Chapter 6
Transportation Sector

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Photo Credit:
US DOT

6.1 Introduction

- The transportation sector is critical to the community, the community built environment, and community disaster response and disaster recovery
- The transportation sector is very complex with multiple stakeholders and interconnecting modes: roadway networks, rail lines, airports, harbors, ports, waterways and pipelines
- It is vital to community evacuation, emergency response, access to critical community facilities and recovery from disasters
- Movement of people and goods usually relies on multiple modes
- The vulnerability of the transportation sector will directly affect the resilience of the community and its infrastructure

6.1 Introduction

6.1.1. Societal Needs and System Performance Goals

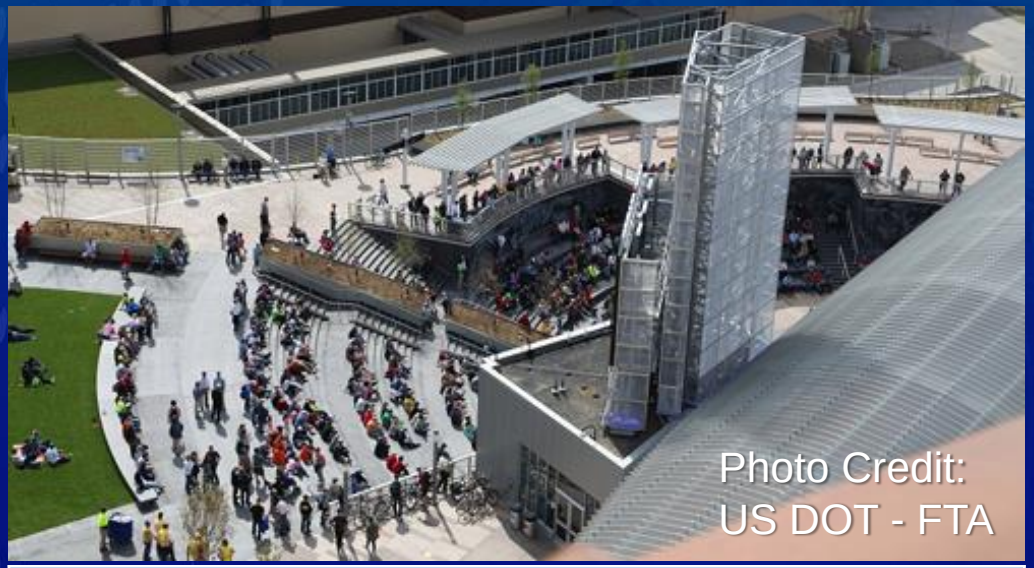
The community has short (0-3 days), intermediate (1-12 weeks), and long term (4-36+ months) recovery needs that are dependent on transportation

- Access for emergency responders
- Access for those that restore critical infrastructure (energy, communications, water/wastewater)
- Access to facilities for shelter, medical care, banks/commerce, and food
- Egress/evacuation from a community before (if advanced warning is provided) or immediately after a disaster event, if needed
- Ingress of goods and supplies immediately after event to provide aid

6.1 Introduction

6.1.2. Interdependencies

- Dependencies of other sectors on transportation
- Dependencies of transportation sector on other sectors
- Intermodal transportation dependencies



Target Field Station multi-modal hub Minneapolis, MN

Electric vehicle charging station in Portland, OR

6.2 Transportation Infrastructure

6.2.1. Roads, Bridges, Highways, and Road Tunnels

Roads and Highways:

- loss of a key road, bridge or tunnel will negatively impact the community's short, intermediate, and long term recovery needs that are dependent on transportation

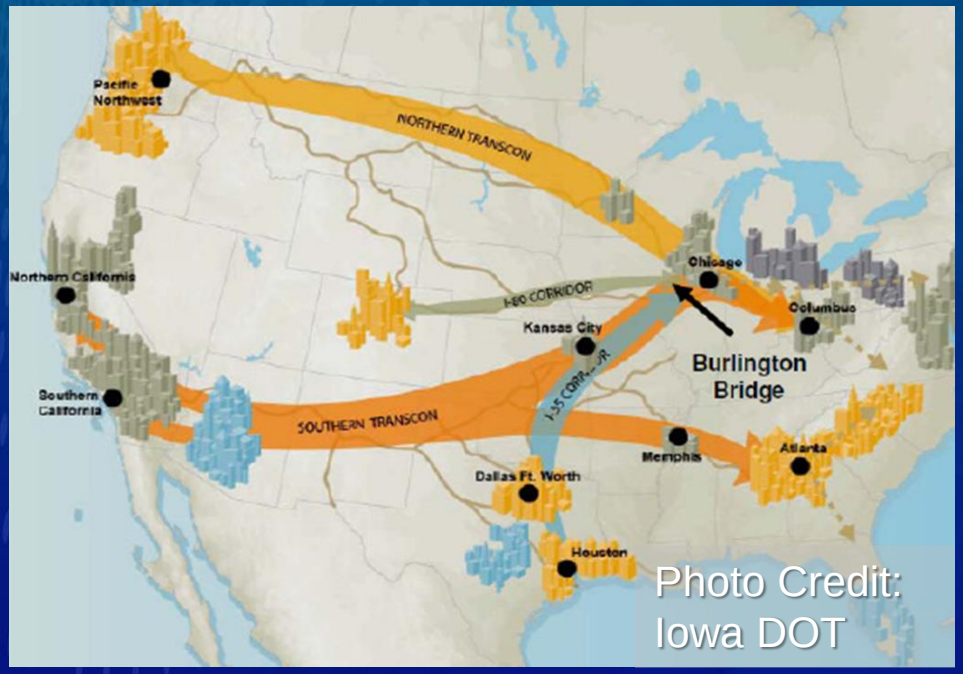
Road undercutting in the aftermath of Hurricane

Local Road Blocked by Fallen Trees

Bridge sections slid off their supports during Hurricane

6.2 Transportation Infrastructure

6.2.2. Rail



Freight Line Networks Have Little Redundancy. Closure of a Single Bridge has National Impact

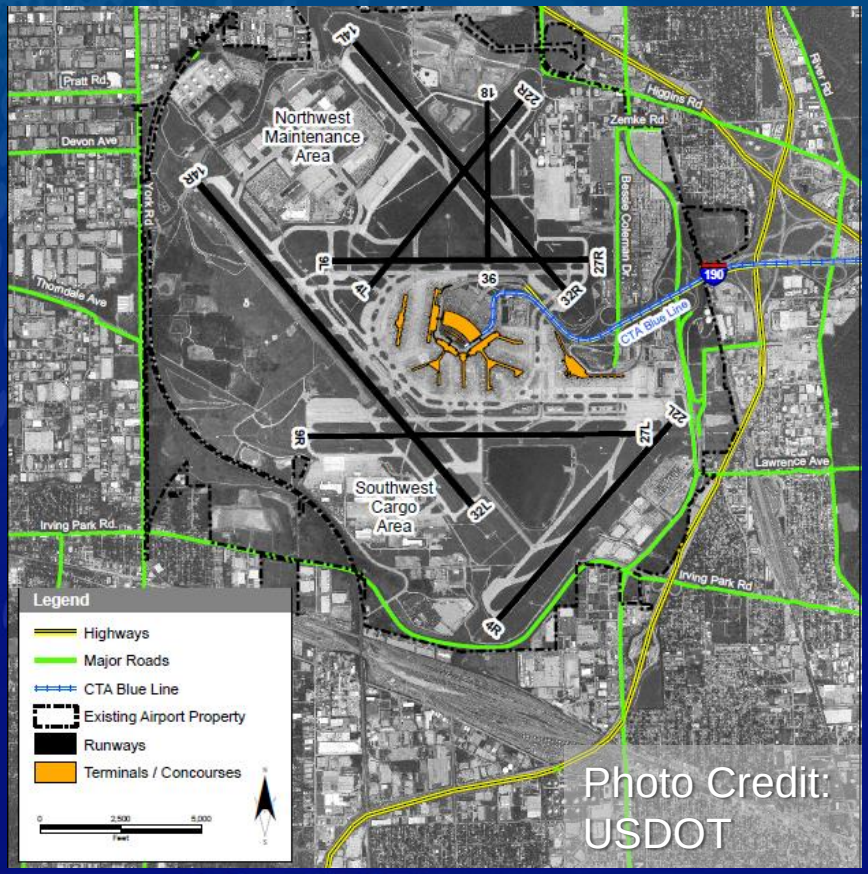
Repairs of Subway Tunnel in Brooklyn, NY After Flooding Damage from Hurricane Sandy

Freight Rail Bridge in New Orleans Washed Out By Flooding

6.2 Transportation Infrastructure

6.2.3. Air

Airports like Chicago O'Hare are Communities unto themselves with Banks, Restaurants, Retail Stores and Intermodal Stations



Airports play an integral role in moving people and supplies before and after a disaster

6.2 Transportation Infrastructure

6.2.4. Ports, Harbors and Waterways

Inland waterways in the US are relied upon to move large volumes of bulk cargo. One barge can carry the same tonnage as 58 tractor trailer trucks.

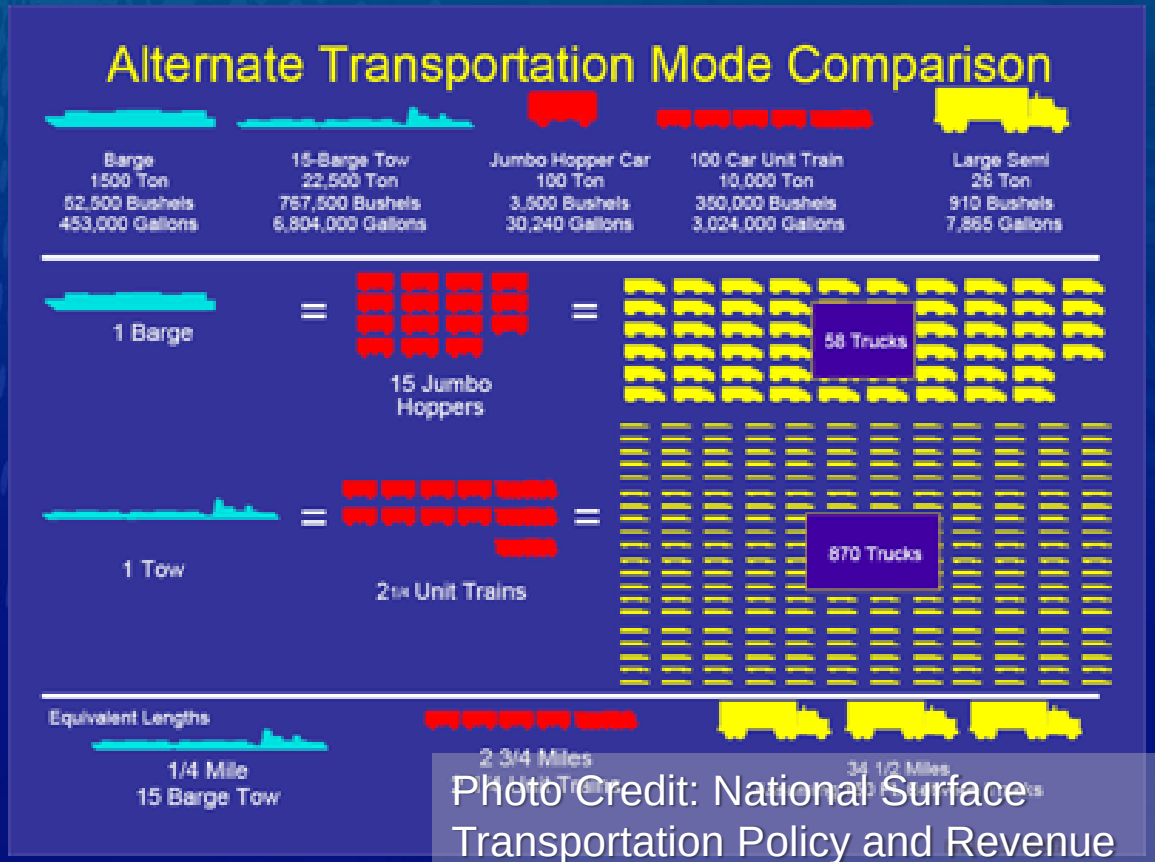


Photo Credit: National Surface Transportation Policy and Revenue Study Commission

Photo Credit: FTA

Ferries provide safe and reliable transport across bodies of water where tunnels and bridges are not available

Shipping containers are displaced by high winds and storm surge

6.2 Transportation Infrastructure

6.2.5. Pipelines

Key Lifelines under the U.S. DOT's Pipeline and Hazardous Materials Administration (PHMSA):

- Pipelines deliver natural gas, crude oil, refined products such as gasoline and diesel, and natural gas liquids such as ethane and propane.

Natural gas crew shuts off gas after Hurricane Sandy

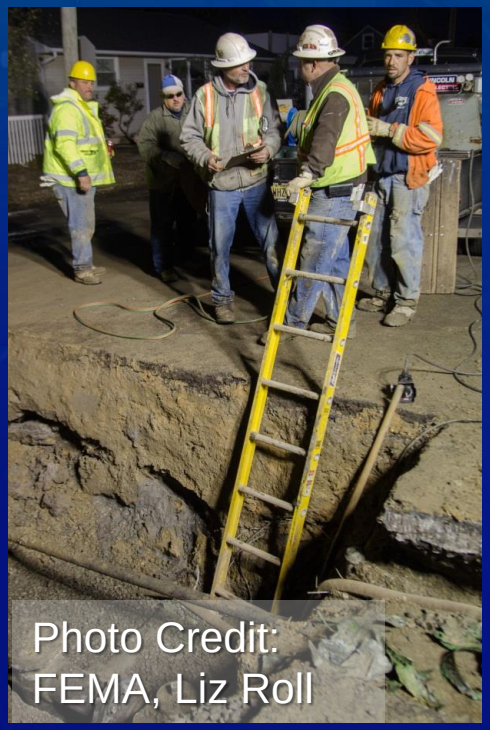


Photo Credit: FEMA, Liz Roll

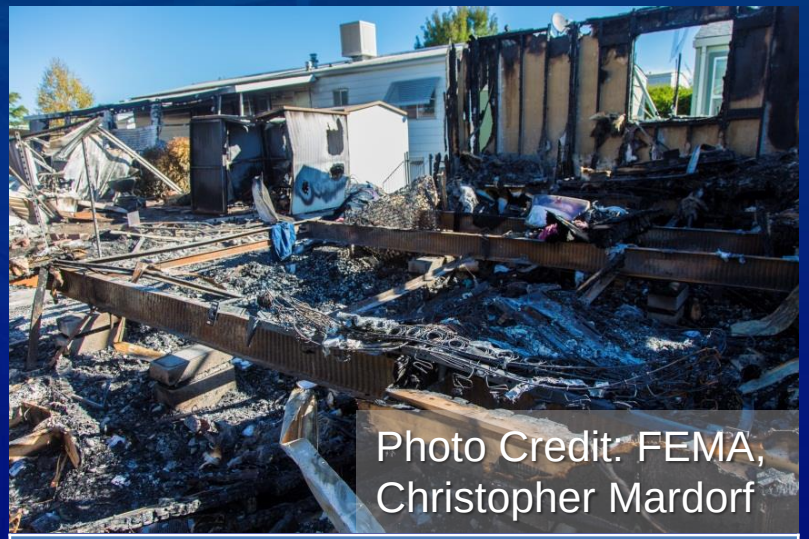
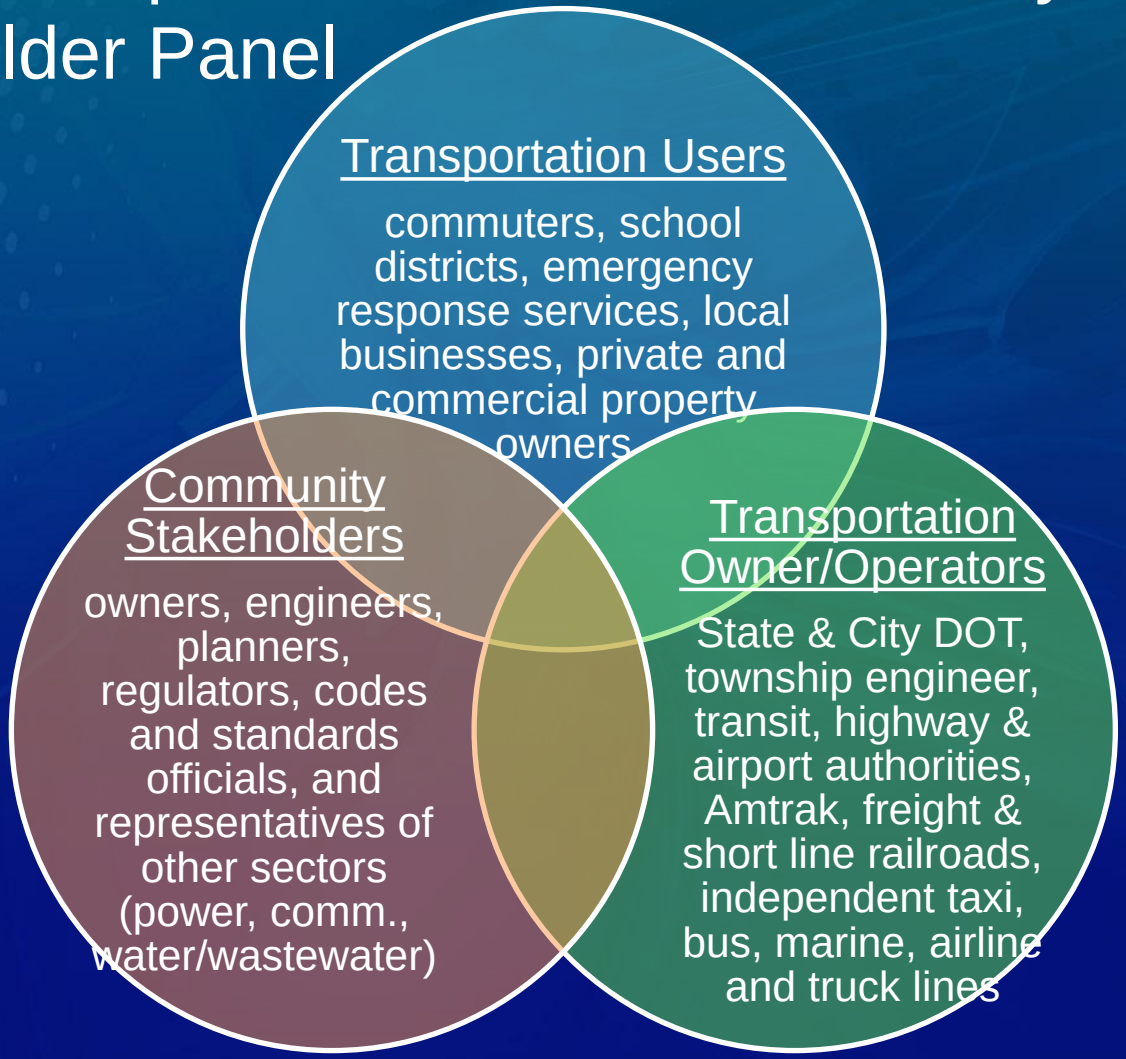


Photo Credit: FEMA, Christopher Mardorf

Fire damage from broken gas

6.3 Performance Goals

Set by Transportation Sector Community Stakeholder Panel



6.3 Performance Goals

Transportation Sector Prioritization

1. Designated Evacuation and Emergency Access Routes
2. Interstate Highways
3. State Highways
4. Numbered County Routes
5. Pipelines (Power and Energy Sector)
6. Pipelines (Serving Community)
7. Subway Mass Transit Systems
8. Large Ferry Terminals
9. Light Rail Systems
10. Regional Commuter Rail Lines
11. National or International Airports
12. Intercity rail such (Amtrak)
13. Regional Airports
14. Marine Ports
15. Freight Rail Lines
16. Ferry Terminals for Smaller Vessels (water taxi)

Phase 1
Short Term

Phase 2
Intermediate

Phase 3
Long Term

6.3 Performance Goals

Example: Routine Hazard Ingress (goods, services, disaster relief)

Disturbance		
(1)	Hazard	Any
	Affected Area for Routine Event	Localized
	Disruption Level	Minor

Restoration times		
(2)	30%	Restored
	60%	Restored
	90%	Restored
(3)	X	Current

Functional Category: Cluster	(4) Support Needed	(5) Target Goal	Overall Recovery Time for Hazard and Level Listed – Routine Hazard Level								
			Phase 1 – Short-Term Days			Phase 2 – Intermediate Wks			Phase 3 – Long-Term Mos		
			0	1	1-3	1-4	4-8	8-12	4	4-24	24+
Ingress (goods, services, disaster relief)		**A**									
Local Roads, Bridges and Tunnels			90%	X							
State Highways, Bridges and Tunnels			90%	X							
National Highways, Bridges and Tunnels			90%	X							
Regional Airport			60%	90%	X						
National/International Airport			60%	90%	X						
Military Airports			60%	90%	X						
Marine Port			60%	90%	X						
Ferry Terminal			60%	90%	X						
Subway Station			60%	90%	X						
Rail Station, Local			60%	90%	X						
Rail Station, Regional				30%	60%	90%	X				
Rail Station, National				30%	60%	90%	X				

6.3 Performance Goals

Example: Expected Hazard Ingress (goods, services, disaster relief)

Disturbance		
(1)	Hazard	Any
	Affected Area for Routine Event	Localized
	Disruption Level	Minor

Restoration times		
(2)	30%	Restored
	60%	Restored
	90%	Restored
(3)	X	Current

Functional Category: Cluster	(4) Support Needed	(5) Target Goal	Overall Recovery Time for Hazard and Level Listed — Expected Hazard Level								
			Phase 1 – Short-Term			Phase 2 – Intermediate			Phase 3 – Long-Term		
			Days			Wks			Mos		
			0	1	1-3	1-4	4-8	8-12	4	4-24	24+
Ingress (goods, services, disaster relief)		A									
Local Roads, Bridges and Tunnels			60%	90%	X						
State Highways, Bridges and Tunnels			60%	90%		X					
National Highways, Bridges and Tunnels			90%		X						
Regional Airport				30%	60%	90%		X			
National/International Airport			30%	60%	90%	X					
Military Airports			30%	60%	90%	X					
Marine Port				30%	60%	90%	X				
Ferry Terminal			30%	60%	90%	X					
Subway Station			30%	60%	90%		X				
Rail Station, Local			30%	60%	90%	X					
Rail Station, Regional				30%	60%	90%	X				
Rail Station, National				30%	60%	90%	X				

6.3 Performance Goals

Example: Extreme Hazard Ingress (goods, services, disaster relief)

Disturbance		
(1)	Hazard	Any
	Affected Area for Routine Event	Localized
	Disruption Level	Minor

Restoration times		
(2)	30%	Restored
	60%	Restored
	90%	Restored
(3)	X	Current

Functional Category: Cluster	(4) Support Needed	(5) Target Goal	Overall Recovery Time for Hazard and Level Listed Extreme Hazard Level								
			Phase 1 – Short-Term Days			Phase 2 – Intermediate Wks			Phase 3 – Long-Term Mos		
			0	1	1-3	1-4	4-8	8-12	4	4-36	36+
Ingress (goods, services, disaster relief)		A									
Local Roads, Bridges and Tunnels					30%	60%	90%	X			
State Highways, Bridges and Tunnels					30%	60%	90%	X			
National Highways, Bridges and Tunnels				30%	60%	90%	X				
Regional Airport					30%	60%	90%	X			
National/International Airport				30%	60%	90%		X			
Military Airports					30%	60%	90%	X			
Marine Port					30%	60%	90%	X			
Ferry Terminal					30%	60%	90%	X			
Subway Station					30%	60%	90%	X			
Rail Station, Local					30%	60%	90%	X			
Rail Station, Regional					30%	60%	90%	X			
Rail Station, National					30%	60%	90%	X			

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Questions?