CLIMATE CHANGE ADAPTATION in MASSACHUSETTS

Kathleen Baskin
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Content

- The Global Warming Solutions Act and the Adaptation Advisory Committee
- Observed Climate Change and Impacts
- Predicted Climate Change
- Impacts and Vulnerabilities
- The Report
- Ongoing State Agency Activities
- Immediate Next Steps
The Global Warming Solutions Act (2008)

**Mitigation** – Reduce Greenhouse Gas (GHG) Emissions

- Track and report GHG
- Develop 1990 Baseline and 2020 “Business as Usual” GHG projections
- GHG reductions of 10-25% by 2020, 80% by 2050 (compared to 1990)
- Advisory Committee to Oversee Reduction Planning

**Adaptation** – Prepare for Effects of Climate Change

- Advisory Committee to Analyze Adaptation Strategies
GWSA - Adaptation Advisory Committee

- EEA Secretary Convene Climate Change Adaptation Advisory Committee (CCAAC)
- CCAAC - Prepare report to Legislature: “analyze strategies for adapting to the predicted impacts of climate change in the Commonwealth”
- CCAAC and Development of the Report
  - CCAAC: Consisted of 35+ members; 3 meetings
  - 5 Subcommittees: 200+ participants; 4-6 meetings each
  - 9 Public Meetings
  - 4 Legislative Hearings

Executive Office of Energy and Environmental Affairs
Advisory Committee Expertise

- transportation and built infrastructure
- commercial, industrial and manufacturing activities;
- low income consumers
- energy generation and distribution
- land conservation
- water supply and quality
- ecosystems dynamics
- coastal zone and oceans
- rivers and wetlands
- recreation
- local government
- public health
- insurance, forestry
- agriculture
- public safety
Observed Northeast Climate Impacts

- Warmer annual temperatures - up 2°F since 1970
- Warmer winters - up 5.2°F since 1970
- Sea surface temperatures – up by 2.3°F between 1970-2002
- Sea level rise – 22 cm between 1921-2006
- Decreasing winter snowpack & earlier snowmelt
- Earlier flowering plants
- 24% breeding bird species have smaller distributions since 1979
- Earlier nesting for 28 migrating east coast bird species
- More frequent extreme summer heat
Observed Annual Average Temperature

BLUE HILL OBSERVATORY ANNUAL TEMPERATURE, 1831-2008

Maximum: 10.5 deg C (50.9 deg F), 1999
Minimum: 5.8 deg C (42.5 deg F), 1875
Record Mean: 8.2 deg C (46.8 deg F)

10-Year Mean  30-Year Mean

Note: Plot includes temperature data for 1831-1884 from Milton and Canton that were adjusted to the Blue Hill summit location.
Michael J. Iacono, Atmospheric and Environmental Research, Inc. / Blue Hill Observatory
Observed Mean Sea Level Rise in Boston

Source: http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8443970
## Predicted Northeast Climate Change Impacts

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CURRENT (1961-1990)</th>
<th>PREDICTED RANGE by 2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Temperature ($^\circ$ C)</td>
<td>8</td>
<td>10 to 13</td>
</tr>
<tr>
<td>Annual Precipitation (inches)</td>
<td>41</td>
<td>43 to 46</td>
</tr>
<tr>
<td>Sea Level Rise (inches)</td>
<td>3.1</td>
<td>11 to 79</td>
</tr>
<tr>
<td>Streamflow-spring peak flow (days from Jan 1)</td>
<td>85</td>
<td>74 to 75</td>
</tr>
<tr>
<td>Short Droughts (#/30 yr)</td>
<td>13</td>
<td>16 to 23</td>
</tr>
<tr>
<td>Snow Days/Month (days)</td>
<td>5</td>
<td>3 to 1</td>
</tr>
<tr>
<td>Length of growing season (days)</td>
<td>184</td>
<td>213 to 227</td>
</tr>
</tbody>
</table>

(Hayhoe et al., 2006)
Sea Level Rise: Northeast Predictions
How hot will it feel?

Source: NECIA/UCS, 2007 (see: www.climatechoices.org/ne/)

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Potential Impacts and Vulnerabilities

• Temperature Increases
  - Air quality (asthma)
  - Extreme heat and heat stress
  - Warm weather energy demand
  - Irrigation demand on public water supply

• Precipitation Changes: to amount, frequency and timing - more droughts and floods
  - More winter precipitation as rain and not snow
  - More extreme precipitation & flooding
  - Current 100-year flood could occur every 2-3 years by 2100
  - Increased CSO discharges
  - More low streamflow periods, decreased summer water supply
  - Decrease in traditional winter recreation
Examples of Potential Vulnerabilities

- **Sea Level Rise and Flooding**
  - Coastal inundation and storm surges
  - Property damage, loss of natural habitats
  - Interruption of key services (emergency response, infrastructure)

- **Extreme Weather Events**
  - Damage due to high winds, hurricanes, storm surges, waves, ice storms
  - Increased flooding
  - Reduced emergency response capacity
THE REPORT: Cross-Cutting Strategies

- Combine mitigation and adaptation strategies
- Identify and fill critical information gaps
- Advance risk and vulnerability assessments
- Evaluate and prioritize adaptation strategies for implementation
- Support local communities
- Improve planning and land use practices
- Enhance emergency preparedness
- Encourage ecosystem-based adaptation
- Continue to seek expert advice and stakeholder input
- Ensure agency and regional coordination
- Promote communication and outreach
- Start now – be bold!
THE REPORT: Natural Resources and Habitat

• Identified Ecosystem Types in MA
  Forest, Coastal, Aquatic, Wetland

• Established Guiding Principles
  • Protect ecosystems of sufficient size, across environmental settings
  • Maintain large-scale ecosystem processes, prevent isolation; maintain diversity
  • Use nature-based adaptation solutions; embrace adaptive management

• Developed Broad Categories of Strategies
  • Land Protection
  • Policy, Flexible Regulation, Planning and Funding
  • Management and Restoration
  • Monitoring, Research and Adaptive Management
THE REPORT: Key Infrastructure

• Sub-Sectors
  
  Energy (electric, gas, petroleum)  
  Water (supply, wastewater, stormwater)  
  Waste (solid and hazardous)  
  Telecommunications  

  Transportation (land, sea, air)  
  Dam Safety and Flood Control  
  Built Infrastructure and Buildings

• General Strategies
  
  Accurate Mapping and Surveys using current & future conditions  
  Timely maintenance, Building Redundancies  
  Increased conservation, Efficiencies & Reuse of resources  
  Change Land Use, Design, Site Selection and Building Standards  
  Enhance Natural Systems  
  Identify Lead Times for Adaptive Construction

• Key Infrastructure Interconnections
  
  Energy and Transportation  
  Within Water Resource Sectors – integrated water to mimic natural hydrology  
  Increased Conservation Measures and “Green” Designs – in energy, transportation, and using urban forests

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THE REPORT: Human Health and Welfare

• **Sub-Sectors**
  - Public Health (infrastructure and vector-borne diseases)
  - Air Quality (ambient and indoor)
  - Water Quality/Sanitation
  - Agriculture and Food Systems
  - Vulnerable Populations

• **Advancing Adaptation and Mitigation from a Public Health Perspective**
  - A Healthy Cities Initiative
  - Alternative Fuel Vehicles
  - Improving Electricity Grid Infrastructure

• **General Strategies**
  - Enhance regionalization efforts to address non-emergency situations
  - Relocating vulnerable health care facilities
  - Improve capacity to detect and treat against pests and diseases
  - Address and maintain outdoor air quality
  - Improve indoor air quality
THE REPORT: Local Economy and Government

• **Sub-Sectors**
  - Agriculture
  - Cultural Resources
  - Forestry
  - Government
  - Fisheries
  - Manufacturing (computers, electronics, fabricated metal, machinery)
  - Services Industry (real estate mgmt, tourism and recreation, health care, higher education)

• **Local Economy Strategies**
  - Industries establish redundant routes and sources
  - Develop local and renewable sources of energy
  - Assess and protect vulnerable facilities and cultural sites
  - Insurance markets to better capture future climate risks

• **Government Strategies**
  - Sponsor data collection and research;
  - Include predictions in procurement and grant criteria
  - Develop standards, codes and regulations
  - Enhance emergency preparedness and essential services
  - Improve planning and land use practices
THE REPORT: Coastal Zone and Oceans

- **Common Theme – Strong Planning, Management and Collaboration!**
- **Residential/Commercial Development, Ports and Infrastructure**
  - Avoid vulnerable areas; design according to projected risk
  - Decrease repetitive losses to existing development
- **Coastal Engineering for Shoreline Stabilization and Flood Protection**
  - Assess local erosion and flooding, evaluate coastal hazards mgmt approaches
  - Incorporate higher sea levels in new coastal designs
- **Coastal, Estuarine, and Marine Habitats, Resources, and Ecosystem Services**
  - Bolster land conservation
  - Improve resiliency through habitat restoration, green infrastructure, design
  - Reduce anthropogenic stressors through improved water quality
  - Incorporate flexibility into fisheries mgmt systems
  - Improve shellfish management
  - Increase monitoring, observations, and assessments
Potential Coastal Flooding in Boston
Under Present and High Emission Sea Levels

Source: NECIA/UCS, 2007 (see: www.climatechoices.org/ne/)

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LiDAR (Light Detection and Ranging)

- Cooperative project with contributions from federal, state and research agencies (USDA, WHOI, MassDOT, EEA, FEMA)
- Highly detailed elevation data for coastal MA
- Detailed terrain model, with data points every meter or two measuring vertical elevation to within 15 cm or better
- Data suitable for
  - determining vulnerability of built infrastructure
  - analyzing drainage at a watershed or even a town-wide scale
  - doing preliminary planning for major construction projects
  - characterizing habitat and vegetative cover
  - deriving the locations of structures and many other purposes
- Data supports detailed analysis of inland flooding and coastal inundation scenarios associated with extreme weather events
LiDAR in Massachusetts

LiDAR status for Mass. as of November 2011
- new ARRA data expected by Dec. 2011
- Federal and State existing data
Examples of Ongoing EEA Agency Activities

• DAR, DFG, DCR, CZM: Protecting existing habitats, forests and farms through land acquisition & conservation restrictions

• DAR: Promoting buy-local, pest management, encouraging best practices to control runoff of pesticides, nutrients & fertilizers

• DFG: Climate-smart State Wildlife Action Plan

• DCR: Regional precipitation modeling (using data in design)

• DEP: Promoting “green infrastructure,” assisting with renewable energy, conservation and treatment plants

• CZM: StormSmart Coast tools, technical information (i.e. visualization of sea level rise and coastal surges)

• DOER: Zero Net Energy buildings
Examples of Activities at Other State Agencies

**Department of Public Health**
- CDC grant supporting needs and capacity assessments to create plans for towns to address health consequences of climate change

**MassPort**
- Developing complete topographic ground survey information for its waterfront properties in Boston Harbor
- Incorporating design refinements in response to projected sea level rise in Green Bus Depot (under construction)
- Emergency response planning in response to sea level rise

**Department of Transportation**
- Determining flood prone areas on highway network; developing methodology for ranking vulnerability of assets
- Incorporating climate change effects into stormwater design & engineering
- Pervious pavement: 25% of all new non-highway facilities by 2015, 75% by 2020
- Partnering with federal agencies to help develop local/regional climate prediction model to meet engineering needs
- Energy efficiency, audits, solar panels, electric vehicle charging stations, wind turbine, transforming highway fleet to renewable fuels
Immediate Next Steps

• Agencies evaluating potential strategies

• EEA and agencies will assess feasibility of implementation of these strategies

• Stakeholder group to assess impacts of climate change as part of MEPA review
Thank you

Report Website:
http://www.mass.gov/environment/cca