5. RISK MANAGEMENT

Managing risk is an integral part of asset management. Transportation agencies manage physical assets which are subject to a range of risks, from daily operational concerns to potentially catastrophic asset failures. By anticipating, identifying, and planning for potential scenarios, Iowa DOT can reduce uncertainty and mitigate the effects of risks.

Introduction

This chapter describes the federal requirements pertaining to risk management in transportation asset management (TAM), Iowa DOT's existing risk management activities, and Iowa DOT's TAM risk management processes and risk mitigation plan. Additionally, this chapter summarizes an assessment of NHS pavements and bridges repeatedly damaged by emergency events, consistent with federal requirements, and discusses considerations of extreme weather and resilience in the context of risk management.

Iowa DOT practices formal and informal risk management and considers risks at multiple levels. This can be as granular as managing risk associated with a particular activity or phase of a project, or as wide-ranging as risks to a group of assets, a funding program, or enterprise level risks for the department. At the broader level, a recent example of risk management is the 2021 update to the department's organizational structure, which included the consolidation of planning, programming, modal, asset management, and project delivery functions within a single division, the Transportation Development Division. This change was to support continued integration of multimodal efforts, allow for more focused and integrated asset management efforts, and enhance the connection between research, data collection, analysis, planning, programming, and development activities. At the planning level, resiliency has been incorporated into the department in a more visible manner through the creation of a Resiliency Working Group. Its efforts, particularly related to extreme weather and resiliency, are discussed at the end of this chapter. At the project level, risk management efforts related to bridge and pavement life cycle planning are discussed in Chapter 3.

Federal Requirements

Requirements for consideration of risk in a TAMP are detailed in 23 CFR 515. Risk is defined as "the positive or negative effects of uncertainty or variability upon agency objectives" and risk management is defined as "the processes and framework for managing potential risks."

23 CFR 515.7(c) mandates that, "A State DOT shall establish a process for developing a risk management plan." Specific requirements for the process are listed below.

- Identification of risks that can impact the condition and performance of NHS pavements and bridges.
- Assessment of the identified risks in terms of the likelihood of their occurrence and their impact and consequence if they do occur.
- Evaluation and prioritization of the identified risks.
- Mitigation plan for addressing the top priority risks.
- Approach for monitoring the top priority risks.
- Summary of the evaluation of NHS pavements and bridges repeatedly damaged by emergency events.

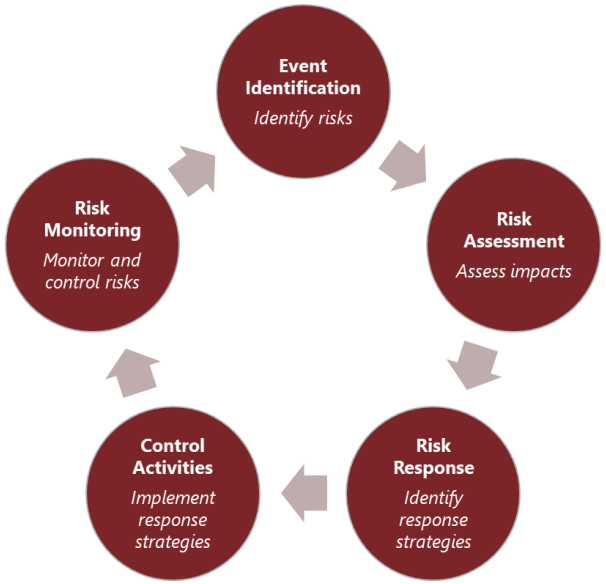
In 2021, the Infrastructure Investment and Jobs Act also added the specific requirement that risk management analysis include consideration of extreme weather and resilience.

5.1 Asset Management Risks

A key part of the asset management planning process is identifying and mitigating TAM risks. The iterative process that Iowa DOT uses to manage its asset management risks is consistent with federal requirements and involves the following elements, depicted in Figure 5.1.

- **Event Identification**: Identify events that could impact Iowa DOT's ability to effectively manage its bridges and pavements.
- **Risk Assessment**: Assess the likelihood of an event happening and the consequences if it were to happen.
- **Risk Response**: Identify an approach for responding to each of the priority risks.
- **Control Activities**: Implement the risk response approaches.
- **Risk Monitoring**: Monitor and respond to possible events, and evaluate the response approaches.

Figure 5.1: TAM risk management process



Risk Identification and Assessment Methodology

Identifying risks is the first step in risk management. To begin the risk identification process, Iowa DOT distributed an online survey to key agency staff, including members of the TAM Implementation Team and technical working group leads. The survey included risks identified in the 2019 TAMP along with additional risk statements for consideration. Respondents were asked to rank the risks based on their likelihood of occurring and consequence if they occurred, and to provide any additional feedback on the risk statements. Participants were also asked to identify any additional significant risks that could enhance or constrain Iowa DOT's ability to manage its bridges and pavements.

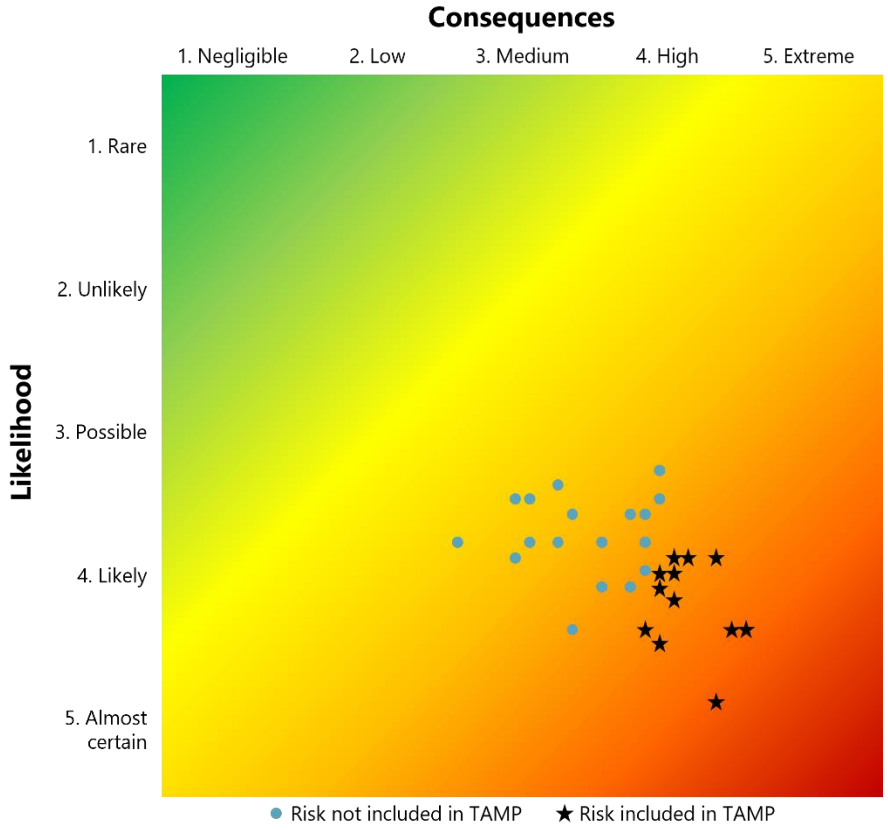
To rank the risks, respondents assessed risk likelihood on a scale of one (rare) to five (almost certain); votes were then averaged to determine the overall likelihood score. Similarly, respondents assessed risk consequence on a scale of one (negligible) to five (extreme); votes were then averaged to determine the overall consequence score. The two scores were multiplied to determine an overall score for each risk.

Risk Prioritization

The results of the online survey were compiled in ranked order for a workshop where participants discussed which risks were most critical to focus on for the TAMP. Once this was determined, participants worked to build out the TAMP's risk register by discussing response strategies, owners, and the status or actions to take regarding the response strategies.

Out of 30 strategies included in the survey, 13 strategies with a combined likelihood and consequence score of 12 or higher were carried forward into the workshop. During the workshop, these strategies were refined into nine high and medium priority risks to focus on; no very high priority risks have been identified. Figure 5.2 shows the distribution of the initial 30 risks and notes which ones were incorporated into the TAMP. These risks are identified on Table 5.1. The likely reason that no risks resulted in scores in the lowest risk quadrant is that these risks are already being handled as part of routine business practices and were not included in the survey.

Figure 5.2: Risk priority matrix, showing the survey results for 30 identified risks



Note: some of the starred risks were combined for the TAMP risk register.

After assessing and prioritizing the risks at the risk workshop, participants defined a response approach for each risk. Response approaches for risks with negative impacts included avoid, transfer, mitigate, or accept the risk. Response approaches for risks with positive impacts included exploit, share, enhance, or accept. Two of the nine risks included in the TAMP are positive risks.

Risks are also labeled according to eight risk areas defined by Iowa DOT. These areas help categorize the risks and mitigation strategies.

- **Business Processes** include operations, management, and support processes. Examples include financial forecasting and risk identification and management. Note that certain business processes (e.g., capital planning and programming; data collection) are categorized as separate areas for the purposes of this TAM risk register.
- **Capital Planning and Programming** includes long-term planning activities such as analysis of relevant trends, evaluation of potential investments, review of other factors, and stakeholder engagement; and short-term programming activities such as selecting projects, identifying funding, and finalizing investments.
- **Communication** involves communicating the asset management progress made by Iowa DOT and educating stakeholders, including state and local lawmakers, users, and institutions. This includes messages about shortcomings and needs at Iowa DOT and also messages of success.
- **Data Collection** is a key part of Iowa DOT's asset management approach. Gathering accurate, complete, and current data helps inform and drive the decision-making process.
- **Management Systems** include bridge and pavement systems. These systems can collect and store asset inventory and condition data, analyze that data to project future conditions, and recommend asset treatments.
- **Organizational Structure** refers to the interrelatedness and function of work units within Iowa DOT and how they relate to asset management. Organizational structure issues include staffing levels, roles and responsibilities, and governance.
- **Research** helps support and improve asset management practices and processes at Iowa DOT.
- **Training** is necessary to educate new staff and keep current staff up to date on asset management at Iowa DOT.

Risk Mitigation

After identifying risks and response approaches, Iowa DOT also developed response strategies for each priority risk included in the TAMP. Together, the set of risks and response strategies are the foundation of a risk mitigation plan, which is a series of strategies for addressing the priority risks identified in the risk register. Groups or individuals have been identified to take ownership of each strategy and be responsible for its implementation. Iowa DOT's risk mitigation plan for the priority risks is also presented in Table 5.1.

Risk Monitoring

Iowa DOT's risk management process does not stop with the development of the risk register. The next steps in the process are to implement the risk response strategies, monitor the risks over time, and periodically update the risk register. Iowa DOT identified an owner for each risk response strategy. Progress will be reviewed quarterly through Iowa DOT's TAM Implementation Team, and the risk responses will be reviewed annually and updated as appropriate. This group meets regularly and serves as the proper forum to monitor these risks and implement any necessary response adjustments. Over time, as Iowa DOT implements the risk response strategies, it is anticipated that some risks will fall off the priority list. These risks will be replaced with new priorities, as appropriate.

Table 5.1 (Part 1 of 4): Priority risks and mitigation actions

Risk Statement	Response Strategies	Owner(s)	Status/Actions
1. If costs continue to increase in an unpredictable manner (due to factors such as inflation, fuel, supply chain disruptions, and limited contracting workforce), the resulting increased project costs could impact the delivery of the program.  *Likelihood: 4.4* *Consequence: 3.9* *Response Approach: Mitigate* *Categories: Business Processes; Capital Planning and Programming*	**1A**. Readjust the program as necessary and ensure asset management projects take priority.	Transportation Development Division (TDD) Director	Continue to discuss the outstanding issues impacting the program with the Commission. A 2022 Business Plan objective is to improve the project delivery cycle to improve agility and reduce waste.
	1B. Coordinate with the Association of General Contractors (AGC) and industry partners to discuss and address impacts of these issues.	TDD Director	Meet to coordinate as needed.
	1C. Continue research on alternative materials and construction strategies to construct and maintain assets more cost effectively over their life cycles.	Pavement and Bridge Management Teams (PBMT)	Continuous; examples include improved pavement treatments and use of accelerated bridge construction. *(Same as 5C.)*
2. If the Iowa Transportation Commission approves future increases to planned stewardship expenditures, then Iowa DOT may be able to maintain existing bridge and pavement conditions.  *Likelihood: 3.9* *Consequence: 4.1* *Response Approach: Enhance* *Category: Capital Planning and Programming*	**2A**. Identify asset management projects that could be developed quickly, where feasible, and prioritize unmet needs to help guide project development activities.	Districts, Design Bureau (DB), Bridges and Structures Bureau (BSB), TAM Implemen-tation Team (TAM-IT)	Projects are being identified and prioritized for pavement replacement funding that has been budgeted in the 5-Year Program.
	2B. Identify opportunities for increasing asset life on a project if funds are available to utilize a more substantial treatment that would be more cost-effective over the life cycle of the asset (e.g., deck replacement rather than overlay).	Districts, DB, BSB, TAM-IT	
	2C. Continue annual activities to communicate stewardship needs and predicted conditions.	Districts, DB, BSB, TAM-IT	Commission discussions regarding pavement and bridge condition are scheduled for early CY 2023 as part of the annual program development cycle of presentations. *(Same as 5A.)*

Table 5.1 (Part 2 of 4): Priority risks and mitigation actions

Risk Statement	Response Strategies	Owner(s)	Status/Actions
3. If appropriate protective features are not integrated into projects in locations vulnerable to extreme weather impacts, then assets may be less resilient and response and recovery efforts may be prolonged.  *Likelihood: 3.9* *Consequence: 4.0* *Response Approach: Mitigate* *Categories: Data Collection; Management Systems; Research*	**3A**. Adapt to and incorporate evolving protective measures utilizing findings of the Resiliency Working Group.	Chief Operating Officer (COO), TDD	The Resiliency Working Group meets regularly and coordinates with the COO as their Executive Leadership Team (ELT) Champion.
	3B. Incorporate climate change and extreme weather considerations into design manuals and processes.	DB, BSB	Guidelines for considering future hydrological conditions have been drafted for consideration for the bridge design manual. The Design Bureau has been defining betterment design standards and guidance for embankment protections, which can help stabilize slopes.
4. If Iowa DOT takes advantage of increased discretionary funding programs, then additional funds could be available to implement asset management and resiliency investments.  *Likelihood: 4.0* *Consequence: 3.5* *Response Approach: Enhance* *Category: Capital Planning and Programming*	**4A**. As an agency be more strategic in pursuing discretionary grants.	TDD Deputy Director	ELT has been discussing how to be strategic with discretionary grant opportunities, including developing an improved process for identifying, screening, and prioritizing candidate projects.
	4B. Monitor local agency applications for discretionary grants.	TDD Deputy Director	
	4C. Coordinate on identifying priority applications in order to avoid competing internally for funds.	TDD Deputy Director	
	4D. Undergo vetting process of options within and across the agency.	TDD Deputy Director	

Table 5.1 (Part 3 of 4): Priority risks and mitigation actions

Risk Statement	Response Strategies	Owner(s)	Status/Actions
5. If Iowa DOT is unable to select bridge and pavement treatments consistent with its life cycle strategies, then asset management costs may increase and conditions may decrease.  *Likelihood: 3.4* *Consequence: 3.9* *Response Approach: Mitigate* *Categories: Capital Planning and Programming; Management Systems*	**5A**. Communicate effectively to ELT and the Commission regarding stewardship needs.	BSB, Districts, PBMT	Commission discussions regarding pavement and bridge condition are scheduled for early CY 2023 as part of the annual program development cycle of presentations. *(Same as 2C.)*
	5B. Improve bridge and pavement asset models.	BSB, Districts, PBMT	BSB is working to utilize the AASHTO BrM system to model future conditions. Pavement management has transitioned to a new version of dTIMS and an in-house pavement stewardship tool is also being utilized. *(Same as 7A.)*
	5C. Continue to seek innovative treatments and low-cost options.	BSB, Districts, PBMT	Continuous; examples include improved pavement treatments and use of accelerated bridge construction. *(Same as 1C.)*
	5D. Continue to develop system stratification efforts, including consideration of unique state of good repair targets and policies or strategies related to the range of treatments that will be considered based on stratification.	BSB, Districts, PBMT	A preferred stratification has been developed and implementation plans are underway.
6. If transportation systems management and operations (TSMO) and travel demand strategies are not used instead of capacity expansion where feasible, then new capacity projects and long-term maintenance commitments could be required, impacting the ability to deliver the asset management program.  *Likelihood: 3.7* *Consequence: 3.6* *Response Approach: Avoid* *Categories: Business Processes; Capital Planning and Programming*	**6A**. Develop a tool kit of projects/strategies that could improve operational capacity without adding lane miles.	Traffic Operations Bureau (TOB), TSMO Engineers	TOB will finish the Active Traffic Demand Management service layer plan.
	6B. Develop and implement a process for planning studies that will increase the consideration of alternatives that help address highway capacity needs without adding lanes.	Location & Environment Bureau	This initiative and several others for incorporating TSMO into project delivery are currently underway.
	6C. Continue integrating TSMO into project delivery.	TDD Deputy Director	Several objectives for integrating TSMO into project delivery have been prioritized and are underway.

Table 5.1 (Part 4 of 4): Priority risks and mitigation actions

Risk Statement	Response Strategies	Owner(s)	Status/Actions
7. If Iowa DOT is unable to adequately communicate the how and why of asset management, then the program may not be adequately funded or properly implemented.  *Likelihood: 3.6* *Consequence: 3.5* *Response Approach: Mitigate* *Categories: Communication; Organizational Structure; Training*	**7A**. Improve modeling systems to enable better communication and better demonstration of funding impacts.	PBMT	BSB is working to utilize the AASHTO BrM system to model future conditions. Pavement management has transitioned to a new version of dTIMS and an in-house pavement stewardship tool is also being utilized. *(Same as 5B.)*
	7B. Prepare examples illustrating impacts of funding (e.g., before and after bridge project).	TAM-IT	Work with Asset Managers and Strategic Communications to develop this type of material.
	7C. Add more documentation to the consistency review to show what TAM investments are achieving.	TAM-IT	
	7D. Celebrate TAM successes through photos and communication materials to help institutionalize an emphasis on TAM.	TAM-IT	
8. If the State Legislature raises permit weight limits for bridges, then funding may need to be reallocated to address impacts on assets.  *Likelihood: 3.5* *Consequence: 3.5* *Response Approach: Avoid* *Categories: Capital Planning and Programming; Communication*	**8A**. Perform research to quantify the loss of asset value and the impact from heavier loads on bridges.	BSB, Research & Analytics Bureau	Scope research project.
	8B. Develop a "one pager" to educate legislature on this issue and/or provide a briefing to legislature.	Strategic Comm. Bureau, BSB	Would follow research project.
9. If flooding becomes more severe and/or frequent then additional labor, funding, and other resources will be diverted from TAM and other activities.  *Likelihood: 3.4* *Consequence: 3.6* *Response Approach: Mitigate* *Categories: Capital Planning and Programming; Data Collection; Management Systems; Research*	**9A**. Improve documentation of flood incidents to maximize reimbursement opportunities for Federal ER funds.	Resiliency Working Group (RWG); TOB	An RWG objective includes establishing an internal workflow for applying to FHWA's ER Program and for implementing betterments.
	9B. Fund resiliency investments for critical infrastructure (e.g., U.S. 30 over the Skunk River).	RWG, DB, BSB	A framework for identifying and prioritizing resiliency project candidates has been developed by the RWG.

5.2 Summary of Transportation Assets Repeatedly Damaged by Emergency Events

Legislative Context

As part of a separate regulation promulgated by FHWA, state DOTs must perform periodic evaluation of facilities repeatedly requiring repair and reconstruction due to emergency events. According to FHWA, state DOTs "shall conduct statewide evaluations to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events." Evaluation is defined as "an analysis that includes identification and consideration of any alternative that will mitigate, or partially or fully resolve, the root cause of the recurring damage, the costs of achieving the solution, and the likely duration of the solution." Reasonable alternatives are defined as "options that could partially or fully achieve the following:

1. Reduce the need for Federal funds to be expended on emergency repair and reconstruction activities;
2. Better protect public safety and health and the human and natural environment; and
3. Meet transportation needs as described in the relevant and applicable Federal, State, local, and tribal plans and programs."

While the requirement for evaluations is its own rule (23 CFR 667), the FHWA requires that the TAM risk management process include a summary of the evaluations for NHS pavements and bridges.

Methodology and Results

To prepare this evaluation, Iowa DOT researched records from the Emergency Relief (ER) program, including all available Detailed Damage Inspection Report (DDIR) forms since 2004. Financial records from 1997 to 2004 were also investigated. Additionally, a database of geolocated DDIRs was created. After reviewing the records, eight candidate locations were identified that appear to meet the requirements. Two of the locations are on the NHS, including U.S. 20 in Buchanan County and I-35 in Decatur County. Four other locations were on the Primary Highway System in Story, Decatur, and Appanoose counties and two were on county routes in Des Moines and Winneshiek counties.

Data gathered for this evaluation will be incorporated into Iowa DOT's Project Prioritization and Scoping (PP/S) Tool, which is used at the initial stages of the project development cycle. Any locations meeting the criteria set forth in the regulation will be noted in the case that a project encompassing that location is scoped. Including the evaluation data as a layer in the scoping tool will prompt the project development team to evaluate locations that have been identified in this analysis, including any future locations as they are added to the dataset. Furthermore, on an annual basis, local agencies will be notified of any sites that are identified by the process, and Program Management staff will compare local agency projects in the STIP against locations identified by this process to ensure compliance with the regulations. Iowa DOT will continue to monitor all identified damage locations for future ER events and communicate within the department and with other system owners whenever new locations are found to meet the requirements.

5.3 Incorporating Extreme Weather and Resilience

Iowa's extensive transportation system empowers the movement of people and goods throughout the state to reach diverse destinations. The NHS and Primary Highway System provide a reliable backbone to the state's economy and serve as a crossroads for economic productivity for the nation. However, the state's highways, like all systems, are vulnerable to disruptions in the form of natural and human-induced events. Resiliency is key to being able to maintain and operate the highway system during and after these types of events. Iowa DOT defines resiliency as the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and quickly recover from disruptions. Resiliency can be enhanced through improvements in rapidity, resourcefulness, robustness, and redundancy.

Resiliency and sustainability are building blocks of stewardship and asset management. Iowa DOT has the responsibility not only to meet the expectations of the public to ensure that the system is available and in good condition, but that it will continue to be so in the future, despite pressures from fiscal constraints and the risks posed by increasing extreme weather and natural disasters. Incorporating resiliency and sustainability principles into the decision-making process and project development will further support Iowa DOT's commitment to stewardship of Iowa's transportation system.

Over the past couple decades, Iowa has been increasingly impacted by natural disasters, including historic flooding, snowstorms, tornados, and derechos. This is likely to increase in the future as climate data shows strong trends towards increasing temperatures, precipitation, stream flows, and flooding. Additionally, awareness of human-induced disruptions has amplified as vigilance for potential terrorism and cyberattacks has increased. Examples of potential disruptions to Iowa's transportation system include the following.

- Natural, environmental, and extreme weather events
    - Flooding
    - Erosion
    - High wind
    - Increased precipitation (e.g., rain, snow, ice)
    - Landslide/rockfalls
    - Tornados and derechos
    - Snow/blizzard
- Human-induced hazards
    - Adverse actor physical threat
    - Congestion
    - Crashes
    - Cyberattack
    - Asset failure

Resiliency Working Group

Iowa DOT has established a Resiliency Working Group (RWG). The group meets quarterly, has an established charter, and is working to integrate resiliency more fully into Iowa DOT's business processes. The RWG provides guidance, support, and coordination of resiliency efforts within Iowa DOT. The mission of the RWG is to properly prepare for and reduce the impact of future disruptions to Iowa's transportation system. This includes proactive efforts to increase the system resiliency as well as enhancing response efforts to restore the operation of the system after a disruption. The group plans to accomplish this through synthesizing existing efforts, developing standard operating procedures, and strategically planning for future events.

The RWG prioritized the following five strategies at a 2021 visioning workshop. These strategies are essentially risk management efforts to enhance the system's resiliency and mitigate potential impacts on the system itself and the ability of Iowa DOT to manage it in times of emergencies.

- **Explore vulnerability assessments for various hazards for the state transportation system and others.** A flood resiliency analysis has been completed and is discussed in the next section. Analyses of additional hazards will be considered as appropriate.
- **Employ a programmatic method for implementing vulnerability or resiliency into the Five-Year Program.** In 2021, the Infrastructure Investment and Jobs Act created a formula program and discretionary grant program for Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) funds. PROTECT will help fund planning, resilience improvements, and community resilience and evacuation routes. Iowa DOT plans to develop a Resilience Improvement Plan that will identify strategies and types of projects to increase the resiliency of the state highway system. Additionally, a framework has been developed for identifying and prioritizing candidate projects eligible for the PROTECT program.
- **Improve department cybersecurity.** This includes continuous evaluation of IT systems and assets for vulnerabilities, prioritizing risk mitigation, investing in automated systems to improve cybersecurity incident response, developing redundant infrastructure and system restoration processes, and upgrading legacy systems that were not engineered to meet the current cyber threat environment. Iowa DOT also partners with the State of Iowa Office of the Chief Information Officer (OCIO) and the Federal Cybersecurity and Infrastructure Security Agency (CISA) to protect critical infrastructure. Additionally, emergency network communication kits are being developed that would include multiple methods for communication in case of issues such as the commercial cellular network being down. These kits would be available throughout DOT districts and would enhance the ability of the department to maintain communication during disaster events, which will help keep the transportation system operational.
- **Determine alternative routes for emergency closures.** This is particularly important for critical routes, such as Interstates and heavy freight corridors. Efforts such as the flood resiliency analysis may help in prioritizing emergency routing locations.
- **Incorporate resiliency and climate change into the planning and design of roadways, roadsides, and vertical infrastructure.** This is a particularly important strategy for improving resiliency in the context of asset management. Efforts to incorporate resiliency and extreme weather considerations into pavement and bridge life cycle planning are discussed in Chapter 3.

Flood Resiliency Analysis

A recent example of incorporating resilience and extreme weather considerations into the highway planning process is the flood resiliency analysis, which assessed the Primary Highway System in terms of its robustness and redundancy against flooding. The analysis focused on screening the system to identify locations vulnerable to a 100-year flood event. The analysis was comprised of three broad components under which seven individual factors were considered, with the outcome of a composite metric to assess highways' vulnerability to flooding.

- **Robustness component**: analyzes the vulnerability of the highway network to a 100-year flood event based on the 100-year floodplain boundary, whether past flooding events have occurred, and roadway shoulder data to estimate how sensitive a specific location may be to flooding.
    - 100-year flood exposure and bridge scour (45 percent)
    - Evaluation of past flood events (15 percent)
    - Roadway resistance (10 percent)
- **Redundancy component**: reviews the extent of alternative routes that can be employed in the event that elements of the system lose function.
    - System availability (20 percent)
- **Criticality component**: identifies the most operationally important assets within the system.
    - Federal functional classification (4 percent)
    - Annual average daily truck traffic (4 percent)
    - Social vulnerability index (2 percent)

The data for each attribute were normalized on a one (worst) to ten (best) scale, then combined based on the weight factor for each attribute. This weighting was determined by the RWG. The maximum composite score is 100; higher scores indicate greater resiliency towards a 100-year flood event, whereas lower scores indicate greater vulnerability to those events.

Figures 5.3 and 5.4 show the results of the flood resiliency analysis. For analysis purposes, the Primary Highway System was divided into 464 planning corridors. The overall distribution of corridor-level composite ratings ranged from 36.6 to 93.4, with a corridor-level average of 82.4. To identify corridors of most concern from a planning standpoint, corridors that had a composite score that was one or more standard deviation below the statewide average were identified. There are 72 such corridors which have a composite score of 75.1 or less and are highlighted on Figures 5.3 and 5.4. The majority of these corridors are on the NHS.

The analysis helps identify corridors where there is a greater risk of flood events and where strategies related to preparedness for possible flooding events and infrastructure improvements to enhance the resiliency of the system may be most beneficial. This helps Iowa DOT manage its assets more effectively by potentially mitigating impacts before they occur through enhanced design and construction activities, and through being prepared to respond by having emergency communication protocols and proactive traffic detour planning in place for vulnerable locations.

Figure 5.3: Flood resiliency analysis composite scores and corridors targeted for resiliency improvements – statewide view

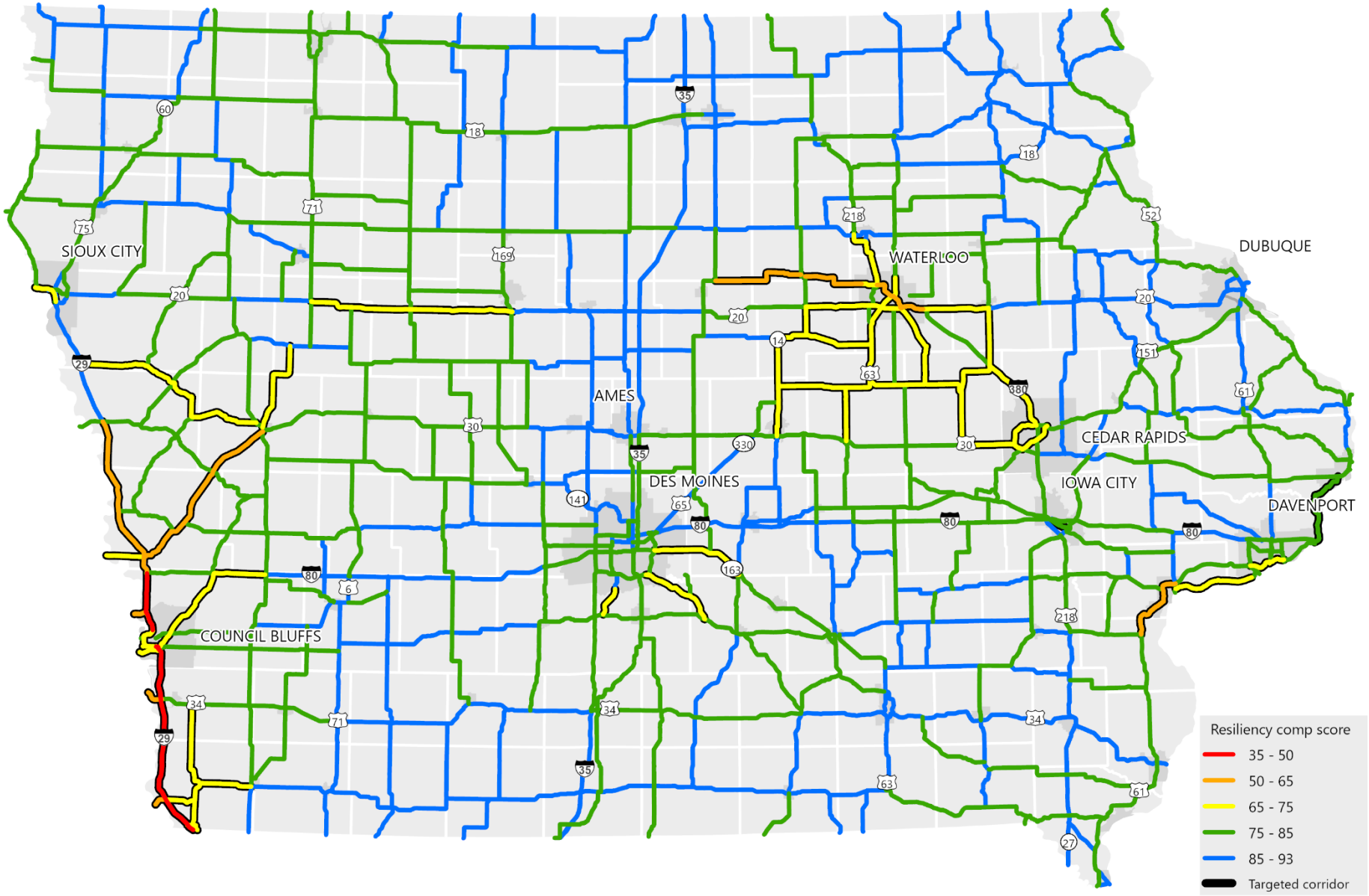
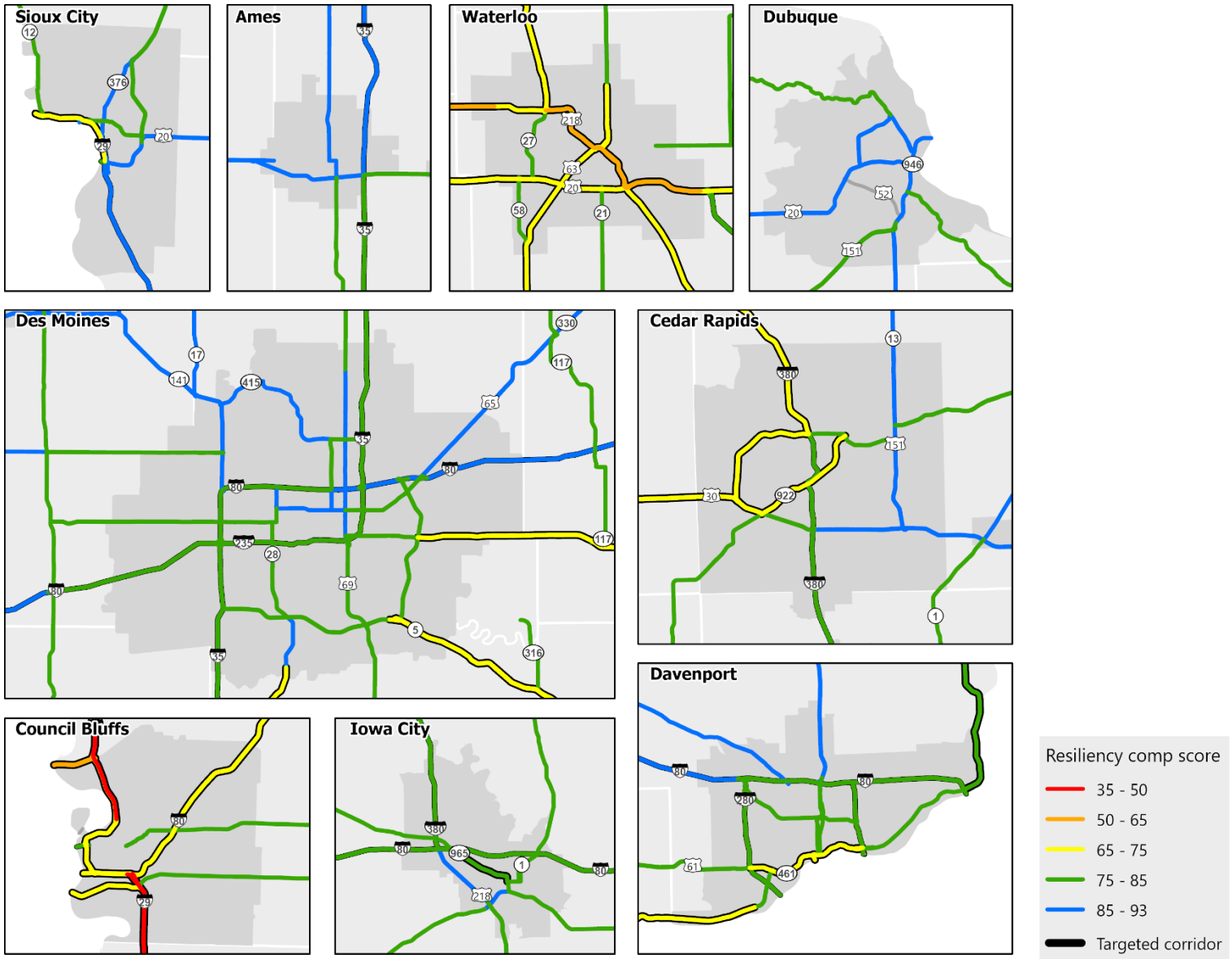


Figure 5.4: Flood resiliency analysis composite scores and corridors targeted for resiliency improvements – urban insets



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