

Roaring Run Diversion Study

City of Franklin
April 2012

Table of Contents

Executive Summary 2

Introduction 3

Study Location..... 4

Data Collection..... 5

Existing Conditions 6

Options 8

Alternatives 9

Best Management Practice Basin..... 11

Project Costs..... 12

Permitting and Agency Coordination 13

Conclusions and Recommendations 14

Appendix

- A. Alternatives
- B. Project Cost Breakdown
- C. Diversion Calculations
- D. Water Quality Calculations
- E. Study Area Photographs



Executive Summary

The purpose and goal of this study is to investigate alternatives for a proposed route to divert flow from the Roaring Run drainage system to Hurricane Creek in order to alleviate flooding further downstream on the Roaring Run system. The area downstream has been inundated with storm water on multiple occasions. The existing Roaring Run system has been overburdened to the extent that manholes have been displaced because of surcharging of the downstream system. The area bounded by Kentucky Street to the north, Hurricane Street to the east, Jefferson Street to the south, and Johnson Avenue to the west will also be analyzed for potential drainage infrastructure in order to most effectively eliminate drainage issues within this area. In addition, a Best Management Practice (BMP) was studied and preliminarily sized for the area along Hurricane Creek, south of east Jefferson Street. The BMP is recommended to meet a minimum water quality volume of 0.98 ac.ft.

This report has studied two solutions: The first being to divert the existing full flow of the Roaring Run pipe, and the second, to divert half of the existing flow being conveyed within the pipe. These pipe sizes were 54-inch and 36-inch respectively. From these solutions, two alternative routes were analyzed: Alternative 1 proposes taking the pipe east down Kentucky Street to Hurricane and heading south down Hurricane to Hurricane Creek. Alternative 2 proposes taking the diversion pipe south down Johnson to King Street, then King Street east to Hurricane, and south to Hurricane Creek. Alternative II is the recommended route as it is more cost effective and has less utility conflicts. This route also allows for the collection of stormwater runoff within portions of the localized area, and lessens flooding on the roadways south of King Street to Jefferson.

This study was initiated by the City of Franklin via a Request for Proposal through the Department of Planning and Economic Development/Department of Engineering, to conduct a drainage study in the above described area.

DLZ Indiana LLC under it's contract with the City has participated in two public meetings regarding the project.



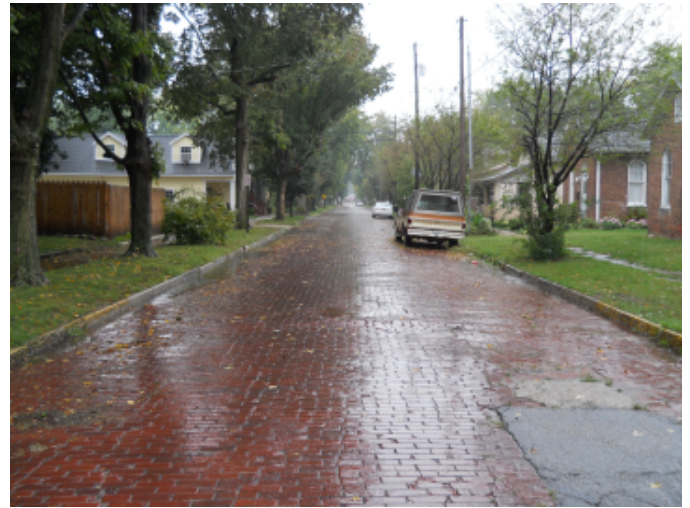
Introduction

The purpose of this study is to investigate alternatives of a proposed route to divert flow from the Roaring Run drainage system to Hurricane Creek in order to alleviate flooding further downstream on Roaring Run. The area within the proposed project location shall also be analyzed to determine effective ways of incorporating drainage infrastructure that will most effectively reduce drainage issues within this area. As part of this study, an investigation was done to determine the feasibility of constructing a Storm Water Quality Best Management Practice (BMP) within the open lots south of Jefferson Street and north of Hurricane Creek.

DLZ Indiana, LLC was retained by the City of Franklin via a Request for Proposal through the Department of Planning and Economic Development/Department of Engineering to conduct a drainage study as previously discussed.

DLZ has met with city staff and has participated in two public meetings to solicit information as to the potential routing of the system.

Calculations were performed to determine the most practical and feasible alternative to divert the Roaring Run flows and alleviate/abate drainage issues within the localized area. Information gathered during site visits was used to augment the feasibility of the alternatives.



Study Location

This study investigated intercepting/diverting a portion of the Roaring Run drainage system at the northeast corner of the intersection of Kentucky Street and Johnson Avenue. The proposed route is located in the vicinity of the area bounded by Kentucky Street to the north, Hurricane Street to the east, Jefferson Street to the south, and Johnson Avenue to the west will also be analyzed for potential drainage infrastructure in order to most effectively eliminate drainage issues within this area. The study area, of the localized section, is approximately 20 acres in size with a total contributing watershed area of approximately 1.2 square miles.

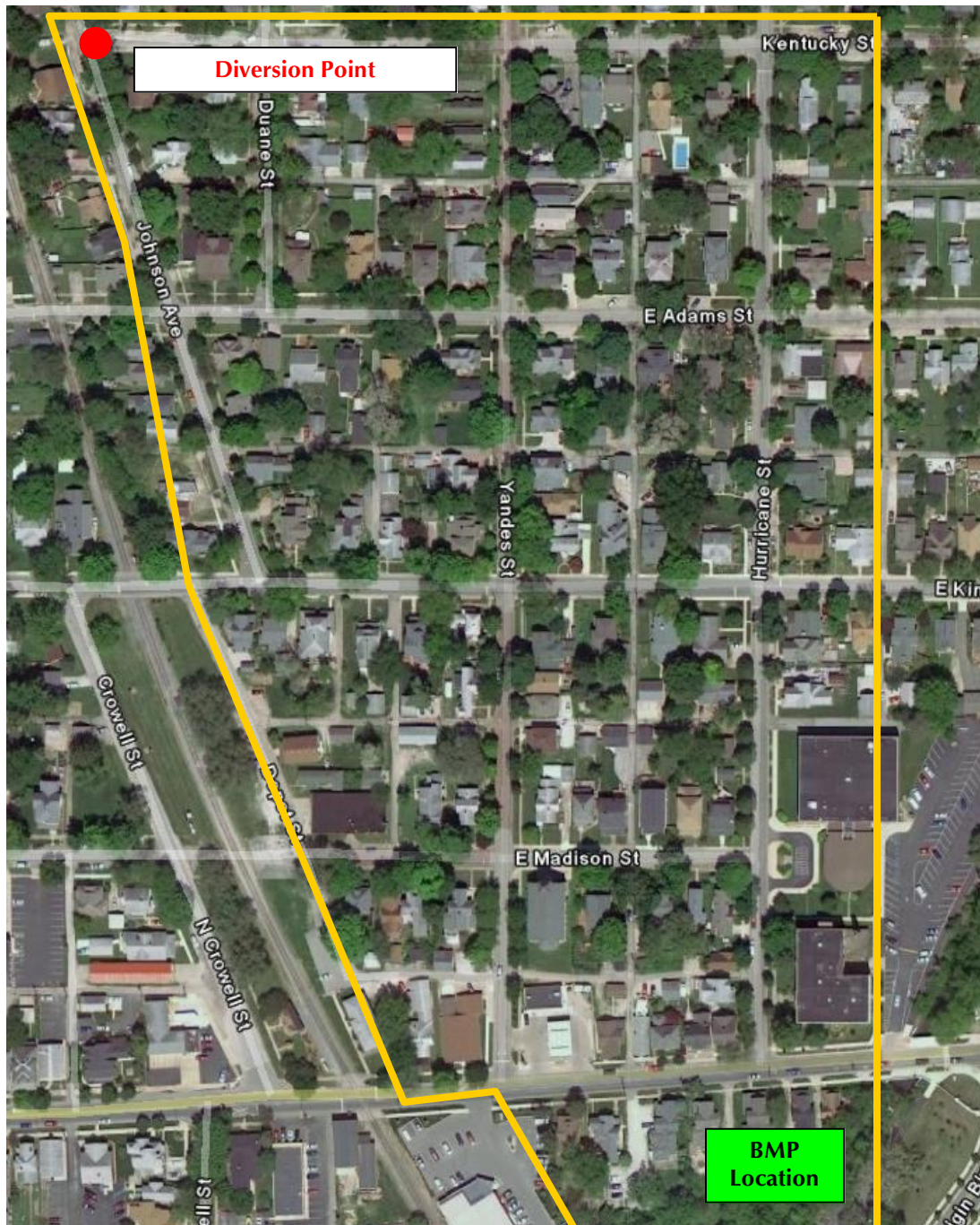


Figure 1. Aerial Location Map (Local Area)

Data Collection

A topographic survey was completed at select locations within the study area in order to determine pipe sizes and inverts associated with the diversion point and outlet point, structure locations, and elevations at intersections and other key locations that will assist with the layout of the proposed diversion pipe.

Site visits were also conducted within the study area on at least two occasions. One of the visits was conducted during a rain event (± 0.6 -inches of total rain), on September 19, 2011. The study area was evaluated during this rain event to determine the areas with standing water and other drainage related issues.

Geographic Information System (GIS) was utilized from the Johnson County GIS Department in order to get information on existing topography and utilities throughout the drainage basin.

At the request of City Staff, a meeting was held with Remenschneider and Associates, Inc. to discuss the BMP proposed along Hurricane Creek, and coordinate any efforts that may provide opportunities for additional funding and planning for the site.



Parameter	Value
Channel 10-85 slope in feet per mile	13.6
Contributing drainage area in square miles	1.177
Region number	1008
Percent of area covered by water and wetland	0
Total Drainage area in square miles	1.177
Percent of area covered by urban land cover	30.2

Table 1. Parameters (obtained through USGS Indiana StreamStats)

The United States Geological Survey (USGS) Stream Stats software/website was utilized to determine the size of the contributing watershed of Roaring Run at the interception location. This website was used to utilize regression equations to determine the flow for various events at this location.

Public meetings were held on in December 2011 and March 2012, with the City Representatives, DLZ Engineers and residents within the project area. Conceptual routes were shown to the community and feedback was generated in order to finalize the study.

Existing Conditions

The overall drainage basin contributing to Roaring Run at the diversion point is approximately 1.2 square miles. The general slope of the basin is from north to south continuing southwest. The contributing flow to this area is for each storm event can be found in the table below.

Peak Flow Basin Characteristics			
Region number = 1008			
100% Region 4 Peak Flow (1.18 mi ²)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Contributing Drainage Area (square miles)	1.18	0.31	2444
Stream Slop 10 and 85 method (feet per mi)	13.6	2.7	48.7
Percent Urban (percent)	30.2	0	83.9

Table 2. Basin Characteristics

Peak Flow Streamflow Statistics					
Statistic	Flow (ft ³ /s)	Standard Error (percent)	Equivalent Years of Record	90-Percent Prediction Interval	
				Minimum	Maximum
PK10	277	23	7.7	154	496
PK25	350	23	11	230	532
PK50	404	22	13	265	647
PK100	459	22	15	299	705
PK200	511	23	17	330	793
PK500	581	24	18	369	915

Table 3. Peak Flow Statistics

The existing Roaring Run storm sewer is an approximate 3' x 6' corrugated elliptical metal pipe with an average slope of 0.0025 ft/foot. However, because the intent of this study is to alleviate downstream flooding directly related to Roaring Run's capacity the more relevant flow pertaining to the scope of this study would be the full flow capacity being conveyed underground within the Roaring Run pipe. That is because the upstream end of the Roaring Run pipe system will remain unchanged. This flow was calculated using Manning's equation and is approximately 98 cfs, or about 35% of the total 10-year peak flow.

The local drainage area bounded by the study area described above is approximately 20 acres. Site visits were conducted in order to determine drainage problem areas, and existing utility locations. Please refer to Appendix A for pictures of the existing study area. Existing storm sewer is located intermittently throughout the local study area. These sewers will be utilized whenever possible to assist with providing adequate drainage infrastructure throughout the area. Sanitary sewer is also located throughout the area. The majority of the sanitary sewers are located in alleys; however, crossings of the roadways may pose a potential problem with the proposed storm infrastructure. These issues will be evaluated in the Alternative Sections of the Study.

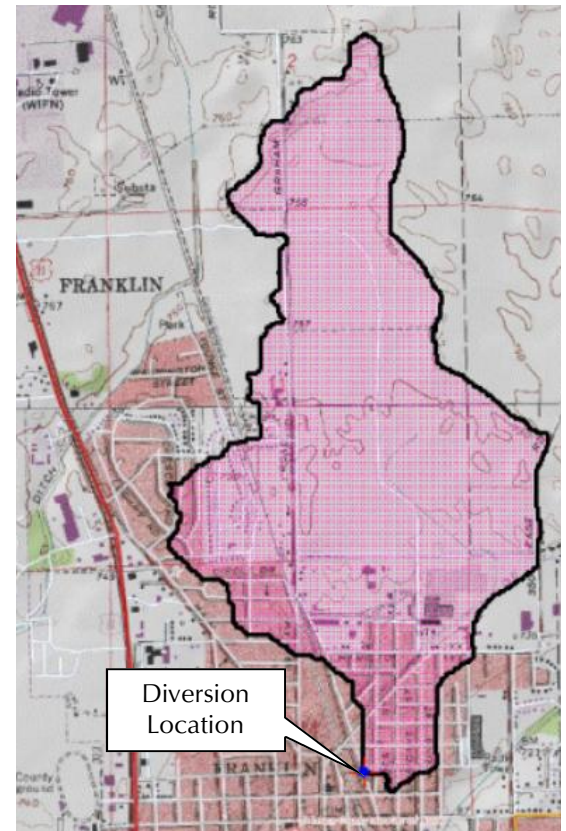


Figure 2 Overall Contributing Watershed Map

Existing Conditions

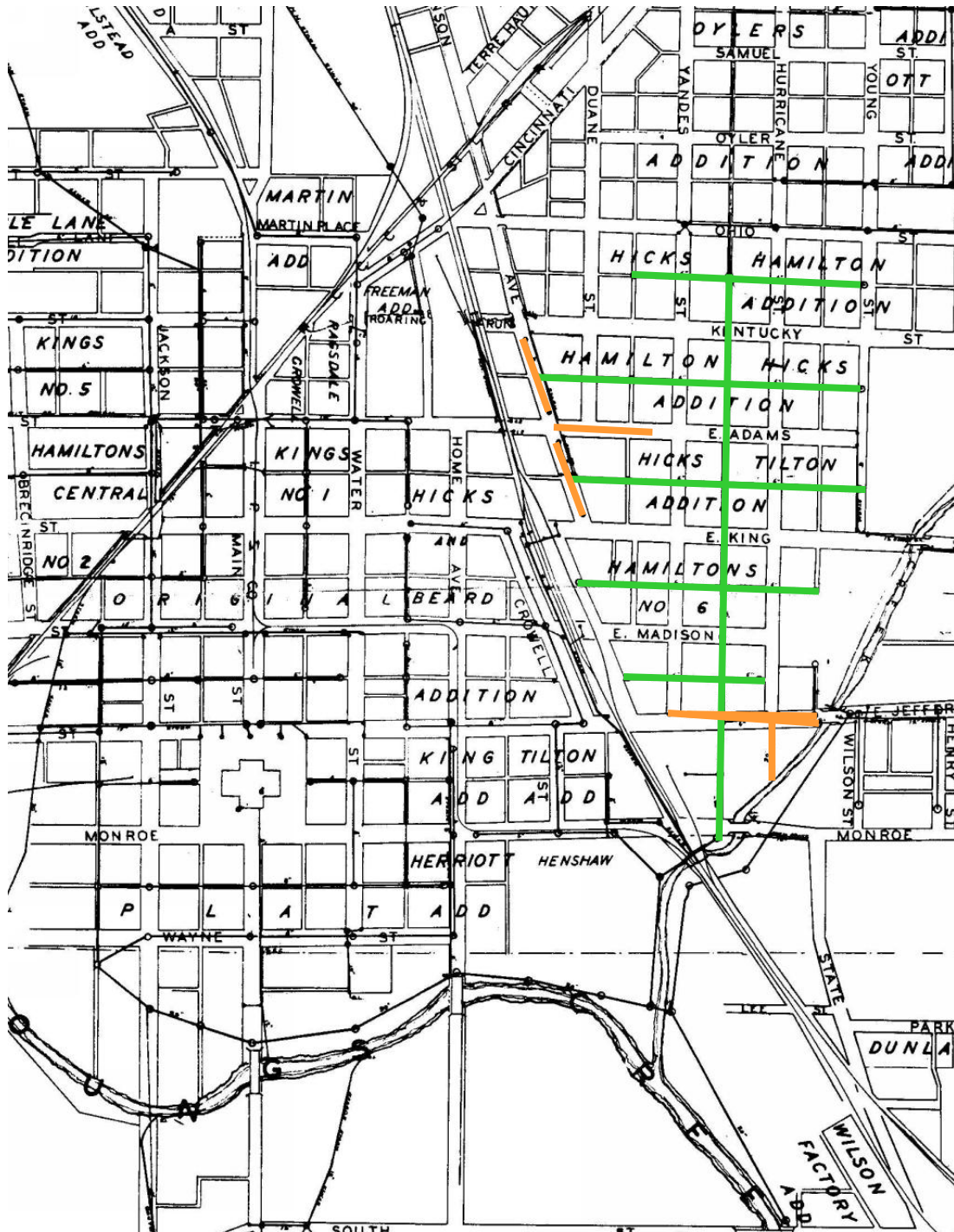


Figure 3. Existing Utilities (Map provided by Franklin Planning Dept.)



Options

Many options were investigated to determine an appropriate size for the proposed diversion. Please refer to Appendix C for detailed calculations. However, this report will focus on two options, a full flow and half flow diversion. Option 1 is the complete diversion of the full flow Roaring Run conveyance system, and Option 2 is the diversion of only half of the flow from the existing system. Both of these options propose diverting the water at the existing manhole located at the northeast intersection of Kentucky Street and Johnson Avenue. This diversion would be accomplished with a diversion structure utilizing a weir wall with the elevations of that wall varying depending on which option is chosen. It is recommended that the diversion also be sumped in order to redirect the low flow to the water quality BMP and alleviate strain on the existing system.

Option 1 involves the complete diversion of the full flow capacity of the existing Roaring Run sewer utilizing a 54-inch pipe set at approximately 0.003 feet/foot. This option reduces the impact on the existing line, and provides more capacity in larger events from the runoff from the localized areas currently draining to the existing pipe.

Option 2 involves the partial diversion accounting for half of the existing flow through the system. This can be accomplished with a 36-inch pipe at approximately 0.003 feet/foot slope. This option does not divert the entire flow, however it does provide for relief in the downstream area that has experienced flooding issues during previous events.

The table below shows diverted flow and pipe sizes for each solution.

These solutions were then evaluated to determine practical alternatives in order to implement these solutions.

	Proposed Pipe Size	Existing Full Flow	Diverted Flow	Percent Diverted
Option 1 (Full Flow)	54-inch	98 cfs	98 cfs*	100%*
Option 2 (Half Flow)	36-inch	98 cfs	40 cfs	40%

Table 4. Flow Summary of Diversion

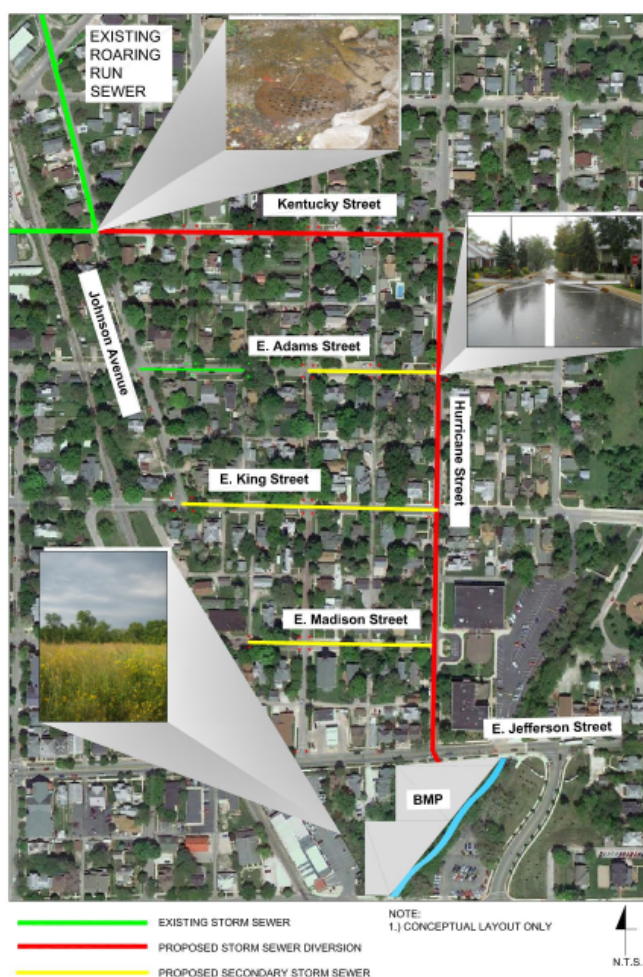
* actual capacity of the 54-inch pipe is greater than 98 cfs

Alternatives

Utilizing the information from the two options and the public meeting, alternative layouts were derived that provide the most feasible and practical alternatives that will divert water off of the existing Roaring Run system.

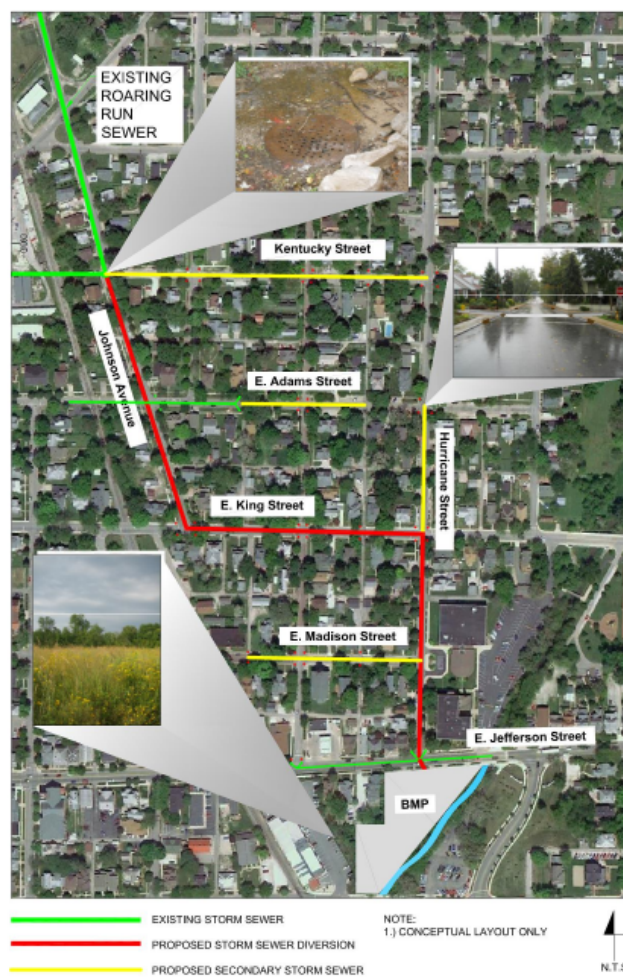
Alternative 1 proposes a diversion point at Kentucky Street and Johnson Avenue and heading east on Kentucky to Hurricane Street, then heading south on Hurricane through East Jefferson Street and into the BMP Basin on the vacant lots and ultimately into Hurricane Creek. See Appendix A for more detailed layout.

Alternative 2 proposes diversion point at Kentucky Street and Johnson Avenue and heading south on Johnson Avenue to East King Street, heading east on East King Street to Hurricane Street, then heading south on Hurricane through East Jefferson Street and into the BMP Basin on the vacant lots and ultimately into Hurricane Creek. See Appendix A for more detailed layout.



ALTERNATIVE 1

Figure 4. Conceptual Routing of Diversion



ALTERNATIVE 2

Figure 5. Conceptual Routing of Diversion

Alternatives

Alternative 1 and 2 both avoid being routed directly down Yandes Street to avoid the brick street and limestone curb. Alternative 2 is approximately 200-300 feet shorter than Alternative 1 providing the potential for cost savings. Alternative 2 also limits the amount of construction with respect to Alternative 1 on Hurricane Street, which appears to have more traffic flow in this area. Alternative 2 also appears from preliminary investigation to better avoid the sanitary sewer crossing conflicts that would be encountered in Alternative 1. With the diversion pipe being routed down King Street as proposed in Alternative 2, the north half of the localized area can be intercepted to lessen the drainage issues in the southern portion of the area and on East Jefferson Street.

The neighborhood area where the diversion project would be located was also analyzed to determine if there are any drainage issues that may be able to be solved either at the time of construction of the diversion pipe or be phased in at a later date. This area was visited during rain events, to determine where any issues may be located within the area. After visiting the site, it appears that most of the streets are able to drain to the intersections despite being relatively flat. Most of the streets have curbs with the main exception being Kentucky Street. Ponding and standing water appears to be concentrated at the intersections which have the potential to be areas of hydroplaning or ice buildup making stopping difficult. See Appendix E for pictures of the area. Adding inlets at these intersections will intercept runoff flowing down the streets and should limit the total amount of runoff reaching East Jefferson Street. Each alternative shown has a layout of the “localized/secondary” drainage improvements that can be implemented with the diversion project or can be phased in overtime.



Figure 6.



Figure 7.

Best Management Practice Basin

The Best Management Practice (BMP) Basin proposed is a wetland type basin with a forebay to capture pollutants, particularly suspended solids. This type of BMP fits in with the natural feature along Hurricane Creek and is a suitable water quality control for urban areas. This type of BMP also appears to fit into the City of Franklin's Gateways, Greenways, and Redevelopment Study plan.

In order to quantify the effectiveness of the water quality basin, the Indiana Storm Water Quality Manual was utilized to calculate a water quality volume. The goal should be to maximize the amount of runoff that can be treated. This should be completed during a more detailed design. However, using the drainage area for the neighborhood that the diversion project will be constructed through, approximately 20-acres, a minimum water quality volume of 0.98 acre-feet should be met.

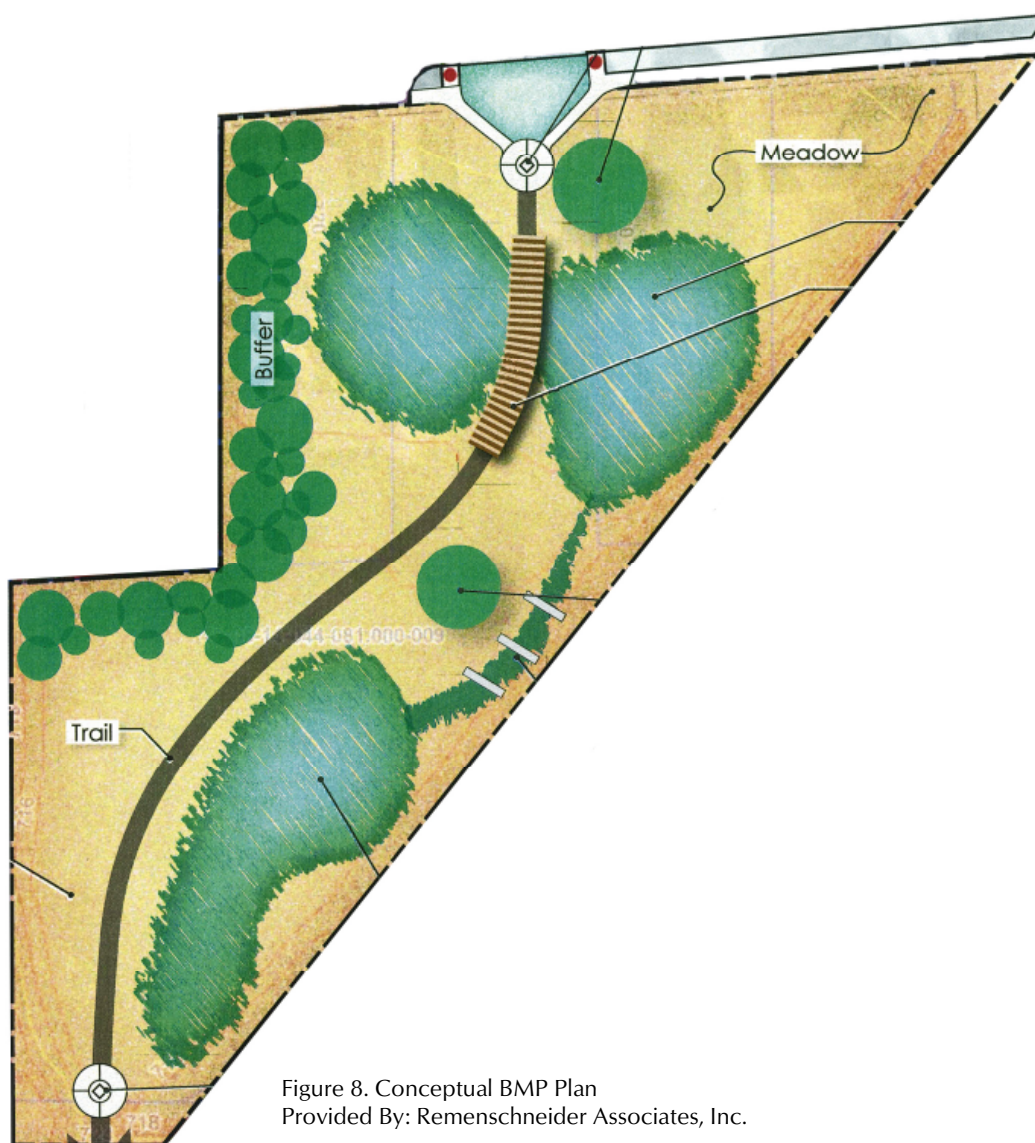


Figure 8. Conceptual BMP Plan
Provided By: Remenschneider Associates, Inc.

Project Costs

Project costs were derived from the Solutions and Alternatives presented previously in this report. The project cost estimates are provided as a reference. A 20 percent contingency has been added to each scenario to account for any unforeseen costs that were not discovered at this level of investigation.

ENGINEER'S OPINION OF PROBABLE COST ROARING RUN DIVERSION PROJECT FRANKLIN, INDIANA SUMMARY

	ALTERNATIVE 1		ALTERNATIVE 2	
	OPTION 1 (FULL DIVERSION)	OPTION 2 (HALF DIVERSION)	OPTION 1 (FULL DIVERSION)	OPTION 2 (HALF DIVERSION)
DIVERSION PIPE	\$ 825,125.00	\$ 633,450.00	\$ 758,800.00	\$ 586,000.00
SECONDARY/ LOCALIZED IMPROVEMENTS	\$ 415,825.00	\$ 415,825.00	\$ 424,025.00	\$ 424,025.00
WETLAND	\$ 194,250.00	\$ 194,250.00	\$ 194,250.00	\$ 194,250.00
CONTINGENCY 20%	\$ 287,040.00	\$ 248,705.00	\$ 275,415.00	\$ 240,855.00
TOTAL	\$ 1,722,240.00	\$ 1,492,230.00	\$ 1,652,490.00	\$ 1,445,130.00

1. Prices do not include engineering or inspection services.

Recommended Option and Alternative Estimate

The approximate cost of the recommended alternative and option (including the secondary drainage structures only along the diversion route) is approximately \$750,000. If additional funds are available, the wetland BMP should be incorporated bringing the total to approximately \$984,100.

Permitting and Agency Coordination

Various permits will need to be secured before construction of this project can begin. The permits identified are not intended to be an exhaustive list, but a guide as the planning of this project moves forward. Various state and federal agencies may need to be consulted (Army Corps of Engineers (ACOE), Indiana Department of Environmental Management (IDEM), and Indiana Department of Natural Resources (INDR). The following permits have been identified at this stage of the planning as being required or having a potential to be required:

- 327 IAC 15-5 (Rule 5)
- IDEM IAC 16-5 (Rules)
- IDNR Construction in a Floodway Permit
- Section 404 and Section 401 Permits
- Local City of Franklin and/or Johnson County Permits
- INDOT Permits (East Jefferson Street)

Conclusions and Recommendations

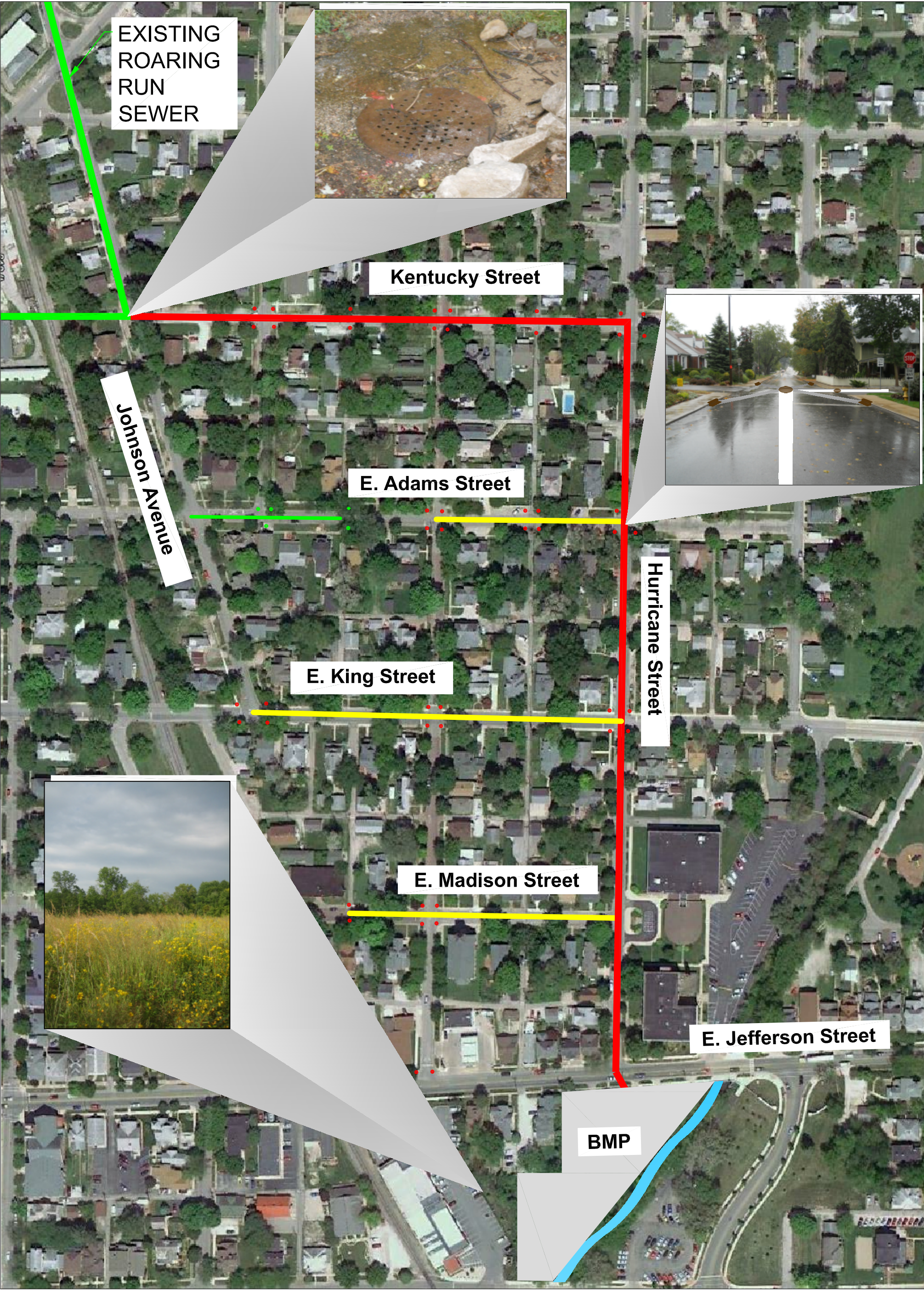
All of the options and alternatives presented in this report appear viable based on the level of study discussed in the report. However, it is recommended that the city pursue Option 2 with Alternative 2. This will alleviate the stress on the existing Roaring Run system by reducing flows by over 40%. Inlets at the intersections along the diversion in east King Street should be incorporated in order to gather runoff from the north end of the study area. This cutoff of the drainage at King Street will substantially lessen flows reaching Jefferson Street. It is not recommended at this time that the secondary/localized improvements be completed as the drainage issues in the intersections above (north of) King Street appear minor, however, these improvements could be phased in over time and conditions and funding allows.

If funds are available, the city should also consider construction of the wetland BMP to address water quality within the area, to enhance the natural area around Hurricane Creek and to provide a recreational/educational area for the citizens of Franklin.

Appendix A

Alternatives

Alternative 1



- EXISTING STORM SEWER
- PROPOSED STORM SEWER DIVERSION
- PROPOSED SECONDARY STORM SEWER

NOTE:
1.) CONCEPTUAL LAYOUT ONLY

N.T.S.

ALTERNATIVE 1

Alternative 2



Appendix B

Project Cost Breakdown

Appendix B

**ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA
FULL DIVERSION OPTION - ALTERNATIVE 1**

ITEM NO.	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing Right-Of-Way	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$100,000.00	\$ 100,000.00
3	Maintenance of Traffic	LS	1	\$20,000.00	\$ 20,000.00
	SubTotal				\$ 125,000.00
4	Erosion Control	LS	1	\$30,000.00	\$ 30,000.00
5	54-inch Pipe, Type 2 w/granular backfill	LFT	2,400	\$180.00	\$ 432,000.00
6	Manhole, E4	EACH	8	\$6,000.00	\$ 48,000.00
7	Diversion Structure	EACH	1	\$10,000.00	\$ 10,000.00
8	54-inch End Section w/ Rip-Rap	EACH	1	\$6,000.00	\$ 6,000.00
	SubTotal				\$ 526,000.00
9	Pavement Removal	SY	5,500	\$8.00	\$ 44,000.00
10	HMA Surface, Type B	TON	440	\$65.00	\$ 28,600.00
11	HMA Intermediate, Type B	TON	985	\$65.00	\$ 64,025.00
12	Aggregate Base No. 53	TON	2,500	\$15.00	\$ 37,500.00
	SubTotal				\$ 174,125.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 825,125.00
20% CONTINGENCY					\$ 165,025.00
TOTAL ESTIMATED PROJECT COST =					\$ 990,150.00

Appendix B

**ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA
FULL DIVERSION OPTION - ALTERNATIVE 2**

ITEM NO.	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing Right-Of-Way	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$100,000.00	\$ 100,000.00
3	Maintenance of Traffic	LS	1	\$20,000.00	\$ 20,000.00
	SubTotal				\$ 125,000.00
4	Erosion Control	LS	1	\$30,000.00	\$ 30,000.00
5	54-inch Pipe, Type 2 w/granular backfill	LFT	2,100	\$180.00	\$ 378,000.00
6	Manhole, E4	EACH	7	\$6,000.00	\$ 42,000.00
7	Diversion Structure	EACH	1	\$10,000.00	\$ 10,000.00
8	54-inch End Section w/ Rip-Rap	EACH	1	\$6,000.00	\$ 6,000.00
	SubTotal				\$ 466,000.00
9	Pavement Removal	SY	5,000	\$8.00	\$ 40,000.00
10	HMA Surface, Type B	TON	420	\$65.00	\$ 27,300.00
11	HMA Intermediate, Type B	TON	975	\$65.00	\$ 63,375.00
12	Aggregate Base No. 53	TON	2,475	\$15.00	\$ 37,125.00
	SubTotal				\$ 167,800.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 758,800.00
20% CONTINGENCY					\$ 151,760.00
TOTAL ESTIMATED PROJECT COST =					\$ 910,560.00

Appendix B

**ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA
HALF DIVERSION OPTION - ALTERNATIVE 1**

ITEM NO.	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing Right-Of-Way	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$100,000.00	\$ 100,000.00
3	Maintenance of Traffic	LS	1	\$20,000.00	\$ 20,000.00
	SubTotal				\$ 125,000.00
4	Erosion Control	LS	1	\$20,000.00	\$ 20,000.00
5	36-inch Pipe, Type 2 w/granular backfill	LFT	2,400	\$140.00	\$ 336,000.00
6	Manhole, D4	EACH	8	\$3,000.00	\$ 24,000.00
7	Diversion Structure	EACH	1	\$10,000.00	\$ 10,000.00
8	36-inch End Section w/ Rip-Rap	EACH	1	\$4,000.00	\$ 4,000.00
	SubTotal				\$ 394,000.00
9	Pavement Removal	SY	3,400	\$8.00	\$ 27,200.00
10	HMA Surface, Type B	TON	290	\$65.00	\$ 18,850.00
11	HMA Intermediate, Type B	TON	660	\$65.00	\$ 42,900.00
12	Aggregate Base No. 53	TON	1,700	\$15.00	\$ 25,500.00
	SubTotal				\$ 114,450.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 633,450.00
20% CONTINGENCY					\$ 126,690.00
TOTAL ESTIMATED PROJECT COST =					\$ 760,140.00

Appendix B

**ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA
HALF DIVERSION OPTION - ALTERNATIVE 2**

ITEM NO.	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing Right-Of-Way	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$100,000.00	\$ 100,000.00
3	Maintenance of Traffic	LS	1	\$20,000.00	\$ 20,000.00
	SubTotal				\$ 125,000.00
4	Erosion Control	LS	1	\$20,000.00	\$ 20,000.00
5	36-inch Pipe, Type 2 w/granular backfill	LFT	2,100	\$140.00	\$ 294,000.00
6	Manhole, D4	EACH	7	\$3,000.00	\$ 21,000.00
7	Diversion Structure	EACH	1	\$10,000.00	\$ 10,000.00
8	36-inch End Section w/ Rip-Rap	EACH	1	\$4,000.00	\$ 4,000.00
	SubTotal				\$ 349,000.00
9	Pavement Removal	SY	3,350	\$8.00	\$ 26,800.00
10	HMA Surface, Type B	TON	280	\$65.00	\$ 18,200.00
11	HMA Intermediate, Type B	TON	650	\$65.00	\$ 42,250.00
12	Aggregate Base No. 53	TON	1,650	\$15.00	\$ 24,750.00
	SubTotal				\$ 112,000.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 586,000.00
20% CONTINGENCY					\$ 117,200.00
TOTAL ESTIMATED PROJECT COST =					\$ 703,200.00

Appendix B

**ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA
SECONDARY DRAINAGE IMPROVEMENTS - ALTERNATIVE 1**

ITEM NO.	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing Right-Of-Way	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$40,000.00	\$ 40,000.00
3	Maintenance of Traffic	LS	1	\$10,000.00	\$ 10,000.00
	SubTotal				\$ 55,000.00
4	Erosion Control	LS	1	\$15,000.00	\$ 15,000.00
5	12-inch Pipe, Type 2 w/granualr backfill	LFT	2,100	\$40.00	\$ 84,000.00
6	15-inch Pipe, Type 3 w/granualr backfill	LFT	900	\$45.00	\$ 40,500.00
7	18-inch Pipe, Type 4 w/granualr backfill	LFT	450	\$50.00	\$ 22,500.00
8	Inlet, C4	EACH	65	\$1,000.00	\$ 65,000.00
9	Manhole, C4	EACH	12	\$2,500.00	\$ 30,000.00
	SubTotal				\$ 227,000.00
9	Pavement Removal	SY	4,000	\$8.00	\$ 32,000.00
10	HMA Surface, Type B	TON	330	\$65.00	\$ 21,450.00
11	HMA Intermediate, Type B	TON	775	\$65.00	\$ 50,375.00
12	Aggregate Base No. 53	TON	2,000	\$15.00	\$ 30,000.00
	SubTotal				\$ 133,825.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 415,825.00
20% CONTINGENCY					\$ 83,165.00
TOTAL ESTIMATED PROJECT COST =					\$ 498,990.00

Appendix B

**ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA
SECONDARY DRAINAGE IMPROVEMENTS - ALTERNATIVE 2**

ITEM NO.	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing Right-Of-Way	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$40,000.00	\$ 40,000.00
3	Maintenance of Traffic	LS	1	\$10,000.00	\$ 10,000.00
	SubTotal				\$ 55,000.00
4	Erosion Control	LS	1	\$15,000.00	\$ 15,000.00
5	12-inch Pipe, Type 2 w/granular backfill	LFT	2,200	\$40.00	\$ 88,000.00
6	15-inch Pipe, Type 3 w/granular backfill	LFT	950	\$45.00	\$ 42,750.00
7	18-inch Pipe, Type 4 w/granular backfill	LFT	460	\$50.00	\$ 23,000.00
8	Inlet, C4	EACH	65	\$1,000.00	\$ 65,000.00
9	Manhole, C4	EACH	15	\$2,500.00	\$ 37,500.00
	SubTotal				\$ 233,750.00
9	Pavement Removal	SY	4,100	\$8.00	\$ 32,800.00
10	HMA Surface, Type B	TON	335	\$65.00	\$ 21,775.00
11	HMA Intermediate, Type B	TON	780	\$65.00	\$ 50,700.00
12	Aggregate Base No. 53	TON	2,000	\$15.00	\$ 30,000.00
	SubTotal				\$ 135,275.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 424,025.00
20% CONTINGENCY					\$ 84,805.00
TOTAL ESTIMATED PROJECT COST =					\$ 508,830.00

Appendix B

**ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA
BMP - WETLAND IMPROVEMENTS**

ITEM NO.	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$20,000.00	\$ 20,000.00
3	Maintenance of Traffic	LS	1	\$2,000.00	\$ 2,000.00
	SubTotal				\$ 27,000.00
4	Common Excavation	CY	5,000	\$15.00	\$ 75,000.00
5	Wetland Plantings	SYS	2,500	\$15.00	\$ 37,500.00
6	Erosion Control	LS	1	\$20,000.00	\$ 20,000.00
7	Outlet Control Structure	EACH	1	\$8,000.00	\$ 8,000.00
8	18-inch Pipe, Type 2	LFT	75	\$50.00	\$ 3,750.00
9	Flap Gate	EACH	1	\$8,000.00	\$ 8,000.00
10	18-inch End Section w/ Rip-Rap	EACH	2	\$2,500.00	\$ 5,000.00
11	Dewatering	LS	1	\$10,000.00	\$ 10,000.00
	SubTotal				\$ 167,250.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 194,250.00
20% CONTINGENCY					\$ 38,850.00
TOTAL ESTIMATED PROJECT COST =					\$ 233,100.00

Appendix B

ENGINEER'S OPINION OF PROBABLE COST
ROARING RUN DIVERSION PROJECT
FRANKLIN, INDIANA

RECOMMENDED OPTION
HALF DIVERSION OPTION - ALTERNATIVE 2
W/ INLETS ON DIVERSION ROUTE

ITEM NO.	DESCRIPTION	UNITS	ESTI- MATED QUANTITY	UNIT PRICE	AMOUNT
1	Clearing Right-Of-Way	LS	1	\$5,000.00	\$ 5,000.00
2	Mobilization and Demobilization	LS	1	\$100,000.00	\$ 100,000.00
3	Maintenance of Traffic	LS	1	\$20,000.00	\$ 20,000.00
	SubTotal				\$ 125,000.00
4	Erosion Control	LS	1	\$20,000.00	\$ 20,000.00
5	36-inch Pipe, Type 2 w/ granular backfill	LFT	2,100	\$140.00	\$ 294,000.00
6	Manhole, D4	EACH	7	\$3,000.00	\$ 21,000.00
7	Diversion Structure	EACH	1	\$10,000.00	\$ 10,000.00
8	36-inch End Section w/ Rip- Rap	EACH	1	\$4,000.00	\$ 4,000.00
9	12-inch Pipe, Type 2 w/ granular backfill	LFT	360	\$40.00	\$ 14,400.00
10	Inlet, C4	EACH	18	\$1,000.00	\$ 18,000.00
	SubTotal				\$ 381,400.00
11	Pavement Removal	SY	3,700	\$8.00	\$ 29,600.00
12	HMA Surface, Type B	TON	290	\$65.00	\$ 18,850.00
13	HMA Intermediate, Type B	TON	660	\$65.00	\$ 42,900.00
14	Aggregate Base No. 53	TON	1,670	\$15.00	\$ 25,050.00
	SubTotal				\$ 116,400.00
SUBTOTAL ESTIMATED PROJECT COST					\$ 622,800.00
20% CONTINGENCY					\$ 124,560.00
TOTAL ESTIMATED PROJECT COST =					\$ 747,360.00

Appendix C

Diversion Calculations

Appendix C

Capacity of existing 3'x6' elliptical pipe

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 2.25 \text{ ft} - 27 \text{ in}$

$A = 15.90333$

$w = 8 \text{ ft} - 54 \text{ dia}$

$S = 14.1363 \text{ ft} - 15.90 \text{ X-area (ft}^2\text{)}$

$n = 0.0025$

$n = 0.013$

$R = 1.125$

$V = 6.182209$

$V = 7$

$Q = 98.32 \text{ cfs}$

Q Target=

Initial Diversion Pipe Alt 1.

(54" @ 0.3% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 2.25 \text{ ft} - 27 \text{ in}$

$A = 15.90334$

$w = 54 \text{ dia}$

$S = 14.1363$

$S = 15.90 \text{ X-area (ft}^2\text{)}$

$n = 0.003$

$n = 0.012$

$R = 1.125$

$V = 7.336627$

$Q = 116.68 \text{ cfs}$

Q Target=

Initial Diversion Pipe Alt. 2

(48" @ 0.3% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 2 \text{ ft} - 24 \text{ in}$

$A = 12.5656$

$w = 48 \text{ dia}$

$S = 12.5656$

$S = 12.57 \text{ X-area (ft}^2\text{)}$

$n = 0.003$

$n = 0.012$

$R = 1$

$V = 6.782631$

$Q = 85.23 \text{ cfs}$

Q Target=

Initial Diversion Pipe Alt. 3

(42" @ 0.3% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 1.75 \text{ ft} - 21 \text{ in}$

$A = 9.620538$

$w = 42 \text{ dia}$

$S = 10.9949$

$S = 9.62 \text{ X-area (ft}^2\text{)}$

$n = 0.003$

$n = 0.012$

$R = 0.875$

$V = 6.204985$

$Q = 59.70 \text{ cfs}$

Q Target=

Initial Diversion Pipe Alt. 4

(36" @ 0.3% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 1.5 \text{ ft} - 18 \text{ in}$

$A = 7.06815$

$w = 36 \text{ dia}$

$S = 9.4242$

$S = 7.07 \text{ X-area (ft}^2\text{)}$

$n = 0.003$

$n = 0.012$

$R = 0.75$

$V = 5.599045$

$V = 9$

$Q = 39.57 \text{ cfs}$

Q Target=

Secondary Diversion Pipe Alt. 1

(54" @ 0.4% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 2.25 \text{ ft} - 27 \text{ in}$

$A = 15.90334$

$w = 54 \text{ dia}$

$S = 14.1363$

$S = 15.90 \text{ X-area (ft}^2\text{)}$

$n = 0.004$

$n = 0.012$

$R = 1.125$

$V = 8.471608$

$Q = 134.73 \text{ cfs}$

Q Target=

Appendix C

Secondary Diversion Pipe Alt. 2 (48" @ 0.4% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 2\text{ft} - 24\text{in}$
 $A = 12.5656 \quad 48\text{dia}$
 X-area
 $w = 12.5656 \quad 12.57\text{ (ft}^2\text{)}$
 $S = 0.004$
 $n = 0.012$
 $R = 1$
 $V = 7.831907$
 $V = 7$

$Q = 98.413\text{ cfs}$
 Q Target=

Secondary Diversion Pipe Alt. 3 (42" @ 0.4% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 1.75\text{ft} - 21\text{in}$
 $A = 9.620538 \quad 42\text{dia}$
 X-area
 $w = 10.9949 \quad 9.62\text{ X-area (ft}^2\text{)}$
 $S = 0.004$
 $n = 0.012$
 $R = 0.875$
 $V = 7.1649$

$Q = 68.93\text{ cfs}$
 Q Target=

Secondary Diversion Pipe Alt. 4 (36" @ 0.4% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 1.5\text{ft} - 18\text{in}$
 $A = 7.06815 \quad 36\text{dia}$
 X-area
 $w = 9.4242 \quad 7.07\text{ (ft}^2\text{)}$
 $S = 0.004$
 $n = 0.012$
 $R = 0.75$
 $V = 6.465221$
 $V = 3$

$Q = 45.70\text{ cfs}$
 Q Target=

Secondary Diversion Pipe Alt. 5 (54" @ 0.5% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 2.25\text{ft} - 27\text{in}$
 $A = 15.90334 \quad 54\text{dia}$
 X-area
 $w = 14.1363 \quad 15.90\text{ X-area (ft}^2\text{)}$
 $S = 0.005$
 $n = 0.012$
 $R = 1.125$
 $V = 9.471545$

$Q = 150.63\text{ cfs}$
 Q Target=

Secondary Diversion Pipe Alt. 6 (48" @ 0.5% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 2\text{ft} - 24\text{in}$
 $A = 12.5656 \quad 48\text{dia}$
 X-area
 $w = 12.5656 \quad 12.57\text{ (ft}^2\text{)}$
 $S = 0.005$
 $n = 0.012$
 $R = 1$
 $V = 8.756339$

$Q = 110.03\text{ cfs}$
 Q Target=

Secondary Diversion Pipe Alt. 7 (42" @ 0.5% slope)

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

where $R = A/w$

$r = 1.75\text{ft} - 21\text{in}$
 $A = 9.620538 \quad 42\text{dia}$
 X-area
 $w = 10.9949 \quad 9.62\text{ X-area (ft}^2\text{)}$
 $S = 0.005$
 $n = 0.012$
 $R = 0.875$
 $V = 8.010602$

$Q = 77.07\text{ cfs}$
 Q Target=

Appendix C

Secondary Diversion Pipe Alt. 8

(36" @ 0.5% slope)

$$V = 1.486/n \cdot R^{2/3} \cdot S^{1/2}$$

where $R = A/w$

$$r = 1.5 \text{ ft} - 18 \text{ in}$$

$$A = 7.06815 \quad 36 \text{ dia}$$

$$w = 9.4242 \quad 7.07 \text{ X-area}$$

$$S = 0.005$$

$$n = 0.012$$

$$R = 0.75$$

$$V = 7.2283372$$

$$Q = 51.09 \text{ cfs}$$

Q Target=

Appendix D

Water Quality Calculations

Appendix D

$$R_v = 0.05 + 0.009(I)$$

$$A = 20 \text{ acres}$$

$$WQ_v = \frac{(P)(R_v)(A)}{12}$$

$$P = 1 \text{ inch}$$

$$= \frac{(1)(.059)(20)}{12}$$

$$I = \text{percent impervious cover} \\ (\text{assume } 60\%)$$

$$= 0.98 \text{ ac ft}$$

Notes:

1.) Equation is from the Indiana Water Quality Manual.

Appendix E

Study Area Photographs

Appendix E



Appendix E



Appendix E



Appendix E



Appendix E

