Adaptation Technical Working Group
ADP Policy Options

Summary List of Draft Policy Options

Option No.	ADP Policy Option	Level of Support	TWG Drafters
ADP-1	Advancing Science Data and Analysis for Climate Change	Pending	Hilary Swain
ADP-2	Comprehensive Land Use Planning	Pending	Jim Murley
2.1	Local Government Level	Pending	-
2.2	Regional Government Level	Pending	-
2.3	State Government Level	Pending	-
ADP-3	Protection of Ecosystems and Biodiversity	Pending	Laura Gesselbracht
3.1	Uplands, Freshwater and Marine Systems	Pending	-
3.2	Beaches and Beach Management	Pending	Gary Appelson
3.3	Species Protection	Pending	-
ADP-4	Water Resource Management	Pending	Matt Alvarez. Jay Yingling
ADP-5	Built Environment, Infrastructure and Community Protection	Pending	Ricardo Alvarez
5.1	Building Codes and Regulation	Pending	-
5.2	Flood Protection	Pending	-
5.3	Beaches as Infrastructure (or part of 5.2?)	Pending	Ricardo
ADP-6	Transportation and Other Infrastructure	Pending	Kathy Neill (DOT)
ADP-7	Economic Development	Pending	Steve Adams
7.1	Tourism	Pending	Steve Adams
7.2	Other Resource-based Industries	Pending	Marine Resources Council & Steve Adams
7.3	Construction	Pending	Ricardo Alvarez
ADP-8	Insurance (Property and Casualty)	Pending	Kathy Baughman-McLeod
ADP-9	Emergency Preparedness and Response (Extreme Events)	Pending	Steve Adams
ADP-10	Human Health Concerns	Pending	Camille Coley

10.1	Health Care	Pending	-
10.2	Air Quality	Pending	-
10.3	Waste Water Treatment	Pending	-
10.4	Disaster Response	Pending	-
10.5	Medical Treatment and Biomedicine Development	Pending	-
ADP-11	Social Effects	Pending	Camille Coley
11.1	Social Justice Issues	Pending	-
11.2	Food and Water Security	Pending	-
11.3	Housing	Pending	-
11.4	Intersection of Climate Change and Human Behavior	Pending	-
ADP-12	Organizing State Government for the Long Haul	Pending	Steve Adams
ADP-13	State Funding and Financing	Pending	Pending
ADP-14	Coordinating with Other Regulatory and Standards Entities	Pending	Matt Alvarez
14.1	Federal Government	Pending	-
14.2	Professional Societies	Pending	-
ADP-15	Public Education and Outreach	Pending	Meg Lowman and Alex Score (WWF through Debbie Harrison)

Note: The numbering used to denote the above pending priority policy options is for reference purposes only; it does not reflect prioritization among these important draft policy options.

ADP-1. Advancing Climate Change Science Data and Analysis

Hilary Swain drafted ADP-1.

Description of Issues:

Florida is one of the most vulnerable areas in the world to the consequences of climate change, especially sea level rise and the possibility of increased hurricane activity (for recent review see e.g. FAU Murley et al. 2008). Regardless of the underlying causes of climate change, glacial melting and expansion of warming oceans are causing sea level rise, although its extent or rate for Florida cannot as yet be predicted with certainty. In addition, hurricane activity in the North Atlantic Basin has increased significantly in recent years, but there is controversy over whether the primary cause is global warming or natural weather cycles, making the long-term trend indeterminate at this time. These uncertainties make planning for Florida extremely difficult, not knowing which of Florida's barrier islands, floodplains, and what portions of major cities will be inundated, or when.

Scientific data, analyses, and predictive modeling are needed to understand how Florida's climate is likely to change, and what consequences are likely, as well as possible solutions. Focusing on four key issues will help advance the science.

- First, reducing uncertainty in climate projections and enhancing predictive power of climate models for Florida, especially their temporal and spatial resolution, is critical. Improving models requires addressing specific Florida considerations: strong marine influence and peninsula effect; the wide climate gradient from temperate north Florida to subtropical south Florida leading to variable regional predictions; lack of long-term physical climate measurements for historical trends (although proxies including lake sediments, speleothems, and tree rings are available); huge climate variability, especially in rainfall and hydrological responses, with other climate teleconnections such as the Atlantic Multi-decadal Oscillation AMO and ENSO events; complicating effects of the interaction of land use change (e.g. wetland loss) and climate change.
- Given climate modeling limitations for Florida the current planning focus on sea level rise and potential for increasing hurricane strength, is appropriate. Scientific data and analyses to predict other potential effects of global warming that could affect Florida are still extremely weak. We do not have data to adequately assess potential effects including increased drought, wildfires, flooding, and invasive species. Until models improve, appropriate risk management and adaptive management is challenging.
- Recognize that adaptability refers to the ability of humans to manage resilience -the capacity of the system (ecological, economic, social) to absorb the disturbance of climate change. Our science needs to address three crucial aspects of resilience; the *latitude* of the system, the amount of change Florida can withstand before switching over to another state or condition

from which it cannot recover its former function, *resistance*, which is the ease of difficulty making changes, and *precariousness*, which gauges how close the current system is to a switching threshold (Walter et al. 2004).

- Improving our understanding of socio-economic responses to alternative climate predictions will better guide public policy and incentive programs. New approaches and tools such as agent based models (ABMs) will provide a better framework to examine interactions of socio-economic and climate change. ABMs are computer simulations that represent policy or agent (e.g. homeowners, agencies, industry) decision-making and their interactions at multiple scales. ABMs can be coupled to spatially explicit factors so they can be used to link policy and agent decisions, and resultant responses at the landscape level.

Objectives: Describe the policy objectives for the ADP, broad scientific agenda that will continually update and refine climate models, and adaptively help to prioritize issues – what are the climate change trends we should be most worried about. . .

Assets at Risk: Scientific data and improved understanding of climate change is at the core of policy enumerating potential risks to Florida associated with global climate change in the context this specific issue area.

Existing Actions:

To be drafted by DEP staff.

Goals and Strategies:

Goal 1: Essentially every goal and strategy outlined in all the ADPs needs a measurable outcome, and scientific evaluation by which to assess whether the goal has been met. Evaluation should be science-based, using the complementary skills of climate scientists, ecologists, hydrologists, social scientists and economists. We encourage test programs and pilots to measure and assess alternative outcomes.

Strategy:

Goal 2: Foster and support Florida climate science research agenda with some broad priorities as outlined below. Consider a new Climate Change Scientific Advisory Council to advise state government on this research agenda. Establish and identify long-term funding to support research. Funding should be protected from short term economic or political cycles.

Priorities for Further Research and Analysis: Narrative describing critical gaps in knowledge to be addressed by the research community or further analysis among state agencies.

Florida needs to *emphasize collaborations with international climate scientists, to refine climate predictions for Florida*. Since climatological studies and modeling to date cannot reliably predict changes in Florida's climate, which is idiosyncratic because the Florida peninsula is surrounded by the Atlantic Ocean and the Gulf of Mexico, the state in partnership with federal agencies,

international efforts, and FL universities should (i) undertake review of current studies and models and (ii) consider undertaking updating model development to more precisely forecast Florida's changes in weather patterns, (iii) Undertake specific analysis of uncertainties and contingencies in climate scenarios for Florida

Considering that Florida is so vulnerable to potential impacts of *sea level rise and hurricane activity, the state should place a special emphasis* on establishing or enhancing existing programs to follow developments in this field. This should include forecasting the effects of sea level rise on seawater intrusion, water tables, inland waterway levels, and stormwater. Florida should sponsor research to provide data and analysis that are not currently addressed by the international science community at a sufficient spatial scale for Florida. Included in this could be e.g. synthesis of the new statewide coastal LIDAR data, sea surface and marine temperatures, Gulf Stream flow rate and temperature profiles in the Florida Straights as an indicator of the Global Ocean Conveyor, interactions with climate teleconnections such as AMO and ENSO, and the latest theories, correlations and predictions of future trends in hurricane activity.

In addition to work on sea level rise and hurricane activity *the state needs to establish or enhance existing programs to monitor and determine trends in other climate related impacts* that could have consequences in Florida including: increased drought, wildfires, flooding and storm water runoff, heat waves, problems with invasive species and insect-borne disease resulting from changes in temperature and rainfall regimes, adverse effects on native terrestrial species, natural communities and marine life, salt water intrusion into aquifers, more frequent and intense storms, storm surges, tidal regimes, and coastal erosion. Ensure analyses include indirect as well as direct effects such as the likely impact of a Florida diaspora - flight from the coast to interior Florida associated with sea level rise, and all the concomitant effects of a landward migration. Build a decision support structure to guide and prioritize ongoing Florida-specific research agenda.

Deploy a "Florida Land and Sea Mesonet" (see e.g. the Oklahoma Mesonet for terrestrial counterpart) *to serve as a world class network of integrated environmental monitoring stations*, drawing from and contributing to existing terrestrial and marine networks, capitalizing and building upon deployed meteorological stations, ET stations (expansion of the USGS/WMD network), micro-meteorology towers (eddy flux), flow gauges and well/aquifer monitoring, and other critical monitoring networks, to meticulously track changes in Florida's climate and hydrology, filling missing gaps in statewide network coverage. Support for existing Florida Coastal Observing System should include climate impacts. Emphasis for design should be on climate science, although such a network has obvious value for weather forecasting. Store and link data in a permanent manner so data can be integrated and consistent statewide, web delivered, serving the needs of climate scientists, biologists, hydrologists, and all public agencies. Such a mesonet would place Florida at the forefront of regional climate modeling, attracting outside researchers and international efforts to use these data, enhancing value and serving as a case study for other global regions. Serve as calibration sites for #5.

In conjunction with #4, Florida needs to support scientists working on *methods and availability of remote sensing data for areally-continuous statewide coverage* (and associated surrounding oceanographic area of influence), with consistent spatial grids and measurements, for common inputs for climate and hydrologic models.

Long-term Climate Proxy data. Create a new Center, or virtual center, to coordinate and align data from available proxy datasets (e.g. lake sediment cores, palynology, speleothems, tree rings, calcite growth rings, ocean cores) to build a more precise picture of climate change in Florida over last few thousand years with associated responses in e.g. vegetation, sea level, changes in fire regimes, etc. Consider a conference session and/or conference proceedings/publication to compile what is known about climate trends from these proxy datasets. Examine need for more proxy work and gaps in knowledge – spatial and temporal.

Evaluation of likely persistence of Florida's rare species, natural communities, coastal ecosystem and parks and protected areas in relation to climate change. Suggest every 2 ands 10-year review of state park, date forest and Wildlife Management Area Management Plans include a thoughtful analysis of vulnerability to climate change as part of their systematic management planning. Provide training for state employees in park and protected area management on climate change scenarios so they can better anticipate and assess likely impacts. Summarize the likely scenarios on state and federal managed lands in a major published review within 5-7 years. Include climate change analysis in all federal and state listed species recovery plans. develop decision tools and other assessments to help quantify the contingent values of existing natural lands, parks and protected areas, and agricultural land uses to buffering the state from climate change.

Linking climate scientists with ecologists, economists and social scientists. Issue a RFP from interdisciplinary teams of social scientists, economists and climate scientists, to build interactive models, including non-linearities and feedbacks, to better predict Floridian responses to anticipated changes. Agent based models are appropriate here because of the complexity of climate change models and responses—due to variability in agent circumstances, interdependencies, and feedbacks among multiple levels—all of which are beyond traditional modeling. Agents could vary from homeowners, agriculture, business and industry choices. ABMs will require social scientists to conduct systematic surveys to characterize predilections for different options and outcomes.

Build socio-economic models to evaluate the effectiveness of alternative incentives and policies. We have time to try and offer different incentive programs and approaches to compare responses and behavioral changes, and adaptively improve policies and programs accordingly. Select pilot areas and locations of the state to test policy programs. Evaluate effectiveness of adaptation strategies at regular intervals

Build better decision tools to incorporate total cost accounting for local and regional planning decisions, so that proposed land use change, agricultural policy shifts, water use policies, transportation decisions, siting of major new industries, etc. have a full assessment of all public

costs including likely carbon/greenhouse gas footprint, and water use. Decision tools should also include assessments of proposals land use changes in the light of predicted climate changes.

Science needs for carbon mitigation in Florida. With cap and trade programs and new carbon credit systems (currently look like they are designed for Iowa farm fields) we need a large injection of science in Florida to better understand the distribution of our carbon stocks and our potential to increase sequestration. *Recommend the development of a statewide network of mobile carbon towers* (Florida Carbon Tower Network) to be deployed to collect data on carbon flux (and methane fluxes) in relation to the suite of Florida's natural communities, agricultural land uses and management practices. Such data to date are largely limited to pine plantations, oak scrub, pasture/sod fields, mangroves and Everglades. Will also need a body or group (perhaps part of Florida Mesonet) to coordinate tower data and findings. The pay back for this science may be high if Florida landowners and the state could better capitalize on carbon credits with improved data.

Other Remaining Issues:

TBD

ADP-2. Comprehensive Land Use Planning

*****Note from Jim: We may want to recommend that the overall ADP be reworded to be "Comprehensive Planning", using land use may unintentionally limit the scope to include other required LGCP elements, e.g. coastal zone management.**

Description of Issues:

Florida has an integrated planning process for state, (regional) and local governments to prepare comprehensive plans that address future growth for the entire state. Florida's State Comprehensive Plan (SCP) (Chapter 187, F.S.) contains goals, objectives and policies that address energy, land use and other issue relevant to future adaptation to climate change. The 2008 Florida Legislature amended the SCP to address green house gas (GHG) reduction strategies and also amended the Local Government Comprehensive Planning Act (LGCPA) to require that local governments address GHG reductions in their future land use, housing and transportation elements.

The state's eleven regional planning Councils and five water management districts also produce plans that will need to contemplate specific strategies for reducing GHG and anticipating adaptation planning and actions.

Objectives: Florida's state, regional and local comprehensive plans should be amended, based on best available date, to include goals, objectives and policies that will prepare the state for adapting to the future impacts of climate change, e.g. sea level rise.

What is at Risk:

The projected consequences from climate change impacts such as sea level rise may lead to future questions about the rights of private property owners and the police power and trusteeship responsibilities of state and local government to protect the community at large. These issues will be focused on property adjacent to the beach and in low lying areas subject to increased flooding.

Based on data from various studies and models Florida may be one of the most at risk states due to the fact it is surrounded by water on three side and the relatively flat terrain will mean its coastal areas and some interior area will experience significant impacts due to climate change.

Natural areas along the coasts, including estuaries and mangrove forests will require areas that allow them to move inland due to sea level rise. Urban areas will need to be assessed to determine appropriate strategies. Between now and 2030, Florida will need to develop residential, commercial and retail areas to serve twice our current population.

Sea level rise will impact Florida valuable shoreline resources, including the beach, coastal vegetation and habitat and significant public and private built investment. Overtime decisions

will need to be made about relocation, redevelopment and where appropriate retreat from the shoreline.

Existing Actions:

To be drafted by DEP staff.

Goals and Strategies:

2.1 Local Government Level

Goal 1: Ensure that all relevant elements of local government comprehensive plans, e.g., future land use, coastal zone management and capital facilities, are updated to reflect the best available date and strategies for adapting to future climate change impacts.

Strategy:

Goal 2: State and regional agencies should provide financial and technical assistance to local governments to ensure timely updates of local plans.

Strategy:

Goal 3: Local governments should review their coastal management elements to determine necessary amendments to make their coastal areas, especially the coastal high hazard area, resilient to the future impacts of climate change, including sea level rise.

Strategy: amend Chapter 163.3178 (8) which call for coastal counties to prioritize lands for acquisition through state programs to include sea level rise as a criteria.

2.2 Regional Government Level

Goal 1: Regional Planning Councils should update their Strategic Regional Policy Plans to reflect important regional issues concerning adaptation to the impacts of climate change.

Strategy:

Goal 2: Water Management Districts should modify regional water supply plans and other regional water management activities to include adaptation measures addressing impacts from climate change.

Strategy:

2.3 State Government Level

Goal 1: The State Comprehensive Plan and relevant state agency strategic plans should be updated to reflect future actions to promote adaptation measures addressing the impacts from climate change.

Strategy:

Goal 2: The Florida Energy and Climate Change Commission should encourage intergovernmental cooperation at all levels of government and recommend additional goals and strategies to ensure adequate measure are taken to adapt to future impacts from climate change.

Strategy:

Goal 3: Balancing Property Rights and Protecting Communities

Florida statutes should be reviewed by the Florida Attorney General to determine potential conflicts with private property rights and the State and local government responsibility to protect communities. **{Also relevant for ADP-8 Insurance?}**

Goal 4: The State Comprehensive Plan, Chapter 187. 201 (8) Coastal and Marine Resources , the goal and policies should be amended to address adaptation to the consequences of climate change.

Priority For Further Research And Analysis:

TBD

Other remaining issues:

TBD

ADP-3. Protection of Ecosystems and Biodiversity

Note: Gary and Eric both submitted text for ADP-3. Gary's text which focused on beaches is in light blue.

Definition of Issues:

Most of the information in this definitions section is excerpted from the Australian action plan on Biodiversity and Climate Change (NRMMC, 2004).

Temperature, rainfall, sea level and ocean chemistry play major roles in determining where individual species of plants and animals can live, grow and reproduce. The effects of climate change on species and ecosystems can be both direct and indirect as discussed below:

Changes in the structure and composition of ecosystems and communities: Environmental changes leading to changes in distribution, phenology (lifecycles), physiology, habitat use and extinction rates of individual species will lead to changes in the structure and composition of communities and ecosystems as we know them today.

Changes in coastal and estuarine habitat due to rising sea levels: Distribution of mangroves, coastal wetlands, and seagrass communities will be affected in various ways, depending on erosion, depositional processes, proximate development, coastline relief, shoreline hardening and underlying substrate.

Changes in ocean chemistry due to increased atmospheric carbon: Lower pH levels in the ocean (aka ocean acidification) are likely to result from higher concentration of CO2 in the atmosphere. As a consequence, all sea life that relies on shells or exoskeletons formed from calcium carbonate (e.g., corals, shellfish, some algae) will be adversely affected.

Changes in the geographic range of species: Restricted species may be very vulnerable to even modest changes in climate. Because of dependence on environmental conditions that are now shifting, many species will tend to move north or upward in elevation (if suitable habitats exist) in order to keep pace with shifting climate zones

Changes to the timing of species' lifecycles: There is mounting evidence, for example, that species are breeding earlier in many parts of the world and are out of sequence with other species on which they depend (pollinators, prey, etc.). These shifts will change species population dynamics and survival. Alterations in interactions between species (e.g. competition and predation), will result in changes in the structure and composition of communities and ecosystems.

Increases in the risk of extinction for species that are already vulnerable: Species with limited climatic ranges, limited dispersal ability, specialized habitat requirements, small populations and/or low genetic diversity, or obligate dependence on another species with these characteristics

are typically the most vulnerable to extinction. These species include endemic species biota restricted to islands, peninsulas, small reserves or coastal areas Species with extensive, nonpatchy ranges, long-range dispersal mechanisms, large populations and high genetic diversity are likely to be at less risk of extinction.

Increased opportunity for range expansion of invasive species: Many weedy and pest species already possess characteristics that will allow them to take advantage of climatic changes (highly mobile, opportunistic breeding, wide climatic tolerance). Native communities under stress from climatic changes may be more susceptible to invasion and other disturbances.

In addition to climatic changes, the associated increase of the carbon dioxide concentration in the atmosphere will lead to changes in plant growth, nutrient composition, plant–animal interactions and ecosystem nutrient cycles. This will interact with temperature and rainfall changes. Climate change is also expected to exert an indirect effect by influencing the intensity and magnitude of existing stresses, such as invasive species and fire regimes, on biodiversity and ecosystem structures, functions and processes. For example, changes in climate can influence fire regimes by altering the frequency, intensity and extent of fire events. Scientific evidence is rapidly mounting that many of the changes listed above are already occurring, consistent with the warming trends over the past century (reviewed in Hughes 2000, 2003; Parmesan and Yohe 2003; Root et al 2003). These changes are expected to accelerate and become more obvious over the next few decades, though the precise nature and rate of change for individual species and ecosystems is uncertain.

Description of Issues: (for Beaches) MOVE TO SUB-SECTION 3.2 OR INTEGRATE WITH ABOVE?

Gary: The sandy beaches that surround most of our state are an integral part of the quality of life for many Floridians. Currently over half of Florida's 825 miles of sandy beaches are experiencing chronic erosion and about 42% are designated as critically eroding, meaning they need long term maintenance in order to ensure protection of vulnerable upland properties, recreational interests, wildlife habitat or important cultural resources. Sea level rise and other predicted impacts of climate change, such as increases in frequency and intensity of coastal storms and higher storm surges, will increase beach erosion, shoreline recession, and barrier migration and have a profound impact on Florida's beaches, the beach using public, and the tourism industry.

Objectives:

Describe the policy objectives for the ADP, e.g., protect communities from the 100 year event; protect threatened habitats.

- Maximize the resilience of species and habitats to climate change impacts by minimizing other human induced threats. Traditional conservation actions (e.g., land and water protection, prescribed fire, invasives management and restoration) will comprise the most important elements of a strategic response to climate change

- Maintain/facilitate the persistence of coastal ecosystems and the ecological and human services they provide;
- Increase understanding of how Florida's marine and coastal ecosystems may morph into new states.
- Identify areas, natural communities and species of particular ecological vulnerability
- Protect natural communities vulnerable to sea level rise from loss resulting from shoreline hardening and other actions that prevent/inhibit natural upslope migration.
- Identify and secure paths for other inland habitats to migrate with changes in temperature, rainfall patterns and groundwater levels.
- Protect inland natural communities from competing climate change adaptation pressures, such as the landward relocation of coastal development, human demands for ground and surface water, and engineered solutions for flood mitigation.

Managing ecosystems for resilience enhances their ability to naturally adapt to the stresses of climate change and other pervasive threats. Characteristics of resilient ecosystems include high native biological and genetic diversity, complex and redundant ecological interactions, the ability and room to expand and migrate, a high degree of connectivity, the presence of refugia and threats that are well managed. By focusing our planning and management on these characteristics we protect the ability of species, communities, and systems to adapt to stressors, even when the direction (e.g., increased or decreased rainfall) or magnitude of impacts is uncertain.

Objectives: (for Beaches)

Ensure the long term protection of the beach/dune system and preserve its ecological functions. (State laws are very clear on legislative intent placing a high priority on beach and dune protection. FS 161.053**:** The Legislature finds that the beaches and the coastal barrier dunes…are subject to frequent and severe fluctuations and represent one of the most valuable natural resources of Florida and that it is in the public interest to preserve and protect them from imprudent construction which can jeopardize the stability of the beach-dune system, accelerate erosion, provide inadequate protection to upland structures, and interfere with public access.")

1. Currently, Florida's beach management and protection program has few policies in place specifically designed to mitigate for or adapt to climate change and its associated coastal impacts. Consideration of climate change could be incorporated into all aspects of the beach management and coastal construction regulatory programs. Data modeling could consider different predicted sea level rise scenarios.

2. In areas at increasing risk from sea level rise, shoreline erosion, and storm surge property owners will often choose bulkheading to protect their investments in structures and infrastructure. This activity can prohibit beach migration and accretion, impact ecosystem functions, may accelerate beach loss, and can limit public access to public trust lands. Policies to discourage development adjacent to eroding shorelines and encourage the placement of

structures and infrastructure away from retreating shorelines may reduce future reliance on coastal bulkheading. Such polices, often referred to as "retreat" or "relocation", could be market-based, non-confrontational, fair, and generational in scope. In many areas development densities and land values are so high that that these strategies may not be applicable.

3. If we are to retain substantial amounts of natural shorelines and their associated values in an era of rising seas, then ultimately people in many of these areas will have to be persuaded to give up their land to the public or to the sea. In order to provide buffers for retreating shorelines, to preserve and protect habitats and ecosystem function, and to increase the resiliency of the shoreline to recover from storm events private lands will have to be purchased and placed in the public domain. The development of a strategically targeted coastal land acquisition program would facilitate this objective.

4. Land use planning will be an integral component of any effort to develop adaptation policies to ensure the long term protection and sustainability of shorelines in an era of rising seas. Incorporating projections of climate change and sea level rise in all relevant aspects of comprehensive planning can assist local governments in reducing the risks for the built environment, in planning for impacts, and in ensuring protection of coastal resources.

5. Several state regulatory agencies have oversight of activities that can affect the long term protection of coastal resources. Enhanced communication on coastal resource protection between and within these agencies can ensure more efficient use of resources and expertise in developing adaptation responses and strategies. (Should be worded better, but you get the idea. Currently DCA and DEP have very limited communication on coastal/beach protection issues. There may be a need to develop a Coastal Commission - see Sarasota County for a good model on how this can be accomplished.)

Assets at Risk:

Florida's terrestrial, freshwater and marine systems extend from temperate north Florida to sub-tropical south Florida. Many tropical species are at their northern range limits in Florida, many temperate species are at their southern limits. The result is a highly diverse, unique assemblage of species, and in terrestrial and freshwater systems, high levels of endemism. Florida has a 1,350-mile coast that is home to a diverse array of marine and coastal natural communities and associated species including the world's third largest fringing barrier reef and most morphologically diverse barrier island system.

Many of Florida's natural resources are at risk of loss in the face of the above described climate change impacts.

Non-market values

A lot of Florida's recreation is based on these resources

New report on coastal economy

Assets at Risk: (Beaches)

Beaches are one of the state's most important economic engines, generating tens of billions of dollars in annual revenues through jobs, tourism, recreation, and tax dollars. A healthy beach/dune system provides protection for upland property and infrastructure and increases a beach's resiliency, its ability to recover from storm events. Florida's beach/dune system also provides important habitat for marine turtles, shorebirds, beach mice, invertebrates and other species. As beaches erode and recede all these values and benefits are threatened. In addition, public access to lands held in trust for the public, including both the wet sand beach and near shore submerged lands, is greatly diminished. Conflicts over public usage and private property rights will likely increase as beaches recede and the area of dry sand beach decreases.

Goals and Strategies:

ADP 3.1 – Uplands, Freshwater and Marine Systems

Goal 1: By 2015, a representative portfolio of Florida terrestrial, freshwater and marine natural communities with redundant representation (of habitats and species) and connecting corridors (aka Florida's Biodiversity Blueprint) has been protected and is being well managed.

Strategy:

Goal 2: By 2010, all publicly funded land acquisition programs are taking into consideration future anticipated sea level rise (for example, lands that will become the new shore areas around existing estuaries are rated as high priority), increased tropical storm frequency and intensity, coastal flooding and other climate change impacts as part of the process to prioritize acquisition projects.

Beginning with the fiscal year 2008-2009, the Department of Environmental Protection shall include in its annual Florida Forever workplan, a list of lands on the Florida Forever list that provide opportunities to sequester carbon, provide habitat, protect coastal lands or barrier islands, and otherwise mitigate and help adapt to the effects of sea-level rise.

Strategy:

Goal 3: By 2015, important natural communities vulnerable to sea level rise (e.g., intertidal and coastal habitats) are buffered/protected (from shoreline stabilization and hardening) to maximize the probability of their persistence into the future. For example, the ecologically valuable estuaries identified under Goal 1 above would be protected from development, shoreline hardening and stabilization measures to minimize their disappearance and to reduce/eliminate their capacity to provide critical nursery habitat for fish, foraging habitat for shorebirds, etc.

Strategy:

Goal 4: By 2015, the acquisition of lands needed to complete critical south to north migration corridors to accommodate climate change driven range changes in species and natural communities has been completed and these corridors are being appropriately managed.

Strategy:

Goal 5: By 2015, the economic value and services provided by Florida's natural communities and associated species have been calculated to inform decisions regarding state budget and policy requirements and the resulting information broadly disseminated.

Strategy:

Goal 6: By 2015, likely new "states" of Florida ecological systems have been described to inform decisions regarding state budget and policy requirements and the resulting information has been broadly distributed.

Strategy:

Goal 7: By 2015, areas that may serve as refuges for at risk species are identified, prioritized, protected and managed in a manner that maximizes the persistence of at-risk species.

Goal 8: Identify species and habitats likely unable to migrate naturally due to geographic constraints and craft strategies to assist the relocation or re-create habitat elsewhere to facilitate this shift.

Strategy:

Goal 8: By 2015, the portfolio of sites identified under Goal 1 above are managed in a manner that maximizes the health of these systems and confers the greatest resilience to climate change impacts (for example, prescribed fire, invasive species control, appropriate stream flows, management of waste water, and commercial and recreational extractive activities, etc.).

Strategy:

Goal 9: By 2010, climate change impacts on sea level, precipitation and wildfire patterns, storm frequency and intensity, ocean chemistry (pH levels), ambient temperature, etc. and how these changes will affect Florida's natural communities have been estimated with uncertainties articulated so that the state can prioritize adaptation strategies and the resulting information is widely distributed..

Strategy:

Goal 10: By 2010, state law has been enacted that defines newly submerged lands contiguous to existing state aquatic preserves, parks, etc. as part of the contiguous state managed areas.

Strategy:

Goal 11: By 2010, hardening/stabilization of estuarine shorelines is no longer permitted under state and local law.

Strategy:

ADP 3.2 – Beaches and Beach Management

Goal 1: Beaches are not constrained from natural upslope migration as sea level rises. (This is a subset of Goal 3 above).

Strategy:

Goal 2: Prioritize the ecological value of beach resources around the state and select some subset of these (30%?) in each geographic region to aggressively protect. (This is a subset of Goal 1 above).(For example, in the face of limited sand for renourishment, renourishment activities might focus on the highest value sea turtle nesting beaches that are experiencing high erosion rates. If beach/dune continues to erode, it may be necessary to remove existing structures to accommodate upslope migration of this habitat.)

Strategy:

Goal 3: By 2015, conditions inhibiting natural long shore sand movement (e.g., the presence of inlets) are minimized so as to minimize the need for beach renourishment.

Strategy:

Goal 4: The value of ecologic and economic services provided by Florida's beaches is well understood by all interested stakeholders. (This is a subset of Goal 5 above).

Strategy:

Goal 5: Beaches are managed in a manner that maximizes the long term health of this natural community and all its components with special attention to rare and imperiled species (includes invasive non-native species control, public access management, etc.) (This is a subset of Goal 8).

Strategy:

Goal 6: By 2009, state and local governments implement a public information campaign that informs owners of coastal shoreline property that in the face of sea level rise, they may lose their property and may have to abandon structures damaged by rising seas and increased storm intensity/frequency.

Strategy:

Goal 7: By 2009, state and local governments establish policies and regulations that clearly define when, how, where and under what circumstances emergency beach stabilization is allowed.

Strategy:

Goal 8: By 2009, state and local governments establish policies and regulations addressing coastal retreat and at what point vulnerable structures will have to be abandoned.

Goal 9: by 2010, state and local governments establish policies and regulations to protect coastal resources from contamination resulting from inundation, structural failure or abandonment of residential, industrial and municipal assets due to SLR or storm events.

Strategy:

Second Goals and Strategies:

Goal 1: Ensure that the beach management program can accomplish its intended goals in an era of climate change and rising seas.

Goal 2: Provide incentives to encourage public and local governments to site structures and infrastructure away from areas at high risk from the impacts of climate change and sea level rise.

Goal 3: Ensure the long term sustainability and resiliency of the beach/dune system.

Goal 4: Preserve ecosystem functions.

Goal 5: Reduce future reliance on bulkheading to protect structures and infrastructure. (An ancillary goal would also be to reduce reliance on beach re-nourishment and ideally increase the times between re-nourishment.)

Goal 6: Increase and expand the toolbox of adaptation strategies (Currently the beach protection program relies on one leg; beach nourishment.)

Goal 7: Enhance communication and planning between state and local governments and between and within regulatory agencies.

Goal 3.3 Species Protection

Goal 1: By 2010, the vulnerability of Florida's fish and wildlife to climate change impacts (temperature, sea level, precipitation, ocean pH, etc) has been assessed, the most vulnerable species have been identified and plans have been prepared to enhance their chances of persistence where there is a greater than X% probability that the species will persist over the next 50 years. (related to goals 8 & 9 above).

Strategy:

Goal 2: By 2011, a system for monitoring how Florida's natural communities and associated species are responding to climate change impacts is in place and the results of this monitoring is widely distributed/available to all interested stakeholders.

Strategy:

Priorities for Further Research and Analysis:

Narrative describing critical gaps in knowledge to be addressed by the research community or further analysis among state agencies.

Priorities for further research may include:

- Estimating the absolute and relative vulnerability of species and habitats to climate change impacts;
- Determining the anticipated new states of natural communities in the face of climate change impacts; and
- Assessing the potential economic costs and benefits of climate change impacts on biodiversity, ecosystem processes, functions and services.

Some of these priorities for research can be found in Florida's Comprehensive Wildlife Conservation Strategy (FWC, 2005) and Florida Ocean and Coastal Council's 2008-2009 Scientific Research Plan (FOCC, 2008).

Second set of priorities for Analysis:

1. Determine future costs (including environmental mitigation costs) of beach nourishment under different sea level rise scenarios. Will these costs be different in areas where adequate buffers have been established and where the shoreline is lined with high density development?

2. Does the state need an Open Beaches Act. (This is a very complicated issue and gets more complicated and confrontational as the beaches recede. Who owns the beach and what are the public's rights of access? On eroded shorelines with bulkheads, what happens to the public's common law right of access and customary use? The need to address these issues will increase as seas rise and erosion increases.)

3. How or does the Burt Harris Act (takings law) impact the ability to adequately address coastal protection in an era of rising seas? Is it having a dampening effect on adequate regulatory policies? Will it increase the cost of implementing adaptation strategies?

4. How can the state legally authorize bulkheading or other armoring that will result in imperiled species take, violating state and federal endangered species law?

5. How will beach access be impacted.

6. Determine offshore sand availability for renourishment under differing scenarios and for different regions of the coast.

7. Model shoreline recession and erosion rates under different sea level rise scenarios.

8. Model need for bulkheading under different scenarios (The last time the state did this type of analysis was under Governor Chiles in 1990).

9. Inventory coastal public lands susceptible to impacts and assess those impacts. Determine need for buffers to allow habitat migration. (TNC folks on TWG should really flush this out.)

Other Remaining Issues:

Brief overview of issues not addressed by the TWG, but recommended for further consideration in the future.

References

Florida Fish and Wildlife Conservation Commission. 2005. Florida's Wildlife Legacy Initiative. Florida's Comprehensive Wildlife Conservation Strategy. Tallahassee, Florida, USA. http://myfwc.com/wildlifelegacy/StrategyDownload.html

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Natural Resource Management Ministerial Council (2004), National Biodiversity and Climate Change Action Plan 2004–2007, Australian Government, Department of the Environment and Heritage, Canberra, ACT. http://www.environment.gov.au/biodiversity/publications/nbccap/

ADP-4. Water Resources Management

Merged Draft ADP-4

Description of Issues: The State of Florida is currently facing many water resource management challenges including shortages due to drought, salt water intrusion and deterioration in quality and limits on the availability of its groundwater sources. Continued pressures from population growth, development styles and potential new challenges resulting from climate change stress the system even further. There are a wide variety of scientific opinions regarding how climate changes will manifest in Florida over the next 100 years. Water managers must nonetheless plan for potential increased variability in precipitation regimes, storm events, and rising sea levels. Significant changes in these phenomena from historical patterns are likely to result in changes to the amount of fresh water resources and land available to sustain life and maintain healthy water dependent natural systems.

While Florida's extensive coast line provides a unique ability to tap saltwater as a future water source, primary water resource concerns revolve around changes to water dependent ecosystems, impacts to and from human activity and ground and surface water quality. There may be shifts in water demands for agricultural and municipal supply, increased energy consumption for advanced water treatment, transmission and disposal as well as for changing environmental needs. Incorporating methods to quantify and plan for uncertainties and risks related to population growth, climate change and environmental regulations will be critical to maintain the quality of life, economic vitality and environmental sustainability for the state. This is particularly true as our population continues to grow along the coast, where public water and wastewater facilities are located to serve those populations. The rate of climate change and potential consequences over the next 100 years is uncertain, but the more rapid the rate of change, the more quickly Floridians will have to respond to manage Florida's water resources effectively. Planning and action now may significantly reduce costs relative to deferring action until later.

Objectives: Local, regional and statewide policies to protect groundwater and other water resources are designed to ensure adequate supplies to meet needs for man and the environment. Policies and measures to encourage conservation, protect existing supplies, identify and develop new supplies, and further invest in innovative technologies to treat water will be needed. Florida recognizes four major water resource management areas of responsibility (AORs) as expressed in Chapter 373, F.S.:

(1) Water Supply – Managing water resources to ensure that there are adequate supplies for current and future Floridians.

(2) Water Quality – Implementing measures to ensure that changes to existing landscapes will not cause degradation of existing ground and surface water quality.

(3) Flood Protection – Identifying and protecting floodprone areas to minimize the risk of floods to human activities through structural and non-structural means.

(4) Natural Systems Protection – Managing water and related land resources to ensure that there are supplies of adequate quantity and quality to protect and maintain healthy natural systems.

What is at Risk: A Tufts University Report, Florida and Climate Change: The Costs of Inaction (Stanton and Ackerman, 2007) describes the possibility of lower annual average precipitation, increased sea level rise - as much as 45 inches by 2100, and fewer, but more intense storms. These three currently predicted impacts alone could have serious implications for Florida's major areas of water resource responsibility.

Less Precipitation:

- Increased population pressures and dwindling fresh water supplies will present unprecedented challenges to ensuring that Floridians have adequate fresh water available to meet basic reasonable and beneficial needs. It is already clear that traditional groundwater sources will not support continued growth and this may be exacerbated by potential reductions of groundwater recharge and recharge areas, less (or more) surface water flows into watersheds, degradation of groundwater quality and existing wellfields as sea level rises, and loss of wetlands. Intensive conservation of all water uses will be essential and alternative water sources will need to play a larger role in meeting Florida's future water needs. Additionally, Florida's springs and ephemeral wetlands, and the species they support, will be at risk.
- Diminished surface water resources will require greater care to protect the quality and quantity of existing resources. In particular estuarine health, the source of Florida's commercial and recreational fisheries, may be at risk.
- Longer dry periods may change average annual rainfall requiring a change in how drought and other extreme events are defined. This would require changes in monitoring compliance with Minimum Flows and Levels and Water/Consumptive Use Permits, how structures are operated and when alternative supplies sources are needed.
- Both water supply sources and the essential infrastructure to capture, store, treat, distribute and reuse water and the disposal of waste for municipal and industrial users throughout the state may be affected.

Sea Level Rise:

- Sea levels are known to be rising at present. According to Stanton and Ackerman the 27 inches in sea level rise predicted for 2060 will place some 4,700 square miles and one-tenth of Florida's current population or 1.5 million people at risk. This currently includes nuclear reactors and other power generation plants, a huge proportion of the State's tourism industry, superfund sites, wastewater treatment facilities and other vulnerable infrastructure.

- The majority of Florida's population, and the water infrastructure to serve them, reside within 50 miles of the coast. The Florida population is also projected to increase by an additional 50% by 2030 according to the Census Bureau (U.S. Census Bureau. "Interim Projection: Ranking of Census 2000 and Projected 2030 State Population and Change: 2000-2030"). In addition to new infrastructure required to develop and distribute water supplies to meet the needs of a growing population (ADP-5), existing coastal and groundwater resources may be at risk due to salt water intrusion and sea level rise. Additional consumptive use of freshwater will further diminish the head of pressure needed to stave off saltwater intrusion. It will be essential to retain as much freshwater in natural systems, and restore previously drained systems, to ensure this head of pressure. Similarly, the restoration of peat layers in extreme South Florida in the course of Everglades restoration will help buffer that region from saltwater intrusion.
- Ecosystems are dynamic, evolve and transition even without rapid changes in climate. Management paradigms will need to focus on ensuring healthy ecosystems, rather than preserving familiar ones. In the course of changing rainfall and heat regimes, flora, fauna and soil types will change and migrate to fill more hospitable niches. Coastal ecosystems will likely migrate farther inland. Therefore, along with the need for human flexibility through adaptive management, we will also need to allow ecosystems to be flexible and adaptive.
- Many projects underway and in the planning stages may need to be reconsidered. Coastal recovery strategies that attempt to hold back saltwater intrusion, coastal restoration projects, coastal land acquisition and others may require redesign to allow for natural adaptations and movement inland.
- It may no longer make sense to allow land, transportation and water planning and management to be considered separately at all levels of government. To manage these elements effectively, planning and implementation efforts will need to be better integrated. Primarily, land uses and infrastructure placement cannot take place in the absence of water resource considerations.

More Intense Storms:

- If large, intense storm events become the norm, Floridians will face greater challenges in planning for human safety and infrastructure protection during and after these events.
- Historic structural and non-structural solutions to minimize flooding risks may need to be reconsidered. In many cases, the restoration of previously drained landscapes may provide the most distributed solution with the greatest capacity for storage.
- More intense rainfall events will lead to greater scouring of natural watercourses and surface soils, less infiltration to replenish aquifers, and decreased water quality caused by more overland flow of stormwater carrying nutrients and other pollutants to lakes, rivers, estuaries and other waterbodies.

- These changes will necessitate changes in the basis for current Environmental Resource Permits, watershed and water quality modeling, structural operations and other flood management methodologies.
- As interior groundwater sources become constrained there is greater emphasis on developing surface water and coastal desalination facilities. While an integrated water resource strategy is desirable, full energy costs and risks should be considered in long range plans.
- Wellfields, surface or sub-surface storage facilities and water treatment plants may be vulnerable. Siting such facilities should be closely examined and plans developed to mitigate impacts or relocate them or reduce the risks from winds and flooding.

Goals and Strategies:

Goal 1: To ensure that Floridians have adequate fresh water supplies available to meet basic reasonable and beneficial needs. and the requirements of natural systems.

Goal 2: To optimize water available for use by humans and the environment under changing conditions of a drier and warmer climate, changes in salt and freshwater regimes and more erratic rainfall events. (and environmental impacts.)

Goal 3: (Strategy/Priority?) To develop regional and statewide water demand projection scenarios that account for potential changes in 1) agricultural demand due to changes in growing season or impacts on crop production; 2) municipal and industrial demand as temperatures increase, drought (seasonal or intra-annual) persists; and 3) in water demand for energy generation due to possible changes in fuel source (e.g., fossil fuel generation capacity replaced by nuclear generation or solar) over a 100-year planning horizon, with consideration for Florida's statutory obligation to provide water for the environment.

Strategy: Develop conservation programs that address and incentivize both water and energy usage efficiencies

Goal 4: (Strategy/Priority?) To implement local, regional and statewide water supply planning processes that quantify potential changes in existing water supplies and identify potential new water sources including synergies between flood management structures and water supply. Incorporate methodologies that use not only historic hydrologic data but also consider changes that may result from climate change and prioritize water for natural systems.

Strategy: Provide for stakeholder involvement in regional and statewide water supply planning processes

Goal 5: (Strategy/Priority?) To integrate land use considerations, flood management, stormwater best management practices designed to protect water quality, water demand/supply management and water reservations for the environment in watershed planning and design standards.

Goal 6: To incorporate methods that consider energy, environmental, and economic sustainability when evaluating potential water management strategies.

Goal 7: (Strategy/Priority?) To identify and quantify the vulnerabilities and reliability of existing water supplies to potential effects of differing climate change scenarios with emphasis on source water availability and quality.

Goal 8: (Strategy/Priority?) To identify and quantify risks and environmental impacts associated with siting and constructing desalination plants due to sea level rise and coastal flooding.

Goal 9: (Strategy/Priority?) To address water quality changes that may occur due to less frequent but heavier rainfall events, higher surface water temperatures, and rising sea levels on coastal aquifers.

Goal 10: To ensure the development of adequate plans and designs to address larger than historic storm events.

Goal 11: To minimize impacts of more intense storms and sea level rise on flooding of coastal and tidally influenced waterbodies.

Goal 12: To protect and maintain the natural mosaic of ecosystems, such as upland and lowland interfaces, to ensure the health of water and related natural resources.

Goal 13: To allow coastal estuaries, riverine and other water dependent ecosystems to migrate or adapt to maintain healthy wildlife and fish populations consistent with new weather regimes.

Goal 14: To ensure a sound economic structure that allows for innovative project development, infrastructure retrofits and repairs, adequate data collection and modeling and necessary additional staff resources.

Goal 15: To allow for the retention of more water in previously drained watersheds and systems.

Priorities for Further Research and Analysis:

Water Supply:

- Incorporate consideration of climate change into water resource planning and project development to increase Florida's ability to adapt to changing climate conditions that affect water availability, treatment requirements and alternatives and water demands for essential uses.
- Incorporate robust analytical methods to drive holistic planning and management of the built and natural water cycle. Such planning is essential to appropriately address an unknown future and should address energy requirements for water supply development, treatment and distribution and wastewater management.

- Involve citizens, business and industry, environmental groups and public agencies in planning processes to provide a foundation for implementable plans that balance needs and risks among a variety of water users.
- Apply "risk assessment" and "scenario planning" methodologies to assess risk under different climatic futures so that risks to existing assets can be understood, mitigation approaches evaluated and future assets can be developed within an anticipated risk framework.
- Continue innovation in the administration of District rules authorized under Chapter 373, F.S.
- Develop evolving technologies to improve the quality and reliability of data collection.
- Research to improve water use efficiency in various water use sectors.
- Identify new storage areas and technologies.
- Continue research on development of alternative water sources.
- Partner with other public and private sector entities to leverage resources to extend existing water supplies and develop prospective supplies.
- Research to determine the effects that predicted climate changes will have on the production and cultivation of agricultural commodities.
- Focus research on how change will affect specific regions in FL. Most current research covers large areas such as the southeast U.S.
- Research to identify and determine changes to the rainy season/rainfall patterns.
- Research to forecast quantities needed to fill and retain adequate water in reservoirs and other storage facilities.
- Assess and revise water conservation education activities
- Assess and revise appropriate quantities for water use and other permitting activities.
- Research to determine quantity effects of sea level rise on groundwater resources.
- Conduct regional downscaling on a watershed basis to quantify climate change on existing and potential water supplies.
- Research to determine the effects that predicted climate changes will have on the ground and surface water requirements of imperiled species.

Water Quality:

- Continue aggressive establishment of Minimum Flows and Levels and development of innovative and evolving methods to respond to future adaptations.
- Continue innovation in District rules authorized under Chapter 373, F.S.

- Continue coordination with EPA, the Army Corps of Engineers, and other federal, state and local environmental agencies with shared jurisdiction to ensure that project activities will not degrade water resources.
- Emphasize land acquisition and management programs that preserve and protect land resources including uplands and likely transitional areas.
- Emphasize land acquisitions that provide adequate buffer zones from encroaching activities that can adversely impact water quality.
- Research to determine quality effects of sea level rise on groundwater resources.
- Continue to work with local governments and others to ensure water quality goals are being met.
- Work with the university community, Florida Yards & Neighborhoods, Adopt-A-Pond and other educational efforts to develop climate change and water resource materials to educate the public.
- Research innovative stormwater retention designs that maximize water quality benefits.
- Research necessary adjustments to the TMDL program.

Flood Protection:

- Continue assistance to update FEMA maps and maintain data as development occurs and floodprone areas change.
- Continue innovation in the administration of District rules authorized under Chapter 373, F.S.
- Assist local governments with techniques to minimize development and infrastructure in potentially hazardous coastal areas.
- Research to determine effects of sea level rise on floodprone and historically non-floodprone areas.
- Develop stormwater retention designs and identify additional retention/storage areas to manage larger storm events.
- Create incentives to reverse the historic effects of drainage on landscapes to increase their capacity for natural water storage.
- Continue coordination with federal, state, and local emergency response agencies to develop adequate preparedness plans for potential flooding events as flood regimes change.
- Investigate and implement coastal and shoreline "rolling easements" to minimize potential structural damage and to maintain access and recreational benefits (tourism).

Natural Systems:

- Continue aggressive establishment of Minimum Flows and Levels and development of innovative and evolving methods to respond to future adaptations.
- Continue innovation in the administration of District rules authorized under Chapter 373, F.S.
- Develop processes to ensure environmental restoration work is done where long-term benefit is ensured under changing scenarios..
- Emphasize partnerships with other resource protection organizations to research and better facilitate acquisition and preservation of additional lands critical to preserving Florida's natural water resources.
- Develop a long-term and dense monitoring network for natural system health to ensure these resources are not endangered.
- Investigate strategies such as "rolling easements" (similar to strategies used in Texas, South Carolina and Maine) to allow long-term coastal migration, ecosystem adaptation and public access.
- Research to determine quality and quantity effects of sea level rise on ecosystems in transition.

Other Remaining Issues:

It is critical to ensure that the science needed to address these future unknowns is increasingly robust. Much of the current research is focused on large regional areas. The ability to better project the effects of sea level rise, increasingly intense storms and precipitation and temperature changes in different areas of Florida will be essential to adapt to an uncertain future.

Increases in prolonged droughts may increase Florida's wildfire and ecosystem migration potential. Refocusing land acquisition priorities on those lands upland of wetlands to enhance protection and allow for migration may be warranted.

As the State endeavors to address the complex challenges of potential climate changes over the next 100 years, the need for staff resources with the appropriate education, training and expertise to handle the many new responsibilities that may be engendered should be anticipated. New personnel with skills in the emerging areas of concern may be necessary to ensure success in meeting the many new challenging opportunities that lie ahead.

ADP-5. Built Environment, Infrastructure and Community Protection

Drafted by Ricardo A. Alvarez

Definition of Issues:

The built environment can be defined as the aggregate of all buildings, facilities and structures designed and built to provide shelter or to house the full breadth of human activity, as well as the infrastructure designed and built to supports or protect such human activity.

The built environment includes buildings, facilities, structures and infrastructure for purposes such as: residential, commercial, industrial, governance, health-services, educational, research, recreational, transportation, communication, water management, waste management, power generation and distribution and others.

Several factors have over time influenced and shaped the amount, location, distribution, concentration and type of built environment throughout Florida. These built environment shaping factors include the shape of Florida as a peninsula, geographic location, climate zones, geology, some 1,400 miles of coastline and barrier islands, environmental features and ecosystems, as well as a development model that has emphasized tourism, agriculture, international commerce and service industries.

The conjugation of these factors have resulted in more than 75% of the population living in coastal counties and perhaps close to 85% of the built environment, on the basis of total area of construction, located in coastal counties with a high concentration in large urban areas such as the tri-county [Pam Beach, Broward and Miami-Dade] corridor in Southeast Florida, the west-central region around Hillsborough and Pinellas counties, and the Jacksonville-St. Augustine region.

U.S. Census Bureau projections and other studies estimate Florida's population will reach close to 29 million by 2030, which means an increase of some 10 million people over the estimated 2007 state population and 7 to 8 million more residents in coastal counties. Should these projected trends continue it can be concluded that the concentration of built environment will continue along the same parameters that are currently in place.

Consider the vulnerability of Florida. The state is vulnerable to a wide range of natural hazards including hurricanes, coastal storms, floods, tornadoes, wildfire, drought, extreme heat, winter storms and freezes, erosion, sinkholes, landslides and tsunami.

Natural hazards must be considered as sources of potential damage, which have the capability of causing damage when impacting the built environment. Direct damage is caused by damage components in hazards. Some examples of damage components are: wind velocity pressure from hurricanes and tornadoes, hydrodynamic pressure and wave impact from storm surge, hydrostatic

pressure from flooding, flying debris impact, water-borne debris impact, extreme precipitation, extreme temperature and others.

Damage components apply loads [external forces] and create stresses in buildings while these interact with given natural hazards. When these loads and stresses exceed the design criteria of the buildings and its components damage results. Depending on the magnitude and combination of loads damage may range from light to destructive, and could lead to eventual structural failure.

With regard to the built environment its interaction with natural hazards and the resulting potential for damage, it is important to analyze how building design criteria are established and used in the design and construction of buildings, facilities and structures.

Studies of the effects of various types of loads acting on buildings, and historical data and annual probability of exceedance for parameters such as precipitation, temperature, flood levels, storm surge, wind speed, acceleration of gravity from seismic waves and others, are used today to establish design standards for the construction of buildings and structures. A well known example of these design standards is the American Society of Civil Engineers' ASCE-7 that establishes Minimum Design Loads for Buildings and Other Structures.

Such design criteria are part of building codes used to design buildings that we expect will have a minimum service life of 75 – 100 years. In Florida the Florida Building Code, which incorporates ASCE-7, became the single state building code as of March 1, 2002. The expressed intent of the Florida Building Code is "…..to establish the minimum requirements to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributed to the built environment…"

Before the adoption of the Florida Building Code, counties and municipalities throughout Florida were allowed to choose among four model codes, and as a result buildings were designed on the basis of diverse minimum design criteria, which in many cases proved inadequate when subjected to the test of an actual impact by a hurricane or other hazard. Before then, going back to the 1950s, 1960s and even the early 1970s buildings were designed using a range of standards that in some cases did not even address the issue of lateral loads such as those exerted by hurricane winds.

From the above it can be summarized that the existing built environment includes a large stock of buildings, facilities and structures that have been designed and built using a wide range of minimum design criteria, which in a large number of cases may not meet the minimum requirements of the current Florida Building Code.

Against this background it is important to consider that climate change will modify and/or exacerbate most of the factors mentioned before, which were used to establish design criteria, during the remaining service life of existing buildings and new buildings just now being built.

Take for example the damage components of a hurricane. While considerable differences remain in the scientific community regarding any linkage between climate change and hurricane formation, it is clear however that certain aspects of climate change specifically global warming and sea level rise have the capacity to exacerbate specific damage components of a hurricane.

For example: global warming has led to sea level rise that is conservatively projected to range from 3.3 ft to 5 ft above current levels by the year 2100, although recent studies suggest a much higher rate of rise based on the rate of melting of the Greenland ice cap. Sea level rise will have a direct impact on storm surge, perhaps the most damaging damage component of hurricanes as they impact the built environment in the coastal region.

Higher sea level leads to higher, fastest flowing, storm surge from hurricanes. The deeper water leads to higher waves. Higher waves result in much higher wave impact upon buildings hit by storm surge. Faster flowing surge means faster flowing water-borne debris and much higher debris impact. Faster flowing surge increases the hydrodynamic pressure [load] acting on a coastal building, which combined with the higher depth of water results in a much greater total load acting on the building.

Another example has to do with how global warming has increased the capacity of the atmosphere to hold moisture, and this in turn has lead to a higher threshold for precipitation to occur, which results in a higher incidence of extreme rain events. An extreme rain event may overwhelm the drainage capacity of most roofs, which may lead to higher loads acting on roofs from water accumulation eventually resulting in roof damage and water penetration.

This means that a building designed on the basis of current design criteria and the minimum requirements of the Florida Building Code may be subjected to much higher loads, from storm surge, wave impact and precipitation during hurricanes than what it was designed for, during its remaining service life. It is likely and perhaps highly probable that a building under such conditions will suffer severe damage and even structural failure. Those buildings built before the Florida Building Code came into effect, or even earlier, are clearly at much higher risk of suffering catastrophic damage under the impact of climate change exacerbated hazards.

With regard to the built environment then, the critical issue that Florida confronts is how to enhance or change the way new buildings are designed in order to make them resistant to future climate change exacerbated loads that they may encounter during their service lives. An even more critical issue is what to do with the existing stock of built environment to adapt it, as much as possible, to future impacts from climate change exacerbated natural hazards.

Beyond the potential for damage to the built environment, on an individual building basis, an equally critical issue results from the fact that sea level rise, and more frequent extreme precipitation events, will lead to higher rates of beach erosion, increased coastal flooding, and other adverse impacts on a community and even regional basis throughout Florida. It is clear that adaptation of the built environment to the impacts of climate change will also require adaptation alternatives that are regional in scope if the objective is to preserve the Florida built environment

as it now exists and as it will need to develop to meet the needs associated with the projected increases in population.

Objectives:

1. Reducing the potential for damage to the built environment from the impact of natural hazards, especially from those hazards caused or exacerbated by climate change, must become a high priority of all levels of government and the private sector in Florida.

2. Make the practice of adaptation of the built environment to the impact of climate change an integral component of comprehensive planning, building codes, life-safety codes, emergency management, land development and zoning regulations, water management, flood control, coastal management and community development.

3. Make the practice of adaptation of the built environment to the impact of climate change a preferred objective of building design, siting and construction research funded by public monies in Florida.

4. Foster an environment of communication and shared knowledge about adaptation to climate change and the adaptation/protection of the built environment among the scientific community, lawmakers, various professional sectors [practitioners], and the general public.

5. Promote an environment to connect science with decision-making regarding climate change and the need to adapt the built environment to its impacts.

6. Promote an environment to connect scientific research with practical applications that will contribute to the adaptation of the built environment to the impact of climate change.

7. Encourage the search for practical and effective solutions to ensure that existing and future built environment in Florida will remain inhabitable, providing a viable shelter for the full range of human activity and ensuring continuity of critical and essential functions in the aftermath of impact by climate change exacerbated hazards.

8. Establish educational and professional licensing requirements to ensure that key professional sectors become practitioners of adaptation in support of planning, building design and construction activities.

9. Require the State, county and municipal governments throughout Florida to develop and maintain a Local Climate Change Adaptation Plan, to provide a framework for assessing vulnerability, identifying risks, defining and quantifying the value of the built environment that is at risk, and for identifying and implementing effective adaptation measures at each jurisdictional level [state, county, municipality, individual facility].

10. Exercise fiscal responsibility in recognizing not only the magnitude of the problem to be confronted by future generations, but also the need to start implementing and paying for

solutions now while also creating reserves to pay for future measures, especially those that may be community-wide or regional in scope.

Value at Risk:

In order to assess the vulnerability of the built environment to hazards driven or exacerbated by climate change, it is essential to define and quantify the value at risk. In this specific case this refers to the value of the built environment and associated infrastructure.

The value at risk provides a baseline to assess the potential for damage from the impact of climate-driven or exacerbated hazards over a given time period, and to identify and evaluate the cost effectiveness of adaptation alternatives.

Defining the Value at Risk

Before quantifying the value of the built environment that is or may be at risk it is necessary to first define what is meant by value at risk. In defining the value at risk of the built environment the following criteria must be considered:

- The value of the built environment is dynamic, meaning that it changes over time in response to a range of factors, such as total population, density of population, demographics, land use and zoning, the mix of occupancies in a given community or region, importance or criticality of the functions sheltered by given buildings or structures, total area of constructed space and others.
- The value of the built environment is not limited to the cost of construction of the physical buildings, facilities and structures, but it is directly affected by the value of the human activity or function sheltered or supported by components of the built environment in a given community or region.
- The value of the built environment is interlinked with the value of the land on which it is located. To the degree that buildings change the character of land from natural to developed, they also change the value of the land. In this sense the value of the built environment and the value of property become synonymous.
- The value of the built environment is a function of the vulnerability of the location on a regional and/or a site-specific basis.

Given the above criteria it is clear that there are several factors to be taken into account to define the value of the built environment that is at risk of being damaged by the impact of hazards caused or exacerbated by climate change. With respect to the built environment it is also clear that defining and quantifying the value at risk can at best be achieved through a series of snapshots that represent either current conditions or projected conditions based on future scenarios.

Given the variability of these factors from region to region, or from one community to the next, it should be noted that the value at risk must be defined by community or regional basis. The

aggregate of all the regionally defined values at risk constitute the value at risk for the whole state of Florida.

In essence this means that the definition and quantification of the value at risk, of the built environment, must be a continuous exercise requiring the establishment of a baseline for a given region, community or site and periodic updates at specific time intervals.

Quantifying the Value at Risk

Once the value at risk has been defined on the basis of region or community-specific criteria and factors the value at risk can be quantified at the community or regional scale.

Quantifying the value at risk provides an essential foundation for the following:

1. The potential for damage to the built environment, from the impact of climate change caused or exacerbated hazards can be estimated as a percentage of the value at risk.

2. The effectiveness and benefits of adaptation measures can be quantified on the basis of their damage reduction capabilities.

3. The cost-effectiveness of adaptation measures can be assessed on the basis of their respective benefit-to-cost ratio.

Quantification of the value at risk [of the built environment] can be based, at a minimum, on the following parameters:

a) Replacement Value of Building[s]
b) Replacement Value of Contents
c) Criticality Factor: a multiplier reflecting the type of function housed in the building

Use of these parameters is represented by the equation below:

$$Vr = (C + N) \times Fc$$

Where: Vr = Value at Risk in current U.S. Dollars
C = Replacement value of building in current $
N = Replacement value of contents in current $
Fc = Criticality factor

Quantification of the value at risk for the built environment can be simplified at the local level, by quantifying the value on the basis of the type of function sheltered by various buildings, facilities and structures. For example, all residential use buildings can be grouped together, the same as all educational facilities, or health-care facilities, or government buildings etc. In the end

the aggregate of all the values at risk by type of function will constitute the total value at risk at the municipal level for example.

Existing Actions:

To be drafted by DEP staff.

Goals and Strategies:

Goals:

Goal 1: Require that the Florida Building Code incorporates design criteria for buildings to resist future loads that may result from the impact of climate change exacerbated hazards during a minimum service life of fifty years.

Strategy:

Goal 2: Require the State Building Commission to establish a technical committee focusing of vulnerability to climate change, which will recommend updates to the building code as evidence of new trends of risk factors from climate change, arise.

Strategy:

Goal 3: Require public universities in Florida to develop and deliver required educational programs for building design and construction professionals, planners and other pertinent fields, focusing on vulnerability to climate change and adaptation methodologies.

Strategy:

Goal 4: Develop a required training program to educate existing professionals, in relevant fields such as architecture, engineering, construction management etc., on the need to incorporate adaptation to climate change as a basis for establishing design criteria for new buildings. Completion of such required training to be a condition for relicensing.

Strategy:

Goal 5: Empower the Department of Professional Regulation and the various professional licensing boards to incorporate sections on climate change vulnerability and built environment adaptation methodologies in all licensing examinations.

Strategy:

Goal 6: Create and fund a State Climate Change Adaptation Plan Advisory Team charged with drafting a periodically revising a State Climate Change Adaptation Plan to be officially adopted by the state subject to legislative approval.

Strategy:

Goal 7: Have a pertinent agency of the state of Florida provide guidance, technical assistance and funding to counties in support of efforts to create and manage a Local Climate Change Adaptation Working Group, which will be charged with drafting a Local Climate Change Adaptation Plan to be adopted by resolution of the county governing authority, and with involving all municipalities and county agencies in such an effort.

Strategy:

Goal 8: Require Comprehensive Plans, at all jurisdictional levels in Florida, to incorporate cost-effective climate change adaptation measures or plans for the built environment as a requirement for approval of any new development or redevelopment projects in Florida.

Strategy:

Goal 9: Create and fund a Built Environment Climate Change Adaptation Program as a state research initiative charged with engaging the scientific and research community, by way of competitive research projects and annual announcements of funds availability, in the assessment of vulnerability and risk of the built environment to the impact of climate change with a focus on the development of adaptation methodologies based on new design criteria, methods and materials of construction and similar initiatives.

Strategy:

Goal 10: Require the Water Management Districts to consider the adaptation of the built environment to climate change impacts on a community-wide or regional basis in the implementation of flood control and other civil works projects and the adoption of related policy.

Strategy:

Goal 11: Request and engage the support of pertinent federal agencies such as the USGS, FEMA, USACE, that can provide technological and logistical support and work with Regional Planning Councils and other state, county and local planning bodies, in the creation and maintenance of a cartographic depiction of vulnerability to climate change based on current levels of risk and on future scenarios.

Strategy:

Goal 12: Create and fund a State Climate Adaptation Commission charged with identifying engineering and technical solutions, developing design concepts for preferred solutions, and with conducting initial feasibility studies relative to the scope, budgets, regulatory compliance and timelines for the implementation of specific proposed adaptation solutions on regional scales.

Strategy:

Goal 13: Revise the state Sunshine Standards for K12 education so that vulnerability to climate change and the practice of adaptation become require subject matter in the curricula of public schools in Florida.

Strategy:

Priorities for Further Research and Analysis:

Storm Surge:

Storm surge is the most destructive damage component of hurricanes and coastal storms. Through a combination of loads caused by hydrodynamic pressure, hydrostatic pressure, wave impact, the impact of water-borne debris, and other damaging effects such as erosion, scouring, undermining and translational loads, storm surge has the capacity to inflict severe and even catastrophic damage to the built environment in coastal locations.

Although ASCE-7 and the Florida Building Code prescribe methodology to quantify the main loads resulting from storm surge, the reality of the matter is that there is very little region or site-specific information regarding the behavior of storm surge at specific locations and under the influence of .local impact modifiers. Information such as: the angle of attack of storm surge at a given coastal location as a function of the direction of travel of a tropical cyclone, the velocity of flow of storm surge as it approaches a coastal location and the factors that influence such velocity of flow, and other related information are not readily available or not available at all for building design professionals to use in establishing design criteria for a specific building.

Research to identify such storm surge behavioral parameters on a basin-specific basis throughout the state could provide invaluable information to design professionals. The state needs to fund such research and engage the national and international scientific community in tackling the same.

Research to develop protocols for the removal of abandoned residential, industrial and municipal structures will be essential to insure these structures do not release contaminants into coastal waters when inundated by sea level rise.

Other Remaining Issues:

ADP-6. Transportation and Other Infrastructure

Definition of issues:

Potential impacts of climate change to Florida include rising temperatures, increases in more intense heavy rainfalls and hurricanes and rising sea levels. Because of this, transportation and other infrastructure along the coast and in low lying areas are susceptible to damage from sea-level rise, storm surge, erosion, flooding and higher temperatures. However, adaptation, particularly related to transportation, has not yet received as much attention or research compared to climate change mitigation.

Objectives:

Protect and reduce the impact on transportation and other infrastructure from climate change.

Assets at Risk:

Roads, airports, rail, pipelines, ports, beaches and other infrastructure along and close to Florida's coastline are potentially vulnerable to climate change impacts. Unfortunately, a comprehensive listing of transportation infrastructure at risk in the United States has not been prepared. Improved information about projected climate change impacts and timing of such events will be needed to identify specifically transportation and other infrastructure at risk.

Existing Actions:

To be drafted by DEP staff.

Goals and Strategies:

Goal 1: Ensure that tools and models are developed to project climate changes at smaller scales to better forecast state and local impacts and to pinpoint infrastructure at risk.

Strategy:

Goal 2: Inventory critical infrastructure at risk; determine whether, when, and where projected impacts from climate change might be significant; and evaluate the costs and benefits of alternatives of needed actions.

Strategy:

Goal 3: Ensure the coordination of adaptation efforts across jurisdictional boundaries and the exchange of information, resources, and best practices among government, the private sector and other stakeholders.

Strategy:

Goal 4: Ensure that the long range planning process addresses adaptation and the protection of critical infrastructure.

Strategy:

Priorities for Further Research and Analysis:

TBD

Other Remaining Issues:

TBD

ADP-7. Economic Development

Description of Issues:

Climate change impacts are likely to have significant effects on all sectors of Florida's economy. Some sectors will face acute challenges while others will enjoy substantial growth opportunities. GHG mitigation and climate adaptation are also likely to create entirely new economic and employment opportunities. Substantial investment is expected in energy efficiency implementation and renewable energy technologies. These investments hold the promise of diversifying and strengthening the Florida economy.

The State will benefit by early identification of business opportunities associated with climate change to increase its global competitive advantage and job creation within the state. An impact assessment is also needed to forecast potential disruption to Florida's major economic sectors due to climate change impacts such as to more frequent tropical storms, sea level rise, drought, acute flooding events, salt water intrusion, and possible habitat and species disruption.

Such an analysis might identify economic trends such as a reduction in international trade and agricultural export due to fuel prices; a reduction in real estate values, especially along coasts; a reduction in retiree in-migration due to severe weather; a contraction in tourism due to loss of beaches, unique species and other natural resources among other stresses.

At the same time, there is potential to leverage a state's specific talents and natural resources for climate change solutions into securing the business opportunities and market advantages that well-supported "early bird" efforts are likely to reap in a carbon-constrained world. Public and/or private capital might be organized to support innovative, environmentally effective market solutions. For-profit investors, pension funds, mutual funds, and/or venture capitalists may be looking to fund similar business opportunities in the New Energy Economy.

Successful economic adaptation will require anticipating and responding to the challenges and opportunities, given such economic trends.

Assets at Risk:

Significant damage to some economic sectors such as real estate, tourism, agriculture (e.g. productivity and export markets) and other resource-based industries to name some examples. Economic opportunities and market advantages might be missed or underachieve.

Objectives:

To adapt Florida to new economic trends and realities brought on by the powerful drivers of energy and climate change;

To generate useful economic trend analysis and data to guide economic development decision making; and

To create policies, programs and implementation mechanisms that support the adaptation of Florida's economy.

Goal 1: The Office of Tourism and Economic Development and Enterprise Florida – in conjunction with the Florida Energy and Climate Commission - should undertake an analysis to look at new opportunities and at economic sectors that may be negatively impacted. Particular attention should be paid to the potential impact on Florida's tourism and other natural resource-based economic sectors. Develop specific economic analysis of impact of energy and climate trends on state revenues.

Goal 2: Establish the economic value and importance of natural resources to the state economy overall and to tourism and other resource-based sectors.

Goal 3: Identify policy issues related to habitat and species management, human needs, hunting, fishing, boating, and outdoor recreation.

7.1 Tourism

Is Tourism a Resource-based Industry?

Tourism in Florida constitutes xx% of the state economy. The state's thriving tourism sector depends upon the richness and diversity of Florida's natural resources. State forests, parks, water ways, beaches, marine systems, habitat, species, flora and fauna bring xx millions of tourists to the state each year.

Goal 1: Assess the economic impact of climate change on the tourism sector.

Goal 2: Given the state's interest in ensuring a healthy tourism sector, assess the level of appropriate investment in the state's natural resources.

Goal 3: Identify possible programs or policies to mitigate any climate-rated damage.

7.2 Other Resource-Based Industries

Resource-based industries include tourism but also agriculture, forestry, marine, aquaculture and mining. Resource-based industries constitute xx% of the state economy. The state should contemplate its interest and role in mitigating the impact of a changing climate on these sectors.

Goal 1:

7.2.1 Agriculture

Description: Agriculture in Florida constitutes xx% of the state economy. Agricultural exports are x% of the economy. The productivity of some crops may be impacted by hotter temperatures, altered precipitation, invasive species, and new pests. Bio-fuels may present new growth opportunities however adequate care should be taken not to displace food crops. Planning for adequate water supplies may be important to sustain this sector.

7.2.2 Forests

Description: Aside from the inherent value of Florida's forests as habitat for many native species, our forests have obvious economic applications as recreational areas for eco-tourism activities and in their traditional commercial application as a resource for building products. However, Florida's many acres of longleaf pines and bottom hardwoods, on both public and private lands, are excellent carbon sinks and could be a source of revenue for landowners, public and private, through a carbon credit trading system.

Objectives: Explore commercial carbon sequestration strategies and capacities for Florida's variety of forest species and existing forestry lands.

Assets at Risk: Forest resources must be conserved and expanded. Work needs to be done to determine the level and areas of risk from climate change impacts (drought, pests, storms, saltwater intrusion and invasive species) for this valuable resource.

Goals and Strategies:

Goal 1: Continue existing land acquisition/management programs for forested lands

Goal 2: Adopt land acquisition/management programs with a climate change component

Goal 3: Explore relative carbon sequestration capacity of Florida's native tree species

Goal 4: Explore adaptation of forest stocks through genetics to strengthen stocks against climate change associated risks.

Priorities for Further Research and Analysis:

Relative carbon sequestration capacity of Florida's native tree species

Determine at-risk areas of forest resources due to climate change impacts

Other Remaining Issues:

TBD

7.2.3 Marine Sector

Description: (Should this be moved up to 7.2.0?)

Florida's industries based on living marine resources include commercial and recreational fishing, marine ecotourism including coastal parks and conservation areas, marine pharmaceuticals, and marine research and education. The direct 2006-2007 value of these industries to Florida's economy was $ 4.4 billion (NOEP, 2008) and the indirect value of related infrastructure and support was many times larger. Adaptive responses to protect the core living resources upon which these industries rely are addressed in ADP-3, "Protection of Ecosystems and Biodiversity." This section addresses threats to the usability and human uses of the resources, beyond considerations made in other adaptation response actions.

Objective:

The adaptive management of Florida's marine resources and their sustainable use in a changing climate will be designed to protect the living resources and the social, economic, and cultural systems that form our industries.

What is at Risk?

- The geographic ranges and abundances of living marine resources are likely to change as climate, ocean temperatures and currents, water quality, and related controlling factors change.
- Likewise, the ranges, abundances, and impacts of marine diseases, invasive species, parasites, and harmful algal blooms could change
    - As direct responses to climate change, and
    - As unintended results of the industries, themselves.
- One consequence of these changes is that future fisheries, principal fishing grounds, ecotourism destinations, and the land-based operations and facilities that support the industries may "migrate" from their present locations to different areas of the state. Such changes have the potential to affect the economic viability of industries dependent on living marine resources.
- The same changes can also have negative effects on the health and safety of industry workers and consumers of industry products and service.
- Public and private investments in land acquisition for future parks and conservation areas, future working waterfronts for fishing and ecotourism, and future marine research and education facilities will be affected by climate change, and the effects could be significant.

What might be gained? The same processes that may diminish Florida's existing marine industries may lead to new opportunities for fisheries, ecotourism, and allied economies. Truly adaptive management will require an ability to detect and exploit such possibilities.

Existing Actions:

To be drafted by DEP staff:

The Department of Environmental Protection…

The Fish and Wildlife Conservation Commission…

The Department of Agriculture and Consumer Services…

Goals and Strategies:

ADP- 7.2.3: Industries Based on Living Marine Resources

Goal 1: Provide an integrated tracking and reporting system for the ranges, abundances and condition of species valued for their roles in fisheries, ecotourism, aquaculture, pharmaceuticals, and research.

Goal 2: Develop and implement an integrated screening and tracking program for species die-offs, marine diseases, invasive species, and parasites, modeled after the state's harmful algal bloom programs.

Goal 3: Implement educational programs to reduce vessel-based conveyances of unwanted species in Florida waters, and to protect industry workers and consumers from novel health and safety challenges.

Goal 4: Develop conceptual plans for the co-location of new working waterfronts for fishing, ecotourism, marine research, etc. that employ green infrastructure adapted to emerging challenges of climate change.

Strategies: Goals 1 and 2 will be met through the use and expansion of existing state and federal programs and platforms for monitoring, event responses, data management, and public reporting.

Goal 3 will be met through collaboration with the Florida Sea Grant Extension Service. University planning, engineering, and architectural schools will be engaged to address Goal 4.

Priorities for Further Research and Analysis:

1. Couple IPCC outputs, regional climate and oceans data, and ocean circulation models to forecast areas and rates of coastal water temperature changes under several scenarios.

2. Expand existing state programs and platforms for monitoring, event responses, data management, and public reporting to include range extensions, shifts in population centers of valued species, dispersion patterns of non-native marine and coastal species, marine diseases, and biological threats to industry workers and consumers.

3. Couple future land use plans, sea level projections, hurricane risk models, energy-efficiency standards for marine ops, and land-based transportation systems to co-locate new parks, conservation areas, and working waterfronts for fishing, ecotourism, and marine research.

Ernest D. Estevez, Ph.D. Director, Center for Coastal Ecology, Mote Marine Laboratory

1600 Ken Thompson Parkway Sarasota, FL 34236 estevez@mote.org

7.2.4 Aquaculture

Description:

TBD

7.2.5 Mining

Description: Nationally, Florida ranks fifth in the production of limestone, sand and gravel, clay, peat, heavy minerals and phosphate. Mining occurs throughout the state with phosphate mines located primarily in northern and central Florida. These mines supply one-quarter of the world's and three-quarters of the U.S. domestic needs. Nearly all of the phosphate mined is used for the national and international production of agricultural fertilizer. In 2000, an approximate $1.13 billion dollars worth of fertilizer was exported.

Phosphate mines in northern and central Florida have been a valuable resource for the national and international production of agricultural fertilizers; although many of these lands are now considered degraded and disturbed. However a cursory examination gives reason to believe that various carbon management strategies (e.g., bioenergy crops and soil carbon sequestration) could be implemented on these lands. Additionally, lands associated with phosphate and other mining activities in Florida certainly have potential to store carbon in soils.

After mining operations have ceased, these lands typically remain undeveloped because they cannot structurally support buildings for commercial or residential development. However, research has shown that these areas are frequently fertile, and high in potassium and phosphorus.

These properties may be useful for growing short-rotation bioenergy crops, as well as for carbon sequestration. Biomass derived from crops can be used in co-firing power plants and in the production of transportation fuels. These lands generally have high moisture holding capacity and high clay content; researchers from Oak Ridge National Laboratory have begun to explore their use for carbon sequestration and scientists at the University of Florida and Common Purpose Institute are examining the use of these lands for bioenergy crop production.

Objectives, Goals and Strategies:

- Soil carbon dynamics must be studied to estimate the long-term potential for carbon sequestration both in new growth forest and through underground sequestration.
- Determine environmental and cost benefits of developing short-rotation woody crops on formerly mined lands.
- Review and select tree species appropriate for such sites
- Identify management practices to ensure plant survival and maximize growth.

Assets at Risk: None

Priorities for Further Research and Analysis:

Examination of soil characteristics for use of such properties as forested carbon sinks, bioenergy crop production and underground carbon sequestration.

ADP- 7.3. Construction

TBD Ricardo plans to provide comments.

ADP-8. Insurance (Property and Casualty)

Kathy Baughman-McCleod drafted. 850-413-4914

Description of Issues: With more than 2,000 miles of coastline, Florida is physically and financially vulnerable to the effects of climate change. Ninety percent of Floridians live within 50 miles of the coast, and Florida's residential exposure is approaching $2 trillion. Additionally, the state's largest insurance company — Citizens Property Insurance Corporation — has 1.3 million policyholders and is financially supported by Florida's insurance consumers.

Science has established that climate change increases the intensity of hurricanes. Given Florida's geography, coastal density and a $65 billion dollar tourism economy, plus eight major storms in 2004 and 2005, property insurance and affordability issues are one of Florida's major challenges.

Objectives / Goals: Our policy objective is to encourage insurance companies to provide policyholders with greater disclosure about climate risk. Are insurance companies adequately informing their customers and their shareholders about the risks climate change poses to their business and their ability to pay policy holders' claims? Are insurance companies taking the necessary steps to mitigate against these risks?

A second objective is to understand the relationship between the threats of climate change, sea level rise and providing affordable insurance premiums to Florida home and business owners.

Thirdly, we need to develop policies that make our coastal communities and infrastructure more resilient to natural disasters through programs such as the My Safe Florida Home program (www.mysafefloridahome.com). This successful program has contributed to building a culture of hurricane mitigation in Florida.

Finally, we need to fully define the issues surrounding risk-based pricing in the property and casualty insurance industry for Florida. Our current pricing structure does not truly reflect the risk of loss, particularly for Florida's coastal regions.

Assets at Risk: Insurance companies insure billions of dollars of assets -- homes, businesses, agriculture, infrastructure, parks and beaches -- in Florida. All of these assets and more are at risk to the myriad effects of climate change.

Existing Actions:

To be drafted by DEP staff.

Priorities for Further Research: There needs to be further research and consensus on how hurricane models incorporate climate change. There also needs to be more research on

mitigation techniques and effectiveness. For example, Ren Re and Florida International University is researching how to build homes to withstand stronger hurricanes at the Wall of Wind, a cutting edge facility in Miami-Dade County (www.renre.com/wow.html).

ADP-9. Emergency Preparedness and Response (Extreme Events)

Definition of Issues: Throughout the history of settlement in Florida, extreme weather events – particularly in the form of hurricanes – have played a major role in shaping culture, commerce, and community development. As a result, Florida's state government has developed one of the more robust emergency preparedness and response infrastructures in the nation. This was particularly evident in the depth of aid provided by Florida during the 2006 hurricane season to Mississippi in the aftermath of Hurricane Katrina.

Global climate change is likely to increase Florida's risk of extreme weather events over the next 100 years. While the question of whether hurricane frequency will increase given rising sea-surface temperatures remains uncertain at present, current science does support increased intensity and duration for those storms that do form in the Atlantic and the Gulf of Mexico. When coupled with rising sea levels, future hurricane events may yield greater storm surge effects to put coastal communities at greater risk for damage than is the case today.

To be prepared, Florida must build upon its current excellence in emergency preparedness and response in order to protect Florida's people and build environments from the worst possible effects of heightened extreme weather events.

Objectives: Florida's current emergency preparedness and response functions are a coordinated effort between federal, state, and local governmental agencies as well as non-governmental organizations. The objective of Florida's future emergency preparedness and response functions must be to build on the excellence gained through past experience to assure sufficient capacity and capabilities in protecting public heath and welfare in more severe storm events with increased incidence of storm surge and the associated coastal damage.

Assets at Risk: While all of Florida's counties are subject to extreme weather events, our coastal communities and ecosystems are at particular risk from increased storm surge and increased hurricane intensity. The vast majority of Florida's population lives within a short distance from the coast [Add info on % within 1 mile and % within 5 miles?] Likewise, the vast majority of the state's existing building stock is situated near the coast. While many coastal ecosystems have adapted to periodic extreme weather, system resiliency in some cases may be undermined due to the loss of extent, pressures from invasive exotic species or other perturbations which prevent post-hurricane recovery.

Goals and Strategies:

Goal 1: Assure sufficient response capability among state and local first-responders

Strategy:

Goal 2: Increase the resiliency of coastal communities to storm surge

Strategy:

Goal 3: Increase the resiliency of coastal ecosystems to extreme weather events

Strategy:

Priorities for Further Research and Analysis: Enhancing Florida's emergency preparedness and response functions to perform effectively in extreme events exacerbated by global climate change will require additional science and analysis. Current priorities include:

- Additional research to better understand and predict the effects of global climate change on hurricane frequency in the Atlantic Basin;
- Local and regional analysis of shoreline elevation to better predict storm surge using statewide LIDAR survey data recently completed for the state's coastline;
- Additional research and analysis into the behavior of Floridians when facing extreme weather events and communications strategies that more effectively result in the evacuations of high-risk areas;
- Analysis of strategies to ensure that special-risk populations can be effectively evacuated from high-risk areas.

Other Remaining Issues: Brief overview of issues not addressed by the TWG, but recommended for further consideration in the future.

ADP-10. Human Health Concerns

Description of Issues: Climate change is expected to have a wide range of impacts on Florida's health systems. The historical range of mosquito- and vector-borne diseases may shift with a changing climate. More intense extreme weather events such as hurricanes, heat waves, flooding, and wildfires, will directly impact human health in Florida. Successful research in this area will identify the increasing risks to human health, which segments of the population are most vulnerable, and how risks to their health can be reduced.

As our climate experiences change, many potential stressors to human health change as well. Enhancing the frequency of floods and droughts, for example, impacts the life cycle of water-borne vectors of diseases. Further, these alterations have the potential effect to the healthfulness of the place, now challenged by the prospect of increased tropical pests and diseases.

Equally important are alterations in the moisture content of the air and wind patterns which will likely affect the concentration of air-borne particulates in a given location. Florida is also home to several large cities, such as, Miami, Jacksonville, Orlando and Tampa, and changes in climate in these areas have the potential to affect air quality and, by extension, human health within the state. Understanding how climate change will impact human health in the future requires the cooperation of scientists in many disciplines, including climatology, biology, and environmental science.

Objectives: Human health is rather intimately connected with climate and the environment on local and regional scales. The health and well-being of the citizens of the state of Florida is of prime importance to the health of our state. Incorporating considerations of climate change into the state's health plan to protect the citizens is as important as designing water treatment infrastructure to reduce harm to human health.

What is at Risk?

Climate change may increase the risk of some infectious diseases, particularly those diseases that appear in warm areas and are spread by mosquitoes and other insects. These "vector-borne" diseases include malaria, dengue fever, yellow fever, and encephalitis. Also, algal blooms could occur more frequently as temperatures warm — particularly in areas with polluted waters — in which case diseases (such as cholera) that tend to accompany algal blooms could become more frequent.

Existing Actions:

To be drafted out by DEP staff.

Goals and Strategies:

ADP- 10.1: Health Care

Goal 1: Ensure that health codes and policies are adequate to protect against known risks from observed climate and appropriately incorporate potential changes in risk from climate change.

Goal 2: Regularly revisit health codes and regulations as new evidence of new or altered risks from climate change arises.

Goal 3: Strengthen vaccine campaigns.

ADP – 10.2 Air Quality

Goal 1: Ensure that air quality polices provide an adequate level of safety to protect against known risks from current climate.

Goal 2: Ensure that new air quality policies incorporate potential changes in risks from climate change to ensure appropriate design and mitigation factors.

ADP – 10.3 Waste Water Treatment

Goal 1: Ensure that waste water infrastructure provides an adequate level of safety to protect against known risks from current climate.

Goal 2: Ensure that new waste water infrastructure incorporates potential changes in risks from climate change to ensure appropriate design and capacity over the lifetime of projects.

ADP – 10.4 Disaster Response

Goal 1: Establish communication mechanism to coordinate efforts between disaster relief and public health agencies.

Goal 2: Communication systems and plans that address health issues associated with low-income and under-served populations and other vulnerable groups.

Goal 3: Adequate training for first responder and emergency responder personnel.

Goal 4: Limit growth in areas whose evacuation will be challenged by sea level rise and increased storm frequency/severity.

ADP – 10.5 Medical Treatment and Biomedicine Development

Goal 1: Increase state universities medical schools focus to include diseases that can be attributed to climate change.

Strategy:

Goal 2: Promote the research and development of biopharmaceuticals that can treat the diseases that can be attributed to climate change.

Strategy:

Priorities for Further Research and Analysis:

- Improved projections of potential public health risk from the interaction of increasingly intense and long heat waves with existing air-quality problems in major urban areas.
- Projects on the potential in Florida for increases in the transmission of vector-borne infectious diseases (e.g., malaria, dengue, yellow fever, and some viral encephalitis) resulting from immigration from other climate change affected areas.
- Analysis of the relationship between heavy rainfall and biological contamination of water supplies, the influence of climate variability and extremes on notified illnesses, and quantification of the burden of water-related illnesses (including conditions such as gastroenteritis and skin infections).

Other Remaining Issues:

TBD

ADP-11. Social Effects

Description of Issues:

Currently Florida's population is around 18M, and its projected growth is 28.5M by 2025. Additionally, Florida's coasts are home to an estimated 70% of the population. The coastal environment also provides diverse habitats for countless marine and terrestrial species. For centuries, humans have lived, worked, and played along the coasts, and the ocean has long been an important component of the economy from fishing to tourism.

Sea levels are expected to rise in the foreseeable future as the earth's climate warms, which makes Florida's coastlines particularly vulnerable. Climate change will likely impact not only the physical coastline, but also the billions of people who live and work in Florida. Understanding the impacts of climate change on our coasts and also our inland areas therefore requires the perspectives of sociologists, economists, and scientists alike.

Society can deal with slow trends in climate, occurring over the many thousands of years that are characteristic of ice age cycles. But decade-to-century changes, i.e., those that occur on the time scales of a human lifetime and the ability of societies to evolve, are potentially catastrophic.

Objectives:

Climate change has the potential to play a major role on human behavior over the next century. Even if all human activities that contribute to global change were stopped today, change would continue as the present surplus of greenhouse gases in the atmosphere will remain for centuries. As of yet, the climate system is not well enough understood to "reverse-engineer" the climate to a state that best suits humanity. Therefore, today Floridians must decide what changes that they must make in their present behaviors in order to live in the changing climate.

What is at Risk?

Increased development to accommodate Florida's projected population growth will most likely increase climate exposure and risks to Florida's citizens and their current way of life. Florida must recognize that all regions of the state will encounter socio-economic changes including:

- Increased housing and insurance costs, especially related to storm events and sea level rise;
- Increased charges for energy consumption and transportation changes; and
- Increased cost of infrastructure improvements including roads, sewer systems, waste-water treatment facilities, water control structures and property protection.

Existing Actions:

To be drafted out by DEP staff.

Goals and Strategies:

ADP- 11.1: Social Justice Issues

Goal 1: Promote social and economic equity, reduce poverty, increase consumption efficiencies, decrease the discharges of wastes, environmental management, and increase the quality of life of vulnerable.

Strategy:

Goal 2: Assess potential social impacts of climate change on incomes, and other measures of wellbeing in vulnerable communities.

Strategy:

ADP – 11.2 Food and Water Security

Goal 1: Ensure basic access to safe food supply and water.

Strategy:

ADP – 11.3 Housing Security

Goal 1: Ensure basic access to shelter.

Strategy:

Priorities for Further Research and Analysis:
TBD.

Other Remaining Issues:
TBD

ADP-12. Organizing State Government for the Long Haul

Definition of Issues: The range of adaptation planning issues outlined in this document are testament to the number of issue areas and concerns to be adequately addressed in order to assure that Florida successfully adapts to impacts caused by global climate change over the next century. In developing and implementing such a wide-ranging adaptation plan for Florida will require a single point of focus within state government.

During the 2008 regular session of the Florida Legislature, HB 7135 created the Florida Energy and Climate Commission and imbued the commission with a broad range of duties and powers, including the responsibility for coordinating adaptation planning development and implementation within state government. The Florida Energy and Climate Commission is appropriately housed within the Executive Office of the Governor, thus elevating the issue and enabling cross-agency coordination of efforts.

Objectives: The principal objective is to assure the creation of a single point of focus within state government that can continue assessing the risks posed to Florida by global climate change, that can develop increasingly informed adaptation planning over many decades, and that can learn from prior implementation to adjust adaptation planning in Florida as events on the ground change.

Assets at Risk:

TBD

Goals and Strategies:

No goals or strategies are proposed here given the action of the Legislature in creating the Florida Energy and Climate Commission. The new commission appears at present to have the sufficient scope, powers, and resources to accomplish the intent of this adaptation planning element.

Priorities for Further Research and Analysis: Beyond the creation of the Florida Energy and Climate Commission, other entities and coordinating mechanisms may be required. Development and implementation of Florida's first generation adaptation plan should bring these additional organizational requirements to light. At this time, the technical working group suggests further analysis of the following issues:

- What coordinating mechanisms are required to assure that multiple state agencies with similar powers and duties are collaborating on adaptation planning and implementation?
- What coordinating mechanisms are required to assure that state government is working in concert with regional and local agencies to reduce risk and increase Florida's adaptability?

Other Remaining Issues: none at this time.

ADP-13. State Funding and Financing

Description of Issues: Adequate adaptation funding for Florida would include funds made available to address the impacts of climate change. Many programs are already intact and intended to address some of these impacts. Some of these programs are already funded and some may even have dedicated financing streams, but most of those existing programs are subject to political/economic cycles and disruption. Climate change impacts can be expected to intensify in the future and might also be expected to occur simultaneously, on all fronts, as opposed to the isolated incidences that Floridians and program resources are accustomed to. If and when this happens, it can be expected to greatly increase the pressure on the funding and financing infrastructure.

Objectives: Be prepared to fund the protection of human health and critical infrastructure as well as address other impacts of climate change, where feasible, within a framework of protection, accommodation and, in some cases, retreat.

Assets at Risk: Florida is a state with more than 2000 miles of coastline and mostly low elevations. It is within the historic pathway of destructive weather events and particularly vulnerable to sea level rise, tidal surge saltwater intrusion and flooding. Coastal infrastructure such as roads and bridges, utilities as well as town and cities are also at risk. Under certain historic climatic conditions, Florida has already felt the effects of mass human migrations for storm events alone, these conditions are expected to worsen in the future and be less temporary in nature. Freshwater resources are increasingly precious in the state and already pressured by Florida's growing population. Climate change poses risks to terrestrial and aquatic ecosystems, agriculture, forestry and fisheries as well. All of these stresses can add to existing stresses, such as population growth, land-use change and pollution, further straining any existing funding and financial resources intended to address these impacts.

Goals and Strategies:

Goal 1: Examine existing funding and financing infrastructure to determine adequacy for meeting increased demands of climate change impacts.

Goal 2: Examine alternative financing methods to meet climate change demands and consider protecting these from short term economic and political cycles by dedicating funding.

Goal 3: Consider strategies for emergency funding/financing mechanisms for unforeseen and unplanned consequences of climate change.

Goal 4: Consider carbon credit revenues ad adaptation financing resource

Goal 5: Examine opportunities for federal funds from emerging federal climate change legislation.

Goal 6: Encourage investment of state employee pension funds.

Priorities for Further Research and Analysis:

- Traditional funding mechanisms such as state, regional and local taxes, utility and land use fees.
- Develop new revenue streams resulting from federal legislation, cap and trade program revenues, potentials for carbon offsets/sequestration, resource use taxes, etc.

ADP-14. Coordinating with Other Regulatory and Standards Entities

Description of Issues:

The federal government is participating in a wide range of climate activities nationwide. They also fund state and regional entities that provide climate services. Activities include data collection, interpretation and product dissemination. Primary agencies involved include the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), Environmental Protection Agency (EPA), Natural Resources Conservation Service (NRCS) and U.S. Department of Agriculture (USDA). Several products produced by federal agencies, such as drought severity categories and river flood forecasts that trigger a variety of Florida emergency and economic relief activities. Additional Federal entities to be considered include: U.S. Energy Information Administration (EIA), Dept. of Energy including the Energy Star Program, National Science Foundation, and others.

In addition, a number of professional societies are actively involved in climate change activities to better understand the potential impacts of climate change on the members they serve. Additionally, these societies often represent fundamental public service providers (e.g. water utilities) and need early involvement in decision-making, require sufficient data to make informed decisions regarding risk and reliability, public health and safety and financial management. Collectively, they represent a broad base of the population, possess unmatched knowledge of the industry they represent and offer tremendous opportunities for technology transfer, public education and widespread reach.

Objectives:

There is considerable research, data, potentially impacted end-users and other interested parties directly involved with climate change, directly affected by climate change and/or have the ability to directly impact funding, research priorities, communications or other aspects of the climate change community.

- Develop functional relationships between selected federal government agencies/departments/entities, the State of Florida and key professional societies to collaborate on climate change issues of mutual interest
- Develop a research agenda to address shared interests priorities
- Identify and align with funding sources and allocation decisions essential to Florida's future as it relates to climate change

What is at Risk?

The Federal Government has the lead and is central to most of the significant climate change and related programs, research, funding and information dissemination. Failing to actively engage with the various agencies will result in missed opportunities to ensure that Florida needs are expressed, understood and addressed. Additionally, working in a vacuum will result in waste

and inefficient use of our limited financial, intellectual and physical resources and will under leverage the vast pool of resources that have been working on climate change and related issues for years. Lastly, we must actively engage with the Federal process and work as a cohesive unit (a state with numerous needs, challenges and sometimes competing objectives) to ensure that we are not competing among each other for limited dollars and research priorities.

Existing Actions:

To be drafted out by DEP staff.

14.1 Federal Government

Goals and Strategies:

Goal 1: Develop a clear understanding of the functions and information available (needed) of key federal agencies.

Goal 2: Identify data gaps and prioritize research needs to establish an agreed-upon research agenda representing Florida's collective needs.

Goal 3: Prioritize funding needs, develop a strategy to secure federal and federal flow-down funding to meet strategic needs in Florida.

The following list includes the name and summarizes the function of key Federal agencies (by category) involved with or who have a stake in climate change.

Drought Preparedness

- National Drought Mitigation Center (NDMC)

This site hosts the Drought Monitor and The Drought Impact Reporter. NDMC helps people and institutions develop and implement measures to reduce societal vulnerability to drought. http://www.drought.unl.edu/dm/index.html, http://droughtreporter.unl.edu/

- National Integrated Drought Information System (NIDIS)

This National Oceanic and Atmospheric Administration (NOAA) site hosts the federal drought monitoring system. NIDIS provides a complete summary of drought information at national, regional, state and local scales.

- Climate Prediction Center (CPC-NOAA)

CPC provides a variety of climate analysis and prediction products, including the Drought Outlook, which projects drought category tendencies for a 3-month period. http://www.cpc.ncep.noaa.gov/

Climate Information

- National Climatic Data Center (NCDC)

NCDC is the national archive for climate data and products.
http://www.ncdc.noaa.gov/oa/ncdc.html

- Applied Climate Information System (ACIS)

ACIS is supported by the National Climatic Data Center (NCDC) under the National Virtual Data System and operated by the six Regional Climate Centers. ACIS provides both real-time and historical climate data from a variety of networks. ACIS also allows execution of user adjustable programs to support drought risk analysis. http://rcc-acis.org/

- Florida State Climatologist

The Florida Climate Center is part of three-tiered system that serves to provide climate data, information, and services for the United States.
http://www.coaps.fsu.edu/climate_center/nav.php

- Southeast Climate Consortium

The mission of the Southeast Climate Consortium is to use advances in climate sciences, including improved capabilities to forecast seasonal climate, to provide scientifically sound information and decision support tools for agriculture, forestry, and water resources management in the Southeastern USA. http://secc.coaps.fsu.edu/

Water Information

- National Water Information System (NWIS)

NWIS is operated by the United States Geologic Survey (USGS) and provides both real-time and historical surface streamflow, reservoir and groundwater information.
http://water.usgs.gov/waterwatch/

- U.S. Water Monitor

This site provides a summary of water information at national, regional, state and basin scales.
http://watermonitor.gov/

- National Weather Service – Hydrology

The River Forecast Centers provide streamflow and flood forecasts for the U.S.
http://www.nws.noaa.gov/oh/index.html

- U.S. Army Corps of Engineers

In support of Nation's interests, build broad-based relationships and alliances to collaboratively provide comprehensive, systems-based, sustainable and integrated solutions to water resources national and international challenges. http://www.usace.army.mil/

The majority of Florida is served by the Jacksonville District Office (http://www.saj.usace.army.mil/) and the Panhandle is served by the Mobile, Alabama office (http://www.sam.usace.army.mil/)

Agriculture

- Joint Agricultural Weather Facility (JAWF)

This joint USDA/Department of Commerce operation provides production agriculture predictions for the U.S. and the world. http://www.usda.gov/oce/commodity/index.htm

- Natural Resources Conservation Service (NRCS)

NRCS's natural resources conservation programs help people reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. http://www.nrcs.usda.gov/programs/

Ecosystems

- The Mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people .

The challenge of climate change to the U.S. Fish and Wildlife Service is two-fold. The scientific challenge is one of translating projections of climate change into transparent predictions of trust resource response that can guide management decisions. The resource conservation challenge is one of articulating and directing a conservation response that is strategic, adaptive, and collaborative.

- The mission of the Environmental Protection Agency is to protect human health and the environment. Since 1970, EPA has been working for a cleaner, healthier environment for the American people. http://www.epa.gov/

14.2 Professional Societies

Goals and Strategies:

Goal 1: Engage professional societies to establish industry priorities for research and funding; to work with state and Federal officials to promote priorities.

Goal 2: Develop training and technology transfer tools and engage professional societies to reach members.

Goal 3: Establish a "cross functional" professional society task force responsible for coordinating climate change issues within their respective industries.

The following list includes the name and summarizes the function of key professional societies involved with or who have a stake in climate change.

Professional Societies

- American Water Works Association (AWWA) and the Florida Section AWWA (FSAWWA)
- AWWA Research Foundation (AWWARF)
- Water Environment Foundation (WEF) and Florida Water Environment Association (FWEA)
- Water Environmental Research Foundation (WERF)
- American Water Resource Association (AWRA)
- WateReuse Foundation
- Southeast Desalting Association (SDA)
- Florida Stormwater Association (FSA)
- American Society of Highway Engineers (ASHE)
- Florida Engineering Society (FES)
- Association of Public Works Administrators (APWA)
- Others as identified

Priorities for Further Research and Analysis:

Identify targeted Federal agencies based on Florida needs and issues addressed.

Other Remaining Issues:

TBD

ADP 15. Public Education and Outreach

Note that there were two submitters: Prof. Meg Lowman and Alex Score from WWF. Alex's text will be in light blue.

Description of the issues:

As a state surrounded by water on three sides, with a relatively low elevation, situated in the eye of hurricane alley, and with easy access for infectious disease vectors and tropical invasive species, Florida has an enormous challenge to educate its constituents about climate change. Public understanding of complex, non linear problems, like climate change, is not always easy to convey since much of the jargon and information exchange has been limited to technical journals accessible to and read by only a small minority of professionals. Over the next few decades, political and civic leaders will face difficult choices. Few will have sufficient access to dependable scientific assessments. Designing a dynamic program that marries current climate change findings with business insight to educate a wide array of constituents about adaptation to environmental changes is a critical next-step.

Public education and outreach about climate change in Florida is needed to support necessary mitigation and adaptation actions. Florida is "ground zero" for climate change impacts in the US with its low lying and densely populated coastal zones, susceptibility to hurricanes, and vulnerable natural resources. It seems that few people realize Florida's vulnerability, but these few are crying out for detailed and accurate information and solutions. A focused and comprehensive stakeholder education and outreach program is a key component in building support for the mitigation and adaptation policy changes that will become critical issues in Florida.

Objectives:

Florida can become a national and international leader in the dissemination of climate change information, educating a broad diversity of constituents with a cutting-edge and successful public education program. Other states are currently implementing adaptation and mitigation strategies, but relatively few have implemented broad, comprehensive public education programs at any level. There are myriad grass-roots organizations attempting to educate the public about climate change, but in actual fact some of this effort can actually communicate and disseminate knowledge that may not be accurate or up-to-date. The success of any climate change adaptation demands full participation of the stakeholders (i.e. citizens of Florida). The objectives of a successful public education outreach program would be three fold –

1. To educate all of the stakeholders including state leadership, state and regional government who implement adaptations, citizens of Florida (including retirees, families, work force, and students K-16), and the broader business community both within and outside of Florida but who are important stakeholders in Florida's adaptation actions;

2. To design an over-arching program that could be quickly and effectively disseminated to the stakeholders listed above (a kind of Earthwatch "blitz" of sound science presented in clear, concise and simple terms so that all Floridians can embrace the knowledge); and

3. To link the public education outreach programs to the best climate change science, so that issues relating to adaptation and risk management create positive solutions to the environmental challenges of the near future.

- Educate and engage a wide audience about climate change in Florida. Share not only current knowledge of the impacts already occurring and expected in Florida, but also short and long term solutions. An informed population will better understand, become involved in local and state issues, and support needed policy changes.
- Train, engage and coordinate climate change adaptation practitioners, and needed technical support, to help Florida plan for climate change. Climate change adaptation science and related policy improvements are developing fields requiring specific conceptual and technical skills which independently exist in the expert community but require facilitation and training to bring together in an adaptation experts support group.

Assets at Risk:

The best climate change adaptation programs will be at risk if they are not embraced by the stakeholders. The best policies might be approved in Tallahassee, but the full understanding and education of citizens will insure their timely implementation and endorsement. A good example is Sarasota County, which has excellent sustainability policies in force with local leadership, but very little comprehension of the issues or "buy-in" by the constituents as witnessed by the face that Sarasota County was recently "awarded" last place in a statewide carbon footprint audit.

In summary, all assets are at risk without a careful and comprehensive program of education throughout the state at all levels – leadership, regional government, citizens, students K-16, and businesses who deal with Florida.

Second: Principal risks include misunderstood and failed policy actions resulting in political stalemate and inaction. Additionally, adaptation only "buys time." Rapid and significant greenhouse gas mitigation is the only long term solution. Understanding that the two must go hand-in-hand is crucial.

Goals:

Goal 1: Immediate Training on Climate Change Adaptation

Two tiers of immediate training could be implemented:

a. short (2 day) executive seminars for CEOs and State Legislators, designed for policy makers, conducted by scientists trained in public education outreach (e.g. graduates of the Aldo Leopold Leadership Program from Stanford University); and

b. A follow-up series of comprehensive workshops (4-6 days) mixing business and civic leaders from public and private sectors. Local teachers should be included in all sessions. The curricula would be akin to executive business seminars conducted at Harvard Business School, Stanford, and Wharton but tailored to Florida's emergent issues in water management, coastal adaptation, renewable energy production, agricultural strategies, evolving transportation and construction standards for smart growth, public health, and the economics of sustainable development. Initially, participation in Florida Future executive seminars will be at the governor's invitation, with each team designed to be interdisciplinary, matching industry executives from different sectors with key policy makers and scientists to foster cross sector thinking.

Over a two year development period, different types of education programs aimed at other stakeholders (excluding the leadership who are earmarked for a and b above) would be developed and piloted by a Public Education Outreach taskforce, including (but not limited) to school curricula, television segments, government fact sheets, signage, business incentives, and other creative learning pedagogy.

Goal 2: Initiate major public education campaign (15.1, 15.3, 15.4, 15.5, 15.6, 15.7, 15.8, 15.9)

a. Use high profile media and other appropriate outlets to raise general awareness on climate change in Florida.

b. Make connections between mitigation and adaptation solutions and policy changes.

c. Educate about the expected costs of inaction and delayed action compared to the costs of acting proactively.

d. Focal topics can include: Heat waves and associated health risks, sea level rise and associated infrastructure and property risks, wildfire risks, species disturbances and habitat loss/change and associated ecosystem services losses (impacts to valuable and highly visible resources such as coral bleaching), risks to water supplies, etc..

e. Focus groups can include: the public, policymakers, media, business leaders, developers, landowners/buyers/sellers, etc..

Goal 3. Create adaptation training and collaboration opportunities (15.2, 15.3)

f. Create opportunities for government agencies to work together and with climate change adaptation experts to develop needed skills in applying adaptation concepts in their every day management and planning.

g. Build an interacting and idea sharing community that includes members which can

h. Bring together experts in climate change adaptation, environmental scientists, economists, social scientists, human health experts, political scientists, and policy makers to combine the needed expertise that can guide Florida.

i. Adaptation focus areas: Natural resources and ecosystem services, infrastructure and development, financial markets, job markets, human health and welfare,

j. Technical expert focus groups: Florida's policy makers, research institutions, NGOs, water boards, state agencies, media, etc..

Strategies

In brief, a program should be dedicated to building strategic consensus and civic leadership to address the uncertainties of climate change and its probable impacts on Florida's 18 million residents. A 10 year education plan should design and establish a 'think and do' tank to create a Florida climate change curricula to train 10,000 civic leaders, to educate K-16 teachers and their students, and to mobilize top scientists to advise Florida's business leadership and counsel Florida's Climate Action Plans. The full participation of relevant State agencies and NGOs, public and private, is envisioned. When formed, a Florida Leadership Institute (working title) would leverage the intellectual resources of Florida's state and private universities to train civic leaders through a series of climate change impact seminars hosted by participating institutions across the state, simple sound-bytes translated in a variety of venues, simulated gaming that engage the youth, incentives linking education with business, critical partnerships (such as with Sierra Club, home-owners associations, AARP, NEON, and other groups representing broad constituents) and strategically defined levels of education programs to service all of the diverse constituents in the state.

The mission of the Florida Leadership Institute is to build a generation of progressive thinkers who are conversant with the metrics of climate change; its potential impacts on natural, civic, government, and business systems that support the quality of life in Florida; and who can create adaptation plans based on their education of environmental changes.

Given the urgency of mobilizing civic support, the speed of delivery will be critical to program success. Scientists need to be convened to establish models for Florida adaptation and thresholds for State actions. Training venues need to be identified. Accommodations should be reserved at universities and at field stations in state parks, marine preserves, estuaries, and vulnerable coastal sites. Field-based training could be stewarded by Florida's best scientists and educators, but should include experts in public science education outreach (not just academics trained in professional communication to peers).

Existing Actions:

To be drafted out by DEP staff.

Priorities for Further Research and Analysis:

Florida can learn from other successful outreach and education strategies for climate change in other states and countries which are farther along in these areas. Just as we are learning about managing coral reefs in a changing climate from Australia, Florida can learn how to engage stakeholders from similar efforts.

Other Remaining Issues:

Successful outreach and education requires considerable investment in capacity and operating support. It also requires full understanding of audiences through market research, etc.. The TWG should be ready to support allocation of the necessary resources.