KY 362 DRAINAGE STUDY

OLDHAM COUNTY, KENTUCKY

HWY 362 near intersection of KY 362 and Ashbrooke Dr.

Tributary of Floyds Fork, near instersection of KY 362 and Village Green Blvd.

Prepared For:
Oldham County Fiscal Court

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February 2011

KY 362 DRAINAGE STUDY – OLDHAM COUNTY

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SECTION 1 – INTRODUCTION AND BACKGROUND

1.0 PROJECT PURPOSE AND NEED

The purpose of the KY 362 Drainage Study is to investigate the causes of and recommend solutions to flooding issues along KY 362 and within the Ashbrooke Subdivision located near Pewee Valley in Oldham County, Kentucky. The Ashbrooke Subdivision has experienced frequent standing water in several locations along with access problems due to overtopping flow from the tributary to Floyd's Fork along KY 362 creating hazards to the residents of this community and to the traveling public using KY 362 during storm events.

This project is being funded through a Kentucky Infrastructure Authority Grant obtained by Oldham County Fiscal Court.

1.1 PROJECT AREA

The project is located in Oldham County south of Pewee Valley, KY along KY 362. The overall watershed being studied contains approximately 2.7 square miles and is located between KY 146 on the north and Floyd's Fork (Oldham County/Shelby County Line) to the south. A USGS map of the project location is shown in Figure 1.

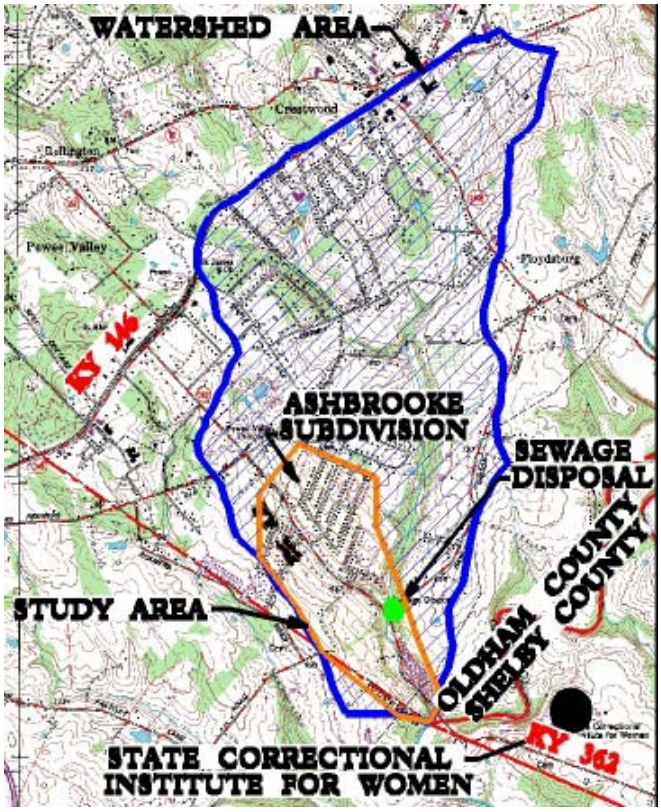


FIGURE 1 – PROJECT LOCATION

1.2 PROJECT SCOPE

The scope of work for this project was separated into two phases. Phase I consisted of data collection and existing system analysis. Upon completion of Phase I, DLZ was able to gain a better understanding of the existing problems and proceed to Phase II which consisted of analyzing potential solutions and providing recommendations.

The data collection for this project included field survey, rainfall event research, and questionnaire dissemination. The field survey included obtaining information on major streams, drainage structures, paved ditches, and other miscellaneous drainage features on known drainage issues providing more detail to the existing topography. Oldham County also provided topographic mapping from LOJIC in order to delineate the overall watershed along with incremental watersheds. The field survey and LOJIC mapping were combined to provide a more accurate overall model of the existing terrain and characteristics which was used for analysis. DLZ also performed rainfall event research to obtain historic events in the

area which may have produced flooding problems. This research is described in more detail below.

In order to obtain a better understanding of specific problems, questionnaires were disseminated to all residents within the project area. The questionnaire consisted of several general questions along with an area to describe specific situations. A sample questionnaire is located in Appendix A and a summary of the results can be found in Section 1.4.

Once the data collection and existing analysis were completed, proposed solutions analysis was performed. Several coordination meetings were held throughout project development to obtain clarification on existing problems and subsequently, proposed solutions.

1.3 HISTORY OF PROJECT DEVELOPMENT

As indicated previously, the Ashbrooke Subdivision and KY 362 have experienced frequent flooding problems. In addition to video evidence and questionnaire responses, DLZ contacted Oldham County Emergency Management to obtain a list of road closures reported along KY 362 in recent years. As indicated by Oldham County Emergency Management, this list contains only those road closures that were reported or required emergency response. Additional closures may have occurred but are not contained in the list below.

TABLE 1 - ASH AVENUE ROAD CLOSURES

DATE	TIME REPORTED
06/14/2003	2230 HRS
06/02/2006	0952 HRS
09/23/2006	0011 HRS
04/04/2008	0020 HRS
05/08/2009	1830 HRS
07/25/2009	2300 HRS
08/10/2009	1900 HRS

On July 30, 2009, the Oldham Era reported on a recent flood event that trapped two people on the roof of their vehicle on KY 362. A swift water rescue team responded to the scene and moved these people to safety. No one was injured in this event.

The county has also received numerous complaints about standing water and erosion problems within Ashbrooke Subdivision. These issues were cited in the questionnaires and have been tabulated along with other information obtained from the questionnaire in the following section.

1.4 RESIDENT QUESTIONNAIRE

As part of the contract with Oldham County, DLZ Kentucky was tasked with disseminating, collecting, and compiling resident questionnaires. These questionnaires were distributed to all residents located within the project area with a survey notification letter and self-

addressed, stamped return envelope. Addresses were obtained from PVA maps and GIS information provided by Oldham County. As a result, some properties were either owned by an adjacent property or were undeveloped and therefore had no resident. Approximately 480 questionnaires were sent, of which, 49 were undeliverable and 108 were completed and returned (approximately 25% of those delivered). The questionnaire included a brief description of how the information will be used along with questions ranging from personal property damages to accessibility issues due to flooding in the area. The results of the questionnaires that were received have been tabulated and shown below with the number of those responding "yes" as well as a percentage of those returned.

TABLE 2 - SUMMARY OF QUESTIONNAIRE RESULTS

QUESTION	RESPONDED YES	PERCENTAGE
Have you experienced flooding problems on your property?	45	42%
If yes, Do you have "high water" marks on your property?	16	15%
Have you experienced standing water on your property?	48	44%
Have you experienced erosion problems on your property?	41	38%
Has access to your property been affected by flooding on Ash Avenue (KY 362)?	66	61%

In addition to these responses, several property owners provided comments in various locations on the questionnaire and in some instances, provided photos of problem areas. A scanned copy of all questionnaires received has been provided to Oldham County for their future use.

1.5 HISTORIC RAIN DATA

Rainfall records were obtained from Hite Creek Wastewater Treatment Plant Rainfall Gauge owned and maintained by the Louisville Metropolitan Sewer District. This rain gauge is located 4.85 miles northwest of the project area. The information from this rain gauge can be obtained online at the address provided in the References Section. The rain gauge information was obtained from September 2003 to May 2010. The rainfall frequency was determined by using the information from the rain gauge and analyzing it for every 5 minute increments that rain was recorded. This allowed for the total accumulation within a specific time frame to be recorded. The storm events were analyzed for 30 minutes, 1, 2, 3, 6, 12, and 24 hour storms. The total accumulation which occurred during each storm event was evaluated with chart _____ located in the ___BOOK. This determined the frequency of each storm. Table 3 is a summary of the analysis. The summary indicates that seven 100 year storm events have taken place within the past six years (shown red in the table).

On August 4, 2009, a 100 year storm event occurred. A representative from DLZ Kentucky visited the site during this rain event and obtained video and photographic evidence of the flooding problems along KY 362 and within Ashbrooke Subdivision. The pictures are located in Appendix B and depict major failures located within the study area. A digital copy of all video and pictures has been provided to Oldham County for their records.

TABLE 3 – STORM EVENTS SUMMARY						
DATE	**FREQUENCY**	**INCHES**		**DATE**	**FREQUENCY**	**INCHES**
9/27/2003	10 Yr, 1 Hr	2.17		8/27/2006	10 Yr, 3 Hr	2.94
9/28/2003	10 Yr, 3 Hr	2.68		8/28/2006	25 Yr, 6 Hr	3.63
10/26/2003	10 Yr, 30 min	1.75		8/29/2006	5 Yr, 12 Hr	3.75
10/28/2003	50 Yr, 3 Hr	3.64		9/22/2006	2 Yr, 30 Min	1.23
11/1/2003	5 Yr, 12 Hr	3.64		9/23/2006	100 Yr, 12 Hr	5.40
11/6/2003	2 Yr, 24 Hr	3.64		9/27/2006	100 Yr, 12 Hr	5.51
11/12/2003	10 Yr, 6 Hr	2.47		9/28/2006	100 Yr, 24 Hr	6.65
11/14/2003	1 Yr, 12 Hr	2.56		7/5/2007	5 Yr, 3 Hr	2.46
5/25/2004	2 Yr, 3 Hr	2.02		8/16/2007	5 Yr, 2 Hr	2.32
5/27/2004	10 Yr, 6 Hr	3.29		9/27/2007	1 Yr, 1 Hr	1.28
5/28/2004	50 Yr, 12 Hr	4.92		10/23/2007	100 Yr, 24 Hr	6.41
5/30/2004	50 Yr, 12 Hr	5.14		12/15/2007	1 Yr, 12 Hr	2.64
5/31/2004	100 Yr, 24 Hr	6.77		3/4/2008	2 Yr, 12 Hr	2.82
7/9/2004	1 Yr, 30 Min	1.08		3/19/2008	1 Yr, 12 Hr	2.63
10/18/2004	2 Yr, 6 Hr	2.54		3/20/2008	2 Yr, 24 Hr	3.59
10/19/2004	2 Yr, 12 Hr	2.78		3/28/2008	2 Yr, 12 Hr	2.58
1/6/2005	2 Yr, 24 Hr	3.69		4/4/2008	2 Yr, 6 Hr	2.25
5/19/2005	2 Yr, 2 Hr	1.99		6/16/2009	2 Yr, 30 Min	1.18
5/20/2005	5 Yr, 3 Hr	2.49		7/25/2009	5 Yr, 3 Hr	2.44
5/28/2005	1 Yr, 24 Hr	2.71		7/26/2009	5 Yr, 24 hr	4.04
8/28/2005	2 Yr, 30 Hr	1.21		7/29/2009	2 Yr, 3 Hr	2.05
8/29/2005	1 Yr, 3 Hr	1.66		7/30/2009	100 Yr, 12 Hr	7.01
8/30/2005	10 Yr, 12 Hr	4.00		8/4/2009	100 Yr, 12 Hr	7.38
8/31/2005	10 Yr, 24 Hr	4.98		8/10/2009	2 Yr, 1 Hr	1.34
11/15/2005	10 Yr, 3 Hr	2.27		8/11/2009	2 Yr, 3 Hr	2.11
3/12/2006	2 Yr, 12 Hr	2.82		8/28/2009	5 Yr, 1 Hr	1.94
3/13/2006	1 Yr, 12 Hr	2.55		8/29/2009	5 Yr, 6 Hr	2.95
7/14/2006	10 Yr, 3 Hr	2.39		5/2/2010	2 Yr, 12 Hr	3.02

SECTION 2 – EXISTING ANALYSIS

2.0 INTRODUCTION

The project area is located within a 1,734 acre watershed. DLZ analyzed existing conditions for the project area within this watershed using StormCADV8i. StormCAD is a comprehensive modeling system which provides calculations for storm drainage analysis using existing ground and topography conditions and existing storm sewer hydraulics. During this analysis, DLZ determined that several drainage components in the existing system are not adequately designed for current conditions. The project area has been divided into eight smaller areas of emphasis. These areas are labeled Area A through Area H throughout the study.

2.1 DRAINAGE ANALYSIS

The eight project areas were subsequently divided into 157 sub-basins, each draining into points along the existing storm sewer system, ditches, natural streams, creeks, or tributaries of Floyd's Fork. The sub-basins were delineated and modeled using StormCAD in MicroStation. The maximum size of any sub-basin is 55.5 acres with an average size of 11.0 acres.

A soil investigation was performed for the drainage basin using information from the National Cooperative Soil Survey available online through the United States Department of Agriculture. The majority of the soils in the area were found to be various silt loams classified in Hydraulic Soil Group (HSG) B.

Each sub-basin's weighted C-Factor was determined based on the runoff coefficients applicable to each area based on land use, ground coverage, and slope. Using the Louisville and Jefferson County Metropolitan Sewer District Design Manual, the suburban housing in the area was determined to be R-3 Residential with a C-Factor of 0.48 based on the HSG B and slopes between 2% and 7%. For the same HSG and land slopes, the following five basic groups defined the various land uses throughout the drainage basin. The average weighted C-Factor for the overall watershed was 0.326.

TABLE 4 - RUNOFF COEFFICIENTS

LAND USE	C-FACTOR
Impervious Areas (roofs, drives, streets)	0.95
R-3 Residential	0.48
Pasture and Farmland	0.23
Open Spaces, Lawns, and Parks (cemetery)	0.19
Woodlands	0.18

The Time of Concentration (T_c) for each sub-basin was determined using the TR-55 Method for Sheet Flow and Channel Flow based on the topography within each area. The TR-55

Sheet Flow Method requires input of the hydraulic length (limited to 100 feet), the Manning's Roughness Coefficient (n), slope, and 2-Year 24-Hour Depth ($P_{2,24}$) for each area. According to the Kentucky Transportation Cabinet Design Manual the $P_{2,24}$ for Oldham County is 3.2 inches. Manning's n for sheet flow was determined from TR-55, Table 3-1. The TR-55 Channel Flow Method requires input of the hydraulic length, Manning's n, and slope as well as the flow area and wetted perimeter of the channel. The channel dimensions were approximated by contour mapping and field measurement for the ditches, natural streams, and creeks. Manning's n for channel flow was determined from Exhibit DR-05.901 of the KYTC Drainage Manual.

The existing model was analyzed for the 2, 5, 10, 25, 50, and 100 year storm events in order to determine the points at which failure was occurring in the system. The Intensity Duration Frequency (IDF) curves for the model were developed in StormCAD as a User Defined IDF Curve and the input was based on the equation for rainfall intensity given on page DR-04-16 of the KYTC Drainage Manual. The coefficients for the Louisville Zone of Influence were used in the equation for each return interval and the intensities were calculated using durations at 1 minute intervals from 5 minutes to 15 minutes and then at 5 minute intervals from 15 minutes to 280 minutes. This wide range of time intervals was used to encompass all time of concentrations throughout the drainage basin.

2.2 EXISTING NETWORK EVALUATION

There are several drainage components within the existing system that fail to handle the rain events as required by design. Several areas in the existing system fail before the 25 year design storm event and even more fail before the 100 year storm event. Other portions of the system that had prior complaints from drivers and residents were shown to fail as early as the 2 year or 5 year storm events. Portions of the system that are not performing to standard are causing hazardous driving conditions, access restriction, and property damage. The failure locations have been broken down into eight areas of emphasis and are discussed in the following sections along with the significance of the problems in each area.

The figures in the following sections show the analyzed portions of the storm drainage system for each of the areas of emphasis. In these figures, the drainage path is delineated by a thick black like. If a section of the system failed at any point during analysis, it was color coded to represent the least storm event from which it failed. A solid red line represents a failure at the 2 year storm event, orange at the 5 year storm event, magenta at the 10 year storm event, cyan at the 25 year storm event, blue at the 50 year storm event, and a dashed red line for failures at the 100 year storm event. Appendix B shows photographs taken during the August 4, 2009 100 year storm event in which flooding overtopped the roadway at the entrance to Ashbrooke Subdivision and flooded yards and driveways of residences in the subdivision as well as along KY 362. Appendix C contains an overall map which depicts the 8 area locations within the project, a figure indicating failures for the entire area, and figures for each area showing labels associated with the StormCad analysis used to differentiate each part of the existing storm system followed by the existing analysis report for each area.

2.2.1 AREA A – KY 362 North

Excessive flooding along KY 362 from north of Missionary Ridge Drive to the point just before the stream crosses under KY 362 approximately 750 feet south of Dunnlea Drive (Figure 2) is caused by undersized pipes, clogged pipes or shallow swales. Several residents have incorporated the natural stream into their landscaping creating narrow channels. Many of the pipes and swales in this area are failing at a 2 year storm event due to capacity limitations. Two locations exist where concrete channels perpendicular to KY 362 terminate at KY 362 Terminate perpendicular to KY 362 emptying into a shallow roadside swale. Currently there are no headwalls in place to prevent the flow from these channels from overtopping KY 362. Two pipes are also located between Missionary Ridge Drive and Dunnlea Drive that are intended to direct the water under the highway and into the major stream. Erosion in this area has created an undefined channel creating sedimentation blockage of the inlets and preventing the two pipes from performing at design capacity. The water levels in this area have been high enough to prevent access to the subdivision and excessive flooding is causing erosion and property damage.

FIGURE 2 – AREA A

2.2.2 AREA B – KY 362 Culvert

Area B, Figure 3, is located from the point just before the stream crosses under KY 362, approximately 750 feet south of Dunnlea Drive to where the stream crosses back under KY 362, north of Hawley Gibson Road. Undersized and inverted pipes cause flooding in this area. Much of this area has pipes failing at the 2 year storm event. The storm water from Area A is flowing to Area B from both sides of KY 362. Two existing 36" pipes carry the flow from the southwest side of KY 362 while one existing 15" pipe carries the flow from the northeast side of KY 362. All Flow from these three pipes flow into one 36" pipe. The limited pipe capacity causes water to flow across the road and into neighboring areas. An earthen berm is located at 9007 Ash Avenue before the stream crossing under Ashbrooke Drive. The berm traps water on the road, preventing the flow from entering the pipe.

FIGURE 3 – AREA B

2.2.3 AREA C – KY 362 South

KY 362 floods during major storm events starting from the stream crossing north of Hawley Gibson Road and ending at Floyds Fork. Two types of flooding occur in this area: flash flooding and backwater flooding. The backwater flooding is due to the road elevations being below the FEMA flood limits. This stretch of KY 362 is shown inside the blue area listed as the FEMA flood limits in Figure 4. According to FEMA, the flood limit elevation for the project area is 628 feet. The road elevations with in this area are typically two feet below this elevation. In general, backwater from Floyd's Fork will not occur until after an equivalent storm event takes place within the project area. This is a result of the differing times of concentration for each watershed. The Floyd's Fork watershed is significantly larger which increases the time of concentration and therefore increasing the duration of a flood event. Flash flooding is due to undersized entrance pipes and roadside ditches which run parallel to KY 362 and undersized pipes which cross underneath KY 362 as indicated in figure 4. The majority of the entrance pipes located in this area act as a low flow entrance. During storm events, water overtops these entrances blocking access to personal property, however water does not overtop the roadway. One of the entrance pipe located in this area restricts the amount of water that should be passing through the properties location and diverts the water onto the roadway.

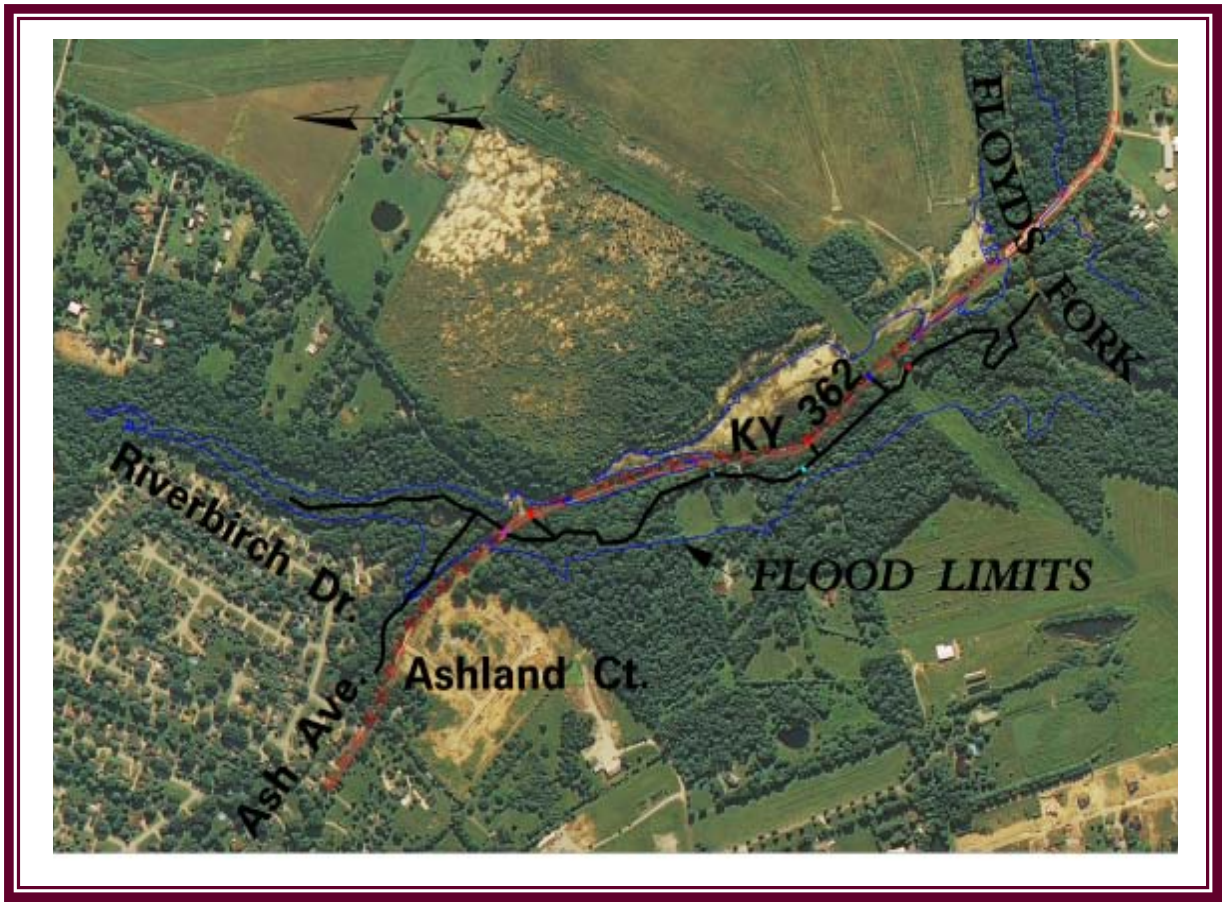


FIGURE 4 – AREA C

2.2.4 AREA D – Ashbrooke Subdivision at Confederate Place Dr.

Storm water from the subdivision and cemetery, located northeast of the project area, flows in the direction of the residences located along Confederate Place Drive and neighboring streets. As figure 5 indicates, the majority of pipes and swales in this area fail before a two year storm. Local residents within this area indicate experiencing standing water, erosion, and flood damage on their property. Several swales in the area were designed to turn ninety degrees without the use of headwalls. Residents, located downstream between Hickory Falls Lane and Shenadoah Drive, have incorporated the natural stream into their living environment. One particular residence incorporate a set of stairs located approximately 2 to 5 feet away from the existing stream.

FIGURE 5 – AREA D

2.2.5 AREA E – Ashbrooke Subdivision at Riverbirch Dr.

Within this area several drainage pipes have zero slopes. The rainfall from Willowrun Lane leads to the back yard located at 6613 Riverbirch Drive (located in Figure 6). A concrete pipe is located in the back of the property. All storm water from the neighboring subdivision is designed to flow to this location through a concrete pipe. The flow makes two ninety degree turns in the back yard of 6613 Riverbirch Drive. The flow then run into a concrete pipe which carries the flow into a catch basin located in the same said property owners front yard. The flow then crosses the street and down into the stream located outside of area E.

The concrete pipe located in the back yard of the property referenced above has broken approximately 3 feet from the outlet. As a result of this break, the pipe has fallen slightly forcing the flow downward and forming a hole. Sedimentation from erosion in this area has collected in the existing channel raising the channel elevation above the surrounding ground elevation. As a result, storm water is currently flowing in the opposite direction than the original design. The residents living at this property previously asked to fix the problem but were instructed not to do so. Subsequently, the residents placed large stones at the outlet of the pipe in order to prevent the hole from eroding further. However the existing designed channel elevation remains higher than the existing ground elevation.

Figure 6 shows the existing storm drainage for this area. The red pipes, located in the cul-de-sacs of Raintree Circle and Willowrun Lane, are inverted pipes. The majority of the remaining system fails at a 2 year storm event. The red catch basin is undersized and after a site visit to this location, the lid to the catch basin does not fit securely to the basin.

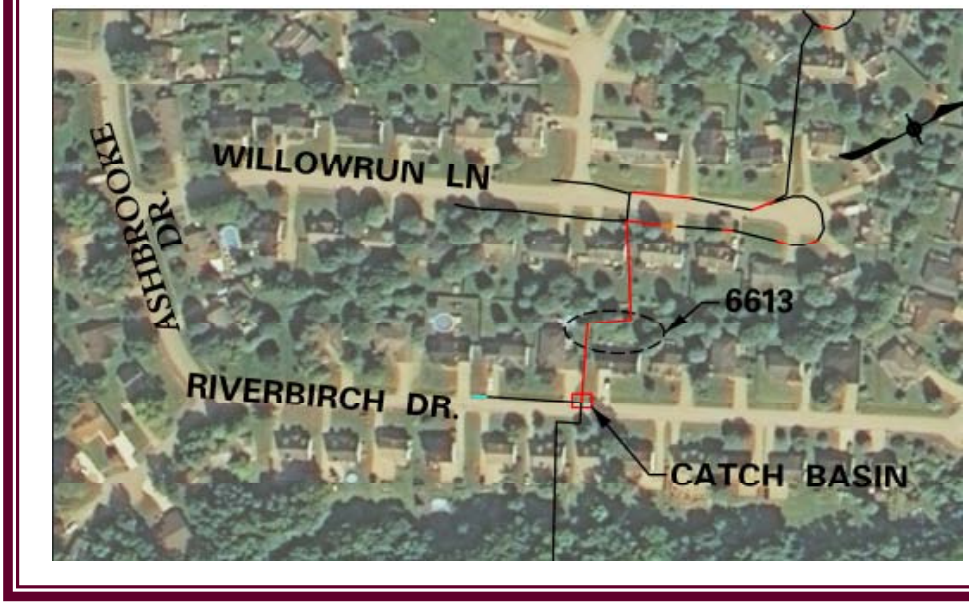


FIGURE 6 – AREA E

2.2.6 AREA F – Ashbrooke Subdivision along Ashbrooke Dr.

Figure 7 shows the location of residences along Ashbrooke Drive that experience flooding, erosion, and standing water on their property. The property located at 6615 Ashbrooke Drive experiences severe flooding within the garage and living room. Runoff from the street, neighboring driveways, and sidewalk flows down the sidewalk until it reaches the driveway to this property which is below the elevation of the sidewalk. The slope of the entrance then directs the storm water to flow towards the garage. The resident installed a catch basin which is located in the middle of the driveway. A pipe runs underground from the catch basin to the stream located behind the house. The driveway catch basin helps but flooding still occurs.

The residences located at 6642 and 6646 Ashbrooke Drive indicated problems with standing water and erosion. Runoff, from Raintree Court and the east side of Ashbrooke drive, flows freely into these two properties. There are no pipes or swales to direct the flow across the street. The road elevation is higher than the yard elevation therefore standing water and erosion is experienced on these properties. The pipe crossing the intersection at Ashbrooke Drive and Willowrun Lane is inverted causing ponding at the inlet.

6604 Ashbrooke Drive also experiences flooding and standing water. The area located at the corner of Ashbrooke Drive and Raintree Circle has an undefined channel causing water to pond in this location.

The property located at 6620 Ashbrooke Drive experiences standing water and erosion. The driveway slopes were nearly flat and water ponds on driveway after storm events. The drain spouts drains onto the driveway adding additional runoff to the standing water in the driveway.

The residents located at 6623 and 6625 Ashbrooke Drive experience standing water, minor flooding, and high water marks on their properties. No pipes or swales exist along Ashbrooke Drive in front of these two properties.

FIGURE 7 – AREA F

2.2.7 AREA G – Ashbrooke Subdivision along Shenadoah Dr.

A couple properties along Shenadoah Drive experience flooding inside their garage. Within this area several driveways are relatively flat or the driveway slopes away from the road. The existing pipes located in the area shown in figure 8 are 15 inch corrugated metal pipe. The design analysis for this location indicates that a 15 inch concrete pipe would have had sufficient capacity for a 10 year storm event however due to the change in Manning's n, the 15 inch corrugated metal pipe (CMP) fails at a 2 year storm event.

The pipe leading out of the catch basin located at the intersection of Shenadoah Drive and Riverbirch Drive is inverted. This pipe fails at a two year storm event.

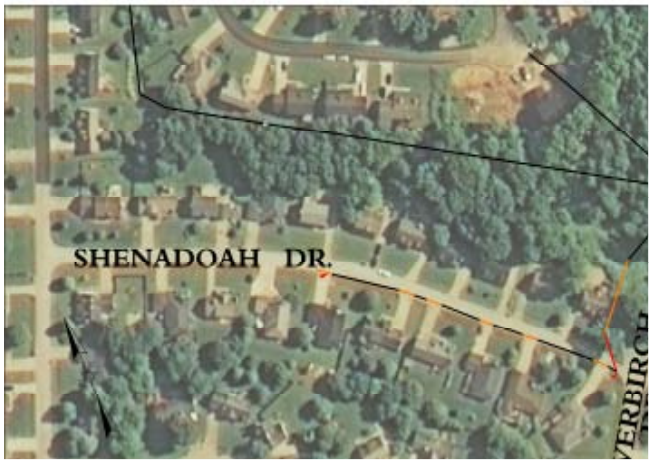


FIGURE 8 – AREA G

2.2.8 AREA H – Ashbrooke Subdivision at Five Forks Dr.

The residence located at 6517 Five Forks Drive experiences flooding, high water, and standing water in the back yard of their property. These problems are due to a 15" CMP located on an adjacent property which outlets into a swale located on the back side of the property. An outlet channel filled with large DGA leads from the pipe and runs toward a gate located at the edge of the property. Approximately 8' before the fence the channel becomes grass covered and not well defined. The DGA lined channel has been placed above existing grade causing water from the pipe to become divided flow. A portion of the flow is contained in the channel while the other part flows into the back yard of the property and becomes trapped by an earthen berm located at 6517 Five Forks Drive. In addition, Silt deposits have built up at the inlet of the pipe located at 6516 Five Forks Drive. The existing pipe located at this location is a 15 inch corrugated metal pipe. The design analysis for this location indicates that a 15 inch concrete pipe would have had sufficient capacity for a 10 year storm event however corrugated metal pipe (CMP) fails before a 10 year storm event.

FIGURE 9 – AREA H

SECTION 3 – PROPOSED SOLUTIONS ANALYSIS

3.0 INTRODUCTION

The proposed analysis was divided into the same eight smaller areas of emphasis as previously mentioned in the existing analysis. Each area was analyzed in StormCad using several alternates based on topography, land availability, environmental impacts, and location within the project area. Downstream impacts were taken into consideration with each area. According to the KYTC Drainage Manual, all solutions and drainage network components should be designed for the 25 year storm event along KY 362 for the major stream and roadway crossings. Roadside ditches and subdivision components should be designed for the 10 year storm event. Each structure was then analyzed at the 100 year storm event to check the hydraulic grade elevation to ensure that during those flood events, water would not overtop roadways. Each proposed alternate solution is represented in Appendix D with a labeled exhibit map followed by a summary table of the analysis. Each segment used within the StormCad program is represented on each individual area's exhibit map.

Preliminary cost estimates are shown with each alternate solution discussed. The detailed preliminary estimates for each solution can be found in Appendix E. Material cost was determined using RS Means. The quantities used for the estimate are based on survey data and FSA mapping. Actual quantities will need to be determined during design. Reinforced concrete pipe (RCP) cost more than other equivalent pipes yet has a better life cycle cost therefore the preliminary estimates utilize this higher cost for budgetary and life expectancy considerations.

3.1 PROPOSED SOLUTIONS – AREA A

Proposed Area A begins its location between the intersection of KY 362 and Missionary Drive, and terminates at 8930 Ash Avenue. Area A's flash flooding is caused primarily by undersized channels and entrance pipes. In order to reduce flooding occurrences, two solutions have been considered for the west side of KY 362 and two solutions have been considered for the east side of KY 362. These solutions include the use of inline detention and increased pipe sizes on both sides of KY 362. Upgrading inadequately sized entrance pipes and culverts in this area alone will not eliminate flooding on residential property therefore upsizing channels should also be considered. The west side of KY 362 is a tributary to Floyd's Fork. This natural "blue line" stream may require US Army Corp of Engineers permitting for any construction taking place. If incorporated, this solution would have a direct impact on Area B. Upsizing the channels and pipes will allow storm water to release downstream faster within the area, increasing the flow into Area B causing water to overtop the roadway more frequently.

Pipes, culverts, and swales located on the West side of KY 362 are designed for the 25 year storm event while the storm system located on the East side of the highway is designed using a 10 year storm.

3.1.1 PROPOSED WEST SOLUTION A-1

An inline detention basin is one possible solution that will be located on the West side of KY 362 before the intersection of KY 362 and Village Green Boulevard. Ideally, the basin would be designed with an outflow rate equal to a 10 year storm event; however there is not enough property available to obtain the proper amount of volume associated with a 10 year storm. The detention basin was subsequently designed to store runoff and reduce the flow rate for a storm greater than the 10-year event. However, culverts and pipes downstream will have to be upgraded in order to meet capacity requirements. In addition, several channel sections that have been incorporated into landscape will need to be modified to increase capacity. The inlets from the two pipes located between Missionary Ridge Drive and Dunnlea Drive will need to be cleaned out and reopened. The estimated preliminary cost for this solution is $299,964. This cost does not include land acquisition for the detention basin. Land acquisition will significantly increase the actual cost of this solution.

3.1.2 PROPOSED WEST SOLUTION A-2

The second alternate solution is to upgrade the existing pipes, culverts, and swales within Area A that are located on the West side of KY 362 without the use of inline detention. Eliminating the detention basin will reduce property acquisition, cost associated with excavation, and materials used to construct the basin. The inlets from the two pipes located between Missionary Ridge Drive and Dunnlea Drive will need to be cleaned out and reopened. By eliminating the detention basin and focusing solely on improving the existing drainage system by increasing pipe sizes and channel capacity, the preliminary cost estimate is $117,894.

3.1.3 PROPOSED EAST SOLUTION A-3

Another solution for this area analyzes the East side of KY 362. This solution utilizes ell headwalls to capture the flow coming from the concrete channels. Swales and entrance pipes will be used to keep the flow along the East side. This will reduce the amount of flow entering into the natural stream located on the West side of KY 362 and allowing the use of smaller pipes and channels to be placed within this area. This new system will tie into the drainage system located downstream from Area A. Solution A-3 alone will have minimal effect on the downstream flow and will not correct the flooding located on the West side of Area A. This solution should be used in conjunction with Proposed Solution A-1 or A-2.The estimated preliminary cost for this solution is $122,808.

3.1.4 PROPOSED EAST SOLUTION A-4

The final solution for this area looks at modifying the existing structures currently present along the East side of KY 362. This solution should be used with solution one or two within area A to eliminate most flooding within this area. The Ell headwalls will still be placed at the concrete channel locations in order to increase capture of storm runoff and to prevent water from over topping the roadway; however a new system will not be designed. The Ell headwalls will redirect the flow to its proper channel. The channels and pipes that direct the flow across KY 362 should be cleaned in order to allow the drainage system to properly function. The system, starting at 8909 Ash Avenue and ending at 8929 Ash Avenue, will be

upgraded in order to allow proper drainage. The estimated cost for this preliminary design is $122,568. Solution A-4 alone will have minimal effect on the downstream flow and will not correct the flooding located on the Southwest side of Area A.

3.2 PROPOSED SOLUTIONS – AREA B

Proposed Area B begins where the two 36 inch concrete pipes cross KY 362 near 8929 Ash Avenue and ends immediately upstream of the KY 362 bridge north of Hawley Gibson Road. This tributary to Floyd's Fork is a natural "blue line" stream which may require US Army Corp of Engineers permitting for any construction taking place. With this in mind, several solutions were considered which consist of upgrading the structures located within Area B without changing the grade, creating a new system allowing the storm water to travel down the opposite side of the street, or upsizing the existing pipes and channels which will require grade changes. Solutions B-1 and B-2 require that the two existing 36" pipe culverts under KY 362 be replaced. These pipes are currently inverted with half the inlet submerged in standing water. In order to control the erosion around these pipes, headwalls will need to be placed on both sides of the pipes. A one lane road closure will be required when replacing them. This proposed solution will have an impact on structures located in Area C by increasing the flow released downstream causing a potential increase in the frequency of roadway overtopping at Hawley Gibson. However, this will decrease the amount of flooding in front of Ashbrooke Drive.

3.2.1 PROPOSED SOLUTION B-1

This solution considers upsizing the existing pipes without changing the grade along the existing stream in order to disturb the stream as little as possible. The proposed driveway entrances would consist of a double box culvert in place of the existing 36 inch pipes with one barrel's flow line being lower than the other in order to provide a low flow channel and a more natural habitat. No other changes will be made to the existing system with this solution. The estimated preliminary cost for this solution is $306,217.

3.2.2 PROPOSED SOLUTION B-2

Another solution requires a complete grade change starting from the inlet of the double 36" culvert pipes that cross KY 362 at approximately 8929 Ash Avenue to the pipe outflow located under Ashbrooke Drive. Currently, all entrance pipes within this location consist of one 36 inch pipe. According to the hydraulic analysis used in StormCad, two 36 inch pipes (or equivalently sized structure) will have to be placed at each entrance in order to allow for the system to pass a 25 year storm event. The estimated preliminary cost for this solution is $249,477.

3.2.3 PROPOSED SOLUTION B-3

The final solution associated with area B utilizes a parallel system that will run along the opposite side of KY 362 starting from the inlet of the double 36" pipe culverts located near 8929 Ash Avenue and ending on the downstream side of the KY 362 bridge, diverting the flow from Area A into the new system. This solution will eliminate the KYTC Encroachment permit and road closure. This solution will have no impact on the capacity of

the bridge since the flow is separated from the existing system and released downstream of the bridge. The estimated preliminary cost, not including the necessary right of way acquisition, is $202,296.

3.3 PROPOSED SOLUTIONS – AREA C

Proposed Area C begins at the KY 362 Bridge, north of Hawley Gibson Road, and terminates at Floyd's Fork. Analysis was performed for both backwater flooding and flash flooding situations. Due to the differing times of concentration within each watershed, flood events occurring within the project area do not necessarily occur along Floyd's Fork and vice versa, therefore, both situations were analyzed separately. Solutions presented for this area are intended to alleviate flooding along the existing roadway as a result of backwater from Floyd's Fork or to accommodate storm flow from the tributaries along KY 362. One entrance within this area contributes to the flash flooding along KY 362. The other entrance pipes are low flow entrances were flash flooding will occur across the entrances but the water at these locations usually does not overtop the road. These low flow entrances has a negative impact within this area due to low flows will cause erosion and change the characteristics of the stream therefore the proposed solutions for Area C will consider upgrading these entrances.

3.3.1 PROPOSED SOLUTION C-1

Proposed solution C-1 raises the road by an average of four feet, alleviating potential flooding along the road by restricting the backwater from Floyds Fork to its proper channel. The elevation increase will be carried from the bridge near Hawley Gibson Road to the existing bridge over Floyd's Fork and is designed to avoid overtopping at a 100 year flood. This will allow vehicles to travel safely along KY 362 during storm events. This solution does not affect any other areas and is the only solution to prevent backwater flooding. The preliminary construction cost estimate for raising the highway is $1,435,044. This cost estimate does not account for permits that may need to be obtained before construction. Such permits include Encroachment, Corp of Engineers, and KYTC.

3.3.2 PROPOSED SOLUTION C-2

This solution considers upgrading drainage pipes running parallel and perpendicular to KY 362 within the tributary. Analysis was performed without consideration of backwater to ensure that proposed pipe sizes would function adequately under independent conditions for the storm flow from the tributaries to Floyd's Fork. Various pipe sizes and the amount of pipes needed at each entrance varies due to the terrain (Appendix D, Area C- Alternate 2). Any driveways where entrance pipes are replaced will need to be re-graded due to the current elevations being below the roadway. The driveways considered for improvement are located at or near 9200, 9300, and 9320. The storm water flowing through the drainage pipes located at 9200 and 9300 does not overtop roadway elevations during major storm events however the entrance pipe and driveway configuration located on 9320 Ash Avenue creates a barrier and directs water onto of the roadway. This solution will not prohibit flooding due to backwater, but will eliminate flash flooding within this area. The preliminary cost estimate for this alternate is $460,061.

3.3.3 PROPOSED SOLUTION C-3

Alternate C-3 considers upgrading the same drainage pipes as C-2 however this solution utilizes box culverts under the driveways instead of the multiple pipe configurations. See Appendix D, Area C-Alternate 3. Again, the three driveway entrances will have to be re-graded. The preliminary cost estimate for this alternate is $ 433,932.

3.4 PROPOSED SOLUTIONS – AREA D

The flow from the subdivision located northeast of the Ashbrooke Subdivision and the cemetery located adjacent to this area was not taken into consideration for the initial design of the existing storm sewer. The natural stream located behind 8529 Confederate Place Drive may be jurisdictional water and proper permitting from the Corp of Engineers may be required before improvements can be made. Several residents between Hickory Falls Lane and Shenandoah Drive have incorporated this stream into their natural living area. One residence within this same location is located approximately 2 to 5 feet from the stream. The solutions for area D will have an impact on these downstream properties.

3.4.1 PROPOSED SOLUTION D-1

This solution considers installing one catch basin on the north east property corner of 8517 Confederate Place Drive and a second catch basin located on the north east property corner of 8529 Confederate Place drive. The catch basins will capture storm water from the cemetery and adjacent subdivision. A new pipe system will be placed in order to connect the proposed catch basins to the remaining storm water facilities located within Ashbrooke Subdivision.

The remaining system, consisting of multiple pipes and ditches, will be upgraded to carry a 10 year storm event. This solution will allow for more storm water to pass through the properties located between Hickory Falls Lane and Shenandoah Drive at a faster rate and could contribute to flooding and property damage at those locations. Estimated preliminary cost is $402,737.

3.4.2 PROPOSED SOLUTION D-2

Another solution is to install a new underground pipe system located along the back property lines of the residences located along Confederate Place drive. The new storm system is designed to carry the flow for a 10 year storm event. Multiple drop box inlets will be added to contain the storm water runoff from the adjacent subdivision and connected through a series of storm sewer pipes with an outlet to the tributary to Floyd's Fork located on the south side of the Ashbrooke subdivision. This system will decrease the amount of flow through the remaining portion of Area D and eliminate the amount of existing pipes that would have to be upgraded throughout the remaining system. The residence along Hickory Falls Lane and Shenandoah Drive will not be affected as a result of this improvement. The preliminary estimated cost is $304,624.

3.5 PROPOSED SOLUTIONS – AREA E

The survey data for this area indicated that several pipes along Willowrun Lane have either inverted or zero percent slopes. According to topographic mapping, all contours above this area, including Willowrun Lane, direct flow to the back yard of 6613 Riverbirch Drive. This one property collects runoff from all properties located on Raintree Court, Willowrun Lane, and surrounding areas. With the problems mentioned previously under Area E and the amount of runoff being received by this one property a couple of solutions have been considered.

3.5.1 PROPOSED SOLUTION E-1

The direct problem solution consists of the statement "fix what's broken". This solution consists of fixing everything on property 6613 which includes installing a new pipe in place of the broken concrete pipe and installing two-ell headwalls where the channel makes 90 degree turns. Ell headwalls will be used to help prevent erosion and help direct flow to remain in the channel. This solution will also include upsizing and redefining the existing pipe, channel, and catch basin located on property 6613 Riverbirch Drive to redirect flow to follow the original design and eliminate flooding on adjacent properties. This proposed solution is designed for a 10 year storm event with a preliminary cost estimate of $3,960.

3.5.2 PROPOSED SOLUTION E-2

The whole area solution consists of fixing all problems within this area. This includes everything stated in Area E-1 and the undersized or inverted pipes located along Raintree Court and Willowrun Lane. The proposed pipes are designed to handle a 10 year storm event and the road elevations have been checked for a 25 year storm event. This solution has no adverse effect on downstream structures. The estimated preliminary cost for this solution is $77,266.

3.6 PROPOSED SOLUTIONS – AREA F

There are three distinctive issues taking place in area F. these include sidewalk settlement, water being trapped in property owner's back yards, and standing water due to the lack of a defined channel. The proposed solution for these areas is designed to convey a 10 year storm event.

3.6.1 PROPOSED SOLUTION F-1

The first solution looks into the area that has sidewalk and driveway runoff issues. Due to the excessive settlement from the sidewalk, approximately 80 linear feet of sidewalk will need to be replaced. In addition, approximately 34 linear feet of driveway will have to be replaced in order to properly contain the drainage. The new sidewalk will be sloping towards the proposed ditch located in the opposite side from the house and will continue to run along Ashbrooke drive until it reaches the existing ditch. This solution has minimal effect on the downstream. These improvements have an estimated preliminary cost of $7,450.

3.6.2 PROPOSED SOLUTION F-2

The second solution will utilize a new storm sewer system in order to capture storm water from the area to eliminate the flooding. The installation of 4 catch basins will be required along with connecting storm sewer pipes in order to direct the flow across Ashbrooke Drive and into the existing system. The improvements to this location will have minimal impact on the downstream area. The estimated preliminary cost of this solution is $33,275.

3.6.3 PROPOSED SOLUTION F-3

The third solution consists of swale re-grading and pipe replacement at the intersection of Ashbrooke drive and Willowrun Lane in order to allow proper drainage flow and eliminate standing water issues within the existing pipe. This solution does not have a negative impact on the downstream locations and has an estimated preliminary cost is $8,430.

3.7 PROPOSED SOLUTIONS – AREA G

The solutions for this area are designed for a 10 year storm event and checked with the 25 year flood event. Due to the manning's n factor for corrugated metal pipes that are currently being used, as mentioned under Area G, the majority of the drainage pipes in this area fail at a 2 year storm event. The manning's n factor for concrete pipes with the same diameter as the existing pipes would pass a 10 year storm. The solution for this area is to re-grade entrance pipes and swales, upsize the existing undersized catch basin and pipe that crosses Shenandoah Drive, and increase the driveway elevations for the properties located at 8608 and 8616 Shenadoah Drive, and increase the crest elevation along the back side ditch. The preliminary cost estimate for this solution is $74,761.

3.8 PROPOSED SOLUTIONS – AREA H

An earthen berm located on a resident's property prevents water from draining out of the back yard. Solutions for this area pertain to ways of getting water past this berm. The solutions for this area were designed for a 10 year storm event and checked for a 25 year storm event for a residential neighborhood. The downstream structures are not affected by removing the berm.

3.8.1 PROPOSED SOLUTION H-1

The first solution would be to remove the berm. This would allow water flowing towards the berm to continue to flow out of the yard reducing the amount of standing water trapped on the property. The estimated preliminary cost for berm removal is $3,352.

3.8.2 PROPOSED SOLUTION H-2

Solution two is to installing a pipe under the berm that would allow water to flow under it. A channel would then be used to redirect the flow coming from under the berm to its proper drainage path. This solution has an estimated preliminary cost of $7,362.

3.8.3 PROPOSED SOLUTION H-3

Solution three consists of upgrading the pipe located on the property and realigning the channel extending it past the berm. This will allow the flow to stay within the designed drainage system and reduce the amount of water trapped on the property. Estimated preliminary cost is $10,429.

SECTION 4 – RECOMMENDATIONS

4.0 INTRODUCTION

Recommendations for each area are based on the following criteria: severity of the problem, benefit vs. cost, and the amount of people affected by the flood event. A rating scale was developed with these criteria in mind to score each recommendation in order of potential benefit. Table 5 below shows the evaluation criteria with an associated ranking. Solutions with a higher total ranking provide the higher potential benefit.

TABLE 5 - RECOMMENDATION RANKING CRITERIA

RANKING	1	2	3	4	5
Cost Estimate	> $350,000	$350,000 - $200,000	$200,000 - $100,000	$100,000 - $30,000	<$30,000
Impacted Residences	< 2	2 - 5	5 - 20	20 - 50	>50
Severity	Nuisance	-	Property Damage	-	Safety Issue

Under the "Cost Estimate" criteria, the higher costs were given a lower ranking. The "number of impacted residents" criterion is provided a higher ranking when the flooding event impacted more residents. And finally, the "Severity" criterion ranks the type of flooding that is occurring. If the flooding is mostly standing water around the property, it is given a ranking associated with "Nuisance," whereas potential safety issues such as flooded roadways are given a ranking of "Safety Issues." Table 6 below shows the solution ranking based on the evaluation criteria. Cost estimates for each alternate are also shown for a side by side comparison. Recommendations are shown in the following section.

TABLE 6 - SOLUTION SCORING

SOLUTION	COST ESTIMATE		RESIDENCE	SEVERITY	CUMULATIVE SCORE
	COST	SCORE			
A-1	$ 229,964.00	2	3	3	8
A-2	$ 117,894.00	3	3	2	8
A-3	$ 122,808.00	3	3	3	9
A-4	$ 122,568.00	3	3	3	9
B-1	$ 306,217.00	2	5	5	12
B-2	$ 249,477.00	2	5	5	12
B-3	$ 202,296.00	2	5	5	12
C-1	$ 1,435,044.00	1	5	5	11
C-2	$ 460,061.00	1	5	5	11
C-3	$ 433,932.00	1	5	5	11
D-1	$ 402,737.00	1	4	3	8
D-2	$ 304,624.00	2	4	3	9
E-1	$ 3,960.00	5	1	3	9
E-2	$ 77,266.00	4	2	3	9
F-1	$ 7,450.00	5	1	3	9
F-2	$ 33,275.00	4	2	2	8
F-3	$ 8,430.00	5	1	1	7
G	$ 74,761.00	4	2	2	8
H-1	$ 3,352.00	5	1	2	8
H-2	$ 7,362.00	5	1	2	8
H-3	$ 10,429.00	5	1	1	7

4.1 RECOMMENDATIONS

All solutions recommended will require additional analysis and final design prior to construction. With any drainage improvement, consideration must be given to downstream structures to ensure avoidance of impact. As stated in the previous discussions pertaining to individual solutions, there may be adverse impacts downstream of each. Careful consideration should be given to each downstream recommendation prior to moving forward with construction improvements upstream. Table 7 shows a solution summary based on the scoring criteria discussed in section 4.0 and provides ranking of our recommendations. Each recommendation is then discussed below.

TABLE 7 - SOLUTION SUMMARY

ALTERNATE	ALTERNATE COST	CUMULATIVE SCORE
B-2	$ 249,477.00	12
C-3	$ 433,932.00	11
C-1	$ 1,435,044.00	11
D-2	$ 304,624.00	9

The flash flooding across KY 362 located in Area B poses a significant hazard to vehicles traveling along the highway. The residents within the Ashbrooke Subdivision cannot obtain access to their residency through Ashbrooke Drive. This area will benefit more residents and travelers located within the drainage study at a reasonable cost. Solution B-2 is recommended due to the lower cost and all construction impacts property owners directly affected by flood events.

Improvements to Area C (KY 362 South) would be the second recommendation. The backwater of Floyds Fork and the inadequacy of entrance pipes along this stretch pose the most hazardous conditions to the traveling public. The cost and time of raising Highway 362 is cumbersome, however the area involves protecting the public. At a minimum, DLZ recommends that Solution C-3 be incorporated to prevent flash flooding. If additional funding is obtained through FEMA Grant Applications, then Solution C-1 should be constructed to prevent flooding as a result of backwater from Floyds Fork.

The final recommendation would be to construct improvements within Area D. The runoff from the adjacent subdivision and Confederate Cemetery are overburdening the existing storm sewer system within Ashbrooke Subdivision. As a result, we would recommend incorporating Solution D-2 to separate and contain the storm runoff from the adjacent area into an independent storm system.

In addition to the above mentioned recommendations, all other solutions presented may be incorporated at any time as funding becomes available at the discretion of Oldham County. None of the other Areas present an immediate safety concern and have a direct impact on fewer residents.

4.2 FUNDING SOURCES

Oldham County has already taken steps to obtain funding for improvements along KY 362. With assistance from DLZ, FEMA Hazard Mitigation Grant Applications were submitted to assist in construction improvements for Areas A, B and C. In addition to FEMA assistance, Oldham County may coordinate with the KYTC to incorporate solutions into future planned roadway improvements or maintenance activities for Areas A, B, and C.

The Oldham County Clean Water Program may be able to assist in funding with some or all of these Capital Projects if structural BMPs can be utilized to improve water quality in the immediate streams. The Oldham County Road Department may also be able to perform the work or fund the projects that are within County Right of Way.

SECTION 5 – REFERENCES

American Association of State Highway and Transportation Officials, "A Policy of Geometric Design of Highways and Streets," Washington D.C., 2004.

Hite Creek Rain Gauge Data - http://www.msdlouky.org/aboutmsd/rainfall.cfm

Kentucky Transportation Cabinet (KYTC), Drainage Manual, 1994, DR-04.939.1

Kentucky Transportation Cabinet (KYTC), Division of Planning, "Traffic Station Counts; Oldham County," May 2009

Louisville and Jefferson County Metropolitan Sewer District, Design Manual, 2009, Exhibit 10-5

United States Department of Agriculture, Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55), 1986, page A-1

U.S. Department of Homeland Security, FEMA. Mapping Information Platform. June 25, 2010.

APPENDIX A

MISCELLANEOUS INFORMATION

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

August 5, 2009

Re: Oldham County
Ash Avenue (KY 362) Drainage Study

To Whom It May Concern:

The Oldham County Fiscal Court will be completing a Drainage Study along Ash Avenue (KY 362) in southern Oldham County. The engineering firm of DLZ Kentucky, Inc. has been contracted to perform the field surveys and to analyze the project area. If you have any questions, please contact one of the following project team members:

Engineer: Michael S. Draper
Company: DLZ Kentucky, Inc.
Address: 201 Brighton Park Blvd.
Frankfort, KY 40601
Phone: 502-695-2300
E-mail: mdraper@dlz.com

Surveyor: Ray Shepherd
Company: DLZ Kentucky, Inc.
Address: 201 Brighton Park Blvd.
Frankfort, Kentucky 40601
Phone: 502-695-2300
E-mail: wshepherd@dlz.com

Manager: Beth Stuber, County Engineer
Company: Oldham County Fiscal Court
Address: 100 West Jefferson Street
LaGrange, KY 40031
Phone: 502-222-1476
E-mail: bstuber@oldhamcounty.net

This letter is to inform you that our engineers and surveyors will be working on or near your property collecting data necessary for the analysis of the tributaries to Floyd's Fork along Ash Avenue (KY 362) and adjacent subdivisions. Every effort will be made to personally contact all property owners prior to entry of their property. A variety of information will be collected and alternative solutions will be studied. The specific area in which these persons will be working does not necessarily indicate the final location or extent of proposed improvements.

In addition, a questionnaire has been included with this letter. This questionnaire will help DLZ and Oldham County better understand your specific concerns and impacts associated with flooding around your property. By completing this questionnaire and returning it to our office in the self-addressed, stamped envelope, we hope to provide solutions to benefit all property owners.

Our work is scheduled to begin on or after **August 10, 2009**. We appreciate your cooperation and are pleased to have the opportunity to study and provide recommendations for the drainage system in your area.

Sincerely,

DLZ Kentucky, Inc.

Michael S. Draper, P.E.
Project Engineer

Questionnaire

Ash Avenue (KY 362) Drainage Study
Oldham County, Kentucky

Name: _____

Address: _____

The responses provided on this form will assist DLZ and Oldham County in citing specific problems within the study area and provide a better understanding of the problems that occur. A location map has been provided on the reverse side to indicate locations of problems and additional space is provided for comments. Please take a moment to respond to the questions listed below to the best of your knowledge:

Have you experienced flooding problems on your property? O Yes O No

If Yes, How frequently do these problems occur? _____

Month and year of most recent events? _____

Do you have "high water" marks on your property? O Yes O No

Have you experience standing water on your property? O Yes O No

Have you experienced erosion problems on your property? O Yes O No

Please describe any damage that has occurred on your property as a result of flooding:

_____

_____

_____

Has access to your property been affected by flooding on Ash Ave. (KY 362)? O Yes O No

If Yes, How frequently do these problems occur? _____

Month and year of most recent events? _____

Please provide a brief description of the location that problems occur: _____

_____

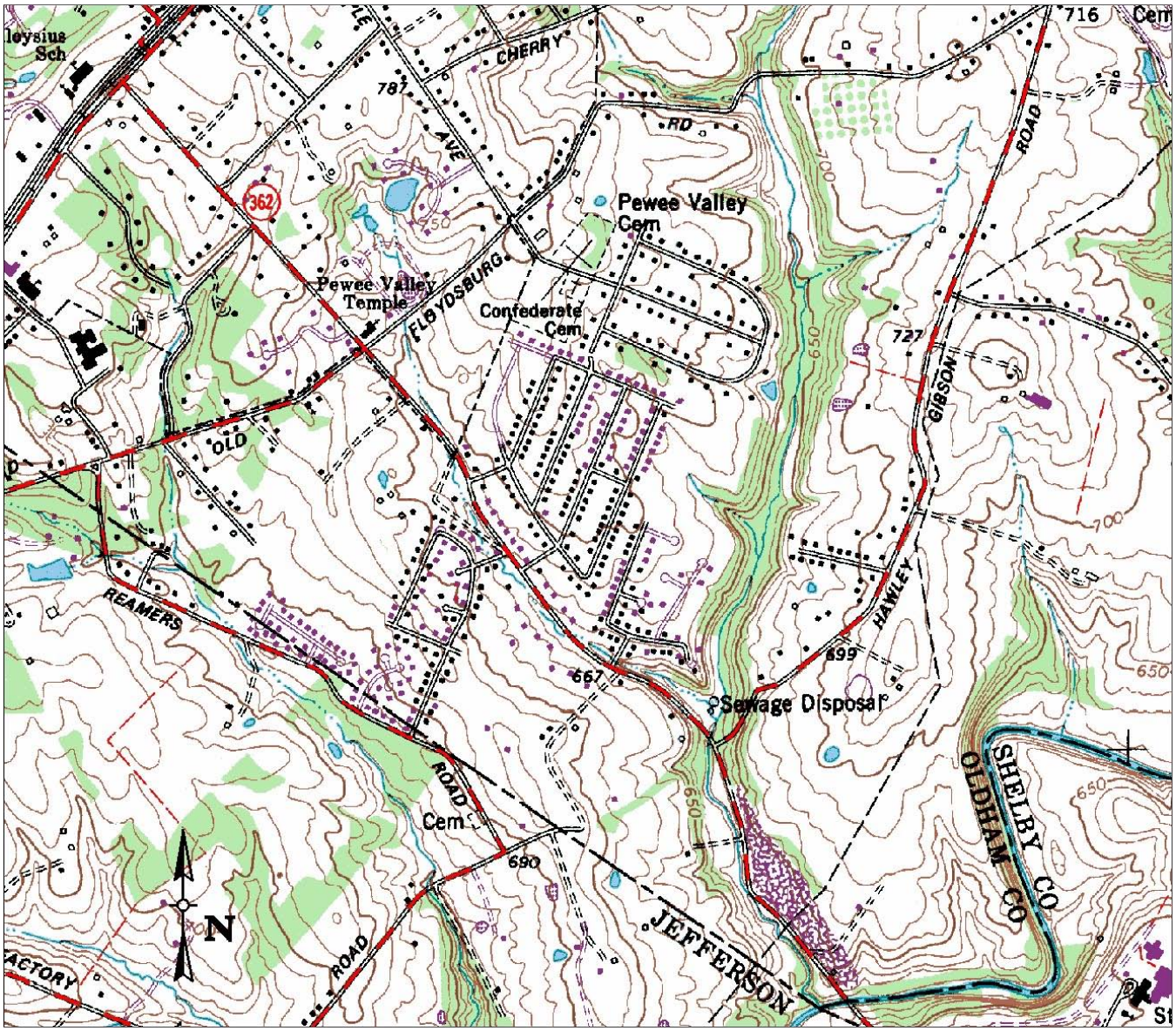
_____

_____

May we contact you at your home for additional information? O Yes O No

Phone: _____ Best time to contact: _____

Thank you very much for your participation. Please return this questionnaire in the self-addressed stamped envelope provided. Any further inquiries can be made by contacting the personnel listed within the cover letter.



Please provide any additional comments or experiences you may have regarding flooding problems along Ash Avenue (KY 362).

Michael S. Draper

From: Nuss, Kevin [knuss@oldhamcounty.net]
Sent: Monday, August 17, 2009 2:46 PM
To: Michael Hesse
Subject: Ash Ave Closures
Attachments: ASH Closures.doc

Michael: Attached are the closures we have had reported. I am confident there are more, but we don't always get notified.

Kevin Nuss
Director, Oldham County
Emergency Management &
Oldham County Dispatch
1020 Dispatchers Way
LaGrange, KY 40031
(O) 502-222-0799
(C) 502-379-1452
(F) 502-222-0380
knuss@oldhamcounty.net

Reported Ash Avenue Road Closures

Date	Time Reported
06-14-2003	2230 HRS
06-02-2006	0952 HRS
09-23-2006	0011 HRS
04-04-2008	0020 HRS
05-08-2009	1830 HRS
07-25-2009	2300 HRS
08-10-2009	1900 HRS

MSD
Louisville and Jefferson County
Metropolitan Sewer District
700 W. Liberty Street
Louisville, Kentucky
40203-1913
502-587-0603 – WWW.MSDLOUKY.ORG

EXHIBIT 10-3
RAINFALL FOR JEFFERSON COUNTY * (INCHES)

EFFECTIVE DATE: JUNE 30, 2009

FREQUENCY (YEARS)

DURATION	1	2	5	10	25	50	100	PMP
30 min.	1.0	1.1	1.4	1.6	1.9	2.0	2.3	
1 hour	1.2	1.4	1.8	2.0	2.3	2.6	2.8	
2 hour	1.5	1.7	2.2	2.5	2.8	3.2	3.5	
3 hour	1.6	1.9	2.4	2.7	3.2	3.4	3.8	
6 hour	2.0	2.3	2.8	3.3	3.7	4.2	4.5	28.0
12 hour	2.4	2.8	3.4	3.9	4.4	4.9	5.4	33.0
24 hour	2.7	3.2	4.0	4.5	5.2	5.7	6.2 **	35.0
2 day	0.0	3.6	4.4	5.1	6.1	6.4	7.3	38.5
4 day		4.3	5.3	6.0	6.9	7.6	8.4	
7 day		5.0	6.1	6.8	8.0	8.8	9.6	

* SOURCE:
DIVISION OF WATER RESOURCES
DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION
ENGINEERING MEMORANDUM NO. 2 (4-30-71), REVISED (6-1-79)

** NOTE:
RAINFALL RANGED FROM 7.5 TO 12.5 INCHES DURING THE FEBRUARY 28/ MARCH 1, 1997 EVENT.

APPENDIX B

PROJECT PHOTOGRAPHS

Area A Photos

Property at corner of Village Green Boulevard and Ash Avenue looking Southeast (downstream).

Entrance to 8924 Ash Avenue.

8924 Ash Avenue looking downstream towards 8928 Ash Avenue.

Entrance to 8930 Ash Avenue.

Ash Avenue looking northwest (uphill) at 8917 Ash Avenue.

Area B Photos

8931 Ash Avenue looking Southeast (downhill). Ashbrooke Subdivision is located to the left.

9001 Ash Avenue looking Southeast at the approximate location of the double 36" cross drains. Ashbrooke Dr. is located at the top of this picture on the left.

9003 Ash Avenue looking downstream.

Between 9003 and 9005 Ash Avenue (north side of road)

Intersection of Ashbrooke Drive and Ash Avenue (KY 362).

Area C Photos

Ash Avenue (KY 362) south of Hawley Gibson Road. Looking Downstream.

Ash Avenue (KY 362) south of Hawley Gibson Road. Looking Downstream.

Ash Avenue (KY 362) Bridge north of Hawley Gibson Road looking upstream.

Ash Avenue (KY 362) Bridge north of Hawley Gibson Road looking downstream.

Area D Photos

Property located at 8529 Confederate Place Dr.

Property located at 8529 Confederate Place Dr.

Property at 8529 Confederate Place Dr. (Back yard).

Entrance to 8929 Confederate Place Drive.

Area E Photos

Overland ditch located behind 6613 Riverbirch Drive.

Outlet pipe and erosion problems behind 6613 Riverbirch Drive.

Separation of Outlet pipe behind 6613 Riverbirch Drive.

Sedimentation at outlet behind 6613 Riverbirch Drive.

Area F Photos

Driveway at 6615 Ashbrooke Drive slopes down and away from roadway.

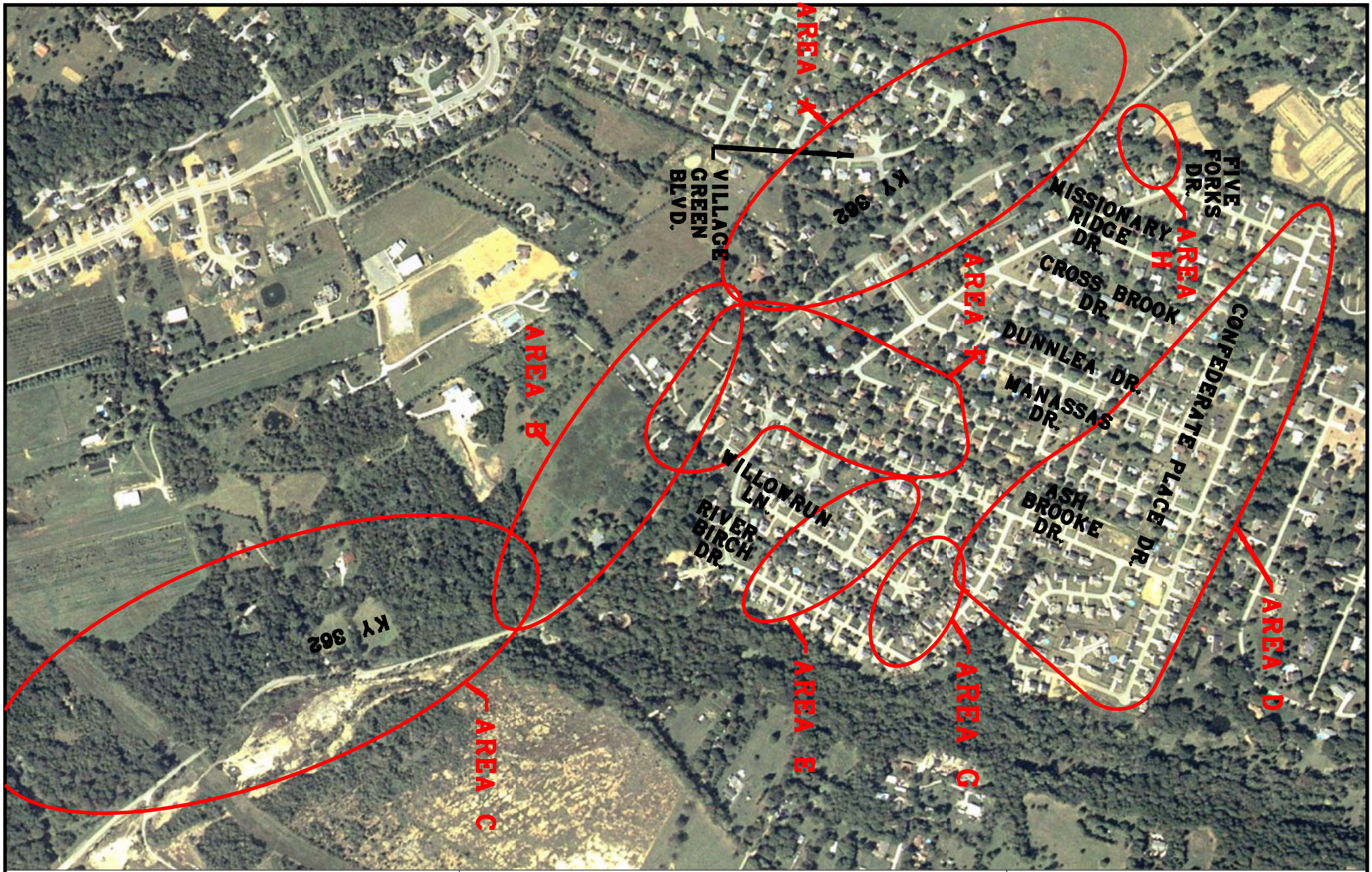
Questionnaire comments indicate standing water problems at 6623 and 6625 Ashbrooke Drive.

No pipes or swales to contain water at intersection of Ashbrooke Drive and Raintree Court.

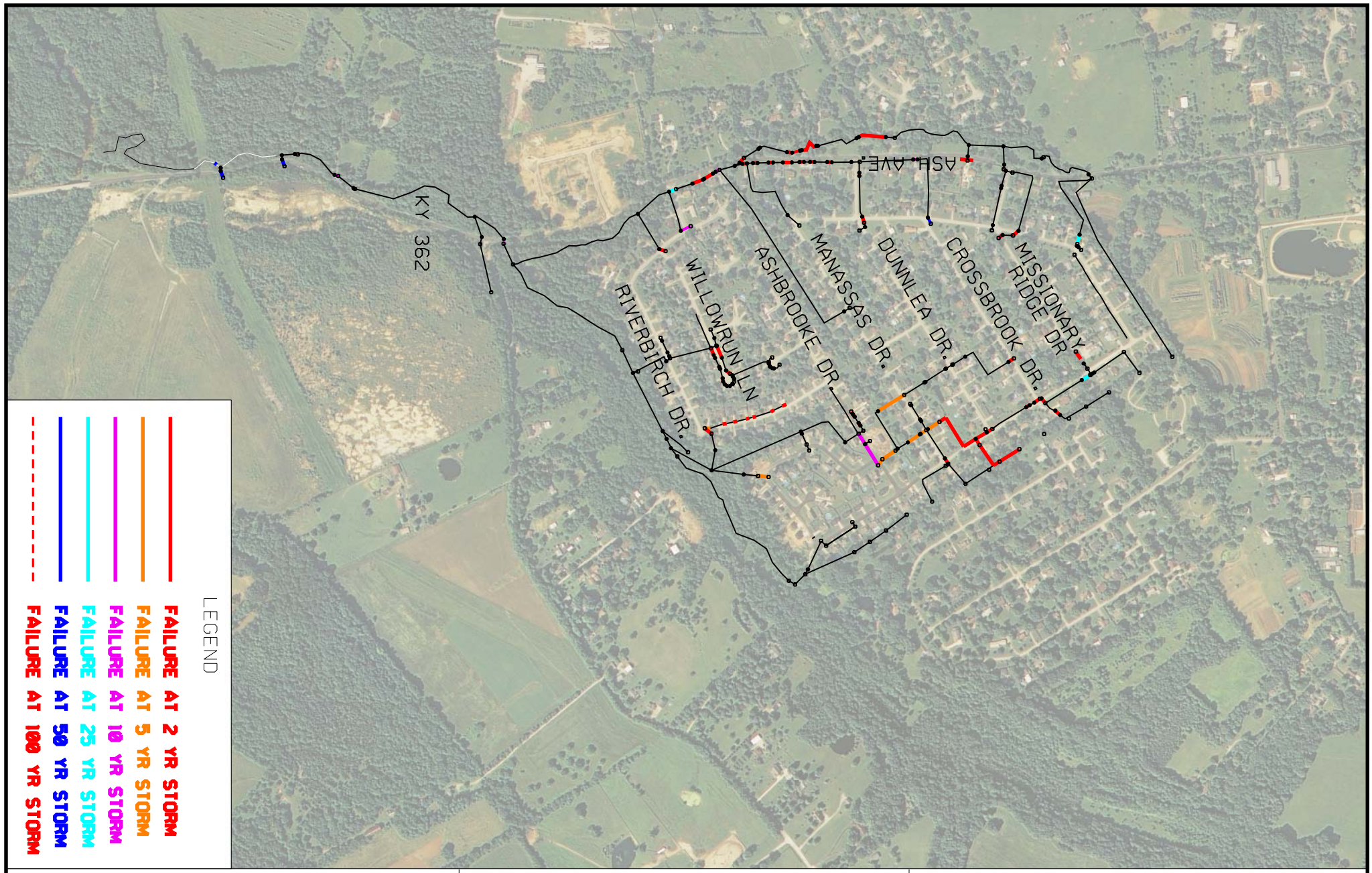
Standing water concerns at 6620 Ashbrooke Drive. Undersized swale.

APPENDIX C

EXISTING ANALYSIS



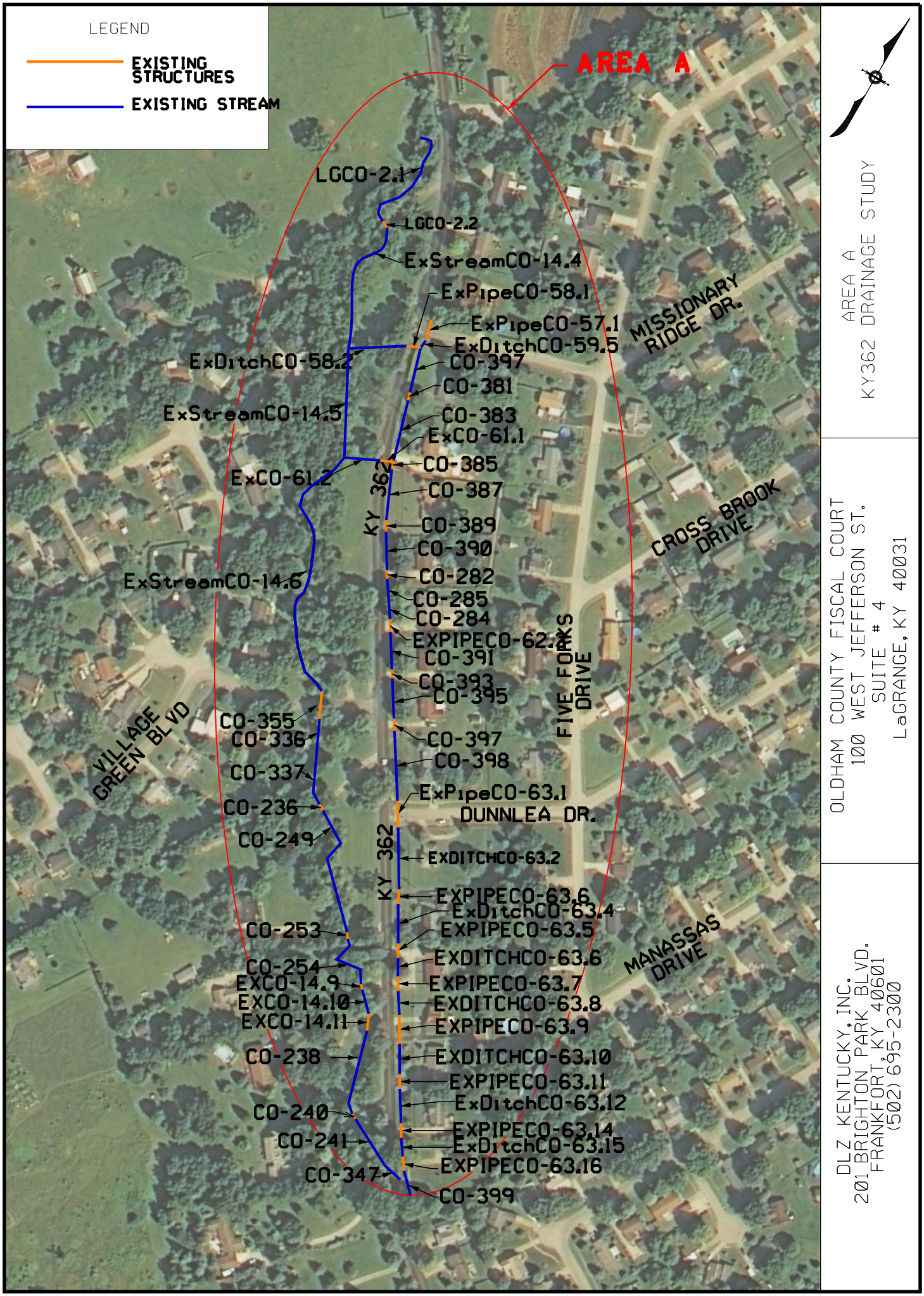
DLZ KENTUCKY, INC. 201 BRIGHTON PARK BLVD. FRANKFORT, KY 40601 (502) 695-2300	OLDHAM COUNTY FISCAL COURT 100 WEST JEFFERSON ST. SUITE # 4 LaGRANGE, KY 40031	KY 362 AREA'S A-H



DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

KY362
DRAINAGE STUDY
SCALE: 1" = 800'



AREA A
KY362 DRAINAGE STUDY

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

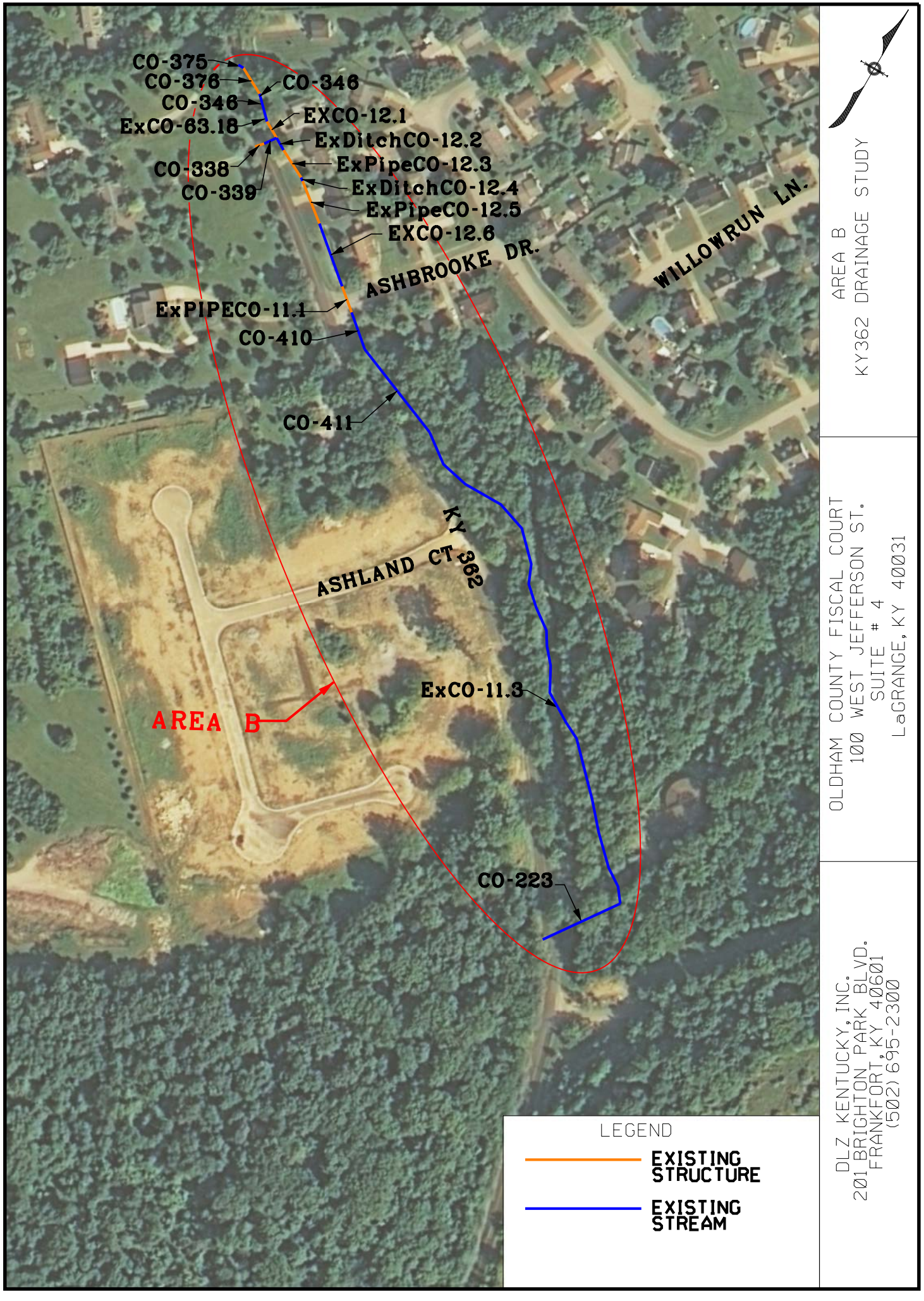
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area A - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
LG CO-2.1	ExPipeMH-14.1	LG CB-2	Trapezoidal Channel	4' road Culvert	0.008	648.22	39.93	51.37	58.61	3.47	3.77	3.93
LG CO-2.2	LG CB-2	ExCulvertMH-14.3	Rectangular Channel	Natural Stream	0.093	616.22	55.06	71.76	82.42	7.00	7.70	8.09
ExStreamCO-14.4	ExCulvertMH-14.3	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.009	2065.60	55.03	71.72	82.37	3.47	3.66	5.26
ExPipeCO-57.1	ExCB-57	ExPipeMH-59.4	Elliptical Pipe	24x38 inch	0.006	32.44	4.29	5.33	5.97	4.32	4.61	4.78
ExDitchCO-59.5	ExPipeMH-59.4	ExCB-58	Trapezoidal Channel	Natural Stream	0.007	52.86	5.00	6.26	7.05	1.95	2.06	2.13
ExPipeCO-58.1	ExCB-58	ExPipeMH-58.1	Circular Pipe	18 inch	0.051	23.82	5.52	6.90	7.76	10.97	11.67	12.05
ExDitchCO-58.2	ExPipeMH-58.1	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.054	145.66	5.52	6.90	7.76	4.26	4.51	4.64
ExStreamCO-14.5	ExInStreamMH-14.4	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.009	2113.12	57.43	74.91	86.04	3.57	3.76	5.44
ExCO-61.1	ExCB-61	ExMH-61.1	Circular Pipe	18 inch	0.053	24.11	6.53	8.45	9.71	11.60	12.44	12.91
ExCO-61.2	ExMH-61.1	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.095	206.40	6.52	8.44	9.70	5.44	5.82	6.03
ExStreamCO-14.6	ExinStreamMH-14.5	LG CB-3	Trapezoidal Channel	Natural Stream	0.006	1740.69	59.98	78.47	90.29	3.08	5.06	5.65
CO-355	LG CB-3	ExMH-14.7	Elliptical Pipe	83x53 inch	0.009	311.04	68.77	90.79	105.09	10.64	11.39	11.81
CO-336	ExMH-14.7	MH-105	Trapezoidal Channel	Natural Stream	0.011	4.30	68.68	90.68	104.97	10.73	12.13	12.91
CO-337	MH-105	MH-44	Trapezoidal Channel	Natural Stream	0.011	179.34	68.61	90.61	104.90	2.32	1.67	1.75
CO-236	MH-44	MH-45	Rectangular Channel	4'x4' Driveway Crossing	0.026	360.16	68.23	90.16	104.41	8.33	16.26	16.94
CO-249	MH-45	MH-50	Trapezoidal Channel	Natural Stream	0.008	82.18	68.21	90.14	104.38	4.89	5.97	6.53
CO-253	MH-50	MH-53	Box Pipe	24x24 inch	-0.067	-148.73	67.23	89.07	103.33	8.40	11.13	12.92
CO-254	MH-53	ExMH-14.8	Trapezoidal Channel	Natural Stream	0.011	34.29	67.21	89.04	103.30	6.74	7.99	8.71
ExCO-14.9	ExMH-14.8	ExMH-14.9	Circular Pipe	24 inch	0.025	36.09	66.85	88.70	102.97	21.28	28.24	32.78
ExCO-14.10	ExMH-14.9	ExMH-14.10	Rectangular Channel	Natural Stream	0.002	4.49	66.84	88.69	102.96	11.72	13.86	15.09
ExCO-14.11	ExMH-14.10	ExMH-14.11	Circular Pipe	26 inch	0.010	27.58	66.78	88.63	102.90	18.12	24.04	27.91
CO-238	ExMH-14.11	MH-46	Trapezoidal Channel	Natural Stream	0.005	560.63	66.75	88.60	102.87	3.16	3.40	3.53
CO-240	MH-46	MH-47	Circular Pipe	48 inch	0.048	315.78	65.86	87.43	101.58	19.85	21.49	22.39
CO-241	MH-47	ExCB-13	Trapezoidal Channel	Natural Stream	0.020	435.24	65.85	87.42	101.57	5.35	5.77	6.00

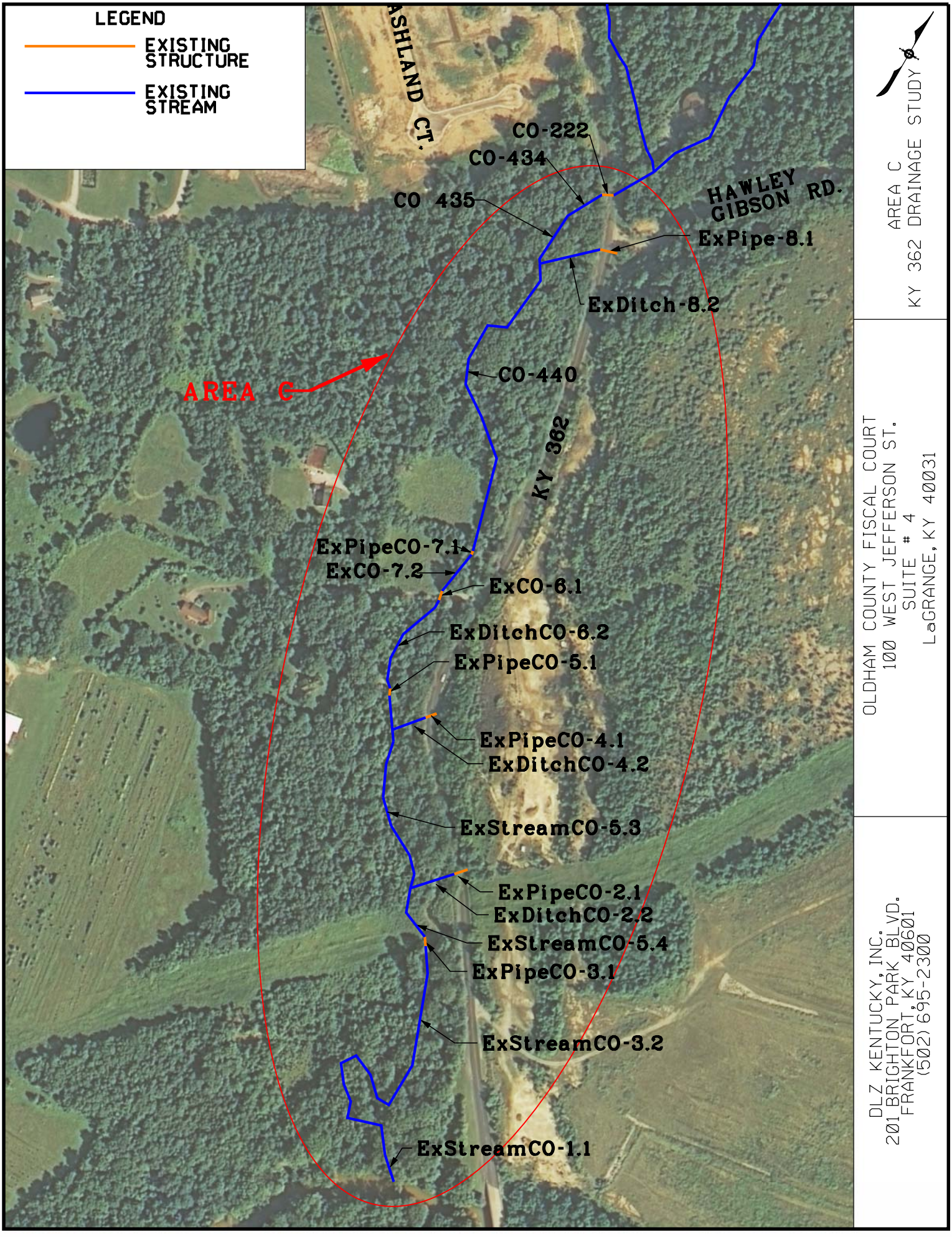
Area A - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
ExPipeCO-62.3	ExPipeMH-62.2	ExPipeMH-62.3	Circular Pipe	12 inch	0.011	2.04	1.38	1.73	1.96	2.79	2.91	2.96
CO-391	ExPipeMH-62.3	MH-128	Trapezoidal Channel	Natural Stream	0.023	34.79	1.37	1.73	1.95	2.19	2.32	2.39
CO-393	MH-128	MH-129	Trapezoidal Channel	Natural Stream	0.023	6.47	1.35	1.70	1.92	2.94	3.36	3.65
CO-395	MH-129	MH-130	Trapezoidal Channel	Natural Stream	0.023	34.82	1.34	1.69	1.91	2.17	2.31	2.38
CO-397	MH-130	MH-131	Trapezoidal Channel	Natural Stream	0.023	6.44	1.32	1.67	1.89	2.14	2.28	2.35
CO-398	MH-131	ExCB-63	Trapezoidal Channel	Natural Stream	0.023	34.81	1.32	1.66	1.88	2.16	2.30	2.37
ExPipeCO-63.1	ExCB-63	ExPipeMH-63.1	Elliptical Pipe	24x38 inch	0.028	68.27	13.18	17.28	19.96	10.20	11.10	11.62
ExDitchCO-63.2	ExPipeMH-63.1	ExPipeMH-63.2	Trapezoidal Channel	Natural Stream	0.002	17.98	13.16	17.24	19.92	1.56	1.67	2.60
ExPipeCO-63.3	ExPipeMH-63.2	ExPipeMH-63.3	Circular Pipe	15 inch	0.012	3.84	12.72	16.74	19.40	10.39	13.64	15.81
ExDitchCO-63.4	ExPipeMH-63.3	ExPipeMH-63.4	Trapezoidal Channel	Natural Stream	0.013	46.08	12.71	16.72	19.39	3.14	3.36	3.49
ExPipeCO-63.5	ExPipeMH-63.4	ExPipeMH-63.5	Circular Pipe	15 inch	0.015	4.29	12.57	16.56	19.21	10.26	13.50	15.66
ExDitchCO-63.6	ExPipeMH-63.5	ExPipeMH-63.6	Trapezoidal Channel	Natural Stream	0.011	40.77	12.55	16.55	19.20	2.86	3.06	3.18
ExPipeCO-63.7	ExPipeMH-63.6	ExPipeMH-63.7	Circular Pipe	15 inch	0.004	2.15	12.48	16.46	19.11	10.19	13.42	15.57
ExDitchCO-63.8	ExPipeMH-63.7	ExPipeMH-63.8	Trapezoidal Channel	Natural Stream	0.008	35.24	12.47	16.45	19.09	2.56	2.74	2.84
ExPipeCO-63.9	ExPipeMH-63.8	ExPipeMH-63.9	Circular Pipe	15 inch	0.015	4.32	12.36	16.33	18.96	10.10	13.31	15.45
ExDitchCO-63.10	ExPipeMH-63.9	ExPipeMH-63.10	Trapezoidal Channel	Natural Stream	0.019	64.14	12.33	16.30	18.93	3.55	3.81	3.96
ExPipeCO-63.11	ExPipeMH-63.10	ExPipeMH-63.11	Circular Pipe	15 inch	0.002	1.72	12.24	16.19	18.81	10.00	13.20	15.33
ExDitchCO-63.12	ExPipeMH-63.11	ExPipeMH-63.12	Trapezoidal Channel	Natural Stream	0.012	43.88	12.22	16.17	18.80	3.00	3.21	3.34
ExPipeCO-63.14	ExPipeMH-63.12	ExPipeMH-63.14	Circular Pipe	15 inch	0.021	5.12	12.10	16.02	18.64	9.89	13.06	15.19
ExDitchCO-63.15	ExPipeMH-63.14	ExPipeMH-63.15	Trapezoidal Channel	Natural Stream	0.012	43.80	12.09	16.01	18.62	2.98	3.20	3.33
ExPipeCO-63.16	ExPipeMH-63.15	ExPipeMH-63.16	Circular Pipe	15 inch	0.025	5.53	13.15	17.25	19.98	10.73	14.06	16.28
CO-399	ExPipeMH-63.16	MH-120	Trapezoidal Channel	Rough Channel	0.081	1063.31	13.14	17.24	19.96	6.20	6.64	6.89


CO-375
CO-376
CO-346
CO-346
ExCO-63.18
EXCO-12.1
ExDitchCO-12.2
ExPipeCO-12.3
ExDitchCO-12.4
ExPipeCO-12.5
EXCO-12.6
CO-338
CO-339
ASHBROOKE DR.
WILLOWRUN LN.
ExPIPECO-11.1
CO-410
CO-411
KY 362
ASHLAND CT
ExCO-11.3
AREA B
CO-223
LEGEND
EXISTING STRUCTURE
EXISTING STREAM
AREA B
KY362 DRAINAGE STUDY
OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area B - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
CO-375	ExCB-13	CB-187	Trapezoidal Channel	Natural Stream	0.011	333.2	77.66	104.61	122	4.59	4.96	0.02
CO-376	CB-187	MH-120	Circular Pipe	36 inch	-0.013	-153.01	77.63	104.58	121.96	6.12	7.86	0.01
CO-373	MH-120	MH-110	Trapezoidal Channel	Natural Stream	0.076	1028.99	86.12	116.14	135.47	9.70	10.46	0.01
CO-346	MH-110	ExMH-63.17	Trapezoidal Channel	Natural Stream	0.024	576.90	86.11	116.12	135.45	6.29	6.78	0.04
ExCO-63.18	ExMH-63.17	ExCulvertCB-12	Trapezoidal Channel	Natural Stream	0.010	201.83	86.05	116.05	135.36	3.39	3.65	0.43
ExCO-12.1	ExCulvertCB-12	CxPipeMH-12.1	Circular Pipe	36 inch	0.008	32.61	90.85	122.74	143.25	12.94	17.39	0.02
CO-338	CB-173	MH-106	Circular Pipe	18 inch	0.029	9.67	1.99	2.60	3.00	4.31	7.08	0.06
CO-339	MH-106	CxPipeMH-12.1	Trapezoidal Channel	Natural Stream	0.158	33.57	1.99	2.60	2.99	6.53	4.64	0.05
ExDitchCO-12.2	CxPipeMH-12.1	ExPipeMH-12.2	Trapezoidal Channel	Natural Stream	0.053	471.53	92.00	124.34	145.14	6.13	6.62	0.05
ExPipeCO-12.3	ExPipeMH-12.2	ExPipeMH-12.3	Circular Pipe	36 inch	-0.003	-19.16	91.92	124.24	145.03	13.08	17.60	0.05
ExDitchCO-12.4	ExPipeMH-12.3	ExPipeMH-12.4	Trapezoidal Channel	Natural Stream	0.079	695.40	91.81	124.14	144.93	11.49	12.43	0.01
ExPipeCO-12.5	ExPipeMH-12.4	ExPipeMH-12.5	Circular Pipe	36 inch	0.008	33.17	91.79	124.12	144.91	13.07	17.58	0.06
ExCO-12.6	ExPipeMH-12.5	ExCB-11	Trapezoidal Channel	Natural Stream	0.043	873.59	91.67	124.01	144.80	5.64	6.09	0.28
ExPipeCO-11.1	ExCB-11	ExPipeMH-11.1	Elliptical Pipe	48x60 inch	0.008	169.50	100.33	135.98	158.92	11.31	12.20	0.07
CO-410	ExPipeMH-11.1	MH-143	Trapezoidal Channel	Rough Channel	10.697	62003.41	101.04	136.86	159.89	55.79	62.44	0.02
CO-411	MH-143	ExMH-11.2	Irregular Channel	Rough Channel	-3.696	-118410.93	101.02	159.86	159.88	0.62	0.82	7.41
Ex CO-11.3	ExMH-11.2	Stream CB-1	Irregular Channel	Natural Stream	0.025	128800.27	88.76	124.28	147.37	2.79	3.09	4.50
CO-223	Stream CB-1	LG CB-12	Trapezoidal Channel	Natural Stream	0.018	2307.79	409.56	558.83	653.27	8.80	9.63	0.23



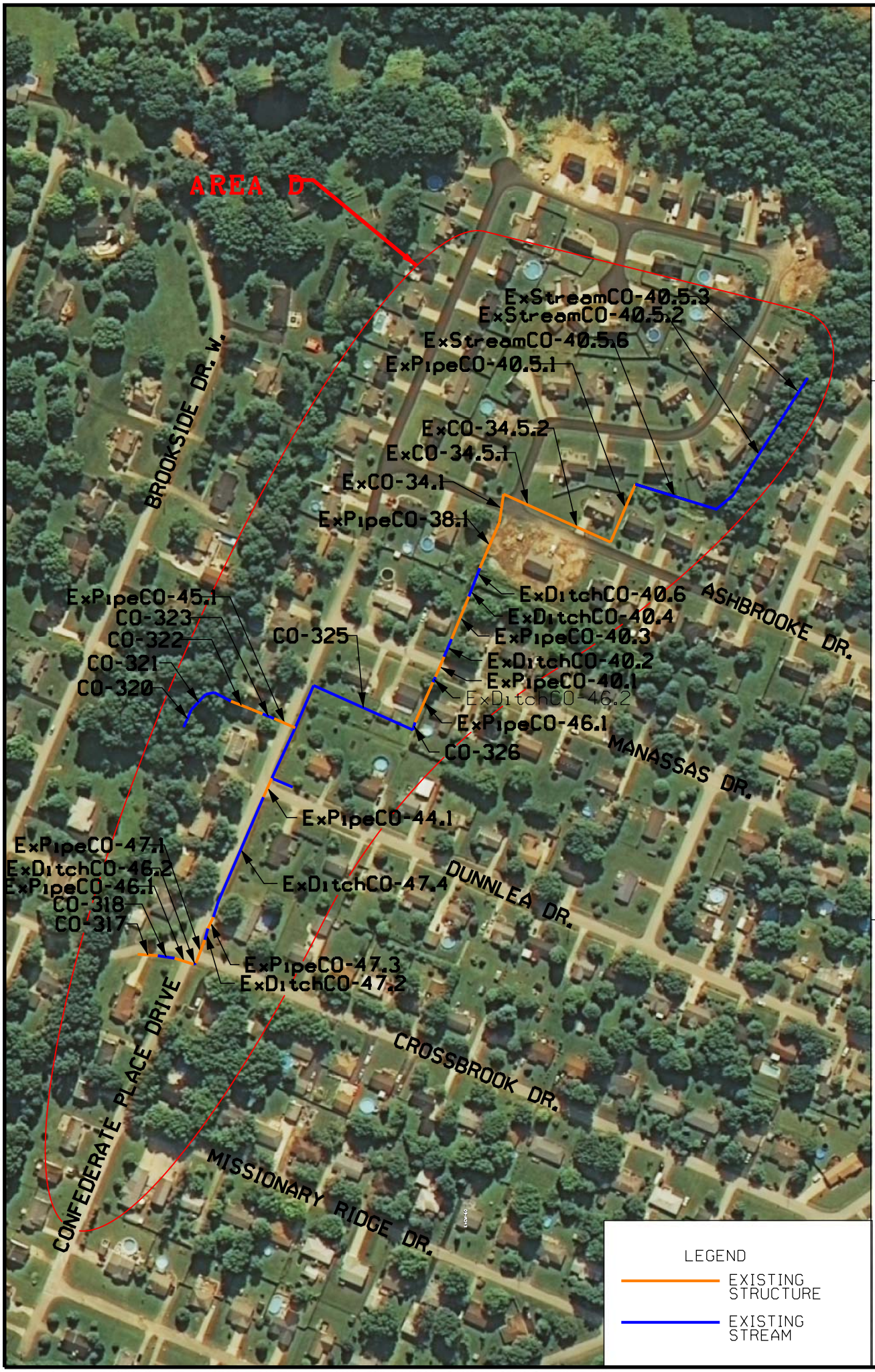
AREA C
KY 362 DRAINAGE STUDY

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area C - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
CO-222	LG CB-12	ExPipeMH-9.1	Rectangular Channel	Natural Stream	0.003	443.18	411.10	560.98	655.86	3.60	6.02	6.77
CO-434	ExPipeMH-9.1	MH-159	Irregular Channel	Natural Stream	0.019	1902.06	410.66	560.48	655.37	6.99	7.83	8.28
CO-435	MH-159	ExStreamMH-9.2	Irregular Channel	Natural Stream	-0.001	-27854.37	410.33	560.05	654.90	0.23	0.31	0.36
ExPipeCO-8.1	ExCB-8	ExSomethingMH-8.1	Circular Pipe	30 inch	0.042	84.50	28.94	37.57	43.24	15.60	16.71	17.32
ExDitchCO-8.2	ExSomethingMH-8.1	ExStreamMH-9.2	Trapezoidal Channel	Natural Stream	0.032	1747.30	28.89	37.52	43.19	3.29	3.64	3.84
CO-440	ExStreamMH-9.2	ExCB-7	Irregular Channel	Natural Stream	0.002	53643.21	331.23	477.45	570.52	1.67	1.81	1.88
ExPipesCO-7.1	ExCB-7	ExPipeMH-7.1	Circular Pipe	24 inch	0.010	135.73	326.29	470.23	561.84	17.32	24.95	29.81
ExCO-7.2	ExPipeMH-7.1	ExCB-6	Trapezoidal Channel	Natural Stream	0.005	553.24	326.27	470.21	561.82	3.59	3.97	5.63
ExCO-6.1	ExCB-6	ExPipeMH-6.1	Circular Pipe	48 inch	0.011	608.04	327.68	472.30	564.38	12.32	13.37	13.74
ExDitchCO-6.2	ExPipeMH-6.1	ExCB-5	Trapezoidal Channel	Natural Stream	0.005	506.57	327.61	472.20	564.27	3.68	4.07	5.95
ExPipeCO-5.1	ExCB-5	ExPipeMH-5.1	Circular Pipe	36 inch	0.023	219.90	327.03	471.43	563.76	11.70	16.70	19.95
ExDitchCO-5.2	ExPipeMH-5.1	ExPipeMH-5.2	Trapezoidal Channel	Natural Stream	0.059	2633.96	326.97	471.37	563.70	8.60	9.59	10.11
ExPipeCO-4.1	ExCB-4	ExPipeMH-4.1	Circular Pipe	24 inch	-0.003	-7.07	97.92	126.75	145.72	31.17	40.34	46.39
ExDitchCO-4.2	ExPipeMH-4.1	ExPipeMH-5.2	Trapezoidal Channel	Natural Stream	0.156	517.17	97.83	126.67	145.64	13.11	13.99	14.48
ExStreamCO-5.3	ExPipeMH-5.2	ExStreamMH-5.3	Irregular Channel	Natural Stream	0.005	2722.21	347.99	501.74	600.08	2.48	2.57	2.65
ExPipeCO-2.1	ExCB-2	ExPipeMH-2.1	Circular Pipe	18 inch	0.072	28.12	16.83	21.10	23.95	16.62	17.46	17.87
ExDitchCO-2.2	ExPipeMH-2.1	ExStreamMH-5.3	Trapezoidal Channel	Natural Stream	0.063	329.46	16.83	21.10	23.95	6.00	6.36	6.57
ExStreamCO-5.4	ExStreamMH-5.3	ExCB-3	Trapezoidal Channel	Natural Stream	0.017	1831.62	343.95	495.22	592.26	7.78	8.52	8.91
ExPipeCO-3.1	ExCB-3	ExMH-3.1	Circular Pipe	60 inch	-0.013	-591.96	344.73	496.37	593.61	9.45	12.95	15.28
ExStreamCO-3.2	ExMH-3.1	ExStreamOutletCB-1	Irregular Channel	Natural Stream	0.002	4481.10	344.63	496.28	593.51	2.52	2.82	2.96
ExStreamCO-1.1	ExStreamOutletCB-1	ExOF-1	Trapezoidal Channel	Natural Stream	0.004	710.23	333.56	481.54	576.46	0.09	0.13	0.16



AREA D
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Area D - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
CO-317	MH-93	MH-94	Circular Pipe	8 inch	0.012	0.71	3.53	4.57	5.26	10.11	13.10	15.07
CO-318	MH-94	ExCB-46.1	Trapezoidal Channel	Grass Channel	0.016	4.46	3.52	4.57	5.26	5.43	6.32	6.83
ExPipeCO-46.1	ExCB-46.1	ExPipeMH-46.1	Circular Pipe	15 inch	0.018	4.72	5.52	7.21	8.33	4.82	6.06	6.91
ExDitchCO-46.2	ExPipeMH-46.1	ExCB-47	Rectangular Channel	Natural Stream	0.046	0.80	5.49	7.18	8.31	10.68	12.17	13.03
ExPipeCO-47.1	ExCB-47	ExPipeMH-47.1	Circular Pipe	12 inch	0.023	5.46	5.81	7.58	8.74	7.45	9.66	11.14
ExDitchCO-47.2	ExPipeMH-47.1	ExPipeMH-47.2	Trapezoidal Channel	Natural Stream	0.023	62.09	5.79	7.56	8.73	3.12	3.34	3.46
ExPipeCO-47.3	ExPipeMH-47.2	ExPipeMH-47.3	Circular Pipe	15 inch	0.024	5.47	5.76	7.52	8.69	5.00	6.30	7.18
ExDitchCO-47.4	ExPipeMH-47.3	ExCB-44	Trapezoidal Channel	Natural Stream	0.034	41.72	5.75	7.51	8.67	3.61	3.87	4.01
ExPipeCO-44.1	ExCB-44	ExPipeMH-44.1	Circular Pipe	12 inch	0.008	3.24	6.61	8.54	9.81	8.45	10.88	12.49
ExDitchCO-44.2	ExPipeMH-44.1	ExPipeMH-44.2	Trapezoidal Channel	Grass Channel	0.027	5.75	7.16	9.27	10.66	8.06	9.20	9.85
CO-320	Ex-for Proposed Area CB-7	Ex-for Proposed Area CB-8	Trapezoidal Channel	Grass Channel	0.041	7.09	0.52	0.68	0.78	2.05	2.22	2.32
CO-321	Ex-for Proposed Area CB-8	MH-95	Trapezoidal Channel	Grass Channel	0.009	45.05	20.21	26.46	30.53	2.28	2.44	2.53
CO-322	MH-95	MH-96	Circular Pipe	15 inch	0.004	3.96	20.20	26.49	30.58	16.46	21.58	24.92
CO-323	MH-96	ExCB-45	Trapezoidal Channel	Natural Stream	0.018	11.44	20.17	26.45	30.55	12.03	13.62	14.51
ExPipeCO-45.1	ExCB-45	ExPipeMH-44.2	Circular Pipe	15 inch	0.023	9.72	22.37	29.35	33.89	18.23	23.91	27.62
CO-325	ExPipeMH-44.2	MH-97	Trapezoidal Channel	Grass Channel	0.009	6.98	28.47	37.18	42.83	5.66	6.54	7.04
CO-326	MH-97	ExCB-46	Trapezoidal Channel	Concrete 3' FB	0.004	19.54	28.11	36.82	42.47	8.75	10.08	10.84
ExPipeCO-46.1	ExCB-46	ExPipeMH-46.1	Circular Pipe	28 inch	0.014	39.86	31.93	41.87	48.32	10.36	9.93	11.38
ExDitchCO-46.2	ExPipeMH-46.1	ExCB-40	Trapezoidal Channel	Natural Stream	0.019	118.78	31.83	41.75	48.20	4.47	4.80	4.98
ExPipeCO-40.1	ExCB-40	EXMH-40.1	Elliptical Pipe	19x30 inch	0.013	24.44	34.80	45.65	52.71	11.22	14.69	16.96
ExDitchCO-40.2	EXMH-40.1	ExPipeMH-40.2	Trapezoidal Channel	Natural Stream	0.050	493.87	34.75	45.60	52.66	6.55	7.02	7.28
ExPipeCO-40.3	ExPipeMH-40.2	ExPipeMH-40.3	Circular Pipe	28 inch	0.013	39.12	34.74	45.59	52.64	10.34	10.76	12.36
ExDitchCO-40.4	ExPipeMH-40.3	DetentionMH-40.5	Trapezoidal Channel	Natural Stream	0.060	427.46	34.63	45.46	52.51	7.92	8.74	9.19
ExDitchCO-40.6	DetentionMH-40.5	ExCB-38	Trapezoidal Channel	Natural Stream	-0.014	-303.08	45.00	59.00	68.10	1.92	2.34	2.60
ExPipeCO-38.1	ExCB-38	ExCB-34	Circular Pipe	30 inch	0.016	52.18	44.88	58.93	68.05	9.14	12.01	13.86
ExCO-34.1	ExCB-34	ExCB-34.5	Circular Pipe	30 inch	0.007	34.21	45.02	59.16	68.33	9.17	12.05	13.92
ExCO-34.5.1	ExCB-34.5	ExPipeMH-34.5.1	Circular Pipe	30 inch	0.010	41.46	45.20	59.40	68.62	9.41	12.17	14.01
ExCO-34.5.2	ExPipeMH-34.5.1	ExCB-40.5	Circular Pipe	30 inch	0.010	41.46	45.55	59.97	69.32	9.28	12.22	14.12
ExPipeCO-40.5.1	ExCB-40.5	ExMH-40.5.1	Circular Pipe	36 inch	0.019	91.69	47.32	62.16	71.76	13.08	13.94	14.35
ExStreamCO-40.5.2	ExMH-40.5.1	ExStreamMH-40.5.2	Trapezoidal Channel	Natural Stream	0.029	237.25	47.19	62.00	71.59	6.19	6.67	6.93
ExStreamCO-40.5.3	ExStreamMH-40.5.2	ExMH-28.2	Trapezoidal Channel	Natural Stream	0.063	348.38	47.31	62.22	71.86	8.17	8.82	9.18


LEGEND
EXISTING STRUCTURE
EXISTING STREAM
AREA E
ExDitch CO-27.6
ExPipe CO-26.1
ExPipe CO-27.1
ExDitch CO-27.2
ExPipe CO-27.3
ExDitch CO-27.4
ExPipe CO-27.5
ExPipeCO-25.1
CO-309
CO-305
ExPipeCO25.3
CO-306
ExCO25.4
ExPipeCO23.1
ExPipeCO25.6
ExDitchCO-23.2
ExPipe CO-24.1
ExPipeCO-21.1
WILLOWRUN LN
ExDitchCO-22.1
ExPipeCO-21.1
CO-308
ExCO-18.1
ExPipeCO-24.3
ExDitchCO-24.4
ExPipeCO-24.5
ExPipe CO-15.1
ExCO-24.6
ExPipeCO-24.7
ExDitchCO-24.8
ExDitch CO-15.2
ExPipeCO-24.9
ExCO-15.4
ExCO-24.10
ExPipe CO-16.1
RIVERBIRCH DR.
ExPipe CO-15.3
ToExistingStreamCO-16.2
AREA E
KY 362 DRAINAGE STUDY
OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area E - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
ExPipeCO-27.1	ExCB-27	ExPipeMH-27.1	Circular Pipe	15 inch	0.006	2.76	0.71	0.89	1.00	1.88	2.00	2.07
ExDitchCO-27.2	ExPipeMH-27.1	ExPipeMH-27.2	Trapezoidal Channel	Natural Stream	0.007	7.07	0.71	0.89	1.00	1.60	1.70	1.76
ExPipeCO-27.3	ExPipeMH-27.2	ExMH-27.3	Circular Pipe	15 inch	0.016	4.46	0.71	0.89	1.00	2.66	2.83	2.93
ExDitchCO-27.4	ExMH-27.3	ExPipeMH-27.4	Trapezoidal Channel	Natural Stream	0.012	9.25	0.71	0.89	1.00	1.94	2.07	2.15
ExPipeCO-27.5	ExPipeMH-27.4	ExPipeMH-27.5	Circular Pipe	15 inch	0.003	1.79	0.71	0.89	1.00	1.37	1.46	1.50
ExDitchCO-27.6	ExPipeMH-27.5	ExCB-25	Trapezoidal Channel	Natural Stream	0.171	34.94	0.71	0.89	1.00	0.65	0.72	0.76
ExPipeCO-26.1	ExCB-26	ExCB-25	Circular Pipe	15 inch	0.056	8.26	0.62	0.72	0.79	0.62	0.65	0.68
ExPipeCO-25.1	ExCB-25	ExPipeMH-25.1	Circular Pipe	12 inch	0.038	6.95	1.53	1.86	2.07	7.10	7.49	7.72
CO-305	ExPipeMH-25.1	CB-169	Trapezoidal Channel	Natural Stream	0.021	6.24	1.53	1.86	2.07	2.97	3.57	3.84
ExPipeCO-25.6	ExPipeMH-25.4	CB-168	Circular Pipe	10 inch	0.022	1.77	0.05	0.06	0.07	0.16	0.19	0.22
ExCO-25.4	ExPipeMH-25.3	ExPipeMH-25.4	Trapezoidal Channel	Natural Stream	0.030	14.63	0.05	0.06	0.07	0.13	0.16	0.18
ExPipeCO-25.3	ExPipeMH-25.2	ExPipeMH-25.3	Circular Pipe	10 inch	0.013	2.51	0.04	0.05	0.06	0.13	0.17	0.20
CO-309	ExPipeMH-25.2	CB-169	Trapezoidal Channel	Natural Stream	0.002	2.13	0.03	0.05	0.06	0.42	0.47	0.50
CO-306	CB-169	MH-86	Circular Pipe	15 inch	0.008	3.11	1.91	2.68	3.08	2.66	2.85	2.89
CO-307	MH-86	ExCB-23	Trapezoidal Channel	Natural Stream	0.003	12.50	1.90	2.67	3.06	1.11	1.21	1.25
ExPipeCO-23.1	ExCB-23	ExPipeMH-23.1	Circular Pipe	15 inch	0.015	4.35	3.60	4.63	5.30	3.96	4.17	4.66
ExDitchCO-23.2	ExPipeMH-23.1	ExCB-22	Trapezoidal Channel	Natural Stream	0.087	24.86	3.57	4.59	5.26	6.21	6.61	5.93
ExPipeCO-21.1	ExCB-21	ExPipeMH-21.1	Circular Pipe	12 inch	0.024	5.54	1.13	1.42	1.61	5.55	5.91	6.12
ExDitchCO-21.2	ExPipeMH-21.1	ExCB-22	Trapezoidal Channel	Natural Stream	0.034	15.50	1.13	1.42	1.61	3.21	3.43	3.55
ExPipeCO-22.1	ExCB-22	ExCB-18	Circular Pipe	18 inch	0.036	19.91	5.18	6.68	7.66	2.93	3.78	4.33
ExPipeCO-24.1	ExCB-24	ExPipeMH-24.1	Circular Pipe	8 inch	0.002	0.29	0.13	0.17	0.19	0.82	0.86	0.89
CO-308	ExPipeMH-24.1	ExPipeMH-24.2	Trapezoidal Channel	Natural Stream	0.019	5.95	0.13	0.17	0.19	1.31	1.43	1.49
ExPipeCO-24.3	ExPipeMH-24.2	ExPipeMH-24.3	Circular Pipe	8 inch	0.002	0.31	0.13	0.17	0.19	0.85	0.90	0.93
ExDitchCO-24.4	ExPipeMH-24.3	ExPipeMH-24.4	Trapezoidal Channel	Natural Stream	0.022	12.67	0.13	0.17	0.19	1.38	1.50	1.56
ExPipeCO-24.5	ExPipeMH-24.4	ExPipeMH-24.5	Circular Pipe	8 inch	0.004	0.43	0.13	0.17	0.19	1.08	1.15	1.19
ExCO-24.6	ExPipeMH-24.5	ExPipeMH-24.6	Trapezoidal Channel	Natural Stream	0.004	5.45	0.13	0.17	0.19	0.62	0.66	0.68
ExPipeCO-24.7	ExPipeMH-24.6	ExMH-24.7	Circular Pipe	12 inch	0.001	0.70	0.13	0.17	0.19	0.69	0.73	0.76
ExDitchCO-24.8	ExMH-24.7	CB-170	Trapezoidal Channel	Natural Stream	0.005	6.17	0.13	0.17	0.19	0.87	0.93	0.97
ExPipeCO-24.9	CB-170	ExPipeMH-24.9	Circular Pipe	10 inch	0.014	1.42	0.50	0.64	0.73	2.38	2.54	2.62
ExCO-24.10	ExPipeMH-24.9	ExCB-18	Trapezoidal Channel	Natural Stream	0.055	19.81	0.50	0.64	0.73	0.19	0.23	0.27
ExCO-18.1	ExCB-18	ExCB-16	Circular Pipe	18 inch	0.060	25.83	5.78	7.44	8.53	11.78	12.63	13.11

Area E - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
ExPipeCO-15.1	ExCB-15	ExPipeMH-15.1	Circular Pipe	15 inch	0.005	2.35	1.03	1.21	1.31	1.85	1.93	1.97
ExDitchCO-15.2	ExPipeMH-15.1	ExPipeMH-15.2	Trapezoidal Channel	Natural Stream	0.008	7.57	1.03	1.20	1.30	1.86	1.94	1.98
ExPipeCO-15.3	ExPipeMH-15.2	ExPipeMH-15.3	Circular Pipe	15 inch	0.005	2.42	1.00	1.17	1.28	1.88	1.96	2.00
ExCO-15.4	ExPipeMH-15.3	ExCB-16	Trapezoidal Channel	Natural Stream	0.333	24.60	0.99	1.17	1.27	6.73	7.10	7.31
ExPipeCO-16.1	ExCB-16	ExMH-16.1	Circular Pipe	24 inch	0.011	24.08	10.47	13.41	15.34	6.60	6.82	7.00
ToExistingStreamCO-16.2	ExMH-16.1	ExDraintoStreamMH-29.3	Trapezoidal Channel	Natural Stream	0.131	2481.68	10.45	13.39	15.31	7.53	8.24	8.65

AREA F
KY 362 DRAINAGE STUDY

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area F - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
ExPipeCO-67.1	ExCB-67	ExPipeMH-67.1	Circular Pipe	12 inch	0.035	6.64	2.26	2.93	3.38	7.65	8.20	8.49
ExDitchCO-67.2	ExPipeMH-67.1	ExCulvertCB-12	Trapezoidal Channel	Natural Stream	0.027	37.49	2.25	2.93	3.37	2.63	2.81	2.91
ExCO-20.1	ExCB-20	ExMH-20.1	Circular Pipe	12 inch	0.004	2.29	1.73	2.01	2.18	3.20	3.28	3.31
ExCO-20.2	ExMH-20.1	ExPipeMH-11.1	Trapezoidal Channel	Natural Stream	0.056	98.05	1.71	1.99	2.15	3.18	3.31	3.38
CO-410	ExPipeMH-11.1	MH-143	Trapezoidal Channel	Rough Channel	10.697	62003.41	104.49	139.70	162.86	56.50	62.94	66.61
CO-411	MH-143	ExMH-11.2	Irregular Channel	Rough Channel	-3.696	-118410.93	104.47	139.67	162.82	0.64	0.83	0.96
ExPipeCO-19.1	ExCB-19	ExPipeMH-19.1	Circular Pipe	24 inch	-0.002	-10.60	3.83	4.97	5.72	1.71	2.13	2.39
ExDitch to Stream CO-19.2	ExPipeMH-19.1	ExMH-11.2	Trapezoidal Channel	Natural Stream	0.079	406.29	3.76	4.91	5.66	4.33	4.65	4.84

AREA G
KY362 DRAINAGE STUDY

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area G - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
CO-444	CB-194	MH-163	Circular Pipe	15 inch	0.016	4.46	5.41	6.78	7.69	4.74	5.75	6.43
CO-445	MH-163	MH-164	Trapezoidal Channel	Natural Stream	0.018	64.54	5.37	6.75	7.66	3.04	3.23	3.33
CO-446	MH-164	MH-165	Circular Pipe	15 inch	0.020	4.89	5.18	6.54	7.45	4.58	5.57	6.24
CO-447	MH-165	MH-166	Trapezoidal Channel	Natural Stream	0.018	64.62	5.15	6.51	7.42	3.01	3.20	3.31
CO-448	MH-166	MH-167	Circular Pipe	15 inch	0.020	4.89	5.12	6.47	7.38	7.57	5.52	6.19
CO-449	MH-167	MH-168	Trapezoidal Channel	Natural Stream	0.037	87.70	5.10	6.45	7.35	3.92	4.17	4.31
CO-450	MH-168	MH-169	Circular Pipe	15 inch	0.011	3.66	5.02	6.35	7.25	6.08	5.43	6.10
CO-451	MH-169	MH-170	Trapezoidal Channel	Natural Stream	0.016	62.00	5.00	6.33	7.23	2.89	3.08	3.19
CO-452	MH-170	MH-171	Circular Pipe	15 inch	0.017	4.56	4.92	6.25	7.14	7.10	5.35	6.01
CO-453	MH-171	MH-172	Trapezoidal Channel	Natural Stream	0.028	66.68	4.91	6.22	7.11	3.25	3.45	3.58
CO-454	MH-172	MH-173	Circular Pipe	15 inch	0.025	5.56	4.78	6.08	6.97	8.15	5.23	5.88
CO-455	MH-173	ExCB-17	Trapezoidal Channel	Natural Stream	0.348	234.24	4.76	6.05	6.94	0.38	0.04	0.37
ExPipeCO-17.1	ExCB-17	ExCB-17.5	Circular Pipe	15 inch	-0.006	-5.05	2.72	3.10	3.33	2.70	3.01	3.19
ExPipeCO-17.5.1	ExCB-17.5	ExPipeMH-17.5.1	Circular Pipe	15 inch	0.151	25.07	3.55	4.12	4.47	14.45	15.09	15.43
ExDitchtoStreamCO-17.5.2	ExPipeMH-17.5.1	ExMH-28.2	Trapezoidal Channel	Natural Stream	0.119	2363.13	3.53	4.09	4.44	4.84	5.13	5.29

AREA H DRAINAGE STUDY
KY362

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

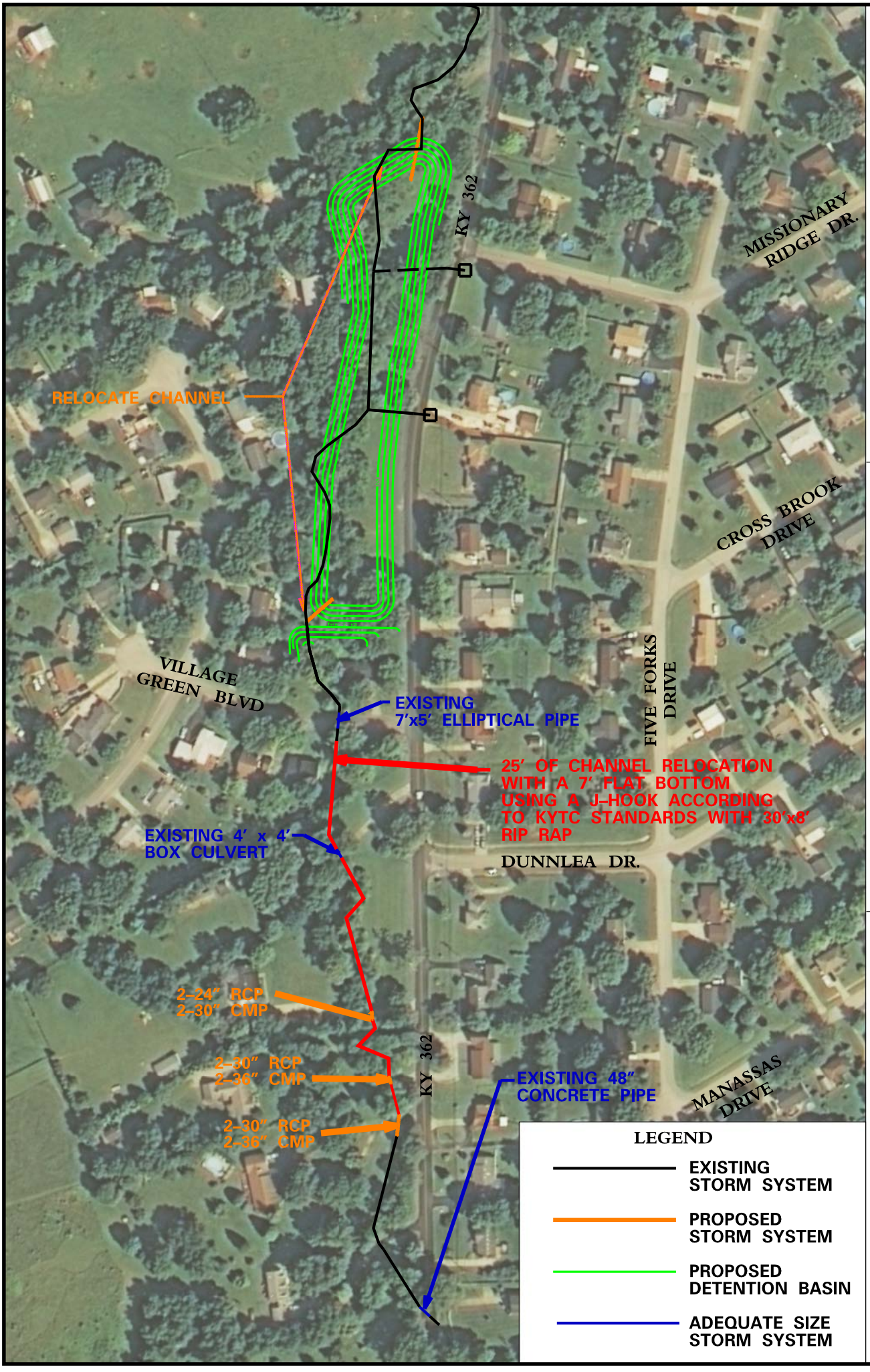
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area H - Existing

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							2 Year	5 Year	10 Year	2 Year	5 Year	10 Year
ExCO-53.1	ExCB-53	ExMH-53.1	Circular Pipe	15 inch	0.041	7.12	1.27	1.63	1.87	4.38	4.71	4.89
ExCO-53.2	ExMH-53.1	ExCB-55	Trapezoidal Channel	Natural Stream	0.092	12.93	1.26	1.63	1.87	4.72	5.10	5.30
ExPipeCO-54.1	ExStructureCB-54	ExPipeMH-54.1	Circular Pipe	12 inch	0.025	5.62	1.54	1.77	1.90	6.10	6.33	6.46
ExDitchCO-54.2	ExPipeMH-54.1	ExCB-55	Trapezoidal Channel	Grass Channel	-0.002	-13.21	1.53	1.76	1.89	0.36	0.40	0.43
ExCO-55.1	ExCB-55	ExMH-55.1	Circular Pipe	15 inch	0.018	4.76	3.42	4.17	4.63	4.22	4.37	4.42
ExCO-55.2	ExMH-55.1	ExCB-14	Trapezoidal Channel	Rough Channel	0.039	297.24	3.40	4.13	4.59	3.69	3.88	3.99

APPENDIX D

PROPOSED ANALYSIS



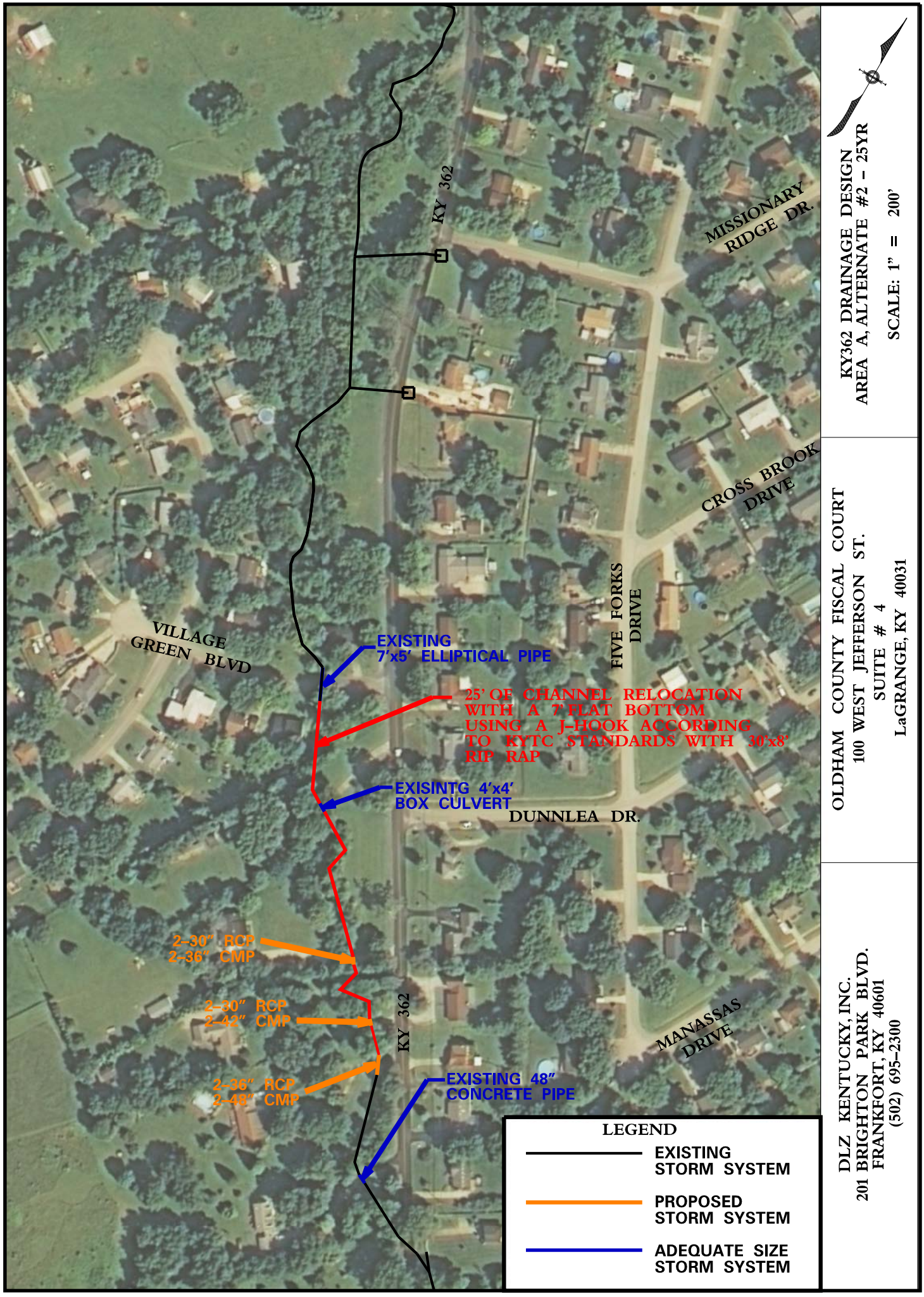
KY362 DRAINAGE STUDY
AREA A, ALTERNATE #1 – 10YR
DETENTION BASIN &
PIPE UPSIZING
SCALE: 1" = 200'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area A - Alternative 1

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	100 Year	10 Year	100 Year
LG CO-2.1	ExPipeMH-14.1	LG CB-2	Trapezoidal Channel	4' road Culvert	0.008	648.22	58.61	78.37	3.93	4.30
LG CO-2.2	LG CB-2	ExCulvertMH-14.3	Rectangular Channel	Natural Stream	0.093	616.22	82.42	112.85	8.09	9.04
ExStreamCO-14.4	ExCulvertMH-14.3	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.009	2065.60	82.37	112.80	5.26	6.68
ExPipeCO-57.1	ExCB-57	ExPipeMH-59.4	Elliptical Pipe	24x38 inch	0.006	32.44	5.97	7.85	4.78	5.20
ExDitchCO-59.5	ExPipeMH-59.4	ExCB-58	Trapezoidal Channel	Natural Stream	0.007	52.86	7.05	9.39	2.13	2.28
ExPipeCO-58.1	ExCB-58	ExPipeMH-58.1	Circular Pipe	18 inch	0.051	23.82	7.76	10.31	12.05	12.99
ExDitchCO-58.2	ExPipeMH-58.1	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.054	145.66	7.76	10.30	4.64	4.99
ExStreamCO-14.5	ExInStreamMH-14.4	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.009	2113.12	86.04	118.47	5.44	6.93
ExCO-61.1	ExCB-61	ExMH-61.1	Circular Pipe	18 inch	0.053	24.11	9.71	13.66	12.91	14.07
ExCO-61.2	ExMH-61.1	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.095	206.40	9.70	13.64	6.03	6.59
CO-353	ExinStreamMH-14.5	OF-6	Trapezoidal Channel	Area 1 detention	5.525	147439.10	90.29	125.29	18.20	20.74
CO-355	LG CB-3	ExMH-14.7	Elliptical Pipe	83x53 inch	0.009	311.04	96.13	127.00	11.55	12.36
CO-336	ExMH-14.7	MH-105	Trapezoidal Channel	Natural Stream	0.011	58.23	96.13	127.00	6.21	4.46
CO-337	MH-105	MH-44	Trapezoidal Channel	Natural Stream	0.011	179.34	96.13	127.00	2.13	2.12
CO-236	MH-44	MH-45	Rectangular Channel	4'x4' Driveway Crossing	0.026	360.16	96.13	127.00	9.90	12.96
CO-249	MH-45	MH-50	Trapezoidal Channel	Natural Stream	0.008	130.44	96.13	127.00	5.35	4.04
CO-253	MH-50	MH-53	Circular Pipe	24 inch (2)	0.052	103.66	92.70	127.00	10.73	16.36
CO-254	MH-53	ExMH-14.8	Trapezoidal Channel	Natural Stream	0.011	137.85	96.13	127.00	3.59	3.63
ExCO-14.9	ExMH-14.8	ExMH-14.9	Circular Pipe	30 inch (2)	0.025	130.87	96.13	127.00	14.57	15.19
ExCO-14.10	ExMH-14.9	ExMH-14.10	Trapezoidal Channel	Natural Stream	0.002	100.68	96.13	127.00	1.45	2.50
ExCO-14.11	ExMH-14.10	ExMH-14.11	Circular Pipe	30 inch (2)	0.029	140.64	96.13	127.00	15.42	16.22
CO-238	ExMH-14.11	MH-46	Trapezoidal Channel	Natural Stream	0.001	236.01	96.13	127.00	1.81	1.94
CO-240	MH-46	MH-47	Circular Pipe	48 inch	0.048	315.78	96.13	127.00	22.05	23.76
CO-241	MH-47	ExCB-13	Trapezoidal Channel	Natural Stream	0.011	323.91	96.13	127.00	4.75	5.10



KY362 DRAINAGE DESIGN
AREA A, ALTERNATE #2 – 25YR

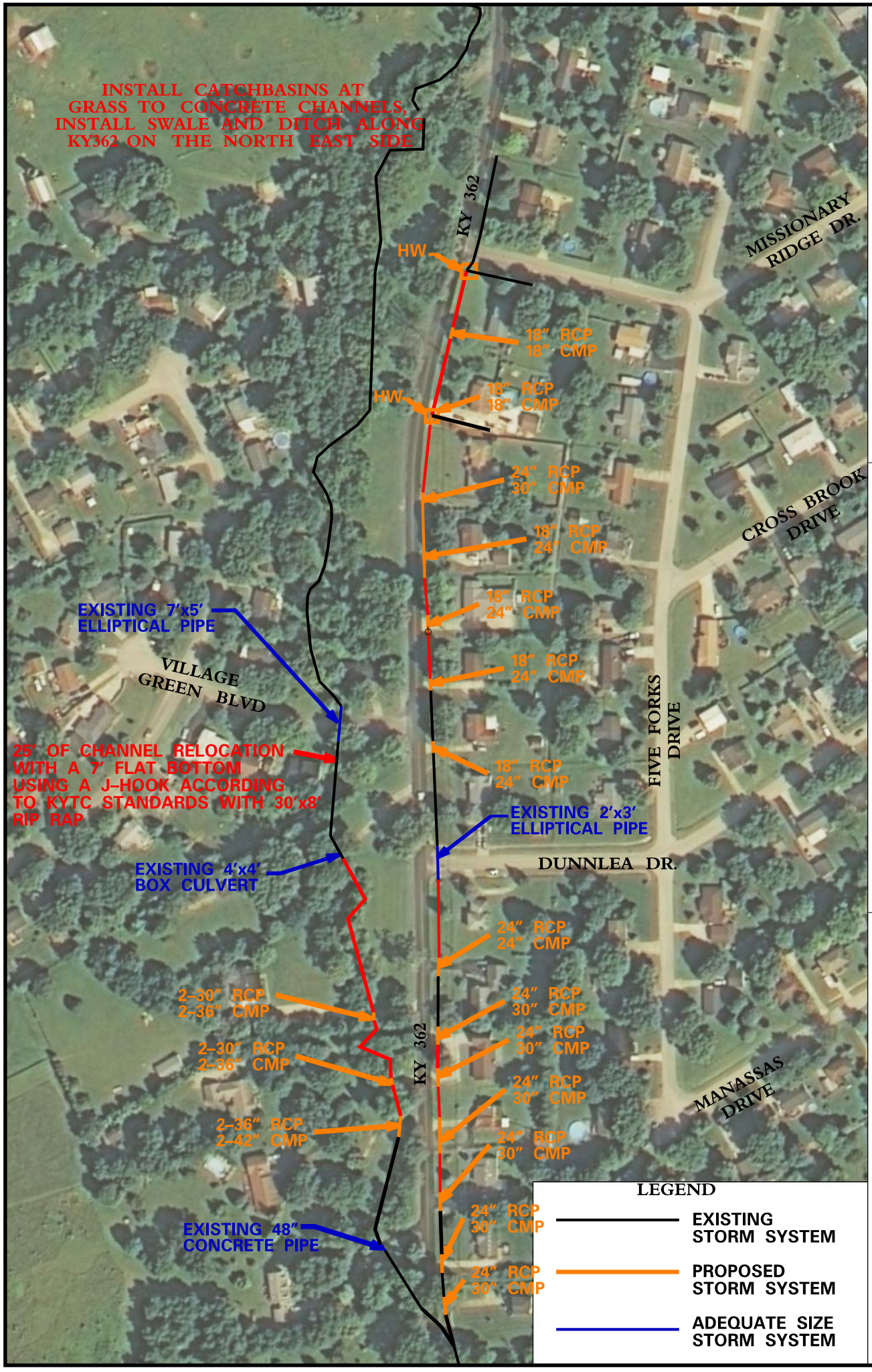
SCALE: 1" = 200'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area A - Alternative 2

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							10 Year	25 Year	100 Year	10 Year	25 Year	100 Year
LG CO-2.1	ExPipeMH-14.1	LG CB-2	Trapezoidal Channel	4' road Culvert	0.008	648.22	58.61	67.13	78.37	3.93	4.10	4.30
LG CO-2.2	LG CB-2	ExCulvertMH-14.3	Rectangular Channel	Natural Stream	0.093	616.22	82.42	95.43	112.85	8.09	8.52	9.04
ExStreamCO-14.4	ExCulvertMH-14.3	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.009	2065.60	82.37	95.38	112.80	5.26	5.89	6.68
ExPipeCO-57.1	ExCB-57	ExPipeMH-59.4	Elliptical Pipe	24x38 inch	0.006	32.440	5.970	6.780	7.850	4.780	4.970	5.200
ExDitchCO-59.5	ExPipeMH-59.4	ExCB-58	Trapezoidal Channel	Natural Stream	0.007	52.86	7.05	8.05	9.39	2.13	2.20	2.28
ExPipeCO-58.1	ExCB-58	ExPipeMH-58.1	Circular Pipe	18 inch	0.051	23.820	7.760	8.850	10.310	12.050	12.490	12.990
ExDitchCO-58.2	ExPipeMH-58.1	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.054	145.66	7.76	8.84	10.30	4.64	4.80	4.99
ExStreamCO-14.5	ExInStreamMH-14.4	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.009	2113.12	86.04	99.93	118.47	5.44	6.10	6.93
ExCO-61.1	ExCB-61	ExMH-61.1	Circular Pipe	18 inch	0.053	24.110	9.710	11.340	13.660	12.910	13.440	14.070
ExCO-61.2	ExMH-61.1	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.095	206.40	9.70	11.33	13.64	6.03	6.28	6.59
ExStreamCO-14.6	ExinStreamMH-14.5	LG CB-3	Trapezoidal Channel	Natural Stream	0.006	1740.69	90.29	105.27	125.29	5.65	6.35	7.22
CO-355	LG CB-3	ExMH-14.7	Elliptical Pipe	83x53 inch	0.009	311.040	105.090	123.430	148.340	11.810	12.270	12.820
CO-336	ExMH-14.7	MH-105	Trapezoidal Channel	Natural Stream	0.011	4.30	104.97	123.30	148.15	3.71	13.80	4.05
CO-337	MH-105	MH-44	Trapezoidal Channel	Natural Stream	0.011	179.340	104.230	123.230	147.060	1.870	2.050	2.450
CO-236	MH-44	MH-45	Rectangular Channel	4'x4' Driveway Crossing	0.026	360.16	103.73	122.68	146.32	12.46	6.88	15.33
CO-249	MH-45	MH-50	Trapezoidal Channel	Natural Stream	0.004	97.640	103.710	122.630	146.290	3.390	4.980	3.700
CO-253	MH-50	MH-53	Circular Pipe	30 inch (2)	0.038	160.61	101.68	120.81	143.72	17.31	17.97	18.50
CO-254	MH-53	ExMH-14.8	Trapezoidal Channel	Natural Stream	0.009	139.260	101.660	120.790	143.700	3.450	3.580	3.760
ExCO-14.9	ExMH-14.8	ExMH-14.9	Circular Pipe	30 inch (2)	0.025	130.87	100.66	119.68	142.45	14.84	15.12	16.13
ExCO-14.10	ExMH-14.9	ExMH-14.10	Trapezoidal Channel	Natural Stream	0.002	121.640	100.640	119.660	142.430	1.500	1.680	1.640
ExCO-14.11	ExMH-14.10	ExMH-14.11	Circular Pipe	36 inch (2)	0.010	131.35	99.77	118.76	141.34	10.31	10.52	11.19
CO-238	ExMH-14.11	MH-46	Trapezoidal Channel	Natural Stream	0.005	388.790	99.690	118.670	141.230	3.500	4.010	3.820
CO-240	MH-46	MH-47	Circular Pipe	48 inch	0.048	315.78	98.43	117.36	139.61	22.24	23.27	23.61
CO-241	MH-47	ExCB-13	Trapezoidal Channel	Natural Stream	0.010	308.550	98.420	117.350	139.590	2.690	4.820	2.940



KY362 DRAINAGE DESIGN
AREA A, ALTERNATE #3 – 25YR
DIRECT EAST FLOW
ALONG KY 362 (EAST) &
PIPE UPSIZE (WEST)
SCALE: 1" = 200'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

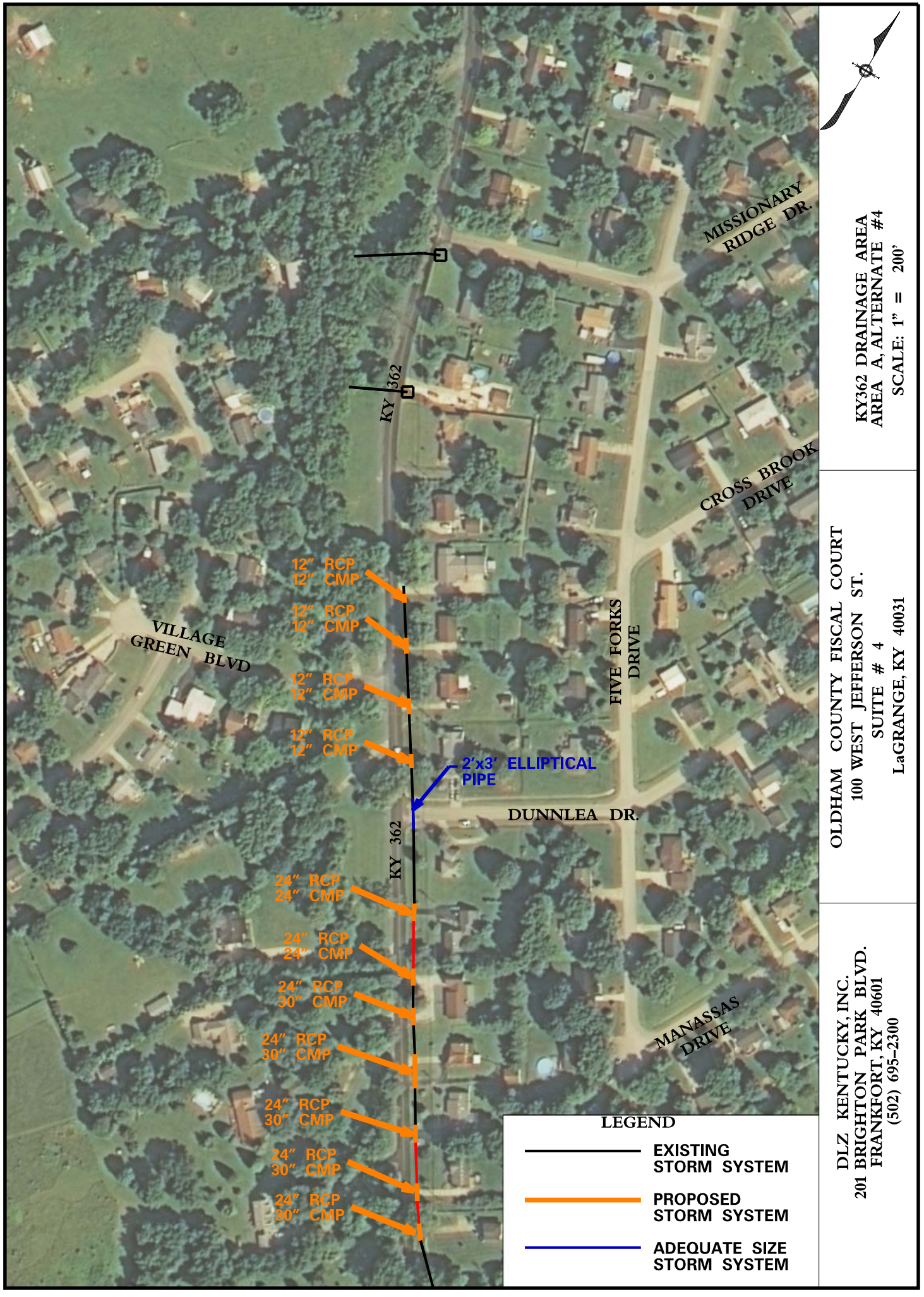
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area A - Alternative 3

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							10 Year	25 Year	100 Year	10 Year	25 Year	100 Year
LG CO-2.1	ExPipeMH-14.1	LG CB-2	Trapezoidal Channel	4' road Culvert	0.008	648.22	58.61	67.13	78.37	3.93	4.10	4.30
LG CO-2.2	LG CB-2	ExCulvertMH-14.3	Rectangular Channel	Natural Stream	0.093	616.22	82.42	95.43	112.85	8.09	8.52	9.04
ExStreamCO-14.4	ExCulvertMH-14.3	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.009	2065.60	82.37	95.38	112.80	5.26	5.89	6.68
ExStreamCO-14.5	ExInStreamMH-14.4	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.009	2113.12	80.58	93.63	111.06	3.81	5.81	6.61
ExStreamCO-14.6	ExinStreamMH-14.5	LG CB-3	Trapezoidal Channel	Natural Stream	0.006	1740.69	79.29	92.32	109.76	5.11	5.74	6.55
CO-355	LG CB-3	ExMH-14.7	Elliptical Pipe	83x53 inch	0.009	311.04	94.05	110.46	132.69	11.49	11.95	12.49
CO-336	ExMH-14.7	MH-105	Trapezoidal Channel	Natural Stream	0.011	136.23	93.94	110.33	132.52	4.13	13.18	4.51
CO-337	MH-105	MH-44	Trapezoidal Channel	Natural Stream	0.011	179.34	93.34	110.27	131.64	1.56	2.04	2.20
CO-236	MH-44	MH-45	Rectangular Channel	4'x4' Driveway Crossing	0.026	360.16	92.88	109.76	131.01	5.21	11.20	13.20
CO-249	MH-45	MH-50	Trapezoidal Channel	Natural Stream	0.005	88.68	92.83	109.74	130.99	4.62	3.49	4.07
CO-253	MH-50	MH-53	Circular Pipe	30 inch (2)	0.030	142.08	91.22	107.69	128.91	15.36	20.15	16.39
CO-254	MH-53	ExMH-14.8	Trapezoidal Channel	Natural Stream	0.009	115.82	91.21	107.67	128.89	3.35	3.50	3.64
ExCO-14.9	ExMH-14.8	ExMH-14.9	Circular Pipe	30 inch (2)	0.025	130.87	90.28	106.65	127.73	14.38	14.86	15.19
ExCO-14.10	ExMH-14.9	ExMH-14.10	Trapezoidal Channel	Natural Stream	0.002	107.37	90.26	106.63	127.70	1.56	1.63	1.60
ExCO-14.11	ExMH-14.10	ExMH-14.11	Circular Pipe	36 inch (2)	0.010	131.35	87.65	105.80	126.70	9.15	10.34	10.58
CO-238	ExMH-14.11	MH-46	Trapezoidal Channel	Natural Stream	0.005	560.63	89.43	103.60	125.43	3.40	10.30	10.58
CO-240	MH-46	MH-47	Circular Pipe	48 inch	0.048	315.78	88.30	104.39	125.11	21.55	22.55	23.67
CO-241	MH-47	ExCB-13	Trapezoidal Channel	Natural Stream	0.010	308.55	88.29	104.37	125.09	4.48	4.85	4.90
ExPipeCO-57.1	ExCB-57	ExPipeMH-59.4	Elliptical Pipe	24x38 inch	0.006	32.44	5.97	6.78	7.85	4.78	4.97	5.20
ExDitchCO-59.5	ExPipeMH-59.4	ExCB-58	Trapezoidal Channel	Natural Stream	0.002	11.87	7.05	8.05	9.39	1.39	2.20	1.49
CO-379	ExCB-58	MH-121	Trapezoidal Channel	Rough Channel	0.001	12.69	8.60	8.85	11.59	1.10	0.94	1.04
CO-381	MH-121	MH-122	Circular Pipe	18 inch	0.034	10.45	8.38	8.59	11.28	6.57	5.79	11.34
CO-383	MH-122	MH-123	Trapezoidal Channel	Rough Channel	0.001	15.45	8.37	8.58	11.27	1.26	0.83	1.24
CO-385	MH-123	MH-124	Circular Pipe	18 inch	0.044	22.01	8.06	8.11	10.86	11.49	12.07	12.42
CO-386	MH-124	ExCB-61	Trapezoidal Channel	Rough Channel	0.002	18.88	8.06	8.10	10.86	1.45	1.02	1.43
CO-387	ExCB-61	MH-125	Trapezoidal Channel	Rough Channel	0.000	22.63	15.55	16.68	21.46	0.92	1.15	1.35
CO-389	MH-125	MH-127	Circular Pipe	24 inch	0.014	26.68	14.78	16.08	20.71	8.71	8.32	8.75
CO-390	MH-127	Res-CB-3	Trapezoidal Channel	Rough Channel	0.001	23.89	14.77	16.07	20.69	1.51	1.41	1.50
CO-282	Res-CB-3	Res-MH-3	Circular Pipe	18 inch	0.037	20.22	15.46	16.88	21.71	12.61	8.16	12.30
CO-285	Res-MH-3	MH-71	Trapezoidal Channel	Natural Stream	0.002	23.08	15.46	16.86	21.70	1.91	1.67	2.08
CO-284	MH-71	ExPipeMH-62.2	Trapezoidal Channel	Rough Channel	0.009	63.28	16.06	17.52	22.47	3.20	2.97	3.18
ExPipeCO-62.3	ExPipeMH-62.2	ExPipeMH-62.3	Circular Pipe	18 inch	0.040	20.91	15.96	17.40	22.33	13.03	8.40	12.65
CO-391	ExPipeMH-62.3	MH-128	Trapezoidal Channel	Rough Channel	0.013	74.40	15.95	17.38	22.31	3.61	2.40	3.58
CO-393	MH-128	MH-129	Circular Pipe	18 inch	0.042	21.59	15.84	17.19	22.16	13.35	10.92	12.55
CO-395	MH-129	MH-130	Trapezoidal Channel	Rough Channel	0.014	76.57	15.83	17.18	22.14	3.68	4.17	3.65
CO-397	MH-130	MH-131	Circular Pipe	18 inch	0.036	19.88	15.71	17.07	21.99	12.47	10.87	12.46
CO-398	MH-131	ExCB-63	Trapezoidal Channel	Rough Channel	0.019	31.62	15.70	17.06	21.97	3.79	4.16	4.12
ExPipeCO-63.1	ExCB-63	ExPipeMH-63.1	Elliptical Pipe	24x38 inch	0.028	68.27	30.85	34.61	43.84	13.36	13.85	14.89
ExDitchCO-63.2	ExPipeMH-63.1	ExPipeMH-63.2	Trapezoidal Channel	Natural Stream	0.001	32.91	30.80	34.57	43.79	1.80	1.99	1.96
ExPipeCO-63.3	ExPipeMH-63.2	ExPipeMH-63.3	Circular Pipe	24 inch	0.067	58.36	30.05	33.86	42.84	18.72	10.08	20.30
ExDitchCO-63.4	ExPipeMH-63.3	ExPipeMH-63.4	Trapezoidal Channel	Natural Stream	0.001	43.82	30.03	33.83	42.81	1.77	4.01	1.94
ExPipeCO-63.5	ExPipeMH-63.4	ExPipeMH-63.5	Circular Pipe	24 inch	0.049	50.22	29.61	33.64	42.20	16.64	10.97	17.91

Area A - Alternative 3

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)			Velocity (Out) (ft/s)		
							10 Year	25 Year	100 Year	10 Year	25 Year	100 Year
ExDitchCO-63.6	ExPipeMH-63.5	ExPipeMH-63.6	Trapezoidal Channel	Natural Stream	0.001	29.88	29.59	33.61	42.17	1.66	2.79	1.81
ExPipeCO-63.7	ExPipeMH-63.6	ExPipeMH-63.7	Circular Pipe	24 inch	0.030	38.96	29.39	33.48	41.87	13.62	9.57	13.35
ExDitchCO-63.8	ExPipeMH-63.7	ExPipeMH-63.8	Trapezoidal Channel	Rough Channel	0.002	69.98	29.37	33.45	41.84	2.05	3.26	2.23
ExPipeCO-63.9	ExPipeMH-63.8	ExPipeMH-63.9	Circular Pipe	24 inch	0.024	34.81	29.17	33.30	41.58	12.41	11.02	13.26
ExDitchCO-63.10	ExPipeMH-63.9	ExPipeMH-63.10	Trapezoidal Channel	Natural Stream	0.002	68.48	29.13	33.25	41.53	2.01	3.87	2.20
ExPipeCO-63.11	ExPipeMH-63.10	ExPipeMH-63.11	Circular Pipe	24 inch	0.039	44.65	28.86	33.09	41.19	15.11	11.44	16.13
ExDitchCO-63.12	ExPipeMH-63.11	ExPipeMH-63.12	Trapezoidal Channel	Natural Stream	0.001	46.93	28.85	33.07	41.17	1.85	3.85	2.02
ExPipeCO-63.14	ExPipeMH-63.12	ExPipeMH-63.14	Circular Pipe	24 inch	0.042	46.59	28.52	32.89	40.76	15.57	12.50	16.72
ExDitchCO-63.15	ExPipeMH-63.14	ExPipeMH-63.15	Trapezoidal Channel	Rough Channel	0.003	83.14	28.50	32.87	40.74	2.31	3.84	2.52
ExPipeCO-63.16	ExPipeMH-63.15	ExPipeMH-63.16	Circular Pipe	24 inch	0.029	38.71	29.57	34.11	42.05	13.57	13.38	13.41
CO-399	ExPipeMH-63.16	MH-120	Trapezoidal Channel	Rough Channel	0.014	188.18	29.55	34.09	42.02	4.30	7.88	4.70



KY362 DRAINAGE AREA
AREA A, ALTERNATE #4
SCALE: 1" = 200'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

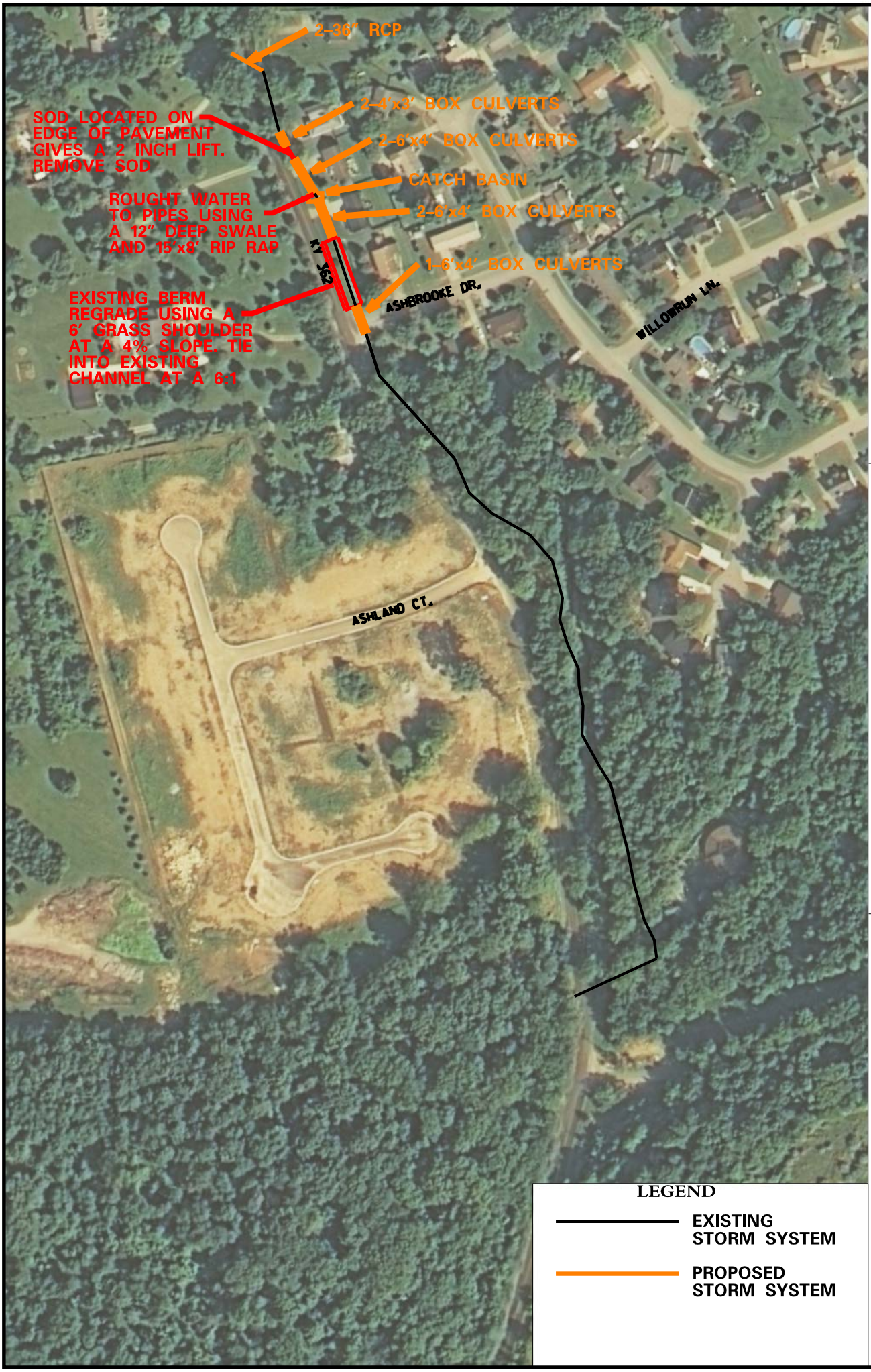
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area A - Alternative 4

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	100 Year	10 Year	100 Year
LG CO-2.1	ExPipeMH-14.1	LG CB-2	Trapezoidal Channel	4' road Culvert	0.008	648.22	58.61	78.37	3.93	4.30
LG CO-2.2	LG CB-2	ExCulvertMH-14.3	Rectangular Channel	Natural Stream	0.093	616.22	82.42	112.85	8.09	9.04
ExStreamCO-14.4	ExCulvertMH-14.3	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.009	2065.60	82.37	112.80	5.26	6.68
ExPipeCO-57.1	ExCB-57	ExPipeMH-59.4	Elliptical Pipe	24x38 inch	0.006	32.44	5.97	7.85	4.78	5.20
ExDitchCO-59.5	ExPipeMH-59.4	ExCB-58	Trapezoidal Channel	Natural Stream	0.007	52.86	7.05	9.39	2.13	2.28
ExPipeCO-58.1	ExCB-58	ExPipeMH-58.1	Circular Pipe	18 inch	0.051	23.82	7.76	10.31	12.05	12.99
ExDitchCO-58.2	ExPipeMH-58.1	ExInStreamMH-14.4	Trapezoidal Channel	Natural Stream	0.054	145.66	7.76	10.30	4.64	4.99
ExStreamCO-14.5	ExInStreamMH-14.4	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.009	2113.12	86.04	118.47	5.44	6.93
ExCO-61.1	ExCB-61	ExMH-61.1	Circular Pipe	18 inch	0.053	24.11	9.71	13.66	12.91	14.07
ExCO-61.2	ExMH-61.1	ExinStreamMH-14.5	Trapezoidal Channel	Natural Stream	0.095	206.40	9.70	13.64	6.03	6.59
ExStreamCO-14.6	ExinStreamMH-14.5	LG CB-3	Trapezoidal Channel	Natural Stream	0.006	1740.69	90.29	125.29	5.65	7.22
CO-355	LG CB-3	ExMH-14.7	Elliptical Pipe	83x53 inch	0.009	311.04	105.09	148.34	11.81	12.82
CO-336	ExMH-14.7	MH-105	Trapezoidal Channel	Natural Stream	0.011	4.30	104.97	148.15	12.91	14.88
CO-337	MH-105	MH-44	Trapezoidal Channel	Natural Stream	0.011	179.34	104.90	148.08	1.75	2.47
CO-236	MH-44	MH-45	Rectangular Channel	4'x4' Driveway Crossing	0.026	360.16	104.41	147.34	16.94	8.27
CO-249	MH-45	MH-50	Trapezoidal Channel	Natural Stream	0.003	111.32	92.00	130.50	6.46	4.70
CO-253	MH-50	MH-53	Box Pipe	24x24 inch (2)	0.055	135.09	75.00	105.80	18.58	17.86
CO-254	MH-53	ExMH-14.8	Trapezoidal Channel	Natural Stream	0.009	181.25	55.90	78.80	8.61	3.41
ExCO-14.9	ExMH-14.8	ExMH-14.9	Circular Pipe	30 inch (2)	0.025	130.87	77.20	108.10	32.15	14.44
ExCO-14.10	ExMH-14.9	ExMH-14.10	Rectangular Channel	Natural Stream	0.002	4.49	102.96	145.71	15.09	18.24
ExCO-14.11	ExMH-14.10	ExMH-14.11	Circular Pipe	36 inch (2)	0.010	131.35	75.30	145.65	26.84	39.50
CO-238	ExMH-14.11	MH-46	Trapezoidal Channel	Natural Stream	0.005	560.63	102.87	107.60	3.53	10.22
CO-240	MH-46	MH-47	Circular Pipe	48 inch	0.048	315.78	101.58	144.01	22.39	24.55
CO-241	MH-47	ExCB-13	Trapezoidal Channel	Natural Stream	0.020	435.24	101.57	143.99	6.00	6.56
ExPipeCO-62.3	ExPipeMH-62.2	ExPipeMH-62.3	Circular Pipe	12 inch	0.020	4.99	1.94	2.63	5.77	6.43
CO-391	ExPipeMH-62.3	MH-128	Trapezoidal Channel	Natural Stream	0.021	33.14	1.94	2.63	2.31	2.49
CO-393	MH-128	MH-129	Circular Pipe	12 inch	0.023	5.40	1.91	2.58	6.08	6.81
CO-395	MH-129	MH-130	Trapezoidal Channel	Natural Stream	0.024	104.11	1.90	2.59	2.37	2.57
CO-397	MH-130	MH-131	Circular Pipe	12 inch	0.023	5.38	1.88	2.54	6.23	6.76
CO-398	MH-131	ExCB-63	Trapezoidal Channel	Natural Stream	0.023	101.84	1.87	2.54	2.32	2.57
ExPipeCO-63.1	ExCB-63	ExPipeMH-63.1	Elliptical Pipe	24x38 inch	0.028	68.27	19.90	28.40	11.61	13.01
ExDitchCO-63.2	ExPipeMH-63.1	ExPipeMH-63.2	Trapezoidal Channel	Natural Stream	0.001	88.42	19.86	28.36	1.43	1.57

Area A - Alternative 4

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	100 Year	10 Year	100 Year
ExPipeCO-63.3	ExPipeMH-63.2	ExPipeMH-63.3	Circular Pipe	30 inch	0.067	106.08	19.19	27.51	16.40	11.36
ExDitchCO-63.4	ExPipeMH-63.3	ExPipeMH-63.4	Trapezoidal Channel	Natural Stream	0.001	80.76	19.17	27.48	1.32	1.45
ExPipeCO-63.5	ExPipeMH-63.4	ExPipeMH-63.5	Circular Pipe	24 inch	0.050	50.58	18.71	26.90	14.89	10.32
ExDitchCO-63.6	ExPipeMH-63.5	ExPipeMH-63.6	Trapezoidal Channel	Natural Stream	0.002	60.93	18.69	26.87	1.74	1.91
ExPipeCO-63.7	ExPipeMH-63.6	ExPipeMH-63.7	Circular Pipe	24 inch	0.028	38.04	18.52	26.66	12.03	8.27
ExDitchCO-63.8	ExPipeMH-63.7	ExPipeMH-63.8	Trapezoidal Channel	Natural Stream	0.001	29.64	18.50	26.62	1.46	1.60
ExPipeCO-63.9	ExPipeMH-63.8	ExPipeMH-63.9	Circular Pipe	24 inch	0.024	35.33	18.25	26.30	11.34	7.77
ExDitchCO-63.10	ExPipeMH-63.9	ExPipeMH-63.10	Trapezoidal Channel	Natural Stream	0.005	64.26	18.21	26.22	2.60	2.85
ExPipeCO-63.11	ExPipeMH-63.10	ExPipeMH-63.11	Circular Pipe	24 inch	0.032	22.06	18.07	25.99	7.83	8.67
ExDitchCO-63.12	ExPipeMH-63.11	ExPipeMH-63.12	Trapezoidal Channel	Natural Stream	0.001	20.85	18.05	25.95	1.44	1.57
ExPipeCO-63.14	ExPipeMH-63.12	ExPipeMH-63.14	Circular Pipe	24 inch	0.044	47.34	17.76	25.53	13.99	9.69
ExDitchCO-63.15	ExPipeMH-63.14	ExPipeMH-63.15	Trapezoidal Channel	Natural Stream	0.001	29.88	17.74	25.51	1.46	1.60
ExPipeCO-63.16	ExPipeMH-63.15	ExPipeMH-63.16	Circular Pipe	24 inch	0.031	39.87	18.96	26.99	12.53	8.60
CO-399	ExPipeMH-63.16	MH-120	Trapezoidal Channel	Rough Channel	0.014	154.19	18.95	26.97	3.51	3.83



KY362 DRAINAGE STUDY
AREA B, ALTERNATE #1
SCALE: 1" = 200'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area B - Alternate 1

							Flow (ft^3/s) Without Grade Change		Velocity (Out) (ft/s) Without Grade Change	
Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	25 Year	100 Year	25 Year	100 Year
CO-344	ExCB-13	CB-183	Trapezoidal Channel	Natural stream	0.003	213	144.08	174.6	3.06	3.22
CO-347	CB-183	MH-110	Circular Pipe	36 inch (2)	0.026	215.41	143.59	174.05	16.31	16.96
CO-346	MH-110	ExMH-63.17	Trapezoidal Channel	Natural Stream	0.024	576.90	163.63	197.88	7.38	7.74
ExCO-63.18	ExMH-63.17	ExCulvertCB-12	Trapezoidal Channel	Natural Stream	0.010	201.83	163.52	197.77	3.99	4.18
ExCO-12.1	ExCulvertCB-12	CxPipeMH-12.1	Box Pipe	4 x 3 ft (2)	0.008	223.44	173.18	209.74	10.44	10.93
CO-338	CB-173	MH-106	Circular Pipe	18 inch	0.029	9.67	3.52	4.24	5.04	5.29
CO-339	MH-106	CxPipeMH-12.1	Trapezoidal Channel	Natural Stream	0.158	33.57	3.51	4.24	7.70	8.11
ExDitchCO-12.2	CxPipeMH-12.1	ExPipeMH-12.2	Trapezoidal Channel	Natural Stream	0.053	471.53	175.42	212.51	7.22	7.57
ExPipeCO-12.3	ExPipeMH-12.2	ExPipeMH-12.3	Box Pipe	6 x 4 ft (2)	0.001	204.90	175.29	212.36	4.93	5.77
ExDitchCO-12.4	ExPipeMH-12.3	ExPipeMH-12.4	Trapezoidal Channel	Natural Stream	0.047	540.08	174.71	211.59	11.26	11.83
ExPipeCO-12.5	ExPipeMH-12.4	ExPipeMH-12.5	Box Pipe	6 x 4 ft (2)	0.008	568.80	174.68	211.56	10.24	10.86
ExCO-12.6	ExPipeMH-12.5	ExCB-11	Trapezoidal Channel	Natural Stream	0.043	873.59	174.38	211.22	6.63	6.96
ExPipeCO-11.1	ExCB-11	ExPipeMH-11.1	Box Pipe	6 x 4 ft (1)	0.008	272.46	191.56	232.42	12.47	13.11
CO-410	ExPipeMH-11.1	MH-143	Trapezoidal Channel	Rough Channel	10.697	62003.41	192.64	233.63	70.82	75.99
CO-411	MH-143	ExMH-11.2	Irregular Channel	Rough Channel	0.019	8395.84	2.20	2.70	4.88	5.19
Ex CO-11.3	ExMH-11.2	Stream CB-1	Irregular Channel	Natural Stream	0.025	128800.27	179.97	221.39	3.44	3.65
CO-223	Stream CB-1	LG CB-12	Trapezoidal Channel	Natural Stream	0.018	2307.79	781.37	952.11	10.58	11.18
CO-222	LG CB-12	ExPipeMH-9.1	Rectangular Channel	Natural Stream	0.003	443.18	784.47	955.98	7.72	8.90

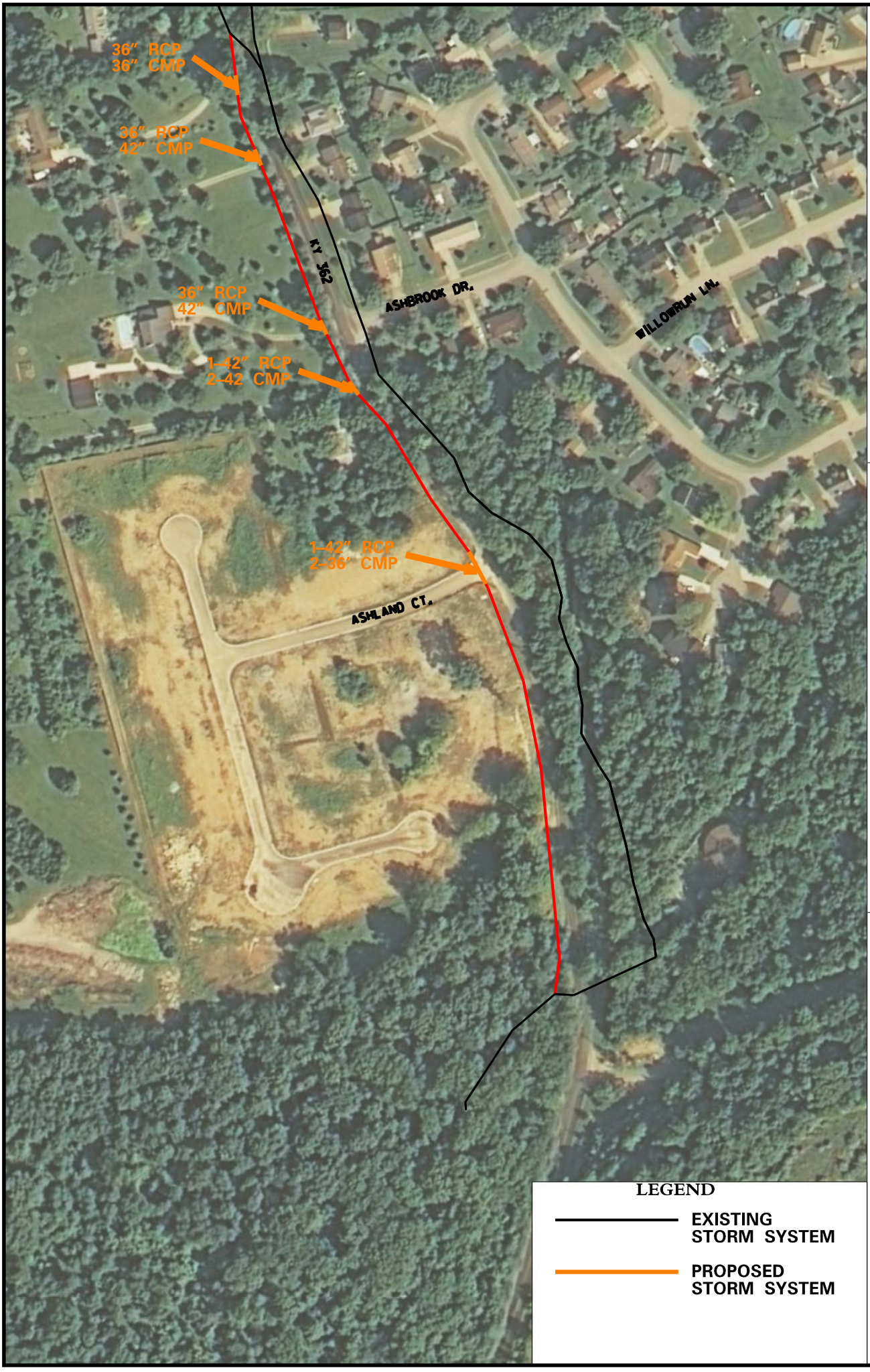
KY362 DRAINAGE STUDY
AREA B, ALTERNATE #2 – 25YR
PIPE UPSIZING
COMPLETE GRADE CHANGE
SCALE: 1" = 200'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area B - Alternate 2

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s) 25 Year	Velocity (Out) (ft/s) 25 Year
CO-344	ExCB-13	CB-183	Trapezoidal Channel	Natural stream	0.003	145.83	141.66	4.14
CO-347	CB-183	MH-110	Circular Pipe	36 inch (2)	0.026	215.41	141.19	19.99
CO-346	MH-110	ExMH-63.17	Trapezoidal Channel	Natural Stream	0.002	184.82	157.13	2.69
ExCO-63.18	ExMH-63.17	ExCulvertCB-12	Trapezoidal Channel	Natural Stream	0.005	167.02	156.89	2.88
ExCO-12.1	ExCulvertCB-12	CxPipeMH-12.1	Circular Pipe	36 inch (2)	0.033	243.53	165.92	16.81
CO-338	CB-173	MH-106	Circular Pipe	18 inch	0.029	9.67	3.52	5.04
CO-339	MH-106	CxPipeMH-12.1	Trapezoidal Channel	Natural Stream	0.147	32.38	3.51	7.51
ExDitchCO-12.2	CxPipeMH-12.1	ExPipeMH-12.2	Trapezoidal Channel	Natural Stream	0.005	219.89	168.12	2.85
ExPipeCO-12.3	ExPipeMH-12.2	ExPipeMH-12.3	Circular Pipe	36 inch (2)	0.028	223.7	167.84	15.82
ExDitchCO-12.4	ExPipeMH-12.3	ExPipeMH-12.4	Trapezoidal Channel	Natural Stream	0.025	665.25	167.68	7.79
ExPipeCO-12.5	ExPipeMH-12.4	ExPipeMH-12.5	Circular Pipe	36 inch	0.026	213.9	167.64	15.3
ExCO-12.6	ExPipeMH-12.5	ExCB-11	Trapezoidal Channel	Natural Stream	0.029	398.79	167.47	5.62
ExPipeCO-11.1	ExCB-11	ExPipeMH-11.1	Circular Pipe	36 inch (3)	0.018	267.88	183.94	13.61
CO-410	ExPipeMH-11.1	MH-143	Trapezoidal Channel	Rough Channel	0.023	6403.38	178.59	8.83
CO-411	MH-143	ExMH-11.2	Trapezoidal Channel	Rough Channel	0.024	6530.8	185.73	9.06
Ex CO-11.3	ExMH-11.2	Stream CB-1	Irregular Channel	Natural Stream	0.025	128800.27	188.64	3.49
CO-223	Stream CB-1	LG CB-12	Trapezoidal Channel	Natural Stream	0.018	2307.79	781.37	10.58
CO-222	LG CB-12	ExPipeMH-9.1	Rectangular Channel	Natural Stream	0.003	443.18	784.47	7.72



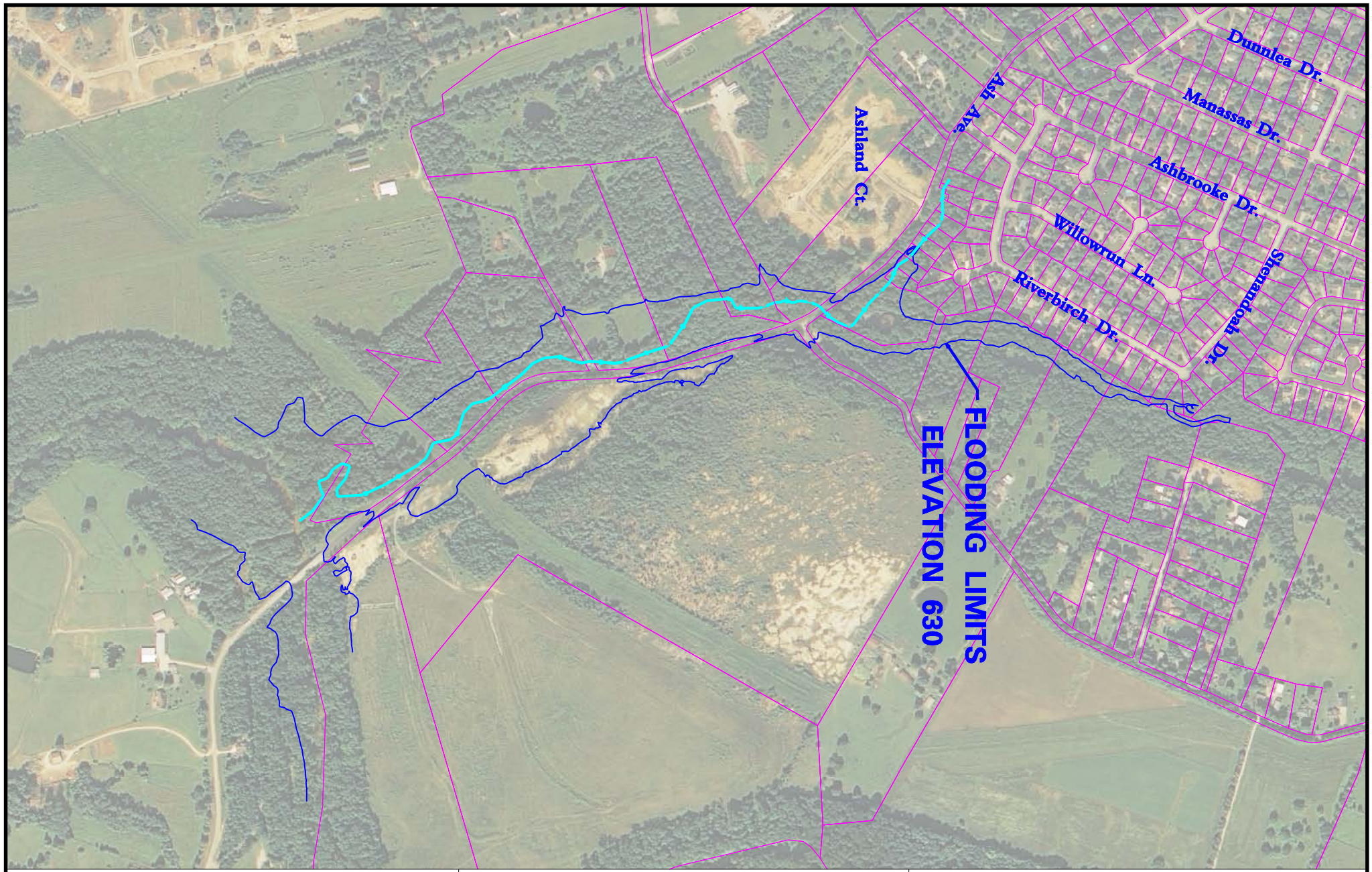
KY362 DRAINAGE STUDY
AREA B ALTERNATE
SCALE: 1" = 200'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area B - Alternate 3

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							25 Year	100 Year	25 Year	100 Year
CO-373	MH-120	MH-110	Trapezoidal Channel	Natural Stream	0.076	1028.99	39.84	97.21	8.00	10.00
CO-346	MH-110	ExMH-63.17	Trapezoidal Channel	Natural Stream	0.024	576.90	39.83	97.20	5.18	6.48
ExCO-63.18	ExMH-63.17	ExCulvertCB-12	Trapezoidal Channel	Natural Stream	0.010	201.83	39.77	97.13	2.77	3.49
ExCO-12.1	ExCulvertCB-12	CxPipeMH-12.1	Circular Pipe	36 inch	0.008	32.61	53.92	109.21	8.06	8.15
ExDitchCO-12.2	CxPipeMH-12.1	ExPipeMH-12.2	Trapezoidal Channel	Natural Stream	0.053	471.53	53.85	109.11	5.36	6.40
ExPipeCO-12.3	ExPipeMH-12.2	ExPipeMH-12.3	Circular Pipe	36 inch	-0.003	-57.48	53.78	109.02	3.26	4.60
ExDitchCO-12.4	ExPipeMH-12.3	ExPipeMH-12.4	Trapezoidal Channel	Natural Stream	0.079	695.40	53.33	108.55	9.94	12.00
ExPipeCO-12.5	ExPipeMH-12.4	ExPipeMH-12.5	Circular Pipe	36 inch	0.008	66.33	53.32	108.53	5.22	8.11
ExCO-12.6	ExPipeMH-12.5	ExCB-11	Trapezoidal Channel	Natural Stream	0.043	873.59	53.08	108.28	4.91	5.88
ExPipeCO-11.1	ExCB-11	ExPipeMH-11.1	Elliptical Pipe	48x60 inch	0.008	169.50	77.03	129.14	10.47	12.07
CO-410	ExPipeMH-11.1	MH-143	Trapezoidal Channel	Rough Channel	0.025	3012.12	78.64	130.40	7.12	8.31
CO-411	MH-143	ExMH-11.2	Trapezoidal Channel	Rough Channel	0.074	5166.89	78.41	130.15	10.25	12.07
Ex CO-11.3	ExMH-11.2	Stream CB-1	Irregular Channel	Natural Stream	0.015	100330.50	83.19	134.28	2.30	2.65
CO-223	Stream CB-1	LG CB-12	Trapezoidal Channel	Natural Stream	0.018	2307.79	700.55	892.94	10.27	10.99
CO-222	LG CB-12	ExPipeMH-9.1	Rectangular Channel	Natural Stream	0.003	443.18	703.76	896.89	7.13	8.51
CO-344	ExCB-13	CB-183	Trapezoidal Channel	Natural Stream	0.004	148.93	131.83	96.03	3.73	3.44
CO-429	CB-183	MH-156	Circular Pipe	36 inch	0.138	134.43	131.47	95.75	21.68	20.65
CO-430	MH-156	CB-173	Trapezoidal Channel	Natural Stream	0.001	147.22	131.44	95.73	2.51	2.22
CO-431	CB-173	MH-157	Circular Pipe	36 inch	0.078	186.58	131.82	96.96	28.62	16.28
CO-432	MH-157	MH-144	Trapezoidal Channel	Natural Stream	0.001	193.84	131.79	96.93	2.34	2.16
CO-417	MH-144	MH-145	Circular Pipe	36 inch	0.081	189.76	128.50	94.15	28.84	16.49
CO-418	MH-145	MH-146	Trapezoidal Channel	Natural Stream	0.003	217.73	128.48	94.13	3.34	3.09
CO-419	MH-146	MH-147	Circular Pipe	42 inch Concrete	0.020	142.28	127.73	93.53	16.73	9.83
CO-420	MH-147	MH-148	Trapezoidal Channel	Natural Stream	0.003	157.70	127.69	93.48	3.32	3.07
CO-421	MH-148	MH-149	Trapezoidal Channel	Natural Stream	0.012	337.78	126.80	92.79	5.86	5.41
CO-422	MH-149	MH-150	Trapezoidal Channel	Natural Stream	0.032	552.70	126.39	92.46	8.45	7.80
CO-423	MH-150	MH-151	Circular Pipe	36 inch Concrete	0.035	251.03	126.06	92.20	17.77	18.17
CO-424	MH-151	MH-152	Trapezoidal Channel	Natural Stream	0.001	152.92	125.90	92.09	2.31	2.14
CO-425	MH-152	MH-153	Trapezoidal Channel	Natural Stream	0.035	835.26	124.38	90.89	8.67	8.00
CO-426	MH-153	MH-154	Trapezoidal Channel	Natural Stream	0.014	519.53	124.14	90.70	6.08	5.62
CO-427	MH-154	MH-155	Trapezoidal Channel	Natural Stream	0.066	793.41	123.42	90.14	10.99	10.13
CO-428	MH-155	ExPipeMH-9.1	Trapezoidal Channel	Natural Stream	0.065	784.08	122.97	89.77	10.88	10.03

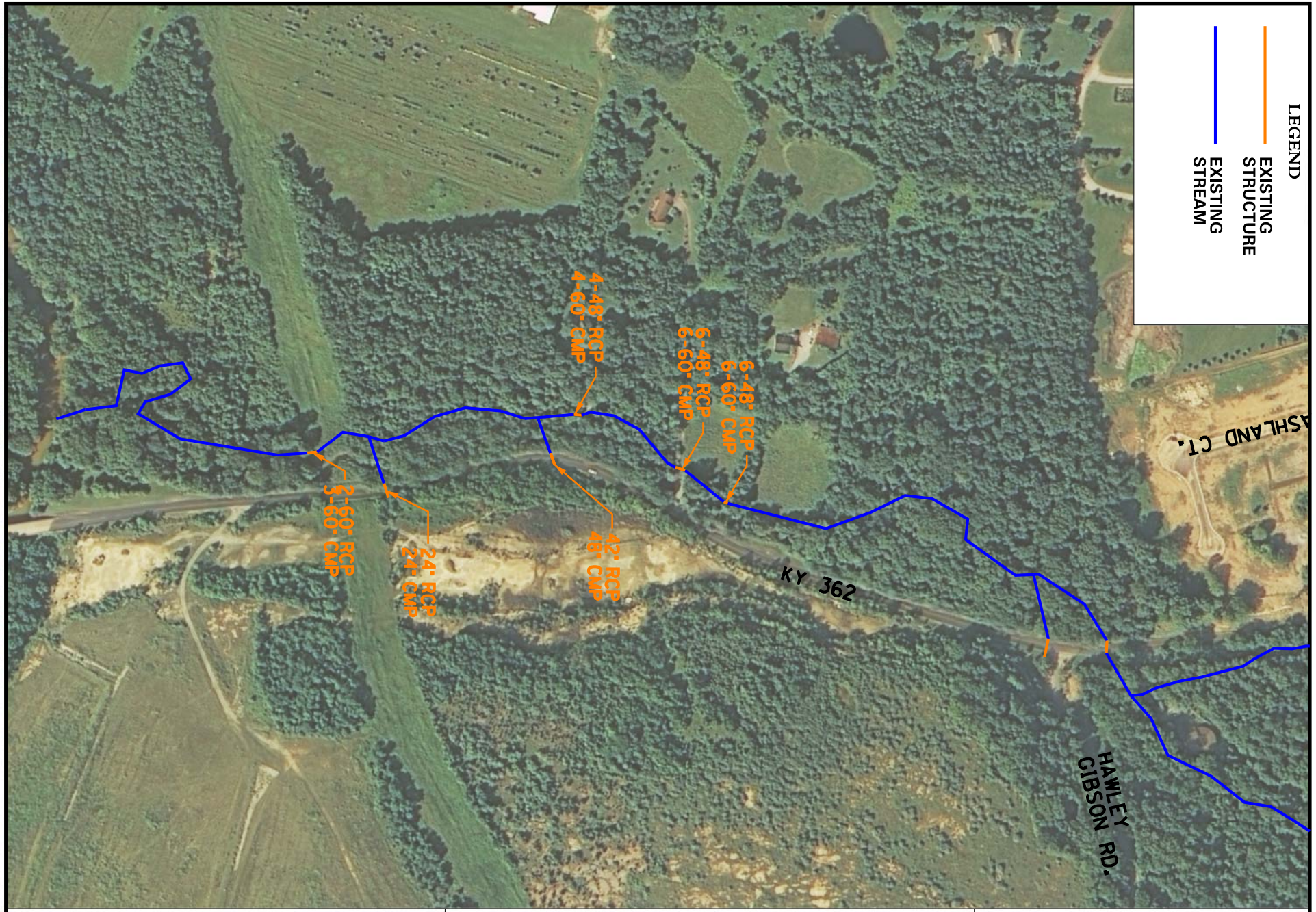


DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695–2300

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

KY 362 DRAINAGE STUDY
PROPOSED SOULUTION C–1
FLOODING LIMITS

SCALE: 1" = 600'



DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
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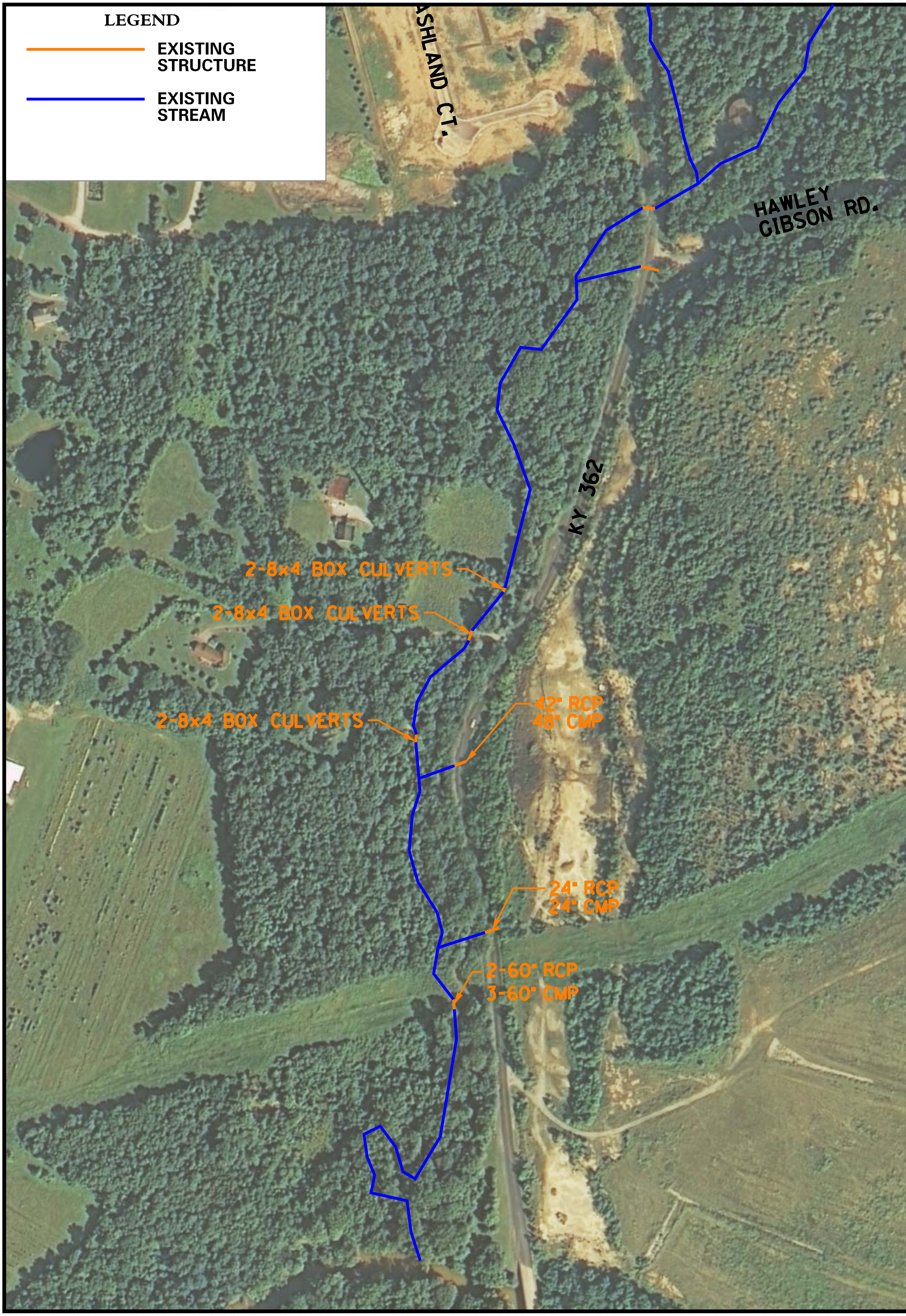
OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

AREA C, ALTERNATE 2
KY 362 DRAINAGE STUDY

Area C - Alternative 2

							Flow (ft^3/s)		Velocity (Out) (ft/s)	
Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	25 Year	100 Year	25 Year	100 Year
CO-222	LG CB-12	ExPipeMH-9.1	Rectangular Channel	Natural Stream	0.003	969.47	784.47	955.98	3.81	4.10
CO-434	ExPipeMH-9.1	MH-159	Irregular Channel	Natural Stream	0.019	54811.07	783.63	954.94	7.73	6.79
CO-435	MH-159	ExStreamMH-9.2	Irregular Channel	Natural Stream	0.004	48307.00	783.04	954.05	2.65	0.51
ExPipeCO-8.1	ExCB-8	ExSomethingMH-8.1	Circular Pipe	30 inch	0.042	84.50	50.61	60.98	17.99	18.75
ExDitchCO-8.2	ExSomethingMH-8.1	ExStreamMH-9.2	Trapezoidal Channel	Natural Stream	0.032	1747.30	50.55	60.91	4.33	4.36
CO-440	ExStreamMH-9.2	ExCB-7	Irregular Channel	Natural Stream	0.001	8975.53	792.92	869.24	1.69	2.09
ExPipesCO-7.1	ExCB-7	ExPipeMH-7.1	Circular Pipe	48 inch (6)	0.010	861.81	769.12	858.03	40.80	45.52
ExCO-7.2	ExPipeMH-7.1	ExCB-6	Trapezoidal Channel	Natural Stream	0.005	872.52	769.10	858.01	6.96	7.47
ExCO-6.1	ExCB-6	ExPipeMH-6.1	Circular Pipe	48 inch (6)	0.011	912.06	773.01	862.78	15.46	17.21
ExDitchCO-6.2	ExPipeMH-6.1	ExCB-5	Trapezoidal Channel	Natural Stream	0.005	787.19	772.85	862.63	7.33	7.87
ExPipeCO-5.1	ExCB-5	ExPipeMH-5.1	Circular Pipe	48 inch (4)	0.023	874.32	772.99	863.64	27.34	30.55
ExDitchCO-5.2	ExPipeMH-5.1	ExPipeMH-5.2	Trapezoidal Channel	Natural Stream	0.059	2633.96	772.92	863.57	11.07	11.43
ExPipeCO-4.1	ExCB-4	ExPipeMH-4.1	Circular Pipe	42 inch	0.064	255.39	170.28	205.04	28.42	29.01
ExDitchCO-4.2	ExPipeMH-4.1	ExPipeMH-5.2	Trapezoidal Channel	Natural Stream	0.038	861.60	170.16	204.87	8.87	9.34
ExStreamCO-5.3	ExPipeMH-5.2	ExStreamMH-5.3	Irregular Channel	Natural Stream	0.005	2722.21	822.88	919.63	2.84	2.96
ExPipeCO-2.1	ExCB-2	ExPipeMH-2.1	Circular Pipe	24 inch	0.072	60.56	27.58	32.85	18.14	18.59
ExDitchCO-2.2	ExPipeMH-2.1	ExStreamMH-5.3	Trapezoidal Channel	Natural Stream	0.063	329.46	27.53	32.85	6.80	7.11
ExStreamCO-5.4	ExStreamMH-5.3	ExCB-3	Trapezoidal Channel	Natural Stream	0.017	1831.62	811.03	908.62	9.64	9.92
ExPipeCO-3.1	ExCB-3	ExMH-3.1	Circular Pipe	60 inch (2)	0.040	1041.71	812.77	973.70	29.34	24.81
ExStreamCO-3.2	ExMH-3.1	ExStreamOutletCB-1	Irregular Channel	Natural Stream	0.001	2381.68	812.69	973.57	1.95	3.33
ExStreamCO-1.1	ExStreamOutletCB-1	ExOF-1	Trapezoidal Channel	Natural Stream	0.004	710.23	769.47	885.09	0.02	0.25



AREA C, ALTERNATE 3
KY 362 DRAINAGE STUDY

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area C - Alternate 3

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							25 Year	100 Year	25 Year	100 Year
Area B-Diverges										
CO-223	Stream CB-1	LG CB-12	Trapezoidal Channel	Natural stream	0.018	2,307.79	781.37		10.58	
Area C										
CO-222 (Diverge)	LG CB-12	ExPipeMH-9.1	Rectangular Channel	Natural Stream	0.003	621.22	518.77	599.13	3.09	4.09
CO-434	ExPipeMH-9.1	MH-159	Irregular Channel	Natural Stream	0.019	1902.06	518.22	598.49	7.61	8.01
CO-439 (Diverge)	LG CB-12	MH-160	Trapezoidal Channel	Natural Stream	-0.048	-790.38	265.70	356.84	7.91	7.91
CO-438	MH-160	MH-158	Box Pipe	5 x 5 ft	0.003	360.99	265.70	356.84	7.91	8.41
CO-436	MH-158	MH-159	Trapezoidal Channel	Natural Stream	0.023	1806.78	265.58	356.67	8.88	9.58
CO-435	MH-159	ExStreamMH-9.2	Irregular Channel	Natural Stream	0.004	48307.71	783.04	954.18	0.42	0.51
ExPipeCO-8.1	ExCB-8	ExSomethingMH-8.1	Circular Pipe	30 inch	0.042	84.50	50.61	60.98	17.99	18.75
ExDitchCO-8.2	ExSomethingMH-8.1	ExStreamMH-9.2	Trapezoidal Channel	Natural Stream	0.032	1747.30	50.55	60.91	4.07	4.36
CO-440	ExStreamMH-9.2	ExCB-7	Irregular Channel	Natural Stream	0.002	53643.21	698.79	869.36	1.97	2.09
ExPipesCO-7.1	ExCB-7	ExPipeMH-7.1	Box Pipe	8 x 4 ft (2)	0.010	886.18	688.95	858.14	15.78	16.77
ExCO-7.2	ExPipeMH-7.1	ExCB-6	Trapezoidal Channel	Natural Stream	0.005	690.15	688.90	858.08	6.47	7.47
ExCO-6.1	ExCB-6	ExPipeMH-6.1	Box Pipe	8 x 4 ft (2)	0.011	937.85	692.41	862.85	16.46	17.50
ExDitchCO-6.2	ExPipeMH-6.1	ExCB-5	Trapezoidal Channel	Natural Stream	0.005	506.57	692.29	862.70	6.82	7.87
ExPipeCO-5.1	ExCB-5	ExPipeMH-5.1	Box Pipe	8 x 4 ft (2)	0.023	1348.57	692.42	863.71	21.24	22.70
ExDitchCO-5.2	ExPipeMH-5.1	ExPipeMH-5.2	Trapezoidal Channel	Natural Stream	0.059	2633.96	692.35	863.63	10.73	11.43
ExPipeCO-4.1	ExCB-4	ExPipeMH-4.1	Circular Pipe	42 inch (2)	0.064	255.39	170.28	205.04	28.42	29.01
ExDitchCO-4.2	ExPipeMH-4.1	ExPipeMH-5.2	Trapezoidal Channel	Natural Stream	0.038	861.60	170.16	204.87	8.87	9.34
ExStreamCO-5.3	ExPipeMH-5.2	ExStreamMH-5.3	Irregular Channel	Natural Stream	0.005	2722.21	737.16	919.69	2.74	2.96
ExPipeCO-2.1	ExCB-2	ExPipeMH-2.1	Circular Pipe	21 inch	0.072	42.42	27.58	32.85	18.77	19.47
ExDitchCO-2.2	ExPipeMH-2.1	ExStreamMH-5.3	Trapezoidal Channel	Natural Stream	0.063	329.46	27.53	32.85	6.80	7.11
ExStreamCO-5.4	ExStreamMH-5.3	ExCB-3	Trapezoidal Channel	Natural Stream	0.008	1270.53	727.70	908.68	7.13	7.54
ExPipeCO-3.1	ExCB-3	ExMH-3.1	Circular Pipe	60 inch (2)	0.039	1025.31	728.97	910.33	28.34	29.50
ExStreamCO-3.2	ExMH-3.1	ExStreamOutletCB-1	Trapezoidal Channel	Natural Stream	0.002	935.48	728.90	910.24	2.79	2.95

Area C - Alternate 3

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							25 Year	100 Year	25 Year	100 Year
ExStreamCO-1.1	ExStreamOutletCB-1	ExOF-1	Trapezoidal Channel	Natural Stream	0.004	710.23	705.15	881.24	0.02	0.24

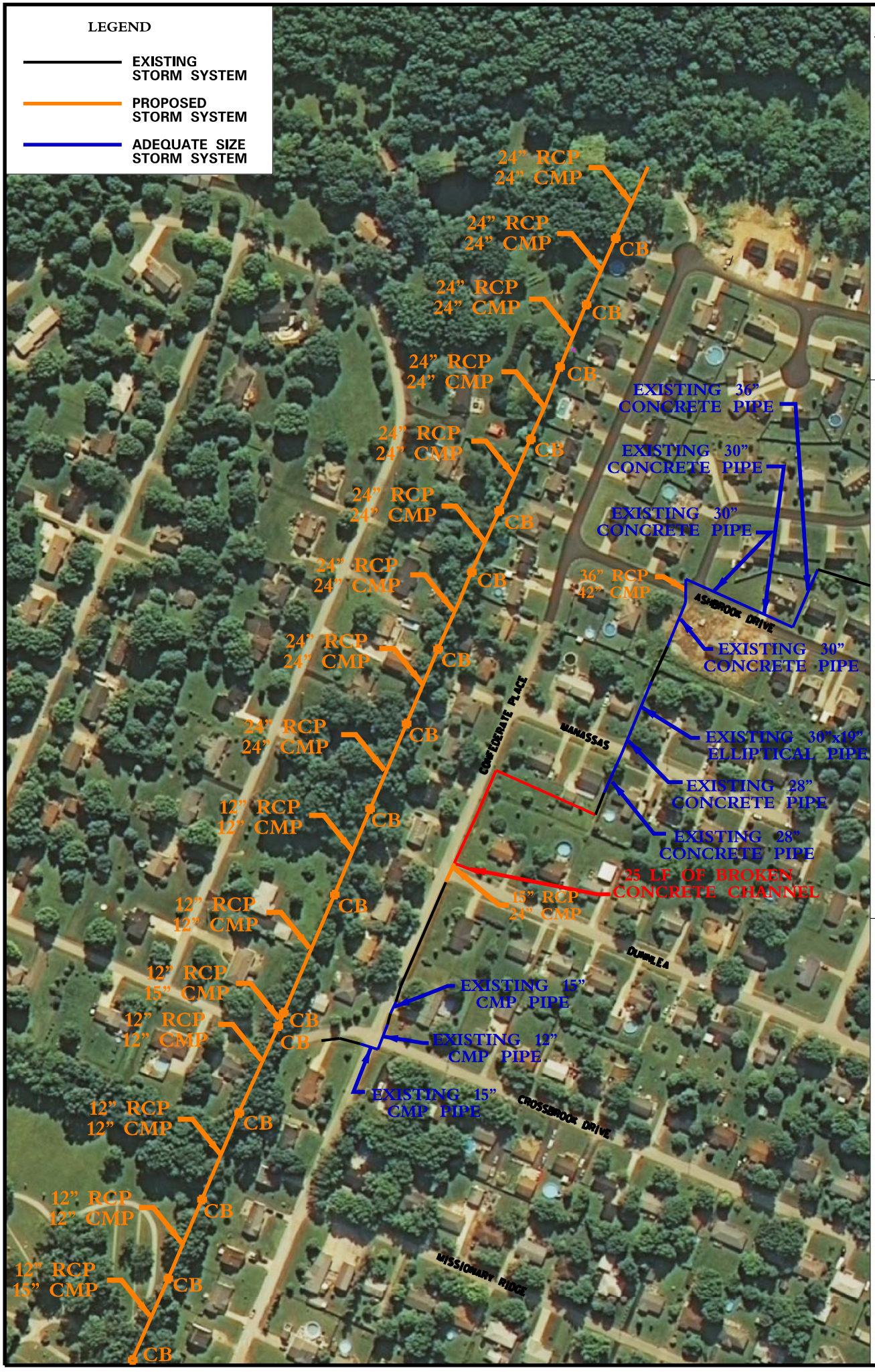
KY 362 DRAINAGE STUDY
AREA D, ALTERNATE 1
SCALE: 1" = 250'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area D - Alternative 1

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	25 Year	10 Year	25 Year
CO-317	MH-93	MH-94	Circular Pipe	18 inch	0.012	6.15	5.05	5.91	3.88	3.96
CO-318	MH-94	ExCB-46.1	Trapezoidal Channel	Grass Channel	0.016	4.46	5.04	5.90	6.67	7.27
ExPipeCO-46.1	ExCB-46.1	ExPipeMH-46.1	Circular Pipe	21 inch	0.018	11.58	8.33	9.78	5.24	5.40
ExDitchCO-46.2	ExPipeMH-46.1	ExCB-47	Trapezoidal Channel	Natural Stream	0.046	11.25	8.30	9.75	4.17	4.34
ExPipeCO-47.1	ExCB-47	ExPipeMH-47.1	Circular Pipe	15 inch	0.023	9.90	8.73	10.23	9.10	8.39
ExDitchCO-47.2	ExPipeMH-47.1	ExPipeMH-47.2	Trapezoidal Channel	Natural Stream	0.023	62.09	8.71	10.21	3.46	3.60
ExPipeCO-47.3	ExPipeMH-47.2	ExPipeMH-47.3	Circular Pipe	18 inch	0.024	8.89	8.67	10.16	5.73	6.02
ExDitchCO-47.4	ExPipeMH-47.3	ExCB-44	Trapezoidal Channel	Natural Stream	0.034	41.72	8.65	10.14	4.01	4.17
ExPipeCO-44.1	ExCB-44	ExPipeMH-44.1	Circular Pipe	21 inch	0.008	14.39	9.78	11.39	6.43	6.63
ExDitchCO-44.2	ExPipeMH-44.1	ExPipeMH-44.2	Trapezoidal Channel	Grass Channel	0.027	29.66	10.61	12.37	2.85	2.97
CO-320	Ex-for Proposed Area CB-7	Ex-for Proposed Area CB-8	Trapezoidal Channel	Grass Channel	0.041	7.09	0.78	0.91	2.32	2.43
CO-321	Ex-for Proposed Area CB-8	MH-95	Trapezoidal Channel	Grass Channel	0.007	38.30	30.53	35.86	2.24	2.34
CO-322	MH-95	MH-96	Circular Pipe	30 inch	0.006	32.99	30.53	35.89	7.63	7.67
CO-323	MH-96	ExCB-45	Trapezoidal Channel	Natural Stream	0.018	11.44	30.42	35.75	14.49	15.54
ExPipeCO-45.1	ExCB-45	ExPipeMH-44.2	Circular Pipe	30 inch	0.023	61.75	33.75	39.67	12.86	13.35
CO-325	ExPipeMH-44.2	MH-97	Trapezoidal Channel	Natural Stream	0.009	50.66	42.62	49.96	4.04	4.21
CO-326	MH-97	ExCB-46	Trapezoidal Channel	Natural Stream	0.004	46.57	41.63	48.86	2.74	3.65
ExPipeCO-46.1	ExCB-46	ExPipeMH-46.1	Circular Pipe	36 inch	0.014	77.91	46.97	55.19	11.53	11.96
ExDitchCO-46.2	ExPipeMH-46.1	ExCB-40	Trapezoidal Channel	Natural Stream	0.019	118.78	46.85	55.06	4.94	5.15
ExPipeCO-40.1	ExCB-40	EXMH-40.1	Circular Pipe	36 inch	0.013	74.74	51.23	60.21	11.39	11.76
ExDitchCO-40.2	EXMH-40.1	ExPipeMH-40.2	Trapezoidal Channel	Natural Stream	0.050	493.87	51.16	60.13	7.23	7.53
ExPipeCO-40.3	ExPipeMH-40.2	ExPipeMH-40.3	Circular Pipe	36 inch	0.013	76.47	51.14	60.12	11.59	11.98
ExDitchCO-40.4	ExPipeMH-40.3	DetentionMH-40.5	Trapezoidal Channel	Natural Stream	0.056	246.41	51.01	59.96	8.26	8.61
ExDitchCO-40.6	DetentionMH-40.5	ExCB-38	Trapezoidal Channel	Natural Stream	0.002	118.88	66.12	77.64	2.41	2.51
ExPipeCO-38.1	ExCB-38	ExCB-34	Circular Pipe	36 inch	0.016	84.85	66.16	77.69	9.36	10.99
ExCO-34.1	ExCB-34	ExCB-34.5	Circular Pipe	42 inch	0.007	83.91	66.35	77.94	6.90	8.10
ExCO-34.5.1	ExCB-34.5	ExPipeMH-34.5.1	Circular Pipe	42 inch	0.010	101.69	66.54	78.19	11.27	11.66
ExCO-34.5.2	ExPipeMH-34.5.1	ExCB-40.5	Circular Pipe	42 inch	0.010	101.69	67.15	78.93	6.98	8.20
ExPipeCO-40.5.1	ExCB-40.5	ExMH-40.5.1	Circular Pipe	36 inch	0.019	91.69	69.37	81.45	14.26	14.65
ExStreamCO-40.5.2	ExMH-40.5.1	ExStreamMH-40.5.2	Trapezoidal Channel	Natural Stream	0.029	237.25	69.19	81.25	6.87	7.17
ExStreamCO-40.5.3	ExStreamMH-40.5.2	ExMH-28.2	Trapezoidal Channel	Natural Stream	0.063	348.38	69.40	81.53	9.09	9.50



KY 362 DRAINAGE STUDY
AREA D, ALTERNATE 2
SCALE: 1" = 250'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

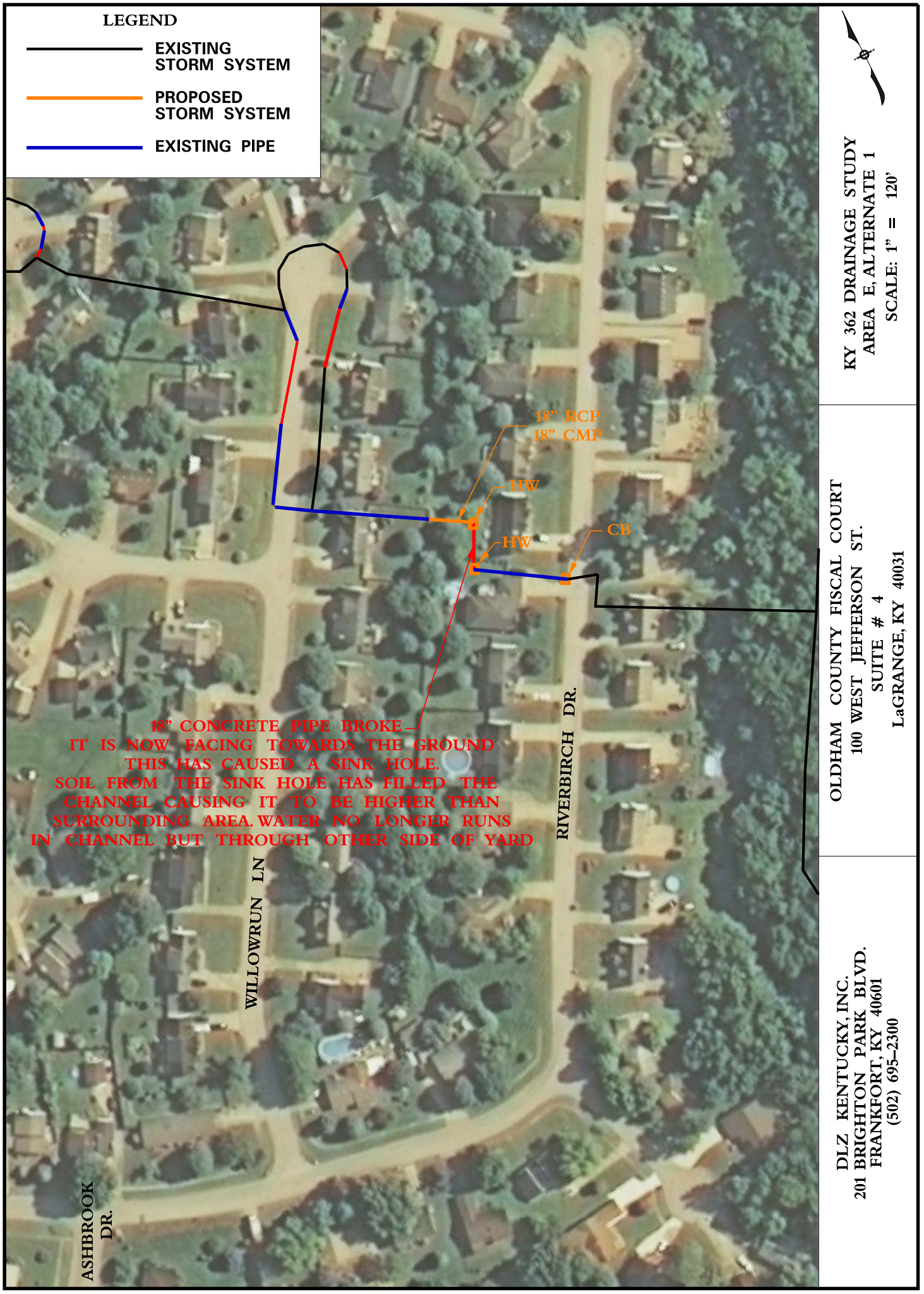
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area D - Alternative 2

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	25 Year	10 Year	25 Year
ExPipeCO-46.1	ExCB-46.1	ExPipeMH-46.1	Circular Pipe	15 inch	0.018	4.72	3.57	4.18	4.23	4.34
ExDitchCO-46.2	ExPipeMH-46.1	ExCB-47	Trapezoidal Channel	Natural Stream	0.046	11.18	3.55	4.17	3.87	4.08
ExPipeCO-47.1	ExCB-47	ExPipeMH-47.1	Circular Pipe	12 inch	0.023	5.46	3.98	4.65	7.58	7.80
ExDitchCO-47.2	ExPipeMH-47.1	ExPipeMH-47.2	Trapezoidal Channel	Natural Stream	0.023	62.09	3.97	4.64	2.83	2.94
ExPipeCO-47.3	ExPipeMH-47.2	ExPipeMH-47.3	Circular Pipe	15 inch	0.024	5.47	3.95	4.61	4.85	4.99
ExDitchCO-47.4	ExPipeMH-47.3	ExCB-44	Trapezoidal Channel	Natural Stream	0.034	41.72	3.94	4.60	3.28	3.42
ExPipeCO-44.1	ExCB-44	ExPipeMH-44.1	Circular Pipe	15 inch	0.008	5.87	5.16	5.95	5.39	5.14
ExDitchCO-44.2	ExPipeMH-44.1	ExPipeMH-44.2	Trapezoidal Channel	Grass Channel	0.027	11.58	5.99	6.93	2.32	2.41
CO-322	MH-95	MH-96	Circular Pipe	15 inch	0.004	3.96	0.00	0.00	0.00	0.00
CO-323	MH-96	ExCB-45	Trapezoidal Channel	Natural Stream	0.018	11.44	0.00	0.00	0.00	0.00
ExPipeCO-45.1	ExCB-45	ExPipeMH-44.2	Circular Pipe	15 inch	0.023	9.72	5.27	6.13	8.08	8.38
CO-325	ExPipeMH-44.2	MH-97	Trapezoidal Channel	Grass Channel	0.009	16.19	9.70	11.35	2.02	2.11
CO-326	MH-97	ExCB-46	Trapezoidal Channel	Concrete 3' FB	0.004	16.43	9.19	10.76	3.71	3.87
ExPipeCO-46.1	ExCB-46	ExPipeMH-46.1	Circular Pipe	28 inch	0.014	39.86	15.52	18.28	8.74	9.12
ExDitchCO-46.2	ExPipeMH-46.1	ExCB-40	Trapezoidal Channel	Natural Stream	0.019	118.78	15.46	18.21	3.71	3.88
ExPipeCO-40.1	ExCB-40	EXMH-40.1	Elliptical Pipe	19x30 inch	0.013	24.44	20.20	23.83	9.05	9.26
ExDitchCO-40.2	EXMH-40.1	ExPipeMH-40.2	Trapezoidal Channel	Natural Stream	0.050	493.87	20.16	23.79	5.68	5.93
ExPipeCO-40.3	ExPipeMH-40.2	ExPipeMH-40.3	Circular Pipe	28 inch	0.013	39.12	20.15	23.78	9.22	9.59
ExDitchCO-40.4	ExPipeMH-40.3	DetentionMH-40.5	Trapezoidal Channel	Natural Stream	0.033	189.80	10.60	12.50	1.80	5.59
ExDitchCO-40.6	DetentionMH-40.5	ExCB-38	Trapezoidal Channel	Natural Stream	0.097	784.04	4.70	5.50	8.53	8.89
ExPipeCO-38.1	ExCB-38	ExCB-34	Circular Pipe	30 inch	0.016	52.18	31.66	38.24	6.45	7.79
ExCO-34.1	ExCB-34	ExCB-34.5	Circular Pipe	30 inch	0.007	34.21	31.99	38.55	6.52	7.85
ExCO-34.5.1	ExCB-34.5	ExPipeMH-34.5.1	Circular Pipe	30 inch	0.010	41.46	32.26	38.86	9.34	9.60
ExCO-34.5.2	ExPipeMH-34.5.1	ExCB-40.5	Circular Pipe	30 inch	0.010	41.46	32.98	39.71	6.72	8.09
ExPipeCO-40.5.1	ExCB-40.5	ExMH-40.5.1	Circular Pipe	36 inch	0.019	91.69	35.23	42.29	12.12	12.71
ExStreamCO-40.5.2	ExMH-40.5.1	ExStreamMH-40.5.2	Trapezoidal Channel	Natural Stream	0.029	237.25	35.14	42.17	5.71	6.00
ExStreamCO-40.5.3	ExStreamMH-40.5.2	ExMH-28.2	Trapezoidal Channel	Natural Stream	0.063	348.38	35.90	43.05	7.56	7.96
Proposed CO-1	Proposed CB-1	Proposed CB-2	Circular Pipe	12 inch	0.002	2.07	1.29	1.44	2.15	2.24
Proposed CO-2	Proposed CB-2	Proposed CB-3	Circular Pipe	12 inch	0.024	7.13	1.51	1.70	1.92	2.16
Proposed CO-3	Proposed CB-3	Proposed CB-4	Circular Pipe	12 inch	0.059	11.26	1.86	2.09	2.49	2.69
Proposed CO-4	Proposed CB-4	Proposed CB-5	Circular Pipe	12 inch	0.027	7.61	2.16	2.43	2.78	3.10
Proposed CO-5	Proposed CB-5	Proposed CB-6	Circular Pipe	12 inch	0.005	3.29	2.13	2.41	2.83	3.08
Proposed CO-6	Proposed CB-6	Proposed CB-7	Circular Pipe	12 inch	0.020	6.51	2.60	2.93	3.31	3.73
Proposed CO-7	Proposed CB-7	Proposed CB-8	Circular Pipe	12 inch	0.040	9.24	2.72	3.08	3.46	3.92
Proposed CO-8	Proposed CB-8	Proposed CB-9	Circular Pipe	18 inch	0.005	9.68	8.34	9.11	4.72	5.15
Proposed CO-9	Proposed CB-9	Proposed CB-10	Circular Pipe	18 inch	0.005	9.69	8.56	9.38	4.85	5.31
Proposed CO-10	Proposed CB-10	Proposed CB-11	Circular Pipe	18 inch	0.005	9.69	8.56	9.40	4.84	5.32
Proposed CO-11	Proposed CB-11	Proposed CB-12	Circular Pipe	18 inch	0.005	9.66	8.48	9.33	4.80	5.28
Proposed CO-12	Proposed CB-12	Proposed CB-13	Circular Pipe	18 inch	0.005	9.64	8.59	9.46	4.86	5.35
Proposed CO-13	Proposed CB-13	Proposed CB-14	Circular Pipe	18 inch	0.024	21.24	8.65	9.55	4.90	5.40
Proposed CO-14	Proposed CB-14	Proposed CB-15	Circular Pipe	18 inch	0.040	27.26	8.84	9.77	5.00	5.53
Proposed CO-15	Proposed CB-15	Proposed CB-16	Circular Pipe	18 inch	0.053	31.38	9.03	9.99	5.11	5.65

Area D - Alternative 2

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	25 Year	10 Year	25 Year
Proposed CO-16	Proposed CB-16	Ex-for Proposed Area CB-16	Circular Pipe	18 inch	0.152	53.30	9.36	10.37	22.71	23.37
Existing for Proposed area CO-16	Ex-for Proposed Area CB-16	LG CB-18	Trapezoidal Channel	Natural Stream	0.056	149.13	12.85	14.35	5.37	5.52


LEGEND
EXISTING STORM SYSTEM
PROPOSED STORM SYSTEM
EXISTING PIPE
18" RCP
18" CMP
HW
HW
CB
18" CONCRETE PIPE BROKE — IT IS NOW FACING TOWARDS THE GROUND THIS HAS CAUSED A SINK HOLE. SOIL FROM THE SINK HOLE HAS FILLED THE CHANNEL CAUSING IT TO BE HIGHER THAN SURROUNDING AREA. WATER NO LONGER RUNS IN CHANNEL BUT THROUGH OTHER SIDE OF YARD
RIVERBIRCH DR.
WILLOWRUN LN
ASHBROOK DR.
KY 362 DRAINAGE STUDY
AREA E, ALTERNATE 1
SCALE: 1" = 120'
OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300

Area E - Alternative 1

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	100 Year	10 Year	100 Year
ExPipeCO-27.1	ExCB-27	ExPipeMH-27.1	Circular Pipe	15 inch	0.006	2.76	1.00	1.38	2.07	2.25
ExDitchCO-27.2	ExPipeMH-27.1	ExPipeMH-27.2	Trapezoidal Channel	Natural Stream	0.007	7.07	1.00	1.38	1.76	1.90
ExPipeCO-27.3	ExPipeMH-27.2	ExMH-27.3	Circular Pipe	15 inch	0.016	4.46	1.00	1.38	2.93	3.20
ExDitchCO-27.4	ExMH-27.3	ExPipeMH-27.4	Trapezoidal Channel	Natural Stream	0.012	9.25	1.00	1.38	2.15	2.33
ExPipeCO-27.5	ExPipeMH-27.4	ExPipeMH-27.5	Circular Pipe	15 inch	0.003	1.79	1.00	1.38	1.50	1.61
ExDitchCO-27.6	ExPipeMH-27.5	ExCB-25	Trapezoidal Channel	Natural Stream	0.171	34.94	1.00	1.38	0.76	0.88
ExPipeCO-26.1	ExCB-26	ExCB-25	Circular Pipe	15 inch	0.056	8.26	0.79	0.97	0.68	0.79
ExPipeCO-25.1	ExCB-25	ExPipeMH-25.1	Circular Pipe	12 inch	0.038	6.95	2.07	2.71	7.72	8.30
CO-305	ExPipeMH-25.1	CB-169	Trapezoidal Channel	Natural Stream	0.021	6.24	2.07	2.71	3.84	4.55
ExPipeCO-25.6	ExPipeMH-25.4	CB-168	Circular Pipe	10 inch	0.022	1.77	0.07	0.09	0.22	0.29
ExCO-25.4	ExPipeMH-25.3	ExPipeMH-25.4	Trapezoidal Channel	Natural Stream	0.030	14.63	0.07	0.09	0.18	0.24
ExPipeCO-25.3	ExPipeMH-25.2	ExPipeMH-25.3	Circular Pipe	10 inch	0.013	2.51	0.06	0.09	0.20	0.29
CO-309	ExPipeMH-25.2	CB-169	Trapezoidal Channel	Natural Stream	0.002	2.13	0.06	0.09	0.50	0.59
CO-306	CB-169	MH-86	Circular Pipe	15 inch	0.008	3.11	3.08	4.19	2.89	3.20
CO-307	MH-86	ExCB-23	Trapezoidal Channel	Natural Stream	0.003	12.50	3.06	4.18	1.25	1.36
ExPipeCO-23.1	ExCB-23	ExPipeMH-23.1	Circular Pipe	15 inch	0.015	4.35	5.30	7.38	4.66	6.19
ExDitchCO-23.2	ExPipeMH-23.1	ExCB-22	Trapezoidal Channel	Natural Stream	0.087	24.86	5.26	7.33	5.93	7.18
ExPipeCO-21.1	ExCB-21	ExPipeMH-21.1	Circular Pipe	12 inch	0.024	5.54	1.61	2.21	6.12	6.66
ExDitchCO-21.2	ExPipeMH-21.1	ExCB-22	Trapezoidal Channel	Natural Stream	0.034	15.50	1.61	2.21	3.55	3.86
ExPipeCO-22.1	ExCB-22	ExCB-18	Circular Pipe	18 inch	0.036	19.91	7.66	10.73	4.33	6.07
ExPipeCO-24.1	ExCB-24	ExPipeMH-24.1	Circular Pipe	8 inch	0.002	0.29	0.19	0.26	0.89	0.95
CO-308	ExPipeMH-24.1	ExPipeMH-24.2	Trapezoidal Channel	Natural Stream	0.019	5.95	0.19	0.26	1.49	1.66
ExPipeCO-24.3	ExPipeMH-24.2	ExPipeMH-24.3	Circular Pipe	8 inch	0.002	0.31	0.19	0.26	0.93	0.99
ExDitchCO-24.4	ExPipeMH-24.3	ExPipeMH-24.4	Trapezoidal Channel	Natural Stream	0.022	12.67	0.19	0.26	1.56	1.75
ExPipeCO-24.5	ExPipeMH-24.4	ExPipeMH-24.5	Circular Pipe	8 inch	0.004	0.43	0.19	0.26	1.19	1.28
ExCO-24.6	ExPipeMH-24.5	ExPipeMH-24.6	Trapezoidal Channel	Natural Stream	0.004	5.45	0.19	0.26	0.68	0.74
ExPipeCO-24.7	ExPipeMH-24.6	ExMH-24.7	Circular Pipe	12 inch	0.001	0.70	0.19	0.26	0.76	0.83
ExDitchCO-24.8	ExMH-24.7	CB-170	Trapezoidal Channel	Natural Stream	0.005	6.17	0.19	0.26	0.97	1.08
ExPipeCO-24.9	CB-170	ExPipeMH-24.9	Circular Pipe	10 inch	0.014	1.42	0.73	1.01	2.62	2.82
ExCO-24.10	ExPipeMH-24.9	ExCB-18	Trapezoidal Channel	Natural Stream	0.055	19.81	0.73	1.01	0.27	0.37

Area E - Alternative 1

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	100 Year	10 Year	100 Year
ExCO-18.1	ExCB-18	ExCB-16	Circular Pipe	18 inch	0.060	25.83	8.53	11.91	13.11	14.32
ExPipeCO-15.1	ExCB-15	ExPipeMH-15.1	Circular Pipe	15 inch	0.005	2.35	1.31	1.60	1.97	2.06
ExDitchCO-15.2	ExPipeMH-15.1	ExPipeMH-15.2	Trapezoidal Channel	Natural Stream	0.008	7.57	1.30	1.59	1.98	2.69
ExPipeCO-15.3	ExPipeMH-15.2	ExPipeMH-15.3	Circular Pipe	15 inch	0.005	2.42	1.28	1.56	2.00	2.10
ExCO-15.4	ExPipeMH-15.3	ExCB-16	Trapezoidal Channel	Natural Stream	0.333	24.60	1.27	1.55	7.31	7.80
ExPipeCO-16.1	ExCB-16	ExMH-16.1	Circular Pipe	24 inch	0.011	24.08	15.34	21.32	7.00	7.68
ToExistingStreamCO-16.2	ExMH-16.1	ExDraintoStreamMH-29.3	Trapezoidal Channel	Natural Stream	0.131	2481.68	15.31	21.29	8.65	9.73

KY 362 DRAINAGE STUDY
PROPOSED SOLUTION
F–1 THROUGH F–3
SCALE: 1" = 150'

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695–2300

Area F - Alternate 1

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	25 Year	10 Year	25 Year
ExPipeCO-67.1	ExCB-67	ExPipeMH-67.1	Circular Pipe	12 inch	0.035	6.64	3.38	3.95	8.49	8.82
ExDitchCO-67.2	ExPipeMH-67.1	ExCulvertCB-12	Trapezoidal Channel	Natural Stream	0.027	37.49	3.37	3.94	2.91	3.03
CO-346	MH-110	ExMH-63.17	Trapezoidal Channel	Natural Stream	0.024	576.90	138.61	164.22	7.09	7.39
ExCO-63.18	ExMH-63.17	ExCulvertCB-12	Trapezoidal Channel	Natural Stream	0.010	201.83	138.52	164.12	3.82	3.99
Area B Intercept Flow										
ExCO-12.1	ExCulvertCB-12	CxPipeMH-12.1	Circular Pipe	36 inch	0.008	65.22	146.43	173.71	10.56	12.39
ExDitchCO-12.2	CxPipeMH-12.1	ExPipeMH-12.2	Trapezoidal Channel	Natural Stream	0.053	471.53	148.28	175.95	6.92	7.22
ExPipeCO-12.3	ExPipeMH-12.2	ExPipeMH-12.3	Circular Pipe	36 inch	-0.003	-19.16	148.17	175.82	20.97	24.88
ExDitchCO-12.4	ExPipeMH-12.3	ExPipeMH-12.4	Trapezoidal Channel	Natural Stream	0.079	695.40	148.05	175.71	13.02	13.61
ExPipeCO-12.5	ExPipeMH-12.4	ExPipeMH-12.5	Circular Pipe	36 inch	0.008	33.17	148.02	175.68	20.95	24.86
ExCO-12.6	ExPipeMH-12.5	ExCB-11	Trapezoidal Channel	Natural Stream	0.043	873.59	147.89	175.55	6.36	6.64
ExPipeCO-11.1	ExCB-11	ExPipeMH-11.1	Elliptical Pipe	48x60 inch	0.008	169.50	162.11	192.70	12.49	12.48
Area F										
CO-462	CB-199	CB-196	Trapezoidal Channel	Natural Stream	0.012	72.34	12.00	12.00	2.92	2.92
CO-459	CB-196	CB-197	Trapezoidal Channel	Natural Stream	0.026	108.72	12.00	12.00	1.16	1.16
CO-460	CB-198	CB-197	Trapezoidal Channel	Natural Stream	0.015	54.49	3.00	3.00	2.49	2.49
CO-461	CB-197	ExCB-20	Circular Pipe	18 inch	0.022	15.44	15.00	15.00	9.95	9.95
ExCO-20.1	ExCB-20	ExMH-20.1	Circular Pipe	15 inch	0.004	4.14	17.18	17.37	14.00	14.16
ExCO-20.2	ExMH-20.1	ExPipeMH-11.1	Trapezoidal Channel	Natural Stream	0.056	98.05	17.17	17.37	5.78	5.80
Area B Intercept Flow										
CO-410	ExPipeMH-11.1	MH-143	Trapezoidal Channel	Rough Channel	10.697	62003.41	178.07	208.75	68.83	72.93
CO-411	MH-143	ExMH-11.2	Irregular Channel	Rough Channel	-3.696	-118410.93	178.03	208.71	1.04	1.20
ExPipeCO-19.1	ExCB-19	ExPipeMH-19.1	Circular Pipe	24 inch	0.046	48.31	5.72	6.69	10.33	10.81
ExDitch to Stream CO-19.2	ExPipeMH-19.1	ExMH-11.2	Trapezoidal Channel	Natural Stream	0.079	406.29	5.71	6.68	4.85	5.06

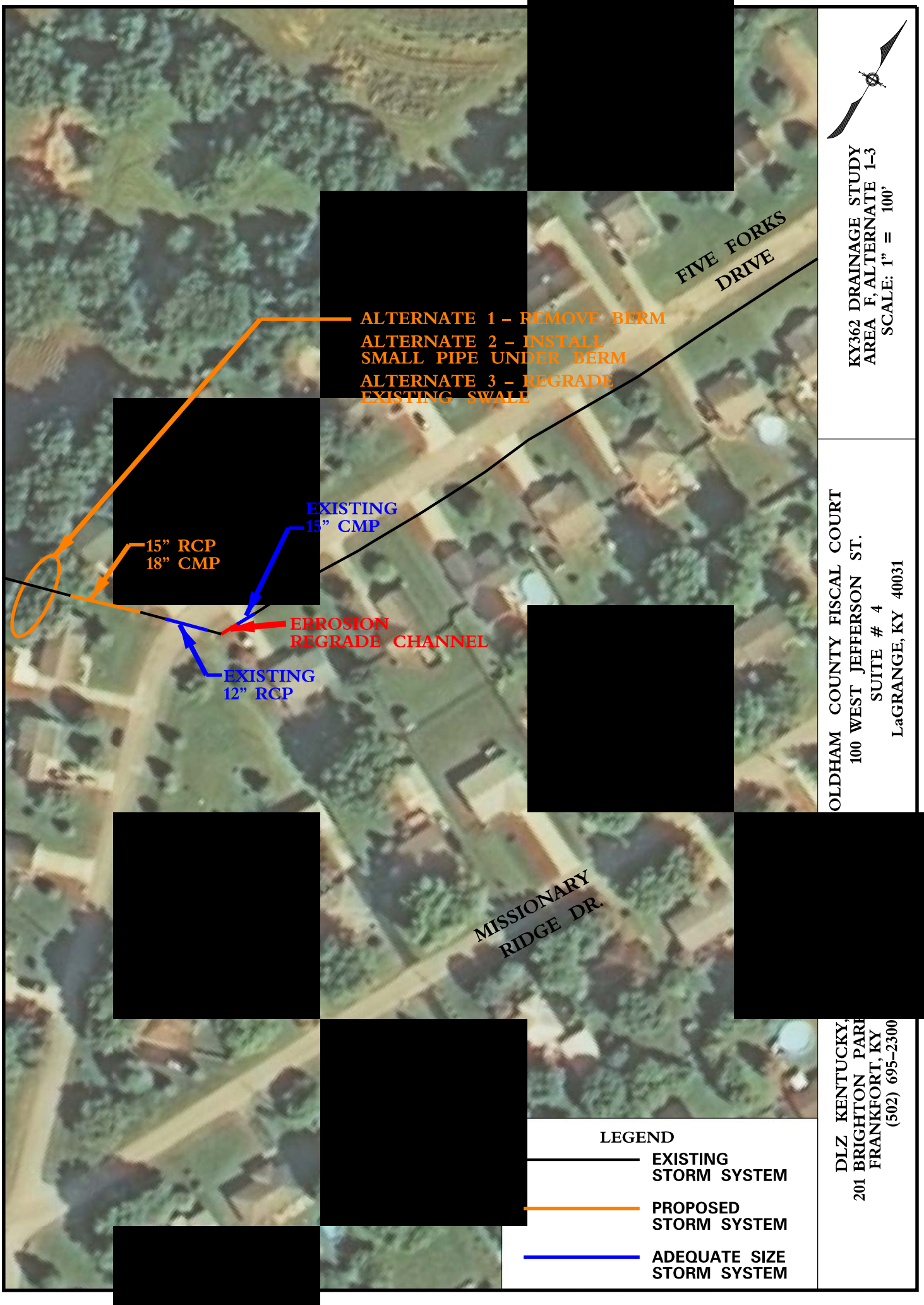
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695–2300

OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031

KY362 DRAINAGE STUDY
AREA G
SCALE: 1" = 100'

Area G - Alternate 1

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	25 Year	10 Year	25 Year
CO-444	CB-194	MH-163	Circular Pipe	18 inch	0.016	13.39	7.69	8.86	7.84	8.10
CO-445	MH-163	MH-164	Trapezoidal Channel	Natural Stream	0.018	64.54	7.69	8.86	3.34	3.46
CO-446	MH-164	MH-165	Circular Pipe	18 inch	0.020	14.69	7.69	8.86	8.41	8.70
CO-447	MH-165	MH-166	Trapezoidal Channel	Natural Stream	0.018	64.62	7.69	8.86	3.34	3.47
CO-448	MH-166	MH-167	Circular Pipe	18 inch	0.020	14.69	7.69	8.86	8.41	8.70
CO-449	MH-167	MH-168	Trapezoidal Channel	Natural Stream	0.037	92.80	7.69	8.86	4.37	4.53
CO-450	MH-168	MH-169	Circular Pipe	18 inch	0.011	10.99	7.69	8.86	6.73	6.92
CO-451	MH-169	MH-170	Trapezoidal Channel	Natural Stream	0.016	62.00	7.69	8.86	3.24	3.36
CO-452	MH-170	MH-171	Circular Pipe	18 inch	0.017	13.68	7.69	8.86	7.97	8.23
CO-453	MH-171	MH-172	Trapezoidal Channel	Natural Stream	0.028	66.68	7.69	8.86	3.65	3.78
CO-454	MH-172	MH-173	Circular Pipe	18 inch	0.025	16.68	7.69	8.86	9.25	9.58
CO-455	MH-173	ExCB-17	Trapezoidal Channel	Natural Stream	0.348	234.24	7.69	8.86	0.36	0.35
ExPipeCO-17.1	ExCB-17	ExCB-17.5	Circular Pipe	24 inch	0.011	24.24	17.31	19.94	8.38	8.61
ExPipeCO-17.5.1	ExCB-17.5	ExPipeMH-17.5.1	Circular Pipe	18 inch	0.142	39.53	17.33	19.97	21.64	22.43
ExDitchtoStreamCO-17.5.2	ExPipeMH-17.5.1	ExMH-28.2	Trapezoidal Channel	Natural Stream	0.119	2363.13	17.26	19.89	8.75	9.21


FIVE FORKS DRIVE
ALTERNATE 1 – REMOVE BERM
ALTERNATE 2 – INSTALL SMALL PIPE UNDER BERM
ALTERNATE 3 – REGRADE EXISTING SWALE
EXISTING 15" CMP
15" RCP 18" CMP
ERROSION REGRADE CHANNEL
EXISTING 12" RCP
MISSIONARY RIDGE DR.
LEGEND
EXISTING STORM SYSTEM
PROPOSED STORM SYSTEM
ADEQUATE SIZE STORM SYSTEM
KY362 DRAINAGE STUDY
AREA F, ALTERNATE 1–3
SCALE: 1" = 100'
OLDHAM COUNTY FISCAL COURT
100 WEST JEFFERSON ST.
SUITE # 4
LaGRANGE, KY 40031
DLZ KENTUCKY,
201 BRIGHTON PARK
FRANKFORT, KY
(502) 695–2300

Area H - Alternate 1

Label	Start Node	Stop Node	Conduit Shape	Section Size	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Flow (ft^3/s)		Velocity (Out) (ft/s)	
							10 Year	25 Year	10 Year	25 Year
ExCO-53.1	ExCB-53	ExMH-53.1	Circular Pipe	15 inch	0.041	7.12	1.87	2.18	4.89	5.10
ExCO-53.2	ExMH-53.1	ExCB-55	Trapezoidal Channel	Natural Stream	0.098	13.35	14.00	16.30	5.30	5.67
ExPipeCO-54.1	ExStructureCB-54	ExPipeMH-54.1	Circular Pipe	12 inch	0.025	5.62	1.90	2.05	6.46	6.60
ExDitchCO-54.2	ExPipeMH-54.1	ExCB-55	Trapezoidal Channel	Grass Channel	0.008	24.12	7.80	8.50	0.43	1.18
ExCO-55.1	ExCB-55	ExMH-55.1	Circular Pipe	18 inch	0.016	13.40	34.50	40.10	7.21	7.16
ExCO-55.2	ExMH-55.1	ExCB-14	Trapezoidal Channel	Rouch Channel	0.039	297.24	4.60	5.17	3.99	4.11

APPENDIX E

COST ESTIMATES

Area A, Alternate 1, 10Yr

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
Detention Basin-Excavation	8,518	CY	$ 15.00	$ 127,770
Detention Basin -Control Structure	1	EA	$ 5,000.00	$ 5,000
Detention Basin - 8" Concrete Outlet Pipe	55	LF	$ 25.00	$ 1,375
24" RCP	25	LF	$ 90.00	$ 2,250
30" RCP	88	LF	$ 135.00	$ 11,880
Channel Lining Class II	27	Ton	$ 25.00	$ 675
Excavation for Channel Relocation	618	LF	$ 15.00	$ 9,270
Double 24" Headwall	2	Ea	$ 5,910.00	$ 11,820
Double 30" Headwall	4	Ea	$ 7,200.00	$ 28,800
Stone Work	5	Ea	$ 4,000.00	$ 20,000
Remove and Replace Driveway	3	Ea	$ 1,000.00	$ 30,000
Seeding and Protection Type II	1,130	SF	$ 1.00	$ 1,130
Alternate 1 Subtotal				$ 249,970
Contingency	20%			$ 49,994
Estimate of Construction Cost				**$ 299,964**

Area A, Alternate 2, 25Yr

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
30" RCP	50	LF	$ 135.00	$ 6,750
36" RCP	66	LF	$ 165.00	$ 10,890
Channel Lining Class II	27	Ton	$ 25.00	$ 675
Ditch Improvements	618	LF	$ 15.00	$ 9,270
Stone Work	5	Ea	$ 4,000.00	$ 20,000
Double 30" Headwall	4	Ea	$ 7,200.00	$ 28,800
Double 36" Headwall	2	Ea	$ 8,850.00	$ 17,700
Remove and Replace Driveway	3	Ea	$ 1,000.00	$ 3,000
Seeding and Protection Type II	1160	SF	$ 1.00	$ 1,160
Alternate 2 Subtotal				$ 98,245
Contingency	20%			$ 19,649
Construction Estimated Cost				**$ 117,894**

Area A, Alternate 3, 25YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
18" RCP	122	LF	$ 60.00	$ 7,320
24" RCP	251	LF	$ 90.00	$ 22,590
18" Headwall	12	Ea	$ 2,650.00	$ 31,800
24" Headwall	16	Ea	$ 3,000.00	$ 48,000
Remove and Replace Driveway	14	Ea	$ 1,000.00	$ 14,000
Ditch Improvements	690	LF	$ 7.00	$ 4,830
Seeding and Protection Type II	3710	SF	$ 1.00	$ 3,710
Alternate 3 Subtotal				$ 102,340
Contingency	20%			$ 20,468
Construction Estimated Cost				**$ 122,808**

Area A, Alternate 4, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
12" RCP	88	LF	$ 45	$ 3,960
24" RCP	229	LF	$ 90	$ 20,610
12" Headwall	8	Ea	$ 2,300	$ 18,400
24" Headwall	14	Ea	$ 3,000	$ 42,000
Remove and Replace Driveway	14	EA	$ 1,000	$ 14,000
Seeding and Protection Type II	3,170	SF	$ 1	$ 3,170
Alternate 4 Subtotal				$ 102,140
Contingency	20%			$ 20,428
Construction Estimated Cost				**$ 122,568**

Area B, Alternate 1, 25YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
36" RCP	120	LF	$ 165	$ 19,800
Double 36" Headwall	2	EA	$ 8,850	$ 17,700
4'x3' Box Culvert	76	LF	$ 348	$ 26,448
6' X4' Box Culvert	365	Ea	$ 415	$ 151,475
Double Catch Basin	1	EA	$ 3,110	$ 3,110
Remove and Replace Driveway	3	EA	$ 1,000	$ 3,000
Regrade Berm	171	CY	$ 6	$ 1,026
Ditch Improvements	35	LF	$ 15	$ 525
Channel Lining Class II	22.5	Tons	$ 25	$ 563
Saw Cut, Remove and Replace Asphalt	29	SY	$ 106	$ 3,074
Saw Cut, Remove and Replace Asphalt KYTC	40	SY	$ 142	$ 5,680
2' Temporary Road Widening	1	LS	$ 8,640	$ 8,640
Remove Existing Drainage Structure	1	LS	$ 3,000	$ 3,000
Traffic Control	1	LS	$ 10,000	$ 10,000
Seeding and Protection Type II	1,140	SF	$ 1	$ 1,140
Alternate 1 Subtotal				$ 255,181
Contingency	20%			$ 51,036
Construction Estimated Cost				**$ 306,217**

Area B, Alternate 2, 25YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
36" RCP	506	LF	$ 165	$ 83,490
42" RCP	110	LF	$ 215	$ 23,650
Double 36" Headwall	6	Ea	$ 8,850	$ 53,100
Double 42" Headwall	1	Ea	$ 9,135	$ 9,135
Remove and Replace Driveway	3	Ea	$ 1,000	$ 3,000
Saw Cut, Remove and Replace Asphalt	29	SY	$ 106	$ 3,074
Saw Cut, Remove and Replace Asphalt KYTC	40	SY	$ 142	$ 5,680
2' Temporary Road Widening	1	LS	$ 8,640	$ 8,640
Remove Existing Drainage Structure	1	LS	$ 3,000	$ 3,000
Traffic Control	1	LS	$ 10,000	$ 10,000
Regrade Berm	171	CY	$ 6	$ 1,026
Ditch Improvements	160	LF	$ 15	$ 2,400
Channel Lining Class II	22.5	Tons	$ 25	$ 563
Seeding and Protection Type II	1,140	SF	$ 1	$ 1,140
Alternate 2 Subtotal				$ 207,898
Contingency	20%			$ 41,580
Construction Estimated Cost				**$ 249,477**

Area B, Alternate 3, 25YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
36" RCP	58	LF	$ 165	$ 9,570
42" RCP	120	LF	$ 215	$ 25,800
36" Headwall	6	Ea	$ 8,850	$ 53,100
42" Headwall	4	Ea	$ 9,135	$ 36,540
Remove and Replace Driveway	4	Ea	$ 1,000	$ 4,000
Saw Cut, Remove and Replace Asphalt	15	SY	$ 106	$ 1,590
Excavation for Swales	1,448	LF	$ 15	$ 21,720
Seeding and Protection Type II	16,260	SY	$ 1	$ 16,260
Alternate 3 Subtotal				$ 168,580
Contingency	20%			$ 33,716
Construction Estimated Cost				**$ 202,296**

Area C, Alternate 1, 25YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
Asphalt Surface	11022	SY	$ 6	$ 65,472
3" Asphalt Binder	33067	SY	$ 10	$ 344,885
12" Crush Stone Base	11022	SY	$ 20	$ 220,444
Earthwork	27556	CY	$ 14	$ 385,784
Roadway Subtotal				$ 1,016,586
Contingency	10%			$ 101,659
Roadway Construction Total				$ 1,118,244

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
Bridge (estimated use of materials and Labor)	1280	SF	$ 225	$ 288,000
Structural Subtotal				$ 288,000
Contingency	10%			$ 28,800
Bridge Construction Total				$ 316,800

Estimated Area C Construction Cost				**$ 1,435,044**

Area C, Alternate 2, 25 YR

			Engineering Estimate	
Description	quantity	Unit	Total Unit Cost	Total Cost
24" CMP	37	LF	$ 80	$ 2,960
48" CMP	45	LF	$ 235	$ 10,575
48" RCP	289	LF	$ 225	$ 65,025
60" RCP	48	LF	$ 450	$ 21,780
24" Headwall	2	Ea	$ 3,000	$ 6,000
48" Headwall	2	Ea	$ 4,400	$ 8,800
25 LF Structural Headwall	4	Ea	$ 32,350	$ 129,400
17 LF Structural Headwall	2	Ea	$ 21,570	$ 43,140
Double 60" Headwall	2	Ea	$ 14,363	$ 28,726
Replace Driveway Entrance (Raise Entrance above Low Flow)	4	Ea	$ 3,000	$ 12,000
Bore and Jack Pipe	102	LF	$ 90	$ 9,180
Seeding and Protection Type II	3200	SF	$ 1	$ 3,200
				$ 340,786
Contingency	35%			$ 119,275
Construction Estimated Cost				**$ 460,061**

Area C, Alternate 3, 25 YR

			Engineering Estimate	
Description	quantity	Unit	Total Unit Cost	Total Cost
24" CMP	37	LF	$ 80	$ 2,960
48" CMP	45	LF	$ 235	$ 10,575
60" RCP	48	LF	$ 450	$ 21,780
8'x4' Box Culvert	130	LF	$ 683	$ 88,790
24" Headwall	2	Ea	$ 3,000	$ 6,000
48" Headwall	2	Ea	$ 4,400	$ 8,800
17 LF Structural Headwall	6	Ea	$ 21,570	$ 129,420
Double 60" Headwall	2	Ea	$ 14,363	$ 28,726
Replace Driveway Entrance (Raise Entrance above Low Flow)	4	Ea	$ 3,000	$ 12,000
Bore and Jack Pipe	102	LF	$ 90	$ 9,180
Seeding and Protection Type II	3200	SF	$ 1	$ 3,200
				$ 321,431
Contingency	35%			$ 112,501
Construction Estimated Cost				**$ 433,932**

Area D, Alternate 1, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
18" RCP	51	LF	$ 60	$ 3,060
24" RCP	80	LF	$ 90	$ 7,200
30" RCP	210	LF	$ 135	$ 28,350
36" RCP	415	LF	$ 170	$ 70,550
42" RCP	278	LF	$ 215	$ 59,770
18" Headwall	8	EA	$ 2,650	$ 21,200
24" Headwall	2	EA	$ 3,000	$ 6,000
36" Headwall	14	EA	$ 4,425	$ 61,950
42" Headwall	4	EA	$ 4,400	$ 17,600
Ditch Improvements	585	LF	$ 7	$ 4,095
Saw Cut, Remove and Replace Asphalt	87	SY	$ 106	$ 9,172
Replace Driveway Entrance	3	Ea	$ 1,000	$ 3,000
Remove and Replace Concrete Channel	70	CF	$ 8	$ 560
Seeding and Protection Type II	5817	SY	$ 1	$ 5,817
Alternate 1 Subtotal				$ 298,324
Contingency	35%			$ 104,413
Construction Estimated Cost				**$ 402,737**

Area D, Alternate 2, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
12" RCP	1164	LF	$ 45	$ 52,380
15" RCP	43	LF	$ 50	$ 2,150
24" RCP	1451	LF	$ 90	$ 130,590
36" RCP	47	LF	$ 170	$ 7,990
Remove and Replace Concrete Channel	70	CF	$ 8	$ 560
15" Headwall	2	Ea	$ 2,500	$ 5,000
36" Headwall	2	Ea	$ 4,425	$ 8,850
Catch Basin	16	Ea	$ 1,500	$ 24,000
Ditch Improvements	410	LF	$ 7	$ 2,870
Saw Cut, Remove and Replace Asphalt	29	SY	$ 106	$ 3,062
Seeding and Protection Type II	40,575	SF	$ 1	$ 40,575
Alternate 2 Subtotal				$ 225,647
Contingency	35%			$ 78,977
Construction Estimated Cost				**$ 304,624**

Area E, Alternate 1, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
18" RCP	10	LF	$ 120	$ 1,200
Catch Basin	1	EA	$ 1,500	$ 1,500
Ditch Improvements	50	LF	$ 12	$ 600
Alternate 1 Subtotal				$ 3,300
Contingency	20%			$ 660
Construction Estimated Cost				**$ 3,960**

Area E, Alternate 2, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
12" RCP	156	LF	$ 50	$ 7,800
18" RCP	262	LF	$ 60	$ 15,720
Catch Basin	1	Ea	$ 1,500	$ 1,500
12" Headwalls	6	Ea	$ 2,300	$ 13,800
18" Headwalls	6	Ea	$ 4,000	$ 24,000
Ditch Improvements	224	LF	$ 7	$ 1,568
Seeding and Protection Type II	6270	SF	$ 1	$ 6,270
Alternate 2 Subtotal				$ 64,388
Contingency	20%			$ 12,878
Construction Estimated Cost				**$ 77,266**

Area F, Alternate 1, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
Remove and Replace Concrete Drive	33	LF	$ 125	$ 4,168
Remove and Replace Sidewalk	79	LF	$ 26	$ 2,041
Ditch Improvements	80	LF	$ 7	$ 560
Seeding and Protection Type II	800	SF	$ 1	$ 800
Alternate 1 Subtotal				$ 6,209
Contingency	20%			$ 1,242
Alternate 1 Estimated Construction Total				**$ 7,450**

Area F, Alternate 2, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
18" RCP	364	LF	$ 60	$ 21,840
Catch Basins	4	Ea	$ 1,250	$ 5,000
Ditch Improvements	127	LF	$ 7	$ 889
Saw Cut, Remove and Replace Asphalt	28	SY	$ 106	$ 2,968
Seeding and Protection Type II	4,910	SF	$ 1	$ 4,910
Alternate 2 Subtotal				$ 27,729
Contingency	20%			$ 5,546
Alternate 2 Estimated Construction Total				**$ 33,275**

Area F, Alternate 3, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
24" RCP	62	LF	$ 90	$ 5,580
Ditch Improvements	206	LF	$ 7	$ 1,445
Saw Cut, Remove and Replace Asphalt	20	SY	$ 106	$ 2,120
Seeding and Protection	2060	SF	$ 1	$ 2,060
Alternate 3 Subtotal				$ 7,025
Contingency	20%			$ 1,405
Alternate 3 Estimated Construction Total				**$ 8,430**

Area G, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
15" RCP	70	LF	$ 50	$ 3,500
18" RCP	171	LF	$ 60	$ 10,260
24" RCP	54	LF	$ 90	$ 4,860
15" Headwall	6	Ea	$ 2,500	$ 15,000
18" Headwall	6	Ea	$ 2,650	$ 15,900
Catch Basin	2	Ea	$ 1,500	$ 3,000
Replace Driveway Entrance	6	Ea	$ 1,000	$ 6,000
Saw cut, Remove and Replace Asphalt	15	SY	$ 106	$ 1,590
Ditch Improvements	313	LF	$ 7	$ 2,191
Seeding and Protection Type II	2950	LS	$ 1	$ 2,950
Area G Subtotal				$ 62,301
Contingency	20%			$ 12,460
Estimated Construction Total				**$ 74,761**

Area H, Alternate 1, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
Remove Berm	114	CY	$ 25	$ 2,793
Seeding and Protection Type II	250	SF	$ 1	$ 250
Alternate 1 Subtotal				$ 2,793
Contingency	20%			$ 559
Alternate 1 Estimated Total				**$ 3,352**

Area H, Alternate 2, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
12" RCP	32	LF	$ 30	$ 960
12" Headwalls	2	Ea	$ 2,300	$ 4,600
Ditch Improvement	25	LF	$ 7	$ 175
Seeding and Protection	400	SF	$ 1	$ 400
Alternate 3 Subtotal				$ 6,135
Contingency	20%			$ 1,227
Alternate 3 Estimated Total				**$ 7,362**

Area H, Alternate 3, 10YR

			Engineering Estimate	
Description	Quantity	Unit	Total Unit Cost	Total Cost
15" RCP	60	SF	$ 60	$ 3,600
15" Headwalls	2	Ea	$ 2,500	$ 5,000
Ditch Improvements	13	LF	$ 7	$ 91
Channel Lining Class II	20	Ton	$ 25	$ 500
Seeding and Protection	730	SF	$ 1	$ 730
Alternate 2 Subtotal				$ 8,691
Contingency	20%			$ 1,738
Alternate 2 Estimated Total				**$ 10,429**