



# MILL POND-MUD BROOK GREENWAY MASTER PLAN

*City of Cuyahoga Falls, Ohio*

JANUARY 22, 2016



Ohio & Erie Canalway Coalition



## ACKNOWLEDGEMENTS

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## Introduction/Executive Summary

The City of Cuyahoga Falls, the second largest city in Summit County, has seen increased development in recent years. To improve the quality of life for residents, the City has continued to search for ways to alleviate flooding, protect sensitive ecosystems and provide recreation areas and open space. One location with the potential to work toward these goals is the Mill Pond-Mud Brook Greenway. Located within the Cuyahoga River Watershed (HUC 04110002), the watershed for Mill Pond includes parts of Cuyahoga Falls, Hudson, Stow, Boston Township, Boston Heights, and Silver Lake. The Cuyahoga River's watershed consists of over 800 square miles, and the Mill Pond drainage area is 25.38 square miles, of which 4.85 square miles is located within the City of Cuyahoga Falls.

The goals of this report are not only to make recommendations for natural resource protection, flood mitigation and passive recreation opportunities within the Mill Pond-Mud Brook Greenway, but to also guide public infrastructure improvements and economic development activities within the area. To be able to make a recommendation, Environmental Design Group followed a process that included generating base plans from available data, field reconnaissance, analysis of data gathered, stormwater calculations and modeling to determine flood impacts, development of conceptual alternatives and cost opinions for the conceptual alternatives. This plan also identified gaps in existing infrastructure that should be remedied to meet potential future development needs.

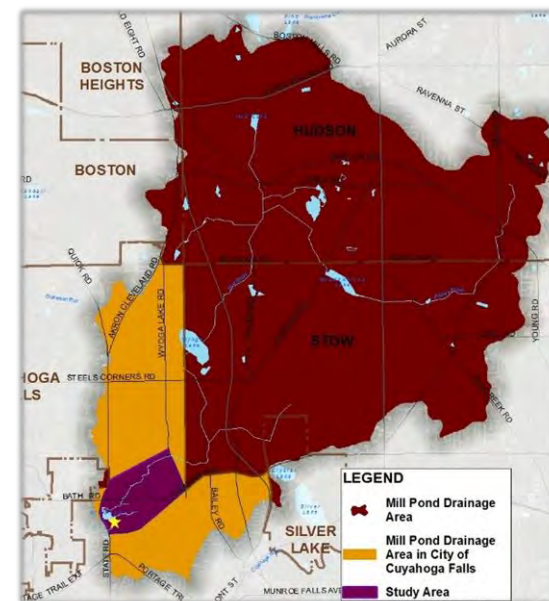
Through a series of public and stakeholder meetings, the team identified an overall master plan that balances the study area's need for flood mitigation, connectivity, ecological stability and quality of life for residents and businesses. These meetings were held at various times and locations during the study timeframe. Information presented at these meetings is included in the appendix documents.

***This plan specifically supplants the deed restrictions set forth in the Purchase, Sales and Development Agreement dated 09-02-2014 between the City of Cuyahoga Falls, Menard Inc. and First Akron Development Corporation.***

## General Project Information

The original study area follows Mud Brook from Wyoga Lake Road to State Road, and includes the area surrounding Mill Pond. However, during the analysis portion of the project, it was discovered that there were impacts to this area outside of the original study area boundary. Therefore, after the analysis, the original study area was changed into two incentive districts. The northern district – *Mud Brook Incentive District* – includes the septic system areas to the eastern city limits and Cochran Road, which impacts flooding and water quality of the area. The southern district – *Mill Pond Incentive District* – includes the historic dam west of State Road and the historic residential village around that dam. The different boundaries are shown later in this document.

Mud Brook flows from the northeast to the southwest. Near State Road, two dams have been installed over time. The first was installed on the west side of State Road in 1805, as the mill that the dam fed became



**Figure 1: Figure of the Mill Pond-Mud Brook Watershed shown in red (25.38 sq. miles), portion of watershed within Cuyahoga Falls shown in yellow (4.85 sq. miles (19.10% of watershed)), and our study Area shown in purple (0.717 sq. miles (457 acres) (2.8% of watershed))**

operational in 1806. The dam is still in existence, while the mill was demolished sometime in the 1960's. The second dam was built on the east side of State Road sometime before 1953, as Mill Pond is evident on the USGS Topographic Quadrangle map dated 1953 (included in Phase I Environmental Site Assessment prepared by T&M Associates). This dam is also still in existence, however it does not impound water.

The majority of the project area is wooded with some areas of streams, ponds and wetlands. Mud Brook has steep side slopes in some areas and erosion has occurred with the increased development within the watershed. The project area is surrounded mostly by commercial and residential development with a small adjacent industrial use at the northeast corner of the study area.

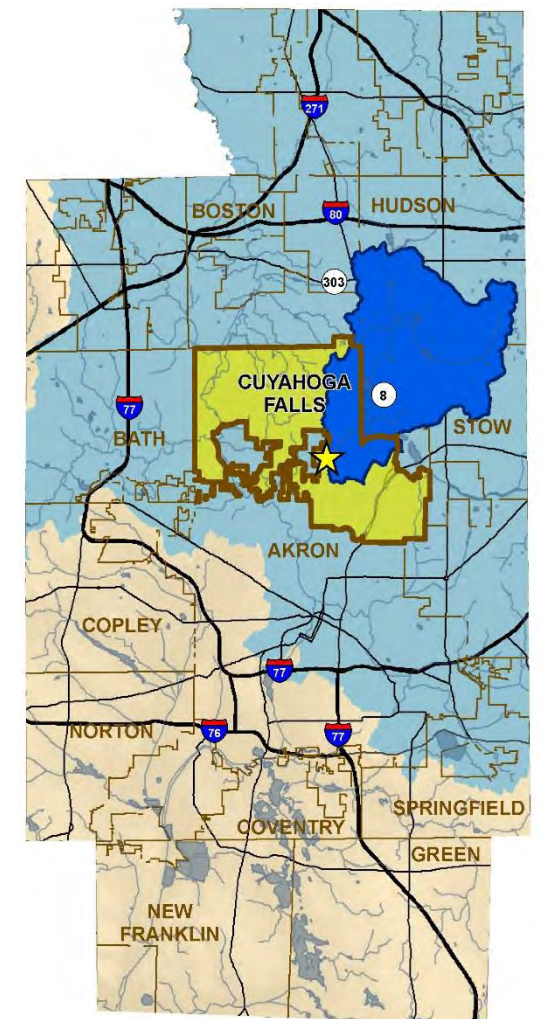
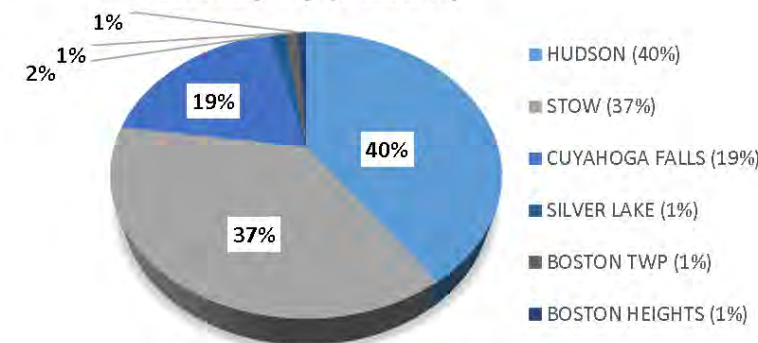
## Summary of Process

The first step in the inventory process was for Environmental Design Group (EDG) personnel to collect and analyze information from available known data and augment that data with limited field observation. To generate base mapping, geographic information system (GIS) data was gathered from Summit County Geographic Information Systems (GIS), City of Cuyahoga Falls, Esri Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, FEMA, USGS Streamstats, USGS flow gauge data for upstream lakes, US Census Bureau, and USDA soils.

Once information was collected, a site walkover was conducted by EDG and City of Cuyahoga Falls (City) personnel on May 22, 2015. The walkover started at the west end of Pleasant Meadow Boulevard at the north end of the study area and proceeded generally to the southwest to the west side of State Road. At State Road, the route of the walkover headed north along State Road then east along Bath Road. Photographs were taken along the route and are included in the appendix documents.

Further site visits of the corridor, dams, flooding areas, gun club site, mill site, North Point development and other sites were performed with and without City personnel. Although these site visits were limited in nature, they provided valuable information to assist the planning team in formulating recommendations.

**Figure 2: Mill Pond-Mud Brook Watershed by Municipality (Percent)**



**Figure 3: Mill-Pond-Mud Brook watershed (dark blue) with Cuyahoga River Watershed (light blue)**

## Inventory Information

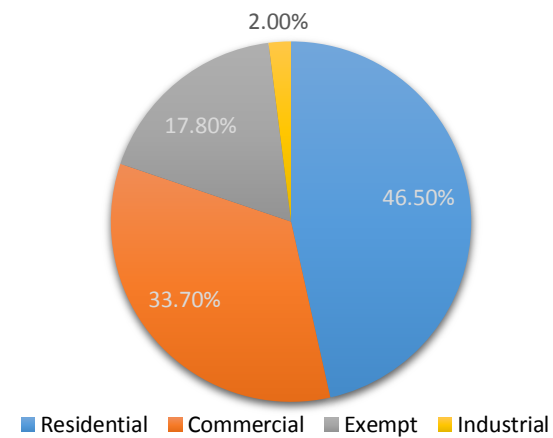
### Mill Pond Drainage Area

In order to understand the complexity and dynamics of Mill Pond and the study area, we first need to identify the footprint of water tributary to this point in Mud Brook watershed and how the water gets to the pond. Figure 1 illustrates the approximate drainage area (25.38 square miles) of the Mill Pond-Mud Brook watershed (generated from USGS Stream Stats website). This watershed represents roughly 6% of the total land in Summit County and includes parts of Cuyahoga Falls, Stow, Hudson, Silver Lake, Boston Heights and Boston Township. Three-fourths of the water draining to Mill Pond is from land outside of Cuyahoga Falls.

### Land Use

Current land use within the study area is mainly residential and commercial. Figure 4 breaks down land use for the study area based on information from the Summit County Auditor's GIS data. Land use for the watershed draining into the Mill Pond area is 65.6% developed areas (USGS stream stats).

**Figure 4: Land Use in Study Area**

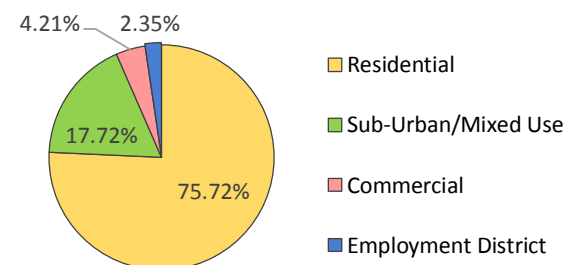


### Zoning

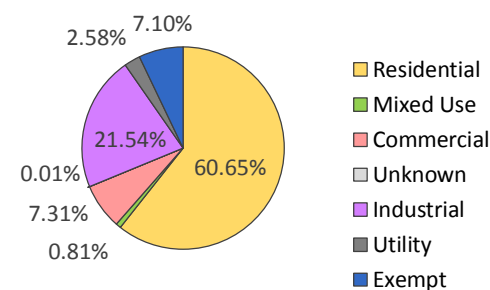
Within the study area, 4.21% is zoned for commercial use, 75.72% for residential uses, 2.35% for employment district uses and 17.72% is zoned for sub-urban/mixed use development. Properties classified as exempt land use may be zoned residential, which would explain the zoning disparity.

Within the overall watershed, 7.31% is zoned for commercial use, 21.54% for industrial use, 2.58% for utility use, 0.81% for mixed use, 60.66% for residential use, 7.10% for exempt use and 0.01% has unknown zoning.

**Figure 5: Study Area Zoning**



**Figure 6: Overall Watershed-Wide Zoning**



The city's existing zoning code also provides definition of development setbacks for stream corridors. Chapter 1125 of the *Cuyahoga Falls General Development Code* details Stream Corridor Protection requirements

within the City. Mud Brook is classified as a Type IV stream which has a Preserved Buffer, a Managed Buffer and a Limited Development Buffer. The Preserved Buffer includes the stream itself and the area immediately adjacent to the high water level. Within the Preserved Buffer, only uses that leave the soil and vegetation undisturbed are allowed unless the disturbance is in conjunction with stream restoration or a stream crossing. Beyond the Preserved Buffer, the Managed Buffer zone allows conservation uses, passive recreation and park uses and sustainable agriculture practices. The width of the buffers also increases beyond the minimum 25 foot requirement based on the slope and impervious surfaces in the buffer area. Based on these criteria, the buffer areas will vary along the study area.

### Land Use vs Zoning

Impervious surfaces do not allow for rainwater absorption into the ground, increase rain runoff velocities and introduce many pollutants into our waterways. To see if there is a potential increase of impervious area within the study area, which might affect flooding and corridor health, a quick analysis was performed between current land use and future land use (zoning). By comparing the current land use to the current zoning district, we can deduce where future development may result in a greater amount of impervious area and therefore additional stormwater runoff and flooding concerns. This quick analysis identified the potential for up to a 20% increase in impervious surfaces within the study area.

Current zoning districts in order of greatest percentage of impervious area allowed to least percentage of impervious area allowed are:

- C-1 (Commercial, 85% Lot Impervious Coverage Allowed)
- MU-3 (Suburban Center, 80% Lot Impervious Coverage Allowed) & MU-4 (Suburban Corridor, 80% Lot Impervious Coverage Allowed)
- MU-2 (Neighborhood Center, 75% Lot Impervious Coverage Allowed) & E-1 (Employment District, 75% Lot Impervious Coverage Allowed)
- R-5 (Mixed Density Residential, 65% Lot Impervious Coverage Allowed)
- R-4 (Urban Density Residential, 50% Lot Impervious Coverage Allowed)
- R-3 (Suburban Density Residential, 35% Lot Impervious Coverage Allowed)

### Demographics

Demographic data was collected from the U.S. Census Bureau website for year 2013. The study area is within Block Group 4, Census Tract 5329.02. By 2017, Millennials (currently in their mid-teens to mid-30s) are estimated to have more spending power than any other generation. By 2030, Millennials will outnumber other demographic groups by a whopping 22 million (See Figure 6). Millennials will be the first generation to value quality of home life more than work life. Therefore, if cities wish to remain relevant to future generations, they will need to retain existing residents while making improvements to attract future residents. Connected neighborhoods with links to shopping, parks, libraries and schools will be a strong demand for these types of residents.

A summary of the study area's current demographic information is below:

**Population and Age** (American Community Survey 2013)

- The total population within Block Group 4, Census Tract 5329.02 is 2,772 individuals (1170 males, 1602 females).
- Of the 2,772 individuals, 1,107 (39.9%) are above the age of 55.

**Marital Status** (American Community Survey 2013)

- 2,327 individuals are married within Block Group 4, Census Tract 5329.02.

**Family** (2010 Census Data)

- There are 1,481 households within Block Group 4, Census Tract 5329.02.
- Of the 1,481 households, 768 are family households (51.8% of households).
- Of the 768 family households, 318 households (41.4% of family households, 21.5% of all households) include related children under the age of 18.
- The average household size is 1.97 individuals.
- The average family size is 2.69 individuals.

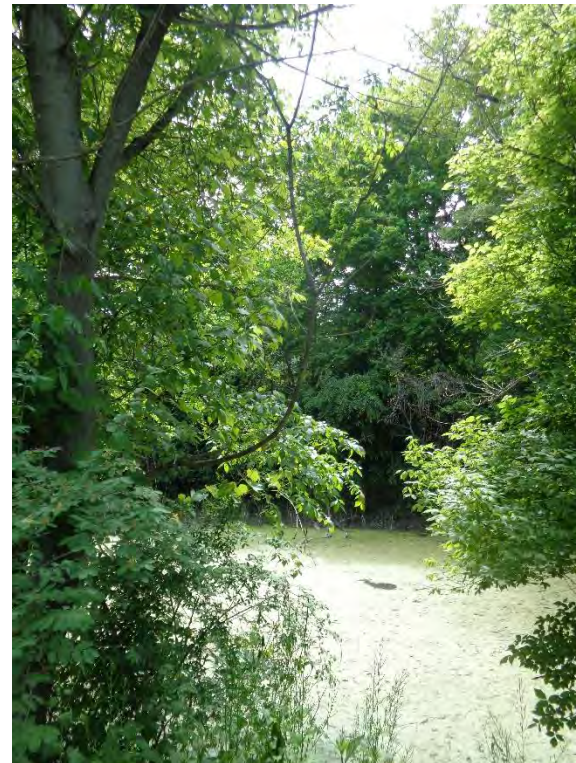
**Employment** (American Community Survey 2013)

- 2,327 individuals are above the age of 16 within Block Group 4, Census Tract 5329.02.
- There are 1,305 individuals within the labor force (56% of the population above the age of 16, 47% of the total population).
- Of the 1,305 individuals within the labor force, 1,242 are employed (95.2%) and 63 are unemployed (4.8%).

**Income** (American Community Survey 2013)

- 556 households make less than \$30,000 total within Block Group 4, Census Tract 5329.02 (39.4% of households).
- 205 households make less than \$10,000 (14.5% of households).

The demographics of the census block group containing the study area indicates that 41.4% of the households have children under the age of 18 – an age that are more likely to utilize trails and parks. Also, 39.9% of the population in Block Group 4, Census Tract 5329.02 is over the age of 55 years, which also is an age group more likely to use parks and trails. During the inventory of the project, there was found to be a lack of sidewalks and connections to schools, parks and surrounding commercial areas. Trails could provide the demographics' desire for connectivity.



**Photo 1: Pond just south of the Old Gun Club shows signs of algae and water quality issues.**

**Wetlands, Waterways and Floodplain**

Probable wetland information within the study area was collected from Summit County GIS. This information was not field verified. The lower portion of the study

area has many probable wetlands identified. During site walks for this study, many of these probable areas exhibited wetness and wetland vegetation. However, many of these areas also showed signs of invasive species, erosion, rills and algal blooms which greatly depreciates the health and functionality of wetlands.

There are three ponds within the study area. One is located on private property just north of the Old Gun Club, another is located just south of the Old Gun Club on City property, and another is Mill Pond itself. There are also a number of stormwater control measures that are detention/retention ponds.

The pond north of the Old Gun Club is along a tributary stream and is located within a heavily wooded area. As this is on private property, no site visit was performed. The pond located on city property just south of the Old Gun Club shows signs of stagnant water. This pond is located in close proximity to the stream channel which could provide the opportunity to provide additional water flow and increased diversity. A more detailed investigation is proposed for this area to determine if modification of the flow regime would provide ecological benefits.

Mill Pond is controlled by a concrete dam structure that was privately built in the early 1950s. There are no records of this dam structure and it is not monitored by ODNR. There are no known drawings or historic records of the privately installed dam for the Mill Pond. There are many logs behind the concrete dam structure and there is an observable underflow pipe that protrudes from the downstream side of the dam. However only a trickle of water was observed flowing from this pipe. The existing pond has a footprint of approximately 13 acres. The vegetation surrounding the pond has many invasive species of plants and the pond itself is heavily silted.

There is approximately 1.7 miles of main stem Mud Brook within the study area. There are also a number of smaller tributaries and stormwater drainage ditches flowing into this study area. Many of the tributaries show signs of erosion, rilling and flooding. Multiple areas along Mud Brook also have erosion and flooding marks.

The Federal Emergency Management Agency (FEMA) keeps records and analyzes waterways to determine their potential for flooding during 100 year flood events. The 100-year flood is referred to as the 1% annual exceedance probability flood, since it is a flood that has a 1% chance of being equaled or exceeded in any single year. The 100 year floodplain within the drainage area to Mill Pond shows significant changes from 1978 to 2009. This flood prone area has increased by over 20 acres in 30 years.

**Topography**

As the study area is located near the bottom of the Mill Pond watershed, steep slopes and undulating topography are prevalent. These slopes have been cut and eroded from multiple natural and man-made waterways. Down the center of the study area is the stream channel. The stream channel is defined by very steep slopes on either side, with a relatively flat floodplain in the middle. The side slopes of the stream valley are generally steep (for example, 37%, 55%, 70% slopes) and lead to a flatter floodplain area at the bottom of the slope.

The flat floodplain area disappears along the west side of Mill Pond. The topography on the west side of Mill Pond is steep as well, with slopes ranging from 34% to 67%. This slope is adjoining State Road.



**Photo 2: Mill Pond dam and underflow pipe**

## Hydric Soils

Per the USDA Natural Resources Conservation Service, hydric soils “are those soils that are sufficiently wet in the upper part to develop anaerobic conditions during the growing season”. Hydric soils tend to contain a high level of clay which can be difficult to build on and the presence of hydric soils is one of the three indicator factors for the presence of wetlands. Hydric soils are found mostly adjacent to Mud Brook from Hunter Parkway to the first tributary south of Bath Road and includes a portion of Emidio’s Party Center’s property. There is an area of hydric soils south of the west end of Pleasant Meadow Boulevard and another area between Riverrock Drive and Haggarty Way. Hydric soils or soils with hydric inclusions create the potential for exceptional wetland restoration for ecological improvements in the study area.

## Bikeways, Road Network and Sidewalk Gaps

Chapter 1122 of the *Cuyahoga Falls General Development Code* describes the different types of streets and the design characteristics of each. In the study area, there are three types of roadways. State Road and Graham Road are minor arterials, Bath Road and Wyoga Lake Road are urban collectors and the remainder of the roads are classified as streets. Each of these streets have different design speeds and will require different trail signage and crossing(s) per the FHWA guidelines for bikeways.

The study area has a number of already planned and completed bike trails/lanes. Bike lanes were recently installed along State Road and are partially installed along Wyoga Lake Road. The Wyoga Lake Multi-Purpose Trail is planned to be built along Wyoga Lake Road from Graham Road to E. Steels Corners Road and from Hardman Drive to Akron Cleveland Road. The portion of this trail between E. Steels Corners Road and Hardman Drive currently exists.

Other potential trails were identified from the Summit County Trail and Greenway Plan (commissioned previously by a consortium of Summit County municipalities and agencies). Additionally, a previous plan (Mud Brook Trail Concept Plan) was created for this area (2000s) where trails were proposed on the west side of Mud Brook. Since the completion of the Mud Brook Trail Concept Plan, additional development has been constructed and planned in the study area and the City that necessitated the preferred alignment move to the east side of Mud Brook. Placing the potential trail on the east side of Mud Brook enables the alignment to take advantage of an old historic barn for a trailhead, existing underpass potential under the Hunter Parkway bridge and a more advantageous connection with the proposed residential and commercial developments between Bath Road and Graham Road.

## Storm and Sanitary Utilities and other Utilities

Existing storm and sanitary sewers are shown based on information provided by the City of Cuyahoga Falls and County of Summit GIS. There are public sewers that run along the north side of Mud Brook from a point near Peoplecare Park Drive westward into Akron. Sanitary sewers also exist under Mill Pond from the south side near Peoplecare Park Drive north to Bath Road. Sanitary sewers run along East Bath Road from State Road to a point near the Historic Barn and continuing northeast on the east side of Mud Brook and extending east beyond Wyoga Lake Road. When considering any flooding or flood storage, the sewer’s structural capacity, location and rim elevations of manholes should be considered.



**Photo 3: Erosion area above a stormwater outlet structure**

There are properties with septic systems in the immediate vicinity of the study area, and drain into the area upstream from Mill Pond – east and north of the original study area. Home septic systems are the most commonly reported source of groundwater contamination in the United States. The most serious effect of a failing system is the spread of serious disease from untreated wastewater. Mosquitoes and flies that spread infectious diseases can breed in areas where wastewater reaches the surface. Household chemicals can be poisonous to humans, pets, and wildlife if they are not treated. Most septic systems have a useful life of 20-30 years with the most common reason for early failure as misuse or inadequate maintenance by homeowners. Septic systems are inspected in this area by the Summit County Board of Health. Currently there are no sanitary sewers for these homeowners and businesses to connect to. The area lacks the infrastructure needed for development.

Storm sewers exist in most of the newer developments within the study area with outfalls to Mud Brook. Older developed areas and roadways lack storm sewers. Many of the storm sewers that discharge to this study area have water quality/detention basins. Health, capacity and design of these stormwater quantity & quality treatment facilities were not evaluated for this study. However, during field investigations, it was observed that multiple storm sewer outlet structures and channels were heavily eroded, with some under cutting hillsides. As with sanitary sewers, this area lacks the stormwater infrastructure for zoned development suggesting that lack of infrastructure is potentially inhibiting economic development.

Like many developed areas, there are significant overhead electric utility lines. Utilities often provide opportunity for trails as the sites are cleared of vegetation, have existing use easements and are relatively flat.

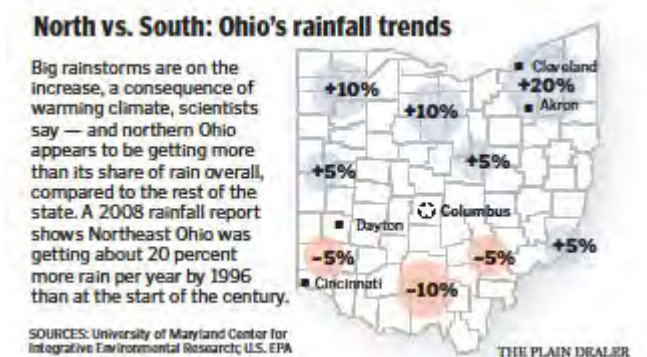
## Physiography & Climate/Precipitation

In Northeast Ohio, the exponential increase in impervious area has played a significant role in the increasing amount of stream degradation, flooding and combined sewer overflow volume. Additionally, there are shifting weather patterns. Over the past 10 years, National Oceanic and Atmospheric Administration (NOAA) has been recording weather patterns that suggest patterns for a “new normal” in rainfall intensity and volume for northeast Ohio. NOAA predicts these new normal rains will have shorter duration with larger overall volumes. With these changes in weather, maximizing flood control will be paramount for the long term success of any development proposed in this study area.

## Opportunities and Constraints

After existing condition inventory information was compiled with site reconnaissance information, the information was analyzed into an overall opportunities and constraints map. This map identifies the study area’s overall prospects and limitations for flood control, ecological restoration, connectivity and flood mitigation. Overall opportunities and constraints are:

- As this study area is located at the lower portion of the overall watershed where flood water is at its fastest and most voluminous, flood control upstream of this area will provide additional flood mitigation with greater control. Since the watershed includes five other cities and townships out of the City of Cuyahoga Falls’ control, the City must work with these jurisdictions to mitigate flooding.



**Figure 7: Ten-year trend for Ohio rainfall events**

The original study area was expanded to the eastern city limits and Cochran Road to include additional opportunities for stormwater control.

- City ownership of the property surrounding Mud Brook and Mill Pond will require minimal property acquisition to meet project goals.
- Multiple areas exist where sanitary sewer infrastructure is hindering development. Additionally, failing septic systems could lead to potential water quality issues in Mill Pond.
- Preserving the floodway, floodplain and wetlands will conserve sensitive ecosystems while providing some flood mitigation and conserving open space.
- In some locations, stream banks have eroded and sediment has been deposited in the channel. Eroded areas provide opportunities for streambank stabilization to reinforce the side slopes of the stream which will also reduce further erosion and improve water quality.
- The Old Gun Club has potential contamination that will require remediation, which may provide funding that will include flood storage.
- Two sites were identified and reviewed as potential trailhead locations, one near the historic Brookpoint Farm Barn at 223 East Bath Road and the other at the west end of Pleasant Meadow Boulevard. The opportunities and constraints of each site are discussed in the following paragraphs.
  - The Brookpoint Farm barn, built in 1873, provides historic value and interpretive opportunities. However, the site is currently surrounded by private residences that share a private drive with the barn. Utilizing the same drive to access a potential trailhead at the barn would create conflicts with the private residences. The adjacent residential properties were recently sold. Since Americans generally move every seven years, there is a likelihood that the adjacent properties will be put up for sale in the future. EDG recommends that the barn property be purchased for future use as a trailhead with the knowledge that for the site to be successful as a trailhead, that additional properties will need to be purchased in the future. Having the Barn located on a spur of the trail instead of on the main trail alignment allows for the site to be separate and more private for use as a rentable facility. Until additional properties are purchased and a parking lot installed, the site may be used as a rest area for trail users. There is already an existing aggregate pavement area that could be added to or paved over. The existing woods in the vicinity of the barn would provide shade and the addition of a water fountain, overlook and some benches would create a pleasant resting spot along the trail.
  - Proposed development at the end of Pleasant Meadow is proposed to be senior assisted living with approximately 64 units. Additionally, this area is the Old Gun Club which requires remediation. A trailhead with parking, a picnic shelter, overlooks, wetland flood storage, and a potential trail bridge for future connections could be intertwined with the proposed development. Per discussions with City Planning Staff, lead on site will be cleaned up to recreational standards which would be symbiotic with a proposed trailhead. There is an existing aggregate drive that extends from the end of Pleasant Meadow Boulevard, which would require minimal regrading and clearing to provide visitor access. The existing aggregate drive slopes down to a relatively flat aggregate parking area that appears to require only minimal regrading and paving to be usable as a trailhead. Between the parking area and Mud Brook is an open field that provides opportunities for amenities such as picnic shelters and play areas. Existing woods around the perimeter of the site provide a sense of privacy and

immersion in nature. The stream is very channelized in this area and the banks should be regraded to form more gentle side slopes.

## Flood Storage Opportunities and Alternatives

Mill Pond has a watershed of approximately 25.38 square miles (16,243 acres). Utilizing FEMA mapping and information on flooding within the study area, the team utilized HEC-ras hypothetical modeling to identify and quantify the opportunities for potential flood storage areas within the study area. The study area is at the lowest end of an extremely large watershed, which complicated this review as once the runoff reaches the study area, volumes are large and velocity is rapid.

## Old Gun Club Wetland Storage Potential

The Old Gun Club represents one of the study area's best potentials for mitigating flood water. It is located within the upper most portion of the study area and is a relative large flat area that doesn't receive much flood water currently. Utilizing the modeling software and USGS standard rain events, creating a hypothetical 1.6 acre footprint floodplain oxbow wetland with an average storage depth of 5.5 foot within the gun club area, would reduce flood elevations during a typical 1-year storm event by ½ to 1 inch from this area all the way to the Mill Pond dam.

This will also elongate the time of concentration for flood water entering the stream channel, allowing for more water to enter from tributary drainage ways within the study area. Many of these tributary drainage ways cannot flow into Mud Brook during flooding events as the stream channel and floodways are full. This creates backups within the tributaries and stream bank erosion.

## Increased Capacity of Wetlands North of Bath Road

Further south from the Old Gun Club are a series of existing probable wetlands that provide some storage capacity and ecological benefits, but could also be enhanced. Vernal pools could be added to the existing northern-most probable wetland. Vernal pools are small depressions placed in forested wetland areas that provide some storage and provide multiple benefits for invertebrates and amphibians. This will increase storage capacity and provide additional ecological diversity to the study area.

Within this same area, between a stream meander and the main channel is the potential to carve out additional wetland storage and provide improved habitat through the eradication of invasive species. Utilizing the modeling software and USGS standard rain events, creating a hypothetical 4.7 acre footprint floodplain oxbow wetland with an average storage depth of 3 foot within the gun club area, would reduce flood elevations during a typical 1-year storm event by 1 to 2 inches from this area all the way to the Mill Pond dam. This area has less effect on tributary back up since the potential flood storage area is downstream of a majority of the tributary erosion areas.

## Modifications to Mill Pond

There are no known drawings or historic records of the privately installed dam for Mill Pond, therefore proposed modifications and costs are very preliminary and rely on anecdotal information. There are currently many logs caught behind the concrete dam structure. There is an observable underflow pipe that protrudes from the dam downstream, however only a trickle of water was observed flowing from this pipe. The existing pond has a footprint of approximately 13 acres.

Limited field reconnaissance indicates the pond appears to be flowing full over the spillway, which is estimated to be at an elevation of 963. FEMA profile for Mud Brook illustrate that Mill Pond causes backwatering for nearly 0.5 miles upstream of Bath Rd. Reduction of flooding effects within the backwatered portion of stream by lowering the initial water surface elevation of Mill Pond was investigated.



Modifying the existing concrete dam to lower the initial water surface elevation of Mill pond by 2 feet could potentially reduce flooding upstream of the pond to the old gun club by 1.5 inches for the 2 year flow event. There are no historic records of how the dam was designed or installed, therefore only potential modifications based on limited field observation are suggested.

One of these suggested modifications is clearing the blocked underflow pipe, which may be prohibiting water from flowing freely from behind the dam, lowering the normal water elevation. If the existing protruding pipe from the dam structure is an underflow pipe, a potential modification could be removing field observed logs and restoring/fixing the flow of this pipe. If this pipe is the underflow and connected to a flow controlling structure behind the dam, that potential flow controlling structure could be modified to lower the initial water surface elevation. Structural analysis of the dam structure and the historic dam downstream as well as surveyed information with detailed modeling would need to be performed to determine the best solution for this potential project.

Any modification to the initial water surface elevation of the pond should be designed to provide additional flood storage behind the existing concrete dam, while not increasing flows downstream and retaining sufficient water within the upstream channel to retain healthy water elevations of the stream. A detailed study of the dam structure should be performed to determine modification potentials.

### North Point Tributary

During the project, this tributary was observed to have more significant erosion and flooding issues than other tributaries within the study area. FEMA mapping does not identify this area for backwater. However, upon review of information and photographs provided by residents, the area where the tributary meets the main stem stream channel illustrates issues with flood capacity that effect areas upstream within North Point's Development. Providing additional storage within the main stem stream channel will provide some relief, however providing storage upstream within the tributary will provide more capacity. Two areas were identified as potential storage sites. Utilizing the modeling software and USGS standard rain events, creating a hypothetical 0.5 acre footprint floodplain oxbow wetland with an average storage depth of 3 foot, would reduce flood elevations during a typical 5-year storm event by 1 inch from the potential storage area down to the main stream channel. This will also provide additional capacity within the stream channel for other flood events upstream of Hunter Parkway.

### Potential Trail Alternatives

After existing site conditions were inventoried and analyzed and opportunities and constraints determined, several proposed trail alignments were identified. The goal of each alternative was to create connections to existing and planned bike facilities, connect potential trailheads and link residents. Three alternatives were identified for consideration for the preferred route – Trail Option A: trail mainly on city property, Trail Option B: trail maximized for grades and ecological coordination and Trail Option C: mainly on-road bike lanes.

Trail Option A & B both utilize the opportunity of Pleasant Meadow Boulevard. The street is a dead end residential street with a low speed limit of 25 mph. Therefore, a combined bicycle lane along that street is appropriate to connect any trail along the river and the proposed Old Gun Club Trailhead to the existing Wyoga Lake Multi-Purpose Trail and proposed Wyoga Lake Road bike lanes.

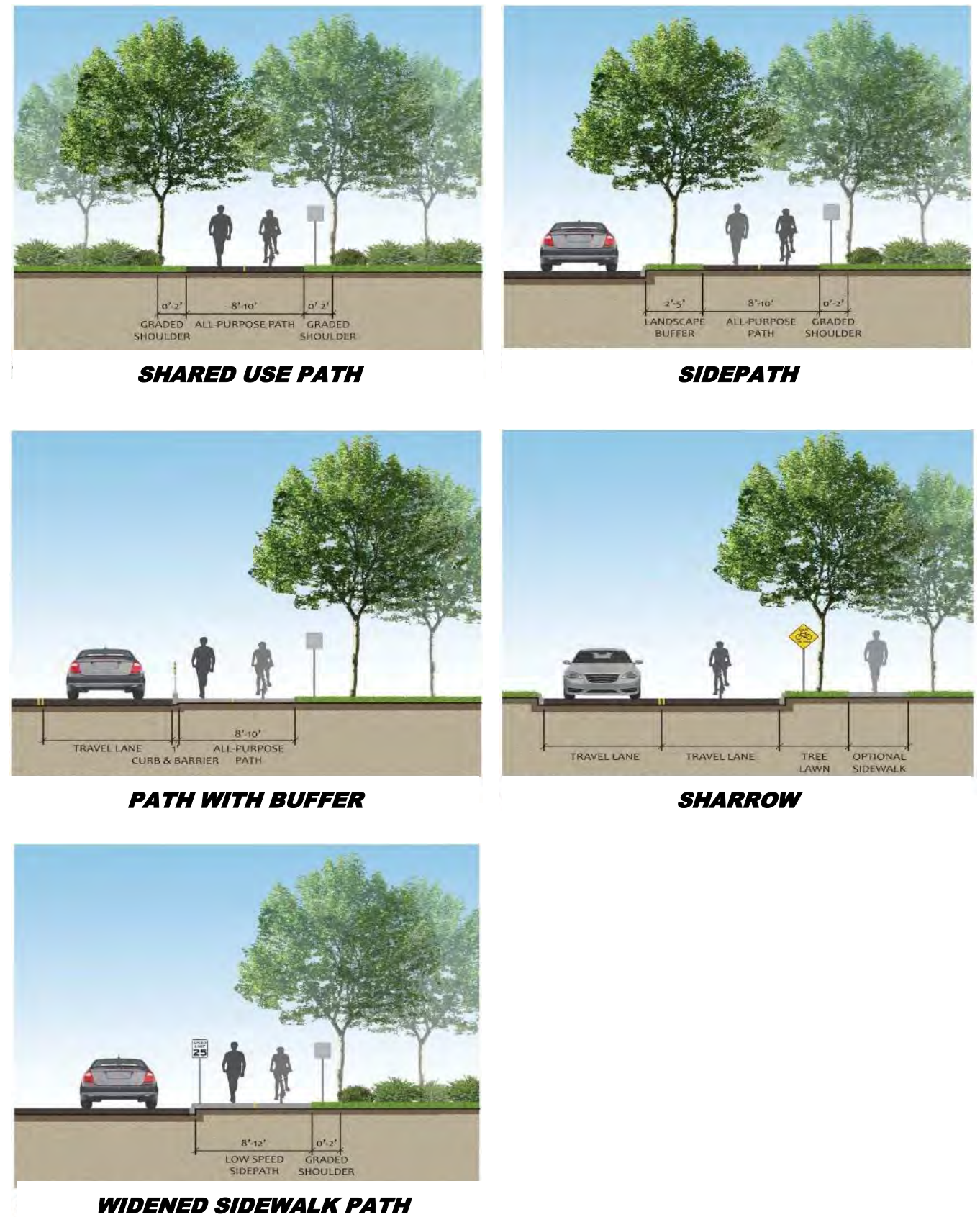


Figure 8: Typical Trail Types

## Trail Option A – Mainly City Property

Trail Option A begins at the proposed Pleasant Meadow Trailhead (Old Gun Club) and continues south on the east side of Mud Brook and under Hunter Parkway via an existing bridge underpass. Currently, the ground under the bridge is relatively flat and devoid of vegetation. Minimal grading and clearing would be required to install a trail in that location.

South of Hunter Parkway the Trail Option A continues southwest on the east side of Mud Brook to a grassy area west of the cul-de-sac on Brookpoint Lane, which is Homeowners Association Property. The trail connection up the hillside to this vantage point could also restore the deeply eroded areas. This vantage point from this grass area is approximately 20' higher than the stream and therefore provides wide views of the stream and opposite stream bank. A wood deck with some benches would be appropriate and a nice neighborhood amenity. The trail and the deck would be shielded from the homes by fencing and landscaping.

Trail A continues up the hillside within City property to Bath Road. The trail then splits east and west. East towards the potential trailhead at the historic barn and west towards an at-grade crossing at Bath Road. Traffic counts from 2012 indicate 7,513 vehicles travel this section of Bath Road, which even with the proposed residential development does not warrant a traffic light at the new proposed development. The at-grade trail crossing would require flashing warnings signs. There are no sidewalks within this area of Bath Road and there are large, mostly flat graded berms along both sides of the road.

The team reviewed multiple options for crossing Bath Road. These included review of opportunities for a bridge over or an underpass under Bath Road. The current vehicular bridge and roadway are very low to the river and would not enable safe underground passage without significant raising of the roadway. A pedestrian bridge over Bath Road was also reviewed. However, this bridge would need to accommodate semi-truck passage, necessitating a very tall bridge with abutments and wing walls that would negatively affect the ecology and aesthetics of the area. Additionally, the bridge would be cost prohibitive. Review of the existing road sight lines between State Road and Graham Road show the proposed intersection with the new development will be one of the best areas for a safe pedestrian crossing.

A connection is proposed to the French Mill Run Development (currently under construction) along the southern side of Bath Road. There are less parcel and utility conflicts along the southern portion of Bath Road at State Road than at the northeast corner. French Mill Run is a multi-use development containing residential and commercial uses. As previously mentioned, State Road already contains bike lanes in the vicinity of Mud Brook and Mill Pond that extend past the French Mill Run Development, so a connection from the Mill Pond-Mud Brook Greenway Trail would need to extend to State Road and the existing bike lanes would provide the connection to the Development.

Trail Option A then utilizes an existing city owned parcel to connect to Mill Pond. Two scenic overlooks are proposed near Mill Pond, both on the northeast side of the pond. The first is at a high point in the peninsula of land between Mud Brook and Mill Pond, across the stream from Emidio's Party Center. This vantage point provides views of Mill Pond and of the adjacent stream and woods. Views could be enhanced with some strategic pruning of understory vegetation. The second overlook is approximately 400 feet southeast of the first overlook and is lower in elevation to allow views just above the normal water level. Both of the overlooks will provide opportunities for wildlife observation. The overlooks could provide a deck or boardwalk, benches and interpretive signage describing local wildlife that may be seen.

This option then traverses along the eastern edge of the pond and the proposed Menards development. This section of the trail will heavily depend upon further review of the Mill Pond dam and proposed modifications to the dam structure. Currently the dam seems to not be functioning as a dam for flood water control. If the dam were to be modified to hold flood water, then the typical water elevation would be lowered, potentially allowing for more land to be exposed on the eastern side of the pond. This additional land could be used for a trail. This trail segment also has the potential to be installed as a floating boardwalk.

Trail Option A travels across a hillside to the existing private drive owned by Falls Oral Surgery and Dental Implant Center. The trail would share this lightly traveled roadway with a proposed sidepath connection from it to the northeast corner of Graham Road, where the trail would connect to the existing bike lanes on State Road. This sidepath may necessitate some property acquisition and utility relocation.



**Photo 4: Potential trail along pond or steep sloped areas may require a leaning rail fence for safety and promote wildlife viewing.**

## Trail Option B – Proposed Development

Trail Option B also begins at the proposed Pleasant Meadow Trailhead (Old Gun Club). This trail option maximizes opportunities with proposed developments. Most of the trail alignment is similar to Trail Option A. Deviations from that alignment are:

- Trail maximizes wetland storage potential at the Old Gun Club. The trail would be utilized as a berm for a floodplain wetland. Trailhead facilities would be intermixed with the proposed senior housing at the end of Pleasant Meadow, requiring an easement and/or use agreements.
- Trail maximizes trailhead potential at the historic barn. The trail would come up within the historic barn parcel and wrap in front of the barn. In the future, the buildings surrounding the barn would be purchased and reworked to include trail parking with a few of the more historic houses used as programmatic space. The trailhead could be transformed into a "Heritage Village" that would be a wonderful regional amenity. It could be programmed with Cuyahoga Falls history and agricultural information.
- Trail would then share the road of the proposed residential development on the south side of Bath Road. This will keep trail users in the front of people's houses, provide a cost effective alternative for this section and link to the overlooks at Mill Pond.
- The trail links through a beautiful wetland owned by the City between Menards and the proposed residential development. The trail would be a boardwalk at this point.
- The trail then skirts the eastern edge of the Menards loading yard through a narrow clearing between it and the abutting senior living property.

## Trail Option C – Bike Lanes

Trail Option C provides bike lane connectivity to the existing bike lanes on State Road and the proposed bike lanes on Wyoga Lake Road. Right of way along Bath road is wide in most areas and the road shoulders are relatively flat. Bike lanes would be a cost effective alternative to connect up to the proposed historic barn trailhead and the existing/proposed bike lanes. However, this option does not provide a connection to the ecological areas of the corridor, nor does it provide an inviting multi-user experience. Additionally, Bath Road has a 35 MPH speed limit and vehicles tend to speed on this straight street that has few connections.

## Proposed Improvements and Master Plan

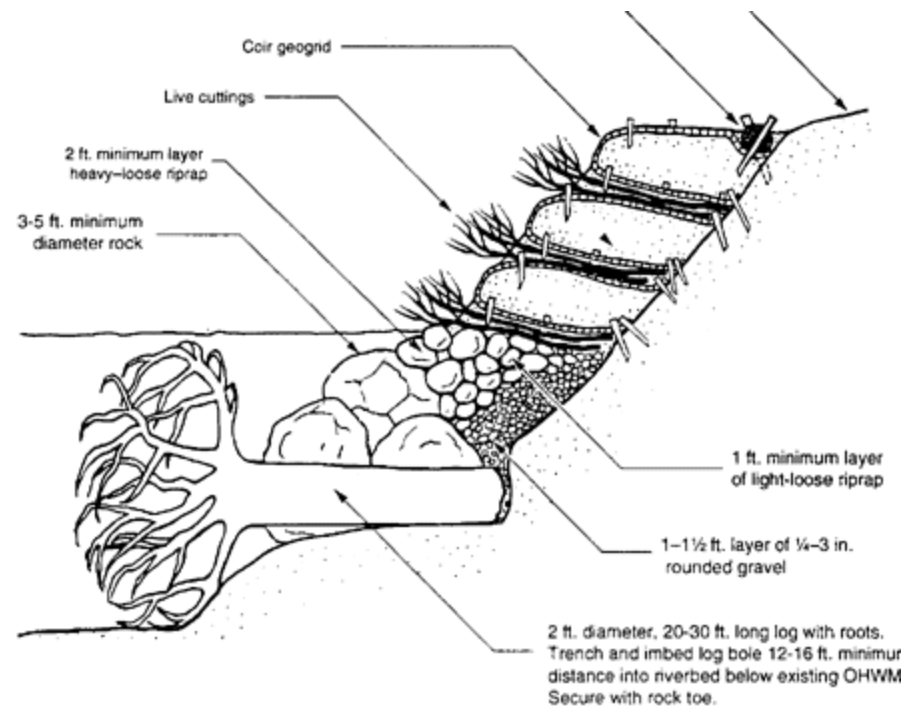
The goals of this report are to make recommendations for natural resource protection, flood mitigation and passive recreation opportunities within the Mill Pond-Mud Brook Greenway Study Area. The Overall Master Plan identifies preferred alignments for trails, potential connector trails for adjoining residents, multiple areas that can be used for flood mitigation and areas for ecological enhancements. Each of the trail alternatives, flood storage areas, and ecological enhancements were combined to create a holistic Overall Master Plan that maximizes each of the three goals.

### Preferred Trail Alignment

Through the design process, including feedback with the public and stakeholders, the Preferred Trail Alignment was defined as Trail Option B north of Bath Road and Trail Option A south of Bath Road. The combination of these two alternatives maximizes opportunities on City owned property, ecological benefits, flood control opportunities and connections. Many of these trail segments can be combined with ecological restoration to expand potential funding sources. The main spine of the trail is approximately 1.8 miles with an addition of 2.1 miles of community connector trails. The preferred alignment has two formal trailheads identified and multiple overlooks.

### Ecological Restoration, Stream Bank Stabilization and Floodplain Wetland Storage

There are multiple opportunities to enhance the existing ecology within the corridor while also improving flood storage. One of the potentially significant storage areas will be the modification of Mill Pond. Modification of the dam structure to allow for more flood water control will not only provide storage, but it will provide additional habitat for wildlife and potentially room for trail building. Wetlands have significantly more diverse habitat than ponds. Wetlands water elevations fluctuate with the seasons, providing migrating birds with a source of food and a place to rest, providing invertebrates with a complex environment while still providing fish habitat.



**Figure 9: Conceptual detail of natural streambank restoration where fish habitat is needed and high velocities are present**

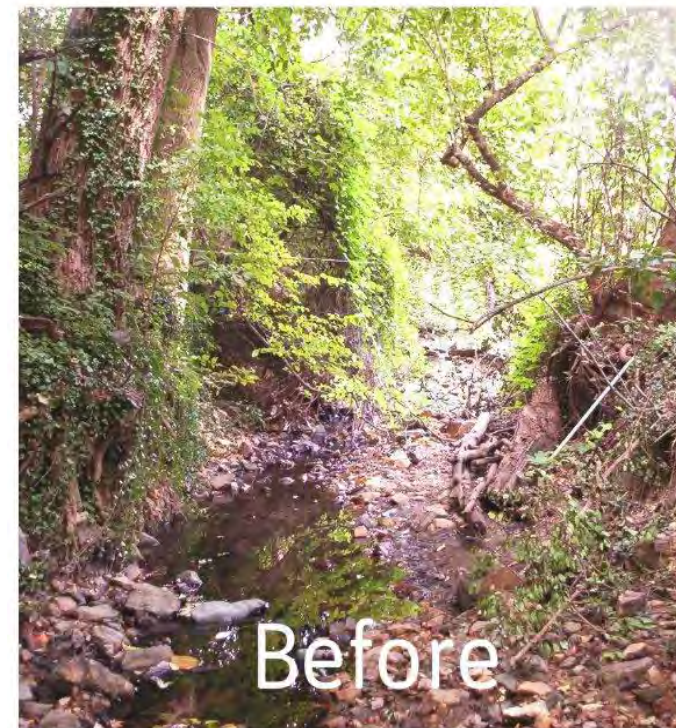
The plan also suggests multiple areas for vernal pool installation. A vernal pool is a small basin lacking a permanent above ground outlet but rather uses soil and evaporation to manage water. Water elevations are typically no more than 3 inches and the footprint is no more than 200 square feet each. In Ohio, it fills with water with the rising water table of fall and winter or with the meltwater and runoff of winter and spring snow and rain. They contain water for a few months in the spring and early summer. By late summer, a vernal pool is generally (but not always) dry. These are easily retrofit into forested areas as their construction can be minimally invasive. A vernal pool, because of its periodic drying, does not support breeding populations of

fish. Many organisms have evolved to use a temporary wetland which will dry but where they are not eaten by fish. These organisms are the "obligate" vernal pool species, so called because they must use a vernal pool for various parts of their life cycle. If the obligate species are using a body of water, then that water is a vernal pool. In the northeast, easily recognizable obligate species are fairy shrimp, mole salamanders and wood frogs.

Throughout the study area, there are many, many stream banks and hillsides that are eroded. The concept of natural streambank and hillside restoration refers to returning the degraded slope and its ecosystem back to a stable and healthy condition. Natural streambank and hillside restoration involves using plants, tree stumps and logs; synthetic geofabrics/textiles such as coir fiber logs and mats; large stone and other materials to minimize erosion potential on regraded banks.



**Photo 5: A vernal Pool (above) is a small depression that seasonally holds water and provides excellent habitat for obligate species**



Before



After

**Photo 6 & 7: Photos illustrating one type of natural streambank restoration technique. Streambanks are laid back to provide storage during flooding, native vegetation is planted for shading and toe rock is installed for erosion armoring**

## Design Standards for Roadway Floodway and Floodplain Protection

Municipalities and regulatory agencies throughout the country have instituted a variety of codes and design standards for development in floodplains. Additionally, the USEPA has produced developmental guidelines for stormwater control within the right-of-way. This document is attached as an appendix.

## Opportunities for Flood Mitigation/Stabilization for Homeowners

During the project, the team and the City staff had the opportunity to walk the common areas with multiple homeowners and the City Councilman. Many of the problem areas identified by the residents were exacerbated unknowingly by well-intentioned restoration techniques. Attached to this report are four appendix documents that can assist and educate homeowners specifically around condominium developments, with understanding the challenges and opportunities of living next to a stream channel and how they can assist with flood and erosion reduction.

## Phasing & Prioritization

Phasing is important in plan development and implementation. Phasing and prioritization of projects should recognize known planned development, funding cycles and monetary constraints. Phase 1 projects capitalize upon the known planned developments in the Mill Pond and Mud Brook Incentive Districts. Within the Mill Pond Incentive District, Phase 1 projects include modification of the dam at Mill Pond, trails surrounding the proposed trailhead at the historic barn and safe crossings for the planned residential development south of Bath Road to that proposed trailhead. Phase 1 projects within the Mud Brook Incentive District include trail and flood storage surrounding the Old Gun Club. This gun club has significant potential for environmental cleanup grants and the projects should be coordinated with this potential funding source.

Please see the attached detailed Opinion of Probable Costs for a breakdown of phased projects.

## Public and Stakeholder Engagement

During this project, there were multiple opportunities for the public and stakeholders to provide input on this plan. A kickoff meeting with the City was performed on April 16, 2015 to identify the scope of the study area. To get a better understanding of the study area, a site walk was performed with city staff from multiple departments on May 22, 2015 with Environmental Design Group personnel. After these two meetings, Environmental Design Group held the first of multiple stakeholder meetings on July 23, 2015. At this first meeting, inventory information was presented for the study area, opportunities and constraints were discussed and potential trail options through the corridor were deliberated.

During this meeting multiple stakeholders discussed severe flooding and erosion within and surrounding the study area. Leading from this stakeholder meeting, a second stakeholder meeting was performed in the field to visually identify the issues brought up by the stakeholders. At this meeting, held September 15, 2015, the city and Environmental Design Group walked the North Point development and study area with stakeholders and City Councilman Mike Brillhart. During this meeting, a number of potential flood mitigating measures for homeowner groups to perform was discussed. These included less mowing, reducing the clearing of forest understory and reducing the encroachment of patios and development into riparian areas and forests.

The first public meeting, held on September 17, 2015 included information presented at the stakeholder meetings. It also included an educational program on what homeowners can do to provide a healthy stream buffer corridor including flood control and erosion abatement. A second meeting was held December 3, 2015

and a third public meeting was held January 19, 2016. Additional stakeholder meetings were held November 9, 2015 and multiple field visits and discussions with the USEPA for the old gun club were held.

## Cost Opinion and Potential Funding

### Opinion of Probable Project Costs

Costs will fluctuate contingent up on final design, coordination of projects listed, time of year for construction, amount of clean up required for contaminated properties, property acquisition, and final hydrologic modeling. Opinion of probable project costs were estimated using industry-standard construction cost estimating practices (i.e., RSMeans construction cost data (an industry standard database for construction estimation published by Reed Construction Data), Ohio Department of Transportation (ODOT) bid tabulation results, and local project bid tabs.). Estimates includes a 50% construction contingency with a cost accuracy range of -50% to +150%, which is within the Association for the Advancement of Cost Engineering (AACE) accepted range for a Class 5 planning level construction cost estimate.

Please see the attached detailed Opinion of Probable Costs broken down by Incentive District and phase.

### Potential Funding

There are two state grant programs available to communities for trails - Recreation Trails and Clean Ohio Fund. Many times, a community must submit these grant applications more than once to receive funding, however, the grants are for 75% or 80% of the cost of the project, which is a significant amount.

Other sources of funding may be secured from private foundations that have an interest in the community and/or promoting trails or ecology. For example, a national organization entitled Bikes Belong, funds bike routes and programs that encourage bicycling at all levels. Private foundations have stated missions and purposes for their funds. Most are interested in public projects that enhance the quality life of the populace.

Another method for funding is a Special Improvement District (SID) allowed by the Ohio Revised Code for communities to pay for a capital improvement. ORC Section 1117.02 allows property owners to pay an additional tax or fee designated for specific services or improvements within the district's boundaries. Property owned by government and churches are exempt unless representatives of these properties request in writing to be included. The SID enables a community, neighborhood, or business district to tax itself for specific improvements and services. A SID can capture the energy of property owners motivated to make community improvements, and can provide benefits to the community-at-large with no additional financial burden to local government coffers.

Additionally, TIF (Tax Increment Finance) districts can be established based upon the study area's potential development. TIF is a mechanism utilized throughout the country to help finance real estate development and improvements for those developments by using potential future property tax revenues to fund a current development project. Ohio Revised Code has two types of TIF districts defined – 5709.40 and 5709.41. 5709.40 is a district where the "incentive area" does not have to be owned by the City. This area naturally creates two unique "incentive areas".

Many communities also use revenue generated from travel and tourism activities as a dedicated revenue source for projects like these since they will bring people to the city to utilize their businesses, restaurants and other retail operations.

Communities must always be aware of available funding for capital projects. The first and usually the most difficult step is having a realistic and practical plan. This document is an accomplishment for the City of Cuyahoga Falls and puts them ahead of the competition for funding since the planning for the recommended routes will be completed. It will be critical for the community to now review these suggested funding streams to ascertain the best match for the top priorities of the community.

Other potential grant sources include:

**Ohio EPA 319 Grant:** This federal grant is locally awarded through the Ohio EPA. Awards can be for stream restoration, wetland restoration, dam removal, riparian restoration, or riparian, wetland protection and innovative stormwater management projects (bioswales, raingardens, pervious pavement and rain water collection systems). Section 319(h) implementation grant funding is targeted to Ohio waters where nonpoint source (NPS) pollution is a significant cause of aquatic life impairments. Applications are typically due each spring. The local match is 40%.

<http://www.epa.ohio.gov/dsw/nps/index.aspx#120843254-319-grants>

**Surface Water Improvement Fund (SWIF):** Administered by the Ohio EPA Division of Surface Water will make grants for projects that restore or improve Ohio's impaired waters. Funding for this grant will come from supplemental environmental projects, alternative mitigation and payments and contributions from state agencies, corporate sponsors and others. Ohio municipalities, county and township governments, statewide conservation organizations and metro park districts may be eligible to receive grants from this fund. Watershed groups may also be eligible, with the support of a co-sponsoring local government. Projects such as stream restorations, dam removals, wetland and riparian restoration and innovative storm water management projects (bioswales, raingardens, pervious pavement and rain water collection systems) are all possibilities. Rounds for this very popular grant are typically due in spring.

<http://www.epa.state.oh.us/dsw/>

**Water Resource Restoration Sponsor Program (WRRSP):** A funding source that is a component of the Ohio Water Pollution Control Loan Fund (WPCLF). The goal of the WRRSP is to counter the loss of ecological function and biological diversity largely from NPS(Non-Point Source Pollution) that jeopardizes the health of Ohio's water resources. To participate in the WRRSP, a community applies to the Waste Water State Revolving Load Fund (WWSRF) program for a loan to support wastewater treatment system improvements and also for WRRSP assistance for water resource restoration activities. If both projects are deemed fundable, the Ohio EPA will provide a loan with a lower interest rate than either individual project could receive by itself.

The average funding for each project is \$2 million. Projects are divided between two categories: a) protection category, and b) restoration category, with \$15 million total being split evenly between the two. Projects will be selected for funding during the program year based on the ranking of the WRRSP project priority list, the priority ranking of the sponsoring project, and the readiness of project sponsors to enter into loan agreements within the program year. The application period is typically open in May with applications due in June. There will be a new scoring methodology in 2016.

<http://epa.ohio.gov/defa/EnvironmentalandFinancialAssistance.aspx#155508734-water-resource-restoration-sponsor-program-wrrsp>

**Five Star Restoration Grant Program:** The Five Star Restoration Program brings together students, conservation corps, other youth groups, citizen groups, corporations, landowners and government agencies to provide environmental education and training through projects that restore wetlands and streams. The program provides challenge grants, technical support, and opportunities for information exchange to enable community-based restoration projects. Funding levels are modest, from \$5,000 to \$20,000, with \$10,000 as the average amount awarded per project. Each project would ideally involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution. This grant application is typically due February 2nd.

<http://www.epa.gov/wetlands/restore/5star/>

**Great Lakes Restoration Initiative (GLRI):** The Great Lakes Restoration Initiative goal is to address the wide range of pollutants that occur within the largest surface freshwater in the world. An estimated \$40 million may be awarded under this program for an estimated 150 projects. Awards may be fully or incrementally funded. Applicants may also submit more than one application provided that each one is for a different project. Projects will be chosen based upon the following four GLRI focus areas:

- Toxic substances and Areas of Concern - including pollution prevention and cleanup for the most polluted areas in the Great Lakes.
- Invasive Species - including efforts to institute a zero tolerance policy" toward new invasions.
- Nearshore Health and Nonpoint Source Pollution - including a targeted geographic focus on high priority watersheds and reducing polluted runoff from urban, suburban, and agricultural sources.
- Accountability, Education, Monitoring, Evaluation, Communication and Partnerships

Applications for this funding source are typically due in April.

<http://www.greatlakesrestoration.us>

**Land and Water Conservation Grant:** This statewide grant typically funds open space acquisition and small recreation based projects. Typical award amount is \$50,000. Funding requires a minimum of 50% local match. This grant application is due May 1st every year.

<http://realestate.ohiodnr.gov/outdoor-recreation-facility-grants>

**Natureworks Grant:** This statewide grant typically funds playgrounds, parking improvements, landscaping and other small projects. Typical award amount is less than \$30,000. Funding requires a minimum of 25% local match. This grant application is due May1st every year.

<http://realestate.ohiodnr.gov/outdoor-recreation-facility-grants>

**Clean Ohio Open Space Conservation Grant:** This grant could be used to purchase open space, create easements, restore streams or wetlands, and public access construction including parking lots and trails. This project would be in NRAC District #8. Past projects have received from \$75,000 to \$1 million. Funding requires a minimum of 25% local or federal match. The application period for this funding source has not been listed yet.

<http://development.ohio.gov/cleanohio/GreenSpaceConservation/>

**Transportation Alternatives Program/ Map 21:** The purpose of the Transportation Alternatives (TA) Program is to strengthen the cultural, aesthetic, and environmental aspects of the intermodal transportation system. Approximately \$3 million was available for TA funding in 2014 from AMATs. The next round of TA funding will be June 2016.

<http://amatsplanning.org/funding/>

**USEPA Brownfield Clean Up Grant:** Cleanup grants provide funding for a grant recipient to carry out cleanup activities at brownfield sites. An eligible entity may apply for up to \$200,000 per site. Due to budget limitations, no entity can apply for funding cleanup activities at more than three sites. These funds may be used to address sites contaminated by petroleum and hazardous substances, pollutants, or contaminants (including hazardous substances co-mingled with petroleum). Cleanup grants require a 20 percent cost share, which may be in the form of a contribution of money, labor, material, or services, and must be for eligible and allowable costs (the match must equal 20 percent of the amount of funding provided by EPA and cannot include administrative costs). A cleanup grant applicant may request a waiver of the 20 percent cost share requirement based on hardship. An applicant must own the site for which it is requesting funding at

time of application. The performance period for these grants is three years. Projects can also be phased so there are multiple projects and multiple applications. These federal grants are due typically in January.

<http://www.epa.gov/brownfields/types-brownfields-grant-funding#tab-3>

**The Kresge Foundation:** Provides grants to support planning costs associated with designing environmentally sustainable buildings. The foundation also provides workshops and educational materials for nonprofits as part of its Green Building Initiative. Facilities-capital grants fund the acquisition and construction of facilities, including land, new construction and existing property renovation, and major equipment purchases. Facilities-capital grants historically have been awarded as challenge grants to organizations engaged in capital campaigns to raise private funds for their projects. Facilities-capital challenge grants are awarded to organizations that cater specifically to the needs of the poor, disadvantaged and disenfranchised in six program areas: Health Program, the Environment Program, Arts and Culture Program, Education Program, Human Services Program, and Community Development / Detroit Program.

[http://www.kresge.org/index.php/our\\_funding\\_methods/challenge\\_grant\\_program/](http://www.kresge.org/index.php/our_funding_methods/challenge_grant_program/)

## Appendices

### A. Existing Conditions Inventory Maps

- Mill Pond Watershed Area of Summit County
- Mill Pond Watershed General Land Use
- Mill Pond Watershed General Zoning
- Study Area Parcel Ownership
- Study Area Topography
- Study Area Wetlands, Floodway and Floodplain
- Study Area Hydric Soils
- Study Area Erosion Risk of Soils
- Study Area Streambank Erosion Areas
- Study Area Existing & Planned Trail / Road Network
- Study Area Sidewalk Gaps
- Study Area 2015 Land Use
- Study Area Zoning
- Study Area Storm, Sanitary and Electric Utilities

### B. Opportunities and Constraints Map

### C. Alternatives and Options Maps

- Trail Option A – Mainly City Property
- Trail Option B – Proposed Development
- Trail Option C – Bike Lanes

### D. Mill Pond – Mud Brook Greenway Master Plan

### E. Priority Maps with Property Acquisition Targets, Projects with Priorities

- Old Gun Club Proposed Improvement Sketch
- Mill Pond Wetland Restoration and Dam Modification
- North of Bath Road Proposed Improvement Sketch
- North Point Stream Restoration & Flood Storage (Cochran Road) Proposed Improvement Sketch
- Trail Crossing at Bath Road and Trailhead Proposed Improvement Sketch
- Trail Connection at Menards Proposed Improvement Sketch
- Mud Brook Incentive District Implementation Phases
- Mill Pond Incentive District Implementation Phases

### F. Detailed Opinion of Probable Costs

### G. Photo Logs

### H. Homeowners Presentation to Living Streamside

### I. Backyard Buffers

### J. Living Streamside for Condos and Apartments (Philadelphia Water Department)

### K. USEPA Guidelines for Green Streets

### L. Establishing Streamside Buffer Areas in your Park or Community (Bushkill Stream Conservancy)