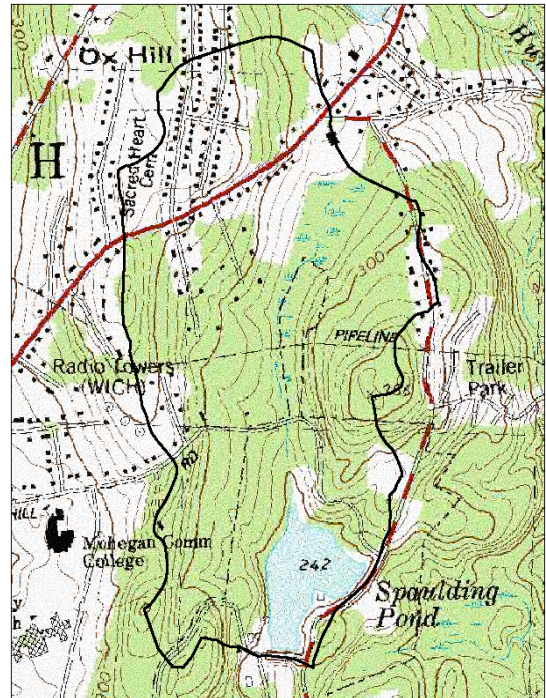


Figure 5: Topography of Spaulding Pond Watershed (USGS).

Spaulding Pond is a 14.3 acre waterbody located in Mohegan Park. The pond is an impoundment of an unnamed intermittent stream that originates in a forested wetland in the northern portion of the watershed. The impoundment is formed by a 30.5 foot high earthen embankment located at the south end of the pond. An emergency spillway is located at the right end of the dam. The pond has a maximum storage capacity of approximately 235 acre-feet, or roughly 10.2 million cubic feet of water. Peak inflow to the pond, as determined by the Army Corps of Engineers, is 780 cubic feet per second (cfs). Peak outflow through the principle spillway, a drop inlet structure, is 490 cfs. Combined spillway capacity (via the drop inlet and emergency spillway) is 1142 cfs.

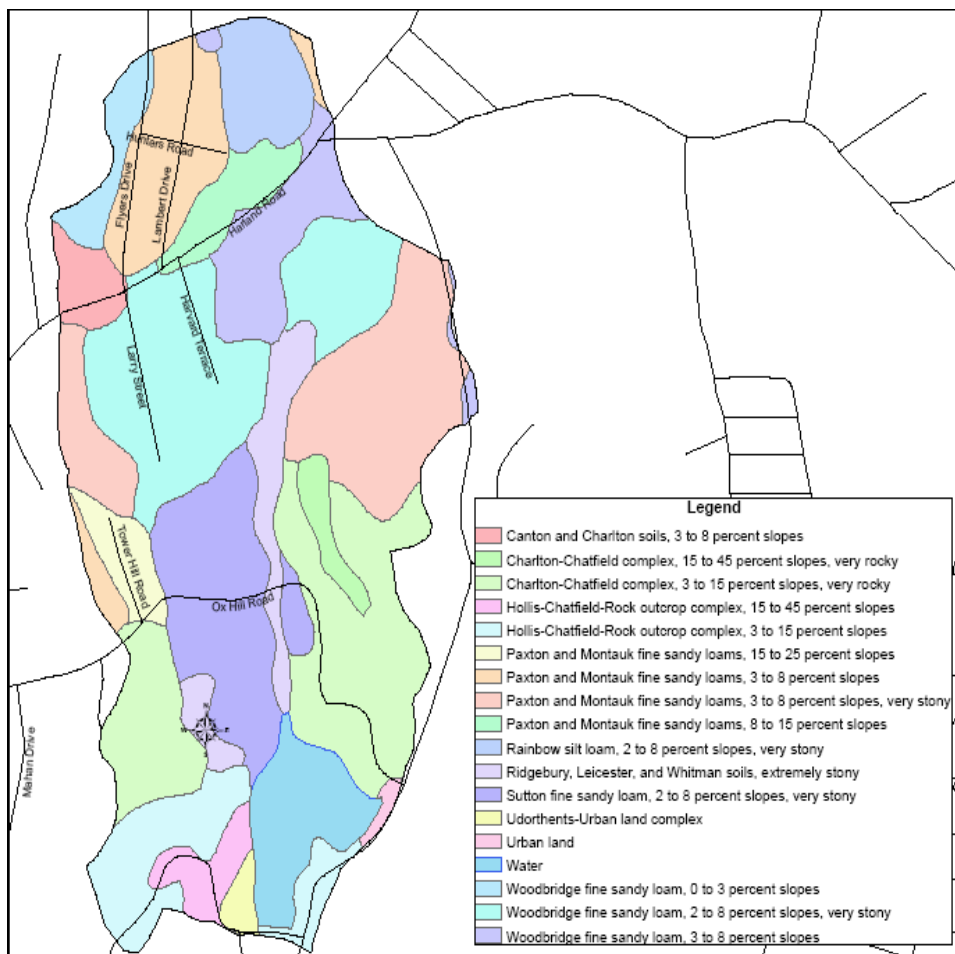


Figure 6: Soil types in the Spaulding Pond Watershed (from NRCS soils data).

Approximately 54% of the watershed is forested, comprised primarily of deciduous tree species. Suburban development occurs primarily in the north portion of the watershed (see Figure 7). Impervious cover (roadways, driveways, sidewalks) accounts for 22% of the watershed. Approximately 12% of the watershed is turf or grass, 10% is forested wetland or water (including Spaulding Pond), and 2% is designated other grasses (see Figures 8 and 9).



Figure 7: Aerial image of the Spaulding Pond Watershed.

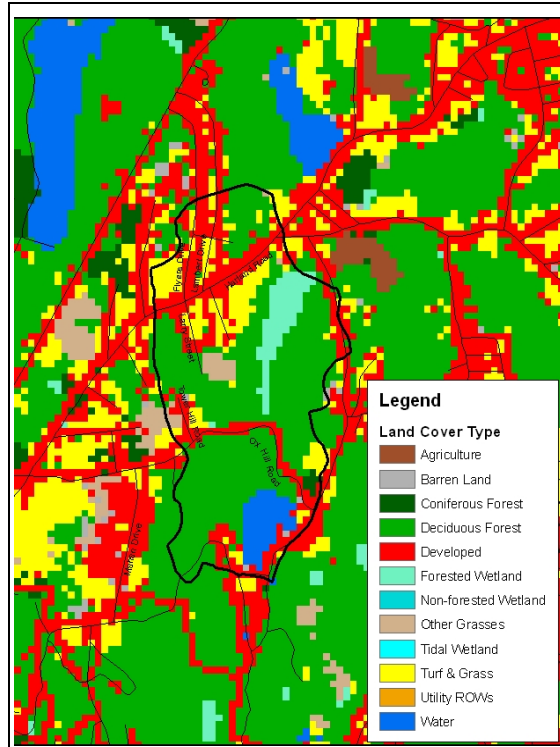


Figure 8: Land Use and Land Cover in the Spaulding Pond Watershed.

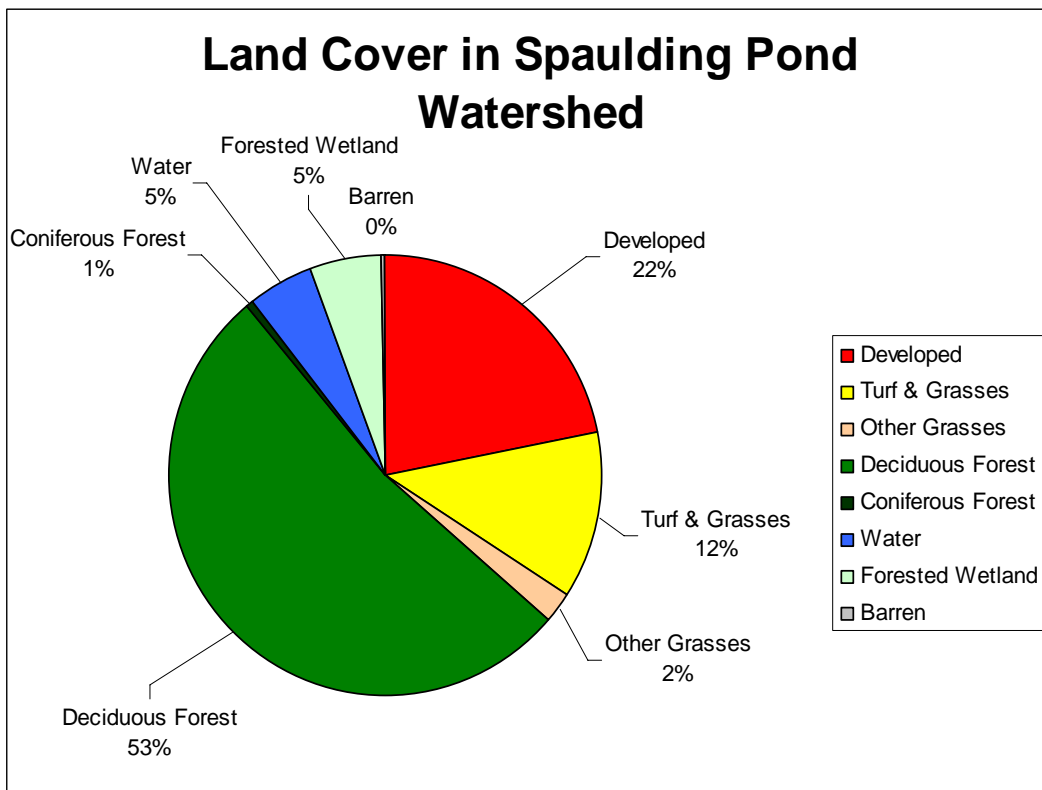


Figure 9: Percentages of Land Cover in Spaulding Pond Watershed

V. Nine Element Watershed Based Plan

A. Identification of Pollutant Causes and Sources

As part of the Spaulding Pond water quality investigation, ECCD investigated potential non-point sources of bacterial contamination including waterfowl, residential septic systems, swimming “accidents” at the public swim area, and dog waste.

1. Waterfowl

The 2008 Connecticut Integrated Water Quality Report lists waterfowl as the suspected source of bacterial contamination to Spaulding Pond. Spaulding Pond is seasonally inhabited by a large population of waterfowl. The primary species include Canada geese and mallard ducks, although other (unidentified) ducks species were observed. Students from a nearby middle school were recruited to document bird populations, including breeding/nesting pairs of Canada geese, and offspring, from April to June 2010. The largest number of Canada geese counted, 14, was documented on April 29th. On the same day students observed 6 possible nesting pairs of geese and one gosling. The largest number of Mallard ducks, 58, was counted on June 10th. Unofficial counts by ECCD staff over the course of the investigation indicated the Mallard duck population was maintained at approximately that level throughout the summer.

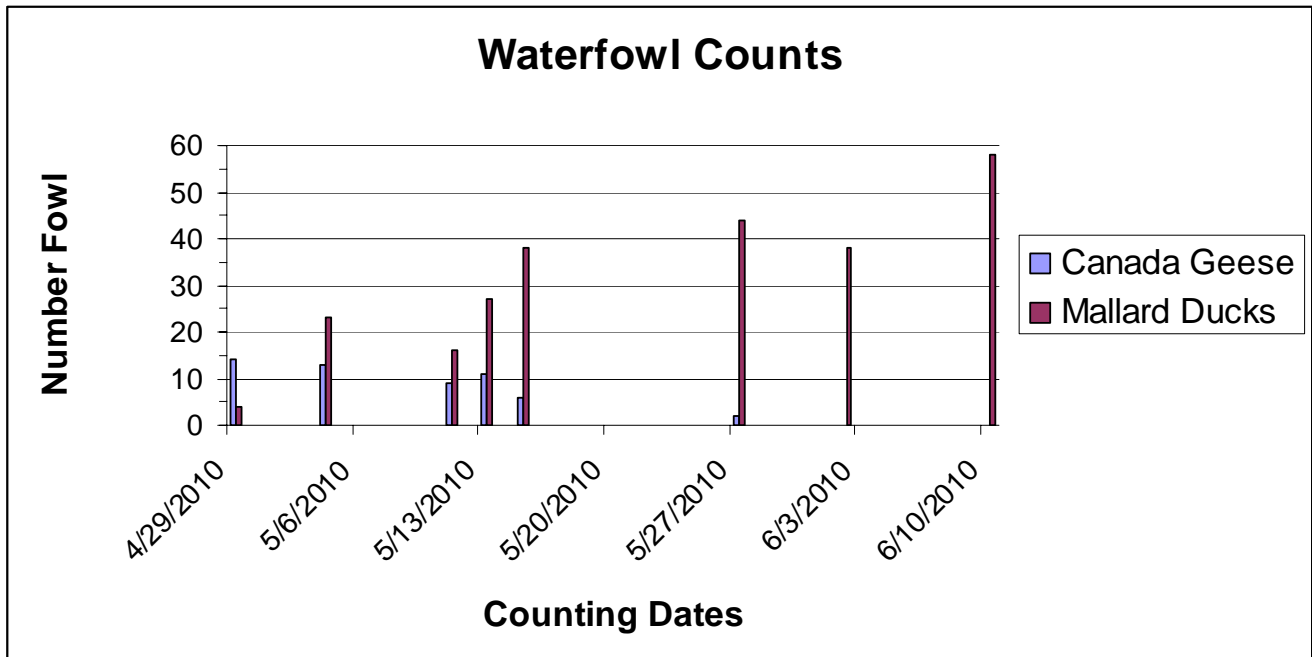


Figure 10: Results of Spring 2010 Waterfowl Counts by Kelly Middle School students.

2. Septic Systems

Much of the Spaulding Pond watershed is undeveloped. The areas at the northerly extent of the watershed and beyond are developed as residential neighborhoods (R-40 zone). Norwich Public Utilities has been installing sewer service in the developed residential area to the north of Harland Road, which intersects the upper watershed area west to east, in the Flyers Drive and Lambert Drive neighborhoods, in response to documented septic systems problems related to poor soils, high water table, small lot size and aging septic systems. Neighborhoods south of Harland Road, including Harland Road, Larry Street, Harvard Terrace, Ox Hill Road, and Tower Hill Road remain on individual septic systems. Although a review of septic suitability of the soils in the area south of Harland Road indicates they have low septic potential, the Uncas Health District has no record of septic system failures for that area.

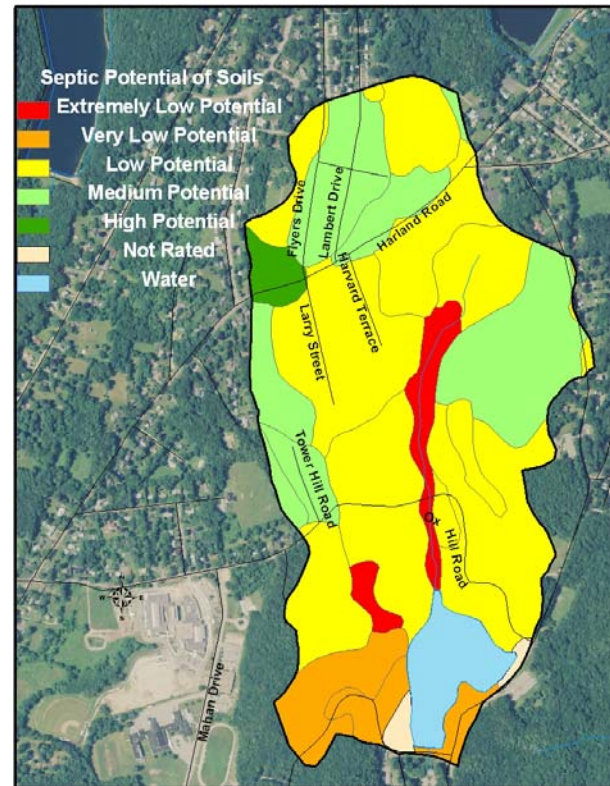


Figure 11: Suitability of soils for subsurface sewage disposal in the Spaulding Pond Watershed.

To test for the presence of septic leachate or other contaminants in the stream flowing to Spaulding Pond, ECCD staff placed an optical brightener pad (OBP) in the stream north of the Ox Hill Road stream crossing for a one week period, from August 16 – 23, 2010. On August 16th and 23rd, the days the OBP was placed and removed, Uncas Health District staff took water samples in two locations, south of the stream crossing at Ox Hill Road and at the stream inlet to Spaulding Pond, to test for bacteria. The OBP tested negative for optical brightener agents. However, the results are considered inconclusive, rather than indicative that no contribution of septic system effluent was present, since a number of variables, including extremely low stream flow related to below average rainfall in the summer of 2010, and whether the seven day sampling period coincided with the laundry schedule of the nearby residences, can affect the results.

The water samples taken at the stream crossing and at the pond inlet on the days the optical brightener pad was placed in the stream and removed tested in excess of the upper testing range of 2000 cfu/100 ml (see Appendix D for results). This sample set of four data points indicates that additional bacteria testing in the stream may be warranted.

A reconnaissance survey of the stream identified a property on Ox Hill Road from which three drainage pipes discharged near the stream. One of the pipes had fungal growth associated with the area of discharge.

The site was reported to and field inspected by Uncas Health District personnel in dry weather when no discharge was being emitted by any of the pipes. We recommend that Uncas Health District check the pipes periodically, especially after a significant rain, to ensure that the drains are discharging clean water.



Figure 12: Fungal growth associated with the 6" PVC pipe discharging near the unnamed stream.

ECCD also reviewed City records for the location of the on-site subsurface sewage treatment system for the public restroom at Mohegan Park, which is located at the south end of Spaulding Pond, near the pavilion (see Appendix G for building locations). The subsurface sewage treatment system is located south of the dam, down gradient of the pond, and thus was ruled out as a potential source of bacterial contamination.

3. Swim Beach

The effects of swim “accidents” by diaper-wearing swimmers were considered as a potential source of bacterial contamination. Although not quantifiable, the potential for bacterial contamination via direct contact with soiled diapers exists. The City of Norwich has posted signage at the swim area informing beach-goers that diapers are not allowed in the water. In conversation with Norwich Recreation Department staff, it was learned that the main reason for the ban was that regular disposable diapers tend to disintegrate when saturated. In recent years, special swim diapers (“swimmies”) have been promoted for the diaper-wearing population. However, a recent study conducted by James Aubrey, PhD, of University of North Carolina-Charlotte and his colleagues, found that swim diapers, plastic pants, and swim trunks do not protect against the spread of recreational water illness (RWI), diseases spread by water-borne germs, especially and including diarrhea.

The City of Norwich has provided “porta-potties” for the sanitary needs of beach-goers. The portapotties are owned and maintained by a private waste service, and are located at the entrance to the beach area by Mohegan Park Road. The portapotties are installed in mid-June to coincide with the opening of the beach, and are removed at the end of August, when the beach closes. They are pumped twice weekly by the waste management company. All indications are that the portapotties do not contribute to the bacteria loading of Spaulding Pond.

4. Dog Waste

The Norwich Animal Control Facility is located at Mohegan Park, near the southwest shore of Spaulding Pond, behind the maintenance garage (see Appendix F for building locations). A drainage system was observed at the kennel that channels run-off from the concrete dog runs into a drain pipe that is connected to an on-site septic system which will be abandoned when the new facility is completed. Communication with the animal control officer, Norwich DPW and Recreation staff indicate that solid dog waste is removed and disposed of in a waste receptacle. A new animal control facility is under construction near the existing facility, which has its own newly installed on-site septic system, which is located south of and down gradient to Spaulding Pond.

Storm run-off from the existing animal control facility has been observed flowing to a storm drain located behind the park maintenance/public restroom building (Figure 12). Investigation indicates this storm drain does not outlet to Spaulding Pond, but rather has its discharge point south of the pond.

Visitors are regularly observed walking dogs in Mohegan Park even though “no dog walking” signs are clearly posted throughout the park. If spotted, park employees politely inform dog walkers that dogs are not permitted in the park, but the City does not have a policy in place to enforce the prohibition.

Waste from dogs walked by park visitors, especially along the paved paths circling Spaulding Pond, has the potential to contribute to bacteria loading to the pond via surface runoff. However, based on numerous informal inspections by ECCD staff, it is apparent that the quantity of dog feces in the vicinity of the pond is minute in comparison to the amount of waterfowl feces.

5. Storm Drain System

The storm drain system located in Mohegan Park was evaluated for potential bacteria contributions from the adjacent upland areas, park roads and parking lots.

With one exception described below, runoff from park roads and parking areas via the storm drain system was ruled out as a significant source of bacteria. The Mohegan Park Road parking lot (on the east side of Spaulding Pond, see Figure 13 for location) does not discharge to Spaulding Pond. The Park Center parking lot (to the southwest of Spaulding Pond near the animal control facility, see Appendix G



Figure 13: Overland Flow from the Animal Control Facility to a Storm Drain at the Maintenance Garage.

for location) discharges north to a small forested wetland before draining via a poorly defined intermittent stream to Spaulding Pond. ECCD staff did not observe animal feces in the parking areas or along the roads that would indicate that either area contributed bacteria in any significant amount to the pond. City operations such as maintenance, sanding and snow plowing would not contribute to bacteria loading and were therefore not evaluated as potential sources.

The one area where storm flow may contribute to bacteria loading is a storm drain near Wilderness Road (on the north side of Spaulding Pond) that outlets onto the grassy area north of the swimming beach (see Figures 13 and 14). After heavy rain events, water discharging from this outlet may flow across the land surface near the grassy area where waterfowl forage and goose feces have been observed, transporting bacteria into the pond. Establishment of a vegetative buffer along the lake shore, which is one of this Plan's recommendations, would intercept much of the runoff and reduce the contamination potential.



Figure 14: Location of storm drain outlet from Mohegan Park Road relative to the swimming area.

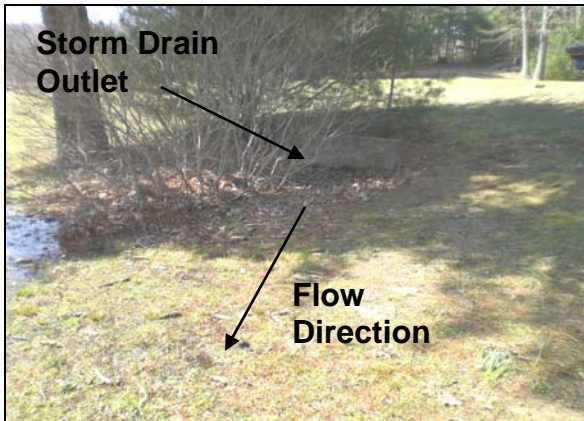


Figure 15a: Storm drain outlet across from the beach area.

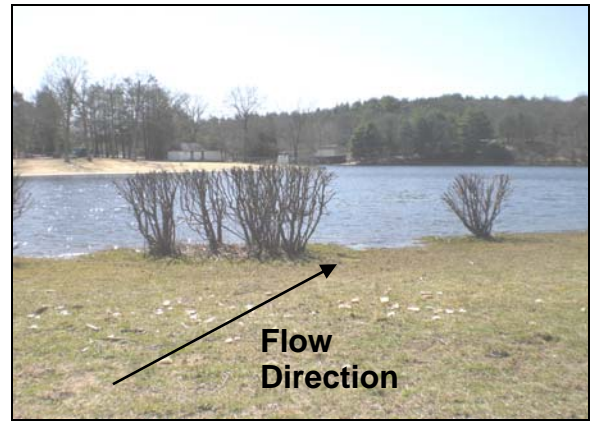


Figure 15b: Bread left from waterfowl feeding activity.

B. Pollutant Load Reduction Estimates

To estimate loads and load reductions, EPA recommends the use of models which have been developed for these purposes. ECCD has found that there are few models that provide quantitative estimates of loading or load reductions for bacteria. Therefore, ECCD emulated previously approved Watershed Based Plans, which utilize qualitative estimates to predict load reductions. Resident and migratory waterfowl, septic systems, swimming “accidents,” and

Table 4: Estimated *E. coli* Load Reduction for Existing and Potential Management Strategies

Source	Management Strategy	Load Reduction Potential	Amount of Impact		
Waterfowl	➤ Flock Reduction	Moderate to High	Eight <i>E. coli</i> exceedances from 2007 to 2010 that resulted in closure of swim area		
	➤ Vegetative Buffer Installation	Moderate			
	➤ Installation of Reractable Fencing along Beach	Moderate			
	➤ Beach BMPs & Maintenance	Moderate			
	➤ Prohibit Feeding	Moderate			
	➤ Installation of Pond Circulator	Low to Moderate			
	➤ Use of Aerators	Low			
Septic Systems/ Sewers	➤ Homeowner BMPs including Regular Tank Pump-out	Low *	Eight <i>E. coli</i> exceedances from 2007 to 2010 that resulted in closure of swim area		
	➤ Installation of Sewer Lines	Low *			
Swimming “Accidents”	➤ Sanitary Facilities at Swim Area	Low to Moderate		Eight <i>E. coli</i> exceedances from 2007 to 2010 that resulted in closure of swim area	
	➤ Enforcement of "No Diapers in Water" Policy	Low to Moderate			
Dogs	➤ Enforcement of Dog Ban	Low			Eight <i>E. coli</i> exceedances from 2007 to 2010 that resulted in closure of swim area
	➤ Implementation of BMPs at Animal Control Facility	Low			

* Pending the results of additional testing in the stream and at the drain pipes near the stream on Ox Hill Road, the load reduction potential of these strategies may increase.

waste from dogs that are either brought to the Park or kept at the animal control facility were identified in previous section of this report as potential sources of *E. coli*. Since no quantitative data for bacteria loading was obtained as part of this project, qualitative estimates for bacteria load reduction from these sources for the various recommended management measures are listed in Table 4.

C. Watershed Best Management Practices

Descriptions of existing and recommended management strategies necessary to achieve the estimated load reductions are provided below.

1. Existing NPS Management Strategies to Achieve Load Reduction Goals

a. Structural Controls:

- Three (3) Aquamaster Master Series 5hp aerators. In recent years, the Norwich Department of Public Works has installed three aerators in Spaulding Pond to increase oxygenation and promote water movement.
- Beach maintenance BMPs to remove waste left by waterfowl. During the summer months, the swimming beach is raked several times during the day by Recreation Department staff to remove waterfowl droppings from the beach and shoreline. Waste is deposited in nearby waste containers.
- Installation of municipal sewer lines in the upper watershed by Norwich Public Utilities. In response to problems with existing septic systems in the upper watershed, NPU has been installing sewer lines on Flyers Avenue and Lambert Avenue.

b. Nonstructural Controls:

- Posted restriction for no diapers in water and accessible sanitary facilities at swim area. Norwich DPW has clearly posted the beach area with signs prohibiting diapers in the water, and has provided easily accessible sanitary facilities (portalettes).
- Posted restriction on walking dogs in Mohegan Park. Norwich DPW has posted signs prohibiting dogs throughout Mohegan Park.
- Dog waste/general maintenance BMPs at Animal Control Facility. Kennels are cleaned daily and the solid waste is removed and placed in a waste container.

2. Recommended NPS Management Strategies to Achieve Load Reduction Goals

a. Structural Controls:

- Installation of a vegetative buffer north of the beach area. Vegetative buffers along shorelines are effective in discouraging the establishment of Canada geese nesting and feeding areas.
- Installation of retractable fencing along beach. Retractable fencing has proven effective in preventing geese from utilizing shoreline areas and can be used to prevent waterfowl from using the beach area at night during the swimming season and during the off-season. For more

information, see http://www.virginalakemanagement.com/goose_d-fence.php.

- Installation of a pond circulator to circulate stagnant water in swimming cove. The swimming beach is located in a small cove on the east side of Spaulding Pond. The main flow of water through the pond is north to south on the west side of the pond. Installation of a pond circulator may increase flow the cove to the main channel of the pond and reduce stagnation and the possible concentration of bacteria in the cove area.
- Replacement of aging aerators. The existing aerators have been in use for several years and breakdowns are common due to heavy use.
- Completion of sewer hookup currently underway on Lambert and Flyers Drives. Hook-up of failing septic systems in the upper watershed to the municipal sewer lines will reduce potential for bacterial contamination in the upper watershed.
- Identify/repair/replace failing septic systems in non-sewered areas. Bacterial loading due to failing septic systems will be reduced if systems are identified and repaired.

b. Nonstructural Controls:

- Posting of “Don't Feed Waterfowl” signs at strategic locations in Mohegan Park. Feeding the waterfowl is a popular activity at Mohegan Park. Posting informational signs at strategic locations throughout the park informing visitors why feeding is not healthy for waterfowl may help reduce flock size and reduce bacterial loading.
- Distribution of “Do Not Feed Waterfowl” literature at Mohegan Park and Recreation Office. Providing informational brochures educating the public why feeding waterfowl is detrimental to their health may help reduce flock size and reduce bacterial loading.
- Reduction in flock size
 - Consultation with CT DEP Wildlife Division/Migratory Birds Program regarding migratory Canada Geese and resident mallard flock management strategies.
 - Recruitment of Master Wildlife Conservationist volunteers or others to monitor flock size and conduct geese tagging for resident geese.
 - Development of a flock management strategy that may include techniques such as egg addling, if resident Canada geese flock size appears to be increasing.
- Implementation of homeowner BMPs for septic system maintenance. Good septic system maintenance, including regular pump outs, ensures septic systems are functioning properly, allows for detection of malfunctions and extends the life of septic systems.
- Enforcement of “no diapers in water” policy at beach. Soiled diapers contribute directly to bacteria loading of the water.
- Enforcement of “no food” policy in beach area. Discarded or dropped food attracts wildlife, which may defecate while scavenging on the beach.
- Location of trash cans away from beach. Locating trash away from the beach area discourages wildlife foraging in the beach area.
- Enforcement of dog walking ban in park.

- Evaluation of enforcement of the existing policy excluding dogs from Mohegan Park.
- Enlistment of staff or volunteers to distribute informative “warning tickets” to educate public about Spaulding Pond water quality issues and dog restriction policy

3. Additional NPS Management Strategies Recommended to Achieve Watershed Goals

Below are descriptions of additional management measures that will need to be implemented to achieve additional watershed goals identified watershed-based plan.

- a. Conduct laboratory testing to identify the species from which the *E. coli* originates.
- b. Continue water quality monitoring program at beach area at Spaulding Pond, increase from bi-weekly to weekly.
- c. Expand water quality monitoring program to include sampling the unnamed stream that flows into Spaulding Pond.
- d. Expand water quality monitoring of Spaulding Pond and stream to include sampling immediately after rainfalls of 1” or more.
- e. Implement periodic use of optical brightener pads to detect presence of laundry detergents in the unnamed stream.
- f. Expand monitoring area to bracket potential sources if optical brightener pad testing is positive.
- g. Facilitation of dye testing for area homeowners if future optical brightener pad testing is positive.
- h. Conduct wet weather water testing of yard drains at the Ox Hill Road residence.
- i. Perform dye testing of septic system of Ox Hill Road residence if wet weather testing of yard drains indicates the presence of high *E. coli* bacteria levels.
- j. Continue aerator use. Although no data has been collected to support the effectiveness of the aerators in reducing bacteria levels, park managers feel that the addition of the aerators has coincided with a reduction in the number of beach closures due to high bacteria levels.
- k. Purchase a back-up aerator pump to avoid delayed installation if a pump should fail.
- l. Develop a dog park area in an upland section of Mohegan Park in an area down gradient from Spaulding Pond.

D. Financial and Technical Assistance Needed

The costs associated with each proposed management measure will need to be estimated individually. Costs listed in Table 5 are estimates. Grants from local, state, and federal sources, including the Clean Water Act Section 319 program and the Long Island Sound programs, should be pursued as possible sources of funding. Technical assistance for implementation can be sought from organizations

and agencies such as, but not limited to, the Eastern Connecticut Conservation District, Uncas Health District, the University of Connecticut Extension Service, the USDA Natural Resources Conservation Service, and the CT DEP.

Table 5: Management Measure, Estimated Cost and Technical Assistance

Management Measure	Cost	Funding Source/Requirements	Technical Assistance
Waterfowl Flock Size Evaluation	CT DEP at no cost	N/A	CT DEP
Waterfowl Flock Size Management	TBD	Municipality	CT DEP, CT Master Wildlife Program
Riparian Buffer Installation	650 feet @ \$3.70/ft = \$2400	Local grant sources such as CT Rivers Alliance, American the Beautiful Grant Program	ECCD, NRCS, Univ. CT Extension System Master Gardener Program
Install Waterfowl Fence along Beach	Basic kit – 250 ft of line and 1 post - \$95 Add'l Posts - \$15	Municipality	Manufacturer
Swim Area BMPs	Staff salary	Municipality	CT DEP, Univ. CT Extension System, ECCD
<i>Don't Feed Waterfowl</i> Signage	Provided by CT DEP at no charge	N/A	CT DEP/ECCD
<i>Don't Feed Waterfowl</i> Brochures	~ \$240/100 brochures	EPA CWA §319 Grant/ 40% Match Req't.	CT DEP/ECCD
Kasco 4400A 1 HP 120V Water Circulator - De-icer	\$1500 plus \$1500 labor = \$3000	Municipality	Manufacturer
Aquamaster Master Series Aerator, 5hp, stainless steel, with panel - 208 240 volt, single phase.	\$6500 plus \$1500 labor = \$8000	Municipality	Manufacturer
Water Quality Monitoring	As contracted with local health district	Municipality	Uncas Health District, CT DPH
Bacteria Source Lab Testing	\$500/sample x 3 samples over summer = \$1500	ECCD, Municipality	ECCD, Uncas Health District
Septic System Maintenance, Repair	Determined on Individual Basis	Homeowner	Uncas Health District
Sewer Line Expansion	TBD	State and Federal Gov't, Municipality, Homeowners	Professional Engineer
Distribution of Informational "Warning Tickets" to Dog Walkers	~ \$240/100 brochures Staff salary	Local grant sources such as CT Rivers Alliance, Pfizer Community Grant	ECCD
Animal Control Facility BMPs	Staff salary	Municipality	NRCS, ECCD, UConn Extension System
Dog Park	TBD	Municipality, Donations, Grant Funding	Professional Engineer, Contractor

E. Education/Outreach Component

ECCD conducted an outreach campaign in the summer of 2010 to raise awareness and educate the public on the occurrence and causes of bacterial contamination in Spaulding Pond. ECCD staff visited Mohegan Park on two separate occasions to educate park visitors on the consequences of feeding waterfowl to both the birds and to water quality. Additionally, articles were published in area newspapers including the *Norwich Bulletin* and *The Day* regarding the water quality investigation. ECCD provided Norwich Department of Public Works and the Recreation Department with informational signage and brochures to educate park visitors why not to feed waterfowl.

Watershed stakeholders including the City of Norwich and Uncas Health District should be encouraged to continue to focus public education and outreach on the following issues:

- Consequences of feeding waterfowl
- Septic system care and maintenance
- Public beach best management practices
- Pet waste management

F. Implementation Schedule

Year 1 (2010):

- Initiate education and outreach program to inform public of water quality problems at Spaulding Pond and probable causes, including outreach events at Mohegan Park and press releases in news media
- Post “Do Not Feed the Waterfowl” signage at strategic locations within Mohegan Park
- Distribute “Do Not Feed the Waterfowl” informational brochures to Mohegan Park visitors
- Continue use of swim beach BMPs including raking the beach to remove waterfowl waste, providing sanitary facilities for visitors, enforcing “no food on the beach” and “no diapers in water” policies.
- Continue sewer line expansion in upper watershed
- Continue bi-weekly water testing while swim beach is open for public use

Year 2 (2011):

- Consult with CT DEP Wildlife Division regarding Canada Geese and Mallard duck flock management strategies, including evaluation of waterfowl flock to determine if flock size is appropriate for the pond.
- Design and install riparian buffer along northeast shoreline of Spaulding Pond to discourage waterfowl nesting and foraging.
- Purchase and install geese fencing to keep ducks and geese off the beach during evening hours and during the off-season.
- Purchase back-up aerator to avoid delayed installation should an installed aerator fail.

- Evaluate pond hydrology to determine if pond circulator will effectively move stagnant water out of beach area.
- Continue use of swim beach BMPs, including raking the beach to remove waterfowl waste, providing sanitary facilities for visitors, enforcing “no food on the beach” and “no diapers in water” policies.
- Conduct weekly water testing in swim area during swimming season.
- Have bacteria samples tested several times over the course of the summer to determine the host animal.
- Expand water quality testing program to include sampling in unnamed stream flowing to Spaulding Pond.
- Implement periodic use of optical brightener pads to detect septic system discharges in the unnamed stream.
- Continue sewer line hookups for residences in sewerred areas of the watershed.
- Mail septic system maintenance brochures to all homeowners in watershed not on public sewer service.
- Complete move to new animal control facility.
- Evaluate animal control facility procedures and implement BMPs for pet waste management.
- Develop strategy to enforce dog ban in park, including public education regarding link between pet waste and water quality.

Year 3 (2012):

- Implement waterfowl management strategies as recommended by CT DEP Wildlife Division.
- Inspect winter mortality of riparian buffer plants and replant as needed.
- Continue use of goose fencing to keep ducks and geese off the beach during evening hours and during the off-season.
- Seek funding for pond circulator if pond hydrology evaluation determines pond circulator will effectively move stagnant water out of beach area/cove.
- Continue use of swim beach BMPs including raking the beach to remove waterfowl waste, providing sanitary facilities for visitors, enforcing “no food on the beach” and “no diapers in water” policies.
- Continue weekly water testing in swim area during swimming season.
- Continue expanded water quality sampling in unnamed stream.
- Expand stream monitoring area to bracket potential sources if optical brightener pad testing is positive.
- Encourage or facilitate dye testing for area homeowners if optical brightener pad results are positive.
- Complete sewer line hookups for residences in sewerred areas of watershed.
- Implement dog ban enforcement strategy/public education.
- Continue Animal Control Facility BMPs for pet waste management.
- Evaluate feasibility of a dog park in Mohegan Park away from Spaulding Pond and its tributary.

Year 4 (2013):

- Institute flock size maintenance, such as "Geese Peace" egg addling

program, with Master Wildlife Volunteers or others if flock size is determined to exceed pond carrying capacity.

- Inspect winter mortality of riparian buffer plants and replant as needed.
- Continue use of goose fencing to keep ducks and geese off the beach during evening hours and during the off-season.
- Install pond circulator if pond hydrology evaluation determines pond circulator will effectively move stagnant water out of beach area/cove.
- Continue use of swim beach BMPs including raking the beach to remove waterfowl waste, providing sanitary facilities for visitors, enforcing “no food on the beach” and “no diapers in water” policies.
- Continue weekly water testing in swim area during swimming season.
- Continue expanded water quality sampling in unnamed stream.
- Encourage or facilitate septic system repair or replacement for area homeowners if dye test results are positive.
- Evaluate potential for sewer line expansion in neighborhoods on south side of Harland Road.
- Continue Animal Control Facility BMPs for pet waste management
- Seek funding sources for dog park, if determined feasible.

Year 5 (2014):

- Monitor waterfowl flock size, and maintain as necessary.
- Continue use of goose fencing to keep ducks and geese off the beach during evening hours and during the off-season.
- Continue use of swim beach BMPs including raking the beach to remove waterfowl waste, providing sanitary facilities for visitors, enforcing “no food on the beach” and “no diapers in water” policies.
- Continue weekly water testing in swim area during swimming season.
- Continue expanded water quality sampling in unnamed stream.
- Pursue sewer line expansion in neighborhoods on south side of Harland Road, if evaluation is favorable.
- Continue Animal Control Facility BMPs for pet waste management
- Construct dog park in Mohegan Park in area away from Spaulding Pond and its tributary.
- Evaluate plan for effectiveness, revise as necessary.

G. Interim Milestones

Implementation is scheduled over a five year period. After the first two years, indicator bacteria levels in Spaulding Pond should decrease in response to increased public awareness and behavior change in response to education and outreach efforts, use of goose barrier and continued animal waste BMPs at the swim beach, continued sewer line hook-ups and promotion of septic system maintenance to homeowners. Over the second two years, indicator bacteria levels in Spaulding Pond should continue to decrease in response to implementation of waterfowl management strategies, including flock size management, installation of a riparian buffer to discourage waterfowl from foraging and nesting along the shoreline near the swim beach, completion of sewer line hook-ups in the northern

part of the watershed, and repair or replacement of any identified failing septic systems. After year five, indicator bacteria levels should continue to decrease as implementation of plan strategies continues.

H. Monitoring and Assessment Component

The criteria for determining the success of the BMP implementations is based on the number of *E. coli* colony forming units (cfus) in the water samples collected at Spaulding Pond. The goal is to significantly reduce or completely eliminate samples which exceed the single sample established limit of 235 cfus/100 ml of water, or the sample set geometric mean of 126 cfu/100 ml.

Secondary indicators include:

- a reduction in the number of park users who feed the waterfowl
- reduction or elimination of dog walkers
- number of homes hooked up to municipal sewer lines
- negative results in stream testing

I. Implementation Effectiveness

Water testing of the swim area at Spaulding Pond by Uncas Health District will be the primary monitoring component of this plan and will provide documentation of the effectiveness of the recommended management measures. This testing should be conducted weekly during the summer season when the swim area is open for public use. Test results over a five year period after the commencement of BMP implementation should show significant reductions in bacteria levels.

The Spaulding Pond Watershed Management Plan should be reviewed periodically by the stakeholders. The review should include an evaluation of completed implementations and post-completion water quality data to see if the implementations have been effective. Revisions will be made to improve the effectiveness of implementation efforts if monitoring shows no improvement post BMP efforts. If a completed implementation has not been as effective as predicted, the implementation should be re-evaluated to determine if it was implemented as recommended, or if additional efforts are required.

Plan recommendations may change if new information becomes available regarding possible bacterial sources, such as DNA fingerprinting to identify the species source of the contamination, or if new technologies are developed that might address the contamination more adequately than plan recommendations.

It is recommended that a standing committee comprised of the major stakeholders including the City of Norwich (Recreation Department and DPW), Norwich Public Utilities and Uncas Health District be organized to implement the recommendations of this watershed management plan. Table 6 outlines management measures, participants and implementation timelines.

Table 6: Recommended Management Measures, Participants and Timelines

Management Measure	Lead Participants	Other Participants	Implementation Timeline*
Waterfowl Flock Size Evaluation	City of Norwich/DPW	CT DEP	Year Two
Waterfowl Flock Size Management	City of Norwich/DPW	CT DEP, CT Master Wildlife Program	Year Three, thereafter ongoing
Riparian Buffer Installation	City of Norwich/DPW	ECCD, NRCS, Univ. CT Extension System Master Gardener Program	Year Two
Install Waterfowl Fence along Beach	City of Norwich/Recreation Department		Year One or Two
Swim Area BMPs	City of Norwich/Recreation Department	CT DEP, Univ. CT Extension System, ECCD	Year One, thereafter ongoing
<i>Don't Feed Waterfowl</i> Signage	City of Norwich/DPW	CT DEP/ECCD	Year One
<i>Don't Feed Waterfowl</i> Brochures	City of Norwich/Recreation Department	CT DEP/ECCD	Year One
Kasco 4400A 1 HP 120V Water Circulator - De-icer	City of Norwich/DPW		Year Two
Aquamaster Master Series Aerator, 5hp, stainless steel, with panel - 208 240 volt, single phase.	City of Norwich/DPW		Year Two
Water Quality Monitoring, including expansion to include un-named stream	Uncas Health District	CT DPH	ongoing
Bacteria Source Lab Testing	Uncas Health District	ECCD,	Year Two
Septic System Maintenance, Repair	Uncas Health District	Homeowners	Year Two
Sewer Line Expansion	Norwich Public Utilities	Homeowners	Year One, ongoing until all failing properties have hooked up
Distribution of Informational "Warning Tickets" to Dog Walkers	City of Norwich/DPW	ECCD	Year Three, thereafter ongoing
Animal Control Facility BMPs	City of Norwich/Animal Control Officer	NRCS, Univ. CT Extension System, ECCD	Year Two, thereafter ongoing
Dog Park	City of Norwich/DPW	Professional Engineer, Contractor, Residents	Year Three
*See Section F - Implementation Schedule for more detailed information regarding each proposed management measure			

APPENDICES

Appendix A – Geese Counting Data Sheet

Appendix B – Results of Waterfowl Tallies

Appendix C – Results of Bacteria Sampling by Uncas Health District

Appendix D – Stream Bacteria Test Results

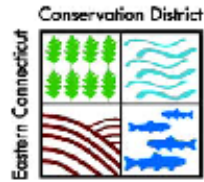
Appendix E – Rainfall Data from Norwich Public Utilities

Appendix F – Comparison of Bacteria Data to Rainfall Data

Appendix G – Location Map of Animal Control Facility

Appendix H - Location Map of Optical Brightener Pad and Drainage
Pipes on Ox Hill Road

APPENDIX A: Geese Counting Datasheet



Data Collected by: _____

Geese Counting Datasheet for Spaulding Pond*

Date, Time, Temp., Location	Cloud Cover	Wind Conditions	Geese Tally	Park Use Tally	Comments
Date: _____	<input type="checkbox"/> Sunny	<input type="checkbox"/> None (glassy water)	Overall _____	Dog walkers _____	
Time (24hr): _____	<input type="checkbox"/> Pt. Cloudy	<input type="checkbox"/> Slight (ripples)	Pairs _____	Fisherman _____	
Temp. (*F): _____	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Breezy (small wavelets)	Goslings _____	Swimmers _____	
Location: _____	<input type="checkbox"/> Rainy	<input type="checkbox"/> Storm (waves)		People feeding geese _____	
Date: _____	<input type="checkbox"/> Sunny	<input type="checkbox"/> None (glassy water)	Overall _____	Dog walkers _____	
Time (24hr): _____	<input type="checkbox"/> Pt. Cloudy	<input type="checkbox"/> Slight (ripples)	Pairs _____	Fisherman _____	
Temp. (*F): _____	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Breezy (small wavelets)	Goslings _____	Swimmers _____	
Location: _____	<input type="checkbox"/> Rainy	<input type="checkbox"/> Storm (waves)		People feeding geese _____	
Date: _____	<input type="checkbox"/> Sunny	<input type="checkbox"/> None (glassy water)	Overall _____	Dog walkers _____	
Time (24hr): _____	<input type="checkbox"/> Pt. Cloudy	<input type="checkbox"/> Slight (ripples)	Pairs _____	Fisherman _____	
Temp. (*F): _____	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Breezy (small wavelets)	Goslings _____	Swimmers _____	
Location: _____	<input type="checkbox"/> Rainy	<input type="checkbox"/> Storm (waves)		People feeding geese _____	
Date: _____	<input type="checkbox"/> Sunny	<input type="checkbox"/> None (glassy water)	Overall _____	Dog walkers _____	
Time (24hr): _____	<input type="checkbox"/> Pt. Cloudy	<input type="checkbox"/> Slight (ripples)	Pairs _____	Fisherman _____	
Temp. (*F): _____	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Breezy (small wavelets)	Goslings _____	Swimmers _____	
Location: _____	<input type="checkbox"/> Rainy	<input type="checkbox"/> Storm (waves)		People feeding geese _____	
Date: _____	<input type="checkbox"/> Sunny	<input type="checkbox"/> None (glassy water)	Overall _____	Dog walkers _____	
Time (24hr): _____	<input type="checkbox"/> Pt. Cloudy	<input type="checkbox"/> Slight (ripples)	Pairs _____	Fisherman _____	
Temp. (*F): _____	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Breezy (small wavelets)	Goslings _____	Swimmers _____	
Location: _____	<input type="checkbox"/> Rainy	<input type="checkbox"/> Storm (waves)		People feeding geese _____	

* This project is funded in part by the CT DEP through the US EPA Nonpoint Source grant under section 319 of the Clean Water Act.

APPENDIX B: Results of Waterfowl Tallies

Spaulding Pond at Mohegan Park, Norwich, CT												
Date	Time	Temp	Cloud Cover	Wind	# Geese	# Pairs	# Goslings	# Dog Walkers	# Fishermen	# Swimmers	# People Feeding Geese	Comments
4/29/2010	3:10 PM	55° F	pt cloudy	breezy	6	6	0	0	10	0	4	4 mallard ducks (males), 1 domestic duck, 1 squirrel
4/29/2010	3:10 PM	55° F	sunny	breezy	14	2	0	0	9	0	6	3 ducks, 2 squirrels, 7 birds
4/29/2010	3:10 PM	55° F	pt cloudy	breezy	13	2	1	0	8	0	6	4 ducks, 2 squirrels, 6 birds
5/4/2010	3:30 PM	70° F	pt cloudy	slight	13	2	0	3	9	0	0	23 ducks
5/11/2010	3:30 PM	74° F	pt cloudy	slight	9	2	0	3	0	0	0	16 ducks, 1 domestic duck
5/13/2010	3:30 PM	80° F	sunny	none	11	3	0	0	3	0	2	27 ducks, 1 domestic duck
5/15/2010	3:30 PM	75° F	pt cloudy	slight	6	1	0	0	1	0	0	38 ducks
5/27/2010	3:30 PM	68° F	pt cloudy	slight	2	1	0	1	4	0	0	44 ducks
6/2/2010	3:30 PM	68° F	cloudy	slight	0	0	0	0	2	0	4 (ducks and squirrels)	38 ducks
6/10/2010	4:30 PM	70° F	sunny	slight	0	0	0	0	4	0	3 (ducks)	58 ducks

APPENDIX C: Results of Bacteria Sampling by Uncas Health District

Bacteria Sampling - Spaulding Pond, Norwich CT					
Date	Sample ID	Time Collected	Bacteria Level (per 100 ml)	Exceeds*	Geomean
Year: 2007					34.02
6/6/2007	E-O1	8:40	160		
6/11/2007	W-02	9:25	270	yes	
6/13/2007	E-O1	9:20	31		
6/18/2007	E-O1	9:00	20		
7/2/2007	E-O1	8:50	20		
7/9/2007	E-O1	9:40	75		
7/16/2007	SPE	9:01	10		
7/23/2007	W-02	9:18	20		
7/23/2007	E-O1	9:15	10		
7/30/2007	E-O1	9:53	31		
8/6/2007	E-O1	9:03	20		
8/13/2007	W-02	8:43	31		
8/20/2007	W-02	9:53	53		
Year: 2008					
6/2/2008	SPW-62	9:06	10		
6/9/2008	SPE-69	8:55	31		
6/11/2008	SPE	8:55	20		
6/16/2008	SPE-616	9:00	10		
6/23/2008	SPE	9:21	210		
6/23/2008	SPW-62	9:22	360	yes	
6/25/2008	SPE-625	9:10	87		
6/30/2008	SPW-630	9:30	64		
7/7/2008	707 -E	10:06	320	yes	
7/14/2008	SPW-714	9:05	20		
7/21/2008	SPW-721	7:30	41		
7/28/2008	SPE-728	8:58	31		
8/4/2008	SPE-84	10:05	1200	yes	
8/6/2008	SPE-86	9:51	53		
8/18/2008	SPW-818	8:58	31		
Year: 2009					40.09
5/18/2009	SPW-150	10:31	10		
6/8/2009	SPW-602	10:20	10		
6/15/2009	SPE-200	9:33	20		
6/22/2009	SPE-622	9:06	110		
6/29/2009	SPE-629	10:08	120		
7/13/2009	SP-713W	8:58	10		
7/15/2009	SPE-715	8:54	31		

7/20/2009	MPE-720	8:40	190		
7/29/2009	SPW-729	9:16	240	yes	
8/3/2009	SPW-803	9:15	110		
8/10/2009	SPW-400	9:31	42		
8/17/2009	SP-817W	9:15	<10		
Year: 2010					76.25
6/9/2010	SPW-69	9:31	10		
6/9/2010	SPE-69	9:30	20		
6/21/2010	SP-621W	8:28	700	yes	
6/21/2010	SP-621E	8:28	290	yes	
6/23/2010	SP623W	6:37	430	yes	
6/23/2010	SP623E	6:37	150		
6/29/2010	SPW629	10:52	190		
6/29/2010	SPE629	10:50	310	yes	
6/29/2010	SPC629	10:51	450	yes	
7/6/2010	SPW706	9:25	110		
7/6/2010	SPE706	9:25	20		
7/19/2010	SPW719	10:00	20		
7/19/2010	SPE719	9:59	42		
8/2/2010	SPW82	9:40	180		
8/2/2010	SPE82	9:41	10		
8/16/2010	SPW100	9:21	63		
8/16/2010	SPE200	9:18	10		
8/30/2010	SPW830	9:24	53		
8/30/2010	SPE830	9:25	75		

APPENDIX D: Stream Bacteria Test Results

Bacteria Sampling – Un-named Stream to Spaulding Pond, Norwich CT					
Date	Sample ID	Time Collected	Bacteria Level (per 100 ml)	Exceeds*	Geomean
8/16/10	RB-300	9:32 AM	>2000	yes	>2000
8/16/10	OM-400	9:41 AM	>2000	yes	
8/23/10	RB-10	8:56 AM	>2000	yes	
8/23/10	OH-200	9:01 AM	>2000	yes	

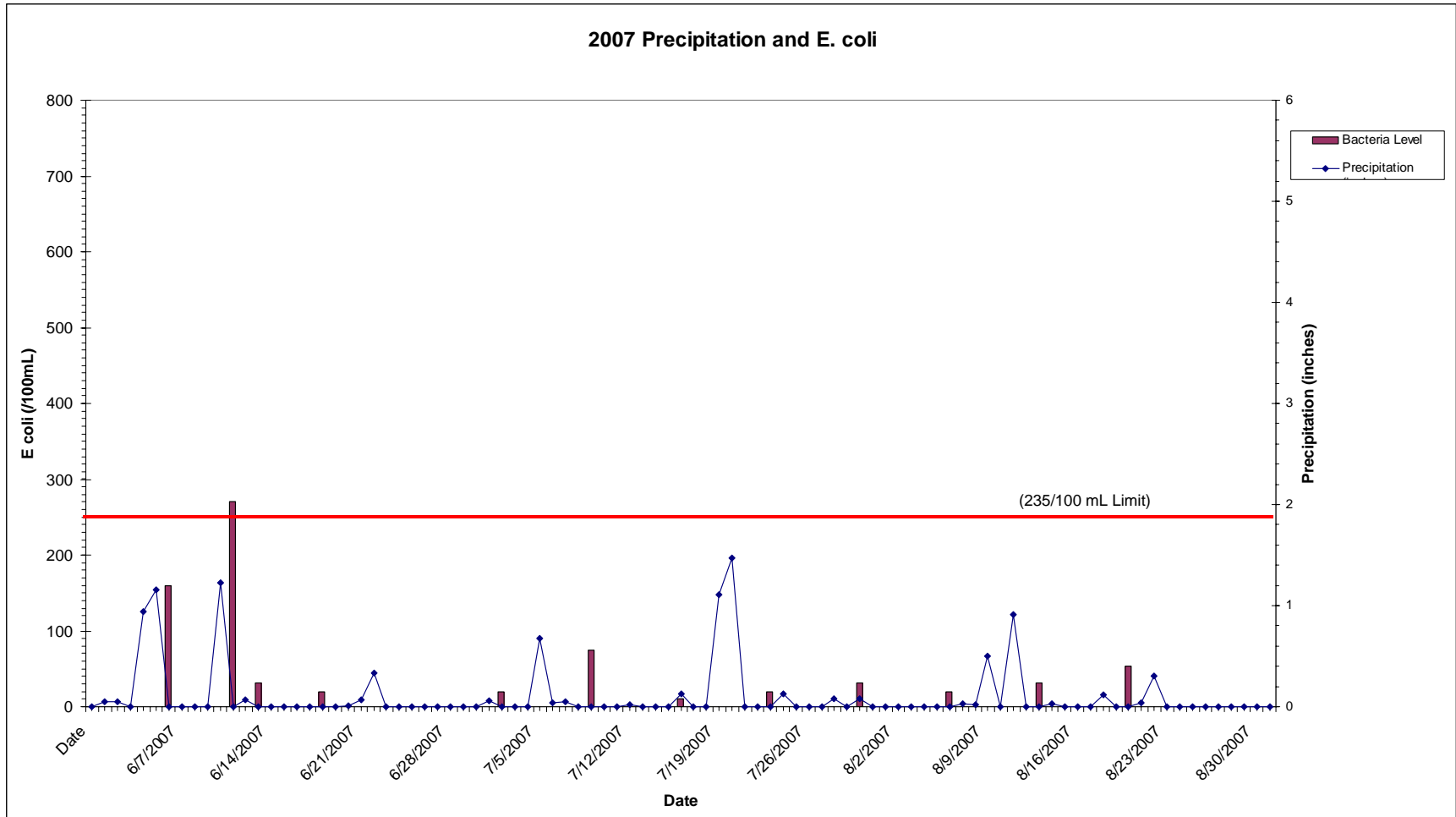
APPENDIX E: Precipitation Data from Norwich Public Utilities

Rainfall - Norwich, CT (NPU)				
Date	Precipitation (inches)			
	2007	2008	2009	2010
1-Jun	0.05	0.01	0.00	0
2-Jun	0.05	0	0.00	0.26
3-Jun	0	0	0.03	0
4-Jun	0.94	0.44	0.24	0.07
5-Jun	1.16	0	0.39	0
6-Jun	0	0.41	0.02	0.09
7-Jun	0	0.01	0.00	0.02
8-Jun	0	0.36	0.00	0
9-Jun	0	0.00	0.64	0
10-Jun	1.23	0.00	0.09	0.22
11-Jun	0	0.00	0.05	0.05
12-Jun	0.07	0.00	0.43	0
13-Jun	0	0.00	0.02	1.4
14-Jun	0	0.08	0.29	0
15-Jun	0	0.20	0.11	0
16-Jun	0	0.85	0.00	0
17-Jun	0	0.42	0.01	0.11
18-Jun	0	0.36	0.84	0
19-Jun	0	0.01	0.17	0
20-Jun	0.01	0.01	0.02	0
21-Jun	0.07	0.01	0.20	0.1
22-Jun	0.33	1.57	0.02	0
23-Jun	0	0.17	0.00	0.18
24-Jun	0	0.00	0.00	0
25-Jun	0	0.00	0.00	0
26-Jun	0	0.00	0.16	0
27-Jun	0	0.01	0.36	0.02
28-Jun	0	0.01	0.01	0
29-Jun	0	0.00	0.00	0.73
30-Jun	0	0.01	0.00	0
1-Jul	0.06	0.00	0.03	0
2-Jul	0	0.16	4.81	0
3-Jul	0	0.00	0	0
4-Jul	0	0.50	0.13	0
5-Jul	0.68	0.38	0	0
6-Jul	0.04	0.00	0	0
7-Jul	0.05	0.00	0	0
8-Jul	0	0.00	2.37	0.02
9-Jul	0	0	0	0
10-Jul	0	0.00	0	0
11-Jul	0	0.00	0	0.06
12-Jul	0.02	0.00	0.27	0
13-Jul	0	0.00	0	0
14-Jul	0	0.00	0	0.2

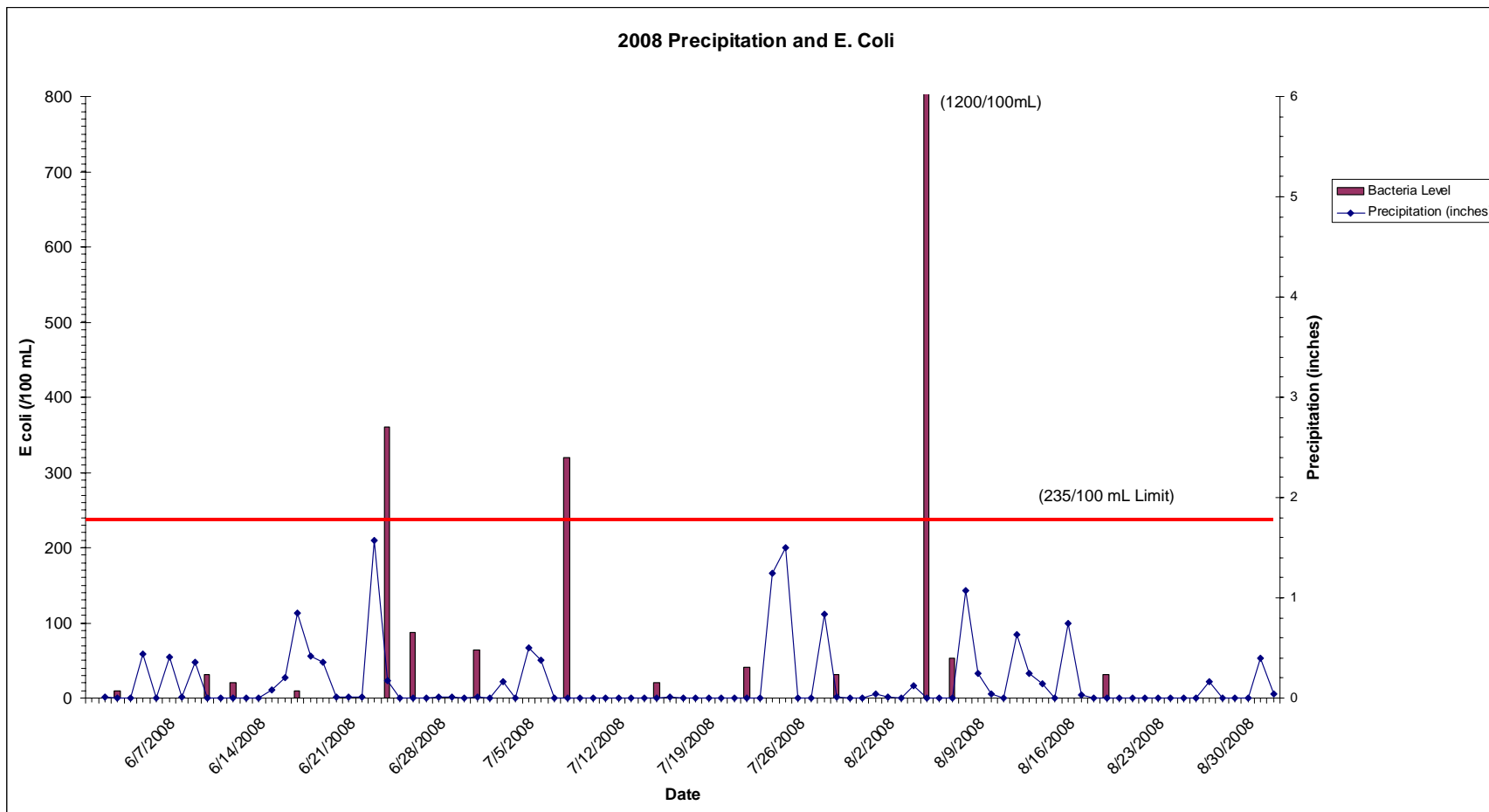
15-Jul	0	0.01	0	0.86
16-Jul	0.13	0.00	0	0
17-Jul	0	0.00	0.12	0
18-Jul	0	0.00	0.34	0
19-Jul	1.11	0.00	0.03	0
20-Jul	1.47	0.00	0	1.2
21-Jul	0	0.00	0.16	0
22-Jul	0	0.00	0.54	0.86
23-Jul	0	1.25	0	0
24-Jul	0.13	1.50	4.06	0.62
25-Jul	0	0.00	0.21	0.26
26-Jul	0	0.00	0.65	0
27-Jul	0	0.84	0.04	0
28-Jul	0.08	0.01	0	0
29-Jul	0	0.00	0	0
30-Jul	0.08	0.00	0.03	0
31-Jul	0	0.04	0	0
1-Aug	0	0.01	2.11	0
2-Aug	0	0	0	0
3-Aug	0	0.12	0	0
4-Aug	0	0	0	0
5-Aug	0	0	0	0
6-Aug	0	0	0	0.15
7-Aug	0.03	1.07	0	0
8-Aug	0.02	0.24	0	0
9-Aug	0.5	0.04	0	0
10-Aug	0	0	0.02	0.02
11-Aug	0.91	0.63	0.04	0
12-Aug	0	0.24	0	0
13-Aug	0	0.14	0	0.01
14-Aug	0.03	0	0.03	0
15-Aug	0	0.75	0	0
16-Aug	0	0.03	0	0.28
17-Aug	0	0	0	0.17
18-Aug	0.12	0	0	0
19-Aug	0	0	0	
20-Aug	0	0	0	
21-Aug	0.04	0	0	0
22-Aug	0.3	0	0	0
23-Aug	0	0	0	3.06
24-Aug	0	0	0	0.01
25-Aug	0	0	0	0.11
26-Aug	0	0.16	0	0.06
27-Aug	0	0	0.02	0
28-Aug	0	0	0	0
29-Aug	0	0	0.86	0
30-Aug	0	0.4	0.59	0
31-Aug	0	0.04	0	0

APPENDIX F: Comparison of *E. coli* Levels to Rainfall - 2007 to 2010

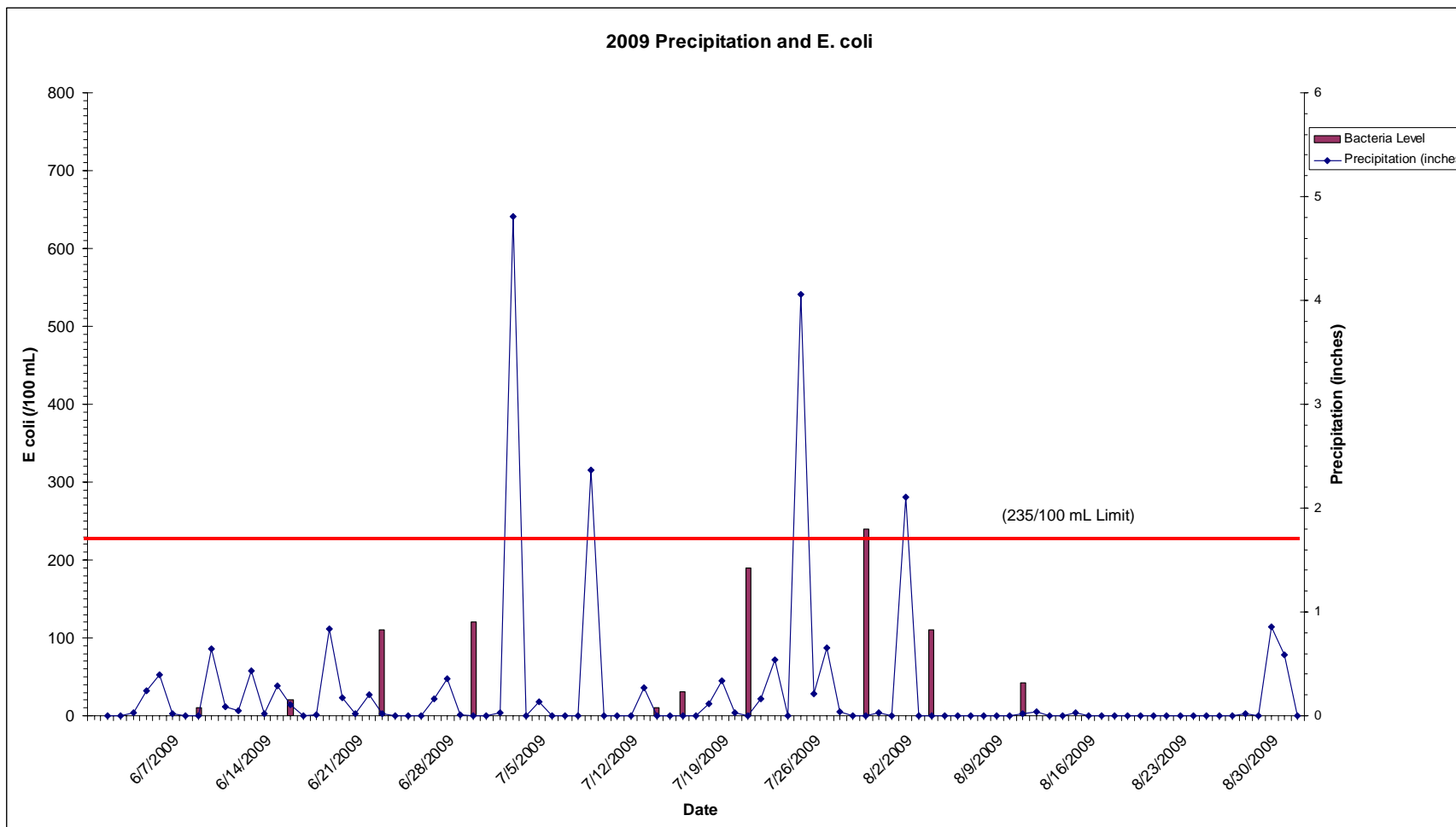
2007 Precipitation and *E. coli* Measurements



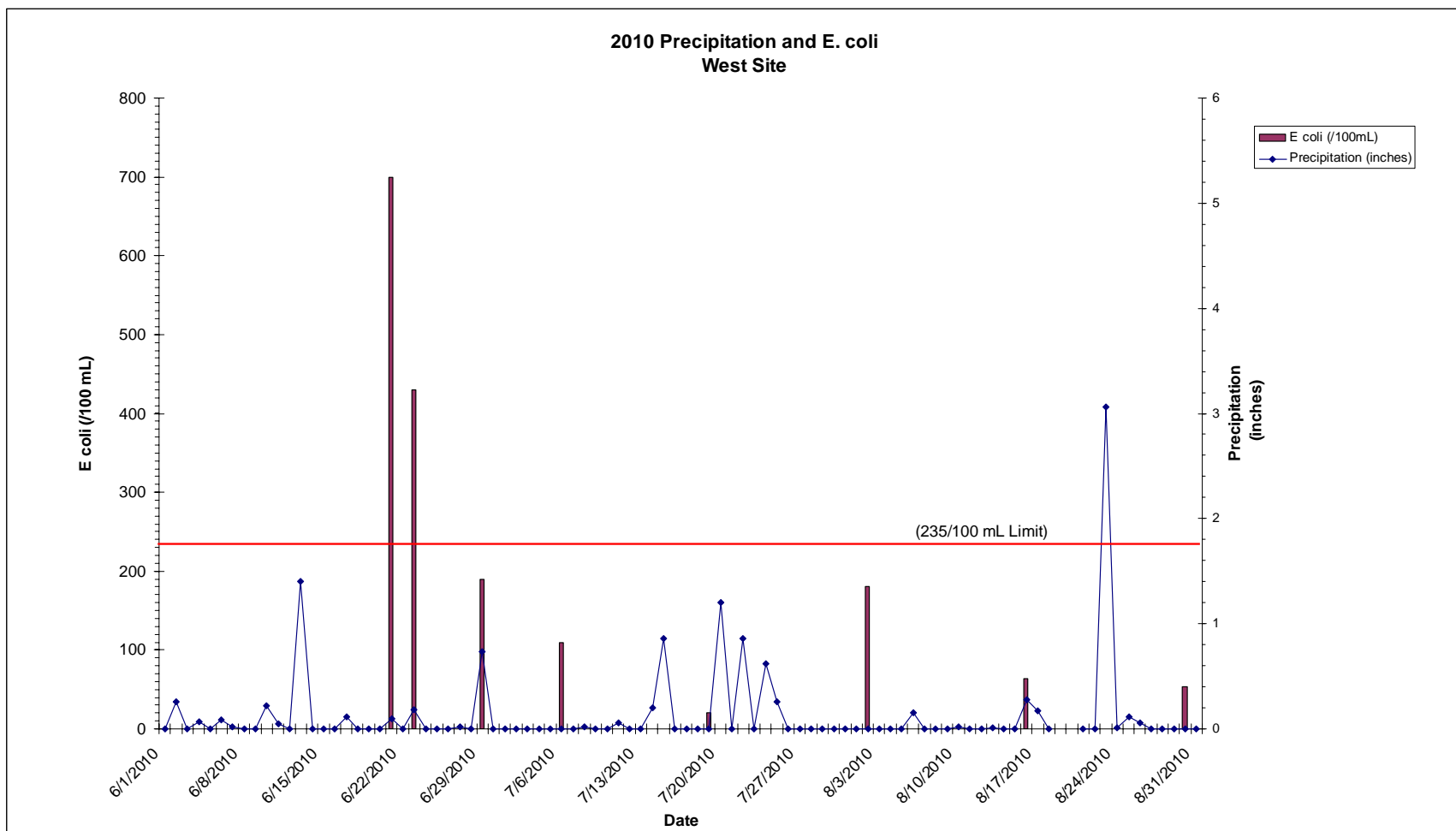
2008 Precipitation and E. coli Measurements



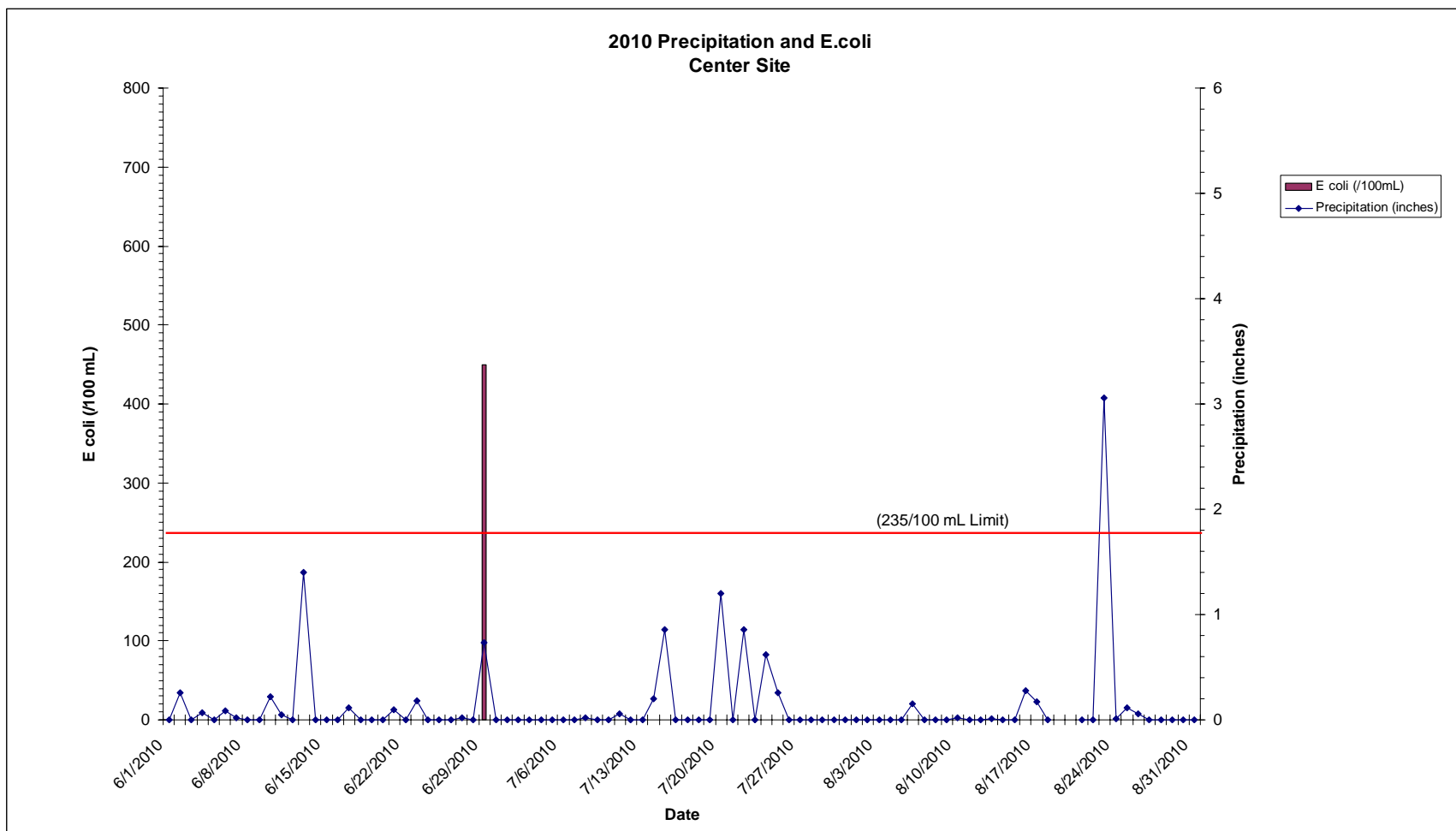
2009 Precipitation and E. coli Measurements



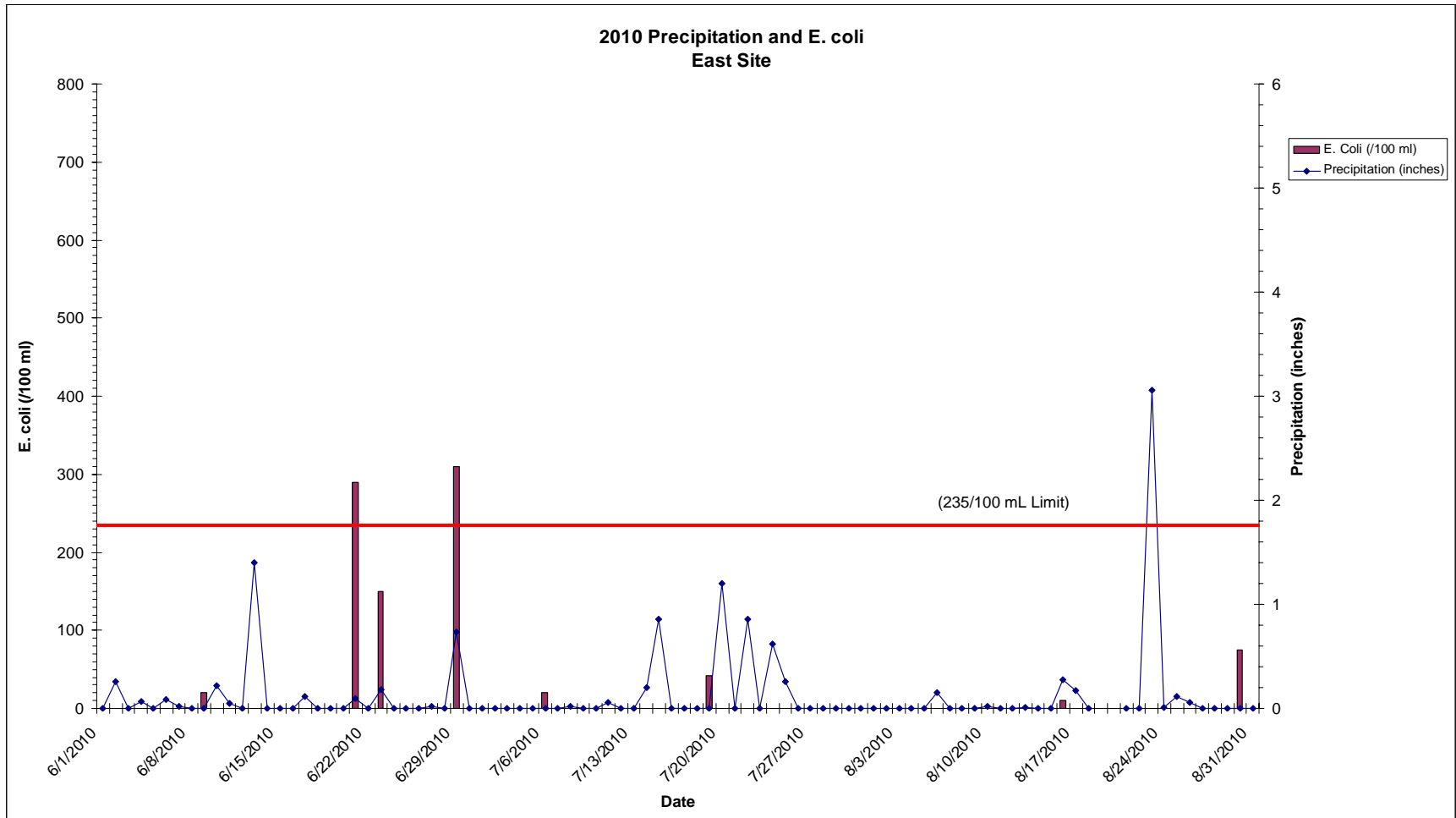
2010 Precipitation and E. coli Measurements West End of Beach



2010 Precipitation and E. coli Measurements Center of Beach



2010 Precipitation and E. coli Measurements East End of Beach



APPENDIX G: Location of Animal Control Facility within Mohegan Park



Dog Pound located near Spaulding Pond

APPENDIX H: Location of Optical Brightener Pad and Drainage Pipes on Ox Hill Road

