Safeguarding Worker Health and Safety from a Changing Climate:

Delaware's Climate-Ready Workforce Pilot Project

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Abstract

Changing climate conditions threaten the health and safety of the State of Delaware's most important assets: its workforce. Building on momentum at the state level to assess climate risks and implement relevant adaptation actions, five state agencies implemented the Climate- Ready Workforce Pilot Project to identify and safeguard at-risk workers from the impacts of extreme events such as storms and floods as well as extreme temperatures.

Findings indicate that the five participating agencies have an important foundation of worker health and safety policies, procedures and practices. Enhancing their climate resilience will require both strengthening the fundamentals of current policies and procedures by improving processes for policy development, implementation, and enforcement, more explicitly incorporating climate considerations, and sharing agency good practices are key actions.

Introduction

Delaware's Changing Climate

Delaware is already experiencing higher temperatures, increasing rainfall, and rising sea levels, and these changes are expected to continue—and become more serious—in the coming years. Findings from the Delaware Climate Change Impact Assessment[1] indicate that:

- Annual and seasonal temperatures have increased by approximately 2˚F over the past century.

- Average temperatures are expected to increase by another 2.5 to 4.5˚F by 2050, and as much as 8˚F by the end of this century.

- The number of very hot days (over 95˚F) is expected to increase, and heat waves are projected to become longer and more frequent.

- Heavy rainstorms are expected to become more frequent and more intense, with an increasing number of very wet days with two inches or more of rainfall.

- Sea level rise is already occurring along Delaware's coast, with an increase of 13 inches over the past century.

- Higher sea levels will likely increase coastal flooding as storm surge reaches further inland.

Climate-related Risks to Worker Health and Safety

Changing climate conditions pose health and safety risks to state employees whose duties require extended periods of outdoor exposure. These risks include increased exposure to high heat days and other extreme weather conditions, including flooding and storm-related hazards, as well as indirect impacts related to air quality, vector-borne diseases, and water-related illnesses. Table 1 summarizes climate change hazards that may affect workers, occupational health impacts, the work and individual factors that contribute to vulnerabilities, and the types of work environments that are most affected.

Climate change effects can be a "risk magnifier" for vulnerable populations, such as outdoor workers who face greater exposure to environmental conditions.

Individual workers may have additional vulnerabilities that increase their risk. For example, people with underlying health conditions, such as asthma or cardiovascular disease, may be more sensitive to extreme heat and worsened air quality. Age, weight, and fitness can all affect an individual worker's vulnerability to weather-related challenges.

Table 1. Climate Change-Related Hazards and Impacts on Worker Health and Safety

Climate Change Related or Induced Hazards	Impacts on Worker Health and Safety	Work-Related Factors	Individual Factors	Locations Most Affected
Air Quality				
Increased particulates and pollutants such as ozone and pollen Indoor air pollutants including mold	Respiratory illnesses Cardiovascular disease Increased allergies	Work practices Work/rest cycles Protective gear, personal protective equipment (PPE) Indoor air quality Hazard exposure Proper ventilation	Age Weight Metabolism Degree of physical fitness Medical conditions Use of alcohol or drugs Clothing worn	Indoor/Outdoor Rural/Urban
Extreme Weather				
Hazards associated with clean-up following an extreme event (e.g.,	Respiratory illnesses Cardiovascular disease	Work practices Work/rest cycles Access to water	Age Weight Degree of physical fitness	Indoor/Outdoor Rural/Urban

flood, storm) such as hazardous debris, mold, sediments, chemicals	Vector-born infections Skin irritations, rashes Allergies Heat stroke Cold stress Traumatic injuries Mental stress, depression	Protective gear, PPE Location and condition of work place	Medical conditions Mental health Previous experience with disasters Clothing worn	
Extreme Temperatures				
Heat stress	Dehydration Heat cramps Heat exhaustion, heat fatigue Heat rash Heat stroke Heat syncope/ fainting	Work practices Work/rest cycles Access to water Access to shade, cooling Properly worn PPE	Age Weight Metabolism Degree of physical fitness Medical conditions Degree of acclimatization Prior heat injury Use of alcohol or drugs Clothing worn	Outdoor Rural/Urban

Cold stress	Frost bite	Work practices	Age	Outdoor
	Hypothermia	Work/rest cycles	Weight	Rural/Urban
	Chilblains	Access to heating	Metabolism	
		Properly worn PPE	Degree of physical fitness	
			Medical conditions Degree of acclimatization	
			Use of alcohol or drugs	
			Clothing worn	
Infectious and Vector-borne Diseases				
Greater incidence of and changes in pathogens	Infectious diseases	Work practices	Age	Healthcare facilities
	Vector-borne infections	Protective equipment, PPE	Weight	Outdoor
Greater incidence of and changes in insect distribution More plant allergens	Allergies, asthma		Degree of physical fitness,	Rural/Urban
	Dermatitis		Medical conditions	
			Medications used	
			Clothing worn	
			Use of insecticides	

Climate Adaptation in Delaware

Delaware has been taking action to adapt to these changing climate conditions. In September 2013, former Governor Markell issued Executive Order 41: Preparing Delaware for Emerging Climate Impacts and Seizing Economic Opportunities from Reducing Emissions. The Executive Order acknowledged the challenges facing Delaware from climate change and the opportunities for building a cleaner, more sustainable state. It directed state agencies to develop strategies to address both the causes and consequences of climate change. One result was the development of the Delaware Climate Change Impact Assessment,[1] which summarizes the best available science on the potential impacts of climate change to people, places and resources in the State. The Climate Framework for Delaware was prepared in 2014 in response to findings in the Climate Change Impact Assessment and contains over 150 climate change adaptation recommendations

from Delaware's eleven state agencies. Many agencies recognized a common concern—the risks climate change poses to one of the State's most valuable assets: its workforce.

The Climate-Ready Workforce Pilot Project was launched in 2016 to protect the health and safety of state workers, particularly in the face of changing and unprecedented extreme weather conditions.

Four Twenty Seven and MDB, Inc. were hired as the consultants for this project, and five of Delaware's agencies were involved: the Department of Natural Resources and Environmental Control, the Delaware Department of Transportation, the Department of Health and Social Services, the Department of Safety and Homeland Security, and the Office of Management and Budget. Representatives of each of these agencies created the inter-agency pilot project team which helped to steer the project. Four Twenty Seven and MDB, Inc. worked with the inter-agency pilot project team to:

- Review and evaluate current state agency health and safety policies and practices,

- Conduct outreach to at-risk state workers (e.g., outdoor workers) to identify opportunities to improve current policies and practices, and

- Recommend "best practices" for supporting worker health and safety and reducing risks posed by climate change.

Delaware's At-Risk Workers and Their Work Environments

The inter-agency pilot project team members identified the at-risk positions that work in six types of climate- exposed environments. Rather than focusing simply on "outdoor workers," participating agencies identified at-risk workers as individuals who spend time in work environments in which they are exposed to weather- related hazards, such as extreme heat, cold, storms, and flooding. At-risk work environments include both indoor and outdoor settings:

- Indoor unconditioned spaces, which vary in size and include both smaller spaces such as mechanic shops, electrical rooms, and fee booths, and larger spaces such as buildings, homes and warehouses.

- Indoor confined spaces, which include compost rooms, crawl spaces, drainage systems, and building mechanical spaces.

- Outdoor urban spaces, which consist of paved areas such as garages, bridges, and outdoor areas surrounding buildings, as well as unpaved areas such as crawl spaces, roofs, and outdoor open areas.

- Outdoor natural areas, which are commonly identified as wooded forests, meadows, state parks, beaches, and trails. Many of these outdoor work areas are adjacent to or near built infrastructure such as a rest area or a highway.

- Outdoor suburban areas, which can be found in the suburbs or in neighborhoods, include residents' yards, streets, empty lots, and other grassy areas.

- Heavy equipment, which are used by agencies' staff and include loaders, leaf vacuums, wood chippers, and spare tires, and vehicles, which include trucks, skid steers, snow plows, street sweepers, tractors, and fork lifts.

Agencies identified at-risk workers who spend time in each type of work environment. An at-risk worker in the climate change context is one who is more exposed to the negative impacts of climate change during her or his workday.[2] The inter-agency pilot project team recognized that at-risk workers will be affected by changing climate conditions related to extreme heat, flooding, and storms, with impacts on air quality, vector-borne diseases, and water-related illnesses.

The vulnerability of at-risk workers is defined in part by the work environment (exposure) and the type of work being done (e.g., degree of physical exertion, use of tools). Other factors that contribute to risk is a worker's age, health and physical condition, level of safety training, availability of safety equipment or protective gear, and a workplace culture that values and supports health and safety.

Different agencies considered a variety of positions to be at-risk but there were commonalities among the five agencies. The positions that were most often classified as being at-risk by at least three of the five agencies include technicians, maintenance workers, engineers, those who provide support services and managers and supervisors. In addition, many agencies indicated that they had seasonal positions which accounted for a large number of employees, as in the case of DNREC, which employs more than 190 seasonal maintenance workers. Pilot project team members identified the types of job positions and work environments that could be considered at-risk, and estimated the numbers of positions in their agency divisions.

Framework for Analysis

The framework used for this analysis and good practice recommendations are the Occupational Health and Safety Administration's (OSHA) Publication 3885 entitled "Recommended Practices for Safety and Health Programs" (2016).[3] Although OSHA's coverage in Delaware extends only to private sector employers and does not include public employers and employees, the federal agency's guidelines are a useful and widely accepted benchmark for assessing the effectiveness of occupational health and safety policies and procedures. The core elements in the OSHA guidelines, outlined below in Figure 1, informed the determination and organization of the key findings and recommendations.

Figure 1. Core Elements of OSHA Guidelines

Additionally, "advancing the framework for considering the effects of climate change on worker safety and health" provided a climate change specific framework for the policy review.[4] This framework for climate related occupational hazards includes: 1) increased ambient temperature, 2) air pollution, 3) ultra-violet radiation, 4) extreme weather, 5) vector-borne diseases and other

biological hazards, 6) industrial transitions and emerging industries, and 7) changes in the built environment.

Methods

The Climate-Ready Workforce Pilot Project included three methodological components to inform the assessment of the five Delaware agencies' readiness for climate change. They were: 1) a thorough review of participating agencies' existing policy documents relevant to employee health and safety in changing climate conditions, 2) key informant interviews with staff responsible for defining or implementing health and safety policies and procedures, and 3) a survey targeted to obtain feedback from at-risk and other staff across the participating agencies.

Policy Review

The participating agencies provided the consultant team with the relevant written policy documents relating to worker health and safety. The consultant team reviewed each document to evaluate assurance of employee health and safety and the applicability of those policies to at-risk workers as climate conditions change. Relevant sections of each policy were highlighted as either good practices or gaps in assuring employee health and safety, and recorded in a policy review matrix.

Good practices were defined as policies that account for worker health and safety in a variety of climate conditions, including extreme heat, cold and severe storms. These policies identify the risks associated with these conditions, explain how to prepare for them, detail the training needed to prepare for and respond to these conditions, provide information on recognizing hazards and/or climate related illness, and/or instruct staff on how to respond to those hazards. Policies were categorized as gaps if they lacked the type and level of information that could be found in policies labeled as good practices. For example, policies could be defined as gaps because they include instructions limited to the care of equipment, or only provide information on reactive actions such as emergency response functions.

Key Informant Interviews

The goal of the interviews was to better understand key informant's thoughts, experiences, and knowledge about the existing safety and health policies and procedures in each agency and the potential impacts of climate change on those policies and procedures. The inter-agency pilot project team identified the key informants and provided their contact information to the consultant team. Key informants are agency staff that were identified by participating divisions as being important actors in the development or implementation of agency health and safety policies. Their insights were used to inform survey development, in order to obtain a broader understanding of issues highlighted during the interviews.

The consultant team reached out to these potential interviewees via email and conducted eleven interviews between December 19, 2016 and February 9, 2017.

Based on availability, the consultant team was able to conduct interviews with representatives from four (DHSS, DNREC, DSHS, and OMB) of the five agencies. Each interview was approximately 45 minutes long, and interviewees included director-level, manager-level, supervisor-level, and technical-level staff. The interview questions focused on familiarity with and the perceived effectiveness of agency health and safety policies, procedures and training; the

impact of climate conditions on interviewee's (or their staff's) work, and opportunities for improvement.

Surveys

An employee survey was also conducted to compile a broad range of feedback on agency health and safety policies and procedures from agency staff. The survey was deployed using SurveyMonkey and distributed to staff either via email or on paper depending on whether those staff had access to a computer. Each participating agency selected the employees to take the survey. While the focus was on employees who were considered "at- risk" to changing climate conditions, the agencies also disseminated the survey to staff who are not considered at-risk (e.g., work in offices) at their discretion.

Survey questions focused on staff familiarity with and perceived effectiveness of agency health and safety policies and procedures. Questions included inquiries into whether staff were informed of agency polices, how and by whom; whether they were notified before extreme weather, how and by whom; what the most significant hazards affecting staff work are; and what the most important improvements to make might be.

All electronic and paper survey responses were entered into SurveyMonkey for analysis. The analysis of survey responses was conducted using the SurveyMonkey "Analyze Results" feature, in addition to an agency- specific analysis conducted in Microsoft Excel.

Key Findings

Based on the policy review, key informant interviews, and surveys, the consultant team identified:

Cross-Agency

- The strengths of the overall set of policies and procedures of all five participating agencies in incorporating climate resilience, and

- Opportunities for improvement in the overall set of policies and procedures of all five agencies.

For Individual agencies

- What each of the five agencies is doing well in regard to incorporating climate resilience into its worker health and safety policies and procedures, and

- What each of the five agencies is not addressing and/or could improve.

Background and Key Concerns

The work environments in which agency staff spend the majority of their work day is an important factor in exposure to climate change-related hazards. The work environments that are subject to the greatest exposure to these hazards include outdoor urban spaces and natural areas as well as vehicles and facilities that are not fully protected from weather.

Thirty percent of survey respondents spend the majority of their work day outdoors in urban or paved work sites, and another 30% spend the greatest part of their work day in an office. The remainder of respondents spend the majority of their work day in a facility that is not fully

protected from weather conditions (11%), outdoors in rural or park work sites (8%), or in a vehicle (4%) (see Figure 2).

Figure 2. Work Environments in which Survey Respondents Spend the Majority of their Work Day
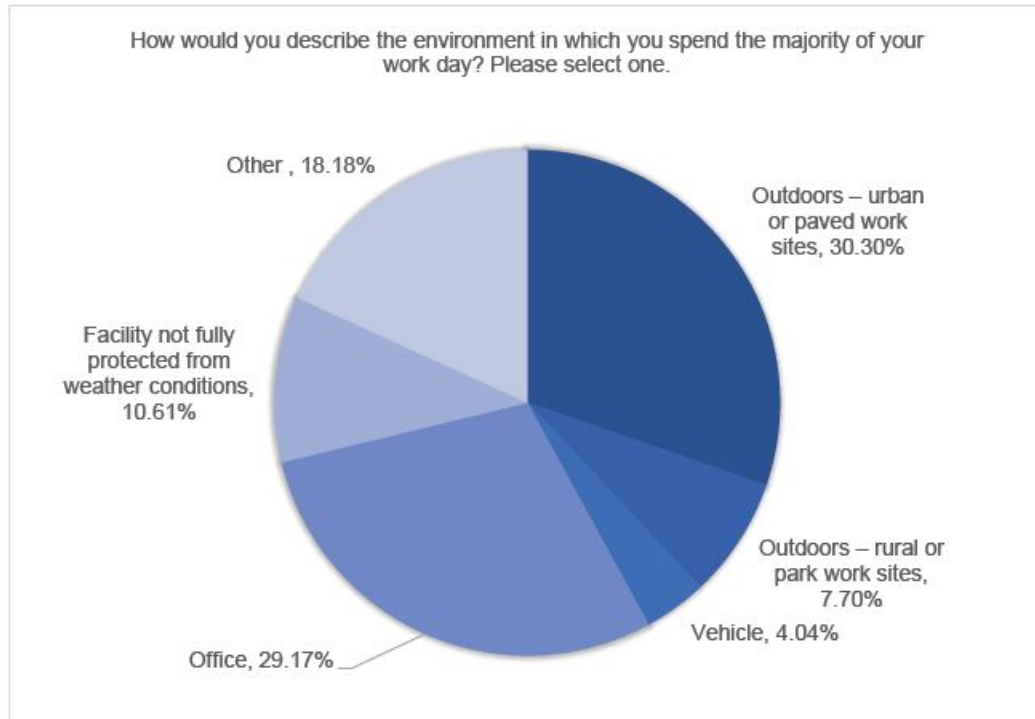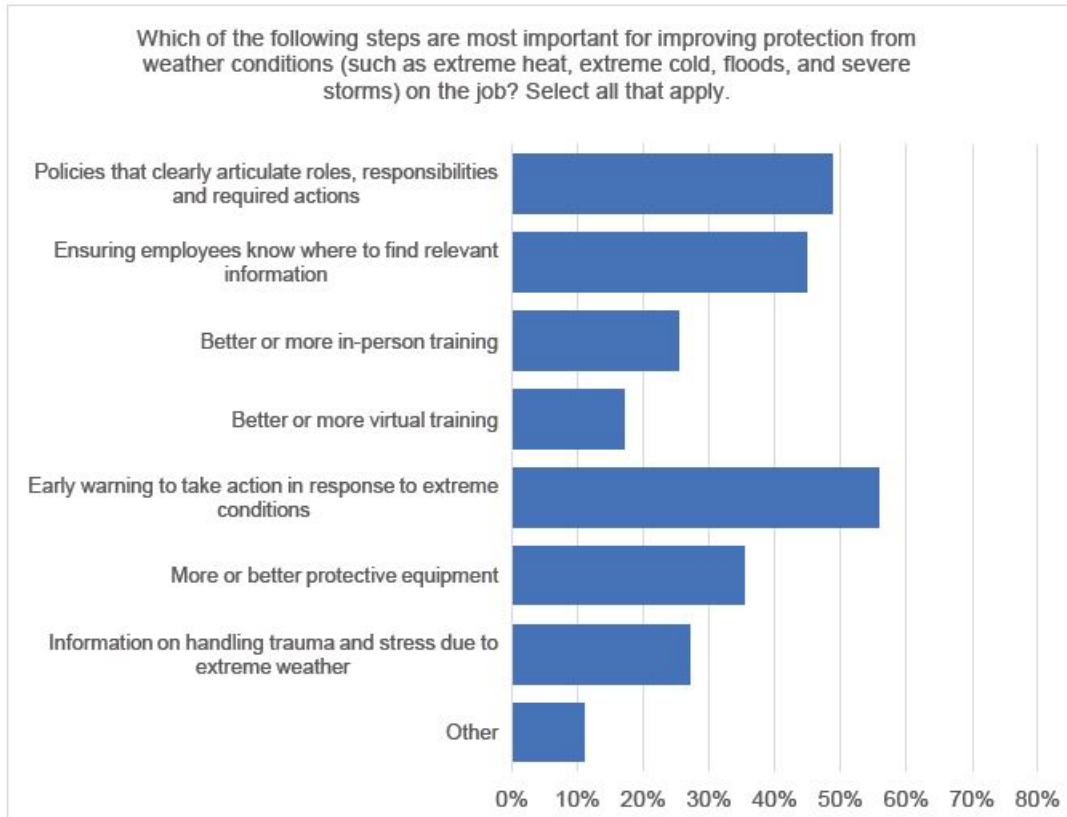

In terms of climate hazards that affect their work, survey respondents indicated that extreme heat is the greatest concern (71%), followed by extreme cold (68%), severe storms (64%), strong winds (55%), and floods (39%) (see Figure 3).

Figure 3. Weather Conditions of Greatest Concern in relation to Survey Respondent

What types of weather conditions are of greatest concern for your work? Select all that apply.
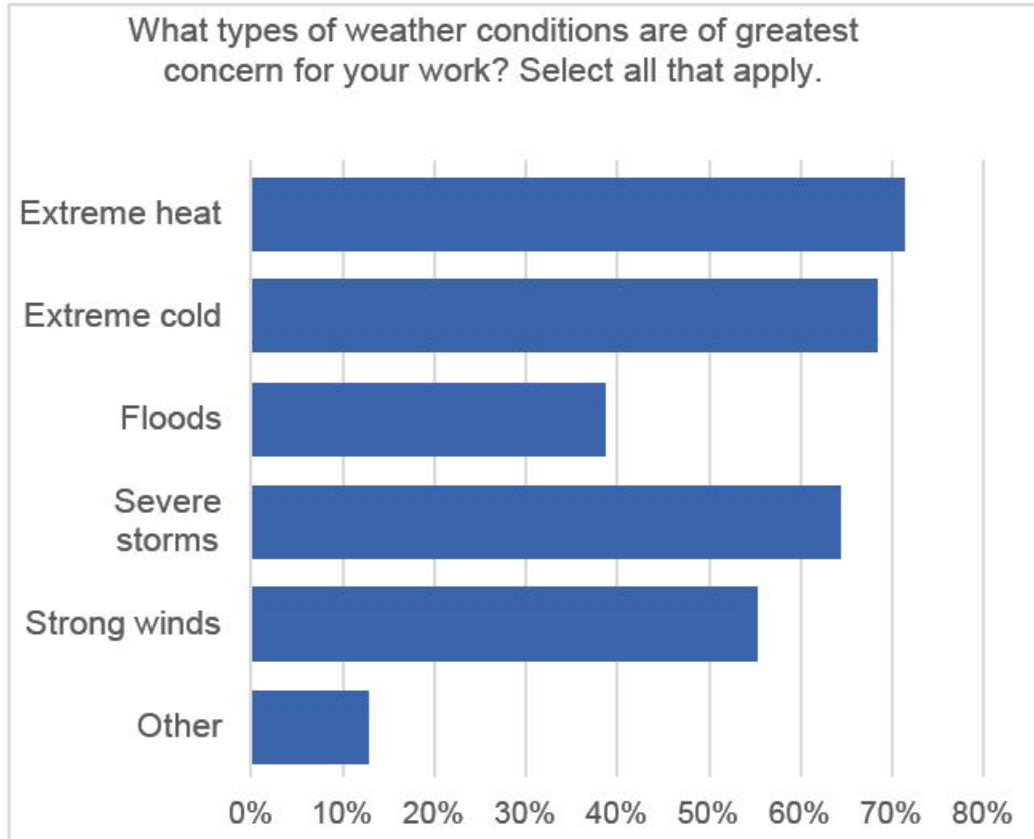
Appropriate adaptation actions can help to reduce the impacts of climate change-related hazards on worker health and safety. While some of these actions may be more explicitly linked to weather and climate hazards (e.g., early warning), in many cases, strengthening the processes related to health and safety policies will enhance worker protection from climate change hazards. The greatest number of respondents (56%) indicated that early warning to take preventive action would be most valuable. A significant number of survey respondents also indicated that the following would be important: policies and procedures that clearly articulate roles, responsibilities and required protective actions, and employees knowing where to find relevant policies, procedures and other information (see Figure 4).

Figure 4. Most Important Actions to Improve Worker Protection from Weather Conditions

Which of the following steps are most important for improving protection from weather conditions (such as extreme heat, extreme cold, floods, and severe storms) on the job? Select all that apply.

Summary of Findings

Policy Guidance

- Addressing gaps in safety and health programs related to climate change is built on the foundation of core safety and health policies and procedures.

- In reviewing health and safety policies across the five agencies we discovered a high degree of variation in detail and implementation of the written policies.

- There is a need to improve clarity and consistency in agency-level policies and incorporate relevant weather and climate factors, including high heat, extreme cold, and vector-borne diseases, into safety and health policies and procedures.

Roles and Responsibilities

- Supervisory leadership was repeatedly rated highly by survey respondents, and many supervisors play a key role in informing workers about the agency's safety and health policies and guidance.

- There is a need for clearly defined agency- wide guidance on roles and responsibilities for leadership and staff, detailing specific actions required for safety and health policy development, implementation, training, and review.

Communications and Training

- Communications and alerts regarding severe weather events varied by agencies, and many surveyed employees reported being unaware of the location of relevant

safety and health policy information. However, they also commonly expressed an interest in learning more about existing policies.

- Across the five agencies there is a need to increase communications and training regarding health and safety policies and procedures.

Implementation and Enforcement

- Effective implementation of policies requires a specific action plan with personnel assigned to action steps on a detailed time line.

- There is a need to develop systems for accountability to ensure policies are implemented, and time lines and responsibility are established for solving problems, and updating policies and procedures.

Evaluation and Improvement

- Managers are responsible for customizing, writing, and implementing health and safety policies for their staff.

- There appears to be a lack of systems for employee and union involvement across the agencies, and there was no evidence of cross-agency or inter- agency cooperation in developing policies and sharing good practices.

- There is a need to establish an appropriate process for reviewing and updating safety and health policies, engaging staff, eliciting feedback and sharing health and safety information, policies and good practices between and within agencies.

Recommendations

Our review of the impacts of climate change on Delaware state agencies' occupational safety and health policies and procedures reveals important opportunities for improvement. Strengthening the fundamentals of the current policies and procedures by improving processes for policy development, implementation, and enforcement, focusing on gaps specifically related to climate change, and sharing agency good practices are key actions. Establishing a system of safety and health committees that include front line employees will be an important part of creating an ongoing process of management commitment and employee involvement to achieve continuous improvement of policies and procedures. In so doing, Delaware will provide a model of leadership on addressing the occupational safety and health impacts of climate change on employee well-being.

To help inform next steps in state agencies' efforts to take advantage of identified opportunities for improvement and integrate climate change considerations into worker health and safety policies, the consultant team developed a set of recommendations.

Policy Guidance

- Develop detailed agency occupational safety and health policies in recognition of the higher occurrence of extreme weather events. These policies should:

- Address thermal stress, working in hot and cold environments,

- Include detailed procedures,

Describe:

- The signs and symptoms of health effects,

- Employer provided equipment and clothing,

- Preventive actions such as hydration and response actions related to first aid procedures, and mandatory training, early warning and communications.

- Use and reference relevant national and industry guidelines and standards in developing the above polices such as the NIOSH Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments,[5] the American Conference of Governmental Industrial Hygienists' Threshold Limit Values on Thermal Stress (Cold Stress, Heat Stress and Heat Strain), and the CalOSHA Heat Illness Prevention Standard.[6]

- Require development of Emergency Action Plans that set forth site-specific emergency and disaster plans (preparation for responding to floods, other extreme weather events, air pollution, and the mental health impacts of exposure to traumatic events and fatigue).

- Develop policies, procedures, information, and training on biological exposures certain field employees are likely to encounter such as Lyme Disease. Other biological exposures that may be of concern include Zika, Histoplasmosis, and mold.

- Convene an inter-agency working group to identify shared concerns and opportunities to develop policies, procedures or supporting materials (e.g., factsheets describing hazards) that may be used across agencies. Seek to leverage an existing inter- agency mechanism.

Roles and Responsibilities

- Ensure that policies clearly state that staff who are assigned safety responsibilities are adequately trained and have access to necessary resources and equipment.

Communications and Training

- Develop and implement a consistent method and process to provide early warning for at-risk employees to take action in extreme conditions based on established, clearly articulated thresholds as well as reminders of the appropriate protective actions.

- Include training on the impacts of climate change, and designate an individual to integrate the information into decision-making processes.

- Provide additional information and training such as factsheets with photos of potential threats (e.g., ticks) and training on hazard specific safety and health control policies.

- Create a regular schedule to update all staff about health and safety policies and procedures.

- Ensure that safety and health policies, standards and guidelines are posted in a visible and highly trafficked area, and that employees are aware of where they are posted.

Implementation and Enforcement

- Establish systems for accountability to ensure policies are implemented, and timelines and responsibility are established for solving problems and updating policies and procedures.

- Promote monitoring and accountability by:

  o Tracking incidents, and

  o Ensuring staff are aware of and implement relevant health and safety policies and procedures.

Evaluation and Improvement

- Create a system of safety and health committees to provide an ongoing process for employee participation and management leadership.

- Create a regular schedule to review and update safety and health policies.

- Create a product evaluation committee and process that is charged with incorporating risk evaluation information provided by relevant staff and selecting protective clothing, PPE, and other safety equipment.

Conclusion

The State of Delaware has already taken important steps to characterize changing climate conditions and identify potential opportunities to integrate climate considerations more explicitly into existing policies in order to safeguard the health and well-being of the State's most valuable asset, its workers. The findings from this project will be used to inform the next steps that the state should take with regard to health, safety and climate change.

Climate change does and will continue to affect all agencies' workers and operation. Looking forward and thinking about how health and safety policies and procedures address climate change is important to build resilience in the state as well as protect our workers.

Participating State agencies now have an opportunity to leverage and share their experiences and lessons learned as well as use the results of the Pilot Project to more explicitly incorporate climate considerations into existing health and safety policies and improve relevant processes.

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