This is a set of slides from a presentation given at

**RISING WATERS**

*Maryland Prepares for Floods & Sea Level Rise*

2011 Water Resources Symposium

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Watershed Management and Resilience in the Face of Climate Change

Photo: Jane Thomas, UMCES
The New “Normal”

• Piedmont most affected
• Rising
  – Rainfall (~2”)
  – Max Temp (1.4 F)
  – GDD (60-80)
• Falling
  – Snow (2-4”)
  – HDD (80-100)
2010 and 2011: A Time for Breaking Records

• August and September of 2011 wettest
• July of 2010 and 2011 hottest
• Hurricane Irene set new records for stream gages in some parts of Maryland and below a major dam (Conowingo)
Climate Change and Our Water

Climate change impacts
1. Increased frequency and variability of extreme rain may lead to flooding, surface runoff, and high energy flows, impacting water quality, stormwater infrastructure, and water and wastewater treatment infrastructure.

2. Increased likelihood of summer drought may affect stream ecosystems, lead to increased demand for irrigation, and result in water shortages.

3. Saline intrusion of freshwater resources may occur as a result of the combined effects of sea level rise and storm surge, and as a result of increased rates of groundwater withdrawal.

4. Increased withdrawal due to drought may reduce groundwater supplies.
What about Extremes?
Climate Change Threatens Ecosystem Health

- Water temperatures increase by up to 6°F
- Smaller fish
- Loss of small wetlands and intermittent or ephemeral streams
- Habitat and water quality degradation
Flooding Will Place our Health at Risk

• Rain and storms have driven 3.3 Billion gallons of sewage into waterways in Maryland

• More runoff places drinking water at risk
Sector-Based Adaptation Planning
Basic Principles for Adaptation

- Maintain benefits of current programs and seek co-benefits
- Invest according to risk
- Limit creation of additional risks
- Measures should not increase greenhouse gases or stresses to the environment
Resilient Watershed Characteristics

• Riparian Zones
  - Wide as possible
  - Floodplain connection
  - Diverse vegetation
  - Few invasive species

• Habitat
  - Deep pools
  - Bank habitat
  - Complex
Building Resilience: A Focus on Ephemeral Habitats

- High elevation
- Seeps/springs
- Vernal pools
- Non-flowing streams
- Cool water hyporheic inflows
- Tributary junctions
Enhance Ability to Detect Change

• Identify climate sensitive regions and ensure stream gages are located
• Protect reference sites
• Couple with temperature, nutrient and weather data
• Enable communities to understand risks and participate in management strategies
  - Education and climate knowledge
  - Local governance
  - Monitor, evaluate and share information
Improve Water Supply Resilience

- Develop state water plan
- Encourage counties to plan across boundaries in WREs
- Integrated management of surface and groundwater
- Upgrade buildings, distribution systems, and other infrastructure to withstand flooding events
- Identify backup and alternative water sources
Protect Water Supplies

• Avoid development in high risk areas
• Prioritize funding streams for source water/wellhead protection
  – In water and sewer plans
  – Water Resource Elements
  – CW/DW SRF
  – Ecosystem Markets and land conservation efforts
Value Natural Processes

• Address ecosystem services
• Increase floodplain connectivity and wetland protection and restoration
Enhance Protection of Ephemeral and Headwater Systems

- Develop standardized field protocol and mapping effort
- Protect through local planning process
- Develop adequate impact regulations
Reduce Impacts of Flooding and Stormwater

- Evaluate design guidelines and accelerate ESD
- Ensure sustainable flows
- Reduce impervious surface cover
ESD: A Climate Buffer

- Conventional
- SWM
- ESD
- Open Space

Change in Runoff Volume (%)

Precipitation Scenarios:
- V(-20)
- Historical
- I(10)
- I(45)
- I(10)+V(3)
- V(+20)
Guidance for Land Use Planning

Maryland Flood Hazard Map

Legend
- Water
- 100-yr Flood Plain
- 500-yr Flood Plain

Data was obtained from Maryland Emergency Management Agency State Hazard Mitigation Plan
Moving Forward

- Tools
  - Risk maps and web based tools
  - Guidelines for design and planning
  - Adaptation metrics
- Research
  - Socioeconomic, ecological, and regulatory impacts of strategies and policies
  - Coupling between mitigation and adaptation
  - Developing management thresholds
  - Changes in hydrology: flooding and water supply
- Education (e.g. www.madeclear.org)
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