Coastal Systems Resilience (CSR) R&D

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Regional Sediment Management
In Progress Review
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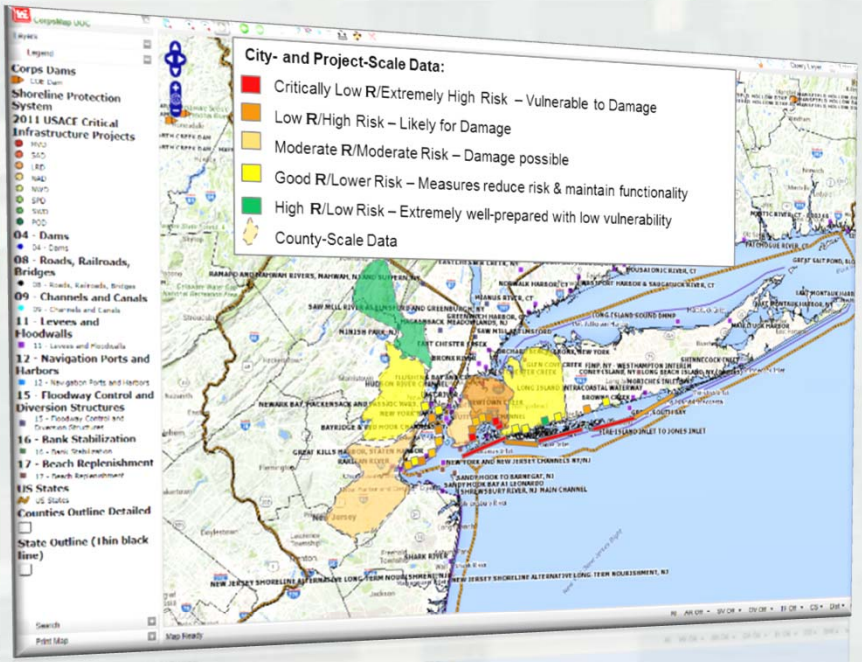
Outline

- Bottom Line Up Front: Vision for end-goal product
- Motivation: Why CSR R&D is needed
- Overview: Snapshot for CSR research initiated
- Definitions: What is resilience?
- Analysis: Assessing the magnitude of resilience
- R&D: Summary of research initiated
- RSM: How Regional Sediment Management supports resiliency
- Conclusions: CSR R&D needs your input

Bottom Line Up Front

*Goal of CSR Research**

**subject to revision!*



At the conclusion of the CSR R&D, goal is to provide Districts…

- GIS-based tool to analyze CSR

Linking…

- USACE Databanks
- Empirical & analytical relationships
- Numerical model information
- Partner data, methods via Webservices

To create….

- Tools to integrate user input, data and calculations

…based priorities
…are scalable (*project-community-region*); and

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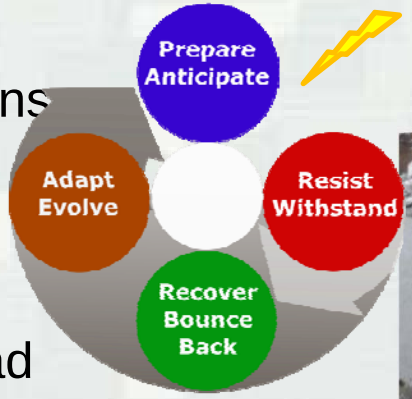
Motivation: Coastal Sys Resilience (CSR)

- Presently coastal resilience is:
  - A qualitative term in many applications
  - Applied with varied meanings
  - Primarily local (project) scale



- So-called ‘resilient’ solutions:
  - May be resilient in name only, instead addressing risk or vulnerability
  - May be based on subjective input
  - May not consider *system functioning* *(e.g., project may perform well but system as a whole fails)*
  - Lack planning, design & maintenance guidance
  - Are difficult to justify (i.e., cost, design features, O&M)
- Districts need methods to *quantify* coastal <u>system</u> resilience
  - For the integrated system including community and ecosystem function
  - For storm damage reduction, environmental, and navigation infrastructure
  - As applied to Planning, Design, O&M

Overview: CSR R&D

- Initiated in FY16
- Research within three business lines
  - **Navigation (NAV):** Dr. Kate Brodie, CHL; Jackie Keiser, RSM CX; Nick Spore, CHL; Dr. Bilal Ayyub, *Univ. of Maryland;* Dr. Austin Becker, *Univ. of Rhode Island;* Dr. Meg Palmer, *Naval Research Laboratory*
  - **Environmental (ENV):** Dr. Candice Piercy, EL; Dr. Jesse McNinch, CHL; Dr. Todd Swannack, EL; Dr. Bradley Johnson, CHL, Katherine Touzinsky, CHL
  - **Flood Risk Management (FRM):** John Childs, EL; Cate Fox-Lent, EL; Dr. Candice Piercy, EL; Dr. Brett Webb, *Univ. of South Alabama*
- Contributors
  - Committee on the Marine Transp. System's Resilience Integrated Action Team, NOAA, Naval Research Laboratory, USACE Resilience PDT, Coastal Working Group (CWG), American Shore and Beach Preservation Association (ASBPA), LRP, SAB, NAE, Assateague Island National Seashore, Planning CX, NACCS, MsCIP, LACPR

Definitions of Resilience

Study	Definition
American Society of Civil Engineers (2006) http://www.asce.org/Content.aspx?id=8478	"Resilience refers to the capability to mitigate against significant all-hazards risks and incidents and to expeditiously recover and reconstitute critical services with minimum damage to public safety and health, th d national security."
National Disaster Recovery Framework, Strengthening Disaster Recovery for the Nation (FEMA 2011) http://www.fema.gov/media-library/assets/documents/24647?fromSearch=fromsearch&id=5124	A resilient community has … respond to and recover from disasters."
The Infrastructure Security Partnership and Society of Military Engineers (SAME). "Understanding Resilience – Disaster Resilience Begins with You" (2012)	Disaster Resilience is…"the capacity, rapidly with limited damage."
Disaster Resilience 2012)	"Resilience successfully adapt to adve
Hurricane Sandy Region (2013) http:// df	"The ability to recover rapidly from
Infrastructur http://coastalm pdf	"Ability to disruption due to emerge
Coastal Army http://www.corpsclimate.us/docs/US S_201	"The ability to and to withstand a
Urban Land Resilience and Docu	"The capac before the event."
Presidential http://www.whitehous prepar	"Resilience means the ability ng conditions and withstand, respond to
Rockefeller Foundation (2013) http://www.rockefellerfoundation.org/blog/city-resilient	"The capacity of individu and grow in the face of changes, even ca
Community and Regional Resilience Institute (CARRI) (2013) http://www.resilientus.org/wp-content/uploads/2013/08/definitions-of-community-resilience.pdf	"Community resilience is the capab impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change"
U.S. Army Corps of Engineers Safety of Dams, Policy and Procedures, ER 1110-2-1156 (2014) http://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-1156.pdf	"The ability to avoid, minimize, withstand, and recover from the effects of adversity, whether natural or manmade, under all circumstances of use."
Intergovernmental Panel on Climate Change Fifth Assessment Report, "Climate Change 2014: Impacts, http://ipcc-wg2.go	"The capacity of a social-ecological system to cope with a hazardous event or disturbance, ial function, identity, and g the capacity for p , g, and transformation

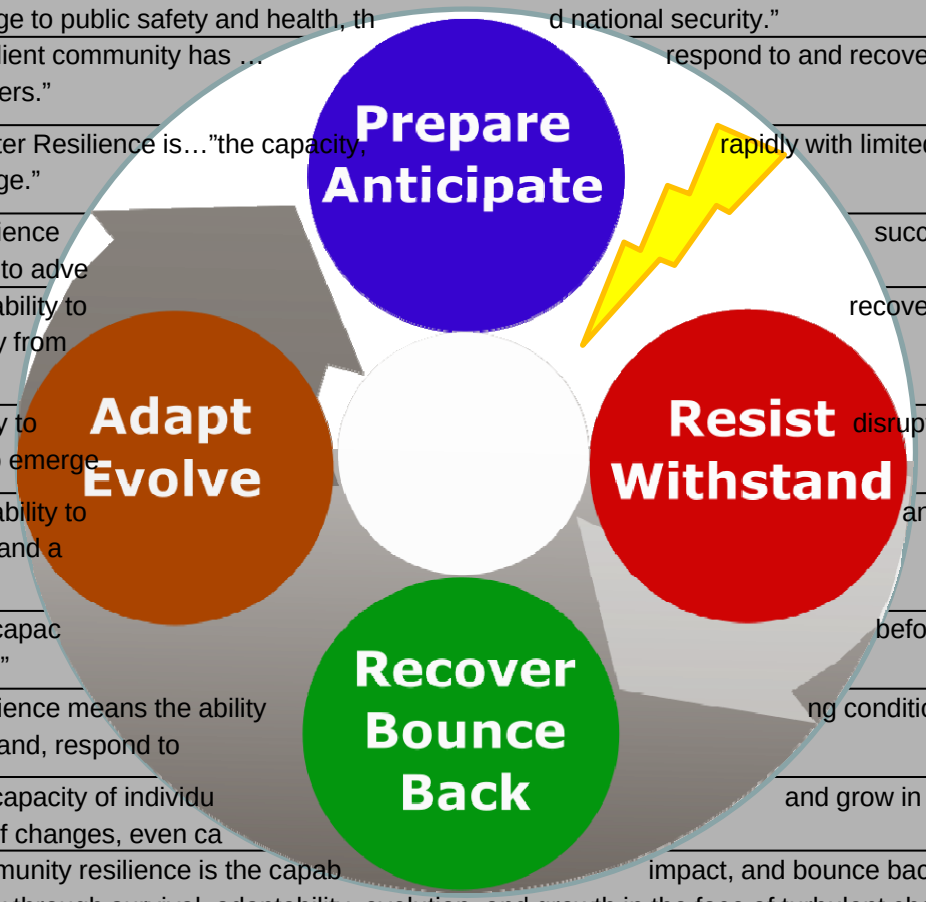
Key words:

Prepare

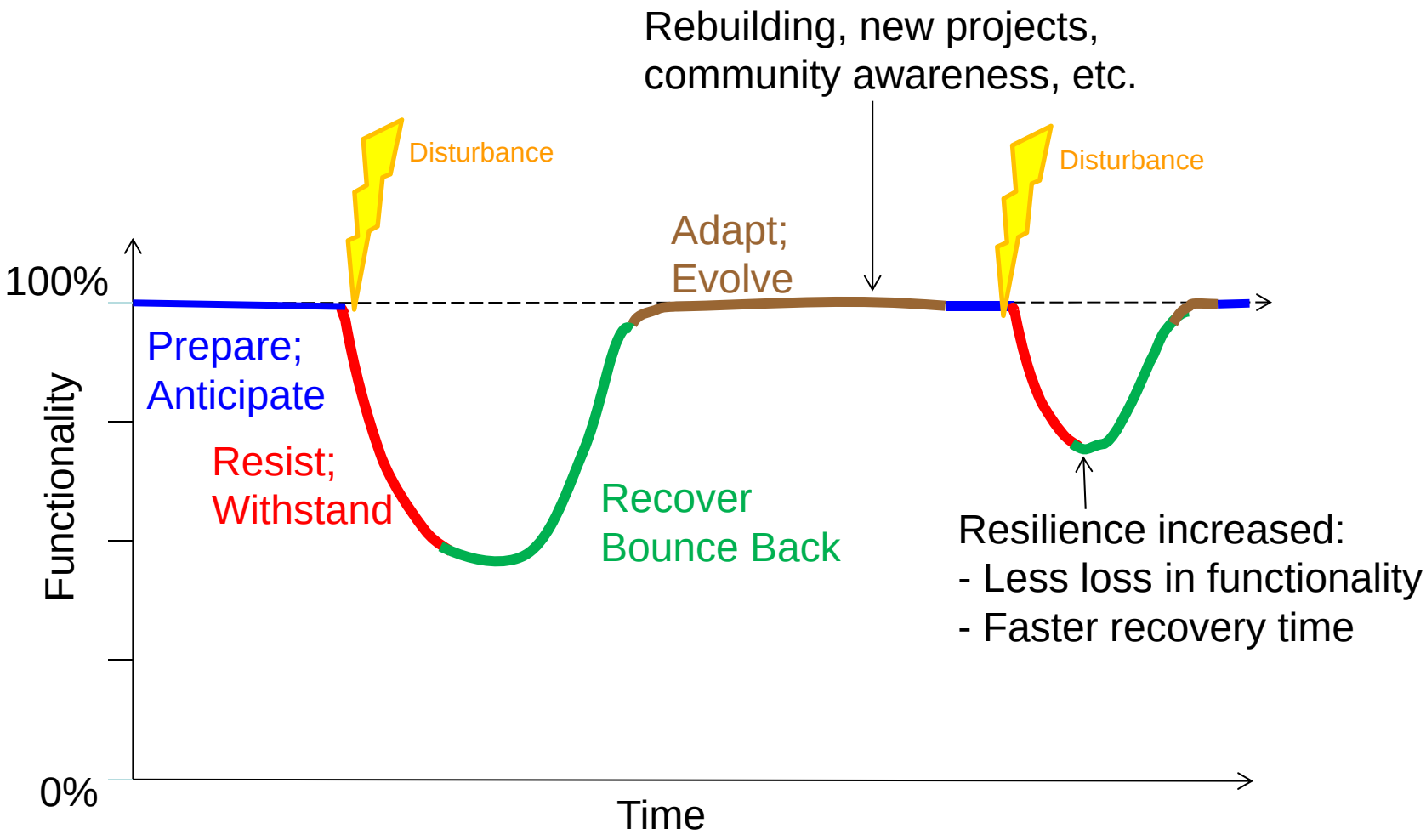
Resist or Absorb

Recover

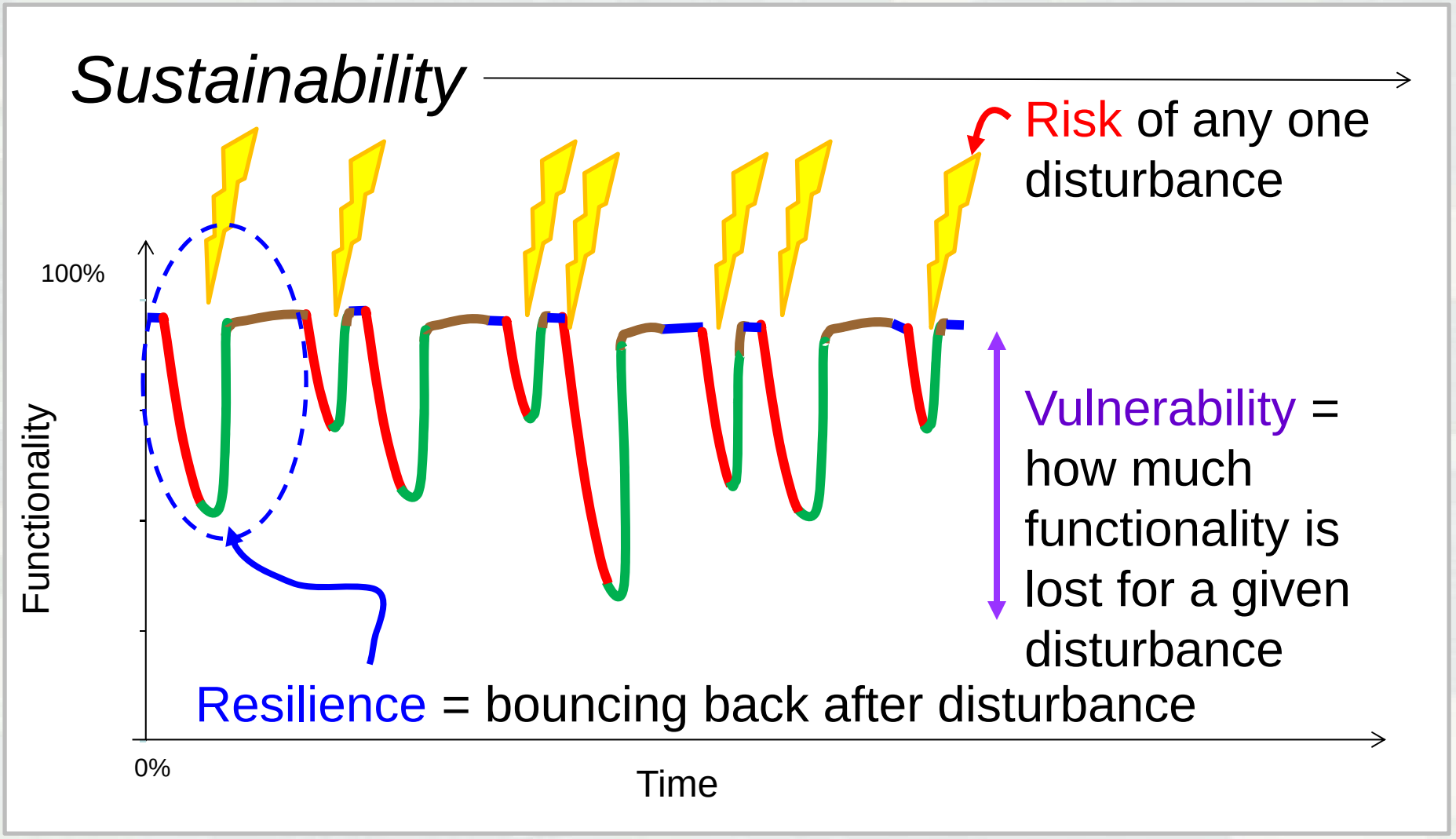
Adapt



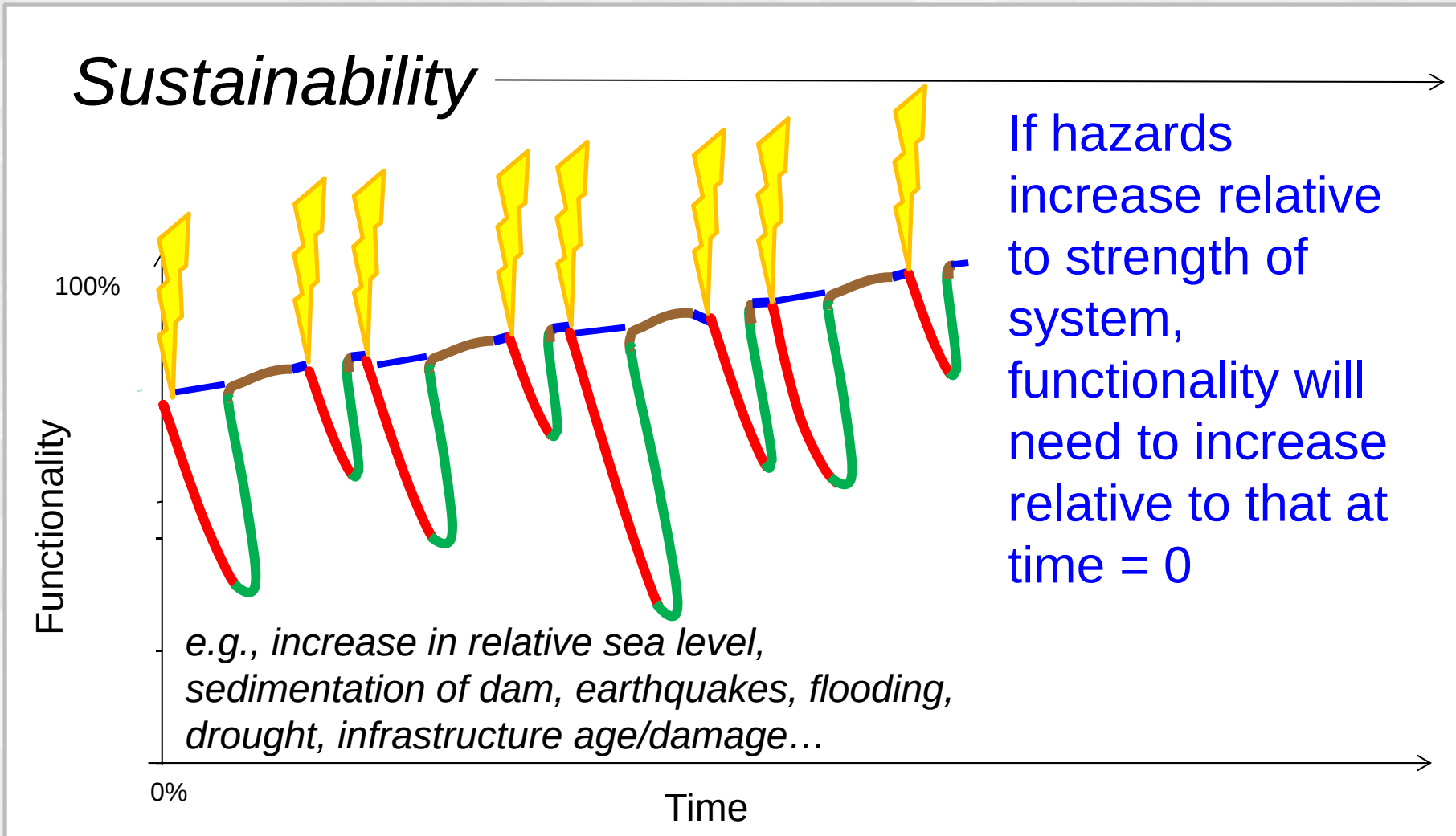
Concepts: Resilience Timeline



Risk, Vulnerability, Sustainability, and Resilience



Risk, Vulnerability, Sustainability, and Resilience with Increasing Hazards



If hazards increase relative to strength of system, functionality will need to increase relative to that at time = 0

Sustainability and Resilience: Complementary Concepts

Sustainability

- Goals are based on a predicted or desired future condition
- Focuses on overall health and persistence of the system

Resilience

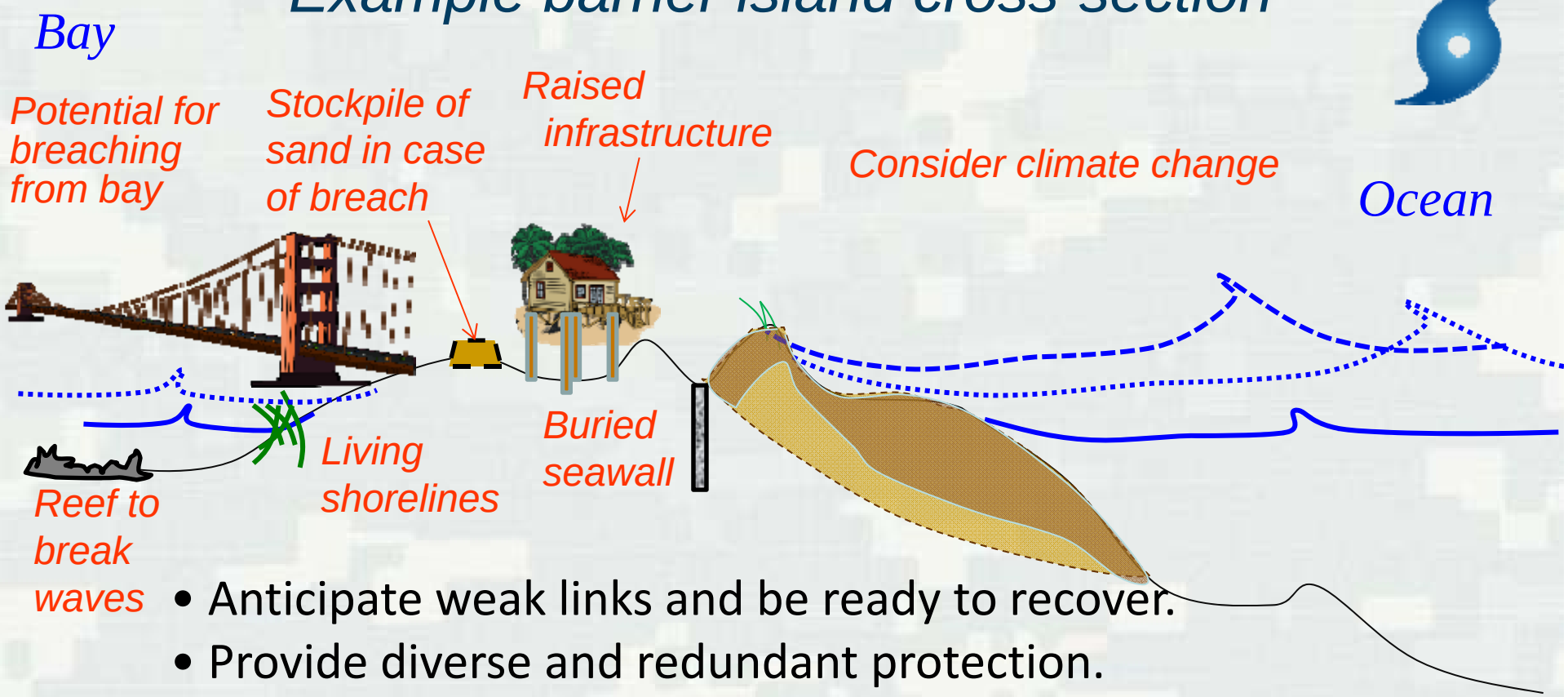
- Goals are based on unpredictability and accept that change is inevitable
- Episodic and focused on minimizing direct or indirect losses from destructive events
- Complements sustainability by ensuring capacity to overcome and adapt to disturbances within a system

Both sustainability and resilience

- Combine infrastructure analysis with environmental and social factors
- Relate to life cycle analysis and decision making
- Attempt to optimize a system

Best Practices: CSR

Example barrier island cross-section



- Anticipate weak links and be ready to recover.
- Provide diverse and redundant protection.
- Ensure availability of alternate networks –components are independent of, and complement each other.
- Provide accessible information for rapid decision-making.

Assessing CSR

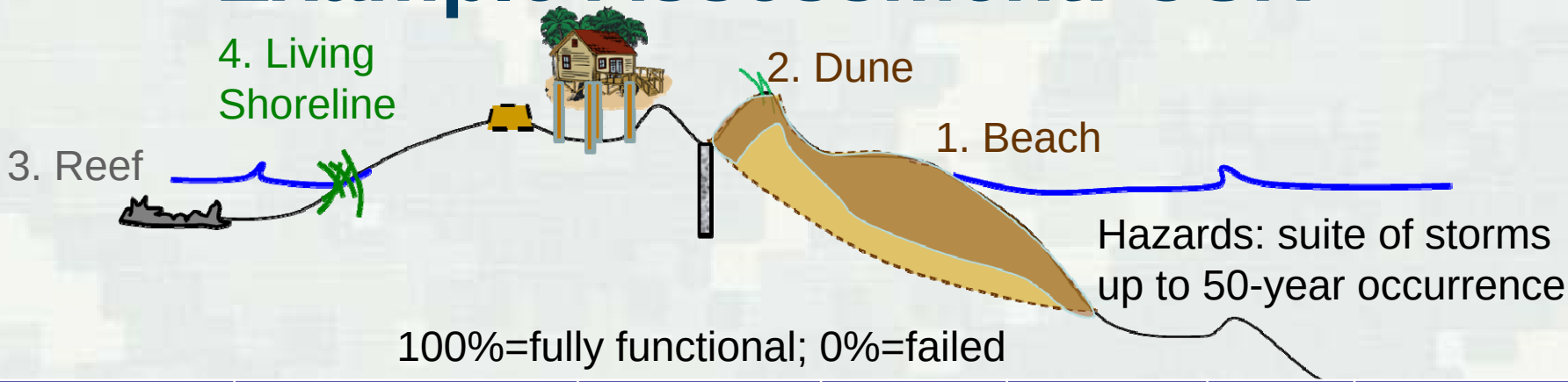
4. What is the capacity of the system to adapt in advance of future hazards?

1. How prepared is the system to withstand a disturbance?

2. Has the system been able to absorb damages and resist loss in functioning during disturbances?

3. Has recovery been adequate to restore functioning in a desirable timeframe?

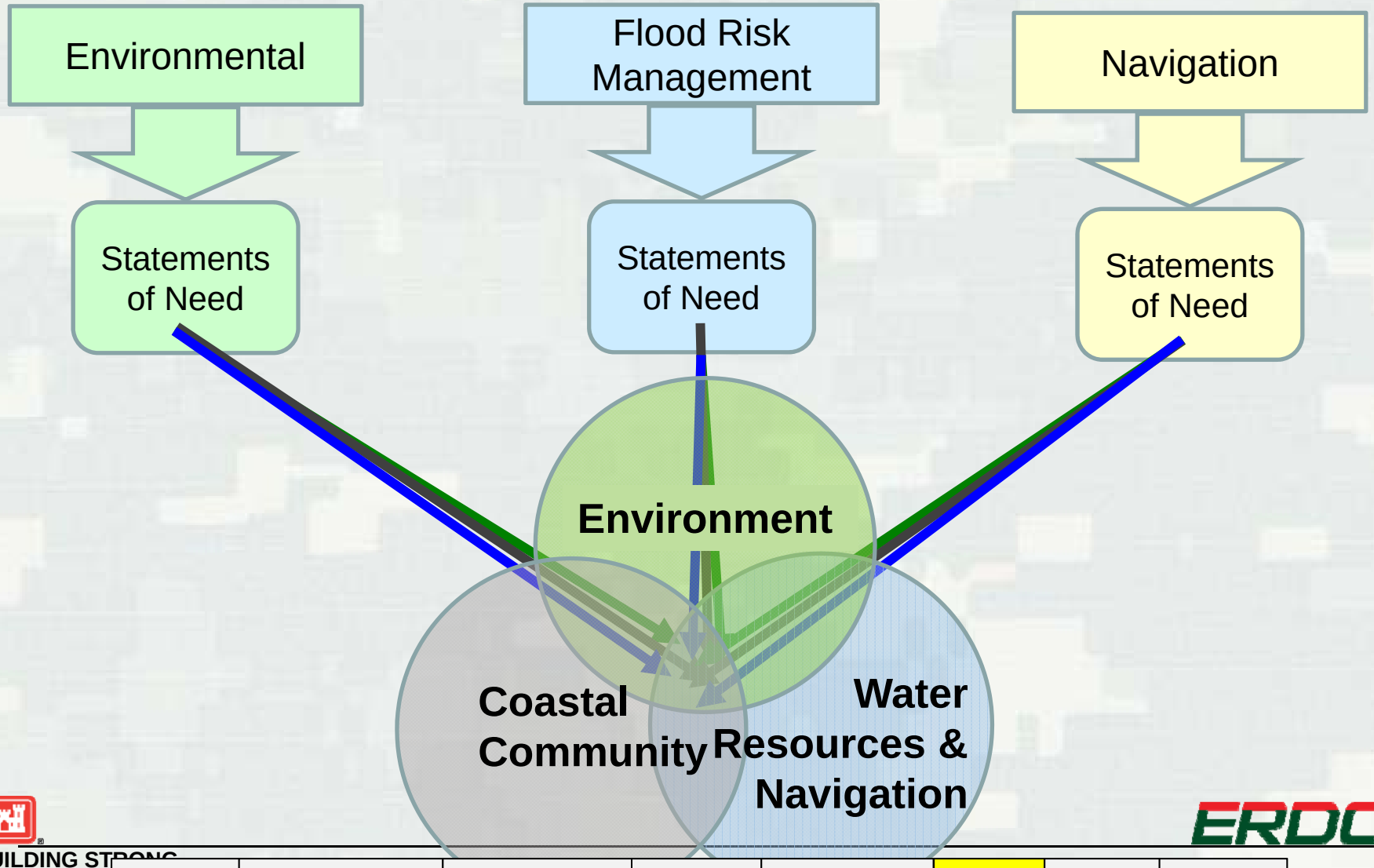
Example Assessment: CSR



Critical Element	Functional Obj, F	Recovery Obj, R	Was F met?	Was R met?	Avg (F,R)	Weighting W
1. Beach	Prevent surge	3 mos	100%	100%	100%	25%
2. Dune	Prevent overtopping	3 mos	50%	30%	40%	30%
3. Reef (bay)	Reduce erosion by 10%	6 mos	20%	50%	35%	20%
4. Living Shoreline (bay)	Reduce erosion by 30%	6 mos	10%	70%	40%	25%
Resilience = Avg (F,R) * W = (100*25+40*30+20*35+40*25)%=						**54%**

CSR: R&D from Statements of Needs

SoNs from three business lines to integrate environment, water resources, navigation infrastructure, and community expertise and create resilient coastal solutions.



CSR: Work Units

SoNs from three business lines to integrate environment, water resources, navigation infrastructure, and community expertise and create resilient coastal solutions.

Environmental

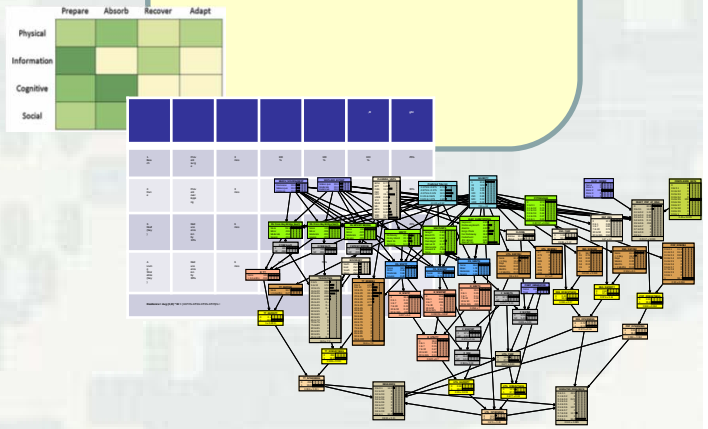
Vegetation and Dune Storm Response and Recovery

Flood Risk Management

Natural & Beneficial Functions of Coastal Landscape Features

Navigation

Quantification of CSR: Tools & Guidance



RSM and CSR: How does RSM support System Resilience?

Prepare
Anticipate

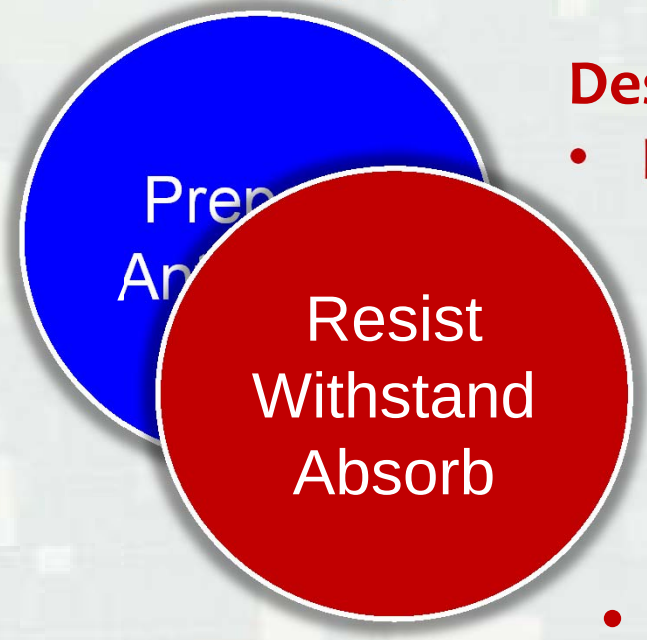
Knowledge & Partnering:

- Data: Existing conditions
- Analysis: Hindcasting & forecasting; providing easily-interpreted findings
- Building partnerships
- Decisions: Strategies & plans, e.g., developing contingency plans

Actions:

- Placement of sediment in anticipation of impacts
- Removal of sediment in advance to ensure future functionality (e.g., advanced maintenance dredging of channel; removal of sediment from confined disposal facility in preparation for future placement)

RSM and CSR: How does RSM support System Resilience?

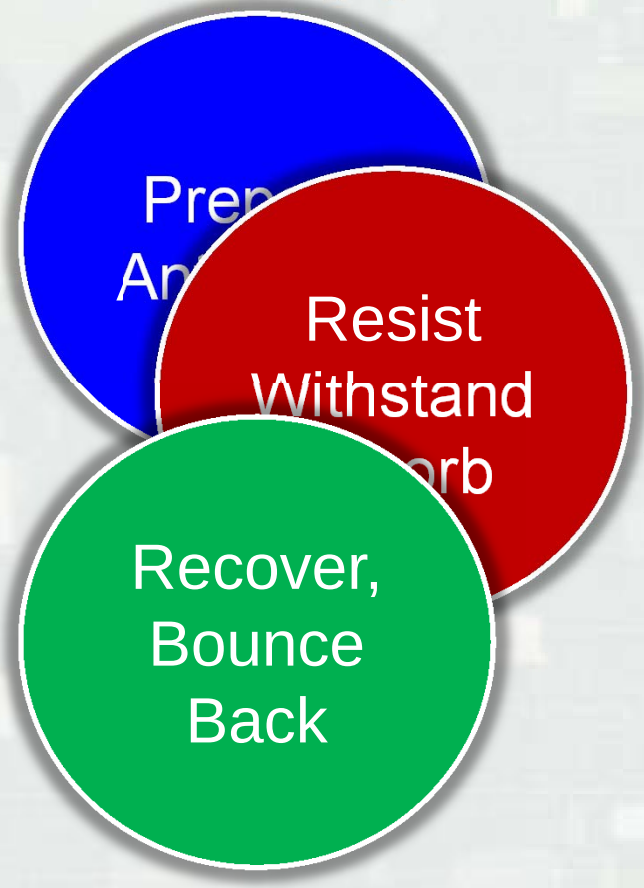


Design & Construct:

- Resist/withstand damage:
  - Protective sediment features - e.g., beaches, dunes, levees, islands…
  - Protective stone features – e.g., jetties, revetments, training structures…
  - Protective vegetative features

- Absorb impact: Features to accommodate stress associated with disturbance – e.g., retention basin for flood waters, sediment traps, living shorelines, wetlands…

RSM and CSR: How does RSM support System Resilience?



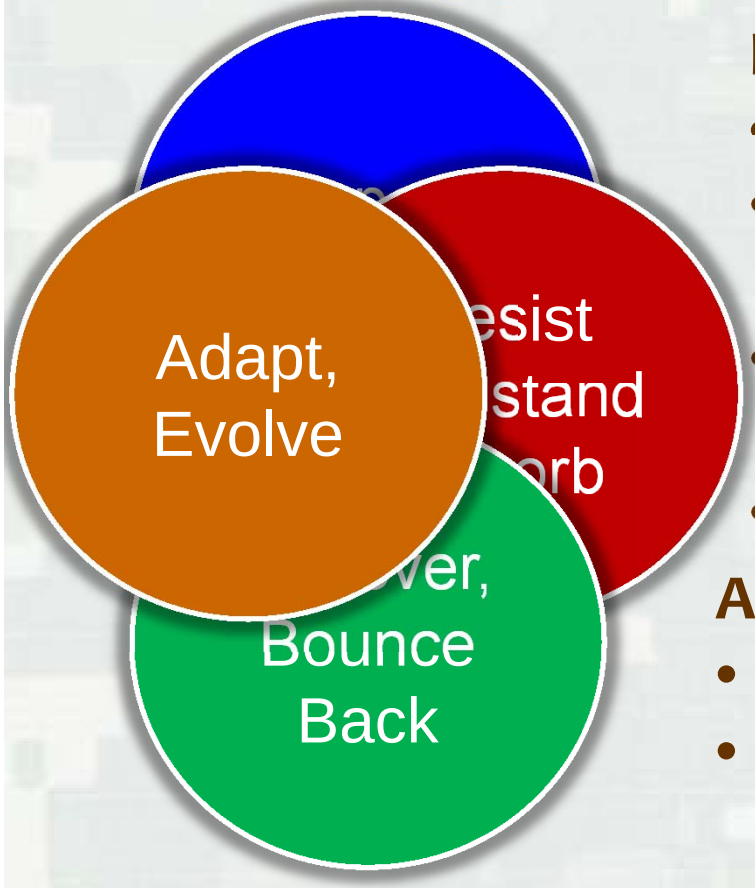
Knowledge & Partnering:

- Data: Post-disturbance data collection
- Engaging existing and new partners
- Analysis, strategies & decisions
- Providing readily-understood analyses

Actions:

- Placement of sediment/stone/vegetation to rebuild/restore functionality
- Removal of sediment to restore functionality (e.g., dredging to removed sediment from shoaled channel)

RSM and CSR: How does RSM support System Resilience?



Knowledge & Partnering:

- Analysis: Forecasting future scenarios
- Strategies & decisions, e.g., developing contingency plans
- Proposing creative, adaptive designs and practices
- Convincing partners of new strategies

Actions:

- Testing & monitoring new practices
- Diversifying risk reduction and operations; e.g., multiple lines of protection, stockpiling sediment for rapid repair, providing alternate networks

RSM and CSR: Examples of ongoing CSR R&D that supports RSM

Environmental

- *Barrier island modeling framework*
- *Numerical modeling: coupling beach, vegetated dune, and swash evolution*

Flood Risk Management

- *Numerical modeling: capacity of living shorelines to reduce storm damages*
- *Lit review: capacity of NNBF to reduce storm damages*
- *Dune Management Challenges Workshop*

Navigation

- *Metrics for Seaport Resilience to Climate Change*
- *Proof-of-Concept: GIS Tool for Coastal Resilience*
- *Coastal Infrastructure Resilience Metrics*
- *Beach-fx Resilience Metrics*

RSM and CSR: How can you influence CSR R&D?

- Submit statements of need for CSR R&D
- Let us know what is needed to support CSR within RSM
  - Planning, O&M, design, construction
  - Environmental, Flood Risk Management, Navigation
  - Media to better relay information, partner & communicate

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