Adaptations for Operations, Infrastructure and Policy

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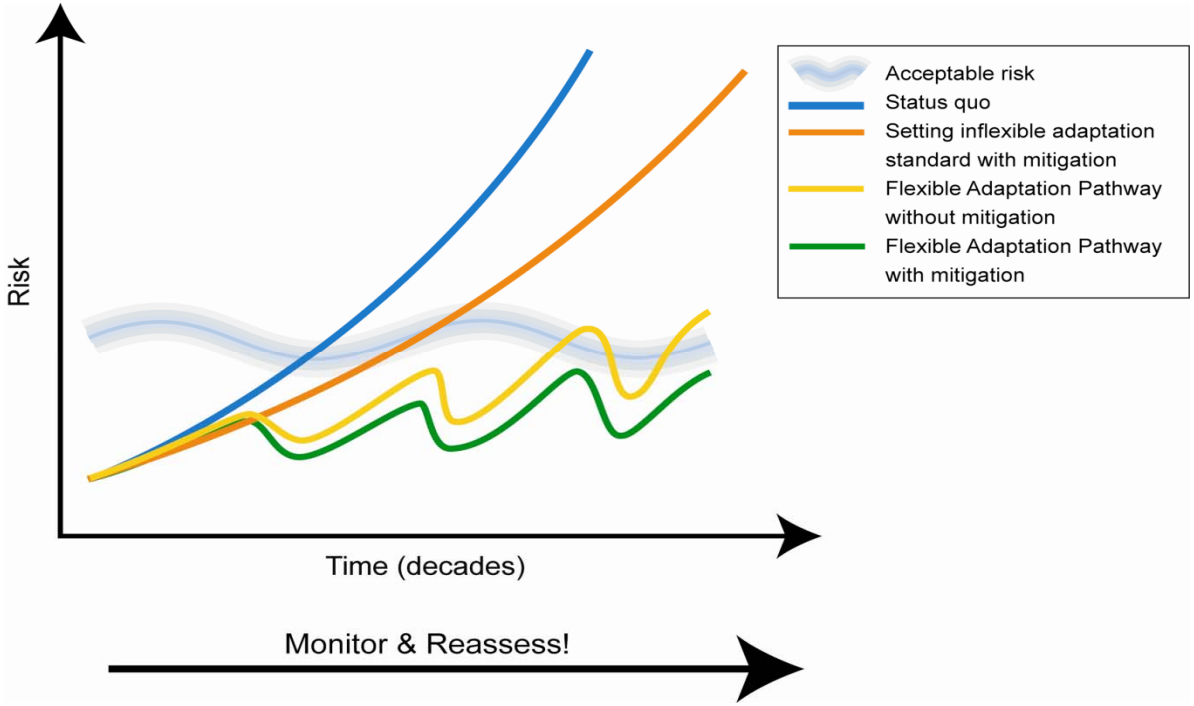
Adaptation: Unified But Also Composed of Many Segments

- Adaptation to climate change is unified by the framework of adaptation assessment and the need for long term adaptation plans
- Adaptation is in practice also segmented
  - By type: maintenance and operation, infrastructure, policy
  - By time period: short-, medium- and long-term
  - By cost: easily funded, extremely capital-intensive

Flexible Adaptation Pathways: a Useful Principle in Adaptation Planning



Key elements to achieve Flexible Adaptation Pathways are a guiding framework, stakeholder engagement, expert knowledge providers, recurring assessment process, Action Plans by decision-makers, and vertically/horizontally integrated projects with ongoing evaluation

Source: Major and O'Grady, 2010

Prioritization

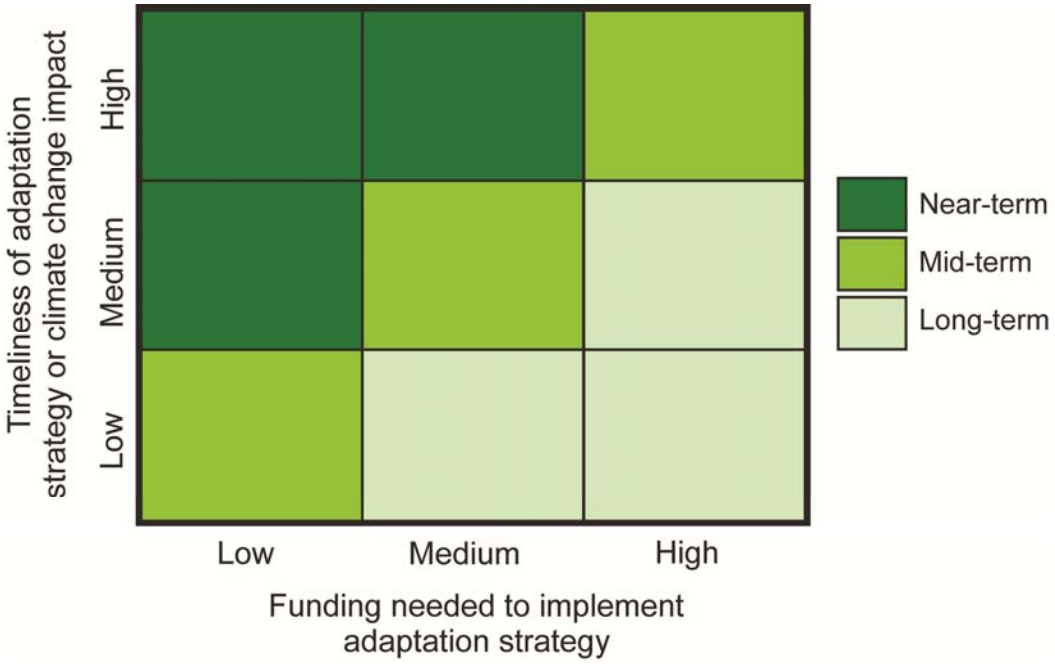
TABLE 5. An Example of a Generalized Strategy Prioritization Framework

Adaptation Strategy	Strategy Cost (1 = low to 3 = high)	Strategy Feasibility (1 = high to 3 = low)	Timing of implementation (1 = high to 3 = low)	Efficacy (1 = high to 3 = low)	Resiliency rating (1 = high to 3 = low)	Co-benefits (1 = high to 3 = low)	Average*	Notes & institutional considerations
Strategy 1	1	1	1	2	2	2	1.8	
Strategy 2	3	2	2	1	3	2	2.2	

**1 = high priority strategy, 2 = medium priority strategy, 3 = low priority strategy*
Rankings are illustrative only

Source: Major and O'Grady, 2010

Step 4: Develop Initial Adaptation Strategies



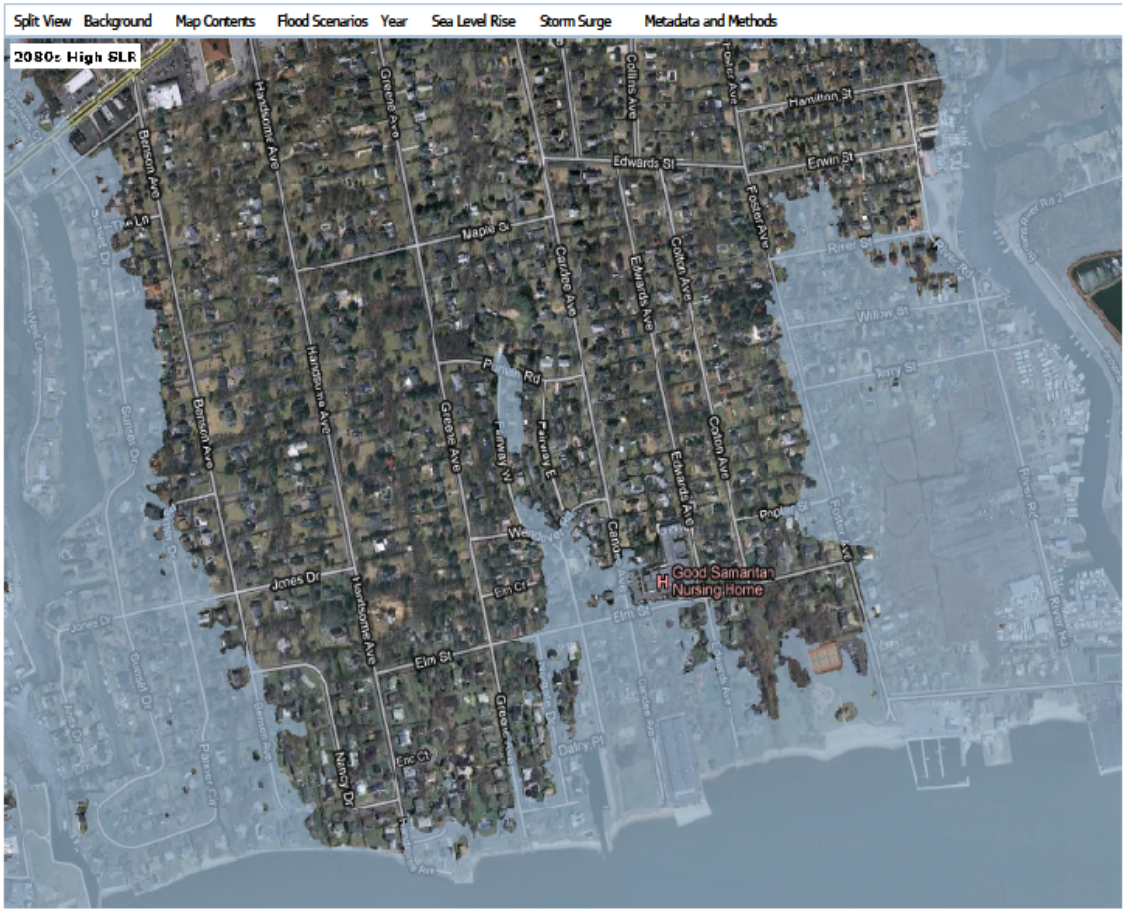
Source: Major and O'Grady, 2010

The Importance of Effective Communication

Interactive mapping tool developed by The Nature Conservancy and partners that shows inundation with different future sea levels and storm surge.

Map is for Sayville LI, with a 2080 high end sea level rise scenario. (Preliminary results for illustration only.)

An effective tool at public meetings. Source: http://Coastalresilience.org



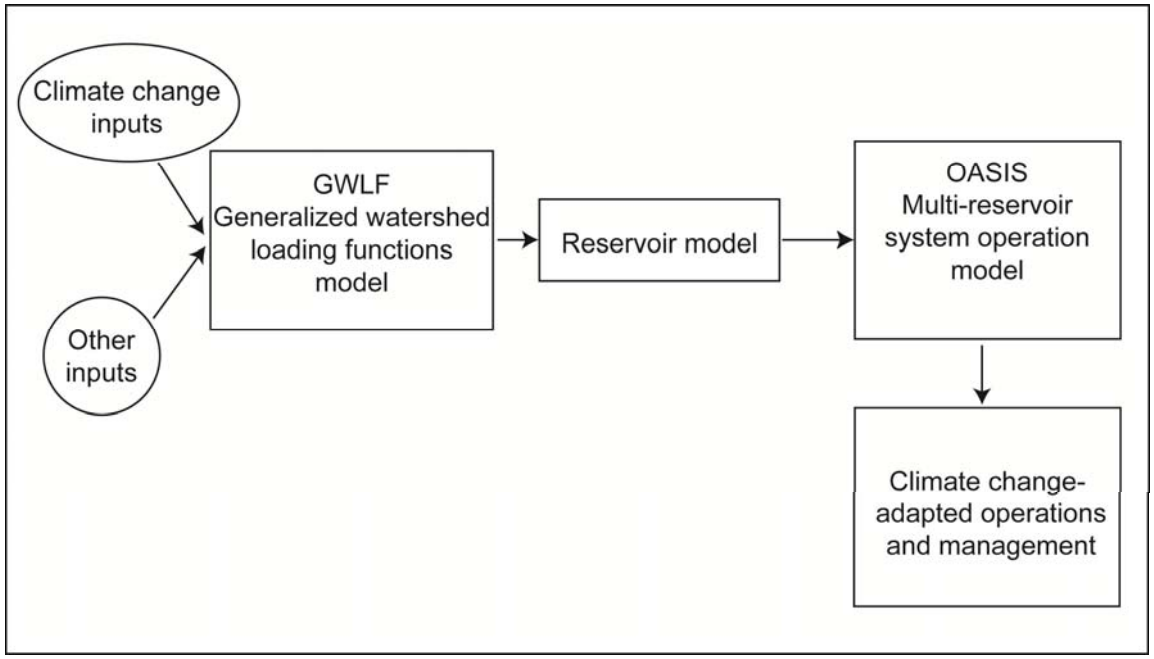
Range of Adaptations: A Useful Starting Point

TABLE 3.4 Water. Examples of ideas about specific options for facilitating water sector adaptation to climate change and identification of entities best poised to implement each option. Most adaptations are local and need to be tailored to local conditions. The suitability of each adaptation option must therefore be evaluated in the context of local conditions. Where possible, the table refers to assessments and syntheses that consider multiple adaptation options and provide references to specific studies.

Climate change	Impact	Possible adaptation action	Federal	State	Local govt.	Private sector	NGO / Indiv.
Higher temperature and reduced precipitation	Insufficient water supplies	Enhance supplies through traditional supply approaches including dams, larger reservoirs and other storage facilities, importing water or transferring water between basins (IPCC4; IPCC3; CALI; NRC)[a]. Other approaches include increasing system redundancy to ensure backup supplies, sharing integrated facilities between jurisdictions and sectors, obtaining a portfolio of multiple sources of water, including reuse of municipal wastewater (IPCC4; IPCC3; USGS; NRC; CCAWS)	■	■	■		
		Purchase alternative supplies through water trading and exchange (USGS; IPCC4). Store water during wet years or seasons (conjunctive management).		■	■	■	
		Participate in water supply protection through watershed management, including protecting surface water sources and groundwater recharge zones	■	■	■	■	■
		Encourage water harvesting and gray water use (NRC; IPCC4; CALI; IPCC3)					

Source: National Research Council, 2010

Operations and Maintenance Example: Climate Scenarios and Watershed Models (in operation now)



Source: Major and O'Grady, 2010

“Soft” Infrastructure: Architects’ Ideas for New York Harbor

A team of architects, engineers and planners, using as a base the sea level rise scenarios in Horton and Rosenzweig, 2010, developed “soft” infrastructure proposals for adaptation to climate change in New York Harbor. These include:

- Offshore windmills
- Oyster beds
- Artificial islands
- Subway car reefs
- Offshore piers
- New wetlands
- Piers and slips

These and other proposals are described in the web record of the *Rising Currents* exhibit, Museum of Modern Art, NY, http://www.moma.org/visit/calendar/exhibitions/1031

Infrastructure: Rotterdam, the Floating Pavilion

•Floating Pavilion is operational

•A Dutch company is commercializing this technology for housing and other structures

Reference: http://www.rotterdamclimateinitiative.nl/documents/Persberichten/RCP-08102009-English-persbericht-pavilion.pdf

Infrastructure: Large Tidal Barrier: the Narrows, New York Harbor

- One of 3 proposed barriers
- Alternative is one barrier further out
- Environmental and other impacts not studied

Source: Aerts et al., 2009

Policy measures

- Interagency cooperation in adaptation
- Conservation measures
- Physical linking of regional systems
- Staff training for adaptation
- Encourage domestic and international conference participation and publication by staff
- Evacuation planning

Range of Adaptations: Local Example

Adaptations to Climate Change and/or Current Variability, with Locations and Costs in the New York City region. Many adaptations to climate change are also adaptations to current variability

Adaptation	**Climate (current or future) and/or other variables**	**Location and year of proposal or project**	**Estimated Cost ($ as of plan date)**
Reconnecting a salt marsh	Adapt to development	LI Sound (CT shoreline) (2003)	Total cost $60,000 to $141,000 for 10 acres
Wetlands restoration	Sea level, storm surge	Jamaica Bay-Elders West (2010)	$10 million for 40 acres
Wetlands restoration	Sea level, storm surge	Soundview (2010)	$5 million for 4 acres
Sea wall repair	Sea level, storm surge	Roosevelt I. (2001)	$6,222,000
Beach nourishment	Sea level, storm surge	Coney Island (1995)	$9,000,000
Beach nourishment	Sea level, storm surge	Westhampton Beach (1996)	$30,700,000
Storm surge barriers	Sea level, storm surge	NY Harbor (2009)	$9.1 billion for 3-barrier system

Source: Leichenko et al., 2011

The Need for Case Studies

Benefit Cost Analysis of Potential Climate Change Adaptation: Raising Local Streets Subject to Flooding

Activity in Freeport, NY	**Total Costs (2002 $M)**	**FEMA Costs (2002 $m)**	**Best Estimate Benefits (2002 $M)**	**Best Estimate Benefit-Cost Ratio**	**BCR Range**
Street grading/elevation	$2.76	$2.07	$6.52	2.4	0.19-9.6

- It is important that more case studies be developed, including cost analysis and analysis of design changes depending on date of implementation

Source: adapted from: Multihazard Mitigation Council, 2005, p.107,Table 5-14.

Immediate Needs

- Prepare complete high-resolution LIDAR (Light Detection and Ranging) elevation datasets.
- Provide a detailed inventory of as-built infrastructure within, say, 10 to 20 feet (3m to 6m) of current sea level, calibrated to the current geodetic datum, NAV88.
- Review all large-scale infrastructure projects currently in the planning stage to make appropriate adjustments for adaptation to climate change.
- Develop detailed benefit-cost estimates for different available adaptation options to assist in the development of a climate adaptation plan for various time periods.
- Prepare a set of plans for adaptation, using flexible adaptation pathways for the short, medium and long terms. Review on a regular basis as new information on climate variables accumulates.
- Continue to utilize the latest climate change inputs as a central element in planning for climate adaptation.

Future Prospects

- Effective planning for adaptation to climate change is possible
- At least the next few decades will be manageable, but plans for longer periods should be made now
- If humans deal well with mitigation, adaptation will still be needed but on a slower schedule; however:
- If warming continues at a rapid pace, need for adaptation will become more urgent more quickly
- We have time, but the time is now

Sources

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