

3 RISK ASSESSMENT

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The risk assessment process identifies and profiles relevant hazards and assesses the effects of exposure to these hazards on the lives, property, and infrastructure of Warren County residents. The process allows Warren County and its communities to better understand the potential risk from natural and manmade hazards and it provides a framework for developing and prioritizing mitigation actions to further reduce risk from future hazard events should they occur.

The risk assessment for Warren County and its jurisdictions followed the methodology described in the Local Mitigation Planning Handbook (March 2013).

This section is further divided into four parts; Hazard Identification, Assets at Risk, Land Use and Development, and Vulnerability Assessment.

Section 3.1 Hazard Identification identifies the hazards that threaten the planning area and provides a factual basis for elimination of hazards from further consideration;

Section 3.2 Assets at Risk provides the planning area's total exposure to natural hazards, considering critical facilities and other community assets at risk;

Section 3.3 Land Use and Development discusses development that has occurred since the last plan update and any increased or decreased risk that resulted. This section also discusses areas of planned future development and any implications on risk/vulnerability;

Section 3.4 Hazard Profiles and Vulnerability Analysis provides more detailed information about the hazards impacting the planning area. For each hazard, there are three sections: 1) Hazard Profile provides a general description and discusses the threat to the planning area, the geographic location at risk, potential Strength/Magnitude/Extent, previous occurrences of hazard events, probability of future occurrence, risk summary by jurisdiction, impact of future development on the risk; 2) Vulnerability Assessment further defines and quantifies populations, buildings, critical facilities, and other community/school or special district assets at risk to natural hazards; and 3) Problem Statement briefly summarizes the problem and develops possible solutions.

3.1 HAZARD IDENTIFICATION

The Warren County Emergency Management Director, along with members of the MPC and the Boonslick Regional Planning Commission, reviewed existing mitigation plans, researched historical disaster declaration records, and surveyed various other sources, including anecdotal information, to fairly identify hazards to be included in this plan.

3.1.1 Review of Existing Mitigation Plans

The MPC reviewed the hazards identified in the previously approved plan from 2016, as well as the hazards identified in the most recent State Plan. There were no significant differences between the lists of hazards included in the previously approved plan and this plan update. The Warren County plan differs from a typical Natural Hazard Mitigation plan in that it includes some manmade hazards.

Missouri requires only natural hazards to be included in county plans because federal regulations do not require manmade hazards to be included. However, as discussed above, the MPC determined some manmade hazards should be included; specifically, hazards relating to Terrorism, Transportation, Utility Disruption, and Hazardous Material Spills. These hazards were included as they are significant risks for Warren County due to its proximity to a nuclear power plant and several major railroads and highways bisecting the county.

3.1.2 Review Disaster Declaration History

Federal and state declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster is so severe that both the local and state governments' capacities are exceeded; a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

FEMA also issues emergency declarations, which are more limited in scope and do not include the long-term federal recovery programs of major disaster declarations. Determinations for declaration type are based on scale and type of damages and institutions or industrial sectors affected.

The following table lists FEMA disaster declarations made since 2000 that include Warren County.

Table 3.1 FEMA Disaster Declarations that included Warren County, Missouri, 2000 -Present

Disaster Number	Description	Declaration Date / Incident Period	Individual Assistance (IA) / Public Assistance (PA)
FEMA-1328-DR	Severe Thunderstorms and flash flooding	12-May-2000	IA
FEMA-3232-DR	Hurricane Katrina evacuation	10-Sep-05	PA
FEMA-1676-DR	Severe Winter Storms and Flooding	14-Jan-07	PA

Disaster Number	Description	Declaration Date / Incident Period	Individual Assistance (IA) / Public Assistance (PA)
FEMA-3281-DR	Severe Winter Storms	12-Dec-07	PA
FEMA-1736-DR	Severe Winter Storms	27-Dec-07	PA
FEMA-1749-DR	Severe Storms and Flooding	19-Mar-08	PA
FEMA-3303-DR	Severe Winter Storms	30-Jan-09	PA
FEMA-3317-DR	Severe Winter Storms	03-Feb-2011	PA
FEMA-3325-DR	Flooding	30-Jun-11	PA
FEMA- 3374-DR	Severe storms, tornadoes, straight line winds and flooding	02-Jan-16	PA
FEMA-3482-EM	Pandemic	12-Mar-20	PA
FEMA-4490-DR	Pandemic	30-Apr-20	IA & PA

Source: Federal Emergency Management Agency,
<https://www.fema.gov/data-visualization-summary-disaster-declarations-and-grants>

3.1.3 Research Additional Sources

The following additional data sources were also consulted during the completion of this plan.

- Missouri Hazard Mitigation Plans (2013 and 2018)
- Previously approved planning area Hazard Mitigation Plan (2016)
- Federal Emergency Management Agency (FEMA)
- Missouri Department of Natural Resources
- National Drought Mitigation Center Drought Reporter
- US Department of Agriculture’s (USDA) Risk Management Agency Crop Insurance Statistics
- National Agricultural Statistics Service (Agriculture production/losses)
- Data Collection Questionnaires completed by each jurisdiction
- State of Missouri GIS data
- Environmental Protection Agency
- Flood Insurance Administration
- Hazards US (Hazus)
- Missouri Department of Transportation
- Missouri Division of Fire Marshal Safety
- Missouri Public Service Commission
- National Fire Incident Reporting System (NFIRS)
- National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI);
- County and local Comprehensive Plans to the extent available
- County Emergency Management

- County Flood Insurance Rate Map, FEMA
- Flood Insurance Study, FEMA
- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- U.S. Army Corps of Engineers
- U.S. Department of Transportation
- United States Geological Survey (USGS)
- Various articles and publications available on the internet (appropriate citations are provided in the plan)

The only centralized source of data for many of the weather-related hazards is the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI). Although it is usually the best and most current source, there are limitations to the data which should be noted. The NCEI documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. Some information appearing in the NCEI may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, law enforcement and/or other government agencies, private companies, individuals, etc. An effort is made to use the best available information but because of time and resource constraints, information from these sources may be unverified by the NWS. Those using information from NCEI should be cautious as the NWS does not guarantee the accuracy or validity of the information.

The NCEI damage amounts are estimates received from a variety of sources, including those listed above in the Data Sources section. For damage amounts, the NWS makes a best guess using all available data at the time of the publication. Property and crop damage figures should be considered as a broad estimate. Damages reported are in dollar values as they existed at the time of the storm event. They do not represent current dollar values.

The database currently contains data from January 1950 to September 2020, as entered by the NWS. Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. The following timelines show the different time spans for each period of unique data collection and processing procedures.

1. Tornado: From 1950 through 1954, only tornado events were recorded.
2. Tornado, Thunderstorm Wind and Hail: From 1955 through 1992, only tornado, thunderstorm wind and hail events were keyed from the paper publications into digital data. From 1993 to 1995, only tornado, thunderstorm wind and hail events have been extracted from the Unformatted Text Files.
3. All Event Types (48 from Directive 10-1605): From 1996 to present, 48 event types are recorded as defined in NWS Directive 10-1605.

Note that injuries and deaths caused by a storm event are reported on an area-wide basis. When reviewing a table resulting from an NCEI search by county, the death or injury listed in connection with that county search did not necessarily occur in that county.

3.1.4 Hazards Identified

The table below lists in alphabetical order the hazards that significantly impact Warren County that were chosen by the MPC for further analysis. Not all hazards impact every jurisdiction. An “X” in the table column indicates the jurisdiction is impacted by the hazard, and an empty cell indicates the hazard is not applicable to that jurisdiction, Each of the hazards listed have an equal likelihood of occurrence throughout the county and its communities, with the exception of dam failure, flooding, and levee failure which by natural are located in low-lying areas downstream from dams, levees, and rivers.

Table 3.2 Hazards Identified for Each Jurisdiction

Jurisdiction	Dam Failure	Drought	Earthquake	Extreme Temperatures	Flooding (River and Flash)	Hazardous Materials Release	Levee Failure	Radiation Release	Severe Winter Weather	Terrorism	Thunderstorm/Lightning/Hail/High Wind	Tornado	Utility Interruptions	Wildfire	Transportation disruption
Warren County	x	x	x	x	x	X	x	X	x	X	x	x	X	x	x
Innsbrook	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Marthasville	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pendleton		x	x	x		x		x	x	x	x	x	x		
Warrenton		x	x	x		x		x	x	x	x	x	x	x	
Wright City		x	x	x		x		x	x	x	x	x	x	x	
Truesdale		x	x	x		x		x	x	x	x	x	x		
Schools															
Warren County R-II			x	x		x		x	x	x	x	x	x		x
Wright City R-II			x	x		x		x	x	x	x	x	x		x
Gasconade County R-I School			x	x	x	x	x	x	x	x	x	x	x		x
School District of Washington	x		x	x	x	x	x	x	x	x	x	x	x		x

3.1.5 Multi-Jurisdictional Risk Assessment

For this multi-jurisdictional plan, the risk assessment assesses each jurisdiction's risk where they deviate from risk's facing the entire county. Warren County is not geographically large at 431 square miles, and is fairly uniform in terms of climate and topography, as well as construction characteristics and development trends. Accordingly, overall hazards and vulnerability do not vary greatly across the planning area.

This is an update to the 2016 plan. Hazards added since the last update will be noted as such. For this update, all hazards were assessed on a county-wide basis, except as noted. Some hazards, like flooding, vary in risk across the planning area. Those variations were discussed by the MPC and included in the profile where appropriate. The hazards that vary across the planning area, in terms of risk, are dam failure, flash flood, wild fire, and levee failure.

The county is essentially rural with more densely populated areas in and around Warrenton, Truesdale, Wright City, and Marthasville. All the aforementioned cities have school attendance centers located within their boundaries. Marthasville lies in an alluvial plain and as such is subject to occasional flooding brought on by levee breaches and the high waters of the Missouri River. Development tends to take root in these cities and along major US and State highways; Interstate 70 and Missouri 47. Row crops across the county are susceptible to drought, floods, hail, and high winds. Livestock is not as big a concern but ranching is adversely affected by flooding, drought, and extremes of heat and cold. Where appropriate, these differences will be explained in greater detail in the vulnerability sections of each hazard.

Each hazard identified in Section 3.1, Hazard Identification, is profiled individually in this section in alphabetical order for easier reference. The level of information presented in the profiles varies by hazard based on the information available. With each update of this plan, new information will be incorporated to provide for better evaluation and prioritization of the hazards that affect Warren County.

The sources used to collect information for these profiles include those mentioned in Section 3.1.3. and those cited individually in each hazard section. Detailed profiles for each of the identified hazards include information on the following characteristics of the hazard.

Hazard Description

This section consists of a general description of the hazard and the types of impacts it may have on a community. It also includes a ranking to indicate typical warning times and duration of hazard events.

Historical Statistics

This section describes the geographic extent or location of the hazard in the planning area and includes the information on historic incidents and their impacts based upon the sources described in Section 3.1.4, Hazard Identification and the information provided by the MPC. Where available, maps are utilized to indicate the areas of the planning region that are vulnerable to the subject hazard.

Probability of Future Occurrence

The frequency of past events is used to gauge the likelihood of future occurrences. Where possible, the probability and severity of occurrence was calculated based on historical data. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. An example would be three droughts occurring over a 30-year period, which suggests 10 percent chance of drought in any given year.

Magnitude of Severity

The magnitude of the impact of a hazard event (past and perceived) is related directly to the vulnerability of the people, property, and the environment it affects. This is a function of when the event occurs, the location affected, the resilience of the community, and the effectiveness of the emergency response and disaster recovery efforts.

3.2 ASSETS AT RISK

In this section of the plan, the Warren County population, structures, critical facilities and infrastructure and other important assets that may be at risk to hazards are assessed. There were no changes to the planning area since the previously approved plan was adopted.

Missouri Mitigation Viewer

With the 2018 Hazard Mitigation Plan Update, SEMA now provides online access to risk assessment data and associated mapping for the 114 counties in the State, including the independent City of St. Louis. Through the web-based Missouri Hazard Mitigation Viewer, local planners or other interested parties can obtain all State Plan datasets.

The Missouri Hazard Mitigation Viewer includes a Map Viewer with a legend of clearly labeled features, a north arrow, a base map that is either aerial imagery or a street map, risk assessment data symbolized the same as in the 2018 State Plan for easy reference, search and query capabilities, ability to zoom to county level data and capability to download PDF format maps. The Missouri Hazard Mitigation Viewer can be found at this link:

- <http://bit.ly/MoHazardMitigationPlanViewer2018>
- <https://drive.google.com/file/d/1bPkc0jqF9ofwQLnTL9N0u-oPFWi9hkst/view> - User Guide

Assets at Risk available from the Mitigation Viewer include:

- State Owned Facilities
- State Leased Facilities
- Department of Higher Education Facilities
- State Owned Bridges

Flood Risk Datasets

Data sources include:

- FEMA Flood Insurance Rate Maps (FIRM)
<https://msc.fema.gov/portal/home>
- FEMA National Flood Hazard Layer
<https://hazards.fema.gov/femaportal/wps/portal/NFHLWMS>
- FEMA Hazus Program
<https://www.fema.gov/hazus>
- 2010 US Census Population and Housing Unit Counts

3.2.1 Total Exposure of Population and Structures

For the 2018 State Plan, SEMA utilized a structure inventory dataset developed by the University of Missouri GIS Department (MSDIS) to determine the number of structures exposed to risks. MSDIS created a point and/or footprint dataset for every roof line in every county in the state of Missouri. This dataset is attributed with the type of structure such as Residential, Commercial, etc. This dataset was utilized throughout this section.

Unincorporated County and Incorporated Cities

In the following three tables, population data is based on 2017 population estimates. Building counts and building exposure values are based on parcel data provided by the State of Missouri Geographic Information Systems (GIS) database which can be obtained directly from the SEMA Mitigation Management Section. Contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The multipliers were derived from the Hazus and are defined below in **0**. Land values have been purposely excluded from consideration because land remains following disasters, and subsequent market devaluations are frequently short term and difficult to quantify. Another reason for excluding land values is that state and federal disaster assistance programs generally do not address loss of land (other than crop insurance). It should be noted that the total valuation of buildings is based on county assessors' data which may not be current. In addition, government-owned properties are usually taxed differently or not at all, and so may not be an accurate representation of true value. Note that public school district assets and special districts assets are included in the total exposure tables assets by community and county.

0 shows the total population, building count, estimated value of buildings, estimated value of contents and estimated total exposure to parcels for the unincorporated county and each incorporated city. For multi-county communities, the population and building data may include data on assets located outside the planning area. **0** provides the building value exposures for the county and each city in the planning area broken down by usage type. Finally, **0** provides the building count total for the county and each city in the planning area broken out by building usage types (residential, commercial, industrial, and agricultural).

All the exposure of population and exposure tables shows unincorporated county and Three Creeks combined numbers under Warren County. The reason is Three Creeks is not an incorporated place, it is considered as unincorporated area.

Table 3.3 Building Exposure by Jurisdiction (times 1,000)

Jurisdiction	Building Count	Building Exposure	Contents Exposure	Total Exposure
Warren County	14,773	\$1,221,357	\$645,388	\$1,866,746
Innsbrook	1293	\$192,074	\$96,227	\$288,302

Jurisdiction	Building Count	Building Exposure	Contents Exposure	Total Exposure
Marthasville	399	\$57,651	\$29,450	\$87,101
Pendleton	40	\$2927	\$1,734	\$4,661
Truesdale	253	\$51,228	\$37,843	\$89,072
Warrenton	2608	\$461,334	\$270,082	\$731,415
Wright City	1043	\$202,396	\$141,789	\$344,185
TOTALS	20,409	\$ 2,189,707	\$1,222,817	\$3,412,658

Source: U.S. Bureau of the Census, Annual population estimates/ 5-Year American Community Survey 2015; Building Count and Building Exposure, Missouri GIS Database from SEMA Mitigation Management; Contents Exposure derived by applying multiplier to Building Exposure based on Hazus MH 2.1 standard contents multipliers per usage type as follows: Residential (50%), Commercial (100%), Industrial (150%), Agricultural (100%). For purposes of these calculations, government, school, and utility were calculated at the commercial contents rate

Table 3.4 Building Values/Exposure by Usage Type (times 1,000)

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Residential	Total
Warren County	\$ 25,230	\$ 34,785	\$ 15,746	\$ 2,045	\$ 37,338	\$ 516,344	\$ 631,488
Innsbrook	\$ 100	\$ 3,569	\$ 1,430	\$ 251	\$ -	\$ 282,950	\$ 288,302
Marthasville	\$ 71	\$ 3,569	\$ 715	\$ 503	\$ -	\$ 82,242	\$ 87,101
Pendleton	\$ 54	\$ 1,190	\$ -	\$ -	\$ -	\$ 3,417	\$ 4,661
Truesdale	\$ 33	\$ 1,190	\$ 2,860	\$ 754	\$ 32,975	\$ 51,259	\$ 89,072
Warrenton	\$ 205	\$ 173,700	\$ 15,730	\$ 5,280	\$ 6,595	\$ 529,906	\$ 731,415
Wright City	\$ 83	\$ 52,348	\$ 3,575	\$ 1,257	\$ 72,545	\$ 214,377	\$ 344,185
TOTALS	\$ 16,569	\$ 297,431	\$ 24,310	\$ 12,319	\$ 178,066	\$ 2,906,963	\$ 3,435,658

Source: Missouri GIS Database, SEMA Mitigation Management Section

Table 3.5 Building Counts by Usage Type

Jurisdiction	Residential	Residential Outbuildings	Commercial	Education	Industry	Agriculture	Government	Total
Warren County	77	202	9	-	-	427	-	715
Innsbrook	1	-	-	-	-	-	-	1
Marthasville	7	63	1	-	-	20	-	91
Pendleton	-	-	-	-	-	-	-	-
Truesdale	2	1	-	-	-	-	-	3
Warrenton	3	14	3	-	-	-	1	21
Wright City	8	9	-	-	-	1	-	18

Jurisdiction	Residential	Residential Outbuildings	Commercial	Education	Industry	Agriculture	Government	Total
TOTALS	100	293	13	-	-	485	1	892

Source: Missouri GIS Database, SEMA Mitigation Management Section; Public School Districts and Special Districts

School district assets are included in the tables above. However, more discrete school district data is provided below and was taken from the School District Data Collection Questionnaire, data provided by Missouri’s Department of Elementary and Secondary Education (DESE) and district-maintained websites. The number of enrolled students at the participating public-school districts is provided in **0** below. Additional information includes the number of buildings, building exposure and contents exposure. These numbers will represent the total enrollment and building count for the public school districts regardless of the county in which they are located.

Table 3.6 Population and Building Exposure by Jurisdiction-Public School Districts

Public School District	Enrollment	Building Count	Contents value (\$)	Replacement value (Insured \$)
Warren County R-III School District	3,137	20	14,270,800	82,473,000
Wright City R-II School District	1,702	5	Not submitted	Not submitted
Gasconade County R-II	955	3	Not submitted	Not submitted
School District of Washington	400	1	1,123,594	6,284,707
TOTALS	1,599	17	\$15,394,394	\$88,757,707

Source: The Building Exposure, Contents Exposure, and Total Exposure amounts come from the completed Data Collection Questionnaires from Public School Districts. In general, the school districts obtain this information from their insurance coverage amounts.

3.2.2 Critical and Essential Facilities and Infrastructure

This section includes information from the Data Collection Questionnaire and other sources concerning the vulnerability of participating jurisdictions’ critical, essential, high potential loss, and transportation/lifeline facilities to identified hazards. Definitions of each of these types of facilities are provided below.

- **Critical Facility:** Those facilities essential in providing utility or direction either during the response to an emergency or during the recovery operation.
- **Essential Facility:** Those facilities that if damaged, would have devastating impacts on disaster response and/or recovery.
- **High Potential Loss Facilities:** Those facilities that would have a high loss or impact on the community.
- **Transportation and lifeline facilities:** Those facilities and infrastructure critical to transportation, communications, and necessary utilities.

0 includes a summary of the inventory of critical and essential facilities and infrastructure in the planning area. The list was compiled from the Data Collection Questionnaire as well as the following sources:

- Interviews with County Emergency Planning Director
- Interview with County Flood Plain Manager
- Interviews with City Government Employees
- Tribal Knowledge of Regional Planning Commission employees
- Tribal Knowledge of State Office of Homeland Security Region C Planner
- Chemical Facilities (Tier II Facilities) information
- Hazus

Table 3.7 Inventory of Critical/Essential Facilities and Infrastructure by Jurisdiction

Jurisdiction	Airport Facility	Bus Facility	Childcare Facility	Communications Tower	Electric Power Facility	Emergency Operations	Fire Service	Government	Housing	Shelters	Highway Bridge	Hospital/Health Care	Military	Natural Gas Facility	Nursing Homes	Police Station	Potable Water Facility	Rail	Sanitary Pump Stations	School Facilities	Stormwater Pump Stations	Tier II Chemical Facility	Wastewater Facility	Total
Warren County	1		3	7	1				1	NA	74							1	NA		NA	3	28	119
Innsbrook								1		NA									NA		NA	1	1	3
Marthasville			1		1	1	2	1	1	NA	2	1				1	1		NA	2	NA	6	1	21
Pendleton				2			1			NA						1	1		NA		NA	1		6
Truesdale								1	1	NA						1			NA	1	NA	2		6
Warrenton			11	9		2	2	3	1	NA	6	2	1		3	1	3		NA	1	NA	23	1	69
Wright City			3	3		1	2	1		NA	2						2		NA	1	NA	15	1	31
Warren County R-III		1						1		NA									NA	4	NA	1		7
Wright City R-II		1						1		NA				1					NA	4	NA	1		8
Gasconade R-I										NA									NA		NA			0
Washington City (Marthasville)		1								NA									NA	1	NA			2
										NA									NA		NA			0
Totals	1	3	18	21	2	4	7	9	4	0	84	3	1	1	3	4	7	1	0	14	0	53	32	272

Source: Missouri 2018 State Hazard Mitigation Plan and Hazard Mitigation Viewer; Data Collection Questionnaires; Hazus, etc.

The table below lists the two bridges in Warren County that are scour critical. This term refers to one of the database elements in the National Bridge Inventory which is quantified using a “scour index”; a number indicating the vulnerability of a bridge to scour during a flood. Bridges with a scour index between 1 and 3 are considered “scour critical”, or a bridge with a foundation determined to be unstable for the observed or evaluated scour condition. There is one on Route D east near Tuque & Wolf creek and the other bridge is on MO 94 east near Treloar Creek.

Figure 3.1. Location of Scour Critical Bridges in Warren County



Source: Missouri Department of Transportation

3.2.3 Other Assets

Assessing the vulnerability of the planning area to disaster also requires data on the natural, historic, cultural, and economic assets of the area. This information is important for many reasons.

- These types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- Knowing about these resources in advance allows for consideration immediately following a hazard event, which is when the potential for damages is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- The presence of natural resources can reduce the impacts of future natural hazards, such as wetlands and riparian habitats which help absorb floodwaters.
- Losses to economic assets like these (e.g., major employers or primary economic sectors) could have severe impacts on a community and its ability to recover from disaster.

Warren County is home to several threatened and endangered species including the bats, fish, and plants listed in the table below.

Table 3.8 Threatened and Endangered Species in Warren County

Common Name	Scientific Name	Status
Indiana Bat	Myotis sodalist	Endangered
Northern Long-eared Bat	Myotis septentrionalis	Threatened
Least Tern	Sterna antillarum	Endangered
Piping Plover	Charadrius melodus	Threatened
Rufa Red Knot	Calidris canutus rufa	Threatened
Pallid Sturgeon	Scaphirhynchus albus	Endangered

Source: U.S. Fish and Wildlife Service, <http://www.fws.gov/midwest/Endangered/lists/missouri-cty.html>; see also <https://ecos.fws.gov/ipac/>

Natural Resources: The Missouri Department of Conservation (MDC) provides a database of lands it owns, leases, or manages for public use. These assets are listed in the table below for the Warren County planning area along with Graham Cave State Park.

Table 3.9 Parks in Warren County

MDC Area Name	Address	City
Daniel Boone Conservation Area	Tower Road	Jonesburg
Little Lost Creek Conservation Area	Route B	Pendleton
Reifsnider State Forrest	Schuetzenground Road	Warrenton

Source: <http://mdc7.mdc.mo.gov/applications/moatlas/AreaList.aspx?txtUserID=guest&txtAreaNm=s>

Park Name	Address	City
Katy Trail State Park	Trail Head	Marthasville
Marthasville Ball Park	601 One Street	Marthasville
Rueche Park	701 East Main	Marthasville
Binkley Woods & Spector Lake	418 South Morgan Street	Warrenton
Dyer Park	510 Dryden Street	Warrenton
Khoury Park	609 East Walton	Warrenton
Lakeview Park	1001 Lakeview Drive	Warrenton
Morgan Park	312 Morgan Street	Warrenton
Paddock Fields Park	1907 Cranberry Street	Warrenton
Corwin S. Ruge Memorial Park	1601 South Elm Street	Wright City
Diekroeger Bros. Park	West South Service Road	Wright City
Katy Trail State Park	Trail Head	Marthasville
Marthasville Ball Park	601 One Street	Marthasville
Rueche Park	701 East Main	Marthasville

Source: <http://warrenton-mo.org>, <http://wrightcity.org>, <http://marthasvillemo.org>

Historic Resources: The National Register of Historic Places is the official list of registered cultural resources worthy of preservation. It was authorized under the National Historic Preservation Act of 1966 as part of a national program. The purpose of the program is to coordinate and support

public and private efforts to identify, evaluate, and protect our historic and archeological resources. The National Register is administered by the National Park Service under the Secretary of the Interior. Properties listed in the National Register include districts, sites, buildings, structures and objects that are significant in American history, architecture, archeology, engineering, and culture.

The table below lists the Warren County properties that are included in the National Register of Historic Places. The location of the Pinnacle Lake Rock Shelter is restricted to preserve the archeological integrity of the ancient site.

Table 3.10 Warren County Properties on the National Register of Historic Places

Property	Address	City	Date Listed
Borgman Mill	5 miles east of Marthasville off CR D	Marthasville	November 10, 1970
Flanders Callaway House	1 mile south of Marthasville off MO 94	Marthasville	July 29, 1969
Herman H. Fortmann Building	207 Depot Street	Marthasville	March 21, 2006
Glosemeyer General Store	16011 Concord Hill Rd	Marthasville	January 29, 2018
Marthasville Hardware Building	203 Depot Street	Marthasville	December 27, 2007
Schowengerdt House	308 East Boonslick	Warrenton	October 3, 1980
Southwestern Bell Repeater Station	North Service Road and Bell Road	Wright City	December 27, 2006
Starke-Meinershagen-Boerke Rural Historic District	West of Marthasville	Marthasville	November 24, 1992

Source: Missouri Department of Natural Resources – Missouri National Register Listings by County
<http://dnr.mo.gov/shpo/mnrlist.htm>

Economic Resources The table below shows non-government (private) employers with 10 or more employees operating within Warren County. The table is sorted by number of employees, then by Company. Exact numbers of employees are unknown so a range of employees is cited. In some cases there are multiple locations; however, only the main location is listed.

Table 3.11 Major Non-Government Employers in Warren County

Employer Name	Main Locations	Product or Service	Employees
Ameriwood Corporation	Wright City	Pressed wood furniture	324
Holland Binkley Company	Warrenton	Truck gears	297
Emmaus Homes	Marthasville	Adult Care facility	210
Wal-Mart	Warrenton	Retail trade	157
Warrenton Downtown	Warrenton	Retail/offices	150
Innsbrook Resort and Conference Center	Innsbrook	Recreation & sales	150
C E F Press	Warrenton	Printing	138

Employer Name	Main Locations	Product or Service	Employees
Rock-Tenn Company	Wright City	Laminated paper	116
H G P Industries Incorporated	Warrenton	Glass	95
CCE Truesdale Packaging	Warrenton	Coca-Cola bottling	97
Metzo Minerals	Warrenton	Wire screens	94
Gateway Refrigeration	Warrenton	Underground storage	87
Flying J Travel Plaza	Warrenton	Retail	72
TEMCO Incorporated	Marthasville	Sheltered workshop	55
Warco Incorporated	Marthasville	Porcelain insulators	50
Greif Brothers	Wright City	Paper barrels	50
Warrenton Oil Company	Warrenton	C-store headquarters	50

Source: Data Collection Questionnaires; local Economic Development Commissions, Missouri Department of Economic Development, February 2019

Agriculture According to the USDA's 2017 Census of Agriculture, there are 568 farms in Warren County for a total of 127,860 acres. The average size farm in Warren County is 225 acres while the state average is smaller at 285 acres. The number of farms in Warren County in 2017 is down 9% from 2012.

The total value of farm products sold in Warren County in 2012 is \$46,529,000. Crop sales account for 78% of the total sales and livestock account for the remaining 22% of sales.

3.3 LAND USE AND DEVELOPMENT

3.3.1 Development Since Previous Plan Update

Population growth in Warren County has been in decline since the bottom fell out of the housing market in the mid-2000s. For the most-part, Warren County is just outside the accepted commute range for those working in St. Charles and St. Louis Counties. The county; however, remains attractive to those born and raised there and those adventurous souls looking for a quiet retirement.

Table 3.12 Warren County Population Growth, 2010-2018

Jurisdiction	2010 Population	2018 Population	2010-2018 # of Change	2010-2018 % of Change
Total Warren County	32,513	33908	1,395	4.29
Innsbrook	552	700	148	26.8
Marthasville	1,136	1328	192	16.9
Pendleton	43	34	-9	-20.9
Truesdale	732	781	49	6.69
Warrenton	7,880	8129	249	3.15
Wright City	3,119	3593	474	15.19

Jurisdiction	2010 Population	2018 Population	2010-2018 # of Change	2010-2018 % of Change
Warren County – Unincorporated	18,785	19343	558	2.97

Source: U.S. Bureau of the Census, Decennial Census, Annual Population Estimates, American Community Survey 5-year Estimates; Population Statistics are for entire incorporated areas as reported by the Census bureau

Table 3.13 Change in Housing Units, 2010-2018

Jurisdiction	Housing Units 2010	Housing Units 2018	Change in Housing Units	Percent of Change
Warren County Total	14,685	15297	612	4.16
Innsbrook	1,315	1501	186	14.14
Marthasville	478	497	19	3.97
Pendleton	12	14	2	16.67
Truesdale	304	309	5	1.64
Warrenton	3,196	3428	232	7.25
Wright City	1,288	1353	65	5.04
Warren County – Unincorporated	9,407	8195	-1212	-12.88

Source: U.S. Bureau of the Census, Decennial Census, American Community Survey 5-year Estimates; Population Statistics are for entire incorporated areas as reported by the U.S. Census Bureau

All sectors of Warren County continue to grow with the county being one of the top 5 fastest growing counties in the state. Most of the growth is anchored along I70 in and around Wright City, Truesdale, and Warrenton. Further south in the county, along MO47, the Marthasville area continues to attract new residents. Warren County is expected to grow by approximately 12.5 percent in the next five years.

Future Land Use and Development

City of Wright City, City of Warrenton and City of Truesdale are being attracted for development through infrastructure development and by promoting the area.

- Warren County issued 82 commercial, 94 single family residential, 11 mobile/modular homes, 20 RV/Campers, 139 residential buildings (all buildings not single family residential or mobile homes) from 2016- December 24, 2020.
- City of Warrenton issued 15 commercial, 87 multi-family and 257 single-family unit building permits from 2016-2020.
- City of Wright City issued 440 residential, 3 commercial and 11 industrial building permits from 2016-2020.
- City of Truesdale issued 90 new residential home permits, 13 new commercial and 2 commercial city projects.

School District's Future Development

Enrollment in the Warren County R-II School District for the 2018-2019 school year stands at 3,137 students. The district plans to add keyless entry to all district building exterior doors. Also, plans to add a tornado shelter that could function as a theater/auditorium. It is projected that the enrollment would increase by 8% in the next five years.

The Marthasville Elementary school located in Washington School District has an occupancy of 400. There are no plans to construct any buildings in the next 5 years. The enrollment is projected to be flat over the next 5 years.

Wright City R-II School District enrollment is 1,702. The district plans to add a new high school in the next 5 years. It is projected that the enrollment would increase by 3% in the next five years.

The Gasconade County R-I School District transports students from Warren County into Gasconade County attendance centers. It operates no facilities in Warren County has no plans to do so within the next five years.

Wright City R-II School District and Gasconade County R-I School District are planning to apply for funding to build a safe room.

3.4 HAZARD PROFILES, VULNERABILITY, AND PROBLEM STATEMENTS

Each hazard will be analyzed individually in a hazard profile. The profile will consist of a general hazard description, location, strength/magnitude/extent, previous events, future probability, a discussion of risk variations between jurisdictions, and how anticipated development could impact risk. At the end of each hazard profile will be a vulnerability assessment, followed by a summary problem statement.

Hazard Profiles

Each hazard identified in this section will be profiled individually for easier reference. The level of information presented in the profiles will vary by hazard based on the information available. With each update of this plan, new information will be incorporated to provide better evaluation and prioritization of the hazards that affect Warren County. Detailed profiles for each of the identified hazards include information categorized as follows:

- **Hazard Description:** This section consists of a general description of the hazard and the types of impacts it may have on a community or school/special district.
- **Geographic Location:** This section describes the geographic areas in the planning area that are affected by the hazard. Where available, use maps to indicate the specific locations of the planning area that are vulnerable to the subject hazard. For some hazards, the entire planning area is at risk.
- **Strength/Magnitude/Extent:** This includes information about the strength, magnitude, and extent of a hazard. For some hazards, this is accomplished with description of a value on an established scientific scale or measurement system, such as an EF2 tornado on the Enhanced Fujita Scale. This section should also include information on the typical or expected strength/magnitude/extent of the hazard in the planning area. Strength, magnitude,

and extent can also include the speed of onset and the duration of hazard events. Describing the strength/magnitude/extent of a hazard is not the same as describing its potential impacts on a community. Strength/magnitude/extent defines the characteristics of the hazard regardless of the people and property it affects.

- **Previous Occurrences:** This section includes available information on historic incidents and their impacts. Historic event records form a solid basis for probability calculations. Tables are a good way to convey this data and when available. When data is available, tables showing random events for the past 20 years are included.
- **Probability of Future Occurrence:** The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability can be determined by dividing the number of recorded events by the number of years of available data and multiplying by 100. This gives the percent chance of the event happening in any given year. For events occurring more than once annually, the probability is reported as 100% in any given year, with a statement of the average number of events annually. For hazards such as drought that may have gradual onset and extended duration, probability is based on the number of months in drought in a given time-period and expressed as the probability for any given month to be in drought.
- **Changing Future Conditions Considerations:** In addition to the probability of future occurrence, changing future conditions were considered, including the effects of long-term changes in weather patterns and climate on the identified hazards.

Vulnerability Assessments

The vulnerability assessment will follow the hazard profile for each hazard. The vulnerability assessment further defines and quantifies populations, buildings, critical facilities, and other community assets at risk to damages from natural hazards. The vulnerability assessments are based on the best available county-level data available in the Missouri Hazard Mitigation plan (2018).

The vulnerability assessments in the Warren County plan will also be based on:

- Written descriptions of assets and risks provided by participating jurisdictions;
- Existing plans and reports;
- Personal interviews with planning committee members and other stakeholders; and
- Other sources as cited.

Within the Vulnerability Assessment, the following sub-headings will be addressed:

- **Vulnerability Overview:** The plan provides an overall summary of each jurisdiction's vulnerability to the identified hazards. The overall summary of vulnerability identifies structures, systems, populations or other community assets as defined by the community that are susceptible to damage and loss for hazard events.
- **Potential Losses to Existing Development:** For each participating jurisdiction, the plan describes the potential impacts of the hazard. Impact means the consequences of effect of the hazard on the jurisdiction and its assets. Assets are determined by the community and include, for example, people, structures, facilities, systems, capabilities, and/or activities that have value to the community. For example, impacts could be described by referencing historical disaster impacts and/or an estimate of potential future losses.
- **Previous and Future Development:** This section includes information on how changes in

development have impacted the community's vulnerability to this hazard and describes how changes in development in known hazard prone areas since the previous plan have increased or decreased the community's vulnerability.

- **Hazard Summary by Jurisdiction:** For hazard risks that vary by jurisdiction, this section will provide an overview of the variation and the factual basis for that variation.

Problem Statements

Each hazard analysis must conclude with a brief summary of the problems created by the hazard in the planning area, and possible ways to resolve those problems. Jurisdiction-specific information is included in those cases where the risk varies across the planning area.

3.4.1 Flooding (Riverine and Flash)

Hazard Profile

Hazard Description

A flood is partial or complete inundation of normally dry land areas. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. There are several types of riverine floods, including headwater, backwater, interior drainage, and flash flooding. The areas adjacent to rivers and stream banks that carry excess floodwater during rapid runoff are called floodplains. A floodplain is defined as the lowland and relatively flat area adjoining a river or stream. The terms "base flood" and "100- year flood" refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year. Floodplains are part of a larger entity called a basin, which is defined as all the land drained by a river and its branches.

Flooding caused by dam and levee failure is discussed elsewhere in this plan and will not be addressed here.

A flash flood occurs when water levels rise at an extremely fast rate as a result of intense rainfall over a brief period, sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil, or impermeable surfaces. Flash flooding can happen in Special Flood Hazard Areas (SFHAs) as delineated by the National Flood Insurance Program (NFIP) and can also happen in areas not associated with floodplains.

Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation.

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow.

Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area. Flash flooding is a dangerous form of flooding which can reach full peak in only a few minutes. Rapid onset allows little or no time for protective measures. Flash flood waters move at very fast speeds and can move boulders, tear out trees, scour channels, destroy buildings, and obliterate bridges. Flash flooding can result in higher loss of life, both human and

animal, than slower developing river and stream flooding.

In certain areas, aging storm sewer systems are not designed to carry the capacity currently needed to handle the increased storm runoff. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. This combined with rainfall trends and rainfall extremes all demonstrate the high probability, yet generally unpredictable nature of flash flooding in the planning area.

Although flash floods are somewhat unpredictable, there are factors that can point to the likelihood of flash floods occurring. Weather surveillance radar is being used to improve monitoring capabilities of intense rainfall. This, along with knowledge of the watershed characteristics, modeling techniques, monitoring, and advanced warning systems has increased the warning time for flash floods.

Geographic Location

Riverine flooding can occur in any low-lying area of Warren County which is adjacent to rivers and creeks during periods of heavy rain when ground is saturated. Many rural roads within the County are dependent upon low water crossings which are not navigable during periods of high water. During times of flooding, these low water crossings can present a risk to life and property if an attempt to cross is made.

According to the National Mapping System, major rivers and creeks in Warren County include the Missouri River, Charrette Creek, Tuque Creek, North Fork Charrette Creek, Peruque Creek, Camp Creek, Hickory Lick Creek, Lost Creek, Massie Creek, Little Lost Creek, Cullum Branch, Loutre Slough, Clear Branch, Smith Creek, Peers Slough, Wolf Creek, Indian Camp Creek, Dry Creek, and Engelmann Spring. The following pages show 100-Year Flood Zone maps for Warren County and communities.

Figure 3.1. Low Water Crossings in Warren County Flood Zones

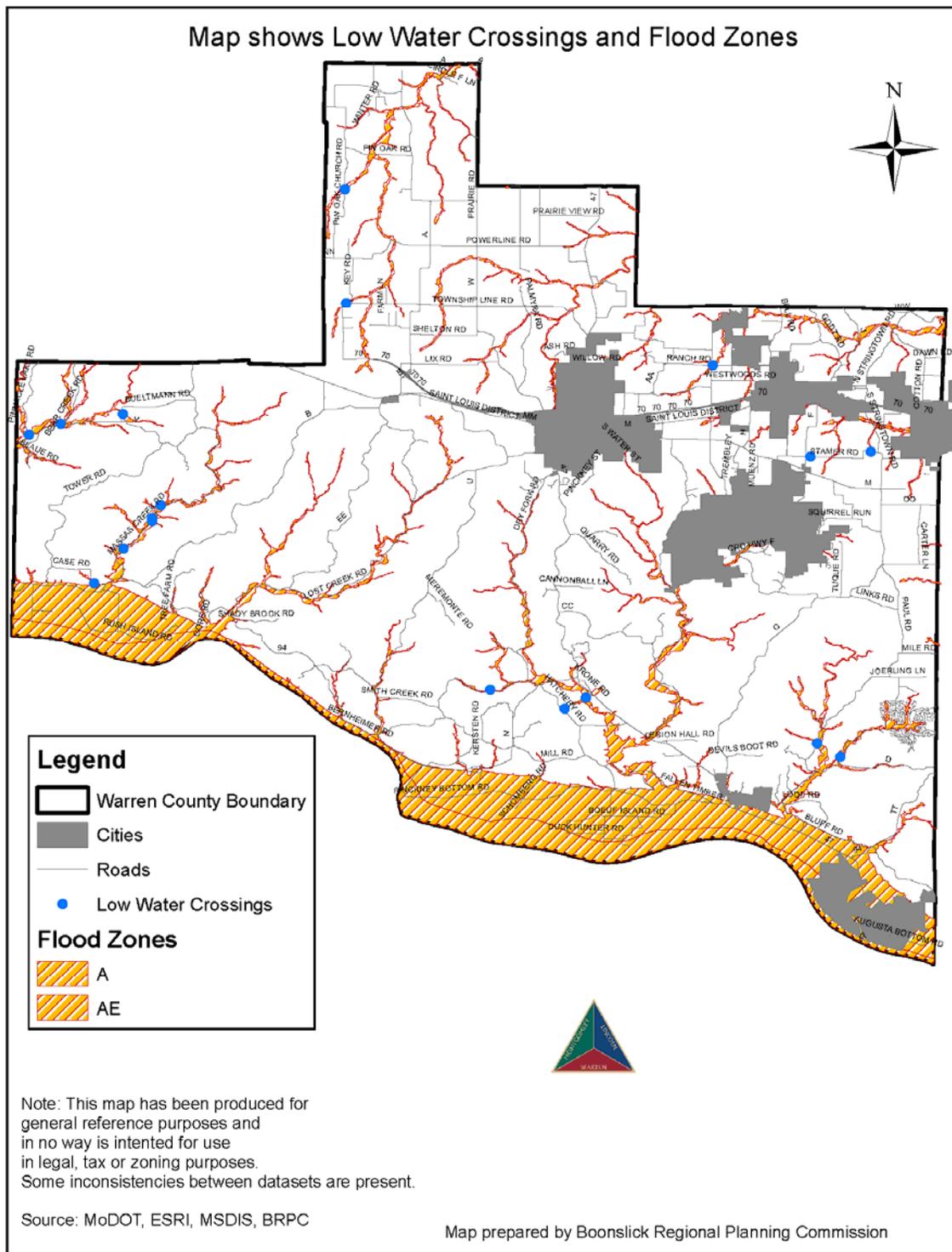


Figure 3.2. Village of Innsbrook

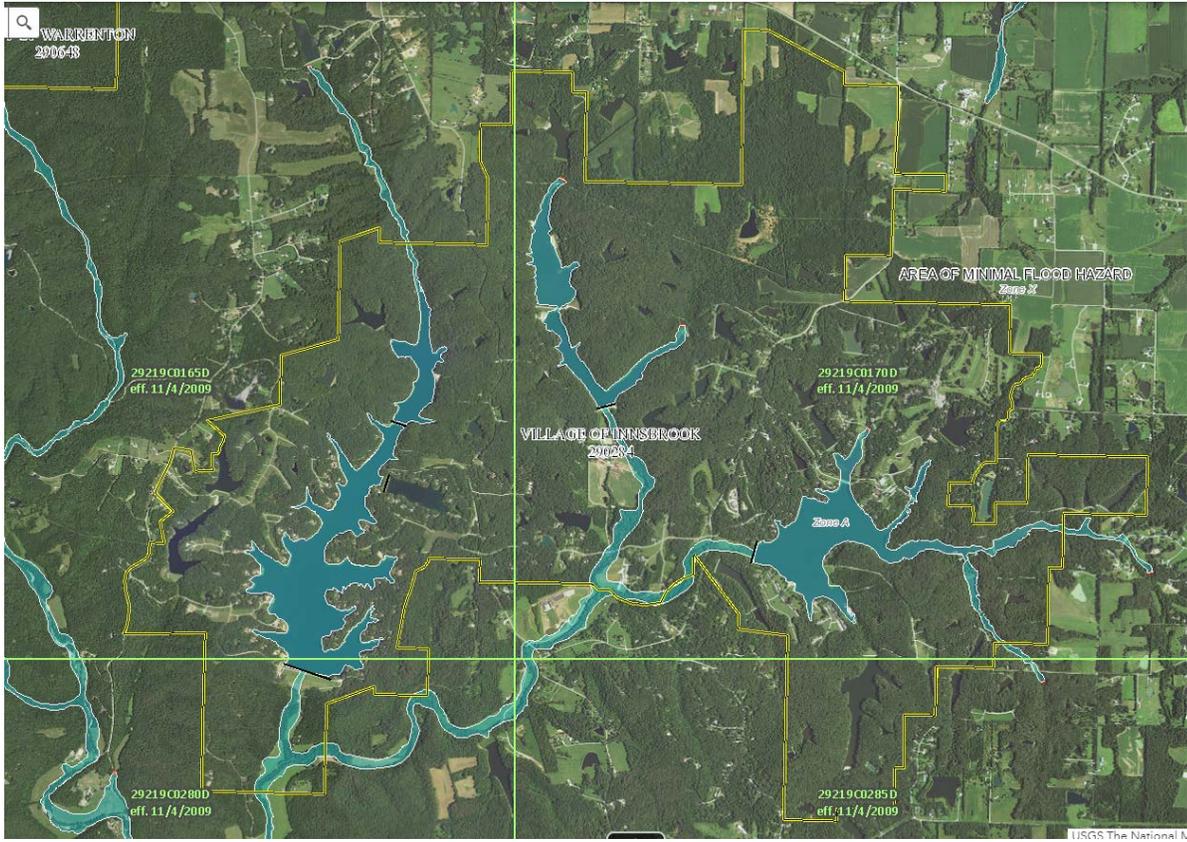


Figure 3.3. City of Marthasville

