

# APPENDIX B

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## Sustainable Design Standards (SDS) Climate Change Vulnerability Assessment



**Client:** Milwaukee County

**Project:** Investing in Justice Courthouse Complex (IJCC)

**File:** Climate Change Vulnerability Assessment

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Climate Change Vulnerability Assessment

Project: Investing in Justice Courthouse Complex (IJC)

No Action

Choosing not to implement any specific adaptation measures; allowing natural or existing processes to continue without interference.

Minimize

Reducing the extent or impact of potential harm through limited interventions or mitigation strategies

Avoid

Taking steps to prevent exposure to risk or harm altogether, often by changing plans or locations.

Restore

Returning a system, habitat, or area to its original or a more natural state to improve resilience and function.

Accommodate

Adjusting existing systems or infrastructure to cope with changes or risks, rather than preventing them outright.

| Primary Climate Change Hazards          |                                                                                               |                       |                                                    |                                                                                                                                                                                                                                                                                                                                                                     |                                 |                                  |                                                                                                                                                                                                                                                                             |                              |                     |                                                                                                                                                                                                                                                                                                                         |              |                                          |                                     |              |                   |            |  |  |
|-----------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------------|-------------------------------------|--------------|-------------------|------------|--|--|
| Hazard and Critical Systems Information |                                                                                               |                       | Impact to the System (Direct, Network & Community) |                                                                                                                                                                                                                                                                                                                                                                     |                                 | Probability of Hazard Occurrence |                                                                                                                                                                                                                                                                             |                              | Risk Score          | Mitigation                                                                                                                                                                                                                                                                                                              |              |                                          | Mitigation Evaluation Criteria      |              |                   | Scores     |  |  |
|                                         | Critical Systems Vulnerable to Hazard                                                         | Hazard                | Score (I)                                          | Description (I)                                                                                                                                                                                                                                                                                                                                                     | Consequence Type                | Score (P)                        | Description (P)                                                                                                                                                                                                                                                             | Probability x Impact (P x I) | Mitigation Strategy | Description (M)                                                                                                                                                                                                                                                                                                         | Reduces Risk | Can Be Completed with Existing Resources | Aligns with Broader Community Goals | Impact Score | Probability Score | Risk Score |  |  |
| 1                                       | Building envelope, HVAC systems, electrical systems, public access infrastructure             | Heat Waves            | Major                                              | <b>Direct:</b> Extreme heat stresses HVAC systems, increases cooling demand, and accelerates wear on building materials and infrastructure.<br><b>Network:</b> Strains the electrical grid, risking outages that affect cooling and emergency services.<br><b>Community:</b> Poses acute health risks to occupants and visitors, especially vulnerable populations. | Social, Economic, Environmental | Very Likely                      | Heat waves are projected to become more frequent and intense due to climate change. By mid-century, average heat wave temperatures may range from 94°F to 100°F. Urban heat island effects intensify local temperatures.                                                    | 20                           | Minimize            | Increase tree canopy and vegetative cover on site, use high-performance building insulation and reflective materials, install energy-efficient HVAC systems, design for passive cooling, provide shaded outdoor areas                                                                                                   | Y            | Y                                        | Y                                   | 4            | 5                 | 20         |  |  |
| 2                                       | HVAC systems, indoor air quality filters and monitoring systems, public access infrastructure | Air Quality           | Major                                              | <b>Direct:</b> Poor air quality affects indoor air systems, filters, and occupant health.<br><b>Network:</b> Increased HVAC load and maintenance due to pollutant filtration.<br><b>Community:</b> Exacerbates respiratory conditions, especially for children, elderly, and those with pre-existing health issues.                                                 | Social, Economic, Environmental | Very Likely                      | Air quality hazards are expected to worsen due to increased heat, with ground-level ozone and PM2.5 concentrations rising, especially in urban areas with high traffic and limited green space. Wildfire smoke from regional events may also periodically impact Milwaukee. | 20                           | Minimize            | Install high-efficiency HVAC filters (e.g., MERV 13+), incorporate indoor air quality sensors and real-time monitoring systems, use low-emitting materials and finishes indoors, design for enhanced ventilation and air air exchange rates, integrate green buffers (e.g., trees, shrubs) to reduce pollutant exposure | Y            | Y                                        | Y                                   | 4            | 5                 | 20         |  |  |
| 3                                       | Building envelope, electrical systems, stormwater infrastructure, utilities                   | Extreme Precipitation | Major                                              | <b>Direct:</b> Overwhelms stormwater infrastructure; causes localized flooding; damages building envelope and below-grade systems.<br><b>Network:</b> Disrupts transit and emergency access routes.<br><b>Community:</b> Increase risk of sewer backups and waterborne diseases in surrounding neighborhoods.                                                       | Social, Economic, Environmental | Likely                           | Extreme precipitation events are projected to increase in intensity by single-digit percentages over the coming century. Localized flooding and ponding are expected to become more frequent due to increased impervious surfaces and aging infrastructure.                 | 16                           | Minimize            | Design with enhanced stormwater management (e.g., bioswales, permeable pavement, green roofs), elevate critical systems above flood-prone zones, use flood-resistant materials and sealants, incorporate real-time flood monitoring and emergency access planning.                                                      | Y            | Y                                        | Y                                   | 4            | 4                 | 16         |  |  |

| Primary Climate Change Hazards          |                                                                                                                                     |                           |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |                                  |                                                                                                                                                                                                                                                                 |                              |                     |                                                                                                                                                                                                                                                                                                                                                                                                       |              |                                          |                                     |              |                   |            |  |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------------|-------------------------------------|--------------|-------------------|------------|--|
| Hazard and Critical Systems Information |                                                                                                                                     |                           | Impact to the System (Direct, Network & Community) |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 | Probability of Hazard Occurrence |                                                                                                                                                                                                                                                                 |                              | Risk Score          | Mitigation                                                                                                                                                                                                                                                                                                                                                                                            |              | Mitigation Evaluation Criteria           |                                     |              | Scores            |            |  |
|                                         | Critical Systems Vulnerable to Hazard                                                                                               | Hazard                    | Score (I)                                          | Description (I)                                                                                                                                                                                                                                                                                                                                                                                                                            | Consequence Type                | Score (P)                        | Description (P)                                                                                                                                                                                                                                                 | Probability x Impact (P x I) | Mitigation Strategy | Description (M)                                                                                                                                                                                                                                                                                                                                                                                       | Reduces Risk | Can Be Completed with Existing Resources | Aligns with Broader Community Goals | Impact Score | Probability Score | Risk Score |  |
| 4                                       | Basement and subgrade levels, electrical infrastructure, access roads                                                               | Storms / Flooding         | Major                                              | <b>Direct:</b> Flooding of basements, mechanical rooms, and parking areas; damage to electrical and IT systems.<br><b>Network:</b> Disruption of public transit routes and emergency services.<br><b>Community:</b> Displacement, property damage, and health risks in adjacent neighborhoods.                                                                                                                                             | Social, Economic, Environmental | Unlikely                         | Flooding risk is concentrated in 500-year floodplains, but increased precipitation and impervious surfaces raise actual risk. However, project site is not located in a flood hazard zone.                                                                      | 8                            | Minimize            | Elevate critical infrastructure, install backflow preventers and sump pumps, use flood barriers and deployable flood protection systems.                                                                                                                                                                                                                                                              | Y            | Y                                        | Y                                   | 4            | 2                 | 8          |  |
| 5                                       | Landscaping / green infrastructure, water supply systems                                                                            | Drought / Drier Summers   | Moderate                                           | <b>Direct:</b> Reduces water availability for cooling and landscaping; increases soil subsidence risk.<br><b>Network:</b> Strains water supply infrastructure and increases maintenance needs.<br><b>Community:</b> Increases urban tree canopy and green space health, reducing cooling benefits.                                                                                                                                         | Social, Economic, Environmental | Likely                           | Summer precipitation projected to decrease, and longer dry spells and higher evapotranspiration rates expected.                                                                                                                                                 | 12                           | Minimize            | Use drought tolerant landscaping and native species, install water-efficient fixtures and irrigation systems, design for rainwater harvesting and/or greywater reuse.                                                                                                                                                                                                                                 | Y            | Y                                        | Y                                   | 3            | 4                 | 12         |  |
| 6                                       | Building envelope, HVAC systems, public access infrastructure                                                                       | Wetter Winters            | Moderate                                           | <b>Direct:</b> Increased snow and ice loads on roofs and walkways; accelerated free-thaw damage to roads and facades.<br><b>Network:</b> Higher maintenance costs for snow removal and deicing.<br><b>Community:</b> Reduced mobility and increased slip/fall risks.                                                                                                                                                                       | Social, Economic, Environmental | Likely                           | Winter precipitation projected to increase. Free-thaw cycles expected to decrease, but heavier snow events will increase.                                                                                                                                       | 12                           | Minimize            | Design roofs for higher snow loads and efficient drainage, use durable and freeze-resistant materials for pavements and facades, implement heated walkways or snow-melt systems in critical access areas.                                                                                                                                                                                             | Y            | Y                                        | Y                                   | 3            | 4                 | 12         |  |
| 7                                       | Building envelope, HVAC systems, stormwater management infrastructure, roofing systems, electrical and public access infrastructure | Changing Weather Patterns | Moderate                                           | <b>Direct:</b> Increased variability in temperature, precipitation, and seasonal transitions can stress building systems (e.g., HVAC, envelope, drainage) and reduce performance predictability.<br><b>System:</b> Alters operational schedules, maintenance cycles, and energy demand forecasting.<br><b>Community:</b> Impacts public access, safety, and comfort, especially for vulnerable populations relying on consistent services. | Social, Economic, Environmental | Likely                           | Climate models project greater variability in seasonal weather patterns, including warmer winters, more intense rainfall events, and longer dry spells. These shifts may not follow historical norms, complicating design assumptions and operational planning. | 12                           | Minimize            | Design systems with flexibility and redundancy to accommodate a wider range of conditions, use climate-resilient materials, implement smart building controls to dynamically respond to changing conditions, incorporate scenario-based planning into facility operations and emergency preparedness, and engage in ongoing climate monitoring and update design/operations based on observed trends. | Y            | Y                                        | Y                                   | 3            | 4                 | 12         |  |

| Risk Score Table<br>(Risk Score = Probability x Severity) |                         |               |               |               |                  |
|-----------------------------------------------------------|-------------------------|---------------|---------------|---------------|------------------|
| Probability Score                                         | Severity (Impact) Score |               |               |               |                  |
|                                                           | Negligible<br>1         | Minor<br>2    | Moderate<br>3 | Major<br>4    | Catatrophic<br>5 |
| Very Likely<br>5                                          | Moderate<br>5           | High<br>10    | Extreme<br>15 | Extreme<br>20 | Extreme<br>25    |
| Likely<br>4                                               | Moderate<br>4           | High<br>8     | High<br>12    | Extreme<br>16 | Extreme<br>20    |
| Moderate<br>3                                             | Low<br>3                | Moderate<br>6 | High<br>9     | High<br>12    | Extreme<br>15    |
| Unlikely<br>2                                             | Low<br>2                | Moderate<br>4 | Moderate<br>6 | High<br>8     | High<br>10       |
| Rare<br>1                                                 | Low<br>1                | Low<br>2      | Low<br>3      | Moderate<br>4 | Moderate<br>5    |

|            | Impact Score |
|------------|--------------|
| Negligible | 1            |
| Minor      | 2            |
| Moderate   | 3            |
| Major      | 4            |
| Severe     | 5            |

|             | Probability Score |
|-------------|-------------------|
| Rare        | 1                 |
| Unlikely    | 2                 |
| Moderate    | 3                 |
| Likely      | 4                 |
| Very Likely | 5                 |