Risk Assessment – Campbell County

The Northern Kentucky Area Development District has developed a Risk Assessment for the Multi-Jurisdictional Hazard Mitigation Plan for the 8 counties and 53 incorporated cities within the planning region. Each of the 8 counties within the NKADD region has formed a Hazard Mitigation Planning committee and will consist of local officials from the county and city level, representatives from other organizations who offer expertise in specific areas, as well as members of the public.

Identifying Hazards

Based on guidance in the FEMA publication "Understanding Your Risks, Identifying Hazards, and Estimating Losses", NKADD staff along with mitigation planning committee members researched the natural hazards that could potentially affect the region. An initial list of natural hazards was composed and subsequently narrowed to include only those hazards that pose a significant threat. These judgments were based on historical evidence, probability statistics, and input from committee members and the public. The following natural hazards were considered and identified by the planning committee members as high, moderate, low or no potential threat. Please see Regional Risk Assessment Section for reasoning behind what hazards are and are not considered threats to the NKADD.

High	Moderate	Low	None
Flooding	Tornadoes	Drought/Extreme Heat	Tsunamis
Thunderstorms/Hail	Severe Winter Storms	Dam/Levee Failure	Volcanoes
Landslides	Fog	Earthquakes	Wildfires
		Hurricane Winds	

Profiling Hazards

This section will discuss each hazard in detail; including the likelihood of occurrence and the risks they pose to the region. Data presented in this section includes both incorporated and unincorporated areas of each county wherever possible. For most datasets, city level information is unavailable and therefore only countywide data is listed. In these circumstances, data from the incorporated cities within those counties is included in the county total.

Tornado

A tornado is a mobile, destructive vortex of violently rotating winds having the appearance of a funnel-shaped cloud and advancing beneath a large storm system. It is spawned by a thunderstorm (or sometimes as a result of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Peak months of tornado activity are usually April, May, and June. However, tornadoes have occurred in every month and at all times of the year. They tend to occur in the afternoons and evenings.

The NKADD region is within wind zone four of the Design Wind Speeds map in the FEMA publication "Taking Shelter From the Storm: Building a Safe Room Inside Your House". This wind classification places the region in the high risk category for tornados. According to National Severe Storms Laboratory probability statistics for tornados, the NKADD region is likely to experience between ten to fifteen F2 or greater tornado days per century.

Types of Tornadoes:

The magnitude of a tornado is determined by the Enhanced-Fujita Scale, an updated version of the Fujita-Pearson Scale. The six categories for the EF scale are listed below, in order of increasing intensity. For the actual EF scale in practice, damage indicators (the type of structure which has been damaged) are predominately used in determining the tornado intensity. There are 28 damage indicators and they take into account quality of construction.

Scale	Wind speed (Estimated)[5]	Relative frequency	Potential damage
	mph		
EF0	65–85	53.5%	Minor or no damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86–110	31.6%	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	10.7%	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	3.4%	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations are badly damaged.
EF4	166–200	0.7%	Extreme damage. Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated.
EF5	>200	<0.1%	Total destruction of buildings. Strong framed, well built houses leveled off foundations and swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; some cars, trucks and train cars can be thrown approximately 1 mile.

http://www.spc.noaa.gov/efscale/ef-scale.html

Impacts:

• The primary impacts of tornado outbreaks affect infrastructure and human life most directly. Catastrophic damage may result from tornadoes leaving houses, businesses, and even streets destroyed.

• The secondary impacts of loss of critical infrastructure may result in hazards and additional problems well after a tornado has passed. Citizens may be without shelter, power, or running water for several days, depending on the severity of the tornado.

• Loss of critical infrastructure may also impact local or regional economies by inhibiting transportation of goods and the availability of certain services.

Profiling Hazards: Tornado

Tornado Profile Risk Table	
Location:	All areas in Campbell County are susceptible
Period of Occurrence:	Spring, Summer, Fall, Winter
Number of Events (1956-2015):	3
Annual Rate of Occurrence:	0.05

Probability of Future Events:	Occasional
Warning Time:	Minutes to hours
Potential Impacts:	Utility damage and outages, infrastructure damage (transportation and communication systems), structural damage, fire, damaged or destroyed critical facilities, and hazardous material releases. Impacts human life, health, and public safety.
Recorded losses:	$1,275,000.00
Annualized Loss:	$21,610.17
Extent (Scale)	Tornado 3/2/2012 Scale: EF3 Damages: 0 deaths, 0 injuries, $1,000,000

NCDC Storm Events Database: collected 4/25/16

Tornado Events:

COUNTY	DATE	EVENT TYPE	F_SCALE	DEATHS/INJURIES		Property Damage (dollars)
CAMPBELL CO.	07/11/1958	Tornado	F2	0	8	250.00K
CAMPBELL CO.	11/25/1973	Tornado	F1	0	2	25.00K
CAMPBELL CO.	03/02/2012	Tornado	EF3	0	0	1.000M

Narratives:

Tornado, 11/25/1973: “Skipped for some 4 miles through farm country damaging several homes and barns. Two children received minor injuries at one of the more heavily damaged homes”.

Tornado, 3/2/2012: Thunderstorms developed during the afternoon in a high wind shear environment ahead of a strengthening low pressure system. Many of these storms became severe, with large hail, damaging thunderstorm winds, and tornadoes all being the main threats. Isolated flooding also became possible due to the intense rainfall. The tornado initially touched down in south central Campbell County at 1639 EST near Peach Grove Road and crossed Fisher Road northwest of Peach Grove. The tornado then crossed into Pendleton County at 1641 EST after producing high end EF3 damage along Reid Ridge Road near the Campbell and Pendleton County line. The tornado then moved across Mays Road producing significant and widespread EF2 to low end EF3 damage. The tornado then crossed AA highway and eventually the Ohio River, after crossing Kentucky Highway 8. Based on the damage surveyed, the maximum wind speed of the tornado was estimated to be 160 miles per hour in Campbell County and 140 miles per hour in Pendleton County. The tornado traveled a total of 2.68 miles in Campbell County, and 4 miles in Pendleton County. The tornado then moved into Clermont County Ohio at 1646 EST, where it hit the town of Moscow, causing EF3 damage. The tornado continued on the ground across Clermont County, crossing into Brown County at 1658 EST. The tornado then lifted south of Hamersville in western Brown County at 1702 EST. This tornado caused extensive damage to structures and trees along its entire path on both sides of the Ohio River. Numerous homes were very heavily damaged or destroyed. Many homes lost their roofs, having complete exterior wall failure. Some modular homes were completely removed from their foundations, lifted, and thrown in excess of 100 yards where they were destroyed. The damage in Ohio from this tornado was consistent with maximum winds estimated at 160 miles per hour in Clermont County, and 100 miles per hour in Brown County. The tornado traveled a total of 11.04 miles in Clermont County, and 2.69 miles in Brown County.

Hail

Hail is commonly associated with severe storms. While severe storms and super cell storms usually produce the most damaging hail occurrences, many non-super cell storms have produced golf ball size hail. Storms which produce hail are more frequent during the late spring and early summer months.

Although there is no scientific classification of hail, NOAA provides the following comparisons to identify hail sizes with common items.

NOAA Hail Size Comparison	
Non-Severe Sizes	
Pea	¼ inch diameter
Marble	½ inch diameter
Severe Sizes	
Dime/Penny	¾ inch diameter
Nickel	7/8 inch diameter
Quarter	1 inch diameter
Ping-Pong Ball	1 ½ inch diameter
Golf Ball	1 ¾ inch diameter
Tennis Ball	2 ½ inch diameter
Baseball	2 ¾ inch diameter
Tea Cup	3 inch diameter
Grapefruit	4 inch diameter
Softball	4 ½ inch diameter

Impacts

The primary impacts of hail are mainly property and infrastructure damages, including crop damages, and personal injuries. Although extensive damage occurs as a result of hail, the event by itself causes few, if any, additional hazards.

Hail Profile Risk Table	
Location:	All areas in Campbell County are susceptible
Period of Occurrence:	Any time of the year, but especially April to June
Number of Events (1956-2015):	38
Annual Rate of Occurrence:	0.64
Probability of Future Events:	Likely
Warning Time:	Predicting hail is difficult. Most advance warning comes from knowledge of conditions present that could produce hail; it is minutes to an hour at best.
Potential Impacts:	Impacts to human life, health and public safety are possible. Utility damage and failure, infrastructure damage, structural damage, fire, damaged or destroyed critical facilities, and hazardous material releases are additional impacts.
Recorded losses:	$10,000
Annualized Loss:	$169.49
Extent (Scale)	Hail 4/26/2007 Scale: 0.75 inches Damages: 0 deaths, 0 injuries, $2,000

NCDC Storm Events Database, collected 4/25/16

Hail Events:

COUNTY	DATE	EVENT TYPE	Mag.	DEATHS/INJURIES		Property Damage (dollars)
CAMPBELL CO.	04/12/1962	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	08/27/1965	Hail	1.75 in.	0	0	0.00K
CAMPBELL CO.	04/18/1969	Hail	1.75 in.	0	0	0.00K
CAMPBELL CO.	06/08/1995	Hail	0.88 in.	0	0	0.00K
CAMPBELL CO.	07/02/1997	Hail	1.75 in.	0	0	0.00K
CAMPBELL CO.	04/08/1998	Hail	1.75 in.	0	0	0.00K
CAMPBELL CO.	05/24/1998	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	05/24/1998	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	06/09/1998	Hail	1.00 in.	0	0	0.00K
CAMPBELL CO.	07/20/1998	Hail	1.75 in.	0	0	0.00K
CAMPBELL CO.	06/02/2000	Hail	0.88 in.	0	0	0.00K
CAMPBELL CO.	08/09/2000	Hail	1.00 in.	0	0	0.00K
CAMPBELL CO.	04/06/2001	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	02/20/2002	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	05/01/2003	Hail	0.75 in.	0	0	2.00K
CAMPBELL CO.	06/30/2005	Hail	0.88 in.	0	0	0.00K
CAMPBELL CO.	05/25/2006	Hail	1.00 in.	0	0	0.00K
CAMPBELL CO.	04/11/2007	Hail	0.88 in.	0	0	2.00K
CAMPBELL CO.	04/11/2007	Hail	0.75 in.	0	0	2.00K
CAMPBELL CO.	04/26/2007	Hail	0.75 in.	0	0	2.00K
CAMPBELL CO.	11/05/2007	Hail	0.88 in.	0	0	1.00K
CAMPBELL CO.	05/30/2009	Hail	0.75 in.	0	0	1.00K
CAMPBELL CO.	06/02/2009	Hail	0.88 in.	0	0	0.00K
CAMPBELL CO.	09/08/2009	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	07/17/2010	Hail	1.00 in.	0	0	0.00K
CAMPBELL CO.	06/10/2011	Hail	2.00 in.	0	0	0.00K
CAMPBELL	07/20/2011	Hail	1.00 in.	0	0	0.00K

CO.						
CAMPBELL CO.	07/20/2011	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	03/15/2012	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	04/25/2012	Hail	1.25 in.	0	0	0.00K
CAMPBELL CO.	04/25/2012	Hail	0.88 in.	0	0	0.00K
CAMPBELL CO.	07/25/2012	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	07/26/2012	Hail	0.88 in.	0	0	0.00K
CAMPBELL CO.	08/09/2012	Hail	1.75 in.	0	0	0.00K
CAMPBELL CO.	08/09/2012	Hail	0.75 in.	0	0	0.00K
CAMPBELL CO.	05/21/2014	Hail	0.88 in.	0	0	0.00K
CAMPBELL CO.	08/03/2015	Hail	2.50 in.	0	0	0.00K
CAMPBELL CO.	09/04/2015	Hail	0.88 in.	0	0	0.00K

Narratives:

Hail, 4/26/2007: Scattered thunderstorms developed across northern Kentucky along a cold front during the evening.

Hail, 4/25/2012: Low pressure moving across the region helped trigger thunderstorms in an unstable environment. Several of these storms became severe, with the main threat being large hail.

Hail, 7/26/2012: Strong upper level winds combined with an unstable airmass to produce widespread convection during the evening hours. The primary threat from these storms was damaging winds. The storms later began to weaken and congeal into heavy rainfall producers, making flash flooding a threat into the overnight hours.

Hail, 8/9/2012: Disorganized convection developed ahead of a shortwave trough during the afternoon and evening hours. Some of these storms became severe with damaging winds and isolated large hail the primary threats. Heavy rainfall also produced isolated flooding.

Hail, 5/21/2014: Thunderstorms developed in an unstable air mass ahead of a cold front. These thunderstorms were capable of producing large hail and damaging winds.

Thunderstorms/Lightning/Straight Line Winds

Thunderstorms often produce extremely severe winds that may cause major damage. Although the intensity of the winds in thunderstorms is less than tornados, they cover a broader geographic area and can leave a much wider damage path. Thunderstorms also occur much more frequently than tornados. The following tables illustrate the location by county, the magnitude, and the impact in terms of property damage and injuries, of historical thunderstorm events in the NKADD region.

Thunderstorm activity can range from mild to severe. Severe thunderstorms can produce winds in excess of 58 miles per hour, ¾ inch diameter hail and/or tornadic activity. Four significant considerations when comparing severe thunderstorms and tornadoes; thunderstorms are generally easier for the science community to predict, tornadoes are typically stronger, more intense storms, thunderstorms typically cover a broader, larger area; and, thunderstorms occur far more frequently than tornadoes in Northern Kentucky. For these reasons, the cost of damage resulting from tornados in our region was nearly 40% higher than damage resulting from severe thunderstorms.

Straight-line winds are common with the gust front of a thunderstorm or originate with a downburst from a thunderstorm. These events can cause considerable damage, even in the absence of a tornado. The winds can reach 130 km/h (80 mph) and can last for periods of twenty minutes.

Lightning is a giant spark of electricity in the atmosphere or between the atmosphere and the ground. Although most lightning occurs in the summer, people can be struck at any time of year. Lightning kills an average of 49 people in the United States each year, and hundreds more are severely injured (NOAA).

Thunderstorm Types

- Single Cell (pulse storms). Typically last 20-30 minutes. Pulse storms can produce severe weather elements such as downbursts, hail, some heavy rainfall and occasionally weak tornadoes. This storm is light to moderately dangerous to the public and moderately to highly dangerous to aviation.
- Multicell Cluster. These storms consist of a cluster of storms in varying stages of development. Multicell storms can produce moderate size hail, flash floods and weak tornadoes. This storm is moderately dangerous to the public and moderately to highly dangerous to aviation.
- Multicell Line. Multicell line storms consist of a line of storms with a continuous, well developed gust front at the leading edge of the line. Also known as squall lines, these storms can produce small to moderate size hail, occasional flash floods and weak tornadoes. This storm is moderately dangerous to the public and moderately to highly dangerous to aviation.
- Supercell. Even though it is the rarest of storm types, the supercell is the most dangerous because of the extreme weather generated. Defined as a thunderstorm with a rotating updraft, these storms can produce strong downbursts, large hail, occasional flash floods, and weak to violent tornadoes. This storm is extremely dangerous to the public and aviation.
- Storms with Straight-line Winds. Straight-line winds are convective wind gusts, outflow and downbursts that are produced by the downward momentum in the downdraft of a thunderstorm. An environment conducive to strong straight-line wind is one in which the updrafts and thus downdrafts are strong, the air is dry in the middle troposphere and the storm has a fast forward motion If these winds meet or exceed 58 miles per hours then the storm is classified as severe by the National Weather Service.
    - A *downdraft* is a small-scale column of air that rapidly sinks toward the ground.
    - A *downburst* is a result of a strong downdraft. A downburst is a strong downdraft with horizontal dimensions larger than 4 km (2.5 mi) resulting in an outward burst of damaging winds on or near the ground. (Imagine the way water comes out of a faucet and hits the bottom of the sink.) Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
    - A *microburst* is a small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally small (less than 4km across) and short-lived, lasting only 5-10 minutes, with maximum windspeeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
    - A *gust front* is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
    - A *derecho* is a widespread, long-lived wind storm that is associated with a band of rapidly moving showers or thunderstorms. A typical derecho consists of numerous microbursts, downbursts, and downburst clusters. By definition, if the wind damage swath extends more than 240 miles (about

400 kilometers) and includes wind gusts of at least 58 mph (93 km/h) or greater along most of its length, then the event may be classified as a derecho.

There are four different types of lightning:

1. Cloud to Air. Lightning that occurs when the air around a positively charged cloud top reaches to the negatively charged air around it.

2. Cloud to ground. Lightning that occurs between the cloud and the ground.

- Bolt from the blue. A positive lightning bolt which originates within the updraft of the storm, typically 2/3rds of the way up, travels horizontally for many miles, then strikes the ground.
- Anvil Lightning. A positive lightning bolt which develops in the anvil, or top of the thunderstorm cloud, and travels generally straight down to strike the ground.

3. Intra-cloud. The most common type of lightning which happens completely inside the cloud, jumping between different charge regions in the cloud. This is sometimes called sheet lightning because it lights up the sky with a 'sheet' of light.

4. Inter-cloud. Lightning that occurs between two or more separate clouds.

Impacts of Thunderstorms/Lightning

- Fires may occur in structures such as storage and processing units, aircraft, and electrical infrastructure and components.
- Forest fires may be initiated by lightning. Half the wildfires in the western U.S. are caused by lightning.
- Injury and death to people

Thunderstorm/Lightning/Straight Line Wind Profile Risk Table	
Location:	All areas in Campbell County are susceptible
Period of Occurrence:	Spring, Summer, Fall
Number of Events (1956-2015):	90
Annual Rate of Occurrence:	1.53
Probability of Future Events:	Highly Likely
Warning Time:	Minutes to hours
Potential Impacts:	Impacts to human life, health and public safety are possible. Utility damage and failure, infrastructure damage, structural damage, fire, damaged or destroyed critical facilities, and hazardous material releases are additional impacts.
Recorded losses:	$10,697,000
Annualized Loss:	$181,305.08
Extent (Scale)	Thunderstorm Wind 7/25/1994 Scale: 0 kts. Damages: 0 deaths, 0 injuries, $50,000 Lightning 7/20/1998 Damages: 0 deaths, 0 injuries, $25,000 High Wind (Straight Line Wind) 9/14/2008 Scale: 60 kts. EG Damages: 0 deaths, 0 injuries, $10,200,000

NCDC Storm Event Database, collected 4/25/2016

Thunderstorm Events (2004-2015)/Wind Events (2000-2015):

COUNTY	DATE	EVENT TYPE	Mag.	DEATHS/INJURIES		Property Damage (dollars)
CAMPBELL CO.	05/30/2004	Thunderstorm Wind	50 kts. EG	0	0	3.00K
CAMPBELL CO.	06/14/2005	Thunderstorm Wind	50 kts. EG	0	0	5.00K
CAMPBELL CO.	04/02/2006	Thunderstorm Wind	55 kts. EG	0	0	10.00K
CAMPBELL CO.	05/25/2006	Thunderstorm Wind	57 kts. MG	0	0	0.00K
CAMPBELL CO.	07/21/2006	Thunderstorm Wind	50 kts. EG	0	0	5.00K
CAMPBELL CO.	12/01/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
CAMPBELL CO.	07/04/2007	Thunderstorm Wind	53 kts. MG	0	0	1.00K
CAMPBELL CO.	07/15/2007	Thunderstorm Wind	50 kts. EG	0	0	5.00K
CAMPBELL CO.	08/16/2007	Thunderstorm Wind	50 kts. EG	0	0	4.00K
CAMPBELL CO.	08/29/2007	Thunderstorm Wind	50 kts. EG	0	0	3.00K
CAMPBELL CO.	06/03/2008	Thunderstorm Wind	55 kts. EG	0	0	8.00K
CAMPBELL CO.	06/04/2008	Thunderstorm Wind	60 kts. EG	0	0	25.00K
CAMPBELL CO.	07/20/2008	Thunderstorm Wind	50 kts. EG	0	0	3.00K
CAMPBELL CO.	06/26/2009	Thunderstorm Wind	50 kts. EG	0	0	0.00K
CAMPBELL CO.	06/12/2010	Thunderstorm Wind	52 kts. MG	0	0	0.00K
CAMPBELL CO.	06/15/2010	Thunderstorm Wind	50 kts. EG	0	0	1.00K
CAMPBELL CO.	09/07/2010	Thunderstorm Wind	50 kts. EG	0	0	1.00K
CAMPBELL CO.	04/27/2011	Thunderstorm Wind	50 kts. EG	0	0	1.00K
CAMPBELL CO.	05/25/2011	Thunderstorm Wind	50 kts. EG	0	0	1.00K
CAMPBELL CO.	05/25/2011	Thunderstorm Wind	78 kts. EG	0	0	20.00K
CAMPBELL CO.	04/25/2012	Thunderstorm Wind	50 kts. EG	0	0	0.50K
CAMPBELL CO.	04/30/2012	Thunderstorm Wind	54 kts. MG	0	0	0.00K
CAMPBELL CO.	06/29/2012	Thunderstorm Wind	50 kts. EG	0	0	2.00K
CAMPBELL CO.	06/29/2012	Thunderstorm Wind	50 kts. EG	0	0	10.00K
CAMPBELL CO.	07/05/2012	Thunderstorm Wind	50 kts. EG	0	0	2.00K
CAMPBELL CO.	07/18/2012	Thunderstorm Wind	55 kts. EG	0	0	10.00K
CAMPBELL CO.	01/30/2013	Thunderstorm Wind	50 kts. EG	0	0	2.00K

CAMPBELL CO.	06/26/2013	Thunderstorm Wind	50 kts. EG	0	0	3.00K
CAMPBELL CO.	08/31/2013	Thunderstorm Wind	50 kts. EG	0	0	10.00K
CAMPBELL CO.	08/31/2013	Thunderstorm Wind	50 kts. EG	0	0	5.00K
CAMPBELL CO.	11/17/2013	Thunderstorm Wind	55 kts. EG	0	0	20.00K
CAMPBELL CO.	11/17/2013	Thunderstorm Wind	50 kts. EG	0	0	1.00K
CAMPBELL CO.	12/21/2013	Thunderstorm Wind	50 kts. EG	0	0	10.00K
CAMPBELL CO.	05/10/2014	Thunderstorm Wind	50 kts. EG	0	0	1.00K
CAMPBELL CO.	06/30/2015	Thunderstorm Wind	50 kts. EG	0	0	3.00K
CAMPBELL CO.	07/13/2015	Thunderstorm Wind	50 kts. EG	0	0	8.00K
CAMPBELL CO.	07/14/2015	Thunderstorm Wind	50 kts. EG	0	0	5.00K
CAMPBELL CO.	09/04/2015	Thunderstorm Wind	50 kts. EG	0	0	3.00K
CAMPBELL CO.	12/23/2015	Thunderstorm Wind	50 kts. EG	0	0	17.50K
CAMPBELL (ZONE)	12/11/2000	High Wind	50 kts. E	0	0	0.00K
CAMPBELL (ZONE)	03/09/2002	High Wind	55 kts. E	0	0	10.00K
CAMPBELL (ZONE)	09/14/2008	High Wind	60 kts. EG	0	0	10.200M
CAMPBELL (ZONE)	02/11/2009	High Wind	50 kts. EG	0	0	0.00K
CAMPBELL (ZONE)	12/09/2009	High Wind	50 kts. EG	0	0	0.00K

Narratives:

High Wind (Straight Line Wind), 9/14/2008: The remnants of Hurricane Ike raced northeast through the mid-west and merged with a frontal boundary across the lower Ohio Valley Sunday morning. Abundant sunshine promoted deep mixing of the atmosphere, and warm, dry air aloft translated down to the surface. Gusty winds in excess of 70 mph persisted for a period of several hours, causing significant damage. Over 700,000 power outages occurred for Duke energy customers in the Cincinnati area, some taking over a week to be restored. Strong winds of 40 to 50 miles per hour were sustained for several hours. Gusts over 60 mph were common. Widespread damage occurred across the region, from trees being blown down on power lines to significant structural damage.

High Wind (Straight Line Wind), 2/11/2009: A cold front crossed the Ohio Valley on the evening of the 11th. A very tight pressure gradient behind this front in the cold air created damaging winds during the late evening of the 11th. Several trees were downed in Fort Thomas.

High Wind (Straight Line Wind), 12/9/2009: A strong center of low pressure tracked out of the plains states to the Great Lakes region. Ahead of this low in the Ohio Valley, southwest winds of 30 to 40 mph with gusts to 50 and 60 mph were common throughout the day. These strong winds peaked in the early afternoon with the passage of a cold front, and diminished later in the evening. A few trees and large limbs were blown down across the county.

Thunderstorm, 1/30/2013: An organized line of storms developed ahead of a cold front during the overnight hours. Some of these storms along the line produced severe weather. The main threat from these storms was damaging winds. Trees were reported down along Stonehouse Road due to damaging thunderstorm winds.

Thunderstorm, 6/26/2013: Thunderstorms developed in an unstable air mass ahead of an approaching disturbance. Some of these storms became severe. The main threat from these storms was damaging winds. Trees and branches were downed near Moock road and Canterbury Apartments due to thunderstorm winds.

Thunderstorm, 8/31/2013: Disturbances moving along a stalled frontal boundary interacted with an unstable air mass to produce numerous showers and thunderstorms across the area. Some of these storms organized and became severe. The main threat from these storms was damaging winds. A tree fell on a house near Alexandria due to thunderstorm winds.

Thunderstorm, 11/17/2013: \A strong low pressure system combined with an unseasonably warm airmass to produce organized storms across the region. These storms were tornadic across Illinois and western Indiana, and began to transition to non-tornadic storms as they entered northern Kentucky. The main threat from these storms when they moved across northern Kentucky was damaging thunderstorm winds. Roof and fascia damage occurred to a shopping plaza due to thunderstorm winds.

Thunderstorm, 12/21/2013: Low pressure drew an unseasonably warm and moist air mass across the region. Convection organized ahead of the low and brought heavy rainfall and damaging winds to the area from the evening of the 21st into the morning of the 22nd. Numerous large trees were down in Alexandria and surrounding areas due to thunderstorm winds.

Thunderstorm, 5/10/2014: A disturbance moving east across the region produced thunderstorms during the afternoon. Isolated severe weather was possible with damaging winds being the primary threat. A few large limbs were blown down due to thunderstorm winds.

Severe Winter Storm

A **winter storm** can range from moderate snow over a few hours to blizzard conditions with blinding wind-driven snow, sleet and/or ice that lasts several days. Some winter storms may be large enough to affect several states while others may affect only a single community. All winter storms are accompanied by low temperatures and blowing snow, which can reduce visibility.

A **severe winter storm** is defined as an event that drops four or more inches of snow during a 12–hour period or 6 or more inches during a 24 hour span. All severe winter storms make driving and walking extremely hazardous. The aftermath of a severe winter storm can impact a community or region for days, weeks, or months.

Blizzards are the most dangerous of all winter storms. They are characterized by temperatures below twenty degrees Fahrenheit and winds of at least 35 miles per hour. In addition to temperatures and winds, to be classified as a blizzard, a storm must have a sufficient falling *or* blowing snow. Blizzard snow reduces visibility to less than one-quarter mile for at least three hours. With high winds and heavy snow, these severe storms can punish residents throughout much of the United States during the winter months each year.

An **ice storm** occurs when freezing rain falls from clouds and freezes immediately on impact. Ice storms occur when surface *cold* air overrides warm, moist air at higher altitudes. As the warm air descends over the cold air, precipitation, which falls as rain at high altitudes, becomes super cooled and freezes as it passes through the cold air mass below. In extreme cases, ice may accumulate inches thick, though just a thin coating is often enough to cause severe damage. The weight of ice can produce tree loss, and damage to power lines, and even structures.

From March 12th to the 15th, 1993, what some call the "storm of the century" ravaged the eastern United States. The National Weather Service's sophisticated computer models indicated that a severe storm was forming in the

Gulf of Mexico. Later in that same week, the NWS computer models showed that the storm was growing significantly. The storm actually formed from the combination of three different atmospheric disturbances. A major cluster of thunderstorms in the Gulf of Mexico, a band of snow and rain from the Pacific, and gusty winds with light snow from the Arctic Circle all joined over the southeast to create this historic storm. By Thursday, March 12th, the storm was barreling up Florida's west coast with high winds, tornadoes, and a storm surge twelve feet above normal. The next day, the storm was carving a destructive path up the southeastern states, leaving Eastern Kentucky paralyzed. The blizzard of March 1993 was one of the largest winter storms in terms of snowfall and size in Kentucky history. Until that day, the record for a single day's snowfall had been 18 inches. This snowfall record was broken at more than one station in Eastern parts of the state. Most of Eastern and Southeastern Kentucky was covered with up to 30 inches of snow. Snow was not the only damaging factor in the storm. Brutal winds crossed most of Kentucky, making the cleanup effort extremely difficult. Winds up to 30-mph blew over much of the state. The heavy snows, coupled with high winds created large snow drifts over roads and highways. All state and federal highways east of I-75 were closed. Most travel was stopped, leaving over 4,000 motorists stranded. The blizzard of 1993 was responsible for 270 deaths and over $1 billion of damage throughout the Eastern United States.

The Blizzard of 1996 struck the Northern Kentucky region on January 6, 1996. This massive system brought the greatest snowfall from a single storm in Greater Cincinnati/N. Kentucky airport, as well as the greatest 24-hour snowfall. Total snowfall from this storm at the airport was 14.3 inches, while a typical entire season at this location normally receives only 23 inches of snowfall. Many homes and businesses experienced partial or total roof collapses due to the weight of the snow. Road conditions remained hazardous in some locations for many days. Many believed that this was the worst winter storm since the Blizzard of '78 (source: the National Climatic Data Center).

Severe Winter Storm Profile Risk Table	
Location:	All areas in Campbell County are susceptible
Period of Occurrence:	Most likely in December, January or February
Number of Events (1996-2015):	40
Annual Rate of Occurrence:	2.11
Probability of Future Events:	Highly Likely
Warning Time:	No official warnings
Potential Impacts:	Extreme cold impacts human life, health, and public safety. Rivers and lakes freeze causing transportation issues. Energy consumption goes up and depending on the time of year extreme cold can have large impacts on agriculture. Cold temperatures can also cause ruptured pipes and stressed on engines and motors.
Recorded losses:	$300,000
Annualized Loss:	$15,789.47
Extent (Scale)	Winter Storm 1/6/1996 Damages: 0 deaths, 0 injuries, $300,000

NCDC Storm Event Database, collected 4/25/16

Severe Winter Storm Events (1996-2015):

COUNTY	DATE	EVENT TYPE	DEATHS/INJURIES		Property Damage (dollars)
CAMPBELL (ZONE)	01/06/1996	Winter Storm	0	0	300.00K
CAMPBELL (ZONE)	03/07/1996	Ice Storm	0	0	0.00K
CAMPBELL (ZONE)	03/19/1996	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/24/1997	Ice Storm	0	0	0.00K
CAMPBELL (ZONE)	01/27/1997	Ice Storm	0	0	0.00K

CAMPBELL (ZONE)	02/03/1998	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/02/1999	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	03/08/1999	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	03/13/1999	Heavy Snow	0	0	0.00K
CAMPBELL (ZONE)	12/13/2000	Ice Storm	0	0	0.00K
CAMPBELL (ZONE)	12/05/2002	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	12/11/2002	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/25/2004	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/29/2004	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	12/22/2004	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/20/2005	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	12/08/2005	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	03/21/2006	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	02/06/2007	Heavy Snow	0	0	0.00K
CAMPBELL (ZONE)	02/13/2007	Ice Storm	0	0	0.00K
CAMPBELL (ZONE)	02/21/2008	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	03/07/2008	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/27/2009	Ice Storm	0	0	0.00K
CAMPBELL (ZONE)	02/03/2009	Heavy Snow	0	0	0.00K
CAMPBELL (ZONE)	02/09/2010	Heavy Snow	0	0	0.00K
CAMPBELL (ZONE)	02/15/2010	Heavy Snow	0	0	0.00K
CAMPBELL (ZONE)	12/16/2010	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/20/2011	Heavy Snow	0	0	0.00K
CAMPBELL (ZONE)	01/20/2012	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	12/28/2012	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	03/05/2013	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	12/06/2013	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	01/20/2014	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	02/04/2014	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	02/14/2014	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	03/02/2014	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	11/16/2014	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	02/15/2015	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	02/21/2015	Winter Storm	0	0	0.00K
CAMPBELL (ZONE)	03/04/2015	Winter Storm	0	0	0.00K

Narratives:

Ice Storm, 1/27/09: A frontal boundary was stalled over the Tennessee Valley for the early part of the week. Upper level disturbances crossed through the Ohio Valley during this time and accumulating snowfall began on Tuesday. Warmer air aloft on Tuesday afternoon brought a significant amount of freezing rain to Kentucky. Almost eight inches of snow accumulated over northern portions of the county. Significant sleet and freezing rain caused icy accumulation of almost an inch, which cut down on the total snow amounts.

Heavy Snow, 1/20/11: A low pressure system moved across the Tennessee Valley during the day of Thursday, January 20th. Widespread snow developed across the region in the morning and continued through the afternoon, tapering off in the evening. Snow became heavy at times during the afternoon. The county garage in Alexandria measured 4.5 inches of snowfall.

Winter Storm, 2/4/14: A fast moving winter storm moved across the Ohio Valley on Tuesday evening, February 4th. Locations across northern Kentucky and southern Ohio started with heavy snow and transitioned to sleet and freezing rain. Significant ice accumulations caused tree damage and power outages to 5-10,000 people. Further north, snow mixed briefly with sleet, before changing to freezing rain as precipitation tapered off. The resulting 5 to 10 inches of snow and sleet accumulation in west-central and central Ohio. This storm brought widespread travel impacts with many schools and businesses being closed on Wednesday, February 5th. Snow, sleet, and freezing rain caused a large disruption to the region. Two to three inches of snow were found across the county before the mixed precipitation cut snowfall totals significantly.

Winter Storm, 2/14/14: A strong upper-level disturbance moved through the Ohio Valley Friday evening, February 14th, ending on Saturday morning, February 15th. Surface low pressure crossed east across the state of Kentucky at the same time, allowing for an extended period of snow to develop. The Fort Thomas Fire Department measured 4 inches of snow.

Winter Storm, 3/2/14: A low pressure system moving through the Tennessee Valley combined with a cold front dropping down across the Ohio Valley to produce widespread freezing rain, sleet and snow across the area. The precipitation remained mainly snow along and north of Interstate 70. However, to the south, the precipitation began as rain and freezing rain before changing to sleet and then snow through the afternoon and evening hours of March 2nd. Snow then continued along and south of the Ohio River through much of the night and on into the morning hours of March 3rd. Snow and ice caused numerous wrecks were across the region, and Interstate 275 was closed for several hours due to the adverse conditions.

Winter Storm, 11/16/14: A surge of cold air worked into the Ohio Valley with an upper level disturbance pivoting through the region on Sunday night, November 16th. This cold surge changed any rain that was in the area to snow overnight for areas west of the I-75 corridor. East of this line, the changeover to snow did not occur until Monday and there were significantly lower snowfall amounts recorded here. Based on nearby surrounding observations, it is estimated that 4 to 5 inches of snow had fallen over much of Campbell County.

Flood

Flooding is the most frequent and costly natural hazard in the United States. It poses severe problems in portions of the NKADD region and has been identified as the highest regional threat. Floods result from excessive precipitation and are classified under two categories: Flash floods, which are the result of heavy localized precipitation in a short time period over a particular location and, General floods, which are caused by precipitation over a longer time period and over a given geographical area.

Flash floods are characterized by a rapid rise in water level, high velocity and large amounts of debris. Major factors in flash flooding are intensity and duration of rainfall and the watershed steepness and stream gradients. The amount of watershed vegetation, the natural and artificial flood storage areas and the configuration of the streambed and floodplain are also factors. Flash floods may result from the failure of a dam or the sudden breakup of an ice jam. They are capable of tearing out trees, undermining buildings and bridges and scouring new channels.

General floods are long-term events and may last for several days. The primary types of general flooding are riverine, coastal, and urban flooding.

There are a multitude of reasons that floods may occur, with each type of flooding having a variety of environmental effects post-flood, and are generally grouped into seven (7) types; regional, river or riverine, flash, ice-jam, storm surge, dam and levee failure, and debris, landslide, and mudflow flooding.

1. Regional Flooding can occur seasonally when winter or spring rains, coupled with melting snow, fill river basins with too much water too quickly. The ground may be frozen, reducing infiltration into the soil and thereby increasing runoff. Extended wet periods during any part of the year can create saturated soil conditions, after which any additional rain runs off into streams and rivers, until river capacities are exceeded. Regional floods are many times associated with slow-moving, low-pressure or

2. *River or Riverine Flooding* is a high flow or overflow of water from a river or similar body of water, occurring over a period of time too long to be considered a flash flood.

3. *Flash Floods* are quick-rising floods that usually occur as the result of heavy rains over a short period of time, often only several hours or even less. Flash floods can occur within several seconds to several hours and with little warning. They can be deadly due to the rapid rises in water levels and devastating flow velocities produced.

4. *Ice-Jam Flooding* occurs on rivers that are totally or partially frozen. A rise in stream stage will break up a totally frozen river and create ice flows that can pile up on channel obstructions such as shallow riffles, log jams, or bridge piers. The jammed ice creates a dam across the channel over which the water and ice mixture continues to flow, allowing for more jamming to occur. Backwater upstream from the ice dam can rise rapidly and overflow the channel banks. Flooding moves downstream when the ice dam fails, and the water stored behind the dam is released. At this time the flood takes on the characteristics of a flash flood, with the added danger of ice flows that, when driven by the energy of the flood-wave, can inflict serious damage on structures. An added danger of being caught in an ice-jam flood is hypothermia, which can quickly kill.

5. *Storm-surge flooding* is water which is pushed up onto otherwise dry land by onshore winds. Friction between the water and the moving air creates drag which, depending upon the distance of water (fetch) and the velocity of the wind, can pile water up to depths greater than 20 feet. Intense, low-pressure systems and hurricanes can create storm-surge flooding. The storm surge is unquestionably the most dangerous part of a hurricane as pounding waves create very hazardous flood currents.

6. *Dam-and Levee-Failure Flooding* are potentially the worst flood events. A dam failure is usually the result of neglect, poor design, or structural damage caused by a major event such as an earthquake. When a dam fails, an excess amount of water is suddenly released downstream, destroying anything in its path. Dams and levees are built for flood protection. They usually are engineered to withstand a flood with computed risk of occurrence. For example, a dam or levee may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If a larger flood occurs, then that structure will be overtopped. If during the overtopping the dam or levee fails or is washed out, the water behind it is released and becomes a flash flood. Failed dams or levees can create floods that are catastrophic to life and property because of the tremendous energy of the released water. Note: Due to their severe hazard potential of a dam/levee failure and the number of dams within the NKADD region, Dam/levee failure has its own dedicated section.

7. *Debris, Landslide, and Mudflow Flooding* is created by the accumulation of debris, mud, rocks, and logs in a channel, forming a temporary dam. Flooding occurs upstream as water becomes stored behind the temporary dam and then becomes a flash flood when the dam is breached and rapidly washes away. Landslides can create large waves on lakes or embankments and can be deadly. Mudflow floods can occur when volcanic activity rapidly melts mountain snow and glaciers, and the water mixed with mud and debris moves rapidly down slope. Note: The landslide hazard specified in its own section is primarily focused on landslides due to poor soils and gradual erosion, not major flood events.

Impacts

Though fatalities associated with all types of flooding have steadily declined in the U.S. over the last half century, the average annual death toll is still over 200. Advanced warning systems are now commonplace and give residents time to plan, but an increase in urban and coastal development has caused the monetary losses associated with flooding to increase drastically.

Most homeowners' insurance policies do not cover floodwater damage, so homeowners without flood insurance are at a high risk for loss. 2005 had by far the most loss dollars paid (almost $18 billion), as a result of Hurricane Katrina. The next largest yearly paid loss dollars amount was in 2008 at almost $3.5 billion, largely as a result of Hurricane Ike. New Jersey had the highest total flood loss payments in 2011 in the United States, followed by New York, Pennsylvania, North Carolina, North Dakota, Connecticut, Vermont, Mississippi, Missouri and Louisiana.

It bears noting that while the NKADD area does not technically experience direct hurricanes, we frequently experience hurricane after affects in the form of strong storms, damaging winds, and flooding.

In the frequently flooded area of the City of Silver Grove, floods typically come from Four-Mile Creek, not the Ohio River as often assumed. The City of Silver Grove and the City of Melbourne are low-lying areas between the Ohio River and Four-Mile Creek. Many of the roads flood frequently, and while these do not always affect residences or other properties, even small floods can cut off road access, which prevents Emergency Services access along with preventing residents from being able to work, etc. For example, along Uhl Road, at 46-48 feet flood, the road is cut off from EMS services.

There are many major effects that flooding has on Silver Grove and Melbourne. The railroad line that runs roughly parallel to the Ohio River is shut down at 70 feet and would go underwater during a 100 year flood event. Anderson Avenue in Melbourne floods frequently, which not only strands the residents that live east of the railroad, but also cuts off access to the marina that supplies tugboats to the businesses along the river. The City of Silver Grove School and Postal Office are located in the 100 year floodplain.

Severe Repetitive Loss (SRL) and Repetitive Loss (RL) Properties

SRL Properties are residential properties that are covered by an NFIP Flood insurance policy and either have had at least 4 NFIP claim payments over $5,000 each, or at least 2 separate claims payments that exceed the market value of the building. A RL property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

The table below shows the number of SRL/RL properties in the NKADD area by county. Of the 17 RL properties in Campbell County, 5 are in Bellevue, 1 is in unincorporated Campbell County, 3 are in Dayton, 4 are in Melbourne, 1 in Newport, and 3 in Silver Grove.

County	**Single Family**	**2-4 Family**	**Assmd Condo**	**Other Resident**	**Non Resident**	**Total Number of SRL/RL Properties**	**Total Amount Paid**
Boone	2	0	0	0	0	2	$98,391.29
Campbell	12	0	1	0	4	17	$1,118,131.10
Carroll	2	0	0	0	0	2	$9,549.80
Gallatin	1	0	0	0	0	1	$21,473.29
Grant	0	0	0	0	0	0	$0.00
Kenton	9	1	0	2	1	14	$353,310.55
Owen	4	0	1	0	0	5	$248,389.88
Pendleton	1	0	0	0	0	1	$36,187.32

Source: KY DOW, October 2015

Flood Profile Risk Table	
Location:	Areas near rivers, creeks and storm water drainage areas are most susceptible
Period of Occurrence:	River flooding - January through May Flash flooding - Anytime, but primarily in the summer months
Number of Events (1996-2015):	44
Annual Rate of Occurrence:	2.32

Probability of Future Events:	Highly Likely
Warning Time:	River flooding - 3 to 5 days Flash flooding - minutes to several hours
Potential Impacts:	Impacts human life, health, and public safety. Utility damages and outages, infrastructure damage (transportation and communication systems), structural damage, fire, damaged or destroyed critical facilities, and hazardous material releases. Can lead to economic losses such as unemployment, decreased land values, and agribusiness losses. Floodwaters are a public safety issue due to contaminants and pollutants.
Recorded losses:	$235,000
Annualized Loss:	$12,368.42
Extent (Scale)	Flood 7/4/2013 Damages: 0 deaths, 0 injuries, $50,000

NCDC Storm Event Database, collected 4/25/16

Flood Events (1996-2015):

COUNTY	DATE	EVENT TYPE	DEATHS/INJURIES		Property Damage (dollars)
CAMPBELL (ZONE)	01/23/1996	Flood	0	0	20.00K
CAMPBELL (ZONE)	05/15/1996	Flood	0	0	0.00K
CAMPBELL CO.	05/31/1997	Flash Flood	0	0	10.00K
CAMPBELL CO.	06/01/1997	Flash Flood	0	0	10.00K
CAMPBELL CO.	06/11/1998	Flash Flood	0	0	10.00K
CAMPBELL CO.	01/03/2000	Flash Flood	0	0	10.00K
CAMPBELL CO.	02/18/2000	Flash Flood	0	0	15.00K
CAMPBELL CO.	07/18/2001	Flash Flood	0	0	0.00K
CAMPBELL CO.	07/18/2001	Flash Flood	0	0	5.00K
CAMPBELL (ZONE)	04/21/2002	Flood	0	0	0.00K
CAMPBELL CO.	05/07/2002	Flash Flood	0	0	2.00K
CAMPBELL CO.	05/08/2002	Flash Flood	0	0	0.00K
CAMPBELL (ZONE)	06/06/2002	Flood	0	0	0.00K
CAMPBELL (ZONE)	11/10/2002	Flood	0	0	0.00K
CAMPBELL (ZONE)	05/10/2003	Flood	0	0	0.00K
CAMPBELL CO.	05/10/2003	Flash Flood	0	0	50.00K
CAMPBELL (ZONE)	07/10/2003	Flood	0	0	0.00K
CAMPBELL (ZONE)	07/18/2003	Flood	0	0	0.00K
CAMPBELL (ZONE)	08/08/2003	Flood	0	0	0.00K
CAMPBELL CO.	08/08/2003	Flash Flood	0	0	0.00K
CAMPBELL (ZONE)	07/31/2004	Flood	0	0	0.00K
CAMPBELL (ZONE)	07/31/2004	Flood	0	0	0.00K
CAMPBELL (ZONE)	10/18/2004	Flood	0	0	0.00K
CAMPBELL (ZONE)	03/28/2005	Flood	0	0	0.00K
CAMPBELL (ZONE)	11/15/2005	Flood	0	0	0.00K
CAMPBELL CO.	03/12/2006	Flash Flood	0	0	0.00K
CAMPBELL CO.	07/21/2006	Flash Flood	0	0	0.00K
CAMPBELL CO.	03/04/2008	Flood	0	0	3.00K
CAMPBELL CO.	03/18/2008	Flood	0	0	10.00K
CAMPBELL CO.	04/04/2008	Flash Flood	0	0	1.00K
CAMPBELL CO.	05/15/2008	Flood	0	0	2.00K
CAMPBELL CO.	06/04/2008	Flash Flood	0	0	10.00K
CAMPBELL CO.	07/30/2009	Flash Flood	0	0	2.00K
CAMPBELL CO.	09/08/2009	Flood	0	0	10.00K

CAMPBELL CO.	06/15/2010	Flash Flood	0	0	1.00K
CAMPBELL CO.	06/15/2010	Flash Flood	0	0	1.00K
CAMPBELL CO.	07/13/2010	Flash Flood	0	0	1.00K
CAMPBELL CO.	07/21/2010	Flash Flood	0	0	5.00K
CAMPBELL CO.	06/21/2011	Flash Flood	0	0	1.00K
CAMPBELL CO.	12/05/2011	Flood	0	0	1.00K
CAMPBELL CO.	01/27/2012	Flood	0	0	1.00K
CAMPBELL CO.	07/01/2013	Flash Flood	0	0	1.00K
CAMPBELL CO.	07/04/2013	Flood	0	0	50.00K
CAMPBELL CO.	12/21/2013	Flash Flood	0	0	3.00K

Narratives:

Flash Flood, 6/21/2011: An approaching shortwave trough combined with ample instability in a warm and moist air mass across Ohio and Northern Kentucky during the afternoon. This led to the development of severe thunderstorms that also produced flash flooding across central Ohio and Northern Kentucky into the evening hours. The main severe weather threats were large hail, damaging winds, and flash flooding. Four to six inches of flowing water was reported over roadways due to heavy rain.

Flood, 12/5/2011: A low pressure system combined with a slow moving cold front to produce widespread rain across the Ohio Valley. The result of the heavy rain was numerous reports of flooding in the area. Several roads across the county were closed due to high water caused by heavy rain.

Flood, 1/27/2012: Low pressure tracking over the region brought heavy rain to parts of northern Kentucky during the evening hours of January 26th and into the morning of the 27th. This produced flooding during the early morning hours of the 27th. Several rural roads in the county were reported closed due to high water caused by recent heavy rain.

Flash Flood, 7/1/2013: Slow moving thunderstorms resulted in flash flooding across portions of extreme northern Kentucky during the evening hours. Roads were closed from 11th Street and Monmouth Street to 18th Street and Monmouth Street due to heavy rainfall.

Flood, 7/4/2013: Deep tropical moisture being drawn north across the region helped to produce heavy rain and thunderstorms during the afternoon. Localized flooding and flash flooding occurred as a result of the heavy rain. Several basements of homes on Riddle Place in Newport were flooded due to heavy rainfall.

Flash Flood, 12/21/2013: Low pressure drew an unseasonably warm and moist air mass across the region. Convection organized ahead of the low and brought heavy rainfall and damaging winds to the area from the evening of the 21st into the morning of the 22nd. Significant street flooding was reported throughout the county due to high water caused by heavy rainfall. Several roads were closed due to rushing water across the southern portions of Campbell County.

The NKADD region is located along the Ohio River and is bisected by numerous small rivers and streams. Flooding is inherent to the region. The topography consists of steep sloping hills separated by narrow drainage. This topography makes flash flooding a major issue as fast moving water often exceeds the carrying capacity of these narrow drainages basins. This problem is often exacerbated by deforestation and development that increases the rate and amount of water runoff. In many cases, the drainage system is further hindered by stream channel debris.

The Campbell County Road Department provided information on county-maintained roads that are prone to flash flooding. This list should be viewed as active, as it is continually updated. Also, the entirety of these roads are not prone to flash flooding, only parts.

- Aulick Road
- Branch Lick Road
- Craft Road
- Eight Mile Road

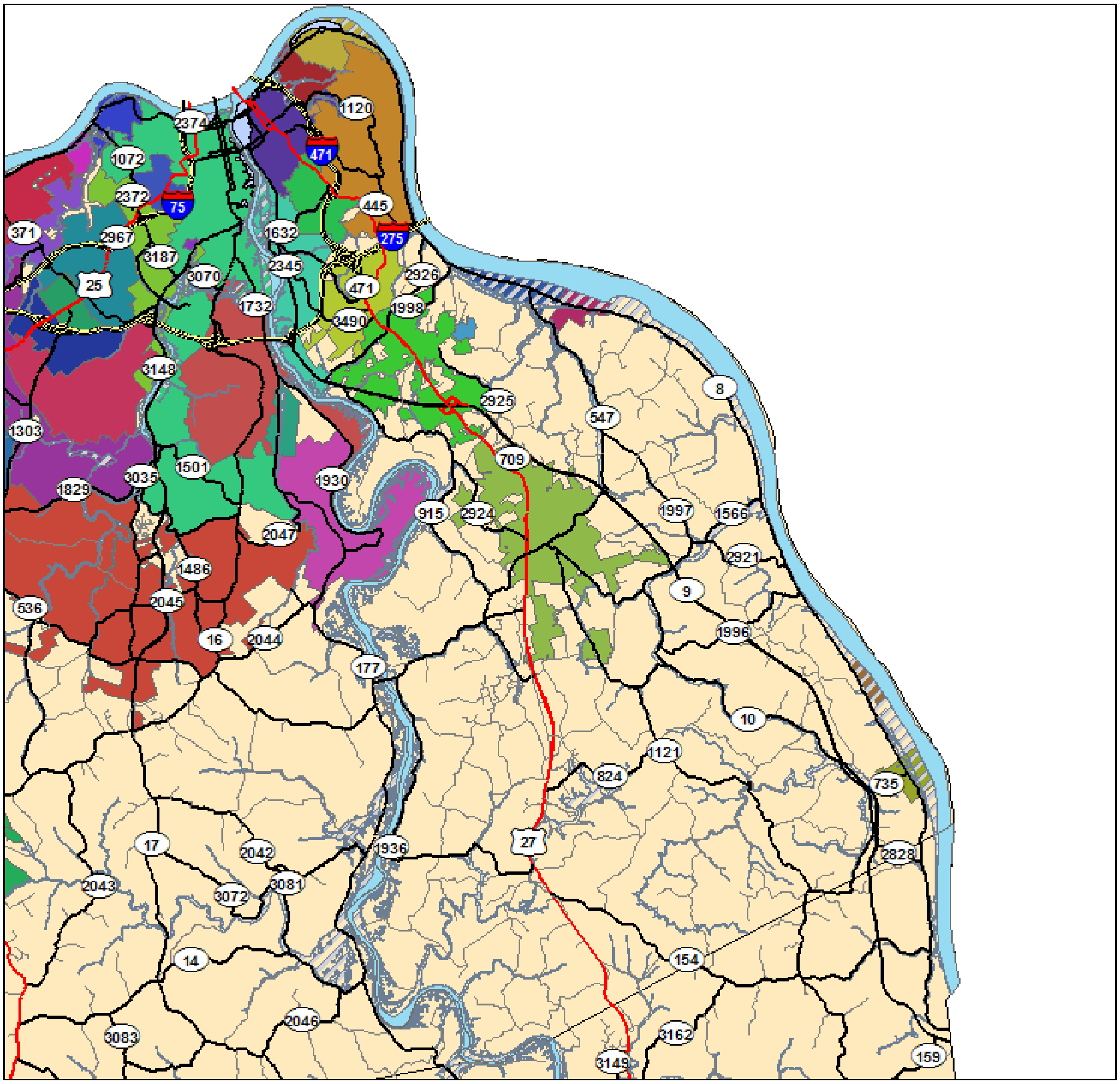
- Flatwoods Drive
- Koehler Road (Low Water Crossing)
- Lee’s Road
- Owl Creek Road
- Tarvin Road
- Ten Mile Road
- Uhl Road
- Upper and Lower Tug Fork Road
- Vineyard Drive

About 10 County roads are below the Base Flood Elevation. These areas require action during periods of flooding. The actions include road closure, traffic rerouting and emergency coordination. Post Flooding repairs are common.

Flooding of areas alongside rivers and streams is natural and inevitable; however, the potential effects are often ignored. Development of areas within mapped floodplains continues to occur. As such development occurs, it increases loss potential and danger to people who live and work in these areas. Immediate attention has been given to improve floodplain management practices in local jurisdictions throughout the region. Within the NKADD region, there are many homes and structures located within mapped flood prone areas. There are also many locations with repetitive flooding problems that are not located within a mapped floodplain.

The current FIRM maps for Campbell County are from 2014. Some areas have received Letter of Map Changes (LOMC), please go to FEMA’s Map Service Center website for that information.

Campbell County Flood Hazard Area

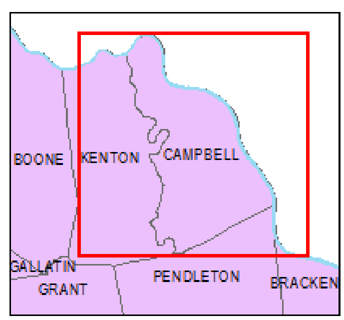


- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- Floodway

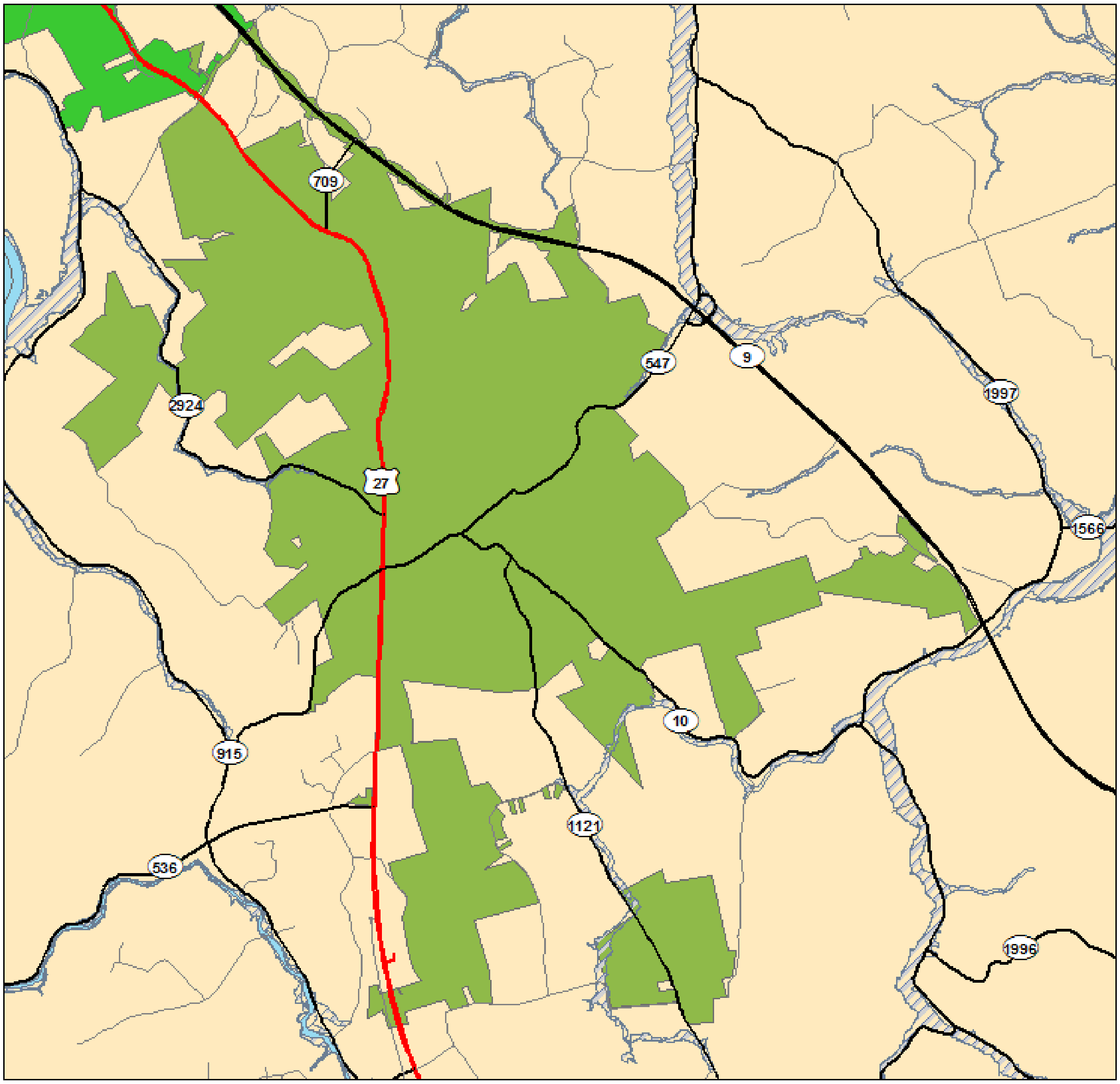
0 0.75 1.5 3 4.5 6 Miles

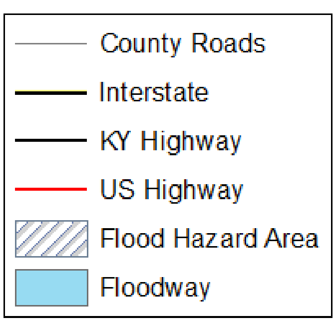
N

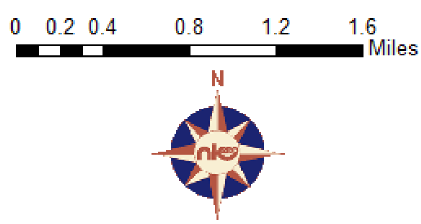
LIMITATION OF LIABILITY. THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.



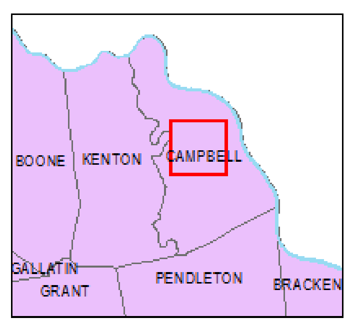
City of Alexandria Flood Hazard Area



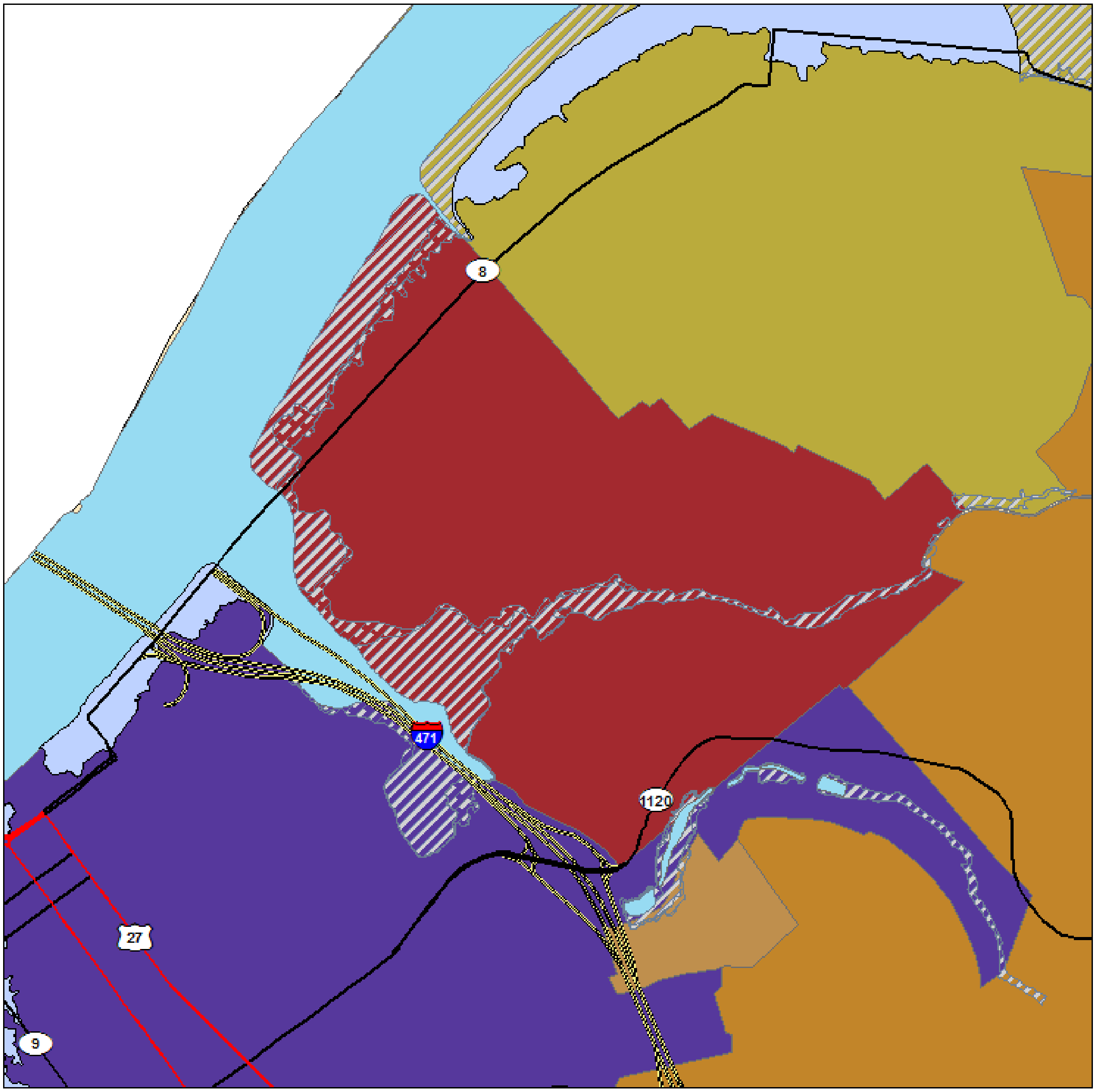




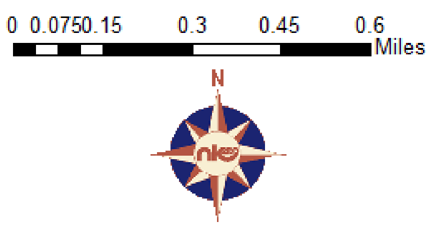
LIMITATION OF LIABILITY: THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.

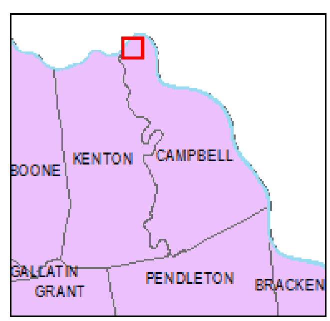


City of Bellevue Flood Hazard Area

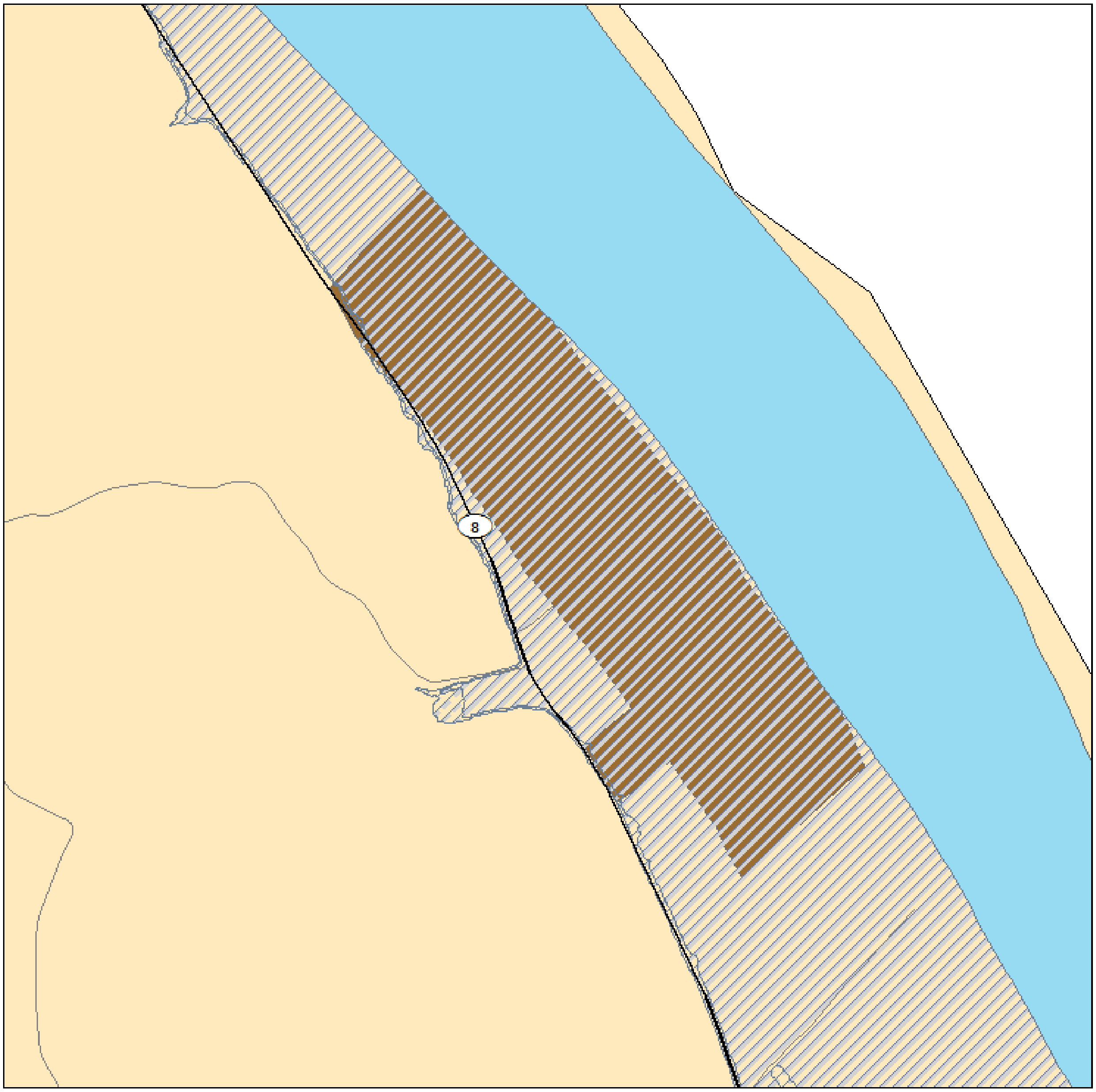


- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway

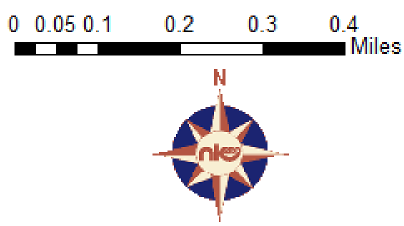


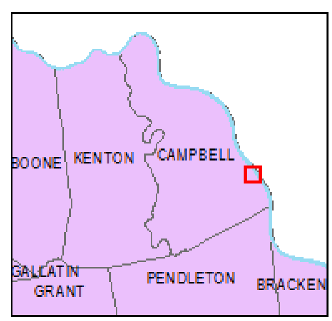


City of California Flood Hazard Area

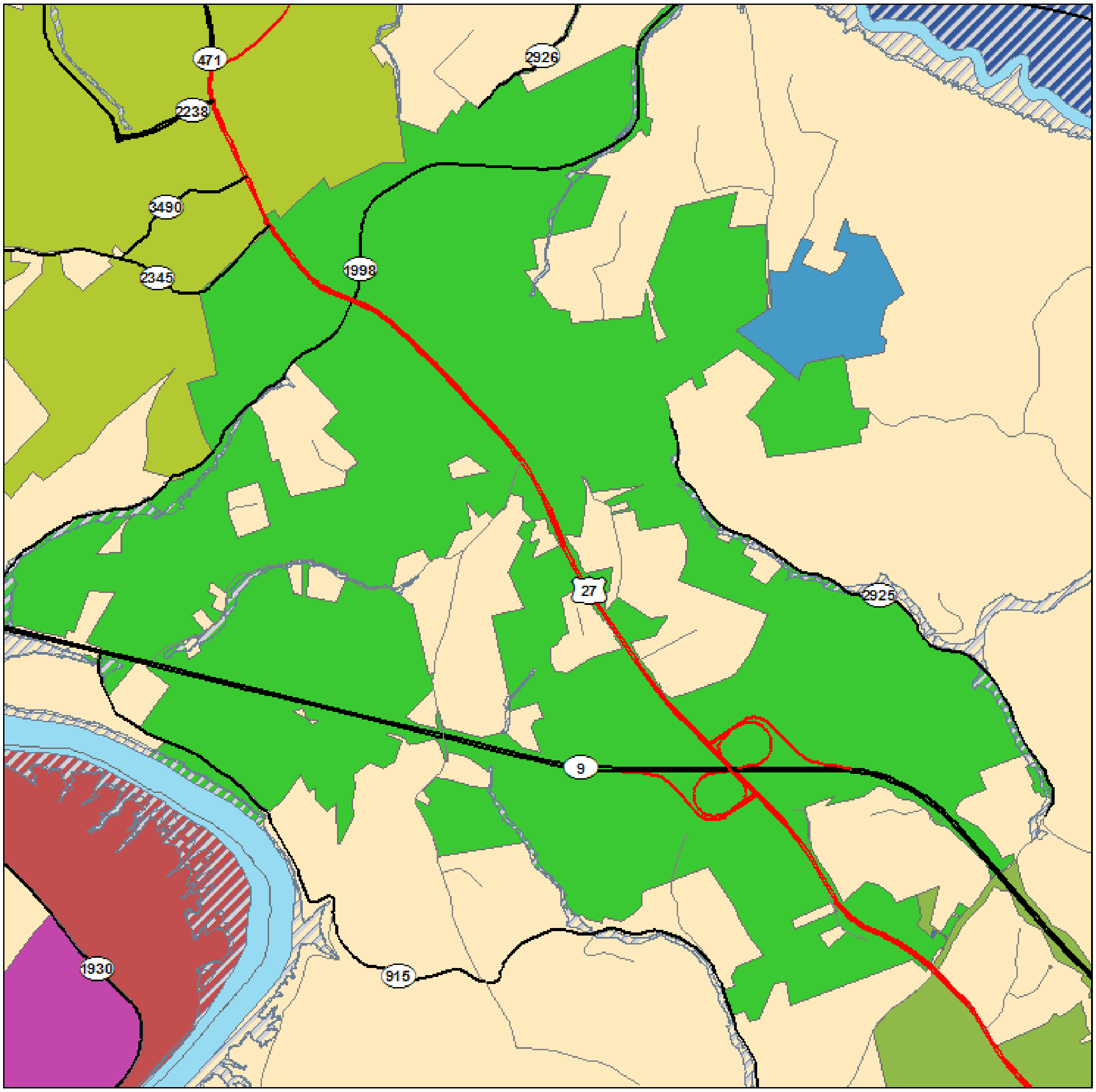


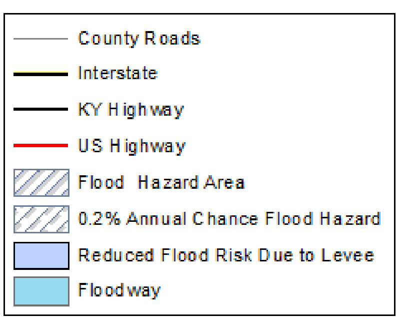
- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway

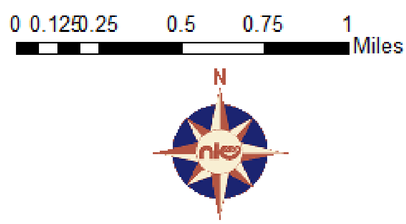


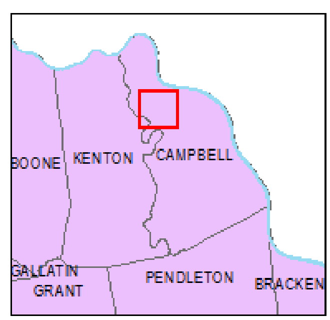


City of Cold Spring Flood Hazard Area

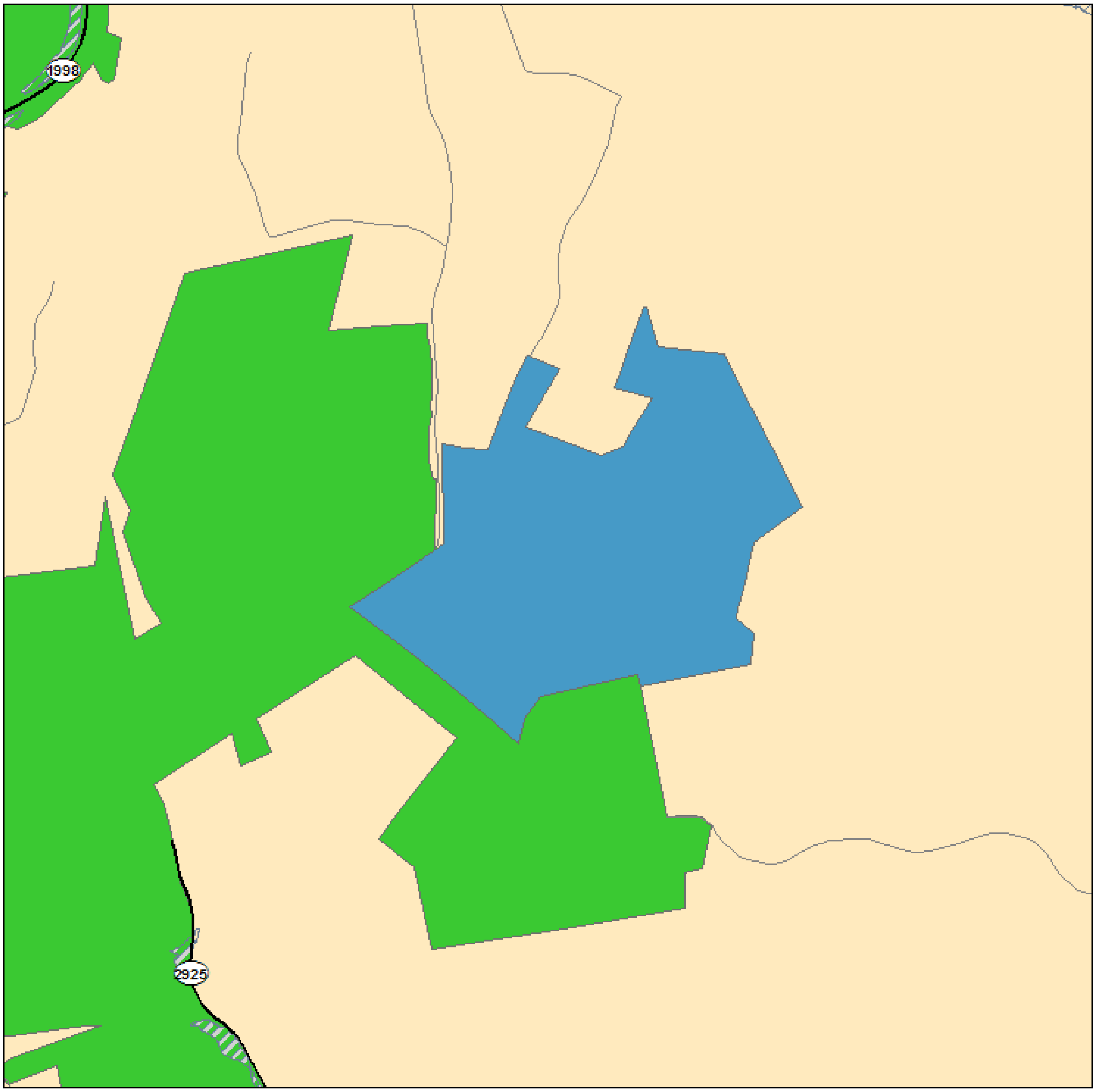




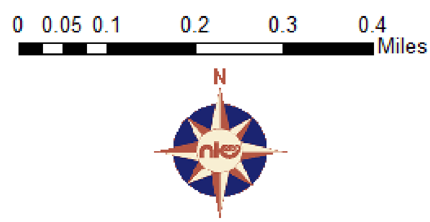


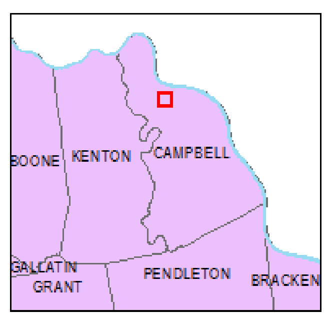


City of Crestview Flood Hazard Area

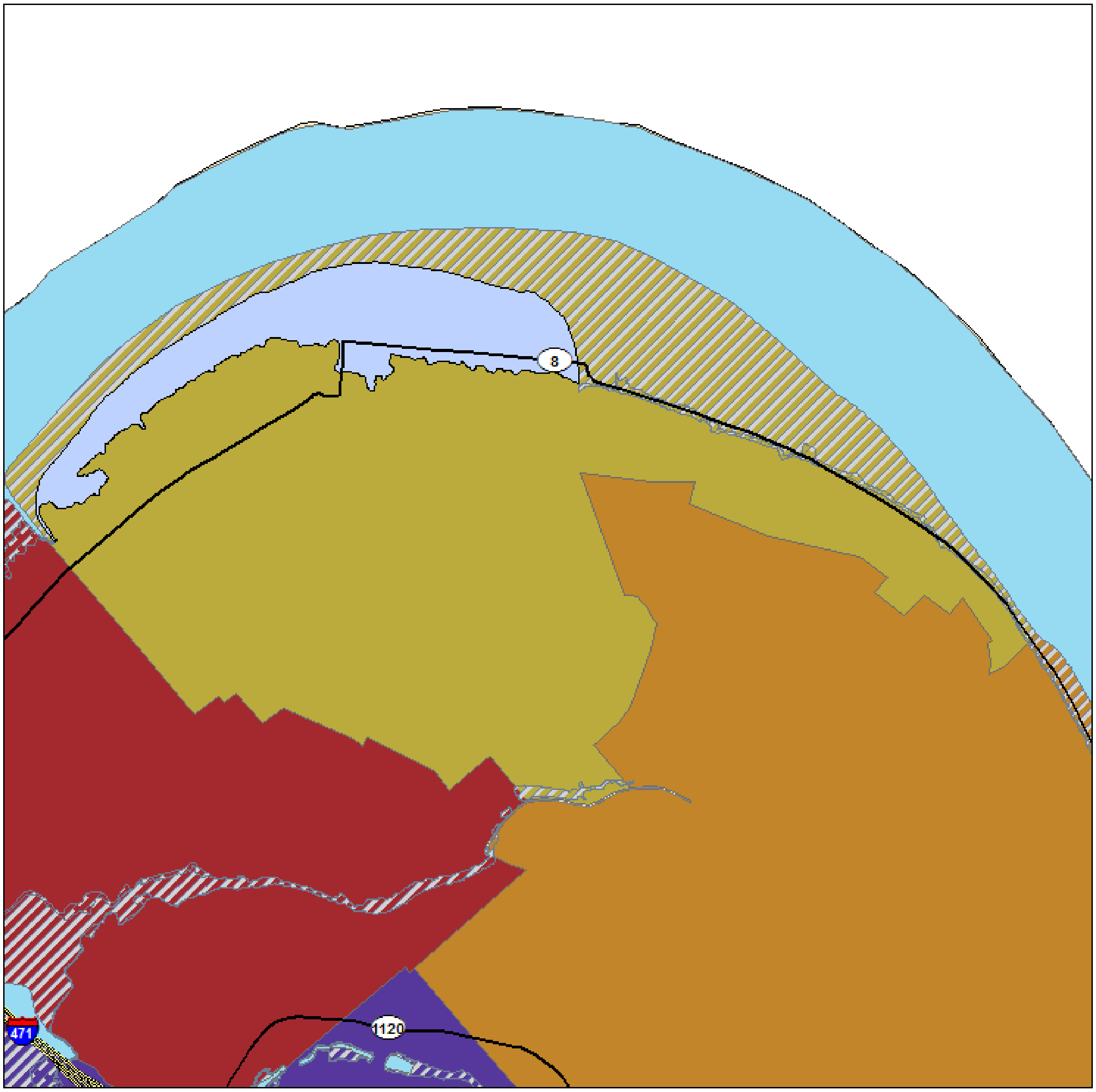


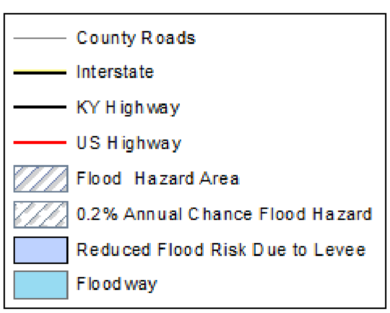
- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway

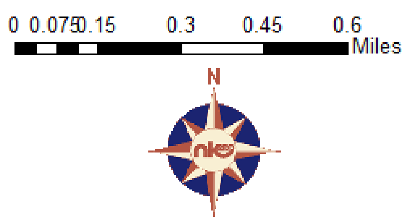




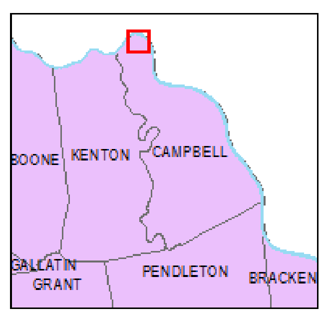
City of Dayton Flood Hazard Area



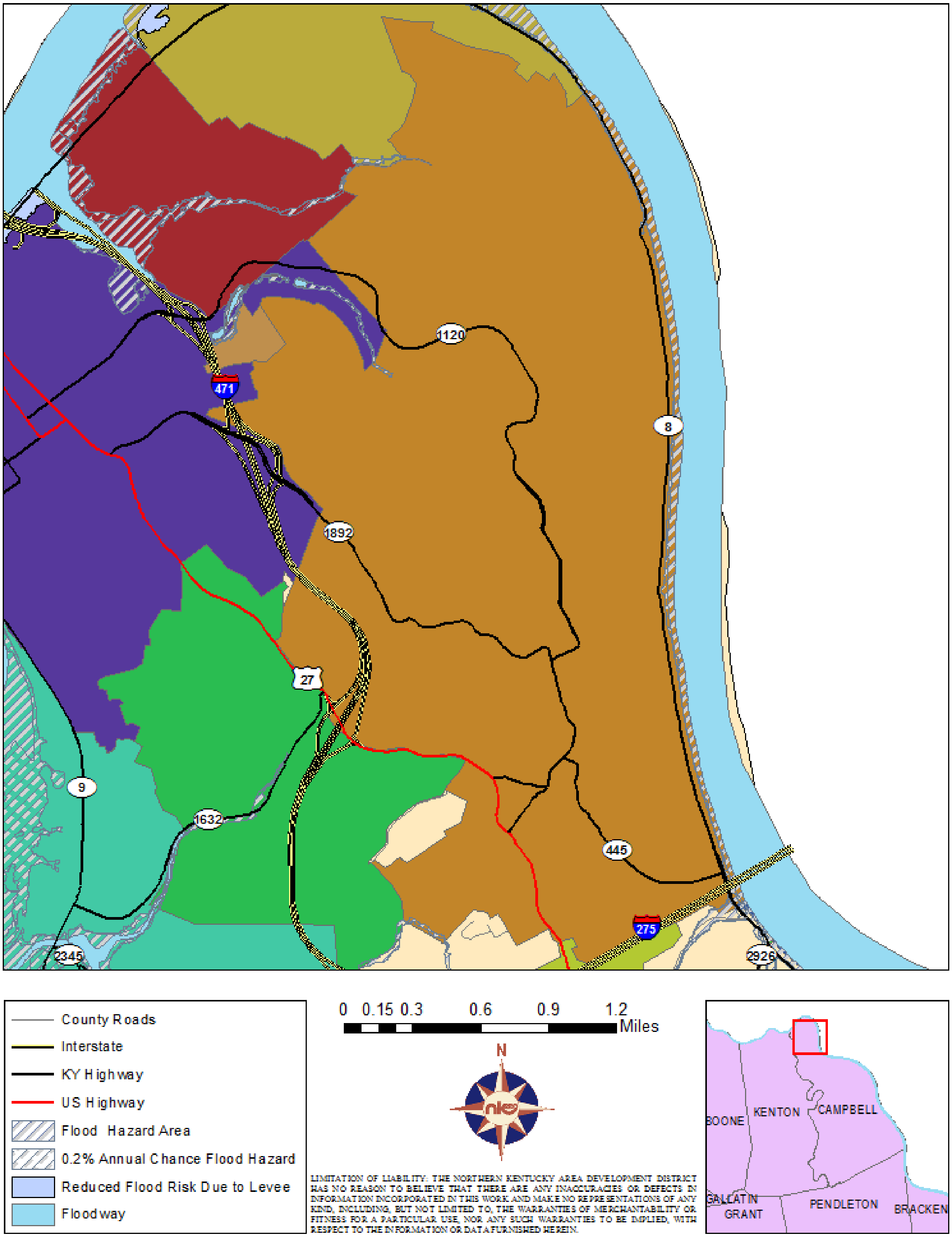




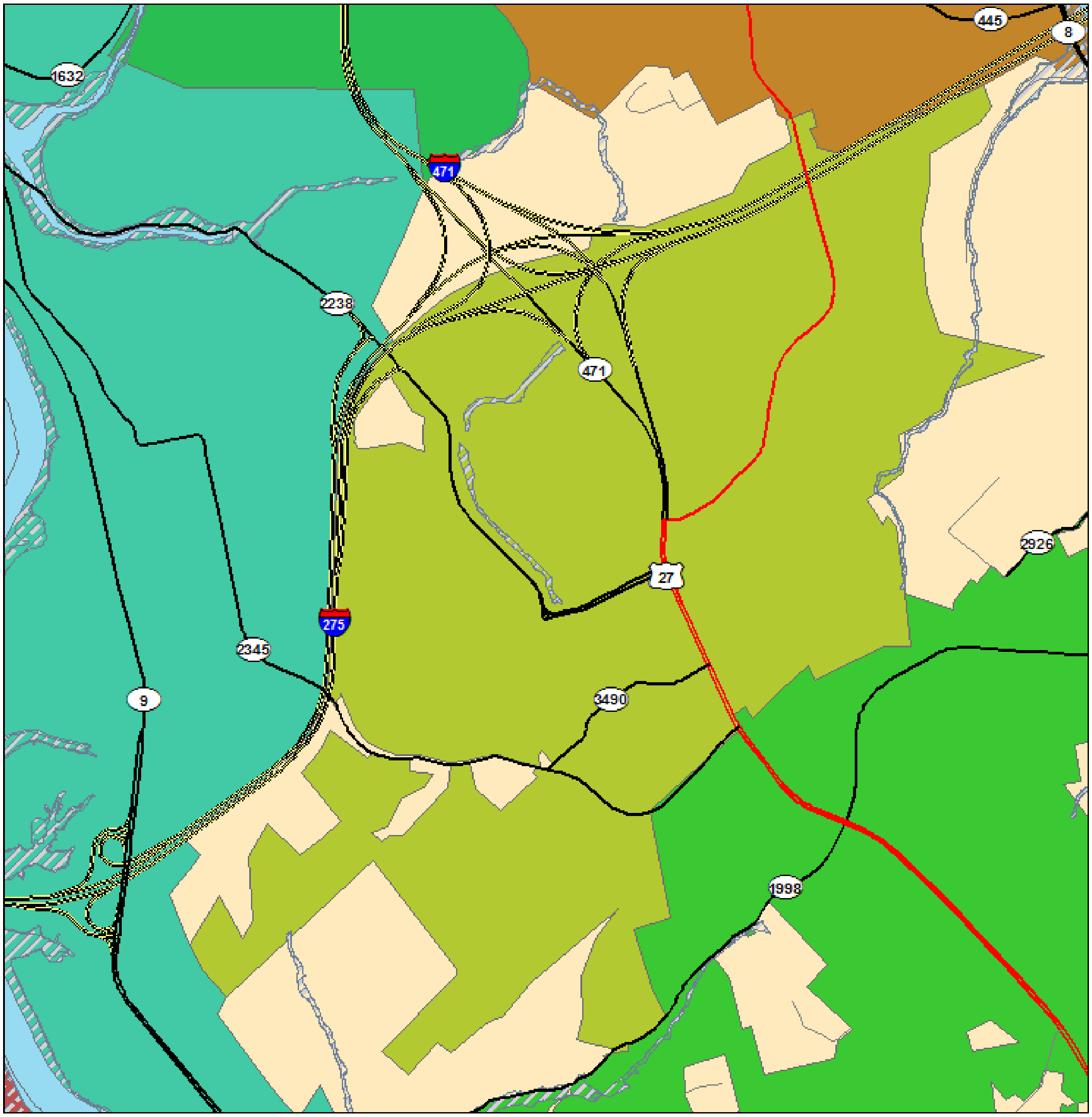
LIMITATION OF LIABILITY: THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.



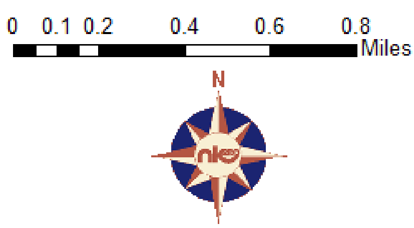
City of Fort Thomas Flood Hazard Area



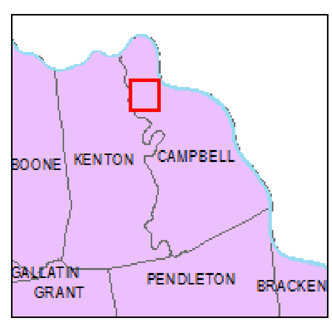
City of Highland Heights Flood Hazard Area



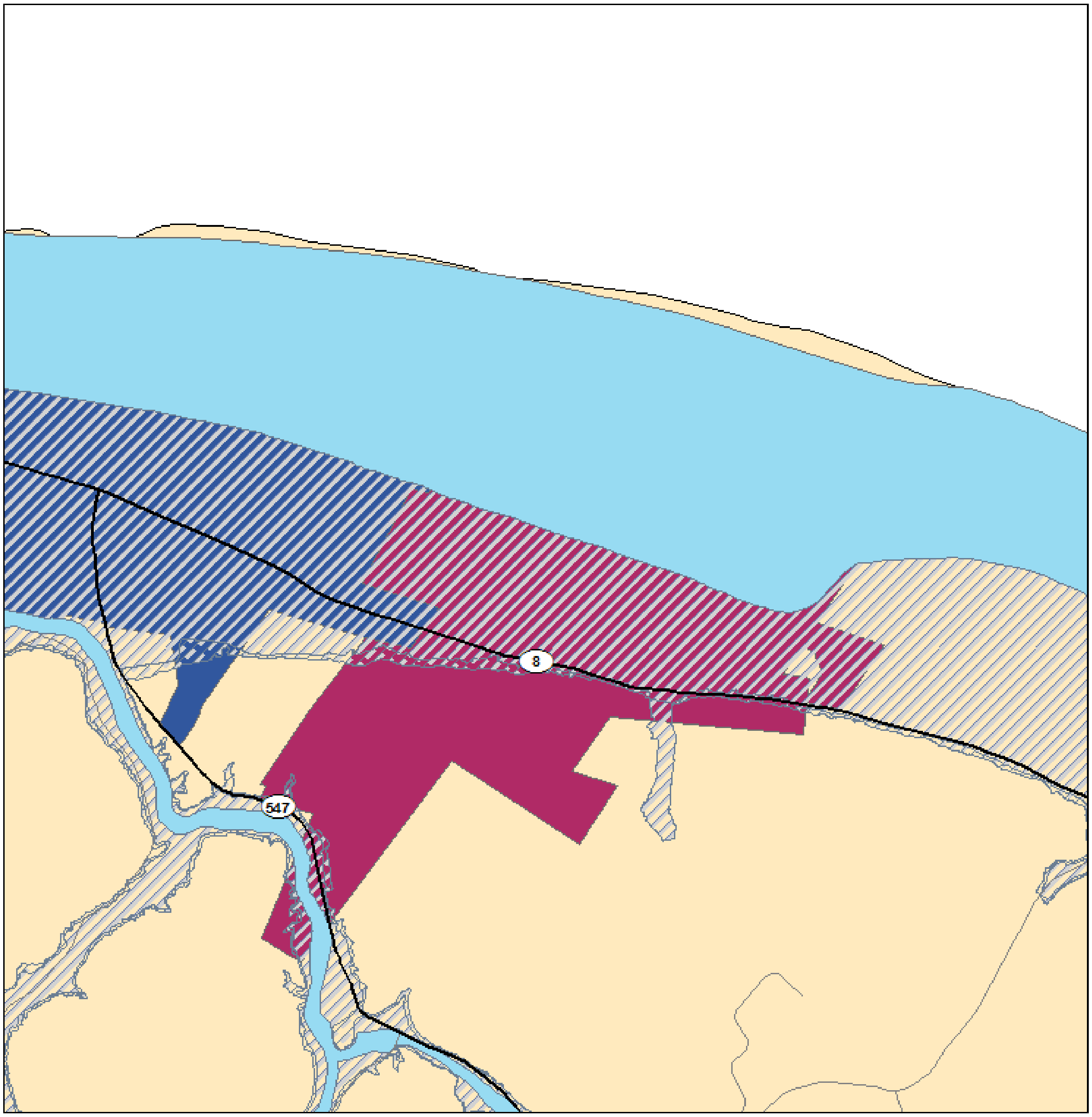
- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway



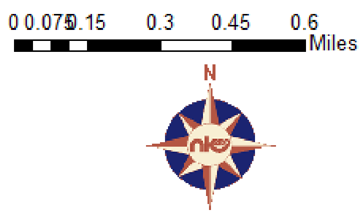
LIMITATION OF LIABILITY: THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.

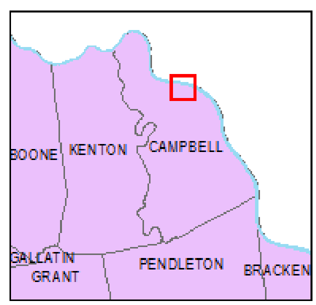


City of Melbourne Flood Hazard Area

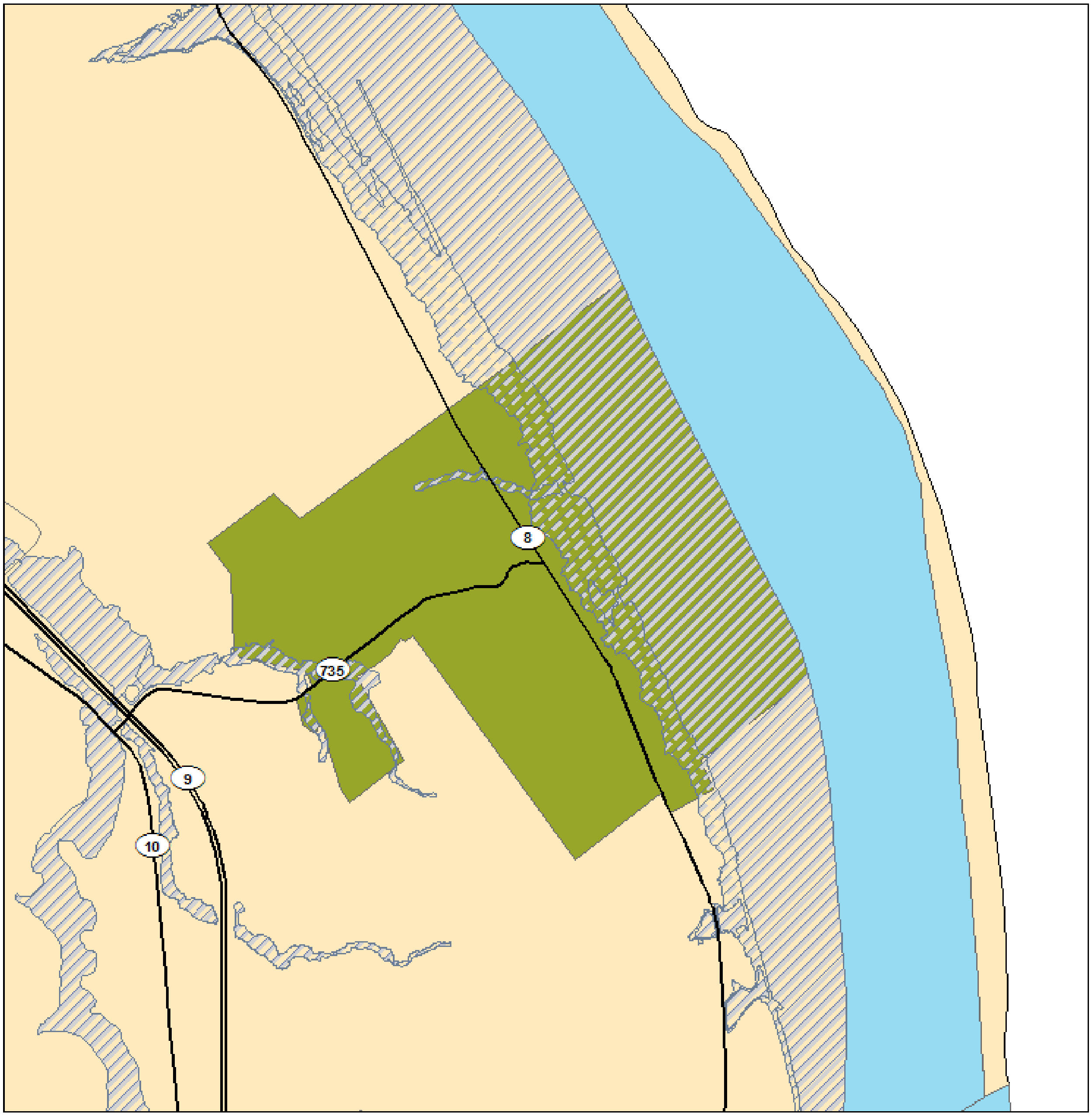


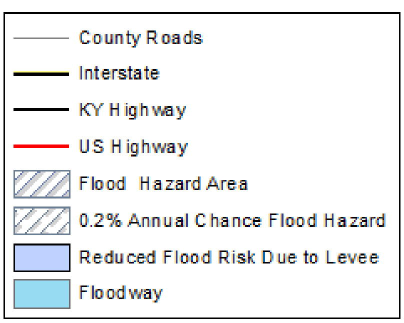
- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway

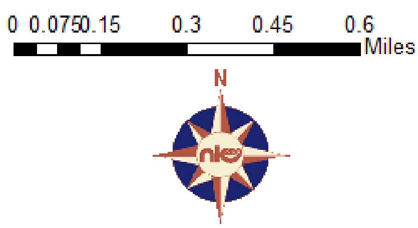


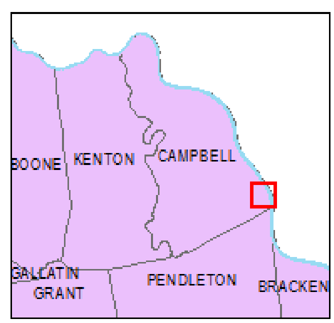


City of Mentor Flood Hazard Area

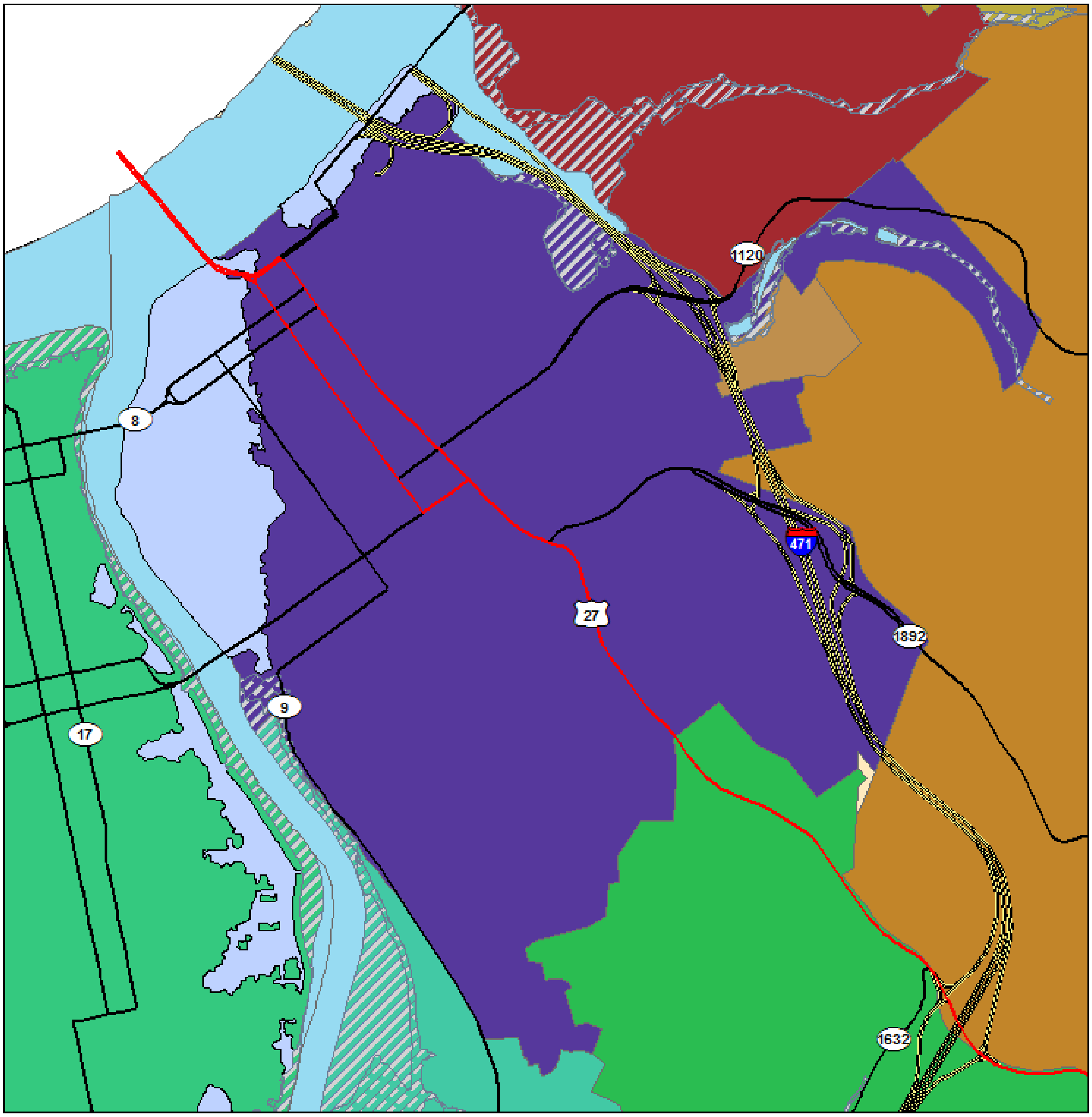








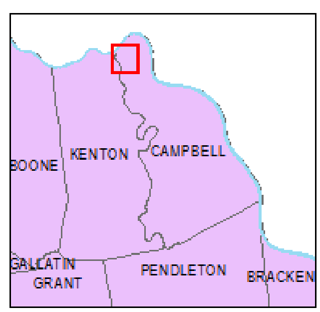
City of Newport Flood Hazard Area



- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway

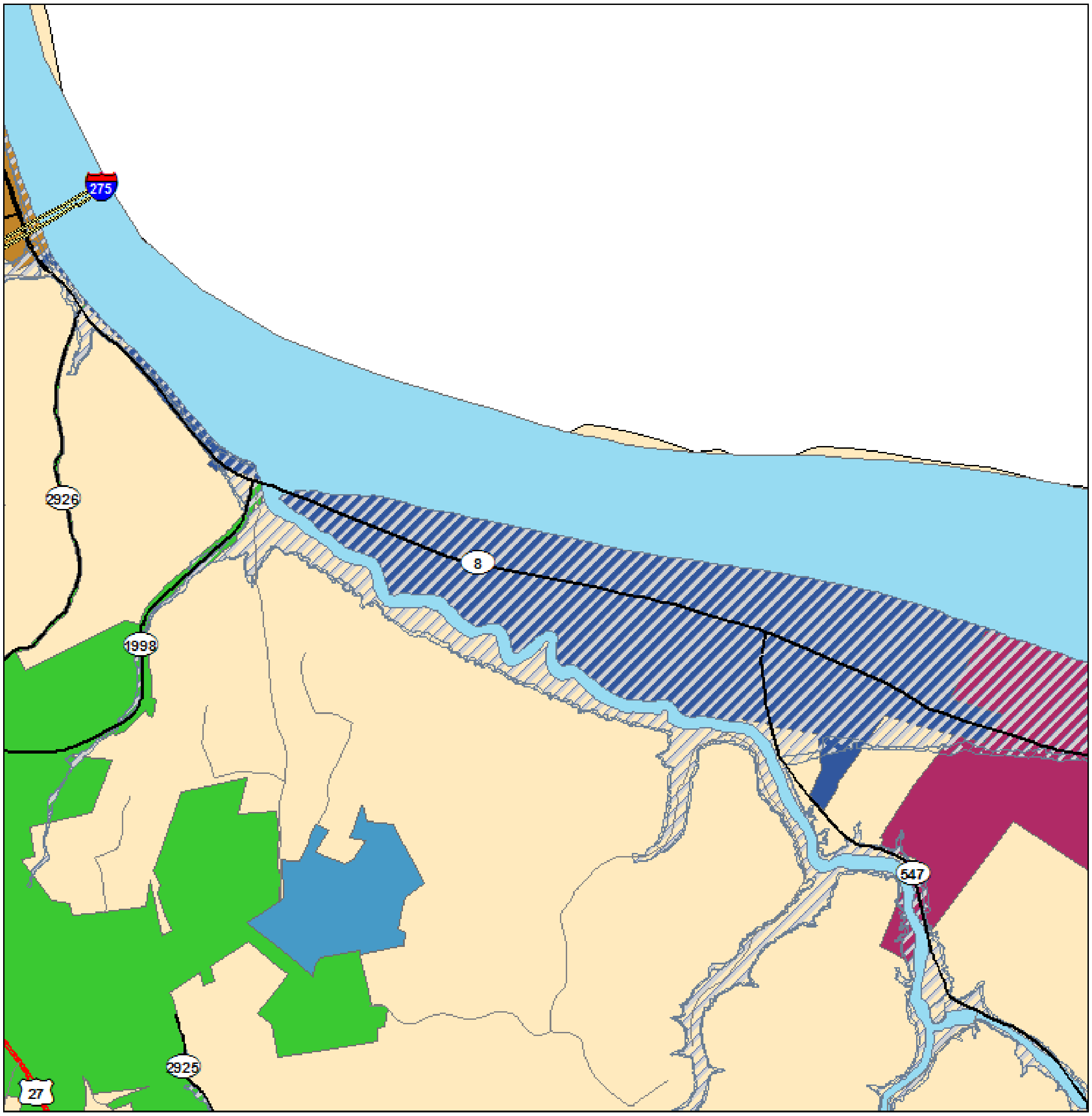
0 0.1 0.2 0.4 0.6 0.8 Miles

N



LIMITATION OF LIABILITY: THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.

City of Silver Grove Flood Hazard Area

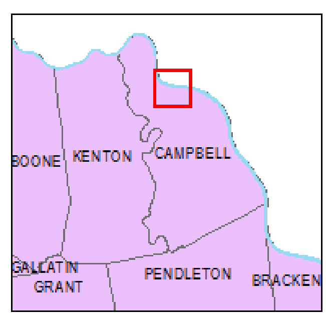


- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway

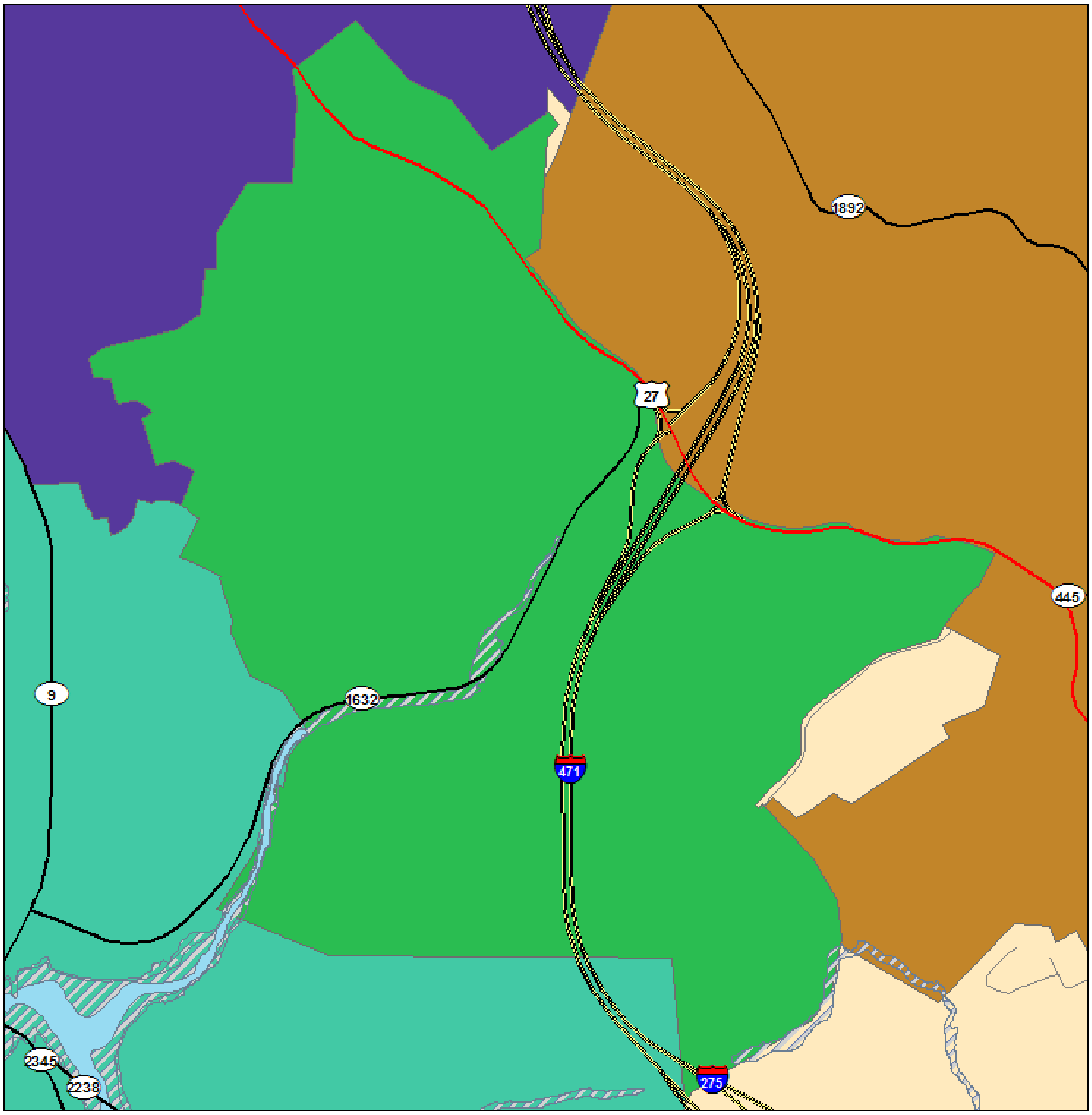
0 0.125 0.25 0.5 0.75 1 Miles

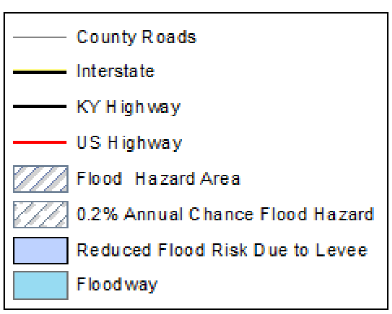
N

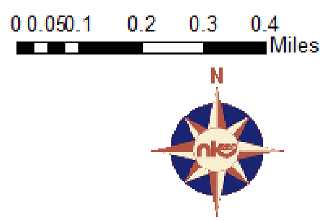
LIMITATION OF LIABILITY: THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.

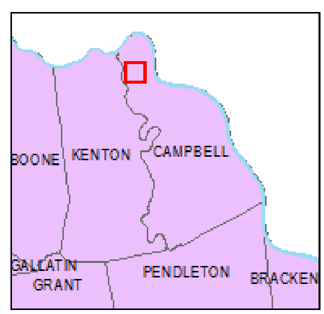


City of Southgate Flood Hazard Area

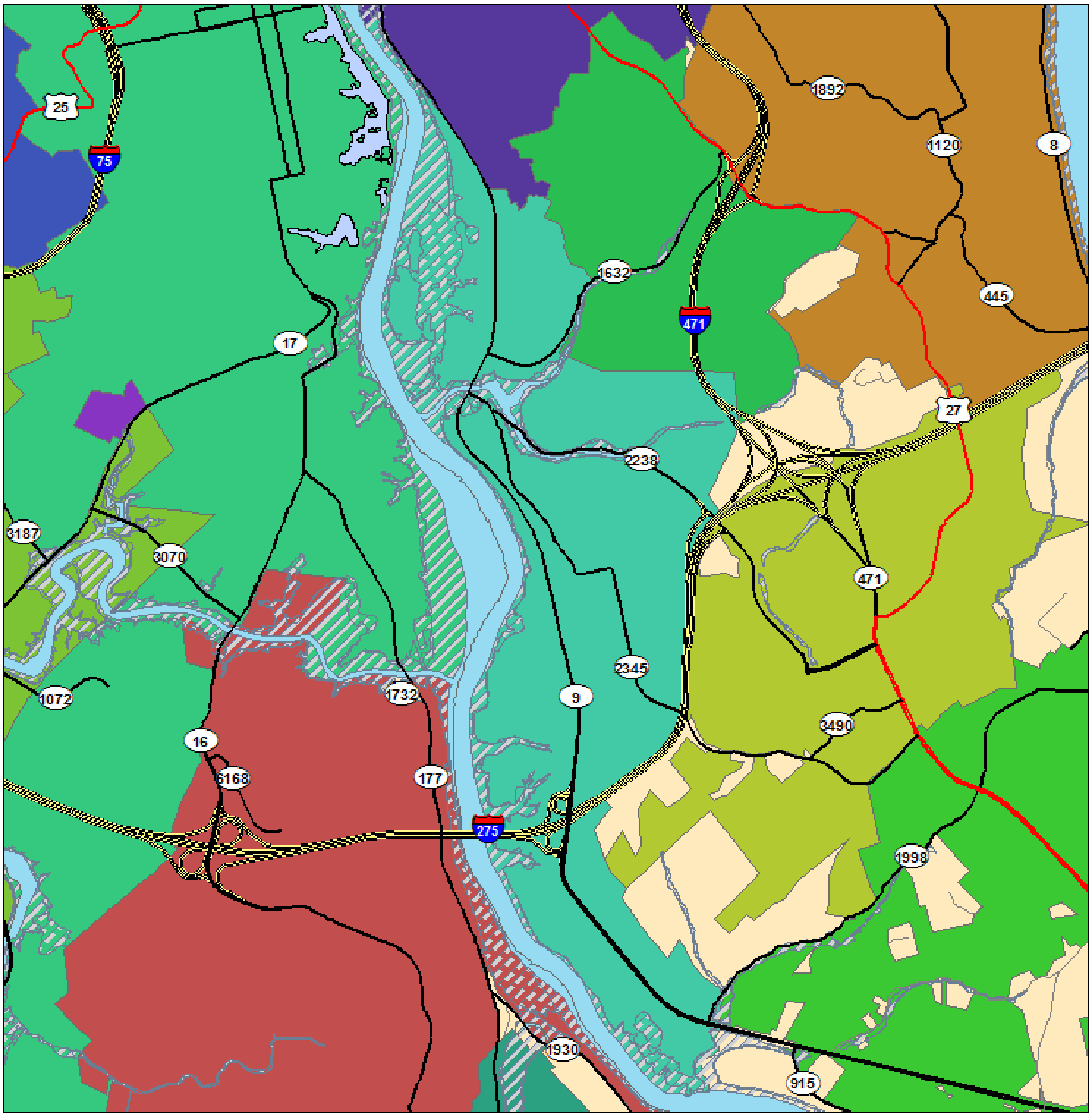




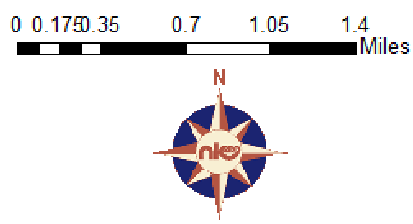




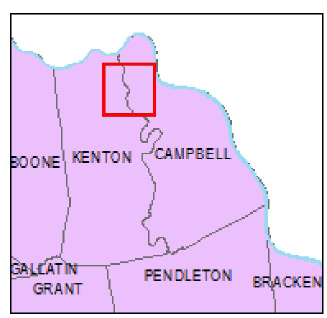
City of Wilder Flood Hazard Area



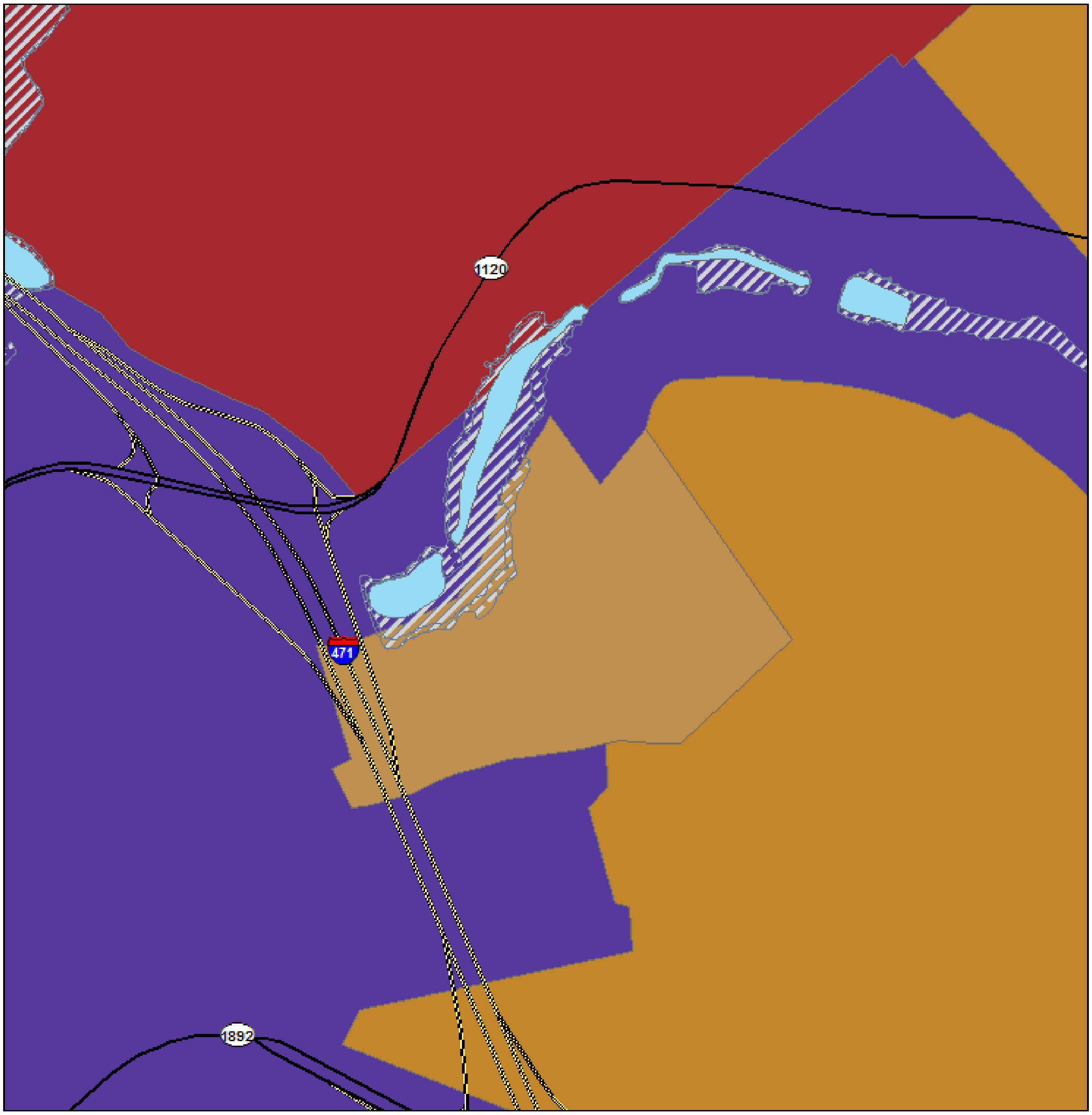
- County Roads
- Interstate
- KY Highway
- US Highway
- Flood Hazard Area
- 0.2% Annual Chance Flood Hazard
- Reduced Flood Risk Due to Levee
- Floodway



LIMITATION OF LIABILITY: THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.



City of Woodlawn Flood Hazard Area

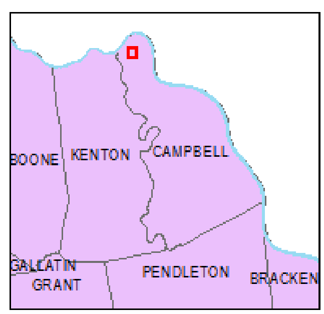


County Roads
Interstate
KY Highway
US Highway
Flood Hazard Area
0.2% Annual Chance Flood Hazard
Reduced Flood Risk Due to Levee
Floodway

0 0.03 0.06 0.12 0.18 0.24 Miles

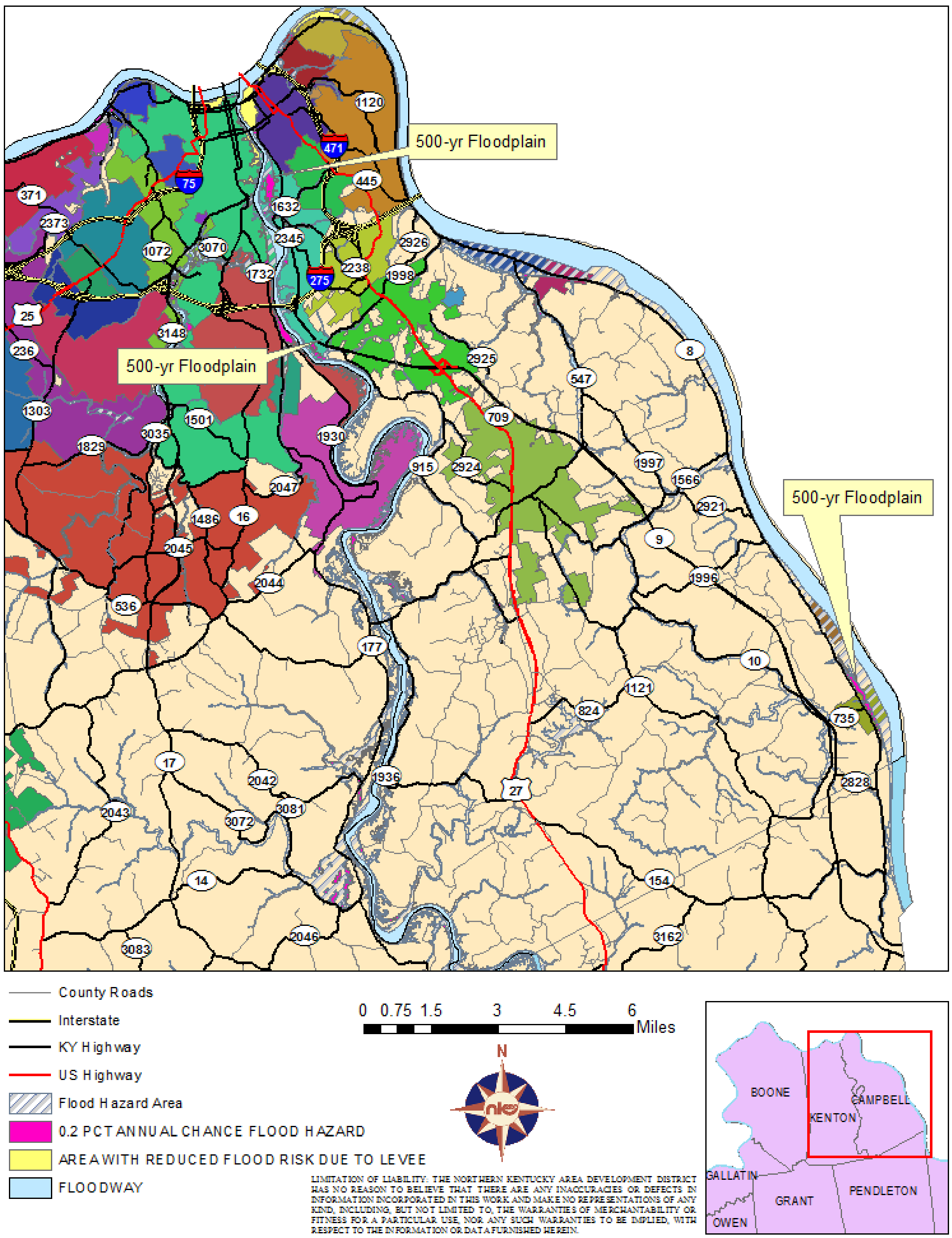
N

LIMITATION OF LIABILITY: THE NORTHERN KENTUCKY AREA DEVELOPMENT DISTRICT HAS NO REASON TO BELIEVE THAT THERE ARE ANY INACCURACIES OR DEFECTS IN INFORMATION INCORPORATED IN THIS WORK AND MAKE NO REPRESENTATIONS OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, NOR ANY SUCH WARRANTIES TO BE IMPLIED, WITH RESPECT TO THE INFORMATION OR DATA FURNISHED HEREIN.



The map below shows the estimated 500-year floodplain, where there is a 0.2% annual chance of a flood. While there is not much difference between the 500-year and 100-year floodplain, there are some areas that will be affected by a larger historic event. It is important to keep in mind that this map does not include flash flooding, where many problems can be anticipated from such an historic event that would cause a 500-year flood.

Campbell County 500 Year Floodplain



Dam/Levee Failure

Types

Manmade dams may be classified by: 1) the type of materials used; 2) the methods used in construction; 3) the slope or cross-section of the dam; 4) the way the dam resists water pressure forces; 5) the means for controlling seepage; and 6) the purpose of the dam. Materials used for dams may include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, and miscellaneous materials such as plastic or rubber.

- Embankment dams, the most common type of dam in use today, are made from materials which include natural soil or rock, or waste materials obtained from mining or milling operations. An embankment dam is termed an “earth-fill” or “rock-fill” dam depending on whether it is comprised of compacted earth or of dumped rock. The ability of an embankment dam to resist the reservoir water pressure is primarily a result of the mass weight and the type and strength of the materials from which the dam is made.

- Concrete dams may be categorized as gravity or arch dams according to the design used to resist the stress of reservoir water pressure. Concrete gravity dams use the mass weight of concrete and friction to resist reservoir water pressure. A buttress dam is a specific type of gravity dam in which the large mass of concrete is reduced, and the forces are diverted to the dam foundation through vertical or sloping buttresses.

- Concrete arch dams are typically thin in cross-section. The reservoir water forces acting on an arch dam are carried laterally into the abutments. The shape of the arch may resemble a segment of a circle or an ellipse, and the arch may be curved in the vertical plane as well. Such dams are usually constructed of a series of thin vertical blocks that are keyed together with barriers to stop water from flowing between the blocks.

- Coal impoundments are any structure associated with coal mining operations built to impound water and are either 20 feet high or capable of impounding 20 acre feet of water. Coal impoundments store coal slurry comprised of wastewater and impurities that result from coal washing and processing. A bulkhead or embankment is made of coarse coal refuse and acts as a dam. Behind it lies a pond of coal slurry. Sediment settles out of this turbid mixture, filling the pond, while wastewater is recycled back into the coal washing process. The sizes of the ponds and bulkheads vary, but pond basins are often hundreds of feet deep and hold millions of gallons of slurry. Coal impoundment failures have resulted in property damage, environmental contamination and, in one case, loss of life.

A levee is a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

Signs of Potential Dam/Levee Failure

- Seepage. The appearance of seepage on the downstream slope, abutments, or downstream area is cause for concern. If the water is muddy and is coming from a well-defined hole, material is probably being eroded from inside the embankment and a potentially dangerous situation can develop.

- Erosion. Erosion on the dam and spillway is one of the most evident signs of danger. The size of erosion channels and gullies can increase greatly with slight amounts of rainfall.

- Cracks. Cracks are of two types: traverse and longitudinal. Traverse cracks appear perpendicular to the axis of the dam and indicate settlement of the dam. Longitudinal cracks run parallel to the axis of the dam and may be the signal for a slide, or slump, on either face of the dam.

- Slides and Slumps. A massive slide can mean catastrophic failure of the dam. Slides occur for many reasons and their occurrence can mean a major reconstruction effort.

- Subsidence. Subsidence is the vertical movement of the foundation materials due to failure of consolidation. Rate of subsidence may be so slow that it can go unnoticed without proper inspection. Foundation settlement is the result of placing the dam and reservoir on an area lacking suitable strength, or over collapsed caves or mines.

- Structural. Conduit separations or ruptures can result in water leaking into the embankment and subsequent weakening of the dam. Pipe collapse can result in hydraulic failures due to diminished capacity.

- Vegetation. A prominent danger signal is the appearance of "wet environment" types of vegetation such as cattails, reeds, mosses and other wet area vegetation. These types of vegetation can be a sign of seepage.

- Boils. Boils indicate seepage water exiting under some pressure and typically occur in areas downstream of the dam.

- Animal Burrows. Animal burrows are a potential danger since such activity can undermine the structural integrity of the dam.

- Debris. Debris on dams and spillways can reduce the function of spillways, damage structures and valves, and destroy vegetative cover.

Types of Failures

- Hydraulic Failure. Hydraulic failures result from the uncontrolled flow of water over the dam, around the dam and adjacent to the dam, and the erosive action of water on the dam and its foundation. Earth dams are particularly vulnerable to hydraulic failure since earth erodes at relatively small velocities.

- Seepage Failure. All dams exhibit some seepage that must be controlled in velocity and amount. Seepage occurs both through the dam and the foundation. If uncontrolled, seepage can erode material from the foundation of an earth dam to form a conduit through which water can pass. This passing of water often leads to a complete failure of the structure, known as piping.

- Structural Failure. Structural failures involve the rupture of the dam or its foundation. This is particularly a hazard for large dams and for dams built of low strength materials such as silts, slag, fly ash, etc. Dam failures generally result from a complex interrelationship of several failure modes. Uncontrolled seepage may weaken the soils and lead to a structural failure. Structural failure may shorten the seepage path and lead to a piping failure. Surface erosion may lead to structural or piping failures.

Impacts

Dam failures cause flooding much different from natural flooding. A flood from a dam failure may arrive before any warning or evacuation can occur and the resulting wall-of-water makes evacuation based on limited environmental cues very problematic. The failure of large dams results in flooding with enough energy to damage or destroy residences and other structures.

Dam Failure Profile Risk Table	
Location:	Any area below a dam is susceptible
Period of Occurrence:	Dam Failure is often precipitated by another event such as flooding or earthquake
Number of Events (1978-2014):	0
Annual Rate of Occurrence:	0

Probability of Future Events:	Unlikely
Warning Time:	Can see signs as early as years prior, but actual event warning time is minimal
Potential Impacts:	Impacts on human life and public safety. Economic loss, environmental damage, and disruption of lifeline facilities.
Recorded losses:	Unknown
Annualized Loss:	Unknown
Extent (Scale)	None

National Performance of Dam Program, Dam Incident Database, collected 10/20/2015

Dam Inventory

Name	Impoundment	Hazard[1]	Height	Drainage Area (sq mi)	Lake Area (acres)	Lake Volume	Owner Type[2]	County
Campbell County Lake Dam	AJ Jolly Park Lake	H	48	6.400	204	2,260	S	Campbell
Claryville Lake Dam	Bob White Club Lake	H	15	0.310	13	42	P	Campbell
Alexandria Dam (Old)	Alexandria Reservoir (Old)	H	35	0.220	6	61	L	Campbell
Covington Dam (North)	Covington_Reservoir (North)	S	22	0.050	6	40	L	Campbell
Covington Dam (South)	Covington_Reservoir (South)	S	22	0.060	6	40	L	Campbell
Alexandria Dam(New)	Alexandria Reservoir (New)	H	58	0.410	7	111	L	Campbell
Milburn Lake	Milburn Lake	L	42	0.100	3	27	P	Campbell
Dietz Lake (Lower)Dam)	Dietz Lake	H	35	0.170	8	60	P	Campbell
River Hills Golf Club Lake	River Hills Golf Club Lake	L	47	0.180	6	87	P	Campbell
Newport Reservoir	Newport Reservoir	S	25	0.210	0	0	L	Campbell
Shadow Lake Dam	Shadow Lake	L	63	0.110	1	0	P	Campbell

US Army of Corps of Engineers, National Inventory of Dams, 2015; and KYDOW

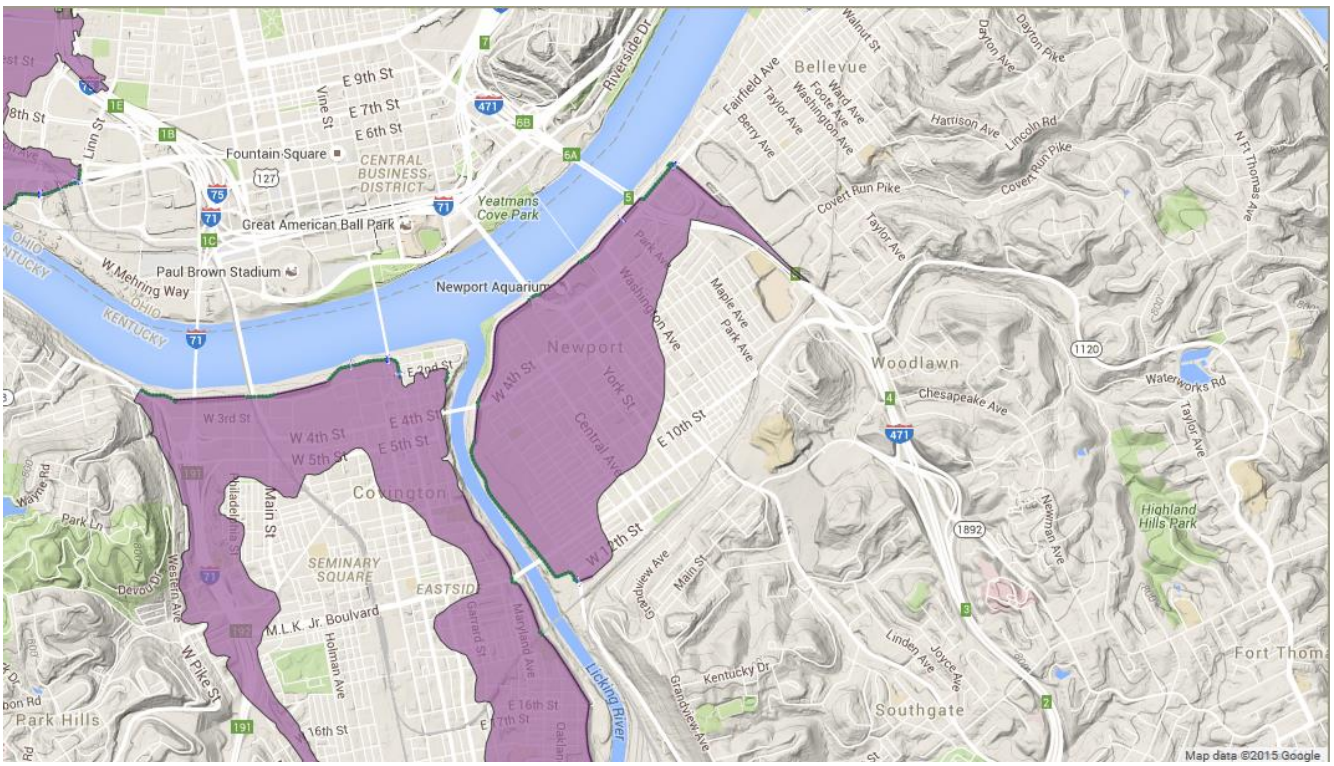
1. Hazard: H = High, S = Significant, L = Low
2. Owner: F = Federal Government, L = Local Government, S = State Government, P = Private

There are 5 'high-risk' dams in Campbell County that pose a threat to property and loss of life, however there is no history of events in this region. High risk is defined as primarily being a risk for loss of life, and secondarily as a loss to commerce, recreation, etc. The condition of the dam is not taken into account in this particular risk definition. Those 5 'high-risk' dams are:

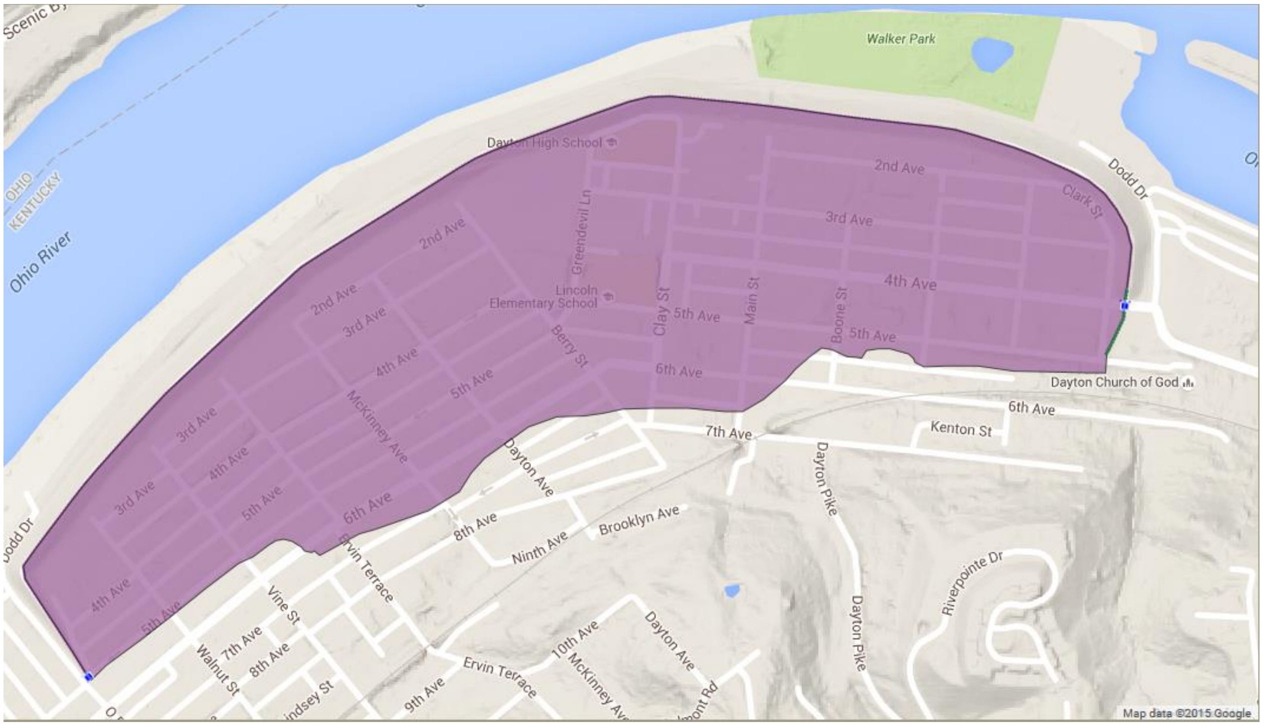
- Campbell County Lake Dam (AJ Jolly)
- Claryville Lake Dam (Bob White Club Lake)
- Alexandria Dam (New)
- Alexandria Dam (Old)
- Dietz Lake (Lower) Dam

There are 2 levees in Campbell County, along the Ohio River in the City of Newport and the City of Dayton. According to the US Army Corps of Engineers National Levee Database, the levee in Newport is 1.26 miles long, is designed for a 500 year flood with 3 feet of freeboard. The levee construction was completed in 1951. Its last routine inspection date was March 22, 2013 and it was found minimally acceptable. The leveed area is over 439 acres. The levee in Dayton is 1.45 miles long, is designed for a 500 year flood with 3 feet of free board. The levee construction was completed in 1981. Its last routine inspection February 22, 2013 and it was found minimally acceptable. The leveed area is over 170 acres.

Newport Leveed Area (USACE, National Levee Database):



Dayton Leveed Area (USACE, National Levee Database):



Landslide

A landslide is the movement of a mass of earth or rock from a higher elevation to a lower level under the influence of gravity. Landslides can be large or small, slow or fast.

Several natural and human factors may contribute to or influence landslides. The three principal natural factors are topography, geology, and precipitation. The principal human activities are cut-and-fill construction for highways, construction of buildings and railroads, and mining operations. Landslides are often correlated with other natural hazards. For instance, flooding may trigger a landslide because both involve heavy precipitation, runoff, and ground saturation. Landslides constitute a major geologic hazard because they are widespread and occur in all 50 states. Landslides pose serious threats to roadways, utilities, and structures.

Slumping landslides that occur along roadways are typical in the region where steep slopes, thick colluvial soils, and loading or undercutting of the slope by road construction create slope instability. Landslides regularly close sections of Ky. 8 after sudden movement of the steep slopes along the riverside route washes mud and trees onto the highway.

Landslides have a significant social and economic impact on the Northern Kentucky region, and the costs of landslide prevention and remediation in this area are reportedly among the highest in the nation. To date however, it has been difficult to quantify the cost of landslide damage because of the variety and degree of applicability of accessible records available providing information on the extent of repair and replacement costs or the costs associated with the implementation of procedures to prevent landslide damage (U.S. Geologic Survey).

Public and private economic losses from landslides include not only the direct costs of replacing and repairing damaged facilities, but also the indirect cost associated with lost productivity, disruption of utility and transportation systems, reduced property values, and costs for any litigation. Some indirect costs are difficult to evaluate, thus estimates are usually conservative or simply ignored. If indirect costs were realistically determined, they likely would exceed direct costs.

Much of the economic loss is borne by federal, state, and local agencies responsible for disaster assistance, flood insurance, and highway maintenance and repair. Private costs involve mainly damage to land and infrastructures. A severe landslide can result in financial ruin for the property owners because landslide insurance (except for debris flow coverage) or other means of spreading the costs of damage are unavailable.

Types – based on the mode of movement

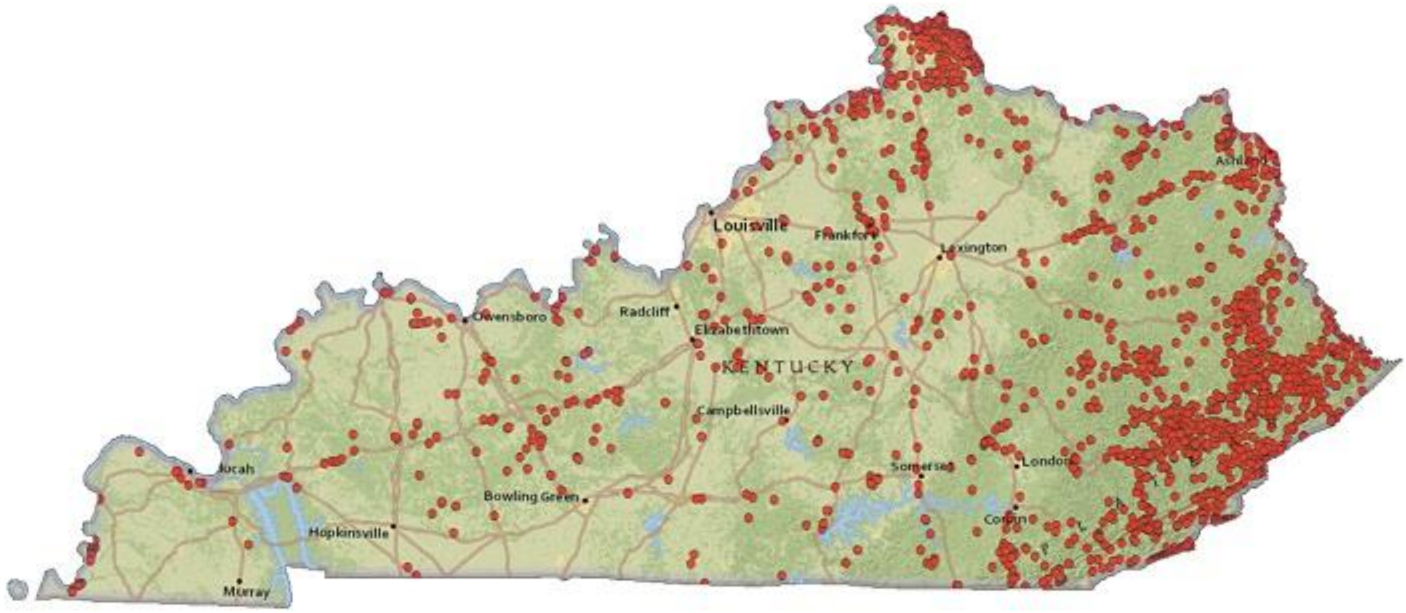
• Slides of soil or rock involve downward displacement along one of more failure surfaces. The material from the slide may be broken into a number of pieces or remain a single, intact mass. Sliding can be rotational, where movement involves turning about a specific point. Sliding can be translational, where movement is down slope on a path roughly parallel to the failure surface. The most common example of a rotational slide is a slump, which has a strong, backward rotational component and a curved, upwardly-concave failure surface.

• Flows are characterized by shear strains distributed throughout the mass of material. They are distinguished from slides by high water content and distribution of velocities resembling that of viscous fluids. Debris flows are common occurrences in much of North America. These flows are a form of rapid movement in which loose soils, rocks, and organic matter, combined with air and water, form slurry that flows downslope. The term "debris avalanche" describes a variety of very rapid to extremely rapid debris flows associated with volcanic hazards. Mudflows are flows of fine-grained materials, such as sand, silt, or clay, with high water content and less than 50 percent gravel.

• Lateral spreads are characterized by large elements of distributed, lateral displacement of materials. They occur in rock, but the process is not well-documented and the movement rates are very slow. Lateral spreads can occur in fine-grained, sensitive soils such as quick clays, particularly if remolded or disturbed by construction and grading. Loose, granular soils commonly produce lateral spread through liquefaction. Liquefaction can occur spontaneously, presumably because of changes in pore-water pressures, or in response to vibrations such as those produced by strong earthquakes.

• Falls occur when masses of rock or other material detach from a steep slope or cliff and descend by free fall, rolling, or bouncing. These movements are rapid to extremely rapid and are commonly triggered by earthquakes. Topples consist of forward rotation of rocks or other materials about a pivot point on a hill slope. Toppling may culminate in abrupt falling, sliding, or bouncing, but the movement is tilting without resulting in collapse.

The map below is from the Kentucky Geological Survey's website and depicts selected locations of landslides. The Northern Kentucky region experiences a vast amount landslides compared to the rest of the state, particularly when taking into account that the eastern region that experiences numerous landslides also has mines. From the KGS website on the map below: "Selected known landslides in Kentucky. Although exact costs are not documented, landslides affect roads, buildings, pipelines, private residences, and other parts of the built environment. Direct costs such as repair and maintenance exceed $10 million per year, and indirect costs may exceed direct costs but are difficult to quantify. With a good landslide inventory, citizens can begin to understand landslides processes, assess risk, and prevent damage from the threats they pose."



Source: Kentucky Geological Survey, University of Kentucky, http://www.uky.edu/KGS/geologichazards/landslide.htm, last modified 9/18/2015, collected 10/22/2015.

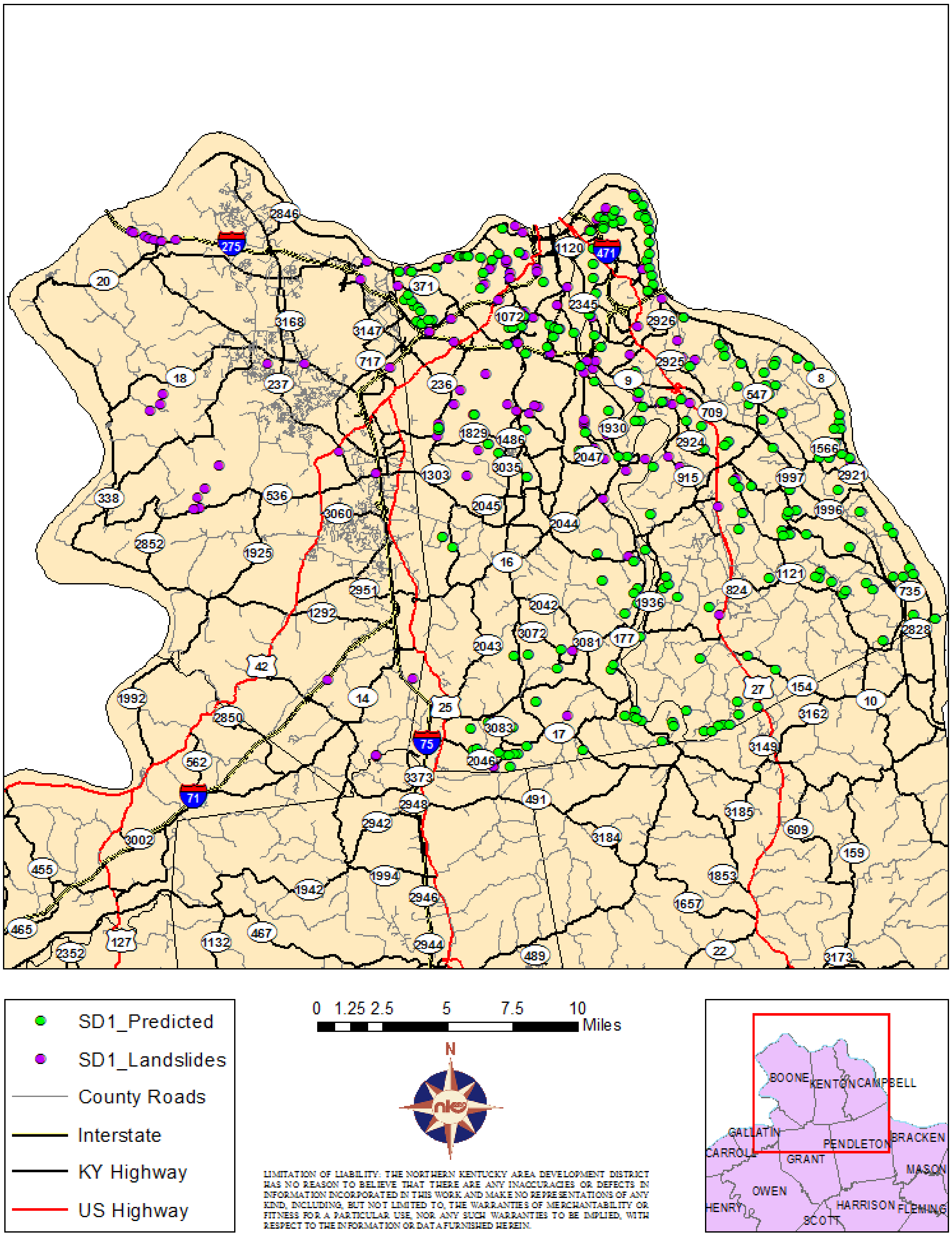
Landslide Profile Risk Table	
Location:	Areas with steep slopes and slippery soils are most susceptible.
Period of Occurrence:	Anytime, but chance increases after heavy rain, snow/ice melt, or construction activities.
Number of Events (1975-2014):	dozens - from road cracking to washouts, the exact number is difficult to calculate for all local, county, and state roads 22 recorded including costs
Annual Rate of Occurrence:	Days to months
Probability of Future Events:	Highly Likely
Warning Time:	Anytime, but chance increases after heavy rain, snow/ice melt, or construction activities.
Potential Impacts:	Economic losses such as decreased land values, infrastructure damage, and agro-business losses. May cause minimal to severe property damage and destruction.
Recorded losses:	$950,128 (not including most county roads)
Annualized Loss:	$24,632
Extent (Scale)	No current measurement to compare severity of events. Some small slides cause a lot of property damage, while some large slides cause minimal damage. From the limited information we have available, the largest slide in Campbell was on an unspecified date in Alexandria on Sheridan Drive, costing about $275,000 (SD1).

Estimates for losses due to landslides are difficult to quantify, as damage varies greatly from one event to the next, and some events are quick while others occur slowly over time.

The Commonwealth of Kentucky Enhanced Hazard Mitigation Plan: 2013 Version states that the recorded losses from 1975-2013 was $28,365,706 for the entire state (Kentucky Geological Survey). This number is only for tracked and recorded landslides; it does not account for numerous other issues that local entities cope with before they become major issues.

The Landslide map below shows past and predicted events that Sanitation District No. 1 tracks. This information comes from KYTC, PDSKC (formerly NKAPC), KGS, and other sources. Sanitation District No. 1's jurisdiction only covers Boone, Kenton and Campbell counties, which is why our information is very limited. However, the other counties have generally similar soils and topographies, so we can estimate that they experience the same issues. The Predicted Events are areas that SD1 has observed are susceptible to landslides.

Boone, Kenton, Campbell Landslide Events, Past & Predicted



The table below shows roads in KYTC's and Campbell County's jurisdiction that have issues with landslides. It does not account for local city roads because that data was unavailable. This table should be considered active as it is continually updated.

Landslides		
Road Name	**MP/Locator**	**Jurisdiction**
KY 8	unknown	KYTC
KY 9	in Newport and Wilder	KYTC
KY 915	Licking Pike	KYTC
Blangey Road	-84.438986, 39.047314	County
California Cross Road	-84.323845, 38.874090; -84.306275, 38.892993	County
Clay Ridge	-84.420, 38.835	County
Covert Run Pike	-84.459, 39.102	County
Dry Creek Road	-84.440, 39.013	County
East Alexandria Pike	-84.401, 38.998	County
Hissem Road	-84.399412, 38.833937	County
John Miller Road	-84.431908, 38.924104	County
Poplar Thicket Road	-84.422104, 38.955345	County
Rifle Range Road	-84.438081, 38.9613432	County
Shaw Hess Road	-84.354932, 38.899160	County
Upper Tug Fork Road	-84.380574, 38.993109	County
Visalia Road	-84.434, 38.906	County

The most landslide prone road is KY 8. There are multiple sections in Campbell County that frequently experience slides. Some of these slides are due to repeated flooding, but often it is due to the geography and soil types on which the road is located. Maintenance is the most cost effective way for KYTC to handle these slides at this time. Reconstruction can cost millions of dollars, without a guarantee that it will not slide again.

The need for slide repairs is fairly constant each year. The County Road Department and Planning Office estimate the County will need to spend about $100,000 each year for the next 10 years on slide related repairs on county roads.

Earthquake

An earthquake is a shaking of the ground caused by the sudden release of accumulated strain by an abrupt shift of rock along a fracture in the Earth or by volcanic or magmatic activity, or other sudden stress changes in the Earth (USGS). These fractures are called faults. Fault lines are found anywhere that two or more tectonic plates come together. The tectonic plates are always slowly moving, but they get stuck at their edges due to friction. When the stress on the edge overcomes the friction, there is an earthquake that releases energy in waves that travel through the earth's crust and cause it to shake.

The magnitude of earthquakes is measured on the Richter scale. The scale is based on a logarithmic scale so for each whole number increase on the scale, the amplitude of the ground motion recorded by a seismograph goes up ten times. In other words, a magnitude 5.0 earthquake would result in ten times the level of ground shaking as a magnitude 4.0 earthquake. Each year thousands of earthquakes occur, but most are under a magnitude 2.5 or too small to be felt by most people.

Types

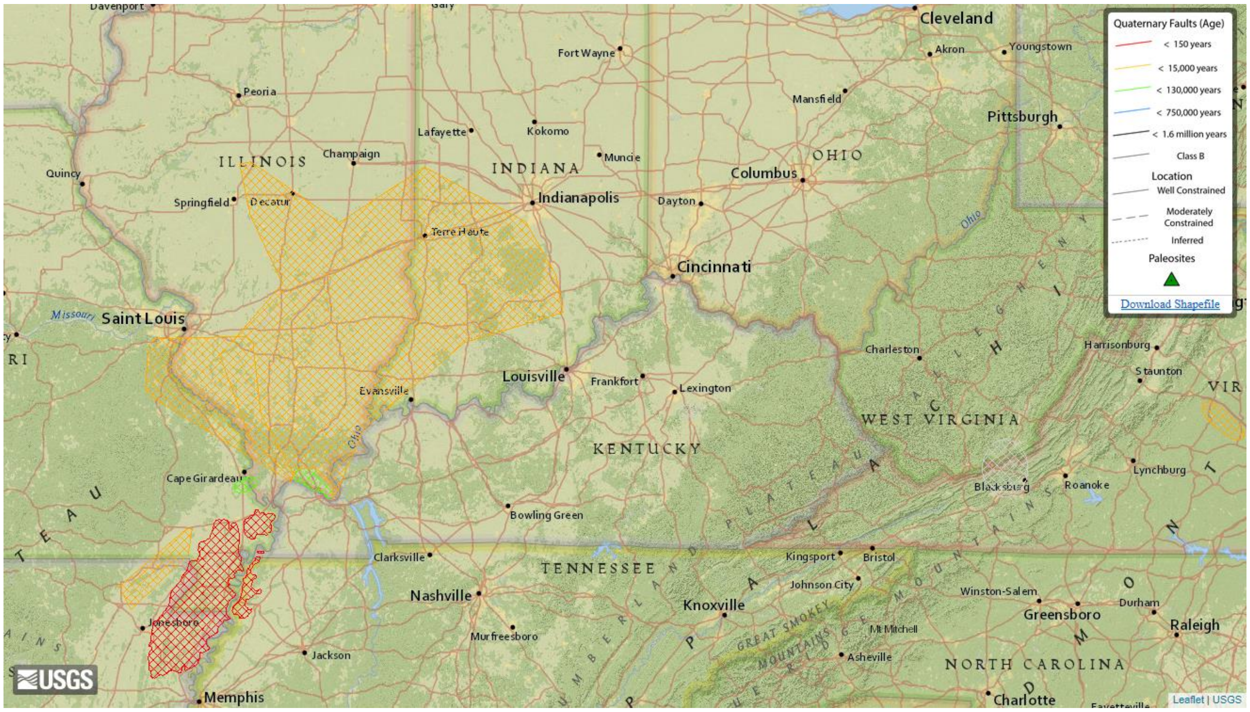
Plate boundaries are characterized into four (4) distinct types:

1) Divergent boundaries – a new crust is created as two plates move away from another
2) Convergent boundaries – areas where tow plates are coming together and thus losing crust as one plate slides under another
3) Transform boundaries –two plates slide horizontally past one another without creating or destroying boundaries
4) Plate boundary zones – broad belts without well-defined boundaries or plate interaction

The Richter Scale

Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph	900,000
2.5 to 5.4	Often felt, but only causes minor damage	30,000
5.5 to 6.0	Slight damage to buildings and other structures	500
6.1 to 6.9	May cause a lot of damage in very populated areas	100
7.0 to 7.9	Major earthquake. Serious damage	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 5 to 10 years
Source: http://www.geo.mtu.edu/UPSeis/magnitude.html		

Earthquakes affect large areas and cause varying amounts of damage that make them difficult to document on a local level. Because of the varying reports of effects and damage caused, historical data is only available on a state level. The following table provides a list of earthquakes that have been felt in Kentucky, along with their origin, magnitude, and the most significant damage reported. While the NKADD region has experienced earthquakes in the past, most seismic activity in Kentucky has occurred in the western portion of the state, near the New Madrid and Wabash Valley Seismic Zones. The New Madrid Seismic Zone is made up of several thrust faults that stretch from Marked Tree, Arkansas to Cairo, Illinois. In December of 1811, the first of three large earthquakes (magnitude 7.5 - 8.0) occurred, where effects were felt as far away as Boston, Massachusetts. In 2002 and 2008, earthquakes emanating from the Wabash Valley Seismic Zone struck Evansville, Indiana (5.0 magnitude) and Mt. Caramel, Illinois (magnitude 5.4). While the potential for a large significant earthquake does exist for the area based on historical accounts and location of fault lines, both of the seismic zones discussed do not extend to the NKADD region. The closest seismic activity stations are located in Maysville, KY, Oxford, OH, and northwest of Paris, KY. The University of Memphis' Center for Earthquake Research and Information collects and catalogs data produced by the stations.



USGS Interactive Fault Map, Collected 10/28/2015. The orange area is the Wabash Valley liquefaction. The red area is the New Madrid seismic zone. The bright green areas are the Fluorspar Area fault complex and the Thebes Gap faults.

Past Occurrences of Earthquakes felt in Kentucky

Origin of Earthquake	**Date**	**Magnitude**	**Property Damage**
New Madrid, Missouri	1811 to 1812 1874 tremors occurred		
Maysville, Kentucky	1828 four shocks		
	11/20/1834		
Hickman	12/27/1841		
	11/13/1904		
	11/25/1904		
Mayfield	10/26/1915		
Mouth of Ohio River	12/7/1915		
Mouth of Ohio River	3/2/1924		
Henderson	9/2/1925		Chimney fell
Middlesboro	1/1/1954		
Southern Illinois	11/9/1968		Masonry damage
Maysville, Kentucky	7/27/1980	5.1	$ 1,000,000

Bardwell, Kentucky	6/6/2003	4	
Illinois basin-Ozark dome region	4/18/2008	5.2	
Ottawa, Canada	6/23/2010	5.5	
Greentown, Howard County, IN	12/30/2010	3.8	
Richmond, VA	8/23/2011	5.8	

Earthquake Profile Risk Table	
Location:	All areas in Campbell County
Period of Occurrence:	Anytime of the year, anytime of the day
Number of Events (1811-2014):	about 20 that were recorded felt in KY
Annual Rate of Occurrence:	currently unpredictable
Probability of Future Events:	Unlikely
Warning Time:	Almost non-existent
Potential Impacts:	Earthquakes can heavily impact human life, health, and public safety. Large events can cause infrastructure damage, utility damage, and critical facilities damage. Secondary events often trigger landslides, dam failure/flooding, and may facilitate the release of hazardous materials from containment structures.
Recorded losses:	None
Annualized Loss:	$0.00
Extent (Scale)	Year: 1980 Scale: 5.1 Damage: $1,000,000 in Maysville, unknown in NKADD area

The county hazard mitigation planning committees all agree that earthquakes do pose a threat to the NKADD region. Historical data on landslides is not available to map and analyze, because of the inability to pinpoint specific areas affected. While there are many earthquake prediction theories and programs around the world, there is not a dependable way of predicting earthquakes. Regions that experience a lot of seismic activity, like California and Japan focus on creating early detection and warning systems for their residents. Shaking and ground rupture are the main effects created by earthquakes, principally resulting in more or less severe damage to buildings and other rigid structures. Earthquakes can produce slope instability leading to landslides, fires, soil liquefaction, tsunamis, and floods (if a dam is damaged).

In Campbell County, there are numerous bridges that should be inspected and potentially reconditioned for earthquake pre-disaster mitigation. These assessments are typically done during major maintenance cycles.

Additional Hazard: Invasive Species
Primarily: Emerald Ash Borer

Please note that the Emerald Ash Borer is not the only invasive species in Northern Kentucky, but it is currently the most problematic and will cost the most money to prevent damage over the next few years. Other invasive species in Kentucky are Bush Honeysuckle, Chinese Silvergrass, Garlic Mustard, Japanese Knotweed, Japanese Stiltgrass, Kudzu, Multi-Flora Rose, Oriental Bittersweet, Purple Loosestrife, and Winged Burningbush (KY Division of Forestry). Bush honeysuckle grows densely and competes with native plants for undergrowth space- this can cause erosion and ultimately soil slippage. Kudzu covers and smothers anything in its path; it can grow up to 1 foot a day.

What is the Emerald Ash Borer and why is it a hazard?

The emerald ash borer (EAB) is an invasive beetle originating in Asia that has existed in America since at least 2002; some members of the species are confirmed to have entered Kentucky by 2009. As its name suggests, EAB is a major threat to ash trees. However, there is evidence that other species such as the White Fringe tree are at risk. Due to the lack of natural predators and human intervention, the beetle poses an increasingly serious threat to the ash tree population.

Although there are native ash borers that pose less of a threat; the EAB is easy to distinguish from these species. EAB beetles are metallic green ranging about 1/2-1 inch long and 1/8 inch wide. EAB lives 1-2 years and their larvae feed under ash bark, typically from late July/early August until the end of October. It is this early stage that does the most damage to ash trees.

All species of ash tree are susceptible to infestation and trees that have been infected may exhibit several symptoms. Woodpeckers feed on EAB juveniles so excessive damage from woodpeckers to ash trees is an indicator that they are infected with EAB. Other signs that an EAB infestation has occurred are “D” shaped holes in trees about 1/8 inch thick where the beetles exit, snake-like grooves or splitting in the bark, and a reduction in leaf coverage. EAB can kill an ash tree in 3-4 years (Gardener’s Network, http://www.gardenersnet.com/tree/ashborer.htm) and it is unlikely that trees with over a 50% canopy reduction will survive.

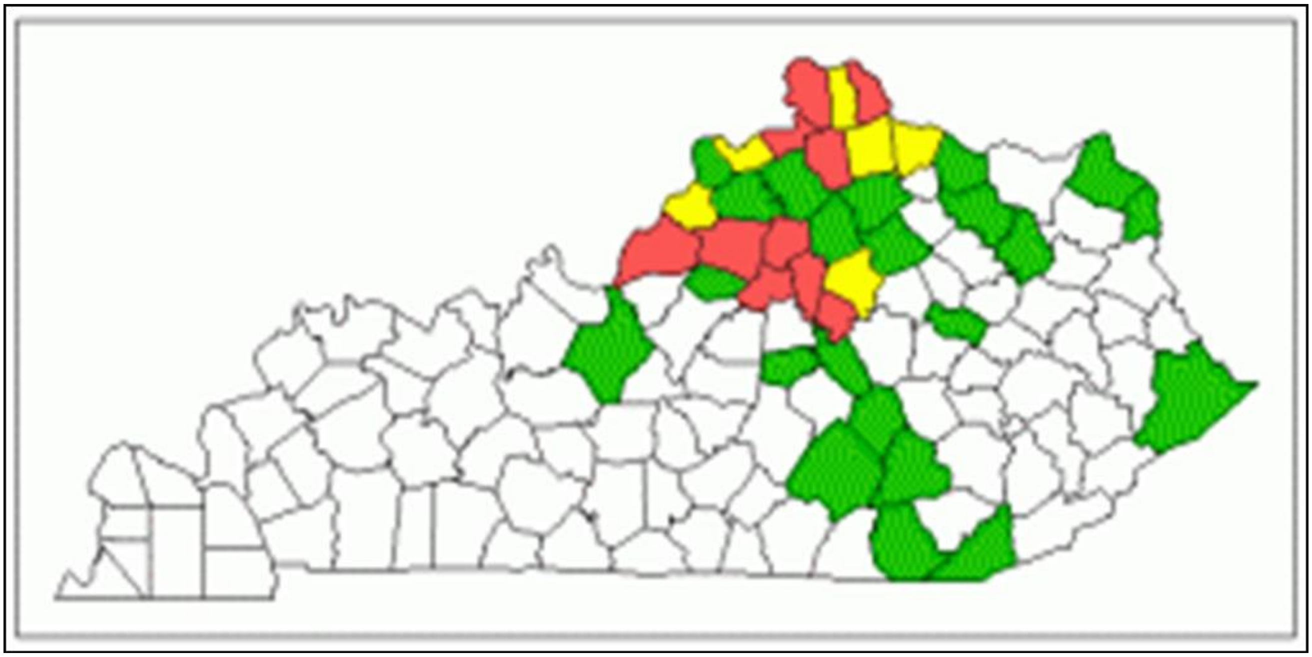
Since EAB are not able to travel far independently, their natural rate of spread would be very slow. However, human intervention has allowed them to expand rapidly. Transporting firewood, logs, felled trees, etc. allows the beetle to spread since its larvae may still reside in felled trees. This rapid spread has compounded the already severe threat posed by EAB.

Many species of ash tree can grow between 40 and 60 feet at maturity, with some growing up to 80 feet. Ash trees also tend to grow in groups. For example, one side of a lake may have a plethora of ash trees, while the other side of the lake may have none. While the grouping of ash trees may make it somewhat easier to cut them down, their height means that they will have detrimental effects to infrastructure such as power lines and roadways, far outside the right-of-way.

Pervasiveness

In 2009, EAB was discovered in Campbell, Kenton, and Owen Counties followed by discovery in Boone County in 2010, and Carroll and Pendleton Counties in 2013. Since the infestation began in the US, over 25 million ash trees have been killed by EAB, which most commonly occurs when “the EAB’s larvae enter an ash tree and feed just under its bark” (KYTC D-6).

County	# of Stems	Rank in State
Boone	2,230,515	42
Campbell	3,793,681	19
Carroll	3,020,825	34
Gallatin	3,760,463	20
Grant	3,454,077	24
Kenton	5,538,870	8
Owen	5,209,244	11
Pendleton	3,317,913	25



Red is high infestation, yellow is moderate and green is low.

Action plans

There are three principal methods of treating EAB that have been developed: quarantines, insecticide, and the introduction of predators. The limited options result in low costs for combating EAB (since quarantines have already been implemented and the use of predators is controlled). Although Kentucky removed its own quarantine, the USDA placed the entirety of Kentucky under quarantine in 2014 (UK, http://pest.ca.uky.edu/EXT/EAB/welcomeeab.html). This means that individuals are asked not to transport felled wood anywhere that is not quarantined. Educational programs have been introduced to reinforce quarantines by informing the population and media about the threat of EAB.

The Kentucky Transportation Cabinet has begun treating ash trees within quarantined districts with insecticide in order to prevent the spread of EAB. Insecticide use can be complicated—insects that cause damage beneath tree bark are more difficult to combat—and its effects should be understood before using. There are four different kinds of insecticide: (1) soil applied systemic insecticide; (2) trunk-injected systemic insecticide; (3) noninvasive, systemic basal trunk spray; (4) protective cover spray. A study discovered that emamectin benzoate, or Tree-age, and azadirachtin, both trunk-injected systemic insecticides, tend to provide effective control for up to two years. Professionals are best suited, and in some case the only ones permitted, to apply insecticides.

A relatively recent attempt to control the spread of EAB is by releasing wasp species that are hostile to the EAB (APHIS). This form of biocontrol has been conducted by the USDA using stingless wasps that attack either EAB larvae or eggs. This method is largely controlled by the USDA and its effects are still being studied.

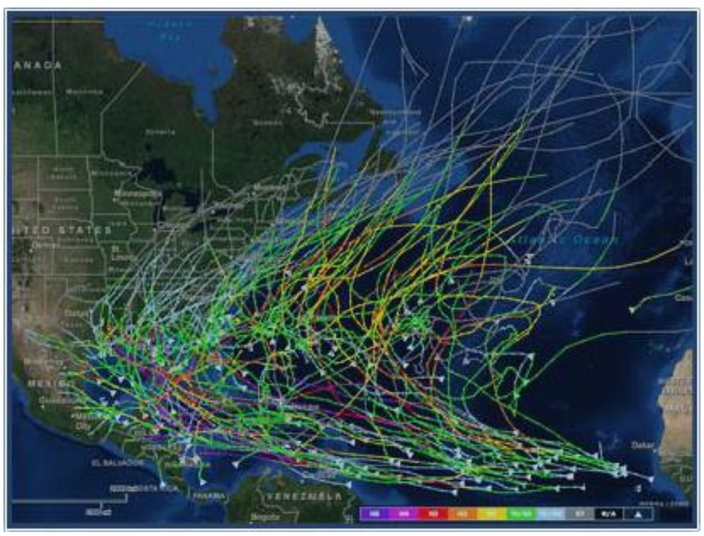
Owen Electric Cooperative, Inc. (OEC), a rural co-operative serving the 8 NKADD counties as well as Scott County, also has an aggressive strategy in place to eliminate risk from falling ash trees. OEC used the estimated number of ash trees by county produced by the USDA Forest Service (above table) and compared it to how many members were in each county and how far the EAB infestation had progressed. The results were a ranking of counties prioritized for ash removal.
The ranking is as follows:

1. Boone
2. Kenton
3. Campbell
4. Grant
5. Gallatin
6. Pendleton
7. Carroll
8. Owen
9. Scott

OEC has ROW crews in multiple counties, but certain infrastructure also ranks higher than others. The first priority for ash tree removal in and near the right-of-way are the 3-phase primary lines that could cause fairly extensive power outages if brought down by falling ash trees. The second priority is the single-phase primary lines, which would cause minimal power outages if damaged by falling ash trees. One issue that OEC runs into is that the ROW for the 3-phase lines is 40 feet and the ROW for the single-phase lines is 20 feet. Ash trees can be very large trees and therefore ash trees outside of the ROW are a threat to the infrastructure and must be professionally taken down. While many property owners do not have a problem with OEC taking down dead trees, obtaining permission to cut down trees outside of the ROW could potentially cause delays to OEC's ash tree removal schedule. The total estimated cost for OEC to remove the ash trees that threaten their infrastructure is an additional $1,000,000 over the normal 4 year ROW maintenance cycle budget. This is just one example of the time and cost that will be necessary over the next couple of years (2016-2017) as the dead ash trees further degrade and begin to fall on roads, houses, and other important infrastructure.

Additional Hazard: Hurricane Wind

Hurricanes are enormous storms that originate in the Atlantic Ocean and threaten the southeastern coast of the United States. They do not always make landfall, but their extreme levels and of water and speed of winds make them very dangerous. Hurricanes can result in high winds, tornadoes, storms, and flooding. They pose a significant threat to the environment, manmade structures, and human lives.



Where are they?

This graphic illustrates the path of hurricanes and major storms from 2000-2008. Beginning in the mid-Atlantic, most storms approach the southeastern US where they either make landfall or veer east into the upper Atlantic without affecting land masses. Although the most severe effects are experienced on coastal regions, inland areas also experience hazards related to hurricanes.

The hazard of hurricane winds

Since the power of hurricanes continues long after they make landfall, regions such as northern Kentucky frequently experience hurricane after affects in the form of strong storms, damaging winds, and flooding. Important examples include Hurricane Katrina in 2005 and Hurricane Ike in 2008. The former resulted in billions of dollars in damage in the US while the latter, Hurricane Ike, caused straight line winds to blow in northern Kentucky exceeding 60 mph. Such activity resulted in widespread damage "from trees being blown down on power lines". Straight line winds, which can also accompany thunderstorms, can be powerful enough to cause severe damage. In 2008, Hurricane Ike and the resulting winds caused 700,000 power outages in the area served by Duke Energy.

Flooding is also a serious consideration that can result in the aftermath of a hurricane. Hurricanes or consequent storms that travel inland can cause storm surge flooding, which can occur very rapidly onto areas of land that typically remain dry. Some of the events found in the High Winds (Straight Line Winds) and Floods sections are the result of hurricane aftermath.

Action plans

While preparedness is vitally important for residents of coastal regions, inland residents can also prepare for hurricane results. It is advised that households have an emergency plan in place for hazardous events such as hurricanes or floods and for households to assess whether flood insurance is necessary. Such a plan should identify "all of the steps a family needs to take before, during, and after a disaster to ensure maximum personal safety and property protection" (Hurricanes: Science and Society http://www.hurricanescience.org/society/impacts/stormsurge/). Survival kits can also help families in the event of unexpected emergencies.

Safety during hurricane-related hazards is important. When high speed winds have been reported on should remain indoors—while the wind itself may not be harmful, it can be strong enough to blow heavy items that can cause serious harm. In the event of flooding it is important to remember to remain indoors and to "turn off electricity at the main breaker" (Hurricanes: Science and Society). It is also advised to avoid using any electrical items and to turn off appliances if power is lost. In drastic circumstances an evacuation may be called to minimize the risk to human life as a result of flooding.

Additional Hazard:
Fog

What is it and why is it a hazard?

Fog "is a collection of water droplets suspended in the atmosphere in the vicinity of the earth's surface that affects visibility" (Weather Channel). It is a common weather condition in which clouds lay close to the ground and vary in thickness depending on the density of the water droplets. Fog is common in the northeast, upper west coast, and Appalachian region. The NKADD region falls on the edge of the Appalachian fog area and encounters about 25-30 days per year with dense fog.

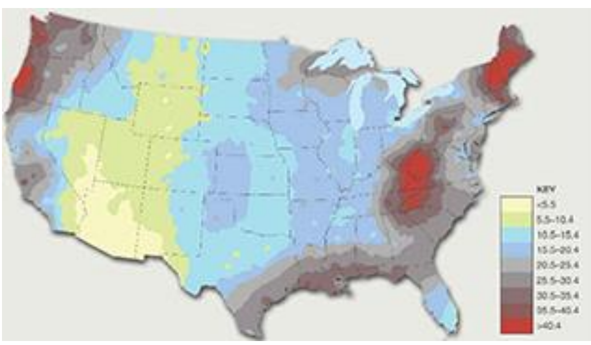


Image shows the average days per year with dense fog (defined as reducing visibility to one-quarter mile or less) in the U.S. Areas with most frequent fog are shown in darker gray, red shading. (Image courtesy: NOAA)

There are many varieties of fog, such as radiation, advection, and freezing. Radiation fog is the most common and is caused when moist air cools above the surface of the Earth. This fog, depending on the amount of wind, can become very thick. Advection fog forms when a cold surface encounters warm air, which means it can appear to move along or near the ground. Finally, freezing fog occurs when water droplets in the air freeze in temperatures below freezing—this type may cause an additional hazard of frost or ice on roadways and bridges. Fog dissipates as "vertical mixing brings drier air into the fog's edge, evaporating it" (Weather Channel https://weather.com/science/news/how-does-fog-form-20131010).

It does not cause direct damage, but fog can obscure vision to a greater or lesser degree. This potential impediment on vision makes it a hazard to people's lives and well-being, especially when driving. In fact, on average there are 31,385 crashes and 511 deaths annually in fog-related incidents (Weather Channel https://weather.com/news/news/fog-driving-travel-danger-20121127).

Action plans

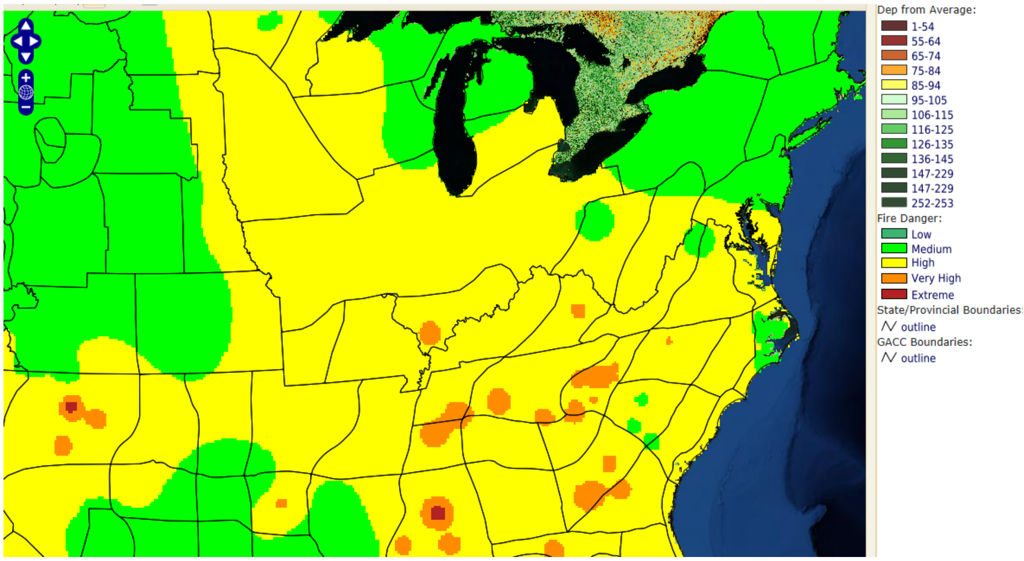
Few strategies exist to respond to fog as it cannot be controlled and poses no direct risk of property damage. However, given its pervasiveness and associated risk to human well-being it is wise to drive carefully in fog incidents. This involves observing the speed limit, increased distance between cars, and controlled stops.

ADDITIONAL HAZARD: WILDFIRES

A wildfire, also known as wildland fire, is a fire in an area of combustible vegetation that occurs in a rural area. Wildfires are particularly dangerous due to their ability to spread quickly and difficulty to control.

Location

As seen in the map below, wildfires can occur in essentially any rural setting. In urban settings, there is typically not enough vegetation for a fire to spread. The Northern Kentucky area currently has a 'High' Fire Danger according to the Wildland Fire Assessment System interactive map (below). Due to the proximity of the rural counties in our area to even more rural and wooded areas, the risk of wildfires is markedly increased. In November 2016, there are wildfires throughout Eastern Kentucky and according to some local news sources, smoke could be detected in Pendleton County, even though the wildfires had not yet entered the county. Additionally, a drought has been declared for all Kentucky counties except for Boone, Kenton and Campbell. Drought is a major catalyst for wildfires.



Causes

While droughts tend to make wildfires condition worse, they do not cause wildfires. Natural causes of wildfires include lightning, sparks from rock falls, spontaneous combustion, and volcanic eruption. Unnatural (human) causes of wildfires include arson, discarded cigarettes, power-line arcs and sparks from equipment. According to the Kentucky Division of Forestry website, Year-To-Date Fire Statistics, there have been 1,085 fires, burning 37,770 acres in 2016. The causes of those fires have been arson (757), debris (201) and other (127). Other includes lightning, smoking, equipment use, railroads, children, and other methods.

Effects on Northern Kentucky

While there have not been any major recognized wildfires in our 8 county region in the recent past, there have been a couple of note locally. There was a wildfire in the early 2010s in southern Kenton County and northern Pendleton County. It is unknown what property damage occurred, no one was injured. Many of the rural counties also report fires along interstate highways due to cigarette butts. Most of the 8 counties implement burn bans in the more susceptible summer months to head off accidental wildfires. More education and diligence is needed to continue to decrease the risk of wildfire in this area.