City of Franklin

Stormwater Master Plan

February 27, 2015

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Executive Summary

The City of Franklin retained Whitaker Engineering, P.C., (WE) to prepare a Stormwater Master Plan (SWMP) to identify stormwater drainage problem areas throughout the City. The study prioritizes the identified problem areas and provides estimated costs for the design and construction of the projects. The study identifies 12 potential projects ranging from a $100,000 project that provides localized benefits to multi-million dollar projects offering regional benefits for the community. The projects include detention facilities, new storm sewers, storm sewer lining, streambank stabilization and channel improvements, and an outfall rehabilitation project (Table 1). The total cost of these improvements is estimated to be $42 million in 2015 dollars. Implementation of the Stormwater Master Plan requires dedicated sources of funding and, ideally, would be phased over a period of time. The project areas can be further broken up into manageable pieces to maximize funding sources.

The City is a regulated Municipal Separate Storm Sewer System (MS4) community and has an active National Pollution Discharge Elimination System (NPDES) Stormwater Permit from the Indiana Department of Environmental Management (IDEM). The Stormwater Master Plan and the City's NPDES permit are linked through permit requirements. The NPDES permit requires the City to carry out annual stormwater quality program compliance tasks related to establishing measurable goals and using best management practices (BMPs) to address water quality.

Introduction

Franklin is located at the confluence of Youngs Creek and Hurricane Creek. Youngs Creek has 56-square-mile watershed extending as far north as Main Street in Greenwood and as far south as Trafalgar in southern Johnson County. Hurricane Creek has a 16-square-mile watershed. Together these creeks drain almost one quarter of the runoff from Johnson County (Exhibit 1).

The volume of water that flowed through the City in June 2008 was unprecedented. Between June 6th and 7th the City received 7.6 inches of rain in a 24-hour period. According to an open file report issued by the United States Geological Survey (USGS), a storm of this magnitude is between a 500-year and 1,000-year storm event (Appendix A). The 500-year and 1000-year storm events yield 7.2 inches and 7.8 inches of rain respectively. Therefore, the June 2008 storm event in Franklin could be characterized as an 800-year storm event. Over 100 homes were damaged or destroyed.

Flood mitigation quickly came to the forefront as a major issue and concern. In response as a result of the flood, the City retained various engineering consultants to perform numerous studies and complete projects that could mitigate flooding and reduce damage from future floods. The studies addressed localized and regional flooding and proposed traditional solutions along with green infrastructure solutions. Most of the projects recommended from the studies have not been built as funding was not available at the time; however, in 2010 the stormwater utility rate structure was adopted and funds began accumulating, which may be used to fund these types of projects. The City is actively preparing to design and construct projects in a strategic manner that will benefit and improve the quality of life for its citizens.

The need for a comprehensive, guiding document that not only addresses drainage issues from a city-wide perspective but also prioritizes those issues and associated projects for current and future staff members and city officials to reference. The stormwater master plan addresses this need.

Purpose

The Stormwater Master Plan (SWMP) presents findings, observations, and recommendations for future stormwater infrastructure projects and improvements which are based upon short and long-term needs. Miscellaneous discussions pertaining to public policy and funding are also summarized and addressed. The purpose of the master plan is to provide an understanding of the stormwater infrastructure capacity and quality and to address the areas of concern. Ideally, current and future city staff and elected officials will be able to use the SWMP as a guiding document for future planning, design, and construction.

Scope of Work

The City retained WE to complete a Stormwater Master Plan. The scope of work consisted of several tasks.

1. Administrative Project Meetings – held a variety of meetings, including meetings with staff and board meetings and a public input meeting,
2. Evaluation & Assessment – reviewed existing drainage studies, prepared an overall capital improvement plan map showing areas of major and minor drainage concerns, performed field reconnaissance in existing areas of deficient drainage, and documented with photographs, and prepared Initial Priority Rating (IPR) spreadsheets of the 10 most critical and highest priority projects
3. Storm Sewer System Mapping –gathered relevant design and as-built drawings, assessed the storm sewer data collected by previous consultants and the City and to determine the extent of remaining data to be collected, collected horizontal and vertical coordinates in survey-grade accuracy for up to 400 storm structures, and produced a GIS map of collected storm sewer piping runs and structures.
4. Modeling for Proposed Areas of Concerns and Potential Projects –created stormwater management model (SWMM) model of storm sewer infrastructure including pipes, 18 inches and larger.
5. Report –generated a document with the following information:
    a. Summary of the history of stormwater problems,
    b. A listing of prioritized projects (12 projects) with an implementation plan and an opinion of probable cost (OPC) associated with each project, and
    c. Summary of advantages and disadvantages for each project.
6. Review Stormwater Ordinance – consisted of the following:
    a. Reviewed the draft stormwater management ordinance with regards to economic impact of environmental controls for discharges,
    b. Reviewed implementation of green infrastructure practices with regards to future development, water quality and the financial impact to private developers,
    c. Reviewed post-construction BMP inspection and/or maintenance issues and policies as it relates to the overall stormwater management of the MS4, and

d. Prepared a comment letter with recommended revisions to the draft stormwater ordinance.

Staff & Public Input

Input from city staff and citizens is critical to the creation and implementation of a Stormwater Master Plan. Harnessing the local knowledge and testimony of past events provides a general understanding of the types and locations of projects that are needed and is a resource that could be referenced for design.

During the spring of 2014, WE met with city staff and members of the Board of Works (BOW) and City Council to begin identifying drainage problem areas within the corporate limits of the city. City staff provided information related to areas with a history of flooding and drainage issues.

On June 11, 2014 a public meeting was held at City Hall to provide citizens an opportunity to share their concerns regarding drainage throughout the city. The purpose and goals of the Stormwater Master Plan were shared with citizens and a questionnaire was distributed to attendees. Citizens could mark problem areas on a paper map and discuss their issues with city staff and WE individually. Completed questionnaires are included in Appendix B.

Existing Studies & Plans

WE collected the studies the City had on file that were completed by other consultants and then provided a brief overview of the scope of work of the studies and stated whether any of the study was implemented and what value came from the study. WE analyzed each study to identify the capital projects that could be incorporated into the short-list of projects that would be further analyzed and prioritized in the Stormwater Master Plan.

Canary Ditch Regional Detention Pond Study & Design (1997)

In 1997 the City retained an engineering consultant to study and design a regional detention pond located on a 20-acre site approximately 0.5 mile east of U.S. 31 on the north side of Commerce Drive along Canary Ditch and adjoining industrial zoned land. Design and specifications were completed and environmental permitting was obtained for the project. As funding was allocated for another project, the pond was never constructed. The pond was to serve as regional detention for future development in its watershed, which would eliminate the need for numerous, site specific small ponds. The pond was designed to be an in-line pond constructed by excavating the existing channel embankments below the ordinary high water mark. Permitting this particular design today would be nearly impossible due to more stringent regulatory requirements. An opinion of probable costs was not included in this study.

Hurricane Creek Regional Detention Study

In February 1998 a study was completed that investigated the costs and benefits of constructing a detention facility along Hurricane Creek. The pond was proposed to be located immediately east of Eastview Drive, as suggested by Franklin Engineering. It would have been adjacent to future

development, which would have required fill to raise it above the base flood elevation. The bridge at Upper Shelbyville Road was to be utilized as the outlet control structure; however, the bridge opening was too large, and therefore, it would not be restrictive enough for the pond to temporarily store flow and provide adequate downstream benefits.

The pond location was re-investigated as part of this study. A 139-acre detention pond was proposed on the upstream side of CR N 400 E with the existing CR N 400 E bridge structure being utilized as the outlet control structure. The land proposed to be used is used for agricultural purposes today. The proposed pond would reduce peak flows by approximately 70 percent and 50 percent during the 2-year and 100-year storm events respectively. An opinion of probable costs for design and construction of this project was not included in this study.

Youngs Creek Watershed: A Plan for the Future

In 2003 the Johnson County Soil & Water Conservation District prepared the plan as part of a grant. Water quality and watershed health were the focal points of the report with the end goal being the reduction of pollution from non-point sources in the watershed. The information presented in the report did not address proposed project or issues. It focused on the Youngs Creek watershed characteristics, water quality, and watershed health.

There are two key points made in the report that should be noted:

- ***Youngs Creek is on Indiana's list of 303(d) List of Impaired Waterbodies for pathogens.***
- ***The percent of impervious surface for 3 of the 5 Youngs Creek sub-watersheds significantly increased.***

In summary, Youngs Creek remains on the 303(d) List of Impaired Waterbodies for E. Coli. Also, the increase in impervious surface within the watershed will continue to occur and result in increased flooding over time. The conversion of land use from agricultural to commercial and residential with regard to percentage of total watershed area is addressed in the Floodplain Buyout Program section.

Canary Ditch 2007 Floodplain Study

New Flood Insurance Rate Map (FIRM) panels were adopted in 2007. FEMA allowed the City to keep Special Flood Hazard Area (SFHA) boundaries for Canary Creek/Ditch that were used prior to 2007 in order to give the city time to provide a study revising the SFHA boundaries.

The City commissioned the floodplain study of Canary Creek to update the Flood Insurance Study of a 3.7-mile stretch of Canary Ditch from its mouth at Youngs Creek to the northern boundary of the city limits. The consultant included the Canary Ditch Regional Detention Pond in the hydrologic and hydraulic modeling even though the pond was never constructed. In 2008 the modeling was revised to remove the regional pond and the study was completed and re-submitted for review by the IDNR & FEMA. A revised FIRM panel will be issued once it has been reviewed and approved by the IDNR. A hydraulic model was created and utilized as part of this SWMP in order to determine the viability of constructing the Canary Ditch Flood Mitigation and Wetlands Restoration project discussed below.

Youngs Creek Basin Drainage Analysis & Master Basin Plan

In 2009 the City commissioned a drainage analysis and master plan focusing on Green Infrastructure Best Management Practices (GI BMPs) and how it compares to traditional stormwater solutions. Examples of GI BMPs suggested for use in the city include, but are not limited to, bio-swales, stormwater wetlands, rain gardens, and pervious pavement. The study focused on the area bounded by Monroe Street to the south, Forsythe Street to the east, U.S. 31 to the west, and Eastview Drive/Arvin Road to the north.

The study proposed 17 projects ranging in cost from approximately $30,000 to $485,000 and totaling $2.15 million. Criteria used to determine the selection included cost, performance, and advantages and disadvantages. None of the projects were constructed after the study. The GI approach is about bringing together natural and built environments and using the natural landscape as infrastructure. GI is normally associated with smaller scale projects as the ones proposed. One of the highest ranked projects in the study was the Temple Park Stormwater Storage Expansion project. The purpose was to assist in the relief of a downstream storm sewer connecting into the system on Main Street, which is currently being improved. The Main Street trunk line should provide additional capacity to reduce any tail water on the smaller, upstream residential storm sewer systems. The Main Street storm sewer improvements were recently completed and their actual impacts on the surrounding drainage issues are still unknown. Later this spring the issues in the area can be further evaluated to determine the need and associated benefits with improvements such as the Temple Park Stormwater Storage Expansion project.

The study also recommends three “capacity re-allocation” projects where storm sewers are replaced with larger capacity sewers or existing ones are re-routed. Two of these could potentially be affected by the Main Street improvements and the third is a project that would be considered after the Roaring Run diversion sewer would be completed. The diversion sewer allows smaller secondary sewers to serve the area bounded by Madison Street to the south, Ott Street to the east, Hamilton Avenue to the north, and Johnson Avenue to the west.

As mentioned above the proposed projects were not constructed. The importance of a green infrastructure and low-impact development approach and its importance to the City and its goal of mitigating future flood loss is discussed in the Stormwater Ordinance Review section.

International Drive Drainage Basin Study

In February of 2010 the City completed a study to propose solutions and prioritize projects with the regard to the International Drive Drainage Basin. The study identified solutions to address a history of localized flooding during larger storm events due to undersized infrastructure. The recommended projects included restoring capacity of ditches, replacing pipes to increase capacity, and constructing dry detention basins in open areas to reduce flooding. A total of nine projects were proposed for a total estimated cost of $1.25 million.

Of the nine projects, four were constructed. The focus of those four projects was to restore and increase roadside ditch capacities and culverts. This was accomplished by widening ditch bottoms,

excavating a more defined channel, and replacing smaller, existing culverts with multiple, larger culverts. Of the projects not constructed, none were short-listed in the Stormwater Master Plan.

Canary Ditch Flood Mitigation and Wetlands Restoration

In 2011 the City retained WE to modify the original design completed in 1997 and to obtain environmental permits to construct the project. WE re-designed the project as an off-line flood mitigation and wetlands restoration project. An off-line project is one where the existing embankment is not disturbed below the ordinary high water mark. Drawings and specifications were completed and environmental permitting was obtained for the project. City administration changed prior to its construction. An opinion of probable construction costs was included with the design. It is estimated the project would cost $2.8 million. The cost of this project is greatly influenced by the disposal location of the excavated spoil material as it represented 85 percent of the overall cost. This project and its benefits to downstream property owners and mitigating flooding was analyzed as part of this SWMP and is discussed later in this report.

Roaring Run Diversion Study

In April 2012 a consultant performed a study to analyze the feasibility of diverting a portion of the runoff upstream of Roaring Run to Hurricane Creek. Two routes and storm sewer sizes were proposed for the diversion sewer. The first option, and larger of the two, was a 54-inch storm sewer. It would divert the equivalent of the full capacity of Roaring Run to Hurricane Creek. The second option, and smaller of the two, was a 36-inch storm sewer. It would divert the equivalent of one-half the capacity of Roaring Run to Hurricane Creek. The study recommended installing the 36-inch diversion storm sewer on a route extending along Johnson Avenue, King Street, and Hurricane Street.

The diversion storm sewer would not only alleviate the burden on Roaring Run, but would also allow the City to construct the necessary localized/secondary improvements to improve drainage at intersections in the surrounding neighborhoods. Secondary improvements could be constructed with a phased approach based on need and available funding.

The diversion storm sewer would divert runoff from the Roaring Run watershed to the Hurricane Creek watershed and alleviate flooding in the neighborhoods along Roaring Run. The Roaring Run Relief Storm Sewer did get short-listed as a capital improvement project; however, its viability is dependent upon the construction of the Hurricane Creek Railroad Bridge Re-Construction project.

Storm Sewer Mapping

A portion of the City's storm sewer system was previously mapped by other consultants. The existing mapping was supplemented as a part of this project. WE surveyed an additional 400 structures and 18" storm sewer pipes located east of U.S. 31 from Lochry Subdivision to the north, U.S. 31 to the west, South Street to the south, and Forsythe Street to the east. Horizontal and vertical coordinates were collected for catch basins, curb inlets, storm manholes at tops of casting,

inverts, and sumps, in survey-grade accuracy (0.05 ft). The data was collected using survey grade GPS. The horizontal coordinates were in State Plane Coordinates on NAD83 datum and elevations shall be based upon NAVD 88.

As-built drawings were collected and reviewed as part of the process. As-built drawings were used to supplement the mapping effort and to help determine the needs in the field. WE staff coordinated the work with DPW and MS4 staff to ensure the most critical data was collected first. Some storm sewers were not able to be located, and therefore, not surveyed. Figure 2 delineates the previously surveyed storm sewers along with the data collected and surveyed as part of this project. Storm sewer sizes and materials are shown on the map. Inverts are included in the GIS file for those structures collected by WE. The data, in GIS format, has been shared with Johnson County GIS for incorporation into their system and an electronic copy has been submitted with this report for future use by the City.

Modeling & Methodology

Environmental Protection Agency's (EPA) Stormwater Management Model (SWMM), Version 5.1, is a hydrology-hydraulic-water quality simulation model used for modeling the stormwater system. For this particular study, it was used for a single event simulation of runoff quantity. Modeling water quality was not in the scope of work. The program calculates runoff from a collection of sub catchment areas that receive precipitation. The routing portion transports this runoff through a system of pipes, channels, etc.

Pipes 18 inches in diameter and larger within the storm sewer system east of U.S. 31 were modeled. The catchment areas were modeled for the 10-year storm using the 24-hour duration. The Natural Resources Conversation Service (NRCS) Type II Rainfall Distribution was utilized for the runoff calculations in the modeling, which is consistent with the City's draft Stormwater Management Ordinance.

Roaring Run was the focal point of the model for a variety of reasons. It traverses a densely populated, poorly drained portion of the city, has a large watershed, and is an older storm sewer in need of repair in the short-term future. The capacity of the Roaring Run storm sewer at its entrance and exit are presented in the Roaring Run Rehabilitation section of this report.

Determination and Prioritization of Problem Areas

The City experiences stormwater issues that stem from a combination of flooding, poor drainage, and old infrastructure. As part of this master plan, WE makes recommendations to address these issues based on staff concerns and overall community impacts.

WE staff completed assessments of the identified problem areas using Initial Priority Rating (IPR) worksheets (Appendix C) for the affected areas. The IPR worksheet allows a problem area to be ranked based on factors such as street and infrastructure type, flooding concern, and property classification. The IPR worksheet scores a problem area on a graduated point scale and allows for a numerical ranking to be established, which provides a starting point for project prioritization. The purpose of using the IPR worksheets is to eliminate bias. The IPR worksheets are included,

but are not used to determine a priority for the projects for two reasons. The projects are too dissimilar in nature and the ranking process is highly subjective, which skews the prioritization. Instead of relying on the IPR prioritization, the projects were ranked based on their viability and a need-based approach in the order that maximizes benefits to the community (Table 1). The project phasing plan (Exhibit 2) presents a logical, yet subjective, approach to phasing the project construction based upon need and ideal timing rather than available funding.

The unique and more challenging projects have an implementation plan summarized after the project description. Many of the projects are straight forward and follow a typical approach to implementation, retain a consultant, complete preliminary and final design, obtain permits, bid the project, and complete construction.

Table 1 – Stormwater Capital Improvements Project List

Rank	Project Name	Description of Scope	Type	Preliminary Cost	Low	High
1	Hurricane Creek Railroad Bridge Span Re-Construction	Remove existing railroad bridge and replace with longer-span structure over Hurricane Creek to reduce significant backwater.	Bridge	$ 7,000,000	$ 4,900,000	$ 9,100,000
2	Community Park Drainage Improvements	Construct a storm drainage sewer or low impact development solution to flooding in park south of King Street and east of Hurricane Creek.	Drainage	$ 118,000	$ 82,600	$ 153,400
3	Outfall Storm Sewer Rehabilitation	Repair and restore various outfalls throughout the Franklin MS4.	Outfalls	$ 149,000	$ 104,300	$ 193,700
4	Roaring Run Rehabilitation	Rehabilitate the existing 48-inch and 72-inch diameter CMP with cementitious structural lining and install additional access manholes.	Lining	$ 5,571,000	$ 3,899,700	$ 7,242,300
5*	Roaring Run Relief Storm Sewer	Construct relief storm sewer to alleviate capacity issues in the existing Roaring Run sewer.	Drainage	$ 1,671,000	$ 1,169,700	$ 2,172,300
6**	Hurricane Creek Flood Mitigation & Wetlands Restoration Facility	Construct a regional detention basin near Needham Elementary School and Paris Estates to detain storm runoff and reduce downstream flooding along Hurricane Creek in Franklin.	Regional Detention	$ 20,280,000	$ 14,196,000	$ 26,364,000
7	Canary Ditch Flood Mitigation & Wetlands Restoration	Construct a regional detention basin near Commerce Drive along Canary Ditch to detain storm runoff and reduce downstream flooding and provide water quality benefits.	Regional Detention	$ 3,806,000	$ 2,664,200	$ 4,947,800
8	Youngs Creek Streambank Stabilization	Repair eroded streambanks along Youngs Creek from upstream of Main Street to South Street and remove sandbars and sediment deposited over time from larger storm events.	Channel	$ 1,133,000	$ 793,100	$ 1,472,900
9	Roaring Run Downstream Channel Improvements	Clean, regrade and stabilize the channel and streambanks downstream of Roaring Run headwall (Jefferson Street) to Youngs Creek.	Channel	$ 384,000	$ 268,800	$ 499,200
10	Forsythe Street Culvert Replacement	Remove existing culverts and replace with new expanded opening structures to reduce frequency of road overtopping.	Bridge	$ 473,000	$ 331,100	$ 614,900
11	Water Street Drainage Improvements	Alleviate standing water in the intersection of Water Street & Adams Street and Water Street & King Street.	Drainage	$ 528,000	$ 369,600	$ 686,400
12	Cincinnati Street Drainage Improvements	Alleviate standing water and poor drainage along Cincinnati Street.	Drainage	$ 2,037,000	$ 1,425,900	$ 2,648,100
			TOTAL	$ 43,150,000	$ 30,205,000	$ 56,095,000

*** This project is not viable if the Hurricane Creek Railroad Bridge Span Re-Construction project is not constructed**

**** This project can be delayed, and possibly eliminated, if the Hurricane Creek Railroad Bridge Span Re-Construction project is constructed.**

Master Plan Project Summary

Hurricane Creek Railroad Bridge Span Re-Construction

The Roaring Run Relief Storm Sewer proposed in the SWMP is a viable project; however, the issue that was not considered in the 2012 Roaring Run Diversion study is backwater created by the railroad embankment bridge span opening south of Monroe Street and the Monroe Street Bridge (Exhibit 3). The railroad embankment bridge span opening creates 6.5 feet of backwater during a 500-year storm event. The Monroe Street Bridge creates 5.5 feet of backwater during a 100-year storm event. Together they create a damming effect that extends upstream of Forsythe Street. Both need to be enlarged to reduce the backwater to normal levels. Diverting flow from Roaring Run to Hurricane Creek without addressing the backwater issue, would only exacerbate the flooding problem along Hurricane Creek.

It is recommended the railroad bridge span opening be reconstructed and widened to reduce the backwater prior to diverting flow to the Hurricane Creek watershed (Figure 3). This project is the single most important project in mitigating flood losses along Hurricane Creek. It would result in an immediate reduction in flood levels upstream during larger storm events. If completed the City could perform a Letter of Map Revision (LOMR), which is FEMA's method to modify an effective Flood Insurance Rate Map (FIRM). The LOMR changes the Base Flood Elevations (BFEs), or the Special Flood Hazard Area (SFHA). Homeowners along Hurricane Creek could potentially be relieved of the requirement to purchase flood insurance. In addition, the reduction of backwater at the railroad bridge would delay the need to construct the multi-million dollar Hurricane Creek Flood Mitigation Basin & Wetlands Restoration (dry-bottom detention pond) project upstream. It is considered more of a complimentary project to Railroad Bridge Span Re-Construction project and is discussed in the paragraphs to follow.

Franklin College is in the process of demolishing a fraternity house located at the southwest corner of Monroe Street and Branigan Boulevard west of the railroad. The demolition would allow the bridge opening to be expanded further if needed. Louisville Illinois/CSX railroad has tripled the usage of the tracks in recent months and is currently in the process of planning upgrades to the rail system within the city. The City needs to capitalize on this opportunity to plan, design, and construct this project as timing is ideal.

WE considers the Hurricane Creek Railroad Bridge Span Re-Construction to be the one most important projects in the SWMP. Obstacles to accomplishing a project of this magnitude include working and coordinating with the railroad, which has a history of being demanding and time consuming. It is a project that would need political attention and a large capital expenditure to bring to fruition; however, the City would reap the dividends for years to come as the upstream watershed develops creating more runoff.

The scope of work for the project and requirements of the railroad are largely unknown without meeting with railroad representatives. Therefore, the costs associated with this project are very subjective and are included as a “ballpark” figure. The project involves coordination and

participation from the railroad, the county highway department, and the county surveyor. Implementation steps are as follows:

1. Initiate discussions with railroad to investigate viability of project;
2. Obtain specific construction, permitting, and timing requirements and scope of work from the railroad;
3. Retain a consultant to perform preliminary engineering and give an opinion of probable cost;
4. Prepare a preliminary LOMR showing effects of proposed changes;
5. Prepare final design documents;
6. Apply for permits from the railroad, the county surveyor, and environmental agencies associated with excavating, re-shaping, grading, and stabilizing the Hurricane Creek channel;
7. Construct project including demolishing, enlarging, and reconstructing the railroad bridge span opening, and then complete the as-built survey for LOMR; and
8. Finalize LOMR and submit to IDNR and FEMA for review and approval.

Community Park Drainage Improvements

Community Park is an existing municipal park located immediately south of East King Street adjacent to Hurricane Creek (Figure 4). The existing park floods frequently, due to its location within the floodplain of Hurricane Creek. The proposed project will not eliminate flooding, a large levee or storm protection wall would be needed to prevent inundation; however, a new storm sewer would reduce the amount of time water stands in the park after a flooding event. A French drain system was installed years ago, but is no longer functioning properly. A better, more permanent solution is needed.

As part of this project, a new outfall and headwall, PVC (plastic) storm sewer and several new beehive inlets would be installed, along with swales, to facilitate drainage within the park. The new storm sewer would help drain the park more quickly after a storm event and prevent water from standing behind the homes located on King Street and Edwards Street. Basements of homes located on the north side of East Jefferson Street, adjacent to the park, frequently flood and experience damage to equipment including furnaces and hot water heaters on a regular basis. In addition, the park suffered damage to the tennis courts after the December 2013 flood due them being submerged for an extended period of time. The Parks Department incurred $40,000-$50,000 in damages from that flood throughout their entire facilities in the city.

Community Park Drainage Improvements is a relatively inexpensive improvements project that could be designed and constructed quickly to solve a drainage problem that would benefit residents, a local bed and breakfast business, and the Parks Department.

Storm Sewer Outfall Rehabilitation

The Storm Sewer Outfall Rehabilitation project will be a comprehensive capital project to address failing stormwater outfalls to the open channel drains present within the city. Hurricane Creek, Canary Ditch and Youngs Creek are the primary open channel drains that convey storm sewer flow that discharges from the enclosed city storm sewer. The project may include the repair of

existing infrastructure, installing check valves, and rehabilitating existing sewer outfall pipes. Based on current pricing, an estimate of $50,000 per outfall could be used to address the larger (>30") outfalls with a programmed price of $20,000 to $30,000 for smaller outfalls depending on the severity of erosion and condition of pipe daylighting to the open channel.

The City has mapped all of the existing outfalls that discharge stormwater runoff to the existing natural streams and ditches within the community. As part of the Stormwater Master Plan, the City requested WE conduct an assessment of the outfalls most in need of improvement in order to maintain compliance with their MS4 NPDES permit requirements. As part of the stormwater NPDES permit, the City must maintain and stabilize the existing outfalls to the natural regulated drains and streams within their corporate limits. Table 2 describes the outfalls that have experienced the most deterioration and the ones that need to be included in an outfall rehabilitation project.

Table 2 – Deteriorated Outfalls Needing Repair

Outfall No.	Waterbody	Location	Type	Description	Outfall
YC27000	Youngs Creek	Near Dog Park	24" VCP	Pipe is eroded and needs to be repaired. If this outfall is not repaired as part of this project, it could be done as part of the Youngs Creek Streambank Stabilization project.	
CD56000	Canary Ditch	Scott Park	18" RCP	Pipe has broken and embankment is eroding. Needs to be rebuilt and concrete apron and headwall need to be installed to provide protection and prevent erosion.	
YC10000	Youngs Creek	Fuel Station at Hospital Road	18" CMP	Pipe flap gate needs to be repaired or replaced. A couple of sections of pipe may need to be replaced.	

Table 4 – Deteriorated Outfalls Needing Repair (Continued)

Outfall No.	Waterbody	Location	Type	Description	Outfall
GD7000	Graham Ditch	Bottling Plant	12" CMP	Remove debris and add concrete apron.	

Roaring Run Rehabilitation

Roaring Run storm sewer is an existing drainage facility that was constructed in the 1970s. It is routed through old town Franklin and closely parallels Cincinnati Street and an abandoned railroad. Its entrance is located at the intersection of Cincinnati Street and Hamilton Avenue and its exit is located on the south side of Jefferson Street across from Walnut Street (Figure 5). The existing sewer consists of uncoated corrugated steel pipe in various diameters ranging from 48-inch up to an existing three-sided structure near Youngs Creek.

The service life of uncoated corrugated steel pipe is highly variable depending on the characteristics of the soil such as pH and electrical resistivity. It also depends on the exposure to de-icing salts and chemicals in the stormwater. Depending on the aforementioned factors, the service life of uncoated corrugated steel pipe generally varies between 30-60 years depending upon the publication referenced. The useful life of the Roaring Run storm sewer is nearing its end or at its end.

According to city staff, there are portions of the sewer that are already failing. In addition, after the flood in 2008, the city excavated a portion of Roaring Run on Adams Street west of Main Street. There was approximately 18-24" of sediment in the bottom of the pipe arch. The city has attempted to televise Roaring Run, but failed due to obstructions blocking the camera. These obstructions included accumulation of debris and sediment.

The capacity of the sewer is significantly diminished and the sewer is nearing the end of its useful life. In order to maintain this existing storm infrastructure, a full-length structural rehabilitation project of the enclosed sewer system is proposed. As part of this project, the existing corrugated metal pipe will be inspected, cleaned and the entire length of the sewer will be lined with centrifugally cast fiber-reinforced cement. In addition to the lining system, additional manholes and cleanouts will be installed to allow access to the sewer to facilitate cleaning and future inspections. The pipe lining system will add service life to the existing storm sewer that is similar to a concrete pipe. The U.S. Army Corp of Engineers estimates the useful life of a concrete pipe to be 75-100 years.

The project would be very challenging even to an experienced contractor. There are complicated tie-ins, access is limited, and there are atypical structures needed. To lessen the financial burden to the City, it could be done in a single project or it could be done in multiple phases. The only viable alternative would be lining sections where the proximity of the sewer to existing homes would prohibit open cutting and/or purchasing properties and then open cutting the remaining portions and replacing the existing sections in place with new concrete pipe.

For budgeting purposes, it was estimated there are approximately 4,500 linear feet of 48" CMP and 300 linear feet of 72" CMP. A standard 2" thick PL-8000 cementitious structural liner would be centrifugally applied. This design thickness could change during the design phase.

The lining project offers numerous benefits listed below:

- Increase hydraulic capacity of system,
- Rehabilitate the sewer structurally,

- Increase service life for an additional 75-100 years, and
- Add manholes for accessibility for inspection and cleaning.

Table 3 presents the approximate capacities of Roaring Run in its existing state and after the cementitious structural liner is applied. The cementitious structural liner increases the hydraulic capacity of the sewer by approximately 35 to 40 percent. Even though the inner diameter slightly decreases due to the liner, the liner smoothes the interior corrugations making it more hydraulically efficient.

Table 3 – Roaring Run Capacity

Roaring Run Location	Roaring Run Size	Approximate Capacity		10-Year Runoff (24-hour duration)
		Existing Manning's Value (n = 0.024)	Proposed Manning's Value (n = 0.014)	
Near entrance (Cincinnati & Hamilton)	48" CMP	38 cfs	57 cfs	188 cfs
At exit (Jefferson & Walnut)	72" CMP	115	168	366 cfs

Implementation steps are as follows:

1. Retain engineering consultant to perform preliminary design including the following:
    a. Phasing plan to mitigate financial burden if necessary;
    b. Conceptual design of rehabilitated storm sewer;
    c. Coordinate new manhole locations and necessary easements with City staff;
    d. Identify and quantify amount of debris needed to be removed from sewer; and
    e. Prepare an Advancement of Cost Engineering (AAEE) Level 2 opinion of probable cost to design, permit, and construct the facility.
2. Acquire temporary and permanent easements from landowners, and
3. Perform final design and permitting.

Roaring Run Relief Storm Sewer

The Roaring Run Relief Sewer concept was originally developed in 2012 as part of a proposed project to provide additional storm capacity to Roaring Run by diverting excess stormwater flow to Hurricane Creek. The bypass storm sewer would begin at the intersection of Johnson Avenue and Kentucky Street, and proceed eastward to Hurricane Street where it would turn south and proceed to Hurricane Creek.

Two options were provided in the 2012 study. The first was to install a 36-inch diameter pipe that would divert the equivalent of 50% of the capacity of Roaring Run to Hurricane Creek. The second option was to install a 54-inch storm sewer, which would divert the equivalent the 100% of the capacity of Roaring Run to Hurricane Creek. The study recommended installing the diversion storm sewer on a route extending along Johnson Avenue, King Street, and Hurricane Street (Figure 6). WE recommends constructing the second option with the 54-inch pipe for several reasons:

- The 54-inch pipe will allow more flow to be diverted from Roaring Run, which will become increasingly important as the upstream watershed develops.
- The additional cost for upsizing is insignificant compared to the overall cost to design and construct the project,
- It will provide additional capacity needed to serve the surrounding neighborhoods in the future.

Drainage in the surrounding neighborhoods is poor. An ancillary benefit of the project would be to improve drainage in those areas after construction of the main portion of the relief sewer has been completed. Additional secondary storm sewer trunk lines could be constructed along Adams, King and Madison Streets to address local drainage problems within the adjacent residential area. Its viability is contingent upon the construction of the Hurricane Creek Railroad Bridge Span Re-Construction project.

Hurricane Creek Flood Mitigation & Wetlands Restoration

Hurricane Creek is an existing regulated drain that serves a 16-square-mile watershed northeast of the City. The existing drain floods during moderate storm events due to the insufficient channel capacity. Regulated drains are typically designed for 10-year storms. Even though they are not designed to convey runoff from larger storm events, flooding during larger storm events is exacerbated by downstream restrictions including an existing railroad bridge embankment and bridge span and the Monroe Street Bridge. The flooding is caused by a combination of sources: headwater flooding, excessive runoff from a large watershed, and backwater flooding from downstream restrictions. In order to alleviate flooding within the corporate limits of the city, a regional detention basin could be constructed in the area immediately east of County Road N 400 E on 139 acres consisting of several parcels as proposed in the study (Figure 7).

The proposed regional detention basin will hold excess stormwater flows and restrict the amount of water entering the portion of the stream passing through the residential areas near downtown Franklin. The detention facility would utilize the existing bridge opening on N CR 400 E, as originally proposed, as the outlet control structure to regulate the amount of flow that would discharge back into the lower reach of Hurricane Creek and to optimize temporary storage within the pond.

This project offers significantly better peak flow reductions than the Canary Ditch Flood Mitigation and Wetlands Restoration project and the construction cost reflects it. Table 4 provides a basic summary of the key aspects of each project's design as a comparison to demonstrate value.

Table 4: Canary Creek & Hurricane Creek Detention Benefit Comparison

	Canary Ditch Flood Mitigation & Wetlands Restoration	Hurricane Creek Flood Mitigation & Wetlands Restoration
Watershed Area (acre)	2,830	8,821
Impervious Surface	12%	12%
Peak Flows (cfs)		
Before Pond Construction	2,150	4,315
After Pond Construction	1,930	2,126
Pond Size (acres)	20	140
100-year Peak Flow Reduction	10%	50%

In addition, the proposed peak flow reduction extends significantly farther downstream than the Canary Ditch Flood Mitigation and Wetlands Restoration project. The Hurricane pond, due to its much larger storage capacity, would push the peak time upstream of the pond back four hours allowing the downstream, residential developed areas adequate time for their peak flows to pass before the larger upstream peak hits.

This project is one that will ultimately need to be considered to mitigate the effect of development in the upstream watershed. Potential funding sources will be discussed in more detail later in the document.

Implementation steps are as follows:

1. Retain engineering consultant to perform preliminary design including the following:
    a. conceptual layout of facility based upon contour data available,
    b. hydrologic study of watershed and with appropriate facility size,
    c. confirmation of using existing bridge geometry as outlet control structure, and
    d. an opinion of probable cost to design, permit, and construct the facility.
2. Acquire property from landowners, and
3. Perform final design and permitting.

Canary Ditch Flood Mitigation and Wetlands Restoration

This project had been designed and was permitted as an off-line flood mitigation and wetlands restoration project (Figure 8). The permits have since expired and construction never started. The project will not only provide peak flow reductions for the residential neighborhood immediately downstream, but will also provide a water quality benefit as well. The 20-acre project site will provide 189 acre-ft of detention from elevation 745 to elevation 751. It will reduce flows of Canary Ditch downstream of the project site. The flows would be reduced by approximately 10 percent at the 100-year critical duration storm. The design modifications not only allow the City to obtain all of the permits necessary to construct the project, but will also provide a similar volume of storage to the original design. The permits have expired and would need to be obtained if construction were to occur.

It is important to note that the project will not eliminate downstream flooding. It will only mitigate it during larger storm events, but not to the extent that the Hurricane Creek Flood Mitigation Basin

& Wetlands Restoration project would as summarized in Table 4. First, it is a much smaller pond compared to the upstream watershed. Second, the capacity of the downstream ditch at US 31 is 570 cfs. Even with the proposed peak flow reductions, the peak outflow from the pond would exceed the ditch capacity by a factor of 3.5 to 4 for the 100-year critical storm duration. The peak outflow from the pond at the 100-year storm's critical duration is over 1,900 cubic feet per second (cfs).

U.S. 31 is approximately 0.75 mile downstream of Commerce Drive. The existing culvert underneath U.S. 31 is a reinforced concrete arch with a 25' span. It was constructed in 1946 before enforcement of backwater rules were put into effect. INDOT Hydraulics Engineering Manager, Crystal Weaver, indicated there were no plans to enlarge the U.S 31 structure. Ms. Weaver indicated that INDOT is pursuing policies to do less extensive work on bridges. Restoration is more of a focus than replacement. When INDOT replaces structures that create significant backwater, the structures are designed to create a maximum backwater of one foot. The existing structure creates two feet of backwater during the 100-year storm and four feet of backwater during the 500-year storm. The backwater at U.S. 31 will continue to exist for the foreseeable future. Flooding upstream of U.S. 31 from future development will need to be addressed by reducing headwater flooding by controlling runoff volume.

The project would also provide some smaller scale water quantity and quality benefits to the downstream properties located in Lochry Subdivision. This subdivision frequently floods during larger storm events; however, the peak flow reductions would not be large enough to remove homes in the Lochry Subdivision from the floodplain.

This project would not detain a sufficient volume of water to make the impact to downstream properties that is desired and needed during larger storm events due to its smaller storage volume. Table 4 compares the peak flow reductions between ponds with drastically different footprints.

Youngs Creek Streambank Stabilization

Youngs Creek is a state-regulated waterbody that conveys stormwater runoff from a 56-square mile watershed extending as far north as Main Street in Greenwood and as far south as Trafalgar in southern Johnson County. It converges with Hurricane Creek in Province Park. As mentioned earlier in the report, together they serve an upstream watershed draining approximately one quarter of the county's runoff. Youngs Creek and Hurricane Creek, similar to other creeks and rivers, are constantly transporting sediment from upstream areas undeveloped areas to downstream areas as part of its natural process. The sediment is repeatedly suspended, transported, deposited, and re-suspended depending upon the channel's flow and velocity. Large quantities of sediment have been transported to and deposited in Province Park over the last several decades.

The existing streambanks of Youngs Creek have eroded slopes, and moderate to severe undercutting has formed a soil overhang. A headwall of an outfall is in disrepair and near failing. The erosion is a potential threat to the existing pedestrian bridges, the trail, and access roads located along Youngs Creek within Province Park. The eroded sediment from the embankments and transported sediment accumulate at the local bridge structures contributing to the reduction in the flow capacity of the creek through Province Park.

Starting at U.S. 31 and proceeding downstream to South Street, Youngs Creek has several bridges and pedestrian walkways over the waterbody upstream and downstream of Province Park. The three existing roadway bridges – Main Street, Home Street, and South Street act as constrictions during large storm events. The expansion reach of the Main Street Bridge and the contraction reach of the South Street bridge are unusually constricted. Sand bars have been created in the expansion reach of the Main Street Bridge (Photo 1) making Youngs Creek susceptible to collecting debris during flood events and reducing the flow capacity of the creek.

Photo 1: Sediment Accumulation Downstream of Main Street Bridge

In the fall of 2014 the Youngs Creek Streambank Stabilization project was designed and permit applications submitted for the first phase of this project. Permitting is expected to be secured in the winter of 2015 and construction is scheduled to begin in the spring of 2015. The scope of the project consisted of stabilizing approximately 345 feet of the streambanks under the Home Avenue Bridge and 426 feet of the streambanks under the South Street Bridge with revetment mattresses, PVC-coated gabion mattress system, coir logs and turf reinforcement mats to prevent future erosion. The area will be graded and backfilled. Additionally, deposited sediment will be removed. The project was intended to be representative of a larger project to be constructed in the future to include the entire length of embankments between South Street and Main Street along Youngs Creek (Figure 9).

This project will dredge accumulated sediment, repair and stabilize streambanks, and remove flow obstructions was implemented to continue to allow for maximum flow capacity within the reach of Youngs Creek in Province Park. The condition of the Youngs Creek embankments within Province Park will continue to degrade unless they are stabilized. Eventually the erosive effects will have an adverse impact on the trail or road by undermining them. A long-term solution, with a much larger scope and significantly higher cost is inevitable. This project addressed those issues.

Roaring Run Downstream Channel Improvements Project

Roaring Run storm sewer currently discharges to an open channel south of Jefferson Street near the existing Indiana-American water storage tank before proceeding southwest and discharging to Youngs Creek (Figure 10).

The existing headwall that terminates the closed portion of Roaring Run is deteriorated from weathering and erosion at the discharge to the open channel. In addition to the headwall deterioration, there are numerous trees with exposed roots, brush, and trash that are present. Erosive effects of the Roaring Run discharge are undercutting the western embankment.

In order to improve the existing channel and prevent future erosion, a combination of channel clearing, streambank grading and stabilization, outfall headwall repairs and armoring is recommended. These improvements will stabilize the bank from future erosion and improve the flow capacity of this drainage way.

Forsythe Street Culvert Replacement

Hurricane Creek intersects Forsythe Street approximately 1,000 feet north of King Street. Forsythe Street is overtopped several times per year during moderate storm events causing the street to be temporarily impassable (Figure 11). The Forsythe Street Culvert Replacement consists of replacing the existing twin corrugated metal culverts with one reinforced concrete box culvert with a larger capacity, raising the elevation of the road, re-paving, and stabilizing the streambank within the work area.

As mentioned earlier in the report, the Louisville Illinois/CSX railroad embankment and bridge span creates a damming effect that extends upstream of Forsythe Street. Replacing the culverts before the railroad bridge span re-construction would provide inconsequential benefits during the larger storm events. Ideally, this project would be constructed after the Hurricane Creek Railroad Bridge Span Re-Construction project has been constructed to maximize benefits; however, it is a lesser expensive project that will eventually need to be completed as the upstream watershed of Hurricane Creek develops increasing runoff and as the existing corrugated metal culverts approach their useful life.

Water Street Drainage Improvements

The intersections of Adams Street and King Street with Water Street retain standing water for extended periods of time after small storm events. There is not a means for conveying the water away from the intersection (Figure 12). This project consists of a scope very similar to the Lochry & Schoolhouse Intersection Improvements completed in 2013. A proposed storm sewer would connect the two intersections to the existing Main Street storm sewer, which was recently installed. In addition, curb inlets, curbs, sidewalk, and handicap ramps would be installed along with resurfacing the streets. If sanitary sewer improvements are needed within the working area, the provisions could be made in the design to accommodate improvements to occur simultaneously.

Cincinnati Street Drainage Improvements

Cincinnati Street is an existing local street located within central Franklin between Johnson Avenue and Yandes Street (Figure 13). After storm events, the road collects standing water, which remains for extended periods of time. The standing water frequently impedes parking and the safe passage of two vehicles at one time along this street. In addition, the accumulated water deteriorates the road more quickly than if it were properly drained.

In order to alleviate drainage problems along Cincinnati Street, new storm sewer, curb and gutter and pavement rehabilitation will be completed. A secondary benefit of this project would be to beautify an older part of the City.

Recommended Improvement Projects and Cost Analysis

After identifying and analyzing the problem areas using the criteria and analysis discussed in the previous section, twelve projects were recommended for improving drainage in the city. Refer to Table 1 for a list of the proposed projects.

Generally, project opinions of probable cost (OPC) include a planning and design fee, a construction administration and observation fee, easement and land acquisition costs, if necessary, and legal fees, which otherwise are known as project "soft costs". Estimates for land acquisition services and land purchases were included in project costs if acquisition was considered necessary for project completion; however, most of WE's project recommendations have avoided the need to acquire easements and additional right-of-way.

Appendix D contains preliminary opinions of probable costs based on WE's review of the problem areas, previous studies, and projects proposed by city staff. The opinions of probable construction costs includes a contingency, up to 20 percent, while soft costs are estimated at approximately 25 percent of the estimated construction cost, which is considered typical for this level of planning. The total project cost includes land acquisition services and land costs if discussed during preliminary project discussions.

Each project of the 12 projects has an estimate, or opinion of probable cost, performed in accordance with the Association for the Advancement of Cost Engineering (AACE). A Level 4 estimate is based upon a project's maturity level relative to the final deliverable. A Level 4 estimate maturity level is 1 to 15 percent. WE assigned the accuracy range for a Level 4 estimate to be 30 percent plus or minus of the projected estimated cost. Therefore, each project has a "low" cost representing 70 percent and a "high" cost representing 130 percent of the calculated or estimated project cost with one exception: the Canary Creek Flood Mitigation & Wetlands Restoration project, which has been designed in its entirety. In the case of a project already designed, a Level 1 estimate was used. It has project's maturity level relative to the final deliverable of 65 to 100 percent. WE assigned the accuracy range for a Level 1 estimate to be 10 percent plus or minus of the projected estimated cost. Therefore, the Canary Creek Flood Mitigation & Wetlands Restoration project has a "low" cost representing 90 percent and a "high" cost representing 110 percent of the calculated or estimated project cost. Table 5 on the following page summarizes the advantages, disadvantages, and the costs for each project.

Table 5: Summary of Advantages, Disadvantages, & Costs

Item	Project Name	Advantages	Disadvantages	Opinion of Probable Cost
1	Hurricane Creek Railroad Bridge Span Re-Construction	• Significantly reduces backwater during large storm events • Potentially could remove homes from floodplain • Reduces damage to residences and business during larger storm events • Makes Roaring Run Relief Storm Sewer project viable • Provides long-term benefits to watershed	• High capital cost • Unknown scope • Difficulty working with railroad	$ 7,000,000
2	Community Park Drainage Improvements	• Low capital cost and easily constructed • Reduces damage to residences and business • Reduces duration of standing water in park	• More of a local solution benefitting few people	$ 118,000
3	Outfall Rehabilitation	• Low capital cost and easily constructed • Prevents further damage and erosion • Keeps MS4 in good standing with NPDES Permit requirements	• More of a local solution benefitting few people • Low profile project from public's perspective	$ 149,000
4	Roaring Run Rehabilitation	• Reduces disruption to local residents compared to alternative • Adds manholes for accessibility for inspection and cleaning • Increases hydraulic capacity of system • Rehabilitates the sewer structurally • Increases service life from 75-100 years	• High capital cost • Disruptive to local residents • Unknown costs to clean and repair prior to lining • Challenging to construct	$ 5,571,000
5*	Roaring Run Relief Storm Sewer	• Relieves Roaring Run of burden from conveying all upstream runoff from watershed • Provides ability to easily construct secondary trunk lines to drain neighborhoods • Reduces flooding to resident in old town area due to insufficient Roaring Run capacity	• Project viability is dependent upon the successful completion of another project • Disrupts and alters traffic flow for substantial number of residents other than those within the vicinity of the project	$ 1,671,000
6**	Hurricane Creek Flood Mitigation & Wetlands Restoration	• Provides significant reduction in peak flows downstream during small and large storm events • Mitigates increased runoff from future development • High profile project	• High capital cost • Uncertain costs associated with volume of excavation and location of disposal • Politically difficult to implement and complete • Difficult permitting process	$ 20,280,000
7	Canary Ditch Flood Mitigation & Wetlands Restoration	• Provides reduction in peak flows downstream • Mitigates increased runoff from future development • Provides undefined water quality benefits • High profile project	• High capital cost for benefits provided • Storage is not large enough to remove downstream homes from floodplain	$ 3,806,000
8	Youngs Creek Streambank Stabilization	• Stabilizes eroding embankments • Mitigates future damage and loss to embankment protection • Increases capacity of channel • Aesthetically improves park	• Difficult permitting process • Benefits are related more to aesthetics and embankment stabilization rather than flood reduction and mitigation	$ 1,133,000
9	Roaring Run Downstream Channel Improvements	• Stabilizes eroding embankments • Aesthetically improves area near downtown • Increases capacity of channel • Low capital cost	• Low profile project from public's perspective • Benefits are related more to aesthetics and embankment stabilization rather than flood reduction and mitigation	$ 384,000
10	Forsythe Street Culvert Replacement	• Stabilizes eroding embankments • Increases hydraulic capacity of culvert • Reduces road overtopping during moderate storm events • Addresses any structural issue with existing corrugated metal culvert • Potential for cost sharing with other governmental agencies • Low capital cost	• Low profile project from public's perspective • Project viability is dependent upon the successful completion of another project	$ 473,000
11	Water Street Drainage Improvements	• Provides drainage to collector street intersections where water stands for extended periods of time • Easy and cost effective discharge connection to Main Street trunk line	• Reconstruction of intersections and sidewalks recently improved	$ 528,000
12	Cincinnati Street Drainage Improvements	• Provides drainage to roadside and intersections where water stands for extended periods of time • Easy and cost effective discharge connection to Roaring Run • Opportunity to aesthetically improve blighted area of city	• Street was recently resurfaced • Low profile project from public's perspective • Low visibility project	$ 2,037,000

*** This project is not viable if the Hurricane Creek Railroad Bridge Span Re-Construction project is not constructed**

**** This project can be delayed, and possibly eliminated, if the Hurricane Creek Railroad Bridge Span Re-Construction project is constructed.**

Non-Structural Solutions

National Flood Insurance Program - Community Rating System

The City participates in the National Flood Insurance Program (NFIP). Its participation in the NFIP program makes flood insurance available to home and business owners simply by adopting and enforcing local floodplain management ordinances.

The vast majority of the upstream watershed is undeveloped. Therefore, flooding will continue to be a concern for the City and its citizens for the foreseeable future. The NFIP has a voluntary incentive program called the Community Rating System (CRS), which provides communities with discounts to flood insurance rates. It rewards communities that engage in activities exceeding the minimum NFIP requirements. The more activities a community performs, the more points it accrues. The more points it accrues, the lower classification rating its gets, which translates into larger premium discounts for policy holders. There are 10 CRS Classes: Class 1 requires the most credit points and provides the largest flood insurance premium reduction (45 percent), while Class 10 means the community does not participate in the CRS or has not earned the minimum required credit points, and residents receive no premium reduction.

Exhibit 4 shows a list of the Indiana communities which currently participate in the CRS and their respective premium discounts. There are 22 cities, towns, and counties that participate in the CRS program. In Indiana the highest class rating a community can achieve is Class 7. Classes 7, 8, and 9 provide 15 percent, 10 percent, 5 percent discounts respectively for properties in the Special Flood Hazard Area (SFHA) and a 5 percent discount for those outside the SFHA. This is typical not only for Indiana communities, but also many other communities throughout the country. Achieving a rating lower than 7 would most likely require changes in the Indiana building code. A Class 8 rating would result in a reduction in flood insurance rates and would demonstrate to the citizens that the City is not only taking a proactive approach to attempting to mitigate not only the physical losses, but also the financial losses associated with flooding.

As of July 31, 2014, there are 176 flood insurance policies in effect within the city. The premiums for those policies cost a total of $184,577 per year and provide $28,294,000 worth of flood protection coverage (Exhibit 5). By participating in the CRS program and attaining a Class 8 Rating, the policy holders would save approximately $18,500 per year assuming all policy holders are in the SFHA.

There are numerous activities a community can perform to accrue points and they fall under four different categories listed below:

1. Public Information – example includes outreach projects.
2. Mapping and Regulations – example(s) includes regulating stormwater runoff and maintaining flood data.
3. Flood Damage Reduction – example includes implementing a voluntary buyout program.
4. Warning and Response – example includes utilizing an early flood warning system for public.

The CRS program activities offer several benefits as listed below.

- Help projects qualify for certain other Federal assistance programs,
- Enhance public safety, and
- Reduce damages to property and public infrastructure.

It is recommended the City participate in the CRS. In addition to the premium reductions for home and business owners, the CRS program provides an incentive to maintaining and improving a community's floodplain management program over the years. As turnover with new officials and staff occur, data, programs, and projects associated with the floodplain can lose momentum and even be forgotten. An official program will reduce the likelihood of that occurring.

The implementation path for establishing participation in CRS is as follows:

1. Appoint staff or retain consultant to administer CRS program on behalf of City;
2. Complete CRS Self-Assessment;
3. Meet with CRS Specialist to discuss and determine class designation; and
4. Complete CRS application.

The City has a staff member qualified to administer this process. It would save the City money; however, this staff member's workload might dictate retaining a consultant to assist with the application project.

Floodplain Buyout Program

At the confluence of Youngs Creek and Hurricane Creek, the city drains a 75-square mile watershed. Johnson County is 322 square miles in area. Therefore, almost one quarter of the county's runoff is conveyed through the city. Approximately 25 percent of the land in the 75-mile watershed is impervious surface (Exhibit 6). According to the *Youngs Creek Watershed: A Plan for the Future,* the land use within the watershed changed dramatically from 1992 to 2001 as summarized in Table 6 below.

Table 6: Youngs Creek Watershed Land Use

Land Use	% of Total Watershed Area	
	1992	2001
Agricultural	84.8%	73.6%
Commercial/Industrial	2.5%	4.1%
Residential	3.5%	12.3%

Johnson County has increased 65.2 percent in population from 1990 to 2013 (http://www.thestatshouse.org). Similar growth is projected to occur in future decades. With the development of land, comes an increase in impervious surface and associated runoff. Citizens who have lived in Franklin for an extended period can attest that flooding has worsened during that time. As the watershed develops, flooding issues will only become exacerbated. The floodplain will theoretically continue to expand and engulf more properties requiring owners to purchase flood insurance.

Flood control and drainage ordinances require developments to discharge at pre-developed rates through the use of detention facilities; however, structural solutions, such as detention facilities, do not reduce the volume of runoff. They attenuate the peak flow by temporarily storing flow and releasing it. The volume runoff is not reduced. As development increases, the runoff from the watershed will increase, which in turn will increase risk for the potential damage. Structural solutions must be combined with non-structural solutions to yield the maximize benefits and reduce the risk for potential flood damage and reduce the financial burden associated with large capital projects.

A voluntary buyout program is a long-term, non-structural solution to flood mitigation. The purchase and demolition of flood-prone structures in the FEMA-regulated floodplain would remove the buildings at highest risk of flooding. The advantages and disadvantages are summarized below.

Advantages of a Floodplain Buyout Program

- Reduces flood damage and losses after flood events;
- Restores the floodplain to be used for it intended purpose;
- Allows the City to purchase properties as they come to the market or at the will of the owner thus reducing upfront costs; and
- Reduces the cost and/or eliminates the need for structural solutions.

Disadvantages of a Floodplain Buyout Program

- Reduces tax revenue;
- Increases administrative costs and property maintenance costs for city;
- Leaves neighborhoods with a disjointed, incomplete appearance until all properties have been acquired; and
- Requires administrative oversight, patience, and persistence from city staff over a long period of time.

Property owners are not forced to sell. They are offered fair market value for their property. If their flood-prone property is bought through this program, the sellers must sign agreements stating that they will not buy another home or business in a regulated floodplain within the city.

Flood mapping has several designations used to indicate flood risk. Floodway, floodway fringe, and floodplain are the common designations (Exhibit 7). The 100-year floodplain is the extent of the water that one would see after a 100-year storm. The floodplain consists of the floodway and the fringe. The floodway is defined as the portion of the water body and its adjoining overbanks needed to convey the flow generated by a 100-year storm. The floodway is the portion of the floodplain that could be completely obstructed without increasing the water surface elevation of a 100-year flood event more than 0.14 ft. The floodway cannot be seen after a storm event.

Homes in the floodway are considered to be a higher risk than those in the fringe. The majority of these homes were constructed prior to the floodplain regulatory requirements being established. In addition, these homes do not comply with the National Flood Insurance Program building requirements. Therefore, they are considered to be high risk for flooding and severe damage. Exhibit 8 shows the number of homes along Canary Creek and Hurricane Creek located within the

Special Flood Hazard Area (SFHA) floodway and floodplain fringe respectively and their 2014 assessed values as of August 2014.

The Canary Creek Watershed has 19 homes in the floodway and 56 homes in the floodplain fringe east of U.S. 31 with assessed values of $1.47 million and $3.84 million respectively. The Hurricane Creek Watershed has 21 homes in the floodway and 106 homes in the floodplain fringe with assessed values of $2.61 million and $9.38 million respectively.

Future flooding within the city cannot be feasibly eliminated. It can only be mitigated. A floodplain buyout program is one of the most effective means to mitigating future damage. There are several different types of purchases as listed below:

- Annually planned purchases – purchases created from a list of volunteers and planned for purchase based upon risk, need, strategic purposes for future infrastructure improvement, etc.
- Quick buys – unplanned purchases of homes in the designated SFHA whose homeowners did not volunteer for the program, but put their home on the market and the home is strategically located.
- Dilapidated properties in designated areas – homes that have fallen into disrepair and whose acquisition would provide ancillary benefits to the city such as improvement to a neighborhood or city beautification project.

Two sources of funding for this program are discussed in the following paragraphs.

Funding Sources

The master plan report discusses structural and non-structural solutions. Each has its own advantages and drawbacks. The City currently has three funding mechanisms for these solutions: the stormwater utility service fee, tax increment finance (TIF) districts, and the Unsafe Building Fund.

Stormwater Utility

On October 25, 2004, Franklin Ordinance Number 04-18 created within the existing municipal Sewage Works a Department of Storm Water Management, a special taxing district, and a storm water utility fund. The stormwater utility was created under the existing wastewater utility. This configuration affords the city a couple of key benefits. First both utilities are administered without adding another level of government. Second the wastewater utility, which is financially stable with a good credit rating, can be leveraged for increased bonding capacity, if needed, for large municipal stormwater projects.

The stormwater fee was adopted by the Franklin City Council on December 2, 2009. In February 2010 the fee began being collected. Its purpose is to improve drainage, control flooding, improve water quality and fund the implementation of the EPA water quality regulations in Franklin. The stormwater service fee generates the capital funding required to address drainage issues, reduce water pollution as well as implementing the EPA water quality regulations.

The utility currently collects fees in accordance with the following structure:

- Residential Users:
  - Single Family - $5.00
  - Apartments & Mobile Homes - $2.50

- Non-residential Users:
  - Less than 40,000 sq. ft. of land - $5.00
  - Greater than 40,000 sq. ft. of land - $15.00

In a typical month, it generates approximately $40,000 in revenue and incurs approximately $20,000 in expenses. Therefore, it generates approximately $225,000 on an annual basis that could be used for capital improvements. In addition to funding projects and repairs, the stormwater utility could be used to make annual planned purchases or quick buys for the Floodplain Buyout Program.

The stormwater utility rate has remained unchanged since its inception and is in need of an adjustment considering the capital improvements projects, flood mitigation projects, and repairs to the stormwater system. Table 7 is a summary of the communities' residential stormwater utility fees.

Table 7: Community Residential Stormwater Utility Fees

Community	Residential	Year Adopted
Brownsburg	$5.00	2008
Carmel	$4.95	2014
Fishers	$4.95	2007
Fort Wayne	$3.65	----
Greenwood	$5.00	2012
Indianapolis	$2.25	2005
Lebanon	$5.00	2015
Mooresville	$3.00	----
Plainfield	$4.00	----
West Lafayette	$8.00	2013
Zionsville	$3.86	----

The City has a stormwater utility fee that would be considered typical. All of the communities are faced with constructing a long list of stormwater capital improvements projects. The City of Indianapolis website states their "fee is well below the amount required to meet the current storm water drainage and water quality needs in the community". In addition, it states that "without additional funding, DPW will not be able to address many of the storm water problems". Some of the communities have discussed the possibility of increasing their fees, but discussions are in the early stages. An additional funding source is vital to the City's ability to design and construct the stormwater infrastructure needed both short-term and long-term.

Tax Increment Finance District

Tax Increment Finance (TIF) permits the use of increased tax revenues stimulated by redevelopment to pay for the capital improvements needed to induce the redevelopment. It is a funding mechanism the City has utilized for previous projects and one which could be utilized for a project located within a district. It is not considered to be a primary funding source as funds cannot be used for projects outside of TIF districts.

The Unsafe Building Fund

The Unsafe Building Fund was adopted by the City Council on May 18, 2009 in an effort to promote the health, safety, and general welfare of the public. At the time this report was written, the city had accumulated approximately $160,000. It could be utilized to purchase dilapidated properties in designated areas if a Floodplain Buyout Program were created. It could not however be used to make annual planned purchases or quick buys for the Floodplain Buyout Program. It is not considered to be a primary funding source due to the limitations of the use of the funds and the amount of funds available.

Stormwater System Development Charges

The creation of another primary funding mechanism is vitally important to the health of the stormwater utility. While grants are available for certain types of project, the bulk of the burden has been placed on local governments. A system development charge, or a connection fee, is a commonly used method to subsidize wastewater and water projects and could be used for stormwater projects. Developer impact fees and system development charges are a funding option for communities looking for ways to pay for stormwater infrastructure associated with new development without raising taxes. In addition, new customers pay for future infrastructure needed to mitigate flooding associated with the increase in impervious surface.

Impact fees place the costs of new infrastructure needs from development directly on developers and indirectly on those who buy property in the new developments. Impact fees free other taxpayers from the obligation to fund new projects that do not directly benefit them. They also can be used to promote smart growth in communities because they subject developers to more of the costs involved in a new project.

Impact fees can be charged to fund new stormwater systems, but the amount of money available is dependent on the growth rate of the community. There are also legal constraints that communities must consider when implementing impact fees of any kind. Impact fees have been challenged as takings or illegal taxes in several communities so the fee must be designed carefully to assure that the fee amount is justified and that the people paying the fee are receiving its benefits. Impact fees have also been challenged on the premise of intergenerational equity for requiring new developments to pay their own way while older developments had their infrastructure needs financed by the government.

Impact fees are a helpful funding tool that can be used in conjunction with a stormwater utility or other funding mechanisms. For example, residents of a new development can pay impact fees or

system development charges during the construction of their new home or business and then remain stormwater utility customers after the building is completed.

Stormwater Ordinance Review

The draft City of Franklin Stormwater Ordinance and Technical Standards Manual from 2011 outline a proposed policy for development within Franklin. These documents lay out best management practices (BMPs) which are design, construction and maintenance practices and criteria for stormwater facilities that minimize the impact of stormwater runoff rates and volumes, prevent erosion, and capture pollutants.

These best management practices (BMPs) are classified into two categories:

- Conventional approach and
- Low Impact Development (LID).

The conventional approach utilizes typical construction practices to achieve stormwater requirements. The LID approach tries to maintain or recreate preconstruction stormwater characteristics. These approaches are outlined in chapter 8 of the draft Stormwater Technical Standards Manual.

Since the City allows for both types of BMP's to be utilized, there is currently no negative economic impact to potential developers. However, there could be considerable impact to the City if no LID development occurs. Since the watershed upstream of Franklin is largely undeveloped, future conventional development increases the total volume and peak of water that travels through Franklin. LID would decrease the potential impact of the upstream watershed.
There is currently no fee structure in place for encouraging LID versus conventional development. Developing this policy could negatively impact conventional development, but mitigate long term negative effects of larger stormwater events. Using LID potentially provides greater area for potential development because the floodplain does not increase over time. One advantage for developers using the LID approach is that the water quality flow requirement can potentially be fulfilled by the LID BMPs. This is outlined in Chapter 8 of the draft Stormwater Technical Standards Manual.

Post-construction BMP data sheets and maintenance schedules are not included in Appendix D of the draft City's Stormwater Technical Standards Manual from August 2011 or in any City of Franklin stormwater documents as mentioned in the ordinance and technical standards. In general, the more conventional BMPs that are constructed in Franklin, the more time is needed by staff to inspect and follow-up on maintenance. It is recommended that conventional BMP documentation be added to the City's Stormwater Technical Standards Manual.

Similar ordinances and technical standards are utilized by many communities around central Indiana including Fishers, Greenfield, Zionsville, Lebanon and Boone County, Indiana. The BMP's mentioned in the draft City of Franklin Stormwater Ordinance and Technical Standards Manual from 2011 are typical. Due to Franklin's unique watershed situation, LID development should be encouraged. This could be accomplished by offering credits on the stormwater development system charges if LID development is utilized.

Stream Gauging

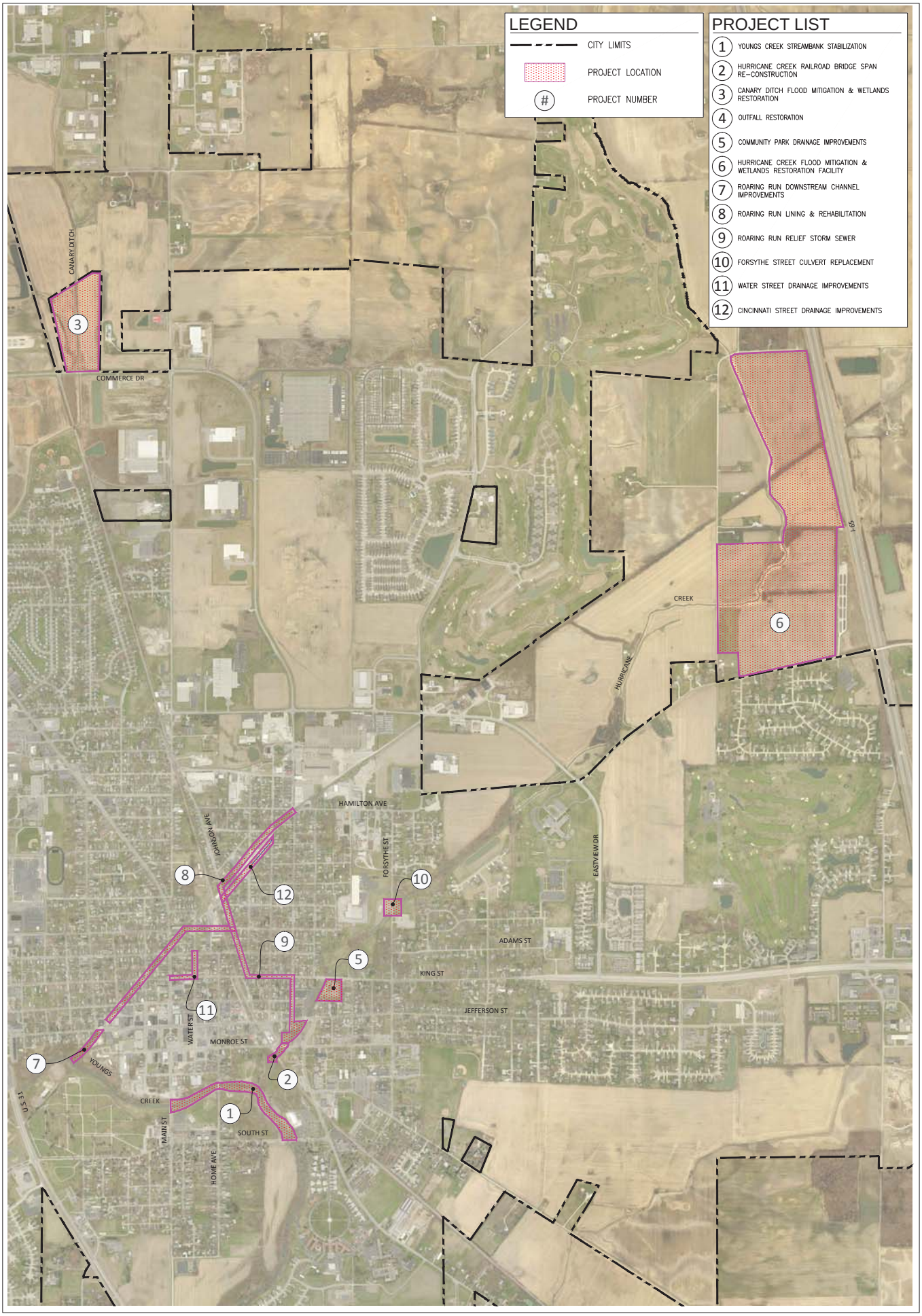
WE recommends that the City invest in a USGS-monitored stream gauging station on Youngs Creek and possibly Hurricane Creek within the project area (Exhibit 9). The initial cost of the station would be between $13,500 to $15,000. The yearly operation and maintenance of the gauging station can range between $4,500 and $13,000 depending on the amount of data collected. USGS would maintain the gauge station for the City.

Considering the size of the upstream watershed and the amount of undeveloped land remaining, investing in a stream gauging station(s) should be strongly considered. The data collected could be useful for designing projects, calibrating floodplain studies, and disputing revised floodplain mapping. The data would give the City power in the form of knowledge.

Conclusion

The Stormwater Master Plan outlines the stormwater capital improvements projects that will address current flooding problems and prepare the City for mitigating future flooding problems in the form of structural and non-structural solutions. The stormwater capital improvements projects not only address localized and regional drainage problems, but also keep the City in compliance with its MS4 requirements.

The phasing plan presents timelines to complete each of the structural solutions' designs and construction and times to implement the non-structural solutions. A financial analysis was not part of the scope of this project, so funding, or lack thereof, could affect when and how long each of the projects take to complete.



WHITAKER ENGINEERING
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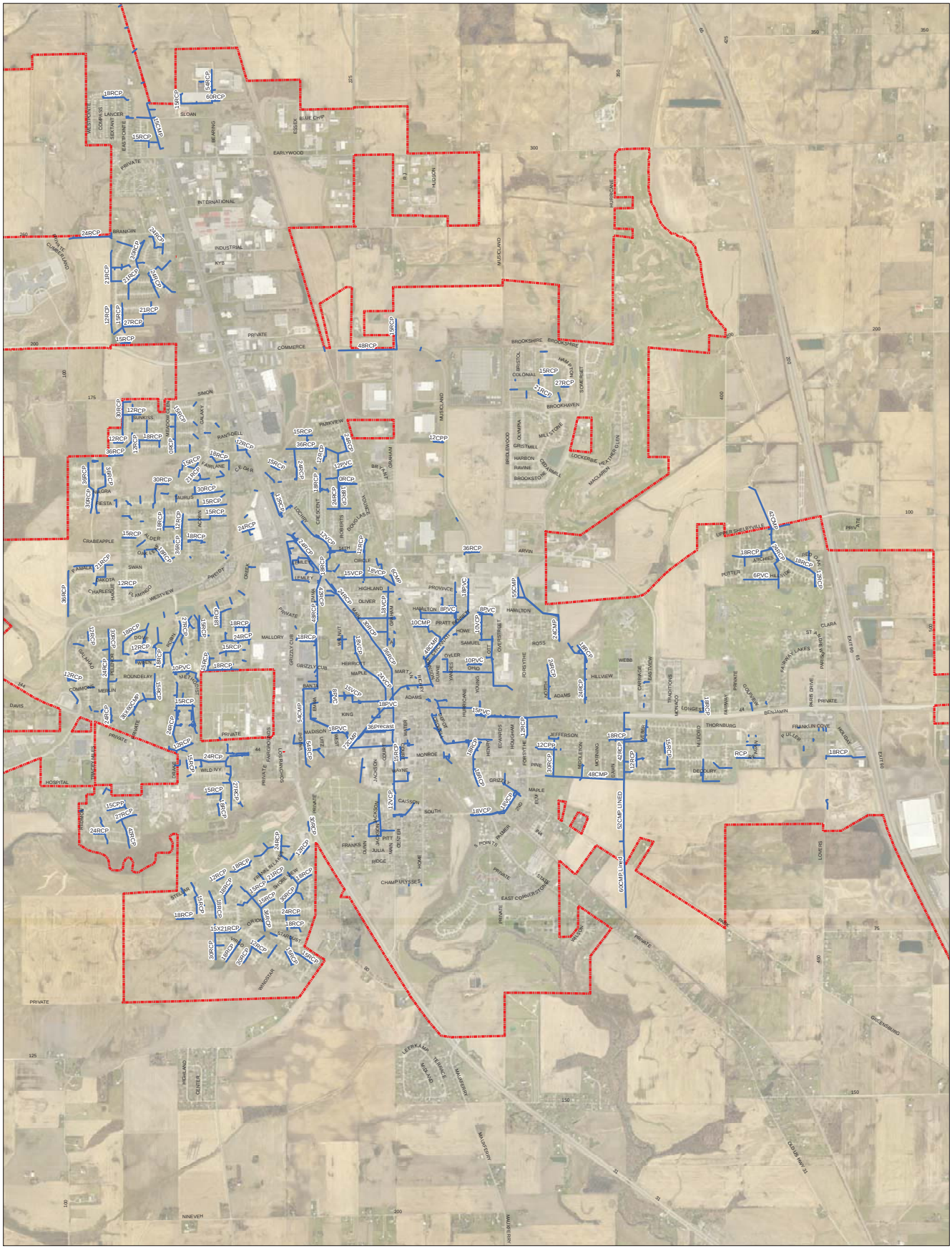
(317) 324-1275 - Corporate (317) 324-1276 -Fax

NORTH

GRAPHIC SCALE
600 0 300 600
(IN FEET)
1 inch = 600 ft.

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN
DRAWING NAME: CAPITAL IMPROVEMENTS PROJECTS
DRAWN BY: JLE
CHECKD BY: ACC
SCALE: 1" = 600'
DATE: 12/09/14
SKETCH NO.:

FIGURE 1



WHITAKER ENGINEERING
WHITAKER ENGINEERING, PC.
8145 Halyard Way • Indianapolis, IN 46236-9572
(317) 324-1275 - Corporate (317) 324-1276 -Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN
DRAWING NAME: SURVEYED STORM SEWER SYSTEM
DRAWN BY: JLE SCALE: _____
CHECKED BY: ACC DATE: 12/09/14
SKETCH NO.:

FIGURE 2

NORTH

FRANKLIN INDIANA CITY OF CHOICE

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

DRAWING NAME: HURRICANE CREEK RAILROAD BRIDGE SPAN RE-CONSTRUCTION

DRAWN BY: JLE SCALE: 1" = 200'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 3

NORTH

FRANKLIN INDIANA CITY OF CHOICE

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

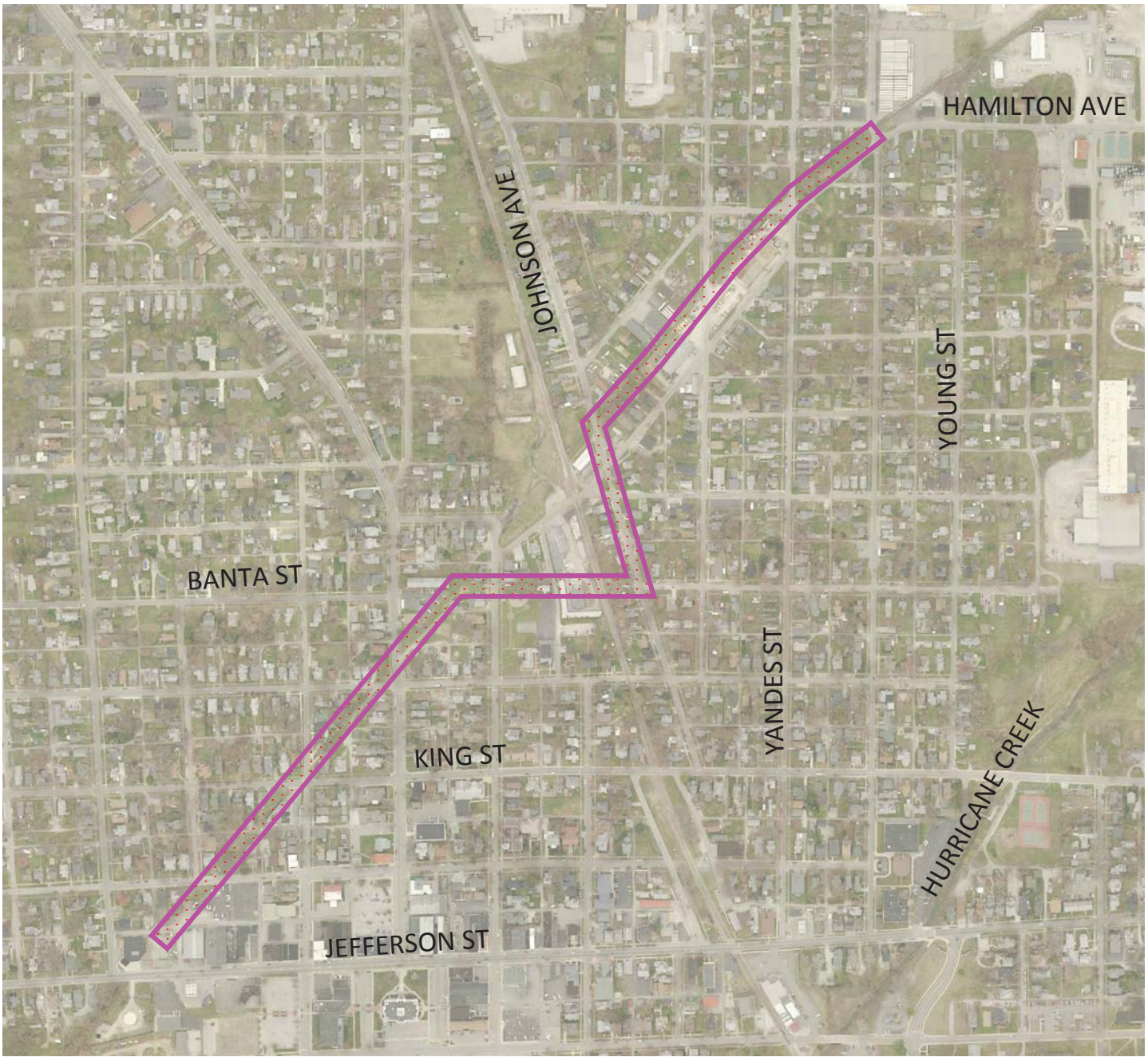
DRAWING NAME: COMMUNITY PARK DRAINAGE IMPROVEMENTS

DRAWN BY: JLE SCALE: 1" = 200'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 4



NORTH

FRANKLIN INDIANA CITY OF CHOICE

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

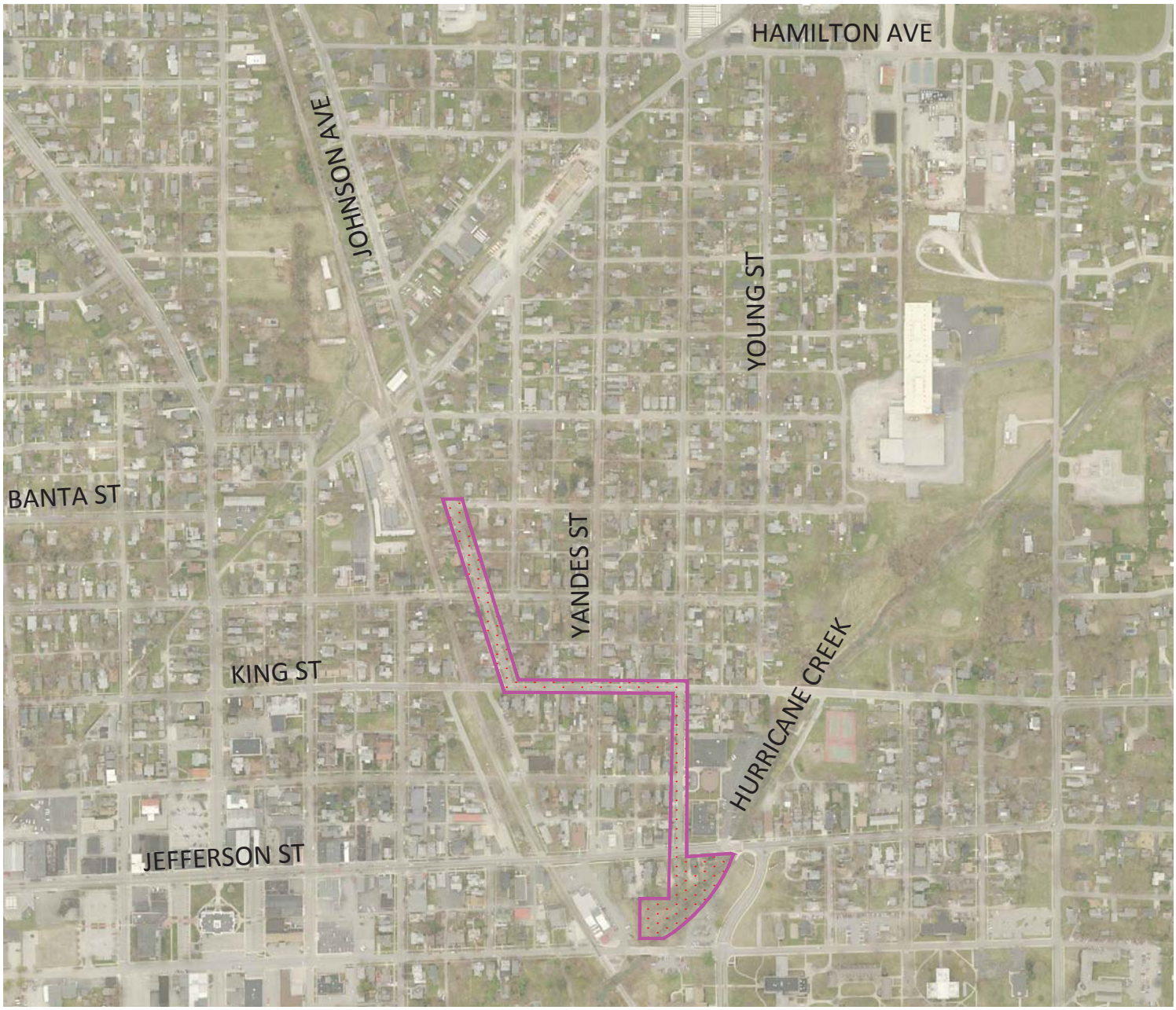
DRAWING NAME: ROARING RUN REHABILITATION

DRAWN BY: JLE SCALE: 1" = 600'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 5



NORTH

FRANKLIN INDIANA CITY OF CHOICE LIVE, WORK AND PLAY FOR A LIFETIME

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WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

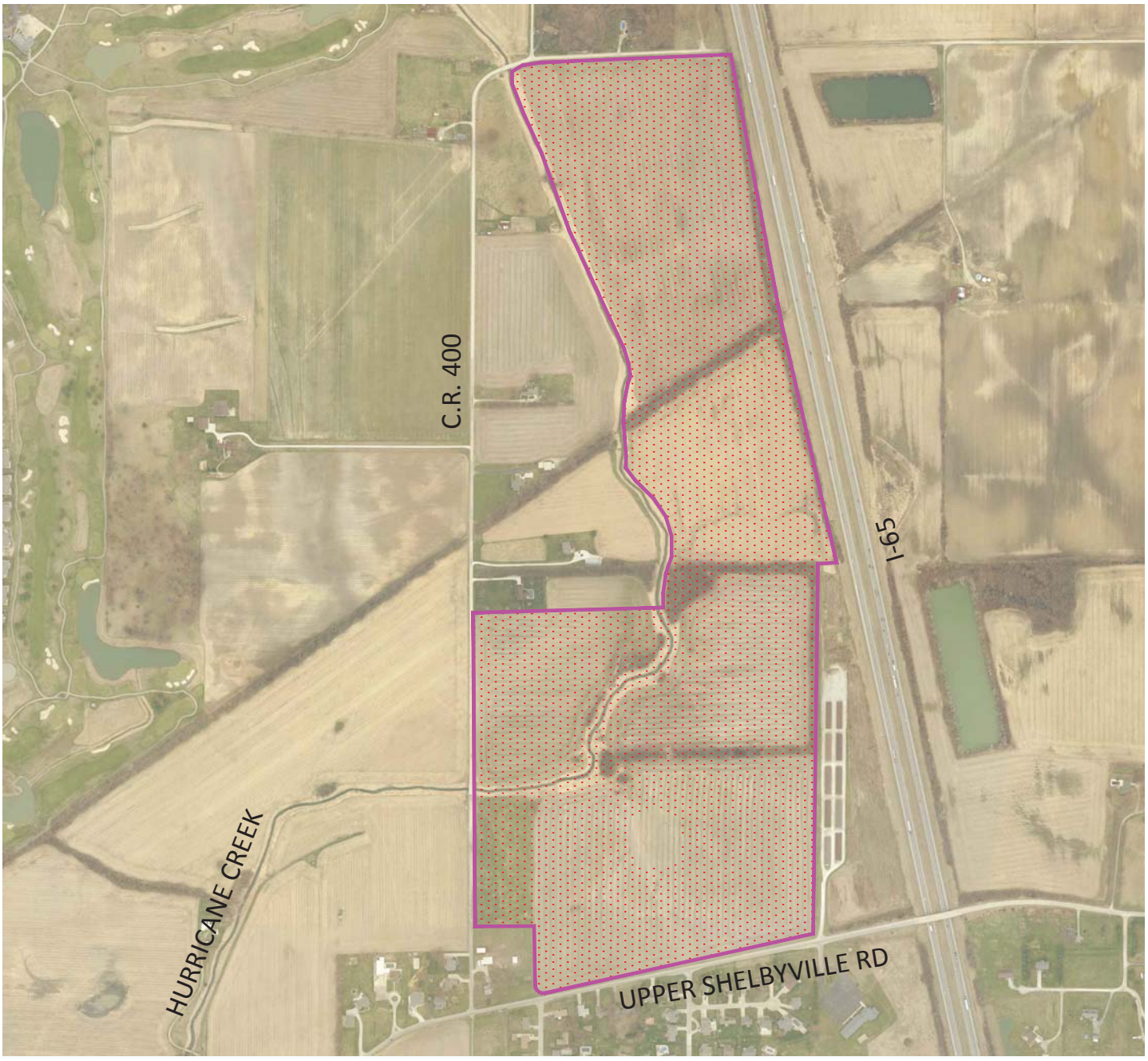
DRAWING NAME: ROARING RUN RELIEF STORM SEWER

DRAWN BY: JLE SCALE: 1" = 600'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 6



NORTH

FRANKLIN INDIANA CITY OF CHOICE

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

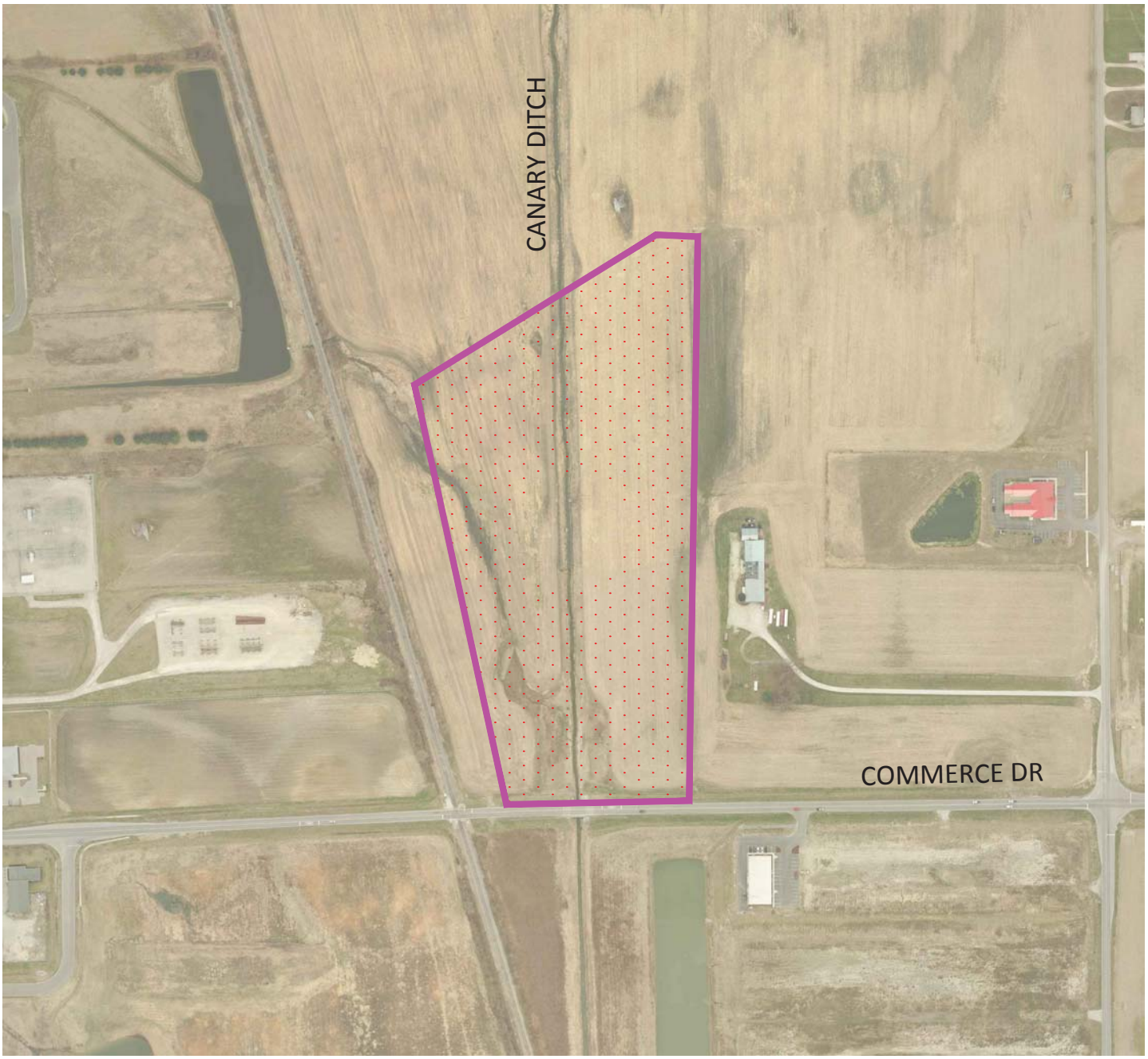
DRAWING NAME: HURRICANE CREEK FLOOD MITIGATION & WETLANDS RESTORATION FACILITY

DRAWN BY: JLE SCALE: 1" = 800'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 7



NORTH

FRANKLIN INDIANA CITY OF CHOICE

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

DRAWING NAME: CANARY DITCH FLOOD MITIGATION & WETLANDS RESTORATION

DRAWN BY: JLE SCALE: 1" = 400'

CHECKD BY: ACC DATE: 12/10/14

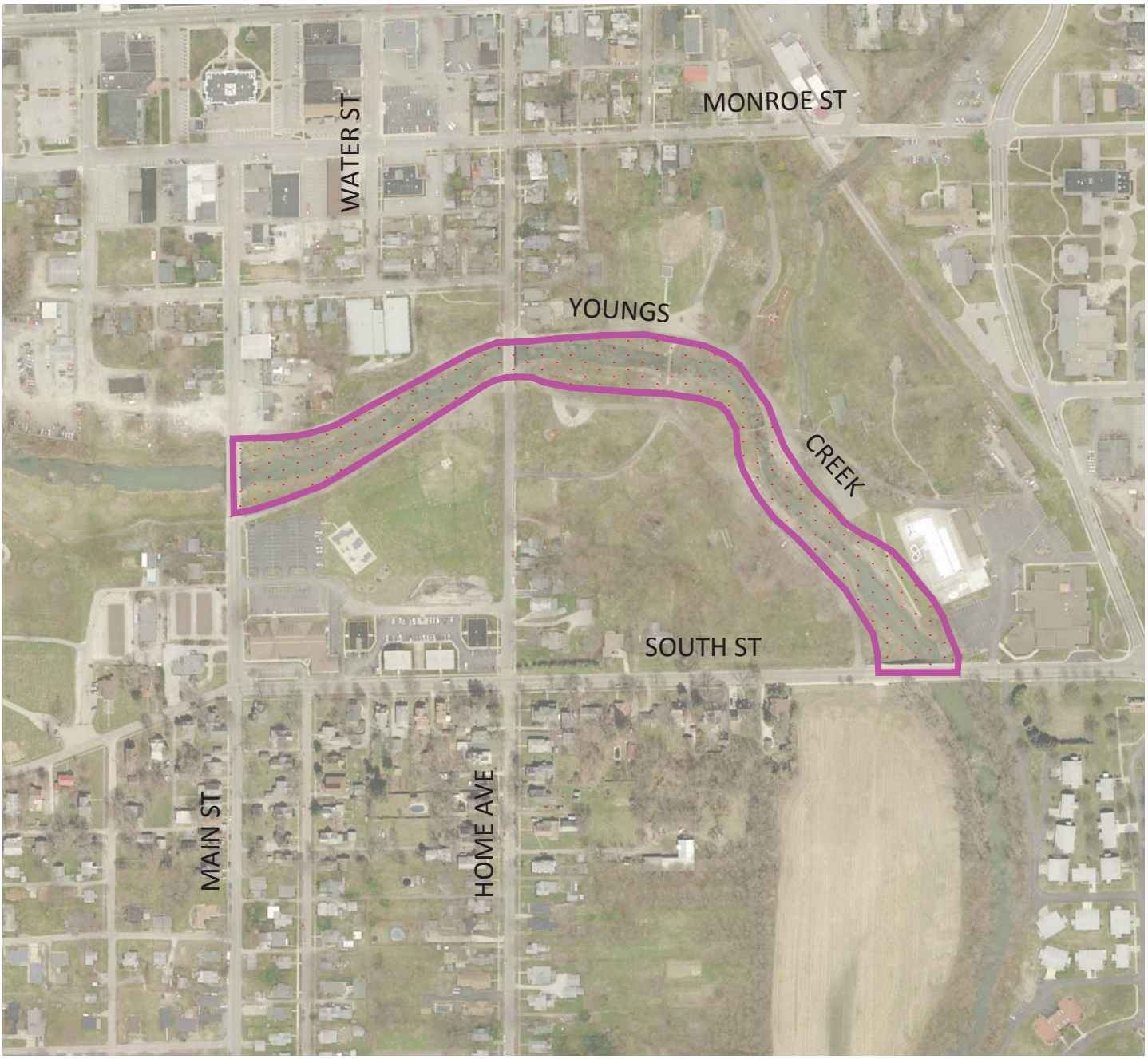
SKETCH NO.:

FIGURE 8

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax



NORTH

FRANKLIN INDIANA CITY OF CHOICE

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

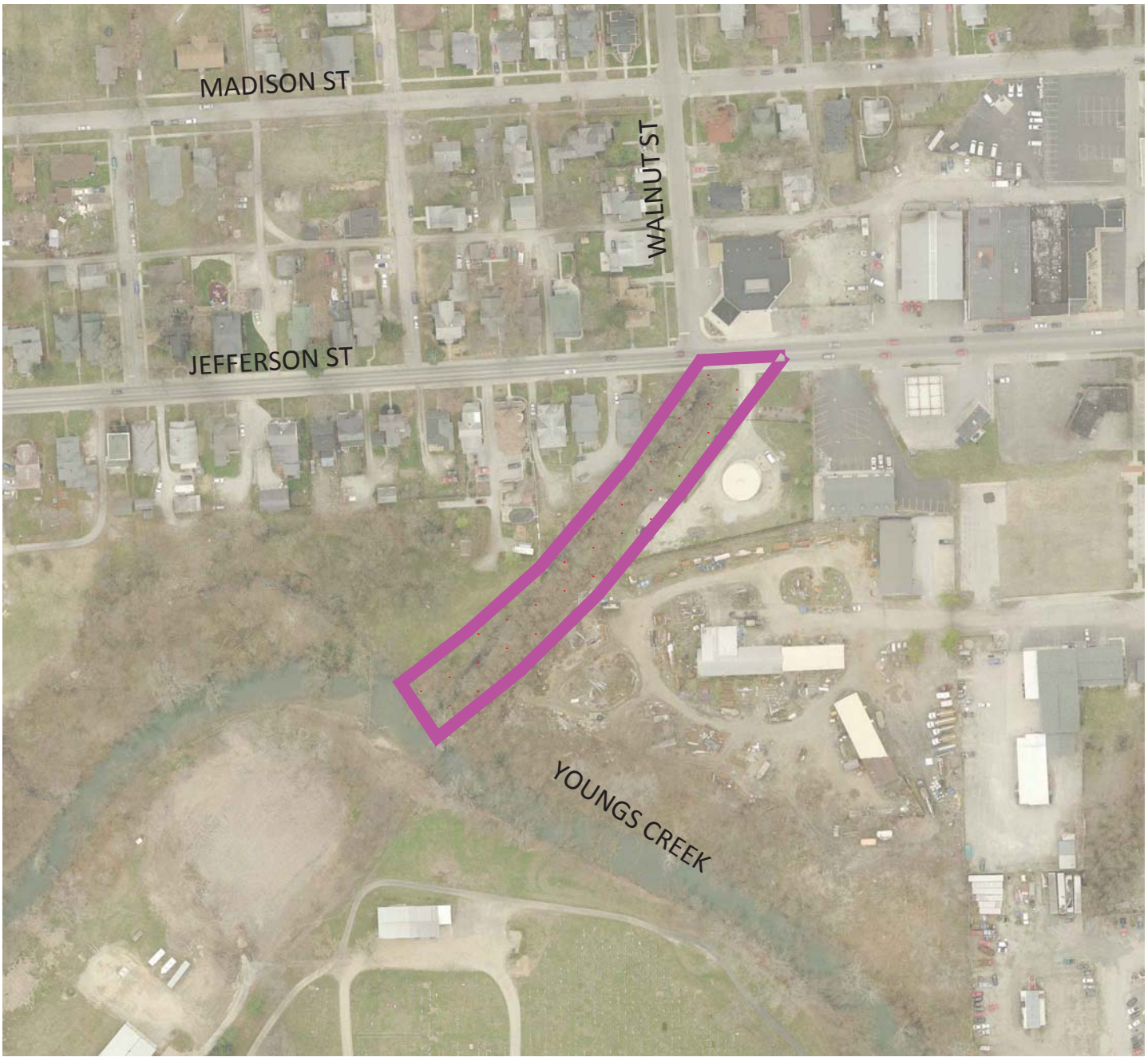
DRAWING NAME: YOUNGS CREEK STREAMBANK STABILIZATION

DRAWN BY: JLE SCALE: 1" = 400'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 9



NORTH

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

DRAWING NAME: ROARING RUN DOWNSTREAM CHANNEL IMPROVEMENTS

DRAWN BY: JLE SCALE: 1" = 200'

CHECKD BY: ACC DATE: 12/10/14

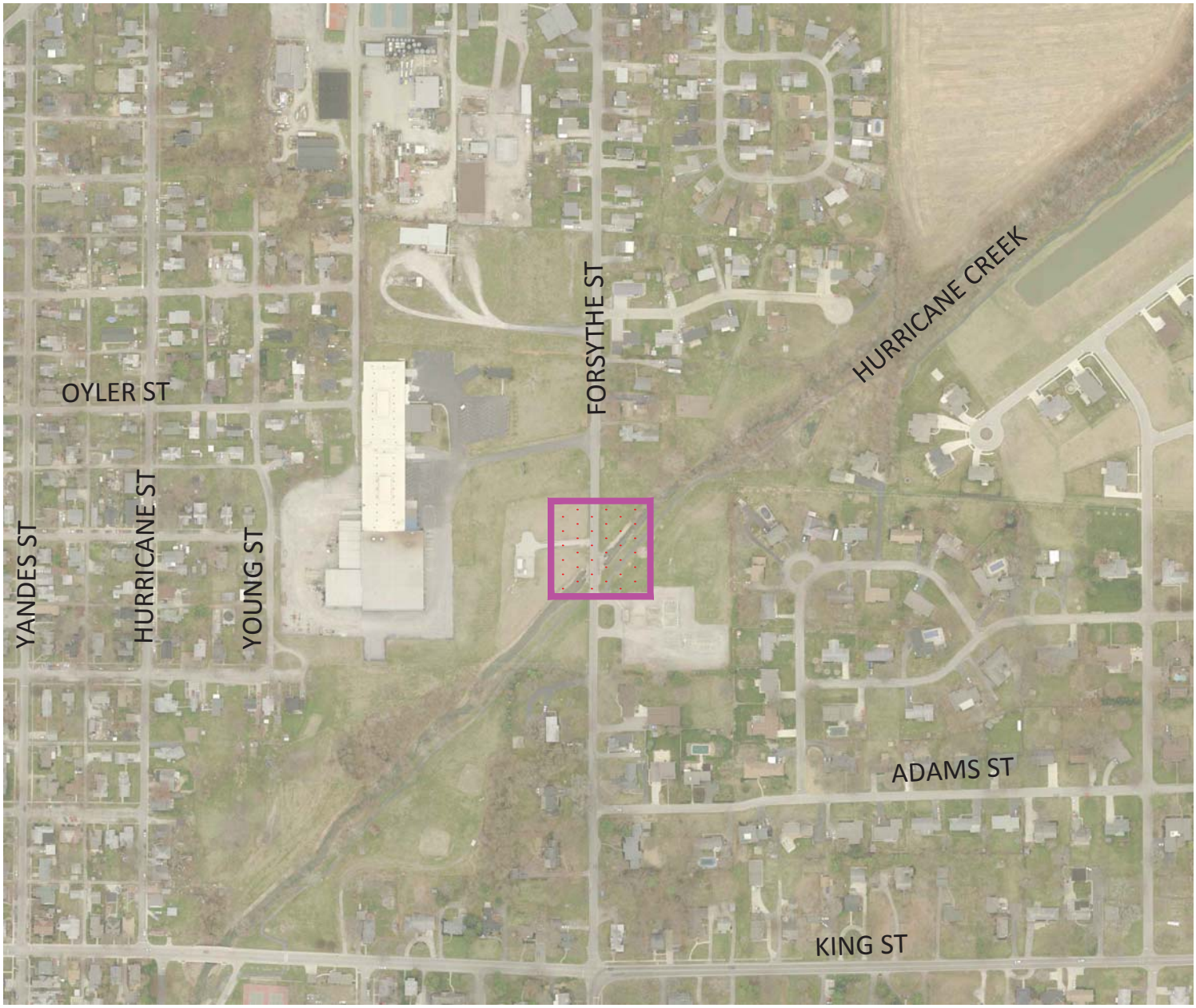
SKETCH NO.:

FIGURE 10

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax



NORTH

FRANKLIN INDIANA CITY OF CHOICE

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

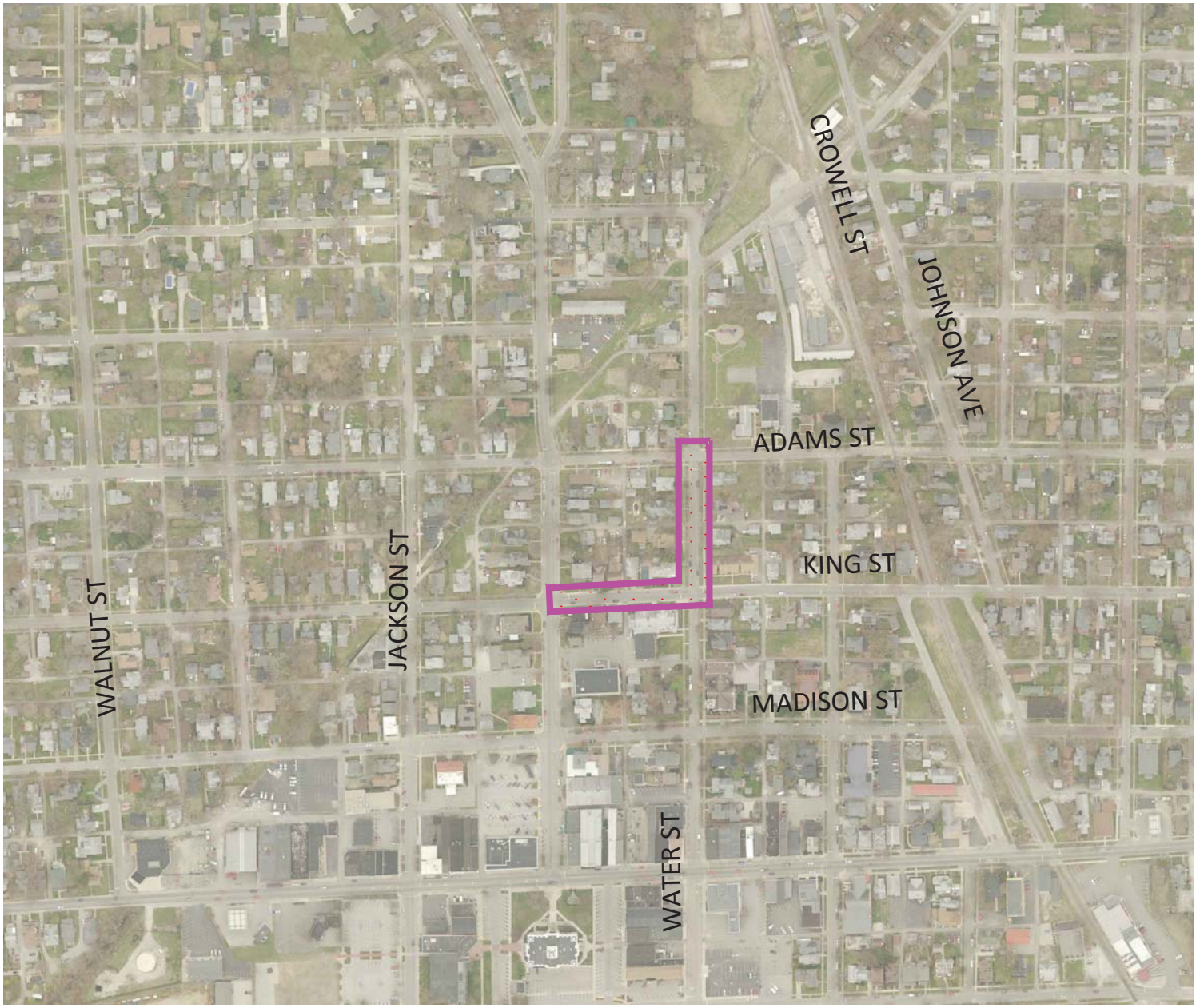
DRAWING NAME: FORSYTHE STREET CULVERT REPLACEMENT

DRAWN BY: JLE SCALE: 1" = 400'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 11



NORTH

FRANKLIN INDIANA CITY OF CHOICE LIVE, WORK AND PLAY FOR A LIFETIME

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

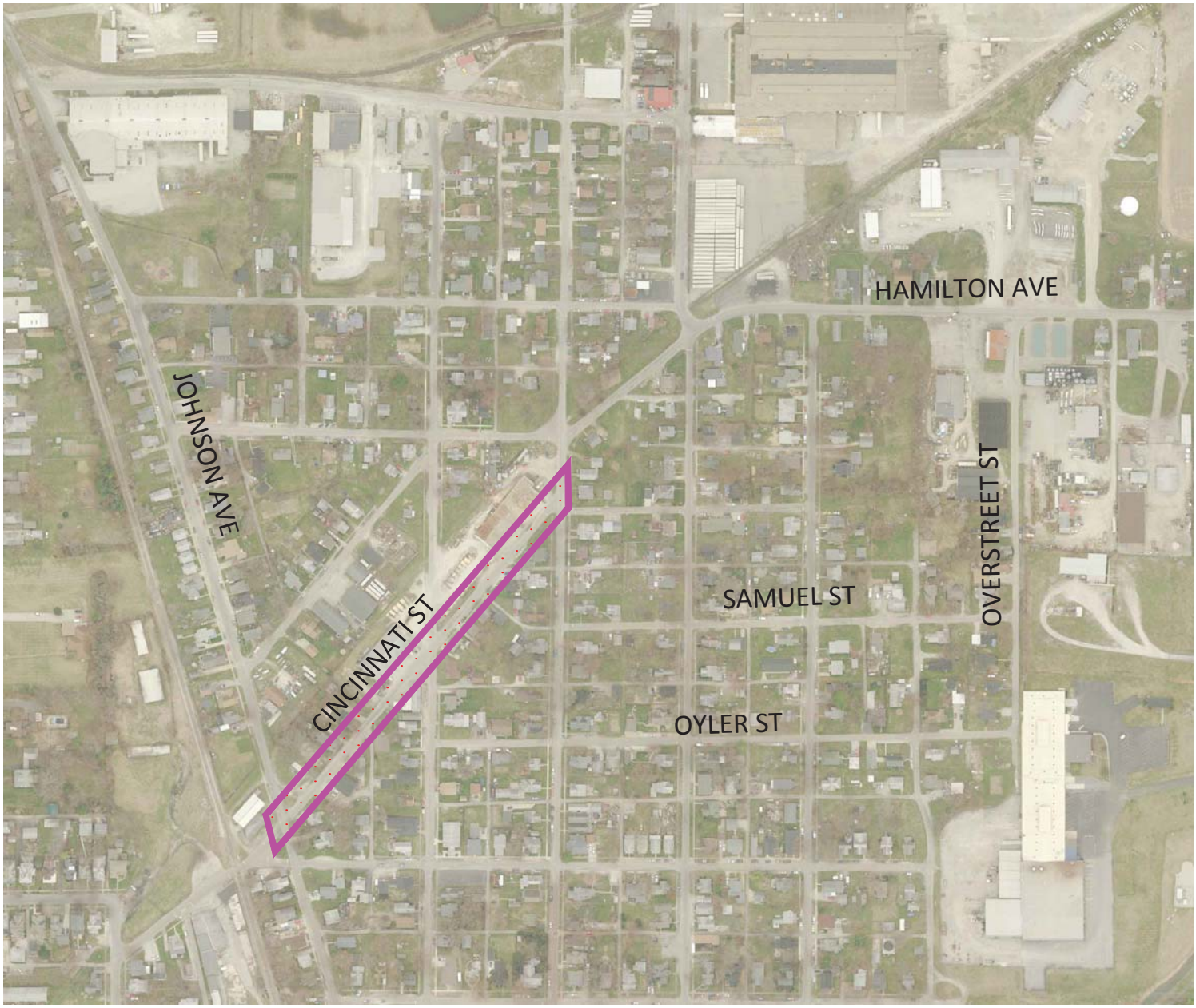
DRAWING NAME: WATER STREET DRAINAGE IMPROVEMENTS

DRAWN BY: JLE SCALE: 1" = 400'

CHECKD BY: ACC DATE: 12/10/14

SKETCH NO.:

FIGURE 12



NORTH

PROJECT NAME: CITY OF FRANKLIN STORMWATER MASTER PLAN

DRAWING NAME: CINCINNATI STREET DRAINAGE IMPROVEMENTS

DRAWN BY: JLE SCALE: 1" = 400'

CHECKD BY: ACC DATE: 12/10/14

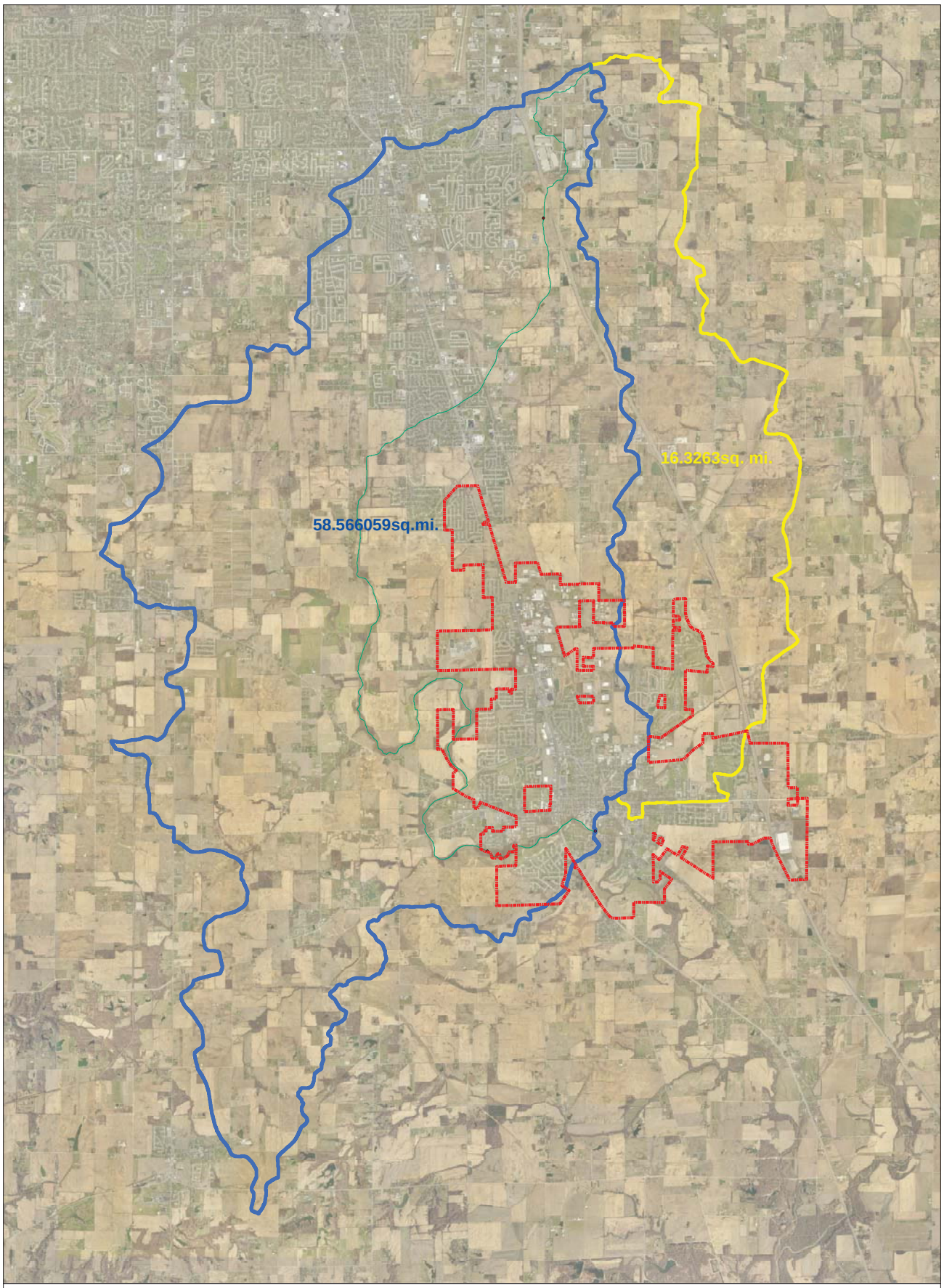
SKETCH NO.:

FIGURE 13

WHITAKER ENGINEERING

WHITAKER ENGINEERING, PC.

8145 HALYARD WAY (317) 324-1275 - Corporate
INDIANAPOLIS, IN 46236-9572 (317) 324-1276 - Fax



CITY OF FRANKLIN
STORMWATER MASTER PLAN

0 6,250 12,500
Feet

N

YOUNGS CREEK &
HURRICANE CREEK
WATERSHEDS

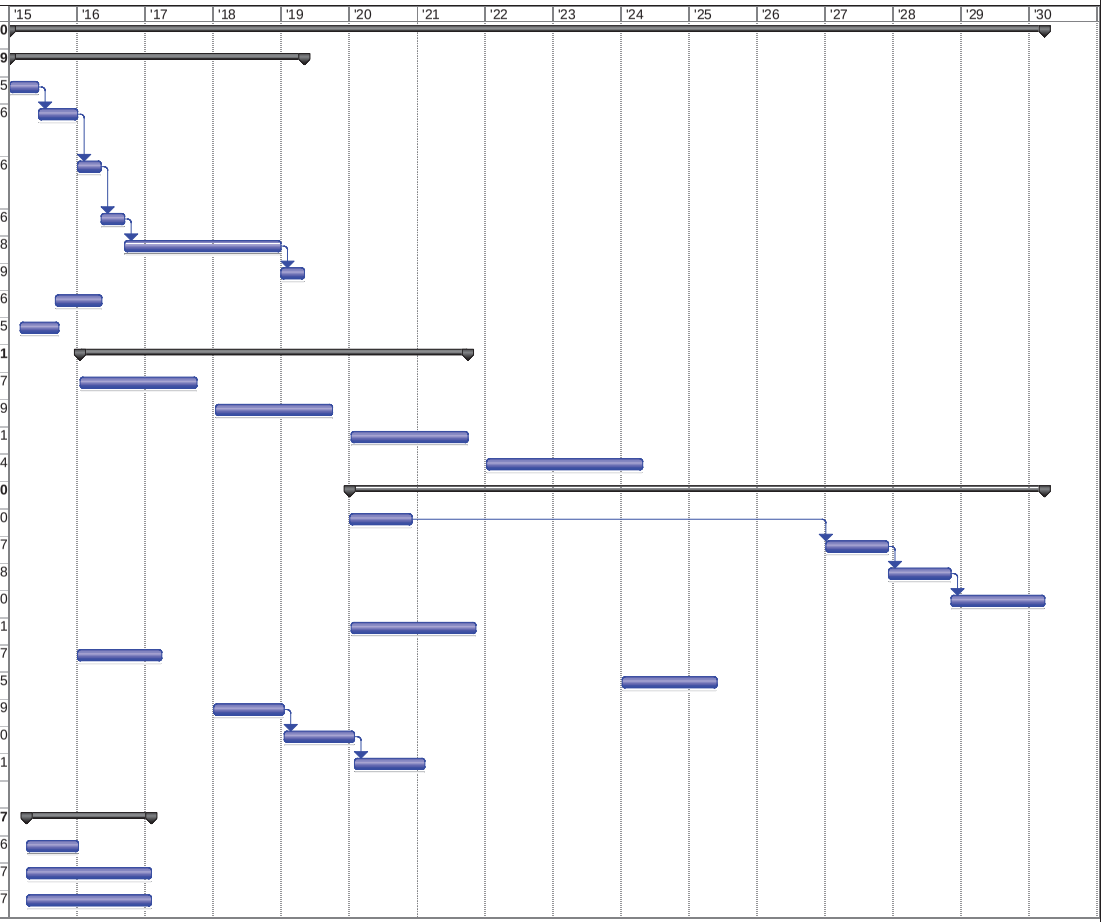
Legend

- City Limits
- Youngs Creek Watershed
- Hurricane Creek Watershed

EXHIBIT 1: Watershed Map

City of Franklin
Stormwater Master Plan
Exhibit 2: Project Phasing Plan

ID	Task Name	Duration	Start	Finish
1	**Structural Solutions**	**3971 days**	**Tue 1/6/15**	**Tue 3/26/30**
2	**Hurricane Creek Railroad Bridge Span Re-Construction**	**1130 days**	**Tue 1/6/15**	**Mon 5/6/19**
3	Investigate viability of project	110 days	Tue 1/6/15	Mon 6/8/15
4	Obtain specific construction, permitting, and timing requirements and scope of work from railroad	150 days	Tue 6/9/15	Mon 1/4/16
5	Retain consultant to perform preliminary engineering and opinion of probable cost	90 days	Tue 1/5/16	Mon 5/9/16
6	Prepare a preliminary LOMR	90 days	Tue 5/10/16	Mon 9/12/16
7	Design, bid, construct	30 mons	Tue 9/13/16	Mon 12/31/18
8	Finalize LOMR	90 days	Tue 1/1/19	Mon 5/6/19
9	Community Park Drainage Improvements	180 days	Mon 9/7/15	Fri 5/13/16
10	Outfall Restoration	150 days	Mon 3/2/15	Fri 9/25/15
11	**Roaring Run Rehabilitation**	**1490 days**	**Mon 1/18/16**	**Fri 10/1/21**
12	Phase I	450 days	Mon 1/18/16	Fri 10/6/17
13	Phase II	450 days	Mon 1/15/18	Fri 10/4/19
14	Phase III	450 days	Mon 1/13/20	Fri 10/1/21
15	Roaring Run Relief Storm Sewer	30 mons	Mon 1/10/22	Fri 4/26/24
16	**Hurricane Creek Flood Mitigation & Wetlands Restoration Facility**	**2667 days**	**Mon 1/6/20**	**Tue 3/26/30**
17	Land acquisition	12 mons	Mon 1/6/20	Fri 12/4/20
18	Design	12 mons	Wed 1/6/27	Tue 12/7/27
19	Permitting	12 mons	Wed 12/8/27	Tue 11/7/28
20	Construction	18 mons	Wed 11/8/28	Tue 3/26/30
21	Canary Ditch Flood Mitigation & Wetlands Restoration	24 mons	Mon 1/13/20	Fri 11/12/21
22	Youngs Creek Streambank Stabilization	325 days	Mon 1/4/16	Fri 3/31/17
23	Roaring Run Downstream Channel Improvements	365 days	Mon 1/8/24	Fri 5/30/25
24	Forsythe Street Culvert Replacement	270 days	Fri 1/5/18	Thu 1/17/19
25	Water Street Drainage Improvements	270 days	Fri 1/18/19	Thu 1/30/20
26	Cincinnati Street Drainage Improvements Project	270 days	Fri 1/31/20	Thu 2/11/21
27				
28	**Non-Structural Solutions**	**480 days**	**Mon 4/6/15**	**Fri 2/3/17**
29	NFIP - Community Rating System	200 days	Mon 4/6/15	Fri 1/8/16
30	Floodplain Buyout Program	24 mons	Mon 4/6/15	Fri 2/3/17
31	Stormwater System Development Charges	24 mons	Mon 4/6/15	Fri 2/3/17



Project: Project1
Date: Mon 12/29/14

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

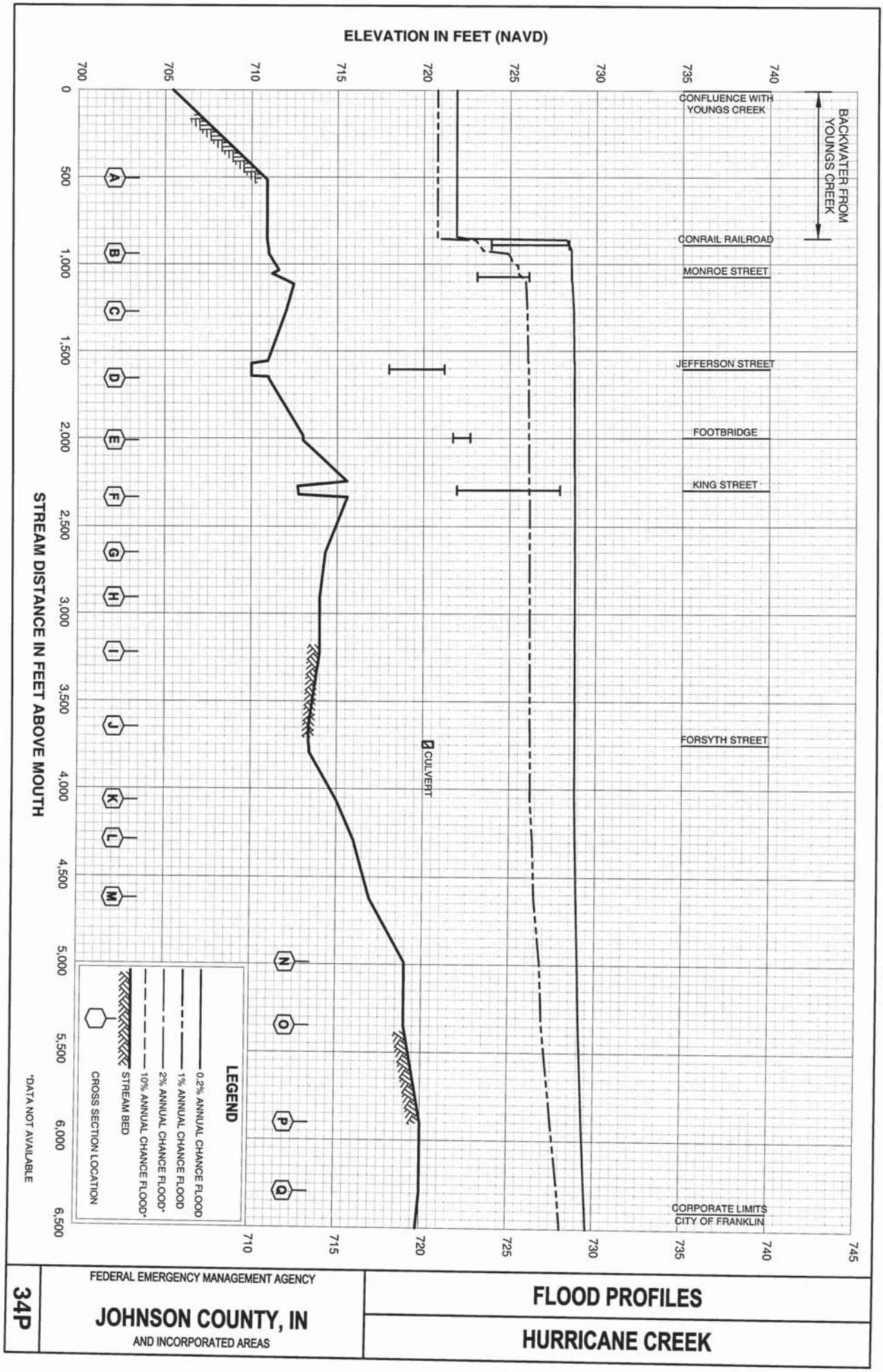


EXHIBIT 3: Hurricane Creek Flood Profile

TABLE 3. COMMUNITY RATING SYSTEM ELIGIBLE COMMUNITIES EFFECTIVE MAY 1, 2014 (continued)

COMMUNITY NUMBER	COMMUNITY NAME	CRS ENTRY DATE	CURRENT EFFECTIVE DATE	CURRENT CLASS	% DISCOUNT FOR SFHA[1]	% DISCOUNT FOR NON-SFHA	STATUS[2]
	Illinois (continued)						
170214	Oak Brook, Village of	10/1/92	10/1/97	7	15	5	C
170172	Orland Hills, Village of	10/1/96	10/1/02	5	25	10	C
170405	Ottawa, City of	10/1/10	10/1/10	5	25	10	C
175170	Palatine, Village of	10/1/94	05/1/04	7	15	5	C
170533	Peoria County	10/1/92	05/1/09	5	25	10	C
170919	Prospect Heights, City of	10/1/94	05/1/04	8	10	5	C
170151	River Forest, Village of	05/1/12	05/1/12	7	15	5	C
170387	Riverwoods, Village of	05/1/07	05/1/07	8	10	5	C
170582	Rock Island County	10/1/06	10/1/06	7	15	5	C
170448	Roxana, Village of	10/1/11	10/1/11	8	10	5	C
170912	Sangamon County	05/1/00	05/1/00	8	10	5	C
170332	South Elgin, Village of	10/1/12	10/1/12	5	25	10	C
170163	South Holland, Village of	10/1/92	10/1/02	5	25	10	C
170330	St. Charles, City of	10/1/94	10/1/11	5	25	10	C
170333	Sugar Grove, Village of	10/1/06	10/1/11	6	20	10	C
170191	Sycamore, City of	05/1/12	05/1/12	7	15	5	C
170169	Tinley Park, City of	10/1/05	10/1/11	6	20	10	C
170170	Westchester, Village of	10/1/12	10/1/12	8	10	5	C
170173	Wheeling, Village of	10/1/91	05/1/14	6	20	10	C
170687	Whiteside County	10/1/07	10/1/07	8	10	5	C
170222	Willowbrook, Village of	10/1/91	05/1/12	6	20	10	C
170224	Wood Dale, City of	10/1/99	10/1/04	5	25	10	C
170488	Woodstock, City of	05/1/11	05/1/11	7	15	5	C
	Indiana						
180302	Allen County	10/1/02	10/1/09	8	10	5	C
180150	Anderson, City of	05/1/07	10/1/12	9	5	5	C
180006	Bartholomew County	10/1/93	10/1/09	8	10	5	C
180026	Clarksville, Town of	05/1/14	05/1/14	9	5	5	C
180007	Columbus, City of	10/1/98	10/1/09	8	10	5	C
180001	Decatur, City of	10/1/93	05/1/08	8	10	5	C
180257	Evansville, City of	10/1/99	10/1/04	8	10	5	C
180003	Fort Wayne, City of	10/1/91	05/1/07	8	10	5	C
180080	Hamilton County	10/1/91	05/1/04	7	15	5	C
180419	Hancock County	10/1/03	10/1/06	8	10	5	C
180415	Hendricks County	05/1/12	05/1/12	8	10	5	C
180159	Indianapolis, City of	10/1/07	10/1/07	8	10	5	C
180027	Jeffersonville, City of	05/1/14	05/1/14	8	10	5	C
180093	Kokomo, City of	10/1/95	10/1/96	8	10	5	C
180121	Kosciusko, County of	10/1/97	10/1/12	8	10	5	C
180013	Lebanon, City of	10/1/13	10/1/13	8	10	5	C
180382	Milford Junction, City of	10/1/97	05/1/08	8	10	5	C
180082	Noblesville, City of	10/1/91	10/1/09	8	10	5	C
180465	North Webster, City of	10/1/97	05/1/08	8	10	5	C
180122	Syracuse, City of	10/1/97	05/1/08	8	10	5	C
180256	Vanderburgh County	05/1/99	05/1/99	8	10	5	C
180263	Vigo County	10/1/95	10/1/05	10	0	0	R
	Iowa						
190169	Coralville, City of	10/1/92	10/1/96	10	0	0	R
190017	Cedar Falls, City of	05/1/14	05/1/14	5	25	10	C

1 For the purpose of determining CRS discounts, all AR and A99 Zones are treated as non-SFHAs.
2 Status: C = Current, R = Rescinded

EXHIBIT 5: In-Force Flood Insurance Policies Per State & County

Policy Statistics

in effect on report "AS OF" date below

Policy Statistics
Country-Wide
AS OF 07/31/2014

State Name	Policies In-force	Insurance In-force whole $	Written Premium in-force
Alaska	3,097	759,469,200	2,865,023
Alabama	57,663	12,541,130,500	38,031,207
Arkansas	20,011	3,181,439,600	14,596,263
Arizona	34,712	8,075,926,400	22,744,297
California	239,218	64,026,299,600	211,220,883
N Mariana Islands	13	1,507,200	25,189
Colorado	24,411	5,839,263,100	19,832,772
Connecticut	42,497	10,489,873,700	55,153,950
District Columbia	2,432	457,418,000	1,433,806
Delaware	24,981	6,652,621,400	20,278,221
Florida	2,004,347	475,892,169,900	1,068,684,997
Georgia	93,809	23,444,990,700	71,352,131
Guam	252	48,180,800	497,195
Hawaii	59,602	12,867,315,600	37,128,706
Iowa	15,764	2,876,597,500	14,645,594
Idaho	6,575	1,497,434,400	4,754,236
Illinois	47,820	8,873,197,000	45,593,021
Indiana	28,351	5,097,836,800	25,858,813
Kansas	12,330	2,083,814,100	10,331,605
Kentucky	23,947	3,689,904,500	20,337,720
Louisiana	473,160	113,018,238,100	368,251,780
Massachusetts	56,969	14,534,783,200	76,797,831
Maryland	73,019	16,377,407,600	47,341,108
Maine	9,199	2,059,254,200	9,808,133
Michigan	24,219	4,251,916,300	22,622,949
Minnesota	12,000	2,610,691,800	9,660,846
Missouri	24,966	4,303,964,000	23,589,247
Mississippi	71,164	16,183,816,600	45,335,633
Montana	6,248	1,213,675,100	4,327,846
North Carolina	136,638	32,690,986,600	109,881,713
North Dakota	12,258	3,121,986,300	7,939,993
Nebraska	12,233	2,086,547,000	10,842,811
New Hampshire	9,187	1,938,898,400	9,142,496
New Jersey	239,595	57,386,642,500	243,038,739
New Mexico	15,600	2,970,792,100	12,184,693
Nevada	13,891	3,339,789,300	9,052,964
New York	190,750	50,242,237,000	209,611,094
Ohio	40,307	6,862,400,400	36,585,818
Oklahoma	16,960	3,169,967,600	12,756,058
Oregon	32,640	7,616,328,600	27,474,660
Pennsylvania	71,327	13,547,711,600	74,909,397
Puerto Rico	28,416	2,505,511,500	16,116,763
Rhode Island	15,468	3,948,408,600	21,691,443
South Carolina	193,191	51,137,580,900	138,125,747
South Dakota	5,227	1,130,295,500	4,528,708
Tennessee	31,309	7,166,521,300	24,409,192
Texas	607,576	157,465,697,700	379,459,280
Utah	4,197	1,002,222,600	2,795,405
Virginia	113,224	28,120,466,600	84,853,341
Virgin Islands	1,867	339,019,200	2,143,238
Vermont	4,458	912,827,800	5,414,546
Washington	43,440	10,294,076,000	37,230,663
Wisconsin	15,629	2,830,226,000	13,508,208
West Virginia	19,759	2,645,308,000	18,717,431
Wyoming	2,383	538,249,700	2,078,873
Total	5,370,306	1,277,960,835,700	3,807,594,276

Policy Statistics
Alabama
AS OF 07/31/2014

County Name	Community Name	Policies In-force	Insurance In-force whole $	Written Premium In-force
AUTAUGA COUNTY	AUTAUGA COUNTY *	82	17,225,900	58,602
	AUTAUGAVILLE, TOWN OF	32	2,794,000	23,405
	MILLBROOK, CITY OF	193	32,750,500	109,856
	MONTGOMERY, CITY OF	1,651	350,272,400	1,337,326
	PRATTVILLE, CITY OF	181	39,476,900	114,837

	SPICELAND, TOWN OF	20	1,477,800	14,304
	SULPHUR SPRINGS, TOWN OF	2	194,600	2,001
HOWARD COUNTY	HOWARD COUNTY *	141	36,027,200	89,503
	KOKOMO, CITY OF	121	21,983,800	190,027
	RUSSIAVILLE, TOWN OF	1	350,000	460
HUNTINGTON COUNTY	ANDREWS, TOWN OF	7	791,600	4,619
	HUNTINGTON COUNTY *	55	7,175,900	38,892
	HUNTINGTON, CITY OF	20	3,287,700	8,260
	ROANOKE, TOWN OF	19	4,109,800	23,993
	WARREN, TOWN OF	5	689,000	5,594
JACKSON COUNTY	BROWNSTOWN, TOWN OF	1	105,000	281
	JACKSON COUNTY *	69	9,705,600	46,833
	MEDORA, TOWN OF	75	5,447,200	51,558
	SEYMOUR, CITY OF	160	35,685,200	146,558
JASPER COUNTY	DEMOTTE, TOWN OF	5	1,030,000	2,775
	JASPER COUNTY *	115	12,289,400	99,565
	REMINGTON, TOWN OF	20	2,636,300	13,893
	RENSSELAER, CITY OF	21	4,206,700	16,470
JAY COUNTY	JAY COUNTY*	17	850,600	10,634
	PORTLAND, CITY OF	78	7,927,700	54,269
JEFFERSON COUNTY	BROOKSBURG, TOWN OF	5	403,300	5,077
	DUPONT, TOWN OF	1	51,000	597
	HANOVER, TOWN OF	5	379,400	3,375
	JEFFERSON COUNTY *	81	9,551,600	69,180
	MADISON, CITY OF	80	8,994,700	89,930
JENNINGS COUNTY	JENNINGS COUNTY *	27	3,245,400	16,593
	NORTH VERNON, CITY OF	1	175,000	334
JOHNSON COUNTY	BARGERSVILLE, TOWN OF	3	805,000	1,134
	FRANKLIN, CITY OF	176	28,294,000	184,577
	GREENWOOD, CITY OF	123	22,651,900	136,079
	JOHNSON COUNTY *	336	75,085,300	279,325
	NEW WHITELAND, TOWN OF	11	2,064,800	6,486
	PRINCES LAKE, TOWN OF	8	1,357,000	6,852
	WHITELAND, TOWN OF	18	4,411,700	10,342
KNOX COUNTY	KNOX COUNTY *	115	17,327,400	111,045
	VINCENNES, CITY OF	37	9,029,400	30,710
KOSCIUSKO COUNTY	KOSCIUSKO COUNTY*	617	93,219,400	519,437
	MENTONE, TOWN OF	4	343,000	1,702
	MILFORD, TOWN OF	2	345,000	730
	NORTH WEBSTER, TOWN OF	11	1,629,100	5,735
	SYRACUSE, TOWN OF	22	3,994,100	20,326
	WARSAW, CITY OF	133	21,754,000	121,862
	WINONA LAKE, TOWN OF	52	10,221,500	45,162
LA PORTE COUNTY	LA PORTE COUNTY*	175	28,328,100	130,057
	LA PORTE, CITY OF	45	8,694,100	45,885
	LONG BEACH, TOWN OF	25	7,404,200	27,334
	MICHIANA SHORES, TOWN OF	15	3,856,000	10,987
	MICHIGAN CITY, CITY OF	54	8,860,900	42,097
LAGRANGE COUNTY	LAGRANGE COUNTY*	296	47,994,000	210,271
	TOPEKA, TOWN OF	2	90,000	1,094
LAKE COUNTY	CEDAR LAKE, TOWN OF	43	7,197,400	34,504
	CROWN POINT, CITY OF	55	12,809,000	53,301
	DYER, TOWN OF	179	44,976,500	134,345
	EAST CHICAGO, CITY OF	6	1,288,000	2,230
	GARY, CITY OF	98	25,632,600	153,155
	GRIFFITH, TOWN OF	300	49,005,100	430,708
	HAMMOND, CITY OF	539	78,683,700	522,310

* Unincorporated areas of county only

Policy Statistics
Indiana
AS OF 07/31/2014

County Name	Community Name	Policies In-force	Insurance In-force whole $	Written Premium In-force
LAKE COUNTY	HIGHLAND, TOWN OF	337	61,253,800	286,279
	HOBART, CITY OF	53	12,805,800	45,081
	LAKE COUNTY *	266	39,502,400	239,036
	LAKE STATION, CITY OF	45	6,163,100	62,810
	LOWELL, TOWN OF	26	4,427,300	21,682
	MERRILLVILLE, TOWN OF	142	34,346,400	124,007
	MUNSTER, TOWN OF	372	87,592,000	260,220
	NEW CHICAGO, TOWN OF	3	588,000	899
	SCHERERVILLE, TOWN OF	211	44,529,000	133,542
	SCHNEIDER, TOWN OF	46	4,509,500	45,157
	ST. JOHN, TOWN OF	25	5,869,800	23,451
	WHITING, CITY OF	5	793,000	5,710
	WINFIELD, TOWN OF	2	700,000	874
LAWRENCE COUNTY	BEDFORD, CITY OF	10	1,878,400	4,673
	LAWRENCE COUNTY *	33	4,754,000	19,231
	MITCHELL, CITY OF	1	140,000	344
MADISON COUNTY	ALEXANDRIA, CITY OF	43	4,308,900	42,414
	ANDERSON, CITY OF	136	22,096,200	105,578

Watershed Spatial Data Summary

Apparent outlet point coordinate (NAD83 UTM Zone 16, meter): X = 581866, Y = 4369995 [More information about the outlet point (precipitation and elevation)]

Watershed size is greater than 2000.0 acres, the rational method may not be applicable.

Watershed longest flow length: 21120 ft Watershed average slope: 1.7 percent		
Watershed Area (acres)	48613.7	
Land use	Soil group	Area(acres)
Water	B	32.1
Water	C	7.6
Water	D	86.6
Commercial	B	884.7
Commercial	C	820.7
Commercial	D	6.9
Agriculture	B	19311.2
Agriculture	C	15237.1
Agriculture	D	31.8
HD-Residential	B	2112.5
HD-Residential	C	2039.2
HD-Residential	D	21.9
LD-Residential	B	2096
LD-Residential	C	1702.3
LD-Residential	D	23.2
Grass/Pasture	B	1090.7
Grass/Pasture	C	742.2
Grass/Pasture	D	17.7
Forest	B	1181.6
Forest	C	510.7
Forest	D	17.2
Industrial	B	296.4
Industrial	C	340.8
Industrial	D	0.9
Others	Undefined	0
Total Area		48613.7

Click links below to view data from other sources:

- EPA EnviroMapper

Modeling Toolbox	

Review Maps change lands	Use this tool to view the watershed, change land use, add agricultural best management practices (BMPs) to farm fields, and apply structural BMPs in the watershed.
Review Google Maps lands	Use this tool to view the watershed image on google maps.
Estimate Imperviousness	Use this tool to estimate impervious surface area in this watershed.
Estimate Peak Runoff	Use this tool to estimate the peak rate of runoff, depth of runoff (computed using the SCS CN method), computed time of concentration (using the Kirpich formula), and the corresponding rainfall depth for the watershed.
Run TR-55 L-THIA Model	Use this tool to run LTHIA model with standard curve numbers.
Run Calibrated LTHIA	Use this tool to run Midwest Calibrated LTHIA model .
Run SWAT LTHIA	Use this tool to run SWAT CN LTHIA model.
Run SEDSPEC Model	The Sediment and Erosion Control Planning, Design and SPECification Information and Guidance tool allows user to design a channel, culvert, sediment basin, level terraces, runoff diversion, or low water crossing for the watershed.
Download Data	Use this tool to download Watershed data (boundary, landuse raster etc) from this site (Purdue ABE)
Low Impact Development	Use this tool to run Low Impact Development L-THIA Spreadsheet Model. Copy the landuse, soil and area summary into the spreadsheet.
Download KML	Use this tool to download KML file.
Delineation API	Our API is available to connect to delineation engine.
Download STEPL Input Data	Download STEPL Input Data (beta)

Watershed Delineation Program by Dr.Bernard A. Engel and Spatial Decision Support System Team
Department of Agricultural & Biological Engineering, Purdue University
West Lafayette, Indiana, 47907-2093

[Home] [E-mail]
[Index Map]

EXHIBIT 7: Floodway Schematic

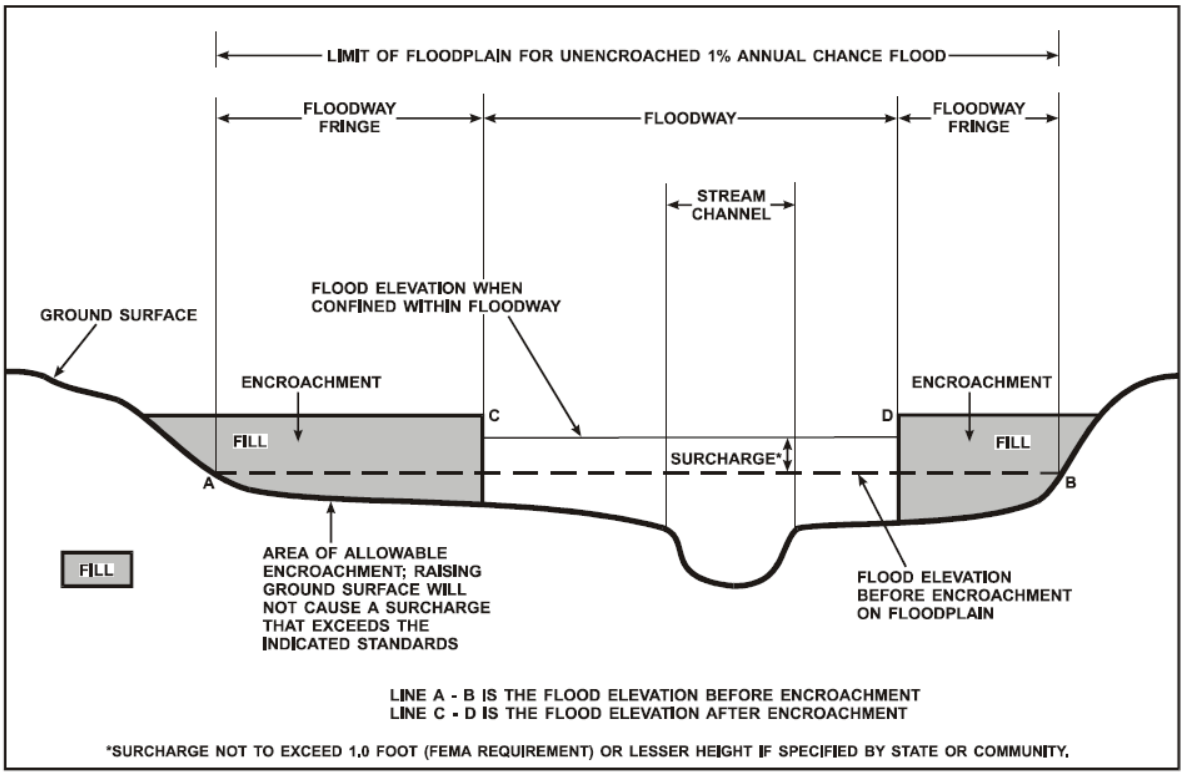


EXHIBIT 8: Homes within SFHA Along Canary & Hurricane Creek

FID	OBJECTID	PARCEL_NUM	ADDRESS	ASSESSED VALUE	Floodway/Floodplain
12049	12050	41-08-11-032-111.000-009	1855 LOCHRY RD	$ 82,100	Floodplain
12056	12057	41-08-10-041-030.000-009	1846 LOCHRY RD	$ 65,100	Floodplain
12057	12058	41-08-10-041-029.000-009	1856 LOCHRY RD	$ 85,500	Floodplain
12058	12059	41-08-10-041-021.000-009	1855 N MAIN ST	$ 88,000	Floodplain
12059	12060	41-08-10-041-020.000-009	1847 N MAIN ST	$ 56,800	Floodplain
15738	15739	41-08-10-041-027.000-009	1876 LOCHRY RD	$ 69,200	Floodplain
16075	16076	41-08-11-023-026.000-009	60 LINCOLN CT	$ 100,500	Floodway
16076	16077	41-08-11-023-025.000-009	50 LINCOLN CT	$ 96,600	Floodway
16616	16617	41-08-10-041-110.000-009	101 JORDAN DR	$ 70,700	Floodplain
16617	16618	41-08-11-032-109.000-009	105 JORDAN DR	$ 64,300	Floodplain
16618	16619	41-08-11-032-108.000-009	113 JORDAN DR	$ 61,700	Floodplain
16623	16624	41-08-11-032-107.000-009	121 JORDAN DR	$ 62,300	Floodplain
16624	16625	41-08-11-032-106.000-009	129 JORDAN DR	$ 75,900	Floodplain
16752	16753	41-08-11-023-027.000-009	70 LINCOLN CT	$ 70,500	Floodway
17509	17510	41-08-10-041-028.000-009	1866 LOCHRY RD	$ 61,300	Floodplain
17741	17742	41-08-11-032-116.000-009	20 LOCHRY RD	$ 77,200	Floodplain
17748	17749	41-08-10-041-031.000-009	1838 LOCHRY RD	$ 60,300	Floodplain
17749	17750	41-08-10-041-019.000-009	1839 N MAIN ST	$ 69,600	Floodplain
17750	17751	41-08-10-041-018.000-009	1831 N MAIN ST	$ 60,900	Floodplain
17766	17767	41-08-10-041-023.000-009	1879 N MAIN ST	$ 54,600	Floodplain
17772	17773	41-08-10-041-026.000-009	1886 LOCHRY RD	$ 73,100	Floodplain
17774	17775	41-08-10-041-024.000-009	1889 N MAIN ST	$ 69,000	Floodplain
17777	17778	41-08-10-041-005.000-009	1887 LOCHRY RD	$ 72,200	Floodplain
17780	17781	41-08-11-032-088.000-009	126 JORDAN DR	$ 62,800	Floodplain
17781	17782	41-08-11-032-087.000-009	118 JORDAN DR	$ 69,200	Floodplain
17782	17783	41-08-10-041-025.000-009	1899 N MAIN ST	$ 73,200	Floodplain
17783	17784	41-08-10-041-013.000-009	1882 N MAIN ST	$ 111,400	Floodway
17796	17797	41-08-10-041-004.000-009	1897 LOCHRY RD	$ 68,500	Floodplain
17956	17957	41-08-11-032-086.000-009	110 JORDAN DR	$ 59,800	Floodplain
17957	17958	41-08-11-032-085.000-009	102 JORDAN DR	$ 62,800	Floodplain
17961	17962	41-08-10-041-012.000-009	1886 N MAIN ST	$ 68,500	Floodway
17978	17979	41-08-10-041-003.000-009	1935 LOCHRY RD	$ 71,300	Floodplain
17982	17983	41-08-11-032-083.000-009	1988 CRESCENT ST	$ 56,600	Floodplain
17983	17984	41-08-11-032-082.000-009	1992 CRESCENT ST	$ 61,100	Floodplain
17990	17991	41-08-10-041-011.000-009	1892 N MAIN ST	$ 71,800	Floodway
17991	17992	41-08-10-041-010.000-009	1898 N MAIN ST	$ 76,500	Floodway
18001	18002	41-08-11-032-084.000-009	1998 CRESCENT ST	$ 70,500	Floodplain
18002	18003	41-08-10-041-002.000-009	1963 LOCHRY RD	$ 71,500	Floodplain
18015	18016	41-08-10-041-009.000-009	1940 LOCHRY RD	$ 63,400	Floodway
18018	18019	41-08-11-032-001.000-009	1995 LOCHRY RD	$ 77,900	Floodplain
18022	18023	41-08-11-032-055.000-009	1987 CRESCENT ST	$ 60,600	Floodplain
18024	18025	41-08-10-041-008.000-009	1958 LOCHRY RD	$ 65,100	Floodway
18033	18034	41-08-11-032-054.000-009	1995 CRESCENT ST	$ 60,700	Floodplain
18036	18037	41-08-10-041-007.000-009	1976 LOCHRY RD	$ 72,300	Floodway
18037	18038	41-08-11-032-053.000-009	2010 CHURCHILL RD	$ 62,400	Floodplain
18042	18043	41-08-11-032-052.000-009	2008 CHURCHILL RD	$ 63,100	Floodplain
18043	18044	41-08-10-041-006.000-009	1998 LOCHRY RD	$ 66,900	Floodway
18045	18046	41-08-11-032-050.000-009	2002 CHURCHILL RD	$ 68,000	Floodplain
18053	18054	41-08-11-032-051.000-009	2004 CHURCHILL RD	$ 68,500	Floodplain
18074	18075	41-08-10-041-001.000-009	2015 CHURCHILL RD	$ 69,200	Floodway
18141	18142	41-08-11-032-006.000-009	2003 CHURCHILL RD	$ 71,600	Floodplain
18142	18143	41-08-11-032-005.000-009	2005 CHURCHILL RD	$ 56,300	Floodplain
18143	18144	41-08-11-032-004.000-009	2007 CHURCHILL RD	$ 79,200	Floodplain
18146	18147	41-08-11-032-003.000-009	2009 CHURCHILL RD	$ 63,200	Floodway
18147	18148	41-08-11-032-002.000-009	2011 CHURCHILL RD	$ 76,000	Floodway
18185	18186	41-08-11-023-041.000-009	2108 GRANT ST	$ 67,800	Floodplain
18186	18187	41-08-11-023-040.000-009	177 WASHINGTON ST	$ 71,500	Floodplain
18187	18188	41-08-11-023-039.000-009	169 WASHINGTON ST	$ 61,500	Floodplain
18188	18189	41-08-11-023-038.000-009	161 WASHINGTON ST	$ 67,200	Floodplain
18189	18190	41-08-11-023-037.000-009	153 WASHINGTON ST	$ 90,500	Floodplain
18190	18191	41-08-11-023-036.000-009	145 WASHINGTON ST	$ 78,200	Floodplain
18191	18192	41-08-11-023-035.000-009	137 WASHINGTON ST	$ 64,700	Floodplain
18192	18193	41-08-11-023-034.000-009	129 WASHINGTON ST	$ 79,300	Floodplain
18193	18194	41-08-11-023-033.000-009	121 WASHINGTON ST	$ 63,900	Floodplain
18194	18195	41-08-11-023-032.000-009	113 WASHINGTON ST	$ 99,200	Floodway
18195	18196	41-08-11-023-031.000-009	128 WASHINGTON ST	$ 58,100	Floodway
18196	18197	41-08-11-023-030.000-009	136 WASHINGTON ST	$ 81,100	Floodway
18197	18198	41-08-11-023-029.000-009	144 WASHINGTON ST	$ 74,000	Floodway
18198	18199	41-08-11-023-028.000-009	80 LINCOLN CT	$ 84,000	Floodway
18199	18200	41-08-11-023-024.000-009	40 LINCOLN CT	$ 76,000	Floodplain
18200	18201	41-08-11-023-023.000-009	30 LINCOLN CT	$ 80,100	Floodplain
18202	18203	41-08-11-023-021.000-009	10 LINCOLN CT	$ 65,300	Floodplain
18203	18204	41-08-11-023-020.000-009	168 WASHINGTON ST	$ 70,000	Floodplain
18204	18205	41-08-11-023-019.000-009	176 WASHINGTON ST	$ 56,600	Floodplain
18205	18206	41-08-11-023-018.000-009	184 WASHINGTON ST	$ 73,100	Floodplain

Floodway	$ 1,470,000	19
Floodplain	$ 3,840,000	56
Total	**$ 5,309,400**	Canary Ditch

*All assessed values collected from Johnson County GIS courtesy of Beacon. Assessed values current as of 8/27/2014.

EXHIBIT 9: Homes in SFHA Hurricane Creek

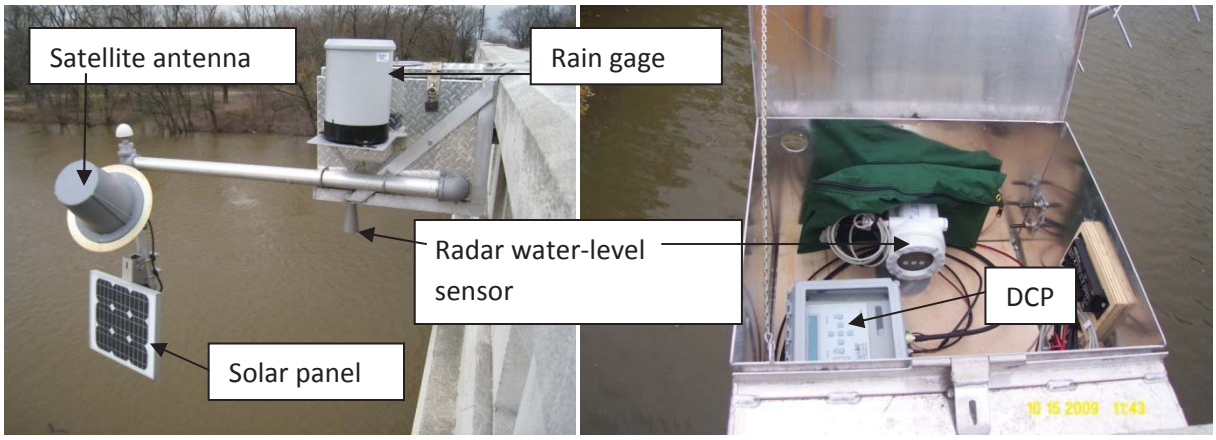
FID	OBJECTID	PARCEL NUMBER	ADDRESS	ASSESSED VALUE	Floodway/Floodplain
2593	2594	41-08-13-032-038.000-009	150 N FORSYTHE ST	$ 178,300	Floodplain
2594	2595	41-08-14-041-091.000-009	301 YOUNG ST	$ 105,600	Floodplain
2595	2596	41-08-14-041-090.000-009	297 YOUNG ST	$ 82,400	Floodplain
3075	3076	41-08-13-032-005.000-009	140 NORTH DR	$ 115,800	Floodplain
3076	3077	41-08-13-032-007.000-009	320 NORTH DR	$ 149,300	Floodplain
3077	3078	41-08-13-032-034.000-009	325 N FORSYTHE ST	$ 210,500	Floodplain
3078	3079	41-08-13-032-036.000-009	248 N FORSYTHE ST	$ 140,000	Floodway
3080	3081	41-08-14-041-084.000-009	651 KENTUCKY ST	$ 53,700	Floodplain
3088	3089	41-08-14-041-083.000-009	665 KENTUCKY ST	$ 61,500	Floodplain
3089	3090	41-08-14-041-082.000-009	671 KENTUCKY ST	$ 65,700	Floodplain
3455	3456	41-08-14-044-034.001-009	100 HURRICANE ST	$ 92,300	Floodplain
3456	3457	41-08-14-044-034.002-009	475 E MADISON ST	$ 88,300	Floodplain
3457	3458	41-08-14-044-036.000-009	498 E JEFFERSON ST	$ 95,200	Floodplain
3458	3459	41-08-14-044-033.000-009	451 E MADISON ST	$ 87,800	Floodplain
3459	3460	41-08-14-044-042.000-009	449 E MADISON ST	$ 122,400	Floodplain
3515	3516	41-08-14-044-016.000-009	600 E JEFFERSON ST	$ 161,200	Floodway
3516	3517	41-08-14-044-015.000-009	662 E JEFFERSON ST	$ 89,700	Floodway
3517	3518	41-08-14-044-014.000-009	664 E JEFFERSON ST	$ 95,400	Floodway
3562	3563	41-08-14-044-018.001-009	550 E JEFFERSON ST	*EXEMPT*	Floodway
3641	3642	41-08-13-024-010.000-018	1164 HERITAGE TRL	$ 279,400	Floodway
3642	3643	41-08-13-024-017.000-018	1199 HERITAGE TRL	$ 223,500	Floodplain
3644	3645	41-08-13-024-027.000-018	1219 HERITAGE TRL	$ 321,700	Floodplain
3786	3787	41-08-13-032-001.000-009	1110 NORTH DR	$ 98,100	Floodplain
4475	4476	41-08-13-023-062.000-009	1000 ROSS CT	$ 70,300	Floodplain
5523	5524	41-08-13-023-009.000-009	872 GLENDALE DR	$ 59,700	Floodplain
9415	9416	41-08-14-044-038.001-009	460 E JEFFERSON ST	$ 1,500	Floodplain
9416	9417	41-08-14-044-038.000-009	462 E JEFFERSON ST	$ 114,800	Floodplain
9418	9419	41-08-14-044-035.000-009	50 HURRICANE ST	$ 80,400	Floodplain
9419	9420	41-08-14-044-034.000-009	56 HURRICANE ST	$ 26,600	Floodplain
9421	9422	41-08-14-044-040.000-009	400 E JEFFERSON ST	$ 256,200	Floodplain
9422	9423	41-08-14-044-039.000-009	436 E JEFFERSON ST	$ 69,200	Floodplain
9424	9425	41-08-14-044-066.000-009	398 E JEFFERSON ST	$ 106,800	Floodplain
9449	9450	41-08-13-033-016.000-009	87 N EDWARDS ST	$ 50,200	Floodplain
10742	10743	41-08-13-023-061.000-009	690 N FORSYTHE ST	$ 57,700	Floodplain
10743	10744	41-08-13-023-063.000-009	1020 ROSS CT	$ 63,300	Floodplain
10744	10745	41-08-13-023-064.000-009	1030 ROSS CT	$ 56,800	Floodplain
11903	11904	41-08-13-024-011.000-018	1152 HERITAGE TRL	$ 269,600	Floodway
11904	11905	41-08-13-024-012.000-018	1149 HERITAGE TRL	$ 314,800	Floodplain
11942	11943	41-08-14-044-023.000-009	151 HURRICANE ST	$ 138,400	Floodplain
11959	11960	41-08-13-032-013.001-009	E KING ST	$ 13,600	Floodplain
11968	11969	41-08-13-033-014.000-009	845 E KING ST	$ 107,400	Floodplain
11969	11970	41-08-13-033-015.000-009	813 E KING ST	$ 88,200	Floodplain
11971	11972	41-08-14-041-002.001-009	84 N EDWARDS ST	$ 61,400	Floodplain
11972	11973	41-08-14-044-120.000-009	94 N EDWARDS ST	$ 8,700	Floodplain
11973	11974	41-08-14-044-002.000-009	94 N EDWARDS ST	$ 8,700	Floodplain
13266	13267	41-08-14-043-151.000-009	*NO DATA*	*NO DATA*	Floodplain
13849	13850	41-08-13-032-006.000-009	330 NORTH DR	$ 130,100	Floodplain
13857	13858	41-08-13-032-031.000-009	1000 E ADAMS ST	$ 130,700	Floodplain
13859	13860	41-08-13-032-037.000-009	240 N FORSYTHE ST	$ 142,500	Floodplain
13891	13892	41-08-14-043-156.000-009	303 E MONROE ST	$ 80,900	Floodplain
13893	13894	41-08-14-043-155.000-009	301 E MONROE ST	$ 132,600	Floodplain
13897	13898	41-08-13-032-002.000-009	1100 NORTH DR	$ 120,000	Floodway
13898	13899	41-08-13-032-004.000-009	350 NORTH DR	$ 158,800	Floodplain
13899	13900	41-08-13-023-010.000-009	874 GLENDALE DR	$ 66,900	Floodplain
13900	13901	41-08-13-023-017.000-009	888 GLENDALE DR	$ 58,300	Floodplain
13902	13903	41-08-13-023-060.000-009	720 N FORSYTHE ST	$ 60,900	Floodplain
13903	13904	41-08-13-023-071.000-009	1035 ROSS CT	$ 62,700	Floodplain
14911	14912	41-08-14-044-093.000-009		$ 1,700	Floodplain
15309	15310	41-08-14-044-082.001-009	501 E JEFFERSON ST	*EXEMPT*	Floodplain
15310	15311	41-08-14-044-081.000-009	499 E JEFFERSON ST	*PARK BOARD*	Floodplain
15311	15312	41-08-14-044-080.000-009	481 E JEFFERSON ST	*PARK BOARD*	Floodplain
15312	15313	41-08-14-044-079.000-009	459 E JEFFERSON ST	*PARK BOARD*	Floodplain
15314	15315	41-08-14-041-132.000-009	500 E KING ST	$ 127,300	Floodplain
15319	15320	41-08-14-044-078.000-009	447 E JEFFERSON ST	$ 115,200	Floodplain
15320	15321	41-08-14-044-077.000-009	425 E JEFFERSON ST	$ 127,300	Floodplain
15321	15322	41-08-14-044-076.000-009	401 E JEFFERSON ST	$ 9,000	Floodplain
15426	15427	41-08-14-041-130.000-009	550 E KING ST	$ 96,600	Floodplain
15427	15428	41-08-14-041-129.000-009	590 E KING ST	$ 75,900	Floodplain
15428	15429	41-08-14-041-128.000-009	598 E KING ST	$ 60,800	Floodplain
15429	15430	41-08-14-041-127.000-009	599 E ADAMS ST	$ 44,600	Floodplain
15430	15431	41-08-14-041-126.000-009	555 E ADAMS ST	$ 51,100	Floodplain
15434	15435	41-08-14-044-101.000-009	6 HENRY ST	$ 177,200	Floodplain
15439	15440	41-08-14-044-092.000-009	0 Branigin Blvd	$ 1,200	Floodplain
15440	15441	41-08-14-044-091.000-009	601 E JEFFERSON ST	$ 900	Floodplain
15441	15442	41-08-14-041-092.000-009	325 YOUNG ST	$ 93,700	Floodplain
15442	15443	41-08-14-041-089.000-009	255 YOUNG ST	$ 56,700	Floodplain
15443	15444	41-08-14-041-087.000-009	241 YOUNG ST	$ 80,400	Floodway
15682	15683	41-08-13-032-046.000-009	1006 E ADAMS DR	$ 251,500	Floodplain
15686	15687	41-08-14-044-082.000-009	525 E JEFFERSON ST	*PARK BOARD*	Floodplain
15703	15704	41-08-13-032-032.000-009	250 N FORSYTHE ST	$ 108,900	Floodplain
15932	15933	41-08-13-032-003.000-009	360 NORTH DR	$ 149,700	Floodway
15936	15937	41-08-13-023-011.000-009	1842 ARCHIES CT	$ 60,800	Floodplain
15937	15938	41-08-13-023-012.000-009	878 GLENDALE DR	$ 73,100	Floodplain
15938	15939	41-08-13-023-014.000-009	882 GLENDALE DR	$ 61,500	Floodplain
15939	15940	41-08-13-023-015.000-009	884 GLENDALE DR	$ 68,600	Floodplain
15940	15941	41-08-13-023-016.000-009	886 GLENDALE DR	$ 56,000	Floodplain
15943	15944	41-08-13-023-059.000-009	721 N FORSYTHE ST	$ 60,000	Floodplain
15944	15945	41-08-13-023-065.000-009	1040 ROSS CT	$ 73,200	Floodplain
15945	15946	41-08-13-023-066.000-009	1050 ROSS CT	$ 83,200	Floodplain
15946	15947	41-08-13-023-067.000-009	*NO DATA*	*NO DATA*	Floodplain
15947	15948	41-08-13-023-068.000-009	1070 ROSS CT	$ 60,700	Floodway
15948	15949	41-08-13-023-069.000-009	1080 ROSS CT	$ 84,400	Floodway
15949	15950	41-08-13-023-070.000-009	1045 ROSS CT	$ 73,000	Floodway
15950	15951	41-08-13-023-072.000-009	1025 ROSS CT	$ 54,300	Floodplain
15951	15952	41-08-13-023-073.000-009	1015 ROSS CT	$ 57,500	Floodplain
15952	15953	41-08-13-023-074.000-009	1005 ROSS CT	$ 60,000	Floodplain
15953	15954	41-08-13-023-075.000-009	481 N FORSYTHE ST	$ 104,800	Floodplain
15954	15955	41-08-13-023-076.000-009	451 N FORSYTHE ST	$ 108,400	Floodway
15955	15956	41-08-13-023-077.000-009	441 N FORSYTHE ST	$ 29,300	Floodway
15956	15957	41-08-13-023-078.000-009	1112 NORTH DR	$ 244,400	Floodway
16940	16941	41-08-14-044-005.000-009	50 N EDWARDS ST	$ 105,600	Floodplain
16941	16942	41-08-14-044-004.000-009	56 N EDWARDS ST	$ 69,900	Floodplain
18540	18541	41-08-14-044-032.000-009	450 E MADISON ST	$ 127,600	Floodplain
18541	18542	41-08-14-044-031.000-009	474 E MADISON ST	$ 113,600	Floodplain
18542	18543	41-08-14-044-030.000-009	498 E MADISON ST	$ 127,000	Floodplain
18545	18546	41-08-14-044-026.000-009	109 HURRICANE ST	$ 107,200	Floodplain
18546	18547	41-08-14-044-025.000-009	197 HURRICANE ST	$ 74,500	Floodplain
18547	18548	41-08-14-044-024.000-009	545 E KING ST	$ 68,800	Floodplain
18628	18629	41-08-13-033-017.000-009	69 N EDWARDS	$ 67,000	Floodplain
18660	18661	41-08-14-044-018.000-009	101 HURRICANE ST	*PARK BOARD*	Floodplain
18661	18662	41-08-14-044-021.000-009	551 E KING ST	$ 136,800	Floodplain
18663	18664	41-08-14-044-019.000-009	597 E KING ST	$ 135,500	Floodway
18664	18665	41-08-14-044-013.000-009	668 E KING ST	$ 115,300	Floodplain
18665	18666	41-08-14-044-012.000-009	670 E JEFFERSON ST	$ 114,000	Floodway
18667	18668	41-08-14-044-011.000-009	690 E JEFFERSON ST	$ 84,000	Floodway
18668	18669	41-08-14-044-010.000-009	700 E JEFFERSON ST	$ 121,200	Floodway
18669	18670	41-08-14-044-009.000-009	720 E JEFFERSON ST	$ 124,300	Floodplain
18670	18671	41-08-14-044-008.000-009	740 E JEFFERSON ST	$ 139,300	Floodplain
18671	18672	41-08-14-044-006.000-009	48 N EDWARDS ST	$ 81,500	Floodplain
18672	18673	41-08-14-044-003.000-009	74 N EDWARDS	$ 76,100	Floodplain
18673	18674	41-08-14-044-001.000-009	98 N EDWARDS	$ 113,200	Floodplain
19007	19008	41-08-14-041-131.000-009	548 E KING ST	$ 61,800	Floodplain
19046	19047	41-08-13-032-041.000-009	900 E KING ST	$ 138,200	Floodplain
19047	19048	41-08-13-032-042.000-009	898 E KING ST	$ 157,000	Floodplain
19048	19049	41-08-13-032-043.000-009	850 E KING ST	$ 149,900	Floodplain
19049	19050	41-08-13-032-044.000-009	800 E KING ST	$ 175,200	Floodway
19052	19053	41-08-14-041-088.000-009	249 YOUNG ST	$ 82,700	Floodplain

Floodway	$ 2,615,500	21
Floodplain	$ 9,381,100	106
Total	**$ 11,996,600**	Hurricane Creek

*All assessed values collected from Johnson County GIS courtesy of Beacon. Assessed values current as of 8/27/2014.

U.S. Geological Survey Streamgage Information

The U.S. Geological Survey (USGS) operates and maintains a network of about 200 streamgages across Indiana. A typical streamgage consists of a water-level sensor, data collection platform (DCP) that records water-level data and transmits the data through satellite telmetry, and a 12-volt solar-charged power system. Some streamgages are equipped with rain gages to record and transmit rainfall amounts.



Streamgage Features

- Rugged, flood-hardened and vandal-resistant infrastructure.
- Stream water levels are measured to an accuracy of 0.02 feet.
- Water levels are recorded every 15 minutes and transmitted via satellite 24/7/365.
- Streamflow (volume of water passing the gage every second) data are computed for each river level reading. Streamflow is critical for National Weather Service flood forecasting and important for other activities such as: flood plain mapping and studies, bridge design, and water quality studies.
- All data are available 24/7/365 through the Internet: http://waterdata.usgs.gov/in/nwis/rt
- All data are quality assured and stored long term for historical data purposes.
- Gage information can be text messaged or emailed to emergency management if certain level thresholds are reached for flood warnings through the USGS WaterAlert system: http://water.usgs.gov/wateralert/

Streamgage Funding

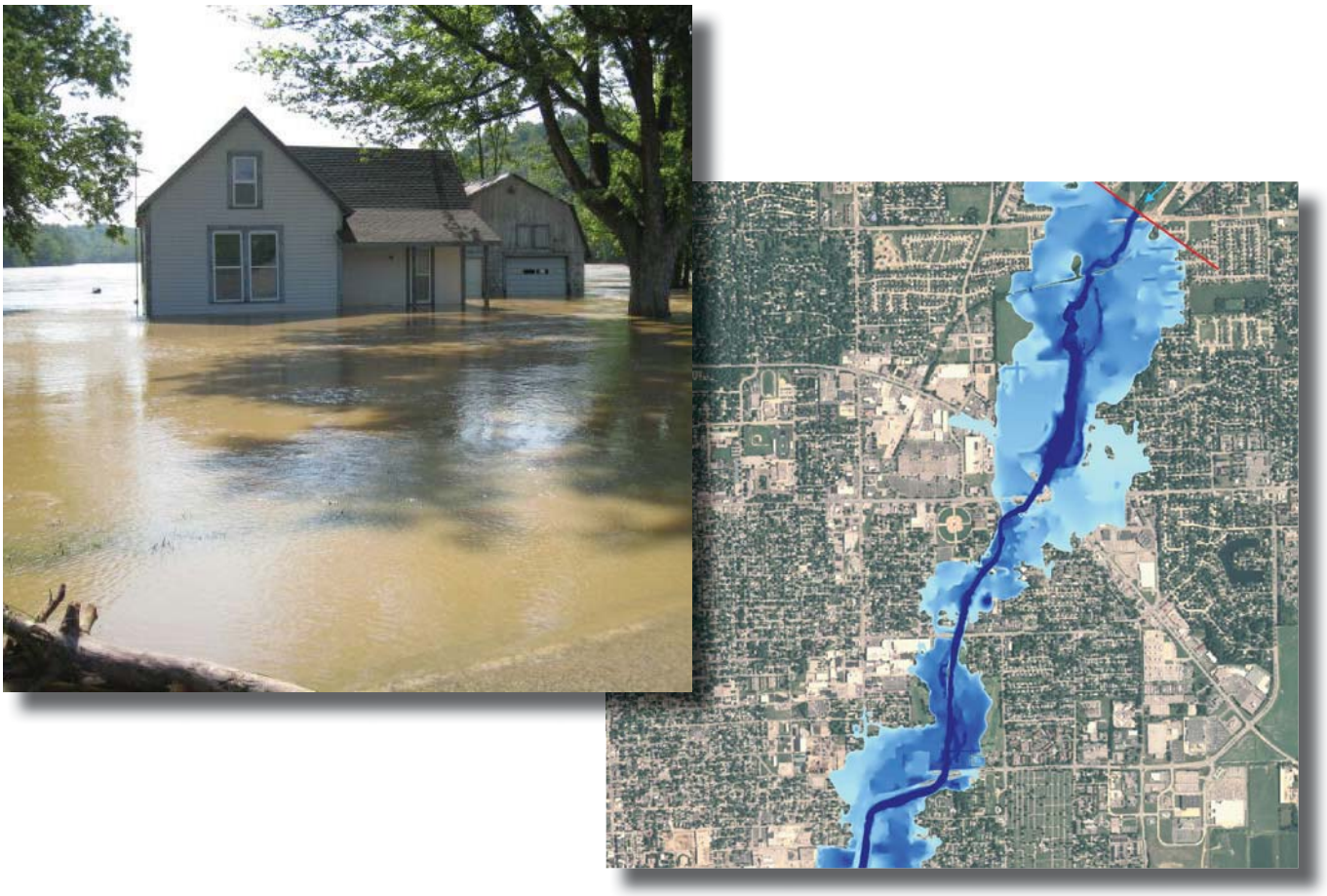
- Gage installation cost is typically $12,000 to $15,000.
- Gage operation and maintenance (O&M) is $13,500 per year for a full streamflow gage:
  - A stage-only gage (no streamflow) has a $4,500 per year O&M cost
  - USGS matching funds may be available for annual O&M of a full streamflow gage

For more information regarding USGS streamgages in Indiana, contact Jeff Woods: 317-600-2762, jwoods@usgs.gov.

USGS
science for a changing world

In Cooperation with the Federal Emergency Management Agency and the Indiana Department of Natural Resources, Division of Water

Flood of June 7–9, 2008, in Central and Southern Indiana



Open-File Report 2008–1322

U.S. Department of the Interior
U.S. Geological Survey

Cover images: Home flooded by the White River near Spencer, Indiana, June 9, 2008 (photograph by Chad Menke, U.S. Geological Survey) and part of an inundation map showing approximate flood-peak extents and depths, June 7–9, 2008, for Haw Creek at Columbus, Indiana (entire map is in Appendix 2 of the report).

Flood of June 7–9, 2008, in Central and Southern Indiana

By Scott E. Morlock, Chad D. Menke, Donald V. Arvin, and Moon H. Kim

In Cooperation with the Federal Emergency Management Agency and the Indiana Department of Natural Resources, Division of Water

Open-File Report 2008–1322

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
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Contents

Figures

Tables

Conversion Factors, Datums, and Abbreviations

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
acre	0.4047	hectare (ha)
	Volume	
cubic foot (ft^3)	28.32	cubic decimeter (dm^3)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
inch per hour (in/h)	0 .0254	meter per hour (m/h)

Vertical elevation (altitude) information is referenced to the North American Vertical Datum of 1988 (NAVD 88) or the National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Abbreviations

AML	Arc macro language
DEM	Digital elevation model
EDT	Eastern Daylight Time
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
IDHS	Indiana Department of Homeland Security
IDNR	Indiana Department of Natural Resources
NAVD 88	North American Vertical Datum of 1988
NGVD 29	National Geodetic Vertical Datum of 1929
NWS	National Weather Service
TIN	Triangular irregular network
USGS	U.S. Geological Survey

Flood of June 7–9, 2008, in Central and Southern Indiana

By Scott E. Morlock, Chad D. Menke, Donald V. Arvin, and Moon H. Kim

Abstract

On June 6–7, 2008, heavy rainfall of 2 to more than 10 inches fell upon saturated soils and added to already high streamflows from a wetter than normal spring in central and southern Indiana. The heavy rainfall resulted in severe flooding on many **streams** within the White River Basin during June 7–9, causing three deaths, evacuation of thousands of residents, and hundreds of millions of dollars of damage to residences, businesses, infrastructure, and agricultural lands. In all, 39 Indiana counties were declared Federal disaster areas.

U.S. Geological Survey (USGS) streamgages at nine locations recorded new record peak **streamflows** for the respective periods of record as a result of the heavy rainfall. **Recurrence intervals** of flood-peak streamflows were estimated to be greater than 100 years at five streamgages and 50–100 years at two streamgages. Peak-gage-height data, peak-streamflow data, and recurrence intervals are tabulated for 19 USGS streamgages in central and southern Indiana. Peak-streamflow estimates are tabulated for four ungaged locations, and estimated recurrence intervals are tabulated for three ungaged locations. The estimated recurrence interval for an ungaged location on Haw Creek in Columbus was greater than 100 years and for an ungaged location on Hurricane Creek in Franklin was 50–100 years. Because flooding was particularly severe in the communities of Columbus, Edinburgh, Franklin, Paragon, Seymour, Spencer, Martinsville, Newberry, and Worthington, high-water-mark data collected after the flood were tabulated for those communities. **Flood peak** inundation maps and water-surface profiles for selected streams were made in a geographic information system by combining the high-water-mark data with the highest-resolution digital elevation model data available.

Introduction

Flood data are needed by Federal, State, and local agencies to make informed decisions in meeting mission requirements related to flood hazard mitigation, planning, and response. For example, the Federal Emergency Management Agency (FEMA), Indiana Department of Natural Resources (IDNR), and Indiana Department of Homeland Security (IDHS) need timely information on the magnitudes and recurrence intervals of floods to help respond to flood damage, preserve emergency response management, protect infrastructure, provide recovery guidance from the National Flood Insurance Program and State regulatory programs, and plan for future flood events.

Heavy rains caused severe flooding on June 7–9, 2008, in parts of central and southern Indiana. Rainfall amounts from about 2 in. to more than 10 in. fell in south-central Indiana on June 6–7 (Shipe, 2008), causing the National Weather Service (NWS), by June 9, to issue 21 flash-flood warnings, 10 areal flood warnings, and 10 river flood warnings and statements (David Tucek, National Weather Service, written commun., August 2008). A state of emergency was declared on June 7 in the affected areas; and during June 7–9, there were numerous evacuations and water rescues in communities affected by the flooding. Flood impacts were particularly severe in communities in Bartholomew, Greene, Johnson, Morgan, Owen, Vermillion, and Vigo Counties. The flooding caused three fatalities, major transportation disruptions, damage to thousands of homes and businesses, damage to dams and flood-control structures, and damage to critical facilities, including utilities and two hospitals (Shipe, 2008). Damage caused by the flooding, and other damage caused by severe storms, resulted in a Presidential Disaster Declaration for 39 Indiana counties (Federal Emergency Management Agency, 2008).

Given the severity of the June 2008 flooding in Indiana, the U.S. Geological Survey (USGS), in cooperation with the FEMA and the IDNR, Division of Water, did a study to document the meteorological and hydrological conditions leading to the flood; compile flood-peak gage heights, streamflows, and recurrence intervals at USGS streamgages and estimate streamflows and recurrence intervals at selected ungaged locations; construct flood profiles and peak-stage inundation maps; and summarize flood damages and impacts.

Purpose and Scope

The purpose of this report is to present the results of the study. The meteorological and hydrologic conditions leading to the floods are discussed. Meteorological data were provided by the NWS and the Indiana State Climate Office, and hydrologic-condition information was obtained from streamflow data at USGS streamgages. Peak-gage-height and peak-

Figure 1. Study area in central and southern Indiana.

streamflow data are presented for 19 active USGS streamgages and peak-streamflow data are presented for 4 ungaged locations (locations on streams that do not have an active streamgage). High-water marks set by the IDNR and the USGS were surveyed to obtain water-surface elevations for about 50 mi of streams in nine communities (fig. 1). The streams, all within the White River Basin of Indiana, include Blue River, Canary Ditch, Clifty Creek, East Fork White River, East Side Swale, Eel River, Flatrock River, Haw Creek, Hurricane Creek, an unnamed tributary of Fall Creek at Paragon, an unnamed tributary of Youngs Creek at Franklin, Youngs Creek, and White River. The communities include Columbus, Edinburgh, Franklin, Martinsville, Newberry, Paragon, Seymour, Spencer, and Worthington. The high-water-mark data were used to produce flood-peak inundation maps and flood profiles for selected streams in the communities studied. Information for the flood damage and impact summary was furnished by FEMA, NWS, IDHS, IDNR, the Indiana Office of Disaster Recovery, local agencies, news accounts and photographs, and corroborated testimony from individuals in affected communities.

Conditions Leading to the Flood

The June flooding in Indiana was caused by heavy rain falling upon saturated soils at a time when streamflows already were much above normal. A wetter than normal spring preceded the June flood in Indiana. Precipitation totals in central and southern Indiana for the period March–May 2008 ranged from 123 to 180 percent of normal (Indiana State Climate Office, 2008). Rainfall amounts of 1–3 in. on May 30–31 and 1–5 in. on June 3–4 in parts of central and southern Indiana resulted in above-normal streamflows in the days prior to the June flood (National Weather Service, 2008). On the basis of the USGS WaterWatch Recent Streamflow Conditions map for June 5, 2008, daily mean streamflows at many USGS streamgages in central and southern Indiana (with 30 or more years of record) were either much above normal or were record highs for June 5 (U.S. Geological Survey, 2008). On June 6, an abnormally high amount of moisture from the Gulf of Mexico was available for thunderstorms, and a nearly stationary frontal boundary was in place across south-central Indiana to enhance thunderstorm development and anchor a common storm path (David Tucek, National Weather Service, written commun., June 2008). A strong inflow of Gulf moisture, lifted by the frontal boundary, resulted in frequent to nearly continuous showers and thunderstorms of moderate to heavy rainfall intensity for 12 to 16 hours on June 6–7 (David Tucek, National Weather Service, written commun., August 2008).

A map of estimated precipitation totals prepared from NWS radar data (Thomas Adams, National Weather Service Ohio River Forecast Center, written commun., 2008) shows rainfall totals ranging from about 2 in. to more than 10 in. for June 6–7 across south-central Indiana (fig. 2). Rainfall in most locations fell between about 6:00 p.m. Eastern Daylight Time (EDT) on June 6 and about 1:00 p.m. EDT on June 7. Provisional total rainfall amounts for June 6–7 from selected NWS precipitation stations (table 1, fig. 2) ranged from 6.1 in. at Jasonville, Greene County, to 10.4 in. at Spencer, Owen County. Average recurrence intervals[1] (Bonnin and others, 2006), given in total rainfall amount for a 24-hour duration, are presented in table 1. Average recurrence intervals were greater than 50 years at Jasonville, Greene County; greater than 100 years at Brazil, Clay County; greater than 500 years at Martinsville, Morgan County, and Franklin, Johnson County; and greater than 1,000 years at Spencer, Owen County. A plot of hourly cumulative rainfall (fig. 3) at the Spencer precipitation station illustrates the rainfall pattern for the period 8:00 a.m. EDT June 6 to 11:00 a.m. EDT June 7. The slope of the line is indicative of rainfall rates; a steeper slope indicates higher rates.

[1] The recurrence interval is the average interval of time within which the given event will be equaled or exceeded once (American Society of Civil Engineers, 1953, p. 1221). For example, the 100-year rainfall is the rainfall that would be exceeded or equaled, on long-term average, once in 100 years. Recurrence interval relates the magnitude of an event to a probability of occurrence and does not imply that the event will happen at regular intervals; for example, two 100-year floods can occur within the same year at the same location. The reciprocal of the recurrence interval is the **annual exceedance probability**, which is the probability that a given event magnitude will be exceeded or equaled in any given year (Hodgkins and others, 2007). For example, the annual exceedance probability of the 100-year peak flood streamflow is 0.01. In other words, there is a 1-percent chance that the 100-year peak flow will be exceeded or equaled in any given year.

Table 1. Provisional total rainfall for June 6–7, 2008, and average-recurrence-interval rainfalls for a 24-hour duration at selected National Weather Service precipitation stations.

[Provisional total rainfall provided by National Weather Service (Al Shipe, written commun., July 2008). Average recurrence intervals from Bonnin and others (2006)]

Site name	County	Total rainfall (inches)	Average-recurrence-interval rainfall for 24-hour duration (inches)				
			50-year	100-year	200-year	500-year	1,000-year
Spencer	Owen	10.4	5.7	7.0	7.8	9.0	10.0
Martinsville	Morgan	8.2	5.7	6.3	7.0	7.9	8.6
Franklin	Johnson	7.6	5.3	5.9	6.4	7.2	7.8
Brazil	Clay	7.0	6.1	6.9	7.7	8.9	9.9
Jasonville	Greene	6.1	5.9	6.6	7.3	8.2	9.0

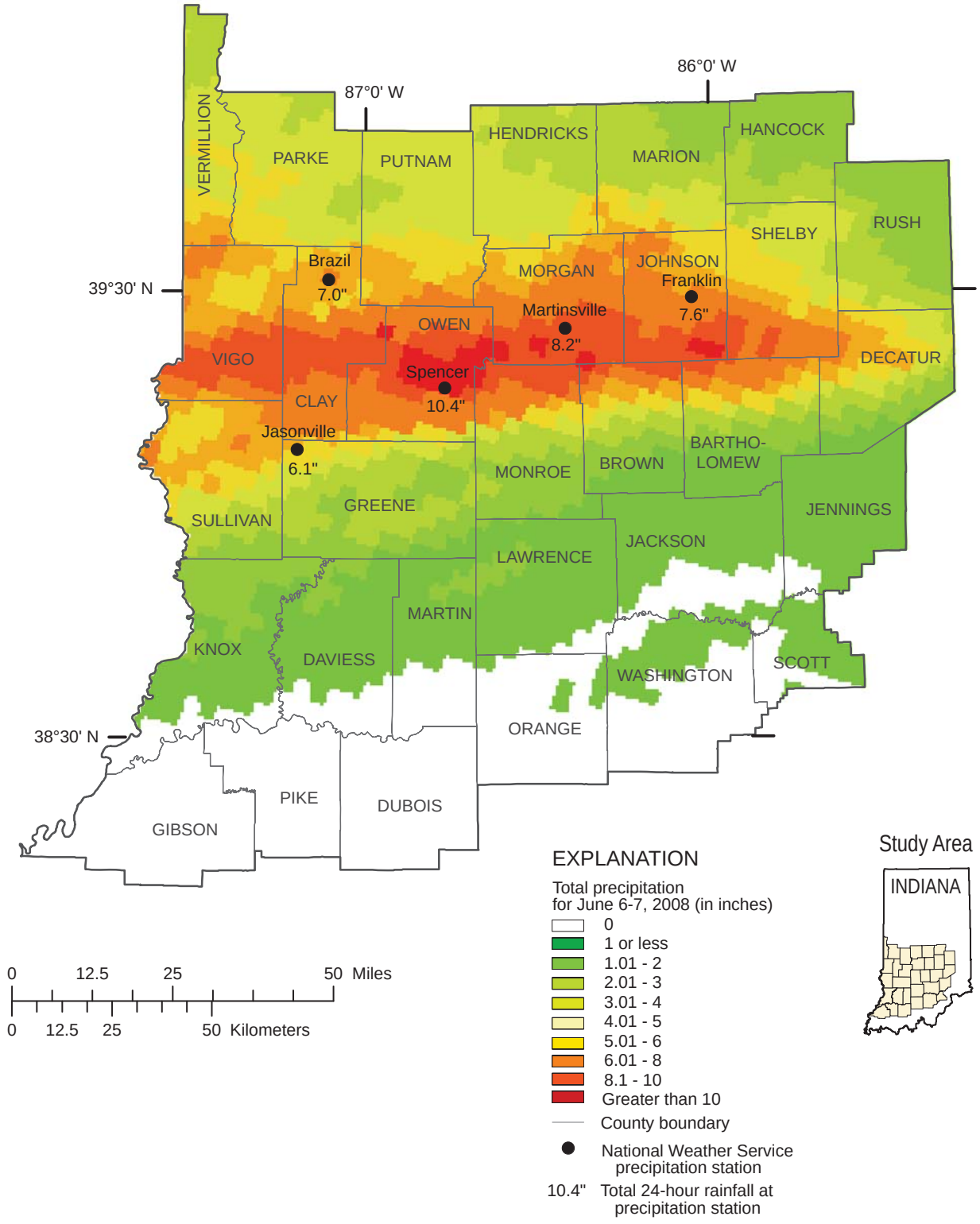

Figure 2. Distribution of rainfall totals June 6–7, 2008, and provisional rainfall totals for the National Weather Service stations (by station name) listed in table 1. Rainfall-distribution data provided by the National Weather Service (Thomas Adams, National Weather Service Ohio River Forecast Center, written commun., 2008).

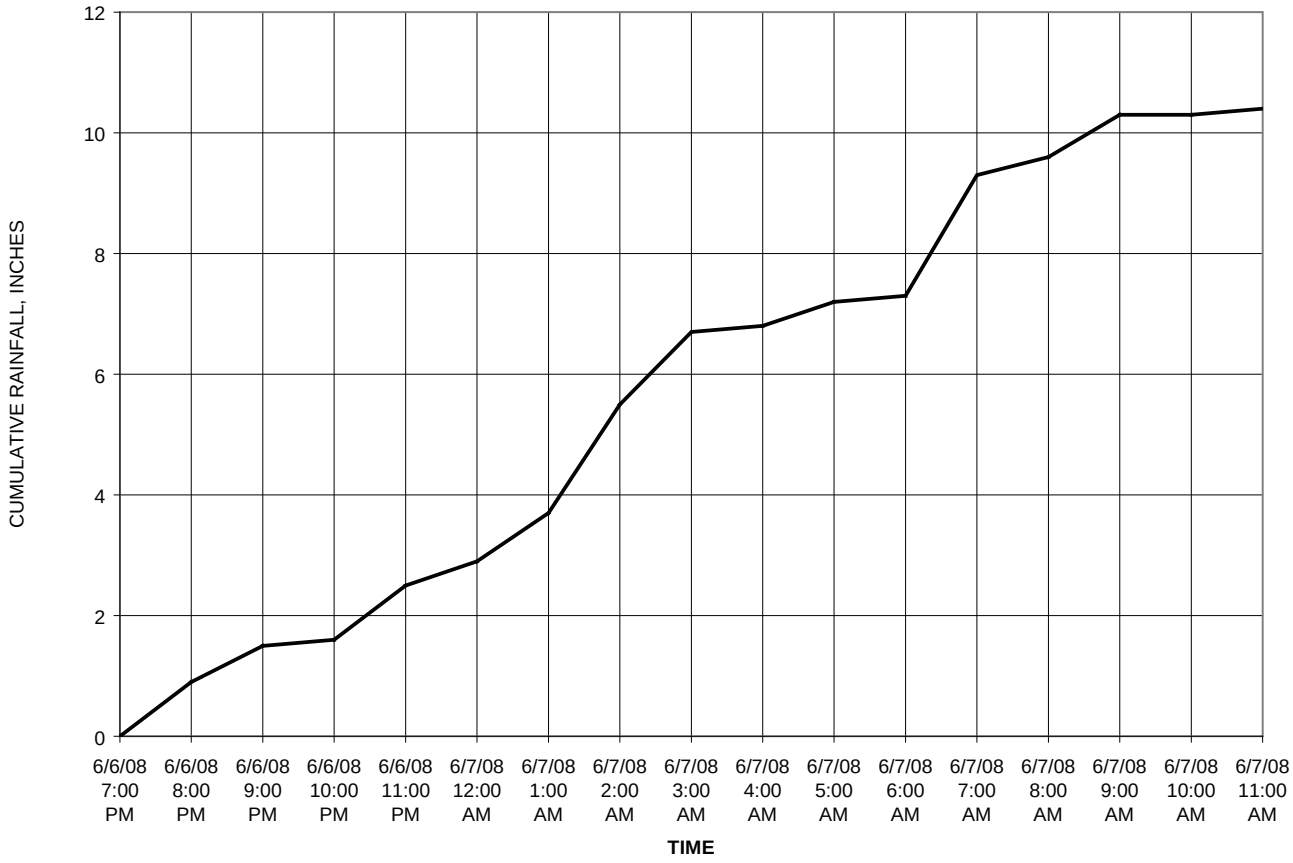

Figure 3. Cumulative hourly rainfall during June 6–7, 2008, recorded at the National Weather Service precipitation station at Spencer, Owen County, Indiana.

Collection of High-Water-Mark Data

High-water marks were identified and flagged in the field by IDNR and USGS field crews after floodwaters receded. High-water marks were set along approximately 240 mi of streams after the floods. For this study, high-water marks were fully documented for about 50 stream miles on the following streams: Blue River, Canary Ditch, Clifty Creek, East Fork White River, East Side Swale, Eel River, Flatrock River, Haw Creek, Hurricane Creek, an unnamed tributary of Fall Creek at Paragon, an unnamed tributary of Youngs Creek at Franklin, Youngs Creek, and White River (fig.1). The IDNR, USGS, and IDHS collectively determined the areas where high-water marks were to be flagged in order to effectively document the flooding. The accuracy of high-water marks was rated subjectively by field personnel as "excellent," "good," "fair," or "poor" according to guidelines of Lumia and others (1986). "Excellent" means the reported high-water mark is within 0.02 ft of the true high-water elevation; "good" within 0.05 ft; "fair" within 0.10 ft; and "poor" less than "fair" accuracy.

High-water marks at each site were surveyed to obtain peak-water-surface elevations and were referenced to North American Vertical Datum of 1988 (NAVD 88). High-water-mark descriptions, locations (latitude and longitude), and accuracy ratings are presented in Appendix 1.

Methods of Estimating the Magnitudes and Recurrence Intervals of Peak Streamflows

Estimation of Magnitudes

Peak streamflows documented in this study were determined at 19 USGS streamgages (table 2, fig. 4) by use of the rating curve (the relation between river height and flow) for each station. Rating curves at streamgages are developed by relating gage height to streamflow for a range of flows (Rantz and others, 1982). Streamflow data points used to develop a rating are determined most commonly by direct measurement at the gage; or, if direct measurement is not possible, by indirect methods. The rating curve is interpolated between streamflow data points and can be extrapolated beyond the highest streamflow data point; however, excessive extrapolation of the rating at high gage heights can result in large errors in streamflow (Sherwood and others, 2007).

Peak gage heights (table 2) were obtained either from electronic data recorders or from surveyed high-water marks where recorders or stage sensors malfunctioned. The rating curve was used to compute peak streamflow (table 2) from peak gage height. Direct streamflow measurements or stream-

Table 2. Flood-peak gage heights, peak streamflows, and estimated recurrence intervals during the flood of June 7–9, 2008, at selected U.S. Geological Survey streamgages in Indiana. (Streamgage locations are shown in figure 4.)

[mi^2, square miles; ft, feet; ft^3/s, cubic feet per second; Q, streamflow; GH, gage height; YR, year; <, less than; >, greater than]

						Peak flow for period of record prior to June 2008			Peak flow for June 2008						
Station number	Station name	Drainage area (mi^2)	Gage vertical datum (feet NGVD 29)	Period of record (water years)[1]	Length of record of annual peaks (years)	Date	Gage height (feet above gage datum)	Streamflow (ft^3/s)	Date	Gage height (feet above gage datum)	Streamflow (ft^3/s)	Estimated recurrence-interval range for June 2008 peak streamflow (years)	Estimated[2] 100-year peak streamflow (ft^3/s)	Historic larger peaks outside period of record	Comments
03341500	Wabash River at Terre Haute, IN	12,263	445.78	1928-2008	81	5/20/1943	30.5 (0.6 mile downstream at datum 442.90)	189,000	6/8/2008	25.02	92,400	< 10	[3] 154,000	1913 peak GH=31.2 ft (at current datum), Q=245,000 ft^3/s	Moderate regulation at high flow by upstream reservoirs.
03342000	Wabash River at Riverton, IN	13,161	414.65	1939-2008	70	5/21/1943	29.36	201,000	6/10/2008	26.56	98,100	< 10	[3] 157,000	1913 peak GH=26.4 ft, Q=250,000 ft^3/s	Moderate regulation at high flow by upstream reservoirs.
03353637	Little Buck Creek near Indianapolis, IN	17	666.2	1990-2008	19	12/30/1990	[4] 9.10	2,300	6/7/2008	13.01	[8] 2,850	< 10	[3] 7,230		
03354000	White River near Centerton, IN	2,444	595.44	1931-1932,1947-2008	64	9/2/2003	20.04	65,700	6/7/2008	19.85	63,500	50-100	[3] 71,100	1913 peak GH=21.9 ft 0.4 mile downstream (at current datum), Q=90,000 ft^3/s	Minor reguation at high flow by upstream reservoirs.
03357000	White River at Spencer, IN	2,988	526.04	Q 1926-1971, GH 1988-2008	47	5/15/1933	[5] 23.20	[6] 59,400	6/8/2008	26.84	[7] 63,500	25-50	[3] 80,300	1913 peak GH=28.5 ft	
03357350	Plum Creek near Bainbridge, IN	3	828.44	1970-2008	39	9/14/1989	6.50	940	6/4/2008	7.15	[8] 1,000	25-50	[9] 1,180		
03358000	Mill Creek near Cataract, IN	245	706.4	1950-2008	59	12/30/1990	Unknown	12,200	6/7/2008	22.61	10,800	10-25	[9] 14,000		
03360500	White River at Newberry, IN	4,688	465.59	1929-2008	80	11/18/1993	[10] 25.87	105,000	6/9/2008	28.59	[8] 138,000	> 100	[3] 106,000	1913 peak GH=27.5 ft, Q=130,000 ft^3/s	Minor regulation at high flow by upstream reservoirs.
03362000	Youngs Creek near Edinburgh, IN	107	670.2	1944-2008	65	1/27/1952	13.40	10,700	6/7/2008	15.67	[8] 20,500	> 100	[3] 13,400		
03362500	Sugar Creek near Edinburgh, IN	474	646.23	1944-2008	65	5/29/1956	18.38	27,600	6/7/2008	19.23	[8] 39,900	> 100	[3] 30,000		
03363500	Flatrock River at St. Paul, IN	303	764.84	1931-2008	78	1/5/1949	[11] 10.60	18,500	6/7/2008	12.82	16,400	10-25	[3] 24,400	1913 peak GH=20.5 ft	

03363900	Flatrock River at Columbus, IN	534	610.14	1968-2008	41	1/7/2005	16.45	22,400	6/7/2008	19.83	[8] 62,500	> 100	[3] 31,300		
03364000	East Fork White River at Columbus, IN	1,707	603.12	1949-2008	60	1/7/2005	17.05	57,300	6/8/2008	18.61	[8] 68,100	25-50	[3] 79,200	1913 peak GH=17.9 ft, Q=100,000 ft^3/s	
03364500	Clifty Creek at Hartsville, IN	91.4	677.34	1949-2008	60	1/21/1959	14.29	11,300	6/7/2008	17.85	[8] 17,600	> 100	[3] 14,300	1913 peak Q=20,000 ft^3/s	
03365500	East Fork White River at Seymour, IN	2,341	550.67	1928-2008	81	1/5/1949	19.67	78,500	6/8/2008	20.91	[8] 96,400	50-100	[3] 97,800	1913 peak Q=120,000 ft^3/s	
03371500	East Fork White River near Bedford, IN	3,861	473.59	1940-2008	69	1/9/2005	37.84	92,300	6/10/2008	34.41	67,100	10-25	[3] 108,000	1913 peak GH=47.5 ft (9.8 miles downstream at 469.2 ft datum), Q=155,000 ft^3/s	
03373500	East Fork White River at Shoals, IN	4,927	442.25	1904-2008	105	3/28/1913	42.20	160,000	6/12/2008	28.11	53,500	< 10	[3] 114,000		Moderate regulation at high flow by upstream reservoirs.
03374000	White River at Petersburg, IN	11,125	400	1929-2008	80	1/22/1937	28.30	183,000	6/12/2008	26.96	135,000	10-25	[3] 186,000	1913 peak GH=29.5 ft, Q=235,000 ft^3/s	Moderate regulation at high flow by upstream reservoirs
03377500	Wabash River at Mt. Carmel, IL	28,635	369.46	1928-2008	81	5/25/1943	[12] 27.54	305,000	6/14/2008	33.24	255,000	25-50	[3] 311,000	1913 peak GH=33.0 ft (at current datum), Q=428,000 ft^3/s	Moderate regulation at high flow by upstream reservoirs.

[1] A water year is the 12-month period from October 1 through September 30 and is designated by the calendar year in which it ends.

[2] The recurrence interval is the average interval of time within which the given flood will be equaled or exceeded once (American Society of Civil Engineers, 1953, p. 1221). The reciprocal of the recurrence interval is the annual exceedance probability, which is the probability that a given event magnitude will be exceeded or equaled in any given year. The exceedance probability for a recurrence interval of 10 years is 0.10; for 25 years, 0.04; for 50 years, 0.02; and for 100 years, 0.01.

[3] Coordinated discharge from the Indiana Department of Natural Resources, Division of Water publication entitled "Coordinated Discharges of Selected Streams in Indiana," accessed August 15, 2008, at http://www.in.gov/dnr/water/8726.htm.

[4] A higher maximum gage height occurred during a separate event: GH=11.21 ft on November 14, 1993.

[5] A higher maximum gage height occurred during a separate event: GH=25.06 ft on January 7, 2005.

[6] The historical peak flow for 03357000 White River at Spencer, IN, represents only the period 1926–1971, prior to when the station was converted to a stage-only site.

[7] The June 8, 2008, peak discharge for 03357000 White River at Spencer, IN, was determined by adjusting the 1971 stage-discharge relation on the basis of streamflow measurements made in 2008. For the purposes of this report, this peak flow is considered to be outside the period of systematic discharge record, and is therefore not identified as a new peak of record. This value does exceed the existing peak of record.

[8] New streamflow peak of record.

[9] Discharge determined by methods described in Interagency Advisory Committee on Water Data, Guidelines for Determining Flood Flow Frequency, Bulletin 17B (1982).

[10] A higher maximum gage height occurred during a separate event: GH=26.89 on January 8, 2005.

[11] A higher maximum gage height occurred during a separate event: GH=12.87 on January 6, 2005.

Figure 4. Locations of selected U.S. Geological Survey streamgages and ungaged sites (see tables 2 and 3 for flood-related data).

flows determined by indirect methods served as recent data points for rating-curve verification and extrapolation.

Indirect methods for determination of streamflow were required for rating extrapolation for the Flatrock River at Columbus streamgage, which is USGS station 03363900 (table 2), and for the determination of peak streamflow at four ungaged sites (table 3, fig. 4). Indirect determinations of streamflow make use of the energy and continuity equations for computing flow; specific forms of those equations differ for different types of flow, such as unobstructed open-channel flow and flow through culverts and bridge openings (Rantz and others, 1982). The data required for the computation of streamflow by indirect methods are obtained in a field survey that includes the elevation and location of high-water marks corresponding to the peak stage; cross sections of the channel along the reach; selection of roughness coefficients; and description of the geometry of structures such as culverts or bridges, depending on the method (Rantz and others, 1982).

The indirect methods used to estimate streamflow for this study were the contracted-opening method, culvert method, slope-area method, and step-**backwater** method. A general description of these methods can be found in Rantz and others (1982); detailed descriptions can be found in Bodhaine (1968), Dalrymple and Benson (1967), Davidian (1984), and Matthai (1967). Brief descriptions of the four methods follow:

- In the contracted-opening method, the abrupt drop in water-surface elevation between a bridge approach section and the contracted section under the bridge is used to compute flow.
- In the culvert method, the peak flow through a culvert can be determined from high-water marks that define the culvert headwater and tailwater elevations.
- In the slope-area method, flow is computed on the basis of a uniform-flow equation involving channel characteristics, water-surface profiles, and a roughness coefficient.
- In the step-backwater method, computer models are used to compute the water-surface elevation at a series of stream cross sections for a specific value of flow. Model input parameters include cross-section geometry, roughness coefficients, bridge-configuration data (bridge-opening geometry and roadway elevations) for modeled reaches with bridges, water-surface elevation at the most-downstream cross section, and streamflow. Streamflow is determined by inputting flow values iteratively until water-surface elevations at model cross sections match surveyed high-water-mark elevations.

If all flow was confined to a bridge or culvert, the contracted-opening method or culvert method was used; if flow was not confined to a bridge, the slope-area method or the step-backwater method was used. USGS software used included the Culvert Analysis Program (CAP) for the culvert method (Fulford, 1995), Slope Area Computation Program (SAC) for the slope-area method (Fulford, 1994), and the Water Surface Profile Program (WSPRO) for the step-backwater method (Shearman, 1989). For three sites, two different methods were used to estimate a peak-streamflow magnitude in an effort to improve the quality of the estimate. The methods used for each site were the contracted-opening and step-backwater methods for the Flatrock River at Columbus streamgage (table 2) rating extrapolation; the slope-area and step-backwater methods for the ungaged site Haw Creek near State Street, Columbus (table 3); the culvert method for the ungaged site Canary Ditch at U.S. Highway 31, Franklin (table 3); the step-backwater method for the ungaged site Hurricane Creek near mouth, Franklin (table 3); and the culvert and step-backwater methods for the ungaged site Sartor Ditch at south end of high school parking lot, Martinsville (table 3). Because many factors associated with the indirect computation of streamflow can have various levels of accuracy, and because the methods can depend considerably on engineering judgment, estimates may have large errors associated with them.

It was not possible to estimate peak streamflows associated with several streams in study communities; these included an unnamed tributary of Fall Creek in Paragon, an unnamed tributary of Youngs Creek in Franklin, and the Eel River in Worthington. Field surveys and the statements of local residents indicate that the flooding in Paragon appeared to be associated mostly with overland flow rather than an overflow from the unnamed tributary. The unnamed tributary of Youngs Creek in Franklin runs underground in a large box culvert; however, some of the flow from this tributary ran above ground level during the June 2008 flood and caused damage in the community. The flow dynamics of this situation were too complex to allow the estimation of streamflow. Potential backwater effects from the White River prevented the estimation of streamflow for Eel River in Worthington.

Estimation of Recurrence Intervals

Recurrence intervals associated with the peak streamflows for 19 active streamgages (table 2) and 3 ungaged locations (table 3) were estimated to indicate the relative magnitude of the June 2008 flooding. Recurrence intervals were obtained for 17 active streamgages and 3 ungaged locations from "coordinated" discharge-frequency curves available in the IDNR online publication "Coordinated Discharges of Selected Streams in Indiana" (*http://www.in.gov/dnr/water/8726.htm*). The coordinated discharge-frequency curves were established and are maintained according to a Memorandum of Understanding of May 6, 1976, signed by the U.S. Department of Agriculture, Soil Conservation Service (now the Natural Resources Conservation Service), the USGS, the U.S. Army Corps of Engineers, and the IDNR. These agencies mutually agreed to coordinate discharge-frequency values for use in water-resources investigations and planning activities in Indiana.

To estimate recurrence intervals for the streamgages Plum Creek near Bainbridge, USGS station 03357350 (table 2) and Mill Creek near Cataract, USGS station 03358000 (table 2) that are without coordinated discharge-frequency curves, the method (commonly called the "Bulletin 17B" method) described in Interagency Advisory Committee on Water Data (1982) was used. This method calculates recurrence intervals by fitting systematic annual peak discharge data to a log-Pearson type III distribution.

The recurrence interval could not be determined for the ungaged site Sartor Ditch at south end of high school parking lot, Martinsville (table 3). Recurrence-interval streamflows have not been established through the interagency coordination process, and regionalized regression equations and selected basin characteristics could not be used to estimate recurrence interval streamflows (basin characteristics for Sartor Ditch were beyond the range used for development of regression equations).

Table 3. Estimated peak streamflows and estimated recurrence intervals during the flood of June 7–9, 2008, at selected ungaged locations in Indiana. (Locations of sites 1-4 are shown on figure 4.)

[mi^2, square miles; ft^3/s, cubic feet per second; <, less than; >, greater than]

Site number	Stream and location	County	Drainage area at site (mi^2)	Peak flow (ft^3/s) for given recurrence interval				Estimated peak flow during June 2008 flood		
				[1] 10-year	25-year	50-year	100-year	Estimated peak flow (ft^3/s)	Recurrence interval (years)	Comment
1	Haw Creek near State Street, Columbus	Bartholomew	55.7	[2] 4,690	[2] 6,210	[2] 7,380	[2] 8,430	[3] 13,900	> 100	Peak flow 65% greater than 100-year flood
2	Canary Ditch at US Highway 31, Franklin	Johnson	5.39	[2] 1,410	[2] 1,750	[2] 2,100	[2] 2,370	[3] 1,600	10-25	
3	Hurricane Creek near mouth, Franklin	Johnson	16.4	[2] 2,500	[2] 3,100	[2] 3,700	[2] 4,200	[3] 3,860	50-100	
4	Sartor Ditch at south end of high school parking lot, Martinsville	Morgan	1.66	[4] Undetermined	Undetermined	Undetermined	Undetermined	860	Undetermined	

[1] The recurrence interval is the average interval of time within which the given flood will be equaled or exceeded once (American Society of Civil Engineers, 1953, p. 1221). The reciprocal of the recurrence interval is the annual exceedance probability, which is the probability that a given event magnitude will be exceeded or equaled in any given year. The exceedance probability for a recurrence interval of 10 years is 0.10; for 25 years, 0.04; for 50 years, 0.02; and for 100 years, 0.01.

[2] Coordinated discharge from the Indiana Department of Natural Resources, Division of Water publication "Coordinated Discharges of Selected Streams in Indiana, accessed August 15, 2008 at http://www.in.gov/dnr/water/8726.htm.

[3] Peak streamflow estimated by indirect measurement methods.

[4] Recurrence-interval flows have not been established through the interagency coordination process. One or more basin characteristics are beyond the range used for development of models from regression analysis.

Estimated Magnitudes and Recurrence Intervals of Peak Streamflows for the Flood of June 7–9, 2008

Peak-gage-height data, peak-streamflow data, and estimated recurrence intervals from the June flood for 19 USGS streamgages in central and southern Indiana are listed in table 2, and streamgage locations are shown in figure 4. New streamflow peaks of record were set at 7 of the 19 streamgages. For the 19 streamgages, estimated recurrence intervals were greater than 100 years at 5 streamgages, 50–100 years at 2 streamgages, 25–50 years at 4 streamgages, 10-25 years at 4 streamgages, and less than 10 years at 4 streamgages. Peak-streamflow data from the June flood for four ungaged locations in central and southern Indiana and estimated recurrence intervals for three ungaged locations are listed in table 3, and site locations are shown in figure 4. The estimated recurrence interval was greater than 100 years at Haw Creek near State Street, Columbus; 50–100 years at Hurricane Creek near Mouth, Franklin; and 10–25 years at Canary Ditch at U.S. Highway 31, Franklin. An estimated recurrence interval could not be determined for Sartor Ditch at south end of high school parking lot, Martinsville.

Flood-Peak Inundation Maps

Flood-peak inundation maps were produced for 17 stream reaches in the study area (fig. 1) by use of geographic information system (GIS) software and programs. High-water-mark elevations (NAVD 88) and locations (latitude-longitude) were used in conjunction with GIS land-surface elevation data files termed digital elevation models (DEMs) to develop the maps. For study reaches that had a streamgage, the peak-gage height recorded by the streamgage also was used to develop the maps. The White River at Newberry map was developed from the peak-gage height recorded at the White River at Newberry streamgage (table 2, fig. 4) and not from high-water marks. GIS Arc Macro Language (AML) programs were written to produce a plane representing the flood-peak water surface that was fit through the high-water marks and that sloped in the direction of water flow. The program duplicated the high-water-mark elevation data points across the **flood plain** perpendicular to the direction of the flood flow. Elevations between high-water marks are proportional interpolations of the high-water-mark data and are positioned to generate a flood surface sloping with the water flow. A TIN (triangular irregular network) surface was usually fit through the data points because TIN-generated surfaces pass exactly through the data-point elevations. After the flood surface was generated, a flood depth map was made by subtracting the DEM from the flood surface. The flood-peak inundation maps were produced in a GIS file format that provides peak flood extent and depth. This format allows the maps to be overlain upon other maps and aerial photographs, and to be imported into various GIS applications, such as FEMA's HAZUS-MH (Federal Emergency Management Agency, 2008) program to estimate flood damages. An inundation map was not produced for Sartor Ditch in Martinsville because the DEM was not adequate to produce accurate mapping. An inundation map produced for the community of Elnora was reviewed by IDNR personnel and was found to contain inaccuracies associated with complex flow regimes caused by levee breaks; thus, the map is not included in this report. Selected flood-map illustrations created from the peak flood extent and depth GIS files and from aerial photographs are shown in Appendix 2.

Flood-Peak Profiles

The AML programs used to produce flood-peak maps were further developed to also generate flood-peak profile plots. Flood profiles were produced for 15 streams in the study area (Appendix 3). The profiles were produced by plotting high-water-mark elevations (NAVD 88) by mile of stream as measured upstream from the mouth of the stream. The water surface between high-water marks was estimated by linear interpolation. A linear interpolation between high-water marks is an approximation of the actual water surface; the actual water surface may have substantially departed from the water surface depicted in the profiles in some locations. For example, it is common for the water surface to drop between the upstream and downstream face of a bridge or culvert; potential water-surface elevation drops may not be reflected in the profiles. Locations of street crossings over the streams were added to the plots in another software package. The river-mile location of the street crossings was calculated by GIS-based programs. There was not sufficient high-water mark data to produce profile plots for the Blue River at Edinburgh, White River at Martinsville, and White River at Newberry reaches. A profile was not created for the unnamed tributary of Fall Creek at Paragon because most of the flooding in Paragon appeared to be associated with overland flow rather than an overflow from the unnamed tributary.

Description of Flood Damages and Impacts

The immediate impact of the heavy rainfall of June 6–7 was widespread flash flooding. The Paragon, Spencer, Franklin, and Martinsville areas all had extensive flooding early on June 7 (Shipe, 2008) as small streams such as Sartor Ditch in Martinsville rose rapidly. Later in the afternoon and into the evening of June 7, extensive flooding occurred in the Edinburgh and Columbus areas as larger streams such as Haw Creek, Youngs Creek, and Sugar Creek rose rapidly and peaked. The East Fork White River at Columbus rose from lowland flooding to a near-record peak stage within 6 hours on June 7 (Shipe, 2008). Early on June 8, flash flooding and flooding on small to medium-sized streams had dissipated, but extensive flooding of the White and East Fork White Rivers

occurred in the Spencer, Seymour, Worthington, and Newberry areas (Shipe, 2008). Flood crests continued to travel downstream on the White, East Fork White, and Wabash Rivers on June 8 and 9; but because little rain had fallen in southern Indiana and southern Illinois, these flood crests dissipated as they moved downstream.

Communities that were extensively flooded included Martinsville, Franklin, Paragon, Spencer, and Columbus. Residences and businesses in these communities received extensive damage. Most of the town of Paragon and nearly half of Martinsville were inundated by floodwaters (Shipe, 2008). In Franklin, the Johnson County Hospital and several local government office buildings flooded.

The hardest hit community was Columbus, which became isolated because nearly all roads into the city were flooded. About 15 percent of all structures in the city were flooded (Shipe, 2008). The first floor and basement of the Columbus Regional Hospital was flooded by Haw Creek, causing the evacuation of 157 patients and $125 million in damage (Indiana NewsCenter, 2008). More than 70 businesses in Columbus received flood damage (Indianapolis Star, 2008), including $100 million in damage to a research and development center for a diesel engine manufacturer (Insurance Journal, 2008).

The following is a summary of flood impacts compiled as of August 31, 2008.

- The flooding caused three fatalities and five injuries.
- More than 8,400 evacuations and water rescues were made during the flooding (National Weather Service, 2008).
- Approximately 1,300 National Guard members (National Guard, 2008), 350 Red Cross staff, 75 State Troopers, and 140 U.S. Marines were mobilized to help flood victims (Indianapolis Star, 2008). The Indiana Salvation Army set up three feeding sites, eight mobile feeding units, and one shelter, providing more than 5,000 meals and 10,000 bottles of water and sports drinks; FEMA set up 15 regional offices and sent about 140,000 bottles of water to Indiana (Indianapolis Star, 2008).
- More than 5,600 residential dwellings were damaged in the counties included in the Presidential Disaster Declaration (Indiana Office of Disaster Recovery, 2008).
- Transportation impacts were numerous and widespread. Temporary interstate closures included I–70 near Cloverdale and I–65 near Edinburgh (Shipe, 2008). Many state and local roads were closed; for example, the entire transportation network in the White River flood plain in Greene County was closed (Shipe, 2008).
- Damage to infrastructure included more than 650 roads, more than 60 bridges, approximately 100 culverts, more than 100 dams and levees, and 56 water-supply or wastewater-treatment facilities (Indiana Office of Disaster Recovery, 2008). There was a major dam break at Princes Lake in Johnson County that forced the evacuation of about 100 persons, and levee breaks affected large areas of agricultural lands in Daviess and Greene Counties (Indianapolis Star, 2008).
- Agricultural impacts were major: an estimated 7 percent of Indiana's total soybean, corn, and wheat acres were flooded, and an estimated 1.4 million acres of Indiana farmland needed repair or rehabilitation (Indiana Office of Disaster Recovery, 2008).
- Requests to FEMA for Public Assistance have included 243 from local units of government, 39 from nonprofit groups, and 23 from units of State Government; there have been more than 16,300 requests for Individual Assistance (Indiana Office of Disaster Recovery, 2008).

By August 31, 2008, $117.3 million in disaster assistance had been approved by FEMA or the U.S. Small Business Administration for Indiana residences and businesses (Indiana Office of Disaster Recovery, 2008). Damages to the Columbus Regional Hospital and the diesel engine facility totaled in excess of $200 million. The damage to agricultural lands (funds needed for repair or rehabilitation of crop-producing acreage) was estimated to be $200 million (Indiana Office of Disaster Recovery, 2008). There are many other costs associated with the floods not yet tallied, such as damage to public and private infrastructure and damage to personal property, such as automobiles. Total damage costs resulting from the June flooding are expected to be the highest of any disaster in the history of Indiana (National Climatic Data Center, 2008).

Summary

Heavy rains caused severe flooding on June 7–9, 2008, and caused hundreds of millions of dollars worth of damage to homes, businesses, infrastructure, and agricultural lands in central and southern Indiana. Three deaths were attributed to the flooding, and thousands of persons were evacuated from flooded areas.

Estimated rainfall totals of 2 to more than 10 in. fell June 6–7 upon saturated soils and added to already above-normal streamflows. Average recurrence intervals of total rainfall amounts for a 24-hour duration ranged from greater than 50 years to greater than 1,000 years at five NWS precipitation stations. Given the severity of the June 2008 flooding in Indiana, the USGS, in cooperation with the FEMA and the IDNR, Division of Water, did a study to document the meteorological and hydrological conditions leading to the flood; compile flood-peak gage heights, streamflows, and recurrence intervals at USGS streamgages and at selected ungaged locations; construct flood profiles and peak-gage-height inundation maps; and summarize flood damages and impacts.

The IDNR and the USGS set and surveyed high-water marks to obtain peak water-surface elevations for about 50 mi of streams. Peak gage heights were obtained either from electronic data recorders or from surveyed high-water marks at 19 USGS streamgages. Peak streamflow for the streamgages was tabulated by use of the rating curve developed for that streamgage. Indirect methods were used to estimate peak streamflow at ungaged locations on four streams and to extrapolate the rating curve at the USGS streamgage on the Flatrock River at Columbus. New streamflow peaks of record occurred at nine streamgages. Estimated recurrence intervals of greater than 100 years occurred at five USGS streamages and one ungaged location. Estimated recurrence intervals of 50–100 years occurred at two streamgages and one ungaged location. Estimated recurrence intervals for 13 other streamgages and 2 ungaged sites ranged from less than 10 years to 25–50 years.

Surveyed high-water-mark data and ground-elevation data were used to produce flood-peak inundation maps for 17 stream reaches and were used to produce flood-peak profiles for 15 stream reaches.

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Glossary

The following definitions, except where noted, are from Langbein and Iseri (1960).

annual exceedance probability The probability that a given event magnitude will be exceeded or equaled in any given year. For example, the annual exceedance probability of the 100-year peak flood streamflow is 0.01. In other words, there is a 1-percent chance that the 100-year peak flow will be exceeded or equaled in any given year.

backwater Water backed up or retarded in its course as compared with its normal or natural condition of flow. In stream gaging, a rise in stage produced by a temporary obstruction such as ice or weeds, or by the flooding of the stream below. The difference between the observed stage and that indicated by the stage-discharge relation, is reported as backwater.

cubic feet per second A unit expressing rates of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section, 1 foot wide and 1 foot deep, flowing water an average velocity of 1 foot per second.

flood peak The highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge. Flood crest has nearly the same meaning, but since it connotes the top of the flood wave, it is properly used only in referring to stage—thus, crest stage, but not crest discharge.

flood plain A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a living flood plain if it is overflowed in times of highwater, but a fossil flood plain if it is beyond the reach of the highest flood.

flood profile A graph of elevation of the water surface of a river in flood, plotted as ordinate, against distance, measured in the downstream direction, plotted as abscissa. A flood profile may be drawn to show elevation at a given time or crests during a particular flood.

frontal boundary A boundary or transition zone between two air masses of different density, and thus (usually) of different temperature. A moving front is named according to the advancing air mass; for example, cold front if colder air is advancing (National Weather Service, 2005).

gage height The water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term stage, although gage height is more appropriate when used with a reading on a gage.

recurrence interval (return period) The average interval of time within which the given flood will be equaled or exceeded once.

stationary front A front between warm and cold air masses that is moving very slowly or not at all (National Weather Service, 2005).

stream A general term for a body of flowing water. In hydrology the term is generally applied to the water flowing in a natural channel as distinct from a canal.

streamflow The discharge that occurs in a natural channel. Although the term discharge can be applied to the flow of a canal, the word streamflow uniquely describes the discharge in a surface stream course.

stream gaging The process and art of measuring the depths, areas, velocities, and rates of flow in natural or artificial channels.

streamgage A gaging station where a record of discharge of a stream is obtained. Within the U.S. Geological Survey this term is used only for those gaging stations where a continuous record of gage-height is obtained.

Appendix 1. Site Descriptions and High-Water Marks at Study Sites, Flood of June 7–9, 2008, Indiana (separate document)

Appendix 2. Flood-Peak Inundation Maps for Selected Communities, Flood of June 7–9, 2008, Indiana (separate document)

Appendix 3. Flood-Peak Elevation Profiles for Selected Sites, Flood of June 7–9, 2008, Indiana (separate document)

SIGN-IN

Name	Email	Phone
BRYAN JOHNSON		317-640-6497
PENNY JOHNSON		317-640-6497
JIM WILLIAMS		317.753.6629
BRETT JONES		DONT CALL
RICHARD DEWEY		317-346-1280
Jason Wilson		850-0835
Sarah Mann		736-9023
Scott & Michelle Graham	generationsautoroad	736-6900
Phil Williams	PWILLIAMS1112@GMAIL.com	418-6085
JOANNA MYERS		736-3631
MARY Gent	indygent1750@gmail.com	409-8418
Charles W. Harmening Jr.		736-6834
DALE SEDLER		736-4425
RON COLLINS		474-0077
Donna Hughes		812-350-7610
Derek Snyder		317-780-1555
Doug Heavilin	dwheavilin@yahoo.com	317-560-4727
Tim Janis	ftjanis@outlook.com	317-736-8218
Danny R Popplewell II	dpopp08@aol.com	317-507-5002
HARVEY WHITAKER		3177365084
Andrew & Mary Smith	7007@aol.com	

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	BRYAN JOHNSON
Property Address:	70 RANSDELL DR
Owner Address:	SAME
Phone #:	317-640-6497
E-mail:	

1. What is the nature of your problem? (please circle all that apply)
   - A. Standing water
   - B. Street drainage
   - C. Flooding
   - D. Water in ~~Basement~~ CRAWLSPACE
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	2008 BIG FLOOD
Location	RANSDELL DRIVE
Depth of water	5 OR MORE INCHES
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	WHEN WE GET ALOT OF RAIN
Location	RETENTION POND BEHIND MATLOCK FORD
Depth of water	VARIES
Date	
Location	
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood? YES
AROUND POND

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?
WAS INFORMED TO SMALL QUESTION

   If yes, check all situations that apply.

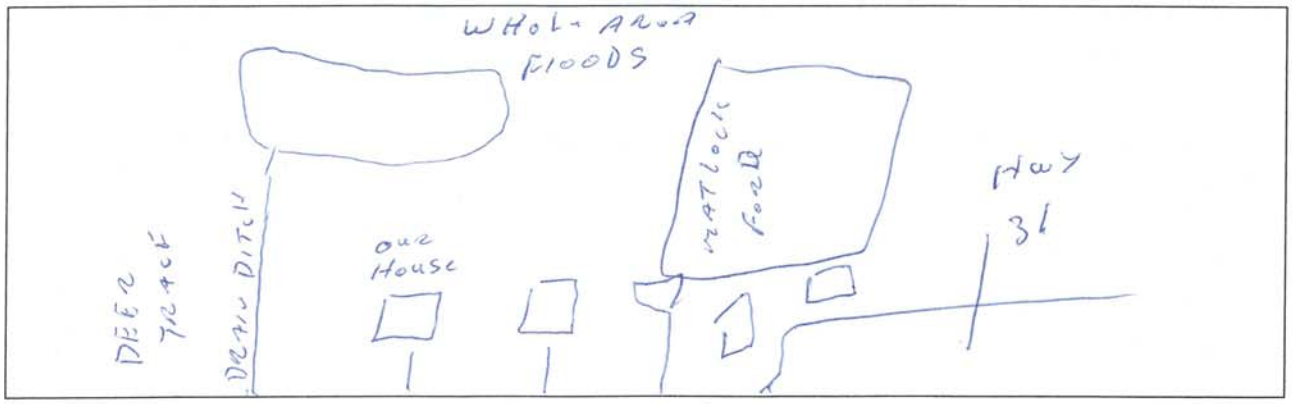
   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☐ Pipe blockage
   - ☐ Stream or ditch blockage
   - ☐ Drains in need of repair
   - ☐ Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood? NO

7. Would you be willing to grant a drainage easement to the City of Franklin? YES

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities? YES

Please provide a sketch of the drainage problem:



The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	Danny R Popplewell
Property Address:	1090 Yandes
Owner Address:	Shelby materials
Phone #:	317-507-5002
E-mail:	

1. What is the nature of your problem? (please circle all that apply)
   - A. Standing water
   - B. Street drainage
   - C. Flooding
   - D. Water in Basement
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	6-11-2014
Location	1090 Yandes
Depth of water	4-6 inches
Date	5/1/2014
Location	1090 Yandes
Depth of water	4-6-inches

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	6-11-2014
Location	1090 Yandes
Depth of water	2-3 inches
Date	5/1/2014
Location	1090 Yandes
Depth of water	3-4 inches

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?
   Yes

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   If yes, check all situations that apply.

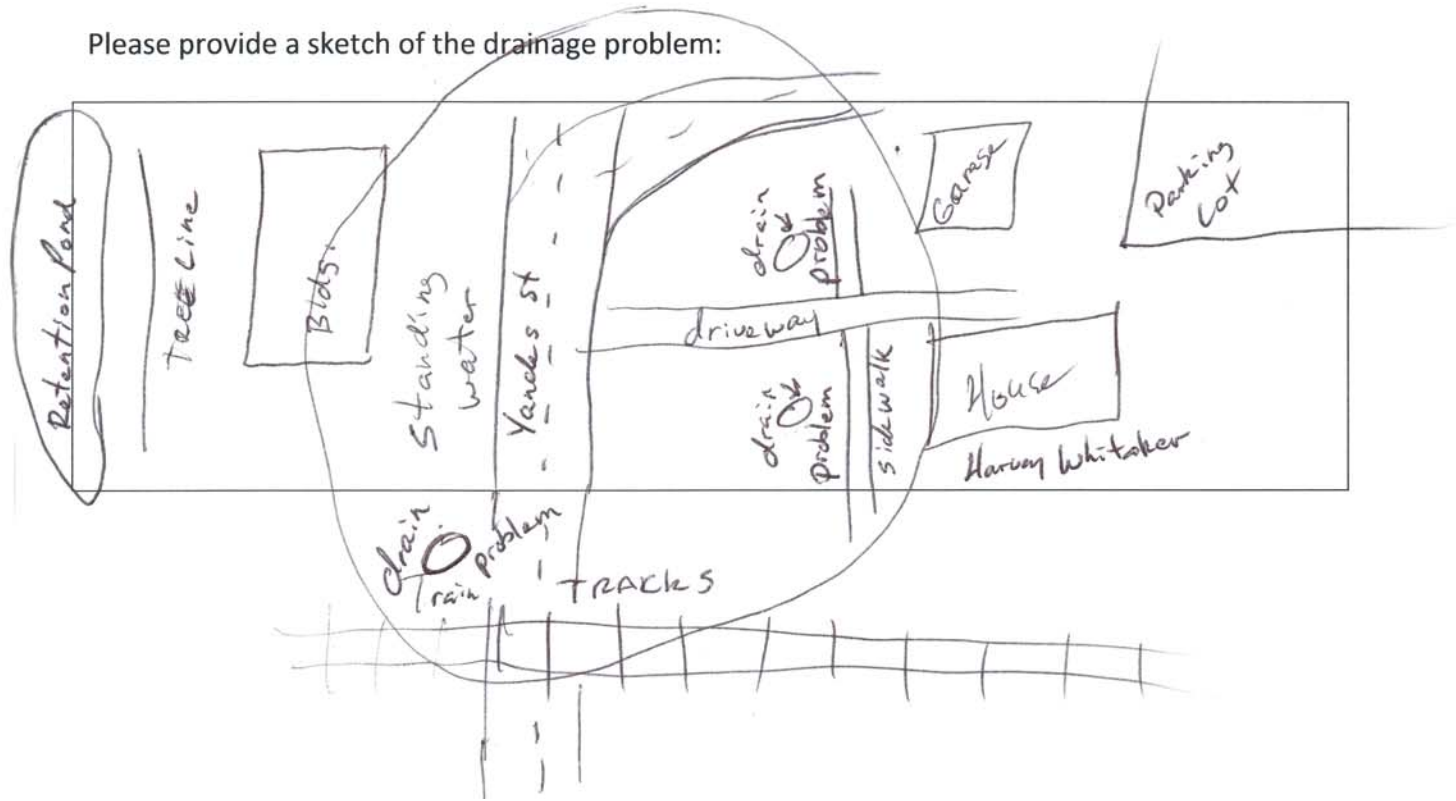
   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☒ Pipe blockage
   - ☐ Stream or ditch blockage
   - ☒ Drains in need of repair
   - ☐ Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?
   Yes

7. Would you be willing to grant a drainage easement to the City of Franklin?

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities?

Please provide a sketch of the drainage problem:



The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	SARALEE MANN
Property Address:	248 N. FORSYTHE ST
Owner Address:	SAME
Phone #:	736-9023
E-mail:	saraleemann@comcast.net

1. What is the nature of your problem? (please circle all that apply)
   A. Standing water
   B. Street drainage
   C. Flooding
   D. Water in Basement
   E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	whenever flooding occures in
Location	Hurricane Creek
Depth of water	
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	Dec 2013 and whenever flooding
Location	occures
Depth of water	
Date	
Location	
Depth of water	

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	
Property Address:	
Owner Address:	
Phone #:	
E-mail:	

1. What is the nature of your problem? (please circle all that apply)
   A. Standing water
   B. Street drainage
   C. Flooding
   D. Water in Basement
   E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	Dr. Paul Jarvis
Property Address:	950 W. Jefferson Franklin
Owner Address:	Brandon Ct Franklin
Phone #:	317-738-2181
E-mail:	pjidoc@hotmail.com

1. What is the nature of your problem? (please circle all that apply)
   - A. Standing water
   - B. Street drainage
   - C. Flooding
   - D. Water in Basement
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	last week, this week, every time have 7 1/2" rain
Location	950 W. Jefferson
Depth of water	6-12"
Date	
Location	
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?
   Some

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   If yes, check all situations that apply.

   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☒ Pipe blockage (storm sewer)
   - ☐ Stream or ditch blockage
   - ☐ Drains in need of repair
   - ☐ Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?
   Yes - have report from assessment of storm sewer lines on property. Fiberoptic camera run to the street - results no breaks or blockage found.

7. Would you be willing to grant a drainage easement to the City of Franklin?
   Yes

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities?
   Yes

Please provide a sketch of the drainage problem:

This problem originated (other than 2008) after city/state/utility co's repaired the culvert under st route 44 ~~last~~ summer. City officials have been out but have no solution. Water backs up storm sewer drains in basement. The likely problem is that the storm sewer was damaged during the culvert repair. Every rain now produces water in the basement. Not only costly nuisance but can lead to mold & other structural damage in the office (Optometrist).

Need city's help to get state & other to repair the storm sewer.

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	Dr. Tim Janis
Property Address:	604 Davis Dr Franklin
Owner Address:	- same -
Phone #:	317-736-8218
E-mail:	ftjanis@outlook.com

1. What is the nature of your problem? (please circle all that apply)
   - A. Standing water
   - B. Street drainage
   - C. Flooding
   - D. Water in Basement
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Youngs Creek flooding

Date	~ Dec 13 ~ 4'; May, June 11 (today)
Location	- 604 Davis Dr
Depth of water	4'; over the bank
Date	
Location	
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   Yes

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   If yes, check all situations that apply.

   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☐ Pipe blockage
   - ☐ Stream or ditch blockage
   - ☐ Drains in need of repair
   - ☐ Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?

   Yes

7. Would you be willing to grant a drainage easement to the City of Franklin?

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities? Yes

   Davis Dr just outside of city

Please provide a sketch of the drainage problem:

Youngs Creek flooding.
Suggestion - study potential of building detention/retention lake in former Wright Farm (west of AT&N) as a metering mechanism for retaining Young's Creek overflow.

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   Yes

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   If yes, check all situations that apply.

   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☐ Pipe blockage
   - ☐ Stream or ditch blockage
   - ☐ Drains in need of repair
   - ☐ Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?

   Yes

7. Would you be willing to grant a drainage easement to the City of Franklin?

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities? Yes

   Davis Dr just outside of city

Please provide a sketch of the drainage problem:

Youngs Creek flooding.
Suggestion - study potential of building detention/retention lake in former Wright Farm (west of AT&N) as a metering mechanism for retaining Young's Creek overflow.

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	MARY GENT
Property Address:	1750 WALTERS LANE (100N & 400E)
Owner Address:	Same
Phone #:	317-409-8418
E-mail:	indygent1750@gmail.com

1. What is the nature of your problem? (please circle all that apply)
   - (A) Standing water
   - (B) Street drainage, some of this water (on 100N.) runs onto my property and others facing 100N
   - (C) Flooding
   - (D) Water in ~~Basement~~ Crawl (use a sump)
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	Occurs w/ EVERY heavy or prolonged rainfall
Location	along 100N, and along property lines (swells that are not effective)
Depth of water	varies - up to 4"-5" (3-4 days to go away).
Date	
Location	Along property lines between 1740 Upper Shelbyull. Rd and 1800, 1850 WALTERS LN. (back of these properties - swells)
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood? No storm sewers
Standing water in swells of subdivision.

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   If yes, check all situations that apply.

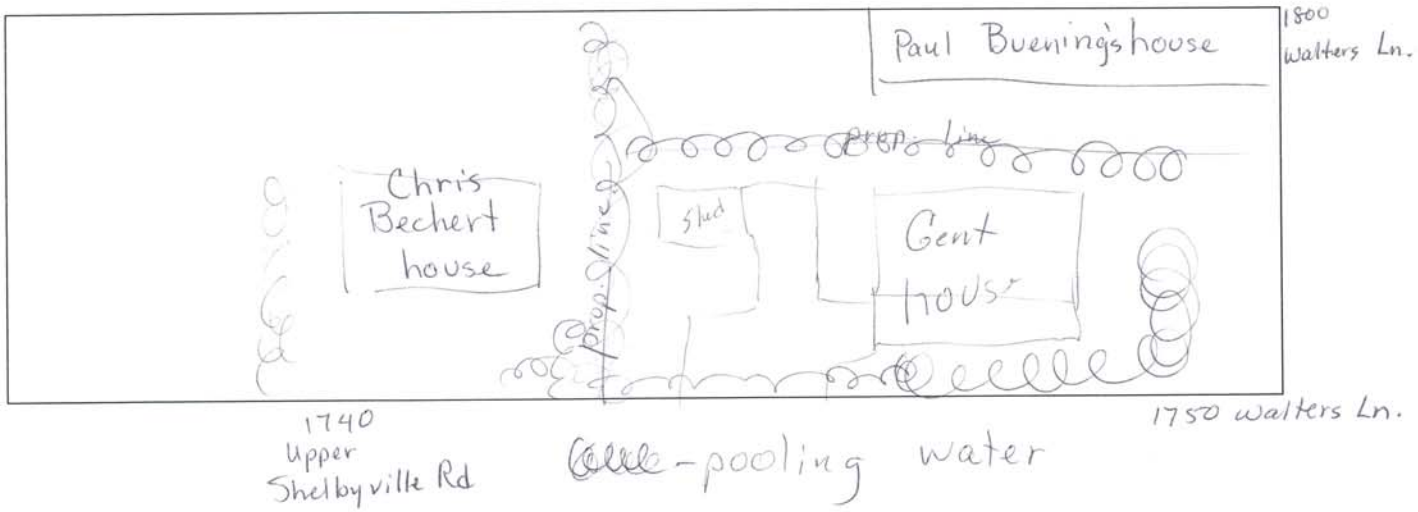
   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☐ Pipe blockage
   - ☐ Stream or ditch blockage
   - ☐ Drains in need of repair
   - ☐ Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood? No, but I will be willing to get these when problem occurs.

7. Would you be willing to grant a drainage easement to the City of Franklin?
Yes - I would like to be advised prior to changes.

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities? yes

Please provide a sketch of the drainage problem:



The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	Andy & Mary Smith
Property Address:	220 Hole-In-One Ct
Owner Address:	SAME
Phone #:	317-346-6697
E-mail:	Smitty7007@aol.com

1. What is the nature of your problem? (please circle all that apply)
   - A. Standing water
   - B. Street drainage
   - C. Flooding
   - D. Water in Basement
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	Everytime it rains
Location	(Street)
Depth of water	3/4" three to Four inches
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   Small drain beteween to homes

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   If yes, check all situations that apply.

   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☐ Pipe blockage
   - ☒ Stream or ditch blockage
   - ☒ Drains in need of repair
   - ☒ Other Pipe may need replaced

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?

   Everytime it rains

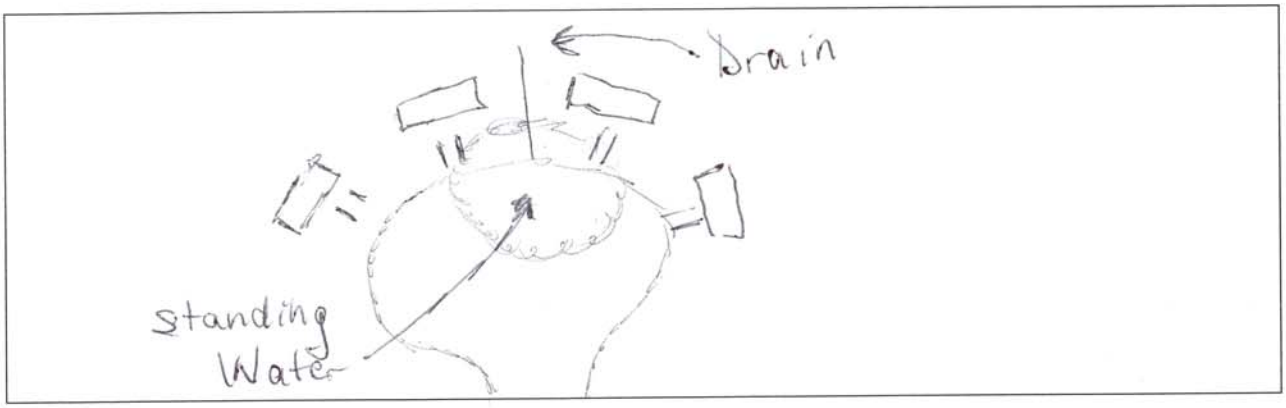
7. Would you be willing to grant a drainage easement to the City of Franklin?

   Yes

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities?

   Yes

Please provide a sketch of the drainage problem:



Jim Williams

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	
Property Address:	180 BRANIGIN RD
Owner Address:	SAME
Phone #:	317 738 3798 HM 317 418 6083 CELL
E-mail:	PWilliams1112@GMAIL.com

1. What is the nature of your problem? (please circle all that apply)
   - A. Standing water
   - B. Street drainage
   - C. Flooding
   - D. Water in Basement
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	6-4-14 TO DATE
Location	FRONT & BACK yard
Depth of water	10-12" front 3-4" back
Date	Every time 1.5 - 2+ inch rain
Location	
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   no

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   yes

   If yes, check all situations that apply.

   - ☐ Corroded pipes
   - ☐ Sink holes
   - ☐ Pipe blockage
   - ☑ Stream or ditch blockage
   - ☐ Drains in need of repair
   - ☐ Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?

   yes

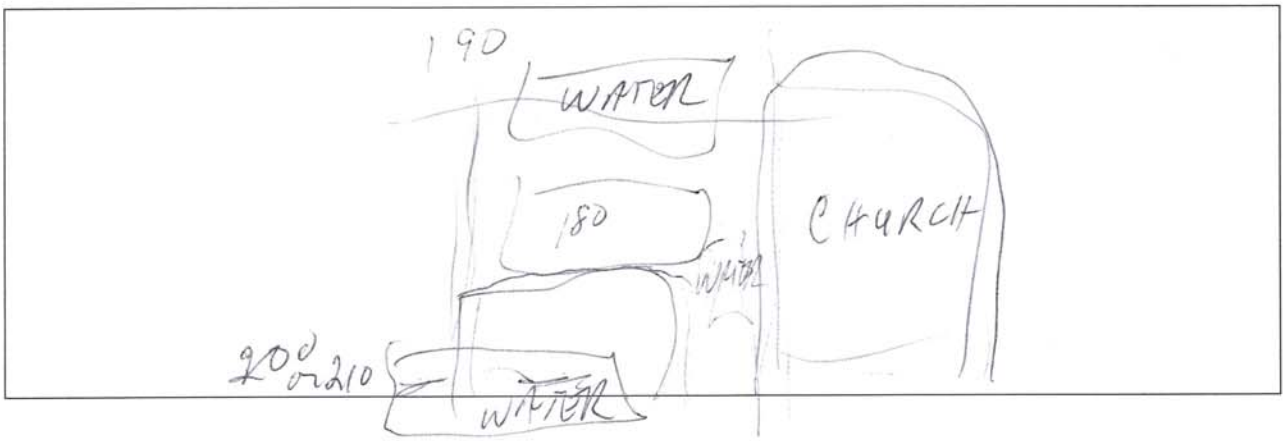
7. Would you be willing to grant a drainage easement to the City of Franklin?

   yes

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities?

   yes

Please provide a sketch of the drainage problem:



180 Branigin Rd. is the low point in the area. All water accumulates there from east and west. Drainage ditch is incomplete. No pipe under drive between 180 and the church. Area has been this way since we moved to the address in 1984.

Since the church paved the parking lot, a lot of water runs off to our yards at 180 and 190 Branigin Rd., and stands for several days. Many trees have been lost due to being too wet. Extreme time and expense to repair a leak in our pool due to ground water seeping in constantly. I had a drainage tile run to front of the property a few years ago and that helped the back yard some as it only stands for a few days to a week instead of two to three weeks now.

Reverend Palmer at 190 Branigin Rd. has had several city engineers up to look at the situation and they usually agree something needs done, but nothing has ever been done past the initial visit.

Sump in basement runs all the time.

Imagery ©2014 DigitalGlobe, IndianaMap Framework Data, Map data ©2014 Google 50 ft

(OVER)

(OVER)

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	Ron & Nancy Collins
Property Address:	60 N. Water St.
Owner Address:	Same
Phone #:	(317) 474-0077
E-mail:	ronnan73@gmail.com

1. What is the nature of your problem? (please circle all that apply)
   - (A) Standing water
   - (B.) Street drainage
   - (C.) Flooding
   - D. Water in Basement
   - E. Water in Home

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	6/7 + 6/8 2014
Location	Madison & Water Intersection
Depth of water	2-3 inches standing water
Date	6/7 & 6/8 2014
Location	Alley entrances on Water St. between Madison & Jeff St.
Depth of water	4-5 inches standing water @ entrance to Water St.

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	
Location	
Depth of water	
Date	
Location	
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?
Large buildings have large amounts of water run-off during rain events.

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?
Concerned about sewer pipes that run down Alley behind mutual Bank
If yes, check all situations that apply.

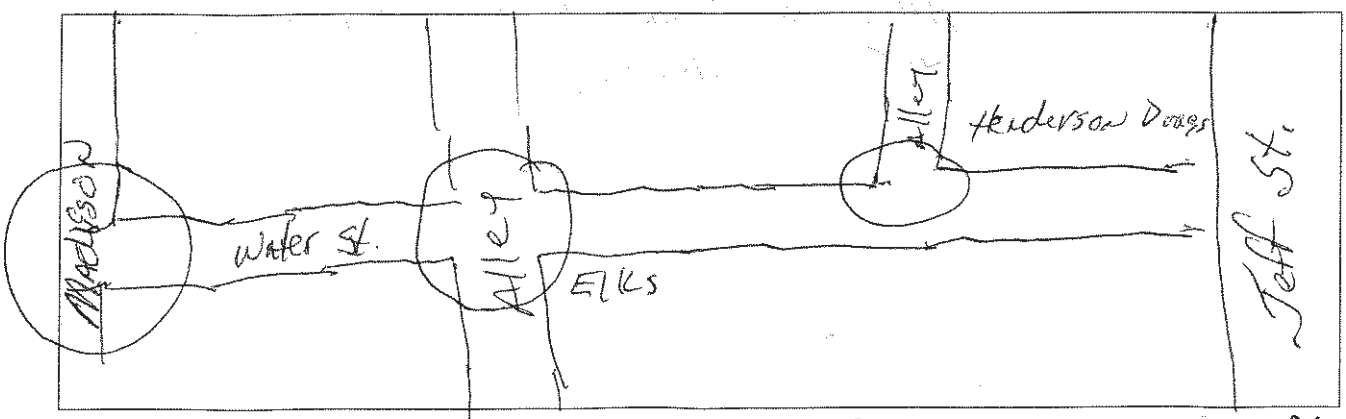
- [x] Corroded pipes
- [ ] Sink holes
- [x] Pipe blockage
- [ ] Stream or ditch blockage
- [ ] Drains in need of repair
- [ ] Other _____

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?

7. Would you be willing to grant a drainage easement to the City of Franklin?
Yes, if advised ahead of actual visit

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities?
Same as #7

Please provide a sketch of the drainage problem:



Circles indicate where standing water exists after a rain event.

The City of Franklin would like your input on existing storm water issues. Your input and suggestions will assist the City in defining drainage and flooding problem areas. Please take a few minutes to check the appropriate answer and write comments where needed.

Thank you for your input. *The personal information is for project purposes only and will not be shared with anyone outside of the Storm Water Department.*

Name	Scott Graham
Property Address:	159 W. Monroe St.
Owner Address:	2865 E. 200 So. Franklin
Phone #:	317-408-5714
E-mail:	generationsandco@aol.com

1. What is the nature of your problem? (please circle all that apply)
   - ✓ A. Standing water
   - ✓ B. Street drainage
   - ✓ C. Flooding
   - ✓ D. Water in Basement
   - ✓ E. Water in ~~Home~~ Business

2. If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.

Date	Dec. 22 2013
Location	159 W. Monroe
Depth of water	5" - 12"
Date	
Location	
Depth of water	

3. If flooding occurred, please list the approximate date(s), location and indicate depth of flooding.

Date	Dec. 22 2013
Location	159 W. Monroe St
Depth of water	5" - 12"
Date	
Location	
Depth of water	

4. Are there any soil erosion problems from a stream or storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

5. Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?

   If yes, check all situations that apply.

   - ☑ Corroded pipes
   - ☐ Sink holes
   - ☑ Pipe blockage
   - ☑ Stream or ditch blockage
   - ☑ Drains in need of repair
   - ☐ Other SUPERVISOR NEEDED

6. Do you have any photographs, videotape or other records of erosion or flooding problems that occurred on your property or in your neighborhood?

   yes - Andrew Cochrane has them

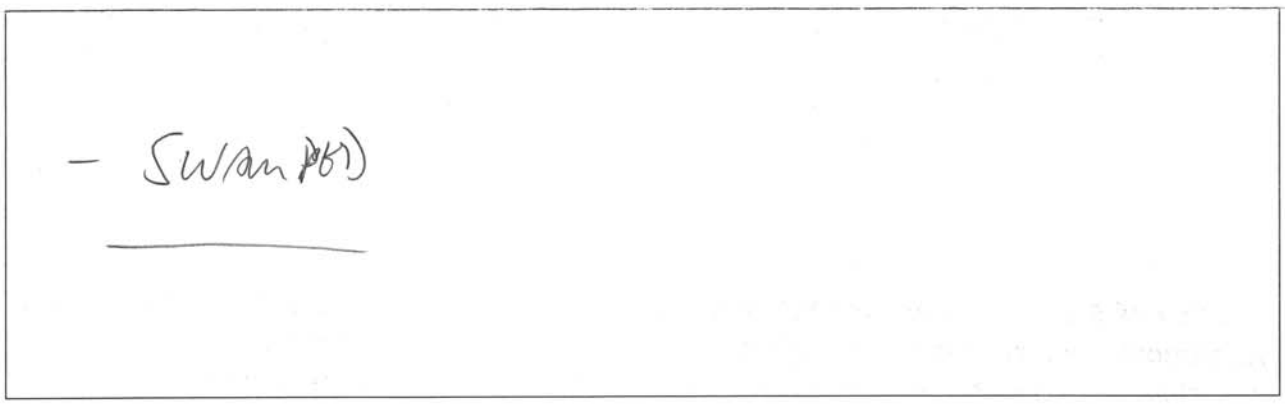
7. Would you be willing to grant a drainage easement to the City of Franklin?

   yes - already offered

8. Would you be willing to allow the City of Franklin to enter your property to complete construction activities?

   yes - already offered

Please provide a sketch of the drainage problem:



City of Franklin, Indiana — **Stormwater Master Plan**

Canary Ditch Flood Mitigation & Wetlands Restoration — **Initial Priority Rating Evaluation Sheet**

Street Address: Commerce Drive

Reduce flooding in downstream residential neighborhood

Rating By: CRB — **Date: 8/05/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable

Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1						0
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					Rating
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3						0
	Local Storm/Sanitary Main/Road Drainage	2						0
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Homes	4		X				12
	Business/Industry	3						0
	Parking Lots	2						0
	Yards / Fields	1		X				3
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					Rating
			1 - 10	11 - 25	26 - 50	> 50		
			1	2	3	4		
	Homes	4			X			12
	Business/Industry	2						0
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1						0
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					Rating
			10 - 100	101 - 250	251 - 500	> 500		
			10	20	30	40		
	Observed Erosion	1						0
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1						0
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1		X		8		4
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	31
	Public or Private Benefit?		Public	X	Private		IPR RATING	36

City of Franklin, Indiana — **Stormwater Master Plan**

Hurricane Creek Flood Mitigation & Wetlands Restoration — **Initial Priority Rating Evaluation Sheet**

Street Address: north of Upper Shelbyville Road & CR 400N

Reduce flooding along Hurricane Creek

Rating By: CRB — **Date: 8/05/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable — Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		Rating
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1						0
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		Rating
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3						0
	Local Storm/Sanitary Main/Road Drainage	2						0
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		Rating
			4	3	2	1		
	Homes	4				X		4
	Business/Industry	3						0
	Parking Lots	2						0
	Yards / Fields	1						0
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					
			1 - 10	11 - 25	26 - 50	> 50		Rating
			1	2	3	4		
	Homes	4				X		16
	Business/Industry	2	X					2
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1				X		0
EXTENT OF EROSION	EROSION			LINEAL FEET OF EROSION				
			10 - 100	101 - 250	251 - 500	> 500		Rating
			10	20	30	40		
	Observed Erosion	1						0
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1	X					5
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1		X		8		4
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	31
	Public or Private Benefit?		Public	X	Private		IPR RATING	36

City of Franklin, Indiana — **Stormwater Master Plan**

Water Street Drainage Improvements — **Initial Priority Rating Evaluation Sheet**

Street Address: Intersection of Water With Adams & King Streets

Alleviate standing water at intersection

Rating By: CRB — **Date: 8/05/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable — Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		Rating
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2	X					8
	Local Street or Place	1						0
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		Rating
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3						0
	Local Storm/Sanitary Main/Road Drainage	2				X		2
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		Rating
			4	3	2	1		
	Homes	4				X		4
	Business/Industry	3						0
	Parking Lots	2			X			4
	Yards / Fields	1			X			2
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					
			1 - 10	11 - 25	26 - 50	> 50		Rating
			1	2	3	4		
	Homes	4	X					4
	Business/Industry	2						0
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1			X			5
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					
			10 - 100	101 - 250	251 - 500	> 500		Rating
			10	20	30	40		
	Observed Erosion	1						0
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1	X					5
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1	X					2
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	36
	Public or Private Benefit?		Public	X	Private		IPR RATING	41

City of Franklin, Indiana — **Stormwater Master Plan**

Roaring Run Storm Sewer Rehabilitation — **Initial Priority Rating Evaluation Sheet**

Street Address: Roaring Run Enclosed Storm Sewer

Entire length of the existing enclosed component of Roaring Run Storm Sewer

Rating By: CRB — **Date: 8/5/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable

Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1						0
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					Rating
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3		X				9
	Local Storm/Sanitary Main/Road Drainage	2						0
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Homes	4				X		4
	Business/Industry	3				X		3
	Parking Lots	2						0
	Yards / Fields	1						0
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					Rating
			1 - 10	11 - 25	26 - 50	> 50		
			1	2	3	4		
	Homes	4				X		16
	Business/Industry	2	X					2
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1				X		0
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					Rating
			10 - 100	101 - 250	251 - 500	> 500		
			10	20	30	40		
	Observed Erosion	1						0
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1	X					5
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1	X					2
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	41
	Public or Private Benefit?		Public	X	Private		IPR RATING	46

City of Franklin, Indiana — **Stormwater Master Plan**

Cincinnati Street Drainage Improvements — **Initial Priority Rating Evaluation Sheet**

Street Address: Cincinnati Street

Cincinnati Street between Johnson Avenue and Yandes Street

Rating By: CRB — **Date: 3/20/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable

Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1	X					4
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					Rating
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3						0
	Local Storm/Sanitary Main/Road Drainage	2			X			4
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Homes	4				X		4
	Business/Industry	3				X		3
	Parking Lots	2				X		2
	Yards / Fields	1	X					4
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					Rating
			1 - 10	11 - 25	26 - 50	> 50		
			1	2	3	4		
	Homes	4		X				8
	Business/Industry	2	X					2
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1			X			5
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					Rating
			10 - 100	101 - 250	251 - 500	> 500		
			10	20	30	40		
	Observed Erosion	1						0
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1	X					5
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1	X					2
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	43
	Public or Private Benefit?		Public	X	Private		IPR RATING	48

City of Franklin, Indiana — **Stormwater Master Plan**

Roaring Run Relief Storm Sewer — **Initial Priority Rating Evaluation Sheet**

Street Address: Numerous in area between SR-44 and Ohio Street

Nearest address or intersection of problem: Starting at Johnson/Kentucky and Terminating at Hurricane/SR-44

Rating By: CRB — **Date:** 3/10/2014

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable — Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		Rating
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1		X				3
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		Rating
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3						0
	Local Storm/Sanitary Main/Road Drainage	2						0
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		Rating
			4	3	2	1		
	Homes	4				X		4
	Business/Industry	3						0
	Parking Lots	2			X			4
	Yards / Fields	1			X			2
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					
			1 - 10	11 - 25	26 - 50	> 50		Rating
			1	2	3	4		
	Homes	4				X		16
	Business/Industry	2	X					2
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1			X			5
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					
			10 - 100	101 - 250	251 - 500	> 500		Rating
			10	20	30	40		
	Observed Erosion	1						0
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1	X					5
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1	X	X				6
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1						0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	47
	Public or Private Benefit?		Public	X	Private		IPR RATING	52

City of Franklin, Indiana — **Stormwater Master Plan**

Community Park Drainage Improvments — **Initial Priority Rating Evaluation Sheet**

Street Address: 802 E. King Street

Nearest address or intersection of problem: E. King Street over Hurricane Creek

Rating By: CRB — **Date: 4/22/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable — Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1	X					4
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					Rating
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3						0
	Local Storm/Sanitary Main/Road Drainage	2						0
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Homes	4	X					16
	Business/Industry	3	X					12
	Parking Lots	2						0
	Yards / Fields	1						0
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					Rating
			1 - 10	11 - 25	26 - 50	> 50		
			1	2	3	4		
	Homes	4	X					4
	Business/Industry	2	X					2
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1			X			5
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					Rating
			10 - 100	101 - 250	251 - 500	> 500		
			10	20	30	40		
	Observed Erosion	1						0
WATER QUALITY	Area Type		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1	X					5
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1	X					2
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	50
	Public or Private Benefit?		Public	X	Private		IPR RATING	55

City of Franklin, Indiana — **Stormwater Master Plan**

Roaring Run Downstream Channel Improvements — **Initial Priority Rating Evaluation Sheet**

Street Address: Jefferson & Walnut

Stabilize streambank and improve flow capacity of Roaring Run channel near Youngs Creek

Rating By: CRB — **Date: 7/15/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable — Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1						0
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					Rating
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3		X				9
	Local Storm/Sanitary Main/Road Drainage	2						0
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Homes	4						0
	Business/Industry	3						0
	Parking Lots	2				X		2
	Yards / Fields	1						0
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					Rating
			1 - 10	11 - 25	26 - 50	> 50		
			1	2	3	4		
	Homes	4	X					4
	Business/Industry	2	X					2
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1			X			5
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					Rating
			10 - 100	101 - 250	251 - 500	> 500		
			10	20	30	40		
	Observed Erosion	1		X				20
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1		X				10
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1				X		8
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	60
	Public or Private Benefit?		Public	X	Private		IPR RATING	65

City of Franklin, Indiana — **Stormwater Master Plan**

Youngs Creek Streambank Stabilization — **Initial Priority Rating Evaluation Sheet**

Street Address: Youngs Creek between Main and South Streets

Stabilize streambank and improve flow capacity of Roaring Run channel near Youngs Creek

Rating By: CRB — **Date: 7/15/2014**

INSTRUCTIONS: Fill in only one "X" per Group Rating as applicable

Revision Date: MM/DD/YYYY

STREET FLOODING	STREET CLASSIFICATION		STREET FLOODING OCCURRENCES					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Primary Arterial	4						0
	Secondary Arterial	3						0
	Collector	2						0
	Local Street or Place	1						0
INFRASTRUCTURE DETERIORATION	PUBLIC INFRASTRUCTURE TYPE		MAJOR FAILURE POSSIBLE WITHIN					Rating
			Immediate	1-2 Years	3 -5 Years	6-10+ Years		
	(as applicable)		4	3	2	1		
	Arterial/Sanitary Int./Major Tributary	4						0
	Collector/Storm/Sanitary Collector/Stream	3		X				9
	Local Storm/Sanitary Main/Road Drainage	2						0
FLOODED	PROPERTY OR FACILITY CLASSIFICATION		FLOODING FREQUENCY					Rating
			Every Rain	Once/1-2 Yr	Once/2-10 Yr	Once/10-25 Yr		
			4	3	2	1		
	Homes	4						0
	Business/Industry	3				X		3
	Parking Lots	2				X		2
	Yards / Fields	1						0
NUMBER IMPACTED	PROPERTY CLASSIFICATION		NUMBER OF FEATURES AFFECTED					Rating
			1 - 10	11 - 25	26 - 50	> 50		
			1	2	3	4		
	Homes	4						0
	Business/Industry	2	X					2
FLOODING IMPACT	FLOODING CONCERN		Sewage in basement	Standing water > 1 wk	Standing water 2-7 d	Standing water < 48 hr		Rating
			15	10	5	0		
	Observed Impact	1						0
EXTENT OF EROSION	EROSION		LINEAL FEET OF EROSION					Rating
			10 - 100	101 - 250	251 - 500	> 500		
			10	20	30	40		
	Observed Erosion	1				X		40
WATER QUALITY	(AREA TYPE)		Non-Combined Sewer Area	Erosion Effecting Water Quality	Combined Sewer Area			Rating
			5	10	15			
	Area Type	1		X				10
SOLUTIONS	RESOLUTION TYPE		Storm Sewer	Structural BMP	Bridge/ Culvert	Open Channel		Rating
			2	4	6	8		
	Solution	1				X		8
PUBLIC INVOLVE.	COST SHARE (When property owner ask to participate or is required for a solution)		> 75%	26 - 75%	6 - 25%	0 - 5%		Rating
			15	10	5	0		
	% by Developer/Owner	1				X		0
MS4 REQ'MNT	SATISFIES REGULATORY REQUIREMENT FOR MS4 PERMIT		YES		NO			
			5		0			
			X					5
							Subtotal	74
	Public or Private Benefit?		Public	X	Private		IPR RATING	79

City of Franklin Stormwater Master Plan
CIP #02 - Community Park Drainage Improvements

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Clearing & Grubbing	LS	1	$ 5,000.00	$ 5,000.00
2	12-inch HDPE, Double-Wall	LF	420	$ 40.00	$ 16,800.00
3	Granular Backfill	LF	50	$ 12.00	$ 600.00
4	24" x 36" Inlet	EA	1	$ 1,800.00	$ 1,800.00
5	18" x 18" Inlet	EA	3	$ 1,250.00	$ 3,750.00
6	Concrete Headwall	EA	1	$ 2,500.00	$ 2,500.00
7	Pavement Removal	SY	800	$ 12.00	$ 9,600.00
8	1.5" #11 HMA Surface	TON	65	$ 150.00	$ 9,750.00
9	2.5" #9 HMA Binder	TON	109	$ 115.00	$ 12,535.00
10	7" Compacted Aggregate Base Course (INDOT #57)	TON	300	$ 25.00	$ 7,500.00
11	Seeding	SY	480	$ 3.25	$ 1,560.00
12	Erosion Control	LS	1	$ 5,000.00	$ 5,000.00
				Subtotal	**$ 76,395.00**
13	Contingency (20%)	LS	1	$ 15,300.00	$ 15,300.00
14	Mobilization/Demobilization (5%)	LS	1	$ 3,900.00	$ 3,900.00
	Preliminary Opinion of Probable Construction Cost				**$ 95,595.00**
15	Design & Permitting (15%)	LS	1	$ 14,400.00	$ 14,400.00
16	Construction Engineering (8%)	LS	1	$ 7,700.00	$ 7,700.00
	Preliminary Opinion of Probable Costs - CIP #02				**$ 118,000.00**

City of Franklin Stormwater Master Plan
CIP #03 - Storm Sewer Outfall Restoration (5 Outfalls)

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Excavation & Disposal	CY	20	$ 20.00	$ 400.00
2	Headwalls	EA	5	$ 2,500.00	$ 12,500.00
3	24-inch Check Valves	EA	5	$ 15,000.00	$ 75,000.00
4	Class 1 Riprap	SYS	15	$ 45.00	$ 675.00
5	Granular Backfill	LF	50	$ 12.00	$ 600.00
				Subtotal	**$ 89,175.00**
6	Contingency (20%)	LS	1	$ 17,900.00	$ 17,900.00
7	Mobilization/Demobilization (15%)	LS	1	$ 13,400.00	$ 13,400.00
	Preliminary Opinion of Probable Construction Cost				**$ 120,475.00**
8	Design & Permitting (15%)	LS	1	$ 18,100.00	$ 18,100.00
9	Construction Engineering (8%)	LS	1	$ 9,700.00	$ 9,700.00
	Preliminary Opinion of Probable Cost - CIP #03				**$ 149,000.00**

City of Franklin Stormwater Master Plan
CIP #04 - Roaring Run Rehabilitation

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	48" & 72" CMP Cementitious Liner & Cleaning	LF	4,800	$ 750.00	$ 3,600,000.00
2	72-inch Precast Concrete Manhole with Top Slab and Casting	EA	8	$ 15,000.00	$ 120,000.00
3	Pavement Removal	SY	128	$ 12.00	$ 1,536.00
4	1.5" #11 HMA Surface	TON	65	$ 150.00	$ 9,750.00
5	2.5" #9 HMA Binder	TON	109	$ 115.00	$ 12,535.00
6	7" Compacted Aggregate Base Course (INDOT #57)	TON	300	$ 25.00	$ 7,500.00
7	Maintenance of Traffic	LS	1	$ 15,000.00	$ 15,000.00
8	Erosion Control	LS	1	$ 10,000.00	$ 10,000.00
				Subtotal	**$ 3,776,321.00**
9	Contingency (20%)	LS	1	$ 755,300.00	$ 755,300.00
10	Mobilization/Demobilization (5%)	LS	1	$ 188,900.00	$ 188,900.00
	Preliminary Opinion of Probable Construction Cost				**$ 4,720,521.00**
11	Design & Permitting (10%)	LS	1	$ 472,100.00	$ 472,100.00
12	Construction Engineering (8%)	LS	1	$ 377,700.00	$ 377,700.00
	Preliminary Opinion of Probable Costs - CIP #04				**$ 5,571,000.00**

City of Franklin Stormwater Master Plan
CIP #05 - Roaring Run Relief Storm Sewer

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Right-of-Way Clearing	LS	1	$ 15,000.00	$ 15,000.00
2	54-inch RCP, Class II, Granular Backfill	LF	2,400	$ 300.00	$ 720,000.00
3	72-inch Precast Concrete Manhole with Top Slab and Casting	EA	8	$ 8,000.00	$ 64,000.00
4	Diversion Structure	EA	1	$ 25,000.00	$ 25,000.00
5	54-inch End Section	EA	1	$ 15,000.00	$ 15,000.00
6	Pavement Removal	SYS	3,400	$ 12.00	$ 40,800.00
7	1.5" #11 HMA Surface	TON	290	$ 150.00	$ 43,500.00
8	2.5" #9 HMA Binder	TON	660	$ 115.00	$ 75,900.00
9	Compacted Aggregate Base No. 53	TON	1,700	$ 25.00	$ 42,500.00
10	Maintenance of Traffic	LS	1	$ 20,000.00	$ 20,000.00
11	Erosion Control	LS	1	$ 25,000.00	$ 25,000.00
				Subtotal	**$ 1,086,700.00**
12	Contingency (20%)	LS	1	$ 217,400.00	$ 217,400.00
13	Mobilization/Demobilization (5%)	LS	1	$ 54,400.00	$ 54,400.00
	Preliminary Opinion of Probable Construction Costs				**$ 1,358,500.00**
14	Design & Permitting (15%)	LS	1	$ 203,800.00	$ 203,800.00
15	Construction Engineering (8%)	LS	1	$ 108,700.00	$ 108,700.00
	Preliminary Opinion of Probable Costs - CIP #05				**$ 1,671,000.00**

City of Franklin Stormwater Master Plan
CIP #06 - Hurricane Creek Flood Mitigation & Wetlands Restoration Facility

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Clearing	LS	1	$ 40,000.00	$ 40,000.00
2	Excavation & Disposal*	CY	1,000,000	$ 12.00	$ 12,000,000.00
3	Vinyl Sheet Piling	SF	1710	$ 25.00	$ 42,750.00
4	Articulated Concrete Blocks	SF	2400	$ 11.00	$ 26,400.00
5	Outlet Control Structure	EA	1	$ 20,000.00	$ 20,000.00
6	Class I Riprap	SYS	700	$ 45.00	$ 31,500.00
7	Guardrail	LF	1,500	$ 30.00	$ 45,000.00
8	Plantings	LS	1	$ 200,000.00	$ 200,000.00
9	Maintenance of Traffic	LS	1	$ 5,000.00	$ 5,000.00
10	Erosion Control	LS	1	$ 120,000.00	$ 120,000.00
				Subtotal	**$ 12,530,650.00**
11	Contingency (20%)	LS	1	$ 2,506,200.00	$ 2,506,200.00
12	Mobilization/Demobilization (5%)	LS	1	$ 626,600.00	$ 626,600.00
	Preliminary Opinion of Probable Construction Costs				**$ 15,663,450.00**
13	Design, Permitting, Construction, Legal (25%)	LS	1	$ 3,915,900.00	$ 3,915,900.00
14	Land Purchase	AC	139	$ 5,000.00	$ 695,000.00
	Preliminary Opinion of Probable Costs - CIP #06				**$ 20,280,000.00**

* assumed a 5 ft depth average excavated depth across 125 of the 139 acres

City of Franklin Stormwater Master Plan
CIP #07 - Canary Ditch Flood Mitigation & Wetlands Restoration

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Excavation & Disposal	CY	239,135	$ 12.00	$ 2,869,620.00
2	Vinyl Sheet Piling	SF	1710	$ 25.00	$ 42,750.00
3	Articulated Concrete Blocks	SF	2400	$ 11.00	$ 26,400.00
4	12-inch, Class III, RCP Storm Sewer	LF	75	$ 50.00	$ 3,750.00
5	Class 1 Riprap	SYS	626	$ 45.00	$ 28,170.00
6	Plantings	LS	1	$ 40,000.00	$ 40,000.00
7	Maintenance of Traffic	LS	1	$ 5,000.00	$ 5,000.00
8	Erosion Control	LS	1	$ 20,000.00	$ 20,000.00
				Subtotal	**$ 3,035,690.00**
9	Contingency (10%)	LS	1	$ 303,600.00	$ 303,600.00
10	Mobilization/Demobilization (5%)	LS	1	$ 151,800.00	$ 151,800.00
	Preliminary Opinion of Probable Construction Cost				**$ 3,491,090.00**
11	Permitting	LS	1	$ 35,000.00	$ 35,000.00
12	Construction Engineering (8%)	LS	1	$ 279,300.00	$ 279,300.00
	Preliminary Opinion of Probable Costs - CIP #07				**$ 3,806,000.00**

City of Franklin Stormwater Master Plan
CIP #08 - Youngs Creek Streambank Stabilization (Mainline Creek Portions)

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Clearing & Grubbing	LS	1	$ 60,000.00	$ 60,000.00
2	Excavation	CY	2,100	$ 15.00	$ 31,500.00
3	Geotextile	SYS	5,300	$ 2.50	$ 13,250.00
4	Revetment Mattresses	SF	47,700	$ 9.00	$ 429,300.00
5	Turf Reinforcement Mat	SYS	6,300	$ 15.00	$ 94,500.00
6	12-inch Dia. Vegetated Coir Log	LF	4,500	$ 5.00	$ 22,500.00
7	Tree - Single Stem (2.0"-2.5" diameter)	EA	150	$ 250.00	$ 37,500.00
8	Native Plant Plugs	EA	4,500	$ 4.00	$ 18,000.00
9	Native Seed Mix	LB	150	$ 34.00	$ 5,100.00
10	Outfall Restoration Allowance	LS	1	$ 15,000.00	$ 15,000.00
11	Traffic Control	LS	1	$ 5,000.00	$ 5,000.00
12	Erosion Control	LS	1	$ 5,000.00	$ 5,000.00
				Subtotal	**$ 736,650.00**
13	Contingency (20%)	LS	1	$ 147,400.00	$ 147,400.00
14	Mobilization/Demobilization (5%)	LS	1	$ 36,900.00	$ 36,900.00
	Opinion of Probable Construction Costs				**$ 920,950.00**
15	Design & Permitting (15%)	LS	1	$ 138,200.00	$ 138,200.00
16	Construction Engineering (8%)	LS	1	$ 73,700.00	$ 73,700.00
	Opinion of Probable Costs - CIP #08				**$ 1,133,000.00**

City of Franklin Stormwater Master Plan
CIP #09 - Roaring Run Downstream Channel Improvements

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Pipe De-Silting and Debris Removal	LS	1	$ 50,000.00	$ 50,000.00
2	Excavation & Disposal	CY	300	$ 15.00	$ 4,500.00
3	Turf Reinforcement Mats (North American Green P-550)	SYS	650	$ 15.00	$ 9,750.00
4	Geotextile	SYS	1,867	$ 2.50	$ 4,666.67
5	Revetment Mattress Channel Invert Lining	SF	4,800	$ 9.00	$ 43,200.00
	Revetment Mattresses	SF	12,000	$ 9.00	$ 108,000.00
6	Tree - Single Stem (2.0"-2.5" diameter)	EA	50	$ 250.00	$ 12,500.00
7	Native Seed Mix	LB	50	$ 34.00	$ 1,700.00
8	Maintenance of Traffic	LS	1	$ 5,000.00	$ 5,000.00
9	Erosion Control	LS	1	$ 10,000.00	$ 10,000.00
				Subtotal	**$ 249,316.67**
10	Contingency (20%)	LS	1	$ 49,900.00	$ 49,900.00
11	Mobilization/Demobilization (5%)	LS	1	$ 12,500.00	$ 12,500.00
	Preliminary Opinion of Probable Construction Costs				**$ 311,716.67**
12	Design & Permitting (15%)	LS	1	$ 46,800.00	$ 46,800.00
13	Construction Engineering (8%)	LS	1	$ 25,000.00	$ 25,000.00
	Preliminary Opinion of Probable Costs - CIP #09				**$ 384,000.00**

City of Franklin Stormwater Master Plan
CIP #10 - Forsythe Street Culvert Replacement

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Clearing & Grubbing	LS	1	$ 20,000.00	$ 20,000.00
2	Excavation	CY	600	$ 15.00	$ 9,000.00
3	Turf Reinforcement Mat	SYS	1,500	$ 15.00	$ 22,500.00
4	12-inch Dia. Vegetated Coir Log	LF	300	$ 5.00	$ 1,500.00
5	Gabion Mattress (12-inch thick)	SF	500	$ 8.00	$ 4,000.00
6	Precast Box Culvert	LF	110	$ 1,450.00	$ 159,500.00
7	1.5" #11 HMA Surface	TONS	105	$ 150.00	$ 15,750.00
8	2.5" #9 HMA Binder	TONS	172	$ 115.00	$ 19,780.00
9	7" Compacted Aggregate Base Course (INDOT #57)	TONS	590	$ 25.00	$ 14,750.00
10	Guardrail	LF	220	$ 30.00	$ 6,600.00
11	Remove & Dispose - Existing Guardrail	LF	135	$ 20.00	$ 2,700.00
12	Native Plant Plugs	EA	300	$ 4.00	$ 1,200.00
13	Native Seed Mix	LB	150	$ 34.00	$ 5,100.00
14	Outfall Restoration Allowance	LS	1	$ 10,000.00	$ 10,000.00
15	Traffic Control	LS	1	$ 10,000.00	$ 10,000.00
16	Erosion Control	LS	1	$ 5,000.00	$ 5,000.00
				Subtotal	**$ 307,380.00**
17	Contingency (20%)	LS	1	$ 61,500.00	$ 61,500.00
18	Mobilization/Demobilization (5%)	LS	1	$ 15,400.00	$ 15,400.00
	Opinion of Probable Construction Costs				**$ 384,280.00**
19	Design & Permitting (15%)	LS	1	$ 57,700.00	$ 57,700.00
20	Construction Engineering (8%)	LS	1	$ 30,800.00	$ 30,800.00
	Opinion of Probable Costs - CIP #10				**$ 473,000.00**

City of Franklin Stormwater Master Plan
CIP #11 - Water Street Drainage Improvements

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	12-inch, Class III, RCP Storm Sewer	LF	500	$ 50.00	$ 25,000.00
2	15-inch, Class III, RCP Storm Sewer	LF	350	$ 65.00	$ 22,750.00
3	18-inch, Class III, RCP Storm Sewer	LF	350	$ 75.00	$ 26,250.00
4	INDOT Type A Storm Inlet W/ Catchbasin	EA	8	$ 1,200.00	$ 9,600.00
5	1.5" #11 HMA Surface	TONS	210	$ 150.00	$ 31,500.00
6	2.5" #9 HMA Binder	TONS	344	$ 115.00	$ 39,560.00
7	7" Compacted Aggregate Base Course (INDOT #57)	TONS	1,180	$ 25.00	$ 29,500.00
8	Concrete Roll Curb & Gutter	LF	1,290	$ 23.00	$ 29,670.00
9	12-inch Stop Bar	LF	90	$ 2.00	$ 180.00
10	ADA Handicap Ramps	SF	1800	$ 8.00	$ 14,400.00
11	Granular Backfill	LF	1250	$ 12.00	$ 15,000.00
12	8-inch PVC Sanitary Sewer	LF	180	$ 85.00	$ 15,300.00
13	12-inch PVC Sanitary Sewer	LF	360	$ 105.00	$ 37,800.00
14	8-inch Sanitary Sewer - Removal & Disposal	LF	180	$ 25.00	$ 4,500.00
15	12-inch Storm Sewer - Removal & Disposal	LF	200	$ 25.00	$ 5,000.00
16	Connect to Existing Structure	EA	2	$ 1,500.00	$ 3,000.00
17	Concrete Pavement & Monolithic Curb - Removal & Disposal	SY	800	$ 19.00	$ 15,200.00
18	Sidewalk - Removal & Disposal	SY	50	$ 15.00	$ 750.00
19	Maintenance of Traffic	LS	1	$ 10,000.00	$ 10,000.00
20	Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
				Subtotal	**$ 342,960.00**
21	Contingency (20%)	LS	1	$ 68,600.00	$ 68,600.00
22	Mobilization/Demobilization (5%)	LS	1	$ 17,200.00	$ 17,200.00
	Preliminary Opinion of Probable Construction Costs				**$ 428,760.00**
23	Design & Permitting (15%)	LS	1	$ 64,400.00	$ 64,400.00
24	Construction Engineering (8%)	LS	1	$ 34,400.00	$ 34,400.00
	Preliminary Opinion of Probable Costs - CIP #11				**$ 528,000.00**

City of Franklin Stormwater Master Plan
CIP #12 - Cincinnati Street Drainage Improvements

Item	Item Description	Unit	Quantity	Unit Price	Amount
1	Clearing	LS	1	$ 10,000.00	$ 10,000.00
2	18-inch, Class III, RCP Storm Sewer	LF	1,600	$ 75.00	$ 120,000.00
3	Granular Backfill	LF	1,600	$ 12.00	$ 19,200.00
4	24" x 36" Inlet	EA	6	$ 1,800.00	$ 10,800.00
5	Connection to Existing Sewer	EA	1	$ 2,500.00	$ 2,500.00
6	72-inch Manhole	EA	1	$ 8,000.00	$ 8,000.00
7	Concrete Roll Curb & Gutter	LF	3,300	$ 23.00	$ 75,900.00
8	Pavement Removal	SY	1,300	$ 10.00	$ 13,000.00
9	1.5" #11 HMA Surface	TON	2,265	$ 150.00	$ 339,750.00
10	2.5" #9 HMA Binder	TON	3,776	$ 115.00	$ 434,240.00
10	7" Compacted Aggregate Base Course (INDOT #57)	TON	10,900	$ 25.00	$ 272,500.00
11	Seeding	SY	1,000	$ 3.25	$ 3,250.00
12	Maintenance of Traffic	LS	1	$ 5,000.00	$ 5,000.00
13	Erosion Control	LS	1	$ 10,000.00	$ 10,000.00
				Subtotal	**$ 1,324,140.00**
14	Contingency (20%)	LS	1	$ 264,900.00	$ 264,900.00
15	Mobilization/Demobilization (5%)	LS	1	$ 66,300.00	$ 66,300.00
	Preliminary Opinion of Probable Construction Costs				**$ 1,655,340.00**
16	Design & Permitting (15%)	LS	1	$ 248,400.00	$ 248,400.00
17	Construction Engineering (8%)	LS	1	$ 132,500.00	$ 132,500.00
	Preliminary Opinion of Probable Costs - CIP #12				**$ 2,037,000.00**