Spring Brook No. 1 Watershed Plan



DUPAGE COUNTY STORMWATER MANAGEMENT

NOVEMBER 2015



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1. Abbreviations and Acronyms

ACOE / Army Corps of Engineers: <u>http://www.usace.army.mil/</u>

BMP / Best Management Practice

CMAP / Chicago Metropolitan Association of Planning: <u>http://www.cmap.illinois.gov/</u>

DCSM / DuPage County Stormwater Management: http://www.dupageco.org/swm/

DCCSFPO / DuPage County Countywide Stormwater and Flood Plain Ordinance: http://www.dupageco.org/EDP/Stormwater_Management/Regulatory_Services/1420/

DCHD / DuPage County Health Department: http://www.dupagehealth.org/

DCSMP / DuPage County Stormwater Management Plan: <u>http://www.dupageco.org/EDP/Stormwater_Management/1163/</u>

DRSCW / DuPage River/Salt Creek Workgroup: http://www.drscw.org/

FEMA / Federal Emergency Management Agency: http://www.fema.gov/

FEQ / Full Equations

FPDDC / Forest Preserve District of DuPage County: http://www.dupageforest.org/

GIS / Geographic Information System

HSPF / Hydrologic Simulation Program/Fortran

IDNR-OWR / Illinois Department of Natural Resources – Office of Water Resources: <u>http://www.dnr.illinois.gov/Pages/default.aspx</u>

IEPA / Illinois Environmental Protection Agency: http://www.epa.illinois.gov/index

NRCS / Natural Resources Conservation Service: http://www.nrcs.usda.gov

NIPC / Northern Illinois Planning Commission

IDOT / Illinois Department of Transportation: http://www.idot.illinois.gov/

POTW / Publically Owned Treatment Works

SMPC / Stormwater Management Planning Committee

TCF / The Conservation Foundation: http://theconservationfoundation.org/

TMDL / Total Maximum Daily Load

TSF / Time Series File

- USEPA / United States Environmental Protection Agency: <u>http://www.epa.gov/</u>
- USGS / United States Geological Survey: <u>http://www.usgs.gov/</u>
- WPD / Wheaton Park District: http://www.wheatonparkdistrict.com/

2. Executive Summary

What is a watershed?

Everyone in DuPage County lives in a watershed or area of land that drains water to a stream or lake. Although the definition is simple. the interaction between natural elements, such as climate, surface water, groundwater, vegetation, wildlife, and humans, is complex. It is the human influences that can have the biggest impact by producing polluted stormwater runoff. increasing impervious surfaces and erosion, and altering stormwater flows.

Spring Brook No. 1 is a subwatershed within the West Branch DuPage River watershed. The West Branch DuPage River headwaters originate in Cook County where the waterway flows generally north to south into and through DuPage County. Overall, the West Branch DuPage River watershed encompasses approximately 128 square miles and joins with the East Branch DuPage River near Bolingbrook in Will County. The main channel of West Branch DuPage River has a total length of 32 miles and an average slope of approximately 0.06%.

The Spring Brook No. 1 watershed covers approximately 7.7 square miles (4,921 acres) including Wheaton and unincorporated Milton and Winfield townships. The creek flows into the West Branch DuPage River just upstream of the intersection of Butterfield and Batavia Roads.



Spring Brook No. 1 is a heavily urbanized stream located in primarily residential areas and eventually flows through open areas before reaching the West Branch DuPage River. It could be categorized as a typically degraded urban stream that receives flashy flows, with unstable streambanks, poor water quality, and even worse aquatic life. But this poor prognosis does not mean there is no hope for urban streams. Watershed planning can provide the tools and resources to help revitalize watersheds like Spring Brook No. 1.





Why does Spring Brook No. 1 need a watershed plan?

DuPage County develops watershed plans for many reasons. Watershed plans can identify the potential for stormwater damage to public health, safety, life, and property. The plans can protect and enhance the quality, quantity, and availability of surface and groundwater resources. They encourage preservation of aquatic and riparian environments and control sediment and erosion in and from drainageways, developments, and construction sites.

What is an impaired waterbody? IEPA defines an impaired waterbody as a waterbody (i.e., stream reach, lake, waterbody segment, etc.) that does not support its designated use. If the waterbody is impaired, it is placed on the section §303(d) list.

What is the purpose of this watershed plan?

Spring Brook No. 1 has been listed by Illinois Environmental Protection Agency (IEPA) as an *impaired* waterbody. If an impaired waterbody does not support its designated use for recreation or aquatic life then a plan can help identify not only the current stressors but also those projects and/or activities that will provide a water quality benefit to the watershed.

Spring Brook No.1 is on IEPA's §303(d) impaired waters list. It was first added to Illinois' §303(d) list in 2006 and currently is listed as not supporting neither the aquatic life use nor the primary contact recreation use. The pollutant causes for the impairment listings are chloride, total phosphorus, copper, and fecal coliform bacteria, while low dissolved oxygen concentrations were noted to impact aquatic life. Alteration of streamside vegetative cover and loss of instream cover negatively affect aquatic life, as well. Finally, Silver Lake, a converted quarry lake located within the Blackwell Forest Preserve, is currently listed as impaired for not supporting the aesthetic quality use due to unknown causes. These listings and the recognition that Spring Brook No. 1 has localized flooding concerns prompted the need for development of a watershedbased plan.

What does the Spring Brook No. 1 Watershed Plan hope to accomplish?

In August 2014, as part of development of the *Spring Brook No. 1 Watershed Plan*, a stakeholder group, representing a diverse network of residents, business officials, and government agency staff members, was formed. The primary goal of the stakeholder group is to educate a diverse audience and build partnerships for projects that improve water quality, reduce localized flooding, preserve ecosystems, restore wetlands, and enhance other natural features for current and future generations.

Watershed Goals

- 1. Improve water quality and stream geomorphology within the watershed;
- 2. Update County and local ordinances to protect watershed resources;
- 3. Incorporate green infrastructure into the watershed, whenever possible;
- 4. Manage and mitigate for existing and future flooding problems; and
- 5. Implement additional outreach throughout the watershed.

WATERSHED THREATS

- STORMWATER RUNOFF, SALTS, EROSION, AND BACTERIA ARE MAJOR THREATS TO WATER QUALITY.
- CHANNELIZATION OF THE STREAM HAS CREATED EXTENSIVE WATER QUALITY AND EROSION PROBLEMS.
- LACK OF NATIVE BUFFERS AND WETLAND AREAS WHICH PROVIDE WATER QUALITY AND STABILIZATION BENEFITS.
- DETENTION BASINS PROVIDE POOR WATER QUALITY WITH LACK OF NATIVE VEGETATION AND ERODED BANKS.
- STREAMS ARE CLASSIFIED AS HIGHLY ERODED IN MANY AREAS.
- OLD AND/OR FAILING SEPTIC SYSTEMS ARE POTENTIAL NUTRIENT AND BACTERIA THREAT.

The most widespread challenges facing the Spring Brook No. 1 watershed (and many other watersheds in DuPage County) are the altered and unstable related to hydrologic system caused by past land uses. The sources of these challenges are part of a natural watershed response to disturbance, but in many cases are being exacerbated by current human activity. These activities prevent the watershed from achieving its full habitat potential and improving its resilience to climate change and other potential Improving the unstable disturbances. hydrologic system, reducing pollutant loads, and establishing a more stable and resilient Spring Brook No. 1 watershed will take time. This watershed plan will provide the community with some solutions to successfully meet those challenges.

In order to realize the vision and long-term goals for the Spring Brook No. 1 watershed, best management practices are recommended to set the stage for work that is needed to address current water quality and quantity concerns within the watershed. From protection to restoration to outreach, the recommendations, derived based on land use and unique hydrologic features, are designed to reduce or prevent nonpoint source pollution and also to build a base of knowledge about the watershed that will allow future management efforts to adapt to changes in human needs and pressures on watershed resources. General recommended actions included in the *Spring Brook No. 1 Watershed Plan* are summarized below:

- 1. Reduction of chloride application through use of prewetting/anti-icing techniques, changes in services expectation, calibration, and handling/storage of product.
- 2. Streambank stabilization, coupled with volume reduction, through bioengineering practices.
- 3. Increase of riparian buffer and wetland area to assimilate pollutant loads, detain flood water, establish habitat, and provide stabilization.
- 4. Naturalize ponds to include stabilization of the banks, establishment of vegetation to provide filter strips and discourage goose foraging, reduce algal blooms, and reestablish intended flood storage.
- 5. Enhance the hydrology of the stream channel to include pool and riffle sequences, substrate material, sinuosity, floodplain access, dam modification, and aquatic life refugia.
- 6. Incorporate green infrastructure practices into watershed plan and planning process, whenever applicable.
- 7. Provide continued watershed educational outreach.



Figure 1. Existing conditions of the Spring Brook No. 1 riparian corridor

For recommended items, the party best suited to implement the task was identified, along with estimated cost and potential funding sources. A measure of success was also identified for each action item to assist in evaluation of plan progress. Finally, a timeframe of ten years was used to determine the scope of activities for planning purposes.

3. Introduction

3.1 Watershed Planning Overview

Since the late 1980s, watershed organizations, tribes, and federal, state and local agencies have moved toward managing water quality through a watershed approach. A watershed approach is a flexible framework for managing water resource quality and quantity within specified drainage areas, or watersheds. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. The watershed planning process works within this framework by using a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies, and implement and adapt selected actions, as necessary. The outcomes of this process are documented or referenced in a watershed plan.

A watershed plan is a strategy that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing, and providing a timeframe for implementing the plan. The development of watershed plans requires a certain level of technical expertise and the participation of a variety of people with diverse skills and knowledge.

3.2 Watershed Planning Process

3.2.1 Development of Watershed-Based Plans

The *DuPage County Stormwater Management Plan*, approved by the DuPage County Board in September 1989, states what will be part of each watershed plan: updated and revised flood plain maps; recommended remedial improvement projects, both structural and nonstructural, to alleviate current and anticipated flooding problems; identification of natural storage areas, including wetlands; identification of significant natural areas; identification of groundwater recharge areas within the watersheds; recommended site runoff and watershed storage criteria balanced with the watershed capacities; and flood forecasting recommendations.

In March 2008, the United States Environmental Protection Agency (USEPA) published a *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. The purpose of that document is to provide information on developing and implementing watershed management plans that help to restore and protect water quality. USEPA identifies nine key elements that are critical for achieving improvements in water quality, requires that these nine elements be addressed in watershed plans funded with incremental Clean Water Act §319 funds, and strongly recommends that they be included in all other watershed plans intended to address water quality impairments. The nine elements of watershed plans include:

1. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan. Sources that need to be controlled should be identified

at the significant subcategory level along with estimates of the extent to which they are present in the watershed.

- 2. An estimate of the load reductions expected from management measures.
- 3. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions and a description of the critical areas in which those measures will be needed to implement this plan.
- 4. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.
- 5. An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
- 6. Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.
- 7. A description of interim measureable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
- 8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.
- 9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established.

The Spring Brook No. 1 Watershed Plan addresses all components identified in the DuPage County Stormwater Management Plan or Handbook for Developing Watershed Plans to Restore and Protect Our Waters.

3.2.2 Data Collection and Review

A number of federal, state, local, and private entities monitor waterbodies across the nation. These data might represent specialized data collected to answer a specific question about waterbody conditions, or the data might be collected regularly as part of a fixed network of long-term monitoring to assess trends in water quality. Monitoring data, including chemical, physical, and biological data, are critical to characterizing a watershed. Without such data, it is difficult to evaluate the condition of the waterbodies in a watershed. The waterbody data gathered and evaluated for the watershed characterization typically include flow, water quality (e.g., chemical concentrations), toxicity, and biological data. Other specialized datasets, such as physical stream assessments or groundwater studies, might also be available.

Data that characterizes the condition of Spring Brook No. 1 comes from a variety of sources. In October 2009, IEPA finalized the *DuPage River/Salt Creek Watershed TMDL Stage 1 Report*, which summarized the initial stages in development of a Total Maximum Daily Load (TMDL) for seventeen waterbody impairments (including Spring Brook No. 1) throughout those watersheds. A TMDL is an estimation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. It assesses contributing point and nonpoint sources to identify pollution reductions necessary for designated use attainment. Pollutant reductions are then allocated to contributing sources, thus triggering the need for pollution control and increased management responsibilities amongst sources in the watershed. For this report, IEPA collected all available chemical data, specifically, that which had been collected by the Wheaton Sanitary District adjacent to its waste water treatment facility on Shaffner Road.

In response to concerns about the TMDL that was being developed, a local group of communities, Publically Owned Treatment Works (POTWs), and environmental organizations came together to better determine the stressors to the aquatic systems through a long term water quality monitoring program and develop and implement viable remediation projects. The DuPage River/Salt Creek Workgroup (DRSCW) began collecting data throughout the West Branch DuPage River watershed in 2006 and established two monitoring stations, where chemical, biological, and habitat information is collected at a frequency of once every three years, along Spring Brook No. 1 as part of the network.

Additionally, as part of this watershed plan development, stream assessments were performed for Spring Brook No. 1 mainstem along with its main tributary identifying streambank vegetation, erosion, stabilization, pool and riffle areas, and sedimentation problems. Recommendations of projects will be based on some of the information provided from the field assessments. Some of the areas identified had prior stabilization attempts and those areas will need to be evaluated more thoroughly for specific recommendations. Stream assessment locations are identified in **Figure 2**. Streams were assessed using the following methodology:

- *Channel conditions*: Water depth, bottom channel width, top channel width, bank height, and velocity;
- *Channel flow (stream stage):* A 0-10 scale of identifying water levels in channel with riffle substrate or erosion percentages provided, channelization, and bankfull and baseflow sinuosity;
- *Degree of bank erosion (overall):* A 10-0 scale with left/right bank stability differentiated, with degree of armoring also identified;
- *Sediment accumulations*: A 10-0 scale of sediment accumulations within streambed based on percentages;
- *Floodplain vegetation (100 feet of stream)*: Percentage of dominant land use and land cover identified on both banks;
- *Width of vegetated buffer*: A 0-10 scale of both banks based on buffer width and impacts from human activities; and
- *Bank vegetation (within 10 feet of stream):* Percentage of predominant vegetation on both banks and canopy.



Figure 2. Stream assessment locations

Wetland areas and ponds were also assessed to identify vegetation, erosion and/or sedimentation problems, and adjacent land use. Some of these areas will be evaluated for enhancement, restoration, and conversion to native vegetation, as detailed later in the document. Wetland and pond assessment locations are identified in **Figure 3**. Ponds were assessed with the following methodology:

- *Degree of bank erosion (overall):* A 10-0 scale used to identify bank stability, with degree of armoring also noted;
- *Pond vegetation (within 100 feet of pond):* Percentage of dominant land use, predominant vegetation and buffer width identified; and
- *General notes*: Presence of geese, trash, accumulated sediment, condition of inlet/outlet structures, algae, etc.



Figure 3. Pond assessment locations

Substantial stakeholder outreach efforts were used to gather additional Spring Brook No. 1 characterization, including a survey sent to residents looking to identify areas that flood, determine streambank erosion rates, and determine resident opinion of the stream as a resource. Additionally, a significant number of meetings have taken place with stakeholders to obtain information and project designs that have been developed by other watershed partners. These efforts are summarized below.

3.2.3 Stakeholder Recruitment and Involvement

Bringing together people, policies, priorities, and resources through a watershed approach blends science and regulatory responsibilities with social and economic considerations. The very nature of working at a watershed level means planners should work with at least one partner to improve watershed conditions. In addition, watershed planning is often too complex and too expensive for one person or organization to tackle alone. Weaving partners into the process can strengthen the end result by bringing in new ideas and input and by increasing public understanding of the problems and, more important, public commitment to the solutions. Partnerships also help to identify and coordinate existing and planned efforts.

DuPage County began stakeholder involvement early in the watershed planning process in order to utilize the experience and knowledge of all of the resources within the Spring Brook No. 1 watershed. The first step was to identify potential stakeholders including staff from municipalities, school districts, state agencies, public organizations, businesses, religious entities, and residents. Additionally, a survey was sent to the owners of all parcels located within thirty feet of the Spring Brook No. 1 mainstem. The intent of the survey was to obtain information from the property owner on topics of flooding, water quality, property loss from erosion, and the general perception of the stream as a resource. These responses were useful in defining the property owner concerns in the watershed.



Figure 4. Welcome display at the open house event

The Forest Preserve District of DuPage County (FPDDC) and DuPage County Stormwater Management (DCSM) partnered to host a kickoff event for the watershed plan at the Urban Stream Research Center in the Blackwell Forest Preserve on August 2, 2014. Several of the principal watershed stakeholders were on-hand with activities, exhibits, demonstrations, and tours to highlight the resources that were going to be addressed within the developed plan. The event was well attended by residents, elected officials, municipal leaders, and other interested parties.

Subsequent meetings were held with the representative stakeholders to provide information on Spring Brook No. 1 current water quality, stream and pond assessments, potential projects, and flooding concerns.

Much of the interest with regards to watershed protection and enhancement can be broadly categorized to the following themes:

- *Flooding*: Attempt to reduce continuous flood damage to structures and prevent increased flood damage within the watershed;
- *Natural Resource Protection:* Protect and enhance water quality to include instream habitats, wetlands, and riparian areas to minimize streambank erosion and propagate diverse aquatic life;
- *Recreational Usage*: Reduce bacteria concentrations within the stream to allow for safe passive recreational opportunities; and
- *Enhanced Outreach:* Develop educational tools to disseminate information encouraging practices that protect water quality, encourage stormwater management, and assist in addressing flooding issues.

3.2.4 Watershed Plan Adoption

As a result of severe flooding that occurred in the region in 1987, Illinois Compiled Statutes, Chapter 55, §5/5-1062 was enacted through P.A. 85-905, which allows for the management and mitigation of the effects of urbanization on stormwater drainage in metropolitan counties located in the area served by the Northeastern Illinois Planning Commission (now known as the Chicago Metropolitan Agency for Planning or CMAP). That legislation sought to consolidate the existing stormwater management framework into a united, countywide structure; set minimum standards for floodplain and stormwater management; and prepare a countywide plan for the management of stormwater runoff, including the management of natural and man-made drainageways.

Following authorization allowed through §5/5-1062, the DuPage County Board, through Resolution PW-0326-87, established a Stormwater Management Planning Committee (SMPC). The SMPC was originally composed of four County Board members and four representatives of the municipalities located within DuPage County, but membership has since expanded to include six members from each group. The principal duties of the SMPC are to develop a Stormwater Management Plan for presentation to and approval by the County Board (adopted in 1989) and to direct the Plan's implementation and revision. Once adopted, the *Spring Brook No. 1 Watershed Plan* will be incorporated into Appendix N (*West Branch DuPage River Watershed Plan*) of the *DuPage County Stormwater Management Plan*.

Prior to final adoption, considerable review from both government officials, members of the public, and other interested parties was allowed. The initial draft of the Spring Brook No. 1 Watershed Plan was presented to members of the stakeholder group for comment. The draft was then finalized and brought before the SMPC, at the April 21 meeting, for authorization to commence a 30-day public comment period. Applicable comments and suggested modifications were incorporated into the watershed plan before being sent to both IEPA and USEPA for review and approval. Final adoption of the Spring Brook No. 1 Watershed Plan was approved by the SMPC and County Board at their _____ and _____ meetings, respectively.

4. Watershed Characteristics Assessment

4.1 Watershed Description

The West Branch DuPage River watershed is located in approximately the western third of DuPage County and is part of the DesPlaines River watershed. The headwaters originate in Cook County where the waterway flows generally north to south into and through DuPage County. Overall, the West Branch DuPage River watershed encompasses approximately 128 square miles at the confluence with East Branch DuPage River (near Bolingbrook in Will County). The main channel of West Branch DuPage River has a total length of 32 miles and an average slope of approximately 0.06%. The watershed is a highly developed, urban environment which once supported approximately 26,217 acres of wetlands in DuPage County alone, and now supports roughly 5,843¹.

4.2 Subwatershed Description

The Spring Brook No. 1 watershed covers approximately 7.7 square miles (4,921 acres) including the City of Wheaton and unincorporated Milton and Winfield townships. The creek flows into the West Branch DuPage River just upstream of the intersection of Butterfield Road and Warrenville Road. The watershed encompasses downtown Wheaton, the Wheaton Sanitary District Waste Water Treatment Facility (design average flow of 8.9 million gallons per day), and the Roy C. Blackwell Forest Preserve.

The headwaters of the Spring Brook No. 1 watershed include the heavily urbanized residential and commercial land uses of downtown Wheaton, including a dense network of roadways and railroad tracks. In the upper third of the watershed, stormwater runoff collects in the storm sewer system or flows overland to a defined channel beginning at Elm Street. The middle third of the watershed, from Elm Street to the wastewater treatment plant, is predominantly single family residential subdivisions ranging from ¹/₄-acre lots to 1-acre lots, with open space uses including the Chicago Golf Club. The downstream third of the watershed is primarily open space consisting of the St. James Farm and Roy G. Blackwell Forest Preserves and low density single family residential neighborhoods.

Downstream of Elm Street, a quarter mile south of Roosevelt Road, the creek flows out of the storm sewer into a tree-lined channel. This channel continues southwest past Edison Middle School and through a 7.0-foot by 11.44-foot arched bridge under Hawthorne Lane. Continuing to the northwest, the creek passes Wheaton Cemetery and the Chicago Golf Club before crossing Warrenville Road in an 8-foot by 12-foot concrete box culvert.

The mostly tree-lined and well-defined creek channel continues through residential neighborhoods and under the Prairie Path, Gables Boulevard, and Aurora Way. These streets are crossed in a 12-foot by 12-foot arched bridge, a 7-foot by 14-foot concrete box culvert, and an 8-

¹ Wetland acreage estimates based on hydric soils data and the DuPage County Wetland Inventory.

foot by 14-foot concrete box culvert, respectively. Continuing west, the creek passes under a pedestrian bridge, through a series of heavily armored level pools, and under bridges at Creekside Drive and Stonebridge Avenue.

Downstream of Stonebridge Avenue, the creek passes under a second pedestrian crossing and enters the Wheaton Sanitary District property crossing under the treatment plant entrance bridge. Through the treatment plant the creek passes under two additional access road bridges and continues into Atten Park, crossing under the park entrance road bridge. The creek then flows west beneath the Essex Road bridge, the St. James Farm access road bridge, a pedestrian bridge, and the Winfield Road bridge.

Once under Winfield Road, the creek enters the Blackwell Forest Preserve. Within the preserve the tree-lined creek turns to the southwest and passes through an on-stream reservoir created by a weir upstream of the 84-inch corrugated metal pipe (CMP) under the preserve access road. A natural flow split occurs downstream of the access road, with the main flow path to the east of a secondary overflow path. The two flowpaths join together upstream of a wood plank bridge at Morris Court. Before discharging into the West Branch DuPage River, the creek is crossed one final time with a 4-foot by 6-foot CMP arch culvert at the Cenacle Retreat Center.

4.2.1 Geology and Soils

The soils and geology provide the key to a watershed's ability to infiltrate water, hold water, and resist erosive forces. Geologically, DuPage County is located in the Central Lowland Province. The Natural Resources Conservation Service's (NRCS) *Soil Survey of DuPage County, Illinois* (1997) was used to conduct a soil analysis for the Spring Brook No. 1 watershed. The data was utilized to determine the range of soil types, the extent of hydric soils, soil susceptibility to erosion, and the infiltration capacity.

DuPage County is characterized by moraines, outwash plains, lake plains, kames, stream terraces, flood plains, and The soils of DuPage County wetlands. originated almost entirely from the Wisconsin Glacier Era material: compact mixture of gravel, sand, silt, and clay. Figure 6 displays each of the soil series coverages. Markham, Orthents, Sawmill, Ozaukee, Drummer, Ashkum, Beecher, and Martinton soils are dominant soil series in the watershed. Markham and Ozaukee soils found on uplands are generally well drained and suitable for development. Historic native vegetation growing on these areas

consisted primarily of prairie and hardwood trees. Sawmill, Ashkum, and Drummer soils are generally found in wetlands or drained wetlands and are poorly drained soils. These

types of soils are considered to be hydric.

Figure 5. Example of Drummer type soil

Image taken from extension.illinois.edu/soil /less_pln/color/il.htm





Figure 6. Location and types of soils located within the watershed

Hydric soils are wet frequently enough to produce conditions that are devoid of oxygen (anaerobic) thereby influencing the plant species that can grow there. These areas provide opportunities for wetland restoration/enhancement and stormwater storage. Historic native vegetation in these areas consisted of water tolerant grasses, forbs, trees and shrubs.



Figure 7. Location and types of hydric soils within the watershed

4.2.2 Land Use and Land Cover

Spring Brook No. 1 watershed land use remains predominantly developed (see **Figure 8**), especially in the headwaters area. The majority of the developed areas are located within the City of Wheaton with medium density development consisting mainly of residences and the parcels classified as open space consisting of recreational facilities, cemeteries, golf courses, and schools. The high intensity development consists mainly of public roads, including US Route 38 (Roosevelt Road), as well as some commercial and institutional land uses.

Table 1. Lanu use	Summary (2009)
Landuse Type	Percentage of Watershed
Agriculture ²	0.53
Commercial	1.99
Industrial	0.04
Institutional	6.39
Multi-Family	3.51
Open Space ³	30.59
Residential	46.81
Transportation	8.79
Vacant ⁴	1.35

Table 1.	Land	use	summary	(2009)

Evaluating the land uses of a watershed is an important step in understanding the watershed conditions and source dynamics. Land use types, together with other physical features such as soils and topography, influence the hydrologic and physical nature of the watershed. In addition, land use distribution is often related to the activities in the watershed and, therefore, pollutant stressors and sources. Sources are often specific to certain land uses, providing a logical basis for identifying or evaluating sources.

4.2.3 Floodplain Mapping Efforts

To address flooding and enhance water quality, the Federal Emergency Management Agency (FEMA) requires municipalities to perform floodplain mapping and develop management plans to receive federal flood insurance. This information is also relevant to water quality protection and restoration activities because floodplains, when inundated, serve many functions and provide important habitats for a variety of fish and wildlife. Floodplains are important for spawning and rearing areas. Floodplain wetlands act as nutrient and sediment sinks, which can improve water

² Agriculture totals consist of undeveloped land being used for cultivation of crops and raising livestock. Also includes commercial nurseries.

³ Open space totals consist of the following categories: (1) Local Open Space- open space land and associated parking owned and maintained by a municipal or park district. Also includes swimming pools and recreation centers maintained by the municipality or park district. (2) Regional Open Space- open space land owned and maintained by the county forest preserve. (3) Other Open Space- golf courses, cemeteries, the Illinois Prairie Path, and any other open space that is not defined elsewhere.

⁴ Vacant totals consist of land which is not developed and that is not being used for any other purpose.

quality in streams. They also provide storage that can decrease the magnitude of floods downstream, which can benefit fish and landowners in riparian areas. In addition, streams that are actively connected to their floodplains are less prone to severe downcutting and erosion.



Figure 8. Impervious cover within the watershed

In 2008, DCSM received grant funds from FEMA to perform new studies and develop updated floodplain maps for twenty-five different watersheds in DuPage County, including Spring Brook No. 1. Revised floodplain maps were submitted to the Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR) for review and approval of the hydraulic modeling and proposed floodways. In January 2013, DuPage County received initial approval from IDNR-OWR of the hydraulic modeling and proposed floodways for Spring Brook No. 1, with final approval coming in August 2014. An updated countywide floodplain map is being produced that includes the twenty-five revised watersheds as well as those areas that were not revised with new studies. It is expected that an updated countywide map will become effective by FEMA sometime in late 2016. The remaining watersheds in DuPage County that were not part of the FEMA grant work will be restudied and floodplain maps will be produced internally within the DCSM on a time schedule yet to be determined. As updated maps are produced they will be submitted individually to the IDNR-OWR and to FEMA as Physical Map Revisions (PMR). The frequency with which the PMR's can be submitted is dependent on the number of staff assigned to the project.

4.2.4 Wetlands and Riparian Zones

Wetlands play an important role in supporting the health of the watershed. They facilitate the recharge and discharge of groundwater, which results in a replenished aquifer and cooler instream water temperature. Wetlands also filter sediments and nutrients in runoff, provide necessary wildlife habitat, reduce flooding, and help maintain stable water, temperature, and chemistry levels in streams. Wetlands and their buffers provide the substrate for a complex web of organic and inorganic processes. The products of these ecosystems, which then flow downstream, are crucial resources for a properly functioning riverine ecosystem and riparian environment. By performing these functions, wetlands improve water quality and biological health of streams and lakes located downstream while helping to protect public safety.

As with most of the DuPage County area wetlands, those within the Spring Brook No. 1 watershed were relatively intact until European settlers began to alter significant portions of the watershed's natural hydrology and wetland processes for the rich agricultural resources. Wetland loss within the watershed has been slowed since the inception of the *DuPage County Countywide Stormwater and Flood Plain Ordinance* (DCCSFPO) in 1991. Many of the wetlands within the Spring Brook No. 1 watershed are degraded areas that have been ravaged by invasive species and receive little to no management. As a result, the public perception of these areas may be that they have little to no value, which is not the case. All of the wetland areas and their buffers are protected under the DCCSFPO and most are also federally protected. As a result, all but the most minor of impacts⁵ as a result of local development will require mitigation or compensation.

According to historic soil maps prior to settlement, the Spring Brook No. 1 watershed consisted of approximately 2,288 acres of hydric or potential wetland areas. Wetland mapping from the National Wetland Inventory (NWI) and DuPage County resources identify approximately 213 acres of existing wetland still remaining. This signifies that the Spring Brook No. 1 watershed has lost a staggering 90.7% of its original wetland resources. In 2013, DuPage County received a grant from USEPA to update the County's wetland maps. This work was finalized in July 2015.

Historic wetlands loss is largely attributed to physical alterations made through the removal or addition of material such as dredging, filling, or draining. These impacts were sometimes regulated through the federal and state wetland permitting process; however, even with additional regulations, many wetlands remain susceptible due to indirect impacts, such as those caused by uncontrolled stormwater discharges from upstream development. Altered hydrology, increased pollutant loadings, and buffer encroachment caused by urbanization often promote the spread of invasive species, reduce native habitat and vital ecosystem processes, and increase sediment deposition.

Wetlands within the Spring Brook No. 1 watershed are relatively degraded systems in the upper headwaters, which is probably due to the high urbanization of the area. Lower in the watershed, the land use changes from predominantly residential to consisting more of open areas such as the

⁵ Such exempt impacts are defined in §15-86.C.1 of the DCCSFPO.

Chicago Golf Club and Cantigny Golf courses and several preserves, namely Blackwell Forest Preserve and St. James Farm Forest Preserve. Within these forest preserves are larger wetland complexes with some remnant pockets of high quality vegetation.



Figure 9. Remaining wetland areas within the watershed

4.2.5 Riparian Zones

Riparian areas within DuPage County are protected under Article XII of the DCCSFPO. Under this protection, use or development within the riparian area is limited or restricted to certain activities. Some of the banks of the Spring Brook No. 1 stream channel are highly incised and close to residential properties. Some of the areas are within open space, but still show signs of degraded and destabilized banks, heavy sedimentation, and weedy species dominating the edges of the stream. Riparian areas are defined as the limits of the 100-year floodplain with a minimum width of 15 feet from any Waters unit.

The riparian areas of Spring Brook No. 1 have a varied component to the landscape. Some of the areas are vegetated, but the predominant vegetation is undesirable weedy or invasive species, maintained turf grass, retaining walls, parking lots, structures, and ornamental landscaping. In sections around Kelly Park, the Wheaton Sanitary District, and Cantigny Foundation property, there are indications of past stabilization projects. Some of these techniques are still functioning

and some are in need of replacement. The practices observed along Spring Brook No. 1 are concrete A-Jacks, fiber coir logs, and native plantings. While some of these practices may have been successful, additional reaches along the stream would benefit from stabilization projects. Implementation of stabilization practices would not only provide much needed stability for adjacent property owners, but would reduce transport of sediment and associated nutrient loads to the stream while providing aquatic and wildlife habitat. Aside from the stabilization of erodible soils, the Spring Brook No. 1 watershed would benefit from an increase in buffers adjacent to the entire creek in order to address the water quality impairments.



Figure 10. Example of Spring Brook No. 1 riparian area

Table 2.	Spring	Brook No. 1	watershed	natural	areas summar	v
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Natural Area	Stream	Lakes	Ponds	Wetlands
Size	9.9 miles	60.2 acres	36.26 acres	213 acres

4.2.6 Silver Lake

Silver Lake is a 60.2-acre gravel/clay pit lake located in the Blackwell Forest Preserve. The lake was originally dug from 1965-1968 and was later expanded during 1973-1976. As a gravel and clay pit, Silver Lake is a steep-sided, clear-water lake typical of many gravel pits or quarries in the region. It has a good mix of deep water (north bay) and shallow littoral zone (south bay). The lake has a maximum depth of 31.0 feet, an average depth of 13.4 feet, and a storage capacity of 806.7 acre-feet of water. The shoreline length is 2.32 miles. Sand/gravel/clay substrate is common throughout the lake. Water transparency is high with Secchi visibility between 3.1 and 18.9 feet during spring months. Conductivity ranges between 500 and 1,000 μ mS/cm. The contributory watershed is small and isolated and groundwater is the principal water source. Silver Lake has plentiful shoreline access, fishing piers, boat rental, and a multiple lane concrete ramp for the launching of private boats (trolling motor only). Silver Lake is one of many lakes and ponds owned and maintained for sport fishing by the FPDDC.



Figure 11. Silver Lake being used primarily for recreational purposes

Silver Lake is currently listed as impaired for not supporting the aesthetic quality use due to unknown causes (assessment unit IL_RGD). The impaired listing was first included on the 2006 §303(d) list. In 2002 and 2004, Silver Lake was noted to be only partially supporting the secondary contact recreation caused by pH and aquatic plants (native). Potential sources of the partial support included habitat modification, streambank modification/destabilization, waterfowl, and forest/grassland/parkland.



Figure 12. Comparison of Silver Lake in 1956 and 2012⁶

⁶ Note the gravel pit activity in the 1956 aerial photograph.

4.2.7 Watershed Demographics

Demographic data include information on the people in the watershed, such as the number of persons or families, commuting patterns, household structure, age, gender, race, economic conditions, employment, and educational information. This information can be used to help design public outreach strategies, identify specific subpopulations to target during the implementation phase, or help determine future trends and needs of the populations. Additional outreach efforts can also be provided using this information.

Analysis of watershed demographics provide certain information specific to the Spring Brook No. 1 watershed:

1. The median age of watershed residents varies sharply between the upper and lower portions of the watershed, with the median age of the upper watershed less than 40 years and over 40 years of age in the lower. The success of outreach efforts may be affected by the age of the resident targeted: Both deliverable medium (electronic versus paper messaging) and type of events targeted for outreach may vary depending on the targeted audience.



Figure 13. Median age displayed by census tract

2. The population density of an area typically indicates the type of housing occupying portions of the watershed. The greatest population densities in the Spring Brook No. 1 watershed are in the areas immediately surrounding Wheaton College, the Wheaton Metra Station, and College Avenue Metra Station. There are high densities at several housing developments along S. County Farm Road, as well. High density housing requires outreach that differs from what would be directed toward single family home properties.



Figure 14. Population density displayed by census tract

3. The primary language of a resident targeted for outreach efforts plays a pivotal role in that resident's receipt and acceptance of the messaging. Less than half of the residents located in the eastern portion of the watershed along the Roosevelt Road corridor speak English as their primary language. Additional pockets of Spanish speakers (as a primary language) exist near Wheaton College and both north and southeast of Hoffman Park.



Figure 15. Percentage of population speaking English (primary language) by census tract

4.2.8 Transportation

Roadways represent approximately 24% of the total impervious cover currently within the Spring Brook No. 1 watershed. Public roads are an essential component of the built environment and are closely linked to adjacent land use development patterns. A significant amount of the polluted stormwater runoff generated in the watershed is conveyed along transportation corridors, either through underground stormwater conveyances or road side ditches. The vehicles that travel public roads can also be a source of pollutants (e.g., petroleum products, heavy metals, etc.), as well as winter maintenance activities. Higher traffic volumes potentially increase the amount of pollutants generated from public roads and also increase the likelihood of pollutants from vehicles and winter maintenance activities (e.g., plowing and salting). A particular concern in freshwater streams is road salt, due to its adverse impacts on aquatic organisms. Winter road salt application is typically higher on arterial roads to meet public expectations for travelling conditions.

There are approximately 186 lane miles of public roads within the Spring Brook No. 1 watershed. The traffic volumes of these roadways vary, as does the maintenance and pollutant loads generated. In addition to these public roadways, many other public and private entities maintain a vast network of roads, parking lots, sidewalks, and driveways. On a watershed scale, the cumulative effect from pollutant loads running off of these surfaces is diminishing the overall water quality.

Governmental Entity	Lane Miles	Acres
City of Warrenville	0.8	0.41
City of Wheaton	138.5	234
DuPage County	11.3	17.74
Milton Township	16.9	28.08
State of Illinois	3.5	7.23
Village of Glen Ellyn	4.0	7.92
Winfield Township	11.5	18.51

Table 3. Number of lane miles by jurisdiction

Typical maintenance along roadways within the watershed includes the following: street sweeping and catch basin cleaning; road surface maintenance; underground stormwater infrastructure repair; surface drainage (ditching) maintenance; road-side grass and weed control; and litter and road kill removal.

These maintenance activities can help reduce and control the amount of pollutants, such as sediment and associated metals and nutrients, which are carried with stormwater. Routine street sweeping and catch basin cleaning are particularly important maintenance activities that remove pollutants that accumulate on public roads and in the stormwater conveyance systems before reaching nearby surface waters. While good housekeeping for all entities is important to reduce pollutant loads, the activities of the City of Wheaton, based on the amount of roadways within their jurisdiction, will have greatest impact in the watershed.

5. Watershed Assessment

5.1 Land Management Practices

Information on how the land is managed in a watershed is helpful to identify both current control practices and potential targets for future management. This information not only will support the characterization of the watershed but also will be important in identifying current watershed sources, future management efforts, and areas for additional management efforts.

5.1.1 DuPage County Countywide Stormwater and Flood Plain Ordinance

Pursuant to extensive flood damage from storm events which occurred in October 1986 and August 1987, the *DuPage County Stormwater Management Plan* (DCSMP) was adopted by resolution of the County Board of the County of DuPage, Illinois on September 26, 1989. The DCSMP was established in recognition of the critical need to limit the reoccurrence of extensive flood damages within DuPage County. In accordance with the DCSMP, the DCCSFPO was adopted by the DuPage County Board, through Resolution SMO-0001-91, as Appendix F to the Plan on September 24, 1991, with an effective date of February 15, 1992. Since then, the DCCSFPO has undergone periodic revisions, with the latest revision dated April 23, 2013. The principal purpose of the DCCSFPO is to promote effective, equitable, acceptable, and legal stormwater management measures. There are several aspects that are key to the success of the DuPage County program: an aggressive and comprehensive approach to stormwater and flood plain management; solid cooperation between federal, state, county, and municipal agencies; and steadfast political support. The combination of this cooperation and support provides the environment to develop a strong, successful program.

The authority for control of stormwater facilities is widely distributed to many entities throughout DuPage County. Many stormwater management facilities are not adequately maintained, and inconsistent enforcement of stormwater regulations contributes to the extent and severity of flood damage. It is therefore necessary to consider stormwater management on a watershed basis. Provisions of the DCCSFPO provide mitigation for the effects of land development through wetland, wetland buffer, and riparian buffer protection, site runoff storage, compensatory storage for fill in the flood plain, and post construction best management practices (PCBMPs). Many land development practices upset the natural hydrologic balance of DuPage County streams. Wetlands and buffers represent a significant portion of the natural watershed storage in DuPage County, and they play an essential role in flood storage, conveyance, sediment control, volume control, floristic and wildlife habitat, infiltration, groundwater recharge, and water quality enhancement. The DCCSFPO requirements for development affecting the function and values of wetlands and buffers serve to protect these natural areas or replace their functions in another location within the watershed.

Site runoff storage, also known as detention, is a key provision of the DCCSFPO that helps to prevent localized flooding and provide water quality benefits. Under this provision, with few

specified in the DCCSFPO, exceptions а development that equals or exceeds 25,000 square feet of net new impervious surfaces in the aggregate since February 15, 1992 must provide site runoff storage for the entire disturbed area. The site runoff storage facility must be designed to prevent stormwater runoff from exceeding the maximum allowable discharge rate of 0.1 cubic feet per second per acre (cfs/ac) for all disturbed surfaces. This serves to reduce the peak runoff downstream of a development site during storm events up to and including the 1% chance storm event, or 100-year 24-hour storm event.

Compensatory storage requirements in the DCCSFPO also serve to provide flood protection by maintaining flood plain volume. Flood plains

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provide the functions of flood storage, habitat, and water quality. The placement of fill in a flood plain can inhibit these functions. The DCCSFPO requires that any placement of fill, structures, or other materials above grade in the flood plain shall require compensatory storage equal to at least 1.5 times the volume of flood plain storage displaced, unless otherwise specified.

PCBMPs are required by the DCCSFPO to treat the stormwater runoff for pollutants of concern and reduce runoff volume for all developments if the net new impervious area increases by 2,500 square feet or more in the aggregate since April 23, 2013. This provision of the DCCSFPO serves to limit the addition of impervious areas to developments and encourage the use of PCBMPs while reducing runoff and providing a water quality component to site runoff.

Post-Construction Best Management Practices (PCBMPs) are used within the DCCSFPO for both water quality and quantity benefits. They can include green infrastructure such as bioswales, wetland basins, permeable pavers, vegetated swales, etc.

5.1.2 Wheaton Downtown Strategic and Streetscape Plan

In February 2014, the Wheaton City Council approved the *Wheaton Downtown Strategic and Streetscape Plan*, which articulates an agreed upon vision for downtown Wheaton for the next twenty years, outlines a streetscape plan for downtown Wheaton that will tie with the agreed upon vision and elevate the success of the downtown district, and outlines associated strategies and policies that the City and the private sector may pursue to implement the ideas outlined. The study area covered by the downtown plan is generally bounded by Seminary Avenue on the north, Washington Street and Naperville Road on the east, Roosevelt Road on the south, and

Gary Avenue on the west. However, the study area does not include the existing residential neighborhoods between Illinois Street and Roosevelt Road, and to the east of West Street.

The plan recommends a number of practices relating to stormwater management and pollutant load control as they pertain to the redevelopment of downtown Wheaton:

- Utilize permeable paving and rain gardens along streets to reduce the overall impervious footprint;
- Implement more distinctive, shorter crosswalks (possibly comprised of permeable paver material and including curb bumpouts);
- Use native plants to improve overall landscape performance and reduce the costs to the City associated with watering and replanting;
- Increase landscape areas along city streets, including the planting of trees;
- Assess the potential for green designs in alleys, including permeable pavements and landscaping to aid in stormwater management (to make them inviting public spaces and pedestrian connections capable of attracting activity);
- Enhance and expand open space areas, such as through the development of pocket parks and public plazas that serve as activity places and focal points in the central business district;
- Improve public transportation and bicycling opportunities (as one component to address perception of "lack of convenient on-street parking");
- Upgrade bike racks and trash cans (to help provide a measure for litter control); and
- Explore modifying existing requirements to allow building height limits of at least five stories and no requirements to provide parking on site (rather, pay fee in lieu to common downtown parking fund that would help locate and secure common parking areas).

5.1.3 Warrenville Green Plan

In 2011, the City of Warrenville adopted a strategic master plan that incorporated green infrastructure into many of the areas of the community future development plans that were identified in the plan. Some of the highlights of the plan include the following goals:

- Preserve and protect the river, natural features, open space, and wooded areas that contribute significantly to the City's overall character, setting, and uniqueness, and seek opportunities to showcase, access, and promote these components as important and valuable community assets and
- Implement sound stormwater and water basin management techniques for all new development and incorporate appropriate "sustainable" and "environmentally sensitive" development practices by distributing information and providing technical guidance for developers and residents.

5.1.4 Cantigny Park Storm Water Analysis and Planning

Cantigny Park is in the process of completing a master plan for stormwater management on their property. *The Cantigny Park Storm Water Analysis and Planning* document, expected to be completed in spring 2016, will explore a variety of best management practices for the control of

stormwater, including constructed wetlands, rain gardens, native plantings, underground detention, reduction of imperviousness, and modification of retention ponds. Additionally, the plan will include measures that maintain wetland hydrology and convert a section of current gardens to prairie.

5.1.5 Forest Preserve District of DuPage County

Within the Spring Brook No. 1 watershed, 754 acres are within the jurisdiction of the FPDDC, specifically Blackwell and St. James Farm Forest Preserves. Both preserves receive relatively high visitor use and provide more recreational opportunities that most other forest preserves. Within the watershed, the forest preserves provide habitat for one state-endangered and two state-threatened plant species. Approximately 60% of the land rates 40 or above on the Floristic Quality Index, indicating high vegetative quality. Active management through prescription burns, invasive species control, deer management, seed collection and dispersal, and other activities contribute to the high quality of these areas.

 Table 4. FPDDC land area managed by type

Category	Aquatic	Cropland	Developed	Forest	Grassland	Marsh	Total
Acres	80	39	149	367	64	54	754

The FPDDC has developed a *Strategic Plan 2014* document, which includes a comprehensive, strategic framework setting the District's direction and providing guidance for its evolution over the next three years. This plan incorporates vision, mission, and purpose statements; expands on what role preserves provide for DuPage County residents; and helps with the *Spring Brook No. 1 Watershed Plan* implementation as the FPDDC moves forward with planned, large restoration projects within the St. James Farm and Blackwell Forest Preserves.

5.1.6 Chicago Wilderness Green Infrastructure Vision

In 2004, the Northeastern Illinois Planning Commission (NIPC, now part of CMAP) completed a Green Infrastructure Vision (GIV 1.0) for the Chicago Wilderness region. This product identified large Resource Protection Areas (RPAs) and recommended protection approaches for each, including additional land preservation, ecological restoration, or development restrictions. In 2012, Chicago Wilderness undertook a refinement of the previous work that was intended to classify and characterize important resources in a more analytically robust manner, as well as to define ecological and human connectivity needs and provide enhanced information to support conservation and development decisions. The GIV has often been described as a visual representation of the *Chicago Wilderness Biodiversity Recovery Plan*: Refinements of the GIV were meant to help further advance the broad conservation agenda established by that plan. The main products of the revised GIV project are derived Geographic Information System (GIS) datasets that describe and characterize the regional green infrastructure or ecological network.

The GIV covers the Chicago Wilderness ecoregion, which includes counties in Wisconsin, Illinois, and Indiana, with a small portion of Berrien County, Michigan. The ecoregion includes some or all of the Metropolitan Planning Organization (MPO) boundaries of CMAP, the Northwestern Indiana Regional Planning Commission (NIRPC), and the Southeastern Wisconsin Regional Planning Agency (SEWRPC), along with portions of additional outlying counties in Illinois and Indiana.

The primary purpose of the GIV is to identify a regionally important network of land and water that is critical to protect and restore to conserve the biodiversity of the region. This regional green infrastructure network was developed for the Chicago Wilderness region area using the core-hub-corridor approach. The building blocks of the network are "core areas" that contain well-functioning natural ecosystems that provide high-quality habitat for native plants and animals. By contrast, "hubs" are aggregations of core areas, as well as nearby lands that contribute significantly to ecosystem services like clean water, flood control, carbon sequestration, and recreation opportunities. Finally, "corridors" are relatively linear features linking cores and hubs together, providing essential connectivity for animal, plant, and human movement.

The current, revised GIV retains the emphasis on protecting biodiversity from the original GIV, but it also seeks to address a broader range of issues and provide a wide array of benefits. Continuing the original approach, the current GIV gives "a high priority... to identifying and preserving important but unprotected natural communities, especially those threatened by development, and to protecting areas that can function as large blocks of natural habitat though restoration and management." Thus, GIV addresses the following conservation strategies: creation of large preserves; protection of priority areas, especially remaining high quality; protection of large sites with remnant high-quality areas; and protection of land that connects or expands existing natural areas.



Figure 16. Chicago Wilderness GIV for the Spring Brook No. 1 watershed

This regional open space network also provides multiple benefits. At its broadest, landscapescale green space provides important ecosystem services like clean air and water, critical plant and animal habitat, and wildlife migration corridors along with compatible working landscapes. At the regional scale, green space can help protect water quality and help ensure the availability of drinking water. Green corridors can also provide key recreational areas that link people to natural lands and facilitate the use of transportation modes other than automobiles to reach key community assets. At the site scale, green space enhances neighborhoods and downtowns through environmentally-sensitive site design techniques, urban forestry, and stormwater management systems that reduce the environmental impact of urban settlements and increase community resiliency. All of these scales of activity can be linked together and can ensure resiliency in urban, suburban, and rural areas of a region. Finally, as surveys of conservation organizations by the Land Trust Alliance have documented, producing a strategic conservation plan is associated with a dramatic increase in the pace of land conservation.

The emerging consensus on climate adaptation planning is that well-defined spatial priorities are needed to facilitate adaptation for wildlife and ecosystem processes. This approach identifies those elements of the landscape most relevant to wildlife now, in the face of current threats, as well as in the future as the climate changes. Additionally, it provides a spatial framework for climate adaptation planning relevant to land conservation efforts. At a landscape scale, the GIV network incorporates places where building resilience by conserving large habitat blocks and realigning corridors to build connectivity will ultimately help wildlife and people adapt to an altered climate.

5.1.7 DuPage Natural Areas Master Plan

In 2013, efforts began to coordinate the efforts of all local and regional open space organizations in the acquisition or protection of property that will benefit and improve the quality of life for the residents of DuPage County. The principal goals of the plan were to: identify and prioritize parcels of property in DuPage County that will provide trail and greenway linkages, expand existing open space properties, buffer existing open space, and protect forests, woodlands, prairies, wetlands, watersheds, streams, and river corridors; identify natural areas that will promote protection and preservation of endangered and threatened wildlife and plant species; and create a plan that various agencies in DuPage County can use to protect the identified remaining open space, as well as foster cooperation and partnerships in implementing the plan over time.

5.2 Water Quality Assessment

5.2.1 Impairment Cause Identification

Every two years, to fulfill the requirements set forth in Section 303(d) of the federal Clean Water Act and the Water Quality Planning and Management regulation at 40 CFR Part 130, the IEPA puts together a list of "impaired" waterways within the State of Illinois that do not support a particular use for which they have been designated. Spring Brook No. 1 was first added to Illinois' §303(d) list in 2006 and was divided into two segments: IL_GBKA and IL_GBKA-01. Assessment unit IL_GBKA extends approximately 1.74 miles from the daylighting point of the stream at Kelly Park until the bridge crossing at Creekside Drive. Assessment unit IL_GBKA-01 begins at the crossing of the footbridge (off of Stonebridge Circle) and continues approximately 3.18 miles downstream until the confluence with West Branch DuPage River.

In the following years, several causes were added to the aquatic life impairment of these assessment units, along with an additional impairment of the primary contact use based on high
fecal coliform concentrations in the water column. Currently, Spring Brook No. 1 is listed as not supporting either the aquatic life use or the primary contact recreation use. The pollutant causes for the impairment listings are chloride, total phosphorus, copper, and fecal coliform bacteria, while low dissolved oxygen concentrations were noted to impact aquatic life. Alteration of streamside vegetative cover and loss of instream cover are also recognized as negatively affecting aquatic life.

Assessment Unit	Use	Cause	Source(s)
IL_GBKA	Aquatic Life	Alteration in stream-side or littoral vegetative cover	Agriculture, Channelization, Urban Runoff/Storm Sewers
		Oxygen, Dissolved	
IL_GBKA-01	Aquatic Life	Copper	Municipal Point Source
		Nitrogen (Total)	Discharges
		Phosphorus (Total)	
		Total Dissolved Solids	

Table 5. Initial 2006 §303(d) listing of Spring Brook No. 1

In addition to the above noted stream impairments, Silver Lake, a converted quarry located within the Blackwell Forest Preserve, is currently listed as impaired for not supporting the aesthetic quality use due to unknown causes (assessment unit IL_RGD). The impaired listing was first including on the 2006 §303(d) list. In 2002 and 2004, Silver Lake was noted to be only partially supporting the secondary contact recreation caused by pH and aquatic plants (native). Potential sources of the partial support included habitat modification, streambank modification/destabilization, waterfowl, and forest/grassland/parkland.



Figure 17. Spring Brook No. 1 monitoring locations

Year	Assessment Unit	Use	Cause	First Listed	Source(s)
2014	IL_GBKA	Aquatic Life	Alteration in stream-side or littoral vegetative covers	2006	Agriculture, Channelization, Urban Runoff/Storm Sewers
			Chloride	2008	
			Oxygen, Dissolved	2006	
			Phosphorus (Total)	2008	
		Primary Contact	Fecal Coliform	2008	Source Unknown
	IL_GBKA-01	Aquatic Life	Alteration in stream-side or littoral vegetative covers	2012	Channelization, Municipal Point Source Discharges
			Copper	2006	
			Loss of Instream Cover	2012	
			Phosphorus (Total)	2006	
		Primary Contact	Fecal Coliform	2008	Source Unknown

Table 6. 2014 §303(d) listing of Spring Brook No. 1

In 2006, the DRSCW began a comprehensive monitoring program throughout West Branch DuPage River watershed to including chemical, fish, macroinvertebrate, and habitat information at a frequency of once every three years. The data have been used to assess existing conditions by using a statistical analysis to identify which parameters are degrading aquatic life. Bioassessment surveys of Spring Brook No. 1 were completed in 2009 and 2012, as well.

The DRSCW monitoring takes place at two points along Spring Brook No. 1: approximately 0.60 miles upstream of the Essex Road bridge crossing (WB11) and approximately 0.35 miles upstream of the Morris Court bridge crossing (WB10). The results of this monitoring indicate that high concentrations of nitrogen within the water column are impacting aquatic life, as is a poor riparian habitat throughout the mid to upper portion of the watershed.

Table 7. DRSCW Bioassessment Conclusions

Station	Proximate Stressor(s)	Project Description	Project Objective
WB10	Ammonia-nitrogen	Stormwater treatment	Reduce organic load;
			Stormwater BMPs for metals
WB11	Ammonia-nitrogen; Total Kjehldahl Nitrogen (TKN); Lack of pool and riffle sequence(s);	Habitat restoration	Increase assimilative capacity
	Poor substrate and riparian corridor		

5.2.2 Potential Causes and Sources of Pollution

5.2.2.1 Dissolved Oxygen

All living organisms are dependent upon oxygen in one form or another to maintain the metabolic process that produce energy for growth and reproduction. Oxygen, like all of the gases of the atmosphere, is soluble in water to some degree. The solubility of atmospheric oxygen in fresh waters ranges from 14.6 mg/L at 0°C to about 7 mg/L at 35°C under normal atmospheric pressure. Without an appreciable level of dissolved oxygen, many kinds of aquatic organisms cannot exist in water. The upper portion of Spring Brook No. 1 (assessment unit IL_GBKA) is listed as not supportive of the aquatic life use due, in part, to the low dissolved oxygen cause. Monitoring of dissolved oxygen concentrations were performed monthly by the

Wheaton Sanitary District at station GBKA-04 WSD in 2005 and 2006 and those data are included as **Appendix B**.

Prolonged exposure to low dissolved oxygen levels may not directly kill an organism but may significantly increase its susceptibility to other environmental stresses and diseases. Dissolved oxygen concentrations affect growth rates, swimming ability, susceptibility to disease, and the relative ability to endure other environmental stressors and pollutants. The most critical conditions related to dissolved oxygen deficiency in natural waters occur during summer months when temperatures are high and the solubility of oxygen is at a minimum; however, additional protection is generally provided through criteria for dissolved oxygen in the spring months that correspond to the spawning and nursery season for select aquatic life, as is included in Illinois' Water Quality Standards (WQS):

Section 302.206 Dissolved Oxygen

2)

2)

General use waters must maintain dissolved oxygen concentrations at or above the values contained in subsections (a), (b) and (c) of this Section.

- a) General use waters at all locations must maintain sufficient dissolved oxygen concentrations to prevent offensive conditions as required in Section 302.203 of this Part. Quiescent and isolated sectors of General Use waters including but not limited to wetlands, sloughs, backwaters and waters below the thermocline in lakes and reservoirs must be maintained at sufficient dissolved oxygen concentrations to support their natural ecological functions and resident aquatic communities.
- b) Except in those waters identified in Appendix D of this Part, the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs must not be less than the following:
 - 1) During the period of March through July,
 - A) 5.0 mg/L at any time; and
 - B) 6.0 mg/L as a daily mean averaged over 7 days.
 - During the period of August through February,
 - A) 3.5 mg/L at any time;
 - *B)* 4.0 mg/L as a daily minimum averaged over 7 days; and
 - C) 5.5 mg/L as a daily mean averaged over 30 days.
- *c)* The dissolved oxygen concentration in all sectors within the main body of all streams identified in Appendix D of this Part must not be less than:
 - 1) During the period of March through July,
 - A) 5.0 mg/L at any time; and
 - *B)* 6.25 mg/L as a daily mean averaged over 7 days.
 - During the period of August through February,
 - A) 4.0 mg/L at any time;
 - *B)* 4.5 mg/L as a daily minimum averaged over 7 days; and
 - C) 6.0 mg/L as a daily mean averaged over 30 days.
- *d)* Assessing attainment of dissolved oxygen mean and minimum values.
 - 1) Daily mean is the arithmetic mean of dissolved oxygen concentrations in 24 consecutive hours.
 - 2) Daily minimum is the minimum dissolved oxygen concentration in 24 consecutive hours.

- 3) The measurements of dissolved oxygen used to determine attainment or lack of attainment with any of the dissolved oxygen standards in this Section must assure daily minima and daily means that represent the true daily minima and daily means.
- 4) The dissolved oxygen concentrations used to determine a daily mean or daily minimum should not exceed the air-equilibrated concentration.
- 5) Daily minimum averaged over 7 days means the arithmetic mean of daily minimum dissolved oxygen concentrations in 7 consecutive 24-hour periods.
- 6) Daily mean averaged over 7 days means the arithmetic mean of daily mean dissolved oxygen concentrations in 7 consecutive 24-hour periods.
- 7) Daily mean averaged over 30 days means the arithmetic mean of daily mean dissolved oxygen concentrations in 30 consecutive 24-hour periods.

Dissolved oxygen is consumed by the degradation of organic matter in water. Many fish kills are caused not from the direct toxicity of pollutants but from a deficiency of oxygen because of its consumption in the biodegradation of pollutants. Although oxygen is produced by the photosynthetic action of algae, this process is really not an efficient means of oxygenating water because some of the oxygen formed by photosynthesis during the daylight hours is lost at night when the algae consume oxygen as part of their metabolic process. When the algae die, the degradation of their biomass also consumes oxygen. Where both nitrogen and phosphorus are plentiful, algal blooms occur to produce a variety of nuisance conditions that may severely deplete dissolved oxygen concentrations. Higher concentrations of dissolved oxygen occur in stream systems when the following conditions are present:

- Excess nutrient and organic pollutant loads are controlled, maintaining a balanced biological system in which respiration does not consume more dissolved oxygen then is produced;
- Flowing water, which contains more oxygen than stagnant water through entrainment and mixing;
- In-stream structures, breaking the water surface to create turbulence and mixing; and
- Established riparian buffer, which provides shade for cooler water temperatures to increase the solubility of oxygen in the water column.

5.2.2.2 Nutrients

All surface water supports the growth of minute aquatic organisms. The free swimming and floating organisms are called plankton and are of great interest because of effects on water quality. The plankton is composed of animals (zooplankton) and plants (phytoplankton). Since phytoplankton are chlorophyll-bearing organisms, their growth is influenced greatly by the amount of the fertilizing elements nitrogen and phosphorus in the water. Research has shown that nitrogen and phosphorus are both essential for the growth of algae and cyanobacteria and that limitation in amounts of these elements is usually the factor that controls their rate of growth. Experience has shown that such blooms do not occur where nitrogen and phosphorus are present in very limited amounts: In a freshwater context, phosphorus is almost always the limiting nutrient. Common sources of nutrients include agriculture; improper composting and yard waste disposal; septic systems; soil erosion; cleared vegetation; fertilizers; animal waste; fuel combustion; industrial and household chemicals; industrial processes; and runoff of atmospheric deposition from impervious surfaces. Removal of excess nutrients occurs in stream systems when the following conditions are present:

- Nonpoint sources of excess nutrients are controlled;
- Floodplain connectivity facilitates sediment deposition, provides sediment storage, and establishes the water table to be in contact with the root zone of the riparian buffer, which is required for denitrification to occur;
- Established riparian buffer, which slows runoff rates and facilitates sediment deposition with associated nutrients, stabilizes streambanks, and provides nutrient uptake by riparian vegetation;
- Meandering channel increasing stream length, which decreases stream velocity and increases hydrologic residence times (required process for nutrient processing);
- Channel stability, which reduces streambank erosion and fine sediment inputs; and
- Healthy hyporheic zones, promoting habitat for the microbial community that processes nutrients.

5.2.2.1 Nitrogen

In the water, nitrogen-containing compounds can contribute to plant and algal growth. Three forms of nitrogen can be found in ambient water: ammonia (NH₃), nitrates (NO₂-), and nitrates (NO₃). The compounds of nitrogen are of great importance in water resources, in the atmosphere, and in the life processes of all plants and animals. The respective water-soluble species formed, ammonium, nitrite, and nitrate, are of historical environmental concern in water, and their concentrations in drinking water supplies and surface waters have been regulated for decades. Typically, nitrogen enters waterways as ammonia from industrial and municipal sewage effluent, septic systems, animal waste, and from fertilizer. Ammonia, in turn, is oxidized to nitrite and then to nitrate. The relative proportions of these nitrogen forms will be dependent on pH, temperature, and the initial amount discharged to the waterway.

The autotrophic conversion of ammonia to nitrite and nitrate, called nitrification, requires oxygen, so the discharge of ammonia nitrogen and its subsequent reduce oxidation can seriously the dissolved-oxygen levels in rivers, especially where long residence times, large amounts of suspended solids, and high temperatures required for the growth of the slow-growing nitrifying bacteria available. are Ammonium ion is normally the first inorganic nitrogen species produced in the biodegradation of nitrogenous organic It is oxidized, under the compounds. appropriate conditions, first to nitrite by Nitrosomonas bacteria, then to nitrate by Nitrobacter.



Figure 18. Illustration of the Nitrogen Cycle

In 2013, USEPA revised the water quality criterion for Total Ammonia Nitrogen (TAN) based on new data concerning the sensitivity of freshwater mussels. The revised acute criteria at 7.0 pH and 20°C is 17 mg/L of TAN and the chronic value is 1.9 mg/L TAN.⁷ Toxic effects of ammonia to fish include reduced blood oxygen carrying capacity, depletion of adenosine triphosphate (ATP) in the brain, damage to the gills, liver, and kidney, and increased susceptibility to bacterial and parasitic diseases. These effects can lead to death and population reductions to aquatic life where concentrations are extreme.



Figure 19. Relative amounts of different N forms commonly found in Minnesota surface waters with elevated N levels

5.2.2.2.2 Phosphorus (Total)

Animals use phosphorus in energy exchange, as part of deoxyribonucleic acid (DNA), in muscle movement, and in the hardening of bones. Phosphorus is critical for plant and algal growth, as well, but in excessive amounts it contributes to profuse growth of algae that significantly impacts dissolved oxygen and impairs aquatic communities. Phosphorus in aquatic environments is most often present as phosphate ion (PO_4^{-3}) or some variant thereof, but also adsorb to the surface of fine sediments and are found as components of organic chemicals and polyphosphates.

While there are at least seven different phosphorus fractions that can be measured as part of chemical testing in the ambient water column, the two most common are Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP), or dissolved phosphorus. Phosphorus sources include sewage treatment plants, some industrial discharges, fertilizers from urban lawns or agricultural fields, waterfowl feces, septic systems, and atmospheric deposition. Discharges from sewage treatment plants are largely SRP and, in this form, can readily be taken up by aquatic plant life. Runoff from farm fields and urban lawns, by contrast, often includes phosphorus that is adsorbed to the surface of sediments. Some of this TP will be available for plant and algal growth, but not in the same high percentage as SRP.

⁷ Additional information can be found in EPA 822-R-13-001 (April 2013), *Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater*.

Streams are less sensitive than ponds to phosphorus loading because of the continuous movement of the water. The rate at which the water moves and the rate at which organic forms (bacteria, fungi, algae, and aquatic plants) can absorb nutrients determines the expressed productivity. In areas where there are dams, water gets backed up behind spillways, excessive nutrients can accumulate, and nuisance conditions can be created. Excessive algal growth can also reduce the available supply of oxygen on the upstream side of the dam. In aquatic systems, like streams, other factors such as temperature and available light can also influence expressed productivity.

Illinois does not currently have a numeric standard for phosphorus in streams; however, the State of Illinois does have a narrative standard that mandates that aquatic communities "shall be free from unnatural algal growth."

5.2.2.3 Chloride

DuPage County winters demand an effective and affordable means of deicing roadways. The primary agent used for this purpose is sodium chloride (road salt), which is composed, by weight, of forty percent sodium ions (Na^+) and sixty percent chloride ions (CI^-). Other components in road salt, like ferrocyanide, which is used for anti-caking, and impurities, like phosphorus and iron, can represent up to five percent of the total weight. The sodium, chloride, ferrocyanide, and impurities make their way into our environment through the runoff from rain, melting snow, and ice, as well as through splash and spray by vehicles. These chemicals find their way onto vegetation and into the soil, groundwater, storm drains, and surface waters causing significant impact to the environment.

Chloride is completely soluble, very mobile, and toxic to aquatic life, but also impacts vegetation and wildlife. There is no natural process by which chlorides are broken down, metabolized, taken up, or removed from the environment. Trends show that chloride levels continue to rise with increasing use of road salt. Other potential components and impurities of road salt can include calcium, potassium, iron, magnesium, aluminum, lead, phosphorus, manganese, copper, zinc, nickel, chromium, and cadmium.

Contaminates from road salt enter water resources by infiltration to groundwater, runoff to surface water, and through storm drains. The chloride discharged into these waters remains in solution and is not subject to any significant natural removal methods: Only dilution can reduce its concentration. The accumulation and persistence of chloride poses a risk to the water quality and the plants, animals, and humans who depend upon it. The concentration of chloride found in surface water correlates with the proportion of impervious surfaces in the watershed. Chloride cannot be treated or filtered with BMPs, so once salt is applied, chloride remains in the watershed until it is flushed downstream.

Aquatic Life Impacts: Chloride in surface waters can be toxic to many forms of aquatic life. Aquatic species of concern include fish, macroinvertebrates, insects, and amphibians. Elevated chloride levels can threaten the health of food sources and pose a risk to species survival, growth, and/or reproduction. Chloride toxicity increases when it is associated with other cations, such as potassium or magnesium, which may occur once the ions of road salt have dissolved and

migrated at potentially different rates. Salinity stress on sensitive aquatic communities can impact species diversity. The presence of salt also releases toxic metals from sediment and, when released into the water, can inhibit nutrients and dissolved oxygen within the water upon which aquatic species rely.

Vegetation Impacts: The most visible impact of road salt on the environment is in the grass, shrubs, and foliage along the roadside. Not only does salt effect the terrestrial roadside vegetation, but it also has an impact on emergent and submerged aquatic plants. Salt leaves the roadway and enters the environment by splash and spray from vehicles, transportation by wind, snow melt into the soil, and as runoff to surface waters. Salt primarily causes dehydration which leads to foliage damage, but also causes osmotic stress that harms root growth. Salt can disrupt nutrient uptake and cause injury to seed germination, stems, leaves, and flowering ability. Salt can lead to plant death and can also cause a colonization of salt tolerant species, such as cattails, thereby reducing species diversity. Vegetation along roadways is a natural buffer area between pollutants and the waters. Salt damage and vegetation degradation caused by excessive chloride compromises the pollutant retention and processing ability of these buffer areas.

Wildlife Impacts: Road salt in the environment affects the health of wildlife, including birds and mammals. Birds, the most sensitive wildlife species to salt, often mistake road salt crystals for seeds or grit. Consumption of very small amounts of salt can result in toxicosis and death within the bird population. Wildlife such as deer and moose are also attracted to the roadway to ingest salt crystals, which leads to higher incidents of vehicular accidents and wildlife kills. Particularly high concentrations of sodium and chloride can be found in snow melt, which many animals drink to relieve thirst and potentially can cause salt toxicity including dehydration, confusion, and weakness, among other symptoms. Road salt can cause a decline among populations of salt sensitive species reducing natural diversity. Damage to vegetation can have significant impact on wildlife habitat by destroying food resources, shelter, and breeding and nesting sites, and by creating a favorable environment for non-native invasive species. Additionally, salt spray and runoff near aquatic systems can have detrimental effects on breeding amphibian populations.

Infrastructure Impacts: Chloride ions increase the conductivity of water and accelerate corrosion. Chloride can penetrate and deteriorate concrete on bridge decking and parking garage structures and damage reinforcing rods, causing compromised structural integrity. It damages vehicle parts, such as brake linings, frames, and bumpers, and corrodes other areas of the car body. Chloride impacts railroad crossing warning equipment and power line utilities by conducting electrical current leaks across the insulator that may lead to loss of current, shorting of transmission lines, and wooden pole fires.

Pet Impacts: The two most important concerns for pet owners regarding road salt are ingestion and paw health. Ingestion of road salt by eating salt directly, licking salty paws, and drinking snow melt and runoff can potentially produce effects such as drooling, vomiting, diarrhea, loss of appetite, crying, excessive thirst, depression, weakness, low blood pressure, disorientation, decreased muscle function, and, in severe cases, cardiac abnormalities, seizure, coma, and even death. Exposure of paws to road salt can produce painful irritations, inflammation, and cracking of the feet pads that can be prone to infection and are slow to heal. Illinois' Water Quality Standards (WQS) establishes a total chloride criterion concentration of 500 mg/L in waterways:

Constituent	Unit	Standard
Barium (total)	mg/L	5.0
Chloride (total)	mg/L	500
Iron (dissolved)	mg/L	1.0
Phenols	mg/L	0.1
Selenium (total)	mg/L	1.0
Silver (total)	μg/L	5.0

Section 302.208 Numeric Standards for Chemical Constituents

g) Single-value standards apply at the following concentrations for these substances:

The *Total Maximum Daily Loads for West Branch DuPage River, Illinois* (2004) requires an overall reduction of road salt application of thirty-five percent to meet water quality standards in all impaired segments. Although a similar load calculation has not yet been developed specifically for Spring Brook No. 1, a substantial chloride reduction is expected to be necessary in order for the numerical criterion of 500 mg/L to be achieved. Local communities have already begun incorporating best management practices into snow and ice management and salt handling and storage. Techniques include prewetting of roadways, calibration of application equipment, tarping of salt piles, and alternative deicing mixtures including beet juice additives and calcium magnesium acetate.

5.2.2.4 **Copper**

Copper is a low-toxicity, corrosion-resistant metal widely used because of its workability (ductility and malleability), electrical conductivity, and ability to conduct heat. In surface waters, copper can be toxic to some fish at concentrations near 1.0 mg/L, thus, tends to be much more of an environmental hazard than a human hazard. Copper is also toxic to aquatic plants at concentrations sometimes below 1.0 mg/L and has frequently been used as the sulfate salt to control growth of algae in reservoirs, swimming pools, and fountains.

The State of Illinois has both acute and chronic criteria for dissolved copper using the hardness value for a particular monitoring sample, as outlined in Illinois' WQS:

Constituent	STORET Number	Acute Standard (ug/L)	Chronic Standard (ug/L)
Copper	01040	<i>Exp[-1.464</i> +	<i>Exp[-1.465</i> +
(dissolved)		$0.9422 \ x \ln(H)] x$	$0.8545 \ x \ln(H)] x$
		0.960, where	0.960, where
		H=hardness	H=hardness

Section 302.208.e

On July 6, 2005, the Wheaton Sanitary District collected a grab sample at station GBKA-03 WSD: The dissolved copper concentration was 0.022 mg/L and the duplicate was 0.023 mg/L with hardness values of 197 and 198, respectively. As over ten samples had been collected for the parameter and the 0.022 mg/L value exceeded the chronic standard criterion of 0.020 mg/L, copper is listed as a cause of the aquatic life use not being supported for assessment unit IL_GBKA-01. Further information regarding this impaired designation is available in Table C-3

of Illinois Integrated Water Quality Report and Section 303(d) List, 2014, which is included as Appendix C.

While potential sources of copper are numerous, five likely non-point sources runoff sources include: vehicle brake pads⁸; copper pesticides; soil erosion; copper in domestic water discharged to storm drains; and vehicle fluid leaks and dumping.

Source	Control Measure
Vehicle brake pads	Street sweeping
-	Treating urban runoff
	Reducing vehicle miles traveled
Copper pesticides	Using copper-free alternatives
	Discharging pool water to the sanitary sewer
	Implementing an aquatic pesticide general permit
	Managing aquatic pests with biological, physical, and mechanical control methods
Soil erosion	Inspecting construction sites
	Correcting past hydromodification
Copper in domestic water	Reducing storm drain discharges through water conservation programs
discharged to storm drains ⁹	Reducing copper levels in drinking water
Vehicle fluid leaks and	Implementing engine oil and coolant recycling programs
dumping	Conducting illicit discharge inspections
	Developing public information programs regarding car maintenance

Table 8. Copper sources and control measures

5.2.2.5 Fecal Coliform Bacteria

Fecal contamination in recreational waters is associated with an increased risk of gastrointestinal illness and less often identified respiratory illness. The primary contact use is not supported along Spring Brook No. 1 due to fecal coliform bacteria monitoring performed monthly by the Wheaton Sanitary District at three stations in 2005 and 2006. Primary contact recreation typically includes activities where immersion and ingestion are likely and there is a high degree of bodily contact with the water, such as swimming, bathing, surfing, water skiing, tubing, skin diving, water play by children, or similar water-contact activities.

In the 1960s, the U.S. Public Health Service recommended using fecal coliform bacteria as the indicator of primary contact with Fecal Indicator Bacteria (FIB). Studies conducted by the U.S. Public Health Service reported a detectable health effect when total coliforms density was about 2,300 per 100 mL. In 1968, the National Technical Advisory Committee translated the total coliform level to 400 fecal coliforms per 100 mL based on a ratio of total coliforms to fecal coliforms and then halved that number to 200 fecal coliforms per 100 mL. The National

⁸ On January 21, 2015, USEPA, the automotive industry, and the states signed an agreement to reduce the use of copper and other materials in motor vehicle brake pads. The Copper-Free Brake Initiative calls for cutting copper in brake pads to less than 5 percent by 2021 and 0.5 percent by 2025. This voluntary initiative also calls for cutting the amount of mercury, lead, cadmium, asbestiform fibers, and chromium-6 salts in motor vehicle brake pads. These steps will decrease runoff of these materials from roads into the nation's streams, rivers and lakes, where these materials can harm fish, amphibians, and plants.

⁹ Trace copper in the raw water supply, algaecides used to control nuisance algae in water supply reservoirs, and from chemical corrosion and physical erosion of copper pipes contribute to concentrations in domestic water.

Technical Advisory Committee criteria for recreational waters were recommended by USEPA in 1976. The current fecal coliform criteria to protect the primary contact recreation included in Illinois' WQS, mirror these recommendations:

Section 302.209 Fecal Coliform

- a) During the months May through October, based on a minimum of five samples taken over not more than a 30 day period, fecal coliform (STORET number 31616) shall not exceed a geometric mean of 200 per 100 mL, nor shall more than 10% of the samples during any 30 day period exceed 400 per 100 mL in protected waters. Protected waters are defined as waters which, due to natural characteristics, aesthetic value or environmental significance are deserving of protection from pathogenic organisms. Protected waters will meet one or both of the following conditions:
 - 1) Presently support or have the physical characteristics to support primary contact;
 - 2) Flow through or adjacent to parks or residential areas.
- b) Waters unsuited to support primary contact uses because of physical, hydrologic or geographic configuration and are located in areas unlikely to be frequented by the public on a routine basis as determined by the Agency at 35 Ill. Adm. Code 309.Subpart A, are exempt from this standard.
- c) The Agency shall apply this rule pursuant to 35 Ill. Adm. Code 304.121.

In the late 1970s and early 1980s, USEPA conducted epidemiological studies that evaluated the use of several organisms as possible indicators of fecal contamination, including fecal coliform, *E. coli*, and enterococci. These studies showed that enterococci are good predictors of gastrointestinal illnesses in marine and fresh recreational waters, and *E. coli* are good predictors of gastrointestinal illnesses in fresh waters. As a result, USEPA published *Ambient Water Quality Criteria for Bacteria – 1986*. The 1986 criteria document includes recommendations to use enterococci for marine and fresh recreational waters (a geometric mean of 33 enterococci cfu per 100 mL in fresh water and 35 enterococci cfu per 100 mL in marine water) and *E. coli* for fresh recreational waters (a geometric mean of 126 *E. coli* cfu per 100 mL). The 1986 recommendations replaced USEPA's previously recommended fecal coliform criteria of 200 fecal coliform cfu per 100 mL.

Since USEPA last published recommended Recreational Water Quality Criteria (RWQC) in 1986, scientific advancements have been made in the areas of epidemiology, molecular biology, microbiology, Quantitative Microbiological Risk Assessment (QMRA), and methods of analytical assessment. These advancements demonstrated that culturable enterococci and *E. coli* are better indicators of fecal contamination than the previously used general indicators, total coliforms and fecal coliforms. While most strains of enterococci and *E. coli* do not cause human illness, they do indicate the presence of fecal contamination. The basis for recommending criteria that use bacterial indicators of fecal contamination is that pathogens often co-occur with indicators of fecal contamination.

USEPA recently published *Recreational Water Quality Criteria* – 2012, which outlines recommendations using the fecal indicators enterococci and *E. coli* compared to an established geometric mean (GM) and statistical threshold value (STV). Because densities of FIB are highly variable in ambient waters, distributional estimates are more robust than single point estimates.

In the 2012 RWQC, USEPA is recommending the criteria magnitude be expressed as a GM value corresponding to the 50th percentile and the STV corresponding to the 90th percentile of the same water quality distribution, and, thus, associated with the same level of public health protection. For the STV, USEPA selected the estimated 90th percentile of the water quality distribution to take into account the expected variability in water quality measurements, while limiting the number of samples allowed to exceed the STV (intended to be a value that should not be exceeded by more than 10% of the samples used to calculate the GM), before deciding water quality is impaired. In addition, the approach encourages monitoring because once an exceedance is observed, at least ten more samples need to be below the STV before water quality is considered unimpaired.

USEPA estimated in 1986 that the predicted levels of illness associated with the criteria was 8 Highly Credible Gastrointestinal Illnesses (HCGI) per 1,000 primary contact recreators in fresh water. To facilitate comparisons between the results from 1986 and the 2012 criteria, illness rates from 1986 (in terms of HCGI per 1,000 primary contact recreators) were translated to NEEAR-GI Illness (NGI) rates using a translation factor of 4.5. The criteria that correspond to an illness rate of 36 NGI per 1,000 primary contact recreators correlate to water quality levels associated with the 1986 criteria. Accordingly, the illness rate of 32 NGI per 1,000 primary contact recreators would encourage an incremental improvement in water quality.

Criteria Elements	Estimated Illness Rate (NGI): 36 per 1,000 primary contact recreators			Estimated Illness Rate (NGI): 32 per 1,000 primary contact recreators		
Magnitude				Magr	nitude	
Indicator	GM STV GM STV (cfu/100 mL) (cfu/100 mL) (cfu/100 mL) (cfu/100 mL)					
Enterococci – marine and fresh	35	UK	30	110		
OR						
E. coli – 126 410 100 320						
<i>Duration and Frequency</i> : The waterbody GM should not be greater than the selected GM magnitude in any 30-day interval. There should not be greater than a ten percent excursion frequency of the selected STV magnitude in the same 30 day interval.						

 Table 9. Bacteria recommendations outlined in USEPA's RWQC document (2012)

USEPA's 2012 RWQC recommendations are scientifically defensible for all surface waters of the United States designated by a state for primary contact recreation. For waters dominated by nonhuman sources and in the absence of site-specific criteria, USEPA recommends that the national criteria be used to develop WQS for all waters including those impacted by point and nonpoint sources. USEPA has conducted analyses to characterize the potential differences in magnitude of illness arising from different fecal sources. These analyses indicate that human health risk associated with exposure to waters impacted by animal sources can vary substantially. In some cases these risks can be similar to exposure to human fecal contamination, and in other cases, the risk is substantially lower.

Because the designated use protected by these criteria is primary contact recreation, USEPA believes that a shorter duration (i.e., 30 days), used in a static or rolling manner, coupled with limited excursions above the STV, allows for the detection of transient fluctuations in water

quality in a timely manner. In the development of a monitoring program, USEPA recommends that responsible parties consider the number of samples evaluated in order to minimize the possibility of incorrect use attainment decisions.

5.2.3 Groundwater Evaluation

Groundwater resource protection is an integral component of watershed planning. As regulatory requirements favoring the infiltration of stormwater become more commonplace, it is imperative that proper knowledge exists regarding the location and condition of recharge aquifers and public water supply areas that could be threatened by stormwater management activities. CMAP's *Go to 2040 Comprehensive Regional Plan* makes numerous recommendations regarding water resource conservation, including Integrated Land Use Policies and Site Planning with Water Resources, where it is stated, "[Land use policies that encourage compact development] should be coupled with the identification of sensitive aquifer recharge areas (SARAs) and their protection from potential contamination, which will help ensure the security of water supplies for future generations."

The DCSMP requires that each watershed plan identify remedial measures to protect wetlands, riparian environment, and recharge areas threatened by stormwater management activities. Measures identified are to be coordinated with County and municipal open-space acquisition programs for the identification of land with mutual benefits. The most recent revisions of the DCCSFPO encourage the use of green infrastructure practices to reduce the volume of runoff, as well as minimize the load of pollutants associated with runoff. However, infiltration of runoff from certain land uses is not desired in areas of groundwater recharge for community water system and private wells.

While watershed plans are to identify groundwater recharge areas within the watershed, DuPage County does not have sufficient technical information to provide such information. Although DCSM has sought local technical assistance in identifying sensitive aquifer recharge areas within DuPage County so that the information can be utilized in watershed plan development and outreach efforts to discourage activities that would facilitate the transport of soluble contaminants in these areas, these technical assistance requests have been denied. Outputs of such assistance could include a technical document detailing an overview of this topic and providing clarification regarding the requirements of applicable legislation; review of available data; development of geospatial information; and/or other appropriate materials.

5.3 Watershed Jurisdictional Coordination

5.3.1 Policies and Regulations

5.3.1.1 DuPage County Regulatory Framework

DuPage County Stormwater Management Plan

In 1989, DuPage County adopted the DCSMP. The DCSMP provides the foundation for future watershed planning efforts, the DCCSFPO, and water quality improvements throughout the

County. It was established in recognition of the critical need to limit the reoccurrences of extensive flood damages within the county. Development has historically caused increases in flood risk, flood damage, and environmental degradation. The DCSMP was implemented by the Stormwater Management Planning Committee to reverse that trend. The DCSMP responds to the opportunity inherent in State of Illinois P.A. 85-905, which authorizes regional stormwater management in northeastern Illinois counties. It also recognizes the integrated nature of the watershed system and the need to consider stormwater management planning on a watershed basis. The DCSMP consolidates the stormwater management framework throughout DuPage County into a united, countywide structure; sets minimum countywide standards for flood plain and stormwater management; and provides for countywide coordination for the management of stormwater runoff in both natural and manmade drainageways and storage.

In addition, the DCSMP establishes standards for noted components, including: objectives and policies; watershed plans and flood maps; problems and project planning; maintenance programs; regulatory programs; facility and local data; technical guidance; funding; and implementation and enforcement.

Finally, six primary objectives defined in the DCSMP outline the direction of DCSM:

- 1. Reduce existing potential for stormwater damage to public health, safety, life, and property;
- 2. Control future increases in stormwater damage within DuPage County and in areas of adjacent counties affected by DuPage County drainage;
- 3. Protect and enhance the quality, quantity, and availability of surface and groundwater resources;
- 4. Preserve and enhance existing aquatic and riparian environments and encourage restoration of degraded areas;
- 5. Control sediment and erosion in and from drainageways, developments and construction sites; and
- 6. Promote equitable, acceptable, and legal stormwater measures.

DuPage County Countywide Stormwater Floodplain Ordinance

Precipitation in DuPage County is usually stored naturally in the soils and surface depressions where it falls. Over time, the natural drainage system of creeks and rivers developed a capacity for conveying stormwater that is balanced with these watershed characteristics. Land development practices offset the natural balance by eliminating the naturally occurring storage, reducing the infiltration of stormwater into the ground, and generally increasing the velocity and quantity of the runoff. Receiving streams do not naturally have the capacity for increased flows. Therefore, downstream flooding would be an expected consequence of land development unless each site runoff control plan is developed with full consideration of downstream capacities and flooding potential. This is the basic foundation for the DCCSFPO which is administered by DuPage County and local municipalities. Routine regulatory activities should be performed by the jurisdiction most affected by the activity, with the responsibilities of program authorization, program delegation, and program review retained by the delegating authority.

In accordance with the DCSMP, the DCCSFPO was adopted by the DuPage County Board into

Appendix F of the DCSMP on September 24, 1991, with an effective date of February 15, 1992. Since then, the DCCSFPO has undergone periodic revisions, with the latest revision dated April 23, 2013. The principal purpose of the DCCSFPO is to promote effective, equitable, acceptable, and legal stormwater management measures. There are several aspects that are key to the success of the DuPage County program: an aggressive and comprehensive approach to stormwater and flood plain management; solid cooperation between federal, state, county, and municipal agencies; and steadfast political support. The combination of this cooperation and support provides the environment to develop a strong, successful program.

Community Waiver Status under the DCCSFPO

•Non-Waiver - Under a non-waiver classification, DuPage County Stormwater Management reviews and enforces all areas of the DCCSFPO within the Community

•Partial Waiver - The community enforces all areas of the DCCSFPO, while DuPage County Stormwater Management reviews and certifies proposed work that affects "Special Management Area," e.g., flood plains and wetlands
•Complete Waiver - The community is responsible for review and enforcement of the DCCSFPO within their boundaries

•Opt Out - Communities bordering county boundaries can opt out of the DCCSFPO if it opts out to a county that has a Stormwater Management Program

Army Corps of Engineers General Permit 25

The purpose of the Army Corps of Engineers (ACOE) General Permit 25 (GP25) is to empower DuPage County to administer the review of projects requiring federal authorization under §404 of the Clean Water Act. The transfer of §404 permit review authority to DuPage County allows the County to make decisions involving wetland resources within its jurisdiction and serves to streamline the regulatory process and reduce the burden for applicants by eliminating the duplication of regulatory review at different levels of government. GP25 allows DuPage County to integrate local wetland resource concerns into other water related issues such as flood control, wildlife habitat concerns, preservation and restoration of riparian corridors, stormwater storage, and water quality in long range planning. It is notable that DuPage County is the only county in the United States that has been transferred §404 permit review authority by the ACOE. In 2009, the ability to obtain §401 Water Quality Certification from the IEPA for certain projects was added as a designated authority under the GP25. The ability to obtain §401 and §404 approvals along with DCSM certification greatly simplifies the regulatory process for the applicants and results in reduced overall review time. GP25 was first approved by the SMPC in 1995 and was reauthorized in 2000. The permit was extended in 2005 by the ACOE and reauthorized in 2009 and 2015.

5.3.1.2 National Pollutant Discharge Elimination System Requirements

The National Pollutant Discharge Elimination System (NPDES) Program has achieved significant reductions in pollutant discharges since it was established by the Federal Water

Pollution Control Act Amendments of 1972 and subsequent 1977 amendments, formally known as the Clean Water Act (CWA). The development of this permitting program has, in turn, resulted in tremendous improvement to the quality of this country's water resources as result of the cooperative efforts by federal, state, tribal and local governments and communities to implement the public health and pollution control programs.

Title IV, Permits and Licenses, of the FWPCA Act created the system for permitting wastewater discharges (Section 402), known as NPDES. Under NPDES, all facilities which discharge pollutants from any point source into Waters of the United States are required to obtain a permit.

Spring Brook No. 1 receives effluent discharge from one municipal source, which is a POTW that receives primarily domestic sewage from residential and commercial Larger POTWs will also customers. typically receive and treat wastewater from industrial facilities (indirect dischargers) connected to the POTW sewerage system. The types of pollutants treated by a POTW will always include conventional pollutants, include non-conventional and may pollutants and toxic pollutants depending on the unique characteristics of the commercial and industrial sources discharging to the POTW.

Permittee	Permit Number
City of Warrenville	ILR400274
City of Wheaton	ILR400470
DuPage County	ILR400502
Milton Township	ILR400086
Village of Glen Ellyn	ILR400199
Wheaton Sanitary District	IL0031739
Winfield Township	ILR400155

Table 10. NPDES permitted entities

Over the past decade, IEPA, following federal regulatory mandates, has implemented controls for stormwater management in efforts to meet the goals of the CWA. In a 1995 report to Congress, USEPA determined that small municipalities (urbanized areas with populations less 100,000 individuals) are to be regulated. This report was codified on December 8, 1999 when the USEPA Administrator signed the NPDES Phase II rule for those communities. Following development of a NPDES permit for discharging stormwater into Waters of the State for small municipalities, all municipalities within DuPage County were forced to apply for coverage under the general permit ILR40 in 2003. ILR40 contains six minimum control measures in which each municipality must engage: public education and outreach on storm water impacts; public involvement/participation; illicit discharge detection and elimination (IDDE); construction site storm water runoff control; post-construction storm water management in new development and redevelopment; and pollution prevention/good housekeeping for municipal operations. These measures are designed to ensure that pollutants carried by stormwater are treated to the maximum extent practicable.

5.3.1.3 West Branch DuPage River Total Maximum Daily Load

In 2004, USEPA reviewed and approved a Total Maximum Daily Load (TMDL) for portions of the West Branch DuPage River for the chloride parameter. The TMDL calculates the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue

to meet water quality standards for that particular pollutant and allocates that load to point sources, Waste Load Allocation (WLA), and nonpoint sources, Load Allocation (LA), which includes both anthropogenic and natural background sources of the pollutant. TMDLs must also include a margin of safety (MOS) to account for the uncertainty in predicting how well pollutant reduction will result in meeting water quality standards and account for seasonal variations.

The West Branch DuPage River TMDL provided a WLA of 10,127,000 pounds of chloride per year to be discharged by the Wheaton Sanitary District. IEPA intends to implement the Municipal Separate Storm Sewer System (MS4) WLA for the entire watershed as a lumped value. As TMDL allocations for West Branch DuPage River watershed required an overall reduction of road salt application of thirty-five percent to meet water quality standards in all impaired segments, the proposed TMDL allocation calls for an across the board reduction in chloride usage from deicing activities equal to thirty-five percent. Overall, the goal of developing a TMDL is to end up with an implementation plan or a watershed plan designed to meet water quality standards and restore impaired waterbodies. The implementation plan to reduce chloride loads to the West Branch DuPage River watershed is attached as **Appendix D**. Since the implementation plan was developed, entities partnering in the DRSCW have been working to enact these chloride reduction measures. Those efforts are summarized and attached as **Appendix E**.

5.3.1.4 Spring Brook Total Maximum Daily Load Report

IEPA requested proposals from interested parties to develop TMDLs for Spring Brook No. 1 to include the following TMDL parameters: dissolved oxygen, fecal coliform, chloride, and copper. These parameters have a numeric water quality standard and the TMDL will take into account seasonal variations, percent reduction, WLA, LA, MOS and, if necessary, reserve capacity (RC). As the phosphorus (total) parameter does not have a numeric water quality standard, a Load Reduction Strategy (LRS) will be developed for IEPA. The LRS will consist of a loading capacity to meet a target criteria, percentage reduction needed, MOS, and RC, if applicable. The Spring Brook TMDL is expected to be completed within the next two years.

5.3.2 Roles and Responsibilities

The overarching regulatory mechanism controlling stormwater management within the Spring Brook No. 1 watershed, and the majority of DuPage County, is the DCCSFPO. The authority for control of stormwater facilities is widely distributed to many entities in DuPage County. This regulatory framework is administered by the local municipalities and/or DuPage County, as outlined below.

5.3.2.1 Municipalities

Municipalities are responsible for ensuring all zoning, drainage, permitting and implementation of the DCCSFPO (depending on waiver status), providing safe drinking water, and maintaining sewer service. Local municipalities are also responsible for local roadways, which includes road maintenance, snow removal, salt dispersal, litter and road kill removal, traffic flow, and ensuring overall road safety.

5.3.2.2 Townships

Some areas of roadway and the associated right of way within the Spring Brook No. 1 watershed are under the jurisdiction of local township authorities. Townships are responsible for road maintenance, snow removal, salt dispersal, and any associated hydrology conveyance systems.

5.3.2.3 Illinois Department of Transportation

A limited area of roadway within DuPage County is under the authority of Illinois Department of Transportation (IDOT). IDOT's responsibilities include road maintenance; snow removal; salt application; litter and road kill removal; traffic flow; and ensuring overall road safety.

5.3.2.4 DuPage County

Responsibilities of DuPage County within unincorporated areas of the Spring Brook No. 1 watershed include ensuring all zoning, drainage, permitting, and DCCSFPO requirements are met. The County has been providing a countywide stream maintenance program since the 1990s. This regional program was designed to assist municipalities and residents with debris blockages that could have significant local flooding impacts. Additionally, DuPage County is responsible for certain roadways within the watershed on which it provides road maintenance, snow removal, salt dispersal, traffic flow, and ensuring overall road safety.

5.3.2.5 Forest Preserve District of DuPage County

The FPDDC is responsible for the inspection and maintenance of all drainageways, including Spring Brook No. 1 and any of its tributaries, within the preserves. The FPDDC manages Silver Lake and the surrounding area, as well, for fisheries and other recreational purposes.

5.3.3 Ongoing Outreach Efforts

5.3.3.1 **DuPage County Stormwater Management**

DCSM has established programs to provide much of the public outreach, with respect to water quality, that takes place within the County. These education and outreach efforts satisfy requirements outlined by ILR40 and, by serving as cooperating permitees, the regulatory requirements for the Village of Glen Ellen, City of Warrenville, City of Wheaton, Milton Township, and Winfield Township are satisfied, as well.

Several workshops are put on annually by DCSM and various partners. These typically focus on best management practices for stormwater controls, green infrastructure, maintenance and monitoring of stormwater control facilities, natural areas management, and pollution prevent and good housekeeping. In addition to these, DuPage County sponsors annual deicing reduction workshops for municipal entities and has added a *Parking Lot and Sidewalk Deicing* workshop for local contractors.

DuPage County provides brochures as a response for some of the most frequently asked questions or to assist residents with specific concerns. Examples of these include: Best Management Practices, Car Wash Discharge Guidelines, Green Infrastructure, Homeowners Guide to Naturalized Areas, Illicit Discharge Detection and Elimination Public Awareness, Living on a Stream, PCBMP Brochure for Homeowners, Storm Drain Stenciling, Streambank Stabilization, Wetlands and Streams, and Wetland Map Initiative.

Love Blue. Live Green. Campaign: Social media is considered to be one of the best resources for disseminating timely information to the public and DuPage County has created a campaign to protect and enhance the quality of DuPage County's rivers and streams. Daily updates on green infrastructure and other best management practices for stormwater runoff, stakeholder meetings, or updates can now be followed on Facebook and Twitter.

Currents Newsletter: DCSM publishes a monthly newsletter that provides stormwater information to elected officials, municipal and business members, and residents. Highlights include news, updates, happenings, and upcoming events.

Public Service Announcements (PSAs): The County has developed several PSAs to address stormwater or water quality concerns. These are available through the County website, YouTube, Twitter feeds, and Facebook. Several PSAs have also been shown on local cable stations.

5.3.3.2 **SCARCE**

SCARCE is a non-profit environmental education organization that the County has partnered with for over twenty years to inspire people, through education, to preserve and care for the Earth's natural resources, while working to build sustainable communities. SCARCE assists DuPage County outreach efforts by reaching teachers, school groups, and residents with large scale programs.

Enviroscape Model: The Enviroscape model teaches kids and adults about point and non-point pollution. It's a hands-on activity that demonstrates where pollution could stem from in a small community. DuPage County's SMPC and SCARCE support water quality education in DuPage County schools. The SMPC provided one Enviroscape watershed model to each public middle school within DuPage County, as well as offered six additional models available to be checked out from SCARCE. Each model includes accessories and additional teaching resources, such as a video starring Bill Nye the Science Guy.





Image taken from www.scarceecoed.org/environmentaleducation/workshops-for-teachers/enviiroscapewatershed-model.html SCARCE has trained at least two teachers from each school. As time goes on, they will continue to train all of the teachers in the schools with these models. All DuPage County teachers have access to an Enviroscape watershed model, whether their school owns one or not.

Water Quality Flag: The partnership between SCARCE and DCSM brings recognition to those schools that go above and beyond in their efforts of sustainability with stormwater management goals. If specific target goals are met, the school is provided with a "Love Blue. Live Green." inscribed flag.



5.3.3.3 The Conservation Foundation

Founded in 1972, The Conservation Foundation (TCF) is one of the regions oldest and largest not-for-profit land and watershed conservation organizations dedicated to preserving and restoring open space, protecting rivers and watersheds, and promoting stewardship of the environment in northeastern Illinois. TCF is a land and watershed protection organization with a mission to preserve natural areas and open space, protect rivers and watersheds, and promote stewardship of the environment. TCF is a recognized expert and reasoned voice on conservation issues, and with the help of its members and donors, provides the leadership required to achieve this vision.

Conservation@Home: The Conservation@Home program provides homeowners associations, garden clubs, and interested parties with education on the benefits of native plantings, how individuals can use these approaches to make a difference, as well as on how other practices such as rain barrels and other environmentally-friendly practices can be used.

Conservation@Home

A program started by The Conservation Foundation in 2004. It is an extension of homeowner education and watershed protection efforts that encourages and recognizes property owners that protect and/or create yards that are environmentally friendly and conserve water. It includes planting native vegetation, such as prairie and woodland wildflowers, trees and shrubs, creating butterfly and rain gardens, and removing exotic species of plants. It promotes planting "flower bed" areas. It does not require planting them across an entire yard – as many assume is required in order to achieve some environmental benefit. It encourages individual responsibility to counter practices that have long contributed to environmental degradation, particularly in our rivers and streams.

Securing Land Trusts: TCF works with municipalities to encourage sustainable development practices. This not only includes implementing multiple and cumulative stormwater best

management practices in residential or commercial development, but also working on the development of covenants and restrictions to appropriately address stewardship and maintenance of these areas, with funding dedicated to that.

Youth Based Environmental Education: Additional activities that TCF is involved in include a storm drain stenciling program, educational efforts about stormwater best management practices and where stormwater goes after it hits the street, coordinating volunteers to monitor creeks, and youth-based environmental education.

5.3.3.4 Wheaton Park District

Wheaton Park District (WPD) provides community based education regarding watersheds and their benefits. Coupled with an annual native plant sale, WPD staff discusses the benefits related to water infiltration. These discussions are provided online and through programs broadcast over the local cable channel. TCF provides rain barrels which are pre-ordered from the WPD website. The District also hosts school groups and provides them with information on the benefits of wetlands and water quality within neighborhoods. In 2014 alone, the WPD provided over 68 programs to 1,598 students.

Wetlands Education Program: Fourth and fifth grade students participate in hands-on, experience-based lessons that demonstrate the values of wetlands. During this four-hour field trip, students learn how wetlands improve water quality, control flooding, serve as an important habitat, and provide a place for recreational activities.

Wetland Explorations: Students, ranging from preschool through fifth grade, explore Lincoln Marsh and discover what a wetland is, what organisms use it for habitat, and why wetlands are important.

Marsh Mysteries: Students, ranging from preschool through third grade, assist in building a model marsh and discover what organisms use it for habitat, including an introduction to wetland critters.

5.3.3.5 **DuPage County Health Department**

DuPage County Health Department (DCHD) has countywide jurisdiction and, in addition to health services, oversees private drinking wells and septic systems within unincorporated areas of DuPage County. Outreach programs utilized by the DCHD include: online video resource training tools for private residents on the well disinfection process, as well as a water quality testing program for residents and/or contractors; prescription medication drop box locations currently used by twelve police departments and municipalities; and numerous brochures are available to residents of DuPage County including topics on the signs and symptoms of septic failures, overall septic maintenance, and flood protection procedures.

5.3.3.6 Forest Preserve District of DuPage County

The FPDDC provides educational opportunities to residents, preserve users, and school children who visit the various preserves every day. For the Spring Brook No. 1 watershed the following presentations have been performed regarding the topic of aquatic invasive species:

- Annual display describing impacts of Aquatic Invasive Species (AIS) at "Just For Kids Fishing Derby" at Blackwell in June;
- AIS brochure distributed at various other public events/programming;
- "Protect Your Waters" (PYW) Volunteer Program to monitor for zebra mussel, remove litter, and one-on-one outreach to anglers;
- AIS and PYW information in "Fishing Guide";
- AIS outreach performed during creel surveys;
- Urban Stream Research Center open house and tours; and
- Through the website¹⁰.

¹⁰ <u>http://dupageforest.org/Category.pb.aspx?pageid=317&id=1286&terms=aquatic%20invasive</u>

6. Hydrologic and Hydraulic Analyses

DuPage County is unique in its development of hydrologic and hydraulic models used in its watershed planning and floodplain mapping programs. Rather than using single event, steady state models, DCSM utilizes continuous simulation and dynamic routing models. The models being used in DuPage County for hydrologic and hydraulic analysis were selected for the following reasons. First, the continuous simulation hydrologic model is used to capture the effects of antecedent moisture on runoff volumes and peaks, and to account for a non-uniform precipitation distribution over the watershed. Second, the effects of backwater, floodplain storage, and complex urban stream systems have a significant impact on the hydraulics of streams within DuPage County. Thus, an unsteady flow model has been adopted for use in DuPage County watershed studies.

The approach used by DuPage County produces continuous flow and stage information based on precipitation that has occurred in the past. The County utilizes a historical series of rainfall events that have actually occurred over the County for its watershed planning, project design, and floodplain mapping efforts.

DuPage County hired Earth Tech Inc. (Earth Tech) to perform a watershed study for the Spring Brook No. 1 watershed in 2004. Earth Tech performed a detailed hydrologic, hydraulic, and economic analysis for the watershed as part of that study. At the time that Earth Tech performed their study, the historical series spanned 45 years (1949 - 1993) and consisted of 115 individual rainfall events. Currently the historical series has been extended to span 60 years (1949 – 2008) and contains 157 events. DuPage County staff re-ran the hydraulic models with the extended historical series and updated the structure and contents values for the residential structures within the economic model. The following sections present the work that was completed during the 2004 study, as well as updates to the hydrologic, hydraulic, and economic analyses performed by DuPage County staff. This study is the best available data and will be updated in the future as funding is secured.

6.1 Hydrologic Analysis Using HSPF

The DCSMP requires the use of fully dynamic runoff and flood routing models. This study utilized previously completed Hydrologic Simulation Program/Fortran (HSPF) hydrologic modeling results in conjunction with a detailed Full Equations (FEQ) hydraulic model. HSPF runoff files were created by NIPC for use in DuPage County's watershed planning effort. The HSPF model¹¹ uses detailed precipitation data, other meteorological data, recorded streamflow data, simulated runoff and streamflow, and land cover data throughout DuPage County to produce simulated runoff for six land cover types. A Time Series File (TSF) is generated for each of the six land cover types for each precipitation gage for each discrete event. The TSFs

¹¹ DuPage County's hydrologic modeling procedures are described in detail in *Application Guide for Hydrologic Modeling in DuPage County Using Hydrologic Simulation Program – Fortran (HSPF).*

created by HSPF are then referenced in FEQ, and FEQ routes the simulated runoff through the stream network.

A number of TSF files have been created for use on a countywide or watershed basis. Time Series File TSFLNG08.MPN is based on precipitation data from the O'Hare and Wheaton gages and contains 157 storm events from 1949 through 2008. TSFBIG contains runoff from very large storm events that have occurred throughout the Midwest and is used in conjunction with TSFLNG08.MPN to perform the flood frequency analysis for future floodplain mapping. TSFs for individual storm events in individual watersheds have also been developed for use in hydraulic calibration. TSFJUL96.sb1 and TSFOCT01.sb1 were developed to calibrate the Springbrook No. 1 FEQ model to the July 1996 and October 2001 storm events.

6.2 Hydrologic Calibration

The HSPF model was regionally calibrated to five streamflow gages in the Salt Creek, East Branch DuPage River, and West Branch DuPage River watersheds in DuPage County. The model was verified using additional streamflow gages and a separate period of record.

These HSPF model calibrations and verifications are discussed in *Hydrologic Calibration of HSPF Model for DuPage County; Meteorological Database Extension and Hydrologic Verification of HSPF Model for DuPage County;* and *Hydrologic Calibration and Hydraulic Evaluation of HSPF Model for Sawmill Creek Watershed.*

Spring Brook No. 1 is a gaged watershed, with one United States Geological Survey (USGS) stream gage located in the Blackwell Forest Preserve near the downstream end of the watershed. Calibration to match peak flows and timing of runoff occurs after the FEQ model has been developed. Documentation of the calibration process performed by Earth Tech and results are included in **Appendix A**.

6.3 Hydraulic Analysis Using FEQ

Earth Tech used the unsteady flow program FEQ and its utility program FEQUTL (developed by Delbert Franz of Linsley, Kraeger Associates, Ltd.) for flood routing and to analyze the Spring Brook No. 1 stream system. FEQ and FEQUTL can model the basin hydraulic features, including bridges, culverts, dams, pumps, on-line and off-line storage, and floodplain encroachments. The FEQ model schematic is included as **Appendix G**.

A contracted surveyor performed the field survey and reconnaissance in 1989 to collect cross section (103 surveyed) and structure data for the Spring Brook No. 1 hydraulic model. Earth Tech and DuPage County staff performed field reconnaissance to verify the survey information. Some surveyed cross sections were supplemented and extended as necessary using an ArcInfo script program known as Transect Manager and DuPage County two-foot contour topographic mapping.

Photographs of the cross sections and structures were taken during the cross section survey fieldwork and used to develop Manning's roughness coefficients.

Runoff from the upper third of the watershed is conveyed to the open channel by storm sewers. Storm sewer information was obtained from City of Wheaton Storm Sewer Atlases, various dates 1961 through 1970.

Forty-two sub-basins tributary to Spring Brook No. 1 were delineated using DuPage County twofoot contour topographic mapping. An illustration of these sub-basins is included as **Appendix H**. Sub-basins were primarily defined at hydraulic breaks, including hydraulic structures, reservoirs, and storm sewer inlets. The County's GIS system was used to determine the size and land cover characteristics of each sub-basin.

The 5.7 miles of open channel and 6.2 miles of storm sewer are represented in the Spring Brook No. 1 FEQ model. The stream system is represented by open channel branches, level pool reservoirs, linear reservoirs, and significant hydraulic structures and control features including culverts, bridges, weirs, embankments, reservoir outlets, storm sewer inlets, expansions, and contractions. The reservoirs represent lakes, ponds, wetlands, and depressional storage areas that provide significant storage along the stream system. Linear reservoirs are used to represent the area tributary to a section of storm sewer.

The Spring Brook No. 1 model includes a short section of the FEQ model for West Branch DuPage River at the confluence with Spring Brook No. 1, from Williams Road upstream of the confluence to the Prairie Path, which is just downstream of the Warrenville Dam downstream of the confluence. The downstream boundary condition of the model is the hydraulic structure at the Warrenville Dam.

6.4 Hydraulic Calibration

Calibration of the FEQ model was completed by Earth Tech using information obtained through public input provided on questionnaires sent to property owners near the floodplain in 1995. In September 2001, 15 homeowners who reported flood damages on the questionnaire were contacted by telephone by Earth Tech to obtain additional information regarding the July 1996 storm. Six of those homeowners were interviewed in the field by DCSM staff in spring 2003. County staff marked the location and elevation of high water marks, which were later surveyed by a contracted surveyor.

Specific high water information was obtained from property owners adjacent to the creek for the July 1996 storm in several locations: at the storm sewered area at Main and Park; near Merrill Drive; on the level pool reservoirs downstream of Creekside Drive and Stonebridge Avenue; and at the Cenacle Retreat house at the confluence of Spring Brook No. 1 and West Branch DuPage River. FPDDC also reported frequent overtopping of Arrow Road in the Blackwell Forest Preserve. A small number of high water marks were also obtained at Merrill Drive, the level pool reservoir downstream of Creekside Drive, and the storm sewered area at Main and Park for the October 2001 storm. Additionally, the City of Wheaton provided information related to

flooding and road overtopping in the upper (storm sewered) portion of the watershed during the July 1996 storm event. Many of the residents who responded to the flooding questionnaire did not live in their current residence at the time of the August 1972 flood or August 1987 storm, or did not have detailed high water mark information for those storm events. Thus, specific high water elevations were most readily available for the July 1996 storm. The high water mark descriptions, elevations, and locations are included in **Appendix A**.

The calibration relied on analysis using 4 local rain gages, two of which were centrally located within the Spring Brook No. 1 watershed: Wheaton North; Wheaton Willow; Wheaton Sanitary District; and USGS Kress Creek. A summary of FEQ model calibration results for the July 1996 and October 2001 events is provided in **Tables 11 and 12**. Additional details can be found in **Appendix A**.

HWM Location	Approx. Stream	Simulated	Recorded	Difference between
	Station (ft from	Elevation	Elevation (ft)	Simulated and
	confluence)	(ft)		Recorded (ft)
Arrow Road ¹²	4,700	707.44	705.59 + 1' to 2'	Within range
Center Avenue	13,840	718.23	718.11	+0.12
Wastewater	18,200 and	722.64 and	Between 722 and	Within range
Treatment Plant	18,400	722.69	724	
Pond D/S of	20,725 to 22,125	722.87	723.03 and 723.20	-0.16 and -0.33
Creekside				
Stream U/S of	22,200	723.05	723.53 and 723.78	-0.48 and -0.73
Creekside				
Merrill Drive	27,000	727.55	727.51	+0.04
Hubble Middle	Closed conduit	731.34	731.81	-0.47
School ¹³				
Main and Park	Closed conduit	731.11	730.75 - 731.66	+0.36 to within
area ¹⁴			(6 lowest homes)	range

 Table 11. Hydraulic calibration results summary (July 1996)

6.5 Baseline Condition Model

The calibration model reflected the condition of the watershed during 1996. Several changes occurred in the watershed after the July 1996 calibration storm. As a result, the Spring Brook No. 1 hydraulic model was revised to reflect the existing condition. Changes made to the calibration model to reflect existing conditions included:

• Removal of a horse farm bridge downstream of Essex Road, which was destroyed in a storm and will not be replaced;

¹² Forest Preserve Staff indicated Arrow Road overtopped between 1' and 2' with most storms. Exact overtopping depth during the July, 1996 storm was unknown.

¹³ HWM at Coal Chute at Indiana and Hale, 1996 storm event.

¹⁴ No reported flooding in homes.

- Improvements at the Cantigny Youth Golf Course, including construction of four reservoirs located on the Cantigny property and one reservoir located off the Cantigny Foundation property; and
- Culvert replacement at Arrow Road within the Blackwell Forest Preserve.

After updating the calibration model to reflect the existing condition, the model was run using the historical and "big" time series. Simulated water surface elevations and flows from each historical storm event in the period of record were used to identify existing flooding areas within the watershed and evaluate selected flood control alternatives. Existing flooding areas and flood control alternatives are discussed in detail in **Section 7** of this report.

HWM Location	Approx. Stream Station (ft from confluence)	Simulated Elevation (ft) ¹⁵	Recorded Elevation (ft)	Difference between Simulated and Recorded (ft)
Arrow Road ¹⁶	4,700	707.12	705.59 + 1' to 2'	Within range
Pond D/S of Creekside	20,725 to 22,125	723.36	722.87 to 723.25	+0.11 to +0.37
Merrill Drive	27,000	729.61	727.51	+2.10
Main and Park area,	Closed conduit	732.77	730.80 to 731.75	+1.01 to +1.97
basement flooding ¹⁷	area			
Main and Park area,	Closed conduit	732.77	732.34	+0.43
first floor flooding	area			

	Table 12. Hy	ydraulic	calibration	results	summary	(0	ctober	2001)
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¹⁵ The FEQ model for the 2001 calibration event uses FAC=1.0 and rain gage assignments from the July, 1996 storm event. Results are approximate.

¹⁶ Forest Preserve Staff indicated Arrow Road overtopped between 1' and 2' with most storms. Exact overtopping depth during the October, 2001 storm was unknown.

¹⁷ For homes reporting basement flooding, the recorded elevation range shown is the low entry elevation to the first floor elevation. It is assumed that if water was higher than the first floor elevation, first floor flooding would have been reported.

7. Flood Control Alternatives Evaluation

7.1 Identification of Flood Prone Areas

In general, the flooding problems in the Spring Brook No. 1 watershed are the result of:

- Increased impervious area associated with development;
- The loss of natural floodplain storage areas;
- Development encroachment in the floodplain;
- Undersized storm sewer and conveyance systems;
- Inadequate detention storage associated with watershed development; and
- Undersized hydraulic structures (culverts, bridges, weirs.)

Potential causes for site-specific flooding are described in following sections.

7.2 Historic Flooding

In the previous 2004 study by Earth Tech, potential flooding and drainage problems in the Spring Brook No. 1 watershed were identified through hydrologic and hydraulic modeling and economic analyses. A questionnaire sent to residents in 1995 and telephone calls to selected residents in 2001 were used to assist in confirming the modeling results. The modeling and questionnaire results are summarized in **Appendix F**.

Information collected from the resident questionnaires and telephone calls was sorted and categorized according to the type of problem, severity, and jurisdictional responsibility.

Most problems which were listed on the resident questionnaires were categorized into one of four problem types: flooding, which results from overbank flooding of Spring Brook No. 1; drainage, which results from water overflowing storm sewers or drainage ditches; overland flow, which results from water flowing overland in undefined drainage paths; and erosion problems, which result from water transporting soils away from their original location.

All problems identified in the questionnaires were categorized as having critical or chronic severity. Critical problems are those problems that remain unsolved if inundation is analyzed to occur one or more times during the period of record and results in structure damage or disruption of major traffic routes. Chronic problems are those that occur infrequently or occur frequently but with less severity, including shallow street or yard flooding which does not result in costly repairs. A third category of severity exists: emergency, which results when there is an immediate danger to public health, safety, life, or complete loss of property value. None of the questionnaires or data indicated that emergency problems existed.

The questionnaires were also sorted according to jurisdictional responsibility. Most problems reported by residents are the responsibility of the municipality: DuPage County for unincorporated areas, and the incorporated municipalities within incorporated boundaries.

Most problems identified in the resident questionnaires were chronic problems related to overbank flooding of yards. Residents identified chronic overbank flooding problems on Main Street, Elm Street, Merrill Drive, Foothill Drive, Aurora Way, Center Avenue, Greenwood Road, Plamondon Court, Gables Boulevard, Gone Away Court, Leabrook Cove, Creekside Cove, Pebblestone Court, Sandy Hook Lane, Fox Run, Wallace Road, and Morris Court.

Critical problems most often resulted from overbank flooding that affected structures and roadways at Aurora Way, Pebblestone Cove, Fox Run, Arrow Road, and Batavia Road. Critical drainage problems resulting in a disruption of traffic were also identified in the upper part of the watershed, which is drained by storm sewers. These critical drainage problems were identified at the intersections of Illinois and Main Streets, Indiana and Hale Streets, and Park and Main Streets in Wheaton. For the purposes of the analysis, flood prone areas were broken down into twelve different regions as shown in Figure 6.1 of **Appendix F**.

7.3 Economic Analysis

DuPage County's computer program DEC-2 is used to analyze economic flood damages. Certain elevation information for each structure identified as having the potential to flood is input into the DEC-2 model, namely the structure low entry and first floor elevations. Other inputs to the model include the respective stream stations of each structure; structure type, value, and contents value; and damage curves correlating flood depth to percent damage to a structure and its contents developed by FEMA and the ACOE. The maximum water surface elevations along the stream are compared to each structure's elevation to estimate how much damage occurs to each structure.

The damages calculated by the DEC-2 model include structural damages, content damages, and associated damages such as automobile damage, landscaping, emergency living costs, and lost wages. The DEC-2 model also indicates which structures are eligible for buy-out under current DuPage County criteria. To be eligible for a buy-out under these criteria, the depth of flooding at a structure must exceed 1.0 foot on at least one occasion or exceed 0.5 feet on two or more occasions over the period of record. The DEC-2 model does not include traffic damages, although overtopping of major roads and private drives was identified in the 2004 study. **Table 13** summarizes those results.

It is expected that the actual damages in the watershed are greater than the damages predicted by DEC-2, since traffic damages and non-residential damages are often not included, and the damage curves generally under-predict actual damages.

Using the most current FEQ model results for Spring Brook No. 1 and 2014 tax records information for each structure, the DEC-2 model was rerun. **Table 14** summarizes the total number of flooded structures including the number eligible for buyout and the total dollar estimate of damages.

Structure Name	Maximum Elevation (ft)	Road Overtopping Elevation (ft)	No. of Events Overtopping Occurs
Hawthorne Ave	732.21	732.19	1
Warrenville Rd	729.90	733.55	
Prairie Path	728.52	738.31	
Gables Blvd	726.47	725.4	5
Aurora Way	726.12	725.55	1
Creekside Drive	725.15	725.33	
Stonebridge Drive	725.01	725.16	
Treatment Plant Entrance 1	724.93	722.01	11
Treatment Plant Entrance 2	724.85	724.4	2
Treatment Plant Entrance 3	724.75	721.43	7
Atten Road	724.15	721.9	3
Essex Road	723.42	718.64	22
St. James Crossing	720.83	713.15	55
Winfield Road	715.56	715.32	
Arrow Road	712.30	704.2	115
Morris Court	708.30	699.36	6
Cenacle Bridge ¹⁸	700.87	693.64	113

Table 13. Spring Brook No. 1 watershed road overtopping summary

Table 14. Summary of quantified damages

	No. of Properties Subject to Flood Damage	No. of Structures Meeting Buyout Criteria	Estimated Cumulative Damages ¹⁹
Residential Areas	70	21	\$2,876,356
Non-Residential Areas	8	3	
Total	78	24	

7.4 Alternatives Evaluation

Several alternatives to reduce the identified flood problems were evaluated by Earth Tech in 2004. The evaluation criteria used and the development of alternatives are discussed below.

The goal of the evaluation was to determine which flood control alternatives provided the greatest benefit at the least cost based on an economic comparison. There may have been additional benefits that the evaluation did not consider.

7.4.1 Criteria

Alternatives for reducing the identified flood damages have been evaluated and weighed against the following design criteria:

¹⁸ Some overtopping elevations represent elevations on the adjacent overbank which are lower than the road at the structure itself, including overtopping at Cenacle which occurs on the left overbank 50' from the top of bank.

¹⁹ Estimated Cumulative Damages are based on the events and includes damages to the structure, contents and associated damages. Damages do not include traffic-related damages or damages to non-residential structures.

- Conformance to the *DuPage County Stormwater Management Plan*;
- Level of flood protection provided;
- Capital cost;
- Environmental considerations, including wetland, riparian environment, and habitat impacts;
- Conformance to the DuPage County Countywide Stormwater and Flood Plain Ordinance;
- Opportunities to include best management practices for water quality improvements; and
- Public comments.

7.4.2 Alternatives Development

Each identified flood problem area was analyzed, and one or more of four general alternatives were identified to reduce flooding at each problem area. The four general alternatives that were applied to the flood prone areas were:

- 1. No action.
- 2. Buyouts and/or flood proofing of all eligible structures.
- 3. Structural flood control measure(s) combined with buyouts and/or flood proofing of all eligible structures.
- 4. Structural flood control measure(s) only.

The cost associated with property buyout was based on the total assessed value with a 3.6 multiplier. Flood proofing costs are evaluated based on an estimated \$10,000 cost to flood proof homes identified with 0.01 to 0.50 feet of flooding depth, and \$20,000 to flood proof homes identified with 0.51 to 0.99 feet of flooding depth. It has been the policy of the SMPC that DuPage County will fund the design of the floodproofing measures, but the homeowner must fund the construction of the proposed improvement.

Three different structural design alternatives were evaluated. The alternatives were considered individually and in combination as described below.

7.4.3 Structural Alternative at Chicago Golf Club

The structural design alternative involves excavation and grading in the left overbank at the Chicago Golf Club, to create additional floodplain storage. The alternative included regrading between elevation 738.0 and the approximate normal water elevation of 724.0 from Hawthorne Lane to Warrenville Road. At the existing golf club structure, regrading was proposed between elevations 734.0 and 724.0. The FEQ cross sections were revised to model the impacts of the proposed alternative, assuming 5:1 horizontal:vertical side slopes down from elevation 738.0 and a 1 percent minimum slope up from elevation 724.0. The proposed alternative resulted in an additional 34 acre-feet of floodplain storage between Hawthorne Lane and Warrenville Road.

The structural design alternative was quantitatively evaluated using the Spring Brook No. 1 FEQ hydraulic model to determine the reduction in flood damages associated with the alternative.

The historical time series file was used to evaluate the impact of this alternative on historic flood levels.

The modeling results indicated that the project resulted in a lower flood profile across much of Spring Brook No. 1. The stream profile during three of the largest historical storms (1957, 1972, and 1987) dropped significantly.

The lowered flood profile resulted in a reduction in the frequency and severity of economic damages along the length of Spring Brook No. 1. Economic damages were reduced by approximately 15%.

7.4.4 Structural Alternative at Whittier Elementary School

This structural design alternative required the regrading of a Whittier Elementary School play field near the intersection of Main Street and Park Avenue to create additional floodplain storage. The alternative included regrading the field from an existing elevation of roughly 740.0 to a proposed elevation of roughly 730.0. The proposed outlet is a storm sewer inlet with a rim elevation of 729.7. The proposed alternative would result in approximately 4.7 acre-feet of new storage below elevation 733.0 and 9.0 acre-feet of new storage below elevation 734.0 with a maximum slope of 4:1 horizontal:vertical side slopes of the storage area and a minimum 1% slope across the bottom of the storage area.

The structural design alternative was quantitatively evaluated using the Spring Brook No. 1 FEQ hydraulic model to determine the reduction in damages associated with the alternative. The historical time series file was used to evaluate the impact of this alternative on historic flood levels.

The modeling results indicated that the structural project resulted in a lower flood profile across much of Spring Brook No. 1, especially during three of the largest historical storms (1957, 1972, and 1987). The lowered flood profile results in a reduction in the frequency and severity of economic damages along the length of Spring Brook No. 1. Economic damages were reduced by approximately 12%.

A second structural alternative in the school area that created new floodplain storage in both the school play field and existing school parking lot was also considered and evaluated at a cursory level. It was anticipated that there could be difficulty in obtaining permission to use the parking lot for floodplain storage, and because this alternative did not produce a large reduction in water profile, use of the school parking lot for additional storage was not evaluated further.

7.4.5 Structural Alternative at Both Chicago Golf Club and Whittier Elementary School

A third set of analyses were performed to determine the impact of both structural alternatives in combination. The modeling results indicated that when both structural alternatives are considered, the greatest reduction in water surface profile occurred. The lowered flood profile

resulted in a reduction in the frequency and severity of economic damages along the length of Spring Brook No. 1. Economic damages were reduced by approximately 26%.

7.4.6 Alternatives Evaluation Summary

Earth Tech's study recommended buyouts of the structures that qualified for the voluntary buyout program and floodproofing of the remaining structures that received flooding damages. The structural flood control improvements that were evaluated during the 2004 study were determined to be economically unfeasible. The cost to construct the structural improvements far exceeded the benefits provided by the improvements.

The FPDDC has prepared plans and specifications for water quality improvements involving streambank stabilization, stream meandering, and pool/riffle installation along Spring Brook No. 1 within the St. James Farm Forest Preserve. Grant funds are available for these types of improvements on a limited basis as long as the improvements are identified and approved within a detailed watershed plan. Therefore, the recommendations from the watershed plan at this time will focus on water quality improvements so that grant funds can be pursued for the proposed projects.

DuPage County staff is aware, through feedback from our stakeholders and through our hydraulic modeling efforts, that flooding damages are still a major concern within the watershed. DuPage County has experienced several intense rainfall events since Earth Tech completed their study in 2004. These rainfall events include the September 2008, July 2011, and April 2013 events. Additional flood control alternatives will be analyzed in a future study and incorporated into the Spring Brook No. 1 Watershed Plan by addendum.

8. Nonpoint Source Pollution Control Recommendations

8.1 Site Specific Best Management Practices

For the purpose of project identification the stream was divided into zones. These zones were based on sub basin hydrogeomorphology, watershed demographics, land use, and channel characteristics. Reach characteristics and associated projects will be identified within each of the various zones.



Figure 21. Zone divisions of the Spring Brook No. 1 watershed

8.1.1 Zone A: Headwaters to Kelly Park

The headwaters of Spring Brook No. 1 is confined in a dense network of storm sewer pipes. As a natural channel, the intermittent stream would flow for approximately 2.2 miles through downtown Wheaton until just south of Elm Street. Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, the water is absorbed and filtered by soil and vegetation. These mediums naturally slow down, spread out, and soak up precipitation and runoff. Water percolating into the soil becomes a stable supply of groundwater, and the runoff is naturally filtered of impurities before it reaches ponds, creeks, streams, and rivers. As areas become more developed, the amount of imperviousness increases. Impervious cover is any surface in the landscape, including driveways, roads, parking lots, rooftops, and sidewalks, that cannot effectively absorb and infiltrate rainfall. The water that runs off of impervious surfaces is drained through engineered collection systems and discharged into nearby waterbodies. The stormwater carries trash, bacteria, heavy metals, pesticides, oil, sediment, fertilizers, salt, and other pollutants from the urban landscape, degrading the quality of the receiving waters. Higher flows can also cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

A growing body of scientific literature has shown that groundwater recharge, stream base flow, and water quality measurably change and can decrease as impervious cover increases. Studies illustrate a direct relationship between the intensity of development, as indicated by the amount of impervious surface, and the degree of damage to aquatic life in the watershed. Two examples are illustrated below (**Figure 22**), where the macroinvertebrate community is noted to decline as the imperviousness approaches ten percent and fish species are impacted when imperviousness exceeds fifteen percent. In general, stream quality becomes impacted when imperviousness exceeds 10% of the watershed and non-supportive of aquatic life above 25% impervious, as is illustrated in **Figure 23**.







Images (above) taken from Meeting TMDL, LID and MS4 Stormwater Requirements: Using WinSLAMM to Assess Quality and Volume Controls (2010), while image (left) taken from Impacts of Impervious Cover on Aquatic Systems: Watershed Protection Research Monograph (2003)



While the entirety of the Spring Brook No. 1 watershed is approximately 26% impervious, the portion of the upper watershed that discharges through several storm sewer outfalls at Kelly Park is approximately 44% impervious. This level of development causes a large volume of water, and load of associated pollutants, to be discharged downstream during storm events. Green infrastructure can be one of several tools used by communities to provide a remedy.

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by infiltrating or soaking up and storing water. Examples of green infrastructure can include, but are not limited to, such practices as rain gardens, bioswales, planter boxes, permeable pavers, green roofs, urban tree canopy, and land conservation.

a) Rain gardens (also known as bioretention or bioinfiltration cells) are shallow, vegetated basins that collect and absorb runoff from rooftops, sidewalks, and streets. Rain gardens mimic natural hydrology infiltrating by and evapotranspiring runoff. Rain gardens are versatile features that can be installed in almost any unpaved space.



- b) Planter boxes are urban rain gardens with vertical walls and open or closed bottoms that collect and absorb runoff from sidewalks, parking lots, and streets. Planter boxes are ideal for space-limited sites in dense urban areas and as a streetscaping element.
- c) Bioswales are vegetated, mulched, or xeriscaped channels that provide treatment and retention as they move stormwater from one place to another. Vegetated swales slow, infiltrate, and filter stormwater flows. As linear features, vegetated swales are particularly suitable along streets and parking lots.
- d) Green roofs are covered with growing media and vegetation that enable rainfall infiltration and evapotranspiration of stored water. Green roofs are particularly cost effective in dense urban areas where land values are high and on large industrial or office buildings where stormwater management costs may be high.


- e) Permeable pavements are paved surfaces that infiltrate, treat, and/or store rainwater where it falls. Permeable pavements may be constructed from pervious concrete, porous asphalt, permeable interlocking pavers, and several other materials. These pavements are particularly cost effective where land values are high and where flooding or icing is a problem.
- f) Many cities set tree canopy goals to restore some of the benefits provided by trees. Trees reduce and slow stormwater by intercepting precipitation in their leaves and branches. Homeowners, businesses, and cities can all participate in the planting and maintenance of trees throughout the urban environment.
- g) Protecting open spaces and sensitive natural areas within and adjacent to cities can mitigate the water quality and flooding impacts of urban stormwater while providing recreational opportunities for city residents. Natural areas that are particularly important in addressing water quality and flooding include riparian areas, wetlands, and steep hillsides.

	F	'eature		Condition				
Name	Туре	Extent ²⁰	Size	Buffer ²¹	Erosion ²²	Channelization		
A1	Stream	5.76-7.96	11,616 feet ²³					
8775	Pond		0.566 acres	1	Moderate			
8776	Pond		0.115 acres	0	None			
8777	Pond		0.100 acres	0	None			
6968	Pond		0.620 acres	0	Moderate			
40367	Pond		0.450 acres	5-10	None			

Table 15. Summary of hydrologic features in Zone A

²⁰ River mile segment of stream comprising the individual feature, derived by zone location and soil type.

²¹ Buffer condition consists of the distance, in feet, that vegetation (other than turf grass) extends from top of bank.

²² Erosion condition is based on conditions summarized in the *Bank Stabilization Worksheet of the Region 5 Load Estimation Spreadsheet Model.*

Slight: Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.

Moderate: Bank is predominantly bare with some rills and vegetative overhang.

Severe: Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped.

Very Severe: Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains, and culverts eroding out and changes in cultural features, as above. Massive slips or washouts common. Channel cross-section is U-shaped and streamcourse or gully may be meandering.

²³ Stream segment contained within underground storm sewer pipes.



Figure 24. Catchments comprising Zone A

Numerous stakeholders have expressed interest in implementing projects in the upper portion of the watershed that utilize green infrastructure, including those measures identified in the City of Wheaton's *Downtown Strategic and Streetscape Plan* (October 2013). Additionally, stakeholders intent to conduct localized, flood control studies to identify where green infrastructure can best be utilized to reduce or eliminate flooding in certain areas.

- Construct festival streets on portions of Hale Street (between Front Street and Karskoga Avenue), Karskoga Avenue (between Wheaton Avenue and Hale Street), and Liberty Drive (between Hale Street and Reber Street) in the City of Wheaton;
- Implement green alleys upgrades, particularly off of Hale Street between Front Street and Wesley Street and at the existing alley passageways on the block east of Hale Street between Front Street and Wesley Avenue;
- Create a central park in the heart of downtown Wheaton to the south of the Union Pacific railroad tracks;
- Upgrade of the materials and design of the existing Martin Plaza, along the north side of the railroad tracks and just to the west of Main Street;
- Modify the facilities at Hoffman Park, Central Park, and Clocktower Commons Park to include parking lot conversions to permeable surfaces, incorporation of native vegetation, and opportunities to capture and store stormwater runoff;

- Install a retrofit of the existing Franklin Middle School, Lowell Elementary School, and Whittier Elementary School parking lots to include the use of permeable pavers and native vegetation;
- Construct permeable parking structures to service the Billy Graham Center, Welcome Center, and Performing Arts and Music Center and replace existing facilities;



Figure 25. Permeable paver parking lot at Hubble Middle School

- *Explore potential to daylight, at least in part, the currently sewered stream;*
- Retrofit of parking surfaces at the Wesley Square Condominium Association property; and
- Develop studies to address localized flooding, through the use of green infrastructure, at the intersection of Reber Street and Willow Avenue, Wheaton Christian Reformed Church (catchment SP-F66), College Avenue Metra Station (catchments SP-F64, SP-F52, and SP-F76), Pershing Avenue (catchment SP-F14), and Glendale Ditch (catchment SP-F64).

8.1.2 Zone B: Kelly Park to Creekside Drive Bridge Crossing

Spring Brook No. 1 is piped throughout all of the headwaters and daylights at Kelly Park through numerous storm sewer pipes, depicted in Figure 26, and flows downstream for approximately 1.7 miles until the Creekside Drive bridge crossing. During most storm events, the volume of water discharging at these outfalls is substantial and both the velocity and amount of water has caused issues both with respect to flooding and streambank erosion. In additional to reduced imperviousness that should be realized throughout the entire watershed, Zone B would benefit from implementation of additional streambank stabilization efforts, including vegetation management and an enhanced riparian buffer.



Figure 26. Daylighting of the headwaters of Spring Brook No. 1 at Kelly Park

Riparian areas are the lands along the banks of rivers, and riparian buffers perform a number of different functions: slowing the velocity of stormwater runoff; filtering stormwater pollutants; shading surface water; bank stabilization; habitat; habitat connectivity; and recreational opportunities. These buffers act as a transition zone between uplands and aquatic habitat and also offer pollutant treatment by removing contaminants from runoff through nutrient uptake and soil filtration. Additionally, the deep root systems of trees and shrubs provide soil stabilization, which aids in avoidance of mass wasting of sediment and associated phosphorus into the waterway.

In 1995, DuPage County initiated a conceptual design for needed stabilization along Spring Brook No. 1. The design plans noted three areas: Area 1 extending from the West Branch DuPage River to the bridge crossing at Morris Court; Area 2 extending from Winfield Road to the outlet weir of the ponds with their upstream terminus at Creekside Drive; and Area 3 extending from Creekside Drive to Kelly Park (just south of Elm Street). The intent of the conceptually designed project is to provide vegetative stabilization of both banks for all three areas, and the work may include removal and/or pruning of existing vegetation and replanting along streambanks. The design recommends that, where feasible, a buffer (minimum of ten feet up to a maximum width of twenty-five feet from top of bank) should be established for slope stability and water quality benefits along the stream corridor. Additionally, the buffer should be planted with native species to blend into the existing landscape.

Three years later, a portion of the conceptual plan was finalized and contract bid documents were prepared²⁴ for the area spanning from Kelly Park to approximately 850 feet east of Plamondon Road / Warrenville Road. DuPage County and the City of Wheaton initiated the project because streambank slope failures and erosion at the normal water line were degrading the water quality by contributing large pollutant loads to Spring Brook No. 1 and its receiving waters, West Branch DuPage River. In addition to the short duration and high velocity flows impacting this area, dense growth of shrubs and nuisance vegetation had completely shaded out all ground level vegetation at some locations, with the resulting bare earth even more susceptible to erosion. To stabilize the eroding banks, a variety of biogengineering solutions were featured in this project:

- Vegetated geogrids at locations requiring stabilization of steeper slopes;
- Plantings (seed, cuttings, and shrubs) for the streambanks specifically for their deep root systems (which bind the soils) and low growth height;
- Concrete A-jacks, which offer continuous protection of the slope where it meets the normal water elevation;
- Coir fiber roll, which biodegrade over time, but provide protection and a growing medium for plantings; and
- Temporary and permanent erosion control fabrics, which provide protection to slopes until seeding and plantings become established.

For the project, regrading the slopes back to a stable angle and revegetating them would have solved most of the stability and erosion problems at a cost similar to the bioengineering solution.

²⁴ Bid #98-034, Spring Brook No. 1 Phase A Streambank Stabilization, April 9, 1998.

However, the regrading would have required removal of almost all of the existing trees and work to take place outside of established easements on private property (in addition to affecting fences and other privately owned structures). The selected bioengineering solutions provided cost-effective protection within the physical site constraints. The project was constructed at a total cost of \$222,227.55, with 60% being funded through an IEPA §319 grant (Agreement No. 9706319).

	F	<i>'eature</i>		Condition			
Name	Туре	Extent	Size	Buffer Erosion		Channelization	
B1	Stream	5.13-5.76	3,331 feet	20-30	Moderate	High	
B2	Stream	4.09-5.13	5,492 feet	10-20	Severe	Moderate	
B3	Stream	4.05-4.09	230 feet	0	Severe	Low	
42053	Pond		0.494 acres	5-10	Moderate		
42000	Wetland		0.270 acres	0	None		
42016	Wetland		3.460 acres	0	None		
41977	Pond		0.769 acres	0	Moderate		
42042	Pond		0.254 acres	3-5	Moderate		
7390	Pond		3.091 acres	20-30	Moderate		
42066	Wetland		0.551 acres	0	None		
42024	Pond		1.980 acres	0	Moderate		

 Table 16. Summary of hydrologic features in Zone B

DuPage County contracted Natural Resources Conservation Service (NRCS) in 2003 to provide an evaluation of nine existing streambank stabilization projects (including the one performed along Spring Brook No. 1) and provide guidance for future stream restoration projects. In addition to noting concern about to scour on banks opposite some A-jack installations, NRCS staff offered the following assessment and recommendations for Spring Brook No. 1:

- Although the stream had been channelized in the past, the condition has not degraded significantly since that channelization was performed;
- Existing runoff volumes and sediment loads should be maintained;
- Existing riparian corridor vegetation should be maintained or improved;
- Streambank stabilization practices in some areas should be implemented, as needed;
- Spot treatment with fascines, live stakes, seedlings, rooted stock, or grasses should be sufficient to improve riparian areas in straight segments; and
- Outside bends in curves should be treated with hard structure at the toe slope, i.e. A-jacks, stone toe protection, lunkers, etc.²⁵

While other minor, untreated sites with slight bank erosion were observed, none of those were suggested to warrant treatment. The minor erosion sites were classified as "normal" migration rates and could be treated, but only for aesthetic reasons. It was noted that other sites may become more severe over time and some monitoring may be warranted to plan for future treatment needs.

 $^{^{25}}$ Two areas needing hard toe protection were noted in the NRCS assessment. Both of these are located within Zone D and are mentioned later.

Benefits of Naturalized Streambank Stabilization

Stabilizing streambanks with native vegetation has many advantages over hard armoring such as riprap and gabions. Streams with well-established vegetation on their banks provide for better water quality and fish and wildlife habitats. Vegetation is extremely important for the biological, chemical, and physical health of the stream as well as the stability of the system.



Figure 27. Catchments comprising Zone B

Numerous stakeholders have expressed interest in implementing projects in this portion of the watershed that involve streambank stabilization and creation of additional buffer areas to provide habitat and minimize pollutant loading. Additionally, stakeholders intent to conduct localized, flood control studies to identify where green infrastructure can best be utilized to best reduce or eliminate flooding in certain areas.

Reassess the stabilization practices existing between Kelly Park and the Chicago Golf Club property;

- Determine the potential for streambank stabilization practices between Plamondon Road / Warrenville Road and Creekside Drive;
- Evaluate, for buyout, residential properties located upstream of Wheaton Cemetery that are within the regulatory floodplain;
- Revisit design of the Illinois Prairie Path bridge crossing to address streambank erosion at this location;
- Install a retrofit of the existing Edison Middle School, Lincoln Elementary School, and Madison Elementary School parking lots to include the use of permeable pavers and native vegetation;
- Modify the facilities at Kelly Park, Seven Gables Park, and Briarknoll Park to include stormsewer daylighting, streambank stabilization, pond creation or enhancement, parking lot conversions to permeable surfaces, incorporation of native vegetation, and opportunities to capture and store stormwater runoff;
- Analyze the potential to provide meaningful stormwater detention at the termination of Delles Road or the northeast corner of the Chicago Golf Club property; and
- Develop studies to address localized flooding, through the use of green infrastructure, at Mayo Drive (catchment SP-26) and Delles Road (catchment SP-24).
- 8.1.3 Zone C: Creekside Drive Bridge Crossing to Pond Weir

Just before Spring Brook No. 1 passes under Creekside Drive, the water begins to slow down due to the presence of an 8.1 acre online, wet detention pond, which covers approximately 0.4 miles of stream. Wet detention ponds are storm water control structures providing both detention and treatment of contaminated storm water runoff. The pond consists of a permanent pool of water into which storm water runoff is directed. Runoff from each rain event is detained and treated in the pond until it is displaced by runoff from the next storm. By capturing and retaining runoff during storm events, wet detention ponds control both stormwater quantity and quality. The pond's natural physical, biological, and chemical processes then work to remove pollutants. Sedimentation processes remove particulates, organic matter, and metals, while dissolved metals and nutrients are removed through biological uptake. In general, a higher level of nutrient removal and better storm water quantity control can be achieved in wet detention ponds than can be achieved by some other practices, such as dry ponds, infiltration trenches, or sand filters.

The current condition of the pond is poor, with large chunks of concrete bordering the periphery of the pond, lack of an underdrain, and turf grass providing the only upland vegetation. Existing conditions, which can be observed in **Figures 28 and 29**, are lacking in three principal areas: forebay pretreatment, shallow ledges for aquatic plant establishment, and perimeter wetland buffer. Rather, the current environment allows for free access of nuisance wildlife to the water, which contributes to the nutrient and bacteria causes for the impaired waterway. Rectification of

high nutrient and bacteria loads, as well as low dissolved oxygen concentrations, could be expected through enhancement of the pond.

There are several common modifications that can be made to ponds to increase their pollutant removal effectiveness. The first is to increase the settling area for sediments through the addition of a sediment forebay. Heavier sediments will drop out of suspension as runoff passes through the sediment forebay, while lighter sediments will settle out as the runoff is retained in the permanent pool. A second common modification is the construction of shallow ledges along the edge of the permanent pool. These shallow peripheral ledges can be used to establish aquatic plants that can impede flow and trap pollutants as they enter the pond. The plants also increase biological uptake of nutrients. In addition to their function as aquatic plant habitat, the ledges also have several other functions, which can include including acting as a safety precaution to prevent accidental drowning and providing easy access to the permanent pool to aid in maintenance. Finally, perimeter wetland areas can also be created around the pond to aid in pollutant removal.



Figure 28. View of pond from monitoring station GBKA-04-WSD



Figure 29. Wildlife depositing bacteria and nutrient loads directly into the waterway

While the positive impacts from wet detention ponds will generally exceed any negative impacts, wet detention ponds that are improperly designed, sited, or maintained, may have potential adverse effects. Improperly designed or maintained ponds may result in stratification and anoxic conditions that can promote the resuspension of solids and the release of nutrients and metals from the trapped sediment.

Wet detention ponds function more effectively when they are regularly inspected and maintained. Routine maintenance of the pond includes mowing of the embankment and buffer areas and inspection for erosion and nuisance problems (e.g. burrowing animals, weeds, odors). Trash and debris should be removed routinely to maintain an attractive appearance and to prevent the outlet from becoming clogged. In general, wet detention ponds should be inspected

after every storm event. Without proper maintenance, the performance of the pond will drop off sharply. Regular cleaning of the forebays is particularly important. Maintaining the permanent pool is also important in preventing the resuspension of trapped sediments: Permanent pool depth should not exceed 6 meters (20 feet), while the optimal depth ranges between 1 and 3 meters (3 and 9 feet) for most regions. The accumulation of sediments in the pond will reduce the pond's performance; therefore, the bottom sediments in the permanent pool should be removed about every 2 to 5 years.



Figure 30. Catchments contained in Zone C

			0					
	F	Feature		Condition				
Name	ne Type Extent		Size	Buffer	Erosion	Channelization		
C1	Stream	3.60-4.05	2,361 feet	0	Severe	Low		
7491	Pond		0.433 acres	0	Moderate			
6752	Pond		8.144 acres	0	Moderate			
76150	Wetland		0.213 acres	15	None			

 Table 17. Summary of hydrologic features in Zone C

Numerous stakeholders have expressed interest in implementing projects in this portion of the watershed that involve modification of the online, wet detention pond to improve maintenance efficiency, promote nutrient uptake, and result in an overall aesthetically pleasing natural environment. To best facilitate water quality improvements through maximized removal efficiency, modification efforts should focus on residence time, pool depth, volume and area ratios, and shoreline slopes. Available aerial photography indicates that the pond was installed

sometime between 1956 and 1978 (plans from 1969), meaning that the pond was not established to fulfill any specific detention requirements.

- Install a forebay for the pond to initially collect heavier sediments;
- Naturalize both the upper and lower portions of the pond; and
- Investigate the possibility of weir removal or modification as a portion of a pond enhancement project.



Figure 31. Comparison of Spring Brook No. 1 between 1956 and 2012

8.1.4 Zone D: Pond Weir to Atten Park

The pond, referenced in Zone C, is controlled by a weir, featured in Figure 32. After flowing over the weir outlet, Spring Brook No. 1 continues to flow in a southwesterly direction through the Wheaton Sanitary District property before turning, sharply, to the south at Atten Park. The extent of this segment is approximately 0.6 miles. The 2003 NRCS evaluation of the Spring Brook No. 1 streambank stabilization project noted that two areas within this segment should be treated with hard structure at the toe slope to control erosive forces, specifically, at the weir outlet and sharp bend opposite Atten Park along Shaffner Road: It was determined, as part of current stream assessments, that these areas should receive high prioritization as stabilization efforts proceed.



Figure 32. Constructed weir at the pond outlet



Figure 33. Erosion occuring at the downstream end of Zone D²⁶

	ŀ	Feature	2	Condition				
Name	Туре	Extent	Size	Buffer	Erosion	Channelization		
D1	Stream	3.17-3.60	2,269 feet	30	Severe	High		
D2	Stream	3.05-3.17	619 feet	25-30	Severe – Very Severe	Moderate		
8902	Pond		2.160 acres	20	None			
8903	Pond		0.434 acres	5-10	None			
8899	Pond		0.190 acres	20	None			
8900	Pond		0.348 acres	0	Moderate			
44780	Wetland		1.970 acres	10	None			

	0 0					
l'able 18	8. Sum	mary of	' hvdro	logic fe	eatures in	Zone D
		and y vi				



Figure 34. Catchments contained in Zone D

 $^{^{26}}$ Tree undercutting and erosion of five to six feet behind the outlet structures is evident. Photos were taken January 2015.

Numerous stakeholders have expressed interest in implementing projects in this portion of the watershed that involve streambank stabilization and creation of additional buffer areas to provide habitat and minimize pollutant loading. Additionally, stakeholders support the implementation of green infrastructure practices can best be utilized to best reduce stormwater volume.

- Investigate the possibility of increasing the sinuosity of the stream from the pond outlet, through the Wheaton Sanitary District Property, and to Atten Park so that more natural conditions can be established and hard structures to prevent erosion are not needed;
- Enhance buffer areas along the stream to curtail extensive erosion and protect existing tree canopies;
- Modify the facilities at Atten Park to include streambank stabilization and stream remeander (including land acquisition, if necessary), parking lot conversions to permeable surfaces, incorporation of native vegetation, and creation of additional multiuse paths; and
- Install a retrofit of the existing Wiesbrook Elementary School parking lot to include the use of permeable pavers and native vegetation.

8.1.5 Zone E: Atten Park to Winfield Road Bridge Crossing

After flowing through Atten Park, Spring Brook No. 1 turns in a western direction and flows through the St. James Farm Forest Preserve for until approximately 3.1 miles until reaching the Winfield Road bridge crossing.

In 1994, David Rosgen authored *A Classification of Natural Rivers*, which has since been used to assess mechanisms for predicting channel stability, erosion, aggradation (sediment accumulation), channel enlargement, sediment transport capacity, lateral or longitudinal migration of the river bed, and hydraulics. Midwestern streams, according to Rosgen's classification, are generally Type C streams: slightly entrenched (stable), meandering systems characterized by well-developed floodplains.

The USEPA developed, in May 2012, a document, *A Function-Based Framework for Stream Assessment & Restoration Projects*, to expand upon the classification system outlined by Rosgen and guide future stream corridor restoration efforts to improve or restore lost functions. Knowing why a project is needed requires some form of functional assessment followed by clear project goals. To successfully restore stream functions, it is necessary to understand how these different functions work together and which restoration techniques influence a given function. It is also imperative to understand that stream functions are interrelated and build on each other in a specific order or functional hierarchy. If this hierarchy is understood, it is easier to establish project sequencing and goals. With clearer goals, it is easier to evaluate project success.

Over the past two decades, best management practices (BMPs) have been widely used as tools for addressing watershed health. Common BMP practices such as created wetlands, retention

basins, bioretention areas, infiltration areas, and restoration of riparian buffers are but a few of the practices that have been implemented to improve watershed health. These practices generally seek to reduce the amount of runoff delivered to streams (detention), reduce the rate at which runoff reaches streams (attenuation), increase the amount of water that percolates into the soil (infiltration), and/or promote physical and chemical processes that remove pollutants and sediment from runoff waters. Most of these practices are installed on smaller headwater catchments of a watershed, where such approaches are more feasible and cost effective, and where pollutants can be trapped near their sources.



Figure 35. Catchments contained in Zone E

River restoration is a technique that is applied at the stream reach scale and is generally used to compliment the other techniques described above. BMP approaches can help to improve the quality and timing of water entering a receiving stream; river restoration approaches can address stability and water quality problems that are expressed or develop in the river itself, such as channel incision, streambank erosion, and loss of aquatic habitat.

The practice of stream restoration began to achieve momentum in the 1980s, as interest grew in addressing stream stability problems in a way that was sustainable long-term and also improved recreational uses and ecological functions. Until that time, the primary approach used to stabilize streams was to harden the channel and/or streambanks with such material as loose rock (rip-rap), gabion baskets, concrete, retaining walls, etc. Such practices addressed the stability problems with the stream, but often resulted in dramatic loss of ecological function and aquatic life due to loss of aquatic cover, appropriate bed material, shade, and food sources. In addition, since these approaches did not address overall channel geometry issues, they often lead to downstream instability.

	F	Feature		Condition				
Name	Туре	Extent	Size	Buffer	Erosion	Channelization		
E1	Stream	1.54-3.05	7,966 feet	25	Very Severe	High		
T1	Stream	0.96-1.17	1,128 feet	40	Severe	High		
T2	Stream	0.65-0.96	1,660 feet	40-60	Moderate	None		
T3	Stream	0.45-0.65	1,051 feet	15	Slight	Low		
T4	Stream	0.04-0.45	2,157 feet	20-40	Severe	Low		
T5	Stream	0.00-0.04	232 feet	20	Severe	Low		
8896	Pond		1.525 acres	3	None			
8895	Pond		1.057 acres	1-3	Moderate			
8898	Pond		6.870 acres	2	Moderate			
9498	Pond		5.540 acres	3	Moderate			
66507	Wetland		0.197 acres	15-20	None			
8897	Pond		0.847 acres	15	Moderate			
7783	Pond		1.098 acres	5	Moderate			
66497	Pond		0.251 acres	0	Moderate			
6430	Pond		2.383 acres	5	Moderate			
6735	Pond		0.616 acres	0	None			
6949	Pond		0.342 acres	6	Moderate			
66500	Pond		0.166 acres	0	None			
9499	Pond		1.958 acres	20	None			
66499	Wetland		0.649 acres	20	None			

Table 19. Summary of hydrologic features in Zone E

Practitioners began to develop techniques that would not only address stability issues, but also improve aquatic habitat functions and recreational uses, such as fishing. The resulting designs, often referred to as natural channel designs, seek to replicate the channel forms in stable, natural rivers in order to restore stability and functions to degraded rivers. Natural channel design can be defined as a stream restoration technique that seeks to create a stable stream channel that balances its flow of water and sediment over time so that the channel does not aggrade or degrade. A variety of methods and tools are available to practitioners, but nearly all focus on several important design concepts:

- Providing connection between the channel and its floodplain (floodplain connectivity);
- Sizing low-flow channels to carry a given flow that, over time, carries the most sediment (channel-forming discharge concept);
- Designing channels to carry both their water and sediment loads; and
- Constructing channels to mimic the functions of natural channels to the extent possible.

The Stream Functions Pyramid (SFP), developed by Harman in 2009, provides a framework that organizes stream functions into a pyramid form and illustrates that stream functions are supported by lower-level functions in a hierarchical structure. The SFP uses parameters and measurement methods that are used in stream restoration approaches and restoration methodologies. It also provides a clear illustration of how physical functions support chemical and biological functions. This helps scientists, engineers, and managers to ensure that they are not only addressing the functions they are directly concerned about, but also the supporting functions that are required to achieve success.



Figure 36. Detailed view of the SFP with examples of function-based parameters

Numerous stakeholders have expressed interest in implementing projects in this portion of the watershed that involve natural channel design and the creation of additional buffer areas to provide habitat and minimize pollutant loading. Additionally, stakeholders support the implementation of green infrastructure practices to best reduce stormwater volume.

- **b** Develop appropriate sinuosity of the stream channel;
- Connect the stream to its contiguous floodplain;
- Add gravels, cobbles, and boulders to create aquatic and loafing habitat, spawning sites, and food sources for macroinvertebrate, fish, and mussel species;
- Grade, shape, and plant the adjacent wetland and riparian areas for diversity to improve water quality and promote groundwater-surface water interaction and plant uptake of nutrients;
- Clear invasive, non-native vegetation from the creek's upland areas and replace with native species;
- Secure property to create a connected, open space corridor to be utilized by wildlife and recreationalists;
- Modify facilities at the Cantigny Park to include the conversion of existing parking lots to permeable pavement and naturalization of detention ponds;

- Remove the deteriorated farm bridge that crosses Spring Brook approximately 1,200 feet upstream of the Essex Road bridge crossing, with consideration being given to potential upstream or downstream impacts that may result from the removal;
- Establish upland, wetland areas by terminating existing drain tiles earlier and providing increased residence time before being discharged to Spring Brook No. 1;



Figure 37. Deteriorated farm bridge

- **P** Retrofit septic systems leaching untreated pollutants into the waterway;
- Enhance buffer areas along the stream to curtail erosion and protect existing tree canopies;
- Provide streambank stabilization along the main tributary to Spring Brook No. 1;
- Install a retrofit of the existing Wheaton Warrenville South High School parking lot to include the use of permeable pavers and native vegetation; and
- Develop studies to address localized flooding, through the use of green infrastructure, along the primary tributary to Spring Brook (catchments SP-F92 and SP-F94).

8.1.6 Zone F: Winfield Road Bridge Crossing to West Branch DuPage River

Spring Brook No. 1 flows beneath the Winfield Road bridge crossing and continues for approximately 1.8 miles until the confluence with West Branch DuPage River. This stretch of stream contains an impounded 16.2 acre pond, which is maintained by a weir located at a FPDDC access road located approximately 2,522 feet upstream of the Morris Court bridge crossing.

The ability of fish populations to fulfill their life history requirements normally depends on streamflow, water quality, and habitat availability. Adequate flow in rivers and streams must be maintained to allow fish movement and survival. Impoundment structures can block fish passage and hold streamflow back to levels that will not support fish, as dissolved oxygen and temperature abnormalities typically are a result of impounded waters.

When restoring the functional ecology of a stream, the goal is typically to improve overall fish habitat. Good habitat includes creating riffle, run, pool, and glide bed forms, as well as providing diverse cover elements within the channel. Diverse habitat will support different stages of a fish's life cycle and/or different species of fish over a varying spatial and temporal

scale. Diverse habitat also produces diverse food sources for fish. This may include patches within a stream that support algae or macrophytes for herbivores; riffles or woody debris that supports various benthic macroinvertebrates; or deep pools where piscivorous predators may ambush smaller fish. Habitat diversity is generally correlated with diversity in fish communities within streams. In general, a healthy, functioning fish community occurs when the following conditions are present:

- Continuous upstream streamflow sources, as removal of impoundments and excessive water consumption for human activities will provide adequate streamflow throughout the year;
- Floodplain connectivity and bankfull channel, dissipate energy of large storm events to prevent excessive scouring of substrates used for reproduction (pools), and prevent sediment inundation of substrate habitat;
- Healthy hyporheic zones, which provide habitat for food resources;
- Bed form diversity and in-stream structures, which create diverse habitats for feeding and reproduction, dissipate stormflow energy, provide opportunities for organic carbon storage and retention, provide substrates such as large woody debris, and provide scour pools for reproduction, feeding, and shelter;
- Channel stability, which prevents sediment inundation of habitat and excessive turbidity that is contributed from channel erosion;
- Riparian community, which provides allochthonous carbon inputs for food resources, provides shade for cooler temperatures, and provides vegetative roots for available habitat; and
- Adequate dissolved oxygen, which is required for fish survival and health.



Figure 38. Catchments contained in Zone F

As with other taxa, fish population quality can be expressed in an Index of Biotic Integrity (IBI). Karr et al. (1986) recommends twelve measures of fish assemblages that fall into three broad categories: species composition, trophic composition, and fish abundance and condition. This methodology has been applied to evaluations of fish populations and has been adjusted by state and regional biologists to reflect regional stream conditions. The State of Illinois, as part of the Illinois Integrated Water Quality Report (2014) development process, uses the basic principles outlined by Karr et al., as well as incorporating modifications proposed by other researchers.



The fIBI score resulting from species evaluation along Spring Brook No. 1 (monitoring station WB10) in 2012 is 21.5, indicating that the stream is only slightly better than of poor resource quality and is not supporting the aquatic life use. Although fIBI scores derived from monitoring stations on the mainstem West Branch DuPage River immediately adjacent to the confluence with Spring Brook No.1 are similar, those scores from downstream of the Fawell Dam are markedly higher: Through modification of the dam structure, fish populations would be allowed to migrate upstream. A modification of the Fawell Dam, coupled with habitat restoration efforts²⁷ that have been completed along West Branch DuPage River between Garys Mill Road

²⁷ Initially, a mitigation effort required by federal law through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, entailed the cleanup of thorium deposits in pockets of the riparian area: Construction activities for the cleanup were completed in November 2012. The cleanup efforts extended along the West Branch DuPage River from the West Chicago Regional Wastewater Treatment Plant, just north of Garys Mill Road, through the site of the McDowell Grove Dam, located in the McDowell Grove Forest Preserve. Subsequently, DuPage County Stormwater Management and the Forest Preserve District of DuPage County partnered with IEPA, through receipt of a §319 Nonpoint Source Management Program grant, to implement the West Branch DuPage River Corridor Restoration Project, which extended approximately three and a quarter miles (from Warrenville Road until slightly downstream of the Fawell Dam in the McDowell Grove Forest Preserve) and involved stabilization and restoration of the stream channel, streambanks, and adjacent riparian area. The implemented measures included the removal of non-native invasive species along the banks of the river and cutting back the incised banks to allow the river to access floodplain areas more frequently. The banks were lowered to just above the normal water elevation to create a floodplain terrace. Hummocks and hollows were created within this area to increase the residence time of stormwater runoff and create habitat through interspersion of vegetation zones. This area was vegetated with bottom land wetland/riparian vegetation. Approximately 7,625 linear feet of streambank stabilization consisting of vegetated rock toe and root wad installation planted with native shrub live stakes was installed. Permanent vegetative cover, which includes native seeding and plug installation, was established to provide a transition area between the water and upland areas. Stream channel stabilization ensured that the existing stream substrate is in good condition with six riffles installed, along with several adjacent pools that incorporate large woody structures for improved benthic macroinvertebrate utilization and fish habitat.

and the McDowell Grove Forest Preserve over the past decade, should result in an increase of fIBI scores along the mainstem reach. Expanding natural channel design practices to the Spring Brook No. 1 riparian corridor should elevate fIBI along Spring Brook No. 1, as well, following dam modification. Given the importance of fish in structuring the populations of their food resources, and the significant role fish play in the population dynamics, nutrient cycling, and energy flow in lotic ecosystems, additional benefits will be realized as fIBI scores increase.

	F	'eature		Condition				
Name	Туре	Extent	Size	Buffer	Erosion	Channelization		
F1	Stream	0.87-1.54	3,534 feet	60	Slight	None		
F2	Stream	0.77-0.87	554 feet	55	Moderate	None		
F3	Stream	0.00-0.77	4,045 feet	60	Moderate	None		
8110	Pond		0.537 acres	5	None			
8109	Pond		0.561 acres	3	Moderate			
84663	Wetland		9.419 acres	0	None			
8085	Pond		0.426 acres	20	Moderate			
6439	Pond		15.873 acres	20-50	None			
84655	Wetland		3.043 acres	5-20	Moderate			
7562	Pond		0.655 acres	5	None			
Silver Lake	Lake		60.2 acres	15	None			

Table 20.Summary of hydrologic features in Zone F

Numerous stakeholders have expressed interest in implementing projects in this portion of the watershed that involve restoration of the naturalized stream channel and creation of additional buffer areas to provide habitat and minimize pollutant loading.

- Reconnect the aquatic communities of West Branch DuPage River by removing barriers to fish passage while introducing elements of natural stream morphology;
- Connect the stream to its floodplain and create aquatic habitat, spawning sites, and food sources;
- Grade, shape, and plant an established sinuous channel, as well as adjacent wetland and riparian areas, for diversity to improve water quality and promote groundwatersurface water interaction and plant uptake of nutrients;
- Maintain a diverse natural aquatic environment, flora, and cool/warm water fish fauna suitable for Silver Lake through control of aquatic invasive species, algae, and terrestrial species, as well as continuation of volunteer-led programs;
- Clear invasive, non-native vegetation from the creek's upland areas and replace with native species;

Additionally, energy dissipaters at nine outfall structures along the reach were installed to reduce erosive velocities and total suspended solid load contributions to the waterway.

- Enhance buffer areas along the stream to curtail erosion and protect existing tree canopies;
- Bypass the dam at Forest Preserve service drive to restore a free flowing stream and stabilize sediments as a growing medium for wetlands and other riparian areas;
- Add gravels, cobbles, and boulders to create aquatic and loafing habitat, spawning sites, and food sources for macroinvertebrate, fish, and mussel species; and



Figure 39. Dam, at the FPDDC service drive, creating an impoundment

Secure property to create a connected, open space corridor to be utilized by wildlife and recreationalists.

Parameter	Zone (Acres)									
(lbs/yr)	A (1,327)	B (1,415)	C (187)	D (509)	E (873)	F (598)				
BOD	41,670.014	26,270.133	4,628.433	10,443.105	8,549.038	2,306.025				
COD	369,382.171	234,581.596	38,368.481	104,077.925	76,713.164	27,127.976				
TSS	999,507.592	594,091.763	109,964.273	273,537.526	192,518.385	54,015.188				
LEAD	793.127	478.087	74.409	237.948	127.314	41.294				
COPPER	169.513	103.384	16.305	50.552	29.287	9.282				
ZINC	1,394.290	1,050.298	151.757	433.644	309.406	110.921				
TDS	1,786,622.743	1,207,707.236	170,953.572	557,186.467	457,905.742	237,160.402				
TN	10,380.144	7,011.148	1,158.983	2,721.452	2,334.463	726.910				
TKN	7,317.858	5,120.685	820.914	2,228.027	1,733.878	672.790				
DP	399.713	290.326	50.674	102.599	112.615	39.398				
ТР	1,270.321	1,012.862	159.933	378.644	386.070	156.436				
CADMIUM	6.754	3.946	0.324	2.211	0.703	0.208				

8.2 Potential Pollutant Load Reductions

Table 21. Estimation of existing pollutant load, by zone

An estimate of the pollutant loads from watershed sources to target future management efforts is the component most often missing from current and past watershed plans, although it is one of the most important. Without knowing where the pollutants are coming from, stakeholders cannot effectively control them and restore and protect the watershed. The loading analysis provides a more specific numeric estimate of loads from the various sources in the watershed. By estimating sources loads, one can evaluate the relative magnitude of sources, the location of sources, and the timing of source loading. The loading analysis helps one plan restoration strategies, target load reduction efforts, and project future loads under new conditions. For the Spring Brook No. 1 watershed, pollutant loads were estimated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* and DuPage County's feature class constructed with a base of existing land data as of 2009.

Those calculated, urban runoff loads were then supplemented by total nitrogen, total phosphorus, and sediment loads developed using the *Bank Stabilization Worksheet* of the same model and field assessments along the mainstem Spring Brook #1, as well as the main tributary. Together, these values comprise the Total Background Load, summarized in **Table 22**. That table also identifies the pollutant reduction potential of many of the best management practices summarized previously in this document. **Appendix I** includes a summary of estimated pollutant load reductions for individual projects for those which were able to be calculated.

	BMP CODE	NUMBER	UNIT	BOD (lbs/yr)	COD (lbs/yr)	TSS (lbs/yr)	Pb (lbs/yr)	Zn (lbs/yr)	TN (lbs/yr)	TP (lbs/yr)
RUNOFF BACKGROUND				93,368	841,191	2,200,422	1,724	3,418	24,202	3,346
STREAMBANK EROSION				U	U	U	U	U	10,740	5,370
TOTAL BACKGROUND LOAD				93,368	841,191	2,200,422	1,724	3,418	34,942	8,716
BRUSH MANAGEMENT AND PERMANENT SEEDING ²⁸	880 & 314	23.2	Acre	U	U	U	U	U	120	64
OIL AND GRIT SEPARATORS	10	24.97	Acre	U	1,100	8,465	10	4	16	2
VEGETATED FILTER STRIPS	835	32.64	Acre	108	921	4,047	2	6	23	4
POROUS PAVEMENT	890	29.815	Acre	U	6,772	27,376	13	19	207	22
WEEKLY STREET SWEEPING	17	267.3	Acre	802	U	96,656	U	U	U	29
BIOSWALES	814	46.59	Acre	706	9,653	45,234	33	53	143	23
RAIN GARDENS	13	44.725	Acre	354	U	5,923	2	4	76	12
WET POND ENHANCEMENTS ²⁹	378	225.8	Acre	U	14,409	66,896	50	73	379	63
STREAMBANK STABILIZATION ³⁰	584	73,922	Linear Foot	U	U	U	U	U	10,740	5,370
WETLAND RESTORATION	657	28	Acre	7	210	434	0	0	1	2
RESULTING LOAD				91,391	808,126	1,945,391	1,616	3,259	23,237	3,125
POTENTIAL REDUCTION				2.12%	3.93%	11.59%	6.26%	4.65%	33.50%	64.15%

 Table 22. Calculated pollutant load reductions by BMP type

U = Removal efficiency for the particular BMP and constituent unavailable.

Brush Management and Permanent Seeding: Calculated using the Agricultural Fields and Filter Strips Worksheet of the Region 5 Load Estimation Spreadsheet Model and the acreage (23.2) of FPDDC land to be managed through designed projects.

Oil and Grit Separators: Calculated using the Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model and the total sewered

²⁸ Potential for 43 tons per year of sediment to be reduced through streambank stabilization efforts, as well.

²⁹ The estimated cost per acre of wet pond enhancement is for eleven ponds totaling just over four acres in size. The 225.8 acres used to calculate the potential pollutant load reduction is a sum of the tributary area to those ponds.

 $^{^{30}}$ Potential for 5,273 tons per year of sediment to be reduced through streambank stabilization efforts, as well.

transportation acreage (24.97) for DuPage County and Illinois Department of Transportation roadways.

Vegetated Filter Strips: Calculated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* and the total unsewered acreage (32.64) resulting from a twenty-five foot buffer from top of bank of the mainstem Spring Brook No. 1.

Porous Pavement: Calculated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* and the total sewered transporation acreage (29.815) associated with identified parking lot retrofits to permeable pavement. A 2.34% reduction in watershed impervious surface would result, as well.

Weekly Street Sweeping: Calculated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* and the total sewered transportation acreage (267.3) of roadways within the watershed. This acreage equates to 150.14 curb miles to be swept.

Bioswales: Calculated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* (vegetated filter strip selection) for the total unsewered transportation acreage (46.59) for township roadways.

Rain Gardens: Calculated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* (extended wet detention selection) for 2% of the single family residential acreage (44.725) within the watershed.

Wet Pond Enhancements: Calculated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* for the tributary acreage (225.8) discharging to eleven existing, presumed ineffective, detention ponds located within the City of Wheaton. The size of the ponds themselves total just over four acres.

Streambank Stabilization: Calculated using the Bank Stabilization Worksheet of the Region 5 Load Estimation Spreadsheet Model and present streambank conditions assessed through field surveys. The input streambank information is detailed in **Appendix I**.

Wetland Restoration: Calculated using the *Urban Runoff BMP Pollutant Load Reduction Worksheet of the Region 5 Load Estimation Spreadsheet Model* (wetland detention selection) for the open space acreage (28) associated with planned wetland restoration activities.

The following practices are also proposed; however, no pollutant reduction estimates are available: stream channel restoration (9), spillway restoration (14), dam removal (16), education (1), monitoring (2), regulations (15), and tree planting (612). The BMP code is included in the parenthetical notation following each practice.

8.3 General Watershed Best Management Practices

8.3.1 Wetland Enhancement

Watershed planning will allow communities to make better choices on preserving the highest quality wetlands, protecting the most vulnerable wetlands, and finding the best sites for wetland restoration. The watershed plan can also be used to inform wetland permit decisions made by state, federal and local agencies, and to identify opportunities for voluntary wetland conservation and restoration programs. Other benefits to communities include: improved achievement of watershed goals, improved protection and restoration of wetlands, improved ability to allocate lands to their most appropriate uses, and improved ability to meet landowner needs for complying with wetland regulations.

Protect, restore, and actively manage wetland functions. Where there is no alternative to impacting wetlands within Spring Brook No. 1 watershed, impacted wetlands should be replaced elsewhere within the watershed. Remnant, high quality wetland areas, plus any areas identified with relic hydric soils, are preferred wetland restoration locations within the watershed.

Wetlands can store more water than a basin of equal size. They have the ability to treat pollutants, reduce runoff, and moderate water temperature, among many other benefits. Wetlands function more effectively when they are free of invasive species, have healthy buffers, and host diverse plant and animal communities. If anything helps with flood resiliency, it is wetlands and an undeveloped, natural floodplain.

The general public may be unaware of the benefits that wetlands provide and may have misconceptions about wetlands, including the idea that wetlands function only as breeding grounds for mosquitoes that carry the West Nile Virus. DuPage County and communities have the challenge of educating the public to overcome these barriers and provide information on the benefits that wetlands provide. Key information that should be included in a wetland education program includes providing material on how the average citizen can reduce inputs of nutrients and other pollutants to wetlands, enhance or restore wetlands on or adjacent to their property, and provide input on the federal wetland permitting process and state or local programs, where applicable.

Establish programs that engage citizen volunteers to monitor and adopt wetlands within the Spring Brook No. 1 watershed.

Adopt-a-Wetland programs are similar in concept to the successful Adopt-a-Highway program: Volunteers adopt a specific wetland and can perform a range of general maintenance such as trash removal, invasive species removal, and buffer plantings. These types of programs provide educational and research opportunities for residents and can lead to increased concern, understanding, and stewardship for wetlands. Another way to engage the community is through a wetland monitoring program that can range from simple, qualitative assessments to more

advanced monitoring including surveys of invasive species, water quality, amphibians, and benthic macroinvertebrates. Volunteers can include members of local garden clubs, school children, scout organizations, and senior citizen groups.

By actively engaging the local community, residents become more aware of water quality concerns within their watershed. Communities should work with local land conservation and other non-profit groups to help implement wetland conservation and restoration projects recommended as part of a watershed plan. These groups can provide volunteers to monitor or maintain project sites or implement simple projects, such as wetland buffer plantings or installing habitat structures.

8.3.2 Pond Restoration

Pond restoration programs have been used in other areas of the county and can be very effective in providing water quality benefits to the watershed. These can be implemented by local communities, business campuses, DuPage County programs, or through local homeowner associations looking for pond improvements. The County's Water Quality Improvement Program's reimbursement grants can be used as a partial funding source and incentive for these types of local retrofit initiatives. Retrofits can include but are not limited to turf to native vegetation restoration, removal of rip rap from pond edges, and other stabilization efforts.

Assess existing wet detention ponds to determine the degree to which these can be naturalized to reduce the transport of nutrient loads.

Organizations, such as TCF through the Conservation@Home program, assist residents with creating more natural landscapes, pond and riparian buffer enhancements, and rain garden additions to their property. These outreach efforts open the lines of communication with other neighbors that may want to incorporate similar designs.

Facilitate an education program to reach residents, homeowner associations, and businesses that highlights the environmental and financial benefits of naturalized landscaping features, particularly in ponds and along riparian corridors.

8.3.3 Riparian Buffers

Through extensive field survey work, DuPage County staff identified that much of the Spring Brook No. 1 watershed is characterized by poor riparian buffers. Areas with poor, suboptimal, and marginal riparian zones represent potential buffer restoration sites. In cases where native vegetation is present nearby, buffer plantings are not often necessary. Additionally, it is recognized that buffer restoration is not feasible in certain locations, including where public roads directly border drainages and where the presence of a road dictates clear lines of sight. However, in many cases, buffer plantings would be appropriate and provide watershed benefits. Existing naturalized riparian and wetland buffer areas should not be reduced. Instead, riparian and wetland buffer environments should be protected, restored, and managed to become more functional. Establish riparian buffers, where appropriate, with a minimum goal of twenty-five feet from the top of bank, as recommended in the 1995 conceptual design of streambank stabilization efforts along Spring Brook No. 1.

8.3.4 Good Housekeeping Strategies

Good housekeeping strategies are intended to ensure that existing municipal, State, or Federal operations are performed in ways that will minimize contamination of stormwater discharges. Successful strategies include: maintenance activities, maintenance schedules, and long-term inspection procedures for structural and non-structural controls to reduce floatables and other pollutants discharged from the separate storm sewers; controls for reducing or eliminating the discharge of pollutants from areas such as roads and parking lots, maintenance and storage yards (including salt/sand storage and snow disposal areas), and waste transfer stations. These controls could include programs that promote recycling (to reduce litter), minimize pesticide use, and ensure proper disposal of animal waste; procedures for the proper disposal of waste removed from separate storm sewer systems and areas listed in the bullet above, including dredge spoils, accumulated sediments, floatables, and other debris; and ways to ensure that new flood management projects assess the impacts on water quality and examine existing projects for incorporation of additional water quality protection devices or practices.

- Establish regular schedules for (and perform) pollutant control strategies such as street sweeping, leaf collection, and catch basin cleanout.
- Encourage the control of animal waste at public facilities, including parks, trails, and along street corridors.
- Install sufficiently sized hydrodynamic separator units at key roadway inlets to control for sediment (and associated pollutant loads), as well as organic constituents.
- Address faulty sanitary sewer connections to the storm sewer system throughout the municipal systems.
- Convert underutilized public space, such as right of way areas or undeveloped parcels, to stormwater amenities, such as through the creation of bioswales or pocket parks.

As winter deicing activities have been noted to be responsible for elevated chloride levels within Spring Brook No. 1, local communities have already begun incorporating best management practices into snow and ice management and salt handling and storage. Techniques include prewetting of roadways, calibration of application equipment, tarping of salt piles, and alternative deicing mixtures including beet juice additives and calcium magnesium acetate.

- Invest in equipment and calibration methods to reduce the chloride load placed on roadways.
- Implement municipal ordinances regarding proper salt storage by commercial applicators.

- Engage residential, commercial, and municipal entities regarding proper materials, application rates, and techniques to limit chloride loads from reaching waterways.
- Explore the possibility of developing a deicing vehicle wash/brine reuse facility at a municipal fleet headquarter location to capture and reuse chloride loads that would otherwise be discharged to the wastewater treatment facility (and eventually Spring Brook No. 1).
- Develop a cost:benefit analysis comparing different levels of municipal service in response to winter weather events, with a goal of reducing chloride loads (and municipal costs to purchase salt) while preserving the same level of public safety.

8.3.5 Education and Outreach Opportunities

While DCSM and many stakeholder organizations are active in reaching out to the residents and businesses within the Spring Brook No. 1 watershed, additional targeted efforts could be made in the following areas:

- Inform residents, particularly those with property located within in the Spring Brook No. 1 floodplain, on the techniques to assess and maintain septic systems;
- Educate property owners and landscaping businesses on topics pertaining to lawn care, including fertilizer practices, composing, and yard waste disposal;
- Facilitate water conservation and reuse efforts through the education and amendment of municipal codes that would otherwise make such efforts prohibited;
- Establishment or expansion of waste collection events, particularly for household chemical waste and automobile fluids; and
- Development of campaigns to eliminate the discharge of chemicals into the storm sewer system, including oils, paints, and waters recently treated with aquatic pesticides.

With these watershed goals in place, DuPage County and other stakeholders will continue to provide public outreach with the following tools:

Print	Electronic	Workshops
Newsletters	Websites	Presentations
News Releases	Emails	Events
Brochures	Twitter	Field Trips
Fact Sheets	Facebook	Meetings
Direct Mail	PSAs	Conferences
Surveys	Surveys	Open House
		Surveys

Table 23. Education and outreach tools

9. Plan Implementation

9.1 Implementation Roles and Responsibilities

Implementation of the proposed practices will be provided by the various stakeholders as identified elsewhere in this document. Adoption of the plan will provide assistance to local municipalities who can use it as a resource tool for water quality goals, land acquisition, regulatory guidance, funding assistance, and zoning planning. Combining and coordinating resources, funding, effort, and leadership will be the most efficient and effective means of creating real improvement of watershed resources. To help in plan implementation, the goal should be the establishment of a permanent stakeholder group to organize and coordinate plan implementation. Responsibilities of this organization would include administration, coordination of stakeholders to support individual watershed projects, and working with municipalities and other stakeholders to implement recommended policies and programs. The parties responsible for implementing each best management practice recommendation are included in **Table 25**.

9.2 Funding Sources

Proposed projects will be reliant on State, County, and local budgets and, since no single municipality, district, resident, business, landowner, or organization has the financial or technical resources to accomplish the plan goals and objectives alone, working together will be essential to achieve meaningful results. Possible grants available to help offset the financial costs of associated with recommended practice implementation are included as **Appendix J**. In general, those costs can be calculated using the five year costs estimated for predominant BMP recommendations. More refined cost estimates for individual project recommendations will be developed as plan implementation progresses.

Practice	BMP Code	Unit	Es	Estimated Cost Per Unit by Year			Five Year Sum	
			First	Second	Third	Fourth	Fifth	
BRUSH MANAGEMENT AND PERMANENT SEEDING	880 / 314	Acre	\$15,900	\$8,000	\$7,200	\$7,200	\$7,200	\$45,500
OIL AND GRIT SEPARATORS	10	Acre	\$57,020	\$620	\$620	\$620	\$620	\$59,500
VEGETATED FILTER STRIPS	835	Acre	\$21,500	\$1,500	\$3,000	\$1,500	\$1,500	\$29,000
POROUS PAVEMENT	890	Acre	\$465,000	\$200	\$200	\$200	\$200	\$465,800
WEEKLY STREET SWEEPING ³¹	17	Curb Mile	\$2,745	\$1,748	\$1,748	\$1,748	\$1,748	\$9,737
BIOSWALES	814	Acre	\$217,800	\$1,500	\$3,000	\$1,500	\$1,500	\$225,300
RAIN GARDENS	13	Acre	\$435,600	\$1,500	\$3,000	\$1,500	\$1,500	\$443,100
WET POND ENHANCEMENTS	378	Acre	\$150,000	\$2,200	\$3,700	\$2,200	\$2,200	\$160,300
STREAMBANK STABILIZATION	584	Linear Foot	\$175	\$10	\$10	\$10	\$10	\$215
WETLAND RESTORATION	657	Acre	\$57,000	\$2,200	\$3,700	\$2,200	\$2,200	\$67,300

³¹ First year costs include the purchase of a street sweeper. Costs were calculated using 150.14 curb miles.

9.3 Implementation Schedule

The schedule component of the watershed plan involves turning goals and objectives into specific tasks. A preliminary implementation schedule is included in **Table 25**; however, a more detailed schedule will be developed as part of each annual work plan. In developing these schedules, input of those who have had previous experience in applying the recommended actions, such as resource agency staff and management practice project managers, will be obtained. Additionally, sequence or timing issues that need to be coordinated to keep tasks on track will be considered.

10. Evaluating Plan Performance

10.1 Interim Milestones and Progress Evaluation

Milestones are specific, measureable, achievable, and relevant to a nonpoint source management measure, and time-sensitive subtasks needed to be accomplished over time to fully implement a practice or management measure. These milestones are typically categorized in terms of relevant time scales, such as short-term (one to five years) or long-term (five to ten years).

Progress toward achieving load reductions over time and meeting overall watershed goals is determined through the use of criteria expressed as indicators and associated target values. These indicators will provide quantitative measurements of progress toward meeting watershed goals and can be easily communicated to various audiences. These indicators and associated interim targets serve as a trigger, in that if the criteria indicate that substantial progress is not being made then the implementation approach can be altered.

BMP #	BMP Recommendation	Goal (pg.10)	Indicator	Short Term Milestone	Long Term Milestone	Responsible Partner(s) ³²
1	Animal control practices outreach	5	Number of PSAs developed	1	1 additional	CWh, WPD, FPDDC, DPC
2	Car maintenance public information program	5	Number of maintenance specific brochures produced	1	1 additional	DPC
3	Catch basin/ hydrodynamic separator cleaning	1	Percentage of structures cleaned annually	75	100	CWh, CWa, DPC, MT, SI, VGE, WT
4	Conduct hydrologic studies	4	Number of hydrologic studies completed	6 localized stormwater studies	1 complete watershed study	CWh, DPC
5	Construction site inspections	1	Percentage of sites inspected annually	75	90	CWh, CWa, DPC, VGE
6	Copper monitoring	1	Number of sampling events	Quarterly grab samples at GBKA-03 WSD	Quarterly grab samples at an upstream station (or initiate delisting)	DPC, WSD
7	Corrections to faulty sanitary sewer connections	1	Percentage of faulty sanitary sewer connections corrected	30% of existing faulty connections	75% of existing faulty connections	WSD
8	Dam or weir modification	1	Number of dams or weirs removed	1 barrier located at Pond 6439	1 barrier located at Pond 6572	FPDDC, DPC, CWh, Residents
9	Deicing wash/ brine facility	1	Number of facilities	1 included in efficiency plan	1 constructed	CWh

Table 25. Implementation schedule and milestones

³² Responsible partner abbreviations include: City of Warrenville (CWa); City of Wheaton (CWh); DuPage County (DPC); DuPage River/Salt Creek Workgroup (DRSCW); Forest Preserve District of DuPage County (FPDDC); Milton Township (MT); State of Illinois (SI); Village of Glen Ellyn (VGE); Wheaton Park District (WPD); Wheaton Sanitary District (WSD); and Winfield Township (WT).

BMP #	BMP Recommendation	Goal (pg.10)	Indicator	Short Term Milestone	Long Term Milestone	Responsible Partner(s)
10	<i>E. coli</i> monitoring	1	Number of sampling events	10 sampling events (collected May-Oct) at 2 monitoring stations	10 sampling events (collected May-Oct) at 2 additional monitoring stations	DCHD, DPC
11	Engine oil and coolant recycling programs	5	Number of updates per year to DuPage County Recycling Guide	1	1	DPC
12	Fertilizer application public information program	5	Percentage of identified landscaping companies to attend annual workshop	10	30	DPC
13	Illicit discharge inspections	1	Percentage of MS4 outfalls inspected	100% of known outfalls	100% of known outfalls and 30% of added outfalls	DPC
14	Impervious surface minimization	3	Percent reduction in the watershed	1	5	CWh, CWa, DPC, MT, VGE, WT, SI, Residents
15	Industrial and household chemical waste collection events	1	Number of permanent hazardous waste collection sites	2	3	DPC
16	Installation of hydrodynamic separator units	1	Number of units installed	3	3 additional	DPC, SI
17	Leaf collection program	1	Number of fall collection events per community	1	2	CWh, CWa, VGE, MT, WT
18	Municipal deicing technique and equipment improvements	1	Entities developing efficiency plans	3	4 additional	CWh, CWa, DPC, MT, SI, VGE, WT
19	Nutrient Implementation Plan (NIP) Development	1	Percentage of the plan completed	10	100	DPC, DRSCW, WSD
20	Pet waste stations	1	Percentage of problem areas addressed	75% of existing	75% of newly identified	CWh, WPD, FPDDC, Residents
21	Phosphorus Discharge Optimization Evaluation Plan Development	1	Percentage of the plan completed	25	100	WSD
22	Pond, reservoir, swimming pool, and fountain maintenance public information program	5	Number of workshops held during period	1	2	DPC
23	Pool and riffle sequence installation	1	Increase of fIBI scores	Average score of 20	Average score of 41	FPDDC, DPC
24	Private and public parking lot and sidewalk applicator training	5	Annual training	1	1	DPC, DRSCW
25	Proper composting and yard waste disposal public information program	5	Number of webpages developed and maintained	1	1	DPC
26	Public roadway applicator training	5	Annual training	1	1	DPC, DRSCW

BMP #	BMP Recommendation	Goal (pg.10)	Indicator	Short Term Milestone	Long Term Milestone	Responsible Partner(s)
27	Salt storage ordinance	2	Number of ordinances adopted	2	2 additional	DPC, CWh, CWa, VGE
28	Stream substrate improvement	1	Increase of QHEI scores	Average score of 70	Average score of 77	FPDDC, DPC
29	Streambank stabilization	1	Percentage of existing problem areas addressed through BMPs	30	75	DPC, FPDDC, CWh, CWa, VGE, WPD, WSD, Residents
30	Street sweeping program	1	Number of lane miles addressed annually	3,900	9,698	DPC, CWh, CWa, VGE, MT, WT, SI
31	Vegetated filter strips	3	Acres of riparian buffer established	3.264	8.16	DPC, FPDDC, CWh, CWa, VGE, WPD, WSD, Residents
32	Water conservation programs	5	Number of events addressing topic per year	1	2	DPC
33	Wet retention pond naturalization	3	Number of ponds naturalized	17 ponds conceptualized to naturalize	5 ponds naturalized, to the degree identified in concept	DPC, CWh, Residents
34	Wetland enhancement and restoration	3	Percentage of high quality wetlands	Identify 100% of remnant high quality wetland areas w/ relic hydric soils	Designate 50% of identified areas as priority areas for enhancement or restoration projects	FPDDC, DPC
35	Wetland restoration	3	Acres of wetlands restored	11	17	FPDDC, WPD, DPC, CWh, CWa, VGE, Residents

10.2 Criteria for Determining Progress

Gauging progress and success through watershed improvements depends largely on how many of the plan recommendations are implemented through the direction of the Spring Brook No. 1 watershed plan implementation team. Progress made through the implementation of BMP recommendations should translate, eventually, to improved water quality and subsequent attainment of designated uses and/or water quality standards.

Monitoring pollutant-load reductions, specifically total phosphorus, nitrate, TKN, and chloride, will be the primary criterion by which progress can be judged. **Table 26** summarizes the criteria for each parameter in determining progress within five and ten year timeframes to reflect the fact that it will take time to see improvements manifest in response to plan implementation.

Criteria	Within 5 Years	Within 10 Years	Basis	
Total phosphorus load reduction	10%	25%	Illinois Nutrient Loss Reduction Strategy (2015)	
Nitrate-nitrogen load reduction	5%	15% ³³	Illinois Nutrient Loss Reduction Strategy (2015)	
Total Kjehldahl Nitrogen load reduction	15%	42% ³⁴	Priority Rankings Based on Estimated Restorability for Stream Segments in the DuPage-Salt Creek Watersheds (2010)	
Chloride load reduction	15%	35%	Total Maximum Daily Loads for West Branch DuPage River, Illinois (2004)	

Table 26. Parameter specific criteria

10.3 Data Collection Monitoring

The effectiveness of implementation efforts using the criteria developed is tracked and evaluated through monitoring components. Measurable progress is critical to ensuring continued support of watershed projects, and progress is best demonstrated with the use of monitoring data that accurately reflect water quality conditions relevant to the identified problems.

Long-term monitoring will be necessary to determine whether Spring Brook No. 1 is meeting water quality and aquatic life use standards. In addition, monitoring provides valuable information in reviewing and updating the remedial actions identified.

- Establish a monitoring program for both the copper and bacteria parameters to identify the extent by which the criteria for these parameters are exceeded in Spring Brook No. 1.
- Conduct dry weather illicit discharge storm sewer outfall monitoring, as well as regular inspections of active construction sites.
- Continue chemical (water column), fish, mussel, macroinvertebrate, and habitat monitoring efforts along Spring Brook No. 1, including Silver Lake, to track how restoration efforts have improved biological index and habitat scores.

Habitat restoration is a critical component to improving aquatic life and meeting water quality standards. Appropriate habitat conditions are necessary to provide the necessary food and shelter for macroinvertebrates and other stream biota. Monitoring will be required for all in-stream and

³³ Nitrate concentrations measured at stations upstream and downstream of WSD's outfall differ significantly. Therefore, any watershed reductions of nitrate will likely be realized through operational upgrades at the Sanitary District's facility in future years.

³⁴ The Priority Rankings Based on Estimated Restorability for Stream Segments in the DuPage-Salt Creek Watersheds (2010) document identifies that fIBI scores become impacted when TKN concentrations in streams exceed 1.0 mg/L. The 1.0 mg/L is equivalent to 10,362.855 pounds per year as calculated using annual mean flow data at USGS station 05540091 (Spring Brook at Forest Preserve near Warrenville, IL), minus average flow discharged from WSD. When compared to background runoff loads, a 42% reduction of TKN is estimated so that the 1.0 mg/L concentration can be obtained, but when streambank erosion is included, a reduction percentage of over 60% reduction may be necessary.

bank stabilization restoration projects. Monitoring during and after construction is critical to assess whether projects are functioning and to determine if future habitat restoration plans need to be adjusted. All projects will be required to be evaluated for a minimum of three and up to five years after implementation. These areas are reevaluated for evidence of erosion and scour, native vegetation success, and stabilization, along with stream life sampling, as indicated above.

10.4 Flood Forecasting Development

Severe flooding and resulting damage in the Salt Creek and West Branch DuPage River watersheds has resulted in the design and construction of a series of reservoirs and other flood control projects in these watersheds. Salt Creek is a 117 square mile watershed with several offline flood control reservoirs with moveable gates that operate based on stream elevations at certain locations. The West Branch DuPage River is a 123 square mile watershed with one inline dam that operates based on water surface elevations upstream of the dam. The management and operation of these reservoirs and flood control facilities can be assisted and optimized by using accurate estimates of the time and elevation of flood peaks.

A streamflow simulation system has been developed by DuPage County, in cooperation with the USGS, to simulate continuous streamflows and water surface elevations along the mainstems of Salt Creek and West Branch DuPage River using near real-time hydrological and climatological data. Forecasted data may also be used to obtain forecasted flows and elevations. Data are collected from the United States Department of Energy-Argonne National Laboratory (climatological), USGS/DuPage County cooperative rain-gage (precipitation) and streamgage networks (stage and discharge), and from the National Weather Service (quantitative precipitation forecast or QPF).

Runoff time series are generated from the HSPF and are input into the FEQ hydraulic model for routing through the stream system to estimate peak elevations and flow rates along the mainstems. Six USGS streamflow gaging stations are located along Salt Creek, as well as four additional within the West Branch DuPage River watershed. Streamgage data are utilized as boundary conditions in the routing models to decrease the rainfall-runoff uncertainty by reducing the area to be hydrologically simulated.

The USGS collects precipitation data at 29 gages throughout DuPage County and processes NWS Multisensor Precipitation Estimator (MPE) data for use as precipitation inputs to the system. The NWS meteorological point forecasts and the Quantitative Precipitation Forecast (QPF) are used to extend the input time-series into the future. DCSM maintains four streamgages at critical locations in the two watersheds, and 12 webcams for visual confirmation of the stream conditions and structural facilities. DuPage County also maintains a web site for the public to view the data, webcam images, and simulated streamflow scenarios.

10.5 Continued Public Involvement and Outreach

The objectives of a public outreach program should directly support the watershed management goals and implementation of the watershed management plan. Because many water quality problems result from individual actions and the solutions are often voluntary practices, effective public involvement and participation promote the adoption of management practices, help ensure the sustainability of the watershed management plan, and perhaps, most important, encourage changes in behavior that will help to achieve overall watershed goals.

Upon plan adoption, stakeholders will work to develop a watershed plan implementation team to ensure that watershed-wide restoration goals are being met. The team will be composed of members that possess a variety of expertise and skills, including project management, technical expertise, group facilitation, data analysis, communication, and public relations. Key implementation activities include the following:

- Ensuring technical assistance in the design and installation of management measures;
- Providing training and follow-up support to landowners and other responsible parties in operating and maintaining the management measures;
- Managing the funding mechanisms and tracking expenditures for each action and for the project as a whole;
- Conducting the land treatment and water quality monitoring activities and interpreting and reporting the data;
- Measuring progress against schedules and milestones;
- Communicating status and results to stakeholders and the public; and
- Coordinating implementation activities among stakeholders, between multiple jurisdictions, and within the implementation team.

The implementation team will ensure that all watershed stakeholders are represented; conduct at least four meetings per year to oversee and guide plan implementation; prioritize project implementation; promote one of the meetings with the public and share information about the progress made in restoration efforts; evaluate milestone obtainment through the development of annual work plans; and apply for grants and other funding to assist in the implementation of plan recommendations.

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12. Exhibits

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Attachment 2: Relation of Spring Brook No. 1 to Larger Watersheds / *Executive Summary*

Attachment 3: Stream Assessment Locations / *Figure 2*

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Appendix A: Spring Brook No.1 Calibration Summary

Appendix B: Dissolved Oxygen Monitoring Data from Station GBKA-04 WSD

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Appendix H: Delineated Sub-Basins Tributary to Spring Brook No. 1

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Jurisdictional Boundaries of the Watershed



Attachment 2:

Relation of Spring Brook No. 1 to Larger Watersheds





Attachment 3:

Stream Assessment Locations





Spring Brook No. 1

Stream Assessment Locations



Map Prepared for by: DuPage County Stormwater Management Dept. Date: 5/12/2015 2 Viles

Attachment 4:

Pond Assessment Locations





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Attachment 5:

Location and Types of Soils Located within the Watershed



Attachment 6:

Location and Types of Hydric Soils within the Watershed



Attachment 7:

Impervious Cover within the Watershed



Attachment 8:

Remaining Wetland Areas within the Watershed



Attachment 9:

Median Age Displayed by Census Tract



Attachment 10:

Population Density Displayed by Census Tract



Attachment 11:

Percentage of Population Speaking English (Primary Language) by Census Tract



Attachment 12:

Zone Divisions of the Spring Brook No. 1 Watershed



Attachment 13:

Detailed View of the Streams Function Pyramid (SFP)

BIOLOGY * FUNCTION: Biodiversity and the life histories of aquatic and riparian life * PARAMETERS: Microbial Communities, Macrophyte Communities, Benthic Macroinvertebrate Communities, Fish Communities, Landscape Connectivity

5

4

3

PHYSICOCHEMICAL * FUNCTION: Temperature and oxygen regulation; processing of organic matter and nutrients * PARAMETERS: Water Quality, Nutrients, Organic Carbon

GEOMORPHOLOGY » FUNCTION: Transport of wood and sediment to create diverse bed forms and dynamic equilibrium » PARAMETERS: Sediment Transport Competency, Sediment Transport Capacity, Large Woody Debris Transport and Storage, Channel Evolution, Bank Migration/Lateral Stability, Riparian Vegetation, Bed Form Diversity, Bed Material Characterization

HYDRAULIC » FUNCTION: Transport of water in the channel, on the floodplain, and through sediments » PARAMETERS: Floodplain Connectivity, Flow Dynamics, Groundwater/Surface Water Exchange

HYDROLOGY » FUNCTION: Transport of water from the watershed to the channel » PARAMETERS: Channel-Forming Discharge, Precipitation/Runoff Relationship, Flood Frequency, Flow Duration

Climate



Appendix A:

Spring Brook No. 1 Calibration Summary

Appendix A – Springbrook No. 1 Calibration Summary

1 INTRODUCTION

This appendix presents results of the final FEQ model calibration for Spring Brook No.1 followed by a description of the calibration process, in chronological order. Efforts to calibrate the Spring Brook No. 1 FEQ model include a comparison of model results to observed high water elevations and measured stream flow during the July 1996 storm event. Calibration was finalized and approved by EDP on January 6, 2004 at the monthly Hydraulic Evaluation Meeting.

1.1 FEQ Calibration Model

Earth Tech used the unsteady flow program FEQ and its utility program FEQUTL (developed by Delbert Franz of Linsley, Kraeger Associates, Ltd.) for flood routing and to analyze the Springbrook No. 1 stream system. FEQ and FEQUTL can model the basin hydraulic features, including bridges, culverts, dams, pumps, on-line and off-line storage, and floodplain encroachments.

An FEQ model of Springbrook No. 1 was created to simulate the July 1996 storm event. The FEQ input model was based on the latest "existing conditions" model, and was modified to represent the condition prior to removal of the horse bridge, prior to improvements at the Cantigny youth golf course, and prior to improvements at Arrow Road.

Four rainfall gages were used to model the watershed. Most of the watershed was assigned to gage 2 or 3, each of which is located within the watershed. Gages 1 and 4 are located close to, but not within, the Springbrook No. 1 watershed. The gages used for the July 1996 storm and their corresponding total rainfall depth are as follows:

Gage 1 (DuPage County Gage No. 33,) City of Wheaton North, 5.01 inches Gage 2 (DuPage County Gage No. 79,) Wheaton Willow, 7.03 inches Gage 3, (DuPage County Gage No. 54,) Wheaton Sanitary District, 8.80 inches Gage 4, (DuPage County Gage No. 20,) USGS Kress Creek at Joliet Street, 9.45 inches

The location of each subbasin relative to the rainfall gages and isohyetal rainfall pattern was analyzed. Rainfall FACtors were developed by DuPage County and applied to the branches and reservoirs to assign a specific rainfall depth to each subbasin. An inflow hydrograph for the July 1996 storm was used to represent flow in the West Branch of the DuPage River.

1.2 Description of Calibration Locations

1.2.1 High Water Marks

High water mark information was obtained from a number of sources, including homeowners, the Cenacle Retreat House, the DuPage County Forest Preserve District, and the Wheaton Sanitary District. Most high water marks were surveyed in spring, 2003, with the exception of one high water mark that was surveyed in December, 2003 and a number of high water marks at the intersection of Main and Park that were surveyed in September, 2004.

The high water marks for the July 1996 storm are concentrated in five areas: At Merrill Drive, on the level pools near the Creekside and Stonebridge Avenue bridges, at Center Avenue, at Arrow Road, and near the confluence with the

West Branch. The Wheaton Sanitary District provided a qualitative description of the creek adjacent to their treatment plant during the July, 1996 storm. Information was also obtained from the USGS Gage at the Blackwell Forest Preserve. A watershed map can be found in Figure 3.2 in the main body of this report.

Additionally, the City of Wheaton provided a high water elevation at the Hubble Middle School playing fields for the August, 1987 storm event.

1.2.2 USGS Gauge

The USGS operates a continuous stage gage, located in the Roy C. Blackwell Forest Preserve towards the downstream end of Springbrook No. 1. (Gauge Number 05540091, Springbrook at Forest Preserve near Warrenville.) The gauge is approximately 0.75 miles upstream of the confluence of Springbrook No. 1 with the West Branch DuPage River. The gage is located just upstream of a footbridge and just downstream of the confluence of a flow split on Springbrook No. 1. The gauge has been operational since September, 1991. The USGS developed a rating curve to convert recorded stage to flow at the gage. The rating curve is shown in Figure A.1.

2 CALIBRATION RESULTS

Calibration of the Springbrook No. 1 FEQ model was performed to the July, 1996 storm event. The initial comparison of model results to observed high water elevations and measured stream flows showed that model results were significantly higher than the measured flow and measured water surface elevations. Working with the DuPage County Department of Economic Development and Planning (EDP), Earth Tech investigated the differences between measured and simulated values, which resulted in one permanent change to the model. The investigation and permanent change are discussed in detail in Section 3 of this appendix. The results of the final calibration are presented below.

2.1 Comparison of Computed Water Surface Elevations with Observed High Water Marks

All measured high water marks are within six inches of the simulated profile, and is therefore considered a calibrated model.

A tabular summary of simulated results versus recorded high water marks is shown in Table A.1. A magnitude bias plot of recorded high water marks versus the difference between simulated and measured results is shown in Figure A.2. A description of calibration results at each location follows.

2.1.1 Cenacle Retreat House at West Branch Confluence

A number of high water marks were obtained at the Cenacle Retreat House in Warrenville, at the confluence of Springbrook No. 1 with the West Branch DuPage River. However, these high water marks are located within the backwater influence of the West Branch. Therefore, the points were not considered during calibration.



2.1.2 Arrow Road

The DuPage Forest Preserve provided anecdotal evidence that Arrow Road overtops with one to two feet of overflow depth for most storm events. In the July, 1996 storm event, Arrow Road is overtopped by 1.53 feet, which is within the observed range.

2.1.3 Merrill Drive

The Merrill Drive high water mark correlates well against the 1996 FEQ profile. The FEQ model predicted a peak water surface of 727.55 for the July, 1996 storm event, which is 0.04 feet higher than the measured high water mark of 727.51.

2.1.4 Center Avenue

The Center Avenue high water mark matches well against the 1996 FEQ profile. The FEQ model predicted a peak water surface of 718.23 for the July, 1996 storm event, which is 0.12 feet higher than the measured high water mark of 718.11.

2.1.5 Creekside and Stonebridge Ponds and Lake Weir

Two observed water surface elevations were obtained on the pond downstream of Creekside Avenue, and were surveyed as 723.03 and 723.2. The simulated water surface elevation is 722.87 at the level pool, which is within 0.16 feet and 0.33 feet of the measured high water marks.

Two observed water surface elevations and one reference point were obtained immediately upstream of the Creekside Avenue structure and level pool. The HWMs were surveyed as 723.53 and 723.78. Additionally, it was noted that the water surface should be above a reference point at elevation 722.95. The FEQ model simulated a water surface profile of 723.05, which is higher than the reference point and within 0.48 feet and 0.73 feet of the HWMs.

2.1.6 Berm at Wheaton Sanitary District

The Wheaton Sanitary District constructed a berm around the treatment plant adjacent to Springbrook No. 1 in the late 1980s, to protect the plant from flood events. The Sanitary District noted that water overtopped the berm by 1" to 2" during the July 1996 storm event. The berm was overtopped upstream of the middle treatment plant access road (station 18200) and downstream of the northernmost treatment plant access road (station 18400.) The berm overtopping elevations were not surveyed.

A review of DuPage County two-foot topography showed that the berm overtopping elevation is generally above elevation 724, except at the two structures (at the observed overtopping locations) where the berm overtopping elevation is between 722 and 724. The simulated high water elevation at each berm overtopping location is 722.64 and 722.69, which is within the 722 to 724 range of the overtopping elevation.

TABLE A.1

HWM Location	Approx. Stream Station (ft from confluence)	Simulated Elevation (ft)	Recorded Elevation (ft)	Simulated Recorded (ft)
Arrow Road	4700	707.44	705.59 + 1' to 2'	Within range
Center Avenue	13840	718.23	718.11	+0.12
Wastewater Treatment Plant	18200 and 18400	722.64 and 722.69	Between 722 and 724	Within range
Pond D/S of Creekside	20725 to 22125	722.87	723.03 and 723.20	-0.16 and -0.33
Stream U/S of Creekside	22200	723.05	723.53 and 723.78	-0.48 and -0.73
Merrill Drive	27000	727.55	727.51	+0.04
Hubble Middle School (HWM at Indiana and Hale, 1987 Storm Event)	Closed conduit	734.20	731.63	+2.57
Hubble Middle School (HWM at Coal Chute at Indiana and Hale, 1996 Storm Event)	Closed conduit	731.34	731.81	-0.47
Main and Park area, no reported flooding in homes	Closed conduit	731.11	6 lowest homes 730.75 – 731.66	+0.36 to within range

SIMULATED RESULTS VS. RECORDED HIGH WATER MARKS FOR JULY, 1996 CALIBRATION EVENT

2.1.7 Low Area at Hubble Middle School Play Fields (August, 1987 and July, 1996 Storm Events)

The City of Wheaton surveyed the 1987 and 1996 high water mark at the Hubble Middle School play fields. Hubble Middle School is located at the corner of Roosevelt Road and Main Street in Wheaton, and the ponded area extended to the intersection of Indiana and Hale Streets. The 1987 high water mark was surveyed at the northeast corner of Indiana and Hale, and the 1996 high water mark was surveyed at a coal chute at a home on the southeast corner of Indiana and Hale. Springbrook No. 1 is contained within closed conduits in this area (except when the system surcharges during storm events.)

The 1987 HWM was surveyed as 731.63. The FEQ model (using tsflng01.map as the time-series file and the NOAA gage assignments) simulated a peak elevation of 734.20 at this location for the August, 1987 storm event.

The 1996 HWM was surveyed as 731.81 at the coal chute. The FEQ model simulated a peak elevation of 731.34 for the July, 1996 storm event.

2.1.8 Low Area at Intersection of Main and Park

In fall 2004, a resident provided high water marks at the intersection of Main and Park for the July 1996 and October 2001 storm events. The intersection of Main and Park is a low area in the upper part of the watershed that is drained by storm sewers. The resident reported no flooding of homes in the area.

DuPage County contracted a surveyor to survey low entry and first floor elevations in this area in September, 2004. The six lowest homes have low entry elevations ranging from 730.75 to 731.66. The FEQ model simulated a peak elevation of 731.11 for the July, 1996 storm event. Two homes have low entry elevations which are slightly lower than the simulated elevation.

2.2 Comparison of Model Results to USGS Gauge Data

2.2.1 USGS Gauged Flow

Comparison of simulated to measured flow revealed that the model results were significantly higher than the measured flow. FEQ simulated a peak flow of 935 cfs at node 3800 (XS 286,) which is significantly higher than the recorded peak of 393 cfs at the USGS gauge for the July 1996 event. The flow volume simulated with FEQ was also significantly higher than the measured flow volume (see Figures A.1 and A.3.)

Based on review of various data, and additional review to ensure the integrity of the constructed FEQ model, we believe that the USGS flow measurements may not be accurate for the peak of the 1996 event. Based on the following observations derived from various available data sources, the measured flow collected for the July 1996 event may be questionable.

- The simulated flow, which was considerably higher than the July 1996 measured flow, was produced with well-established, regionally calibrated hydrologic parameters.
- The FIS flow estimates, which are based on a regression of measured flow collected prior to 1985, suggest the 100-year flow to be much higher than the measured peak flow from the July 1996 event. Rainfall depths recorded during the July 1996 event in the Springbrook No. 1 watershed indicate that the magnitude of the storm is approximately equal to the 100-year event.
- It appears that split flow may occur upstream of the USGS gage location in very large events, such that some flow bypasses the USGS gage location, resulting in an underreported peak flow measurement.
- A previous USGS study using data collected at the Forest Preserve stream gage also indicated potential data problems for a large event.

Additional details regarding the USGS gauged flow analysis are presented in section 3 of this appendix


2.2.2 USGS Gauged Water Elevations

As discussed previously, there is a large discrepancy between the July 1996 simulated peak flow and the flow measured by the USGS at the stream gage at the Blackwell Forest Preserve. In a hydraulic evaluation meeting at DuPage County on June 3, 2003, the discrepancy was discussed, and it was generally agreed that the USGS flow data may not correlate to simulated flows for the large July 1996 storm event. However, it was agreed that simulated stages should correlate to measured stages at the gage.

A comparison of the July 1996 stage hydrographs (measured versus simulated) showed that the simulated stage was approximately one foot lower than the measured stage, as shown in Figure A.4. It is clear that the simulated and measured stage vs. discharge relationships are very different at the USGS gage for large storms. Despite assurances, the USGS has not provided information clearly demonstrating that flow measurements for larger peaks accounted for all the potential overbank flow area. This concern is also expressed in their own annual station analysis documentation in which USGS staff internally recommended that discharge measurements are needed at stages between 9 ft to 12 feet.

Therefore, the NOAA.DR2 time series file was simulated in the calibration model, in order to develop a large range of simulated storms with time periods that overlap the USGS period of record at the gage. The USGS stage measurements were compared to simulated stages for the overlapping period of record, from September, 1992 through July, 1996. As opposed to comparison of simulated and measured flows, the simulated and measured stages appear to correlate reasonably well for the NOAA.DR2 period of record. The timing and shape of individual hydrographs match well, as shown in Figures A.5 through A.16. There also does not appear to be discernable bias in the simulation results, as shown in Figure A.17.

2.3 Additional Model Results

Summaries of rainfall depth, runoff depth, and percent impervious for the simulated watershed are as listed below. This data was presented at a DuPage County Hydraulic Evaluation meeting, and it was generally agreed that the ratio of runoff to rainfall in the upper watershed is reasonable. There was some discussion that the total watershed ratio of runoff to rainfall may be high, however, it was also noted that because the July 1996 storm was such a localized storm, it does not always possible to produce results which are typical of other large storms.

Upper Watershed Only (storm sewered area, upstream of open channel area):

Watershed Area = 2	2.1 sq. mi.
Average Rainfall Depth = 6	6.47 inches
Average Runoff Depth = 4	4.14 inches
Ratio Runoff:Rainfall = 0.64	
Percent Impervious = 3	32%

Lower Watershed Only, U/S of USGS Gage (open channel area, not including upper watershed)

Watershed Area =	5.4 sq. mi.
Average Rainfall Depth =	8.46 inches
Average Runoff Depth =	4.71 inches
Ratio Runoff:Rainfall = 0.56	
Percent Impervious =	13%

Total Watershed U/S of USGS Gage (storm sewered and open channel areas)

Watershed Area =	7.5 sq. mi.
Average Rainfall Depth =	7.90 inches
Average Runoff Depth =	4.55 inches
Ratio Runoff:Rainfall = 0.58	
Percent Impervious =	18%

Measurement at USGS Gage (July 17 through July 20, 1996, uniformly subtracting 7 cfs baseflow): Average Runoff Depth = 2.5 inches

Note: Average rainfall depths were calculated by weighting the rainfall depth in each sub-basin (obtained from DuPage County FACtor calculations) by its area. Average runoff depths were determined by calculating the total flow volume simulated by FEQ for the entire duration of the July 96 tsf (July 16 through July 25, 1996) and dividing the total flow volume by the tributary area. (The 10 cfs added to the FEQ model to prevent the model from 'drying out' was subtracted from the flow volume.) The runoff depth for the "lower watershed only" was determined by subtracting the runoff volume from the upper watershed from the runoff volume at the USGS gage, and dividing by the lower watershed tributary area.

3 STEPS TOWARD CALIBRATION

Initial efforts to calibrate the Spring Brook No. 1 FEQ model included a comparison of model results to observed high water elevations and measured stream flow during the July 1996 event. This initial comparison revealed that the model results were significantly higher than the measured flow and measured water surface elevations.

A number of steps were taken to investigate the initial discrepancy between simulated flows and USGS measured flows. Similarly, a number of tests were performed on the FEQ input model in an attempt to lower the simulated water surface profile and provide a better match between simulated and recorded results at the HWMs. These steps are described in detail below.

Ultimately, it was determined that revising the EXPCON at the Lake Weir downstream of the Creekside and Stonebridge ponds was an appropriate adjustment that resulted in a close match between simulated and recorded profiles at all high water mark locations. The EXPCON change at the Lake Weir is the only permanent change in the model.

3.1 Hydrologic Calibration Steps

Although a true hydrologic calibration was not performed, a number of steps were taken to investigate the discrepancy between simulated flows and USGS measured flows.

3.1.1 Comparison of Simulated and Measured Flow

Figure A.3 presents a plot of the measured flow hydrograph and simulated flow hydrograph for the July 1996 event. As shown, the simulated peak flow and flow volume are significantly higher than the measured flow. However, the shape and timing of the measured flow compares well with the simulated flow. The match in hydrograph shape and timing suggests that the discrepancy between the simulated and measured flow is not caused by poor representation of the system hydraulics in FEQ. The difference between simulated and measured flow is most likely attributable to error in the simulated runoff or error in the measured flow.

3.1.2 Additional Model Review

Additional review of the Spring Brook No. 1 FEQ model was completed to ensure the integrity of the constructed model. Review included the following:

- Values entered in the Tributary Area block in the FEQ model were checked. The correct total watershed area of approximately 7.7 square miles is being modeled.
- The current land use assignment was compared to the old land use assignments (from previous versions of the FEQ model.) The current total tributary area has increased slightly, but the ratio of land cover type to total area has remained the same.
- The FAC values used in the Tributary Area block to reflect the use of local rain gages were checked.
- Model results generated for a smaller storm (March 1993) were compared to the corresponding measured flow. The comparison yielded the same discrepancy in peak flow and runoff volume as obtained for the July 1996 event.

3.1.3 FIS Flow Analysis

The July 1996 storm is believed to have a large return period, likely on the order of a 100-year storm. Rainfall depths for the July 1996 storm in the Spring Brook No. 1 watershed range from 5 inches at the upstream end to 9 inches at the downstream end, and the storm was approximately 24 hours in duration. The 24-hour, 100-year rainfall depth for DuPage County is 7.58 inches.

The FIS for Spring Brook No. 1, published in 1985, lists a 100-year flow rate of 795 cfs at the confluence with the West Branch. The FIS flow estimates were developed using regression analysis based on flow monitoring data collected over a 15-year period of record.

The FIS lists a tributary area of 6.6 square miles at the confluence. The current FEQ analysis includes 7.7 square miles of tributary area at the confluence. The 100-year flow published in the FIS was based on a less-developed land cover condition and a smaller tributary area than is being used in the current model. As a result, we would expect the FIS 100-year flow to be smaller, not larger, than the July 1996 storm. However, the FIS 100-year peak flow estimate of 795 cfs is significantly greater than the measured peak flow of 393 cfs.

3.1.4 Analysis of Measured Flow Data

3.1.4.1 Relevant Information from FEQ Verification Study

In 1996, the USGS published a paper titled "Implementation and Verification of a One-Dimensional, Unsteady-Flow Model for Spring Brook near Warrenville, Illinois." The purpose of the study was to document the implementation, calibration and verification of an FEQ model for a relatively small stream with culverts and overbank flow. The downstream portion of Spring Brook No. 1, from the confluence at the West Branch to the stream gage at the Forest Preserve, was the subject of the study. During the study additional stream gages were installed downstream of the Forest Preserve gage. Three high-flow periods were studied: December 1992 – January 1993, March 1993, and June 1993. The study noted that there was a problem with the measured flow at the Forest Preserve gage during June 1993, the largest storm measured during the study.

3.1.4.2 Comparison to Other USGS Gages

The measured flow rates for a number of storms at the Forest Preserve gage were compared to the measured flow rates for the same storms at other nearby USGS gages with relatively small tributary areas. (See Figure A.18.) The July 1996 storm produced peak flow rates that were significantly higher than the other storms for all gages except the Forest Preserve gage. Most notably, the gage at Kress Creek at West Chicago, which is located relatively close to the Forest Preserve gage, produced a peak flow that was almost five times larger than any other storm. The measured peak flow at the Forest Preserve gage for the July 1996 storm was only slightly higher than the other storm events.

3.1.4.3 Split Flow

The simulated peak water surface elevations for the July, 1996 storm were marked on a topographic map, and the corresponding floodplain was delineated by hand. During the July 1996 storm, water upstream of the USGS gage location follows one of three paths: the main Springbrook No. 1 flow path; a secondary flow path parallel to and west of the main flow path, which conveys water when Arrow Road is overtopped; and a tertiary flow path parallel to and west of the secondary flow path, which conveys water when the secondary flow path overtops its western banks. The confluence of the main path and secondary path is just upstream of a footbridge. Runoff in the tertiary flow path reenters the stream just downstream of the footbridge. The resulting floodplain delineation shows a large island between the primary and secondary flow paths, and a very small island at the footbridge abutment location between the primary and tertiary flow paths. This "island" is immediately downstream of the USGS gage location. Therefore, it is possible that some flow in the July, 1996 event actually bypassed the USGS gage location. A review of peak water surface elevations simulated by an uncalibrated version of the model with tsflong showed that the tertiary flow path only conveyed water during the 5 largest storms of the 115-storm series. Because the USGS gage was not operational prior to 1991, it is possible that the July 1996 storm was the first storm that used the tertiary flow path, and it was not considered in development of the gage rating curve.

3.2 Hydraulic Calibration Steps

3.2.1 Sensitivity to FACtors and Gage Assignments

The sensitivity of the model to assigned FACtors and rainfall gages at each tributary area was evaluated.

3.2.1.1 Tributary area review – sensitivity to assigned factors

The model is not very sensitive to the assigned FACtors. A model run with all FACtors set to 1.0 matched very closely with the July 1996 model.

3.2.1.2 Tributary area review – sensitivity to local gage assignments

The model is very sensitive to local gage data. Setting all FACtors to 1.0 and setting all gage assignments to a single gage (1, 2, 3 or 4) has a very large impact on the resulting flow rates. In fact, at the USGS gage location, flow rates range from 386 cfs (with all gage assignments = 1) to 1056 cfs (with all gage assignments = 3.) Resulting water surface profiles also vary widely, although all resulting water surface profiles are higher than the observed high water marks.



3.2.2 Flow vs. Stage Comparison at Observed HWMs

3.2.2.1 Arrow Road

Based on the tsflong results, Arrow Road overtops between 1 and 2 feet between 400 cfs and 1100 cfs. Arrow Road is overtopped in every storm from tsflong with the exception of one. Since a wide range of flows produces water surface elevations that match our calibration data, the Arrow Road location is not a very good calibration point.

3.2.2.2 Merrill Drive

The Merrill Drive calibration point correlates fairly well against the unmodified 1996 FEQ profile. An analysis of tsflong results at the Merrill Drive HWM location show that a small range of flows produces the HWM recorded for July 1996 (727.51.) Flow rates from 390 cfs to 410 cfs produce a water surface elevation equal to the one recorded for the 1996 event. The FEQ model predicted a peak flow of 402 cfs and a peak water surface of 727.72.

3.2.2.3 Creekside and Stonebridge Ponds and Lake Weir

The observed water surface elevations at the Creekside pond were 723.03 and 723.2 for the July 1996 storm. The water surface elevation at the Creekside and Stonebridge ponds is influence by the peak flow rate and flow volume from upstream, as well as the lake weir downstream.

A review of FEQ tsflong results shows that a peak flow rate between 214 cfs and 368 cfs at the Creekside Avenue bridge produces maximum water surface elevations between 723.0 and 723.3 downstream of the bridge in the pond. The peak flow at the Creekside Avenue bridge was calculated as 436 cfs by FEQ during the July 1996 storm event.

A review of FEQ tsflong results shows that a peak flow rate between 243 cfs and 265 cfs at the Lake Weir produces maximum water surface elevations between 723.0 and 723.2 upstream at the pond between Stonebridge and the weir. The peak flow at the lake weir was calculated as 505 cfs by FEQ during the July 1996 storm event.

3.2.3 Additional Analysis at the Creekside and Stonebridge Ponds

3.2.3.1 Lake Weir Cross Section

The cross section at the downstream lake weir appears to pass through a very localized high point on the topography, which would minimize the true storage available in the cross section. Revising the cross section (141) and expcon feq util files to exclude the localized high point did not result in any significant change in water surface profile.

3.2.3.2 Creekside Avenue Bridge

Photos taken during the July 1996 storm show the water surface several inches below the low chord of the Creekside Avenue bridge, which is seen in the distance of the photograph. A possible high water mark on trees in the foreground of the photos indicate the water may have been 1-2 inches higher than shown in the photographs, however, the water would not have been as high as the low chord. The FEQ analysis computed the water surface profile to be 0.1 feet higher than the low chord at the Creekside Avenue bridge.

3.2.3.3 Timing of Peak at Creekside Pond

Two photos were taken at 1492 Pebblestone Cove (on the Creekside Pond, between Creekside and Stonebridge Avenues) on July 18 and July 19, 1996. The photos show the water surface elevation relative to a basketball pole and playhouse. The water surface was at the base of the basketball pole on July 18, and was approximately one foot higher than the base of the pole on July 19. Debris lines are not evident on the July 19 photo, which indicates that the photo was taken before or at peak high water. It is not know what time the photos were taken, although it was daytime. FEQ computed the peak water surface elevation at 5:15 a.m. on July 18. Assuming that the photo on July 19 was taken sometime between 7:00 am and 7:00 pm, the FEQ peak is occurring 26 to 38 hours early.

Several FEQ models were developed, each which assigns all flow in the watershed to a single gage. Assigning all flow to gage 1 or gage 2 reduces the peak water surface profile at the Creekside and Stonebridge ponds, but does not delay the time of peak.

3.2.3.4 Storage at Creekside Pond

The stage-storage ratings in FEQ for the Creekside and Stonebridge ponds were reviewed against the DuPage County 2-foot topographic mapping. The storage at elevation 724 (approximate observed high water mark) as calculated from the topographic mapping was compared to the storage in the FEQ tables. The storage available at elevation 724 based on the topographic mapping is approximately 5 ac-ft more at the Stonebridge pond and 5 ac-ft less at the Creekside pond as compared to the FEQ tables. The total storage available at elevation 724 is nearly identical in both the topographic map calculation and the FEQ table.

3.2.4 Upstream Storage

A review of the two-foot topography indicates that there are 11 separate detention/storage areas upstream of the Creekside and Stonebridge ponds that are not modeled in FEQ. The 11 storage areas have a total of 142 acre-feet of available storage. It is not known whether the area tributary to each storage area has sufficient runoff volume to fill the storage areas. Additionally, the outflow characteristics of the pond are not known.

Of the 11 unmodeled storage areas, 7 areas with a total of 102.4 ac-ft of storage are located upstream of the Merrill Drive HWM. The Merrill Drive HWM correlates well to the unmodified FEQ calibration model for 1996.

3.2.4.1 Simulate Unmodeled Storage – Method 1: Add Online Reservoir

Adding a storage area to the system just upstream of the Creekside and Stonebrige ponds (with 140 ac-ft of storage at the measured HWMs and the discharge tables from Creekside Avenue) does not delay the peak water surface elevation at the Creekside pond and only reduces the peak water surface elevation by approximately 0.13 feet.

3.2.4.2 Simulate Unmodeled Storage – Method 2: Remove Tributary Area

Approximately 380 acres of area tributary to the Springbrook No. 1 Watershed was removed from the model to simulate runoff filling the 142 ac-ft of available storage.

The area to remove was calculated by comparing the total runoff volume calculated at the USGS gage location (1808 acre-feet) to the total tributary area at the gage (4816 acres.) A ratio of 0.375 acre-feet of runoff per acre of tributary area was established. Therefore, 380 acres of tributary area should be removed from the model in order to simulate 142 acre-feet of storage. The tributary area was removed proportionally from each sub-basin that has unmodeled



storage available in it, based on the volume of storage available. The area was also removed proportionally from each land use type.

The 1996 flow hydrograph at the Creekside/Stonebridge pond was compared to the unmodified 1996 flow hydrograph, and 129 acre-feet of runoff was actually removed from the model. The model resulted in a water surface profile at the Creekside/Stonebridge pond that was 0.2 feet lower than the unmodified profile, and still significantly higher than the measured high water marks. The peak flow at the USGS gage site was reduced from 935 cfs to 885 cfs.

3.2.5 Sub-basin SP-12

Sub-basin SP-12 is the largest sub-basin in the watershed, and is wholly assigned to Branch 21. 14% of the watershed area is assigned to Branch 21, which also has twice as much tributary area as the next-largest branch/reservoir. DuPage County staff indicated that large sub-basins and branch assignments sometimes cause problems during modeling. Therefore, several options were studied to reduce the size of the area tributary to Branch 21.

3.2.5.1 Re-assign Sub-basin 12

Half of sub-basin 12 was transferred from branch 21 to the next downstream branch, branch 22. Peak flows and water surface elevations at the downstream end of branch 22 increased as a result of the re-assignment.

3.2.5.2 Delay Peak from Sub-basin 12

The DLAY K function of FEQ was used to delay the peak runoff rate from sub-basin 12 (branch 21.) A short delay of four hours was tested to determine the impact of the delay on the stream at branch 21 and further downstream.

A four hour delay reduced the peak flow at the downstream end of branch 21 from 391 cfs to 305 cfs. However, at the USGS gage, the model showed that peak flow is only reduced by 20 cfs, from 935 cfs to 915 cfs. Additionally, the maximum water surface elevation at the Creekside/Stonebridge pond downstream is only reduced by 0.2 feet.

3.2.6 October, 2001 Storm Calibration

An FEQ model was created to simulate the October, 2001 storm, in an attempt to produce a better match between simulated water surface profile and measured high water marks. The FEQ input model was based on the following parameters:

Hydraulics and land use based on the latest "existing conditions" model.

Based on the same gage assignments (1 through 4) as the July 1996 storm. An analysis was performed to test the sensitivity of the model to the gage assignment, and the results showed that the model is very sensitive to gage assignment. Therefore, the gage assignments should be reviewed and revised based on the October, 2001 storm before any significant conclusions are drawn from this data.

FACtors have not been developed for this storm, so all FACtors were set to 1.0. Based on the July 1996 analysis, the FACtors do not have a significant impact on the resulting water surface profile or flows. Therefore, using FACtors equal to 1.0 for the October, 2001 storm should produce reasonable results.



An inflow hydrograph for the West Branch is not available for the October 2001 storm event. Therefore, the West Branch was modeled using a constant 200 cfs baseflow. No high water marks are available at the downstream end of the watershed, therefore, this assumption is not expected to have a significant impact on the results.

3.2.6.1 2001 High Water Marks

High water marks for the October 2001 storm were measured at a residence on the Creekside Pond, a residence on Merrill Drive, and residences in the upper watershed near Main and Park. The water surface profile generated by FEQ is higher than the high water marks at all locations, as shown in Table A.2.

A series of FEQ analyses was conducted setting all reservoir and branch assignments to a single gage. The FEQ results show that the gage assignment has a significant impact on the resulting flow rates and water surface profile, although it is not as pronounced as a similar analysis conducted for the July 1996 storm. The lowest water surface profile resulted when all branches and reservoirs were assigned to gage 3. However, this water surface profile is still higher than the measured high water marks.

Assigning all reservoirs and branches to gage 3 and a FACtor of 0.75 results in a water surface profile which most closely matches the observed high water marks. The resulting water surface profile is lower than the Merrill Drive high water mark and higher than the Creekside Pond high water mark.

3.2.6.2 USGS Gage

The USGS gage at the Blackwell Forest Preserve recorded a peak flow rate of 364 cfs and a stage of 12.34 during the October, 2001 storm. FEQ calculated a peak flow of 636 cfs and a stage of 11.04 feet at the gage location (using the USGS gage datum.) Setting all gage assignments equal to gage 3 and all FACtors equal to 0.75 resulted in a peak flow of 422 cfs and 10.51 feet at the gage location.



TABLE A.2

SIMULATED RESULTS VS. RECORDED HIGH WATER MARKS

FOR OCTOBER, 2001 CALIBRATION EVENT

HWM Location	Approx. Stream Station (ft from confluence)	Simulated Elevation ¹ (ft)	Recorded Elevation (ft)	Simulated – Recorded (ft)
Arrow Road ²	4700	707.12	705.59 + 1' to 2'	Within range
Pond D/S of Creekside	20725 to 22125	723.36	722.87 to 723.25	+0.11 to +0.37
Merrill Drive	27000	729.61	727.51	+2.10
Main and Park area, basement flooding ³	Closed conduit area	732.77	730.80 to 731.75	+1.01 to +1.97
Main and Park area, first floor flooding	Closed conduit area	732.77	732.34	+0.43

1: The FEQ model for the 2001 calibration event uses FAC=1.0 and rain gage assignments from the July, 1996 storm event. Results are approximate.

2: Forest Preserve Staff indicated Arrow Road overtopped between 1' and 2' with most storms. Exact overtopping depth during the July, 1996 storm was unknown.

3: The recorded elevation range shown for homes reporting basement flooding is equal to the low entry elevation and first floor elevation. It is assumed that if water was higher than the first floor elevation, first floor flooding would have been reported.

3.2.7 Revised EXPCON at Lake Weir

The original model results show a significant amount of head loss across the Lake Weir, located downstream of the level pools at Creekside and Stonebridge Drives. Conditions observed in the field indicate that losses across this weir are probably not be very significant in a large storm event. Therefore, the representation of the weir in the model was analyzed.

Typically, expansion losses are greater than contraction losses, so the original EXPCON focused more on losses after the weir, rather than losses leading up to the weir. The upstream EXPCON cross section represented the cross section through the weir, and the downstream EXPCON cross section represented a cross section through the stream a short distance downstream of the weir. The corresponding results showed a significant amount of head loss across the weir, similar in magnitude to the head loss seen at roadway culverts elsewhere in the watershed.

However, field observations indicated that the weir and the adjacent overbanks would probably not produce significant head loss in large storms. The EXPCON was revised to reflect contraction losses leading up to the weir,



rather than losses after the weir. The revised upstream EXPCON cross section was located upstream of the weir through the level pool, and was fabricated using DuPage County two-foot topography. (The cross section below the normal water level was fabricated by interpolating survey data in the stream upstream and downstream of the new cross section location.) The downstream EXPCON cross section was located at the weir. The resulting profiles showed that for the highest flows, the lake weir has a minimal impact on water surface elevations. This seemed reasonable based on field conditions. Additionally, the resulting water surface profile is within six inches of the high water marks measured in the field for the July, 1996 and October, 2001 calibration storm events, as shown in Figures A.19 through A.23. Therefore, the model revision is justified.

FIGURES



Figure A.1 – USGS Rating and FEQ Rating at USGS Gage



Figure A.2 – Simulated vs Measured High Water Marks



Simulated vs Measured Hydrograph, July 1996 Springbrook No. 1 at USGS Gage Site at Blackwell Forest Preserve

Figure A.3 – Simulated vs Measured Hydrograph at USGS Gauge

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Figure A.9 – Simulated vs Measured Stage Hydrograph at USGS Gauge, June 30, 1993

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Figure A.10 - Simulated vs Measured Flow Hydrograph at USGS Gauge, June 30, 1993



Figure A.11 - Simulated vs Measured Stage Hydrograph at USGS Gauge, June 24, 1994

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Figure A.13 - Simulated vs Measured Stage Hydrograph at USGS Gauge, April 12, 1995

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Figure A.18 - Tributary Area vs Peak Flow for Selected Rain Events and USGS Gages

S Watershed Plan for the Springbrook No. 1 Watershed DuPage County, Illinois



Figure A.19 – July 1996 Calibration Profile with High Water Marks, Springbrook No. 1 at Merrill Drive

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S Watershed Plan for the Springbrook No. 1 Watershed DuPage County, Illinois



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S Watershed Plan for the Springbrook No. 1 Watershed DuPage County, Illinois



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Appendix B:

Dissolved Oxygen Monitoring Data from Station GBKA-04 WSD

		CommentAleme	Ctotion ID	1		Deto Timo	Monitorian American		Sample_	Volue	- Haide
Sreek II	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	1/5/05 640	Wheaton Sanitary District	Dissolved Oxvoen		630	ma/l
Creek IL	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	2/2/05 632	Wheaton Sanitary District	Dissolved Oxygen		9.80	ma/l
Creek II	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	3/2/05 642	Wheaton Sanitary District	Dissolved Oxygen		11.40	mg/l
Creek II	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	4/6/05 643	Wheaton Sanitary District	Dissolved Oxygen		6.90	mg/l
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	5/4/05 653	Wheaton Sanitary District	Dissolved Oxygen		15.60	mg/l
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	6/1/05 651	Wheaton Sanitary District	Dissolved Oxygen		4.80	l/gm
Creek II	L_GBKA GRK∆	Spring Brook Spring Brook	GBKA-04 WSD GBKA-04 WSD	41.849267 41.849267	-88.131517/	7/6/U5 645 8/3/05 640	Wheaton Sanitary District Wheaton Sanitary District	Dissolved Oxygen		2.60	l/gm
Creek IL	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	9/7/05 647	Wheaton Sanitary District	Dissolved Oxvaen		1.70	ma/
Creek II	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	10/5/05 645	Wheaton Sanitary District	Dissolved Oxygen		2.10	mg/l
Creek II	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	11/9/05 652	Wheaton Sanitary District	Dissolved Oxygen		0.80	mg/l
Creek II	GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	1/4/06 645	Wheaton Sanitary District	Dissolved Oxygen		8.30	mg/l
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	2/1/06 647	Wheaton Sanitary District	Dissolved Oxygen		9.60	mg/l
Creek II.	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	3/1/06 631	Wheaton Sanitary District	Dissolved Oxygen		13.00	mg/l
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	4/5/06 635	Wheaton Sanitary District	Dissolved Oxygen		8.90	mg/l
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	5/3/06 642	Wheaton Sanitary District	Dissolved Oxygen		7.40	l/gm
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	6/7/06 659	Wheaton Sanitary District	Dissolved Oxygen		2.70	mg/l
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	7/5/06 711	Wheaton Sanitary District	Dissolved Oxygen		3.20	µĝ₁
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	8/2/06 659	Wheaton Sanitary District	Dissolved Oxygen		0.80	/gm
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	9/6/06 651	Wheaton Sanitary District	Dissolved Oxygen		5.40	ng/l
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	10/4/06 657	Wheaton Sanitary District	Dissolved Oxygen		6.10	l/gm
Creek II	L_GBKA	Spring Brook	GBKA-04 WSD	41.849267	-88.131517	11/1/06 64/	Wheaton Sanitary District	Dissolved Oxygen		0.9.6	" mg/l
Creek II		Spring Brook	GBKA-04 WSD	41.849267	1131313	12/6/06 658	Wheaton Sanitary District	Dissolved Oxygen		9.20	ngu mg/
Creek II		W DI DUPAGE RIVEI		000730914	99 170600	07/12/04 14:21:00	Wheaton Samitary District	Discolved Oxygen		9.7	1/6
Cleek I		W DI DUFAGE RIVEL		024020114	0006/1/000	00.12.61 40/21//0	Wheaton Samitary District	Dissolved Oxygen		40.44	/ñ
Creek II		W DI DUPAGE RIVEI		02420.14	99 170600	00.12.01 40/21//0	Wheaton Samitary District	Discolved Oxygen		10.11	1/6
Crock II		W DI DUFAGE RIVEL		024220.14	000113000	00.12.11 40/21/10	Wheeton Senitory District	Discolved Oxygen		10.05	1/6
Creek II	ר-יפטי-אם	W BI DULAGE RIVEL		41 825A20	-88.170600	00.12.04 10.21.00	Wheaton Sanitary District	Dissolved Oxygen		0.00	10
Creek II	CONOC	W Br DuPade River		41 825420	-88 179600	00.12.01 20/21/20	Wheaton Samuary District	Discolved Oxygen		0.07	<i>b</i>
Creek II	GBK-05	W Br DuPade River	GBK-05 WSD	41.825420	-88.179600	07/12/04 21:21:00	Wheaton Sanitary District	Dissolved Oxvaen		8.30	/ou
Creek II	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/12/04 22:21:00	Wheaton Sanitary District	Dissolved Oxvaen		7.49	
Creek IL	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/12/04 23:21:00	Wheaton Sanitary District	Dissolved Oxvaen		6.77	ma/l
Creek IL	_ GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 00:21:00	Wheaton Sanitary District	Dissolved Oxvaen		6.21	, ma/l
Creek IL	- GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 01:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.78	, ma/
Creek II	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 02:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.51	mg/l
Creek II	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 03:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.35	mg/
Creek II	lGBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 04:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.21	mg/l
Creek II	L_GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 05:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.16	mg/l
Creek II	L_GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 06:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.13	mg/l
Creek II	L_GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 07:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.16	mg/
Creek II	L_GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 09:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.40	/gm
Creek II	L_GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 10:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.86	/gm
Creek II		W Br DuPage River		41.825420	-88.179600	07/13/04 10:12:00	Wheaton Sanitary Listrict	Dissolved Oxygen		6.36	, and
Creek I		W Dr DuPage River		024220.14	99.179600	01/13/04 12:21:00	Wheaton Sanitary District	Discolved Oxygen		0.04	/6
Creek II		W Br DuPage River		024220.14	-88.179600	07/13/04 13:21:00	Wheaton Sanitary District	Dissolved Oxygen		17.1	/6 E
Cleek I		W DI DUPAGE RIVEI		02420.14	99 170600	07/13/04 14:21:00	Wheaton Samitary District	Discolved Oxygen		01.1	1/6
veek II	ר-עםט-חס	W Br DuPage River		024220.14	-88.179600	00:12:01 40/01//0	Wheaton Sanitary District	Discolved Oxygen		0.8.7	1/6m
reek II	ר-יפטי-אםט	W BI DULAGE RIVEL		41 825A20	-88 170600	07/13/04 17:21:00	Wheaton Sanitary District	Dissolved Oxygen		7 04	- /ñ
reek II	CURK-05	W Br DuPade River		41 825420	-88 179600	07/13/04 18:21:00	Wheaton Samilary District	Discolved Oxygen		4 00 a	<i>b</i>
Traak II	GBK-05	W Br DiiPade River	GBK-05 WSD	41 825420	-88 179600	07/13/04 19:21:00	Wheaton Sanitary District	Discolved Oxygen		7 85	2
creek II	GBK-05	W Br DuPade River	GBK-05 WSD	41.825420	-88.179600	07/13/04 20:21:00	Wheaton Sanitary District	Dissolved Oxvaen		7 94	/o
reek II	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 21:21:00	Wheaton Sanitary District	Dissolved Oxvaen		7.64	ma/
creek IL	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 22:21:00	Wheaton Sanitary District	Dissolved Oxvaen		7.15	ma/l
Creek II	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/13/04 23:21:00	Wheaton Sanitary District	Dissolved Oxygen		6.61	
Creek II	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/14/04 00:21:00	Wheaton Sanitary District	Dissolved Oxygen		6.16	mg/l
reek II	GBK-05	W Br DuPage River	GBK-05 WSD	41.825420	-88.179600	07/14/04 01:21:00	Wheaton Sanitary District	Dissolved Oxygen		5.95	mg/l
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Appendix C:

Basis for Copper Impairment Listing

Number of Observa- tions ¹	Type of Parameter	Type of Water Quality Standard	Water Chemistry Condition Indicating Potential for Moderate Impairment of <u>Aquatic Life</u> Use ²	Water Chemistry Condition Indicating Potential for Severe Impairment of <u>Aquatic Life</u> Use ²
Ten or Toxi more observa- tions are available for the applicable water- chemistry parameter Nont	т. : 3	Acute	For any single parameter, two observations exceed the applicable standard ⁴ .	For any single parameter, three or more observations exceed the applicable standard.
		Chronic	For any single parameter, there is one exceedances of the applicable standard ⁵ .	For any single parameter, there are two or more independent exceedances of the applicable standard ⁵ .
	Nontoxic ⁶	Other	For any single parameter, more than 10% but no more than 25% of observations exceed the applicable standard; or, there is one exceedance of any standard that requires multiple observations to apply.	For any single parameter, more than 25% of observations exceed the applicable standard; or, there are two or more exceedances of any standard that requires multiple observations to apply.
Fewer than 10 observa- tions are available for the applicable water- chemistry parameter	Toxic ³	Acute	Among all parameters, one observation exceeds an applicable standard.	Among all parameters, two or more observations exceed an applicable standard.
		Chronic	Among all parameters, there is one exceedance of an applicable standard ⁵ .	Among all parameters, there are two or more independent exceedances of an applicable standard ⁵ .
	Nontoxic ⁶	Other	Among all parameters, two observations exceed an applicable standard.	Among all parameters, three or more observations exceed an applicable standard.

Table C-3. Guidelines for Using Water-Chemistry Data in Table C-1 to Indicate the Potential for Impairment of Aquatic Life Use in Streams

- 1. The most recent consecutive three years of data are used. It is not necessary that observations be available for every parameter of each type; the assessment is based on available data. As used in Table C-1, "*sufficient water chemistry data*" means a dataset at least as representative of water-chemistry conditions as the three-year dataset that is typically available from an Ambient Water Quality Monitoring Network station.
- 2. If conditions in at least one table cell apply, then the potential for impairment is indicated.
- 3. Includes 2, 4-D, alachlor, atrazine, ammonia, arsenic, barium, benzene, cadmium, chloride, chlorine, chromium (hexavalent and trivalent), copper, cyanazine, cyanide, dicamba, endrin, ethylbenzene, fluoride, iron, lead, manganese, mercury, metolachlor, metribuzin, nickel, selenium, silver, sulfate, terbufos, toluene, xylenes, and zinc or any parameter with an acute or chronic aquatic life criteria derived under 35 IAC 302.210. If no specific chronic water quality standard applies, the standard is interpreted as an acute one.
- Hereafter in this table, "applicable standard" refers to an Illinois General Use Water Quality Standard, 35 IAC 302.208, 302.212 and 303.444 and 35 IAC 303.311 through 303.445) or an aquatic life criterion derived according to 35 IAC 302.210 (http://www.epa.state.il.us/water/water-quality-standards/).
- 5. Chronic standards are applied consistent with 35 IAC 302.208, 302.210, 302.212, and 303.444 as follows. If the chronic standard is exceeded for one or more combinations of four consecutive observations, then the water chemistry condition indicates the potential for impairment of <u>aquatic life</u> use. If the chronic standard is exceeded for more than one *independent* set of four consecutive observations, then the water chemistry condition indicates the potential for severe impairment of <u>aquatic life</u> use. An *independent* set of four consecutive observations is one that does not share any observations with any other set of four consecutive observations.
- 6. Includes: water temperature, pH, and dissolved oxygen.

Appendix D:

West Branch DuPage River Watershed Implementation Plan for Chloride

7. West Branch DuPage River Watershed Implementation Plan

7.1 Scope of this Implementation Plan

Each total maximum daily load (TMDL) described in this report should have a reasonable assurance of implementation in the watershed and should be consistent with all applicable federal regulations and guidance provided by the U. S. Environmental Protection Agency (USEPA). This plan includes the management practices to be implemented and the associated costs and institutional arrangements necessary for implementation, and it addresses the following TMDLs:

- Chloride TMDL for West Branch DuPage River
 - Applicable to road salting activities

7.2 General Description of Applicable Pollution Control Programs

7.2.1 Point Sources—Stormwater

The chloride TMDL describes load allocations (LAs; i.e., NPS allocations) applicable to stormwater sources of chloride, such as road salting activities. The LAs will also be applicable to stormwater discharges. Because Phase II of the NPDES stormwater program will apply to most or all of the municipalities in the watershed (see Appendix F for the list of stormwater permittees), as well as to the roads owned and operated by the state and the Tollway Authority, it is anticipated that stormwater-related allocations will actually be implemented as point source controls, as described in recent USEPA guidance and as governed by the Illinois Environmental Protection Agency (IEPA) General Permit for Stormwater Discharges.

7.2.1.1 USEPA Regulations and Guidance

USEPA has recently issued guidance directing how stormwater sources are to be addressed in TMDLs (source: USEPA. *Establishing Total Maximum Daily Load [TMDL] Wasteload Allocations [WLAs] for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs*. Memorandum from Robert Wayland and James Hanlon to Water Division Directors, November 22, 2002). Relevant key points presented in this guidance include:

- NPDES-regulated stormwater discharges must be addressed by the WLA component of the TMDL [40 CFR 130.2(h)].
- NPDES-regulated stormwater discharges may not be addressed by the LA component of the TMDL [40 CFR 130.2(g)&(h)].
- Stormwater discharges from sources that are not currently subject to NPDES regulation may be addressed by the LA component of the TMDL [40 CFR 130.2(g)].

- It may be reasonable to express allocations for NPDES-regulated stormwater discharges from multiple point sources as a single categorical WLA when data and information are insufficient to assign each source or outfall to individual WLAs [40 CFR 130.2(i)]. In such cases where WLAs have been developed for categories of discharges, these categories should be defined as narrowly as available information allows.
- The WLAs and LAs are to be expressed in numeric form in the TMDL [40 CFR 130.2(h)&(i)]. USEPA expects TMDL authorities to make separate allocations to NPDES-regulated stormwater discharges (in the form of WLAs) and unregulated stormwater (in the form of LAs). USEPA recognizes that these allocations might be rudimentary due to data limitations and variability in the system.
- Water Quality Based Effluent Limits (WQBELs) for NPDES-regulated stormwater discharges that implement WLAs in TMDLs may be expressed in the form of best management practices (BMPs) under specific circumstances [40 CFR 122.44(k)(2)&(3)]. If BMPs alone adequately implement the WLAs, then additional controls are not necessary.
- USEPA expects that most WQBELs for NPDES-regulated municipal and small construction stormwater discharges will be in the form of BMPs, and that numeric limits will be used only in rare instances.

According to this guidance, all of the chloride-related allocations for the West Branch DuPage River TMDLs should be characterized as WLAs for point sources. In all other respects, the West Branch DuPage River TMDLs are consistent with this guidance.

7.2.1.2 IEPA General Stormwater NPDES Permit

IEPA has recently issued General Permit No. ILR40, *General NPDES Permit for Discharges from Small Municipal Separate Storm Sewer Systems*. The effective date of this permit is March 1, 2003 through February 29, 2008. Applicable Municipal Separate Storm Sewer Systems (MS4s) are expected to file a notice of intent to be covered by the permit, and then comply with all applicable permit requirements. The two sections of the permit most relevant to this plan are Part III C (Special Conditions for TMDL Watersheds) and Part IV (Stormwater Management Programs). Each of these sections is reproduced below, describing the conditions and requirements for covered permittees:

Part III. Special Conditions for TMDL Watersheds

- C. If a TMDL allocation or watershed management plan is approved for any waterbody into which you discharge, you must review your stormwater management program to determine whether the TMDL or watershed management plan includes requirements for control of stormwater discharges. If you are not meeting the TMDL allocations, you must modify your stormwater management program to implement the TMDL or watershed management plan within 18 months of notification by the Agency of the TMDL's approval. Where a TMDL or watershed management plan is approved, you must:
 - 1. Determine whether the approved TMDL is for a pollutant likely to be found in stormwater discharges from your MS4.
 - 2. Determine whether the TMDL includes a pollutant WLA or other performance requirements specifically for stormwater discharges from your MS4.

- 3. Determine whether the TMDL addresses a flow regime likely to occur during periods of stormwater discharge.
- 4. After the determinations above have been made and if it is found that your MS4 must implement specific WLA provisions of the TMDL, assess whether the WLAs are being met through implementation of existing stormwater control measures or if additional control measures are necessary.
- 5. Document all control measures which are currently being implemented or are planned to be implemented. Also include a schedule of implementation for all planned controls. Document the calculations or other evidence that shows that the WLA will be met.
- 6. Describe and implement a monitoring program to determine whether the stormwater controls are adequate to meet the WLA.
- 7. If the evaluation shows that additional or modified controls are necessary, describe the type and schedule for the control additions/revisions. Continue steps four through seven above until two continuous monitoring cycles show that the WLAs are being met or that WQ standards are being met.

Part IV. Stormwater Management Programs

A. Requirements

You must develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from your small municipal separate storm sewer system to the maximum extent practicable (MEP) to protect water quality and to satisfy the appropriate water quality requirements of the Illinois Pollution Control Board Rules and Regulations (35 Ill. Adm. Code, Subtitle C, Chapter 1) and the Clean Water Act. Your stormwater management program must include the minimum control measures described in section B of this Part. You must develop and implement your program by 5 years from your coverage date under this permit.

B. Minimum Control Measures

The six minimum control measures to be included in your stormwater management program are:

1. Public education and outreach on stormwater impacts.

You must:

- a. implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of stormwater discharges on water bodies and the steps that the public can take to reduce pollutants in stormwater runoff; and
- b. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.

2. Public involvement/participation.

You must:

- a. at a minimum, comply with state and local public notice requirements when implementing a public involvement/ participation program; and
- b. define appropriate BMPs for this minimum control measure and measurable goals for each BMP These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.
- 3. Illicit discharge detection and elimination.

You must:

- a. develop, implement, and enforce a program to detect and eliminate illicit discharges into your small MS4;
- b. develop, if not already completed, a storm sewer system map showing the location of all outfalls and the names and locations of all waters that receive discharges from those outfalls;
- c. to the extent allowable under state or local law, effectively prohibit, through ordinance or other regulatory mechanism, non-stormwater discharges into your storm sewer system and implement appropriate enforcement procedures and actions;
- d. develop, implement, and adequately fund a plan to detect and address non-stormwater discharges, including illegal dumping, to your system;
- e. inform public employees, businesses, and the general public of the hazards associated with illegal discharges and the improper disposal of waste;
- f. address the categories of non-stormwater discharges listed in Section I.B.2 only if you identify them as a significant contributor of pollutants to your small MS4 (discharges or flows from firefighting activities are excluded from the effective prohibition against non-stormwater and only need to be addressed where they are identified as significant sources of pollutants to waters of the United States); and
- g. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all pollutants of concern in your stormwater discharges to the maximum extent practicable.
- 4. Construction site stormwater runoff control.

You must:

a. develop, implement, and enforce a program to reduce pollutants in any stormwater runoff to your small MS4 from construction activities that result in a land disturbance of greater than or equal to 1 acre. Reduction of stormwater discharges from construction activities disturbing less than 1 acre must be included in your program if that construction activity is part of a larger common

plan of development or sale that would disturb 1 acre or more, or it has been designated by the permitting authority.

Your program must include the development and implementation of, at a minimum:

- i. an ordinance or other regulatory mechanism to require erosion and sediment controls, as well as sanctions to ensure compliance, to the extent allowable under state or local law;
- ii. requirements for construction site operators to implement appropriate erosion and sediment control best management practices;
- iii. requirements for construction site operators to control waste, such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste, at the construction site that may cause adverse impacts to water quality;
- iv. require all regulated construction sites to have a stormwater pollution prevention plan that meets the requirements of Part IV of NPDES permit No. ILR10, including management practices, controls, and other provisions at least as protective as the requirements contained in the Illinois Urban Manual, 2002;
- v. procedures for site plan review which incorporate consideration of potential water quality impacts and review of individual pre-construction site plans to ensure consistency with local sediment and erosion control requirements;
- vi. procedures for receipt and consideration of information submitted by the public; and

vii. procedures for site inspections and enforcement of control measures.

- b. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.
- 5. Post-construction stormwater management in new development and redevelopment.

You must:

- a. develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects that that result in a land disturbance of greater than or equal to 1 acre, including projects which are less than 1 acre that are part of a larger common plan of development or sale or that have been designated to protect water quality, that discharge into your small MS4. Your program must ensure that controls are in place which would protect water quality and reduce the discharge of pollutants to the maximum extent practicable;
- b. develop and implement strategies which include a combination of structural and/or non-structural BMPs appropriate for your community that will reduce the discharge of pollutants to the maximum extent practicable;

- c. use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under state or local law;
- d. require all regulated construction sites to have post-construction management that meets or exceeds the requirements of Section IV (D)(2)(b) of NPDES permit No. ILR10, including management practices, controls, and other provisions that are at least as protective as the requirements contained in the Illinois Urban Manual, 2002;
- e. ensure adequate long-term operation and maintenance of BMPs; and
- f. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.
- 6. Pollution prevention/good housekeeping for municipal operations.

You must:

- a. develop and implement an operation and maintenance program that includes a training component and is designed to prevent and reduce the discharge of pollutants to the maximum extent practicable;
- b. using training materials that are available from USEPA, the state of Illinois, or other organizations. Your program must include employee training designed to prevent and reduce stormwater pollution from activities, such as park and open space maintenance, fleet and building maintenance, operation of storage yards, snow disposal, new construction and land disturbances, and stormwater system maintenance procedures for proper disposal of street cleaning debris and catch basin material; it must address ways that flood management projects impact water quality, NPS pollution control, and aquatic habitat; and
- c. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.

7.2.2 Point Sources—WWTPs

The WWTPs already have individual NPDES permits for their discharges. However, WWTP effluent chloride concentrations are not a significant contribution to the chloride exceedances. No permit change for chloride is expected for WWTP point sources.

7.2.3 Nonpoint Sources

Section 319 of the Clean Water Act (CWA) authorizes states to address NPS pollution through the development of assessment reports and the adoption and implementation of NPS management programs. USEPA awards grants to states to assist in implementing these programs. Section 319 programs are largely voluntary, and promote practices on a watershed scale. IEPA is the designated state agency in Illinois for the 319 program. IEPA provides technical assistance, and informational and educational programs and funding to various
units of local government and other organizations to implement projects that utilize costeffective BMPs (source: IEPA. *Illinois EPA and Section 319*. IEPA/BOW/98-010. August 1998).

Previous Section 319 grants for watershed improvements in the West Branch DuPage River watershed primarily used to fund stream stabilization and debris removal projects. These particular projects are not likely to have an impact on chloride concentration levels. Other types of projects that would help implement the chloride TMDL, however, could be funded through the 319 program, including the general BMPs identified above, provided that they are already not being utilized in the watershed. A total of \$20 million in Section 319 grant money has been awarded since 1990 to fund a total of 132 watershed improvement projects (source: IEPA. *Illinois EPA and Section 319*. IEPA/BOW/98-010. August 1998).

7.2.4 Reasonable Assurance

For watersheds that have a combination of point sources and NPS, where reduction goals can only be achieved by including some NPS reduction, the TMDL must incorporate reasonable assurances that implemented NPS reductions will be effective in achieving the load allocation (source: USEPA. *Guidance for Water Quality-Based Decisions: The TMDL Process*. EPA 440/4-91-001, 1991).

Although the West Branch DuPage River watershed is mostly urban, a small percentage of land use is agricultural (approximately 17 percent). As the chloride TMDL largely focuses on the use of road salt for deicing, agricultural activities are not relevant to this TMDL.

The assurance of achievement of TMDL goals will be provided by stormwater permit programs.

7.3 Specific Implementation Considerations for West Branch DuPage River Chloride TMDL

7.3.1 Chloride TMDL

The allocation scenario for chloride assumes that the WQS must be met at nearly all times and that a reduction in overall annual road salt application mass would be used to achieve that end. This is a conservative approach, because a reduction in an overall annual load may not be feasible or necessary to meet the designated uses. Thus, as described below, this approach should be further evaluated in the context of an adaptive or iterative implementation plan.

7.3.1.1 General BMPs for Road Deicing

The following BMPs are generally considered practicable for road deicing activities (source: FHWA. *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring*. FHWQ-EP-00-002. May 2000).

• Optimization of use:

Storage:

- Salt storage piles need to be completely covered (i.e., use of salt domes)
- Storage and handling operations should be performed on impervious surfaces
- Stormwater runoff from areas where salt is stored should be contained in a suitable area

Application:

- Use of calibrated spreaders; trucks can be equipped with ground speed sensors that can accurately control the rate of spreading
- Training programs for drivers and handlers should be implemented to improve the efficiency of application and to reduce losses
- Snow plow operators need to avoid piling snow on or near frozen ponds, lakes, streams, or wetlands
- Other:
 - Identify ecosystems that are sensitive to salts
 - Use of alternatives such as calcium chloride and calcium magnesium acetate may be less environmentally harmful to sensitive ecosystems; these alternatives are more expensive than regular salt, but they are less corrosive to bridges and overpasses (see Tables 7-1 and 7-2 for information on these alternatives)
 - In some instances, sand may be used in place of salt to improve traction, but that may not be appropriate where sedimentation presents adverse environmental impacts

TABLE 7-1

Alternative Road Deicers—Temperature, Cost, and Environmental Considerations

Check the Label For	Works Down to:	Cost is:	Environmental Impacts
Calcium Magnesium Acetate (CMA)	22°F–25°F	$20\times$ more than rock salt	(+) Less toxic
Calcium Chloride (CaCl)	-25°F	3× more than rock salt	(+) Can use lower doses(+) No cyanide(-) Chloride impact
Urea	20°F–25°F	$5 \times$ more than rock salt	(+) Less corrosion(-) Adds needless nutrients
Sand	No melting effect	~\$3 for a 50 lb bag	(-) Accumulates in streets and streams
Sodium Chloride (NaCl; rock salt)	15°F	~\$5 for a 50 lb bag	(-) Contains cyanide (-) Chloride impact

Source: Envirocast Newsletter. Volume 1, No. 3. http://www.stormcenter.com/envirocast/2003-01-01. January 2003.

TABLE 7-2 Alternative Road Deicers—Temperature and Cost Considerations

Deicer	Minimum Operating Temperature	Cost (\$/lane mile/season)
Sodium chloride	12°F	\$6,371–6,909
Calcium chloride	-20°F	\$6,977–7,529
CG-90 Surface Saver ^a	1°F	\$5,931–6,148
Calcium Magnesium Acetate	23°F	\$12,958–16,319

^aCG-90 is a combination of sodium and magnesium chloride with additives. Source: Center for Watershed Protection. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for USEPA. December 1997.

7.3.1.2 Specific Road Salting BMPs–West Branch DuPage River Watershed

Local communities, IDOT, and the Illinois Tollway Authority are the primary parties responsible for the removal of snow and the application of road salt within the West Branch DuPage River watershed. While specific practices may vary from community to community, the following typical general description is applicable. This information is based on responses given during telephone interviews of officials from several of the communities located in the watershed, IDOT, and the Illinois Tollway Authority.

IDOT is responsible for the maintenance of state highways and roads, including snow removal and road salt application operations. These roadways typically have a U. S. or Illinois state highway route number assigned to them. While IDOT has agreements with some municipalities in the state under which the local municipality conducts the maintenance operations in place of IDOT, these agreements are rare in DuPage County.

The Illinois Tollway Authority is responsible for the maintenance of tollways, including snow removal and road salt application operations. The I-88 Tollway is located within the West Branch DuPage River watershed. The Tollway Authority typically dispatches snow removal and road salt application crews during or immediately after a snow event. Snow that is cleared is deposited in the Tollway right-of-way off the road shoulder or within the Tollway median. The Tollway Authority uses digitally-calibrated spreader trucks at an application rate of either 200, 300, or 500 lb/road-mile for its salting operations. The application rate used depends on several factors, including the severity of the storm and present road conditions. The spreader trucks are automated to spread salt at the selected rate regardless of vehicle speed. Operators are required to participate in a yearly training program.

DuPage County and local communities and townships located within the watershed are responsible for maintaining all county roadways and local streets, including local collector and arterial streets. Municipal Public Works Departments typically dispatch snow removal and road salt application crews during or immediately after a snow event. In most cases, snow that is cleared is deposited on the side of the road. In certain locations, such as downtown areas, the snow that is cleared may be hauled away and stored at a central location. With the possible exception of snow storage sites located upstream of a local stormwater detention basin, such sites typically do not have erosion and sediment control practices or structural or non-structural water quality BMPs in place. Some communities are in the process of phasing in new salt spreader trucks which tend to have automated salt spreader controls that are connected to the vehicle's speedometer and which automatically apply salt at a standard rate regardless of vehicle speed. Newer salt spreader trucks are digitally calibrated and do not need to be calibrated yearly, as is generally required for older salt spreader trucks. Those communities which use older salt spreader trucks typically instruct drivers to stop spreading salt when the truck is stationary at a stoplight or in traffic. Training procedures vary by municipality, but all drivers are trained upon hiring, and most communities have some type of annual meeting or annual training requirements.

The following agencies or communities within the West Branch DuPage River watershed were contacted to provide information about their snow removal and salt application activities: DuPage County, Illinois Tollway Authority, Illinois Department of Transportation, Wheaton, Carol Stream, Bartlett, West Chicago, and Milton Township. Information on whether the agency/community has a written snow plan, conducts yearly training, and/or owns digitally-calibrated salt spreading equipment is presented below.

Agency/Community	Written Plan	Yearly Training	Digital Spreaders
IDOT	Yes	No	"Vast Majority"
Tollway	Yes	Yes	Yes
DuPage County	No	No	8 of 40
Bartlett	No	Yes	Yes
Carol Stream	Yes	No	No
West Chicago	Yes	No	No
Wheaton	Yes	Yes	No
Milton Township	No	No	No

 TABLE 7-3

 Summary of Snow Removal and Salt Application Information Collected from Selected Agencies and Municipalities

The following is a list of municipal, government, and other entities which are likely to conduct snow removal and salt application operations within the West Branch DuPage River watershed (see Appendix F for the list of MS4 permittees):

Aurora	Warrenville
Bartlett	Wayne
Batavia	West Chicago
Bloomingdale	Wheaton
Bolingbrook	Winfield
Carol Stream	Bloomingdale Township
Geneva	Lisle Township
Glen Ellyn	Milton Township
Glendale Heights	Schaumburg Township
Hanover Park	Wayne Township
Hoffman Estates	Winfield Township
Lisle	Cook County
Naperville	DuPage County
Roselle	Fermilab
Schaumburg	Illinois Department of Transportation
St. Charles	Illinois Tollway Authority
Streamwood	-

7.3.1.3 Recommended Management Actions and Institutional Arrangements

It is recognized that road deicing is necessary for public safety. Thus, the implementation of the chloride TMDL by MS4s should be based on prudent and practicable road salting BMPs to the extent that public safety is not compromised.

Section III C. of IEPA General Permit No. ILR40, *General NPDES Permit for Discharges from Small Municipal Separate Storm Sewer Systems,* identifies the specific actions and schedule that each permittee will be required to follow to comply with TMDLs. If it is determined that a permittee will need to implement additional BMPs beyond those already in place, then the general road salting BMPs identified should be evaluated for their applicability and effectiveness as a part of that permittee's plan to comply with TMDLs.

The General Permit requires each permittee to notify IEPA if it does not currently meet the WLA for a TMDL. For the chloride TMDL, separate WLAs were not identified according to each individual jurisdiction that conducts road deicing activities. Instead, a single allocation was made for a category of discharges, namely deicing-related discharges. Thus, permittees should have the option of either: 1) demonstrating to IEPA that their activities do not cause or contribute to chloride exceedances, 2) using prudent and practicable BMPs already in place, or 3) proceeding to implement the remaining TMDL provisions of the General Permit.

7.3.1.4 Cost Considerations

It is anticipated that many of the general BMPs identified above for road salting, if not already in place, can be implemented over time by the appropriate jurisdictions. For example, the controlled application of salt is a reasonable and prudent step that is commonly used to avoid over-salting. However, the use of alternative deicing agents will have to be carefully considered by each permittee in relation to cost, applicability, practicability, and public safety. As shown above, costs for alternatives to sodium chloride-based rock salt are substantially higher, and these alternatives cannot be used in all conditions or locations. In addition, each of the alternatives poses its own adverse water quality impacts which must be taken into consideration.

7.4 Adaptive Management

7.4.1 Chloride TMDL

The chloride criteria exceedances for the West Branch DuPage River, both monitored and modeled, are infrequent (less than 0.5 percent of the time). For example, USEPA guidance recommends that water bodies should only be considered impaired if exceedances occur more than a given percent of time, depending on such factors as pollutant type and data distribution (see USEPA July 2002 Consolidated Assessment and Listing Methodology guidance). For acute and chronic chemical criteria for conventional pollutants, USEPA guidance identifies a greater than 10 percent exceedance threshold for non-attainment of standards and 305(b) and 303(d) listings. In addition, it may be possible to identify which specific hydrologic and salt application conditions lead to elevated instream chloride concentrations through further discussion with permittees, or through additional monitoring and/or modeling activities. It may be possible to target control actions specific to these conditions. If successful, it would not be necessary to achieve an overall annual salt application reduction of the magnitude indicated in the TMDL.

7.4.2 Recommended Elements of Adaptive TMDL Implementation

The following discussion summarizes adaptive management language included in the Tualatin River TMDL, as approved by USEPA (source: Oregon DEQ. August 2001).

As a goal of the CWA and associated administrative rules for Illinois, water quality standards shall be met or all feasible steps should be taken toward achieving the highest quality water

attainable. This is a long-term goal in many watersheds. The TMDLs developed for the West Branch DuPage River watershed are based on mathematical models and other analytical methods that are designed to simulate complicated physical, chemical, and biological processes. They are, to a certain extent, simplifications of the actual processes, and thus do not produce an exact prediction of a particular system response to pollutants. These uncertainties have been recognized and conservative assumptions have been used to address them, as acknowledged in the margin of safety considerations. Subject to available resources, IEPA should review, and, if necessary, modify the TMDLs if IEPA determines that new scientific information is available that indicates significant changes are warranted.

This watershed plan is designed to reduce pollutant loads to meet TMDL targets. However, it should be recognized that it may take some period of time from full implementation before management practices identified become fully effective in reducing and controlling certain pollutants. In addition, technology for controlling some pollutant sources such as NPS and stormwater, are still in the development stages and will take one or more iterations to develop effective techniques. Finally, it is possible that after application of all reasonable BMPs, some of these TMDLs cannot be achieved as originally established.

When developing WQBELs for NPDES permits, IEPA should ensure that the limits are consistent with the assumptions of the WLA (40 CFR 122.44(d)(1)(vii)(B)) and work with stormwater permittees in developing management plans that are consistent with the TMDLs.

IEPA should regularly review progress towards achievement of the TMDLs. If and when IEPA determines that the plan has been fully implemented, that all feasible practices have reached maximum effectiveness, and that a TMDL or its target have not been achieved, the TMDL should be reopened to adjust the targets and associated water quality standards as necessary. The determination that all feasible steps have been taken should be based on site-specific balancing of (1) protection of designated uses, (2) appropriateness to local conditions, (3) use of best treatment technologies or BMPs, and (4) cost of compliance.

Appendix E:

Regional Chloride Reduction Strategy and Results

Appendix 4. TMDL Implementation: Chloride

Background

In October 2004, the United States Environmental Protection Agency (USEPA) approved chloride TMDLs for Salt Creek and the East and West Branches of the DuPage River. The TMDLs called for reductions in chloride loading, specifically from winter road salt application. The TMDLs for these watersheds were specifically derived to achieve compliance with the general use chloride water quality standard (WQS) of 500 mg/L adopted in 1972 by the Illinois Pollution Control Board (IPCB). The TMDL reports concluded that "[the] primary contributor to the [chloride WQS] exceedences is application of road salt for snow and ice control purposes. However, due to the sporadic nature of deicing activities, on a yearly basis the chloride mass contributed to the West Branch DuPage River watershed is larger from point sources than nonpoint sources." (IEPA, 2004, West Branch TMDL) The conclusions regarding Salt Creek and the East Branch are the same. In the West Branch watershed, a 35% reduction for chloride applied in deicing operations is specified, in the East Branch watershed a 33% reduction is specified, and a 14% reduction is specified in the Salt Creek watershed (IEPA, 2004, East and West Branch TMDLs). To initiate TMDL implementation, the DRSCW initiated a Chloride Usage Education and Reduction Program Study in 2006. The study findings and recommendations were used to develop the TMDL implementation program described further in this section. Through this program, the DRSCW hopes to catalyze changes in deicing practices and reduce salt application while maintaining public safety.

Data Gathering and Analysis

A local deicing program base line was set in 2007 by sending a questionnaire to about 80 deicing agencies, 39 of whom responded (representing approximately 69% of the total watershed area). These agencies reported a total annual salt use of 126,000 tons. Survey responses indicated a total of 8,369 lane miles of road serviced by deicing programs throughout the watershed. Out of the villages interviewed, only two required that private snow plowing businesses have licenses. In those municipalities the permits were required for the office locations only, and did not regulate how deicing practices are performed. Additionally, eight of approximately 130 private snow removal companies in the watershed area were contacted. Private contractors tend to serve commercial, industrial and residential customers, clearing parking lots and private drives rather than roads. Each company's typical annual salt use ranges from 7.5 to 500 tons per winter.

The total amount of chloride applied to the watersheds annually, in the form of road salt, was estimated from the questionnaire responses. The estimated load includes salt from municipalities, townships, the Illinois State Toll Highway Authority, and county transportation departments. Private snow removal companies and the Illinois Department of Transportation are not accounted for. Table 6 provides the estimated TMDL and DRSCW baselines per watershed and the TMDL target loading.

	Salt Creek	East Branch	West Branch	Total
TMDL Target, Tons of Cl-/yr	13,300	5,200	13,700	32,200
TMDL Baseline, Tons of Cl-/yr	15,500	7,800	21,100	44,400
DRSCW Baseline, Tons of Cl-/yr	32,600	16,900	21,200	70,700

Table 6. Estimated Current Chloride Loading from Road Salt in the Study Area, Compared with TMDL Road Salt Chloride Allocations. Table is for tons of chloride and does not include private snow removal companies or the Illinois Department of Transportation

Program Design and Implementation

The DRSCW carried out a literature review to identify the best management practices to reduce chloride loadings from winter deicing operations. The following target areas were identified:

- Improved Storage and Handling Practices
- Application Practices for Salt (level of service, staff training and record keeping, calibration of equipment, environmental monitoring)
- Chemical Methods (the definitions used by Environment Canada (2003)):
 - "Anti-icing is the application of a deicer to the roadway before a frost or snowfall to prevent melted snow and ice from forming a bond with the road surface."
 - "Pre-wetting is the addition of a liquid to solid deicers or abrasives before application to quicken melting and improve material adherence to the road surface."

In order to improve the adoption of these best management practices, the DRSCW organized, training, technical materials and technical workshops targeting the following core areas:

- Highways staff education of NPDES goals, the impacts of chlorides on waterways, staff training on calibration of equipment, and improved salt storage and handling practices
- Watershed-wide implementation of prewetting and anti-icing programs
- Consideration of alternative non-chloride products, such as acetate deicers and beet and corn derivatives



Plate 1. Flyer for the 2011 Public Roads Chloride Reduction Workshop]

As of 2012, the DRSCW has conducted eight chloride reduction workshops throughout the program area. Four of these workshops have been aimed at public roads (largely the public sector) and three have been aimed at parking lots and sidewalks (largely the private sector). Over 400 participants have attended the public roads workshops, and over 100 attended the parking lots and sidewalks workshops. In a 2010 program survey, 14 agencies confirmed that they had made improvements to their program based on local deicing program workshops. The following is a list of changes reported by agencies due to information gathered at deicing workshops:

- Cutting back salt usage by: re-calibrating salt spreaders, applying less salt per lane mile, and not salting until snow plowing has been completed;
- Obtaining and implementing new equipment for pre-wetting and anti-icing practices;
- Spreading salt in a narrow band down the center of two-lane streets to reduce scatter; and
- Using beet juice as an alternative deicing agent.

A noteworthy finding from the survey is that the private sector (e.g., contractors that provide deicing services at hotels, schools, stores), and who had been initially assumed to have minimal impact, actually apply significant amounts of salt and contribute significantly to chloride loadings. Addressing these activities will likely require different approaches and different

implementation tools. For example, DRSCW is looking at the possibility of having member municipalities adopt licensing programs or ordinances governing operations to require private companies to implement the identified BMPs, especially for storage.



Salt Application Rates and Trends

Figure 6 – Use of Deicing and Snow Removal Agents 2007 & 2010]

Many of the questions in the surveys focused on the use of alternative deicing agents, methods, and practices such as pre-wetting and anti-icing. Figure 6 illustrates the percentage of respondents that use various deicing agents as reported in the 2007 and 2010 questionnaires. Figure 6 shows an increase in the amount of agencies using pre-wetted salt (NaCl) and beet juice and a corresponding decrease in the use of dry NaCl, liquid CaCl2, KA, abrasives, and liquid MgCl2. Information provided in 2007 indicated that 14 agencies reported the use of anti-icing practices, while in 2010, 20 agencies reported using anti-icing practices. This has resulted in an approximate 25 percent increase in the implementation of anti-icing practices. Figure 7 shows salt application rates over the past three winter seasons provided by DuPage County DOT.



Figure 7 – DuPage County DOT Salt Application Data, 2007-2010]

Figure 7 shows that DuPage County DOT has reduced their salt usage per inch of snow consistently over each of the last three winter seasons. Salt used per call out (the number of times trucks were called out to perform deicing operations) and salt used per snow event has varied by season and weather events, as would be expected.

Snowfall in DuPage County during the 2007-08, 2008-09, and 2009-10 winter seasons was above average for the region and greater than the snowfall experienced during the 2006-07 winter season when the original survey was distributed. As would be expected, the total amount of salt used in the winter seasons was higher during seasons with more snow and less in seasons with less snow. It is important to normalize the results between winter seasons based on the severity of the winter season.

The 2010 survey asked respondents about their average salt application rate per lane mile. This information allows for more accurate tracking of a community's salt usage as it is less weather dependent than a total salt used per year. Based on data from responses to the 2010 survey, Figure 8 shows the average annual salt usage in lbs/lane mile for each watershed in the study area. Figure 9 shows the same information by placing the respondents into ranges of application rates.



Figure 8 – Average Salt Application Rates Reported in 2010]



Figure 9 – Application rate ranges for surveyed municipal members]

Survey Conclusions

The purpose of the 2010 survey was to gather follow-up information to determine if alternative deicing practices are being implemented in the DuPage River and Salt Creek watersheds and any resulting effects on salt application rates. While not directly comparable, survey responses indicate that the use of alternative deicing practices has increased since 2007, and select agency data indicates a general reduction in salt application rates between 2007 and 2010. Improvements in deicing practices and lower application rates are the result of an increase in the price of road salt and improved education and information provided by local deicing program workshops.

In order to perform a more definitive trend analysis of program improvements and reductions in salt usage, additional information will need to be collected over time. Information should be collected for several more years to continue to characterize deicing program improvements and resulting reductions in salt usage occurring within the DRSCW watersheds, and indicate water quality improvements.

Project Proposal: Chlorides

Details on the projects provided below are supplied in Table 1. Monitoring and assessment under this initiative are integrated into the data gathering and analysis set out in Appendices 1 and 2. Chloride is one of the proximate stressors identified by the stressor ID methodology described in Appendix 1. DRSCW will continue with this program by executing a minimum of two workshops per year to meet the following 5-year bench marks (based on the current municipal survey group of 33 agencies):

- Increase agencies participating in survey to 43 (currently 33)
- Move all agencies application rate to < 500 lbs/lm (currently 3 higher than that)
- Increase number of agencies anti-icing to 18 communities (currently 12)
- Increase number of agencies pre-wetting (currently 33, new additions will come from new participants)
- Reduce number of agencies storing exposed salt to 0 (currently 11)
- Carry out full review of current calibration practices and improve it by 50%
- Train 30 private companies and 10 parks departments to carry out regular calibration on equipment

Elgin O'Hare Western Access Project Offset Program

The DRSCW will work collaboratively with the Illinois Tollway (the Tollway) to identify opportunities and implement measures that help reduce and offset additional chloride loading created by the Elgin O'Hare Western Access Project (EOWA) within the DRSCW's program area. It is estimated that the project will introduce approximately 1500 tons of sodium chloride into the DRSCW program area annually. The Tollway and the DRSCW will cooperate to calculate additional loadings based on agreed upon assumptions about winter storm frequency and severity.

The Offset Program will establish a framework to offset increased loadings by a ratio of 1 ton incremental increase to 1.25 offset. The offset will be realized by "Tier 1" communities, local government entities that are immediately upstream or bridging the project corridor, and the Tollway.

The Tollway will identify operational efficiencies that will result in reduced application rates. The DRSCW will review the winter operations of the Tier 1 communities for efficiencies in the following areas:

- 1) Driver training
- 2) Salt spreader calibration
- 3) Develop appropriate application rates
- 4) Pre-wet de-icer
- 5) Equipment updates Speed servo controls On-board pre-wet Computer controls Storage & Handling
- 6) Coordinate salt application during plowing
- 7) Control salt spread width
- 8) Prioritize road system
- 9) Anti-Ice

The Tollway will provide funding for Tier 1 communities to implement identified efficiencies to reduce their chloride loadings. The aggregate of the two reductions (Tollway + Tier 1 communities) will be greater than the calculated marginal increase in chloride loading created by the Elgin O'Hare Western Access Project.

Appendix F:

Hydrologic and Hydraulic Modeling Overview

1	1	1	1	1				
Problem	Problem Area	Complaint	Mariainalita	Description	Probl	em Classification ¹		States
Area ID	Description	Source	Municipanty	Description	Cause	Jurisdiction	Severity	Status
0	Intersection Flooding in/near Downtown Wheaton	Photo Record, FEQ modeling	City of Wheaton	Intersection and street flooding	Drainage	Municipal	Critical	Recommendations to reduce flood damages included in this plan
1	Roosevelt Road to Elm Street	Resident Complaints, FEQ modeling	City of Wheaton	Intersection and street flooding, yard and structure flooding	Drainage	Municipal	Critical	Recommendations to reduce flood damages included in this plan
2	Elm Street to Hawthorne Lane	Questionnaire, FEQ modeling	City of Wheaton	Yard flooding, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Chronic	Recommendations to reduce flood damages included in this plan
3	Hawthorne Lane to Warrenville Road	Questionnaire, FEQ modeling	City of Wheaton, Unincorporated DuPage County	Yard and structure flooding, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed
4	Warrenville Road to Gables Boulevard.	Questionnaire, FEQ modeling	City of Wheaton, Unincorporated DuPage County	Yard and structure flooding, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed
5	Gables Boulevard to Aurora Way	Questionnaire, FEQ modeling	City of Wheaton, Unincorporated DuPage County	Yard and structure flooding, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed

SUMMARY OF QUESTIONNAIRES AND MODELING RESULTS

Problem	em Problem Area Complaint		Municipality Description		Prob	Status		
Area ID	Description	Source	Municipanty	Description	Cause	Jurisdiction	Severity	Status
6	Aurora Way to Creekside Drive	Questionnaire, FEQ modeling	City of Wheaton	Yard and structure flooding, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed
7	Creekside Drive to Stonebridge Trail	Questionnaire, FEQ modeling	City of Wheaton	Yard and structure flooding, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed
8	Stonebridge Trail to Upstream- Most Treatment Plant Access Road	Questionnaire, FEQ modeling	City of Wheaton, Unincorporated DuPage County	Yard and structure flooding	Flooding	Multi- Jurisdictional	Critical	Recommendations to reduce flood damages included in this plan
9	Upstream-Most Treatment Plant Access Road to Downstream- Most Treatment Plant Access Road	Questionnaire, FEQ modeling	Unincorporated DuPage County	Yard and structure flooding	Flooding	Multi- Jurisdictional	Critical	Recommendations to reduce flood damages included in this plan
10	Essex Road to St. James Court	Questionnaire, FEQ modeling	Unincorporated DuPage County	Yard and structure flooding, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed
11	Winfield Road to Morris Court	Questionnaire, FEQ modeling	Unincorporated DuPage County	Road overtopping, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed

Problem	m Problem Area Complaint Municipality		Municipality	Description	Probl	Status		
Area ID	Description	Source	Municipanty	Description	Cause	Jurisdiction	Severity	Status
12	Morris Court to Confluence with West Branch	Questionnaire, FEQ modeling	Unincorporated DuPage County, Town of Warrenville	Road overtopping, Streambank Erosion	Flooding, Erosion	Multi- Jurisdictional	Flooding Critical, Erosion Chronic	Recommendations to reduce flood damages included in this plan; Stream- bank stabilization project completed

1 Problems are classified as described in Section 6.1 of this report.

Summary of Questionnaire Results and FEQ Modeling Results

Area 0: Intersection Flooding in/near Downtown Wheaton

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: Several intersections in and near downtown Wheaton are reported to have drainage problems in large storm events. FEQ modeling results also indicate damages in this location.

<u>Probable Cause</u>: Intersection flooding appears to be the result of inadequate downstream storm sewer capacity.

Area 1: Roosevelt Road to Elm Street

Complaint Source: Resident complaints and FEQ Modeling Results.

<u>Problem Description</u>: An intersection is reported to have drainage problems in large storm events. Several homeowners also reported yard flooding and property damage due to basement and first floor flooding. FEQ modeling results also indicate damages in this location.

<u>Probable Cause</u>: Intersection and structure flooding appears to be the result of inadequate downstream storm sewer capacity.

Area 2: Elm Street to Hawthorne Lane

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: Three homeowners reported yard flooding due to overtopping of Springbrook No. 1 banks. FEQ modeling results do not show damages at these three locations, but do indicate associated damages at two different locations within this area.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect.

Area 3: Hawthorne Lane to Warrenville Road

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: One homeowner reported property damages due to basement and garage flooding as a result of overbank flooding. FEQ modeling results also indicate damages in this location.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect.

Area 4: Warrenville Road to Gables Boulevard.

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: Two homeowners reported yard flooding and a third homeowner reported multiple instances of yard flooding and one instance of basement flooding. None of these were shown as damages in the FEQ and DEC-2 analysis. The FEQ and DEC-2 analysis showed one structure with structural damages and a second structure with associated damages.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect.

Area 5: Gables Boulevard to Aurora Way

<u>Complaint Source</u>: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: Three homeowners reported multiple instances of yard flooding due to bank overtopping. One of the three also reported basement flooding due to overtopping of the banks, which was confirmed with FEQ modeling. FEQ modeling also showed structural damages at four other structures in this area.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect.

Area 6: Aurora Way to Creekside Drive

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description:</u> Eight homeowners on both sides of the creek reported flooding of yards due to overtopping of the banks. All homeowners reported multiple instances of overbank flooding, and some reported multiple instances of overbank flooding every year. One of the eight homeowners also reported flooding at his garage, which was confirmed with FEQ modeling. FEQ modeling also indicated associated damages at one home that reported yard flooding. FEQ modeling results also indicated damages at 4 additional structures in this area.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect.

Area 7: Creekside Drive to Stonebridge Trail

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: Ten homeowners on both sides of the creek reported flooding of yards due to overtopping of the banks. Five of those homeowners indicated yard flooding on multiple occasions, one of whom reported yard flooding due to overtopping of the banks in excess of forty times. That homeowner has also sustained property damages to the first floor and basement of

his home due to overbank flooding. FEQ modeling results indicate damages at 4 of these structures and 1 additional structure in this location. FEQ modeling results also indicate associated damages at two additional structures in this location.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect. Additionally, some homes adjacent to the level pool have a low area in their backyard, which contributes to the extent of the flooding problems.

Area 8: Stonebridge Trail to Upstream-Most Treatment Plant Access Road

<u>Complaint Source</u>: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: One homeowner on the left overbank reported overbank flooding of his yard on multiple occasions. The homeowner sustained basement flooding as a result of overbank flooding on two occasions. The FEQ results do not show flooding at this location, but the FEQ and DEC-2 modeling results do indicate structural damages at six other structures and also show associated damages at an additional structures in this location.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect.

Area 9: Upstream-Most Treatment Plant Access Road to Downstream-Most Treatment Plant Access Road

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: Wheaton Sanitary District reported flooding problems prior to 1985, when a berm was constructed between the WWTP and Springbrook No. 1 to provide flood protection to the plant. The sanitary district reported one instance of berm overtopping. FEQ modeling results also indicate damages in this location.

<u>Probable Cause</u>: The overbank flooding is most likely due to a series of factors, including a channel that is too small to convey the flood flows, a wide overbank area, and undersized hydraulic structures downstream which create a backwater effect.

Area 10: Essex Road to St. James Court

Complaint Source: Property Owner Questionnaire and FEQ Modeling Results

<u>Problem Description</u>: Two homeowners, one on each side of Springbrook No. 1, reported overbank flooding of yards on multiple occasions. One of the homeowners sustained damages to his crawl space and swimming pool as a result of overbank flooding. A third homeowner on the right overbank reported overbank flooding of his yard multiple times per year. FEQ modeling results indicate damages in two of the three locations.

<u>Probable Cause</u>: The channel through this area is narrow, and most likely has insufficient capacity to convey flood flows. Additionally, a wide overbank area results in a large flooding area

Area 11: Winfield Road to Morris Court

<u>Complaint Source</u>: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: DuPage County Forest Preserve staff report overtopping of Arrow Drive multiple times each year. FEQ modeling results also indicate damages in this location.

<u>Probable Cause</u>: A weir at the upstream end of the Arrow Road culvert controls flow through the culvert. The low point on the road profile is at 705.7, which is only 1.5 feet higher than the weir elevation of 704.2. The weir does not have sufficient capacity below the road overtopping elevation to convey flow.

Area 12: Morris Court to Confluence with West Branch

<u>Complaint Source</u>: Property Owner Questionnaire and FEQ Modeling Results.

<u>Problem Description</u>: A non-residential structure, located between the confluence of the West Branch of the DuPage River and Springbrook No. 1, reported overbank flooding of the yard on multiple occasions each year. FEQ modeling results also indicate damages in this location. FEQ results also show damages at a residential structure in the area.

<u>Probable Cause</u>: Backwater from the West Branch of the DuPage River and inadequate capacity within the Springbrook No. 1 channel banks contributes to the flooding problems at the Cenacle Retreat house and other structures near the confluence.







Appendix G:

Spring Brook No. 1 FEQ Modeling Schematic





Appendix H:

Delineated Sub-Basins Tributary to Spring Brook No. 1





Appendix I:

Estimated Pollutant Load Reductions for Individual Projects

Appendix I-1.	Individual	Permeable	Pavement	Projects
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Project Name	LOT SIZE		Par	ameter (po	unds per ye	ear)	
Project Name	(acres)	COD	TSS	LEAD	ZINC	TN	ТР
Atten Park	1.98	72.864	108.702	0.03168	0.1584	1.683	0.50193
Cantigny Foundation	4.048	148.9664	222.2352	0.064768	0.32384	3.4408	1.026168
Central Park	3.999	1,023.744	4,750.812	1.467633	2.27943	37.39065	3.63909
Clocktower Commons	0.082	3.0176	4.5018	0.001312	0.00656	0.0697	0.020787
Edison Middle School	0.967	247.552	1,148.796	0.354889	0.55119	9.04145	0.87997
Festival Streets & Alleys	2.44	1,719.712	4,962.96	6.5148	7.808	26.962	2.8548
Franklin Middle School	0.467	119.552	554.796	0.171389	0.26619	4.36645	0.42497
Hoffman Park	0.31	11.408	17.019	0.00496	0.0248	0.2635	0.078585
Lincoln Elementary School	0.497	127.232	590.436	0.182399	0.28329	4.64695	0.45227
Lowell Elementary School	0.532	136.192	632.016	0.195244	0.30324	4.9742	0.48412
Madison Elementary School	0.414	105.984	491.832	0.151938	0.23598	3.8709	0.37674
Seven Gables Park	2.501	92.0368	137.3049	0.040016	0.20008	2.12585	0.634004
WSCA	0.365	93.44	433.62	0.133955	0.20805	3.41275	0.33215
Wheaton College	2.78	711.68	3,302.64	1.02026	1.5846	25.993	2.5298
WWS High School	7.158	1,832.448	8,503.704	2.626986	4.08006	66.9273	6.51378
Whittier Elementary School	Whittier Elementary School 0.586 150		696.168	0.215062	0.33402	5.4791	0.53326
Wiesbrook Elementary School	0.689	176.384	818.532	0.252863	0.39273	6.44215	0.62699
SUM	29.815	6,772.229	27,376.07	13.43015	19.04046	207.0898	21.90941

Broject Name	POND SIZE		Par	rameter (po	unds per ye	ear)	
Project Name	(acres)	COD	TSS	LEAD	ZINC	TN	ТР
Pond 66500	0.166456	401	1,489	2	2	6	1
Pond 66499	0.648636	3,330	20,475	7	9	100	17
Ponds 8899 and 8900	0.5385	1,984	7,023	8	15	52	9
Pond 7491	0.432772	2,224	10,701	8	11	53	9
Pond 42042	0.254508	1,860	11,086	5	5	53	9
Pond 41977	0.769064	925	3,190	4	7	25	5
Pond 42053	0.493589	1,785	6,486	8	13	41	7
Ponds 8776 and 8777	0.2152	596	1,795	2	2	18	1
Pond 8775	0.565681	1,304	4,651	6	9	31	5
SUM	4.084406	14,409	66,896	50	73	379	63

Appendix I-2. Individual Wet Pond Enhancement Projects

		Sogmont		Bank #1		Bank #2			тр	SEDIMENT
Zone	Stream	Length (lf)	Soil Type	Height (ft)	Category	Height (ft)	Category	TN (lbs/yr)	(lbs/yr)	(tons/yr)
	Spring Brook No. 1	3,331	Silty clay loam, silty clay	9	Moderate	9	Moderate	623.6	311.8	311.8
В	Spring Brook No. 1	5,492	Silty clay loam, silty clay	7.25	Severe	7	Severe	2,504.3	1,252.2	1,252.2
	Spring Brook No. 1	230	Clay	4	Severe	4	Severe	59.2	29.6	25.8
С	Spring Brook No. 1	2,693*	Clay	4	Severe	4	Severe	693.7	346.8	301.6
D	Spring Brook No. 1	2,269	Clay	6	Severe	5.5	Severe	840.2	420.1	365.3
	Spring Brook No. 1	619	Silty clay loam, silty clay	7	Very Severe	5.5	Severe	316.9	158.5	158.5
	Spring Brook No. 1	7,966	Silty clay loam, silty clay	6.5	Very Severe	5	Very Severe	4,397.2	2,198.6	2,198.6
	Tributary 1	1,128	Silty clay loam, silty clay	3	Severe	2	Severe	180.5	90.2	90.2
E E	Tributary 1	1,660	Silt loam	3	Moderate	4	Moderate	128.4	64.2	64.2
E.	Tributary 1	1,051	Silty clay loam, silty clay	6	Slight	6	Slight	30.2	15.2	15.2
	Tributary 1	2,157	Silt loam	2.5	Severe	2	Severe	330.0	165.0	165.0
	Tributary 1	232	Silty clay loam, silty clay	3	Severe	3	Severe	44.6	22.2	22.2
	Spring Brook No. 1	3,534	Silty clay loam, silty clay	3	Slight	3	Slight	50.8	25.4	25.4
F	Spring Brook No. 1	554	Loams, sandy clay loams, sandy clay	5	Moderate	9	Moderate	77.1	38.6	45.4
	Spring Brook No. 1	4,045	Silty clay loam, silty clay	5.5	Moderate	5.5	Moderate	462.8	231.4	231.4
							SUM	10,739.5	5,369.8	5,272.8
	* Length values of 2,46	6 (Bank #1) an	d 2,920 (Bank #2) were used due to presence	e of pond.						

Appendix I-3. Individual Streambank Stabilization Projects
Appendix J:

Grant Opportunities Available to Assist Funding of Recommended Practice Implementation

United States Environmental Protection Agency

United States Environmental Protection Agency (USEPA) issues federal environmental regulations, enforces federal environmental law, and manages a number of grant programs.

Assessment and Watershed Protection Program Grants

Helps to develop innovative approaches to watershed protection, make a contribution to the body of restoration and management techniques, and transfer knowledge. Application of established techniques may be funded if doing so would contribute to the general understanding of an environmental problem.

Eligibility: States, local governments, public agencies, nonprofit organizations, individuals.

Assistance: \$5,000 to \$80,000 with no local match requirement, although match offers are considered during evaluation as 10 percent of the ranking.

Website: <u>http://www.epa.gov/owow/funding.html</u>.

Contact: USEPA Office of Wetlands, Oceans, and Watersheds, 1200 Pennsylvania Avenue, N.W., Washington, D.C. 20460.Phone: 202-566-1211. Phone: 202-566-1206.

Water Quality Cooperative Agreements

Assists public or nonprofit organizations in developing, implementing, and demonstrating innovative that reduce wastewater related pollution. Primarily meant to fund exemplary projects, e.g., new BMPs, that increase and transfer knowledge. Not to be used for land acquisition and development.

Eligibility: States, public agencies, and nonprofit organizations.

Assistance: \$10,000 to \$500,000 with no local match requirement, although match offers are considered during evaluation.

Website: http://www.epa.gov/owm/wqca/

Contact: USEPA Region 5, 77 W. Jackson Blvd. Chicago, IL 60604. Phone: 312-353-4378.

Wetland Program Development Grants

Supports strengthening state comprehensive wetland programs, developing a comprehensive wetland monitoring and assessment program, improving the effectiveness of compensatory mitigation, and refining the protection of vulnerable wetlands and aquatic resources.

Eligibility: States, local governments, public agencies, and interstate agencies.

Assistance: \$50,000 to \$420,000 grants with 25 percent local match requirement.

Website: http://www.epa.gov/owow/wetlands/grantguidelines/.

Contact: US EPA Region 5, 77 West Jackson Blvd., Chicago, IL, 60604. Phone: 312-886-0241.

Targeted Watersheds Grants Program (formerly Watershed Initiative)

Funds projects that demonstrate innovative approaches to watershed restoration with an emphasis on inter- organizational collaboration, market-based techniques, and demonstrable environmental improvement. Does not support activities directly required under the Clean Water Act.

Eligibility: Any public entity, but must be nominated by the state.

Assistance: \$600,000 to \$900,000 with 25 percent local match required.

Website: http://www.epa.gov/owow/watershed/initiative/.

Contact: USEPA Region 5, 77 W. Jackson Blvd. Chicago, IL 60604. Phone: 312 -886-7742.

USEPA Guidebook for Financial Tools

Used for identifying conservation funding source options.

Eligibility: anyone can access the guidebook.

Assistance: informational only.

Website: http://www.epa.gov/efinpage or http://cfpub.epa.gov/fedfund/

Contact: See website.

USEPA Catalog of Funding Sources for Watershed Protection Useful for identifying programs that will protect both urban and rural watersheds. Eligibility: anyone can access the guidebook. Assistance: informational only. Website: <u>http://www.epa.gov/owow/funding.html</u> <u>http://cfpub.epa.gov/fedfund/</u>. Contact: See websites.

The Brownfields Assessment, Revolving Loan Fund, and Cleanup Grants Intended the re-use and remediation of brownfield sites throughout Illinois. **Eligibility:** local governments, private not-for-profit(501C3) groups, and others.

Assistance: \$2 to \$3 million annually. Cleanup grants require 25% cost-share, grants range from under \$15,000 to over \$50,000.

Website: <u>http://www.epa.gov/brownfields/</u> Contact: Call 312-886-7576 or 301-589-5318

The Environmental Education Grants Program

Funds environmental education activities such as curricula design or dissemination, designing or demonstrating educational field methods for the public, and training educators.

Eligibility: Educational organizations, private not-for profit groups, and local governments.

Assistance: Minimum of 25% matching funds or in kind services required. Awards of \$25,000 or less are granted by regional offices.

Website: http://www.epa.gov/enviroed/grants.html

Contact: Call 312-353-5282 or visit the website for most current information and deadlines.

The Environmental Justice Grant Programs

Include community-based approaches for environmental protection.

Eligibility: Educational organizations, private not-for profit groups.

Assistance: No match is required. Up to \$15,000 per non-superfund site, other project grants variable up to \$100,000.

Website: <u>http://www.epa.gov/Compliance/environmentaljustice/grants/index.html</u> Contact: Call 312-886-5993 or 1-800-962-6215.

Smart Growth Technical Assistance Opportunities

Assist local communities develop in an environmentally friendly, sustainable manner.

Eligibility: Local governments, private not-for-profit groups, and others.

Assistance: In-kind contributions with assistance preferred.

Website: <u>http://www.epa.gov/smartgrowth/sgia.htm</u> Contact: Call 202-566-2878

The Priority Lake and Watershed Implementation Program

Provides funding to implement protection/restoration practices that improve water quality.

Eligibility: Local governments, private not-for-profit groups. Priority given to publicly-owned and accessed lakes.

Assistance: Funding up to 100%, projects range up to \$40,000.

Website: http://www.epa.gov/smartgrowth/sgia.htm

Contact: 202-566-2878

Five Star Restoration Challenge Grants

Bring together citizen groups, corporations, youth groups and students, landowners, and government agencies to undertake projects that restore streambanks and wetlands. Projects must include a strong wetland or riparian restoration component, and should also include education, outreach, and community stewardship.

Jointly administered by the National Fish and Wildlife Foundation, the National Association of Counties, and the Wildlife Habitat Council, and mainly funded by USEPA.

Eligibility: Requires at least five or more partnering organizations.

Assistance: \$5,000 to \$20,000 with a 1 to 1 match requirement.

Website: http://www.epa.gov/owow/wetlands/restore/5star/.

Contact: USEPA Wetlands Division, Room 6105 (4502T), 1200 Pennsylvania Avenue, NW, Washington, DC.

Email: price.myra@epa.gov

Illinois Environmental Protection Agency

Illinois Environmental Protection Agency (IEPA) administers state and federal environmental programs and regulations.

Clean Water Act Section 319 Grants

Provide funding for implementing corrective and preventative best management practices on a watershed scale, for the demonstration of innovative BMPs on a sub-watershed scale, and the development of information and education non-point source pollution control programs.

Administered by Illinois EPA.

Eligibility: State and local governments, nonprofits, individuals, businesses.

Assistance: Federal cost share at 60 percent maximum.

Website: <u>http://www.epa.illinois.gov/topics/water-quality/watershed-management/nonpoint-</u>sources/faqs/index

Contact: Illinois EPA, 1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois, 62794-9276. Phone: 217-782-3397.

Clean Water State Revolving Loan Funds (SRF)

Initially designed for wastewater treatment plant upgrades, supports watershed and non-point source control measures. These can include projects such as agricultural and urban runoff control, wetweather flow control including stormwater and sewer overflows, buffers, wetland protection, habitat restoration, and community-based comprehensive watershed management. Currently IEPA targets SRF funding to point source pollution control, i.e., upgrading wastewater infrastructure, but recently there has been approximately 20% set aside for nonpoint source control green infrastructure projects.

Eligibility: State and local governments, nonprofits, individuals, businesses.

Assistance: Funds projects at 100 percent at a national average interest rate of 2.2 percent, subject to change.

Website: http://water.epa.gov/grants_funding/cwsrf/cwsrf_index.cfm

Contact: Illinois EPA, 1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois, 62794-9276. Phone: 217-782-3397.

The Illinois Clean Lakes Program

Supports lake owners' interest and commitment to long-term, comprehensive lake management. Detailed diagnostic/feasibility studies scientifically document the causes, sources and magnitude of lake impairment (Phase I). Data generated from these monitoring studies are used to recommend lake protection/restoration practices for future implementation (Phase II).

Eligibility: Lake owners, local units of government, private not-for-profit (501C3) groups.

Assistance: up to \$75,000 for Phase 1, 40% match required; up to \$300,000 for Phase II study costs with 50 percent local match required. Available for publicly owned lakes larger than 6 acres with public access.

Website: http://www.epa.illinois.gov/topics/water-quality/surface-water/clean-lakes-program/index

Contact: IEPA Bureau of Water–Surface Water Section, Des Plaines Monitoring and Assessment Unit, 9511 West Harrison, Des Plaines, IL 60016. Phone: 847-294-4000. State contact: 217-782-3362.

Lake Education Assistance Program

Supports educational programs on inland lakes and lake watersheds. Eligibility: local governments, educational organizations, and private not-for- profit groups. Assistance: Maximum funding of \$500 is reimbursed after completion. Website: <u>http://www.epa.illinois.gov/topics/water-quality/surface-water/leap/index</u> Contact: 217-782-3362.

The Streambank Cleanup and Lakeshore Enhancement (SCALE) Program

Provides funds to assist groups that have established a recurring stream or lakeshore cleanup. Funds can be used for safety attire, litter bags, event promotion, logistical needs and dumpster or landfill fees.

Eligibility: organizations that have an established streambank or lakeshore cleanup including environmental groups, soil and water conservation districts, park districts and nonprofit organizations. **Assistance:** Ranges from \$500 to \$3,500.

Website: <u>http://www.epa.state.il.us/water/watershed/scale.html</u>. Contact: 217-782-3362.

The Illinois Green Infrastructure Grant (IGIG) Program

Assists in the implementation of green infrastructure management practices to control stormwater runoff for water quality protection. Funds are limited to the implementation of projects to install best management practices and are awarded based on three categories: Combined Sewer Overflow Rehabilitation, Stormwater Retention and Infiltration, and Green Infrastructure Small Projects.

Eligibility: Any entity that has legal status to accept funds from the state, including state and local government units, nonprofit organizations, citizen and environmental groups, individuals and businesses.

Assistance: Annually \$5 million.

Typical grant range: Combined Sewer Overflow Rehabilitation \$300,000-\$3,000,000 (total available \$3 million); Stormwater Retention and Infiltration \$100,000-\$750,000 (total available \$1.8 million); and Green Infrastructure Small Projects \$15,000-\$75,000 (total available \$200,000).

Website: <u>http://www.epa.state.il.us/water/financial-assistance/igig.html</u>. Contact: 217-782-3362.

Federal Emergency Management Agency

Federal Emergency Management Agency (FEMA) manages a number of programs that assist communities in disaster planning and hazard mitigation.

Flood Mitigation Assistance (FMA)

Helps states and communities identify and implement measures to reduce the risk of flood damage to structures insured under the National Flood Insurance Program (NFIP). Awards planning grants to assist development of Flood Mitigation Plans and project grants for projects that reduce flood losses, such as elevation, relocation demolition, acquisition of insured structures and property, flood proofing, and minor structural projects that reduce the risk of flood to insured structures.

Eligibility: State agencies, NFIP communities, qualified local organizations, Tribal governments.

Assistance: Federal cost share maximum of 75 percent.

Website: https://www.fema.gov/flood-mitigation-assistance-program

Contact: FEMA Region 5, 536 South Clark St., Chicago, IL 60605. Phone: 312-408-5500.

Hazard Mitigation Grant Program (HMGP)

Implements long-term hazard mitigation measures following a major disaster declaration and, in Illinois, for post-disaster floodplain building buy-outs, elevation, relocation, retrofit, and demolition on public and private land.

Eligibility: State and local governments, qualified nonprofit organizations, Tribal governments.

Assistance: Federal cost share maximum of 75 percent.

Website: https://www.fema.gov/hazard-mitigation-grant-program

Contact: Mr. Ron Davis, Illinois Emergency Management Agency, 110 East Adams Street, Springfield, IL 62701-1109.

Phone: 217-782-8719.

E-mail: RDavis@iema.state.il.us.

Pre-Disaster Mitigation Program (formerly Project Impact)

Implements the pre-disaster mitigation program for states and communities to reduce risk to the population, the costs and disruption caused by severe property damage and the cost to all taxpayers of Federal disaster relief efforts. Eligible projects include: acquisition, relocation, elevation, and strengthening of structures, development of standards to protect structures from disaster damage, and drainage improvement projects.

Eligibility: State and local governments, universities, Tribal governments.

Assistance: Federal cost share maximum of 75 percent with a \$3 million cap.

Website: https://www.fema.gov/pre-disaster-mitigation-grant-program

Contact: FEMA Region 5, 536 South Clark St., Chicago, IL 60605. Phone: 312-408-5500.

National Flood Insurance, Increased Cost of Compliance Program

Provides flood insurance policyholders with flood damaged homes and businesses in high-risk areas, also known as Special Flood Hazard Areas, with assistance to help pay the costs to bring their home or business into compliance with their community's floodplain ordinance, including building elevation, relocation, demolition, or floodproofing.

Eligibility: flood insurance policy holders.

Assistance: Federal assistance up to \$30,000.

Website: <u>https://www.fema.gov/national-flood-insurance-program-2/increased-cost-compliance-coverage</u> and <u>https://www.fema.gov/national-flood-insurance-program</u>

Contact: FEMA Region 5, 536 South Clark St., Chicago, IL 60605. Phone: 800-427-4661.

United States Department of Agriculture

United States Department of Agriculture, Natural Resource Conservation Service (NRCS), the successor agency to the Soil Conservation Service, partners with state conservationist offices and provides funding and technical assistance to landowners to promote soil and water conservation. United States Department of Agriculture, Forest Service (USDA-FS) manages programs that promote forestry and natural enhancement of urban areas through urban forestry programs.

Wetland Reserve Enhancement Partnerships (WREP)

Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities.

Eligibility: Eligible private landowners engaged in farming

Assistance: NRCS pays 50 to 75 percent of the easement value for the purchase of the term easement and 100 percent of the permanent easement. Additionally, NRCS pays between 50 to 75 percent of the restoration costs.

Website: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/easements/acep/?cid=stelprd b1242695

Conservation Reserve Program (CRP)

Offers annual rental payments, incentive payments for certain activities, and cost-share assistance to remove highly erodible cropland or sensitive acres from crop production. Program encourages farmers to plant long term resource conserving vegetative covers to improve soil, water, and wildlife resources. Eligible practices include riparian buffers along streams, ditches, lakes, wetlands, and ponds, grass or contour filter strips, and windbreaks. Funds also may be used to retire agricultural floodplain land. Program is administered by the Farm Service Agency.

Eligibility: Non-federal landowners engaged in farming or ranching.

Assistance: Farmers receive compensation, based on agricultural rent, for retiring sensitive land over a multiyear contract, usually 10-15 years.

Website: http://www.nrcs.usda.gov/programs/crp/

Contact: USDA Farm Service Agency, 1400 Independence Ave, SW Washington, DC 20250-0506 Phone: 800-457-3642. State office: 217-353-6600.

Emergency Watershed Protection Program (EWP)

Provides assistance to reduce hazards to life and property in watersheds from erosion and flooding due to severe natural events. May be used to establish vegetative cover, open restricted channels, repair diversions and levees, and purchase floodplain easements on flooded land in non-urban areas.

Eligibility: Public and private landowners with a project sponsor, i.e., a state or local government or special government district. Applications must be submitted within 60 days of disaster or 10 days in an emergency.

Assistance: Up to 75 percent federal cost-share for projects.

Website:<u>http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/ewpp/?cid=nrcs14</u> 3_008258

Contact: USDA, NRCS, Financial Assistance Programs Division, 14th and Independence Ave., SW, Room 6103A-S, Washington, DC 20250. Phone: 202-690-0793. State: 217.353.6600.

Conservation Reserve Enhancement Program (CREP)

Cooperative effort between landowners, state, local and federal agencies designed to enhance the Illinois River by protecting water quality and land in the Illinois River Watershed. Landowners who take environmentally sensitive land out of agricultural production in the Illinois River Watershed will receive financial incentives, cost-share incentives and technical assistance for establishing long-term, resource conserving covers. Supported practices include: tree planting, habitat, wetlands, filter strips, and buffers. Terms may be 15, 30, or 50 years or permanent.

Eligibility: Individuals, corporations, non-governmental organizations.

Assistance: varies by practice and type of land.

Website: http://www.fsa.usda.gov/FSA

Contact: IDNR Region 2, 2050 W. Stearns Road, Bartlett, IL 60103. Phone: 847-608-3100. State: 217.785.8287.

United States Department of the Interior

U.S. Department of the Interior, Fish and Wildlife Service (USFWS) manages programs to protect wildlife and habitat by means such as issuing rules for hunters and anglers, administering the Endangered Species Act, and awarding grants for environmental restoration.

Partners for Fish and Wildlife Programs

Assist private landowners in restoring habitat in accordance with USFWS goals, including, for example, restoration of wetland hydrology, use of prescribed burns, and planting with native vegetation. Wetlands are the primary focus of the program in Illinois. Landowners enter into at least a 10-15 year agreement to refrain from returning the land to its former use or otherwise nullifying the restoration. Eligible projects include restoration or enhancement of transient waterfowl habitat, improve water quality, flood protection, and groundwater recharge.

Eligibility: Non-state and non-federal landowners, individuals, local government, and non-government organizations.

Assistance: Project grants at 50-60 percent local cost share with matching or in-kind services preferred, but not required.

Website: http://www.fws.gov/midwest/partners/

Contact: USFWS, Branch of Habitat Restoration, Room 400, 4401 N. Fairfax Blvd., Arlington VA 2220 Phone: (703) 358-2201 USFWS Region 3 Office, 2651 Coolidge Rd, East Lansing, MI 48823. Phone: (517) 351-8470.

Illinois Department of Natural Resources

Land and Water Conservation Fund (LWCF)

Provides funds to states and localities for park and recreational land planning, acquisition, and development. Public access must be granted in perpetuity. Funds are awarded through the Illinois Department of Natural Resources, which also manages a similar program, using state funding, called the Open Space Lands Acquisition and Development (OSLAD) Program. Points are generally awarded for applications that place natural resources in protection.

Eligibility: Local government agencies with authority to develop land for parks.

Assistance: Up to \$750,000 for acquisition projects, with 50 percent match required.

Website: http://dnr.state.il.us/ocd/newoslad1.htm.

Contact: Illinois DNR, One Natural Resources Way, Springfield, IL 62702. Phone: 217-782-6302.

Urban Flood Control Assistance

Involves initial study process and determination of appropriate flood control solutions. Funding depends on General Assembly appropriations for tributary studies and project feasibility investigations, focused on structural flood control solutions.

Eligibility: Local sponsorship, positive net benefit formally shown by benefit-cost analysis, membership in good standing in National Flood Insurance Program.

Assistance: Varies with appropriation.

Website: http://www.dnr.illinois.gov/WaterResources/Pages/Planning.aspx

Contact: IDNR Office of Water Resources, One Natural Resources Way, 2nd Floor, Springfield, Illinois 62702-1271. Phone: (217) 782-4637.

The Illinois Habitat Fund

One of three programs funded through the purchase of a State Habitat Stamp. For the Illinois Habitat Fund Grant Program, eligible projects are limited to those seeking to preserve, protect, acquire or manage habitat (all wetlands, woodlands, grasslands, and agricultural lands, natural or altered) in Illinois that have the potential to support populations of wildlife in any or all phases of their life cycles.

Eligibility: Not-for-profit organization or government agency that has the expertise, equipment, adequate staff/workforce and permission from the landowner (if applicable) to develop and/or manage habitat. **Assistance**: projects designed to protect, preserve, acquire, or manage habitat. Contact program administrator for assistance amounts.

Website: http://www.dnr.state.il.us/grants/Special_Funds/WildGrant.htm.

Contact: Vera Bojic, RiverWatch Coordinator, 618-468-4870 or vbojic@lc.edu.

The Open Space Lands Acquisition and Development (OSLAD) Program

State-financed grant program that provides funding assistance to local government agencies for acquisition and/or development of land for public parks and open space. The federal Land & Water Conservation Fund program (known as both LWCF and LAWCON) is a similar program with similar objectives.

Eligibility: Local governments having statutory authority to acquire and develop land for public park purposes.

Assistance: Under both programs, funding assistance up to 50% of approved project costs can be obtained. Grant awards up to \$750,000 are available for acquisition projects, while development/renovation projects are limited to a \$400,000 grant maximum.

Website: http://dnr.state.il.us/ocd/newoslad1.htm.

Contact: IDNR Office of Office of Architecture, Engineering and Grants, One Natural Resources Way, 2nd Floor, Springfield, Illinois 62702-1271. Phone: 217/782-6302.

The Division of Wildlife or Resource Protection and Stewardship Trees, Shrubs and Seedlings at No Cost Program

Intended to encourage landowners to reforest land, increase wildlife, and control erosion.

Eligibility: individuals; landowner must have an approved management / conservation plan.

Assistance: Seedlings provided at no charge. Shipping costs paid by grantee.

Contact: IDNR 217-785-2361.

The Forestry Assistance Grant Programs

Intended to create or enhance landowner or local forestry programs. Eligibility: Local governments, individuals, and others. Assistance: varies by program; 50% cost share grants and reimbursement up to \$5,000. Website: http://www.dnr.state.il.us/orc/Urbanforestry/financialasst.html Contact: 217-782-2361.

Schoolyard Habitat Action Grants

Support enhancement of wildlife habitat, with emphasis on youth involvement and education. **Eligibility:** Educational organizations and others. Project must involve a trained Project WILD educator or facilitator.

Assistance: Maximum funding to \$600. Website: <u>http://dnr.state.il.us/lands/education/CLASSRM/grants.htm</u>. Contact: 217-524-4126.

Illinois Biodiversity Field Trip Grants & Free Educational Materials

Support field trips for students to visit natural areas, natural history museums, and other natural resource related activities. Conservation education materials, including lesson plans, can be used separately. **Eligibility**: Educational organizations and others.

Assistance: Funding for field trips up to \$500 per class, per project. Website: <u>http://dnr.state.il.us/lands/education/CLASSRM/grants.htm</u>. Contact: 217-524-4126

County of DuPage

DuPage County Water Quality Improvement Program

Provides financial assistance to projects providing a regional water quality benefit.

Eligibility: This program is open to any organization or individual within DuPage County with an eligible water quality project.

Assistance: Funding up to 25% total project costs related to construction and maintenance and monitoring expenses.

Website: http://www.dupageco.org/EDP/Stormwater_Management/Water_Quality/1312/

Other Organizations and Entities

The Illinois Clean Energy Community Foundation

Support projects that enhance natural areas, increase renewable energy, or improve energy efficiency. Can be used to purchase land.

Eligibility: Private not-for-profit organizations, educational organizations, local governments.

Assistance: Call for details, which change year to year.

Website: http://www.illinoiscleanenergy.org

Contact: 312-372-5191

Northeastern Illinois Wetlands Conservation Account

Intended for restoration, enhancement, and/or replacement of wetland functions and values which have been degraded or destroyed as a result of activities conducted in violation of the Clean Water Act or the Rivers and Harbors Act. Also funds activities that promote understanding, appreciation, and stewardship of wetlands.

Eligibility: Governmental agencies, non-profit conservation organizations, and private home owner associations

Assistance: Project grants up to \$150,000. Matching funds preferred, but not required.

Website: <u>http://grants.fws.gov/</u>

Grand Victoria Foundation

Funds projects in restoration, pollution prevention, BMP implementation, environmental education, and land acquisition. Can be used to purchase land.

Eligibility: To be considered for funding, an organization must be registered with the IRS as a 501(c)(3) public charity.

Website: <u>http://www.grandvictoriafdn.org/</u> Contact: (847) 289-8575

McGraw Foundation

Primary areas of interest are the fields of higher education, science, medical research, health, civic and cultural organizations, social services, and the environment.

Eligibility: The Foundation will support only organizations qualified as tax-exempt, (i.e., 501(c)(3) organizations),

Website: <u>http://maxmcgrawfoundation.org/</u>