NEW CLIMATE CHANGE INFORMATION FOR ENHANCING EVERGLADES RESTORATION CLIMATE PREPAREDNESS AND RESILIENCE

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USACE Jacksonville District
GEER Conference, Coral Springs, FL
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PRESENTATION OUTLINE

• CISRERP 2014 and 2016 Findings on Climate Change
• The RECOVER 5-Year Plan and Climate Change
• USACE Climate Preparedness and Resilience Guidance
• Climate Change and SLR Scenarios for CERP Planning
CISRERP 2014 REPORT FINDINGS ON CLIMATE CHANGE AND SLR

- Potential significant changes in precipitation and temperatures coupled with increasing sea level have important implications for the CERP (under some future scenarios there is “…insufficient freshwater to sustain the natural and built systems.”)

- Climate change is not adequately considered in the CERP planning process and should be integrated into future ongoing analysis and monitoring

- CERP planners should consider implications of sea-level rise and potential hydrologic change in systemwide planning and project prioritization

- High priority research needs related to climate change and Everglades restoration
CISRERP 2016 REPORT FINDINGS ON CLIMATE CHANGE AND SLR

- Major advances in knowledge since the CERP was developed in the 1990s:
  - Predrainage hydrology
  - Climate change and sea level rise
  - Feasibility of storage alternatives

- A reexamination of CERP restoration goals is in order – should consider the need for benefits that are robust in the face of climate change or mitigate its effects

- Uncertainties of future storage and climate should be incorporated into CERP planning

- A systemwide analysis of the potential future state of the Everglades ecosystem needs to be conducted to inform decision making – Should include scenario analyses of storage and climate change
INCORPORATING CLIMATE CHANGE IN THE RECOVER: 5-YEAR PLAN

1. Science Review and Integration
   - Consider new (or updated) drivers related to climate change

2. RECOVER’s role in CERP implementation

3. Recommendations for refinements of CERP Interim Goals (IG)

4. Recommendations for refinements of CERP Interim Targets (IT)

5. Opportunities for Adaptive Management

6. Communication of RECOVER Science
### SCIENCE INTEGRATION

<table>
<thead>
<tr>
<th>Science Review and Integration Tasks</th>
<th>FY2017</th>
<th>FY2018</th>
<th>FY2019</th>
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<td><strong>Task 4</strong>: Review 2009 MAP</td>
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<td><strong>Task 5</strong>: Update MAP components</td>
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USACE CLIMATE PREPAREDNESS AND RESILIENCE GUIDANCE

• **ER 1100-2-8162:** *Incorporating Sea Level Change in Civil Works Programs*, 31 Dec. 2013
  – Permanent Design Requirement for all phases of Corps Civil Works subject to tidal influence
  – Consider three future scenarios per National Research Council guidance

• **ETL 1100-2-1:** *Procedures To Evaluate Sea Level Change: Impacts, Responses and Adaptation*, 30 June 2014 to 31 March 2019
  – Planning Horizon extended to 100 years

• **ECB 2016-25:** *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects*, 16 Sep 2016 to 16 Sep 2018
HYDROLOGIC + TEMPERATURE CHANGES

TEMPERATURE/RAINFALL
- +5 to +9 F by 2100
- ET: +15-20%
- Rainfall: + / - 20%
- More Intense Rainfall Events, But More Severe Droughts

HURRICANES
- Warmer ocean temperatures create potential for stronger hurricanes (e.g., Andrew, Katrina)
- Effect of Climate Change on natural cycle of hurricanes is uncertain

LAKE OKEECHOBEE DROUGHT
- All time low stages in 2007 and 2008
Climate and Sea Level Rise Scenarios

-10% Rainfall
1.5°C Temp
1.5 feet SLR

+10% Rainfall
1.5°C Temp
1.5 feet SLR
Potential changes in Rainfall Extremes: Do we have “actionable science”?

Uncertainty due to significant model spread (General Circulation Model & Regional Climate Model Combinations)
Tropical Storms & Climate Change

- Tropical cyclones to shift towards strong storms (2-11% intensity increase by 2100)
- Decrease in global frequency of tropical cyclones (6-34%)- recent paper says this will increase!
- Increase in the frequency of the most intense cyclones
- Increase in rainfall rate, 20% within 100 km of storm center
CERP SLR SCENARIOS

- EPA was designated as the lead federal agency for guiding coastal communities in preparing for SLR.
- CERP SLR Scenarios were modeled with SLR in 2050 +6 inches above 1995 levels per EPA guidance.
- Modeling indicated that some coastal canal stages might need to be raised +6 inches to mitigate potential saltwater intrusion, and that additional water use restriction days might be needed.
## RELATIVE SEA LEVEL CHANGE SCENARIOS FOR KEY WEST, FL (FEET) (USACE, 1989-2014)

<table>
<thead>
<tr>
<th>Year</th>
<th>USACE Low</th>
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Notes: USACE projections are for historic, modified NRC Curve I and modified NRC Curve III rates of sea level change developed for Key West, Florida per USACE Engineering Circular (EC) 1105-2-186 (1989), 1165-2-211 (2009) and Engineering Regulation (ER) 1100-2-8162 (2013). These documents were based on guidance in the National Research Council (NRC) report, *Responding to Changes in Sea Level; Engineering Implications* dated September, 1987. The projections are developed using the local historic rate of sea level rise at Key West as reported by NOAA (2.20 mm/yr). The USACE and NRC guidance documents do not address dates beyond 2100. All projections start from 1992 control for the national survey datum.
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# Relative Sea Level Change Scenarios for Key West, FL (Feet) (USACE 2014 + NOAA 2017)

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**Key West, FL: 2.20 (mm/yr)**

Curves computed using criteria in NOAA SLR Report 06-Dec-2012 (with subsidence) and USACE EC 1165-2-212 (with subsidence)

- **USACE High Rate**
- **USACE Intermediate Rate**
- **USACE Low Rate (Current Rate)**
- **NOAA Lowest Rate Curve**
- **NOAA Intermediate - Low Rate Curve**
- **NOAA Intermediate - High Rate Curve**
- **NOAA Highest Rate Curve**
FLOOD RISK VS. WATER SUPPLY

- Shallow wells are the primary source of drinking water in South Florida communities.
- Protecting water supply wells with higher canal stages will increase flooding in many low elevation communities.
- Long-term sea level rise will cause saltwater intrusion into wells and create a need for new freshwater sources.

Conceptual diagram of hydrologic system of south Florida (Langevin, USGS, 2000)
CLIMATE CHANGE CONCERNS FOR EVERGLADES RESTORATION

• **Hydrologic Pattern Changes**
  – Potential for less frequent and more intense rain events
  – Potential increased tropical storm intensity or frequency

• **Warmer Temperatures**
  – Evaporation losses up; water supply down
  – Stresses on plant, animal, and marine ecosystems
  – Changes in growing season and migratory bird patterns
  – Changes in water quality (higher temp, lower oxygen, more acidic?)

• **Sea Level Rise**
  – Salinity changes in coastal bays, plus tidal creeks and rivers
  – Accelerating shoreline retreat due to loss of freshwater peat soils
  – Higher water levels in SRS = increasing flood risks (Sparrows, 8.5 SMA)
  – Saltwater moving up SRS will eventually threaten water supply wells