

1. INTRODUCTION



38 74 94 100 124

These aren't lottery numbers - these are the total number of days that various highway segments were closed to traffic during 2019 due to widespread flooding that also devastated many homes and businesses and disrupted lives throughout western Iowa.

In March 2019, rapid snowmelt and heavy rain caused widespread flooding and flash flooding events in the Missouri River basin in western Iowa. This event caused parts of Interstate 680, Interstate 29, U.S. Highway 34, Iowa Highway 2, and many local roads to go out of service for weeks or months. Some routes experienced multiple closures for flooding throughout the year as Iowa's transportation system was inundated and heavily damaged in many places along the Missouri River.



March



April



June



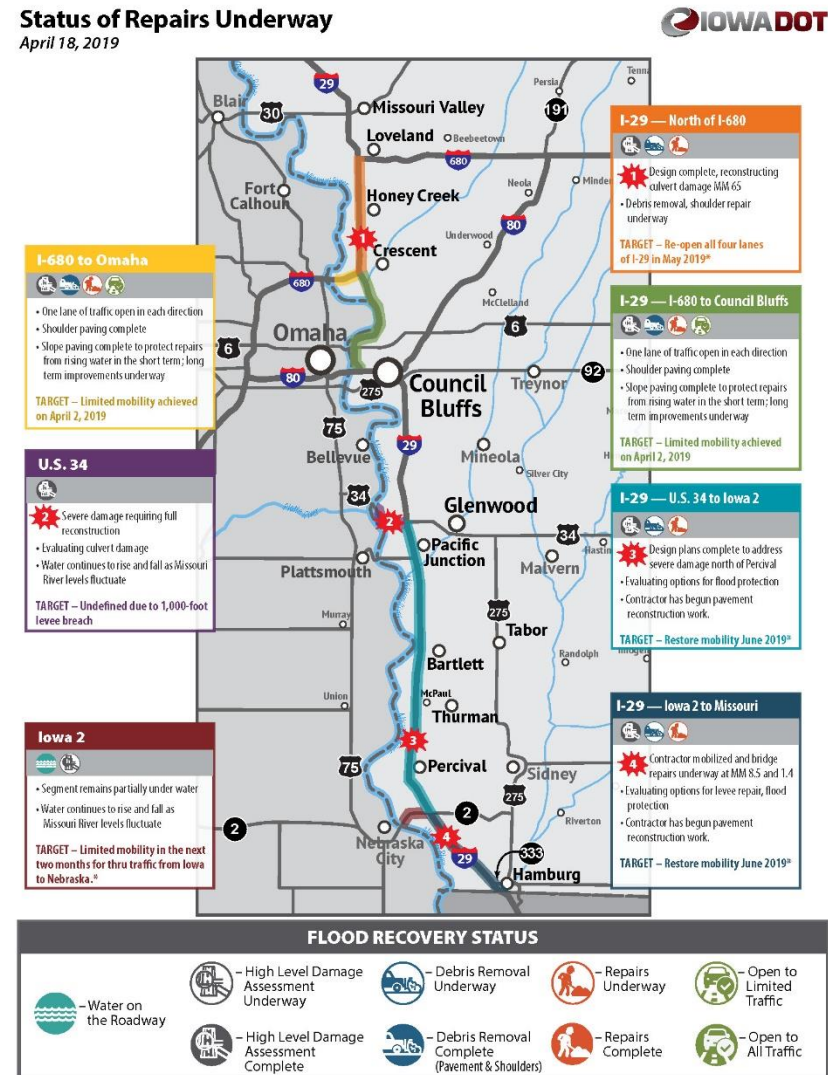
October

The Great Flood of 2019 was an extreme example of the natural hazards that Iowa's transportation system faces year in and year out. Improving system resiliency is not a new concept for the Iowa Department of Transportation (DOT) – it is a key element in its mission of stewardship for the transportation system and making lives better through transportation. As hazards threaten and countermeasures evolve, the Iowa DOT has routinely incorporated proactive and reactive resiliency measures to mitigate the impact of disasters on the transportation system.

The flooding in 2019 provides a unique case study for resiliency because it involved so many aspects of proactive and reactive mitigation strategies that are not normally applied all at the same time and place.

- **Preparedness** activities that were in place at the time of flooding included coordination agreements among agencies involved in the response to flooding and traffic incident management plans that had predetermined detour routes for specific road closures.
- **Reactive** activities that occurred throughout 2019 were numerous. Among the most critical were multiagency coordination and communication, clear communication with the public on the status of closures and repairs, and emergency work to open critical routes.
- **Mitigation** activities were undertaken during the rebuilding process, such as shoulder hardening and installation of materials to help mitigate future slope erosion due to overtopping.
- **Prevention** activities were also incorporated into major rebuilding work, such as the reconstruction of the Iowa 2 corridor in Fremont County. While temporary solutions were put into place within a few months, it was necessary to quickly develop and design long-term, resilient solutions to help mitigate the likelihood of future flooding impacts on the corridor. The long-term solutions were three-fold.
 - A federal levee was relocated and two new bridges were constructed immediately adjacent to the river bridge, dubbed the “overflow bridges,” to allow floodwaters to run under Iowa 2.
 - The grade of Iowa 2 was raised four feet and four bridges were constructed to allow for water flow.
 - A protective dike was constructed around the I-29/Iowa 2 interchange to protect both the roadways and nearby businesses.

Figure 1.1: Example communication of road closures and repairs, April 2019



The Great Flood of 2019 is just one in a long series of natural hazards that have impacted Iowa's land, people, and infrastructure. Chapter 2 details additional colloquially known disasters from Iowa's past. Lessons learned through these disasters have increased the resiliency of the transportation system and the Iowa DOT as an agency. This plan documents the integration of these resilience efforts into Iowa DOT's planning, programming, and project development process.



1.1 Why Resiliency?

Iowa's extensive transportation system empowers the movement of people and goods throughout the state to reach diverse destinations. This network provides a reliable backbone for the state's economy and serves as a crossroads for economic productivity for the nation. However, this system, like all systems, is vulnerable to disruptions in the form of natural and human-induced events. When these events occur, the state's transportation system provides critical support for the initial response to the event and the phases of recovery afterwards. But what happens when a disruption impacts the transportation system? How can recovery begin when the network we rely on is taken offline? What can we do to prevent or minimize these impacts?

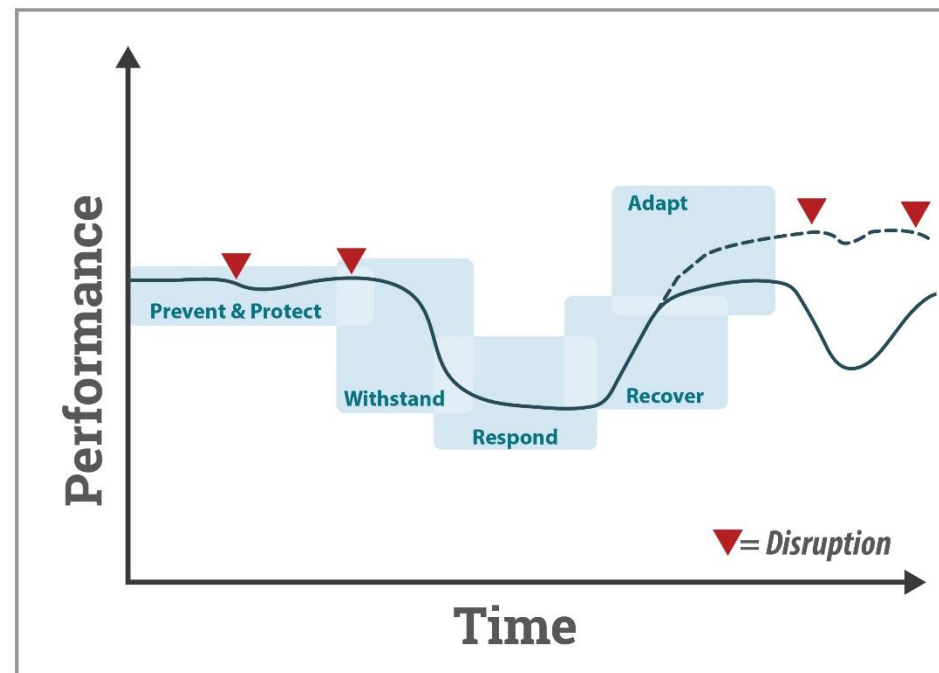
The Iowa DOT has the responsibility to not only meet the expectations of the public by ensuring the transportation system is available and in good condition, but to also ensure it will continue to be so in the future, despite pressures from aging infrastructure, fiscal constraints, and increasing natural disasters. Incorporating resiliency principles into the decision-making and project development process will further support the Iowa DOT's commitment to stewardship of the transportation system.

This chapter will introduce how the Iowa DOT defines resiliency and why it is more important than ever to consider the concept of resiliency as we plan for the future.

Defining Resiliency





The 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. Figure 1.2 provides a visual representation of the resiliency of an asset during times of disruption. Initially, an asset will withstand the impacts of a disruption until it meets a level of impact that initiates failure in performance. When failure is met, the asset's performance will degrade until proper response and recovery efforts are implemented. When recovery efforts are underway, there is typically a crucial decision point in the process – should the asset be replaced as it was, or should adaptation occur to mitigate similar disruptions in the future? In the Figure 1.2 example, adaptation of an asset occurs following disruption to the performance of the asset. This would be a reactive response to the resiliency of that asset. Ideally, improvements to increase the resiliency of an asset occur concurrently to other improvements.

Figure 1.2: Resilience of an asset over time



Although the Iowa DOT has developed a definition of resiliency, the concept of resiliency is complex. The four properties of robust, redundant, resourceful, and responsive are often used to convey the essence of what a resilient transportation system is.

Figure 1.3: The 4 Rs of resilience

 <p>Robust</p>	<p>The system is strong enough to withstand a given level of stress or demand without suffering degradation or loss of function.</p>
 <p>Redundant</p>	<p>Elements of a system exist that are substitutable and capable of satisfying the functional requirements of the system in the case of disruption.</p>
 <p>Resourceful</p>	<p>There are resources (e.g., monetary, physical, technological, and informational) available that can be leveraged in the process of recovery.</p>
 <p>Responsive</p>	<p>There is capacity to meet priorities and achieve goals in a timely manner in order to minimize losses, recover functionality, and avoid future disruption.</p>

Iowa DOT's Resiliency Efforts

Over the last few decades, Iowa has been increasingly impacted by natural disasters including historic flooding, snowstorms, tornados, and straight-line wind events. This is likely to continue as data shows trends towards increasing temperatures, precipitation, stream flows, and flooding. Additionally, awareness of human-induced disruptions has been amplified as vigilance for potential terrorism and cyberattacks has increased. These trends have prompted the Iowa DOT to bolster resiliency efforts to ensure the system is safe and reliable for users.

Resiliency Working Group (RWG)

The RWG was created in response to significant flooding in southwest Iowa in 2019 as the department coordinated and facilitated recovery efforts in response to the flooding. As flood waters receded and improvements were made, the purpose of the group transitioned from that of reactive response to proactive resiliency planning. The current mission of the RWG is to properly prepare for and reduce the impact of future disruptions to Iowa's transportation system by concentrating on how resilient improvements can be planned for, designed, and implemented to support the transportation system.

This holistic approach to resiliency at the Iowa DOT is purposeful. The RWG is intentionally a multidisciplinary group of professionals from across the department's many divisions and bureaus. Group members have diverse professional expertise including the areas of planning, engineering, operations, law enforcement, and asset management, among others. The RWG provides guidance, support, and coordination of resiliency efforts within the Iowa DOT. This includes proactive efforts to increase the system's resiliency and response efforts to get the system functioning quickly and safely after a disruption.

Sustainability Working Group (SWG)

Although the focus of this Plan is resiliency, the department's sustainability efforts work in tandem with our resiliency efforts to ensure the Iowa DOT is practicing effective stewardship with the resources of the state. The SWG was created to support and guide decision making within the department as it relates to sustainability. The concept of sustainability is multifaceted but, simply put, sustainability is the acknowledgement that resources and energy are finite. The group serves as the governance body within the department and acts as a resource for new sustainability efforts. Ongoing support from the SWG will help ensure that the Iowa DOT considers and integrates new sustainability practices as appropriate.

2021 Visioning Workshop

On November 30, 2021, the RWG and SWG participated in a Visioning Workshop. The goal of the workshop was to identify long-term and near-term goals and strategies for each group, with the outcome being several strategies for each group to focus on.



Resiliency Working Group Strategies

- Explore vulnerability assessments for various hazards for our transportation system and others.
- Employ a programmatic method for implementing vulnerability or resiliency into the Five-Year Program.
- Improve department cybersecurity.
- Determine alternative routes for emergency closures.
- Incorporate resiliency into planning and design of roadways, roadsides, and vertical infrastructure.

Sustainability Working Group Strategies

- Support workforce sustainability – attract and retain a quality workforce.
- Incorporate renewable energy and other sustainable design methods; expand alternative uses of roadsides and roadside vegetation management.
- Utilize long-life pavements and research recycled/sustainably sourced materials.
- Invest in innovation.
- Collaborate with other state agencies (within and between states).
- Promote electric and alternative-fueled vehicles.

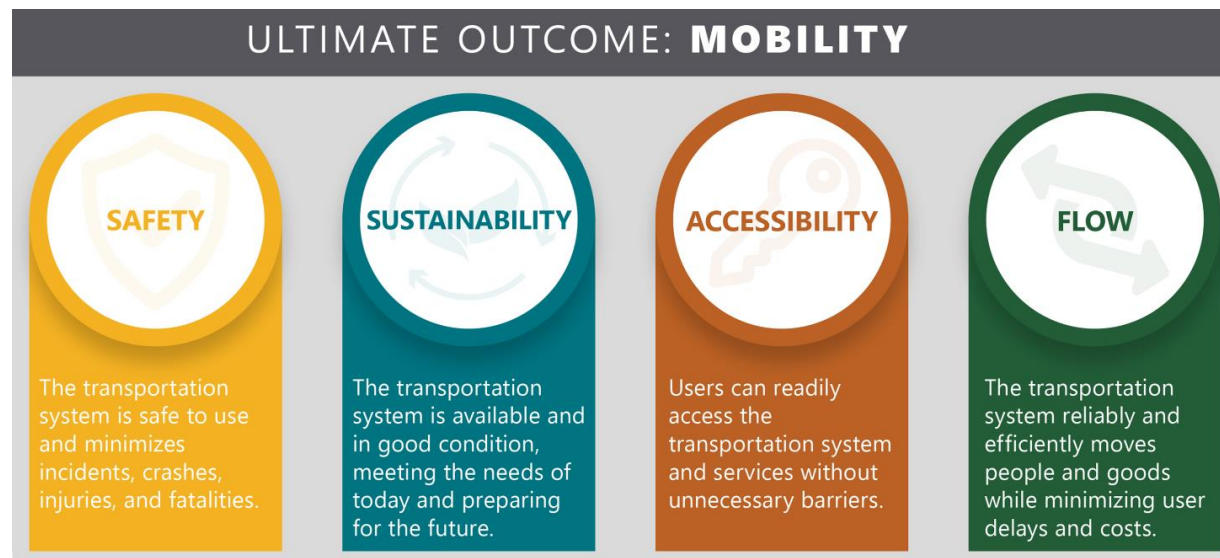
Resiliency’s Role in Statewide and Long-Range Planning

While resiliency and sustainability activities have been occurring for some time, the focus has increased significantly in recent years. Safety, financial, social, and economic benefits are among the widespread and multifaceted outcomes of proactively addressing the resiliency of Iowa’s transportation system. Measured and appropriate improvements can be made prior to disruptions in areas of need; these improvements to the resiliency of assets results in Iowa’s roadways being safer and more reliable for the traveling public. This approach is often less costly than taking a reactive response after an event. Finally, acting before a disruption occurs means that businesses may continue to operate and have access to markets through Iowa’s transportation system. Ultimately, this ensures Iowa will remain economically competitive at a regional and national level. Although near-term costs may be higher, investing in resilience can reduce long-term, life-cycle infrastructure costs by avoiding and mitigating disruptions of the future.

System Objectives

By focusing on resiliency, the Iowa DOT is supporting the ultimate purpose of the transportation system – getting people and goods where they need to go. In Iowa in Motion 2050, the State Long-Range Transportation Plan (SLRTP), this ultimate outcome of mobility is further defined through the four system objectives of safety, sustainability, accessibility, and flow. Resiliency planning aligns with and supports the system objectives identified in the SLRTP, particularly sustainability.

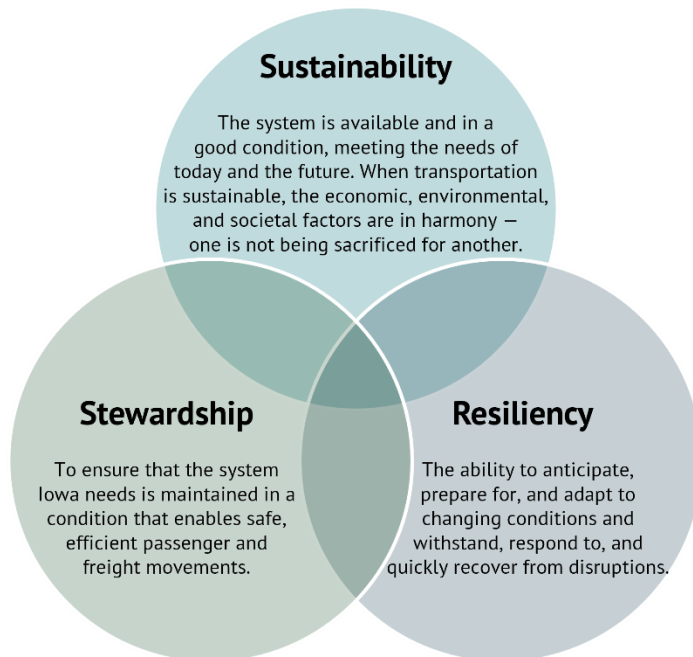
Figure 1.4: Iowa DOT System Objectives



Stewardship

The Iowa DOT views stewardship as efficient investment and prudent, responsible management of the existing transportation system. Resiliency and sustainability are building blocks of stewardship. Incorporating resiliency and sustainability principles into the decision-making and project development process will further support the Iowa DOT’s commitment to stewardship of Iowa’s transportation system. Being good stewards ensures that the system Iowa needs is maintained in a condition that enables safe and efficient passenger and freight movements.

Figure 1.5: Stewardship, resiliency, and sustainability definitions



Rightsizing Policy

A new Rightsizing Policy was adopted as part of the most recent update of the SLRTP to clarify Iowa DOT’s definition of rightsizing and to help further formalize and institutionalize rightsizing practices. At its essence, rightsizing is about trying to make the best choices for the overall transportation system when developing individual projects. The Iowa DOT defines rightsizing as seeking an appropriate level and type of investment that avoids overinvesting or underinvesting, overbuilding or underbuilding, and overserving or underserving the market based on user and system needs. The department’s role in rightsizing should be viewed as leveraging existing assets and limited resources to maximize the returns for users of the multimodal transportation system, with operating, maintaining, and constructing this system as a means to this end. To support rightsizing implementation, ten policy statements have been developed to help guide investment decisions for Iowa DOT projects, one of which focuses on resiliency.

- Project needs
- Comprehensive needs
- Stewardship priority
- Stratification of the system
- Equity
- Resiliency
- Congestion or operational issues
- Emerging technologies
- Speculative development
- New or revised interchange access

Resiliency Rightsizing Policy Statement

The department shall assess, plan for, and invest in the resiliency of the multimodal transportation system to mitigate against natural and human-made disruptions. Such activities should consider proactive and reactive measures that are proportional to existing and potential threats.



1.2 Resilience Improvement Plan (RIP) Background

On November 15th, 2021, the President signed the Infrastructure Investment and Jobs Act (IIJA) into law. The law added the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program in section 176c of Title 3, United States Code (23 U.S.C.). As part of the PROTECT program, states may develop a voluntary RIP to address transportation system resiliency. Developing a RIP can reduce a state's overall non-federal share of the cost of projects funded through the PROTECT program.

PROTECT Program

The purpose of the PROTECT program is to provide formula funding for states to address resiliency through four eligible activities.

- **Planning Activities** include developing a RIP; resilience planning, predesign, design, or the development of data tools to simulate transportation disruptions scenarios, including vulnerability assessments; technical capacity building to facilitate the ability of the state to assess the vulnerabilities of its surface transportation assets and community response strategies under current conditions and a range of potential future conditions; or evacuation planning and preparation.
- **Resilience Improvements** to improve the ability of an existing surface transportation asset to withstand one or more elements of a weather event or natural disaster, or to increase the resilience of surface transportation infrastructure from the impacts of changing conditions, such as sea level rise, flooding, wildfires, extreme weather events, and other natural disasters.
- **Community Resilience and Evacuation Route Activities** that strengthen and protect evacuation routes that are essential for providing and supporting evacuations caused by emergency events, including: resilience improvements if they will improve evacuation routes, and projects to ensure the ability of the evacuation route to provide safe passage during an evacuation and reduce the risk of damage to evacuation routes as a result of future emergency events.
- **At-Risk Coastal Infrastructure Activities** to strengthen, stabilize, harden, elevate, relocate or otherwise enhance the resilience of highway and non-rail infrastructure, including: bridges, roads, pedestrian walkways, and bicycle lanes, and associated infrastructure, such as culverts and tide gates to protect highways that are subject to, or face increased long-term future risks of, a weather event, a natural disaster, or changing conditions, including coastal flooding, coastal erosion, wave action, storm surge, or sea level rise, in order to improve transportation and public safety and to reduce costs by avoiding larger future maintenance or rebuilding costs.

RIP

A RIP is developed by a state DOT to address surface transportation system resilience to current and future weather events and natural disasters. The development of a RIP is optional, but it is encouraged as an integral part of the transportation planning process. The development of a RIP and resulting information produced to support the effort may help identify vulnerabilities, develop proposed resilience solutions, and schedule and prioritize resilience improvements to meet the needs of travelers. The RIP should be informed by asset management plans, evaluations of repeatedly damaged facilities, and state freight plans, and must be consistent with state and local hazard mitigation plans. States are also encouraged to align the development timeline with that of the SLRTP and to incorporate information from the RIP into the SLRTP.



According to (23 U.S.C. 176 (e)(2), the RIP shall:

- Be for the immediate and long-range planning activities and investments of the State with respect to resilience of the surface transportation system within the boundaries of the State, as applicable.
- Demonstrate a systemic approach to transportation system resilience and be consistent with and complementary of the State mitigation plans required under section 322 of the Stafford Act.
- Include a risk-based assessment of vulnerabilities of transportation assets and systems to current and future weather events and natural disasters, such as severe storms, flooding, drought, levee and dam failures, wildfire, rockslides, mudslides, sea level rise, extreme weather, including extreme temperatures, and earthquakes.

The development of a RIP is not required for the state to receive funding through the PROTECT Program. However, the benefit to state is an authorized reduction in the non-Federal share of the cost of a project carried out using PROTECT Formula Program funds. The non-Federal share of a project may be reduced by the following amounts, subject to the limitations and requirements detailed below. Iowa DOT has developed this RIP to meet both requirements.

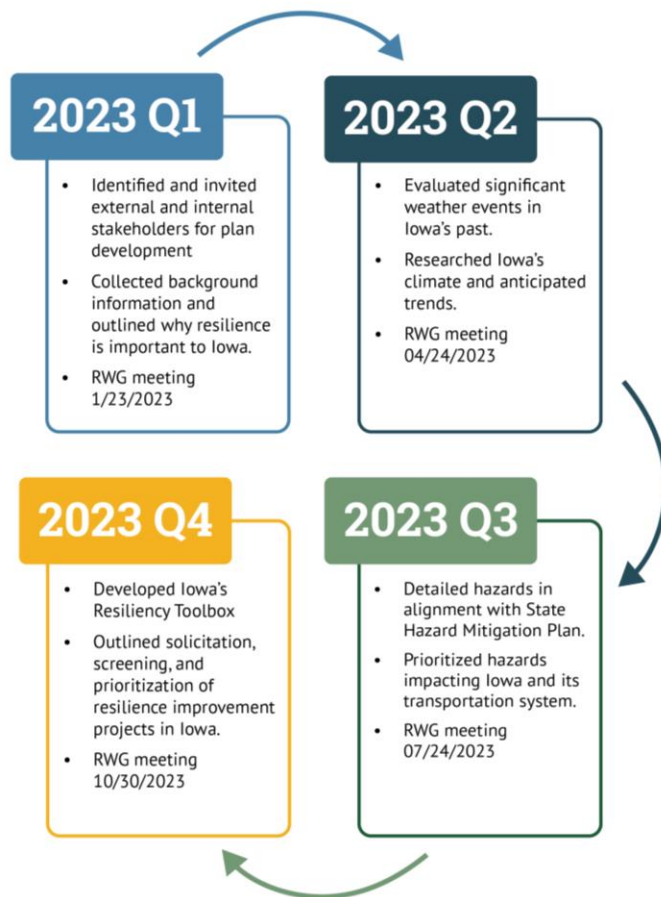
- 7 percentage points if the State has developed a RIP and prioritized the project in the RIP (23 U.S.C. 176 (e)(1)(B)(i)).
- 3 percentage points if a State RIP developed in accordance with Section 176(e) is incorporated (directly or by reference) into the metropolitan transportation plan under 23 U.S.C. 134 or the statewide long-range transportation plan under 23 U.S.C. 135, as applicable. (23 U.S.C. 176 (e)(1)(B)(ii)).

Iowa RIP Development

Timeline

Development of this plan began in January 2023 and concluded in January 2024. The plan was then approved and published in the first quarter of 2024.

Figure 1.6: RIP Development Timeline



Key Components

Key components of this plan include the following.

- **Consideration of Iowa's climate**
 - Review over time and evaluation of billion dollar natural disasters.
 - Near-term and long-term trends in Iowa's climate and weather.
- **Summary and assessment of Iowa's hazards**
 - Natural and other hazards that may impact Iowa's transportation system.
 - Risk prioritization matrix and priority hazard analysis.
- **Iowa's resiliency toolbox**
 - Identification of natural and man-made infrastructure countermeasures to mitigate hazards to Iowa's transportation system.
 - Discussion of other potential tools including policy, research, and co-beneficial improvements.
 - Identification of strategies to increase transportation resiliency in Iowa.
- **Targeted corridors and segments**
 - Listing of specific corridors and/or segments of Iowa's transportation system with a high risk for flooding or other natural disasters.

Stakeholder Input

Two groups of stakeholders were consulted during the development of this RIP. The first was the RWG, which provided input related to how the plan could best be utilized and implemented throughout the department, including the internal project development process. The second was an external group that included representatives from other state agencies and universities that provided input related to their fields of resiliency expertise. The external stakeholders included subject matter experts in climatology, hydrology, meteorology, hazard mitigation, economic development, and climate research. Specific input included hazard identification, risk prioritization, and strategy and toolbox development. Both the internal RWG and external stakeholders met on a quarterly basis during plan development.

External stakeholders that supported plan development include:

- Iowa Department of Agriculture & Land Stewardship
- Iowa Department of Homeland Security & Emergency Management
- Iowa Department of Natural Resources - GIS Analysis and Support
- Iowa Economic Development Authority - Disaster Recovery
- Iowa State University – Institute for Transportation
- Iowa State University – Department of Geological and Atmospheric Sciences
- University of Iowa – Iowa Flood Center

Coordination and Integration of Other Plans and Studies

This RIP is the Iowa DOT's primary document to support integration of resiliency into the transportation system and the planning, programming, and project development processes. In development of this Plan, a variety of other plans, reports, and studies were considered. As other plans were reviewed, consideration was given as to how the RIP could align with and be consistent with existing efforts. Many of these documents may be referenced throughout this plan; a full list and specific descriptions for many of these plans, reports, and studies is included in the Appendix.

Plans particularly critical for the RIP's development included:

- SLRTP – Iowa in Motion 2050
- Iowa Transportation Asset Management Plan
- Iowa State Freight Plan
- Iowa Drought Plan
- State Hazard Mitigation Plan



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