



# Geotechnical Engineers, Engineering Geologists and Geology Professionals Climate Questions!

(FHWA Geohazards, Extreme Events and Climate  
Change Program)

Khalid T. Mohamed, P.E., PMP  
Senior Geotechnical Engineer  
Federal Highway Administration  
HIF / HIBS-20  
Washington, DC

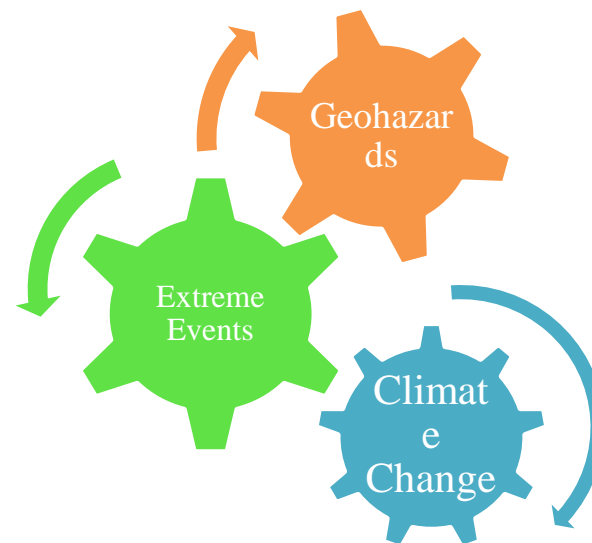
Geohazards Impacting Transportation in Appalachia  
Skelton Conference Center  
Blacksburg, VA  
August 2017



U.S. Department of Transportation  
Federal Highway Administration

# AGENDA

- ❑ Introduction
- ❑ Climate in Geohazards Definition!
- ❑ FHWA Geohazards Program Relations
- ❑ Geohazards in Highway System Performance
- ❑ Climate Questions For Geo-Professionals?
- ❑ What is Resilience and Adaptation
- ❑ Example: ADAP Process



FHWA Geohazards, Extreme Events and Climate Change



# INTRUDUCTION

- The FHWA Geohazards, Extreme Events and Climate Change Program is an Initial Effort that Investigates and Evaluates the *Frequency and Severity* of Geohazards; the Influences of and *Sensitivities to Climate Change and Extreme Events*; and the Extent and Impacts of Geohazards on *Transportation Infrastructure and System Performance*.



I-15 Cajun Pass Highway Embankment Failure  
CA (Source: Caltrans District 8)



# CLIMATE IN GEOHAZARDS DEFINITION!

- **General Geohazards Definition;**

- Geohazards are generally defined as *geological and climatic conditions* that have the potential to cause damage to property, infrastructure and the environment; loss of life; and economic losses.
- the Federal Emergency Management Agency (FEMA 2014) reported that *annual human and financial losses* from landslides alone are estimated to *average 25 to 50 deaths* and cost approximately *\$2 to \$4 billion per year*

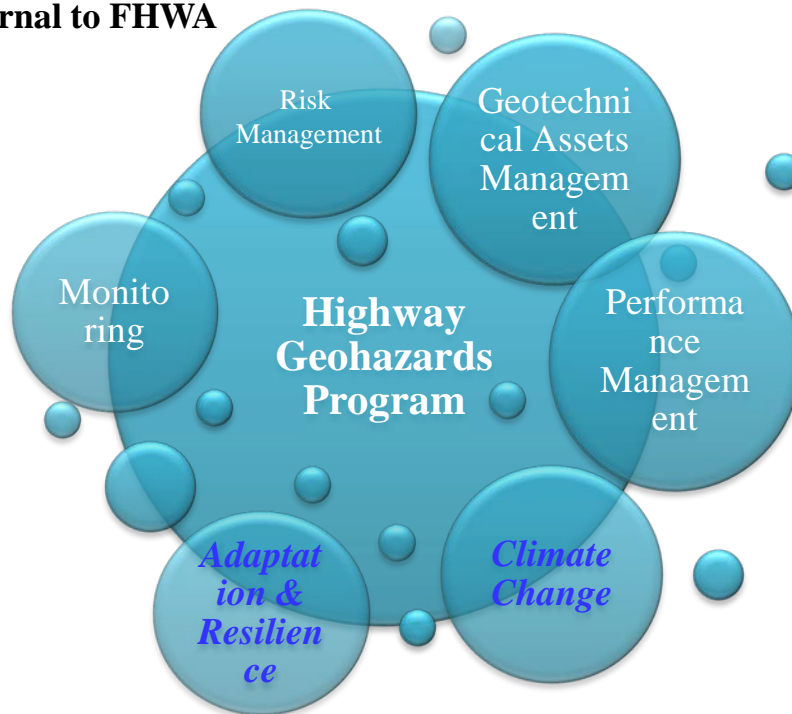


SR 530 Oso Landslide, Snohomish County,  
WA  
41 life lost ((Source; Wash DOT)



# FHWA GEOHAZARDS PROGRAM RELATIONS

## Internal to FHWA



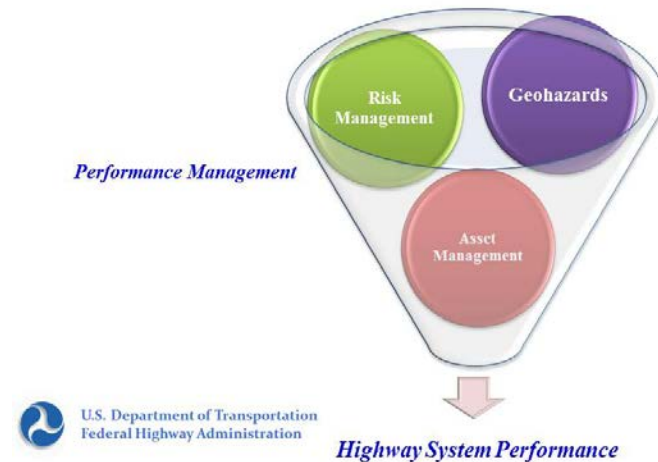
## External Links

- **National:**
  - USGS Landslides
  - USGS Earthquakes
  - GEER
  - FEMA
  - Other USA
- **International:**
  - Int. Centre for GeoHazards
  - Safeland
  - Others

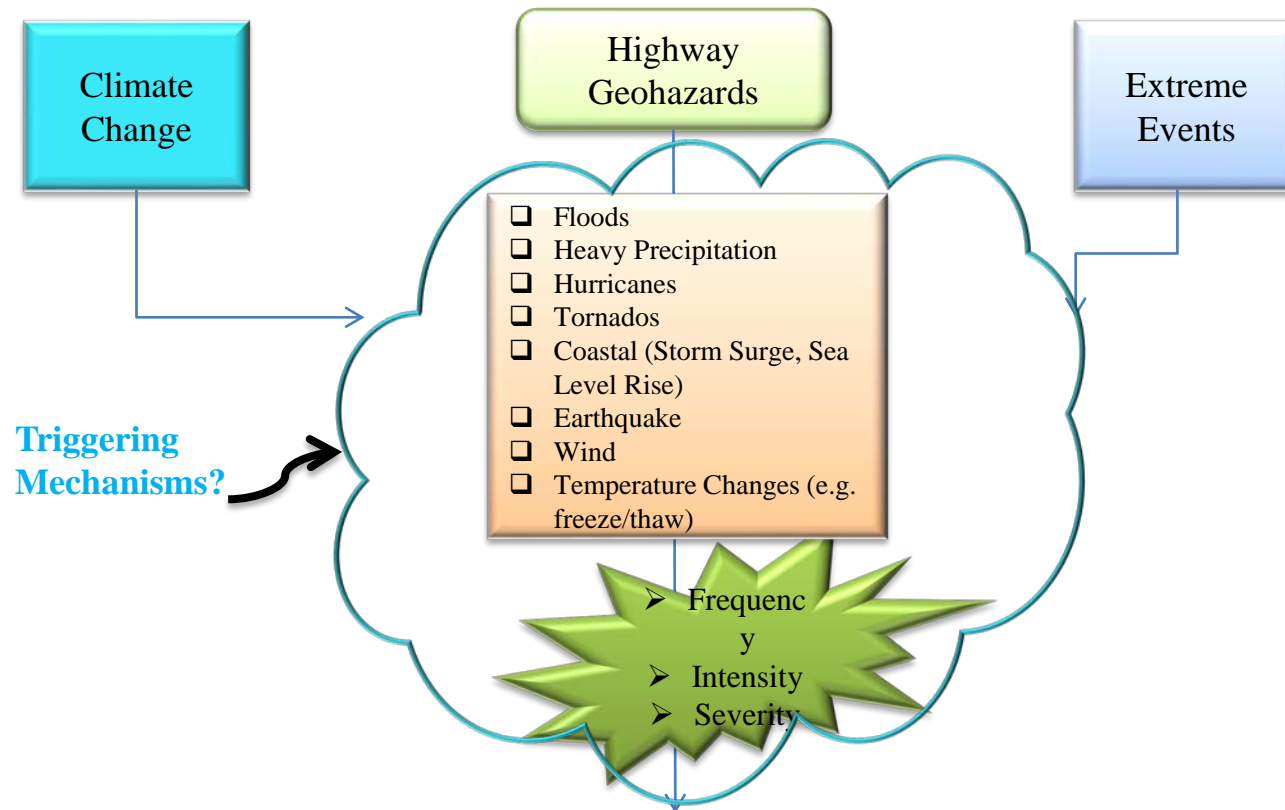


# GEOHAZARDS IN HIGHWAY SYSTEM PERFORMANCE

- Federal MAP-21 Legislation Encourages Asset Management Plans To Include All Assets Within The Right-of-way Corridor.
- Minimize Lifecycle Costs For Managing And Maintaining The Department's Assets Subject To *Acceptable Levels Of Risk*.
- Meet *Life-cycle Performance Goals* Through The Management Of Assets In The Most Cost-effective Manner

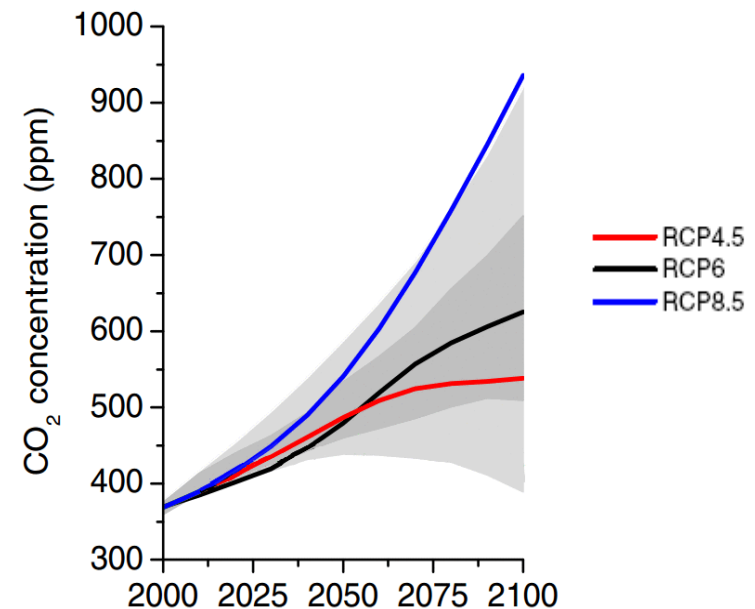


# HIGHWAY GEOHAZARDS TRIGGERING MECHANISMS



# CLIMATE QUESTIONS FOR GEO-PROFESSIONALS?

- ❑ Do Geo-professionals Have Interest Or Stake in Climate Factors That Might Impact Geotechnical Features Performance?
- ❑ Can We Continue to Design and Manage Performance Based on Historic Data?
- ❑ Can We Ignore Climate Projections?
- ❑ What Climate Information Geo-Professionals Need to Learn?
  - ❑ Global Climate Models (GCM)
  - ❑ Green House Gases (GHG)
  - ❑ Representative Concentration Pathways (RCP)
  - ❑ Hydraulics Example;
    - ❑ *Stationarity*: Past Predicts Future
    - ❑ *Non-Stationarity*: Patterns and trends of past not necessarily predict the future
- ❑ Climate Stressors



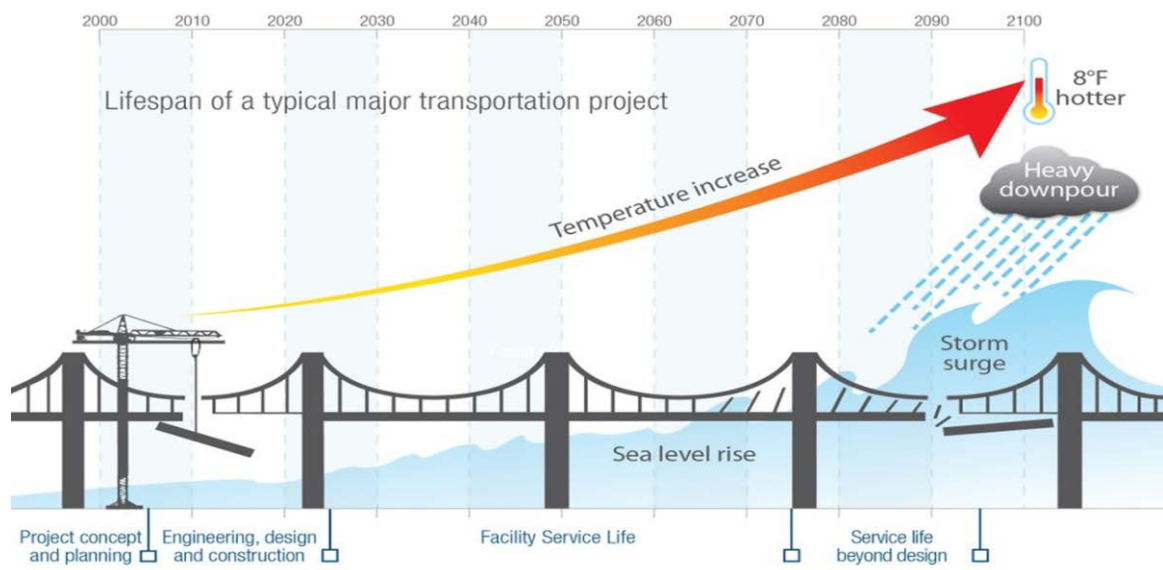
Radiative Forcing Trajectories of Different Representative Concentration Pathways

Source: [http://sedac.ipcc-data.org/ddc/ar5\\_scenario\\_process/RCPs.html](http://sedac.ipcc-data.org/ddc/ar5_scenario_process/RCPs.html).



# WHAT IS RESILIENCE AND ADAPTATION?

- **Resilience** = The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions
- **Adaptation** = Adaptation involves taking practical actions to manage risks from climate impacts, protect communities and strengthen the resilience of the economy.



Source: FHWA Gulf Coast Study | USGCRP, National Climate Assessment 2014

# Example: Adaptation Decision-making Assessment Process (ADAP)

## 11-Step Engineering Assessment “Process”

1. Describe the site context
2. Describe the existing or proposed facility
3. Identify environmental factors that may impact infrastructure components
4. Decide on climate scenarios and determine magnitude of changes
5. Assess performance of the existing or proposed facility
6. Develop adaptation option(s)
7. Assess performance of the adaptation options
8. Conduct an economic analysis
9. Evaluate additional decision-making considerations
10. Select a course of action
11. Develop a Facility Management Plan



*Determine scope of the analysis*

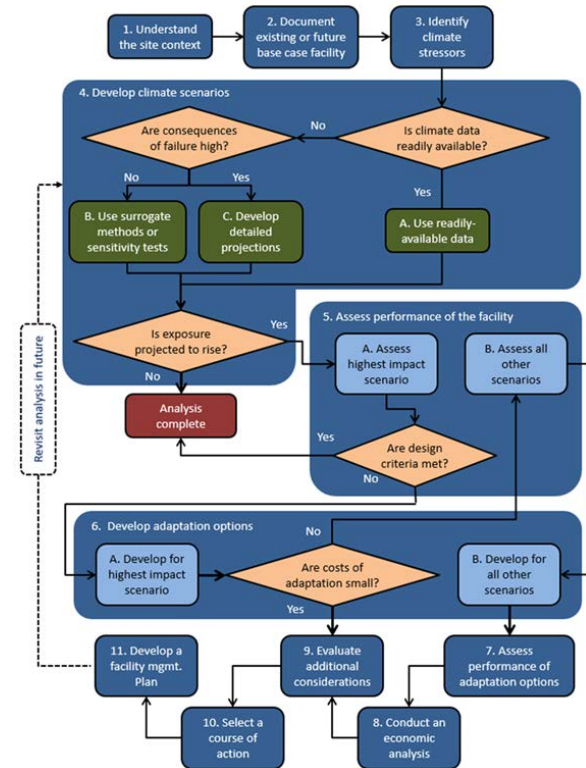
*Learn what might harm the facility*

*Develop solutions to make the asset more resilient*

*Make a decision, and monitor*

# FHWA ADAPTATION AND RESILIENCE RESOURCES AND TOOLS

- ❑ FHWA Office of Infrastructure (*HIF*) Examples;
  - *Hydraulics*
    - ❑ Hydraulic Engineering Circular (HEC 25)  
*Highways in Coastal Environment*
    - ❑ Hydraulic Engineering Circular (HEC 17)  
*Highways in the River Environment-  
Floodplains, Extreme Events, Risk, and Resilience*
  - *Geotechnical (Currently Specific Hazards Included)*
    - ❑ <https://www.fhwa.dot.gov/engineering/geotech/hazards/>
- ❑ FHWA Office of Planning, Environment, & Reality (*HEP*)  
Examples;
  - ❑ [Transportation Engineering Approaches to Climate Resiliency \(TEACR\) Study](#)
  - ❑ [Adaptation Decision-Making Assessment Process \(ADAP\)](#)





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**Thank You**

**[Khalid.mohamed@dot.gov](mailto:Khalid.mohamed@dot.gov)**  
**(202) 366 0886**

FHWA Office of Infrastructure (HIF)  
Office of Bridges and Structures (HIBS-20)

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