MASON CARR
CIVIL ENGINEERING

TECHNICAL MEMORANDUM

TO: Sean Blake, P.E., Sanitation District No. 1 of Northern Kentucky
FROM: Richard W. Carr, P.E., Mason Carr Civil Engineering, LLC
DATE: April 19, 2021
RE: Vincent Drive, Taylor Mill, KY Drainage Improvements Technical Assistance

Introduction

During recent storm events, there have been excessive flooding issues occurring at Vincent Drive located in Taylor Mill, KY. On May 24, 2020, one flooding event is pictured in Figure 1 as documented by the residents.

Figure 1 – Flooding at Vincent Drive in Taylor Mill, KY on May 24, 2020

In order to evaluate the extent of the flooding, Mason Carr Civil Engineering, LLC began our investigation by meeting with Mr. Brian Haney and Mr. Marc Roden of the City of Taylor Mill. After this meeting, Mr. Haney also provided Mason Carr with a list of property owners in the vicinity who had filed complaints regarding flooding issues. Upon receipt of this list of property owners, Mason Carr visited the site again and met with the following property owners:

- [redacted] (714 Vincent Dr and 736 Bonnie Dr)

- [redacted] (716 Vincent Dr)
- [redacted] (718 Vincent Dr)
- [redacted] (736 Vincent Dr)

Drainage Areas

In addition to on-site field investigation, Mason Carr reviewed GIS maps, SD1 maps, and the SD1 drainage folder containing information from the construction of Pride Parkway. Mason Carr demarcated the drainage areas associated with the flooding issues at Vincent Drive by focusing on the area from the headwall that empties into the existing creek at 748 Vincent Drive through the paved channel behind 716 Vincent Drive and to the intersection of Pride Parkway and Wayman Branch Rd. By separating out each of these drainage areas, Mason Carr was able to assign a land use assessment to each of the areas and distinguish between the pervious (grass, woods, etc.) and impervious areas (roadways, sidewalks, driveways, rooftops, etc.) associated with each of these drainage areas. Distinguishing between these pervious and impervious areas allows a storm water runoff model to be developed and evaluated in order to view the effect that various conditions have on the storm water in the area including pre- and post- construction activities. Table 1 below summarizes the drainage areas and impervious areas contributing to each, Figure 2 shows a map view of these delineated drainage areas, and Figure 3 shows a map view of the impervious areas.

Location	Drainage Area (Acres)	Impervious Area (Acres)	Percent Impervious (%)
Right-of-way at Wayman Branch Rd	4.8	2.2	45.8
Right-of-way of Pride Parkway and Woods	1.7	0.0	0.0
710 -718 Vincent Drive Housing Area	4.6	0.3	6.5
Heathermoor Housing Area	5.8	1.0	17.2
Vincent Dr and Bonnie Dr Right-of-way	2.2	0.8	36.4
724 – 730 Vincent Drive Housing Area	3.9	1.2	30.8
733 – 741 Vincent Drive Housing Area	4.7	1.4	29.8
732 – 740 Vincent Drive Housing Area	2.3	0.6	26.1
740 – 742 Vincent Drive Housing Area	0.9	0.3	33.3
744 – 746 Vincent Drive Housing Area	1.0	0.3	30.0
Bonnie Dr Housing Area	6.8	2.4	35.3

Table 1 – Drainage Area and Impervious Area Summary

Figure 2 – Delineation of drainage areas

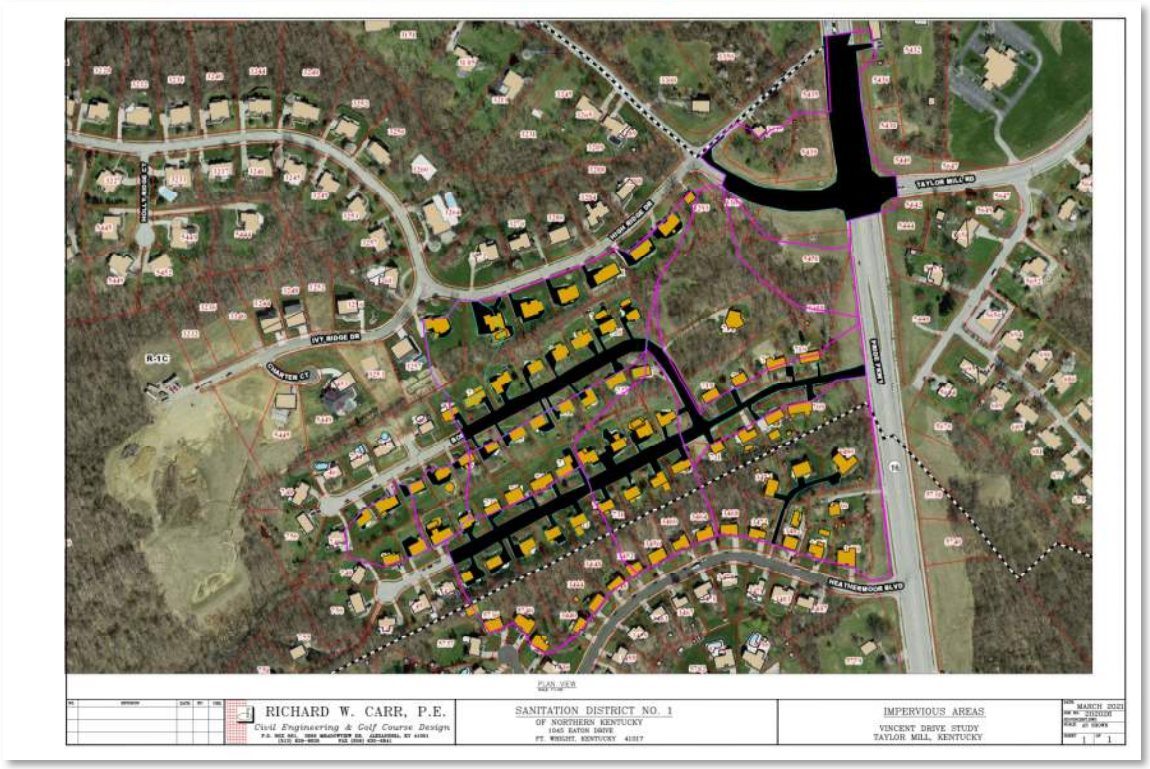

Figure 3 – Delineation of drainage areas – Impervious

The total drainage area contributing stormwater flow to this location is 38.7 acres with 10.5 acres of that area being impervious surfaces. The drainage area that discharges into the creek at the bottom of the 748 Vincent Drive property discharges through the headwall pictured in Figure 3.

Figure 3 – Headwall at 748 Vincent Drive

From this headwall at 748 Vincent Drive, the existing storm pipe is a 36" corrugated metal pipe consisting of 537 LF passing through two manholes to a manhole in the east side yard of 740 Vincent Drive at which point a 15" PVC pipe joins the manhole discharging stormwater flow from the north at Bonnie Drive. This 15" PVC pipe extends to a manhole in the back yard of 738 Vincent Drive and directs flow to the manhole in the east side yard of 740 Vincent Drive. During storm events, the manhole in the back yard of 738 Vincent Drive has been shown to surcharge as shown in Figure 4 below. There is 276 ft of 15" PVC that transitions to a 12" CPP as it runs along Bonnie Dr. There is also 93 LF of private 8" PVC that ties into this 12" CPP along Bonnie Dr in order to drain the backyard of 736 Bonnie Dr.

Figure 4 – Manhole #89 during a flooding event

From the manhole in the east side yard of 740 Vincent Drive, the pipe extends out to Vincent Drive including 170 LF of 36" corrugated metal pipe along Vincent Drive to a manhole directly in front of 736 Vincent Drive at which point the pipe transitions to a 24" Reinforced Concrete Pipe. Several curb inlet catch basins along Vincent Drive collect stormwater that discharges into this 24" RCP. There is 559 LF of 24" RCP that transitions to a 15" Reinforced Concrete Pipe at a catch basin directly in front of 724 Vincent Drive near the intersection of Bonnie Drive and Vincent Drive. Subsequent repaving of the street on Vincent Drive over the course of its lifetime has caused the pavement thickness to increase, which effectively reduces the capacity of the curb and gutter system to be able to collect stormwater flows as pictured in Figure 5. This section of Vincent Drive is also part of a natural "sag" area of the street where stormwater has no way out. This is the location indicated in Figure 1 which is the main location of the extreme flooding conditions.

Figure 5 – Curb inlets along Vincent Drive

From the catch basin directly in front of 724 Vincent Drive, an 18" PVC pipe extends to the south through another catch basin and three manholes to a headwall in the west side yard of 721 Vincent Drive which collects stormwater from the creek at the base of the Heathermoor properties to the south of Vincent Drive. Also from the catch basin directly in front of 724 Vincent Drive, there is 84 LF of 15" Reinforced Concrete Pipe that crosses Bonnie Dr. Once crossing Bonnie Dr., the pipe system ends at a catch basin in Bonnie Drive just west of 718 Vincent Drive. From there, the stormwater collection system consists of a paved, rock-lined channel for about 200 LF behind 716 and 718 Vincent Dr as shown in Figure 6.

Figure 6 – Paved, rock-lined channel behind 716 and 718 Vincent Dr

At this point, the paved channel transitions to a grass swale for another approximately 200 LF to a private culvert through a crossing to a private cemetery that uses this access from Vincent Drive. Upon Mason Carr's site visits, this culvert was buried, so for this purposes of this study, Mason Carr and SD1 staff determined the best course of action was to proceed as though the culvert is not there.

Figure 7 – Grass swale behind 714 Vincent Drive

Stormwater flows into the grass swale from the existing grated headwall, which is the outfall from the retention pond built in the right-of-way in the intersection of Wayman Branch Rd and Pride Parkway. Upon review of the Kentucky Transportation Cabinet drainage folder for the construction of Pride Parkway, it was determined that this retention pond was added after the fact in the design process and

therefore does not have any applicable design parameters/calculations. For the purposes of this study, no additional field measurements were taken to determine the effectiveness of the retention. Upon investigation, it did appear that the retention area was being maintained, and that was confirmed by Mr. Brian Haney during our initial site visit. Upon request, SD1 staff did map out the storm piping system associated with this retention pond and provided the schematic of the system as shown in Figure 8. There appears to be a 24" corrugated metal riser section that acts as the control structure for this retention area effectively controlling the outfall to the grated headwall at the base of the pond. This retention area appears to hold back a significant amount of flow, which is then allowed to slowly discharge by way of the 24" corrugated metal riser control structure.

Figure 8 – Wayman Branch and Pride Parkway Intersection Retention Area

Existing Conditions and Stormwater Model

A Computer Aided Design system for modeling the hydrology and hydraulics of stormwater runoff known as HydroCAD was utilized. It is based largely on the hydrology techniques developed by the Soil Conservation Service (SCS/NRCS), combined with other hydrology and hydraulics calculations. For a given rainfall event, these techniques were used to generate hydrographs throughout a watershed. The Dynamic Storage-Indication routing method was used so that the stage-discharge and storage-indication curves are re-evaluated at each time step, based on the current elevation of any downstream nodes. The Type II, 24 hour design storms used for the model were the 1 year, 2 year, 10 year, 25 year, 50 year, and 100 year storms, and the rainfall depths used in the model for each of these storms was as follows in Table 2:

Design Storm	Rainfall Depth (inches)
1 year	2.60
2 year	3.05
5 year	3.70
10 year	4.36
25 year	5.15
50 year	5.78
100 year	6.44

Table 2 – Design Storm Rainfall Depths

In order to accurately show the existing maximum flood depths and provide control points for comparison of potential improvement alternatives, three specific locations have been identified within the area of this study. These locations are as follows:

- Point A – location of manhole in Vincent Drive near the lot line between 738 and 736 Vincent Drive in the existing "sag" area of Vincent Drive
- Point B – location of catch basin directly in front of 724 Vincent Drive near the intersection of Vincent Drive and Bonnie Drive
- Point C – location of Existing Creek behind 716 Vincent Drive

Figure 9 below is a map indicating the locations of each of these "control" points, which will be used for further comparison purposes throughout this report. Exhibit A is the full size 11x17 version of Figure 9, and it is attached at the end of this report.

Figure 9 – Existing Conditions and "Control" Points Map

Figure 10 below shows a diagram of the system model indicating the study nodes and sub-catchments.

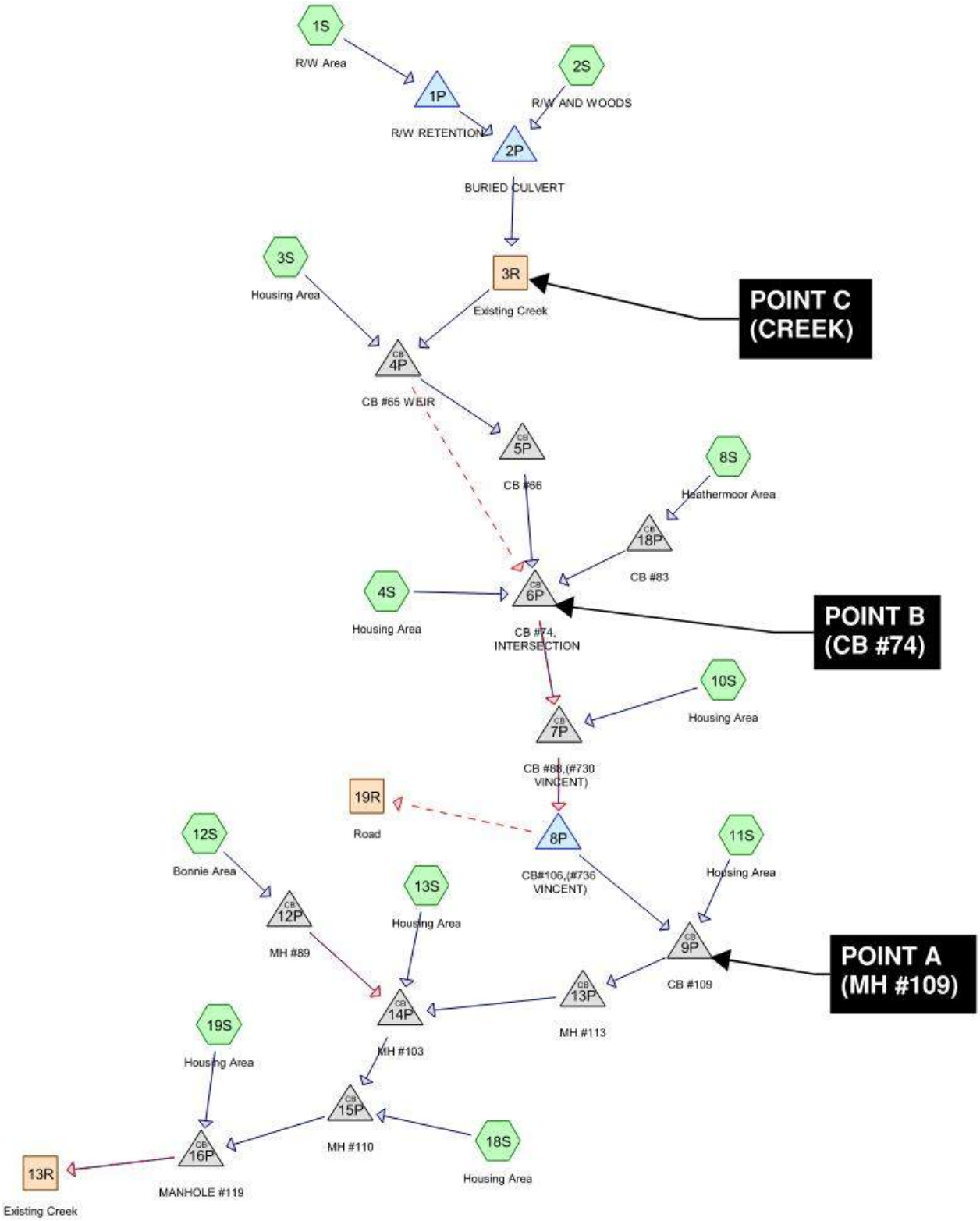

Figure 10 – Diagram of Stormwater Model – Existing Conditions

The stormwater model referenced above in Figure 10 was used to analyze the existing conditions and the overall capacity of the existing storm sewer system in the area designated for this study. It appears that that the existing storm sewer system does not have enough capacity to properly manage the storm water runoff associated with the design storms that were evaluated. Based on the stormwater model, most of the nodes demonstrated approximately a 5 year level of service with a couple of nodes demonstrating less than a 2 year level of service. Table 3 below summarizes the maximum water depths for the existing conditions at each of the "control" points established earlier in this report. The values in Table 3 represent the elevation of the Hydraulic Grade Line (HGL) minus the rim elevation of the corresponding storm structure (or the floor elevation of the nearby houses in the case of Point C). Thus, a positive value corresponds to a flood condition; whereas, a negative value corresponds to the water level being below the flood condition.

Location	2-Year 24-Hour Maximum Water Depth (feet)	5-Year 24-Hour Maximum Water Depth (feet)	10-Year 24-Hour Maximum Water Depth (feet)	25-Year 24- Hour Maximum Water Depth (feet)
Point A	-0.25	-0.06	0.59	1.67
Point B	-2.61	0.03	0.59	0.93
Point C	0.66	0.72	0.77	0.81

Table 3 – Maximum Water Depths (Existing Conditions)

Existing Areas of Concern

During the site visits and compiling of information from the City of Taylor Mill and the residents, Mason Carr identified five (5) Areas of Concern. Following is a list of the Areas of Concern associated with the stormwater runoff in the Vincent Drive vicinity:

1. Street flooding in the sag area in front of 736 Vincent Drive (Point A)
2. Catch basin directly in front of 724 Vincent Drive near the intersection of Vincent Drive and Bonnie Drive (Point B)
3. Back yards of 716 and 718 Vincent Drive (Point C)
4. Back yard of 736 Bonnie Drive
5. Manhole in the back yard of 738 Vincent Drive surcharges

Area of Concern #1 – Roadway Flooding at 736 Vincent Drive

The roadway flooding near 736 Vincent Drive is the result of several factors. The street grades and lot grading created a "sag" condition in the subdivision. The condition is worsened by upstream street drains allowing flows to pass-by due to resurfacing and pavement reconstruction. The direct drainage area into the "sag" is approximately 4.7 acres with over half of that from the uphill Heathermoor Subdivision. The total drainage area into the "sag" area is approximately 28 acres. During storm events in recent years, residents have reported flooding that has occurred on the street as deep as 18" for short periods. Residents indicate the flooding lasts for 5 to 10 minutes.

Area of Concern #2 – Storm Headwall flooding behind 721 Vincent Drive

Flooding occurs around the headwall in the west side yard of 721 Vincent Drive. Approximately 5.8 acres drain toward this area. The existing Heathermoor Subdivision which is in Covington is uphill from the problem area and accounts for 78% of the drainage area.

Area of Concern #3 – Flooding behind 716 & 718 Vincent Drive

The existing natural stream behind 716 Vincent Drive and the masonry channel behind 718 Vincent Drive drain an area of approximately 11.1 acres. The existing KY-16 right-of-way (4.8 acres) is directed into a retention basin at the southwest side of the Wayman Branch and KY-16 intersection. Although no design criteria are available from the Kentucky Transportation Cabinet, the riser discharge system seems to effectively regulate runoff. The Right-of-Way retention basin discharges to a natural creek via a 24" pipe. Additionally, 1.7 acre of Right-of-Way and woodland drain into that creek. A private driveway to the cemetery crosses that creek. Based on field observations, it appears there is a pipe of unknown size and depth buried under that driveway. The existing creek behind 716 Vincent Drive has a drainage area of approximately 11.1 acres. The creek overflows the banks causing water to flow into the basement of 716 Vincent Drive. The existing masonry channel behind 718 Vincent Drive is approximately 24" wide x 30" deep x 100' long at 2% slope. This channel is in a state of disrepair due to movement in the side walls and general lack of maintenance. Over time sediment has built up and the creek no longer has much definition. In addition, several issues cause impediments to the flow of the creek, which may cause the flow to jump out of the creek including debris, the walking bridge behind 718 Vincent Drive, and the storage shed that was built in the creek behind 716 Vincent Drive. When flow exceeds the capacity of the channel, water flows toward the house.

Area of Concern #4 – Flooding behind 736 Bonnie Drive

An increase in surface water flow in the backyard of 736 Bonnie Drive has been reported by the homeowner. An existing 8" PVC private drainage system was installed by the homeowners between 738 and 736 Bonnie Drive. The drainage area into this private system is approximately 1.2 acres consisting mostly of two single family homes in the High Ridge Park Subdivision. The increase in impervious area and redirection of surface water runoff has increased flow to the rear of 736 Bonnie Drive. Although this private system was not specifically involved in the analysis of the three control points established for the study, additional considerations are warranted to address potential improvements that could alleviate the flooding risks associated with this area. It is probable that the provision of additional surface drainage and uphill retention/detention areas could help alleviate the flooding conditions in this area. This could include construction of detention areas on lots in the High Ridge Park Subdivision that drain into the yard of 736 Bonnie Drive. Also, swales could be constructed to direct surface water to the drains. Sub-surface water can be collected with underdrains. Due to the 8" PVC outfall, inlet design and site grading must be considered; however, it does not appear that upsizing the 8" PVC outfall is feasible due to the shallow nature of the existing pipe and lack of pipe cover if the pipe size were increased.

Area of Concern #5 – Manhole Flooding behind 736 Vincent Drive

The existing storm manhole in the back yard of 738 Vincent Drive has been reported to surcharge during storm events. The manhole rim is elevated and no surface flow enters at the manhole. The drainage

area upstream is approximately 6.8 acres of single family homes and street. The pipe of this manhole is a shallow 15" PVC at a rather steep slope of 18.8%.

Alternatives Evaluation

SD1 has requested that Mason Carr evaluate alternatives at a planning level to determine potential methods that could be implemented in order to reduce the risk of flooding in the Vincent Drive study area. These alternatives primarily involve storm sewer replacement and upsizing in order to increase the capacity of the storm sewer system in this area. After analysis of the stormwater model was completed, Mason Carr developed the following two alternatives to address the flooding issues in the Vincent Drive study area:

- ***Alternative 1 for the problematic areas***
  This alternative involves the following potential improvements:
  - Constructing a new ditch behind 714 and 716 Vincent Drive (approximately $36,000),
  - Installing a new 24" PVC storm sewer along the property line between 716 and 718 Vincent Drive from the new ditch to a new catch basin at Vincent Drive and then along Vincent Drive to the catch basin directly in front of 724 Vincent Drive (approximately $68,000)
  - Upsizing to a 36" PVC Storm Sewer between the catch basin directly in front of 724 Vincent Drive and the catch basin directly in front of 736 Vincent Drive (this pipe would be 24" deeper than the existing pipe at the catch basin directly in front of 724 Vincent Drive) (approximately $117,000)
  - Upsizing to a 48" PVC Storm Sewer from the manhole in Vincent Drive near the intersection of the lot lines of 738 Vincent Drive and 736 Vincent Drive to the manhole in the backyard of 744 Vincent Drive (approximately $71,000)
  - Deepen the manhole in the backyard of 740 Vincent Drive by 4.3 feet on the downstream side. (approximately $9,000)

  The total planning level opinion of probable cost for this alternative is $301,000. Exhibit D provides the full detail of the opinion of probable cost, and it is attached at the end of this report. Figure 11 below shows the improvements suggested for Alternative 1. Exhibit B is the full size 11x17 version of Figure 11, and it is attached at the end of this report.

Figure 11 – Alternative #1 Map

In order to analyze the potential reduction in flooding risk associated with the improvements describing in Alternative 1, a new stormwater model was developed using these new parameters. The model for Alternative 1 is shown below in Figure 12:

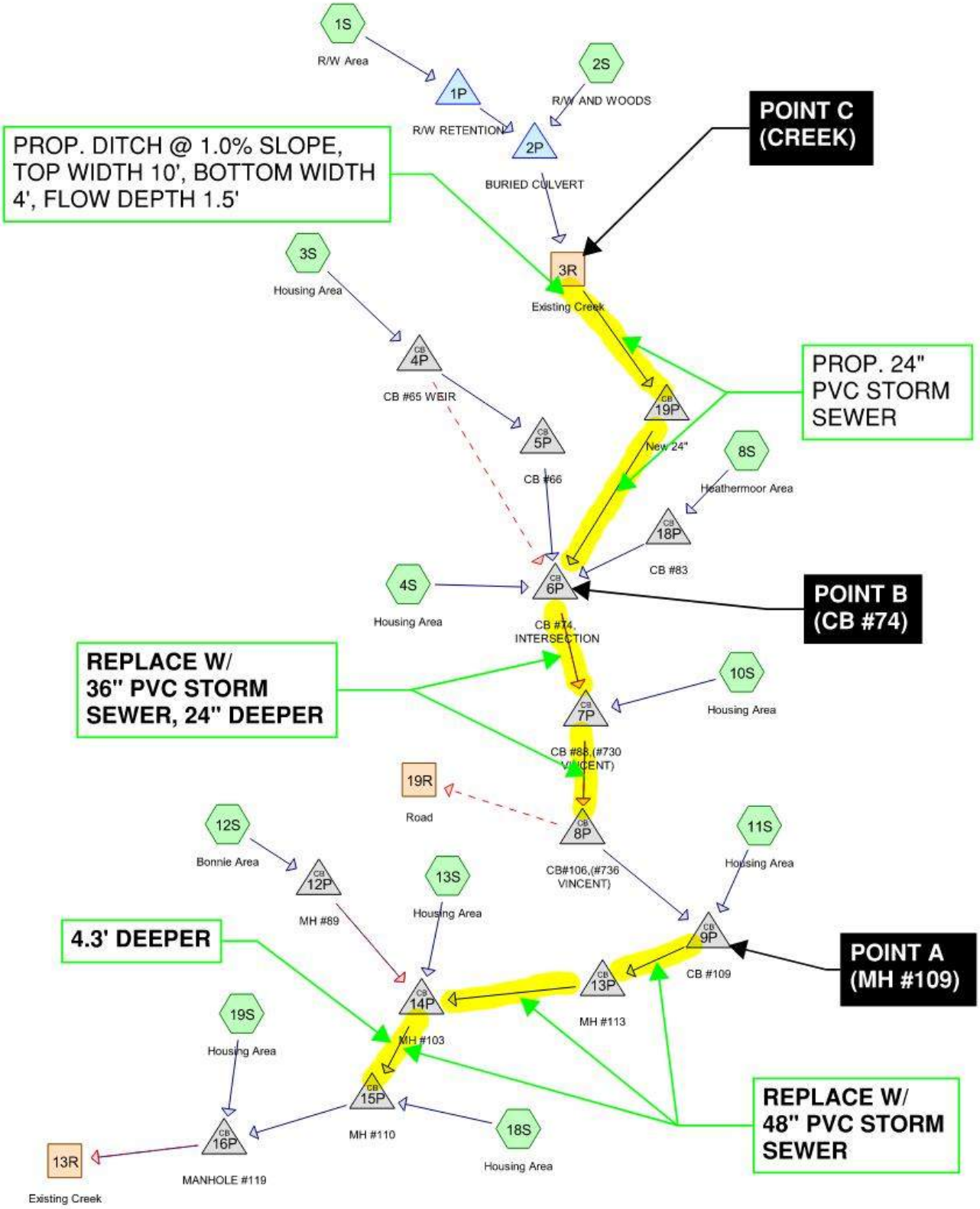

Figure 12– Diagram of Stormwater Model – Alternative 1

The stormwater model referenced above in Figure 12 was used to analyze Alternative 1 and the overall capacity of the existing storm sewer system in the area designated for this study. Table 4 below shows a comparison of the maximum water depths at the "control" points for the existing system and the new system suggested in Alternative 1. The values in Table 4 represent the elevation of the Hydraulic Grade Line (HGL) minus the rim elevation of the corresponding storm structure (or the floor elevation of the nearby houses in the case of Point C). Thus, a positive value corresponds to a flood condition; whereas, a negative value corresponds to the water level being below the flood condition.

	2-Year 24-Hour			5-Year 24-Hour			10-Year 24-Hour			25-Year 24-Hour		
Location	Existing Max Water Depth (feet)	Alt. #1 Max Water Depth (feet)	Change in Max Water Depth (feet)	Existing Max Water Depth (feet)	Alt. #1 Max Water Depth (feet)	Change in Max Water Depth (feet)	Existing Max Water Depth (feet)	Alt. #1 Max Water Depth (feet)	Change in Max Water Depth (feet)	Existing Max Water Depth (feet)	Alt. #1 Max Water Depth (feet)	Change in Max Water Depth (feet)
Point A	-0.25	-4.08	-3.83	-0.06	-3.49	-3.43	0.59	-2.84	-3.43	1.67	-1.66	-3.33
Point B	-2.61	-6.80	-4.19	0.03	-6.28	-6.31	0.59	-5.61	-6.20	0.93	-4.59	-5.52
Point C	0.66	-2.42	-3.08	0.72	-2.18	-2.90	0.77	-1.91	-2.68	0.81	-1.64	-2.45

Table 4 – Maximum Water Depths (Alternative 1)

- ***Alternative 2 for the problematic areas***
  This alternative involves the following potential improvements:
  - Constructing a new ditch behind 716 and 718 Vincent Drive (approximately $58,000),
  - Installing a new 24" PVC storm sewer parallel to the existing rock channel from the new ditch to the catch basin in Vincent Drive near the southwest corner of 718 Vincent Drive. The new pipe would be located between the existing rock channel and the house at 718 Vincent Drive (approximately $36,000)
  - Upsizing to 24" PVC Storm Sewer from the catch basin in Vincent Drive near the southwest corner of 718 Vincent Drive to the catch basin directly in front of 724 Vincent Drive (approximately $20,000)
  - Upsizing to a 36" PVC Storm Sewer from the catch basin directly in front of 724 Vincent Drive to the catch basin directly in front of 730 Vincent Drive (this pipe would be 12" deeper than the existing pipe) (approximately $59,000)
  - Upsizing to a 36" PVC Storm Sewer from the catch basin directly in front of 730 Vincent Drive to the manhole directly in front of 736 Vincent Drive (this pipe would be 30" deeper) (approximately $48,000)
  - Upsizing to a 48" PVC Storm Sewer from the manhole in Vincent Drive near the intersection of the lot lines of 738 Vincent Drive and 736 Vincent Drive to the manhole in the front side yard between 740 and 738 Vincent Drive (approximately $23,000)
  - Upsizing to a 48" PVC Storm Sewer from the manhole in the front side yard between 740 and 738 Vincent Drive to the manhole in the back side yard between 740 and 738 Vincent Drive (approximately $20,000),

- Upsizing to a 48” PVC Storm Sewer from the manhole in the back side yard between 740 and 738 Vincent Drive to the manhole in the backyard of 744 Vincent Drive (approximately $45,000)
- Upsizing to a 18” PVC Storm Sewer from the manhole in the back yard of 738 Vincent Drive to the manhole in the back side yard between 740 and 738 Vincent Drive (the manhole in the backyard of 738 Vincent Drive would need to be deepened) (approximately $12,000)

The total planning level opinion of probable cost for this alternative is $321,000. Exhibit D provides the full detail of the opinion of probable cost, and it is attached at the end of this report. Figure 13 below shows the existing storm sewer system along with the improvements suggested for Alternative 2. Exhibit C is the full size 11x17 version of Figure 13, and it is attached at the end of this report.

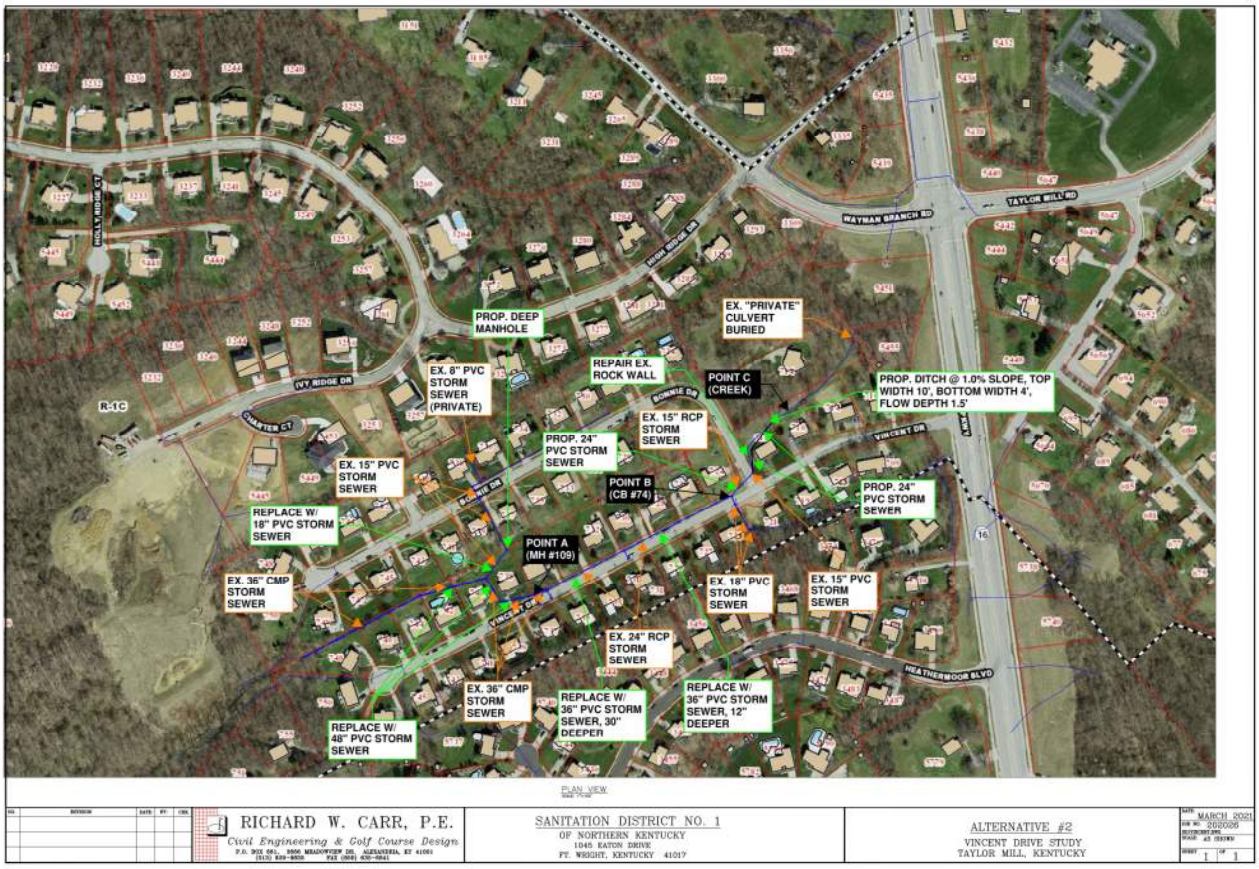

Figure 13 – Alternative 2 Map

In order to analyze the potential reduction in flooding risk associated with the improvements describing in Alternative 2, a new stormwater model was developed using these new parameters. The model for Alternative 2 is shown below in Figure 14:

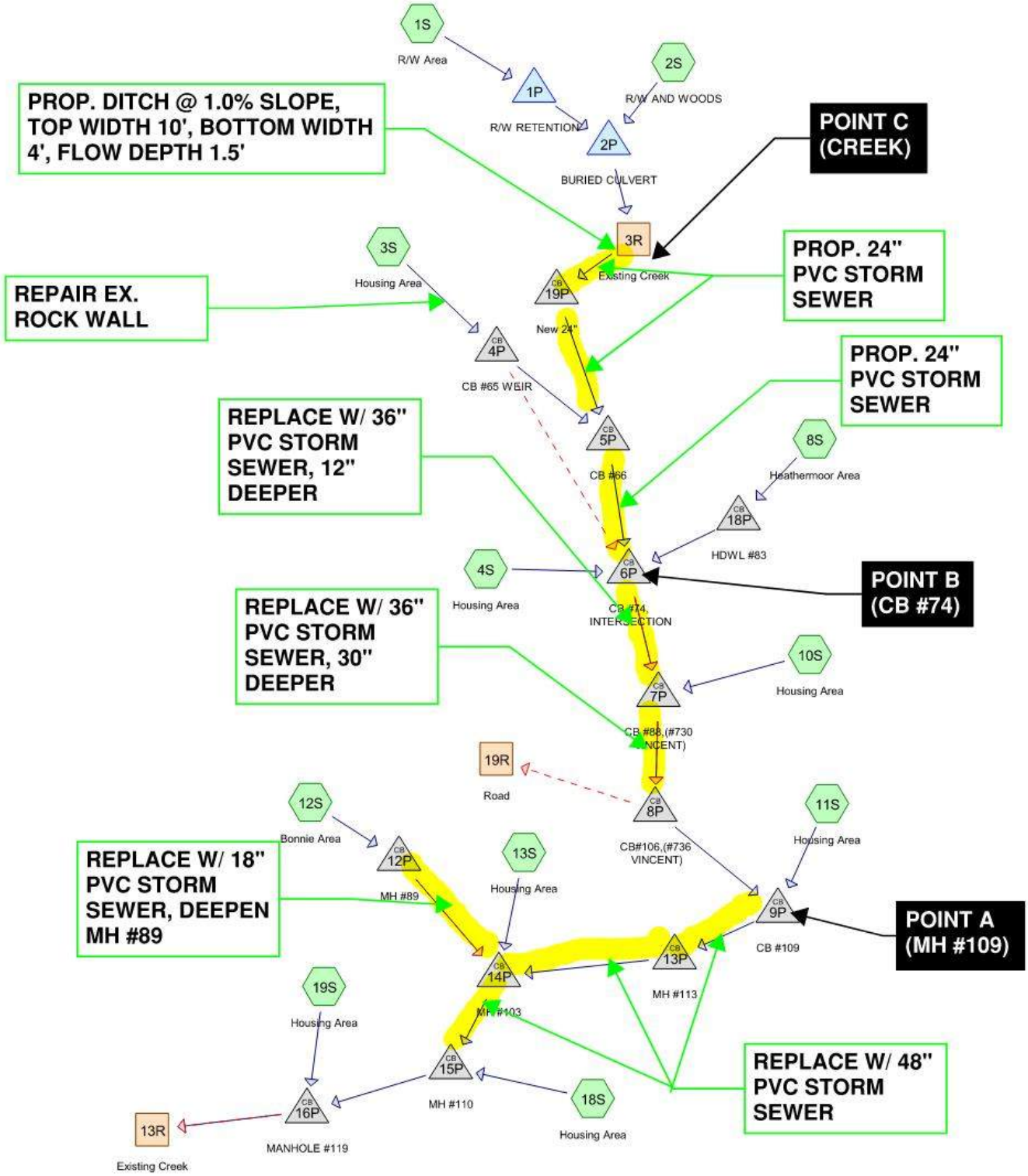

Figure 14– Diagram of Stormwater Model – Alternative 2

The stormwater model referenced above in Figure 14 was used to analyze Alternative 2 and the overall capacity of the existing storm sewer system in the area designated for this study. Table 5 below shows a comparison of the maximum water depths at the "control" points for the existing system and the new system suggested in Alternative 2. The values in Table 5 represent the elevation of the Hydraulic Grade Line (HGL) minus the rim elevation of the corresponding storm structure (or the floor elevation of the nearby houses in the case of Point C). Thus, a positive value corresponds to a flood condition; whereas, a negative value corresponds to the water level being below the flood condition.

	2-Year 24-Hour			5-Year 24-Hour			10-Year 24-Hour			25-Year 24-Hour		
Location	Existing Max Water Depth (feet)	Alt. #2 Max Water Depth (feet)	Change in Max Water Depth (feet)	Existing Max Water Depth (feet)	Alt. #2 Max Water Depth (feet)	Change in Max Water Depth (feet)	Existing Max Water Depth (feet)	Alt. #2 Max Water Depth (feet)	Change in Max Water Depth (feet)	Existing Max Water Depth (feet)	Alt. #2 Max Water Depth (feet)	Change in Max Water Depth (feet)
Point A	-0.25	-6.02	-5.77	-0.06	-5.44	-5.38	0.59	-4.81	-5.40	1.67	-3.47	-5.14
Point B	-2.61	-5.80	-3.19	0.03	-5.29	-5.32	0.59	-4.62	-5.21	0.93	-3.60	-4.53
Point C	0.66	-2.43	-3.09	0.72	-2.18	-2.9	0.77	-1.91	-2.68	0.81	-1.64	-2.45

Table 5 – Maximum Water Depths (Alternative 2)

Additional Considerations

As depicted in the maps showing the existing storm sewer system, the storm water runoff from the Vincent Drive study area discharges through a manhole in the backyard of 748 Vincent Drive to a headwall also in the backyard of 748 Vincent Drive, which empties into a creek behind 748 Vincent Drive. It is important to include an evaluation of the overall discharge from the study area into this creek to provide SD1 with an understanding of the potential impacts that could occur downstream of this study area if the suggested alternatives were implemented. In order to provide an analysis of this information, the peak flow rates were determined from each of the models and a comparison of these peak flow rates is provided in Table 6 below.

	10-Year 24-Hour		25-Year 24-Hour	
Alternative	Peak Flow Rate (cfs)	Change (cfs)	Peak Flow Rate (cfs)	Change (cfs)
Existing Conditions	102.41	-	115.96	-
Alternative 1	110.60	8.19	139.02	23.06
Alternative 2	110.51	8.10	138.93	22.97

Table 6 – Comparison of Peak Flow Rates at Storm Sewer Outfall behind 748 Vincent Drive

Summary

SD1 requested Mason Carr to analyze alternatives that could help alleviate the flooding risks along Vincent Drive in Taylor Mill, KY. In order to analyze each of these alternatives, three "control" points were established at critical points along the existing storm sewer system. The maximum water level was compared to the existing conditions for each of these alternatives for the 2-year, 5-year, 10-year, and 25 year rainfall events. In addition, the peak flow rates at the outfall of the storm sewer system for this study area were also determined. Each alternative also includes a planning-level opinion of probable construction cost. The information provided in this memorandum is intended to provide an overview of the existing conditions and potential alternatives that may help alleviate the flooding concerns that were identified in this study area. Further discussions with the City of Taylor Mill and affected property owners may be aided by the review of the information included in this memorandum. Prior to implementing any of the alternatives provided in this memorandum, further analysis of the existing and design conditions should be conducted. It should also be noted that each separate part of the alternatives presented in this report is not intended to be implemented apart from the other parts of that alternative. While it is possible that individual parts of the alternatives could be implemented separately and provide some degree of flood reduction for a particular area, it is likely that the areas that are not addressed would see increased flooding issues after partial upstream improvements are implemented.

Exhibit A

EX. "PRIVATE" CULVERT BURIED

EX. 8" PVC STORM SEWER (PRIVATE)

EX. 12" CPP STORM SEWER

POINT C (CREEK)

EX. 15" RCP STORM SEWER

EX. 15" PVC STORM SEWER

EX. 15" PVC STORM SEWER

POINT B (CB #74)

POINT A (MH #109)

EX. 36" CMP STORM SEWER

EX. 18" PVC STORM SEWER

EX. 24" RCP STORM SEWER

EX. 36" CMP STORM SEWER

HOLLY RIDGE CT

IVY RIDGE DR

CHARTER CT

R-1C

HIGH RIDGE DR

BONNIE DR

VINCENT DR

WAYMAN BRANCH RD

TAYLOR MILL RD

PRIDE PKWY

HEATHERMOOR BLVD

PLAN VIEW

NO.	REVISION	DATE:	BY:	CHK.

RICHARD W. CARR, P.E.
Civil Engineering & Golf Course Design
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SANITATION DISTRICT NO. 1
OF NORTHERN KENTUCKY
1045 EATON DRIVE
FT. WRIGHT, KENTUCKY 41017

EXISTING CONDITIONS
VINCENT DRIVE STUDY
TAYLOR MILL, KENTUCKY

DATE: MARCH 2021
JOB NO. 202026
SD1VINCENT.DWG
SCALE: AS SHOWN
SHEET 1 OF 1

PLAN VIEW

NO.	REVISION	DATE:	BY:	CHK.

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SANITATION DISTRICT NO. 1
OF NORTHERN KENTUCKY
1045 EATON DRIVE
FT. WRIGHT, KENTUCKY 41017

ALTERNATIVE #1
VINCENT DRIVE STUDY
TAYLOR MILL, KENTUCKY

DATE: MARCH 2021
JOB NO. 202026
SD1VINCENT.DWG
SCALE: AS SHOWN
SHEET 1 OF 1

PLAN VIEW

NO.	REVISION	DATE:	BY:	CHK.

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SANITATION DISTRICT NO. 1
OF NORTHERN KENTUCKY
1045 EATON DRIVE
FT. WRIGHT, KENTUCKY 41017

ALTERNATIVE #2
VINCENT DRIVE STUDY
TAYLOR MILL, KENTUCKY

DATE: MARCH 2021
JOB NO. 202026
SD1VINCENT.DWG
SCALE: AS SHOWN
SHEET 1 OF 1

Vincent Drive - Storm Sewer Study

Exhibit D ***Richard W. Carr, P.E.*** **04/19/2021**

Opinion of Probable Costs Alternative 1				
	Quantity	**Units**	**Unit Price**	**Unit Cost**
Clearing and Mobilizing	1	ls	**11,000.00**	11,000.00
Grading for new ditch	120	lf	**200.00**	24,000.00
24" PVC Storm Sewer	332	lf	**92.40**	30,676.80
Storm Inlet	4	ea	**2,887.50**	11,550.00
Storm Headwall	1	ea	**4,400.00**	4,400.00
36" PVC Storm Sewer	559	lf	**96.00**	53,664.00
Storm Manhole	5	ea	**5,775.00**	28,875.00
48" PVC Storm Sewer	353	lf	**100.00**	35,300.00
Concrete street replacement	256	sy	**46.20**	11,842.60
Construction Entrance	1	ls	**2,310.00**	2,310.00
Seed and Mulch (Subdivision)	200	sy	**2.90**	580.00
Total Bid				**214,198.40**
	25% Misc. and Contingency			**53,549.60**
				267,748.00
	12.5% Engineering Fee			**33,468.50**
				301,216.50

Opinion of Probable Costs Alternative 2				
	Quantity	**Units**	**Unit Price**	**Unit Cost**
Clearing and Mobilizing	1	ls	**11,000.00**	11,000.00
Repair rock wall	1	ls	**10,000.00**	10,000.00
Grading for new ditch	120	lf	**200.00**	24,000.00
24" PVC Storm Sewer	233	lf	**92.40**	21,529.20
Storm Inlet	4	ea	**2,887.50**	11,550.00
Storm Headwall	1	ea	**4,400.00**	4,400.00
36" PVC Storm Sewer	559	lf	**96.00**	53,664.00
Storm Manhole	6	ea	**5,775.00**	34,650.00
48" PVC Storm Sewer	353	lf	**100.00**	35,300.00
18" PVC Storm Sewer	94	lf	**85.00**	7,990.00
Concrete street replacement	248	sy	**46.20**	11,457.60
Construction Entrance	1	ls	**2,310.00**	2,310.00
Seed and Mulch (Subdivision)	200	sy	**2.90**	580.00
Total Bid				**228,430.80**
	25% Misc. and Contingency			**57,107.70**
				285,538.50
	12.5% Engineering Fee			**35,692.31**
				321,230.81