

Transport Asset Management: Geohazard Perspective

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WORLD BANK GROUP

Major Road Geohazards

						
Glacial Lake Outburst Floods	Avalanche	Volcano	Earthquakes, Liquefaction	Tsunami	Landslides, Rock Slides, Debris Flows	Mud Slide

Infrastructure is Vulnerable to Climate and Disaster Risks

Infrastructure is built in highly hazard prone areas		Risk assessments are not properly used in planning		Policy and planning don't address disaster and climate risks		Options needed for connectivity (redundancy)	
Proper geotechnical studies are not carried out	Design codes and standards are not updated	Infrastructure is not designed for safe failure	Tools needed to address these vulnerabilities	Poor industry capacity	High upfront costs		
Lack of updated and easily accessible asset management system			Lack of funding and political will for resilience and maintenance			Infrastructure is poorly maintained	
Disaster recovery process and protocols are needed			Poor financial planning			Poor understanding of systems functioning in the aftermath of a disaster	

Multi-dimensional Approach to Geohazard Risk Management: Landscape Perspective



Building a resilient transport network by incorporating:

- people
- environment
- hydrology
- geology
- transportation infrastructure

Traditional approach:
reactive and remediates hazards as they occur

Proactive approach:
evaluates hazards,
monitors the network
manages the infrastructure

can result in 60-80% life-cycle cost savings



ROAD GEOHAZARD RISK MANAGEMENT HANDBOOK



ROAD GEOHAZARD RISK MANAGEMENT

APPENDIX A: TERMS OF REFERENCE

Geohazard Risk Management Objectives



One

Improve understanding of geohazard risk through:

- ✓ Better institutional coordination
- ✓ Disaster-Resilient Infrastructure Life Cycle Approach
- ✓ Risk-based Transport Asset Management



Two

Minimize risk on:

- ✓ New roads alignment
- ✓ Realignment of existing roads
- ✓ People, infrastructure asset, and environment



Three

Protect people through:

- ✓ Early warning systems
- ✓ Precautionary road closures
- ✓ Emergency preparedness and response services

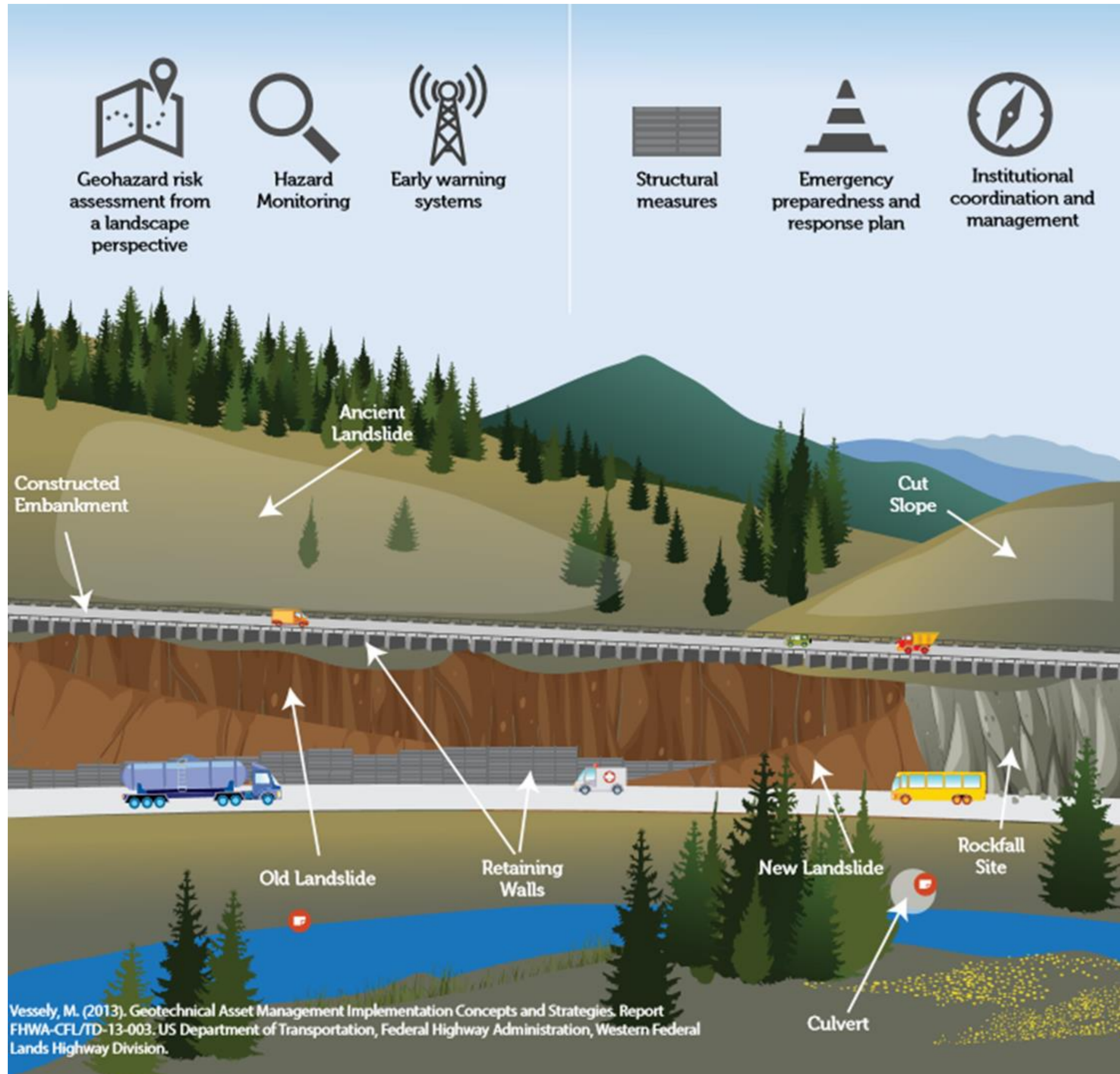


Four

Planning for:

- ✓ Risk financing and insurance
- ✓ Efficient recovery and reconstruction
- ✓ Build Back Better

Transport Asset Management includes:

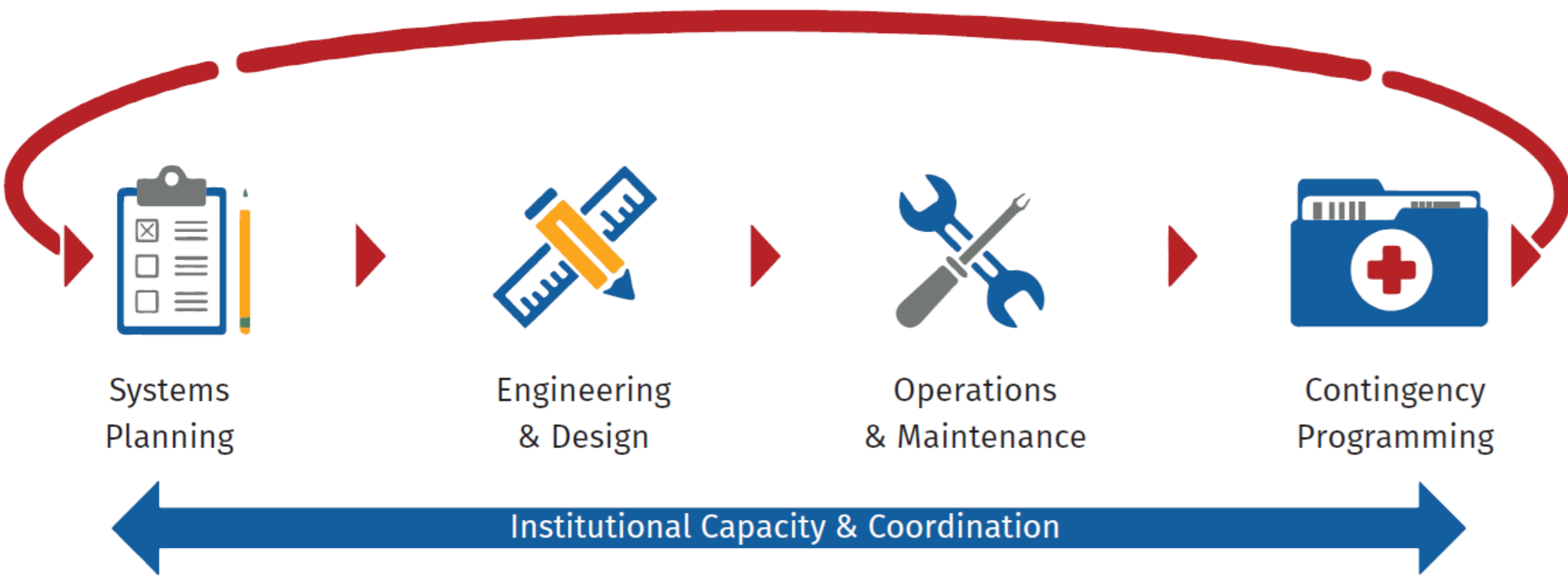


- Geohazard risk assessment from landscape perspective
- Hazard monitoring
- Early warning system
- Structural measures
- Emergency preparedness and response plan
- Institutional coordination and management

Main Handbook

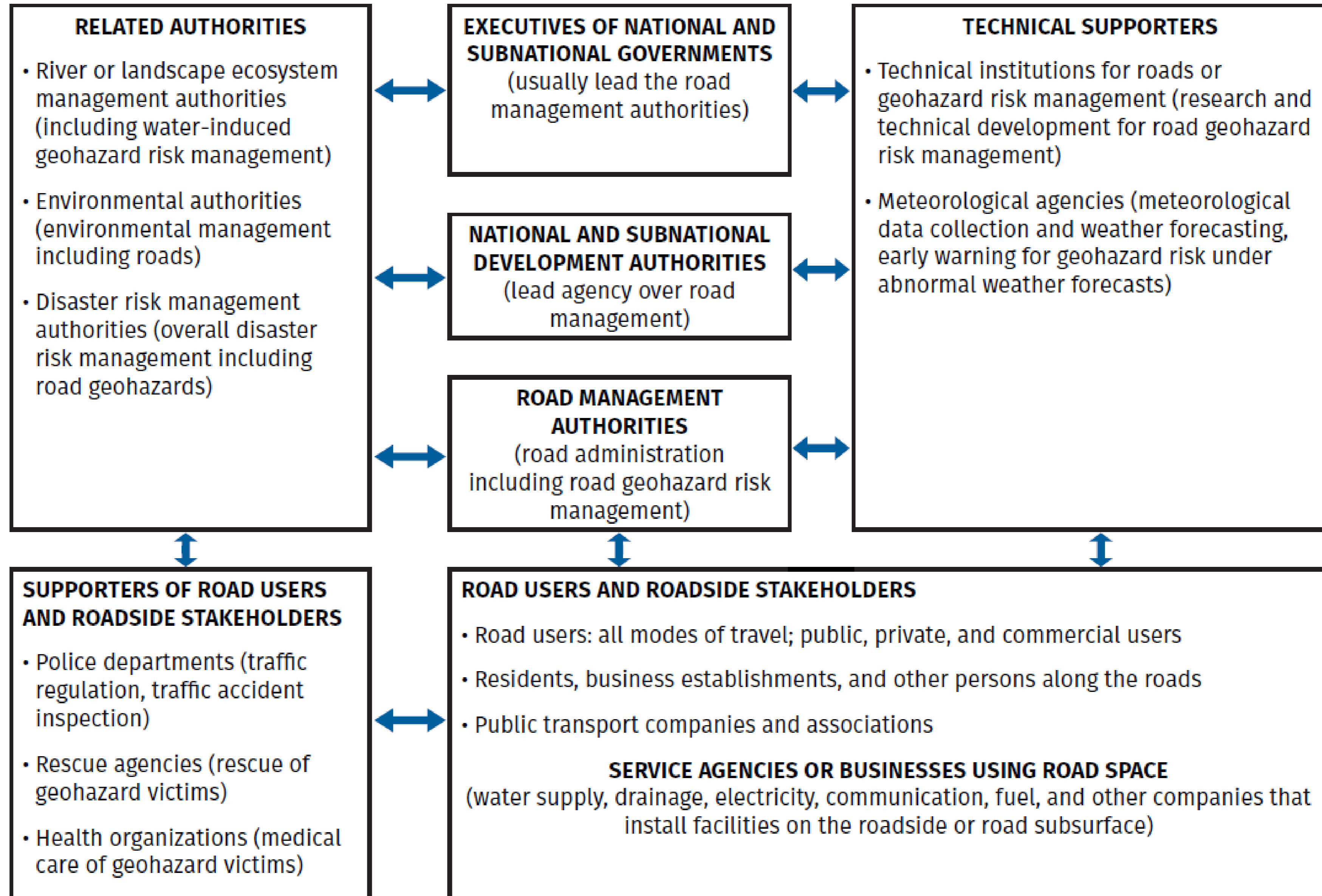
Appendix A (Model ToRs)

PART OF HANDBOOK	KEY CONCEPTS	TERMS OF REFERENCE (TOR) (REFER TO APPENDIX A)
<i>Part II:</i> Institutional Capacity and Coordination	Institutional setup <ul style="list-style-type: none"> • Laws, regulations, and technical standards • National or subnational plans or strategies • Mechanisms for implementation 	ToR 1: Institutional Capacity Review and Target Setting
<i>Part III:</i> Systems Planning	Risk identification, assessment, and evaluation of geohazard Disaster awareness	ToR 2: Systems Planning: Risk Identification, Assessment, and Evaluation ToR 3: Development of Manual for Promotion of Road Disaster Awareness and Partnership
<i>Part IV:</i> Engineering and Design	Geohazard risk management planning <ul style="list-style-type: none"> • For new roads • For existing roads 	ToR 4: Design of Structural Measures
<i>Part V:</i> Operations and Maintenance	Operations and maintenance of engineered solutions Nonengineered solutions Asset management as a response	ToR 5: Development of Manual for Operation and Maintenance for Road Geotechnical Assets, and Implementation of a Road Geotechnical Asset Management Information System (AMIS) ToR 6: Development of Emergency Information System
<i>Part VI:</i> Contingency Programming	Postdisaster response and recovery	ToR 7: Development of Manual for Postdisaster Response and Recovery



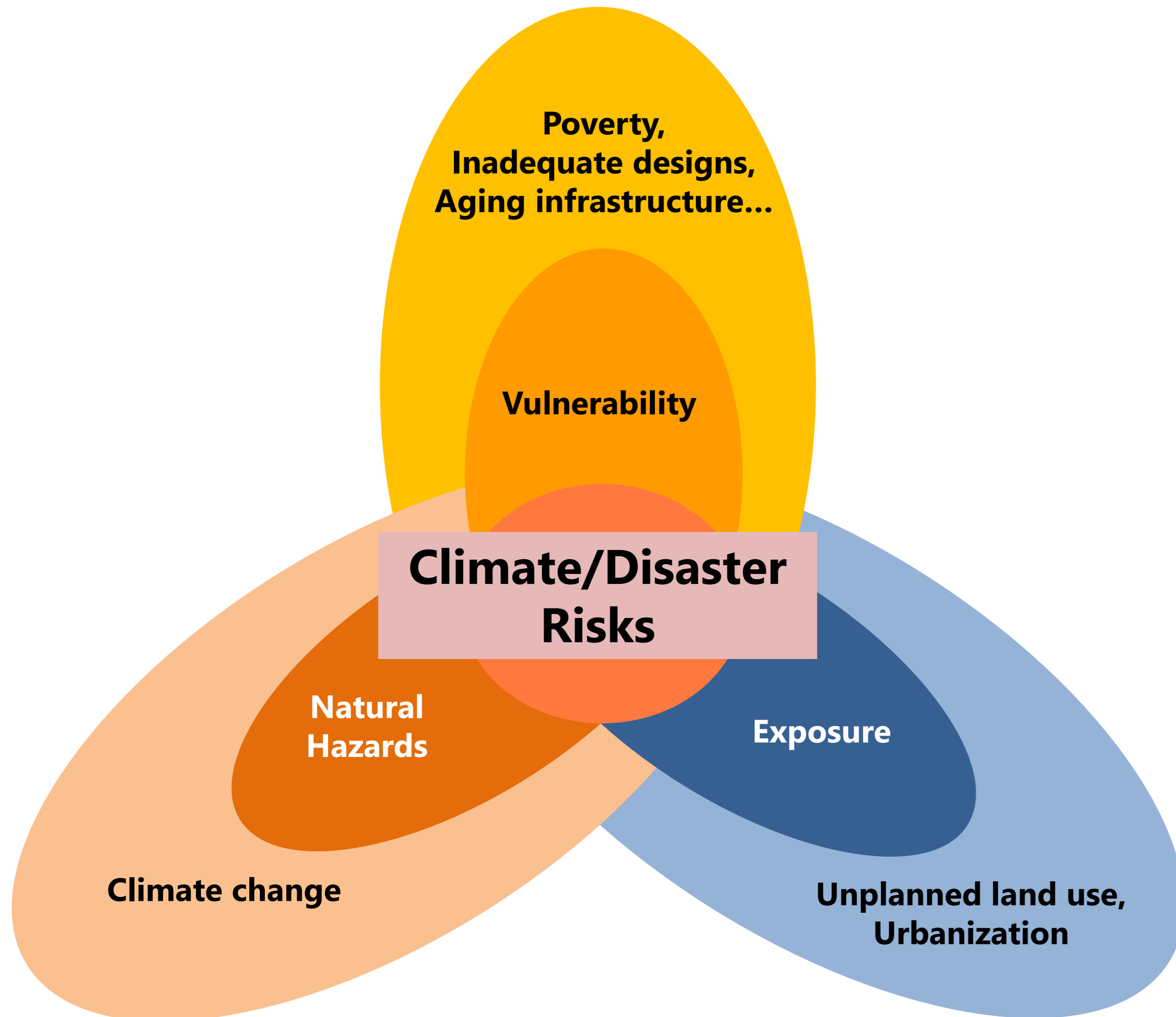
1. Institutional Capacity and Coordination

Structure of Institutions and Stakeholders in Coordination Mechanisms for Road Geohazard Risk Management



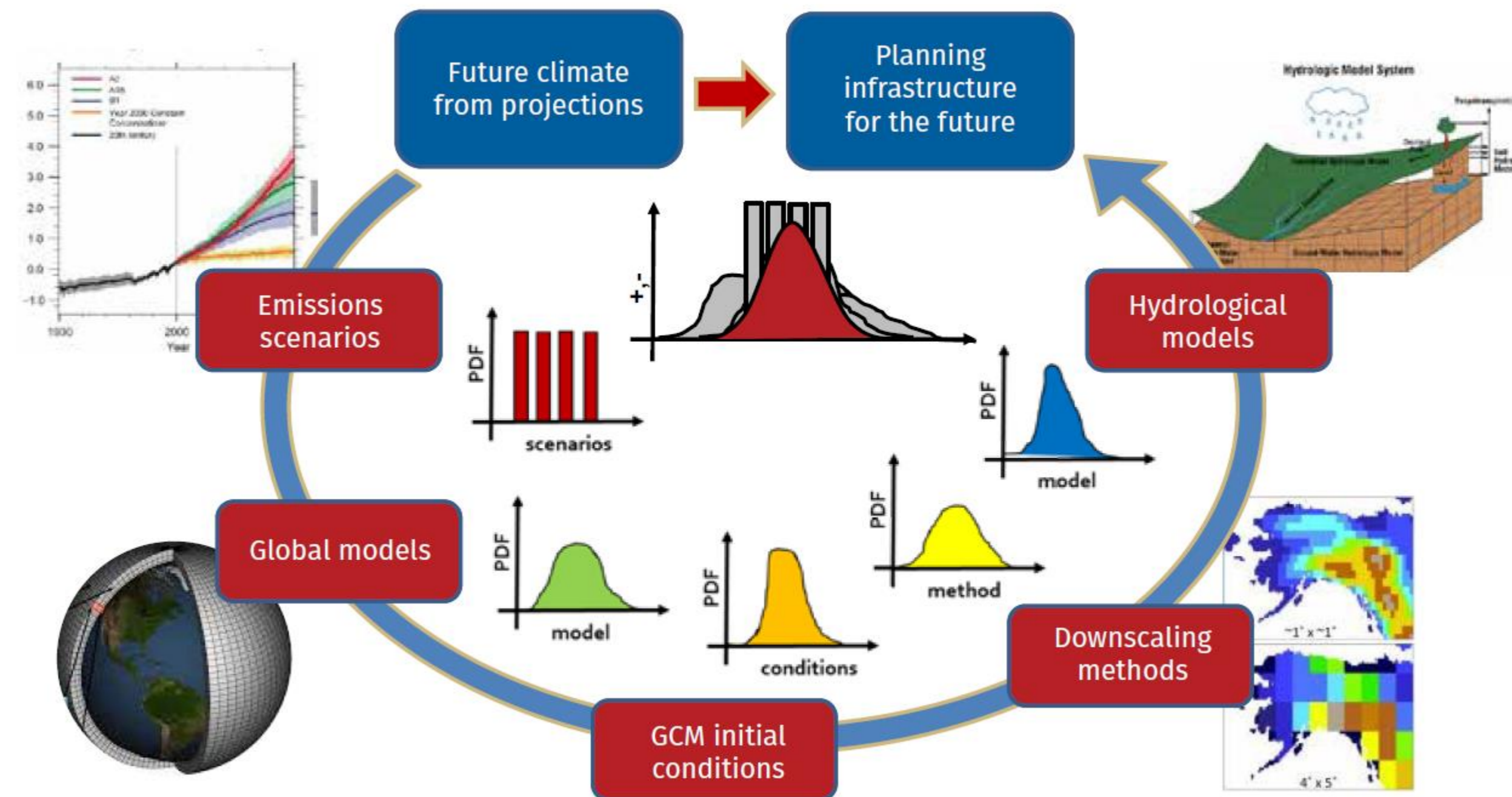
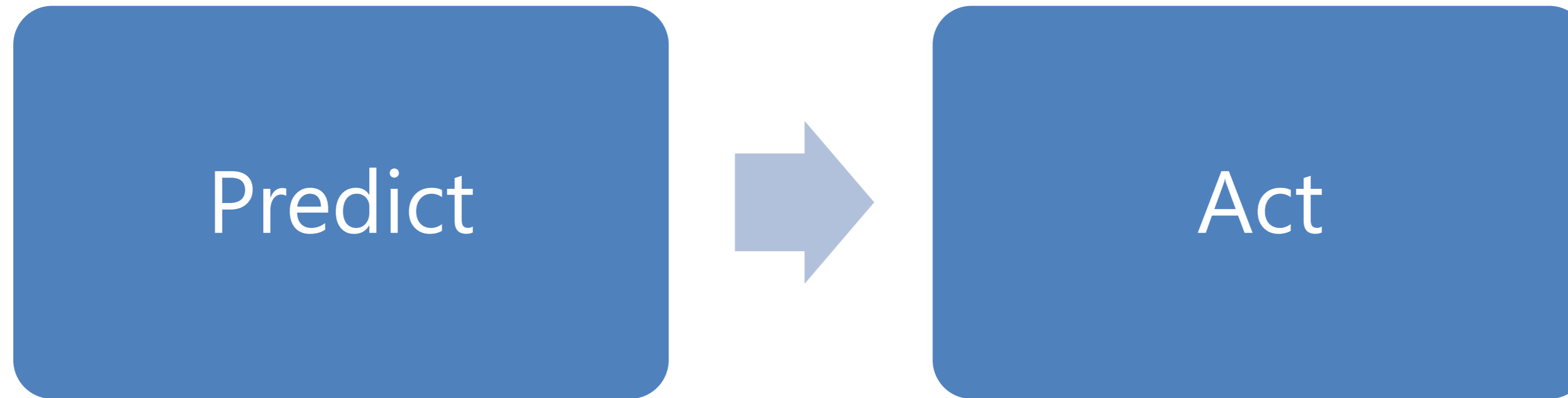
2. Systems Planning

Understanding the fundamental equation of risk



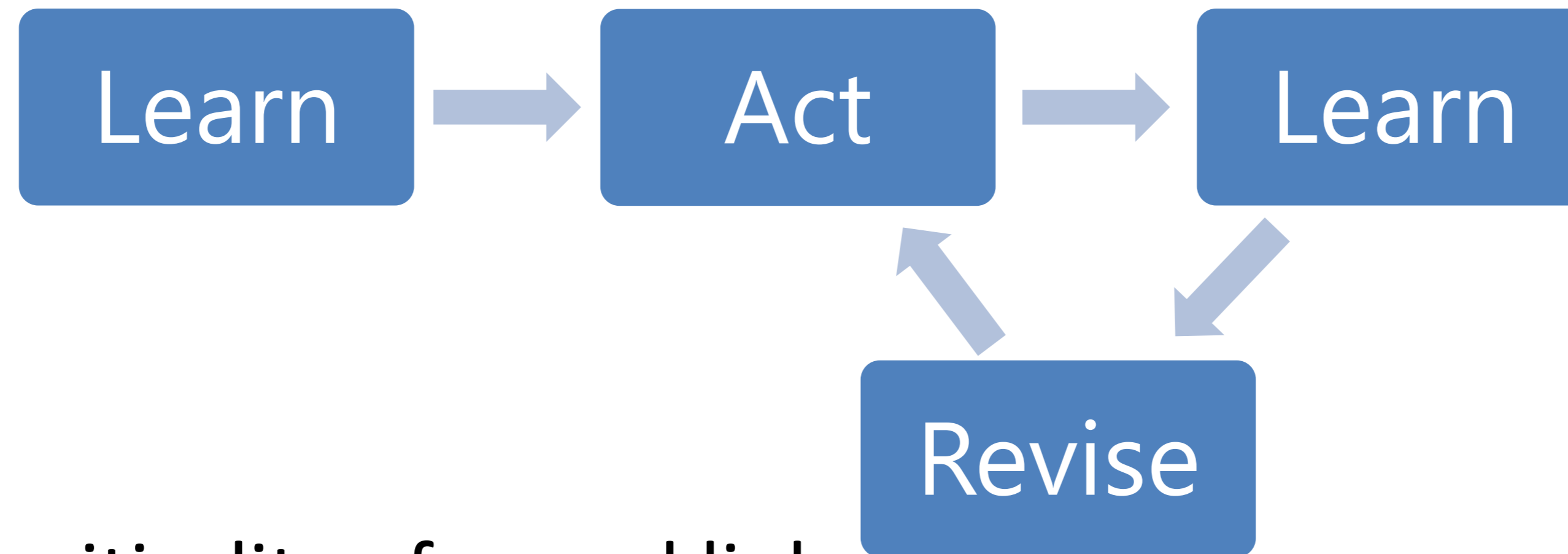
2. Systems Planning

The traditional way of making decisions

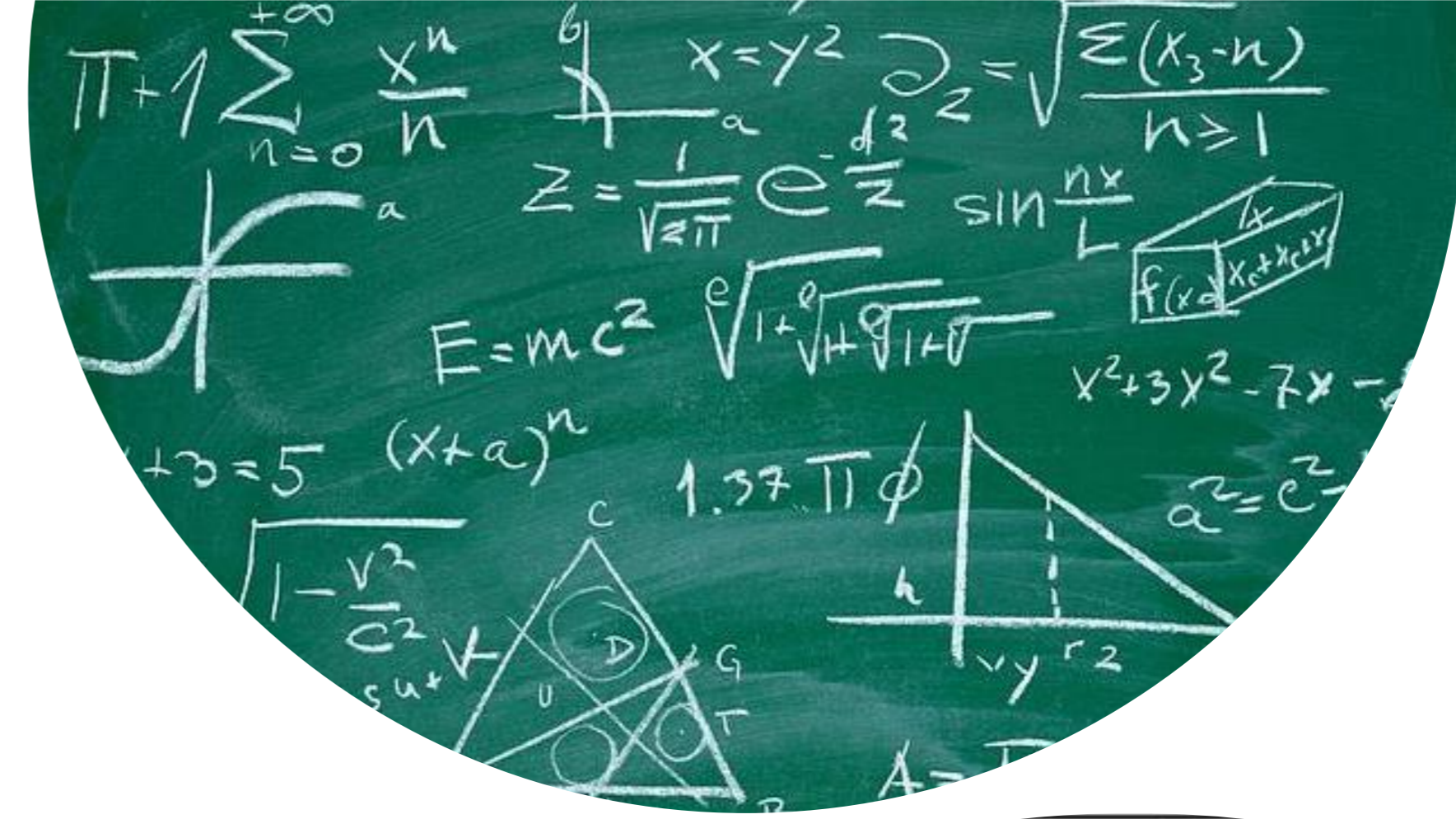


2. Systems Planning

Decision Making under Deep Uncertainty (DMDU)

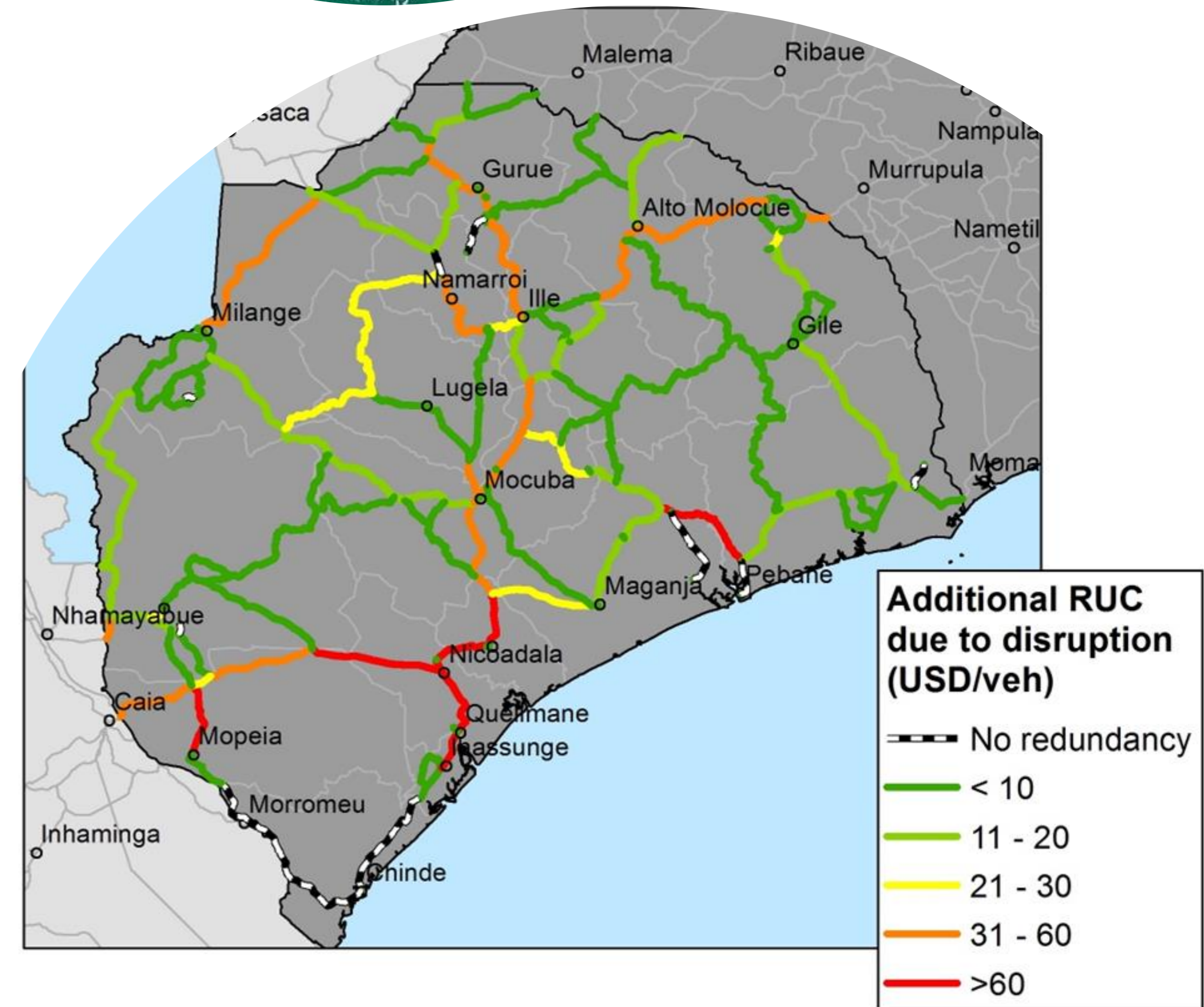


1. Determine the criticality of a road link
2. Determine the exposure of the road link to geohazard events
3. Determine the vulnerability of the road link to geohazard events
4. Determine the risk to the infrastructure (expected annual damage to the infrastructure)
5. Calculate the resultant priority of the road link.



WB developed a model for Mozambique to:

- Quantify network criticality
- Estimate flood damage to infrastructure
- Estimate network disruption from floods
- Quantify costs and benefits from interventions
- Identify uncertainties



3. Engineering and Design

- Innovative materials, design standards and specifications that enhance robustness and flexibility of infrastructure
- Conducting hazard assessment of project site to identify and reduce risks of and around infrastructure.
- Conducting infrastructure level vulnerability assessments to identify points of weakness and identify what preventative measures and response mechanisms could be put in place to reduce the likelihood of failure or for ensuring safe failure.



Conduct geotechnical studies



Update Design Codes and Standards



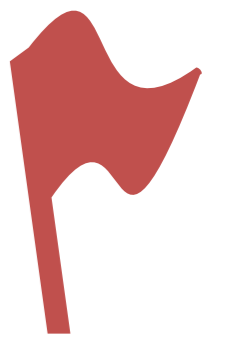
Design for Safe Failure



Identify Alternative Materials



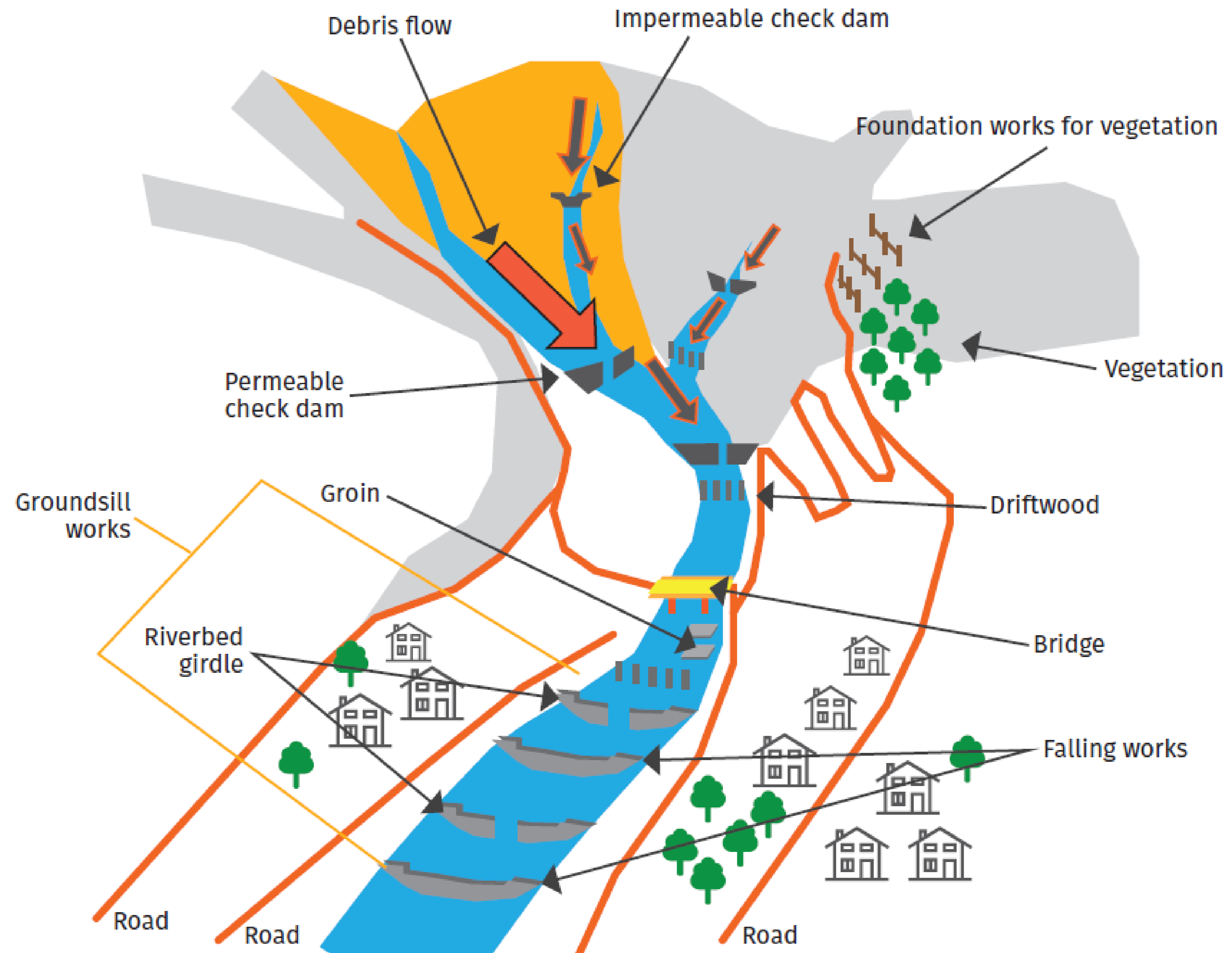
Strengthen Industry Capacity



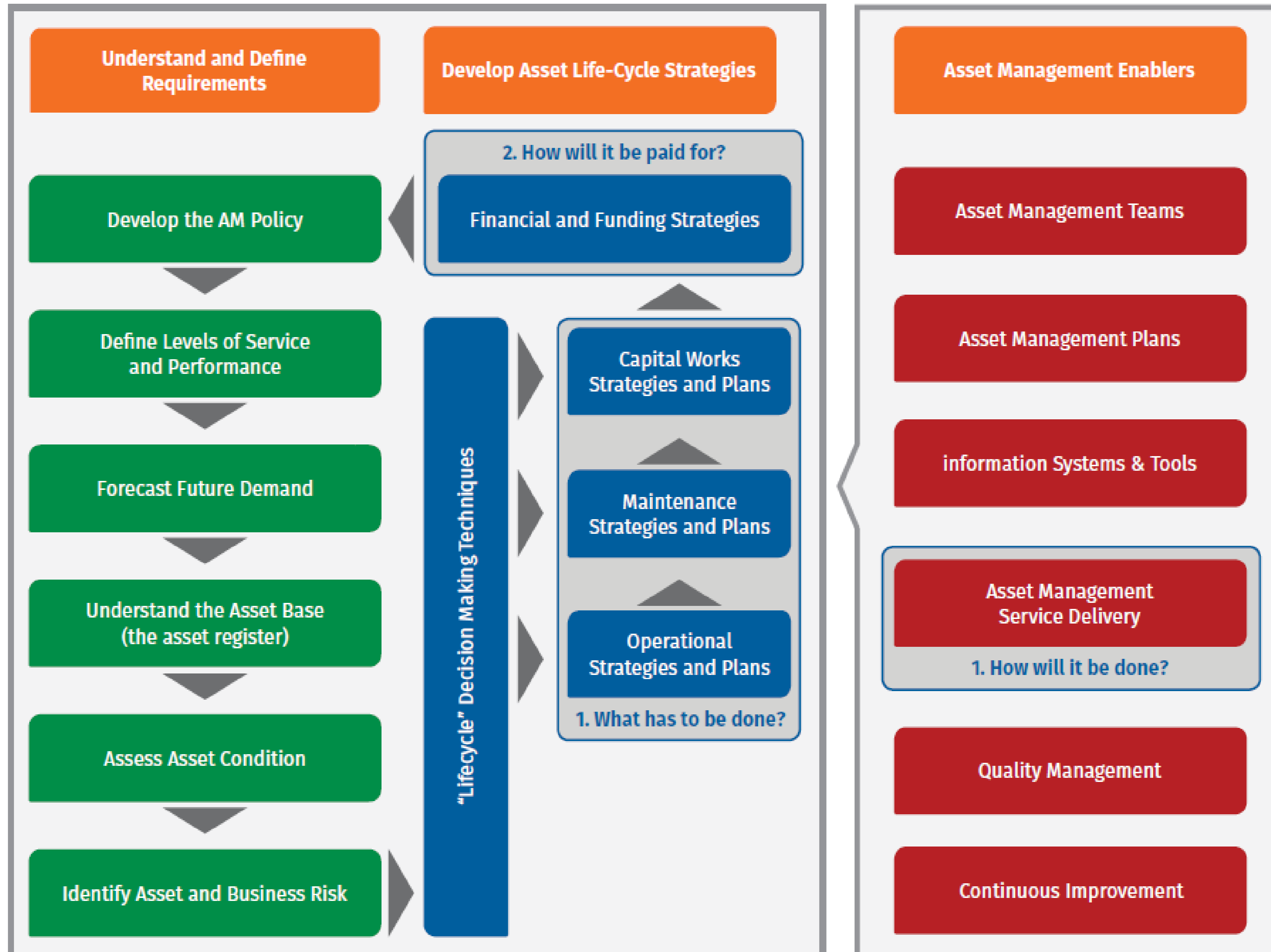
Consider Lifecycle Costs

3. Engineering and Design

Landscape Ecosystem Management Facilities to Mitigate Road Riverside Erosion and Flow-Type Geohazards



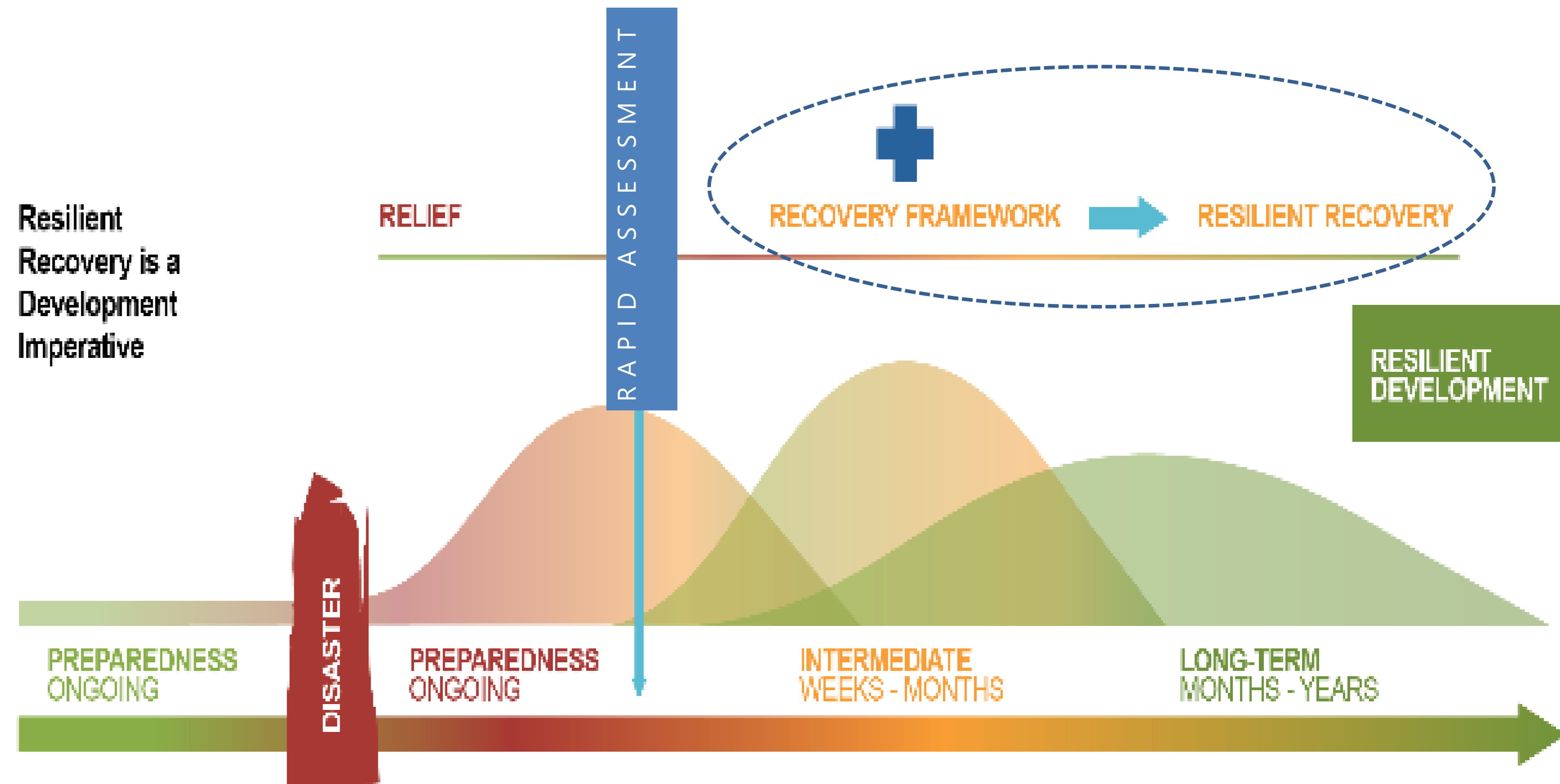
4. Operations and Maintenance Asset Management Process



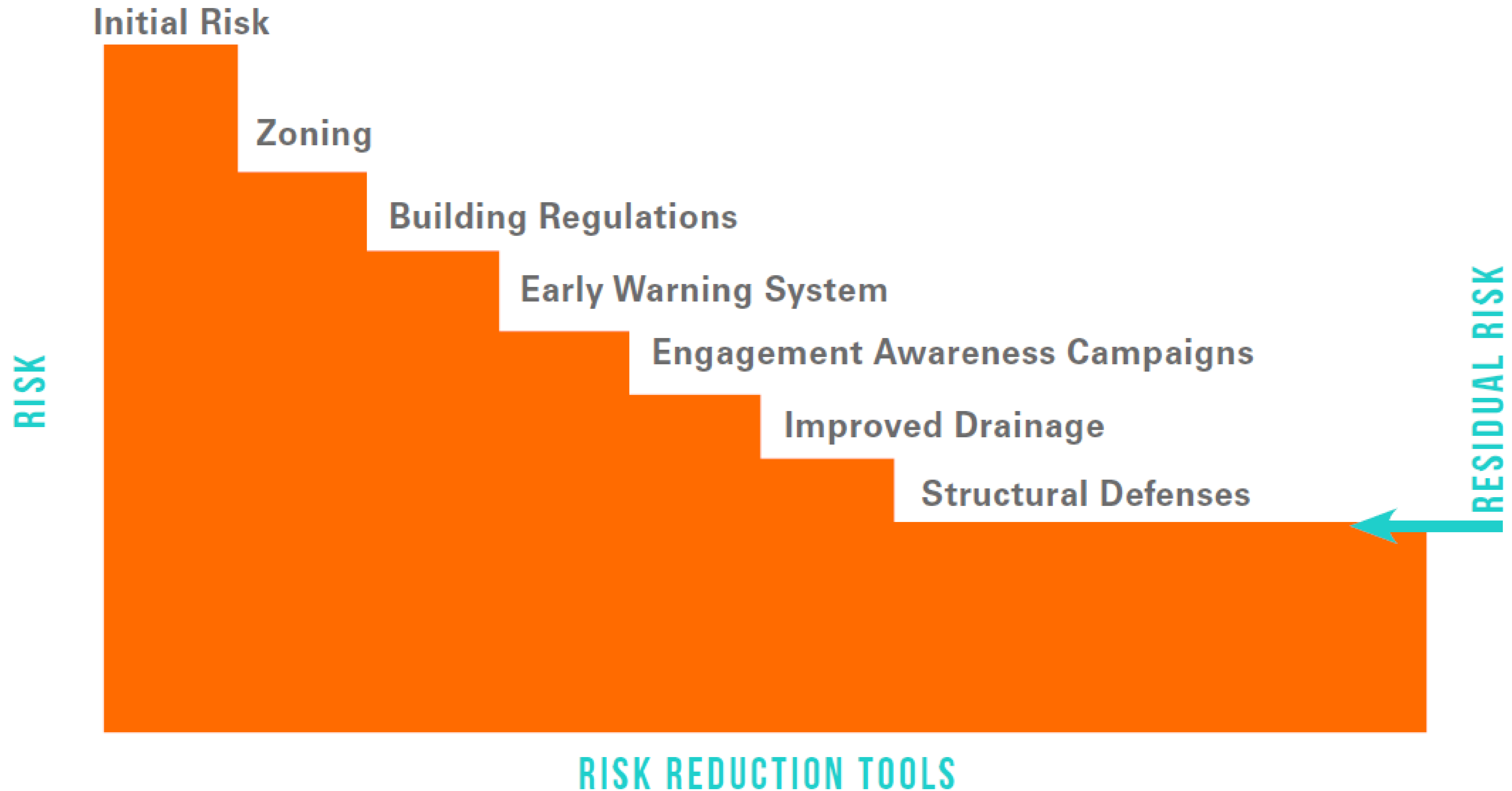
5. Emergency Preparedness, Response, and Recovery

Organize and facilitate inter-sectoral, inter-institutional, multi-stakeholders framed recovery in five key areas:

1. Policy Development for Recovery;
2. Institutional Framework for Recovery;
3. Prioritization and Sequencing of Recovery;
4. Recovery Financing Strategy; and
5. Implementation Arrangements, Monitoring and Evaluation.



Comprehensive Risk Management: “Buying Down the Risk”



Geohazard Risk Management in Transport Sector Community of Practice

The screenshot shows a web browser window displaying the 'Geohazard Risk Management in Transport Sector' community page. The URL in the address bar is <https://collaboration.worldbank.org/groups/geohazard-risk-management-for-transport/overview>. The page features a navigation menu with 'Home', 'Browse', 'My Groups', and 'My Content'. A 'Log in' button is visible in the top right. The main header includes the group logo and the title 'Geohazard Risk Management in Transport Sector', with sub-navigation for 'Overview', 'Activity', 'Content', 'People', 'Projects', 'Calendar', 'Actions', 'About', and 'Share'. A blue banner below the header encourages users to 'Log in to follow, share, and participate in this socialgroup. Not a member? Join Now!'. The main content area is divided into three sections: 'USEFUL LINKS' with logos for GFDRR (Global Facility for Disaster Reduction and Recovery), UNDERSTANDING RISK, and DRM TOKYO Hub; a central welcome message titled 'Welcome to Geohazard Risk Management in Transport Sector Community of Practice!' which states the community's purpose; and a 'SEARCH WIDGET' with a search input field and a 'Search' button. Below the search widget is a 'COUNTRY PROJECTS' section featuring a map of South Asia with labels for Afghanistan, Pakistan, Nepal, Bhutan, India, and Bangladesh. The Windows taskbar at the bottom shows the search bar, several application icons, and the system tray with the date and time '5:23 PM 1/20/2018'.

<https://collaboration.worldbank.org/groups/geohazard-risk-management-for-transport>



THANK YOU

Transport Asset Management: Geohazard Perspective

Geohazard Perspective: Transport Asset Management



Orange: People

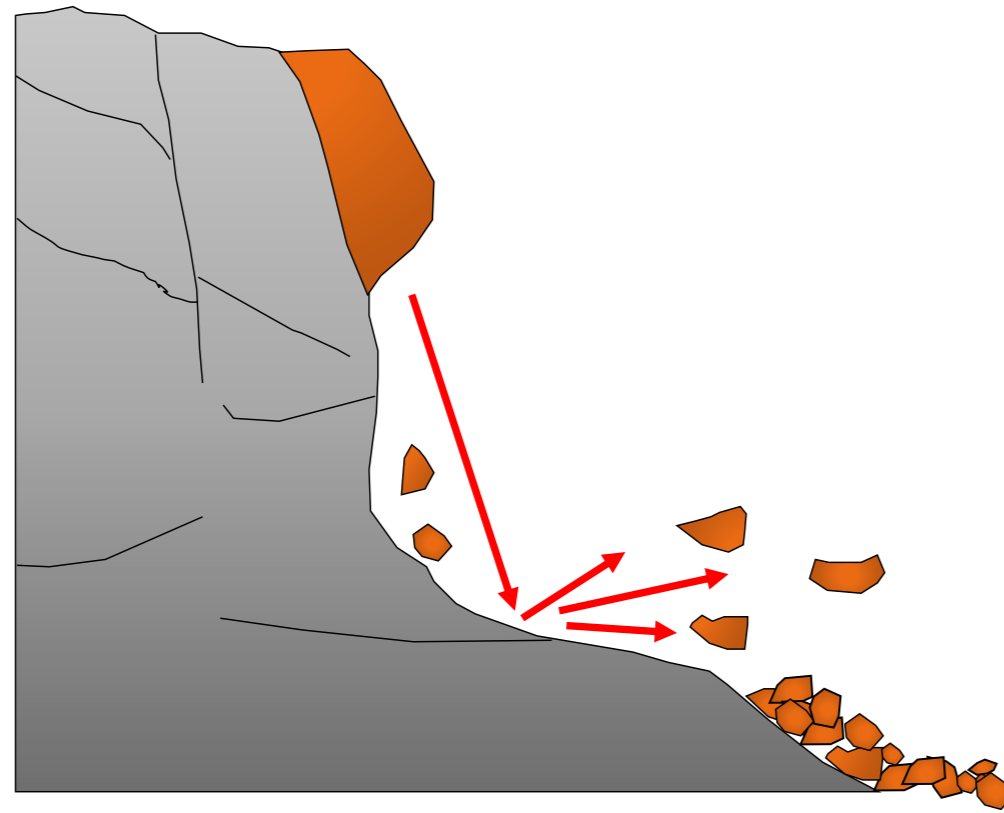
**Brown: Soil properties and
Geology**

Blue: Hydrology

Green: Ecology

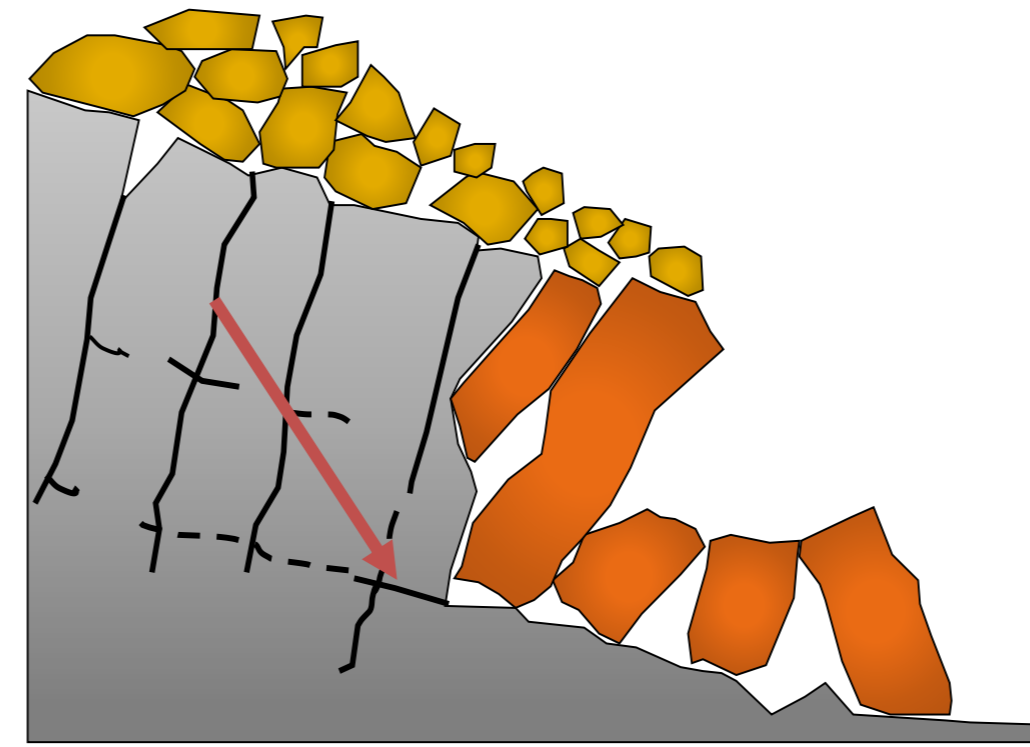
Grey: Infrastructure





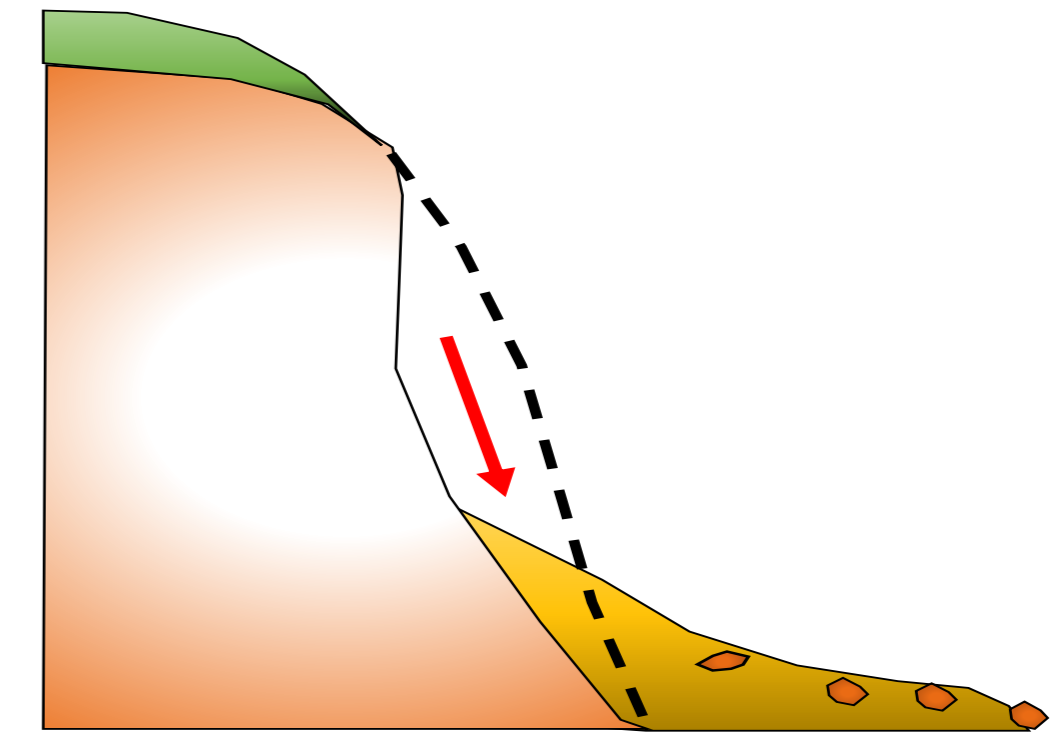
Fall (rockfall)

a rapid gravity free fall movement of a mass of rock or soil



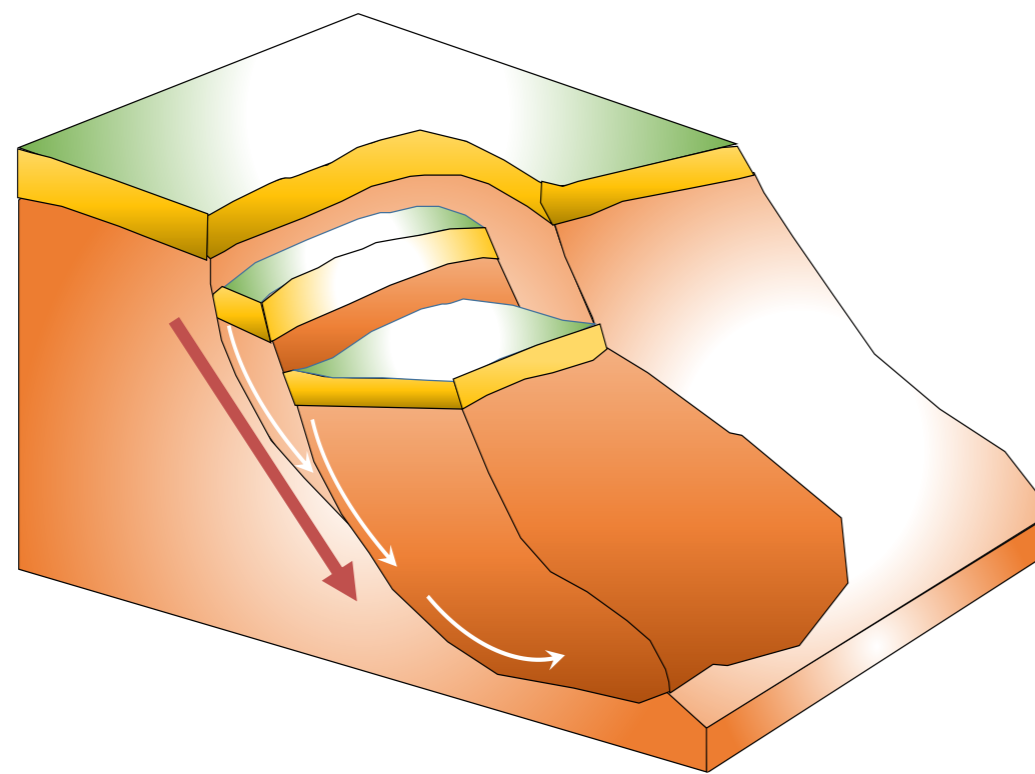
Collapse (Rocks)

a gravity movement of soil or **rock**, often as a result of artificial factors



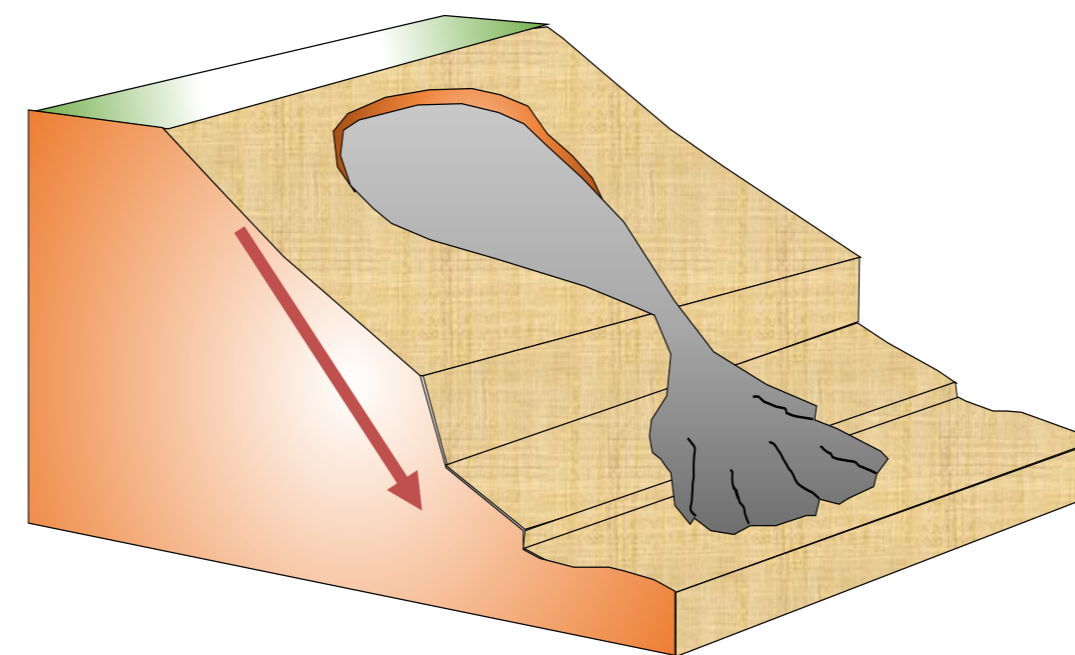
Collapse (Soil)

a gravity movement of **soil** or rock, often as a result of artificial factors



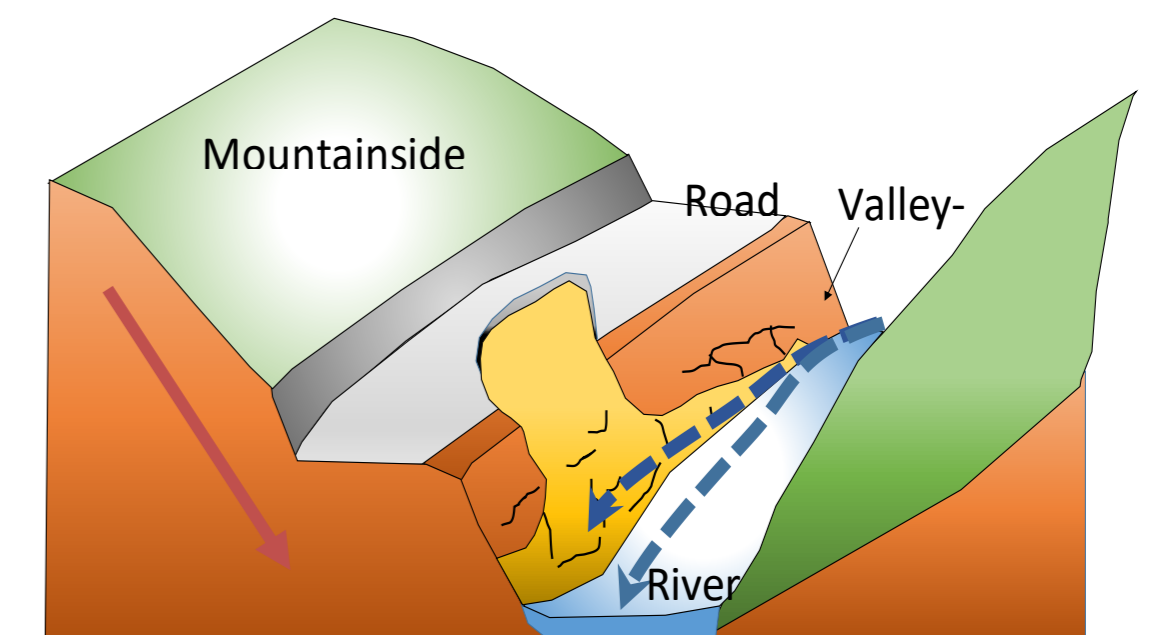
Slide

a mass movement of earth, snow, or rock under shear mode along one or several sliding surfaces



Flow

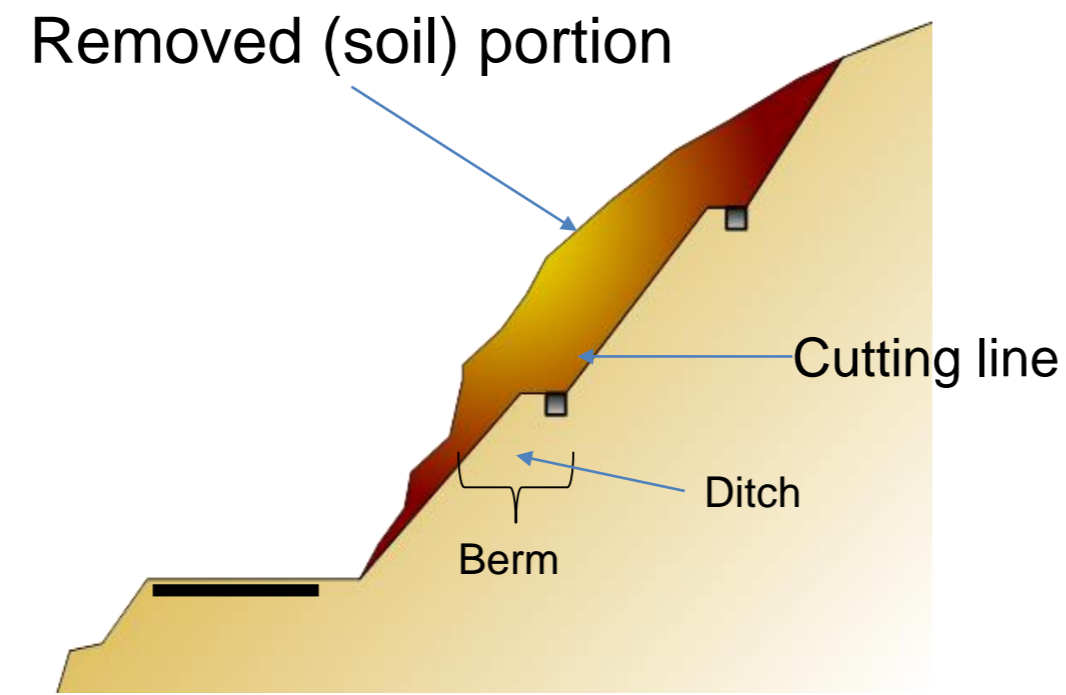
a movement that exhibits a continuity of motion and a plastic or semifluid behavior with water



Erosion (River Erosion)

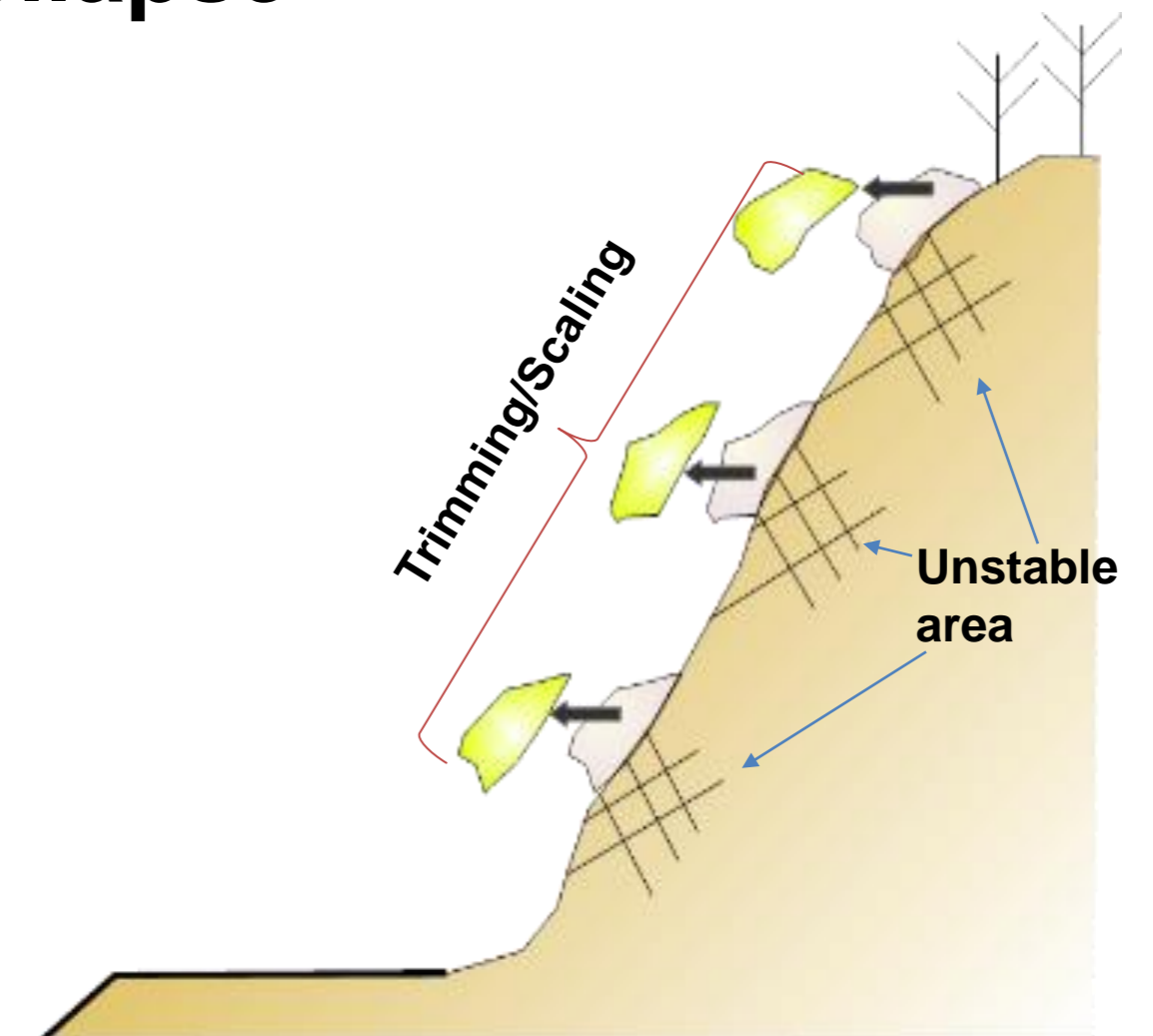
a movement of rock fragments or soil particles from one place to another usually by water

Typical Structural Measures for Mountainside Fall or Collapse

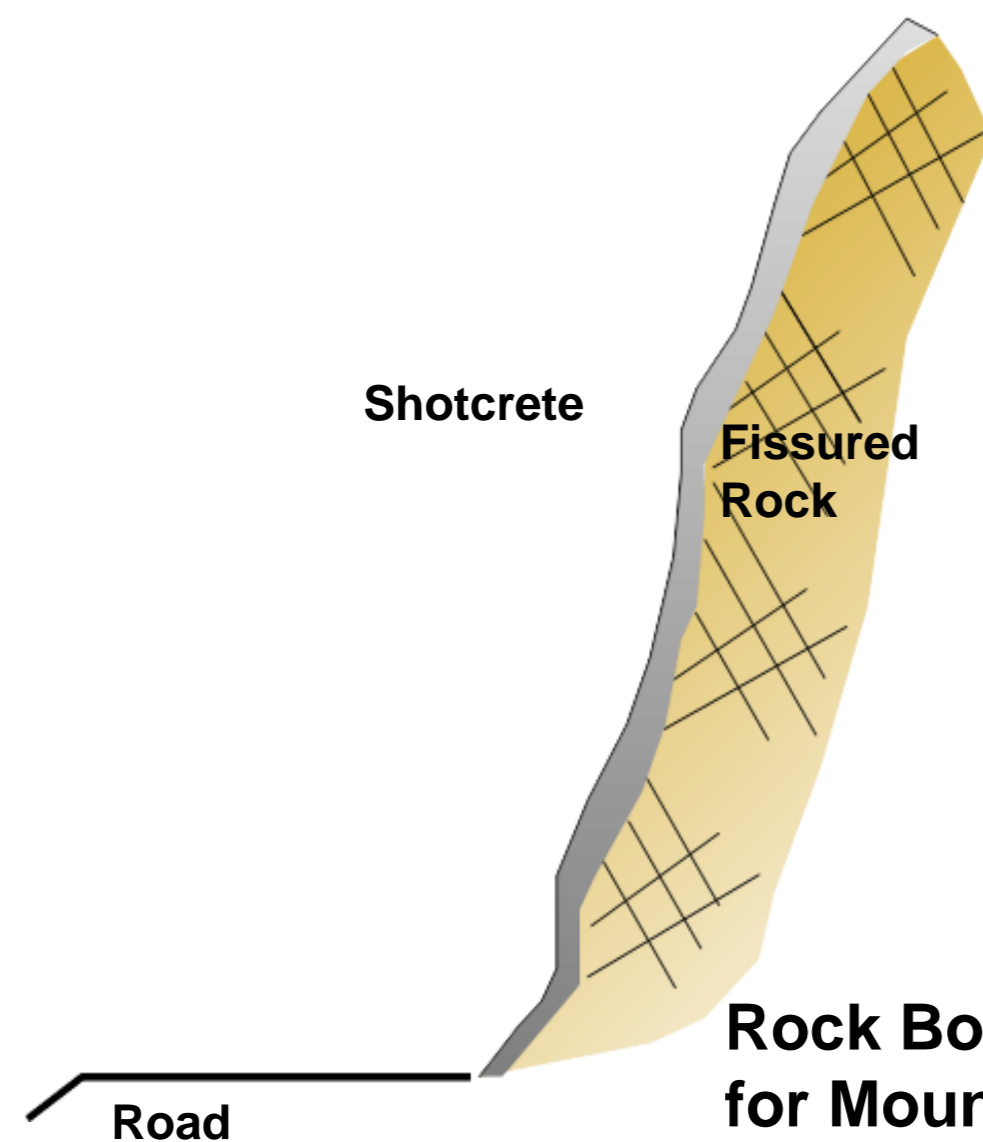


Slope cutting

Slope Cutting or Removal

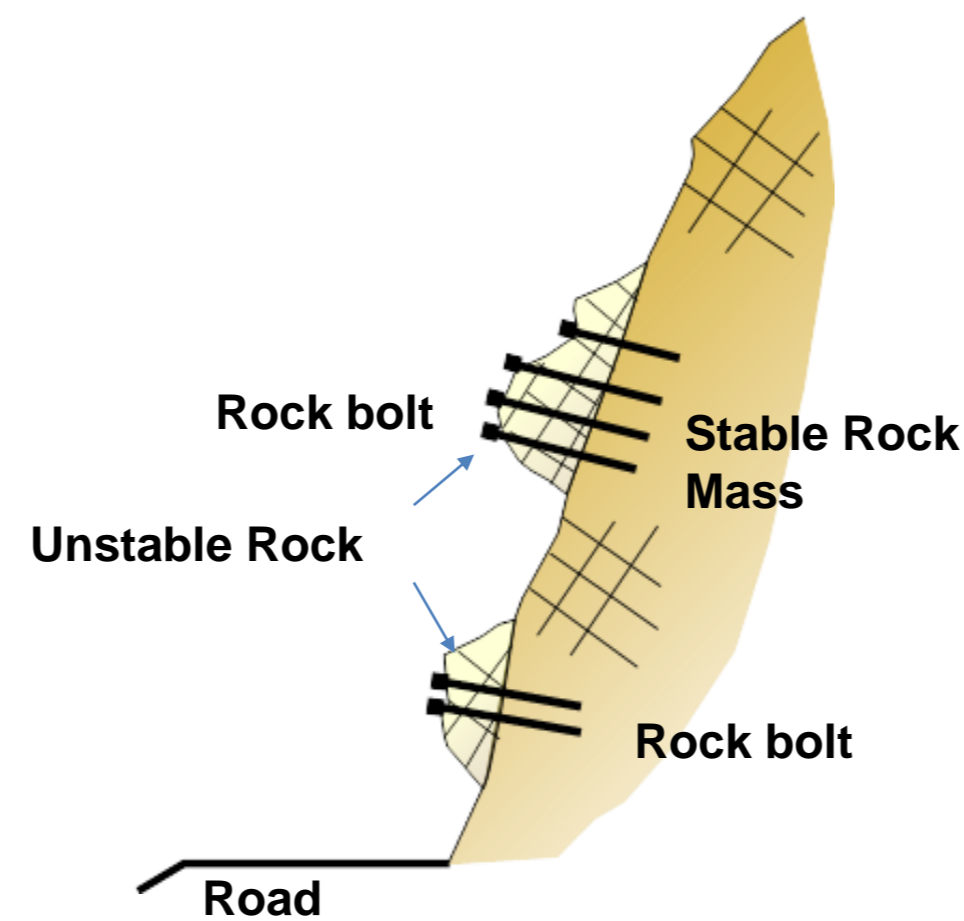


Removal

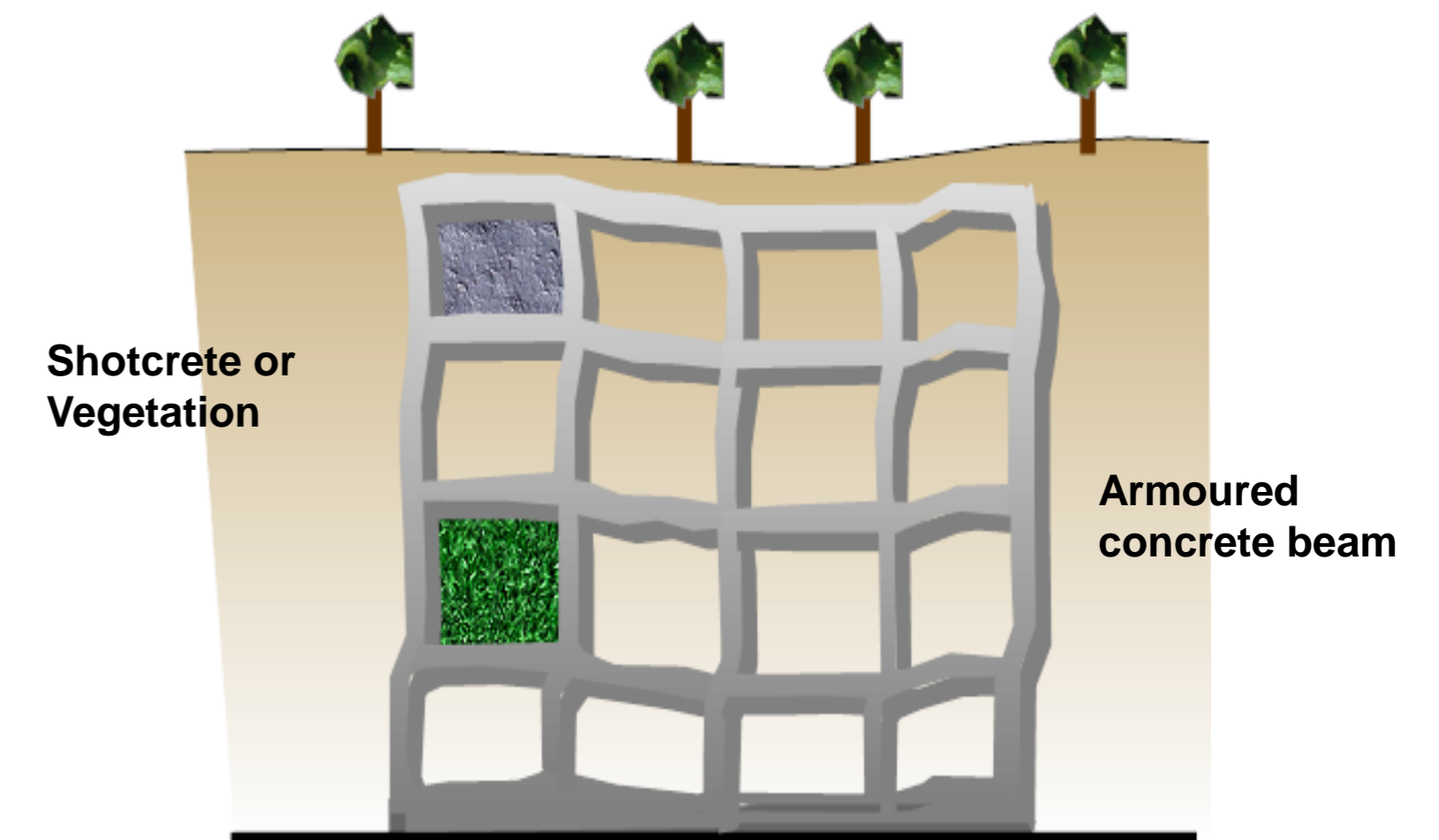


Shotcrete (spraying)

Rock Bolting and Shotcrete for Slope Reinforcement for Mountainside Fall or Collapse



Rock bolting



Framework (Grid Beam)

Slope Framework (Grid Beam) for Slope Reinforcement for Mountainside Fall or Collapse