To:	Donald J. Smith, Attorney at Law - Katz Korin Cunningham
From:	Jon Stolz, PE - Christopher B. Burke Engineering, LLC
Subject:	Preliminary Findings Regarding Flooding at Burnside and E-shaped ponds
Date:	December 7, 2020
Project Name:	Burnside and E-shaped Pond Flood Impacts, Shelbyville, Indiana
Project No.:	20-0481.00000
Cc:	

The purpose of this study was to evaluate the impact of fill activity and a proposed development on two separate, existing ponds located on the north side of Shelbyville, Indiana. The City and the property owner of the ponds would like to have a hydrologic study of the area performed to examine the impact of earlier fill activity at one site and proposed construction adjacent to the second site.

Site 1: Burnside Pond

The site is located on the west side of Riley Highway (formerly State Road 9) about 3,300 feet north of the Big Blue River. Burnside Pond is currently 13.6 acres in size under normal non-flood conditions. It is bounded by agricultural ground to the north, which is also the site of the proposed development. To the east is Riley Highway, to the south there are additional undeveloped low ground and light commercial, and to the west there is also light commercial, a few homes, and the Shelby County Highway Garage.

The Burnside pond was presumedly created for extraction of gravel material many decades ago. The pond is of unknown depth and does not appear to have any dedicated drainage infrastructure for maintaining a water level or

for drainage of runoff flowing to it. While it appears that filling of the pond may have begun around 1998, fill activity apparently ended around 2008.

1998

2008

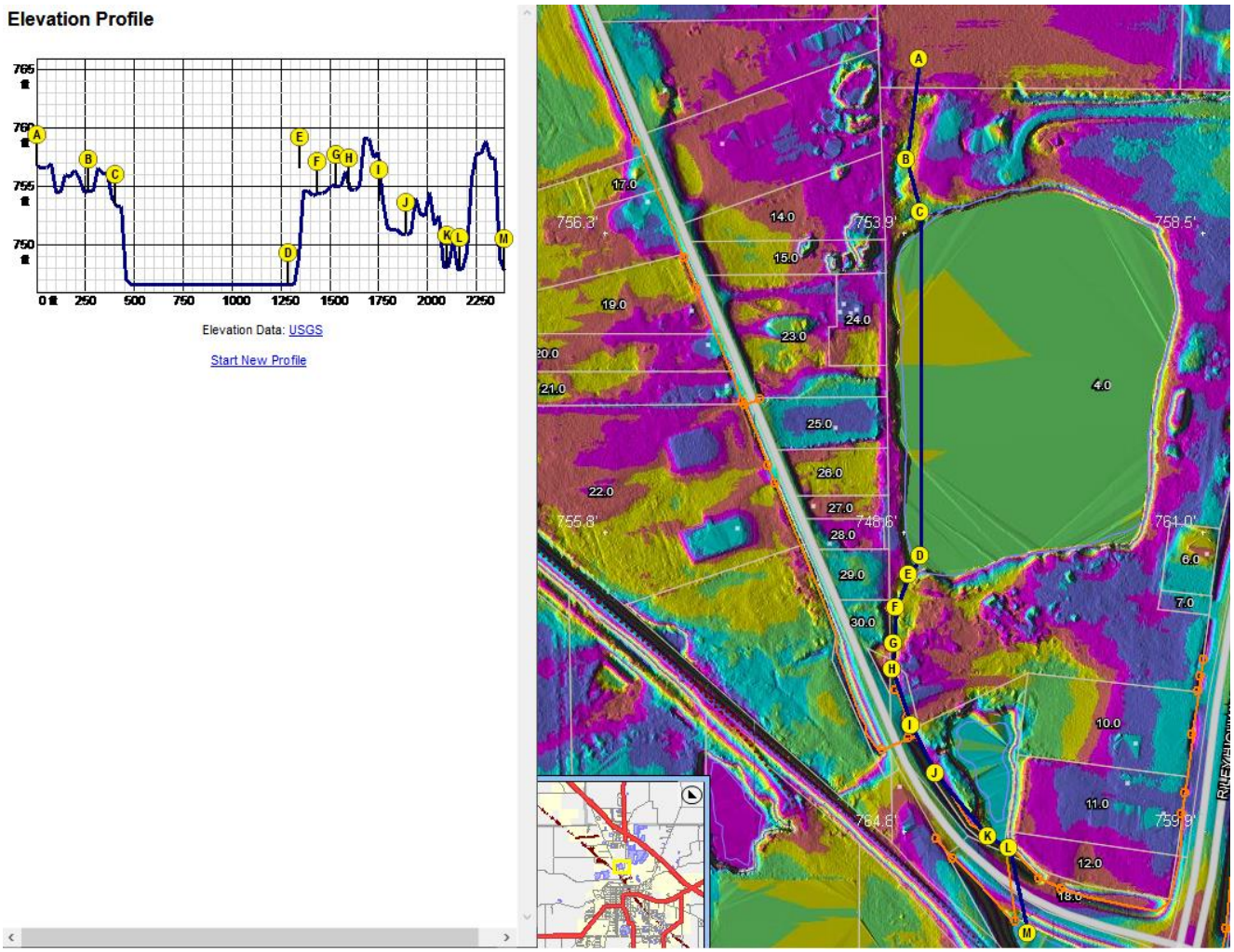
With the fill activity, the grading of the material left a partial flow path in the very northwest corner of the site for certain high flows into the pond. In the southwest corner of the pond another undefined low flow path exists that could possibly be engaged as an outflow location if the pond were to reach a very high elevation. Without detailed site survey, it is difficult to ascertain the exact outflow capacity or elevation of this potential flow path. There is also a 24-inch concrete pipe in the northern section of the fill that conveys surface flow from the north into the pond. The inlet of this pipe is also connected to an adjacent lower area that runs along the site's north boundary. There appears to be another pipe of unknown, but similar, size that connects the pond in the northeastern corner to the eastern edge of the site. Additionally, there is a 36-inch pipe in the southeast corner of the pond that flows under Riley Highway from east to west based on provided roadway plans. The invert elevation of this pipe is approximately 753 feet.

Southwest of Burnside Pond is a low-lying area where runoff combines with that from an adjacent ditch which collects runoff from the Michigan Road corridor to the northwest. Localized flow and the Michigan Road corridor drainage ultimately combine into a small pond and run under Michigan Road through an eight-foot-square concrete box culvert. This runoff then empties into a larger southern pond adjacent to Riley Highway and the adjacent railroad. The ultimate outlet is a six-foot diameter pipe under Riley Highway then into the Big Blue River.

24-inch pipe at north side of Burnside Pond

Lower pond next to railroad/Riley Highway

The use of LiDAR data available for the area provides a profile of the approximate and adverse flow path for the subject area. The profile provided below is intended to indicate a general grade in the area and not necessarily a flow path for any specific flows in the watershed since positive outlets and drainage infrastructure are sparse.



Development Activity

The area immediately north of Burnside Pond is currently in the process of seeking City approval for approximately 80 acres of residential development. Arbor Homes has provided initial plans for the overall drainage of the development with a network of storm sewers and detention facilities on the subject property. The ultimate outlet for the development is a larger pond of approximately two acres along the southern boundary immediately adjacent to the Burnside property. Options for draining the pond are currently being evaluated by the developer and relate to the drainage in this area as already noted. The more prevalent concept for drainage of the Arbor development appears to be the utilization of a pipe into the Burnside Pond.

The development includes plans for 263 single-family dwellings, a conservation area, and a street system as part of the support infrastructure for the homes. With the development, the drainage system will collect excess runoff and direct it to the southern pond within the development as referenced. With the planned extent of the development an additional 25 acres located in the northwest portion of the site, will be included into the proposed site drainage where previously it drained toward the Michigan Road corridor near St. Mark Lutheran Church. The Michigan Road corridor drainage is a mix of side ditches, depressional areas, pipes, and a more defined drainage ditch along the west side of the roadway. Property located in the general triangle between Michigan Road, the proposed development, and Burnside Pond does not have a clearly defined, or obvious outlet. Generally, runoff appears to flow southeast to the access road intersection east of the auto salvage facility.

Hydrologic Study Results

The existing condition of the watershed contributing to the Burnside Pond was developed using HydroCAD modeling software. This model was developed to represent existing conditions as generally noted above. The watershed's topography was developed from available LiDAR data provided both from the Indiana Map portal and information from the Shelbyville GIS online data. Additionally, information from the proposed development included existing condition topography. This data collectively appeared to be very similar and useful in the development of watershed boundaries.

The proposed condition was subsequently developed to reflect the plans as they were provided. The primary changes in the modeling comes in the form of altered watershed boundaries, greater impervious surface in the development property along with changes in time of concentration (flow velocity within a watershed). The internal flow network and other detailed flow conditions of the proposed condition were not developed, as the focus of this study was primarily the effects upon Burnside Pond.

The following is a portion of the key input parameters into the modeling along with the results:

Drainage Area Existing Condition: 150 acres
Drainage Area Proposed Condition: 174 acres
Weighted Curve Number Existing: 75
Weighted Curve Number Proposed: 83
Burnside Pond Normal Pool Area: 13.6 acres
Normal Pool Elevation of Pond: 748.0 feet
24-Hour Storm Rainfall: 2-Year: 2.89 inches
10-Year: 4.02 inches
100-Year: 5.72 inches

Burnside Pond Storage Values

Modeled Condition	2-Year Flood	10-Year Flood	100-Year Flood
Existing Condition	11.1 acre-feet	21.0 acre-feet	38.0 acre-feet
Proposed Condition	19.7 acre-feet	33.5 acre-feet	55.7 acre-feet
Change in Storage	8.6 acre-feet	12.5 acre-feet	17.7 acre-feet

Burnside Pond Water Surface Elevations

Modeled Condition	2-Year Flood	10-Year Flood	100-Year Flood
Existing Condition	748.8 ft	749.5 ft	750.7 ft
Proposed Condition	749.4 ft	750.4 ft	751.9 ft
Change in Elevation	0.6 ft	0.9 ft	1.2 ft

Since there is no outflow from the pond, it is the assumption that flow in the subject watershed eventually gets to the pond where it is ultimately stored. There has not been a routing of flows or hydraulic analysis of conveyance capacity in the development or overall watershed. This study has focused on the volumetric impact due to the development.

The assumption is made that the drainage network will ultimately convey flows to the Burnside Pond. Also, there is the awareness that the stored water from flood events would infiltrate via subsurface flow in time but this outflow potential is assumed relatively slow as compared to a flood event and has not been analyzed as part of this study.

Conclusion

The proposed development north of Burnside Pond will increase the water surface elevation up to 1.2 feet from the existing condition during the 24-hour, 100-year flood event. This increase is due to both the increased watershed area of diverting flow in the northwest portion of the basin from Michigan Road to the east and into the drainage system along with increased impermeable surface of the residential construction. There is no positive outlet from the Burnside Pond and therefore changes as described are expected. The anticipated flood pool elevations for both existing and proposed conditions appear to be contained within the banks of the pond. There is no apparent surface or piped overflow at these anticipated flood elevations.

Site 2: E-Shaped Pond

The site is located on the east side of Riley Highway about 1,350 feet south of Rampart Street. The E-Shaped Pond is approximately 12 acres in size currently and under normal non-flood conditions. It is bounded by partially developed commercial property to the north. To the east is Shelby Materials, to the south there is additional undeveloped low ground with ponds, and to the west is Riley Highway adjacent to an area of residential development and other commercial businesses.

The E-Shaped Pond was also created presumedly due for extraction of gravel material many decades ago. The pond is of unknown depth and does not appear to have any dedicated drainage infrastructure for maintaining a water level or for drainage of runoff flowing to it. Fill activity was mostly from 2006 through this past year.

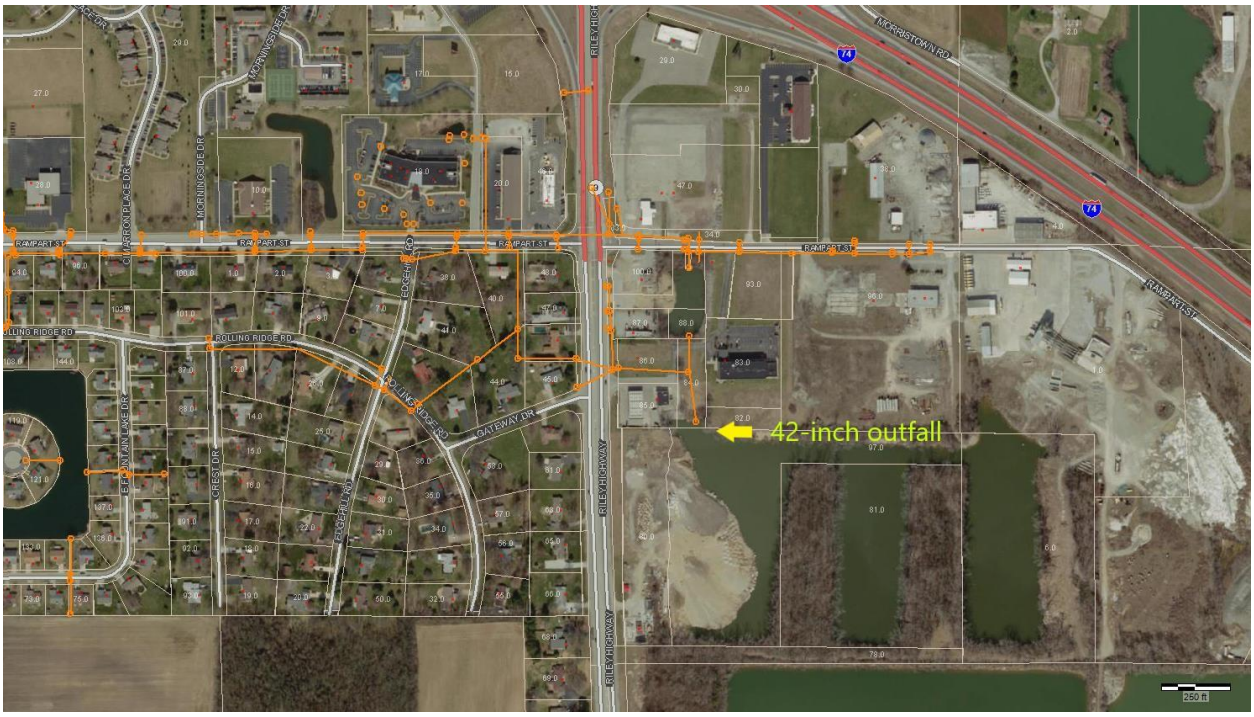
2007

2013

2020

The specific fill activity in this area has been located along the western edge of the pond. Many years previously, the pond extended to the north with another area extended nearly to Rampart Road. A smaller portion of that original arm of the pond exists today adjacent to the roadway. A significant portion of the flow to the current E-Shaped Pond comes through the existing storm sewer network that extends north and west of the site. The end of this network is

a 42-inch concrete pipe that outlets along the north bank of the E-Shaped Pond. This pipe network conveys runoff from the residential area west of Riley Highway and along Rampart Street along with its associated drainage.



The E-Shaped Pond does not appear to have any surface outlet or dedicated outfall infrastructure. This area has been greatly altered through time, but the general flow direction is to the south and ultimately to the Big Blue River. The southern boundary of the E-Shaped Pond is an elevated strip of land at roughly 770 feet elevation between adjacent ponds. It is approximately 80 to 90 feet in width. The elevation of this strip of land is approximately 10 feet above the elevation of the normal pool of the E-Shaped Pond. To the south are very large, excavated ponds as part of the Knauf property.

North boundary of pond

42-inch outfall at north bank of pond

Analyzed Condition

The E-Shaped Pond has a contributing watershed that includes an area immediately surrounding the pond, but the majority is through a storm sewer system servicing an area north and mostly west of the pond. A letter from the City Engineer dated October 23, 2020 provides a description and watershed delineation for this portion of the watershed. This information appears to adequately represent the contributing area and was incorporated in part into the total watershed of the pond.

The existing condition of this study was the on-site condition of pre-fill activity of the pond's western leg around 2006. The only activity analyzed for the impact to the pond was the fill that has subsequently been placed up until recently. This fill was assumed to occupy the pond's footprint between the stated time period and to the approximate bank elevations as surround the pond today. No other hydrologic condition, such as land use or other drainage infrastructure within the watershed, was altered.

Hydrologic Study Results

The existing condition of the watershed contributing to the E-Shaped Pond was developed using HydroCAD modeling software. This model was developed to represent existing conditions as generally noted above. The watershed's topography was developed from available data provided both from the 2017 Statewide LiDAR and information from the Shelbyville GIS online data. Additionally, the delineation provided by the City Engineer was utilized for that portion of the watershed since it represents the storm sewer network that exists in the area and contributes to the pond.

The proposed condition was subsequently developed to reflect the plans as they were provided. The primary change in the modeling comes solely in the reduction of available runoff storage volume in the E-Shaped Pond due to fill activity. The internal flow network and other detailed flow conditions of this condition were not developed, as the focus of this study was primarily the effects upon the E-Shaped Pond water surface elevations.

The following is a portion of the key input parameters into the modeling along with the results:

Drainage Area Pre-Existing Condition:		148 acres
Drainage Area Current Condition:		148 acres
Weighted Curve Number:		92
Normal Pool Elevation of Pond:		757.0 feet
Normal Pool Area, Pre-Existing Condition:		15.7 acres
Normal Pool Area, Existing Condition:		12.4 acres
Available Storage Volume in Pond Pre-Existing:		279 acre-feet (between elevation 757 and 770)
Available Storage Volume in Pond Currently:		236 acre-feet (between elevation 757 and 770)
24-Hour Storm Rainfall:	2-Year:	2.89 inches
	10-Year:	4.02 inches
	100-Year:	5.72 inches

E-Shaped Pond Storage Values

Modeled Condition	2-Year Flood	10-Year Flood	100-Year Flood
Pre-Existing Condition	25.4 acre-feet	38.7 acre-feet	59.1 acre-feet
Existing Condition	25.4 acre-feet	38.7 acre-feet	59.1 acre-feet
Change in Storage*	0 acre-feet	0 acre-feet	0 acre-feet

** There was not a substantial change to runoff conditions in either analysis, therefore no change in runoff volume.*

E-Shaped Pond Water Surface Elevations

Modeled Condition	2-Year Flood	10-Year Flood	100-Year Flood
Pre-Existing Condition	758.6 ft	759.4 ft	760.5 ft
Existing Condition	759.0 ft	760.0 ft	761.4 ft
Change in Elevation	0.4 ft	0.6 ft	0.9 ft

Since there is no outflow from the pond, it is the assumption that flow in the subject watershed eventually gets to the pond where it is ultimately stored. There has not been a routing of flows or hydraulic analysis of conveyance capacity in the contributing storm sewer network or overall watershed. This study has focused on the volumetric impact due to the reduction in flood storage from the placement of fill in the pond. The assumption is made that the drainage network will ultimately convey flows to the E-Shaped Pond. Also, there is the awareness that the stored water from flood events would infiltrate via subsurface flow in time but this outflow potential is assumed relatively slow as compared to a flood event and has not been analyzed as part of this study.

Conclusion

The placement of fill in the E-Shaped pond has increased the water surface elevation up to 0.9 feet from the pre-fill condition during the 24-hour, 100-year flood event. This noted increase is due to the location of fill that displaced a portion of the storage volume in the pond.

There is no positive outlet from the E-Shaped Pond and therefore changes in water surface elevations as described are expected. However, the anticipated flood pool elevations for both pre-existing and current conditions appear to be contained within the banks of the pond. To give scale to this pond and its capacity to retain water, the entire rainfall of a 100-year, 24-hour event could be contained and still have extensive storage available within the pond.

Floodplain Issues for Area

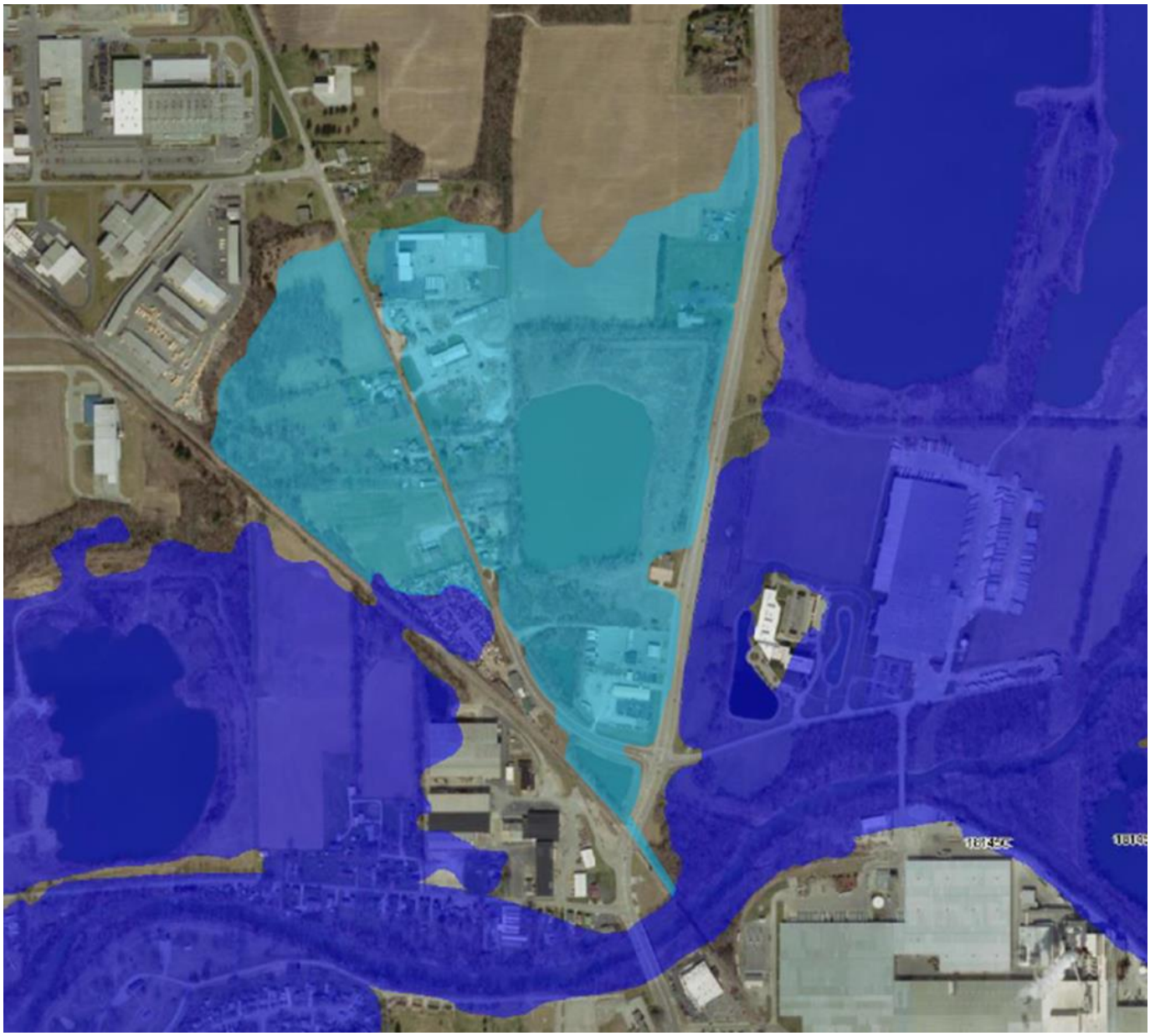
The area of both Burnside Pond and the E-Shaped Pond is exceptional as the landscape consists of several large, excavated gravel pits and has experienced large scale grading. Another key element of the area and potential impact to work within it is the Big Blue River floodplain. Since it is the common outlet to both watersheds that were examined, it is important to understand how the floodplain might affect the results of this study along with existing or proposed development in the area.

With the Big Blue River in lower flood stages, the findings of this study will not likely change. The elevations of the river are generally low enough to not impact drainage significantly at Burnside Pond or the E-Shaped Pond. However, with the Big Blue River at or near the 100-year elevation, the results will appear to impact the Burnside Pond system

and could also have an effect on the E-Shaped Pond. For this discussion, the Burnside site is of greater concern due to its location and applicable elevations, while the E-Shaped Pond is likely less impacted.

The concern is that the Burnside Pond appears to be hydraulically connected to the river without backflow protection. In short, water from the Big Blue River can currently backflow into the pond and surrounding property. The 100-year flood elevation at the bridge crossing near Harrison Street (Riley Highway) is at approximately 760 feet. This elevation is hydraulically connected in one if not multiple directions to the Burnside Pond, meaning water can achieve the 760 feet elevation level of the river. This elevation currently would back up well into property of the Arbor Homes development in its undeveloped condition.

To further complicate the situation, the current floodplain mapping of the area does not fully indicate the flood risk of the area between Riley Highway and Michigan Road. The Burnside Pond and adjoining property are not mapped within the floodplain even though flood flows of the Big Blue River could back up into this area. The following image indicates the area of the 100-year floodplain. The dark blue is what the floodplain maps currently indicate. The light blue is an approximate delineation of the area that is also at risk from the 100-year flood from the Big Blue River but is not indicated on published best available mapping.



The floodplain risk to the Burnside Pond site is significant but has not been examined in detail for other factors related to it. It is important to share the information about this apparent risk and the management of projects in this area along with awareness of those who work or live in the area. An additional consideration for this area is the ability of existing or proposed drainage infrastructure to provide an adequate outlet from localized runoff. The absence of a positive, free-flow outfall for property in this area should be examined if the drainage system is located in a floodplain such as this area.

SUMMARY OF FINDINGS

1. The Burnside Pond will experience an additional increase in flood pool elevations as a result of the proposed development north of the pond. This increase is approximately 1.2 feet in the 24-hour, 100-year frequency flood event; however, this increase is contained in the pond area.
2. The E-Shaped Pond has increased flood pool elevations as a result of fill placement for over 10 years along the western edge of the property. The increase is approximately 0.9 feet in the 24-hour, 100-year frequency flood event; however, this increase is contained within the pond area.
3. The flood risk from the Big Blue River is not apparent from best available floodplain mapping despite hydraulic conductivity to the area between Riley Highway and Michigan Road. Significant flood depths could impact this area if this risk is confirmed by additional study.

Overall, this area includes a large volume of runoff retention potential due to the excavated ponds that are prevalent along Riley Highway. While the storage exists, there does not appear to be dedicated outlets or control from these facilities if that is the need for either landowners or the community overall. The basis for all findings in this study were from available information and could be refined further if discussion warrants it and if additional information is provided. Evaluation of the floodplain risk is important not only for the potential risk from a major flood, but also to potential drainage improvements in the area. Background information from this study is available if needed.