City of Belvidere

South Side Stormwater Study

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LIST OF ABBREVIATIONS

B&W	-	Baxter & Woodman, Inc.
CES	-	Civil Engineering Services, Inc.
City	-	City of Belvidere
CN	-	curve number
FEMA	-	Federal Emergency Management Agency
ft	-	feet
GIS	-	Geographic Information System
in	-	inches
NLCD	-	National Land Cover Database
SCS	-	Soil Conservation Service
Tc	-	time of concentration
USGS	-	United States Geological Survey

LIST OF DEFINITIONS

Curve Number (CN)

An empirical parameter used to estimate runoff from a rainfall event, for each subbasin.

Design Storm

Rainfall amount and distribution in space and time, used to determine a design flood or design peak discharge.

Flood Insurance Study (FIS)

A compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community.

Overland Flow Path

An above-ground component of a drainage system that caters for overland flows that occur when underground drainage pipes reach their capacity and cannot cope with more run-off from heavy rainfall.

Stormwater Conveyance

Stormwater features designed for the movement of stormwater through the drainage system, such as pipes, inlets, manholes, ditches, depressions, swales, streams, etc.

Time of Concentration (Tc)

The time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet.

1. PURPOSE OF STUDY

The City of Belvidere has experienced frequent, long-term flooding and stormwater drainage issues in several locations on the south side of the Kishwaukee River. The City retained Baxter & Woodman, Inc. to study the existing stormwater infrastructure within the south side of the City and develop a conceptual plan for system improvements. The primary goals for the study include:

- Analysis of the conveyance and storage capacity of the existing drainage system;
- Evaluation of the nature and extent of flooding throughout the south side, focused on known problem areas; and
- Development of a conceptual improvement plan that will reduce the impact of flooding on residents, and increase the operational capacity of south side stormwater infrastructure.

This report summarizes the input B&W received from local residents impacted by south side flooding, the data and tools used to analyze the existing drainage system, proposed stormwater conveyance and storage improvement alternatives, planning level costs, and a conceptual improvement plan with recommended implementation phasing.

2. BACKGROUND

2.1 Watershed and Study Area

The City of Belvidere is located in Boone County, Illinois and covers a total area of just over 12 square miles. Its current population is over 25,000 residents. The Kishwaukee River generally flows west through the City, dividing the north and south sides. The south side study area is loosely bounded by the Kishwaukee River to the north, US-20 to the south, Appleton Road to the east, and Belvidere Road to the west.

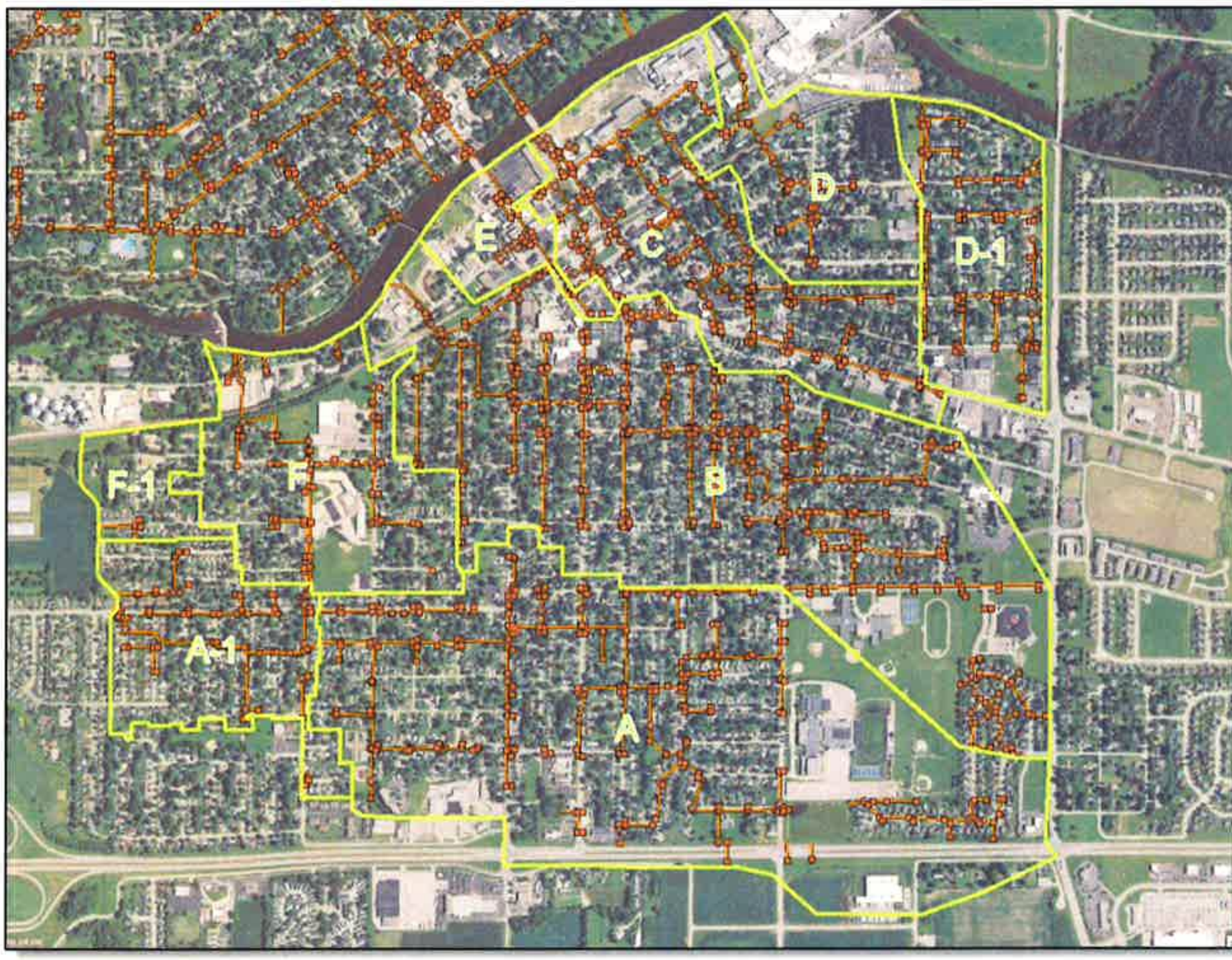


Figure 1: Study Area Map. Map shows the major storm basins in green and the existing storm sewer system in orange.

The total south side watershed area is approximately 1,300 acres, consisting of nine (9) of the City's separate drainage basins. These basins are designated as Basins A, A-1, B, C, D, D-1, E, F, and F-1. Land use is mostly residential with pockets of commercial and institutional development. The area includes four schools: Belvidere High School and Middle School, Washington Elementary, and

Immanuel Lutheran School. A downtown commercial area is located along State Street. The south side of the City was mostly developed before modern stormwater regulations were in effect. Topography is hilly and rolling, creating areas where large amounts of stormwater flow overland through streets and properties. The rolling topography also includes large depressional areas where ponding can reach several feet deep before surface flow can continue downstream.

3. EXISTING CONDITIONS

3.1 Existing Drainage System

The existing stormwater drainage system consists mostly of closed conduits, with curb and gutter road drainage to storm inlets. While a large portion of the storm sewer system is contained within roadway right of way, several runs of mainline storm sewer are located within side and rear yard drainage easements. Some portions of the study area are drained by roadside ditches and culverts. Generally, the drainage system conveys stormwater northwest to storm sewer outfalls located along the south bank of the Kishwaukee River.

Basin A is a large basin at the southern end of the study area. The storm infrastructure flows mostly west and has two outlets. At the outlet of the basin, flow is divided into Basin A-1 to the west and basin F to the north. The majority of the flow continues west to Basin A-1. Near the western limits of the basin, the storm sewer system outlets to a drainage ditch through three (3) 57-inch by 38-inch elliptical corrugated metal pipes northwest of the intersection at West 6th Street and 13th Avenue. This ditch flows north and then northwest to the Kishwaukee River, and receives discharge from 27-inch and 15-inch storm sewer outfalls flowing west from Aspen Court and West 5th Street, respectively.

The storm sewer that connects basin A to basin F acts as an overflow relief sewer to the trunk line. Basin F has four outfall locations to the Kishwaukee River, one (1) large 72-inch pipe that drains the majority of the basin, and three small outfalls that directly drain a small section of West Locust Avenue.

Basin B runs southwest through the middle of the study area and drains directly to the Kishwaukee River via a 91-inch by 58-inch elliptical storm pipe. The basin has many areas where the storm sewer trunk line does not follow the road, and instead cuts through yards and easements. These pipes provide a maintenance challenge for the City and have to be cleaned and repaired more often than pipes that are under the road or road right-of-way.

Basin C is a midsize basin, north of Basin B, that runs primarily northwest and outlets directly to the Kishwaukee River. It has three outfall pipes, a 24-inch, 30-inch, and 48-inch pipes, that outlet under the Main Street Bridge.

The last four basins, Basins D, D-1, E, and F-1 are smaller basins with smaller, shorter, more localized stormwater infrastructure. Basin F-1 is on the west side of the study area and drains via a 15-inch outfall to the same drainage ditch as Basin A-1. Basins D and E are small areas to the northeast side of the study area and directly drain to the Kishwaukee River. Basin D-1 drains to the drainage swale that runs along US-20 BUS Route on the east side of the study area.

There are a few small existing stormwater detention basins, specifically in Basins A, B, and D. All of the stormwater basins ultimately drain to the Kishwaukee River. The largest of these detention basins is located in Basin A at Belvidere High School at the northwest corner of Route 20 and East Avenue.

3.2 System Deficiencies

Flooding problems within the study area generally fall into the following categories:

- Overland flow through yards and roadways resulting from surcharged storm sewer;
- Ponding due to insufficient overland conveyance routes; and
- Overbank flooding from the Kishwaukee River.

Because most of the south side was developed before implementation of current stormwater regulations, the existing system lacks adequate storage and conveyance capacity to effectively detain or convey runoff from large storm events. The undersized system surcharges and causes problematic flow of stormwater through yards, roadways, and other properties. These flows often reach low-lying areas that lack a suitable overland flow route, typically intersections or roadway sags. Runoff to these areas collects and ponds during large rain events until the storm sewer system can drain down floodwaters.

Several specific problem areas were identified by City staff and local residents. These areas are described in detail in the following section. In some locations, flooding occurs frequently and has been reported multiple times over the course of a year.

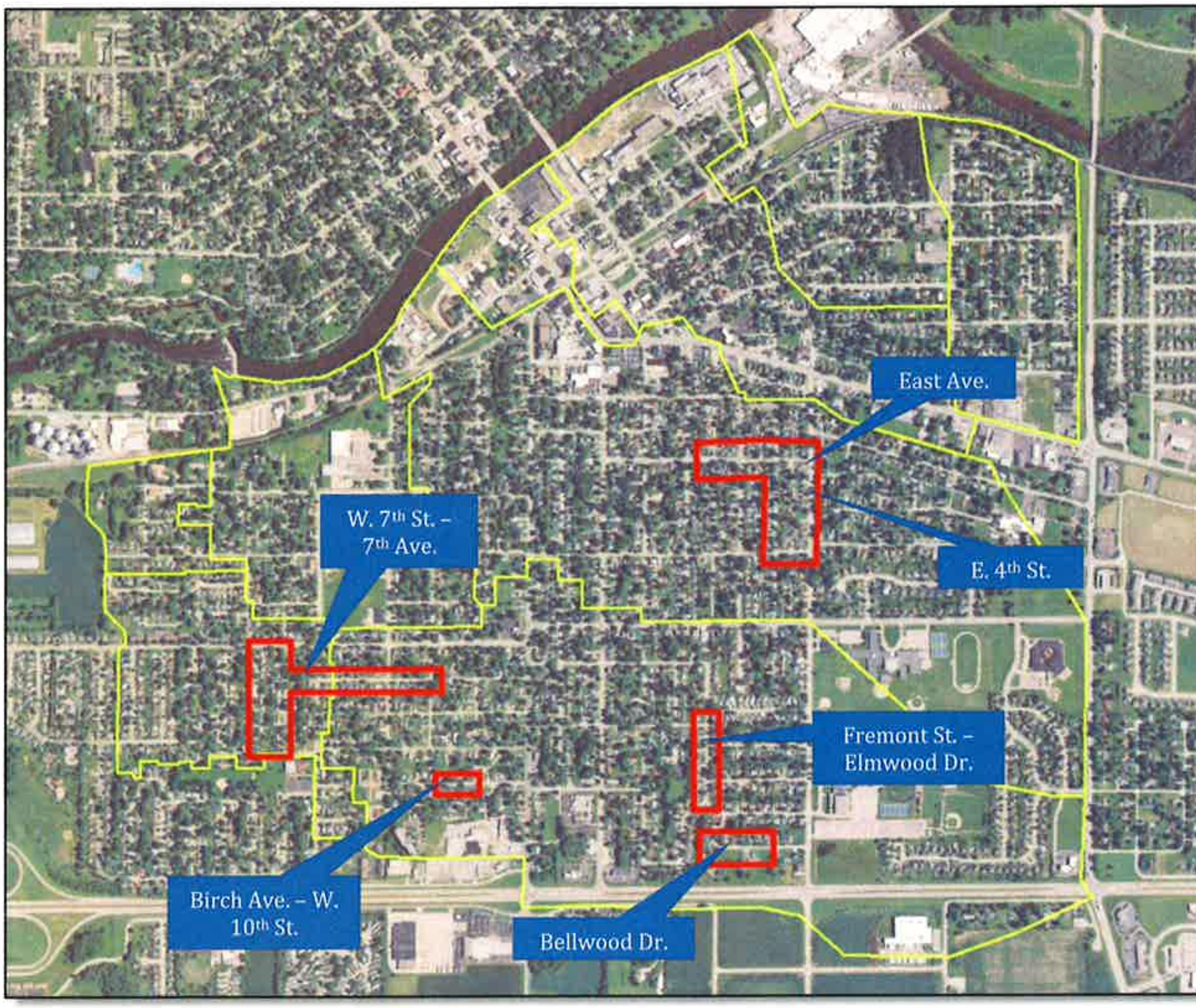


Figure 2: Problem Area Locations. Known problem areas are outlined in red.

East Avenue

East Avenue runs north/south through Basins A and B of the City between Route 20 to the south and Logan Avenue to the north. The road profile undulates, creating low spots that pond with water during large storm events. Specific problem areas include the intersections of East Avenue with Bellwood Drive and East 4th Street.

Currently, at the intersection of East Avenue and Route 20, water from the highway runs down the roadside ditch, overwhelms the channel, and overtops East Avenue at Bellwood Drive during large storm events. A berm separates the roadside ditch from a stormwater detention area owned by Belvidere High School.

Bellwood Drive

Bellwood Drive is a short stretch of road that intersects with East Avenue to the east, and turns into Cedardale Drive to the west. It is mostly residential with two church properties on the south side of the street. A sag in the Bellwood Drive roadway collects water during large storms, and significant ponding can occur below the overland flow outlet.

Fremont Street and Elmwood Drive

The south end of Fremont Street is a low-lying area that collects water during large storm events. Currently, there is no storm sewer under Fremont Street between Elmwood Drive and E 8th Street. Instead, the existing 36" trunk line storm sewer from Elmwood Drive cuts across backyards and continues to South Main Street. This storm sewer location is difficult to access and presents maintenance difficulties for the City. The existing storm sewer is undersized for the area draining to it and becomes surcharged during large storm events.

East 4th Street, from East Avenue to Fremont Street

This entire trunk line segment of storm sewer is located in a low-lying area in Basin B that holds water during large rain events. The storm drain is routed through side-yards and easements, making maintenance difficult and likely causing accelerated deterioration of stormwater infrastructure. When the storm drain is surcharged, the water flows rapidly through yards and driveways, flooding houses and garages in the area. These problems are caused by inadequate storm drain capacity, aging infrastructure, and a lack of a defined overland flow route.

West 7th Street and 7th Avenue

This intersection used to have an open channel stormwater outlet that was converted to storm sewer in the 1980s when the area to the west of the intersection developed. The open channel was replaced by two (2) 38-inch x 60-inch elliptical storm pipes. The area lacks stormwater storage and the storm drain is undersized for the amount of flow that moves through the area. The intersection is a low-lying area that lacks an adequate overland flow route and floods during large storm events.

Birch Avenue and West 10th Street

This is a depressional intersection in Basin A where water ponds during large storm events. The storm drain is undersized for the area draining to it and the intersection lacks a suitable overland flow route. The storm sewer surcharges during large storm events, and residents have witnessed stormwater flowing out of inlet structures. Ponding depths can make navigating the road difficult.

3.3 Theoretical Detention Analysis

Development within City of Belvidere has altered hydrologic conditions of the area, adding a significant amount of impervious area and increasing stormwater runoff. Most of the City's south side was developed before implementation of current stormwater regulations. As a result, these areas pass stormwater runoff to downstream areas without detaining it to control peak discharge rates. In many instances, the downstream drainage system does not have enough capacity to convey these flows without flooding roads, homes, and other properties during large storm events.

In order to understand the deficiencies of the existing drainage system, B&W evaluated the detention volumes that would have been required in the south side if it had been developed to meet current stormwater ordinance requirements. The City follows Boone County's detention standards, which limit 100-year discharge rates from a developed site to the lower of 0.15 cfs per acre or the pre-development release rate in the absence of a watershed plan. The purpose of this requirement is to prevent increases in downstream flow rates and enlargement of floodplain as the watershed area develops.

B&W created an XPSWMM model of the City's nine (9) south side drainage basins. In this model, runoff from each basin was routed through a storage node to compute the required detention volume for each basin. Orifice restrictors were included to control outflow from each storage node, and each restrictor was sized to meet the required release rate. Model results indicate that a total of approximately 359 acre-feet of stormwater detention volume would be needed in the south side to meet current ordinance requirements. Results of the analysis are summarized in Table 1 below.

TABLE 1

Detention Volume Required to Meet Current City Requirements

Drainage Basin	Area (ac)	Allowable Release Rate (cfs)	Required Detention Vol. (ac-ft)
A	382.47	57.4	105.1
A-1	82.04	12.3	24.6
B	360.98	54.1	99.1
C	143.34	21.5	41.5
D	78.49	11.8	22.0
D-1	80.88	12.1	22.7
E	30.96	4.6	9.3
F	113.09	17.0	26.8
F-1	26.87	4.0	7.8
Total	**1,299.12**	**194.9**	**358.8**

4. ANALYSIS APPROACH

4.1 Approach and Data Collection

B&W developed an existing conditions hydrologic and hydraulic model covering all nine (9) of the City's south side drainage basins for the purpose of evaluating existing and proposed conditions. While several stormwater drainage studies have previously been completed in different areas of the south side, this study was a more comprehensive analysis. Information from previous reports was utilized for this study.

4.1.1 Data Collection and Review

B&W collected data from the City, and a variety of other state and local sources. This data included:

- GIS Mapping Data
- 2-foot topographic contours (Boone County)
- Previous stormwater reports and modeling
- Historical record drawings
- FEMA Flood Insurance Study (FIS)
- FEMA Flood Insurance Rate Map (FIRM)
- Photos and personal accounts of flooding

Additionally, B&W performed field reconnaissance and collected site-specific survey data in selected locations. Survey included invert and rim elevations of the storm sewer system, ground surface elevations, low opening elevations of residences, and other pertinent information.

This data was used to assess the area and construct a detailed hydrologic and hydraulic model of the south side.

4.1.2 Public Meeting

A public meeting was held on October 9th, 2017 to gather resident information about flooding in the study area.

Figure 3: Stop sign is at the northeast corner of 8th St and Fremont, July 2016.

Attendees provided photographs, videos, map drawings, and other documentation of drainage issues they have experienced or have knowledge of. They also provided dates and frequency of flooding events, as well as magnitude information. Most of the drainage issues described coincided with known large rainfall events over the past two decades.

Figure 5: East Ave., July 2016

Figure 4: Back yard at Warren Ave., July 2016.

4.2 Model Development

XP Solutions' XPSWMM modeling software was used to analyze the study area. XPSWMM is a fully dynamic hydraulic and hydrologic modeling software that allows for a robust analysis of stormwater flow for complex engineered and natural systems. XPSWMM evaluates the interaction of all parts of the drainage system, including pipes, channels, street flow, and stormwater storage. XPSWMM is capable of running multiple storm duration and event scenarios.

4.2.1 Hydrologic Analysis

XPSWMM was used to model the watershed and rainfall attributes of the south side of the City. Watershed subbasins were delineated based on review of the County's 2-foot contour data and aerial photography. The study area is divided into the City's nine (9) south side drainage basins. This study slightly amended the basin boundaries from previous studies to better correlate with available contour data. Additionally, B&W subdivided each of these drainage basins into smaller subbasin areas to evaluate stormwater flows to modeled components of the drainage system.

B&W utilized the SCS curve number method to determine runoff depths for each subbasin. Land use data was gathered from the USGS National Land Cover Database (NLCD), 2011 edition. Soils data was collected from the NRCS Soil Survey. This information was used to compute a Curve Number (CN), an empirical parameter used to estimate runoff from a rainfall event, for each subbasin. Time of Concentration (Tc) is the time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet. B&W calculated Times of Concentration for each subbasin utilizing the County's 2-foot contour data and aerial photography.

A catchment map showing subbasin delineation is included below. The subbasins that are not included in the model are:

- Areas that do not contain storm sewer pipes 24 inches in diameter or larger and do not discharge to downstream pipes that are 24 inches or more in diameter; or
- Drain directly to the river by overland flow routes.

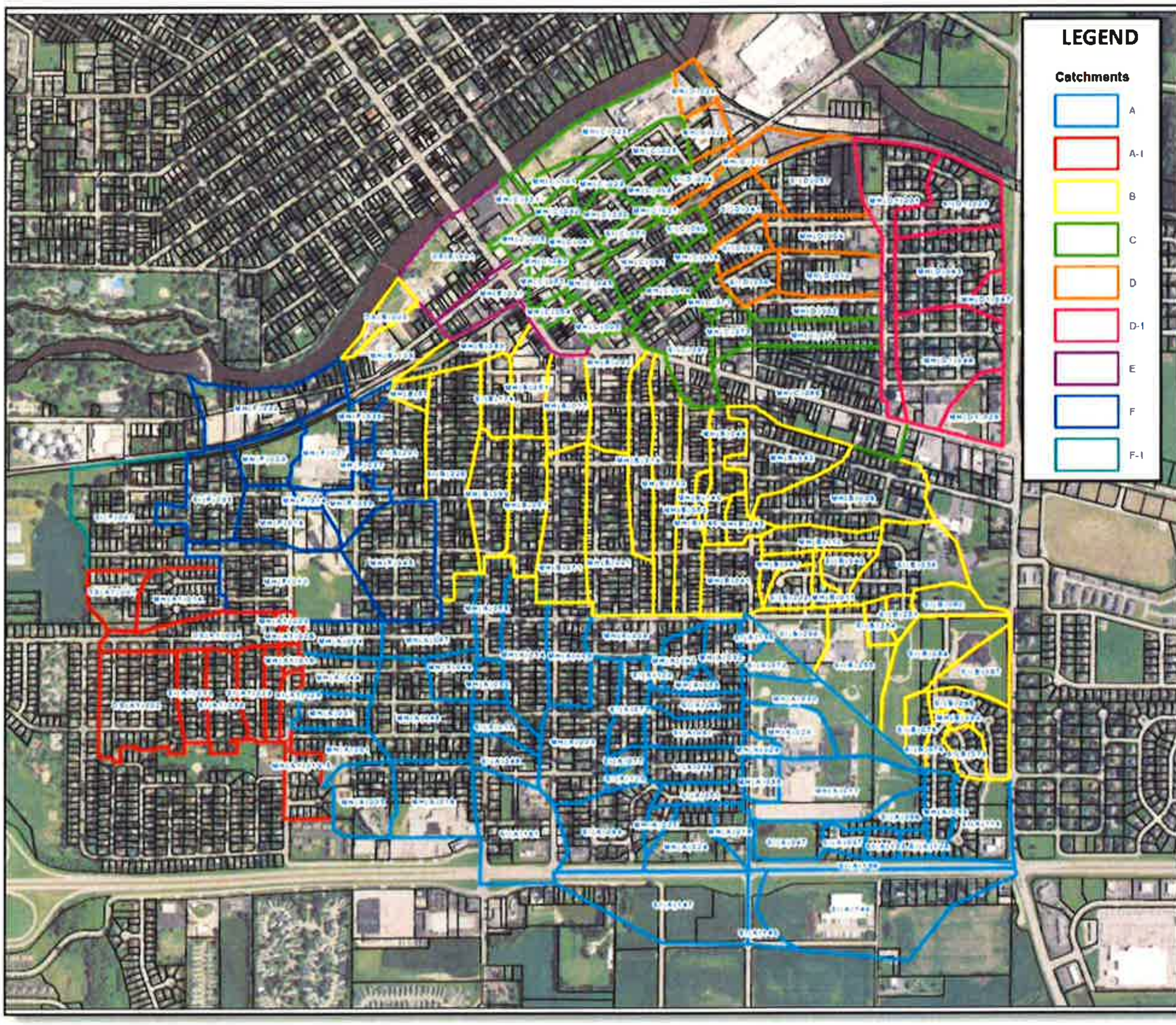


Figure 6: Drainage Basin Map

4.2.2 Hydraulic Analysis

The XPSWMM model includes all pipes on the south side that are 24 inches in diameter or larger, with specific problem areas modeled in finer (smaller diameter) detail. Pipe size information was derived from City GIS storm sewer data and B&W's site-specific survey. Rim elevations were taken from spot survey data of the area, past hydraulic models, or interpolated from the County's 2-foot contour data, in that order. Invert elevations were assigned based on survey data, model input from previous studies, or interpolation between points of known elevation if data was not available. Pipe slopes generally range between 0.3% to 2%.

Overland flow paths were added to the model along roads and through properties that are either known to be overland flow routes or were determined to be possible overland flow routes based on review of the 2-foot contour data for the area. Road cross sections were input as 20 feet wide and include a curb and road crest. Cross sections representing flow through yards and natural areas were input as a trapezoidal channel, with a 20-foot wide bottom and 1:1 side slope. All overland flow routes were assumed to be 3 feet deep to convey the majority of floodwaters, even in large storm events. Existing stormwater detention basin volumes were computed based on the 2-foot contours for the area.

Tailwater elevations were added at pipe outlets that discharge into the Kishwaukee River. Tailwater elevations were derived from the Flood Insurance Study (FIS) 10-year flood profile.

Figure 7 shows the XPSWMM model schematic. Orange links represent storm sewers or a combination of both storm sewer and overland flow. Green links represent overland flow paths.

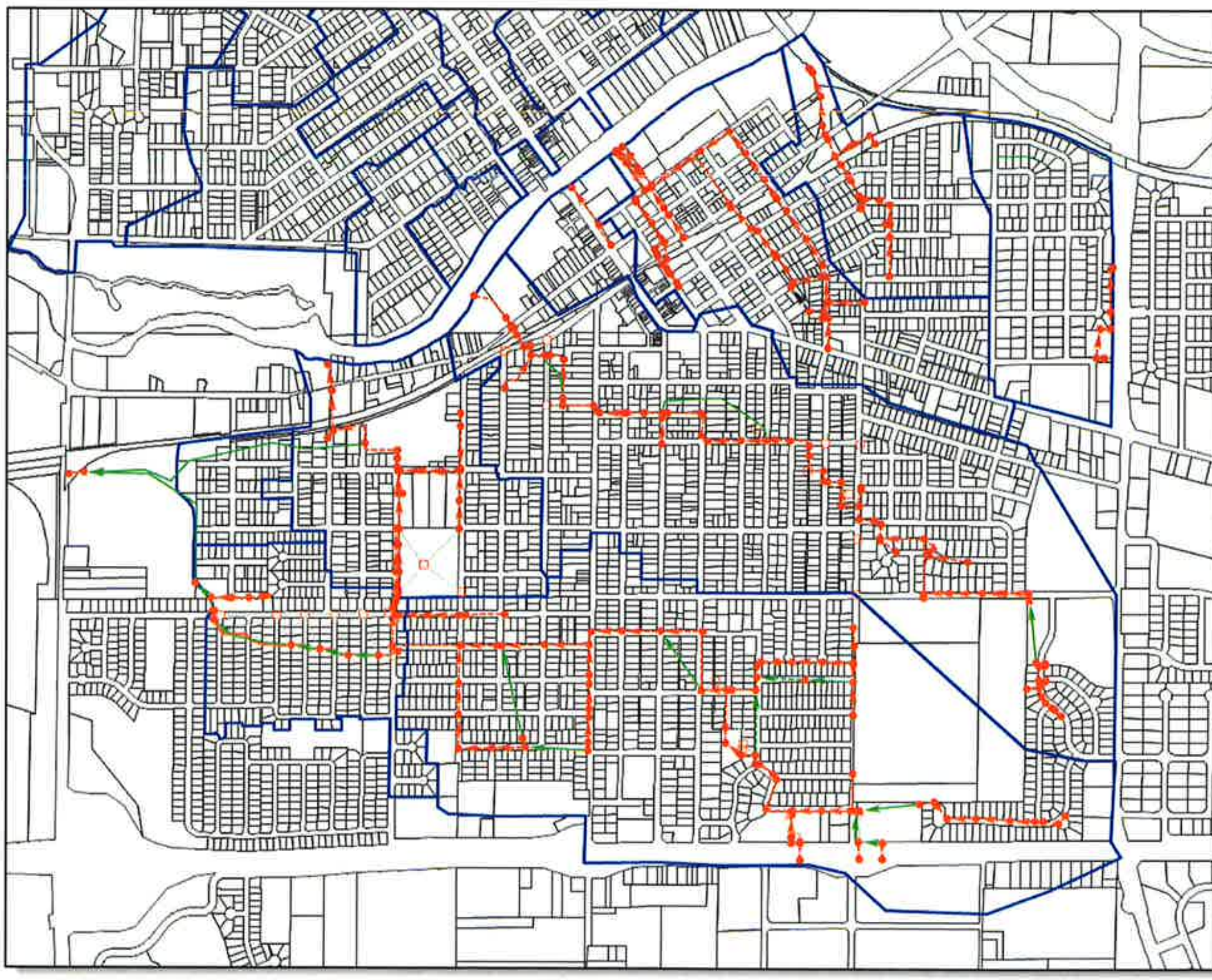


Figure 7: XPSWMM Model Schematic

4.2.3 Model Calibration

The model was calibrated to show flooding in all known problem areas. The existing conditions model results were examined to verify that reported flood depths correlated to flooding observed during the July 2017 rainfall event. The July 2017 storm event was chosen for calibration because it was the storm that had the most available historical data. Rainfall data was taken from a rain gage at the City's wastewater treatment plant. The July 2017 event produced at total of 5.7 inches of rain in four days, which equates to approximately a 10-year storm event.

The model's reported flood depths were calibrated to match observed flooding depths using pictures and testimonials from residents and City staff about known problem areas. Model calibration for urban storm drain systems is difficult because there are rarely any measured data on flood heights, and the calibration must depend on remembered accounts. There is rarely any data from flow meters or stage recorders. This is why resident feedback and historical pictures that include high water marks are especially valuable.

4.2.4 Critical Duration Analysis

B&W performed critical duration analysis of the south side drainage system to determine the storm duration that induces the most severe flooding conditions. A critical duration design storm is the storm duration that produced the highest runoff flows or flood stages for the range of storm durations evaluated. Generally, neighborhood stormwater conveyance systems have critical durations up to a couple of hours. However, for systems with large tributary drainage areas or significant storage, the critical duration can be much longer. For the south side of Belvidere, critical durations are expected to be relatively short, because of the lack of stormwater storage infrastructure.

B&W performed a critical duration analysis of the south side drainage system for both the 10- and 100-year storm events. Rainfall data was derived from the northwest sectional rainfall depths published in the Illinois State Water Survey's *Bulletin 70*, along with appropriate Huff distributions. For this study, the 30-min, 1-hr, 2-hr, 3-hr, 6-hr, 12-hr, 18-hr, and 24-hr storms were analyzed to determine the duration that caused the most severe flooding conditions. The critical analysis for the study area was found to generally alternate between the 1-hr and 2-hr storm, depending on the specific area in the model.

4.2.5 Existing Conditions XPSWMM Results

The model was evaluated using 2-, 5-, 10-, and 100-year storm events to determine the existing capacity of the system. Overall, the system showed a maximum of a 2-year storm event capacity, meaning that the 2-year rainfall can be contained in the storm drain system. The 5-, 10-, and 100-year design storms all showed instances of overland flooding and surcharging of the storm sewer system. Existing conditions flood depths reported by the XPSWMM model are presented in Table 2. This table includes results for the six (6) known flooding problem areas described in Section 3.1. Results show that flooding depths at these locations range from 1.9 feet to 4.5 feet in the 100-year, critical duration storm event.

TABLE 2

Existing Conditions Flood Depths at Flooding Problem Areas

Location	Flood Depth (ft)			
	2-Year	5-Year	10-Year	100-Year
East Ave.	0	1.7	2.5	3.7
Bellwood Dr.	2.6	2.9	3.0	4.0
Fremont St. – Elmwood Dr.	1.2	1.5	1.6	1.9
East 4th St.	0	0	1.0	3.1
West 7th St. – 7th Ave.	0.9	2.0	2.7	4.5
Birch Ave. – West 10th St.	0	0.6	1.4	2.4

5. ALTERNATIVES ANALYSIS

B&W developed and analyzed several alternatives for improving stormwater drainage system performance. These alternatives included storm sewer system improvements, new storage basins, upsizing existing detention basins, and improving overland flow routes. Alternatives were evaluated both individually and in combination at each problem area.

5.1 Optimizer Software

Optimatics' Optimization software was used to enhance and support engineering input and design decisions for alternatives development. Its "Optimizer" software is a cloud-based optimizations software that is used with the hydraulics and hydrology model to determine the most effective way to improve a system. Optimizer was programmed to evaluate all conveyance, storage, and surface drainage options by weighing each option against performance and cost. Optimizer's analyzed each option within constraints that were input to account for site limitations such as available pipe cover, maximum pipe depth due to outfall conditions, and available footprints for storage facilities. The software analyzed hundreds of planning options, and displayed the options that give the best results while minimizing capital and operating costs.

5.2 Current Plans

The City has already started addressing flooding concerns in the south side prior to this study, and conceptual plans were available for some of these projects. One objective of this study was to confirm that the existing designs would benefit the system overall, and recommend modifications to the designs if needed.

5.2.1 Bellwood Ponds

The Bellwood Ponds are two (2) proposed stormwater storage ponds to be located on church properties on the south side of Bellwood Avenue. The ponds would utilize available open space to detain water that flows from the highway to Bellwood Avenue. Plans developed by Civil Engineering Services, Inc. (CES) were used to determine the storage volumes in the model for this analysis.

The model analysis showed that these two ponds would help alleviate flooding on Bellwood Drive. If combined with the proposed High School Pond Improvements (Section 4.2.2), flooding depths on Bellwood would decrease from 36 inches to 11 inches for the 10-year storm. For the 100-year storm, flooding would decrease from 48 inches to 32 inches. At the south end of Fremont Street, located immediately downstream, flooding depths would decrease from 58 inches to 20 inches for the 10-year storm. For the 100-year storm, flooding depths would decrease from 78 inches to 46 inches. Since the storage location is upstream in the watershed, most of the benefits are localized in the upper reaches of the watershed.

5.2.2 Redesign of the High School Detention Pond

Belvidere High School has an existing stormwater detention pond on the northeast corner of East Avenue and Route 20. The pond currently has a berm between the Route 20 roadside drainage ditch and the detention pond, preventing stormwater from the roadway drainage system from the ditch from entering the pond. The City has obtained permission from IDOT to remove the berm and allow water from the ditch to enter the detention pond. Modeling shows that the pond is currently oversized and does not fill up during the 100-year storm. The pond could manage additional detention without adverse effects.

5.3 Conveyance Options

Modeling of the system shows that there are many conveyance choke points in the drainage system that do not provide sufficient conveyance capacity. Modeling shows that flooding at the identified problem area locations are typically caused by a lack of conveyance capacity in the storm sewer system coupled with inadequate overland flow routes. During large storm events, the system becomes surcharged and cannot accept more runoff. In certain areas, the pipes become pressurized and water is pushed out of the system through inlet structures.

A conveyance solution would include upsizing pipes to eliminate choke points in the system and allow for enough capacity to move water through the storm sewer system without backups. Generally, design conventions call for conveyance systems to provide 10-year capacity. Modeling results show that the City's current system generally operates at a 2-year conveyance level. Conveyance improvements were added where the existing storm drain system does not provide 10-year capacity and the model showed more than 6 inches of flooding. There are also areas where the storm sewer size was increased upstream of an area to provide attenuation or downstream to eliminate choke points in the system.

Currently, pipes running through yards and easements are a maintenance concern for the City. This analysis removed and reconfigured those areas if it was determined that an increase in pipe capacity was needed. If a storm sewer was determined to need upsizing and the pipe is not currently within a roadway right of way, the original pipe was abandoned and an upsized sewer was re-routed along a road.

Increasing conveyance by upsizing storm sewer pipes is effective but can be costly. Increases in conveyance can also increase outfall flowrates, which can be detrimental to the environment and may cause or exacerbate flooding problems downstream. Because of the cost and potential downstream impacts, it is best practice to combine conveyance improvements with stormwater storage solutions and improved overland flow routes to best manage stormwater.

5.4 Storage Options

The south side was largely developed before stormwater detention was required and, in its developed state, does not have much open space to add storage without the acquisition of properties. The City is already planning two stormwater storage improvements, discussed in Section 4.2 above, but additional storage was evaluated.

Open space areas within the south side were considered the preferred locations for stormwater storages. Three existing open spaces were analyzed to determine if they were viable options for stormwater storage. Washington Elementary has a large open area to the south of the school that could be utilized for stormwater storage. Additionally, an open plot of land is located at the north end of 8th Avenue that is currently open space. A third open area is situated at the west limits of the study area, along Appleton Road, and is currently being used as farmland.

Of these three options, Washington Elementary was found to be the best viable open space to put stormwater storage. By connecting a new pond at this location to the trunk line drain that runs along 7th Avenue, water can be diverted to the pond and stored, taking pressure off of the drainage system and preventing overflows.

The open plots at 8th Avenue and Appleton Road were not good candidates because they are located too far downstream of the problem area locations and do not remediate flooding without the addition of large conveyance improvements. The site could be used for storage to mitigate increased flow to the Kishwaukee River, if that becomes a requirement for future permitting.

Because of the lack of open space available for stormwater storage, property acquisitions would be necessary for all additional storage locations. Using the Optimizer tool, six (6) possible locations were analyzed, and a total of four (4) additional storage areas were chosen. These locations would require property acquisition by the City. Storage ponds were sized for the 100-year design storm to prevent flooding depths of six (6) inches or greater in conjunction with conveyance improvements. The ponds are proposed in low areas, close to or within problem area locations, to provide the most flood relief and minimize the need for conveyance improvements and pipe upsizing. Additionally, many of these properties are known to experience repeat flood damage.

5.5 Additional Analysis

B&W evaluated overland conveyance options in many areas to determine the most cost effective alternatives for flood relief. Surface drainage improvements are designed to provide a positive drainage path away from the problem areas and reduce the potential for ponding in those locations. One area that would benefit from an overland drainage route is at Birch Avenue and 8th Street. The intersection currently lacks a suitable overland flow route, and the storm sewer system does not have enough capacity for large storm events. Of the options evaluated to address flooding at this location, the most cost effective improvement would be to acquire property between W 10th Street and W 9th Street and excavate a swale that allows water to flow by gravity out of the depressional area.

Stormwater pumping options were also evaluated, specifically for the stormwater storage pond at Belvidere High School. Construction of a lift station was considered to pump water from downstream locations at the intersection of Whitney Boulevard and West 8th Avenue up to the Route 20 roadside ditch so it can flow by gravity to the pond and be stored. Under this alternative, additional stormwater storage would be added on the school property. This option was not chosen because initial evaluation indicated it would be more costly to construct than the other storage options considered. Additionally, it would require maintenance and operation cost in perpetuity.

6. CONCEPTUAL IMPROVEMENT PLAN

6.1 100-Year Level of Service Improvement

The conceptual improvement plan is designed to provide flood protection during the 100-year, critical duration storm event. Design criteria stipulated that no more than six (6) inches of flooding was acceptable. Generally, six (6) inches of flooding is assumed to be confined to the road and does not overtop the curb. The plan provides a 100-year level of service, with less than six (6) inches of flooding for the 100-year storm, and the elimination of stormwater ponding in the 10-year storm.

The plan includes a combination of increased storm sewer system conveyance, stormwater storage, and improved overland flow routes. The plan is limited to Basins A, A-1, B, and F, which contain the identified flooding problem areas.

Modeled proposed conditions flood depths are presented in Table 3. This table includes results for the six (6) known flooding problem areas described in Section 3.1. Results show that flooding is limited to depths of less than or equal to 0.5 feet for all storm events evaluated, and that the storm sewer system has capacity to convey storms up to the 10-year critical duration event. Due to the storage added to the drainage system, the critical duration changed from the existing conditions analysis in some locations.

TABLE 3

Proposed Conditions Flood Depths at Flooding Problem Areas

Location	Flood Depth (ft)			
	2-Year	5-Year	10-Year	100-Year
East Ave.	0	0	0	0
Bellwood Dr.	0	0	0	0.5
Fremont St. – Elmwood Dr.	0	0	0	0
East 4th St.	0	0	0	0
West 7th St. – 7th Ave.	0	0	0	0
Birch Ave. – West 10th St.	0	0	0	0

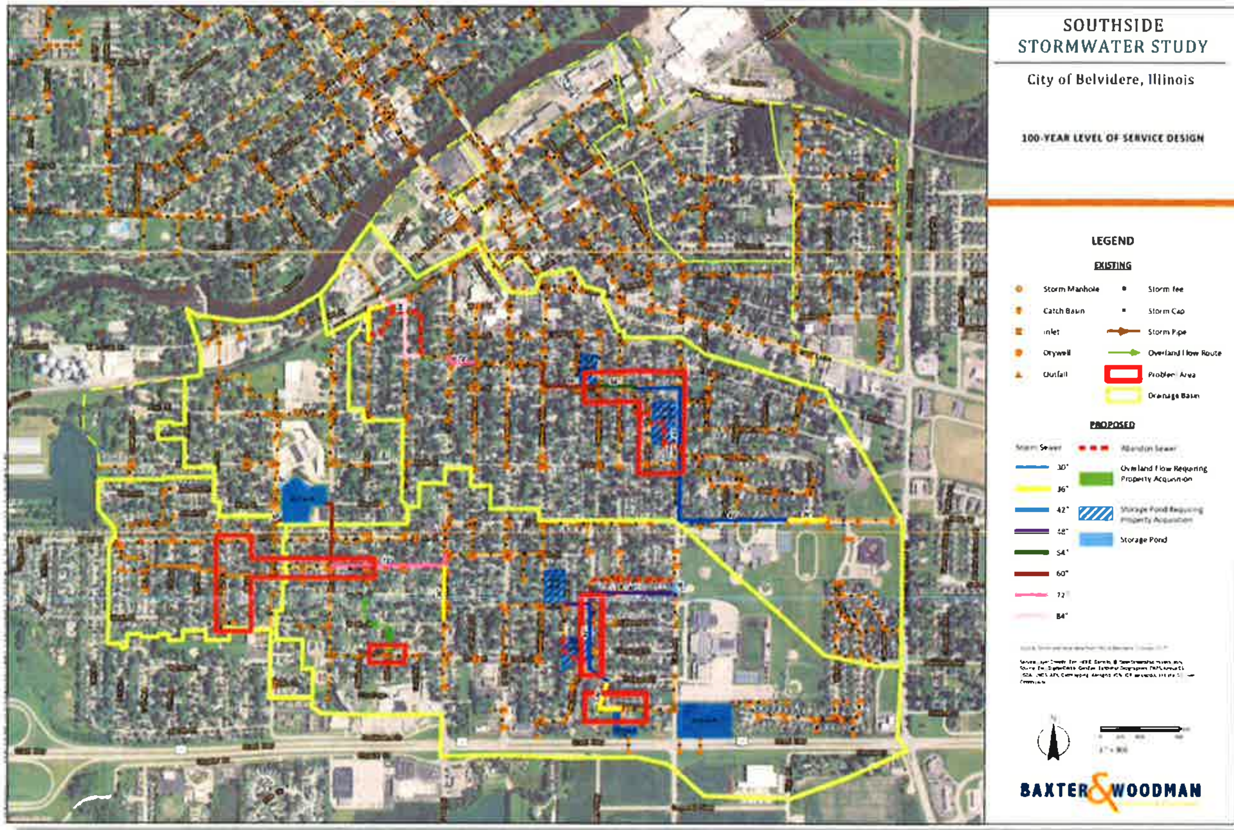


Figure 8: 100-Year Level of Service Plan

TABLE 4 shows the engineer's estimate of cost for each phase. A full breakdown of cost estimates is included in Appendix E.

TABLE 4

Overview of Engineer's Estimate of Probable Cost

Overview of Engineer's Estimate of Cost	
Phase 1	$370,000
Phase 2	$1,810,000
Phase 3	$11,490,000
Phase 4	$19,180,000
Phase 5	$9,400,000
Total Project Cost	**$42,160,000**

6.2 Phasing Plan

The conceptual plan is divided into five implementation phases, with Phases 1 and 2 already undergoing planning by the City. Phases 3, 4, and 5 consist of a series of improvements based on the analysis presented in this report. The phases are divided by problem area location and basin, with downstream projects being slated first, so as not to accrue negative downstream effects. Within each phase, projects are prioritized, starting with the most needed first, and listed in recommended order.

6.2.1 Phase 1

Phase 1 consists of the construction of the Bellwood Ponds on two church properties south of Bellwood Drive. These ponds were analyzed as part of the system and are discussed in more detail in Section 4.2.1 of this report.

6.2.2 Phase 2

Phase 2 includes the redesign of the Belvidere High School Detention Pond. The expansion and reconfiguration of the pond and highway ditch were modeled as part of this study, and determined to be a benefit to the system. Analysis is included in Section 4.2.2.

6.2.3 Phase 3

Phase 3 includes improvements in Basin F and at the downstream end of Basin A. Phase 3 addresses flooding for the problem areas grouped in the southwest side of the study area. Improvements include a new stormwater pond at Washington Elementary, conveyance improvements along W 7th Street, 5th Avenue, and Pearl Street, and an addition of a swale at Birch Avenue and W 10th Street to provide a positive overland flow outlet.

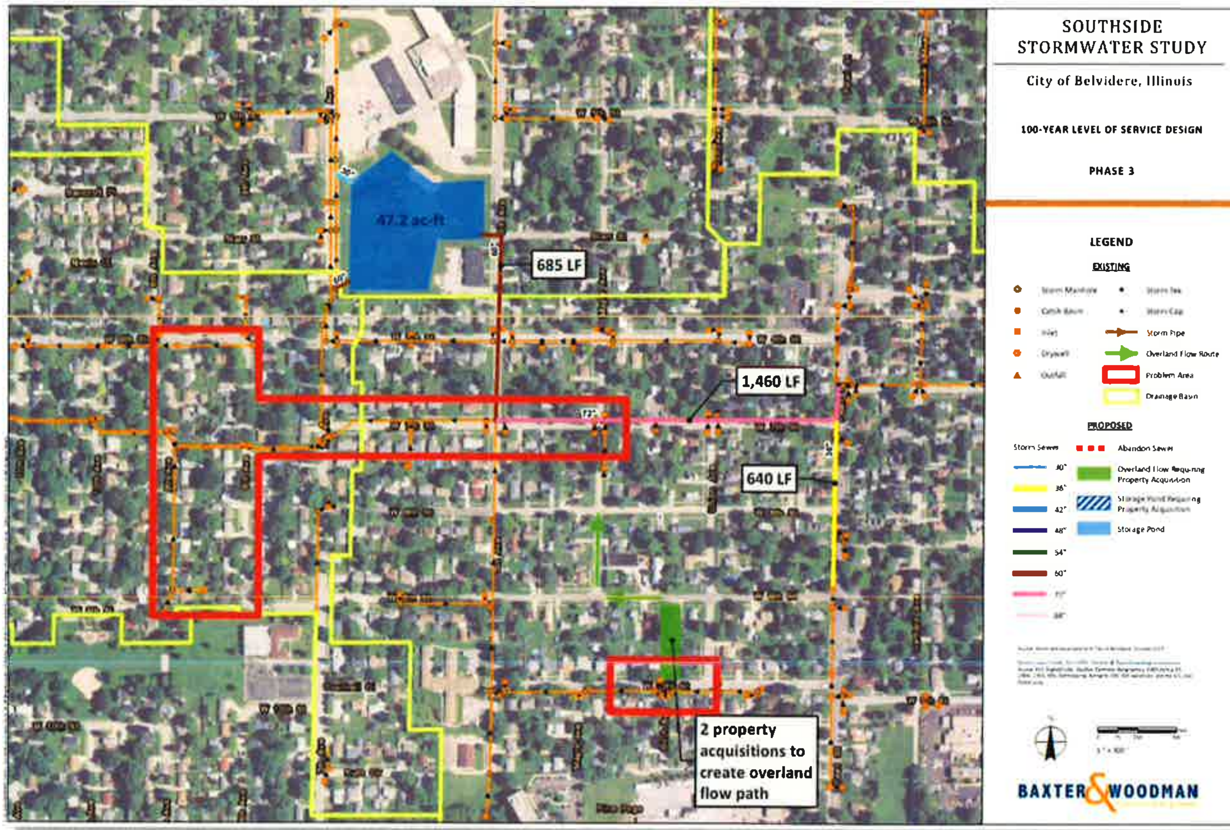


Figure 9: Phase 3 Plan

The highest priority project in this area would be the addition of a detention pond at Washington Elementary that would provide 47.2 ac-ft of surface storage. The pond would be connected to the existing storm sewer system that runs along 7th Avenue. The pond would outlet to the downstream segment of the existing storm sewer on 7th Avenue. The space for this pond would have to be acquired from the school or an easement would need to be provided, and the associated costs are not included in the cost estimate.

The next project would be to add a new 60-inch storm sewer along 5th Avenue, from West 7th Street to Washington Elementary to divert water to the 47.2 acre-foot pond at the school. The diversion pipe would take pressure off of the existing system and redirect water to the new pond to be stored until the storm sewer system has capacity to drain the pond.

The third project would be upsizing the trunk line storm sewer along West 7th Avenue, replacing the existing storm sewer with a 72-inch diameter pipe from 5th Avenue to East 7th Street.

Additional proposed improvements for the area include an upsized 36-inch storm sewer along Pearl Street, from West 9th Street to West 7th Street, and an improved overland flow path at Birch Avenue and West 10th Street. The overland flow path would require two property acquisitions.

The engineer's estimate for this work is $11,490,000. This total includes the cost of the two property acquisitions necessary for the overland flow path at Birch Avenue and West 10th Street, but does not include the cost for property acquisition at Washington Elementary.

6.2.4 Phase 4

Phase 4 includes all proposed improvements in Basin B. Improvements would start upstream on East 6th Street and continue throughout the system to West Locust Street. The plan includes conveyance improvements along East 6th Street, East Avenue, East 4th Street, East 3rd Street, Union Avenue, Maple Avenue, and West Pleasant Street, and two proposed stormwater detention ponds at East 4th Street and East Avenue and East 4th Street and Fremont Street.

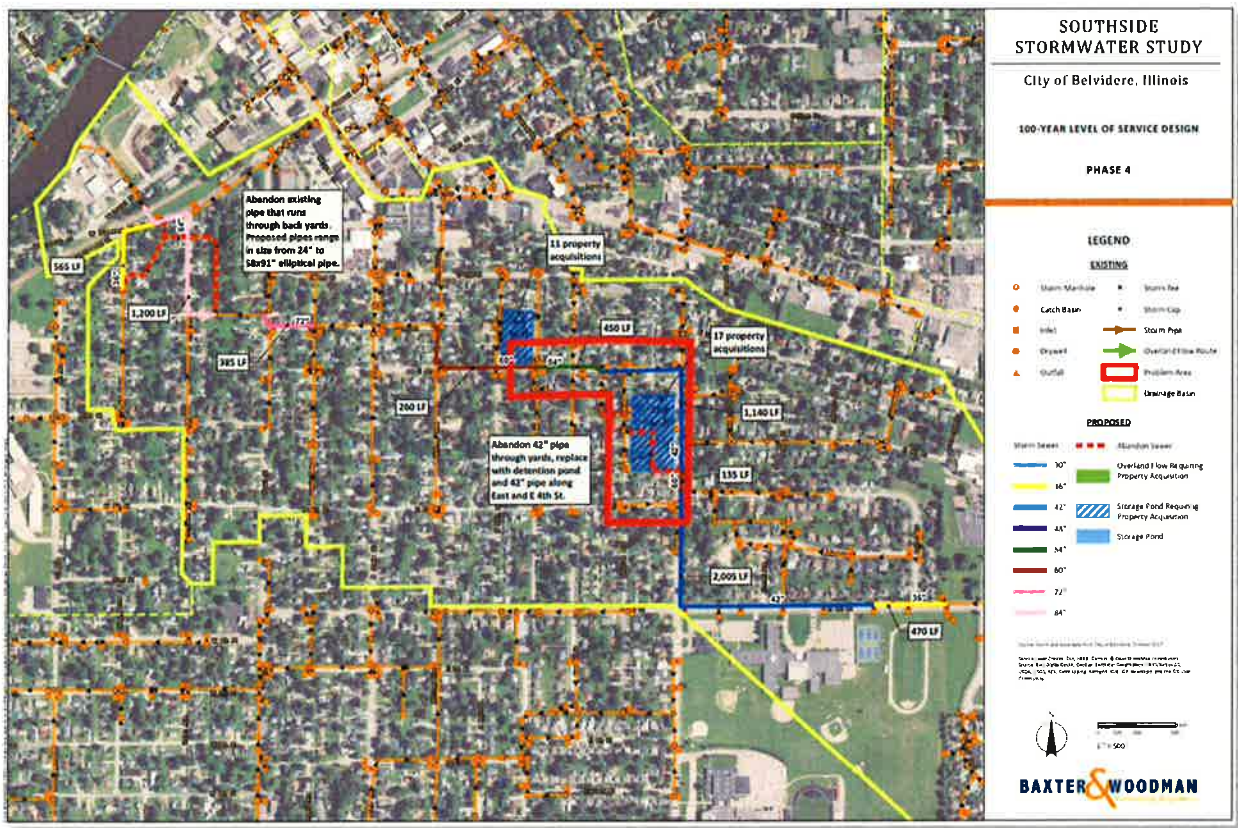


Figure 10: Phase 4 Plan

The first project would be the installation of a relief drain along East Avenue and East 4th Street. The 42-inch relief storm sewer would add capacity to the system and provide relief where the existing flooding is the most extreme.

The next project would be immediately downstream of the new relief storm sewer, and would include upsizing the mainline storm sewer along East 4th Street and Whitney Boulevard to 54-inch and 60-inch diameter pipe.

Following the conveyance improvements, the City could install the proposed stormwater pond at East 4th Street and East Avenue. The proposed pond provides 17.8 acre-feet of storage and would likely require at least 17 property acquisitions to be constructed. The location of this storage is somewhat flexible and could be relocated or broken up into smaller ponds in the design stage, as long as enough storage volume was provided. This study includes abandoning (or removing, if necessary) the existing storm sewer that runs through the yards in that area.

The fourth project would be to install the second detention pond at East 4th Street and Fremont Street. The pond should provide 6.5 ac-ft of storage volume and would likely require at least 11 property acquisitions. Again, this pond could potentially be relocated or divided up, as long as enough storage is provided for the area.

Additional improvements include conveyance improvements on East 6th Street and East Avenue ranging from 36-inch to 60-inch diameter storm sewer. These improvements include a 42-inch relief storm sewer that runs along East 6th Street to East Avenue, connecting back up to the main trunk line sewer at East 5th Street. The relief sewer will add capacity in the area, without removing the storm sewer that currently runs through the side and back yards of the neighborhood to the east of East Avenue. A short run of 72-inch diameter pipe would be upsized along East 3rd Street, from Garfield Avenue to Pearl Street, to provide added capacity. The last two conveyance improvements are along Union Avenue and Maple Avenue. The existing storm sewer runs through the properties on either side of Union Avenue. The proposed plan calls for these pipes to be abandoned and the upsized pipes to be run north along Maple Avenue and Union Avenue, and meet along West Pleasant Street. The proposed pipe along Union Avenue is 84-inches and the proposed pipe along Maple Avenue is 36-inches. After they meet on West Pleasant Street, the proposed 84-inch pipe continues under the rail road tracks and joins up with the existing system.

The engineer's estimate for this work is $19,180,000. This estimate includes the cost of the property acquisitions for the two stormwater storage areas.

6.2.5 Phase 5

The final phase includes upstream improvements to Basin A. Improvements include conveyance increases along Bellwood Drive, Cedardale Drive, Elmwood Drive, Fremont Street, East 8th Street, and a small section of East Avenue. The plan also includes two proposed stormwater detention ponds at Fremont Street and the intersection of East 8th Street and Whitney Boulevard.

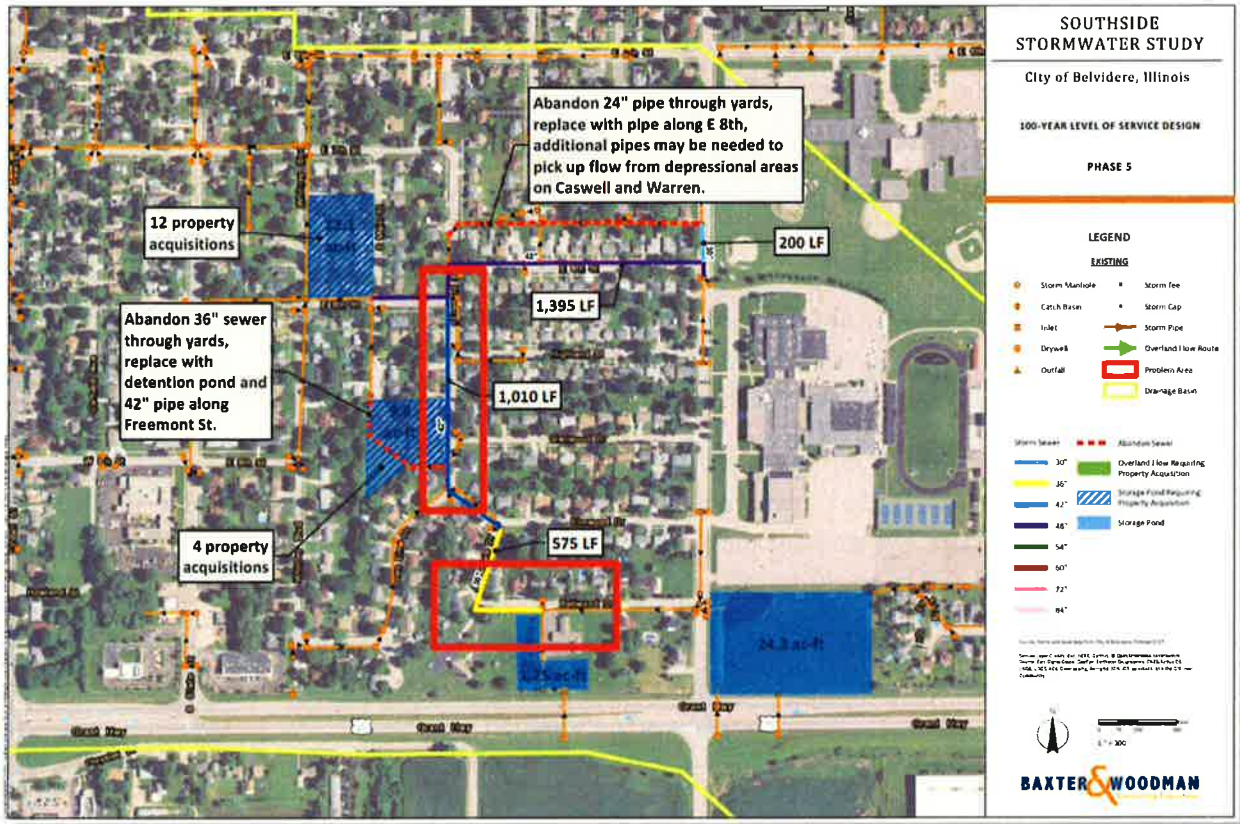


Figure 11: Phase 5 Plan

The highest priority project in this phase is the conveyance improvements along Bellwood Drive, Cedardale Drive, Elmwood Drive, and the relief drain along Fremont Street. The conveyance upgrades include installing 36-inch pipe along Bellwood Drive and Cedardale Drive and 42-inch pipe along Elmwood Drive and Fremont Street.

The next project would be the installation of the stormwater pond along Fremont Street. The pond along Fremont Street would require four property acquisitions and should provide 9.8 ac-ft for stormwater storage. As part of pond installation, the section of existing 36-inch pipe that runs through the pond properties should be abandoned or removed.

Additional components of this plan include upsizing pipes along East Avenue and East 8th Street with pipes ranging from 30-inches to 48-inches in diameter. Currently there is an undersized pipe running along the backyards of the properties north of East 8th Street. We recommend that this pipe be abandoned and 48-inch pipe be installed under East 8th Street, for ease of maintenance. An additional stormwater storage pond will be needed at the end of this upsized line, at the intersection of East 8th Street and South Main Street. This pond will provide 12.1 acre-feet of stormwater storage and would likely require property acquisitions of 12 residential lots.

The engineer's estimate for this work is $9,400,000. This estimate includes the cost of the property acquisitions for the two stormwater storage areas.

6.3 Study Considerations

B&W developed the plan improvements presented in this study based on conceptual modeling of the south side drainage area. The model includes a limited analysis of the existing storm sewer system that omits pipes under 24 inches in most cases, and does not include all inlets and laterals necessary for detailed study and design. The improvements included in this report are conceptual, and will require additional analysis and refinement prior to design. Changes to proposed storage configurations, storage locations, storm sewer, and overland flow routes may be necessary.

Proposed storage locations and configurations will require property acquisition. They are proposed in locations that are not currently owned by the City that may not be available or desirable. Relocation of these storage facilities may be required to make the project constructible, and further analysis may be needed to confirm flood reduction benefits.

Downstream impacts of increasing stormwater discharges to the Kishwaukee River have not been analyzed as part of this study. Downstream impacts and associated permitting requirements should be evaluated fully before advancing any recommended improvements to design engineering. Additional modeling may be needed to assess the effects of increased stormwater flows to the river.

APPENDIX A

HISTORICAL PHOTOS AND DOCUMENTATION

900 block of East Avenue

Pictures June 28, 2017

The pictures are mild. The flooding is usually a lot worse.

Street has flooded in 900 block of East Avenue at least four times this spring. We deal with this every year.

Unable to get in and out of drive ways.

I do not have pictures of the flooding between drive ways.

This is mild. Water is usually higher. The water is coming from the East Avenue north and south. It looks like a river between our drive ways. That water is coming from Washington Street behind us. Back yards are flooded and water just sits and goes into our basements.

When the flooding occurs cars and trucks continue to drive in it making things worse.

Russ & Betty McAllister

815-218-9044

Flooding Meeting to Study Storm Water

Monday 10-9-2017

At City Hall 4:00 P.M. to 6:00 P.M.

Your photos and videos of your flooding are needed, with dates. This will be used to link it up with weather data too make plans on dealing with the flooding in your area. If you cannot make the meeting your pictures can be given to the Public Works Department at a later date. This is one small step toward solving the flooding problem. It will engineers information on the problem and hopefully lead to a solution. The Council Meeting that will follow has flooding on the agenda.

Ward Five Aldermen

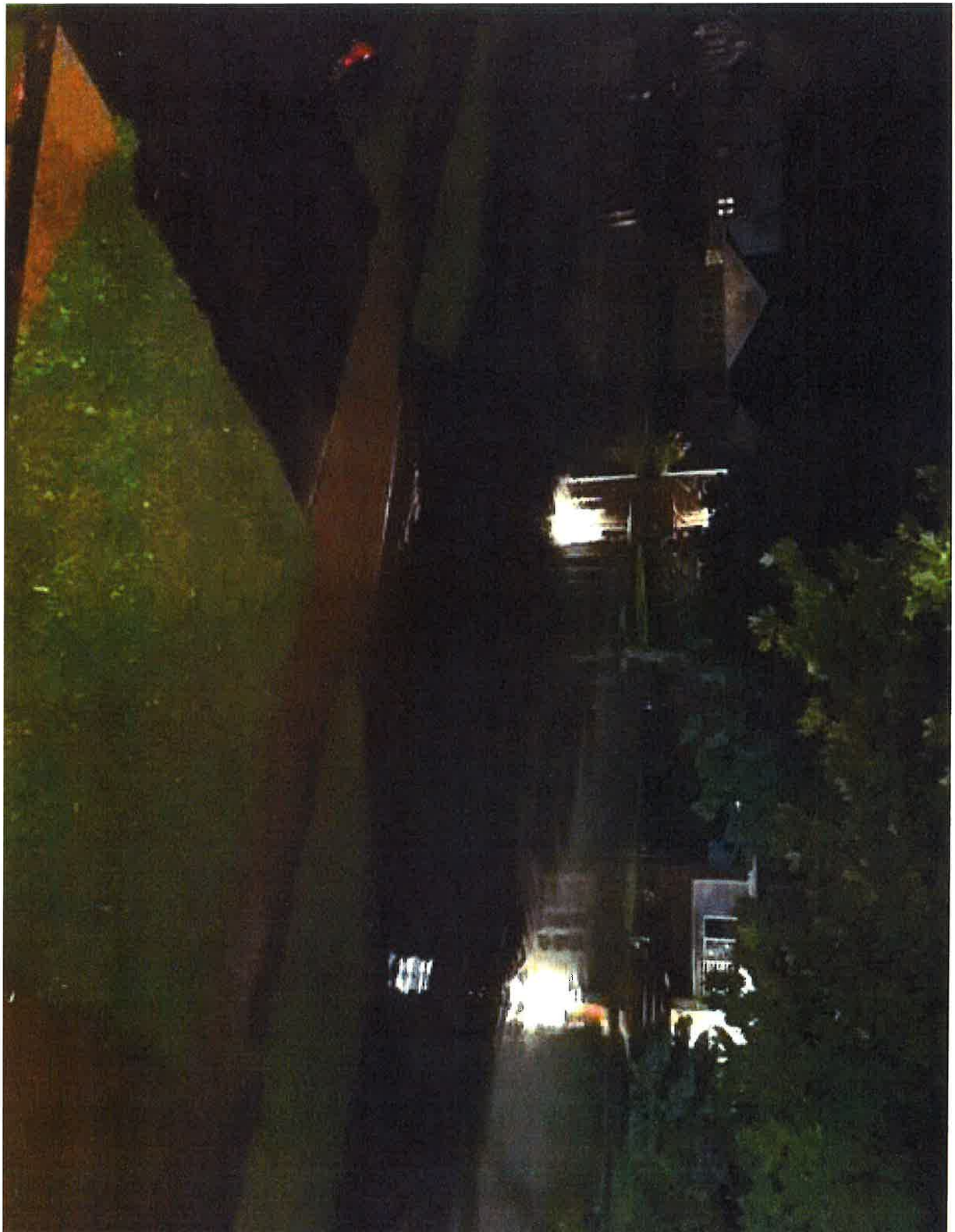
Mark Sanderson 1-815-975-9290

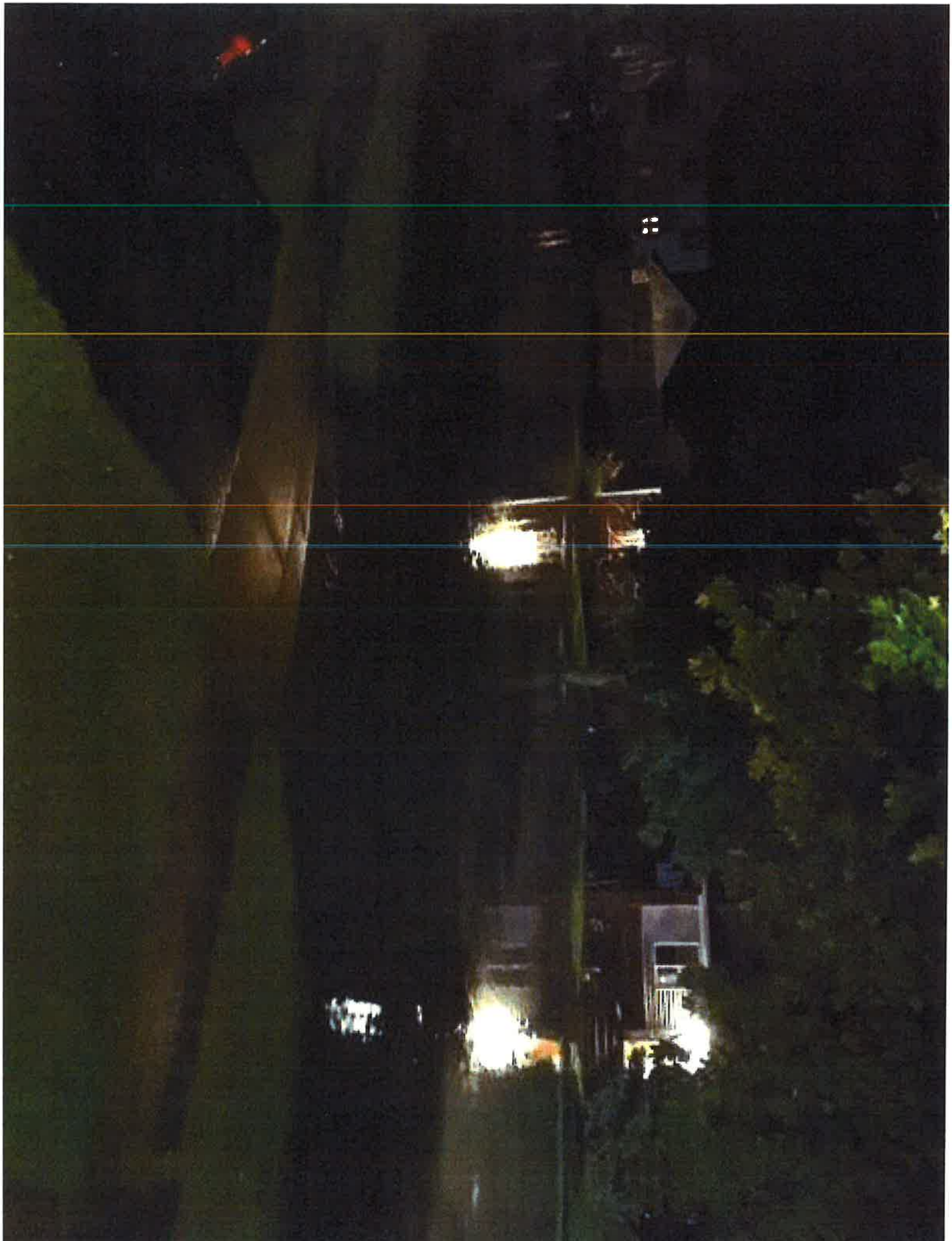
Marsha Freeman 1-815-914-5990

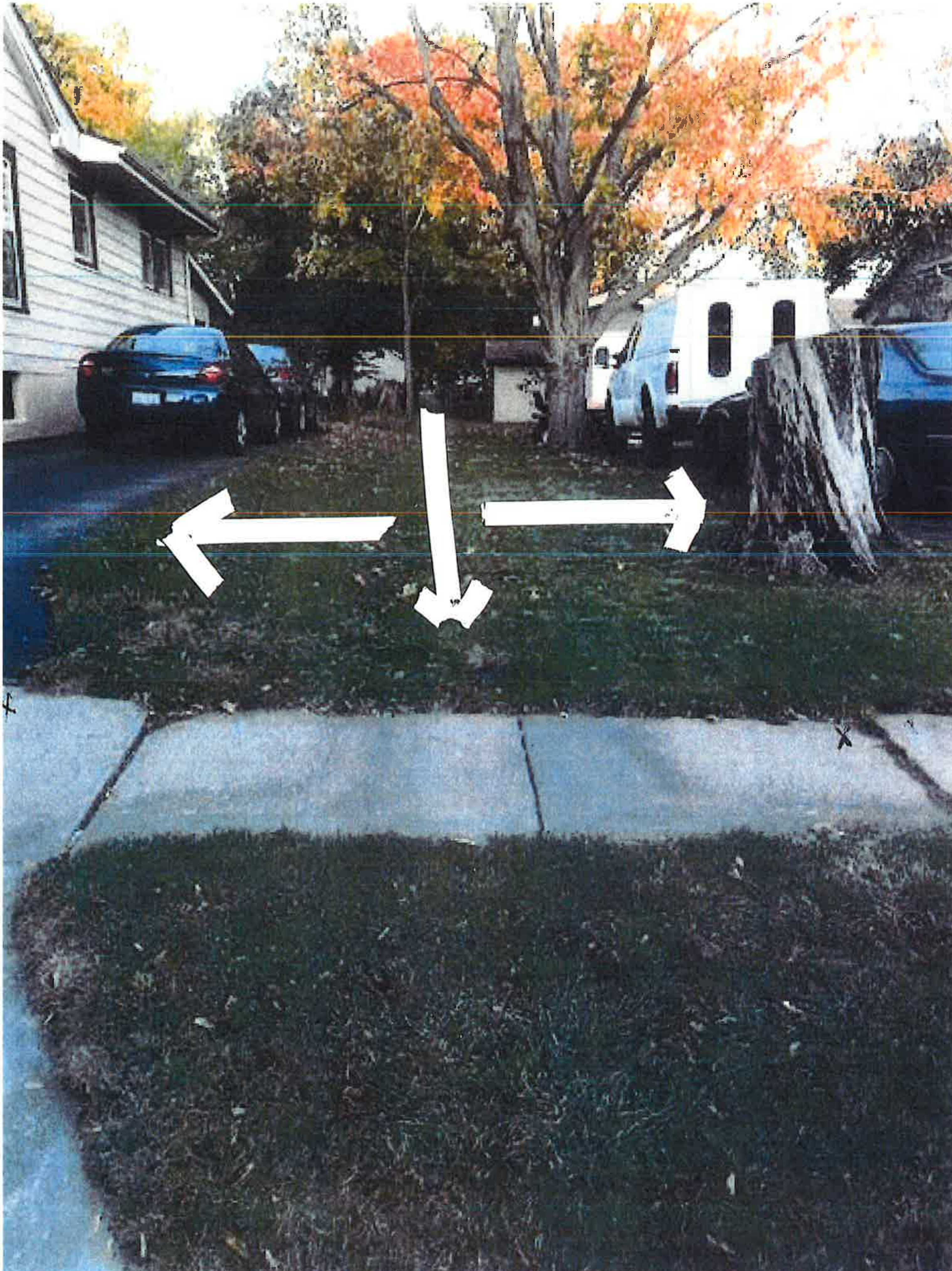
Ward One Alderman

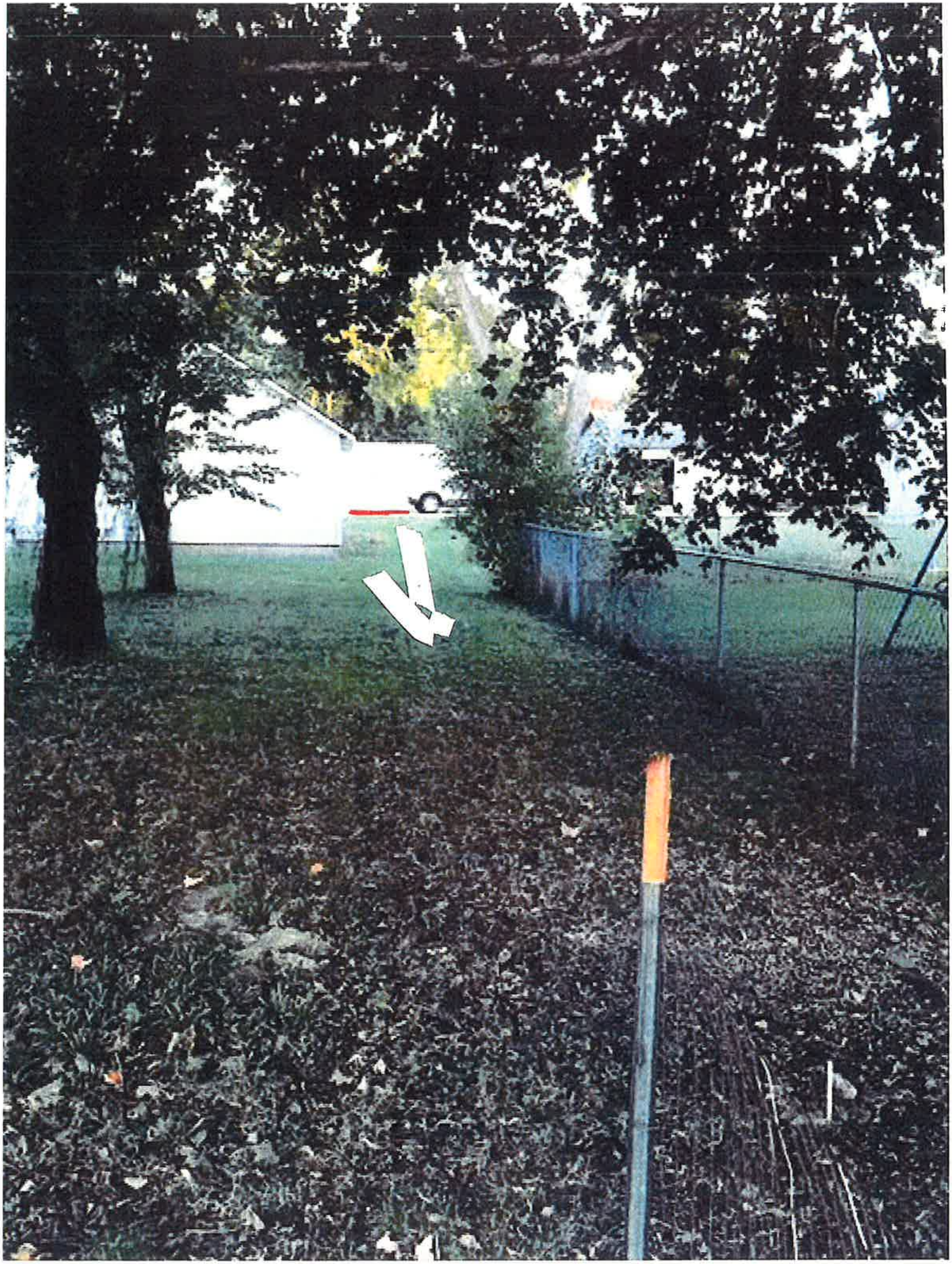
Clayton Stevens

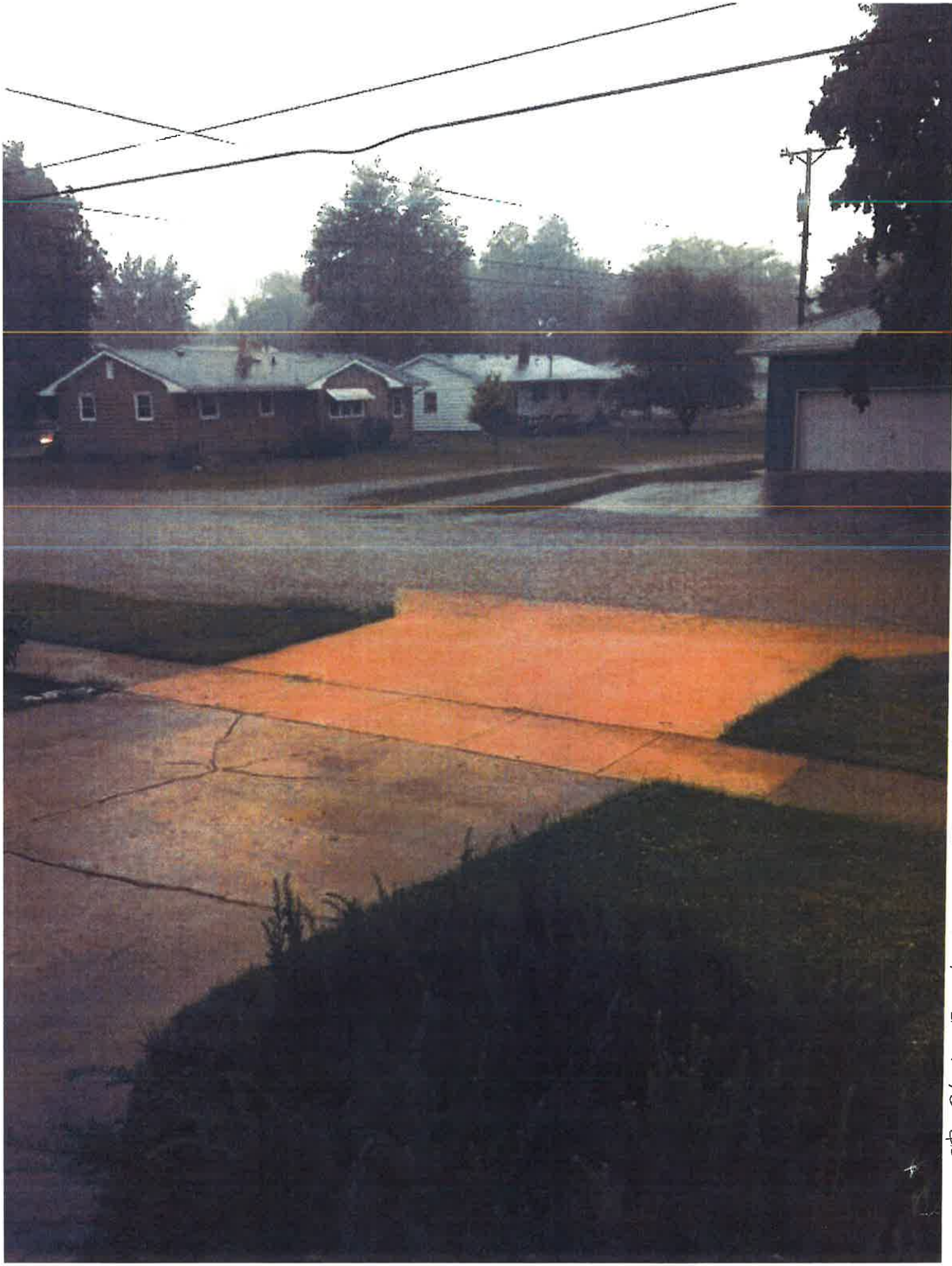
1-815-544-6163





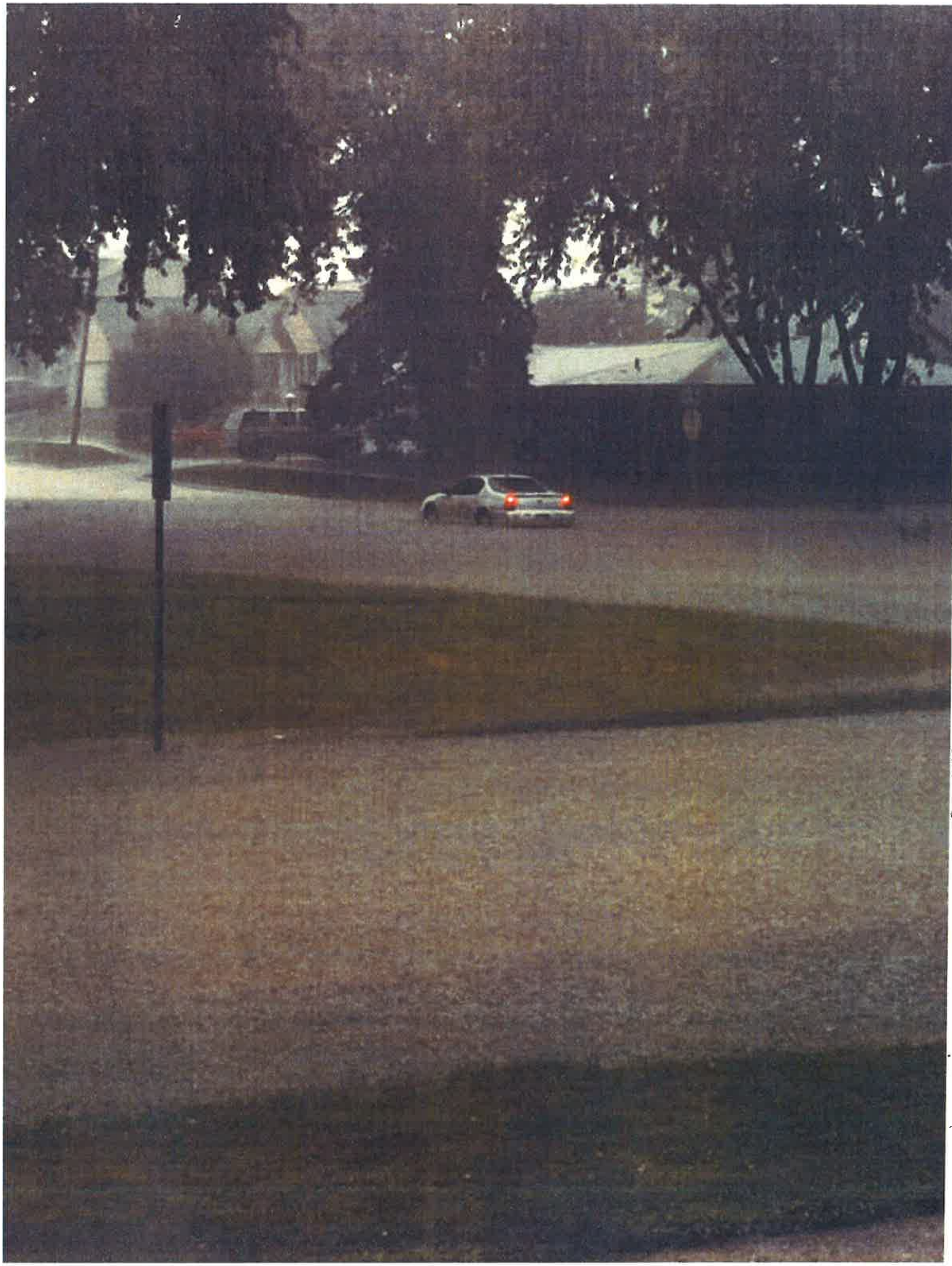






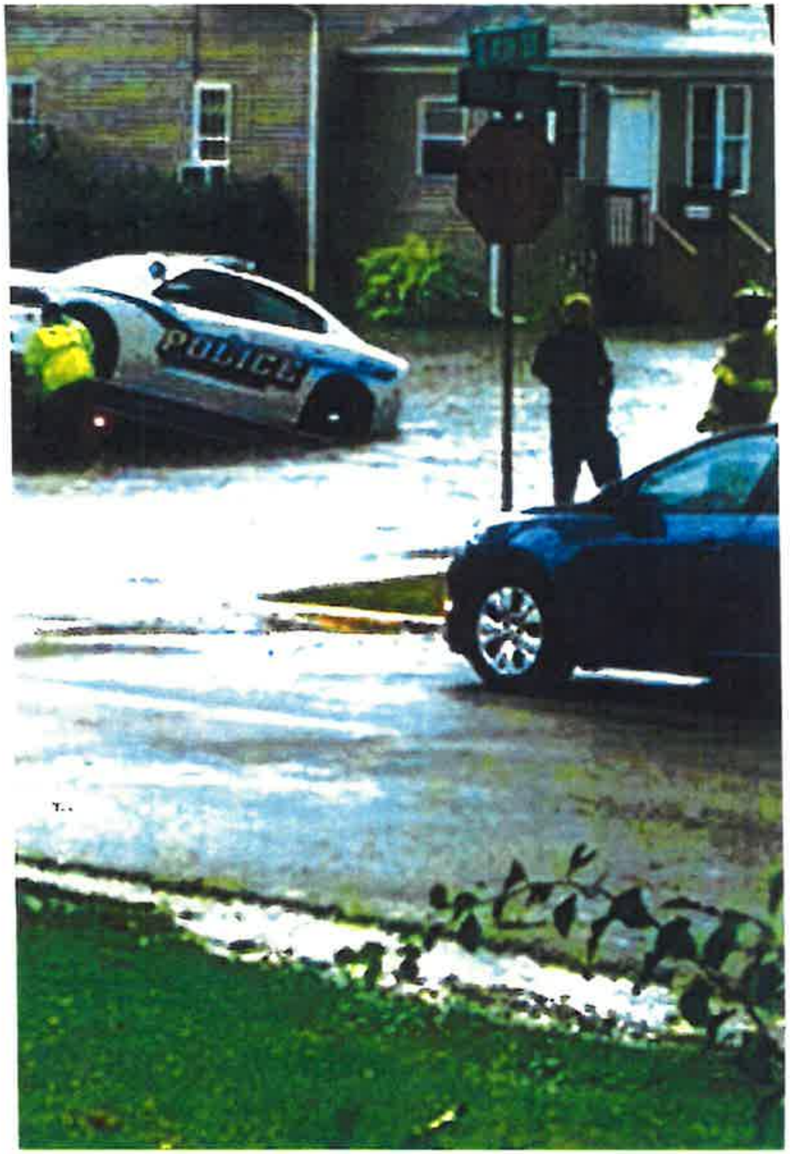
8th St in front of [illegible]

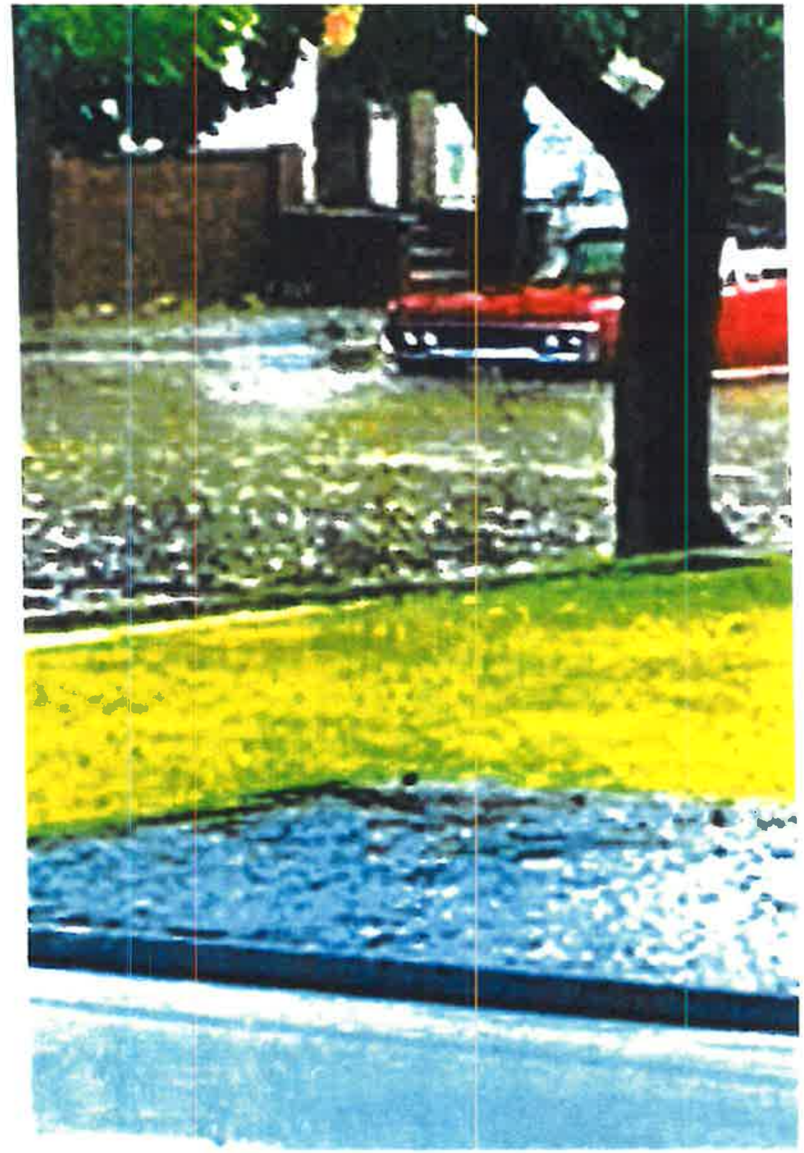
tan house is BOB Fenmunt



Stop sign is at corner of 87th & Fremont [illegible] 2011

Fremont



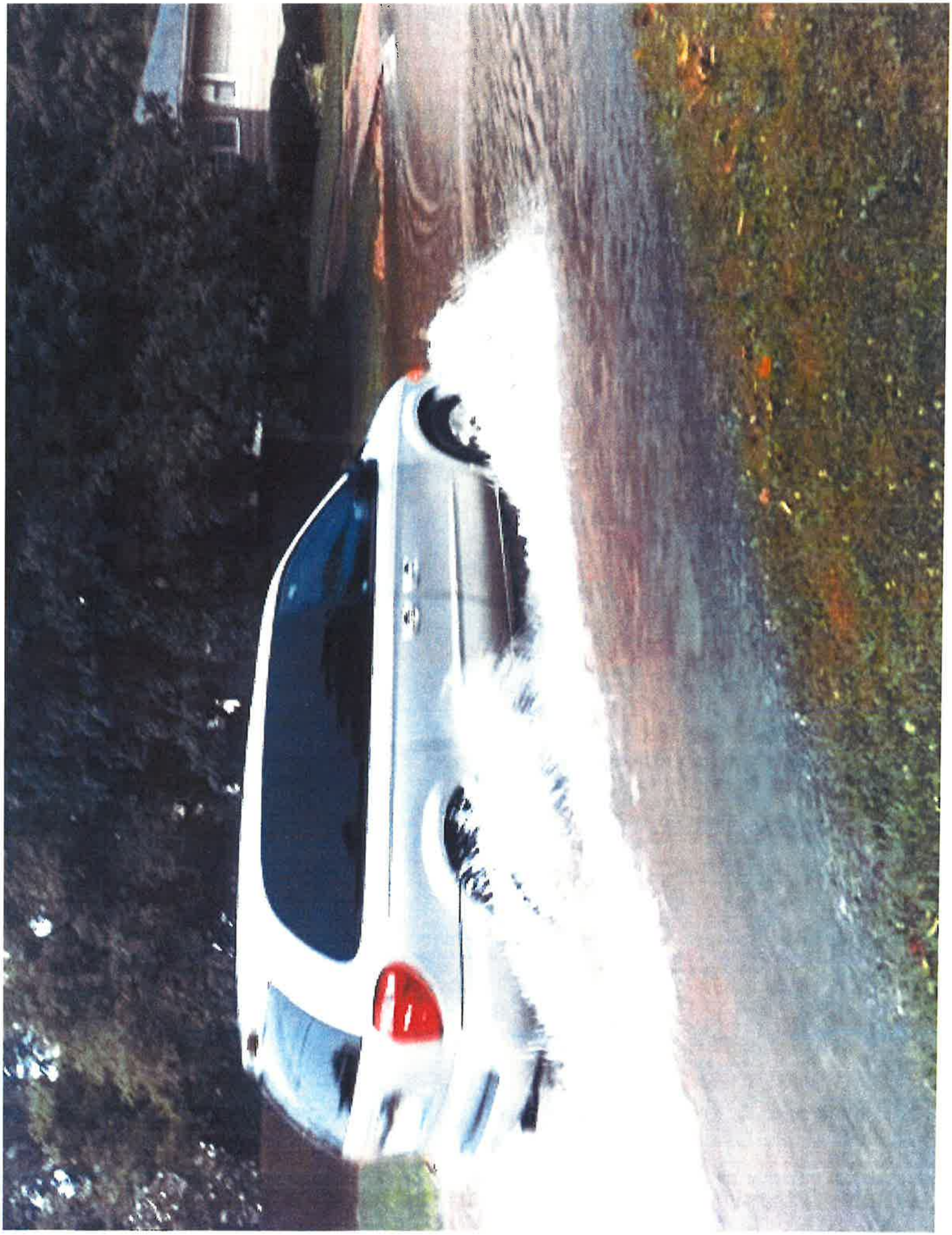


7/23/16

933 East Ave

East Ave & 4th St

July?
2016



22" Deep

July storm 2017

1507 S. Main St.

July 23, 2016

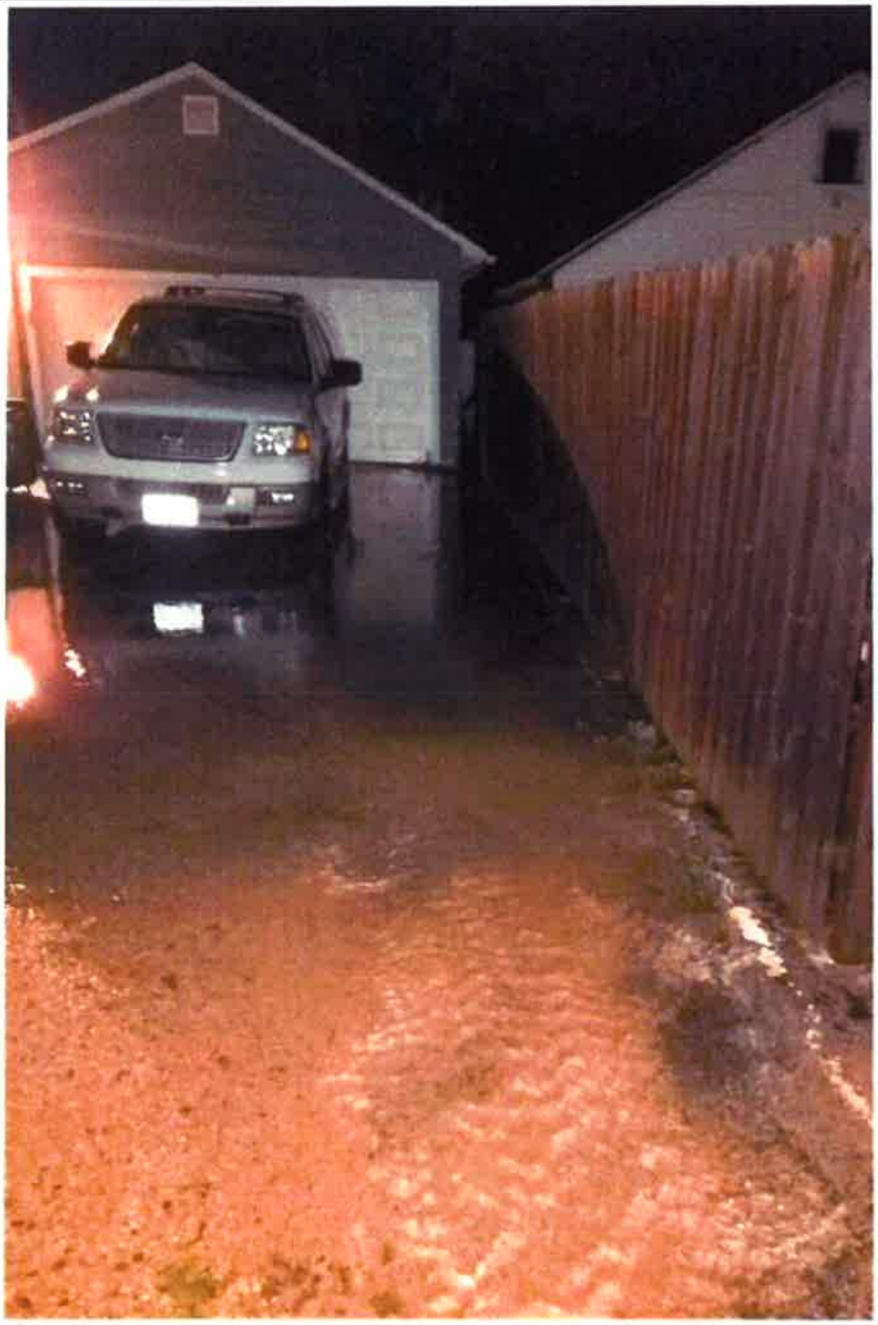
5:38 pm

913 Casswell St.

Driveway and front yard over 1 foot deep

June 28, 2017

11:19 pm



June 28, 2017

11:19 pm

913 Casswell St.

Driveway

July 23, 2016

5:37 pm

903 and 913 Casswell St.

Driveways

July 23, 2016

5:38 pm

903 Casswell St.

Driveway and front yard

June 28, 2017

10:25 pm

913 Casswell St.

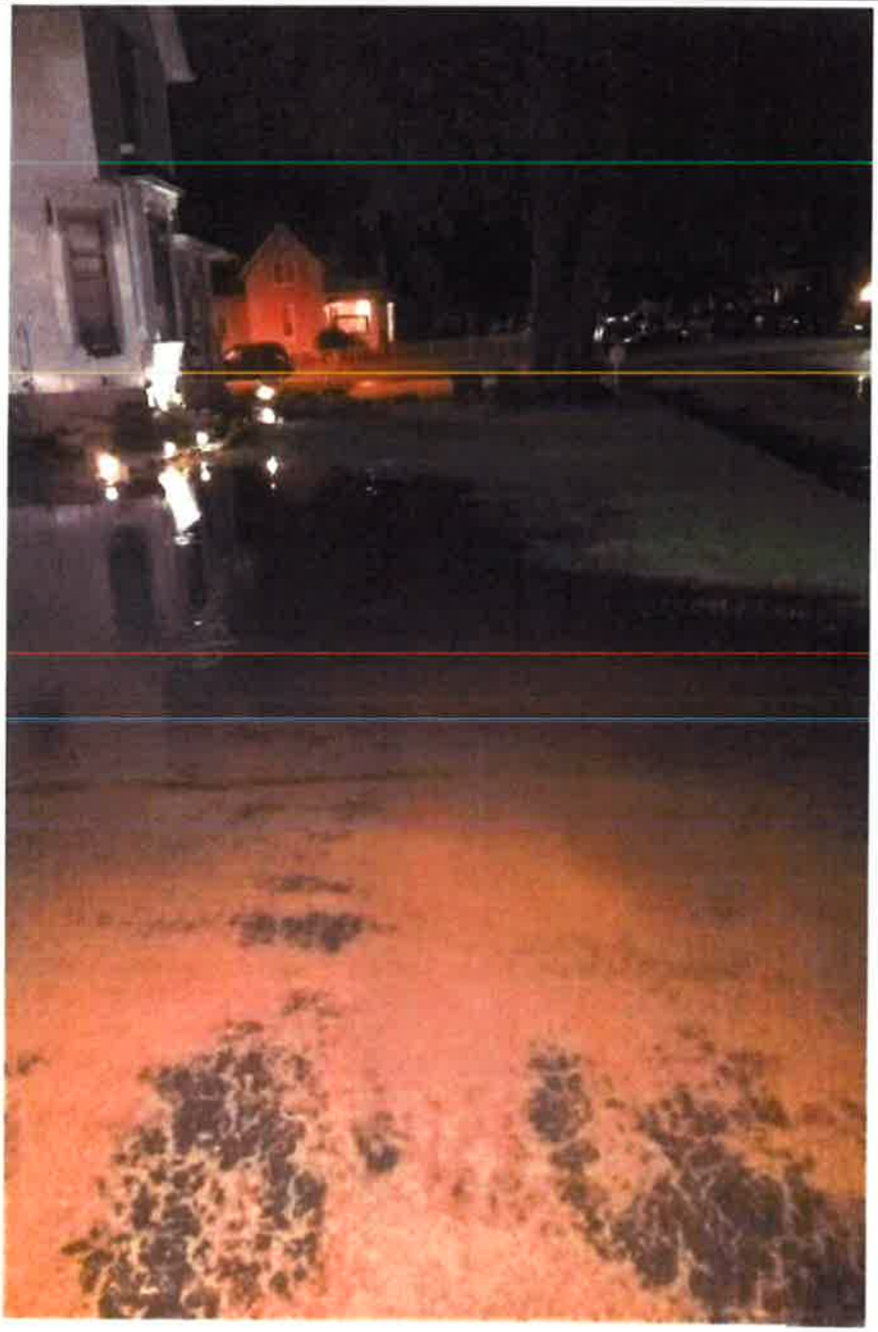
Basement

June 28, 2017

11:18 pm

903 Casswell St.

Driveway and Yard

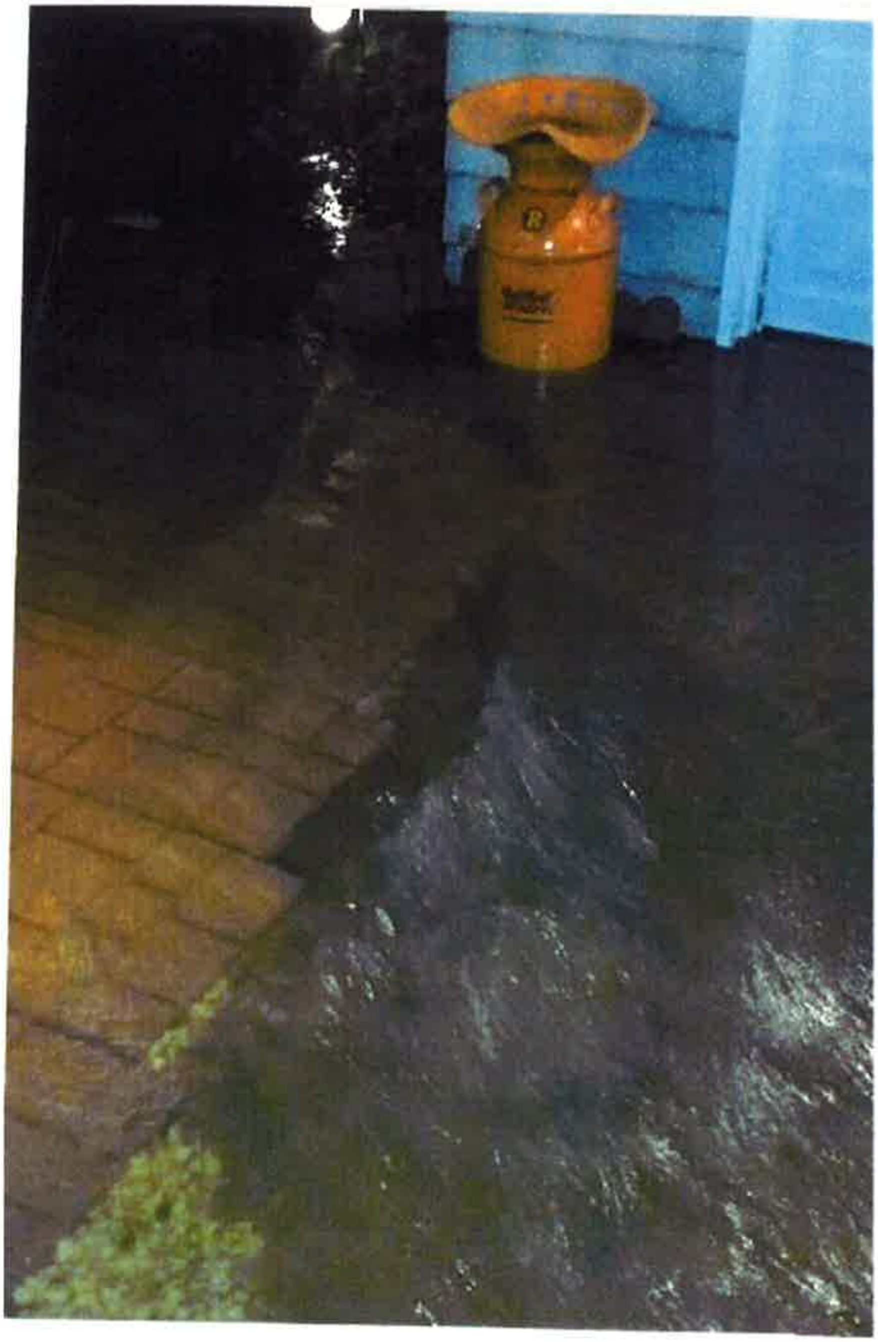


June 28, 2017

11:18 pm

903 Casswell St.

Driveway and side yard

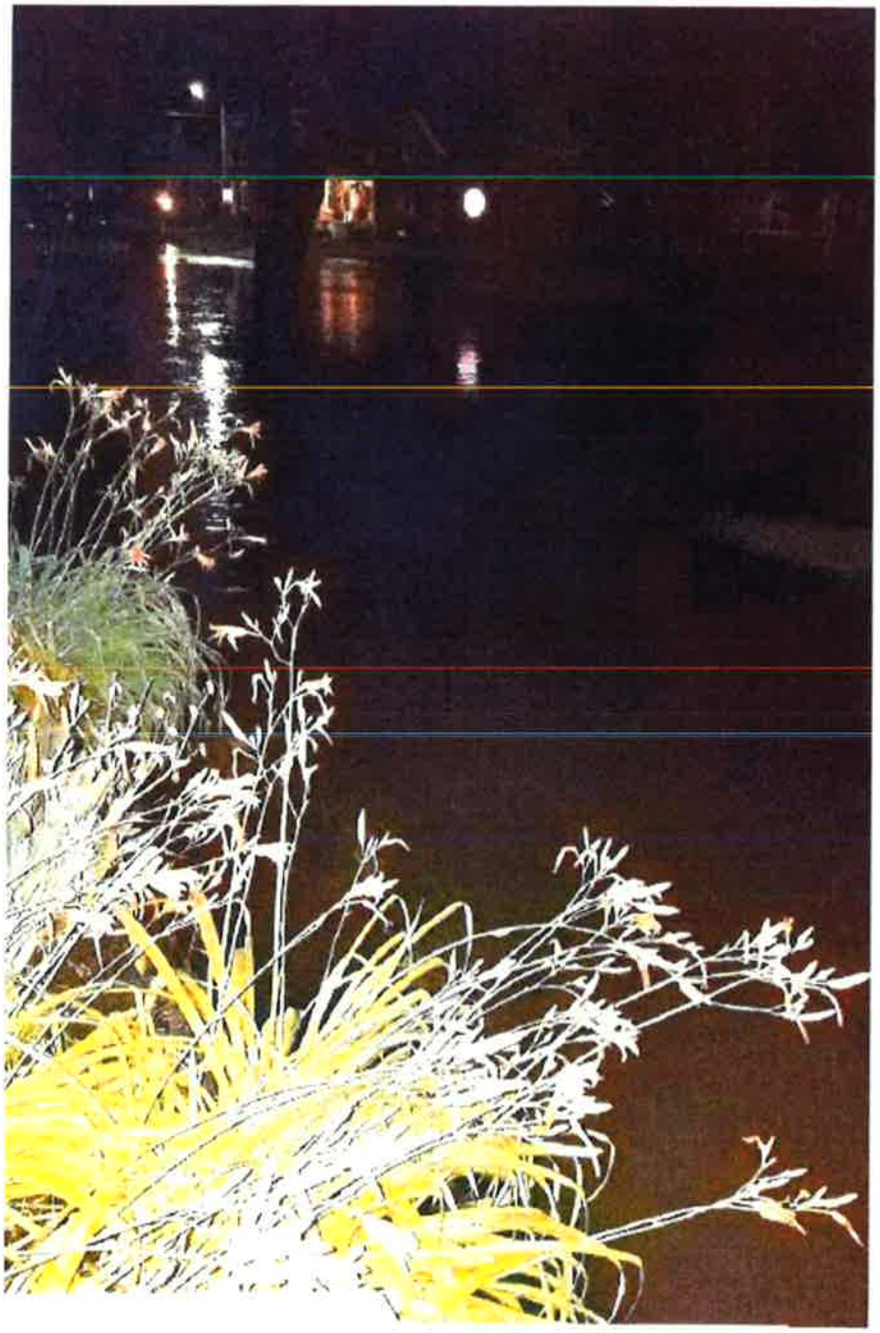


June 28, 2017

11:18 pm

407 E. 4^{th} St.

Water coming from backyard into driveway

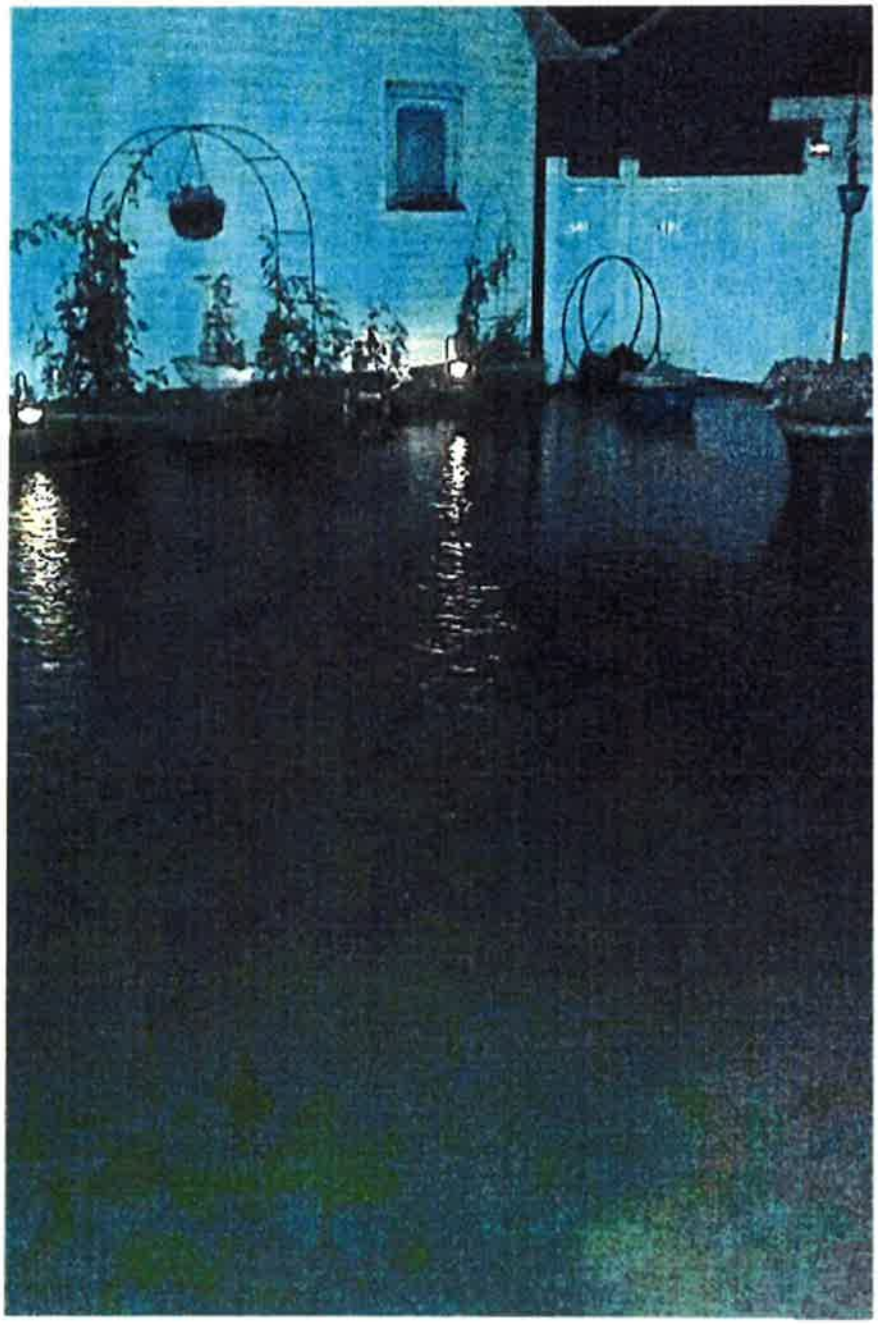


June 28, 2017

10:55 pm

Casswell St.

Taken from 913 Casswell front porch look to E. 4th St. and Casswell St. intersection.



June 28, 2017

10:40 pm

407 E. 4^{th} St.

Back yard

June 28, 2017

10:49 pm

407 E. 4th St.

Front yard and street

July 23, 2016

935 East Ave.

July 23, 2016

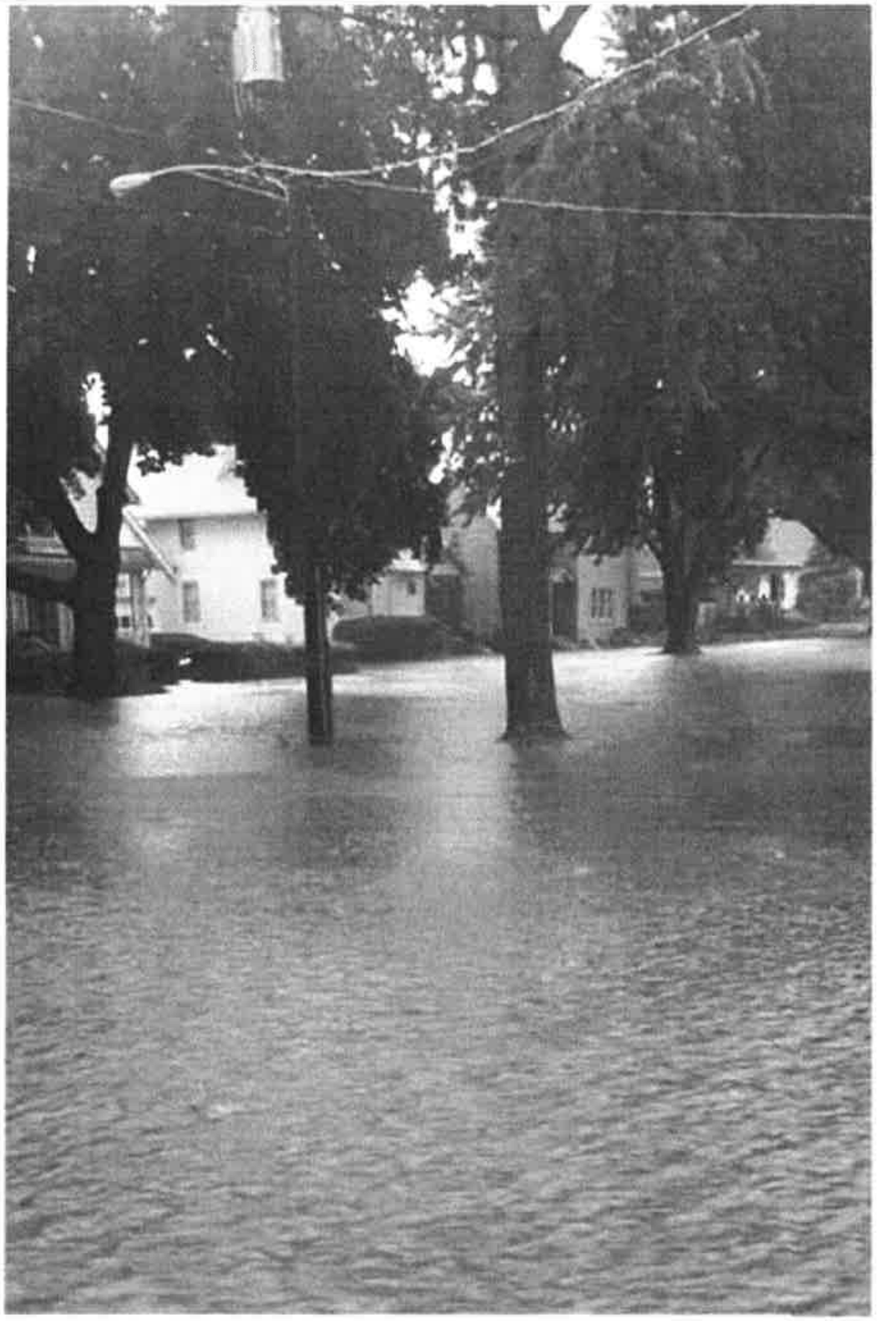
Side yard of 928 Warren Ave. and 932 Warren Ave. at start of water flow

July 23, 2016

Back yard at 928 Warren Ave at the start of water flow. Water got as deep as the door and came in through bottom of back door.

July 23, 2016

Back yard at 928 Warren Ave. at the start of water flow



July 23, 2016

Warren Ave.

Address left to right

919 Warren, 915 Warren, 909 Warren, 903 Warren

Photo taken from 928 Warren Ave.

407 4th St.

June 2009

Water line in yard

Garage door in back yard

July 2016

8TH AVE JULY 2016

APPENDIX B

RAINFALL DATA

Climatological Data for BELVIDERE, IL - July 2007

Date	Precipitation	Snowfall	Snow Depth
2007-07-01	0.00	0.0	0
2007-07-02	0.00	0.0	0
2007-07-03	0.00	0.0	0
2007-07-04	0.55	0.0	0
2007-07-05	0.00	0.0	0
2007-07-06	0.00	0.0	0
2007-07-07	0.00	0.0	0
2007-07-08	0.00	0.0	0
2007-07-09	0.00	0.0	0
2007-07-10	0.35	0.0	0
2007-07-11	0.10	0.0	0
2007-07-12	0.00	0.0	0
2007-07-13	0.00	0.0	0
2007-07-14	T	0.0	0
2007-07-15	0.00	0.0	0
2007-07-16	0.00	0.0	0
2007-07-17	0.03	0.0	0
2007-07-18	0.25	0.0	0
2007-07-19	0.30	0.0	0
2007-07-20	T	0.0	0
2007-07-21	0.00	0.0	0
2007-07-22	0.00	0.0	0
2007-07-23	0.00	0.0	0
2007-07-24	0.00	0.0	0
2007-07-25	0.00	0.0	0
2007-07-26	0.83	0.0	0
2007-07-27	0.05	0.0	0
2007-07-28	0.00	0.0	0
2007-07-29	0.00	0.0	0
2007-07-30	0.00	0.0	0
2007-07-31	0.00	0.0	0
Sum	2.46	0.0	-
Average	-	-	0.0
Normal	3.98	0.0	-

Observations for each day cover the 24 hours ending at the time given below (Local Standard Time).
Precipitation : 7am
Snowfall : unknown
Snow Depth : unknown

WS FORM B-91
(12-93)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Belvidere WWTP (River Station, if different)
MONTH: June 2009
STATE: Illinois
COUNTY: Boone
RIVER: Kishwaukee
TIME (local) OF OBSERVATION RIVER
TEMP
PRECIPITATION
STANDARD TIME IN USE
TYPE OF RIVER GAGE
ELEVATION OF RIVER GAGE ZERO Ft
FLOOD STAGE Ft
NORMAL POOL STAGE Ft

DATE	TEMPERATURE F. 24 HRS ENDING AT OBSERVATION MAX	MIN	AT OBSN	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins and hundredths)	Snow, ice pellets (Ins and tenths)	At Ob Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day)	RIVER STAGE	REMARKS (Special observations, etc.)
1				0.65					
2				1.57					
3				0.01					
4				Ø					
5				Ø					
6				Ø					
7				0.12					
8				0.90					
9				0.01					
10				Ø					
11				0					
12				Ø					
13				0.50					
14				0.52					
15				T					
16				Ø					
17				T					
18				0.02					
19				0.36					
20				4.00					1.82 wr 0930 6-19 Dumped - 0.48 new
21				Ø					
22				0.03					
23				Ø					
24				T					
25				Ø					
26				0					
27				Ø					
28				0.06					
29				T					
30				Ø					
31									
SUM				8.75					

CHECK BAR (For wire weight) NORMAL CK. BAR
READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER
SUPERVISING OFFICE
STATION INDEX NO. 11-0583-1

WS FORM B-91 (03-09)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Belvidere | (River Station if different): | MONTH: Jul | 2016

STATE: IL | COUNTY: Boone | RIVER:

TIME (local) OF OBSERVATION RIVER: | TEMPERATURE: 07:00 | PRECIPITATION: 07:00 | STANDARD TIME IN USE:

TYPE OF RIVER GAGE: | ELEVATION OF RIVER GAGE ZERO: | FLOOD STAGE: | NORMAL POOL STAGE:

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a wavy line (~~~~) through hours precipitation probably occurred unobserved

WEATHER (Observation Day): Mark 'X' for all types occurring each day

DATE	TEMP MAX	TEMP MIN	TEMP AT OBSN	Rain melted snow etc (in and hundredths)	Snow ice pellets hail (ins and tenths)	Snow ice pellets hail ice on ground (in)	Fog	Ice pellets	Glaze	Thunder	Hail	Damaging winds	Time of occurrence if different from above	River Stage Condition	Gage reading at ___ AM	Tendency	REMARKS (SPECIAL OBSERVATIONS ETC.)
1				0.03	0.0	0											
2				0.00	0.0	0											
3				0.00	0.0	0											
4				0.00	0.0	0											
5				0.00	0.0	0											
6				1.13	0.0	0											
7				0.02	0.0	0											
8				0.00	0.0	0											
9				0.00	0.0	0											
10				0.00	0.0	0											
11				0.00	0.0	0											
12				0.00	0.0	0											
13				0.00	0.0	0											
14				0.05	0.0	0											
15				0.00	0.0	0											
16				M	M	M											
17				M	M	M											
18				0.35	0.0	0											
19				0.00	0.0	0											
20				0.00	0.0	0											
21				0.01	0.0	0											
22				1.65	0.0	0											
23				0.00	0.0	0											
24				4.80	0.0	0											
25				0.00	0.0	0											
26				0.00	0.0	0											
27				0.00	0.0	0											
28				0.00	0.0	0											
29				0.00	0.0	0											
30				0.28	0.0	0											
31				0.00	0.0	0											
			SUM	8.32			Fog	Ice pel	Glaze	Thund	Hail	Dam winds					

CHECK BAR (for wire weight) NORMAL CHECK BAR

READING	DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice
B. Frozen, but open at gage
C. Upper surface smooth ice
D. Ice gorge above gage
E. Ice gorge below gage
F. Shore ice
G. Floating ice
H. Pool stage

OBSERVER: Closed by Dean Chambers (bwwtp) on 01 Aug 2016 07:13AM

SUPERVISING OFFICE: LOT Chicago

STATION INDEX NO: 11-0583-02

WS FORM B-91
(03-09)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Belvidere
(River Station if different):
MONTH: Jun 2017
STATE: IL
COUNTY: Boone
RIVER:
TIME (local) OF OBSERVATION RIVER: TEMPERATURE 07:00 PRECIPITATION 07:00
STANDARD TIME IN USE:
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO:
FLOOD STAGE:
NORMAL POOL STAGE:

TEMPERATURE (24 HRS ENDING AT OBSERVATION) / PRECIPITATION (24 HR AMOUNTS; AT OB) / WEATHER (Observation Day) — Mark X for all types occurring each day / RIVER STAGE

PRECIPITATION: Draw a straight line (-------) through hours precipitation was observed and a wavy line (~~~~~~) through hours precipitation probably occurred unobserved. A.M. 1 2 3 4 5 6 7 8 9 10 11 NOON 1 2 3 4 5 6 7 8 9 10 11 P.M.

DATE	MAX	MIN	AT OBSN	Rain, melted snow, etc (in and hundredths)	Snow, ice pellets, hail (ins and tenths)	Snow, ice pellets, hail, ice on ground (in)	Fog	Ice pellets	Glaze	Thunder	Hail	Damaging winds	Time of occurrence if different from above	Condition	Gage reading at ___ AM	Tendency	REMARKS (SPECIAL OBSERVATIONS, ETC.)
1				0.00	0.0	0											
2				0.00	0.0	0											
3				0.00	0.0	0											
4				0.07	0.0	0											
5				0.00	0.0	0											
6				0.00	0.0	0											
7				0.00	0.0	0											
8				0.00	0.0	0											
9				0.00	0.0	0											
10				0.00	0.0	0											
11				0.00	0.0	0											
12				0.00	0.0	0											
13				T	0.0	0											
14				0.74	0.0	0				X	X						Heavy rains and up to pea size hail at around 2
15				2.40	0.0	0					X	X					
16				0.17	0.0	0											
17				0.09	0.0	0											
18				0.90	0.0	0											
19				0.00	0.0	0											
20				0.05	0.0	0											
21				0.00	0.0	0											
22				T	0.0	0											
23				1.07	0.0	0				X							
24				T	0.0	0											
25				0.00	0.0	0											
26				0.00	0.0	0											
27				0.00	0.0	0											
28				0.00	0.0	0											
29				4.70	0.0	0											
30				0.11	0.0	0											
31																	
			SUM	10.30			Fog	Ice pel	Glaze	Thund	Hail	Dam winds					

CHECK BAR (for wire weight) NORMAL CHECK BAR
READING | DATE

CONDITION OF RIVER AT GAGE
A Obstructed by rough ice
B Frozen, but open at gage
C Upper surface smooth ice
D Ice gorge above gage
E Ice gorge below gage
F Shore ice
G Floating ice
H Pool stage

OBSERVER
Closed by Dean Chambers (bwwtp) on 05 Jul 2017 09:08AM

SUPERVISING OFFICE
LOT Chicago

STATION INDEX NO
11-0583-02

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(03-09)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Belvidere (River Station if different):
MONTH: Jul 2017
STATE: IL COUNTY: Boone RIVER:
TIME (local) OF OBSERVATION RIVER: TEMPERATURE: 07:00 PRECIPITATION: 07:00 STANDARD TIME IN USE:
TYPE OF RIVER GAGE: ELEVATION OF RIVER GAGE ZERO: FLOOD STAGE: NORMAL POOL STAGE:

PRECIPITATION: Draw a straight line (------) through hours precipitation was observed and a wavy line (~~~~~) through hours precipitation probably occurred unobserved. A.M. 1–11, NOON, P.M. 1–11

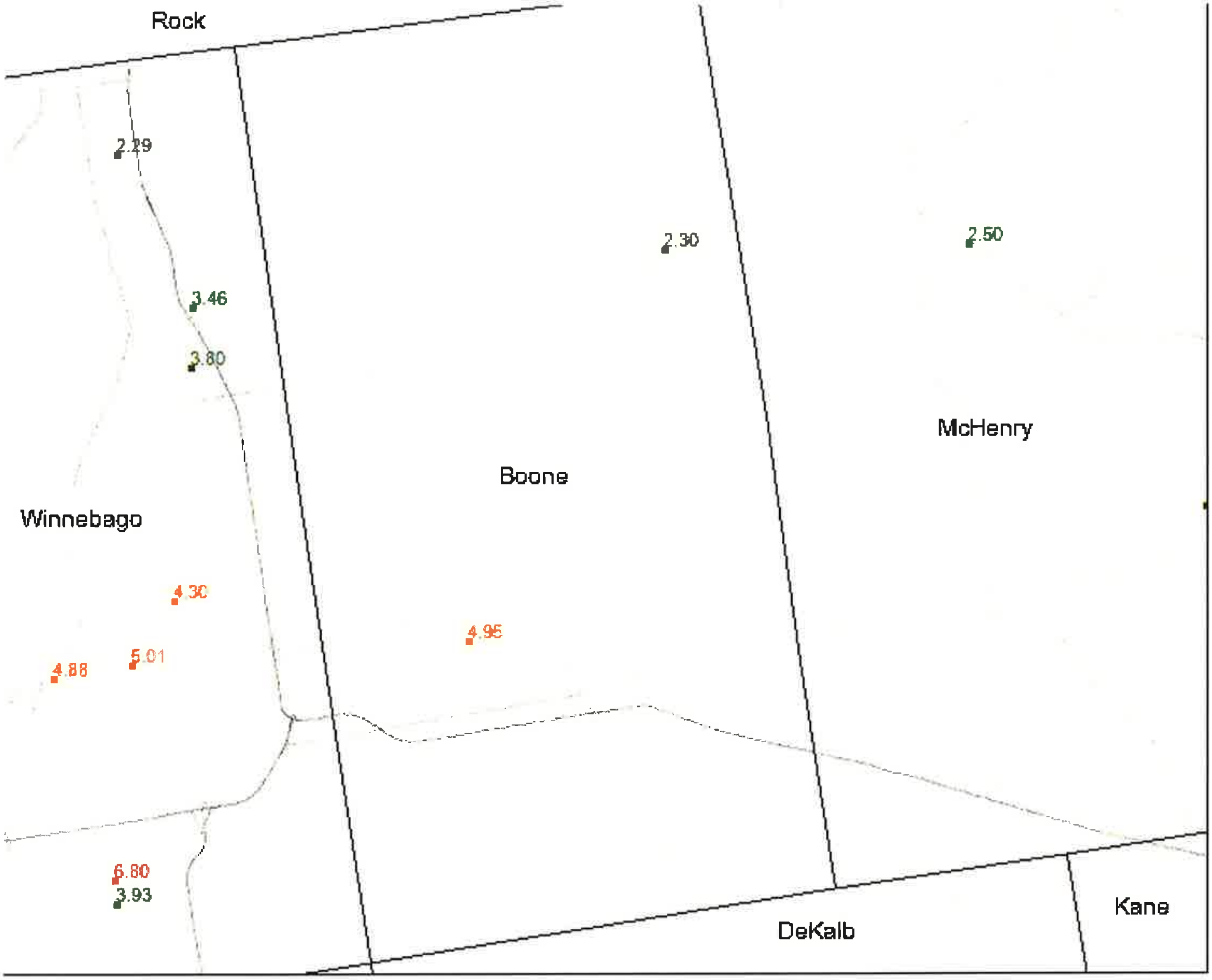
WEATHER (Observation Day): Mark 'X' for all types occurring each day

DATE	TEMPERATURE 24 HRS ENDING AT OBSERVATION MAX	MIN	AT OBSN	24 HR AMOUNTS Rain, melted snow, etc (in and hundredths)	Snow, ice pellets, hail (ins and tenths)	AT OB Snow, ice pellets, hail, ice on ground (in)	Fog	Ice pellets	Glaze	Thunder	Hail	Damaging winds	Time of occurrence if different from above	RIVER STAGE Condition	Gage reading at __ AM	Tendency	REMARKS (SPECIAL OBSERVATIONS, ETC.)
1				0.00	0.0	0											
2				0.00	0.0	0											
3				0.12	0.0	0											
4				0.00	0.0	0											
5				0.00	0.0	0											
6				0.38	0.0	0											
7				0.00	0.0	0											
8				0.00	0.0	0											
9				0.00	0.0	0											
10				1.14	0.0	0				X		X					
11				0.00	0.0	0											
12				0.92	0.0	0				X		X					
13				0.85	0.0	0											
14				0.00	0.0	0											
15				0.00	0.0	0											
16				0.51	0.0	0											
17				0.00	0.0	0											
18				0.00	0.0	0											
19				0.00	0.0	0											
20				2.35	0.0	0				X	X	X					
21				0.06	0.0	0											
22				2.55	0.0	0											
23				0.00	0.0	0											
24				0.74	0.0	0											
25				0.00	0.0	0											
26				0.00	0.0	0											
27				0.09	0.0	0											
28				0.00	0.0	0											
29				0.00	0.0	0											
30				0.00	0.0	0											
31				0.00	0.0	0											
SUM				9.71			Fog	Ice pel	Glaze	Thund	Hail	Dam winds					

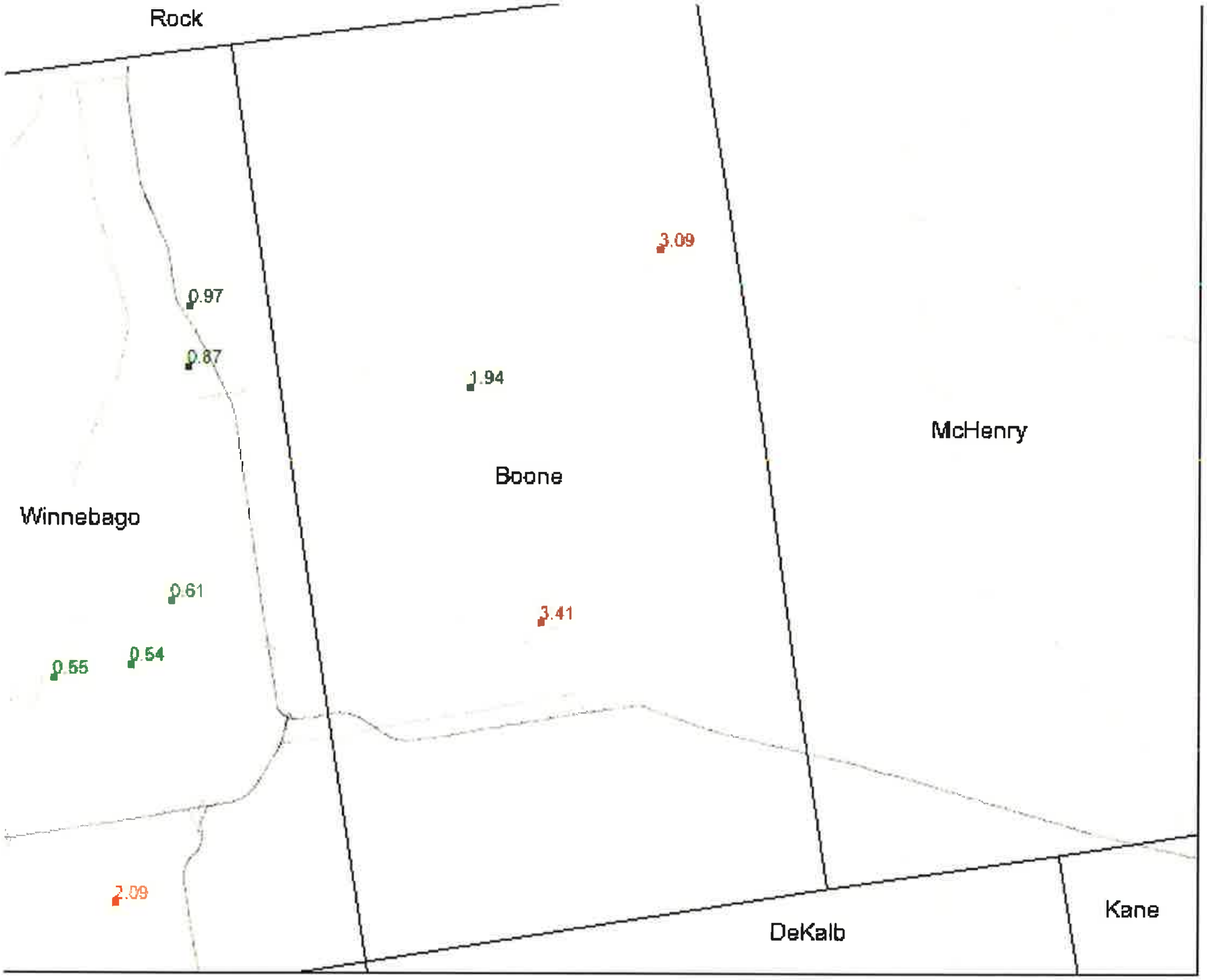
CHECK BAR (for wire weight) NORMAL CHECK BAR
READING | DATE

CONDITION OF RIVER AT GAGE
- A Obstructed by rough ice
- B Frozen, but open at gage
- C Upper surface smooth ice
- D Ice gorge above gage
- E Ice gorge below gage
- F Shore ice
- G Floating ice
- H Pool stage

OBSERVER: Closed by Dean Chambers (bwwtp) on 01 Aug 2017 11:05AM
SUPERVISING OFFICE: LOT Chicago
STATION INDEX NO: 11-0583-02



For questions or comments concerning this web page please contact info@cocorahs.org.


Rock
3.09
0.97
0.87
1.94
McHenry
Boone
Winnebago
0.61
3.41
0.55
0.54
2.09
Kane
DeKalb

APPENDIX C

MODELING INPUT AND SITE ANALYSIS

FEMA's National Flood Hazard Layer (Official)

NFHL (click to expand)

FIRM Panels

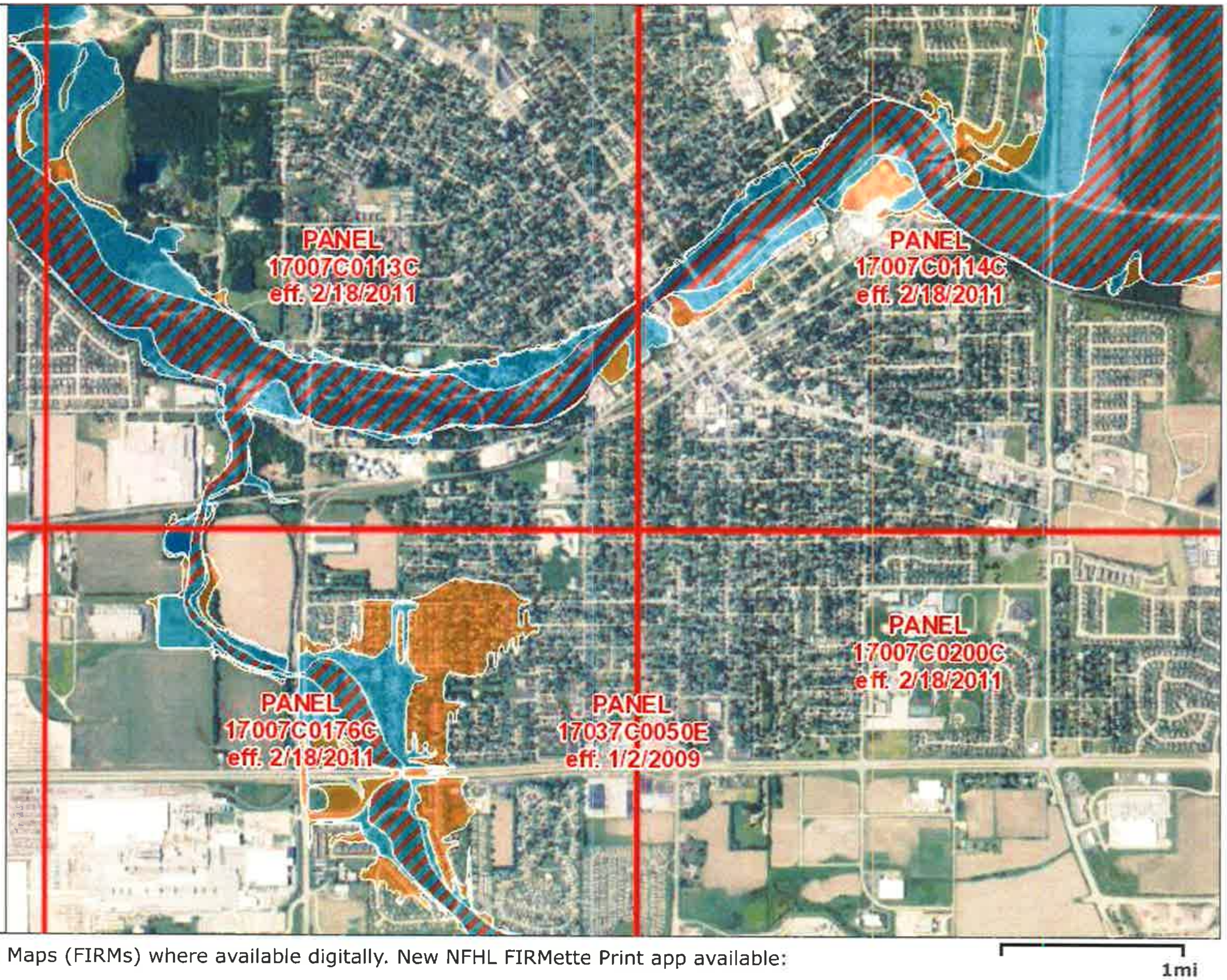
Limit of Moderate Wave Action

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary
- Other Boundaries

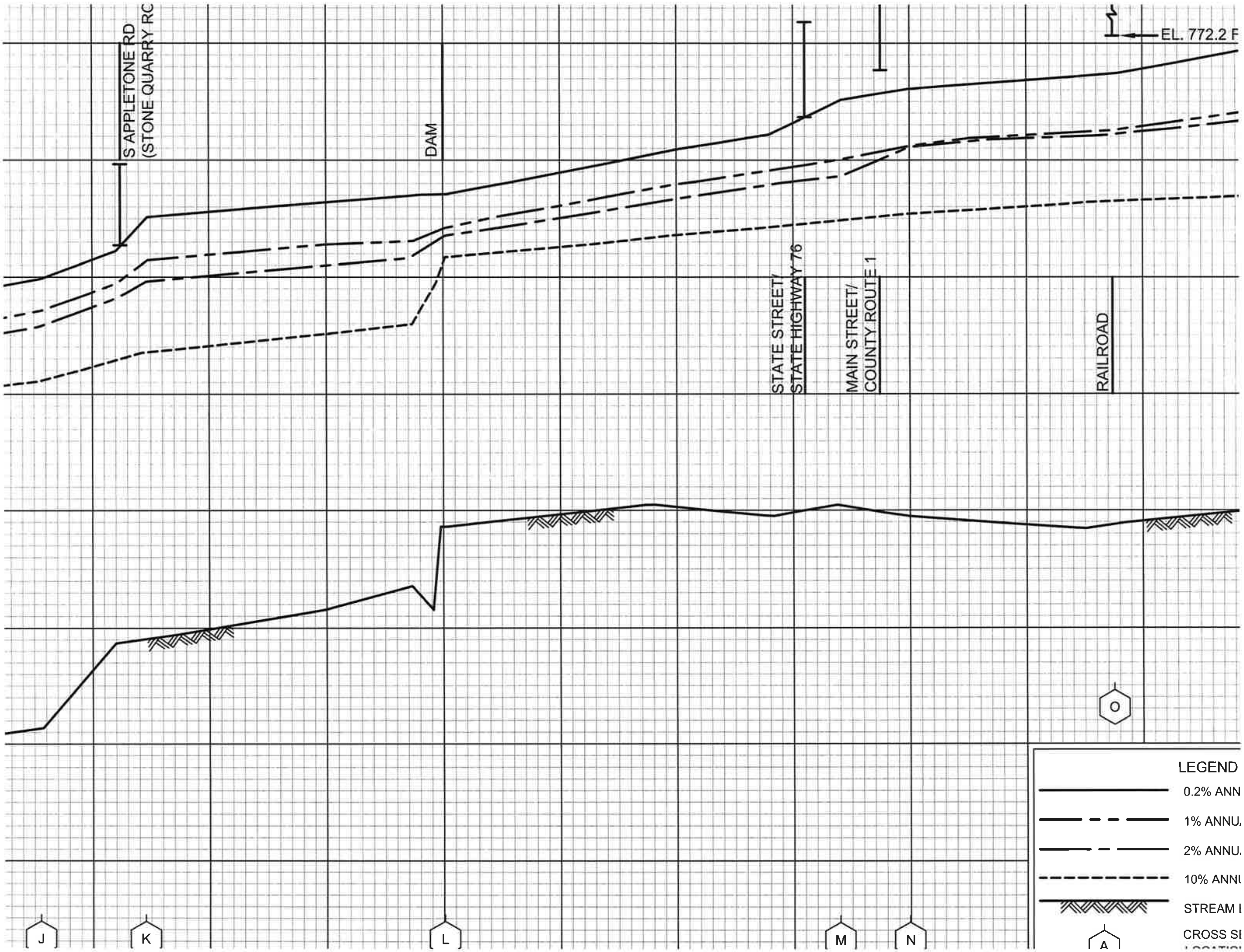
Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee

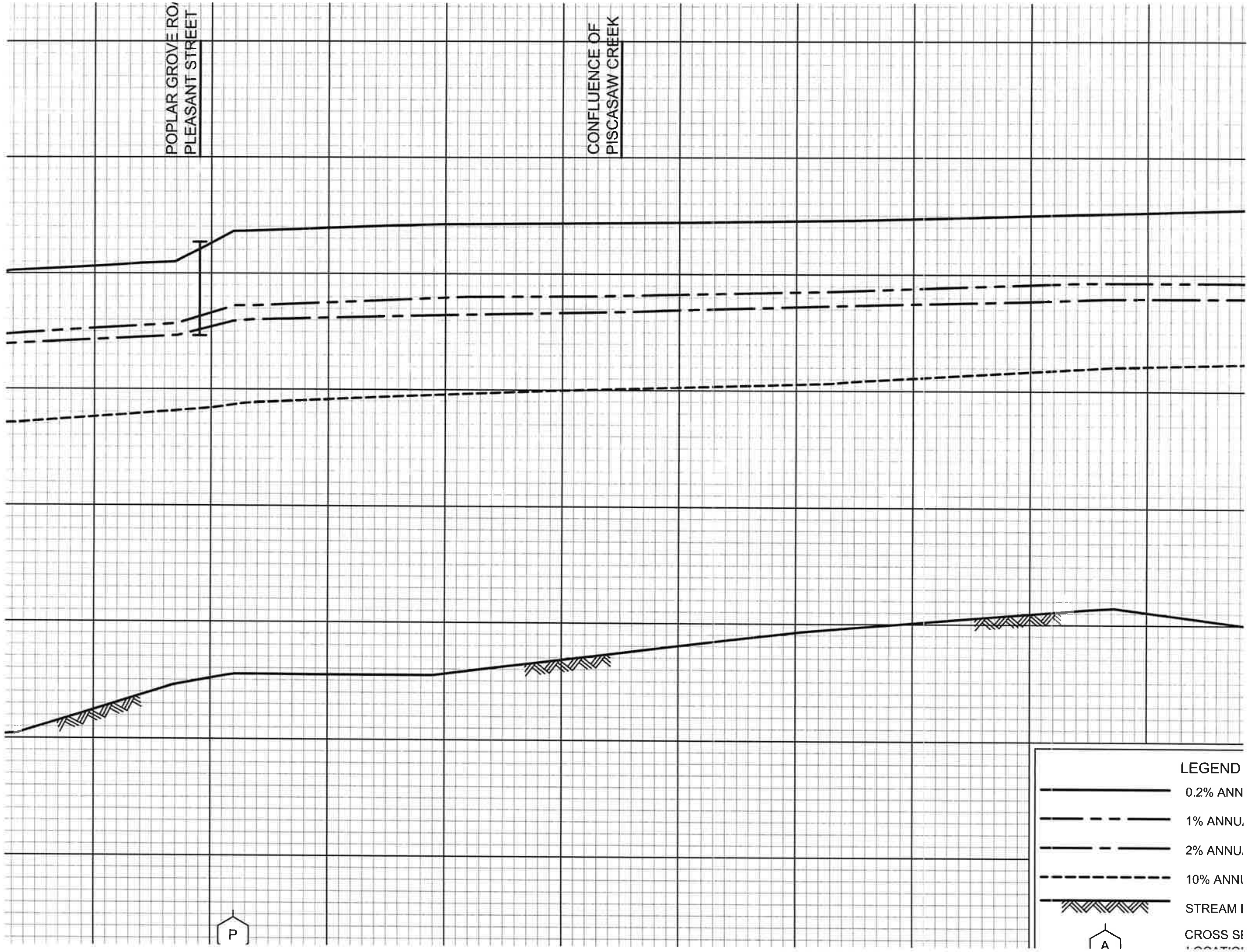


Data from Flood Insurance Rate Maps (FIRMs) where available digitally. New NFHL FIRMette Print app available: http://tinyurl.com/j4xwp5e

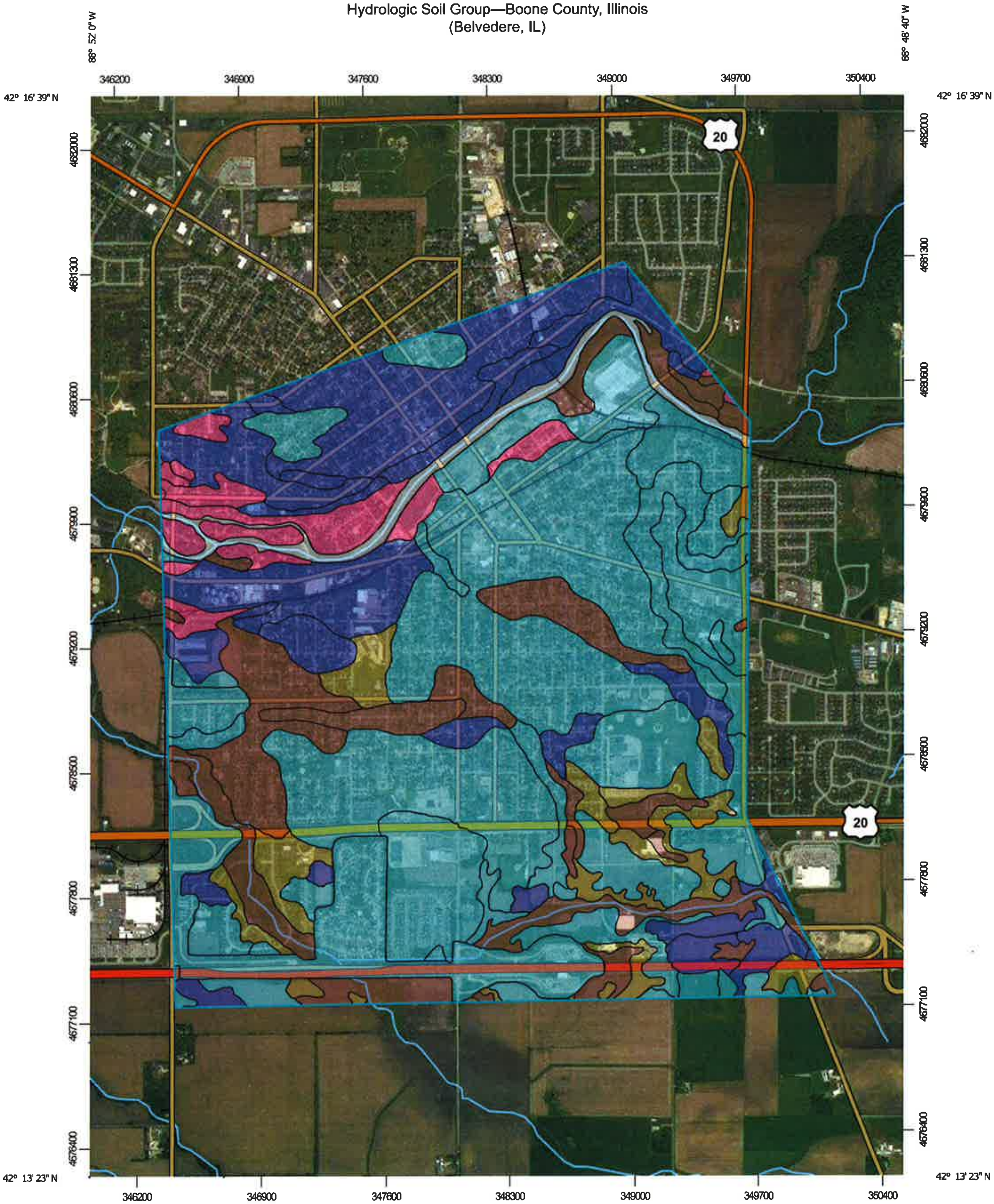
USGS The National Map: Orthoimagery | National Geospatial-Intelligence Agency (NGA); Delta State University; Esri | Print here instead: http://tinyurl.com/j4xwp5e Support: FEMAMapSpecialist@riskmapcds.com | USGS The National Map: Orthoimagery



EL. 772.2 F
S APPLETONE RD
(STONE QUARRY RC
DAM
STATE STREET/
STATE HIGHWAY 76
MAIN STREET/
COUNTY ROUTE 1
RAILROAD
O
J
K
L
M
N
LEGEND
0.2% ANN
1% ANNU
2% ANNU
10% ANNU
STREAM
CROSS SE
A



POPLAR GROVE RO
PLEASANT STREET
CONFLUENCE OF
PISCASAW CREEK
P
LEGEND
0.2% ANN
1% ANNU
2% ANNU
10% ANNU
STREAM
CROSS SE
A



Map Scale: 1:29,500 if printed on A portrait (8.5" x 11") sheet.

N

0 400 800 1600 2400 Meters

0 1000 2000 4000 6000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boone County, Illinois
Survey Area Data: Version 11, Sep 20, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 26, 2010—Jul 24, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
59A	Lisbon silt loam, 0 to 2 percent slopes	C/D	60.1	2.0%
62A	Herbert silt loam, 0 to 2 percent slopes	C/D	37.7	1.2%
102A	La Hogue loam, 0 to 2 percent slopes	B/D	179.0	5.9%
125A	Selma loam, 0 to 2 percent slopes	B/D	148.1	4.8%
152A	Drummer silty clay loam, 0 to 2 percent slopes	B/D	40.6	1.3%
188A	Beardstown loam, 0 to 2 percent slopes	B/D	4.2	0.1%
197A	Troxel silt loam, 0 to 2 percent slopes	B	2.7	0.1%
198A	Elburn silt loam, cool, 0 to 2 percent slopes	C	33.4	1.1%
221B	Parr silt loam, 2 to 5 percent slopes	C	459.6	15.0%
221C2	Parr silt loam, 5 to 10 percent slopes, eroded	C	77.7	2.5%
290B	Warsaw loam, 2 to 4 percent slopes	B	47.0	1.5%
290C2	Warsaw loam, 4 to 6 percent slopes, eroded	B	20.9	0.7%
327B	Fox silt loam, 2 to 4 percent slopes	B	10.0	0.3%
329A	Will loam, 0 to 2 percent slopes	B/D	7.1	0.2%
332B	Billett sandy loam, 2 to 5 percent slopes	A	27.1	0.9%
343A	Kane silt loam, 0 to 2 percent slopes	B/D	6.5	0.2%
354A	Hononegah loamy coarse sand, 0 to 2 percent slopes	A	3.7	0.1%
354B	Hononegah loamy coarse sand, 2 to 6 percent slopes	A	0.3	0.0%
369A	Waupecan silt loam, 0 to 2 percent slopes	B	186.5	6.1%
387A	Ockley silt loam, 0 to 2 percent slopes	B	60.5	2.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
440A	Jasper silt loam, 0 to 2 percent slopes	B	35.7	1.2%
440B	Jasper silt loam, 2 to 5 percent slopes	B	117.0	3.8%
490A	Odell silt loam, 0 to 2 percent slopes	C/D	76.8	2.5%
512B	Danabrook silt loam, 2 to 5 percent slopes	C	624.4	20.4%
512C2	Danabrook silt loam, 5 to 10 percent slopes, eroded	C	12.3	0.4%
527C2	Kidami loam, 4 to 6 percent slopes, eroded	C	52.3	1.7%
528A	Lahoguess loam, 0 to 2 percent slopes	B/D	5.3	0.2%
623A	Kishwaukee silt loam, 0 to 2 percent slopes	B	119.2	3.9%
623B	Kishwaukee silt loam, 2 to 5 percent slopes	B	38.0	1.2%
625B	Geryune silt loam, 2 to 5 percent slopes	C	43.7	1.4%
783A	Flagler sandy loam, 0 to 2 percent slopes	A	13.3	0.4%
802B	Orthents, loamy, undulating	C	312.7	10.2%
939C2	Rodman-Warsaw complex, 4 to 6 percent slopes, eroded	A	14.3	0.5%
939D2	Rodman-Warsaw complex, 6 to 12 percent slopes, eroded	A	0.5	0.0%
3082A	Millington silt loam, 0 to 2 percent slopes, frequently flooded	B/D	3.5	0.1%
3776A	Comfrey loam, 0 to 2 percent slopes, frequently flooded	B/D	32.5	1.1%
3800A	Psamments, 0 to 2 percent slopes, frequently flooded	A	82.8	2.7%
W	Water		63.1	2.1%
Totals for Area of Interest			**3,060.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

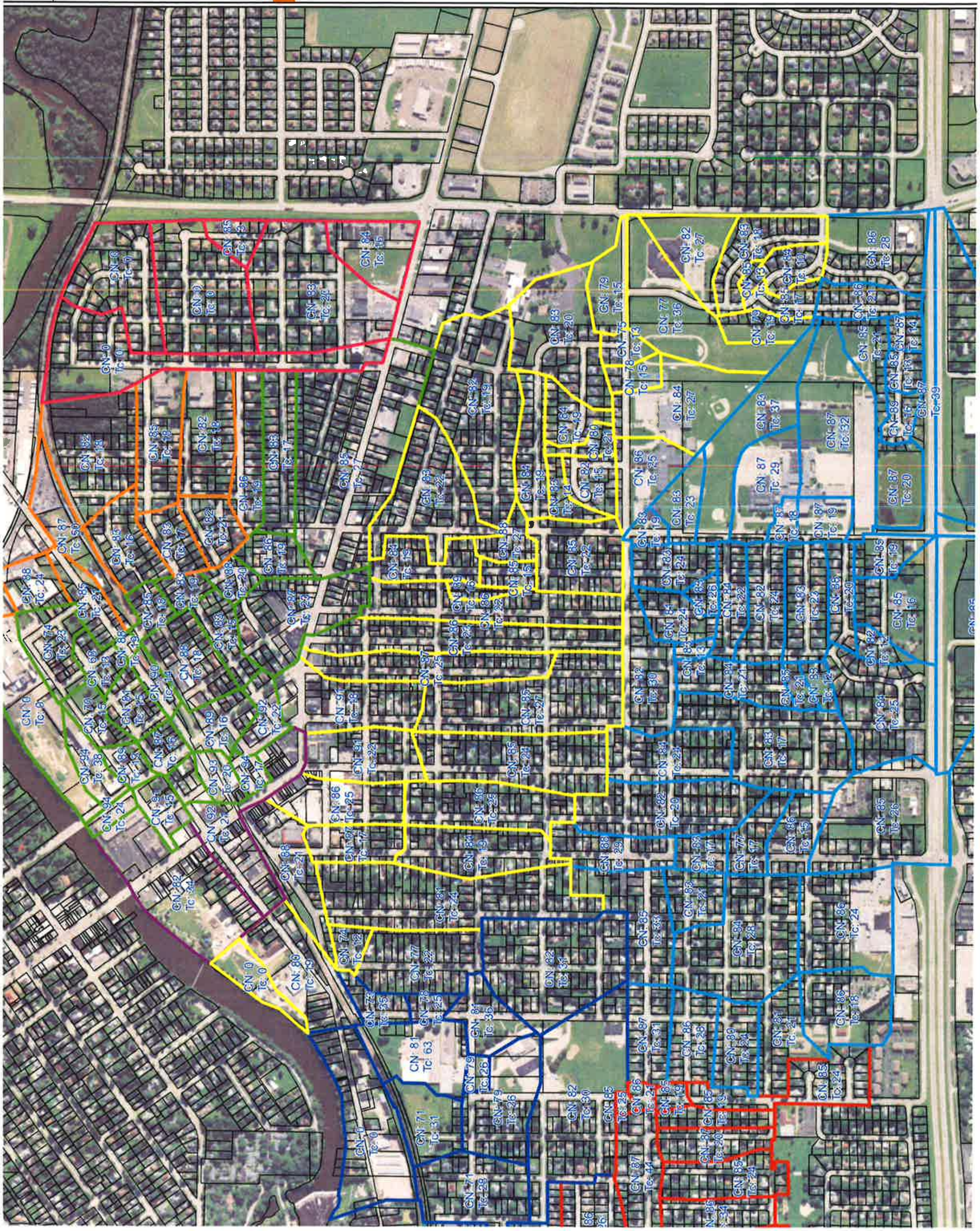
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

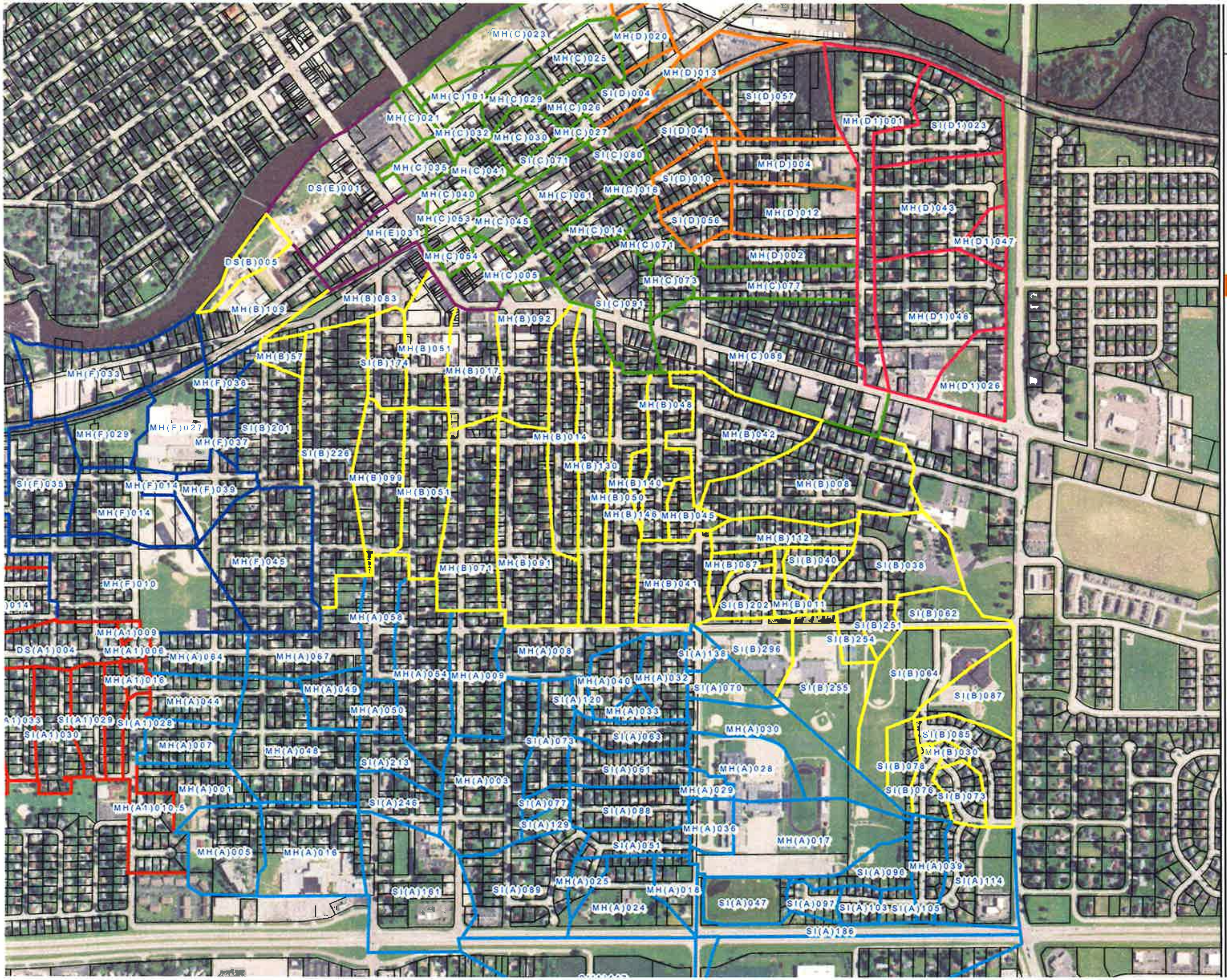
Rating Options

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher





MH(C)023
MH(D)020
MH(C)025
MH(D)013
MH(C)161
MH(C)029
SI(D)004
SI(D)057
MH(C)021
MH(C)026
MH(D1)001
SI(D1)023
MH(C)032
MH(C)030
MH(C)027
SI(D)041
SI(C)071
SI(C)080
MH(C)035
MH(C)041
MH(D)004
SI(D)010
DS(E)001
MH(C)040
MH(C)061
MH(C)018
MH(D)043
MH(D)012
MH(C)053
MH(C)045
SI(D)056
MH(E)031
MH(C)014
MH(D1)047
MH(C)054
MH(C)071
MH(D)002
DS(B)005
MH(C)005
MH(C)073
MH(C)077
MH(B)083
SI(C)091
MH(B)109
MH(B)092
MH(D1)046
MH(B)051
MH(B)57
MH(C)089
SI(B)174
MH(F)033
MH(B)017
MH(F)036
MH(D1)026
MH(B)048
MH(F)029
MH(F)027
SI(B)201
MH(B)014
MH(B)042
MH(F)037
SI(B)226
MH(B)130
SI(F)035
MH(B)099
MH(F)014
MH(F)039
MH(B)140
MH(B)008
MH(B)054
MH(B)050
MH(F)014
MH(B)146
MH(B)045
MH(B)112
MH(F)045
SI(B)040
MH(B)067
MH(B)071
MH(B)091
SI(B)038
MH(F)010
MH(B)041
SI(B)202
MH(B)011
SI(B)062
MH(A)058
SI(B)251
MH(A1)009
SI(B)254
DS(A1)004
MH(A1)006
MH(A)084
MH(A)067
MH(A)008
SI(A)138
SI(B)296
MH(A)054
MH(A)009
MH(A)040
MH(A)032
SI(B)064
MH(A1)016
SI(A)070
SI(B)255
SI(B)087
MH(A)049
MH(A)044
SI(A)120
MH(A)050
MH(A)033
SI(A1)033
SI(A1)029
SI(A1)028
SI(A1)030
MH(A)030
SI(B)085
SI(A)063
SI(A)073
MH(A)007
MH(A)048
MH(B)030
SI(A)213
MH(A)028
SI(B)078
SI(A)061
MH(A)003
MH(A)001
MH(A)029
SI(B)076
SI(B)073
SI(A)246
SI(A)077
MH(A1)010.5
SI(A)088
SI(A)129
MH(A)036
MH(A)017
SI(A)081
MH(A)005
MH(A)016
MH(A)039
SI(A)096
SI(A)114
SI(A)161
SI(A)089
MH(A)025
MH(A)018
SI(A)047
SI(A)097
SI(A)103
SI(A)105
MH(A)024
SI(A)186

Curve Numbers

Catchment ID	Area	CN	Tc
SI(F)035	12.56	71	28
SI(D)057	14.74	82	18
SI(D)041	7.27	83	16
SI(D)010	4.40	83	17
SI(D)003	4.72	85	21
SI(C)091	13.25	87	23
SI(C)080	2.62	85	18
SI(C)071	2.40	90	14
SI(B)296	7.07	86	25
SI(B)255	10.74	84	27
SI(B)254	4.96	78	15
SI(B)251	2.33	75	13
SI(B)226	23.12	81	24
SI(B)202	4.13	82	15
SI(B)201	11.32	77	22
SI(B)174	5.52	87	17
SI(B)087	7.53	82	27
SI(B)085	7.70	83	18
SI(B)078	3.72	79	19
SI(B)076	2.99	85	17
SI(B)073	3.73	84	10
SI(B)064	13.92	77	36
SI(B)062	6.64	79	15
SI(B)040	4.16	84	19
SI(B)038	14.61	83	20
SI(A1)033	6.08	86	34
SI(A1)030	7.63	85	24
SI(A1)029	5.33	87	20
SI(A1)028	3.44	85	19
SI(A)246	5.62	86	15
SI(A)213	4.66	77	17
SI(A)186	28.74	87	39
SI(A)161	16.89	85	26
SI(A)149	3.11	84	25
SI(A)148	37.32	86	35
SI(A)147	23.44	85	25
SI(A)129	1.73	83	12
SI(A)120	1.00	83	13
SI(A)114	14.88	86	28
SI(A)105	2.24	87	14
SI(A)103	2.40	85	13
SI(A)097	2.47	89	16
SI(A)096	6.23	85	21
SI(A)089	15.74	84	25
SI(A)088	7.91	83	23

SI(A)077	1.57	85	21
SI(A)073	6.57	84	21
SI(A)063	5.12	84	22
SI(A)061	7.51	82	24
SI(A)051	6.20	88	20
SI(A)047	6.90	87	20
MH(F)045	20.29	82	31
MH(F)039	6.50	81	36
MH(F)037	2.54	78	25
MH(F)036	4.27	73	35
MH(F)029	3.48	71	31
MH(F)027	10.56	78	63
MH(F)014	12.55	79	26
MH(F)010	24.35	82	30
MH(E)031	11.51	92	21
MH(DI)047	2.87	85	15
MH(D1)046	21.92	83	20
MH(D1)026	7.54	84	16
MH(D)020	4.27	88	24
MH(D)013	7.47	87	50
MH(D)012	10.30	82	18
MH(D)004	9.48	85	18
MH(D)003	4.86	82	21
MH(D)002	7.36	86	19
MH(C)101	3.85	94	38
MH(C)086	33.13	85	27
MH(C)077	8.20	83	17
MH(C)073	4.14	86	19
MH(C)071	2.44	88	20
MH(C)061	8.18	88	18
MH(C)054	1.66	94	17
MH(C)053	2.88	93	20
MH(C)045	5.53	89	16
MH(C)041	2.76	87	16
MH(C)040	1.99	92	16
MH(C)035	3.47	91	15
MH(C)032	2.45	89	13
MH(C)030	4.20	81	15
MH(C)029	3.51	70	15
MH(C)027	0.72	88	19
MH(C)026	3.09	68	13
MH(C)025	6.73	74	23
MH(C)021	1.52	94	24
MH(C)016	2.29	83	19
MH(C)014	4.50	83	15
MH(C)005	3.80	92	22
MH(B)57	2.18	74	12

MH(B)146	2.34	85	15
MH(B)140	1.41	89	16
MH(B)130	14.28	86	23
MH(B)112	6.33	84	19
MH(B)109	11.59	80	19
MH(B)099	10.29	84	19
MH(B)092	11.82	91	18
MH(B)091	19.32	85	27
MH(B)087	2.59	83	14
MH(B)083	9.18	88	21
MH(B)071	15.62	85	24
MH(B)051	19.61	86	25
MH(B)050	12.93	86	22
MH(B)048	6.23	84	19
MH(B)045	3.13	88	27
MH(B)042	14.71	83	22
MH(B)041	9.99	85	22
MH(B)030	0.98	85	13
MH(B)017	9.02	91	22
MH(B)014	10.55	87	25
MH(B)011	2.00	80	21
MH(B)008	22.33	82	19
MH(A1)016	1.32	85	19
MH(A1)014	10.08	86	26
MH(A1)010.5	9.38	85	24
MH(A1)009	0.58	85	25
MH(A1)006	1.00	86	21
MH(A)067	10.60	85	33
MH(A)064	6.61	87	31
MH(A)058	6.71	88	29
MH(A)054	13.97	82	20
MH(A)050	2.99	83	17
MH(A)049	4.94	83	21
MH(A)048	4.81	86	28
MH(A)044	6.51	86	28
MH(A)040	4.78	81	24
MH(A)033	35.81	83	26
MH(A)025	1.78	82	12
MH(A)024	9.16	85	16
MH(A)018	3.24	85	19
MH(A)009	9.94	84	24
MH(A)008	9.91	82	30
MH(A)007	13.02	80	24
MH(A)005	24.65	86	18
MH(A)003	17.71	83	17
MH(A)001	13.86	81	21
DS(E)001	17.80	82	34

DS(A1)004	11.86	87	44
DS(A1)002	18.64	87	44

Time of Concentration (Tc) Calculations

Project: Belvedere Southside Drainage Study
Project #: 170791.3
Date: 11/7/2017
Calcs by: EFG

Subbasin	Total Length (ft)	Upstream Elevation	Downstream Elevation	Slope	T_c (hr)	T_c (min)	Sheet Flow					Shallow Concentrated Flow					Other						
							n	L (ft)	P_2 (in)	s (ft/ft)	T_t (hr)	Paved	L (ft)	s (ft/ft)	V (ft/s)	T_t (hr)	Type	L (ft)	Diam (ft)	r (ft)	s (ft/ft)	V (ft/s)	T_t (hr)
DS(A1)002	1603	786	780	0.004	0.73	44	0.24	100	3.04	0.004	0.48	YES	794	0.004	1.2	0.18	pipe	709	1	0.25	0.004	2.8	0.07
DS(A1)004	1932	784	778	0.003	0.73	44	0.24	100	3.04	0.003	0.51	YES	103	0.003	1.1	0.03	pipe	1729	1	0.25	0.003	2.5	0.19
DS(E)001	1235	774	764	0.008	0.57	34	0.24	100	3.04	0.008	0.35	NO	1135	0.008	1.5	0.22							
MH(A)001	661	802	794	0.012	0.35	21	0.24	100	3.04	0.012	0.30	NO	205	0.012	1.8	0.03	pipe	356	1.25	0.3125	0.012	5.8	0.02
MH(A)003	1309	836	803	0.025	0.28	17	0.24	100	3.04	0.025	0.22	YES	169	0.025	3.2	0.01	pipe	1040	1	0.25	0.025	7.2	0.04
MH(A)005	911	819	801	0.020	0.30	18	0.24	100	3.04	0.020	0.25	NO	327	0.020	2.3	0.04	pipe	484	1.25	0.3125	0.020	7.4	0.02
MH(A)007	686	798	790	0.012	0.40	24	0.24	100	3.04	0.012	0.30	NO	586	0.012	1.7	0.09							
MH(A)008	1817	818	806	0.007	0.51	30	0.24	100	3.04	0.007	0.38	YES	161	0.007	1.7	0.03	pipe	1556	1.25	0.3125	0.007	4.3	0.10
MH(A)009	770	806	799	0.009	0.40	24	0.24	100	3.04	0.009	0.33	YES	345	0.009	1.9	0.05	pipe	325	1	0.25	0.009	4.3	0.02
MH(A)016	1142	818	802	0.014	0.40	24	0.24	100	3.04	0.014	0.28	YES	1042	0.014	2.4	0.12							
MH(A)017	2031	840	815	0.012	0.53	32	0.24	100	3.04	0.012	0.30	YES	1931	0.012	2.3	0.24							
MH(A)018	701	821	810	0.016	0.31	19	0.24	100	3.04	0.016	0.27	YES	308	0.016	2.5	0.03	pipe	293	2	0.5	0.016	9.0	0.01
MH(A)024	778	827	808	0.024	0.27	16	0.24	100	3.04	0.024	0.23	YES	374	0.024	3.2	0.03	pipe	304	1.75	0.4375	0.024	10.3	0.01
MH(A)025	358	826	810	0.045	0.20	12	0.24	100	3.04	0.045	0.18	NO	258	0.045	3.4	0.02							
MH(A)028	1245	828	816	0.010	0.49	29	0.24	100	3.04	0.010	0.33	YES	1145	0.010	2.0	0.16							
MH(A)029	428	827	820	0.016	0.30	18	0.24	100	3.04	0.016	0.26	YES	328	0.016	2.6	0.03							
MH(A)030	2126	840	814	0.012	0.61	37	0.24	100	3.04	0.012	0.30	NO	2026	0.012	1.8	0.32							
MH(A)032	756	818	810	0.011	0.40	24	0.24	100	3.04	0.011	0.31	YES	656	0.011	2.1	0.09							
MH(A)033	341	812	810	0.006	0.44	26	0.24	100	3.04	0.006	0.40	NO	154	0.006	1.2	0.03	pipe	87	1.75	0.4375	0.006	5.1	0.00
MH(A)036	544	827	817	0.018	0.31	19	0.24	100	3.04	0.018	0.25	NO	444	0.018	2.2	0.06							
MH(A)039	840	846	834	0.014	0.35	21	0.24	100	3.04	0.014	0.28	NO	415	0.014	1.9	0.06	pipe	325	1.25	0.3125	0.014	6.3	0.01
MH(A)040	812	816	808	0.010	0.39	24	0.24	100	3.04	0.010	0.32	NO	273	0.010	1.6	0.05	pipe	439	1.25	0.3125	0.010	5.2	0.02
MH(A)044	395	788	786	0.005	0.46	28	0.24	100	3.04	0.005	0.42	NO	117	0.005	1.1	0.03	pipe	178	1.25	0.3125	0.005	3.8	0.01
MH(A)048	1327	808	790	0.014	0.47	28	0.24	100	3.04	0.014	0.29	NO	1227	0.014	1.9	0.18							
MH(A)049	477	798	792	0.013	0.35	21	0.24	100	3.04	0.013	0.29	NO	377	0.013	1.8	0.06							
MH(A)050	425	803	795	0.019	0.29	17	0.24	100	3.04	0.019	0.25	NO	325	0.019	2.2	0.04							
MH(A)054	939	814	797	0.018	0.34	20	0.24	100	3.04	0.018	0.25	YES	839	0.018	2.7	0.09							
MH(A)058	1110	802	795	0.006	0.49	29	0.24	100	3.04	0.006	0.39	NO	271	0.006	1.3	0.06	pipe	739	1.75	0.4375	0.006	5.2	0.04
MH(A)064	660	790	787	0.005	0.52	31	0.24	100	3.04	0.005	0.44	NO	249	0.005	1.1	0.06	pipe	311	2	0.5	0.005	4.9	0.02
MH(A)067	1236	801	793	0.006	0.55	33	0.24	100	3.04	0.006	0.39	NO	570	0.006	1.3	0.13	pipe	566	1.5	0.375	0.006	4.6	0.03
MH(A1)006	219	788	786	0.009	0.36	21	0.24	100	3.04	0.009	0.33	NO	119	0.009	1.5	0.02							
MH(A1)009	170	786	785	0.006	0.41	25	0.24	100	3.04	0.006	0.40	NO	70	0.006	1.2	0.02							
MH(A1)010.5	1832	816	784	0.017	0.40	24	0.24	100	3.04	0.017	0.26	YES	1053	0.017	2.7	0.11	pipe	679	1	0.25	0.017	6.0	0.03
MH(A1)014	1012	786	777	0.009	0.43	26	0.24	100	3.04	0.009	0.34	YES	431	0.009	1.9	0.06	pipe	481	1.25	0.3125	0.009	5.0	0.03
MH(A1)016	289	788	784	0.014	0.31	19	0.24	100	3.04	0.014	0.28	NO	189	0.014	1.9	0.03							
MH(B)008	1827	840	798	0.023	0.31	19	0.24	100	3.04	0.023	0.23	YES	424	0.023	3.1	0.04	pipe	1303	1.5	0.375	0.023	9.0	0.04
MH(B)011	575	816	808	0.014	0.35	21	0.24	100	3.04	0.014	0.28	NO	475	0.014	1.9	0.07							
MH(B)014	1021	802	790	0.012	0.42	25	0.24	100	3.04	0.012	0.30	YES	921	0.012	2.2	0.12							
MH(B)017	905	792	780	0.013	0.37	22	0.24	100	3.04	0.013	0.29	NO	439	0.013	1.9	0.07	pipe	366	1.25	0.3125	0.013	6.1	0.02
MH(B)030	293	842	834	0.027	0.22	13	0.24	100	3.04	0.027	0.22	NO	38	0.027	2.7	0.00	pipe	155	1	0.25	0.027	7.5	0.01
MH(B)041	1130	816	800	0.014	0.37	22	0.24	100	3.04	0.014	0.28	YES	606	0.014	2.4	0.07	pipe	424	1	0.25	0.014	5.4	0.02
MH(B)042	1683	828	798	0.018	0.37	22	0.24	100	3.04	0.018	0.26	YES	913	0.018	2.7	0.09	pipe	670	1.5	0.375	0.018	8.0	0.02
MH(B)045	676	802	796	0.009	0.44	27	0.24	100	3.04	0.009	0.34	NO	576	0.009	1.5	0.11							
MH(B)048	832	808	793	0.018	0.32	19	0.24	100	3.04	0.018	0.25	NO	404	0.018	2.2	0.05	pipe	328	1	0.25	0.018	6.1	0.01
MH(B)050	1583	816	790	0.016	0.37	22	0.24	100	3.04	0.016	0.26	YES	553	0.016	2.6	0.06	pipe	930	1	0.25	0.016	5.8	0.04
MH(B)051	1234	790	775	0.012	0.41	25	0.24	100	3.04	0.012	0.30	NO	494	0.012	1.8	0.08	pipe	640	1	0.25	0.012	5.0	0.04
MH(B)051	1416	800	775	0.018	0.31	19	0.24	100	3.04	0.018	0.26	YES	94	0.018	2.7	0.01	pipe	1222	1.25	0.3125	0.018	7.0	0.05
MH(B)57	315	780	766	0.044	0.19	12	0.24	100	3.04	0.044	0.18	NO	215	0.044	3.4	0.02					0.044		
MH(B)071	1516	804	784	0.013	0.41	24	0.24	100	3.04	0.013	0.29	NO	544	0.013	1.9	0.08	pipe	872	1.5	0.375	0.013	6.8	0.04
MH(B)083	1232	788	770	0.015	0.35	21	0.24	100	3.04	0.015	0.28	NO	251	0.015	2.0	0.04	pipe	881	1.5	0.375	0.015	7.2	0.03
MH(B)087	495	819	802	0.034	0.23	14	0.24	100	3.04	0.034	0.20	NO	395	0.034	3.0	0.04							
MH(B)091	1873	810	786	0.013	0.46	27	0.24	100	3.04	0.013	0.29	NO	831	0.013	1.8	0.13	pipe	942	1.5	0.375	0.013	6.7	0.04
MH(B)092	1382	798	782	0.012	0.31	18	0.24	80	3.04	0.012	0.25						pipe	1302	1.75	0.4375	0.012	7.1	0.05
MH(B)099	1391	802	773	0.021	0.32	19	0.24	100	3.04	0.021	0.24	YES	658	0.021	2.9	0.06	pipe	633	1.5	0.375	0.021	8.6	0.02
MH(B)109	796	779	763	0.019	0.31	19	0.24	100	3.04	0.019	0.25	YES	696	0.019	2.8	0.07							
MH(B)112	1226	824	801	0.019	0.32	19	0.24	100	3.04	0.019	0.25	NO	311	0.019	2.2	0.04	pipe	815	1.5	0.375	0.019	8.2	0.03
MH(B)130	1589	812	788	0.015	0.38	23	0.24	100	3.04	0.015	0.27	YES	575	0.015	2.5	0.06	pipe	914	1	0.25	0.015	5.6	0.05
MH(B)140	453	804	793	0.024	0.26	16	0.24	100	3.04	0.024	0.23	NO	353	0.024	2.5	0.04							
MH(B)146	472	805	794	0.023	0.25	15	0.24	100	3.04	0.023	0.23	NO	138	0.023	2.5	0.02	pipe	234	1	0.25	0.023	6.9	0.01
MH(C)005	829	798	788	0.012	0.37	22	0.24	100	3.04	0.012	0.30	YES	459	0.012	2.2	0.06	pipe	270	1.5	0.375	0.012	6.5	0.01
MH(C)014	536	798	786	0.022	0.26	15	0.24	100	3.04	0.022	0.23	NO	94	0.022	2.4	0.01	pipe	342	1.25	0.3125	0.022	7.9	0.01
MH(C)016	344	798	793	0.015	0.31	19	0.24	100	3.04	0.015	0.28	NO	244	0.015	1.9	0.03							
MH(C)021	484	760	756	0.008	0.41	24	0.24	100	3.04	0.008	0.35	YES	384	0.008	1.8	0.06							
MH(C)025	949	774	765	0.009	0.38	23	0.24	100	3.04	0.009	0.33	YES	69	0.009	2.0	0.01	pipe	780	1.5	0.375	0.009	5.8	0.04

Time of Concentration (Tc) Calculations

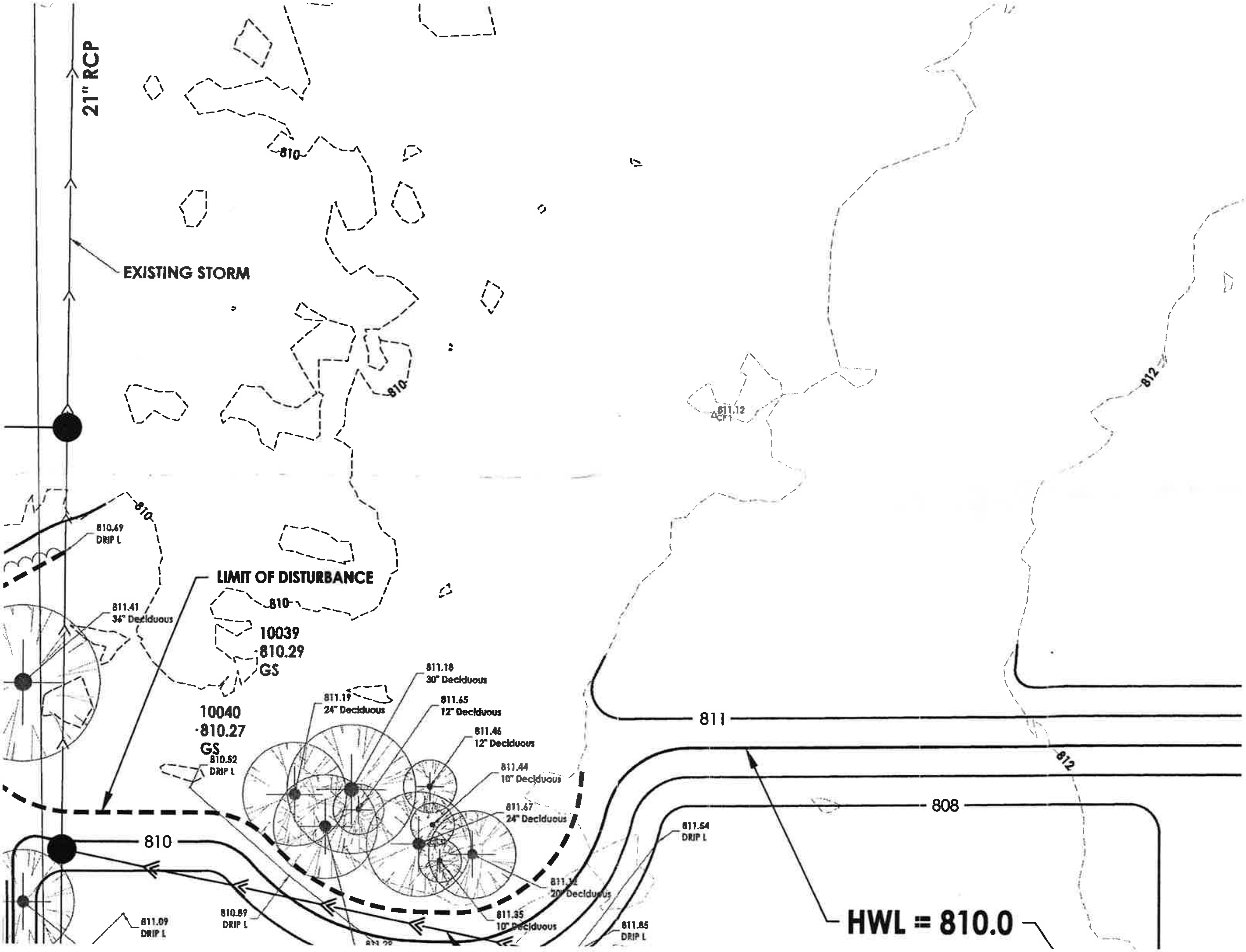
MH(C)026	353	782	769	0.037	0.21	13	0.24	100	3.04	0.037	0.19	NO	253	0.037	3.1	0.02							
MH(C)027	170	784	782	0.012	0.31	19	0.24	100	3.04	0.012	0.30	NO	70	0.012	1.8	0.01							
MH(C)029	451	774	762	0.027	0.25	15	0.24	100	3.04	0.027	0.22	NO	351	0.027	2.6	0.04							
MH(C)030	476	780	766	0.029	0.25	15	0.24	100	3.04	0.029	0.21	NO	376	0.029	2.8	0.04							
MH(C)032	397	776	760	0.040	0.21	13	0.24	100	3.04	0.040	0.18	NO	297	0.040	3.2	0.03							
MH(C)035	455	772	761	0.024	0.25	15	0.24	100	3.04	0.024	0.23	NO	211	0.024	2.5	0.02	pipe	144	1.5	0.375	0.024	9.3	0.00
MH(C)040	377	780	772	0.021	0.27	16	0.24	100	3.04	0.021	0.24	NO	277	0.021	2.3	0.03							
MH(C)041	417	780	770	0.024	0.26	16	0.24	100	3.04	0.024	0.23	NO	317	0.024	2.5	0.04							
MH(C)045	728	798	782	0.022	0.27	16	0.24	100	3.04	0.022	0.24	NO	206	0.022	2.4	0.02	pipe	422	1.5	0.375	0.022	8.8	0.01
MH(C)053	565	788	780	0.014	0.33	20	0.24	100	3.04	0.014	0.28	YES	465	0.014	2.4	0.05							
MH(C)054	376	792	785	0.019	0.28	17	0.24	100	3.04	0.019	0.25	NO	198	0.019	2.2	0.02	pipe	78	1.5	0.375	0.019	8.1	0.00
MH(C)061	608	798	787	0.018	0.29	18	0.24	100	3.04	0.018	0.25	NO	199	0.018	2.2	0.03	pipe	309	1	0.25	0.018	6.1	0.01
MH(C)071	316	800	796	0.013	0.33	20	0.24	100	3.04	0.013	0.29	NO	216	0.013	1.8	0.03							
MH(C)073	397	800	794	0.015	0.31	19	0.24	100	3.04	0.015	0.27	NO	297	0.015	2.0	0.04							
MH(C)077	1388	834	802	0.023	0.29	17	0.24	100	3.04	0.023	0.23	YES	222	0.023	3.1	0.02	pipe	1066	1.25	0.3125	0.023	8.0	0.04
MH(C)086	2056	840	797	0.021	0.44	27	0.24	100	3.04	0.021	0.24	NO	1615	0.021	2.3	0.19	pipe	341	1.75	0.4375	0.021	9.6	0.01
MH(C)101	855	762	758	0.005	0.63	38	0.24	100	3.04	0.005	0.44	NO	755	0.005	1.1	0.19							
MH(D)002	1104	830	804	0.024	0.32	19	0.24	100	3.04	0.024	0.23	YES	1004	0.024	3.1	0.09							
MH(D)003	748	802	792	0.013	0.34	21	0.24	100	3.04	0.013	0.29	NO	275	0.013	1.9	0.04	pipe	373	1.25	0.3125	0.013	6.1	0.02
MH(D)004	1108	824	794	0.027	0.30	18	0.24	100	3.04	0.027	0.22	NO	647	0.027	2.7	0.07	pipe	361	1.25	0.3125	0.027	8.7	0.01
MH(D)012	1034	824	794	0.029	0.30	18	0.24	100	3.04	0.029	0.21	NO	934	0.029	2.7	0.09							
MH(D)013	1203	788	784	0.003	0.83	50	0.24	100	3.04	0.003	0.50	NO	1103	0.003	0.9	0.33							
MH(D)020	505	775	770	0.010	0.39	24	0.24	100	3.04	0.010	0.32	NO	405	0.010	1.6	0.07							
MH(D1)026	816	834	812	0.027	0.27	16	0.24	100	3.04	0.027	0.22	NO	359	0.027	2.6	0.04	pipe	357	1	0.25	0.027	7.5	0.01
MH(D1)046	1752	836	798	0.022	0.33	20	0.24	100	3.04	0.022	0.24	NO	406	0.022	2.4	0.05	pipe	1246	1.25	0.3125	0.022	7.8	0.04
MH(D1)047	408	806	790	0.039	0.21	13	0.24	100	3.04	0.039	0.19	NO	308	0.039	3.2	0.03							
MH(E)031	929	782	769	0.014	0.35	21	0.24	100	3.04	0.014	0.28	YES	458	0.014	2.4	0.05	pipe	371	1	0.25	0.014	5.4	0.02
MH(F)010	1290	796	782	0.011	0.51	30	0.24	100	3.04	0.011	0.31	NO	1190	0.011	1.7	0.20							
MH(F)014	735	784	777	0.010	0.44	26	0.24	100	3.04	0.010	0.33	NO	635	0.010	1.6	0.11							
MH(F)014	314	781	777	0.013	0.32	19	0.24	100	3.04	0.013	0.29	NO	214	0.013	1.8	0.03							
MH(F)027	1102	778	776	0.002	1.04	63	0.24	100	3.04	0.002	0.64	NO	1002	0.002	0.7	0.41							
MH(F)029	660	778	774	0.006	0.52	31	0.24	100	3.04	0.006	0.39	NO	560	0.006	1.3	0.12							
MH(F)036	712	780	777	0.004	0.59	35	0.24	100	3.04	0.004	0.45	NO	459	0.004	1.0	0.12	pipe	153	1	0.25	0.004	3.0	0.01
MH(F)037	405	780	777	0.007	0.42	25	0.24	100	3.04	0.007	0.36	NO	305	0.007	1.4	0.06							
MH(F)039	538	782	780	0.004	0.60	36	0.24	100	3.04	0.004	0.48	NO	438	0.004	1.0	0.12							
MH(F)045	1362	796	784	0.009	0.51	31	0.24	100	3.04	0.009	0.34	NO	821	0.009	1.5	0.15	pipe	441	1.25	0.3125	0.009	5.0	0.02
SI(A)047	733	826	812	0.019	0.33	20	0.24	100	3.04	0.019	0.25	NO	633	0.019	2.2	0.08							
SI(A)051	799	820	807	0.016	0.34	20	0.24	100	3.04	0.016	0.27	YES	699	0.016	2.6	0.07							
SI(A)061	1241	820	805	0.012	0.40	24	0.24	100	3.04	0.012	0.30	YES	621	0.012	2.2	0.08	pipe	520	1	0.25	0.012	5.0	0.03
SI(A)063	976	818	805	0.013	0.37	22	0.24	100	3.04	0.013	0.29	YES	524	0.013	2.3	0.06	pipe	352	1.25	0.3125	0.013	6.1	0.02
SI(A)070	739	824	814	0.014	0.38	23	0.24	100	3.04	0.014	0.29	NO	639	0.014	1.9	0.09							
SI(A)073	611	812	804	0.013	0.35	21	0.24	100	3.04	0.013	0.29	YES	511	0.013	2.3	0.06							
SI(A)077	300	809	806	0.010	0.36	21	0.24	100	3.04	0.010	0.32	NO	200	0.010	1.6	0.03							
SI(A)088	1027	820	806	0.014	0.39	23	0.24	100	3.04	0.014	0.28	YES	826	0.014	2.4	0.10	pipe	101	1	0.25	0.014	5.3	0.01
SI(A)089	1647	829	806	0.014	0.41	25	0.24	100	3.04	0.014	0.28	YES	930	0.014	2.4	0.11	pipe	617	1.5	0.375	0.014	7.0	0.02
SI(A)096	1149	842	822	0.017	0.35	21	0.24	100	3.04	0.017	0.26	NO	558	0.017	2.1	0.07	pipe	491	1.5	0.375	0.017	7.9	0.02
SI(A)097	343	832	825	0.022	0.26	16	0.24	100	3.04	0.022	0.24	NO	198	0.022	2.4	0.02	pipe	45	1	0.25	0.022	6.7	0.00
SI(A)103	370	840	828	0.032	0.22	13	0.24	100	3.04	0.032	0.20	NO	216	0.032	2.9	0.02	pipe	54	1	0.25	0.032	8.2	0.00
SI(A)105	329	841	832	0.027	0.23	14	0.24	100	3.04	0.027	0.22	NO	38	0.027	2.7	0.00	pipe	191	1.25	0.3125	0.027	8.7	0.01
SI(A)114	1442	860	839	0.015	0.47	28	0.24	100	3.04	0.015	0.28	NO	1342	0.015	1.9	0.19							
SI(A)120	281	817	808	0.032	0.22	13	0.24	100	3.04	0.032	0.20	YES	181	0.032	3.6	0.01							
SI(A)129	353	822	808	0.040	0.21	12	0.24	100	3.04	0.040	0.19	NO	253	0.040	3.2	0.02							
SI(A)138	321	818	814	0.012	0.32	19	0.24	100	3.04	0.012	0.29	YES	221	0.012	2.3	0.03							
SI(A)147	1343	838	814	0.018	0.42	25	0.24	100	3.04	0.018	0.26	NO	1243	0.018	2.2	0.16							
SI(A)148	2384	858	820	0.016	0.58	35	0.24	100	3.04	0.016	0.27	NO	2284	0.016	2.0	0.31							
SI(A)149	989	836	822	0.014	0.41	25	0.24	100	3.04	0.014	0.28	NO	889	0.014	1.9	0.13							
SI(A)161	1714	836	810	0.015	0.43	26	0.24	100	3.04	0.015	0.27	YES	1267	0.015	2.5	0.14	pipe	347	1.25	0.3125	0.015	6.5	0.01
SI(A)186	2928	862	814	0.016	0.64	39	0.24	100	3.04	0.016	0.26	NO	2828	0.016	2.1	0.38							
SI(A)213	766	820	800	0.026	0.29	17	0.24	100	3.04	0.026	0.22	NO	666	0.026	2.6	0.07							
SI(A)246	804	836	805	0.039	0.25	15	0.24	100	3.04	0.039	0.19	NO	657	0.039	3.2	0.06	pipe	47	1	0.25	0.039	8.9	0.00
SI(A1)028	638	796	784	0.019	0.32	19	0.24	100	3.04	0.019	0.25	NO	538	0.019	2.2	0.07							
SI(A1)029	758	794	782	0.016	0.34	20	0.24	100	3.04	0.016	0.27	YES	658	0.016	2.6	0.07							
SI(A1)030	814	791	781	0.012	0.41	24	0.24	100	3.04	0.012	0.30	NO	714	0.012	1.8	0.11							
SI(A1)033	739	784	780	0.005	0.56	34	0.24	100	3.04	0.005	0.41	NO	639	0.005	1.2	0.15							
SI(B)038	1270	838	812	0.020	0.33	20	0.24	100	3.04	0.020	0.24	NO	555	0.020	2.3	0.07	pipe	615	1.25	0.3125	0.020	7.6	0.02
SI(B)040	636	820	808	0.019	0.32	19	0.24	100	3.04	0.019	0.25	NO	536	0.019	2.2	0.07							
SI(B)062	676	842	820	0.033	0.26	15	0.24	100	3.04	0.033	0.20	NO	576	0.033	2.9	0.05							
SI(B)064	1545	836	822	0.009	0.60	36	0.24	100	3.04	0.009	0.33	NO	1445	0.009	1.5	0.26							
SI(B)073	618	849	836	0.021	0.17	10	0.24	57	3.04	0.021	0.15						pipe	561	1.5	0.375	0.021	8.6	0.02
SI(B)076	764	844	831	0.017	0.28	17	0.24	99	3.04	0.017	0.26						pipe	665	1.5	0.375	0.017	7.8	0.02
SI(B)078	651	842	830	0.018	0.32	19	0.24	100	3.04	0.018	0.25	NO	551	0.018	2.2	0.07							
SI(B)085	1260	856	830	0.021	0.31	18	0.24	100	3.04	0.021	0.24	YES	441	0.021	2.9	0.04	pipe	719	1.5	0.375	0.021	8.6	0.02
SI(B)087	1120	842	828	0.012	0.45	27	0.24	100	3.04	0.012	0.29	NO	1020	0.012	1.8	0.16							
SI(B)174	823	788	772	0.019	0.29	17	0.24	100	3.04	0.019	0.25	NO	161	0.019	2.3	0.02	pipe	562	1.25	0.3125	0.019	7.4	0.02
SI(B)201	1030	788	774	0.014	0.36	22	0.24	100	3.04	0.014	0.28	NO	296	0.014	1.9	0.04	pipe	634	1	0.25	0.014	5.3	0.03
SI(B)202	506	820	805	0.030	0.25	15	0.24	100	3.04	0.030	0.21	NO	406	0.030	2.8	0.04							
SI(B)226	2256	798	768	0.013	0.41	24	0.24	100	3.04	0.013	0.29	YES	288	0.013	2.3	0.03	pipe	1868	1.25	0.3125	0.013	6.1	0.09
SI(B)251	297	827	817	0.034	0.21	13	0.24	100	3.04	0.034	0.20	NO	153	0.034	3.0	0.01	pipe	44	1.25	0.3125	0.034	9.7	0.00
SI(B)254	407	826	815	0.027	0.25	15	0.24	100	3.04	0.027	0.22	NO	307	0.027	2.7	0.03							

Time of Concentration (Tc) Calculations

SI(B)255	1260	834	816	0.014	0.45	27	0.24	100	3.04	0.014	0.28	NO	1160	0.014	1.9	0.17							
SI(B)296	553	820	815	0.009	0.42	25	0.24	100	3.04	0.009	0.34	NO	453	0.009	1.5	0.08							
SI(C)071	307	784	776	0.026	0.24	14	0.24	100	3.04	0.026	0.22	NO	207	0.026	2.6	0.02							
SI(C)080	473	796	787	0.019	0.30	18	0.24	100	3.04	0.019	0.25	NO	373	0.019	2.2	0.05							
SI(C)091	1290	806	789	0.013	0.38	23	0.24	100	3.04	0.013	0.29	NO	394	0.013	1.9	0.06		796	1.5	0.375	0.013	6.8	0.03
SI(D)003	629	784	776	0.013	0.34	21	0.24	100	3.04	0.013	0.29	YES	346	0.013	2.3	0.04	pipe	183	1	0.25	0.013	5.1	0.01
SI(D)010	581	800	786	0.024	0.28	17	0.24	100	3.04	0.024	0.23	NO	481	0.024	2.5	0.05							
SI(D)041	551	798	784	0.025	0.27	16	0.24	100	3.04	0.025	0.22	NO	451	0.025	2.6	0.05							
SI(D)057	1156	820	784	0.031	0.31	18	0.24	100	3.04	0.031	0.20	NO	1056	0.031	2.8	0.10							
SI(F)035	1156	784	774	0.009	0.46	28	0.24	100	3.04	0.009	0.34	YES	695	0.009	1.9	0.10	pipe	361	1.25	0.3125	0.009	4.9	0.02

APPENDIX D

AS-BUILTS AND PLANS


21" RCP
EXISTING STORM
810
810
810
810
LIMIT OF DISTURBANCE
810
810.69
DRIP L
811.41
36" Deciduous
10039
810.29
GS
10040
810.27
GS
810.52
DRIP L
811.19
24" Deciduous
811.18
30" Deciduous
811.65
12" Deciduous
811.46
12" Deciduous
811.44
10" Deciduous
811.67
24" Deciduous
811.12
CP1
812
811
812
808
811.54
DRIP L
810
811.09
DRIP L
810.89
DRIP L
811.35
10" Deciduous
811.85
DRIP L
HWL = 810.0

APPENDIX E

COST ESTIMATES

ENGINEER'S OPINION OF PROBABLE COST

Client City of Belvidere
Project 170791.3

BAXTER & WOODMAN

100 YEAR DESIGN STORM - FULL PLAN

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	BASIN A STORM SEWER				
	72" RCP	1,460	LF	$ 1,950	$ 2,847,000
	60" RCP	685	LF	$ 1,700	$ 1,164,500
	48" RCP	1,395	LF	$ 1,100	$ 1,534,500
	42" RCP	1,010	LF	$ 900	$ 909,000
	36" RCP	1,215	LF	$ 750	$ 911,250
	30" RCP	200	LF	$ 550	$ 110,000
	ABANDONMENT OF EXISTING SEWERS	214	CY	$ 180	$ 38,520
2	BASIN B STORM SEWER				
	84" RCP	1,200	LF	$ 2,400	$ 2,880,000
	72" RCP	385	LF	$ 1,950	$ 750,750
	60" RCP	395	LF	$ 1,700	$ 671,500
	54" RCP	450	LF	$ 1,450	$ 652,500
	42" RCP	3,145	LF	$ 900	$ 2,830,500
	36" RCP	1,035	LF	$ 750	$ 776,250
	ABANDONMENT OF EXISTING SEWERS	1,480	CY	$ 180	$ 266,400
3	DETENTION POND, CHURCH PROPERTY, 1.75 AC-FT	1	LS	$ 260,000	$ 260,000
4	EXPAND DETENTION POND, HIGH SCHOOL PROPERTY, 24.3 AC-FT TOTAL	1	LS	$ 1,308,000	$ 1,308,000
5	SURFACE STORAGE, WASHINGTON ELEMENTARY, 47.2 AC-FT	1	LS	$ 3,553,000	$ 3,553,000
6	SURFACE STORAGE, GLENWOOD DR AND FREEMONT ST, 9.8 AC-FT, 4 LOT BUY-OUTS	1	LS	$ 1,514,000	$ 1,514,000
7	SURFACE STORAGE, E 8TH ST AND S MAIN ST, 12.1 AC-FT, 12 LOT BUYOUTS	1	LS	$ 2,376,000	$ 2,376,000
8	SURFACE STORAGE, E 4TH ST AND EAST AVE, 17.8 AC-FT, 17 LOT BUY-OUTS	1	LS	$ 3,417,000	$ 3,417,000
9	SURFACE STORAGE, E 4TH ST AND FREEMONT ST, 6.5 AC-FT, 11 LOT BUY-OUTS	1	LS	$ 1,873,000	$ 1,873,000
10	IMPROVED OVERLAND FLOW ROUTE, W 10TH ST AND BIRCH AVE, 2 LOT BUY-OUTS	1	LS	$ 400,000	$ 400,000

		SUBTOTAL, CONSTRUCTION	$ 31,050,000
10	CONSTRUCTION CONTINGENCY	15 %	$ 4,660,000
		OPINION OF PROBABLE CONSTRUCTION COST	**$ 35,710,000**
11	ENGINEERING, DESIGN	6.0 %	$ 2,150,000
12	ENGINEERING, CONSTRUCTION	7.5 %	$ 2,680,000
13	LEGAL AND ADMINISTRATIVE	2.0 %	$ 720,000
14	FINANCIAL CONSULTANT	2.5 %	$ 900,000
		OPINION OF PROBABLE TOTAL PROJECT COST	**$ 42,160,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2018.

ENGINEER'S OPINION OF PROBABLE COST

Client City of Belvidere
Project 170791.3

BAXTER & WOODMAN

100 YEAR DESIGN STORM - PHASE III

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	BASIN A STORM SEWER				
	72" RCP	1,460	LF	$ 1,950	$ 2,847,000
	60" RCP	685	LF	$ 1,700	$ 1,164,500
	36" RCP	640	LF	$ 750	$ 480,000
2	$11,	1	LS	$ 3,553,000	$ 3,553,000
3	IMPROVED OVERLAND FLOW ROUTE, W 10TH ST	1	LS	$ 400,000	$ 400,000

		SUBTOTAL, CONSTRUCTION	$	8,450,000
10	CONSTRUCTION CONTINGENCY	15 %	$	1,270,000
		OPINION OF PROBABLE CONSTRUCTION COST	**$**	**9,720,000**
11	ENGINEERING, DESIGN	6.0 %	$	590,000
12	ENGINEERING, CONSTRUCTION	7.5 %	$	730,000
13	LEGAL AND ADMINISTRATIVE	2.0 %	$	200,000
14	FINANCIAL CONSULTANT	2.5 %	$	250,000
		OPINION OF PROBABLE TOTAL PROJECT COST	**$**	**11,490,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2018.

ENGINEER'S OPINION OF PROBABLE COST

Client City of Belvidere
Project 170791.3

BAXTER & WOODMAN Consulting Engineers

100 YEAR DESIGN STORM - PHASE IV

No.	Pay Item	Quantity	Unit	Unit Price	Amount
2	BASIN B STORM SEWER				
	84" RCP	1,200	LF	$ 2,400	$ 2,880,000
	72" RCP	385	LF	$ 1,950	$ 750,750
	60" RCP	395	LF	$ 1,700	$ 671,500
	54" RCP	450	LF	$ 1,450	$ 652,500
	42" RCP	3,145	LF	$ 900	$ 2,830,500
	36" RCP	1,035	LF	$ 750	$ 776,250
	ABANDONMENT OF EXISTING SEWERS	1,480	CY	$ 180	$ 266,400
8	SURFACE STORAGE, E 4TH ST AND EAST AVE, 17.8 AC-FT, 17 LOT BUY-OUTS	1	LS	$ 3,417,000	$ 3,417,000
9	SURFACE STORAGE, E 4TH ST AND FREEMONT ST, 6.5 AC-FT, 11 LOT BUY-OUTS	1	LS	$ 1,873,000	$ 1,873,000

		SUBTOTAL, CONSTRUCTION	$ 14,120,000
10	CONSTRUCTION CONTINGENCY	15 %	$ 2,120,000
		OPINION OF PROBABLE CONSTRUCTION COST	**$ 16,240,000**
11	ENGINEERING, DESIGN	6.0 %	$ 980,000
12	ENGINEERING, CONSTRUCTION	7.5 %	$ 1,220,000
13	LEGAL AND ADMINISTRATIVE	2.0 %	$ 330,000
14	FINANCIAL CONSULTANT	2.5 %	$ 410,000
		OPINION OF PROBABLE TOTAL PROJECT COST	**$ 19,180,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2018.

ENGINEER'S OPINION OF PROBABLE COST

Client City of Belvidere
Project 170791.3

BAXTER & WOODMAN Consulting Engineers

100 YEAR DESIGN STORM - PHASE V

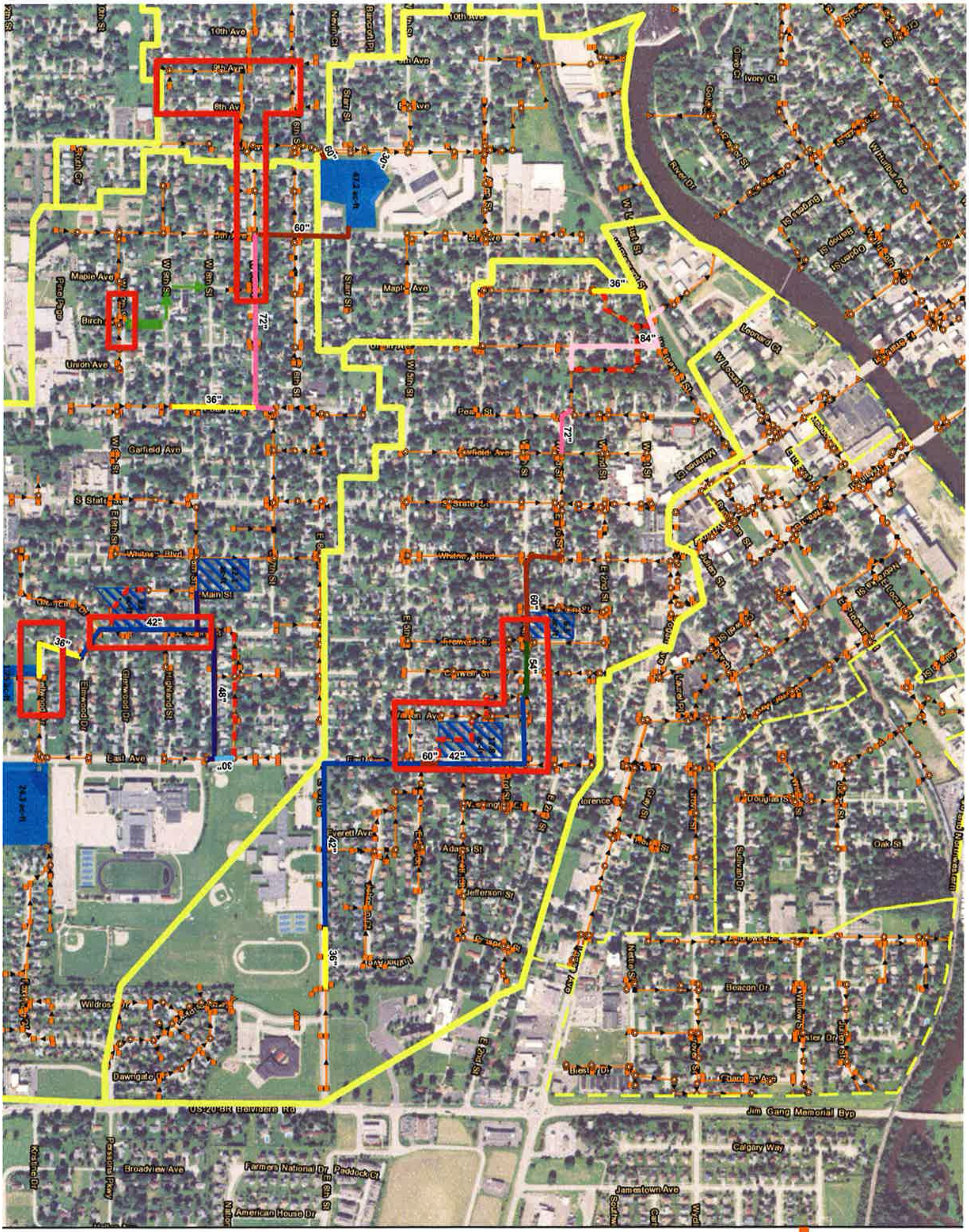
No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	BASIN A STORM SEWER				
	48" RCP	1,395	LF	$ 1,100	$ 1,534,500
	42" RCP	1,010	LF	$ 900	$ 909,000
	36" RCP	575	LF	$ 750	$ 431,250
	30" RCP	200	LF	$ 550	$ 110,000
	ABANDONMENT OF EXISTING SEWERS	214	CY	$ 180	$ 38,520
6	SURFACE STORAGE, GLENWOOD DR AND FREEMONT ST, 9.8 AC-FT, 4 LOT BUY-OUTS	1	LS	$ 1,514,000	$ 1,514,000
7	SURFACE STORAGE, E 8TH ST AND S MAIN ST, 12.1 AC-FT, 12 LOT BUYOUTS	1	LS	$ 2,376,000	$ 2,376,000

		SUBTOTAL, CONSTRUCTION	$ 6,920,000
10	CONSTRUCTION CONTINGENCY	15 %	$ 1,040,000
		OPINION OF PROBABLE CONSTRUCTION COST	**$ 7,960,000**
11	ENGINEERING, DESIGN	6.0 %	$ 480,000
12	ENGINEERING, CONSTRUCTION	7.5 %	$ 600,000
13	LEGAL AND ADMINISTRATIVE	2.0 %	$ 160,000
14	FINANCIAL CONSULTANT	2.5 %	$ 200,000
		OPINION OF PROBABLE TOTAL PROJECT COST	**$ 9,400,000**

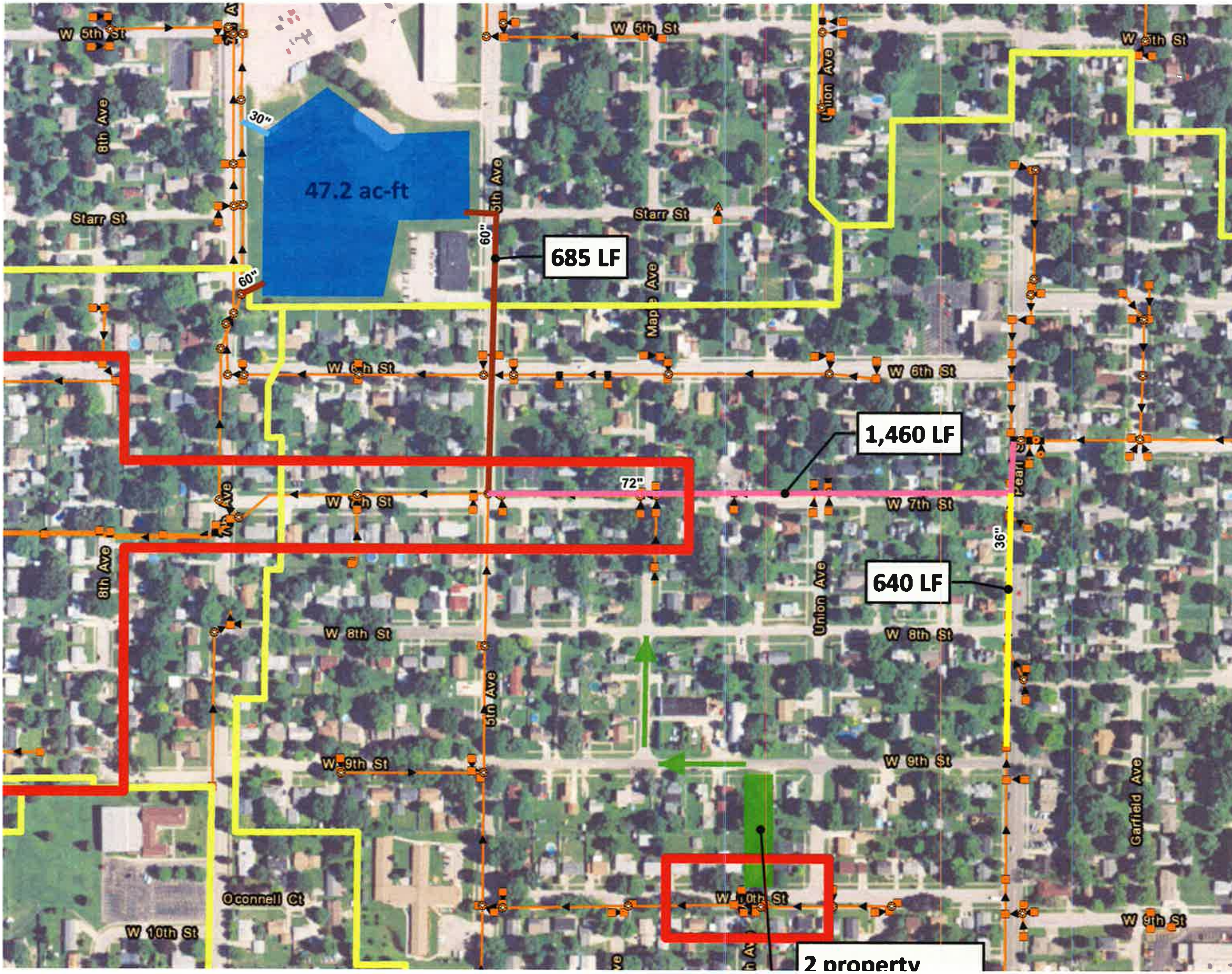
Notes
1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2018.

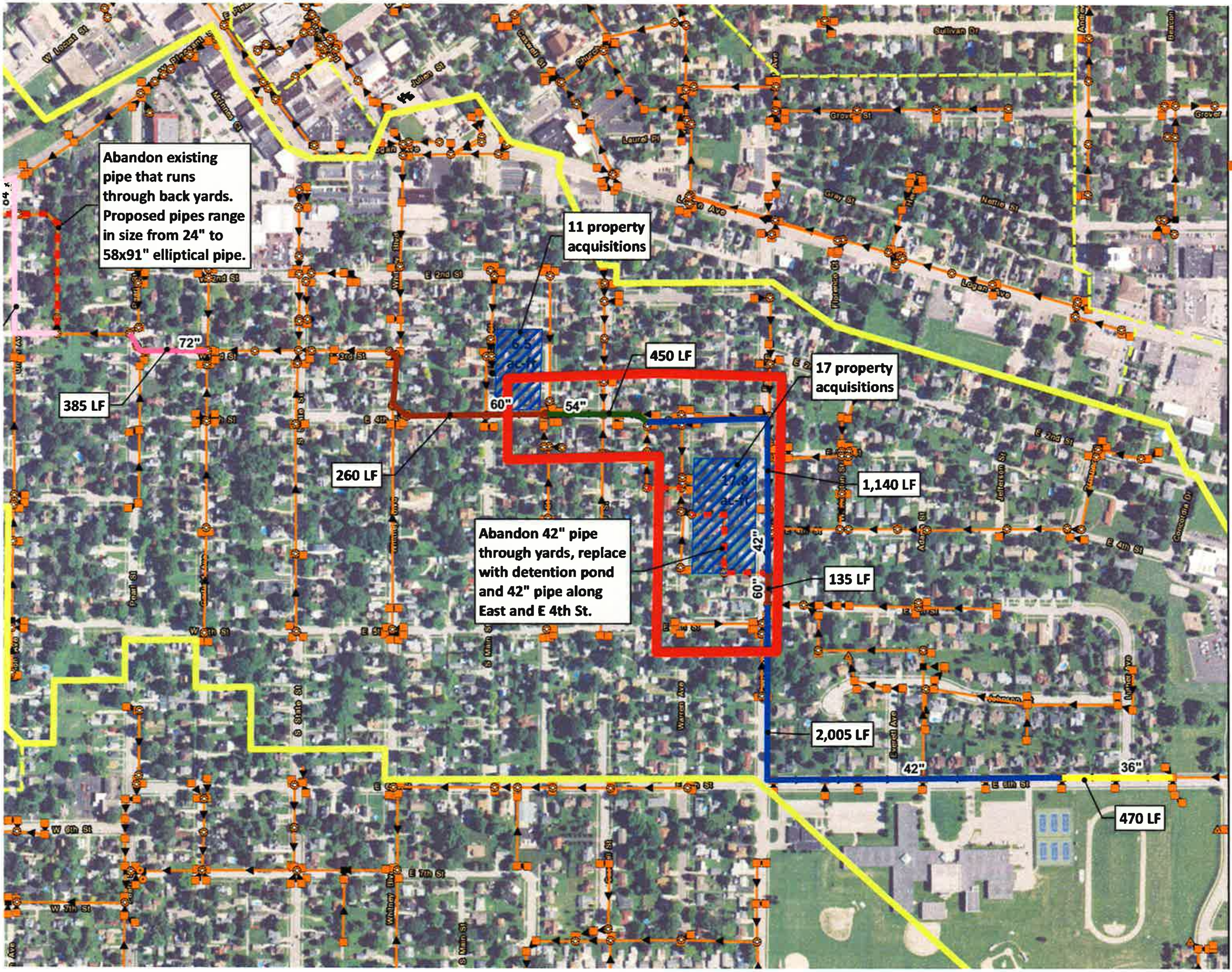
APPENDIX F

CONCEPTUAL IMPROVEMENT PLAN EXHIBITS

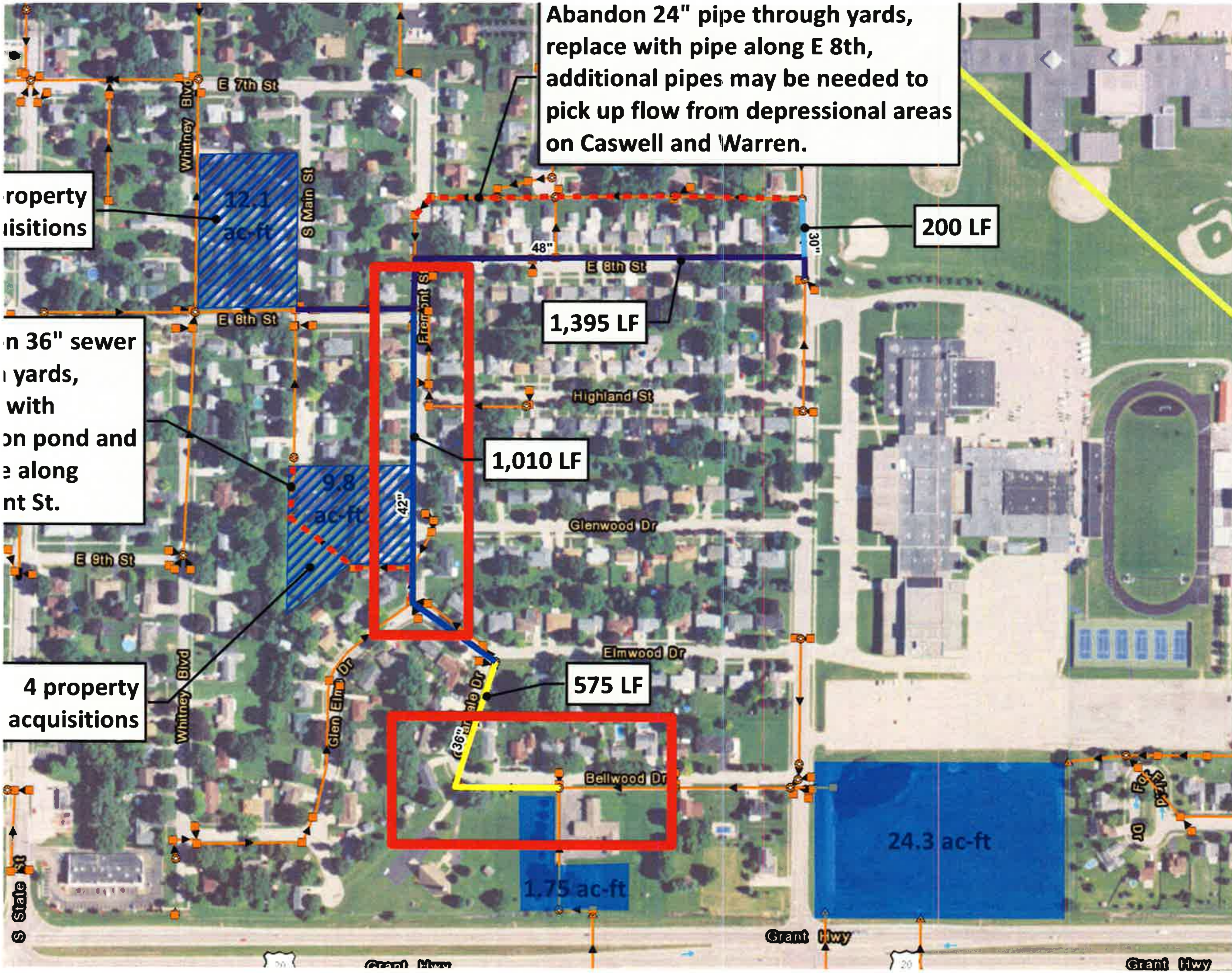


10th Ave
8th Ave
Starr St
47.2 ac-ft
60"
30"
72"
36"
84"
Maple Ave
Birch
Union Ave
Garfield Ave
S State St
Whitney Blvd
Main St
42"
48"
East Ave
24.3 ac-ft
Elmwood Dr
Glenwood Dr
Highland St
54"
Adams St
Jefferson St
Everett Ave
Luther Ave
Pearl St
Oak St
Sullivan Dr
Douglas St
Beacon Dr
Dawngate
Wildrose Dr
US-20 BR Belvidere Rd
Jim Gang Memorial Byp
Calgary Way
Jamestown Ave
Broadview Ave
Farmers National Dr
Paddock Ct
American House Dr
Kristine Dr
Parsons Pkwy
River Dr
Leonard Ct
W Locust St
Ivory Ct
Olive Ct
Bishop St
Ogden St
Burgess St
Whittier Ave


47.2 ac-ft
30"
60"
60"
685 LF
1,460 LF
72"
640 LF
36"
2 property
W 5th St
W 6th St
W 7th St
W 8th St
W 9th St
W 10th St
8th Ave
Starr St
5th Ave
Maple Ave
Union Ave
Pearl St
Garfield Ave
Oconnell Ct



Abandon existing pipe that runs through back yards. Proposed pipes range in size from 24" to 58x91" elliptical pipe.
11 property acquisitions
450 LF
17 property acquisitions
72"
385 LF
60"
54"
260 LF
1,140 LF
Abandon 42" pipe through yards, replace with detention pond and 42" pipe along East and E 4th St.
42"
135 LF
60"
2,005 LF
42"
36"
470 LF


Abandon 24" pipe through yards, replace with pipe along E 8th, additional pipes may be needed to pick up flow from depressional areas on Caswell and Warren.
200 LF
30"
48"
1,395 LF
1,010 LF
42"
575 LF
36"
roperty
iisitions
n 36" sewer
yards,
with
on pond and
e along
nt St.
4 property acquisitions
12.1 ac-ft
9.8 ac-ft
1.75 ac-ft
24.3 ac-ft
E 7th St
E 8th St
E 9th St
S Main St
Whitney Blvd
Fremont St
Highland St
Glenwood Dr
Elmwood Dr
Bellwood Dr
Glen Elm Dr
S State St
Grant Hwy