Stormwater Model Update and Flood-Risk Area Identification and Prioritization

Prepared for
City of Richfield

Prepared by
Barr Engineering Co.

August 2025

This study was paid for in part by a grant from the MPCA.

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Certification

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Kelly Miller
PE #: 52619

August 15, 2025
Date

Stormwater Model Update and Flood-Risk Area Prioritization Identification

August 2025

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Abbreviations

Barr	Barr Engineering Co.
BMP	Best Management Practice
city	City of Richfield
H&H	hydrologic and hydraulic
LiDAR	Light Detection and Ranging
MCE100-year	Mid-21st century 100-year moderate rainfall estimate
MSE3	Midwest Southeast 3
PCSWMM	Personal Computer Stormwater Management Model
SVI	Social Vulnerability Index
USGS	United States Geological Survey

1 Introduction

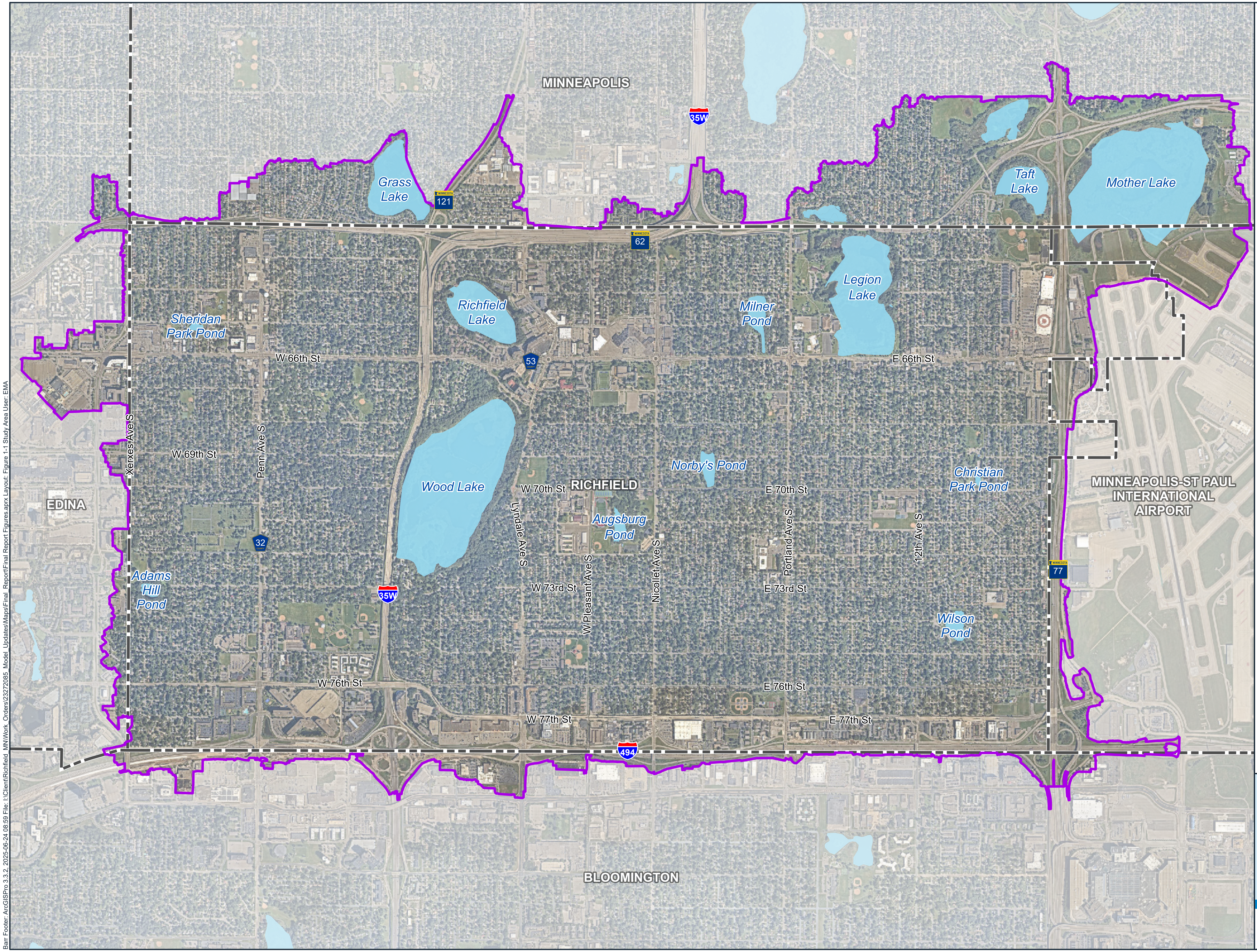
In 2018 and 2019, Barr Engineering Co. (Barr) helped the city of Richfield (city) develop a hydrologic and hydraulic (H&H) stormwater model that covers the municipal boundary [reference (1)]. The model covers the entire city and the areas of adjacent cities that drain into Richfield. The model study area covers the total watershed area included in the H&H model which is approximately 8.8 square miles and is shown in Figure 1-1. The stormwater model was originally developed for multiple purposes, which include:

- Identifying inundation extents for the 2-, 10-, and 100-year 24-hour precipitation events
- Identifying potentially flood-prone structures
- Assessing the performance of existing stormwater infrastructure
- Prioritizing areas for infrastructure upgrades and stormwater BMP implementation
- Evaluating the impact of development and redevelopment within the city

The city has experienced redevelopment since the original model development, and the city's goals for this project were to:

- Update the existing H&H stormwater model
- Climate adaptation evaluation by simulating a larger storm in the model
- Prioritize flood-risk project areas through environmental justice and additional factors
- Evaluate concept-level flood-risk reduction projects at selected locations.

This report is organized following the chronological order of the project. Stormwater model updates are discussed in Section 2, followed by the climate adaptation assessment in Section 3, the environmental justice analysis and project prioritization in Section 4, the flood-risk reduction project identification and alternatives in Section 5, and conclusions in Section 6.



- Study Area
- Municipal Boundary
- Lakes and Ponds

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Nearmap Imagery, 2024

Study Area
Richfield, MN

FIGURE 1-1

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2 Stormwater Model Updates

The original stormwater model was developed using the Personal Computer Stormwater Management Model (PCSWMM) and had not been updated since provided to the city. Updates to the model as part of this project included:

- New topographic information published by the USGS since the original model development, which was incorporated in the updated model, as discussed in Section 2.1.
- City staff provided information about construction projects with stormwater impacts that have occurred in the study area since 2018, as discussed in Section 2.2.
- Barr added additional data to the PCSWMM model based on collected survey data and information from the city of Minneapolis stormwater model, which is discussed in Section 2.3

In addition to the changes listed above and described in more detail below, the existing model was divided into two PCSWMM model files (East and West) which required intermediate boundary conditions or flows from one file to the other. The model has been updated to be one PCSWMM model file that covers the entire city. This removed the need for intermediate boundary conditions.

2.1 2022 USGS LiDAR Model Updates

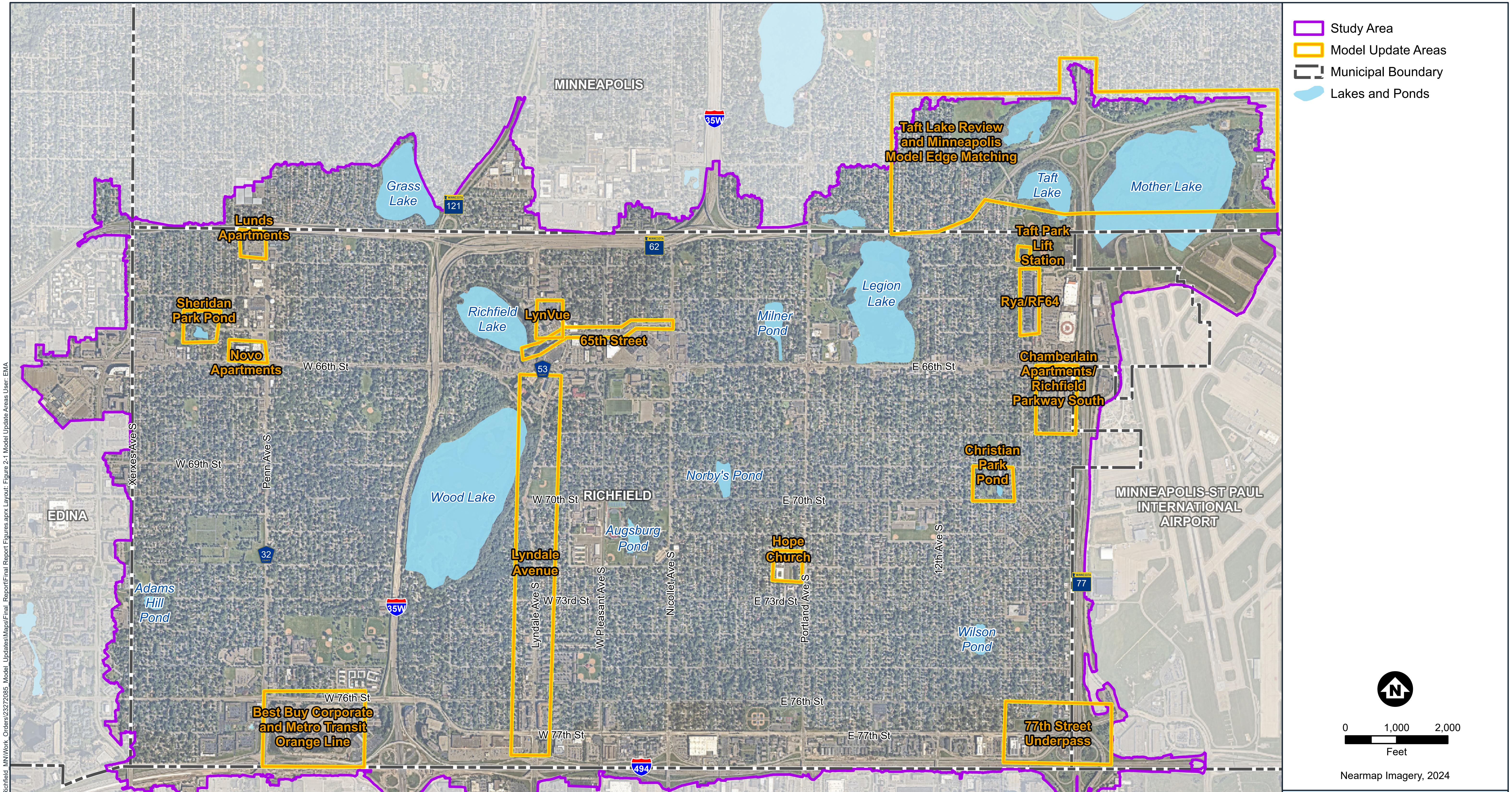
Barr updated the existing PCSWMM model to incorporate the Light Detection and Ranging (LiDAR) data collected in 2022 and published by the United States Geological Survey (USGS) [reference (2)]. The 2018 model was based on LiDAR data collected in 2011 [reference (3)]. Model updates included revisions to storage curves and overland flow paths. Storage curve updates included adjustments to inverts and initial depths in natural depressions where the updated LiDAR data provided additional data at lower elevations. Overland flow paths were reviewed for LiDAR elevation changes of greater than 0.5 feet and new overland flow paths were added to the model using the updated LiDAR data to simulate a larger rainfall event, as discussed in Section 3.

2.2 Model Update Areas

Barr updated the existing PCSWMM model for areas identified by the city as shown in Figure 2-1. These update areas included redevelopments, pond improvement projects, street and storm sewer projects, and areas of the city that had been part of stormwater evaluations since 2018. Updates in these areas were based on data provided by the city and available data including the city's updated GIS storm sewer data, as-built drawings, and the 2022 LiDAR data. The 2022 LiDAR dataset was used for watershed boundary updates, except locations with specific grading plans available.

Additionally, the city provided updated storm lift station data, and where applicable, Barr updated the model inputs in the PCSWMM model. As part of the model update areas the storm pump station at Taft Park was added to the model.

The methodology outlined in the original model development report *Richfield Hydrologic and Hydraulic Modeling Report* [reference (1)] was followed to update the model.



Model Update Areas
Richfield, MN

FIGURE 2-1

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2.3 Taft Lake Review

Available storm sewer and outlet structure data on the lake connections between Mother Lake and Taft Lake, and Taft Lake north of Highway 62, were identified as high importance to the city for current stormwater-related efforts. Barr surveyed from the outlet structure on Mother Lake to Taft Lake and from Taft Lake north of Highway 62. This survey data consisted of pipe inverts, material, shape, diameter, and additional details on the Mother Lake outlet structure. Information from the survey was used to update the PCSWMM model in this area. Survey locations are shown on Figure 2-2.

2.3.1 Minneapolis Model Edge Matching North of Mother Lake and Taft Lake

As part of the Taft Lake Review, the extent of the modeled watersheds and boundary conditions north of Mother and Taft Lake in Minneapolis was reviewed. Additional watershed area in the city of Minneapolis was added to the city of Richfield PCSWMM model that was previously accounted for in model inflows. Including this area in the model allows for a greater understanding of the direct watershed runoff to the two lakes and the contributing watershed area. Along with the additional watershed area, the connecting storm sewer pipes were also added to the model.

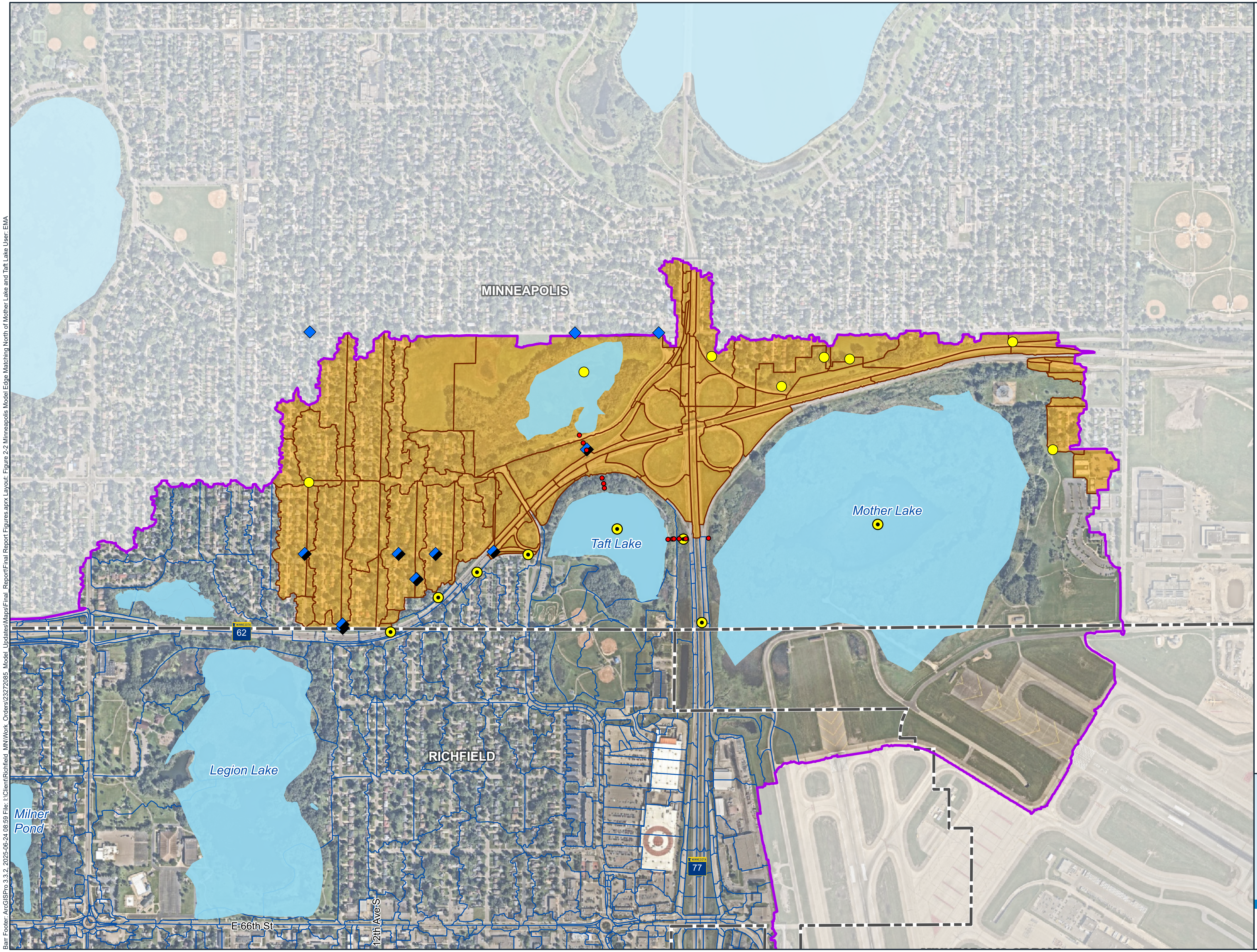
Boundary conditions were re-evaluated with the expansion of the watershed area. Inflow boundary conditions were set to locations where surface overflows during the peak of storm events occur. The downstream boundary condition along the outflow path from Taft Lake to Lake Nokomis in Minneapolis was set just downstream of the outlet control from the wetland area north of Highway 62 and Taft Lake. The updated boundary conditions are shown on Figure 2-2 and summarized in Table 2-1.

The additional watershed area, connecting storm sewer pipes, and boundary condition timeseries data were originally sourced from the city of Minneapolis stormwater model, with their approval [reference (4)].

Table 2-1 Updated Boundary Conditions with Minneapolis

Added or Removed	Inflow or Outflow	Richfield PCSWMM Junction/ Storage ID	Boundary Condition Data Source
Removed	Outflow	432571Z	Minneapolis South Region XP-SWMM Model[1]
Removed	Outflow	432526Z	Minneapolis South Region XP-SWMM Model[1]
Removed	Outflow	432577Z	Minneapolis South Region XP-SWMM Model[1]
Removed	Outflow	432577Z2	Minneapolis South Region XP-SWMM Model[1]
Removed	Outflow	433867Z1	Minneapolis South Region XP-SWMM Model[1]
Removed	Outflow	433867Z2	Minneapolis South Region XP-SWMM Model[1]
Removed	Outflow	545102	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	MOL01	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	979959A	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	692463	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	509725	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	433860	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	433789	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	433530	Minneapolis South Region XP-SWMM Model[1]
Removed	Inflow	433326	Minneapolis South Region XP-SWMM Model[1]
Added	Outflow	9OUT03	Minneapolis South Region XP-SWMM Model[2]
Added	Outflow	9OUT02	Minneapolis South Region XP-SWMM Model[2]
Added	Outflow	9OUT01	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	559084	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	559120	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	9C538983	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	9A441934	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	9A433585	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	9A632715	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	632715	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	433536	Minneapolis South Region XP-SWMM Model[2]
Added	Inflow	432521	Minneapolis South Region XP-SWMM Model[2]

1 - City of Minneapolis ‘MPLS_So_Region.xp’ provided in 2017 during original model development [reference (5)]
2 - City of Minneapolis ‘MPLS_So_Region.xp’ provided in 2024 during model updates [reference (6)]



Study Area
Watersheds Added From Minneapolis Model
Model Subwatersheds
MnDOT Survey Points

Updated Boundary Condition

Added Inflow
Deleted Inflow
Added Outflow
Deleted Outflow
Municipal Boundary
Lakes and Ponds

0 400 800
Feet

Nearmap Imagery, 2024

Minneapolis Model Edge Matching North of Mother Lake and Taft Lake
Richfield, MN

FIGURE 2-2

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3 Rainfall Events, Climate Adaptation Assessment, and Model Results

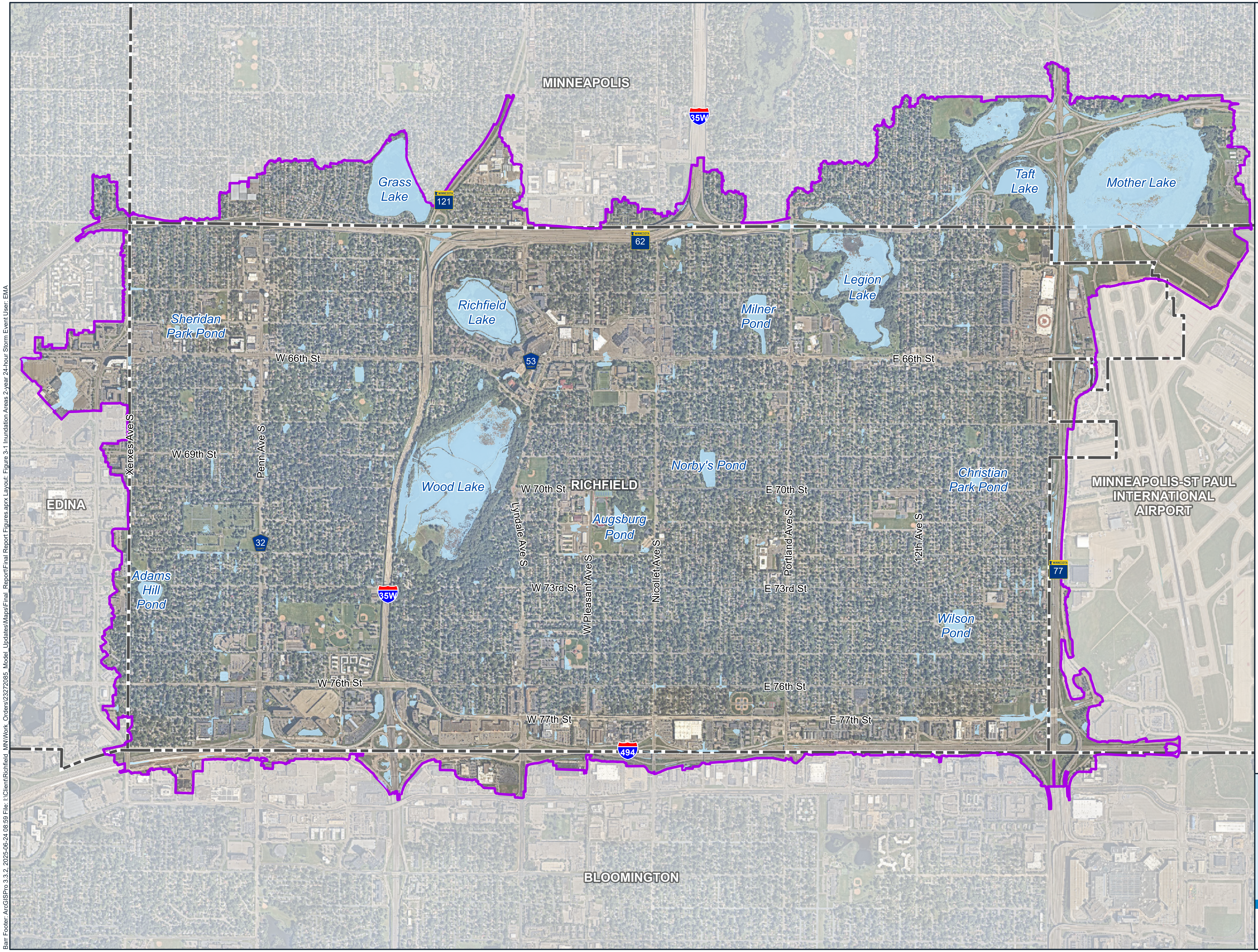
The PCSWMM model was used to simulate four design rainfall events. Three design rainfall events were simulated in the original model developed in 2018 and 2019 and are the Atlas 14 2-year, 10-year, and 100-year 24-hour storm events [reference (7)]. To provide additional information for the city to assess climate adaptation, the updated model also represents the Mid-21st century 100-year moderate rainfall estimate (MCE100-year) 24-hour storm event [reference (8)]. The MCE100-year 24-hour storm event is intended to estimate the long-term extreme weather trends on flood mitigation. The four design storm events use the Midwest Southeast 3 (MSE3) rainfall distribution [reference (9)]. Rainfall depth for the four design storm events is listed in Table 3-1.

Table 3-1 Precipitation Depth for Design Storm Events

Storm Event and Return Period	Duration	Precipitation Depth (inches)
Atlas 14 2-year	24-hour	2.83
Atlas 14 10-year	24-hour	4.24
Atlas 14 100-year	24-hour	7.50
MCE100-year	24-hour	10.20

The larger precipitation depth for the MCE100-year 24-hour storm event resulted in more stormwater runoff conveyed through the stormwater system, causing greater surface ponding and overland flow rates compared to the 100-year MSE3 event. To account for additional surface flow directions additional overland flow paths were added to the model using transects developed from the 2022 LiDAR data or standard street cross sections consistent with the methodology outlined in the original model development report [reference (1)]. To account for additional surface ponding, rim elevations were increased at modeled junctions and storages. The MCE100-year storm event used the 100-year 24-hour storm event boundary conditions. For model consistency, all four storm events were simulated in the updated model.

Model results of the peak water level for the 2-, 10-, 100-, and MCE100-year 24-hour rainfall events were used to create inundation areas. Inundation areas were delineated where water is stored in ponds, wetlands, and topographic depressions using level pool mapping in ArcGIS (i.e., inundation mapping of sloped water surface along roadways and through the floodplain was not completed). Inundation areas were adjusted in locations where the LiDAR surface did not accurately represent existing topographic conditions. This typically occurred near bridges or large buildings where the 2022 LiDAR data set does not capture the features accurately. The inundation maps for each rainfall event are shown in Figure 3-1 through Figure 3-4.



Study Area

2-year 24-hour Storm Event Inundation Extent

Municipal Boundary

Note: Inundation areas were delineated where water is stored in ponds, wetlands, and topographic depressions using level pool mapping in ArcGIS (i.e., inundation mapping of sloped water surface along roadways and through the floodplain was not completed).

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Nearmap Imagery, 2024

Inundation Areas
2-year 24-hour Storm Event
Richfield, MN

FIGURE 3-1

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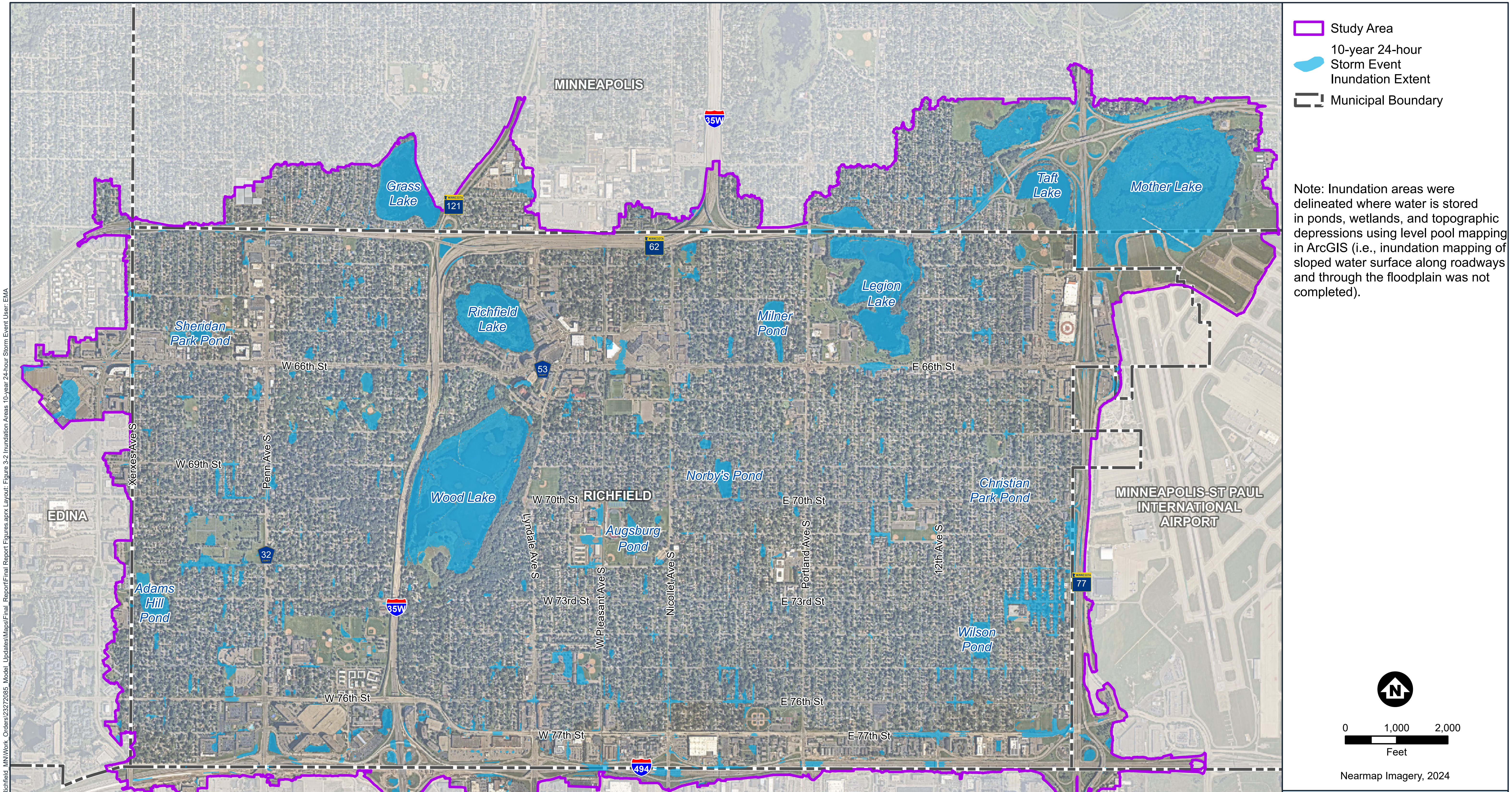
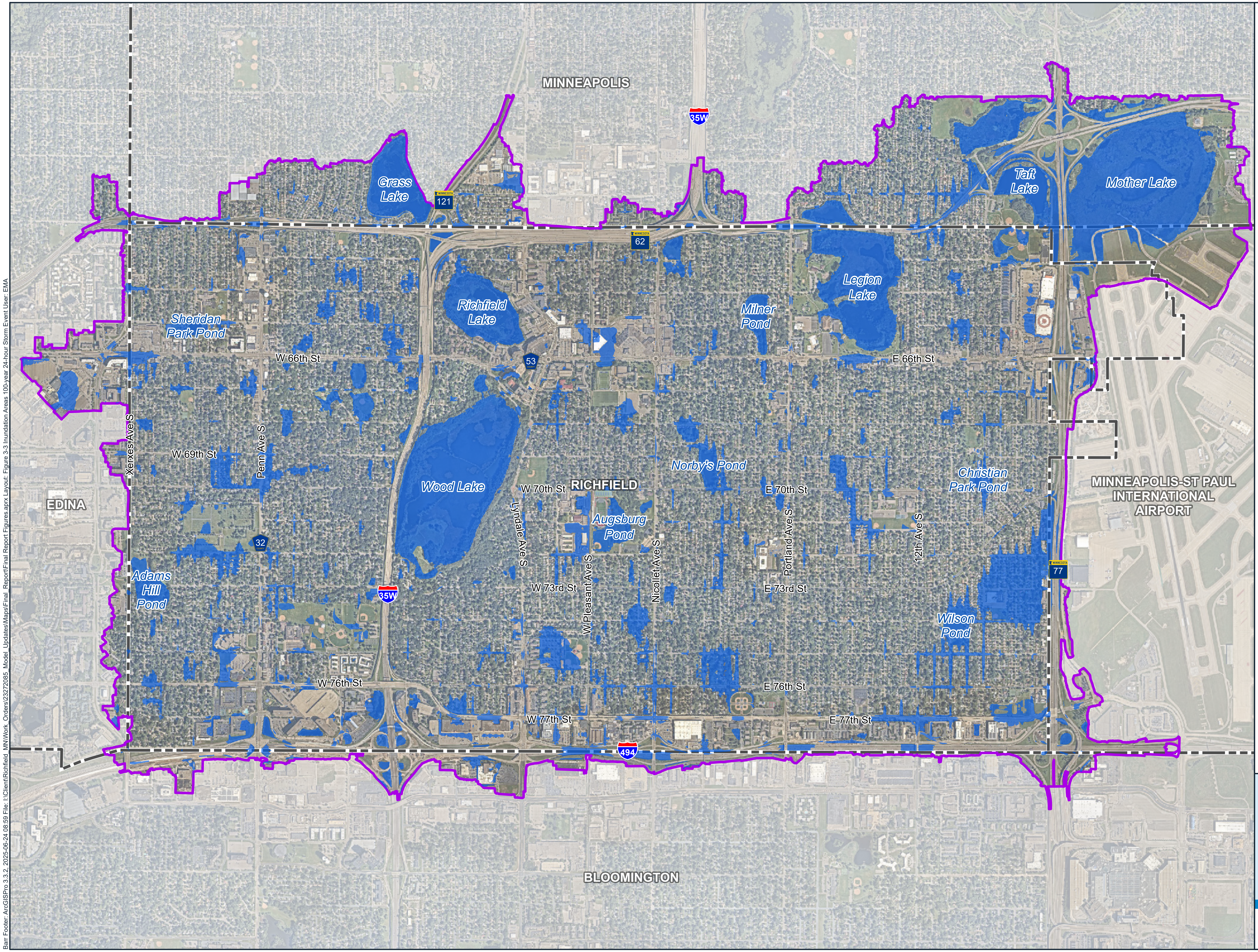
Barr Footer: ArcGISPro 3.3.2, 2025-06-24 08:59 File: I:\Client\Richfield_MN\Work_Orders\23272085_Model_Updates\Maps\Final_Report\Final Report Figures.aprx Layout: Figure 3-1 Inundation Areas 2-year 24-hour Storm Event User: EMA



Inundation Areas
10-year 24-hour Storm Event
Richfield, MN

FIGURE 3-2

BARR



Study Area

100-year 24-hour Storm Event Inundation Extent

Municipal Boundary

Note: Inundation areas were delineated where water is stored in ponds, wetlands, and topographic depressions using level pool mapping in ArcGIS (i.e., inundation mapping of sloped water surface along roadways and through the floodplain was not completed).

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Feet

Nearmap Imagery, 2024

Inundation Areas
100-year 24-hour Storm Event
Richfield, MN

FIGURE 3-3

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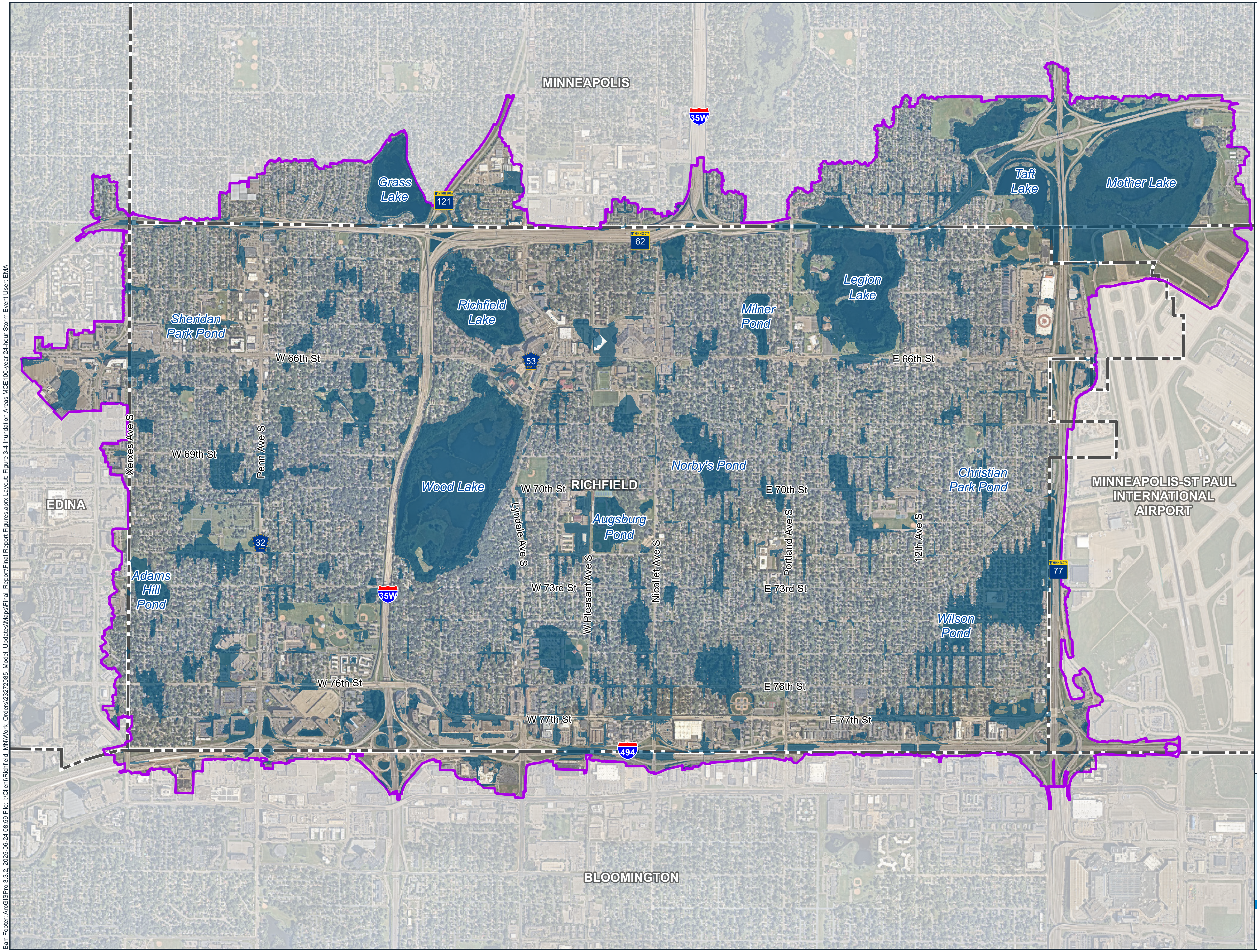

Study Area

MCE100-year 24-hour Storm Event Inundation Extent

Municipal Boundary

Note: Inundation areas were delineated where water is stored in ponds, wetlands, and topographic depressions using level pool mapping in ArcGIS (i.e., inundation mapping of sloped water surface along roadways and through the floodplain was not completed).

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Feet

Nearmap Imagery, 2024

Inundation Areas
MCE100-year
24-hour Storm Event
Richfield, MN

FIGURE 3-4

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4 Environmental Justice Analysis and Project Prioritization

Using the inundation areas discussed in Section 3 and the criteria the city identified for prioritizing flood-risk areas, a tool was developed to help the city identify the general prioritization of flood-risk areas for further evaluation. This process is described in Section 4.1 and the results of the analysis are described in Section 4.2.

4.1 Methodology

Multiple criteria were considered in the evaluation to identify potential multi-faceted mitigation measures to address potentially flood-prone areas. Barr consulted with the city to identify criteria that would be considered in prioritizing flood-risk areas, and the city provided the scoring and weight applied to each criterion. While the approach has limitations, it provides a consistent methodology to determine where to begin evaluating and planning stormwater improvements that align with the city's priorities. The criteria selected to score the flood-risk areas are:

- Storm system conditions
- Critical infrastructure
- Frequency of flooding
- Social vulnerability index (SVI)
- Number of flood-prone structures

Each of the criteria was assigned a score. A score of zero represents that the criteria do not apply for a given area, whereas a higher score indicates that it is a high priority for the area. Each of the criteria was also assigned a weight to allow the city to prioritize the criteria relative to each other.

Using the 100-year 24-hour inundation areas based on the model results, shown on Figure 3-3 flood-risk areas were developed by grouping inundation areas where the inundation polygons touched across watershed boundaries.

The model study area extends beyond the city municipal boundary, so flood-risk areas outside or mostly outside of the municipal boundary were identified within the prioritization tool spreadsheet. Results include scores for all flood-risk areas, but those outside of the municipal boundary naturally scored lower, as the majority of the data sets used for the prioritization did not extend outside of the municipal boundary.

The following sections describe the prioritization criteria that were considered.

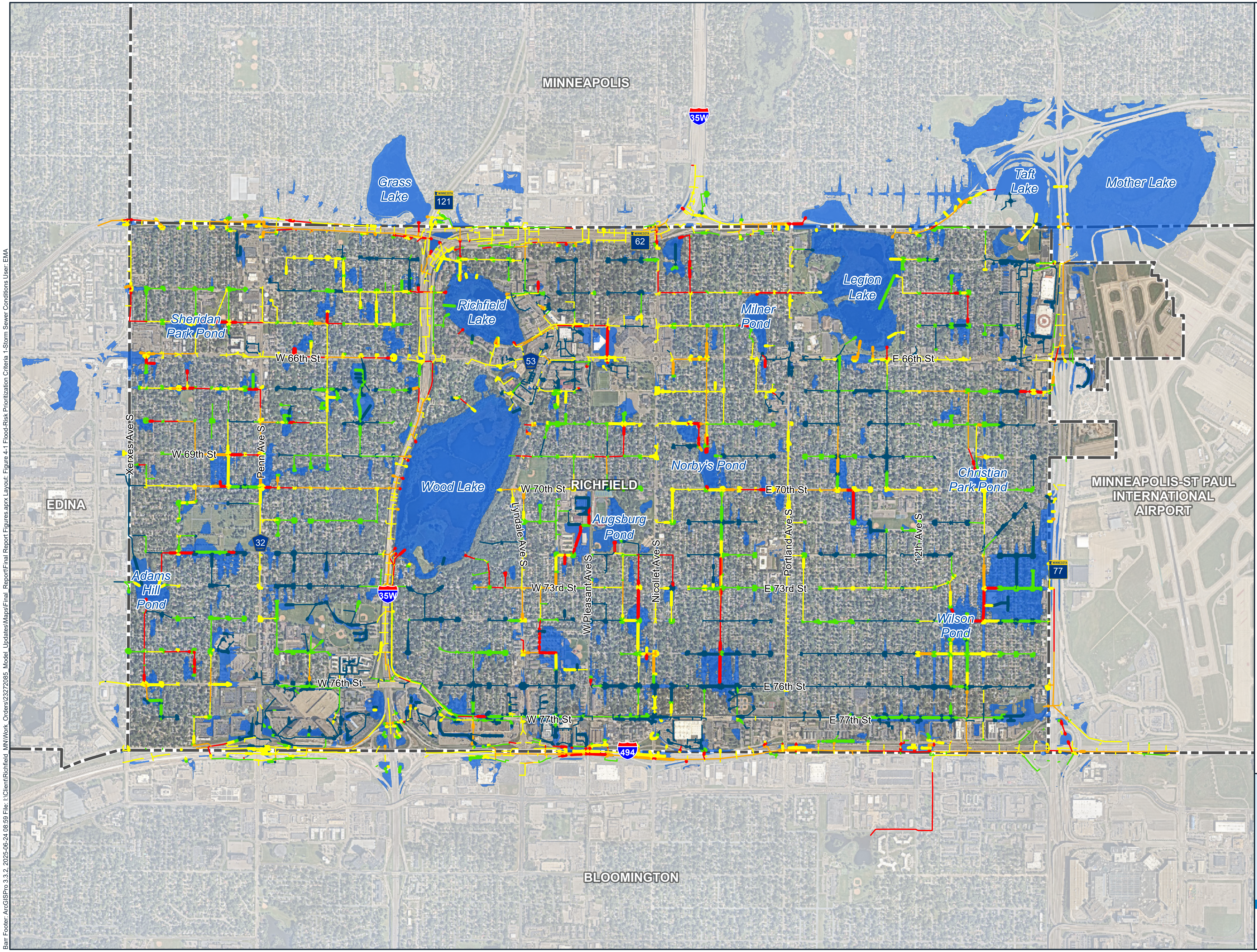
4.1.1 Storm System Conditions

Scoring from the Stormwater Infrastructure Qualitative Risk Analysis for the City of Richfield memo was used for the analysis of storm system conditions [reference (10)]. This scoring system was created to identify pipe segments or culverts with a higher likelihood of failure due to age, material, and ground slope. The identified infrastructure was also assessed to determine the consequences of pipe failure, including the potential for roadway or railway collapse, inundation or washout, flooding or settlement of structures, flooding or critical or high-value public buildings, and slope failure. The combined risk score percentiles are based on all pipes included in the analysis of the memo, and percentiles were selected at identified percentile breaks in the data.

Table 4-1 defines the scoring and weighting associated with the storm system conditions criteria. To score and weigh each flood-risk area for the storm system condition, the city's storm sewer pipe network was intersected with the 100-year flood-risk areas. Then the average combined risk score from all intersected pipes per flood-risk area was calculated, and the score and weight shown in Table 4-1 was applied. The pipes within each flood-risk area are shown on Figure 4-.

Table 4-1 Storm System Conditions Scoring

Criteria	Score	Weight
Low risk (combined risk score 0-34th percentile)	0	10%
Low to moderate risk (combined risk score 34-59th percentile)	1	
Moderate to high risk (combined risk score 59-91st percentile)	4	
High risk (combined risk score 91-96th percentile)	7	
Highest risk (combined risk scores 96-100th percentile)	10	



Municipal Boundary

100-year 24-hour Storm Event Inundation Extent

Storm Sewer Conditions*

- Low Level of Combined Risk
- Low to Moderate Risk
- Moderate to High Risk
- High Risk
- Highest Risk

*Storm sewer within 100-year 24-hour Storm Event Inundation Extent is shown in **bold**.

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Feet

Nearmap Imagery, 2024

Flood-Risk Prioritization Criteria 1: Storm Sewer Conditions
Richfield, MN

FIGURE 4-1

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4.1.2 Critical Infrastructure

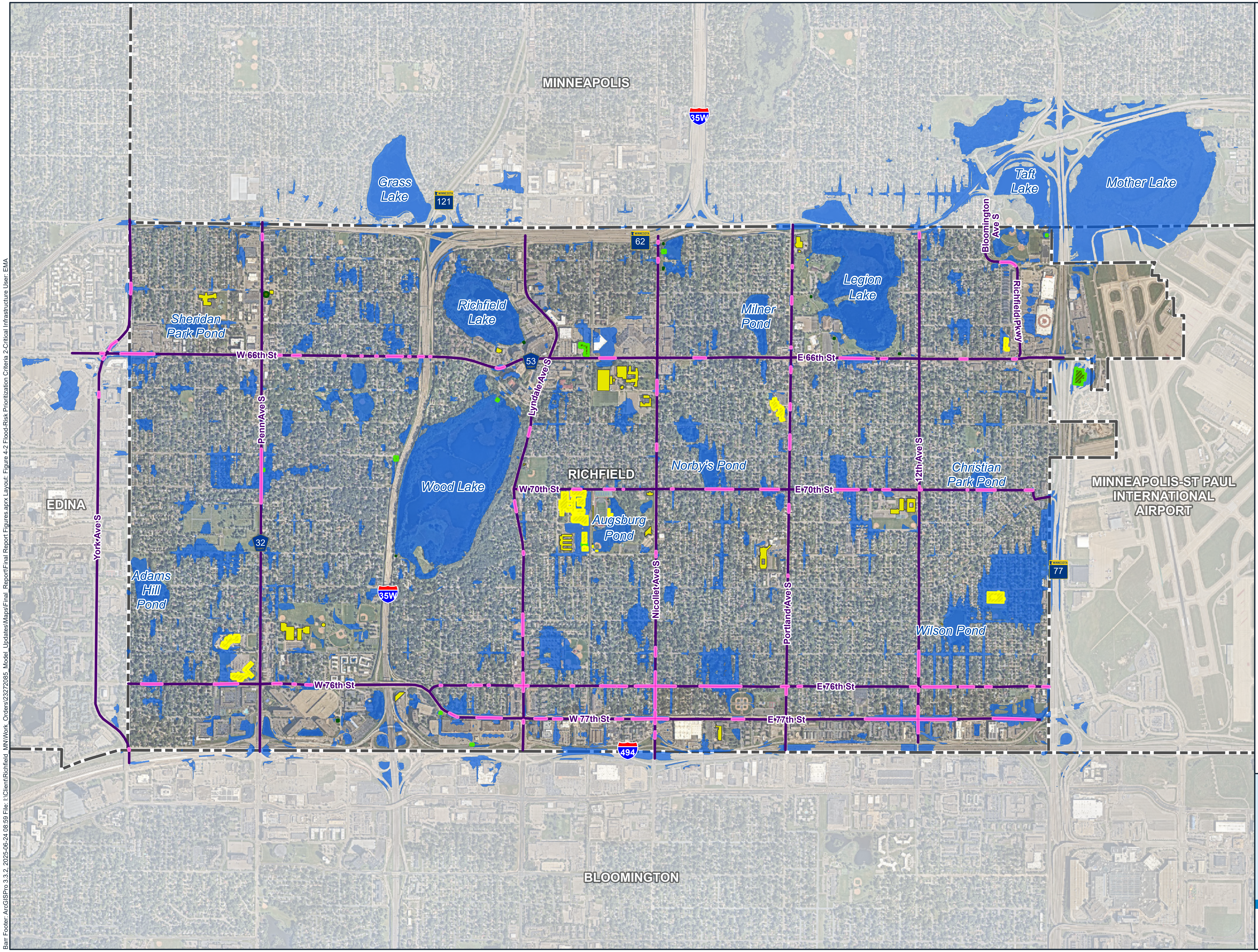
Critical infrastructure for this analysis was identified by the city to include critical transportation routes, city infrastructure for specific utilities, emergency service locations, and schools. These types of infrastructure were identified by the city as providing essential services during a flood event. For scoring, three categories of critical infrastructure were identified:

- Critical transportation routes – these are roadways that need to remain open to allow for evacuation or access by emergency services. Critical transportation routes were defined by the city.
- Critical city utility infrastructure – city staff identified critical utility infrastructure that includes sanitary and storm lift stations. These locations were determined to provide critical services, and it is critical that they continue to operate during a flood event.
- Emergency service locations and schools – these are defined as locations that provide essential services before, during, or following a flood event. These include hospitals, police stations, fire stations, local government buildings, and schools.

Table 4-2 defines the scoring and weighting associated with the critical infrastructure criteria. To score each flood-risk area for critical infrastructure, points were awarded for each structure that was located within the 100-year flood-risk area, following the scores outlined in Table 4-1. The critical infrastructure within each flood-risk area is shown on Figure 4-2.

Table 4-2 Critical Infrastructure Scoring

Criteria	Score	Weight
Critical infrastructure is not located in flood-risk area	0	15%
Critical transportation route is located within a flood-risk area	1 per each 600 feet of route	
Critical city infrastructure is located within a flood-risk area (specifically utilities)	4 per each location	
Emergency service(s) locations and schools are located within a flood-risk area	3 per each location	



Municipal Boundary

100-year 24-hour Storm Event Inundation Extent

Critical Transit Route

Critical Infrastructure: Emergency Services or School

Critical Infrastructure: Utility

Impacted Critical Transit Route

Impacted Critical Infrastructure: Emergency Services or School

Impacted Critical Infrastructure: Utility

Critical transportation routes – These are roadways that need to remain open to allow for evacuation or access by emergency services. Critical transportation routes were defined by the city.

Critical city utility infrastructure – City staff identified critical utility infrastructure that includes sanitary and storm lift stations. These locations were determined to be providing critical services, and it is critical that they continue to operate during a flood event.

Emergency service locations and schools – These are defined as locations that provide essential services before, during, or following a flood event. These include hospitals, police stations, fire stations, local government buildings, and schools.

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Feet

Nearmap Imagery, 2024

Flood-Risk Prioritization Criteria 2: Critical Infrastructure

Richfield, MN

FIGURE 4-2

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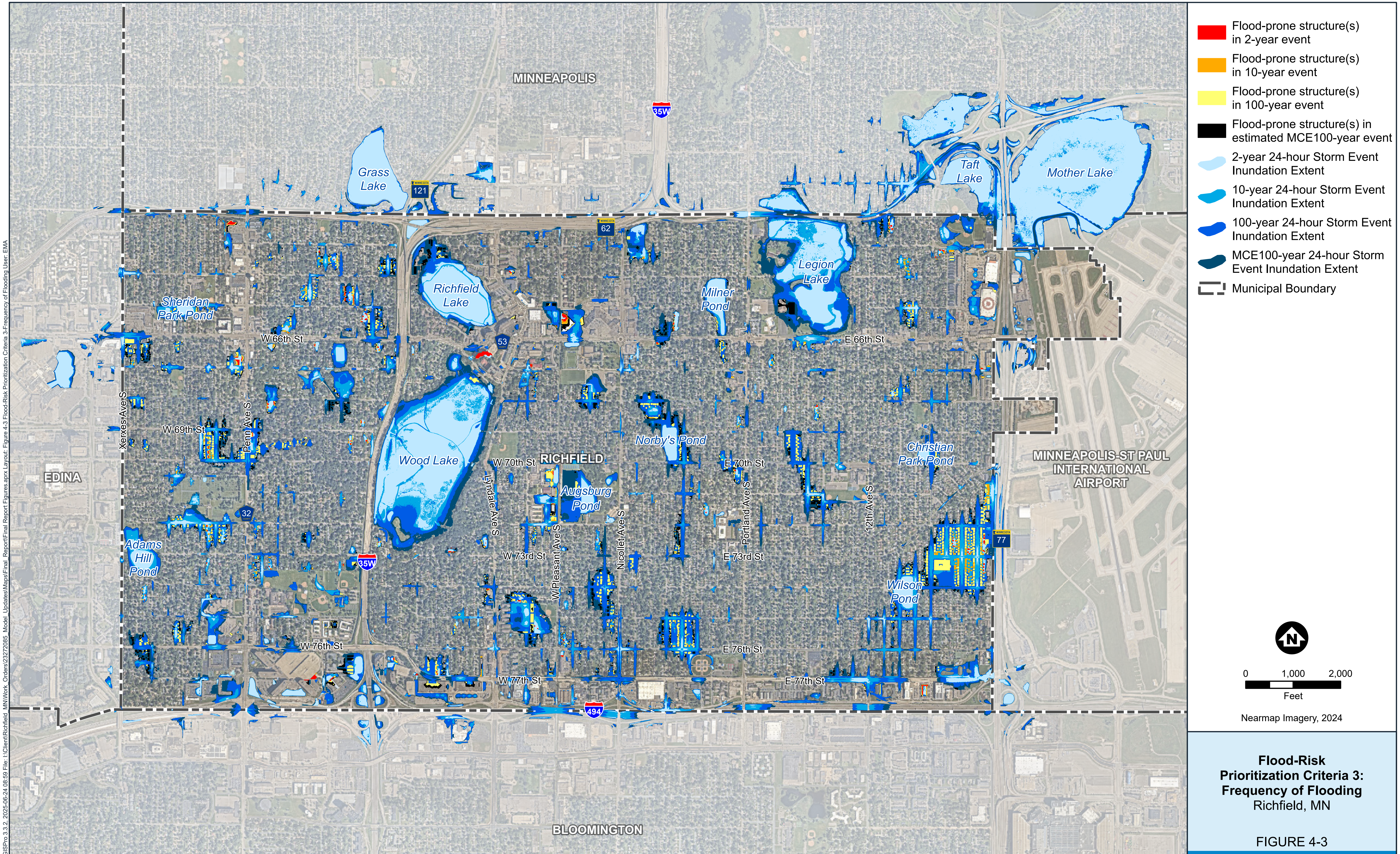
4.1.3 Frequency of Flooding

The frequency of flooding refers to how often a location is potentially inundated. Areas that could be inundated more frequently generally also have larger inundation depth during less frequent events (i.e., deeper inundation depth during the 100-year event). Therefore, areas that are inundated more frequently received higher scores than areas that do not flood as often. Scores were determined by considering the lowest structure within a given floodplain area (i.e., the structure that floods the most frequently).
Table 4-3 defines the scoring and weighting associated with the frequency of flooding criteria. Structures are shown on Figure 4-3 that intersect the inundation areas and are color-coded by the first storm event that impacts the structure.

Table 4-3 Frequency of Flooding Scoring

Criteria	Score	Weight
No flooding of structure(s) during a 100-year event	0	25%
Flood-prone structure(s) in estimated MCE100-year event	1	
Flood-prone structure(s) in 100-year event	3	
Flood-prone structure(s) in 10-year event	5	
Flood-prone structure(s) in 2-year event	10	



Flood-Risk Prioritization Criteria 3: Frequency of Flooding
Richfield, MN

FIGURE 4-3

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4.1.4 Social Vulnerability Index

Social vulnerability is a measure of a community's ability to respond to a natural disaster. The database referenced to determine the social vulnerability index for this scoring is the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry Social Vulnerability Index (SVI) [reference (11)]. This database was created to help public health officials and emergency response planners identify and map areas of the community that would most likely need support before, during, and after a hazardous event. The SVI indicates the relative vulnerability of every U.S. census tract to prepare for and respond to hazardous events, whether a natural disaster like a flood or a disease outbreak, or an anthropogenic event such as a harmful chemical spill. The social factors incorporated in SVI are shown in Figure 4-4.

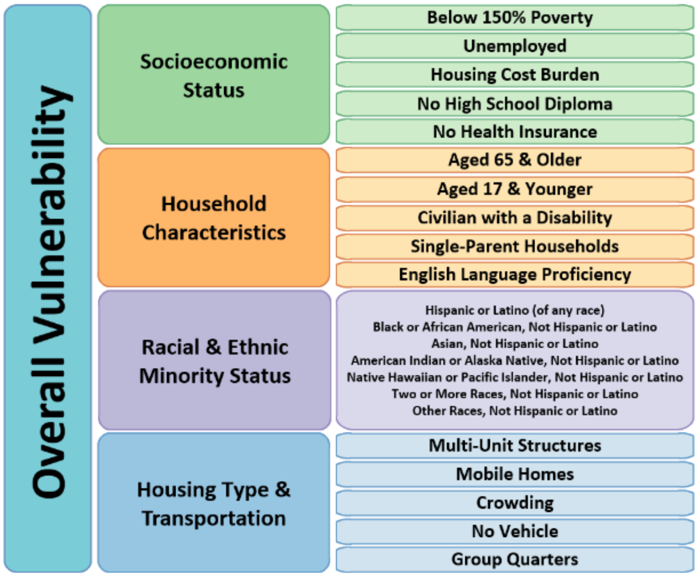


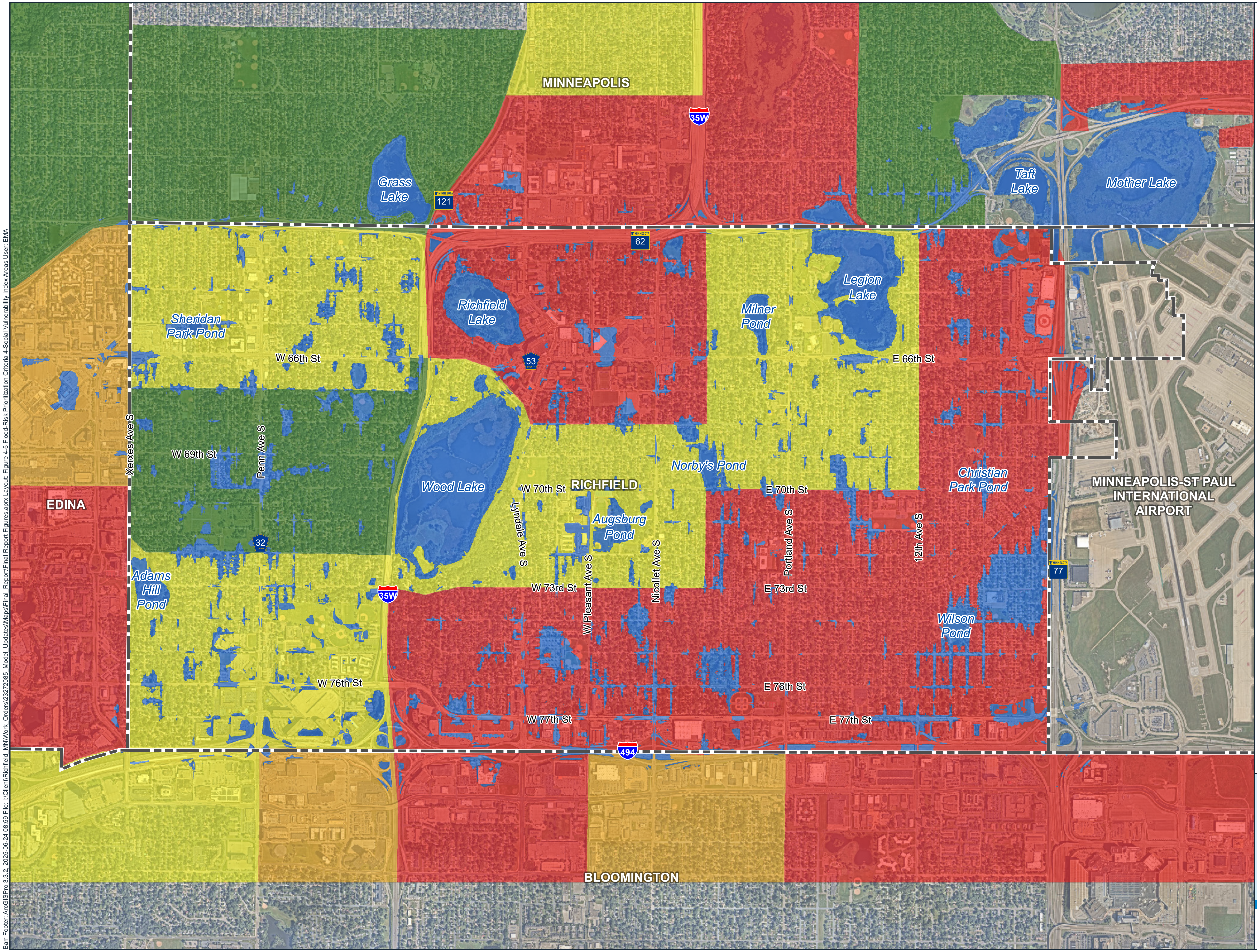
Image from Centers for Disease Control and Prevention / Agency for Toxic Substances and Disease Registry SVI [reference (11)]

Figure 4-4 Social Vulnerability Index Factors

Table 4-4 defines the scoring and weighting associated with the social vulnerability index of the floodplain area. To score each flood-risk area using the social vulnerability index, the area weighted average was computed based on the 100-year flood-risk area over the SVI value by census tract [reference (11)]. The area weighted average method means that if a flood-risk area was entirely within one census tract the value would be the same as the census tract; alternatively, if a flood-risk area crosses a census tract boundary the area in each census tract is multiplied by the SVI rating of the census tract, then those two values are added and divided by the total area of the flood-risk area. The flood-risk areas over the SVI census tract data are shown on Figure 4-5.

Table 4-4 Social Vulnerability Index Scoring

Criteria	Score	Weight
Low level of vulnerability (SVI 0-25th percentile)	1	10%
Low to moderate level of vulnerability (SVI 25-50th percentile)	4	
Moderate to high level of vulnerability (SVI 50-75th percentile)	7	
High level of vulnerability (SVI 75-100th percentile)	10	



Municipal Boundary

100-year 24-hour Storm Event Inundation Extent

Social Vulnerability Index

- Low level of vulnerability (SVI 0-25th percentile)
- Low to moderate level of vulnerability (SVI 25-50th percentile)
- Moderate to high level of vulnerability (SVI 50-75th percentile)
- High level of vulnerability (SVI 75-100th percentile)

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Feet

Nearmap Imagery, 2024

Flood-Risk Prioritization Criteria 4: Social Vulnerability Index Areas
Richfield, MN

FIGURE 4-5

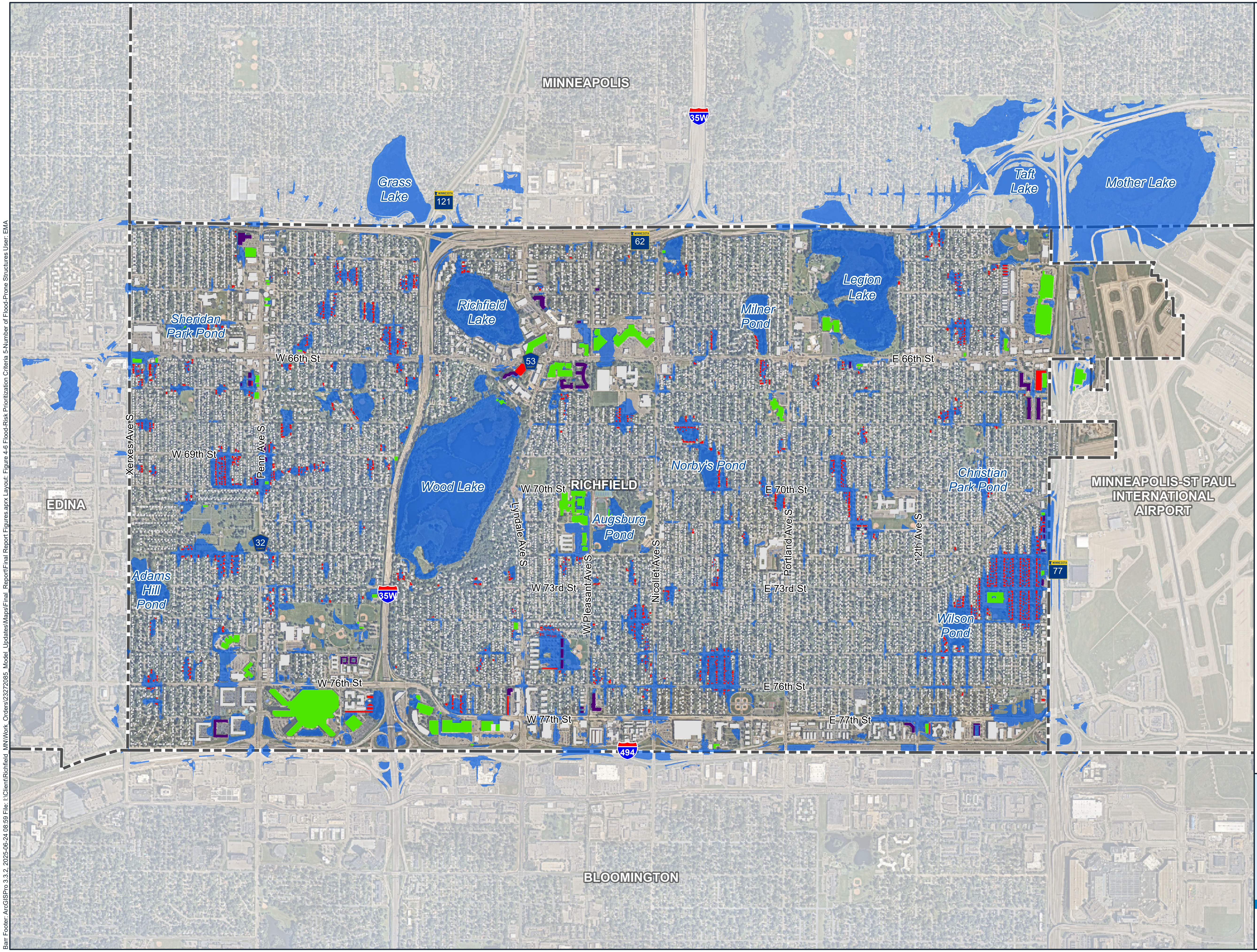
BARR

4.1.5 Number of Flood-Prone Structures

The number of potentially flood-prone structures was calculated by intersecting building outlines provided by the city of Richfield with the 100-year flood-risk areas. Areas where more structures were located within an inundation area were assigned a higher score. Table 4-5 defines the scoring and weighting associated with the number of flood-prone structures criteria, and flood-prone structures are shown on Figure 4-6.

Table 4-5 Number of Flood-Prone Structures Scoring

Criteria	Score	Weight
No flood-prone structures	0	40%
1-5 flood-prone commercial structures	1	
1-5 flood-prone commercial structures OR greater than 5 flood-prone commercial structures	3	
6-10 flood-prone residential structures OR 1 high-density housing structure	5	
Greater than 10 flood-prone residential structures OR greater than 1 high-density housing structure	10	



Municipal Boundary

100-year 24-hour Storm Event Inundation Extent

Building Footprint

Flood-Prone Structures

Commercial

High-Density Housing

Residential

N

0 1,000 2,000

Feet

Nearmap Imagery, 2024

Flood-Risk Prioritization Criteria 5: Number of Flood-Prone Structures

Richfield, MN

FIGURE 4-6

BARR

Barr Footer: ArcGISPro 3.3.2, 2025-06-24 08:59 File: I:\Client\Richfield_MN\Work_Orders\23272085_Model_Updates\Maps\Final_Report\Final Report Figures.aprx Layout: Figure 4-6 Flood-Risk Prioritization Criteria 5-Number of Flood-Prone Structures User: EMA

4.2 Results

Each flood-risk area was assigned scores and weights based on the criteria listed in Section 4.1.1 through Section 4.1.5 and ranked based on the total score. Areas with higher scores indicate locations that are a higher priority for mitigating flood-risk.

A total of 746 flood-risk areas were evaluated from the study area with 601 flood-risk areas located within or primarily within the municipal boundary. The top 10 locations are summarized in Table 4-6. The locations of all flood-risk areas evaluated are shown on Figure 4-7.

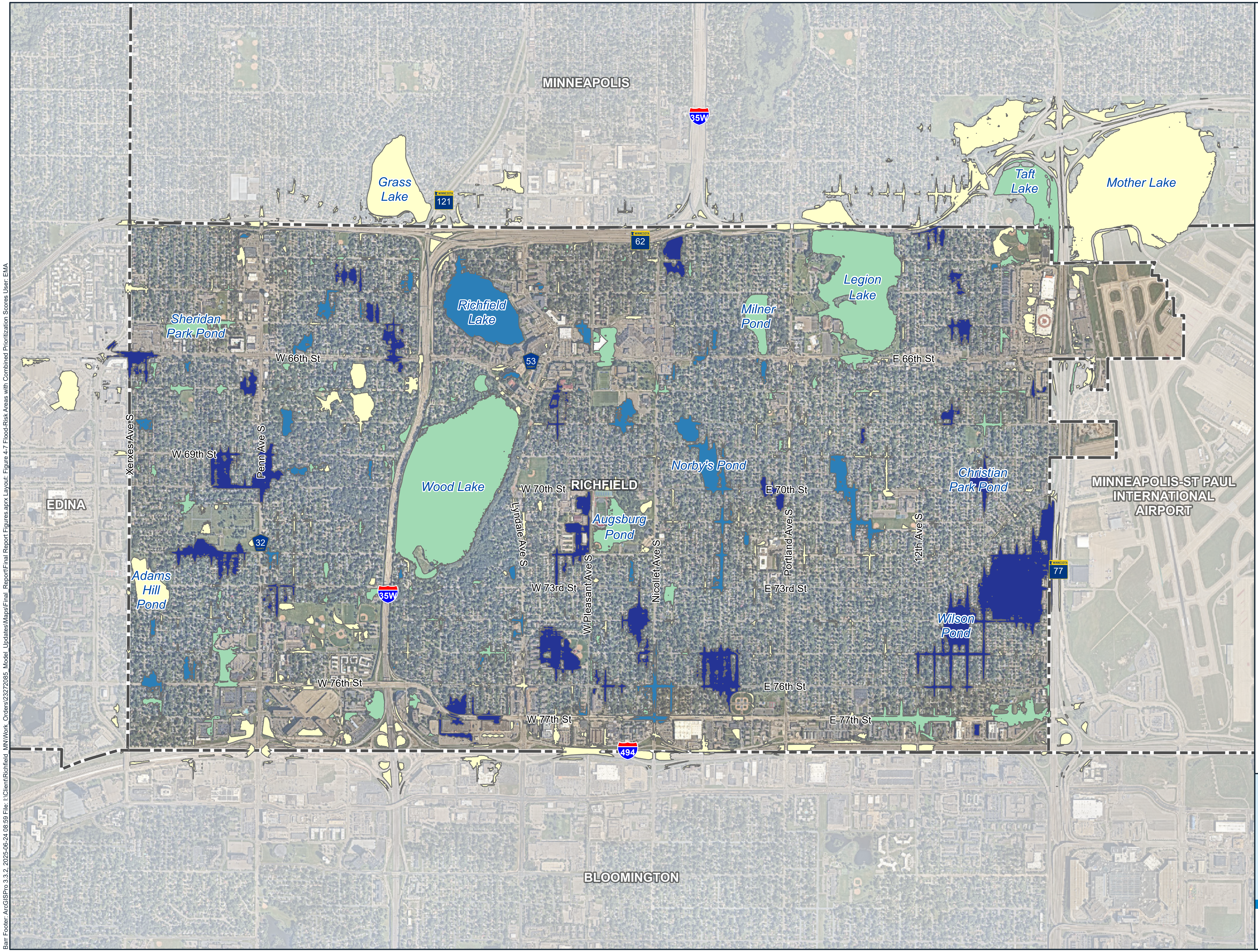
Table 4-6 Top 10 Flood-Risk Locations in the City of Richfield

Flood-Risk Area	Total Score
FPA_1913	9.4
FPA_581	9.1
FPA_1889	8.5
FPA_3434	8.05
FPA_1054	7.9
FPA_2134	7.9
FPA_763	7.65
FPA_2353	7.6
FPA_2501	7.6
FPA_2874	7.6

This prioritization by flood-risk area is a framework to help the city identify flood-risk areas that have a larger impact on buildings or critical infrastructure, have storm sewer infrastructure that has been identified as higher risk, and are impacting community areas that most likely need support before, during, and after a hazardous event. While evaluating future flood-risk reduction projects, the prioritization scoring should be considered with other factors which may include the following:

- Opportunities for improvement from other public works projects (i.e., road reconstruction projects)
- Potential project partners for improvements to offset project costs
- Solving flood-risk areas from upstream to downstream to account for additional volume or flow rate to downstream projects

As such, the prioritization list of potentially flood-prone areas within the city is not intended to be used as a defined order for evaluating areas. Rather, it should be used to provide guidance to the city when determining where to begin with further evaluation of system modifications that could be implemented to reduce the risk of flooding within the city.



Flood-Risk Areas with Combined Prioritization Scores
Richfield, MN

FIGURE 4-7

BARR

5 Flood Control Project Identification and Alternatives Study

The prioritization by flood-risk area was reviewed by city staff who identified three locations for a planning-level evaluation. For each of these three areas, concept level flood-risk reduction projects were modeled to evaluate the reduction in flood risk. Based on the concept level design, a planning-level cost estimate was developed for city staff to consider when planning for further evaluation of each project.

Section 5.1 through Section 5.3 describe the details of the three selected flood-risk areas and identified potential projects. Additional notes on limitations and additional considerations are included in Section 5.4. The cost estimates provided are described in more detail in Appendix A.

5.1 Flood-Risk Area Near Wilson Pond

The area around Wilson Pond is one of the locations with the largest risk of flooding in the city. This area impacts the most residential structures in a single location, the lowest structures are affected during the 2-year 24-hour rainfall event, Wilson Pond is located within an area of the city with a high social vulnerability index, and surface inundation impacts a critical transportation route through the city as well as a school. For these reasons the city selected this area to evaluate concepts for system modifications to reduce flood risk.

Options that were considered but not pursued for the area near Wilson Pond include adding surface storage areas, underground storage, and a pump to lower the water level in Wilson Pond ahead of a storm event. Surface storage was not considered due to a lack of undeveloped space near the flood-risk area and the city's direction to not consider property acquisition for flood-risk reduction. Underground storage was not considered due to the expected shallow groundwater in the area. The groundwater atlas of Hennepin County shows that groundwater in this area is expected to be less than 10 feet below the ground surface [reference (12)]. The pump option was not considered after review of the volume of water stored in Wilson Pond and an assumed predictive timeframe of 24 hours to lower the water level resulted in a high pumped flow rate for a stormwater system.

Three potential project flood-risk mitigation concepts were identified for the Wilson Pond area:

- Flood Mitigation Concept A: Reduce the water level in Wilson Pond ahead of a storm event and modify the outlet by lowering the invert and increasing the storm sewer capacity from Wilson Pond south, discussed in Section 5.1.1.
- Flood Mitigation Concept B: Increase the storm sewer capacity from Wilson Pond south, discussed in Section 5.1.2.
- Flood Mitigation Concept C: Increase the storm sewer capacity and number of pipes from Wilson Pond south, discussed in Section 5.1.3.

A comparison of the concept level cost estimate for these three potential projects is provided in Table 5-1. The cost estimate is further described in Appendix A.

Table 5-1 Wilson Pond Flood Mitigation Concepts - Cost Estimate Comparison

Concept	Description	Cost Estimate
A	Reduce the water level in Wilson Pond ahead of a storm event and modify the outlet by lowering the invert and increasing the storm sewer capacity	**$8,853,000** $6,198,000 – $15,493,000
B	Increase storm sewer capacity	**$11,536,000** $8,076,000 – $20,188,000
C	Increase storm sewer capacity and number of pipes	**$17,333,000** $12,134,000 – $30,333,000

Note: Total project cost accuracy range is -30% to +50%.

Each of these concepts evaluated from the discharge from Wilson Pond to Highway 494. Model results assume sufficient capacity to route the additional flow away from the city which may need to be conveyed through the city of Bloomington or along the Highway 494 corridor to the Minnesota River. This assumption is not accounted for in the planning-level cost estimates, and further coordination will be required with the city of Bloomington or MnDOT if the city of Richfield decides to further evaluate one of the flood mitigation concepts.

5.1.1 Wilson Pond Flood Mitigation Concept A

This flood mitigation concept is to leverage the existing surface storage in Wilson Pond for storm volume retention and increase the storm sewer capacity downstream of Wilson Pond. This mitigation concept is shown on Figure 5-1. By lowering the water level in the pond ahead of a storm event there is additional capacity to route the runoff from upstream and attenuate the flow before discharging downstream.

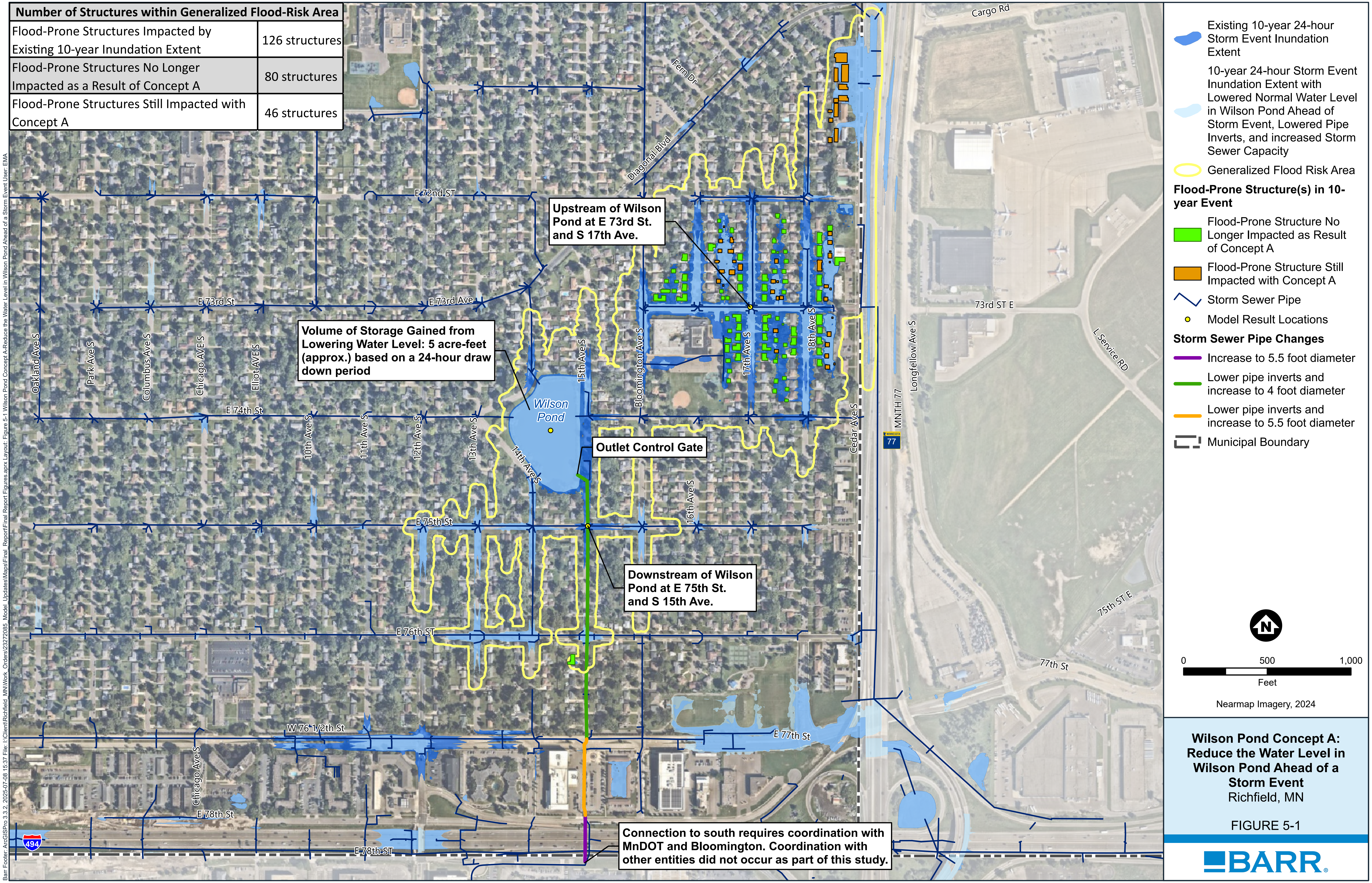
The concept design includes a gate with remote access controlled based on weather forecasts to lower the water level in Wilson Pond ahead of a storm event. This concept design would leverage the existing storage in Wilson Pond and result in approximately 5 acre-feet of additional storage ahead of a storm event with an assumed draw down time of 24-hours. A pumped option was not considered based on the high flow rate needed to lower the water level in the assumed 24-hour period. The storm sewer pipe out of Wilson Pond would be lowered and the storm sewer pipe downstream lowered until the pipe grade was able to re-connect at the existing elevation. A larger pipe size was included downstream of Wilson Pond to Highway 494 to increase both the ability to draw down the water level of Wilson Pond ahead of the storm event as well as increase conveyance capacity during the storm event. For this concept storm sewer pipe changes would be required within the city from Wilson Pond to Highway 494 and from there continued into the city of Bloomington or along the Highway 494 corridor. This concept would result in a larger volume and a higher peak rate of discharge leaving the municipal boundary.

Model results of this concept design are shown in Figure 5-1 with inundation comparison for the 10-year 24-hour storm event and a summary of modeled peak water levels at a few locations around the flood-risk area are compared to the existing condition model results in Table 5-2. The locations summarized in Table 5-2 are also shown on Figure 5-1.

Table 5-2 Modeled Peak Water Levels Wilson Pond Flood Mitigation Concept A: Reduce the Water Level in Wilson Pond Ahead of a Storm Event

Storm Event	Model Condition	Modeled Peak Water Level by Location (feet)		
		Wilson Pond	Upstream of Wilson Pond at E 73rd St. and S 17th Ave.	Downstream of Wilson Pond at E 75th St. and S 15th Ave.
2-year 24-hour	Existing Conditions	823.9	825.3	825.9
	Mitigation Concept A	822.0	825.2	821.6
	Lowered Water Level	1.9	0.1	4.2
10-year 24-hour	Existing Conditions	826.9	826.8	827.3
	Mitigation Concept A	825.4	826.0	823.4
	Lowered Water Level	1.4	0.8	3.9
100-year 24-hour	Existing Conditions	828.6	828.4	828.6
	Mitigation Concept A	828.3	828.1	828.3
	Lowered Water Level	0.3	0.3	0.3

Number of Structures within Generalized Flood-Risk Area	
Flood-Prone Structures Impacted by Existing 10-year Inundation Extent	126 structures
Flood-Prone Structures No Longer Impacted as a Result of Concept A	80 structures
Flood-Prone Structures Still Impacted with Concept A	46 structures



Wilson Pond Concept A: Reduce the Water Level in Wilson Pond Ahead of a Storm Event
Richfield, MN

FIGURE 5-1

BARR

5.1.2 Wilson Pond Flood Mitigation Concept B

This flood mitigation concept is to increase the storm sewer capacity downstream of Wilson Pond by increasing the size of the pipe from Wilson Pond to Highway 494. This mitigation concept is shown on Figure 5-2.

The storm sewer pipe is currently circular with a diameter ranging from 2.5 feet to 4.5 feet. This flood mitigation concept represents a single box culvert with dimensions of 5 feet by 5 feet downstream of Wilson Pond to Highway 494. For this concept storm sewer pipe changes would be required within the city from Wilson Pond to Highway 494 and from there continued into the city of Bloomington or along the Highway 494 corridor. This concept would result in a larger volume and a higher peak rate of discharge leaving the municipal boundary.

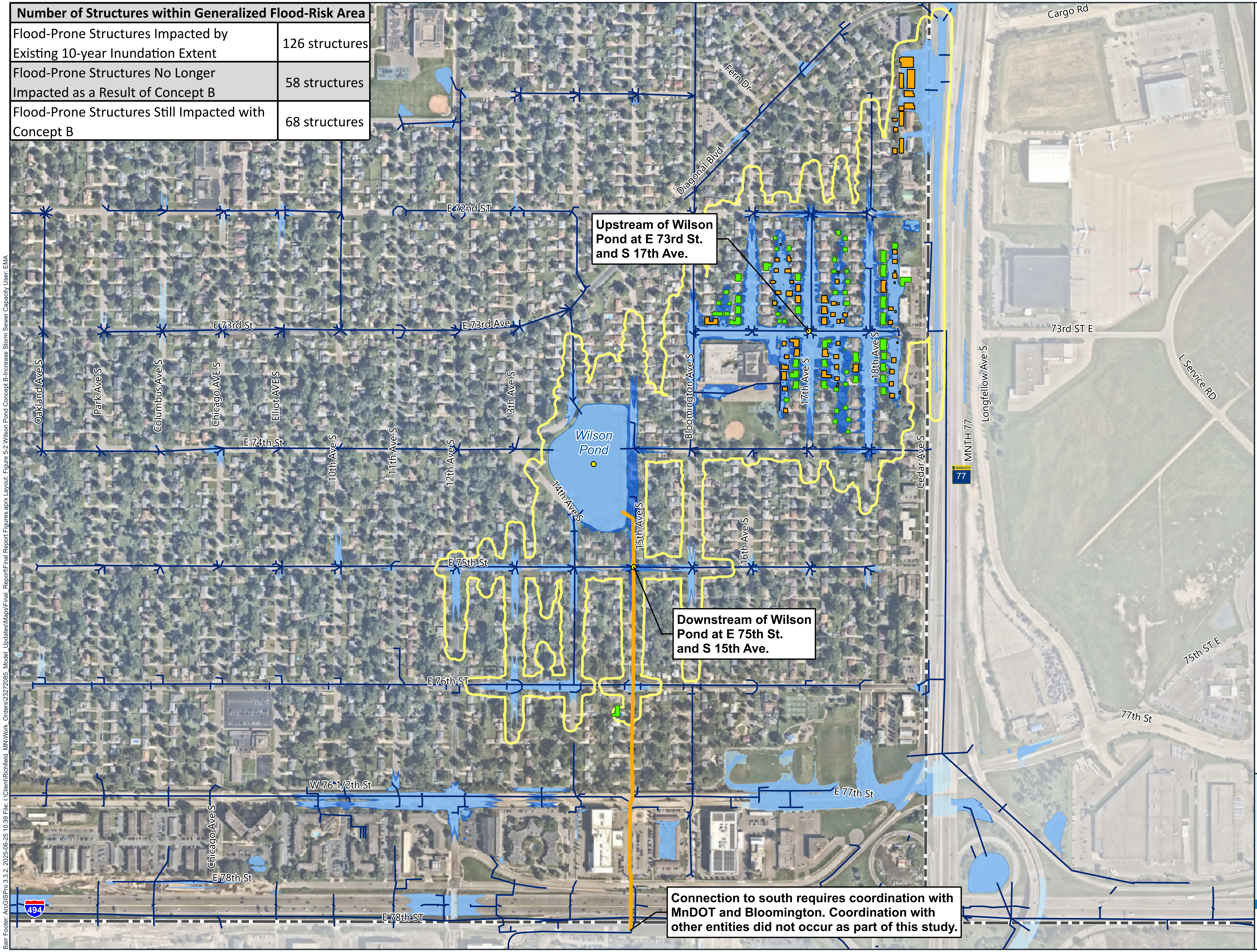
Model results of this concept design are shown in Figure 5-2 with inundation comparison for the 10-year 24-hour storm event and a summary of modeled peak water levels at a few locations around the flood-risk area are compared to the existing condition model results in Table 5-3. The locations summarized in Table 5-3 are also shown on Figure 5-2.

Table 5-3 Modeled Peak Water Levels Wilson Pond Flood Mitigation Concept B: Increase Storm Sewer Capacity

Storm Event	Model Condition	Modeled Peak Water Level by Location (feet)		
		Wilson Pond	Upstream of Wilson Pond at E 73rd St. and S 17th Ave.	Downstream of Wilson Pond at E 75th St. and S 15th Ave.
2-year 24-hour	Existing Conditions	823.9	825.3	825.9
	Mitigation Concept B	824.3	825.3	823.9
	Lowered Water Level	-0.4[1]	0.0	2.0
10-year 24-hour	Existing Conditions	826.9	826.8	827.3
	Mitigation Concept B	826.3	826.4	825.4
	Lowered Water Level	0.6	0.4	1.9
100-year 24-hour	Existing Conditions	828.6	828.4	828.6
	Mitigation Concept B	828.3	828	828.0
	Lowered Water Level	0.3	0.4	0.6

1 – Model shows increased backflow in the pipe out of Wilson Pond during the 2-year 24-hour event resulting in an increased modeled peak water level in Wilson Pond.

Number of Structures within Generalized Flood-Risk Area	
Flood-Prone Structures Impacted by Existing 10-year Inundation Extent	126 structures
Flood-Prone Structures No Longer Impacted as a Result of Concept B	58 structures
Flood-Prone Structures Still Impacted with Concept B	68 structures



Existing 10-year 24-hour Storm Event Inundation Extent

10-year 24-hour Storm Event Inundation Extent with Increased Storm Sewer Capacity from Wilson Pond

Generalized Flood Risk Area

Flood-Prone Structure(s) in 10-year Event

Flood-Prone Structure No Longer Impacted as Result of Concept B

Flood-Prone Structure Still Impacted with Concept B

Model Result Locations

Storm Sewer Pipe

Increased Storm Sewer Pipe to 5'x5' Box Culvert

Municipal Boundary

N

0 500 1,000
Feet

Nearmap Imagery, 2024

Wilson Pond Concept B: Increase Storm Sewer Capacity
Richfield, MN

FIGURE 5-2

BARR

5.1.3 Wilson Pond Flood Mitigation Concept C

This flood mitigation concept is to increase the storm sewer capacity downstream of Wilson Pond by increasing the number of pipes and size of the pipe from Wilson Pond to Highway 494. This mitigation concept is shown on Figure 5-3.

This flood mitigation concept represents a double box culvert with dimensions of 5 feet by 5 feet downstream of Wilson Pond to Highway 494, or twice the cross-sectional area as Concept B discussed in Section 5.1.2. For this concept storm sewer pipe changes would be required within the city from Wilson Pond to Highway 494 and from there continued into the city of Bloomington or along the Highway 494 corridor. This concept would result in a larger volume and a higher peak rate of discharge leaving the municipal boundary.

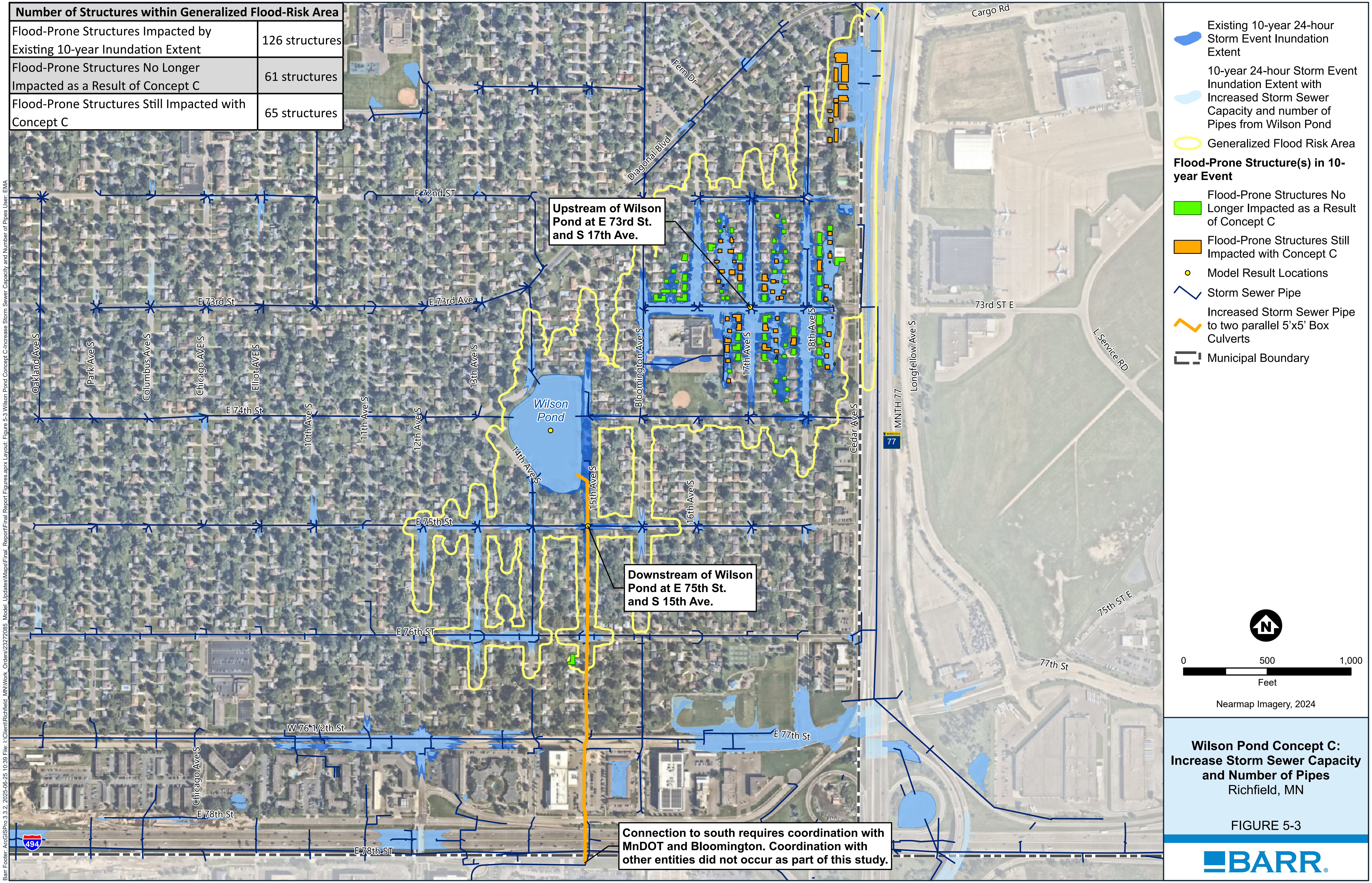
Model results of this concept design are shown in Figure 5-3 with inundation comparison for the 10-year 24-hour storm event and a summary of modeled peak water levels at a few locations around the flood-risk area are compared to the existing condition model results in Table 5-4. The locations summarized in Table 5-4 are also shown on Figure 5-3.

Table 5-4 Modeled Peak Water Levels Wilson Pond Flood Mitigation Concept C: Increase Storm Sewer Capacity and Number of Pipes

Storm Event	Model Condition	Modeled Peak Water Level by Location (feet)		
		Wilson Pond	Upstream of Wilson Pond at E 73rd St. and S 17th Ave.	Downstream of Wilson Pond at E 75th St. and S 15th Ave.
2-year 24-hour	Existing Conditions	823.9	825.3	825.9
	Mitigation Concept C	824.5	825.3	824.0
	Lowered Water Level	-0.6[1]	0.0	1.9
10-year 24-hour	Existing Conditions	826.9	826.8	827.3
	Mitigation Concept C	826.3	826.3	825.0
	Lowered Water Level	0.6	0.5	2.3
100-year 24-hour	Existing Conditions	828.6	828.4	828.6
	Mitigation Concept C	827.9	827.8	827.5
	Lowered Water Level	0.7	0.6	1.1

1 – Model shows increased backflow in the pipe out of Wilson Pond during the 2-year 24-hour event resulting in an increased modeled peak water level in Wilson Pond.

Number of Structures within Generalized Flood-Risk Area	
Flood-Prone Structures Impacted by Existing 10-year Inundation Extent	126 structures
Flood-Prone Structures No Longer Impacted as a Result of Concept C	61 structures
Flood-Prone Structures Still Impacted with Concept C	65 structures



Wilson Pond Concept C: Increase Storm Sewer Capacity and Number of Pipes
Richfield, MN

FIGURE 5-3

BARR

5.2 Flood-Risk Area Northwest of Roosevelt Park

The flood-risk area Northwest of Roosevelt Park was selected by the city for further evaluation. This flood-risk area impacts multiple structures in a single location, the lowest structures are affected during the 10-year 24-hour duration rainfall event, the flood-risk area is located within an area of the city with a high social vulnerability index, and surface inundation impacts a critical transportation route through the city. For these reasons, as well as the potential for flood reduction with open space near the flood-risk area, the city selected this area to evaluate concepts for system modifications to reduce flood risk.

Options that were considered but not pursued for the area Northwest of Roosevelt Park include adding surface storage areas and increasing capacity downstream of the flood-risk area. Surface storage was not considered because the undeveloped portion of Roosevelt Park is at a higher elevation than the nearby flood-risk area. Preliminary grading of a potential pond at this site did not add significant storage volume below the modeled water level of the flood-risk area and getting the water to the pond by gravity drainage was not feasible. Increasing capacity of the downstream storm sewer system was not evaluated further as the flood-risk area drains to Norby's Pond which is also identified as a flood-risk area.

One potential project flood-risk mitigation concept was identified for the area Northwest of Roosevelt Park, adding an underground storage chamber upstream of the flood-risk area. This concept is discussed more in Section 5.2.1. A concept level cost estimate for this potential project is provided in Table 5-5. The cost estimate is further described in Appendix A.

Table 5-5 Northwest of Roosevelt Park Flood Mitigation - Cost Estimate

Concept	Description	Cost Estimate
A	Add underground storage chamber	**$15,491,000** $10,844,000 – $27,110,000

Note: Total project cost accuracy range is -30% to +50%.

5.2.1 Northwest of Roosevelt Park Flood Mitigation Concept A

This flood mitigation concept is to add an underground storage chamber beneath the baseball fields at Roosevelt Park and is shown on Figure 5-4. Surface drainage upstream of the flood-risk area from Roosevelt Park and along 76th Street would be diverted to the underground storage chamber. The underground storage chamber would retain runoff from the upstream contributing watersheds and attenuate the flow rate to the flood-risk area during the peak of the storm event.

The concept design includes adding approximately 354,000 cubic feet of underground storage for water retention based on a surface area of 300-foot by 300-foot, a depth of 5.25 feet, and an assumed 75% of underground volume available for stormwater storage. An outlet control structure would be used to retain water in the underground storage but still allow the underground storage to drain completely after the storm event. Along 76th Street the downstream invert of one storm sewer pipe would need to be adjusted and a new pipe added to direct drainage towards the new underground storage. Additional pipe modifications would be required to connect the surface drainage around the baseball fields to the underground storage chamber.

Model results of this concept design are shown in Figure 5-4 with inundation comparison for the 10-year 24-hour storm event and a summary of modeled peak water levels at a few locations around the flood-risk area are compared to the existing condition model results in Table 5-6. The locations summarized in Table 5-6 are also shown on Figure 5-4.

Table 5-6 Modeled Peak Water Levels Northwest of Roosevelt Park Flood Mitigation Concept A: Add Underground Storage Chamber

Storm Event	Model Condition	Modeled Peak Water Level by Location (feet)		
		Baseball Fields	Upstream of Underground Storage at 76th St. and S Clinton Ave.	Downstream of Underground Storage at 76th St. and S 3rd Ave.
2-year 24-hour	Existing Conditions	842.3	842.0	840.6
	Mitigation Concept A	837.7	839.9	840.2
	Lowered Water Level	4.6	2.2	0.4
10-year 24-hour	Existing Conditions	842.5	842.9	842.2
	Mitigation Concept A	838.8	841.9	841.7
	Lowered Water Level	3.7	1.0	0.5
100-year 24-hour	Existing Conditions	843.6	843.6	843.6
	Mitigation Concept A	842.9	843.1	842.9
	Lowered Water Level	0.7	0.5	0.7

Number of Structures within Generalized Flood-Risk Area	
Flood-Prone Structures Impacted by Existing 10-year Inundation Extent	9 structures
Flood-Prone Structures No Longer Impacted as a Result of Concept A	6 structures
Flood-Prone Structures Still Impacted with Concept A	3 structures

Existing 10-year 24-hour Storm Event Inundation Extent

10-year 24-hour Storm Event Inundation Extent with Underground Storage

Generalized Flood Risk Area

Proposed Underground Storage Chamber

Flood-Prone Structure(s) in 10-year Event

Flood-Prone Structures No Longer Impacted as a Result of Concept A

Flood-Prone Structures Still Impacted with Concept A

Storm Sewer Pipe

Model Result Locations

Storm Sewer Pipe Changes

Add

Remove

Replace with new slope

Note: Additional pipe modifications needed around baseball field area to connect stormwater pipes to underground storage chamber.

N

0 200 400
Feet

Nearmap Imagery, 2024

Northwest of Roosevelt Park Concept A: Add Underground Storage Chamber
Richfield, MN

FIGURE 5-4

BARR

5.3 Flood-Risk Area Near Woodlawn Terrace

The flood-risk area near Woodlawn Terrace was selected by the city for further evaluation. This flood-risk area impacts multiple structures in a single location, the lowest structures are affected during the 2-year 24-hour duration rainfall event, the storm sewer pipes are classified as moderate to high risk, the flood-risk area is located within an area of the city with a high social vulnerability index, and the surface inundation impacts three high-density housing structures. For these reasons, as well as the potential for flood reduction with open space near the flood-risk area, the city selected this area to evaluate concepts for system modifications to reduce flood risk. Options that were considered but not pursued for the area near Woodlawn Terrace include adding surface storage areas. Surface storage was not considered because while the area has open space, the space is developed with baseball fields and parking lots.

Two potential project flood-risk mitigation concepts were identified for the area near Woodlawn Terrace:

- Flood Mitigation Concept A: Add underground storage chamber below the parking lot, discussed in Section 5.3.1.
- Flood Mitigation Concept B: Increase the storm sewer capacity from the flood-risk area to Wood Lake by increasing the pipe sizes, discussed in Section 5.3.2.

A comparison of the concept level cost estimate for these two potential projects is provided in Table 5-7. The cost estimate is further described in Appendix A.

Table 5-7 Near Woodlawn Terrace Flood Mitigation - Cost Estimate Comparison

Concept	Description	Cost Estimate
A	Add underground storage chamber	**$1,540,000** $1,078,000 - $2,695,000
B	Increase storm sewer capacity	**$7,440,000** $5,208,000 - $13,020,000

Note: Total project cost accuracy range is -30% to +50%.

5.3.1 Near Woodlawn Terrace Flood Mitigation Concept A

This flood mitigation concept is to add an underground storage chamber under the parking lot next to Lynwood Commons Apartments as shown in Figure 5-5. The underground storage chamber would retain runoff from the upstream contributing watersheds and attenuate the flow rate to the flood-risk area during the peak of the storm event.

The concept design includes adding approximately 24,000 cubic feet of underground storage for water retention based on a surface area of approximately 8,000 square feet, a depth of 3 feet, and an assumed 75% of underground volume available for stormwater storage. To achieve the 3-foot depth with 2 feet of cover, the parking lot would have to be re-graded. Additional pipe modifications would be required to connect the existing storm sewer pipes under the parking lot to the proposed storage chamber. This mitigation concept would require agreements with the owner of the parking lot next to the Lynwood Commons Apartments.

Model results of this concept design are shown in Figure 5-5 with inundation comparison for the 10-year 24-hour storm event and a summary of modeled peak water levels at a few locations around the flood-risk area are compared to the existing condition model results in Table 5-8. The locations summarized in Table 5-8 are also shown on Figure 5-5.

Table 5-8 Modeled Peak Water Levels Near Woodlawn Terrace Flood Mitigation Concept A: Add Underground Storage Chamber

Storm Event	Model Condition	Modeled Peak Water Level by Location (feet)		
		Parking lot in flood-risk area	Downstream at Wood Lake	Upstream at Lincoln Baseball Fields
2-year 24-hour	Existing Conditions	842.5	822.1	841.9
	Mitigation Concept A	841.9	822.1	841.7
	Lowered Water Level	0.6	0.0	0.2
10-year 24-hour	Existing Conditions	843.3	823.7	842.9
	Mitigation Concept A	843.2	823.7	842.8
	Lowered Water Level	0.1	0.0	0.1
100-year 24-hour	Existing Conditions	844.5	827.1	844.5
	Mitigation Concept A	844.5	827.1	844.5
	Lowered Water Level	0.0	0.0	0.0

Number of Structures within Generalized Flood-Risk Area	
Flood-Prone Structures Impacted by Existing 10-year Inundation Extent	6 structures
Flood-Prone Structures No Longer Impacted as a Result of Concept A	0 structures
Flood-Prone Structures Still Impacted with Concept A	6 structures

Existing 10-year 24-hour Storm Event Inundation Extent

10-year 24-hour Storm Event Inundation Extent with Underground Storage

Generalized Flood Risk Area

Proposed Underground Storage Chamber

Flood-Prone Structure(s) in 10-year Event

Flood-Prone Structures Still Impacted with Concept A

Flood-Prone Structures No Longer Impacted as a Result of Concept A

Storm Sewer Pipe

Model Result Locations

Note: Additional pipe modifications needed around baseball field area to connect stormwater pipes to underground storage chamber.

N

0 200 400

Feet

Nearmap Imagery, 2024

Near Woodlawn Terrace Concept A: Add Underground Storage Chamber

Richfield, MN

FIGURE 5-5

BARR

5.3.2 Near Woodlawn Terrace Flood Mitigation Concept B

This flood mitigation concept is to increase the storm sewer capacity downstream of the northwest corner of the parking lot next to Lynwood Commons Apartments by increasing the size of the pipe to Wood Lake. This mitigation concept is shown on Figure 5-6.

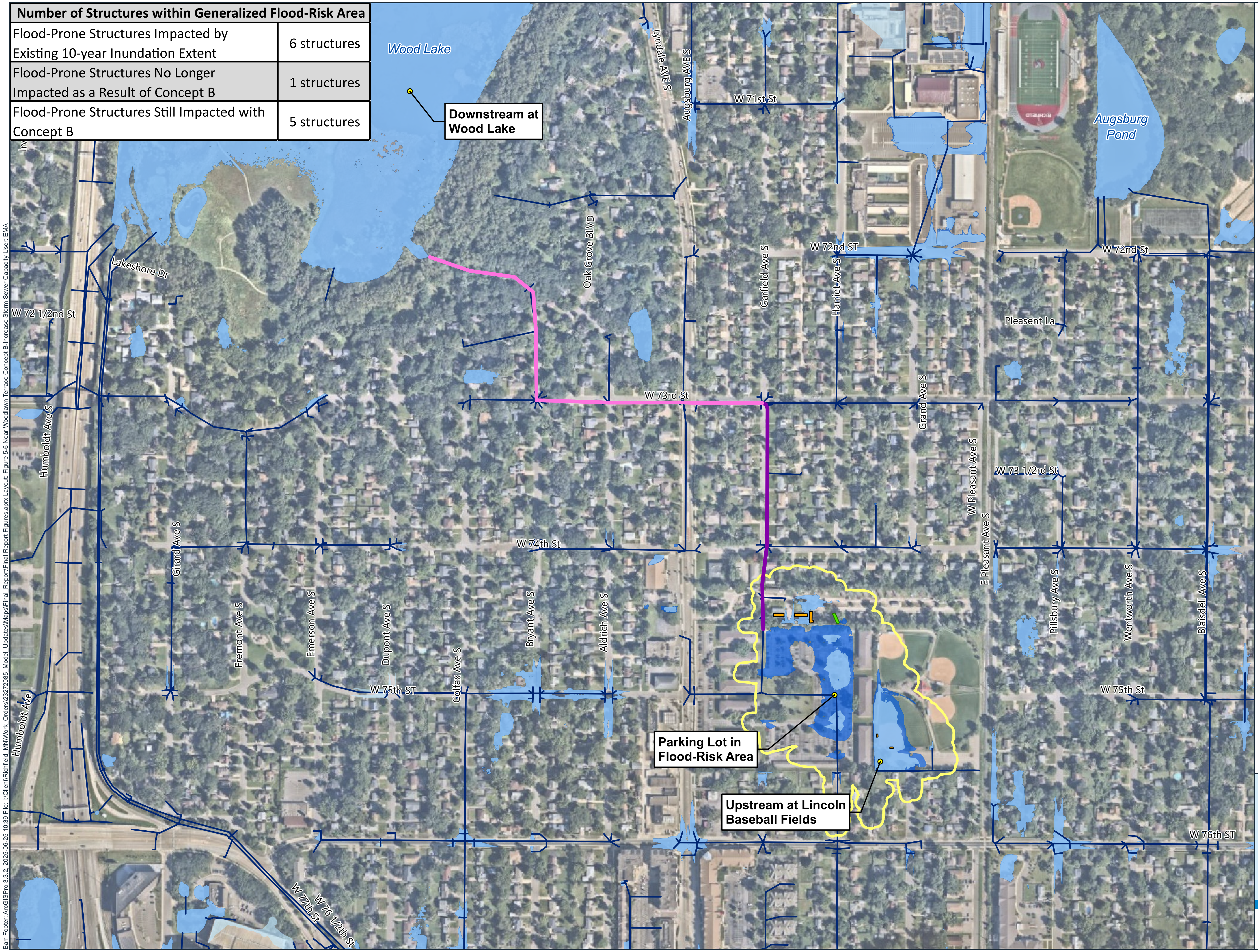
The storm sewer pipe is currently circular and arch pipes with a diameter ranging from three feet to four feet. This flood mitigation concept increases the pipe diameter to range from three feet to six feet. The pipe upstream of northwest corner of the parking lot next to Lynwood Commons Apartments to the middle of the parking lot is not currently included in this mitigation concept to be increases in size due to shallow cover over the existing pipe.

Model results of this concept design are shown in Figure 5-6 with inundation comparison for the 10-year 24-hour storm event and a summary of modeled peak water levels at a few locations around the flood-risk area are compared to the existing condition model results in Table 5-9. The locations summarized in Table 5-9 are also shown on Figure 5-6.

Table 5-9 Modeled Peak Water Levels Near Woodlawn Terrace Flood Mitigation Concept B: Increase Storm Sewer Capacity

Storm Event	Model Condition	Modeled Peak Water Level by Location (feet)		
		Parking lot in flood-risk area	Downstream at Wood Lake	Upstream at Lincoln Baseball Fields
2-year 24-hour	Existing Conditions	842.5	822.1	841.9
	Mitigation Concept B	841.4	822.1	841.6
	Lowered Water Level	1.1	0.0	0.3
10-year 24-hour	Existing Conditions	843.3	823.7	842.9
	Mitigation Concept B	842.5	823.7	842.4
	Lowered Water Level	0.8	0.0	0.5
100-year 24-hour	Existing Conditions	844.5	827.1	844.5
	Mitigation Concept B	843.4	827.1	843.8
	Lowered Water Level	1.1	0.0	0.7

Number of Structures within Generalized Flood-Risk Area	
Flood-Prone Structures Impacted by Existing 10-year Inundation Extent	6 structures
Flood-Prone Structures No Longer Impacted as a Result of Concept B	1 structures
Flood-Prone Structures Still Impacted with Concept B	5 structures



Existing 10-year 24-hour Storm Event Inundation Extent

10-year 24-hour Storm Event Inundation Extent with Increased Storm Sewer Capacity to Wood Lake

Generalized Flood Risk Area

Flood-Prone Structure(s) in 10-year Event

Flood Prone Structures No Longer Impacted as a Result of Concept B

Flood Prone Structures Still Impacted with Concept B

Storm Sewer Pipe

Model Result Locations

Storm Sewer Pipe Changes

Increase to 5 foot diameter

Increase to 6 foot diameter

N

0 400 800

Feet

Nearmap Imagery, 2024

Near Woodlawn Terrace Concept B-Increase Storm Sewer Capacity
Richfield, MN

FIGURE 5-6

BARR

5.4 Limitations and Considerations

The projects, model results, and cost estimates presented in Section 5 are represent a concept level design. Each flood-risk area was evaluated at a high level for potential flood-risk mitigation options and those discussed were identified as potential options while some other options were not considered based on available information and city direction. Some of the limitations identified to rule out mitigation options were expected shallow groundwater levels, flood-risk areas identified downstream, and the city's direction to not consider property acquisition for flood-risk reduction.

Additional evaluations of each site and mitigation concept will need to be completed as they are pursued further. This includes design optimization, evaluating utility conflicts, reviewing permitting requirements, in some cases agreements with private landowners or other public entities, and additional considerations specific to each project. For example, the three mitigation concepts for Wilson Pond include increased flow to Highway 494 which would need to be conveyed to the Minnesota River through the city of Bloomington or along the Highway 494 corridor. The details of this stormwater routing beyond the city boundary have not been determined and would also require additional permitting discussions to find an acceptable solution. Other mitigation options presented do not have this exact challenge but are expected to have other challenges that would be identified as the design progresses and becomes more detailed.

Additional limitations and description of the cost estimates included for each mitigation concept in Section 5 are described in Appendix A.

6 Conclusions

The prioritization framework was developed with the city. The prioritization framework can be used as one tool to determine where to begin with further evaluation of flood-risk mitigation projects. This provides the city a methodology to compare potential benefits of flood-risk mitigation projects and prioritize how to invest limited resources for mitigating flood-risk.

It is anticipated that overtime the prioritized list of areas will change. For example, as flood-risk mitigation projects are completed or as city census data changes. When these changes occur or new information becomes available, the prioritized list could be updated to reflect changing priorities.

Finally, this prioritization framework provides a consistent methodology to evaluate how to prioritize flood-risk mitigation projects for the city. Additionally, this framework uses a similar methodology, though with some different criteria, than the city of Bloomington for work within the Richfield Bloomington Watershed Management Organization.

Three flood-risk areas were selected by the city based on the project prioritization framework developed. For these three flood-risk areas a total of six mitigation concepts were identified and evaluated in the updated stormwater model. Each concept provides some level of flood-risk mitigation but at varied cost and with additional project considerations. Additional design and evaluation of the alternatives will be required as the city plans for future flood-risk mitigation projects. The project prioritization process identified multiple flood-risk areas across the city. The framework outlined in this report will be used by the city to inform future flood-risk mitigation studies.

Data sets used for model development are not always complete or error-free. As additional information is collected or provided by the city, the prioritized list of areas may be affected. For example, no survey data was collected to verify flood-prone structures. However, if surveys are completed in the feasibility study phase of flood-risk mitigation projects to better address the cost-benefit relationship of specific projects, new survey information may demonstrate that existing structures are or are not flood-prone.

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Appendix A

Opinion of Probable Construction Cost

1 Opinion of Probable Construction Cost

There are several factors that affect the cost of implementing a flood-risk reduction project:

- The volume of stormwater that must be stored within the watershed or conveyed downstream;
- The potential to reduce flood-risk by retrofitting existing stormwater infrastructure;
- The potential to reduce flood-risk by constructing new flood detention facilities; and
- The potential need to acquire property when other flood-reduction alternatives are not feasible.

Evaluating the most cost-efficient flood reduction project for a given flood-risk area requires (1) review of the source(s) and cause(s) of flooding (requiring detailed hydrologic and hydraulic review), (2) high-level review of available options to mitigate flooding (e.g., is there sufficient available space for a flood detention project? Is there sufficient grade to excavate and tie-in to existing storm sewer utilities, etc.), and (3) preliminary design and cost-comparison analysis of feasible flood-mitigation alternatives. Due to the large number potential system modifications identified, it was not practical to perform detailed review of flood-mitigation alternatives for each location within the study area, and it is anticipated that the configuration of system modifications to reduce flood-risk will change during subsequent phases of design.

An important note is that, based on a more-detailed review of flood-mitigation alternatives, optimization of potential system modifications, and completion of detailed design, the final cost of flood-mitigation may be lower or higher than the concept level opinions of cost included in this report. The costs provided in this report are intended to provide a planning-level estimate for the potential system modifications that were evaluated.

The opinions of cost, project reserves, contingency, documentation and discussion presented in this report are intended to provide background information for concept-level alternatives assessment, analysis purposes, and budget planning. The cost of time escalation is not included in the opinions of probable cost. All costs are presented in 2025 US dollars.

Quantities were estimated with calculations based on available information presented. Dimensions, areas, and volumes for construction were estimated using excel, GIS, and manufacturer information.

Unit costs are based on recent bid prices, published construction cost index resources, and similar stormwater BMP projects.

Costs associated with Base Planning Engineering and Design (PED), Construction Management (CM), Permitting, and Property or Easement acquisition are not included in the overall estimate for construction costs.

The opinions of cost also do not include other tasks following construction of each alternative presented such as operations and maintenance, or monitoring.

Contingency used in these opinions of probable cost are intended to help identify an estimated construction cost amount for the minor items included in the current Project scope but have not yet been quantified or estimated directly during the feasibility evaluation. Stated another way, contingency is the resultant of the pluses and minuses that cannot be estimated at the level of project definition that exists.

The contingency includes the cost of ancillary items not currently itemized in the quantity summaries but commonly identified in more detailed design and required for completeness of the work. A 25% contingency is applied to the estimated construction cost to account for the costs of these items.

Industry resources for cost estimating (*AACE International Recommended Practice No. 18R-97, and ASTM E2516-06 Standard Classification for Cost Estimate Classification System*) provide guidance on cost uncertainty, depending on the level of project design developed. The opinion of probable cost for the alternatives evaluated generally corresponds to a Class 4 estimate characterized by completion of limited engineering and use of deterministic estimating methods. As the level of design detail increases, the level of uncertainty is reduced. Figure A-1 provides a graphic representation of how uncertainty (or accuracy) of cost estimates can be expected to improve as more detailed design is developed.

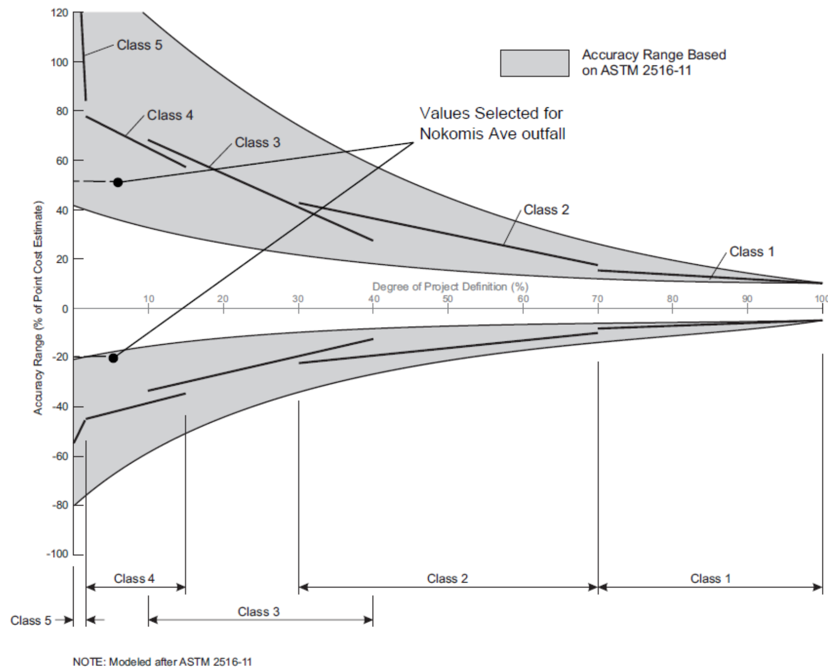

Figure A-1 Relationship between Cost Accuracy and Degree of Project Definition

At this early stage of planning, the range of uncertainty of total project cost is high. Due to the early stage of the project, it is standard practice to place a broad accuracy range around the point cost estimate.

The accuracy range is based on professional judgment considering the level of design completed, the complexity of the project, and the uncertainties in the project scope; the accuracy range does not include costs for future scope changes that are not part of the project as currently defined or risk contingency. The estimated accuracy range for this point estimate is -30% to +50%.

The opinion of probable construction cost is made on the basis of Barr Engineering's experience and qualifications and represents our best judgment as experienced and qualified professionals familiar with the project. It is acknowledged that additional investigations and additional site-specific information that becomes available in future stages of design may result in changes to the proposed configuration, cost and functioning of project features. This opinion is based on project-related information available to Barr Engineering at this time and includes a concept-level feasibility design of the project. In addition, because we have no control over the eventual cost of labor, materials, equipment or services furnished by others, or over the contractor's methods of determining prices, or over competitive bidding or market conditions, Barr Engineering cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinion of probable cost presented. If the city wishes greater assurance as to the probable construction cost, the city should authorize further investigation and design of a selected alternative.

2 References

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