Technical Memo

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Date: February 2, 2018

Subject: Laddie Lake Drainage Area Study

The purpose of this memorandum is to summarize the project purpose, model setup, model results and potential future needs for the Laddie Lake drainage area within Blaine. All elevations reported in this memo are referenced to the NAVD 88 vertical datum.

Background

Existing Conditions

Laddie Lake has a 369-acre drainage area that is in the Cities of Blaine (77%) and Spring Lake Park (23%). Within Blaine, landuse is primarily single family residential homes (54%), undeveloped/park land (18%) and Laddie Lake (12%). Figure 1.

The storm sewer network in the study area can be separated into two main systems. The area east of Laddie Lake is collected in the storm sewer beneath 87th Ave NE which serves as the main trunk line from Hastings St NE to Laddie Lake. The area north of Laddie Lake is directed to the storm sewer beneath 89th Ave NE and then discharges to the northern part of Laddie Lake. Figure 2.

In addition to the storm sewer network, there are natural depressions that will abstract or store storm water before discharging to the storm sewer. The largest areas include a wetland identified on the National Wetland Inventory (NWI) northeast of Davenport St NE and 87th Ave NE (LL_10), a ditch system that drains along Davenport (LL_7), north to 87th Ave NE and a low spot south of the Blainevilla Apartment (LL_13). Figure 2.

Potential Flooding Concerns

Blaine staff provided areas that have been identified by residents as flooding concerns. The flooding locations shown in Figure 3 are generalized locations and do not show the actual flood area.

Rainfall Events

Table 1 shows the last 10 years of rainfall events with greater than 2.8 inches of rain in 24 hours. Rainfall depths were obtained from the Minnesota Climatology Working Group for the Spring Lake Park target location.

Table 1: Historical Rainfall Depths in 24 Hours

Date	Rainfall Depths (in)
9/22/2016	6.21
7/16/2011	3.78
5/24/2012	2.93
8/17/2011	2.88
7/24/2016	2.82

Stormwater Model

Model Setup and Data Inputs

Wenck used the Coon Creek Watershed District's (CCWD) XP-SWMM model (Model) for the Laddie Lake Drainage Area Study. The study area was redelineated to street intersection level subwatersheds to provide the accuracy and detail to verify the flood areas and propose potential upgrades to the storm sewer to resolve flooding. Figure 4.

The Model was run using nested Atlas 14 rainfall depths obtained from NOAA for the 2-Yr (2.8"), 10-Yr (4.2"), and 100-Yr (7.3") 24-hr storm events.

Pipe invert, diameter and material were obtained from as-built information provided by the City of Blaine. All pipes for this drainage study are reinforced concrete pipe (RCP). The model assumes that there is no sediment build-up within the storm sewer system and that the catch basin inlets are not plugged.

The Curve Numbers (CN) and Time of Concentrations (Tc) for each subwatershed were determined using TR-55 methods that reflects soil type, existing land use and local topography. Soil types were classified using Soil Survey Geographic Database (SSURGO), land use type is based on Minnesota Land Cover Classification System (MLCCS) data. MnDNR LiDAR was used for local topography.

Storage areas were created in the model to represent the natural drainage areas where stormwater will pool before discharging into the storm sewer.

Results & Discussion

Storm Sewer Capacity

The 2-Yr (2.8") and 10-Yr (4.2") storm events were run in the model to review potential flooding concerns that were noted by residents. A 2-Yr storm event means that on average, 2.8" of rainfall will fall within a 24-hr period once every 2 years and similarly, 10-Yr storm

event means that on average, 4.2" of rainfall will fall within a 24-hr period once every 10 years. Table 1 shows the rainfall events that resulted in greater than 2.8 inches over the last 10 years.

Surcharging is the condition in which water raises above the rim of a catch basin within a storm sewer system and causes localized flooding. The model indicates that there is no surcharging during the 2-Yr storm event but that there is surcharging during the 10-Yr storm event for five locations within the study area. Table 2 presents the location, length of time that surcharging occurs and the volume of water that will pool above the catch basin structures. Figure 5 shows the locations of surcharging.

Table 2: Storm Sewer Surcharging, 10-Yr Storm

Subwatershed ID	Location	Time Surcharging (min)	Volume (CF)
LL_1	Hastings St & 87th Ave	100	16,824
LL_5	Goodhue St & 87th Ave	27	2,254
LL_8	87th Ave between Davenport St and Baltimore St	2	3.54
LL_12	Davenport & 87th Ave	20	3,865
LL_18	Capra Sporting Good Parking Lot	60	7,017

Water Surface Elevations at Storage Nodes

Even though natural drainage areas are not sized for storm events, the 10-Yr storm event water surface elevations (WSE) are also provided in these areas for comparison. Table 3 shows for water surface elevations and Figure 5 shows the impacted areas.

Table 3: Natural Drainage Area Water Surface Elevations

Subwatershed ID	Location	2-Yr WSE	10-Yr WSE
LL_7	Drainage Ditch	906.0	907.0
LL_10	Wetland (NWI)	905.4	906.3
LL_13	Blainevilla Apartments	905.8	906.8

Identified Flooding

Comparing Figures 4 and 5 illustrates that the model did predict storm water ponding at the locations noted by residents as areas of flooding concern in both the storm sewer locations and natural drainage areas. However, according to Table 1, the only rainfall depth that has fallen on the region that was at least equal to the 10-Yr storm event rainfall depth was on September 22, 2016.

Conclusion

Storm Sewer Capacity

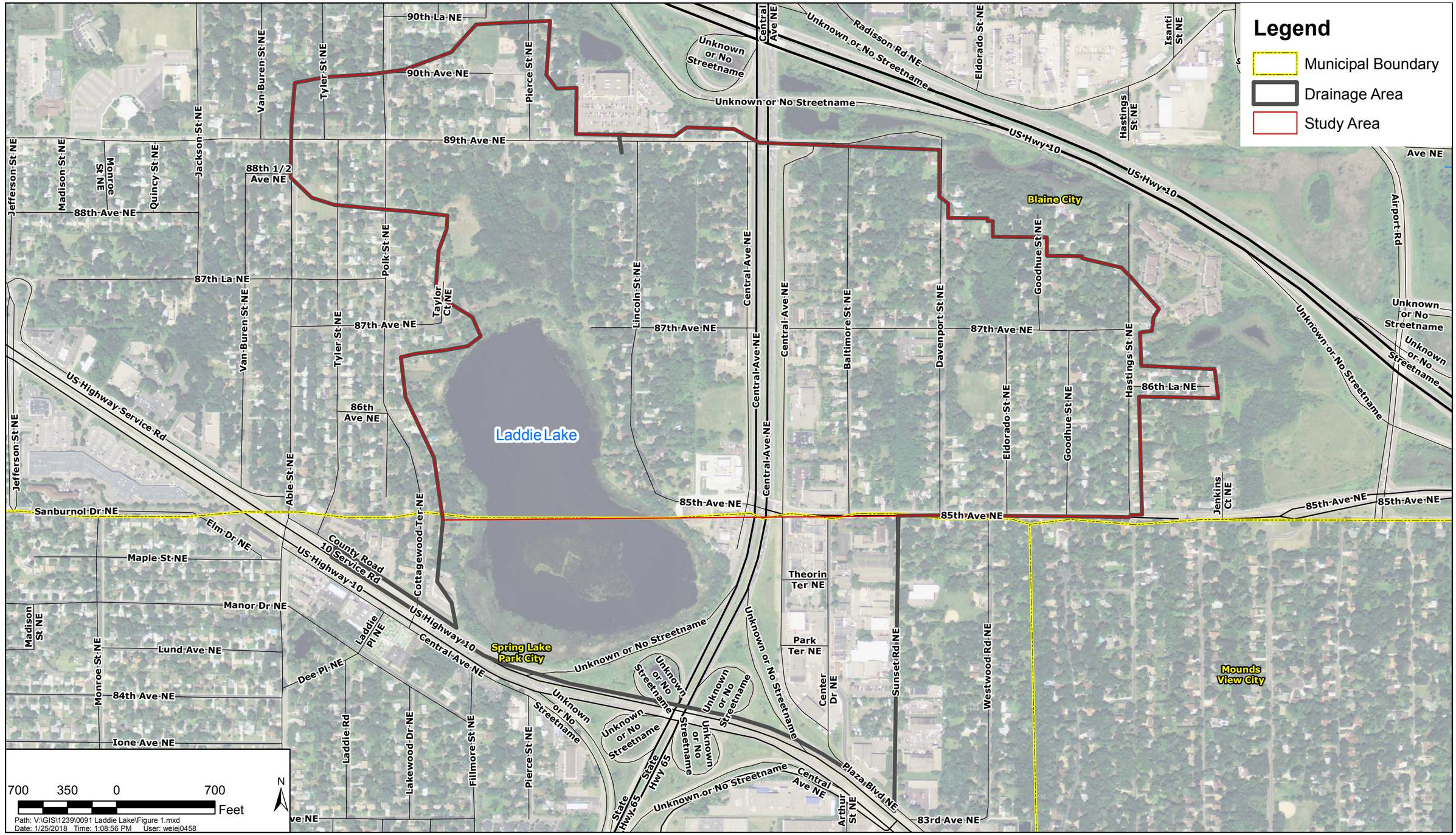
The model indicates that the existing storm sewer is at or slightly below capacity for the 10-Yr storm event using the current standard of design for precipitation and rainfall type. The Laddie Lake storm sewer was most likely designed using the TP-40 precipitation and a Type II rainfall distribution that would have been the standard of practice at the time. The TP-40 precipitation depth is 4.1 inches compared to 4.3 inches in Atlas 14. Meaning 5% more water is used if this were designed today. In addition, the change from a Type II rainfall to nested Atlas 14 results in a shorter rainfall time.

The localized flooding that may be the result of surcharging is unlikely to last more than 100 minutes. The typical storm event in the Twin Cities region is approximately 0.45 inches which is significantly less than the 10-Yr storm event (4.3 inches of rain) used to determine storm sewer capacity. This would indicate under typical rainfall amounts, there will minimal to no flooding according to the model.

The model also indicated that the storm sewer for the area is not affected by Laddie Lake during the 2-Yr and 10-Yr storm events. Therefore, no additional analysis is needed on the Laddie Lake outlet structure.

In summary, the modeling shows temporary street and low lying natural areas flood where and for how long one could expect it. The observations of more frequent flooding may be due to increased storm volumes in a shorter amount of time and temporary pipe or catch basin blockages. The pipe system appears to be adequately sized and the Laddie Lake outlet does not negatively affect performances.

To address resident's observations of more frequent flooding, we suggest regular inspections and maintenance of the storm sewer system to remove obstructions.



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Laddie Lake Drainage

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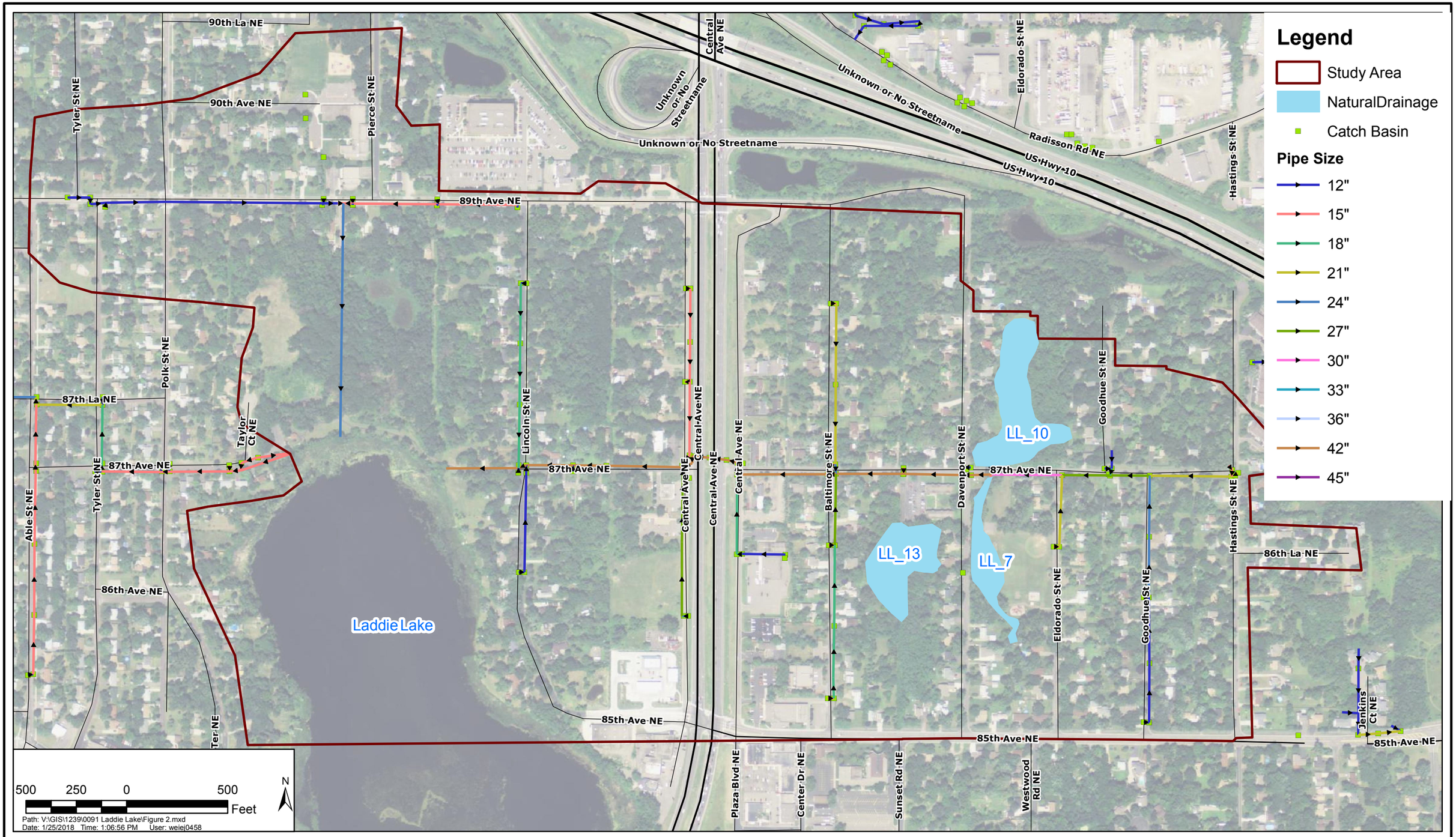
Figure 1



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City Storm Sewer

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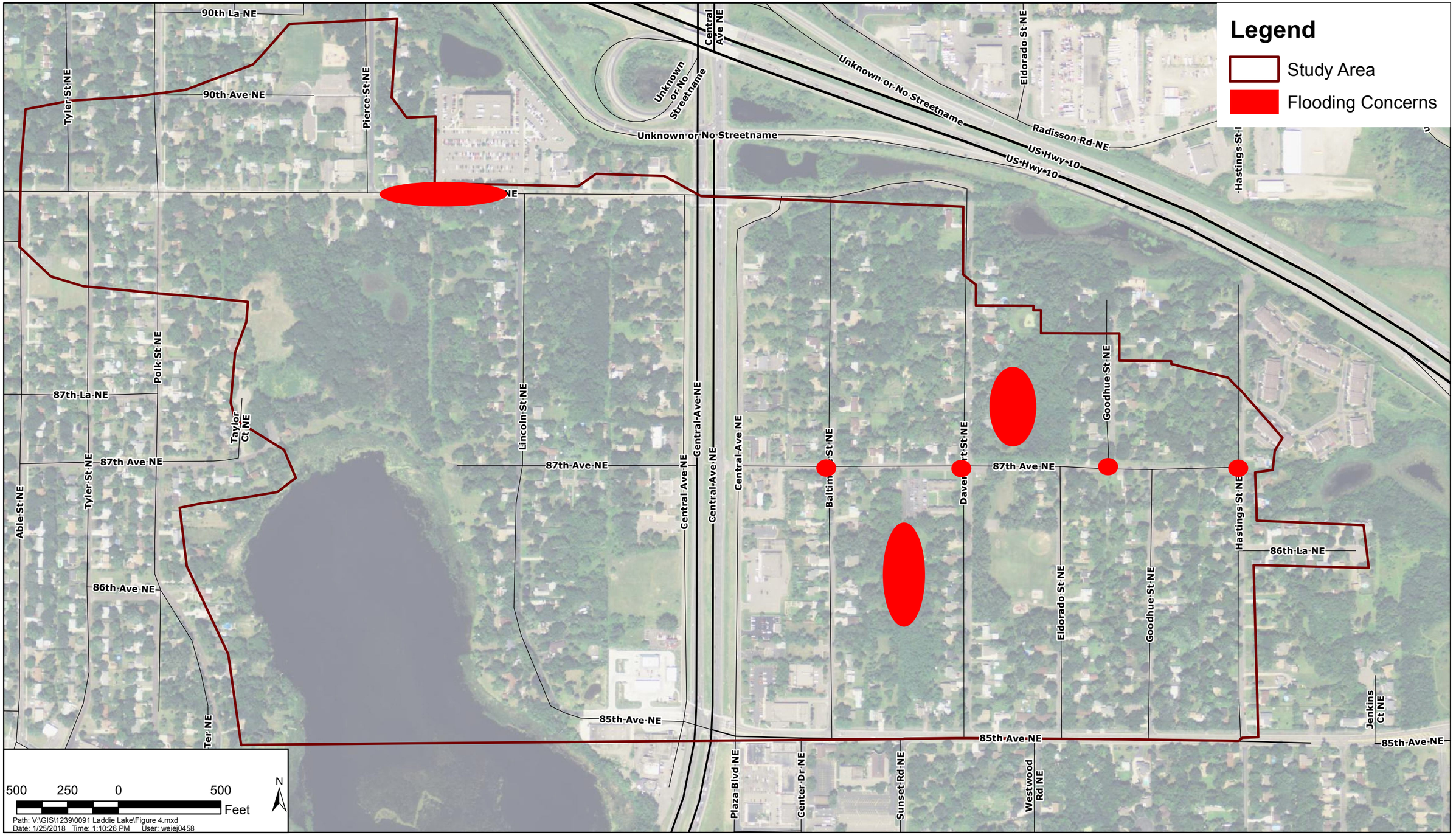
Figure 2



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Identified Flooding Concerns

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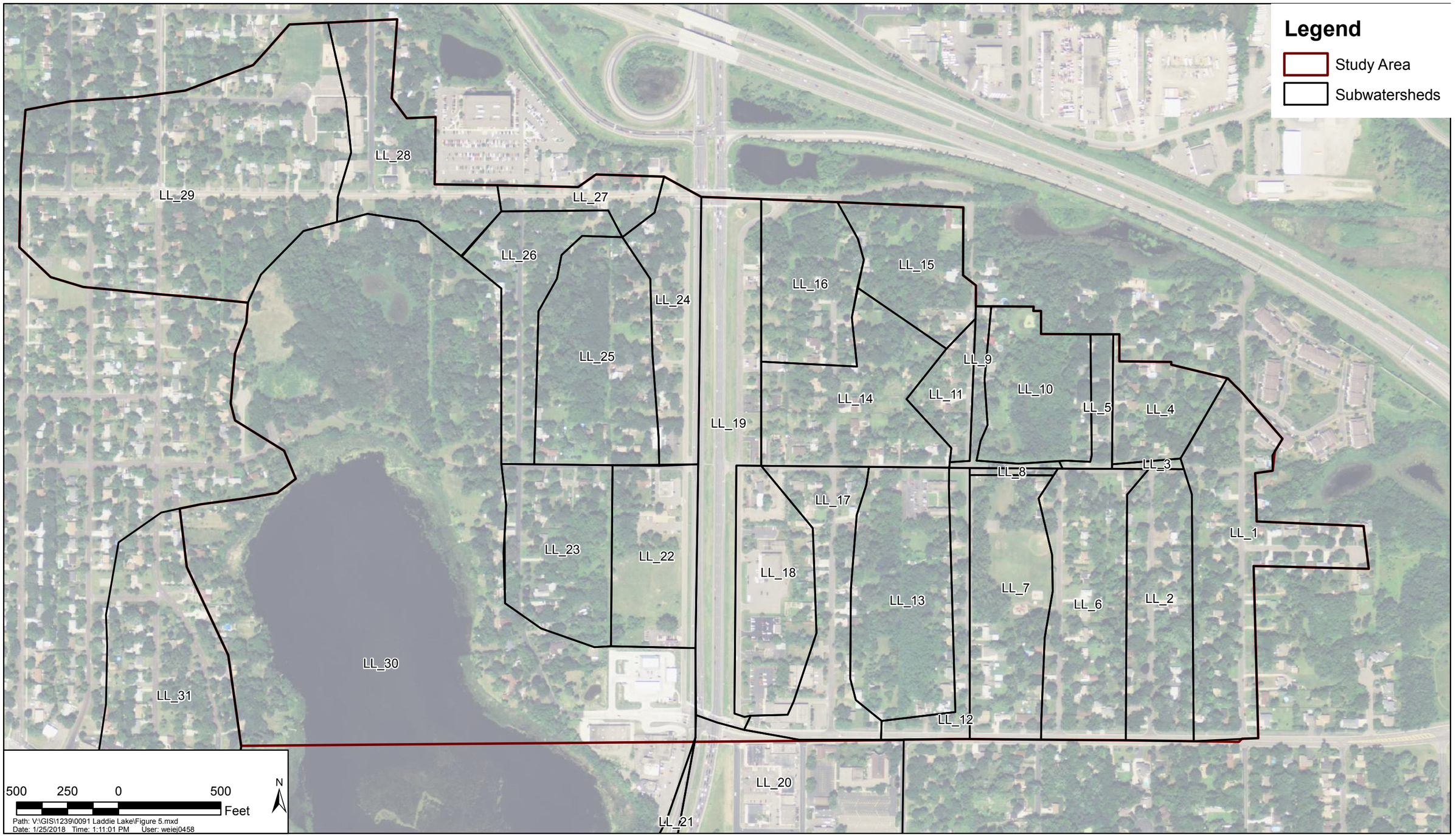
Figure 3



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Subwatersheds

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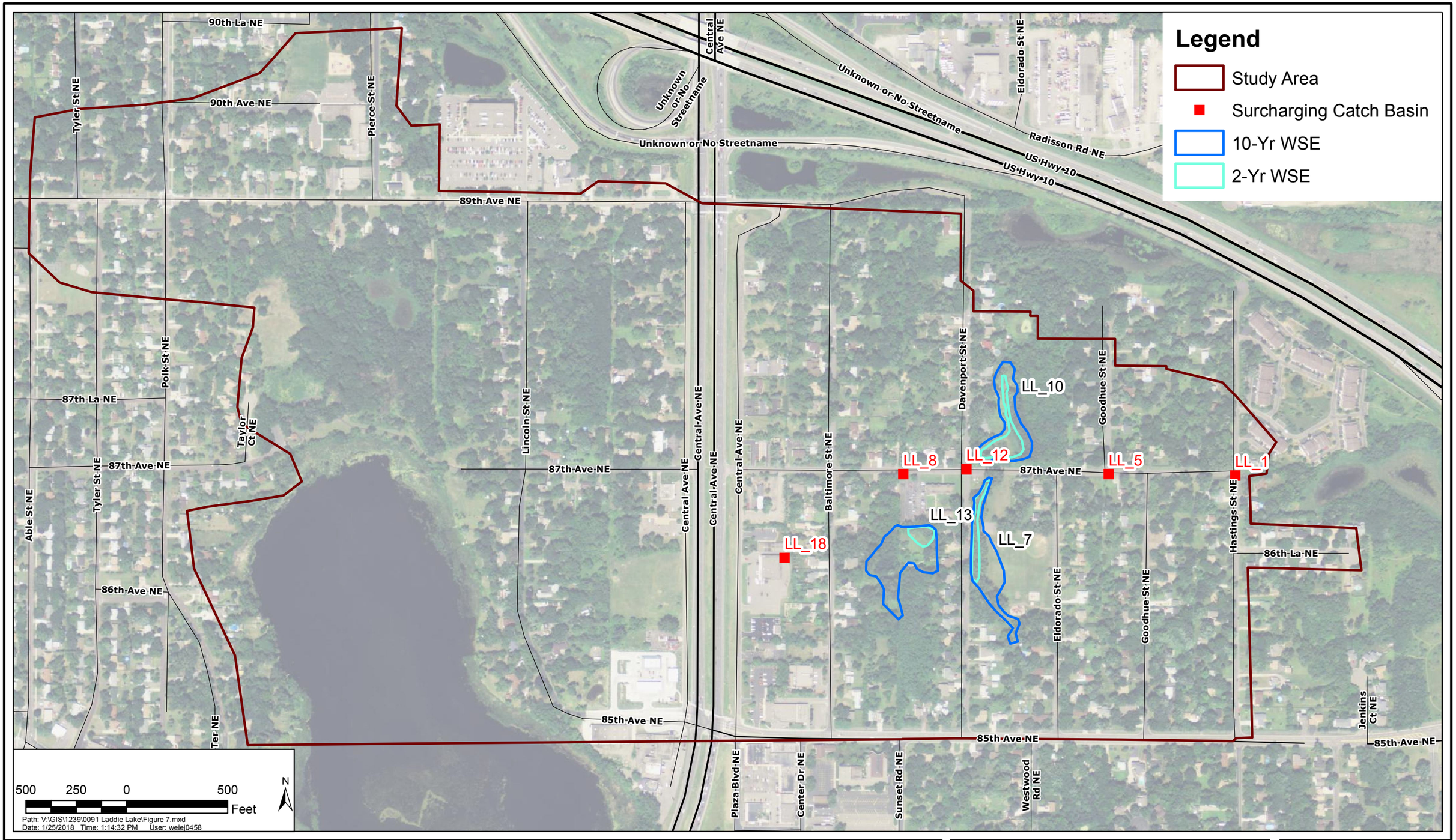
Figure 4



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Model Results

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Figure 5