City of Piqua, Ohio

Stormwater Master Plan - Phase 1

Draft Stormwater Master Plan Report

January 2, 2014

Project No. 14578347

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December 27, 2013

City of Piqua, Ohio
201 West Water Street
Piqua, Ohio 45356

Attention: Mr. Devon Alexander, Stormwater Coordinator.

RE: Stormwater Master Plan Phase 1 (Draft)

Dear Devon:

Attached is one (1) copy of the City of Piqua, Draft Stormwater Master Plan Report-Phase 1. A digital copy of this report is also available and a link will be sent to you with a download location. This report summarizes our investigations of the Piqua separate storm sewer system that began early in 2013.

We will be happy to meet with you and other City staff to discuss this report in detail. Please look over the attached draft and let us know if you have comments.

Sincerely,

URS Corporation

Jeffrey R. Kerr, P.E.
Senior Project Manager

Attachments

cc: Mike Frommer, P.E., URS
Bill Porteus, URS

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Section One Executive Summary

1.0 Executive Summary

1.1 Work Summary

Background investigations of the City of Piqua storm sewer system were conducted in the year 2013. These investigations included a review of:

- Existing stormwater planning studies and other City records,
- Existing maps and record plans for the storm sewer system,
- Existing maps and record plans for the Miami County ditch and tile system,
- Existing stormwater regulatory criteria including the Stormwater Management Plan, NPDES Industrial Stormwater Permits, and City drainage design criteria, and
- City stormwater maintenance program activities and costs.

City staff was interviewed to further define stormwater problem areas. Field surveying activities were conducted to verify storm structure locations and elevations and improve existing stormwater maps.

A stormwater questionnaire was sent out to storm/sanitary customers to obtain further information on maintenance and flooding problems. The results of this questionnaire were tabulated and shown on a map.

Stormwater GIS maps were reviewed and updated based on new data obtained from field surveyors and City maintenance crews. Additional stormwater shape files were created to improve the City's stormwater GIS maps. A hydraulic model of the storm sewer system was created to model the storm sewer system during the 2, 5 and 10 year rain events.

Based on the above investigations, a list of stormwater problem areas requiring further study was identified. A separate Deerfield/Eagles Nest Subdivision Stormwater Letter Report was prepared and submitted to the City on October 9, 2013. The Letter Report evaluated alternatives to improve stormwater detention in the Deerfield/Eagles Nest Subdivisions and to reduce the erosion of the Echo Lake Western Ditch.

1.2 Stormwater Problem Area Summary

Stormwater problem areas were identified by City staff during interviews on May 8, 2013. The locations of these problem areas are shown on **Figure 5-3**. A summary of these problem areas is presented below:

- Area 1-Cleveland Street (severe street/yard flooding, stormwater pump station not keeping up with flows)
- Area 2-Deerfield Subdivision (dry detention does not work, farm fields drain onto adjacent properties, severe erosion of Western Ditch of Echo Lake)

- Area 3-Manier Ditch (field tile drainage floods local streets, culverts and storm sewers)
- Area 4-Commercial Street/Roosevelt Street (Underserved by storm sewers and catch basins, street and yard flooding)
- Area 5-Eagles Lake/Colleen/Coronada (farm fields drain onto adjacent properties, severe erosion of Western Ditch of Echo Lake)
- Area 6-Harley Davidson/US 36/Garbry Road (flooding of parking at Heartland of Piqua, box culver under US 36 and 36-inch storm sewer are at different elevations)
- Area 7-North of Patrizio/South of Gabry/East of I-75) (flooding problems south of Garbry and north of Patrizio, 48-inch culvert under I-75 may be too small)
- Area 8-Gordon/Ellerman/Grant Streets (storm sewers not mapped)
- Area 9-Sunset Area (flooding problems, storm sewer may be undersized)
- Area 10-The Path near Propeller Street (County tile drainage may be a problem, water boiling out of ground near RR track).

Based on stormwater questionnaire results, the areas of the City with the largest number of reported street/yard flooding problems (shown on **Figure 5-4**) were as follows:

- Cleveland Street Area (First Street, Second Street, Cleveland Street)
- Deerfield/Eagles Nest Subdivision Area (Eagles Lake, Coronada)
- Propeller Street Area (Brentwood, Pinewood, Glenwood, Briarcliff, and Propeller)
- Lakewood Street Area (Lakewood, Hopewood, and Marymont)
- Blaine Street Area (Blaine, Wilson, Plum and Grant)
- Manier Street Area (Manier and Brook)
- Gordon Street Area (Gordon, Ridge)

The above areas had the largest number of reported street and yard flooding greater than 24 hours in duration.

Maintenance problems in the City (that were reported on questionnaires) appeared to be widely dispersed. However, a number of maintenance problems were concentrated on the following streets: Blaine, Boone and Grant.

Section Two Introduction

2.0 Introduction

2.1 Purpose of the Study

The City of Piqua requested a Phase 1 Stormwater Master Plan (SMP) study and report. This study consisted of the following tasks:

Task 1 – Background Research/Problem Identification

Task 2 – Stormwater GIS Mapping Review and Update

Task 3 – SWMM Model Development

Task 4 – Public Involvement / Public Outreach

Task 5 – Prepare Stormwater Master Plan Phase 1 Report, and

Task 6 – Prepare Stormwater Letter Report for Deerfield Subdivision Area

The Phase 1 SMP is a preliminary study that determines stormwater quantity deficiencies in the City's existing stormwater system. The Phase 2 SMP will include the evaluation of alternatives and the recommendation of capital improvement projects for the problem areas identified in the Phase 1 SMP.

The Phase 1 SMP has been developed based on:

- Background research,
- City staff interviews,
- Field observations,
- Public feedback through meetings and questionnaires,
- Evaluation of existing GIS data,
- Collection of new GIS and survey data in the field, and
- The preparation of a hydrologic and hydraulic model of the stormwater system.

The development of the Phase 1 SMP was coordinated with the City's Sanitary Sewer Master Plan (July 2012), Stormwater Utility Plan, Stormwater Management Plan (NPDES Phase II Permit), and the Strategic Plan (2012-2016).

Task 6 has been completed and a separate Deerfield/Eagles Nest Subdivision Stormwater Letter Report was submitted to the City on October 9, 2013. The Letter Report evaluated alternatives to improve stormwater detention in the Deerfield/Eagles Nest Subdivisions and to reduce the erosion of the Echo Lake Western Ditch.

Section Three Background Research/Problem Identification

3.0 Background Research/Problem Identification

3.1 Stormwater Planning

3.1.1 Previous Planning Studies

West End Stormwater Report. A West End Stormwater Management Master Plan Report was completed by consultants for the City of Piqua in 1992. The study area for this plan consisted of 1,200 total acres in the Eagles Nest Subdivision and the agricultural property adjacent to the Park Ridge Subdivision. This study area generally drained toward Franz Pond and Echo Lake. The purpose of the study was to evaluate stormwater alternatives for the area and to evaluate the effectiveness of the Eagles Nest Detention Basin.

In 1992, localized flooding and downstream impacts from residential development were determined to be problems in the area. Stormwater problems reported in the West End Report in 1992 included the following:

- Flooding immediately downstream of the Eagle's Nest Detention Basin and the main channel on the north side of State Route 185 opposite the Detention Basin.
- Flooding in the vicinity of West View and Carlyle Drive
- Flooding at two homes on West View and Carol Drive.
- Flooding of a home on Lambert Drive.
- Water in basements at three homes on State Route 185 (3848, 3888, and 3902 S.R. 185).

The report stated that the Eagles Nest Detention Basin was effectively controlling stormwater runoff for storms ranging in frequency from the 1-year to the 100-year, 24 hour design events. The report recommended the following stormwater projects:

- Replacement of 517 lineal feet of 21-inch field tile draining the Eagle's Nest Detention Basin up to State Route 185.
- Correction of the standing water at Carlyle Drive by installing an under drain system which would connect to the storm sewer system in Carlyle Drive.
- Installing a 31 acre-foot, wet detention basin in the Lambert Drive area and 600 lineal feet of 42-inch storm sewer.
- Installing a new 47 acre-foot, wet detention basin for the Park Ridge West Area and 4,280 lineal feet of storm sewer ranging in size from 30-inch to 42-inch.

The status of the 1992 recommendations is as follows:

- An 18-inch storm sewer draining Eagles Nest Detention basin to a SR 185 drainage ditch was constructed.
- The two recommended detention basins (31 and 47 acre-feet of storage) were not constructed. Smaller, new detention basins were privately built as part of the Deerfield Subdivision in 1994.

3.1.2 Storm Water Management Program

The City of Piqua has developed a Stormwater Management Plan (SWMP) as required by the National Pollutant Discharge Elimination System (NPDES) Phase 2 requirements for its Municipal Separate Storm Sewer System (MS4). According to the Phase 2 Rule, small MS4 owners and operators (such as Piqua) must reduce pollutants in stormwater to the maximum extent practicable (MEP) to protect water quality. This MEP requirement is to be attained by complying with the six minimum control measures identified in the Phase 2 Rule (for additional information regarding the City's activities under the NPDES Phase 2 program, please see the City's SWMP).

The City has implemented the following stormwater management tasks in response to the requirements of their Phase 2 program:

1. Established a stormwater public education program and held approximately five public involvement activities per year.
2. Created an updated storm sewer system and stormwater outfalls map for the City.
3. Inspected stormwater outfalls annually and collected samples of stormwater discharges with questionable odors or color.
4. Enacted ordinances to eliminate illicit discharges, enforce construction site erosion and sediment control and require post construction stormwater management.
5. Set up an enforcement program for illicit discharges.
6. Trained City employees on pollution prevention, and
7. Filed annual reports with the Ohio EPA on Phase 2 program implementation.

The storm sewer maps discussed in Item 2 have been further updated as part of the Phase 1 SMP. Copies of these maps, in both hard copy and GIS format, will be delivered to the City as part of this report and can be found in **Appendix A**.

The public meeting held as part of the Phase 1 SMP is as a public involvement activity under Item 1 shown above.

3.2 Regulatory Criteria and Guidance

As noted above, the NPDES Phase 2 program requires that the City work to reduce pollutants in receiving streams. There are also several other regulatory criteria in place that must be considered within the SMP. These criteria are described in more detail below.

3.2.1 Piqua Stormwater Drainage Design Criteria

The City has developed minimum design criteria that are to be used during the "…preparation of development plans and engineering design…also intended to be used during reconstruction or replacement of existing facilities or utility construction within the City right-of-way," (Section 600, City of Piqua Design Criteria, August 2008).

New storm sewers within the City are to be designed such that the full flow capacity of the pipe is sufficient to carry "…at least the runoff from the 5-year storm event." The City further requires that "…the Hydraulic Grade Line (HGL) should be checked to ensure that a 25-year storm event will not cause ponding water at catch basins and manholes."

City design criteria also include requirements for roadway culverts. Culverts are to be designed according to requirements in the Ohio Department of Transportation's Location and Design Manual, Volume 2, Drainage Design. The design of the culvert is to have a full flow capacity for a 25-year storm and an overtopping capacity of at least a 100-year storm.

In addition to the pipe capacity requirements, the City requires that stormwater detention be implemented with new development. The detention requirements require that the release rate from the detention facility not be greater than the runoff generated by the 5-year event in a pre-developed state and that there should be sufficient storage volume to contain the 100-year event. In the event that the outlet becomes inoperable or that there is a storm event larger than the 100-year, an emergency overflow is required to be implemented within the detention facility, and that overflow needs to have an outlet pathway that can convey the design flow without adverse impacts to the detention facility or adjacent properties. If an overflow pathway would be compromised by the overflows, additional detention storage may be necessary to mitigate downstream impacts.

Additional design specifics for both detention facilities and stormwater conveyance are contained within Section 600 of the City of Piqua Design Criteria.

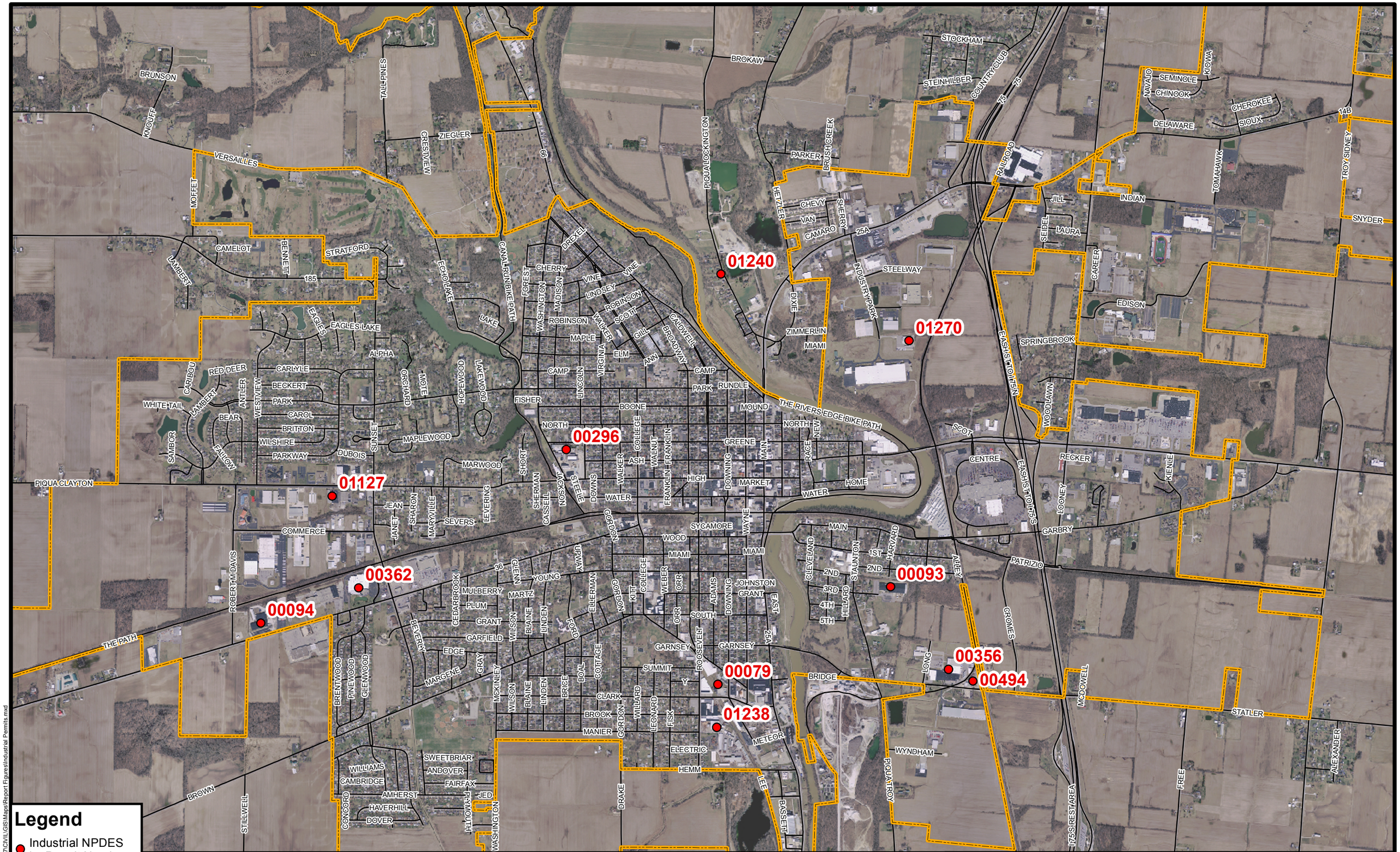
3.2.2 Ohio EPA NPDES Industrial Stormwater Discharge Permits

As part of the City's NDPES Phase 2 compliance, they are to maintain a listing of the entities within the City that have obtained coverage under the OEPA's Industrial Stormwater Discharge Permit. Within Piqua those entities are listed in **Table 3-1** and shown on **Figure 3-1**. This listing should not be considered comprehensive as it

is based on information obtained from the OEPA's website, and may not be a complete listing of sites with permits, nor is it a comprehensive listing of sites that should have permits but are not aware that a permit is required. The City should conduct a review of their own municipal operations to determine whether or not any City owned facilities should apply for an Industrial Stormwater Permit.

Table 3-1: Summary of Industrial Stormwater Discharge Permits in Piqua

Permit No.	Applicant Name	Applicant Address	Facility Name	Facility Address	Issue Date
1GR00094*EG	Crane Pumps & Systems Inc	420 Third St Piqua, OH 45356	Covington Crane Pumps & Systems	1950 Covington Ave Piqua, OH 45356	2/20/2012
1GR00093*EG	Crane Pumps & Systems Inc	420 Third St Piqua, OH 45356	Crane Pumps & Systems Inc	420 Third St Piqua, OH 45356	2/20/2012
1GR00296*EG	French Oil Mill Machinery Co	1035 W Greene St Piqua, OH 45356	French Oil Mill Machinery Co	1035 W Greene St Piqua, OH 45356	2/20/2012
1GR00079*EG	Hartzell Fan Inc	Po Box 919 Piqua, OH 45356	Hartzell Fan Inc	910 S Downing St Piqua, OH 45356	2/17/2012
1GR01238*EG	Hartzell Hardwoods Inc	Po Box 919 Piqua, OH 45356	Hartzell Hardwoods Inc	1025 S Roosevelt Ave Piqua, OH 45356	4/19/2012
1GR01128*EG	Hartzell Propeller Inc	One Propeller Place Piqua, OH 45358	Hartzell Propeller Inc	5465 W State Route 185 Piqua, OH 45356	2/20/2012
1GR00362*EG	Hartzell Propeller Inc	One Propeller Place Piqua, OH 45358	Hartzell Propeller Inc	One Propeller Place Piqua, OH 45356	2/20/2012
1GR00356*EG	Industry Products Company	500 Statler Rd Piqua, OH 45356	Industry Products Company	500 Statler Rd Piqua, OH 45356	2/20/2013
1GR00079*EG	Hartzell Fan Inc	Po Box 919 Piqua, OH 45356	Hartzell Fan Inc	910 S Downing St Piqua, OH 45356	2/17/2012
1GR01127*EG	Perfecto Industries Inc	1729 W High St Piqua, OH 45356	Perfecto Industries Inc	1729 W High St Piqua, OH 45356	3/22/2012
1GR01240*EG	Piqua Concrete Co	8395 N Piqua-Lockington Rd Piqua, OH 45356	Piqua Concrete Co	8395 N Piqua-Lockington Rd Piqua, OH 45356	4/19/2012
1GR00025*EG	Piqua Emery Foundry Inc	Po Box 406 Piqua, OH 45356	Piqua Emery Foundry Inc	821 S Downing St Piqua, OH 45356	11/1/2012
1GR01270*DG	United Parcel Service Inc	11141 Canal Rd Sharonville, OH 45241	Ups-Piqua Center	8460 Industry Park Dr Piqua, OH 45356	5/15/2012
1GR00494*EG	Urban Elsass & Son Inc.	600 E Statler Rd Piqua, OH 45356	Urban Elsass & Son Inc	600 E Statler Rd Piqua, OH 45356	2/24/2012



Piqua Stormwater Master Plan

Figure 3-1: Industrial NPDES Permits

3.2.3 Ohio EPA NPDES Construction General Permit

The OEPA Construction General Permit (CGP) mandates controls on construction site runoff (i.e. sediment and erosion control) for sites that disturb more than 1-acre of land. In addition to the construction phase requirements in the permit, there are requirements for post construction water quality control through the control of a water quality volume of runoff which also apply to sites that disturb more than one acre.

The CGP applies state-wide, however, within the City's NPDES Phase 2 program, they are required to adopt a sediment and erosion control program that is at least as stringent as the requirements within the CGP.

Like the Industrial Stormwater Permit, the CGP is most frequently obtained by others, and the City is instructed to monitor sites with coverage under the CGP. However, the City should obtain coverage under the CGP if any City project falls within the criteria listed within the CGP.

3.2.4 Miami River TMDL Report

The Total Maximum Daily Load (TMDL) program was established under Section 303(d) of the Clean Water Act and focuses on identifying and restoring polluted rivers, streams, lakes and other surface waters. TMDL reports are prepared by the Ohio EPA for waters identified as impaired.

The TMDL reports include a quantitative assessment of water quality problems in surface water and the contributing sources of pollution. The TMDL should specify the amount of a pollutant that needs to be reduced to meet water quality standards, allocates pollutant load reductions, and provides the basis for taking actions needed to restore surface water quality.

The NPDES MS4 general permit includes a reference to incorporate TMDL pollutant reduction recommendations into the SWMP that is prepared for any MS4 if the TMDL is complete. This means that stormwater treatment, for such pollutants as total suspended solids, total phosphate, nitrogen and bacteria, is required to meet TMDL requirements in these areas. In Ohio, stormwater treatment to meet TMDL requirements is not currently fully enforced, but could be implemented in the future.

The City of Piqua is located in the Middle Great Miami River Watershed TMDL area. The TMDL report for this watershed is currently in preparation. This watershed was monitored for Aquatic Life Use Assessment in the Year 2009 with the following results:

- Total Miles Monitored: 48.9
- Assessment Unit Score: 94.3

- Miles in Full Attainment: 46.1 (94.3%)
- Miles in Partial Attainment: 2.8 (5.7%)

Causes of impairment in the Middle Great Miami River watershed were found to include ammonia and direct habitat alterations. Sources of impairment in this watershed include dams or impoundments and municipal point source discharges.

Locations in partial attainment in the City included the following:

- Great Miami River Mile 114.9 (0.25 miles upstream of Statler Road), Warmwater Habitat, Partial Attainment
- Great Miami River Mile 114.3 (Upstream of Piqua Wastewater Treatment Plant) Warmwater Habitat, Partial Attainment

While the TMDL is not complete at this time, it is recommended that the City continue to monitor the progress of the report to ensure that they are aware of any recommendations that could have an effect on their operations.

3.3 Stormwater Maintenance Program Activities

The City operates and maintains approximately 105 miles of storm sewer. In the past, maintenance that has been performed on this storm sewer was done in response to a major problem such as a pipe collapse or a completely clogged storm sewer. However, as funding has become available through the City's stormwater utility, more proactive maintenance of the storm sewer system is being performed. This maintenance has included:

- Closed circuit television (CCTV) inspection and cleaning of parts of the storm sewer system;
- Repair or replacement of stormwater structures such as curb inlets, catch basins, storm manholes, and end walls;
- Making repairs in response to flooding complaints,
- Moving forward with stream restoration projects, and
- Other stormwater capital improvement projects (CIPs).

The City owns and operates their own CCTV inspection and cleaning equipment and has assigned a two person stormwater crew to use this equipment to clean and televise storm sewers.

A summary of the annual stormwater maintenance budget in the City is presented in **Table 3-2**. **Table 3-2** shows actual costs incurred in 2011 and 2012 plus the budget for the Year 2013. **Table 3-2** also shows the costs of stormwater capital improvement projects incurred in 2012 and budgeted for 2013.

Table 3-2: Piqua Annual Stormwater Maintenance and Capital Costs
Years 2011-2013

Item Description	Year 2011 Actual	Year 2012 Actual	Year 2013 Budget	Comment
Construction In Process (A-70)		$303,043	$510,000	
Salaries and Wages (E01)	$133,201	$128,988	$290,545	
Supplies (E20)	$42,840	$40,802	$108,500	Fuel, equipment, department supplies, uniforms, clothing
Utilities (E-24)	$603	$9,175	$21,596	Utilities, telephone
Outside Services (E-28)	$115,282	$87,852	$272,924	Tipping fees, rents, contract services, laboratory
Training/Travel (E42)	$1,139	$582	$1,350	Training, travel
Billing Costs (E-32)	$29,749	$30,866	$32,668	
Employee Benefits (E-10)	$48,237	$44,676	$73,208	Health insurance, life insurance, workers comp, OPERS, Medicare
Bad Debt Expense (E-48)	$5,877	$0	$4,000	
Depreciation (E-70)	$4,052	$7,128	$0	
Other Not Deferred Expenses (E40)	$22,502	$21,147	$25,530	Dues, subscriptions, recording fees, freight and postage, Permit fees, taxes, safety expenses
Total Annual Expenses	**$420,029**	**$400,538**	**$838,551**	
Fund Revenues	$819,270	$1,083,966	$1,009,654	

Section Four Stormwater GIS Mapping Review/Update

4.0 Stormwater GIS Mapping Review/Update

4.1 Stormwater GIS Update Process

In order to perform a complete system characterization, information was gathered to acquire a more thorough understanding of the existing stormwater system. The information that was gathered was compiled into GIS shapefiles to better organize, analyze, and visualize the data collected. Data was gathered from a variety of sources, including:

- County drainage maps,
- County field tile records,
- Field survey,
- Record drawings,
- Visual analysis, and
- Stormwater questionnaires.

The existing GIS shapefiles were enhanced by the new data collected from the referenced sources. The existing Storm GIS shapefiles include information on:

- Storm Manholes
- Storm Catch Basins
- Storm Sewers

The existing GIS shapefiles were also reviewed to confirm accuracy and to update any data gaps. Data gaps included missing storm sewers, missing invert elevations, mislabeled sewer sizes, and storm sewers drawn flowing the wrong direction. Discrepancies in the GIS shapefiles were identified and corrected with the best available data. Discrepancies that could not be corrected have been identified for correction during future phases of the master planning process.

New GIS shapefiles that were created include:

1. Detention basins
2. Storm catchments (drainage areas)
3. County field tiles
4. County ditches
5. Impervious surfaces (i.e. parking lots, sidewalks, roadways, driveways, but not the rooftop areas)
6. Residential structures (i.e. rooftop areas)
7. Non-Residential structures (i.e. rooftop areas)

Each one of the shapefiles was used to develop the information necessary to construct the Stormwater Model, which is described in greater detail in Section 6 of this report. A complete collection of these updated shapefiles are included on a CD in **Appendix A**.

4.2 Base Map Update

In each of the new shapefiles, attributes were added to gather information for analysis purposes. The newly acquired attributes provide a more comprehensive base map that will provide the City with enhanced ability to analyze the existing conditions within the City. The base map for the stormwater system is shown on **Figures 4-1** and **4-2**. **Figure 4-1** shows the storm sewer system overlaid on a current aerial photograph. **Figure 4-2** shows the storm sewer system overlaid on a street and drainage basin base. The storm sewer is shown in a color gradient to indicate sewer size and flow direction, while the new shapefiles are used to show better connectivity and drainage patterns throughout the system.

4.3 New GIS Shapefiles and Attribute Data

The main GIS update involved the creation of new shapefiles. All old shapefiles were reviewed to confirm attribute accuracy; however changes to the attribute data were required. Attributes within the new shapefiles were created for analysis purposes and may not be completely populated. The following new shapefiles are listed with the corresponding attribute types that were added to each.

1. Detention Basins- name, surface area, type (wet or dry), water elevation (if applicable), inlet size, outlet size
2. Storm Catchments- basin name, outlet structure, area, percent impervious
3. County Field Tiles- size, name
4. County Ditches- no attributes added for this shapefile
5. Impervious Surfaces- area (acres)
6. Residential Structures- area (acres)
7. Non-Residential Structures- area (acres)

Section Five System Characterization

5.0 System Characterization

5.1 Stormwater Infrastructure

5.1.1 Storm Sewers and Structures

As previously noted, the GIS mapping was updated to reflect the existing connectivity of the stormwater infrastructure in the City. **Figures 4-1** and **4-2** show the GIS mapping that was utilized to create the hydraulic model. This system is comprised of the following layers: storm manholes, catch basins, storm pipes, ditches, swales, and detention basins. The layers that were provided by the City consisted of attribute information with only a few areas missing connectivity within the City. In the infrastructure that was added to the base map as part of this SMP, the attribute information was inserted when available and provided by the City. **Table 5-1** is a summary of pipe and structure quantities shown on the mapped stormwater infrastructure.

Table 5-1: Stormwater Infrastructure Summary

Item	Quantity
Sewer – Pipes and Culverts 12-inch and less	217,257 L.F.
Sewer – Pipes and Culverts 15-inch to 33-inch	284,395 L.F.
Sewer – Pipes and Culverts 36-inch and greater	55,305 L.F.
Inlets – Catch Basins and Curb/Gutter Inlets	4,289
Manholes	1,683
End Treatments – 10-inch to 60-inch	291

5.1.2 Detention Basins

Detention basins can be either wet or dry. A dry detention basin is planted with grass or other vegetation and functions as a lawn or vacant land most of the time. During storm events, stormwater enters the dry basin through an inlet pipe on one end and flows through vegetation or a concrete channel toward a smaller outlet pipe. When more water enters the basin than is able to leave through the outlet, the water level rises throughout the basin and is stored. The stored water slowly drains through the outlet after the rain event is over and/or infiltrates into the ground. Dry basins are designed to hold water for a minimal amount of time (typically it is approximately 48-72 hours) so that the existing groundcover is not adversely affected. It is also

necessary that the dry basins drain completely to avoid ponding or wet soil, which hinders or prohibits maintenance activities.

Wet detention basins function and appear as local ponds or lakes. Wet basins hold water year-round and accommodate increased water volume during storms. During a rain event, water enters the basin through one or more inlet structures or pipes. If water cannot leave the basin fast enough through a smaller outlet structure, the basin fills. Once the incoming volume becomes less than the outgoing, the basin slowly drains back to its normal water level. Some wet basins are equipped with wells to keep water levels consistent during dry periods to counteract water lost to evaporation and infiltration.

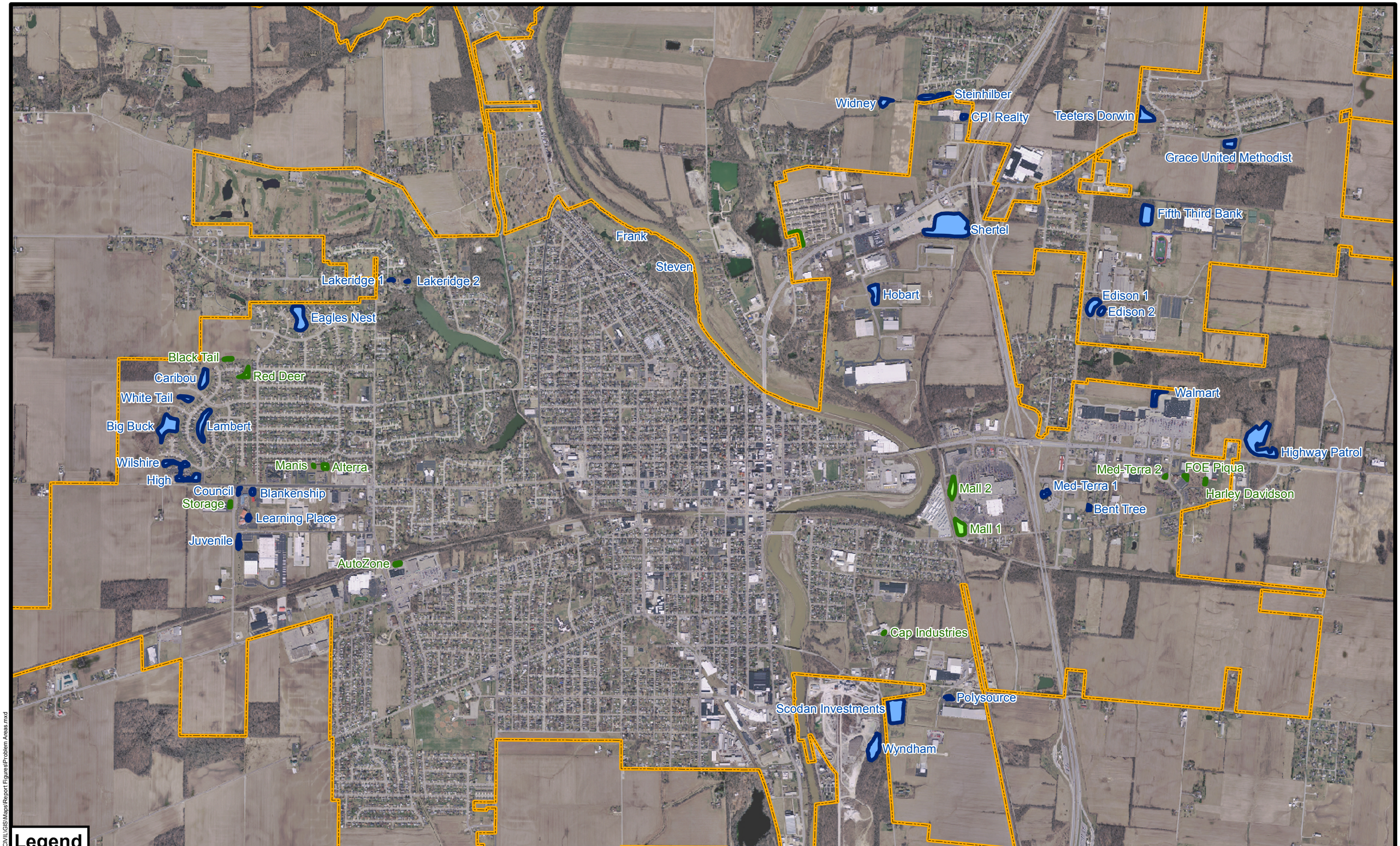
Both dry and wet detention basins are designed to control the amount of runoff entering the downstream storm sewer system or surface water body from a specific tributary area. As the amount of impervious area increases in the tributary area (due to construction of buildings, parking lots and roads) the need for detention basins increases. Detention basins are also used to prevent surcharging and backups of storm sewer systems, reduce erosion of channels and streams, and mitigate downstream flooding problems.

Wet basins have advantages over dry basins. Wet basins provide higher pollutant removal efficiencies than dry basins and offer less chance of re-suspending pollutants that have settled out. Wet basins also tend to be more aesthetically appealing than dry basins and provide habitat for aquatic life. Wet basins allow for the establishment of wetland vegetation, vegetated buffers, and no mow zones that improve water quality by providing filtration of pollutants.

A description of known privately owned detention basins in the City is presented in **Table 5-2** and shown in **Figure 5-1**. The table shows a total of 43 detention basins within the City. **Table 5-2** summarizes the detention basins that have been identified throughout the City and lists the attributes associated with each basin. Information on this table was gathered using best available data and is missing in some areas due to lack of information. The detention basins were generally constructed for either subdivisions or commercial properties and serve adjacent properties. Each detention basin that is shown to have a photo in **Table 5-2** has a photo provided in **Appendix C**, along with a brief description of the basin. Items left blank in **Table 5-2** are not available. Other data shown in this table were taken from the GIS database.

Table 5-2: Detention Basin Summary

Name	Type	Area (ac)	Water Elevation	Inlets	Outlets	Photo
Bent Tree	Wet	0.16045	942	12"-940.99	Outlet unknown	
Big Buck	Wet	2.70976	963.78	-	18"-963.60,15"963.78	Yes
Blankenship	Wet	0.23378	958.53	15"-958.63, 12"-958.66	12"-958.53	
Caribou	Wet	1.13454	960.04	30"-960.66, 18"-959.93, 15"-960.14	18"-960.04	Yes
Council	Wet	0.13365	962.28	15"-962.26, 15"-962.19	12"-962.28	
CPI Realty	Wet	0.2171	919.91	12"-919.78	12"-919.91	
Eagles Nest	Wet	2.39752	944.35	42"-944.45, 21"-944.9, 15"-944.9	18"-944.35	Yes
Edison 1	Wet	1.27752	933.54	42"-933.93	15"-933.54	
Edison 2	Wet	0.38239	935.95	24"-936.08	15"-935.95	
Fifth Third Bank	Wet	2.01925	938.68	42"-939.03, 30"-938.53	36"-938.68	
Grace United Methodist	Wet	0.71176	954.72	15"-954.62, 18"-954.84	12"-957.02,12"-954.7	
High	Wet	0.96806	963.8	18"-963.49, 18"-963.46, 12"-963.5	12"963.8	Yes
Highway Patrol	Wet	5.39368	966	Outside City limits		
Hobart	Wet	1.24471	898.28	18"-899.44, 24"-898.46	18"-898.28	
Juvenile	Wet	0.3688	959.02		12"-959.02	
Lakeridge 1	Wet	0.06758	928	15"-926.77	Ditch	
Lakeridge 2	Wet	0.05097	906.34	15"-910.46	24"-906.34	
Lambert	Wet	1.63115	961.65	18"-961.54, 15"-962.25, 15"-962.2	12"-961.65	Yes
Learning Place	Wet	0.18031	961.49	15"-961.50	18"-961.49	
Med-Terra 1	Wet	0.38147	925.85	18"-925.929, 12"-925.91	18"-925.85	
Polysource	Wet	0.22524	886.08	24"-887.47, 8"-889.3, 18"-890.74	12"-886.08	
Scodan Investments	Wet	3.53908	876		Outlet unknown	
Shertel	Wet	7.82808	902	36"-900.49	Outlet unknown	
Steinhilber	Wet	1.03587		Outside City limits		
Teeters Dorwin	Wet	1.42847	939.7	42"-939.67, 18"-939.52, 36"-938.8	24"-939.59,24"-939.7	
Walmart	Wet	0.68907	954		Outlet unknown	Yes
White Tail	Wet	0.45197	960.9	24"-960.53	30"-960.90	Yes
Widney	Wet	0.61799	904	Outside City limits		
Wilshire	Wet	0.8441	963.8	18"-963.72, 12"-963.79	18"	Yes
Wyndham	Wet	2.12697	840	48"-874.21	Outlet unknown	
Alterra	Dry	0.26781		15"-954.96	8"-952.87	
AutoZone	Dry	0.20751			8"-944.4,15"-944.10	Yes
Black Tail	Dry	0.1836		24"-958.80	36" 958.45	
Camaro	Dry	0.70026		36"-883.70, 21"-884.54, (2)12"-884	12"-882.67	
Cap Industries	Dry	0.05565		10"-878.33, 12"-877.16	10"-876.77	
FOE Piqua	Dry	0.13954		12"-953.59, 10"-952.45	6"-950.68	
Mall 1	Dry	1.19849			Outlet unknown	Yes
Mall 2	Dry	0.98955			Outlet unknown	Yes
Manis	Dry	0.04526		12"-955.24	8"-954.91,12"-954.66	
Med-Terra 2	Dry	0.05824		12"-954.05	12"-952.69	
Red Deer	Dry	0.43234		15"-959.66, 24"-957.76	12"-957.5, 24"-962.2	Yes
Storage	Dry	0.13196		12"-962.94, 12"-962.83, 24"-962.35	21" 962.02,12"962.12	
Harley Davidson	Dry	0.11387		15"-952.301	10"-952.07	Yes



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Piqua Stormwater Master Plan

Figure 5-1: Detention Basins

5.1.3 Miami County Drainage Ditch System

The Miami County drainage ditch system consists of natural and improved watercourses, gutters, ditches, and channels. There are many natural or man-made drainage channels within the City and these drainage channels include intermittent tributaries of Echo Lake and the Miami River and other drainage ditches. **Figure 5-2** is a map of surface drainage in and around the City. Maintenance of the Miami County drainage ditch system is performed by the Miami County Engineer and involves cleaning and dredging as needed.

Drainage from the Deerfield Subdivision tributary area discharges into a 36-inch storm sewer that begins near Red Deer Drive and flows east to Sunset Drive where it discharges to a local ditch known as Echo Lake Western Ditch. This Ditch discharges directly into Echo Lake. The City obtained a 40 foot wide drainage easement for this ditch in 1994.

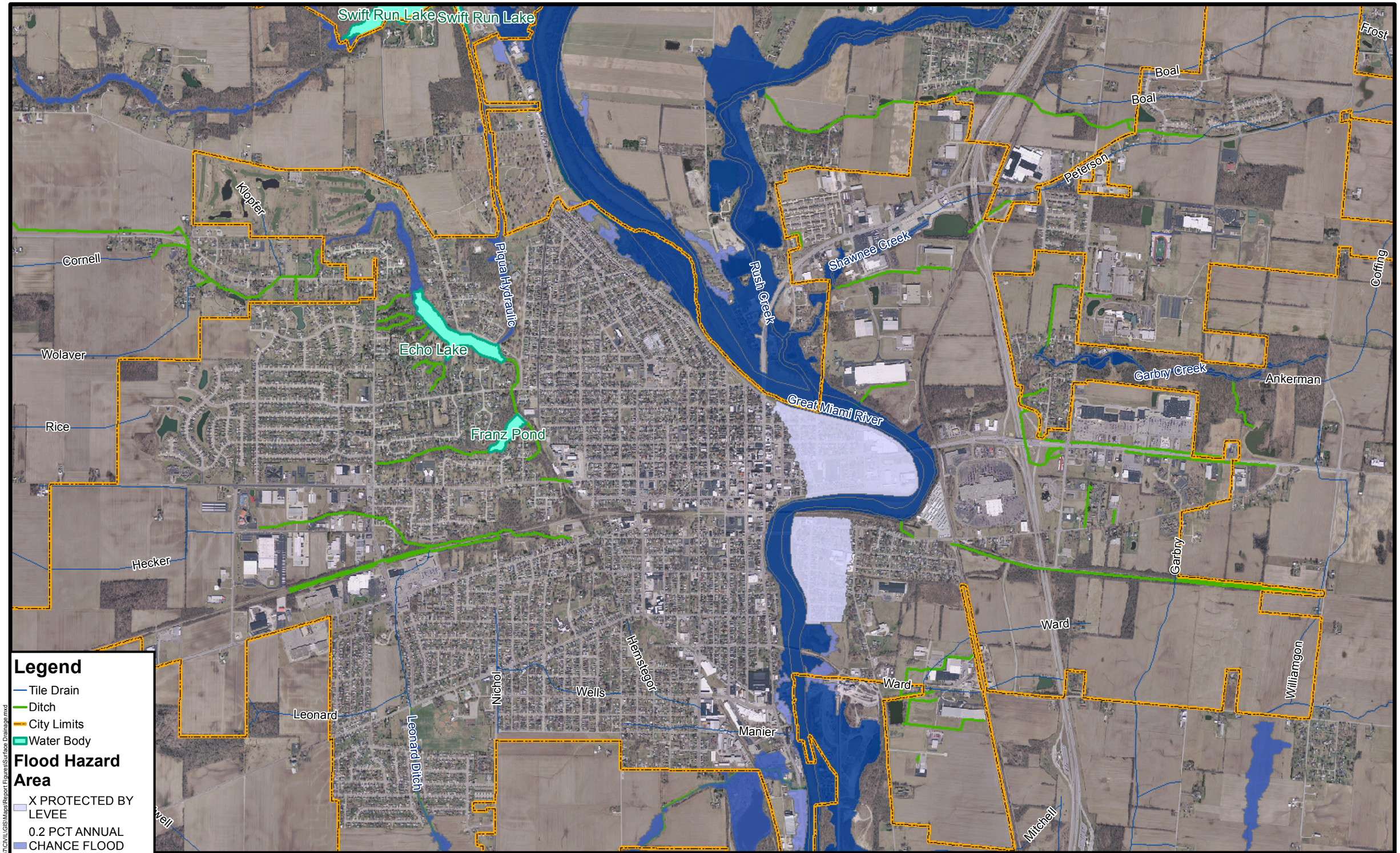
Echo Lake Western Ditch is currently eroding due to peak flow discharges from the Deerfield Subdivision tributary area. This erosion has created a channel that is wider than the natural channel would otherwise be. The channel bottom is soil with occasional cobbles and boulders. The ditch discharges to a wetland area that is adjacent to Echo Lake.

5.1.4 Miami County Drain Tile System

The Miami County drain tile system consists of an agricultural drainage tile system that is operated and maintained by the Miami County Engineer, who also maintains records of the location of the drain tiles. Copies of these records for tile and ditches in and around the City were obtained for the Phase 1 SMP. There are approximately 15 miles of drain tiles that flow into the City's storm sewer system. These tiles, in and near the City, are shown on **Figure 5-2**.

The Miami County drain tile system drains hundreds of acres of agricultural land and connects into the Miami County ditch system or directly into the City's storm sewer system. Some of the tiles are located in areas of high groundwater and convey large quantities of groundwater. County drain tiles are not believed to contribute to peak flow conditions due to the slow infiltration time into the tiles. However, within the City, the added flow from the drain tile system could lengthen flooding durations in neighborhoods or in the storm sewer system during large storm events.

A 12-inch, Miami County Rice Tile currently discharges into a 24-inch storm sewer in the Deerfield Subdivision near Big Buck Drive. This storm sewer drains a high groundwater area and discharges through the Whitetail and Caribou Detention Basins located adjacent to Lambert Drive. The drainage area for this field tile is 121 acres as shown in the Miami County Engineer's records.



Piqua Stormwater Master Plan

Figure 5-2: Surface Drainage

5.2 Surface Waters

The Great Miami River flows through the City from north to south. The Great Miami River has a total length of approximately 160 miles and a watershed area of 5,373 square miles. The Great Miami River has a gradient of 3.43 feet per mile and an average stream flow of 5,370 cubic feet per second (3,470 MGD), which ultimately discharges to the Ohio River. Surface waters and storm sewer outfalls in the City ultimately discharge to the Great Miami River. The Great Miami is classified as Warmwater Habitat by the Ohio EPA Water Quality Standards.

Local surface waters in the City, which are a part of the Raw Water Supply of the City, include Echo Lake, Franz Pond, the Hydraulic Canal and Swift Run Lake. A Raw Water Engineering Study was prepared by Hull and Associates for the City in 2008. The study evaluated surface water and sediment quality in Echo Lake, Franz Pond and the Hydraulic Canal by conducting a water and sediment sampling program. Water quality sampling by Hull and Associates included analyses for ammonia nitrogen, nitrate/nitrite, phosphorous, organic carbon, dissolved and suspended solids and pesticides. Sediment samples were analyzed for phosphorous, ammonia nitrogen, total nitrogen and pesticides. The depth of sediment in Franz Pond was estimated to range from 4.0 to 6.5 feet.

Swift Run Lake was sampled several times by the Ohio EPA in 2008. Ohio EPA sampling data show elevated levels of nutrients, chlorophyll-a, and certain pesticides (e.g., atrazine). Swift Run Lake was also found to have excessive growth of algae and aquatic plants due to nutrient loadings.

Excessive sediment inputs to Echo Lake, Franz Pond, the Hydraulic Canal and Swift Run Lake were thought to be due to stormwater hydrologic changes that were causing stream bank erosion. It was recommended that stormwater detention be increased in the watershed of these surface waters wherever possible to reduce stream bank erosion and related sedimentation. Control of aquatic vegetation in these surface waters by mechanical, chemical or biological methods was also recommended as a short term option. The Franz Pond watershed was found to be in particular need of stream restoration to improve stream bank stability and to reduce excess erosion, sedimentation and aquatic plant growth.

The recommended long term plan (3-5 years) was to provide a Watershed Action Plan and to provide dredging to deepen lakes.

5.3 Floodplains

The Federal Emergency Management Agency (FEMA) has mapped the 1-percent annual chance (100-year) floodplain in the City along the Great Miami River and other tributaries. The 1-percent annual chance floodplain for major waterways in the City is shown on the Flood Insurance Rate Map for Miami County and Incorporated Areas, dated August 2, 2011. The floodplain information for the City is also shown on **Figure 5-2**, which was obtained from the City's GIS.

City policy and federal guidelines prohibit filling of the floodway of the Great Miami River and other surface waters. The City also prohibits fill and development in the 1-percent annual chance floodplain.

A river gauge is located in the center of town on the Great Miami River north of the Ash Street Bridge that records river levels.

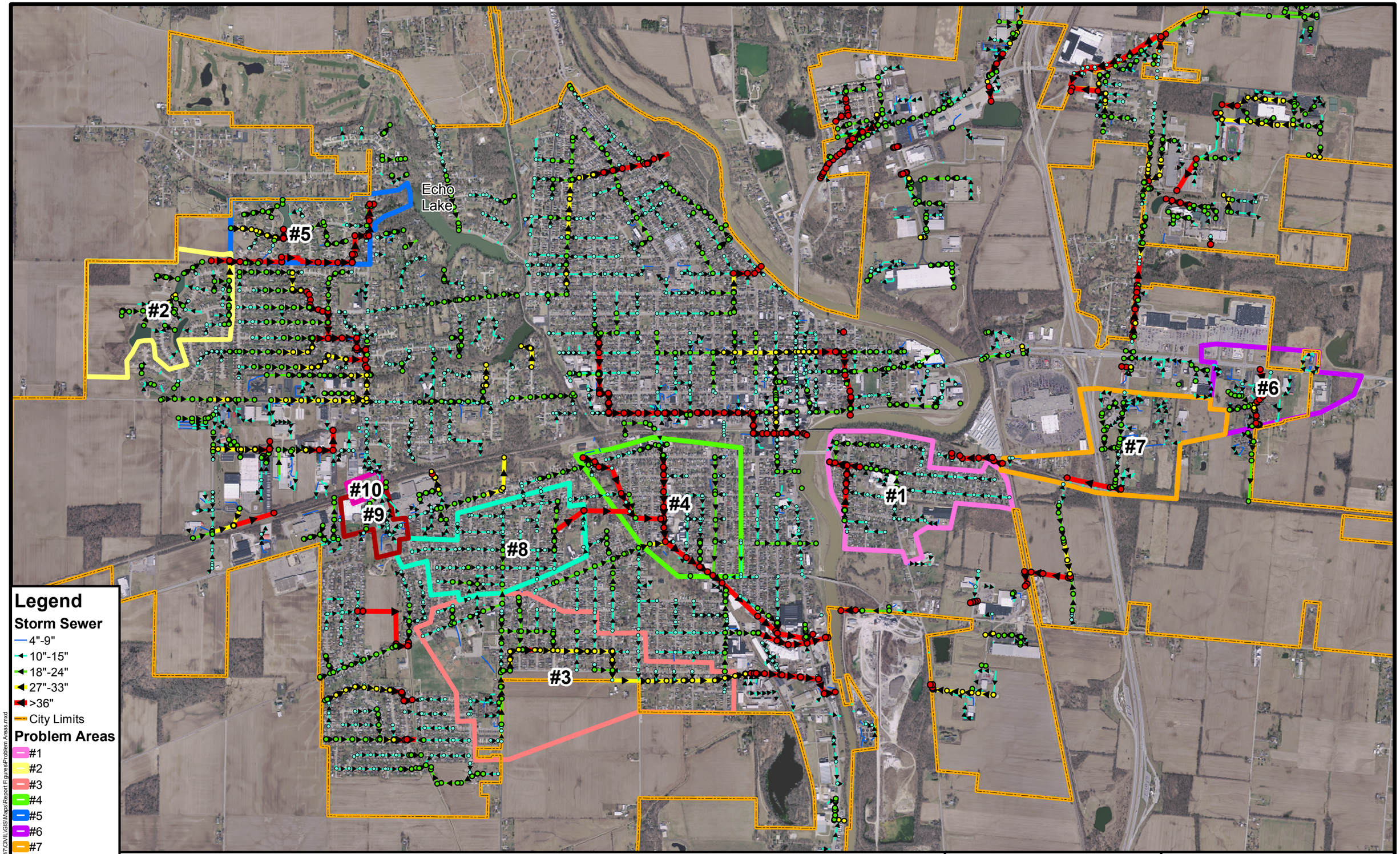
5.4 Stormwater Problem Areas

Stormwater problem areas were identified by City staff during interviews on May 8, 2013. The locations of these problem areas are shown on **Figure 5-3**. The following information was provided by City staff on each stormwater problem area:

- Area 1-Cleveland Street.
  - Siltation of storm sewers is a problem in the area. Cleaning of storm sewers and structures has been performed by City staff.
  - Staunton Street has been rebuilt.
  - Some shallow water mains (3 feet deep along Cleveland, Staunton and Bassett) and shallow bedrock are located in the area.
  - Large amounts of stormwater flow down the hill on First and Second Streets after a rain event. Surcharges of storm structures have been a problem at the bottom of this hill.
  - Severe flooding problems (up to doors on some cars) have occurred on Cleveland and other streets. Damage to cars and private property has resulted from this flooding.
  - The Shawnee Stormwater Pump Station cannot keep up with flows. The pump station has two, Flygt, 60 Hp, submersible pumps rated at 5,000 gpm each at 28 feet TDH. The capacity of the inlet pipe may be an issue. The discharge pipe may also be undersized. The pump station intakes can clog with debris and this plugging may remain undetected. The pump station outfall is deteriorated and the river bank at this location is eroded.

Shawnee Stormwater Pump Station

- The City needs to know the best way to operate the Shawnee Pump Station.
- A new SCADA package has been developed to monitor the pump station by Rawdon and Meyers (using the Pumpview system).



Piqua Stormwater Master Plan

Figure 5-3: Problem Areas

- Area 2-Deerfield Subdivision (see Deerfield/Eagles Nest Subdivision Letter Report, October, 2013)
  - Dry detention basin does not work as designed.
  - Residents complain about farm fields draining onto their property.
  - Western Ditch of Echo Lake has significant erosion problems that contribute to sedimentation in Echo Lake.

Western Ditch of Echo Lake Erosion Problem

- Area 3-Manier Ditch Area (Manier Street and Fields to the West)
  - Field tile drainage from the agricultural land to the west enters the Manier Street area. These flows exceed the conveyance capacity of culverts and storm sewers and causes flooding.
  - A storm sewer runs directly beneath the culvert. The agricultural land drains through the culvert that empties into a catch basin. Once the storm sewer and catch basin reach capacity, excess flow travels down the alley for multiple blocks before it can be captured by additional catch basins.

Roadway Culvert and Ditch, Manier Ditch Area

- Area 4-Commercial Street/Roosevelt Street (and other streets between College on the west and Route 25A on the east)
  - This area is underserved by storm sewers and catch basins.
  - Some storm sewers may have collapsed in the area.
  - Street and yard flooding is a problem.
  - The drainage runs toward the old Railroad.
- Area 5-Eagles Lake/Colleen/Coronada (see Deerfield/Eagles Nest Subdivision Letter Report, October, 2013)
  - Some storm sewers built in the 1990s were not shown on the previous GIS map. Storm sewer outside the City limits are not mapped.
  - An update of the stormwater GIS is needed for this area.
  - A portion of this development drains directly into the Western Ditch of Echo Lake without any detention. These peak flows are creating an erosion problem in the ditch.
- Area 6-Harley Davidson/US 36/Garbry Road
  - Flooding of parking lots occurred at Heartland of Piqua.
  - A 12-inch storm sewer upstream of Heartland was previously cleaned by the City in response to upstream flooding problems. The problem appears to have moved downstream causing flooding of parking lots at Heartland of Piqua.

- A 2-foot x 2-foot box culvert under U.S. 36 has a lower invert elevation than nearby 36-inch storm sewer which is receiving some of the discharge. The City is looking at options to modify the 2-foot x 2-foot box culvert and other nearby storm sewers to resolve this problem.
- A County tile drains some of this area.

Flooding Problem at Heartland of Piqua

- Area 7-North of Patrizio/South of Garbry, East of I-75
  - Flooding problems are located south of Garbry and north of Patrizio.
  - A concrete junction structure with diagonal bars receives flow from the County tile and ditch system and the City storm sewer system.
  - A County ditch runs parallel to Patrizio.
  - The 48-inch culvert under I-75 may be undersized and requires further study.

Concrete Junction Structure
Receiving Tile and Ditch Drainage

- Area 8-Gordon/Ellerman/Grant Streets
  - Storm sewers in this area are not shown on the current GIS map.
  - An update of the stormwater GIS is needed for this area.
- Area 9-Sunset Area
  - This area is subject to flooding.
  - The storm sewer serving this area may be undersized and requires further study.
- Area 10-The Path Near Propeller Street
  - Rusty red water is boiling out of ground next to an old railroad track. The City cannot find the source of this water and/or make repairs.
  - A County tile may be located in this area and partly responsible for the problem. A railroad tile may also be located in the area.

5.5 Storm Drainage Questionnaire Results

A stormwater questionnaire was distributed to City sanitary/stormwater customers between May 20 and June 10, 2013. The purpose of this questionnaire was to obtain further information on the location and type of stormwater problems being experienced in the City.

The questionnaire focused on street and yard flooding problems, the frequency and duration of the flooding, property damage caused by the flooding and the need for stormwater maintenance. A copy of the questionnaire and a summary of all those received is included in **Appendix D**.

Approximately 500 stormwater questionnaires were returned to the City. Out of this total, 333 questionnaires reported either flooding, stormwater damage or stormwater maintenance problems of some type. A summary of the 333 questionnaires is presented in **Appendix D**. **Figure 5-4** shows the locations of the reported problems. **Table 5-3** provides a listing of 23 reported basement and structure flooding problems. These problems are described and highlighted in the **Appendix D** summary. These problems are located throughout the City, although two problems were reported on Covington and seven problems were reported in the Cleveland Street vicinity east of the Miami River. It should be noted that given the open ended nature of the question on the questionnaire, several of the flooding occurrences listed were more than a decade ago, and none of them can be tied directly to a specific rainfall event. In other words, the flooding being reported may not be indicative of a current problem in the area. The areas of the City with the largest number of reported problems (shown on **Figure 5-4**) were as follows:

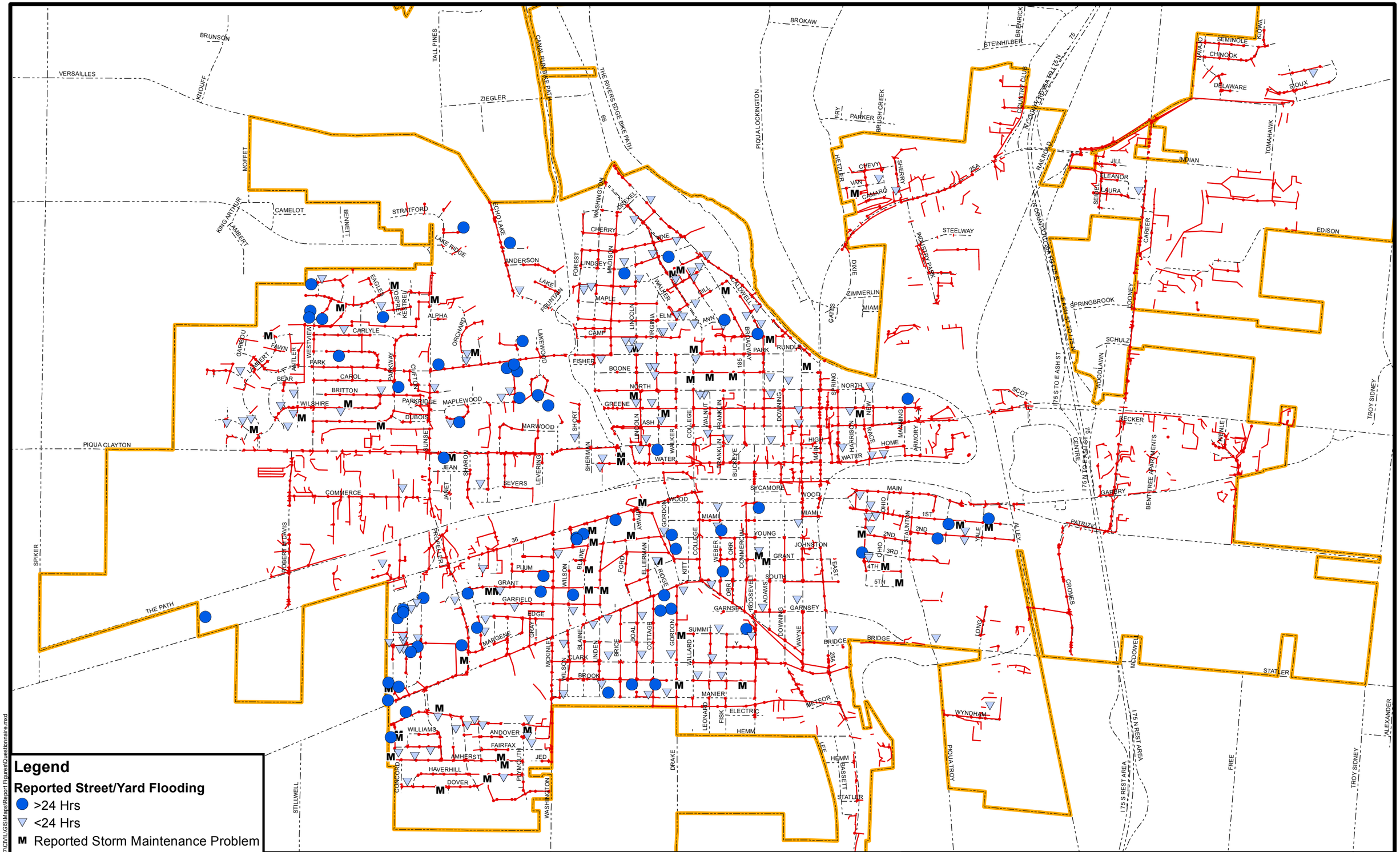
- Cleveland Street Area (First Street, Second Street, Cleveland Street)
- Deerfield/Eagles Nest Subdivision Area (Eagles Lake, Coronada)
- Propeller Street Area (Brentwood, Pinewood, Glenwood, Briarcliff, and Propeller)
- Lakewood Street Area (Lakewood, Hopewood, and Marymont)
- Blaine Street Area (Blaine, Wilson, Plum and Grant)
- Manier Street Area (Manier and Brook)
- Gordon Street Area (Gordon, Ridge)

Maintenance problems in the City that were reported on questionnaires appeared to be widely dispersed. However, a number of maintenance problems were concentrated on the following streets: Blaine, Boone and Grant.

Table 5-3: Basement or Structure Flooding Summary

	Address
1	609 (Street Not Given)
2	422 Brentwood
3	1017 Brook
4	934 Caldwell
5	1906 Carlyle
6	121 Cleveland
7	226 Cleveland
8	325 Cleveland
9	406 Cleveland
10	(Number Not Given) CLEVELAND
11	919 Covington
12	1900 Covington
13	502 Glenwood
14	636 Gordon
15	6 Greenbriar
16	19 Kestrel
17	8333 Lambert
18	226 Main
19	131 Morrow
20	306 Pinewood
21	421 Second
22	741 South
23	310 Weber

Other than the areas identified above, it is difficult to draw any specific conclusions from the questionnaires. The returned forms are from addresses all over the City, and there are no significant clusters of concerns that should be pursued outside of areas that are already known by the City. Several of the forms contain references to catch basins filling up with debris that then cause roadway, and possibly yard flooding. These structures should be reviewed in the field to ensure that catch basins remain free and clear to convey the runoff that is tributary to them.


Legend
Reported Street/Yard Flooding
>24 Hrs
<24 Hrs
Reported Storm Maintenance Problem
Storm Sewer
Manhole
City Limits
0 500 1,000 2,000 3,000 4,000
Feet
N
Prepared By
URS
City of PIQUA Ohio
Piqua Stormwater Master Plan
Figure 5-4: Questionnaire Results
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Section Six Hydraulic Model

6.0 Hydraulic Model

6.1 Model Methodology

The hydraulic model construction and calibration was performed utilizing the USEPA Stormwater Management Model (SWMM) Version 5.0.022. The SWMM5 model can simulate complex hydraulics that occurs in closed conduits, such as branched or looped networks, pressure flow, flow reversals, backwater, weirs, orifices, and storage. The SWMM5 model also allows for the dynamic representation of the hydraulic grade line and the viewing of hydraulic time series at any point within the modeled collection system for the duration of model simulation.

The model is currently intended as a master planning tool. GIS and model enhancement should be considered when using the model for project level planning and design.

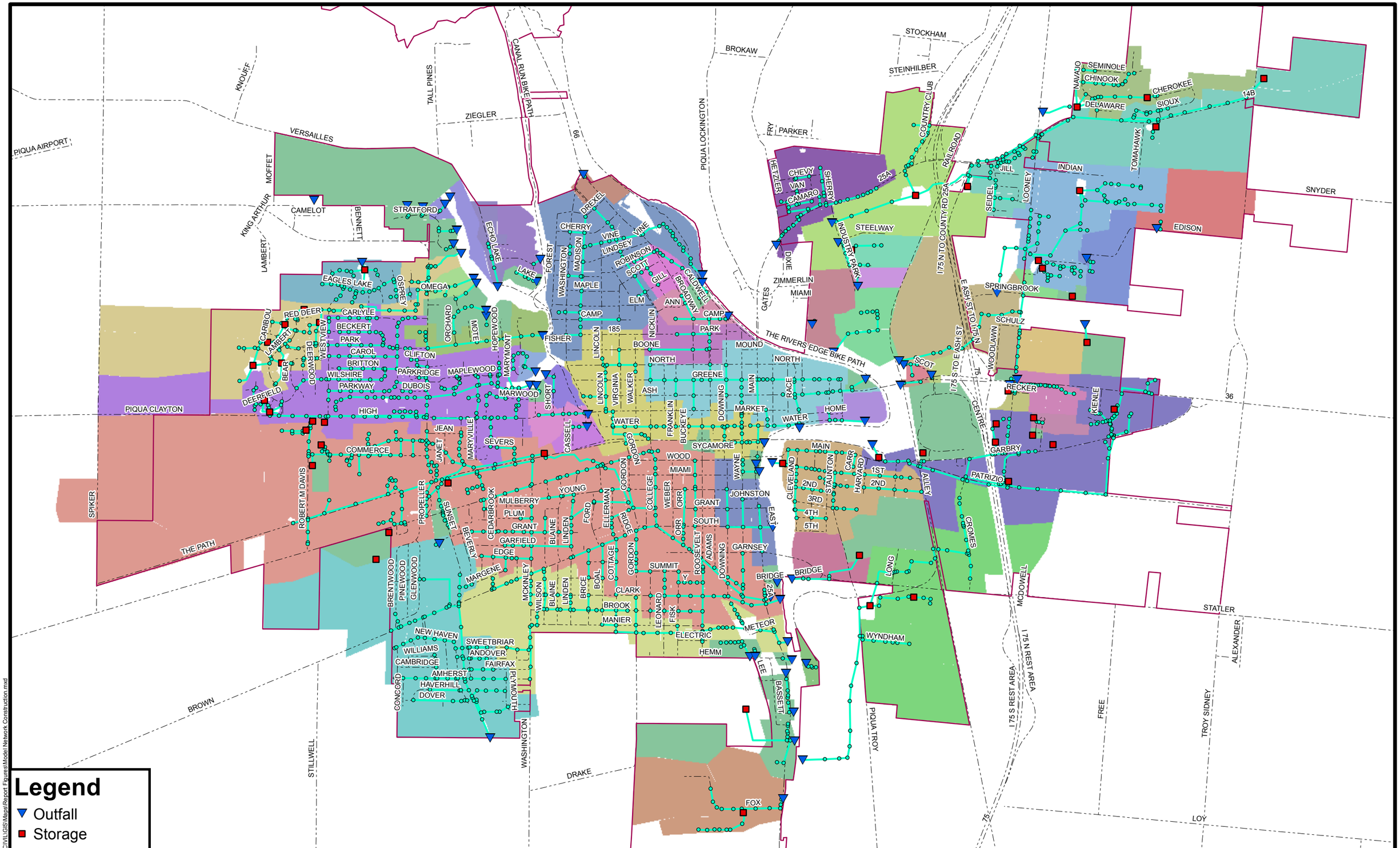
6.2 Model Network Construction

The original model scope was to include all sewers 18-inch diameter and larger in the model of the City's storm sewer system. However, smaller diameter storm sewers (down to 12 inches in diameter) were also modeled in all previously known or identified problem areas and smaller diameter sewers were also modeled in areas that were not served by sewers that were 18-inches or larger. **Figure 6-1** depicts modeled tributary basins and storm sewers.

Sewer attributes from the City's GIS were the primary source of information for model development. Sewer attributes from record plans (rim and invert elevations, pipe/channel shape, diameter, and roughness) and sewer tributary drainage areas, delineated based on GIS contours, were also used to develop the model.

In addition to using GIS, the City's field crew was utilized for field inspection. Site visits were also performed to confirm and complete missing data. As part of the model construction, new GIS shapefiles were created to represent:

- Drainage ditches
- Drainage tiles
- Wet and dry detention basins
- Impervious areas for both residential and non-residential buildings.
- Delineated areas for both individual catchments and the larger drainage basins associated with those catchments.


Legend
Outfall
Storage
Junction
Conduits
Drainage Basins
0 500 1,000 2,000 3,000 4,000
Feet
N
Prepared By
URS
City of PIQUA Ohio
Piqua Stormwater Master Plan
Figure 6-1: Model Network Construction
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PIQUA AIRPORT
KNOURF
TALL PINES
ZIEGLER
CANAL RUN BIKE PATH
VERSAILLES
MOFFET
KING ARTHUR
LAMBERT
CAMELOT
BENNETT
STRATFORD
ECHO LAKE
PIQUA CLAYTON
THE PATH
SPIKER
ROBERT M DAVIS
BROWN
STILLWELL
DRAKE
WASHINGTON
PIQUA LOCKINGTON
BROKAW
STOCKHAM
STEINHILBER
FRY
PARKER
COUNTRY CLUB
RAILROAD
HETZLER
CHEVY
VAN
CAMARO
SHERRY
25A
STEELWAY
INDUSTRY PARK
DIXIE
ZIMMERLIN
MIAMI
GATES
I75 N TO COUNTY RD 25A
E ASH ST TO I75 N
I75 S TO E ASH ST
THE RIVERS EDGE BIKE PATH
SEMINOLE
CHINOOK
NAVAJO
CHEROKEE
DELAWARE
SIOUX
14B
TOMAHAWK
SEIDEL
JILL
LOONEY
INDIAN
EDISON
SNYDER
SPRINGBROOK
SCHULZ
WOODLAWN
RECKER
KIENLE
GARBRY
PATRIZIO
ALLEY
CROMES
CENTRE
SCOT
36
75
WYNDHAM
LONG
MCDOWELL
STATLER
ALEXANDER
I 75 N REST AREA
I 75 S REST AREA
FREE
TROY SIDNEY
PIQUA TROY
LOY
FOX
BRIDGE
METEOR
ELECTRIC
HEMM
LEE
BASSETT
EAST
GARNSEY
SUMMIT
CLARK
BROOK
MANIER
MCKINLEY
WILSON
BLAINE
LINDEN
BRICE
BOAL
COTTAGE
LEONARD
FISK
ROOSEVELT
ADAMS
DOWNING
ORR
WEBER
COLLEGE
GORDON
RIDGE
ELLERMAN
FORD
YOUNG
MULBERRY
PLUM
GRANT
GARFIELD
EDGE
MARGENE
CEDARBROOK
SUNSET
BEVERLY
PROPELLER
BRENTWOOD
PINEWOOD
GLENWOOD
NEW HAVEN
WILLIAMS
CAMBRIDGE
AMHERST
HAVERHILL
DOVER
CONCORD
PLYMOUTH
SWEETBRIAR
ANDOVER
FAIRFAX
JOHNSTON
GRANT
SOUTH
WOOD
MIAMI
SYCAMORE
WATER
MARKET
HOME
MAIN
1ST
2ND
3RD
4TH
5TH
CLEVELAND
STAUNTON
CARR
HARVARD
WAYNE
DOWNING
RACE
GREENE
NORTH
BOONE
MOUND
PARK
CAMP
ANN
ELM
GILL
SCOTT
ROBINSON
LINDSEY
VINE
CHERRY
DREXEL
MADISON
MAPLE
WASHINGTON
FOREST
LAKE
FISHER
185
LINCOLN
NICKLIN
BROADWAY
CALDWELL
VIRGINIA
WALKER
ASH
FRANKLIN
BUCKEYE
CASSELL
SHORT
MARYWOOD
MARYMONT
HOPEWOOD
WOLTER
ORCHARD
OSBORN
OMEGA
EAGLES LAKE
RED DEER
CARLYLE
BECKERT
PARK
CAROL
BRITTON
WILSHIRE
PARKWAY
CLIFTON
PARKRIDGE
MAPLEWOOD
DUBOIS
HIGH
JEAN
JANET
MARYVILLE
SEVERS
COMMERCE
CARIBOU
LAMBERT
BEAR
DEERWOOD
WESTVIEW
DEERFIELD

6.3 Watershed Drainage Data

GIS topographic mapping provided by the City was used to delineate watershed drainage boundaries and catchments. This topography included 2-foot contours, considered land use and the layout of the stormwater conveyance system. For each catchment, the average slope, flow width and percentage of imperviousness are calculated for use in the model, as well creating shapefiles for future use. Catchment sizes were decreased within the known problem areas (such as the Deerfield Subdivision Area) to increase the resolution of the model within these areas.

Open channel cross-section geometry was also obtained from the topographic mapping where necessary to model the open channel conveyance network. Water levels in waterways can influence surcharging and flooding in the storm sewer system. Therefore, many of the waterways within the City (i.e., ditches, streams, and rivers) were incorporated into the model with corresponding cross-sections and approximated water levels.

6.4 Detention Basin Data

Approximately 43 privately owned detention basins have been constructed in the City. Many of these basins are very small and record drawings of some basins are not available. GIS data was reviewed and field survey was used to create the following feature data that was entered into the model:

- Size, invert, and configuration of outlet control structure.
- Stage storage curve.

Most of the information utilized within the model for the detention basins was previously summarized in **Table 5-2**.

6.5 Rainfall and River Flood Level Data

The Rainfall Frequency Atlas of the Midwest, which is also known as Bulletin 71, (Floyd A. Huff and James R. Angel) was used to determine total rainfall amounts for different design storms, which are summarized in **Table 6-1**. Copies of a portion of Bulletin 71 are included in **Appendix E** highlighting Piqua's location within the data. The rainfall values were combined with the Soil Conservation Service (SCS) Type II rainfall distribution for the runoff calculations.

Table 6-1: Total Rainfall for Different Return Period Storms[1]

	Total Rain (in)		
	24 hr	6 hr	2 hr
1 year	2.15	1.61	1.25
2 year	2.69	2.02	1.56
5 year	3.34	2.50	1.94
10 year	3.80	2.85	2.20
25 year	4.46	3.35	2.59
50 year	5.06	3.80	2.93
100 year	5.70	4.27	3.31

[1] Rainfall Frequency Atlas of the Midwest, Huff and Angel, 1992.

6.6 Model Quality Assurance/Quality Control (QA/QC)

After establishing the model, the input data was subjected to a QA/QC procedure. This procedure included verifying that manhole and sewer elevations and attributes were properly represented in the model from the record drawings, and confirming consistency between upstream and downstream manholes and sewer attributes. Sewer model attributes included rim and invert elevations, pipe/channel shape, diameter, and roughness.

The City Underground Utility crew was given areas throughout the City to investigate as part of the QA/QC process. The crew evaluated connectivity issues and missing data within the model and GIS system. The findings provided further insight into the storm sewer system and helped to improve the model. The typical issues that the crew had to investigate were areas within the GIS that had missing sewers and no obvious outlet to the sewer system.

Additional detail was utilized for the modeling of the detention basins in the Deerfield Subdivision. Surveying was conducted on two dry basins to obtain accurate sizing of the basins to be incorporated into the model.

6.7 Field Observations and Model Adjustments

In this phase, observations from the field were used to adjust the model. Field visits during two storm events and documented flooding and storm runoff in different parts of the City were used to adjust model results. Adjustments could only be performed in portions of the City were observations were taken. One area of the City where known flooding occurs is along US-36 east of Kienle. In this location both road side ditches flow into a 12-inch sewer which flows to the south. This sewer is unable to keep up with the demand of a large storm event and will surcharge to over six feet before the flows is redirected to a 36-inch sewer.

The model was also validated by using City identified problem areas and results of the resident responses to questionnaires.

Parameters used to adjust the model included infiltration parameters, catchment width, Manning's coefficient and catchment depression storage (volume of water that is held within the catchment before runoff begins to occur).

Since no flow monitoring data or depth of flow data are available for the storm sewer system, the collection of such data in the future is recommended to continue to validate and verify the model.

6.8 Modeling Results

Multiple design storms were utilized to determine the capacity of the existing storm sewer system within the City. The design storms utilized include the 2-year, 5-year and 10-year events. The current City design standards (described in Section 3.2.1) requires that the 5-year design storm be contained within the pipe and the 25-year event is not to cause ponding at catch basins and manholes. The 25-year design storm was not run for two reasons:

- Most of the existing storm sewer system was designed and constructed prior to the current regulations and should not be expected to meet current design standards without modification.
- Based on the results described below, flooding concerns during smaller design storms show that the 25-year event would cause widespread flooding and sewer surcharging conditions.

During the 2-year, 5-year, and 10-year design storms, the model results indicate that there are storm sewer structures throughout the City that are flooded. These results can be seen on **Figures 6-2** through **6-7** and in **Table 6-2**. **Figures 6-2**, **6-4** and **6-6** show the volume of stormwater that surcharges out of the structure. **Figures 6-3**, **6-5** and **6-7** show the duration in hours when a structure experiences surcharging outside of the structure. In **Table 6-2**, model results are summarized by hours surcharged, hours flooded and maximum volume flooded. Hours surcharged is the amount of time in which a structure experiences a depth beyond the capacity of the sewer pipe. Hours flooded is the amount of time in which a structure experiences a surcharged depth larger than the depth of the structure. The maximum volume flooded is the total volume that surcharges out of the structure. A typical surcharging duration is about 1-3 hours near the middle of a 24-hour storm event, which is when the most intense rain is predicted to be falling. The model has a total number of 1,631 nodes in the model.

Table 6-2: Model Results Summary

	Number of Model Nodes			Percentage of Model Nodes		
Hours Surcharged [1]	2-Year	5-Year	10-Year	2-Year	5-Year	10-Year
>1 Hr	461	616	715	28.3%	37.8%	43.8%
>4 Hrs	90	218	285	5.5%	13.4%	17.5%
>10 Hrs	12	48	73	0.7%	2.9%	4.5%
Hours Flooded [2]						
>1 Hr	204	321	392	12.5%	19.7%	24.0%
>4 Hrs	24	86	123	1.5%	5.3%	7.5%
>10 Hrs	5	10	29	0.3%	0.6%	1.8%
Volume Flooded [3]						
>0.01 MG	312	451	542	19.1%	27.7%	33.2%
>0.1 MG	81	154	226	5.0%	9.4%	13.9%
>1.0 MG	5	10	14	0.3%	0.6%	0.9%

[1] Total number of model nodes with surcharging greater than 1, 4 and 10 hours.

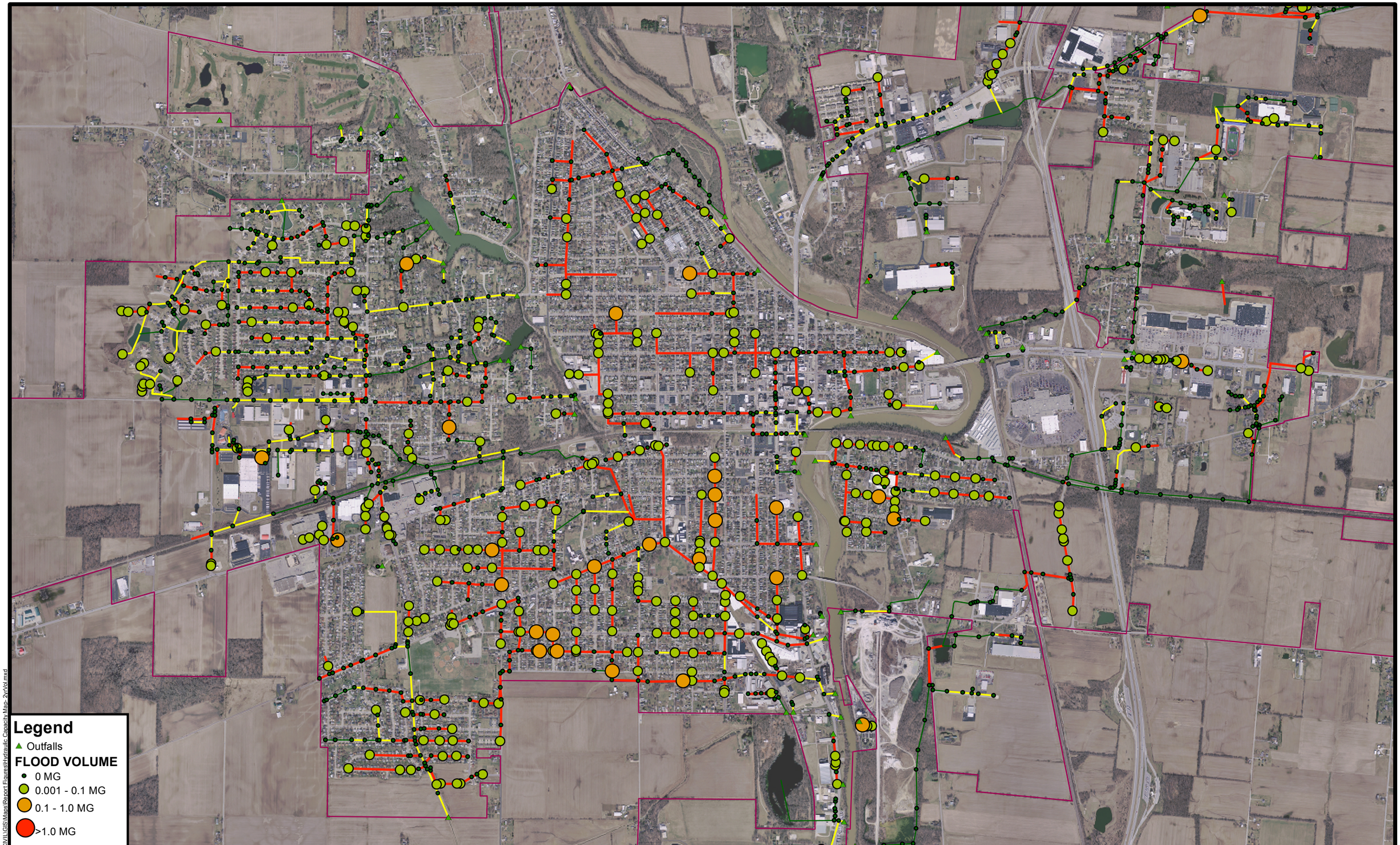
[2] Total number of model nodes with flooding greater than 1, 4 and 10 hours.

[3] Total number of model nodes with flooding volume greater that the quantity shown.

Table 6-2 show the following:

- 12% and 48% of the storm sewer system model nodes are **surcharged** for more than 10 hours by a 2 year and 5 year storm, respectively.
- 5% and 10% of the storm sewer system model nodes are **flooded** for more than 10 hours by a 2 year and 5 year storm, respectively.
- 5% and 10% of the storm sewer system model nodes have a flooding volume greater than 1.0 MGD by a 2 year and 5 year storm, respectively.

Much of the surcharging that is predicted by the model during the design storms is in the central, older part of the City. This is not unexpected since the older parts of the storm sewer system were not designed using current standards.



Prepared By URS

City of PIQUA Ohio

Piqua Stormwater Master Plan

Figure 6-2: 2-Year Event Model Results- Volume Flooded

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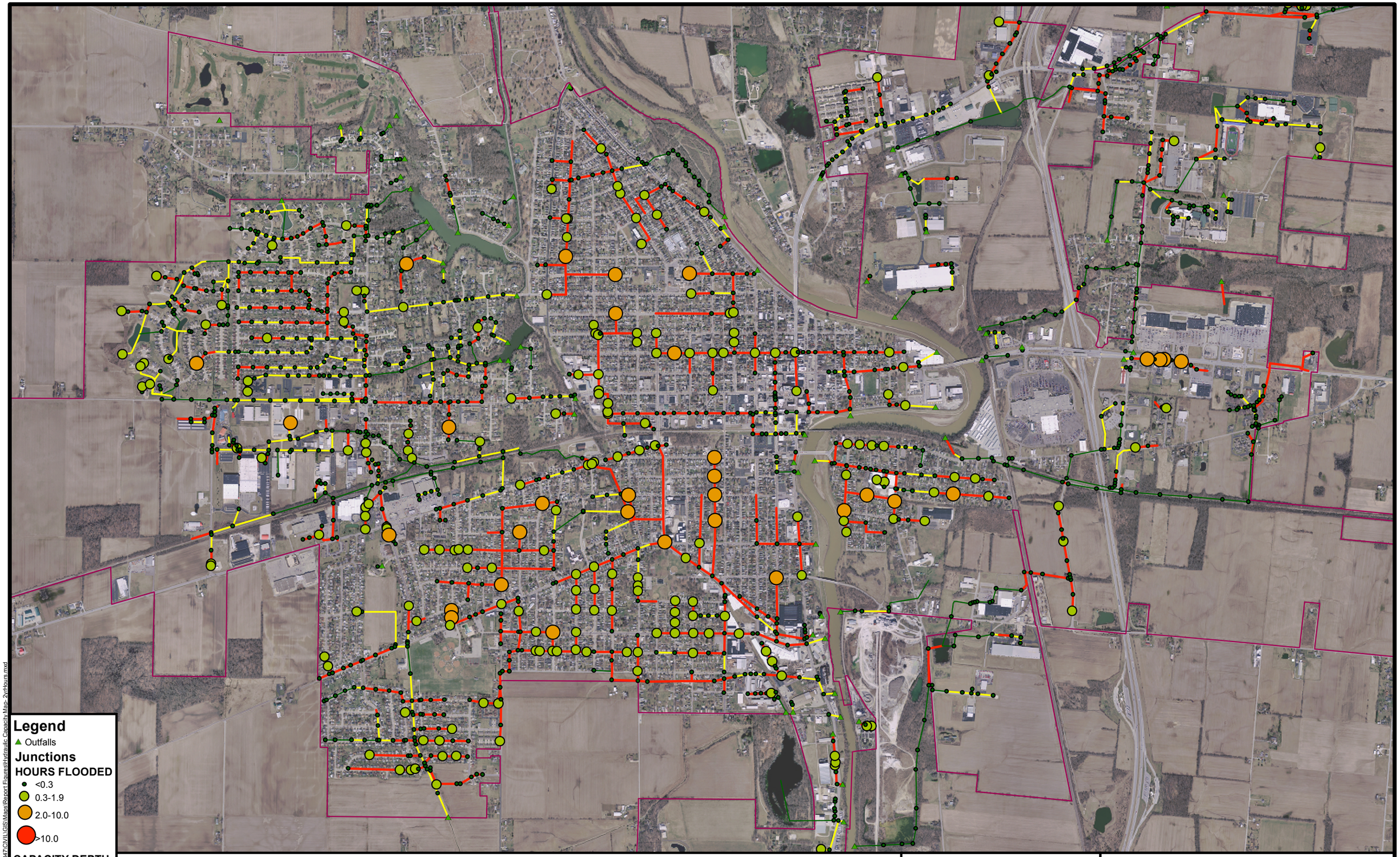
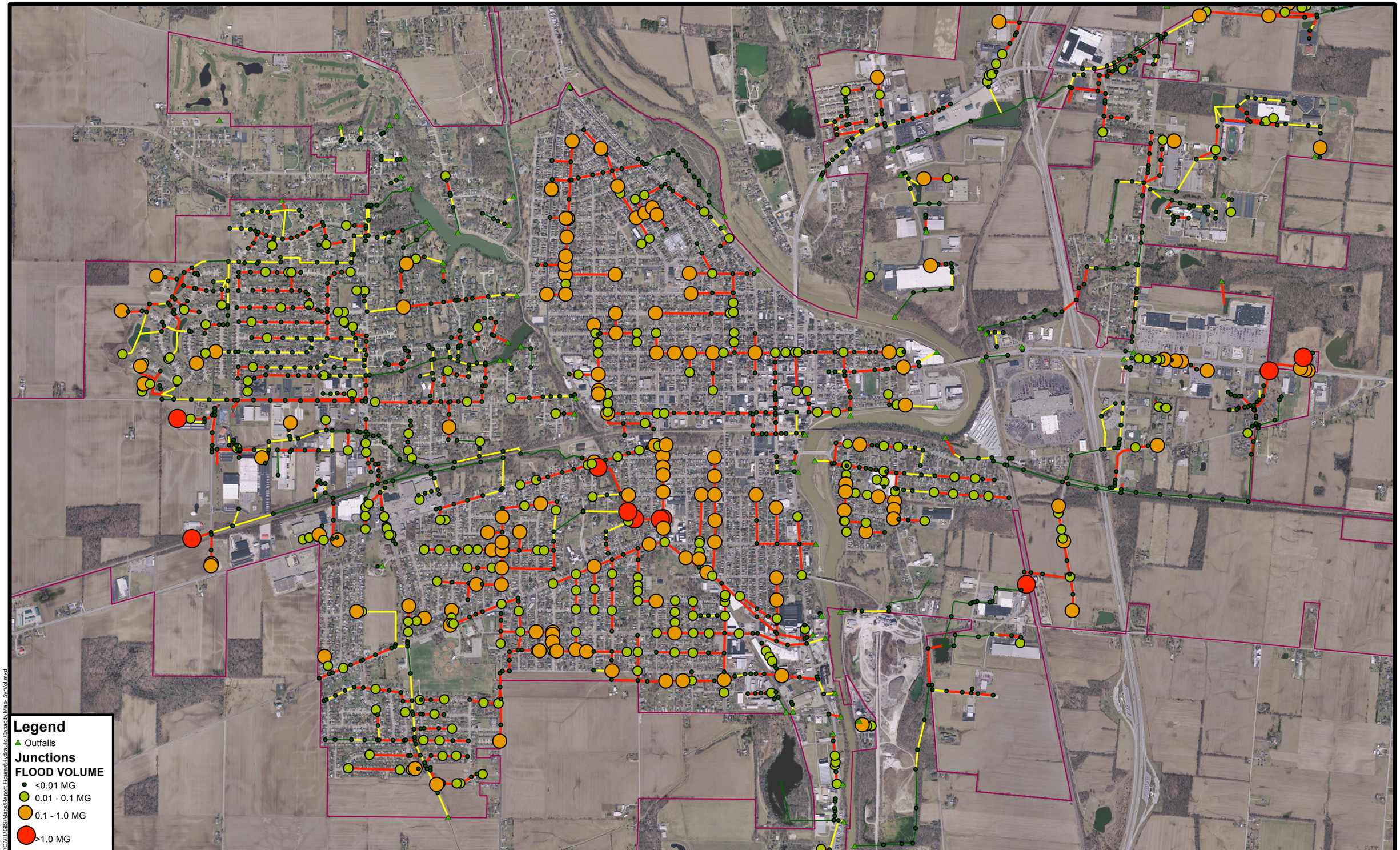


Piqua Stormwater Master Plan

Figure 6-3: 2-Year Event Model Results- Hours Flooded



Prepared By URS

City of PIQUA Ohio

Piqua Stormwater Master Plan

Figure 6-4: 5-Year Event Model Results- Volume Flooded

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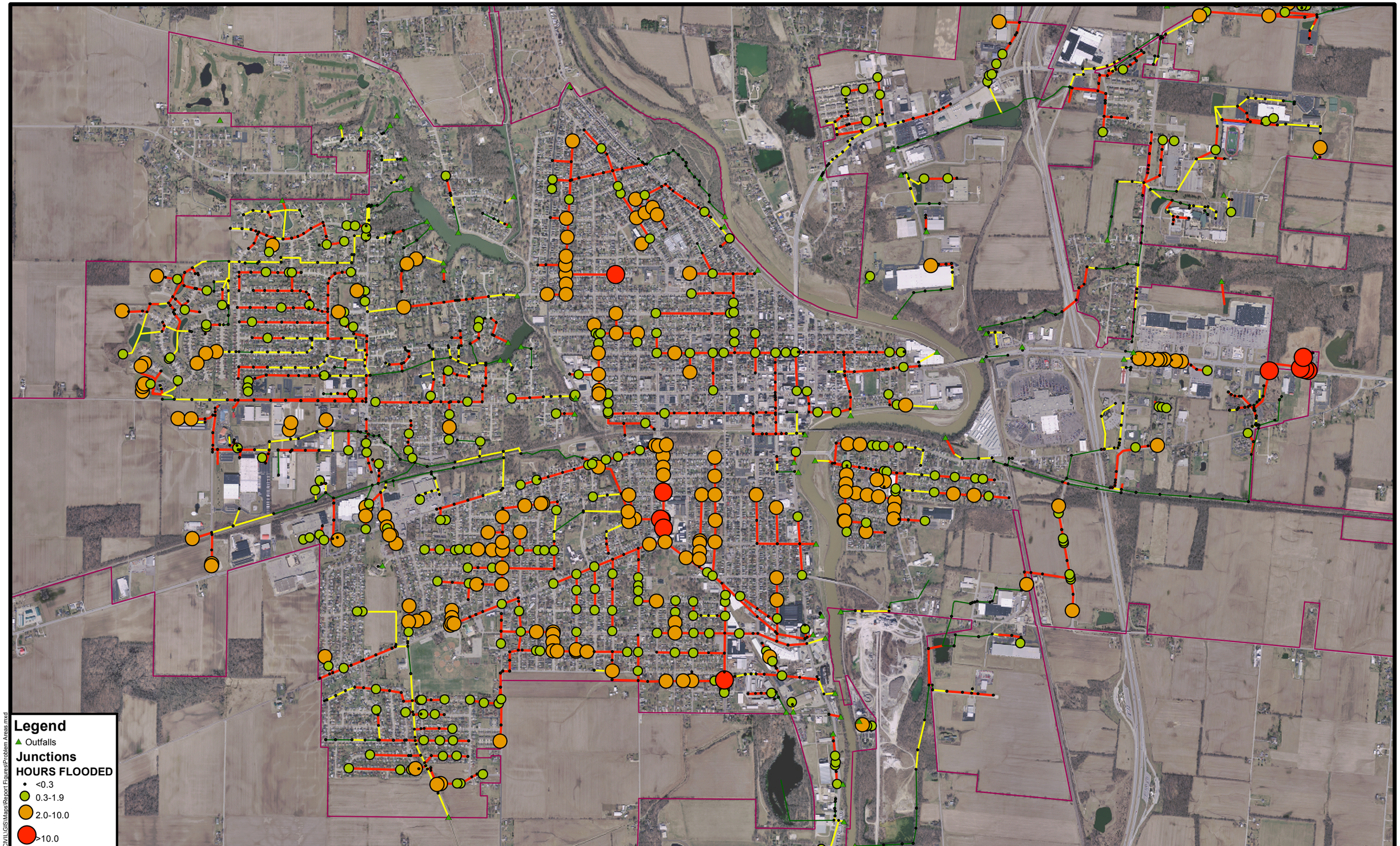

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City of PIQUA Ohio

Piqua Stormwater Master Plan

Figure 6-5: 5-Year Event Model Results- Hours Flooded

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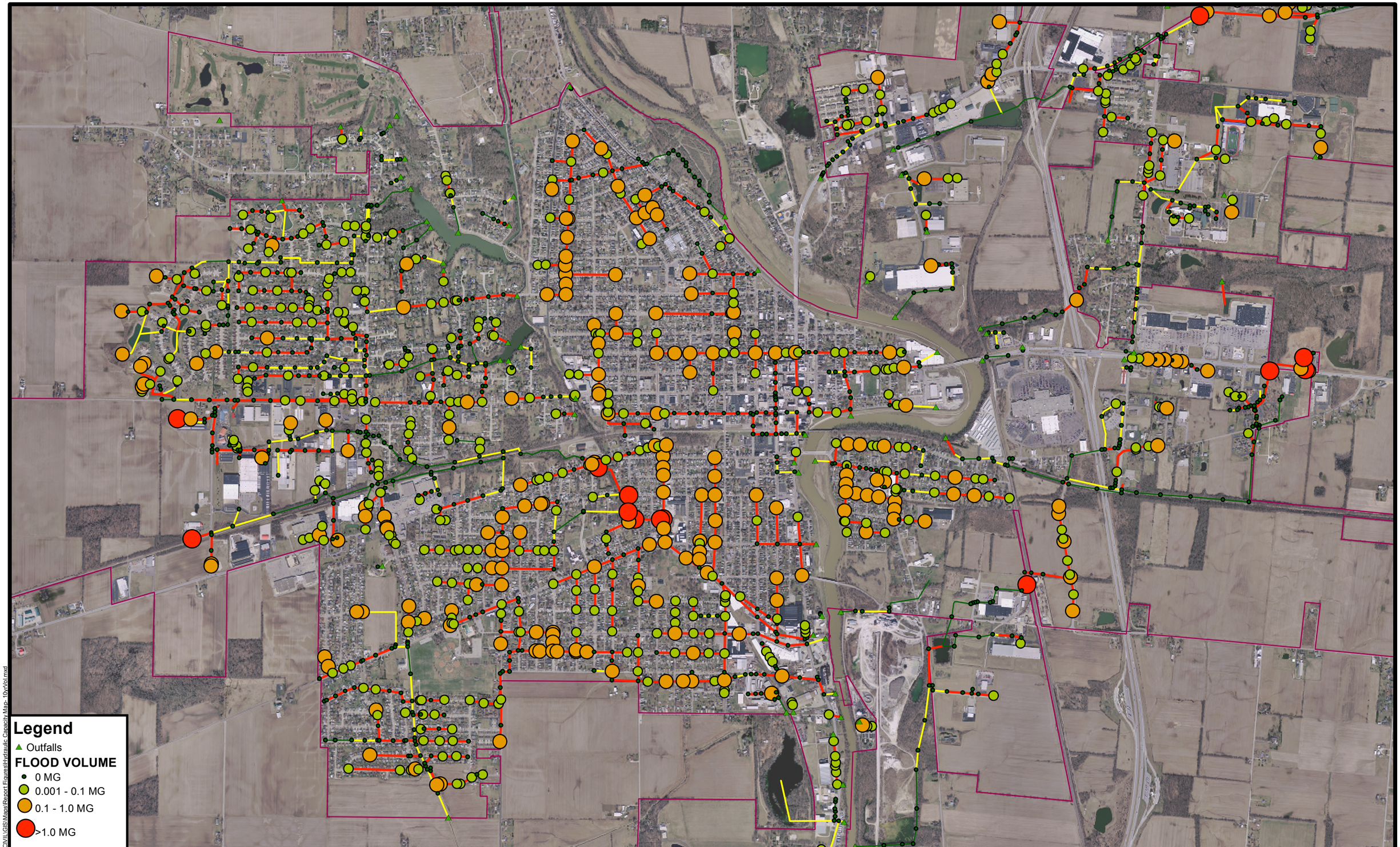

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Piqua Stormwater Master Plan

Figure 6-6: 10-Year Event Model Results- Volume Flooded

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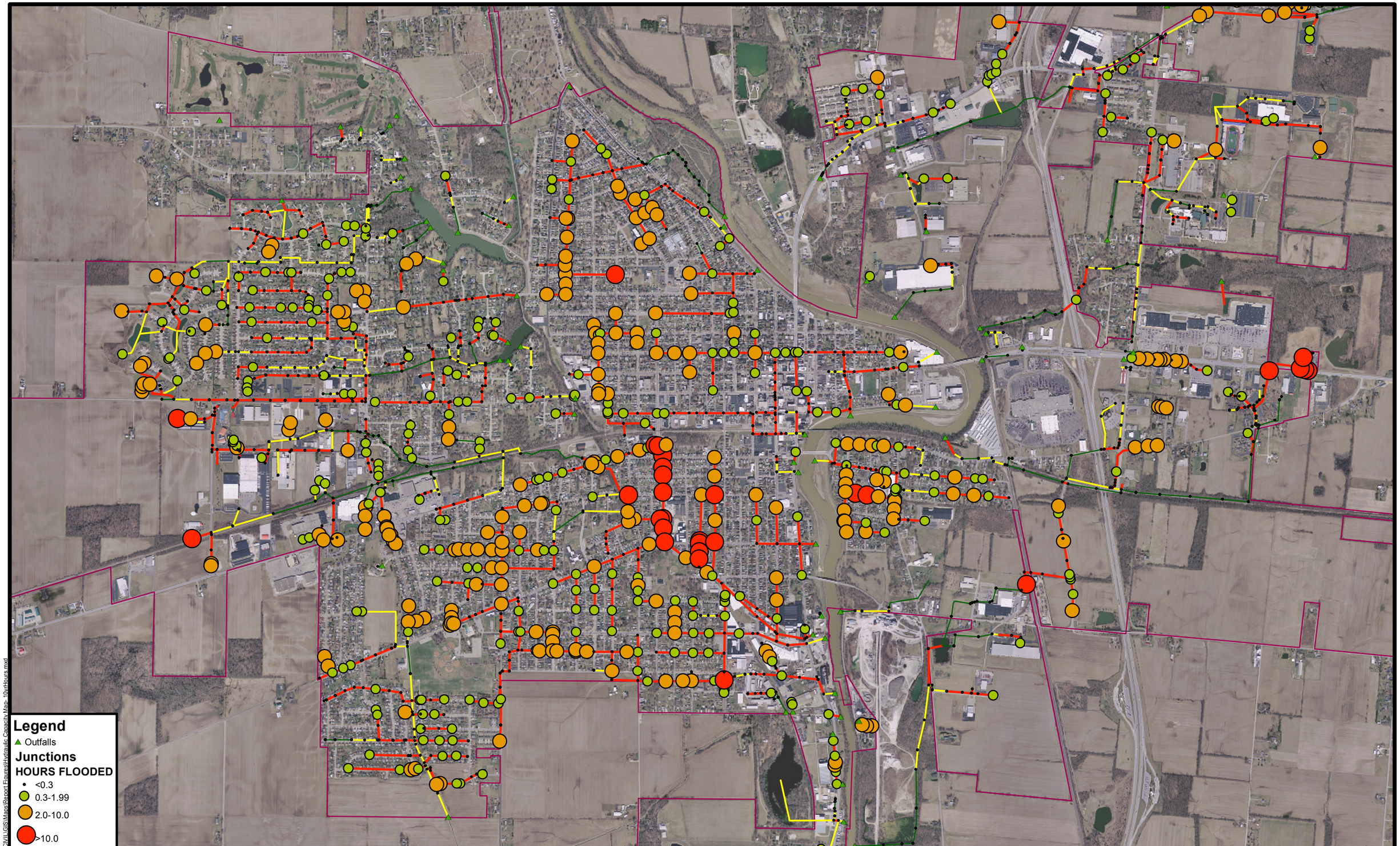

Prepared By URS

City of PIQUA Ohio

Piqua Stormwater Master Plan

Figure 6-7: 10-Year Event Model Results- Hours Flooded

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6.9 Hydraulic Capacity Assessment

As noted above, the existing storm sewer system is predicted to surcharge and flood during events as small as the 2-year storm, with significant surcharging and flooding predicted during the 5-year and 10-year storms. This indicates that much of the system is only providing sufficient hydraulic capacity for events smaller than the 2-year storm, and that much of the existing system does not meet current design standards. The capacity of the existing storm system is shown in **Appendix B**, which shows the progression of capacity from the 2-year to the 10-year event along eleven profile routes. **Figure B-1** in **Appendix B** shows the locations of these eleven profile routes along the storm sewer system.

The path of the profiles was chosen to highlight portions of the system that are either under capacity for the design storms (and therefore show flooding) or are the discharge location for identified problem areas, and frequently, the profile is for both. **Figure 6-8** shows a typical model profile generated by the model.

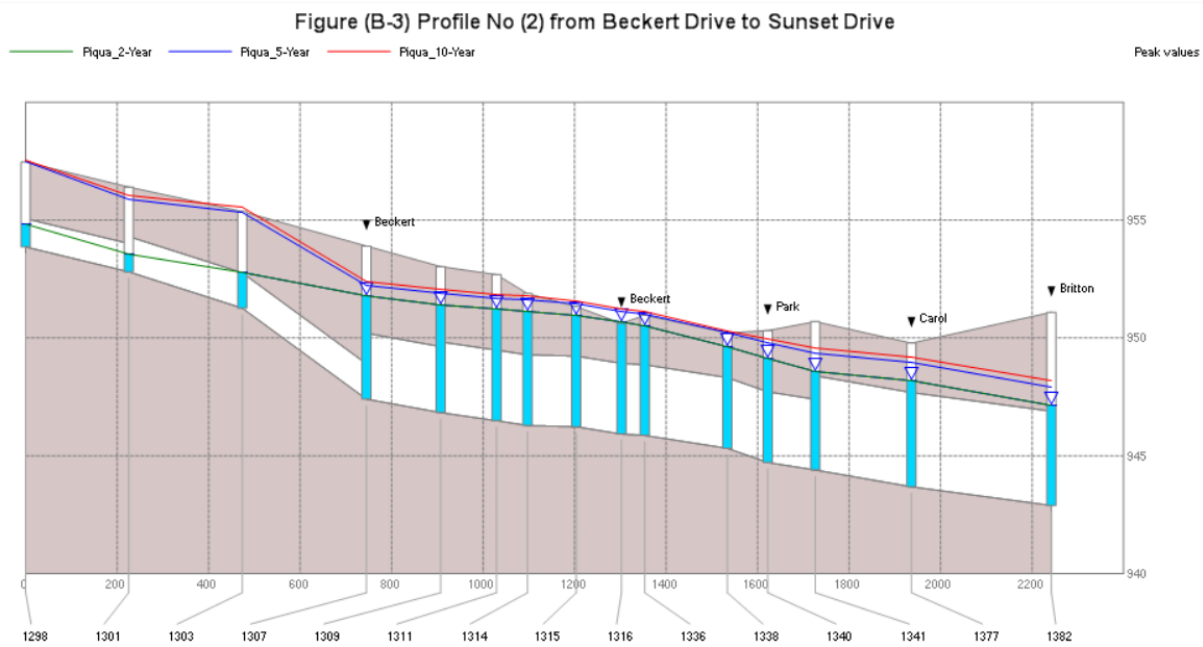


Figure 6-8: Typical Model Profile

6.10 Problem Area Analysis

Once the hydraulic capacity assessment was completed, an analysis of the problem areas began. By comparing the model results with the City's stormwater questionnaire results and the information obtained from City staff, a visual analysis was conducted to verify model results and an assessment was done to determine where problem areas within the City are

most prevalent. This evaluation is shown on **Figures 6-2** through **6-7**. In these figures, either flood volume or capacity depth is displayed.

A review of **Figures 6-2** and **6-7** and the hydraulic profiles in **Appendix B** shows that the much of the existing storm system begins to flood during the 2-year storm with much of the system not having sufficient capacity to convey the smallest design storm within the City's current design criteria, the 5-year event. Once the 10-year model results were reviewed it became apparent that the City's current criteria to have no flooding at manholes and catch basins during the 25-year event will not be attainable for most of the existing storm sewer system.

Section Seven Public Involvement/Public Outreach

7.0 Public Involvement/Public Outreach

7.1 Public Involvement Summary

Public involvement on the Stormwater SMP Phase 1 project has consisted of the following:

1. URS created a stormwater questionnaire that was mailed out to all sewer/stormwater customers by the City during May 20 through June 10, 2013. Approximately 500 questionnaire responses were received and tabulated and a stormwater problem map was created for the City using the results of these questionnaires. This map was placed on display at the Public Meeting as discussed below.
2. An open house public meeting was held at 201 West Water Street on October 16, 2013 from 4 to 6 p.m. The time and date of this public meeting was previously advertised by the City. The purpose of this meeting was to provide further information on the project to local residents and to respond to questions. A copy of the public meeting handouts and the attendance sheet at the meeting is presented in **Appendix F.** Maps on display at the public meeting included an updated stormwater system map for the City and a stormwater problem map created using the questionnaire responses. The Deerfield/Eagles Nest Subdivision Letter Report dated October 9, 2013 was also placed on display at the meeting.
3. A summary of the open house public meeting was published in the Piqua Daily Call on October 21, 2013. A copy of this newspaper article is presented in **Appendix F.**

Section Eight Conclusions and Recommendations

8.0 Conclusions and Recommendations

8.1 Conclusions

Ten stormwater problem areas were identified by City staff during interviews held on May 8, 2013. The locations of these problem areas are shown on **Figure 5-3**. A discussion of each problem area is presented in **Section 5.4**. Recommended projects for the Area 2-Deerfield Subdivision problem area were presented in the Deerfield/Eagles Nest Subdivision Stormwater Letter Report. The development of recommended projects for the other problem areas should be included in a Phase 2 SMP.

A stormwater questionnaire was distributed to City sanitary/stormwater customers between May 20 and June 10, 2013. Approximately 500 stormwater questionnaires were returned to the City. Out of this total, 333 questionnaires reported either flooding, stormwater damage or maintenance problems. A summary of these questionnaires is presented in **Appendix D**. **Figure 5-4** shows the locations of the reported problems. **Table 5-3** provides a listing of 23 reported basement and structure flooding problems. Follow ups on specific stormwater problems listed in the questionnaires should be addressed as part of the Phase 2 SMP.

Approximately 40 stormwater detention basins are located in the City and three are outside the City. Design data for these basins is presented in **Table 5-2** where such data are available. Basin locations are shown on **Figure 5-1**. The 43 detention basins are privately owned and maintained and were constructed for either subdivisions or commercial properties. Improvements to two of these detention basins were recommended in the Deerfield/Eagles Nest Subdivision Stormwater Letter Report. Field investigations and/or further study of all detention basins in the City are needed to determine maintenance needs and hydraulic performance.

Updated GIS shape files have been provided to the City by URS for the storm sewer system. A copy of these shape files is provided in **Appendix A**. The shape files were based on new data obtained during inspections of the storm sewer system by City staff and by field surveying. A listing of new and/or updated shape files provided is listed in **Section 4.1.** These updated shape files should be incorporated into the City's GIS mapping system. Updated maps of the storm sewer system are shown as **Figures 4-1 and 4-2.** The existing Miami County ditch and tile system is shown on **Figure 5-2.**

A hydraulic model of the Piqua storm sewer system was constructed and calibrated by URS utilizing the USEPA Stormwater Management Model (SWMM). A copy of this model is presented in **Appendix A**.

Model results indicate that during the 2-year, 5-year, and 10-year design storms, there are storm sewer structures throughout the City that are flooded. These results can be seen on **Figures 6-2** through **6-7** and in **Table 6-2**. **Figures 6-2**, **6-4** and **6-6** show the volume of stormwater that surcharges out of the structure. **Figures 6-3**, **6-5** and **6-7** show the duration in hours when structures are flooded.

In **Table 6-2**, model results are summarized by hours surcharged, hours flooded and maximum volume flooded. **Table 6-2** shows that 12% and 48% of the storm sewer system model nodes are surcharged for more than 10 hours (by a 2 year and 5 year storm), respectively.

Figure B-1 in **Appendix B** shows the locations of eleven profile routes along the storm sewer system. The path of the profiles was chosen to highlight portions of the storm sewer system that are either under capacity for the design storms or are near identified problem areas. Hydraulic grade lines of these profiles for the modeled design storms are shown in **Appendix B**.

8.2 Recommended GIS Improvements

During the preparation of the Phase 2-SMP, it is recommended that further information be collected and added to the City's GIS database. This information includes:

1. Field survey data on stormwater structures outside of the City limits but connected to the storm sewer system.
2. Field survey data on stormwater structures with missing attribute data that are located within the City limits.
3. Record plan information for any new civil engineering projects constructed by the City that include stormwater features.

This new GIS information can be used to update the storm sewer system model as discussed in Section 8.3.

8.3 Recommended Hydraulic Model Improvements

During the preparation of the Phase 2-SMP, it is recommended that further improvements be made to the storm sewer system model. This will allow the City to continue to refine the location and capacity of needed stormwater CIPs. Recommended stormwater model improvements include the following:

1. Add new GIS shape file data described in Section 8.2.
2. Continue to gather further information on stormwater flooding events. This information should include the location, extents and depth of localized flooding of streets and yards. Correlate the additional flooding data with rainfall data collected from the City's rain gage at the waste water treatment plant.
3. Continue to improve model by monitoring flow depths at specific locations throughout the stormwater system. This can be accomplished by installing and monitoring depth sensors at specific locations.
4. Expand and improve the model in stormwater problem areas by adding additional storm structures, refining catchment areas, and enhancing the simulation of surface detention at catch basins.

5. Collect additional data on open channel streams and ditches in the City. Model the open channel system in the City for the 25-year design storm.
6. Collect additional data on the existing detention basin outlet structures to ensure that the model accurately represents the conditions in the field.

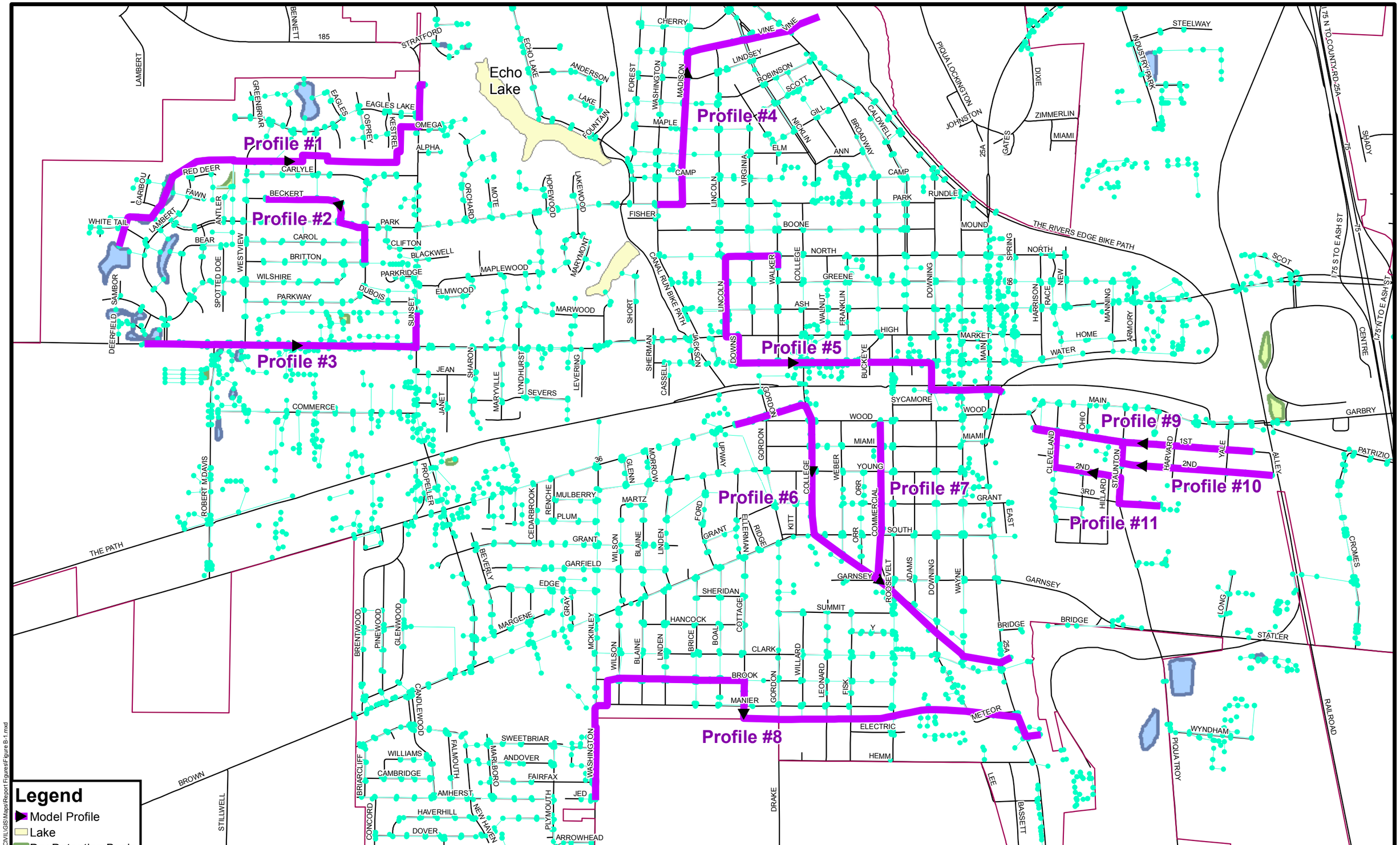
8.4 Recommended Phase 2 SMP

The preparation of a Phase 2 SMP is recommended. This Phase 2 plan would accomplish the following:

1. Evaluate alternatives for stormwater problem areas identified in the Phase 1 SMP. This will include problem areas identified by the City and problem areas found through the stormwater model results.
2. Refine and adjust the stormwater model prepared for the Phase 1 SMP. Use the model to evaluate stormwater problem areas in detail.
3. Develop a recommended, prioritized list of stormwater CIPs for the next 5-year period. The projects that would improve the quality of stormwater discharges and/or reduce the extent of street and yard flooding in the City.
4. Prepare a separate report to address the Shawnee Stormwater Pump Station and Cleveland Street problem area as requested by the City.
5. Evaluate the cost of the recommended stormwater projects and recommend adjustments to the stormwater utility to pay for future projects.

Appendix A GIS Shapefiles and SWMM Model

Appendix B Modeling Results (2013)



Piqua Stormwater Master Plan

Figure B-1: Model Profile Routes

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Figure (B-2) Profile No (1) from Whitetail Lane to Sunset Drive

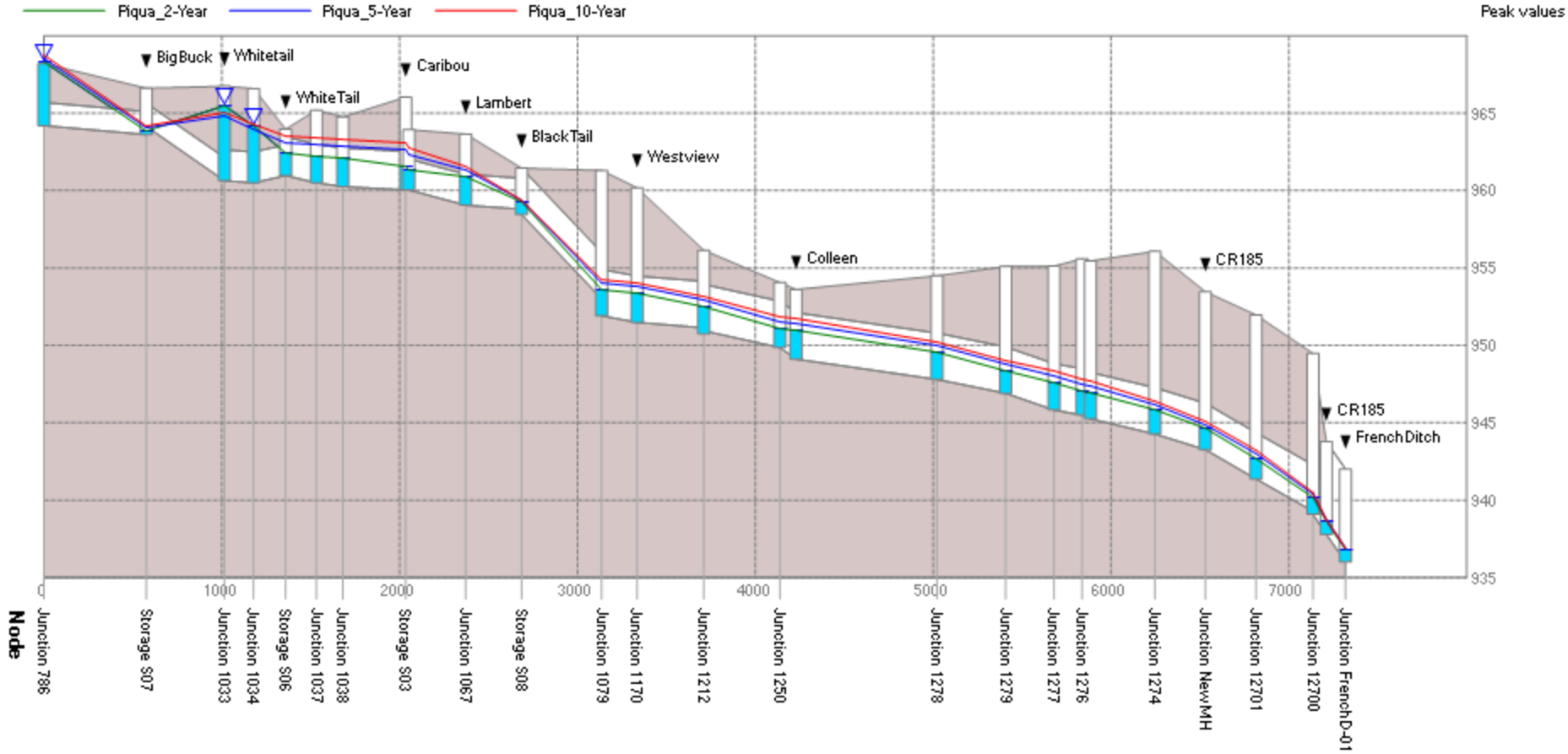


Figure (B-3) Profile No (2) from Beckert Drive to Sunset Drive

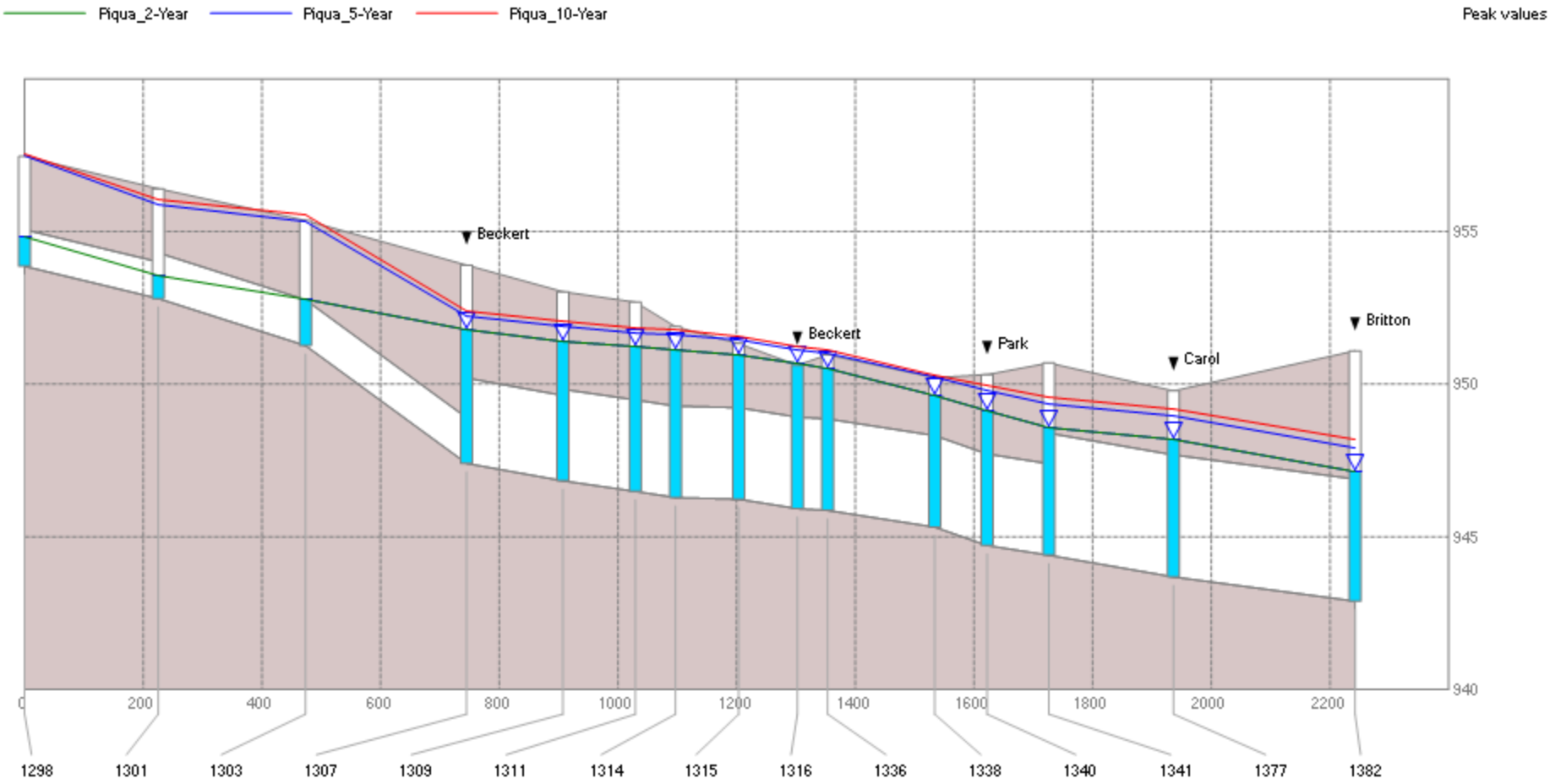


Figure (B-4) Profile No (3) from High Street to Drive

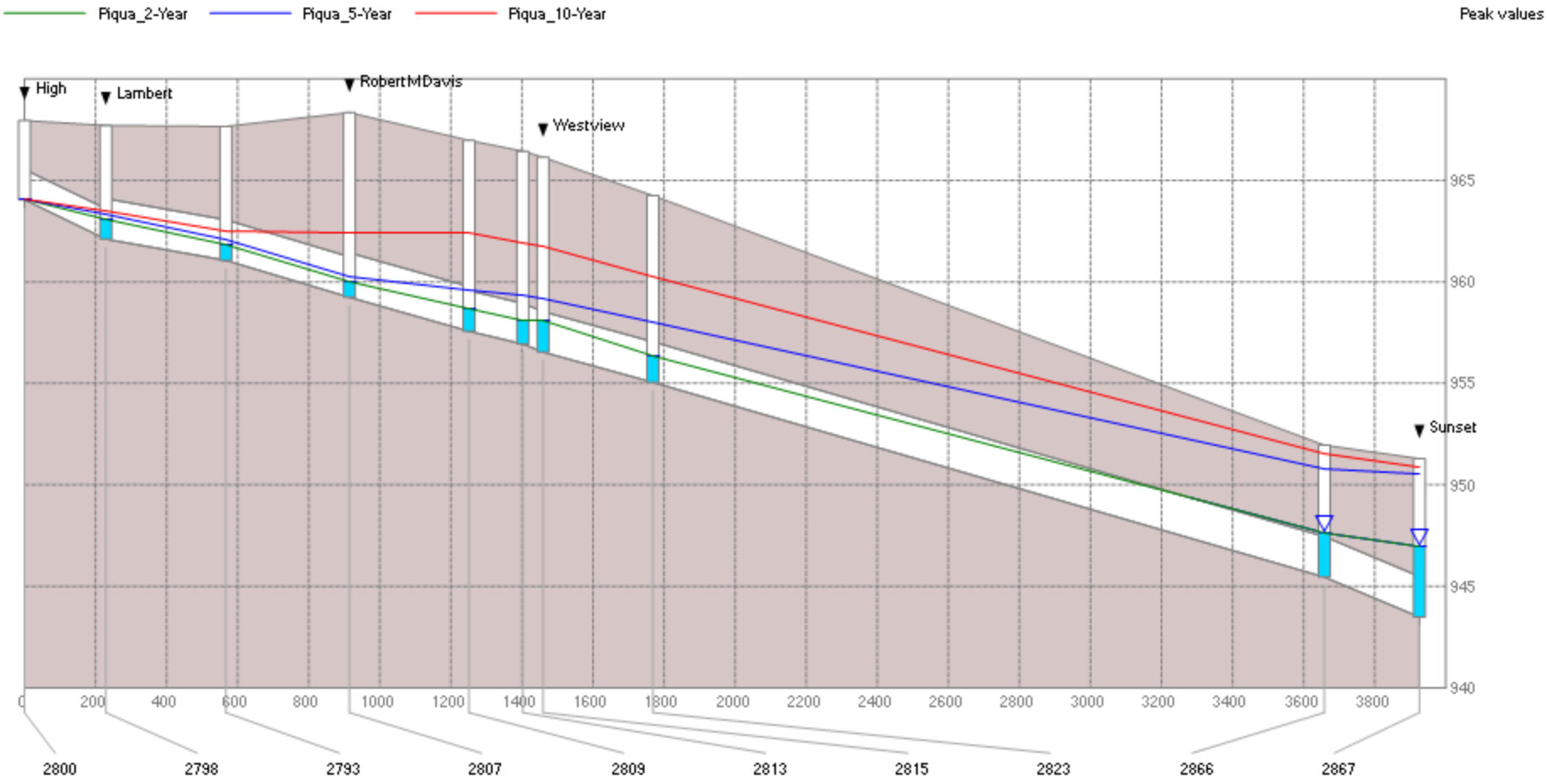


Figure (B-5) Profile No (4) from Park Avenue to Vine

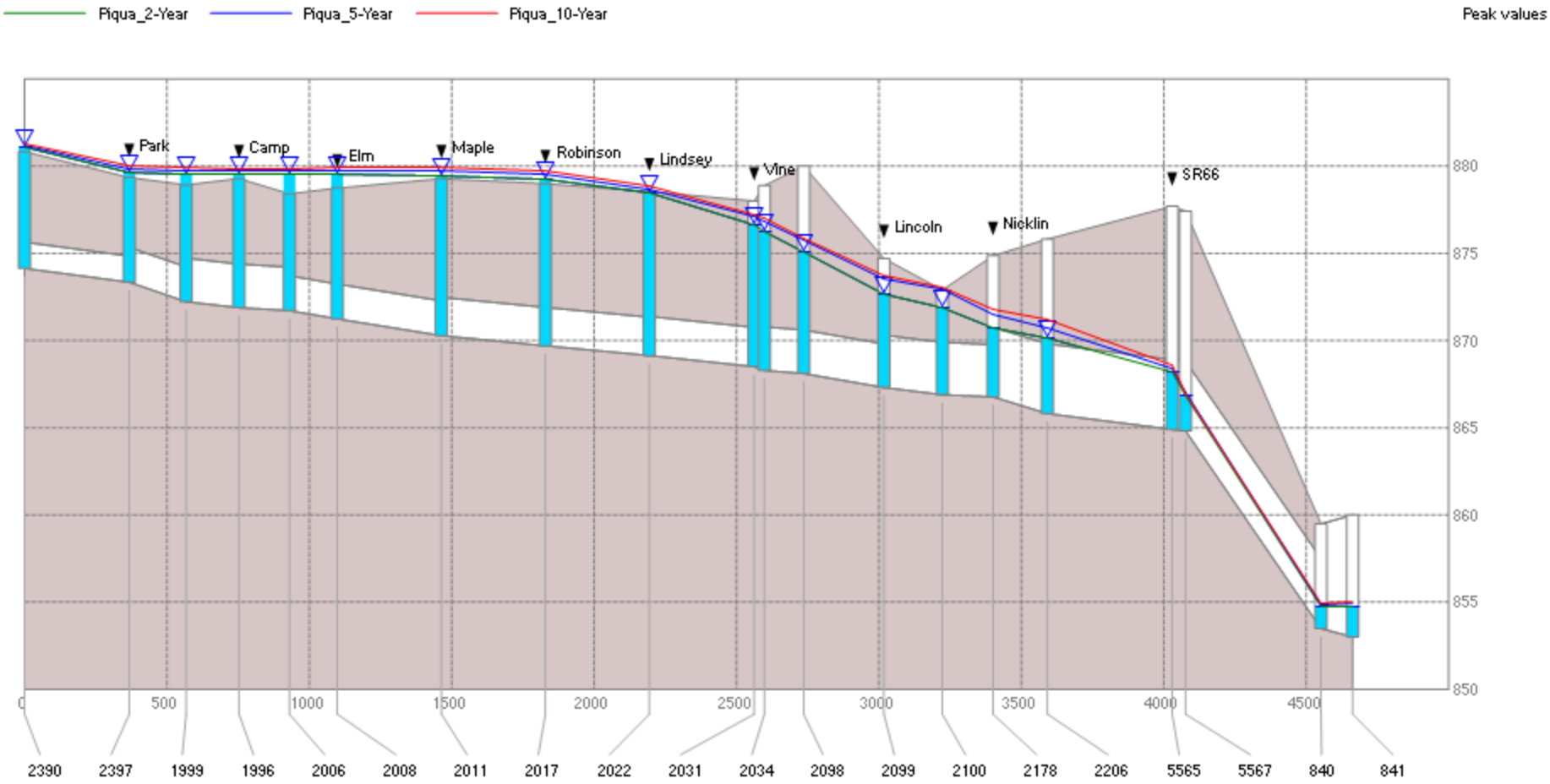


Figure (B-6) Profile No (5) from North Street to CR-25A

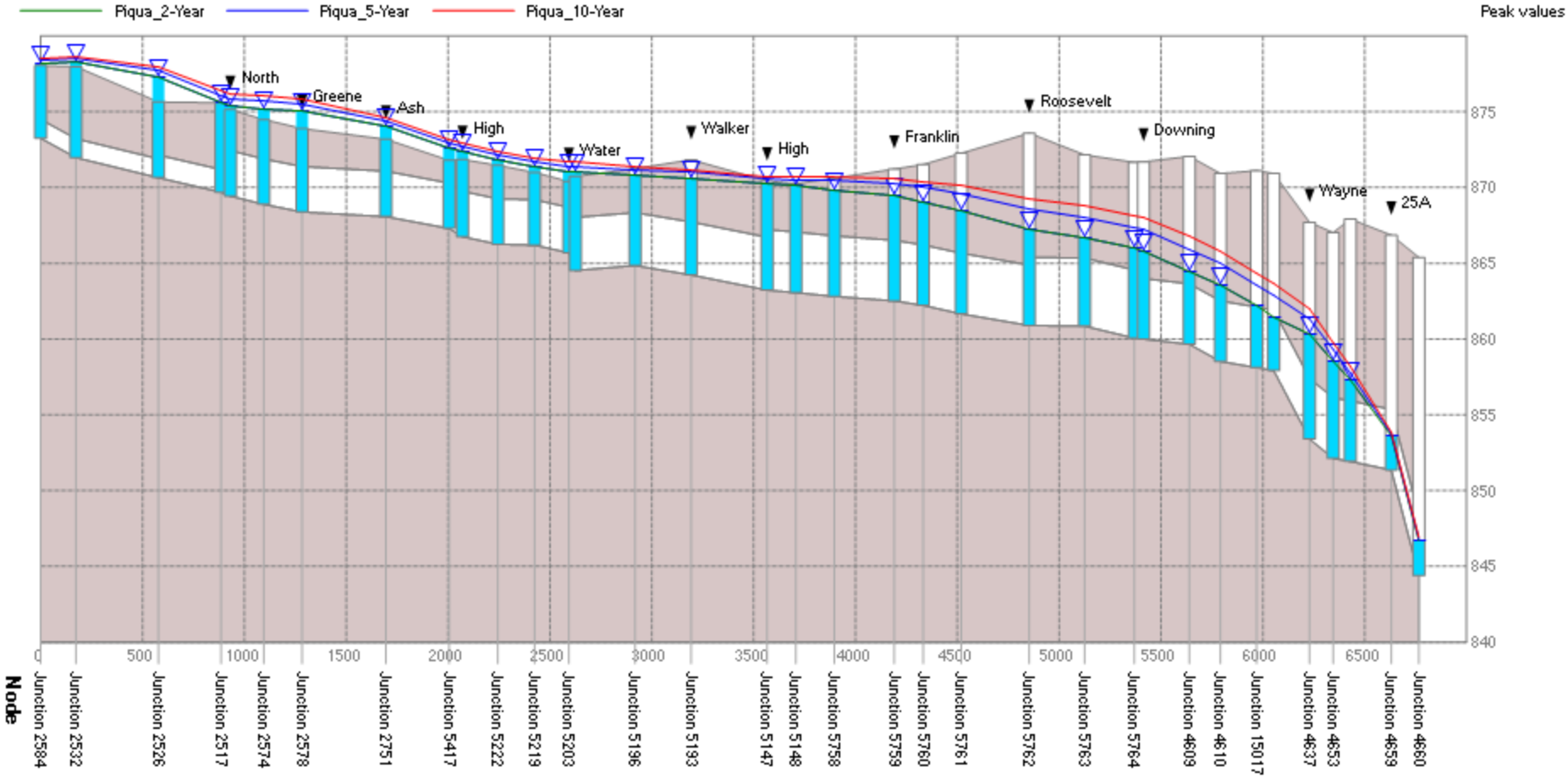


Figure (B-7) Profile No (6) from US-36 to South Street

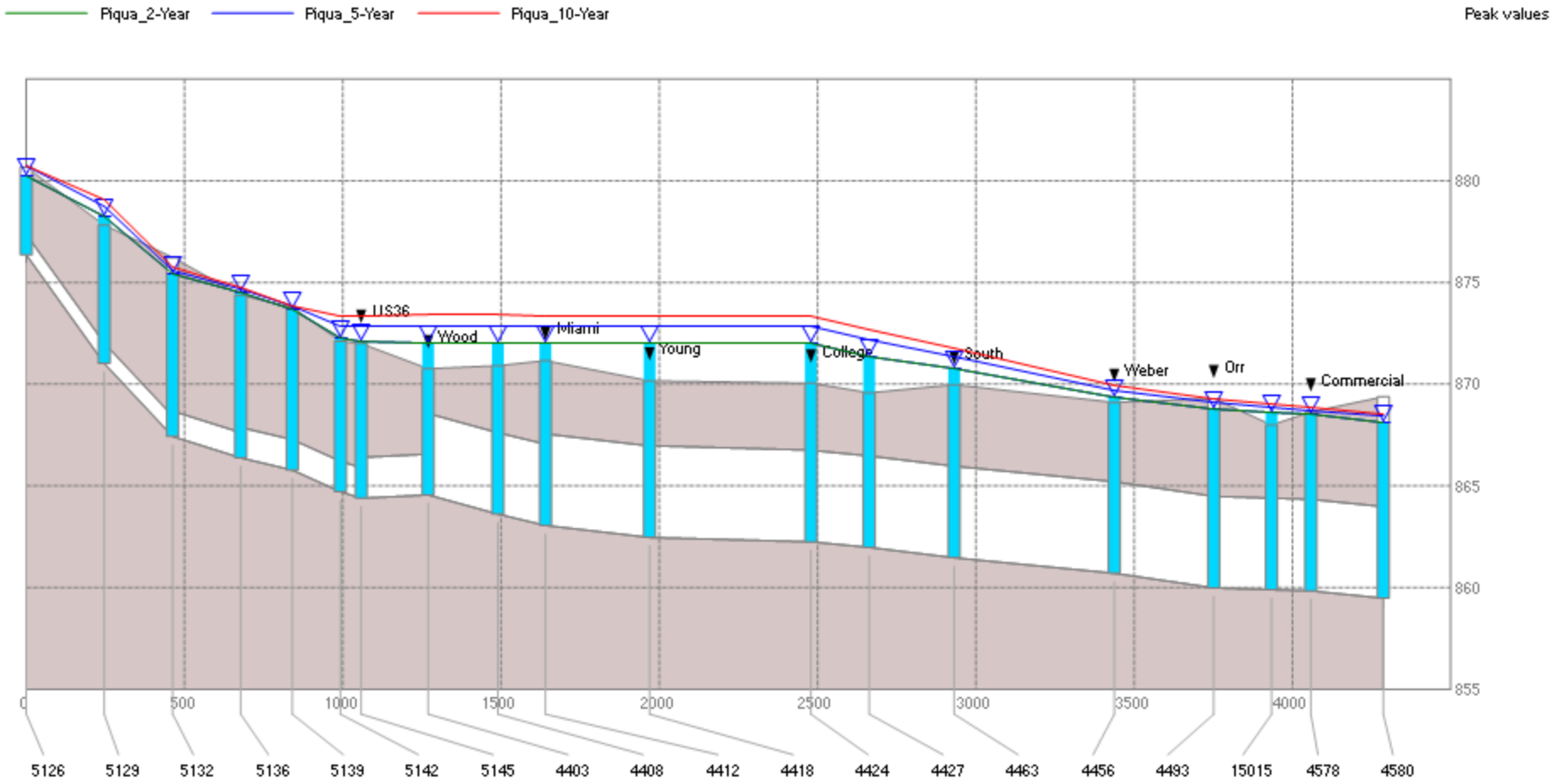


Figure (B-8) Profile No (7) from US-36 to Commercial Street

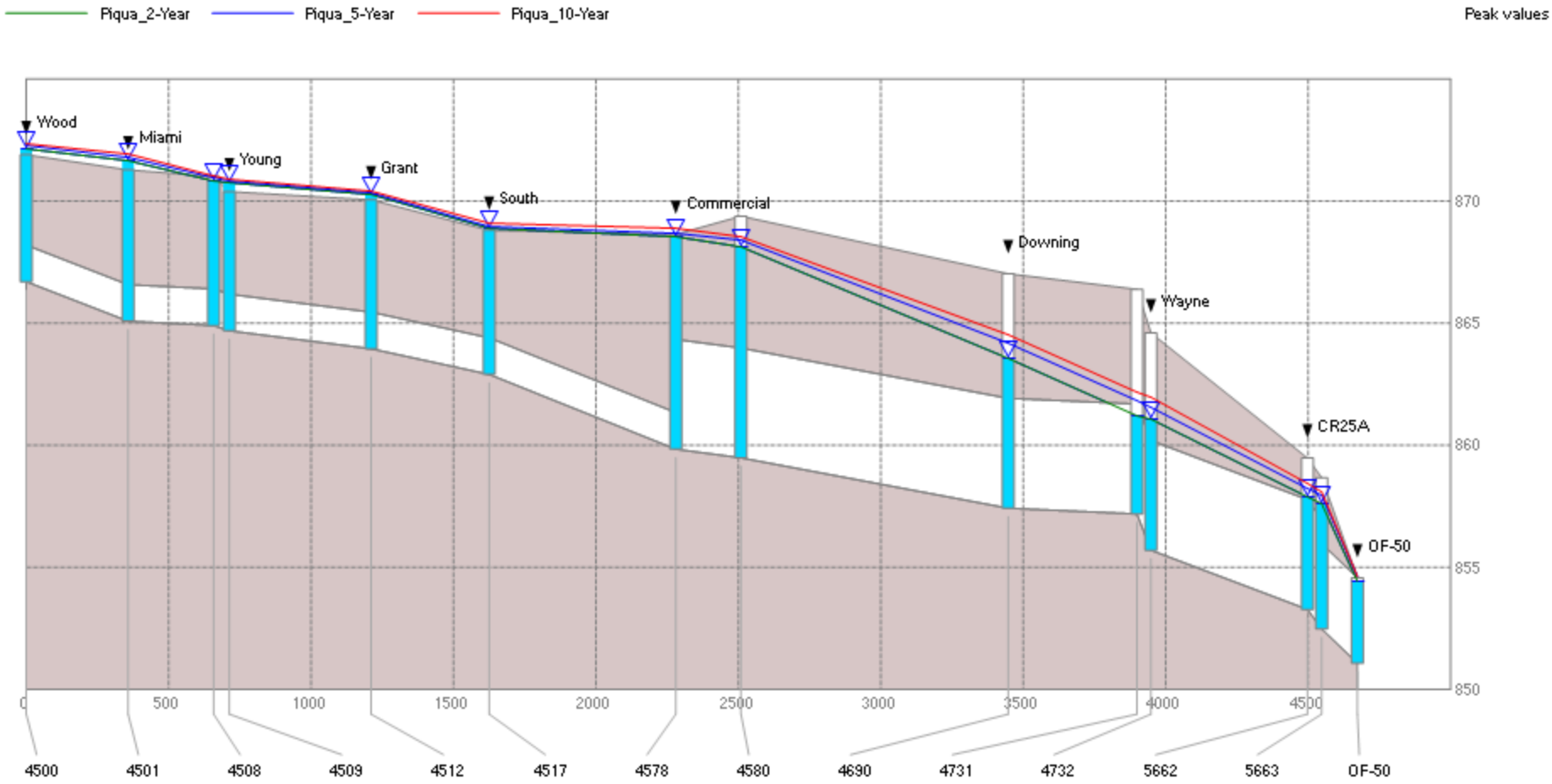


Figure (B-9) Profile No (8) from Jed Way to CR-25A

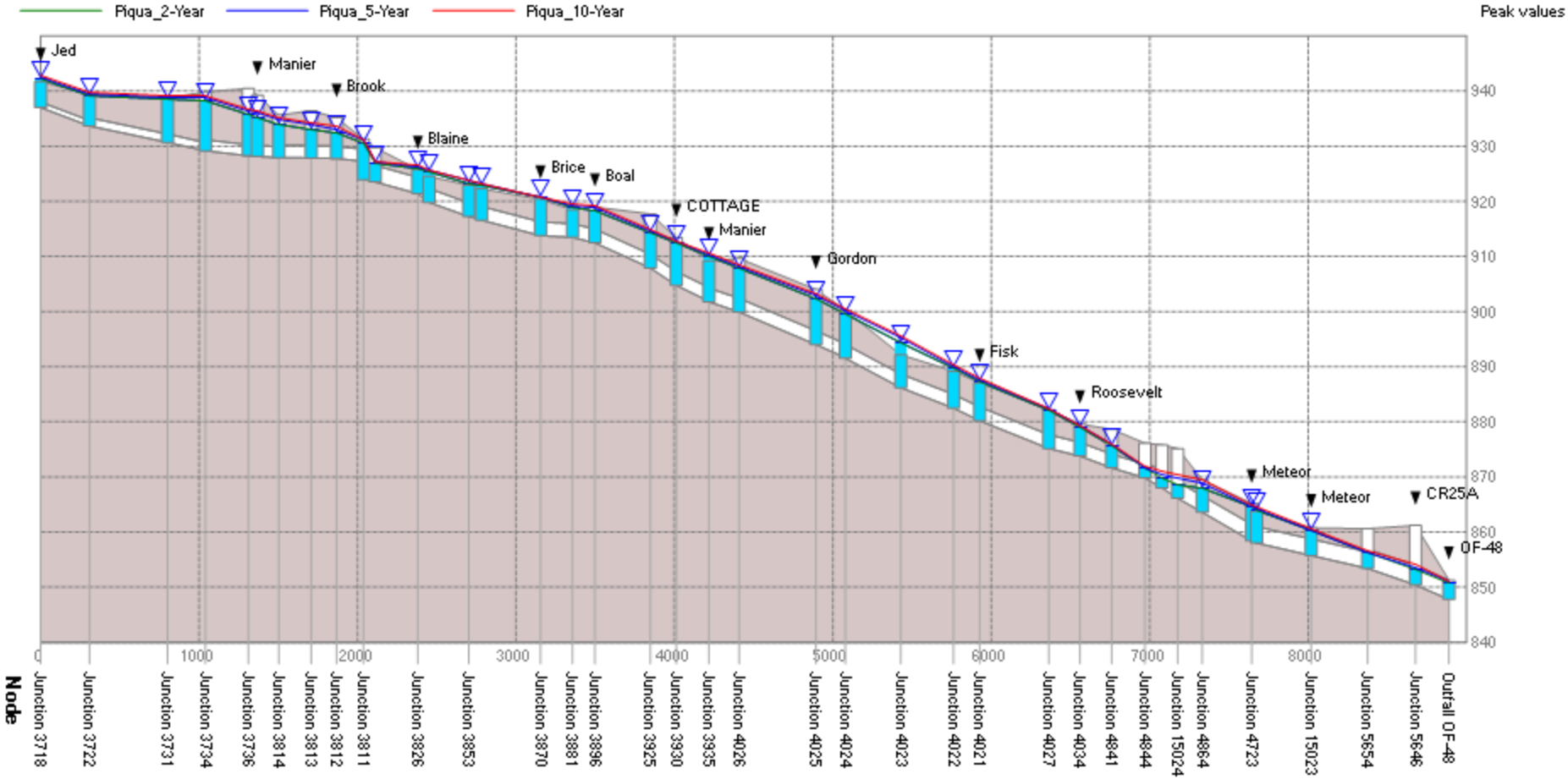


Figure (B-10) Profile No (9) from 1st Street to 1st Street

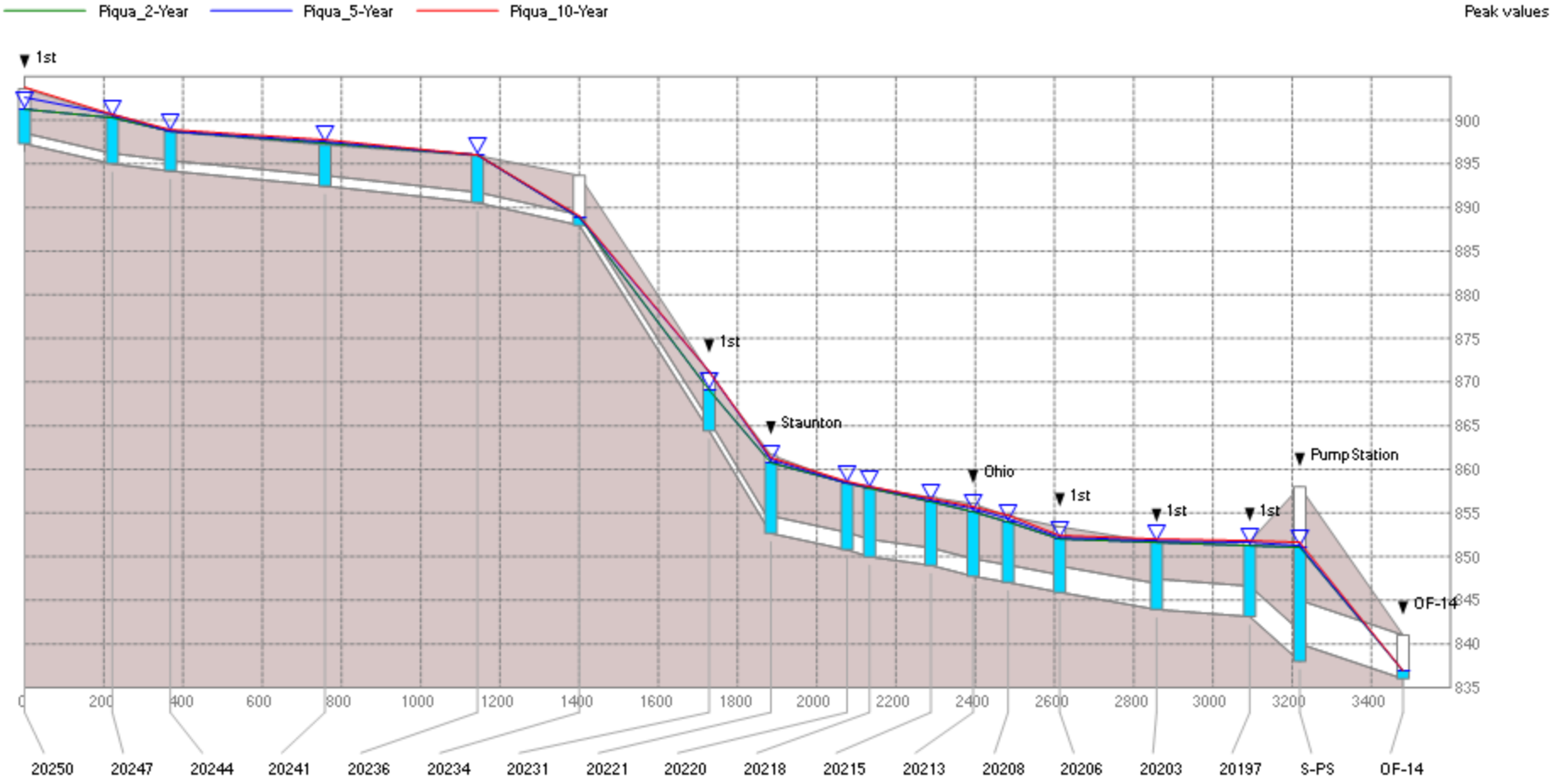


Figure (B-11) Profile No (10) from 2nd Street to 1st Street

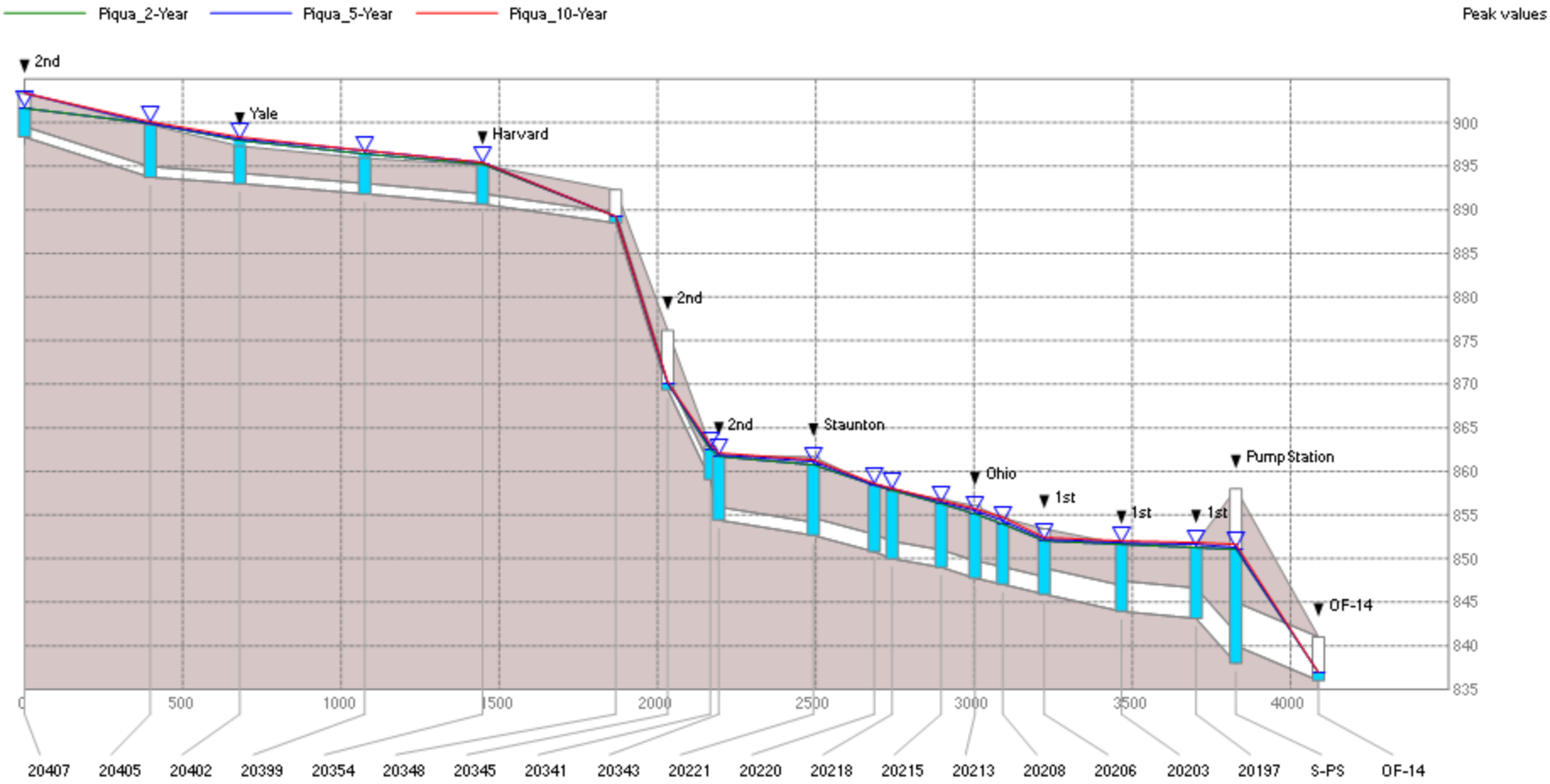
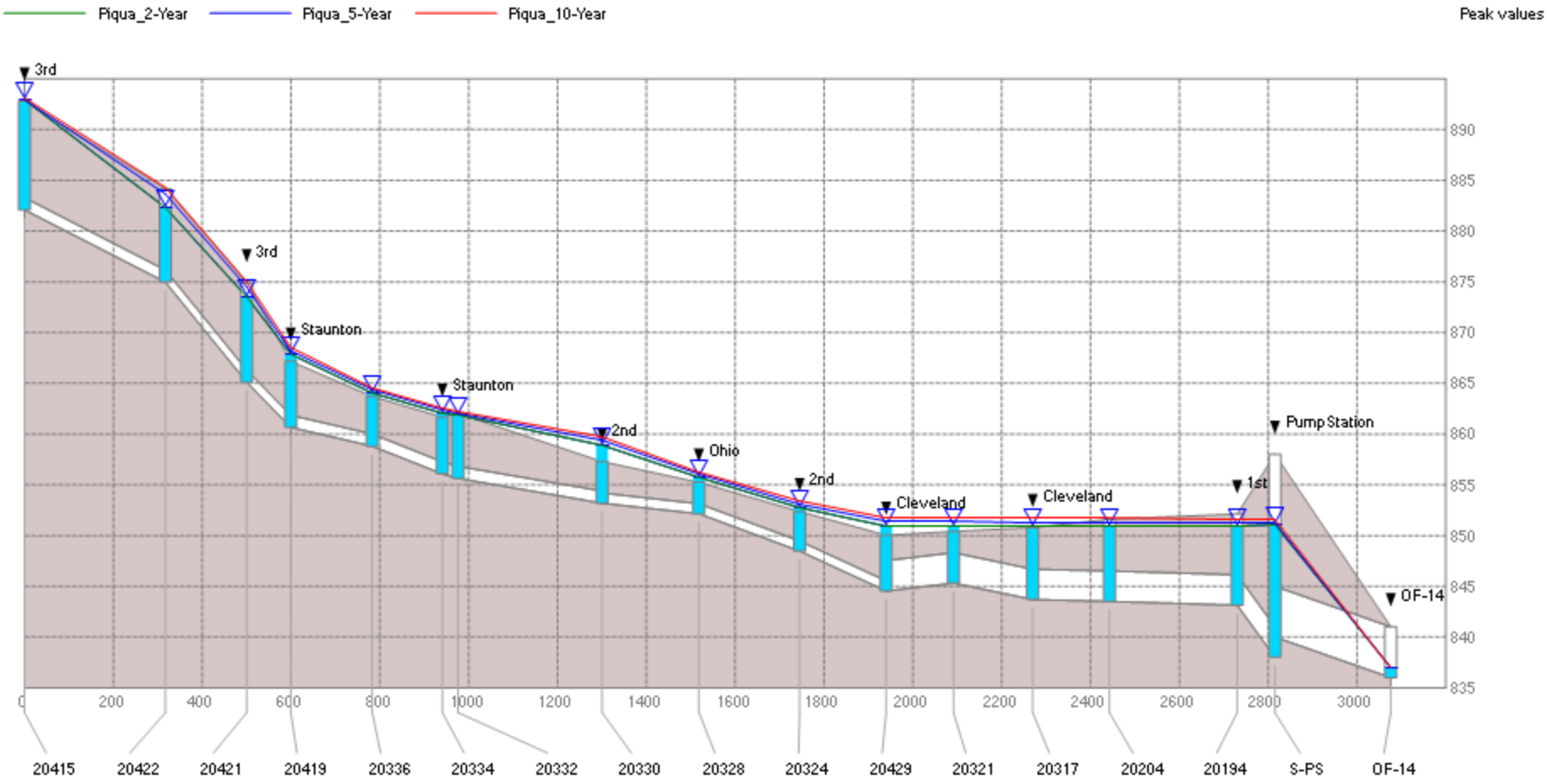


Figure (B-12) Profile No (11) from 3rd Street to 1st Street



Appendix C Detention Basin Photos

Autozone Dry Detention Basin
The AutoZone dry detention basin is 0.21 acres and located north of the AutoZone in the Market Place Plaza. The basin receivers runoff from all roof drains in Market Place and outlets to a water quality structure in the northeast end through an 8-inch pipe. The outlet structure also has a grated top and outlets through a 15-inch pipe to The Path Ditch.

Big Buck Wet Detention Basin
The Big Buck wet detention basin is 2.71 acres and located at the south end of Big Buck Drive in the Deerfield subdivision. The basin has no active inlet structures but receives runoff from the neighboring residential buildings. There is an inlet structure in the southwest end for future development of the Deerfield subdivision Big Buck has two outlets: north through an 18-inch pipe at 963.60 feet and from the northeast through a 15-inch pipe at 963.78 feet.

Big Buck Outlet
18-inch outlet structure north to the White Tail detention basin.

Big Buck Outlet
15-inch outlet structure on the northeast end of the basin.

Big Buck Inlet
Southwest inlet structure for future development of the Deerfield subdivision.

Black Tail Dry Detention Basin
The Black Tail dry detention basin is 0.18 acres and runs along the tree line north of Red Deer Trail in the Deerfield subdivision. This basin receives flow from the Caribou detention basin through a 24-inch pipe and outlets to the east through a 36-inch sewer.

Black Tail Inlet
24-inch inlet pipe on the west end of the Black Tail dry detention basin. This storm sewer conveys the overflow from the Caribou detention basin as well as catch basins at the intersection of Lambert Drive and Red Deer Trail.

Caribou Wet Detention Basin
The Caribou wet detention basin is 1.13 acres and located east of Caribou Court in the Deerfield Subdivision. This detention basin receives flow from three inlet structures: a 15-inch sewer from Fawn Court, an 18-inch from the west, and a 30-inch from the White Tail Detention Basin to the south. The outlet structure for Caribou is an 18-inch in the northeast corner.

Caribou Inlet
30-inch inlet structure on the south end. This pipe delivers flow from the White Tail detention basin, Lambert detention basin, and stormwater from Lambert Drive and Park Avenue.

Eagles Nest Wet Detention Basin
The Eagles Nest wet detention basin is 2.39 acres and located between Golden Eagle Court and Eagles Way in the northern section of the Deerfield subdivision. There is a 42-inch inlet pipe on the southern end that receives stormwater from most of Eagles Lake Drive, as well a 21-inch inlet from the west and a 15-inch inlet from the east.. The outlet structure is within the basin on the north end.. This outlet has a raised trash rack and discharges to an 18-inch storm sewer.

Harley Davidson Dry Detention Basin
The Harley Davidson dry detention basin is .11 acres and located south of the Harley Davidson off of US-36. There is a 15-inch inlet pipe on the east. The outlet structure is a 10-inch pipe in the southwest corner.

High Wet Detention Basin
The High wet detention basin is 0.96 acres and located along High Street south of the Deerfield Crossing apartment complex. The basin collects runoff from the apartment parking lot and Lambert Drive and outlets to a storm sewer along High Street. The three inlet structures are as follows: an 18-inch pipe on the northwest end, a 12-inch pipe from the north, and an 18-inch pipe from the northeast . The outlet structure is a 12-inch pipe in the southeast corner.

High Outlet
A 12-inch outlet structure in the southeast. conveys flow to the 24-inch sewer along High Street.

High Inlet
An 18-inch inlet pipe from the northeast that collects stormwater from catch basins in the intersection of Lambert Drive and Wilshire Drive.

Lambert Wet Detention Basin

The Lambert wet detention basin is 1.63 acres and located between Lambert Drive and Bear Run in the Deerfield subdivision. Lambert collects stormwater from catch basins along both Lambert Drive and Bear Run and outlets to the northwest towards the Caribou Detention Basin. The three inlets are all concrete pipes as follows: an 18-inch from the west, 15-inch feet from the south, and 15-inch from the east. The outlet structure is a 12-inch concrete pipe in the northwest.

Lambert Outlet

The 12-inch outlet structure in the northwest corner is surrounded by cattails.

Miami Valley Center Mall 1
The Mall 1 dry detention basin is 1.19 acres and located in the southwest corner of the Miami Valley Centre Mall property. This basin receives runoff from the southern mall parking lot. The inlet and outlet structures were not available.

Miami Valley Center Mall 2
Outlet structure on the north end of the Mall 2 detention basin.

Miami Valley Center Mall 2
The Mall 2 dry detention basin is 0.98 acres and located on the west end of the Miami Valley Centre Mall, just north of the Mall 1 detention basin. This basin receives runoff from the northern mall parking lot. The inlet and outlet structures sizes were not available.

Red Deer Dry Detention Basin

The Red Deer dry detention basin is 0.43 acres and located in the back yard of 917 Red Deer Trail within the Deerfield Subdivision. There is a 15-inch inlet pipe that conveys flow from Antler Court and a 24-inch pipe that conveys flow from Bear Run. Both of these inlets discharge to a concrete pad that eventually outlets east through a 12-inch pipe. If stormwater reaches the overflow elevation feet it outlets north through a 24-inch pipe to a 36-inch pipe.

Red Deer Inlets and Outlet Catch Basin

Walmart Wet Detention Basin
The Walmart wet detention basin is 0.68 acres and located behind the Walmart on US-36. There is a large inlet pipe in the southeast corner and a small concrete outlet on the southwest edge. The inlet and outlet pipe sizes were not available.

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Walmart Inlet Structure
Inlet structure in the southeast corner.

Walmart Outlet Structure
Outlet structure to the southwest.

Whitetail Wet Detention Basin

The White Tail wet detention basin is 0.45 acres and located north of White Tail Lane and west of Lambert Drive in the Deerfield Subdivision. The inlet structure is a 24-inch pipe on the west end that comes from the Big Buck detention basin to the south. White Tail outlets through a 30-inch sewer on the east end that flows north to the Caribou detention basin.

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Wilshire Wet Detention Basin

The Wilshire wet detention basin is 0.84 acres and located between Wilshire Drive and the Deerfield Crossing apartment complex, just north of the High detention basin. Wilshire receives flow and runoff from Wilshire Drive through two inlet structures on the north edge: an 18-inch pipe and a 12-inch pipe. There is an 18-inch outlet pipe that travels south under the parking lot to the High detention basin.

Wilshire Outlet

An 18-inch outlet pipe travels south to the High detention basin.

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Appendix D Storm Drainage Questionnaire Results (2013)

City of Piqua
Stormwater Master Plan

STORM DRAINAGE QUESTIONNAIRE

The City of Piqua is currently evaluating stormwater drainage in the City. The purpose of this evaluation is to determine what areas of the City have local flooding problems due to inadequate storm sewers or drainage structures.

In order to obtain further information on stormwater problem areas, the City has developed the following Storm Drainage Questionnaire. The results of these questionnaires will be summarized in a Phase 1-Stormwater Master Plan for the City.

Please help us identify these problems by filling out this form as completely as possible and returning it with your monthly Utility Bill. The results will be tabulated and used to help determine what areas of the City need upgrades to the storm sewer system to reduce flooding problems and prioritize projects throughout the City. Your response and involvement is important to us!

If you have any questions regarding this questionnaire, please contact Devon Alexander, Stormwater Coordinator at 937-778-2059.

1. Name(Optional) _____

2. Address
   _____

3. Has your street or yard periodically flooded in the past? ____ Yes ___ No

4. How many times did your street or yard flood in 2012 and 2013?_____
   Explain:_____

5. How long does it take for your street or yard to drain after flooding? Please indicate a flooding duration. Hours___ Days____ A Week or More____.

6. Has this street or yard flooding caused damage to your property? __ Yes___ No.
   Explain the damage:_____

7. Are you aware of stormwater inlets, catch basins, manholes, detention basins or ditches that need repair or maintenance on your street? ___ Yes ____ No
   a. If so, what is the problem and where is it located?
      _____

8. Please provide any additional comments you would like to make on stormwater problems in your neighborhood.
   _____
   _____
   _____

City of Piqua
Stormwater Questionnaire Results
2013

Number	Street	Location	Flooding Frequency	Flooding Problems	Flooding Recovery Period (Hours)	Flooding Damage (Yes/No)	Flooding Damage Problems	Maintenance Required (Yes/No)	Maintenance Problems	Comments
609		609	0	Every time it rains	<24	Y	Basement floods	Y	Alley on Scoot St and corner of scott and Scudder	
519	2nd	519 2nd	>5		<24	N		Y		
1117	50	1117 SOUTH	0		<24	N		N		
500	ADAMS	500 ADAMS			N/A	N		Y	At the intersection of Grant & Downing, storm drain backs up	
615	ADAMS	615 ADAMS	0		N/A	N		N		
1521	AMESBURY	1521 AMESBURY	0		N/A	N		Y	Behind my property water lays in bottom of catch basin and is an insect breeding ground	
1511	AMESBURY	1511 AMESBURY	2		2	N		N		
1512	AMHERST	1512 AMHERST	0		N/A	N		Y	Some are raised up & metal is broken	
1800	AMHERST	1800 AMHERST	0		N/A	N		Y	Briarcliff has catch basins that have colapsed	
1716	AMHERST	1716 AMHERST	0		1	N		N		
1511	AMHERST	1511 AMHERST	0		N/A	N		Y	Curbs are crumbling at many driveways. Water pools	
514	ANN	514 ANN	>4	Every time it rains	>24	Y	It ends up over sidewalks, washed away curb	Y	Water runs off garden street to ours since they changed drive	Our closest drain is Broadway and dips in front of my house and 514-516. It gets ankle deep
517	ANN	517 ANN	>4	Standing water every time it rains hard.	<24	N		N		
1317	ARROWHEAD	1317 ARROWHEAD	0		N/A	N		N		
420	ASH	420 ASH				N	We have a new street			
1937	BECKERT	1937 BECKERT	15		>24	N		N		
500	BEVERLY	500 BEVERLY	>4	Flooding has occurred many times.	>24	N		Y	Catch basin needs repaired or replaced	Catch basin is sinking into curb & street
418	BEVERLY	418 BEVERLY	0		N/A	N		N		There is a tile & ditch between my backyard & the sidewalk on Sunset St it only filled up high when we had a really bad rainstorm only about 2 or 3 times in 5 years. Only once the street had high water signes on it from this. So it is ok.
616	BEVERLY	616 BEVERLY	10	Approximately 4-6 inches of standing water, covering 25% of the yard	24	Y	Damage to my deck	N		I imagine the draingage is pretty outdate
617	BEVERLY	617 BEVERLY	0		<24	N		N		
100	BLACKWELL	100 BLACKWELL	0		12	N		Y	Inlet located between 100 & 102 Blackwell. The concrete appears to be collapsing	
610	BLAINE	610 BLAINE	0		N/A	N		N		This building does not drain to any storm water drains. It is completely surrounded by grass
315	BLAINE	315 BLAINE	0		N/A	N		Y	Loose drain cover directly in front of my driveway	
904	BOAL	904 BOAL	0		>24	Y		N		
521	BOAL	521 BOAL	0		1	N		N		My yard floods only after extremely heavy rain and is gone in an hour at most
721	BOAL	721 BOAL	0		<24	N		Y	Big holes in alley behind me	
623	BOONE	623 BOONE	0		N/A	N		Y	620 Block of Boone - partially blocked	
900	BOONE	900 BOONE	0		<24	N		N		
606	BOONE	606 BOONE	0		N/A	Y		N		
910	BOONE	910 BOONE	>4	Every time heavy rain	12	N		Y	Sewer drains clogged	
519	BOONE	519 BOONE	3	Heavy Rainfall	N/A	N		Y	Front of property, clogs easily	
901	BOONE	901 BOONE	0		<24	N		N		
428	BRENTWOOD	428 BRENTWOOD	0		N/A	N		Y	Sewer at stop sign (Brentwood & Glenwood) cannot handle amount of water. Storm drain South St & Greenwood (field) gets covered up	
422	BRENTWOOD	422 BRENTWOOD	4	Coming from field, not enough drainge in old Kroger area	48-72	Y	Basement floods	N		Manholes get full and shoot up out of street. Need more drainage
309	BRENTWOOD	309 BRENTWOOD	0		48	N		N	The backyard floods with heavy rain. Gets maybe 2 feet into yard	
907	BRIARCILFF	907 BRIARCLiFF	0		N/A	N		Y	Drain has completely collapsed infron of 907 Briarcliffe	Drain collapsed 3 months ago. An orange cone was placed as marker but was removed within one week.
906	BRIARCLIFF	906 BRIARCLIFF	0		72	N		Y	Catch basin in front of my home and catch basin between 909 and 907 Briarcliff	On my side of street water stands in gutter for days after rain. Three homes south of me have the same problem.
909	BRIARCLIFF	909 BRIARCLIFF	0		N/A	N		Y	Sunken drain grate between 907-909 Briarcliff Ave	
917	BRIARCLIFF	917 BRIARCLIFF	0		1	N		N		Fairly good drainage
1806	BRITTON	1806 BRITTON	0		<24	N		N		
1139	BROADWAY	1139 BROADWAY	0		N/A	N		N		Need drains in the "1100" block
1059	BROADWAY	1059 BROADWAY	0		N/A	N		Y	Manholes infront of home	
1204	BROADWAY	1204 BROADWAY	0		<24	N		N		
1518	BROADWAY	1518 BROADWAY	0		N/A	N		N	Several stormwater inlets damaged on Nicklin Ave 1600 Block for sure	
1611	BROADWAY	1611 BROADWAY	0		<24	N		N		
939	BROOK	939 BROOK	0		N/A	N		Y	Im aware of all of these things but no problems	
820	BROOK	820 BROOK	0		<24	N		N		
1017	BROOK	1017 BROOK	>10	Too many to count	>24	Y	Basement floods	N	Not sure	
704	BROOK	704 BROOK	0		<24	N		N		
435	BROOK	435 BROOK	0		N/A	N		Y	Roosevelt & book full of trash & weeds	
1313	BROOK	1313 BROOK	0		1	N		N		
902	CALDWELL	902 CALDWELL	10	Drains clog every rain.	36	UKN		Y	Corner of Caldwell & Camp	Doesn't drain, causes large flooding in street
915	CALDWELL	915 CALDWELL	0		<24	N		N		
709	CALDWELL	709 CALDWELL	0		N/A	N		N	As long as leaves & stuff are cleaned off the basin our streets seem to drain pretty fast	
934	CALDWELL	934 CALDWELL	1		<24	Y	Backed up into basement	Y	Drains smell in summer	

Number	Street	Location	Flooding Frequency	Flooding Problems	Flooding Recovery Period (Hours)	Flooding Damage (Yes/No)	Flooding Damage Problems	Maintenance Required (Yes/No)	Maintenance Problems	Comments
621	CALDWELL	621 CALDWELL	>4	Heavy Rainfall	<24	N		N	Parking area in front of home often has standing water. Takes a few hours to drain	
1705	CAMBRIDGE	1705 CAMBRIDGE	0		<24	N		N		
812	CAMP	812 CAMP	0		1	N		N		
1003	CAMP	1003 CAMP	4	Flooding during heavy rainfall	<24	N		N		
828	CAMP	828 CAMP	0		1	N		N		Need to keep drains free of trash and leaves
321	CAMP	321 CAMP	1	Every heavy rain	N/A	N		Y	Caldwell corner drainage	
1038	CAMP	1038 CAMP	0		N/A	N		N		Neighbors have backup problem
1021	CAMPT	1021 CAMP	0		<24	N		N		
1906	CARLYLE	1906 CARLYLE	0		<24	Y	Basement flooded	N		
1831	CAROL	1831 CAROL	0			N				
3217	CHEROKEE	3217 CHEROKEE	0		<24	N		N		
1203	CHERRY	1203 CHERRY	0			N		Y		
724	CLARK	724 CLARK	0		<24	N		N		
1304	CLARK	1304 CLARK	2		4	N		Y	Corner of Virginia & Adams. Grass growing in street	
406	CLEVELAND	406 CLEVELAND	14	The whole street. Floods up to the car door or to side walks	3	N		Y		Needs better drainage. For questions call 937-606-2055
226	CLEVELAND	226 CLEVELAND	2		<24	Y	In 1995 I lost my furnace	N		Had water in basement in 1995, but now I have a sump pump. No water
	CLEVELAND	CLEVELAND	2	Rain	N/A	Y	Basement flooded in 1995			
325	CLEVELAND	325 CLEVELAND	0		>24	Y	Flooded truck	N		If the pump doesn't turn on the street is flooded!
206	CLEVELAND	206 CLEVELAND	0		1	N		Y	Potholes are real bad around sewer drains	
121	CLEVELAND	121 CLEVELAND	>5	Cellar floods. But have sump pump	<24	N		N		Live where river used to be
229	CLEVELAND	229 CLEVELAND	>3	Heavy Rainfall	N/A	Y	1995	Y		
123	CLEVELAND	123 CLEVELAND	0		<24	N		N		
404	CLEVELAND	404 CLEVELAND	1		2	N		N		Water to bottom of car door
608	COLLEGE	608 COLLEGE	0		N/A	N		Y		
719	COLLEGE	719 COLLEGE	0		<24	N		N		
1704	COMMERCE	1704 COMMERCE	0		<24	N		N		
8550	CORD	8550 CORD	2		3	N		N		
2	CORONADA	2 CORONADA	0		N/A	N		Y	Storm water doesn't all flow into the catch basin because of the grade of the street. It forms a small pool in the street in fron of the mail box on Coronada. Freezes in winter.	
1	CORONADA	1 CORONADA	0		N/A	N		N		We do occasionally get puddle in the east edge of the property due to poor grading
523	COTTAGE	523 COTTAGE	>4	After heavy rain	>168	N		N		
711	COTTAGE	711 COTTAGE	20	Rear yard won't drain in this block. Alley is too high	120	Y	Had to haul in gravel. Rear yard turns into swamp. Vehicles get stuck. Gravel helps but water still won't drain	Y	Alley inlet to far north in hole	Rear of 700 Block of Cottage is mudhole. Alley is too high and has only 1 storm drain 800' north of 711 Cottage
9160	COUNTRY CLUB	9160 COUNTRY CLUB	8	Apron into front lot floods during hard rain	>24	N		N		
1433	COVINGTON	1433 COVINGTON	0		<24	N				
824	COVINGTON	824 COVINGTON	0		N/A	N		Y	Potholes located out front of 826 Covington Ave/Church entrance also	
919	COVINGTON	919 COVINGTON	0	Water in basement	48	N		N	When it rains heavy our basement floods	
601	COVINGTON	601 COVINGTON	0		N/A	N		N		Work need near driveway on street
1900	COVINGTON	1900 COVINGTON	3	Front near Route 36 floods and water backs up through the floor	<24	N		N		We also had an issue with the back of the building (north) flooding for days; the city repaired an outlet for us at the bike path. We installed two (2) new catch basins and the tile connecting to this outlet that the city repaired. No flooding to this point.
1722	DOVER	1722 DOVER	0		<24	N		N		We have little trouble with runoff on the west end of Dover Ave
1703	DOVER	1703 DOVER	0		N/A	N		Y	Every street potholes if the street dept get off their can they would see these	
615	DOWNING	615 DOWNING	2	The sewer is always backed up	<1	N		Y	Both sides of the 600 block	
1717	DUBOIS	1717 DUBOIS	0		N/A	N		N		
1824	EAGLES LAKE	1824 EAGLES LAKE	0		N/A	N		Y	Corner of Eagles Lake Dr and Falcons Nest Ct. Huge hole in street by storm sewer	
1203	ECHO LAKE	1203 ECHO LAKE	0		<24	N		N		
1903	EDGE	1903 EDGE	0		2	N		N		
2000	EDGE	2000 EDGE	5		<24	N		Y	Inlets off farmers field to the west	
1553	EDGE	1553 EDGE	0		<24	N		N		
718	ELM	718 ELM	2	Over by storm drains, when it has rained a lot	1	N		Y	Corner of Elm & Walker, NE corner top of storm sewer on sidewalk	
13215	ELMWOOD	1325 ELMWOOD	>4	Heavy Rainfall	24	Y	Erosion under concrete pad. Bringing down stone wall	Y	Along the creek behind the property	The water level in the creek rises 10 feet during a heavy rainfall and becomes a white water rapid! This is when the land is eroded and the stonewall is brough down!
1335	ELMWOOD	1335 ELMWOOD	5	Near creek	4	N		N		
1416-1420	FAIRFAX	1416-1420 FAIRFAX	0		<24	N		N		
1416	FAIRFAX	1416-1420 FAIRFAX	0		<24	N		N		
1304	FAIRFAX	1304 FAIRFAX	3	Heavy Rainfall	N/A	N		N		Everytime it rains items come up through the graound in my yard (glass, plastic, beer caps, etc)
309	FALLOW	309 FALLOW	0		1	N		N		
907	FALMOUTH	907 FALMOUTH	0		<24	N		N		
320	FIFTH	320 FIFTH			N/A	N		Y	Pot holes out front of house & on side street	

City of Piqua
Stormwater Questionnaire Results
2013

Number	Street	Location	Flooding Frequency	Flooding Problems	Flooding Recovery Period (Hours)	Flooding Damage (Yes/No)	Flooding Damage Problems	Maintenance Required (Yes/No)	Maintenance Problems	Comments
513	FIRST	513 FIRST	0		N/A	N		Y	Second St & Harvard	
606	FIRST	606 FIRST	2		>24	N		Y	After a lot of rain, it backs up into the basement. Plumber states lines are clear from house; not drainage out fast	Have had lines cleared of tree roots & such on property. Lines are clear that way
605	FIRST	605 FIRST	0		N/A	N		Y	We live on top of a hill	
214	FIRST	214 FIRST	0		<24	N		N		
501	FIRST	501 FIRST	7		>24	Y	curb crumbled	Y	Cover keeps coming out corner of Harvard & Second	Standing water along lowpoint on Harvard Str
1123	FORREST	1123 FOREST	0		3	N		N		
1125	FORREST	1125 FOREST	0		3	N		N		
304	FOURTH	304 FOURTH	0		N/A	N		Y	Fourth & Ohio St	
320-322	FRANKLIN	320-322 FRANKLIN	0		1	N		N		
819	GARBRY	819 GARBRY	>4	Everytime it rains	6	N		Y	The whole are on south side of Garbry from Trailer court to tracks	I think my landlord needs to fill in with stones my driveway and fill in ruts in front yard
1532	GARFIELD	1532 GARFIELD	0		N/A	N		N		
1509	GARFIELD	1509 GARFIELD			<24	N		N		
4122	GARNSY	412 GARNSEY	0		<24	N		N		
609	GILL	609-611 GILL	0		<24	N		N		
709	GILL	709 GILL	0		2	N		N		
129	GLENN	129 GLENN	0		>24	N		N		
125	GLENN	125 GLENN	1		>24	N		N		
326	GLENWOOD	326 GLENWOOD	4	Water backs up from storm drain	<24	N		Y	At the intersection of Glenwood & Edge. The stormwater inlets are not large enough to carry the water away	
512	GLENWOOD	512 GLENWOOD	0	Storm drain in corner of yard gets blocked with field debris	>24	Y	Washed away dirt around basin			When heavy rains come, it should be checked. We have cleabed it ourselves several times. Also the city has cleaned it out several times. It NEEDS to be checked after we get a lot of rain!
307	GLENWOOD	307 GLENWOOD	2	Backyard floods after hard heavy rain.	N/A	N		N		
301	GLENWOOD	301 GLENWOOD	0	Floodng every time hard or heavy rain	24-48	N		Y	Water drain by Edge St we do not have very many street drains up here	
302	GLENWOOD	302 GLENWOOD	>4		<24	N	Had pipes put in backyard	Y	Corner-Brentwood and Glenwood	Landin Park area has a lot of drainage problems
315	GLENWOOD	315 GLENWOOD	0		N/A	N		N		No problems since drains fixed several years ago
502	GLENWOOD	502 GLENWOOD	>5	Flooding too many times to count. Rain causes runoff from fields behind Brentwood and water runs down Brentwood and Glenwood. Sometimes water will shoot about a foot out of manholes	>168	Y	Water seeps through the slab into the heating vents if not emptied by hand	N		
400	GLENWOOD	400 GLENWOOD	>10	Heavy Rainfall	>24	Y	Washes out driveway	N		
636	GORDON	636 GORDON	8	Any time it rains a lot it floods	48	Y	It enters into the basement	N	I get a lot of run off water from the neighbors yards and the alley	
329	GORDON	329 GORDON	1	The dam broke up on top of the hill, but Gordon Street floods every time it rains.	48	N		N	On the corver of Gordon/ Young Streets	They used to be the city would keep the drains cleaned out. Now you except the public to do the job/city gets paid to do. Back in '70/'80 the city kept this city better than they do today
318	GORDON	318 GORDON	0	Flooding during heavy rains.	6	N		Y	Street not graded properly, northwest corver of Gordon & Young St	We have lived here for 37 years, gordon was torn up several years back, re-paved, but still has same puddles & flooding
774	GORDON	774 GORDON	0		<24	Y		Y		We don't have flooding in the yard but the basement gets a lot of water seeping in. Strange because we are at the top of the hill on the corner of Gordon & Clark St
427	GORDON	425-427 GORDON	0		>24	N		N		
1609	GRANDT	1609 GRANT	0		<24	N		N		
1407	GRANT	1407 GRANT	3	Flooding of side yard and then home crawl space.	72	N		Y	Front of 1405 Grand general repair	Basin at McKinley- Grant south side has had orange barrel for several years. It is deep and has holes around it. Gutters broken, need repair
1611	GRANT	1611 GRANT	0		N/A	N		Y	Between 1611-1613 W Grant St	
1121	GRANT	1121 GRANT	0		N/A	N		Y	Corner of Grant and Wilson	
1617	GRANT	1617 GRANT	0		N/A	N		Y	The sewer drains at 1611-1613 Grant need checked on	
839	Grant	839 GRANT	0		1	N		N		
816	GRANT	816 GRANT	0		N/A	N		Y		There are areas of the street where a pipe would burst at times and water would flow down the hill. The City would repair temporarily
1851	GRANT	1851 GRANT	>4	Installed drain 2 years ago in southeast area by WPTW. Always floods	>24	N		N		
6	GREENBRIAR	6 GREENBRIAR	0	Flooding after heavy rainfall	24	Y	Flooded basement	N		I am constantly battling field run-off at the end of eagles lake drive. At times my street because the storm drains at the end of eagles lake drive can't handle the storm water so it causes water to back up on greenbriar court
912	GREENE	912 GREENE	0		1	N		N		No problems noticed - only standing water in extreme weather
817	GREENE	817 GREENE	0					Y	Have racoons living in catch basins	
1006-1008	GREENE	1006-1008 GREENE	0		1	N		N		
205	GREENE	205 GREENE	1		<24	N		N		
502	GREENE	502 GREENE	>4		>24	N		Y	Driveway always a mess	
215	GREENE	215 GREENE	0		<24	N		N		
9	GREENRIAR	9 GREENBRIAR	0		<24	N		N		
1016	HANCOCK	1016 HANCOCK				N		N		
423	HARRISON	423 HARRISON	>4	Heavy Rainfall	N/A	N		Y	Consistent backup & minimal drainage of water corner of Greene & Harrison	
1003	HIGH	1003 HIGH	4		<24	N		Y	Drain on this side of street is down on corner. Across the street, corner of High and Lincoln	Drains not taking water (rain) fast enough. Have seen water sptraying back out of manhole
306	HIGH	306 HIGH	0		1	N		N		

City of Piqua
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Number	Street	Location	Flooding Frequency	Flooding Problems	Flooding Recovery Period (Hours)	Flooding Damage (Yes/No)	Flooding Damage Problems	Maintenance Required (Yes/No)	Maintenance Problems	Comments
901	HIGH	901 HIGH	4	Flooding on odd side of street--no outlet for water.	48	N		N	No outlet for watr at intersection of Lincoln & High	
1015-1021	HIGH	1015-1021 HIGH	1		<24	N		N		
924	HIGH	922-924 HIGH	4	Every time there is heavy rain, trash accumulates in the drain.	3	Y	Flooding in car	Y	Storm drain and Lincoln & High St	Clean out drain
530	HIGH	530 HIGH	0		1	N		N		
1101	HIGH	1101 HIGH	0		N/A	N		Y	Catch basin sinking at the end of Jackson, High St	
1101	HIGH	1101 HIGH	3	Water comes out of curb and runs down street even when it is not raining.	<24	Y		Y	Corner of Jackson & High	Been problem for years
1607	HIGH	1607 HIGH				N		Y	Corner of High & College on north side of road appear to have a problem	
1615	HIGH	1615 HIGH	6		>24	Y		N		
1318	HILLCREST	1318 HILLCREST	0		>168	N		N		
5	HOPEWOOD	5 HOPEWOOD	>12		24	N		N		The empty lot next to our home floods all the time
225	JACKSON	225 JACKSON	0		N/A	N		Y	Corner of high & Jackson SE Corner	
19	KESTREL	19 KESTREL	0		N/A	Y	Basement flooded, carpet/furniture ruined	N		
400	LAMBERT	400 LAMBERT	0		12	N		N		
1000	LAMBERT	1000 LAMBERT	>3	Flooding occurs every hard rain.	N/A	N		Y	The catch basin is too high. We live at dead end	
8333	LAMBERT	8333 LAMBERT	1	Drain goin through sidewalk along Main St. Not large enough causing water to back up into basement		N		N		
1013	LAURA	1013 LAURA	0		N/A	N		N		
1115	LENOX	1115 LENOX	>4	Flooding occurs every time there is a moderate to heavy rain	>24	Y	Standing water damages vegetation	N	This street has NO drainage structures (sidewalks/curbs/catch basins, etc.)	This street has NO drainage structures (sidewalks/curbs/catch basins, etc.)
811	LINCOLN	811 LINCOLN	>24		<24	N		N		
405	LINDA	405 LINDEN	0		N/A	N		Y	Street pavement falling in at storm drain.	
407	LINDEN	407 LINDEN	0						Our street and yard has never flooded since I have lived here. That is almost 30 years	
613	LINDSEY	613 LINDSEY	>5	Every time it rains	>168	Y	Foundation driveway to garage	N		I have emailed pictures 5 times to dseeberger@piqua.org. They will fill holes with light gravel a few times and the flooding always comes back. They tore up the asphalt for no reason and layed gravel. Now we have MASSIVE flooding, that looks like a river in the alley (between Lindsey & Robinson St). Would appreciate ANY help. Call 570-0928 Cell
810	LINDSEY	810 LINDSEY	>3	Every hard rain	2	N		Y	Corner of Lindsey & Lincoln, it may just need cleaned out. We have seen raccons come out of there	
807	LINDSEY	807 LINDSEY	10	Alley floods and holds water, front street floods during downpours	>24	Y	Water pooling in alley collects on driveway causing concrete to lean & crack	N		
8610	LOCKINGTON	8610 LOCKINGTON	10	Heavy Rainfall	>24	N		N		
8910	LOONEY	8910 LOONEY	1	High water on Looney Road in one lane after extremely heavy downpour	<24	N		N		
917	MADISON	917 MADISON	0		N/A	N		N		
226	MAIN	226 MAIN		Our basement floods	N/A	Y	Basement	N		
134	MAIN	134 MAIN	0		<24	N		N		
735	MAIN	735 MAIN	0		<24	N		N		
1600	MANIER	1600 MANIER	0		2	N		N		
1010	MANIER	1010 MANIER	1	Flooding during heavy rainfall.	2	N		N	Drains have built up grass leaves/debris. Mowers known to throw grass clippings in sewers	
1310	MANIER	1310 MANIER	3		24	N		N		
1100	MANIER	1100 MANIER	>3	Every hard rain. Alley & lane to garage	3	N		Y	Alley by the garage needs gravel to reduce flooding	
1108	MAPLEWOOD	1108 MAPLEWOOD	0		1	N		N		
1204	MAPLEWOOD	1204 MAPLEWOOD	0		<24	N		N		
1098	MAPLEWOOD	1098 MAPLEWOOD	>5	Every time it rains	>168	Y	Mud in Lawn	N	My problem begain in fall 2012 after neighbors finished new drive & parking	
902	MARLBORO	902 MARLBORO	0	Flooding occcurred years ago.	<24	N		Y	Down on Marlbor sewer on streets all broken pavement is gone when they replaced some in plat, shouve have observed more of them	
17	MARYMONT	17 MARYMONT	10	Street slopes wrong and there are no drains at our end of the street.	48-72	N		Y	Very few on Marymont Dr.	Street drainage needs redone
6	MARYMONT	6 MARYMONT	3	Heavy Rainfall	48-72	N	Street is breaking up, getting worse			
211	MCKINLEY	211 MCKINLEY	0		<24	N		N		
115	MORROW	115 MORROW	0		N/A	N		Y	Parking in front of house (sewer cover)	Sewer cover is messed up. Has caused torn up tires on serveral cars if they don't know it is in need of repair has been reported several times but nothing has been done
131	MORROW	131 MORROW	0		N/A	Y	Years ago lost two (2) furnaces	Y	Water comes down Blain, off of Young and can not get out at Morrow	Lady next door has problems, does not empty out
124	MORROW	124 MORROW	1	Up to curb on sidewalk alley exit	48	N	Car hit bottom goin out of alley	Y	Morrow St	Flush out sewer more often. We are not end of sewer line
808	MOTE	808 MOTE	0		N/A	N		Y	North side of my driveway - Driveways passed over	The water backs up into my driveway
529	NEW	529 NEW				N		N		Ciy seems to spend a lot of time diging up E North St to work on sewer drainage
903	NEW HAVEN	903 NEW HAVEN	2	Flooding in backyard and easement between 901 and 903 New Haven.	1	N		Y	Several catch basins in our area Leonard ditch runs over when have downpour. Flooding yard and easement	I believe the drain between Leonard ditch and New Haven is broken and nees looked into basement floods also
1620	NEW HAVEN	1620 NEW HAVEN	0		N/A	N		Y	Hole between sewer and street in front of my house	

Number	Street	Location	Flooding Frequency	Flooding Problems	Flooding Recovery Period (Hours)	Flooding Damage (Yes/No)	Flooding Damage Problems	Maintenance Required (Yes/No)	Maintenance Problems	Comments
1617	NEW HAVEN	1617 NEW HAVEN	0		1	N		N		
1710	NEW HAVEN	1710 NEW HAVEN	2	Floods where backyards meet	>24	N		N		
904	NICKLIN	904 NICKLIN	0		<24	N		Y	The drain at the corner of Nicklin & Elm is slow	
1801	NICKLIN	1801 NICKLIN	0		N/A	N		N	None on the street but our alley floods every time it rains. Manhole needs attention!	
1209	NICKLIN	1209 NICKLIN	0		N/A	N		Y	Storm drains in the winter	
1606	NICKLIN	1606 NICKLIN	0		<24	N		N		Street drains in 15 minutes
1203	NICKLIN	1203 NICKLIN	0		<24	N		N		
1400	NICKLIN	1400 NICKLIN	0		2	N		Y	Corner of Nickline & Lindsey always full of trash that we cannot get to. Never cleaned out. Top bent by snow plow!	
1055	NORTH	1055 NORTH	0		N/A	N		N		
600	NORTH	600 NORTH	0		N/A	N		N		
641	NORTH	641 NORTH	0		<1	N		N		
923	NORTH	923 NORTH	0		N/A	N		N		
819	NORTH	819 NORTH	0		N/A	N		N		The corner of Virginia and North St will flood for minutes with storms
633	NORTH	633 NORTH	0		<24	N		Y	After a large rain main sewer pipe backflow	
1011	NORTH	1011 NORTH	0		N/A	N		Y	Deep holes in street	
323	NORTH	323 NORTH	2		1	N		N		
320	NORTH	320 NORTH	0		<24	N		Y	Painted	
14	OMEGA	14 OMEGA						Y	Catch basin in front of 18 Omega Drive	
15	ORCHARD	15 ORCHARD	0		<24	N		N		
25	ORCHARD	25 ORCHARD	0		<24	N		N		
710	PARK	710 PARK	0		N/A	N		Y	In front of our house close to street. Two pipes are sticking out of hole	
1115	PARK	1115-1115 1/2 PARK	0		1	N		N		
1376	PARK	1376 PARK	3	Not too bad, a little towards back of property	24-48	N		N		
1008	PARK	1008 PARK	0		<24	N		N		
925	PARK	925 PARK	6	Every heavy rain		N		N		
1000	PARK	1000 PARK	0		N/A	N		Y	Corner of Park & Lincoln by stop sign	
1250	PARK	1250 PARK	0		N/A	Y	Sump pump backs up	N		
320	PARK	320 PARK				N		N		
1818	PARKWAY	1818 PARKWAY			N/A	N		N		
417	PARKWAY	417 PARKWAY	5	Backyard flooding.	>24	N		N		Several houses have heating ducts?? Fill up with water
1805	PARKWAY	1805 PARKWAY			N/A	N		Y		
15	PEREGRINE	15 PEREGRINE	>4	Large pudle at end of driveway every time it rains. Back & side yard flooded a couple times after heavy rain	48-72	N		N		
5	PEREGRINE	5 PEREGRINE	0	Back yard drain was blocked and the yard flooded	2	N		N		
322	PINEWOOD	322 PINEWOOD	0		<24	N		Y	A storm water inlet & catch basin needs to be installed at the southwest corner of the intersection of Pinewood and Brentwood	Standing water is a persistent problem at the intersection of Pinewood and Brentwood especially in winter when it freezes
409	PINEWOOD	409 PINEWOOD	0		N/A	N		N	Costs keep going up	
324	PINEWOOD	324 PINEWOOD	4	Drain acts like it is stopped up	4	N		Y	Corner of lot drainage seems plugged up	I don't understand why you have to pay for an act of God. It does not cost the city for water running to the river. The city is the reason the water is pooling because of the cement you have put down
304	PINEWOOD	304 PINEWOOD	5	Every time it rains	>168	N				Standing water a problem
305	PINEWOOD	305 PINEWOOD	0		1	N		N		Our street never has flooded since we've lived here
485	PINEWOOD	405 PINEWOOD	>4	Every time we get an inch of rain	>168	Y	Fence is rusting	N		Neighbors have similar problems
306	PINEWOOD	306 PINEWOOD	>4	Backyard flooding every hard rain.	48-72	Y	Flooded shed	N		
400	PINEWOOD	400 PINEWOOD	0		<24	N		N		
1409	PLUM	1409 PLUM	>3	Heavy Rainfall	48	N		N		My yard and neighboors flood a lot. 1413, 1411, and 1409 Plum St
907	PLYMOUTH	907 PLYMOUTH	0		<24	N		N		
903	PLYMOUTH	903 PLYMOUTH	0		N/A	N		Y	In front of the house, a bad hole is getting worse	
367	RIVERSIDE	367 RIVERSIDE	0		<24	N		N		
538	RIVERSIDE	538 RIVERSIDE	0		<24	N				
150	ROBERT M DAVIS	150 R M DAVIS	0	When business was built, run off pond installed		N		N		
917	ROBINSON	917 ROBINSON	0		<24	N		N		
603	ROBINSON	603 ROBINSON	0		N/A	N		Y	Manholes Robinson and Curb no yellow paint	They need cleaned from time to time. Nickin floods a little bit
834	ROBINSON	834 ROBINSON	7	Corner of Robinson & Lincoln (SE corner) @ drain	<24	N		Y	Corner of Robinson & Lincoln (SE corner) @ drain	
431	ROOSEVELT	431 ROOSEVELT	0		N/A	N		Y		
700	ROOSEVELT	700 ROOSEVELT			2	N		Y	Lids are off storm basins at curbs. We've reported and still no repair on Summit St. & Roosevelt Ave	
425	ROOSEVELT	425 ROOSEVELT	2		2	N		Y	Intersection at Miami St and Roosevelt Ave floods	
207	ROOSEVELT	207 ROOSEVELT	>4	Heavy Rainfall	>24	N		N		
635	ROOSEVELT	635 ROOSEVELT	0			N		N		
512	SCOTT	512 SCOTT	3	After heavy rain intersection of Scott & Saudder will flood and drain slowly.	<24	N		N		
515	SCOTT	515 SCOTT	3	Flooding during hard downpour.	1	N	Must move car	N		
421	SECOND	421 SECOND	2	Water pools. Basement floods	>24	Y	Flooding to basement	N		
520	SECOND	520 SECOND	0		1	N		Y	Grass & leaves clog it up	
1404	SEVERS	1404 SEVERS	0		<24	N		N		
302	SHOAT	302 SHORT	0		1	N		N		
541	SOUTH	541 SOUTH	0		<24	N		N		
1031	SOUTH	1031 SOUTH	0		<24	N		N		

City of Piqua
Stormwater Questionnaire Results
2013

Number	Street	Location	Flooding Frequency	Flooding Problems	Flooding Recovery Period (Hours)	Flooding Damage (Yes/No)	Flooding Damage Problems	Maintenance Required (Yes/No)	Maintenance Problems	Comments
1705	SOUTH	1705 SOUTH	>3	Every hard rain	N/A	N		N	Tends to be more from Brom Pike fiels to 1713 to 1707. We built our yard up over 48 years to save damage in our garden. It flows down boulevard (East) in Candlewood	
741	SOUTH	741 SOUTH	20-30	Everytime it rains	>168	Y	Garage foundation, rear sidewalk, fence post have sunk	Y	The alley parallel to Gordon & Cottage has no drainage. Many yards around here flood	No drainage on the backside of property (lived here 9 years).
669	SOUTH	669 SOUTH	0		<24	N		N		
1711	SOUTH	1711 SOUTH	0		N/A	N		N		
905	SOUTH	905 SOUTH	0		N/A	N		N		
726	SOUTH WAYNE	726 SOUTH WAYNE	0		N/A	N		N		
512	SPOTTED DOE	512 SPOTTED DOE	0		<24	N		N		
424	SPOTTED DOE	424 SPOTTED DOE	0		1	N		N		
421	SPOTTED DOE	421 SPOTTED DOE	0		N/A	N		Y		
225	SPRING	225 SPRING	0		<24	N		N		
8900	SR 66	8900 SR 66	0	We have four (4) storm water inlets	N/A	N		N		I try to keep leaves & trash clear of storm water inlets as much as possible
741	STAUNTON	741 STAUNTON	>4	Heavy Rainfall	2	N		Y	No curbs or catch basins	
708	SUMMIT	708 SUMMIT	0		<24	N		N		
839	SUMMIT	837-839 SUMMIT	0		N/A	N		Y	Gordon St side of property sewer grate is plugged up	
416	SUMMIT	416 SUMMIT	20	Everytime it rains	>168	Y	hot water tank foes out			
704	SUNSET	704 SUNSET	0		N/A	N		Y	Corner of sunset and Convington Ave flooded once in last 2 years	
596	SUNSET	596 SUNSET	0		<24	N		N		
626	SUNSET	626 SUNSET	0		24	N		N		
1428	SWEETBRIAR	1428 SWEET BRIAR	0		3	N		N		
1523	SWEETBRIAR	1523 SWEET BRIAR	0		<24	N		N		
4317	US RT 36	4317 US RT 36	8		48	Y	Pavement	Y		Back of parking lot
1123	VAN WAY	1123 VAN WAY			N/A	N		Y	Manhole cover removed behind 1200 Block of Van Way (odd side)	
1170	VAN WAY	1170 VAN WAY	0		<24	N		N		
509	VINE	509 VINE	0		1	N		N		
805	VINE	805 VINE	0	Flooding once in 1995 (18" in back yard).	N/A	N		N		
744	VINE	744 VINE	0			N		N		My alley needs repaired
409	VIRGINIA	409 VIRGINIA	1	Racoons live in drain	4	N		Y	400 Block	The City needs to clean out the animals and trash outside of the drain
948	WALKER	948 WALKER	>5	Everytime it rains	<24	N		N		
362	WALNUT	362 WALNUT	0		<24	N		Y	Out SE corner Ash & Walnut, it fills up for past 50 some years	
1104	WASHINGTON	1104 WASHINGTON	0		N/A	N		N	The alley behind our house needs gravel. We havea big water mess everytime it rains. Puddles	
1128	WASHINGTON	1128 WASHINGTON	0		1	N		N		606 Virginia used to flood all the way across the street
1125	WATER	1125 WATER	0		<24	N		N		
1122	WATER	1122 WATER	0		<24	N		N		
624	WATER	624 WATER	0		N/A	Y	10 years ago	N	On High St, 633 W High St by utility pole there has been a sink hole for 10 years	
300	WATER	300 WATER	3		<24	N		Y	Drain infront of 340 E Water St needs to be made bigger	
340	WATER	340 WATER	3	Drain clogs in front of house.	4	Y	Sidewalk collapsed	N		I've seen standing water 18"
400	WAYNE	400 WAYNE	0		4	N		N		
711	WAYNE	711 WAYNE	0		N/A	N		Y	Corner of Wayne & Greene St (by the old library)	I've witnessed 5 flat tires from people making sharp turns over this grate
308	WAYNE	308 WAYNE	0		10	N		N		
636	WAYNE	636 WAYNE	0		<24	Y		Y		The drain needs to be checked/cleaned often
446	WEBER	446 WEBER	0		N/A	N		N		
523	WEBER	523 WEBER	0		24	N		Y	Drainage is very slow	The water run off from the factory floods the street every time it rains. The street is deteriorating. Not to mention all of the semi trailers on a daily basis
310	WEBER	310 WEBER	3	Any hard rain	<24	Y	Basement floods			Intersection of Weber takes hours or days to drain
317	WEBER	317 WEBER	>4		>24	Y	Foundation crumbling in front of house	Y		Standing water
1016	WESTVIEW	1016 WESTVIEW	20	Swale creates a pond in backyard during rain events.	>168	Y	Killed grass	Y	Swall in backyard installed wrong	Neighbor has water backed up in back yard as well. Also water flows through empty lot next door & floods sidewalk
1015	WESTVIEW	1015 WESTVIEW	>4	Flooding every time it rains	>24	Y	At corner of westview & Eagles Lake Dr runs down sidewalk	Y	The so called "drain" on the other side of street takes water from field down to Eagles Lake	Would like to be contacted at 1-927-418-4447
1012	WESTVIEW	1012 WESTVIEW	>3	Flooding every heavy rain	>168	Y	Soil erosion	Y	Field behind property needs upgraded to 30" storm drain 30 yards to the south	1012 Westview Drive.pdf
2304	WHITE TAIL	2304 WHITE TAIL	0		<24	N		N		
1839	WILSHIRE	1839 WILSHIRE			<24	N		N		
2225	WILSHIRE	2225-2227 WILSHIRE	1	Flooding occurs during extra heavy rain between Westfield to the middle of Sambor.	3	N		N		
2212	WILSHIRE	2212 WILSHIRE	0		<24	N		N		
2200	WILSHIRE	2200 WILSHIRE	0		N/A	N		Y	Manholes @ intersction of Lambert Dr & Wilshire Dr	
2008	WILSHIRE	2008 WILSHIRE	0		<24	N		N		
1830	WILSHIRE	1830 WILSHIRE				N		Y		
710	WILSON	710 WILSON	6	Alley drainage is causing this issue.	3	Y	Has caused concrete slab to sink gravel dumps from alley into yard	N		This issue also causes flooding issues in the back of the neighboring house 714 Wilson
515	WILSON	515 WILSON	0		<24	N		N		

City of Piqua
Stormwater Questionnaire Results
2013

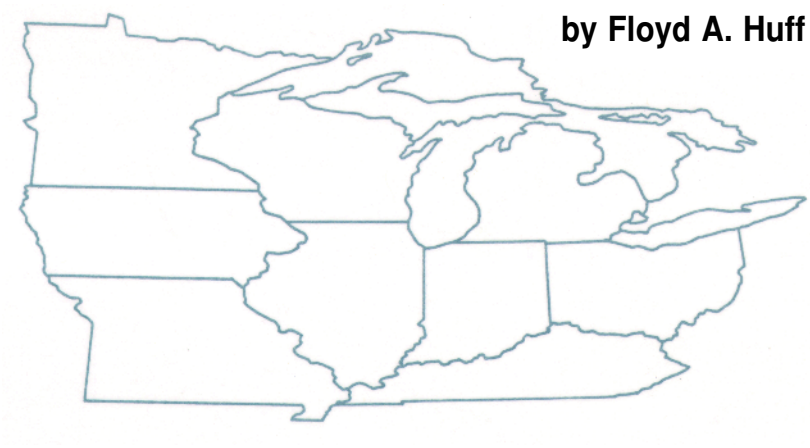
Number	Street	Location	Flooding Frequency	Flooding Problems	Flooding Recovery Period (Hours)	Flooding Damage (Yes/No)	Flooding Damage Problems	Maintenance Required (Yes/No)	Maintenance Problems	Comments
427	WILSON	427 WILSON	>4	Every rain	>168	Y	Large potholes	Y	At corner of Wilson/Grant, this area has not drained in years	
501	WOOD	501 WOOD	0		<24	N		N		The street at the corner of Wood and Wever is lower than the drain. It takes a while to drain.
339	WOOD	339 WOOD	0		N/A	N		N		Wood St doesn't flood and water drains quickly
322	WYNDHAM	322 WYNDHAM	0		<24	N		N		
908	YOUNG	908 YOUNG	0		N/A	N		Y	Corner of Young & Gordon water backs up onto street	
451	YOUNG	451 YOUNG	3	A few times I think it flooded from hard rains. It's not all that bad	N/A	N		N		
										There is a field between 382 Garbry and 336 Garbry which floods our garage and there is a pond of standing water that sits and draws mosquitoes

Appendix E Bulletin 71 Documentation

Bulletin 71
(MCC Research Report 92-03)

RAINFALL FREQUENCY ATLAS OF THE MIDWEST

by Floyd A. Huff and James R. Angel



Midwestern Climate Center
Climate Analysis Center
National Weather Service
National Oceanic and Atmospheric Administration

and

Illinois State Water Survey
A Division of the Illinois Department of Energy and Natural Resources

1992

(MCC) with Stanley Changnon and Peter J. Lamb as the co-principal investigators. The work was continued and completed under the general direction of Kenneth Kunkel, present MCC Director.

Special appreciation goes to Stan Changnon for his foresight, guidance, and encouragement in establishing and accomplishing the program objectives. He and Ken Kunkel reviewed the report and made useful comments and suggestions. Special thanks go to Richard Katz, National Center for Atmospheric Research; Tibor Farago, Hungarian Meteorological Service; and J.R.M. Hosking, IBM Research Division, for providing software for some of the extreme rainfall analyses. Fred Nurnberger, Michigan State Climatologist, provided valuable long-term precipitation data for his state as well as comments on the manuscript. We also thank the following state climatologists for their review and comments on this project: Wayne Wendland, Illinois; Ken Scheeringa, Indiana; Harry Hillaker, Iowa; Glen Conner, Kentucky; Jim Zandlo, Minnesota; Wayne Decker, Missouri; Jeff Rogers, Ohio; and Pam Naber-Knox, Wisconsin.

John Brother and Linda Hascall supervised the extensive drafting work required for the report. Jean Dennison typed and assembled the report, which Eva Kingston edited and formatted.

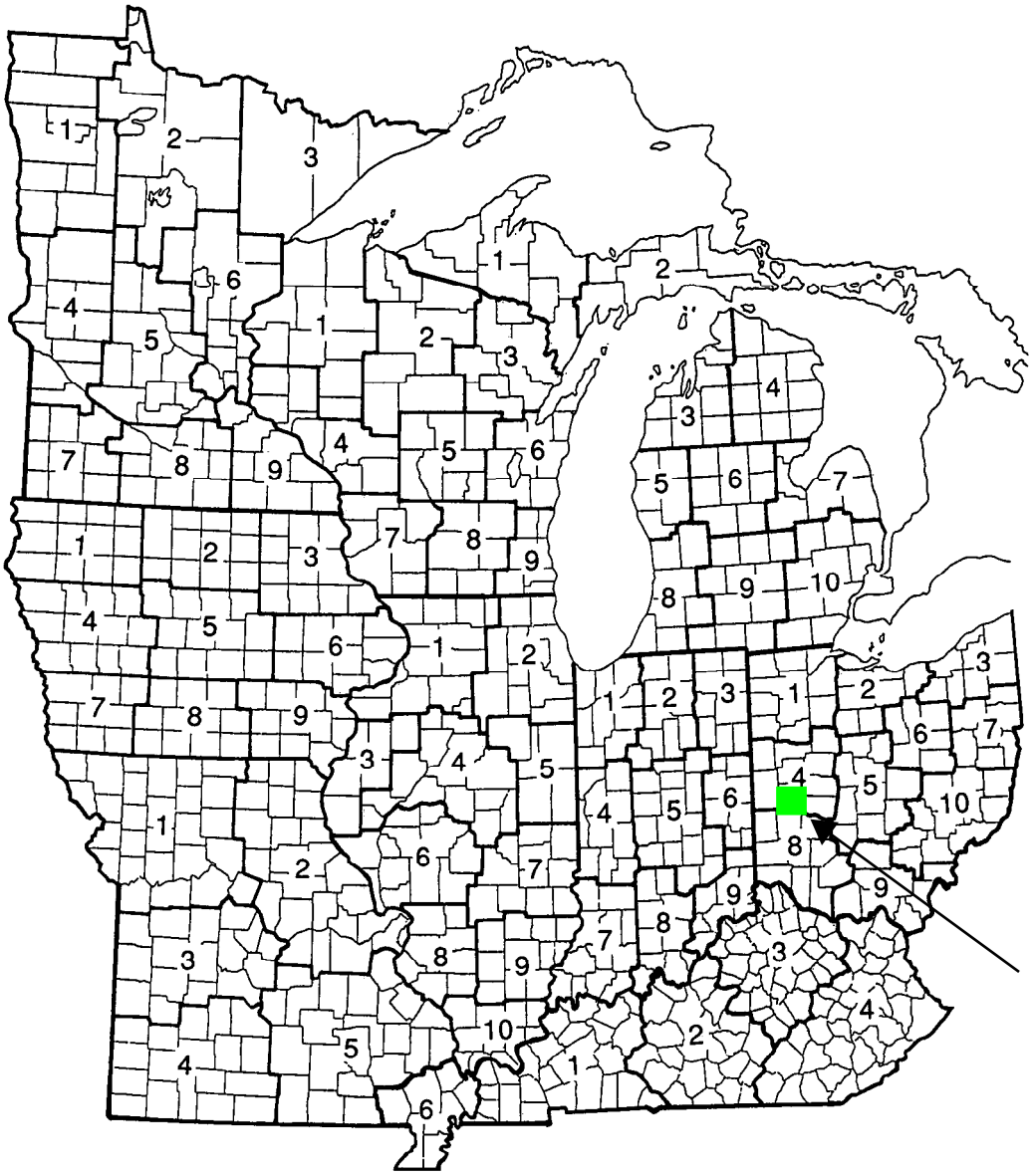


Figure 1. Climatic sections for the Midwest

Table 8. Sectional Mean Frequency Distributions for Storm Periods of 5 Minutes to 10 Days and Recurrence Intervals of 2 Months to 100 Years in Ohio

Sectional code (see figure 1 on page 4)

01 – Northwest	*06 -Central Hills*
02 - North Central	*07 - Northeast Hills*
03 – Northeast	*08 - Southwest*
04 - West Central	*09 - South Central*
05 – Central	*10 - Southeast*

Rainfall (inches) for given recurrence interval

Section	*Duration*	*2-month*	*3-month*	*4-month*	*6-month*	*9-month*	*1-year*	*2-year*	*5-year*	*10-year*	*25-year*	*50-year*	*100-year*
01	10-day	1.69	2.04	2.35	2.76	3.17	3.45	4.22	5.17	5.89	6.83	7.56	8.31
01	5-day	1.42	1.70	1.93	2.23	2.57	2.79	3.43	4.29	4.92	5.81	6.51	7.26
01	72-hr	1.27	1.49	1.69	1.96	2.25	2.45	3.05	3.77	4.33	5.17	5.89	6.71
01	48-hr	1.17	1.36	1.52	1.76	2.02	2.20	2.74	3.43	3.96	4.74	5.40	6.14
01	24-hr	1.12	1.30	1.42	1.64	1.87	2.03	2.52	3.18	3.70	4.43	5.05	5.73
01	18-hr	1.05	1.22	1.34	1.55	1.76	1.91	2.37	2.99	3.48	4.16	4.75	5.39
01	12-hr	0.97	1.13	1.24	1.43	1.63	1.77	2.19	2.77	3.22	3.85	4.39	4.99
01	6-hr	0.84	0.97	1.06	1.23	1.40	1.52	1.89	2.38	2.78	3.32	3.79	4.30
01	3-hr	0.71	0.83	0.91	1.05	1.20	1.30	1.61	2.04	2.37	2.84	3.23	3.67
01	2-hr	0.65	0.76	0.83	0.96	1.09	1.18	1.46	1.84	2.15	2.57	2.93	3.32
01	1-hr	0.52	0.61	0.66	0.77	0.87	0.95	1.18	1.49	1.74	2.08	2.37	2.69
01	30-min	0.41	0.48	0.52	0.61	0.69	0.75	0.93	1.18	1.37	1.64	1.87	2.12
01	15-min	0.30	0.35	0.38	0.45	0.51	0.55	0.68	0.86	1.00	1.20	1.36	1.55
01	10-min	0.24	0.28	0.30	0.35	0.40	0.43	0.53	0.67	0.78	0.93	1.06	1.20
01	5-min	0.13	0.15	0.17	0.19	0.22	0.24	0.30	0.38	0.44	0.53	0.61	0.69
02	10-day	1.63	1.96	2.26	2.66	3.05	3.32	4.19	5.31	6.19	7.40	8.35	9.35
02	5-day	1.35	1.61	1.82	2.11	2.43	2.64	3.33	4.32	5.10	6.21	7.14	8.14
02	72-hr	1.22	1.43	1.61	1.87	2.15	2.34	2.93	3.69	4.34	5.39	6.33	7.39
02	48-hr	1.14	1.33	1.48	1.72	1.98	2.15	2.67	3.37	3.94	4.86	5.70	6.68
02	24-hr	1.09	1.27	1.39	1.60	1.82	1.98	2.44	3.06	3.55	4.35	5.08	5.92
02	18-hr	1.02	1.19	1.30	1.51	1.71	1.86	2.29	2.88	3.34	4.09	4.78	5.56
02	12-hr	0.95	1.10	1.20	1.39	1.58	1.72	2.12	2.66	3.09	3.78	4.42	5.15
02	6-hr	0.82	0.95	1.04	1.21	1.37	1.49	1.83	2.30	2.66	3.26	3.81	4.44
02	3-hr	0.70	0.81	0.89	1.03	1.17	1.27	1.56	1.96	2.27	2.78	3.25	3.79
02	2-hr	0.63	0.74	0.80	0.93	1.06	1.15	1.42	1.77	2.06	2.52	2.95	3.43
02	1-hr	0.51	0.60	0.65	0.75	0.86	0.93	1.15	1.44	1.67	2.04	2.39	2.78
02	30-min	0.40	0.47	0.51	0.59	0.67	0.73	0.90	1.13	1.31	1.61	1.88	2.19
02	15-min	0.29	0.34	0.37	0.43	0.49	0.53	0.66	0.83	0.96	1.17	1.37	1.60
02	10-min	0.23	0.27	0.29	0.34	0.39	0.42	0.51	0.64	0.75	0.91	1.07	1.24
02	5-min	0.13	0.15	0.17	0.19	0.22	0.24	0.29	0.37	0.43	0.52	0.61	0.71
03	10-day	1.70	2.05	2.36	2.78	3.19	3.47	4.29	5.34	6.17	7.30	8.19	9.14
03	5-day	1.37	1.64	1.86	2.15	2.47	2.69	3.34	4.23	4.95	5.96	6.82	7.74
03	72-hr	1.26	1.48	1.67	1.94	2.23	2.42	2.99	3.72	4.34	5.31	6.15	7.09
03	48-hr	1.18	1.38	1.53	1.78	2.04	2.22	2.75	3.42	3.99	4.87	5.66	6.55
03	24-hr	1.12	1.31	1.43	1.65	1.88	2.04	2.50	3.10	3.60	4.39	5.11	5.89
03	18-hr	1.06	1.23	1.34	1.56	1.77	1.92	2.35	2.91	3.38	4.13	4.80	5.54
03	12-hr	0.97	1.13	1.24	1.43	1.63	1.77	2.17	2.70	3.13	3.82	4.45	5.12
03	6-hr	0.84	0.98	1.07	1.24	1.41	1.53	1.88	2.32	2.70	3.29	3.83	4.42
03	3-hr	0.72	0.84	0.92	1.06	1.21	1.31	1.60	1.98	2.30	2.81	3.27	3.77
03	2-hr	0.65	0.76	0.83	0.96	1.09	1.18	1.45	1.80	2.09	2.55	2.96	3.42
03	1-hr	0.53	0.61	0.67	0.78	0.88	0.96	1.17	1.46	1.69	2.06	2.40	2.77
03	30-min	0.41	0.48	0.52	0.61	0.69	0.75	0.93	1.15	1.33	1.62	1.89	2.18
03	15-min	0.30	0.35	0.38	0.45	0.51	0.55	0.68	0.84	0.97	1.19	1.38	1.59
03	10-min	0.24	0.28	0.30	0.35	0.40	0.43	0.52	0.65	0.76	0.92	1.07	1.24
03	5-min	0.13	0.15	0.17	0.19	0.22	0.24	0.30	0.37	0.43	0.53	0.61	0.71

Table 8. Continued

Rainfall (inches) for given recurrence interval

Section	*Duration*	*2-month*	*3-month*	*4-month*	*6-month*	*9-month*	*1-year*	*2-year*	*5-year*	*10-year*	*25-year*	*50-year*	*100-year*
04	10-day	1.85	2.23	2.57	3.02	3.48	3.78	4.59	5.63	6.43	7.48	8.30	9.19
04	5-day	1.54	1.84	2.08	2.41	2.77	3.01	3.65	4.54	5.22	6.17	6.92	7.74
04	72-hr	1.36	1.59	1.80	2.09	2.40	2.61	3.19	3.88	4.46	5.33	6.12	6.97
04	48-hr	1.25	1.46	1.62	1.88	2.16	2.35	2.91	3.58	4.09	4.88	5.56	6.35
04	24-hr	1.18	1.38	1.50	1.74	1.98	2.15	2.69	3.34	3.80	4.46	5.06	5.70
04	18-hr	1.11	1.29	1.41	1.64	1.86	2.02	2.53	3.14	3.57	4.19	4.76	5.36
04	12-hr	1.03	1.20	1.31	1.51	1.72	1.87	2.34	2.91	3.31	3.88	4.40	4.96
04	6-hr	0.89	1.03	1.13	1.30	1.48	1.61	2.02	2.50	2.85	3.35	3.80	4.27
04	3-hr	0.76	0.88	0.97	1.12	1.27	1.38	1.72	2.14	2.43	2.85	3.24	3.65
04	2-hr	0.69	0.80	0.88	1.01	1.15	1.25	1.56	1.94	2.20	2.59	2.93	3.31
04	1-hr	0.56	0.65	0.71	0.82	0.93	1.01	1.26	1.57	1.79	2.10	2.38	2.68
04	30-min	0.44	0.51	0.56	0.65	0.74	0.80	1.00	1.24	1.41	1.65	1.87	2.11
04	15-min	0.32	0.37	0.41	0.47	0.53	0.58	0.73	0.90	1.03	1.20	1.37	1.54
04	10-min	0.25	0.29	0.31	0.36	0.41	0.45	0.56	0.70	0.80	0.94	1.06	1.20
04	5-min	0.14	0.17	0.18	0.21	0.24	0.26	0.32	0.40	0.46	0.54	0.61	0.68
05	10-day	1.81	2.18	2.51	2.95	3.39	3.69	4.69	5.93	6.78	7.82	8.56	9.27
05	5-day	1.49	1.78	2.01	2.34	2.69	2.92	3.67	4.65	5.39	6.37	7.11	7.89
05	72-hr	1.36	1.59	1.80	2.09	2.40	2.61	3.23	3.99	4.54	5.36	6.09	6.92
05	48-hr	1.27	1.48	1.65	1.91	2.20	2.39	2.97	3.67	4.21	5.02	5.72	6.50
05	24-hr	1.19	1.39	1.52	1.76	2.00	2.17	2.70	3.35	3.86	4.64	5.33	6.06
05	18-hr	1.12	1.31	1.43	1.65	1.88	2.04	2.54	3.15	3.63	4.36	5.01	5.70
05	12-hr	1.04	1.21	1.32	1.53	1.74	1.89	2.35	2.91	3.36	4.04	4.64	5.27
05	6-hr	0.90	1.04	1.14	1.32	1.50	1.63	2.03	2.51	2.89	3.48	4.00	4.55
05	3-hr	0.76	0.89	0.97	1.13	1.28	1.39	1.73	2.14	2.47	2.97	3.41	3.88
05	2-hr	0.69	0.81	0.88	1.02	1.16	1.26	1.57	1.94	2.24	2.69	3.09	3.51
05	1-hr	0.56	0.65	0.71	0.83	0.94	1.02	1.27	1.57	1.81	2.18	2.51	2.85
05	30-min	0.44	0.51	0.56	0.65	0.74	0.80	1.00	1.24	1.43	1.72	1.97	2.24
05	15-min	0.32	0.38	0.41	0.48	0.54	0.59	0.73	0.90	1.04	1.25	1.44	1.64
05	10-min	0.25	0.29	0.32	0.37	0.42	0.46	0.57	0.70	0.81	0.97	1.12	1.27
05	5-min	0.14	0.17	0.18	0.21	0.24	0.26	0.32	0.40	0.46	0.56	0.64	0.73
06	10-day	1.72	2.08	2.39	2.82	3.24	3.52	4.35	5.47	6.38	7.61	8.66	9.74
06	5-day	1.41	1.68	1.90	2.21	2.54	2.76	3.33	4.24	4.98	6.15	7.12	8.21
06	72-hr	1.30	1.53	1.73	2.00	2.30	2.50	2.99	3.72	4.41	5.53	6.54	7.69
06	48-hr	1.22	1.43	1.59	1.85	2.13	2.31	2.78	3.44	4.09	5.12	6.06	7.17
06	24-hr	1.16	1.35	1.48	1.71	1.94	2.11	2.51	3.11	3.68	4.57	5.41	6.39
06	18-hr	1.09	1.27	1.39	1.60	1.82	1.98	2.36	2.92	3.46	4.30	5.09	6.01
06	12-hr	1.01	1.18	1.29	1.49	1.69	1.84	2.18	2.71	3.20	3.98	4.71	5.56
06	6-hr	0.87	1.01	1.11	1.28	1.45	1.58	1.88	2.33	2.76	3.43	4.06	4.79
06	3-hr	0.74	0.86	0.94	1.09	1.24	1.35	1.61	1.99	2.36	2.92	3.46	4.09
06	2-hr	0.67	0.78	0.85	0.99	1.12	1.22	1.46	1.80	2.13	2.65	3.14	3.71
06	1-hr	0.54	0.63	0.69	0.80	0.91	0.99	1.18	1.46	1.73	2.15	2.54	3.00
06	30-min	0.43	0.50	0.55	0.63	0.72	0.78	0.93	1.15	1.36	1.69	2.00	2.36
06	15-min	0.31	0.36	0.40	0.46	0.52	0.57	0.68	0.84	0.99	1.23	1.46	1.73
06	10-min	0.24	0.28	0.31	0.36	0.40	0.44	0.53	0.65	0.77	0.96	1.14	1.34
06	5-min	0.14	0.16	0.17	0.20	0.23	0.25	0.30	0.37	0.44	0.55	0.65	0.77

Table 8. Continued

Rainfall (inches) for given recurrence interval

Section	*Duration*	*2-month*	*3-month*	*4-month*	*6-month*	*9-month*	*1-year*	*2-year*	*5-year*	*10-year*	*25-year*	*50-year*	*100-year*
07	10-day	1.71	2.06	2.37	2.79	3.21	3.49	4.33	5.37	6.10	7.03	7.77	8.48
07	5-day	1.40	1.67	1.89	2.19	2.52	2.74	3.32	4.11	4.72	5.55	6.26	6.99
07	72-hr	1.28	1.51	1.70	1.98	2.27	2.47	2.98	3.64	4.15	4.94	5.63	6.39
07	48-hr	1.19	1.39	1.55	1.79	2.06	2.24	2.73	3.33	3.81	4.53	5.15	5.81
07	24-hr	1.12	1.30	1.42	1.64	1.87	2.03	2.50	3.02	3.42	3.94	4.41	4.92
07	18-hr	1.05	1.22	1.34	1.55	1.76	1.91	2.35	2.84	3.21	3.70	4.15	4.62
07	12-hr	0.97	1.13	1.24	1.43	1.63	1.77	2.17	2.63	2.98	3.43	3.84	4.28
07	6-hr	0.84	0.97	1.06	1.23	1.40	1.52	1.88	2.26	2.57	2.95	3.31	3.69
07	3-hr	0.71	0.83	0.91	1.05	1.20	1.30	1.60	1.93	2.19	2.52	2.82	3.15
07	2-hr	0.65	0.76	0.83	0.96	1.09	1.18	1.45	1.75	1.98	2.29	2.56	2.85
07	1-hr	0.52	0.61	0.66	0.77	0.87	0.95	1.17	1.42	1.61	1.85	2.07	2.31
07	30-min	0.41	0.48	0.52	0.61	0.69	0.75	0.93	1.12	1.27	1.46	1.63	1.82
07	15-min	0.30	0.35	0.38	0.45	0.51	0.55	0.68	0.82	0.92	1.06	1.19	1.33
07	10-min	0.24	0.28	0.30	0.35	0.40	0.43	0.52	0.63	0.72	0.83	0.93	1.03
07	5-min	0.13	0.15	0.17	0.19	0.22	0.24	0.30	0.36	0.41	0.47	0.53	0.59
08	10-day	1.96	2.35	2.71	3.19	3.67	3.99	4.97	6.15	7.02	8.09	8.89	9.71
08	5-day	1.59	1.90	2.15	2.49	2.86	3.11	3.92	4.94	5.66	6.58	7.32	8.05
08	72-hr	1.45	1.70	1.92	2.22	2.56	2.78	3.43	4.22	4.83	5.70	6.47	7.29
08	48-hr	1.35	1.58	1.76	2.04	2.35	2.55	3.15	3.87	4.44	5.26	5.98	6.77
08	24-hr	1.28	1.49	1.63	1.89	2.14	2.33	2.86	3.49	3.99	4.70	5.32	6.04
08	18-hr	1.20	1.40	1.53	1.77	2.01	2.19	2.69	3.28	3.75	4.42	5.00	5.68
08	12-hr	1.12	1.30	1.42	1.64	1.87	2.03	2.49	3.04	3.47	4.09	4.63	5.25
08	6-hr	0.96	1.12	1.23	1.42	1.61	1.75	2.14	2.62	2.99	3.52	3.99	4.53
08	3-hr	0.82	0.95	1.04	1.21	1.37	1.49	1.83	2.23	2.55	3.01	3.40	3.87
08	2-hr	0.74	0.86	0.94	1.09	1.24	1.35	1.66	2.02	2.31	2.73	3.09	3.50
08	1-hr	0.61	0.70	0.77	0.89	1.01	1.10	1.34	1.64	1.88	2.21	2.50	2.84
08	30-min	0.47	0.55	0.60	0.70	0.79	0.86	1.06	1.29	1.48	1.74	1.97	2.23
08	15-min	0.35	0.40	0.44	0.51	0.58	0.63	0.77	0.94	1.08	1.27	1.44	1.63
08	10-min	0.27	0.31	0.34	0.40	0.45	0.49	0.60	0.73	0.84	0.99	1.12	1.27
08	5-min	0.15	0.18	0.20	0.23	0.26	0.28	0.34	0.42	0.48	0.56	0.64	0.72
09	10-day	1.91	2.30	2.65	3.12	3.59	3.90	4.91	6.09	6.92	7.92	8.62	9.35
09	5-day	1.61	1.92	2.17	2.52	2.90	3.15	3.92	4.92	5.66	6.65	7.43	8.24
09	72-hr	1.46	1.71	1.94	2.25	2.59	2.81	3.42	4.20	4.82	5.78	6.65	7.58
09	48-hr	1.35	1.58	1.76	2.04	2.35	2.55	3.10	3.79	4.39	5.31	6.14	7.08
09	24-hr	1.26	1.47	1.60	1.85	2.11	2.29	2.79	3.42	4.01	4.87	5.66	6.50
09	18-hr	1.18	1.38	1.50	1.74	1.98	2.15	2.62	3.21	3.77	4.58	5.32	6.11
09	12-hr	1.09	1.27	1.39	1.61	1.83	1.99	2.43	2.98	3.49	4.24	4.92	5.66
09	6-hr	0.95	1.10	1.20	1.39	1.58	1.72	2.09	2.57	3.01	3.65	4.24	4.88
09	3-hr	0.81	0.94	1.03	1.19	1.35	1.47	1.79	2.19	2.57	3.12	3.62	4.16
09	2-hr	0.73	0.85	0.93	1.08	1.22	1.33	1.62	1.98	2.33	2.82	3.28	3.77
09	1-hr	0.59	0.69	0.76	0.87	0.99	1.08	1.31	1.61	1.88	2.29	2.66	3.06
09	30-min	0.47	0.54	0.60	0.69	0.78	0.85	1.03	1.27	1.48	1.80	2.09	2.40
09	15-min	0.34	0.40	0.43	0.50	0.57	0.62	0.75	0.92	1.08	1.31	1.53	1.76
09	10-min	0.26	0.31	0.34	0.39	0.44	0.48	0.59	0.72	0.84	1.02	1.19	1.37
09	5-min	0.15	0.17	0.19	0.22	0.25	0.27	0.33	0.41	0.48	0.58	0.68	0.78

Table 8. Concluded

Rainfall (inches) for given recurrence interval

Section	*Duration*	*2-month*	*3-month*	*4-month*	*6-month*	*9-month*	*1-year*	*2-year*	*5-year*	*10-year*	*25-year*	*50-year*	*100-year*
10	10-day	1.70	2.04	2.35	2.77	3.18	3.46	4.41	5.58	6.38	7.38	8.09	8.80
10	5-day	1.43	1.71	1.93	2.24	2.58	2.80	3.52	4.44	5.07	5.86	6.42	6.98
10	72-hr	1.28	1.51	1.70	1.98	2.27	2.47	3.07	3.78	4.32	5.08	5.69	6.33
10	48-hr	1.18	1.38	1.54	1.78	2.05	2.23	2.77	3.42	3.94	4.67	5.25	5.88
10	24-hr	1.12	1.30	1.42	1.64	1.87	2.03	2.54	3.17	3.64	4.34	4.91	5.51
10	18-hr	1.05	1.22	1.34	1.55	1.76	1.91	2.39	2.98	3.42	4.08	4.62	5.18
10	12-hr	0.97	1.13	1.24	1.43	1.63	1.77	2.21	2.76	3.17	3.78	4.27	4.79
10	6-hr	0.84	0.97	1.06	1.23	1.40	1.52	1.90	2.38	2.73	3.26	3.68	4.13
10	3-hr	0.71	0.83	0.91	1.05	1.20	1.30	1.63	2.03	2.33	2.78	3.14	3.53
10	2-hr	0.65	0.76	0.83	0.96	1.09	1.18	1.47	1.84	2.11	2.52	2.85	3.20
10	1-hr	0.52	0.61	0.66	0.77	0.87	0.95	1.19	1.49	1.71	2.04	2.31	2.59
10	30-min	0.41	0.48	0.52	0.61	0.69	0.75	0.94	1.17	1.35	1.61	1.82	2.04
10	15-min	0.30	0.35	0.38	0.45	0.51	0.55	0.69	0.86	0.98	1.17	1.33	1.49
10	10-mín	0.24	0.28	0.30	0.35	0.40	0.43	0.53	0.67	0.76	0.91	1.03	1.16
10	5-min	0.13	0.15	0.17	0.19	0.22	0.24	0.30	0.38	0.44	0.52	0.59	0.66

Appendix F Public Meeting Information

Storm Water Open House
Attendance Register

Date: 10-16-13

Name	Association – Phone #
1. Dick Brandewie	CAC 773-2460
2. Michael Rindler	Piqua FD 778-2014
3. Cindy Holtzapple	City of Piqua 778-2070
4. Dan Frinch	Sunset Dr, PPP
5. Dean Burch	City of Piqua
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Christmas Extravaganza
Grand Prize $1,000 Christmas Cash
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10/21/2013 9:37:00 AM

Phase I of city's storm water project reviewed

By Bethany J. Royer
Staff Writer

PIQUA - Half-fixes won't do when it comes to tackling issues related to the city's stormwater system, as evaluation, careful planning and knowing what one is working with takes precedence. These were just a few of the items emphasized at a recent open house to review Phase I of the stormwater master plan, held in the commission chambers at the government complex.

"First we did a GIS map, showing the storm system," explained David Burtner, director of utilities, of steps already taken in Phase I. The idea behind the open house was to not only review the first phase, which includes the western section of the city, but high-light the reasons for bringing in URS Corporation, an engineering, construction and technical services firm. Who will consult the city of Piqua through the development of a master plan (Course of action) to address concerns related to the stormwater system.

What is stormwater?

* Water that originates during precipitation events

* Snow-melt that enters the stormwater system

* Stormwater that does not soak into the ground and becomes surface runoff

Burtner was joined by Devon Alexander, stormwater coordinator, Shane Johnson, underground utilities supervisor, and many other city leaders and URS consultants, with a variety of maps on display including the GIS map or geographic information system. A pivotal step allowing for an assessment to be made of the multiple components making up the stormwater system, one that consists of some 130 miles of pipes. From this vantage point the city now knows what they are working with, can gauge both current and potential problems, and implement the best course of action.

"We don't want to throw money away," said Burtner of the need for proper evaluation and the time it will take for such so the city doesn't end up with, "a half-fix. We need to solve the problem completely. "

While the stormwater master plan is considered to be in its infant stage, which will eventually include all parts of the city, Burtner sees positives already in action. Those being preventive maintenance programs such as the recent hiring of two new employees to the underground utilities department to clean sewers and replace/clean catch-basins, among many other necessities to a properly functioning system.

Why is a stormwater master plan so important?

* Control flooding and erosion

* Manage and control hazardous materials to prevent release of pollutants into the environment

* Plan and construct storm water systems so contaminants are removed before they pollute surface waters or groundwater resources

* Acquire and protect natural waterways where they still exist or can be rehabilitated

* Revise current storm water regulations to address comprehensive storm water needs

* Develop long-term asset management programs to repair and replace aging infrastructure

Next year the city will begin to look into Phase II with a plan to evaluate the Shawnee neighborhood due to flooding in that area.

URS

City of Piqua
Stormwater Master Plan-Phase 1
Summary of Work Completed

October 15, 2013

DISCUSSION ITEMS:

1. **Stormwater Master Plan Phase 1- (75% complete)**

Task 1-Background Investigations/Problem Identification
Items Completed:

- Attended two field review meetings with City staff.
- Conducted interviews of City staff.
- Reviewed stormwater master planning studies, detention basin information and stormwater engineering reports made available to date.
- Created a marked up map of areas of street, yard and structure flooding due to localized stormwater runoff problems that the City is aware of.

Task 2: Stormwater GIS Mapping Review and Update.
Items Completed:

- Imported new aerial photograph of the City into GIS.
- Created a new layer showing major stormwater problem areas reported by City staff.
- Created a new impervious area layer.
- Created a new drainage tile and drainage ditch layer based on mapping received from County.

Task 3: Stormwater Management Model (SWMM Model) Development
Items Completed:

- Imported existing GIS data on storm sewer system into the SWMM model
- Made corrections to storm sewer system data using available information.
- Used field surveyors and the City crew to resolve pipe size and alignment issues.
- Entered impervious areas in the City into the GIS.
- Entered County drainage tile and ditches information into the GIS.
- Developed drainage areas using the model.
- Ran SWMM model on the entire City.

Task 4: Public Involvement/Public Outreach
Items Completed:

- Held initial meeting with City staff.
- Created a stormwater questionnaire that was mailed out by the City.
- Reviewed and tabulated 500 questionnaire responses received.

- Developed a problem area map for the entire City showing stormwater problem locations by address.

Task 5: Prepare Stormwater Master Plan Phase 1 Report

Items Completed:

- Created figures and tables showing data collected.
- Prepared modeling and existing conditions sections of report.

Task 6: Prepare Letter Report for Deerfield/Eagles Nest Subdivision Area

Items Completed:

- Reviewed existing Stormwater Master Plan Report (1992)
- Reviewed existing drainage easement for French's Ditch.
- Reviewed calculations and drawings for Eagles Nest/Deerfield detention basins.
- Reviewed City GIS maps for deficiencies and reported storm sewer mapping problems to City.
- Revised GIS mapping of the storm sewer system and inputted new mapping into the SWMM model.
- Met with City field staff in Eagles Nest/Deerfield and participated in field work to resolve pipe sizing and alignment questions. Met with one property owner to discuss problems related to French's Ditch.
- Obtained and reviewed County Engineer ditch and tile plans for drainage that enters the Subdivision Area.
- Prepared a working storm sewer model of the Eagles Nest/Deerfield Subdivision storm sewers.
- Prepared a final letter report that looks at three alternatives to resolve stormwater problems the area (submitted October 15, 2013).