Glenview, Illinois
Section 205
Flood Risk Management

Detailed Project Report and Integrated Environmental Assessment

DRAFT
JANUARY 2020

US Army Corps
of Engineers
Chicago District

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EXECUTIVE SUMMARY

The Village of Glenview Flood Risk Management Feasibility Study was conducted to investigate measures to address flood risks associated with overbanking of the West Fork of the North Branch of the Chicago River (WFNBCR) in the Village of Glenview, Illinois. The identified flood prone areas include the Tall Trees neighborhood, which is located on the west bank of the WFNBCR. The neighborhood has historic flooding problems due to the WFNBCR overtopping its banks as well as back flowing into low-lying areas via the South Navy Ditch or an existing storm sewer system. Several structures located along the east bank of the WFNBCR, outside of the Tall Trees neighborhood, are also included in the study. Recent flooding includes six measurable events since 2007, including three 4% annual chance of exceedance (ACE) storms, two 2% ACE storms, and one 1% ACE storm in September 2008.

The study was conducted under the Continuing Authorities Program (CAP) 205 Authority with the Village of Glenview as the non-federal sponsor.

An economic analysis was conducted to estimate the without project condition damages expected over the 50-year period analysis of the study. Flood damages and costs considered in the economic analysis included flood damages to residential and non-residential structures and contents, damages to vehicles, and public damages (infrastructure and emergency response expenditures).

The Without Project Conditions (WOPC) was estimated to have Expected Annual Damages (EAD) of $406,000 based on current year hydraulics and $678,000 based on forecasted changes in hydraulic conditions due to climate change in 50 years. Given that the period of analysis is 50 years, the two levels of EAD were averaged together to derive an EAD for the period of analysis of $541,603.

Four alternative plans, including the 'no action' plan, were considered on a conceptual level:

Plan 1 - No action: Implement no project.

Plan 2 - Floodwall along WFNBCR: Construct a floodwall adjacent to the WFNBCR.

Plan 3 - Floodwall along Sequoia: Construct a floodwall along Sequoia Trail.

Plan 4 - Floodproof impacted homes: Provide dry-floodproofing for the most vulnerable homes.

In the evaluation of flood risk management projects, a benefit-cost analysis is intended to provide a measure of net National Economic Development (NED) benefits, which are defined as "increases in the economic value of the goods and services that result directly from a project." Project benefits are compared to costs. If the benefits of implementing a project are greater than costs, a project has a benefit to cost ratio (benefits divided by costs) greater than one and positive net benefits (benefits minus cost). **Table ES-1** provides a summary of the benefit-cost analysis for each of the alternative plans.

Table ES -1. Benefit Cost Analysis Summary

	Estimated Value ($1,000)			
	Plan 1	**Plan 2**	**Plan 3**	**Plan 4**
	No Action	Floodwall (WFNBCR)	Floodwall (Sequoia)	Floodproof
Average Annual Benefits	$0	$180	$24	$43
Average Annual Costs	$0	$418	$375	$62
Average Annual Net Benefits	$0	-$238	-$350	$19
Benefit to Cost Ratio (Average)	N/A	0.43	0.07	0.7
	Base Year: 2017 *Federal Discount Rate: 2.875% (FY2019)* *Price Level: October 2016 (FY2017)* *Period of Analysis: 50 years*			

Based on the summary of the benefit cost analysis, none of the alternatives evaluated were deemed to be federally justified based on economic justification. This was due to a combination of facts:

- Structural damage was estimated not to occur until between the 4% and 2% annual chance events for present day conditions (25-year and 50-year storm). This fairly low frequency of flooding causing structural damage makes project justification difficult from an economic evaluation standpoint.
- The structural (floodwall) alternatives were only able to provide risk reduction up until the 1.59% ACE event due to limitations in the topography. There is no flood damage reduction for events greater than the 1.59% ACE event, which limits the economic benefits of the proposed projects.
- There were limited possible structural protection options given the geography and development of the area.
- There was a high cost to install a pump station to manage the South Navy Ditch for each of the structural alternatives.
- For the floodproofing options considered, the cost was high due to components which would be required to ensure structural stability against hydrostatic pressure and uplift in the event of a flood. The cost of floodproofing was estimated to be too high compared to the potential economic benefits.

As a result of these issues, the recommended plan is Alternative Plan 1 – the no action plan.

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1 INTRODUCTION

1.1 STUDY PURPOSE AND SCOPE

This study has been initiated to investigate measures to address flood risks associated with overbanking of the West Fork of the North Branch of the Chicago River (WFNBCR) in the Village of Glenview, Illinois. The identified flood prone areas include the Tall Trees neighborhood, which is located on the west bank of the WFNBCR, and includes 175 single-family homes that were constructed in the early 1960's. The neighborhood has historic flooding problems due to the WFNBCR overtopping its banks as well as back flowing into low-lying areas via the South Navy Ditch or an existing storm sewer system. Residential roadways in the subdivision frequently flood restricting ingress and egress, which poses a life-safety risk for residents. Several structures located along the east bank of the WFNBCR, outside of the Tall Trees neighborhood, are also included in the study. Recent flooding includes six measurable events since 2007, including three 4% annual chance of exceedance (ACE) storms, two 2% ACE storms, and one 1% ACE storm in September 2008.

The study was conducted under USACE's Authorities Program (CAP) 205 Authority with the non-federal sponsor, the Village of Glenview.

Figure 1. Flooding in Tall Trees Neighborhood – September 2008

1.2.1 Study Area

The study area is within the *West Fork North Branch Chicago River Watershed*, defined as Hydrologic Unit Code (HUC) 071200030103 by the United States Geological Survey (USGS), as shown in Figure 2.

The study area includes the Tall Trees neighborhood located along the west bank of the WFNBCR at the confluence of the South Navy Ditch in the Village of Glenview, approximately 4.5 miles north of the Chicago City limits in Cook County, Illinois. Structures at risk of flooding across the river from the Tall Trees neighborhood, along the east bank, are also included in the study. The WFNBCR watershed upstream of the Tall Trees neighborhood is approximately 23.5 square miles with the headwaters located in Lake County, Illinois. The watershed consists mostly of developed suburban residential and

commercial neighborhoods as well as a large portion of forest preserve areas in the northern part of the watershed. The watershed is served by 3 reservoirs, collectively called the Techny Reservoirs (32A, 32B, and 32C), which provide a total of 1,620 acre-feet (528 million gallons) of stormwater storage upstream of the study area.

The South Navy Ditch is approximately 0.5 miles of open channel stream. The drainage area for the ditch is approximately 0.15 square miles (94 acres) entirely located within the Village of Glenview and consists almost entirely of single and multi-family residential areas. The South Navy Ditch flows through the Tall Trees neighborhood where is reaches its confluence with the WFNBCR just south (downstream) of the Chestnut Avenue bridge. The location of the ditch is included in Figure 3.

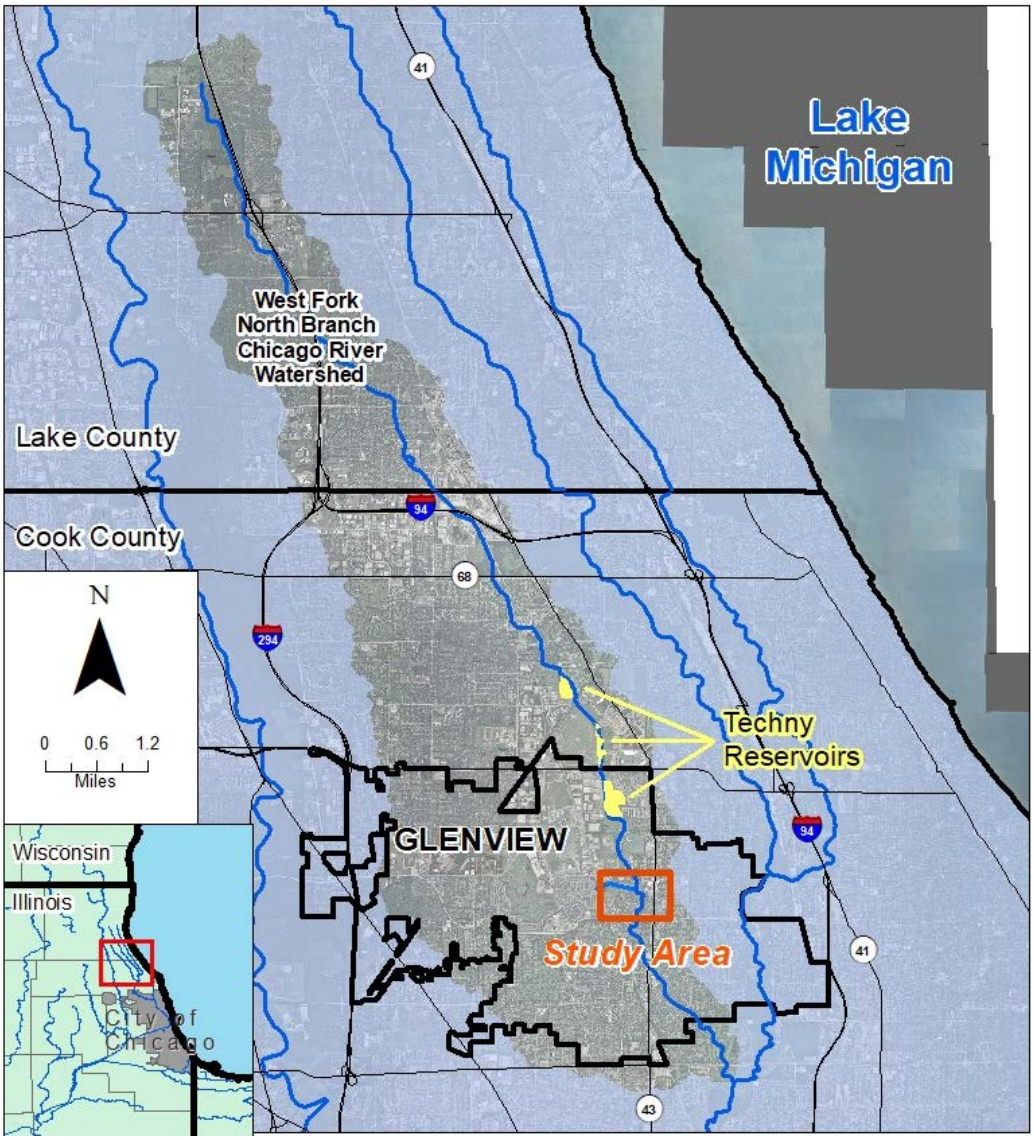


Figure 2. Study Area

1.2.2 Project Area

The project area includes the residential neighborhoods on the east and west banks of the NFWBCR in the vicinity of the South Navy Ditch. The Tall Trees Neighborhood, located on the west bank, was constructed in the early 1960s and consists of 175 homes. The residential area on the east bank includes 19 structures along Riverside Court which were constructed in the early 1970s. Much of the area was later designated by the Federal Emergency Management Agency (FEMA) as a special flood hazard area (SFHA) in the original 1979 flood insurance rate maps (FIRMs).

The WFNBCR has a narrow cross-section in the vicinity of the neighborhood, making flow depths extremely sensitive to small amounts of rainfall. Several structures in the neighborhood are subject to direct damage from a 1% annual chance flood. However, during extreme flood events residents of all of the 175 homes in the area are impacted as local streets are inundated when the river rises, limiting access into and out of the Tall Trees Neighborhood. Surface flooding can also contribute to increased infiltration into local sanitary sewers, exacerbating problems with sanitary sewer backup into homes. Figure 3 highlights the hydraulic features of the project area.

The project area is located within the Illinois 9th Congressional District, represented by Janice "Jan" Schakowsky.

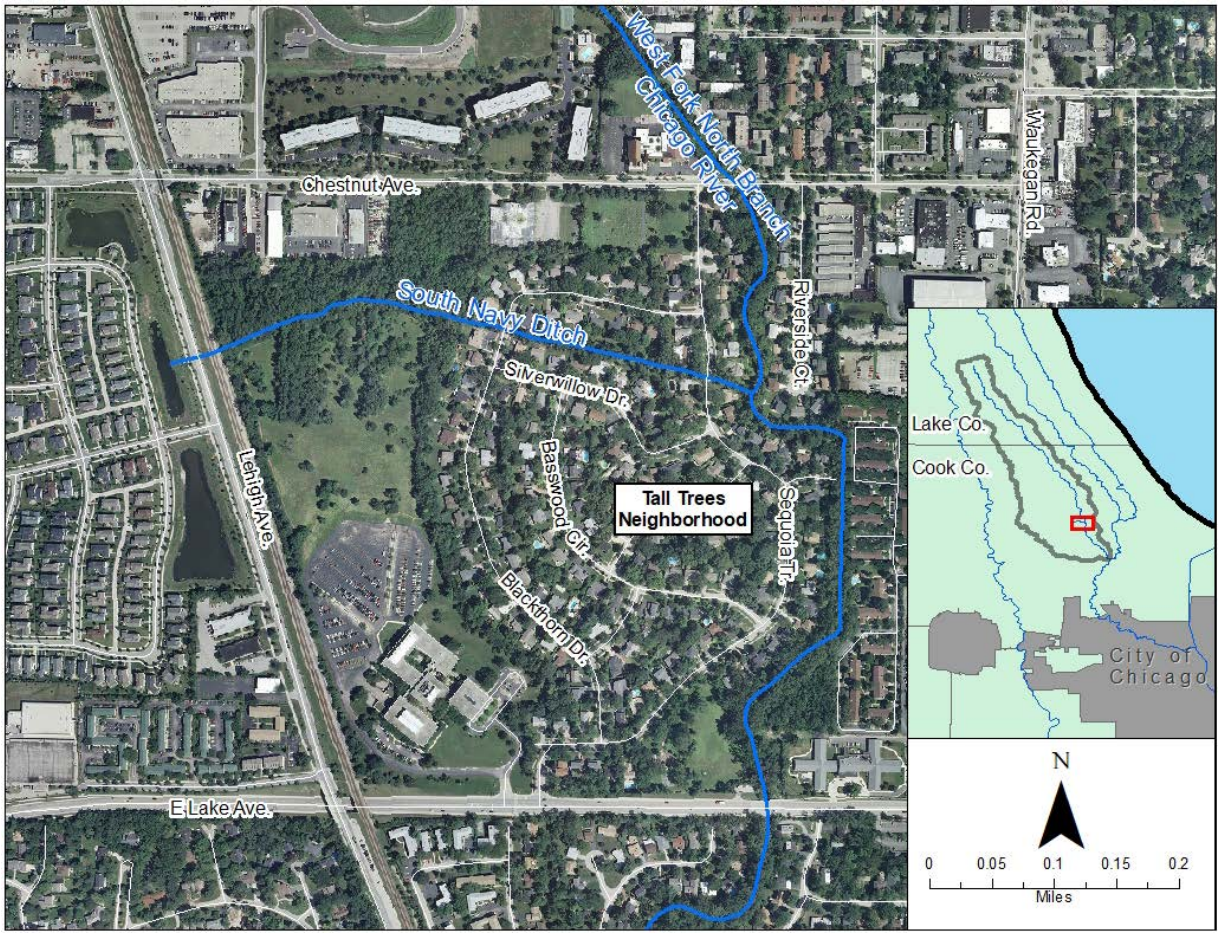


Figure 3. Project Area

1.3 STUDY AUTHORITY

Section 205, Flood Control Act of 1948 (P.L. 80-858), as amended. Section 205 authorizes the Secretary of the Army, in cooperation with non-Federal interests, to plan, design and construct small flood risk management (FRM) projects. Section 205 projects are part of the U.S. Army Corps of Engineers (USACE) Continuing Authorities Program (CAP). Individual projects are limited to $10,000,000 in total Federal expenditures, including all planning, design, and implementation costs.

A non-Federal sponsor must support all phases of the project. While the first $100,000 of feasibility study costs are at 100% Federal expense, the remaining study costs are shared 50% Federal and 50% non-Federal. Design and implementation costs are shared 65% Federal and 35% non-Federal. The non-Federal sponsor must provide all lands, easements, rights-of-way, relocation, and disposal areas (LERRDs). While the sponsor may receive credit toward this cost-share for work-in-kind and LERRDs, a minimum cash contribution of 5% is required. Once a project has been implemented, operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project is a 100% non-Federal responsibility.

FRM projects being considered for further investigation must also meet economic criteria with respect to the benefits and costs associated with the implementation of a project. A Federal interest is determined by having demonstrated National Economic Development (NED) benefits that outweigh costs; i.e. positive net benefits.

1.4 RELEVANT PRIOR STUDIES AND REPORTS

The following studies and reports were utilized in determining federal interest in proceeding with a cost-shared feasibility study.

Detailed Watershed Plan for the North Branch of the Chicago River and Lake Michigan Watershed, January 2011 (MWRDGC, by HDR, Inc.): The Detailed Watershed Plan (DWP) for the North Branch of the Chicago River and Lake Michigan Watershed was developed to meet the goals of the Cook County Stormwater Management Plan, published by Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) in February 2007. The plan:

- Documents stormwater problem areas
- Evaluates existing conditions
- Provides flow, stage, frequency, and duration information for flood events along the waterway
- Estimates damages associated with stormwater management problems
- Evaluates potential solutions to regional stormwater management problems

The Glenview Tall Trees neighborhood study area was one of the overbank flooding problem areas identified in the DWP (NB-NVDS-GV-FR-06 and NB-WFNB-GV-FL-24). The solution evaluated in the plan (identified as WF-06), which was recommended to reduce flood risk for this area as well as several other identified flood problem areas upstream in Northbrook, Illinois and unincorporated Cook County, Illinois. The proposed project included a modification and expansion of Techny Reservoir 32A as well as

a modification to the reservoir's inlet weir and restrictor barrels to fully utilize the additional storage. Total project costs were estimated at $116.1 Million.

Project Definition Report for a Flood Control Project for the West Fork of the North Branch of the Chicago River, June 2015 (MWRDGC, by MWH Global): The goal of this project and report was to build upon the results of the DWP, described above, and to identify and advance cost effective projects for reducing flood damages to properties along the WFNBCR. As part of this effort, the proposed project in the DWP (WF-06) faced significant resistance from the Village of Northbrook due to the impacts that it would have on recreation within the community. Additionally, further analysis indicated that the benefits anticipated for this recommended project were significantly lower than initially estimated, and therefore the project did not proceed towards implementation. As a result, several additional flood risk reduction project concepts were developed and analyzed for the WFNBCR. The concepts developed included floodwall and buyout options, as well as combination options that included compensatory floodplain storage where appropriate. Changes to the Techny Reservoirs 32A and 32C intake structure designs were also reviewed and no changes to the structures were recommended.

The study recommended construction of an approximately 950 foot long floodwall on the west bank of the WFNBCR extending from Chestnut Avenue south through private back yards of affected homes within the Tall Trees neighborhood. The recommended floodwall would provide physical protection up to the 1% annual chance flood level, but would provide no freeboard. Dry floodproofing or site grading measures were proposed for an additional 10 structures which would not be protected by the floodwall structure. Additional elements proposed to provide a comprehensive flood protection system for the Tall Trees neighborhood included a gate structure at the floodwall crossing of South Navy Ditch, a stormwater pump station to provide a reliable outlet for the South Navy Ditch, storm sewer modifications within the Tall Trees neighborhood, and compensatory storage at the Techny Reservoir 32C to mitigate any potential impacts to downstream flood levels. Total project costs were estimated at $13.5M - $20M. Although this particular project was recommended, since the costs significantly exceeded estimated benefits, MWRDGC has indicated that they are unlikely to proceed with this project in the near-term future.

2 AFFECTED ENVIRONMENT - EXISTING CONDITIONS

An inventory of the study area is an essential step in defining the scope of the issues to be addressed. The inventory is also used to identify and evaluate appropriate measures to address the identified problems and opportunities. The following inventory of physical, ecological, cultural, and environmental resources are provided to guide the study process.

Elevations used in this study are in the North American Vertical Datum (NAVD) 1988. Elevations cited in this report are referenced to this datum, unless otherwise noted.

2.1 CLIMATE

Climate in northeastern Illinois is classified as humid continental, characterized by warm summers, cold winters, and daily, monthly, and yearly fluctuations in temperature and precipitation. Average annual

rainfall is usually between 30 to 40 inches per year, with greater proportions falling between April and August. Seasonal snowfall averages about 28 inches annually. Early spring floods occur when snow accumulations extend into a period of increasing temperatures that result in melting. If this occurs when soils are already saturated, runoff increases dramatically due to the large area of impervious surfaces within the basin caused by urban development.

To establish existing conditions, hydrologic and hydraulic (H&H) modeling was completed using the precipitation depths for the various storm frequencies defined in *"Frequency Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois"*, also known as "Bulletin 70" and National Oceanic and Atmospheric Administration's (NOAA) *"Precipitation-Frequency Atlas of the United States, Atlas 14 Volume 2 Version 3.0"*. Precipitation data from Bulletin 70 was originally published in 1988 and was revised in 1989. The data represents an 83-year period of record from 1901-1983 in which 61 precipitation stations in Illinois were sampled. Additional information about existing conditions H&H modeling is included in Appendix D (Hydrology and Hydraulics).

Increased precipitation volumes and intensity in Northeastern Illinois have been documented and attributed to climate change. Additional information regarding climate change is include in Section 3.3.2 as part of the discussion on most probable future conditions forecasting and in in Appendix D (Hydrology and Hydraulics).

2.2 SOILS AND GEOLOGY

2.2.1 Geology and Physiography

The geology of the Chicago area is largely a consequence of a series of continental glacial advances and retreats. During the most recent glaciations, the Wisconsinan, the area was covered by several thousand feet of ice of the Lake Michigan lobe. The area had been covered with surficial deposits which vary from very thin and up to 300 feet thick (IDNR drift thickness map) that were deposited by glaciers and higher level stages of Lake Michigan. Bedrock typically consists of sedimentary dolomitic limestone, dolomite shale, and sandstone.

Based on the Illinois State Geological Survey (ISGS), Surficial Geology of the Chicago Region Map (1970), the majority of the project is within the Glacial Sluiceway (sl) and Lake Plain (lp), with the Cahokia Alluvium (c) and exposed bedrock (S) regions nearby. Descriptions of each of these regions are included in the Geotechnical Appendix.

The Natural Resources Conservation Service website was used to develop a soil survey map below. This source provides general data of the predominant soil classification in an area. The majority of the project area of the Tall Trees development is considered Alfic Udarents, which is described as urban land partially covered with pavement, buildings, and other impervious features. The parent materials are from the Elliott complex which consists of a thin mantle of loess or other silty material underlain with clayey till. Two areas to the south in the existing park consist of Beecher silt loam and Varna silt loam, which are also described as having a thin mantle of loess underlain by till.

The NRCS map was also checked to determine the extent of hydric soils onsite. Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Of the soil types identified, all but the Urban Land soil-type was identified as having at least some indicators that the soils could be hydric.

The main takeaways from the geology maps presented above indicate the subsurface is fairly uniform, likely consisting of clayey till overlain by a varying amount of fill and/or loess.

Bedrock is approximately 100-200 feet below grade in the project area, per the IDNR drift thickness map. Soil borings are available from the bridge work at Chestnut Ave from 2014, as well as, new borings completed for this project in 2017. The results are discussed in the Geotechnical Appendix.

2.3 SURFACE WATER AND OTHER AQUATIC RESOURCES

2.3.1 Surface Water

As discussed in Section 1.2, the surface water in the study area includes the WFNBCR and the South Navy Ditch. The WFNBCR originates in Lake County, Illinois and flows south to Cook County where it passes through the study before it combines with the North Branch of the Chicago River in Morton Grove, Illinois. The South Navy ditch originates in Glenview, Illinois just west of Lehigh Road, approximately 0.2 miles west of the Tall Trees neighborhood and terminates at its confluence with the WFNBCR.

Section 303(d) of the Clean Water Act requires that all states maintain and publish lists of impaired waterways—water that does not meet water quality standards set by those states. In its 2018 303(d) list, the State of Illinois identified impairments in the WFNBCR, summarized in Table 1 below. South Navy Ditch is not mapped as part of this list.

Table 1: Surface Water Impairments

Waterway	Designated Uses[1]	Causes	Sources
West Fork North Branch Chicago River (IL_HCCBG-39)	Aquatic Life (N) Fish Consumption (X) Primary Contact Recreation (N) Aesthetic Quality (F)	Aldrin, alteration in stream-side or littoral vegetative covers, chloride, DDT, endrin, hexachlorobenzene, dissolved oxygen, total phosphorus, total suspended solids, fecal coliform, changes in stream depth and velocity patterns	Channelization, contaminated sediments, highway/road/bridge runoff (non-construction related), loss of riparian habitat, municipal point source discharges, site clearance (land development or redevelopment), urban runoff/storm sewers, unknown sources

[1] N = Waterway does not support designated use; F = waterway fully supports designated use; X = not assessed
Source: *Illinois Integrated Water Quality Report and Section 303(d) List, Appendix B-2.* Illinois Environmental Protection Agency – Bureau of Water. 2016.

2.3.2 Groundwater

Of the borings completed for the Chestnut Ave Bridge, only one (B-01A) encountered water during and after drilling at 68 feet below grade and 8 feet, respectively. Of the boreholes collected as part of this feasibility study, only 2 (GV-17-02 and GV-17-04) encountered water during drilling, at 4 and 6-½ feet below grade, respectively. Since the subsurface is predominantly clays, these readings are likely unreliable due to the slope rate of seepage. Wells would have to be open for a substantial amount of time to record accurate water levels. Also, water encountered during and right after drilling may be a result of water perched on less permeable materials. Groundwater quality in the area of the project is unknown.

2.3.3 Floodplains

A significant amount of the northern portion of the Tall Trees neighborhood has been designated as SFHA Zone AE by FEMA, indicating that it is anticipated to be inundated by the 1% annual chance flood. Additionally, the area immediately adjacent to both the WFNBCR and the South Navy Ditch has been designated as 'Regulatory Floodway' by FEMA, stipulating that this area must be kept free of encroachments so that the 1% annual chance flood can be conveyed without increasing the base flood elevation. A signification amount of the southern part of the Tall Trees neighborhood is defined as Zone X (areas of 0.2% annual chance flood). MWRDGC has conducted an additional, more detailed, floodplain analysis and has designated a 1% annual chance flood inundation areas, which are slightly different than FEMA's SFHA near the South Navy Ditch and include significantly more area at risk of flooding during the 1% annual chance storm in the southern portion of the neighborhood. FEMA's floodplain and MWRDGC's inundation area are both depicted in Figure 4.

Note that several stakeholders and the public frequently uses the terminology "[x]-year flood" in place of or in addition to the "percent chance exceedance" terminology that USACE guidance specifies should be used. For readability, theses terminologies are both used in this report. The following correlations are made.

- 1-year → 99% annual chance exceedance (ACE)
- 2-year → 50% annual chance exceedance (ACE)
- 5-year → 20% annual chance exceedance (ACE)
- 10-year → 10% annual chance exceedance (ACE)
- 25-year → 4% annual chance exceedance (ACE)
- 50-year → 2% annual chance exceedance (ACE)
- 100-year → 1% annual chance exceedance (ACE)
- 200-year → 0.5% annual chance exceedance (ACE)
- 500-year → 0.2% annual chance exceedance (ACE)

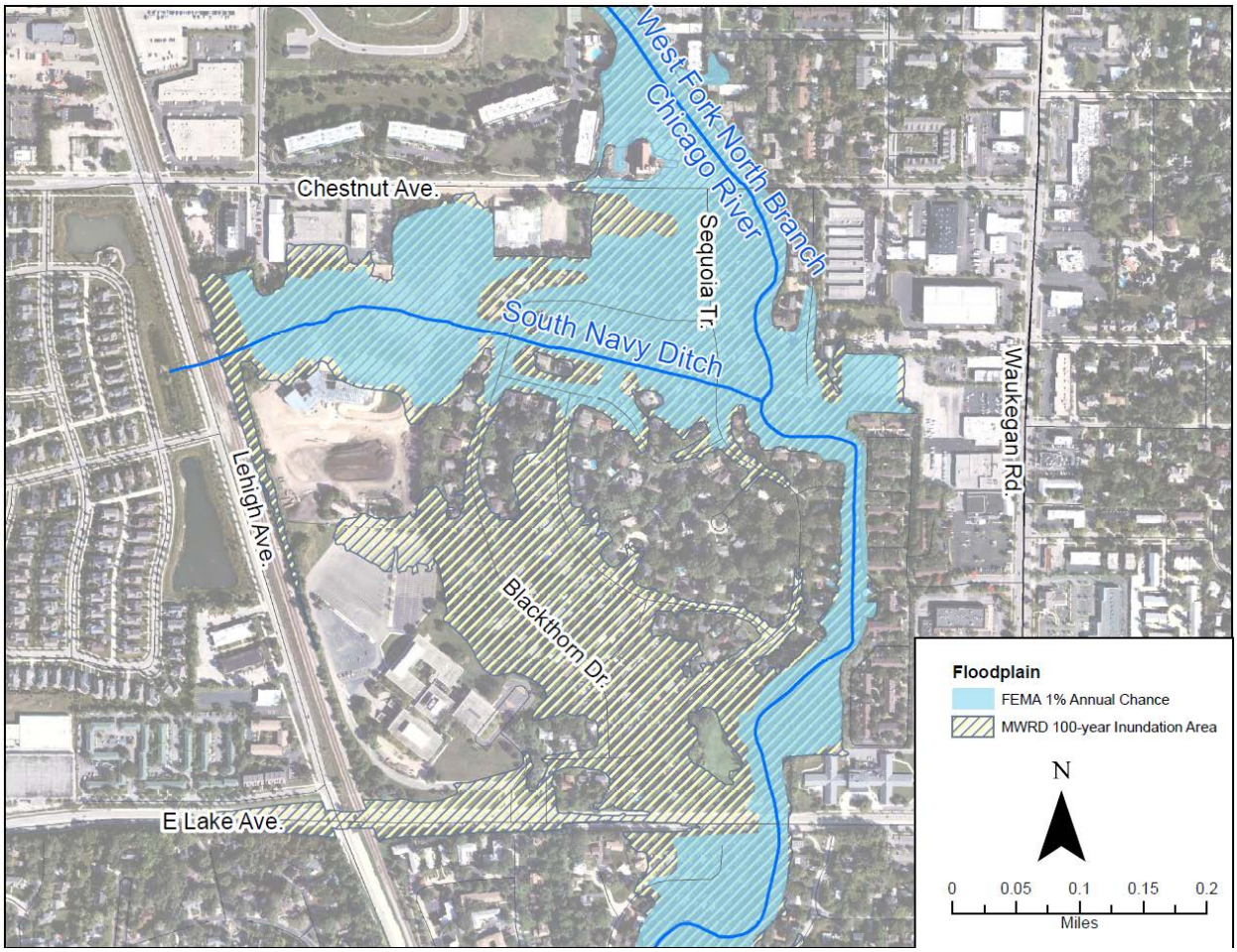


Figure 4. Floodplain Areas

As part of this study, updated hydraulic modeling was completed utilizing the recently added 2-dimentional (2-D) modeling capabilities of the Hydraulic Enigneering Center River Analysis System (HEC-RAS) software. The 2-D capabilities were used to better account for storage and conveyance in the project area. The 2-D area is located on the west side of the river and extends north of Chestnut Avenue and south of Lake Avenue with the western boundary near the railroad. Additional detaile about the model development and results is icnluded in Appendix D (Hydrology and Hydraulics). Figure 5 includes the estimates 1% ACE flood inundation area based on the 2-D model results. The reuslts are very similar to the MWRDGC 100 year inundation area depicted in Figure 4.

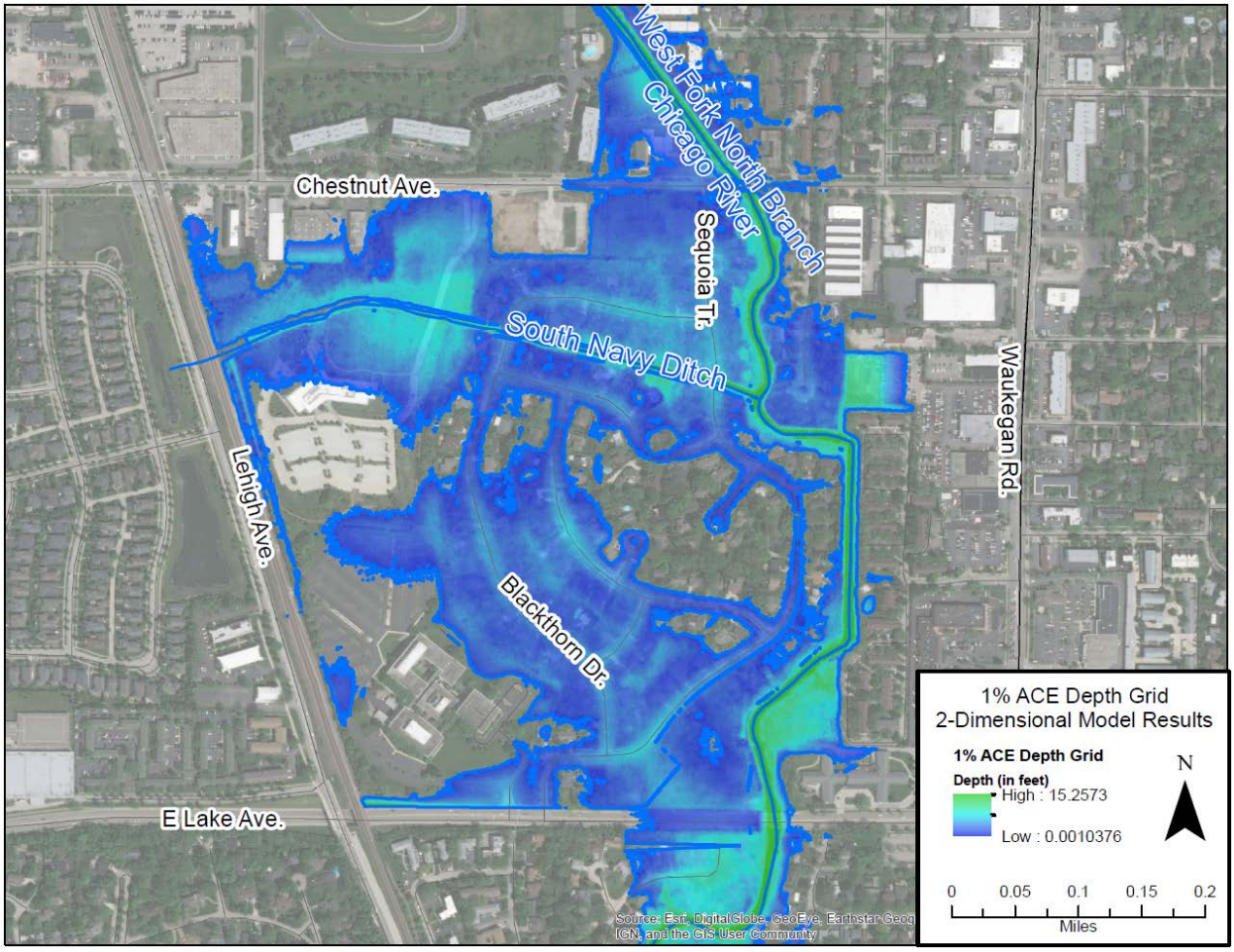


Figure 5. Updated Hydraulic Model Results - 1% ACE Depth Grid

2.3.4 Wetlands

A preliminary review of the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) Wetland Mapper shows no known wetlands within the project area (NWI Wetland Mapper V2, data last modified November 22, 2016).

A site visit was conducted to visually inspect the potential project area for the presence of wetland hydrology or vegetation. With the exception of the river channel itself, no wetlands were identified. The channel is mostly confined without the presence of an adjacent floodplain. There are no side stream riverine or palustrine wetlands within the foot print aside from the river channel.

2.4 FISH AND WILDLIFE HABITATS

The project areas consists primarily of floodplain forest habitat and the condition of this habitat is highly variable dependent on individual landscaping and other improvements that residents adjacent to the river have implemented on their property.

Since no the "no action" plan was ultimately selected for this study, a complete review of fish and wildlife habitats was not completed, as would have been required if an action alternative was selected.

2.4.1 Terrestrial and Aquatic Vegetation

Assessment not completed for this study since the "no action" plan is recommended.

2.4.2 Fauna

Assessment not completed for this study since the "no action" plan is recommended.

2.4.3 Existing Terrestrial and Aquatic Habitats

Assessment not completed for this study since the "no action" plan is recommended.

2.5 ENDANGERED AND THREATENED SPECIES

2.5.1 Federal

The countywide distribution of Federally-listed threatened, endangered, and candidate species was reviewed for Cook County. The following Federally-listed species, their status, and critical habitat are identified by the U.S. Fish and Wildlife Service (USFWS) as occurring within Cook County and have potential habitat within the project area:

- Piping Plover (*Charadrius melodus*) – Endangered – Wide, open, sandy beaches with very little grass or other vegetation
- Rufa Red Knot (*Calidris canutus rufa*) – Threatened – Only actions that occur along coastal areas or large wetland complexes during migratory window of May 1 - September 30
- Eastern Massasauga (*Sistrurus catenatus*) – Threatened – Graminoid dominated plant communities (fens, sedge meadows, peatlands, wet prairies, and shrublands)
- Hine's Emerald Dragonfly (*Somatochlora hineana*) – Endangered – Spring fed wetlands, wet meadows, and marshes
- Rattlesnake-master Borer Moth (*Papaipema eryngii*) – Candidate – Undisturbed prairie and woodland openings that contain their only food plant, rattlesnake-master (*Eryngium yuccifolium*)
- Rusty Patched Bumble Bee (*Bombus affinis) – Endangered* – Grasslands with flowering plants from April through October, underground and abandoned rodent cavities or clumps of grasses above ground as nesting sites, and undisturbed soil for hibernating queens to overwinter
- Eastern Prairie Fringed Orchid (*Platanthera leucophaea*) – Threatened – Moderate to high quality wetlands, sedge meadow, marsh, and mesic to wet prairie
- Prairie Bush Clover (Lespedeza leptostachya) – Threatened - Dry to mesic prairies with gravelly soil
- Northern Long-Eared Bat (*Myotis septetrionalis)* – Threatened – Hibernates in caves and mines, swarms in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods
- Indiana Bat (*Myotis sodalis*) – Endangered - Caves, mines (hibernacula); small stream corridors with well-developed riparian woods; upland forests (foraging)

A complete list of Federally-listed threatened, endangered and candidate species found in Illinois and their habitat is published by USFWS at www.fws.gov/midwest/endangered/lists/illinois-spp.html.

2.5.2 State

Assessment not completed for this study since the "no action" plan is recommended.

2.5.3 Critical Habitat

There is no designated critical habitat for any listed or candidate species within or adjacent to the project area. However, the general habitat for roosting of the Northern Long-Eared Bat and the Indiana Bat is located within and adjacent to the project area.

2.6 RECREATIONAL, SCENIC AND AESTHETIC RESOURCES

2.6.1 Local Resources

As the project area consists entirely of private property (excluding public roadways in the neighborhood), there is no public recreation within the area. All scenic and aesthetic resources, mainly the scenic view of the WFNBCR, are available to the private property owners adjacent to the waterway.

2.6.2 Regional Resources

No regional recreation, scenic, or aesthetic resources exist in the project area.

2.7 CULTURAL RESOURCES

No known cultural resources exist in the project area, however a formal assessment was not completed for this study since the "no action" plan is recommended for this study.

2.7.1 Cultural History

No knowledge of significant cultural history exists at this site, however a formal assessment was not completed for this study since the "no action" plan is recommended for this study.

2.7.2 Previous Investigations

No known previous investigations have been completed for this area.

2.8 AIR QUALITY

The study area is within Cook County, Illinois, which is considered a non-attainment area under the Clean Air Act for ozone.

2.9 NOISE

Existing noise in the study area is minimal and associated with background traffic noises from nearby Chestnut Avenue and East Lake Avenue.

2.10 HAZARDOUS AND TOXIC SUBSTANCES

A very limited screening investigation did not suggest any hazardous, toxic and radioactive waste (HTRW) issues that preclude a conclusion that there could be a Federal interest in a flood risk management solution in the general project area.

Because the project area is located in a developed residential and commercial area, the number of returns from the State of Illinois Resource Conservation and Recovery Act (RCRA) and leaking underground storage tank (LUST) database would have required additional investigation if a project had

been selected for implementation. An HTRW investigation cannot wholly eliminate uncertainty regarding the potential for HTRW associated with a project area. In order to reduce the uncertainty of HTRW in connection with a project area, the HTRW evaluation must consider the work proposed at each location and site specific information that was not evaluated.

2.11 SOCIOECONOMIC AND ENVIRONMENTAL JUSTICE

Assessment not completed for this study since the "no action" plan is recommended. No known socioeconomic or environmental justice implications are directly related to the proposed alternatives, including the no action alternative.

All alternatives considered, including the no action plan, were determined to be in compliance with EO 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*) and EO 13045 (*Protection of Children from Environmental Health Risks and Safety Risks*).

According to census data (U.S. Department of Commerce), the population of the Village of Glenview is 76.3% White non-Hispanic, 7.1% Hispanic or Latino, 1.2% Black or African American, and 3.1% Asian. This compares to the State of Illinois's population of 61.9% White non-Hispanic, 16.8% Hispanic or Latino, 14.3% Black or African American, and 1.8% Asian. Based on these statistics, the Village of Glenview does not have a significant minority population and any project selected is not likely to disproportionately affect minority populations.

The Village of Glenview had 2.8% of its population earning below the poverty line in 2017 and 2.1% unemployment, compared to 9.8% and 4.8%, respectively, nationally. Based on these statistics, the Village of Glenview does not have a significant low-income population and any project selected is not likely to disproportionately affect impoverished populations.

3 PLAN FORMULATION

3.1 PROBLEMS AND OPPORTUNITIES

Problems: Many residential structures within the Village of Glenview are at risk of flooding as a result of the WFNBCR overflowing its banks and limiting conveyance through the South Navy Ditch due to backwater obstruction. Additionally, residential roadways frequently flood restricting ingress and egress posing a safety risk for all residents within the Tall Trees neighborhood.

Opportunities: Managing flood risks in the community can improve the safety of residents and reduce economic damages.

3.2 OBJECTIVES AND CONSTRAINTS

3.2.1 Planning Objectives

The Federal objective of water and related land resources planning is to contribute to National Economic Development consistent with protecting the nation's environment. For this study, the following planning objectives have been identified:

- Reduce flood risk in the Village of Glenview associated with the WFNBCR within and adjacent to the Tall Trees neighborhood.
- Improve community awareness of flood risk and ability to respond to flood emergencies.

3.2.2 Planning Constraints

Formulated plans are limited by constraints, including resource, legal, and policy constraints. Resource constraints are associated with limits on knowledge, expertise, experience, ability, data, information, funding, and time. Legal and policy constraints are those defined by law and USACE policy and guidance. For this study, the following constraints have been identified:

- Minimize impacts (e.g. aesthetic, scenic, ingress/ egress disturbances) of flood risk management project on residents in and adjacent to the Tall Trees neighborhood.
- Flood risks addressed in plan formulation are limited to overbank flooding of the WFNBCR and the resulting backwater impacts on the South Navy Ditch. Flooding associated with insufficient local drainage infrastructure or flooding issues caused directly by the installed sewer system is not within the scope of this study
- Any plans to address flood risk must avoid increasing flood stages in other areas impacted by the WFNBCR and South Navy Ditch

3.3 MOST PROBABLE FUTURE WITHOUT PROJECT CONDITIONS

The future without-project (FWOP) condition of the project area is the basis for comparing the outputs of alternative plans and describes the future condition of the "No Action Alternative." In forecasting these conditions, an effort is made to describe foreseeable changes to the most important aspects of the study area that may impact plan formulation/justification over a 50-year period of analysis. This forecasting is based on an assessment of the existing conditions within the study area. The without-project conditions describes the future conditions that will exist if no new Federal action is taken. Expected conditions, previous trends, and predicted trends are considered in describing the without-project condition. Forecasted environmental conditions can be based on a variety of key assumptions and different sources of information available from Federal, State, local agencies, and private conservation entities. National and State environmental and health standards and regulations are recognized and considered in the description of without-project conditions.

3.3.1 Without Project Hydrologic and Hydraulic Conditions

Since most of the watershed is fully developed or designated as open space, there are no significant changes to landuse or the total amount of impervious surfaces, which impacts the amount and rate of rainfall runoff into area waterways. No flood risk management projects outside the scope of this study are anticipated over the period of analysis. Therefore, no changes to landuse or drainage routes and raters are made to the hydrologic model and no changes to channel geometry of associated flood management infrastructure are made to the hydraulic model to estimate future conditions flooding.

3.3.2 Future Precipitation – Climate Change

USACE Engineering and Construction Bulletin (ECB) 2018-14 (*Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects*) provides guidance for incorporating climate change information in hydrologic analyses in accordance with the USACE

overarching climate change adaptation policy. This policy requires consideration of climate change in all current and future studies to reduce vulnerabilities and enhance the resilience of our water resources infrastructure.

An investigation of the trends in the annual maximum flow gage data was performed to qualitatively assess impacts of climate change within the watershed using several of the USACE developed tools. A full analysis of the tools was completed for the 2 river gages nearest to the project site. The nearest upstream gage is USGS gage number 05535500 on the West Fork of the North Branch of the Chicago River at Northbrook, Illinois with a drainage area of 11.5 square miles and a period of record from 1953 to the present. The next gage downstream is the USGS gage number 05536000 on the North Branch of the Chicago River at Niles, Illinois with a drainage area of 100 square miles and a period of record from 1951 to the present. The data from these gages include various stream statistics such as peak streamflow and daily discharge data that is used in the analyses. Based on the analysis, which is detailed in Appendix D (Hydrology and Hydraulics), it appears that the project area could be significantly impacted by climate change.

In December 2017, Illinois State Water Survey (ISWS), a Division of the University of Illinois at Urbana-Champaign, released a report titled "*Impacts of Potential Future Climate Change on the Expected Frequency of Extreme Rainfall Events in Cook, DuPage, Lake, and Will Counties in Northeastern Illinois."* The purpose of this study was to assess future rainfall intensities for the Counties of Cook, DuPage, Lake, and Will in Northeastern, Illinois and to identify future frequency precipitation depths for the 24- and 48-hour rainfall durations and 50% ACE (2-year) through 1% ACE (100-year) recurrence intervals. The study applies a methodology for defining precipitation frequency depths using projected rainfall using Coupled Model Intercomparison Project (CMIP) 3 and CMIP5 datasets. The study included a risk assessment to identify confidence limits based on modeling variability. More information regarding this study is summarized in Appendix D (Hydrology and Hydraulics).

To evaluate formulated plans for this study, an evaluation of flood frequency profiles for the years 2020, 2050, and 2100, defined as "existing," "future," and "end of period of analysis" conditions, respectively, was conducted. The future conditions hydrology analysis included projected precipitation depths as a hydrologic input. The A1B climate scenario was conservatively selected to represent the expected future conditions scenario. The A1B scenario is defined by the Intergovernmental Panel on Climate Change (IPCC) and assumes rapid economic growth followed by a decline after 2050 due to the introduction of new and more efficient technologies and assumes a balance across all energy sources (fossil and non-fossil).

A comparison between the existing, mid-century (2050), and late century (2100) precipitation depth (in inches) for each frequency event for the 48-hour duration, which was defined as the critical duration for the H&H analysis, is included in

Table 2.

Table 2. Comparison of 48-hour Existing and Future Precipitation Depths (A1B scenario, in inches) in Northeast Illinois

Annual Chance Exceedance (ACE)	99.9%	50%	20%	10%	4%	2%	1%	0.5%	0.2%
	1-year	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year
Bulletin 70 (existing)	2.7	3.3	4.09	4.81	5.88	6.84	8.16	9.64	11.9
Mid Century - 2050	3.16*	3.94	4.9	5.65	6.67	7.51	8.39	9.64*	11.90*
Difference	0.46	0.64	0.81	0.84	0.79	0.67	0.23	0.00	0.00
	17%	19%	20%	18%	13%	10%	3%	0%	0%
Late Century – 2100	*3.32**	4.21	5.21	6.01	7.09	8	8.94	*10.12**	*12.5**
Difference	*0.62*	0.91	1.12	1.2	1.21	1.16	0.78	*0.48*	*0.60*
	23%	27%	27%	25%	21%	17%	10%	5%	5%
* Indicates estimated values by extrapolation									

Figure 6 includes a schematic diagram all of the precipitation data incorporated into the study. For the purposes of the economic analysis without project conditions and evaluating economic impacts of the formulated plans, estimates of flood frequency profiles for the years 2020, 2050, and 2100, defined as "existing," "future," and "end of period of analysis" conditions, respectively were established. For the "future" conditions analysis, flood profiles were adjusted based on projected precipitation depths in the year 2050. Damage Estimates for the 2070 precipitation frequencies were made by interpolating between the 2050 and 2100 projections. Note that the economic analysis documentation refers to the 50-year period of analysis for the study as from the years 2020-2069. The interpolated precipitation depths developed from the methodology described are for the beginning of the year 2070 (January 1), while the economics model accounts for the full year 2069 as the 50th year of the period of analysis (December 31). References to period of analysis ending in 2069 and 2070 are considered equivalent.

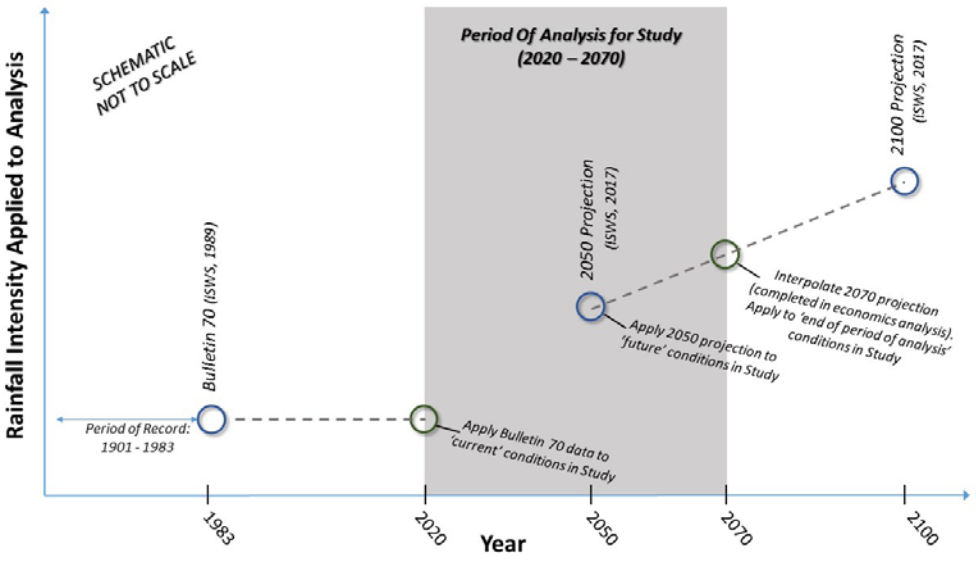


Figure 6. Schematic of Precipitation Data Incorporation into Study

3.3.3 Without Project Condition Damages

An economic analysis was conducted to estimate the without project condition damages expected over the 50-year period analysis of the study. Flood damages and costs considered in the economic analysis included flood damages to residential and non-residential structures and contents, damages to vehicles, and public damages (infrastructure and emergency response expenditures).

The USACE Hydrologic Engineering Center's Flood Damage Assessment (HEC-FDA) version 1.4.2 software tool was utilized to estimate flood damages and potential alternative plan benefits. This software uses risk-based analysis to compute expected annual damages (EAD) in a systematic, evidence based approach for quantifying, describing and communicating risk. A complete description of the development of the HEC-FDA model, including a summary of data used for the analysis, is included in Appendix Economic Analysis (Appendix C).

The Without Project Conditions (WOPC) was estimated to have Expected Annual Damages (EAD) of $406,000 based on current year hydraulics and $678,000 based on forecasted changes in hydraulic conditions due to climate change in 50 years. Given that the period of analysis is 50 years, the two levels of EAD were averaged together to derive an EAD for the period of analysis of $541,603.

3.4 MEASURES TO ACHIEVE PLANNING OBJECTIVES

In order to reduce flood risk, several flood management measures were considered. The costs of all measures considered are expected to fall well below the maximum $10 million per project Federal cost limit of the Section 205 authority.

3.4.1 Structural Measures

Two separate structural measures were considered to address the flood risk in the Tall Trees neighborhood:

Sheet Pile Floodwall Adjacent to River – The construction of a sheet pile floodwall adjacent to the river was considered due to the small footprint required for construction. Since residential homes were constructed along the west bank of the WFNBCR, limited land is available for structural flood risk reduction measures along the river.

Concrete Block Floodwall Parallel to River – The construction of a concrete block floodwall parallel, but offset from the river was also considered. Due to residential homes located along the west bank of the WFNBCR, alignment of the floodwall was considered along the road in front of the homes. Dry floodproofing would be considered for structures between the floodwall and the WRNBCR. USACE, Chicago District has implemented similar concrete block floodwall structures along the Little Calumet River in Hammond, Indiana as shown in Figure 7.

Figure 7. Concrete Block Floodwall Structure

3.4.2 Non-structural Measures

Dry Floodproofing – Non-structural measures are activities such as floodproofing, relocations and buyouts, and development of flood warning plans that can manage flood risk without affecting the hydrologic or hydraulic conditions. The only feasible non-structural measure considered for this problem area was dry floodproofing of residential structures. Exclusion of other common non-structural measures is explained below.

A structural analysis was completed to determine the feasibility of dry floodproofing of structures with basements. Dry flood proofing would require the installation of door and windows shields, window wells, floodproofing membrane around each structure, and drainage system with a sump pump. Dry floodproofing of these structures was determined to be feasible with the inclusion of features which would act to reinforce the structural stability of basement structures in order to avoid possible failure associated with hydrostatic pressure on foundation walls during flood loadings. The structural strengthening of the walls would include shear wall steel panels on the outside of the structures as well as timber connection and columns installation to reinforce the walls. The structural analysis also pointed to a possible failure mode caused by uplift forces acting on the basement floor. To eliminate this failure, additional drainage collection piping system was developed with an extra sump pump.

Additional information about assumptions for floodproofing of structures is included in Appendix G (Structural Engineering).

3.4.3 Excluded Measures

Earthen Levee – The construction of an earthen levee rather than a flood wall was eliminated from consideration due to space constraints. Since this is a residential area, the footprint that would be required for a levee and setback easements is not available without significantly reducing residential back yard space or buying out structures for the construction of the levee. Construction of a levee is not likely to be supported by the Village or private property owners impacted and would significantly increase real estate acquisition costs.

Elevation or Buy-out of Residential Structures – Due to the large number of homes that are subject to flood damage, a program of voluntary buy-outs would not be effective for this area. Homes that are currently subject to moderate levels of damage would not meet benefit/cost criteria for buy-outs, and residents throughout the neighborhood would remain vulnerable to the overall effects of widespread flooding.

Fill Basements – Filling in basements are relocating any necessary building utilities is often considered as a flood damage reduction measure. This measure was excluded from consideration, as it was determined not to be and acceptable solution to impacted property owners and participation rates in a program including basement filling was expected be extremely low.

3.5 FORMULATION AND COMPARISON OF ALTERNATIVE SOLUTION SETS

Three alternative plans beyond 'No Action' were considered on a conceptual level. Each of these plans employ one or more of the measures described in Section 3.4.

3.5.1 Alternative Plan Descriptions

Plan 1 – *No Action:* In the No Action plan, no flood risk management measures would be implemented. This plan is synonymous with the future without project conditions.

Plan 2 – Floodwall along the West Fork of the North Branch of the Chicago River (WFNBCR). This plan includes the construction of a steel sheet pile floodwall through residential back yards adjacent to the west bank of the WFNBCR to isolate the homes in the Tall Trees neighborhood from the river. This plan is similar to the project proposed in MWRDGC's Project Definition Report described in Section 1.4. After consideration of multiple configurations by MWRDGC's consultant MWH Global, reviews of topography determined that an approximately 950 foot long structure extending from Chestnut Avenue south through private back yards as depicted in Figure 8, could be built to provide physical protection up to the 1.59% annual chance flood level (roughly the 63 year frequency event). This wall would provide physical flood protection up to the design flood level, but would not meet FEMA freeboard standards. Ground elevations in the Tall Trees neighborhood and adjacent areas are such that a floodwall constructed to meet FEMA requirements for freeboard would need to be on the order of about a mile long and include segments extending north across Chestnut Avenue and west along East Lake Street to the railroad crossing. The necessary tiebacks to high ground make providing freeboard cost prohibitive.

The proposed floodwall would provide physical reduction against flooding up to the 1.59% annual chance flood level (with no freeboard) for properties identified as potentially vulnerable to direct overbank flood damages.

The general proposed alignment of this plan is included in Figure 10. Figure 9 provides a more detailed alignment plan.

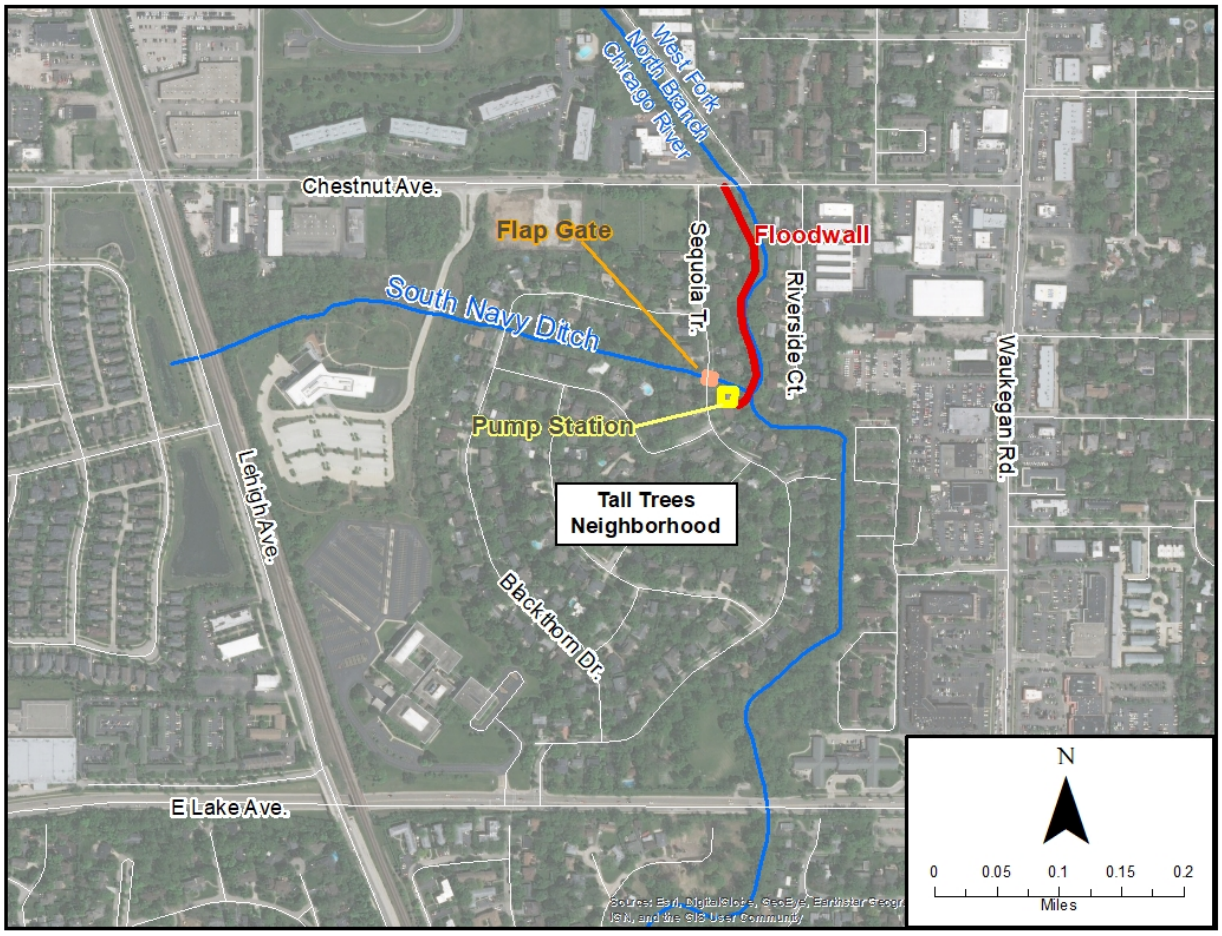


Figure 8 Plan 2 Schematic

Figure 9. Plan 2 Schematic – Detail

In addition to the floodwall structure itself, other elements of Plan 1 include:

- *A gate structure at the floodwall crossing of the South Navy Ditch.* The gates would normally be left open to allow flow in the South Navy Ditch to drain to the WFNBCR by gravity. During flood events, the gates would be closed to isolate the Tall Trees neighborhood and the South Navy Ditch from backwater from the WFNBCR.

- *A stormwater pump station adjacent to the South Navy Ditch and the WFNBCR.* A new stormwater pump station would be required to provide a reliable outlet for the South Navy Ditch during periods when the WFNBCR is high and the gate structure at the South Navy Ditch is closed. The pump station would be sized to convey peak flows from the South Navy Ditch together with interior runoff from the Tall Trees neighborhood.

Additional improvements may be implemented separately by the Village of Glenview to address local drainage and state regulatory requirements:

- *Storm sewer modifications.* Existing storm sewers draining the Tall Trees neighborhood discharge to the WFNBCR. However, during periods of high river levels, these sewers also provide a means for river water to back up into the Tall Trees neighborhood, flooding low-lying areas along Blackthorn Drive, Basswood Circle, and Silverwillow Drive. A new storm sewer would be constructed along Sequoia Trail from the intersection of Basswood Circle and Sequoia Trail north to the new pump station. A gate would be installed at any existing storm sewer outfalls so that they could be isolated from the river during periods of high stage.
- *Compensatory Storage.* The hydraulic model simulations indicated that construction of the proposed floodwall would result in flood elevation (i.e. stage) impacts on the WFNBCR. A 15-acre-foot volume expansion of the Techny 32C reservoir was modeled to be sufficient to eliminate any flood stage impacts to comply with the State of Illinois' 'no adverse impact' requirement for construction within the floodway. The Village would be responsible for this project cost, as this would not be a federal requirement.

If benefits of this plan are estimated to exceed the costs, flood proofing could be considered for properties that would not be directly protected by the system, as an incremental risk reduction improvement. Structures which could be considered for floodproofing include homes near the south end of Riverside Court on the east side of the WFNBCR and homes located along the west side of the WFNBCR along Sequoia Trail south of the intersection of Silverwillow Drive and Sequoia Trail.

Plan 3 – *Floodwall along Sequoia Trail and floodproofing riverward structures:* This plan includes the construction of a concrete block floodwall structure along the Sequoia Trail roadway centerline. In order to construct the 4-foot wide concrete block floodwall, the centerline of the roadway would be shifted 2 feet to the west to maintain the existing lane width for northbound traffic. An additional 8 feet of road widening would be constructed in the south bound lane for a total south bound road width of 18' to facilitate north- and south-bound driving lanes, the concrete block structure, and parked cars on the roadside. The floodwall would have a maximum height of approximately 3.8 feet and provide physical protection up to the 1.59% annual chance flood level (roughly the 63 year frequency event). This wall would provide physical flood protection up to the design flood level, but would not meet FEMA freeboard standards. Ground elevations in the Tall Trees neighborhood and adjacent areas are such that a floodwall constructed to meet FEMA requirements for freeboard would need to be on the order of about a mile long and include segments extending north across Chestnut Avenue and west along East Lake Street to the railroad crossing. The necessary tiebacks to high ground make providing freeboard cost prohibitive.

The general proposed alignment of this plan is included in Figure 10 and a more detailed schematic highlighting specific features is included in Figure 11.

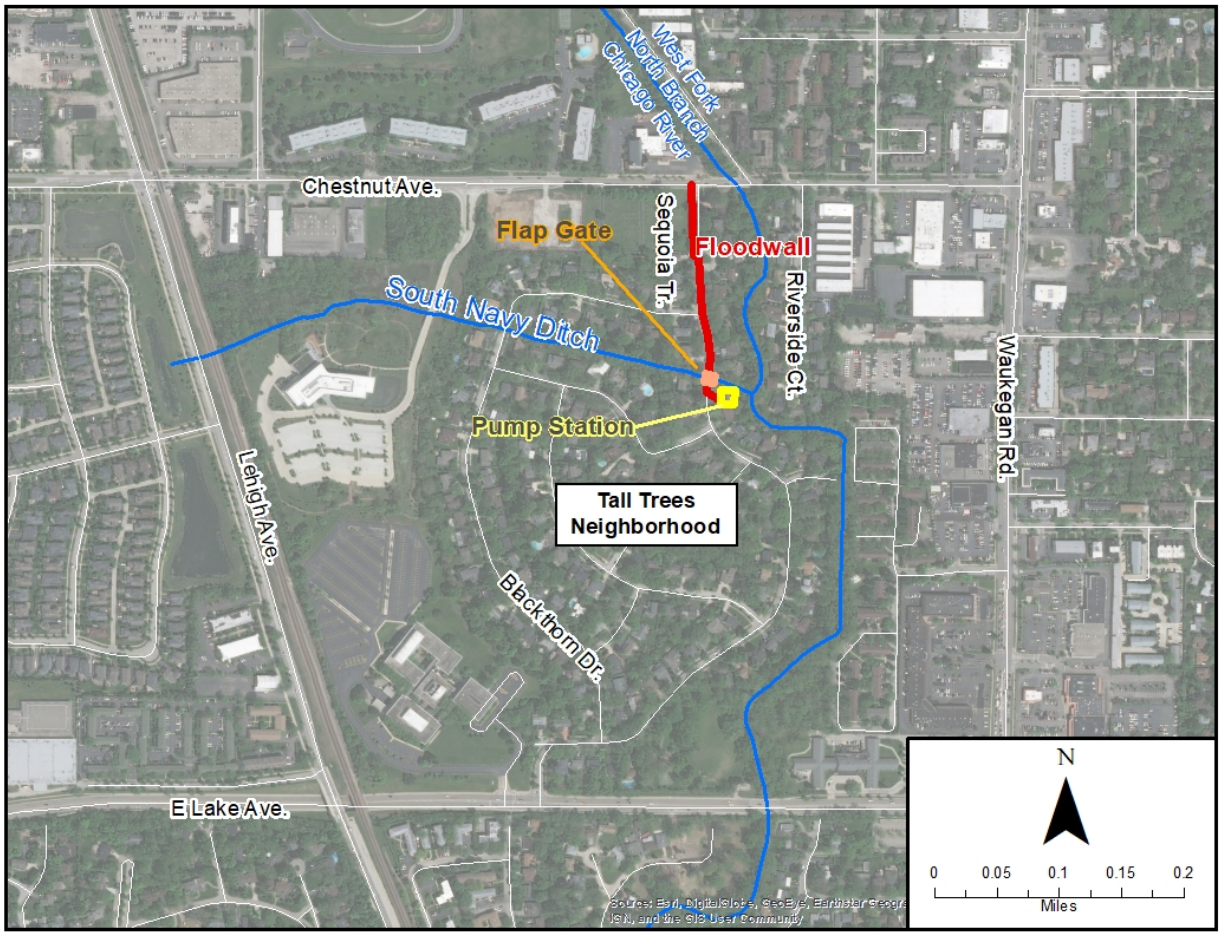


Figure 10. Plan 3 Schematic

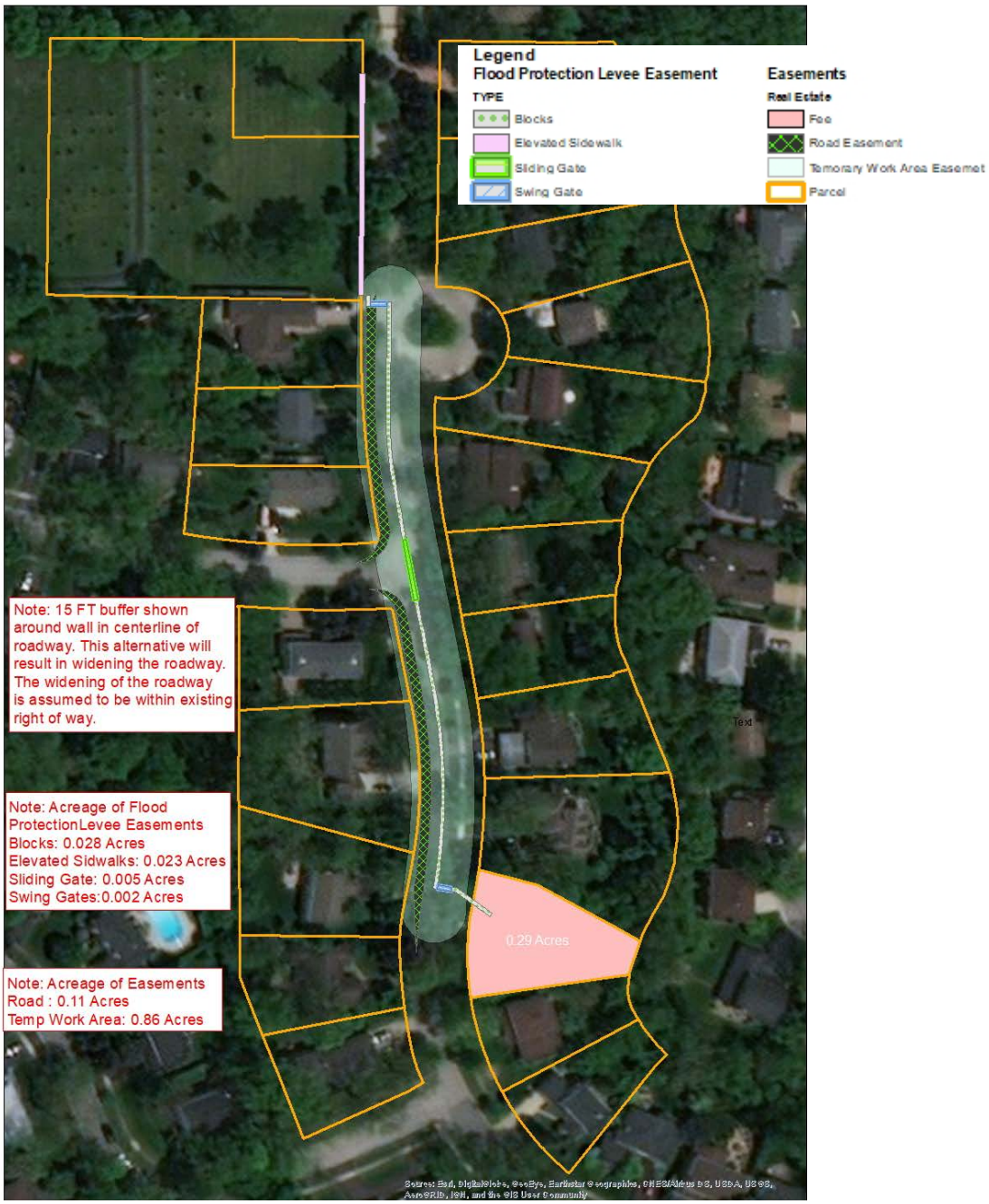
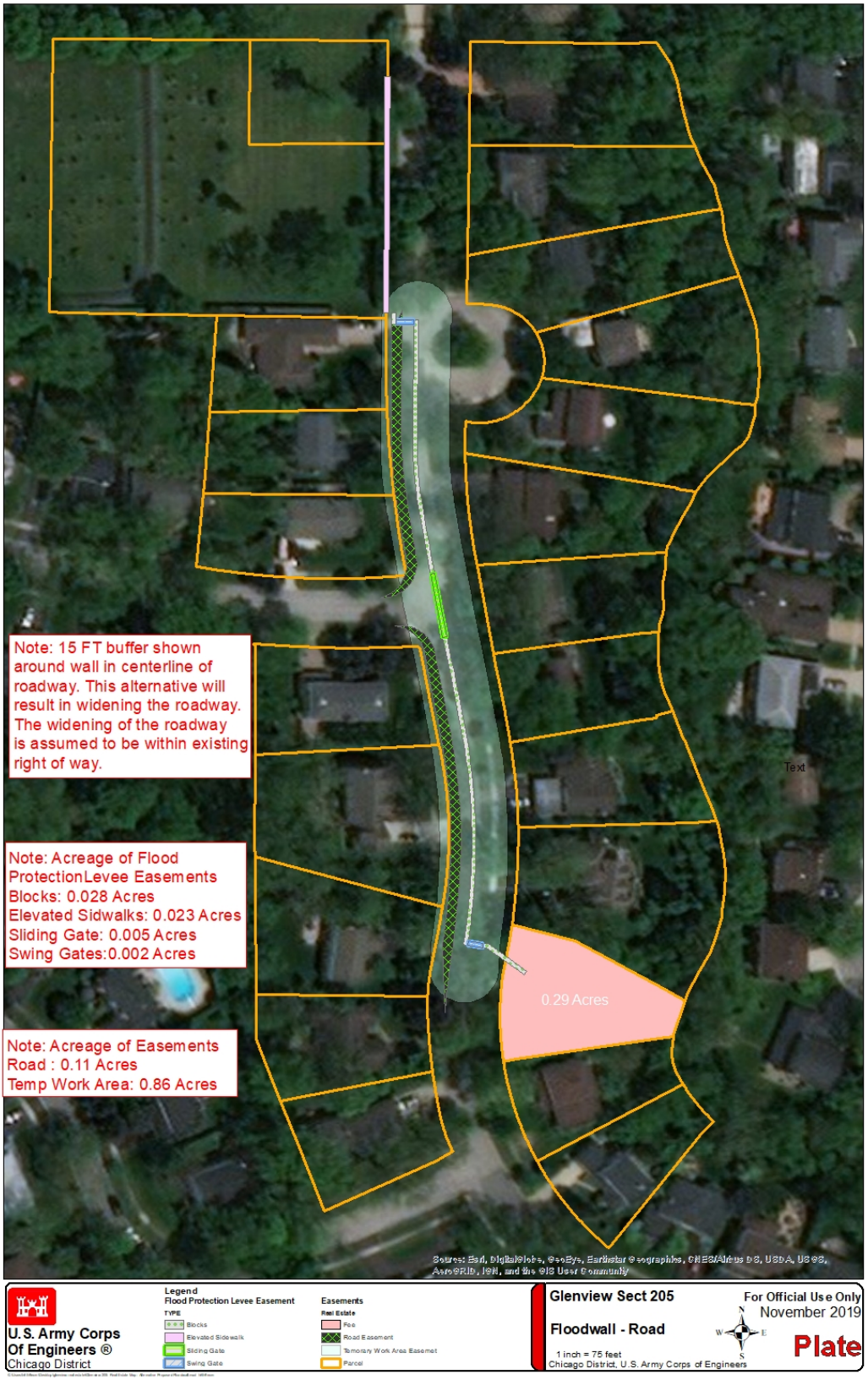


Figure 11. Plan 3 Schematic - Detail

Two 15 to 20 foot wide swing gates would be required on either end of the flood protection structure, which would be closed during flood events. Additionally, an approximately 60-foot wide sliding gate would be required at the intersection of Blackthorn Drive and Sequoia Trail.


Note: 15 FT buffer shown around wall in centerline of roadway. This alternative will result in widening the roadway. The widening of the roadway is assumed to be within existing right of way.
Note: Acreage of Flood ProtectionLevee Easements
Blocks: 0.028 Acres
Elevated Sidwalks: 0.023 Acres
Sliding Gate: 0.005 Acres
Swing Gates:0.002 Acres
Note: Acreage of Easements
Road : 0.11 Acres
Temp Work Area: 0.86 Acres
0.29 Acres
Text
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
U.S. Army Corps Of Engineers ®
Chicago District
Legend
Flood Protection Levee Easement
TYPE
Blocks
Elevated Sidewalk
Sliding Gate
Swing Gate
Easements
Real Estate
Fee
Road Easement
Temporary Work Area Easement
Parcel
Glenview Sect 205
Floodwall - Road
1 inch = 75 feet
Chicago District, U.S. Army Corps of Engineers
For Official Use Only
November 2019
Plate

Emergency vehicle access to residents and hydrants during flood events will be specifically reviewed and confirmed.

In addition to the floodwall structure itself, other elements of Plan 2 include:

- *A gate structure at the floodwall crossing of the South Navy Ditch.* The gates would normally be left open to allow flow in the South Navy Ditch to drain to the WFNBCR by gravity. During flood events, the gates would be closed to isolate the Tall Trees neighborhood and the South Navy Ditch from backwater from the WFNBCR.
- *A stormwater pump station adjacent to the South Navy Ditch and the WFNBCR.* A new stormwater pump station would be required to provide a reliable outlet for the South Navy Ditch during periods when the WFNBCR is high and the gate structure at the South Navy Ditch is closed. The pump station would be sized to convey peak flows from the South Navy Ditch together with interior runoff from the Tall Trees neighborhood.

Additional improvements may be implemented separately by the Village of Glenview to address local drainage and state regulatory requirements:

- *Storm sewer modifications.* Existing storm sewers draining the Tall Trees neighborhood discharge to the WFNBCR. However, during periods of high river levels, these sewers also provide a means for river water to back up into the Tall Trees neighborhood, flooding low lying areas along Blackthorn Drive, Basswood Circle, and Silverwillow Drive. A new storm sewer would be constructed along Sequoia Trail from the intersection of Basswood Circle and Sequoia Trail north to the new pump station. A gate would be installed at any existing storm sewer outfalls so that they could be isolated from the river during periods of high stage.
- *Compensatory Storage.* The hydraulic model simulations indicated that construction of the proposed floodwall would not result in increased flood surface profiles on the NBCR. During design, more detailed analysis would need to be completed to confirm this. If compensatory storage volume is determined to be needed to comply with the State of Illinois' 'no adverse impact' requirement for construction within the floodway, the Village would likely be responsible for this project cost, as this would not be a federal requirement. If needed, new storage could be constructed through a modest expansion of the existing Techny Reservoir 32C facility. Preliminary analysis suggest induced flooding would be minor, not constitute a real estate taking and compensatory storage would not be economically justified.

If benefits of this plan are estimated to exceed the costs, flood proofing could be considered for properties that would not be directly protected by the system, as an incremental risk reduction improvement. Structures which could be considered for floodproofing include homes near the south end of Riverside Court on the east side of the WFNBCR and homes located along the west side of the WFNBCR along Sequoia Trail south of the intersection of Silverwillow Drive and Sequoia Trail in addition to all houses lining the east edge of Sequoia Trail and north of the stream intersection.

Plan 4 – *Floodproof impacted homes:* This plan consists of floodproofing of impacted structures to protect them from structure and content damage. Figure 12 highlights the structures designated via the economic analysis to be the 20 most vulnerable to flooding. The most vulnerable structures were identified as all structures impacted by the 2% ACE flood event as well as a few structures (4) which were estimated to have the most significant economic damages at the 1% ace event. This determination was based on the elevation of the low entry point of the structure compared to flood elevations (depth of flooding), structure type, and structure and content value. More information about the designation of the most vulnerable structures is included in the economics appendix.

Additional groupings of nonstructural alternatives could be considered to expand the number of homes based included in a more comprehensive nonstructural plan if implementation of floodproofing of the most vulnerable structures is estimated to produce positive net benefits.

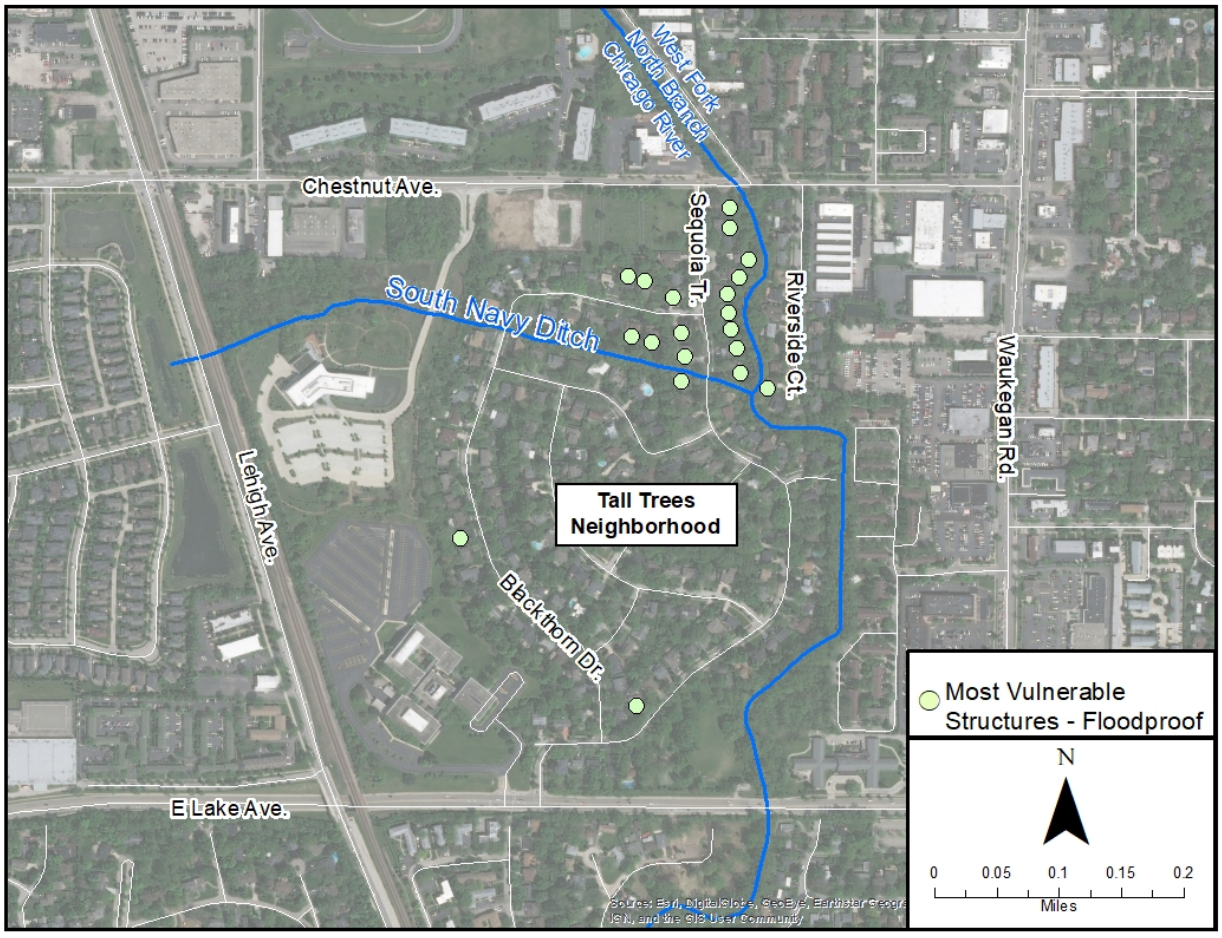


Figure 12. Plan 4 Schematic

As described in Section 3.4.2, dry floodproofing would include installation of door and windows shields, window wells, floodproofing membrane around each structure, and a drainage system with a sump pump. Floodproofing would also require features which would act to reinforce the structural stability of basement structures in order to avoid possible failure associated with hydrostatic pressure on

foundation walls during flood loadings. Additional information about assumptions for floodproofing of structures is included in Appendix A (*Civil Design*).

3.5.2 Evaluation of Alternative Plans

Flood risk management (FRM) benefits consist of reductions in potential flood damages to structures as well as reductions in other flood related costs such as emergency response, clean-up, and traffic detours. These cost reductions are compared to the costs of project implementation. A project is considered economically justified if the total value of the average annual benefits exceeds the average annual costs. The future without project condition and all alternatives plans were evaluated over a 50 year period, using the FY19 Federal discount rate (2.875%).

All structures within the study area are residential. FRM benefits were estimated for reductions in potential flood damages to both the structures and their contents. FRM benefits related to emergency management were also included. Impacts on traffic and clean-up costs were assumed to be minimal and not included in this initial evaluation.

Parcel Data and Historical Claims: The Village of Glenview's contractor conducted field surveys of residential structures that were either in or adjacent to the WFNBCR floodplain. Surveys included first floor elevation and low entry elevation for each residential structure, accompanied by photographs of each survey location. A database containing the results of the surveys were used to construct a detailed structure inventory consisting of 175 residential parcels as shown in Figure 13.

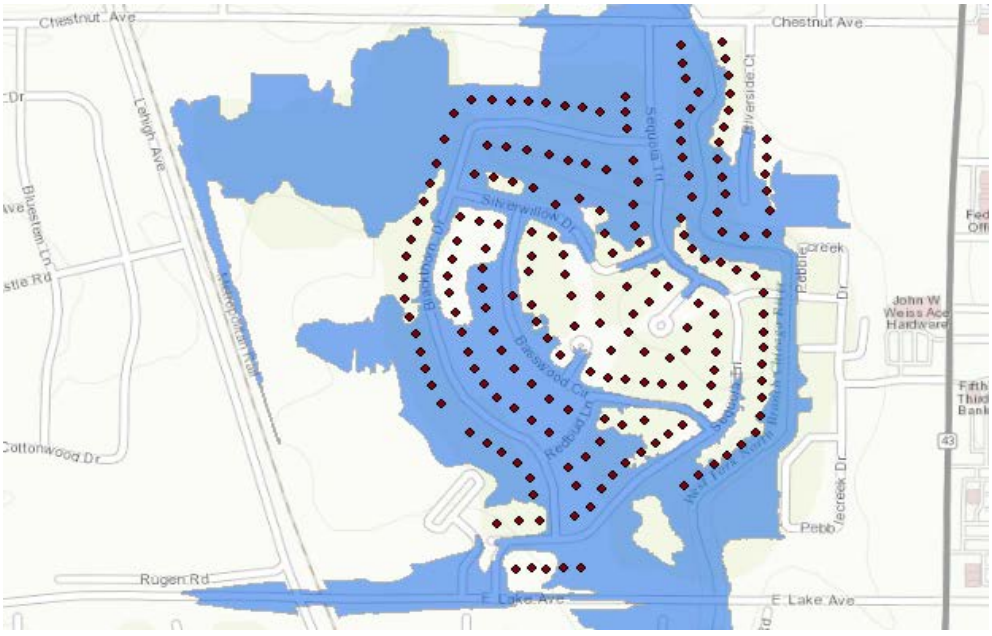


Figure 13. Parcels included in economic analysis

Limited information was available relating to actual damage claims to property and contents for individual residential parcels associated with historical flood events. Limited information was provided by FEMA on individual residential damage claims for historical floods. Overall, property damage data did not include detailed historical claim information for each parcel, or each individual flood event and therefore historical modeling was not included in this analysis.

Future Without Project Expected Annual Damages: As described in Section 3.3.3, HEC-FDA was used to estimate flood damages. The Without Project Conditions (WOPC) was estimated to have Expected Annual Damages (EAD) of $406,000 based on current year hydraulics and $678,000 based on forecasted changes in hydraulic conditions due to climate change in 50 years. Given that the period of analysis is 50 years, the two levels of EAD were averaged together to derive an EAD for the period of analysis of $541,603.

Estimated Flood Risk Management Benefits

In the *No Action* alternative (Plan 1), no flood risk management measures would be implemented. This plan is synonymous with the future without project conditions, therefore there would be no benefits associated with this plan.

Alternative Plan 2 and Plan 3 developed for this investigation include a floodwall that provides physical protection up to the 1.59% annual chance flood level (roughly the 63 year frequency event). Since the level of protection of both structural plans was limited due to tieback limitations, they are both are assumed to have residual damages.

Alternative Plan 4 includes dry floodproofing of the 20 homes identified as being the most vulnerable, as those were considered to be the most likely structures for which floodproofing could be economically feasible.

Economic benefits of a plan are synonymous with damages avoided; therefore, the benefits of a project are equal to the without-project damages minus the with-project damages. Estimated average annual benefits are shown in Table 3.

Table 3. Summary of Alternative Plan Average Annual Benefits

Plan	Expected Average Annual Damages	Expected Average Annual Benefits
Plan 1 – No Action	$541,603	•
Plan 2 – Floodwall along WFNBCR	$361,512	$180,092
Plan 3 –Floodwall along Sequoia	$517,142	$24,461
Plan 4 – Floodproof impacted homes	$498,784	$42,819
* Expected Average Annual Damages are defined as the 'residual damages'		

Estimated Alternative Plan Costs

For the estimate of costs, several factors were taken into account:

General Design considerations*:* Preliminary cost estimates were developed for all three alternatives. The costs are based on preliminary designs based on the components for each plan listed in Section 3.5.1.

Real Estate: Lands, Easements, Relocations, Rights-of-Way, and Disposal Areas (LERRDs) real estate estimates were prepared based on an estimate of acreage required for each alternative plan. Fee values were assumed given the early designs and the small acreages needed for each easement area (i.e. 0.07 acres, 0.11 acres, 0.09 acres, etc.) It is doubtful that portion of the property will be used for other purposes once floodwalls are constructed. The estimated easement requirements are summarized below. Flood protection levee easements and temporary work area easements are required for Plans 2 and 3 as described in Section 3.5.1.

It was assumed that the existing home on Sequoia Trail (PIN 0426308008) would be demolished and the site will be subsequently used for construction of a flood wall along the creek and a pumping station within the parcel for Alternative Plan 2 and Plan 3. Public Law 91-646, Uniform Relocation Assistance must be provided to the residents of this parcel. Demolition costs would be treated as construction cost and a staging area will be set up within the parcel.

For Plan 2, flood protection levee easements will be secured from ten additional private parties covering the 1.29 acres required for construction of the floodwall. It is assumed that excavated material will be managed within the project footprint and that no additional land acquisition will be necessary for disposal materials. Non-standard estates are not anticipated.

The order of magnitude of estimated real estate costs was sourced from the Cook County Assessor's records and a review of 2016 vacant land sales within the project vicinity. The assessor records for land values appears not to have been updated since approximately 2007; therefore, land values seemed exceptionally low. A review of recently sold lands was conducted to establish an estimated per acre value.

A summary of the estimated real estate costs for each plan is shown in Table 4.

Table 4. Estimated Real Estate Costs

Plan 1: No Action		
	No LERRDs required	
Plan 2: Floodwall through residential back yards adjacent to WFNBCR		
	Flood protection easements: (10)	$ 425,000
	P.L. 91-646 just compensation relocation	$ 575,000
	Subtotal LERRD	$1,000,000
	15% contingency	$ 150,000
	PLAN 2 TOTAL estimated LERRD	$1,150,000
Plan 3: Floodwall along Sequoia Trail		
	P.L. 91-646 just compensation relocation	$ 575,000
	Land for widening of roadway within right-of-way	$ 500

	Subtotal LERRD	$ 575,500
	15% contingency	$ 86,300
	PLAN 3 TOTAL estimated LERRD	$ 661,800
Plan 4: Floodproof impacted homes		
	No LERRDs required	

NOTE: Following completion of the cost estimate and economic analysis, the LERRD cost estimate for Alternative Plan 2 was updated based on a real estate appraisal. The updated LERRD cost estimate is summarized in Appendix F (Real Estate) of this report. The LERRD costs for Alternative Plan 2 was updated to $1,743,763 (compared to the initial estimate of $1,150,000 reported above). The cost estimate and economic analysis were not updated in the cost and economic analysis tables because the plan had been determined not to be economically justified and therefore was not recommended for implementation. The increased LERRD cost would further reduce the net economic benefits, (i.e. reduce the benefit to cost ratio) and not change the decision not to recommend this plan. .

Operations and Maintenance: This preliminary estimate is based on typical operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) activities for similar floodwalls in the region. The most significant costs would be associated with inspection of and periodically operating gate structures.

Alternative plan average annual costs are presented in Table 5. Items include Contractors Earnings plus Contingencies, Engineering & Design Costs, Construction Management Costs, and Lands, Easements, Rights of Way, Relocations & Disposal Costs (real estate costs). Total First and Investment Costs were converted to Average Annual Costs using a 2.875% interest rate and a 50-year period of analysis. Project Average Annual Costs reflect October 2016 price levels and a 2.875% annual interest rate. Interest during construction is based on a 12 month construction period where costs are evenly distributed over the construction period.

Table 5. Structural Alternative Project Average Annual Costs

	Estimated Cost ($1,000)	
	Plan 2	**Plan 3**
	Floodwall along WFNBCR	**Floodwall along Sequoia**
Construction[1]	$7,165,000	$6,684,000
Engineering and Design (5%)	$358,250	$334,200
Construction Management (5%)	$358,250	$334,200
LERRDs	$1,150,000	$661,800
Total First Costs	**$9,031,500**	**$8,014,200**
Interest During Construction	$103,300	$96,400
Total Investment Costs	**$9,134,800**	**$8,110,625**
Annualized Investment Costs	$346,600	$307,800
Annual OMRR&R[2]	$71,700	$66,800
Average Annual Cost	**$418,300**	**$374,000**

Base Year: 2017
Federal Discount Rate: 2.875% (FY2019)
Price Level: October 2016 (FY2017)
Period of Analysis: 50 years
[1]Construction estimate includes 18% contingency
[2]Annual OMRR&R estimated at 1% of construction costs

Benefit-Cost Analysis: In the evaluation of flood risk management projects, a benefit-cost analysis is intended to provide a measure of net National Economic Development (NED) benefits, which are defined as "increases in the economic value of the goods and services that result directly from a project." Project benefits are compared to costs. If the benefits of implementing a project are greater than costs, a project has a benefit to cost ratio (benefits divided by costs) greater than one and positive net benefits (benefits minus cost). These projects will make a positive impact on the economy and possess federal interest in their implementation. Table 6 provides a summary of the benefit-cost analysis for each of the alternative plans.

Table 6. Benefit Cost Analysis Summary

	Estimated Value ($1,000)			
	Plan 1	**Plan 2**	**Plan 3**	**Plan 4**
	No Action	Floodwall (WFNBCR)	Floodwall (Sequoia)	Floodproof
Average Annual Benefits	$0	$180	$24	$43
Average Annual Costs	$0	$418	$375	$62
Average Annual Net Benefits	$0	-$238	-$350	-$19
Benefit to Cost Ratio (Average)	N/A	0.43	0.07	0.7

Base Year: 2017
Federal Discount Rate: 2.875% (FY2019)
Price Level: October 2016 (FY2017)
Period of Analysis: 50 years

Based on the summary of the benefit cost analysis, none of the alternatives evaluated were deemed to be federally justified based on economic justification. This was due to a combination of facts:

- Structural damage was estimated not to occur until between the 4% and 2% annual chance events for present day conditions (25-year and 50-year storm). This fairly low frequency of flooding causing structural damage makes project justification difficult from an economic evaluation standpoint.
- The structural (floodwall) alternatives were only able to provide risk reduction up until the 1.59% ACE event due to limitations in the topography. There is no flood damage reduction for events greater than the 1.59% ACE event, which limits the economic benefits of the proposed projects.
- There were limited possible structural protection options given the geography and development of the area.
- There was a high cost to install a pump station to manage the South Navy Ditch for each of the structural alternatives.
- For the floodproofing options considered, the cost was high due to components which would be required to ensure structural stability against hydrostatic pressure and uplift in the event of a flood. The cost of floodproofing was estimated to be too high compared to the potential economic benefits.

As a result of these issues, the recommended plan is Alternative Plan 1 – the no action plan.

3.5.3 Key Analysis Assumptions, Risk and Uncertainty

Key uncertainties associated with the development and evaluation of alternative plans are summarized in Table 7. The risks are qualitatively described regarding the key assumption, the reason for concern, and how each was incorporated in the analysis. These uncertainties focus on how these assumptions were derived and carried through the alternative development and evaluation process. These are focused on the critical engineering, environmental, and economic inputs used to evaluate the with-project alternatives.

Table 7. Summary of Major Risk Areas that Could Impact Federal Interest

Risk Element/ Assumption	Consequence Description (Reason for Concern)	How Incorporated in the Analysis (Mitigation Technique)
Hydraulic and Hydrologic Analysis	Flow and stage estimates from the hydraulic model help to define the without and with-project flood damages. The exact frequency of flooding is unknown. If the frequency of flooding estimated is not correct, damages could be over- or under-estimated	Previously developed and vetted models were used as a starting point and updated to add detail to suit the needs of this analysis.

Table 7. Summary of Major Risk Areas that Could Impact Federal Interest

Risk Element/ Assumption		Consequence Description (Reason for Concern)	How Incorporated in the Analysis (Mitigation Technique)
	River Flow Frequency	The exact flow in the river for any event frequency is not known. Flow frequency is used to quantify the frequency that the river will reach a given stage and therefore the probability that a levee will be loaded to a certain elevation or overtopped. Discontinued gages, reservoir construction and landuse changes have added many uncertainties to the peak flow frequency statistics.	Illinois State Water Survey's Bulletin 70 precipitation frequency data was used in the HEC-HMS (Cook County) and the HEC-1 model (Lake County) was updated to also use this data to estimate flow frequency in the project area. Uncertainty associated with river flows was included in the economic model.
	River stage	River stages are used to quantify the economic damages based on established stage-damage curves. The exact stage resulting from a particular flow rate is not known and there may be a deviation between observed stages and modeled stages.	The base hydraulic model used was MWRDGC's Detailed watershed plan (DWP) model, which was carefully calibrated. Uncertainty associated with river stages was included in the economic model.
	Localized flood depths	Depth of flooding in the tall trees neighborhood is impacted by the WFNBCR and the South Navy Ditch. The existing 1-D hydraulic model did not capture localized hydraulic conditions that were not within the channel, and therefore flood depth in the neighborhood and impacts due to the proposed projects could not be accurately estimated.	MWRDGS's DWP model was updated to use the 2-D capabilities of the current version of HEC-RAS to better account for storage and conveyance in the project area. This allows for better estimation of localized flood depths. The 2-D area is located on the west side of the river and extends north of Chestnut Avenue and south of Lake Avenue with the western boundary near the railroad.
	South Navy Ditch Pump Station Requirements	The proposed floodwalls would cut of the gravity flow of South Navy Ditch into the WFNBCR, requiring a pump station.	Hydraulic modeling runs were used to optimize pump station capacity. Optimization was based on reducing flooding caused by the South Navy Ditch behind the proposed levees and avoiding induced flooding on the WFNBCR.
	Future Hydrology Conditions (Climate Change)	Projected rainfall in Illinois is anticipated to increase in intensity throughout the period of analysis which may impact the flow frequency assumptions. If flow frequency increases, the current estimates of economic damages may be underestimated.	Future conditions precipitation estimates were included in the future without project and future with-project analysis to account for estimate changes in precipitation intensity in the future
Engineering Design			
	Suitability of site for construction of proposed floodwalls	The design of the proposed floodwalls are dependent on the geotechnical conditions of the native soil. Embedment depth assumptions effects the quantities, materials, and labor required to implement the project alternatives.	Soil borings were conducted along the proposed floodwall alignments to inform the recommended design.

Table 7. Summary of Major Risk Areas that Could Impact Federal Interest

Risk Element/ Assumption		Consequence Description (Reason for Concern)	How Incorporated in the Analysis (Mitigation Technique)
	Floodproofing – technical feasibility	Floodproofing of buildings with basements is not common practice due to hydrostatic pressure and uplift concerns. If not done properly, structural damage or failure could result.	A structural analysis was completed to determine feasibility of floodproofing of residential structures with basements. Additional features were included in the design to ensure safety of proposed project.
Cost Estimate			
	Rates for Labor, Equipment, and Material	The project cost is a function of the labor, equipment, and material required for each alternative. Estimates for these inputs are uncertain and can change based on market demands. If the cost estimate is too high or too low, project justification could be impacted.	The current rates for current labor, equipment, and material were used, with estimates for escalation over time. Additionally, the uncertainties associated with these inputs were addressed during the cost certification process and accounted for in the cost contingency.
	Construction Schedule	The construction schedule impacts the amount of cost escalation required and increases to the schedule duration can drive up the cost.	The construction duration for similar projects served as the basis for this estimate, accounting for some site-specific needs. The uncertainties associated with these inputs were addressed during the cost certification process and accounted for in the cost contingency.
	Floodproofing Cost Estimate	Since the floodproofing method was proposed included nonstandard activities, existing parametric costs estimates were not available. If the cost estimate is too high or too low, project justification could be impacted	Conservative cost estimates were developed to account for the nonstandard project. Estimates used for this analysis were vetted and certified by the USACE cost center of expertise for another project that was ongoing at the same time.
	Real Estate Cost Estimate	The order of magnitude of estimated real estate costs was sourced from the Cook County Assessor's records and a review of 2016 vacant land sales within the project vicinity. The assessor records for land values appears not to have been updated since approximately 2007; therefore, land values seemed exceptionally low	A review of recently sold lands was conducted to establish an estimated per acre value.
Economic Analysis		Assumptions utilized in the economic model could be incorrect effecting estimated benefits and effect project justification.	Due to limited damage information pertaining to historical flooding, claim damage and the uncertainty of the extent of flooding from sewer back up, the economic analysis attempted to account for such factors.
	Structure & Vehicle Elevations	The elevation of structures affect the beginning damage point for the structure specific depth-damage functions. This affects the estimation of project benefits.	Survey data, collected by Glenview's contractor, of low entry points for each structure was incorporated into the economic analysis to estimate damages.

Table 7. Summary of Major Risk Areas that Could Impact Federal Interest

Risk Element/ Assumption		Consequence Description (Reason for Concern)	How Incorporated in the Analysis (Mitigation Technique)
	Structure & Content Values	The structure & content values are the primary input to determine the economic damages which could be avoided in the with-project conditions. This affects the estimation of project benefits.	Values were developed from county parcel data. Full market assessed value was utilized for each property less land value. Additionally a single car was given to each residential structure. It should be noted that on analysis only residential structures were noted to have flood damage.
	Emergency Costs	The exact type and amount of emergency costs associated with flooding are not known. Potential damages avoided to vehicles affect the benefits provided by the with-project conditions.	These inputs are highly uncertain as only minimal flooding has been experienced and emergency costs are not typically widely available without a detailed post-flood history report. Emergency costs were not explicitly accounted, since it was determined that the scale of emergency management costs would not be large enough to significantly increase total economic benefits enough to meet positive net benefits required for project recommendation.

3.6 RECOMMENDED PLAN

None of the action alternatives evaluated are estimated to result in positive net benefits, and therefore federal interest has not been established. Therefore, the no action alternative, Plan 1, is recommended. There are no federal costs associated with this plan.

4 ENVIRONMENTAL EFFECTS OF RECOMMENDED PLAN

Since the Recommended Plan is the 'No Action' plan, the environment of the project area is anticipated to stay the same as the existing condition. The area is expected to periodically inundate with floodwater, which will impact neighborhood roadways and, less frequently, structures. When roadways and structures are exposed to floodwater, there is a potential for contaminants existing on the roadway surfaces or within structures to be suspended in water and transported and deposited elsewhere. In addition, damaged property will likely need to be disposed of following flood events.

A complete assessment of environmental impacts of the recommended plan was not conducted, as no action is recommended.

5 MITIGATION OF ADVERSE IMPACTS

No Federal action is recommended, and therefore no mitigation is required.

6 IMPLEMENTATION REQUIREMENTS

No Federal action is recommended, and therefore no implementation requirements exist.

7 PUBLIC INVOLVEMENT

7.1 PUBLIC VIEWS AND COMMENTS

Significant communication with the public has been conducted by MWRDGC and MWH Global as part of the completion of both of the study efforts summarized in section 1.4. Additional public outreach has been conducted by the Village of Glenview related to this USACE study. The residents of the Tall Trees community have expressed strong support for a solution to the flood risk within the neighborhood.

USACE and the Village will hold a public meeting to present the results of this study with a recommendation of no Federal action.

7.2 STAKEHOLDER AGENCY COORDINATION

Preliminary coordination has occurred with the Village of Glenview, the project sponsor, and MWRDGC. USACE participated in a site visit of the project area with Village staff on 13 December 2016. In addition, a planning charrette was conducted on 9 January 2017 to identify alternatives to meet planning objectives within the CAP Section 205 authority requirements. The charrette included representatives from the USACE, the Village of Glenview, MWRDGC, and MWH Global consultants.

A scoping letter was sent to potentially interested Tribes as well as Federal and State agencies in compliance with the National Environmental Protection Act (NEPA) on October 16, 2017. The scoping letter informed recipients of the feasibility study and summarized the problem area and measures under consideration and solicited comments on potential impacts or concerns associated with flood risk management in the study area.

Letters were sent to:

- 10 potentially impacted tribes
- U.S. Senate Representatives for Illinois (Durbin and Duckworth)
- Congresswoman Jan Schakowsky
- U.S. Environmental Protection Agency (USEPA)
- U.S. Fish and Wildlife Service (USFWS)
- Federal Aviation Administration (FAA)
- U.S. Department of Agriculture (USDA)
- Illinois Environmental Protection Agency (IEPA)
- Illinois Department of Natural Resources (IDNR)
- Illinois Historic Preservation Association (IHPA)
- Forest Preserves of Cook County

Upon completion of this report recommending no action, follow up letters will be sent to the same list of stakeholders to inform them of the decision.

8 FINDING OF NO SIGNIFICANT IMPACT

No Federal action is recommended, and therefore no findings on impacts were prepared.

9 RECOMMENDATION

The Chicago District recommends Plan 1 – the no action alternative. Economic benefits were not estimated to exceed the costs for any of the action alternatives considered and therefore federal interest could not be established.

10 REFERENCES

North Branch of the Chicago River Detailed Watershed Plan. Prepared for the Metropolitan Water Reclamation District of Greater Chicago by HDR, Inc. January 2011. Chicago, Illinois.

Project Definition Report for a Flood Control Project for the West Fort of the North Branch of the Chicago River. Prepared for the Metropolitan Water Reclamation District of Greater Chicago by MWH Global. June 2015. Chicago, Illinois.

U.S. Army Corps of Engineers. Engineer and Construction Bulletin (ECB). Number 2018-14. *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects*. September 10, 2018. http://www.wbdg.org/FFC/ARMYCOE/COEECB/ecb_2018_14.pdf.

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