

PD-31: Infrastructure Resiliency Planning and Design

1-12 points

Goal: Respond to vulnerabilities and risks associated with current and future hazards (including those associated with climate change) to ensure transportation system reliability and resiliency.

Sustainability Linkage

Designing for infrastructure resiliency in the face of potential hazards supports all of the triple bottom line principles by reducing spending on infrastructure replacement, improving the safety and security of multimodal transportation system, providing energy savings from long-lasting investments, and reducing effects of vehicle travel on climate changes.



Affected Triple Bottom Line Principles

Background and Scoring Requirements

This criterion, PD-31: Infrastructure Resiliency Planning and Design, is related to SPR-16: Infrastructure Resiliency (Regional) and SPS-16: Infrastructure Resiliency (State).

Background

For the purposes of this criterion, key terms are defined as follows:

- **“Adaptation”** is adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative effects.
- **“Climate Change”** refers to any significant change in the measures of climate lasting for an extended period of time. Climate change includes major variations in temperature, precipitation, or wind patterns, among other environmental conditions, that occur over several decades or longer. Changes in climate may manifest as a rise in sea level, as well as increase the frequency and magnitude of extreme weather events now and in the future.
- **“Extreme Weather Events”** can include significant anomalies in temperature, precipitation and winds and can manifest as heavy precipitation and flooding, heatwaves, drought, wildfires and windstorms (including tornadoes and tropical storms). Consequences of extreme weather events can include safety concerns, damage, destruction, and/or economic loss. Climate change can also cause or influence extreme weather events.
- **“Extreme Events”**, for the purposes of this criterion, refers to risks posed by climate change and extreme weather events. The definition does not apply to other uses of the term nor include consideration of risks to the transportation system from other natural hazards, accidents, or other human induced disruptions.¹
- **“Greenhouse Gas (GHG) Emissions”** are gases emitted, in this case, mostly by vehicles engaged in activities to construct or use the transportation facility. These gases absorb and emits radiation within the thermal infrared range and contributes to the greenhouse effect. Greenhouse gases greatly affect the temperature of the Earth and are the primary source of climate change.
- **“Preparedness”** means actions taken to plan, organize, equip, train, and exercise to build, apply, and sustain the capabilities necessary to prevent, protect against, ameliorate the effects of, respond to, and recover from climate change related damages to life, health, property, livelihoods, ecosystems, and national security.

- **“Resilience”** or resiliency is the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

Climate Change Effects on Transportation Infrastructure

The U.S. Global Change Research Program’s 2014 Report, *Climate Change Impacts in the United States*¹ summarizes 4 Key Messages related to transportation infrastructure and climate changes:

1. The impacts from sea level rise and storm surge, extreme weather events, higher temperatures and heat waves, precipitation changes, Arctic warming, and other climatic conditions are affecting the reliability and capacity of the U.S. transportation system in many ways.
2. Sea level rise, coupled with storm surge, will continue to increase the risk of major coastal impacts on transportation infrastructure, including both temporary and permanent flooding of airports, ports and harbors, roads, rail lines, tunnels, and bridges.
3. Extreme weather events currently disrupt transportation networks in all areas of the country; projections indicate that such disruptions will increase.
4. Climate change impacts will increase the total costs to the nation’s transportation systems and their users, but these impacts can be reduced through rerouting, mode change, and a wide range of adaptive actions.”

Scoring Requirements

Requirement PD-31.1

2 points. Address Climate Change in Project Development

Incorporate consideration of climate change at a project-specific level in project development and environmental reviews.

Requirement PD-31.2

1-6 points. Incorporate Future Climate Change Effects in the Design Process or the Design

One of the following scoring requirements may apply; PD-31.2a and PD-31.2b are not cumulative.

- **Requirement PD-31.2a**

3 points. Incorporate Future Consideration of Climate Change Effects in the Design Process

Incorporate and document consideration of the effects of climate change in the design process.

For example, when designing a bridge over a water body, a project analysis might consider future climate change effects, such as rising storm water levels. However, the owner may decide that there is an acceptable factor of safety already included in the design, that the potential impacts are acceptable or can be mitigated, or that the cost to make changes is more significant than the risks of the effects pose.

One of the following scores applies:

- **0 points.** Climate change effects are not considered in the design process.
- **1 points.** Climate change effects are qualitatively considered in the design process.
- **3 points.** Climate change effects are quantitatively considered in the design process.

OR

- **Requirement PD-31.2b**

4 or 6 points. Incorporate Future Consideration of Climate Change Effects into the Design

Based on a project-specific identification of hazards, and assessment of risks and vulnerabilities resulting from those hazards, incorporate additional design efforts above and beyond requirements and regulations to address the vulnerabilities identified. The U.S. Global Change Research Program's 2014 Report, *Climate Change Impacts in the United States*¹ lists additional design actions as "Adaptive Strategies to Reduce Impacts" and describes that actions may include, but are not limited to: retrofitting pavements, stormwater drainage facilities, structures and other infrastructure; relocating facilities to avoid impacts; upgrading design of stormwater drainage facilities above and beyond what is required to mitigate changing weather patterns; designing new pavements, structures and other infrastructure to higher standards than is typically required by design requirement or regulation; or designing protection of existing infrastructure. Some examples of design changes include:

- **Alignment and Grade** – For example, raising the grade of a roadway above levels required in current regulations to address higher flood levels resulting from climate changes.
- **Stormwater Drainage System** – For example, increasing the capacity of conveyance and detention facilities to address higher flood levels resulting from climate changes.
- **Pavement Structures** – For example, designing pavements to withstand the effects of heat waves resulting from climate changes.
- **Bridge Structures** – For example, designing bridge piers to withstand the effects of scour or storm surges resulting from more intense flooding events.
- **Tunnels and other Structures** – For example, designing tunnels or sign structures to withstand the effects of more intense weather or seismic events than is required.

Agencies can use FHWA's 11-step process for engineering transportation assets to be more resilient to climate impacts and the associated tools that were developed under *Phase II of the Gulf Coast Study*^{2,3}. This process describes consideration of multiple alternatives and cost benefit analysis of designed infrastructure.

One of the following scores applies:

- **0 points.** No design changes are required to accommodate future climate change effects or no changes are incorporated in the design.
- **4 points.** Design changes are incorporated in the design of one design discipline (e.g. bridges, pavements, drainage, etc.).
- **6 points.** Design changes are incorporated in the design of more than one design discipline (e.g. bridges and pavements, drainage and bridges, etc.).

Requirement PD-31.3

4 points. Mitigate Climate Change and Extreme Weather Effects

Mitigate the effects of GHG emissions through design efforts above and beyond requirements and regulations. Some examples of strategies meeting this requirement, include, but are not limited to:

- Incorporating transportation system and operational efficiencies by optimizing the design, construction, operation, and use of transportation networks. The strategies range from anti-idling ordinances to traffic management to congestion pricing. The objective of this group of strategies is to reduce the energy use and

GHG emissions associated with a given unit of passenger or freight travel (e.g., person-miles, vehicle-miles, or ton-miles of travel).

- Reduce travel activity by reducing growth in vehicle-miles traveled. The objective of this group of strategies is to influence travelers' activity patterns, thereby reducing total travel, shifting travel to more efficient modes, increasing vehicle occupancy, or otherwise taking actions that reduce energy use and GHG emissions associated with personal travel.

Resources

Above-Referenced Resources

The following resources are referenced in this criterion and consolidated here:

1. U.S. Global Change Research Program, *Climate Change Impacts in the United States* (2014), <http://nca2014.globalchange.gov/downloads>
2. FHWA, *U.S. DOT Gulf Coast Study Phase 2*, http://www.fhwa.dot.gov/environment/climate_change/adaptation/case_studies/gulf_coast_study/engineering_and_tasks/task32.pdf and http://www.fhwa.dot.gov/environment/climate_change/adaptation/ongoing_and_current_research/gulf_coast_study/
3. FHWA, *U.S. DOT Gulf Coast Study Phase 2 (Tools)*, http://www.fhwa.dot.gov/environment/climate_change/adaptation/ongoing_and_current_research/gulf_coast_study/index.cfm#l2

Additional Resources

The following resources provide information on this criterion topic in addition to the sources directly referenced:

4. FHWA, *FHWA Order 5520: Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events* (2014), <http://www.fhwa.dot.gov/legisregs/directives/orders/5520.cfm>
5. FHWA, *Integrating Climate Change into the Transportation Planning Process* (2008), https://www.fhwa.dot.gov/environment/sustainability/energy/publications/integrating_climate_change/index.cfm
6. FHWA, Climate Adaptation Website, http://www.fhwa.dot.gov/environment/climate_change/adaptation/
7. FHWA, Vulnerability Assessment Framework Website, http://www.fhwa.dot.gov/environment/climate_change/adaptation/adaptation_framework/
8. TRB, *E-C152: Adapting Transportation to the Impacts of Climate Change*, <http://onlinepubs.trb.org/onlinepubs/circulars/ec152.pdf>

Scoring Sources

The project is considered to have met this criterion if the requirements above can be reasonably substantiated through the existence of one or more of the following documentation sources (or equal where not available):

1. Contract documents including plans and specifications showing designed infrastructure.
2. Design documentation showing design above and beyond requirements and regulations was performed to specifically address the effects of GHG emissions and climate changes.