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Town of Mooresville Drainage Study

Morgan County, Indiana

July 2016

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Prepared For:
Town of Mooresville

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Scope of Services

1. Develop a stormwater runoff model (100-Year and 10-Year Critical Duration Series) to simulate existing runoff and flooding potential along 2.9 mile study reach. Estimate possible increases in runoff that may be caused by future development.

2. Define existing and potential future flooding problems in the watershed.

3. Develop a set of solutions to the existing and potential future flooding problems under the existing and future development conditions. These solutions may include underground detention, two stage ditching, cutoff channels and / or rerouting runoff to other drainage sheds.

4. Walk study reach with Town of Mooresville staff. Banning Engineering will interview staff to determine areas where significant problems have been documented.

5. Topographic survey along study reach. Includes pipe crossing details and (1) cross-section between pipe crossings.

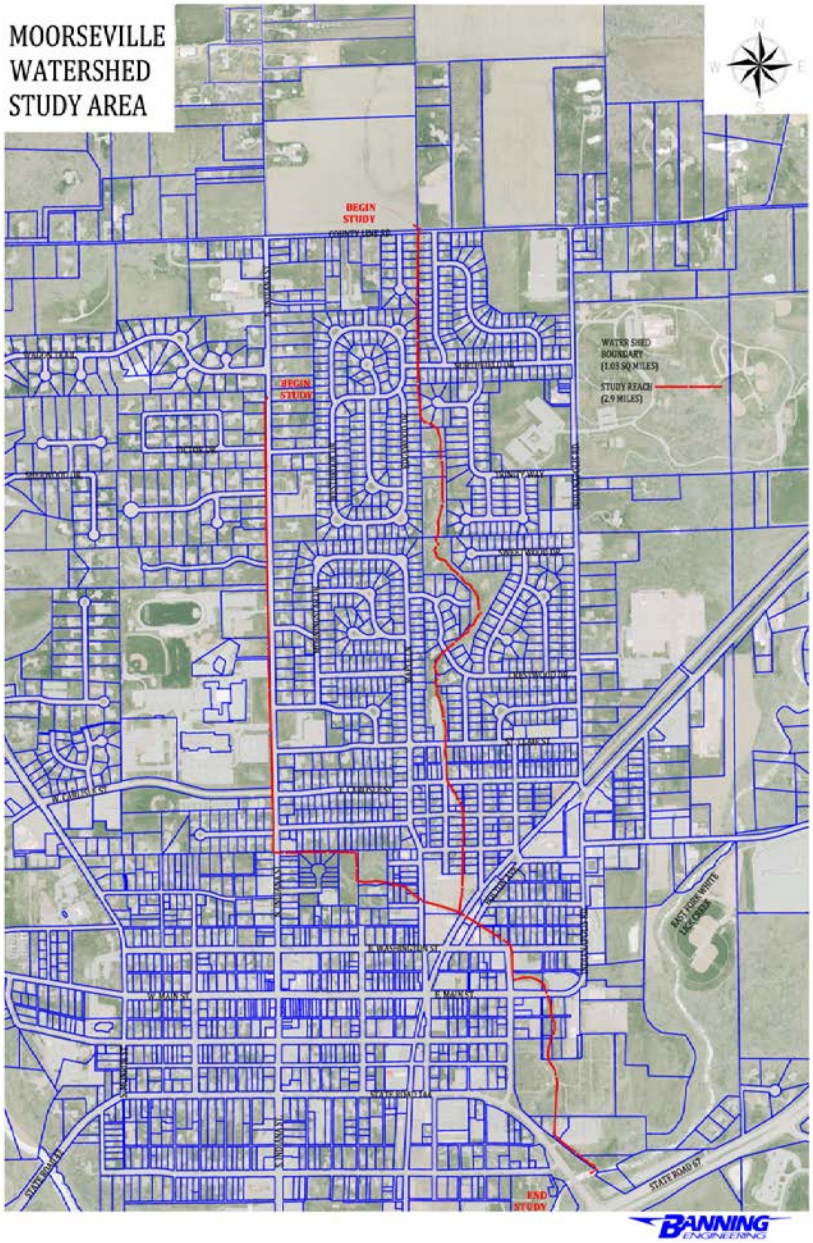
6. Develop preliminary flood plain (100-year) along study reach for planning purposes only.

7. Identify potential financing mechanisms for implementation of needed improvements.

Executive Summary

Introduction

The following report describes the findings of Banning Engineering, P.C., for the Drainage Study of the Town of Mooresville watershed along Goose Creek to East Fork of White Lick Creek. The watershed covers roughly 1 square mile (626 acres), with 86 acres in Hendricks County and 540 acres in Morgan County. The study reach is shown below.



The project was broken into five areas. Each area was analyzed in detail. Potential projects to alleviate flooding issues as discovered through the course of the study were advanced.

Data Collection

Overall topographic information was downloaded from the State of Indiana. The 1 foot contours from 2011 were used to delineate drainage basins and fill in elevation data as appropriate. In areas of specific focus, Banning Engineering surveyors gathered cross-sections, structure finished floor elevations, culvert and bridge details, and roadway profiles. Field Reconnaissance was completed throughout the entire reach. Condition of the existing infrastructure was noted as needed. The field reconnaissance was used to provide assumptions for the hydraulic modeling and confirm watershed delineations.

Additional information was compiled from the July 2015 flood event within the Town. Information from this storm event was used to calibrate the hydraulic modeling and confirm focus areas within the study reach.

Public Input

Public input was obtained using three primary methods. First, information from news coverage of the July 2015 flood event was reviewed for applicable data. Second, Town of Mooresville staff gave Banning Engineering staff a tour of the watershed and highlighted problem areas. Lastly, property owners adjacent to the study reach were sent a letter alerting them of the drainage study and to contact Banning Engineering staff with any questions or comments.

This method provided a definitive area of predominant public input for four of the five areas of study. Area A had a focus area north of Washington Street, west to Maple Land and North to Bridge Street. Area B had a public input focus along Circle Drive. Area C had primary public input along the northern part of the open ditch along Indiana Street. Area D had no focus area for public input. Area E had a focus area at the intersection of Northfield and Edgewood Drives.

Reviewing the public and staff comments found that Areas A and E appear to experience the most significant flooding issues. Area B has some flooding issues as well, but they do not appear to be as severe. Areas C and D do not appear to have significant flooding issues involving residents at this time.

Hydrologic and Hydraulic Analysis

A base hydrologic and hydraulic model was made using all the data collected. A critical storm duration series was used to evaluate both the 10-year and 100-year events. Huff rainfall distributions were used as described within the 2004 Mooresville Stormwater Design Manual. The model was calibrated using estimated rainfall depths from the July 2015 event.

The model was then used to delineate a 100-year and 10-year floodplain. The analysis showed flooding of 29 structures in a 100-year event and 5 structures in a 10-year event. Area A showed flooding of 16 structures in a 100-year event. Area B showed 2 structures being

flooded. Areas C and D showed no structures flooded in a 100-year event. Area E showed 10 structures flooded in a 100-year event. The modeling appears to collaborate the public input from the study.

Flooding within Area A appears to be from lack of capacity due to siltation or the small size of the ditch as well as the close proximity of structures to the ditch. Flooding within Area B is primarily due to the proximity of structures to the ditch. Area E experiences flooding for two primary reasons. First, the pipe under Northfield Drive is undersized requiring water to overflow from the ditch to the intersection of Northfield and Edgewood Drives. Second, the pipes at the intersection of Northfield and Edgewood Drives do not have capacity to discharge the local watershed.

Potential Solution Set

Six different potential solution sets were advanced. The overall watershed was reviewed first, and then the five areas within the watershed were all looked at for potential projects. Several additional projects were reviewed, but not included in the report. The primary reason for not including the projects was lack of benefit or significant damages downstream.

The overall watershed projects were programmatic in nature. There was no project found that could solve all the flooding issues along the study reach. The projects forwarded for the overall watershed include: using the 100-year floodplain mapping for future planning and building requirements, a property acquisition plan, and ordinance updates.

Area A had four projects advanced. The beneficial projects forwarded are A-1 and A-2. These projects include cleaning and dipping the ditch as well as removing unused private crossings. These two projects appear to have a significant benefit in the more frequent 10-year storm events. There is some benefit noted during a 100-year storm as well.

Area B had two projects advanced, but only project B-1 provided benefit. Project B-1 is the construction of a potential offline detention basin along the ditch downstream of Indiana Street. The benefit for this project occurs downstream of its location into Area A. There is no benefit upstream of Indiana Street

Area C had two projects advanced. Both project C-1 and project C-2 appear to have benefit if designed and constructed correctly. Project C-1 includes piping of the Indiana Street ditch and installation of offline dry detention. This project has benefit downstream through Indiana Street. Project C-2 has potentially significant benefit. Project C-2 includes working with Mooresville School Corporation to increase inlet capacity and detention on school property in an effort to eliminate a watershed jump along Carlisle Street.

Area D had one project advanced. The two-staged ditch (Project B-1) did not appear to provide benefit.

Area E had eight projects advanced. Of the eight projects three included some variation of purchasing homes (Projects E-5, E-6 & E-7). Project E-8 (Drainage Impact Area) has already begun implementation. Project E-1 was reviewed, but it was determined that increasing capacity through Northfield Drive had damages downstream that could not be offset. Projects E-2 and E-3 are smaller projects will smaller benefit (10-year storm or less). The projects include cleaning out of the ditch just downstream of Northfield Drive and providing additional inlets to help discharge localized flow from the Northfield and Edgewood Drive intersection.

The only project that fully addresses the flooding issues within Area E is Project E-4. This project includes construction of a regional detention basin upstream of County Line Road in Hendricks County, and additional pipes to help discharge the intersection of Northfield and Edgewood Drives. Benefits for Project E-4 can be documented downstream to Washington Street.

Potentially beneficial Non-Programmatic Project Summaries:

- Project A-1
  - Clean and Dip Ditch within Area A
    - Phase 1 Clean and dip ditch from Washington Street to Bridge Street and Maple Lane
    - Phase 2 Clean and dip ditch from Washington Street downstream to East Fork of White Lick Creek
  - Land Acquisition (multiple property easements or right of entries required)
  - Project Cost Opinion
    - Phase 1 $63,800
    - Phase 2 $52,500
  - Primary Benefit – Area A
    - 100-year elevations reduced on 16 structures
  - Secondary Benefit – Downstream portions of Area B
    - 100-year elevations reduced on 2 structures
- Project A-2
  - Remove unused private crossings
  - Land Acquisition (one easement or right of entry required)
  - Project Cost Opinion $5,000
  - Primary Benefit – Area A
    - 10-Year elevations reduced on 2 structures

- Project B-1
  - Green Space / Offline Detention within open space in Area B
  - Land Acquisition 3.75 Acres +/-
  - Project Cost Opinion $440,000
  - Primary Benefit – Downstream portions of Area B
    - 1 structure removed from 100-year floodplain
    - 100-year elevation reduced on 1 structure
  - Secondary Benefit – Upstream portion of Area A
    - 100-year elevations reduced on 2 structures
- Project C-1
  - Piping of Indiana Street Ditch with Offline Detention
  - Land Acquisition 3 Acres +/-
  - Project Cost Opinion $750,000
  - Primary Benefit – Downstream portions of Area C
  - Secondary Benefit – Upstream portions of Area B
    - 100-year elevation reduced on 1 structure
- Project C-2
  - Work with School Corporation to increase detention and inlet capacity on school property
  - Land Acquisition – none
  - Project Cost Opinion – Not determined
  - Primary Benefit – School Corporation property and Carlisle Street
  - Secondary Benefit – Circle Drive within Area B
- Project E-2
  - Additional inlets at Edgewood and Northfield Drives
  - Land Acquisition – none
  - Project Cost Opinion - $35,000
  - Primary Benefit – Intersection of Northfield and Edgewood Drives
    - 10-Year elevations reduced for 6 structures
- Project E-3
  - Clean ditch downstream of Northfield Drive
  - Land Acquisition – right of entry or easement required (not platted)
  - Project Cost Opinion - $5,000
  - Primary Benefit – Area E, but only in lower frequency events (not 100-year)
- Project E-4
  - Regional detention upstream of Hendricks County Line Road and increase pipe capacity at Northfield and Edgewood Drives
  - Land Acquisition – 12 Acres +/-
  - Project Cost Opinion - $1,000,000
  - Primary Benefit – Area E
    - 9 structures removed from 100-year floodplain
  - Secondary Benefit – Area D & Area A
    - 100-year elevations reduced on 13 structures

- Project E-5
  - Purchase 3 properties in overflow area from open ditch
  - Land Acquisition – 3 properties
  - Project Cost Opinion - $270,000
  - Primary Benefit – No reduction in flood elevations
    - 3 structures removed from 100-year floodplain
- Project E-6
  - Purchase 9 properties in 100-year flood area at Northfield and Edgewood Drives
  - Land Acquisition – 9 properties
  - Project Cost Opinion - $900,000
  - Primary Benefit – No reduction in flood elevations
    - 9 structures removed from 100-year floodplain
- Project E-7
  - Purchase 2 properties at Northfield and Edgewood Drives and install emergency overflows
  - Land Acquisition – 2 properties
  - Project Cost Opinion - $288,000
  - Primary Benefit – No reduction in flood elevations
    - 2 structures removed from 100-year floodplain

Potential Funding Mechanisms

Eight potential funding mechanisms for municipalities were noted from the study. The potential funding sources range from grants with a local match to loans with 40-year payback to utilizing drainage assessments. The most promising funding mechanisms are listed below:

- Flood Control Revolving Loan Fund (IDNR)
  - Maximum $300,000
- State Revolving Fund Loan Program (SRF)
  - 20-Year Loan
  - Must have environmental benefit
- Community Focus Fund Stormwater Improvement Grants (OCRA)
  - $500,000 Grant w/ in kind match required
- Community Facilities Loan (USDA)
  - 40-Year loan bonded against stormwater fees

Town of Mooresville Drainage Study
Narrative

1) Introduction

A. Overall Watershed

The hydrologic and hydraulic study of Mooresville encompassed 626 acres, just under one square mile. A small portion of the watershed, 86 acres, is within Hendricks County. The remaining 540 acres of the watershed is located within the Town of Mooresville and Morgan County. The watershed eventually drains into the East Fork of White Lick Creek, southeast of Mooresville, near the intersection of State Roads 67 and 144.

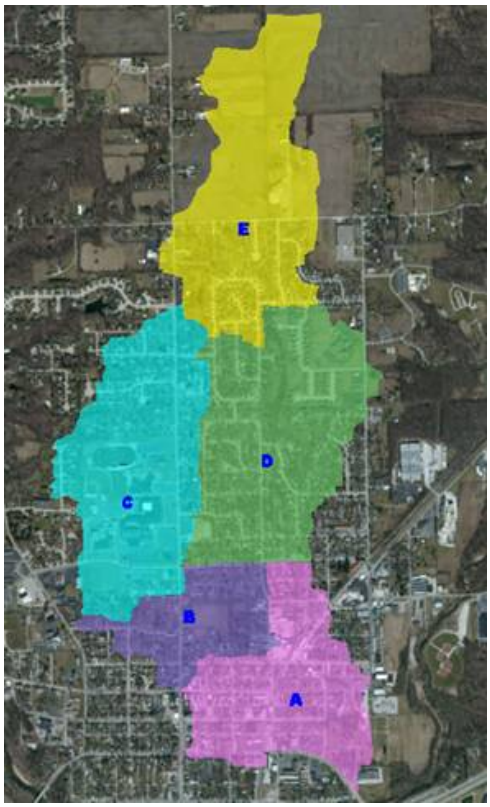


Figure 1: Watershed Boundary

The study area has been split into five separate areas, based on watershed boundaries and issues observed. These areas and overall watershed boundary are shown in Figure 1.

2) Data Collection

A. Topographic Information

Topographic information was pulled from two sources: *Indiana University's ISDP Download Tool*[1] and a survey by Banning Engineering. 2011 LIDAR from the IU GIS website was used to create 1 ft contours of the entire watershed. In addition, the 2015 survey by Banning Engineering gathered approximately 25 cross sections, 41 culverts and bridge crossings, 19 finished floor elevations, and 4 roadway profiles.

B. Geographic Information Systems Data

The available GIS data included parcels, roadway locations and names, aerial photography, municipal boundaries, and parcel reports from *39 Degrees North*[2]. Other online GIS resources included the *USDA Soil Survey*[11]. Fortuitously, the Google Street View images available appear to be taken just hours after the July 2015 storm. It is obvious the water has receded in these images, but the general impacts of the

flooding are still apparent.

C. Field Reconnaissance

Field reconnaissance took place throughout the course of the study to support assumptions for the hydraulic study and to obtain valuable data for project development. Several days were spent by professional staff within the Town of Mooresville studying the lay of the land and confirming watershed boundaries.

Storm sewer locations were observed within the watershed to develop accurate internal basin boundaries. During the course of the site visits, it was discovered that the condition of several manholes were deteriorating. For example, the masonry manhole located on Northfield Drive, shown in Photo 1, appears to have a water line running through it. Some of the bricks have fallen into the manhole along with other debris. This manhole connects the Westwood Drive ditch, from the north, to Edgewood Drive, to the West, and outlets into the ditch just West of Canaan Street. It is the primary outlet for Area E.

Photo 1: Northfield Drive Manhole

In Area A, there were several industrial structures built across the ditch. These buildings, such as the one shown in Photo 2, restrict flow during larger storm events.

Photo 2: Building South of Railroad

D. July 2015 Event

The July 2015 flood event negatively affected many residences and businesses within the town. The event that occurred in was well covered by the local media outlets. As such, there were several sources of useful information used to calibrate the flood model created as part of this study. These sources included news reports, shared photos, resident accounts from field visits, and accounts from Town

personnel. Further information on the model calibration can be found in later sections of the report.

According to *8 WISH TV's* July 12th, 2015 publication[3], the Mooresville Fire Department rescued several families from their homes, by boat, during the night. The report indicated that the problematic areas included Areas A and E predominately with the more intense flooding near Edgewood Drive, Bridge Street, and Taylor Street. Several that were rescued stayed the night at the Middle School, with the assistance of the Red Cross. Several accounts of the event are included below. Additional information from the news coverage was used within portions of the public input sections of the report.

> *"I watched the water come in from the wall and just roll right to the center of the room in the carpet. It was fast." – Timothy Long*

> *"It was waist deep in my yard. This house has been in our family for 30 years and it's the first time this has happened." – Paul Uhls (Bishop Street, Area A)*

According to Fox 59's July 12th, 2015 publication[4], there were approximately a dozen water rescues. Accounts of the event were included, as follows:

> *"I think I lost everything. It's one of those things where you have no control over it and right now there's really nothing I can do." – Timothy Long*

> *"It was like a river." – Judy Ransome Moone (W. Washington St., Outside study watershed)*

Photo 3: Submerged Car

A photo also surfaced on *8 WISH TV's* website[3], at an unidentified location in Mooresville Indiana, showing a car partially submerged at night. The photo, shown in *Photo 3*, was a courtesy of a Cassie Jo White. It is unknown where, in Mooresville, this photo was taken.

3) Public Input

A. Public Input

Public input for the study was obtained using several methods. First, information from the July 2015 news coverage of the flooding event was used to note areas of concern and extent of flooding. Second, Town of Mooresville staff took Banning Engineering staff on a tour of the watershed and highlighted what they observe during flood events. Lastly, property owners adjacent to the study reach were sent a letter alerting them of the drainage study and notify them that surveyors will be in the area to collect elevation data. Many residents took the time to call Banning Engineering staff to pass along their flooding experiences.

Each of the accounts described below were incorporated into this study, as applicable, by mapping out each of the descriptions by origin location. The origin locations of these accounts were determined using *Google Earth*[5], *Google Earth Street View*[6], and *39 Degrees North*[2], Morgan County's GIS platform, after conducting simple searches for each parcel owner. These accounts were invaluable in calibrating the hydraulic model used in this report, as a means to create a more accurate floodplain map for other storm events.

i. Area A

A video from the *8 WISH TV*[3] account shows flooding damages at Big John's Auto Repair Shop at 162 Taylor Street, shown in Photo 4. A house, also located on Taylor Street, appears to have flooding damage. Photo 5 was viewed from a Google Street photo taken not long after the storm event. A pile of carpet & debris is seen next to the street for trash pickup.

Photo 4: Big John's Auto Repair Shop

Photo 5: Residence along Taylor Street

Town Staff provided a tour of Area A. During this tour they indicated the Railroad Trestle, near Bolton Avenue and Taylor Street, had become blocked at some point prior to the major flood on July 12th. The pile of

pallets was verified in a photo taken from the video on *8 WISH TV's* July 12th, 2015 publication[3]. See Photo 6. It is believed the majority of these pallets floated into and blocked the railroad trestle leading up to the July 12th, 2015 storm event.

Photo 6: Railroad Trestle Blockage

Discussions with property owners within Area A indicated the flooding issues were magnified significantly by the blockage of the railroad trestle. Many reported water much higher than they ever experience before.

Owners downstream of the railroad trestle stated they have noticed the ditch has begun to sediment in. This was specifically noted in the area of the railroad trestle and the area just downstream. There appears to be old concrete, sediment, or just general debris accumulated in the ditch. The cross-section of the ditch at this location is noticeably smaller than it is upstream and downstream. One private crossing was noted just downstream of Bolton Avenue that does not appear to be used.

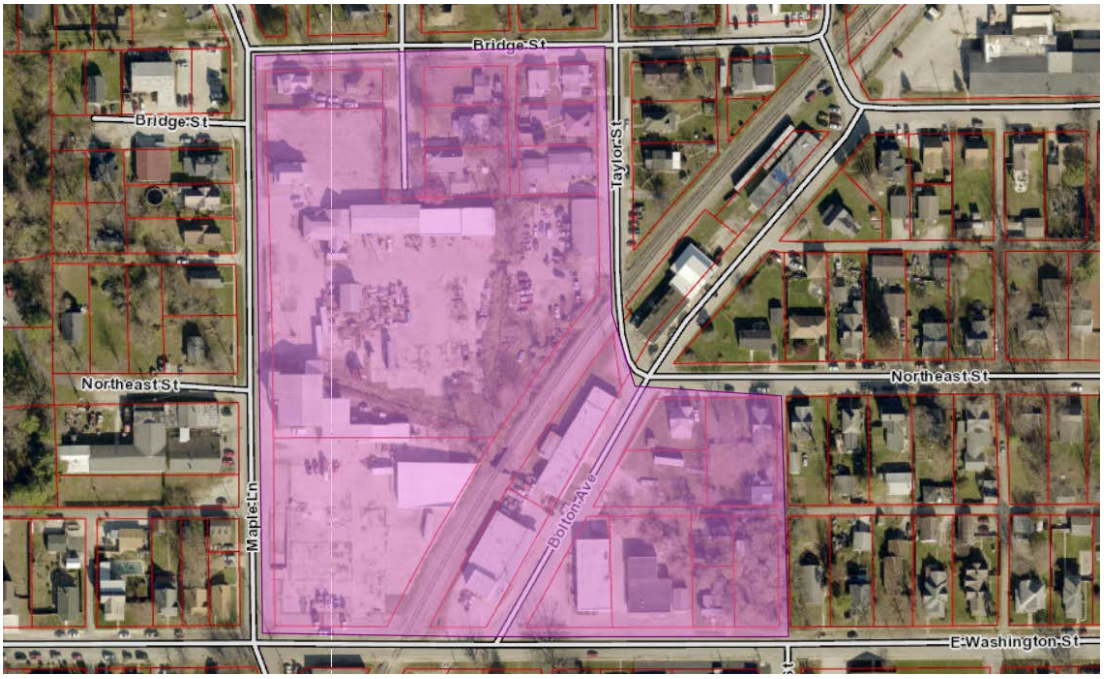


Figure 2: Area of Public Input within Area A

Property owner input for Area A was received predominately within the area bordered by Washington Street to the South, Maple Lane to the East and Bridge

Street to the North. This area was observed to have several structures over the ditch. Additionally, structures located next to the ditch have very little freeboard. Freeboard is elevation above the adjacent ground or flooding source. Figure 2 shows this location within Area A. One owner outside this area, 328 East High Street, expressed reoccurring impacts from flood waters.

ii. Area B

Town staff noted that issues have been expressed to them along Circle Drive just west of Indiana Street. Figure 3 shows this location. The reports state water from the west ponds and cannot go through a pipe west of Circle Drive. The water then proceeds over land as sheet flow across all of Circle Drive. Some vehicles parked on or near the road have reportedly been impacted. This claim is supported by Google Street photos showing vehicles drying out shortly after the floods on July 12, 2016. Photo 7 shows flowing storm water. It was taken standing on Circle Drive looking northeast to Indiana Street and the ditch being studied.

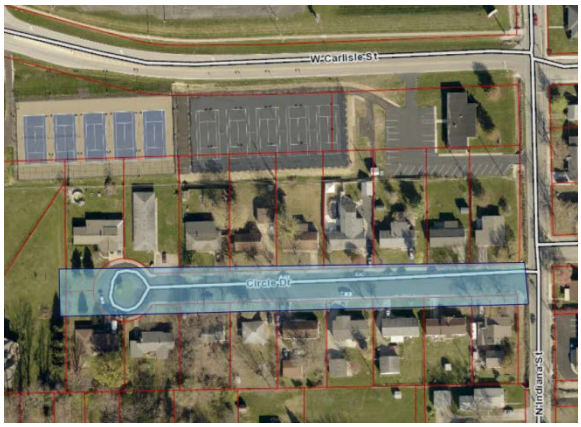


Figure 3: Area of Public Input within Area B

Photo 7: Storm Water at Circle Drive and Indiana Street

iii. Area C

Area C had primary public input north of Mooresville High School along Indiana Street. Residents within this area expressed they had trouble mowing the ditch along Indiana Street. Others expressed they filled there portion of the ditch many years ago. There were no reports of structure or vehicle flooding within this area. Figure 4 shows the area where the most residents expressed opinions about the ditch being studied.

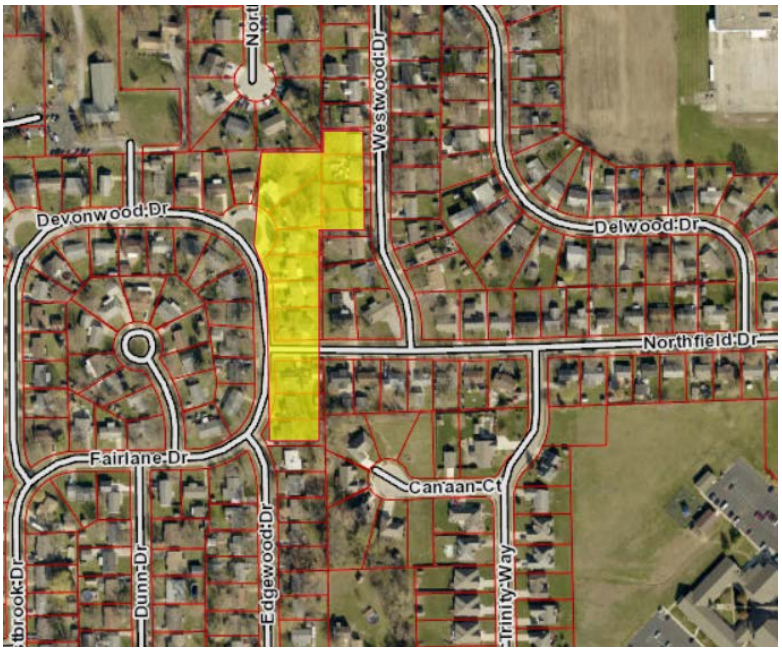
During the tour with Town Staff, an area along Carlisle Street at the Southwest corner of the School property was viewed in detail. This area was noted as an area where, during periods of intense rainfall, stormwater jumps watersheds and heads southeast to the study area of this report. It was also reported the ditch being studied has overtopped Carlisle Street and proceeds towards Circle Drive in Area B as well.

Figure 4: Area of Public Input within Area C

iv. Area D

Area D had limited public input. One storage structure at 111 Trinity Way was noted to be flooded during the July 2015 event. One other property owner with vacant lots stated they may be interested in selling their property. During the interviews with Town personnel, no areas of damage during the July 2015 event were reported.

v. Area E



Area E was another area with significant public input. The primary location for this was bordered on the south by Northfield Drive, on the west by Edgewood Drive and to the east by Westwood Drive. Structure flooding at approximately 10 residents was reported during the July 2015 event. Figure 5 shows the location of the primary public input

Figure 5: Area of Public Input within Area E

for Area E.

Residents expressed flood waters from the north flow south through the ditch between Northfield Park and Highland Meadows subdivision to a 36 inch pipe. During periods of heavy rainfall they note water first begins reversing flow and comes out of the inlets located along Edgewood Drive and flood its intersection with Northifield Drive. Residents went on to state that if the rainfall continues water begins flowing overland at 1010 Edgewood Drive. The structure at this location and its neighbors reported flooding from this overflow in the July 2015 event. The resident at 1010 Edgewood Drive expressed multiple occurrences of this overflow and flooding since 2003.

The flooding was further described to pond to at least waist depth at the intersection of Northfield Drive and Edgewood Drive. From this location the flood water found overland flow exits back into the open ditch by affecting the three houses southeast of the intersection of Northfield and Edgewood Drives. These claims and descriptions were independently supported by Town Staff during the interview process.

Another resident at 1124 Westwood Drive revealed that the water had reached their doorstep and entered their house. Water was ponded several feet deep in Westwood Drive. They noted that when they opened a wooden fence at the rear of their property the flood waters receded. A site visit at this location noted that no dedicated overland flow route exists between the storm inlets on Westwood Drive and the open ditch outlet to the west. This was noted as a reoccurring them of the study.

vi. Public Input Findings

When reviewing the public input and interviews with Town Staff it is apparent there are several areas that have significant flooding issues in Town. The two most significant areas appear to be the areas of focus within Areas A and E. A third, but yet not as severe area of interest, is located within Area B. Based on public comments, Areas C and D do not appear to have as many or as severe of flooding issues as the other three areas of study.

It should be noted, that while Areas C and D do not have as many reported flooding issues, projects within them may benefit other areas. Additionally, projects meant to benefit the more hard hit areas, if not carefully planned, may adversely affect residents within Areas C and D.

4) Hydrologic and Hydraulic Analyses

A. Base Model

The base conditions analysis was completed using a critical duration series. The critical duration series was used for the 10 and 100 year storm events. The 2 year storm simulation was also run, but not analyzed in depth as part of this study. Storm durations included: 0.5, 1, 2, 3, 6, 12, and 24 hours.

The overall watershed for the Town of Mooresville was broken up into 43 drainage basins and 104 nodes of interest representing separate culverts, bridges, or storm sewer inlets. Note that not all inlets within the town were surveyed or modeled. For the purposes of this study, not all of the inlets needed to be included. Rather, it was important that the location and flow direction of the inlets be accounted for in determining the overall watershed boundary.

Runoff was calculated using the *Technical Release 55* (TR-55)[10] methodology from NRCS. Soils were obtained from the USDA Soil survey. Land use was determined based off AutoCAD's geomap feature. Times of concentration were derived using the aerial and 1 foot contours from the 2011 LIDAR.

The routing portion of the modeling was performed using the *Interconnected Channel and Pond Routing (ICPR)* [7] software by Streamline Technologies®. Data for the model also included the survey by Banning Engineering and numerous cross sections along the ditch.

B. Hydrologic Data

Hydrologic input for this study was obtained from the *2004 Mooresville Stormwater Design Manual* [8]. Per the manual, Huff rainfall distributions were used, as shown in *Table 1*.

The hydraulic model was calibrated using reports from residents and municipal employees of the July 12th, 2015 storm event. This storm event reportedly had a rainfall depth of 4.5" in approximately 6 hours, which was used in the modeling. Another account, by word of mouth, stated that there was up to 5.5 inches of rain. That said, both the 4.5" and 5.5" floodplains were mapped in four key areas: Edgewood Drive, Westwood Drive, Circle Drive, and Bishop Street.

It was determined that the 4.5 inches of rainfall in 6 hours most accurately depicted the public observations through the majority of study reach. No certified data verifying the rainfall depth, intensity, or duration of the July 12th, 2015 event was

available through local or national resources. Some areas may have received more rainfall than 4.5 inches. In conclusion, the high water observations from modeling 4.5 inches in 6 hours compared favorably with the model results.

C. USDA Soil Survey

Soil reports for the entire watershed were split into the respective internal watersheds. The USDA Natural Resources Conservation Service's web soil survey was used to retrieve the soil reports, as part of the TR-55 analysis.

D. Noted Issues

The hydraulic modeling was completed using the all the information noted above. The model was then compared and checked against the public and staff accounts of the July 2015 flood event. As stated, the modeling compared favorably with these accounts. The following sections contain a summary of the flooding issues noted within each area based on the modeling, survey and field observation.

i. Area A

100-Year Flood modeling within Area A noted sixteen structures located within the 100-year floodplain. All but one of these structures was located between Washington Street Maple Land and Bridge Street. The one other structure was located at 328 East High Street. The structure at 328 East High Street is also impacted by backwater from East Fork of White Lick Creek. The lowest adjacent grade of this structure is nearly 5 feet below the 100-year base flood elevation from the East Fork of White Lick Creek. Figure 6 shows the predominant areas of flooding for Area A.

Figure 6: Primary 100-Year Floodplain Area A

Viewing topography within Area A it is apparent there is no overflow route between areas upstream of the Indiana Southern Railroad trestle and the area downstream. When the area became clogged with pallets as it did in the July 2015 event the water literally has nowhere to go, but stage higher. This issue greatly increased the flooding impacts incurred at this location.

Photo 8: Channel between Washington & RR

The first primary issue with this area is the relatively small channel size from railroad trestle downstream to Washington Street. Additionally, sediment has accumulated under the railroad trestle, under the building at 210 Bolton Avenue, and under a private crossing at 246 East Washington Street. The site specific survey of the area shows indicates several low spots within this area that hold water on a regular basis. There is nearly 4 feet channel fall within the 500 feet +/- from the upstream side of the railroad trestle to East Washington Street. The majority of that fall, however, occurs between the private crossing and East Washington Street. Photos 8 and 9 show the difference in channel size. Photo 7 was taken while standing on the private crossing at 210 Bolton Avenue.

Photo 9: Channel Downstream of Washington St.

The second primary issue is the flat topography and intense development behind the railroad trestle. The modeling shows this area to be a rather large floodplain when compared to other areas within the study reach. This area is at the confluence of the two primary channels in the study reach. The current land use for the area is predominately industrial/commercial which lessons infiltration and increases runoff.

A review of the 10-year floodplain mapping reveals two structures at risk within Area A. These structures are located at 208 Bolton Avenue and 268 ½ East Washington Street. These structures are both directly affected by the lack of capacity within the ditch in this area.

ii. Area B

100-Year Flood modeling within Area B only notes three structures located within the 100-year floodplain. Two of these structures are located immediately upstream of Maple Lane. The one other residence is located at 180 North Indiana Street. Several other structures appear to be directly adjacent to the 100-year floodplain.

These are predominately along Circle Drive and the South side of Hadley Street.

Area B was the one area of the modeling where calibration was more difficult. The watershed jumping that occurs at the southwest side of the school is difficult to quantify. We believe the 100-year floodplain along Circle Drive and just downstream may be shown on the maps slightly larger than what is documented in the field.

Figure 7: Area B Undeveloped Subdivision

One item that come up during the study of Area B is a new subdivision located just downstream of Indiana Street along the open ditch. None of the structures are built yet, but nearly all of the 13 lots are located within the delineated 100-year floodplain. When fully developed this area will likely either take away existing floodplain storage for the reach or have structures located within the floodplain. This area is shown in Figure 7.

No structures appear to be within the 10-year floodplain within Area B. However, the 10-year floodplain does appear to affect about half of the undeveloped subdivision lots located just downstream of Indiana Street.

iii. Area C

There are no structures noted within the 100-year floodplain in Area C. Area C however, was by far the most complicated area to model. The significant gradient change from north to south compounded with the numerous school additions and infrastructure that is either undocumented or lacks above ground evidence.

The studied reach in Area C is the ditch along Indiana Street. As a whole, the ditch appears to function relatively adequately from a drainage capacity perspective. It is slightly undersized in a few areas when analyzing the 100-year flood events. Several culverts have been noted to overtop roads and driveways during this severe event.

At the southwest side of the school there is a combined watershed. At this location the water is intended to head westerly through a pipe network and through SR 267 to the west. There is little visual evidence of this infrastructure and inlets are sparsely located and appear to be mostly plugged or too high. The drainage on the north side of Carlisle Street adjacent to the school is very poor. Even during very

small events water ponds on Carlisle Street instead of heading westerly. When the water cannot get into the system that heads west along Carlisle Street it ponds, then during larger events heads southeast to Circle Drive or east to Indiana Street.

iv. Area D

There are no structures noted within the 100-year floodplain in Area D. Flooding was noted in a mini barn at 111 Trinity Way. This lot was visually reviewed. The main structure has a walkout basement that is located within what appears to be the detention basin of the subdivision. Visually the house looks to be several feel lower than the emergency overflow elevation of the detention basin. If the outlet pipe was to get clogged or a large event occurred, flooding of this house would occur.

While no structures appear impacted by the 100-year floodplain there are at least 9 different structures along the reach with walk-out basements or very little freeboard. There is nearly 40 feet of vertical fall from the top to bottom end of this area. That equates to a nearly 1 percent slope from north to south. This means water travels very quickly through Area D until it hits the flatter portion of the ditch in Area A.

v. Area E

100-Year Flood modeling within Area E noted ten structures located within the 100-year floodplain. All but one of these structures is located along Edgewood Drive in Highland Meadows. Two flooding regimes exist for this area. The first type of flooding is overland flooding from a lack of capacity within the 36 inch pipe under Northfield Drive. Water comes out of the banks of the ditch to the north of Highland Meadows and proceeds overland at 1010 Edgewood Drive. If the storm is large enough, homes adjacent to 1010 Edgewood Drive get hit by flowing water as well.

The second flooding regime is located at the intersection of Northfield Drive and Edgewood Drive. Floodwaters from both local flow and the overtopping water described in the previous paragraph pond and stage higher until it flows out between houses located at the southeast portion of the intersection. The ground is graded in such a way that the houses to the southeast are slightly lower than those to the north that get hit with the overflow water.

The one other structure noted to be flooded during a 100-year event is at 1124 Westwood Drive. This structure is flooded due to lack of capacity within the pipe outlet along Westwood Drive and no emergency overflow path for the flood waters.

The 10-year floodplain appears to affect three structures within Area E. These

structures are the structures that get hit with the overflow from the open ditch between Highland Meadows and Northfield Park. This flooding is most significant at 1010 Edgewood Drive.

5) Potential Solution Set

A. Entire Watershed (Overall)

Looking at the watershed as a whole is always advisable when determining proper courses of action for flooding issues. Predominately, potential solutions that affect the entire watershed are programmatic in nature due to the significant construction costs and land acquisition costs for a project large enough to affect the entire watershed. The programmatic solutions listed in the following sections will need to be worked on for several years before real change is noticed by their implementation.

i. 100-Year Floodplain for Planning and Building (Project O-1)

Provided in the attached appendices are both a 100-year and 10-year floodplain map. These maps, and corresponding elevations can be adopted and utilized by the planning and building department when approving development within the watershed. This information could be utilized in conjunction with Section 4.5 of the Town of Mooresville Stormwater Design Manual to assist with elevation determination for structures. It is advisable to maintain the State of Indiana freeboard requirements of 2 feet above the adjacent base flood elevations of an open ditch or retention facility.

ii. Property Acquisition Plan (Project O-2)

Properties for sale that are located within the 100-year floodplain may be acquired and retained as green space or converted to green space if desired. Even though Area D has the longest reach within the study area it has the least amount of structures directly affected by flooding. This is predominately due to the location of North Park through much of this reach. Green space can act as a buffer between the flooding source and adjacent structures. Additionally, converting hard surface to green space allows for more rainwater absorption into the ground. This over time reduces surface water runoff peaks and volume.

iii. Ordinance Updates (Project O-3)

Since the last update of the Town of Mooresville Stormwater Design Manual many similar ordinances around the state have been updated. Standard inclusions in

many manuals include: floodplain fill mitigation, restricted release rates, cubic feet per second per acre release rates, updated modeling techniques, easement requirements, additional storm frequency analysis, as well as numerous stormwater quality measures.

B. Area A Projects

Area A being the downstream reach receives floodwaters from the other four upstream areas. Additionally, East Fork of White Lick Creek can back 100-year floodwaters upstream of Main Street based on the published Base Flood Elevations. While it is not likely for peak flows from upstream areas within the study reach and peak elevations along East Fork of White Lick Creek to occur at the same time, it is possible. The 10-year flood elevation along East Fork of White Lick Creek is only 2 feet lower than the 100-year base flood elevation. The 10-year flood along East Fork of White Lick Creek can push flood waters upstream within the channel through Mooresville Cemetery.

The ratio of East Fork of White Lick Creek drainage to the study reach is 50:1. That is, East Fork of White Lick Creek at the project outlet is draining just under 50 square miles, while the study reach is draining just under 1 square mile.

i. Clean and Dip Ditch (Project A-1)

The ditch downstream of Washington Street is in reasonable condition. Upstream of Washington Street however the ditch is in need of maintenance. Significant sediment and debris has accumulated within this reach and the capacity has become limited. Photos 8 and 9 within previous sections show the dramatic difference in channel flow area upstream and downstream of Washington Street.

It is also noted that there is a large amount of sediment under the railroad trestle. See Photo 10 for a view of the sediment accumulated. The large amount of sediment accumulated tends to catch additional sediment or debris such as the pallets that blocked the trestle in July of 2015.

Photo 10: Accumulated Sediment Under at RR

Significant challenges exist in order to perform this maintenance along the ditch. It is our understanding that no easements for the ditch exist throughout most of the reach. There is only a small portion of the ditch within Area A that is under Town control or along right of way for access. In order to clean the ditch the Town will need to acquire a hold harmless right of entry or easements from property owners along the reach to be cleaned. It is recommended Phase 1 of the work start at Washington Street and proceed upstream to both Bridge Street and Maple Lane. Phase 2 would begin at the Squelers Barbecue Grill entrance and proceed upstream to Washington Street. Figure 8 shows the locations of Phase 1 and 2 of this project.

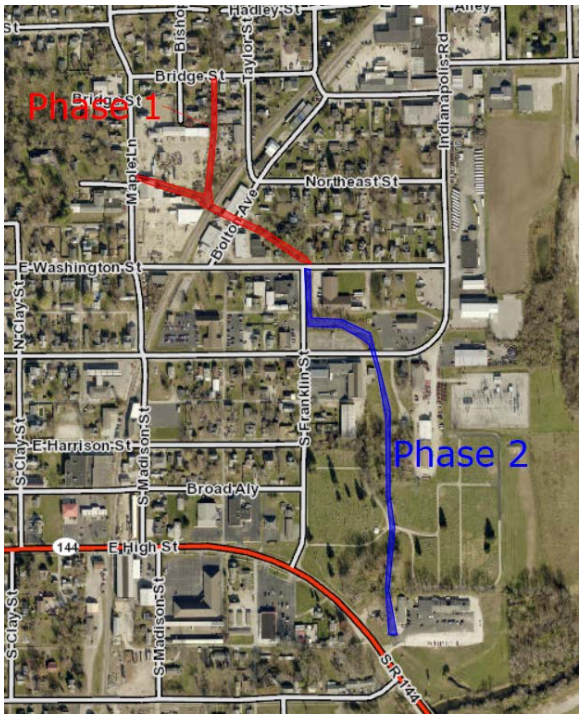


Figure 8: Project A-1 Map

The cleaning of the ditch will benefit Area A for the more frequent storms up to roughly a 10-year frequency. During larger events the ditch cleaning will have little or no effect on peak elevations, but it will lessen the likelihood of debris accumulating and causing significant issues such as those observed in July of 2015.

Phase 1 of the project will be the more intense phase of the project. Hauling away of sediment and debris will be required. The nature of the sediment and debris does not lend itself to depositing on the overbanks or within property owner's yards. Phase 1 is approximately 1,430 feet in length. If an outside contractor was to perform the work it is estimated Phase 1 of Project A-1 could cost $63,800. Phase 2 is estimated at $52,500. Obviously if the work were performed by Town personnel the cost could be substantially reduced.

ii. Remove Unused Private Crossing (Project A-2)

It is recommended, if private crossings are no longer in use they be removed. At least one such structure appears to be in place at 246 East Washington Street. The properties this crossing ties together is owned by two separate parties. The cost to remove this structure should be $5,000 or less. It would ideally be performed as part of the work within Project A-1. The benefit for this project would be most prevalent in the more frequent storm events 10-year and less, but as with Project A-1 removing the structure eliminates a potential place for debris to accumulate along the reach. There is approximately 1.5 feet of flood elevation difference from the downstream to upstream side of this structure during a 10-year event. See Figure 9 for the location of this project. As with Project A-1 approval by the landowner would have to be granted prior to completing this project.

Figure 9: Project A-2 Map

iii. Remove Buildings over Ditch (Project A-3)

Figure 10: Project A-3 Map

At two locations within Area A buildings have been built across the ditch. This project will not be possible in the near future, but long term planning to eliminate these hazards is recommended. There could be two approaches to achieve this. The first approach could be to re-align the ditch around the buildings. The second would be to remove a portion of the building. Obviously, these would either have to be completed by the property owner. This project does not seem feasible at the current time, and therefore no estimated project cost has been calculated for Project A-3. Figure 10 shows the locations of the two buildings over the ditch.

iv. Eliminate Floatable Material Storage within 100-Year Floodplain (Project A-4)

This project is a no cost project and is believed to already be in practice in some locations. It is recommended all floatable materials such as woody debris / vegetation, building materials or other floatable materials be stored outside the 100-year floodplain. The floodplain mapping provided in the attached appendices can be used to facilitate this effort.

C. Area B Projects

Area B is caught between the relatively steep slope and quick discharge of Area C and the slower flatter discharge of Area A. There were only three structures noted to be within the 100-year floodplain in Area B, but many structures along Circle Drive and on the south side of Hadley Street appear to be very near the floodplain delineation. Based on the modeling, it appears detention or diversion projects upstream within Area C would provide the most benefit to the most residents within Area B.

i. Maintained Green Space / Potential Offline Detention (Project B-1)

While maintaining green space is not a direct benefit, this project would allow the floodplain and infiltration to be maintained as is currently exists. If funds allowed at a time later, offline detention, a Town park, or both could be provided within the green space. The area shown as the potential Project B-1 is approximately 3.75 acres in size. A rather large offline dry detention facility could be built within this area. The potential 100-Year benefit of an offline dry detention basin for Project B-1 at Maple Lane would be approximately 0.9 feet. The benefit lessons downstream until it stops just downstream of the Railroad trestle within Area A. Upstream the benefit stops when the ditch gets to Indiana Street. This project would remove 1 structure from the 100-year floodplain, and reduce elevations against another. Both of these structures are just upstream of Maple Lane.

The estimated construction costs for a maximized offline detention facility as Project B-1 is approximately $440,000. This estimate includes land acquisition and soil haul away estimates which can be highly variable. Construction costs could be significantly with a smaller scale project, or eliminated totally with just the maintaining of green space. The potential benefit would be reduced

Figure 11: Project B-1 Map

accordingly. The location of the potential Project B-1 is shown on Figure 11.

ii. New Pipe along Circle Drive (Project B-2)

One other project was reviewed for potential benefit for Area B. A new pipe was analyzed to assist with discharging water along Circle Drive. The primary difficulty with this was the lack of grade and cover available along Circle Drive. The only reasonable alternative was to run a pipe southerly from the low point at the west side of Circle Drive, then proceed east to the headwall at Indiana Street. This slight modification gains enough elevation to be able to run a pipe at a slope of 0.20 percent. By installing a pipe along the length of Circle Drive the pipe would be essentially flat (0.06 percent).

For the purposes of scoping the project a 15 inch pipe was modeled for 900 linear feet along the west and southern boundary of the Circle Drive subdivision. No appreciable benefit was found during the 100-year storm event. It was determined that due to the low lying nature of the subdivision, projects that detain or redirect water within Area C would provide more benefit. No project cost was determined for the project.

D. Area C Projects

Area C primarily consists of Mooresville School property, Indiana Street, and the surrounding residential properties. There is over 40 feet of fall from north to south within Area C. Area C did not have any structures noted within the 100-year floodplain. During the modeling it was discovered that projects within Area C have a very direct impact on Area B. Detention or redirection within Area C will benefit Area B significantly.

i. Piping Indiana Street Ditch with Offline Detention (Project C-1)

Several residents expressed a desire to fill in the ditch along Indiana Street to allow for easier mowing. An analysis was performed to determine the benefits or damages of this project. By just filling the ditch and installing a pipe, it was determined this project would have a detrimental effect on both the drainage along the ditch and Indiana Street, but also downstream in Area B. It is our recommendation that if the ditch is to be filled and replaced with a storm sewers, that additional storage be added to compensate for the loss of storage and capacity within the ditch. This has begun to become a standard practice by local municipalities in areas with noted drainage issues. Figure 12 shows the approximate location of Project C-1.

Three additional detention basins were added in front of the school, which covers a

total of 3 acres +/-. This detention would be similar to the dry pond at the intersection of W Carlisle Street and Indiana Street. The combined storage of these three preliminary layout is approximately 5 acre-ft.

Figure 12: Project C-1 Map

The modeling shows that the dry ponds, in conjunction with the proposed storm sewer, reduces flooding elevations along Indiana Street for a 100 year storm by up to a foot. In addition, where the ditch crosses Circle Drive within Area B, flood elevations would be reduced by 9 inches in a 100 year storm. As stated within the Area B discussion, any detention or diversion within Area C would provide a benefit downstream. The estimated construction cost of Project C-1 is $750,000. This does not include property acquisition or potential environmental permitting. Mitigation may be required by the Indiana Department of Environmental Management and the United States Army Corps of Engineers. Mitigations costs were not included, are highly variable, but could likely be completed within the proposed detention basins.

This project will take extensive coordination with the Mooresville School Corporation, as much of it is located on School property. Planning could be coordinated and the project could be worked into their overall master plan for the property. Underground detention, for example, is a possibility for this area, but would increase construction costs. Underground detention would also need to be well coordinated and carefully designed to be effective.

ii. Work with Mooresville Schools on Drainage Improvements (Project C-2)

During the course of this project a watershed jump was discovered along Carlisle Street at the Mooresville High School and administrative building. Many hours were spent in the field determining intended flow routes for this area. In short, Carlisle Street is extremely flat. Additional observations along Carlisle Street are noted below.

- There are only a few storm inlets along Carlisle Street. With limited inlet flow and very little elevation difference only a small amount of water is required to jump watersheds. Installation of trench drains at known high flow areas should be considered to increase inflow into the pipe.
- The side ditch along the north side of Carlisle adjacent to the High School does not appear to drain well. Water was observed standing in the street after very small rain events.
- Storm infrastructure on the school property appears in need of maintenance. Swale and ditch cleaning is recommended, along with a comprehensive inventory of drainage infrastructures onsite to confirm location and direction of pipes.

There is a 30 inch concrete pipe that runs east to west under Carlisle Street. It is recommended this pipe be videoed to ensure no blockages exist and to determine its exact location and relative size. After the storm sewer location is confirmed it is recommended the school performs maintenance on their property and works with the town to provide additional inlets into the storm sewer. It is also recommended the school and town work together to place additional offline or underground storage within the Carlisle Street Basin on School property. The maintenance work and inlet installation could be performed by Town or School staff.

If the watershed jump can be eliminated it would reduce the amount of flow through Circle Drive, and limit flow to the local drainage basin. This project could be a positive for all parties, as drainage at the Mooresville School administrative building parking lot appears to be very poor.

E. Area D Projects

As stated previously Area D does not have as many drainage issues as the other areas in Town. The slope of the channel through this section of Town is nearly 1 percent. This means any additional storm water that enters Area D will travel quickly downstream into Area A. Several potential projects within Area E require increased peak flows downstream to remedy flooding issues within Northfield Park and Highland Meadows subdivisions. The only project within Area D that could potentially offset these higher flows is analyzed below.

i. Two-Staged Ditch within North Park (Project D-1)

The purpose of this alternative is to provide additional storage within North Park to offset increased flows from Area E prior to entering Area A. Figure 13 shows the approximate location of this project. For Projects that increase flowrates from Area E Project D-1 was added to it. Results of that combined study will be documented for potential projects for Area A. Project D-1 by itself, while beneficial in the localized area does not carry benefit significantly downstream. There are no structures currently within the floodplain in Area D to benefit. The estimated construction cost of Project D-1 is $90,000.

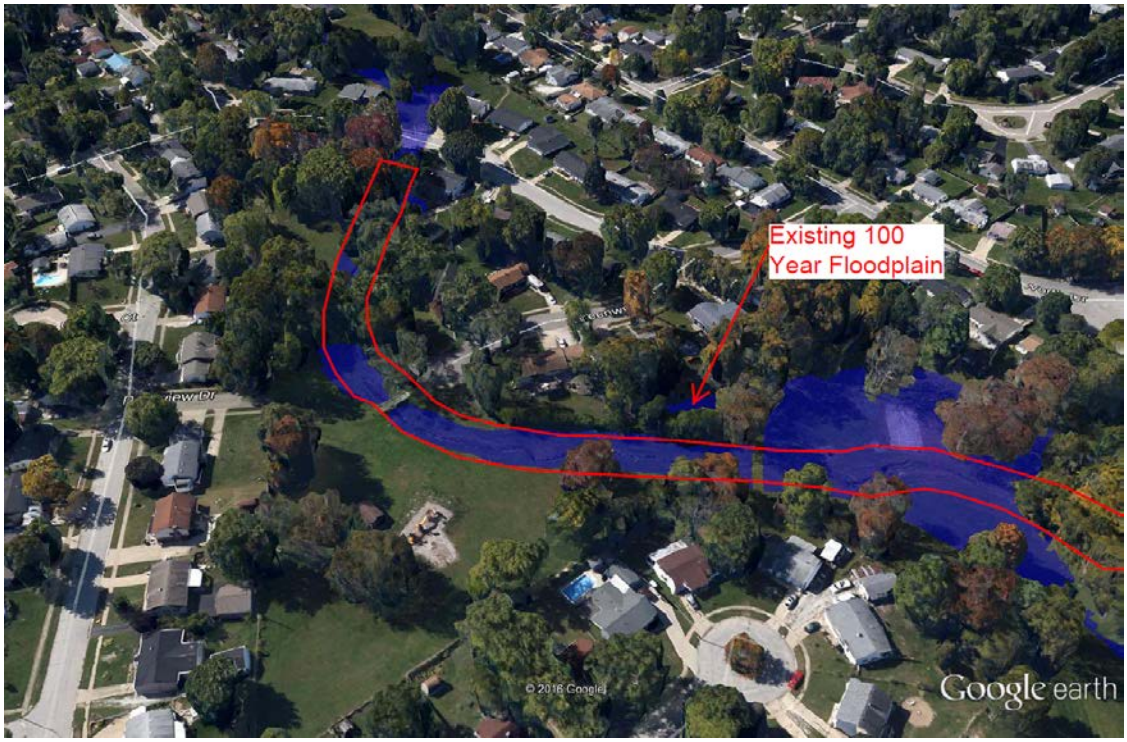


Figure 13: Project D-1 Map

F. Area E Projects

Area E has complicated issues that need to be explained more thoroughly in order to be able to communicate them effectively. There are two primary flooding regimes within Area E. It was discovered through the course of the modeling that these work independently to a large extent, though both need to be addressed to fully benefit the houses near the intersection of Northfield and Edgewood Drives.

The first and most difficult flooding regime to remedy is an undersized pipe at Northfield Drive. The existing 36 inch pipe does not carry the 10-year flow from the upstream 118 acres. Once the capacity of the pipe has been surpassed, flood waters overflow the ditch and inundate three structures along Edgewood Drive beginning with 1010 Edgewood Drive.

The second flooding regime for the area is the flooding of the low area at the intersection of Northfield Drive and Edgewood Drive. Water in this depression will raise 2.5 to 3 feet prior to exiting the area between and against houses to the southeast. There is no defined overflow route for this stormwater. It must rely on storm pipes to discharge. This low area, during periods of intense rain, can receive overland flow from approximately 30 acres in addition to the overflow from the 118 acres noted in the first flooding regime.

Nearly 15 different project alternatives were modeling attempting to find an alternative that provided benefit for Area E.

i. Additional Capacity through Northfield Drive (Project E-1)

Project E-1 evaluated additional capacity through Northfield Drive. This could be done in one of two ways. The first way would be through direct replacement of the pipe. The second way is by running a pipe from the ditch to the north, through the intersection of Northfield and Edgewood Drives, then outlet it into the open ditch downstream of Northfield Drive. A schematic of Project E-1 is shown in Figure 14.

Figure 14: Project E-1 Map

In order to eliminate both flooding regimes documented within this location at least a 48 inch pipe would be required. Project D-1 was added to this project in an attempt to offset the increased peak flow rates downstream. Project D-1 did not offset increased flow rates. A construction cost estimate was not calculated for Project E-1 due to the increased damages downstream.

ii. Tie Low Area at Intersection into Existing Storm Pipe (Project E-2)

Since the large bypass pipe has adverse effects downstream, a less aggressive approach would be to tie into the existing storm sewer at the intersection of Fairlane and Edgewood Drives. There is a 21 inch clay tile that serves as the primary outlet for this area. The tile appears to be low enough to be able to tie into and assist in draining the low intersection of Northfield and Edgewood Drives.

Figure 15: Project E-2 Map

The modeled analysis showed only nominal increases and decreases (less than 0.10 feet) in downstream elevations during the 10-Year and 100-year events. The project does lower 10-year elevations at the intersection of Edgewood and Northfield Drives by 0.25 feet. Very little benefit from the project is seen during the 100-year event.

The estimated construction costs for Project E-2 is approximately $35,000. Project E-2 may be able to be completed by Town staff to save money. Figure 15 shows the approximate location of Project E-2. There may be opportunity, to install the pipe for Project E-2 so it will serve as part of the larger Project E-4. Additional survey and final design would be needed to confirm this possibility.

iii. Clean Ditch South of Northfield Drive (Project E-3)

During the field reconnaissance portion of the project observations were made at the 36 inch pipe outlet downstream of Northfield Drive. There appeared to be debris and sediment blocking a

Photo 11: Outlet South of Northfield Drive

portion of the pipe. This area is hard to access, but needs to be cleaned out to help maintain capacity through the pipe. This could likely be completed with Town staff. If an outside contractor were to complete the work it should not cost more than $5,000. Photo 11 shows the water against the pipe outfall.

iv. County Line Road Storage & New Pipes at Edgewood & Northfield (Project E-4)

The only project that fully rectifies both flooding regimes within Area E is Project E-4. It is a two-pronged approach. First a proposed dry detention basin is to be installed on 12 acres acquired within Hendricks County. A five foot tall berm, with a 15 inch outlet would be constructed across the ditch. The storage available in this basin is approximately 19 acre-ft. The detention facility is shown in Figure 16. This dry detention eliminates the 100 year overflow from the ditch between Northfield Park and Highland Meadows through the three properties at the north end of Edgewood Drive. Significant benefits are found downstream as well with this regional detention basin.

Figure 16: Project E-4 Detention

Figure 17: Project E-4 New Pipe

The second portion of this project is installation of new outlet pipes for the intersection of Northfield and Edgewood Drives. The new pipes will serve as the primary outlet for the low area and the 30 +/- acres of overland flow draining to it. As long as the pipes or inlets do not become clogged this alternative will provide protection for the adjacent houses for the 100-year event. Figure 17 shows the

Figure 18: Project E-4 Benefits

approximate location of the proposed pipes. Figure 18 shows the impact of the full project.

The estimated cost of Project E-4 is $1,000,000. Project E-2 also has benefit through Bridge Street (0.50 foot) and continues downstream to Washington Street (0.25 foot). It is our understanding the regional detention basin was looked at previously by the Hendricks County / Morgan County Joint Drainage Board. At that time, it was reported that property acquisition was difficult and the project stalled.

v. Purchase Three Houses within Overflow Path from Open Ditch (Project E-5)

Three houses currently get hit with water overflowing from the ditch between Highland Meadows and Northfield Park in during the 10-year event. An option exists to purchase the houses and eliminate the risk. After purchase the houses would then be demolished. It is estimated that the cost to purchase the houses would be approximately $270,000. This does not include demolition or professional services. Demolition could be performed as training for local fire departments if allowable.

Figure 19: Project E-5 Location

vi. Purchase Nine Houses Along Edgewood Drive (Project E-6)

Figure 20: Project E-6 Location

Up to nine houses have been hit with flood waters along Edgewood Drive. One alternative is to purchase all nine houses and turn the area into green space or a park. This would eliminate the significant risk for flooding within the area. It is estimated that the cost to purchase the houses would be approximately $900,000. This does not include demolition or professional services. Demolition could be performed as training for local fire departments if allowable.

vii. Purchase One House at Each End of Edgewood Drive and Install Overflow Paths (Project E-7)

By purchasing a house at each end and demolishing the Town would be able to install overflow structures to and from the open ditch. This is not an ideal scenario, but it would provide a definitive overflow location for excess flood waters. If not designed and installed correctly, the overflow structures could increase flow downstream. Project E-7 is estimated to cost approximately $290,000. This does not include demolition costs. Demolition could be performed as training for local fire departments if allowable.

viii. Drainage Impact Area for Watershed North of Northfield Drive (Project E-8)

This programmatic project will limit discharges from upstream development within the watershed. While not an immediate fix, over the course of time the limited discharge from development will allow the pipe under Northfield Drive to handle larger and larger storm events. The critical item is to get this not only approved by

Figure 21: Drainage Impact Area

the Town of Mooresville, but also the Hendricks County Drainage Board. The Hendricks County Drainage Board is currently the responsible authority for the watershed within Hendricks County. The calculated limit is based on the available capacity of the 36 inch pipe under Northfield Drive divided by the acreage upstream of it. The limit is calculated to be 0.18 cfs per acre for any developments 100-year

post developed discharge.

ix. Other Projects Reviewed but Not Forwarded with Area E

Several additional projects were looked at within and for Area E, but not advanced due to damages downstream or lack of benefit. These included the following:

- Diversion of the Hendricks County watershed East through Pioneer Park.
- Diversion of Hendricks County watershed West to Unnamed Tributary.
- Upgrading of County Line Road and Diversion to East Fork of White Lick Cr.

6) Potential Funding Mechanisms

There are several potential funding mechanisms for the various projects listed. A brief overview of the funding sources, requirements and limitations are listed in the following sections.

A. Section 319 Grant Program

The Section 319 grants program is administered by the Indiana Department of Environmental Management's (IDEM) Office of Watershed Management (OWM). Work plans, grants administration, financial administration, annual reporting, and use of the Grants Reporting and Tracking System (GRTS) are carried out by the OWM, in accordance with U.S. Environmental Protection Agency (EPA) guidance from Region 5.

Section 319 projects are normally contracted for two to four years. Projects fall into several categories: watershed planning; implementation of plans; education; and demonstration. The application package submitted by the sponsor contains a budget, schedule, description of the problem, proposed activities for addressing the problem, how the project will be evaluated, and letters of commitment from project partners. Project managers work with the sponsor to refine the application package as needed. This package is used to develop the grant agreement between IDEM and the sponsor.

The requirements for Section 319 project grants are: project sponsors must be units of government; nonprofit organizations; or universities; and the area in which the project takes place must be within the watershed of a waterbody which is listed in the current 303(d) list as impaired due to a pollutant that may have a non-point source pollutant (NPS) or is listed in the current 305(b) report as not fully supporting a designated use due to an impairment that may be due to a NPS.

A Lower White Lick Creek Watershed Management Plan was completed by the Morgan County Soil and Water Conservation District in September of 2005 and covered the watershed within this report. There does not appear to be any further 319 work completed within the watershed since that time. Recently there has been new funding mechanism available. An Urban Cost Share program was started within 319 Grant program. Prior approvals of Environmental Best Management Practices would be required by both the watershed group and IDEM program manager. This particular funding mechanism is intended for environmental work. It would be difficult to get approval for a stormwater conveyance or detention project, but it is worth a discussion with the Morgan County Soil and Water Conservation District to see if one of the selected projects may apply for funding.

B. State Revolving Fund Loan Program (SRF)

Although loans are typically distributed for wastewater and drinking water projects, any project that is needed for pollutant removal is eligible for the SRF program. National Park Service (NPS) projects may be eligible for consideration if they provide the following: wetland protection or restoration; on-site sewage disposal; BMPs for agricultural and stormwater runoff; riparian buffers or conservations easements; and wellhead and source water protection. Several of the projects listed herein provide these potential benefits.

Stormwater projects are not eligible if they are intended: solely for economic development; primarily for fire suppression; or for stormwater projects that have no water quality benefit. The SRF is a 20-year loan where the interest rates are reset quarterly and are at or below 90% of the average 2 year triple A rated municipal bond market. The rate may be additionally discounted based on median household income and local user rates. Cities, towns, and conservancy districts are all eligible for the SRF loan program. There is no set maximum allocation for the loan program, but funds are limited for the program as a whole.

C. Flood Control Revolving Fund

The Flood Control Revolving Fund was created by the Indiana General Assembly in the 1950's in order to provide a low interest loan program to help finance local flood control programs. Through I.C. 14-28-5, a loan may be made to a municipality, city, town, county, or special taxing district for the purpose of instituting, accomplishing, and administering any approved flood control program as defined in the Flood Control Revolving Fund Act. The administration of the fund and the responsibility for the provisions of the Act are vested in the Natural Resources Commission. There has recently been a change in the funding authority for the Flood Control Revolving Fund. The new rules have not been officially publicized. Below is a summary of the former regulations.

The Flood Control Revolving Fund is also available to a conservancy district to pay for the costs of establishing a district and costs associated with preparing the district plan for any of the purposes for which a conservancy district can be established. An approved flood control program includes: clearing and straightening of channels; creating new or enlarged channels; repairing levees or other flood control works; establishing floodways; and removing accumulated debris. The proposed flood control program is subject to approval by the Natural Resources Commission. The program must be needed for the purpose of protecting public health, safety, and general welfare. A Flood Control Revolving Fund Loan to any local unit of government cannot exceed $300,000. A Flood Control Revolving Fund Loan may be made for a period not to exceed ten years and has an interest rate of 3 percent.

D. Community Focus Funds Grant (CFF)

CFF Grants are funded with federal Community Development Block Grant (CDBG) dollars from the U.S. Department of Housing and Urban Development (HUD). The goal of the CFF program is to encourage communities with eligible populations to focus on long-term community development. Storm drainage projects are an eligible activity through the CFF program. The project funding is based on the following criteria: low to moderate income population 51 percent or greater; addresses long term planning and development efforts for the community; the funds granted will have a significant impact on the proposed project; and project is ready to proceed and will be completed within 18 months of award. The program is administered through the Indiana Office of Community and Rural Affairs (OCRA).

There is approximately $20 million available each year through this program. Approximately fifty-five percent (55%) of available funds are dedicated to infrastructure projects (water, sewer, storm drainage, dams and levees) with the remaining percentage being divided among the other projects types. The maximum award amount cannot exceed $500,000 for infrastructure and $400,000 for all other construction project types. Fire trucks are limited to $150,000. A local match of at least 10% of the total project cost is required. A minimum of 5% must be in the form of cash or debt. Additional in-kind contributions can be counted as a local match up to 5% of the total project cost, with a maximum of $25,000.

There used to be one competitive funding round per year, but in 2016 there has been two rounds. The application process consists of the submittal of a Letter of Interest to OCRA, a site visit, and submittal of a final application. Please contact the Grant Support Division for application deadlines. An interested applicant should also meet with a Community Liaison to discuss the project prior to submitting a proposal. At the time of application, a city or town cannot have more than one open CFF, MSRP, FF or Planning Grant, and a county cannot have more than two open CFF, FF,

MSRP and/or Planning Grants. Any open FFs, MSRPs or CFFs must be under construction, and a Notice of Construction received by OCRA before another application is submitted. Open Planning Grants must be under contract with the consulting engineer/architect.

E. Property Acquisition Grants – Indiana Department of Homeland Security

Several potential funding opportunities exist through the Indiana Department of Homeland Security (IDHS) in conjunction with the Federal Emergency Management Agency (FEMA). Funding levels vary significantly based on federal dollars available for the various programs. In general, a minimum 25 percent match is required for the project with a maximum project cost based on availability of funds.

Several types of projects are available for grants funds. A basic fee-simple acquisition project simply acquires land and structures, and demolishes the structures located on the land. It is conducted like any other real estate transaction and is the easiest type of acquisition project to implement and manage. The second type of project is a relocation project. A relocation project is a basic acquisition that acquires land but offers an alternative to demolishing structures by moving them outside the floodplain.

A conservation easement may be used in lieu of fee-simple acquisition in areas where the owner wants to retain title. A conservation easement is an easement that prevents the property owner from developing the property. The property owner retains title to his or her property and can transfer title. However, the terms of a conservation easement acquired using grant funds carry the same restrictions as fee-simple acquisition, and the property is forever subject to those terms, regardless of who has title.

A deed restriction is placed on the property during the fee-simple acquisition and conservation easement process. The restriction limits the use of the property to be of open space or wetlands management. No new structures may be built on the property except for the following: a public facility open on all sides and related to open space or recreational use; or a public rest room that is wet flood-proofed.

To start the property acquisition process, a notice of pre-application should be sent to IDHS. After the pre-application letter is sent in, a public meeting is required to further prepare property owners and tenants for the property acquisition project. Additional information will be required for a formal application.

F. Lake and River Enhancement Grant

The goal of the Indiana Department of Natural Resources Division of Fish and

Wildlife's Lake and River Enhancement (LARE) Program is to protect and enhance aquatic habitat for fish and wildlife to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce nonpoint sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards.

This policy allows a specified portion of the match to be provided as in-kind contributions by the sponsor. Any in-kind contributions provided in excess of the established maximum allowable percentage will be viewed as a generous contribution by the sponsor. However, the minimum percentage cash match required will be 10 percent with a local in-kind match of 10 percent or a total match required for all project types of 20 percent. Generally, the grant is limited to $100,000 per project with a grantee limit of $300,000 over a lifetime. Grant deadlines are typically in January.

G. Community Facilities Loan (USDA)

The United States Department of Agriculture has loans available for communities to address long term facility needs. The loans can fund a variety of projects and include stormwater projects. There is no deadline for project submittal, though funding will be allocated during the next federal fiscal year (October 1). Projects have been funded into the $40,000,000 range, with no lower or upper limit specified. The loan does require a financial bond to be in place for the community to pay back the loan. It is possible for the County to issue a revenue bond against the drainage assessments within the watershed. The loan can be used to pay back previously indebted expenses, such as engineering or environmental studies. Funds can be used for property acquisition, but acquisition is required before closing of the loan. At the time of this study the term of the loan is 40 years with a 3.5% interest rate compounded daily. There is no penalty for early repayment. A general timeline for the loan program is shown below.

1. A Preliminary Engineering Report (PER), environmental study and application are prepared and submitted to the USDA. The environmental study normally takes 60 to 120 days to complete. The PER must be approved by the Rural Development State Engineer. The application consists of the application form, several certifications and financial information. A rate study may also be required.

2. Once the above items are received, reviewed and approved the application is sent to the State Office for approval. If the application is approved and funds are available, a letter of conditions is provided to the applicant and the applicant signs a form called the 1940-1 or “Request for

Obligation of Funds". The funds are then obligated in our Finance Office which means that funds have been set aside for the applicant's project.

3. The following are completed after loan approval and before loan closing:

- Final design is completed and reviewed by Rural Development
- Obtain easements and rights-of-way
- Bond counsel prepares the bond and any ordinances that are required, such as a rate ordinance
- Bid documents and prepared and reviewed by Rural Development
- The project is bid
- The winning bid is selected and reviewed by Rural Development
- Contract documents are prepared and reviewed by Rural Development

4. Loan Closing
- Pre-Construction conference
- Notice to Proceed
- Construction begins
- Monthly pay meetings are held
- Inspection by on-site resident inspector during construction period
- Substantial Completion
- Final Inspection
- Use of remaining funds
- Project close

H. Regulated Drain Construction

Under the Indiana Drainage Code IC 36-9-27, a regulated drain may be constructed. The cost share for construction is split between the parcels within the watershed and directly associated with the regulated drain being reconstructed. Sections 54 through 65 of IC 36-9-27 discuss in detail the procedural process for constructing a regulated drain. Some of the basic parameters to meet are an understanding that: the project is to be paid for by the residents owning property within the watershed; per the code; the balance must be paid for in equal installments within 5 years, 10% interest will be applied to any unpaid balance; failure to pay may result in a lien on the property or eventual tax sale; a public hearing and approval by the county drainage board is required before any construction may occur; under Section 98 of IC 36-9-27 the property assessments within the municipal boundaries may be paid for by the municipal fiscal body on behalf of the owners. There is no limit to the amount of funds raised under this code. However, since the funds are borrowed

and paid back to the County General Drain Improvement Fund (GDIF), fiscal responsibility is required by the county.

The watershed studied within this report is slightly different than most regulated drains studied. This reach could easily be classified as an urban drain. Under this classification, the owners may elect to pay the assessment in equal installments of at least one hundred dollars ($100) per year, plus interest on the deferred payments, over a period of not more than twenty (20) years. The yearly payments are to be made semiannually at the time general taxes are payable.

7) References

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http://gis.iu.edu/
2) 39 Degrees North
http://www.39dn.com/
3) 8 Wish TV News Report (7/12/2015)
http://wishtv.com/2015/07/12/reports-of-homes-evacuated-cars-underwater-in-mooresville/
4) Fox 59 News Report (7/12/2015)
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5) Google Earth
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6) Google Earth Street View
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7) ICPR by Streamline Technologies ®
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8) 2004 Mooresville Stormwater Design Manual
http://mooresville.sites.c2itconsulting.net/wp-content/uploads/sites/10/2013/11/Stormwater-Design-Manual.pdf
9) RTV 6 News Report (7/12/2015)
http://www.theindychannel.com/news/local-news/flooding-in-mooresville-prompts-water-rescues
10) Technical Release 55 (TR-55)
http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?cid=stelprdb1042901
11) USDA Soil Reports
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Appendix A - Figures

Figure 1 Watershed Boundary

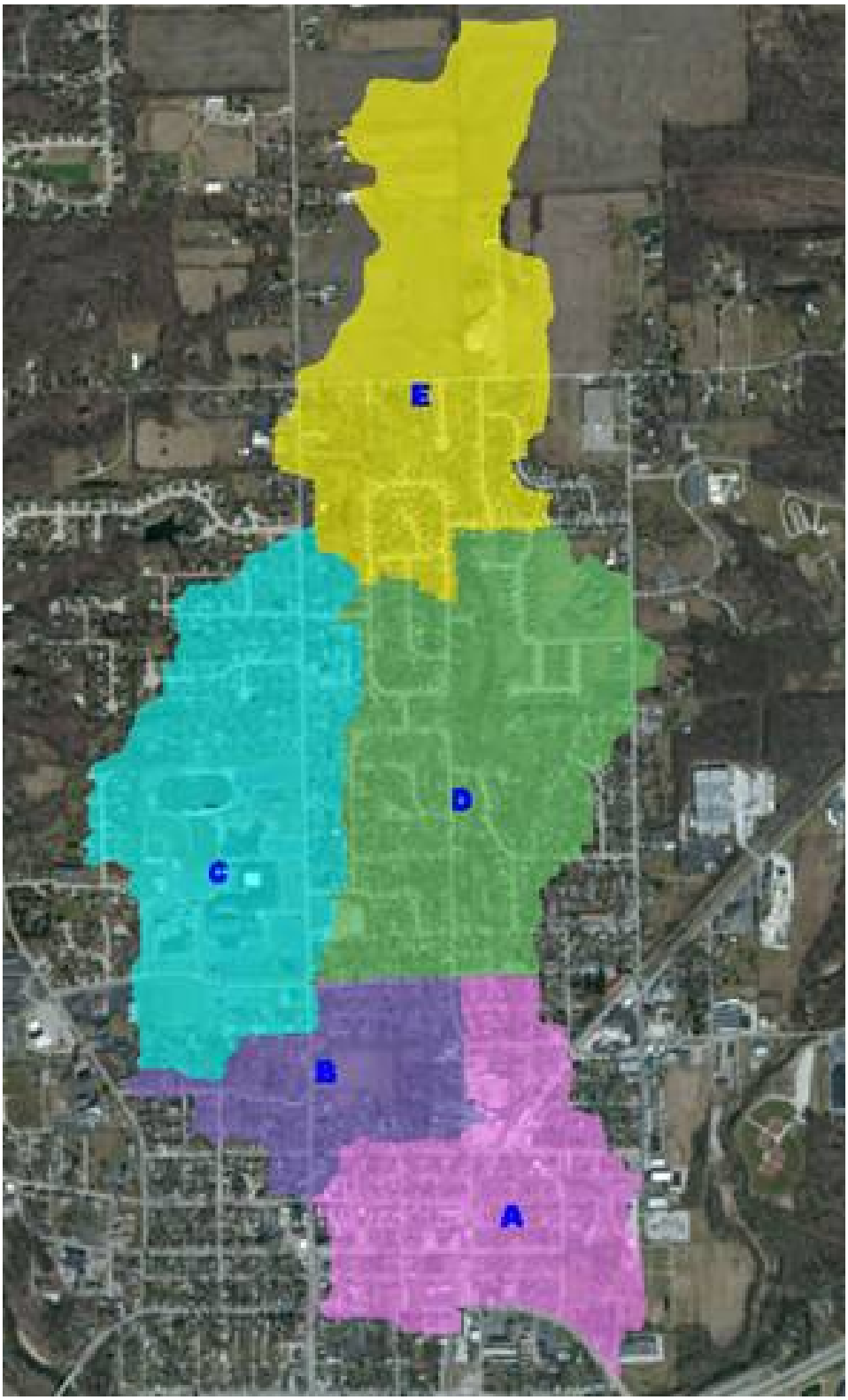


Figure 2 Area of Public Input within Area A

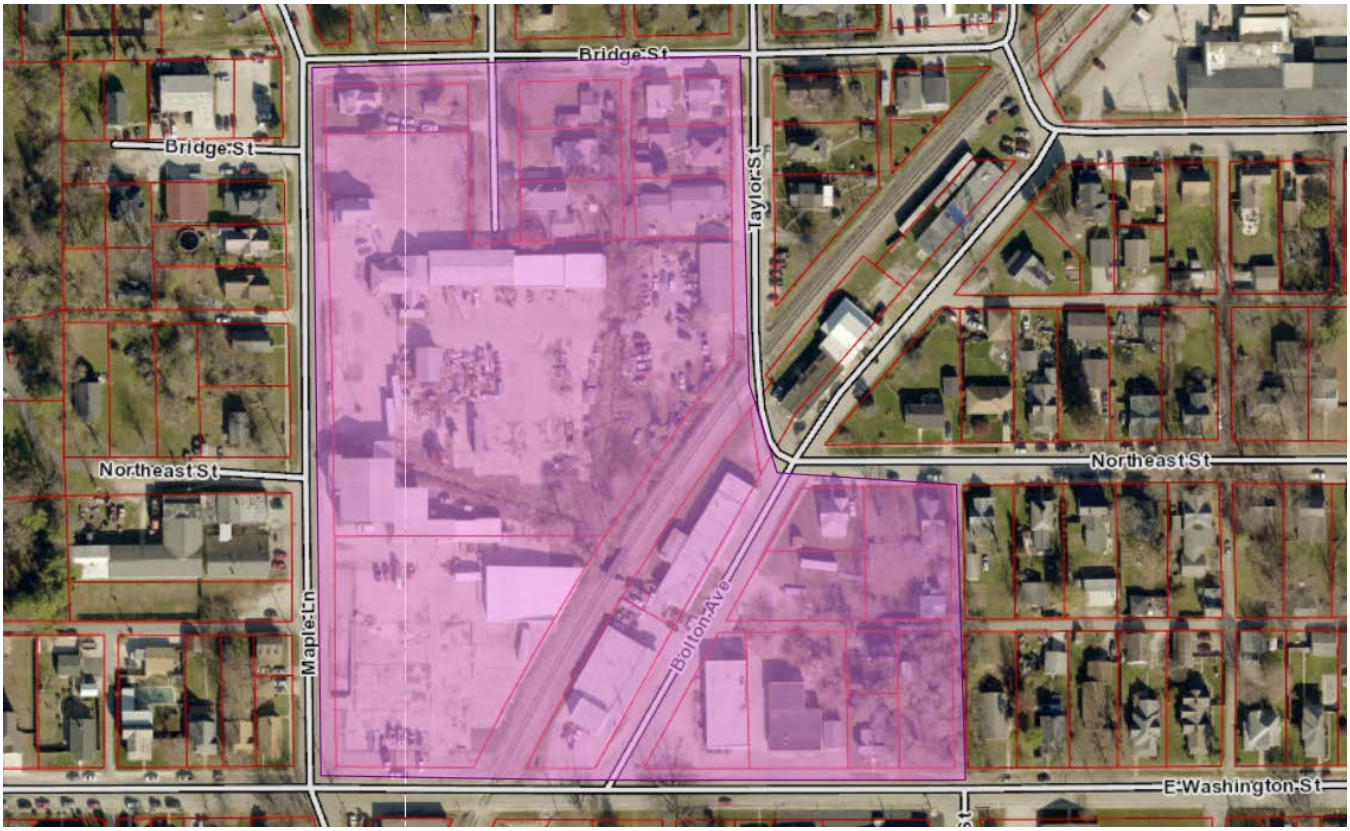


Figure 3 Area of Public Input within Area B

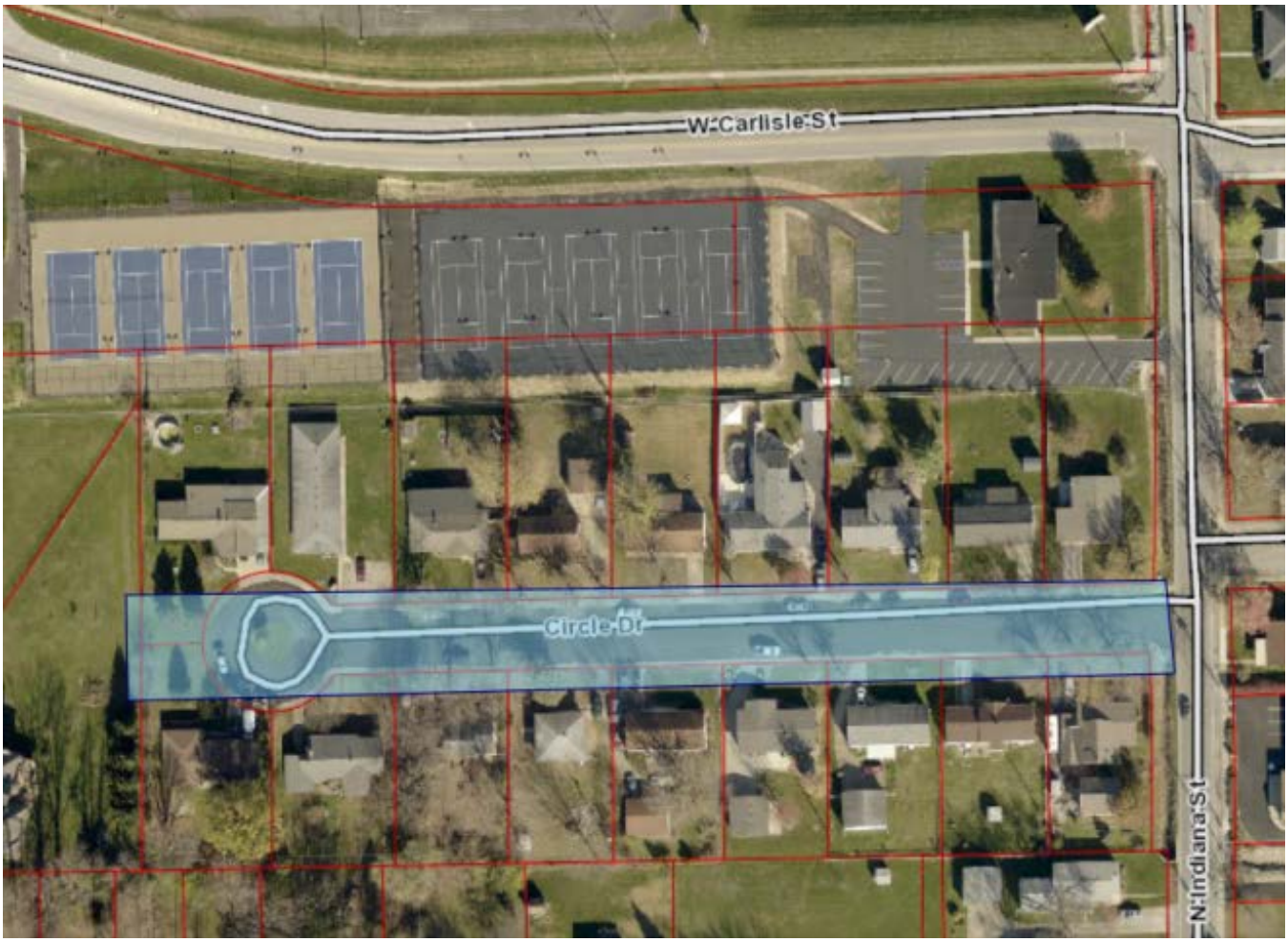


Figure 4 Area of Public Input within Area C

Figure 5 Area of Public Input within Area E

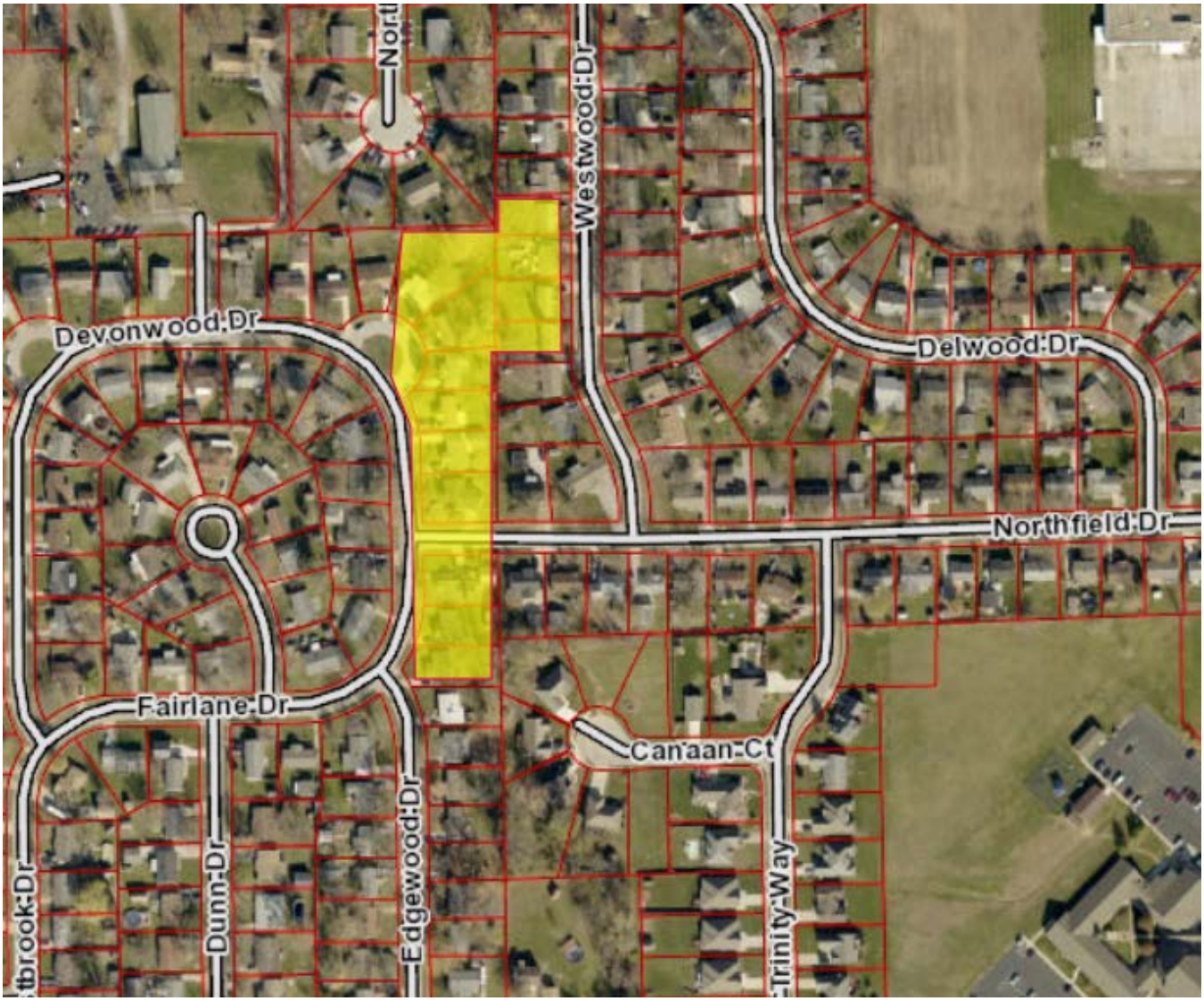


Figure 6 Primary 100-Year Floodplain Area A

Figure 7 Area B Undeveloped Subdivision

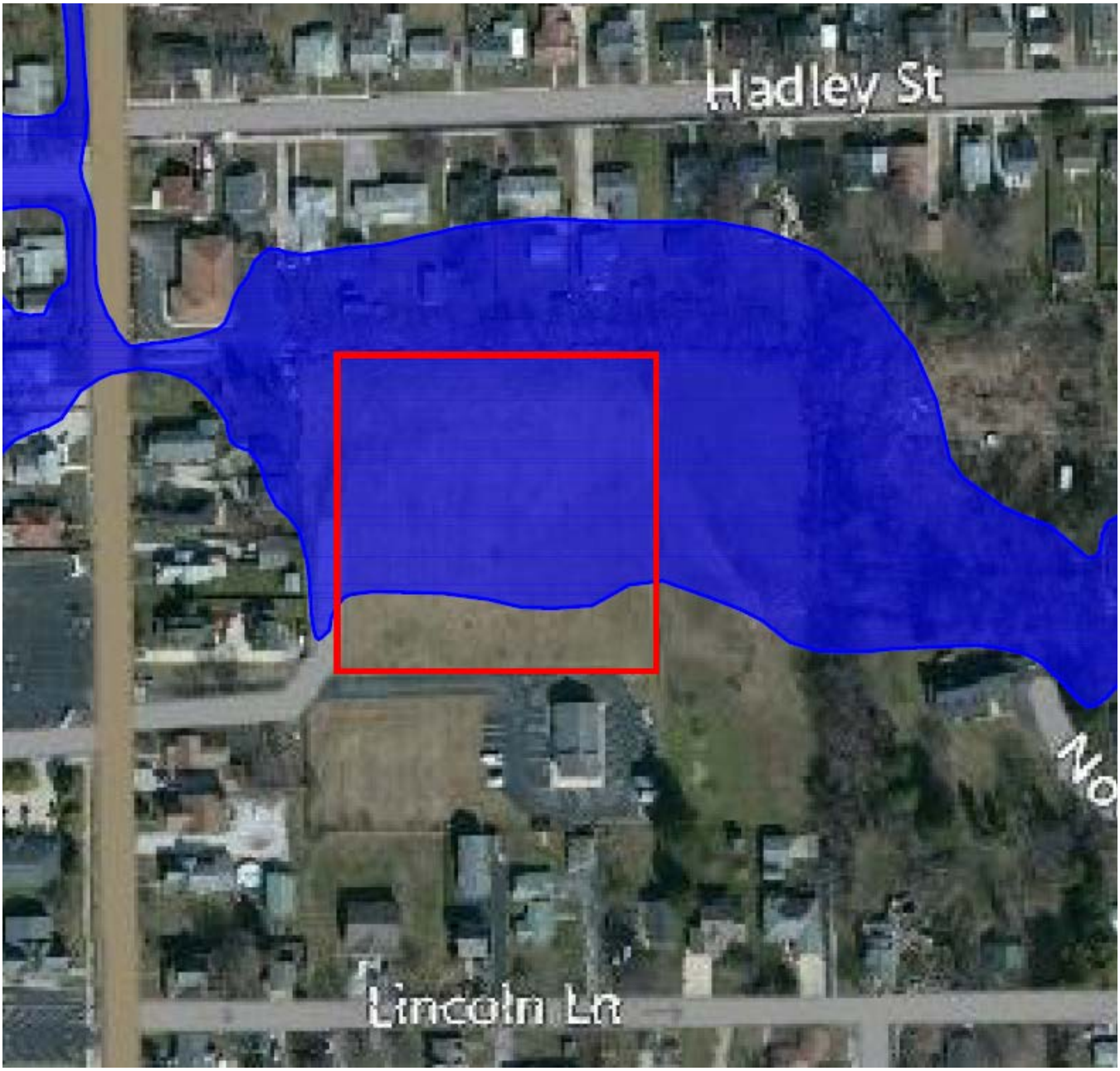


Figure 8 Project A-1 Map

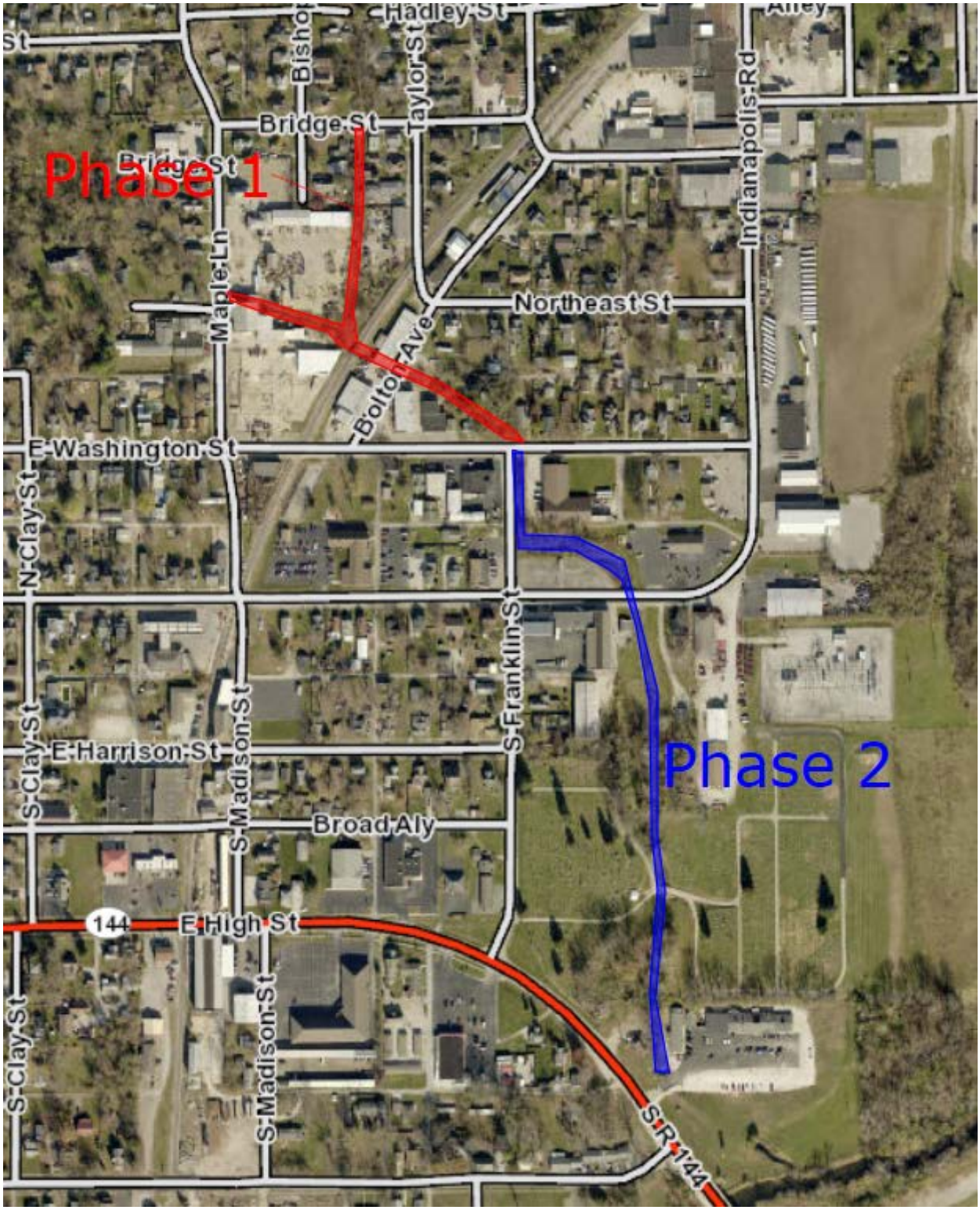


Figure 9 Project A-2 Map

Figure 10 Project A-3 Map

Figure 11 Project B-1 Map

Figure 12 Project C-1 Map

Figure 13 Project D-1 Map

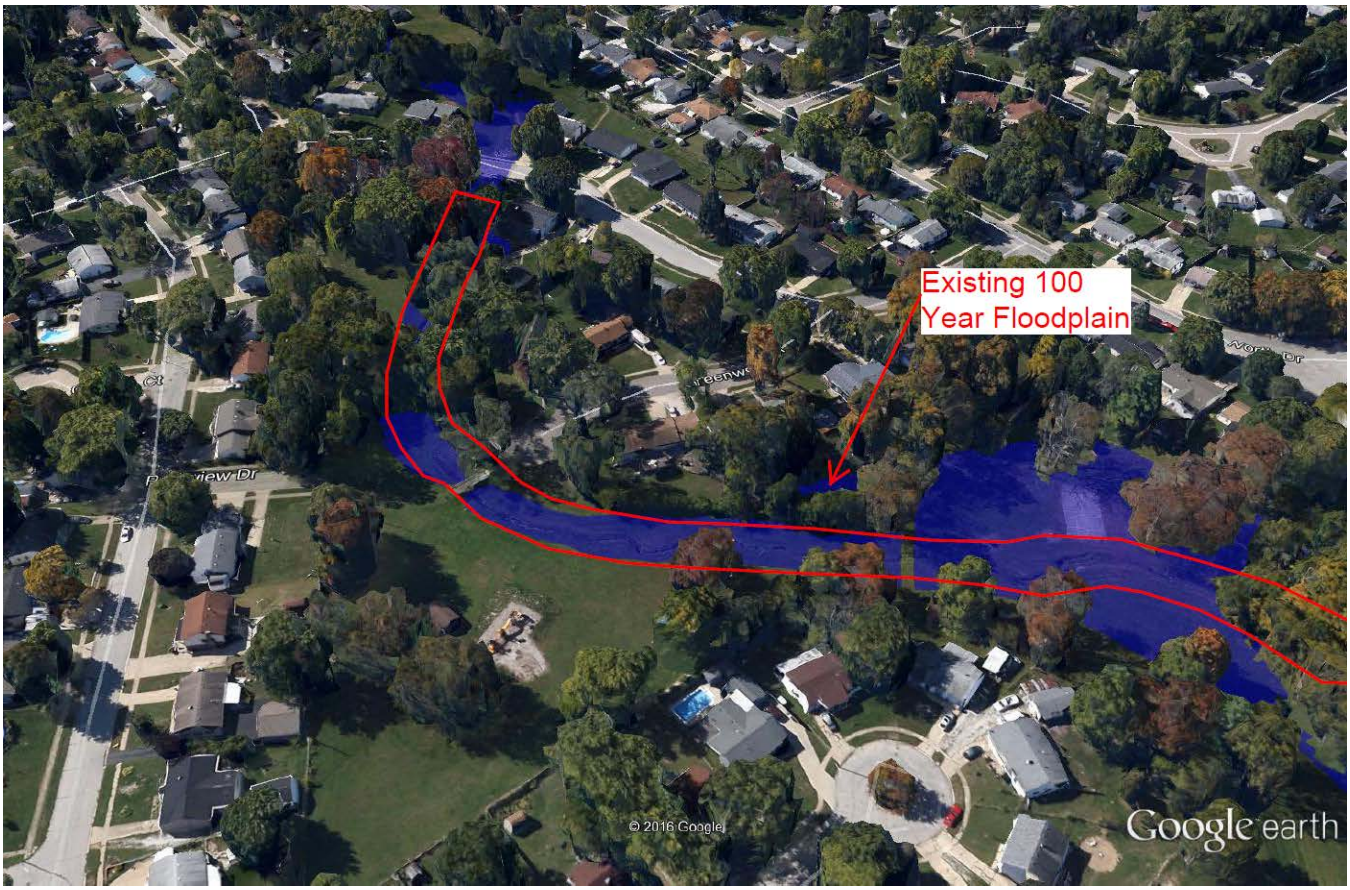


Figure 14 Project E-1 Map

Figure 15 Project E-2 Map

Figure 16 Project E-4 Detention

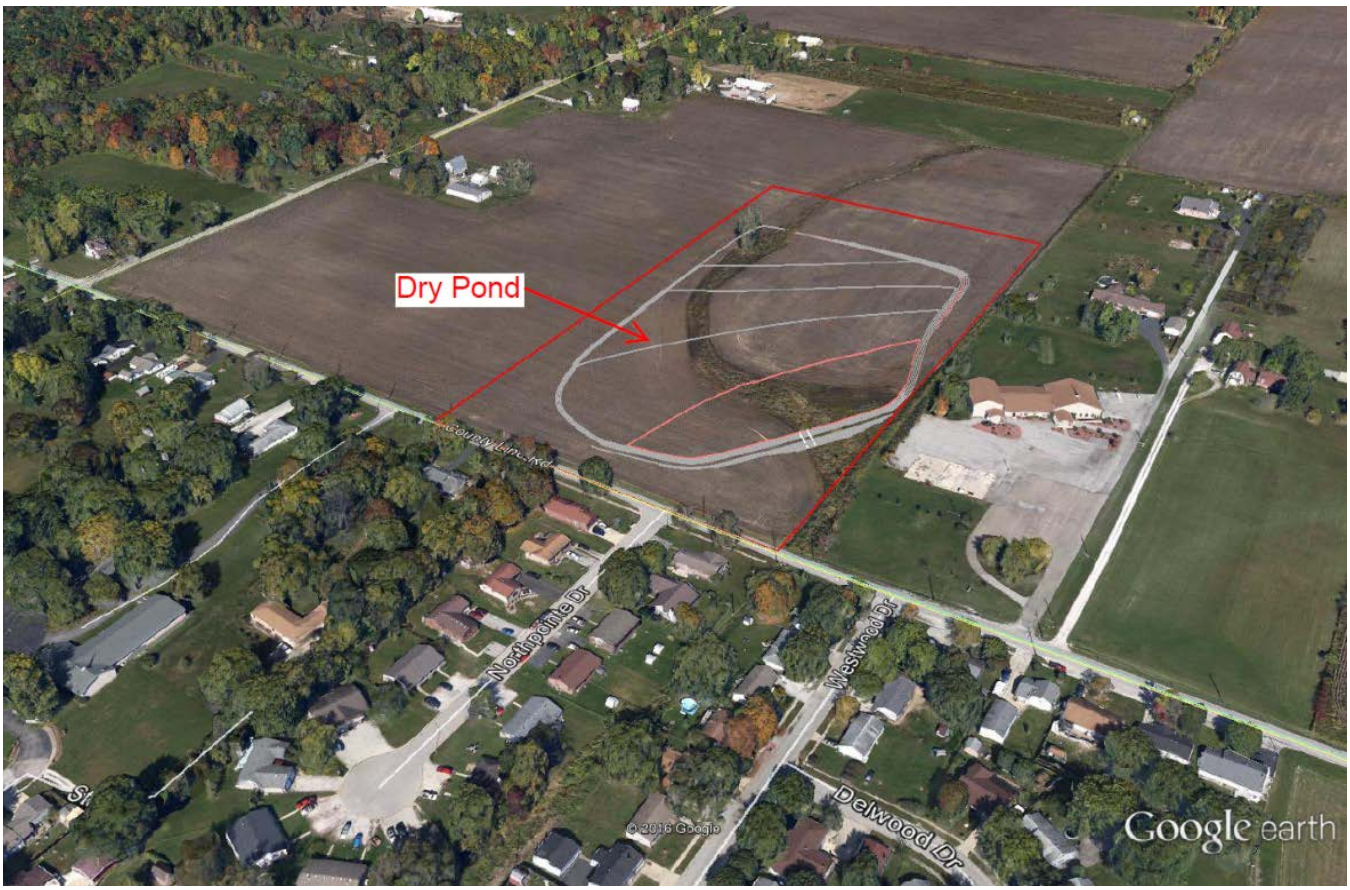


Figure 17 Project E-4 New Pipe

Figure 18 Project E-4 Benefits

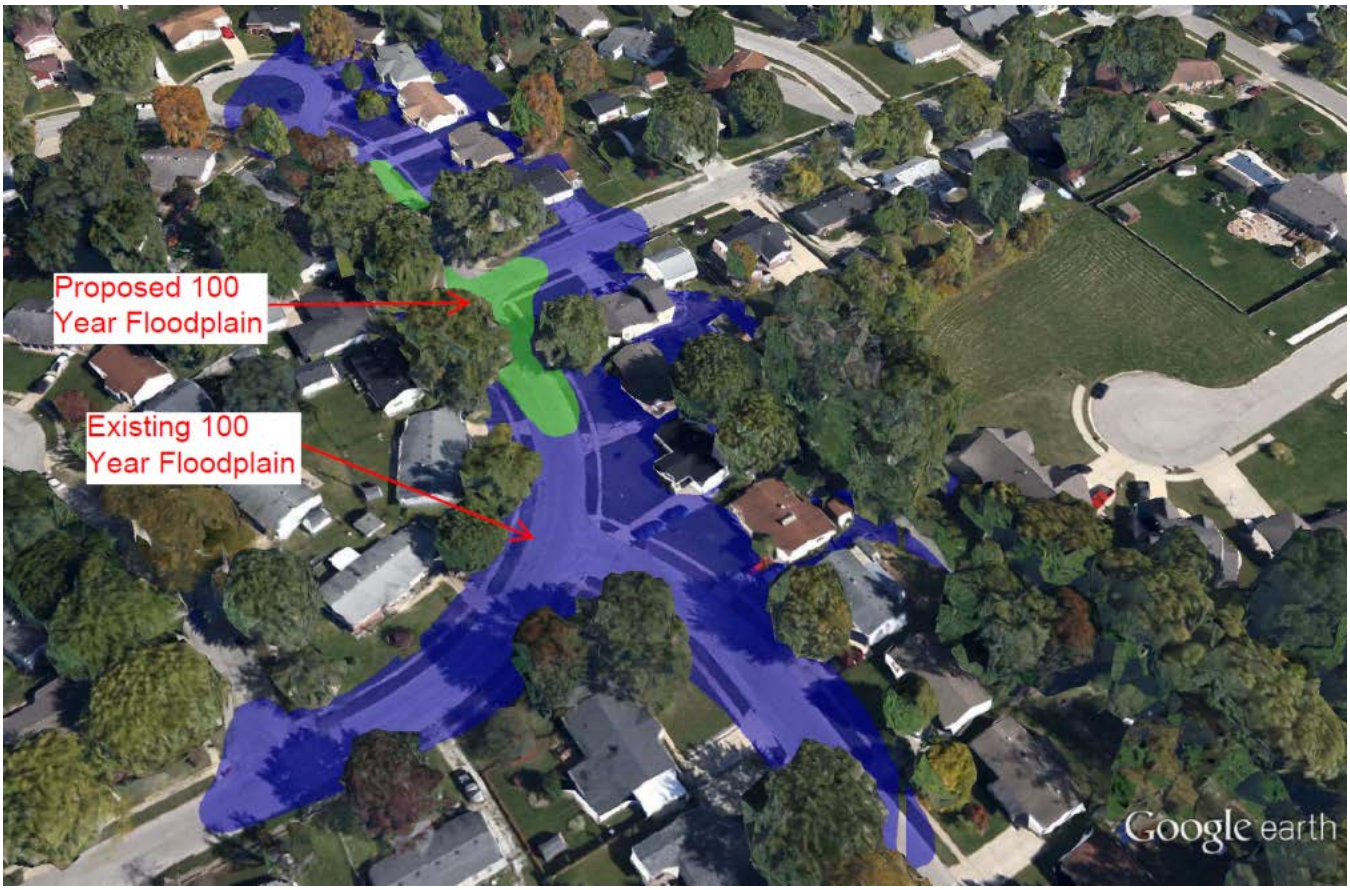
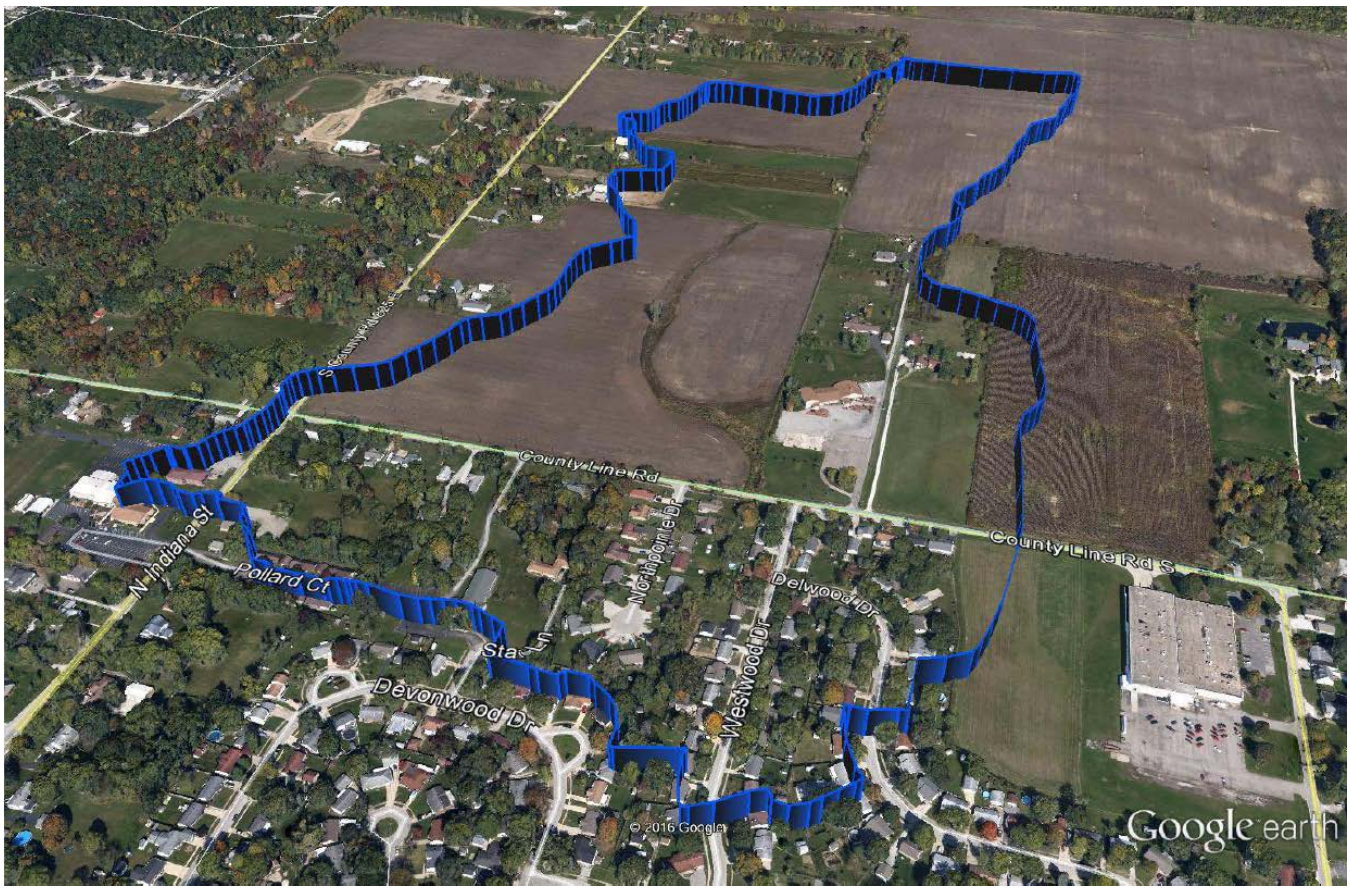


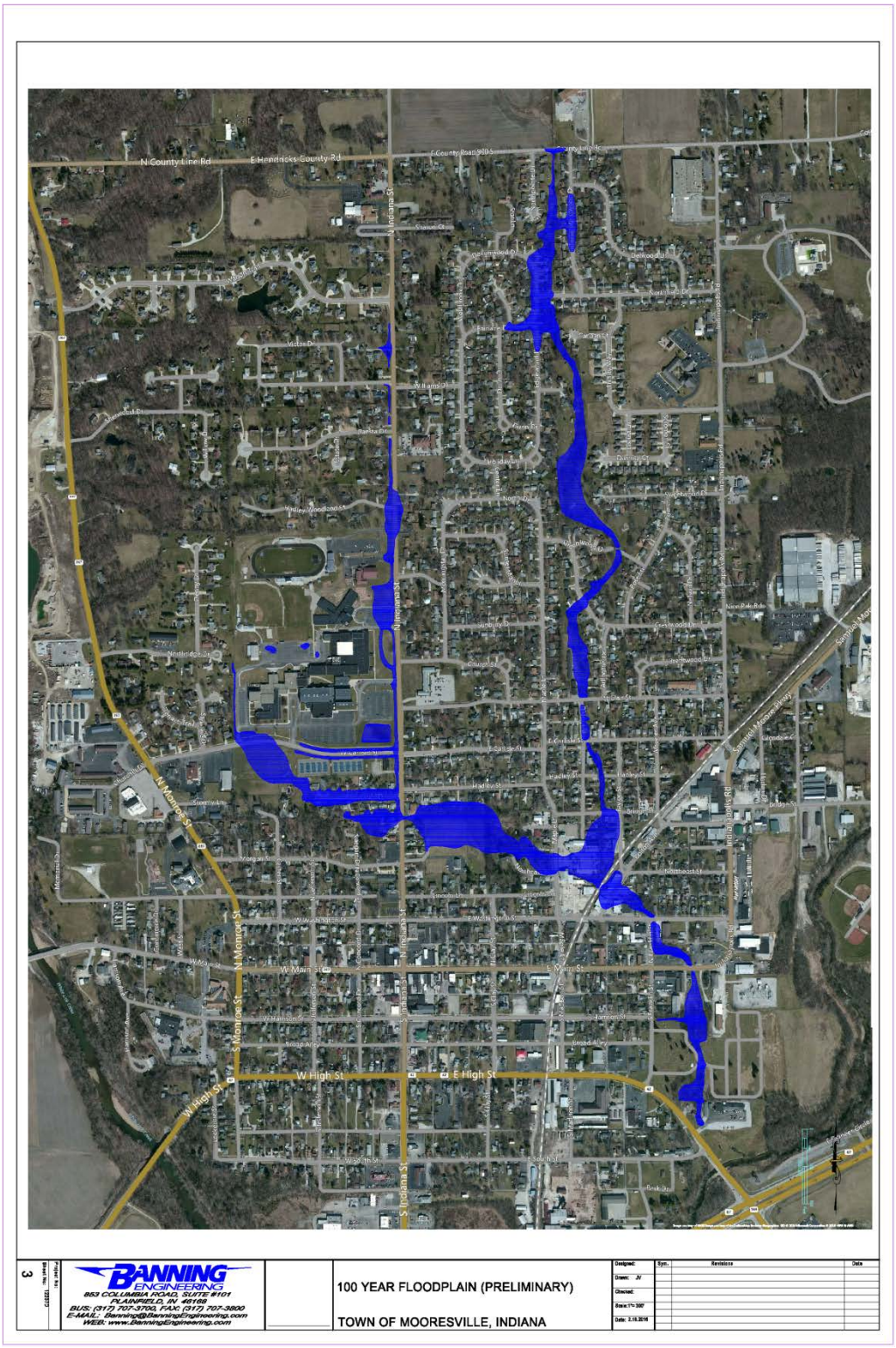
Figure 19 Project E-5 Location

Figure 20 Project E-6 Location

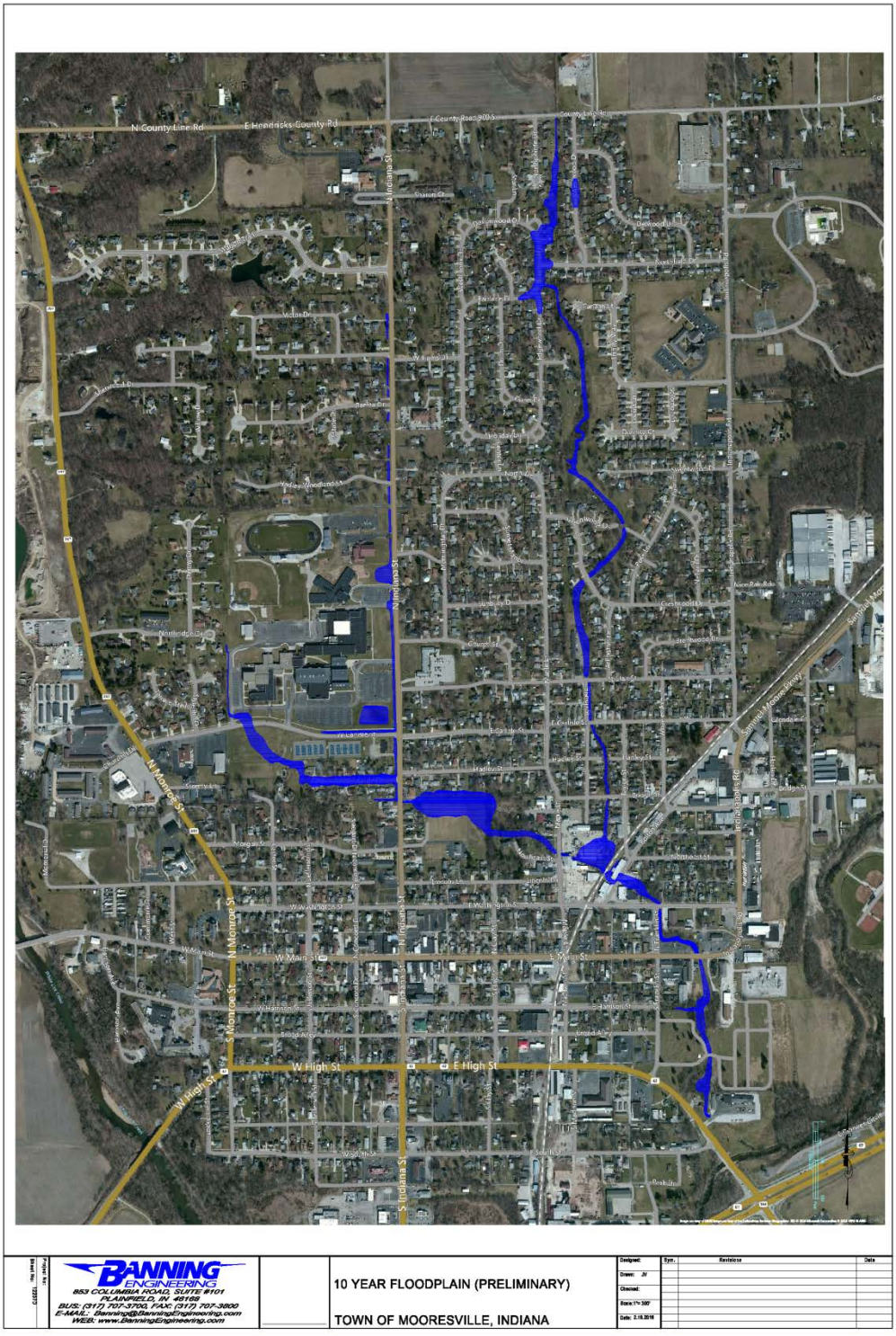
Figure 21 Drainage Impact Area



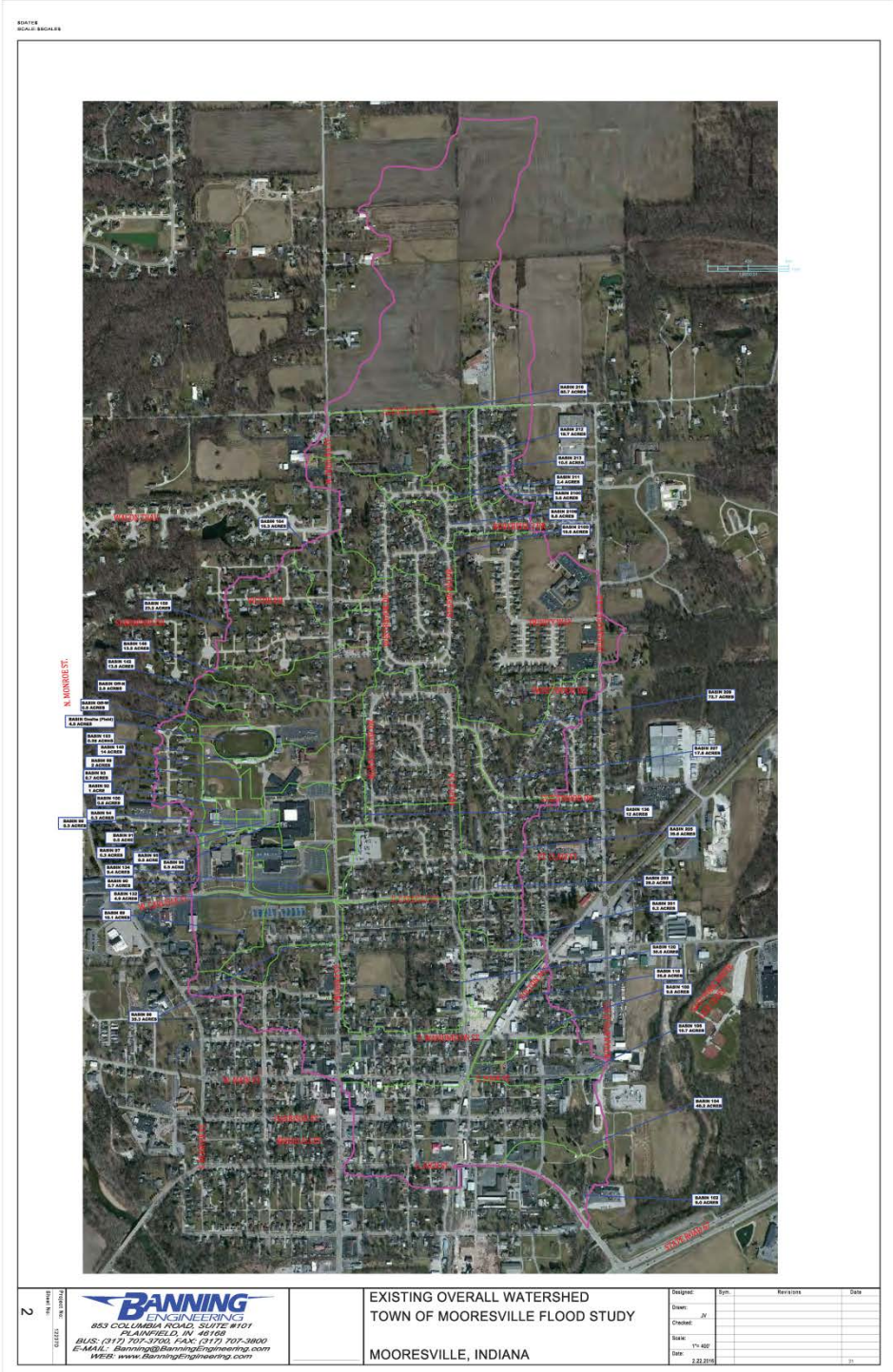
Appendix B – 100-Year Floodplain



Appendix C – 10-Year Floodplain



Appendix D – Overall Watershed



Appendix E – Wetlands Opinion for Project E-4

AquaTerra

AquaTerra Consulting, Inc.
Randy Jones
151 North Home Avenue
Franklin, IN 46131

317/502-7897
866/827-3608 (facsimile)

Randy@aquaterracons.net

Mr. Joe Miller
Banning Engineering, PC
853 Columbia Road Suite 101
Plainfield, IN 46168

January 22, 2016 Re: *Mooresville Drainage Flood Study*
Section 404/401 Permitting
Hendricks County

Dear Mr. Miller:

In regards to our conversation concerning the potential permit ramifications resulting from the construction of a floodwater detention facility at property located near CR 825 East and Countyline Road, in Mooresville, please consider the following:

The US Army Corps of Engineers exercises regulatory authority of all "waters of the United States", including rivers, lakes, streams, and their adjacent wetlands. Based on site observations, I believe that there are jurisdictional waters present in the proposed detention site, including approximately 1-2 acres of emergent/scrub-shrub wetlands, and as much as 600-800 linear feet of ephemeral/intermittent stream channel. To authorize placement of fill material into jurisdictional "waters of the United States", a Section 404 permit from the Corps, and a Section 401 Water Quality Certification, from IDEM, are required. As a condition of permit issuance, the regulatory agencies require that impacts to jurisdictional waters be avoided and minimized, as much as possible, and remaining impacts be compensated for, through mitigation.

We discussed two scenarios for development of a floodwater detention facility at the site.

The first scenario centered on excavation of the area, combined with placement of a water control structure, to create a retention facility, or "wet pond". This method will result in fairly significant impacts to wetlands and stream channels, and the proposal would likely be denied by the agencies because other alternatives, resulting in less impacts to aquatic resources, are available.

Wetland impacts exceeding 1 acre will require issuance of Corps *Individual Permit* (IP), the most stringent permit mechanism. IP issuance requires a comprehensive *alternatives analysis* and *cumulative effects assessment*. For this type of activity, alternatives are presumed to exist. Permit denial is probable for this proposal.

Compensatory mitigation costs could run $30k - $60k per acre of wetland impact, and stream mitigation costs could run $30 - $50 per linear foot. Consulting costs for wetland delineation, IP permitting, and mitigation planning would run approximately $20k - $30k.

Figure 1 **Example of "Wet Pond" scenario**

The second scenario we discussed centered on excavation of areas adjacent to the existing wetlands/streams; to create something functionally similar to floodplain storage areas. This concept involves excavating areas outside of the wetland boundary, and limiting the fill material discharge/impact to jurisdictional waters, to just a control structure. This scenario demonstrates a comprehensive avoidance and minimization of wetland/stream impacts, and would likely result in permit issuance. Although permit applications to Corps and IDEM would still be required, since the fill material discharge could be limited to less than 0.1 acre, mitigation is unlikely to be required.

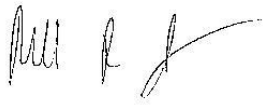
Figure 2 **Example of "Floodplain Storage" scenario**

Permit applications would need to demonstrate that the installation of a water control structure would not cause permanent impacts or degradation to the existing wetlands and/or stream channel functions. This concern can be ameliorated by appropriate water control pipe sizing, which allows for normal stream pass through, and only temporary inundation in existing stream channels, existing wetlands, and excavated floodplain areas, following storm events. Excavation of adjacent "floodplain areas" would serve similar function as existing wetlands, and the project would likely be "self-mitigating".

Consulting costs for this scenario's permit application submittal, including a required wetland delineation of the area, would run approximately $5k-$10k. Mitigation costs would not apply, however, some minimal on-site mitigation measures, such as seeding/planting of the excavated areas, may be required by the agencies.

Please let me know if you have any questions or need additional information at this time.

Sincerely,



Randy Jones
AquaTerra Consulting, Inc.

Figure 3 **Existing wetland areas**

Figure 4 **Existing ephemeral stream channel and adjacent wetlands**

Appendix F – Hendricks / Morgan County Joint Drainage Board Minutes (2012)

HENDRICKS COUNTY / MORGAN COUNTY
JOINT DRAINAGE BOARD

April 20, 2012
11:00 A.M.

Drainage Board members present were: Eric Wathen (Hendricks County), Stan Ryland (Hendricks County), Brian Goss (Morgan County), Don Adams (Morgan County), and Bill Hahn (Park County). Also present were: David Gaston (Hendricks County Surveyor), Terry Brock (Morgan County Surveyor), Deb Verley (Administrative Assistant), and Pete Foley (Morgan County Attorney).

Determination of a Quorum
Pledge of Allegiance
Prayer
Introductions

Election of Officers
Don Adams nominated Eric Wathen for President. Motion seconded by Stan Ryland. There were no other nominations. Motion carried 5-0.

Brian Goss made a motion to appoint Don Adams as Vice President. Motion seconded by Stan Ryland. There were no other nominations. Motion carried 5-0.

Eric Wathen made a motion to appoint Bill Hahn as Secretary. Motion seconded by Brian Goss. There were no other nominations. Motion carried 5-0.

Mudd Creek Drainage Discussion
Terry Brock stated that Mudd Creek goes through the northwest part of Morgan County and also flows through Hendricks County. At a previous meeting, it was discussed that the creek needed cleaning and maintenance. David Gaston stated that there are 10 regulated drains that dump into the creek and showed a map of the area. Mr. Brock stated that they will have to go through the permitting process before any work can begin. Stan Ryland stated that the creek is not wide enough to carry the volume of water and made a motion to have the two county surveyors start a study on the needs of Mudd Creek for the two counties and report back to the board in October. Motion seconded by Don Adams. Motion carried 5-0.

Drainage Issues along County Line Road
David Gaston stated that there are some homes in Mooresville that are getting flooded and the watershed is in Hendricks County. The water flows through a culvert on County Line Road and goes into a swale through the town of Mooresville and into a 36" pipe. Holloway Engineering, at the request of the Morgan County Surveyor, performed an engineering analysis. Ross Holloway, Holloway Engineering, stated that this is a very rudimentary study. There are approximately 141 acres in the watershed and 100 to 110 acres of this is in Hendricks County. There are two issues driving the flooding; there is a restriction above the section of the drainage system that goes through the 36" pipe and will barely handle a two-year flooding event, and the pipe will handle no more than a 10-year event. A viable economic solution would be to retain the water in Hendricks County. This would take a retention basin possibly as large as five acres. Mr. Holloway stated that it is not economical to increase the pipe size because there are houses that are right on the edge of the pipe and it would also be difficult to gain access to the ditch. The retention pond would retain the water upstream so it could be released at a slower rate. The next step would be to analyze the area north of the county line road and determine the size of the pond and where it should be located. The construction of a pond would take agricultural property out of production and would provide minimal benefit to property owners north of County Line Road.

Mr. Wathen asked if there were any public comments. George Watkins, Town of Mooresville Council President, thanked the board for looking at the issue and stated that there are families that have water in their homes because of the flooding and that the town is losing part of their park every season due to erosion. Mr. Watkins stated that it is costing them environmentally as well as financially.

Mr. Ryland asked if the property for the retention pond would be donated or if it would have to be purchased. Mr. Gaston stated that this has not been discussed. Don Adams stated that perhaps a small nature park could benefit the property owner for the retention pond and could be a win, win

solution for everyone. There could also be grant funds available for this purpose. The board discussed who would benefit from the drainage work and how to divide the cost. Stan Ryland made a motion to direct the Morgan County Surveyor to move forward in a study on the detention area and report back to the board in three months. Motion seconded by Brian Goss. David Gaston asked Mr. Holloway to proceed with the preliminary topography work. George Watkins stated that he appreciated the attention the board was giving to the issue. Motion carried 5-0.

Update on Lake Ditch
Terry Brock stated that they have completed the dipping on Lake Ditch, all the spoils have been knocked down, and most of the fields are already planted. It is now clear all the way to the county line and the project was under budget. The next step is to clean under the bridges and then spray for vegetation.

Update on Building One – West Point Business Park
David Gaston stated that it was agreed at a previous joint drainage meeting that the West Point Business Park projects that come in on the Hendricks County portion of property will be reviewed by that county's drainage board and will also send plans to the Morgan County Surveyor for review. There is a project just north of Love's Truck Stop that has received approval by the Hendricks County Drainage Board as well as the Hendricks County Planning Commission. This will be another large building similar to the Johnson & Johnson building.

Wishes to be Heard
There were none.

Next Meeting
The next meeting was set for 11:00 a.m. July 20, 2012 at the Mooresville Government Center, pending confirmation that this date is open.

Adjournment
Stan Ryland made a motion to adjourn the meeting. Motion seconded by Brian Goss. Motion carried 5-0.

HENDRICKS / MORGAN
JOINT DRAINAGE BOARD

_____
Eric Wathen, President

_____
Don Adams, Vice President

_____
Bill Hahn, Secretary

Attest:

_____
David Gaston, Hendricks Co Surveyor

_____
Stan Ryland

_____
Terry Brock, Morgan Co Surveyor

_____
Brian Goss

HENDRICKS COUNTY / MORGAN COUNTY
JOINT DRAINAGE BOARD

October 26, 2012
9:00 A.M.

Drainage Board members present were: Eric Wathen (Hendricks County), Stan Ryland (Hendricks County), Brian Goss (Morgan County), Don Adams (Morgan County). Bill Hahn (Park County) was absent. Also present were: David Gaston (Hendricks County Surveyor), Terry Brock (Morgan County Surveyor), Pete Foley (Morgan County Attorney), and Deb Verley (Administrative Assistant).

Determination of a Quorum

Pledge of Allegiance

Prayer

Minutes
Eric Wathen noted that his name was misspelled in the April 20, 2012 minutes. Stan Ryland made a motion to approve the minutes with the correction. Motion seconded by Don Adams. Motion carried 4-0.

County Line Road Drainage Issue
Terry Brock stated that he received a letter from Russell Webb, Jr., attorney for the Rost Family Farm. The letter stated that Richard and Leo Rost do not believe it is in their best interest to participate in the study that the Joint Drainage Board is conducting. Ross Holloway, Holloway Engineering & Surveying stated that this poses some challenges in devising a solution to the drainage issue along County Line Road and providing relief for the residents whom are getting flooded in Mooresville. Mr. Holloway handed out an elevation map of the area showing an existing wetland in the field close to the church. Expanding the wetland with a 5.93 drainage basin could be a possible solution. The board then discussed legal drains, and urban drains. Pete Foley stated that in order to establish a legal drain there must be a petition filed in the Surveyor's Office with 10% of _____ or 25% of the assessed value. Eric Wathen asked if they would need to issue bonds for the construction and maintenance costs. Mr. Foley stated that the board would need to define the benefits, upstream as well as downstream, and determine if the cost/benefits meet standards. Mr. Holloway stated that the costs could be between $50,000 to $60,000 plus the cost of the land. Dave Gaston asked if the owners were willing to sell. Mr. Ryland suggested making an offer for 10 acres and that would be the starting point. Mr. Gaston stated that he would like to try a regional detention solution before going through the process of a legal drain. Mr. Gaston noted that the homeowners that receive the benefit would be the ones paying for it. Mr. Holloway stated that it could be an annual assessment of $75 to $100.

A discussion followed regarding jurisdiction. Mr. Foley stated that the board would need to purchase the land then petition for a legal drain. Don Adams suggested that there could be funding through the MPO (Metropolitan Planning Organization). Mr. Ryland stated that they should also obtain a commitment for the project from the Town of Mooresville. Mark Mathis (Town of Mooresville Council member) stated that he could not speak for the Council, but would inform them of the issue. The board asked that Mr. Gaston and Mr. Ryland approach Richard and Leo Rost regarding selling property for a retention pond.

Mudd Creek
Terry Brock stated that Mudd Creek will be a major project and he will report back at a future meeting.

Wishes to be Heard
There were none.

Next Meeting
The next meeting was set for 9:00 a.m. November 30, 2012 at the Mooresville Government Center.

Adjournment
Stan Ryland made a motion to adjourn the meeting. Motion seconded by Brian Goss. Motion carried 4-0.

HENDRICKS / MORGAN
JOINT DRAINAGE BOARD

Eric Wathen, President

Don Adams, Vice President

Bill Hahn, Secretary

Attest:

David Gaston, Hendricks Co Surveyor

Stan Ryland

Terry Brock, Morgan Co Surveyor

Brian Goss

Appendix G – Photo Log

Photo 1: Outlet Channel to East Fork of White Lick Creek
Station: 100

Photo 2: 9ft CMP outlet near Squealers BBQ
Station: 100

Photo 3: 9ft CMP near Squealers BBQ
Station: 102

Photo 4: 9ft CMP near Squealers BBQ
Station: 102

Photo 6: Culvert on Main Street
Station: 106

Photo 8: Bridge at Tackle Service Center
Station: 110

Photo 5: Culvert in cemetery
Station: 104

Photo 7: Culvert at E. Washington Street
Station: 107

Photo 10: Structure over ditch near Bolton Avenue
Station: 113

Photo 12: Railroad trestle/bridge
Station: 115

Photo 9: Culvert at Bolton Avenue
Station: 111

Photo 11: Structure over ditch near Bolton Avenue
Station: 114

Photo 14: Industrial access bridge near Maple Lane
Station: 119A

Photo 16: Culvert under Orthodontics parking lot
Station: 121

Photo 13: Structure over ditch near Maple Lane
Station: 118

Photo 15: Culvert under Maple Lane
Station: 120

Photo 18: Culvert under Indiana Street
Station: 123

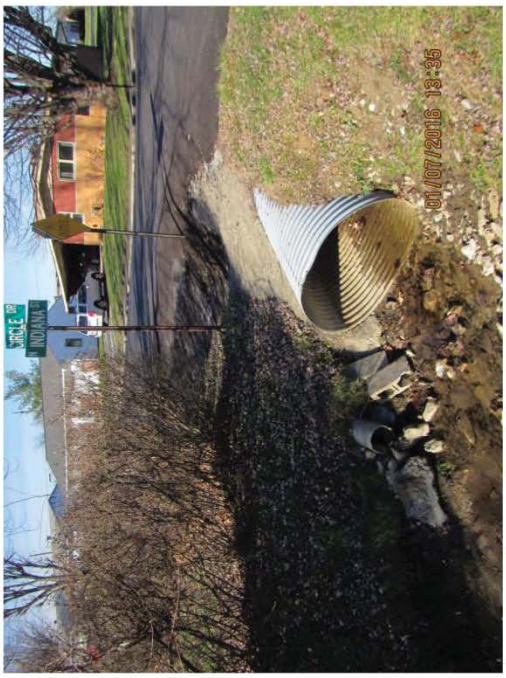


Photo 20: Culvert under Circle Drive along Indiana Street
Station: 125

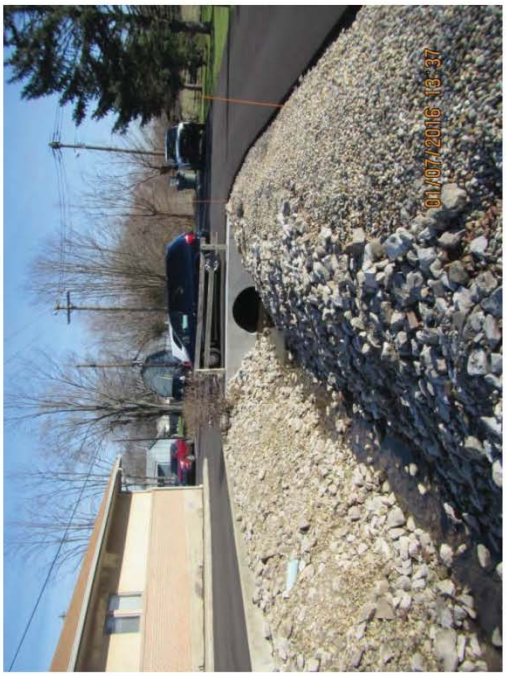


Photo 17: Culvert under Orthodontics parking lot
Station: 122

Photo 19: Culvert under Indiana Street
Station: 124

Photo 22: Circle Drive outlet to the Indiana Street roadway ditch
Station: 126

Photo 24: Culvert under Carlisle Street ; Pedestrian bridge
Station: 130

Photo 21: Circle Drive outlet to the Indiana Street roadway ditch
Station: 125

Photo 23: Culvert under Carlisle Street
Station: 129

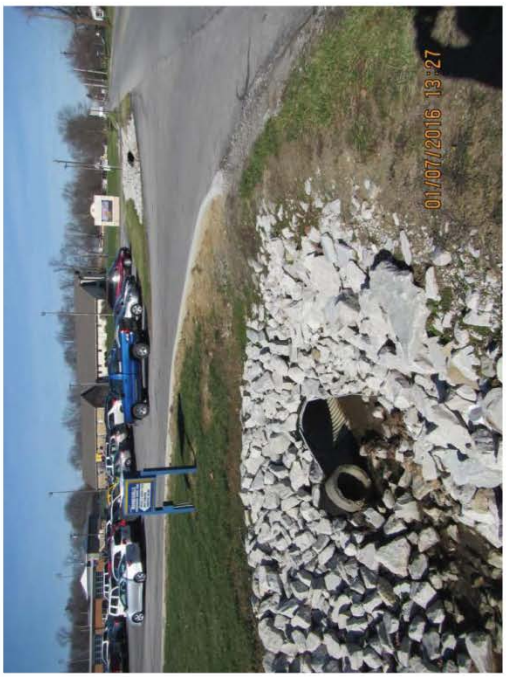


Photo 26: Culvert at school entrance along Indiana Street
Station: 137

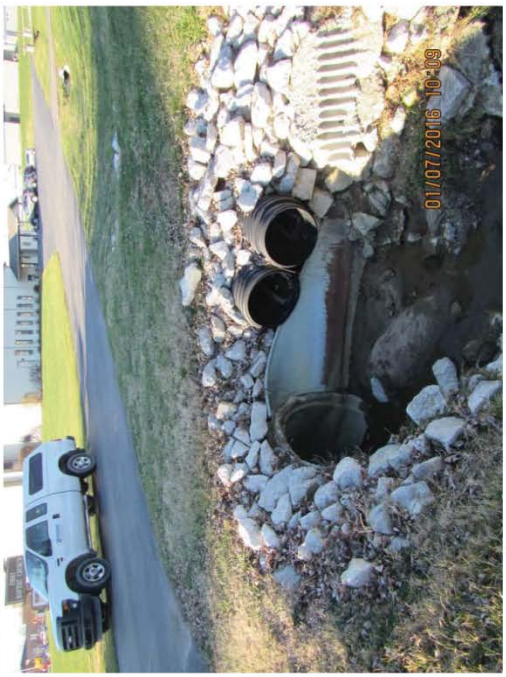


Photo 28: Culvert at school along Indiana Street
Station: 142

Photo 25: Culvert at school entrance along Indiana Street
Station: 136

Photo 27: Culvert at school along Indiana Street
Station: 140

Photo 30: Culvert under Hadley Woodland St.
Station: 146

Photo 32: Storm sewer along Indiana Street
Station: 150

Photo 29: Culvert under access road to football field and parking lot
Station: 143

Photo 31: Culvert under private drive along Indiana Street
Station: 147

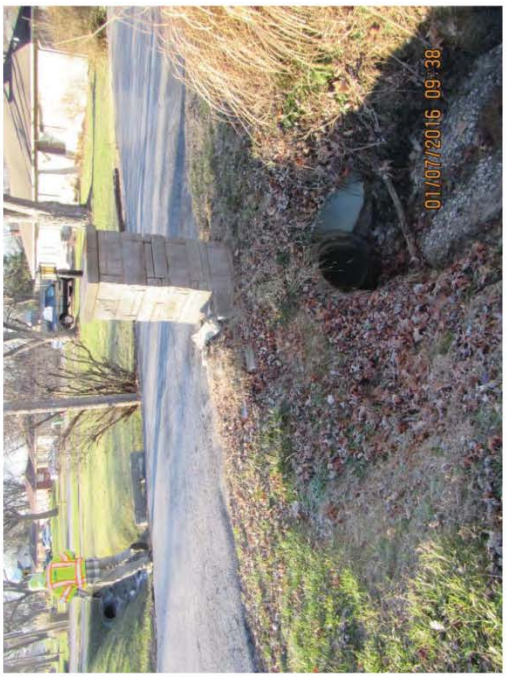


Photo 34: Culvert under private drive along Indiana Street
Station: 157

Photo 36: Storm sewer north of Victor Drive, along Indiana Street
Station: 160

Photo 33: Culvert under Raesta Drive
Station: 153

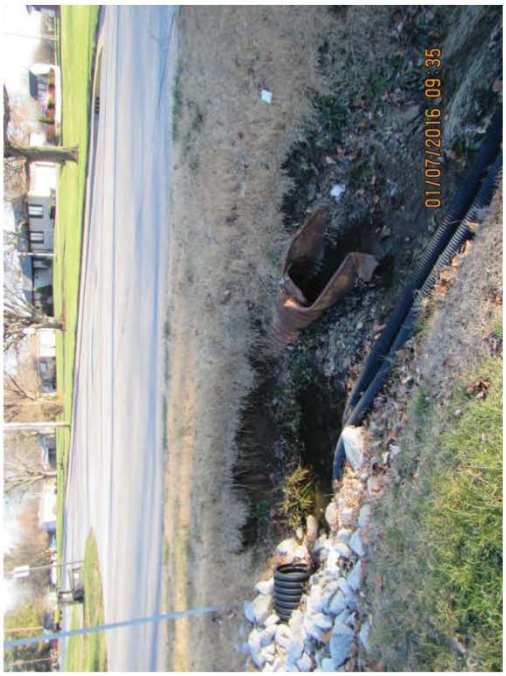


Photo 35: Culvert under Victor Drive
Station: 158

Photo 38: Culvert under Bridge Street, near Bishop Street, looking South
Station: 201

Photo 40: Culvert under E. Carlisle Street, looking South
Station: 202

Photo 37: Upstream end of study reach, along Indiana Street
Station: 164

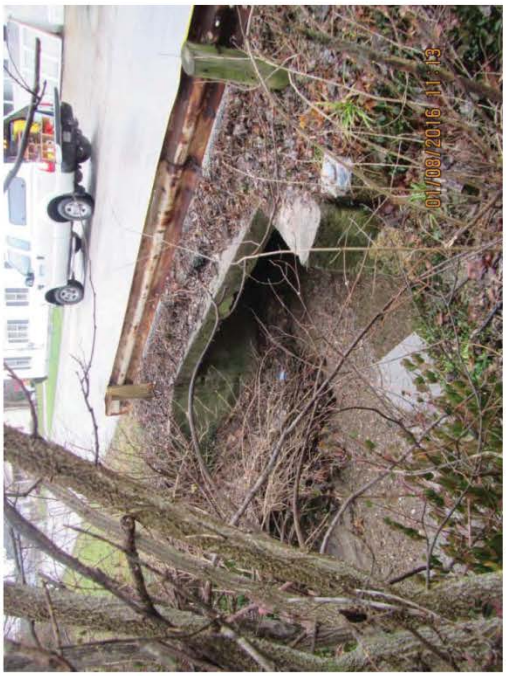


Photo 39: Culvert under Bridge Street, near Bishop Street
Station: 200

Photo 42: Culvert under St. Clair Street
Station: 204

Photo 44: Culvert under Crestwood Drive
Station: 207

Photo 41: Culvert under E. Carlisle Street, looking South
Station: 203

Photo 43: Culvert under St. Clair Street
Station: 205

Photo 46: Pedestrian bridge in park, across from Greenwood Drive
Station: 208

Photo 48: Manhole connection on Northfield Drive
Station: 210A

Photo 45: Culvert under Crestwood Drive
Station: 206

Photo 47: Downstream outlet off of Northfield Drive
Station: 210

Photo 50: Low point on Edgewood Drive, looking North
Station: 210B

Photo 52: Outlet from Westwood drive into backyard ditch
Station: 212

Photo 49: Low point on Edgewood Drive, looking South
Station: 210B

Photo 51: Upstream end of 30"RCP, west of Westwood Drive
Station: 211

Photo 54: E. County Road 900 South, looking South
Station: 215

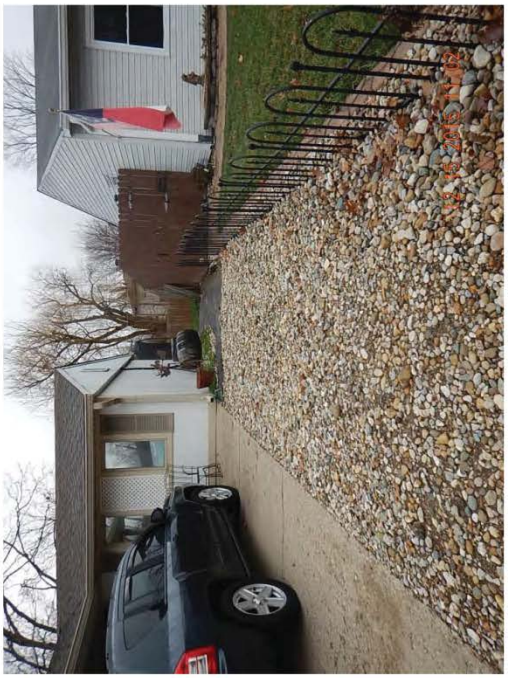


Photo 53: Unofficial overflow route from Westwood Drive between
Station: the houses.

Photo 55: Culvert under E. County Road 900 South
Station: 215

Photo 56:
Station:

Appendix H– Project Cost Estimates

Engineer's Estimate of Probable Costs
Town of Mooresville Drainage Study
Morgan County, Indiana
Project A-1 (Clean and Dip Ditch)

Phase 1

line	item	quantity	unit	unit price	total cost
1	Tree Removal (1-side)	1,000	LF	$20.00	$20,000.00
2	Debris and Sediment Removal	1,430	LF	$10.00	$14,300.00
3	Haul Away	425	CYD	$15.00	$6,375.00
4	Under Buildings and Railroad	3	EA	$2,500.00	$7,500.00
5	Seeding	1	Acres	$5,000.00	$5,000.00

Subtotal	$53,175
20% Contingency	$10,635
Total	$63,810

Phase 2

line	item	quantity	unit	unit price	total cost
1	Tree Removal (1-side)	975	LF	$20.00	$19,500.00
2	Debris and Sediment Removal	1,850	LF	$7.50	$13,875.00
3	Haul Away	275	CYD	$15.00	$4,125.00
4	Seeding	1	Acres	$5,000.00	$6,250.00

Subtotal	$43,750
20% Contingency	$8,750
Total	$52,500

Engineer's Estimate of Probable Costs
Town of Mooresville Drainage Study
Morgan County, Indiana
Project B-1 (Green Space Converted to Offline Detention)

line	item	quantity	unit	Median unit price	total cost
1	Mobilization / Demobilization	1	LS	$24,000.00	$24,000.00
2	Tree & Root Removal	0.5	ACRES	$5,250.00	$2,625.00
3	Strip Stockpile and Place Topsoil	2,420	CYD	$7.00	$16,940.00
4	Silt fence	1,600	LF	$3.00	$4,800.00
5	Erosion Control Blankets	5,000	SY	$3.00	$15,000.00
6	Excavation and Soil Removal	12,000	CYD	$15.00	$180,000.00
7	Seeding	3.3	ACRES	$5,000.00	$16,500.00
8	18" RCP	60	LF	$35.00	$2,100.00
9	Riprap	50	TONS	$60.00	$3,000.00
				Subtotal	$264,965
				W/ 15% Contingency	$304,710
10	Land Acquisition (Estimated)	3.75	ACRES	$20,000.00	$75,000.00
11	Professional Services	1	20%	$60,941.95	$60,942
				Subtotal	$135,942
				Total Project Cost	$440,652

Engineer's Estimate of Probable Costs
Town of Mooresville Drainage Study
Morgan County, Indiana
Project C-1 (Piping Indiana Street with Offline Detention)

line	item	quantity	unit	Median unit price	total cost
1	Mobilization / Demobilization	1	LS	$40,000.00	$40,000.00
2	Strip & Stockpile Topsoil	1,100	CYD	$7.00	$7,700.00
3	Silt fence	3,000	LF	$3.00	$9,000.00
4	Excavation and Soil Removal	8,000	CYD	$15.00	$120,000.00
5	Topsoil Placement	1,100	CYD	$7.00	$7,700.00
6	Seeding	3	ACRES	$5,000.00	$15,000.00
7	Class I Riprap	60	TONS	$40.00	$2,400.00
8	Pipe Removal	6	EACH	$1,200.00	$7,200.00
9	30 Inch Pipe	2200	LF	$70.00	$154,000.00
10	Manholes / Inlets	15	EACH	$3,500.00	$52,500.00
11	Curb	2200	LF	$25.00	$55,000.00
12	Pavement Repair	2200	LF	$35.00	$77,000.00
				Subtotal	$547,500
				W/ 20% Contingency	$657,000
13	Professional Services	1	15%	$98,550.00	$98,550
				Subtotal	$98,550
				Total Project Cost	$755,550

Engineer's Estimate of Probable Costs
Town of Mooresville Drainage Study
Morgan County, Indiana
Project D-1 (Two-Staged Ditch)

line	item	quantity	unit	Median unit price	total cost
1	Mobilization / Demobilization	1	LS	$5,660.00	$5,660.00
2	Silt fence	2,500	LF	$3.50	$8,750.00
3	Erosion Control Blankets	2,000	SY	$3.00	$6,000.00
4	Excavation	3,000	CYD	$8.00	$24,000.00
5	New Pipe	30	LF	$175.00	$5,250.00
6	Seeding	4	ACRES	$3,150.00	$12,600.00
				Subtotal	$62,260
				W/ 20% Contingency	$74,712
7	Professional Services	1	20%	$14,942.40	$14,942
				Subtotal	$14,942
				Total Project Cost	$89,654

Engineer's Estimate of Probable Costs
Town of Mooresville Drainage Study
Morgan County, Indiana
Project E-2 (Additional Inlets to Drain Low Area at Northfield and Edgewood Drives)

line	item	quantity	unit	Median unit price	total cost
1	Mobilization / Demobilization	1	LS	$2,170.00	$2,170.00
2	24 Inch Pipe	110	LF	$70.00	$7,700.00
3	Pavement Repair	110	LF	$35.00	$3,850.00
4	Inlets	2	EA	$3,500.00	$7,000.00
5	Incidentals	1	LS	$3,150.00	$3,150.00
				Subtotal	$23,870
				W/ 20% Contingency	$28,644
6	Professional Services	1	20%	$5,728.80	$5,729
				Subtotal	$5,729
				Total Project Cost	$34,373

Engineer's Estimate of Probable Costs
Town of Mooresville Drainage Study
Morgan County, Indiana
Project E-4 (County Line Storage and New Pipes at Edgwood / Northfield Drives)

line	item	quantity	unit	Median unit price	total cost
1	Mobilization / Demobilization	1	LS	$60,000.00	$60,000.00
2	Strip & Stockpile Topsoil	8,000	CYD	$7.00	$56,000.00
3	Silt fence	2,700	LF	$3.00	$8,100.00
4	Erosion Control Blankets	3,000	SY	$3.00	$9,000.00
5	Excavation & Removal	17,000	CYD	$15.00	$255,000.00
6	Compacted Earthfill	1,300	CYD	$12.00	$15,600.00
7	Topsoil Placement	8,000	CYD	$7.00	$56,000.00
8	Seeding	12	ACRES	$3,500.00	$42,000.00
9	Riprap	400	TONS	$60.00	$24,000.00
10	Structure Removal	3	EA	$3,000.00	$9,000.00
11	15 Inch Pipe	40	LF	$35.00	$1,400.00
12	18 Inch Pipe	280	LF	$55.00	$15,400.00
13	24 Inch Pipe	250	LF	$65.00	$16,250.00
14	30 Inch Pipe	140	LF	$80.00	$11,200.00
15	Manholes and Inlets	3	EA	$3,500.00	$10,500.00
16	Street Repair	1	LS	$30,000.00	$30,000.00
				Subtotal	$619,450
				W/ 20% Contingency	$743,340
17	Land Acquisition	12	ACRES	$9,000	$108,000
18	Professional Services	1	20%	$148,668	$148,668
				Subtotal	$256,668
				Total Project Cost	$1,000,008

Engineer's Estimate of Probable Costs
Town of Mooresville Drainage Study
Morgan County, Indiana
Project E-7 (Purchase 1 House at Each end of Edgewood, Install Overflow Paths)

line	item	quantity	unit	Median unit price	total cost
1	Purchase Residence	2	EA	$90,000.00	$180,000.00
2	Control Structure	2	EA	$5,000.00	$10,000.00
3	Berms	2	EA	$5,000.00	$10,000.00
				Subtotal	$200,000
				W/ 20% Contingency	$240,000
4	Professional Services	1	20%	$48,000.00	$48,000
				Subtotal	$48,000
				Total Project Cost	$288,000