Water Utility Climate Adaptation and Resilience Planning: Some Guiding Principles

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Overview

• Review the challenge of climate adaptation
• Offer some basic principles for adaptation
• Discuss methods for assessing adaptation options
• Address non-climate variables of concern
The Challenge of Adaptation to Climate Change

• We cannot adapt to a specific forecast of future climate
  • At best we know the direction of change of key variables
  • Some key aspects are uncertain

• Challenge is how to make decisions about investments and other decisions with long lifetimes in light of the uncertainties?

• This situation is not unique to climate change adaptation

• There is a path forward!
One Strategy – Wait for Better Information

• The science is unlikely to improve dramatically
  • Even after 30 years, some fundamental uncertainties such as climate sensitivity remain

• Decisions which can be affected by climate change, such as infrastructure and development, still have to be made
  • Either they incorporate climate change considerations or they do not

• Sensible decisions can be made in light of uncertainty
Two Guiding Principles for Adaptation

• Make decisions that work or function over a wide range of possible conditions; what is desired is:
  • Flexibility
  • Robustness
  • Resilience

• Consider Economics
  • Basically, benefits should exceed costs
  • Complicated when benefits (avoided impacts) may not happen or be much larger decades into the future
    • Discounting – do not spend a lot now to avoid risks many years from now
Define Our Terms

• Flexibility
  • The adaptation can accommodate different conditions by adjusting

• Robustness
  • The adaptation can withstand widely varying conditions

• Resilience
  • Classic definition concerns capacity to recover from shocks
  • In context of climate change has been used to also include withstanding shocks

• The terms are often used interchangeably in the climate change context
Adaptation Examples that Satisfy These Principles

• Incremental investments
  • Low cost adjustments to infrastructure
    • Can buy additional protection now and into the future

• Maintain options
  • Buy land on which can build infrastructure in the future

• Diverse portfolio of options (for example, supply)

• Use resilient or flexible management systems
  • Water markets are responsive to changing conditions
How Do We Assess Adaptation Options?

Two basic approaches:

1. Traditional assessment approaches
   • Often used to help identify an optimal solution

2. Deep Uncertainty approaches
   • Recognize “deep uncertainty” is part of problem and try to identify adaptations that can work across an array of possible outcomes
Traditional Assessment Approaches

1. Benefit-Cost Analysis (BCA) - King of traditional approaches
   • Express all benefits and costs in common unit, typically money
   • Seek to maximize
     • Net Benefits
     • Benefit cost ratio

2. Cost-effectiveness
   • Seek the least costly way to achieve a common outcome

3. Multi-criteria assessment
   • It is typically applied where different metrics are used

4. Triple Bottom Line (TBL) splits out financial, social, and environmental benefits
   • TBL can be used in the above approaches

Traditional approaches work best when uncertainties are well-characterized
   • Can also be applied when they are not; for example, for individual scenarios
Challenge of Applying BCA to Climate Change

- Probabilities of outcomes are not known
  - There are no reliable probabilities on GHG emissions
  - Challenging with regional climate change
- Timing of impacts
  - How to assess risks to life and limb over generations
  - Property is more straightforward but even that has challenges

Cost to adapt  Adaptation Benefits

$$ < $$$$$$\quad \checkmark$$

$$ $$ > $$$ \quad \times$$

$$ $$ = $$$ \quad ?$$
Cost-Effectiveness

• Compare relative cost of achieving same or similar objectives
• Key is that objective must have same quantifiable value(s)
• Examples:
  • $ per life saved
  • $ per Disability Life Year (DALY)
  • $ per unit of water supply
### Inability to Continue Reliance on Evaporative Cooling and Chillers, Which Depend on Water

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Evaluation criteria and score</th>
<th>Recommended approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create and implement a climate monitoring and communication system</td>
<td>Create and implement a system to monitor and communicate both indoor and outdoor climate variables, including building temperatures so staff can dress accordingly and lightning and outdoor temperature predictions for outdoor safety</td>
<td>Effectiveness: Fair</td>
<td>Feasibility: Fair</td>
</tr>
<tr>
<td>Add conventional backup air conditioning</td>
<td>Add conventional coolers and backup air conditioners for use during periods of prolonged or intense humidity or heat</td>
<td>Effectiveness: Good</td>
<td>Feasibility: Fair</td>
</tr>
<tr>
<td>Retrofit high-performance computer</td>
<td>Retrofit the high-performance computer so that it is not cooled by chillers that rely on water</td>
<td>Effectiveness: Fair</td>
<td>Feasibility: Poor</td>
</tr>
</tbody>
</table>
Deep Uncertainty Philosophies

• Philosophies
  • Risk Management
  • Adaptive Management

• Types of Adaptation
  • No Regrets
  • Low Regrets
  • Incremental Adaptation
Philosophy: Risk Management

Consider likelihood and consequence of outcomes

Source: Major and O'Grady, 2010
Philosophy: Adaptive Management

• Recognizes that we can make adjustments as conditions change
• Design systems/decisions so future conditions can be incorporated
  • Option to use land for investment in future such as a reservoir
• Examples:
  • Thames River barrier to protect London from storm surges over rest of century
  • MWD organized near-term investments in local supplies expecting some will need to expand and some be contracted as demand, regulations, climate, another factors change
• ASCE recommends adaptive management approach be applied
Adaptive Management for Uncertain Magnitudes of SLR in the Thames River
Adaptive Management Over Time for Flood Risks in Rotterdam
Types of Adaptation: No Regrets and Low Regrets

• No Regrets
  • Adaptation can be justified without consideration of climate change
  • Greater benefits are expected with climate change

• Low Regrets
  • Done to incorporate risks of climate change
  • Typically small investment if only considering long term benefits
  • “Low regret” on cost side if invested too much
  • Might have higher regret if invested too little
Types of Adaptation: Incremental Adaptation

- Incrementally increase size of investment or make other incremental change to adapt to expected climate change.

- Makes most sense when cost of incremental change is low.

- Appropriate for decisions with long-life time.

- Can be inappropriate if fundamental change is needed.
Decision Support Tools

• Emphasis is on “Support”
  • Tools do not tell you the “right” decision
  • But can help organize complex information and get insight on adaptation options

• Advantage is they can serve as a mechanism to bring stakeholders together to work through understanding risks and options so as to:
  • Reduce conflict
  • Identify key uncertainties
  • Suggest approaches or strategies that can work
Other Key Factors Will Change And Should be Considered

- Population
- Income
- Technology
- Preferences/Culture

Key point is not to project these but understand how change in these and other factors can change vulnerability of a system to climate
How Precise Do We Need to Be in Our Projections?

Adaptations Often Incorporate Ranges or are Incremental

• Culverts can accommodate a wide range of flow and come in incremental diameters from 6” to 1’
• Decisions on sea level rise and flooding such as freeboard are often made in 1’ increments
Key Takeaways

- The challenge of anticipating climate change is making decisions in light of uncertainty
  - Note: that is the challenge of anticipating any future change
- Uncertainty approaches are better suited to identify and assess options for anticipation of climate change
  - Adaptive management, risk management
  - No regrets, low regrets
  - Incremental, modular (scalable), diversification
- Decision support can help in analyzing options
  - Traditional assessment approaches (e.g., BCA) can still be useful
- Other factors besides climate are also changing and can be relevant
Final Thoughts on Preparing for Climate Change

• Don’t wait for improved science  
  • You’ll be waiting a long time

• “Plan for your next disaster, not the last one.””  
  • From a story on how flooding devastated the University of Iowa campus

• There is a path forward