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Appendix B  Damage Analysis
Appendix C  Budgetary Cost Estimates
Section 1

Introduction

We all live in watersheds, and it is critical to the success of our communities to understand the nature and benefits of the watersheds in which we live. This watershed plan will introduce the basic concepts of watershed, watershed planning, and the specific conditions present in the Sugar Creek Watershed.

Watersheds

This watershed plan is based on a holistic systems approach to watershed protection and planning. The strategies and plans designed to improve water quality and quantity in one area must encompass all elements that contribute to flow and pollutant loading. Therefore, all plans designed to protect water resources are scaled for watersheds.

What is a Watershed?

A watershed is the land surface that drains into a specific water body (i.e. creek, stream, river, lake). A watershed can be as small as a footprint or large enough to drain 40 percent of the land area of the contiguous United States, which is the size of the Mississippi River watershed.
In most river systems, the smallest creeks and streams that drain land areas are called first order streams. The unnamed tributaries to Sugar Creek, discussed in more detail in Section 2, are first order streams. These small streams feed into larger creeks, or second order streams, such as Sugar Creek, and then flow into third order streams, such as Salt Creek, draining progressively larger areas of land. Figure 3 illustrates the stream order of creeks in the Salt Creek watershed. The Sugar Creek watershed is a smaller watershed within the Salt Creek watershed.

### Why Use a Watershed Approach?

A watershed approach is a flexible framework for managing the quality and quantity of water resources within specified drainage areas, or a watershed. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. The watershed planning process employs a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize issues, define management objectives, develop protection or
remediation strategies, and implement and modify selected actions as necessary. The outcomes of this watershed approach are documented in this Sugar Creek Watershed Plan.

**What is a Watershed Plan?**

A watershed plan is an approach that provides assessment and management information for a geographically defined watershed, in this case the Sugar Creek watershed. This strategy includes the analyses, actions, stakeholders, and resources needed to develop and implement the plan. The Sugar Creek Watershed Plan will become part of the Salt Creek Watershed Plan that was first adopted in 1991.

**Acronyms, Abbreviations, and Glossary**

This section defines some of the common terms and acronyms used throughout this watershed plan. In addition, websites, contact information, and other resources are provided here to inform the reader of this watershed plan.

The DuPage County Stormwater Management Department (SMD) is responsible for developing and implementing the DuPage County Stormwater Management Plan (DCSMP). Staff at the SMD can be reached via phone at 630-407-6700 or email at StormwaterMgmt@dupageco.org. The DCSMP is available online here: http://www.dupageco.org/EDP/Stormwater_Management/6597/.

The DuPage County Stormwater and Floodplain Ordinance (referred to as “Ordinance”), adopted in 1991 and last amended in 2013, can be downloaded from the following website: http://www.dupageco.org/EDP/Stormwater_Management/1165/.

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<th>Table 1: Abbreviations</th>
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<td><strong>List of Abbreviations</strong></td>
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Section 2

Goals and Objectives

The goal of the Sugar Creek Watershed Plan is to maintain, or improve where possible, water quality and to reduce flooding damages within the watershed. This report presents the Watershed Plan for Sugar Creek, a tributary to Salt Creek located in east central DuPage County, Illinois. This watershed plan supplements, and is a component of, the Countywide Stormwater Management Plan (DCSMP) approved by the DuPage County Board in 1989 and the Salt Creek Watershed Plan approved in 1991.

Purpose of the Plan

The primary purpose of the Sugar Creek Watershed Plan is to define watershed issues and identify potential solutions. The Watershed Plan will enable stakeholders to participate in the process of formulating solutions for water quality and flooding problems identified in the watershed. This watershed plan also seeks to:

- Engage the public and stakeholders in the care and protection of water resources;
- Inventory the watershed resources and physical system, including:
  - Drainage ways;
  - Wetlands;
  - Riparian Features;
  - Recreation Areas;
  - Flood Management Facilities;
- Identify flooding and water quality problems;
- Formulate potential solutions; and
- Develop a plan that is acceptable to affected stakeholders

The plan is presented in five sections: Section 1 presents the basic concepts of watersheds and watershed planning. Section 2 defines the goals and objectives of the watershed plan. Section 3 describes the watershed planning approach employed here to analyze the existing drainage system and to evaluate potential flood management solutions. Section 4 describes the watershed analysis, including the hydrologic and hydraulic models that were developed to analyze the existing drainage system and to evaluate potential flood management solutions. Section 4 also presents the estimated damages due to flooding that are anticipated in the watershed. Section 5 presents the formulation of flood mitigation projects and analysis of flood mitigation alternatives.
The Sugar Creek Watershed

The Sugar Creek watershed, which is part of the Salt Creek watershed, covers 4.07 square miles (2,608 acres) in DuPage County. The location of Salt Creek and Sugar Creek within DuPage County is shown on Figure 4. A map of the Sugar Creek watershed is shown in Figure 4. The watershed includes portions of the following communities:

- Village of Villa Park;
- City of Elmhurst;
- Village of Lombard;
- City of Oak Brook Terrace; and
- Areas in unincorporated York Township.

Figure 4: Watershed Location Map
The Sugar Creek Drainage System

The Sugar Creek Drainage System consists of the Sugar Creek mainstem and four major tributaries as shown on Figure 5. The mainstem is 3.85 miles of channel and buried pipe between South Grace Street and Salt Creek. The tributaries in the Sugar Creek Drainage System include:

- Tributary #1 – 0.34 miles (1,780 feet) of underground pipe and overland flow between Lufkin Pond and Sugar Creek;
- Tributary #2 – 0.32 miles (1,670 feet) of underground pipe and open channel between Canterbury Lane and Sugar Creek;
- Tributary #3 – 0.63 miles (3,300 feet) of open channel between Montini Park Pond and Sugar Creek; and
- Tributary #4 – 0.23 miles (1,150 feet) of open channel between East 15th Place and Sugar Creek.

Existing Watershed Resources

**Special Management Areas (SMAs)**

SMAs are places in the watershed that require special attention because there is an increased risk of flooding or important environmental resources are present. Additional regulatory constraints are associated with the development of these areas. SMAs include the floodway, floodplain, wetlands, and
riparian zones. Each of these SMAs is discussed in more detail below. **Figure 6** shows the SMAs within the Sugar Creek watershed.
Floodplain
The floodplain is low-lying land located adjacent to rivers and lakes that periodically floods. The floodplain is defined according to the probability that a flood will occur in any given year. For example, the 100-year flood is defined as a flood event that has a one percent chance of occurring in any given year. Therefore, the one percent chance or 100-year floodplain is land that would be inundated by a 100-year flood. Figure 7 shows homes that were built adjacent to a creek and are located in the floodplain. This was a common occurrence in DuPage County before minimum standards for development were adopted in a Countywide Stormwater and Floodplain Ordinance. Currently, any fill placed in the regulatory floodplain must be compensated by excavating 50 percent more new floodplain storage than the amount filled.

Virtually all of the properties that experience localized flooding in the watershed have property within the Federal Emergency Management Agency (FEMA)-mapped 100-year floodplain of Sugar Creek. In 2001, the DuPage County Stormwater Management Department (SMD) submitted a revised digital flood insurance rate map for the entirety of DuPage County, based on the existing FEMA flood profiles and updated aerial topography. These maps were adopted in December 2004. The SMD is currently in the process of updating the County’s floodplain maps for 24 County watersheds based on an updated methodology and procedure using the Hydrologic Simulation Program-Fortran (HSPF) and the Full Equations (FEQ) Hydraulic Analysis Computer Program in conjunction with updated topography. Drafts of these maps have been approved by the Illinois Department of Natural Resources (IDNR) and are currently following FEMA’s administrative processes for comments and appeals, resolution of all appeals, finalization of maps and adoption. Effective maps are expected in June of 2019.

Floodway
The floodway is comprised of the land within the river channel and adjacent land that is needed to convey the base flood without increasing the water surface elevation more than a designated height (see Figure 8). Development in the floodway is restricted to certain appropriate uses to ensure there are no increases in upstream flood elevations. All structural flood control alternatives that impact the regulatory floodway of Sugar Creek will require a Floodway Construction Permit from the State of Illinois.
Wetlands

Wetlands provide many ecological benefits such as water quality services, wildlife habitat, and natural
flood control. Figure 9 illustrates the benefits wetlands provide and their relation to rivers.

Wetlands are protected under the Ordinance. Wetland areas are defined on DuPage County wetland maps and during project specific delineation studies. Several wetland areas have been identified in the Sugar Creek Watershed. Some of the larger wetland areas are located around the High Point Center ponds, in the Sugar Creek Golf Course, at the confluence of the Sugar Creek mainstem and Tributary No. 3, and at the upstream end of Tributary No. 3.

Wetlands are generally sensitive to changes in flow regime in events with 10-year frequency or smaller. Proposed flood control projects must identify and mitigate all potential adverse impacts to wetlands.

**Riparian Zones**
Riparian areas are vegetated areas within the floodplain generally located adjacent to stream channels. The riparian zone is depicted in Figure 10. The Ordinance seeks to protect and promote expansion and revegetation of riparian areas. Riparian areas with natural, native vegetation provide wildlife habitat, reduce bank erosion, and improve water quality. Proposed flood control projects should not disturb existing riparian areas and should create or expand new areas.

![Figure 10: Riparian Zone Diagram](image)

*Figure Courtesy of the Conestee Foundation*
Flood Protection

After experiencing damage from the August 1987 flood event, DuPage County began to take measures to protect against future flooding. Over the next decade, the County constructed over $100 million in flood control projects, updated regulatory floodplain maps throughout the County, and developed a countywide, comprehensive policy in the form of the DuPage County Countywide Stormwater and Flood Plain Ordinance (herein referred to as “Ordinance”). The primary means of flood protection in the Sugar Creek watershed is through strict enforcement of the Ordinance.

Detention Facilities

There are several detention ponds in the Sugar Creek watershed. These ponds “store” water temporarily during flood events thus delaying and attenuating the peak discharge while they are important in managing local runoff. These detention ponds are not considered to be flood control facilities because they were designed and constructed to manage increases in runoff rather than to reduce flooding or protect structures. Figure 11 shows the locations of major detention ponds in the Sugar Creek watershed. Figure 12 is a photo of the Old Grove Detention Pond in the Sugar Creek watershed.

DuPage Countywide Stormwater and Floodplain Ordinance (Ordinance)

The Ordinance was first adopted in 1991, and enforcement began in February 1992. The DuPage County Stormwater Management Department (SMD) is involved in developing watershed plans for the waterways in DuPage County and enforcing the provisions in the Ordinance. The Ordinance requires detention for new development and redevelopment and compensatory storage for floodplain fill. These requirements generally result in reduced peak flows and flood elevations. The Ordinance is
revised, as needed, to ensure flood protection. The most recent updates to the Ordinance were adopted on April 25, 2013.

**DuPage County Stormwater Management Plan (DCSMP)**

According to the 1989 DCSMP, DuPage County prefers storage-based solutions (such as detention ponds) rather than conveyance-based solutions (increasing channel or culvert size to convey flood flows). Storage facilities generally reduce both flood flows and elevations while conveyance facilities tend to decrease flood elevations while increasing flows. Increasing flows during a storm event can lead to stream bank erosion, which may compromise bank stability. Erosion results in sediment in the water which can cause problems for wildlife and drainage downstream. Conveyance facilities also pose significant difficulties in conforming with the Ordinance because these types of facilities tend to reduce floodplain storage and increase the flows within and downstream of the project area. To conform to the Ordinance, the loss of storage and increase in flow must be fully mitigated through construction of compensatory storage and/or purchase of flood easements.

**Open Space**

Open space can offer valuable flood risk management benefits by providing space for flooding to occur, thereby protecting built up areas. Open spaces may include parks, preserves, hike and bike trails, or may simply be undeveloped land. All of these forms of open space decrease the risk of flooding damage to structures and infrastructure the public depends upon by providing a natural buffer between rivers and structures or infrastructure that could be damaged by floodwaters. Open space also provides aesthetic features that are important to citizens and make the community more appealing.

**Water Quality**

Every two years, in accordance with Sections 305(b) and 303(d) of the federal Clean Water Act (CWA), the IEPA reports to the USEPA on the quality of Illinois surface water (i.e. lakes, streams and wetlands) and groundwater resources (Section 305(b)) and provide a list of those waters where their designated uses are deemed ‘impaired’ (Section 303(d)). There are seven designated uses in Illinois; however, only five of those uses apply within the Sugar Creek Watershed. These designated uses are aquatic life, fish consumption, primary contact, secondary contact and aesthetic quality. While Sugar Creek itself has not been specifically assessed for water quality impairments, it is a tributary to Salt Creek, which has been identified as Not Supporting for Aesthetic Quality, Aquatic Life, Fish Consumption, and Primary Contact. More information on the water quality of Salt Creek can be found in the Chicago Metropolitan Agency for Planning’s Water Quality Based Watershed Plan. http://www.cmap.illinois.gov/programs/lta/lower-salt-creek

*Figure 13: Open Space in the Floodplain*
Section 3

Watershed Planning Approach

The watershed approach is a very effective framework for addressing water resource challenges. Watershed planning is a process that results in a plan of how best to protect and improve water quality and reduce flooding without creating adverse impacts elsewhere in the watershed or further downstream. Often watershed boundaries cross political boundaries. A comprehensive planning process that involves all affected municipalities and stakeholders in the watershed is essential to successful watershed management.

Watershed Planning Goals

Watershed planning is employed in the Sugar Creek watershed to address the following goals:

- Mitigate the effects of urbanization on stormwater drainage;
- Reduce damages caused by flood events;
- Maintain or improve stream water quality; and
- Protect the function of Special Management Areas (SMA).

Planning Approach

DuPage County SMD facilitates collaboration and consensus among various stakeholder groups. The watershed planning approach is hydrologically defined, geographically focused, involves stakeholders, and strategically addresses priority water resource goals; in this case, flooding and water quality. The Stormwater Management Planning Committee (SMPC) and DuPage County SMD play roles in watershed planning in DuPage County.

Stormwater Management Planning Committee (SMPC)

The SMPC is a joint county and municipal committee made up of twelve members. Six of these members are on the DuPage County Board, one representing each county board district. The other six are municipal members from each county board district appointed by the DuPage County Mayors and Managers Organization. The SMPC directs the activities of the DuPage County SMD staff. This watershed study and flood control plan will be presented to the SMPC and DuPage County Board for their evaluation and approval prior to public review.

DuPage County Stormwater Management Department (SMD)

The DuPage County SMD has managed the planning, design, and construction of several major flood control facilities during the last 25 years. Among the main objectives of the DuPage County SMD are:

- Mitigating the effects of urbanization on stormwater drainage,
- Reduction in damaging flood events,
• Water quality improvement in streams, and
• Enforcing the Ordinance.

SMD staff will be instrumental in implementing the Sugar Creek Watershed Plan.

**Stakeholders**

There are a number of stakeholders that could be affected by stormwater management planning in the Sugar Creek Watershed. These stakeholders include, but are not limited to the following:

• DuPage County
• Village of Villa Park
• City of Oak Brook Terrace
• Village of Lombard
• York Township
• DuPage High School District 88
• DuPage Middle School District 45
• Illinois Department of Transportation
• DuPage County Department of Transportation
• Forest Preserve District of DuPage County
• Property Owners
• Residents
• Business Owners
• Sugar Creek Golf Course
• Environmental and Water Resources Interest Groups
• Homeowner’s Associations

Stakeholder involvement is a community based process for hearing concerns and priorities related to water quality and quantity in the Sugar Creek watershed. Stakeholder meetings will be held to solicit input from stakeholders and this input will be considered during the planning process.

**Public Involvement**

Public involvement is necessary to obtain input from citizens and property owners. Citizens and property owners can provide important details and comments regarding social and economic concerns as well as needs and desires of the neighborhoods. The public is also uniquely situated in the community to provide local knowledge on the causes and impacts of flooding in the watershed.
A public meeting will be held following the SMPC’s selection of initial plan adoption. The public will have a 30-day comment period to communicate any concerns, comments, or questions.

**Technical Approach for Flood Damage Protection**

The technical approach to protect structures from flood damage includes a hydraulic and hydrologic analysis using continuous simulation computer software. **Figure 14** is a process diagram of the technical approach employed in this analysis. Model results are then used to determine which structures, roadways, or other facilities are at risk for flooding. Using that information, the model was then used to determine where structural approaches (e.g. detention ponds, increased culvert capacity) would provide flood damage protection. The completed model was used to simulate the September 2008 flood event, used for model calibration. **Figure 15** shows the high water condition at Cross Street during the September 2008 flood event and **Figure 16** shows that same location during normal water conditions. Results are compared to recorded high water marks to confirm that the model is a reasonable representation of flood conditions.

![Figure 14: Water Surface Conditions on Sugar Creek at Cross Street during September 2008 Flood Event](image_url)

**Figure 14: Water Surface Conditions on Sugar Creek at Cross Street during September 2008 Flood Event**

**Figure 15: Technical Approach Process Diagram**
The DuPage County SMD has been conducting regional hydrologic analysis for various watersheds since the mid 1980’s. A continuous hydrologic model, Hydrologic Simulation Program, Fortran (HSPF), was used to simulate the hydrologic characteristics of the watershed. HSPF simulates continuous hourly runoff from precipitation and meteorological data for both surface and subsurface runoff (i.e. groundwater). Thus, both overland flow and baseflow are simulated.

After the HSPF model is calibrated, the simulated runoff is routed through the stream network using a separate hydraulic computer model called the Full Equations (FEQ) Model, discussed in more detail in the next section. Results from the HSPF model are transferred to FEQ using a time series file, or TSF. The TSF contains runoff for each of the six land cover types and for each precipitation gauge used to generate the runoff. A total of 157 individual storm events are simulated from 60 years of historical rainfall records. The results from the model simulations are used to perform analysis of potential flood management projects or other system changes, such as flood storage facilities and channel or culvert improvements.

Hydraulic analysis was conducted using FEQ, the continuous simulation hydraulic analysis computer software. A detailed model of Sugar Creek was developed for five stream reaches in the watershed:

- 3.85 miles of the main channel,
- 5,040 feet of storm sewer in Tributary No. 1,
- 1,670 feet of Sugar Creek Tributary No. 2,
- 3,300 feet of Sugar Creek Tributary No. 3, and
- 1,190 feet of Sugar Creek Tributary No. 4.

The FEQ model was run through the 60-year historical series of 157 storm events contained in the TSF. Based on these runs, the event producing the greatest flows is the August 1972 event. A summary of maximum flows and elevations in the simulated August 1972 event is included as part of Appendix A.

Figure 16: Normal Conditions on Sugar Creek at Cross Street
Section 4

Watershed Analysis

Purpose
The purpose of the watershed analysis component of the Sugar Creek Watershed Plan is to build a computer model representation of the stream channel network of Sugar Creek. The model calculates the flow and depth of water in the channels that results from the simulation of various historical storms. The flow and depths results can be used to make informed planning decisions for future storm events. Once depths and flows are obtained from the hydraulic model, these results are used as input to a damage analysis model which identifies the number of residential and business structures at risk of serious flooding.

Model Components
The hydraulics model components include:

- Stream definition;
- Subcatchments;
- Terrain;
- Land use;
- Channel survey;
- Hydraulic Structure Survey.

Stream Definition
Figure 17 shows the streams and tributaries that were modeled as part of this watershed plan. These stream segments were selected based on the presence of open channels, historical flooding problems and contributing drainage areas. The stream flow paths were defined by the SMD Geographic Information System (GIS) group based on topography and aerial photos. Recent field surveys were conducted in 2009 and 2010 to monitor changes in the stream system and to adjust the FEQ model accordingly. In general, smaller storm sewers not designed to convey large floods are excluded from SMD planning models.

Subcatchments
To determine flows entering each segment of stream, the watershed is broken into subcatchments. Subcatchment delineations were conducted on 2-foot contour interval topographic maps from the DPC-SMD and verified during field inspection. Figure 18 shows the subcatchments delineated within the Sugar Creek Watershed.

Terrain
Terrain describes the elevation, or topography, of a given area, which is used to determine how water will flow within the watershed and where flooding may occur. It is also used to define the average
surface slope in each subcatchment. Slope is an important factor in the amount of storm runoff that occurs when it rains. Figure 19 shows the terrain in the Sugar Creek watershed.

Figure 17: Modeled Streams and Ponds

Figure 18: Sugar Creek Watershed Subcatchments
Land Use

The term land use refers to any activity or use which occurs directly on the land or within structures constructed on the land. Residential land use is the primary land use in the watershed. Land use is important because it determines the quality and quantity of water that flows over various land uses and ends up in the river. Some land use categories may contribute water quality contaminants or increase the amount of water entering the stream, therefore increasing flood flows. Figure 20 shows existing land use within the Sugar Creek watershed.

Existing (2003) conditions land use data for the Sugar Creek watershed was obtained from DuPage County’s GIS system. The existing land use conditions were used for hydraulic calibration, floodplain mapping, and project evaluation. The land use data for the Sugar Creek input to the FEQ program represents the tributary area characteristics of the Sugar Creek Watershed. This data is combined with the individual land use runoff series obtained from the HSPF simulation. This process is further described in the Hydrologic and Hydraulic Methods Report, (DuPage DEC, 1994), and the East Branch Hydraulic Evaluation (Price and Chang, 2001).

Channel Survey

The hydraulic characteristics of the stream system were obtained from field surveys performed first in 1994. Additional survey data was collected in 2001, 2004 and in 2010. Field surveys include the acquisition of cross-section data of the stream channel and floodplain. Data collected from aerial photo and topographic maps of DuPage County further supplemented this information. Figure 21 shows the surveyed cross section locations in the Sugar Creek watershed. In all, there are 77 surveyed cross-sections included in the hydraulic model.
Structure Survey

In addition to the stream channel cross sections, hydraulic structures, such as bridges, culverts, dams, weirs, and other hydraulic controls, were surveyed. The Sugar Creek structure survey included 24 culverts, three weirs, and four conduit inlets/outlets.

Figure 20: Land Use in the Sugar Creek Watershed
Problem Identification

Damage Areas

The Sugar Creek watershed is divided into five damage areas which are listed in Table 2 and shown in Figure 22. In each damage area, structures in or adjacent to the FEMA 100-year floodplains were identified. In 2010, DuPage County SMD staff conducted first floor and low water entry surveys of these structures. A structure database was prepared to develop DEC-2 model input for residential and business structures in the damage areas. DuPage County provided estimated structure values from tax assessor’s records. Contents were assumed to equal 30 percent of the structure value, which is a standard used by FEMA to assess flood damage potential. The baseline FEQ model with future land use was run using historical storm series, and maximum flood elevations (depths) were obtained for 38 locations throughout the watershed for each of the 157 historical storm events. The flood elevations were used as input to the DEC-2 models to determine baseline historical damages.
Table 2: Sugar Creek DEC-2 Damage Clusters

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<th>Location</th>
<th>Type of Structures Analyzed</th>
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<tr>
<td>A</td>
<td>Lower Sugar Creek (Villa Ave. to confluence with Salt Creek)</td>
<td>Residential, Business/Public Buildings</td>
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<tr>
<td>B</td>
<td>Tributary No. 1 from Lufkin Pond to the intersection of South Cornell Ave. and Sugar Creek</td>
<td>Residential</td>
</tr>
<tr>
<td>B2</td>
<td>Tributary No. 1 headwaters Area: Addison St/Wisconsin St Area</td>
<td>Residential</td>
</tr>
<tr>
<td>C</td>
<td>Middle Sugar Creek (Lombard Village limit to Villa Ave.)</td>
<td>Residential, Business/Public Buildings</td>
</tr>
<tr>
<td>D</td>
<td>Upper Sugar Creek (from Fairview Ave. to the Lombard Village limit)</td>
<td>Residential</td>
</tr>
<tr>
<td>E</td>
<td>Upper Sugar Creek (from the confluence with Tributary No. 4 to the confluence with Tributary No. 3)</td>
<td>Business/Public Buildings</td>
</tr>
</tbody>
</table>

Figure 22: Damage Areas
**Damage Analysis**

The purpose of the damage analysis is to use simulated water levels to estimate the expected average damages over a 60-year period. The damage analysis process is as follows:

- Simulate 60 years of historical rainfall;
- Determine water elevations;
- Determine depth of flooding at each at-risk structure during each flood; and
- Estimate potential damages from each storm.

The SMD uses a computer model called DEC-2 to analyze predicted flood damages based on simulated flood heights determined with the FEQ hydraulic model. The DEC-2 flood damage model determines expected structural and associated damages to each structure during each simulated historical storm event. The information used to compute damages include the simulated flood depths and, for each structure:

- low water entry elevations at residential and commercial structures;
- first floor elevations;
- lowest elevation in structure (typically the basement floor);
- type of residence or business;
- location along the stream;
- value of structure; and
- value of contents.

Damage curves for each structure type were developed by the FEMA and estimate the structural damage based on the depth of flooding above the lowest habitable elevation in the structure; often the basement floor. Residences are classified according to number of habitable floors and style (split level or ranch). Each style has a defined damage curve.

**Figure 23** shows a sketch of a typical home and identifies the low water entry and first floor elevations discussed above.
Damage Analysis Results

Flood depths at individual structures are interpolated using the river station for each structure. DEC-2 also determines the number of times flood heights at a particular structure exceed 0.5 and 1.0 feet above the low water entry elevation of the structure. This data is used to establish whether or not a structure is eligible for buyout under the County buyout criteria. Businesses were analyzed to see if they met the buyout criteria even though businesses are not eligible for buyout under the SMD voluntary buyout program. A buyout is the purchase of a residential property that meets the criteria set by the SMPC in its Buyout Program Policy. The DuPage County buyout program is entirely voluntary and is subject to funding constraints. Buyout eligibility does not guarantee that the County will offer to buy the property nor is the property owner required to participate in the program. The purpose of the buyout is to eliminate future flood damages to the property and to turn the property into public open space that enhances the riparian environment.

The results of the DEC-2 analysis are summarized in Table 3. Figure 24 illustrates the results of the damage analysis by identifying overtopped roads and structural damage. The results indicate that over the entire historical storm series, 87 structures experience either structural or associated flood damages. Associated damages include damages to lawns and gardens, incidental expenses incurred because of flooding, added costs for disposal of waste materials, costs for meals and lodging, and traffic disruption on residential streets. The results show that 19 structures meet the County buyout criteria under baseline conditions. All 19 structures are residential structures that would be eligible for buyout if no further actions are taken to mitigate flooding in the watershed.

Total damages during the 60-year historical simulation period, calculated using DEC-2 was over $4.37 million or an average of $72,000 per year. Damages occurred in 24 different historical storm events. However, these damages are not all-inclusive. These damage numbers do not include damages caused
by sanitary sewer backups, sump pump failures, or power outages which result in sump pump failures. They also do not account for structures with cracked or leaking foundations where water seeps through the walls or floor of the basement/foundation.

Traffic damages were also not included in the damage estimates. Traffic damages are associated with flooded roadways which causes traffic disruption and delays. The FEQ analysis indicates that 18 road crossings experience flooding during the historical series. In eight instances, flood depths exceed one foot, likely causing road closure. Two of these overtopping situations affect major thoroughfares, and access to Willowbrook High School is also affected.

Lost wages and emergency services damages were also not considered. Lost wages result when people cannot get to work or their business is flooded. Emergency services damages result when police, fire, or ambulance service cannot be provided due to flooding. Therefore, it is understood that the total damages of $4.37 million for the Sugar Creek Watershed over the 60-year historical simulation period is a low estimate. However, it provides a calculated estimate that can be compared to damage estimates from the flood control alternatives to determine the benefits and effectiveness of each alternative.

### Table 3: Sugar Creek Economic Modeling - Baseline Damages Summary

<table>
<thead>
<tr>
<th>Location (shown on Figure 4-1)</th>
<th>Total Computed Damages (60 year)</th>
<th>Number of Structures Flooded</th>
<th>Buyout Eligible Structures if No Further Action Is Taken</th>
<th>Number of Structures with Associated Damages Only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residential</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Sugar Creek,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage Area A</td>
<td>$0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Tributary No. 1</td>
<td>$1,316,000</td>
<td>15</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Damage Area B</td>
<td>$1,210,000</td>
<td>19</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Tributary No. 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage Area B2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle Sugar Creek,</td>
<td>$327,000</td>
<td>8</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Damage Area C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Sugar Creek,</td>
<td>$173,000</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Damage Area D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Businesses/Public Buildings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Sugar Creek,</td>
<td>$4,000</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Damage Area A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle Sugar Creek,</td>
<td>$1,336,000</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Damage Area C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Sugar Creek,</td>
<td>$2,000</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Damage Area E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td>$4,369,000</td>
<td>50</td>
<td>19</td>
<td>37</td>
</tr>
<tr>
<td><strong>Average Annual Damages:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$73,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
It should be pointed out that approximately $2.5 million of the $4.4 million in total damages occurs in Damage Areas B and B2 which are located along Tributary No. 1. In addition, 34 of the 50 structures that flood as well as 18 of the 19 buyout eligible structures are also located along Tributary No. 1. Therefore, it will be critical to address the significant flooding along Tributary No. 1.

Figure 24: Damage Analysis Results
Section 5

Alternative Analysis

Flood Management Goal
The primary flood management goal for the Sugar Creek Watershed Plan is to eliminate structural flood damages for all storm events in the historical rainfall series.

Criteria
Flood management activities must comply with the Ordinance as well as all applicable State and Federal regulations. The standards include:

- No increase in water levels or flows outside the County rights-of-way; County rights-of-way are drainage or utility easements that are located within the floodplain but do contain structures or services that may be damaged during storm events.
- Impacts to wetlands must be fully mitigated; and
- No increases in flood damage to any property or structures.

Flood Management Strategies
Flood management strategies are developed to eliminate all identified flood damages in the Sugar Creek watershed. Each alternative strategy is evaluated for cost effectiveness and ease of implementation. Available solution strategies include combinations of the following activities.

Non-Structural Solutions
- Voluntary buyouts
- Green infrastructure (e.g. trees, swales, rain gardens, soil amendment)

Structural Solutions
- Voluntary floodproofing of individual structures
- Green infrastructure (e.g. porous pavement, bioretention)
- Excavated storage facilities
- Conveyance improvements
- Berms and floodwalls

A series of potential projects were developed to address specific problem areas in Sugar Creek. These projects were developed based on suggestions from community leaders and SMD staff. The projects included non-structural measures, storage facilities and conveyance improvements. The proposed projects developed for the plan included the following.
1. Buyouts and floodproofing
2. Westmore Road culvert improvement
3. Storage in the High Ridge Forest Preserve
4. Addison Street area outlet sewer with storage
5a. Lufkin Pond expansion with a Van Buren Street storm sewer
5b. Lufkin Pond expansion
6. Storage at WBHS between Riordan Road and Ardmore Avenue

Projects 2, 3, 4, 5, and 6 were sized and represented in the FEQ hydraulic model. Based on initial model results, the projects were adjusted to maximize their effectiveness. Further adjustments were made based on initial comments from affected stakeholders. General descriptions of the proposed projects are provided on the following fact sheets.
Project 1: Buyouts and Floodproofing

Project Description
This project component involves buyouts and floodproofing of structures that are subject to flooding either after structural flood mitigation measures are implemented or if no structural flood mitigation measures are constructed. A buyout is the purchase of a residential property that meets the criteria set by the SMPC in its Buyout Program Policy. The DuPage County buyout program is entirely voluntary and subject to funding constraints.

A structure is eligible for buyout if:

- It has experienced significant flood damage in the past.
- Hydraulic modeling indicates it is at risk of flood damage of greater than one foot above low-water entry or multiple occurrences of flood damage of greater than one-half foot above low-water entry.

Only the model based criteria are considered in this plan.

Floodproofing technical assistance and design are offered to properties, which are shown to have inundation, but not to the depth or frequency required under the voluntary buyout criteria. Floodproofing is also entirely at the discretion of the property owner. Floodproofing options that are viable for structures in the Sugar Creek watershed include closures, sealants and berms.

Figure 25: Structures Requiring Buyouts or Floodproofing if no Flood Improvements are Constructed
Costs
Throughout the plan the following implementation costs are assumed:

- Buyouts: Fair market value plus 20 percent, for legal and closing costs along with the cost of demolition and utility removal.

- Floodproofing: $10,000 per residential structure.

Buyouts are funded by the County as funds become available, typically in conjunction with State or Federal grants. Floodproofing is a private property improvement that is paid for by the homeowner.

Operations and Maintenance Considerations
Following demolition of buyout properties, minimal maintenance would be required beyond mowing and litter removal. The properties would be maintained by the County as open space. Individual homeowners would be responsible for maintenance of floodproofing measures to their homes.
Project 2: Westmore Rd. Culvert and Downstream Channel Improvements, with Compensatory Storage

Project Description

This project involves structural improvements to culverts on South Westmore Road and nearly 1,000 feet of downstream channel improvements. The existing circular culverts located at South Westmore Road shown in Figure 26 would be replaced with two 10-ft by 5-ft box culverts. The channel improvements would include 1,000 feet of bioengineered trapezoidal channel with 12-foot bottom width, a side slope of 3:1, and an approximate top width of 60 feet. The existing channel is shown in Figure 27. The proposed channel would have a bioengineered cross section, meaning it would be constructed with stable materials and overlaid with a natural veneer. The side slopes would be planted with native materials designed to discourage geese. The location of these improvements is shown on Figure 28.

This conveyance improvement will require compensatory storage to mitigate flow increases. There are three potential locations for the required storage: properties in Lombard adjacent to Westmore Rd, two properties on Roosevelt Rd., or the High Ridge Forest Preserve. Considering availability of land and other factors, the preferred location is along Westmore Rd. as shown in Figure 5-4 below. These properties are currently vacant and partly covered by the regulatory floodplain. At least one of the owners has approached the Village of Lombard about selling their property.

The projected shown provides about 4.0 acre-feet (ac-ft) of additional storage (about 2 ac-ft of storage exist on the side at the 1 percent flood level). This is not sufficient to fully mitigate the flow increases caused by the project, thus Project 2 cannot be constructed without additional compensatory storage.
Project 2 is proposed to address the problems identified in Upper Sugar Creek including structural flooding, properties experiencing associated damages, and road overtopping at four locations. Table 4 shows the existing flood hazards in this area as well as the expected benefits if Project 2 is implemented as described above.

Table 4: Summary of Flood Hazards Addressed by Project 2

<table>
<thead>
<tr>
<th>Existing Flood Hazards</th>
<th>Implementation Would</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 structures flooded</td>
<td>Mitigate flooding of 4 structures</td>
</tr>
<tr>
<td>5 structures with associated damages</td>
<td>Mitigate associated damages at 1 structure</td>
</tr>
<tr>
<td>1 structure is buyout eligible in the 60-year storm series</td>
<td>Remove 0 structures from buyout list</td>
</tr>
<tr>
<td>Overtopping of four road crossings</td>
<td>Overtopping eliminated at Westmore Road and remaining depths reduced by 0.1 to 0.3 feet</td>
</tr>
</tbody>
</table>

**Costs**

The approximate cost to implement this project is estimated as follows:

- Culvert Improvement $555,000
- Compensatory Storage $374,000
- Channel Improvement $674,000

Total Estimated Budgeting Cost $1,603,000
The costs account for contingency, design engineering, permitting, and construction management. The costs do not include the cost of acquiring property for compensatory storage or any improvements that might be needed to facilities at the apartment complex.

**Operations and Maintenance Considerations**

Periodic maintenance of the culverts, particularly following storm events, would be necessary to ensure the improvements are operating at the design capacity.

The proposed grassed trapezoidal channel will require little maintenance beyond mowing, litter removal, and inspection of side slopes.

By performing regular inspection activities, the County can proactively identify and address potential erosion issues, which would help extend the useful life of this project.
**Project 3: Storage in High Ridge Forest Preserve**

**Project Description**

Project 3 is construction of a flood storage facility in the High Ridge Forest Preserve located between the Westmore Apartment complex and Willowbrook High School. Several possible configurations were considered for this area. These configurations ranged from small in-line facilities with little or no excavation up to a large off-line storage facility with extensive excavation. The Forest Preserve occupies about half of the vacant land between the apartment complex and the High School property. The larger options for Project 3 assumed that the remaining vacant land could be acquired. Several different options were evaluated in FEQ. The largest, which is illustrated in Figure 29, provides 70 ac-ft of offline storage. This option is defined as Project 3a. Flow would be diverted into the facility via a 100-foot weir and returned to Sugar Creek through a 30-inch outlet pipe. This maximum configuration reduces the maximum discharge entering the High School property by about 40 percent. While flooding of the high school is eliminated, this facility does not resolve all downstream damages on Sugar Creek.

![Figure 27: Project 3a - High Ridge Forest Preserve and Adjacent Property Maximum Storage Configuration](image-url)
Due to the cost and potential environmental disturbance that might be created by the larger storage options, several smaller configurations were developed; including a plan with no excavation, where water would just be retained using a berm built along the High School property line. However, the preferred configuration, shown in Figure 30 and called Project 3b, is an in-line facility that provides approximately 18 ac-feet of additional excavated storage.

Project 3 is proposed to address the problems identified in Middle Sugar Creek, including structural flooding, properties experiencing associated damages, and road overtopping at six locations. Table 5 shows the existing flood hazards as well as the expected benefits if Project 3 is implemented as described above. This project could also provide mitigation for projects 2, or 8, which would need additional mitigation if implemented.

**Table 5: Summary of Flood Hazards Addressed by Project 3**

<table>
<thead>
<tr>
<th>Existing Flood Hazards</th>
<th>Implementation Would</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 structures flooded</td>
<td>Mitigate flooding of 2 structures</td>
</tr>
<tr>
<td>11 structures experience associated damages</td>
<td>Mitigate associated damages at 3 structures</td>
</tr>
<tr>
<td>Overtopping of six pedestrian and road crossings</td>
<td>Overtopping depths reduced by 0.1 to 0.9 feet</td>
</tr>
</tbody>
</table>
**Costs**

The estimated cost to construct the 70 ac-ft flood control facility in the High Ridge Forest Preserve, known as Project 3a, is approximately $6,191,000. Most of this cost is for excavation and removal of soil to create a storage basin. The scaled back 18-ac-ft configuration, known as Project 3b, will cost approximately $1,903,000. Both of these cost values account for contingency, design engineering, permitting, and construction management.

**Operations and Maintenance Considerations**

Periodic maintenance of the detention ponds, particularly following storm events, would be necessary to ensure the improvements are operating at the design capacity. The proposed ponds would require minimal maintenance beyond mowing, litter removal, and regular field maintenance. By performing regular inspection activities, the County could proactively identify and address potential erosion issues, which would help extend the useful life of this project.
Project 4: Addison/Madison Storm Sewer to an Expanded Jackson Pond, Outlet to an Additional Storage Area

Project Description
This project involves the construction of 3,300 linear feet of 72-inch storm sewer to help drain a residential area located in the vicinity of Addison and Madison Streets within the Village of Villa Park. The stormsewer would outlet into the detention basin located at Jackson Middle School (Jackson Pond). Jackson Pond would be expanded and an additional storage basin would be excavated to accommodate the additional flows from the storm sewer. Three storage basin options were evaluated at different locations to mitigate the increased flows.

Project 4a
Jackson Pond would be expanded in size from 1.3 acres to 2.6 acres and would provide a total of 5.7 acre-feet of stormwater storage. A new 30-inch outlet pipe would be constructed at Jackson Pond to avoid the outfield portion of the baseball field located on Villa Park property. The new outlet pipe would discharge into a 1,000 foot long grass-lined channel constructed along the north side of High Ridge Road. The channel would convey flood water to a new storage basin situated on DuPage High School District 88 property just west of Ardmore Avenue and northeast of Willowbrook High School. The basin would provide 15 acre-feet of additional stormwater storage with a 30-inch outlet pipe. The outlet pipe would flow approximately 140 feet to the south discharging into the mainstem of Sugar Creek just west of Ardmore Ave. The location of these improvements is shown on Figure 31.

Figure 31: Project 4a Proposed Improvements
Project 4b

Similar to Project 4a, Jackson Pond would be expanded to provide 5.7 acre-feet of stormwater storage. The 30-inch outlet pipe and grass-lined channel would also be constructed along the north side of High Ridge Road. However, the grass-lined channel would drain to an excavated storage basin on the Willowbrook High School property. The basin would be located just east of the high school adjacent to the softball field. The basin would be an on-line system that is further detailed in the description for Project 6. The location of these improvements is shown on Figure 32.

Figure 32: Project 4b Proposed Improvements
Project 4c

This project would include the expansion of the storage basin at Jackson Middle School and the construction of an overflow swale leading to an additional storage area located on Villa Park property. The new basin would be located southeast of Jackson Pond adjacent to the Park District baseball field. The two basins would provide an additional 42 acre-feet of stormwater storage. The existing outlet structure from Jackson Pond would be increased in size to a 12.0-inch storm sewer leading to Lufkin Pond. This project would also include the construction of an outlet structure and conveyance system from the storage area on Village property that consists of an orifice, overflow weir and a drop inlet structure that will convey flows to Sugar Creek via a 30-inch storm sewer. The location of these improvements is shown on Figure 33.

Figure 33: Project 4c Proposed Improvements
Figure 34: Existing Jackson Pond

Figure 35: Location of Proposed Storm Outfall to Jackson Pond
Project 4 is proposed to address the problems identified on Addison and Wisconsin Streets north of Madison Street and would also alleviate problems along Tributary No. 1 and Lower Sugar Creek,
including structural flooding, properties with associated damages, and road overtopping at three locations. Table 6 shows the existing flood hazards as well as the expected benefits if Project 4 is implemented as described above.

**Table 6: Summary of Flood Hazards Addressed by Project 4**

<table>
<thead>
<tr>
<th>Existing Flood Hazards</th>
<th>Implementation Would</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 structures flooded</td>
<td>Mitigate flooding of 29 structures</td>
</tr>
<tr>
<td>30 properties experiencing associated damages</td>
<td>Mitigate associated damages at properties</td>
</tr>
<tr>
<td>18 structures buyout eligible in 60-year historical series</td>
<td>Remove 18 structures from buyout list</td>
</tr>
<tr>
<td>Overtopping of three road crossings</td>
<td>Overtopping eliminated at Addison Street, Madison Street and Ardmore Avenue</td>
</tr>
</tbody>
</table>

**Costs**

For planning purposes, the implementation cost of this project is estimated (accounting for contingency, design engineering, permitting, and construction management) as follows:

**Option 4a**

- Addison/Madison/Michigan/Jackson Storm Sewer $4,027,000
- Expansion of Jackson Pond $1,566,000
- Open Channel Connection $306,000
- **Excavation of Storage Basin NE of WBHS** $2,086,000

**Estimated Budgetary Cost** $7,985,000

**Option 4b**

- Addison/Madison/Michigan/Jackson Storm Sewer $4,027,000
- Expansion of Jackson Pond $1,400,000
- Open Channel Connection $306,000
- **Excavation of Storage Basin at WBHS** $3,000,000

**Estimated Budgetary Cost** $8,733,000

**Option 4c**

- Addison/Madison/Michigan/Jackson Storm Sewer $4,027,000
- Expansion of Jackson Pond $1,566,000
- **Excavation of Storage Basin on Village Property** $2,007,000

**Estimated Budgetary Cost** $7,600,000

These estimates do not include land acquisition costs.
Operations and Maintenance Considerations

Periodic maintenance of the new storm sewer pipe, grass lined channel and detention ponds, particularly following storm events, would be necessary to ensure the improvements are operating at the design capacity. The proposed grass-lined channel would require minimal maintenance beyond mowing, litter removal, and inspection of side slopes. The proposed ponds would require minimal maintenance beyond mowing, litter removal, and regular field maintenance. By performing regular inspection activities, the County can proactively identify and address potential issues, which would help extend the useful life of the project.
Project 5: Lufkin Pond Expansion with Van Buren Storm Sewer

Project Description

This project includes the expansion of Lufkin Pond located west of Ardmore Avenue near the intersection of Van Buren St. The Lufkin Pond expansion would double the storage capacity from the current capacity of approximately 10 ac-ft to 20 ac-ft of storage. Installation of 1,780 feet of 48-inch storm sewer along Van Buren Street/ Cornell Avenue/ Congress Street/ Summit Avenue would convey flow from the pond to Sugar Creek. This storm sewer would augment the 54-inch pond outlet sewer and pick-up runoff that currently ponds behind homes on Van Buren. These improvements are defined as Project 5a.

The location of these improvements is shown on Figure 38. The existing 48 and 54-inch pipe conveying flow from the pond to the creek is shown in yellow. A large portion of the existing pipe is located on private property which presents difficulty in following the existing path with a new pipe.

The proposed pipe route that avoids private property is shown in orange.

Project 5a is proposed to address the problems identified on Tributary No. 1, including structural flooding, properties experiencing associated damages, and road overtopping. Table 7 shows the existing flood hazards as well as the expected benefits if Project 5 is implemented as described above.
Table 7: Summary of Flood Hazards Addressed by Project 5a

<table>
<thead>
<tr>
<th>Existing Flood Hazards</th>
<th>Implementation Would</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 structures flooded</td>
<td>Mitigate flooding of 14 structures</td>
</tr>
<tr>
<td>3 properties experiencing associated damages</td>
<td>Mitigate associated damages at 1 property</td>
</tr>
<tr>
<td>11 structures buyout eligible in 60-year historical series</td>
<td>Remove 11 structures from buyout list</td>
</tr>
<tr>
<td>Ardmore Ave at Lufkin Pond flood depth: 0.5 ft</td>
<td>Eliminates flooding at Ardmore Ave at Lufkin Pond</td>
</tr>
</tbody>
</table>

**Costs**

The estimated construction cost (accounting for contingency, design engineering, permitting, and construction management) for this project includes the following:

- Expanding Lufkin Pond $944,000
- Construction of 48-inch Storm Sewer $1,312,000
- Estimated Cost for Budgetary Purpose $2,256,000

**Operations and Maintenance Considerations**

Periodic maintenance of the new storm sewer pipe, and detention ponds, particularly following storm events, would be necessary to ensure the improvements are operating at the design capacity. The proposed ponds would require minimal maintenance beyond mowing, litter removal, and regular field maintenance. By performing regular inspection activities, the County can proactively identify and address potential issues, which would help extend the useful life of this project.

**Modified Project (Project 5b)**

During the evaluation of alternatives described in the next section, it was determined that the structural flooding that is resolved by the proposed storm sewer is also resolved by Project 4. As a result, Project 5b was developed as a more cost-effective potential component of the watershed flood control plan. Project 5b includes the expansion of storage at Lufkin pond but eliminates the storm sewer portion of the project.
Project 6: Willowbrook High School Pond by Baseball Field

**Project Description**

This project involves the construction of the Willowbrook-Ardmore detention pond to store flood waters and reduce downstream flows during flood events. The pond would be located downstream of Willowbrook High School (WBHS) adjacent to the softball field. The proposed pond would cover about 12 acres, providing a storage capacity of 96 ac-ft. The proposed pond is an “in-line” pond meaning that Sugar Creek will flow through the pond at all times. This pond can be designed to have a permanent pool but the current design calls for low flows to be passed downstream through the existing channel and a 36-inch pipe. An overflow weir would cause flows to back-up onto the school property which would be excavated for storage. The location of these improvements is shown on Figure 39.

![Figure 39: Project 6 - Proposed 96 ac-ft Storage Facility](image)

Project 6 is proposed to address the problems in Middle Sugar Creek, including structural flooding, properties experiencing associated damages, and road overtopping at 6 locations. Table 8 shows the existing flood hazards as well as the expected benefits if Project 6 is implemented as described above.
The estimated cost to implement this project is approximately $3,647,000 (accounting for contingency, design engineering, permitting, and construction management). The majority of this cost is for excavation which could change as the layout and ultimate size of the project is determined. The cost includes re-development and improvement of the school’s softball and soccer fields.

### Operations and Maintenance Considerations
Periodic maintenance of the detention ponds, particularly following storm events, would be necessary to ensure the improvements are operating at the design capacity. The proposed ponds would require minimal maintenance beyond mowing, litter removal, and regular field maintenance. By performing regular inspection activities, the County could proactively identify and address potential erosion issues, which would help extend the useful life of this project.

### Table 8: Summary of Flood Hazards Addressed by Project 6

<table>
<thead>
<tr>
<th>Existing Flood Hazards</th>
<th>Implementation Would</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 structures flooded</td>
<td>Eliminate flooding at 6 structures</td>
</tr>
<tr>
<td>11 structures experience associated damages</td>
<td>Reduce Associated damages to 8 structures</td>
</tr>
</tbody>
</table>

**Costs**

The estimated cost to implement this project is approximately $3,647,000 (accounting for contingency, design engineering, permitting, and construction management). The majority of this cost is for excavation which could change as the layout and ultimate size of the project is determined. The cost includes re-development and improvement of the school’s softball and soccer fields.
Watershed Plan Alternatives

The individual flood mitigation projects were assembled into various combinations representing alternative watershed flood improvement plans. This activity focused on eliminating flood damages based on the historical series of storms.

None of the proposed projects, except buyouts and floodproofing, can solve all of the structural flood damage problems in the Sugar Creek watershed. Even with the buyout project, road and street flooding would continue to be a problem in the Sugar Creek watershed. Therefore, various combinations of projects have been evaluated to determine the most cost-effective approach for eliminating damages in the watershed. Alternatives and project combinations considered are presented in Table 9.

Table 9: Sugar Creek Alternatives Matrix

<table>
<thead>
<tr>
<th>Project</th>
<th>Alternative</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4*</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project 1. Buyouts and Floodproofing</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 2. Westmore Meyers Culvert with storage upstream and channel improvement downstream</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 3a. Storage in High Ridge Forest Preserve and adjacent property (70 ac-ft)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 3b. Storage in High Ridge Forest Preserve (18 ac-ft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 4a. Addison storm sewer to expanded Jackson Pond with new channel and storage basin NE of WBHS</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 4b. Addison storm sewer to expanded Jackson Pond with new channel discharging to WBHS Project 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 4c. Addison storm sewer to expanded Jackson Pond with overflow channel discharging to storage basin on Village property</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 5a. Lufkin Pond Expansion with Van Buren Storm Sewer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Project 5b. Lufkin Pond Expansion alone without Van Buren Storm Sewer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Project 6. Pond next to WBHS Softball Field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Alternative 4 removed from consideration.

Each alternative was evaluated using the FEQ hydraulic model to simulate the 60-year historical series of storms. The damage analysis was conducted in the same manner as was done for baseline conditions. As indicated in Table 9, all alternatives include some degree of buyouts and floodproofing. This is done to address any residual structural flood damage not resolved by the proposed flood control projects. This requirement also ensures that each alternative is nearly equivalent, although it is important to recognize that buyouts do not resolve road overtopping and floodproofing does not address “associated” damages.
Alternative Evaluation Results

Table 10 presents the analysis results for each alternative and compares the benefits provided by each alternative. Alternative 4 was removed from consideration when it was determined that Project 5 duplicates the benefits of Project 4. These alternatives were evaluated for their ability to eliminate flood damage and mitigate flow and stage increases. Estimated implementation costs versus benefits achieved were also compared. As indicated in Table 10, Alternatives 3, 5, 6, 7 or 8 eliminate all but one buyout and reduce damages at as many as 75 homes. However, as the watershed planning process progressed and feedback was received during various meetings with affected stakeholders, a couple of the potential projects were modified or eliminated from consideration. DuPage High School District 88 indicated that Project 6, which includes the excavation of a 96 acre-foot storage facility just east of Willowbrook High School, could not be accommodated within their long term plan for the school. Therefore, alternatives including Project 6 (Alts 6 & 7) would be difficult to implement.

Similarly, individual meetings with the Forest Preserve District of DuPage County led to modifications of Project No. 3. Project No. 3 includes the excavation of a large 70 acre-foot off-line storage facility within the High Ridge Forest Preserve. Flow would be diverted into the facility via a 100 foot long weir and returned to Sugar Creek through a 30-inch outlet pipe. The Forest Preserve District expressed concern about the potential environmental disturbance that would be created by the large storage basin and the higher cost for tree removal and excavation. The District was also concerned about the level of effort and costs associated with maintaining a large off-line facility at this site. Therefore, without the support of the District, Alternatives 2 – 6 would be difficult to implement. Other options at the High ridge Forest Preserve involved smaller basins with less environmental impacts. The District preferred an on-line facility providing approximately 18 acre-feet of additional excavated storage. This option is represented as Project 3a.

Alternatives which incorporate these original and modified projects have been included in the Alternatives Evaluation for the sake of comparison. Table 11 provides a comparison of the cost estimates for each alternative. The costs are broken down by Buyout Costs, Floodproofing Costs and Construction Costs for the structural improvements.
Table 10: Benefits and Residual Damages

<table>
<thead>
<tr>
<th>Item</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
<th>Alternative 5</th>
<th>Alternative 6</th>
<th>Alternative 7</th>
<th>Alternative 8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefits of Structural Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residences with Reduced Damages</td>
<td>0</td>
<td>44</td>
<td>63</td>
<td>64</td>
<td>75</td>
<td>75</td>
<td>73</td>
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<tr>
<td>Benefit</td>
<td>$0</td>
<td>$568,000</td>
<td>$2,519,000</td>
<td>$2,571,000</td>
<td>$2,921,000</td>
<td>$2,920,000</td>
<td>$2,626,000</td>
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<tr>
<td>Businesses with Reduced Damages</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Benefit</td>
<td>$0</td>
<td>$1,192,000</td>
<td>$1,191,000</td>
<td>$1,191,000</td>
<td>$1,193,000</td>
<td>$1,148,000</td>
<td>$1,110,000</td>
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<tr>
<td>Structures removed from Buyout List</td>
<td>-</td>
<td>-</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Damages Mitigated by Structural Measures</td>
<td>$0</td>
<td>$1,760,000</td>
<td>$3,710,000</td>
<td>$3,762,000</td>
<td>$4,114,000</td>
<td>$4,068,000</td>
<td>$3,736,000</td>
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<tr>
<td><strong>Benefits of Buyouts and Floodproofing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Buyouts Required</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Residential Floodproofing</td>
<td>29</td>
<td>24</td>
<td>13</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>10</td>
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<tr>
<td>Business Floodproofing</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Damages Mitigated by Buyouts and Floodproofing</td>
<td>$3,681,000</td>
<td>$2,089,000</td>
<td>$505,000</td>
<td>$417,000</td>
<td>$69,000</td>
<td>$70,000</td>
<td>$350,000</td>
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<tr>
<td><strong>Total Benefits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total Damages Mitigated</td>
<td>$3,681,000</td>
<td>$3,849,000</td>
<td>$4,215,000</td>
<td>$4,179,000</td>
<td>$4,183,000</td>
<td>$4,138,000</td>
<td>$4,086,000</td>
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<tr>
<td>Residual Damages</td>
<td>$689,000</td>
<td>$522,000</td>
<td>$212,000</td>
<td>$208,000</td>
<td>$187,000</td>
<td>$232,000</td>
<td>$302,000</td>
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</table>
Table 11: Alternatives Cost Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
<th>Alternative 5</th>
<th>Alternative 6</th>
<th>Alternative 7</th>
<th>Alternative 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buyout Costs</td>
<td>$2,836,000</td>
<td>$2,836,000</td>
<td>$308,000</td>
<td>$308,000</td>
<td>$308,000</td>
<td>$308,000</td>
<td>$308,000</td>
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<tr>
<td>Floodproofing Costs</td>
<td>$360,000</td>
<td>$260,000</td>
<td>$150,000</td>
<td>$140,000</td>
<td>$30,000</td>
<td>$50,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>Land Acquisition</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Land Acquisition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Costs</td>
<td>$0</td>
<td>$7,794,000</td>
<td>$15,779,000</td>
<td>$16,723,000</td>
<td>$20,370,000</td>
<td>$16,830,000</td>
<td>$12,050,000</td>
</tr>
<tr>
<td>Total Capital Costs</td>
<td>$3,196,000</td>
<td>$10,890,000</td>
<td>$16,237,000</td>
<td>$17,171,000</td>
<td>$20,708,000</td>
<td>$17,188,000</td>
<td>$12,478,000</td>
</tr>
</tbody>
</table>

As displayed in Tables 10 and 11, Alternative 8 reduces damages at 73 residential structures providing approximately $2.6 million in benefits. It reduces damages at 3 business structures providing approximately $1.1 million in benefits. The total benefits provided by structural measures are approximately $3.7 million. The structural improvements associated with Alternative 8 lower flood elevations such that 18 residential structures no longer meet the voluntary buyout criteria.

Alternative 8 will require 1 buyout of a residential structure and the floodproofing of 10 residential structures and 1 business structure. Once these buyout and floodproofing projects are completed, there will be an additional $350,000 in benefits provided over the historical series of rainfall events. Total benefits provided by Alternative 8 including the reduced damages from structural measures and buyouts and floodproofing is approximately $4.1 million. This total is similar to the other alternatives listed in Table 10.

The total cost of Alternative 8 is approximately $12.5 million. As shown in Table 11, Alternative 8 is one of the lowest cost alternatives when compared to other alternatives involving structural improvements (Alternatives 2-8). The total cost of Alternative 2 is approximately $1.6 million less than Alternative 8. However, Alternative 2 does not address the significant flooding along Tributary No. 1 with structural improvements. Alternative 1 is the lowest cost alternative at approximately $3.2 million and involves buyouts and floodproofing projects only. Buyout and floodproofing alternatives are typically very difficult to implement because they are voluntary programs. If a property owner does not want to participate, the County will not force them. In addition, floodproofing costs are the responsibility of the individual property owners. The County cannot spend public monies to improve private property. Finally, without structural improvements, there will be no reduction in flood elevations. Therefore, streets and yards will continue to flood and emergency services will still be impacted.
Recommended Plan

The recommended plan for flood control and watershed environmental management in the Sugar Creek watershed is Alternative 8. The recommended plan includes the following projects:

- Culvert improvement at Westmore Road with approximately 4 ac-ft of compensatory storage just upstream of the culvert.
- Channel improvement between Westmore Road and the High Ridge Forest Preserve.
- Development of 18 ac-ft of excavated storage in the High Ridge Forest Preserve.
- Construction of 3,300 feet of 72-inch storm sewer to drain the Addison-Madison area to Jackson Pond.
- Expansion of Jackson Pond and the excavation of a new storage basin on Village owned property which will provide 42 acre-feet of additional storage.
- Construction of a new 12-inch outlet storm sewer leading from Jackson Pond to Lufkin Pond.
- Expansion of Lufkin Pond by 10 acre-feet.
- Construction of an outlet structure for the Village basin consisting of a restrictor, overflow weir and 30-inch outlet pipe leading to Sugar Creek.
- Buyout of 1 residential structure, and the floodproofing of 1 business and 3 residential structures.
- Additional projects are recommended to improve water quality and stream health in the watershed.

The buyout and floodproofing elements of the plan are completely voluntary. The main components of the plan are shown in Figure 40. The proposed plan resolves flooding at 45 of the 50 structures projected to experience flood damages. The plan also would remove 18 of the 19 eligible structures from the buyout list.
York Township recently approached DuPage County staff to incorporate a relief sewer project into the Sugar Creek Watershed Plan. There is a low-lying area on Luther Avenue south of Roosevelt Road in unincorporated York Township. The low area is classified as a wetland and is bounded roughly by Roosevelt Road to the north, Addison Avenue to the east, 13th Street to the south and Church Street to the west. The low-lying area is drained by a 12-inch storm sewer that eventually increases in size to a 15-inch storm sewer that outlets into the mainstem of Sugar Creek at the downstream side of Meyers Road.

During large and intense rainfall events, the Luther Avenue depressional area is subject to significant flooding as experienced in April of 2013. The low-lying area has a drainage area of over 70 acres. The 12-inch storm sewer is significantly undersized and results in large backups and ponding areas along Luther Avenue. The relief sewer would be designed to minimize impacts to the existing wetland system at Luther Avenue. The elevation of the inlet would be set to prevent storm water from flooding the streets and surrounding structures. Stormwater would continue to be stored within the existing wetland which provides water quality benefits for the watershed.

The project would include the construction of a 27-inch relief sewer running north along Luther Avenue. The sewer would turn east at Edwards Street and then back to the north in the vicinity of Addison Avenue. The relief sewer would outlet into the High Ridge Forest Preserve which is owned by
the Forest Preserve District of DuPage County. Staff envisions that the relief sewer would drain into an off-line storage basin created on District property and then would flow through a restrictor into the mainstem of Sugar Creek. These improvements are shown in Figure 41.

DuPage County staff has not explicitly evaluated the Luther Avenue Relief Sewer Project with the FEQ hydraulic model. The Luther Avenue depressional area is not adjacent to the mainstem of Sugar Creek or any of its four tributaries. The area is included as drainage area to the mainstem of Sugar Creek but it has not been modeled in detail with cross-sections, hydraulic structures and storm sewers.

Staff has decided to include the Luther Avenue Relief Sewer Project in the Sugar Creek Watershed Plan. Any storage displaced in the vicinity of Luther Avenue could be provided in an on-line or off-line storage basin within the High Ridge Forest Preserve. Once the specific location of the additional storage is determined, hydraulic modeling would be provided during the design/permitting process. These modeling results would need to ensure that there would be no adverse impacts caused by the project. Since the Luther Avenue Relief Sewer Project is identified and recommended within the watershed plan, the project would be eligible for various state and federal grants as well as other outside funding sources.

Figure 41: Luther Avenue Relief Sewer Project
Conformance to the DuPage County Stormwater and Floodplain Ordinance

All projects constructed in DuPage County must meet the provisions of the DuPage County Stormwater and Floodplain Ordinance (DPCSFO). Key provisions affecting this watershed plan include the following:

- **Stormwater Management** – The structural improvements may not increase flows or stages outside the project limits without the acquisition of appropriate easements.
- **Floodways** – Floodway construction activities must be an appropriate use and meet Federal, State and DPCSFO requirements.
- **Wetlands** – Wetland areas must be identified and delineated. Wetland impacts must be quantified and mitigated. Impacts to critical wetlands must be avoided.
- **Riparian Areas** – In general, contiguous natural areas within 50 feet of a stream channel must be preserved or impacts must be mitigated.

Watershed Plan Implementation

Implementation of the Sugar Creek Watershed Plan will include the following steps:

1. The SMC decides on the recommended alternative and opens the public comment period for the Plan. The recommended comment period is 30 days.
2. Comments will be solicited from the impacted municipalities, interested organizations and agencies, property owners, and the public. A public meeting will also be held.
3. Responses to comments received during the public review period will be prepared in a Comment Response Document, and the Plan will be revised as necessary.
4. The Comment Response Document and the revised Plan will go to the SMC for approval.
5. The Comment Response Document and the revised Plan will go to the County Board for approval and adoption, respectively.
6. Implementation of the approved alternative will begin pending dedication of funding.

Funding

The recommended alternative from the Sugar Creek Watershed Plan consists of structural improvements, voluntary buyout of a residential structure and voluntary floodproofing projects. DuPage County has allocated $550,000 for the design and construction of structural solutions in the Sugar Creek watershed. Therefore, current funding is not sufficient to cover the estimated cost of the structural improvements of approximately $12,050,000. In addition, the SMC has not allocated any funds for the voluntary buyout program or the floodproofing assistance program. If the DuPage County Board makes funding available for voluntary buyouts, the funds are used according to a prioritized list of eligible properties throughout the County. The prioritized list is based on actual flood damages that have occurred to the property, the potential for future flood damages based on the
current watershed planning model, and the date of the property owner's request to be purchased through the program.

Once the Sugar Creek Watershed Plan has been approved by the SMC and the DuPage County Board, the projects that make up the recommended alternative will be available for funding from various Federal and State agencies.