

# Acting on Climate Together to Make **DUCK HILL** and Montgomery County More Resilient

## Community Driven Climate Action Plan for Duck Hill, Mississippi

Presented to the Town of Duck Hill Board of Alderman  
March 9, 2020

*Project part of:*

# ASEEDS

*Achieving Sustainability through Education & Economic Solutions*



## **Acknowledgements**

This work would not have been possible without the input of workshop participants throughout both the vulnerability assessment workshop and the adaptation strategy development workshop. We would like to thank the Southeast Sustainability Directors Network and the Kendeda Foundation for the funding to make this work possible. We would also like to thank the North Montgomery Communities United for Prosperity for their vision in the development of this Community Driven Climate Action Plan for Duck Hill, MS. Finally, we would like to thank all the volunteers helping with the workshops, providing delicious meals for workshop participants, and helping with community clean ups.

## **Contacts:**

Duck Hill Mississippi Contact: **Romona Taylor Williams**  
Project Management Lead  
North Montgomery Communities United for Prosperity (M-CUP)  
102 Carrolton Street  
Duck Hill, MS 38925  
Tel: (314) 363-5229  
Email: rftwilliams@gmail.com

EcoAdapt: **Alex Score**, Senior Scientist  
Climate Action Plan Project Lead  
PO Box 11195  
Bainbridge island, WA 98110  
Tel: (305) 509-2635  
Email: Alex.Score@EcoAdapt.org

## Table of Contents

<b>Table of Contents.....</b>	<b>3</b>
<b>Executive Summary.....</b>	<b>5</b>
<b>Chapter 1: Project Overview.....</b>	<b>7</b>
Background .....	7
Duck Hill, Mississippi Community .....	7
Climate Action Planning Process.....	7
Step 1. Community Visioning and Listening: Define goals/values, understand assets and strengths, and define hazards, threats, and vulnerabilities.....	8
Step 2. Climate Vulnerability Assessment: Consider how these interactions affect community vision and goals.....	8
Step 3. Community Climate Adaptation Planning: Develop new or modify old strategies/actions/policy to overcome the vulnerabilities.....	8
<b>Chapter 2: Climate Change Impacts in Mississippi.....</b>	<b>9</b>
AIR TEMPERATURE.....	10
PRECIPITATION .....	10
DROUGHT.....	10
EXTREME WEATHER.....	11
<b>Chapter 3: Community Visioning and Vulnerability Assessment for Duck Hill, MS.....</b>	<b>11</b>
Community Surveys .....	11
Community Visioning and Vulnerability Assessment Workshop.....	12
Community Climate Vulnerability Assessment Workshop .....	13
<b>Chapter 4: Adaptation Strategies and Feasibility Assessment .....</b>	<b>15</b>
Climate Action Workshops .....	15
<b>Chapter 5. Next Steps and Recommendations.....</b>	<b>18</b>
Health Impacts and Recommended Strategies .....	18
<b>Recommendation 1:</b> Maintain public cooling centers and hydration stations throughout heat season, and partner with community organizations to promote their use and warn the public about extreme heat risks .....	18
<b>Recommendation 2:</b> Develop an early warning system to notify the community of high-risk situations (e.g., episodes of poor air quality, extreme heat events), with information about reducing exposure, checking on neighbors and family members, and accessing resources (e.g., cooling centers).....	18
<b>Recommendation 3:</b> Increase public awareness around the health-related risks of climate change, including how to stay safe and healthy during and after extreme events .....	19
<b>Recommendation 4:</b> Identify at-risk individuals (e.g. limited mobility, socially isolated) and residences (e.g. skilled nursing and assisted-living facilities) and develop proactive strategies to address their needs in an extreme event. ....	20
<b>Recommendation 5:</b> Change the frequency or location of monitoring and surveillance programs to detect changes in the geographic range or incidence of vectors (e.g. Aedes aegypti) and vector-borne diseases.....	20
<b>Recommendation 6:</b> Address mosquito protection to reduce vector-borne disease risk. ....	20
<b>Recommendation 7:</b> Collaborate with public works, parks and recreation, urban forestry, planning, and community-based organizations to increase tree canopy over streets, sidewalks, and parking lots to reduce high temperatures and air pollution. ....	20
<b>Recommendation 8:</b> Work with the air district and local community-based organizations to deploy inexpensive real-time air monitors that will provide online data on regional air pollution levels and more detailed information about air quality.....	20
Housing Impacts and Recommended Strategies .....	21

<b>Recommendation 1:</b> Plant trees within residential neighborhoods to provide shade, capture stormwater, and reduce air pollution .....	21
<b>Recommendation 2:</b> Reduce stormwater runoff within residential neighborhoods that flood frequently .....	21
<b>Recommendation 3:</b> Advocate for building codes that encourage the use of gray water, and work with Environmental Health and building inspectors to ensure prevention of cross-contamination to water sources used for drinking or vegetable garden irrigation.....	21
<b>Recommendation 4:</b> Improve weatherization in businesses and homes .....	22
<b>Recommendation 5:</b> Connect low-income residents to existing energy efficiency and weatherization programs, such as the <i>Low Income Home Energy Assistance Program (LIHEAP)</i> and the <i>Weatherization Assistance Plan</i> .....	22
<b>Recommendation 6:</b> Work with utilities and other agencies to inform residents about and ensure enforcement of “disconnection rules” that prohibit electricity cut-offs in Mississippi when the National Weather Service has issued extreme heat or freeze warnings .....	22
<b>Recommendation 7:</b> Educate elected officials and residents on the impacts of climate change and health impacts from mold 22	
<b>Transportation Impacts and Recommended Strategies</b> .....	<b>22</b>
<b>Recommendation 1:</b> Incorporate future climate change projections into siting and design of all new transportation infrastructure (e.g., roads, culverts) and significant retrofits and repairs .....	23
<b>Recommendation 2:</b> Inventory existing bridges and culverts that should be upsized to accommodate future expected stream flows.....	23
<b>Recommendation 3:</b> Reevaluate the service life of transportation infrastructure under future climate conditions and increase the frequency of routine inspections accordingly .....	23
<b>Recommendation 4:</b> Stock up on replacement parts for vehicles and equipment needed for emergency weather .....	23
<b>Recommendation 5:</b> Create and communicate clear evacuation routes in the event of flash floods or other extreme events ..	23
<b>Recommendation 6:</b> Improve stormwater management to reduce the risk of road/street flooding .....	23
<b>Recommendation 7:</b> Plan for expansion of complete streets that accommodate biking, walking, and public transit to promote safe and enjoyable alternatives to car transportation while also reducing vehicle emissions.....	23
<b>Job Opportunities and Recommendations</b> .....	<b>24</b>
<b>Recommendation 1:</b> Support on-site renewable energy development for existing landowners (e.g., farmers, businesses) .....	24
<b>Recommendation 2:</b> Support value-added farm and forest products processing to reduce the financial risk of climate change by diversifying income streams while also creating jobs for other community residents.....	24
<b>Recommendation 3:</b> Prepare residents for meaningful work in the green economy through training programs and pathways to jobs in manufacturing, construction, landscaping, installation, maintenance, etc.....	24
<b>List of Tables</b> .....	<b>25</b>
<b>Table 1. Climate Trends and Projections in Duck Hill, MS</b> .....	<b>25</b>
<b>Table 2. Vulnerability Assessment for Duck Hill, MS</b> .....	<b>27</b>
<b>Table 3. Adaptation Strategies and Feasibility Assessment for Duck Hill, MS</b> .....	<b>30</b>
<b>Appendix A. Duck Hill Sustainability Mission Statement Resolution</b> .....	<b>33</b>
<b>Appendix B. Outreach Fliers</b> .....	<b>34</b>
<b>Appendix C. Climate Definitions</b> .....	<b>37</b>

## Executive Summary

Climate change and associated extreme events will increase the inequities in the town of Duck Hill, Mississippi unless planning efforts are made to increase its climate preparedness. By engaging community members in a vulnerability assessment and climate adaptation strategy planning process, residents become empowered to demand the protection and services to thrive as a community. The Achieving Sustainability through Education and Economic Development Solutions (ASEEDS) project engaged with Duck Hill residents and surrounding areas for 2 years to develop a Climate Action Plan for Duck Hill, MS. The results of this report were derived through a series of workshops, individual conversations, and surveys.

The Climate Action Plan includes an analysis of current and future climate and extreme weather assessment, input from residents on values and assets of Duck Hill, vulnerability assessment of those assets, and adaptation strategies to reduce those vulnerabilities. Community members also prioritized solutions and adaptation options for inclusion of “Adaptation, Resiliency, Smart Growth, and Sustainability Principles and Practices” into a revised Township of Duck Hill, 1975 Zoning Plan. This commitment was adopted August 31, 2017, unanimously during a special meeting of the Mayor and Board of Alderman of Duck Hill, MS. The Climate Action Plan aims to increase the resilience of Duck Hill’s resources, people, and infrastructure by providing a plan to help improve quality of life, water quality, stormwater, public health, safety, and general welfare of its citizens and landowners.

The future climate of Duck Hill will dictate many of the community’s challenges and opportunities. Future heat projections are expected to increase between 2-6 degrees Fahrenheit by 2100. Future rain projections are expected to increase with increased heavy rain events in the Spring, Summer, and Fall causing local flash flooding. These can all cause implications for human health, elderly, housing, critical infrastructure, and local economy.

The **Climate Action Plan** was developed through a community participatory process, community visioning, and listening sessions to address the changes in climate and develop resilience based solutions. Participants conducted a climate vulnerability assessment of Duck Hills’ key assets and resources and developed solutions and adaptation strategies to those vulnerabilities. This systematic process was completed between 2018-2020. The table below depicts the overall vulnerability of the key assets in Duck Hill over the next 25-50 years.

ASSET/RESOURCES	CLIMATE VULNERABILITY
Critical Infrastructure	High Vulnerability
Health Care Access/Hospital	High Vulnerability
Route 51	High Vulnerability
Binford High School & gym	Medium/High Vulnerability
Residential Homes	Medium/High Vulnerability
Elderly residents	Medium/High Vulnerability
Church/Historical sites	Medium Vulnerability
Affordable Housing	Medium Vulnerability
Energy Efficiency	Medium Vulnerability
Open Space and Parks	Medium Vulnerability
Agriculture	Medium Vulnerability
Bogue Creek	Low Vulnerability

The **Duck Hill Adaptation Solutions and Strategies** was derived through a 2-day Climate Action workshop in 2019. The following are the 27 priority action strategies identified by community members to promote a sustainable Duck Hill and reduce its vulnerability to climate impacts. These strategies were then aligned under strategic priorities derived during the listening sessions and workshops.

### **Energy Efficiency**

1. Educate residents on available energy efficiency programs and retrofitting homes
2. Use existing program and resources such as “Low Income Home Energy Assistance Program” (LIHEAP) for weatherization for seniors and veterans

### **Open Space and Parks**

3. Encourage less manicured grass and more natural yards
4. Set up a community land trust and invest in conservation of land and parks
5. Plan community gardens, encourage natural yards and build hoop house for winter growing
6. Build public parks for youth and drive sustainability and economy

### **Agriculture**

7. Train farmers on sustainable and climate-resilient farming, crop rotation, and other methods to prevent soil erosion
8. Farm locally for food access and healthy options

### **Education**

9. Teach climate change solutions in schools, libraries, and/or churches to promote local action
10. Work with the community to implement community outreach- “each one reach one” to pass on knowledge of sustainability and climate solutions
11. Implement “Farm to School” programs
12. Start recycling and composting education programs

### **Voting Rights and Census**

13. Ensure you are counted in the census
14. Vote on all elections and get an identification card and/or driver’s license

### **Bogue Creek**

15. Clean up and restore for erosion protection
16. Conservation of lands around creeks to prevent sedimentation
17. Dredge creek tributaries and make water reservoirs to prevent flooding during extreme events
18. Map tributaries for public awareness

### **Churches**

19. Use churches as short-term cooling centers
20. Connect churches to lead community resilience and connect to the scripture “Green Bible”
21. Develop an emergency plan with churches to help and check on community members after a disaster

### **Cultural Heritage**

22. Preserve Duck Hill’s cultural heritage by “Sharing Stories” on farming, food preservation, midwifery, and other traditional cultures.
23. Share through technology and youth
24. Promote Duck Hill’s history to preserve landmarks and encourage tourism
25. Promote preservation through rural churches

### **Emergency Services** (Not voted on but identified as a priority during workshops)

26. Need for a mobile 911 system
27. Developing a county emergency management plan



## Chapter 1: Project Overview

### Background

The Climate Action Plan is part of a two-year project from 2018-2020 Achieving Sustainability through Education and Economic Development Solutions (ASEEDS). Funded by the Southeastern Sustainability Directors Network (SSDN), the primary focus of ASEEDS is to create a community-driven model for economic development and sustainability in rural towns based on climate resilience principles and practices. The ASEEDS project is being piloted in Duck Hill, Mississippi, the largest rural town on the Rt. 51 corridor in North Montgomery County, Mississippi to improve the health and overall quality of life of its residents and position the area for economic growth through adaptation and resilience education, climate assessments, adaptation actions, and emergency planning.

### Duck Hill, Mississippi Community

The town of Duck Hill is a small rural town in north-central Mississippi, with the largest nearby cities being Memphis (105 miles south) and Jackson (95 miles north). The town was chartered in 1852 and received its name from the Choctaw Indian Medicine Man “Chief Duck.” As of 2016, the population was approximately 1500 residents (72% black or African American and 27% white), with a median household income of half the state average at \$21,000, and an unemployment rate of 10.2%.<sup>1</sup> This is well above the national unemployment average of 3.6%.<sup>2</sup>

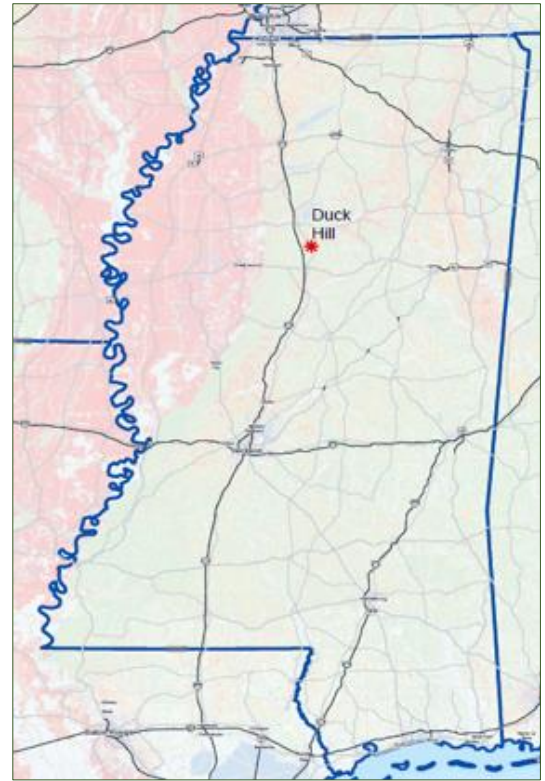


Figure 1. Context map, Duck Hill, Mississippi.  
Map credit: EPR PC

Duck Hill has been declining economically and has been experiencing extensive flooding due to poor stormwater and flood protection measures. Since 2018, ASEEDS project has installed both grey and green infrastructure systems to help with flooding around Main Street, constructed a water diversion system around the community gym and 5 very low-income seniors’ homes, and built a rain garden resulting in reduced flooding in the community. ASEEDS was able to show proof of concept in flood mitigation which has helped the most vulnerable areas in the town. Unfortunately, future climate-related extreme rain, flooding, heat, and drought events will continue to threaten resident’s health and local economy. To address long-term climate impacts, Duck Hill underwent a community vulnerability and adaptation strategy planning process. The results are a Climate Action Plan for Duck Hill to become a resilient and economically thriving community.

### Climate Action Planning Process

To develop a climate action plan, we first assess climate vulnerabilities and then develop adaptation strategies to reduce those vulnerabilities. Climate **vulnerability assessments** provide two kinds of information: (1) which resources/people/infrastructure are likely to be most affected by changing climate conditions, and (2) why these resources/people/infrastructure are likely to be vulnerable. Knowing what is vulnerable, enables community members and managers to develop and prioritize solutions and **adaptation strategies**, which

<sup>1</sup> U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates.  
[https://factfinder.census.gov/bkmk/table/1.0/en/ACS/16\\_5YR/DP05/1600000US2820260](https://factfinder.census.gov/bkmk/table/1.0/en/ACS/16_5YR/DP05/1600000US2820260). Accessed March 25, 2019

<sup>2</sup> Bureau of Labor Statistics; <https://data.bls.gov/timeseries/LNS14000000>

include community and city actions focused on coping with and adjusting to climate change vulnerabilities.<sup>3</sup> Community-driven climate vulnerability assessments and adaptation plans focus on promoting, enhancing, and sustaining community values and goals.<sup>4</sup> They are usually completed in three steps: 1) community visioning and listening, 2) vulnerability assessment and 3) adaptation strategy development (see Figure 1). These tasks may be accomplished via surveys, individual conversations, and/or organized community workshops.

**Step 1. Community Visioning and Listening: Define goals/values, understand assets and strengths, and define hazards, threats, and vulnerabilities**

This first step involves defining the goals, vision, and current strengths or challenges in the community. This initial assessment focuses on engaging with community members who can share knowledge of the strengths, values, assets, and unique aspects of the community. Community members also are asked about the hazards and perceived vulnerabilities of the community, including climate and extreme event threats. Community visioning/listening sessions include an opportunity to share information about climate change and the associated risks of extreme events with community members.

**Step 2. Climate Vulnerability Assessment: Consider how these interactions affect community vision and goals**

The community vulnerability assessment evaluates likely community impacts of climate change and extreme events and includes consideration of demographics, race, income and other socio-economic analysis. It looks at the adaptive capacity of the community and risks. This helps the community assess its climate and extreme event risks while sharing knowledge for the adaptation planning process.

**Step 3. Community Climate Adaptation Planning: Develop new or modify old strategies/actions/policy to overcome the vulnerabilities**

The community adaptation planning is a more thorough analysis of the current climate threats and how the community is currently dealing with those threats along with strategies on how the community plans to overcome them.

---

<sup>3</sup> Glick, P., B.A. Stein, and N.A. Edelson (Eds.). 2011. Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment. National Wildlife Federation, Washington, D.C. ISBN 978-0-615-40233-8

<sup>4</sup> Vogel, Jason et al. 2016. Climate Adaptation: The State of Practice in U.S. Communities, Report by Abt Associates for the Kresge Foundation.



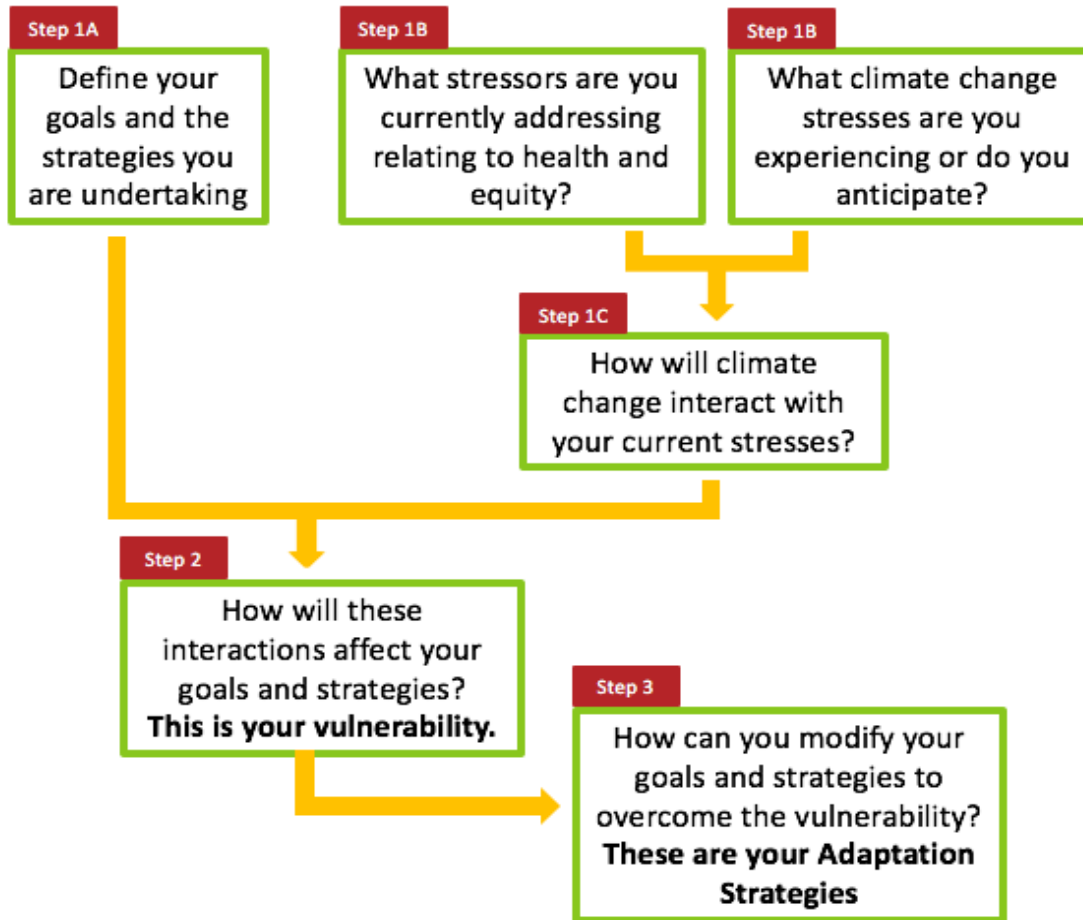


Figure 2. From SPRACC Rapid Climate Vulnerability Assessment

## Chapter 2: Climate Change Impacts in Mississippi

It is important to understand past trends and future projections for the major climate variables to prepare for changing conditions that will dictate the Duck Hill community's challenges and opportunities. There is limited climate data for Duck Hill, but there is enough information from the broader region to assess trends in climate over the next 100 years. Table 1 Climate Trends and Projections in Duck Hill, MS, summarizes the historic trends, future predictions, probable impacts, and level of confidence in these predictions. While these data and associated predictions are inherently uncertain, most published literature and climate models suggest a changing pattern for these climate variables in the Duck Hill region.

Important to note is the implications for impacts to human health by the forecast in rising air temperature and precipitation. It is well documented that air pollution (ground-level ozone) increases the amount and severity of respiratory illness and generally increases with air temperature. Further vector-borne illnesses from disease-carrying insects and harmful bacteria are correlated with increased temperature and flooding. These conditions could lead to increased hospitalizations, emergency room visits, and lost days of productivity, both from work and school.

## AIR TEMPERATURE

Perhaps surprisingly, the average air temperature in Mississippi has shown a downward trend over the last century. The warmest years were between the 1920s and 30s, while the coldest period was between the 1960s and 80s. Since this time average temperatures have shown a relatively stable trend. Model projections by the National Climate Assessment<sup>5</sup> indicate up to a 4-degree Fahrenheit increase in average temperature under a high-emission scenario. Under a lower-emissions scenario, average temperatures would likely still increase to a level proportionate with the warmest years over the last century. However, projected warming trends are uncertain given that the state has not experienced the 1.5-degree Fahrenheit average temperature increase like the rest of the continental United States. Theories to explain this include increased air particulates from coal-burning shading the region and agricultural irrigation cycles reducing the heat flux.

Projected increases in air temperature are likely to impact key economic and societal factors within the region. Livestock and Agriculture are the current lifeblood of the region, and studies have demonstrated that heat stress can reduce dairy and livestock production<sup>6</sup>. Therefore, these activities may become more difficult and less efficient in the Duck Hill area compared to areas further north, suggesting this region may experience an economic disadvantage without planning and action.

## PRECIPITATION

The amount, rate, and periodicity of rainfall is a significant factor in the area's environmental, socioeconomic, and health stability. Currently, Mississippi receives an average of 56 inches of precipitation per year, with higher amounts along the coast versus inland regions. The frequency and intensity of heavy precipitation events have increased across the United States since 1901. Projections for Mississippi depict averages consistent with those observed over the last decade in the region. That said, the pattern or periodicity of rainfall is projected to increase by 10% in Spring and 15% in Summer and Fall<sup>7</sup>. The potential for increased precipitation during these periods could lead to impacts associated with harvesting crops (access and disease) and health (waterborne disease). The confidence in these projections for Duck Hill specifically is reduced by the relatively low spatial distribution of weather and water quality monitoring stations throughout the region whose data were used in the model projections.

## DROUGHT

Mississippi's largely agricultural economy is dependent on available rainfall and/or water supply for irrigation. Water managers and meteorologists estimate that between the years 2000 and 2014 the State experienced drought conditions 45% of the time. While regional conditions are highly variable they found that 50% of the state experienced drought conditions for 12% of the time during the same period.<sup>7</sup> Because conditions and water requirements are so dynamic across the State and regions it is useful to understand the definition of drought and how it is categorized by the scientific community. Essentially drought is defined as a condition

---

<sup>5</sup> Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner, 2017: Precipitation change in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC.

<sup>6</sup> US Environmental Protection Agency, 2016. EPA 430-F-16-026. What Climate Change Means for Mississippi

<sup>7</sup> Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner, 2017: Precipitation change in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC

when precipitation in an area is below historical averages and leads to shortages for both the natural and built environment.

## EXTREME WEATHER

The climate variables and projections described above are based on historic conditions and relatively slow changes to them over time. Extreme weather events may add to or even mitigate the associated impacts. Nonetheless, it is important to understand the current trends and predictions for extreme weather events to incorporate in regional planning activities. Across the United States, heavy precipitation events leading to flooding have increased in both frequency and intensity since 1901. For the Southeastern United States, several researches have proposed increased levels of rainfall precipitation associated with hurricanes particularly over ocean regions in the Atlantic basin. These are the storms likely to influence Mississippi after landfall. In Mississippi, we can measure the number of extreme weather events by the number of US Federal Emergency Management Agency (FEMA) disaster declarations. During the period from 2005-2014, there were 13 FEMA disaster declarations<sup>8</sup>. Nine of these events were for severe storms and associated flooding while the remaining four were due to hurricane impacts. Climate scientists project that the trend of increased frequency and severity of tropical storms will continue in the region with associated increases to episodic flooding across the state. That said the confidence in these projections is tempered by the complexity of predicting tropical storm development and tracks as they are highly variable and influenced by other global weather patterns including El Niño–Southern Oscillation (ENSO) and the Pacific decadal oscillation (PDO).

The impacts of these extreme events are well understood by the region’s population who have lived through past events. From a longer-term community planning and infrastructure perspective, these events may increase nutrient pollution, soil erosion, failure of water treatment systems, and structural damage of homes and businesses.

## Chapter 3: Community Visioning and Vulnerability Assessment for Duck Hill, MS

The following are the results of the community surveys, visioning workshops, and the vulnerability workshop conducted with Duck Hill residents on September 26-27, 2018.

### Community Surveys

During each public meeting and community event held by ASEEDS, we surveyed participants to assess the needs and vulnerabilities of Duck Hill. We received 26 completed surveys between May and October 2018. Survey results confirmed that flooding was indeed the biggest hazard for Duck Hill, as almost 85% of survey respondents stated they experience flooding in their street, yard, or house. Among those, over 50% experience flooding every month, while almost 30% experience flooding quarterly. Comments from community members included:

- Quick heavy rains regularly create flooding on my street
- High waters make it hard to drive
- When it rains my yard floods
- Water runs down from the upside of my yard causing a lot of runoff
- Rain floods the side of the house
- Main Street in Duck Hill floods regularly

---

<sup>8</sup> FEMA Disaster Declarations by Year: <https://www.fema.gov/disasters/year>

- Some homes flood regularly during heavy rain
- Sometimes roads look like rivers during heavy rains causing road damage and erosion
- During rain, even ditches on each side of the road do not drain properly
- Flooding has caused my home to sink and push mud inside my home

Climate change views differed significantly. Almost 30% stated that they believe climate change is happening mostly because of natural changes in the atmosphere, while another 30% believe that climate change is happening because of human activity and natural changes. Only 8.7% believe that climate change is happening because of human activity such as burning fossil fuels, and less than 5% believe that climate change is not happening.

Even though survey respondents differed in the cause of climate change, 56% strongly agreed they were concerned about climate change while only 12% strongly disagreed. The extent of respondent concern is detailed as follows:

- Climate change will affect their family: 48% were very concerned, 43% slightly concerned, and 9% not concerned
- Climate change affecting their community: 62% were very concerned, 29% were slightly concerned, and 10% were not concerned
- Climate change affecting Duck Hill: 68% were very concerned, 24% were slightly concerned, and 8% were not concerned
- Climate affecting Mississippi: 59% were very concerned, 32% were slightly concerned, and 9% were not concerned
- Climate change affecting the United States: 59% were very concerned, 32% were slightly concerned, and 9% were not concerned
- Climate change affecting other countries: 52% were very concerned, 29% were slightly concerned, and 19% were not concerned

Additionally, over 80% of the survey participants believe that their actions to reduce the effects of climate change in the community will encourage others to take action as well. This is encouraging, as it suggests that the community is supportive of implementing a Climate Action Plan to increase community resilience and economic development of Duck Hill.

### Community Visioning and Vulnerability Assessment Workshop

Participants: *Darlene Ohl, Charles Houston, Vickie Rodgers-Ratliff, Billy Nash, David Perkins, Dorothy Woods, Alice Alexander, Larry Laster, Lyla Brown, Joey Cooley, Angela Cooley, Ida Corradine, Louis Esbring, Lakeda Coffey (Winona Times), Sue Stidham (MCEDP), Keith McGee, Michael Woods, Willie R Robinson, Henry Townsend Jr, Alex Score (EcoAdapt) and Lauren Lynch (EcoAdapt)*

Moderators: *Libby Crimmings (McClure Engineering) and Alex Holland (Independent Consultant)*

During the **Creative Place-Making Visioning** sessions, participants were asked two main questions to determine the vision and goals for Duck Hill, MS: 1) “What is unique about Duck Hill?”, and 2) “What is missing in Duck Hill?”. Responses to these questions included the following:

*What’s Unique about Duck Hill?*

- Location- close to highway
- Good people to work with, Sense of community - friendly people; Close knit community
- Committed youth
- Natural resources and green space (e.g., Bogue Creek)
- Rich farm land
- Chief Duck Hill/Duck Hill mountain
- Quiet country town
- Good city services
- Low murder rate
- Binford high school- historic building
- Historic figures- Lucie Campbell; Emmett Till (Poor People’s Campaign)
- Open area for development
- Bull Bottom Farms
- Dollar General also known as the local” Mall”
- ATV Recreation Park

*What is Missing in Duck Hill?*

- Food/ grocery/fresh fruit and vegetables
- Medical services
- Businesses (barber shops, laundromat, new industry)
- Schools
- Public transportation
- New fire truck and infrastructure
- Recreation activities (theater, movies, bowling alley)
- Affordable housing
- Sidewalks
- Training opportunities (workforce development, youth training)

## Community Climate Vulnerability Assessment Workshop

Participants: Jean Woods, Harold Hordin, Roy Worley, Miranda Wilson, Henry Townsend Jr., Charles Houston, Billy Nash, Romona Taylor-Williams, Melba Rodgers, Montina Bloodsaw, Benita Faye Cox, Faye Fox, Linda Bennet, Florence Miers, Shernell Evertt, Mersie Warkins, J. Monique Cooley, Billy Bloodshaw, Louis Meritt, Melvin Johnson, Charles Taylor, Michael Allen, Joe Southerland, Louis Esbring, Venetta Brown, Rosemary Everette, Keith McGee

Moderators: Alex Score (EcoAdapt) and Lauren Lynch (EcoAdapt)



Figure 3. ASEEDS Projects partners from left to right Suzanne Burnes, Al White, Shernell Everett, Charles Houston, Alex Score, Joe Sutherland, Romona Taylor-Williams, Laruen Lynch, and Monique Cooley

During the **Climate Vulnerability Assessment** workshop, Romona Taylor-Williams, Director of North Montgomery Community United for Prosperity and local point of contact, welcomed attendees to the event. She explained that this is the first of a series of climate change discussions in the region to ensure that Duck Hill becomes resilient to climate change and extreme events, and becomes thriving as a successful and vibrant community. Alex Score and Lauren Lynch from EcoAdapt presented on climate change science and current and future climate projections for the region. This was then followed up with a moderated discussion with participants using the following four questions:

1. What are Duck Hills' key assets or resources?
  - Duck Hill churches
  - Elderly - affected by heat
  - Highway/roads-
  - Forests/trees- prevents/mitigates erosion
  - Lagoons- cleans water
  - Homes/personal infrastructure
  - School gym
  - New wells
  - Energy
2. What are the current weather or climate hazards in the town/region? Katrina-sized hurricanes; strange weather
  - Asthma increase
  - Earthquake
  - Survival of the town
  - Infrastructure
  - Flooding
  - Health
  - Economic change
3. What are the extreme weather and climate change impacts?
  - Insurance company telling residents to remove trees (due to downed trees on the property during major storms)
  - Trees dying due to heat/flooding
  - Ditch flooding due to debris and increased water
  - Railroad- cannot change culverts
  - Health can be affected by flooding
  - Blocking course of floodwater
  - Energy grid/power outage
  - Access to healthcare
  - Agriculture
  - Food access
  - No emergency management plan
4. What are the emerging opportunities, values, and/or assets from these impacts?
  - Solar energy for a possible community center/future cooling center
  - Reduce open burning
  - Recycling
  - Erosion protection on hills
  - Possibility of an ordinance against tree removal



- Green infrastructure/Nature-Based Adaptation
- Retention ponds
- River/ recreations/trails
- Duck Hill Mountain trails
- Climate Action Plan will lead to marketing opportunities

The **Duck Hill Vulnerability Assessment** was derived from workshop results and participant input during the Creative Place-Making sessions and Climate Vulnerability Assessment workshops. The vulnerability assessment includes the following overall results (see full assessment results in Table 2).

ASSET/RESOURCES	CLIMATE VULNERABILITY
Critical Infrastructure	High Vulnerability
Health Care Access/Hospital	High Vulnerability
Route 51	High Vulnerability
Binford High School & gym	Medium/High Vulnerability
Residential Homes	Medium/High Vulnerability
Elderly residents	Medium/High Vulnerability
Church/Historical sites	Medium Vulnerability
Affordable Housing	Medium Vulnerability
Energy Efficiency	Medium Vulnerability
Open Space and Parks	Medium Vulnerability
Agriculture	Medium Vulnerability
Bogue Creek	Low Vulnerability

## Chapter 4: Adaptation Strategies and Feasibility Assessment

The following are the results of the stakeholder and community climate action workshops held on July 26 and 27, 2019 with Duck Hill and surrounding towns. Objectives of the workshops were to:

1. Understand connections between extreme weather events and local planning and actions in Duck Hill;
2. Identify individual and community vulnerabilities; and
3. Develop and prioritize actions and opportunities that reduce vulnerabilities and reinforce strengths for the community.

### Climate Action Workshops

Participants: Kameisha Smith, Justice Grisby, Shan Terrius Sly, Rodreckeanne Barnes, Kaniya Smith, JeraKayah Smith, Urban Know, Thomas Gee, Dianna Freelen-Foster, J.C. Stokes, Mersie Watkins, Caydence Jennings, Ashley Mcarskill, Lurean Stokes, Letraneshia James, Al White, Willie Famres, Cristina Seul, Emily Carroll, Ellen Reddy. , Charles Houston, Elizabeth Englebreton, Bertha Mae Burt, Zamaia lakeisha Lassha Burt, Adrenna Neicole Collins, Darlena Allen, Johnnie Gholston, and James Burch

Facilitators: Alex Score (EcoAdapt) and Lauren Lynch (EcoAdapt)

Workshops started with discussions on climate and hazards impacts in the community. Participants were asked how important each statement was:

Priorities	Very Important	Somewhat important	Neutral/Not Important
1. Protecting private property	43%	57%	-
2. Protecting critical facilities (transportation networks, hospitals, fire stations, etc.)	100%	-	-
3. Preventing development in hazard areas	100%	-	-
4. Enhancing function of natural assets (streams, wetlands, creeks, etc.)	71%	29%	-
5. Protecting historic and cultural landmarks	86%	14%	-
6. Protecting and reducing damage to utilities	86%	14%	-
7. Strengthening emergency services (police, fire, ambulance, etc.)	57%	43%	-
8. Promoting cooperation among public agencies, citizens, non-profits, academia, and businesses	86%	14%	-

100% of participants thought that protecting critical facilities and preventing development in natural hazard areas was very important. Only 43% of participants thought it was very important to protect private property, while 57% thought it was somewhat important. This is probably because many private properties are rented, and many do not own their own homes. 86% of participants thought it is very important to protect historic and cultural landmarks, protect and reduce damage to utilities, and promote cooperation among public agencies, citizens, non-profits, academia, and businesses.

Other priorities for the community included:

1. Need for a mobile 911 system
2. Developing a county emergency management plan

Participants were then asked to review the key assets and resources vulnerability assessment and identify strategies and adaptation solutions and were asked the following questions in small groups:

- Are there any other keys assets/resources that are vulnerable to extreme weather events? (examples: food access, potable water, energy, transportation, emergency housing, green space)
- What solutions or strategies can be implemented to reduce the vulnerability of each key asset?




























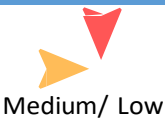
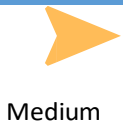
- Using high , medium , and low  parameters:
  - What is the ability to increase resilience to the solution/strategy?
  - What is the economic feasibility of the solution/strategy?
  - What is the environmental impact of the solution/strategy?
  - What is the ability to implement the solution/strategy? (Consider resources, time, and costs)



Figure 4. Workshop participants voting on priority adaptation solutions for Duck Hill and surrounding areas.

Participants added five more keys assets for Duck Hill and the surrounding area to be considered as part of the Climate Action Plan: education, cultural heritage, historical landmark preservation, voting rights, and census participation, and emergency services. Participants created 50 solutions for decreasing the vulnerability to the identified assets and then prioritized the top 25 solutions through a voting process (See full recommendations on Table 3).

ASSET/ RESOURCES	PRIORITY STRATEGIES	ABILITY TO INCREASE RESILIENCE	ABILITY TO IMPLEMENT
Energy Efficiency	<ol style="list-style-type: none"> <li>1. Educate residents on available energy efficiency programs and retrofitting homes</li> <li>2. Use existing program and resources such as “Low Income Home Energy Assistance Program” (LIHEAP) for weatherization for seniors and veterans</li> </ol>	  Medium/ High	  Medium/ High
Open Space and Parks	<ol style="list-style-type: none"> <li>3. Encourage less manicured grass and more natural yards</li> <li>4. Set up a community land trust and invest in the conservation of land and parks</li> <li>5. Plan community gardens, natural yards and hoop house for winter growing</li> <li>6. Build public parks for youth and to drive sustainability and economy</li> </ol>	  Medium/ High	  Medium/ High
Agriculture	<ol style="list-style-type: none"> <li>7. Train farmers on sustainable and climate-resilient farming, crop rotation, and other methods to prevent soil erosion</li> <li>8. Farm locally for food access and healthy options</li> </ol>	  Medium/ High	  Medium/ High
Education	<ol style="list-style-type: none"> <li>9. Teach climate change solutions in schools, libraries, and/or churches to promote local action</li> <li>10. Work with the community to implement community outreach- “each one reach one” to pass on knowledge of sustainability and climate solutions</li> <li>11. Implement “Farm to School” programs</li> <li>12. Start recycling and composting education programs</li> </ol>	  Medium/ High	  Medium/ High
Voting Rights and Census	<ol style="list-style-type: none"> <li>13. Ensure you are counted in the census</li> <li>14. Vote on all elections and get an identification card and/or driver’s license</li> </ol>	  Medium/ High	  Medium/ High
Bogue Creek	<ol style="list-style-type: none"> <li>15. Clean up and restore for erosion protection</li> <li>16. Conservation of lands around creeks to prevent sedimentation</li> <li>17. Dredge creek tributaries and make water reservoirs to prevent flooding during extreme events</li> <li>18. Map tributaries for public awareness</li> </ol>	 High	 Medium
Churches	<ol style="list-style-type: none"> <li>19. Use churches as short term cooling centers</li> <li>20. Connect churches to lead community resilience and connect to the scripture “Green Bible”</li> <li>21. Develop an emergency plan with churches to help and check on community members after a disaster</li> </ol>	 Medium	 Medium

ASSET/ RESOURCES	PRIORITY STRATEGIES	ABILITY TO INCREASE RESILIENCE	ABILITY TO IMPLEMENT
Cultural Heritage	22. Preserve Duck Hill’s cultural heritage by “Sharing Stories” on farming, food reservation, midwifery, and other traditional cultures 23. Share through technology and youth 24. Promote Duck Hill’s history to preserve landmarks and encourage tourism 25. Promote cooperation through rural churches	 Medium/ Low	 Medium

## Chapter 5. Next Steps and Recommendations

The next step is to start implementing the recommended solutions and strategies of this Climate Action Plan by incorporating priorities into the Sustainability Mission Statement Resolution adopted August 31, 2017, into a revised Township of Duck Hill, 1975 Zoning Plan (See Appendix A). During the workshops, ASEEDS project managers also expressed the desire to highlight impacts and recommended strategies for health, housing, transportation, and job opportunities for community members to consider when developing a revised plan for the Township of Duck Hill. The following are some recommendations for Duck Hill, MS and the region to consider adopting.

### Health Impacts and Recommended Strategies

Climate change is likely to impact the health of Duck Hill residents by increasing the risk of heat-related illness and vector-borne diseases, exacerbating asthma and other chronic illnesses due to reduced air quality, and further reducing access to health care services during and after extreme events, among other impacts.

**Recommendation 1:** Maintain public cooling centers and hydration stations throughout heat season, and partner with community organizations to promote their use and warn the public about extreme heat risks

- Work with public agencies and local businesses to make more air-conditioned spaces available for extended hours during extreme heat events
- Work with indoor, air-conditioned recreational facilities to provide access and reduced fees to low-income individuals.
- Make transportation to cooling centers more accessible for homebound individuals
- Ensure there is adequate outreach to communities and vulnerable populations to increase awareness of cooling centers and other resources available during extreme heat events

**Recommendation 2:** Develop an early warning system to notify the community of high-risk situations (e.g., episodes of poor air quality, extreme heat events), with information about reducing exposure, checking on neighbors and family members, and accessing resources (e.g., cooling centers)

- Prepare information in multiple formats (e.g., print, radio, television, webpage, social media) and languages, that is also accessible for people with disabilities

**Recommendation 3:** Increase public awareness around the health-related risks of climate change, including how to stay safe and healthy during and after extreme events

- Incorporate climate change into materials and media messages (e.g., public health alerts, health advisory announcements, educational materials) to increase awareness of climate change as a public health issue. Examples include:
  - Hot and humid summer weather can cause heat illness and even death. As climate change causes increasing temperatures around the world, our area can expect to experience more heat events like this.
  - Heavy rain causes flood waters to rise and pool on streets and throughout neighborhoods. As climate change increases the potential for more intense storms and related flooding, we need to be even more prepared. In these situations, be aware of the following:
    - Rapid flowing water can sweep you off your feet and your vehicle downstream- beware of drowning
    - Floodwaters can hide rocks, trees, and debris that can harm a person or vehicle if trying to get by
    - Floodwater may rise quickly, make sure to get to higher ground quickly
    - Be extremely cautious at night as it is harder to see storm damage
  - Reduce the number of mosquitoes inside your home by patching, repairing or replacing screens with holes or screens that don't fit tightly to the door or window frame. Climate change is altering mosquito habitat ranges and breeding patterns, which may bring them closer to your home.
- Encourage health care facilities to put up posters regarding the impact of climate change on allergies, asthma, heart health, and other issues: <http://climatehealthconnect.org/resources/posters/>
- Educate communities—in multiple languages and via various media formats—on the rising risks of allergens, and how to minimize exposure (e.g., keep windows closed), reduce allergy symptoms, and manage asthma.
  - Check pollen levels frequently—individuals can sign up for free alerts at [National Allergy BureauTM](#)
  - Advise community members with respiratory and heart disease to check the [Air Quality index](#) for unsafe ozone and particulate levels and reduce outdoor activity accordingly, particularly during heatwaves
- Ensure that community members are informed about medications that may increase the risk of heat illness (e.g., psychotropic medications, diuretics, tranquilizers, some antibiotics, some medications for Parkinson's disease) as well as medications that may lose effectiveness if exposed to high temperatures (e.g., insulin).
  - See Polk County, Iowa's medications and heat handout for an example of effective public outreach on this topic

**Recommendation 4:** Identify at-risk individuals (e.g. limited mobility, socially isolated) and residences (e.g. skilled nursing and assisted-living facilities) and develop proactive strategies to address their needs in an extreme event.

- Work with local facilities that serve vulnerable populations (e.g., nursing homes, senior centers, camps, schools, child care providers, homeless services) to ensure plans are in place for extreme heat events, poor air quality days, and increased risk of waterborne/vector-borne diseases

**Recommendation 5:** Change the frequency or location of monitoring and surveillance programs to detect changes in the geographic range or incidence of vectors (e.g. *Aedes aegypti*) and vector-borne diseases.

- Collaborate with vector control agencies to assure the availability of increased mosquito monitoring following extreme precipitation and flood events.
- Collaborate with efforts on preparedness, communicable disease, and vector control to ensure plans to adequately monitor for the introduction and spread of mosquito species new to your jurisdiction (e.g. *Aedes aegypti*)
- Prepare an outreach plan for implementation at the first detection of invasive sp. mosquitoes

**Recommendation 6:** Address mosquito protection to reduce vector-borne disease risk.

- Increase public education about protection against mosquito-borne illnesses, including the use of insect repellent, clothing, and home window screens
- Promote the use of screens and other mosquito deterrents for water storage vessels and rainwater harvest/catchment systems to prevent the spread of mosquito-borne illness
- Educate pool and spa owners about the risk of mosquito breeding in poorly maintained swimming pools, spas, or backyard ponds
- Train building inspectors, sanitation workers, code enforcement workers, and others to look for even small amounts of standing water that would allow vector reproduction
- Collaborate with public works, housing, zoning, and building agencies to upgrade codes and enforcement:
  - Require screens on home doors and windows, including rental properties and multi-family housing
  - Ensure that rain water collection systems include adequate screening
  - Require businesses that sell tires and other mosquito breeding receptacles to keep them inside or covered (e.g. with awning)

**Recommendation 7:** Collaborate with public works, parks and recreation, urban forestry, planning, and community-based organizations to increase tree canopy over streets, sidewalks, and parking lots to reduce high temperatures and air pollution.

- Establish policies to ensure that allergens are considered when selecting trees so that less allergenic trees and plants are used when possible and that tree species are used to minimize the risk of an allergic response to large amounts of a particular pollen

**Recommendation 8:** Work with the air district and local community-based organizations to deploy inexpensive real-time air monitors that will provide online data on regional air pollution levels and more detailed information about air quality.



## Housing Impacts and Recommended Strategies

Climate change is likely to further increase the frequency and severity of flooding, heat waves, and other extreme events that already affect many homes within Duck Hill. However, housing or neighborhood improvements have the potential to significantly improve the safety and comfort of residents.

**Recommendation 1:** Plant trees within residential neighborhoods to provide shade, capture stormwater, and reduce air pollution

- Plant large deciduous trees on the west side of homes to receive maximum cooling benefits
- Plant solar-friendly trees (i.e., species such as black/honey locust that allow light to penetrate while still providing shade) on the southeast or southwest side of homes to provide summer shade while also allowing winter sun to reach the building
- Use trees to shade air conditioning units, which allows them to run more efficiently
- Ensure that trees are selected or placed so that they do not block solar panels (or potential future installation of solar panels)
- Create city-wide or county-wide programs that provide financial and technical support for tree planting on private property
  - Examples:
    - [Tree Northampton](#) (Massachusetts) is a non-profit run by private citizen volunteers that plant and care for trees across the city. They give away trees to residents on Earth Day and are creating a nursery to grow hard-to-find urban tree species within a local community garden.
    - The City of Kelona (California) has a “[Neighbourwoods](#)” program run through the Department of Parks and Recreation, which funds tree planting on private properties. For example, residents can buy trees for \$40 in celebration of Earth Day in April.
  - General resources:
    - [Urban forests: A climate adaptation guide](#)
    - [Urban Forestry Toolkit](#) from the Vibrant Cities Lab (resources, case studies)

**Recommendation 2:** Reduce stormwater runoff within residential neighborhoods that flood frequently

- Create rain gardens to capture stormwater and then allow it to soak slowly into the ground.
  - Examples:
    - [The Vermont Rain Garden Manual “Gardening to Absorb the Storm”](#)
    - [Rain Garden Alliance](#) website (western Pennsylvania)
    - [Raingarden Action in Neighborhoods](#) (RAIN) website
- Increase the use of permeable surfaces (e.g., mulch, native groundcover, paving stones layered over a sand base) for sidewalks, driveways, and parks/playgrounds
- Retain existing trees and shrubs wherever possible, as the deep root systems of established plants allow rainwater to infiltrate deep into the ground
- Build organic matter within soils by adding compost and reducing the raking and collection of leaves.

**Recommendation 3:** Advocate for building codes that encourage the use of gray water, and work with Environmental Health and building inspectors to ensure prevention of cross-contamination to water sources used for drinking or vegetable garden irrigation.

**Recommendation 4:** Improve weatherization in businesses and homes

- Work with businesses and residents on a weatherization program
  - Resources:
    - <https://www.epa.gov/arc-x/outdoor-and-indoor-air-adaptation-strategies-climate-change#tab-2>
    - <https://www.epa.gov/indoor-air-quality-iaq/adapting-buildings-indoor-air-quality-changing-climate>

**Recommendation 5:** Connect low-income residents to existing energy efficiency and weatherization programs, such as the [Low Income Home Energy Assistance Program \(LIHEAP\)](#) and the [Weatherization Assistance Plan](#)

- Partner with local housing and code enforcement departments, home visiting agencies, and community-based organizations to improve awareness of and access to these programs

**Recommendation 6:** Work with utilities and other agencies to inform residents about and ensure enforcement of “disconnection rules” that prohibit electricity cut-offs in Mississippi when the National Weather Service has issued extreme heat or freeze warnings

- State disconnection policies: <https://liheapch.acf.hhs.gov/Disconnect/disconnect.htm>

**Recommendation 7:** Educate elected officials and residents on the impacts of climate change and health impacts from mold

- Develop outreach materials for residents that explain how to properly address in-home dampness and flooding
- Provide impacted communities with information about flood-related hazards (e.g., mold risks, sewage contamination) and guidelines for reentering homes after flooding
  - Remind individuals to NEVER turn the power on or off or use an electric tool or appliance while standing in water
  - Provide information about the risks of sewage contamination and mold for individuals whose homes are flooded
  - Educate individuals on indoor air quality concerns following flooding
  - Provide information on mold prevention and treatment options, including preventing mold by washing surfaces with water and detergent and wearing an N95 mask while treating mold
  - Provide safety guidelines for drying out and cleaning flooded homes
  - Provide information about tenant and landlord responsibilities and how to select a professional contractor

**Transportation Impacts and Recommended Strategies**

Climate change is likely to directly damage or disrupt the use of roads and other transportation infrastructure. Flooding is already impacting Duck Hill residents by limiting travel on Route 51 during and after storm events, and further increases in extreme precipitation and associated flooding are likely to damage roads and stormwater infrastructure (e.g., culverts) and delay or prevent travel. Other climate-related impacts may include downed trees or powerlines following high wind events and damage to asphalt roads from extreme heat.

**Recommendation 1:** Incorporate future climate change projections into siting and design of all new transportation infrastructure (e.g., roads, culverts) and significant retrofits and repairs

- Consider projected changes in stormwater volume over the expected life span of the project. For instance, a culvert may have an expected life span of 75 years, so the structural design should consider climate conditions over that time period
- Ensure that water is diverted from transportation infrastructure is not concentrated in another area.
  - Examples:
    - [Climate vulnerability and economic assessment for at-risk transportation infrastructure in the Lake Champlain Basin, New York](#) (report)
    - [Extreme Rainfall Analyses Can Point to Right Size for Culverts](#) (case study)
    - [Rebuilding Roads to Maximize Resilience](#) (case study)

**Recommendation 2:** Inventory existing bridges and culverts that should be upsized to accommodate future expected stream flows

- Consider vulnerability to flooding as well as the importance of a given road for evacuation or access to critical services (e.g., hospital, fire station, police station)
  - Example: [Climate vulnerability and economic assessment for at-risk transportation infrastructure in the Lake Champlain Basin, New York](#) (report)

**Recommendation 3:** Reevaluate the service life of transportation infrastructure under future climate conditions and increase the frequency of routine inspections accordingly

**Recommendation 4:** Stock up on replacement parts for vehicles and equipment needed for emergency weather

**Recommendation 5:** Create and communicate clear evacuation routes in the event of flash floods or other extreme events

- Ensure that evacuation plans consider people who do not own a car, are elderly or disabled, speak languages other than English, etc.

**Recommendation 6:** Improve stormwater management to reduce the risk of road/street flooding

- Expand use of green infrastructure such as rain gardens, swales, and porous pavement for stormwater control
- Conduct roadside clean-ups to remove debris that blocks the flow of water

**Recommendation 7:** Plan for expansion of complete streets that accommodate biking, walking, and public transit to promote safe and enjoyable alternatives to car transportation while also reducing vehicle emissions

- [Complete Streets Fight Climate Change \(factsheet\)](#)
- [Smart Growth America National Complete Streets Coalition](#) (an organization that provides information and support for the implementation of Complete Streets programs)
- [Complete Streets in the Southeast: A Toolkit](#) (report, includes regional examples)
- [Urban Forestry Toolkit: Transportation](#) from the Vibrant Cities Lab (includes resources, case studies, and information about how street trees benefit communities)

## Job Opportunities and Recommendations

Climate change will also open new job opportunities in the region. These provide opportunities for the region to promote new green industries and help other regions with climate change adaptation needs.

**Recommendation 1:** Support on-site renewable energy development for existing landowners (e.g., farmers, businesses)

- Explore the use of federal tax credits (e.g., Tax Credit for wind farm development) that would provide an economic incentive to landowners
- Explore the use of property tax credits or exemptions for new infrastructure and property improvements for 3-5 years to encourage the development of renewable energy resources that will support community economic development over longer time scales
  - Example: [Oregon Rural Renewable Energy Development program](#) that allows cities or counties to set up energy development zones outside of urban areas (website includes details and additional resources)

**Recommendation 2:** Support value-added farm and forest products processing to reduce the financial risk of climate change by diversifying income streams while also creating jobs for other community residents





- Develop producer-owned processing and/or manufacturing cooperatives

**Recommendation 3:** Prepare residents for meaningful work in the green economy through training programs and pathways to jobs in manufacturing, construction, landscaping, installation, maintenance, etc.

- Integrate green jobs planning and preparation into youth career development and training, such as retrofitting buildings to increase energy efficiency or installing renewable energy infrastructure
  - Resource: <http://www.iff.org/publications/green-career-pathways-framework-postsecondary-and-employment-success-low-income>
- Partner with schools, community college districts, unions, and local trade organizations and green industries to develop green job apprenticeship and pipeline programs.
  - Example: The [Oakland Green Jobs Corps](#) was developed to provide green job training and employment opportunities for low-income residents while also meeting the needs of local green businesses (case study)
  - Resource: [Career Pathways Action Guide: Achieve tree equity through urban forestry jobs training](#) (toolkit)

## List of Tables

Table 1. Climate Trends and Projections in Duck Hill, MS

Climate Variable	Observed Change	Future Projections	Confidence	Impacts
<b>Air temperature</b>  	<b>Mississippi</b> > Very little overall warming trends in near-surface air temperatures between 20 <sup>th</sup> and beginning of the 21 <sup>st</sup> > Average temperature in Jackson, MS decreased by 2.1°F the last century > Temperatures in Mississippi were warmest in the 1920s and 1930s and coolest in the 1960s through the 1980s	<b>Mississippi</b> > By 2100, possible increase in Mississippi of 2°F in winter and summer (with a range of 1-4°F), 3°F in spring (with a range of 1-5°F), and 4°F in fall (with a range of 2-6°F) > By the end of the 21st century temperatures would average about as warm as hottest historical year under a lower emissions scenario and about 4°F warmer than the hottest historical year under a high emissions scenario	<b>High confidence in trend direction</b> > However, magnitude of change varies by greenhouse gas emission scenario (lower for B1 and higher for A2) > No overall warming trends in MS (compared to +1.5°F in the rest of the U.S.), possibly due to increased air particles from coal burning, natural factors related to forest re-growth, decreased heat flux due to irrigation, and multi-decadal variability in North Atlantic and tropical Pacific sea surface temperatures	<b>Agriculture</b> > Reduced dairy and livestock production due to heat stress > Decreased yield in dairy farming milk production due to optimal production range is between 40°F and 75°F > Possible 10% decline in livestock yield > Reduced crop productivity due to summer heat stress, especially when coupled with drought  <b>Health</b> > Increased ground-level ozone is an air pollutant that is harmful to human health and which generally increases with rising temperatures > Possible increase in vector-borne (like disease carrying insects) and zoonotic (animal to human) diseases due to increased temperatures making favorable transmissions (example: malaria, dengue, zika, ticks etc.) > Increase in hospital admissions due to respiratory illnesses, emergency room visits for asthma, and lost school days is expected
<b>Precipitation</b>  	<b>Mississippi</b> > Statewide average annual precipitation is about 56 inches, ranging from 50 inches in the north to about 65 inches along the coast. > Heavy precipitation events in most parts of the United States have increased in both intensity and frequency since 1901	<b>Mississippi</b> > Precipitation is estimated to change little in winter, increase by 10% in spring (with a range of 5-20%), and 15% in summer and fall (with a range of 5-25%). > The annual number of extreme precipitation events (days with more than 3 inches) has been near the long-term average (1.5 events per station per year) in the last decade.	<b>Medium confidence in trend direction and magnitude</b> > Sensitivity of observed precipitation trends to the spatial distribution of rain fall observing stations and to historical changes in station location, rain gauges, the local landscape, and observing practices	<b>Agriculture</b> > Increasing fall precipitation may result in difficulties in harvesting crops, more runoff when fields are not protected.  <b>Health</b> > Possible increase in vector-borne (like disease carrying insects) and zoonotic (animal to human) diseases due to increased temperatures making favorable transmissions (example: malaria, dengue, zika, ticks etc..)






























Climate Variable	Observed Change	Future Projections	Confidence	Impacts
<b>Drought</b> 	<b>Mississippi</b> > Only been completely drought-free for approximately 45% of the time from 2000 to 2014 and has had at least 50% drought coverage for approximately 12% of the time during the same period	<b>Mississippi</b> > Projected to see an increase in severity of widespread summer drought of almost 140 percent by 2050 > Increase the rate of loss of soil moisture during dry spells, increasing the intensity of naturally occurring droughts	<b>Medium confidence in trend magnitude and direction</b> > Sensitivity of observed precipitation trends to the spatial distribution of rain fall observing stations and to historical changes in station location, rain gauges, the local landscape, and observing practices	<b>Agriculture</b> > Decreased water availability will likely have important implications for the region and state's agricultural economy
<b>Extreme weather</b> <b>Intensity Activity</b> 	<b>United States</b> > Heavy precipitation events in most parts of the United States have increased in both intensity and frequency since 1901. <b>Southeastern United States</b> > Several studies have projected increases of precipitation rates within hurricanes over ocean regions, particularly for the Atlantic basin  <b>Mississippi</b> > Between 2005 and 2014, a total of 13 FEMA disaster declarations were awarded to the state, 9 of which were for severe storms, tornadoes, and flooding events and the other 4 declarations were awarded in response to hurricanes	<b>Southeastern United States</b> > Extreme rainfall events will be correlated with tropical storm activity (see below), but are likely to increase in frequency and intensity during the 21st century > Amount of precipitation increased 27% and trends are likely to continue > Increased storm intensity resulting in extreme precipitation events. > Potential for increased hurricane winds and rainfall rates	<b>Moderate confidence in trend direction and low confidence in trend magnitude</b> > Tropical storm tracks and extreme rainfall projections are highly variable based on land form, ENSO/PDO patterns, and other factors. > The region exhibits high inter-annual variability in storm activity	<b>Flooding</b> > Increase extreme precipitation events may result in larger quantities of surface runoff • Larger sediment transport capacity and stream bank erosion, more local flooding, ditch and biological treatment systems are less able to process nutrients, increased rainfall erosivity and likely less soil moisture  <b>Wild Fires</b> > Increased fire frequency that could possibly decrease fire intensity, most likely caused by increased lightning strikes.



Table 2. Vulnerability Assessment for Duck Hill, MS

Key Assets or Resources	Weather or Climate Hazard	Potential or Historical Consequences	Climate stressors and trend	Non-climate stressors and trend	Potential tipping point and probability (probable, increasingly probable, decreasingly probable, improbable)	Sensitivity or Consequence (high, medium, low)	Adaptive Capacity/ Coping Capacity (high, medium, low)	Vulnerability (high, medium, low)
 Binford High School & Gym	 Heavy precipitation on events	Flooding in the street, inside the gym, and surrounding building area	Heavy rain events; increasing	Large parking lot uphill from building's main door; decreasing as parking lot deteriorates	Community exhaustion with the problem; has required closing the building which need lots of retrofit and	 High	 Medium	 Medium / High
 Residential Homes	 Heavy precipitation on events	Flooding in homes, street and surrounding building area	Heavy rain events; increasing	Increased flooding due to ditches not properly flowing with garbage and	Probable increasing, (need to find funds to support)	 High	 Medium	 Medium / High
 Elderly Residents	 Heat waves	Heat-related illnesses, death	Warmer nights with little opportunity to cool down;	Lack of air conditioning and limited mobility; continuing	Probable increasing with summer temperatures increasing and lack of air conditioners and cooling centers	 High	 Medium	 Medium / High
 Church/ Historical Sites	 Flooding	Possible flooding in the yard and not being able to attend	Heavy rain events; increasing	Sidewalks in poor condition, front area flooding; parking lot flooding	Probable increasing with extreme rain and flash flooding	 Medium	 Medium	 Medium

Community Driven Climate Resilience Plan, Duck Hill, Mississippi

Key Assets or Resources	Weather or Climate Hazard	Potential or Historical Consequences	Climate stressors and trend	Non-climate stressors and trend	Potential tipping point and probability (probable, increasingly probable, decreasingly probable, improbable)	Sensitivity or Consequence (high, medium, low)	Adaptive Capacity/ Coping Capacity (high, medium, low)	Vulnerability (high, medium, low)
 Bogue Creek	 Overflooding	Possible breaching and flooding of roads	Heavy rain events; increasing	Needs to be cleaned for better flow and access	Probable increasing with extreme rain events	 Medium	 High	 Low
 Route 51	 Flash flooding	Temporary or permanent road closure	Heavy rain events; increasing	Riverbank hardening upstream reduces sediment supply, increasing scouring power at high water	Highway department declares bridge unsafe; increasingly probable; will shut down food access	 High	 Low	 High
 Affordable Housing	 Extreme heat and local flooding	Lack of housing	↑urban heat due to ↑ temperatures and loss of tree canopy; ↑ utility costs; Insufficient/ inefficient HVAC	Increased house prices	Community residents move away from Duck Hill to find alternative options	 High	 Low (need to find funds to support)	 Medium
 Energy Efficiency	 Extreme heat and local flooding		↑urban heat due to ↑ temperatures and loss of tree canopy; ↑ utility costs; Insufficient/ inefficient HVAC	Increased cost of energy	Community residents move away from Duck Hill to find alternative options	 High	 Low (need to find funds to support)	 Medium

Community Driven Climate Resilience Plan, Duck Hill, Mississippi


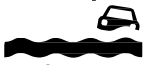












































































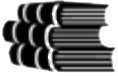
























Key Assets or Resources	Weather or Climate Hazard	Potential or Historical Consequences	Climate stressors and trend	Non-climate stressors and trend	Potential tipping point and probability (probable, increasingly probable, decreasingly probable, improbable)	Sensitivity or Consequence (high, medium, low)	Adaptive Capacity/ Coping Capacity (high, medium, low)	Vulnerability (high, medium, low)
 Critical Infrastructure	 Flash flooding	Temporary outages	Heavy rain events; increasing	Increased cost of energy/water	Utilities retrofit to become more resilient	 High	 Low	 High
 Health Care Access/Hospital	 Flooding/ increased heat	Electrical outage due to back up generators in basement	Heavy rain events, consecutive days of rain causing public health problems such as vector borne diseases and	Health Care/ Hospital is 30-40 minutes away; might not be accessible during extreme events	Inaccessible and no emergency 911 system for support	 High	 Low	 High
 Open Space and Parks	Landscaping may die off due to drought, fires and/or pests)		Increased drought in growing season and changes in precipitation	Invasive plants	Potential loss of interest in community gardens	 Medium	 High	 Medium
 Agriculture	Agriculture may decrease due to soil loss, drought, fires and/or pests)		Increased drought in growing season and changes in precipitation		Loss of income, increasingly probable	 Medium	 Medium	 Medium

Table 3. Adaptation Strategies and Feasibility Assessment for Duck Hill, MS

Key Assets	Community Solutions/ Recommendations	Ability to increase resilience	Economic feasibility	Environmental impact	Ability to implement
 Binford High School & Gym	<ul style="list-style-type: none"> <li>Develop community gardens to divert rain water and provide healthy food for the community</li> <li>Build rain gardens with natural (not manicured) yards</li> <li>Provide place for recreation center for youth and elderly</li> </ul>	 High	 Medium/ High	 Low	 High
 Residential Homes	<ul style="list-style-type: none"> <li>Collect leaves and compost to help promote water flow through ditches</li> <li>Educate elected officials and residents on the impacts of climate change and health impacts from mold</li> <li>Promote rain gardens and rain barrels</li> </ul>	 High	 Medium	 Low	 High
 Elderly Residents	<ul style="list-style-type: none"> <li>Cooling centers both at the county and local level</li> <li>Develop an action plan for assistance of elders and veterans after extreme events</li> </ul>	 Medium	 Medium/ High	 Low	 Medium
 Church	<ul style="list-style-type: none"> <li>Use churches as short term cooling centers</li> <li>Connect churches to lead community resilience and connect to the scripture "Green Bible"</li> <li>Develop an emergency plan with churches to help and check on community members after a disaster</li> </ul>	 Medium	 Medium	 Low	 Medium
 Bogue Creek	<ul style="list-style-type: none"> <li>Clean up and restore for erosion protection</li> <li>Conservation of lands around creeks to prevent sedimentation</li> <li>Dredge creek tributaries and make water reservoirs to prevent flooding during extreme events</li> <li>Map tributaries for public awareness</li> </ul>	 High	 Low (need to find funds to support)	 Low	 Medium
 Route 51	<ul style="list-style-type: none"> <li>Roadside clean-ups to remove debris and prevent water flow blockage</li> <li>Create clear flash flooding/extreme event evacuation routes</li> </ul>	 Medium	 Low	 Medium	 Low

Community Driven Climate Resilience Plan, Duck Hill, Mississippi

Key Assets	Community Solutions/ Recommendations	Ability to increase resilience	Economic feasibility	Environmental impact	Ability to implement
 Affordable Housing	<ul style="list-style-type: none"> <li>Partner with rural programs to help with mobile homes</li> <li>Prioritize energy efficiency multi-family affordable housing</li> <li>Help educate elderly on how to transfer land to family to take advantage of federal and state resources</li> </ul>	 High	 Low	 Medium/ High	 Low
 Energy Efficiency	<ul style="list-style-type: none"> <li>Educate residents on available energy efficiency programs and retrofitting homes</li> <li>Use existing program and resources such as “Low Income Home Energy Assistance Program” (LIHEAP) for weatherization for seniors and veterans</li> </ul>	 Medium/ High	 Medium/ High	 Low	 Medium/ High
 Critical Infrastructure	<ul style="list-style-type: none"> <li>Work with both electric and water utilities for back up plans</li> <li>Create water reservoirs</li> <li>Provide alternate electric sources</li> <li>Work with county on public transportation options</li> <li>Support upgrades of volunteer fire station</li> </ul>	 High	 Low	 Medium	 Low
 Health Care Access/Hospital	<ul style="list-style-type: none"> <li>Serve as cooling centers during disaster</li> <li>Start mobile health care units and senior facility</li> <li>Start a health education campaign on climate change impacts</li> </ul>	 Medium/ High	 Medium/ Low	 Low	 Medium/ High
 Open Space and Parks	<ul style="list-style-type: none"> <li>Encourage less manicured grass and more natural yards</li> <li>Set up a community land trust and invest in the conservation of land and parks</li> <li>Plan community gardens, natural yards and hoop house for winter growing</li> <li>Build public parks for youth and to drive sustainability and economy</li> </ul>	 Medium/ High	 Medium/ Low	 Low	 Medium/ High
 Agriculture	<ul style="list-style-type: none"> <li>Train farmers on sustainable and climate-resilient farming, crop rotation, and other methods to prevent soil erosion</li> <li>Farm locally for food access and healthy options</li> </ul>	 Medium/ High	 Medium	 Low	 Medium/ High

Key Assets	Community Solutions/ Recommendations	Ability to increase resilience	Economic feasibility	Environmental impact	Ability to implement
 Education	<ul style="list-style-type: none"> <li>Teach climate change solutions in schools, libraries, and/or churches to promote local action</li> <li>Work with the community to implement community outreach- “each one reach one” to pass on knowledge of sustainability and climate solutions</li> <li>Implement “Farm to School” programs</li> <li>Start recycling and composting education programs</li> </ul>	 Medium/ High	 Medium	 Low	 Medium/ High
 Cultural Heritage	<ul style="list-style-type: none"> <li>Preserve Duck Hill’s cultural heritage by “Sharing Stories” on farming, food reservation, midwifery and other traditional cultures</li> <li>Share through technology and youth</li> <li>Promote Duck Hill’s history to preserve landmarks and encourage tourism</li> <li>Promote preservation through rural churches</li> </ul>	 Medium/ Low	 Low	 Low	 Medium
 Historical Landmark Preservation	<ul style="list-style-type: none"> <li>Preserve the use Duck Hills historic bus stop, old jail house, old court house, Emmanuel Church, JJ know High School and Binford High School</li> </ul>	 Low	 Low	 Low	 Low
 Voting Rights and Census	<ul style="list-style-type: none"> <li>Ensure you are counted in the census</li> <li>Vote on all elections and get an identification card and/or driver’s license</li> <li>Ensure your community receives the funds it deserves and your voice is counted</li> </ul>	 Medium/ High	 High	 Low	 Medium/ High
 Emergency Services	<ul style="list-style-type: none"> <li>Train community members for emergency management services, retrofitting homes, and other green infrastructure</li> <li>Create an emergency evacuation plan</li> </ul>	 High	 Medium	 Low	 Medium



## Appendix A. Duck Hill Sustainability Mission Statement Resolution

MINUTES OF A SPECIAL CALLED MEETING  
OF THE MAYOR AND BOARD OF ALDERMEN  
DUCK HILL, MISSISSIPPI  
AUGUST 31, 2017

Be it remembered that on Thursday, August 31, 2017, the Mayor and Board of Aldermen met at City Hall at 6:00 P.M., the purpose of the called meeting was to adopt a resolution. Present at the meeting were: Mayor Joey Cooley, Linda Bennett, Leroy Nash, Lula Brown, Cynthia Kountz, and Lovanda Farmer.

Lula Brown led in prayer.

MOTION TO ADOPT A RESOLUTION

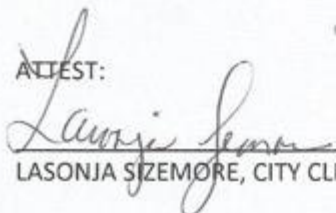
Upon motion made by Linda Bennett, duly seconded by Cynthia Kountz, the board unanimously voted to adopt the Sustainability Mission Statement Resolution and to revise the 1975 Land Use and Zoning Ordinance to include Adaption, Resiliency, Smart Growth and Sustainability Principles and Practices to advance a Triple Bottom Line approach to community and economic development that supports Sustainable Duck Hill's mission statement. This resolution is made a part of these minutes.

MOTION TO ADJOURN

Upon motion made by Linda Bennett, duly seconded by Cynthia Kountz, the board unanimously voted to adjourn the meeting at 6:10 P.M.

  
MAYOR JOEY COOLEY

ATTEST:

  
LASONJA SIZEMORE, CITY CLERK

## Appendix B. Outreach Fliers

# CLIMATE 101

### ? IS CLIMATE CHANGE REAL?

Yes! The scientific community have a broad-based agreement that climate change is real and caused by human activity.

### ? WHAT IS CLIMATE CHANGE?

Climate change is caused by burning of fossil fuels, such as oil and coal, which emits greenhouse gases into the atmosphere—primarily carbon dioxide.

### ? WHAT IS CLIMATE VULNERABILITY?

Climate vulnerability refers to the degree to which people or the things they value are susceptible to, or are unable to withstand, the adverse impacts of climate change. Many factors increase climate vulnerability such as income, age, health, and location.

### ? WHAT IS CLIMATE JUSTICE?

Climate justice links human rights and development to achieve a human-centered approach to climate change, safeguarding the rights of the most vulnerable and sharing the burdens and benefits of climate change and its resolution equitably and fairly. Climate justice is informed by science, responds to science, and acknowledges the need for equitable stewardship of the world's resources. (<http://www.mrfcj.org>)

### ? WHAT IS CLIMATE EQUITY?

Climate Equity is the climate burden on underserved and vulnerable communities, with the intent that no individuals or groups of people should carry a greater environmental burden than the rest of the community/country, especially when they are least responsible for creating climate change.

### ? WHAT IS ADAPTATION?

Adaptation are actions that help you prepare for and adjust to new (climate) conditions, thereby reducing harm or taking advantage of new opportunities. (National Climate Assessment)

 <http://bit.ly/DuckHill>

 EcoAdapt



DUCK HILL, MS

## FUTURE PROJECTIONS

FUTURE HEAT PROJECTIONS:  
INCREASE BETWEEN 2°F- 6°F BY 2100

### RISKS

#### HEALTH PROBLEMS

- Heat Stroke
- Increased vector-borne diseases (malaria, dengue, zika, ticks etc.)

#### RESPIRATORY PROBLEMS

- Increased ground-level ozone (an air pollutant) that is harmful to human health
- Increased hospital admissions due to respiratory illnesses, emergency room visits for asthma, and lost school days is expected

#### INCREASED ENERGY USAGE

- Increased AC use
- Increased percentage of salary dedicated to cooling costs

? How will increased HEAT affect Duck Hill Community?

### SOLUTIONS

#### PLANT MORE TREES

- Trees reduce local heat, provide cooling shade, and help clean local air

#### REDUCE POLLUTION

- Reduce fireplace and wood stove use, avoid using gas-powered lawn and garden equipment.
- Avoid burning leaves, trash and other materials.
- Decrease usage of cars through car-pooling or biking.

#### GREEN INFRASTRUCTURE

- Cooler roof technologies (green, white, and reflective roofs)
- Solar panels

? Any other solutions to help with increased HEAT in Duck Hill?



# RAIN

## DUCK HILL, MS

# FUTURE PROJECTIONS

MORE AND HEAVIER RAIN EVENTS SPRING,  
SUMMER AND FALL

## RISKS



### FLOODING

- Local flash flooding events
- Ditch and biological treatment systems unable to process nutrients
- Inflow into sanitary and combined sewer



### SOIL EROSION

- Difficulties in harvesting crops due to more runoff
- Increased rainfall erosivity and likely less soil moisture



### MOLD AND OTHER PESTS

- Increased rain can draw more pests indoors and possible mold causing health problems



How will increased RAIN affect Duck Hill Community?

## SOLUTIONS



### GREEN INFRASTRUCTURE

- Plant rain gardens
- Create natural overflow areas for river and creek
- Remove impervious areas (that do not allow water to naturally be absorbed)



### REDUCE POLLUTION

- Rotate crops
- Conserve natural areas to absorb rainfall



### PROTECT INFRASTRUCTURE

- Increase insulation and ventilation in the home
- Install roof gutters and rain barrels



Any other solutions to help with increased RAIN in Duck Hill?



<http://bit.ly/DuckHill>



EcoAdapt

## Appendix C. Climate Definitions

**Adaptation:** Action to prepare for and adjust to new (climate) conditions, thereby reducing harm or taking advantage of new opportunities. (National Climate Assessment, [www.globalchange.gov](http://www.globalchange.gov))

**Adaptive Capacity:** The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond.

**Climate Equity:** Alleviating the climate burden on underserved and vulnerable communities, with the intent that no individuals or groups of people should carry a greater environmental burden than the rest of the community/country, especially when they are least responsible for creating climate change.

**Gray infrastructure:** Projects that require engineering and construction—such as pipes, pumps, ditches, ponds, and seawalls—for storm water management and/or to help abate flooding.

**Hazard Mitigation:** The effort to reduce loss of life and property by lessening the impact of disasters. It is most effective when implemented under a comprehensive, long-term mitigation plan. State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters, and develop long-term strategies for protecting people and property from future hazard events. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage. (FEMA, [www.fema.gov](http://www.fema.gov))

**Holistic:** Relating to or concerned with whole or with complete systems rather than with the analysis of, treatment of, or dissection into parts; holistic adaptation views humans and the environment as a single system.

**Nature-Based Adaptation:** Solutions that draw from, restore, or enhance ecosystem services using blue (water) and green (nature and parks) landscape features to protect against flooding, extreme heat, and other effects of climate change. Examples include wetlands and floodplains, living shorelines, and shade trees.

**Resilience:** The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption. (U.S. Climate Resilience Toolkit). The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. (Disaster Resilience A National Imperative)

**Sensitivity:** The climate and climate-driven factors/consequences that currently shape the community, species, habitat or ecosystem services.

**Vulnerability:** The propensity or predisposition of people, resources, ecosystems, infrastructure, and the services they provide to be adversely affected by hazards. Vulnerability encompasses exposure, sensitivity, potential impacts, and adaptive capacity. (U.S. Climate Resilience Toolkit, <https://toolkit.climate.gov>)