Climate Risks and Resilience at Dickinson College: Strategies for Health and Wellbeing

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Introduction

In recent years, extreme weather events have disrupted communities across the nation, highlighting the urgency of addressing climate-related risks. At Dickinson College, the implications of climate change are no longer abstract-they are tangible, immediate, and personal. From rising temperatures that strain physical health to unpredictable storms that challenge our preparedness, the wellbeing of our students and employees is increasingly at stake.

In response to this, this report is part of a Dickinson initiative launched in 2023 at the request of President Jones aiming to assess climate-related risks at Dickinson and in the wider community, investigate options for managing risks and building climate resilience, and develop and implement an action plan. Over the past year, climate-related risks have been examined and shared with the Dickinson, Carlisle, and Cumberland County communities. The initiative is now at the stage of identifying and evaluating strategies that Dickinson can implement to address the risks to the campus and to Dickinson students and employees. Four reports were produced this year, focusing on (1) Student and Employee Health and Wellbeing, (2) Infrastructure, Utility services, and Grounds, (3) College Finances, and (4) Continuity of College Operations. This report focuses on climate risks to the health and wellbeing of the students and employees of the college and strategies to protect their health and wellbeing.

The risks and recommendations proposed in this report were researched by conducting an extensive review of available literature on the risks posed by climate change and best practices for working towards resilience against them. Additionally, a key component of this report was to gather insights from Dickinson employees regarding their perceptions of the risks that should be prioritized for action, how the college is currently managing those risks, areas for improvement, and ways to enhance Dickinson's capacity to manage climate-related risks. To achieve this, a focus group conversation was held, delving into the distinct aspect of climate-related risks related to student and employee health and wellbeing.

The focus group conducted as part of this initiative aimed to explore climate-related risks to the health and wellbeing of students and employees at Dickinson College, with a particular focus on the impacts of extreme weather. Participants included staff members from various departments, such as public safety, facilities, dining services, and student health. A representative from the athletic department was also invited but was unable to attend. These diverse perspectives helped identify specific vulnerabilities within the college community. The focus group was conducted to gather qualitative insights into how climate-related risks specifically impact the health and wellbeing of Dickinson College's students and employees. While extensive literature reviews provided valuable data on the broader implications of climate change, the focus group offered an opportunity to incorporate firsthand experiences and perceptions from the college community. This approach allowed for a more nuanced understanding of vulnerabilities, challenges, and priorities within the unique context of Dickinson.

Key findings from the discussions included concerns about extreme heat affecting outdoor workers, such as public safety officers and grounds employees, and the strain on aging air conditioning systems in campus buildings. Vulnerable groups, including individuals with

respiratory conditions, chronic illnesses, mobility challenges, and student athletes, were highlighted as being at greater risk. The group also identified potential risks associated with power outages, mold, and mental health challenges exacerbated by environmental stressors. Participants emphasized the importance of educational initiatives to prepare staff and students for climate emergencies, such as training on recognizing heat-related illnesses and understanding the broader implications of global temperature increases. They also discussed equity concerns, noting the strain on local healthcare systems during emergencies and the need for the college to provide inclusive support for all community members. Suggestions for enhancing resilience included converting spaces like the Kline into cooling stations, increasing tree cover, and ensuring that building renovations incorporate climate-resilient infrastructure.

The literature on climate risks presents an urgent picture of the intersection between climate change impacts and human health, focusing on how these changes are affecting vulnerable populations and reshaping public health needs. Climate change projections suggest that communities will increasingly face a significant and growing threat to human health, impacting communities worldwide through intensifying weather patterns, extreme temperatures, and shifting environmental conditions. These events are projected to have severe repercussions on physical health, mental well-being, food security, and healthcare systems, especially in areas with pre-existing disparities (Schramm et al., 2023, p. 15.6). Within academic settings, these impacts are increasingly relevant as colleges and universities are situated at the intersection of youth mental health concerns, high-density populations, and aging infrastructure. Under-resourced and overburdened communities and individuals, such as pregnant people, low-income households, people and communities of color, people with chronic diseases, children, elderly individuals, and outdoor workers, are anticipated to experience disproportionate impacts due to limited access to resources, healthcare, and adaptive infrastructure. Structural racism and discrimination against marginalized groups directly contribute to health inequities, which are public health crises (Schramm et al., 2023, p. 15.6).

Dickinson's immediate community is made up by a majority of college-age students, as well as the college's faculty and staff, and are thus less likely to be at risk of experiencing disproportionate impacts due to being unhoused or elderly. Despite this, Dickinson still has elderly employees as well as students who are unhoused during breaks. Additionally, a significant percentage of employees are paid below a living wage, making them potentially vulnerable due to limited financial resources. Beyond this, community members could suffer from underlying health conditions, as well as being of a marginalized community or without

strong access to healthcare. The focus group participants identified specific at-risk populations within the college community, including individuals with respiratory conditions, chronic illnesses, and mobility challenges. Dining services staff, campus safety officers and student athletes were also mentioned as being particularly vulnerable to the effects of extreme heat. For college students, environmental stressors like heat and poor air quality can worsen existing health conditions, impact cognitive functioning, and contribute to mental health challenges that affect academic success and social well-being. Similarly, campus employees, including those in outdoor or physically demanding roles, face heightened exposure to these risks, underscoring the importance of workplace safety and adaptation measures (Leary, 2024, pp. 6–9). Consequently, Dickinson must address both the immediate and long-term health needs of their communities to mitigate climate-related risks effectively. As climate change escalates, Dickinson's student and employee populations will encounter health challenges from extreme heat, worsening air quality, and increased climate anxiety, underscoring the need for tailored institutional policies that prioritize environmental resilience and mental health support.

Climate Risks Review

This section explores how climate change risks, such as extreme heat, worsening air quality, and other climate-related health stressors, may impact students and employees in a college setting. While there is limited existing literature that focuses explicitly on the risks posed to a college campus, this review draws inferences from broader studies on climate-related health risks to assess their potential implications for colleges and universities. It synthesizes findings on physical and mental health outcomes, focusing on the vulnerable nature of academic communities amid escalating climate risks. Furthermore, it will explore existing literature on the mental health effects of climate-related disasters and the challenges in healthcare capacity. In the

following sections, this review will discuss the most salient risks posed to Dickinson and its community. Each section poses a significant risk to the community, but the sections are ordered from highest to lowest importance, measured by the volume of resources found on the topic and by the amount of risk posed. The first section focuses on extreme heat, followed by sections on air quality, mental health, and finally disease and access to healthcare.

Extreme Heat

The literature used in this review highlights that extreme heat poses some of the highest amount of health risks to the college, due to the projected likelihood of higher temperatures and the impact that it would have on student and employees. A report by Howard et al. cites that extreme heat kills more people in the US each year than any other climate-related hazard or extreme weather event, such as flooding or tornadoes, a fact that is corroborated by other bodies of work (Howard et al., 2024, p. 1). Further, increases in heat can cause increased illness and death, both directly through heat-related illnesses, worsening of preexisting conditions, and amplification of harmful health impacts, such as heat stroke, and indirectly through related occurrences such as worsened air quality and wildfires. These further the risk of fatalities, illnesses, physical injuries, negative reproductive effects, mental health challenges, and reductions in psychological well-being (Schramm et al., 2023, p. 15.8).

According to the Centers for Disease Control and Prevention (CDC), heat-related illnesses encompass a spectrum of conditions resulting from exposure to excessive heat. These include heat stroke, heat exhaustion, rhabdomyolysis, heat syncope, heat cramps, and heat rash. Heat stroke is the most severe, occurring when the body can no longer regulate its temperature, leading to potential disability or death without prompt emergency treatment (CDC, 2024). Heat exhaustion occurs when the body loses excessive water and salt through sweating, causing

symptoms like headache, nausea, and weakness. On the other hand, rhabdomyolysis is a more severe condition that involves the rapid breakdown of muscle tissue due to heat stress and prolonged physical exertion, potentially resulting in kidney damage. Similarly, heat syncope, characterized by sudden dizziness or fainting, often arises from standing too long or standing up abruptly in hot conditions. In contrast, heat cramps are painful muscle spasms triggered by heavy sweating during intense physical activity, while heat rash is a skin irritation caused by excessive sweating (CDC, 2024). Prompt recognition and treatment of these heat-related conditions are essential to prevent serious health complications.

Pennsylvania will see an increase of average temperatures as well as a higher number of days in extreme temperatures in this area. Relative to levels in 2000, by mid-century the average annual temperature in Pennsylvania is projected to rise by 5.9°F (*Pennsylvania Climate Impacts Assessment*, 2021, p. 6). In Carlisle, measurable increases in temperature have already occurred and are effectively guaranteed to continue to do so. In the near-term time frame, up to 2035, days over 90°F will be 8-26 days more frequent. By mid-century, temperatures are expected to surpass 90°F for an average of 30 to 60 days per year, and by the end of the century, this figure is projected to rise to between 48 and 96 days. (Leary, 2023, p. 7). Howard et al. focused on the health impacts of such increases find that the age-adjusted mortality rate for heat-related deaths increased by 3.6% per year from 1999 to 2023, with a 16.8% increase overall from 2016 to 2023 (Howard et al., 2024, p. 1). These types of increases both in the frequency and intensity of high heat days will have far-reaching effects on Dickinson students and employees.

As referenced above, athletes, those with preexisting conditions and those who spend considerable amounts of time outside are among the groups of people most at risk from heat-related health effects. The New York Times published a report based on the CDC's Heat Stress

Acclimatization guide, writing that nearly half of all heat-related worker fatalities happen on the first day of the job, with over 70 percent occurring within the first week (Gammon, 2024). For athletes, several health professionals outline the importance of altering practice schedules and length to reduce heat exposure and acclimatize players for hot conditions. As well, implementing extra hydration breaks and wearing cooling clothing or using techniques to cool skin are also important preventative measures.

Mallen et al. also highlights how synthetic sports turf with “high solar absorbency” can reach extreme temperatures under intense heat, with playing surfaces recorded as hot as 188°F. For synthetic athletic tracks, elevated temperatures can even penetrate the soles of athletes' shoes. (Mallen et al., 2023, pp. 4–5). Should an athlete show signs of overheating or heatstroke, an athletic trainer for West Virginia University highlights immersion in a cool water tub as the most effective method for reducing body temperature. This approach allows for rapid cooling as the body is fully or partially submerged, which helps dissipate heat efficiently and stabilize core temperature faster than other methods (Scarneo-Miller, 2024). When thinking about risks posed to workers, nearly 50% of heat-related worker deaths occur on the first day of employment, with over 70% happening within the first week, due to the body not having time to adjust to the climate of their workplace after time away, or to a new job (Gammon, 2024, p. 1).

Air Quality

Climate change is projected to worsen air quality, primarily through increased ground-level ozone and particulate matter concentrations (USEPA, 2024). Studies indicate that poor air quality exacerbates respiratory conditions, such as increased cardiovascular and pulmonary disease, as well as the risk of premature death, posing particular risks for individuals with asthma and other respiratory issues (Schramm et al., 2023, p. 15.7). Research by PennEnvironment and

Frontier research groups find that in 2018, 11 million Pennsylvanians resided in areas where air quality was unhealthy for at least one out of every four days, with levels of ground-level ozone (a primary component of smog) or particulate pollution exceeding the EPA's health risk threshold (Folger et al., 2020). Further, the Harrisburg-Carlisle area was ranked second worst by the same report in 2018. The area had 114 days when at least half of the monitoring stations recorded elevated levels of ozone and/or PM2.5 pollution. This affected nearly 575,000 residents, who endured polluted air for more than three out of every ten days (Folger et al., 2020).

A potential reason for this worsened air quality could be the location of Harrisburg and Carlisle. Transportation pollution is a major source of air pollution in many communities, and Carlisle is especially impacted due to its location as a major hub for trucking and distribution centers (Folger et al., 2020). Research on carbon dioxide concentrations from the pre-industrial era to the present indicates that rising CO2 levels contribute to higher concentrations of tropospheric ozone and PM2.5, pollutants that are linked to degraded air quality. According to Ofremu et al, degraded air quality, exacerbated by higher temperatures, has been associated with an estimated 1.1% increase in mortality for each degree of temperature rise above baseline levels (Ofremu et al., 2024, pp. 4–6). Further, indoor air pollution is also becoming a higher risk. Larger and more frequent floods, as well as other climate-related events, are increasing the prevalence of indoor air pollutants and mold. Such pollutants have been associated with an increased risk of heart disease, respiratory diseases like asthma, and certain types of cancer (USEPA, 2024).

Mental Health

Severe weather and climate disruptions are linked to increased mental health issues, including anxiety, depression, and post-traumatic stress disorder. Campus communities encounter

unique stressors, such as academic disruptions and financial pressures. Climate anxiety, especially among younger populations, is rising, impacting students' mental well-being and academic performance. The U.S. Global Change Research Program produced its Fifth National Climate Assessment, in which it found that children born in 2020 are at a higher risk of encountering climate-related adverse childhood events (ACEs) due to damage to their homes, schools, and communities (Schramm et al., 2023, p. 15.11). Work from Palinkas and Wong finds that individuals exposed to climate disasters are likely to experience heightened stress and even extreme mental illness. Reactions to extreme events, including but not limited to depletion of resources, disruption of social support and networks, or life-threatening losses, are linked to the onset of mental health issues such as PTSD, depression, anxiety, substance use or abuse, and suicidal ideation (Palinkas & Wong, 2020, pp. 12–14). Research indicates that severe weather can also lead to negative mental health effects, and the county has only one mental health provider for every 420 residents, compared to the statewide average of one provider for every 370 residents. Further, with Dickinson counting approximately 3,000 people as community members, its capacity to support its students and employees during a prolonged crisis will be tested (Leary, 2024, p. 9). What's more, an NPR article on the impact climate disasters can have on college students' mental health and academic performance found that they can be tremendously far-reaching.

College is a formative time for young people, and climate disasters experience by a student or even a student's family can impact their self-identity and make them more likely to drop classes or fully drop out. The NPR article above also notes that college students are often overlooked in terms of disaster aid. There is often little support for tuition or transportation to school, highlighting a greater need for disaster support systems (Hersher, 2024). Mental health

was another key topic in the focus group, with several participants recommending that the college as an institution work to focus on using language surrounding climate-related emergencies and impacts that is not anxiety inducing and alarmist. Participants in the group also highlighted a concerning expectation for students and staff to maintain productivity without recognizing the resulting inequities that can quickly accumulate. They pointed out that disparities in resources, workload, and support can create an uneven environment, leading to feelings of injustice and stress.

Disease

Climate change significantly heightens the risk of various diseases, as rising temperatures and shifting weather patterns create more favorable conditions for the spread of pathogens and vectors. The commonality of infectious and respiratory diseases is likely to be exacerbated by climate change. Further, individuals with preexisting cardiopulmonary conditions are especially susceptible to the impacts of climate change. With a heightened risk of heat waves and changing weather, the times of year, areas and infectiousness of such diseases is expected to change (Ofremu et al., 2024, p. 12). Intense rainfall events have also been shown to elevate the risk of infectious diseases (Leary, 2024, p. 8). Environmental fungal and bacterial diseases, as well as vector-borne diseases will also be impacted. Pennsylvania currently faces a higher risk of vector-borne diseases compared to many other states, particularly Lyme disease, which has increased over the last two decades, and cases in the past two years have been higher than they have ever been (Pennsylvania Department of Health, 2024). The state's temperate climate, abundant forested areas, and high populations of white-tailed deer provide ideal conditions for tick vectors, such as Ixodes scapularis, which transmit Lyme disease (Jacobs Sr., 2023). Warming temperatures have further expanded the geographic range and activity periods of these ticks,

increasing human exposure to tick bites and the disease (Thomson & Stanberry, 2022, pp. 1970–1972). While Lyme disease remains the primary vector-borne threat in Pennsylvania, the effects of climate change are expected to alter the distribution and diversity of other potential hazards. Rising temperatures and changes in precipitation patterns could facilitate the northward expansion of mosquito species, such as known carriers of dengue, Zika virus, and West Nile virus. Although Pennsylvania is not currently at significant risk from fungal pathogens or mosquito-borne diseases, these shifts underscore the importance of remaining vigilant about emerging risks in the region (Thomson & Stanberry, 2022, pp. 1971–1975).

Healthcare

Healthcare systems are likely to face heightened demand as climate risks increase, with extreme weather events placing additional strain on resources. Facilities may struggle with surges in demand for emergency services during extreme heat events, as heat waves increase the amount of people visiting emergency rooms. This kind of spike can overwhelm emergency services, as was seen in the summer of 2024 in areas of the south and west coast of the States (Leary, 2024, p. 9). A report focusing on how health systems can prepare for such occurrences found that extreme heat events (EHEs), have become more frequent and unpredictable, affecting areas with no history of such events. In one particularly intense heat wave in Washington state, temperatures reached 116° F, leading to a 69-fold jump in ER visits (Patel et al., 2022, p. 2). Climate-related weather events can heighten the risk for power blackouts, shutting off power and thus air conditioning and home medical equipment, bringing more people to the hospital for heat-related health problems. When the power grid is overburdened, hospitals risk losing power, which can disrupt patient care and leave highly vulnerable individuals exposed to extreme heat.

With hospitals typically designed as sealed buildings, a power outage during a heat wave can cause indoor temperatures to rise rapidly (Patel et al., 2022, pp. 2–4).

In speaking with Dickinson employees, their suggestions included the establishment of an employee health center, offering regular wellness services to promote physical and mental well-being, which could help promote education and improve prevention measures against climate change-related health risks. To ensure accessibility and consistency, the health center could provide services once a month, addressing common health concerns and supporting overall employee wellness. This initiative not only improves individual health but also fosters a culture of care within the workplace, aligning with sustainability goals by promoting long-term wellness and reducing healthcare-related environmental impacts.

Conclusion

The literature referenced above highlights an increasingly urgent need for institutions to address the multi-faceted impacts of climate change on health and well-being. Dickinson College, as a microcosm of these climate challenges, faces localized risks due to extreme heat, degraded air quality, climate-induced mental health stress, and evolving disease threats. As climate patterns continue to shift, these risks will likely intensify, requiring proactive strategies to protect the college community's physical and mental health. Extreme heat and the associated risks are presented by government publications, journal articles and news headlines as one of the most pressing and far-reaching risks to student and employee health. Mental health will also be greatly impacted, and it is important that the mental wellbeing of Dickinson’s students and employees is not overlooked. Dickinson College faces a worsening air quality as climate change progresses, and while the body of works referred to here did not find sources pointing to its location in a valley as a direct cause, it is important to investigate how to better mitigate pollution in a highly

trafficked area like Carlisle. While disease poses a risk as well, the literature cited above suggested that vector-borne and bacterial or fungal infections are less likely, although this is important to monitor. Issues in water quality or diseased water is a potential, but as Dickinson gets its water from a center plant, it is unlikely to be able to directly counteract such issues. There are limited sources discussing stresses put on the university healthcare systems by climate change, but assessments on hospital networks or local systems should be further considered. This review underscores the importance of targeted climate adaptation policies, improved infrastructure, and comprehensive mental health resources. From implementing cooling solutions for heat resilience to strengthening mental health support for students and staff, Dickinson can play a critical role in shaping a sustainable, health-centered approach to campus life.

Multi-Criteria Analysis and Recommended Solutions

Methods

In conducting this research, I engaged with a broad spectrum of resources on climate resilience solutions, considering a wide range of options aimed at enhancing Dickinson College's ability to withstand and adapt to climate-related risks, particularly those that could impact the health and wellbeing of the student body and college staff. Through this comprehensive review, I compiled a list of potential avenues for improving the college’s resilience, ranging from immediate, small-scale solutions to more complex, long-term strategies. I then categorized these smaller solutions into broader, overarching plans that could have the greatest impact.

After evaluating the potential benefits and challenges of these strategies, I selected six solutions that I believe are most appropriate and effective for Dickinson's specific context. In order to assess the merits of these solutions, I developed a set of evaluation criteria that would allow for a structured and thorough comparison. The criteria I used are designed to reflect the key priorities for Dickinson's sustainability and climate resilience goals:

Health Benefits: This criterion evaluates the direct health impact of each solution, considering factors such as reducing heat-related illnesses, improving air quality, or enhancing mental health. This is particularly important because the health of the community—students, faculty, and staff—is a core focus for any resilience strategy. I selected this as a top criterion because improving overall health outcomes has a wide-reaching effect, not just in terms of physical well-being, but also in fostering a productive, engaged, and thriving community.

Equity and Inclusivity: Recognizing that climate change disproportionately affects vulnerable and marginalized groups, I considered how each solution would improve equity and inclusivity, particularly for those who are most at risk. This criterion emphasizes the need for strategies that actively address and reduce disparities, ensuring that all groups—especially those with pre-existing vulnerabilities such as lower-income students or staff—benefit equitably from resilience efforts. By prioritizing equity, I ensured that the solutions not only protect the general population but also safeguard the most vulnerable.

Co-Benefits: In evaluating the co-benefits of each strategy, I looked at additional positive outcomes beyond the primary goal of climate resilience. These might include enhancing campus aesthetics, improving social cohesion, or reducing energy consumption. Solutions with strong co-benefits create broader value for the college, aligning with multiple goals such as sustainability, community engagement, and financial savings. This criterion helps ensure that the selected

solutions contribute to a range of college priorities and have the potential for widespread stakeholder buy-in.

Financial Costs: While it is important to consider the return on investment (ROI) of each solution, I intentionally focused on the initial and ongoing financial costs, without factoring in long-term financial returns. This approach allowed me to prioritize solutions that are financially feasible in the short term, ensuring that Dickinson can begin implementing these strategies quickly without being hampered by budget constraints. I also wanted to capture the financial burden of maintaining these solutions over time, ensuring that they remain sustainable in the long run.

Proven Strategy: It was essential to evaluate how successful these strategies have been in similar contexts. This criterion assesses the extent to which evidence exists to support the effectiveness of each solution, either through case studies or pilot programs at other institutions. Prioritizing proven strategies helps ensure that the selected solutions are not experimental or untested but rather have demonstrated real-world success in addressing climate resilience challenges. This provides confidence that the chosen strategies will yield tangible results for Dickinson.

Practicality and Adaptability: Finally, I evaluated the feasibility of each solution in terms of how easily it could be implemented at Dickinson, as well as how adaptable it would be over time as circumstances change. This includes considering the potential for future updates or scaling the solution as the college's needs evolve. The ability to adapt is especially important in the context of climate change, where the severity and nature of risks may shift over time. Solutions that are easy to implement and flexible in the face of change are more likely to be sustainable and effective in the long run.

These criteria allowed me to evaluate each potential solution through a comprehensive, holistic lens. By balancing health, equity, financial considerations, proven effectiveness, and practical implementation, I aimed to identify solutions that would not only address the immediate risks posed by climate change but also position Dickinson College for long-term success in its climate resilience efforts.

Strategies

Student Mental and Physical Health Resilience Plan

Climate change and the resulting increase in frequency and strength of extreme weather events, natural disasters and extreme heat, as well as the potential for poorer air quality, will have adverse effects on the mental and physical well-being of Dickinson's students. To address the increasing challenges posed by climate change, Dickinson College must develop a well-rounded plan aimed at protecting the mental and physical well-being of its students, faculty, and staff. This plan should address the growing frequency and intensity of extreme weather events, extreme heat, and poor air quality while fostering resilience within the campus community. Its primary purposes would be to reduce risks to health and safety, ensure academic continuity, and provide robust mental health support. The plan should be developed collaboratively with input from environmental experts, health professionals, and students, leveraging resources from OSHA, CDC, and EPA. Regular evaluation and adaptation will ensure it remains effective and responsive to changing conditions. Collaboration with local health departments and peer institutions can also help tailor solutions to Dickinson's specific needs. By implementing this plan, Dickinson can safeguard its community and demonstrate leadership in climate resilience.

Expressly noted in the focus group was the importance of Dickinson College implementing air quality and wet bulb globe temperature (WBGT) monitoring systems. Further, these readings should be readily available on a dashboard for all students and employees to access. It should be established that above certain air quality and temperature thresholds, sports practices or games should be delayed or canceled, outdoor classes should be moved indoors, and students should take care to hydrate and avoid outdoor exertion or exercise. In tandem with this, professors should be asked to incorporate flexibility into their syllabi, permitting virtual class options when extreme weather conditions impact campus operations. This flexibility could encompass recordings or asynchronous learning alternatives. As well, climate change has been associated with climate anxiety and other adverse mental health effects. Dickinson should provide telehealth services on days when weather events pose challenges to travel, especially for therapy and mental health appointments. The college should consult medical professionals on how to best accommodate students who are struggling with the impacts of a natural disaster on themselves or loved ones, or who are experiencing high climate anxiety. Mental health professionals should acknowledge the legitimacy of climate change concerns and explore existential therapies, cognitive-behavioral approaches, and ecotherapy as potential interventions in therapeutic settings. Spending time in nature, limiting exposure to unreliable sources of information, and seeking professional help have been proven to enhance mental well-being. Additionally, joining groups and actively advocating for positive change can also contribute to addressing the climate crisis. Dickinson could consider holding group events to share personal struggles or feelings of climate anxiety, which could help to foster a sense of inclusion, normalize fears, and inspire hope (Schwartz et al., 2023, pp. 16718–16719).

This plan scored well (3.2) in the evaluation. It scored lower than other recommendations in the health category because it is largely focused on informing the campus on decisions about outdoor activities, and while this will reduce the risk of heat-related illnesses and respiratory issues, its impact is largely preventive and situational. That being said, this initiative ensures that all students and employees, regardless of their role or level of physical activity, have access to critical environmental data and safety measures. The flexibility proposed for academic operations, such as virtual class options and support for students affected by climate events, ensures that vulnerable populations are not disproportionately impacted. For this reason, it scored a "2" on the equity category.

When looking at the co-benefits provided, the monitoring systems and accompanying policies contribute to a safer and more adaptable campus environment. They also provide educational opportunities, fostering awareness of climate risks and personal responsibility for well-being. Telehealth services and mental health support not only address immediate mental health concerns but also promote long-term resilience by normalizing conversations about climate anxiety and coping strategies. Thus, this plan receives a "3" for co-benefits. In terms of affordability, implementing monitoring systems and dashboards may require smaller initial investments but long-term benefits of reduced health risks and enhanced campus safety outweigh these costs. Many aspects of the plan, such as telehealth services and syllabus flexibility, build on existing infrastructure, making this initiative financially sustainable. Lastly, there are numerous proven strategies, such as environmental monitoring and evidence-based mental health interventions, that have shown success in similar contexts. However, applying these approaches to Dickinson's unique campus environment will require a nuanced, flexible implementation, which is why the adaptability received a score of "4."

Educate Employees and Students on Risks of High Heat

When dealing with extreme heat, it is important to educate Dickinson College's employees and students on how to understand the implications of climate change on extreme heat and what that means, what the risks are, and on best practices on how to maintain coolness during periods of elevated temperatures. The focus group discussed the necessity of informing the community about the implications of rising global temperatures, noting that many are unaware that an increase of just 1.5 degrees Celsius could lead to a significant rise in the number of days with temperatures exceeding 90°F. There is also a strong need for educational efforts aimed at staff, employees, and students regarding health and safety during climate emergencies. They highlighted the need for training on the significance of hydration and the critical role it plays in maintaining health under extreme heat conditions. Educating staff and students on how to recognize the health effects of high heat-such as heat exhaustion and heat stroke-is essential for ensuring their well-being.

Dickinson should thus institute an education program, putting emphasis on preventive measures and effective recognition and response to heat-related illnesses. Dickinson's plan should draw inspiration from successful education programs like the University of Pennsylvania's Heat Illness Prevention Program and the University of Washington's Heat Education & Awareness Tools (Pacific Northwest Agricultural Safety and Health Center, n.d.; PennEHRS, n.d.) All incoming students and employees should have this training included in their required education materials in Totara. Further, the comprehensive education program could incorporate in-person training sessions, informative infographics strategically placed throughout the campus, social media campaigns, and positive peer influence through reminders to friends to

maintain adequate hydration. It would also be beneficial to develop and update a comprehensive map that identifies designated hydration zones on campus(Patel et al., 2022, pp. 11–15). Involvement from the health studies and psychology departments along with staff from human resource services and the Wellness Center staff, as well as other public health experts, is crucial in developing and testing the program's impact. This could also provide the opportunity for students to be involved in designing aspects of this program, providing valuable experience. The program offers significant health benefits for Dickinson students and employees, with modest costs. This program could also be shared with public schools and other organizations in Carlisle and Cumberland County, building the college's relationship with the community.

This strategy scored the highest (3.5) because of its high effectiveness across all criteria. By raising awareness and promoting actionable strategies, such as hydration, avoiding outdoor exertion, and recognizing signs of heat illness, the plan significantly reduces the risk of adverse health outcomes. These proactive measures empower the campus community to safeguard their physical well-being, but seeing as they are proactive education measures, this plan is not rated higher in the "health benefits category." The education plan prioritizes equitable access to information and resources, ensuring that all members of the Dickinson community, regardless of background or role, have the tools to protect themselves from climate-related health risks. However, this plan does not expressly target inequalities around campus and thus did not receive a high rating in the equity category. In terms of co-benefits, the education plan fosters a culture of preparedness and resilience beyond immediate health impacts. By enhancing awareness of climate risks, it also supports mental well-being by reducing uncertainty and anxiety, earning it a "2." Additionally, the education plan is a cost-effective approach, leveraging existing resources such as campus communications, workshops, and digital platforms, and would require very little

funds to be implemented, earning it the highest score on the affordability scale. A plan of this nature has been recommended by multiple institutions, offering numerous proven strategies, as well as requiring a lower amount of work to implement. For these reasons, combined with the fact that such a plan would be very easy to change and adapt when needed, this plan earns a "5" for both proven strategy and adaptability/practicality.

Conduct Review and Update of Heat Protocol for Athletics

Dickinson College Athletics has already established a robust plan for addressing heat-related risks, including the use of Wet Bulb Globe Temperature (WBGT) monitoring to assess environmental conditions and ensure safe practice and competition environments. WBGT is a comprehensive measure of heat stress that accounts for temperature, humidity, wind speed, and solar radiation, making it more effective than simple temperature measurements for assessing heat-related risks. WBGT is especially valuable for risk management because it reflects the environmental factors that directly impact human health and safety. It is monitored using specialized but easy to use devices, often by safety officers, athletic trainers, or environmental health professionals, and the data informs decisions such as modifying work schedules, implementing cooling measures, and issuing heat advisories to prevent heat-related illnesses (NOAA, n.d.). While this plan is effective, it is essential to expand access and awareness of these protocols beyond varsity athletics to include club sports teams and students who exercise independently. Ensuring that all athletic participants, whether part of an organized team or engaging in casual exercise, understand and can utilize the college's heat safety resources is critical to promoting well-being across campus (Scarneo-Miller, 2024). One area where challenges have been noted is providing quick cooling methods, particularly for sports like cross

country, where athletes may be training or competing in more remote locations. Codifying procedures to ensure that all teams, including club sports, have clear guidelines for accessing cold water immersion tubs or other rapid cooling equipment is essential. These measures should also be accompanied by training for coaches, athletes, and club leaders to recognize signs of heat-related illnesses and respond appropriately (Scarneo-Miller, 2024). Such training is already required for athletic department staff, but Dickinson should review if these programs are up to date and touch on all necessary risks. The athletic department currently has a plan outlining the potential symptoms of heat-related illness and temperature thresholds when practices should be modified or canceled. This should be reviewed and updated if need be and further distributed to the student body.

Synthetic fields pose unique challenges when it comes to heat management, as they can retain and radiate heat at levels nearly twice as high as natural grass fields. This phenomenon occurs because synthetic turf acts as a heat sink, absorbing and releasing heat throughout the day. For sports like field hockey, which is no longer typically played on natural grass, transitioning to alternative surfaces may not be practical, making it essential to address these heat risks directly (Mallen et al., 2023, p. 6). To mitigate these impacts, practices and games should be scheduled during cooler parts of the day, such as early mornings or evenings, whenever possible. This strategy should apply broadly across sports to reduce heat exposure for all athletes. Additionally, games and practices, especially those on synthetic turf, should be postponed or canceled when environmental conditions reach unsafe levels, as determined by WBGT monitoring or other heat safety metrics. These proactive measures are vital for ensuring athlete safety in high-heat conditions (Mallen et al., 2023, pp. 6–10). Sharing information about heat safety protocols, such as where to find cooling equipment and how to use it, can enhance preparedness and ensure that

everyone on campus benefits from Dickinson's commitment to athlete safety. By expanding awareness and access, the college can build on its strong foundation to safeguard the health of its entire community.

The Review and Update of Heat Protocol for Athletics scored highly in the evaluation (3.25), reflecting its alignment with key criteria for health impact, practicality, and equity. The review and expansion of the heat protocols directly address the physical well-being of students engaged in athletics and exercise. By improving access to cooling resources and educating athletes, coaches, and club leaders on recognizing and responding to heat-related illnesses, the initiative reduces the risks of severe health outcomes during extreme heat. These measures extend protection to all members of the campus community who engage in physical activities, regardless of their level of athletic participation. However, Dickinson already has significant amount of such plans in place, so it is more important that they are codified and extended to all students, which is why this strategy only received a "3" on the health scale. The current protocols primarily benefit varsity athletes, but this plan expands access and awareness to club sports participants and independent exercisers. By ensuring all students can benefit from heat safety guidelines and resources, the initiative promotes equity across the athletic community, addressing disparities in access to critical safety measures, which is why it receives a "2" for equity. This plan has also been rated "2" for the co-benefits category, with the idea that students could collaborate in reviewing and implementing these policies. It also supports broader educational goals and enhances the overall well-being of students, and improved protocols and training help reduce liability risks for the college, ensuring compliance with best practices in athlete safety. In terms of affordability, this strategy would require minor investments in WBGT monitoring systems and additional cooling equipment, but these costs are outweighed by the

potential health and safety benefits. When considering the proven strategy category, this plan earns a "5," as the use of WBGT monitoring and heat safety guidelines is a well-documented strategy for managing heat-related risks in athletics. Expanding and updating these protocols builds on proven methods to enhance their effectiveness and applicability to all campus activities. Additionally, training programs for recognizing and responding to heat-related illnesses have a strong track record of success in athletic environments. Finally, this strategy received a "4" because it will need to be scaled and tailored to meet the needs of different athletic groups and individuals on campus.

Develop and Implement a Heat Illness Prevention Plan for Employees

Dickinson College employs a considerable number of people, including students, faculty, and staff. The college should prioritize those at higher risk of heat-related illnesses due to their outdoor work, hot interior spaces, or pre-existing conditions. Vulnerable groups include facilities management and groundskeeping staff, Public Safety officers, Dickinson Farm staff, athletics staff, and dining services kitchen staff. As heat-related illnesses become an increasing risk, it is vital that Dickinson, as an employer, develops a comprehensive plan.

Acclimatization programs that use OSHA heat safety recommendations should be established to help employees and students gradually adjust to heat over one to two weeks, especially those returning after extended breaks. (OSHA, n.d.). Almost half of all heat-related deaths among workers occur on the first day on the job, with more than 70% occurring within the first week (Gammon, 2024, p. 2). This underscores the importance of acclimatization plans, particularly for employees unaccustomed to working in heat. These plans involve gradually increasing heat exposure over time, allowing the body to adapt. For example, an acclimatization

schedule might start with 30 minutes of light or moderate activity in heat for the first few days, progressing to longer durations and more intense activity over the following weeks. Full acclimatization typically takes two weeks of daily exposure to heat while performing physical tasks for 60 to 90 minutes (Gammon, 2024). At Dickinson, acclimatization plans would also benefit students, faculty, and staff returning after summer breaks, as they may lose tolerance to heat during extended periods away.

Workplace practices should also prioritize heat mitigation strategies. The college should assess workplace heat hazards and implement measures such as adjusting uniform policies to allow for shorts and lightweight, breathable clothing during periods of high heat, ensuring safety standards are maintained. In hot, minimally ventilated spaces like kitchens, dining services staff should be encouraged to wear cooling or wicking clothing compatible with their environment. Workplace practices should also include providing uninterrupted access to water and scheduling outdoor work during cooler times of the day whenever possible. Landscaping activities that worsen air quality, such as mowing grass or using high-emission equipment, should be avoided on days with poor air quality to mitigate the risk of heat-related illnesses and protect the health of all individuals, which would benefit not only groundskeeping staff but the broader college community as well. The costs of developing and implementing such a plan will vary depending on the balance between engineered solutions, workplace practices, and personal protective equipment (PPE). These investments should be weighed against the costs of heat-related illnesses, including healthcare expenses, health insurance claims, and reduced productivity. Moreover, students could play an active role in researching and evaluating the performance of new workplace practices, contributing to continuous improvements in campus heat safety policies. Emergency preparedness is another critical component, requiring supervisors and staff

to be trained in recognizing heat-related illnesses and responding effectively. Clear protocols for medical assistance and designated cooling areas should be part of these plans.

The assessment for a heat-illness prevention plan returned a fairly high score (3.25), which tied for the second highest score. It scored a "3" in health benefits, considering that the plan directly mitigates heat-related risks for employees, prioritizing those most vulnerable, such as groundskeeping, farm, and dining services staff. However, the benefits are targeted more toward employees than the broader campus population, limiting the scope of its impact compared to other proposals. With that, this strategy scored well on the equity scale, emphasizing protecting the most vulnerable employees, many of whom perform physically demanding tasks in high-heat conditions. Adjusting policies and providing appropriate personal protective equipment (PPE) ensure that no group is disproportionately affected by workplace heat hazards, promoting equity in workplace safety standards. This plan also provides co-benefits, earning a "2"; through fostering safer workplace practices, the plan indirectly improves morale, productivity, and employee retention. Additionally, the involvement of students in researching and refining these policies enhances experiential learning opportunities. In terms of cost, the plan requires initial low-cost investments in acclimatization programs, cooling equipment, and policy adjustments. As well, the costs are offset by long-term savings. Reducing heat-related illnesses minimizes healthcare expenses, insurance claims, and lost productivity, making this initiative both cost-effective and essential for employee well-being. Finally, it scored well on the practicality and proven strategy scales, as OSHA guidelines and heat illness prevention strategies have been widely implemented and shown to be effective in reducing workplace heat risks. On the other hand, customizing practices for different work environments, such as dining services

and groundskeeping, adds complexity but ensures relevance and effectiveness, which is why the initiative scored a “4” for adaptability.

Increase Campus Tree Canopy

Dickinson’s tree canopy provides a wealth of benefits, ranging from lowering temperatures on campus to improving air quality and offering aesthetic appeal that helps attract and retain students and employees. Strategically enhancing the canopy could amplify these advantages, making the campus not only more sustainable but also more engaging for the community. Expanding tree coverage would further reduce the urban heat island effect, creating cooler, more comfortable outdoor spaces. Studies show that increasing an area’s tree canopy cover to 25% can reduce local temperatures by as much as 4.3 degrees Fahrenheit. Even modest landscaping changes, such as adding grass patches to traditionally dry areas, can lower neighborhood temperatures by 0.4–0.5 degrees. These cooling effects can significantly improve outdoor comfort, reduce heat-related health risks, and make the campus more inviting for students, faculty, and visitors (Huber et al., 2018, pp. 5–6). Urban forests have also been shown to contribute to better air quality, a critical health benefit in an era of increasing pollution and extreme heat (U.S. National Park Service, n.d.) Beyond environmental and health impacts, a tree cover enhances the visual appeal of the campus, offering a greener, more welcoming environment for prospective students, visitors, and the college community. These improvements align with the college's mission to foster a campus that is both functional and beautiful, positively influencing admissions and retention efforts.

Additionally, an enhanced tree canopy would offer mental health benefits, creating greenspaces that foster relaxation, improve mood, and support overall well-being. A long-term

tree canopy program would also present unique opportunities for student engagement. Students from ecology, biology, and environmental studies could play a direct role in selecting climate-resilient tree species, monitoring tree health, and conducting research on how increased canopy coverage impacts air quality and campus temperatures. Such projects could include recording baseline data and tracking changes over time, integrating experiential learning with tangible environmental benefits. While challenges like climate change pressures on tree health may require thoughtful planning, focusing on maintenance and strategic expansion would ensure the benefits of the tree canopy continue to grow. By fostering collaboration among students, staff, and faculty, Dickinson could transform its tree canopy initiative into a long-term educational and environmental asset, ensuring it supports sustainability goals while enriching the campus experience for generations to come.

The initiative to increase Dickinson College's campus tree canopy aligns with the institution's sustainability goals while providing environmental, aesthetic, and educational benefits. Scoring 3.1, this plan represents a thoughtful approach to addressing campus heat risks, improving air quality, and fostering student engagement. It ranks lower out of all the suggested strategies in this section of the report, but that is due to the fact that the benefits that expanding the tree canopy provides are more indirect and long-term, making this initiative less immediately impactful compared to direct interventions like heat illness prevention protocols. This is why it earned only a "3"in the health benefits category. However, it provides strong co-benefits on top of these health benefits, including increased biodiversity and aesthetic improvements that enhance recruitment and retention. The educational opportunities for students in environmental studies and related disciplines further strengthen its value, integrating sustainability with experiential learning. In terms of equity, this plan would not expressly build up an under-

supported population on campus, so it receives a lower mark. Considering the financial costs, the economic case for investing in a larger tree canopy is compelling. According to one study, municipalities typically spend $13-$65 per tree annually for maintenance, yet the benefits, such as cooling, improved air quality, and increased property values, from $31-$89 per tree per year (Huber et al., 2018, pp. 5–6). However, this was done on a larger scale than Dickinson College, and the upfront costs of planting and maintaining trees can be significant. This data suggests that expanding Dickinson's tree canopy could fall within a moderate cost range while delivering a strong return on investment. Conducting a cost analysis tailored to the college's needs and exploring funding opportunities, such as grants for climate resilience, could help Dickinson develop a financially sustainable plan for canopy growth. This strategy scores well on the proven strategy category, as there are well-documented benefits and numerous cases of similar plans. However, implementing and maintaining a tree canopy is highly practical but requires careful planning to select climate-resilient species and ensure long-term health amidst changing environmental conditions. The adaptability score reflects the need for ongoing adjustments to tree species, placement, and care in response to climate and campus-specific factors.

Feasibility Study for Retrofitting the Kline Field House with Cooling

Dickinson's field house presents significant challenges in terms of heat management and air quality due to its lack of cooling and poor ventilation. During moderately warm weather, the space can become uncomfortably warm for athletic activities, while in hot conditions, the risks of heat-related illnesses could become significantly dangerous for students, employees, and event attendees. Issues like condensation on the floor and mold growth, exacerbated by inadequate air circulation, further highlight the need for improved ventilation and climate control (Berg, 2023).

These conditions not only compromise the comfort and safety of athletes but also pose health risks during large gatherings, as evidenced during the indoor commencement ceremony held in 2015.

Retrofitting the field house with air conditioning would address these problems, significantly improving the safety and comfort of the space for both athletic and non-athletic activities. However, such a project would involve high costs, technical complexity, and environmental impacts, including increased energy use and carbon emissions. If the college's central cool plant has the capacity to handle the additional cooling load, the initial and ongoing costs could be more manageable compared to installing a standalone cooling system for the Kline. For context, a 2017 feasibility study for cooling a similar facility at Shippensburg University estimated costs at approximately $900,000 (Shippensburg University, 2017). As the Kline is similar in age, and not originally designing to allow space for such a system, such a project could be equally costly. In order to make an informed decision Dickinson should conduct a feasibility study to evaluate the costs, energy requirements, carbon implications, and logistical challenges of retrofitting the field house. Such a study would provide essential data to guide future investments in improving the facility, ensuring it meets the needs of athletes and event participants while aligning with the college's sustainability goals (Berg, 2023).

The proposal to conduct a feasibility study for retrofitting the Kline Field House with cooling addresses critical concerns about heat-related illnesses and air quality in one of Dickinson's key athletic and event spaces. Scoring 3.0, this initiative recognizes the importance of improving safety and comfort in the field house but ranks lower compared to other strategies due to its narrow scope and high associated costs. While retrofitting the space with cooling would directly benefit athletes, employees, and event attendees, its impact is limited to this

single facility, which is why it received a "3" in the health benefits category. However, the proposal provides strong co-benefits, such as reduced mold risks, enhanced air quality, and improved functionality for events, making the field house a more versatile and appealing campus space. In terms of equity, the proposal would improve conditions for a broad audience, including athletes and community members, but it does not specifically address underserved populations, resulting in a lower score in this category. Financially, the feasibility study ensures the college can make an informed decision about balancing costs, technical challenges, and sustainability goals. Retrofitting similar facilities has been proven effective, with examples like Shippensburg University providing insight into potential costs and logistics. However, the upfront investment, including construction and increased energy consumption, represents a significant challenge. The strategy scores well in practicality, as the study itself is a straightforward step, but the adaptability score reflects the potential complexities of implementing cooling systems in an older structure like the Kline, which was not originally designed to accommodate such technology.

Objective: Reduce risks of adverse health effects from extreme heat, poor air quality, and climate change anxiety among Dickinson students and employees									
Actions	Criteria Weight (%)	Health benefits 25%	Equity 10%	Co-benefits 20%	Financial affordability 25%	Proven strategy 10%	Practicality Adaptability 10%	**TOTAL SCORE** 100%	Rank
Feasibility study of air conditioning field house	Raw score	4	1	2	1	2	2		
	Weighted score	1	0.1	0.4	0.25	0.2	0.2	**2.15**	5
Air quality and Heat Policies	Raw score	2	2	3	4	5	4		
	Weighted score	0.5	0.2	0.6	1	0.5	0.4	**3.2**	3
Tree canopy	Raw score	3	1	4	3	4	3		
	Weighted score	0.75	0.1	0.8	0.75	0.4	0.3	**3.1**	4
Heat protocols for athletes	Raw score	3	2	2	4	5	4		
	Weighted score	0.75	0.2	0.4	1	0.5	0.4	**3.25**	2
Student & employee education plan	Raw score	3	1	2	5	5	5		
	Weighted score	0.75	0.1	0.4	1.25	0.5	0.5	**3.5**	1
Employee heat illness prevention plan	Raw score	3	2	2	4	5	4		
	Weighted score	0.75	0.2	0.4	1	0.5	0.4	**3.25**	2

Recommendations

Overall, in order to effectively address the climate-related health risks posed to Dickinson College's students and employees, this report recommends that each of the above strategies outlined in this report be implemented within the recommended timeframes. These interventions will ensure the college is better equipped to mitigate both immediate and long-term climate-related challenges, safeguarding the physical and mental well-being of the campus community.

Near Term (1-2 Years)

The next one to two years represent a critical window for implementing strategies that address the most immediate risks to student and employee health. The student mental and physical health resilience plan, heat risk education plan, and heat illness prevention plan for employees should all be of high priority. be able to be implemented within a near term time frame. The majority of the recommendations contained within these strategies are policy-based and would require the lowest amount of work and funds to implement, while building the foundational tools and frameworks that get at addressing the most pressing risks to Dickinson's community. By focusing on these near-term strategies, Dickinson can swiftly address critical vulnerabilities with minimal financial and operational burdens. This approach lays the groundwork for more comprehensive, long-term resilience measures while safeguarding the health and safety of the college community today.

Medium Term (3-5 Years)

Over the next three to five years, Dickinson should focus on strategies that build resilience and strengthen the campus environment. Expanding the tree canopy is a clear medium-term priority. While planting and nurturing trees requires time, this effort will yield substantial

long-term benefits by reducing the urban heat island effect, improving air quality, and creating a more inviting and aesthetically pleasing campus. By involving students in species selection, monitoring, and research, this initiative also integrates educational opportunities that align with Dickinson's mission of sustainability and experiential learning.

In the same timeframe, the college should review and update the heat protocols for athletes. While current protocols provide robust protections for varsity athletes, making it less of a priority and thus in the medium-term category, extending these measures to club sports and recreational athletes ensures the entire campus community benefits from enhanced heat safety measures. Addressing gaps in training, access to cooling equipment, and synthetic turf risks will safeguard student health while reinforcing Dickinson's reputation as a leader in proactive climate resilience.

Long Term (5-10 years)

Looking further ahead, Dickinson must consider how to address more complex infrastructure challenges. While retrofitting the Kline Field House with cooling represents a significant long-term investment, conducting a feasibility study in the near to medium term is crucial. This study will prepare the college to act swiftly should the existing infrastructure fail or require an unexpected update. Other schools around the country have put off evaluating the need for air conditioning in their field house, and when faced with the sudden need to protect their students from rising temperatures have dealt with unexpected costs. Moreover, such preparation allows Dickinson to integrate cooling measures seamlessly into the next planned renovation of the facility, avoiding the need for a costly standalone project. By understanding the costs, energy

implications, and potential solutions in advance, the college can make informed decisions that align with its sustainability goals and ensure the health and safety of athletes, staff, and event attendees. Proactively completing the study ensures Dickinson is ready to implement these improvements when the opportunity arises, maximizing efficiency and minimizing disruption.

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