

Climate Ready Monroe County

DECEMBER 2024



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Welcome Letter

January 2024

Dear Monroe Community Members,

Global climate change is a serious and immediate concern for our local environment, as well as our urban and rural character and way of life in Monroe County. The impacts of climate change can greatly increase potential hazards, such as extreme heat and flooding, and adversely impact our local businesses, industries, health, and more. We must act now to reduce future greenhouse gas emissions and prepare for changes that are, in many cases, already underway.

As a commission, we are dedicated to action, working collaboratively across all sectors to build partnerships and develop a roadmap for long-term resilience. This collaborative process has been underway for many months. It is with great pleasure that we introduce *Climate Ready Monroe County*, our first climate resilience plan.

This plan describes how climate change is projected to impact Monroe County and the vulnerabilities that we need to address. Bold strategies have been developed to protect our residents, infrastructure, economy, community culture, and environment. These strategies were created through extensive stakeholder input by diverse community stakeholders to ensure Monroe County maintains its character and quality of life.

This plan is a crucial first step in the process of preparing Monroe County for the effects of climate change. The strategies identified here will serve as a launching point for policy adoption and implementation, while also complementing our greenhouse gas reduction and sustainability efforts.

We encourage you to dive into this plan and evaluate how you can contribute to each resilience measure. To create a climate-ready Monroe County, we must all reduce our individual and collective carbon footprints and adapt to the cascading effects of a changing climate. Together, we can ensure that Monroe endures as a safe and vibrant community for years to come.

Sincerely,

The Monroe County Climate Resiliency Blue Ribbon Commission

Acknowledgements

This report is the product of a year-long process led by the Climate Resiliency Blue Ribbon Commission, a climate resilience commission consisting of key stakeholders in Monroe County and supported by the Environmental Resilience Institute at Indiana University and the Geos Institute's Climate Ready Communities Team. With appreciation and gratitude for their time and expertise, we expressly thank:

Monroe County Climate Resiliency Blue Ribbon Commission

Lee Jones, Monroe County Commissioner
 Peter Iversen, Monroe County Council
 Russell Brummett, Monroe County Sheriff Department
 Dustin Dillard, Monroe County Fire Protection District
 Kelsey Thetonia, Monroe County Stormwater Program
 Greg Grant, Sierra Club
 Scott Smith, Polk Township Trustee

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Much of the information in this report was developed during two day-long stakeholder workshops, which are described in more detail in Appendix 6: Community and Stakeholder Outreach. Thank you to the following people and organizations who helped make them successful. Thank you to all other contributors and editors for developing this report:

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Executive Summary

As the first county in Indiana to develop a Climate Resilience Plan, The Monroe County Climate Resilience Plan represents a comprehensive framework designed to steer Monroe County towards greater resilience against the impacts of climate change. Developed with the foresight and dedication of the Climate Resiliency Blue Ribbon Commission, this plan outlines a strategic approach to safeguarding our community's environmental, economic, and social well-being in the face of evolving climate challenges.

The Role of the Climate Resiliency Blue Ribbon Commission

The Monroe County Climate Resiliency Blue Ribbon Commission (“Commission”) was established to guide the development and implementation of the Monroe County Climate Resilience Plan. Comprised of experts from various sectors, the Commission has been instrumental in ensuring the plan's alignment with community needs and scientific forecasts, thereby setting a strong foundation for Monroe County's sustainable future.

Plan Contents

The plan is structured to provide a comprehensive overview, starting with an Executive Summary and an Introduction that set the stage for understanding the significance and scope of our resilience strategies. The narrative then delves into the connection between our Past and Present, emphasizing the lessons learned and how they inform our current approach to climate resilience. Advancing Climate Equity is a core principle of the plan, recognizing that the impacts of climate change do not affect all community members equally. This section outlines strategies to ensure that our resilience efforts are inclusive and equitable. The Climate Change Trends and Community Trends Summary sections provide a data-driven overview of the environmental changes we are facing and their potential impacts on the Monroe County community. This analysis is critical in identifying our Climate Change Vulnerabilities, which include increased frequency of extreme weather events, challenges to water resources, and threats to biodiversity and public health. Strategies to Prepare for Change encompass a range of initiatives designed to mitigate these vulnerabilities. These strategies are organized into key focus areas:

- **Healthy Residents:** Enhancing public health systems to better respond to climate-related threats.
- **Robust Natural Systems:** Protecting and restoring natural habitats to support biodiversity and ecosystem services.
- **Recreation:** Utilize existing greenspace to mitigate implications of climate change and create safe zones to alleviate climate stress.
- **Sustainable Businesses:** Encouraging economic practices that are environmentally sustainable and resilient to climate impacts.
- **Resilient Infrastructure:** Upgrading and adapting our built environment to withstand extreme weather and changing climate conditions.

- **Community Readiness:** Empowering residents with the knowledge and resources to effectively respond to climate emergencies.
- **Sustainable Agriculture:** Develop and implement sustainable management practices on farms, gardens, and other locations to encourage and promote agricultural conservation.
- **Local Government Leadership:** Demonstrating commitment and proactive governance in climate resilience efforts.

The plan concludes with a detailed Implementation and Evaluation section, outlining mechanisms for executing the strategies, monitoring progress, and making necessary adjustments to ensure the resilience initiatives' success.

Appendices

To support the plan's objectives and strategies, several appendices provide additional resources, including a Climate Change Trends Primer, Community Trends, a Climate Vulnerability Assessment, and guidance on Developing Climate Resilience Strategies. Appendix 5 details our approach to Community and Stakeholder Outreach, highlighting the importance of engaging with residents and stakeholders throughout the planning and implementation process.

The Monroe County Climate Resilience Plan stands as a testament to our community's commitment to addressing the challenges of climate change head-on. Through the collective efforts of the Climate Resiliency Blue Ribbon Commission, local government, businesses, and residents, we are embarking on a path toward a more resilient and sustainable future for Monroe County.

Introduction



Image of Monroe County Aerial View | Photo by Evie Gordan

Monroe County is already experiencing the impacts of climate change with more extreme heat, storms, and flooding. The Climate Resiliency Blue Ribbon Commission and Monroe County are stepping up to the challenge by taking concrete action that protects and benefits people today as well as future generations.

Reducing greenhouse gas emissions is critical to avoid locking-in more extreme climate impacts. In adherence to the Paris Climate Accord, Monroe County has committed to

reducing net carbon emissions across all county buildings by as much as 28% by 2025. By 2050, that number will increase to 80% reductions in emissions from the information generated from inventory programs monitoring GHG levels.ⁱ

Efforts to cut greenhouse gas emissions must go together with actions in order to prepare for the changes that are already taking place. That is why the Climate Resiliency Blue Ribbon Commission launched *Climate Ready Monroe County* to determine the risks climate change poses and the steps that can be taken to increase resilience as outlined in this plan.

Resilience is the ability of people and their communities to anticipate, accommodate and positively adapt to or thrive amidst changing climate conditions and hazard events. Resilient communities enjoy a high quality of life, reliable systems, and economic vitality, and they conserve resources for present and future generations. (Urban Sustainability Directors' Network)

Climate Change Adaptation is anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage.

A more resilient community will be better able to withstand and bounce back from extreme events, such as more intense heat waves, bigger storms, flooding, and drought. Climate action must also include the creation of thriving and resilient neighborhoods, families, businesses, cultural and faith communities, food systems, infrastructure, and other key community components.

Climate change is already underway and must be addressed. Monroe County is dedicated to investing in a vibrant future for all residents by protecting both people and nature from ongoing and future impacts and reducing emissions.

Preparing for climate change is not an easy task — it requires action by every member of the community, as well as government, businesses, organizations, and others. The threat of climate change also presents us with opportunities. Monroe County is in position to harness its innovation, compassion, diversity, and strong community networks to make serious and systemic change. By prioritizing green jobs, living wages, clean technology, healthy parks and waterways and social equity and justice, the *Climate Ready Monroe County* plan aims to benefit all community members and protect future generations.

The *Climate Ready Monroe County* plan is the culmination of an intensive and highly participatory process. The process included extensive engagement by the community, with local stakeholders representing many different sectors, including health care, neighborhood associations, transportation, business, government, emergency preparedness and response, non-profit organizations, conservation groups, industry, and others. The similarly diverse Climate Resiliency Blue Ribbon Commission ensured that all strategies worked to advance equity and protect those most at-risk from climate impacts.

Purpose of this Climate Resilience Plan

Climate Ready Monroe County is more than a planning document. It is an opportunity for our community to clarify our vision for the future and develop a pathway to realize that vision. The guiding principles and vision statements below are the result of a highly collaborative effort with local government staff, the project Commission, and community members. These statements represent our best understanding of the challenges and opportunities in our community today, recognizing that they may shift and change over time.

Vision Statement


“The Commission shall serve in an advisory role and focus on educating the community and engaging residents and businesses in supporting initiatives that will help ensure A healthier and more economically viable future for the County.”

Monroe County Environmental
Commission 2023.

Climate action in Monroe County advances:

- Green jobs and living wages
- Neighborhood networks and support
- Cross-cultural and interracial understanding
- Investment in underserved areas
- Opportunities to be active and healthy
- More efficient and healthier homes
- Preparedness for extreme events
- Cleaner air, waterways, and parks
- Improved ecosystem health
- Greater biological diversity
- Environmental and social awareness

Guiding Principles

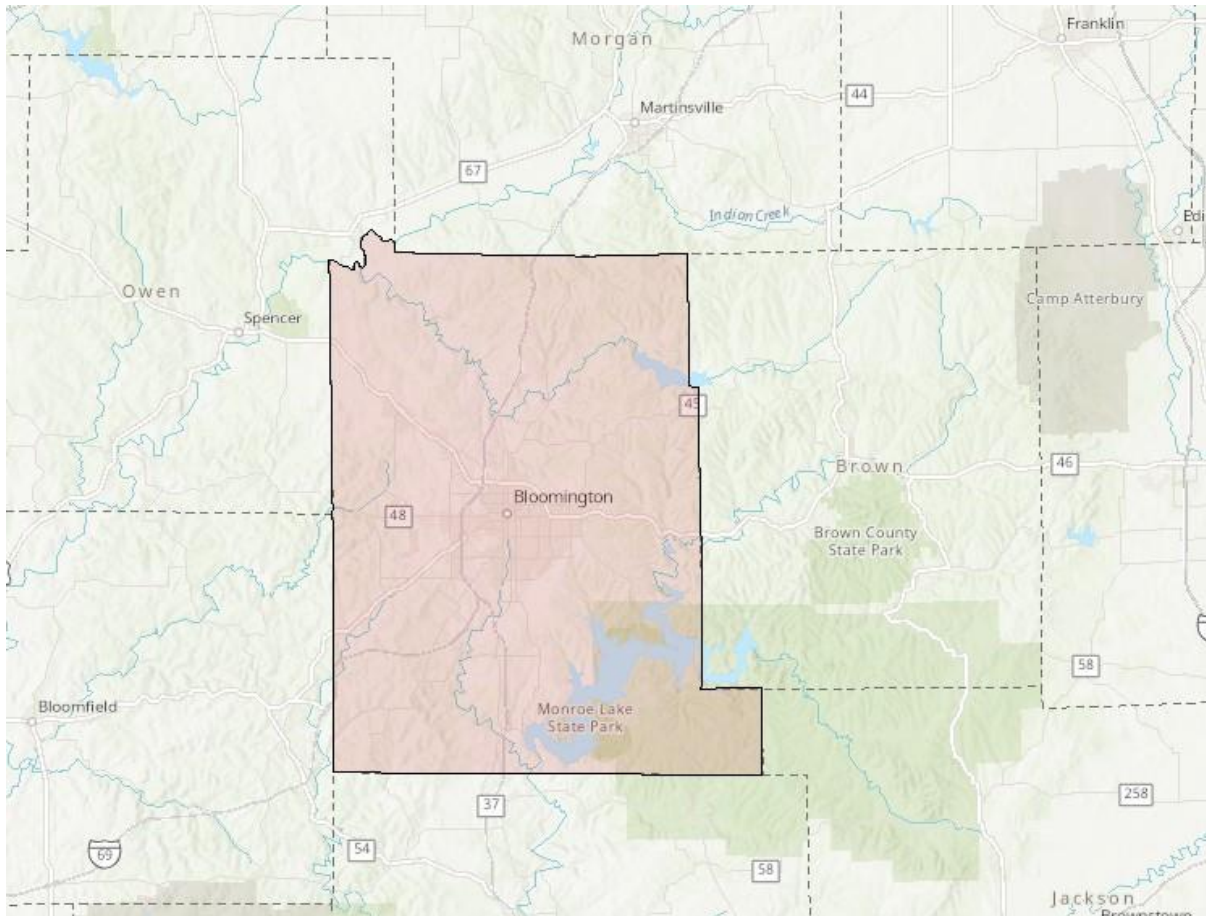


- The CRBRC will assist in the securing information and/or historical data regarding climate change projections for Monroe County
- The CRBRC will assist with the tasks relating to the vulnerability assessment workshop to determine what changing climate conditions mean for Monroe County based on the economy, population, landscape, and existing challenges in cooperation with the McKinney Resilience Cohort
- The CRBRC will assist with tasks relating to the community listening sessions to gather information to assist with developing the vulnerability assessment. Also to help prioritize our community’s vulnerabilities in cooperation with the McKinney Resilience Cohort
- The CRBRC will assist with tasks relating to strategy workshops to focus on developing strategies to address the vulnerabilities identified by the vulnerability workshop including more public engagement sessions to share results and gather feedback
- The CRBRC will assist with the completion of a Climate Resilience Plan including climate projections for Monroe County, results of the vulnerability assessment and strategies identified for each vulnerability highlighted within the assessment. The plan should include an implementation plan, timelines and metrics for each strategy as well as for the plan as a whole. This information may be provided to an implementation team at a later date.

- The Climate Resiliency Blue Ribbon Commission

Scope of Plan

The scope of *Climate Ready Monroe County* encompasses the areas of Monroe County outside of the City of Bloomington and Town of Ellettsville limits.



Whole Community Resilience

Climate change affects everyone and everything in our community at the same time. As people start to make changes to adapt to climate change, some of these changes can have unintended consequences. Close coordination and communication are needed to prevent redundancy or conflicting actions. People will need to work together to ensure all sectors and populations of Monroe County are protected.

The Planning Process

Climate Ready Monroe County is the culmination of an intensive and highly



Figure 1: Steps to Whole Community Resilience

participatory, community-driven process. A Commission from diverse sectors of the community guided the process and ensured that all policies and actions were designed to conserve nature, advance equity, and protect the most vulnerable populations from climate impacts. For more information see Appendix 5: Community and Stakeholder Outreach.



Figure 2. Timeline of major milestones in the Climate Ready Monroe County planning process.

To ensure that *Climate Ready Monroe County* is based on local community values and reflects the expertise of residents, stakeholder workshops and surveys provided community input and feedback throughout the process.

Stakeholder Workshops



Image of Stakeholder Workshop | Photo by Monroe County Stormwater Program

Subject matter experts from a diversity of community sectors came together on two occasions to guide this planning process. In the first workshop, participants reviewed future climate change projections and then identified and prioritized climate impacts across the five community systems: Built, Natural, Economic, Cultural, and Social. This information was combined with broad public input collected via surveys and listening sessions to develop the Vulnerability Assessment portion of this plan.

Two months later, the same stakeholders met again to identify cross-sector and collaborative strategies to address the vulnerabilities identified in the earlier workshop. These strategies, along with input from the broader public, form the foundation of this adaptation plan.

Community Surveys

A survey on the Monroe County community has yet to be completed, given the complexities of reaching a broader audience at the county level. With Monroe earning the distinction as being the first county in Indiana to be a climate-ready community, more information and resources need to be ascertained on how to best distribute the survey on a county-wide scale when it comes to limiting errors and improving the accuracy of responses.

Connecting Past and Present

Monroe County's young people face a future very different from the past, with warmer temperatures, new precipitation patterns, and a faster rate of change. We have a responsibility to prepare for this future by building resilience across all parts of the community to allow people and nature to respond and adapt in positive ways.

As we look to the future, climate change will need to be considered in all decisions. In that consideration is the opportunity to plan for climate impacts in ways that make our community more equitable for people of different income levels and backgrounds.

Building on Local and Regional Efforts

Following the agreements made within the 20 Paris Climate Accords, cities nationwide have joined that coalition to reduce their greenhouse gas emissions. Bloomington, Monroe County's largest city, has taken initiatives to reduce its environmental footprint by passing the 2018 Sustainability Action Plan, the 2021 Climate Action Plan, and Project 46. The following describes the purpose and strategies of each initiative:

Sustainability Action Plan: As part of a five-year plan to reduce Bloomington's impact on the environment, the city developed a list of strategies to address both short and long-term goals when it comes to sustainability. The plan includes a partnership with Gnarly Tree Sustainability and City Operations as a form of cross-sector collaboration that creates a self-reporting system comprising economic, environmental, and equity elements. Since its creation, a 2022 Greenhouse Gas Inventory program was passed to reduce CO₂ emissions across the county and be carbon neutral by 2050.ⁱⁱ

Climate Action Plan: The Climate Action Plan (CAP) was passed unanimously in 2021 by Bloomington to fulfill commitments to reduce greenhouse gas emissions and prepare for regional climate change impacts. Like the 2022 Greenhouse Inventory program, CAP has set targets to reduce emissions in 2030 by 25% and carbon neutral by 2050. The plan also considered implementation strategies for utilities, public health, transportation, water quality, green space, and food sustainability.ⁱⁱⁱ

Project 46: Project 46 is a regional alliance that uses bipartisan, cross-sector, and multi-county initiatives to address challenges related to climate change. The plan includes the collaboration of Monroe, Brown, and Bartholomew counties to effectively identify and pursue solutions that mitigate and adapt to local climate impacts. The resolution follows four goals that include 1)

monitoring and accessing greenhouse gas emissions in the region, 2) funding from state and federal levels that include the Inflation Reduction and Bipartisan Infrastructure Acts, 3) pursuing attainable goals with the assistance of private, nonprofit, and government leadership, and 4) a report that is published annually that highlights the impact and progress of shared goals.^{iv}

Advancing Climate Equity

Climate change does not affect all Monroe residents evenly. Many people experience more severe impacts than others. Climate inequities stem from the existing unequal distribution of social, political, and economic power.

Preparing Monroe County for the impacts of climate change requires significant investment of time and resources across all parts of the community, including businesses, health, schools, infrastructure, community culture, and natural resources. Investments in climate solutions need to support and empower those who are most at risk. Unless climate equity is prioritized from the beginning, and power disparities recognized throughout the process, climate planning will likely default to existing inequitable and exclusionary patterns and approaches and prevent real progress.

What is Climate Equity?

Climate equity is a framework, a goal, and a process. It asks that the diversity of histories, abilities, and needs across community members be accounted for in the design and implementation of climate change solutions. Residents of Monroe County have differing levels of ability to protect themselves from impacts. As climate change progresses, important work on social and environmental justice will increasingly need to focus on climate impacts.

Many residents of Monroe County are disadvantaged due to lower income, race, language, gender, LGBTQ+ status, mobility issues, disability, housing status, health condition, age, etc. By engaging and empowering disadvantaged residents to take on leadership roles and become the recipients of much of the investment in climate resilience, existing inequities can begin to be corrected. All residents of Monroe County benefit when those who are most vulnerable become more resilient and empowered.

More information about those on the frontline of climate change impacts in Monroe County is included in the Community Trends section.

Equitable climate action must address historically disadvantaged and/or marginalized groups or populations by:

- 1. Actively seeking direction**
- 2. Prioritizing investment**
- 3. Reducing stressors and preventing new stressors**
- 4. Shifting power**

Climate Change Trends

Climate change may be a global phenomenon, but the impacts are felt at the local level here, and all around the world. These impacts affect all sectors of our communities, including human health, natural resources, infrastructure, emergency response, and the economy. Those who are already vulnerable in our community will be impacted the most.

Monroe County's Climate is Already Changing

The average annual temperature in Monroe County has already increased from 52.7° F in 1975 to 54.1 in 2024. The extreme maximum temperature is 96.8° F based on data from 1976 to 2005, and will increase to at least 100.4° F by 2044. The average number of days above 90° F has reached 20 days by 2005, and will more than double to 41.3 days by 2044 (CMRA - Climate Mapping For Resilience and Adaptation, n.d.). Higher temperatures can affect the community's air quality, as was seen in 2021 when Monroe County's air quality score 0.35 (Bloomington. IN.gov, 2023).



Flowers blooming in front of Monroe County Courthouse | Photo by Monroe County Stormwater Program

Average precipitation in Monroe County has increased from 43.6 inches as of 2005 to 45.1 inches, and the numbers are projected to increase as emissions continue (CMRA - Climate Mapping For Resilience and Adaptation, n.d.). Despite more total annual precipitation, drought stress has increased due to increasing temperatures and fewer, although larger, precipitation events. Data from 1976 through 2005 showed a maximum number of consecutive dry days, or days without rain, as 12.8. However, these dry periods are anticipated to last longer by 2044, reaching 13.5 days on average (Climate Mapping for Resilience and Adaptation, accessed 2024). Drier summers have caused faster evaporation rates in Monroe Lake that can affect aquatic life, while runoff from extreme precipitation events is causing agriculture fertilizers and other pollutants to drain into the lake.

If summers continue to remain dry with higher temperatures and less precipitation, this can drastically change Monroe County's vegetation makeup as the region's temperate forest environment could disappear and be replaced by cool mixed forests present in the southern United States. Drought-like conditions can also affect Monroe's crop production rates and lead to higher instances of wildfires to occur by the mid to late century (Climatetoolbox.org, 2023).

Future Climate Change in Monroe County

Atmospheric scientists created models that help us predict future climate. These Global Climate Models (GCMs) were adjusted to the local scale and help us understand how Monroe County will be affected. Monroe County's climate is expected to continue to change. If greenhouse gas

emissions are reduced, this change is expected to level off mid-century. Table 1 highlights the expected changes for continued business-as-usual emissions and reduced emissions.

Table 1: Climate Trends Snapshot – Monroe County

	HISTORICAL TRENDS (1971–1990)	MID-CENTURY PROJECTIONS (2040–2069)	LATE-CENTURY PROJECTIONS (2070–2099)	LATE-CENTURY PROJECTIONS <i>with reduced emissions</i>
Average annual temperature	53.5° F	↑ 56.8° F to 62.3° F	↑ 58.9° F to 67.3° F	↑ 56.3° F to 61.7° F
Maximum temperature	96.8° F	↑ 99.5° F to 109.8° F	↑ 101.5° F to 116.9° F	↑ 99.4° F to 109.4° F
Average minimum temperature (winter season)	23° F	↑ 26.8° F to 30.8° F	↑ 28.6° F to 36.5° F	↑ 25.5° F to 30.4° F
Number of days per year above 90° F	20	↑ 36.4 to 96.3	↑ 57.7 to 131.7	↑ 34.4 to 103.4
Number of days per year below freezing	23.1	↓ 6.4 to 19	↓ 1 to 13	↓ 4.9 to 18.6
Annual precipitation (in)	46.8"	↑↓ 44.9" to 52.5"	↑↓ 44.8" to 53.8"	↑↓ 43.6" to 54.4"
Change in annual precipitation (in)	6.9"	↑ 2.7"	↑ 3.5"	↑ 2.5"
Days per year with precipitation (wet days)	186.7	↑↓ 161.9 to 195.7	↑↓ 144.1 to 201.6	↑↓ 168.3 to 196.5
Length of growing season (days)	191	↑ 202 to 252	↑ 208 to 261	↑ 193 to 236

More details about the climate change trends and projections for Monroe County can be found in Appendix 1: Climate Change Trends Primer.

Community Trends Summary



Residents walking in downtown Bloomington | Photo by Dynasti Noble

Climate change threatens our people, resources, and overall quality of life. As Monroe County works to develop a plan that will ensure long term climate resilience, it is important to identify the features and values that create our vibrant quality of life.

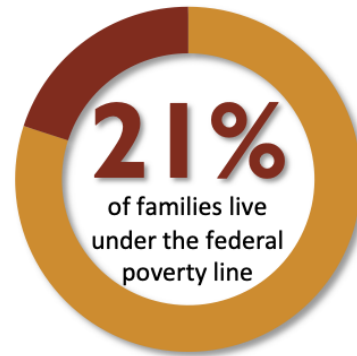
This overview of basic community systems in Monroe County provides a snapshot of how the community and its surrounding area function at the time this report is written. It is intended to support the climate change

vulnerability assessment workshop process, and lead to robust strategies. More information about these community trends can be found in Appendix 2: Community Trends. The following statistics and infographics were taken from the County Community Health Assessment produced by the Monroe County Health Department.

People and the Economy

- Monroe County's population of 139,475 is growing by 15.7% per year
- 82.5% of residents identify as White, 6.9% as Asian, 4.1% as Hispanic or Latino, 3.9% as Black or African American, 0.3% as American Indian or Alaska Native, 0.1% as Native Hawaiian or Pacific Islander, and 2.9% as two or more races.
- The largest employment sector is Government, followed by Private Sector.
- The largest employer in Monroe County is Indiana University
- Important anchor institutions include Indiana University, Ivy Tech Community College, and IU Health Bloomington Hospital.





- 21.1% of families are under the federal poverty line
- Disadvantaged populations in Monroe County include low-income neighborhoods, non-English speakers, people with disabilities, and people without health care.

Nature and the Environment

- Plant and animal species that are of particular importance to our community include hardwood trees (oak, maple, ash, etc.) and wildlife that consist of white-tailed deer, fox, and migratory waterfowl.
- Air quality in Monroe County is generally good/poor. In 2021, the air quality score for the county was 0.35, compared to Indiana and the national average figure of 0.34.
- Lake Monroe, Lemon Lake, and Griffy Lake are a few of the major bodies of water in the county
- Natural assets or preserves in Monroe County include Hoosier National Forest and Morgan-Monroe State Forest.

Infrastructure

- Monroe County's water supply comes primarily through Monroe Reservoir. In 2022, a report was completed on Lake Monroe by the EPA that noted issues in water quality most likely due to agricultural fertilizers and practices on the upper and lower sections of the reservoir (Bloomington.in.gov, 2023). Water treatment is primarily conducted through the City of Bloomington Utilities' Monroe Water Treatment Plant, which provides water for Bloomington, Indiana University, and Monroe County. The facility follows rigorous water quality standards set through state and federal regulations (Bloomington.in.gov, 2023).
- Residents and businesses get electricity from Duke Energy and South-Central Indiana Rural Electric Member-Owned Cooperative (REMC) and natural gas from CenterPoint Energy.
- Major transportation routes include Interstate 69, State Roads 37 and 45 (north-south), and State Roads 46 and 48 (east-west).

Cultural Resources

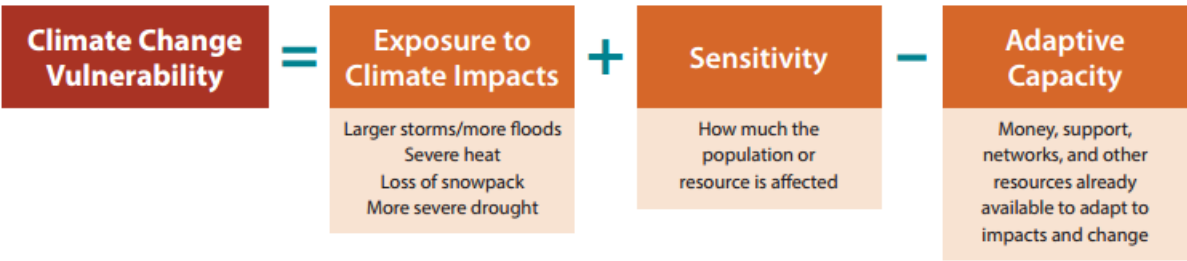
- Important cultural and historical landmarks within Monroe County include the Monroe County History Center, the First Nations Educational & Cultural Center, and the Tibetan Mongolian Buddhist Cultural Center.
- Monroe County has a rich cultural diversity and history that spans from indigenous communities to waves of immigration over time. The County works to preserve this important part of its history as an opportunity to shed light on diversity, equity, and inclusion.
- Community events that occur each year in Monroe County include the Lotus World Music & Arts Festival that celebrates music and diversity from around the world, the Fourth Street Arts Festival, and the Monroe County Fair.



IU Bloomington Art Installation | Photo by Molly Schneider

Climate Change Vulnerabilities

Climate impacts affect every person, structure, business, natural resource, and organization in Monroe County. And yet, some will be impacted far more than others. Vulnerability depends on many factors, including ongoing stressors, potential climate impacts, and existing adaptive capacity. As illustrated below, exposure to impacts and sensitivity increase Monroe County’s vulnerability to climate change, while actions taken to adapt to the changing conditions reduce vulnerability.



This plan examines the vulnerabilities across five community systems:

Health and Emergency Services - this includes the health care system, education and schools, law enforcement, emergency response services, and under-represented populations such as communities of color, people with disabilities, youth, elders, low-income workers, those experiencing homelessness.

Natural Systems – this includes all the aquatic, terrestrial, and marine ecosystems in your community. These may be public lands or privately owned, and includes urban greenways such as parks, tree lawns, and residential yards.

Infrastructure – this includes all the built elements in the community such as stormwater, wastewater, and drinking water systems; transportation networks like roads and railways; energy production and distribution; communications towers; and homes, businesses, and other buildings.

Business and Economy – this includes the economic drivers of the community such as small business owners, large industry, agriculture, commercial spaces, recreation, and tourism.

Community Culture – this includes all the specific ways that make a community special and feel like home to its residents, such as faith communities, civic organizations, local cultural groups, festivals, and events. This also includes any specific cultural practices or needs of the indigenous people in your community, as well as any immigrant populations.

Label	Vulnerability	Theme
1	Decreased Water Quality In Lake Monroe	Infrastructure
2	Drinking Water Will Become Less Available And More Expensive	Infrastructure
3	Flooding And Flash Floods Will Impact Public Infrastructure And Private Properties	Health & Emergency Services
4	Wastewater Collection Systems Will Require More Maintenance	Infrastructure
5	Karst Features Will Become Degraded And Groundwater Quality Will Decrease	Natural Systems
6	Outdoor And Indoor Air Quality Will Decrease	Health & Emergency Services
7	Urban Tree Canopy Will Become Stressed	Natural Systems
8	Habitat Will Become More Fragmented	Natural Systems
9	Quality of Life Will Decrease	Health and Emergency Services
10	Invasive Species Will Increase in Abundance	Natural Systems

11	Extreme Weather Events Will Be More Common	Infrastructure
12	Immigrant Groups Will Be Disproportionately Impacted	Community Culture
13	Vulnerable Populations Will Feel More Isolation	Community Culture
14	Notable Shifts In Population	Business & Economy
15	Tourism Will Be Negatively Affected	Business & Economy
16	Utility Systems Will Be Stressed By High Temperatures	Infrastructure
17	Increased Number of High Heat Days Will Stress Plants And Wildlife	Natural Systems
18	Droughts Will Become More Frequent And Severe	Natural Systems
19	Fire Risk Will Increase And Wildfires Will Become More Frequent And Severe	Natural Systems
20	Food Insecurity Will Become Exacerbated by Climate Events	Business & Economy

“Being a witness to how drastically the climate has changed in my lifetime is why I’m here.”

“Climate change is a concern for me as it affects my children’s future”

Monroe County Residents

Strategies to Prepare for Change

The following sections provide an overview of the ways that our community will prepare and build resilience in the face of accelerating climate impacts. Many of the goals, strategies, and actions within the *Climate Ready Monroe County* plan provide co-benefits, thereby strengthening the whole community by addressing not only climate change but many other stressors.

Effective strategies and actions will address climate vulnerabilities by either *reducing the potential impact* or *increasing the adaptive capacity* for the population or resource affected. Actions that reduce the potential impact may reduce the exposure to the climate hazard, or the sensitivity of the population or resource, or both. Actions that address the adaptive capacity can increase existing or develop new adaptive capacity.

Areas where Monroe County can lead through direct governmental action are highlighted throughout the plan. To achieve success, however, actions must also be supported and implemented by residents, businesses, neighborhoods, nonprofit organizations, faith communities, schools, and others.

How to Read This Plan







Climate Ready Monroe County is organized into seven themes that reflect the future of Monroe County as climate change progresses. Within each theme are key goals, and a suite of strategies to address those goals. Strategies that help to address other important community values such as equity, nature, and mitigation are highlighted throughout the plan.

The themes attempt to encompass all areas within the county and are as follows:



Along with the seven overarching themes, each has symbols to categorize the value associated with the strategy as well as ranking of effectiveness and costs. Listed below is a key to assist in the understanding of each symbol.

Community Values

- | | |
|--|--|
|  Enhances environmental health and biological diversity |  Supports efforts to reduce greenhouse gas emissions (mitigation) |
|  Helps to build equity for historically marginalized groups |  Cross-sector strategy addresses multiple types of needs across the community |
|  Monroe County leads through direct governmental action |  Indicates a high priority item |

Effectiveness**High, Med, Low**

The level of certainty that the strategy will reduce vulnerability and lead to greater climate resilience

Upfront or Capital Costs**\$ or \$\$ or \$\$\$**

The relative upfront costs of initiating the strategy

Ongoing or Maintenance Costs**\$ or \$\$ or \$\$\$**

The relative costs for ongoing support or maintenance for the strategy



Healthy Residents

Maintaining and improving the physical and mental health of Monroe County's residents is a top priority. As new climate-related impacts arise, greater investment in wellness, personal resilience, access to health care, and health care capacity will be needed.

The impacts of climate change on peoples' health are multiple and significant. They include heat-related illnesses, increasing incidences of allergies and asthma, respiratory and heart disease related to ozone exposure, exposure to contaminants and hazardous materials, food-borne and water-borne illnesses, pest-related disease, and mental health impacts. More frequent and severe storms, floods, heat waves, and other extreme events increase the risk of serious injury and add stress to healthcare systems and infrastructure.

Health-related impacts of climate change are not evenly distributed. Those who are most at risk include lower-income residents, people who work or live outdoors, infants and older adults, people with existing health conditions, and people who live in neighborhoods with higher heat, flood risk, and/or pollution.

Strategies to create healthy residents:

Strategy 13.1: Decrease Isolation through County wide connection

Strategy 16.1: Conserve utilities; Establish and Promote Cooling Centers



Monroe County Residents at a Fair | Photo by Evie Gordon

Theme: Healthy Residents

Strategy 13.1: Decrease isolation through County wide connection



Connecting residents throughout the county on a wider scale fosters collective resilience and readiness in facing climate change challenges. By decreasing isolation and promoting collaboration, vulnerable communities can share resources, expertise, and strategies to adapt effectively. This interconnected approach enhances preparedness and empowers residents to address climate-related issues comprehensively.

Addresses Vulnerabilities

13

Implementing Partners

Emergency Management, County Commissioners

Effectiveness

High

Evaluation Metrics

- Increased number of public gathering spaces
- Survey after implementation to assess improvements made

Upfront Costs

\$\$

Ongoing Costs

\$

Potential Actions

- 13.1.1** Increase public gathering spaces
- 13.1.2** Increase broadband access county wide
- 13.1.3** Implement a campaign effort to get community members signed up for notifications of emergencies

Theme: Healthy Residents

Strategy 16.1: Conserve utilities; establish and promote cooling centers



Many residents and businesses depend on electricity as a necessity for daily functions and quality of life standards. Climate change represents a risk to utility systems as the frequency of extreme weather events can cause local power outages. This can significantly affect the health of residents within Monroe County seeking shelter indoors during high heat index days or poor air quality from ground-level ozone.

As temperatures continue to rise, can the current energy grid maintain adequate sufficiency from increasing demand and higher temperatures? Current mid- to late-century projections

estimate that the demand for electricity for cooling during extreme heat events can significantly increase the chances of blackouts and other power disruptions from added stress on utility systems. Currently, some businesses and hospitals use generators when a power outage occurs. However, the luxury of owning a generator may not be accessible to all within the community.

Addresses Vulnerabilities	Implementing Partners	Effectiveness
16	Purdue Extension, Emergency Management	Medium

Evaluation Metrics	Upfront Costs
<ul style="list-style-type: none">• Utility usage rates pre and post education campaign• Record keeping of how many residents utilize cooling stations	\$\$
	Ongoing Costs
	\$\$

- Potential Actions**
- 16.1.1 Public information campaigns on conserving utility rates
 - 16.1.2 Establish new cooling stations at places other than fire departments

Robust Natural Systems

Green spaces and nature are critical for healthy neighborhoods. Parks, clean waterways, and healthy ecosystems provide connections to nature throughout the city. They improve property values, provide recreational opportunities such as walking, hiking, and biking, improve physical and mental health, and support wildlife and biodiversity. Healthy, intact natural systems can also provide valuable ecological functions, such as filtering pollutants from the air and water, reducing flood impacts, and reducing air temperatures. Finally, parks and open spaces contribute to social cohesion by serving as social gathering spaces for sports, education, art, and volunteer work.



Walking Path in the Fall | Photo by Kathik Sreenvias

Natural systems are not limited to parks and protected areas. Yards, grounds, open lots, gardens, and other vegetated areas can provide critical habitat for native insects and birds, stopover areas for migrating species, and connections between more substantial blocks of

habitat. As wilderness and natural areas become stressed and/or degraded, maintaining biological diversity within cities and other inhabited areas becomes increasingly vital to the persistence of native species throughout the region.

Wetlands, riparian areas, meadows, and cold-water fisheries are highly vulnerable to climate impacts. Native trees are susceptible to drought, wildfire, disease, and pests.

Strategies for robust natural systems:

Strategy 1.1: Limit development in the Lake Monroe Watershed

Strategy 1.3: Increase buffers around streams, lakes, and wetlands

Strategy 1.5: Reduce sediment from shoreline erosion

Strategy 1.6: Increase water quality and quantity data for Lake Monroe and its watershed

Strategy 3.5: Work with natural landscapes and structures to mitigate flooding

Strategy 5.1: Protect karst areas

Strategy 5.2: Mitigate degraded karst features

Strategy 8.1: Increase wildlife habitat and promote habitat preservation

Strategy 8.2: Restore floodplains & stream network

Strategy 10.1: Reduce invasive species

Strategy 17.3: Build overall soil health in Monroe County

Strategy 17.4: Plant more drought-resistant plants and trees

Theme: Robust Natural Systems

Strategy 1.1: Limit development in the Lake Monroe Watershed



Limiting development in the Lake Monroe Watershed in Monroe County, Indiana, is crucial for preparing for climate change due to its significant role in water quality, biodiversity, and flood mitigation. Development can increase pollution, disturb wildlife habitats, and exacerbate the impacts of climate change by removing vegetation that acts as a natural buffer against extreme weather events. Protecting this watershed is essential for maintaining the health of Lake Monroe, ensuring a sustainable water supply for the region, and preserving the natural ecosystems that support resilience against the changing climate.

**Addresses
Vulnerabilities**

Implementing Partners

**Effectiveness
Medium**

1

Planning Department, Stormwater Program,
Friends of Lake Monroe, Soil and Water
Conservation District

Evaluation Metrics

- Water quality and land use data

Upfront Costs

\$\$

Ongoing Costs

\$

Potential Actions

- 1.1.1** Work with external partners in the Lake Monroe watershed to encourage limited development using interlocal agreements or helping development ordinances
- 1.1.2** Expand ECO Zone protections outside of Monroe County
- 1.1.3** Expand use of green stormwater infrastructure throughout all of Monroe County

Theme: Robust Natural Systems

Strategy 1.3: Increase buffers around streams, lakes, and wetlands



Increasing buffers around streams, lakes, and wetlands between water and other activities like agriculture is essential for enhancing the resilience of natural systems. These buffers serve as protective zones, filtering pollutants, preventing erosion, and preserving water quality, thereby sustaining biodiversity and ecological balance. By implementing such measures, we not only safeguard the integrity of aquatic habitats but also promote sustainable land use practices that benefit both the environment and human communities in the long term.

Addresses**Vulnerabilities**

1

Implementing Partners

MCSWCD, neighboring SWCD, all
Watershed groups, NRCS, ISDA, IDEM,
IDNR - LRE

Effectiveness

High

Evaluation Metrics

- Water Quality Data
- Erosion Levels
- Runoff Pollution Rates

Upfront Costs

\$\$\$

Ongoing Costs

\$\$

Potential Actions

- 1.3.1 Provide funding for landholders to install riparian buffers, pollinator habitats and grass waterways, tree shelters, etc.
- 1.3.2 Work with Indiana Department of Natural Resources to create stormwater wetlands along North Fork Salt Creek
- 1.3.3 Increase vegetative buffer and/or building setback requirements around riparian areas

Theme: Robust Natural Systems

Strategy 1.5: Reduce sediment from shoreline erosion



To mitigate shoreline erosion at Lake Monroe and enhance community resilience to climate change, implementing vegetation buffers along the shoreline can stabilize soil and reduce erosion rates. Additionally, introducing eco-friendly erosion control structures such as gabions or offshore breakwaters can dissipate wave energy, protecting vulnerable shorelines. Community engagement and education programs on sustainable shoreline management practices can further empower residents to actively participate in preserving the lake's ecosystem and adapting to climate change impacts

Addresses Vulnerabilities
1

Implementing Partners
Planning Department, Parks and Recreation, IDNR, Stormwater Program, GIS, US Army Corp of Engineers

Effectiveness
High

Upfront Costs
\$\$

Evaluation Metrics

- Water Quality
- Shoreline inventory and mapping of severe areas
- Fluctuations as management practices change

Ongoing Costs
\$

Potential Actions

- 1.5.1 Inventory shoreline erosion
- 1.5.2 Stabilize sensitive shoreline areas in Lake Monroe Watershed
- 1.5.3 Change water management practices to minimize fluctuations

Theme: Robust Natural Systems

Strategy 1.6: Increase water quality and quantity data for Lake Monroe and its watershed



Access to reliable data on water quality and quantity is crucial for effective climate change action. As climate change intensifies, shifts in precipitation patterns, temperature, and extreme weather events can drastically affect water resources. Monitoring water quality helps detect pollution, contamination, and ecosystem health, while data on water quantity enables better management of supplies, particularly in drought-prone areas. This information is essential for developing adaptive strategies, ensuring equitable access to clean water, and guiding policies to mitigate the impacts of climate change on both human populations and natural ecosystems. Without comprehensive water data, responding to climate change challenges becomes significantly more difficult.

Addresses Vulnerabilities

1

Implementing Partners

Planning Department, MCSWCD, IDNR, GIS, Stormwater Program, USACE

Effectiveness

High

Upfront Costs

\$

Evaluation Metrics

- Water quality data collected

Ongoing Costs

\$

Potential Actions

1.6.1 Conduct a water quality monitoring program in the Lake Monroe Watershed

1.6.2 Create a bathymetric map of Lake Monroe

Theme: Robust Natural Systems

Strategy 5.1: Protect karst areas



Protecting vulnerable Karst areas is essential for enhancing the resilience of natural systems. These unique landscapes, characterized by porous limestone formations, are highly sensitive to disturbances and play crucial roles in groundwater storage, filtration, and recharge. Preserving Karst areas not only safeguards water resources but also maintains biodiversity, supports local ecosystems, and contributes to the overall health and sustainability of surrounding environments.

Addresses Vulnerabilities

5

Implementing Partners

Parks and Recreation, Stormwater Program, MCSWCD, NRCS, EMA, Planning Department

Effectiveness

Medium

Upfront Costs
\$\$\$

Evaluation Metrics

- Mapping degraded areas
- Updating Stormwater Ordinances and CDO every 5 years following the assessment of groundwater quality in karst areas
- Evaluate drainage rates

Ongoing Costs
\$\$

Potential Actions

- 5.1.1** Create a County-wide inventory of karst features and their watersheds.
- 5.1.2** Update Stormwater Management Ordinance and County Development Ordinance to protect groundwater quality in karst areas.
- 5.1.3** Provide education and enforcement around karst protection (no dumping, no development).
- 5.1.4** Buyout existing development in sensitive karst areas
- 5.1.5** Work on a best management option around Karst features that are located inside agricultural areas and urban areas

Theme: Robust Natural Systems

Strategy 3.5: Work with natural topography to mitigate flooding



Working with natural topography to mitigate flooding is crucial for sustainable land management. By preserving and enhancing the natural contours of the land, such as wetlands, hills, and floodplains, we can improve water absorption, slow runoff, and reduce the risk of floodwaters overwhelming developed areas. This approach allows the land to act as a natural barrier, managing water flow in ways that engineered solutions alone cannot achieve. Embracing natural topography not only mitigates flooding but also supports biodiversity and promotes environmental resilience.

Addresses

Vulnerabilities

3

Implementing Partners

MCSWCD, NRCS, Stormwater Program, Parks and Recreation, Planning Department

Effectiveness

Medium

Upfront Costs
\$\$

Evaluation Metrics

- Utilizing elevation maps to determine most vulnerable areas

Ongoing Costs
\$\$

Potential Actions

- 3.5.1** Educate and provide technical assistance on native plant placement and species recommendations.

3.5.2 Help landowners with rain scaping projects to naturally redirect water flow or create water-catchment systems.

3.5.3 Educate and provide technical assistance and funding for rain gardens.

Theme: Robust Natural Systems

Strategy 5.2: Mitigate degraded karst features



Mitigating degraded karst features in the face of climate change requires a multi-faceted approach to restore and protect these unique landscapes. As climate change exacerbates erosion, droughts, and flooding, karst systems—characterized by limestone formations, caves, and underground streams—become more vulnerable to damage. Conservation efforts must be taken proactively to avoid further destruction and damage.

Addresses Vulnerabilities

5

Implementing Partners

Stormwater Program

Effectiveness

High

Upfront Costs

\$\$\$

Evaluation Metrics

- Rates of sediment accumulation

Ongoing Costs

\$\$

Potential Actions

5.2.1 Remove sediment accumulated at the terminal stream sink of Sinking Creek

Theme: Robust Natural Systems

Strategy 8.1: Increase wildlife habitat and promote habitat preservation



Increasing habitat in Monroe County, Indiana, is crucial for preparing for climate change because it enhances ecological resilience, supports biodiversity, and helps mitigate the impacts of climate extremes. Restored wetlands and forests act as natural carbon sinks, improve water quality and offer habitats that can adapt to changing conditions. This approach not only preserves the natural beauty and ecological integrity of the region but also provides a buffer against climate change impacts, ensuring a healthier, more resilient environment for future generations.

Addresses Vulnerabilities

8

Implementing Partners

Parks and Recreation, Planning Department, MCSWCD, Highway Department

Effectiveness

Medium

Upfront Costs

\$\$

Evaluation Metrics

- Monitor migration patterns
- Macroinvertebrate monitoring in streams

Ongoing Costs

\$\$

Potential Actions

8.1.1 Update County Development Ordinance language to include conservation subdivisions, increase buffers around karst & riparian areas and add incentives for tree canopy preservation.

Theme: Robust Natural Systems**Strategy 8.2: Restore floodplain and stream network**

Restoring a floodplain and stream network is vital for a county's environmental health, resilience, and long-term sustainability. By rehabilitating these natural systems, the county can reduce the risk of flooding, improve water quality, and enhance biodiversity. Floodplains act as natural buffers, absorbing excess water and preventing erosion, while restored streams help support diverse wildlife and provide recreational opportunities. Additionally, these improvements can help mitigate the impacts of climate change, ensuring that the community remains prepared for future weather events. Investing in restoration also brings economic benefits, including increased property values and reduced costs from flood damage.

Addresses**Vulnerabilities**

8

Implementing Partners

Parks and Recreation, Planning Department,
MCSWCD, NRCS

Effectiveness

Medium

Upfront Costs

\$\$\$

Evaluation Metrics

- Map of streams and floodplains to increase over time

Ongoing Costs

\$\$\$

Potential Actions

8.2.1 Restore floodplains & stream network


Theme: Robust Natural Systems**Strategy 10.1: Reduce invasive species**

Invasive species not native to a region they infest can cause harm to native plants,

animals, and biodiversity. In severe cases, invasive species can reduce or permanently alter habitats. Typical forms of invasive species in Indiana include honeysuckle, Callery pear trees, kudzu, and the Asian beetle. With climate change causing longer summers and shorter winters, warmer temperatures are allowing invasive species to expand their territory into areas previously too cold to thrive in. Efforts to reduce the spread of invasive species include citizen reporting to DNR, volunteer organizations removing invasive species, and the Indiana Invasive Species Council that tracks existing and new species occupying locations throughout the state.

Addresses Vulnerabilities 10	Implementing Partners Parks and Recreation, Planning Department, Stormwater Program, MCSWCD, MC IRIS, Commissioners, NRCS	Effectiveness Medium
		Upfront Costs \$\$\$
Evaluation Metrics <ul style="list-style-type: none">• Acreage treated• Number of species eradicated• Species inventory every 5 years		Ongoing Costs \$
Potential Actions <ul style="list-style-type: none">10.1.1 Educate residents about the threat of invasive species and how to manage them.10.1.2 Remove invasive species from public spaces.10.1.3 Create regulations for the presence of invasive species in public spaces10.1.4 Provide funding to remove invasive species from private lands.		

Theme: Robust Natural Systems

Strategy 17.3: Build overall soil health in Monroe County

Building soil health is crucial for a Monroe County’s agricultural productivity, environmental sustainability, and overall community well-being. Healthy soils improve water retention, reduce erosion, and increase the land’s ability to sequester carbon, helping to mitigate climate change. By enhancing soil fertility and structure, farmers can boost crop yields while reducing the need for chemical inputs, promoting more sustainable and cost-effective farming practices. Additionally, healthy soils support biodiversity and improve water quality by filtering pollutants. Investing in soil health strengthens the local economy, supports food security, and fosters a healthier, more resilient ecosystem for future generations.

**Addresses
Vulnerabilities**
17

Implementing Partners
MCSWCD, NRCS

Effectiveness
Low

Upfront Costs
\$

Evaluation Metrics

- Involvement in educational workshops by community members

Ongoing Costs
\$

Potential Actions

17.3.1 Provide incentives to document and improve soil health

17.3.2 Provide education and technical resources on soil health

Theme: Robust Natural Systems

Strategy 17.4: Plant more drought-resistant plants and trees



Planting drought-resistant plants is becoming increasingly important as the impacts of climate change intensify, leading to more frequent and severe droughts. These resilient plants require less water to thrive, making them ideal for conserving water resources in regions facing water scarcity. By incorporating drought-resistant species into landscapes, communities can reduce irrigation needs, lower water usage costs, and maintain vibrant ecosystems even during dry spells. Furthermore, these plants help stabilize the soil, prevent erosion, and support local wildlife. As climate change continues to challenge traditional agricultural and landscaping practices, adopting drought-resistant plants is a key strategy for building more sustainable, climate-resilient communities.

**Addresses
Vulnerabilities**
17

Implementing Partners
MCSWCD, Parks and Recreation

Effectiveness
Low

Upfront Costs
\$

Evaluation Metrics

- Educational programming participation

Ongoing Costs
\$

Potential Actions

17.4.1 Provide guidance and education on proper species selection



Sustainable Businesses

Monroe County's economy is built on a wide diversity of large and small industries and businesses. Our main sectors are the service sectors, health care, higher education, and manufacturing. Sustainable efforts are supported by the Greater Bloomington Chamber of

Commerce as well as our economic development partners the Bloomington Economic Development Corporation (BEDC).

Notably, climate action plans are being adopted by some local entities. The City of Bloomington was the first, and now Indiana University-Bloomington is following up. Thanks to the Indiana University Grand Challenges program, the Environmental Resilience Institute helps local entities access data and consulting services.

Corporate climate responsibility is a growing concern for many stakeholders. Climate change impacts businesses in many ways. More severe storms, flooding, drought, and extreme heat significantly increase business costs including for energy, insurance, goods and services and transportation. Higher costs can result in higher prices for consumers. Support for local businesses comes in the



Kirkwood Avenue in Bloomington | Photo by visitbloomington.com

form of creating sustainable practices, which can also save money. Many of the actions in other sections of *Climate Ready Monroe County* will support the creation of more sustainable businesses, including those that prepare companies for larger and more frequent extreme events, provide affordable housing, ensure adequate healthcare, and increase transportation options for the local workforce.

More severe storms associated with climate change will lead to even greater flood risk to those businesses and industries located in high and medium flood risk areas. Construction and other outdoor businesses could be especially sensitive to the impacts of extreme heat, as outdoor workers' hours of safe exposure become limited. Companies with high energy usage could be exposed to more energy outages related to extreme events. Finally, companies may need to raise prices of their goods and services due to the costs associated with extreme events such as heat waves and severe storms.

Strategies to support sustainable businesses

Strategy 12.1: Increase resources for immigrant groups in the county.

Strategy 15.1: Make it easy to visit Monroe County, despite climate barriers.

Theme: Sustainable Businesses

Strategy 12.1: Increase Resources for immigrant groups in Monroe County



Increasing the immigrant population can bring diverse perspectives, skills, and experiences to climate-resilient businesses and farmers, fostering innovation and adaptation in the face of environmental challenges. Immigrants often possess unique agricultural knowledge and techniques that can enhance sustainable farming practices, such as water conservation methods or crop diversification strategies. By embracing and integrating immigrant communities, businesses and farmers can strengthen their resilience to climate change, build stronger local economies and contribute to a more sustainable future.

Addresses

Vulnerabilities

12

Implementation Partners

Commissioners, EMA, Township Trustees

Effectiveness

Medium

Upfront Costs

\$

Evaluation Metrics

- Record keeping of numbers that participate in cultural engagement opportunities
- Number of small businesses and cultural organizations within the County

Ongoing Costs

\$

Potential Actions

12.1.1 Public engagement for cultural understanding.

12.1.2 Increased opportunities for small businesses and cultural organizations

Theme: Sustainable Businesses

Strategy 15.1: Make it easy to visit Monroe County despite climate barriers



Making it easy to visit Monroe County, Indiana, despite climate barriers involves improving infrastructure, enhancing accessibility, and promoting sustainable tourism practices. As climate change impacts weather patterns, unpredictable conditions like heavy rainfall or extreme temperatures could deter visitors. Tourism is a

To address this, Monroe County can invest in resilient infrastructure, such as well-maintained trails, storm-resistant roads, and climate-adapted facilities. Additionally, promoting indoor attractions, flexible travel options, and year-round events can help ensure that visitors can enjoy the county's natural beauty and cultural offerings, regardless of changing weather patterns.

Addresses
Vulnerabilities
15

Implementation Partners
County Commissioners, Planning Department

Effectiveness
High

Upfront Costs
\$\$\$

Evaluation Metrics

- Improving bus lines, bike paths, and roads
- Monitor usage rates of county amenities in conjunction with high heat days

Ongoing Costs
\$\$

Potential Actions

15.1.1 Promote indoor recreational activities

15.1.2 Increase regional public transportation



Resilient Infrastructure



Lake Lemon Dam | Photo by Monroe County Stormwater Program

Infrastructure includes buildings, energy distribution, water delivery, storm- and wastewater, floodwalls, roads and highways, bridges, culverts, communications networks, and many other basic structures found throughout the region. Monroe County’s infrastructure varies significantly in age and condition and improving its efficiency and resilience.

Resilient infrastructure in Monroe County, Indiana, is vital for adapting to climate change, ensuring the community can withstand and quickly recover from extreme weather events, such as floods and storms. By investing in

sustainable and durable infrastructure, Monroe County aims to protect its natural resources, minimize damage to properties and critical services, and maintain a high quality of life for its residents. This approach is essential for fostering a resilient community that can face the challenges of climate change with minimal disruption.

The most at-risk County infrastructure includes aging storm sewer systems and bridges, flood-prone neighborhoods and businesses, land within the sinking stream watersheds, and the Lake Monroe watershed.

Strategies to support resilient infrastructure

Strategy 2.2: Increase resilience of rural water delivery systems

Strategy 3.1: Increase infiltration and detention of stormwater

Strategy 3.3: Upgrade roads and stormwater drainage infrastructure to better accommodate large storms

Strategy 4.1: Increase resilience of wastewater treatment plants and package plants

Strategy 4.2: Increase resilience of wastewater collection systems

Strategy 7.1: Strengthen & maintain urban tree canopy

Strategy 16.2: Upgrade utility systems to keep up with demand

Strategy 16.3: Minimize Utility conflicts for New Construction

Strategy 17.1: Promote water collection/use of water conserving fixtures

Theme: Resilient Infrastructure

Strategy 2.2 Increase resilience of rural water delivery systems



Increasing the resilience of rural water infrastructure is vital for adapting to the impacts of climate change, such as prolonged droughts and extreme weather events. By bolstering resilience, rural communities can ensure a reliable and sustainable water supply, mitigating the disruptions caused by changing climate patterns. Investing in climate-resilient water infrastructure not only safeguards essential services but also strengthens the overall resilience of rural areas, enhancing their ability to withstand and recover from environmental challenges.

Addresses

Implementation Partners

Effectiveness

Vulnerabilities

Commissioners, City of Bloomington

High

2

Upfront Costs

\$\$\$

Evaluation Metrics

- Access of residents to water over time

Ongoing Costs

\$\$

Potential Actions

2.2.1 Upgrade pipes and digital meter reading infrastructure for local rural water corporations

Theme: Resilient Infrastructure

Strategy 3.1: Increase infiltration and detention of stormwater



Increasing Monroe County, Indiana's capacity to absorb and slow down stormwater is critical in the face of climate change because it directly impacts the region's resilience to extreme weather events. Enhanced stormwater management can mitigate flooding risks, reduce erosion, and improve water quality by preventing runoff from carrying pollutants into waterways. This approach not only protects the environment and public health but also safeguards infrastructure and maintains the integrity of local ecosystems, making the community more adaptable to the unpredictable impacts of climate change.

Addresses

Vulnerabilities

3

Implementation Partners

Commissioners, Stormwater Program, Highway Department

Effectiveness

High

Upfront Costs

\$\$\$

Evaluation Metrics

- Update Stormwater Management Ordinance every 5 years based on up-to-date standards
- Number of facilities retrofitted

Ongoing Costs

\$\$\$

Potential Actions

3.1.1 Retrofit existing stormwater management facilities for water quality treatment

3.1.2 Update Stormwater Management Ordinance to require stormwater quantity management and stormwater quality treatment practices for new development using up-to-date standards

Theme: Resilient Infrastructure

Strategy 3.3: Upgrade roads and stormwater drainage infrastructure to better accommodate large storms



Upgrading and designing roads and bridges to withstand larger storms is crucial in preparing for climate change because it directly impacts public safety, economic stability, and community resilience. Enhanced infrastructure can handle increased rainfall and severe weather, reducing the risk of flooding, damage, and disruptions. This forward-thinking approach ensures that transportation networks remain functional during and after extreme events, facilitating emergency responses and recovery efforts, and safeguarding communities against the escalating impacts of climate change.

**Addresses
Vulnerabilities**

3

Implementation Partners

Planning Department, Stormwater Program,
Highway Department

Effectiveness

Medium

Upfront Costs

\$\$\$

Evaluation Metrics

- Ensure stormwater drainage infrastructure policies are consistent with rainfall data tables as climate changes impacts weather events
- Update Stormwater Master Plan every year, including an updated inventory of sensitive areas

Ongoing Costs

\$\$\$

Potential Actions

3.3.1 Create a policy for designing new stormwater drainage infrastructure using the most up to date rainfall data tables.

3.3.2 Create an updated Stormwater Management and Drainage Master Plan to address drainage issues and inventory sensitive areas.

Theme: Resilient Infrastructure

Strategy 4.1: Increase resilience of wastewater treatment plants and package plants



Increasing the resilience of wastewater treatment plants and package plants is critical in preparation for climate change as it ensures the continuity of essential water treatment services amidst more frequent and severe weather events. Enhanced resilience helps in preventing the overflow and failure of these facilities during extreme rainfall, flooding, or drought conditions, thereby safeguarding public health, protecting water quality, and maintaining environmental standards. This proactive approach is fundamental in mitigating the impacts of climate change on urban and rural water systems, ensuring communities have access to safe, clean water even as environmental conditions evolve.

**Addresses
Vulnerabilities**

4

Implementation Partners

Planning Department, Health Department, Rural
Sewer Districts

Effectiveness

High

Upfront Costs

\$\$\$

Evaluation Metrics

- Percentage of energy used by wastewater treatment plants that comes from the solar panels
- Participation of residents in educational campaigns

Ongoing Costs

\$\$\$

- Number of properties on septic and not connected to the sewer service that are able to be connected

Potential Actions

- 4.1.1 Install solar panels at water and sewer treatment plants in the South-Central Regional Sewer District
- 4.1.2 Add second electrical inputs at wastewater treatment plants in the South-Central Regional Sewer District
- 4.1.3 Educate the public to reduce the risk of failure from fatbergs or other clogs
- 4.1.4 Connect properties on septic hooked onto the sewer system if they are within a sewer service area

Theme: Resilient Infrastructure

Strategy 4.2: Increase resilience of wastewater collection systems



Increasing the resilience of wastewater collection systems through upgrading leaky pipes is pivotal in preparation for climate change. Such enhancements are essential for preventing untreated sewage from contaminating water bodies, reducing water loss, and enhancing the overall efficiency of water management systems. With climate change expected to intensify weather events, robust wastewater infrastructure minimizes the risk of overflows and flooding, safeguarding public health, and ensuring the sustainability of water resources in the face of increasingly unpredictable environmental conditions.

Addresses Vulnerabilities
4

Implementation Partners
Rrual Sewer Districts, Health Department

Effectiveness
High

Upfront Costs
\$\$

Evaluation Metrics

- Monitoring for differences in average flow rate

Ongoing Costs
\$\$

Potential Actions

- 4.2.1 Address inflow and infiltration issues such as leaky pipes that let in stormwater

Theme: Resilient Infrastructure

Strategy 7.1: Strengthen and maintain urban tree canopy



Strengthening and maintaining urban tree canopy is essential for creating healthier, more sustainable Monroe County. Trees provide vital environmental benefits, including improved air quality, reduced urban heat islands, and enhanced biodiversity. To sustain this green infrastructure, the County must invest in tree planting programs, protect existing trees from development pressures, and implement proper care practices such as regular pruning and watering. Engaging local communities in tree care and ensuring diverse species can thrive also contributes to a resilient urban forest that benefits both people and the environment.

Addresses**Vulnerabilities**

7

Implementation Partners

Parks and Recreation, SWCD, NRCS, Planning Department, GIS

Effectiveness

Medium

Upfront Costs

\$\$

Evaluation Metrics

- Conduct a species richness index of planned areas of improvement biannually
- Evaluate canopy health once a year

Ongoing Costs

\$

Potential Actions

7.1.1 Encourage biodiversity

7.1.2 Monitor current tree canopy health

7.1.3 Prevent loss of tree canopy for new development

Theme: Resilient Infrastructure**Strategy 16.2: Upgrade utility systems to keep up with demand**

Many residents and businesses depend on electricity as a necessity for daily functions and quality of life standards. Climate change represents a risk to utility systems as the frequency of extreme weather events can cause local power outages. This can significantly affect the health of residents within Monroe County seeking shelter indoors during high heat index days or poor air quality from ground-level ozone. The concern as temperatures are expected to rise by the mid to late century is whether the current energy grid maintains adequate sufficiency from increasing demand and higher temperatures. Currently, some businesses and hospitals use generators when a power outage occurs. However, the luxury of owning a generator may only be accessible to some within the community.

Addresses**Vulnerabilities**

16

Implementation Partners

EMA, Purdue Extension, Rural Utility Companies, Planning Department, County Council, Commissioners

Effectiveness

Medium

Upfront Costs

\$\$

Evaluation Metrics

- Base number of above ground utilities

Ongoing Costs

- Utility usage rates pre and post education
- Number of residents signed up for the notification system

\$\$

Potential Actions

16.2.1 Notification of issues.

16.2.2 Conserve utility service (education)

16.2.3 Bury existing utility lines

16.2.4 Install all new utility lines under the Streets

Theme: Resilient Infrastructure

Strategy 16.3: Minimize utility conflicts for new construction



Minimizing utility conflicts by burying utilities under the street rather than under trees is important in the context of climate change because it helps preserve the urban tree canopy. Trees play a critical role in mitigating the urban heat island effect, absorbing carbon dioxide, and providing shade, all of which are vital for urban resilience to climate change. By placing utilities under streets, we avoid disrupting root systems and ensure trees remain healthy and effective in combating climate change impacts.

Addresses Vulnerabilities

16

Implementation Partners

Planning Department

Effectiveness

Medium

Upfront Costs

\$

Evaluation Metrics

- Number of above ground utilities

Ongoing Costs

\$

Potential Actions

16.3.1 Bury utility lines under new development and subdivisions

Theme: Resilient Infrastructure

Strategy 17.1: Promote water collection and use of water conserving fixtures



The frequency of droughts over the last decade in Indiana has affected different systems across the region, from reduced water availability to lower crop yields during periods of limited precipitation. In Monroe County, Lake Monroe has seen its water level drop from higher evaporation rates during dry spells, affecting its aquatic life and water quality. Based on current climate trend models, drier summers and wetter winters are expected to

continue in the coming century as global temperatures rise from increased emissions. Monroe County currently has limited water-conserving capabilities in place during drought or limited precipitation during the summer months.

Addresses Vulnerabilities 17	Implementation Partners Rural Utility Companies, Health Department	Effectiveness Medium
		Upfront Costs \$
Evaluation Metrics <ul style="list-style-type: none">County water usage before and after education and incentivization		Ongoing Costs \$
Potential Actions 17.1.1 Incentivize water collection/conservation		



Recreation



Monroe residents enjoying a park | Photo by Evie Gordan

There are a multitude of recreation opportunities for Monroe County residents that allow them to explore new hobbies and activities. These opportunities are essential for residents in maintaining a positive physical and mental well-being that allows for connection with the community and nature, while fostering creativity and reducing stress.

However, climate change poses a growing threat to outdoor recreation by altering ecosystems and increasing the frequency of extreme weather events such as heatwaves, storms, and droughts. These shifts can reduce access to natural spaces, compromise the quality of air and water, and make certain outdoor activities, such as hiking, or fishing more challenging or even unsafe. As ecosystems shift and biodiversity declines, communities may face limited recreational options, leading to decreased overall health benefits and a loss of connection to nature. Addressing climate change and preserving natural spaces is essential not only for environmental health but for ensuring that future generations can continue to enjoy the recreational opportunities that contribute to human well-being.

Strategies to support recreation

Strategy 1.4: Minimize impacts from activities in and on the lake.

Strategy 9.1: Reconnect with nature

Theme: Recreation

Strategy 1.4: Minimize impacts from activities in and on the lake



Minimizing impacts from activities in and around Lake Monroe is crucial in the context of climate change, as it helps protect water quality, preserves biodiversity, and ensures the sustainability of local ecosystems. Activities that disturb this area can exacerbate the effects of climate change by increasing pollution and altering habitats. Effective management and conservation efforts are essential to maintaining the lake's role as a critical water source and as part of the broader strategy to adapt to and mitigate climate change impacts in the region.

*Addresses**Vulnerabilities*

1

Implementation Partners

FLM, IDNR, Stormwater Program

Effectiveness

Medium

Upfront Costs

\$

Evaluation Metrics

- Erosion control
- Water quality data

Ongoing Costs

\$

Potential Actions

- 1.4.1 Expand no wake zones
- 1.4.2 Limit 2-cycle engine use
- 1.4.3 Increase pump out station availability (onboarding toilets)
- 1.4.4 Increase best management practices around fueling

Theme: Recreation

Strategy 9.1: Reconnect with Nature



Reconnecting with nature is essential for making natural systems robust as it fosters a deeper understanding of ecological processes and the interdependence of species. By immersing ourselves in natural environments, we develop a greater appreciation for biodiversity and the delicate balance of ecosystems, which encourages conservation efforts and sustainable practices. Through this reconnection, we cultivate a sense of stewardship, empowering individuals and communities to actively participate in preserving and restoring the health of our planet's diverse ecosystems.

*Addresses**Vulnerabilities*

9

Implementation Partners

Parks and Recreation, SWCD, Stormwater Program

Effectiveness

Medium

Evaluation Metrics

- Log community usage of natural amenities

Potential Actions

9.1.1 Increase access to natural amenities

9.1.2 Revamp existing programs to facilitate connection with nature.

Upfront Costs

\$\$\$

Ongoing Costs

\$\$\$



Community Readiness



Monroe County Residents at Cascades Park | Photo by visitbloomington.com

Extreme events and emergencies can happen with or without warning. Monroe County has systems and policies in place to prepare for and respond to both human caused and natural events. But residents and businesses also need to take steps to reduce the potential for impacts and be prepared for these events.

Communities with close-knit neighborhoods and active networks fare the best during and after disasters. Community networks, including churches, temples, interfaith groups,

neighborhood associations, and less formal systems of friends, family, and neighbors who look out for one another are vital to resilience. Interfacing with existing networks and supporting the development of new ones creates longer-term resilience. Resilience hubs are one way to create the networks and relationships needed. Lower-income community members, people who lack adequate housing, older adults, those with limited mobility or health conditions, outdoor workers and people without access to a vehicle are all more at risk. Also included are community members in care facilities, jails, dorms, or other group settings where people are dependent on others for their emergency response and evacuation. Finally, non-English speakers may not receive timely emergency instructions that they can understand.

Strategies for community readiness

Strategy 2.1: Ensure Monroe County continues to have access to Lake Monroe as our primary drinking water source

Strategy 3.2: Restrict new construction in Special Flood Hazard Area (1% AEP floodplains) and provide education about risks within the 0.2% AEP floodplain.

Strategy 3.4: Buy out properties in floodplains (or provide funding to bring up to compliance with flood standards).

Strategy 6.1: Provide indoor opportunities & mitigate heat exposure

Strategy 11.1: Decrease the number of areas susceptible to negative impacts of extreme weather events

Strategy 14.1: Integrate population shifts in county strategy processes

Strategy 18.1: Reduce the ability for fire to spread.

Theme: Community Readiness

Strategy 2.1: Ensure Monroe County continues to have access to Lake Monroe as our primary drinking water source



Ensuring Monroe County continues to have access to Lake Monroe as our primary drinking water source is crucial for the health and well-being of the community. Protecting the water quality of the lake requires ongoing efforts to prevent pollution, manage land use around the watershed, and reduce contaminants that could affect the water supply. This includes investing in infrastructure to monitor water quality, promoting sustainable practices for nearby development, and collaborating with local stakeholders to safeguard the lake's ecosystem. By taking proactive measures, we can preserve Lake Monroe as a reliable, clean drinking water source for future generations.

Addresses

Vulnerabilities

2

Implementation Partners

Planning Department, Commissioners, City of
Bloomington, IU

Effectiveness

Medium

Upfront Costs

\$\$

Evaluation Metrics

- Monitor how much water is consumed during drought conditions
- Access and amount of access to water over time
- Applicability of new and updated regulations based on water use in drought intensive areas

Ongoing Costs

\$\$

Potential Actions

2.1.1 Lobby state and federal government to ensure Monroe County has access to water for treatment plant (e.g. not given to Indianapolis)

2.1.2 Create rules for when water rationing is required during drought conditions (considering potential impacts of how Bloomington and Ellettsville are expanding)

2.1.3 Update planning and zoning regulations for certain water-intensive uses or industries

Theme: Community Readiness

Strategy 3.2: Restrict new construction in Special Flood Hazard Area (1% AEP floodplains) and provide education about risks within the 0.2% AEP floodplain



Restricting new construction in Special Flood Hazard Areas (1% AEP floodplains) is vital to reducing flood risks and protecting communities. These areas are highly prone to flooding, and limiting development helps prevent loss of life, property damage, and costly infrastructure repairs. Additionally, educating residents and property owners about the risks in the 0.2% AEP floodplain—an area with a lower but still significant chance of flooding—can raise awareness and encourage flood-resilient practices. At the county level, proactive measures, such as zoning regulations and public education campaigns, can significantly reduce the long-term impacts of flooding while promoting safer, more sustainable development.

Addresses

Vulnerabilities

3

Implementation Partners

Planning Department, Commissioners, Stormwater Program, County Council, GIS, Legal, Building Department

Effectiveness

Medium

Upfront Costs

\$\$

Evaluation Metrics

- Number of enforcement cases resolved

Ongoing Costs

\$\$

Potential Actions

3.2.1 Continue enforcement action against added fill and buildings being erected without a permit and perform proactive monitoring of floodplains

3.2.2 Educational Outreach Program regarding risks for building or living in or near the 100 year floodplain (1% and 0.2% AEP)

3.2.3 Hire a designated floodplain coordinator and/or assess staffing needs for floodplain management

3.2.4 Coordinate and create a response plan with Emergency Management

Theme: Community Readiness

Strategy 3.4: Buyout properties in in floodplains (or provide funding to bring up to compliance with flood standards)



Buying out properties in floodplains is an important strategy for Monroe County to reduce the long-term risks and financial burdens of flood damage. By purchasing these properties, Monroe County can relocate residents to safer areas, minimize the need for costly flood control infrastructure, and protect valuable public resources like roads and utilities. Additionally, these buyouts can help restore natural floodplain functions, such as water absorption and wildlife habitats, ultimately contributing to more sustainable and resilient

communities. This proactive approach helps prevent future disasters and promotes long-term environmental and economic stability.

Addresses

Vulnerabilities

3

Implementation Partners

Planning Department, EMA, Stormwater Program, Commissioners

Effectiveness

Medium

Upfront Costs

\$\$

Evaluation Metrics

- Number of properties not bought out in the floodplain over time
- Size of funding program compared to the cost associated with buyout program

Ongoing Costs

\$\$\$

Potential Actions

3.4.1 Create a property buyout program or plan to bring structures up to current flood design standards

3.4.2 Create a funding program to assist with bringing properties into compliance with flood standards.

Theme: Community Readiness

Strategy 6.1 Provide indoor opportunities to mitigate heat exposure



Providing indoor opportunities to mitigate heat exposure is crucial in the face of climate change, especially as extreme heat events become more frequent and intense. Access to cool, air-conditioned spaces can protect vulnerable populations, such as the elderly, children, and those with pre-existing health conditions, from heat-related illnesses like heatstroke and dehydration. Indoor cooling options, like community cooling centers, can help reduce the strain on emergency services during heatwaves, offering safe havens where individuals can recover. Investing in such spaces not only promotes public health but also ensures that Monroe County will be better prepared for the growing challenges of a hotter climate.

Addresses

Vulnerabilities

6

Implementation Partners

Planning Department, Commissioners, City of Bloomington, IU

Effectiveness

Medium

Upfront Costs

\$\$

Evaluation Metrics

Monitor air quality

Ongoing Costs

\$\$

Potential Actions

6.1.1 Create indoor alternatives for recreation

6.1.2 Provide awareness of dangers of poor air quality

Theme: Community Readiness

Strategy 11.1 Decrease the number of areas susceptible to negative impacts of extreme weather events



Decreasing the number of areas susceptible to the negative impacts of extreme weather events is essential for enhancing community resilience in the face of climate change. By reducing exposure in high-risk zones, such as floodplains, Monroe County can protect lives, property, and vital infrastructure. This proactive approach not only saves lives but also reduces the economic costs associated with disaster recovery and rebuilding, fostering safer and more sustainable communities.

Addresses Vulnerabilities
11

Implementation Partners
FLM, GIS, IDNR

Effectiveness
Medium

Upfront Costs
\$\$\$

Evaluation Metrics

- Inventory vulnerable areas and resurvey every 5 years

Ongoing Costs
\$\$

Potential Actions

- 11.1.1 Improve natural drainage through promoting soil health.
- 11.1.2 Improve and maintain existing retention systems
- 11.1.3 Evaluate most vulnerable systems
- 11.1.4 Assist in the management of a program that incentivizes residents in high-risk tornado zones to construct shelters

Theme: Community Readiness

Strategy 14.1: Integrate Population Shifts in County Strategy Processes



By incorporating demographic changes into county strategy processes, communities can better anticipate the unique needs and vulnerabilities of shifting populations in the face of

climate change. Understanding population shifts allows for tailored interventions and infrastructure development to enhance community resilience and adaptation efforts. Integrating this data ensures that county strategies are not only effective in mitigating climate impacts but also inclusive and responsive to evolving demographics.

Addresses Vulnerabilities 14	Implementation Partners Planning Department, Emergency Management, Township Trustees, Health Department, County Commissioners, Highway Department, GIS Division	Effectiveness Medium
		Upfront Costs \$\$\$
Evaluation Metrics <ul style="list-style-type: none">Periodic assessments of shifting populations and infrastructure		Ongoing Costs \$\$\$
Potential Actions 14.1.1 Short-term placement with regional approach. 14.1.2 Infrastructure planning (county only).		

Strategy 18.1: Reduce the ability for fire to spread



Reducing the ability of fire to spread is crucial for Monroe County given its mix of urban, suburban, and rural areas, along with its diverse natural landscapes. With large, forested areas, agricultural land, and residential zones, the county faces a heightened risk of wildfires, especially during dry spells. By creating defensible spaces, implementing controlled burns, maintaining firebreaks, and promoting fire-resistant landscaping, Monroe County can better protect its communities, wildlife, and critical infrastructure. These measures not only reduce the immediate threat of fire but also help ensure long-term environmental health, safeguarding both property and natural resources in the face of increasing fire risks due to climate change.

Addresses Vulnerabilities 18	Implementation Partners SWCD, Stormwater Program, Planning Department, Building Department, Park and Recreation, EMA	Effectiveness Medium
--	--	--------------------------------

Upfront Costs

\$

Ongoing Costs

\$

Evaluation Metrics

- Attendance by residents of fire and burning educational workshops
- Creation of informational materials as a resource for residents and homeowners

Potential Actions

18.1.1 Educate landowners on proper open burn practices

18.1.2 Educate homeowners and contractors on tree and vegetation placement and management



Sustainable Agriculture

Monroe County relies heavily on agriculture, with nearly a fourth of its land dedicated to farmland essential for local livelihoods and homegrown food. This sector is vital not only for farmers' sustenance but also for providing residents with healthy, locally sourced options that strengthen the community's food security.

However, climate change presents a growing threat to agriculture. The increasing frequency of extreme weather events, such as floods and droughts, and the intensification of long-term stressors, like soil degradation, pose significant risks to the sector. To address these challenges, Monroe County must prioritize sustainable agriculture policies that build resilience. These policies should support farmers, agricultural workers, and communities in mitigating risks, adapting to changing conditions, and ensuring the long-term sustainability of agricultural systems.



Field of crops | Photo by Monroe County Soil and Water Conservation District

Strategies to support Sustainable Agriculture

Strategy 17.2: Encourage use of cover crops in agricultural fields

Strategy 17.5: Increase sustainable agriculture practices

Strategy 19.1: Prevent food waste

Strategy 19.2: Encourage personal connection to food sources

Theme: Sustainable Agriculture

Strategy 17.2: Encourage use of cover crops in agricultural fields.



Promoting the use of cover crops in agricultural fields can enhance soil health, improve water management, and bolster resilience against climate extremes. Cover crops act as natural protectors of the land, reducing erosion, sequestering carbon, and fostering nutrient-rich soils that sustain long-term productivity. Cover crops ensure that agricultural systems remain adaptive, sustainable, and capable of supporting food security in the face of changing climate conditions.

Addresses

Vulnerabilities

17

Implementation Partners

MCSCWD, FSA, NRCS, Stormwater Program, all neighboring SWCDs

Effectiveness

Medium

Upfront Costs

\$

Evaluation Metrics

- Number of farms using cover crops
- The type of cover crops that are being used

Ongoing Costs

\$

Potential Actions

17.2.1 Encourage and educate farmers to use cover crops

17.2.2 Provide funding for farmers to use cover crops

17.2.3 Provide technical assistance on best practices for cover crops

Theme: Sustainable Agriculture

Strategy 17.5: Increase sustainable agricultural practices.



Increasing sustainable agricultural practices can build resilient food systems that adapt to climate challenges while preserving natural resources. Practices such as regenerative agriculture can reduce environmental impacts, enhance soil health, and conserve water. Sustainable practices ensure that the agricultural systems remain productive, sustainable, and capable of supporting growing populations in a changing climate.

Addresses

Vulnerabilities

17

Implementing Partners

MCSWCD, all neighboring SWCDs, all watershed groups, NRCS, ISDA, IDEM, IDNR - LRE

Effectiveness

Medium

Evaluation Metrics

- Participation by farmers of sustainable practices

Upfront Costs

\$\$

Ongoing Costs

\$

Potential Actions

17.5.1 Encourage farmers, ranchers, and growers to practice regenerative agriculture, install and maintain best management practices through education technical resources and funding.

Theme: Sustainable Agriculture**Strategy 19.1: Prevent food waste.**

Preventing food waste and educating the public on proper food storage practices can reduce greenhouse gas emissions, conserve resources, and enhance food security. Cultivating knowledge in the community about food storage techniques minimizes spoilage, extends shelf life of food, and encourages sustainable consumption habits. These efforts ensure food systems remain efficient, equitable, and capable of meeting the needs of present and future communities.

Addresses**Vulnerabilities**

19

Implementation Partners

Purdue Extension

Effectiveness

Medium

Upfront Costs

\$\$

Ongoing Costs

\$

Evaluation Metrics

- Participation in environmental programming

Potential Actions

19.1.1 Educate the public on proper food storage practices

Theme: Sustainable Agriculture**Strategy 19.2: Encourage personal connection to food sources.**

Fostering a personal connection to food sources through education and self-sustaining gardens can strengthen food security, promote healthier lifestyles, and reduce detrimental environmental impacts. Encouraging individuals to reconnect with the origin of their food empowers them to take active roles in creating resilient, localized food systems that support both environmental sustainability and community well-being.

Addresses**Vulnerabilities**

19

Implementation Partners

MCSWCD, Parks and Recreation

Effectiveness

Medium

Upfront Costs

\$\$

Ongoing Costs**Evaluation Metrics**

- Participation in programming

\$

Potential Actions

19.2.1 Develop a stronger educational awareness of the importance and need to reconnect with their food sources

19.2.2 Encourage personal, self-sustaining gardening practices

Implementation and Evaluation

Climate Ready Monroe County is a plan for building climate resilience. To realize this vision, the strategies and actions identified here need to be implemented, monitored, and revised as necessary.

To ensure a strong implementation process, there will be reliance on the Monroe County Commissioners to utilize an existing or appoint a new commission to oversee the implementation of these strategies in various departments. It is important to recognize that much of the work outlined in this plan falls on community groups, organizations, and partner agencies. Coordination and collaboration with these entities will be essential.

This plan will also be considered a ‘living document’ and will be re-evaluated and updated as needed in its implementation to change with current events and capacity of Monroe County.

Glossary

100-year flood zone – The land that is expected to be flooded due to a flood event that has a 1 in 100 chance of being equaled or exceeded in any given year.

Bathymetry – The measurement of depth of water in oceans, seas, or lakes. Bathymetry maps chart the underwater topographies of bodies of water.

Biodiversity – The overall number and types of species of plants and animals in a particular place or habitat.

Bioswales – Channels or other low-lying areas that use plant materials and soil mixes to treat, absorb, and convey stormwater runoff, as an alternative to storm sewers. They improve water quality by removing debris and pollution. They also provide landscaping that, depending on the plant species chosen, may create habitats for birds, butterflies, and local wildlife.

Brownfields – A property that may have soil or groundwater contamination.

Carbon Storage or Sequestration – The removal of carbon (CO₂) from the atmosphere to be stored elsewhere, especially in natural systems, such as trees, soils, and wetlands.

Clean energy – Energy used by people and businesses that doesn’t cause pollution. Includes electricity, transportation, buildings, and food systems.

Climate Change Adaptation – Actions that protect people or nature from, or prepare them for, the current and future impacts of climate change.

Climate Change Mitigation – Actions that reduce greenhouse gas emissions (primarily from fossil fuels combustion) or increase the storage of carbon (primarily in soils, forests, and other natural systems).

Climate Equity – Removing or addressing obstacles to climate resilience such as discrimination, poverty and their consequences.

Contaminant/toxin/pollutant – A substance that makes something less pure or makes it poisonous (contaminant); any substance poisonous to an organism (toxin); any substance, as certain chemicals or waste products, that renders the air, soil, water, or other natural resource harmful or unsuitable for a specific purpose (pollutant).

Ecosystem services – Represent the many and varied benefits of a healthy natural environment. They include the production of food and water, the control of climate and disease, nutrient cycles and oxygen production, and spiritual and recreational benefits.

Environmental Constraints Overlay (ECO) District - The character of the Environmental Constraints Overlay (ECO) District is defined as those areas of Monroe County, Indiana, that are within both the Monroe Reservoir and Lake Griffey watershed boundaries, as located by the Environmental Systems Applications Center, Indiana University, Bloomington, and the County Jurisdictional Area. The ECO District is divided into four areas based on topography and proximity to Monroe Reservoir and Lake Griffey and to stream beds that convey water to Monroe Reservoir and Lake Griffey.

Energy efficiency – The reduction of the amount of energy required to provide the same level of products and services.

Equity – Achieving the same level of opportunity based on variable levels of support and assistance depending on the difference in historical disparity and current need. Some types of equity of concern include racial, economic, social, and intergenerational.

Food Insecurity – An economic or social condition of limited or uncertain access to adequate food supply.

Fossil fuels – A group of energy sources that were formed when ancient plants and organisms were subject to intense heat and pressure over millions of years. There are three major types of fossil fuels: coal, oil, and natural gas.

Green Building design – The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation and deconstruction.

Green infrastructure – The use of natural and engineered ecological systems to provide specific services to the community, often in relation to stormwater management, but also including cooling, pollination, and filtration.

Green roofs – A roof of a building that is partially or completely covered with vegetation, planted over a waterproofing membrane, often with drainage and irrigation systems. Also sometimes called a ‘living roof’.

Greenhouse Gas (GHG) – A gas that absorbs infrared radiation (heat) in the atmosphere and contributes to climate change. Greenhouse gases include carbon dioxide, methane, water vapor, nitrous oxide, and others.

Habitat - The natural home or environment of an animal, plant, or other organism.

Impervious surfaces – Land surfaces that repel rainwater and do not permit it to infiltrate (soak into) the ground. Impervious surfaces are mainly artificial structures—such as pavements that are covered by water-resistant materials such as asphalt, concrete, brick, stone—and rooftops. Soils compacted by urban development are also highly impervious. (See “Pervious surfaces”).

Infill – Refers to developing vacant or under-used parcels within existing urban areas that are already largely developed. The slightly broader term “land-recycling” is sometimes used instead.

Infrastructure – Refers to the built environment such as buildings, energy generation and distribution systems, water delivery, storm- and wastewater, floodwalls, roads and highways, bridges, culverts, and many other basic structures.

Multi-modal transportation – Travel by multiple means of transportation, including biking, driving, taking a bus or subway, riding an electric scooter, etc. It is particularly relevant for people using public transportation because routes are usually not completely provided by one mode of transportation. For example, walking to catch a bus to a train station.

Natural Capital – The value of natural systems and the services that they provide for humanity, from the inherent value of biodiversity to the economic value of flood abatement, natural pest control, or tourism.

Passive Solar – Technology that uses sunlight without active mechanical systems. Such technologies convert sunlight into usable heat (in water, air, and thermal mass) with little use of other energy sources. This contrasts with active solar which converts sunlight into electricity.

Pervious surfaces – Surfaces that allow water to percolate through to the area underneath rather than becoming runoff (See “Impervious surfaces”).

Resilience – The ability of people and their communities to anticipate, accommodate and positively adapt to or thrive amidst changing climate conditions and hazard events.

Renewable energy – Energy produced from sources that do not deplete or can be replenished within a human’s lifetime. The most common examples include wind, solar, geothermal, biomass, and hydropower.

Riparian vegetation – The plants along the river margins and banks and are characterized by plants that like water.

Sustainability – A broad concept that refers to meeting the needs of the present without compromising the ability of future generations to meet their needs.

Urban Heat Island – The increase in temperature within an urban area as compared to the surrounding rural and naturally vegetated areas. This additional heat comes from heat-absorbing buildings, impervious surfaces, channelization of waterways, and the removal of canopy cover.

Vectors – An insect that transmits a disease is known as a vector, and the disease is referred to as a vector-borne disease. For example, Lyme disease transmitted by a deer tick.

Weatherization – Weatherization or weatherproofing is the practice of protecting a building and its interior from the elements, particularly from sunlight, precipitation, and wind, and of modifying a building to reduce energy consumption and optimize energy efficiency.

Acronyms

CRBRC – Climate Resiliency Blue Ribbon Commission

MCSWCD – Monroe County Soil and Water Conservation District

SWCD – Soil and Water Conservation District

DNR – Department of Natural Resources

IDEM – Indiana Department of Environmental Management

BECD – Bloomington Economic Development Corporation

DNR-LARE – Department of Natural Resources – Lake and River Enhancement

NRCS – Natural Resources Conservation Services

MC-IRIS – Monroe County – Identify and Reduce Invasive Species

MS4 – Municipal Separate Sewer System

GHG – Green House Gasses

CAP – Climate Action Plan

GCM – Global Climate Models

EPA – Environmental Protection Agency

REMC – Rural Electric Member-Owned Cooperative

USACE – United States Army Corps of Engineers

Appendix I: Climate Change Trends Primer

Climate change is a global problem, yet the impacts and opportunities for action are local. As climate change accelerates with continued greenhouse gas emissions, local communities will need to be prepared for impacts and take action to protect the people and the natural resources they depend on. In Monroe County, residents report changes in severe storms, extreme events like heat waves, timing of the seasons, water availability, plants, and wildlife. All these changes can affect peoples' health, culture, and livelihoods. Local infrastructure such as roads and bridges are also at risk from severe heat, storms, and flooding. Many changes are already occurring, and many more are expected to occur in the future.

If global action to greatly reduce greenhouse gas emissions is explored now, the long-term severity of climate change will be reduced and local strategies to adapt will be more successful. In the near term, because of long-lasting greenhouse gases already emitted, drastic change will continue over the next few decades. Local action and planning to reduce the impacts of climate change are needed.

This climate change primer provides information on the expected trends and impacts specific to Monroe County (Figure A1-1). Understanding climate change trends and impacts is the first step in identifying climate related risks and vulnerabilities. The next step will be to develop strategies that build overall resilience for both the people and natural resources of the region.

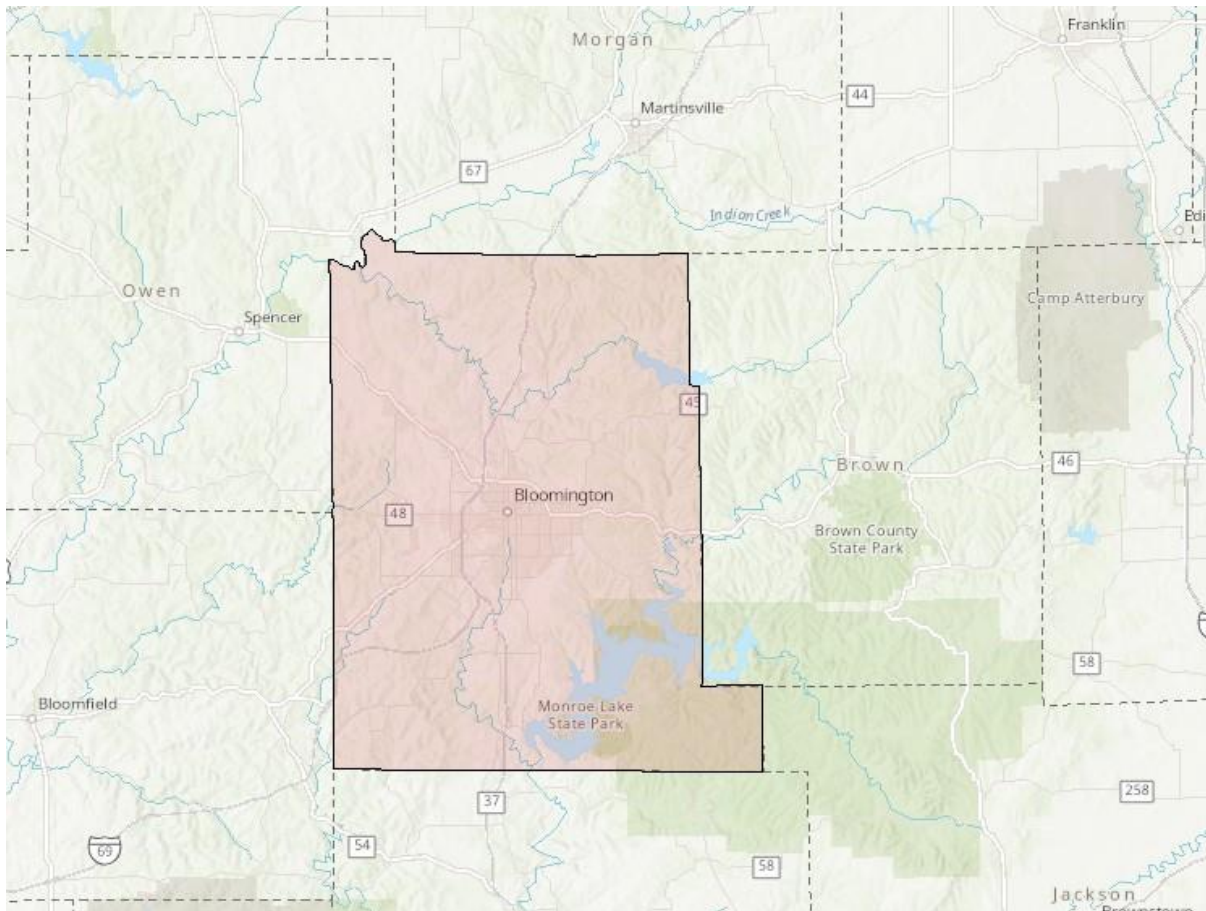


Figure A1-1: Map of project boundaries

Climate change data and models

The Earth's climate is regulated by a layer of gases commonly referred to as greenhouse gases for their role in trapping heat and keeping the earth at a livable temperature. These gases include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and water vapor (H₂O). CO₂ plays an especially large role due to its long-lasting nature and amount compared to other gases. The atmospheric concentration of CO₂ has risen from 280 to more than 415 parts per million (ppm) (*Climate Change: Atmospheric Carbon Dioxide*, 2022) in the past century, driven largely by the burning of fossil fuel, deforestation, and other human activity.

Information from ice cores allows us a glimpse into CO₂ levels over hundreds of thousands of years. This data shows us that CO₂ has fluctuated between about 175 and 300 ppm over the last 800,000 years and the current level is far above anything detected in that time period. As CO₂ levels changed in the past, changes in temperature tracked closely and we can expect this relationship to hold in the future as CO₂ and other greenhouse gases continue to increase.

For over a century, we have known that increases in the concentration of greenhouse gases in the atmosphere result in warmer temperatures. Long-term tracking data from weather stations and other research support this expected trend. Traditional knowledge from indigenous

communities around the globe also indicates that there has been substantial change in conditions over time, especially since the end of the last ice age.

To look at projected future climate, we use computer models based on our understanding of the Earth's climate. The Intergovernmental Panel on Climate Change (IPCC), which is made up of thousands of leading scientists from around the world, has created a suite of 25+ global climate models (GCMs) from different institutions with which to predict future trends.

The IPCC models were created independently and vary substantially in their output. Yet most of the uncertainty in future conditions comes not from the models themselves, but from estimating how much action will be taken to reduce greenhouse gas emissions in the future. The different possible greenhouse gas concentrations (called Regional Concentration Pathways, or RCPs), depend on whether the international community cooperates on reducing emissions.

In this report, we provide projections based on a lower emissions pathway where emissions are greatly reduced (RCP 4.5) and a higher emissions pathway where emissions are only slightly reduced (RCP 8.5) and that is similar to the current global trajectory.

A note about uncertainty

All models have uncertainty because complex processes are simplified, and assumptions are made about how the Earth's processes work. Therefore, different models show different trends in future climate. How much they agree or disagree with each other gives us information about uncertainty. The uncertainty is similar to other types of models that we use every day to make decisions about the future, including economic models, population growth models, and ecological system models.

Much of the data on future trends in this report are compiled from an "ensemble" or average across many GCMs, which have been adjusted or "downscaled" from the global scale (coarse) to local scales (fine) using climatological data that reflects variation across the local landscape. When ensembles are used, it is important to understand the range of variation among the different models, as it can be quite great. In general, precipitation projections are associated with higher uncertainty (more variation among models) while temperature projections are associated with lower uncertainty (more agreement among models). Also, short to medium-term projections have lower uncertainty than long-term projections.

Past and Future Trends in Indiana

Temperature

Since 1895, Indiana has seen an average temperature increase of approximately 1.2° F, or an average of 0.1° F per decade. However, since 1960, the average temperature increase is approximately 0.4° F, showing an increase in climate change’s effects over time. By 2050, temperatures are projected to increase between 5-6° F under the medium and high emissions scenarios, respectively. By the end of the century, average temperatures are expected to be 6 to 10° F higher than the historical average (Widhalm et al., 2018).

Similarly, maximum temperatures have increased decade-on-decade as well, with a marked increase from 1960 to present. Maximum temperatures from 1960 to 2016 have increased by an average of 0.3° F per decade; from 1895 to 2016, maximum winter and spring temperatures have increased by an average of 0.1° F per decade.

Extreme cold days (where the minimum temperature was below 5° F) and frost days have decreased from 1960 to 2016 by 8 and 9 days respectively. The northern third of Indiana is expected to experience the most significant increase, from an average of 13 per year to only six by 2050.

While there has not been an increase in extreme heat days (defined as days where the maximum temperature is over 95° F) from 1960 to 2016, they are projected to increase significantly in the future, from seven per year (present) to between 38 to 51 days per year.

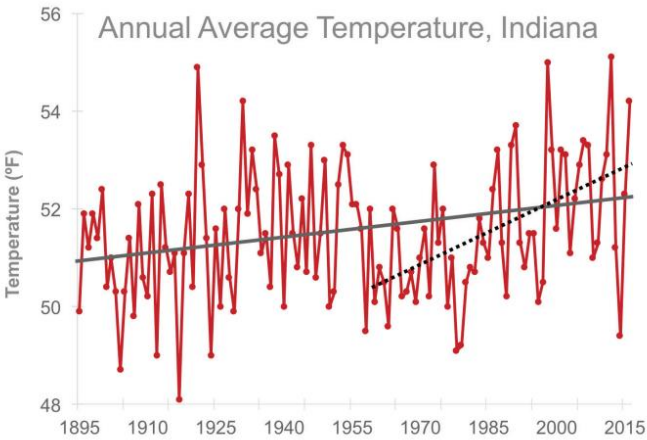


Figure A1-2. Statewide annual average temperature for Indiana from 1895 to 2016 is shown in red. The black solid line shows the increasing trend in annual temperature (0.1°F/decade) for the period from 1895 to 2016. The black dotted line shows the temperature trend since 1960 (0.4°F/decade). Image from Widhalm et al. (2018).

Indiana Temperature Trends (1895 to 2016)

Variable	Winter	Spring	Summer	Fall	Annual
Tmax	0.1°F	0.1°F	- 1°F	0°F	0°F
Tavg	0.1°F	0.2°F	0°F	0.1°F	0.1°F
Tmin	0.2°F	0.2°F	0.1°F	0.1°F	0.2°F

Units = °F per decade

Indiana Temperature Trends (1960 to 2016)

Variable	Winter	Spring	Summer	Fall	Annual
Tmax	0.5°F	0.6°F	0.1°F	0.2°F	0.3°F
Tavg	0.7°F	0.5°F	0.3°F	0.2°F	0.4°F
Tmin	0.8°F	0.5°F	0.5°F	0.3°F	0.5°F

Units = °F per decade

Figure A1-3. Annual and seasonal temperature trends for Indiana from 1895 to 2016 (top) and from 1960 to 2016 (bottom). Both tables show maximum temperature (Tmax), average temperature (Tavg), and minimum temperature (Tmin). Image from Widhalm et al. (2018).

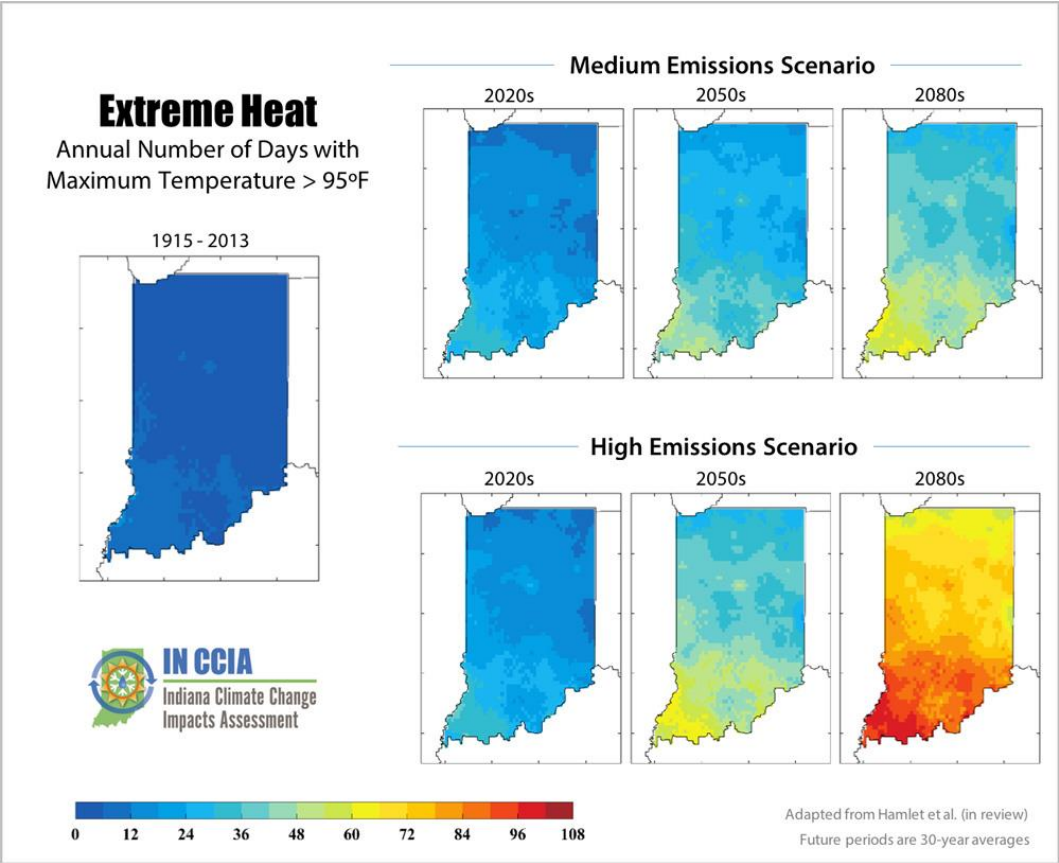


Figure A1-4. Maps showing the annual number of extreme heat days (maximum temperatures above 95°F). Image from Purdue University (n.d.).

Indiana’s frost-free season has increased by nine days since 1895. By the middle of the century, the number of frost-free days is projected to increase by between 3.5 and 4.5 weeks.

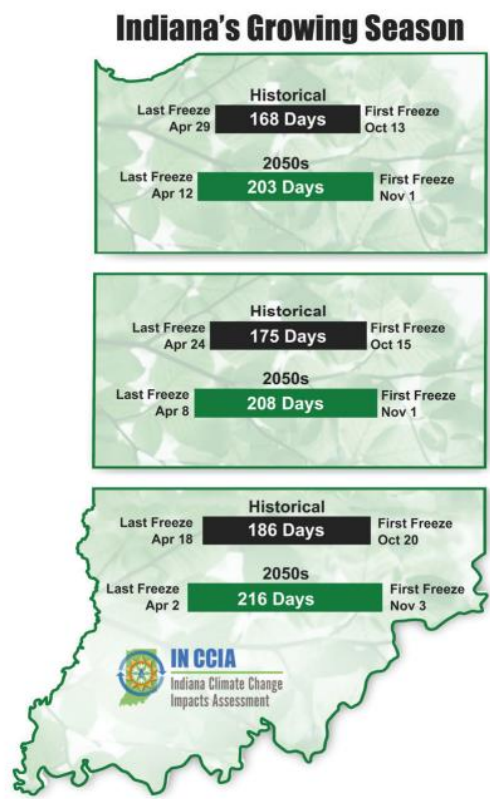


Figure A1-7. Figure A1-5. Growing season length and average first/last freeze dates for northern, central, and southern Indiana. “Historical” is the average for the period 1915 to 2013. For future projections, “2050s” represents the average of the 30-year period from 2041 to 2070 for the high emissions scenario. Image from Widhalm et al. (2018).

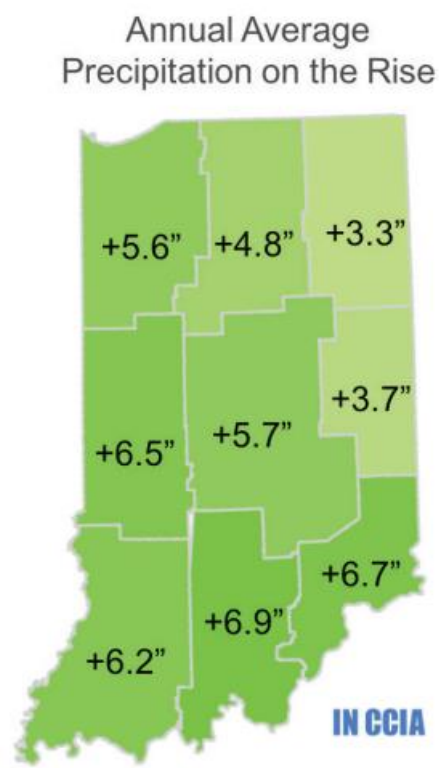


Figure A1-8. Figure A1-6. Increase in annual precipitation for Indiana’s nine climate divisions, based on a linear trend, from 1985 to 2016. Image from Widhalm et al. (2018).

Past and Future Trends in Monroe County
Temperature

Historical Analysis - Spanning three decades from 1976 to 2005, the peak recorded temperature in Monroe County was determined to be 96.8 °F (Fig. A1-10). The minimum annual average temperature throughout this time frame was 43.4 °F. The yearly average

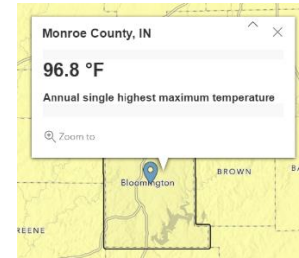
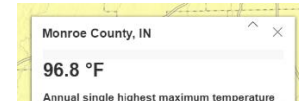


Figure A1-10.



temperature during the same period has increased at a rate of 0.5 °F/decade (Fig. A1-11).

Future Projections - The peak annual temperature in Monroe County is

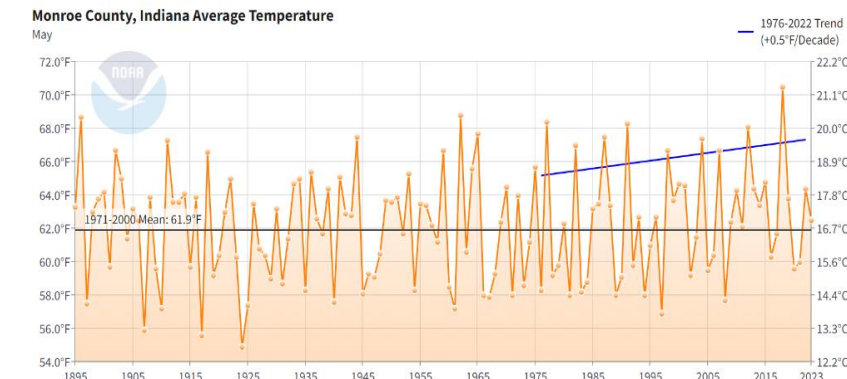


Figure A1-11.

projected to rise incrementally by one °F per decade under a low emissions scenario. This incremental increase could result in a peak temperature of 102.1 °F by mid-century. Comparatively, under a high emissions scenario, the temperature rise could be as high as 6.8 °F by mid-century, leading to a peak temperature of 103.6 °F. Similarly, the temperature by the end of the century could escalate to 103.7 °F under a lower emission scenario and to an alarming 109.1°F under a higher emission projection.

Extreme Events: Extreme Heat -

The number of extremely hot days, with temperatures exceeding 95 °F, is forecasted to increase. Historically, the average has been 3.1 days per year, but future projections predict 28.2 days by mid-century and 61.6 days by the end of the century under the current emission scenario (RCP 8.5). While under a lower emissions scenario (RCP 4.5), there could be 20.1 days and 28.3 days of extreme heat index by the mid-century and end of the century, respectively.

Similarly, the number of days where the heat index would cross 100 °F and even 105 °F are also

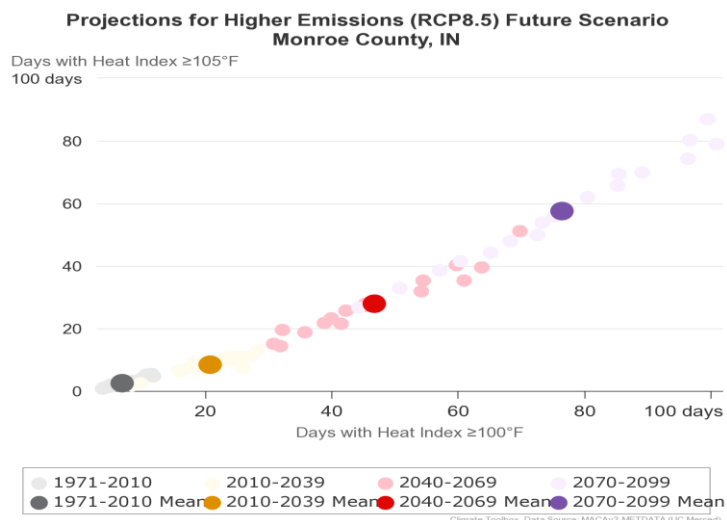


Figure A1-9. Historical and projected days with heat index ≥ 100 °F (x-axis) and days with heat index ≥ 105 °F (y-axis). Source: Climatetoolbox.org

like to increase well beyond current and historical levels under the present emissions scenario (Fig. A1-9).

These soaring temperatures could have numerous adverse effects, including degraded air quality, lengthened allergy seasons, and more conducive conditions for pests and invasive species. According to the National Weather Service, on average, excessive heat kills more Americans each year than all other single weather-related occurrences combined. It is important to note that children, seniors over 65, expectant women, and persons with pre-existing diseases like diabetes, heart disease, or respiratory problems are most at risk. Similarly, people without homes, those living in low-income areas, people living at intersectionality, and those who perform outside jobs, first responders, and athletes are more vulnerable to extreme heat hazards.

Extreme Cold - The number of cold days is expected to decline. Historical data recorded approximately 23 days annually with maximum temperature below 32 °F. However, under the present emissions scenario, this number could reduce to 12.1 days by mid-century and 6 days by late-century. A more optimistic prediction anticipates 13.7 days by mid-century and 11.5 days by the end of the century if emissions are reduced. It's critical to note that colder weather helps suppress disease-bearing insects like mosquitoes, and a decrease in cold days could allow these insects to remain active for longer durations, possibly leading to an increased number of fatalities due to extreme heat (Fig. A1-10).

Moreover, an essential variable power utilities use to estimate energy demand for cooling buildings is the cooling degree days (CDD). CDD can be described as an index that is used to estimate the amount energy expended during the warm season (purdue.edu). Based on the existing emission scenario, the average cooling degree days are expected to increase by 767.7 days by mid-century and 1,525 days by late-century. This exponential increase in the CDD would mean higher demand for energy, and the low-income or marginalized, financially challenged families and communities will be further burdened as a result of the increased cost of living (Fig. A1-11).

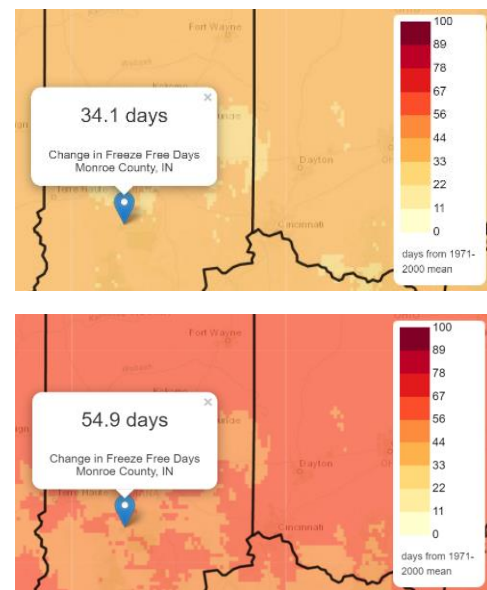


Figure A1-10. Increase in annual freeze-free days. The top image shows the change by mid-century while the bottom image shows the increase by late-century (RCP 8.5).

Source: Climatetoolbox.org

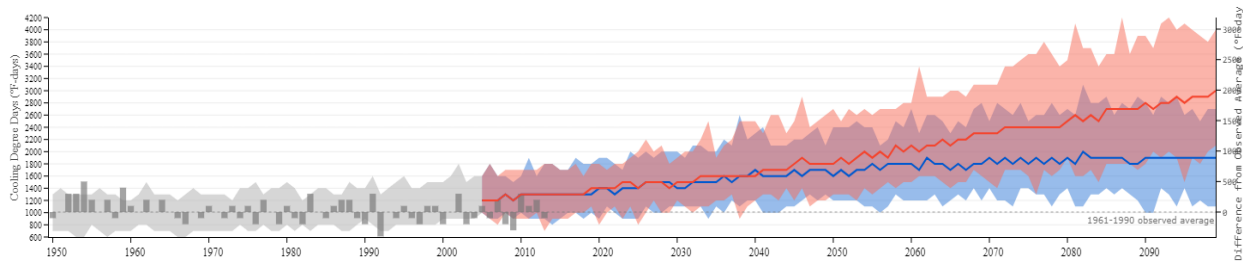


Figure A1-11. Historical and projected cooling degree days for Monroe County. Red line (RCP 8.5) Blue line (RCP 4.5). Source: Climate Explorer

Precipitation

Historical Analysis – Over the last century, Monroe County has witnessed an increase of 6.69 inches in total annual precipitation, translating to a rise of 0.669 inches per decade (Fig. A1-12). In addition to this overall increase in annual precipitation, there has been a notable shift in the intensity of rainfall events. Specifically, since 1980, the frequency of heavy downpours and severe storms has seen a marked increase. This suggests a pattern of more extreme rainfall events, a trend that aligns with the broader effects of climate change (Fig. A1-13).

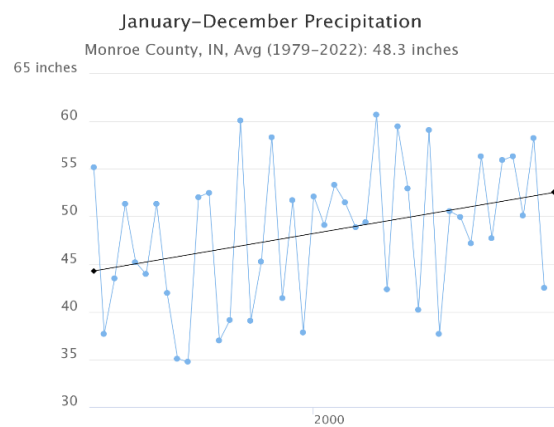
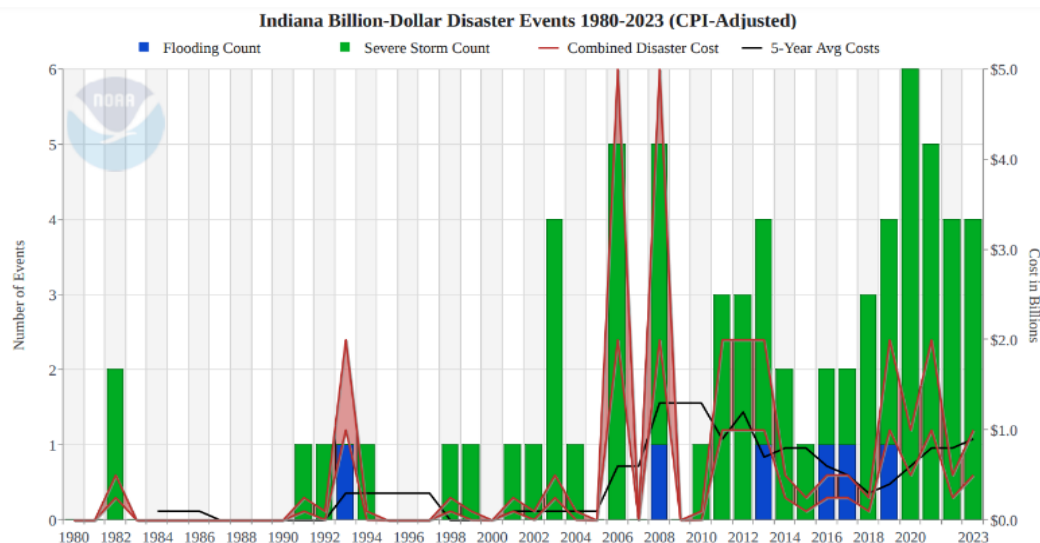


Figure A1-12. The average annual precipitation in Monroe County from 1979 to 2022. Source: Climatetoolbox.org

Figure A1-13. NOAA's Billion-Dollar Weather and Climate Disasters shows the frequency in Indiana's flooding and severe storms events and associated costs.



Future Projections – Monroe County will experience an increase in average annual precipitation in the future (Fig. A1-17). Under the current emissions conditions, the average yearly precipitation is projected to increase by 2.7 inches by mid-century, while by the end of the century, the increased precipitation is projected to be 3.5 inches, compared to the 1990s average of 47 inches. On a percentage basis, the average annual precipitation is expected to increase by 5.8% and 7.4% for the mid and late centuries, respectively.

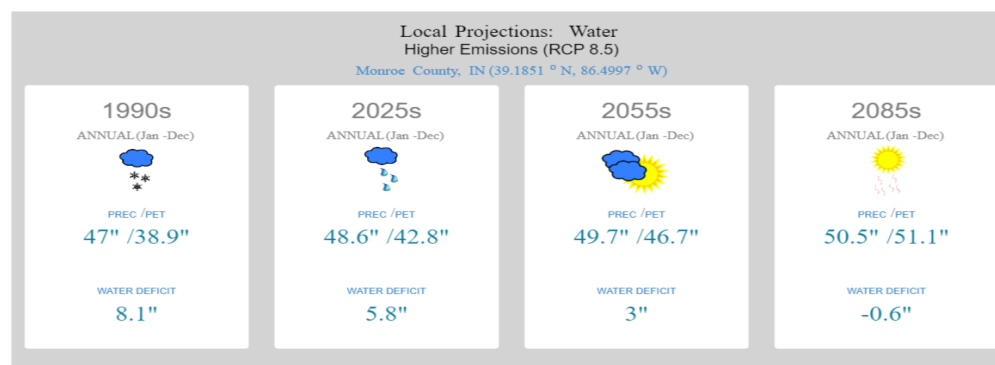


Figure A1-17. Historical, current, and future precipitation and potential evapotranspiration statistics. Source: [Climatetoolbox.org](https://climatemodels.org/)

The distribution of rainfall across the seasons will also alter in the future. For Monroe County, the precipitation projections for winter, spring, and fall indicate an upward trend in the amount of rainfall received, while the summer months will likely experience a decrease. Under the low emissions scenario, the projected increases for mid-century are 6.5% (winter), 11.3% (spring), and 5% (fall). The high emissions scenario projections for these same seasons are 8.6%, 13.1%, and 5%, respectively. Similar patterns are projected for the end of the century, with the low emissions scenario figures being 6.8%, 10.1%, and 3.5% and the high emissions scenario figures being 12.8%, 16.2%, and 5.8% (Fig A1-18).

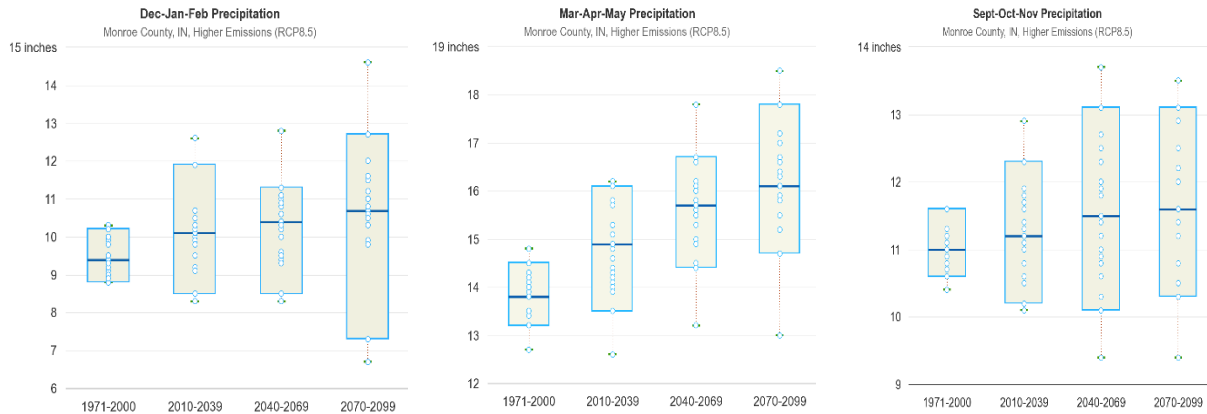


Figure A1-18. (Left to right) Winter, Spring and Fall precipitation projections under the current emission scenario (RCP 8.5). Source: Climatetoolbox.org

Conversely, the average precipitation for the summer season is projected to decrease under both low and high emissions scenarios. The projected decrease for mid-century under the low emissions scenario is 0.6%, while under the high emissions scenario, it is 3.8%. By the end of the century, the decrease under the low emissions scenario could reach 2.9%, and under the high emissions scenario, it could fall to 4.9%. The decrease in precipitation during summer coupled

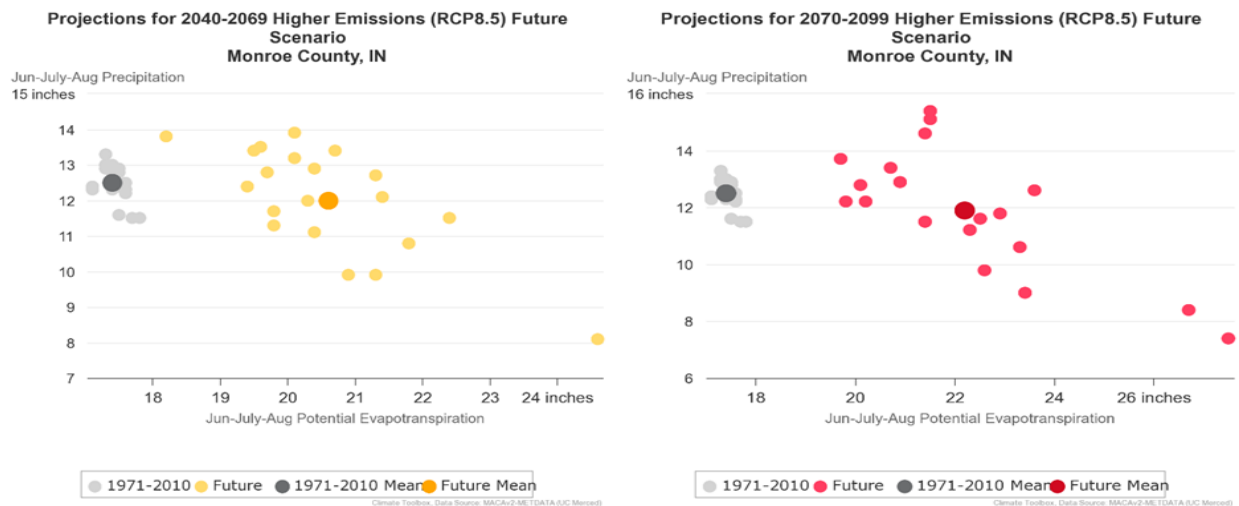


Figure A1-19. Climate toolbox future scatter tool projects a decrease in average precipitation and increase in evapotranspiration during summers for mid-century and late century. Source: Climatetoolbox.org

with heightened potential evapotranspiration will escalate the possibilities of droughts and wild fires.

The precipitation fluctuations in the future have several, possibly disruptive effects for Monroe County. Increased heavy downpours events raise the risk of flooding, and lead to sewer system overflows, contaminating local water bodies with sewage. More rain in the winter and spring would result in fertilizer and sediment runoff from fallow farm fields, which would have a

negative effect on the quality of the water downstream and lower crop yields during the growing season. Increases in springtime precipitation could make it more difficult to grow early-season crops because flooded fields might be inaccessible to large farm equipment. The anticipated decrease in summer precipitation and increased heat may exacerbate crop water stress, posing serious threats to agricultural productivity.

Vegetation, Wildfire and Crop Suitability

Historical Analysis – Historically, Monroe County has been characterized by Temperate deciduous broadleaf forests, which adapt well to the area's four-season climate (Fig. A1-20). In autumn, trees change color and shed their leaves to prepare for winter, entering a dormant phase. With spring's arrival, trees emerge from dormancy and grow new foliage and flowers, continuing into summer. This cycle has supported the local ecosystem and added to the region's scenic beauty.



Figure A1-20. Historical dominant vegetation type. Source: Climatetoolbox.org

Future Projections – Over the past few decades, climate change, induced mainly by human activities, has led to shifts in vegetation patterns in many regions globally, including Monroe County, Indiana. The change from Temperate deciduous broadleaf forests to cool mixed forests can largely be attributed to the rise in average temperatures, changes in precipitation patterns, and increased frequency of extreme weather events (Fig. A1-21). Rising temperatures allow for the expansion of cool mixed forests into areas previously dominated by deciduous broadleaf species. This transition is also influenced by altered precipitation patterns, where some species may have an advantage over others depending on their ability to withstand different moisture conditions. The dominant vegetation type is projected to remain a cool mixed forest until mid-

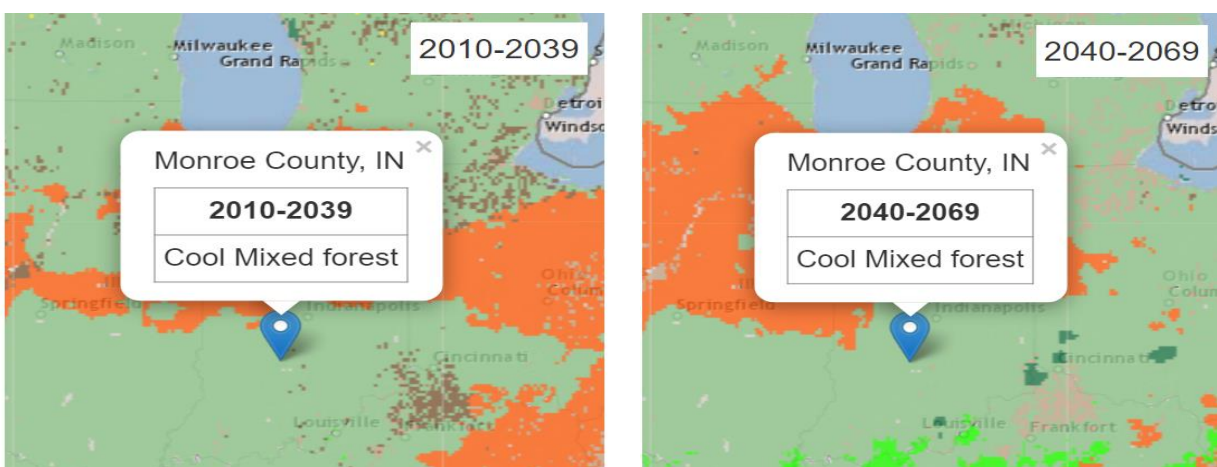


Figure A1-18. (Image on the left) Present vegetation type shows a change from deciduous forest to cool mixed forest. (Image on the right). Mid-century projected vegetation type to remain cool mixed forest under the current emission scenario (RCP century under the current emission scenario (Fig. A1-21).

Changes in Modeled Vegetation Type (Without Fire Suppression)
Monroe County, IN

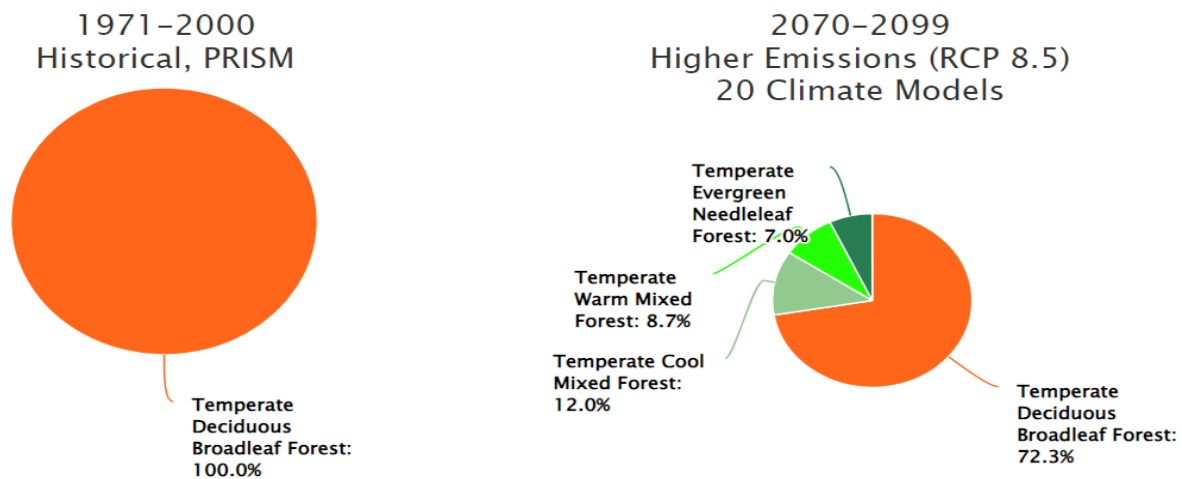


Figure A1-21. Historical dominant vegetation type. Source: Climatetoolbox.org

By the late 21st century, it's projected that Monroe County will transition from a predominantly temperate deciduous to a combination of temperate cool, warm, and evergreen needle leaf due to the ongoing emissions (Fig. A1-21). This shift would make the county resemble areas such as the Piedmont region in the Southeastern United States. The changes in forest composition can significantly impact Monroe County's local climate. For example, mixed forests tend to absorb more sunlight and release more water vapor than deciduous forests, potentially increasing local temperatures and humidity. Moreover, it would bring changes to local biodiversity, potentially altering wildlife habitats due to differing tree species preferences. Economically, this could affect local industries, including timber and tourism, requiring them to adapt to the new forest composition. The introduction of evergreen needle-leaf trees could increase wildfire risks due to their high resin content, especially amidst predictions of more extreme weather events. The anticipated conditions could further dry out the resin-rich vegetation, increasing wildfire prospects. One such factor is the Vapor Pressure Deficit (VPD), which measures the difference between the actual and the maximum possible amount of moisture in the air. Under current emissions, the VPD is expected to increase to 0.9 kilopascals (kPa) by mid-century and 1 kPa by late-century from a historical value of 0.6 kPa. Similarly, a decreasing trend in annual 100-hour fuel moisture (the moisture content in medium-sized dead fuels, 1 to 3 inches in diameter) will elevate the days of high fire danger days (Fig. A1-22).

Based on these projected conditions, Monroe County would likely see an uptick in wildfire danger days. With reduced greenhouse gas emissions (RCP 4.5), we can expect to see 'high' fire danger days in Monroe County rise to 91.7 days annually by the mid-century. However, in a scenario of unabated emissions, this number is predicted to surge to 104.4 days. The 'extreme' fire danger days are

expected to experience an upswing by 5.5 days from historical averages under the reduced emissions scenario, tallying 16.5 days. But in the scenario with continued high emissions, these 'extreme' days are anticipated to swell dramatically, amounting to 24.6 days (Fig. A1-23).

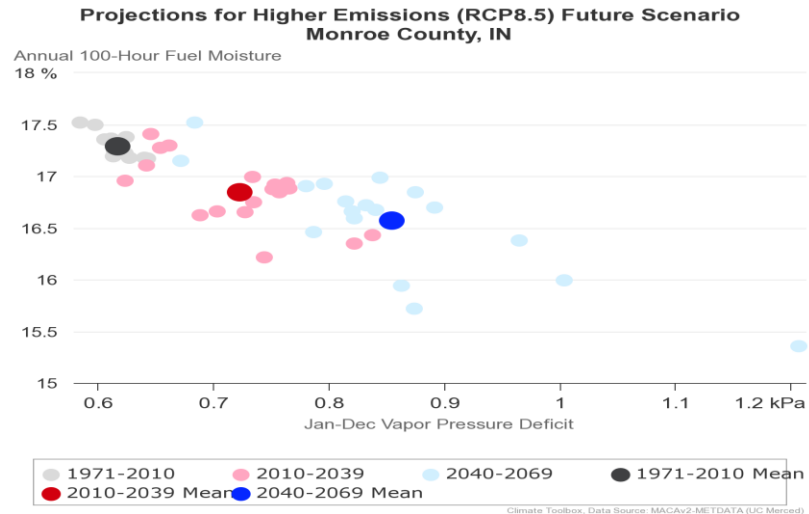


Figure A1-22. Historical, present, and future annual 100-hour fuel moisture and vapor pressure deficit values. Source: Climatetoolbox.org

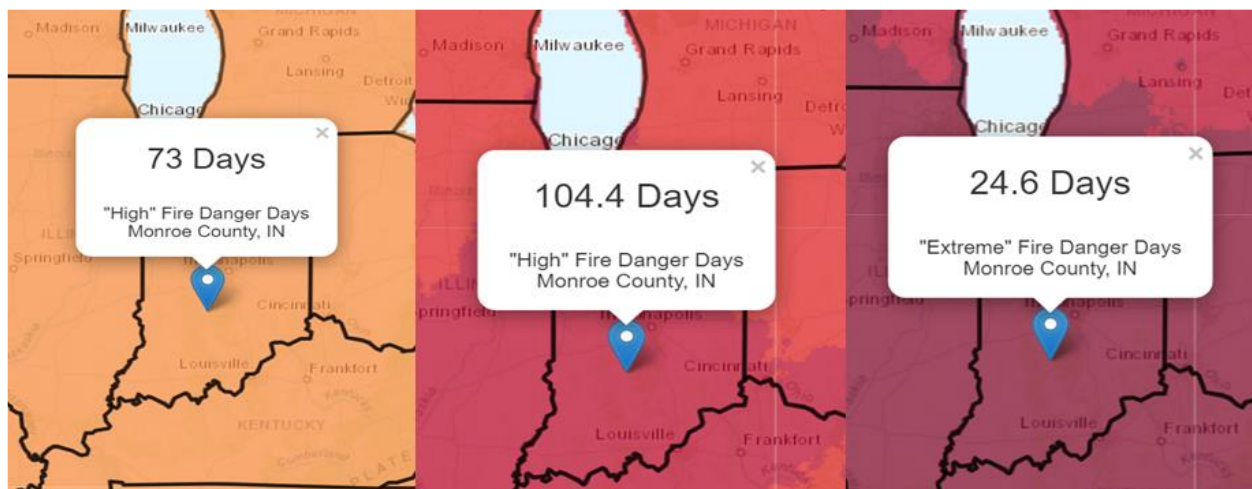


Figure A1-23. (Left to right) Historical “high” fire danger days, mid-century “High” fire danger days and mid-century “Extreme” fire danger days under the current emission scenario (RCP 8.5). Source: Climatetoolbox.org

As temperatures rise, Monroe County could face significant agricultural challenges. Crops such as corn, soybeans, and wheat might experience added stress, potentially impacting productivity. Further, the increased heat contributes to the production of ground-level ozone, a key ingredient in smog, posing a threat to air quality. This could have severe implications for those suffering from respiratory illnesses such as asthma, potentially escalating healthcare costs and mortality rates whilst impacting the growth of crops.

The extended warmth has already started affecting the county's growing season. On average, the frost-free season, when temperatures consistently stay above 32°F, has been elongated by 15 days compared to the annual historical (1971-2000) average. This trend is set to continue, with a possibility of an even more substantial lengthening of the growing season, as shown in Fig. A1-12.

Under the high emissions scenarios, projections for the county indicate an increase in growing season length days per year. From a historical average of 190.5, the length of the growing season has increased to 203.1 days annually. By mid-century, this value is projected to reach 223.9 days under the current emissions scenario. This extended period offers opportunities for more varied crop cultivation or even double-cropping. However, it could also inadvertently extend the allergy season. By the late century, the growing season length would be extended to 231.9 days (Fig. A1-24) (Hegewisch, Krosby, 2023).

The bird species migrating based on temperature or daylight patterns may face challenges as changes in climate could shift the availability of their food sources.

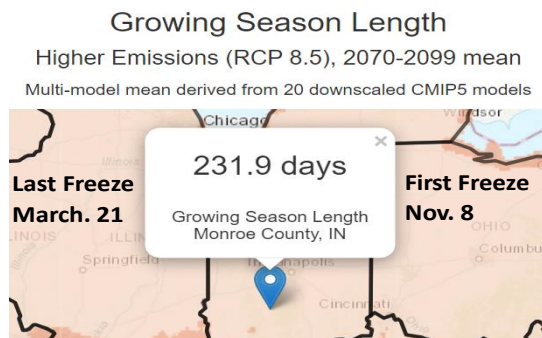
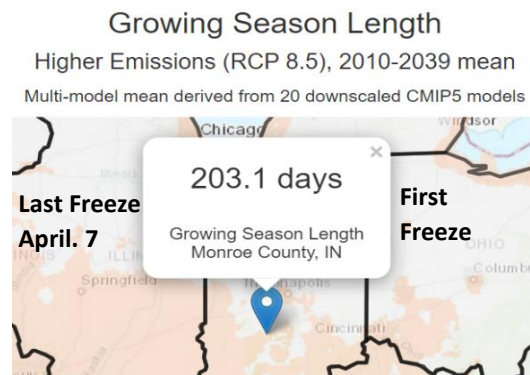


Figure A1-24. Historical, present and projected length of growing season with corresponding dates of first fall and last spring freeze. Source: climatetoolbox.org

Warmer winters would also affect the variety of plant species that can survive in Monroe County. Over the 30 years 1971-2000, as per the U.S. Department of Agriculture cold hardiness zones, Monroe County was classified under zone 6a (Fig. A1-25). By the mid-century, the county's hardiness zone (6b) would mimic the present North-west Kentucky region (Fig. A1-26). Around the turn of the century, under a high emissions scenario, Monroe County's plant hardiness could resemble that of central Tennessee (zone 7b) today, according to the USDA Plant Hardiness Zones (Fig. A1-27)

As the cold hardiness zone in Monroe County transitions from 6a to 7a and possibly to 7b, local farmers and growers will need to adapt to new agricultural challenges and opportunities. This

shift may require changes in crop selection, planting schedules, and pest management strategies.

Monroe County Lake

The effects of climate change on Monroe

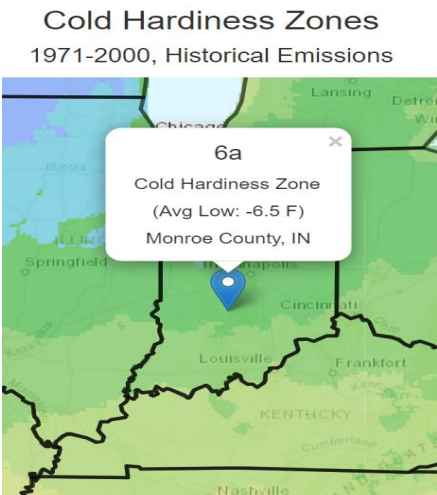


Figure A1-25. Historical plant hardiness zone, 6a, of Monroe County resembled that of present-day north Illinois. Source: climatetoolbox.org



Figure A1-26. Projected mid-century plant hardiness zone, 7a, of Monroe County would resemble that of present-day North-west Kentucky. Source: climatetoolbox.org

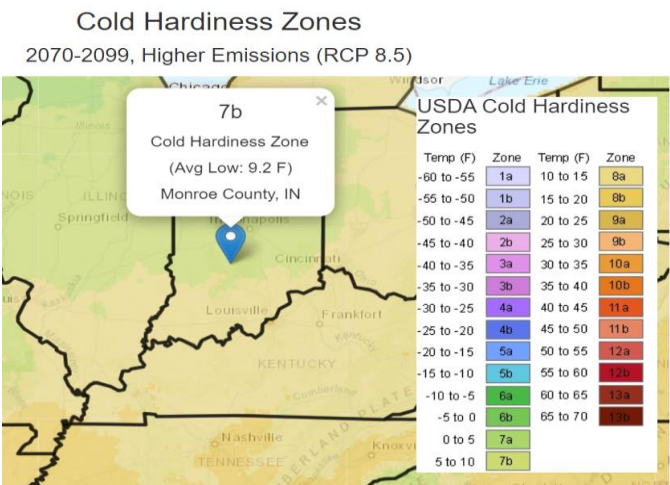


Figure A1-27. Projected late-century plant hardiness zone, 7b, would resemble that of present-day central Tennessee. Source: climatetoolbox.org

County's lake (Fig. A1-28) ecosystem could be multi-faceted and profound. Increased temperatures might contribute to higher water evaporation rates, potentially decreasing lake water volumes and heating the water, causing stress to native aquatic species. Warmer water holds less oxygen, which can negatively affect fish populations and other aquatic organisms, decreasing biodiversity.

Fluctuations in precipitation patterns could lead to either increased runoff during heavy rainfall or water scarcity during drought conditions. More significant runoff may carry more pollutants, such as agricultural fertilizers or urban waste, into the lake, potentially triggering harmful algal blooms that further reduce oxygen levels in the water. On the other hand, periods of reduced rainfall could exacerbate water volume decrease and concentration of pollutants. Changes in the county's vegetation due to the changing climate could impact the lake environment as well. As the types of plants surrounding the lake change, this could alter the habitats of terrestrial wildlife that rely on the lake for sustenance. Furthermore, the shift from deciduous to evergreen trees could potentially modify the lake's nutrient cycle as the types of leaf litter that enter the water change, affecting water quality and the aquatic food web.



Lake Monroe in the Summer | Photo by americanbeautiful.com

Appendix 2: Community Trends

Introduction

Monroe County, Indiana, named in 1818 after President James Monroe and encompassing a land area of 394.52 square miles, is renowned for being home to the vibrant Indiana University Bloomington and its picturesque landscapes, such as Lake Monroe. Consistently garnering attention as an outstanding place to reside, it ranks as the second-best county to live in Indiana (Niche, 2023) due to the unique blend of academia, rich cultural events, and natural beauty that creates a dynamic community spirit in the county. However, emerging challenges, including climate change, urban expansion, and demographic shifts, threaten to alter its distinctive character. As Monroe County embarks on crafting a Climate Resilience Plan, there is a pressing need to identify and counteract vulnerabilities for the benefit of the County and those that reside in it. By grasping this understanding, we can better identify potential vulnerabilities in the face of climate change and other challenges. Embracing Whole Community Resilience is imperative, acknowledging that every segment of the population and the natural world is interlinked and must be considered in our adaptive measures to avoid inadvertently harming marginalized groups or ecosystems.

Demographics

Population, Ethnic and Racial Makeup, Languages, Age, Households, Education, Income and Disabilities

Monroe County's population according to the U.S. Census stands at 139,342 making up just 2% of the population of the State of Indiana, which stands at 6,862,199. There was a growth of approximately 15.7% from 2000 to 2020. Nestled in the heart of Indiana is the vibrant city of Bloomington. Best known as the residence of Indiana University, Bloomington boasts a population of 78,840 (census.gov, 2023). Given its myriad amenities and services, Bloomington naturally acts as a magnet, drawing residents from surrounding counties for employment, shopping, and recreational activities.

A stone's throw from downtown Bloomington is the sprawling campus of Indiana University, a revered institution of the Big 10 Conference. Records from the university reveal that in the fall of 2021, it had an impressive enrollment of 45,328 students, marking a 5% rise from the previous year. A look at student accommodation preferences in 2020 indicates that while 35% of students opted for on-campus living, a significant 65% lived off-campus (U.S. News, 2023). This massive influx of students inherently contributes to the demographic tapestry of Monroe County, rendering them more culturally diverse than many neighboring regions.

Beyond Bloomington, Ellettsville emerges as the third most populous area in Monroe County, housing 6,657 residents according to the 2022 census. This quaint town is situated approximately 8 miles from Bloomington. Further northwest, about 15 miles from Bloomington, lies the town

of Stinesville, with a population of 202 (census.gov, 2023). Additionally, Monroe County is dotted with 30 unincorporated communities, each adding to its unique character.

The racial and ethnic composition is diverse, with 82.5% identifying as White, 6.9% as Asian, 4.1% as Hispanic or Latino, 2.9% as two or more races, 3.9% as Black or African American, 0.3% as American Indian or Alaska Native, and 0.1% as Native Hawaiian or Pacific Islander (Fig. A2-1). Beyond English, the predominant language spoken at home by the foreign-born population is an

Monroe County Racial and Ethnic Makeup

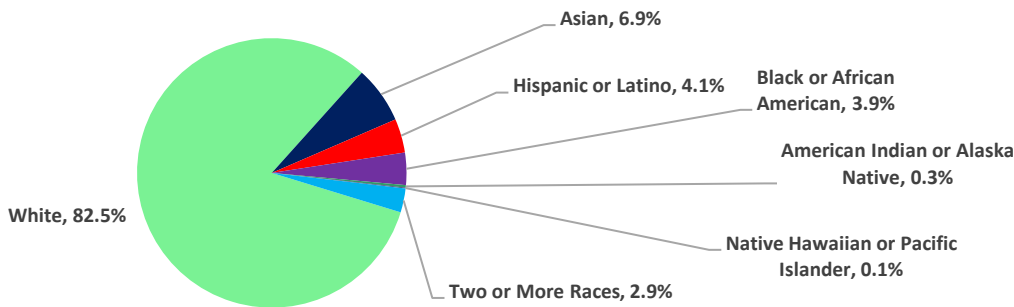


Figure: A2-1. U.S. Census Bureau, QuickFacts, Monroe County, Indiana

Language Spoken at Home Among Foreign-Born

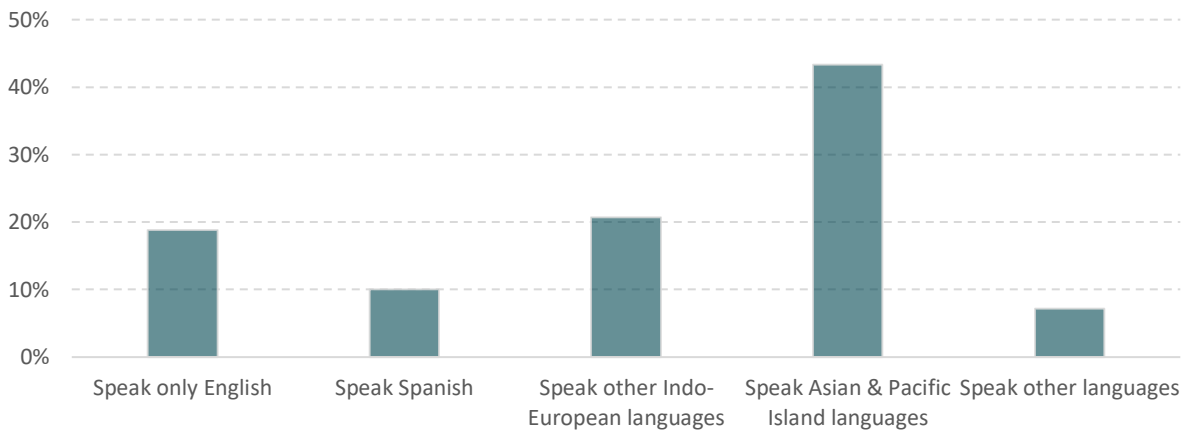


Figure: A2-2. U.S. Census Bureau American Community Survey (ACS), 5-year estimates, Table B16005

Asian and/or Pacific Island language (43%), trailed by Indo-European languages, 21% (Fig. A2-2). This contrasts with the national trend where Spanish is the primary non-English language spoken at home, followed by Asian and/or Pacific Island languages. Approximately 3.16% of individuals who speak a language other than English at home are assessed as having an English proficiency less than "very well."

The demographic structure showcases a senior population aged 65 and above at 14.8% and a youth population under 18 years of age at 15.6%, and in terms of gender distribution, 51.4% identify as female. Per the 2021 US Census statistics, there are 57,160 households in Monroe County. The breakdown of household types is as follows: single adults residing alone make up the majority at 33.1%, next are married adults without children at 25.3%, followed by married couples with kids at 13.3%, and single-parent households at 6.7% (Fig. A2-3) (census.gov, 2023).

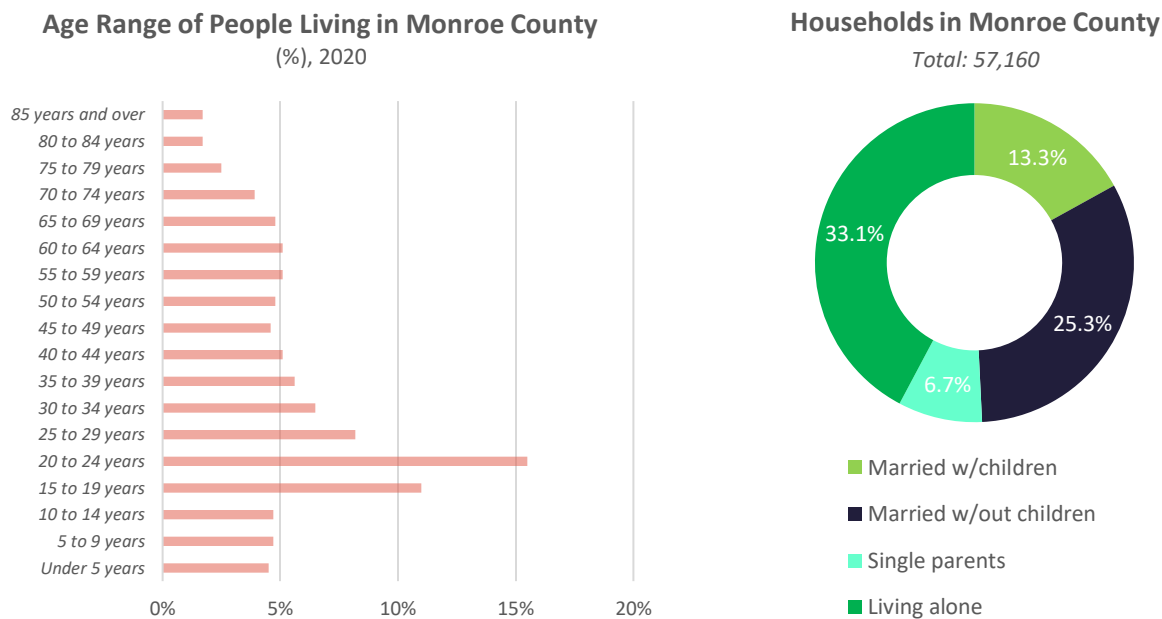


Figure: A2-3. Age range of people living in Monroe County and breakdown of household types in Monroe County. U.S. Census Bureau, Decennial Census, Table DP1

Monroe County is distinguished by its robust educational landscape, anchored by the state's premier institution, Indiana University Bloomington, and complemented by an Ivy Tech Community College branch. This academic presence elevates Monroe County's educational statistics. Among 81,338 residents aged 25 and over, 93.9% have secured a minimum high school diploma, while 47.4% hold a bachelor's degree or more advanced credentials (Fig. A2-4) (census.gov, 2023).

Monroe Education (% of population aged 25 and above)

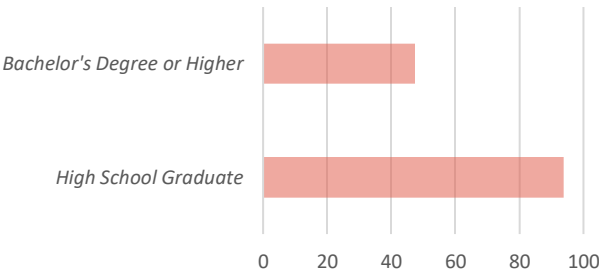


Figure: A2-4. U.S. Census Bureau, QuickFacts, Monroe County, IN

In 2021, Monroe County's median household income stood at \$53,166, while its poverty rate of 21.1%, which is notably higher than Indiana's overall poverty rate of 12.1%. The poverty level for children under 18 in the county, 14.4%, is slightly lower when compared to the state, 15.7%. Employment in Monroe County is primarily dominated by government jobs at 25.7%, followed by roles in healthcare and social services at 11.7% and manufacturing at 9.6%. A smaller percentage, less than 1%, is engaged in farming. The Annual Unemployment Rate stood at 2.8% (Fig. A2-5) (bea.gov, 2023).

Monroe Employment by Industry, 2021

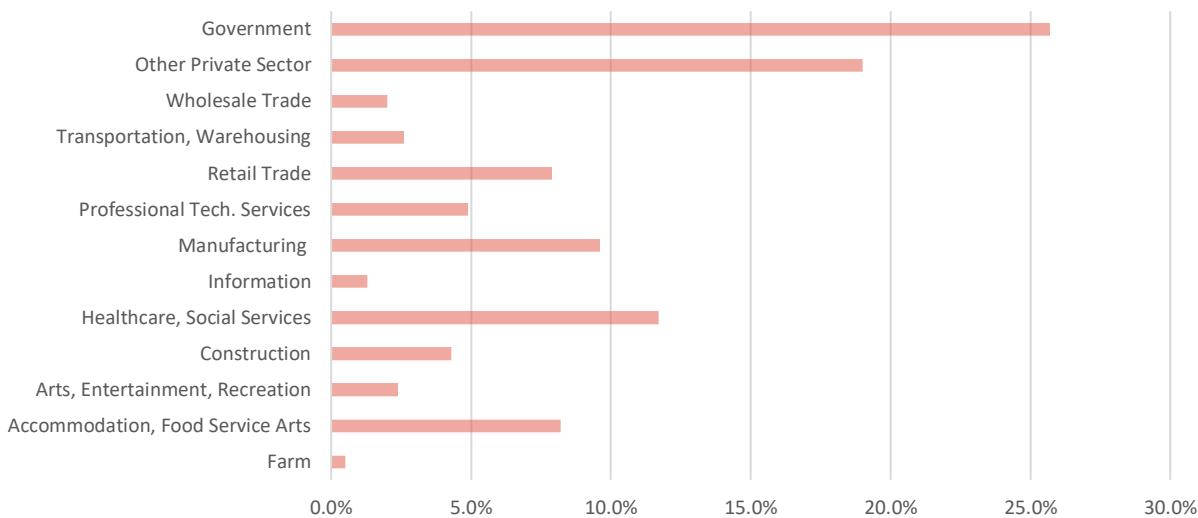


Figure: A2-5. U.S. Bureau of Economic Analysis

Physical Environment and Natural Systems

Prior to the arrival of European settlers in Indiana, 87% of the state was once covered with forest that stretched from the Ohio border to Illinois in the early 1800s. By the 1860s, half of the state lost its forest as trees were cleared to make space for farming and timber production. Monroe County and much of Southern Indiana boosted the region’s finest hardwood trees and even becoming the nation’s largest supplier of timber production. During the Great Depression, Indiana purchased land for the Morgan-Monroe State Forest as part of President Roosevelt’s New Deal to create jobs for the unemployed, such as the Civilian Conservation Corps (CCC), and to prevent further destruction of natural habitats (naturalbloomington.com, 2013). Even today, Monroe County is in the process of purchasing more land to expand the Charles Deam Wilderness for all to enjoy and cherish.

Monroe County distinctly prioritizes green spaces and outdoor recreation, setting it apart from many other regions in the state. According to the 2021 U.S. News Healthiest Communities report, 46% of the county’s population resides within 0.5 miles of a designated park area. This contrasts with the state average of 26% and the national figure of 18% (Bloomington. IN.gov, 2023).

Monroe County is home to 36 public parks, each offering a variety of amenities tailored to serve its residents. These facilities encompass walking trails, splash pads, playgrounds, dog parks, and dedicated sports fields and courts. The B-Line Trail, originating from the Rails to Trails initiative, connects downtown Bloomington to surrounding neighborhoods to the north and south, serving recreational and commuting purposes. Environmental stewardship is evident in Monroe County's commitment to preserving its tree canopy, which covers 24.4% of the county area (Bloomington. IN.gov, 2023).

Water bodies, both large and small, punctuate the county's landscape. One of the most significant water bodies in the region is Lake Monroe, Indiana's largest lake, offering recreational and aquatic activities. Lemon and Griffy lakes also serve as cherished retreats for locals, ideal for various outdoor pursuits. Clear Creek and the Jordan River are notable waterways that meander through the county, providing aquatic life habitats and fishing and canoeing opportunities. These bodies of water are crucial for the county's ecosystem, supporting diverse flora and fauna (Bloomington. IN.gov, 2023).

However, Monroe County faces specific environmental challenges. Its air quality hazards¹ score, as reported in 2021, stands at 0.35, comparable to Indiana's average and the national figure of 0.34. Furthermore, a 2022 EPA report highlighted issues regarding the water quality in the upper and lower sections of the Monroe Reservoir. Specific concerns included compromised taste, algae presence, and detectable mercury levels in fish tissue (Bloomington. IN.gov, 2023).

In conclusion, while Monroe County offers a diverse array of recreational and natural resources, ongoing efforts are essential to address and mitigate environmental challenges, ensuring a balanced and sustainable coexistence between nature and its inhabitants (Bloomington. IN.gov, 2023).

Structures, Energy, and Communication

Energy

In Monroe County, Duke Energy predominantly supplies electricity, which took over from its predecessors, Cinergy/PSI. However, certain sections of the county rely on the services of the South-Central Indiana Rural Electric Member-Owned Cooperative (REMC) for their electrical needs. Vectren is the primary provider for natural gas provisions, especially around the urban cores and specifically designated communities. This includes Bloomington, Ellettsville, Stinesville, Harrodsburg, Smithville/Sanders, Unionville, and New Unionville (specials.idsnews.com).

According to FindEnergy, Monroe County emitted a substantial 1.4 billion kilograms of CO₂ due to total electricity consumption of 2,051,352 MWh, ranking it the 244th highest emitting county

¹ Potential risk of developing serious respiratory complications over the course of a lifetime; smaller values indicate reduced risk

out of the 3,221 nationwide. However, over the past year, the county has seen a 5.07% reduction in CO2 emissions per capita, indicating progress towards more sustainable practices. It is worth noting that Monroe County does not produce its own electricity and primarily depends on Duke Energy Indiana. Residents enjoy competitive electricity rates, with the average residential cost per kilowatt-hour standing at 15.27 cents, which is 2.66% lower than the national average of 15.68 cents (findenergy.com).

According to the Bloomington Climate Plan, the energy mix used to generate electricity consists of 61% coal and 37% natural gas, while hydro, wind, and solar collectively comprise less than 1% of energy (bloomington.IN.gov).

Water Systems

Monroe County has thirty distinct watersheds (Fig. A2-6), spanning roughly 1,243 miles of streams and rivers. The county's primary water features include Monroe Reservoir, Griffy Lake, and Lake Lemon, collectively covering an area of 21 square miles. While Monroe Reservoir's watershed is divided almost equally between Monroe and Brown Counties, the majority of the Lake Lemon watershed falls within Brown County (monroe.in.us, 2023).

Stormwater infrastructure

One issue to be addressed in the County is stormwater runoff. Stormwater runoff originates from melting snow or rainstorms that travels over impervious surfaces such as paved streets, parking lots, agricultural fields, or buildings and is irrigated into rivers, streams, or lakes for flood control (co.monroe.in.us, 2023). Stormwater infrastructure in Monroe County consists of inlets, piped systems, utility holes, roadside ditches in urban environments, and detention ponds or pools in rural areas. Stormwater infrastructure is monitored by the Monroe County Stormwater Program (MCSP), which works to promote the safety and health of residents by mitigating flooding hazards, education, planning, and water quality through stormwater pollution prevention initiatives (co.monroe.in.us, 2023). Water quality is measured through mechanical units or retention ponds that capture and filter stormwater runoff pollutants before being discharged into local waterways. The MCSP also monitors and oversees stormwater standards being met regarding erosion and pollution control measures as new developments are being built. MCSP uses historical data on 100-year or 1000-year floods and NOAA's ATLAS program on precipitation frequency data to design, plan, and manage stormwater infrastructure for the future

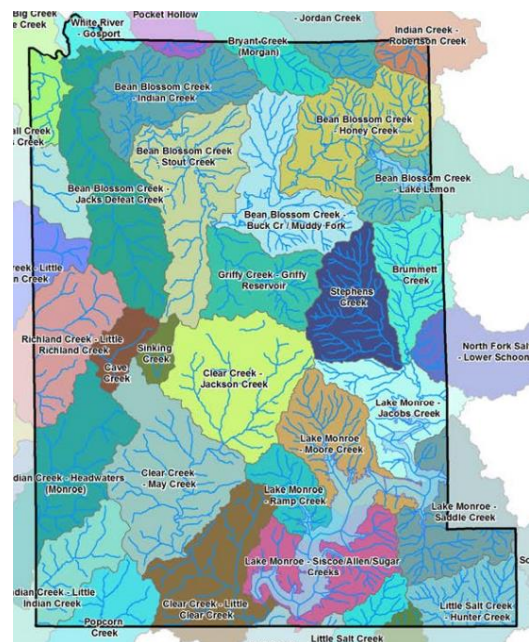


Figure: A2-6. Monroe County Long-Range Stormwater Improvement Plan

(weather.gov, 2023). As annual precipitation rates are expected to increase from the effects of climate change, updating and maintaining aging stormwater infrastructure in Monroe County becomes paramount as it will become costly if left unmonitored.

Roads and Bridges

Monroe County oversees an extensive infrastructure encompassing over 708 miles of roadways, 156 bridges, more than 3,450 culverts, and 9,300 traffic indicators, including signs and signals. The most utilized roads in and out of Monroe County would be State Roads 37, 45, 46, and 48. State Roads 37 and 45 are primary north-south routes, while State Roads 46 and 48 provide essential east-west access. The town of Bloomington, the county seat, particularly benefits from the strategic positioning of these roads, enabling easy commutes to neighboring counties. Interstate 69 (Fig. A2-9) is a critical artery for the county, providing a rapid connection between Bloomington and Indianapolis to the north and Evansville to the southwest. The newly upgraded section of this interstate, often referred to as the I-69 Corridor, enhances regional travel and commerce (aaroads.com, 2023).

As the largest city within Monroe County, Bloomington is nestled amidst rolling hills and bisected by multiple waterways, including the Clear Creek and Jordan River. Consequently, the county has several vital bridges that ensure uninterrupted traffic flow. Of particular significance is the Walnut Street Bridge, a historic truss bridge that serves as a testament to the county's rich architectural heritage. Another noteworthy bridge is the one spanning over Griffy Lake, providing both utility and picturesque views to travelers.

Monroe County's Road and bridge network not only supports the daily commute of its residents but also accommodates the influx of visitors, particularly those heading to Indiana University or the scenic spots around Lake Monroe.

Transportation

Monroe County offers a diverse range of transportation options, particularly Bloomington. The county is served by three public transit systems, including specialized services for Indiana University students and those with disabilities. While IU students can access certain transit services for free, Bloomington Transit charges a standard fare of \$2, with discounts available for select groups. Rural Transit provides on-demand and shared rides with varying fares for residents in Monroe and surrounding counties. In urban areas near Indiana University, rideshare services like Uber and Lyft are prevalent, and rental scooters offer another option for those above 18 years old. Additionally, Monroe County takes pride in its robust bicycling culture, with Bloomington recognized for its bike-friendly initiatives and hosting major biking events like the Hilly Hundred and Little 500. Whether by bus, car, or bike, residents and visitors have multiple means to navigate the county (bloomington.in.gov, 2023).

As per U.S. Healthiest Communities rankings, Monroe County boasts a commendable walking index score of 10.6, significantly surpassing the national median of 6.1. This higher score indicates

a community better optimized for pedestrian activities. The ranking also reports that 46% of the county's population resides within a half mile of a park, emphasizing the county's environmental-centric outlook (countyhealthrankings.org, 2023).

However, when it comes to commuting, most residents rely on personal vehicles; as of 2023 data, 69% of Monroe County residents drive alone to work. A notable one-fourth of these commuters spend more than 30 minutes in transit, reflecting the distances some must travel. As per the U.S. Census, a resident of Monroe County spends about 20 minutes commuting to work, on average. While walking is a popular choice for short distances, personal vehicles remain the dominant mode of transportation for longer journeys, especially to work (doi.org, 2023).

Waste Management

Monroe County emphasizes responsible waste management and environmental stewardship. The county's waste management system is comprehensive, covering residential, commercial, and industrial needs. Monroe County Solid Waste Management District oversees waste reduction, recycling, and safe disposal initiatives, offering numerous drop-off sites and recycling centers throughout the county. Bloomington plays a significant role in these efforts, with facilities like the South Walnut Recycling Center offering residents options for both recyclable and hazardous waste disposal (idsnews,2023).



Garbage truck on route | Photo by IDS News

Communication Networks

Monroe County has a well-established communication network – major telecom providers include AT&T, Verizon, and Comcast and high-speed internet, cellular services, and landline connections are widely available. As technology becomes increasingly integrated into daily life, internet accessibility gains prominence. Currently, 89.1% of residents enjoy broadband internet access, and 95% of households in Monroe County are equipped with a computer (idsnews.com, 2023).

Housing

Monroe County's housing landscape is characterized by a blend of owner-occupied and rental units. According to the U.S. Census data, there were 66,376 housing units as of July 2022, of which 54.7% are owner-occupied. Between 2017-2021, the median home value in the county was \$202,400. In 2022, there were 451 building permits issued in the county: 54.1% for single-family homes, 1.3% for 2-family homes, and 44.6% for larger residential buildings housing five or more families (census.gov, 2023).

Historically, most low-income households have been found in areas subjected to environmental hazards due to cheap housing and job accessibility. This becomes representative of economic injustice or income inequality as individuals suffering from poverty face are less able to recover from natural disasters compared to wealthier communities. In Monroe County, mobile homes have become prominent in flood hazard zones due to cheap or affordable housing. One area of concern prone to flooding for longer durations includes Sinking Creek and Cave Creek communities located on the west side of Bloomington. Both communities are uniquely situated in a location where terminal sinkholes cause flooding to residential areas due to poor drainage capabilities.

Agriculture

As of the 2022 Census of Agriculture, there were 419 farms in Monroe County with a total acreage of 63,216. Most of the farms fall between 10 and 179 acres with an average size of 151 acres. The dominant land use of farm property by farmers is woodland with cropland as a close second. Hay, soybeans, and corn are the most popular crops grown while cattle, calves, and hens for eggs (layers) are the most popular livestock in Monroe County. The average sales from crops for farmers was \$12.9 million and \$3.6 million for livestock, poultry, and products in 2022. The number of farms decreased by 14% since 2017, but the average size of farms increased by 55% since the same year (USDA, 2022).

Indiana has historically been a leader in agriculture productivity in the United States; however, productivity has been affected by increasing temperatures, precipitation, and carbon dioxide levels in the atmosphere. In a state where agriculture contributes nearly 5% of the state's gross domestic product and provides more than 107,000 jobs, mitigating climate change effects on agriculture is more important than ever (Bowling et al., 2018). Although the changes in productivity may be minor now, the issues will be exacerbated if something is not done to slow climate change effects in Monroe County.

Social Services

In Monroe County, the well-being of its residents is of paramount importance, as demonstrated by its comprehensive emergency response and health services. Four local police departments diligently safeguard the county, while the Indiana University police department boasts its dedicated campus-specific police force. Furthermore, the Monroe County Sheriff's Office plays an instrumental role in upholding law and order outside municipal jurisdictions, providing essential services from patrolling to executing court orders and correctional services to the constituents (monroe.in.us, 2023).

In terms of fire emergencies, three city fire departments are stationed strategically in Bloomington, Ellettsville, and Stinesville. For broader coverage, a district fire department is tasked with protecting the non-incorporated areas of Monroe County (monroe.in.us, 2023).

The county is home to three primary hospitals: IU Health Bloomington Hospital, which transitioned to a new site within the IU campus and is part of a statewide care system; Monroe Hospital, situated just outside city limits and affiliated with a network of 45 hospitals across multiple states; and Bloomington Meadows Hospital, focused exclusively on providing mental health services. While the county's health resources are commendable, challenges persist. Monroe County has been designated as both a Medically Underserved Area/Populations (MUA/MUP) for primary care and a Health Professional Shortage Area (HPSA), indicating gaps in access to care. According to County Health Rankings 2023 data, the county has a higher ratio of residents to primary care providers (1720:1) compared to the state ratio (1,500:1). It is essential to consider, however, that these figures do not capture the entire clientele served, given Monroe County's role as a regional service hub. The county also has two specialized Health Professional Shortage Areas (HPSA) facilities: HealthNet, offering a range of services including primary care, mental health, and dental care on a sliding scale, and Centerstone, providing both primary and mental health services (monroe.in.us, 2023).

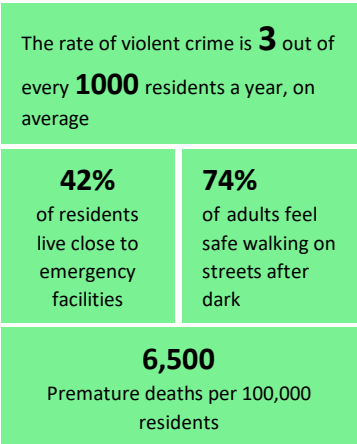


Figure: A2-7. U.S. Healthiest Communities

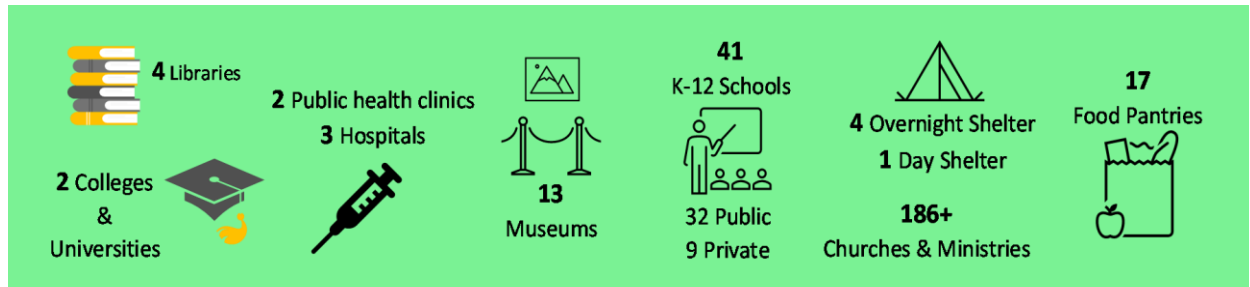


Figure: A2-8. Monroe County Community Health Assessment, 2021

Jurisdictional Coordination

Monroe County has eleven townships that reside in its jurisdictional boundary. Within these townships are major urbanized areas that include Bloomington and Ellettsville. Each township has the power to levy taxes or the capability of creating its own climate action plans. Monroe's three main jurisdictional coordination entities include county, city, and school systems (MCCSC and RBB school corporations). The county does not have any federal, regional, or state agencies within its territory or tribal government services.

Community Culture

Monroe County is rich in cultural resources that make it a distinct and welcoming community. One of the standout features is Indiana University Bloomington, a renowned educational



IU Bloomington Sample Gates | Photo by USNews

institution that infuses the area with a vibrant arts and academic scene. The university's diverse student body and faculty contribute to the community's inclusive atmosphere.

Throughout the year, Monroe County hosts several festivals and events that bring people together. For instance, the Lotus World Music & Arts Festival showcases music from around the globe, celebrating diversity and unity. The annual Fourth Street Arts Festival highlights local artisans,

fostering a sense of community pride.

Historical sites like the Monroe County History Center offer a glimpse into the region's past, preserving its cultural heritage. The Tibetan Mongolian Buddhist Cultural Center provides insight into another facet of global culture and spirituality.

Our community's commitment to education extends to institutions beyond the university. The WonderLab Museum of Science, Health, and Technology engages young minds through interactive exhibits, fostering a love for learning.



Lotus arts festival | Photo by Herald Times

In essence, Monroe County embodies a sense of belonging through its festivals, educational institutions, historical sites, and diverse populations. It is a place where diverse cultures coexist harmoniously, making it a true home for all who live here (Bloomington.in.gov, 2023).



The WonderLab Museum of Science, Health, and Technology | Photo by Expedia.com

The health and well-being of residents are intricately linked with its socio-economic and environmental landscape. With a diverse demographic and a blend of urban and rural settings, Monroe County faces unique health challenges and opportunities. While a focus on health

Monroe County Disability Characteristics

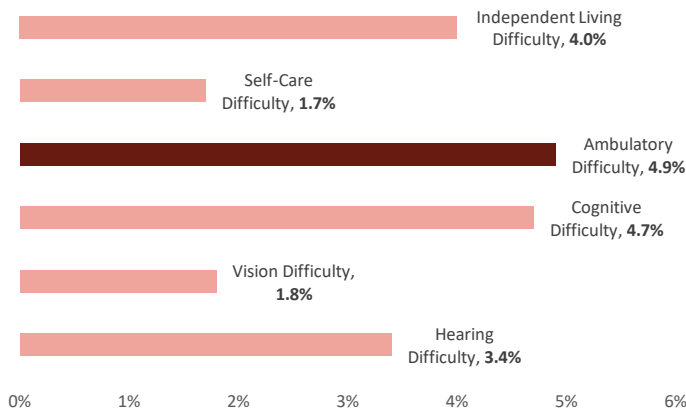


Figure: A2-9. U.S. Census Bureau, Decennial Census, Table S1810

encompasses various dimensions, insurance coverage remains a foundational concern. As per the U.S. Healthiest Communities' most recent data, approximately 9.4% of the population in Monroe County remains uninsured. Diving deeper into specific health challenges, the prevalence of disability in the community is noteworthy. According to the 2021 American Community Survey 5-Year Estimates, about 10.9% of civilian, non-institutionalized residents in Monroe County live with

a disability. Especially among the older age group, those aged 65 years and above, a significant 31.3% are classified as having a disability. The challenges range widely, with ambulatory difficulties and cognitive disabilities being the most common (Fig A2-9). Other significant disabilities include independent living difficulties and hearing impairments (data.census.gov, 2023).

Food Access

The importance of food security and access is closely linked to overall health and vitality. According to the Community Health Rankings of 2023, Monroe County has a food insecurity rate of 13% (higher than Indiana, which stands at 11%). A significant concern is the presence of 14 census tracts designated (Fig. A2-10) as food deserts by the USDA in 2019. These areas, characterized by limited income and access to food, often lack easy access to grocery stores, with residents sometimes only having convenience stores as an option. Such establishments, while convenient, rarely offer an array of healthy food choices further exacerbating the issue of nutritious food accessibility. This not only impacts the immediate health of individuals but also reflects the broader community's ability to support its residents. On the food environment index – which evaluates factors like accessibility, variety, and food security – Monroe County has a score of 7.6 out of 10 (Indiana scores a 6.5 while the national score is a 7.0) (monroe.in.us, 2023).

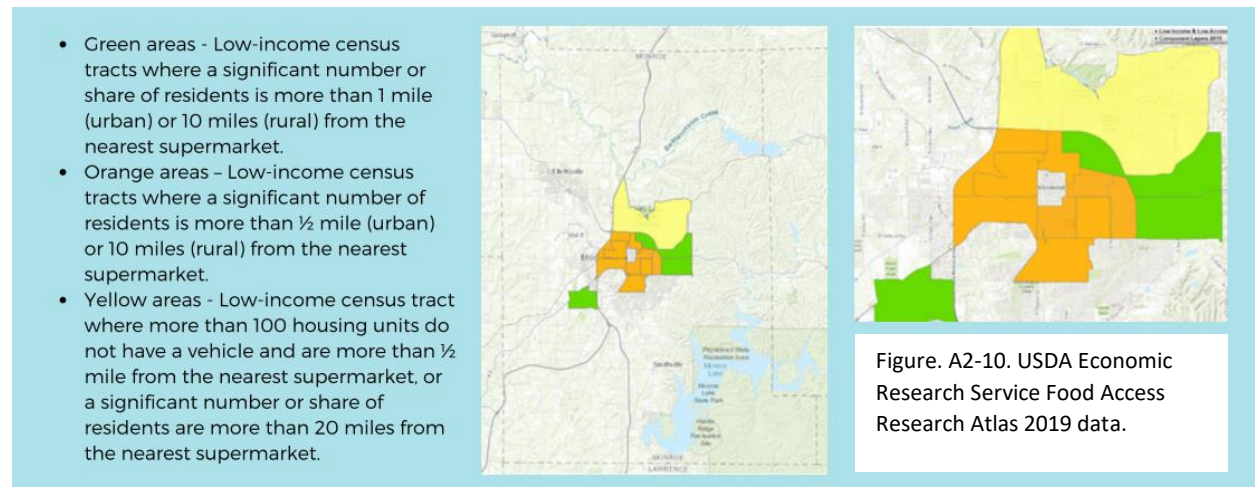


Figure: A2-11. Monroe County Community Health Assessment, 2021

Community History

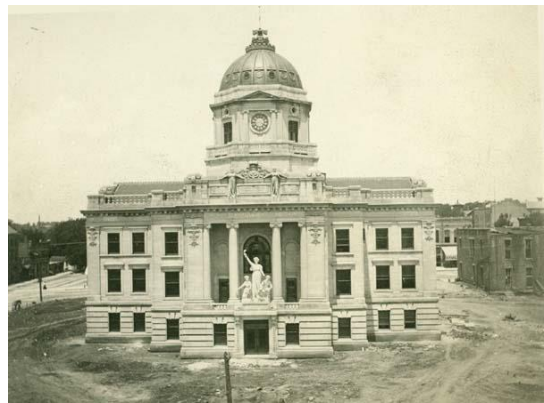
Monroe County has a rich history that encompasses settlement, cultural diversity, and changes over time. The county's history is marked by numerous factors, including indigenous populations, waves of immigration, and relationships with different racial and ethnic groups.

Monroe County's land was originally home to indigenous communities, including the Miami, Delaware, Potawatomi, and Shawnee peoples. Over time, however, settlement by European settlers led to the displacement of these indigenous communities. The historical relationship between the indigenous people and the land has evolved, and today, there is an acknowledgment of their role as caretakers of the land (Bloomington.in.gov, 2023).

Early settlers from Kentucky, Tennessee, the Carolinas, and Virginia established Bloomington, the county seat, in 1818. The city's name was inspired by the abundance of blooms in the area. As the county and city developed, the economy was driven by farming, limestone extraction, and industries like furniture manufacturing. The establishment of Indiana University (IU) in 1820 played a pivotal role in shaping the community and attracting diverse individuals to the region (Bloomington.in.gov, 2023).

Successive waves of immigration punctuate the county's subsequent history. In 1818, settlers from southern states like Kentucky, Tennessee, the Carolinas, and Virginia, enchanted by the lush landscape they likened to a "haven of blooms," established Bloomington. This evolving city later emerged as a dynamic hub, its residents initially relying on farming, limestone extraction, and timbering. Over time, the introduction of the railroad, businesses such as Showers Brother Furniture and Oaks Manufacturing, and significant institutions like the Bloomington Hospital marked eras of innovation and development (Bloomington.in.govm 2023).

The turn of the 20th century heralded further transformation. While infrastructure and businesses continued to grow, the global events of World War II reshaped the social and economic dynamics. This period saw the emergence of corporations such as RCA and the blossoming of educational institutions like Indiana University, especially post-war when the GI Bill facilitated education for countless veterans. In recent decades, the county has witnessed shifts towards a more diversified economy characterized by high-tech, entrepreneurship, nonprofit sectors, and governmental employment. Businesses like Cook, Inc. flourished, further enriching the county's industrial tapestry (Bloomington.in.gov, 2023).



Like many parts of the United States, Monroe County has a complex history with regards to race and ethnicity. The acknowledgment of the land's indigenous caretakers is important, and much of the economic progress and development in the area resulted from the unpaid labor of People of Color, specifically enslaved African labor. This history has left a legacy that continues to affect the community today.

Appendix 3: Climate Vulnerability Assessment



Wildlife vegetation area | Photo by Monroe County Stormwater Program

Cities and counties throughout the nation and world are working to reduce greenhouse gas emissions in efforts to prevent warming more than 1.5°C (2.7° F). This level of warming has been recognized by the international scientific community as an important threshold, below which we can avoid catastrophic and runaway climate change (IPCC, 2022).

In addition to reducing greenhouse gases, however, communities need to respond to the changes already being felt and plan for those still to come. Because greenhouse gases can remain in the atmosphere for decades after release, we will continue to warm and

experience impacts for many decades, even if we reduce emissions today.

While greenhouse gases are measured globally, climate change impacts are experienced locally. Each community feels climate change in a different way, depending on historic conditions and local climatic conditions and patterns of change. As these local impacts and changes worsen over time, we will need to prepare and protect our most vulnerable resources and populations from the impacts.

Monroe County has already experienced changes in temperature, rainfall, and extreme weather events. As changes in climate continue, we can expect increasing severity and frequency of extreme heat, larger storms with more wind and precipitation, more prolonged periods of drought, and changes to the forests and other natural features in and around Monroe County. These changes are expected to become increasingly severe over the course of the century.



Road in Monroe County covered in snow | Photo by Bloom Magazine

Determining which resources and populations are most vulnerable to ongoing and future impacts of climate change is the first step in developing effective strategies and sound solutions. While this Climate Change Vulnerability Assessment presents sector-specific vulnerabilities to the community, it is important to also look at Monroe County in a holistic way. Many of the vulnerabilities identified here cross diverse sectors and affect people of all different walks of life.

Methods

On October 23, 2023, a group of seventeen local experts from diverse sectors of the community met for a daylong vulnerability identification workshop. These stakeholders combined their local knowledge and expertise with information provided about climate science and model



Participants identifying vulnerabilities at the stakeholder workshop on December 6, 2022 | Photo by Geos Institute

projections to identify and prioritize local vulnerabilities in the five primary systems of the community: Health and Emergency Services, Natural Systems, Infrastructure, Business and Economy, and Community Culture.

The workshop participants were provided with a list of community concerns generated from the online survey outreach. They reviewed the scientific information on climate change and identified the impacts that are already underway as well as the potential impacts that are expected in the future. For each identified vulnerability, participants collected the following information:

Exposure	The specific climate trend or projection that is already causing or is expected to cause the impact
Timeframe	When the impact is expected to occur in Monroe County
Certainty	The relative certainty that the impact will occur
Sensitivity	A relative measure of the degree of severity of the impact, given our understanding of the specific sector or population
Adaptive Capacity	The extent of existing resources, programs, or policies <i>already in place</i> to protect people or to respond to the changes with little disruption
Focal Populations	The specific neighborhood, population, area, or resource that is expected to be especially affected by the impact
Other Stressors	Additional and ongoing stressors to the focal population
Secondary Vulnerabilities	Other potential responses to, or effects related to, climate change that are likely to affect the vulnerability under consideration
Indicators	A quality or trait related to the focal population that can be tracked to indicate the effectiveness or success of actions taken to address this vulnerability

After identifying the specific vulnerabilities within each community system, participants ranked vulnerabilities across all systems to determine their relative priority. Most impacts identified in

this vulnerability assessment are important to address, but action on some may be more urgent than on others, which is reflected in the ranking. See Table A3-1 at the end of this Appendix for a list of vulnerabilities in priority rank order. Additional populations and resources not specifically mentioned in this report may also be vulnerable.

Health and Emergency Services

Monroe County is not immune to global health risks from climate change. Existing health threats are expected to be exacerbated with climate change, while new and emerging threats also take hold. Extreme events are already occurring more frequently, and emergency services will be increasingly taxed as these events become even more common.

Heat-Related Illnesses and Mortality – One of the biggest health threats facing Monroe County residents is the increasing incidence, severity, and longevity of heat waves. The number of days per year above 90° F has increased by twenty days. The years with the highest number of severe heat days occurred in 1933 and 1934 with more than 20 days above 90° F (the historical average is two days per year) (Widhalm et al, pgs. 8-9, 2018). Projections indicate that summers in Monroe County will be 36.4 to 96.3 warmer by the middle of this century and 57.7 to 131.7 warmer towards the end of the century. Studies project between 17 to 20 days on average above 100° F throughout Indiana by the middle of this century (2036-2065) (Notaro et al, 2015).

“Climate change is among the greatest health risks of the 21st Century. Rising temperatures and more extreme weather events cost lives directly, increase transmission and spread of infectious diseases, and undermine the environmental detriments of health, including clean air and water, and sufficient food.”
World Health Organization

Even more important than daytime highs are nighttime low temperatures. When nighttime temperatures do not cool below 75° F, core body temperature does not cool enough to protect people from the heat which can lead to increased mortality. People who already suffer from chronic disease are particularly vulnerable.

Many of Monroe County’s residents are already vulnerable to heat waves (Fig. A3-1), and with increasing temperatures, more people will become vulnerable. People in areas with less tree canopy coverage and less access to air conditioning are highly vulnerable. Lower income neighborhoods and communities of color often have fewer trees, putting these communities at higher risk. Elderly people are very sensitive to heat, as are infants and people with existing health conditions.

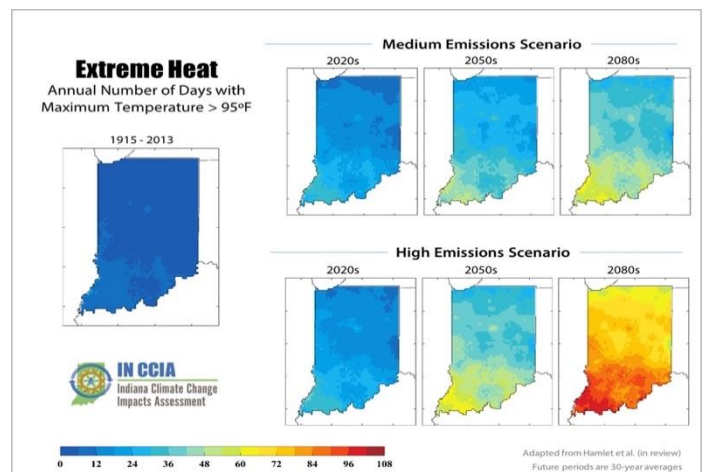


Figure A3-1. Maps showing the annual number of extreme heat days (maximum temperatures above 95°F) Image from Purdue University (n.d.).

Flooding and Hazardous Materials Exposure – Severe thunderstorms are a major source of catastrophic loss. Increasing convective potential energy and strong winds associated with climate change indicate that severe thunderstorms are likely to increase. Severe storms can cause energy outages and flooding. During energy outages, some of the most vulnerable populations include medically sensitive populations and elders, because the loss of power can lead to exposure to extreme heat or cold, as well as failure of vital medical equipment.

Flooding affects many neighborhoods throughout Monroe County. Flood waters often become contaminated with hazardous materials that can impact human health and contaminate drinking water. People most vulnerable to flood impacts include those living in high flood risk areas, and especially those with limited mobility, such as elders, homeless, and people without vehicles. Some vulnerable areas include Ellettsville and Bloomington.

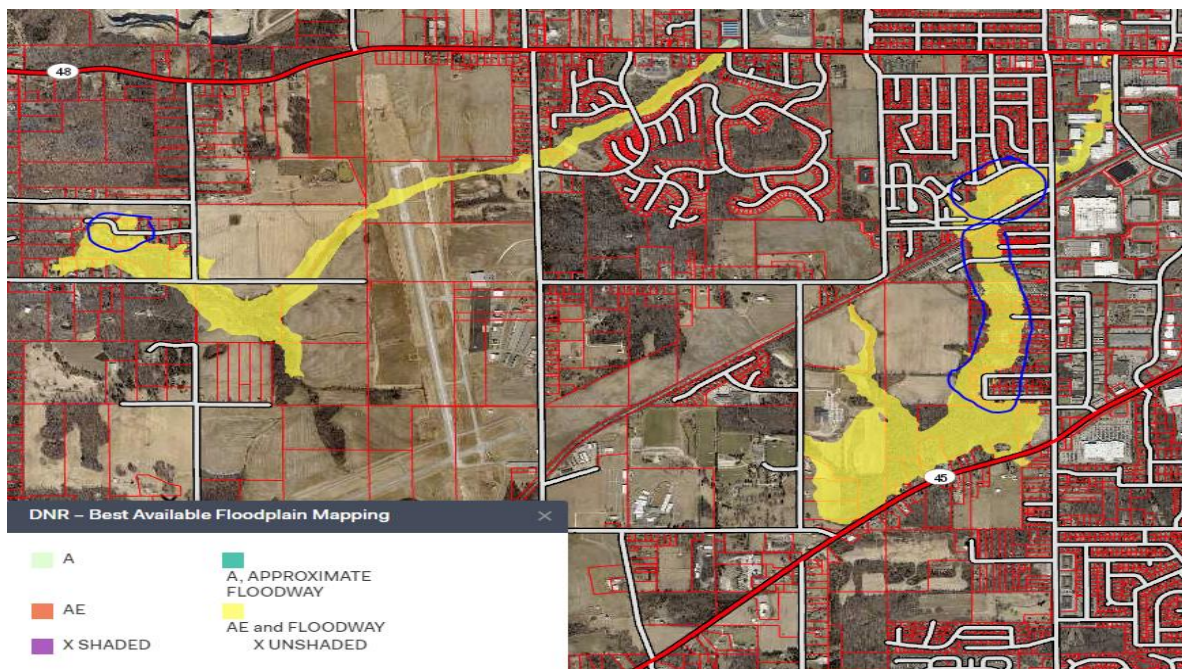


Figure A3-2. Image above provides a description of flooding in Cave Creek and Sinking Creek on the west side of Bloomington from terminal sinkholes.

Pests and Disease – In the last 13 years, the number of disease cases from mosquito, tick, and flea bites has tripled in the U.S (CDC, 2018). Many disease-causing organisms and insect pests experience natural control during winter months, when freezing temperatures reduce populations. The number of days below freezing is now 23.1 lower, on average, than it was historically.

Model projections indicate 6.4 to 19 fewer days below freezing by the 2050s and 1 to 13 fewer by the 2080s. With warmer and wetter winters, diseases such as mosquito-borne West Nile Virus, dengue, and Zika, as well as tick-borne Lyme disease, and Ehrlichiosis, could become more prevalent. Insect pests and disease organisms from the southern regions may begin to

overwinter in northern regions. Many vector-borne diseases seriously affect domestic animals and livestock, so climate change could impact food security as well as human health (Caminade et al., 2019).

State and local health agencies and vector control organizations are responsible for detecting and responding to diseases. Increasing capacity will be needed for continued tracking, diagnosing, and reporting of cases of known and new illnesses.

Stress to public safety (violence and domestic disputes) during extreme heat and other events

– Higher temperatures increase irritability and hostility, which can lead to higher rates of violence and domestic abuse. In addition, economic disruptions due to wildfires or floods can lead to a generation of traumatized families.

Overburdened health care system and non-profit organizations – A primary climate change vulnerability identified for Monroe County is the potential for an overburdened health care system tasked with responding to outbreaks and extreme events. An influx of climate refugees could exacerbate this issue even more. Recurring disasters, such as flooding, disease outbreaks, and heat waves, could overwhelm the current capacity. Vulnerable populations include elderly residents, people who live in flood-prone areas, non-English speaking populations, people without health insurance, homeless populations, and those with already compromised health.

An existing lack of services, including in-home support services, may also be exacerbated. Extreme conditions and events are expected to lead to declines in overall health and struggles to remain independent. Elderly residents and people with disabilities are especially vulnerable.



Monroe Residents participating in a bike race | Photo by Herald Times, 2022

Identified Vulnerabilities: Health & Emergency Services

The vulnerability assessment identified the following health and emergency services-related vulnerabilities to Monroe County

HIGH

- None recorded.

MEDIUM-HIGH

- Extreme weather (high temperatures, flooding, drought, etc.) causing increased pressure on government services and vulnerable populations.
- High Heat Index from extreme heat poses a significant risk to the elderly, homeless, and other residents from lack of cooling stations and poor air quality.
- Drought
- Availability to water
- Wastewater
- Hazardous weather (tornados, wind, etc.) posing a significant threat to residents due to limited storm shelters, outdated homes old building codes, and limited resources.

MEDIUM

- Flooding from extreme rain events that can affect vulnerable populations that reside in flood prone areas and the limited availability of shelters.
- Wildfires from heat and lack of precipitation pose a risk to rural communities from limited resources and shelters.
- Disturbances from extreme weather (heat/cold) for urban, rural, and vulnerable communities.
- Limited availability of venues to host events indoors during extreme weather events occur. This can cause instances of isolation and further tax resources used for mental health.

MEDIUM-LOW

- None recorded.

Note: Overall vulnerability ranking is determined from the combined scores for time frame, sensitivity, and adaptive capacity

Infrastructure

The infrastructure systems covered in this vulnerability assessment for Monroe County include communications, electricity, water, wastewater, and energy utilities as well as roads, bridges,

public buildings, homes, and businesses. Most infrastructure is built based on building codes that take into consideration the range of variation in temperature, precipitation, snowpack, and other climatic factors in the region.

Unfortunately, these codes are based on the historical climate rather than future climate. In many cases, outdated standards will be inadequate to meet the needs for safety and basic functioning under changing climatic conditions.

Some increasingly common infrastructure failures associated with climate change include inadequate stormwater infrastructure leading to road failure and water contamination during extreme precipitation events; dry wells due to drought; schools shut down for lack of air conditioning during extreme heat events; and toxic algae contaminating municipal water supplies, particularly in low water years.

Identified climate change vulnerabilities to infrastructure in Monroe County include:

Aging Infrastructure and Flooding – One of the major disruptions to infrastructure exacerbated by climate change, is flooding. Flooding is expected to become more severe and frequent with climate change. Urban areas are susceptible to flooding because a high percentage of the surface area is composed of impervious streets, roofs, and parking lots where runoff occurs very rapidly.

In 2021, Monroe County had its worst flooding event in decades as flash floods damaged homes and businesses and claimed one life. Torrential downpours overwhelmed Bloomington’s stormwater system as parts of the county saw a month’s worth of rain in one night (Indianapublicmedia.org, 2022). In downtown Bloomington, sections of Kirkwood Avenue had floodwaters reaching heights that nearly submerged cars and caused extensive damage to businesses such as May’s Greenhouse on Old State Road 37. Elsewhere in the county, Ellettsville saw floodwaters rise from Jack’s Defeat Creek that flooded downtown and the city’s town hall.

Large floods are often associated with sewer backups and collapsing combined sewer infrastructure. When a combined sewer and stormwater system gets overwhelmed, some sewage can go untreated. As climate change worsens and storms become even more extreme, dropping larger quantities of precipitation in shorter periods, older and outdated infrastructure will become even more at risk, also creating a risk for health and safety.

As older infrastructure is updated, prices for housing may increase. Increased mandates for energy efficiency, sewer upgrades, extreme heat resistance, water conservation, natural shading, wildfire risk reduction, and other sustainability measures associated with combating climate change could result in fewer housing opportunities for lower income residents unless efforts are made to specifically address housing affordability.

Hazardous Materials – Following the global transition into more widespread and efficient manufacturing during the Industrial Revolution, Monroe County has had a history of

contaminated soil with polychlorinated biphenyls (PCBs) and creosote from railroad and other manufacturing industries. The remnants of those chemicals still linger in the soil to this day and have required the assistance of the Environmental Protection Agency (EPA) to oversee the cleanup of PCBs and creosote as superfund sites. The contaminated locations that the Westinghouse Electric Corporation once owned are Lemon Lane, Neal's Landfill, and Bennett's Quarry. Actions that have been taken to remove PCBs and creosote from contaminated soil and sediment include:

- The construction of a water treatment plant near superfund sites.
- Removing and disposing of contaminated soil at approved landfill sites.
- Monitoring soil and water quality.

The Monroe County Commissioners recently purchased Bennet's Quarry to be made into a public park after it was deemed safe and removed from the Superfund's National Priorities List (co.monroe.in.us, 2023).

Increases in flood risk to the area also result in increased hazardous materials risk. Water pollution and soil contamination in Monroe County will be exacerbated by climate change. As the potential for large storms and floods increases, it becomes increasingly likely that these pollutants will be released from soils and contaminate waterways, homes, and businesses, and affect human health.

Transportation Disruption – Monroe County has a diverse transportation system that includes air, road, and rail. Increasing temperatures and flooding pose risks to these transportation networks. Rail traffic can be disrupted by severe heat, which leads to buckling (sun warping) and derailments (EPA, 2022). In extreme heat asphalt may begin to soften and melt.

Roadways susceptible to flooding are North Bottom Road in Ellettsville and streets in downtown Bloomington that include Walnut Street and Kirkwood Avenue. Washouts, erosion, and water contamination are some of the potential impacts associated with inadequate stormwater infrastructure. As storms become larger with climate change and rain-on-snow events become more likely, adjustments to stormwater infrastructure will be required. Without upgrades and replacements, damage to roads and increased flooding during extreme events is expected.

Extreme temperatures associated with climate change can lead to lower weight limits on air cargo. Because warm air is less dense, planes have a harder time taking off in triple-degree heat, leading to less cargo and weight capacity per flight. More frequent and severe heat waves can increase costs of shipping and disrupt air travel, sometimes grounding all planes until temperatures cool again (Coffel et al., 2017).

Energy Disruption and Pricing – The existing structure of energy supply for Monroe County includes a mixture of coal, natural gas, and solar. The primary providers for electricity in the region are Duke Energy, South-Central Indiana Rural Electric Member Owned Cooperative (REMC), and Vectren. Identify the primary providers of electricity for your region. As temperatures rise and extreme weather events occur more frequently, electrical use is

expected to rise with increased demand for air conditioning, heating, and smoke filtering. New investments in energy production and distribution will be needed to meet peak demand. Because of the community’s heavy reliance on fossil fuel-based energy, replacement of fossil fuels with renewable energy sources (in addition to energy conservation) is necessary to meet Monroe County’s greenhouse gas emissions targets. These new investments could result in higher prices, depending on the cost of new infrastructure and energy prices. Lower income residents could be impacted by increasing energy prices.

Extreme temperatures also reduce the efficiency and reliability of energy production and distribution. In addition, power outages are common during heat waves and extreme cold events, due to overburdening of the power grid. Power outages can put peoples’ lives at risk as they leave people vulnerable to soaring temperatures. Older adults, low-income residents, and people with existing health problems are all at risk. If electric prices increase, even more residents will be unable to afford to cool their homes, putting them at risk during periods of severe heat.



Street flooded due to heavy rainfall | Photo by Chris Howell and the Herald Times

Identified Vulnerabilities: Infrastructure

The vulnerability assessment identified the following infrastructure-related vulnerabilities to Monroe County.

HIGH

- Loss of tree canopy in rural and urbanized areas from development, flooding, and fungus.

MEDIUM-HIGH

- Potential energy outages due to aging infrastructure and extreme events like heat waves, extreme cold, and flood events

	<ul style="list-style-type: none">• Vulnerability of Lake Monroe to extreme weather events (drought, heavy precipitation, etc.) and limited access to water for county residents.• Damage to homes and businesses from extreme precipitation events and flooding in flood prone areas.• Agriculture chemicals contaminating local water and food resources from heavy rain and erosion.• Higher temperatures causing heat stress on vulnerable groups (elderly, youth, outside workers, etc.) and increasing EMS call volume.• Transportation systems (roads, bridges, public transit, etc.) being threatened by extreme weather events.
	MEDIUM <ul style="list-style-type: none">• None recorded.
	MEDIUM-LOW <ul style="list-style-type: none">• None recorded.

Note: Overall vulnerability ranking is determined from the combined scores for time frame, sensitivity, and adaptive capacity

Natural Systems

Climate change can have significant impacts on natural systems, through increases in temperatures, extreme storms, and drought. Increasingly, one of the most important functions of natural systems is to provide a buffer against the impacts of climate change. Intact natural systems can reduce the impacts of extreme events, such as floods, fire, and drought, on local communities. Forest and ecosystem management to maximize natural function is increasingly becoming a priority.

The vulnerability assessment revealed that Monroe County’s natural systems are vulnerable to climate change in the following ways.

Overall degradation of the natural environment and loss of species – Open space is a valued resource, providing a visual and physical connection to the natural environment. Monroe County offers abundant natural areas and parks, including Morgan-Monroe State Forest, Hoosier National Forest, Griffy Lake, and Indiana’s largest land body of water, Lake Monroe. The combination of forest and open land offers a wide variety of habitats for wildlife such as white-tailed deer, fox, turkey, and waterfowl to thrive in. Apart from wildlife, the region also hosts various deciduous trees that consist of oak, hickory, maple, and other types of tree species that are adapted to Monroe’s temperate climate.

Like natural lands outside the city, natural lands and open space within city limits are increasingly being affected by climate change and will need to be managed for continued natural function. Some of the climate-related threats to parks and open spaces include pests

that can affect tree canopy species, drought that weakens vegetation, floods and large storms that knock down trees and destroy landscaping, and overall climate shifts that make existing vegetation incompatible with changing climate conditions.

Studies indicate that changes in local climate conditions will occur on a faster time scale than species and ecosystems are able to shift or adapt. Overall, natural systems are expected to become degraded by climate change, with some specific species and habitats especially vulnerable. These include wetlands, riparian areas, meadows, high elevation species, and species highly dependent on cold waterways or snow.

As climate change progresses, more extremes are expected. This includes an increase in floods, drought, larger storms, severe heat waves, wind speeds, and hailstorms. Many of these extreme events will have impacts on species and their habitats.

Spread of Pests and Disease – Climate change is also expected to lead to increases in pests and disease, affecting natural areas, urban trees, and fish and wildlife. Gardens and crops could also experience reduced production due to extreme events, as well as pests and disease. With increase in temperatures, fewer nights below freezing, and stressed native vegetation, invasive species could decimate urban tree canopies and other vegetation.

Loss of Green Space – The mental health benefits of open spaces, vegetation, parks, and nature are well proven. Access to green space and nature improve mood, ability to concentrate, school test scores, and many other metrics. Unfortunately, these spaces are often considered a luxury, rather than a necessity. Existing urban tree canopy is often higher in higher income neighborhoods.

In lower income areas, often with higher percentages of people of color, there is less natural habitat and fewer parks. Climate change will only exacerbate this disparity, degrading existing natural areas and diversity, thereby leading to more anxiety, less exercise, fewer meeting places for community connections, and more isolation.



Hoosier National Forest | Photo by visitbloomington.com, 2023

Identified Vulnerabilities: Natural Systems

The vulnerability assessment identified the following natural systems-related vulnerabilities to Monroe County

HIGH

- Increase in harmful algae blooms from increased water temperature, nutrient loads, and drought periods.
- Destruction of natural landscapes due to extreme weather
- Flooding/Flash flooding causing increased risk of injury or death, nutrient pollution, and damage to infrastructure from the terrain’s inability to detain flood waters.

MEDIUM-HIGH

- Increased wildfire risk from dry conditions and high volumes of undergrowth or thatch.
- Loss of natural areas from development that poses a risk to native ecosystems, outdoor recreation, and water quality.
- Increase in invasive species that can harm native habitats, biodiversity, soil degradation from increased herbicide use.

	<ul style="list-style-type: none">• Decrease in surface water quality that can affect adequate drinking water for humans, domestic animals (livestock), and wildlife.• Decrease in outdoor recreation due to air pollution.• Limited access to reliable and affordable drinking water as a result of higher temperatures, increased sediment loads from soil erosion, and usable ground water sources.
	MEDIUM <ul style="list-style-type: none">• Habitat fragmentation from flooding, drought, and development that can affect air quality, water quality, biodiversity.• Karst Drainage from flooding and soil erosion that poses a risk to agricultural land, and communities.
	MEDIUM-LOW <ul style="list-style-type: none">• Loss of Urban Tree Canopy and native tree species that are vital to improved air quality, reduced heat island effects, and biodiversity.

Note: Overall vulnerability ranking is determined from the combined scores for time frame, sensitivity, and adaptive capacity

Business and Economy

Monroe County’s economy is built on many different types of businesses and industries, ranging from large industry to small local and diverse businesses. The major employment sectors in Monroe County are centered around government, healthcare and social services, and manufacturing. Indiana University is the region’s largest employer, with a workforce of over 3,000 in academic and faculty roles on the Bloomington campus (indiana.edu, 2023). Because of Indiana University’s illustrious institution, the college draws over 45,000 students each year from around the world and generates a revenue of \$166 million between hosting sporting events and conferences. Wage and earnings include 74,974 employed and an average earning of \$50,285 per job (stats.indiana.edu, 2023). The Annual Unemployment Rate for Monroe County stands at 2.8%, with the poverty rate being at 21.1%, compared to the state’s overall average of 12.1%.

Climate change is expected to affect the local economy in numerous ways. Not only are transportation routes expected to be interrupted more frequently (see the Infrastructure section) but the cost of doing business is expected to rise.

Energy Costs – The cost of energy is likely to increase due to climate impacts, potentially affecting the cost of doing business in the region. With higher temperatures, demand for electricity is expected to increase as residents and businesses increasingly need air conditioning. Heavy reliance on coal and natural gas leaves the region vulnerable to increasingly

volatile energy prices. As demand increases, costs could rise substantially to meet the need for new infrastructure investments.

Transportation Interruptions – Monroe County businesses and industry rely heavily on inexpensive, reliable, and efficient distribution of products throughout the nation. As detailed in the infrastructure chapter, businesses and industry are increasingly vulnerable to disruptions in transportation by river shipping, air cargo, rail, and interstate shipping. As shipping reliability is increasingly impacted by extreme events, overall cost and profitability could be negatively affected.

Insurance Costs – Insurance costs are directly linked to the level of risk involved. As the risk of climate impacts, such as flooding, hail, severe storms, drought, and wildfire increases, premiums will also increase. As climate-induced risk continues to rise, some areas may become uninsurable, transferring the full financial risk to individual property and business owners.

Credit rating agencies have added “resiliency” in their rating criteria for city and state governments, affecting the ability of local governments to raise bond funds and the rates that taxpayers pay for those funds. For instance, Standard and Poor’s regularly publishes extensive research on the climate-related risks to cities (S&P Global, n.d.). They also evaluate environmental, social, and governance risks as a key part of their ratings methodology.

Outdoor Workers at Risk – Increasing smoke and heat events may severely disrupt the productivity of outdoor workers in fields such as construction, agriculture, landscaping, forestry, and recreation. Those employment disruptions are likely to cause financial instability, particularly for low-income workers. Businesses may experience higher turnover of workers in this situation along with increases in workers compensation claims.



Monroe County Courthouse at night | Photo by English.indiana.edu

Identified Vulnerabilities: Business and Economy

The vulnerability assessment identified the following business and economy-related vulnerabilities to Monroe County.

HIGH	<ul style="list-style-type: none"> • None recorded.
MEDIUM-HIGH	<ul style="list-style-type: none"> • Effects of extreme weather on agriculture. • Influx of migrant communities relocating to Monroe County may cause added stress to food sustainability and security. • Heat related stressors on transportation and infrastructure (supply of goods, public commute). • Effects of extreme weather on Bloomington events and attendance. • Natural amenities and quality of life being affected by climate change when it comes to air quality, high temperatures, outdoor recreation, and biodiversity.
MEDIUM	<ul style="list-style-type: none"> • None recorded.
MEDIUM-LOW	<ul style="list-style-type: none"> • Effects of climate change on tourism in Monroe County that can have a cascading effect on region's economy. • Effects of extreme heat on Indiana University and education system that can include student health concerns, such as heat stress, and decreased enrollment of international students.

Note: Overall vulnerability ranking is determined from the combined scores for time frame, sensitivity, and adaptive capacity

Community Culture

The character of Monroe County comes from complex local history and culture that has developed over many generations. Before the arrival of European settlers in Monroe County and much of the Midwest, Indigenous communities once thrived and flourished here as they had done for thousands of years before being forcibly removed from their homeland during the United States push westward. In recent years, efforts have been made to recognize indigenous communities native to this region with the creation of Indiana University's First Nations Educational & Cultural Center to celebrate the Shawnee, Delaware, Potawatomi, and Miami people as the "past, present, and future caretakers of this land (firstnations.indiana.edu, 2023)."

Over a hundred years later, after the Emancipation Proclamation was passed to abolish slavery in America, African Americans seeking to make a livelihood in Monroe County would face

hardships between unpaid labor and instances of redlining. These and other historical events and policies formed the neighborhoods that are present today, with continued legacies in culture, race, education, and opportunity.

Today, Monroe County is a thriving center for many families, business owners, and industries. The community is a melting pot of different cultures and backgrounds that make up the region's demographics as Asian, Hispanic or Latino, African American, American Indian or Native Hawaiian, and White. Each year, thousands gather in the community to celebrate its cultural past and future with events such as the Lotus World Music and Arts Festival and the Fourth Street Festival of Arts and Crafts. Apart from Monroe County's diverse ethnic background and culture, the community also cherishes its unique natural landscape that is unlike any other when it comes to Bloomington's urban tree canopy, water recreation at Monroe Lake, and miles of hiking trails at Charles C. Deam Wilderness.

School and youth experience – Young people in Monroe County participate in many outdoor sports and activities that will be affected by heat and larger storms, leading to a lifetime of poorer health among young people and a loss of nature-based recreational values and activities.

Quality of Life and Sustainable Lifestyles – Monroe County's overall quality of life is vulnerable to climate change impacts. Heat and severe storms could keep people indoors, reduce their connection with nature, and negatively impact their mental health. Tourism may decline, resulting in less revenue and fewer government services. If schools are impacted, families may move away from the area, further exacerbating the issue. Finally, residents that are paying more for housing, energy, and food, may not have the capacity to invest in more sustainable lifestyles, like energy efficient windows, electric cars, and locally produced food.

As climate change solutions are developed, an opportunity arises to develop adaptation strategies that prioritize equity as a major outcome. Careful consideration of governance systems and policies, as well as entrenched systems of power that create relative advantage and disadvantage and make certain populations more and/or less vulnerable to climate change is vital. This demands that resilience strategies be developed that not only address climate change vulnerabilities, but also the intersecting factors that make some populations more prone to experiencing direct and indirect impacts, along with the intentional allocation of resources to support sustainable solutions and enhanced resilience capacity for populations that need it most.

Sustainability more difficult to achieve – Monroe County is currently increasing its efforts to become a sustainable community. Residents care about their impact on the environment, and many programs are in place and are growing. These programs stem from local values and support. They also require significant resources and investment. With greater disruptions to livelihoods and higher stress from climate impacts, residents may no longer have the capacity or values to support sustainability programs and actions. Also of concern is the ability of local

businesses to meet sustainability requirements or mandates, as their resources become more limited and/or variable.

Reduced ability to hold ceremonies and community events – The ability of both Indigenous and other groups in Monroe County to hold culturally important ceremonies and community events will be impacted by extreme heat, storms, flooding, and drought, particularly in the summer months.

Identified Vulnerabilities: Community Culture

The vulnerability assessment identified the following community culture-related vulnerabilities to Monroe County.

HIGH	<ul style="list-style-type: none"> None recorded.
MEDIUM-HIGH	<ul style="list-style-type: none"> <i>Notable shifts in county's population from climate change migrants seeking more livable areas.</i> Disproportionate impact of climate change on immigrant groups and communities when it comes to cultural intensity, fractured cultural groups, and isolation.
MEDIUM	<ul style="list-style-type: none"> <i>Erosion of political, religious, legal traditions, and cultural recreation due to the effects of climate change.</i> <i>Transference of information. Losing digitized and non digital stories and school's inability to conduct in person academic sessions.</i> School and youth experience affected by storms, heat, and loss of outdoor sports and recreation
MEDIUM-LOW	<ul style="list-style-type: none"> None recorded.

Note: Overall vulnerability ranking is determined from the combined scores for time frame, sensitivity, and adaptive capacity

Conclusions

Climate change is a global threat with locally unique impacts for communities. Because each region is affected differently, and each community has a unique combination of existing vulnerabilities and assets, it is vital to develop climate change solutions at the local level. Some

of the most important vulnerabilities to Monroe County include failure of aging infrastructure, health impacts associated with heat and air quality, exacerbated impacts to populations and resources already under stress, and degradation of natural systems that are vital to the health and well-being of residents. The most vulnerable residents and resources are generally those with the least adaptive capacity to deal with the additional impacts of climate change.

The international scientific community agrees that keeping average warming at the global level below 1.5°C (2.7° F) is vital to protect young people and future generations from catastrophic and runaway climate change. Emissions reductions are the first and most important step to preventing many of the worst impacts on the community. However, many impacts are already occurring and need to be addressed to protect people and resources throughout the community. Because climate change affects all sectors and resources, actions must be coordinated to increase overall resilience. Without coordination, actions in one sector or population could shift impacts to other sectors or populations, especially those who are already most vulnerable. Truly co-beneficial solutions to climate change address economic and social inequities, increase ecological health and resilience, and collaborate across diverse groups and resources.

Risk Matrix

The symbol → indicates highest priority for strategy development

Low Adaptive Capacity Medium Adaptive Capacity High Adaptive Capacity

High

<p>→ Damage to homes, businesses, and people from flooding/flash floods in floodplains.</p> <p>→ Effects of extreme weather on agriculture, the environment, water quality (algae blooms, wastewater contamination, etc.), water capacity/availability, food security, emergency services, community events, and residents.</p> <p>Notable shifts in population in Monroe County as migrants impacted by climate change search for livable areas.</p> <p>Disproportionate impact on immigrant groups and communities when it comes to cultural intimacy, fractured cultural groups, and isolation.</p> <p>Impacts to urban/rural trees and tree canopy from development, insects, disease, drought, extreme storms, and heat.</p> <p>Drought poses a significant risk to public health, the environment, and water availability due poor planning and limited resources.</p>	<p>→ Utility systems stressed by demand and high temps that can lead to energy outages and effect public health.</p> <p>→ Poor water quality in Lake Monroe from storms, pollution, drought, and overall climate change, leading to loss of ecological function (water filtration, flood abatement, etc.) and wildlife habitat.</p> <p>Natural amenities and quality of life being impacted by poor air quality, invasive species, and mild winters not killing off harmful insects.</p> <p>Loss of natural areas from development that poses a risk to native ecosystems, outdoor recreation, and water quality.</p>	<p>Agricultural chemicals contaminating local water and food resources from heavy rain and erosion.</p> <p>Increase in invasive species that can harm native habitats, biodiversity, soil degradation from increased herbicide use.</p>
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Medium Sensitivity	<p>→ Transportation (roads, bridges, public transportation) being impacted by extreme weather events.</p> <p>High heat index from extreme heat poses a significant risk to the elderly, homeless, and other residents from lack of cooling stations and poor air quality.</p> <p>Karst Drainage from flooding and soil erosion that poses a risk to agricultural land, and communities.</p> <p>Decrease in outdoor recreation due to air pollution.</p>	<p>Increased pressure on government services due to limited staffing and resource allocation during extreme weather events.</p> <p>Habitat fragmentation from flooding, drought, and development that can affect air quality, water quality, biodiversity.</p> <p>Increased wildfire risk from dry conditions and high volumes of undergrowth or thatch</p>	<p>Erosion of political, religious, legal traditions, and cultural recreation from the effects of climate change on community events, political campaigning, education, government services.</p>
Low Sensitivity	<p>None Recorded</p>	<p>None Recorded</p>	<p>Effects of extreme heat on Indiana University and education system that can include student health concerns, such as heat stress, and decreased enrollment of international students.</p> <p>Effects of climate change on tourism in Monroe County that can have a cascading effect on region's economy.</p>

Appendix 4: Developing Climate Resilience Strategies

On December 8, 2023, a group of 26 local experts from diverse sectors of the community met for a daylong strategy development workshop. Most participants also attended the Vulnerability Assessment workshop (see Appendix 3). These stakeholders combined their local knowledge and expertise to identify and prioritize strategies that address Monroe Counties’ climate vulnerabilities. Workshop participants represented all five community systems: Health and Emergency Services, Natural Systems, Infrastructure, Business and Economy, and Community Culture.

In the first part of the workshop participants reviewed the climate projections and vulnerabilities for Monroe County and learned about the best practices for developing climate adaptation solutions, such as creating win-win and no-regrets strategies. Then participants developed a list of guiding principles that reflect the common values and priorities of Monroe County.

Participants spent most of the day working in cross-sector breakout groups, identifying strategies and actions for a specific sub-set of vulnerabilities from the Vulnerability Assessment (see Appendix 3). These five breakout groups were organized around the following categories: Health Residents; Resilient Infrastructure; Natural Systems; Community Readiness; and Sustainable Businesses. Participants were assigned a group to match their expertise, as well as to ensure representation of all five community systems in each group.

For each vulnerability, group members reviewed a list of possible strategies developed from a review of existing community plans and reports, and a national database of solutions. Participants then brainstormed additional options and prioritized the list of possible strategies for each vulnerability. For each of the top priority strategies, participants collected the following information:

Possible Actions	Specific actions to help achieve the strategy
Co-benefits	Any potential positive impacts of the strategy to groups, resources, or populations other than those that are the focus of the action.
Trade-offs	Any potential negative impacts of the action related to groups, resources, or populations other than those that are the focus of the action, or how the action could make climate change worse or prevent resilience in other sectors.
Responsible Party	Who is potentially responsible for implementing the action, and other implementation partners
Upfront/Capital Cost	The relative upfront or capital cost (High, Medium, or Low)

Ongoing/Maintenance Cost	The relative ongoing or maintenance cost (High, Medium, or Low)
Effectiveness	The relative effectiveness of the proposed action (High, Medium, or Low), based on how much the action will reduce vulnerability and lead to greater climate resilience.
Metrics	What will be measured (both quantitative and qualitative) to help track and evaluate success of the strategy and/or specific actions

At the end of the workshop, participants ranked all strategies across all breakout groups in terms of their relative priority and according to the set of guiding principles developed earlier in the day. See the list of strategies in this priority order below.

It is important to note that this ranking is only a starting point for the implementation phase of *Climate Ready Monroe County*. Additional information and resources may impact which strategies and actions are implemented first, and which may need to wait.

Appendix 5: Community and Stakeholder Outreach

The process of developing the *Climate Ready Monroe County Resilience* plan was the result of significant time and input from a variety of people in and around the Monroe County community. The “Whole Community Resilience” process utilized by Monroe County Government included a series of stakeholder workshops, each designed to solicit feedback to inform the development of appropriate and actionable solutions.

Stakeholder Workshops



Vulnerability workshop group collaboration | Photo by Monroe County Stormwater Program

On October 23rd, 2023, a group of local experts from diverse sectors of the community met for a daylong vulnerability identification workshop. These stakeholders combined their local knowledge and expertise with climate science and model projections to identify and prioritize local vulnerabilities in all major sectors of the community. This information was used to help develop the Climate Vulnerability Assessment, found in Appendix 3.

On December 8th, 2023, Monroe County Government hosted a second stakeholder

workshop with many of the same participants from the vulnerability assessment workshop. This second workshop focused on identifying strategies and actions to address each of the vulnerabilities identified in the Climate Vulnerability Assessment (see Appendix 3). The 26 participants worked in cross-sector breakout groups, each with a set of related vulnerabilities from across the five community systems. These breakout groups were assigned the following systems:

- Water Quality and Public Health (Built)
- Forest, Natural Areas, and Biodiversity (Natural)
- Population, Economy, and Development (Economic)
- Internal and External Influences (Cultural)
- Effects of Extreme Weather on Different Systems (Social)

Monroe County Government deeply appreciates the time, expertise, and knowledge of these workshop participants.

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