OPHA
Ohio Public Health Association
The Voice of Public Health

OHIO PUBLIC HEALTH CLIMATE RESILIENCE COALITION

CLIMATE RESILIENCE IN OHIO

A PUBLIC HEALTH APPROACH TO PREPAREDNESS AND PLANNING

ORGANIZATIONS AND MEMBERS WHO ASSISTED IN THE DEVELOPMENT OF THIS PAPER:

WALLY BURDEN
Ohio Public Health Association

ROSEMARY VALEDES CHAUDRY, PHD, MPH, MHA, RN
Ohio Public Health Association

J. MAC CRAWFORD, MS, PHD
OSU College of Public Health, Division of Environmental Health Sciences, Ret.

RACHAEL DENHOLM, MPH
The Ohio State University

LOIS HALL, MS
Ohio Public Health Association

RICHARD HICKS, MPH
Environmental Health Division, Columbus Public Health

NIKI LEMIN, MS, RS/REHS, MEP
Franklin County Public Health
EPH Section Chair, Ohio Public Health Association

NAILA KHALIL, MBBS, MPH, PHD, CPH
Department of Population and Public Health Sciences, Wright State University

JOE MAZZOLA, MPA
Franklin County Public Health

JENNIE MCADAMS, MPH
Franklin County Public Health

ANDREANNA PAVAN, MPH-VPH CANDIDATE
The Ohio State University

KRISTIN PETERS, MPH
Franklin County Public Health

EXECUTIVE SUMMARY

INTRODUCTION

IN 2016, the Ohio Public Health Association (OPHA) formed the Ohio Public Health Resiliency Coalition (OPHCRC) to develop a document for use by local public health professionals in their efforts to address the public health impacts of climate change and climate-related weather events in their jurisdictions. The result of the OPHCRC's work is this white paper that focuses on the risks and adverse outcomes that the communities served by Ohio's local health departments (LHDs) are likely to face due to climate change effects. It was the Coalition's decision to focus first on adaptation and resilience from a public health perspective and then to build upon this work and address mitigation efforts. In the context of climate change, the term "adaptation" refers to activities, programs and efforts that seek to allow societies to continue functioning in the face of continued temperature increases and fluctuations in local weather patterns.

The OPHA Governing Council approved the Coalition and its focus, because the Coalition's work was consistent with OPHA's mission to be the inclusive voice for public health and to ensure the optimal health of all Ohioans. Among the basic aims of OPHA are the goals of professional education and advocacy. Being a non-governmental and nonpartisan organization, OPHA is well positioned to address a variety of key issues affecting the health of Ohioans.

Climate change is a global social justice issue as well as a public health issue. The impacts of climate change, which are listed below, are expected to be experienced most harshly by vulnerable populations such as those who live in poverty,

Potential public health-related impacts associated with climate change include:

- **Extreme weather events**
- **Decline in air quality**
- **Increased production of pollens**
- **Frequent wildfires and related injuries**
- **Heat stroke and heat-related illnesses**
- **Altered environmental conditions that foster the spread of communicable and vector-borne diseases**
- **Decreased food supply**
- **Decreased water quality**
- **Increased mental health stress.**

METHOD SUMMARY

THE COALITION ORGANIZED its work using the 5-step Building Resilience Against Climate Effects (BRACE) framework (Centers for Disease Control & Prevention [CDC], 2015) as a general outline for its work. For the first step--Anticipate climate impacts and assess vulnerabilities—the Coalition began by using the CMIST (Communication, Maintaining Health, Independence, Safety and Support, Transportation) tool to identify vulnerable populations across Ohio. The framework of the CMIST tool uses a functional approach that provides clarity and specificity to define individuals' restrictions or limitations that may complicate their ability to engage assistance during emergencies (U.S Department of Health and Human Services, 2016). CMIST is both a critical component of health equity for public health preparedness and response as well as a comprehensive approach to protect and improve the health of all Ohioans.

The Coalition next used an email survey of Ohio public health personnel to identify and categorize perceived threats from climate change at a regional level across the state's eight emergency preparedness regions. The results of this survey are presented in Table 1, which categorizes perceived threats by short-term impact, long-term impact, and socio-economic impact.

THE COALITION also reviewed the perceived weather-related climate events and categorized them according to: public health outcome, direct and secondary impacts, vulnerable populations affected, and adaptation strategies. This information is presented in Table 2.

This white paper presents an overview of the impacts that Ohio's communities are likely to experience from the effects of climate change. After this overview, the paper discusses climate change adaptation and mitigation in the context of public health accreditation by the Public Health Accreditation Board (PHAB). Much of climate change adaptation involves preparing for weather related events or emergencies, and there are a number of measures in the PHAB Standards and Measures Version 1.5 (PHAB, 2013) that this work could support. Examples of measures that might align with adaptation to and mitigation of climate effects are provided. After discussing the potential linkages between climate-change related mitigation and adaptation and accreditation, the paper presents examples of areas to address for climate change mitigation and adaptation categorized by the 10 Essential Public Health Services (CDC, 2014). The last section of content in this paper is a listing and brief description of selected resources related to climate change adaptation.

It is important to note that in its approach to creating a document that would support Ohio's LHDs in their efforts to address the potential impacts of climate change in the communities they serve, the Coalition was purposeful in considering the needs of vulnerable populations. This consideration was incorporated to ensure that this effort was consistent with the Ohio Public Health Association's (OPHA) work to advocate for and advance a "Health and Equity in All Policies" approach to policy-making. As previously noted, the BRACE framework (CDC, 2015) includes an assessment of vulnerability that incorporates the social determinants of health, the findings of which are summarized in Table 2.

CONCLUSION

AS WORK ON THIS WHITE PAPER concludes, the Coalition will continue its work by focusing on dissemination of the paper to local health departments in Ohio as well as across various venues at the local, state and national levels (e.g., conferences, newsletters, webinars, etc.). The Coalition also will collaborate with other agencies and organizations to disseminate this work and to support the efforts of LHDs and their communities to protect the public's health and have a prepared public health community. OPHA invites public health professionals and others to join in this effort.

CLIMATE RESILIENCE IN OHIO

A PUBLIC HEALTH APPROACH TO PREPAREDNESS AND PLANNING

DECEMBER 1, 2017

BACKGROUND AND PURPOSE

OPHA IS THE STATE'S public health professional association, with the mission to be the inclusive voice for public health and to ensure the optimal health of all Ohioans. Among the basic aims of OPHA are the goals of professional education and advocacy. Being a non-governmental and nonpartisan organization, OPHA is well positioned to address a variety of key issues affecting the health of Ohioans. In addition, OPHA endorses a Health and Equity in All Policies approach to public health, which supports the optimal health of all Ohioans. OPHA began convening a group of public health professionals and others with interest and expertise in the fields of policy development, climate impact, and preparedness planning to develop a document that could be used by local public health professionals as they consider preventing, preparing for and responding to changing climate events in their jurisdictions. The OPHA Governing Council approved the development of this group in the summer of 2016.

The Ohio Public Health Resiliency Coalition (the Coalition) was formed in 2016 by the Ohio Public Health Association (OPHA). The Coalition, which is comprised of local public health practitioners, academics, students, and stakeholders, developed a white paper for use by local health departments (LHDs) in Ohio. This white paper addresses the risks and adverse outcomes that regions and their vulnerable populations are likely to face due to the effects of climate change. The Coalition decided to focus first on adaptation and resilience from a public health perspective and then to build upon this work and address mitigation efforts.

INTRODUCTION

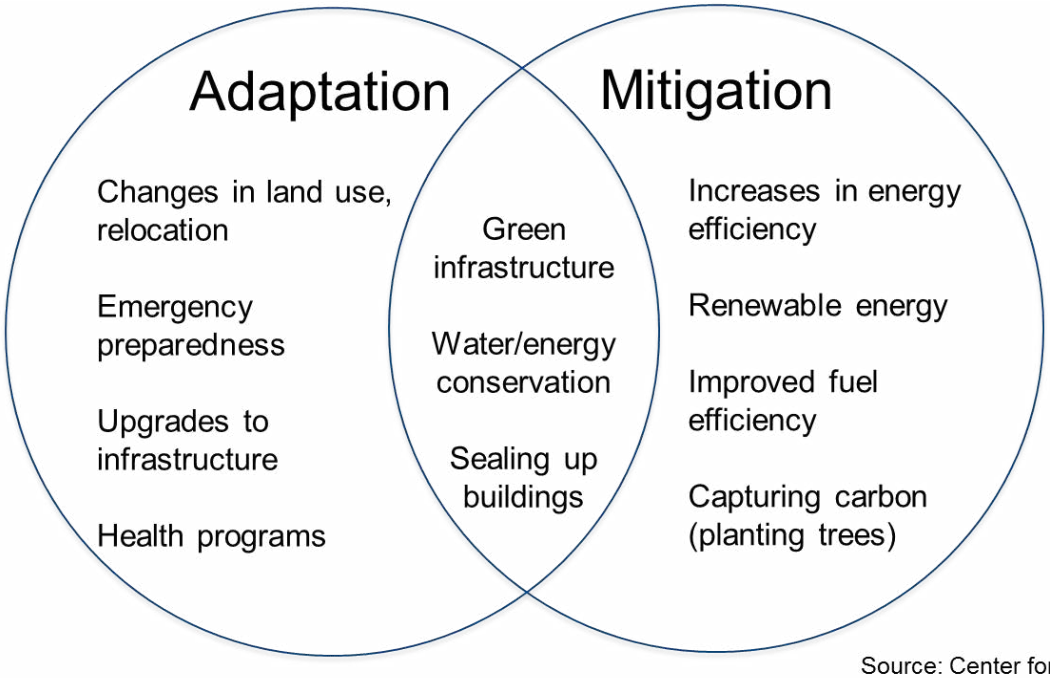
WE HAVE ONLY ONE PLANET. It's the place we live, learn, work, play and age. It has supported us for ages. But that planet comes with only one "set" of air, water and land. In order for future generations to continue to enjoy this planet, we must return care to the environment in which we live. Climate change is expected to alter regional temperatures, rainfall and soil moisture, all of which can impair the growth of crops in many regions of the world. Populations of fish and other wildlife are affected as well by changes in water temperature, ocean currents, air temperature, rainfall and/or shifts in vegetation growth. These changes are expected to produce short-falls in food supplies in many parts of the world. Climate change is a global social justice issue as well as a public health issue. The impacts of climate change are expected to be experienced most harshly in poorer areas of the world, while the heaviest emitters of greenhouse gases are those who live in richer areas of the world.

Potential climate change impacts to public health include:

- **Extreme weather events**
- **Decline in air quality**
- **Increased production of pollens with an increase in allergic diseases**
- **Frequent wildfires and related injuries**
- **Heat stroke and heat-related illnesses**
- **Altered environmental conditions that foster the spread of communicable and vector-borne diseases**
- **Decreased food supply**
- **Decreased water quality**
- **Increased mental health stress.**

ADAPTATION AND MITIGRATION

IN THE CONTEXT OF CLIMATE CHANGE, the term "adaptation" refers to activities, programs and efforts that seek to allow societies to continue functioning in the face of continued temperature increases and fluctuations in local weather patterns. According to the Third Assessment Report by the Intergovernmental Panel on Climate Change (IPCC, 2014a), adaptation is "The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects." Similarly, mitigation refers to strategies to reduce levels of greenhouse gases in the environment, thus slowing the rate of warming. Again, according to the IPCC (2014b), mitigation is "A human intervention to reduce the sources or enhance the sinks of greenhouse gases." Figure 1 below depicts some of the activities that could serve these two complementary, and partially overlapping, approaches to addressing climate change. This white paper will focus on what local health departments need to consider in terms of adaptation and planning for extreme weather as a result of climate change eventuality. The focus on adaptation rather than mitigation for the purposes of this paper is to galvanize local health departments into taking action and recognizing that climate change is an eventuality. Additionally, adaptation is the bare minimum that will need to be done to protect the health of the public. Once local health departments and their populations have adaptation methods in place, it is the goal that these health departments will turn their attention towards mitigation policies and procedures.



Source: Center for Clean Air Policy

FIGURE 1
VENN DIAGRAM SHOWING ADAPTATION AND MITIGATION STRATEGIES, AS WELL AS STRATEGIES THAT OVERLAP (INTERSECTION OF THE TWO CIRCLES), CENTER FOR CLEAN AIR POLICY, 2013

METHOD SUMMARY

THE COALITION BEGAN by using the Centers for Disease Control and Prevention (CDC) Building Resilience Against Climate Effects (BRACE) framework (CDC, 2015) as a general outline of its work. The BRACE framework is a five-step process:

- **Anticipate climate impacts and assess vulnerabilities**
- **Project the disease burden**
- **Assess public health interventions**
- **Develop and implement a climate and health adaptation plan**
- **Evaluate impact and improve quality of activities.**

After discussions and strategic planning, the Coalition determined that the ideal preliminary work of the group would be to work through the first step of the framework and enumerate vulnerable populations to provide local health departments toolkits and resources to complete the work on their own. This paper includes the resources that have been identified as well as health impacts of climate events. The later sections discuss the considerations that a health department must have in mind when creating adaptation or mitigation plans, including accreditation requirements, infrastructure and agricultural concerns, and the CMIST (Communication, Maintaining Health, Independence, Safety and Support and Transportation) tool to identify vulnerable populations.

VULNERABLE POPULATIONS

VULNERABLE POPULATIONS are generally considered to be those subgroups of the population that—compared to the general population—are more at risk of adverse health events and less likely to be able to resist or recover from threats to health. In the context of environmental health emergencies, vulnerable populations have been described as those subgroups or sub-populations in a community that are unlikely to be able to cope with, resist, or recover from an environmental disaster (World Health Organization, 2002). Vulnerable populations are also considered to be those that are unable or limited in their ability to avail themselves of standard resources across the phases of disaster preparedness (Wingate et al., 2007). Whether the term vulnerable population is considered in a general sense or in the context of environmental health emergencies, the term is a relative one that compares the resilience, resistance, response, and/or recovery ability of the vulnerable population to that of the general population. Regardless of the reason(s) why a subgroup of the general population is(are) considered to be vulnerable, the subgroup warrants special consideration in environmental health community planning because of their vulnerability status.

Local health departments (LHDs) focus on the mission of public health—addressing the conditions in which people can be healthy—at the community level in collaboration with their partners throughout the public health system (CDC, 2014; Institute of Medicine, 1988). Different factors are relevant to vulnerability depending on the nature of the emergency being faced by the community (Wingate et al., 2007). These factors include age, race, poverty, language, chronic illness or co-morbid or disabling health conditions, and other individual factors; economic development or decline and infrastructure changes; and exposure levels of a particular environmental emergency or in this case climate event (United States Global Change Research Program [USGCRP] 2016a,b; Wingate et al., 2007). Those factors that relate to vulnerability in emergencies fall under the determinants of health identified in the national health objectives under Healthy People 2020: social environment, physical environment, health services, policy-making, and individual behaviors and biology (US Department of Health & Human Services [USDHHS], 2010).

HEALTH EQUITY

IN ORDER TO execute the public health mission of assuring conditions in which all people can be healthy, public health needs to make intentional efforts to address the needs of vulnerable populations. Health equity is achieved in society when all people attain the highest levels of health (USDHHS, 2010) and it includes the study of differences in the quality of health and health care across different populations that, when achieved, leads to optimal health for everyone(FCPH CHA, 2107). For public health providers, health includes promoting physical and mental health as well as preventing disease, injury, and disability (CDC, 2013). Equity refers to fairness. Unlike equality, equity requires an approach that recognizes the barriers and conditions that lead to inequities in society and in health. Equity therefore requires that rather than being distributed equally, resources must be shifted to account for underlying differences in society which are at the root of systematic obstacles, barriers, or challenges (United Way of the Columbia-Willamette, 2013). Health equity, therefore, requires that special efforts and resources be devoted to address those factors that contribute to health disparities and disproportionate adverse health outcomes among vulnerable populations.

In recognition of the potential for increased harm from climate effects, the BRACE framework (CDC, 2015) includes assessment of vulnerability and social determinants of health (Marinucci et al., 2014). The findings of the Forecasting Climate Impacts and Assessing Vulnerabilities step summarized below in Table 2 identified populations in Ohio that are likely to be more susceptible to harmful health effects that arise from climate and weather events. Adverse health effects that those vulnerable populations may face are also listed in the table.

IDENTIFYING VULNERABLE POPULATIONS USING THE CMIST TOOL

PRIOR TO DEVELOPMENT of the CMIST framework, disaster planning and response utilized an all-inclusive label, i.e., "special needs," to define an extremely broad group of people; this group included individuals with disabilities, people with mental illness, minority populations, people who do not speak English, the elderly, and children. Employing such broad terminology that encompassed approximately 50% of the population led to incomplete planning that put members of populations with specific needs at an extreme disadvantage (U.S Department of Health and Human Services, 2016)

The CMIST framework provided clarity and specificity by taking a functional approach to define individuals' restrictions or limitations that may complicate their ability to engage assistance during emergencies (U.S Department of Health and Human Services, 2016).

The five essential components of access and functional needs, as defined by CMIST, are the following:

- **Communication – Communication refers to an individual's ability to receive and respond to information. Individuals with a communication need require information to be provided in an accessible format that could differ from one that is used for the general population. These individuals could be deaf, have little to no English proficiency, speak American Sign Language, be blind or have a visual impairment, and/or have cognitive or physiological limitations.**
- **Maintaining Health – This category refers to a person's needs associated with the management of health conditions that require ongoing observation or treatment. This includes conditions such as needing medication to maintain health, women who are pregnant, people needing IV therapy or tube feeding, and individuals requiring dialysis or administered oxygen.**

- **Independence – Although originally a category of need, Independence is now the broad goal for all individuals with access and functional needs. Most individuals with access and functional needs are able to maintain independence day-to-day. Emergency-response strategies should focus on providing support to ensure continued independence.**
- **Safety and Support – This category includes individuals who may have lost the support of family, friends, or assistants or may not be able to cope in a new environment. Safety and Support encompasses people with Alzheimer's Disease or other stressors, people who become disoriented in an unfamiliar setting, people who are incarcerated, and children who are unaccompanied.**
- **Transportation – The transportation category refers to those individuals who have needs relating to travel. These needs can include not having an appropriate method of transportation, needing a specialized method of transportation, or not being able to navigate the existing methods of transportation.**

These five categories of need, together with the goal to maintain independence, provide a foundation to strengthen response plans to serve the whole community during emergencies.

CMIST is a critical component of health equity for public health preparedness and response. Along with efforts to address other factors of health equity, e.g. racial status, gender, sexual orientation, etc., CMIST supports a comprehensive approach to protect and improve the health of all Ohioans. The CMIST tool is available for use by all local health departments in Ohio and is an important tool for identifying vulnerable populations to be included in climate preparedness plans as well as emergency planning in general. It must be noted that to fully capture those populations that would be affected by changing climates, some extrapolation of the data is needed. For example, when looking at those who would be unduly burdened due to high heat, a health department could look at the population in poverty who may not have resources or access to air conditioning or temperature control.

PRELIMINARY ASSESSMENT OF CLIMATE CHANGE THREATS PERCEIVED BY PUBLIC HEALTH PERSONNEL IN OHIO

BASED ON 173 RESPONSES from Ohio public health personnel to an email survey, there is regional variation in perceived threats from climate change. There is also variation in what are perceived to be short-term, long-term and socio-economic threats. Across the eight emergency preparedness Ohio regions, thunderstorms were judged to be the greatest threat in the short-term, while flooding was seen as the greatest long-term and socio-economic threat. Table 1 below depicts the overall perceived threats.

TABLE 1
OHIO PERCEIVED THREATS

SURVEY RESULTS		
Top 8 Ranked Short-Term Impacts	Top 8 Ranked Long-Term Impacts	Top 8 Ranked Socio Economic Impacts
1. Thunderstorms	1. Flooding	1. Flooding
2. Flooding	2. Air quality	2. Tornado
3. Winter storm	3. Water quality	3. Drought
4. Tornado	4. Drought	4. Water quality
5. Heat wave	5. Tornado	5. Thunderstorms
6. Vector control	6. Vector control	6. Air Quality
7. Water quality issues	7. Thunderstorms	7. Winter storm
8. Air quality	8. Heat wave	8. Heat wave

By region, respondents were fairly consistent in choosing thunderstorms as the top short-term threat (75%). Almost 88% of respondents by region chose flooding as the top socio-economic threat. There was little consistency by region as to the top eight long-term threats, and there was also little agreement on what the second through eighth threats should be across all three domains (short-term, long-term, and economic impacts)

STATEWIDE PROJECTIONS

CURRENT PROJECTIONS FOR OHIO show that the average temperatures will rise approximately 3-5 degrees Fahrenheit by midcentury with the length of the growing season increasing by an additional 1-2 months. Precipitation is expected to continue to increase as it has over the last 50 years. The average winter temperature for Ohio throughout the century is projected to be more on par with the Carolinas, and the average summer temperature will move to be more in line with that of Arkansas. (Great Lakes Integrated Sciences and Assessment and the University of Michigan Climate Center, 2016) These projections, and indeed what is already occurring, will encompass many issues and events (Figures 2-4). Table 2 presents the climate-related events that were identified throughout the survey as well as the associated public health outcomes, direct and secondary impacts, vulnerable populations impacted, and potential adaptation strategies. Inherent in all of the public health and secondary impacts is the toll that increased weather events will cause on the population's mental health and wellness.

TABLE 2
OHIO WEATHER RELATED EVENTS
*THIS IS NOT A COMPREHENSIVE LIST OF POTENTIAL OR IDENTIFIED EVENTS

Climate Threats	Public Health Outcomes	Direct Impact	Secondary Impact	Vulnerable Populations	Adaptation Strategies
More powerful and frequent thunderstorms	- Power outages resulting in home, business and commercial appliance interruption - Potential foodborne illness - Unhealthy cold or hot indoor temperatures - Potential lifesaving equipment failure.	- Flooding - Loss of electricity - Increases in standing water.	- CSO overflows - Degradation of area surface waters	- Very young and very old - Medically compromised - Those with existing chronic health conditions	- Upgrading of aging utility infrastructure
Flooding	- Standing water creating breeding grounds for vector-borne disease. - Contaminated water causing disease and spread of infectious disease such as cryptosporidium. - Increase in indoor mold growth	- Agricultural damage - Crop loss damage to homes and businesses, - Standing water.	- Spread of disease, - Increase in vectors - Loss of productivity - Rising food prices - Greater food insecurity	- Those on flood plains - Populations with challenged or poor mobility - Poor - Those with chronic respiratory conditions	- Incorporate pet-friendly shelters and animal mortality units in planning, - Ensure dams and areas surrounding water are prepared - Educational materials regarding the dangers of flooding - Plan for prophylaxis or vaccinations due to outbreaks.
Extreme cold events	- Negative cardiovascular health outcomes. - Decreased access to potable water if pipes freeze.	- Hypothermia, frostbite - Loss of electricity.	- Increase cost to consumers, - Loss of revenue and of productivity	- Populations in poverty - Those with access needs and rural populations.	- Include a plan to get population to warm buildings with electricity, - Ensure emergency cache of cold weather supplies
Winter storms/ blizzards	- Cardiac, musculoskeletal, and respiratory events. - Power outages can cause unsafe food. - Unsafe road conditions.	- Trapped populations - Loss/damage of property and livestock.	- Decrease in productivity - Auto accidents - Injury due to poor walking/driving conditions.	- Limited mobility populations - Rural and urban populations - Those who need to travel for work.	- Education and warnings - Transportation and transit plans - Personal preparedness
Extreme heat events	- Increased heat-related death and illnesses - Worsening air quality - Increase in power outages leading to rotting food	- Heat stroke and other heat related illnesses - Food-borne illnesses - Increase in number and severity of asthma attacks	- Droughts - Brownouts - Poor health	- Persons who are incarcerated - Living in poverty, have pre-existing medical conditions, - Farmers - Outdoor workers - Very young and very old - Socially isolated, - Those with cardiac or existing respiratory diseases	- Plan for more funding for low cost air conditioning - City planning for shaded areas - Build infrastructure safeguards (air conditioning, power grid) integrated system of emergency cooling centers
Increase in new/ existing vectors	- Increased risk from emerging vector-borne diseases (ie.g., zika); - Increased risk from endemic vector-borne disease (e.g., West Nile, Lyme Disease)	- More pests carrying local diseases - Increase in zoonotic illnesses - Longer period of vector infestations	New vectors/diseases crossing into areas that traditionally did not have them - Exotic diseases becoming more common - Economic impact of vectors destroying agriculture	- Those with compromised immune systems - Outdoor workers and sportsmen - Agricultural workers - Pregnant women or those wishing to become pregnant	- Education - Plans for prophylaxis and vaccines, - Increased treatments - Insecticides, monitoring of regional information.
Drought	- Amount and patterns of certain diseases such as Valley Fever - Increase inparticulates in the air which can lead to respiratory events such as asthma attacks and cardiovascular events. - Water systems can experience stress and dehydration of vulnerable populations can occur	- Crop loss increase stress on environment	- Increase in wildfire - Increase food cost to consumers - Greater food insecurity	- Those in poverty - Relying on wells - Rural populations	- Increase water storage - Educational materials for conservation
Algae blooms	- Drinking water sources can be affected, causing interruption of service, illness or death in humans and wildlife	- Illness to humans and animals	- Economic impact of non-usable water sources - For recreation and personal use - Raise in potable water treatmentcosts	- Populations reliant on contaminated water systems, - Immunocompromised, - Agricultural interests - Animals	- Education and warnings - Increased monitoring and treatment of known issue areas - Increased educational work with agricultural communities
Tornados	- Power outages creating unsafe food - Dangerous road conditions - Increased risk of unuasable drinking water in well systems	- Loss of electricity - Property damage	- Economic impact - Loss of productivity	- Rural Populations - Those relying on power for medical reasons	- Personal preparedness plans - Structures built with storm shelters

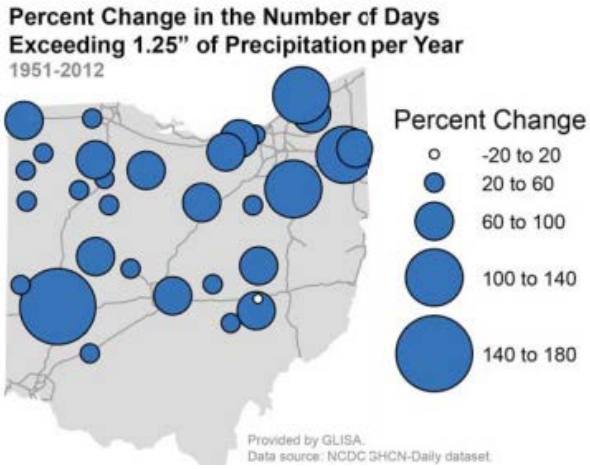


FIGURE 2
OHIO PERCENT CHANGE IN PRECIPITATION

FIGURE 2 DISPLAYS the percent change per year from 1951-2012 of precipitation throughout the state of Ohio. This research, done by the Great Lakes Integrated Science and Assessment Center (GLISA), notes that there was a 32% increase in very heavy precipitation events from 1951-2012 with a 130% increase in number of days per year with more than 1.25" of rain (GLISA 2016). Increases in precipitation can lead to more flooding, which increases the spread of certain diseases, changes in planting and growing seasons, and an increase in harmful water issues such as increases in nitrates or storm run-off. These maps are from the GLISA "Climate Changes and Impacts in Columbus, Ohio," as part of the City of Columbus "Climate Change in Columbus Ohio: *An Assessment of Columbus' Key Climate Changes, Impacts and Vulnerabilities of Concern*."

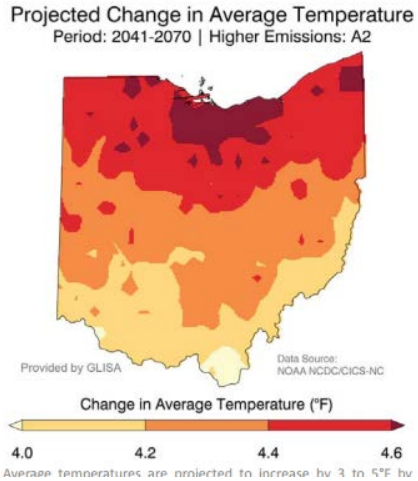


FIGURE 3
OHIO PROJECTED CHANGE IN AVERAGE TEMPERATURE

FIGURE 3 SHOWS the projected change in temperature for the state of Ohio from 2041-2070. While all parts of Ohio will be warming, the area most impacted will be the north, which can see temperatures increaseing up to 4.6 degrees Fahrenheit within the next 50 years. This temperature change will impact the growing seasons in Ohio and can increase the number of days that will carry a heat risk for vulnerable populations, thus also increasing the amount of engery consumed by cooling devices. Air quality will decrease in the increasing heat, which will increase the risk of poor health outcomes for those with respiratory issues as well as those who work outdoors. Higher temperatures can also increase the amount of certain vectors and animals who may typically be found in current warmer climates and force those species who rely on colder temperatures to migrate further north.

FIGURE 4
COMPARISON OF THE FUTURE CLIMATE OF OHIO

FIGURE 4 IS PERHAPS the most telling of all from the *Climate Changes in Columbus, Ohio* report (GLISA 2016). With the current rate of increasing global temperatures and emissions, the very nature of Ohio weather can be expected to change. As calculated from the baseline Ohio weather in 2003 (dark blue 2003 graphic), the summers will be more in line with those in southeastern Indiana and southern Illinois, whereas winters will become milder, similar to West Virginia (light blue 2030 graphic). By 2095, Ohio summers could be on par with Arkansas (orange 2095 graphic) and winters similar to Virginia and North Carolina (light blue 2030 and 2095 graphics, respectively). These changes in weather will drastically change many aspects of life in Ohio (Great Lakes Integrated Sciences and Assessment and the University of Michigan Climate Center, 2016)

INFRASTRUCTURE CONSIDERATIONS

LAND USE PATTERNS can affect climate change vulnerability and the capacity to adapt to climate change. Land use can affect heat-trapping greenhouse gas emission from civic, energy, industrial and agribusiness activities. In addition, changing land use patterns such as growing food, cutting trees, or building cities with concrete infrastructure can impact climate. For example, urban centers are warmer than the surrounding green rural areas because the paved areas in cities are impervious trap heat (Wong, 2011). Therefore, urban populations have higher risk of exposure to extreme heat.

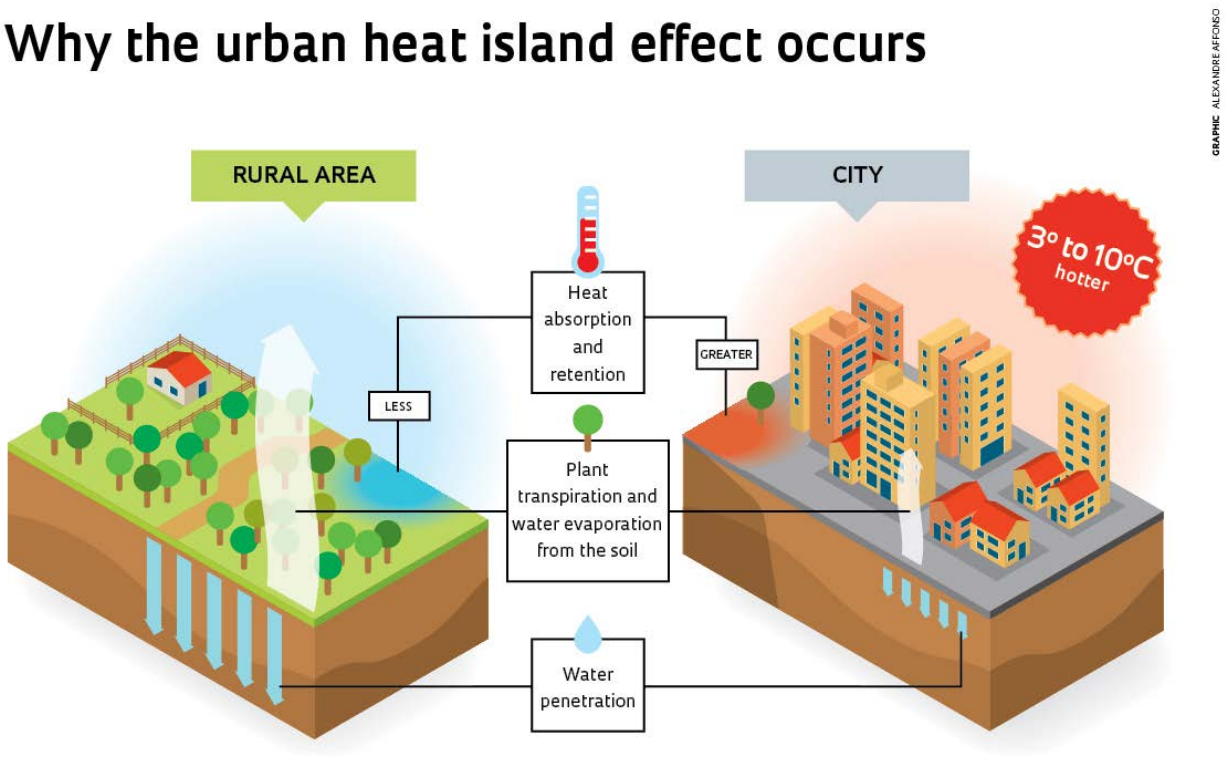


FIGURE 5
WHY THE URBAN HEAT EFFECT ISLAND OCCURS

Land use and land cover decisions can impact adaptation to climate change. As shown in Figure 5, climate adaptation includes changes in land use and relocation of population, upgrading and greening of infrastructure, water and energy conservation measures. Land use adaptation options could include incorporating green areas, vegetation and limiting paved areas to reduce heat island effect in cities. Adaptation could also include elevating homes to prevent flooding and introducing crop varieties tolerant to heat, drought and flooding. Other land use options are expanding forests as greenhouse gas sinks, adjusting the infrastructure and city planning to reduce energy use and motorized transport, and promoting agricultural management practices to increase carbon storage in soil (for example, no-till farming). Success of these adaptation strategies will involve land-use decisions made by individuals, landowners, cities and communities backed by regulatory framework of incentives or penalties (Baule et al., 2014).

THERE IS EVIDENCE that climate-related extreme weather events, storm surge and sea level rise can adversely impact the existing infrastructure (US Environmental Protection Agency, 2015). Over the past 15 years sea level rise and storms have inundated coastal regions damaging property, roads, and businesses. Inland, infrastructure bordering rivers and lakes also have been compromised following heavy rains and melting of snowpack. Extreme hot and cold weather, intense precipitation, and freeze thaw cycles have damaged roads, railway lines, airport runways, and drainage systems, and higher temperatures are causing delay in flights as it becomes harder for smaller aircrafts to take off in elevated temperature(Schwarz et al., 2014).

Adaptive measures can reduce climate change-related infrastructure damage. The following examples illustrate the estimated economic costs in the United States associated with adapting infrastructure to continue provision of services as climate changes:

- **An estimated 190,000 bridges are vulnerable to climate change-related damage by 2100 (peak river flow washes away sediment from bridge structural support; average age of US bridges is 40 years). Adaptation costs are estimated to be $194 billion by the end of 2100. With mitigation $13.4-$67 billion can be saved from the adaptation costs (Wright et al, 2012).**
- **By 2100, adaptation measures for road maintenance will cost $5.8-$10 billion if no mitigation action is taken. However, with mitigation these road sector costs can save $4.2-$7.4 billion.**
- **Drainage infrastructure adaptation costs are estimated at $1.1-$12 billion with no mitigation. Mitigation is projected to save $50 million to $6.4 billion through 2100 (Georgakakos et al, 2014)**

Energy infrastructure is quite complex and extremely vulnerable to climate change especially with water shortage and extreme weather events (fuel resource extraction and processing, transportation and storage, power generation, transmission and distribution). Rising temperatures are projected to increase energy demand by 2-8% (Georgakakos et al, 2014).

AGRICULTURAL CONSIDERATIONS

THE STATE OF OHIO has an estimated 74,500 farms (Turner & Morris, 2015). The agricultural industry contributes roughly $93 billion to the state's economy and directly or indirectly employs 1 out of 7 Ohioans, making it the fifth largest industry in the state. For crops, Ohio is a top-ranking producer of soybeans, corn, and wheat; for livestock, the second largest producer of eggs; the eighth-largest producer of hogs and pigs; and the eleventh largest producer of milk in the United States (Turner & Morris 2015). A healthy agricultural system and rural population is dependent upon a protected environment, safe food and water, and control of infectious disease. The effects of climate change put the agricultural industry in Ohio at risk of serious adverse consequences.

One Health is a guiding philosophy that acknowledges the dependency of human health on the health of the animals and environment that surround us (CDC, 2017). One Health is the integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment. Together, the three levels make up the One Health triad, and the health of each level is inextricably connected to the others in the triad. If the well-being of animals and the environment becomes compromised, it will be reflected in the health of the human population. While generally used as a focus in controlling infectious disease, the One Health concept extends to other public health concerns such as social determinants of health and food security. One Health ties in closely with the effects of climate change on public health and subsequently how these changes alter the wellbeing of vulnerable populations such as agricultural-centered communities.

OVER THE LAST CENTURY the state of Ohio has warmed by approximately one degree Fahrenheit (US EPA2016). The continued increase in temperature is predicted to lengthen the growing season by 3-7 weeks (Fitzpatrick, Freese, & Wadsworth, 2009). The increase in temperature brings heat stress, increased drought and flooding, and expansion of crop pests along with it -all of which could negate any expected increase in production due to longer growing season.

When considering the effects on livestock, the United States Department of Agriculture's (USDA) Climate Adaptation Plan (USDA, 2014) has determined that agriculture will be affected by climatic change in four primary ways:

1. **The availability and price of feed grain due to less production**
2. **Quality of the forage and pastures**
3. **Animal health and production**
4. **Diseases and pest distribution.**

These effects will lead to increases in food prices, decreases in food availability, and increases in vector borne disease.

It is recommended that local public health departments partner with other local and statewide agencies to create or strengthen adaptive practices such as developing an animal response plan, providing information to the community on USDA-Farm Service Agency (FSA) disaster assistance programs, distributing educational material on Federal Emergency Management Agency (FEMA) disaster planning, researching available grants for sustainable farming practices, and supporting policies that provides funding to vector surveillance programs. An additional need is to identify plans and procedures for animal management during a weather emergency to ensure proper evacuation of livestock as well as proper handling of ill or deceased livestock to prevent the spread of diseases such as E. coli or salmonella that can cross vectors.

VECTOR-BORNE DISEASES

THE INTRODUCTION of disease-carrying vectors into new areas or regions of the world at one time may have been limited to importation through travel, commerce, purposeful introduction of certain species, or the natural migration of their hosts. The effects of climate change, such as increases in surface water and ambient air temperatures, extreme periods of drought or rainfall, and less differentiation between seasons may present conditions that would allow disease-carrying vectors, whether native, endemic or imported, to possibly become established and expand their range into areas that before were not previously hospitable. This establishment and expansion causes an increase in the possibility and risk of vector-borne disease transmission to humans.

Mosquitoes may have an impact on human disease as the effects of climate change take place over time. An example is the *Culex pipien* mosquito, which is the primary vector for West Nile virus (WNV) in the midwest, north, and eastern United States. As regions experience longer periods and/or severity of drought, stagnant water and container-breeding mosquitoes such as the *Culex pipien* are known to thrive under these conditions. As other sources of water are eliminated, both mosquitoes and birds are drawn to the same limited water sources, which allow for increased bird and mosquito interaction, thereby allowing for the arboviral cycle to thrive. It is often seen that, in periods of drought, the WNV infection rate in mosquitoes can become very high, as well as the risk for human transmission.

ALTERNATIVELY, when weather conditions present periods of intense and heavy rains over a period of time, floodwater mosquito species thrive and the *Culex* are less abundant. Floodwater mosquito eggs can remain dormant for several years and when flood waters reach them, they begin to hatch into larvae. Some of these mosquito species can be aggressive biters and may have flight ranges of 5-6 miles. Most floodwater mosquitoes don't carry diseases but can impact human quality of life. There is concern that some of these species could become bridge vectors and be competent vectors to transmit mosquito-borne diseases to humans.

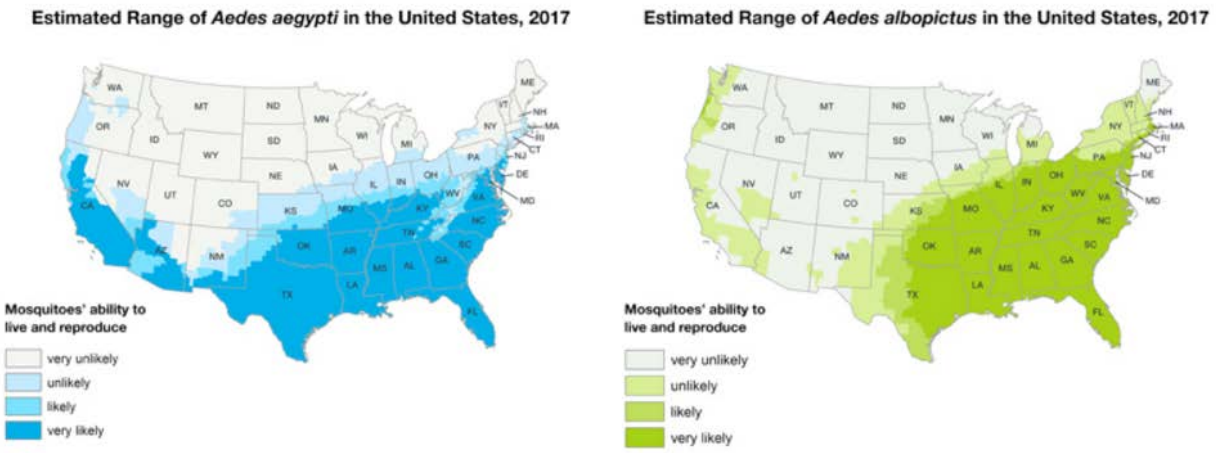


FIGURE 6
ESTIMATED RANGE OF AEDES ALBOPICTUS AND AEGYPTI

INCREASED AND SUSTAINED ambient air and water temperatures may allow mosquitoes to increase their range into areas or regions where the previous environment may have prevented survival and establishment. Concerns would be with the expansion of the *Aedes* and *Anopheles* species of mosquitoes. The range of *Aedes albopictus* and *aegypti* has expanded within the U.S. (see Figure 6). "The estimated range maps (Figure 6) have been updated using a predictive model that used county-level records, historical records, and suitable climate variables to predict the likelihood (very low, low, moderate, or high) that these mosquitoes could survive and reproduce if introduced to an area during the months when mosquitoes are locally active" (CDC, 2017).

Ohio has seen an increase in human cases of Lyme disease over the past seven years from 33 cases in 2007 to 218 in 2017 (Ohio Department of Health, 2017). Until recently Lyme disease cases in Ohio were attributed to travelling to endemic areas and contracting the disease. Now, cases of Lyme disease are being documented without travel and can be attributed to local transmission. Blacklegged tick populations and range continue to increase and expand in Ohio(Ohio Department of Health, 2017). Ohio has seen other tick species become established and other tick-borne diseases such as Anaplasmosis, Babesiosis, Ehrlichiosis, Powassan virus, and Southern tick-associated rash illness (STARI) continue to rise. The increases in tick populations could be attributed to climate change. Richard Ostfeld of the Cary Institute of Ecosystem Studies indicates climate change is partly responsible. Warmer temperatures allow ticks to spread farther north and to higher altitudes. Earlier springs have an impact, too. Says Ostfeld: "As the climate warms, the ticks become active earlier and earlier in the season." (Ostfeld, cited in Lieberman, 2017).

TO REDUCE THE RISK of human disease transmissions, it is important that local health departments establish, maintain and sustain good and comprehensive adult mosquito surveillance programs to include known vectors. The local health departments should also consider the development of a tick surveillance, control, and public education programs.

The state health department should include maintaining a level of support for the local health departments, including but not limited to: consultation and program development, mosquito and tick identification, virus or bacteria testing, statewide vector disease planning, public education and outreach messaging, and statewide data collection.

ACCREDITATION CONSIDERATIONS

WHILE THERE IS no specific measure within the Public Health Accreditation Board (PHAB) Standards and Measures Version 1.5 (PHAB, 2017) that relates to climate change adaptation and mitigation, there are multiple areas where the work might demonstrate conformity to a measure. As much of climate change adaptation involves preparing for weather related events or emergencies, there are a number of measures that this work could support. The list of examples of measures given below is neither exhaustive nor does it guarantee conformity. While developing climate change plans, health departments should consider partners both in the public health system such as regional planning committees as well as representatives of vulnerable populations and their specific needs.

Examples of measures (PHAB, 2016) that might align with adaptation to and mitigation of climate effects are:

- **1.3 - Analyze public health data to identify trends in health problems, environmental public health hazards, and social and economic factors that affect the public's health.**
- **1.4 - Provide and use the results of health data analysis to develop recommendations regarding public health policies, processes, programs or interventions.**
- **2.2 - Contain/mitigate health problems and environmental public health hazards.**
- **4.1 - Engage with the public health system and the community in identifying and addressing health problems through collaborative processes.**
- **4.2 - Promote the community's understanding of and support for policies and strategies that will improve the public's health.**
- **5.1 - Serve as a primary and expert resource for establishing and maintaining public health policies, practices and capacity.**
- **5.4 - Maintain an all hazards emergency plan.**
- **10.1 - Identify and use the best available evidence for making informed public health practice decisions.**
- **10.2 - Promote understanding and use of the current body of research results, evaluations and evidence based practices with appropriate audiences.**

CLIMATE CHANGE AND THE 10 ESSENTIAL PUBLIC HEALTH SERVICES AND PHAB

LOCAL PUBLIC HEALTH PLANNING and response to the effects of climate change can be shown through the 10 Essential Public Health Services and many PHAB domains. The questions under each Essential Service below are suggestions of items to consider related to the Essential Service when undertaking planning to address climate effects (CDC Essential Health Services, 2017) .

While the purpose of this white paper is to adapt to support local health departments in Ohio in efforts to help their communities adapt to the effects of changing climate and to enhance the local public health preparedness and response, it is recognized that taking action to mitigate the severity of climate change is the ideal goal. Included in these 10 Essential Public Health Services are potential action steps that a local health department could take to address the service.

1. MONITOR HEALTH STATUS/DOMAIN 1

- **Are there public health monitoring "needs" your department should consider as they relate to climate change impacts? (e.g., foodborne illness outbreaks, vector-borne surveillance and diseases outbreak, others?)**

2. DIAGNOSE AND INVESTIGATE HEALTH PROBLEMS/DOMAIN 2:

- **Are there any new zoonotic diseases that your health department will need to be on the lookout for with new and different vectors being introduced in your community?**
- **Are there hazards that will occur as a result of changing climate that you are not currently prepared for?**

3. INFORM AND EDUCATE/DOMAIN 3:

- **Are there climate change resources that should be created or distributed to the community by your department's staff?**
- **Are new community programs or activities needed to address climate-related effects? If so, what and why?**
- **What information should these resources, activities or programs contain or distribute?**
- **To whom in the community should these activities or programs be directed?**
- **Action Steps:**
  - Increase public education on the effects of climate change and what individuals can do.
  - Increase Farm to School and Farm to Table education to increase the amount of locally sourced food available.

4. MOBILIZE COMMUNITY PARTNERSHIPS/ DOMAIN 4:

- **Are there other community partners that would need to be identified and secured to assist in adapting to climate change events?**
- **Are there community partners who need to be aware of climate effects?**
- **How do you utilize your partnerships to leverage any additional community messaging?**

5. DEVELOP POLICIES AND PLANS/DOMAIN 5:

- **Are there public health policies and plans needed in your department to address climate change and its impacts as they relate to your workforce, your community, or other agencies?**
- **Action Steps:**
  - Work with policy makers to develop urban forestry, tree and landscape programs.
  - Set policy on building standards and codes.
  - Increase policy prohibiting or limiting idling in parking areas.
  - Create waste reduction packaging policies
  - Improve policies to limit the emission of greenhouse gases and increase active transportation, eco-friendly fleet vehicles, ride sharing and mass transit.

6. ENFORCE LAWS AND REGULATIONS/ DOMAIN 6:

- **Will climate change impact your ability to enforce existing codes, statutes and laws? If so, what is needed to address these impacts?**
- **Are there codes or laws you can foresee coming into effect in efforts to mitigate or adapt to climate change and if so, what is your role in enforcing or preparing the public and your internal team?**

7. LINK PEOPLE TO NEEDED PERSONAL HEALTH SERVICES AND ASSURE THE PROVISION OF HEALTH CARE WHEN OTHERWISE UNAVAILABLE/DOMAIN 7:

- **What other departments or agencies in your community are responsible for addressing climate change impacts not under the public health umbrella? Can the appropriate referrals or linkages be made?**
- **What gaps exist in personal health services that your health department may need to address?**
- **Action Steps:**
  - Increase access to and awareness of family planning practices.
  - Decrease barriers to recycling and composting.

8. ASSURE A COMPETENT PUBLIC AND PERSONAL HEALTHCARE WORKFORCE/DOMAIN 8:

- **Is your staff aware of how climate change impacts public health? Is training needed?**
- **Are additional trainings available for those who would deal with climate change issues?**
- **Are there additional positions you could look to hire?**
- **Is the personal healthcare workforce in the public health system aware of the climate effects on health? Is additional training needed to assure competence in the community's personal healthcare workforce?**

9. EVALUATE EFFECTIVENESS OF SERVICES/ DOMAIN 9:

- **Can newly-created climate change programs or activities be evaluated for effectiveness?**

10. RESEARCH/DOMAIN 10:

- **Is there research or research partnerships that can inform your work related to climate change?**
- **Is there community level data you can collect that would lead to changes in informing your work?**
- **Action Steps:**
  - Explore what case studies in adaptation or communication strategies may pertain to your community.

CONCLUSION

THE CURRENT CLIMATE of the earth is clearly changing and many organizations and scientists recognize that humans are at least partially responsible. The Ohio Public Health Association (OPHA) recognized that fact and that these climate changes would impact the health of the entire population, while also impacting those who are already most disadvantaged. The OPHA convened a group of public health practitioners and others who have a vested interest in public health and created a coalition to address climate change adaptation at a local level. The result of the Coalition's work is this white paper and the resources listed in the paper for local health departments in Ohio to utilize to strengthen their community adaptation efforts and to support public health's role in the area of changing climate.

The Coalition intends to disseminate the results of the white paper and the work done to various local, state and national conferences as well as to local health departments in Ohio to increase the awareness of the public health ramifications of climate change and the resources in the paper. Additionally, the Coalition will begin to work with various other agencies and organizations to create mitigation tools and resources for local communities with the goal of a prepared public health community.

LINKS TO HELPFUL RESOURCES THAT CAN BE FOUND ON OPHA WEBSITE. THESE RESOURCES INCLUDE LARGE DATABASES OF TOOLKITS AS WELL AS WEBINARS AND INFOGRAPHICS.

GENERAL TOPIC TOOLKITS

CENTERS FOR DISEASE CONTROL AND PREVENTION: CLIMATE AND HEALTH

This website has links to climate effects on health (e.g., air pollution, allergens, wildfires, precipitation extremes, temperature extremes, diseases carried by vectors, food and waterborne diarrheal disease, food security, mental health & stress-related disorders), the BRACE Initiative and the Climate-Ready States & Cities Initiative, and guidance, trainings, webinars, data, tools, and publications. As of the release date of this paper, the site was last updated 10/19.2016.

TASK FORCE ON CLIMATE PREPAREDNESS AND RESILIENCE

National Oceanic and Atmospheric Administration (NOAA) US Climate Resilience Toolkit The toolkit on this site includes an overview of the Steps to Resilience framework, case studies, tools, expertise/references, regional information, and topics (built environment, food, marine, ecosystems, tribal nations, coasts, energy, health, transportation, water. As of the release date of this paper, the site was last updated 7/7/2017.

WORLD HEALTH ORGANIZATION (WHO) WHO INTERNATIONAL

Climate Change and Health This website has an overview of climate change and health and also links to a "Climate Change and Health page" with policies, resources, publications, conferences, etc., the report "Global Health Risks: Mortality an Burden of Disease Attributable to Selected Major Risks (2009)", the WHO workplan on climate change and health. As of the release date of this paper, the site was last updated 7/7/2017.

APHA CLIMATE CHANGE TOPIC & ISSUES PAGE

This site has numerous resources including a social media toolkit and links to information (vulnerable populations, extreme weather, water quality, agriculture, mental wellness, air quality, air quality, tribal populations, healthy community design, clean energy, climate justice, partners, climate and health meeting). There also are links to reports, webinars, videoclips, and other helpful links and resources.

ANIMAL RESPONSE PLAN DEVELOPMENT GUIDANCE TOOL KIT OVERVIEW (UNDATED)

This document was developed by the Animal Health Emergency Technical Advisory Committee that included representatives from Ohio departments of Public Safety, the Emergency Management Agency, Health, Agriculture; the Columbus Public Health department, the US Department of Agriculture – Veterinary Services, and representatives of local jurisdictions and animal response groups. The document contains a toolkit for local jurisdictions to develop animal response for use in the response to emergencies and disasters. The document also sample plans, sample implementation instructions, other resources, and contact information for subject matter experts.

ALL-HAZARDS PREPAREDNESS FOR RURAL COMMUNITIES (IOWA STATE UNIVERSITY CENTER FOR FOOD SECURITY AND PUBLIC HEALTH, 2010)

This document is a guide to help rural agriculture communities prepare for threats to their families, farms, animals and businesses. The document has sections on general all-hazards plans for farms, pets, livestock, businesses, and on specific events in rural communities (natural disasters, biological emergencies, man-made or technological threats), and preparedness websites and resources.

NATURAL SUSTAINABLE AGRICULTURAL COALITION (NSAC)

This link is to the "Farm Bill Programs & Grants overview" page on the website of the Natural Sustainable Agricultural Coalition. The quick guide to the programs and grants is organized by issue and eligibility for applying or signing-up. There are other pages on the website of this organization, which describes itself on the "About Us" page as "an alliance of grassroots organizations that advocates for federal policy reform to advance the sustainability of agriculture, food systems, natural resources, and rural communities."

HEALTH ASSESSMENT

THE IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH (US GLOBAL CHANGE RESEARCH PROGRAM, 2016)

This 9-chapter scientific assessment describes in detail how climate change is already affecting human health and possible changes in the future. The 9 chapters are: 1) Climate Change and Human Health; 2) Temperature-Related Death and Illness, 3) Air Quality Impacts, 4) Extreme Events, 5) Vector-Borne Diseases, 6) Water-Related Illness, 7) Food Safety, Nutrition, and Distribution, 8) Mental Health and Well-Being, 9) Populations of Concern. Each chapter has a summary; the full chapter has information presented with specific headings, extensive use of graphics and tables, and references.

THE IMPACT OF CLIMATE CHANGE ON HEALTH AND EQUITY

This link is to a blog within the Culture of Health blog site on the Robert Wood Johnson website. The blog focuses on health equity issues in climate change. Other blogs of interest on the Culture of Health page include farm roles in food security and health and community health solutions in rural communities.

OHIO STATE UNIVERSITY CLIMATE CHANGE WEBINAR SERIES: GLOBAL CHANGE LOCAL IMPACT

- **The OSU Climate Change Outreach Team is comprised of multiple departments within the Ohio State University that are working together to provide information about local impacts of climate change to residents of Ohio and the Great Lakes region. The website has extensive information about local impact of climate change as well as a webinar site that has links to current and archived webinars.**
- **Great Lakes Public Health Coalition (GLPHC) 3-Webinar series on Building Affiliate Capacity to Address Climate Change**
  - The GLPHC is comprised of the six state public health associations (PHAs) in the midwest Great Lakes region: Indiana PHA, Illinois PHA, Michigan PHA, Minnesota PHA, Ohio PHA, and Wisconsin PHA. The GLPHC developed three webinars to support state PHAs in their efforts to work with state and local health agencies in issues related to climate change and health. The three webinars are: 1) Climate Change, Health Equity, & Environmental Justice; 2) Frameworks for State & Local Climate Action Plans, 3) Legal Interventions Relevant to Midwest States & Localities. Each webinar is 1.5 hours and is free unless attendees want to obtain CE credits, for which a nominal fee is required. Webinars will be archived after initial telecasts in I January, February, and March of 2018. Links to webinars will be posted on the GLPHC website, which cn e rached through a link on the home page of the Ohio PHA website at **www.ohiopha.org**

REFERENCES

- Baule, W., Briley, L., Brown, D., & Gibbons, E. (2014). Synthesis of the Third National Climate Assessment for the Great Lakes Region. *Great Lakes Integrated Sciences+ Assessments (GLISA). Graham Sustainability Institute, University of Michigan. Available at: http://glisa. umich. edu/ media/files/Great_Lakes_NCA_Synthesis. pdf (Accessed October 2016)*.

- Center for Clean Air Policy. (2013). *Adaptation-Mitigation Synergies: Connecting the Dots.* Retrieved from http://ccap.org/assets/5a_Udvardy_Adaptation-Mitigation_Nov-15-2013.pdf.

- Centers for Disease Control and Prevention, Office for State, Tribal, Local and Territorial Support (2013, November). *United States Public Health 101*. Retrieved from https://www.cdc.gov/stltpublichealth/docs/usph101.pptx

- Centers for Disease Control and Prevention. (2014, May). *The public health system and the 10 Essential Public Health Services.* Retrieved from https://www.cdc.gov/nphpsp/essentialservices.html

- Centers for Disease Control and Prevention. (2015). *CDC's Building Resilience Against Climate Effects (BRACE) Framework.* Retrieved from https://www.cdc.gov/climateandhealth/BRACE.htm

- Centers for Disease Control and Prevention. (2017). *One Health.* Retrieved from https://www.cdc.gov/onehealth/index.html.

- Centers for Disease Control and Prevention. (2017). *Potential Range in the US*. Retrieved from https://www.cdc.gov/zika/vector/range.html.

- Centers for Disease Control and Prevention. (2017). *The Public Health System and the 10 Essential Public Health Services.* Retrieved from https://www.cdc.gov/stltpublichealth/publichealthservices/essentialhealthservices.html.

- Fitzpatrick, M., Freese, B., & Wadsworth, B. (2009). *Confronting climate change in the U.S Midwest*..Union of Concerned Scientists.

- Franklin County Public Health (2017) *Community Health Assessment.* Retrieved from https://www.myfcph.org/pdfs/CHA/English/FCPH2017-2019CHAReport.pdf.

- Georgakakos, A., P. Fleming, M. Dettinger, C. Peters-Lidard, T.C. Richmond, K. Reckhow, K. White, and D. Yates. 2014. Ch. 3: Water Resources. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. M. Melillo, T.C. Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program. DOI:107930/J0G44N6T.

- Great Lakes Integrated Sciences and Assessment and the University of Michigan Climate Center. (2016). *Climate Change in Columbus, Ohio.*

- Institute of Medicine. (1988) *The future of public health*. Washington, DC: National Academies Press.

- Intergovernmental Panel on Climate Change (IPCC, 2014b, p. 125), *Climate Change 2014, Synthesis Report,* retrieved from: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf

- Lieberman, B. (2017) *Cases of Lyme Disease Increasing nationwide.* Yale Climate Connections. Retrieved from https://www.yaleclimateconnections.org/2017/06/cases-of-lyme-disease-increasing-nationwide/

- Marinucci, G., D., Luber, G., Uejio, C. K., Saha, S., & Hess, J. J. (2014). *Building resilience against climate effects- A novel framework to facilitate climate readiness in public health agencies.* International journal of Environmental Public Health, 11(6), 6433-6458.

- Melillo, J. M., Richmond, T. T., & Yohe, G. (2014). *Climate change impacts in the United States*. *Third National Climate Assessment*.

- Moser, S.C., M.A. Davidson, P. Kirshen, P. Mulvaney, J.F. Murley, J.E. Neumann, L. Petes, and D. Reed. 2014. Ch. 25: Coastal Zone Development and Ecosystems. *Climate Change*

- Ohio Department of Health (2017). *Lyme disease.* Retrieved from http://www.odh.ohio.gov/lyme.

- Public Health Accreditation Board. (2013, December). *Public Health Accreditation Board standards & measures – Version 1.5*. Retrieved from http://www.phaboard.org/wp-content/uploads/SM-Version-1.5-Board-adopted-FINAL-01-24-2014.docx.pdf

- Public Health Accreditation Board. (2014, January). *Public Health Accreditation Board revises health equity standards and measures.* Retrieved from http://www.dhpe.org/news/158936/Public-Health-Accreditation-Board-revises-Health-Equity-Standards-and-Measures.htm

- Public Health Accreditation Board. (2017, March). *Health equity in the PHAB Standards and Measures (1.5).* Retrieved from http://www.phaboard.org/wp-content/uploads/Health-Equity-in-the-SM.pdf

- Schwarz, H.G., M. Meyer, C.J. Burbank, M. Kuby, C. Oster, J. Posey, E.J. Russo, and A. Rypinski. 2014. Chapter 5: Transportation. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J.M. Melillo, T.C. Richmond, and G.W. Yohe, Eds., U.S. Global Research Program. DOI:10.7930/JO6Q1V53

- Turner, C., & Morris, B. (2015). *Ohio agricultural statistics 2015 annual bulletin.* (Bulletin).Ohio Department of Agriculture and United States Department of Agriculture National Agricultural Statistics Services.

- United States Department of Health and Human Services. (2010). *Disparities.* Retrieved from https://www.healthypeople.gov/2020/about/foundation-health-measures/Disparities

- U.S Department of Health and Human Services. (2016, August 08). *Public Health Emergency-Access and Functional Needs*. Retrieved December 01, 2017, from Public Health Emergency : http://www.phe.gov/preparedness/planning/abc/pages/afn-guidance.aspx

- United States Environmental Protection Agency. (2016). *What climate change means for Ohio. (No. EPA 430-F-16-037).* From *https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-oh.pdf*

- United States Global Change Research Program. (2016a): *The impacts of climate change on human health in the United States: A scientific assessment- Executive summary.* Washington, DC: Global Change Research Program. Retrieved from http://dx.doi.org/10.7930/J0R49NQX https://s3.amazonaws.com/climatehealth2016/high/ClimateHealth2016_00a_Front_Matter.pdf

- United States Global Change Research Program. (2016b): *The impacts of climate change on human health in the United States: A scientific assessment – Populations of concern.* Washington, DC: Global Change Research Program. https://s3.amazonaws.com/climatehealth2016/low/ClimateHealth2016_09_Populations_small.pdf

- US Department of Agriculture *Climate Change adaptation plan*. Retrieved from https://www.usda.gov/oce/climate_change/adaptation/USDA_Climate_Change_Adaptation_Plan_Only.pdf

- U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2

- United Way of the Columbia-Willamette (2013). *Measuring up: Assessing ourselves on equity*. Retrieved from http://uwpdx.blogspot.com/2013/07/measuring-up-assessing-ourselves-on.html

- Wingate, M.S., Perry, E.C., Campbell, P.H., David, P., & Weist, E. M. (2007). *Identifying and protecting vulnerable populations in public health emergencies: Addressing gaps in education and training.* Public Health Reports, 122(3), 422–426. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1847489/

- Wong, E., Akbari, H., Bell, R., & Cole, D. (2011). Reducing urban heat islands: compendium of strategies. *Environmental Protection Agency, retrieved May*, *12*, 2011.

- Wright, L., P. Chinowsky, K. Strzepek, R. Jones, R. Streeter, J. Smith, J. Mayotte, A. Powell, L. Jantarasami, and W. Perkins. 2012. Estimated effects of climate change on flood vulnerability of U.S. bridges. *Mitigation and Adaptation Strategies for Global Change*. *17*(8), 939-955. DOI:10.1007/s11027-011-9354-2.

- World Health Organization. (2002). *Environmental health in emergencies - Vulnerable groups*. Retrieved from http://www.who.int/environmental_health_emergencies/vulnerable_groups/en/

OPHA
Ohio Public Health Association
The Voice of Public Health

OHIO PUBLIC HEALTH CLIMATE RESILIENCE COALITION

Franklin County
Public Health

280 EAST BROAD STREET
COLUMBUS, OHIO 43215-4562
WWW.MYFCPH.ORG