Chapter 1
Jackson Purchase Hazard Mitigation Plan 2023 Update

1:4 Risk Assessment

All Components of this Risk Assessment were reviewed and updated using the best available data in the Purchase Region: GIS resources and public input were used to identify which hazards, of those listed below, affect the region. The PADD staff compiled this information to identify hazards and the JPHMC reviewed the definitions and discussed their occurrence in and impact on the region. This review, the resulting prioritization, and risk assessment is contained in the pages that immediately follow.

Further, the MPTs for each county reviewed and prioritized these Hazards from the perspective of how they impacted their jurisdictions. The resulting prioritization and risk assessments are contained in the county annexes.

1:4.1 Identifying Hazards

FEMA recognizes many forms of natural hazards. Major natural hazards that may occur include:

- Geologic hazards
  - Tsunami
  - Volcano
  - Earthquake
  - Land Subsidence/Karst Topography
  - Landslide
- Weather generated hazards
  - Avalanche
  - Hurricane
  - Severe Thunderstorm
  - Hailstorm
  - Windstorm/Microburst
  - Severe Winter storm
  - Tornado
- Wildfire
- Flooding
  - Flashfloods
  - General Flooding
  - Coastal
  - Riverine
- Urban
- Climatological
  - Drought
  - Extreme Heat
- Failure of Man-made structures from the impact of natural forces
  - Dam Failure
  - Levee/flood Wall Failure

Natural Hazards Not Addressed by the Regional Plan

One goal of the planning process was to identify hazards that significantly impact the Purchase Region and eliminate from consideration those natural hazards that do not. This determination does not preclude the plan from including these hazards in future updates of the JPHM Plan if new information warrants such an action.

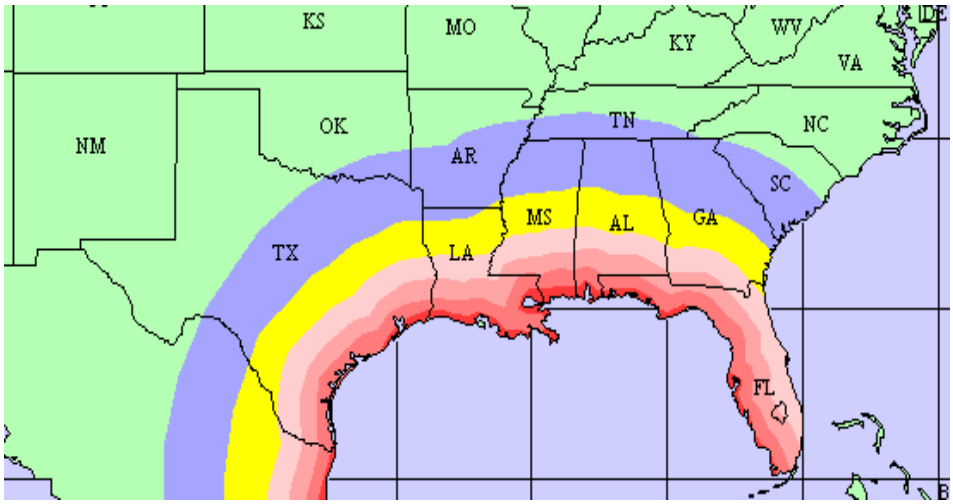
For some of the hazards below, such as Avalanche, Hurricane, Tsunami, Volcano, and Coastal Flooding the geographic setting of the Purchase Region precludes their occurrence. Others occur in the region but are either relatively limited in their geographic extent, their impact, or both.

- **Avalanche**
  The combination of low topography and moderate climate of the PADD is not capable of producing conditions for the formation of avalanches. No historical events have been recorded in the Purchase Region. Avalanches will not be addressed in the plan.

- **Hurricane/Tsunami/Coastal Flooding**
  The PADD is approximately 500 miles from both the Gulf of Mexico and the Atlantic Ocean coasts (see hurricane maps following). This distance from the coast(s) precludes inundation from tsunamis. Tsunamis will not be addressed in this plan.

  The immediate effects of hurricanes and coastal flooding do not impact the Purchase Region; therefore, these two hazards will not be addressed in the plan. The remnants of a hurricane, or tropical depression are sets of weather/climate conditions that can produce severe thunderstorms and flooding when they track over the Purchase Region. Severe thunderstorms, and the hazardous conditions they can spawn such as micro-bursts, hail, and tornadoes, are addressed in the plan.

Figure 1.1 CAT 4 HURRICANE (144mph) FORWARD SPEED: 14mph

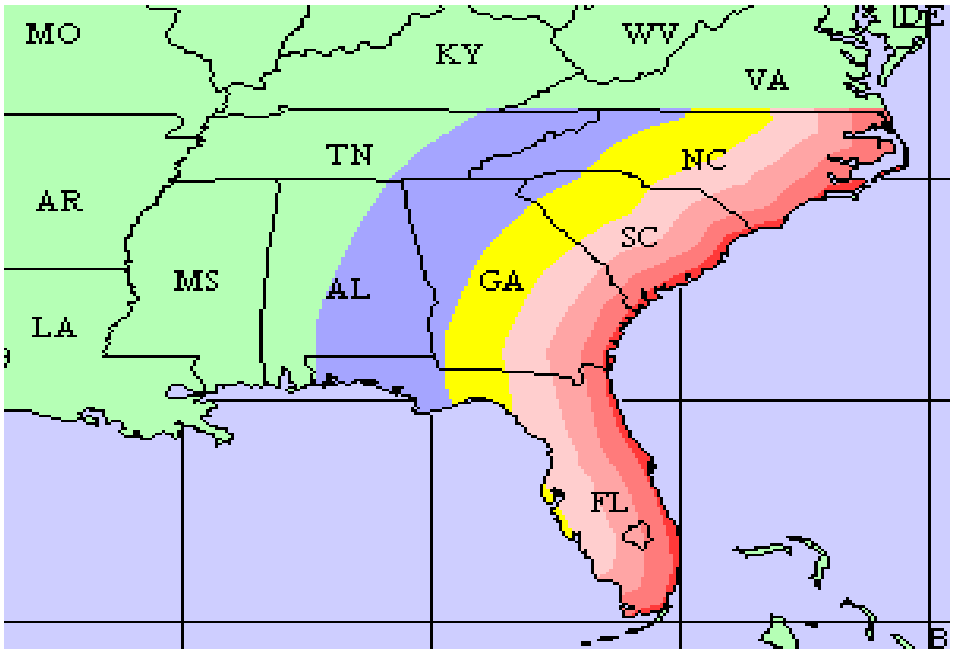


EXTENT OF INLAND WINDS – GULF COAST

>34Kt(39mph) >50Kt(58mph) >64kt(74mph) >80Kt(92mph) >95Kt(109mph) >110kt(127mph)

Source : http://www.floridadisaster.org/hurricane_aware/

Figure 1.2 CAT 4 HURRICANE (144 mph) FORWARD SPEED: 14 mph

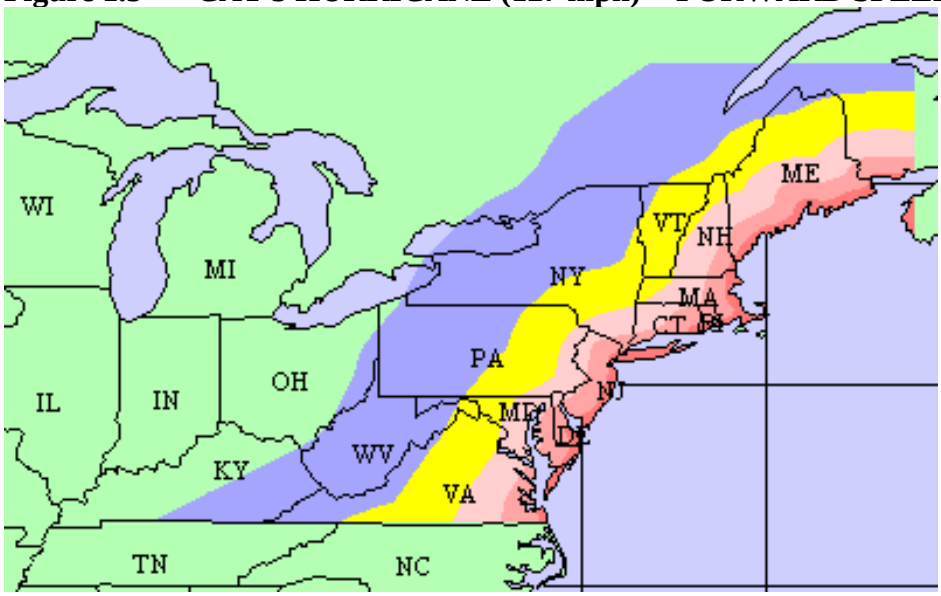


EXTENT OF INLAND WINDS – SOUTHEAST COAST

>34Kt(39mph) >50Kt(58mph) >64kt(74mph) >80Kt(92mph) >95Kt(109mph) >110kt(127mph)

Source : http://www.floridadisaster.org/hurricane_aware/

Figure 1.3 CAT 3 HURRICANE (127 mph) FORWARD SPEED: 23 mph



EXTENT OF INLAND WINDS – SOUTHEAST COAST

>34Kt(39mph) >50Kt(58mph) >64kt(74mph) >80Kt(92mph) >95Kt(109mph) >110kt(127mph)

Source : http://www.floridadisaster.org/hurricane_aware/

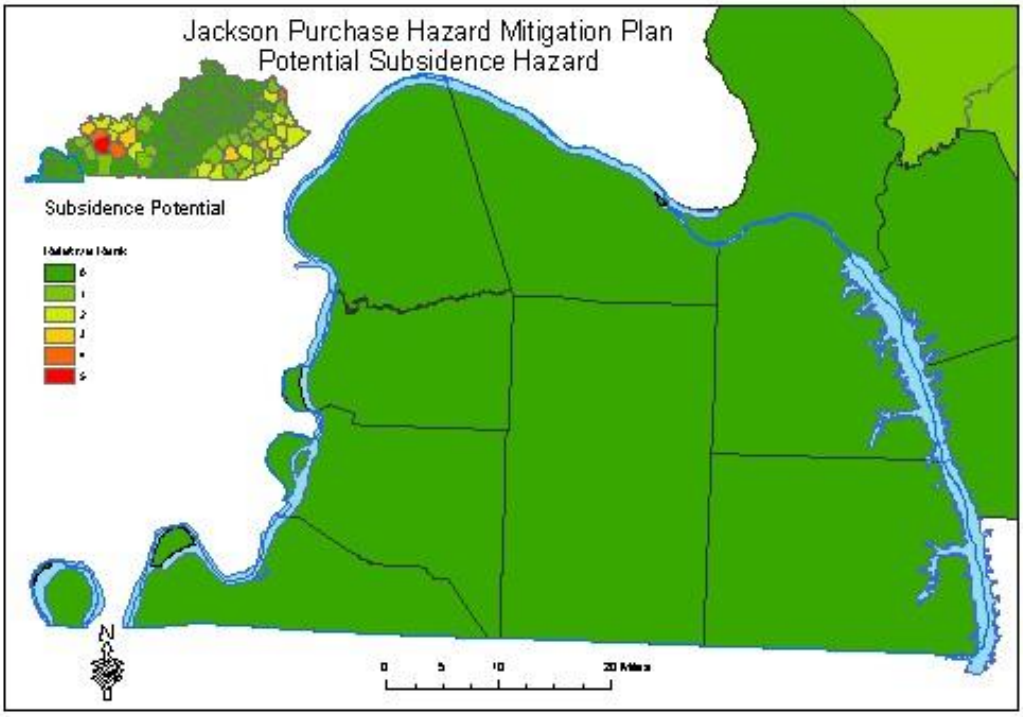
- **Volcano**
  Over the past 200 years, there have been approximately 50 volcanoes in the United States that have erupted at least one time. Volcanoes are a very destructive natural hazard that can produce costly property damage and loss of life. The active volcanoes in North America are located in California, Oregon, Washington, Alaska, Hawaii, Mexico, Canada and the Caribbean Islands. There are no active volcanoes within 1,000 miles of the jurisdictions in the PADD. Volcanoes are not considered to be a threat to the Purchase Region and will not be addressed in the plan.

- **Land Subsidence/Karst**
  Land subsidence occurs when large amounts of ground water have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rock falls in on itself. Land subsidence can occur unnoticed because it covers large areas rather than in a small spot, like a sinkhole.

  Mine subsidence resulting from subsurface mineral extraction is a major geologic hazard in Kentucky. Coal mine subsidence normally begins when the pillars of coal and the roof supports that were left in the mine can no longer support the bedrock above the mine. Conflicts result between the surface development of urban and suburban areas and the subsurface development of mineral resources. While no dollar amount has yet been fixed on the annual loss to Kentucky resulting from ground subsidence, serious damages to highways, public buildings, businesses, private homes and water supplies have been documented. There are no Purchase counties located in the Western Kentucky Coal Field. No significant historical events of land subsidence have been

recorded. Land subsidence poses a minimal threat to those counties and will not be addressed in the plan.

Figure 1.4 Relative Risk of Subsidence

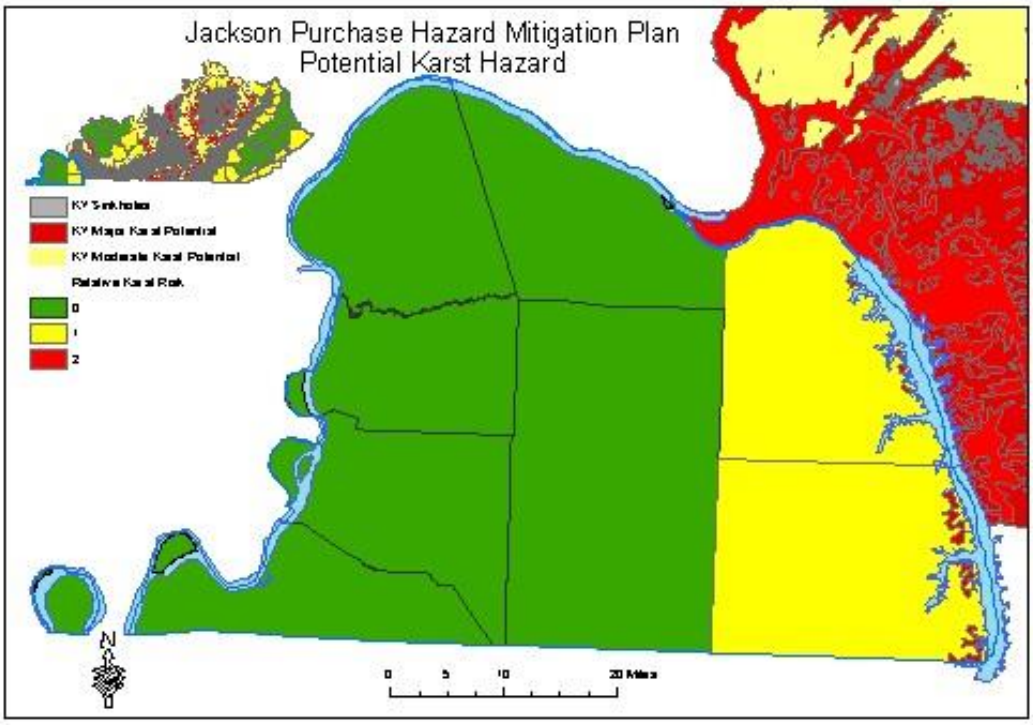


Source: Adapted from Kentucky State Hazard Mitigation Plan

Karst landscapes and aquifers form when water dissolves limestone, gypsum and other rocks. The surface expression of karst includes sinkholes, sinking streams and springs. Kentucky is one of the world's most famous karst areas. About 38 percent of the state has sinkholes that are recognizable on topographic maps, and 25 percent has obvious and well-developed karst features.

During the formation of karst terrain, water percolating underground enlarges subsurface flow paths by dissolving the rock. As some subsurface flow paths are enlarged over time, water movement in the aquifer changes character from one where ground water flow was initially through small, scattered openings in the rock to one where most flow is concentrated in a few well-developed conduits. As the flow paths continue to enlarge, caves may be formed, and the ground water table may drop below the level of surface streams. Surface streams may then begin to lose water to the subsurface. As more of the surface water is diverted underground, surface streams and stream valleys become a less conspicuous feature of the land surface and are replaced by closed basins. Funnels or circular depressions called sinkholes often develop at places in the low points of these closed basins. Like subsidence, Karst topography presents a limited risk to the Purchase Region and is not addressed in the plan.

Figure 1.5 Relative Risk of Karst Hazard



Source: Adapted from Kentucky State Hazard Mitigation Plan

Natural Hazards Addressed by the Regional Plan

The JPHM Plan considers natural hazards where a historical record of damage to people and property exists or where the JPHMC recognized the potential for such damage to occur. Table 1.5 and those that follow are purposely meant to support the rationale used by the JPHMC to consider some hazards and not others. The JPHMC and the PADD has no legal authority to initiate projects or formulate binding strategies/plans.

The JPHMC and the local level MPTs are in agreement on the identification of hazards affecting the region. No local jurisdiction felt compelled to fight back in a hazard because it was excluded. There are several instances, wildfire, "river erosion", and landslides for instance where the hazard is not region wide but has been included in the plan. The more detailed Hazard Profiles and risk assessments for each identified hazard are in each participating county's portion of this plan.

Table 1.1 Hazards Identified and Reasons for Identification

Hazard	How Identified	Why Identified
Tornado	* Review of past disaster damage * Review of FEMA hazard maps * Public Input	* Several past occurrences * Hazard maps show all jurisdictions affected
Flood **Flash Flood** **River Erosion**	* Review of past disaster damage (FEMA & National Climatic Data Center) * Local Emergency Management * Public Input * Review of FIRM maps	* Affects the region frequently * Maps show many floods prone areas * Public identified several regions not mapped affected by flooding * Repetitive flooding has led to the deposit of enormous amounts of silt in Kentucky's Mississippi River ports
Thunderstorm Wind **Hail**	* Review of past disaster damage * Public Input * Review of past occurrences from National Climatic Data Center	* Many events in the past * Widespread: affects all jurisdictions * High wind zone
Earthquake	* Review of Ground Motion Maps * Review of the New Madrid and Wabash Seismic Zone Maps * Public Input	* Proximity to New Madrid/Wabash Seismic Zones * Historic accounts of 1812 disaster. * Potential for destructive impact in some jurisdictions
Winter Storm / Ice Storm	* Review of past disaster damage * Review of past occurrences from National Climatic Data Center * Public Input * Local Emergency Management/KYTC	* Several past occurrences * Variety of events including snow/ ice * Can affect all jurisdictions
Excessive Heat / Drought	* Review of past disaster damage * Public Input * Review of Palmer Drought Severity Index	* Losses have occurred in past * Large impact of agriculture on the region
Dam Failure	* Review of High-Risk Dams in the region * Corps of Engineers Input	* Potential for flooding * Number of High-Risk dams in region
Wildfire	* Review of State Mitigation Plan * Public Input	* Potential for loss at Wildland/urban interface, * Increased fuel supply due to ice storm damage

1:4.2 Profiling Regional Hazard Events

The JPHMC identified these hazards based on, historical evidence gathered from the Kentucky State Climatology Center, the National Center for Environmental Information (NCEI), FEMA's Hazard Mapping website, the Kentucky State Hazard Mitigation Plan and the Kentucky Geological Survey. The PADD staff gathered GIS information and historical data to provide to the council and MPTs. There are some limitations to the best available GIS and historical data pertaining to hazards. However, the JPHMC and subcommittees identified what hazards affected the region based on past experiences. Information collected throughout the planning process by means of public input was a pertinent resource to the plan. Because the purpose of this plan is to identify hazards that present a threat to the safety of life and property, only moderate and high-risk hazards will be fully addressed in this plan.

Summary of Hazard Profiles

Several overall conclusions can be drawn from the information gathered in the Hazard Profiles. Based on historical frequency and past disaster damages, several hazards stand out as more significant threats to the Purchase region, while several others appear to be less significant.

According to frequency and damage figures, Flooding, Tornadoes and Thunderstorm Wind stand out as the most significant threats to the region. Winter Storms and Hail events are also significant hazards that threaten the region. Earthquake is a hazard rated by committee members as one of the biggest potential threats. There is very little historical data on actual damages to analyze the threat and considerable debate as to the severity of the resultant damage even for the "worst case scenario". Drought, Dam Failure, and Landslide are hazards that are possible threats to portions of the region or regional economy, yet historic frequency and damage data do not suggest that these are among the most significant. Wildfires, more specifically brushfires, have occurred, however the only damages documented for these events amount to $10,000 in property damage.

Table 1.2 is a summary of past Declared Disasters as provided by FEMA for the Purchase Region. Throughout our plan, we will refer to this table as we profile our hazard events. This table is limited to providing information only related to declared disasters on the county level and does not list each jurisdiction.

Table 1.2 Presidential Disaster Declarations that Affected PADD Counties

DR#	Declaration Date	Disaster Type	Total Declared Counties	Declared Counties	Counties Declared for Public Assistance and Individual Assistance	Counties Declared for Public Assistance Only	County	DH Approved Funding	IFG Approved
381	5/11/1973	Severe Storms, Flooding	5	Ballard, Carlisle, Fulton, Hickman, McCracken	Ballard, Carlisle, Fulton, Hickman, McCracken	0			
461	3/29/1975	Severe Storms, Flooding	17	Ballard, Calloway, Fulton, Graves, Hickman, Marshall, McCracken	Ballard, Calloway, Fulton, Graves, Hickman, Marshall, McCracken	0			
821	2/24/1989	Severe Storms, Flooding	67	Ballard, Carlisle, Graves, Hickman, Marshall, McCracken	Ballard, Carlisle, Graves, Hickman, Marshall, McCracken	0			
1089	1/13/1996	Blizzard	120	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken,			
1163	3/4/1997	Flooding	101	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	Ballard, Carlisle, Fulton, Hickman, Marshall, McCracken	Calloway	McCracken	$137,084.85	$78,709.00
1802	10/9/2008	Severe Wind Storm	36	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken,			
3302	1/28/2009	Severe Wind Storm	114	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken,			
1818	2/5/2009	Severe Winter Storm, Flooding	117	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken,			
1976	5/4/2011	Severe Storms, Tornadoes, Flooding	22	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken		Calloway			

DR#	Declaration Date	Disaster Type	Total Declared Counties	Declared Counties	Counties Declared for Public Assistance and Individual Assistance	Counties Declared for Public Assistance Only	County	DH Approved Funding	IFG Approved
4057	3/6/2012	Severe Storms, Tornadoes, Straight-line Winds, Flooding	23	Ballard		Ballard			
4216	4/30/2015	Severe Winter Storms, Snowstorms, Flooding, Landslides, Mudslides	41	Ballard, Marshall, McCracken		Ballard, Marshall, McCracken			
4217	5/1/2015	Severe Storms, Tornadoes, Flooding, Landslides, and Mudslides	28	None		None			
4218	5/12/2015	Severe Winter Storms, Snowstorms, Flooding, Landslides, Mudslides	34	Calloway, Fulton, Marshall		Calloway, Fulton, Marshall			
4278	8/26/2016	Severe Storms, Tornadoes, Flooding, Landslides, Mudslides	20	Calloway, Marshall		Calloway, Marshall			
4358	4/12/2018	Severe Storms, Flooding, Landslides, and Mudslides	22	None		None			
4361	4/26/2018	Severe Storms, Tornadoes, Flooding, Landslides and Mudslides	35	Carlisle, Graves, Hickman, Fulton, McCracken		Carlisle, Graves, Hickman, Fulton, McCracken			
4428	4/17/2019	Severe Storms, Straight-line Winds, Flooding, Landslides, and Mudslides	60	Ballard, Carlisle, Fulton, Hickman, Marshall, McCracken		Ballard, Carlisle, Fulton, Hickman, Marshall, McCracken			
3469	3/13/2020	Covid-19	120	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken		Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken			
4497	3/28/2020	Covid-19 Pandemic	120	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman,				

DR#	Declaration Date	Disaster Type	Total Declared Counties	Declared Counties	Counties Declared for Public Assistance and Individual Assistance	Counties Declared for Public Assistance Only	County	DH Approved Funding	IFG Approved
					Marshall, McCracken				
4540	4/24/2020	Severe Storms, Flooding, Landslides, and Mudslides	27	Hickman, McCracken		Hickman, McCracken			
4592	3/31/2021	Severe Winter Storms, Landslides, and Mudslides	45	None		None			
4595	4/23/2021	Severe Storms, Flooding, Landslides, and Mudslides	44	Ballard, Graves, Calloway		Ballard, Graves, Calloway			
3575	12/11/2021	Severe Storms, Straight-line Winds, Flooding and Tornadoes	16	Fulton, Graves, Hickman, Marshall					
4630	12/12/2021	Severe Storms, Straight-line Winds, Flooding and Tornadoes	23	Fulton, Graves, Hickman, Marshall	Fulton, Graves, Hickman, Marshall				
4643	2/27/2022	Severe Storms, Straight-line Winds, Tornadoes, Flooding, Landslides	13	None		None			

Source:https://www.fema.gov/disasters?field_state_tid_selective=49&field_disaster_type_term_tid=All&field_disaster_declaration_type_value=All&items_per_page=20&=GO

The discussion of the Natural Hazard Profiles will follow the order of the revised prioritization summarized from the Risk Assessment listed in Table 1.3. The County Hazard Profiles in the county Annexes will be in accordance with MPT prioritization. Hazard priorities have been re-ordered from the 2018 plan to reflect revised priorities for the 2023 plan.

Table 1.3 Regional Hazard Summary Table

PLAN VERSION	2022	2017
HIGH RISK HAZARDS	TORNADO FLOOD / FLASH FLOOD THUNDERSTORM WIND EARTHQUAKE WINTERSTORM / ICE STORM	TORNADO FLOOD/FLASH FLOOD THUNDERSTORM WIND EARTHQUAKE WINTER STORM/ICE STORM
MODERATE RISK HAZARDS	HAIL EXCESSIVE HEAT DROUGHT	HAIL EXCESSIVE HEAT DROUGHT
LOW RISK HAZARDS	WILDFIRE DAM FAILURE	WILDFIRE DAM FAILURE

Source: JPHMC, PADD Board, Public Input Survey, 2022

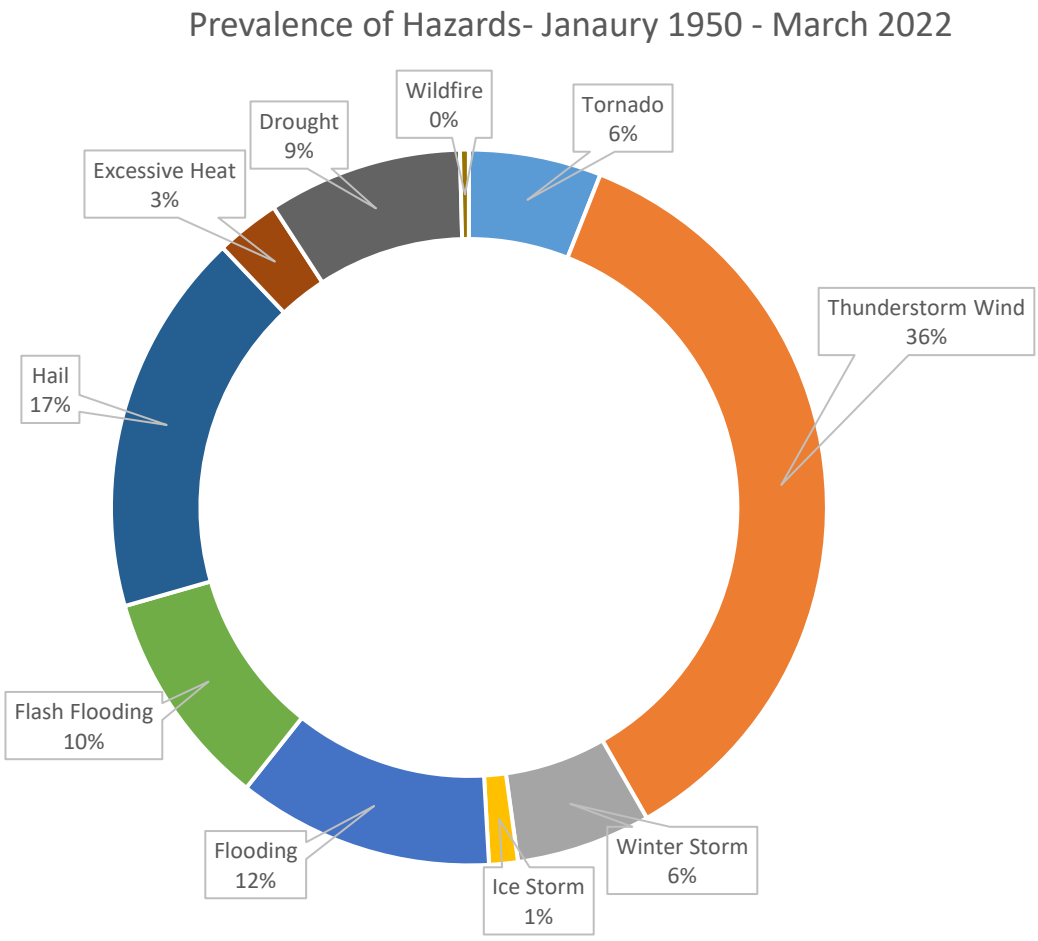
Table 1.4 represents a summary of the events on record in the NCEI Storm Events Database occurring in the Purchase Region for the period January 1, 1950, through March 31, 2022. Data is available as early as 1950, but depending on reporting for some events, the first event on record may come at a much later time. The detailed, disaggregated listing of these events is included in Appendix 1.

Table 1.4 Purchase Region Summary of Previous Hazard Occurrences and Impacts January 1, 1950 – March 31, 2022

Event	Events	Death	Injury	Property Damage ($)	Crop Damage ($)
Tornado	170	33	400	34.886M	95.00K
Thunderstorm	1,029	1	29	76.702M	96.10K
Winter Storm	176	2	0	1.963M	0.00K
Ice Storm	37	0	0	126.675M	0.00K
Flood	332	4	12	45.691M	1.135M
Flash Flood	283	5	1	14.156M	10.00K
Hail	499	0	1	30.992M	103.10K
Excessive Heat	82	1	14	0.00K	0.00K
Drought	254	0	0	0.00K	143.600M
Wildfire	11	0	0	0.00K	0.00K
Dam Failure	NO EVENTS				
1 class A structure = no loss of life anticipated, only damage to dam owner's property					
2 class B structures = loss of life not probable, some economic loss & environmental damage					

For the purpose of the update of the 2023 Jackson Purchase Hazard Mitigation (JPHM) Plan, the events will be reviewed from April 1, 2017, through March 31, 2022. The storm events database maintained by the NCEI will be utilized as the source for the best available data for the Purchase Region.

Figure 1.6 Purchase Region Hazards Pie Chart



Tornado

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. It is most often generated by a thunderstorm when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly and upper-level winds, especially the jet stream runs at an angle relative to the prevailing surface winds. These conditions occur with regularity over the Purchase Region in the spring, but as evidenced recently, can occur at any time of the year. Tornadoes are often accompanied by large hail and damage is most often the result of the high wind velocity and wind-blown debris. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction. They have the power to uproot trees, structures, and turn harmless objects into deadly flying debris.

Most tornadoes aren't very wide and touch down only briefly. However, a highly destructive tornado may carve a path over a mile wide and several miles long. Tornadoes typically cause the most damage to lightly or poorly built structures, such as residential homes. An average of 800-1000 tornadoes are reported nationwide and they are more likely to occur during the spring and early summer months. Tornadoes can occur at any time of the day but are more likely to form in the late afternoon or early evening.

In 2007 the Enhanced Fujita (EF) Scale was introduced to better reflect wind speed and the amount of damage produced by tornadoes. It replaced the Fujita-Pearson Scale that defined every tornado on record in the United States since 1950. EF rankings are assigned after a tornado event has occurred and the National Weather Service has inspected the damage.

Table 1.5 The Enhanced Fujita Tornado Measurement Scale

Scale	Estimated Wind Speed	Typical Damage
EF0	65-85 mph	Light Damage - Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; signboards damaged.
EF1	86 – 110 mph	Moderate Damage - Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
EF2	111 – 135 mph	Considerable Damage - Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light object missiles generated; cars lifted off ground and thrown.
EF3	136 – 165 mph	Severe Damage - Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
EF4	166 – 200 mph	Devastating Damage - Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown, and large missiles generated.
EF5	>200 mph	Incredible Damage - Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

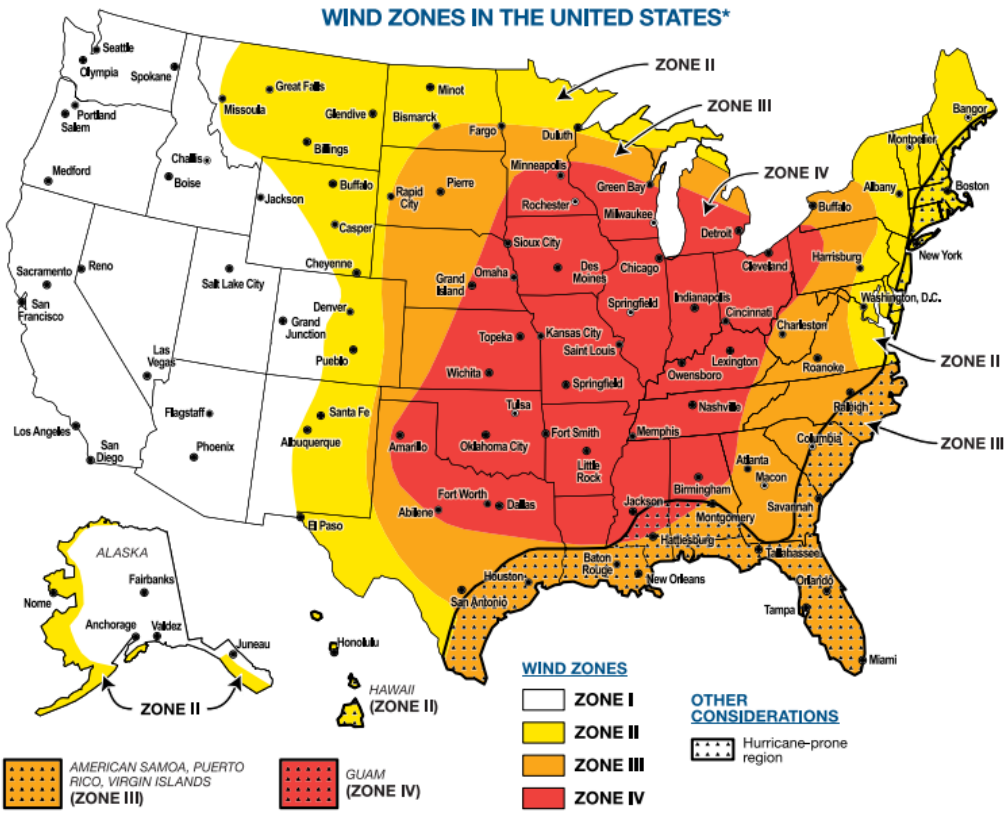
During this last planning period the Purchase Region had four counties (Fulton, Graves, Hickman, and Marshall) impacted by the 220-mile December 10 – 11, 2021 Quad State Tornado. This supercell travelled 165 miles through the state of Kentucky impact the county of Hickman, the Community of Cayce (Fulton), the City of Mayfield (Graves), the Cambridge Shores Community (Marshall) and then continued to travel outside the Purchase Region causing destruction to the communities in its path.

This tornado was scaled as an EF 3 in some areas and EF 4 in other areas. More Detail on the impact on each community will be the correlating counties annex.

Figure 1.7 shows the Wind Zone in the United States from FEMA Read Business Severe Wind / Tornado Toolkit which can be found in the appendix section (Appendix 2) of the Hazard Mitigation Section on the Purchase Area Development District website.

Figure 1.8 maps the tornado paths through the Purchase Region for the 5-year period (April 1, 2017 – March 31, 2022). Including the December 10, 2021, tornado.

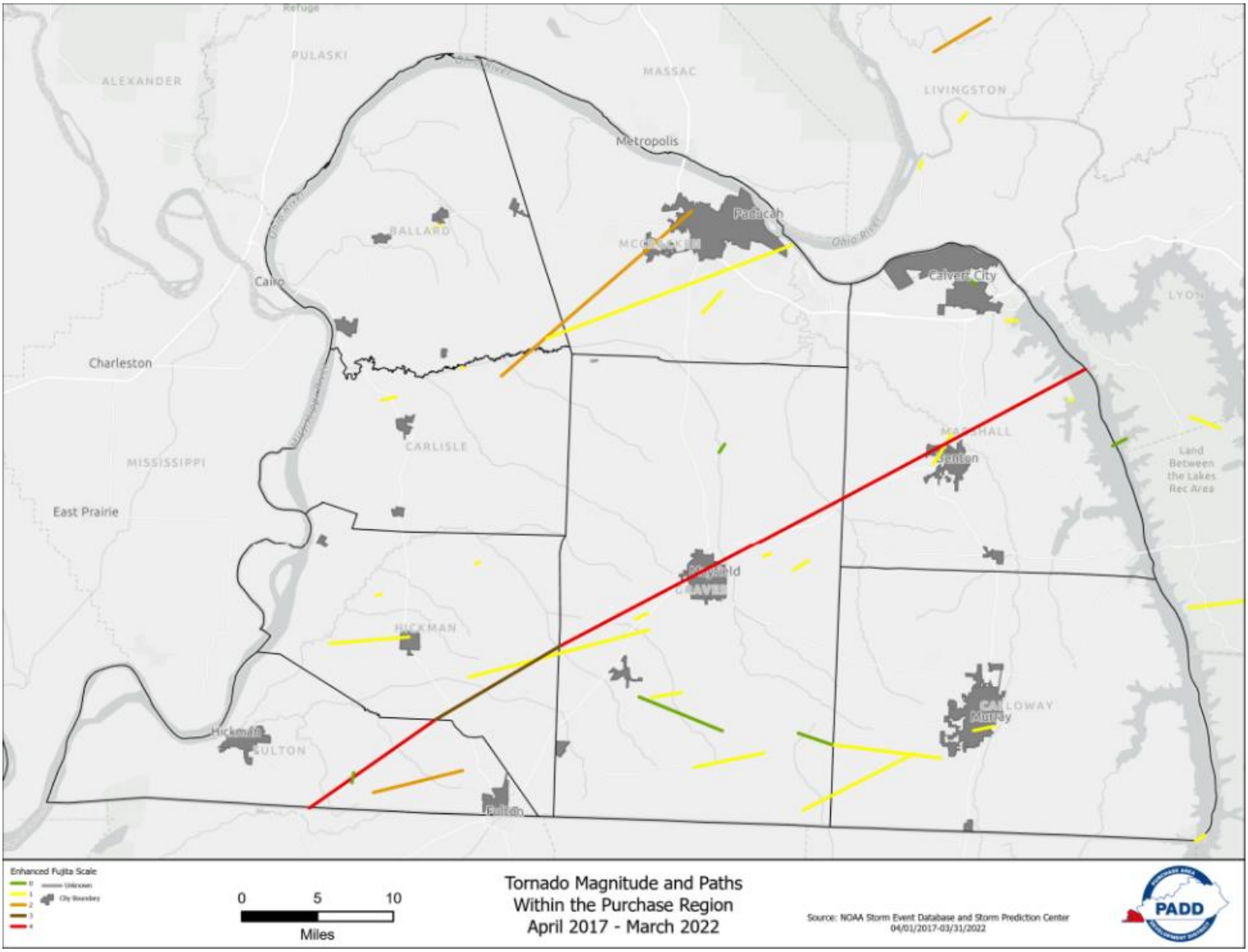
Figure 1.7 Wind Zones in the United States



Source: FEMA P-320, Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business

Source: FEMA Severe Wind and Tornado Toolkit (Appendix 2)

Figure 1.8 Tornado Paths in the Purchase Region



Source: NOAA Storm Events Database 2017-2022

SUMMARY AND CONCLUSIONS OF TORNADO PROFILE

From April 1, 2017, through March 31, 2022, there have been 38 occurrences of tornadoes in Purchase counties reported by the NCEI. These occurrences resulted in 26 deaths, injured 275 people, and totaled over $8,437,000 in reported personal property damage. Information from the above tables and map related to Tornadoes can be used to define the frequency of tornado events and the impact of these events. Data on tornado event magnitude is provided in the form of the Enhanced Fujita Scale as shown on Table 1.5.

Table 1.6 Tornados by County
April 1, 2017 – March 31, 2022

County	Number	Dead/Injured	Value of Property Damage	Value of Crop Damage
Ballard County	3	0/0	$190.00K	$ 0.00K
Calloway County	4	0/0	$1.145M	$ 0.00K
Carlisle County	3	0/0	$45.00K	$ 0.00K
Fulton County	3	1/5	$360.00K	$ 0.00K
Graves County	12	24/210	$2.456M	$ 0.00K
Hickman County	5	0/5	$825.00K	$ 0.00K
Marshall County	5	1/54	$1.531M	$ 0.00K
McCracken County	3	0/1	$1.885M	$ 0.00K
Purchase Region	**38**	**26/275**	**$8.437M**	**$ 0.00K**

Source: NOAA, NCEI, Storm Events Database

**** The Value of Property Damage is currently inaccurate due to the missing total of the 12/10/2021 tornado property damage value.*

The number of Tornado Events per county were rolled together for the region. The region experienced 38 reported Events over a 5-year period, or a better than 100% probability of a Tornado event somewhere in the Purchase Region in any given year. Common sense would dictate that the conditions that generated a Tornado event in one county could have generated a Tornado Event in another. Indeed, several tornadoes have paths that track across multiple counties. During this period both, the largest number of tornados occurred in Graves, with 12 recorded events.
From a regional perspective the cost of a Tornado Event could be calculated as:

- 38 events / 5 years = 7.6 events per year
- $8,437,000 / 38 events = $222,026 in property damage per event
- $222,026 x 7.6 events per year = $ 1,687,400 damage per year on average

Of critical concern to the JPHMC, and the main contributing factor in their consideration of risks and vulnerability, is the human cost of Tornado Events. The cost and frequency for each county will be discussed in the individuals' chapters of this plan.

Flooding

During the 20th century, floods were the number one natural disaster in the United States in terms of number of lives lost and property damaged. The NFIP defines a flood as a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters, unusual and rapid accumulation or runoff of surface waters from any source, a mudflow, or a collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood.

The severity of flooding is determined by the following: rainfall intensity and duration - large amount over a short time can result in flash flooding, small amounts may cause flooding where the soil is saturated, small amounts may cause flooding if concentrated in an area of impermeable surfaces; topography and ground cover – water runoff is greater in areas with steep slopes and little vegetation. Frequency of inundation depends on the climate, soil, and channel slope. In regions without extended periods of below-freezing temperatures, floods usually occur in the season of highest precipitation.

Flooding in Kentucky can be classified under two categories: flash flooding and river basin flooding. Flash flooding usually occurs within minutes or hours of heavy amounts of rainfall. It can be from a dam or levee failure, or from a sudden release of water held by an ice jam. Most flash flooding is caused by slow-moving thunderstorms in a restricted watershed or by heavy rains associated with hurricanes and tropical storms. Flash flooding can happen any time of the year, but it is most prevalent in the spring and summer months. Flash flooding occurs throughout Kentucky. It is most prevalent in eastern Kentucky, where steep terrain—combined with typical dendritic drainage—patterns, have the effect of funneling too much water through too little space.

Flash flooding is the most common form of flooding in the Purchase Region. The cause, once again being too much rainwater, was delivered in too short of time. However, rather than steep slopes and narrow valleys channeling and concentrating the runoff from heavy rains, the runoff is too great in volume for the region's characteristic low lying, meandering streams, to carry away. This slow drainage is often exacerbated by stream blockages of tree limbs and trunks, which form effective check dams and barrages.

River basin flooding is common among Kentucky's major streams and bodies of water during the winter and early spring months. The major bodies of water in the Purchase Region are the Ohio River (Marshall, McCracken and Ballard), the Mississippi River (Ballard, Carlisle, Hickman and Fulton) and the Tennessee River/Kentucky Lake (McCracken, Calloway and Marshall). These rivers delivered catastrophic flooding to the area in the past, most memorably in 1937, but have since been contained, if not controlled by levees, floodwalls, and dams. The potential failure of these structures, especially those that are aging is more of a concern in the region than the direct effects of flooding.

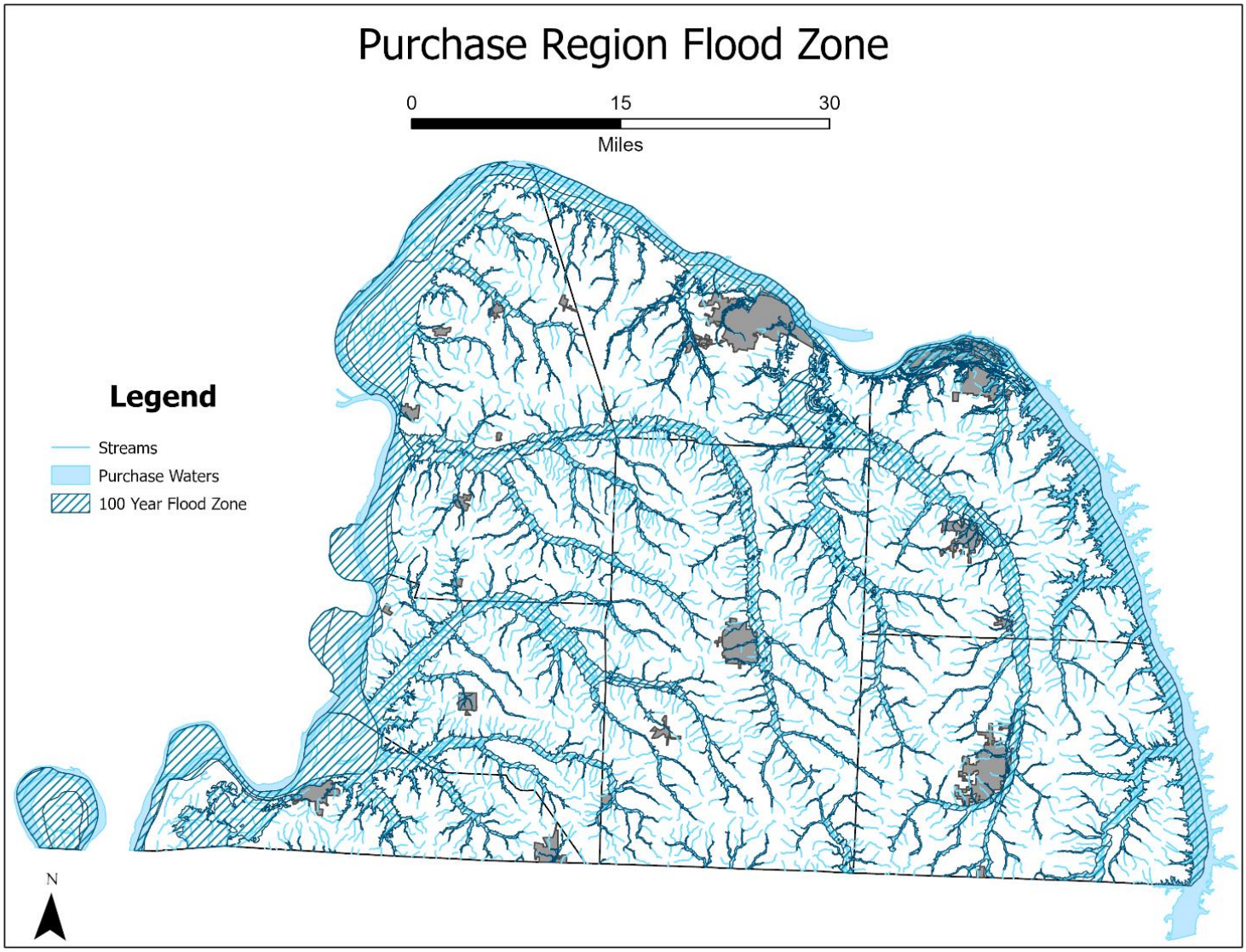
A third type of flooding that happens periodically is urban flooding. Urban flooding occurs where man-made development has obstructed the natural flow of water and/or decreased the ability of natural groundcover to absorb and retain surface water runoff.

Periodic flooding of land adjacent to rivers, streams and shorelines is natural and can be expected to take place at fairly regular intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

A floodplain is the lowland area adjacent to a river, lake or ocean. Floodplains are designated by the frequency of floods that is large enough to cover them. Another way of expressing the flood frequency is the chance of occurrence in a given year. A 100-Year Flood event as determined by FEMA is a flood event of a magnitude expected to be equaled or exceeded once on average during any 100-year period. The term "100-year flood" is misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1- percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most federal and state agencies, is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance.

Figure 1.9 below depicts a composite of the 100-Year Flood Plains of the eight counties comprising the Purchase Region. It overlays the incorporated cities in the region. A larger scale map for each county is included in its chapter.

Figure 1.9 100-Year Flood Plains of the Purchase Region



Source: National Flood Hazard Layer

All eight counties in the region have mapped flood hazard areas. All but Hickman County participate in the NFIP. Although Hickman is not an NFIP participant, the county seat, Clinton, does participate.

Table 1.7 Purchase Region Flood Hazard Vulnerable Assets

County	Estimated Number of Structures in Flood Hazard Areas		
	Number of Structures in County	Percentage of Structures in Flood Hazard Area	Number of Structures in Flood Hazard Area
Ballard	7,041	4.6%	327
Calloway	22,328	1.6%	359
Carlisle	4,476	2.4%	108
Fulton	4,091	4.7%	193
Graves	25,720	1.6%	404
Hickman	3,777	2.3%	85
Marshall	24,216	6.7%	1624
McCracken	36,549	4.3%	1586
Purchase Region	**128,198**	**3.7%**	**4686**

Sources: https://github.com/Microsoft/USBuildingFootprints; Purchase Area Development District GIS Database

SUMMARY AND CONCLUSIONS OF FLOODING PROFILE

From April 1, 2017, through March 31, 2022, there have been 139 occurrences of flooding events in the Purchase counties reported by the NCEI. These occurrences totaled over $6,615,000 in reported personal property damage, $1,050,000 in reported crop damage, injuring one person and killing three people.

Table 1.8 Flooding / Flash Flooding by County
April 1, 2017 – March 31, 2022

County	Number	Dead/Injured	Value of Property Damage	Value of Crop Damage
Ballard County	19 / 3	0/0	$449.00K	$ 1.040M
Calloway County	9 / 8	0/0	3.295M	$ 0.00K
Carlisle County	10 / 0	0/0	$0.00K	$ 0.00K
Fulton County	9 / 1	1/0	$210.00K	$ 0.00K
Graves County	7 / 6	0/0	$1.365M	$ 0.00K
Hickman County	8 / 3	0/0	$5.00K	$ 0.00K
Marshall County	8 / 6	1/0	$40.00K	$ 0.00K
McCracken County	31 / 11	1/1	$1.251M	$ 10.00K
Purchase Region	**101 / 38**	**3/1**	**$ 6.615 M**	**$ 1.050M**

Source NOAA, NCEI, Storm Events Database

Information from Table 1.8 related to flooding can be used to define the frequency of Flood Events and the impact of these events. The number of Flood Events per county were rolled together for the region. The Purchase Region experienced 139 Reported Events over a 5-year period, which divides out to 27.8 Reported Flooding Events per year, a better than 100% probability of a Flood event somewhere in the region in any given year. Common sense would dictate that the conditions that generated a flood event in one county could have generated a flood event in another. The county which recorded the most frequent flooding was McCracken County with 42 events over 5 years with around 8.4 events occurring each year.

From a regional perspective the cost of a Flooding/ Flash Flooding Events could be calculated as:

- 139 Flooding Events / 5-year period = 27.8 events on average
- $6,615,000 property damage / 139 Flooding Events = $47,589 property *damage per event on average
- $47,589 x 27.8 events per year = $1,323,000 average damage per year

The cost and frequency for each county will be discussed in the individual county Annexes of this plan. Repetitive loss properties have been identified in the region. This information has been provided to county- and city-level emergency managers and planners. They will be addressed in the county Annexes, but Privacy Act considerations will prevail over specific identification of properties in this plan.

Thunderstorm Wind

A thunderstorm is formed from a combination of moisture, rapidly rising, warm air, or a force capable of lifting air, such as the meeting of a warm and cold front, a sea breeze, or a mountain. Thunderstorms can produce tornadoes, large hail and heavy rain which can cause flash flooding. The National Weather Service considers a thunderstorm as severe if it develops 1 inch hail or 58 mph winds. Straight line winds during thunderstorms can exceed 100 miles per hour and are responsible for wind damage associated with thunderstorms. One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation.

Thunderstorms affect relatively small areas when compared with winter storms, as the average storm is 15 miles in diameter and lasts an average of 30 minutes. All thunderstorms are dangerous and capable of threatening life and property in localized areas. Every thunderstorm produces lightning, which results from the buildup and discharge of electrical energy between positively and negatively charged areas.

Thunderstorms are quite frequent in the Purchase Region. They can produce damage, injuries, or fatalities. Numerous recorded severe thunderstorms have produced high winds, lightning, and hail, in the county. Many of these thunderstorms have caused property or crop damage. These storms, although relatively short in duration when compared to other weather events, are often long lived enough to track across the entire county before dissipating their energy or exiting the region.

SUMMARY AND CONCLUSIONS OF THUNDERSTORM WIND PROFILE

From April 1, 2017, through March 31, 2022, there have been 118 occurrences of Thunderstorm Wind events in Purchase counties reported by the NCEI. These occurrences totaled over $1,786,000 in reported personal property damage and resulted one injured.

Table 1.9 Thunderstorm Wind Data by County
April 1, 2017 – March 31, 2022

County	Number	Dead/Injured	Value of Property Damage	Value of Crop Damage
Ballard County	13	0/0	$94.00K	$0.00K
Calloway County	26	0/1	$444.00K	$0.00K
Carlisle County	6	0/0	$135.00K	$ 0.00K
Fulton County	4	0/0	$67.00K	$ 0.00K
Graves County	24	0/0	$340.00K	$ 0.00K
Hickman County	5	0/0	$53.00K	$0.00K
Marshall County	21	0/0	$367.00K	$0.00K
McCracken County	19	0/0	$286.00K	$0.00K
Purchase Region	**118**	**0/1**	**$1.786M**	**$0.00K**

Source: NOAA, NCEI, Storm Events Database

Information from Table 1.9 can be used to define the frequency of Thunderstorm Wind Events and the impact of these events throughout the region. Data on Thunderstorm Wind event magnitude in the form of peak wind speeds is provided in the individual county sections of this plan.

The number of events per county, were rolled together for the region. The Purchase Region experienced 118 Reported Events over a 5-year period, which divides out to 23.6 reported Thunderstorm Wind Events per year, or a better than 100% probability of a Storm event somewhere in the purchase area in any given year. Common sense would dictate that the conditions that generated a Thunderstorm Wind Event in one county could have generated an Event in another. The county which recorded the most frequent Thunderstorm Wind Events was Calloway with 26 events over a 5-year time. From a regional perspective the cost of a Thunderstorm Wind Event could be calculated as:

- 118 Thunderstorm Wind Events / 5 Year Period = 23.6
- $1,786,000 property damage / 118 Thunderstorm Wind Events = $15,135.6 property damage per event on average.
- $15,135.6 average property per event x 23.6 events per year = $357,200 damage per year on average

Of critical concern to the JPHMC and the main contributing factor in their consideration of risks and vulnerability, is the potential human cost of Thunderstorm Wind Events.

Earthquake

An earthquake is a geologic event that involves movement or shaking of the earth's crust. Earthquakes are usually caused by the release of stresses accumulated as a result of the rupture of rocks along borders of the earth's ten tectonic plates. Earthquakes can affect hundreds of thousands of square kilometers, causing damage to property, resulting in loss of life and injury, and disrupting the social and economic functioning of the affected area.

According to the New Madrid Seismic Zone Catastrophic Earthquake Response Planning Project Volume 1 all Purchase Region counties will be severely impacted:

"The largest number of damaged buildings occurs in McCracken County where 24,100 structures are damaged. Graves and Marshall Counties also incur substantial building damage at 9,000 and 5,100 buildings, respectively. Conversely, over 90% of all buildings in Ballard and Hickman Counties are expected to experience damage. Additionally, 80% to 90% of buildings in McCracken and Carlisle Counties are damaged" (Page 61-62).

Based on the scenario conducted in the study

"Various modes of transportation are also compromised in western Kentucky following the NMSZ scenario event. Over 250 bridges are damaged; numerous bridges along US-51, US-60 and US-45 are heavily damaged and likely impassible the day after the earthquake. Additionally, damage to major river bridges during the event severely limits traffic between Kentucky and Illinois, Tennessee and Missouri" (Pages 62-63)

To review more information regarding this study, refer to Appendix 3 on the PADDs website.

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends on the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology. Earthquakes may also cause landslides and liquefaction. Landslides are the down-slope movement of soil and rock in mountainous regions and along hillsides. Liquefaction occurs when the ground soil loses the ability to resist shear and flows much like quicksand. When liquefaction occurs, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude. Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale. It is a twelve-level scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with an "I" corresponding to imperceptible (instrumental) events, "IV" corresponding to moderate (felt by people awake), to "XII" for catastrophic (total destruction).

Table 1.10 Modified Mercalli Intensity Scale for Earthquakes Compared to the Richter Scale

Scale	Intensity	Description of Effects	Maximum Acceleration (mm/sec)	Richter Scale
I	Instrumental	Detected only on seismographs	<10	
II	Feeble	Some people feel it	<25	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	<50	
IV	Moderate	Felt by people walking	<100	
V	Slightly Strong	Sleepers awake; church bells ring	<250	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	<500	<5.4
VII	Very Strong	Mild alarm; walls crack; plaster falls	<1000	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	<2500	
IX	Ruinous	Some houses collapse; ground cracks; pipes break	<5000	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7500	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes, and cables destroyed; general triggering of other hazards	<9800	<8.1
XII	Catastrophic	Total Destruction: trees fall; ground rises and falls in waves	>9800	>8.1

Source : https://earthquake.usgs.gov/learn/topics/mercalli.php

The New Madrid Seismic Zone is located in southeastern Missouri, northeastern Arkansas, Western Tennessee, Western Kentucky and Southern Illinois. This area is the most active seismic area east of the Rocky Mountains.

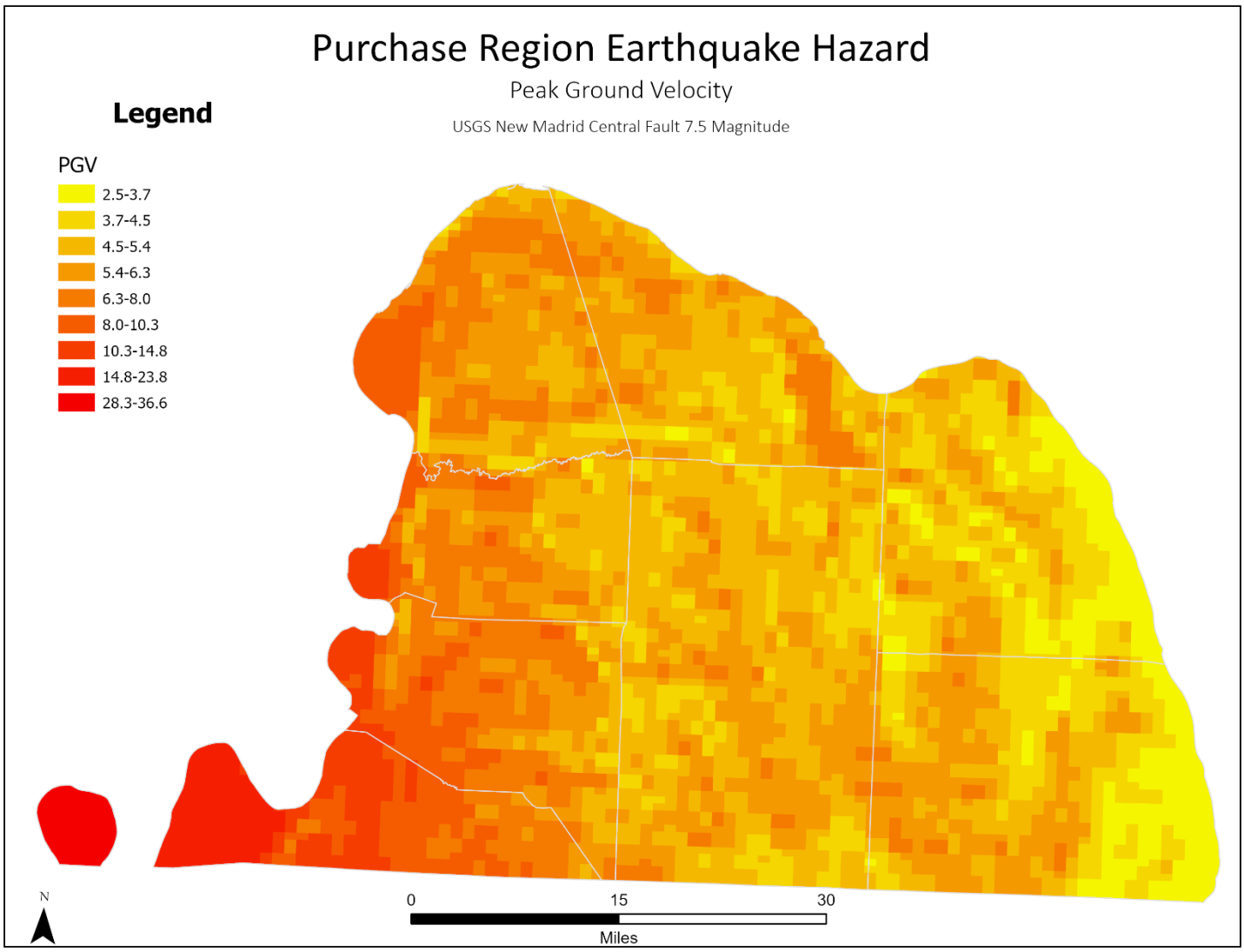
Every Year hundreds of small earthquakes occur in the New Madrid Seismic Zone but are typically too small to be felt by humans and can only be detected by sensitive instruments. The last major earthquake in the state of Kentucky was in 1812. The probability of a large magnitude earthquake impacting the Purchase Region is about 10% based on 50 years of research. Though Earthquakes are hard to predict, and scientists are taking great strides to understand the New Madrid Seismic Zone.

Due to the nature of the bedrock that is present in the New Madrid Seismic Zone the geographic impact in the asking of the ground and be 20 times larger than the earthquakes that impact California. If a large magnitude Earthquake is to occur in the Purchase Region area the damages will be significant.

The primary cause for damage and injuries during an earthquake is because of the destruction of manmade structures. These structures are particularly susceptible 1. Tall Structures (Buildings, Bridges, Dams), 2. Large Open Structures, 3. Brittle Structures, 4. Complex Structures with odd shapes and lots of corners, and 5. Unanchored building contents. Damage will vary depending on the magnitude, zone location, geologic nature of material and degree of urbanization. More information can be found on the Missouri Department of Natural Resources facts page of the New Madrid Seismic Zone https://dnr.mo.gov/land-geology/hazards/earthquakes/science/facts-new-madrid-seismic-zone.

Figure 1.10 shows the Peak Ground Acceleration for the Purchase Region based on the USGS Shake map simulator at an earthquake of 7.5 magnitude. Figure 1.11 shows the Peak Ground Velocity for the Purchase Region based on the USGS Sake Map simulator for an earthquake of 7.5 magnitude.

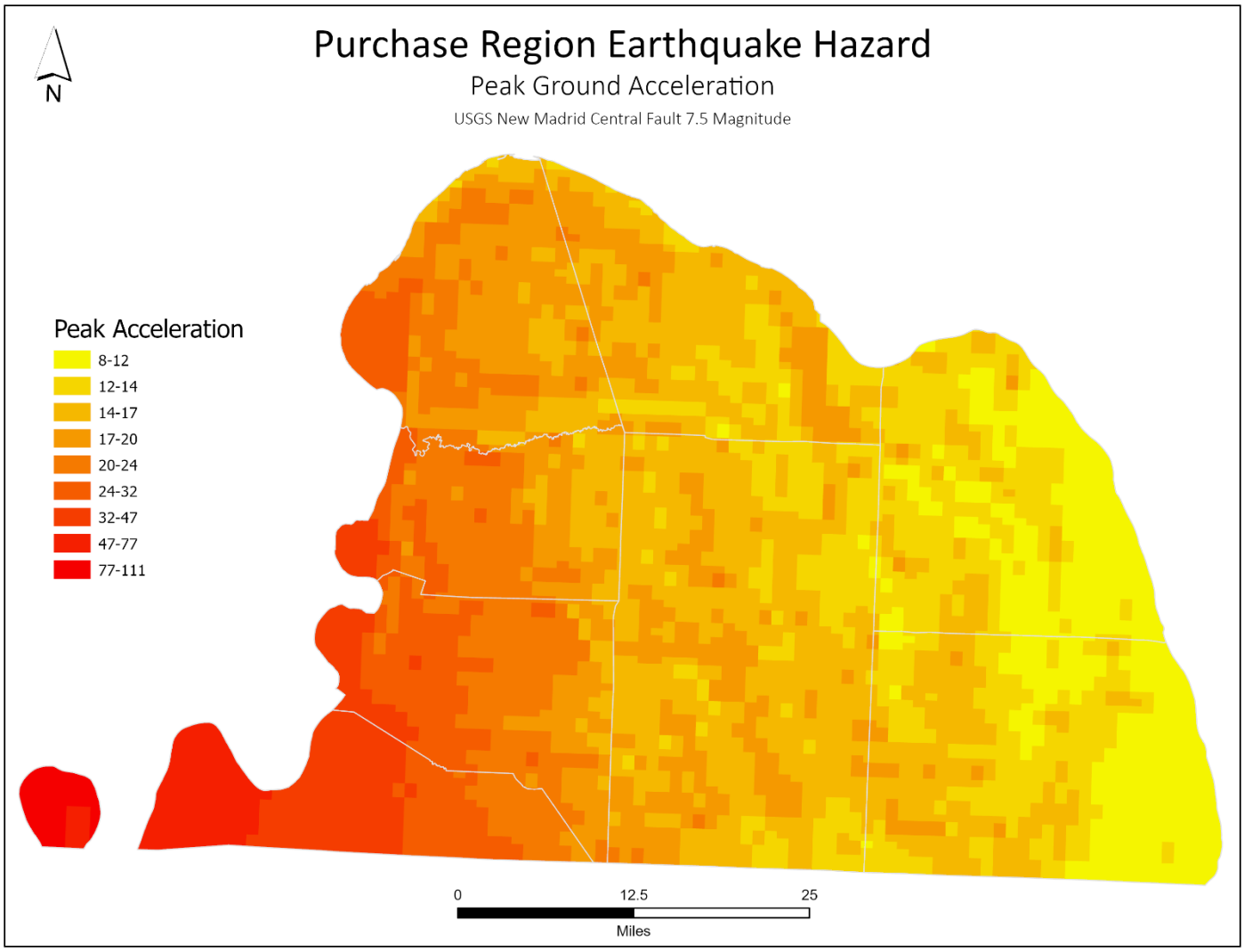
Figure 1.10 USGS New Madrid Central Fault 7.5 Magnitude Peak Ground Velocity



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

Figure 1.11 USGS New Madrid Central Fault 7.5 Magnitude Peak Ground Acceleration



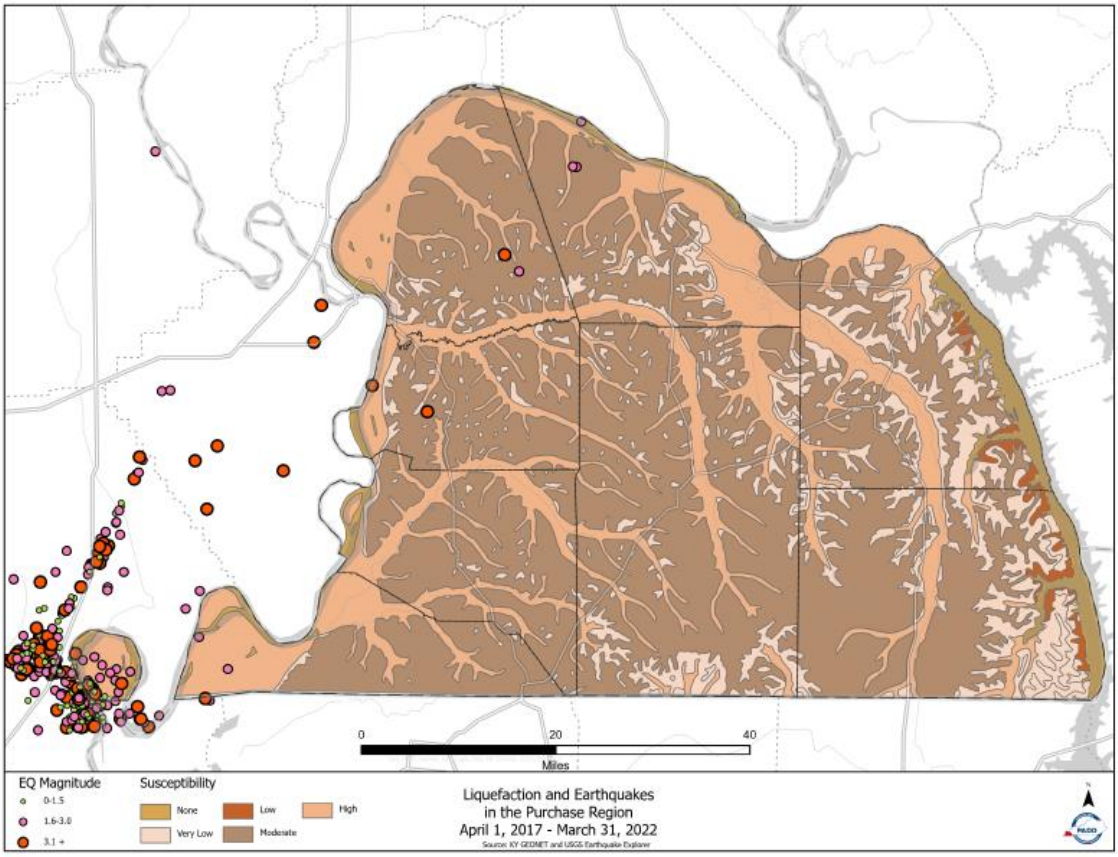
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

An issue for all the Purchase Region would be the effect of a large magnitude quake on the soil underlying the region. The ground shaking estimate accounts for both the likely ranges of recurrence intervals and locations. Due to the relatively low rate of seismicity, ground cover, deep soil, etc., most faults within the region aren't even mapped. Even the precise location of faults within the New Madrid Seismic Zone are subject to debate. No one knows what causes New Madrid earthquakes. However, there are ideas that are being researched. Although there is great uncertainty regarding the cause of earthquakes, scientists generally do agree on what happens when they do occur – that is, the likely levels of ground shaking associated with the wave's earthquakes emit. These levels are reflected in the National Seismic Hazard Maps, which represent the products of a long consensus building process. These maps also account for the uncertainties in our understanding.

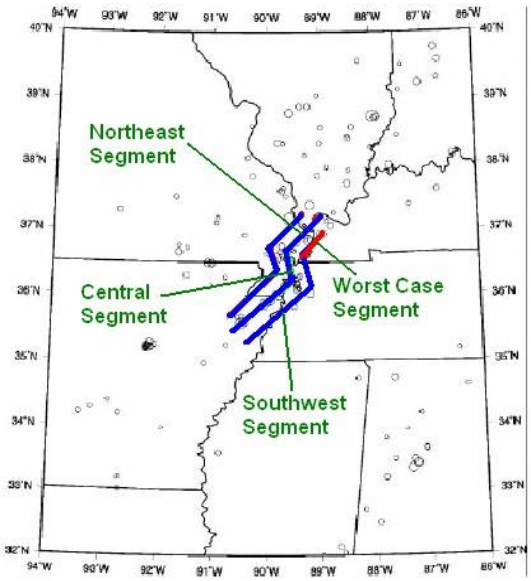
Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends on the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site, and regional geology. Earthquakes may also cause liquefaction. Liquefaction occurs when the ground soil loses the ability to resist shear and flows, much like quicksand. When liquefaction occurs, anything relying on the substrate for support can shift, tilt, rupture, or collapse.
Figure 1.12 illustrates the underlying soil structure for the Purchase Region. It indicates that virtually the entire county is underlain by beds of sediment, not bedrock. This increases the potential for ground shaking and liquefaction.

Figure 1.12 Generalized Liquefaction Susceptibility and Earthquake Magnitude of the Purchase Region



Source: USGS Map was derived from the USGS Earthquake Catalog, Available at: https://earthquake.usgs.gov/earthquakes/search/

Figure 1.13 Scenario Fault Location for the State of Kentucky



SUMMARY AND CONCLUSIONS OF EARTHQUAKE HAZARD PROFILE

Low magnitude earthquakes occur constantly in the New Madrid Seismic Zone. Depending on the depth and magnitude, some of the stronger tremors, 3 and above, are felt throughout the entire region. Damages amount to the rare instance of a picture being knocked off a wall or items shaken from shelves.

The potential for an earthquake of catastrophic proportions is not open to debate. Historic and geologic evidence are proof however, the probability of such an event in any given time frame is open to interpretation and the effects are still a matter of discussion.

The Purchase Region (in vicinity) experienced 25 low magnitude earthquakes between April 1, 2017, to March 31, 2022. Most of the Earthquakes that occurred were near or in Fulton County. A full figure of earthquake occurrences will be found in the appropriate county annexes.

Winter Storm / Ice Storm

Winter Storms can produce an array of hazardous weather conditions that include heavy snow, freezing rain, sleet, high winds, and extreme cold. Ice Storms occur when freezing rain accumulates on surfaces and the ground. When a quarter inch or more of ice builds up, severe impacts can result. Winter storms are fueled by strong temperature gradients and an active upper-level cold jet stream. An Ice Storm can develop when warmer air above the freezing mark above the ground moves over subfreezing air near the ground. Snow aloft falls through the warmer air and melts into rain, then the rain droplets fall into the subfreezing air and freeze upon contact creating a glaze of ice. Winter and Ice storms can paralyze a community by shutting down normal everyday operations. Accumulating snow and ice can result in downed trees and power lines and may block transportation routes or make them hazardous. Heavy snow can lead to the collapse of weak roofs or unstable structures. Often, the loss of electricity results in the loss of heat in some homes and buildings. This presents a threat to human life, especially the elderly population.

The level of impact Winter Storms have is greatly determined by a community's ability to manage and control the affect, for example, the rapid mobilization of snow removal equipment. Because winter storms are sporadic in western Kentucky, many communities cannot afford the expensive equipment and maintenance of snow removal. This increases the potential damage a Winter Storm may cause. Depending on the severity of Ice Storms, impacts can persist for days. If more than a half-inch of accumulation occurs and damage is widespread, it can take a while to remove trees and repair power lines. This can result in a loss of electricity and heat for several days. Because severe winter storms are sporadic in western Kentucky, many communities cannot justify the expense/maintenance of snow removal equipment. Even though Kentucky has a mild, temperate climate, 42 winter storms have been recorded in the Purchase Region over the past 5 years. Of the 25 Presidential Disaster Declarations that have included the Purchase Region, 6 have been for Winter Storms, or severe weather generated during the winter season.

SUMMARY AND CONCLUSIONS OF WINTER STORMS / ICE STORMS PROFILE

From April 1, 2017, through March 31, 2022, there have been 42 occurrences of Winter Storms and one Ice Storm in the Purchase counties reported by the NCEI. The Winter Storm events totaled over $105,000 in reported personal property damage and one death. There were $75.00K in property damages from the single Ice Storm Event.

Table 1.11 Winter Storm / Ice Storm Data by County
April 1, 2017 – March 31, 2022

County	Number	Dead/Injured	Value of Property Damage	Value of Crop Damage
Ballard County	5	0/0	$0.00K	$0.00K
Calloway County	5/ 1	0/0	$5.00K / $75.00K	$0.00K
Carlisle County	5	0/0	$0.00K	$0.00K
Fulton County	5	0/0	$0.00K	$0.00K
Graves County	6	0/0	$10.00K	$0.00K
Hickman County	5	0/0	$0.00K	$0.00K
Marshall County	6	0/0	$15.00K	$0.00K
McCracken County	5	0/0	$0.00K	$0.00K
Purchase Region	**42 /1**	**1/0**	**$105.00K**	**$ 0.00K**

Source NOAA, NCEI, Storm Events Database

Information from Table 1.11 can be used to define the frequency of Winter Storm /Ice Storm Events and the impact of these events throughout the region. Data on the magnitude of these type Events is provided in the individual county sections of this plan.

The number of Events per county, were rolled together for the region. The Purchase Region experienced 42 reported Winter Storm Events over a 5-year period, and only one Ice Strom Event. The Winter Storm divides out to approximately 8.4 Reported Winter Storm Events per year, a better than 100% probability of a storm event somewhere in the Purchase Area in any given year. Six was the highest number of events in a county and that occurred in two counties: Graves and Marshall County. From a regional perspective the cost of a Winter Storm Event could be calculated as:

- 42 Winter Storm Events / 5 Year Period = 8.4 average events per year
- $105,000 property damage / 42 Winter Storm Events = $2,500 property damage per event on average.
- $2,500 average property per event x 8.4 average events per year = $21,000 damage per year on average

Ice Storm Events, such as the one in 2009, have had a major impact on the region in the past; however, for this reporting period this specific type of event has had no impact. Calloway County is the only county to have a reported ice event during this planning update period. It occurred on February 2, 2022, and there were $75,000 in property damage. While Ice Storm Events have decreased during the 5- year updated period, due to the 2009 Ice Storm producing significant damage to the entire Purchase Region, such events are considered a significant risk. The cost and frequency for each county will be discussed in the individual county portions of this plan.

Hail

Hail is one of four types of precipitation that falls from the sky. It's also the most dangerous, damaging type, occurring during severe storms. If hail measuring larger than ¾ inches in diameter falls during a thunderstorm, it is classified as severe weather. Sometimes damaging winds accompany this type of storm as well. According to the National Oceanic and Atmospheric Administration, hail causes over one billion dollars of damage in the United States.

TORRO Hailstorm Intensity Scale

The TORRO Hailstorm Intensity Scale was introduced by Jonathan Webb of Oxford, England, in 1986 as a means of categorizing hailstorms. The scale extends from H0 to H10 (See Table 1.12) with its increments of intensity or damage potential related to hail size, texture, numbers, fall speed, speed of storm translation, and strength of the accompanying wind.

An indication of equivalent hail kinetic energy ranges (in joules per square meter) has now been added to the first six increments on the scale, and this may be derived from radar reflectivity or from hail pads. The International Hailstorm Intensity Scale recognizes that hail size alone is insufficient to accurately categorize the intensity and damage potential of a hailstorm, especially towards the lower end of the scale. For example, without additional information, an event in which hail of up to walnut size is reported (hail size code 3: hail diameter of 21-30 mm) would be graded as a hailstorm with a minimum intensity of H2-3. Additional information, such as the ground wind speed or the nature of the damage the hail caused, would help to clarify the intensity of the event. For example, a fall of walnut-sized hail with little or no wind may scar fruit and sever the stems of crops but would not break vertical glass and so would be ranked H2-3. However, if accompanied by strong winds, the same hail may smash many windows in a house and dent the bodywork of a car, and so be graded an intensity as high as H5.

However, evidence indicates that maximum hailstone size is the most important parameter relating to structural damage, especially towards the more severe end of the scale. It must be noted that hailstone shapes are also an important feature, especially as the "effective" diameter of non-spheroidal specimens should ideally be an average of the co-ordinates. Spiked or jagged hail can also increase some aspects of damage.

Table 1. 12

H	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	Typical Damage Impacts
H0	Hard Hail	5	0-20	No damage
H1	Potentially Damaging	5-15	>20	Slight general damage to plants, crops
H2	Significant	10-20	>100	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	>300	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	>500	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	>800	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60		Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-75		Severe roof damage, risk of serious injuries
H8	Destructive	60-90		(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Size codes are presented in Table 1.13. The Size Code is the maximum reported size code accepted as consistent with other reports and evidence.

Table 1. 13

Hail size and diameter in relation to TORRO Hailstorm Intensity Scale		
Size code	**Maximum Diameter mm**	**Description**
0	5-9	Pea
1	10-15	Mothball
2	16-20	Marble, grape
3	21-30	Walnut
4	31-40	Pigeon's egg > squash ball
5	41-50	Golf ball > Pullet's egg
6	51-60	Hen's egg
7	61-75	Tennis ball > cricket ball
8	76-90	Large orange > Soft ball

SUMMARY AND CONCLUSIONS OF HAIL PROFILE

From April 1, 2017, through March 31, 2022, there have been 60 occurrences of Hail Events in the Purchase Region reported by NCEI. These occurrences totaled $31,000 in reported personal property damage. Data on Hail event magnitude in the form of hailstone diameter, is provided in the individual county sections of this plan.

Table 1.14 Hail Data by County
April 1, 2017 – March 31, 2022

County	Number	Dead/Injured	Value of Property Damage	Value of Crop Damage
Ballard County	12	0/0	$0.00K	$0.00K
Calloway County	11	0/0	$1.00K	$0.00K
Carlisle County	4	0/0	$0.00K	$0.00K
Fulton County	6	0/0	$0.00K	$0.00K
Graves County	8	0/0	$10.00K	$0.00K
Hickman County	1	0/0	$0.00K	$0.00K
Marshall County	9	0/0	$0.00K	$0.00K
McCracken County	9	0/0	$20.00K	$0.00K
Purchase Region	**60**	**0/0**	**$31.00K**	**$ 0.00K**

Source NOAA, NCEI, Storm Events Database

The Purchase Region experienced 60 Reported Hail Events over a 5-year period, which divides out to 12 Reported Hail Events per year or a better than 100% probability of a Hail Event in any given year. Common sense would dictate that the conditions that generated a Hail Event in one county could have generated a Hail Event in another. The county which recorded the most frequent Hail Events was Ballard County, with 12 events over 5 years, or 2.4 events per year. From a regional perspective the cost of a Hail Event could be calculated as:

- 60 Hail Events / 5 Year Period = 12 average events per year
- $31,000 property damage / 60 Hail Events = $516.7 property damage per event on average.
- $516.7 average property per event x 12 average events per year = $6200 damage per year on average

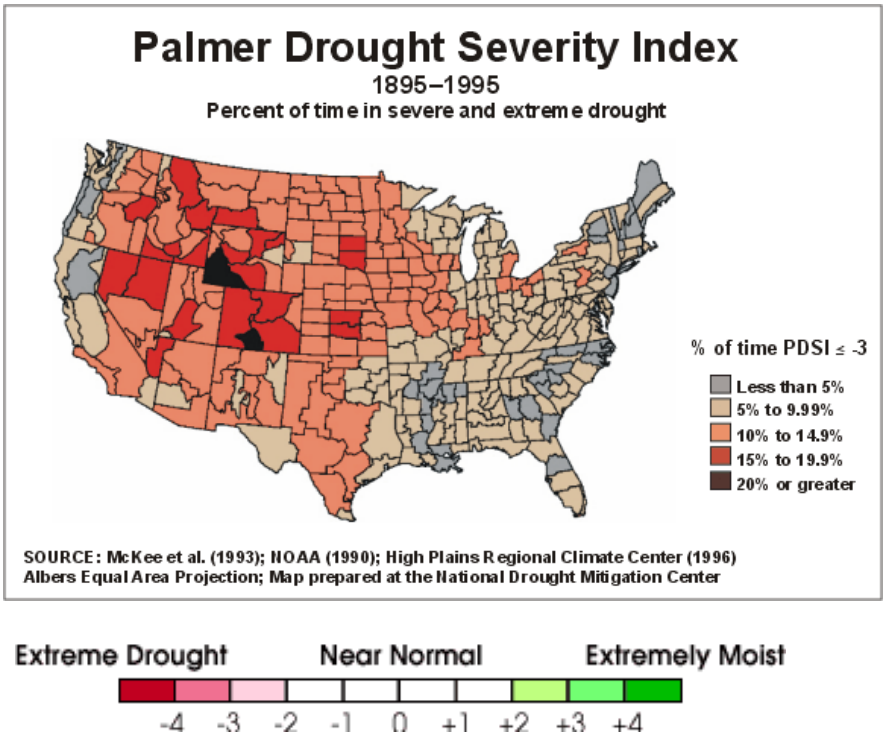
Hail Events can cause human injuries and even death. Fortunately, the human cost in the Purchase region has been low, no deaths or recorded injuries. The property damage amounts are largely accounted for by damage to roofs and to automobiles.

Excessive Heat / Drought

Excessive heat is defined as temperatures that hover 10 degrees or more above the average high temperatures for the region and last for several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms and low visibility. Droughts occur when a long period passes without substantial rainfall.

The Palmer Drought Severity Index (PDSI) is used to show the relative dryness or wetness in an area and indicates prolonged and abnormal moisture deficiency or excess. The PDSI is used for evaluating the scope, severity and frequency of prolonged periods of abnormally wet or dry weather (see Figure 1.14). The PDSI scale follows below.

Figure 1.14 Palmer Drought Severity Index



In the 100-year map for 1895 to 1995, the Western climate zone in Kentucky had a severe drought PDSI rating of greater than or equal to -3, 10% to 14.9% of the time.

Drought conditions can cause significant crop damage, but there is little property damage from excessive heat. Occurrences of drought and excessive heat in the region, these hazards present a threat not only to the agriculture of the region, but to the aged, and chronically ill population.

SUMMARY AND CONCLUSIONS OF EXCESSIVE HEAT / DROUGHT PROFILE

From April 1, 2017, to March 31, 2022, there were 0 recorded cases of Drought and 26 recorded cases of Excessive Heat in the Purchase Region. Information from the above table can be used to define the frequency of Drought Events and the impact of these events throughout the region.

Table 1.15 Excessive Heat/Drought Data by County
April 1, 2017 – March 31, 2022

County	Number	Dead/Injured	Value of Property Damage	Value of Crop Damage
Ballard County	4/0	0/0	$0.00K	$0.00K
Calloway County	2/0	0/0	$0.00K	$0.00K
Carlisle County	4/0	0/0	$0.00K	$0.00K
Fulton County	4/0	0/0	$0.00K	$0.00K
Graves County	3/0	0/0	$0.00K	$0.00K
Hickman County	4/0	0/0	$0.00K	$0.00K
Marshall County	2/0	0/0	$0.00K	$0.00K
McCracken County	3/0	0/0	$0.00K	$0.00K
Purchase Region	**26/0**	**0/0**	**$0.00K**	**$0.00K**

Source NOAA, NCEI, Storm Events Database

Drought Events were regional in nature and extent. The region experienced 0 Reported Drought Events over a 5-year period, which divides out to 0 Reported Drought Events per year. Even though there were zero reports of Drought Events during this planning process there is 100% probability of a Drought Event likely to occur in the Purchase Region in any given year. Common sense would dictate that the conditions that generated a Drought in one county could have generated a Drought Event in another. There were no deaths, injuries, property damage or crop damage reported during this period.

Of critical concern to the JPHMC, and the main contributing factor in their consideration of risks and vulnerability, is the human cost of Excessive Heat.

Wildfire

A wildfire is an uncontrollable burning of grasslands, brush or woodlands. The potential for wildfire depends on surface fuel characteristics, weather conditions, recent climate conditions, and topography and fire behavior. There are three different types of wildfire classes:

- *Surface fires* are the most common type. These fires burn along the forest floor moving slowly and will damage and kill trees.
- *Ground fires* are usually started by lightening. These fires burn on or below the forest floor.
- *Crown fires* spread quickly by wind. These fires will move quickly by jumping along treetops.
  - *Spotting* can be produced by crown fires as well as wind and topography conditions. Large burning embers are thrown ahead of the main fire. Once spotting begins, the fire will be very difficult to control.

Kentucky has two defined wildfire seasons: in the spring, February 15 – April 30 and in the fall, October 1 – December 15. These two seasons are separated by periods of higher moisture and colder, less conducive fire weather. When leaves begin to fall from deciduous hardwood trees a thick litter layer forms in wooded areas creating a fuel source for rapidly expanding wildfires. Also during the fall season, or periods of drought, tall grasses can become very flammable. It is possible for wildfires to occur outside the defined fire seasons during prolonged periods of drought.

Specific outdoor burning laws have been established to lessen the wildfire occurrence during these fire seasons. Kentucky Revised Statute 149.400 prohibits outdoor burning during the defined fire seasons between 6 am and 6 pm unless at a distance of at least 150 feet from woodlands or brushland. In Kentucky, wildfire risks are compounded by the state's extremely high arson rate. Sixty-two percent of Kentucky's wildfires are deliberately set by arsonists.

The biggest threat of wildfires in Kentucky exists in the eastern part of the state. In western Kentucky, specifically the Purchase Region, wildfires are less common. The United States Department of Agriculture and the United States Forest Service has created a database showing wildfire risk to communities. Figure 1.15 show the wildfire hazard potential for the United States and Figure 1.16 show the wildfire hazard for the Purchase Region. Based on the results in Figure 1.16 the wildfire hazard potential to the Purchase Region is very low to low.

Figure 1.15 Wildfire Hazard Potential

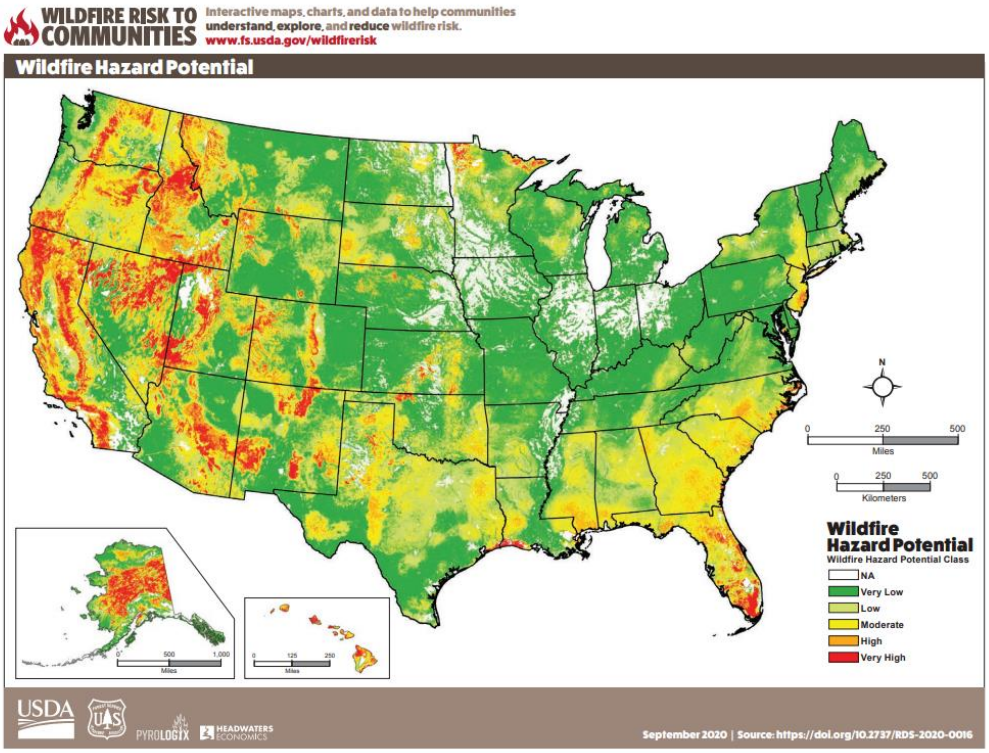


Figure 1.16 Purchase Region Wildfire Risk
Source: United States Department of Agriculture, Wildfire Risk to Communities Profile; https://wildfirerisk.org/download/

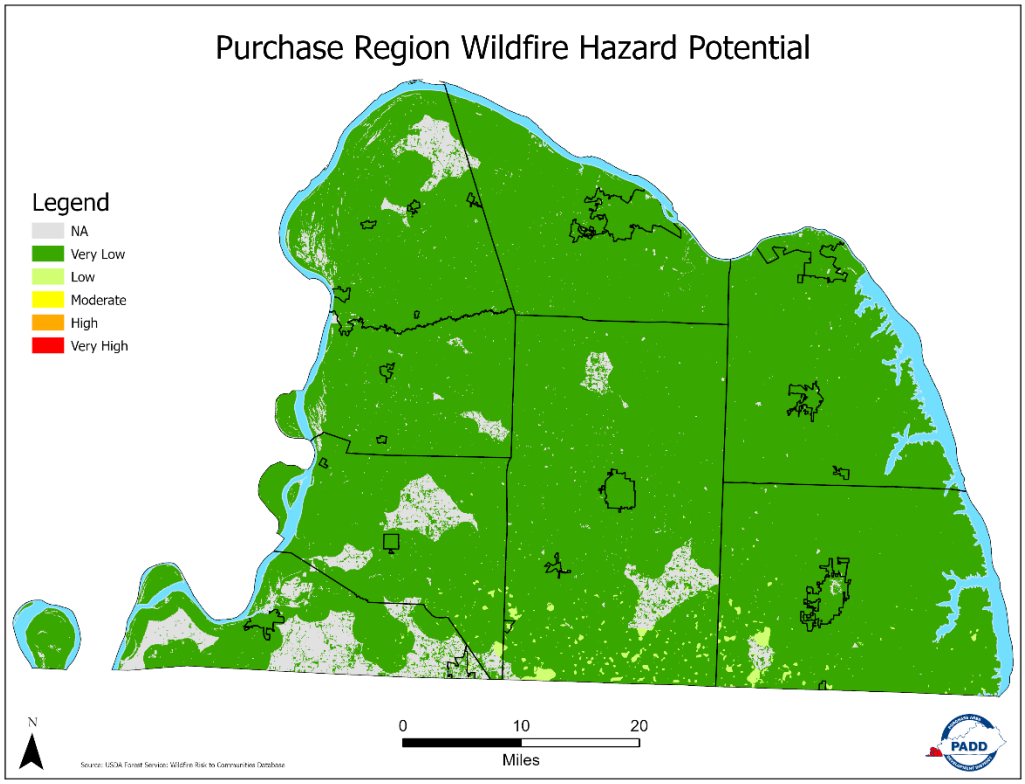


Table 1.16 shows the number of structures in the Purchase Region in the Wildfire Potential Hazard Areas

County	Structures in County	Structures in None to Very Low	Structures in Low	Structures in Moderate	Structures in High
Ballard	7,041	7,041	0	0	0
Calloway	22,328	22,175	153	0	0
Carlisle	4,476	4,476	0	0	0
Fulton	4,091	4,060	31	0	0
Graves	25,720	25,522	198	0	0
Hickman	3,777	3,764	13	0	0
Marshall	24,216	24,214	2	0	0
McCracken	36,549	36,549	0	0	0
Purchase	**128,198**	**127,801**	**397**	**0**	**0**

Source: PADD GIS Department

Table 1.17 shows the percentage of structures in the Purchase Region in the None to Low and Low Wildfire Hazard Potential Areas

County	Structures in County	% In None to Very Low	% In Low
Ballard	7,041	100%	0%
Calloway	22,328	99%	0.6%
Carlisle	4,476	100%	0%
Fulton	4,091	99%	0.7%
Graves	25,720	99%	0.7%
Hickman	3,777	99%	0.3%
Marshall	24,216	99%	0%
McCracken	36,549	100%	0%
Purchase	128,198	99%	0.3%

Source: PADD GIS Department

SUMMARY AND CONCLUSIONS FOR WILDFIRE PROFILE

From April 1, 2017, through March 31, 2022, there have been zero occurrences of Wildfire Events reported in the Purchase Region by the NCEI. In a search of the NCEI Storm Events Database there are only 11 reported events for the entire region. These recorded events occurred between February 1996 and January 2006. The last and only recorded event in the region occurred on February 20, 2004. These figures do not include and should not be construed to be the limit of the cost of brushfire suppression in the Purchase Region. Local volunteer fire departments and fulltime paid departments spend considerable time and resources in suppressing brushfires. Rather these figures serve to indicate the relatively low historical threat of large Wildfire Events in the region.

According to the 2018 Kentucky State Hazard Mitigation plan the Purchase Region counties estimated potential losses to its critical facilities is $3,187,950,000.00.

Dam Failure

There is no historical occurrence of damage or injury due to a dam failure in the Purchase Region. However, dam failure is considered a hazard. There are approximately 80,000 regulated dams in the United States. In Kentucky the Division of Water regulates 81 dams in the region. Dams are classified based on the evaluation of damage possible downstream. The FEMA guide to dam classifications is listed in Table 1.18.

Table 1.18 FEMA Dam Classification

Classification	Description
Class A (Low)	No loss of human life is expected, and damage will only occur to the dam owner's property.
Class B (Moderate/Significant)	Loss of human life is not probable, but economic loss, environmental damage, and/or disruption of lifeline facilities can be expected.
Class C (High)	Loss of one or more human life is expected. Economic loss, environmental damage, and/or disruption of lifeline facilities can be expected but are not necessary for this classification.

Source: FEMA 333.
Federal Guidelines for Dam Safety Hazard Potential Classification System for Dams

Table 1.19 High Hazard Dams in the Purchase Region

Dam Name	Dam ID	Agency	Jurisdiction Affected
East Fork Clarks River FRS 32 Dam	00200	Marshall County Conservation District	Marshall County
East Fork Clarks River FRS 33 Dam	00202	Marshall County Conservation District	Marshall County
West Fork Mayfield Creek FRS 16	00828	West Fork Mayfield Creek FRS 16	Carlisle County
East Ralph Waldrop Lake Dam	00674	Graves County Lake Corporation	Graves County
West Forks Clarks River FRS NO 20	00082	Graves County Soil Conservation District	Graves County
Obion Creek SRS 44	00636	Obion Creek Watershed District	Graves County
West Ralph Waldrop Lake Dam	00885	Graves County Lake Corporation	Graves County

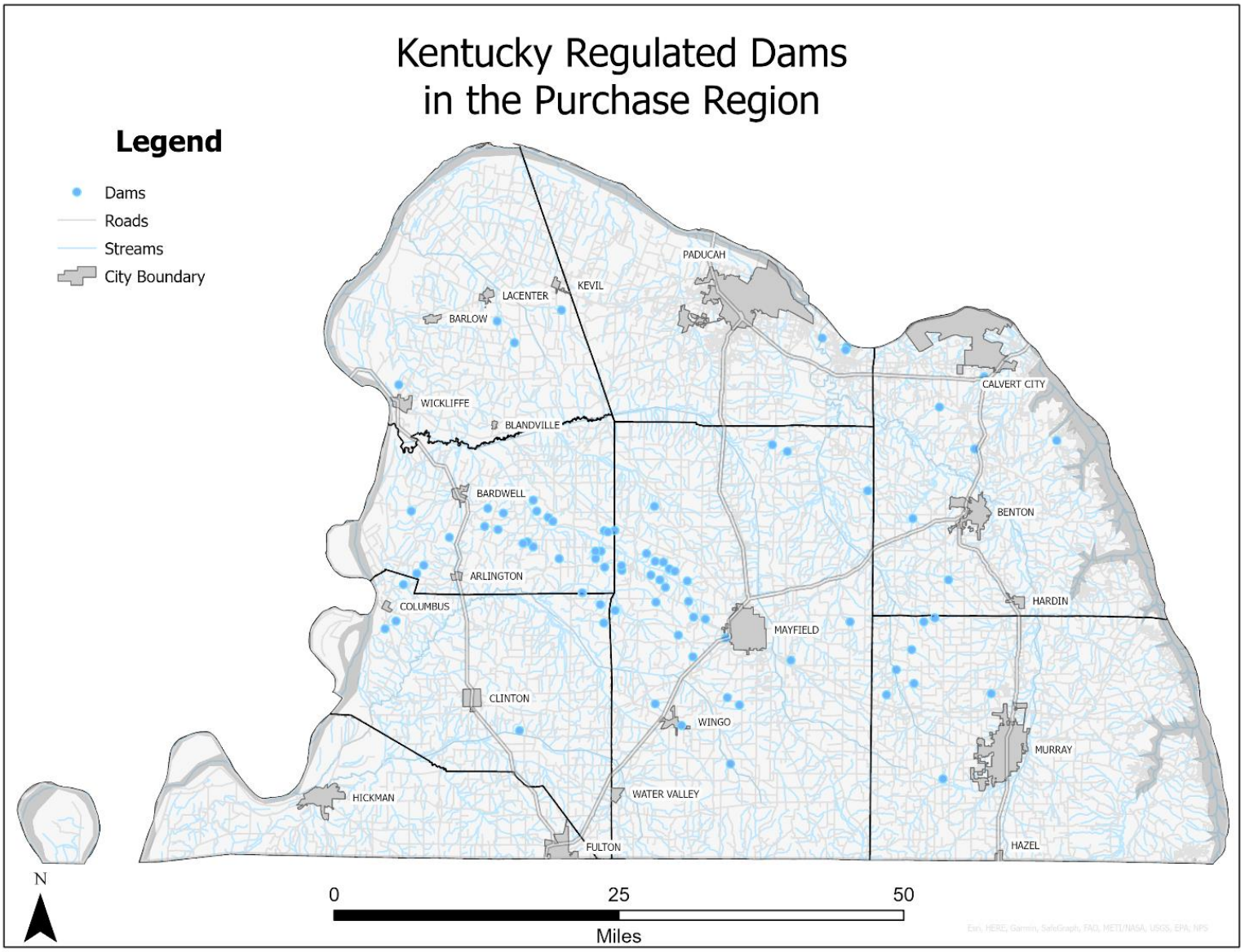
Table 1.20 Dam Classification by County
Table 1.20 lists the existing dams in the area by classification. The Purchase Region has 81 dams, 66 evaluated as Class A and six evaluated as Class B and nine Class C.

** There is a new dam built near Olmsted, Illinois which adjourns Ballard County on the Kentucky side of the Ohio River. This dam is the US Army of Corps of Engineer and Ballard County has no jurisdiction on construction or operation of the dam.

County	Class A (low)	Class B (moderate)	Class C (high)
Ballard	3	1	0
Calloway	7	1	0
Carlisle	22	0	1
Graves	23	2	6
Hickman	5	1	0
Marshall	3	1	2
McCracken	3	0	0
Purchase Region	**66**	**6**	**9**

Not included in this list are the two large dams, Kentucky Dam and Barkley Dam which impound the Tennessee and Cumberland Rivers respectively. The inundation maps have not been made available.

Figure 1.17 Purchase Region Dam Location Map



Source: Includes dam location collected by Kentucky Division of Water, https://opengisdata.ky.gov/datasets/kygeonet::ky-water-resources-regulated-dams/explore?location=35.361573%2C-88.628897%2C7.73&showTable=true

SUMMARY AND CONCLUSIONS FOR DAM FAILURE HAZARD PROFILE

There is no historical occurrence of damage or injury due to a dam failure in the Purchase Region. However, the best data available for this plan indicates that the failure of either of the two major dams, Barkley Dam on the Cumberland River or, Kentucky Dam on the Tennessee River, would totally inundate the 100-year flood plains for those rivers. Posing at least the same risk detailed in the Risk Assessment portions of the Annexes for the downstream counties of Marshall, McCracken, and Ballard, and to some extent Carlisle Hickman and Fulton.

1:4.3 Assessing Vulnerability: Identifying Assets

Kentucky's ADDs should be thought of as partnerships of local units of government. The objective of the JPHM Plan is to encourage the various jurisdictions in the Purchase Region to consider natural hazards in all planning and development decisions for the future. The PADD has no authority over the activities of any of its member jurisdictions. It has served as the initial focal point and forum respectively, for coordinating the hazard mitigation activities of individuals, organizations, local governments, and private industry. The authority and ability to implement hazard mitigation activities resides in the county and city governments.

The effort to identify assets and formulate mitigation goals and develop mitigation activities has been focused at the jurisdictional rather than at the regional level. The Identification of Assets and Assessment of Vulnerability and Analysis of Development Trends are all addressed in detail in each county Annex to the plan. The county Annexes are intended to virtually serve as standalone plans. The hazards, risks, goals, and strategies of are tailored to each county's needs and priorities. The purpose of the annexes is to focus on each county's limited fiscal and personnel resources, and to give them ownership and responsibility for the plan, its maintenance, and its revision. In addition, it is intended that the county Annexes may serve to support or augment other planning documents like comprehensive plans, economic development plans or emergency operations plans.

What follows is a regional summary to provide an overview of the more specific data included in the county Annexes of this plan.

HIGH RISK HAZARDS	TORNADO FLOOD / FLASH FLOOD THUNDERSTORM WIND EARTHQUAKE WINTERSTORM / ICE STORM
MODERATE RISK HAZARDS	HAIL EXCESSIVE HEAT DROUGHT
LOW RISK HAZARDS	WILDFIRE DAM FAILURE

In terms of the human toll in dead and injured, Tornadoes rank as the Purchase Region's most costly natural hazard. Excessive Heat is another natural hazard that has directly resulted in the death of residents in the region, and ranks second as a cause of injuries, followed by Flooding and by Thunderstorm Wind. The human cost of a major earthquake in the region is a matter of conjecture. Each of these hazards put at risk the entire population of the Purchase Region. Additional information on potential earthquake losses can be found in Appendix 3. Property damage figures used throughout this plan are necessarily general. Figures in Table 1.21 have been taken from U.S. Census Bureau Mitigation Plan.

Table 1.21 Flood Hazard Vulnerable Structures by County

County	Number of Structures			Total Property Value	
	Structures in County	Structures in Hazard Area	% In Hazard Area	Total Value in County	Value in Hazard Area
Ballard	7,041	327	4.6%	$562,799,918	$25,888,796
Calloway	22,328	359	1.6%	$2,670,699,673	$42,731,194
Carlisle	4,476	108	2.4%	$268,513,078	$6,444,313
Fulton	4,091	193	4.7%	$285,685,821	$13,427,233
Graves	25,720	404	1.6%	$2,221,703,207	$35,547,251
Hickman	3,777	85	2.3%	$295,853,256	$6,804,624
Marshall	24,216	1624	6.7%	$2,801,935,108	$187,729,652
McCracken	36,549	1586	4.3%	$5,629,613,526	$242,073,381
Purchase Region	**128,198**	**4686**	**3.7%**	**$14,736,803,587**	**$545,261,843**

Sources: Sources: Kentucky Revenue Cabinet, https://revenue.ky.gov/Property/Pages/default.aspx , Statewide Certified Property Values 2021 and Microsoft blueprint

In terms of known property damage, Hail damage should perhaps be taken with a grain of salt. Certainly, the amount of damage sustained over the years is significant, but hail damage is, for the most part, not catastrophic, perhaps only in the rare case that the integrity of a roof is compromised followed by torrential rains.

Consequently, other hazards with lower actual property damage figures rate as a higher risk in the view of the JPHMC. The impact of Winter Storms for instance is deemed higher due to the factors of overall economic and social cost of the disruption of the transportation infrastructure caused by severe winter conditions.

Once again, the wild card in the assessment of property damage is the Earthquake threat, which can only be estimated. The property vulnerability or damage exposure to the hazards of Tornado, Thunderstorm Wind and Earthquake is equal into the property value for each county as the hazards are not limited to a particular geographic region.

Impact & Frequency

The impact and frequency of each hazard is identified in each hazard profile in the previous section through impact and frequency tables and graphs. Impact is addressed further in the charts and narrative discussions found in the county asset vulnerability sections of this plan.

Identification of Assets

The county sections of this plan identify what can be affected by each hazard considered for the Purchase Region. The Hazards are addressed in the order in which they were prioritized by the MPTs of each county. The information to complete the county sections was collected from a variety of sources including the local government provided insurance replacement values for Critical Facilities when available, imagery/Flood Plain GIS layer derived data, the NCEI, and the Kentucky Revenue Cabinet, United States Geological Services (USGS), Kentucky Regulated Dams. The information was collected, mapped and summarized by the PADD staff and reviewed and analyzed by the JPHMC for inclusion in the plan.

MPT members for each jurisdiction reviewed the county level information to determine the vulnerability in each community. Maps were created by the PADD staff to illustrate the location areas in counties and local jurisdictions for identified Flood Hazard, Landslide and Wildfire threat areas.

For the other hazards identified in the plan, JPHMC members determined tornados, thunderstorm wind, earthquakes, and winter storms have the potential affect anything within each jurisdiction depending on the path of the hazard event. These hazards and their occurrence are not limited to any particular area based on past historical events and documentation as provided in the hazard profiles for the hazards. These hazards can affect any jurisdiction at any time making every asset of each jurisdiction vulnerable. Because these hazards make all jurisdictions and their assets vulnerable, only maps specific to flooding hazard, wildfire hazard, and landslide hazard areas were created.

Critical Facilities and Infrastructure

For the purpose of this plan, the JPHMC adopted the definitions of the FEMA HAZUS Loss Estimation Model according to FEMA publication 386-1, version 1.0, and pages 3-9 that states the following definitions of critical facilities and infrastructure. HAZUS separates critical facilities into five categories based on their loss potential. It was determined by the JPHMC that Hazardous Materials Facilities were not a critical facility as long as the existing hazardous materials were kept secure. For the purpose of this plan, all of the following elements are considered critical facilities except Hazardous Materials Facilities.

FEMA Critical Facilities Definitions

- Transportation Facilities include airways – airports, heliports; highways – bridges, tunnels, roadbeds, overpasses, transfer centers; railways – track segments, tunnels, bridges, rail yards, depots; waterways – canals, locks, seaports, ferries, harbors, docks, and piers.

- Lifeline Utility Systems such as potable water, wastewater, oil, natural gas, electric power and communication systems.

- Essential Facilities are essential to the health and welfare of the whole population and are especially important following hazard events. Consider not only their structural integrity and content value, but also the effects on the interruption of their functions because the vulnerability is based on the service, they provide rather than simply their physical aspects. Essential Facilities include hospitals and other medical facilities, police and fire stations, emergency operations systems, evacuation shelters, schools, and health and human services to the PADD.

- High Potential Loss Facilities are facilities that would have a high loss associated with them, both physical and economical, such as nuclear power plants, dams, and military installations.

- Hazardous Materials Facilities include facilities housing industrial/hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins. (Note: Not considered in this Plan)

Critical Facilities Estimated Replacement Value Methodology

Due to a software compatibility problem between FEMA HAZUS Program to determine critical facilities cost replacement values, PADD staff used HAZUS cost replacement values when the value could not be determined.

As a result, staff has supplemented updated HAZUS information when available with local data to establish the estimated value of critical facilities.

PADD staff used a combination of GIS data sources and local GIS data layers to build maps of the critical facilities and infrastructure for each jurisdiction found in the hazard area. Because most of the critical facilities are located throughout the counties, estimates were done on a county basis.

Facilities Critical to the Entire Region

The JPHMC recognized that certain facilities, regardless of the level of jurisdictional ownership or control, are critical to the region as a whole. These "Regional" Critical Facilities are:

Transportation Facilities:

- Barkley Regional Airport
- Kyle-Oakley Airport (Murray)
- Mayfield-Graves County Airport
- Virgil Craven Memorial Airport (Fulton)
- Kentucky Dam Village State Resort Park Airport
- Dorena-Hickman Ferry
- Highway U.S. 51 Ohio River Bridge Wickliffe to Cairo
- Highway U.S. 45 Ohio River Bridge Paducah to Brookport
- Highway KY 80 Tennessee River Bridge from Aurora to Fenton
- Highway U.S. 60 Tennessee River Bridge at Ledbetter
- Highway U.S. 62 Tennessee River Bridge at Gilbertsville/Kentucky Dam
- Interstate 24 Ohio River and Tennessee River Crossings
- All I-24 overpasses and bridges
- All Purchase Parkway (future I-69) overpasses and bridges
- Railroad bridges over the Tennessee, and Ohio Rivers

Essential Facilities:

- Baptist Health Hospital-Paducah
- Jackson Purchase Medical Center-Mayfield
- Lourdes Hospital-Paducah
- Murray Calloway County Hospital-Murray
- Marshall County Hospital

High Potential Loss Facilities:

- Kentucky Dam-Gilbertsville
- Shawnee Power Plant-East Paducah
- US Department of Energy Campus-West Paducah
- Murray State University-Murray
- West Kentucky Community and Technical College

Types and Numbers of Buildings: Earthquake and Severe Weather Hazards

Severe Weather Hazards and Earthquakes have been determined to potentially affect anything within each jurisdiction depending on the path of the hazard event. These hazards and their occurrences are not limited to any particular area based on past historical events and documentation is provided in the hazard profiles.

Table 1.22 lists the total number of structures vulnerable to these hazards. This table represents all structures and was derived from Microsoft US Building Footprint. Due to data limitations, the type of facilities between residential and commercial could not be determined therefore the structures are a combination of residential and commercial structures.

Future updates of the plan will include the distinction between residential and commercial structures if that data becomes available to be used.

Table 1.22 Purchase Region Severe Weather/Earthquake Hazard Vulnerable Assets

County	Number of Residential Structures		
	Structures in County	Structures in Hazard Area	% In Hazard Area
Ballard	7,041	7,041	100%
Calloway	22,328	22,328	100%
Carlisle	4,476	4,476	100%
Fulton	4,091	4,091	100%
Graves	25,720	25,720	100%
Hickman	3,777	3,777	100%
Marshall	24,216	24,216	100%
McCracken	36,549	36,549	100%
Total	**128,198**	**128,198**	**100%**

Sources : https://github.com/Microsoft/USBuildingFootprints
Purchase Area Development District GIS Database

Critical Facilities and Infrastructure at Risk: Severe Weather and Earthquake Hazards

Using the HAZUS MH definition for critical facilities and infrastructure, the PADD staff identified types and numbers of critical facilities and infrastructure that are vulnerable to Tornados, Thunderstorm Wind, Winter Storm, and Earthquakes in the Purchase Region.

Table 1.23 Purchase Region Critical Facilities & Infrastructure Severe Weather and Earthquake

Type of Facility	Facility Name	Current Replacement Value
Airport	Barkley Regional Airport (Paducah)	$1,415,730.00
Airport	Kyle-Oakley Airport (Murray)	$4,700,000
Airport	Mayfield-Graves County Airport	$4,424,170
Airport	Virgil Craven Memorial Airport, Fulton	$4,424,170
Airport	Kentucky Dam Village State Park Airport, Gilbertsville	$4,424,170
Ferry	Dorena-Hickman Ferry, Hickman	$1,331,000
Bridge	Highway U.S. 51 Ohio River	$2,106,020.7
Bridge	Highway U.S. 45 Ohio River	$3,571,078.5
Bridge	Highway KY 80 Tennessee River	
Bridge	Highway U.S. 60 Tennessee River	$4,047,222.3
Bridge	Highway U.S. 62 Tennessee River Bridge	$3,928,186.4
Bridge	RR Bridges over the Tennessee, and Ohio Rivers	
Bridge	Interstate 24 Ohio River and Tennessee River	$250,000,000
Bridge	All I-24 overpasses and bridges	$55,507,886.2
Bridge	All Purchase Parkway overpasses and bridges	
Hospital	Baptist Health Hospital, Paducah	$42,260,820.00
Hospital	Lourdes Hospital, Paducah	$43,471,730.00
Hospital	Jackson Purchase Medical Center, Mayfield	$12,956,760
Hospital	Murray Calloway County Hospital, Murray	$18,405,860
Hospital	Marshall County Hospital, Benton	$3,027,279.30
Dam/Hydroelectric	Kentucky Dam-Gilbertsville	
Power Plant	Shawnee Power Plant-West Paducah	$774,229,170
Other	US Department of Energy Campus-West Paducah	
University	Murray State University	$143,912,343.8
University	West Kentucky Community & Technical College	
		$1,374,215,410.8

Critical Facilities and Infrastructure at Risk: Flooding

The PADD GIS staff produced tables which provide an accurate estimate of the number of structures and Critical Facilities that are vulnerable to flooding. GPS structure points, overlain with the Flood Hazard Areas were the primary source of at-risk data, and for all counties the PADD's data and Water Information System database were used to determine at risk Critical Facilities.

Table 1.24 summarizes the numbers of structures in the Flood Hazard area for each county. These figures by default are also applicable to the vulnerability of structures to Dam Failure.

Table 1.24 Purchase Region Flood Hazard Vulnerable Assets

County	Estimated Number of Structures In Flood Hazard Areas		
	Number of Structures in County	Percentage of Structures in Flood Hazard Area	Number of Structures in Flood Hazard Area
Ballard	7,041	4.6%	327
Calloway	22,328	1.6%	359
Carlisle	4,476	2.4%	108
Fulton	4,091	4.7%	193
Graves	25,720	1.6%	404
Hickman	3,777	2.3%	85
Marshall	24,216	6.7%	1,624
McCracken	36,549	4.3%	1,586
Purchase	**128,198**	**3.7%**	**4,686**

Sources : https://github.com/Microsoft/USBuildingFootprints
Purchase Area Development District GIS Database

Table 1.25 lists the regional critical facilities and infrastructure in the identified flood hazard areas for the Purchase Region. All of these facilities are engineered to be unaffected by 100-year flooding.

Table 1.25 Purchase Region Critical Facilities & Infrastructure: Flood Vulnerability

Type of Facility	Facility Name	Replacement $$
Bridge	Highway U.S. 51 Ohio River	$2,106,020.7
Bridge	Highway U.S. 45 Ohio River	$3,571,078.5
Bridge	Highway KY 80 Tennessee River	$125,000,000
Bridge	Highway U.S. 60 Tennessee River	$4,047,222.3
Bridge	Highway U.S. 62 Tennessee River Bridge	$3,928,186.4
Bridge	RR Bridges over the Tennessee, and Ohio Rivers	
Bridge	Interstate 24 Ohio River and Tennessee River	$250,000,000
Bridge	All I-24 overpasses and bridges	$55,507,886.2
Bridge	All Purchase Parkway overpasses and bridges	
Ferry	Dorena-Hickman Ferry	$1,331,000
Dam/Hydroelectric	Kentucky Dam-Gilbertsville	
		$445,491,394.1

Types and Numbers of Buildings: Wildfire Hazard

Table 1.26 represents the Wildland/Urban Interface Wildfire Risk using the US Building Blueprint dataset. Due to data limitations, the numbers of other types of structures were not available at the time of this plan. Future updates of the plan will include numbers of other types of structures as data becomes available.

Table 1.26 Purchase Region Wildland/Urban Interface Wildfire Potential Areas

County	Structures in County	Structures in None to Very Low	Structures in Low	Structures in Moderate	Structures in High
Ballard	7,041	7,041	0	0	0
Calloway	22,328	22,175	153	0	0
Carlisle	4,476	4,476	0	0	0
Fulton	4,091	4,060	31	0	0
Graves	25,720	25,522	198	0	0
Hickman	3,777	3,764	13	0	0
Marshall	24,216	24,214	2	0	0
McCracken	36,549	36,549	0	0	0
Purchase	**128,198**	**127,801**	**397**	**0**	**0**

Sources: USDA Wildfire Hazard Potential and PADD GIS Staff

Critical Facilities and Infrastructure at Risk in the Wildland/Urban Interface

For vulnerability of Critical Facilities in each jurisdiction, see the appropriate county Annex.

Future Development: Types and Numbers of Future Buildings, Critical Facilities, and Infrastructure

The Purchase Region is expected to grow very slowly in population over the next ten years, and in some counties not at all. There will likely be little increase in the number of residential structures, or critical facilities and infrastructure. The Flood Plain Management ordnances will restrict building of residential structures in mapped flood prone areas. There are no significant changes in land use anticipated for the region and it should remain primarily rural/agricultural. Should land use changes occur, they will be included in future updates of the plan where applicable.

Table 1.27 Census Projections for the Purchase Region of Kentucky

County	Census 2000	Census 2010	Census 2020	Census Projections		
				2030	2040	2050
Kentucky	4,041,769	4,339,367	4,505,836	4,461,150	4,721,118	4,785,233
Ballard	8,286	8,249	7,728	7,180	6,558	5,979
Calloway	34,177	37,191	37,103	38,298	38,626	38,424
Carlisle	5,351	4,874	4,826	4,445	4,090	3,765
Fulton	7,752	6,238	6,515	6,132	5,697	5,349
Graves	37,028	37,421	36,649	36,582	36,163	35,758
Hickman	5,262	4,612	4,521	4,094	3,621	3,139
Marshall	30,125	31,101	31,659	31,430	30,794	30,218
McCracken	65,514	65,018	67,875	69,450	70,529	71,761
Purchase	**193,495**	**195,819**	**196,876**	**197,611**	**196,078**	**194,393**

Source: Kentucky State Data Center Projection Report for 2022 http://ksdc.louisville.edu/

New Residential Structures – Tornado, Earthquake, Thunderstorm Wind, Winter Storm

The PADD staff calculated the estimated future residential structure growth by multiplying the existing number of residential structures by the expected growth rate for each county. Results of these calculations are represented in the following table. These numbers would represent the approximate number of future residential structures vulnerable to tornadoes, earthquakes, thunderstorm wind, and winter storms.

Table 1.28 Household Projections

County	2010	2020	Projections		
			2030	2040	2050
Ballard	3,397	3,228	3,060	2,772	2,478
Calloway	15,530	15,108	16,126	16,569	16,616
Carlisle	2,116	2,003	1,845	1,681	1,532
Fulton	2,864	2725	2,578	2,368	2,157
Graves	14,978	14,742	14,697	14,396	14,180
Hickman	2,028	1,916	1,725	1,512	1,290
Marshall	13,073	13,359	13,301	13,003	12,693
McCracken	28,227	28,932	30,250	30,563	30,828
Purchase Region	**82,2213**	**82,013**	**83,582**	**82,864**	**81,774**

Source: Kentucky State Data Center https://louisville.box.com/s/rh39adf5ou0cd0aduxe5dnodanj3ftf0

1.29 Regional Housing Statistics

Total Housing Units	94,394
Owner Occupied Housing Units	66,577
Owner Occupied Housing Rate	70.5%
Average Home Value	$126,501
Median Monthly Owner Costs	$998
Median Gross Rent	$660
Building Percents	93

Source: Census.gov; 2022-2027 CEDS

The PADD staff and JPHMC members discussed potential increase in numbers of vulnerable critical facilities, industry and infrastructure; however, there was no consensus for making a reliable calculation. In future updates, involvement from the local planning process may assist in estimating the increase of critical facilities and infrastructure based on projected population growth.

In summary, JPHMC members have estimated the numbers of existing residential structures that are located in hazard areas. Future updates of this plan may include actual point data for building locations which will revise the vulnerability figures downward. Better data may result in a better estimate of growth and future buildings for each county, and the region as a whole, that will allow a more accurate assessment of vulnerable assets.

This information was used to determine mitigation strategies and actions to help reduce potential losses from hazard events.

1:4.4 Assessing Vulnerability: Estimating Potential Losses

Tornado, Earthquake, Thunderstorm Wind, Winter Storm

This information was used to determine mitigation strategies and actions to help reduce potential losses from hazard events. Assessing Vulnerability: Estimating Potential Dollar Losses. The total valuation of adjusted property as provided by the Kentucky Department of Revenue was used to estimate the potential dollar loss for all vulnerable structures for the following hazards: Tornado, Thunderstorm Wind including Hail, Winter Storm, and Earthquake.

Table 1.30 summarizes the total value of adjusted property as provided by the Kentucky Department of Revenue, and the population for each county as provided by 2020 American Community Survey information. These values were used to determine potential dollar losses and the number of people at risk in each county and all their jurisdictions, for those hazards that have no defined area: tornado, thunderstorm wind, winter storm, and earthquake.

Table 1.30 Total Value of Adjusted Property for the Purchase Region

County	County Square Miles	Population 2020 Census	Total Property Value 2021($)
Ballard	246.7	7,728	562,799,918
Calloway	385.0	37,103	2,670,699,673
Carlisle	189.4	4,826	268,513,078
Fulton	205.9	6,515	285,685,821
Graves	551.8	36,649	2,221,703,207
Hickman	242.3	4,521	295,853,256
Marshall	301.3	31,659	2,801,935,108
McCracken	248.7	67,875	5,629,613,526
Purchase Region	**2371.1**	**196,876**	**14,736,803,587**

Source: Kentucky State Hazard Mitigation Plan. 2016-2020 American Community Survey 5 Year Estimate, Kentucky Revenue Cabinet, Year Estimate, Kentucky Revenue Cabinet, https://revenue.ky.gov/Property/Pages/default.aspx

Critical Facilities and Infrastructure for Severe Weather and Earthquakes

Table 1.31 summarizes the potential dollar loss of the vulnerable Regional Critical Facilities and infrastructure to the non-geo specific hazards of Severe Weather and Earthquakes for the Purchase Region. Additional information on potential earthquake losses, especially for in-ground infrastructure can be found in the Appendix 2.

Table 1.31 Purchase Region Critical Facilities & Infrastructure

Type of Facility	Facility Name	Current Replacement Value
Airport	Barkley Regional Airport (Paducah)	$1,415,730.00
Airport	Kyle-Oakley Airport (Murray)	$4,700,000
Airport	Mayfield-Graves County Airport	$4,424,170
Airport	Virgil Craven Memorial Airport, Fulton	$4,424,170
Airport	Kentucky Dam Village State Park Airport, Gilbertsville	$4,424,170
Ferry	Dorena-Hickman Ferry, Hickman	$1,331,000
Bridge	Highway U.S. 51 Ohio River	$2,106,020.7
Bridge	Highway U.S. 45 Ohio River	$3,571,078.5
Bridge	Highway KY 80 Tennessee River	$125,000,000
Bridge	Highway U.S. 60 Tennessee River	$4,047,222.3
Bridge	Highway U.S. 62 Tennessee River Bridge	$3,928,186.4
Bridge	RR Bridges over the Tennessee, and Ohio Rivers	
Bridge	Interstate 24 Ohio River and Tennessee River	$250,000,000
Bridge	All I-24 overpasses and bridges	$55,507,886.2
Bridge	All Purchase Parkway overpasses and bridges	
Hospital	Baptist Health Hospital, Paducah	$42,260,820.00
Hospital	Lourdes Hospital, Paducah	$43,471,730.00
Hospital	Jackson Purchase Medical Center, Mayfield	$12,956,760
Hospital	Murray Calloway County Hospital, Murray	$18,405,860
Hospital	Marshall County Hospital, Benton	$3,027,279.30
Dam/Hydroelectric	Kentucky Dam-Gilbertsville	
Power Plant	Shawnee Power Plant-West Paducah	$774,229,170
Other	US Department of Energy Campus-West Paducah	
University	Murray State University	$143,912,343.8
University	West Kentucky Community & Technical College	
		$1,499,215,410.8

Sources: When available local data was used, and all other values were determined using HAZUS MH. The numbers of water treatment facilities are derived from Kentucky Infrastructure Authority, Water Resource Information System and the costs were calculated based on standard planning costs.
*** Cost replacement values left blank were hard to determine due to many factors involved*

Flood

After the vulnerability maps were created for the flood hazard areas, the cost associated with replacing those structures was evaluated. It was the determination of the PADD staff that the best way to estimate the potential dollar loss associated with the flood hazard areas was to use the median structure value as identified by the 2020 Census**.**

Table 1.32 Flood Hazard Vulnerable Structures by County

County	Number of Structures			Total Property Value	
	Structures in County	Structures in Hazard Area	% In Hazard Area	Total Value in County	Value in Hazard Area
Ballard	7,041	327	4.6%	$562,799,918	$25,888,796
Calloway	22,328	359	1.6%	$2,670,699,673	$42,731,194
Carlisle	4,476	108	2.4%	$268,513,078	$6,444,313
Fulton	4,091	193	4.7%	$285,685,821	$13,427,233
Graves	25,720	404	1.6%	$2,221,703,207	$35,547,251
Hickman	3,777	85	2.3%	$295,853,256	$6,804,624
Marshall	24,216	1624	6.7%	$2,801,935,108	$187,729,652
McCracken	36,549	1586	4.3%	$5,629,613,526	$242,073,381
Purchase Region	**128,198**	**4686**	**3.7%**	**$14,736,803,587**	**$545,261,843**

Sources: Kentucky Revenue Cabinet, https://revenue.ky.gov/Property/Pages/default.aspx , Statewide Certified Property Values 2021 and Microsoft U.S. Building Blueprint

Critical Facilities and Infrastructure

Table 1.33 lists the Regional Critical Facilities and infrastructure in the identified special flood hazard areas for the Purchase Region. All of these facilities are engineered to be unaffected by 100 year flooding. In recent episodes, only the elevated road approaching the U.S. 51 Bridge was affected by the high water, e.g., closed by high water. The actual bridge approaches were not affected, and the bridge opened to traffic as soon as the highway was cleared, inspected and necessary repairs effected.

Table 1.33 Purchase Region Critical Facilities & Infrastructure, Flood Vulnerability

Type of Facility	Facility Name	Replacement $$
Bridge	Highway U.S. 51 Ohio River	$2,106,020.7
Bridge	Highway U.S. 45 Ohio River	$3,571,078.5
Bridge	Highway KY 80 Tennessee River	$125,000,000
Bridge	Highway U.S. 60 Tennessee River	$4,047,222.3
Bridge	Highway U.S. 62 Tennessee River Bridge	$3,928,186.4
Bridge	Railroad Bridges over Tennessee and Ohio Rivers	
Bridge	Interstate 24 Ohio River and Tennessee River	$250,000,000
Ferry	Dorena-Hickman Ferry	$1,331,000
Dam/Hydroelectric	Kentucky Dam-Gilbertsville	
TOTAL		**$389,983,507.9**

Wildfire

According to the State Hazard Mitigation Plan, a majority of the region is considered a low risk with two areas in the moderate category. Table 1.34 summarize the potential dollar losses associated with structures in the State assessed Wildfire Hazard areas for the Purchase Region and was derived from American Community Survey data, HAZUS data base and other sources as noted.

Table 1.34 Purchase County Wildland /Urban Interface Wildfire Risk

County	Structures in County	Structures in None to Very Low	Structures in Low	Structures in Moderate	Structures in High
Ballard	7,041	7,041	0	0	0
Calloway	22,328	22,175	153	0	0
Carlisle	4,476	4,476	0	0	0
Fulton	4,091	4,060	31	0	0
Graves	25,720	25,522	198	0	0
Hickman	3,777	3,764	13	0	0
Marshall	24,216	24,214	2	0	0
McCracken	36,549	36,549	0	0	0
Purchase	**128,198**	**127,801**	**397**	**0**	**0**

Sources: USDA Wildfire Hazard Potential and PADD GIS Staff

1:4.5 Assessing Vulnerability: Analyzing Development Trends

The Purchase Region grew 0.54% in population between 2010 and 2020 compared to a growth of 3.8% for the state of Kentucky. The Purchase Region is expected to grow 0.4 % of its population between 2020 and 2030.

The Purchase Region is primarily rural in nature. Most residential development occurs on property that fronts primary and secondary roads. The region could expect a modest increase in residential development over the next ten years to accommodate the additional individuals expected to reside in the Purchase Region. Essential facilities and services will also be expected to increase to accommodate the population increase.

Table 1.35 represents population trends in the Purchase Region as reported by the Kentucky State Data Center using Census information.

Table 1.35 Population Projections for the Purchase Region

County	Census 2000	Census 2010	Census 2020	Census Projections		
				2030	2040	2050
Kentucky	4,041,769	4,339,367	4,505,836	4,461,150	4,721,118	4,785,233
Ballard	8,286	8,249	7,728	7,180	6,558	5,979
Calloway	34,177	37,191	37,103	38,298	38,626	38,424
Carlisle	5,351	4,874	4,826	4,445	4,090	3,765
Fulton	7,752	6,238	6,515	6,132	5,697	5,349
Graves	37,028	37,421	36,649	36,582	36,163	35,758
Hickman	5,262	4,612	4,521	4,094	3,621	3,139
Marshall	30,125	31,101	31,659	31,430	30,794	30,218
McCracken	65,514	65,018	67,875	69,450	70,529	71,761
Purchase	**193,495**	**195,819**	**196,876**	**197,611**	**196,078**	**194,393**

Source: U.S. Census Bureau, http://www.ksdc.louisville.edu/data-downloads/projections/ 2017

Land Use

The Purchase Region is primarily rural in nature. Farmland is the principal land use in the region. Land use for commercial purposes is primarily concentrated in the downtown areas of incorporated cities. Industrial development takes place primarily in the industrial parks located throughout the Purchase Region.

The Purchase Region also makes use of the land for recreation and greenspace. Most of the jurisdictions in the region have a city/county park for recreational purposes. As previously stated, farming is the most prevalent land use in the region. Table 1.36 is a summary of the farmland located in the Purchase Region and the land use for those acres.

Table 1.36 Total Farmland Located in Purchase Region

County	Number of Farms	Land in Farms(acres)	Avg. Farm Size(acres)
Ballard	295	94,340	320
Calloway	710	135,521	191
Carlisle	273	88,015	322
Fulton	146	97,615	669
Graves	1,104	251,192	228
Hickman	246	118,474	482
Marshall	699	84,676	121
McCracken	318	62,082	195
Total	**3,791**	**931,915**	**2,528**

Source: U.S. Department of Agriculture, National Agricultural Statistics Service
2017 Census of Agriculture
https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Kentucky/

Economic and Social Growth Trends

The economy in the Purchase Region is experiencing trends similar to those of the state averages, both in growth and decline. There have been new businesses and industries opening in the region, but in turn there have been layoffs and closures within the market. During the five-year update period the Purchase Region was impacted by the Covid-19 pandemic. The impact of Covid-19 can be reviewed in the 2022-2027 Comprehensive Economic Development Strategy and Disaster Resiliency Plan for the region.

Workforce, housing and transportation are the three key focus areas of the region to best improve local communities and foster economic growth and development. However, agriculture proves to be a vital part of the economy, as a whole. The changes, both hazards related, and non-hazard related, that affect farming greatly impact the Purchase Region. Hazards such as hail, flooding, tornadoes, and high wind damage crops and have an effect on the economy of the region.

Table 1.37 represents the 2010 and 2020 Employment Rate for the Purchase Region counties in comparison to the state of Kentucky.

Table 1.37 Employment Rate for 2010 and 2020 for the Purchase Region

Employment Rate	2010	2020
Kentucky	55.3 %	55.90 %
Ballard	52.10 %	49.50 %
Calloway	57.30 %	55.10 %
Carlisle	47.30 %	46.50 %
Fulton	47.30 %	46.50 %
Graves	52.00 %	53.30 %
Hickman	45.9 %	44.50 %
Marshall	54.9 %	51.30 %
McCracken	53.8 %	55.90 %

Source: U.S. Census 2010 and 2020 Table DP03

Table 1.38 Regional Workforce Statistics: Top Five Industries

Industry	Total
All Government	12,976
Retail Trade	11,623
Healthcare and Social Assistance	10,693
Manufacturing	10,067
Accommodation and Food Services	8,907

Social growth trends also play an important role in the economy of the Purchase region. Median income and housing characteristics of the region are valuable tools in analyzing these growth trends. Table 1.39 and 1.40 describe the median income and housing characteristics for the Purchase Region. This information was retrieved from the Kentucky State Data Center Census 2020 information.

Little to no population growth (0.4%) is expected to occur in the Purchase Region between 2020 and 2030. In the remaining counties of the Purchase Region, development is not likely to occur in flood regions identified in each jurisdiction because these conditions generally occur on an annual basis.

There are no significant changes anticipated in land use for any county in the region. Should land use changes occur, they will be included in future updates of the plan where applicable. Industrial expansion that takes place will be in existing industrial parks, such as the Purchase Area Regional Industrial Park, which have property available that is not located in floodplains.

Table 1.39 2020 Census and ACS 2016-2020 Median Household Income

	Median Household Income		
Area	**2010 ACS**	**2020 ACS**	**Percent Change**
Kentucky	$41,476	$52,238	25.64
Ballard	$41,228	$45,517	10.40
Calloway	$39,194	$41,841	6.75
Carlisle	$33,909	$41,222	21.57
Fulton	$31,965	$31,587	-1.18
Graves	$35,277	$45,614	29.30
Hickman	$31,836	$44,063	38.41
Marshall	$43,326	$57,348	32.36
McCracken	$41,630	$47,011	12.93

*Source: *2010 data http://www.thinkkentucky.com/edis/cmnty/QuickFacts.aspx?cw=096, Kentucky State Data Center; **U.S. Census Bureau, 2016-2020 American Community Survey 5 Year Estimate*

Table 1.40 2020 Census: Selected Housing Characteristics for the Purchase Region

Subject	Ballard	Calloway	Carlisle	Fulton	Graves	Hickman	Marshall	McCracken
Total Housing Units*	3,915	18,924	2,471	3,336	16,862	2,367	16,229	32,237
Occupied Housing Units*	3,052	15,942	2,550	2,550	14,402	1,724	13,119	27,787
Vacant Housing Units*	863	3,432	546	786	2,460	643	3,110	4,450
Seasonal Use Units**	676	2,555	512	164	2,508	307	2,370	3,005
Mobile Homes*	2,403	9,730	1,573	1,680	10,690	1,383	10,926	17,930
Owner- occupied*	649	5,762	352	870	3,712	341	2,193	9,857
Renter- occupied*	2.60	2.44	2.45	2.19	2.56	2.34	2.39	2.46
Household Size – Owner*	2.39	1.99	2.34	2.24	2.47	3.21	2.04	2.03
Household Size – Renter*	$103,800	$141,200	$83,200	$63,800	$109,000	$85,000	$138,000	$145,200
Median House Value – Owner Occupied*	3,915	18,924	2,471	3,336	16,862	2,367	16,229	32,237

*Source * U.S. Census Bureau, 2016-2020 American Community Survey 5 Year Estimate*
***2020 Census Updates; http://ksdc.louisville.edu/1census.html*

1:4.6 Multi-Jurisdictional Risk Assessment

Table 1.41 is a summary assessment of the hazards that are a risk to the entire Purchase Region. This summary includes all hazards that affect the region. All jurisdictions were determined vulnerable to tornadoes, thunderstorm wind, earthquakes, and winter storm because those hazards are not geographically limited to a particular jurisdiction.

Table 1.41 Risk Assessment Summary

Hazards	Occur ?	Casualties	Damage	Threat	Jurisdiction
	Yes/No	I=Injury F= Fatality	S=Structural I=Infrastructure C=Crop	Rank "Yes" 1-X	
Tornado	Yes	I, F	S, I, C	1	Regional
Flood	Yes	I, F	S, I	2	Regional
Windstorm	Yes	I	S, I, C	3	Regional
Earthquake	Yes			4	Regional
Severe Winter Storm	Yes	I	I	5	Regional
Hailstorm	Yes	I	S, C	6	Regional
Wildfire	Yes		C	7	Regional
Drought/Heat	Yes	I, F	C	8	Regional
Dam Failure	Yes			9	Regional
Landslide	Yes		I		County
Erosion/Deposition	Yes		I		County
Non-Occuring Hazards					
Avalanche	No			-	
Coastal Erosion	No			-	
Coastal Storm	No			-	
Expansive Soils	No			-	
Land Subsidence	No			-	
Tsunami	No			-	
Volcano	No			-	
		High Risk	**Moderate Risk**	**Low Risk**	**No Risk**

Table 1.34 includes the hazards that affect the Purchase Region listed by county jurisdictions they directly affect, the potential dollar losses from those hazards for residential structures in each county, and the potential dollar losses from those hazards for critical facilities in each county. Table 1.35 summarizes the potential dollar losses for critical facilities for each hazard type.

The structure vulnerability to Severe Weather and Earthquake hazards was equal to the total Property Value in each county because the hazards are not limited to a particular geographic region.

McCracken County has the greatest residential structure vulnerability to flooding with a potential $242,073,381 in losses. Graves County had the greatest potential for damage to critical facilities by flooding, $418,273,099.

Table 1.42 Hazard Risk Summary: Potential Structure Losses

Jurisdiction	Flood	All Severe Weather and Earthquakes	Landslides
Ballard County	$25,888,796	$562,799,918	NA*
Calloway County	$42,731,194	$2,670,699,673	NA*
Carlisle County	$6,444,313	$268,513,078	NA*
Fulton County	$13,427,233	$285,685,821	$4,087,000
Graves County	$35,547,251	$2,221,703,207	NA
Hickman County	$6,804,624	$295,853,256	NA*
Marshall County	$187,729,652	$2,801,935,108	NA*
McCracken County	$242,073,381	$5,629,613,526	NA*
Purchase Region	**$545,261,843**	**$14,736,803,587**	**$4,087,000**

** MPT did not rate as a local risk hazard.*

Table 1.43 Hazard Risk Summary: Potential Critical Facility Losses

Jurisdiction	Flood	All Severe Weather and Earthquakes	Landslides
Ballard County	$9,436,531	$300,456,450	NA*
Calloway County	$190,411,616	$632,312,417.81	NA*
Carlisle County	$9,659,443	$72,322,257.7	NA*
Fulton County	$261,553,887	$327,514,799	$87,014,480
Graves County	$418,273,099	$2,566,161,204	NA*
Hickman County	$136,954,665	$476,110,392.1	NA*
Marshall County	$178,481,170	$1,693,714,249.9	NA*
McCracken County	$396,299,000	$2,470,244,005.9	NA*
Purchase Region	$1,685,998,193	$5,819,376,803	$87,014,480

** MPT did not rate as a local risk hazard.*

Climate Change and Kentucky

Kentucky's climate is changing. Although the average temperature did not change much during the 20th century, most of the commonwealth has warmed in the last 20 years. Average annual rainfall is increasing, and a rising percentage of that rain is falling on the four wettest days of the year. In the coming decades, the changing climate is likely to reduce crop yields and threaten some aquatic ecosystems. Floods may be more frequent, and droughts may be longer, which would increase the difficulty of meeting the competing demands for water in the Ohio, Tennessee, and Cumberland rivers. Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat trapping greenhouse gases are also

increasing. These gases have warmed the surface and lower atmosphere of our planet by about one degree (F) during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others. Natural cycles and sulfates in the air prevented much of Kentucky from warming during the last century. Sulfates are air pollutants that reflect sunlight back into space. Now sulfate emissions are declining, and the factors that once prevented Kentucky from warming are unlikely to persist.

Kentucky Issues due to Climate Change

- Precipitation and Water Resources
    - Annual precipitation in Kentucky has increased approximately 5 percent since the first half of the 20th century. But rising temperatures increase evaporation, which dries the soil and decreases the amount of rain that runs off into rivers. Although rainfall during spring is likely to increase during the next 40 to 50 years, the total amount of water running off into rivers or recharging ground water each year is likely to decline 2.5 to 5 percent, as increased evaporation offsets the greater rainfall. Droughts are likely to be more severe because periods without rain will be longer and very hot days will be more frequent.

- Flooding
    - Flooding is becoming more severe in the Southeast. Since 1958, the amount of precipitation during heavy rainstorms has increased by 27 percent in the Southeast, and the trend toward increasingly heavy rainstorms is likely to continue. The Tennessee Valley Authority (TVA) and the U.S. Army Corps of Engineers operate Kentucky Dam, Wolf Creek Dam, and other dams to prevent serious floods on the Ohio, Tennessee, and Cumberland rivers. The agencies release water from the reservoirs behind these dams before the winter flood season. By lowering water levels, these releases provide greater capacity for the reservoirs behind those dams to prevent flooding. Nevertheless, dams and other flood control structures cannot prevent all floods. The Ohio River has flooded Louisville several times, for example, and flash floods have caused property destruction and deaths throughout Kentucky.

- Agriculture
    - Longer frost-free growing seasons and increased concentrations of atmospheric carbon dioxide tend to increase yields for many crops during an average year. But more severe droughts and more hot days are likely to reduce yields, especially in the western half of Kentucky, which in seventy years is likely to have 15 to 30 more days with temperatures above 95°F than it has today. Even on irrigated fields, higher temperatures are likely to reduce yields of corn, and possibly soybeans. Higher temperatures are also likely to reduce livestock productivity: hot weather causes cows to eat less, grow more slowly, and produce less milk, and it can threaten their health.

- Human Health
    - Hot days can be unhealthy—even dangerous. High air temperatures can cause heat stroke and dehydration, and affect people's cardiovascular and nervous systems. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. Higher temperatures can also increase the formation of ground-level ozone, a key component of smog. Ozone has a variety of health effects, aggravates lung diseases such as asthma, and increases the risk of premature death from heart or lung disease. EPA and the Kentucky Department for Environmental Protection have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will require even more reductions in the air pollutants that contribute to ozone.
    -

Actionable Climate Change responses, in the Purchase Region, for reducing the impacts of climate change.

- Restoration of natural systems, increases in the use of green infrastructure, and targeted conservation efforts, especially of groundwater aquifers, can help protect people and nature from climate change impacts.
- Improving urban storm water infrastructure to deal with the increase of flooding, as well as limiting nonporous surfaces. Using Green infrastructure is reducing some of the negative impacts by using plants and open space to absorb storm water.
- Improved basic health services and increased public health measures—including surveillance and monitoring of local trends—can prevent or reduce the impacts of the anticipated increased frequency and intensity of poor air quality days. Establishing cooling and heating stations through the year at a local level for extreme high temperature events.
- Integrating climate adaptation into planning Local processes offers an opportunity to better manage climate risks now. Developing knowledge for decision-making in cooperation with vulnerable communities will help to build adaptive capacity and increase resilience. Scaling unban development and Industrial farming that's sustainable for local aquifers

1:5 Mitigation Strategy

1:5.1 Capability Assessment

Mitigation strategies were developed in response to the hazard profiles and vulnerability of the assets in each jurisdiction. These strategies provide each jurisdiction with a blueprint for reducing potential losses identified in the risk assessment. These strategies are based on existing authorities, policies, programs, resources, and the ability to expand on and improve the existing tools.

The capability assessment has been divided into three sections:

(A) Existing Authorities, Policies, Programs, and Resources
(B) Existing Governmental Structure
(C) Existing Professional Staff Departments

The purpose of the capability assessment is to identify potential hazard mitigation opportunities available to each jurisdiction through daily operations as a local unit of government. This assessment will highlight the positive measures already in place in the jurisdiction as well as identify weaknesses that could increase vulnerability in a jurisdiction. Capability assessment serves as the foundation for an effective hazard mitigation strategy by establishing goals and objectives for jurisdictions.

(A) Existing Authorities, Policies, Programs, and Resources

The PADD staff, along with JPHMC members, evaluated existing authorities, policies, programs, and resources in each jurisdiction. Table 1.44 is a summary of each jurisdiction and the current status of these authorities. Local committee members evaluated this information to determine what goals, objectives, and actions would be necessary to effectively mitigate the vulnerability of a jurisdiction and what resources they currently have that can be used to implement the mitigation strategies identified in this plan.

Table 1.44 Existing Authorities, Policies, Programs, and Resources in the Purchase Region

Jurisdiction	Floodplain Management Ordinance	CRS & FMA Plans	Zoning Regulations	Subdivision Regulations	Land Development Plans	Fire Prevention Code	Comprehensive Plan	Capital Improvement Plan	Stormwater Management Plan	CERT Team	NWS Storm Ready Program	Local Economic Development	Regional Economic Development	City Class
Ballard County	X							X		X		X	X	
City of Barlow								X				X	X	6
City of Kevil								X				X	X	6
City of La Center					X		X	X				X	X	5
City of Wickliffe	X							X				X	X	5
Calloway County	X		X	X						X	X	X	X	
City of Murray	X		X	X	X		X		X			X	X	3
City of Hazel												X	X	6
Carlisle County	X									X	X	X	X	
City of Bardwell	X											X	X	5
City of Arlington	X											X	X	6
Fulton County	X									X	X	X	X	
City of Fulton	X		X	X	X		X	X				X	X	4
City of Hickman	X		X		X		X					X	X	4
Graves County	X									X		X	X	
City of Mayfield	X		X	X	X		X		X			X	X	3
City Wingo												X	X	6
Hickman County										X	X	X	X	
City of Clinton	X											X	X	5
City of Columbus												X	X	5
Marshall County	X					X				X	X	X	X	
City of Benton	X		X	X	X	X	X		X			X	X	4
City of Calvert City	X		X	X	X		X	X	X			X	X	4
City of Hardin	X											X	X	5
McCracken County	X		X	X	X	X	X			X	X	X	X	
City of Paducah	X		X	X	X	X	X	X	X			X	X	2

All jurisdictions are members of the PADD. Services are provided by the district in GIS/GPS, economic development, community development, aging services, workforce development, and fiscal management. McCracken County and Marshall County are exceptional in that they have their

own GIS Consortiums which provide GIS and GPS professional service to the county and member jurisdictions.
The existing authorities, policies, and programs are further explained in relation to the existing governmental structure and powers of the local jurisdiction. It is the responsibility of each local jurisdiction to develop, enact, and enforce the above referenced authorities and programs.

(B) Existing Governmental Structure

Tables 1.45 (county government) and 1.46 (city government) summarize the governmental structure for each jurisdiction in the PADD. Each jurisdiction is responsible for the implementation of mitigation strategies in their community. These governmental structures were reviewed by the JPHMC to determine the capability of implementing and enforcing existing and future authorities, policies, programs, and resources.

Table 1.45 County Government Structure in the Purchase Region

County	Type of Government
Ballard County	Judge/Executive and 5 magistrates
Calloway County	Judge/Executive and 4 magistrates
Carlisle County	Judge/Executive and 3 magistrates
Fulton County	Judge/Executive and 4 magistrates
Graves County	Judge/Executive and 3 commissioners
Hickman County	Judge/Executive and 3 magistrates
Marshall County	Judge/Executive and 3 commissioners
McCracken County	Judge/Executive and 3 commissioners

Table 1.46 Governmental Structure and Class of Incorporated Cities

City	Class	County	Type of Government
City of Barlow	6	Ballard	Mayor and 4 commissioners
City of Kevil	6	Ballard	Mayor and 6 council members
City of La Center	5	Ballard	Mayor and 4 commissioners
City of Wickliffe	5	Ballard	Mayor and 6 council members
City of Murray	3	Calloway	Mayor and 12 council members
City Hazel	6	Calloway	Mayor and 6 council members
City of Bardwell	5	Carlisle	Mayor and 6 council members
City of Arlington	6	Carlisle	Mayor and 4 commissioners
City of Hickman	4	Fulton	Mayor and 4 commissioners
City of Fulton	4	Fulton	Mayor and 4 commissioners
City of Mayfield	3	Graves	Mayor and 10 council members
City of Wingo	6	Graves	Mayor and 4 commissioners
City of Clinton	5	Hickman	Mayor and 6 council members
City of Columbus	5	Hickman	Mayor and 6 council members
City of Benton	4	Marshall	Mayor and 6 council members
City of Calvert City	4	Marshall	Mayor and 6 council members
City of Hardin	5	Marshall	Mayor and 6 council members
City of Paducah	2	McCracken	Mayor and 4 commissioners

Legal Authority of Local Jurisdictions

There are many tools available to local governments in Kentucky that may help them implement mitigation programs, policies and actions. Any hazard mitigation program can utilize any or all of the five types of government powers granted by the State of Kentucky: Regulation; Acquisition; Taxation; Spending, and Education.

Regulation

- Police Power: Local governments have been granted broad regulatory powers in their jurisdictions. Kentucky Revised Statutes grant the general police power to local governments, allowing them to enact and enforce ordinances and laws that define, prohibit, regulate or abate acts, omissions, or conditions detrimental to the health, safety and welfare of the citizens of their jurisdiction. The general police power also has the ability to define and abate nuisance ordinances, including those related to public health.

- Jurisdictions can include hazard mitigation requirements in their ordinances as protection of public health, safety and welfare. They may also use this power to enforce nuisance ordinances identifying nuisances that threaten the general health and safety of the public.

- Building Codes and Inspection: The construction and rehabilitation of homes, business and other structures according to standards that will make the structures more resistant to the impact of natural hazards is a big part of mitigation activity in a jurisdiction. These standards can be enforced in a jurisdiction through building codes. Through the adoption and enforcement of building codes in each jurisdiction, it can be assured that mitigation strategies are in place for the planning area.

- Land Use: Local governments can control the use of land in the jurisdiction through regulatory powers granted to them by the State of Kentucky. Jurisdictions can control certain aspects of development under these powers. The amount and type of growth in a jurisdiction can greatly affect the vulnerability of the community in the event of a natural hazard. Land use powers include the power to enact and enforce zoning ordinances, floodplain ordinances, and subdivision controls, as well as the power to engage in planning.

  - Acquisition**:** The State of Kentucky Revised Statutes allows for jurisdictions to acquire property for public purpose. Acquisition can be a useful tool for mitigation goals in that property in hazard prone areas may be acquired so that future development is prohibited in a hazardous area.

  - Taxation**:** Local governments have been given the power to levy taxes and special assignments by the State of Kentucky. Taxation extends beyond the collection of revenue and can provide the means by which the community develops in the future.

  - Spending**:** Local governments have also been given the power to make expenditures on behalf of the public in their interest. Hazard mitigation principles should be incorporated in the spending decisions made by the local government in a jurisdiction.

- Education**:** Although most residents in a jurisdiction have some knowledge of the natural hazards that potentially threaten their community, most of them have had little formal education about what they as individuals can do to reduce their vulnerability to a natural hazard event. Education involving mitigation strategies and potential vulnerability will be essential for all jurisdictions in the planning area.

(C) Existing Professional Staff Departments

Members of JPHMC reviewed their existing capabilities based on the current professional staff departments of the jurisdictions participating. During the public input meetings, participants determined that the implementation of mitigation strategies and projects would depend on the capability of that department in each jurisdiction. Table 1.39 indicates the professional staff available.

Table 1.47 Capabilities Assessment: Existing Professional Staff Departments

Jurisdiction	Board of Education	Building Inspectors	Court Clerk	Emergency Management	County/City Treasurer	Mayor /County Judge/Executive	Health Department	Road Department	Sheriff Department	City Police Department	PVA (Tax Assessment)	Social Services	Utilities Department	Churches	Fire Departments	Kentucky State Police
Ballard County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Wickliffe				X	X	X							X	X	X	X
Barlow				X	X	X							X	X	X	X
Kevil				X	X	X							X	X	X	X
LaCenter				X	X	X							X	X	X	X
Calloway County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Murray	X	X		X	X	X		X		X			X	X	X	X
Hazel				X	X	X			X				X	X	X	X
Carlisle County	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Bardwell		X		X	X	X		X		X			X	X	X	X
Arlington		X		X	X	X		X					X	X	X	X
Fulton County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Hickman				X	X	X		X		X			X	X	X	X
Fulton	X			X	X	X		X		X			X	X	X	X
Graves County	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Mayfield	X	X		X	X	X		X		X			X	X	X	X
Wingo				X	X	X							X	X	X	X
Hickman County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Clinton				X	X	X				X			X	X	X	X
Columbus				X	X	X							X	X	X	X
Marshall County	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Benton		X		X	X	X		X		X			X	X	X	X
Calvert City		X		X	X	X		X		X			X	X	X	X
Hardin				X	X	X							X	X	X	X
McCracken County	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Paducah	X	X		X	X	X		X		X			X	X	X	X

The following definitions summarize the duties and responsibilities of the professional staff departments listed in Table 1.47.

The **Board of Education** maintains the operations of the county school system. This board is elected at large by the people of the community. County funds usually maintain the buildings and provide for other capital projects. State funds usually pay for salaries and the purchase of textbooks and supplies.

The **Building Inspectors** are responsible for enforcing the State Building Code, the National Flood Insurance Program, the Community Rating System, and other applicable local codes. These items are enforced through an inspection and permitting program.

The **PVA, Court Clerk,** and **Sheriff** are elected every four years by the citizens in the county. The PVA is responsible for the valuation of property for tax purposes. The Court Clerk is the custodian of the court system in each county. This office is financed through the State of Kentucky. The Sheriff operates on a budget approved annually by the magistrates (fiscal court) of each county and is responsible for the enforcement of state and local laws.

The **City Police Departments** are responsible for enforcing local and state laws in their designated jurisdiction.

The **Kentucky State Police** are responsible for enforcing local and state law in the entire state of Kentucky.

The **Fire Departments** are responsible for responding to emergencies / medical emergencies, helping with search and rescue after and extinguishing fires in areas where fires have occurred.

The **Road Departments** are responsible for the care and maintenance of the public roadways in their designated jurisdiction.

The **Utility Departments** are responsible for providing water, gas, electric and sewer services to the public.

The **Emergency Management Service** is responsible for the mitigation, preparedness, response and recovery operations for both natural and man-made disasters. The formation of an emergency management office in each county is mandated under the Kentucky Revised Statutes.

The **County/City Treasurers** are responsible for the management of the budget and fiscal programs for their jurisdiction. This also includes the administration of state and federal grants.

The **Mayor or County Judge/Executive** is responsible for overseeing the daily operations of county or city government in their respective jurisdictions. They are also responsible for the enforcement of county/city policies and regulations.

The **Health Departments** and **Social Services** have separate boards appointed by commissioners. Employment in these departments is approved by the commissioners with state personnel policies applying. These agencies protect and promote public health and provide social services for medical care and governmental social programs for displaced families.

The **Churches** provide shelters, food and water to community members. Provide locations for emeregcny response teams to set up, help with search and rescue, help with clean up, etc. They are a fundamental part of the communities in the Purchase Region.

The **Emergency Management, Road Department, Building Inspectors, and Utilities Department** have been identified as the specific departments that will be responsible for carrying out mitigation activities. Each of these departments has been involved in the hazard mitigation planning process by participating in the JPHMC meetings.

It has been determined by the committee that each of these departments have limited available staff that are responsible for multiple duties within their departments. All jurisdictions have limited funding resources available to hire additional staff. Each staff member is adequately trained to accomplish their current workload. Increase in work activities, including hazard mitigation activities, will increase the need for additional staff to effectively perform tasks.

The PADD, as a regional planning agency, has become a primary resource for technical assistance for all jurisdictions in the region. The PADD staff are trained in planning, GIS/GPS, financial management and project development.

SUMMARY: Capability Assessment

The available staff and financial resources of the departments in each jurisdiction determine the ability for expansion and improvement of existing authorities, policies, programs, and resources to reduce potential losses. Each county in the PADD has equal ability to enforce and implement mitigation strategies.

The capability of cities in the Purchase Region varies so communities often work cooperatively with county government to perform projects that improve the quality of life for residents, including mitigation projects and activities. Because counties have more resources available to implement mitigation activities, it has been suggested that the goals and objectives be prioritized at a county level. City jurisdictions will have the opportunity at any given time to implement mitigation activities if their capabilities expand and the opportunity exists.

The jurisdictions that have participated in the mitigation planning process are identified in this plan. In addition to local participation, the PADD staff has provided professional assistance in GIS and plan development to help enhance the ability of the local jurisdictions to implement mitigation activities. Based on the above information, the Local Hazard Mitigation Goals, Objectives and Actions were compiled at a county level, taking city jurisdiction public input into consideration.

1:5.2 Regional Hazard Mitigation Goals

Representatives of all the eligible jurisdictions, state agencies, other regional and local boards and organizations, participated in the JPHMC and the development of the regional portion of the plan. Because a regional authority does not exist, the realization of the goals and objectives of the JPHM Plan depends on the support and cooperation of all the participants.

This is especially true in that the regional goals and objectives affect all jurisdictions in the Purchase Region, damage to or destruction of, the Regional Critical Facilities identified in the plan affect all jurisdictions in the region. The strategies and mitigation projects that will involve these facilities require the participation of all the jurisdictions in the region and will require the cooperation and assistance of other jurisdictions and entities such as hospital boards, airport boards, neighboring and region wide, and the assistance of regional organizations such as the PADD, the Kentucky State Police, KYTC District One, Purchase Area Health Department, The U.S. Army Corps of Engineers, TVA, to plan, and implement hazard mitigation projects.

These goals and objectives were determined to concur with existing community goals and the goals set forth by the Kentucky State Hazard Mitigation Plan. An update is provided in parentheses beside the relevant objectives identified in order to meet the goals.

Mitigation Goals – The mitigation goals were set to be general, long-term guidelines for hazard mitigation in jurisdictions.

Mitigation Objectives – The mitigation objectives define the strategies and process of implementation to achieve the identified goals. The objectives are specific, measurable, and have a defined completion.

The following goals and objectives were determined to be regional in scope and contribute to hazard loss reduction in the Purchase Region, within the Charter of the PADD, and according to the JPHMC as it is currently constituted. They are listed in order of priority for the High Risk Hazards for the region as identified and prioritized by the JPHMC.

Goal 1: Improve early warning/and notification of Jackson Purchase Area citizens to reduce the risk of injuries or fatalities from Tornados and Severe Weather.

Purpose of Goal in Relation to the Risk Analysis: Reducing the vulnerability of the populace of the Purchase Region to injury and potential fatalities caused by Tornados and Severe Weather events is the number one priority of the JPHMC. It has been determined that the best way to achieve this goal is to reduce the exposure of individuals to the direct effects of severe weather; lightening, hail, severe cold, high winds and collateral; blowing debris, falling trees, impassable roads.

The following objectives have been developed as a result of this goal:
1.1: Improve early warning of impending severe weather events.
1.2: Support projects to Increase the availability of adequate shelters from the direct and indirect effects of severe weather events.

Goal 2: Improve the survivability, minimize damages to critical facilities, infrastructure, and private property during flood events by reducing their vulnerability to hazards.

Purpose of Goal in Relation to the Risk Analysis: The damage of critical facilities and infrastructure during a flood event can be detrimental to a jurisdiction. In general, during a flood event, roadways can be impassable, bridges damaged, structures inundated, and utility services knocked out. These types of damages hinder emergency first responders from being able to render aid to those in need and compound the effects of the flooding.

The following objectives have been developed as a result of this goal:
2.1 Provide support to the accomplishment of Planning, engineering, design and execution of the restoration of the Paducah Floodwall.
2.2 Increase control over development in the floodplain to ensure lives and property are not at risk to future flood conditions.
2.3 Enhance the resistance of critical facility and transportation structures against flooding.
2.4 Encourage consideration of the various highway vulnerability studies in the Kentucky Highway Plans particularly the vulnerability of bridge approaches to flooding and earthquake.
2.5 More accurately determine Flood Prone Areas. Request through FEMA, updated Flood Insurance Rate Maps Document all damage causing flash flooding as it occurs.
2.6 Address identified “Repetitive Loss” properties. Continue to monitor and evaluate the vulnerability of repetitive loss properties at the county and city level to determine if mitigation action is warranted. Take mitigation action elevation, acquisition or other as required.

Goal 3: Protect public health and safety by increasing public awareness of natural hazards that affect the Purchase Region and by fostering a sense of responsibility within the public for mitigating risks associated with those natural hazards.

Purpose of Goal in Relation to the Risk Analysis: The general public in each jurisdiction needs to be aware of the threat and high risks areas associated with the natural hazards that affect the

Purchase Region. Through public education, individuals may realize the nature and extent of potential hazards and act upon this realization by taking steps to secure their property and protect their families against the risks of natural hazards.

The following objectives have been developed as a result of this goal:
3.1 Educate the public on potential natural hazards that affect their jurisdiction.
3.2 Increase public understanding and support of the hazard mitigation process.
3.3 Educate the public on how they can take personal responsibility for their own health, safety and property protection.
3.4 Coordinate with State Agencies and Programs such as Homeland Security to Conduct CERT Training and seek resources to conduct this training.

Goal 4: Continue to analyze the earthquake threat to the region posed by the New Madrid and Wabash Seismic Zones.

Purpose of Goal in Relation to the Risk Area: Develop a better understanding of the threats posed by the Wabash Seismic Zone and the New Madrid Seismic zone. Determine the types of construction at risk and the survivability of utility systems especially brittle water and waste water systems.

The following objectives have been developed as a result of this goal:
4.1 Request agencies such as the Kentucky Geological Survey and the University of KY to conduct/expand further studies into seismicity, soils and ground shaking potential within the region.
4.2 Develop a spatially accurate structure point data bases from which to extract precise point locations and structure footprints for buildings and other critical facilities.

4.3 Support the identification, development, and acquisition of alternative sources of potable water.
4.4 Encourage County and city planners to identify emergency water supply points in their emergency action plans and mark these locations for public recognition

Goal 5: Efficiently make use of public and private funds to increase the capabilities of local jurisdictions to reduce potential losses associated with hazard events.

Purpose of Goal in Relation to the Risk Area: Potential losses can be reduced in a jurisdiction by their ability to effectively plan, fund and implement mitigation projects. Efficiently use public or private money to improve communication, planning, and implementation capabilities for the county and city critical facilities can reduce the impact the cost of Hazard Mitigation.

The following objectives have been developed as a result of this goal:
5.1 Promote inter-agency and inter-local cooperation for the use of funds for mitigation activities.
5.2 Identify, review and monitor and map vulnerable structures, critical facilities, and risk prone areas.

5.3 Encourage jurisdictions to use the Department Emergency Management standardized form to document hazard damages, repair and recovery costs for future use in cost-benefit analysis.

Goal 6: Support and participate in regional hazard mitigation planning.

Purpose of Goal in Relation to the Risk Area: Continue the Mitigation Planning process and update the JPHM as required.

6.1 Establish a permanent JPHMC under the aegis of one of the Regional organizations dealing with similar problems and issues, either the Regional Director of Emergency Management, The Four River's Basin Team, or the Purchase Area Development District
6.2 Develop a regional high resolution, spatially accurate imagery data base from which to extract precise locations and structure footprints for buildings and other critical facilities.
6.3 Adopt an All-Hazard Week public awareness campaign to include earthquake, flood, tornados and severe storms.

1:5.3 Identification and Analysis of Mitigation Measures

For the purpose of this plan, only high and moderate risk hazards will be addressed in this section. Those hazards include severe thunderstorms, flood, hailstorm, tornado, and earthquake. The intention of this section is to identify, evaluate, and analyze a range of mitigation actions that will help reduce the potential effects of hazard events identified in the risk assessment in the plan. These actions were derived based on the analysis of the risk assessment and support the goals and objectives identified in the plan.

The goals and objectives for hazard mitigation in the JPHM Plan were developed on a multi-jurisdictional basis. The mitigation activities defined for each goal and objective were largely based on the fact that there is no regional authority empowered to make decisions, allocate funds or sign contracts. The jurisdictions must all work together.

The role of the PADD is to provide technical expertise, advice, encouragement, and through persuasion get communities to do things that left on their own that might not otherwise accomplish or even consider. No specific regional projects are included in this plan. All specific projects are at the county level and included in their respective annexes.

The following list describes the potential loss reduction mitigation actions and techniques identified for the mitigation of hazard events. These actions and objectives were determined to have the greatest influence on hazard loss reduction in the Purchase Region. They are listed in order of priority in accordance with the High-Risk Hazards for the region as identified and prioritized by the JPHMC.

General Actions:

- Prevention activities are designed to keep current problems from getting worse and to eliminate the possibility of future problems. Prevention activities reduce a jurisdiction's vulnerability to hazard events. This type of activity is especially effective in hazard prone areas where development has not occurred. Prevention activities include the following:
  - Planning and Zoning
  - Floodplain regulations
  - Stormwater management
  - Building codes
  - Capital improvement programs.
  - Open space preservation
  - Dam inspection and monitoring

- Property protection activities are designed to adapt existing structures to withstand natural hazards or to remove structures away from hazard prone areas. Property protection activities include the following:
  - Acquisition
  - Relocation
  - Foundation elevation
  - Insurance – flood and homeowner's
  - Retrofitting (includes activities such as wind-proofing, flood-proofing, and seismic design standards)

- Structural projects lessen the impact of a natural hazard by changing the natural progression of the hazard. These types of projects are usually designed by engineers. Structural projects include the following:
  - Storm sewers
  - Floodwalls
  - Highway Projects
  - Retention Basins
  - Reservoirs
  - Dams
  - Levees
  - Dredging
  - Minor flood control projects
  - Culvert resizing
  - Retaining walls
  - Safe rooms
- Emergency services minimize the impact that a natural hazard has on the residents of a jurisdiction. Usually, actions are taken by emergency response services immediately before, during, or in response to a hazard event. Emergency service activities include the following:
  - Warning systems: sirens / automated calling system
  - Evacuation planning and management
  - Sandbagging for flood protection
  - Emergency response services
  - Protection of critical facilities
  - Emergency generators
  - Specifically replace aged generator at County EOC.

- Public information and awareness activities are used to educate the residents of a jurisdiction about the potential hazards that affect their area, hazard prone areas, and mitigation strategies they can take part in to protect themselves and their property. Public information and awareness activities include the following:
  - Public speaking events
  - Outreach projects
  - Availability of hazard maps
  - School programs
  - Library materials
  - Hazard Awareness Weeks
  - Real estate disclosure
  - Storm Ready Community Program
  - Firewise Community Program
  - CERT Teams and CERT Training
  - Citizens Corps Organizations

- Natural resource protection activities include those that minimize hazard losses and preserve or restore the functions of natural systems. Natural resource protection actions include the following:
  - Sediment and erosion control
  - Stream corridor restoration
  - Watershed management
  - Forest and vegetation management
  - Wetlands preservation and management

The hazard specific mitigation activities defined for each goal and objective are listed by priority of risk. They constitute a wish, more or less, as there is no regional authority with the charter or resources to oversee the planning, implementation, or execution of all these activities. It is intended that these potential activities serve as a guideline or framework for the mitigation activities of the jurisdictions which participate in the plan's revision and update.

In addition, it should be noted that there are regional organizations that conduct one or more of these activities under the aegis of their organization's authority, charter, resources and/or objectives.

Table 1.48 Purchase Region County Hazard Summary Table

HIGH RISK HAZARDS	TORNADO FLOOD THUNDERSTORM WIND EARTHQUAKE WINTER STORM/ICE STORM
MODERATE RISK HAZARDS	HAIL WILDFIRE
LOW RISK HAZARDS	EXTREME HEAT/DROUGHT DAM FAILURE

Source: JPHMC, PADD Board, Public Input Survey

Tornado Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Develop a plan of action for a tornado event – include home, work, school, and outdoor situations.
- Have tornado drills on a regular basis.
- Encourage all households to maintain a disaster supply kit:
  - A 3-day supply of water (1 gallon per person per day)
  - Non-perishable food items
  - One change of clothing and shoes per person
  - One blanket or sleeping bag per person.
  - A first-aid kit, including all prescription medicines.
  - A battery-powered NOAA weather radio with warning alarm and extra batteries
  - A flashlight and extra batteries
  - Special items for infants, elderly or disabled individuals
- Listen to the latest forecasts, especially when planning outdoor activities.
- Publicize multi-media access to tornado watches and warnings.
- Inspect designated tornado shelters for compliance with building codes to ensure their ability to withstand high winds.
- Install warning systems that are not completely dependent upon electricity.
- Pursue programs to provide or subsidize the provision of weather radios to low income populations.
- Evaluate the need for tornado safe rooms, particularly for mobile home parks.
- Analyze the shelter requirements for temporary residents/visitors to the elder care facilities.
- Evaluate the need for tornado safe rooms, particularly for mobile home parks.
- Initiate mobile home anchoring program
- Build tornado safe room where deemed necessary.
- Ensure all critical facilities have a backup source of power – generators
- Train, equip and maintain Storm Spotter cadre

Flood Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Enforce City and County Floodplain Ordnances
- Participation in the NFIP
- Promote the purchase flood insurance.
- Construct a levee or flood wall
- Elevate the lowest floor level of existing structures above the floodplain
- Elevate flood prone roads
- When feasible, relocate structures out of the floodplain
- Acquire and demolish structures in the floodplain
- Provide openings in foundation walls to allow water to flow in and out
- Install backflow valves to drains, toilets, and other sewer connections
- Maintain ditches and storm water drainage systems
- Ensure all critical facilities have a backup source of power – generators

- Sedimentation control (dredging)
- Wetland restoration
- Stream re-alignment
- Increase culvert cross section
- Dredge existing channels to maintain current depths and flows
- Identification and removal of stream blockages of tree limbs and trunks forming effective check dams and barrages, and resulting in the pooling of water during flood events
- Continue the program/work to plan, engineer, design and execute restoration of the Paducah Floodwall.
- Work to enroll all eligible jurisdictions in the NFIP.

Thunderstorm Wind /Hail Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Listen to the latest forecasts, especially when planning outdoor activities
- Keep a NOAA weather radio with extra batteries nearby to listen for weather updates.
- Listen especially for severe thunderstorm watches and warnings.
- Practice lightning safety.
  - Outdoor activities should not take place when lightning is present.
  - Fully enclosed vehicles and large permanent buildings provide safe havens from lightning.
- Pursue programs to provide or subsidize the provision of weather radios to low income populations.
- Promote trimming of tree limbs and debris, particularly in areas close to critical facilities and infrastructure such as power lines.
- Ensure all critical facilities have a backup source of power - generators

Earthquake Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Support, encourage, and lobby for the continuing study of the threat of ground shaking from the Wabash and New Madrid Seismic Zones.
- Evaluate public critical facilities and infrastructure to determine their resistance to ground movement.
- Replacement of brittle water and waste water infrastructure specifically cast iron pipe, asbestos cement pipe, and vitreous clay pipe.
- Ensure that all homes and other structures are secured to their foundations.
- Enforce existing seismic building standards (current building code)
- Promote public education to individuals and families, business, and schools for hazard events that may include the following:
- Identify “safe places” in structures that are vulnerable during an earthquake. A safe place might include space under a sturdy table or desk against an interior wall. Stay away from windows.

- Practice the "drop and cover" technique in each identified safe place. Drop, duck your head between your knees, and cover the back of your neck with your hands. Practice makes this process an automatic response in the event of an earthquake.
- Develop an action plan for an earthquake event – include home, work, school, and outdoor situations.
  - Secure heavy furniture to walls. Brace or anchor high or top-heavy objects.
  - Purchase earthquake insurance if available.
  - Install strong latches on all cabinet doors. This will prevent them from spilling their contents in the event of an earthquake.
  - Secure items on shelves or bookcases that might fall and cause injury during an earthquake. Move large or heavy items to lower or bottom shelves.
  - Store breakable or glass items in cabinets with latches.
  - Brace overhead light fixtures.
  - Secure water heater to wall studs.
  - Install flexible pipe fittings. These fittings are less likely to break.
- Consider earthquake resistant engineering for all critical transportation access/chokepoint structures such as bridges and viaducts.

Winter Storm Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Make sure critical facilities have a backup source of heat
- Provide public education as to the safe use of back up heat sources
- Promote trimming of tree limbs and debris, particularly in areas close to critical facilities and infrastructure such as power lines.
- Evaluate subdivision regulations for inclusion of underground utilities for new development
- Promote public education to individuals and families, business, and schools for winter Storm Events and include the following:
  - Insulate the walls and attic of structures
  - Caulk and weather-strip doors and windows
  - Allow water to slowly drip from faucets to prevent pipes from freezing
  - Check the antifreeze and battery in vehicles
  - Stay off snow- or ice-covered roads if possible
  - Keep a supply of non-perishable food and water
- Ensure all critical facilities have a backup source of power - generators

Wildfire Mitigation Activities: Promote public education to individuals and families, business, and schools for hazard events that may include the following.

- Each community to strive to be a "Firewise" Community.
- Promote public education to individuals and families, business, and schools for Wildfire Threat include the following:
  - Proper storage of flammables or Class Shingles or tin on roofs or Masonry construction
  - Remove plants with resins, waxes, or oils from landscaping

  - Remove dead branches
  - Reduce the amount of fuel around homes
- Aggressively reduce available fuels in the vicinity of critical facilities
- Amnesty programs for hazardous materials/storage vessels
- Tire amnesty programs
- Removal of potential fuels from the vicinity of Critical Facilities.
- Pursue the acquisition of equipment and training to rapidly respond to brush fires to mitigate their becoming wildfires.
- Impose burn bans, as required on the county level.

Excessive Heat and Drought Mitigation Activities: Promote public education to individuals and families, business, and schools for hazard events that may include the following.

- Programs focused on at risk populations, Senior Citizens, very young children
- Air conditioner/fan loan or subsidized purchase program
- Identification of cooling shelters.
- Replacement of brittle water and wastewater infrastructure specifically cast iron pipe

Dam Failure Mitigation Activities: Promote public education to individuals and families, business, and schools for hazard events that may include the following.

- Access and analyze USACE and TVA inundation maps or models for the projected downstream impact of the catastrophic failure of the Kentucky Dam and Barkley Dam.
- Assess the structures at risk to inundation.
- Continue to participate in the Kentucky Division of Water monitoring program for the identified dams in each county.

1:5.4 Implementation of Mitigation Measures

The purpose of this section is to provide a road map on how the mitigation actions identified will be prioritized, implemented, and administered in the Purchase Region.

All jurisdictions will adopt the JPHM Plan by September 2023. Each county in the PADD has equal ability to enforce and implement mitigation strategies. The smaller cities in the region depend greatly upon the county government, and the PADD for support and combine resources to perform projects that improve the quality of life for residents, including mitigation projects and activities.

Because counties have more resources available to implement mitigation activities, it has been suggested that the goals and objectives be prioritized at a county level. City jurisdictions will have the opportunity at any given time to implement mitigation activities if their capabilities expand and the opportunity exists.

The jurisdictions that have participated in the mitigation planning process are explained in this plan. In addition to local participation, the PADD staff has provided professional assistance in GIS and plan development to help enhance the ability of the local jurisdictions to implement mitigation activities.

Funding: The jurisdictions of the PADD will attempt to utilize the following funding sources in implementing goals, objectives and actions when possible: the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), the Pre-Disaster Mitigation Program (PDM), Hazard Mitigation Technical Assistance Programs (HMTAP), the National Earthquake Technical Assistance Program, the Wind/ Water Technical Assistance Program, and local funding.

Project Prioritization: Counties, and cities will maintain the list of set goals, objectives, and actions that have been identified in this plan. These items were prioritized based on a set of criteria located in the FEMA Multi-Hazard Mitigation Planning Guidance that includes social, technical, administrative, political, legal, economic, and environmental factors (STAPLE+E) within the county jurisdictions.

Each action was given a high, medium, or low priority based on those criteria. The mitigation actions with the highest priority were the most cost effective and most compatible with the jurisdiction's social and cultural values. The PADD staff reviewed each jurisdiction's priorities annually to ensure that they were properly prioritized. The designated council representative from each jurisdiction will be responsible for maintaining this list.
The STAPLE+E criteria guidelines for action prioritization that were given to the council members in order to analyze their actions were as follows:

Table 1.49 STAPLE+E Criteria Explanation

S - Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
T – Technical	Mitigation actions are technically most effective if they provide long-term reduction of losses and have minimal secondary adverse impacts.
A – Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P – Political	Mitigation actions can truly be successful if all stakeholders have been offered and opportunity to participate in the planning process and if there is public support for the action.
L – Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
E – Economic	Budget constraints can significantly deter the implementation of mitigation actions. It is important to evaluate whether an action is cost-effective, as determined by a cost-benefit review, and possible to fund.
E - Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with Federal, State, and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

Regional Activities

The Purchase Region is an eight-county region who come together in a time of need. Below are Regional Mitigation Actions that require partnerships or multi-jurisdictional projects. Emergency Managers in the Purchase Region work together when a disaster impacts the region never leaving a man alone during a time of need. From helping with water rescues to coming to the aid of a city when a catastrophic tornado directly impacts it.

Regional Building Collapse Training:

After the December 2021 tornado fire departments from the Purchase Region counties came and helped with recovery efforts moments after the tornado. Many of the Purchase Region Fire Departments were the first on the scene and helped with recovery efforts immediately. Years after that night fire departments in the region are looking at growing recovery efforts especially in building collapse training. In the state of Kentucky most fire / recovery effort training is located in Louisville, Kentucky making it hard for the Purchase Region fire departments to send more than one fire fighter to the training. Having a training that is local allows for more attendance from the Purchase Region County fire departments and allows them to prepare for the next disaster. The Purchase Region is located near the New Madrid fault and when the inevitable occurs it will benefit the Purchase Region.

Mitigation Action:

Provide building collapse training for the Purchase Region Fire Departments and surrounding region in far Western Kentucky. Funding would be used for equipment and materials needed for training.

Regional Earthquake Center

The Purchase Region is located on the New Marid Fault Line. Even though there has not been a catastrophic earthquake in the region since 1811 the inevitable is likely to occur. A centralized Earthquake Center allows for all county emergency agencies to use in a time of need to support the Purchase Region. This facility can be used for multiple different hazards including winter storms / ice storm, severe storms and for those displaced by flooding.

Mitigation Action:
Building an Earthquake Center centralized in the Purchase Region for All Hazards that are faced by the Purchase Region. Come together as a shelter and command center during a disaster.

Regional Command Center Trailers (partnership or multi-jurisdictional)
Emergency Mangers across the Purchase Region come to one anothers aid during a time of need after a disaster has occurred. The river counties in the region are very rural in nature and therefore when a disaster occurs command centers are typically located within the cities. During the December 2021 tornado Hickman County was impacted in a rural part of the county but due to technology access the command center was located 20-30 minutes away in the city of Clinton. Mobilized Command Center Trailers allow for the Emergency Manager and Recovery Agencies to work directly in the impact area. These trailers have the ability to be used by multiple jurisdictions.

Mitigation Action:
Mobile command trailers for command centers in areas of disasters.

1:5 Plan Maintenance Procedure

1:5.1 Monitoring, Evaluating, and Updating the Plan

The JPHMC is a task specific committee, not a mandated or full-time standing committee. Its sole purpose was the forging of the initial 2006 plan and was reconstituted to conduct the 2018 and 2023 update and review. It has fulfilled those functions.

The PADD has no authority over the activities of any of its member jurisdictions. It is therefore incumbent upon the jurisdictions participating in the plan to monitor and execute the programs and activities designated by them in their separate annexes. The final objective and action of this planning process therefore is to recommend a procedure for the maintenance of this plan.

Plan Monitoring
The county emergency managers will include a review of the JPHM Plan as an agenda item for at least one Local Emergency Planning Council (LEPC) meeting each year. The topic and discussions will be reflected in the minutes.

Plan Evaluation
The county EMs will evaluate the plan annually as part of training/exercise/ evaluation activities of the Kentucky Emergency Managers (KYEM) Regional Office. The KYEM will schedule an evaluation once a year as one of their quarterly training requirements. It is essential that a representative of either the KYEM Mitigation Officer or the University of Kentucky Mitigation Program Staff participate in this training/evaluation/exercise in order to provide updates on the status of mitigation projects, grant applications, letters of intent or plan revisions. The West Kentucky Emergency Managers Association (WKEMA) will be the responsible agency to request state level participation.

During this evaluation each goal and objective in the county Annexes will be reviewed using the following or similar criteria:

- Relevance and effectiveness in light of changes and any new developments including presidential declarations.
- Whether planned actions address current and expected conditions.
- Whether the nature or magnitude of risks have changed.
- Availability of current or expected resources for implementing the actions.

Plan Update

The PADD may be responsible for facilitating the update and revision of the plan (as required by law) at the next five-year point. The jurisdictions participating in this plan have the right to update the plan following a federally declared disaster involving counties within the Purchase Region and at any other time they feel an update is required to meet a mitigation need or support a project application.

The PADD staff will be available to assist participating jurisdictions on a limited basis pending funding for such activities. The PADD staff may be used as a resource to help obtain funding for both administrative and mitigation activities as outlined in the plan.

Ad Hoc Monitoring/Evaluation/Update

Individual jurisdictions, or any group of jurisdictions, could and should review their mitigation plans with any Notice of Funds Availability (NOFA) from the State Mitigation Office. This presents an excellent opportunity, especially when representatives of the State's Mitigation Office and/or project and program monitoring team from the University of Kentucky, travel to the Purchase Region to provide information and technical assistance for the drafting of Letter of Intent for Mitigation Projects.

1:5.2 Implementation through Existing Programs

Each jurisdiction in the PADD utilizes a variety of authorities, policies and programs for the administration and development of the jurisdiction. After each jurisdiction officially adopts the JPHM Plan, hazard mitigation strategies will be integrated into them where the jurisdiction determines they are applicable.

Upon the adoption of the JPHM Plan, jurisdictions will address hazard mitigation activities when considering planning and land use regulations. Many of the actions listed in the plan address how jurisdictions will enhance and enforce existing policies as well as develop new policies that take mitigation of hazard events into consideration. The county emergency manager (EM) will be responsible for supervising and reviewing the development of these new policies and will provide technical assistance in implementing these requirements.

By adopting the JPHM Plan, each jurisdiction accepts the responsibility of implementing the strategies and actions identified in the plan. They will also be responsible for integrating hazard mitigation strategies into community development plans and activities where applicable.

Below, the plan will elaborate that the Purchase Region operates under unique local governance restrictions that prevents and/or provides disincentives to pursuing a significant degree of planning. However, where the Purchase Region jurisdictions do have the ability and the incentive to develop comprehensive plans and other such plans, the JPHM Plan can be integrated into such plans. Any incorporation should occur during the periodic update of relevant plans where applicable.

Planning at the Local Level in Kentucky

The following information is included to convey acknowledgment of the many types of plans, ordinances, and day-to-day operations that have been, could be, or, perhaps more relevantly, should be included in the jurisdictions of the Purchase Region. However, as aforementioned, many jurisdictions will not possess such planning mechanisms or processes. This is not to say that the jurisdictions normatively are justified in not possessing such planning, or that the inclusion of better planning should not be a goal towards which most jurisdictions in the Purchase Region ascribe. Simply, the Purchase Region does recognize the following common planning mechanisms and processes, and does acknowledge that, if they exist within one of the region's jurisdictions, the JPHM Plan could well be integrated into such mechanisms and processes.

Land Use

Local governments can control the use of land in the jurisdiction through regulatory powers granted to them by the State of Kentucky. Jurisdictions can control certain aspects of development under these powers. The amount and type of growth in a jurisdiction can greatly affect the vulnerability of the community in the event of a natural hazard. Land use powers include: the power to enact and enforce zoning ordinances, floodplain ordinances, and subdivision controls, as well as the power to engage in planning. KRS 100 establishes a comprehensive scheme for land

use control by local governments. The regulation of land use pursuant to KRS Chapter 100 is permissive, but in counties with a population of 300,000, establishment of a countywide planning unit is mandatory. None of the eight counties of the PADD meet this population requirement.

If a local government elects to control land use within its jurisdiction, it must first establish the planning unit. Three types of planning units are permitted: independent, joint city-county, and groups of counties (KRS 100.113). These units have the authority to perform a number of duties related to planning including making studies of the area; determine objectives; developing or adopting plans for the purpose of achieving those objectives; and developing and recommending policies, ordinances and administrative means to implement plans.

If available within a Purchase Region jurisdiction, the JPHM Plan would likely use some of these same planning units in its development and contribute some of its planning units to any development and update of land use ordinances.

Zoning

Zoning is another method of land use control available to local governments. Zoning may be utilized to promote health, safety, morals, or the general welfare of the community. More specifically zoning may be used to: protect natural resources; protect specific areas of the planning unit which need special protection; prevent loss of life, health, or property from fire, flood or other dangers (KRS 100.201).

If such ordinances exist within a Purchase Region jurisdiction, the JPHM Plan would be integrated by aiding in the development of zoning to promote safety, particularly from flooding.

Floodplain Management Plans and Ordinances

The state and federal governments can play a significant role in helping communities develop and implement floodplain management programs and encourage the effective use of mitigation strategies. However, the individual jurisdictions carry the final responsibility to plan for and manage their floodplains. Floodplains in their natural or relatively undisturbed state are important water resource areas. They serve three main purposes: natural water storage and conveyance, water quality maintenance, and ground water recharge. Unsuitable development can destroy their value and cause havoc on the environmental stability of an area.

In Purchase Region jurisdictions that have floodplain management plans and/or ordinances, such information contained therein would be integrated into the JPHM Plan. Conversely, the plan would be an obvious resource to be integrated into and with any new development of or updating of floodplain management plans and/or ordinances: The JPHM Plan would inform: the locations of floodplains throughout the jurisdictions; the impact of flooding throughout the jurisdictions; the location and values of property, which would be especially relevant in locating severe/repetitive loss property; the identification, location, and values of critical facilities, the expectation of costliness from any one particular flood; etc. Ideally, the floodplain management plan and/or ordinances and JPHM Plan would operate in tandem, the resources both informing each other and

the recommendations in one influencing the recommendations in another. Further, the information from the floodplain management plan and/or ordinances would be integrated into any mitigation strategies and actions as such plans/ordinances would help define what is most cost-effective, provides the most safety given a unique situation, and is, subsequently, most feasible.

Acquisition

The State of Kentucky legislation allows for jurisdictions to acquire property for public purpose. Acquisition can be a useful tool for mitigation goals in that property in hazard prone areas may be acquired so that future development is prohibited in a hazardous area.

Acquisitions are already integrated into the JPHM Plan. Conversely, the plan, through the planning process, would identify where acquisition provides the best and most cost-effective option for mitigation of hazards.

Day to Day Operations

- The state and local road departments are responsible for the care and maintenance of the public roadways in their designated jurisdiction.

- The utility departments are responsible for providing water, gas, electric and sewer services to the public.

- The EM is responsible for the mitigation, preparedness response, and recovery operations for both natural and man- made disasters. The formation of an EM Office in each county is mandated under the Kentucky Revised Statutes. In addition the KYEM has encouraged counties to form Local Emergency Planning Councils (LEPC), several of which were the main action organizations for the revision of their county's Annex.

- The county/city treasurers are responsible for the management of the budget and fiscal programs for their jurisdiction. This also includes the administration of state and federal grants.

- The mayor or county judge-executive is responsible for overseeing the daily operations of county or city government in their respective jurisdictions. They are also responsible for the enforcement of county/city policies and regulations.

- The health departments and social services have separate boards appointed by commissioners. Employment in these departments is approved by the commissioners with state personnel policies applying. These agencies protect and promote public health and provide social services for medical care and governmental social programs for displaced families.

- The EM, road department, building inspectors, and utilities departments are functionally the specific departments that will be responsible for carrying out mitigation activities. Each of

these departments has been involved in the hazard mitigation planning process by participating in the JPHMC or MPT meetings.

Thus, the JPHM Plan has been and will continue to be integrated into the day-to-day operations of the Purchase Region jurisdictions' local governance: The same public and stakeholders involved in the implementation of mitigation activities contributed and will continue to contribute to the planning process itself.

Planning in the Purchase Region

Given the unique nature of local governance within many of Purchase Region's jurisdictions, there exists little obvious incentive to perform much formal planning, period.

The reality is that there are 15 jurisdictions where a formal planning/zoning entity does not exist. The departments that would be responsible for the planning for mitigation and the implementation of mitigation actions often consist of one person) This person works for his/her local jurisdiction, which often consists only of a full time city clerk, a part time mayor, and a once-a-month city council implementation of actions that would generally keep communities safe, healthy, and functional simply does not require significant formal planning beyond planning for the difficult-to-predict and likely devastating hazards about which the JPHM Plan addresses.

The following table below, then, lists all of the jurisdictions covered under this JPHM Plan accompanied by the types of formal planning/ordinances that each jurisdiction possesses and into which the plan could be (and will be) integrated via the mechanisms described above. Those 15 jurisdictions described above as not having any formal planning and/or zoning entity are highlighted in yellow in the Table 1.47.

Table 1.50 Existing Authorities, Policies, Programs, and Resources in the Purchase Region

Jurisdiction	Floodplain Management Ordinance	CRS & FMA Plans	Zoning Regulations	Subdivision Regulations	Land Development Plans	Fire Prevention Code	Comprehensive Plan	Capital Improvement Plan	Stormwater Management Plan	CERT Team	NWS StormReady Program	Local Economic Development	Regional Economic Development	City Class
Ballard County	X							X		X		X	X	
City of Barlow								X				X	X	6
City of Kevil								X				X	X	6
City of La Center					X		X	X				X	X	5
City of Wickliffe	X							X				X	X	5
Calloway County	X		X	X						X	X	X	X	
City of Murray	X		X	X	X		X		X			X	X	3
City of Hazel												X	X	6
Carlisle County	X									X	X	X	X	
City of Bardwell	X											X	X	5
City of Arlington	X											X	X	6
Fulton County	X									X		X	X	
City of Fulton	X		X	X	X		X	X				X	X	4
City of Hickman	X		X		X		X					X	X	4
Graves County	X									X		X	X	
City of Mayfield	X		X	X	X		X		X			X	X	3
City Wingo												X	X	6
Hickman County										X	X	X	X	
City of Clinton	X											X	X	5
City of Columbus													X	5
Marshall County	X				X	X				X	X	X	X	
City of Benton	X		X				X					X	X	4
City of Calvert City	X		X	X	X		X	X	X			X	X	4
City of Hardin	X											X	X	5
McCracken County	X		X	X	X	X	X			X	X	X	X	
City of Paducah	X		X	X	X		X	X	X			X	X	2

For the jurisdictions that do have some form of planning and zoning or are fortunate enough to have a planning or engineering department, (those not highlighted), let it be reiterated that the strategies and projects of the plan are and will continue to be integrated into their formal plans, both in terms of short-term and long-term planning.

As evidence of the commitment of all of the Purchase Region jurisdictions to, generally, the goals inherent in hazard mitigation, and, implicitly, to the integration of such goals, strategies, and actions into any formal planning, ordinances, et al., the following spreadsheet is presented below. It conveys, via a snapshot in time, the variety of applications for hazard mitigation actions put forward by the Purchase Region jurisdictions which participate in this plan.

Disaster	Jurisdiction	Project Type	Total Funds Requested	Status
1454	City of Murray	Detention Basin	$787,954.00	Awarded
1454	City of Wickliffe	Lift Station	$439,687.00	Awarded
1746	Fulton County	Notification System	$16,000.00	LOI Submitted to KYEM; not selected by SHMT
1757	Carlisle County	Sirens	$165,879.00	LOI Submitted to KYEM; not selected by SHMT
1757	Fulton County	Notification System	$12,250.00	LOI Submitted to KYEM; not selected by SHMT
1757	City of Fulton	Bank Stabilization	$300,000.00	LOI Submitted to KYEM; BCA information not returned from subapplicant - proposal closed
1818	City of Bardwell	Elevation/Build New Wells	$400,000.00	LOI Submitted to KYEM; determined to be ineligible
1818	City of Murray	Construction - Safe Room	$10,800,000.00	LOI Submitted to KYEM; BCA information not returned from subapplicant - proposal closed
1818	City of Calvert City	Redundant Water Line	$1,325,000.00	Ineligible; sent letter
1818	City of Calvert City	Redundant Water Line	$929,000.00	Ineligible; sent letter
1818	City of Murray	Redundant Communications	$34,259.00	Ineligible; sent letter
1818	Ballard County Fiscal Court	Other - Initiative	$60,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Murray-Calloway County Hospital	Other - Initiative	$34,259.44	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Calloway County Fiscal Court	Warning Siren	$256,405.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Ballard County Fiscal Court	Warning Siren	$146,136.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Ballard County	Generator: Family Life Center	$75,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Wickliffe	Generator	$ 48,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Bardwell	Generator: Water Treatment Plant	$ 55,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Bardwell	Generator: Water Treatment Plant	$ 35,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Bardwell	Generator: Baptist Church	$ 59,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Barlow	Generator: WTP	$ 55,983.00	LOI Submitted to KYEM; not selected by SHMT; sent letter

1818	Calloway County	Generator	$ 46,938.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Fulton County	Generator: Shelters	$ 160,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Fulton	Generator: PW	$ 50,620.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Fulton	Generator: Maintenance Garage	$ 46,340.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Fulton	Generator: Critical Facility at Lagoon	$ 32,121.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Fulton	Generator: Sewer Lift Station	$ 44,251.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Fulton	Generator: PW Lift Station	$ 45,153.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Kevil	Generator	$ 70,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of LaCenter	Generator	$ 136,500.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of LaCenter	Generator	$ 47,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Marshall County Health Department	Generator	$ 24,800.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Marshall County Health Department	Generator	$ 31,750.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Marshall County Health Department	Generator	$ 6,460.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Murray - Calloway County Hospiatl	Generator	$ 385,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Murray State University	Generator	$ 65,200.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Murry-Calloway County Hospital	Generator	$ 46,700.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Murry-Calloway County Hospital	Generator	$ 127,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Murry-Calloway County Hospital	Generator	$ 134,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Paducah Public Schools	Generator	$ 89,800.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Paducah Water	Generator	$ 26,500.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Paducah Water	Generator	$ 68,300.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	Paducah Water	Generator	$ 91,600.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818	City of Wicklife	Generator	$ 50,940.00	LOI Submitted to KYEM; not selected by SHMT; sent letter

1818	City of Wingo	Generator	$ 35,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1818-0023	Paducah Water	Construction – Safe Room	$122,000.00	Application submitted to FEMA
1818-0047	**Ballard County**	**Generator - EOC**	**$54,450.00**	**Awarded**
1818-0048	**Fulton**	**Generator - Fulton**	**$28,412.00**	**Awarded**
1818-0043	Marshall Co	Safe Room	$1,535,450.00	Withdrawn
1818-0013	**Marshall Co**	**Generator - EOC/Court House**	**$57,762.00**	**Awarded**
1818-0023	Paducah Water	Safe Room	$140,000.00	Application submitted to FEMA
1818-0018	**Murray State University**	**Generator - EOC**	**$93,000**	**Awarded**
1818-0020	**Murray State University**	**Generator -2MSU/WKMS**	**$72,735.00**	**Awarded**
1818-0022	**Mayfield Fire Station #1**	**Generator**	**$99,066.00**	**Awarded**
1818-0051	**City of Barlow**	**Generator**	**$50,227.00**	**Awarded**
1818-0095	**Ballard Co**	**3 Generators Project**	**$162,500.00**	**Awarded**
1818-0093	**City of Calvert City**	**Acquisition**	**$375,000.00**	**Awarded**
1818-0078	**Carlisle County**	**Generator**	**$115,200.00**	**Awarded**
1818-0157	City of Hardin	Generator	$55,240.00	Application submitted to FEMA
1818-0152	**City of Hickman**	**Generator**	**$55,823.00**	**Awarded**
1818-0002	**Purchase ADD**	**Plan Update**	**$81,598.00**	**Awarded**
1855	Ballard Co. Fiscal Court	Drainage	$ 20,256.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1855	City of Bardwell	Generator	$ 47,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1855	City of Hickman	Generator	$ 286,783.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1855	McCracken County Fiscal Court	Siren	$ 48,400.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1855	Jonathan Creek Water District	Generator	$ 50,945.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1912/1925	Jackson Purchase Energy Corp	Construction	$ 186,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter
1912/1925	Carlisle County Fiscal Court	Soil Stabilization Project	$329,287.00	Selected to move forward to BCA/Application
1912/1925	City of Calvert City	Civic Center Construction	$ 177,000.00	Selected to move forward to BCA/Application
1912/1925	McCracken County Fiscal Court	McCracken Co (2) Safe Rooms w/ Generators	$ 725,000.00	LOI Submitted to KYEM; not selected by SHMT; sent letter

1912/1925	Fulton County Fiscal Court	Fulton Co. Generator Project	$ 90,000.00	Selected to move forward to application
1912/1925	Marshall County Fiscal Court	Marshall Co Generator Project	$ 100,000.00	Selected to move forward to application
	Awarded		**$2,473,414.00**	
	At FEMA		**$317,240.00**	
	LOI approved		**$696,287.00**	

Public Climate of Support

Virtually all residents have a basic knowledge of what natural hazards are most prevalent in their areas and the potential impact they can have. The gap comes in the form of education regarding mitigation measures that can be put in place by both local governments and residents. Education concerning mitigation strategies and potential losses will be a key factor for all jurisdictions in the planning area. In light of recent natural hazard events and the excessive impact they have had on the Purchase Region, the political climate supports and is proactive concerning hazard mitigation measures.

1:5.3 Continued Public Involvement

The JPHM Plan has been created with considerable input from each jurisdiction. The goal of the regional council is to provide ample opportunity for continued public involvement in hazard mitigation planning and activities. In order to do so it is proposed that the LEPCs, the WEKMA and the KYEM Regional Office periodically (perhaps at a minimum once a year) review the JPHM Plan, particularly the individual county Annexes at a meeting open to the public.

The county EMs will ensure that copies of the JPHM Plan is available at all public libraries as well as each of the county judge-executive and mayor offices for public review during regular business hours. These copies will contain contact information for PADD staff and the county EM where the public can document their concerns or changes regarding the mitigation plan.

A complete copy of the JPHM Plan will be available on the PADD's website (www.purchaseadd.org).

Individual Project Progress Report

From: County Emergency Manager
To: Elected Officials
Subject: **Annual Report Status of Mitigation Projects**
Date:
Project Title:
Status of Project:
Problems/Obstacles & Proposed Corrective Actions:
Name of Reporter:
Address:
Email Address:
Phone Number:

Send to: County Emergency Manager

Local Mitigation Strategy Annual Report

From: County Emergency Manager
To: Elected Officials
Subject: **Annual Report Status of Mitigation Projects**

Date:

This report is prepared to inform locally elected officials in the Purchase Region of the progress being made to make our community more disaster resistant. The following briefly summarizes the status of existing projects presently being developed and identifies new projects expected to be undertaken in the upcoming year.

Existing Projects:			
Project Title	**Purpose of Project**	**Status of Completion**	**Obstacles/Problems/Solutions**

New Projects:				
Project Title	**Purpose of Project**	**Funding Source(s)**	**Anticipated Problems or Solutions**	**Start Date / End Date**