PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

PIANC and its Role Addressing Climate Change Challenges to Inland Waterways

Burton Suedel, Ph.D.
US Army Corps of Engineers
Vicksburg, MS

Brian Joyner, P.E.
Moffatt & Nichol
Norfolk, VA

World Canals Conference
Hagerstown, MD
2 September 2021

PIANC Overview

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

The World Association for Waterborne Transport Infrastructure

- Established in 1885
- Non-political and non-profit
- Convene best international experts, both public and private, on technical, economic and environmental issues pertaining to waterborne transport infrastructure
- High-quality Technical Reports and Briefs
- International Commissions and Working Groups
  - Maritime Navigation Commission
  - Inland Navigation Commission
  - Environmental Commission
  - Recreation Navigation Commission
  - Young Professionals (YP) Commission

PIANC Working Groups

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

The work carried out by the Association on subjects of interest is accomplished through its technical Working Groups (WGs), composed of experts of high standing from different countries. Participation in the international Working Groups results in worthwhile contact with experts studying technical and managerial matters of current importance.

PIANC USA Overview

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

US Section of PIANC

- Established in 1987
- Manage activities of PIANC to advance the purposes of US navigable waterway interests while promoting PIANC-USA objectives:
  - Promote exchange of information with international navigable waterway interests on all aspects pertaining to inland, coastal, and ocean navigation
  - Encourage cooperation between U.S. Government agencies and state, municipal, and private organizations
  - Exchange technical information on climate change and other timely topics of broad interest

EnviCom Overview

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

PIANC Environmental Commission

- Formed in 1994 to demonstrate PIANC's commitment to the environment and sustainable development principles
- Addresses broad as well as specific navigation sustainability and environmental risk issues that crosscut PIANC areas & partners
  - Develop and provide environmental guidance for sustainable waterborne transport infrastructure
  - Network/communicate with international organizations and associations (e.g., IADC) addressing sustainability and environmental risk, including Countries in Transition
  - 30 members from 11 nations and 7 partner organizations
  - Active Working Groups (e.g., Beneficial Sediment Use, Underwater Sound)

Todd Bridges (Chair, USACE)
Burton Suedel (Principal Representative, USACE)
Victor Magar (Alternative Representative, Ramboll)

EnviCom: Mission

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

Provide practical, science-based guidance to shape and inform future environmental practice in the development and operation of sustainable navigation infrastructure

Goals

1. Develop best practice guidance to create environmental value through sustainable, resilient navigation infrastructure
2. Integrate best environmental practice into navigation planning, engineering and operations
3. Use strategic communications to expand PIANC's reach, engagement, partnering, and impact

Major Work Themes

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

- Enhancing the economic, environmental, and social benefits of infrastructure through sound environmental practice
- Support a proactive posture on climate change
- Support the application of risk-informed decision making to environmental management
- Promote Working with Nature philosophy
  - ✓ Permanent Task Group on Climate Change
  - ✓ Engineering With Nature (USACE)
  - ✓ Building with Nature (EcoShape)

Strategic Initiatives

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

PIANC Climate Change Declaration

On 10 December 2019 during COP25 in Madrid, PIANC launched the association's Declaration on Climate Change, providing a 'call-to-arms' for the sector to accelerate and scale up action, urgently and decisively, in order to reduce the potentially significant risks that climate change poses to waterborne transport businesses, operations, safety and infrastructure.

Strategic Initiatives

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

Permanent Task Group on Climate Change (PTGCC)

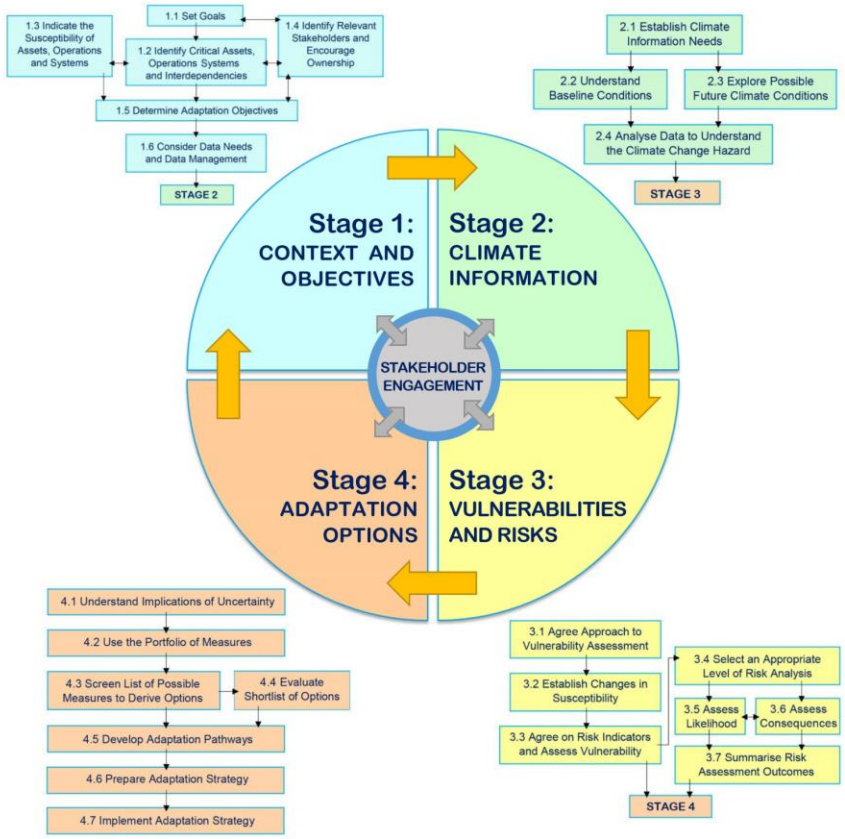
- The main goal for the new cross-commission PTGCC being led by EnviCom is to inform PIANC on how navigation may be affected by climate change and where and how adaptation and mitigation actions need to be taken so that the necessary actions and investment can be performed in a proactive way.

Strategic Initiatives

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

PTGCC Progress

- **Chair:** Jan Brooke (UK)
- **WG 178:** ”Guidance on Climate Change Adaptation for navigation Infrastructure Projects”
- **TG 193:** “Resilience of the Maritime and Inland Waterborne Transport System”
- **TG 3:** “Waterborne Transport, Ports and Waterways: A Review of Climate Change Drivers, Impacts, Responses and Mitigation”



WG 178. Four stages in the climate adaptation planning process.

Strategic Initiatives

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

Working with Nature

- Ongoing WwN presentations/courses worldwide
- WwN Position Paper in many languages available
- Thematic PIANC website (https://www.pianc.org/working-with-nature)
- WwN online database collection and certification process established in 2013
- WG 176 - Guide for Applying Working With Nature to Navigation Infrastructure
- WwN project certification
- WwN awards made every four years

Working With Nature and Climate Change

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

- WwN can help facilitate effective climate change adaptation through natural resilience. Adopting WwN should both:
  - Help to ensure understanding of the implications of changes in temperature, precipitation, sea level, etc. for the natural environment
  - Allow for 'climate proofing' future navigation infrastructure

WwN

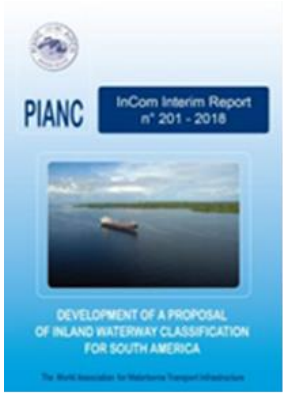
- Establish project need and objectives
- Understand the environment
- Make meaningful use of stakeholder input to identify win-win options
- Prepare project designs to benefit both navigation and nature

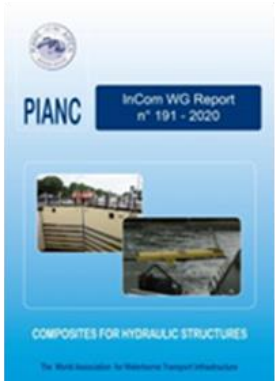
InCom Activities

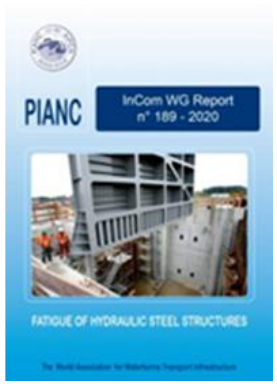
PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

Recently Published Reports

- InCom Report 201-2020: Framework for an Inland Waterway Classification in South America
- InCom Report 179-2020: Standardisation of Inland Waterways - Proposal for the Revision of the ECMT 1992 Classification
- InCom Report 191-2020: Composites for Hydraulic Structures
- InCom Report 189-2020: Fatigue of Hydraulic Steel Structures







Active Working Groups

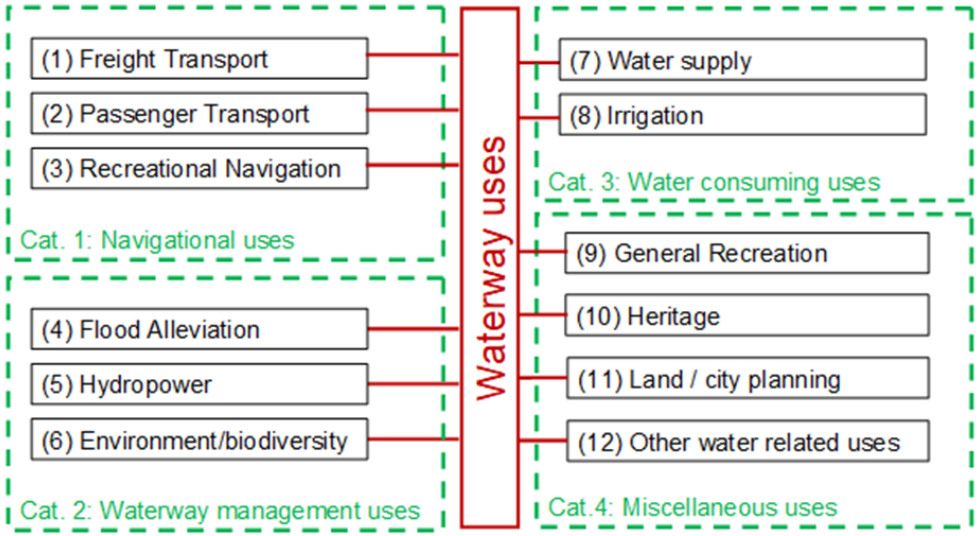
- Guidelines for IW Infrastructure to Facilitate Tourism
- Extended Values of Low-Use Inland Waterways
- Guidelines for Sustainable Performance Indicators for Inland Waterways

InCom WG 203

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

Sustainable Inland Waterways – A Guide for Waterways Managers of Social and Environmental Impacts

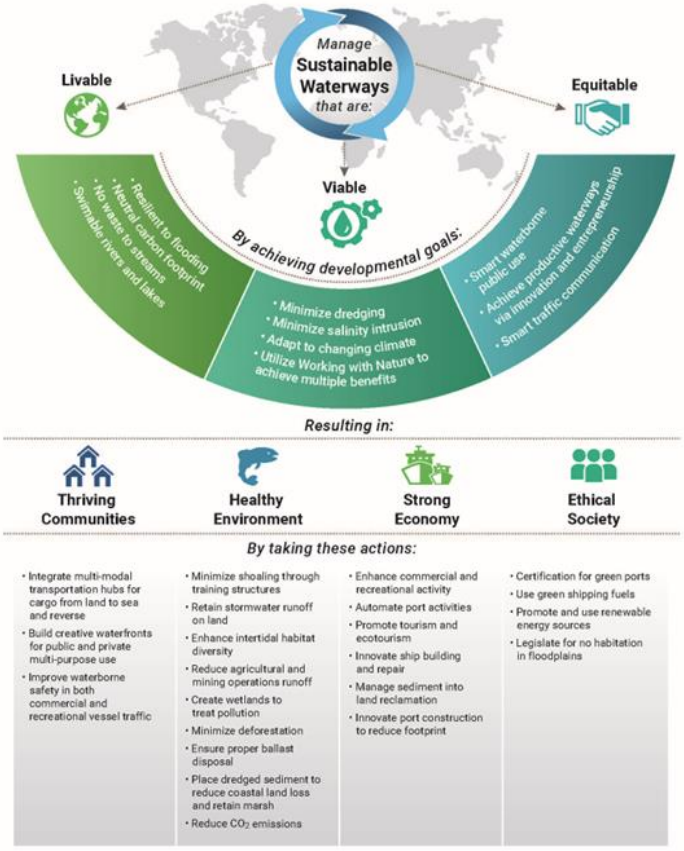
- Increase social and environmental awareness for managers responsible for operating and developing IW
- Address opportunities and challenges for IW managers resulting from the multiple functions and uses of IW
- Joint InCom & EnviCom effort



WG 203 Corporate Social Responsibility (CSR)

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

- ISO 26000 (2010) supported organizations implementing CSR
- Improve robustness of the organization's projects
- Increase social acceptance of sustainable development
- Improve its reputation and the reputation of its stakeholders
- Increase the organizational pride and commitment of its employees
- Improve its relationships with stakeholders
- Improve its contribution to sustainable development
- Lead by example
- Contribute to strengthening the sustainable behavior of all stakeholders



Actions IW managers can take to achieve and maintain sustainable IW.

InCom WG 203

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

Working with Nature and Sustainable IW

- To foster sustainable IW development, seek opportunities to leverage natural processes that improve long-term sustainability and enhance potential environmental, social, and economic benefits consistent with UN SDGs
- WwN captures this concept as it applies to IW infrastructure
- WwN promotes an integrated planning and design process, using the ecosystem's natural processes to produce positive environmental outcomes while also supporting the delivery of project goals

Atlantic middle lock chamber. Neopanamax locks under construction in 2012 (Source: Sergio Gaitan).

- Cutting through Panama has avoided over 700 MT of CO_2 emissions during the last 100 years
- In 2002 The Panama Canal signed the UN Global Compact which requires them to be guided by environmental and social principles
- From 2009 to 2020: 8,375 improved ha & 2,000 ha land under forest protection (2020 Annual Report)

InCom WG 203

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

Connections to UN Sustainable Development Goals (SDGs)

- Circular graphical illustration showing the strength of associatio between sustainable inland navigation and the UN SDGs
- Smaller inner circle icons represen little to no association
- Medium-sized outer circle icons represent moderate association
- Large outer circle icons represent substantial association of sustainable inland navigation practices with the SDGs

Take Home Points

PIANC USA
The US Section of the World Association for Waterborne Transport Infrastructure

- PIANC active in identifying challenges and opportunities associated with climate change impacts
- Pursuing joint WG opportunities among PIANC commissions and organizations
- Opportunities to participate in ongoing and upcoming WGs
- Seeking creative ways to leverage WGs

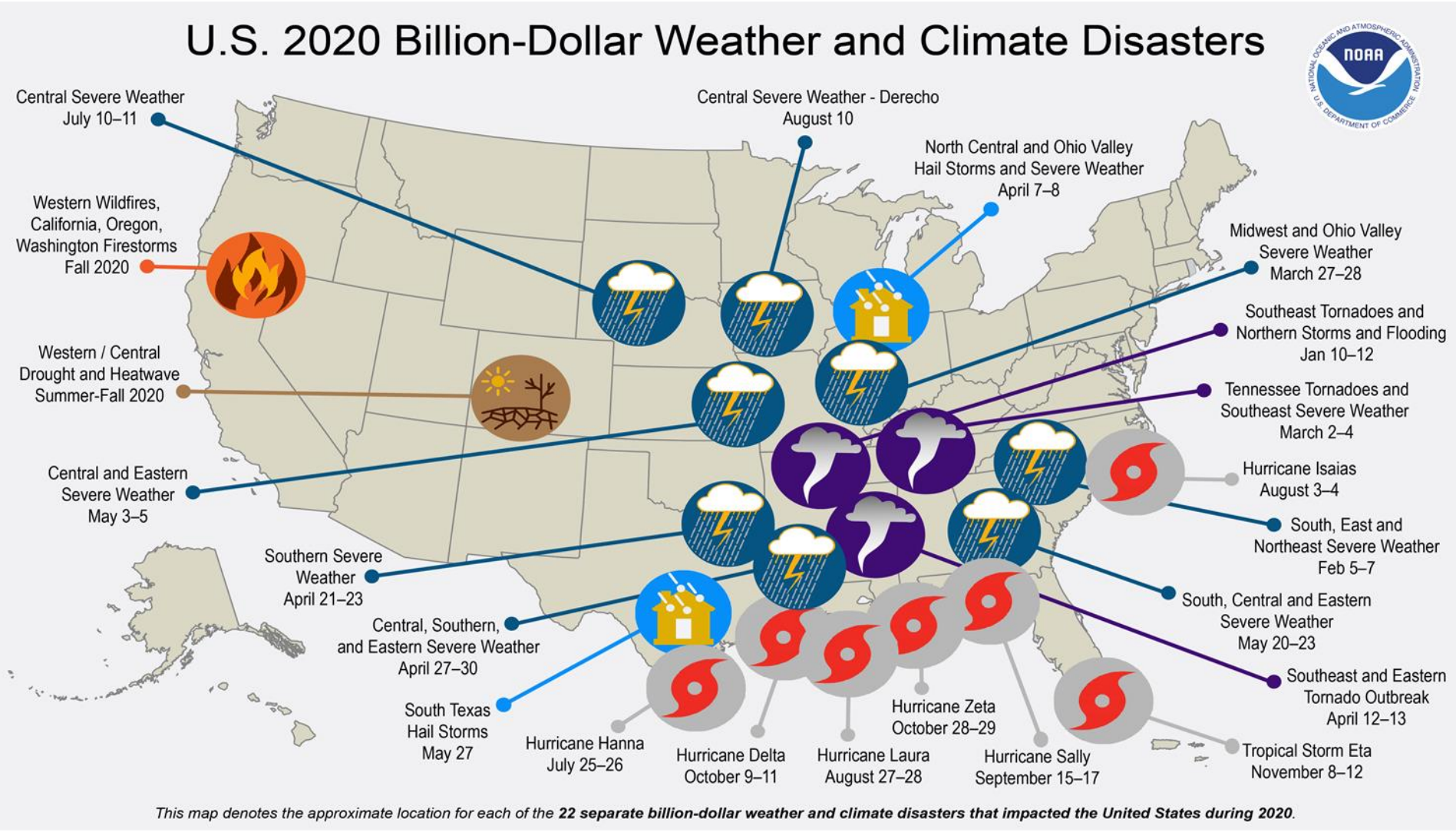
Existing situation at "Pont des Trous" bridge at Tournai, Belgium

Rendering of proposed canal enhancements at "Pont des Trous"

Climate Change Challenges and Adaption Considerations for Inland Waterways

Brian Joyner, P.E.
Moffatt & Nichol
Norfolk, VA


University
Local Connector
Regional / Strategic Highway
Affordable Housing
Historic Neighborhood
Creek / Wetland
Eastern Branch of the Elizabeth River
Water-Dependent Industry
Photo courtesy of vhb



NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2019). https://www.ncdc.noaa.gov/billions/

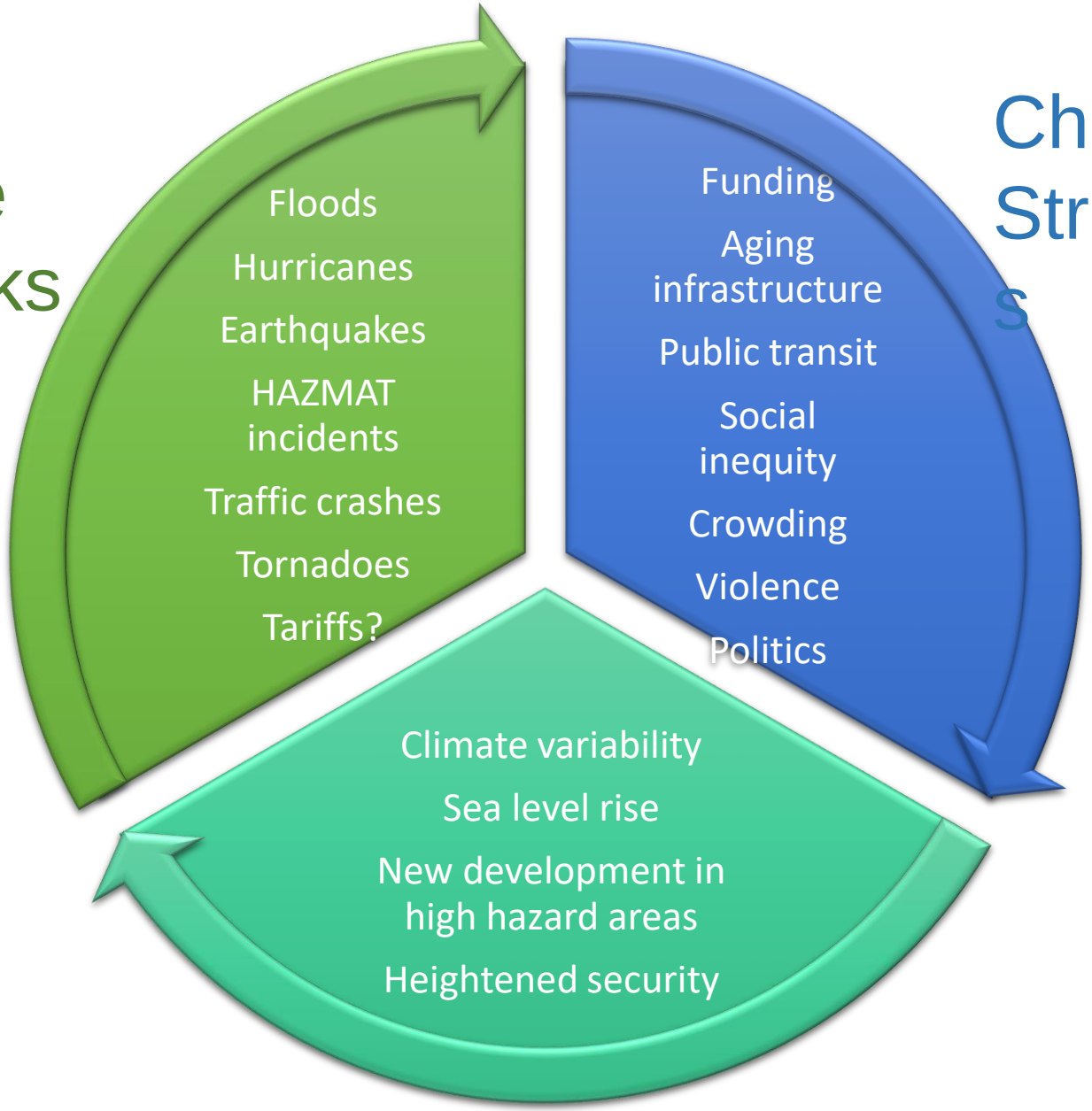
The Resiliency Lens

- Health and Safety, Operational Continuity
- Interconnectivity of systems
- Asset versus system resilience
- Acute shocks & chronic stressors

Resilience

Capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.

(100 Resilient Cities, Rockefeller Foundation)


Acute Shocks
Floods
Hurricanes
Earthquakes
HAZMAT incidents
Traffic crashes
Tornadoes
Tariffs?
Chronic Stressors
Funding
Aging infrastructure
Public transit
Social inequity
Crowding
Violence
Politics
Potential Accelerators
Climate variability
Sea level rise
New development in high hazard areas
Heightened security

Climate Variability and Notable Vulnerabilities of Transportation Assets

moffatt & nichol

Decision Making in Light of Uncertainty

- Scenario Planning
- Probabilistic Approaches
- Dynamic Adaptive Policy Pathways

First Floor Elevation
Site Grading
Nuisance Flooding
Greening Measures
Extreme Rainfall
Deployable Protection
Future Water Surface Elevations
Storm Surge Probability
Sea Level Rise Probability
Economic Consequences
Trade-off Analyses

Technical References to Assist Understanding and Decision Making

- PIANC EnviCom Task Group 3: Climate Change and Navigation
  - Latest release 8 November 2008
  - Update in progress by PIANC PTGCC

- Climate Change 2021: The Physical Science Basis – Summary for Policy
  - Working Group I contribution to the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC)
  - 7 August 2021 release. subject to final copy editing

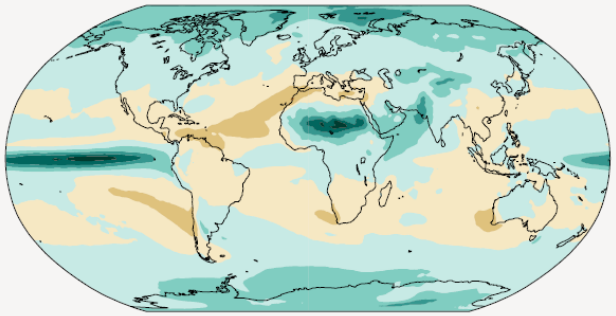
Trends and Projections in Climate Change Factors (IPCC AR6)

- Annual and extreme precipitation

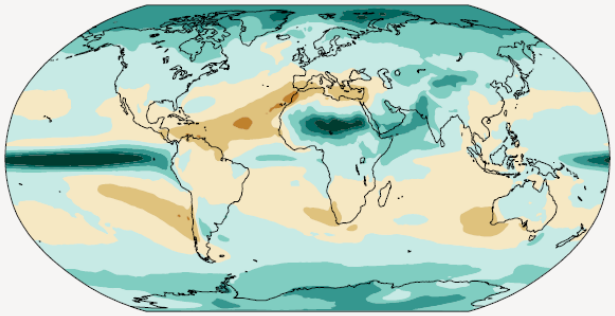
c) Annual mean precipitation change (%) relative to 1850-1900

Precipitation is projected to increase over high latitudes, the equatorial Pacific and parts of the monsoon regions, but decrease over parts of the subtropics and in limited areas of the tropics.

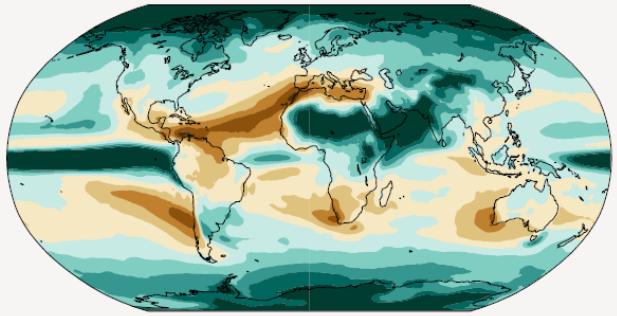
Simulated change at **1.5 °C** global warming



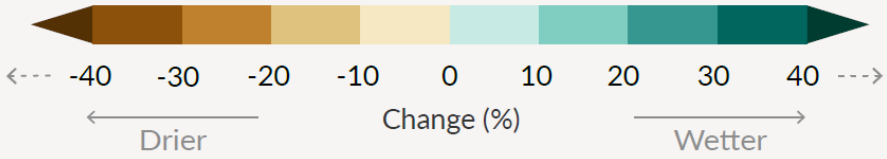
Simulated change at **2 °C** global warming



Simulated change at **4 °C** global warming

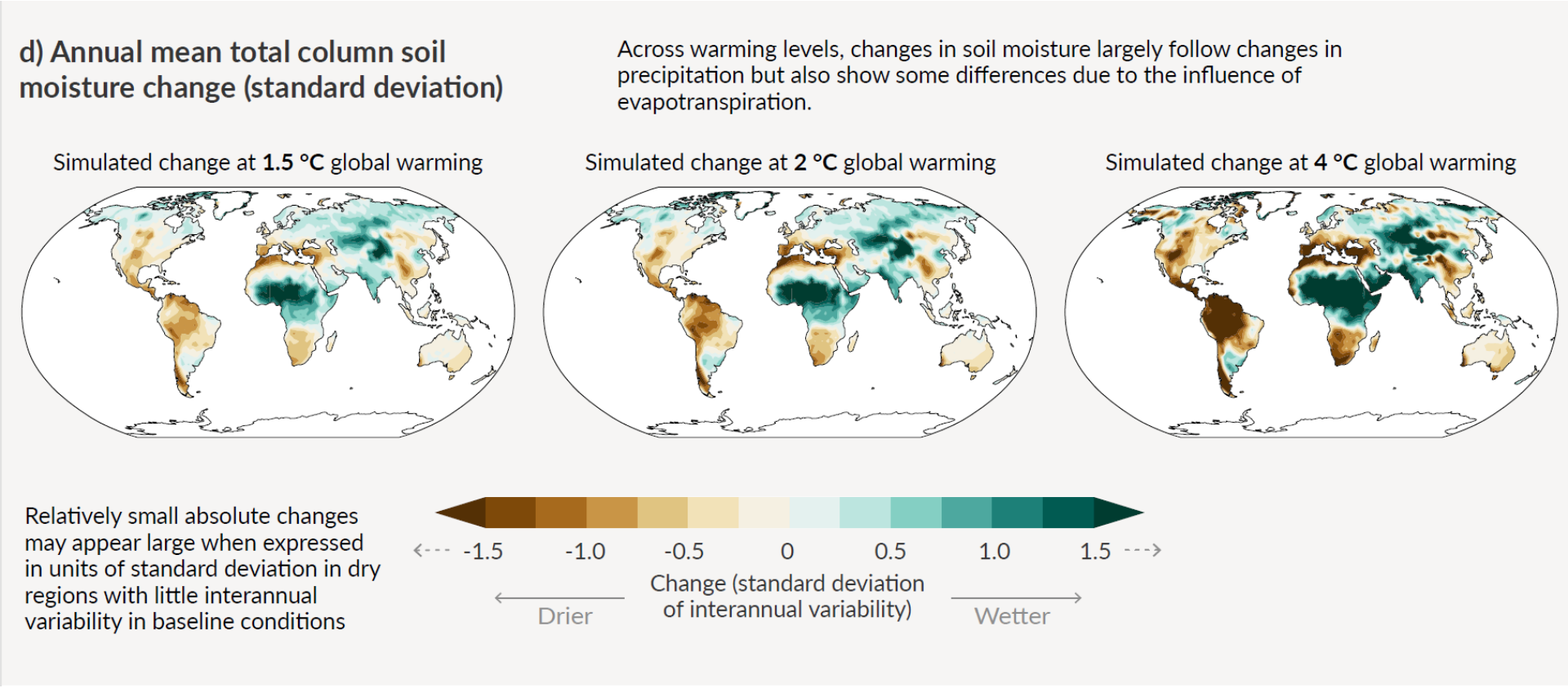


Relatively small absolute changes may appear as large % changes in regions with dry baseline conditions



Trends and Projections in Climate Change Factors (IPCC AR6)

- Soil moisture related to drought



Trends in Climate Change Factors from IPCC AR6

- "Each of the last four decades successively warmer than any decade that preceded it since 1850"
- "Globally averaged precipitation over land has *likely* increased since 1950, with a faster rate of increase since the 1980s (*medium confidence*)"
- "The frequency and intensity of heavy precipitation events have increased since the 1950s over most land area for which observational data are sufficient for trend analysis (*high confidence*)…."
- "…decrease in Northern Hemisphere snow cover since 1950"

Projections for Climate Change Factors from IPCC AR6

- "Many changes in the climate system become larger in direct relation to increasing global warming"
- "For example, every additional 0.5°C of global warming causes clearly discernible increases in the intensity and frequency of hot extremes, including heatwaves (*very likely*), and heavy precipitation (*high confidence*), as well as agricultural and ecological droughts in some regions (*high confidence*)"
- "… precipitation and surface water flows projected to become more variable over most land regions within seasons (*high confidence*) and from year to year (*medium confidence*)"

But Keep In Mind …

- These are simple summary statements. Historical trends and IPCC projections are highly variable over regions.
- Information and maps are publicly accessible and allow region-specific future changes to be considered in planning and design. Downscaling is usually required for quantitative analysis.
- Projections of future changes are by nature uncertain. The business, insurance, engineering and planning communities are responding with tools for continuing to operate and invest considering uncertainty.
- Characteristics of infrastructure itself are also very important to what the industry / community experience: How things are built, when they were built, past and current land use practices, etc.

Changing Design Philosophy to Account for Nonstationarity

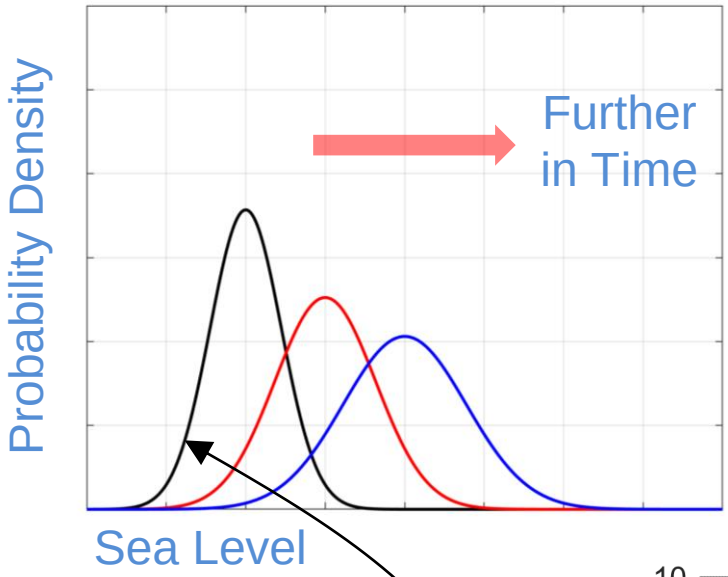
Traditional Design

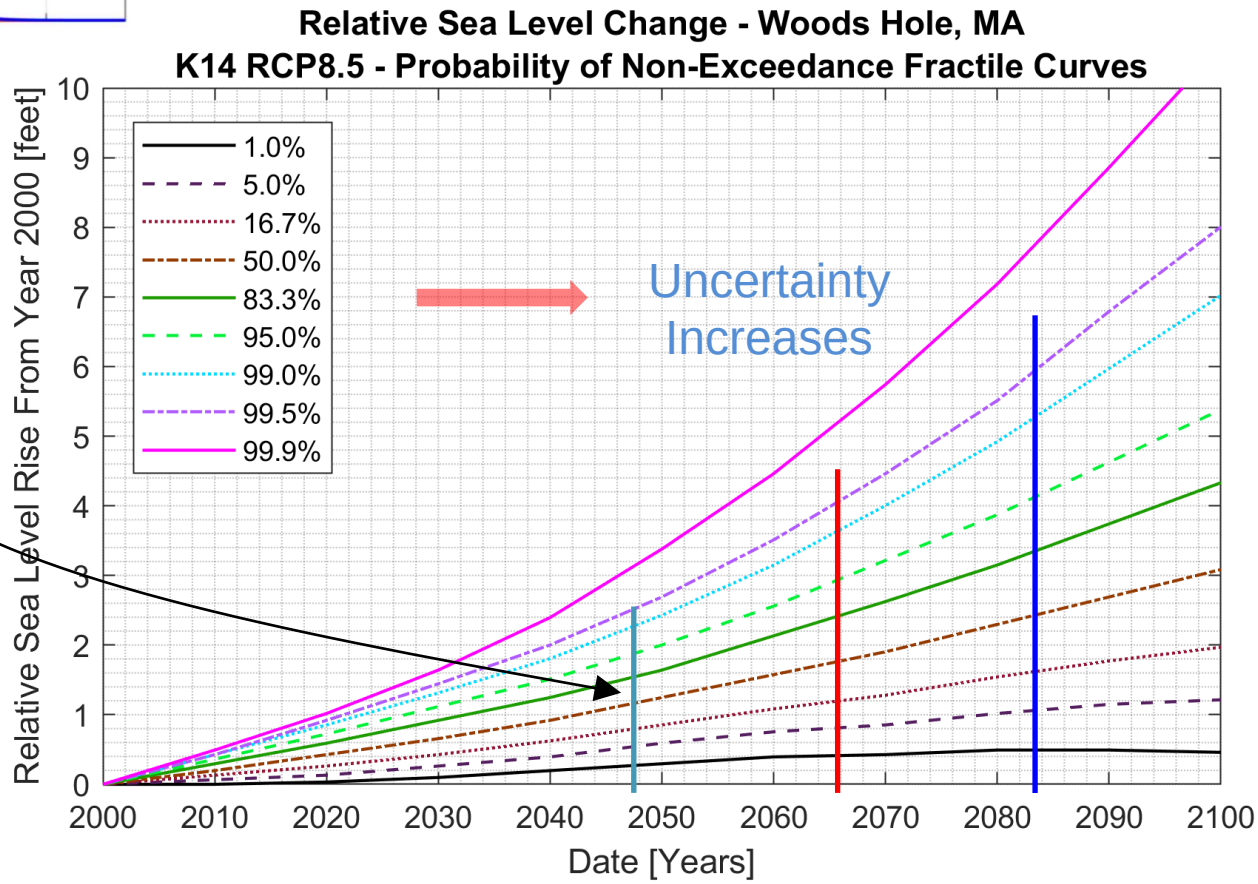
- Think of events in terms of recurrence intervals: 50-year, 100-year, etc.
- Add some margin/freeboard.
- Don’t really know how likely it is that you will see an impact?
- No framework for thinking about how risk will change in the future.

Probabilistic Design

- Think of events in terms of how likely they are to occur.
- Consider the contributing sources of random variability & uncertainty.
- Good Framework for considering how risk might change throughout a project life.

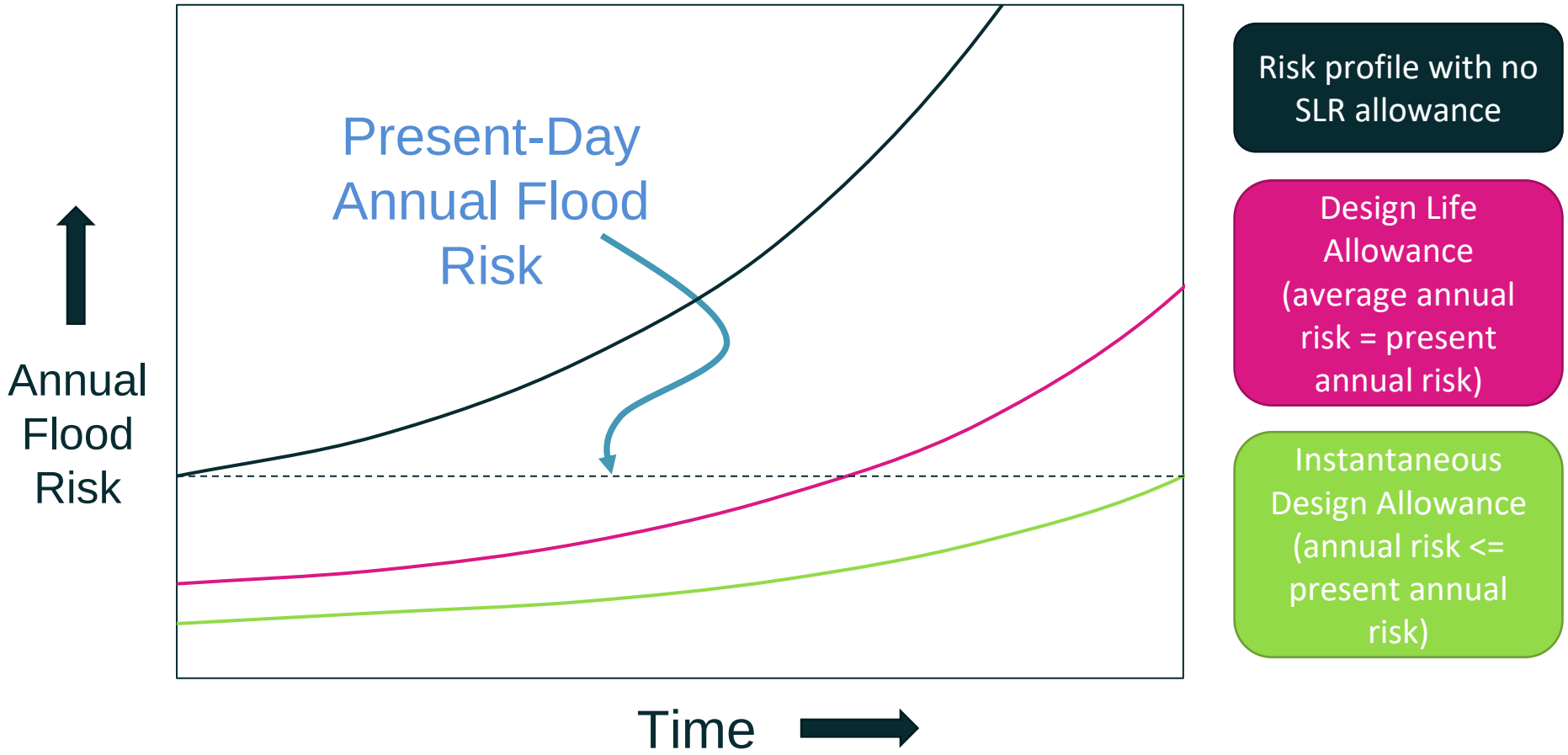
Probabilistic Risk Analysis: Sea Level Rise Example





Probabilistic Risk Analysis: Sea Level Rise Example

Design Allowances → Vertical Offset to Maintain Acceptable Flood Risk



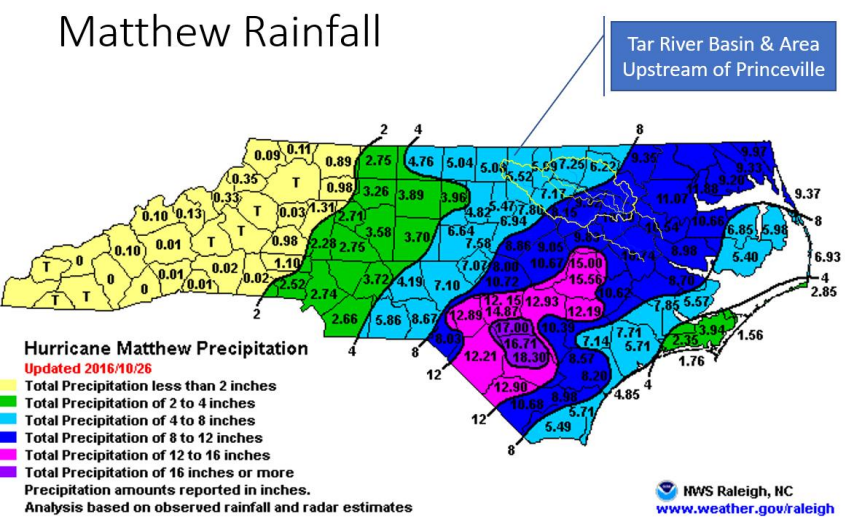
Probabilistic Risk Analysis: Sea Level Rise Example, Design Life Allowance

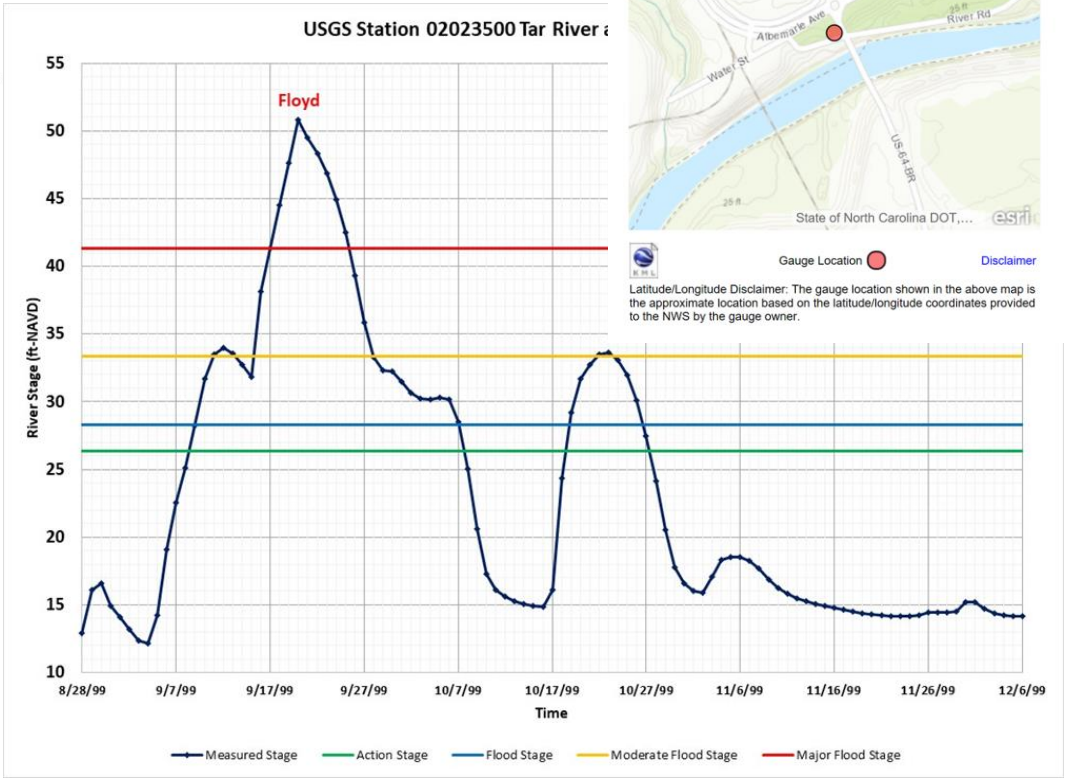
Level [ft NAVD88]	Probability of At Least One Flood Event During 50-year Project Life		
	No SLR	RCP 4.5	RCP 8.5
6.0	89.9%	98.3%	98.9%
6.5	77.4%	93.0%	94.6%
7.0	62.3%	82.5%	85.2%
7.5	50.8%	69.1%	72.3%
8.0	39.9%	56.0%	58.8%
8.5	31.4%	44.5%	46.9%
9.0	24.3%		36.8%
9.5	18.2		.5%
10.0	13.5%		21.7%
10.5	9.9%	15.3%	16.3%
11.0	6.9%	11.2%	12.0%
11.5	4.8%	8.0%	8.6%
12.0	3.3%	5.7%	6.1%

Conclusion
Raise Project 1 ft For SLR

Probabilistic Risk Analysis: Inland Waterway Flood Stage

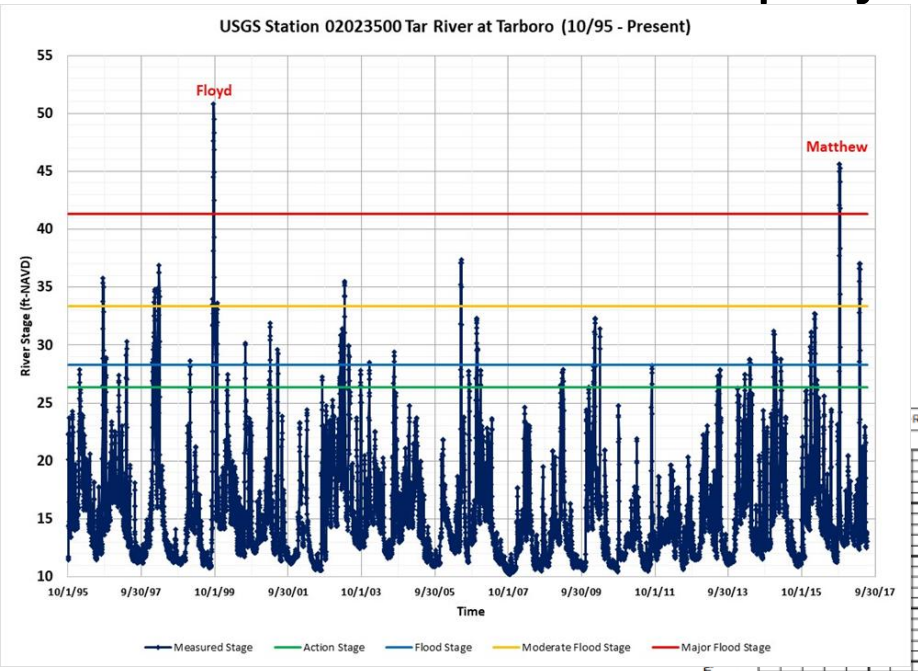
- Measured data and rating curves, convert increased rainfall projections to stream response and stages





Probabilistic Risk Analysis: Inland Waterway Flood Stage

- Measured data and rating curves, convert increased rainfall projections to stream response



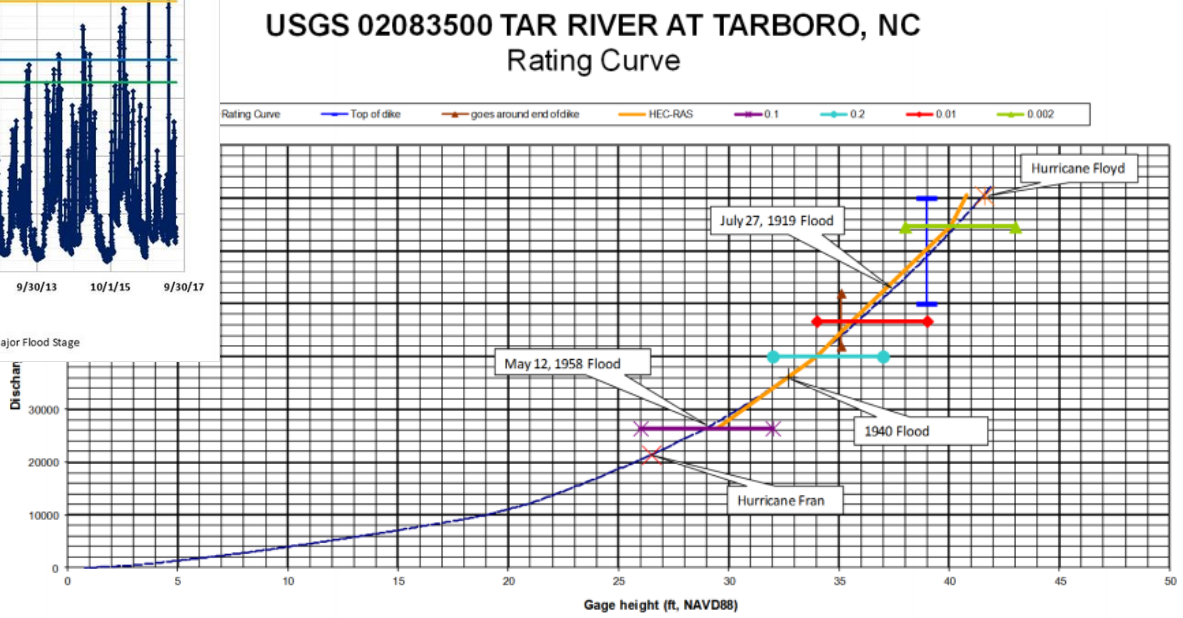
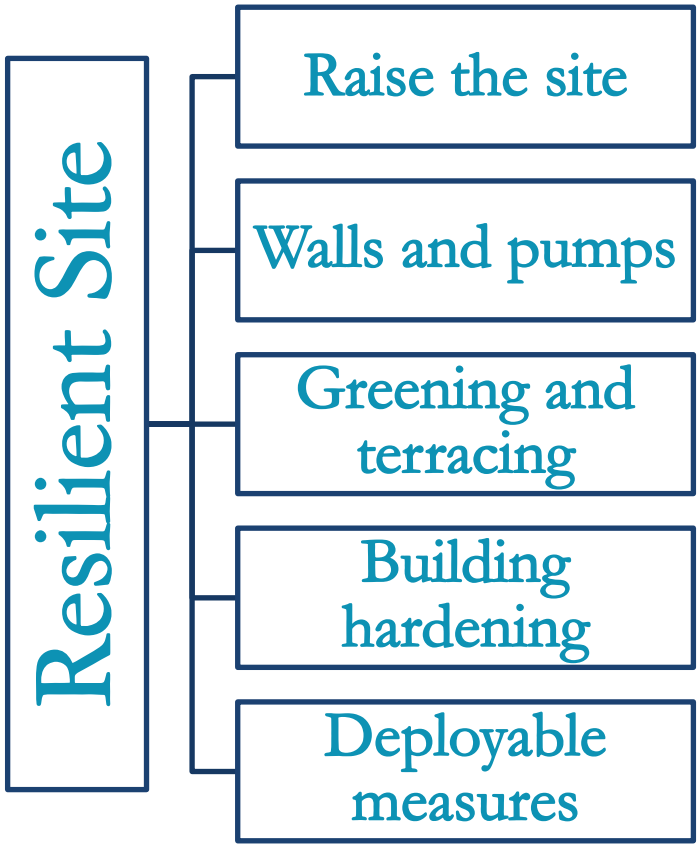


Figure 3-6. Tarboro Gage Rating Curve

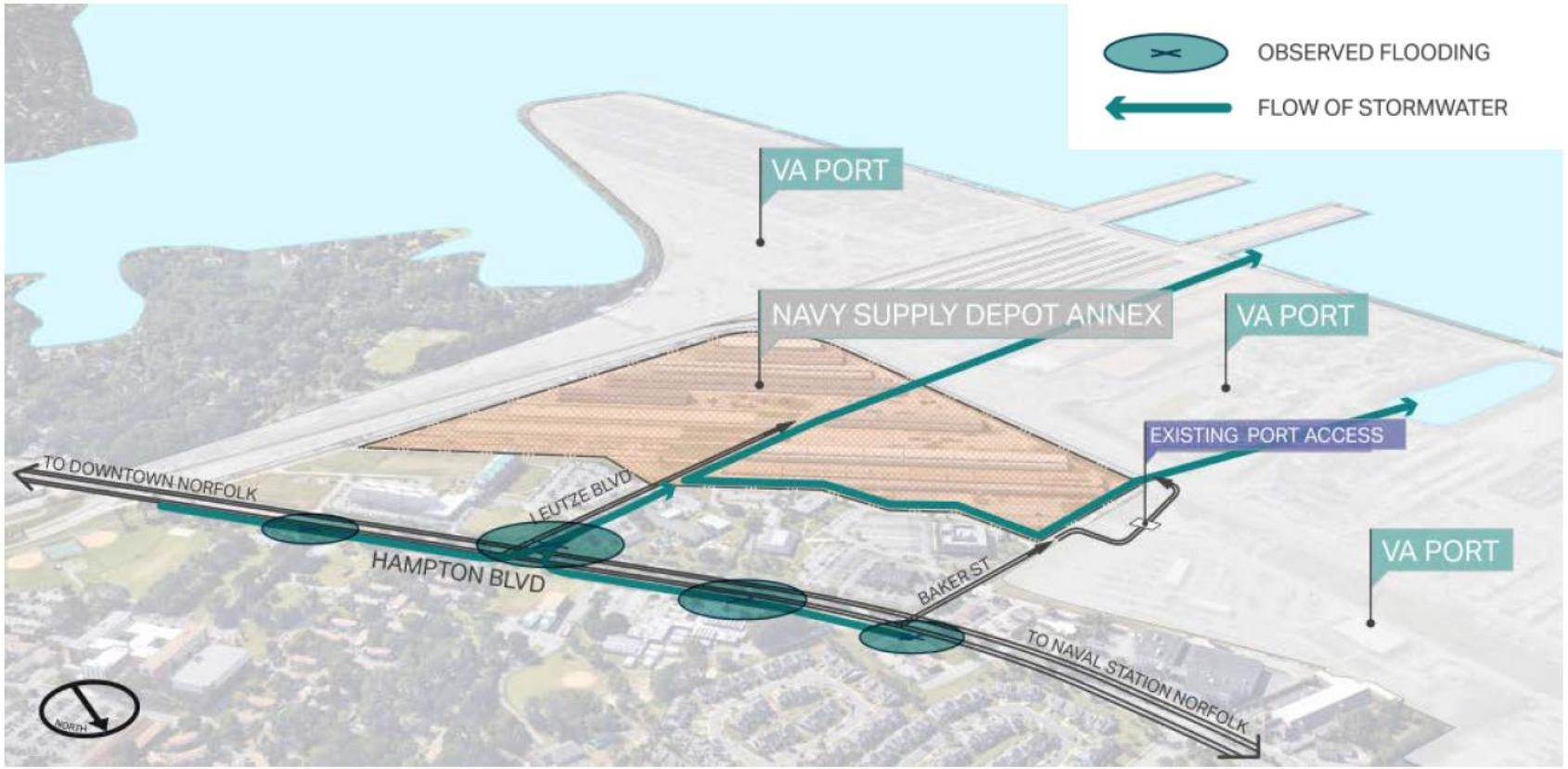
Resilient Waterfront and Upland Sites

- Mitigation of Flooding Vulnerability



Resiliency Partnering Across Areas of Responsibility

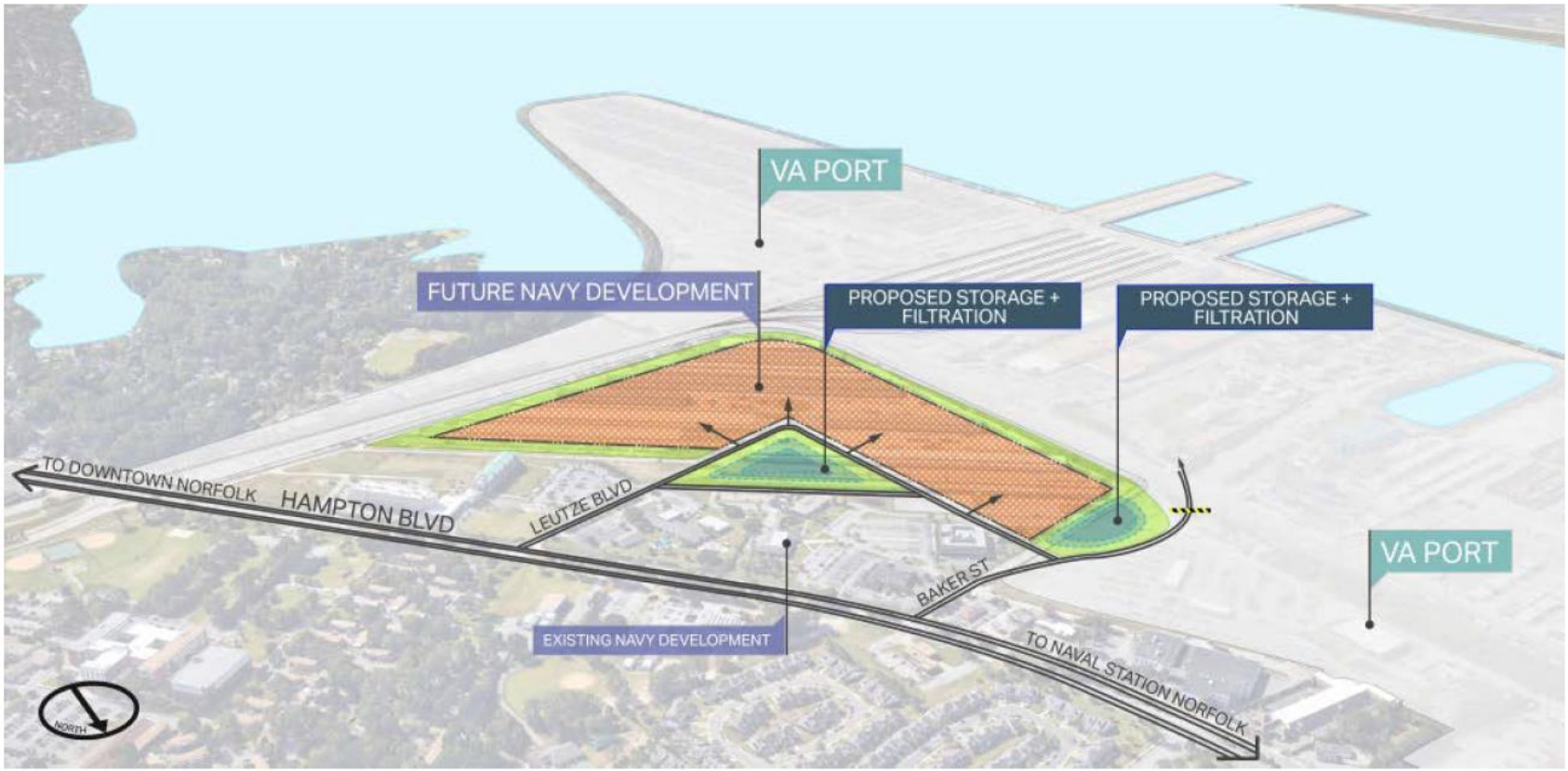
- Interdependencies between industry, communities and regional networks



Norfolk and Virginia Beach Joint Land Use Study (2019). AECOM and partners for Hampton Roads Planning District Commission, Virginia. https://www.hrpdcva.gov/departments/joint-land-use-studies/

Resiliency Partnering Across Areas of Responsibility

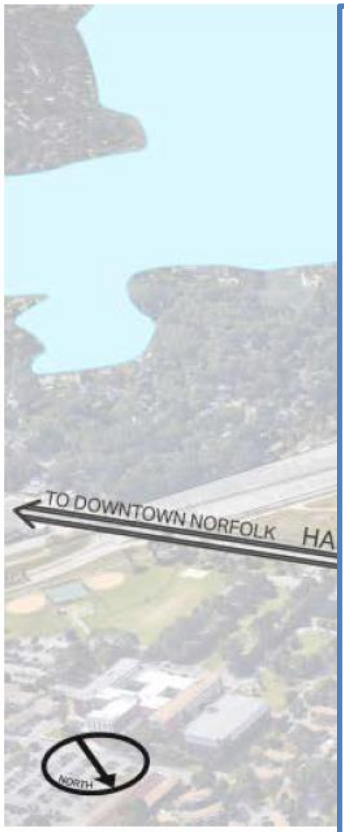
- Interdependencies between industry, communities and regional networks



Norfolk and Virginia Beach Joint Land Use Study (2019). AECOM and partners for Hampton Roads Planning District Commission, Virginia. https://www.hrpdcva.gov/departments/joint-land-use-studies/

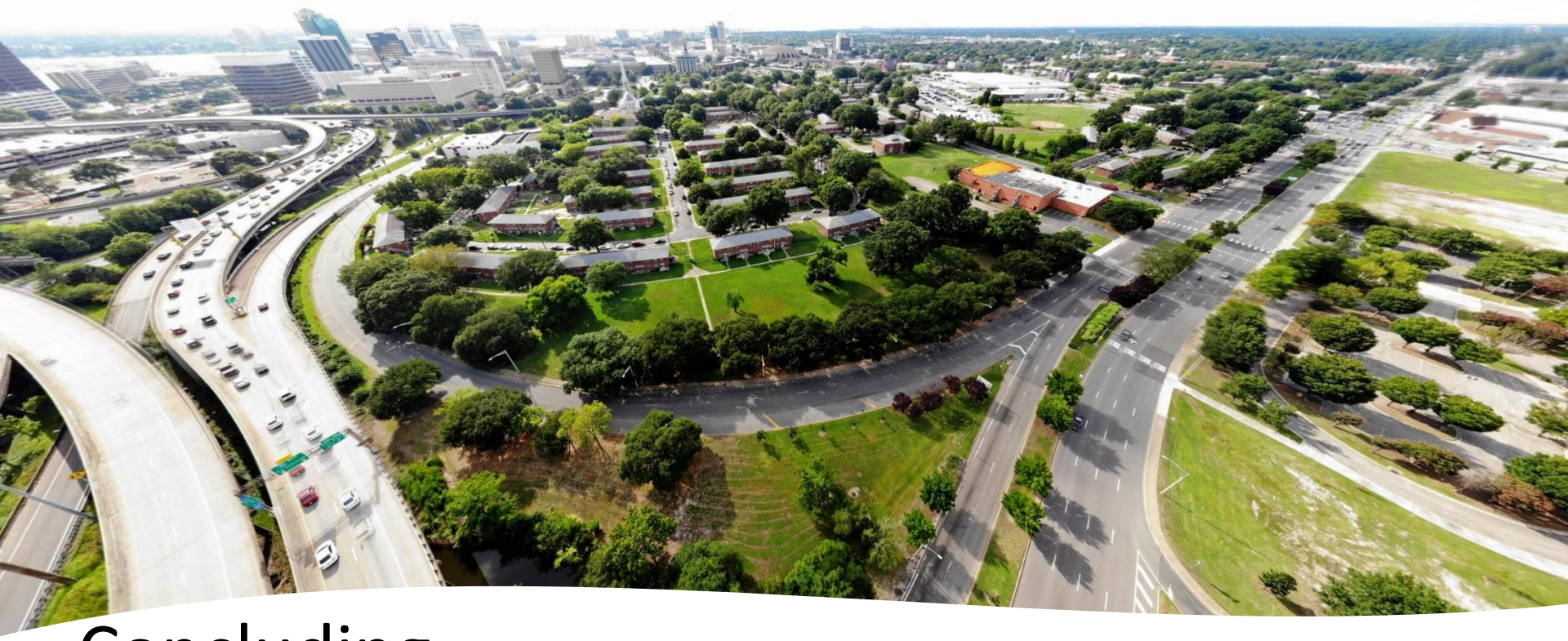
Resiliency Partnering Across Areas of Responsibility

- Planning builds consensus and articulates joint benefits, supporting funding opportunities



BENEFIT	BENEFICIARY		
	NAVY	PORT	NORFOLK
Reduces current and future flood risk for military personnel along a primary DoD strategic corridor.	X		
Reduces delays for military personnel entering and exiting the installations and housing areas.	X		
Provides a stormwater management solution for future Navy development.	X		
Maintains access to businesses, public schools, and neighborhoods along Hampton Boulevard.	X	X	X
Mitigates the effects of tidal backups and overwhelmed inlet capacity to reduce the frequency and duration of flooding on Hampton Boulevard.	X	X	X
Stores runoff outside of the Hampton Boulevard right-of-way.	X	X	X
Improves access alignment for NIT employees and deliveries.		X	
Reduces flood blockage along Baker Street and improves safety.	X	X	X

Norfolk and Virginia Beach Joint Land Use Study (2019). AECOM and partners for Hampton Roads Planning District Commission, Virginia. https://www.hrpdcva.gov/departments/joint-land-use-studies/



Concluding Thoughts: The Resiliency Lens

- Uncertain future processes vs. confidence in actions
- Regional resiliency assessments
- Multi-jurisdictional cooperation
- Robust asset management
- No regrets

William Miles, P.E.
Bergmann

Presenting for Jan Brooke
PIANC PTGCC Chair and NavClimate Focal Point

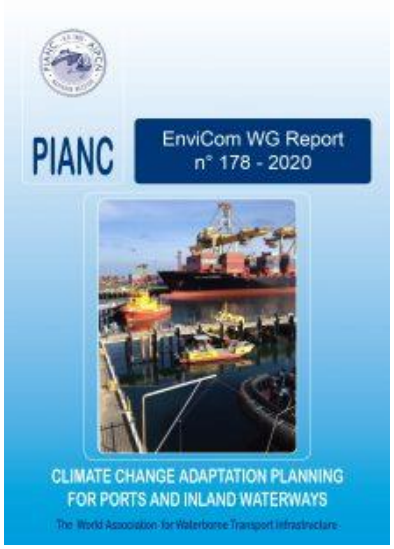
PIANC Climate-Related Initiatives

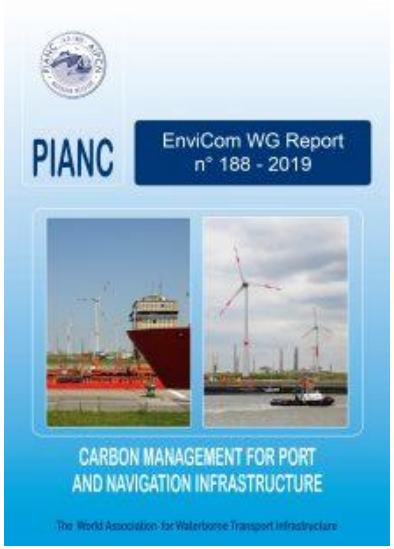
- Permanent Task Group on Climate Change **PTGCC**: a cross-Commission group dealing with internal PIANC climate issues (Working Groups, events, Declaration)
- PTGCC contributes PIANC's technical expertise to Navigating a Changing Climate

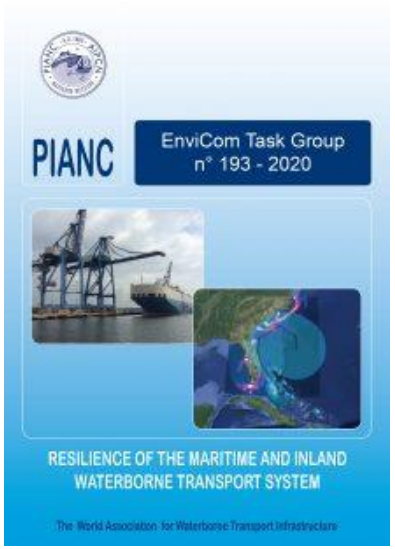
- **Navigating a Changing Climate**: a PIANC-led 'Marrakech Partnership' initiative
- Set up in 2015 under the UNFCCC non-state actor process
- Nine partners: PIANC, Inland Waterways International plus international associations of ports and harbours, maritime pilots, harbour masters and others
- Concluding events for NavClimate's 2015-2020 programme being held in 2021
- A new lead partner currently being sought for a second NavClimate programme

PIANC Climate-Related Resources (1)

- **Technical Working Group reports** on Climate Change Adaptation; Carbon Management; and Resilience of the Maritime and Inland Waterborne Transport System
- More climate-related publications in the pipeline, including from PIANC's Inland Navigation Commission

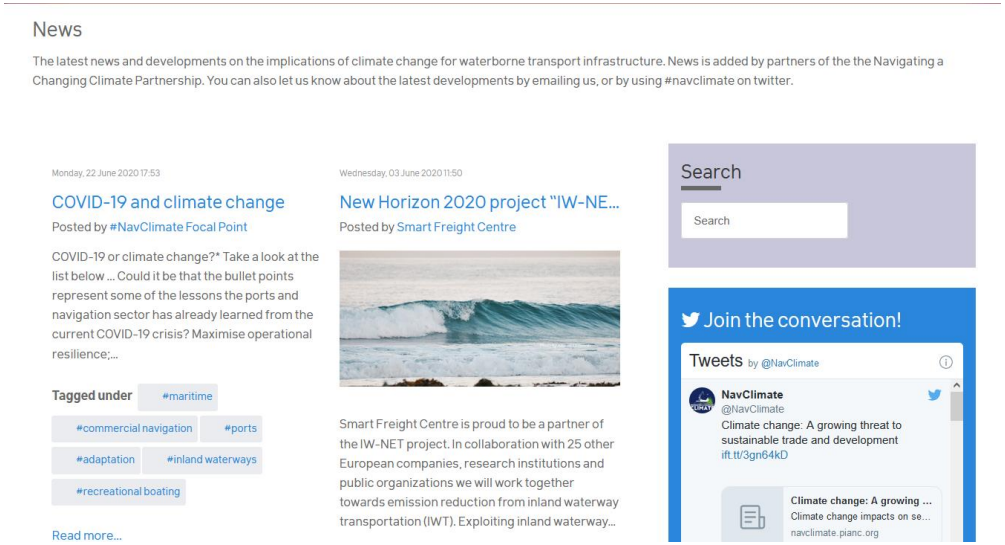


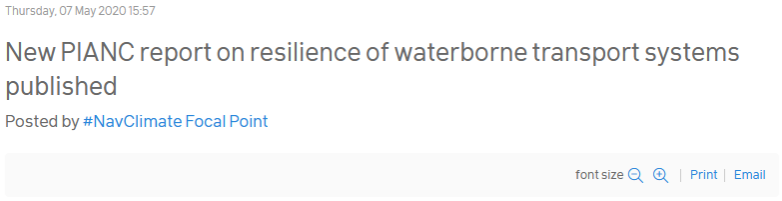




PIANC Climate-Related Resources (2)

- **Navigating a Changing Climate website** https://navclimate.pianc.org/
- Searchable newsfeed at https://navclimate.pianc.org/news - links to news, publications, event information, etc. provides a resource for the wider sector





Examples of Climate-Related Events

- **Sediment management opportunities to address the climate change challenge**. Virtual joint NavClimate event hosted by SedNet, the European sediment network. February 2021. Outcomes available at https://sednet.org/wp-content/uploads/2021/06/Summary-and-outcomes-NavClimate-SedNet.pdf
- **Working with Nature for climate-resilient ports and waterways**. Virtual joint event NavClimate and PIANC EnviCom. September 2021. Call for presentations made June 2021. Outcomes will be posted on PIANC and NavClimate sites
- **Role of ports in decarbonising the transportation industry**. Planned PIANC UK event, October 2021
- Other climate change-related content in 2021 at events organised by NavClimate partners International Association of Ports and Harbors; European Sea Ports Organisation, IMarEST, Smart Freight Centre as well as World Canals Congress …

QUESTIONS?

Burton Suedel
US Army Corps of Engineers
Burton.Suedel@usace.army.mil

Brian Joyner
Moffatt & Nichol
bjoyner@moffattnichol.com

Bill Miles
Bergmann
bmiles@bergmannpc.com

Canal at Tournai, Belgium