

# **EXHIBIT 5**

**UNITED STATES DISTRICT COURT  
SOUTHERN DISTRICT OF FLORIDA**

UNITED STATES OF AMERICA,  
Plaintiff,

v.

METROPOLITAN DADE COUNTY,  
MIAMI-DADE WATER AND SEWER AUTHORITY DEPARTMENT, and the  
STATE OF FLORIDA,  
Defendants

And,

BISCAYNE BAY WATERKEEPER  
465 Ocean Drive, #417  
Miami Beach, FL 33149,  
Plaintiff-Intervenor

And,

JUDI KOSLEN  
251 Galen Drive, Apt. 116  
Key Biscayne, FL 33149,  
Plaintiff-Intervenor

**DECLARATION OF DR. HAROLD R. WANLESS AND DR. BRIAN J. SODEN**

Identifications and Qualifications

I, HAROLD R. WANLESS STATE (#1-#12):

1. My name is Harold R. Wanless. I am a Professor and Department Chair in the Department of Geological Sciences and Cooper Fellow of the College of Arts and Sciences at the University of Miami. My office is located in Coral Gables, Florida. I am Registered Professional Geologist in the State of Florida #985. My professional and educational experience is summarized in the curriculum vitae attached to this declaration.

2. Harold R. Wanless received an A.B. degree in Geology from Princeton University in 1964; a M.S. degree in Marine Geology and Geophysics from the University of Miami in 1967; and a Ph.D. degree in Earth and Planetary Sciences from the John Hopkins University in 1973. My Master's Thesis was on the Holocene sediments that have accumulated in the Biscayne Bay region over the past 7,000 years and the role of sea level rise and storm and biological processes in defining the nature of these sediments. During my time as a Master's student I worked for my Advisor, Dr. A. Conrad Neumann on developing a sea level curve for south Florida, the Bahamas and Bermuda using core boring samples from freshwater peat deposits that formed close to sea level elevation. My Ph.D. dissertation was on the Cambrian strata in Grand Canyon where small-scale sedimentary cyclic sequences were deposited in response to cycles of sea level fluctuation.

3. Since 1971, I have had 41 years of experience as a geologist and marine geologist at the University of Miami. My research specialty is coastal and shallow marine sedimentology, modern and ancient, with a focus on documenting and understanding the role of sea level dynamics and storm processes in creating and modifying coastal and shallow marine environments. Much of my research and that of my students has focused on determining the fine-scale sea level history over the past 7,000 years and the associated response of coastal and shallow marine environments. This research has focused on the South Florida-Bahamas-Caicos region. Research has been funded from a variety of sources including, the National Science Foundation, the Department of Interior (National Park Service) and Department of Commerce (Sea Grant and National Oceanic and Atmospheric Administration), Miami-Dade County Department of Environmental Resource Management, petroleum companies, and development

companies. I have been publishing on past sea level trends in the juried literature since 1976 and have been projecting future trends since 1982 (Wanless, 1976; Wanless, 1982; Wanless and Parkinson, 1989; Dominguez and Wanless, 1991; Wanless, Parkinson, and Tedesco, 1994; Science Committee, 2008; Technical Ad Hoc Work Group, 2011).

4. Since 1981 I have been using our knowledge of past environments to look to the future. My students and I have been documenting the changes in south Florida coastal environments in response to our accelerated sea level rise since 1930 and major (category 4 and 5) hurricanes. This research has studied the coastal and low wetland environments bordering Biscayne Bay, Florida Bay, southwest Florida from Cape Sable to Everglades City, and the 10,000 islands. Environments focused on are coastal sandy beaches and barrier islands, mangrove wetlands, low-lying freshwater wetlands near the coast, the Everglades, and low-lying upland.

5. As polar Ice Sheet melt has significantly accelerated on both Greenland and Antarctica since about 2000, I have been active in working with other scientists, communities, Miami-Dade County, the State of Florida and Federal agencies in using new research data from myself and others to project future sea level rise both globally and regionally and to determine the impact it will have on low-lying coastal environments, coastal communities, agriculture, and industry. This includes an evaluation of the changing anthropogenic effects on coastal and shallow marine environments with rising sea level (Science Committee, 2008; Technical Ad Hoc Work Group, 2011).

Local Agency Recognition & Reliance – Harold R. Wanless

6. In July, 2006, the Board of County Commissioners for Miami-Dade County established the Miami-Dade County Climate Change Advisory Task Force (CCATF), through the adoption

of Ordinance 06-113 sponsored by Commissioner Natacha Seijas. From 2006-2011, the CCATF served as an advisory board to the Board of County Commissioners and was charged with identifying potential future climate change impacts to Miami-Dade County, while providing recommendations regarding mitigation and adaptation measures to respond to climate change.

7. I was an active member of and invited speaker at the Miami-Dade County Climate Change Advisory Task Force (CCATF), comprised of 25 members, appointed by the Commissioners, Mayor, and County Manager. CCATF was a diverse, multidisciplinary and highly knowledgeable group of individuals representing various sectors of the community of Miami-Dade County. Throughout its existence I served as the Chair of CCATF's Science Committee and drafted their reports.

8. Miami-Dade County has officially recognized and relied upon my expertise and peer-reviewed research on climate change and sea level rise as evidenced through County review and adoption of CCATF recommendations, which was based in-part upon my peer-reviewed research, as well my position as the Chair of CCATF's Science Committee. (See *Annual Report and Supplemental Recommendations: Presented to The Miami-Dade Board of County Commissioners*, April 2010; Presentation – Statement On Sea Level in the Coming Century, Science Committee, Miami-Dade CCATF, April 22, 2008, available at:

[http://www.miamidade.gov/derm/library/08\\_04\\_22Statement\\_on\\_Sea\\_Level.pdf](http://www.miamidade.gov/derm/library/08_04_22Statement_on_Sea_Level.pdf)).

9. In 2010, the Southeast Florida Regional Planning Council initiated efforts to create a four county "Regional Compact", an agreed-upon statement of Climate Change and anticipated sea level rise. I was a part of the committee that used the peer-reviewed scientific literature and our expertise to provide a report on anticipated sea level rise for the Compact. That report is now

approved incorporated into the overall “Regional Compact” Document, and in submission to the county commissions (Technical Ad Hoc Work Group, 2011).

State and Federal Agency Recognition & Reliance- Harold R. Wanless

10. The South Florida Water Management District (“SFWMD”) has previously relied upon and cited to my peer-reviewed research in assessing sea level rise implications for South Florida. (SFWMD, “*Preliminary Estimate Of Impacts of Sea Level Rise on The Regional Water Resources of Southeastern Florida;*” SFWMD, “*Estimated Impacts of Sea Level Rise on Florida’s East Coast*”).

11. U.S. Army Corps of Engineers personnel acknowledged and cited to my research regarding sea level rise in a presentation entitled “Climate Change Concerns for Everglades Restoration Planning,” which was presented at the Planning Community of Practice Conference 2008.

12. I have twice been an invited speaker to the State of Florida legislature to present evidence for anticipated sea level rise and implications to South Florida coastal environments and the Everglades (2007). I have been an invited speaker to the Council on Environmental Quality at the White House, addressing sea level rise and the urgent need to shift the Mississippi River outlet (2009).

I, BRIAN J. SODEN STATE (#13 to #16):

13. My name is Brian J. Soden. I am a Professor of Meteorology and Physical Oceanography in the Rosenstiel School of Marine and Atmospheric Science at the University of

Miami. My office is located in Miami, Florida. My professional and educational experience is summarized in the curriculum vitae attached to this declaration.

Statement of Qualifications – Brian J. Soden

14. I received an B.S. degree in Geology from the University of Miami in 1988; a M.S. degree in Geophysical Sciences from the University of Chicago in 1991; and a Ph.D. degree in Geophysical Sciences from the University of Chicago in 1993. My Master's and Doctoral Theses used satellite observations mathematical models of the Earth's climate to understand physical feedback processes which govern the sensitivity of the climate system to increasing greenhouse gases.

15. I have 19 years of experience as a climate scientist at Princeton University, the National Oceanic and Atmospheric Administration, and the University of Miami. My research specialty is observing and predicting the response of the global hydrological cycle to changes in climate, with particular emphasis on tropical climate change. This work has been funded by a variety of sources including, NOAA, NASA, and the Department of Energy. I have published over 90 peer-reviewed scientific articles which have been cited over 8,500 times by other peer-reviewed studies as well as local, national and international reports including the Intergovernmental Panel on Climate Change, the US Global Change Research Program, and the Southeast Florida Regional Climate Change Compact.

16. My research on climate change has been recognized with several honors, including the NOAA Outstanding Scientific Paper Award (2000, 2003 and 2007) and the NOAA Outstanding Review Paper Award (2002). In 2001, I received the *National Space Club's David S. Johnson*

*Award* for “Outstanding and innovative uses of Earth satellite observations” and the *American Meteorological Society’s Henry G. Houghton Award* for “For creative use of multiple satellite observations to better characterize the climate system’s radiative and hydrological balances”. I was a Lead Author of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change which was awarded the Nobel Prize in 2007. In 2012, I was elected to be a Fellow of the American Meteorological Society. Since 2010, I have served as Editor for the Journal of Climate, and have previously served as Associate Editor for the Journal of Climate and the Journal of Geophysical Research.

TOGETHER HAROLD R. WANLESS AND BRIAN J. SODEN STATE (#17 to #41):

Reality of Climate Warming and Accelerating Sea Level Rise

17. There is an extremely strong consensus among actively publishing scientists and strong scientific evidence that the climate is warming due to human activities, primarily the burning of fossil fuels such as coal, oil and gas. The global-mean temperature has increased by  $\sim 1.5^{\circ}$  F over the past century, and is projected to warm by another  $3-10^{\circ}$  F over the next century depending upon future emissions of greenhouse gases. However, due to its large thermal inertia, the climate will continue to warm over the next half-century, even if a reduction in fossil fuel emissions and stabilization of greenhouse gas concentrations occurred today. Put simply, the climate has warmed and future warming is unavoidable.

18. Global warming leads to a number of changes in climate beyond simply an increase in temperature. These include: increased frequency and intensity of heavy rainfall events and floods, increased sea level, and more intense hurricanes. While climate change will be felt



globally, the low-lying and heavily-populated coastline of south Florida makes it extremely vulnerable to the effects of climate change, particularly sea level rise.

19. South Florida is not significantly sinking or rising so sea level change in south Florida basically follows the global sea level change. South Florida's sea level has risen about 12 inches since the mid-19<sup>th</sup> century and is currently increasing at a rate of ~1 inch per decade; a rate that is approximately 10 times faster than what occurred naturally over the past 3,000 years. If the current trend were to continue, the oceans along South Florida's coast would rise another 5 inches by 2060 and 10 inches by the end of the century. However, sea level rise is accelerating due primarily to the rapid loss of ice on Greenland and Antarctica. Projections that account for this acceleration anticipate sea levels will increase by at least 9-24 inches by 2060 and at least 19-57 inches by 2100. These projections are representative of sea level projections in the scientific literature and are consistent with the numbers presently being used by the federal government (USACOE, 2009) (see Slide #3) but lower than those published by the government this month (NOAA, 2012) (see Slides #5 and #6).

20. The Science Committee (of which Harold R. Wanless was Chair) of the M-DCCTAF issued a projection of future sea level rise for south Florida in January, 2008, stating that:

With what is happening in the Arctic and Greenland, many respected scientists now see a likely sea level rise of **at least** 1.5 feet in the coming 50 years and a total of **at least** 3-5 feet by the end of the century, possibly significantly more. Spring high tides would be at +6 to +8 feet. This does not take into account the possibility of a catastrophically rapid melt of land-bound ice from Greenland, and it makes no assumptions about Antarctica (MDC-CCATF, 2008).

Since issuing this statement, evidence for dramatically accelerating Ice Sheet melting has increased on both Greenland and Antarctica (Van den Broeke et al., 2009; Velicogna, 2009;

Kerr, 2009; and Jiang et al., 2010). This is accelerating the rate of global sea level rise. More recent projections of sea level rise through the century are at or above the levels of the 2008 statement (Rahmstorf, 2010).

21. Circular No. 1165-2-211 of the United States Army Corps of Engineers (“USACOE”), issued July 1, 2009 and renewed in 2011, specifically directs incorporation of “the direct and indirect physical effects of projected future sea-level change in managing, planning, engineering, designing, constructing, operating, and maintaining USACOE projects and systems of projects. Impacts to coastal and estuarine zones caused by sea-level change must be considered in all phases of Civil Works programs” (USACOE, 2009). The Corps of Engineers, in their evaluations, always looks 100 years into the future as major modifications and improvements to systems have implications that must be considered far beyond the stated life of the project (see Slide #3). From a scientific and economic standpoint, a major addition and upgrading to a large, publicly-owned sewage treatment plant bordering a vulnerable, low, erosional, sandy coastline should fall under similar scrutiny. This includes considering sea level rises of 9-24 inches by 2060, 14-33 inches by 2080, and 19-57 inches by 2100, and 23-67 inches by 2110. It should be noted that current global sea level rise is at or above the upper level of these projections (NOAA, 2012) (see Slide #4), and that rates of Greenland ice melt acceleration and extent of arctic summer pack ice loss are happening well ahead of model predictions (NOAA-OAR, 2012).

22. Most recently, the United States government has published *Global Sea Level Rise Scenarios for the United States; National Climate Assessment* (NOAA, December 2012) (see Slides #5 and #6) in which they consider global sea level rise to be at plus 3.9 to 6.6 feet (45 to

78 inches) by 2100 in scenarios that incorporate both thermal expansion of the warming ocean and accelerating ice melt from Greenland and Antarctica (see also Paragraph 35).

23. We are familiar with the findings of the U.S. Global Change Research Program (“USGCRP”) and the 2009 Report entitled “Global Climate Change Impacts in the United States: A State of Knowledge Report from the U.S. Global Change Research Program” (commonly referred to as the “USGCRP Report” but cited in the references as Karl et al., 2009.).

24. Miami, as a coastal city, is particularly at risk to the environmental impacts of sea level rise as acknowledged in the USGCRP Report:

In addition, coastal cities are also vulnerable to sea-level rise, storm surge, and increased hurricane intensity. Cities such as New Orleans, **Miami**, and New York are particularly at risk, and would have difficulty coping with the sea-level rise projected by the end of the century under a higher emissions scenario (Karl et al., 2009).

25. All climate and sea level assessments agree that ice melt and sea level rise will be accelerating well into the next century. This means that we will not be adjusting a fixed higher sea level at the end of the century, but one that continues to rise at an accelerating rate. For example, if we have reached plus five feet by the end of the century, sea level will be rising at a foot per decade.

26. We have read over the new, proposed Consent Decree between the EPA and Miami-Dade County and the proposed Capital Plan found on the Water and Sewer Department’s website. We find that these documents neither address the sea level rise that will occur during this century nor consider the vulnerability of the Central Treatment Plant located on Virginia Key to rising sea level. In failing to address and incorporate the projected sea level scenarios, the County risks

spending great amount of taxpayer's money on projects that may well not survive the project lifetime and may well cost greater amounts of money in the future.

27. We have read over the proposed Consent Decree which recognizes that the County is to provide a final plan for phase out of ocean outfalls by July 1, 2013 and have implemented the phase out law by 2025. The ocean outfall phase-out plan to be submitted to the State of Florida by the County in July 2013 must also demonstrate how it will treat and handle its wastewater so that 60% of it can be reused in the system. We do not see this directly addressed in the proposed Consent Decree or the Capital Plan. Rather, the County's "Progress Report" on the Ocean Outfall Phase-Out law dated December 31, 2009 states at page 8 of the report that the County plans to construct a major deep well injection facility on Virginia Key and dispose of 83 million gallons per day of sewage in this manner. While the actual depth of the injection wells is not specified, we assume that the County proposes to inject into the boulder zone, as it is doing at its South Treatment Plant. In our view, disposal by deep well injection is not a meaningful reuse of wastewater, and large injections wells do not need to be located on an increasingly vulnerable barrier island. In addition the County has not demonstrated that there are suitable geologic strata and confining layers in and down flow from the proposed injection site. With rising sea levels, salt water intrusion into the Biscayne Aquifer will be an increasing problem (Heimlich et al., 2009). To push back this salt water intrusion, recharge of the Biscayne Aquifer with fresh water will be required. As sources of freshwater diminish (Science Committee, 2008; Heimlich et al., 2009), it is imperative that the County upgrade the sewage treatment system in such a manner that as much wastewater as possible can be meaningfully reused. Given the risks inherent at Virginia Key and a State law that basically requires the ocean outfall at the Central Plant to be

phased-out and the need to recycle fresh water resources to the Biscayne Aquifer, it is not reasonable for the County to re-build the sewage plant on Virginia Key at the cost of \$555 million, without further study and explanation to the public that specifically addresses the points we have raised in this affidavit.

28. Virginia Key is in a very high risk zone for disruption, damage, and destruction by major hurricanes. The Central Wastewater Treatment Plant is located on Virginia Key, which is a sandy barrier island that will become increasingly vulnerable to erosion and storm damage with projected sea level rise (See Slide #2). The barrier island of Virginia Key is highly erosional and sediment-starved because of the blockage of the southward transport of sand by the jetties of Government Cut. Furthermore, Virginia Key is far from the major source of wastewater and sewage (Miami and Miami Beach) and is dependent on maintenance of major wastewater piping across Biscayne Bay.

29. Virginia Key is a sandy barrier island that was isolated from Miami Beach by the formation of Norris Cut during a hurricane in 1835. Its growth and maintenance has been dependent on longshore southward flow of sand from Miami Beach. The dredging of Government Cut in 1905 and subsequent construction of seaward extending jetties over the following decade permanently cut off sand replenishment to the south tip of Miami Beach (Fisher Island), Virginia Key and Key Biscayne. Over the one hundred plus years since the formation of Government Cut and its jetties, the shoreline of Virginia Key has significantly eroded, and sand has largely been swept southward from the adjacent nearshore marine environment. Several beach renourishment projects (1969 and 1974) attempted to restore the eroding beach, but erosion continues. Granite

groins were placed along the shore as a part of the 1974 project but were ineffective in stopping erosion.

30. Most of Virginia Key west of the beach is mangrove wetland or anthropogenic fill. To the south of the Central Treatment Plant is a major, abandoned, unlined dump; to the north is fill derived from an earlier deepening of the Miami Shipping Channel inside Government Cut. None of these structures have a wave and current resistant protective seawall on their margins. The mangrove wetland is narrow and offers little protection to storm surges and erosion.

31. Sandy barrier islands along tectonically passive margins, such as south east Florida are on a gently sloping continental shelf setting and tend to shift dramatically landward with rising sea level. A one foot rise in sea level will commonly result in a landward migration of a barrier island of 500 to 2,000 feet. This occurs as sand overwashes the island or is swept through inlets during storms. Virginia Key, having experienced severe sand loss offshore, will also permanently lose sand to the offshore during storms. We can thus anticipate that landward migration of the Virginia Key coastline will be at the upper end of the range.

32. There is simply insufficient sand in the narrow beach barrier and adjacent offshore of northern Virginia Key to maintain a protective barrier beach through a further 1-2 feet of sea level rise and the storm surges and currents that will occur over the coming 50 years (See Slides #23 to #35).

33. It is critical that realistic projected sea level rise scenarios be carefully considered for the construction and desired lifespan of the North, Central, and South Sewage Treatment Plants (see Slides #1 to #48). Rising sea level will have significantly changed the coastal environments, interactions of land and water (including salinity), base-level elevations, tidal current patterns

and strengths, and storm surge patterns and strengths. Rising sea level will also change the viability of portions of the treatment facility, access roads, associated facilities, vulnerability to disruption or destruction by storms (see slide #2). With only 1.5 to 3 feet of further sea level rise, the Central Treatment Plant and the adjacent abandoned dump and fill area to the north will be all that is left of Virginia Key (see Slides #28 to #32). These emergent remnants of Virginia Key will be exposed to the full force of the oceans tides, waves and storm surges (see Slide #2).

34. Using the latest U.S. Government projections (NOAA, 2012), the time at which each foot of sea level rise will be reached can be anticipated by using their 'Intermediate High' and 'Highest' scenarios (Slides #5 and #6). The Intermediate High scenario projects sea level rise incorporating a warming ocean and 'limited ice sheet loss' (The 'Intermediate Low' scenario only incorporates sea level rise from ocean warming and no ice melting. Because significant observed ice melt is already occurring, it is not a valid scenario to consider for future projections. The 'Lowest' scenario is a linear projection based on historical sea level rates derived from tide gauge measurements beginning in 1900. It also is not a valid scenario to use for the future and fails to reproduce the observed sea level rise over the past two decades).

35. The range of years at which sea level rises one, two, three, four and five feet using the old (USACOE, 2009) and the updated (NOAA, 2012) U.S. Government projections are:

		(NOAA, 2012)	(USACOE, 2009)
1 foot rise	by	2031 to 2042	2040 to 2073
2 feet rise	by	2048 to 2066	2061 to 2113
3 feet rise	by	2063 to 2085	2090 to later
4 feet rise	by	2074 to 2100	2103 to later
5 feet rise	by	2094 to 2112	2113 to later

36. As you can see from the above, Virginia Key will experience a further two feet of sea level rise within the next 40-50 years. This rise, combined with storm effects, will eliminate all of the island in front of the Central Treatment Plant and expose the Plant to a new regime of daily and storm tides, currents and surges. It will be an isolated entity on the ocean side of Biscayne Bay. Before investing \$555 million dollars of taxpayers' funds into the Virginia Key Plant, it is critical to know how the complex and its fill margins and underpinnings will react to continuous and long-term saltwater exposure, changing tides and currents, changing storm surge patterns and intensities due to sea level rise. This assessment is wholly unaccounted for in the proposals. The environmental impacts of a sewage treatment plant failing to withstand the changing patterns and forces of hurricane surges and currents on the exposed seaward margin of Biscayne Bay should surely warrant careful engineering, environmental, and economic evaluation. The proposed Consent Decree and Capital Plan do not address how future sea level changes due to climate change will change both the safety and structural integrity of the exposed



Central Wastewater Treatment complex during major storms, and how such risks pose significant negative environmental concerns.

37. Given all of the above, it is our opinion, stated to a reasonable degree of scientific certainty, that it is unreasonable for the County to commit to reinvest \$555 million to rebuild a major wastewater treatment plant on Virginia Key without an in-depth and detailed investigation and consideration of all of the factors that we have presented. If a decision is made to keep the wastewater treatment plant at this location, then it must be protected against the predicted impacts or it will likely be flooded and severely damaged by increasingly severe storm surges as sea level rises. There is nothing in the \$555 million capital plan for the Central Plant that purports to protect the rebuilt plant from the impacts of climate change, sea level rise and storm surge destruction.

38. With the scientific consensus on human induced atmospheric warming and accelerating sea level rise and a variety of highly agreeable projections of sea level rise from individual scientists, the Miami-Dade County Climate Change Advisory Task Force, the Southeast Florida Regional Planning Council Compact, and the United States government, climate change and anticipated sea level rise impacts should be incorporated into all of the County's future infrastructure planning of projects of any significant cost, duration, or environmental impact.

39. In a time of rapidly rising sea level we cannot continue to manage our coastal urban infrastructure as we would have in the past. We subscribe to the philosophy recently offered by the Environmental Protection Agency:

The impacts of climate change are likely to worsen many problems that coastal areas already face. Shoreline erosion, coastal flooding, and water pollution affect man-made infrastructure and coastal ecosystems. Confronting existing challenges

is already a concern. Addressing the additional stress of climate change may require new approaches to managing land, water, waste, and ecosystems (EPA, 2012).

40. During the past 4 years, Harold R. Wanless has given expert testimony in two other cases. He gave oral testimony at the request of the Petitioners and Intervenors in OGC CASE NO. 08-0469 / DOAH CASE NO. 08-1511 in a beach renourishment case commonly called Reach-8 with the Town of Palm Beach, Board of Trustees of the Internal Improvement Fund, and the Department of Environmental Protection as Respondents. He also provided a written affidavit in the matter of the proposed Combined License Application for Turkey Point Units 6 & 7 by Florida Power and Light before the Secretary, Nuclear regulatory Commission of the United States of America, Docket No. 52-040 and 52-041.

41. Brian J. Soden and Harold R. Wanless have each agreed to a \$5,000 fee for evaluation of the problems associated with the Consent Decree and Capital Plan and preparation and presentation of this statement and others that might follow. They have each received that.

I declare under penalty of perjury that the foregoing is true and correct.

Date: January 23, 2013

DECLARANT:

A handwritten signature in black ink, appearing to read "Harold R. Wanless". The signature is fluid and cursive, with the first name "Harold" and last name "Wanless" clearly distinguishable.

Executed in Accord with 10 CFR 2.304(d)  
Harold R. Wanless, Ph.D.  
Registered Professional Geologist #985  
1231 Genoa Street, Coral Gables, FL 33134

I declare under penalty of perjury that the foregoing is true and correct.

Date: January 23, 2013

DECLARANT:

A handwritten signature in black ink, appearing to read "Brian J. Soden". The signature is highly stylized and cursive, with the first name "Brian" and last name "Soden" being the most legible parts.

Executed in Accord with 10 CFR 2.304(d)  
Brian J. Soden, Ph.D.  
13740 SW 74 Ave, Miami, FL 33158

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Karl, T.R., Melillo, J.M., and Peterson, T.C., (eds.), 2009. *Global Climate Change Impacts in the United States*, Cambridge University Press, 192p.

## **APPENDIX:**

### **Slides to accompany 1/23/2013 Statement of Brian Soden and Harold R. Wanless**

Slide 2: Storm Surge Simulation

Slides 3-6: Sea Level Rise Scenarios and information.

Slides 7-9: LiDAR elevation/maps of all of Biscayne Bay using NOAA 2012 projections

Slides 10-22: LiDAR elevation/inundation maps of North Biscayne Bay and MDWASD North District Treatment Plant with dates using NOAA, 2012 projections.

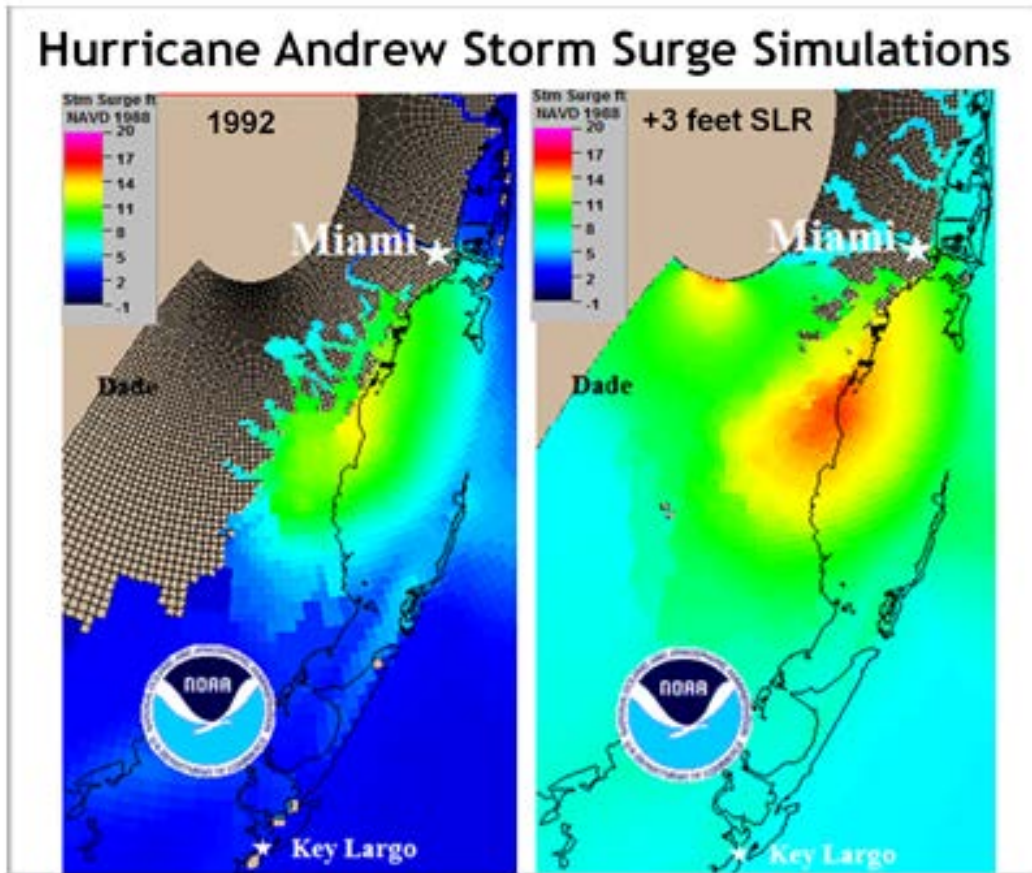
Slides 23-35: LiDAR elevation/inundation maps of North Biscayne Bay and MDWASD Central District Treatment Plant with dates using NOAA, 2012 projections.

Slides 36-48: LiDAR elevation/inundation maps of North Biscayne Bay and MDWASD South District Treatment Plant with dates using NOAA, 2012 projections.

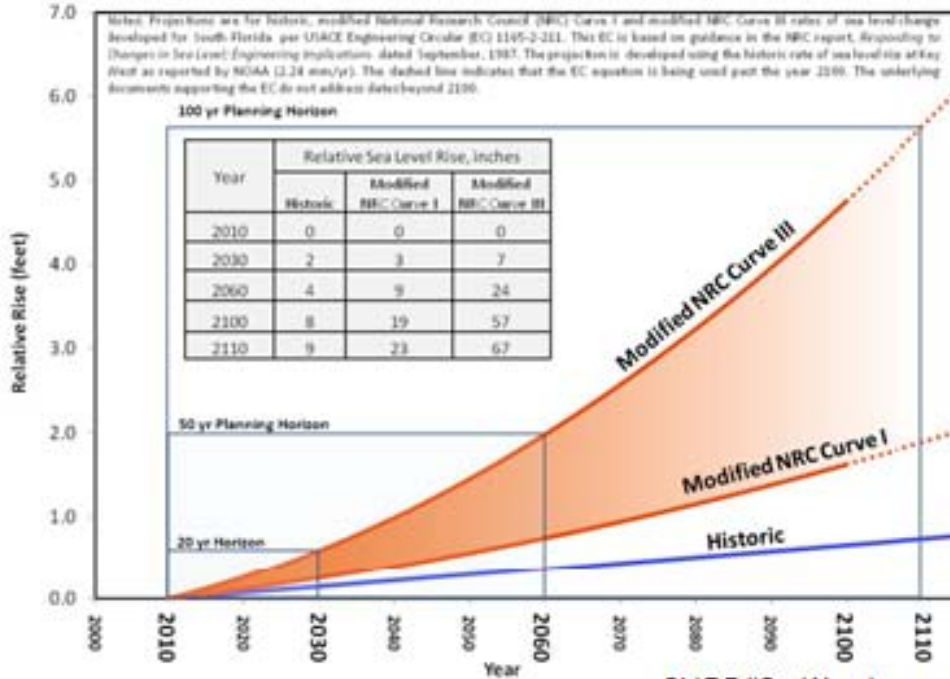
**Slides Prepared by Harold R. Wanless, 2013  
LiDAR maps prepared by Peter W. Harlem, 2013**

SLIDE #1 Wanless and Soden, 2013

SLIDE #2 – Wanless and Soden, 2013

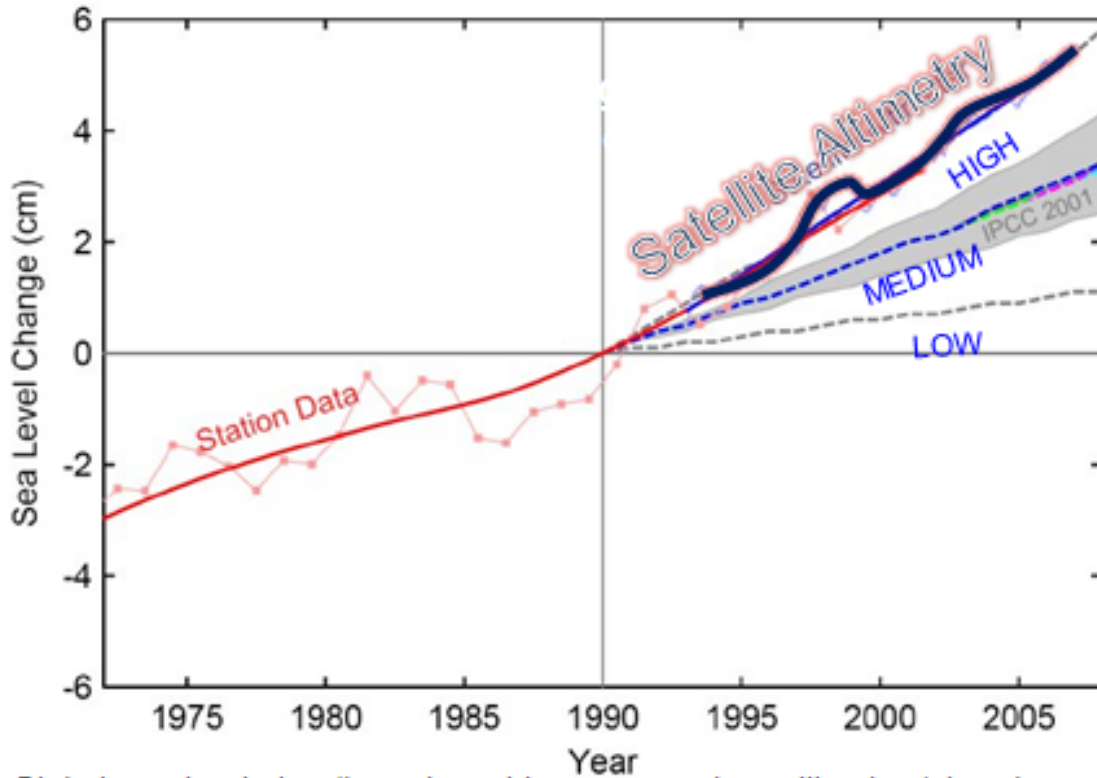


**The U.S. Army Corps of Engineers**  
**has since 2009 been required to incorporate**  
**likely sea level rise into all civil works planning;**  
**this projection is also now used by the Regional Compact of the**  
**Southeast Florida Regional Planning Council**  
**Relative Sea Level Rise Scenarios for South Florida**



SLIDE #3 – Wanless and Soden, 2013

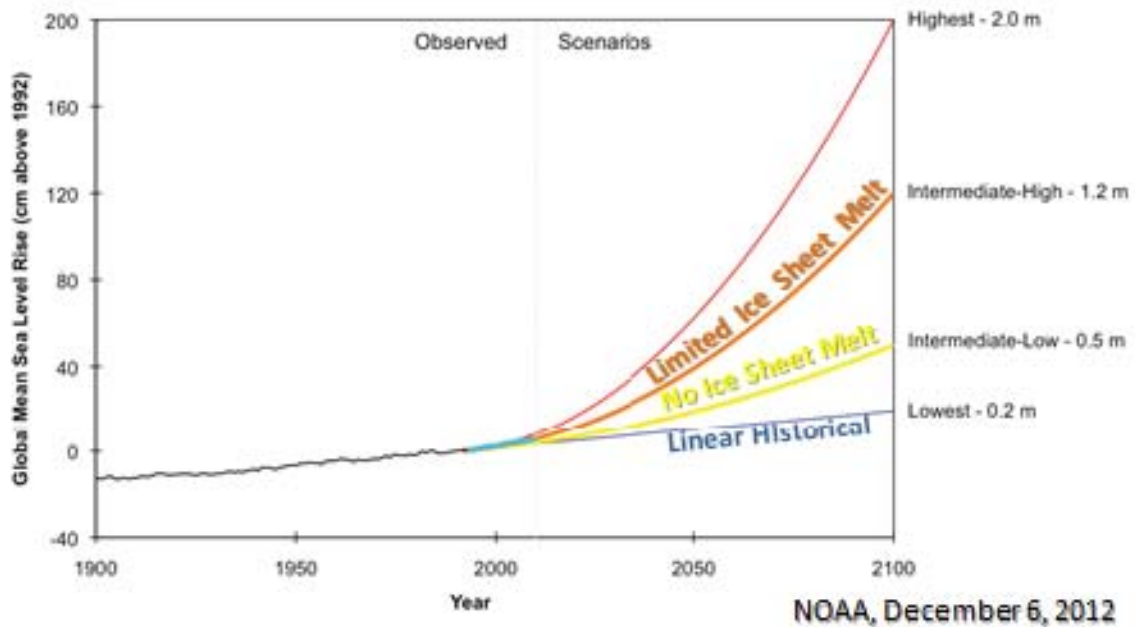




Global sea level rise (based on tide gauge and satellite data) has been following the highest end of the 2001 IPCC sea level projection. This is because of accelerating ice melt from Greenland and Antarctica.

SLIDE #4- Wanless and Soden, 2013

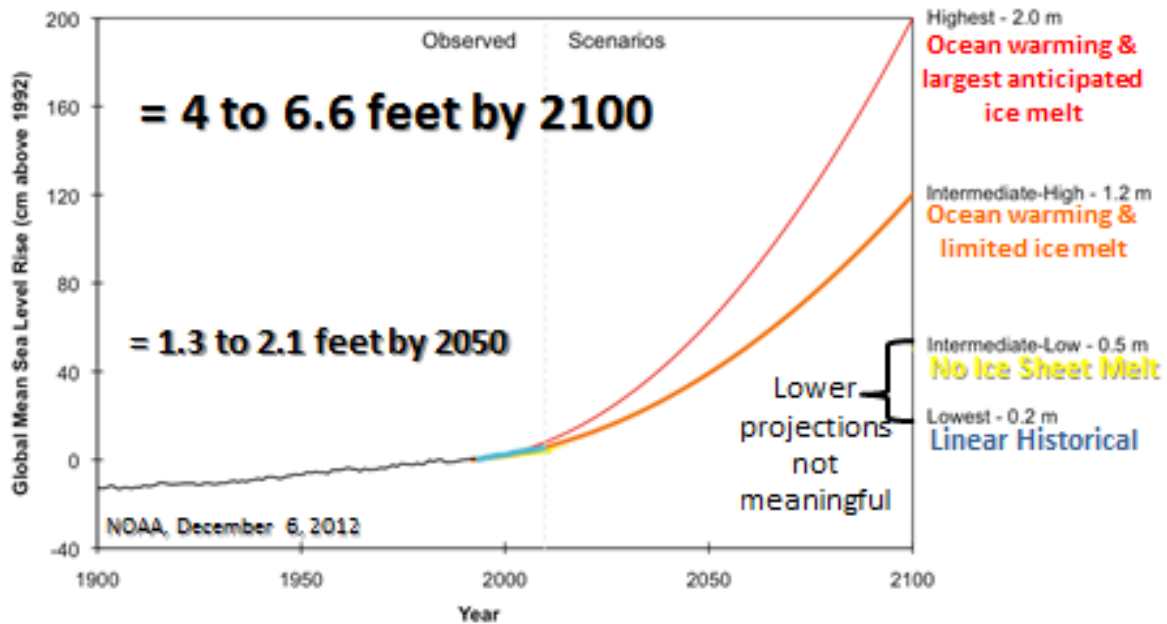
## Most Recent Government Projections



**Because of accelerating polar ice melt, projections for sea level rise are increasing. The above are the most recent. In: "Global Sea Level Rise Scenarios for the United States National Climate Assessment" (NOAA, 2012)**

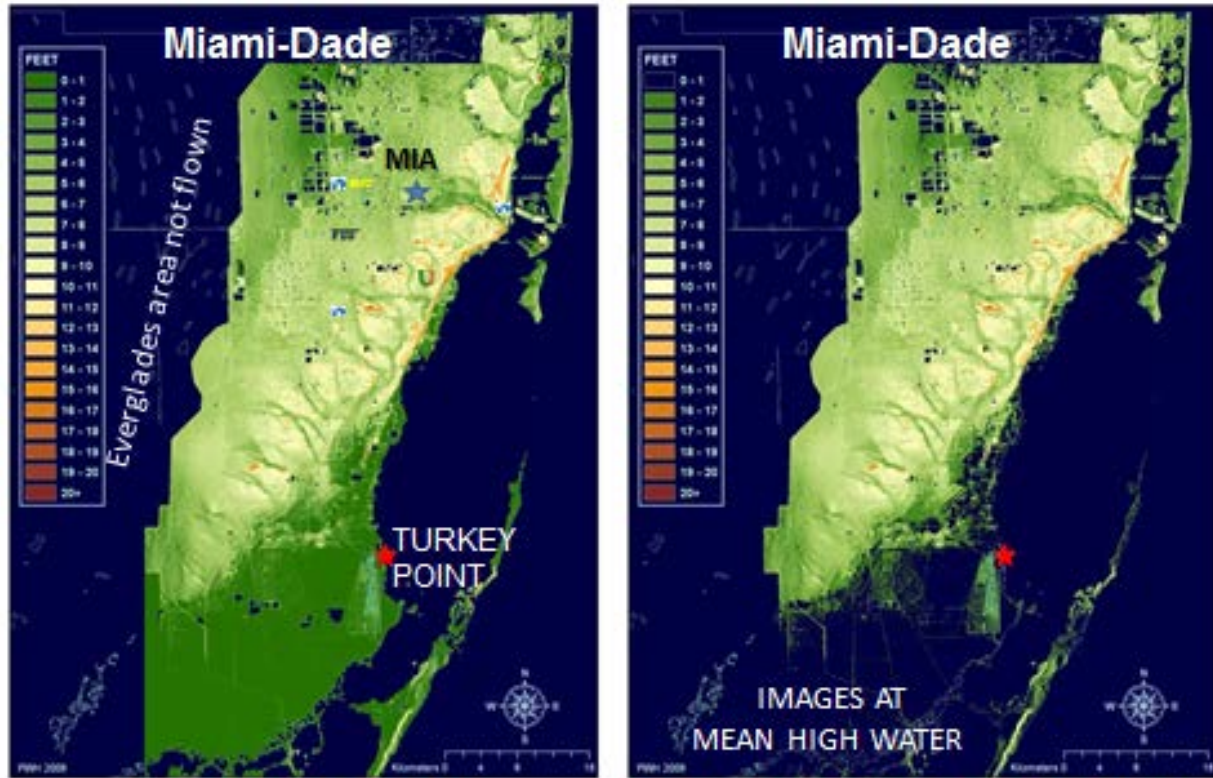
SLIDE #5 – Wanless and Soden, 2013

Most Recent U.S. Government Sea Level Rise Scenario Projections  
by NOAA, United States Geological Survey, Department of Defense, Environmental  
Protection Agency, Department of Energy, and the US Army Corps of Engineers



**Because of accelerating polar ice melt and accelerating addition of melt water to the oceans, the lower projections are not meaningful guidance for the future.**

SLIDE #6 – Wanless and Soden, 2013



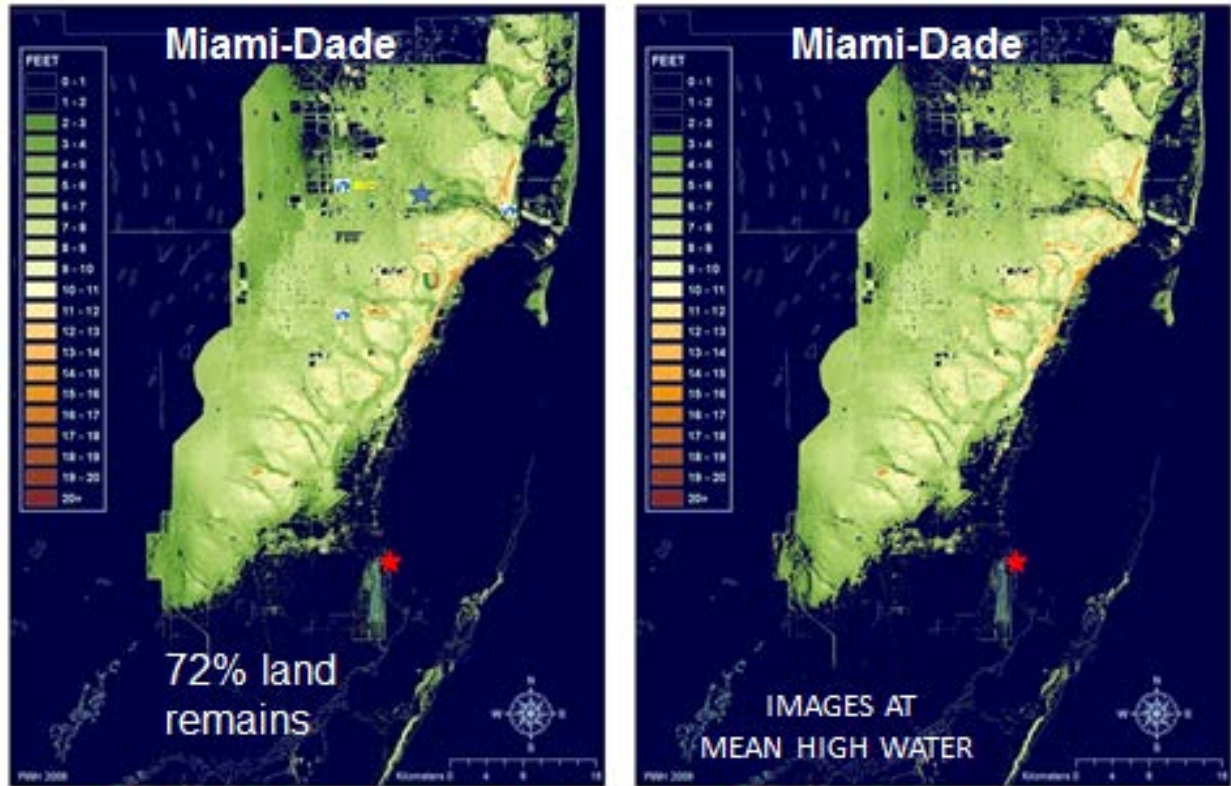
**Present topography**

**1 Foot Sea Level Rise (2031-2042)**

**Inundation projections using LiDAR elevation data**

SLIDE #7 – Wanless and Soden, 2013

from P. Harlem, 2011



**2 Feet Sea Level Rise (2048-2066)**

**3 Feet Sea Level Rise (2063-2085)**

**Inundation projections using LiDAR elevation data**

SLIDE #8 – Wanless and Soden, 2013

from P. Harlem, 2011



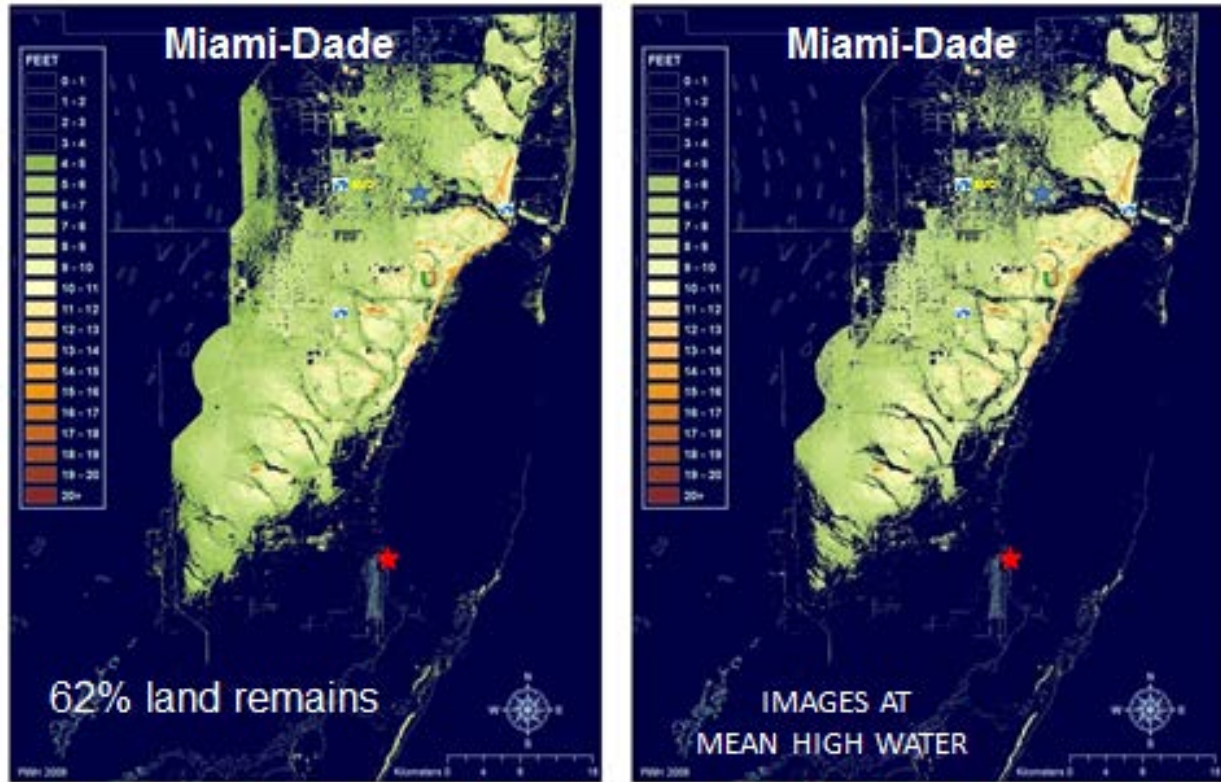
SLIDE #10 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

**Present topography**

**0.5 Feet Sea Level Rise (2018-2024)**





**4 Foot Sea Level Rise (2074-2100)**

**5 Foot Sea Level Rise (2084-2112)**

**Inundation projections using LiDAR elevation data**

SLIDE #9 – Wanless and Soden, 2013

from P. Harlem, 2011

SLIDE #11 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

**1 Foot Sea Level Rise (2031-2042)**      **2 Feet Sea Level Rise (2048-2066)**





SLIDE #12 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

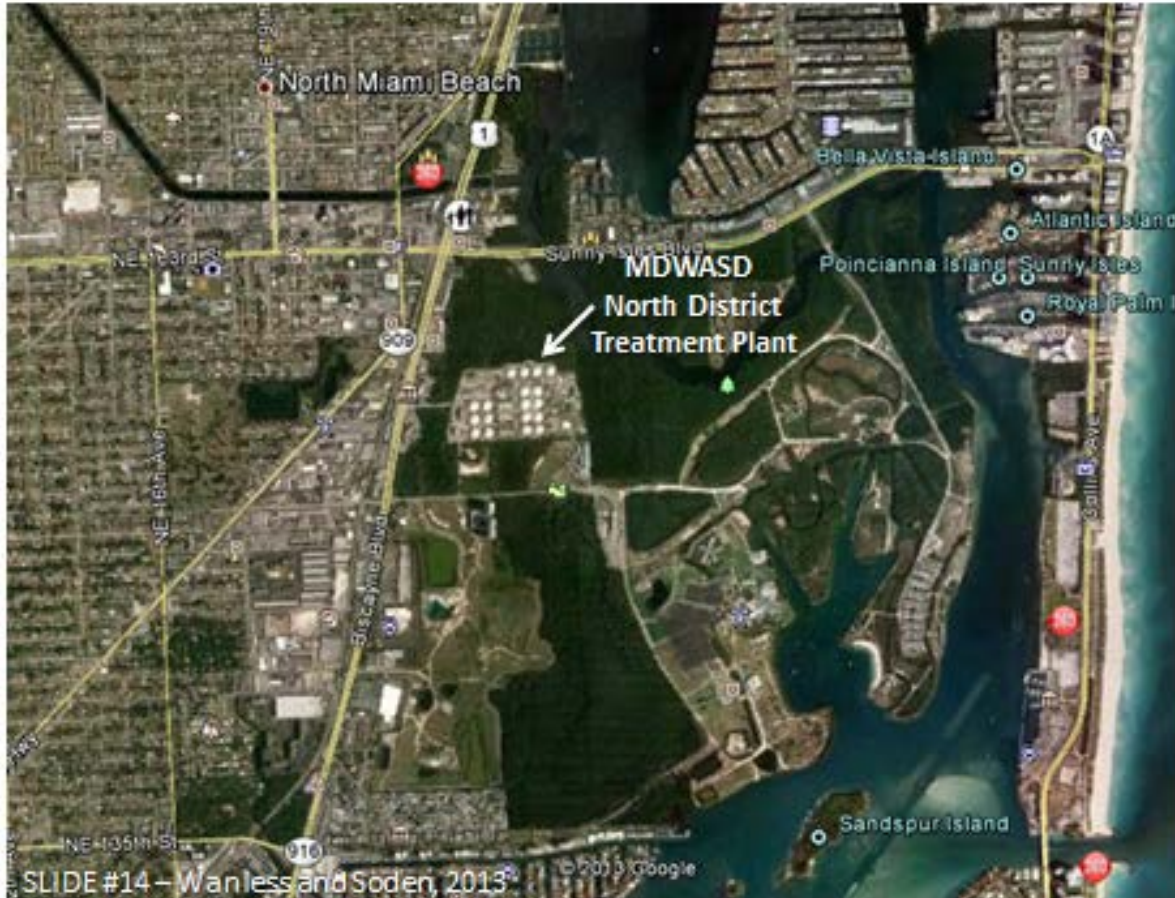
**3 Feet Sea Level Rise (2063-2085)**      **4 Feet Sea Level Rise (2074-2100)**



SLIDE #13 – Wanless and Soden, 2013

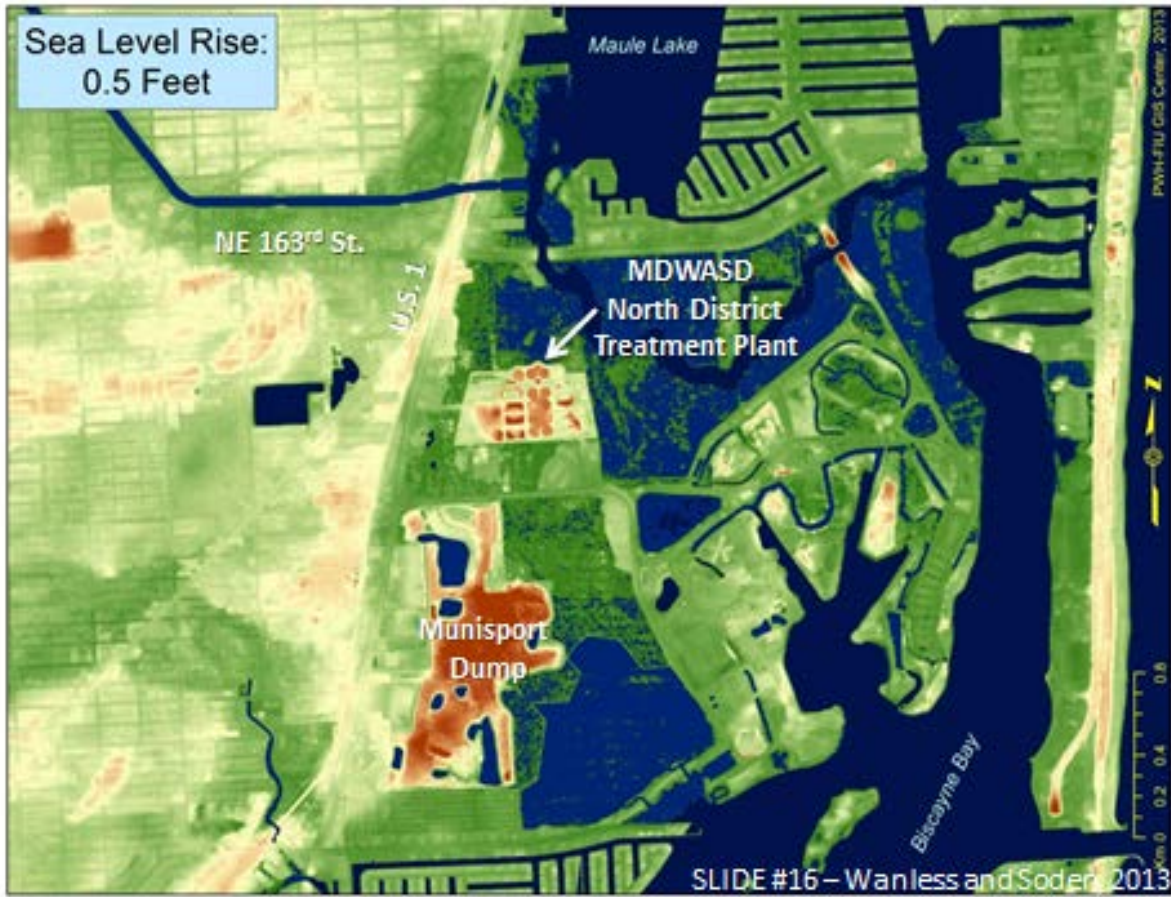
**Inundation projections using LiDAR elevation data**  
**5 Feet Sea Level Rise (2084-2112)**      **6 Feet Sea Level Rise (2094-2122)**

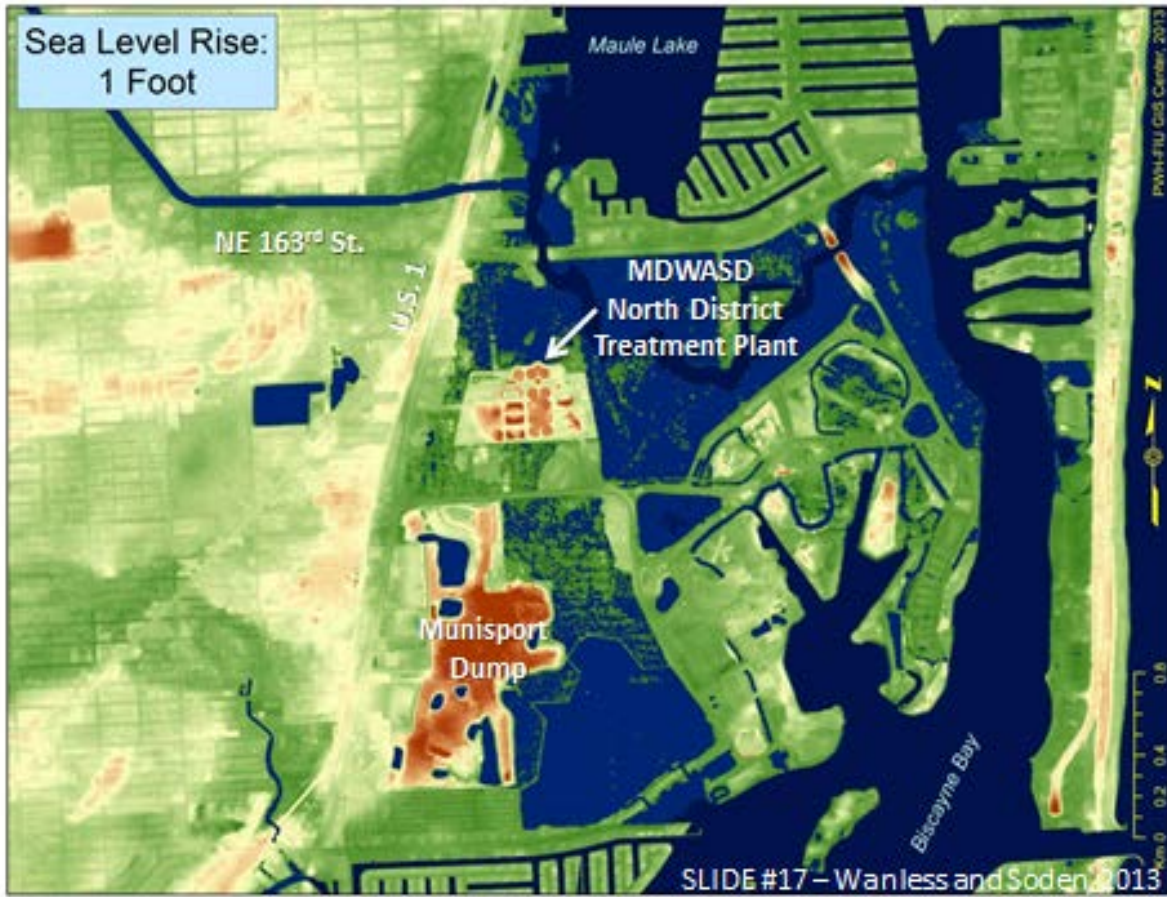




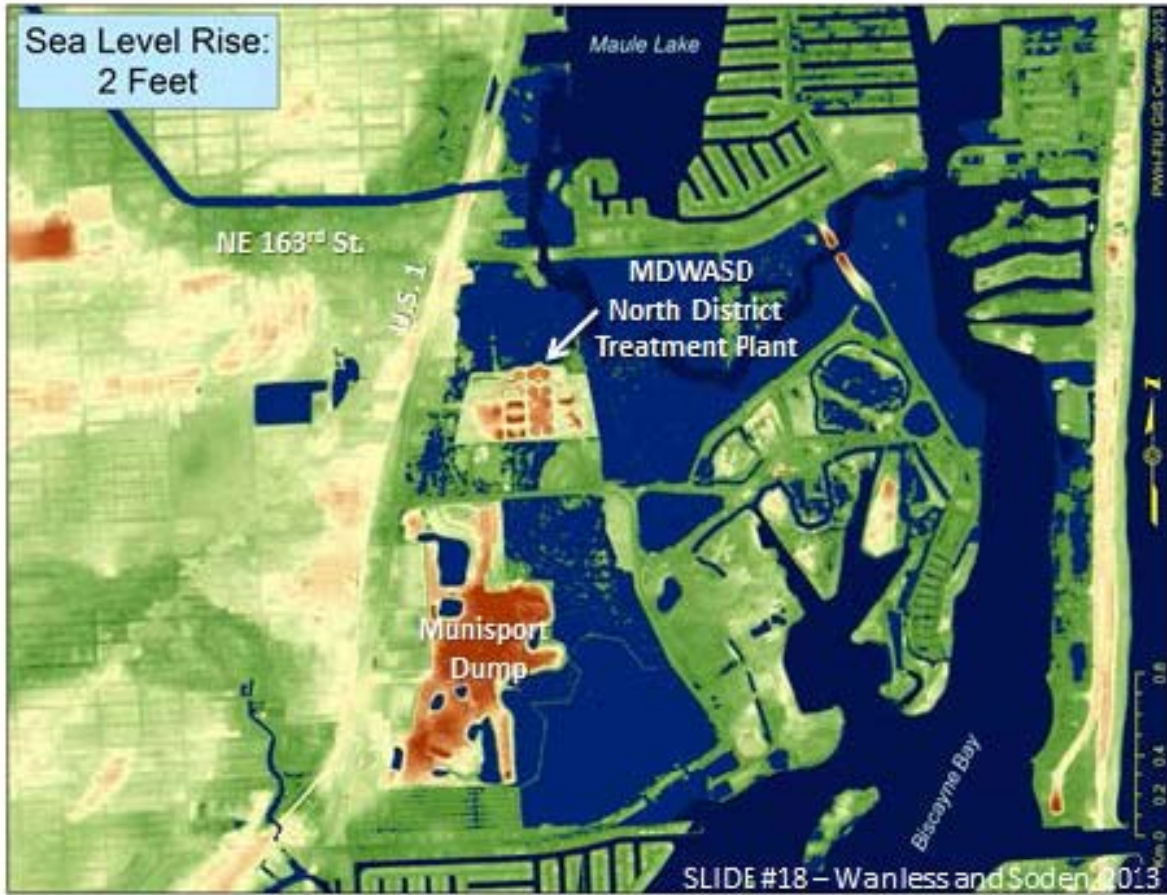


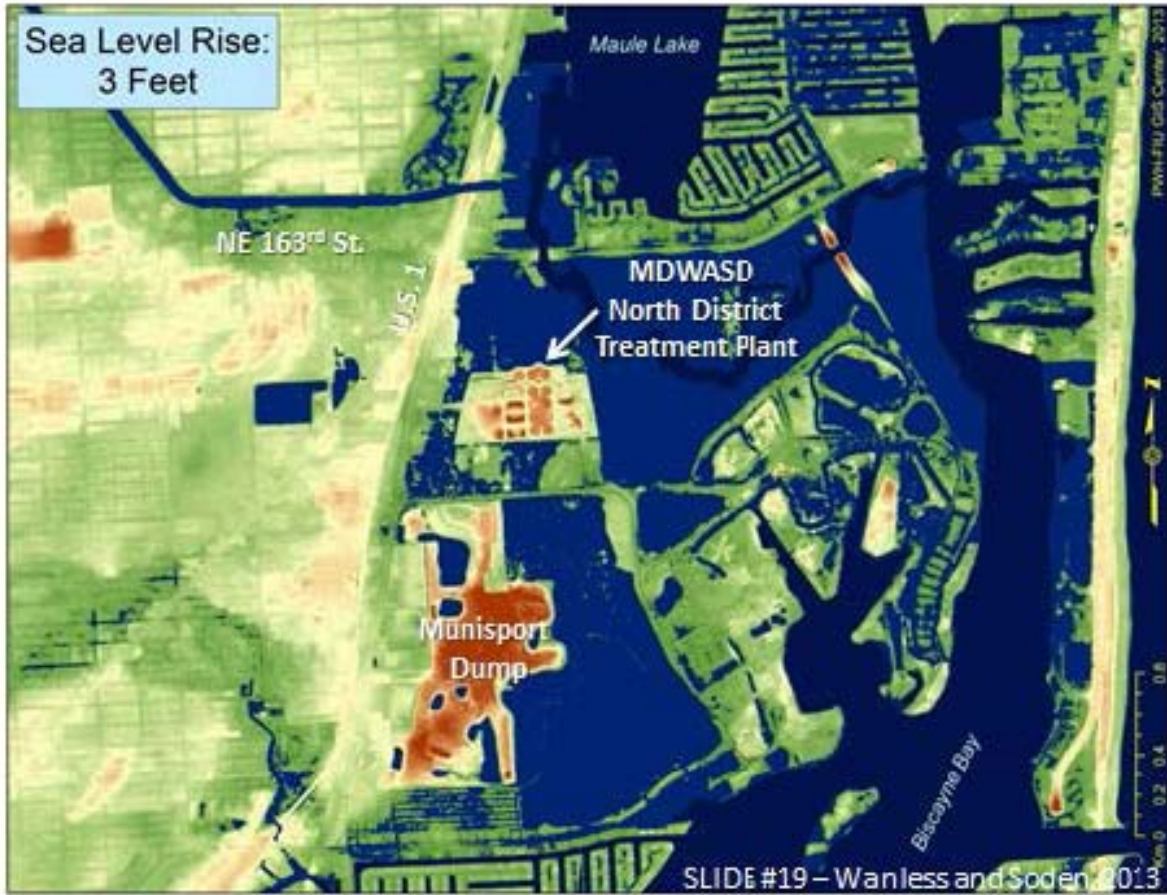




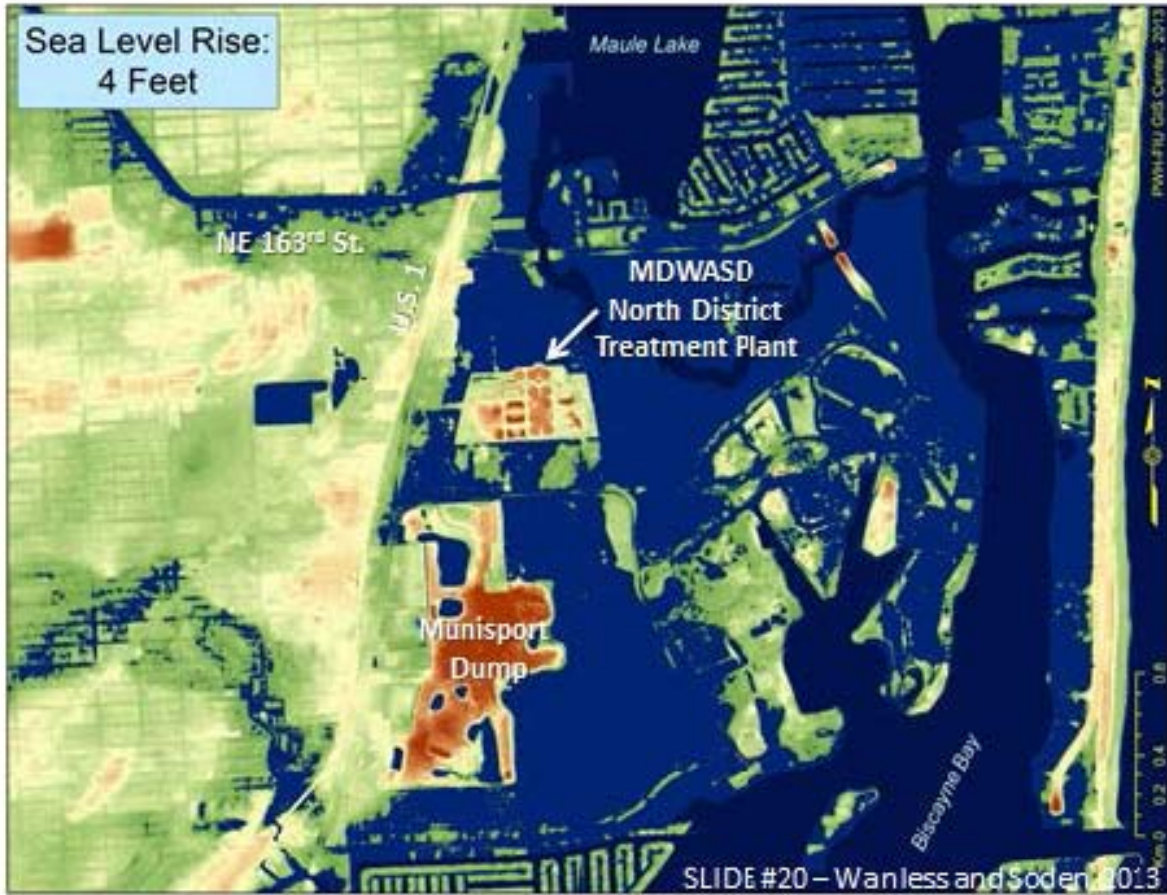


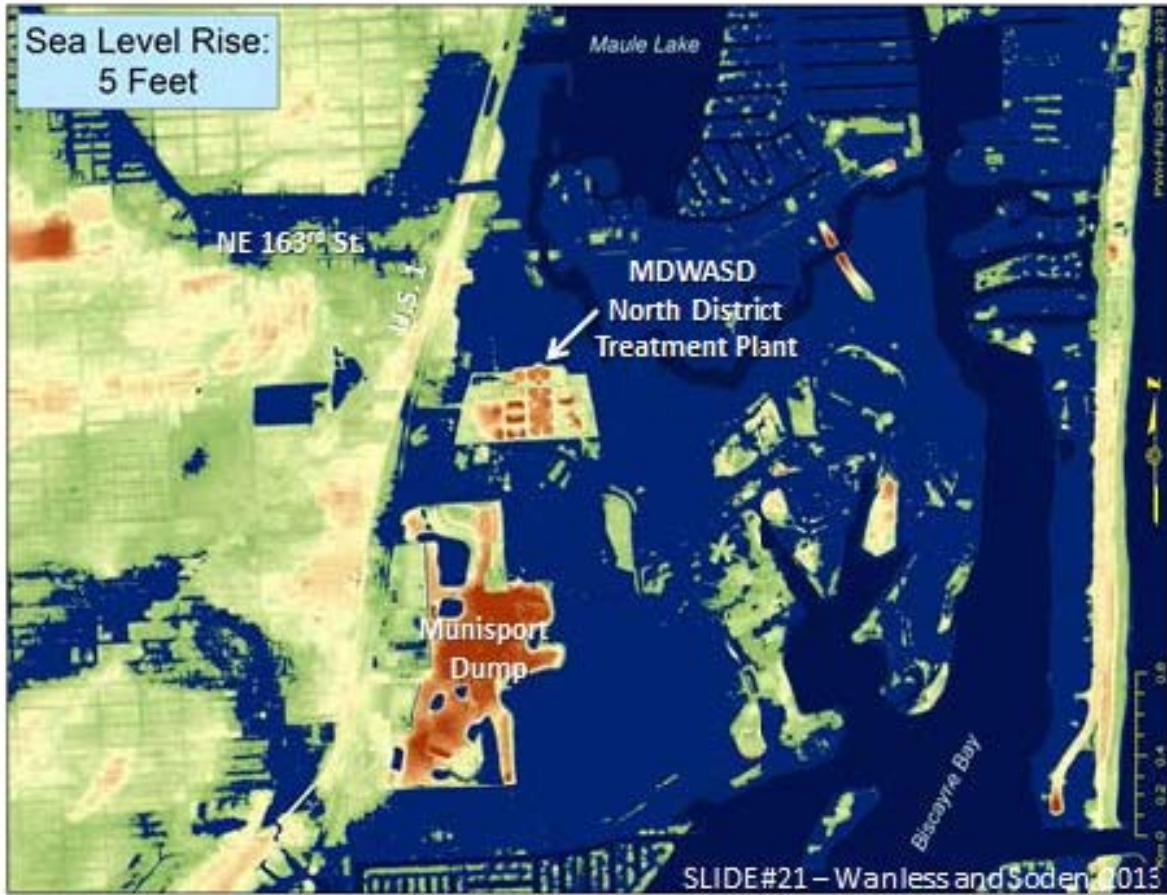


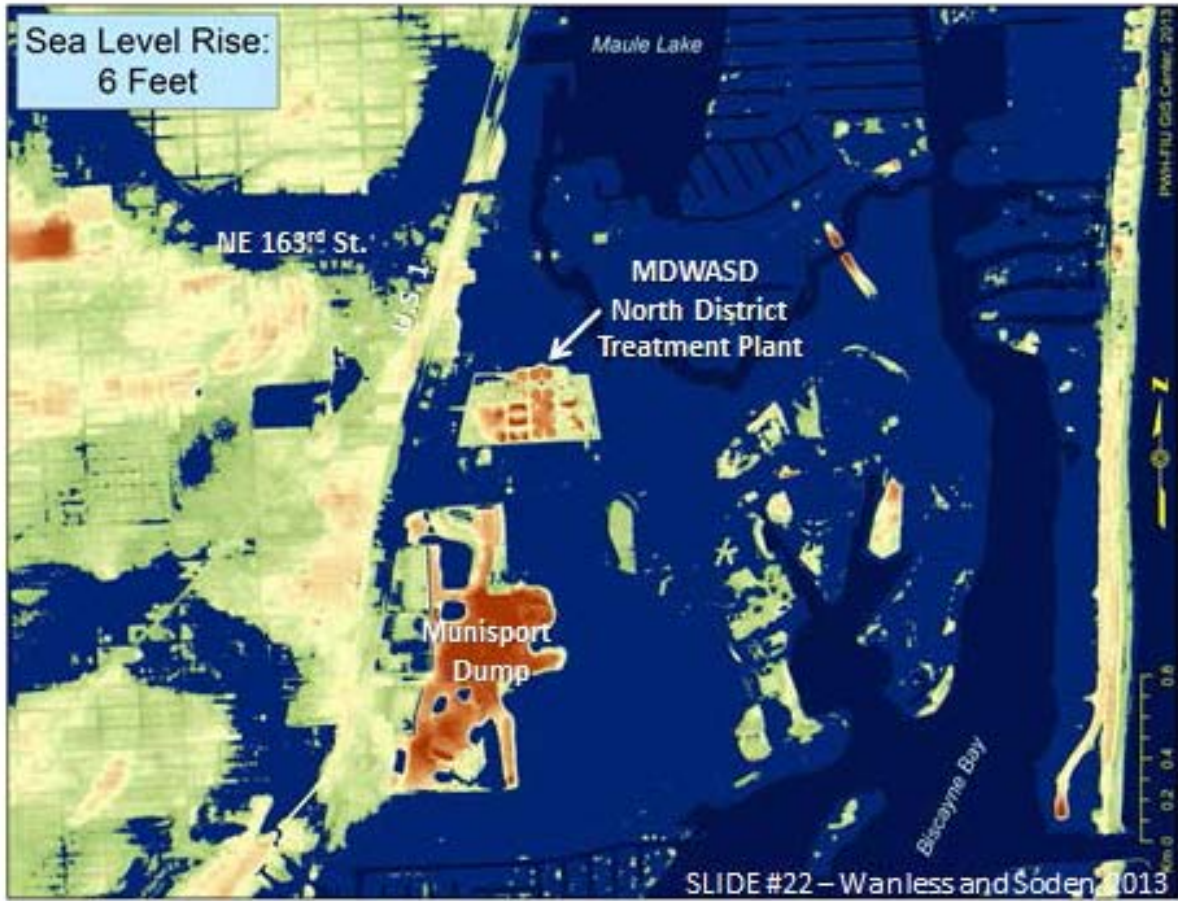














SLIDE #23— Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

**Present topography**

**0.5 Feet Sea Level Rise (2018-2024)**



SLIDE #24 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

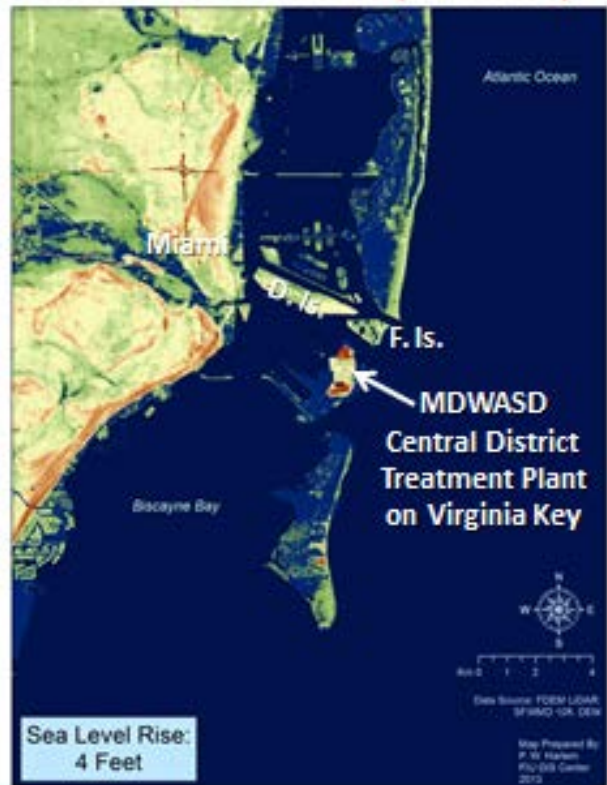
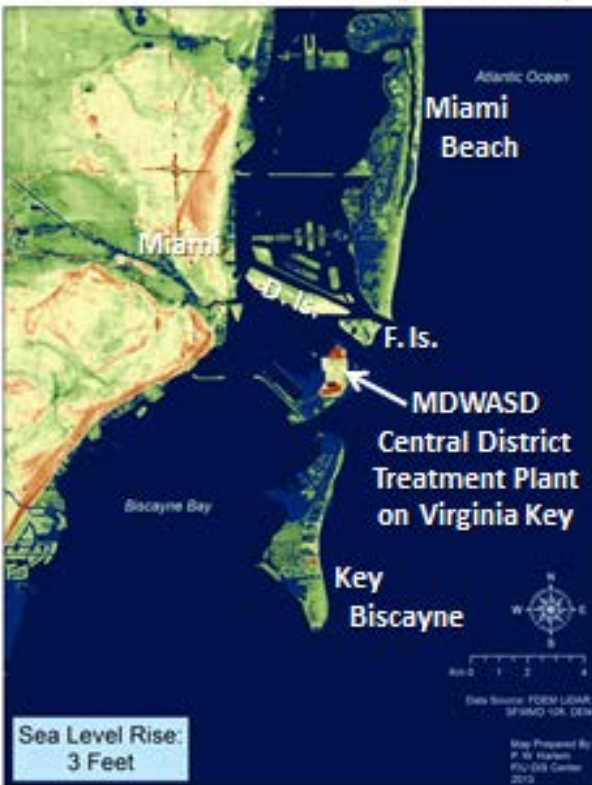
**1 Foot Sea Level Rise (2031-2042)**      **2 Feet Sea Level Rise (2048-2066)**



SLIDE #25 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

**3 Feet Sea Level Rise (2063-2085)**      **4 Feet Sea Level Rise (2074-2100)**





SLIDE #26 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

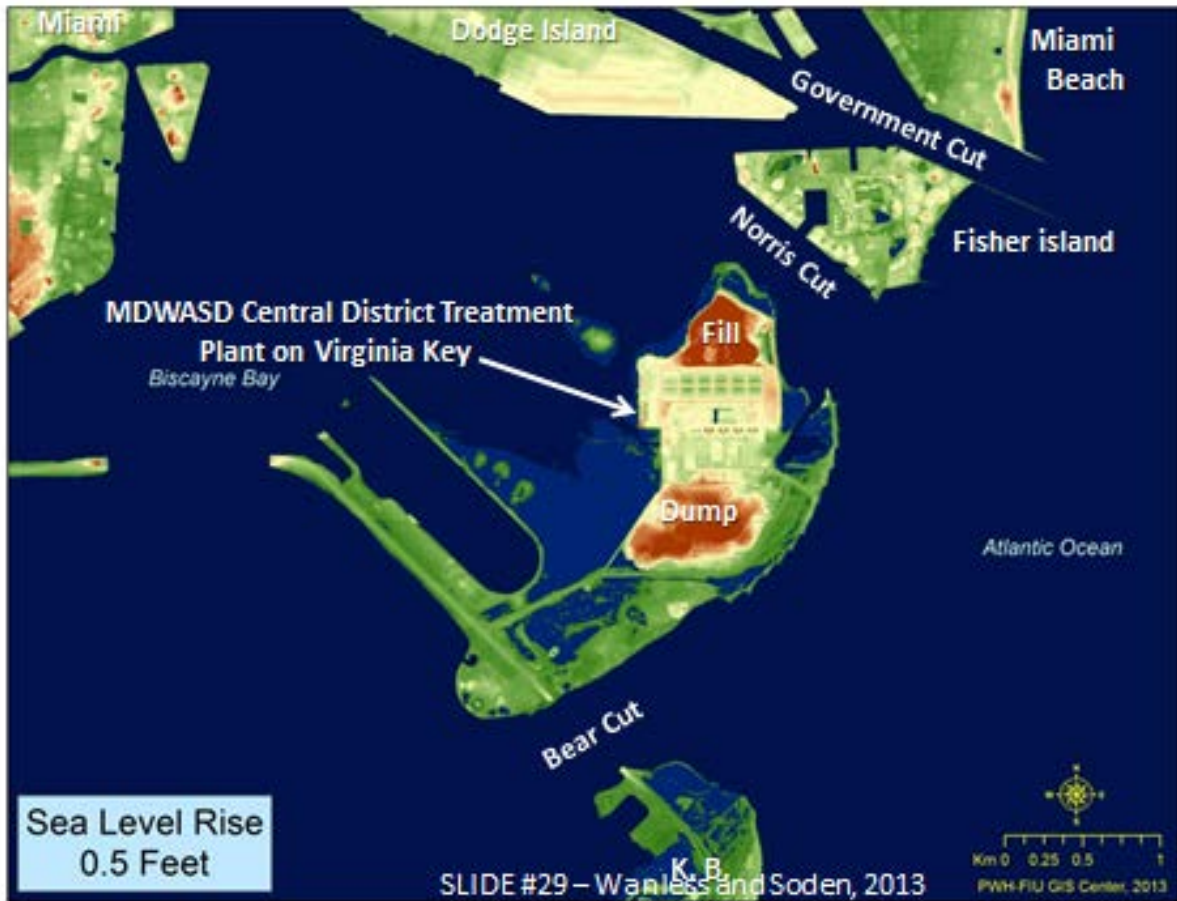
**5 Feet Sea Level Rise (2084-2112)**      **6 Feet Sea Level Rise (2094-2122)**

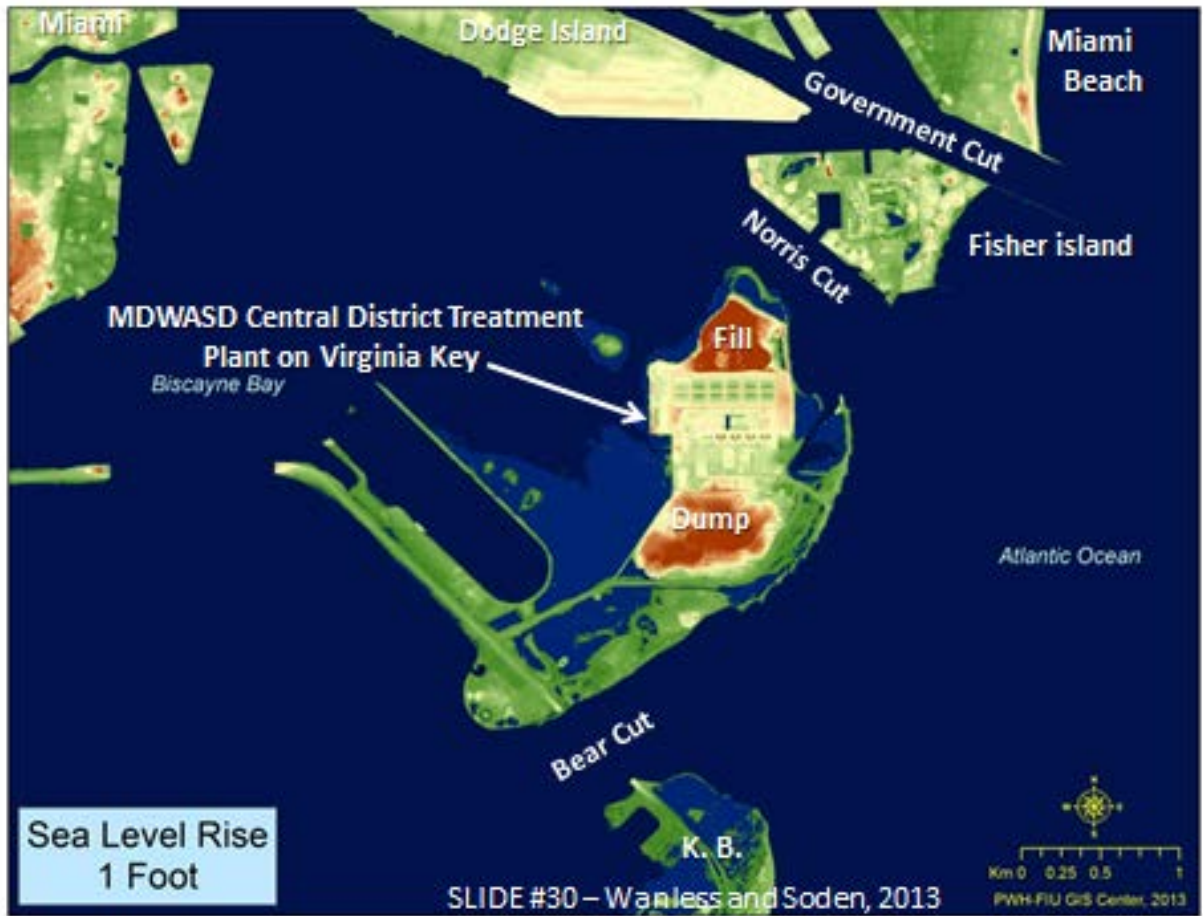




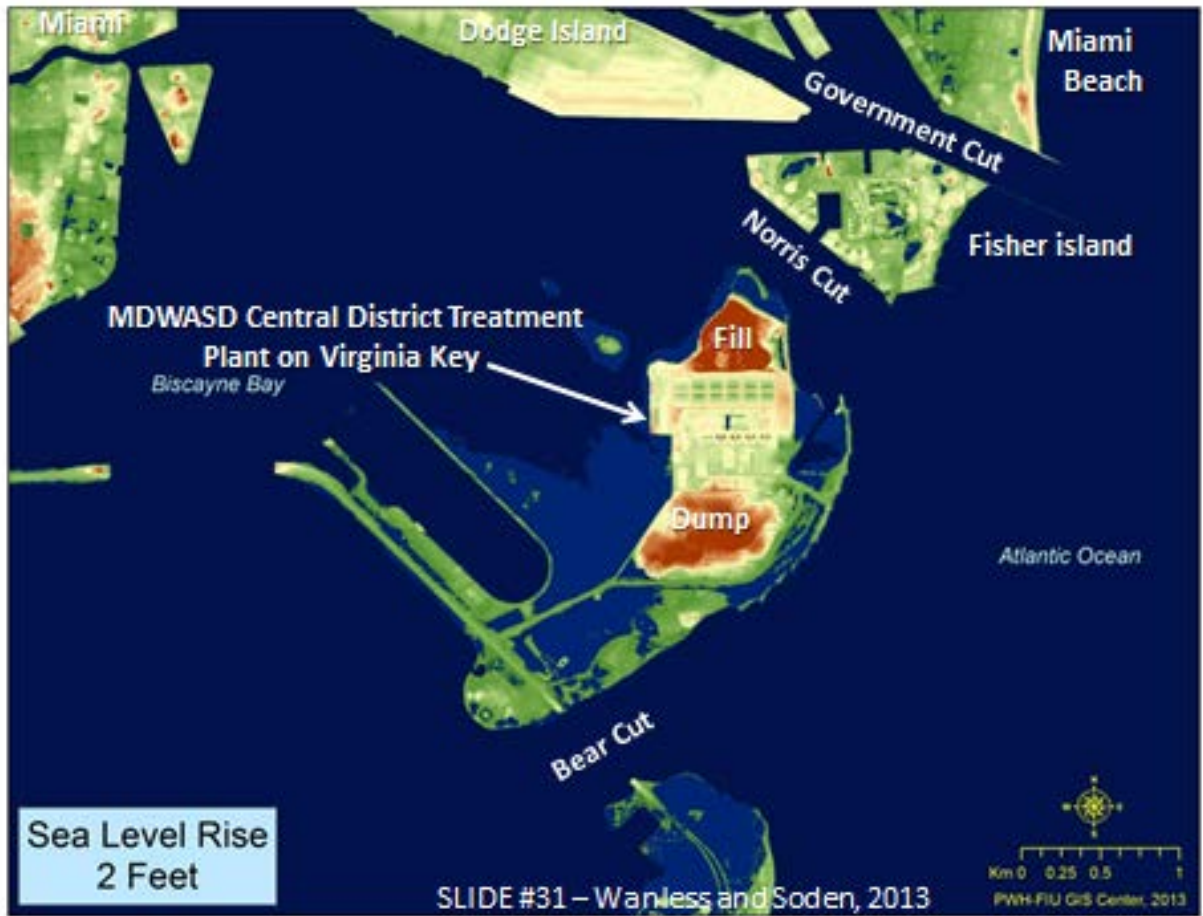


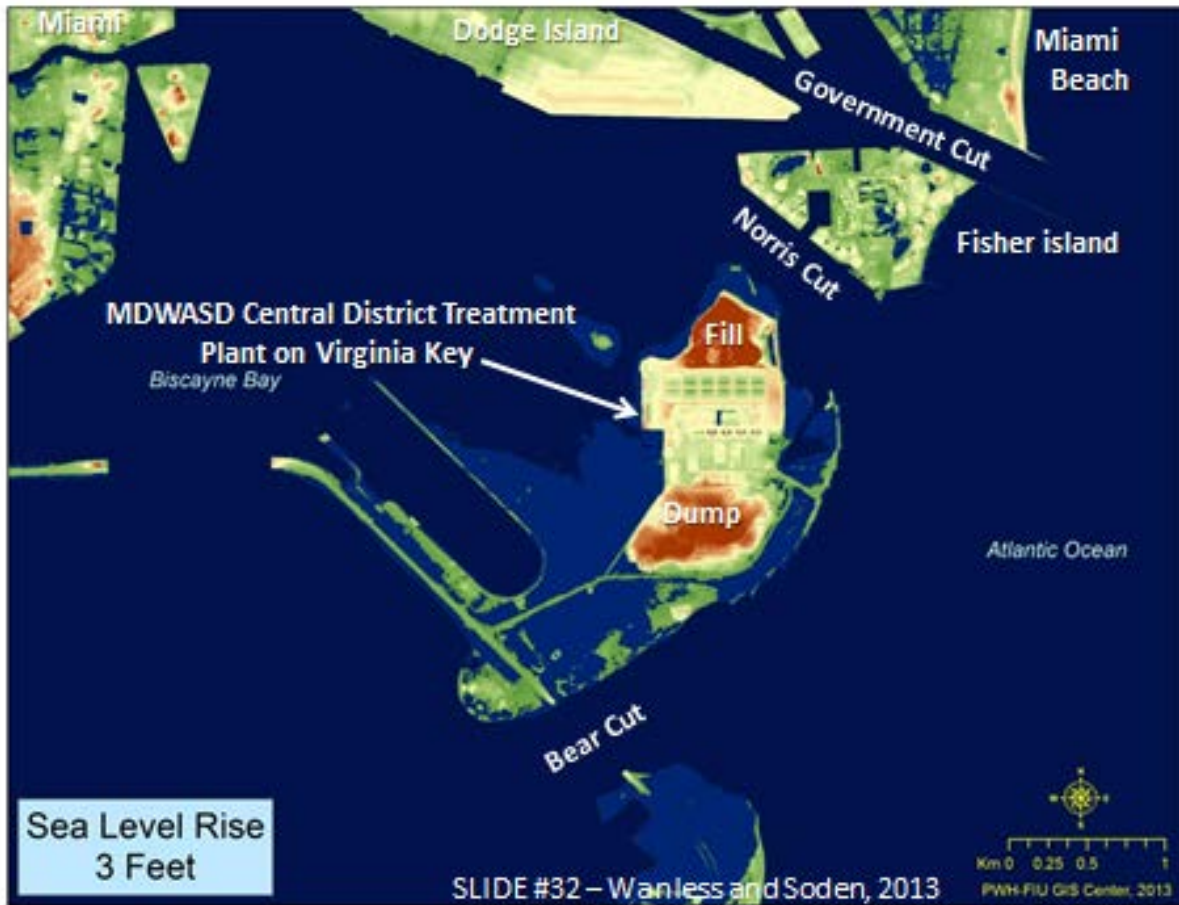


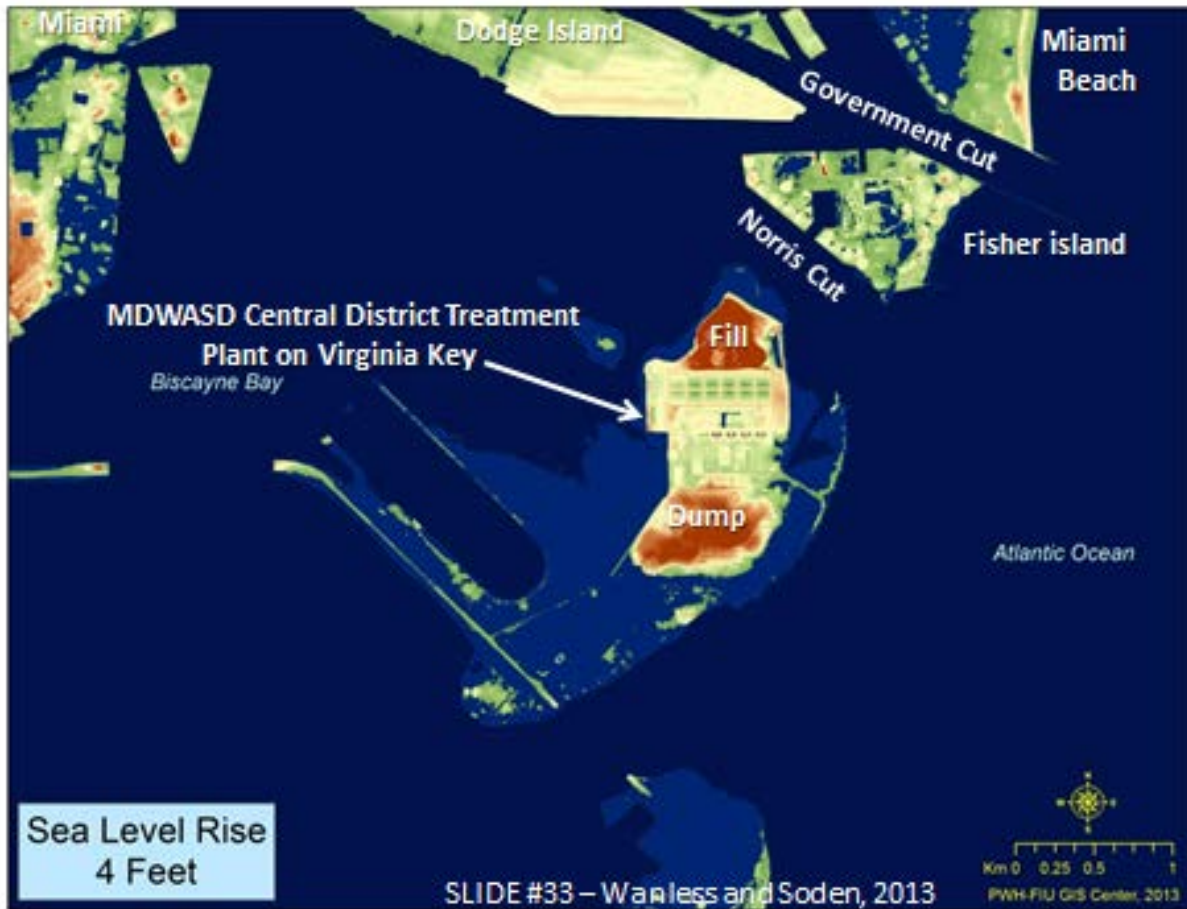




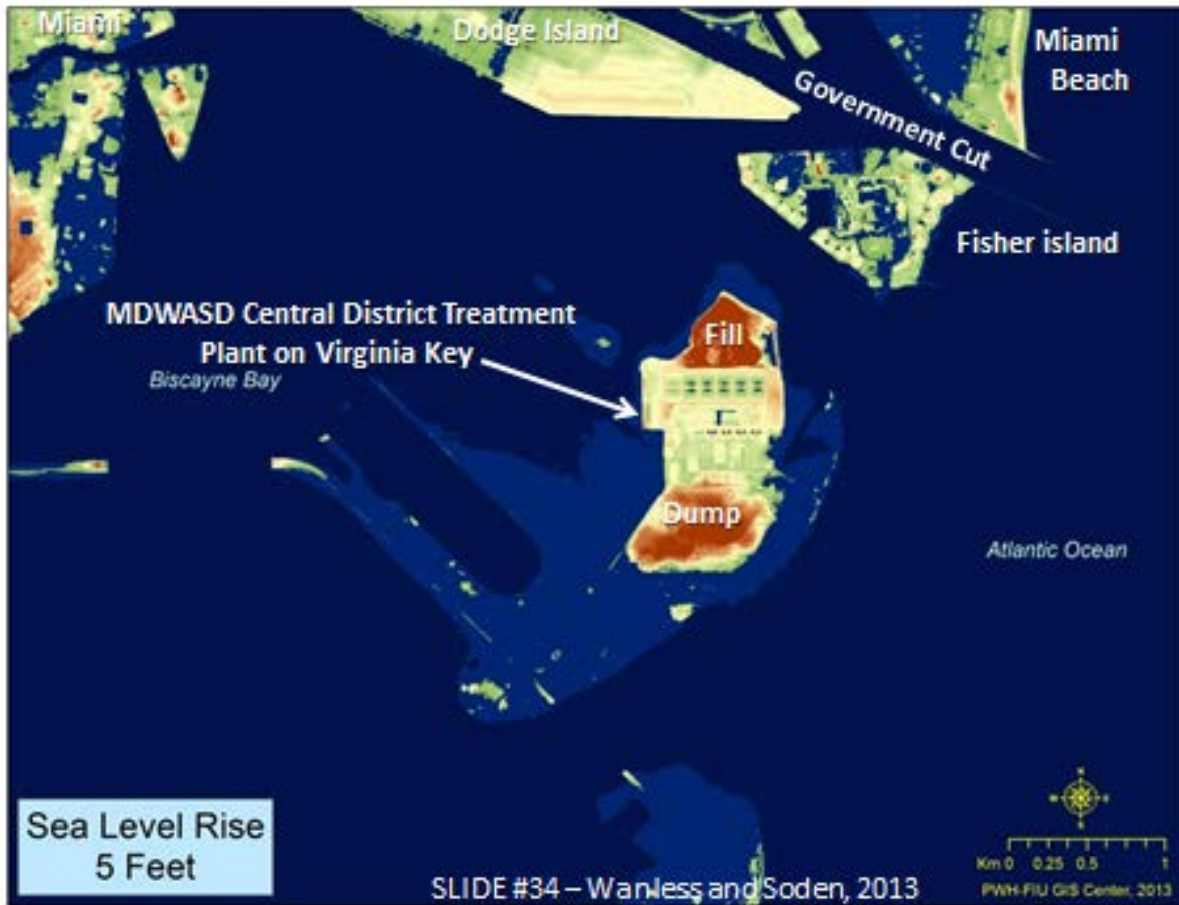


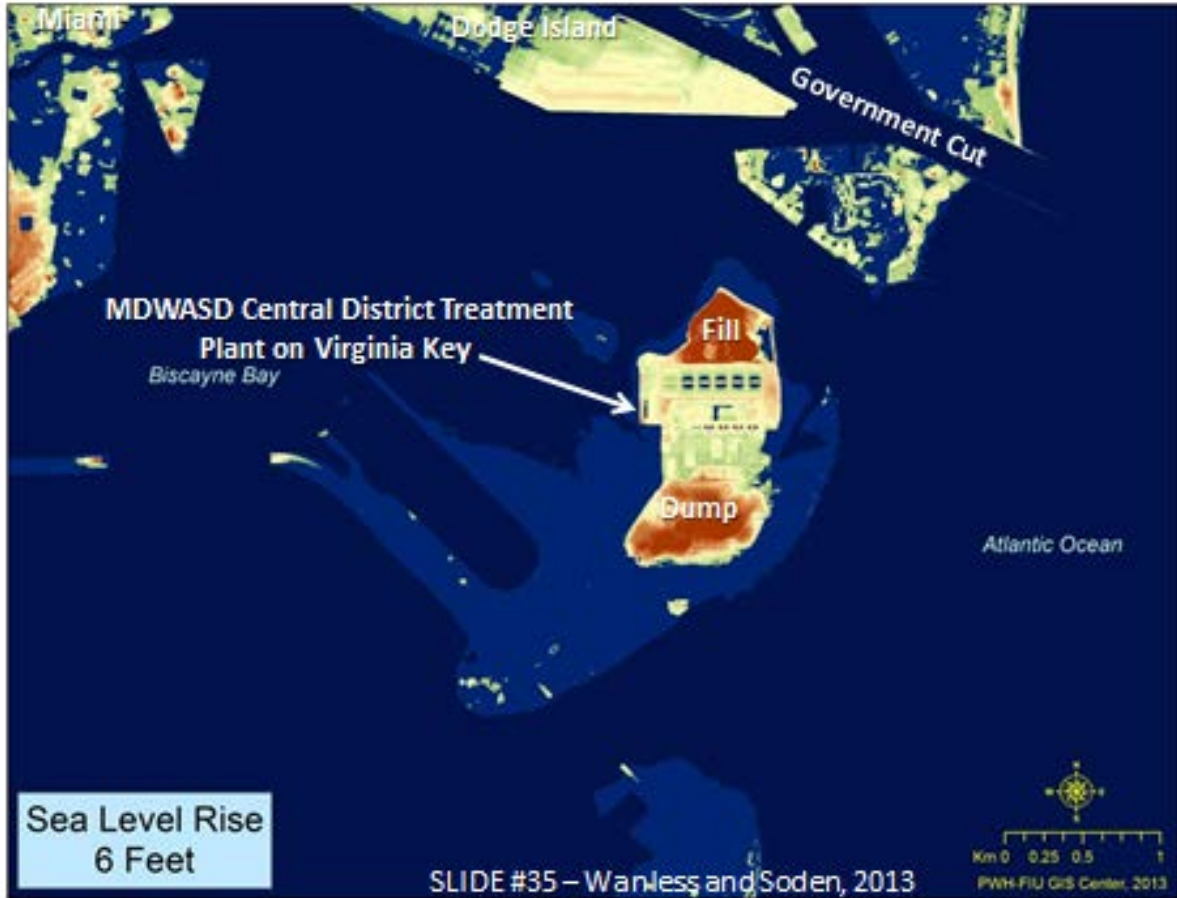










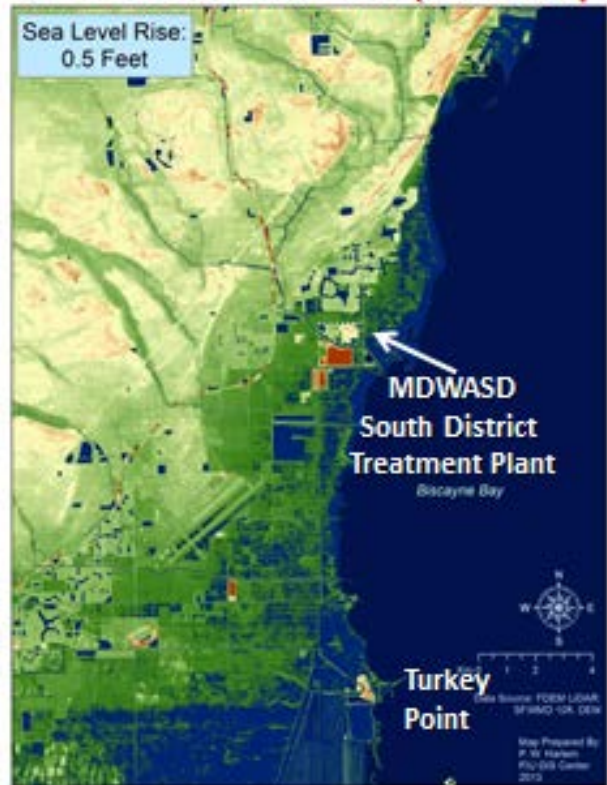
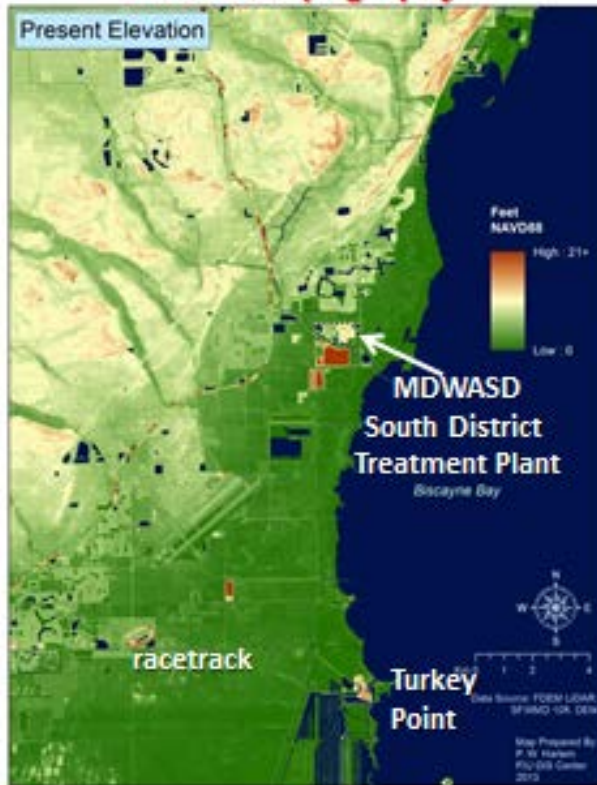


SLIDE #36 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

**Present topography**

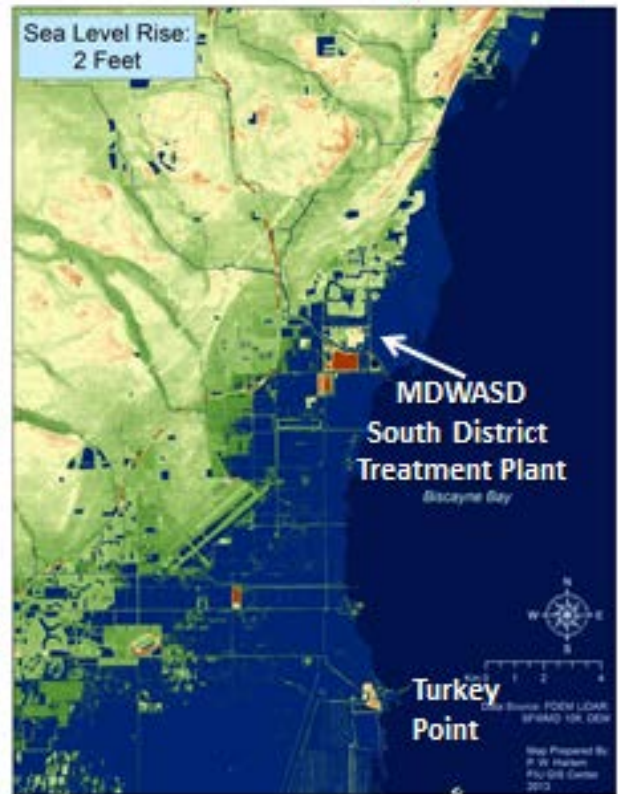
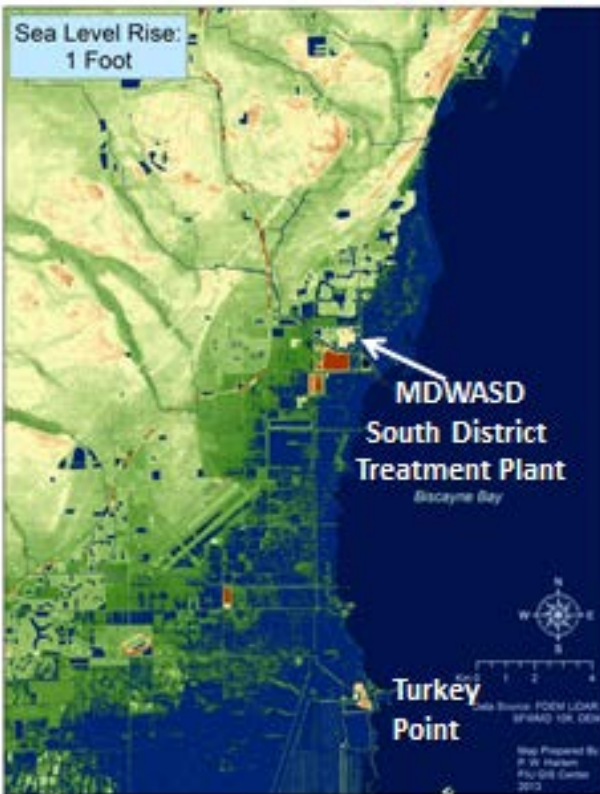
**0.5 Feet Sea Level Rise (2018-2024)**



SLIDE #37 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

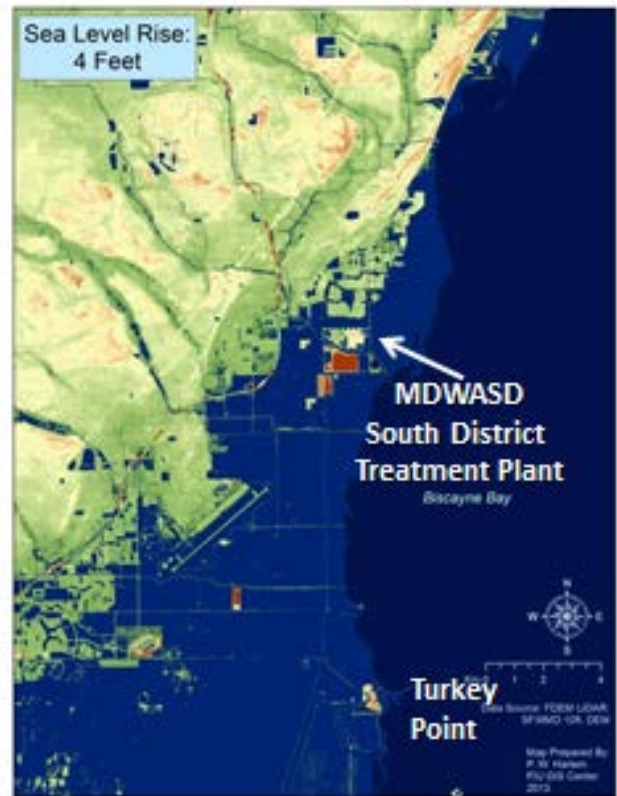
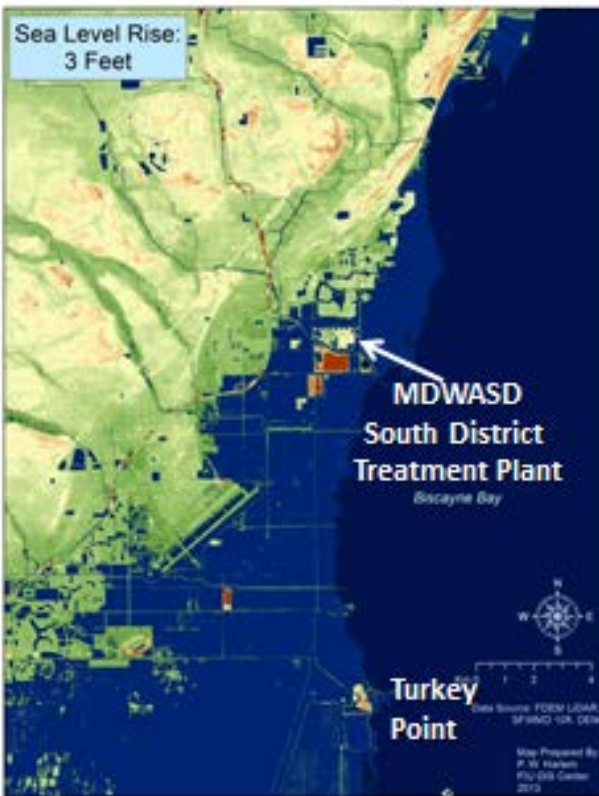
**1 Foot Sea Level Rise (2031-2042)**      **2 Feet Sea Level Rise (2048-2066)**





SLIDE #38 – Wanless and Soden, 2013

**Inundation projections using LiDAR elevation data**  
**3 Feet Sea Level Rise (2063-2085)**      **4 Feet Sea Level Rise (2074-2100)**

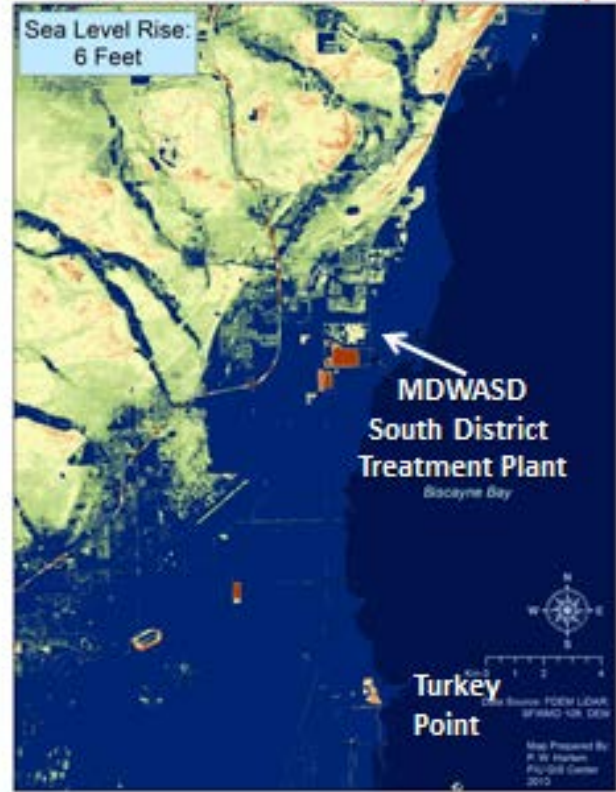
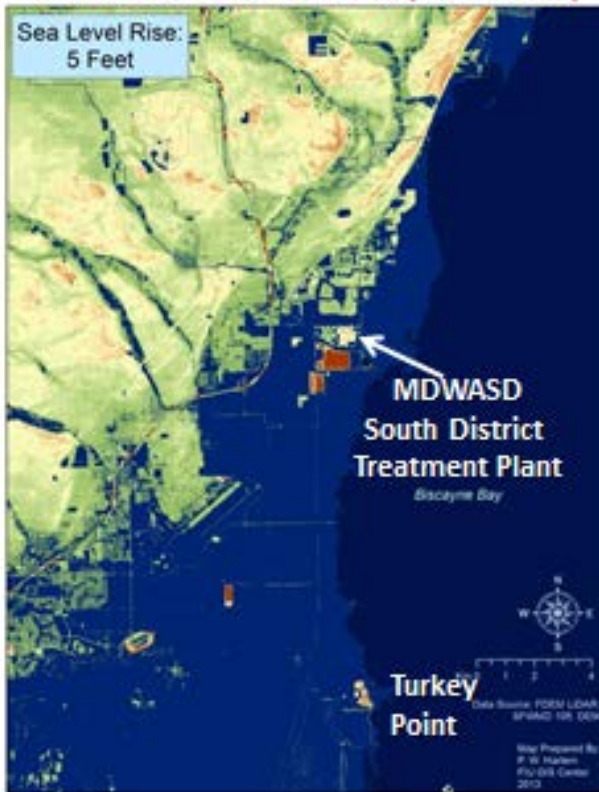




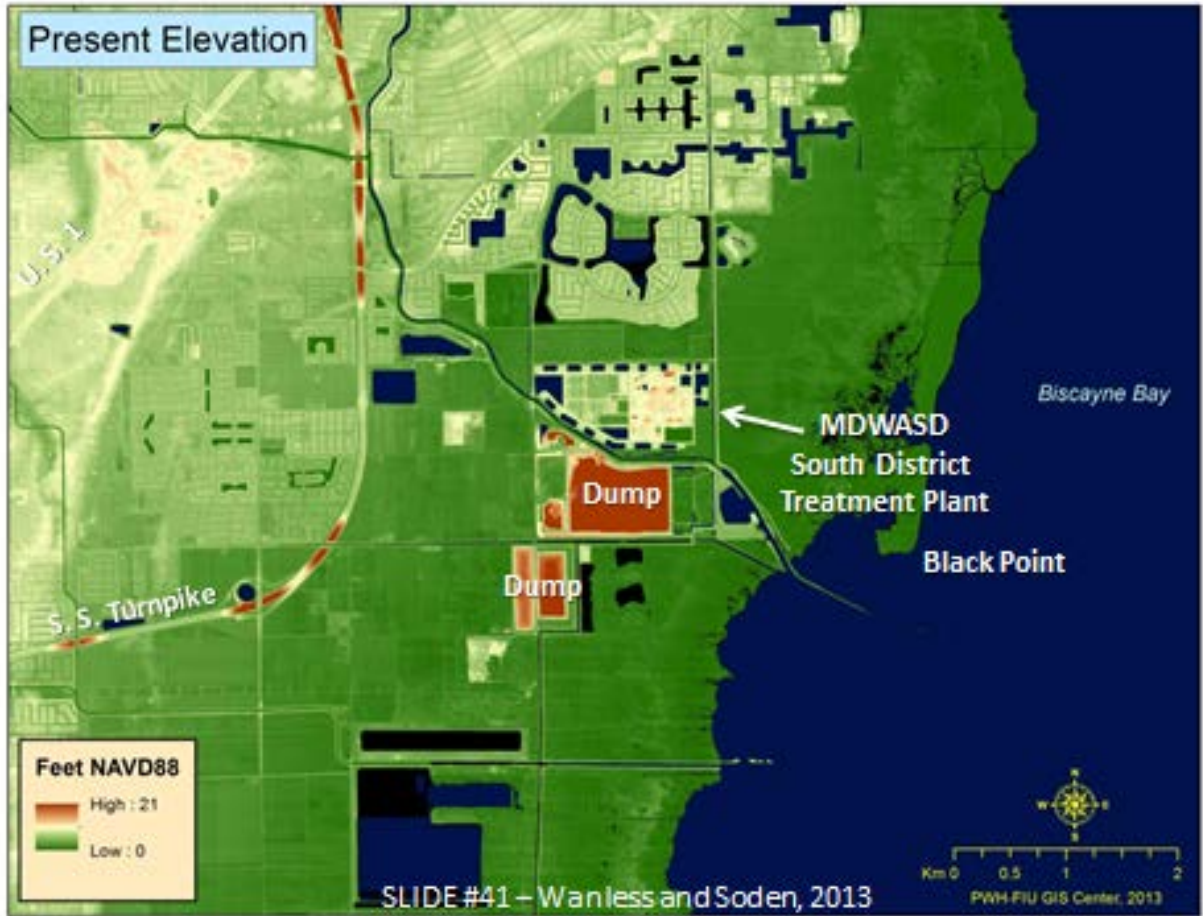
SLIDE #39 – Wanless and Soden, 2013

### Inundation projections using LiDAR elevation data

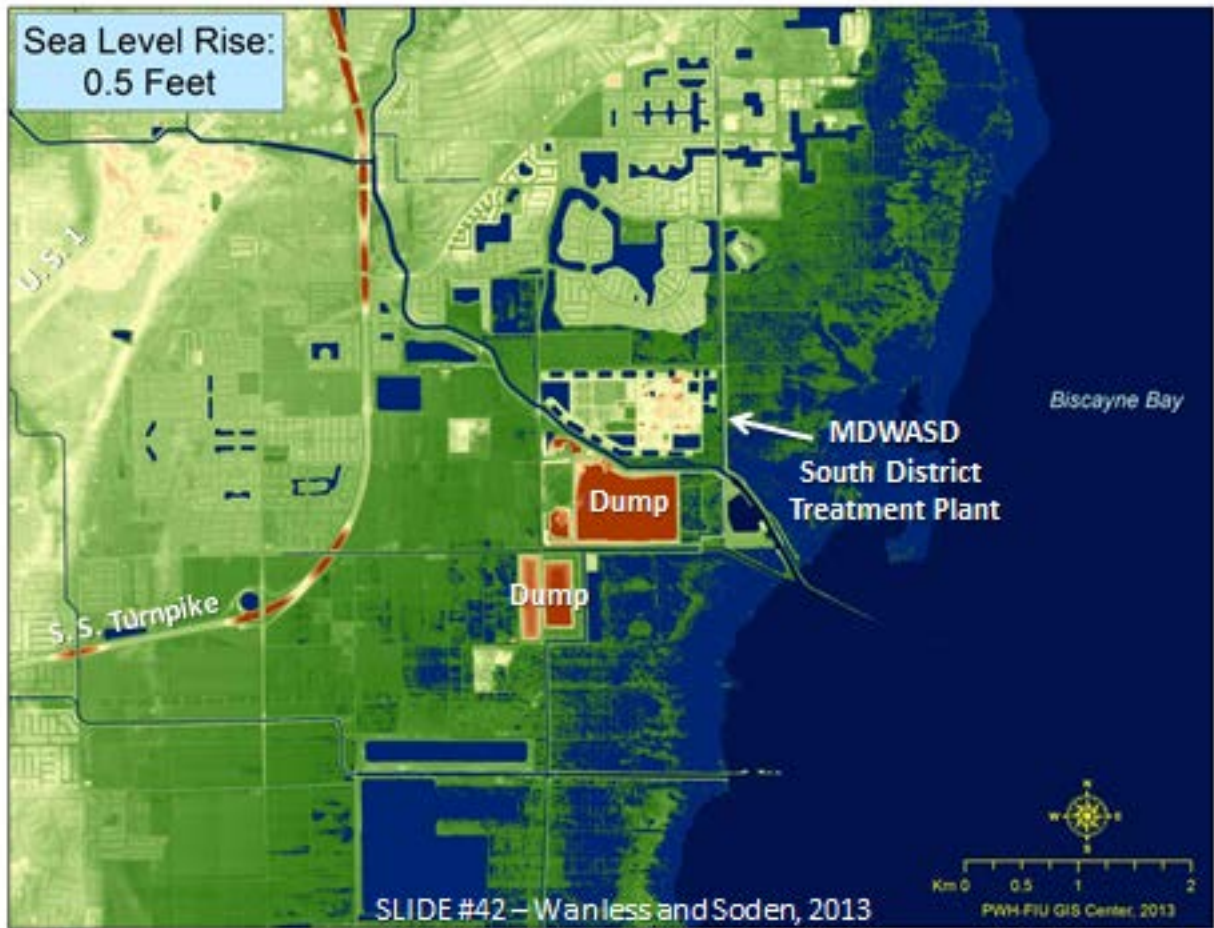
**5 Feet Sea Level Rise (2084-2112)**      **6 Feet Sea Level Rise (2094-2122)**

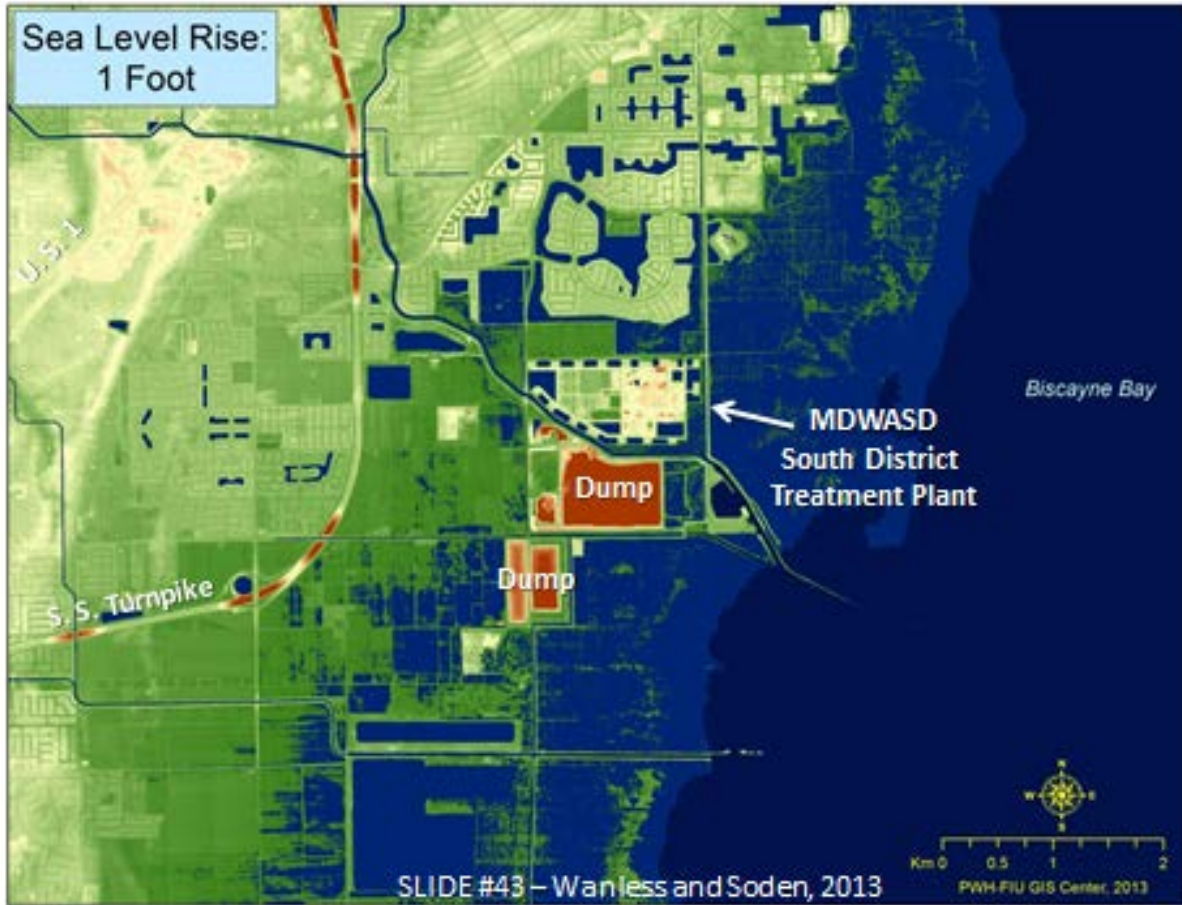




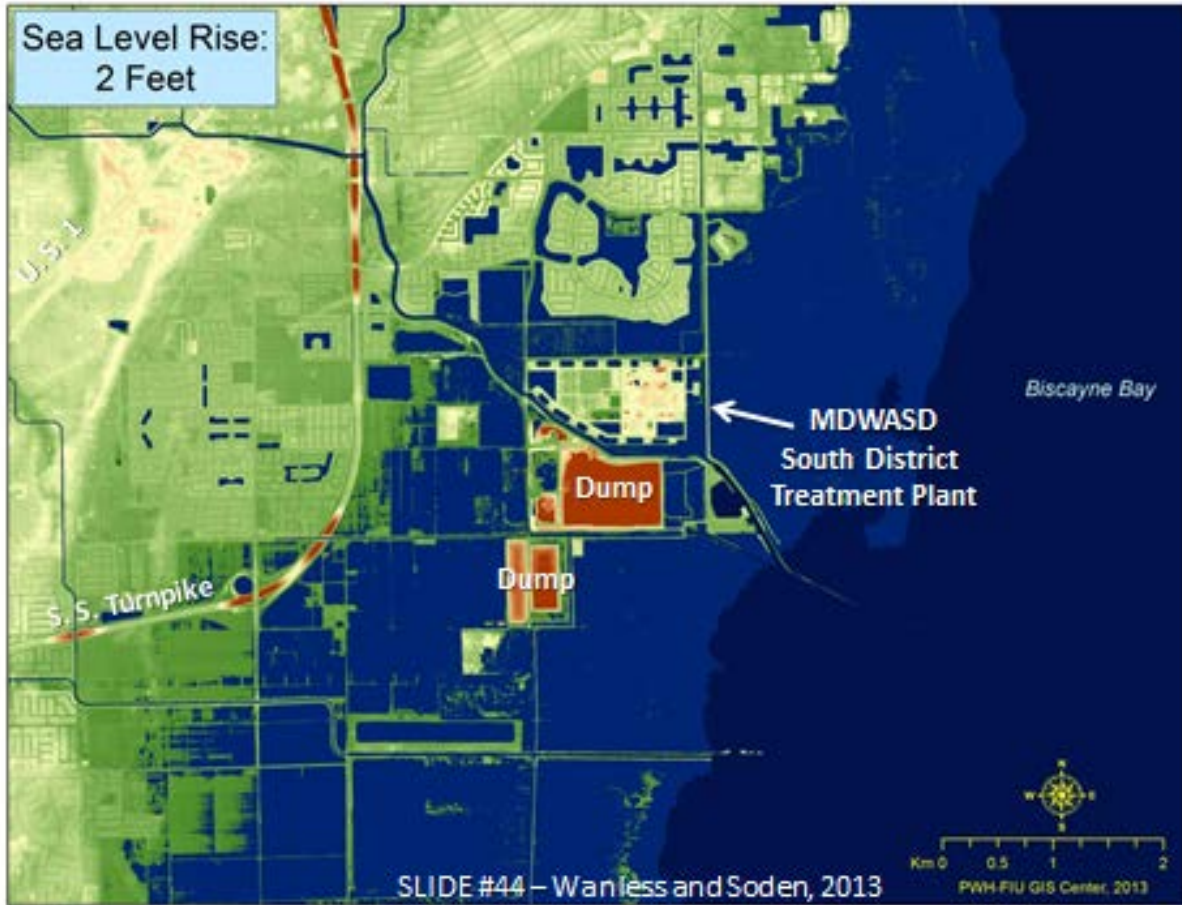


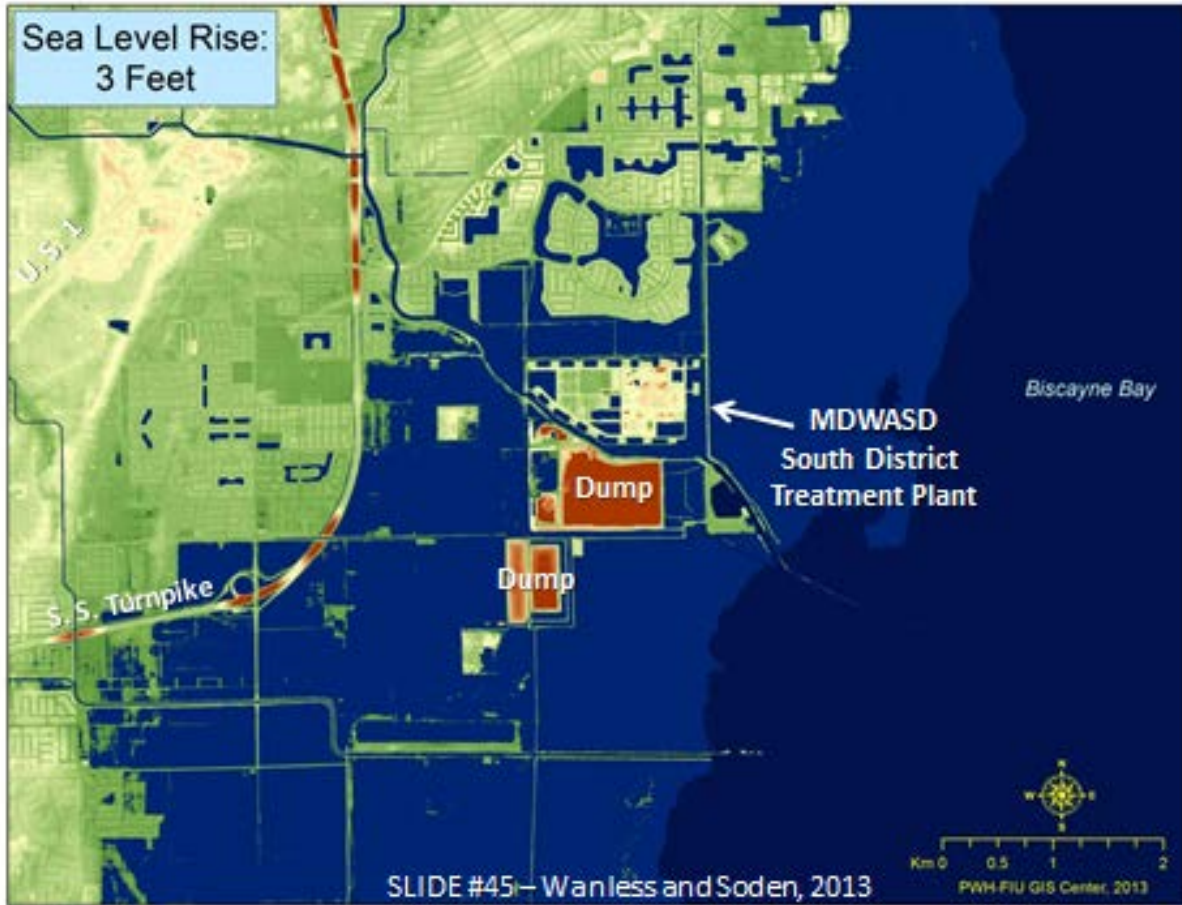


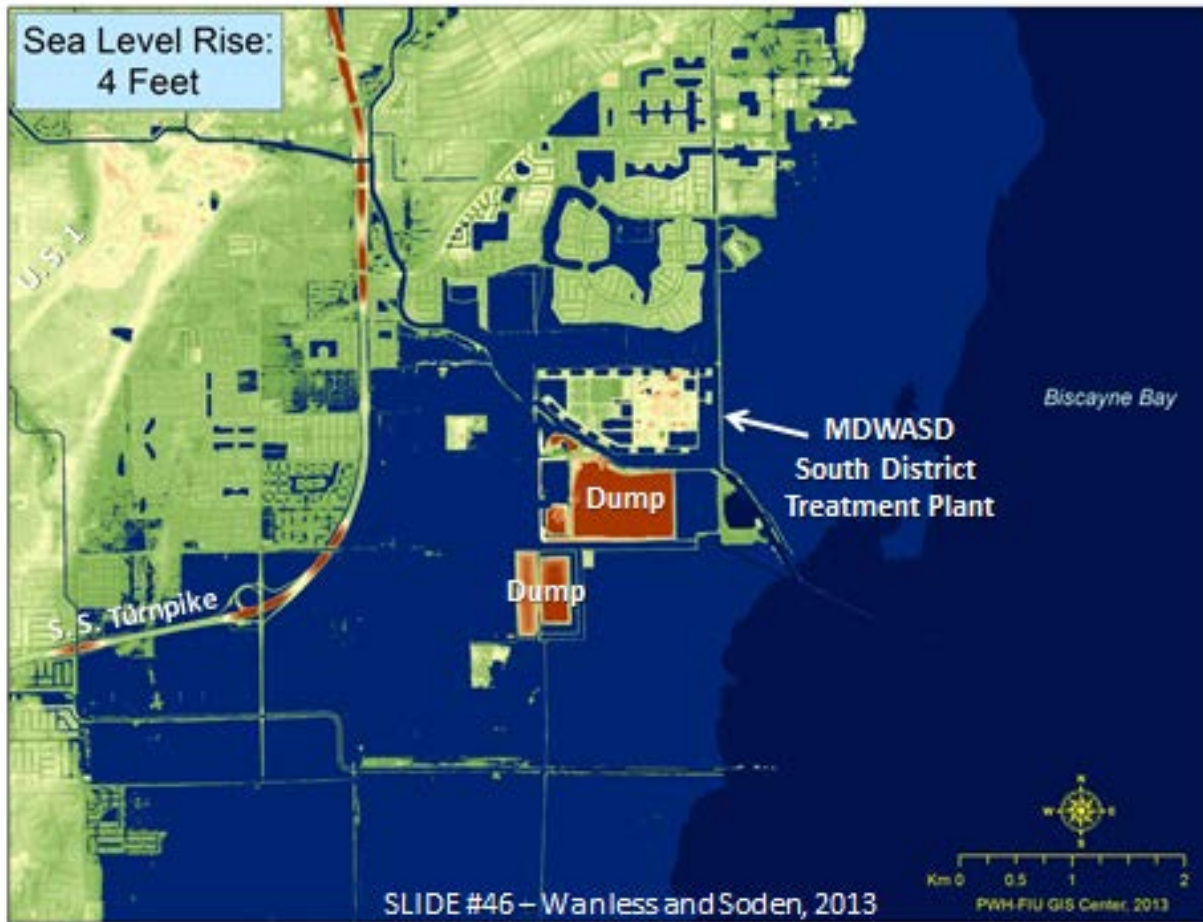


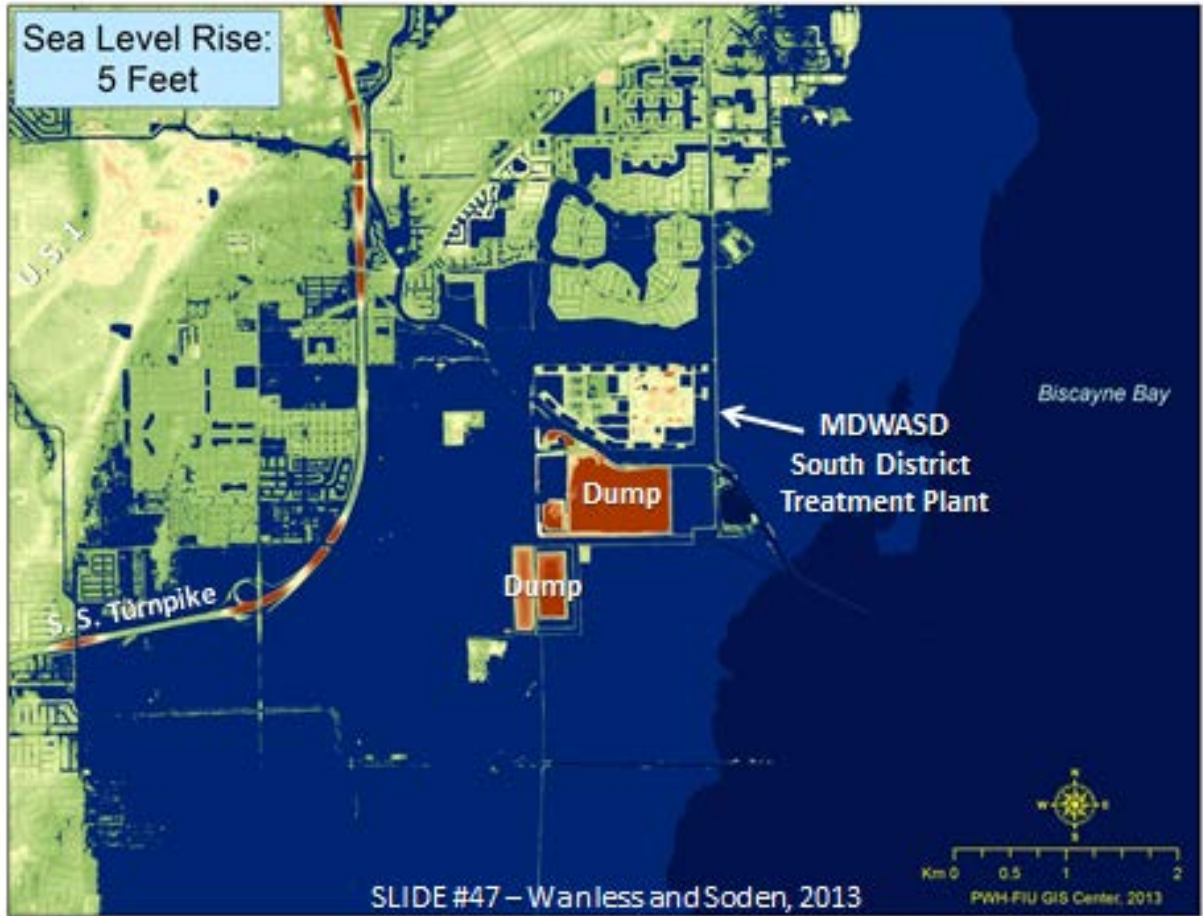




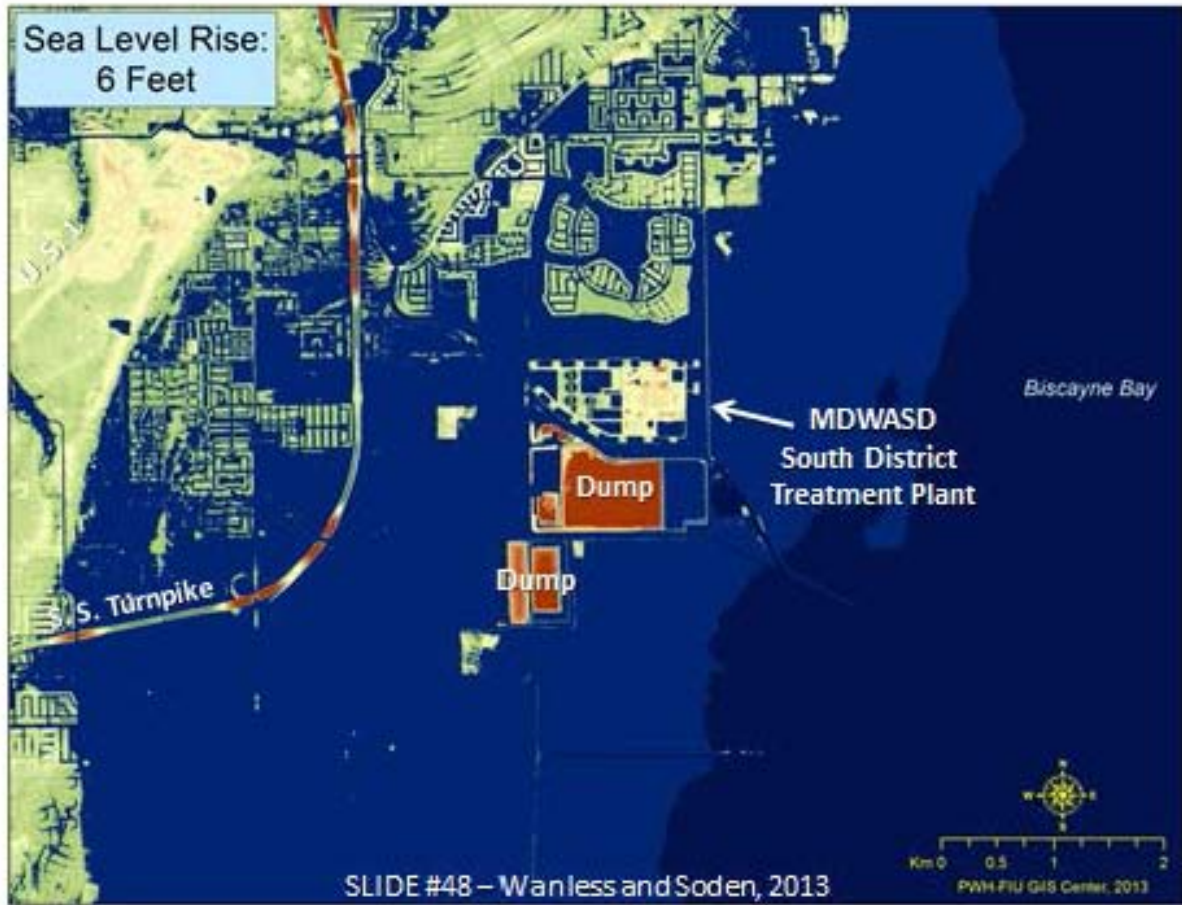














# **EXHIBIT 6**

**UNITED STATES DISTRICT COURT  
SOUTHERN DISTRICT OF FLORIDA**

UNITED STATES OF AMERICA,  
Plaintiff,

v.

METROPOLITAN DADE COUNTY,  
MIAMI-DADE WATER AND SEWER AUTHORITY DEPARTMENT, and the  
STATE OF FLORIDA,  
Defendants

And,

BISCAYNE BAY WATERKEEPER  
465 Ocean Drive, #417  
Miami Beach, FL 33149,  
Plaintiff-Intervenor

And,

JUDI KOSLEN  
251 Galen Drive, Apt. 116  
Key Biscayne, FL 33149,  
Plaintiff-Intervenor

**DECLARATION OF DR. LEONARD BERRY AND MR. RICARDO A. ALVAREZ**

Identifications and Qualifications

I, LEONARD BERRY, STATE (#1 - #7):

1. My name is Leonard Berry. I am Director of the Florida Center for Environmental Studies, Distinguished Research Professor, and Co-coordinator of the Climate Change Initiative at Florida Atlantic University (FAU). My office is located in Jupiter, Florida. My professional and educational experience is summarized in the CV attached to this document as Exhibit "A".

2. I have been Director of the Florida Center for Environmental Studies (CES) since its inception in 1994. CES was created by an act of the Florida State Board of Trustees. In the 18 years of its existence, the Center has acted as an initiator and coordinator of research, education,

and outreach on the environmental problems of Florida, including issues of Everglades Restoration, State-wide Ecosystem Management, Surface Water Area Protection (fresh water drinking wells), Pollution Issues, Total Daily Maximum Loads and, for the past seven years, issues arising from the causes and impacts of sea level rise and other components of climate change.

3. I have also worked on climate change issues in Africa, the Caribbean, and South America. Over time, I have served on eight national and international committees and I've been consultant to the World Bank, USAID, and many other UN bodies.

4. In 2008, FAU established a University-wide research priority initiative to study the ongoing and future impacts of sea level rise and climate change on natural and man-made ecosystems in Southeast Florida. I was a member of the Four County Compact Group, which studied the science and unanimously recommended the use of the US Army Corp of Engineers projections of sea level rise through 2060 as the standard for planning and long-term infrastructure enhancement in the four county area. The recommendations were accepted by the Four County Compact Group, which includes Miami Dade, Broward, Monroe, and Palm Beach counties.

5. I was the Principal Investigator (P.I.) for a commissioned Florida Department of Transportation (FDOT) study, "Methodology for the Identification of Transportation Physical Infrastructure Vulnerable to Sea Level Rise," which outlined the approaches needed to protect and mitigate crucial infrastructure in a future period of climate change. ([http://www.ces.fau.edu/climate\\_change/fdot](http://www.ces.fau.edu/climate_change/fdot)).

6. In April 2012, I testified before the United States Senate Committee on Energy and Natural Resources on the impact of current and future climate change in Florida.

(<http://www.energy.senate.gov/public/index.cfm/2012/4/full-committee-hearing-impacts-of-rising-sea-levels-on-domestic-infrastructures->).

7. I have been an organizer or co-organizer of some ten workshops and conferences dealing with climate change issues in Florida and author or co-author of some 29 papers and reports on this issue. These are listed in my attached CV.

I, RICARDO A. ALVAREZ STATE (#8 - #16):

8. My name is Ricardo A. Alvarez. I am a Research Associate in the Florida Center for Environmental Studies (CES) at Florida Atlantic University (FAU) and a Private Consultant in Vulnerability Assessment, Risk Assessment, Hazard Mitigation, and Adaptation to Climate Change. My office is located in North Miami Beach, Florida. My professional and educational experience is summarized in the curriculum vitae attached to this declaration as Exhibit "B".

9. I have 25 years of experience on the impact of hurricanes on buildings and structures and the reduction of potential damage from recurring impacts through the practice of hazard mitigation. My involvement in this field started in 1988 with my field research in Cancun, Mexico after it was hit by Category 5 Hurricane Mitch, during which I documented damage to numerous buildings and facilities, and to the beach, in the hotel zone, focusing on the causality of damage.

10. From 1993 through 1996, I managed the Hazard Mitigation Program for the Federal Emergency Management Agency (FEMA) for the major disaster declaration following Hurricane Andrew (1992) and three other major disaster declarations involving several regions in Florida. During this process, I directed, participated or otherwise coordinated all aspects of more than 1100 actual hurricane mitigation projects funded by FEMA in Miami-Dade County and other

counties in Florida from initial damage assessment to identification of mitigation alternatives, benefit cost analysis, budgeting, and project regulatory compliance with mitigation scope of work.

11. From 1994 through 2009, I was a professor for the Master of Construction Management Program, Department of Construction Management, College of Engineering and Computing, at Florida International University, teaching Vulnerability Assessment (FIU catalog # BCN-5588) and Hazard Mitigation (FIU catalog # BCN-5589).

12. From 1996 through 2004, I worked for the International Hurricane Research Center (IHRC), the Type 1 Research Center of the State University System of Florida hosted by FIU, where I served as Deputy Director from 1998 through 2004, and as Director of the Laboratory for Structural Mitigation from 2000 to 2004. While at the IHRC, I was the Principal Investigator and Project Director (2000-2004) for the state-funded Hurricane Loss Mitigation Program-Residential Construction Mitigation Program. Total funding reached \$3+ million over the 4-year period.

13. As a Private Consultant from 1996 to the present, I have provided services to numerous institutions in Florida and in other countries, including several of the largest hospitals in Florida related to Vulnerability Assessment and Hurricane Mitigation. I have also served or continue to serve on boards and committees requiring expertise on the topics of hurricanes, storm surge, vulnerability, mitigation, and risk, including the "State Hazard Mitigation Plan Advisory Team", which advises the Florida Division of Emergency Management with respect to mitigation planning, risk assessment and the development and periodic review of the State Hazard Mitigation Plan required by federal law, the "Local Mitigation Strategy Steering Committee in Miami-Dade County", and the "Board of Directors of the Hurricane Warning Project", a non-



profit based in Deerfield Beach, Florida dedicated to education and outreach activities in the field of hurricane vulnerability, mitigation and preparedness.

14. I have 16-years of experience in the field of Climate Change, where I have focused on the Adaptation of the Built Environment. My work in this field started in 1997 when I became Managing Director for one of the regional workshops that was part of the first National Assessment of Climate Change in the United States, an effort managed by the U.S. Global Change Research Program (USGCRP). The workshop, "Climate Change and Extreme Events Workshop", was funded by the National Oceanographic and Atmospheric Administration (NOAA) Office of Global Programs. This workshop took place at FIU in July 1998 and addressed the consequences of global climate change in the South Atlantic Coastal and the U.S. Caribbean Region. We also received support from the White House Office of Science and Technology Policy and from USGCRP. I wrote a white paper "The Need for Action to Confront Global Climate Change on a Regional Basis" ( <..\Ricardo A. Alvarez\WEBSITE\WHITEPAPERDraft1.pdf>) that set the topics of discussion for this workshop.

15. In 2007, I presented a paper introducing the concept of Adapting the Built Environment to Climate Change through Building Design Criteria (See attached CV) at a major climate change conference in Tampa sponsored by CES, during which I also presented a poster "Climate Change, Global Warming, Sea Level Rise: We Must Take Action Now!" More recently, in 2011, I presented a poster presentation on "Storm Surge and Climate Change: the Forgotten Factor" ( <..\POSTERS\Presentation1.pptx> from [mitigate.com/wp-content/uploads/2012/02/Poster-Abstract.pdf](http://mitigate.com/wp-content/uploads/2012/02/Poster-Abstract.pdf)) at a workshop of the State University System of Florida Climate Change Task Force in Gainesville, Florida. On the same topic in May 2012, I

presented a paper on “STORM SURGE: A Dangerous and Neglected Hazard” (See attached CV) at a workshop on “Current Trends in Mitigation of Essential Facilities” at the 26th Annual Governor’s Hurricane Conference, in Fort Lauderdale, Florida. In June 2012, I presented a paper on “The Coastal Built Environment in Southeast Florida and Sea Level Rise: Prognosis for Potential Damage and Needed Change” (..\SLRJUNE2012\The Coastal Built Environment in Southeast Florida and Sea Level Rise.pdf) at the “Risk and Response: Sea Level Rise Summit” sponsored by CES in Boca Raton, Florida.

16. Related to these fields I have written and presented extensively including the following peer-reviewed contributions over the last ten years:

- A. “Proposing an empirical approach to risk management focusing on damage reduction.” Alvarez, R., 2012, Territorium No. 18, pp 5-22; Journal of the Portuguese Association on Risk, Preparedness and Safety. ISBN 978-989-96253-2-7; ISSN 1647-7723 ( ..\Ricardo A. Alvarez\PORTUGAL\TERRITORIUM\Territorium 18corrected.pdf)
- B. “Paraíso Protegido: Hacia una cultura de mitigación (Paradise Protected: toward a culture of mitigation),” Alvarez, R. A., 2012 Book published by Miguel Angel Porrua Publishers, Mexico D.F., Mexico. ISBN 978-607-401-556-0 (..\CANCUN\GRUPO QUINTANA ROO\LIBRO1\PORTADAFinal1.jpg )(..\CANCUN\GRUPO QUINTANA ROO\LIBRO1\PORTADAFinal2.jpg) (..\CANCUN\GRUPO QUINTANA ROO\LIBRO1\BOOK ANNOUNCEMENT.pdf)
- C. “Climate Change and Sea Level Rise in Florida.” Alvarez, R. – contributing author, 2010 Florida Oceans and Coastal Council (..\Ricardo A. Alvarez\WORKSAMPLE\Climate Change and Sea Level Rise.pdf)

- D. "The Effect of Climate Change in Florida's Ocean and Coastal Resources." Alvarez, R. – contributing author, 2009 Florida Oceans and Coastal Council (..\.\Ricardo A. Alvarez\WORKSAMPLE\Climate\_Change\_Report\_v2.pdf)
- E. "Vulnerability Assessment as a Tool for Hazard Mitigation." Alvarez, R.A.; Williams, A.; Submarine Landslides and Tsunamis pp 303-313, 2003 Kluwer Academic Publishers (..\.\Ricardo A. Alvarez\WORKSAMPLE\Vulnerability Assessment as a Tool for Mitigation.pdf)

TOGETHER LEONARD BERRY AND RICARDO A. ALVAREZ STATE (# 17 to # 52):

Vulnerability of WASD WWT Plants in Miami-Dade County, Florida

17. The intersection of geographic location and natural processes make the coastal region of Miami-Dade County particularly vulnerable to the impact of natural hazards, some of which are being exacerbated by global climate change.

18. Of particular concern is the fact that human activity, the built environment that shelters it, and its supporting infrastructure located along the coastal region of Miami-Dade County are all vulnerable to the combination of storm surge (the most destructive cause of damage generated by tropical cyclones) and sea level rise driven by global warming, because of its tremendous potential for damage during land-falling or approaching hurricanes.

19. Miami-Dade County WASD owns, operates and manages three WWTs: the North District WWT, the Central District WWT located in Virginia Key, and the South District WWT. All three of these WWTs are located in close proximity to the waters of the Atlantic Ocean, which makes these critical facilities extremely vulnerable to the impact of hurricanes, and of storm surge exacerbated by sea level rise. These facilities are critical because they provide a

service that is essential for the health and welfare of the entire population of the County. Should the function of any of these three WWTs be reduced or totally cease because of the impact of a hurricane, the adverse health consequences for a large portion of the population of the County and potential damage to the ecology of adjacent waters and coasts could be catastrophic and long lasting.

20. The high risk of direct damage to these three facilities places the entire population of the county and a good portion of its natural environment at risk of suffering indirect and consequential damage.

21. It is vital to understand that this risk will continue to increase over time as the vulnerability of this region (specifically, in this context, we are referring to Miami-Dade County) increases due to sea level rise and climate impacts and, as the natural hazards that affect it become more damaging. The risk also increases as predicted increases in population and additional development occur and/or changes in demographics place more people and human activity in close proximity to rising sea levels.

22. An assessment of natural hazards that affect the coastal region of Miami-Dade County clearly shows that tropical cyclones pose the greatest natural threat to human activity and the built environment both in terms of potential for causing damage and frequency of recurrence. Wind and water are the damaging components of hurricanes. The discussion below of wind and water is specifically applicable to our later recommendations for the WASD's three WWTPs and its sewage collection system, as well.

23. Wind generates pressure on the exterior surfaces of buildings, structures or other objects in its path. Such pressure known as *wind-velocity pressure*, increases in direct proportion to the square of the wind velocity, (e.g., Hurricane Wilma, October 2005), which increases with height

above ground. Wind-velocity pressure applies forces (loads) that push (positive pressure) on the windward side of the object or generate suction (negative pressure) on the leeward side (opposite the wind direction) of the same. Wind can also generate other possible effects as it interacts with a building or structure including: *drag*, *uplift*, *buffeting*, *vibration*, *stagnation*, *vortices*, and what is known as *clean-off effect*. In addition, wind is capable of lifting off loose objects and pieces of damaged buildings or structures carrying them aloft as missiles, in what is known as *flying debris*. All of these forces and various effects become stronger, and consequently more damaging, as the wind speed increases during a hurricane. During a hurricane, most of these forces and effects can impact a building simultaneously leading to the type of severe damage to the built environment that had been so graphically documented over the years especially during major hurricanes. Location is a major contributing factor to the potential for damage from hurricane impacts, especially to buildings and facilities in the coastal region because often hurricane winds rush at them at full force unimpeded over open waters and low lying terrain.

24. Water is another major cause of damage during hurricanes. From extreme rain, flooding, and wind-driven rain, to storm surge and breaking waves, water in one form or another is capable of causing severe damage including structural failure of impacted buildings and facilities during hurricanes. By far, the most damaging form of water during hurricanes is *storm surge* (e.g., Hurricane Katrina [2005], Hurricane Ike [2007], and Hurricane Sandy [2012]). Due to the properties of water as an isotropic, incompressible fluid approximately 800 times denser than air at sea level, storm surge driven by hurricanes generates *hydrodynamic pressure* on the exterior surfaces of buildings and facilities in its path as it rushes inland. This pressure increases in direct proportion to the square of the velocity of flow, resulting in high energy impact forces capable of causing severe damage and structural failure of the buildings and facilities that it interacts with.



Also, storm surge can generate other possible effects such as *drag, scouring, undermining, and erosion*. All are contributors to potential damage. By flooding the coastal region, storm surge leads to saturation and water-logging of the ground which generates *hydrostatic pressure* resulting in loads applied to the underside and below ground surfaces of buildings and structures. Storm surge also has the capacity of propelling pieces of *floating debris* as missiles that can hit buildings and facilities with high energy impacts resulting in severe damage. The potential for damage caused by storm surge is increased by the transfer of wind energy to the water, which continues to generate waves riding above the still-water level and capable of generating high energy dynamic impact loads as they break against buildings or structures in the coastal region.

25. It is critical to recognize that damage caused by storm surge will be exacerbated by *sea level rise*. In this regard, there is strong scientific evidence that: (a) sea level has been rising in response to global warming, and (b) the rate at which sea level has been rising has accelerated in recent years and will continue to do so in response to increasingly faster melting of ice in Greenland and Antarctica and glaciers everywhere. In consequence, storm surge will become increasingly more damaging to the built environment and infrastructure in the coastal regions of Miami-Dade County over time for the following reasons: (i) the energy of impact loads generated by storm surge as it interacts with a building or structure is a function of the magnitude of the hydrodynamic pressure applied by the rushing waters; (ii) hydrodynamic pressure increases in direct proportion to the square of the velocity of flow of storm surge; (iii) the velocity of flow increases with depth of water; (iv) wave height near shore is a function of water depth: the deeper the water, the higher the waves. An accepted value for engineering purposes is that wave height is equivalent to  $0.78 \times$  depth of water (*ASCE Standard 7- Maximum Design Loads for Buildings and Other Structures*); (v) The crest of a wave breaking against a wall in the

coastal region will reach a height equivalent to  $1.2 \times$  depth of water (*ASCE Standard 7-Maximum Design Loads for Buildings and Other Structures*). Thus, it is clear that the depth of water is a major contributor to the magnitude of impact and dynamic loads generated by storm surge and breaking waves crashing against a building or structure. Because accelerating sea level rise is and will continue to be the major contributor to increased water depth along the coastal regions, we can also conclude that: sea level rise and the rate of rise are critical factors in determining the potential for damage to the built environment and infrastructure in the coastal region of Miami-Dade County.

26. Equally critical is the horizontal component (the extent of inland penetration) of sea level rise. The horizontal component of sea level rise is a function of the rate of rise and the slope angle of the shore at the specific location of interest. Even simple models for calculating the rate of shoreline change in response to sea level rise yield a ratio ranging from 150:1 to 200:1 (*Bruun, P. 1962*). From this, we may infer that the same ratio can be applied to the height of storm surge and the horizontal extent of inland penetration. This means, for example, that a storm surge reaching a height of 18 feet at the water line will, as an average, penetrate inland for a distance ranging from 2700 feet to 3600 feet. This also means, for example, that an increase of 2 feet in sea level between today and 2060, at a given location, may equate to a retreat of the waterline ranging from 300 feet to 400 feet. These examples are meant to illustrate the fact that horizontal component is at least two orders of magnitude greater than the rate of sea level rise. It must be understood that only a site-specific assessment, which takes into account all of the contributing factors involved, is capable of characterizing the effects of sea level rise at a given location.

27. A final consideration regarding the capacity of storm surge for causing damage to buildings and facilities in the coastal region is the possibility that the event may coincide with an

astronomical high tide at the location. The combination of storm surge and the astronomical tide, designated as *storm tide*, may as an average add 1.5 feet to the depth of water at the waterline for most locations in Miami-Dade County. In some cases, other factors, such as phase of the moon, time of year, and the influence of atmospheric events, may all coincide to generate exceptionally elevated high tides (highest high water), which would contribute to higher than average storm tides when coinciding with hurricane-driven storm surge. In these cases, astronomical high tide may add from 2 to 3 feet or more to resulting storm tides. Instances of these phenomena were well-documented in Southeast Florida, including Miami-Dade County, in October 2012 when extremely high tides brought inundation to urban areas and beaches along the coastline. While such a confluence of factors should be considered a worst case scenario for purposes of risk assessment, all critical infrastructure in Miami-Dade County, including the sewage collection and treatment system, must undergo site-specific, worst-case scenario risk assessment in order to assure the Public that they will operate properly during their useful life.

28. To understand how these natural hazards and contributing *impact modifiers* will in all probability affect WASD WWT plants in Miami-Dade County, consider the case of the Central District WWT. This large WWTP is located on Virginia Key, which is a barrier island in the middle of Biscayne Bay, exposed to the open waters of the Atlantic Ocean. The Central District WWT plant sits on the northern portion of Virginia Key on a site elevated more than 10 feet above NAVD 88 (mean sea level vertical datum as of 1988). LIDAR data (*PWH-FIU GIS Center 2013*) shows roadways on site at approximately +11' NAVD88. On this basis, ground floor slab elevations for buildings and facilities on site should be from +11.5' to +12.0' NAVD88. Land fill to the north of the plant reaches elevations of +20' NAVD88 and an old dump site to its south is elevated to +21' NAVD88. Areas of mangrove forest, wetlands and

some narrow sandy beaches flank the site on the west and east sides. These natural and man-made features around the WWT Plant may at present afford it some protection from some impacts of storm surge.

29. During hurricane Andrew (24 August 1992), Virginia Key was hit by a storm tide ranging from +7.2' to +7.8' NGVD (National Geodetic Vertical Datum of 1929) at its south end fronting on Biscayne Bay near Bear Cut, from +6.0' to +6.5' NGVD on its east side fronting on the Atlantic Ocean, and approximately +6.6' NGVD at its northernmost point by Norvic Cut (*USGS Open File Report 94-116. Storm Tide Elevations Produced by Hurricane Andrew along the Southern Florida Coast, August 24, 1992. MURRAY, Michael H.*) (..\.\STORMSURGE\STORM\_TIDE\_ELEVATIONS\_PRODUCED\_ANDREW\_SFL.pdf ).

Wave heights ranging from approximately +4.7 to +6.0' at waterline on the south and east sides of the island to less than +1.2' on the eastern perimeter of the WWT plant were not high enough to cause damage. Most of the damage suffered from the impact of Hurricane Andrew was from sustained winds reaching to 110 mph gusting to 125-135 mph (NOAA Surface Wind Map for Hurricane Andrew 1992) and the impacts of flying debris. Considering this, it is important to assess what damages would have been caused had the eastern shore of Virginia Key been hit by a storm tide of +16.9' NGVD, which was the highest recorded storm tide during Hurricane Andrew at the Burger King Headquarters (*USGS Open File Report 94-116*) site some 9 miles south of the Central WWT Plant. Under this scenario, the entirety of Virginia Key would have been overtopped by water and the impact of hydrodynamic pressure and dynamic loads from breaking waves reaching to +37.2' NGVD would certainly have resulted in major to catastrophic damage to the WWT plant.

30. Let us consider the current situation as of January 2013. If we take into account the recent and current rate of sea level rise of ~1” per decade (*Wanless 2012*), mean sea level is in all probability already 2.5” higher today than it was in 1988 when the NAVD was established. This means ground, as well as roadway and ground floor slab elevations at the Central WWT plant are now in reality 2.5” closer to mean sea level, making them slightly more vulnerable to the impact of storm surge.

31. Along the same lines, let us now consider scientific consensus sea level rise projections. Sea level rise projections by the U.S. Army Corps of Engineers (USACOE) published in 2009, which have been adopted by Miami-Dade County as a member of the Four-County Compact, have been updated by a recent study published by the National Oceanic and Atmospheric Administration (NOAA) in 2012. The *NOAA 2012* projections indicate an additional +2’ NAVD88 by 2048 to 2066, generally referred to as 2060, or barely 47 years from today and well within the projected 50-year service life for new or renovated capital building projects at the WWT plant. Under this likely scenario, the small sandy beaches near the WWT plant will have eroded away and the mangroves, unable to migrate landward because of existing built environment, will have been reduced in size. In other words, whatever limited natural defenses existing today around the facility will have disappeared or been significantly reduced by 2060. Also, roadway, ground floor slabs, and all other elevations throughout the facility will be 2’ lower in relation to mean sea level and much more vulnerable to the impact of storm surge. Under such a future scenario, let us visualize the impact of a +16.9’ storm tide on Virginia Key and, we can only conclude that the potential for damage to the Central WWT plant would have risen by a very large margin.



32. In view of the above, there is no doubt in our opinion, stated to a reasonable degree of scientific certainty, that the effect of an accelerating rate of sea level rise on storm surge, the most damaging component of hurricanes, has created a continuously increasing level of risk for all three of the WWT plants operated by WASD in Miami-Dade County.

33. Relative to the high level of risk at all three of the WWT plants operated by WASD in Miami-Dade County, it is critical to understand that such risk has existed from the first day each of these WWT plants was built and put in service on the coastal region of Miami-Dade County, and continues to exist today as a direct result of this region's vulnerability to hurricanes generated in the larger Atlantic basin, and the destructive capacity of winds and storm surge generated by these phenomena. However, existing risk is being exacerbated by climate change and will increase substantially over the life of WASD capital improvement plan, because each time a new storm surge approaches any of these WWTPs, it already carries the imprint, a component if you will, of sea level rise. The Board of County Commissioners and the EPA ignore this increasing risk at their peril – and, of course, at the peril of the residents and visitors to Miami-Dade County.

34. In order to put the vulnerability and increasingly higher risk at the WASD WWT plants in proper perspective, it is critical to consider some of the consequences and indirect damages that may result in case of a damaging impact at any one of them. Take, for example, the fact that these facilities store liquid chlorine under pressure. In the case of the Central WWT plant, 78 tons of chlorine are stored on site, which is piped through manifolds and evaporators to be converted to *chlorine gas*-- a highly toxic chemical that can cause acute and even deadly damage to the human respiratory track. These facilities also store *methane*, a byproduct of the digester process, which is highly flammable and a potent greenhouse gas. In addition, both the North and

the Central District WWT plants have large diameter *ocean outfall pipes* to release treated effluent into the ocean. All three facilities have large diameter *force main pipes*. In the case of the Central WWT plant, there are actually three incoming force main pipes to bring the influent into the facility for treatment. Given these conditions, it is not difficult to visualize how damage to a WWT plant may result in the release of toxic and even deadly chlorine gas, explosive methane fires, or the release of untreated or not fully treated effluent into the bay and the ocean. Interruption of function at one of these facilities could impede the flow of influent through the force mains resulting in sewage backups into communities with grave consequences for human health and the natural environment.

35. Other contributing risk factors include the corrosive nature of some of the processes involved in WWT and location-dependent events such as: (a) the storage and use of chlorine and chlorine gas; (b) the marine environment with salt water spray that is also corrosive; (c) saturation of ground with salt water during coastal inundation events; and, (d) salt water intrusion driven by sea level rise. All of these can corrode metal structures and buildings and can also lead to *spalling* of reinforced concrete structures where reinforcing steel corrodes and expands, cracking the concrete until some layers fall off. This, in turn, accelerates the corrosion weakening the structure. As structures weaken, their performance under the impact of various hazards is degraded to the point of failure.

36. We have reviewed in detail the Specific Capital Improvement Project Descriptions that are part of WASD proposed capital improvement plan for a total cost of \$1.458 billion, which involves a number of upgrades, enhancements and replacement of equipment, renovation of some buildings and some new construction at the North District, Central District and South District WWT plants, as well as improvements to the WW collection and transmission lines, and

to the Sewer Pump Station System. From these descriptions, it would appear some of the proposed projects are more of the nature of preventive maintenance or repairs of equipment and facilities. What is glaring in these lists of projects is the total absence of specific items designed to reduce the potential for damage from the recurring impacts of natural hazards such as those we have identified in this document. Measures such as *Code-Plus* (retrofitting to harden buildings and structures against the impact of hurricane winds and flying debris, or structures designed to diffuse the energy of incoming storm surge or of breaking waves or to prevent flooding of the grounds) are absent from these descriptions of capital improvement projects. There is also no mention that specific design criteria and hazard mitigation measures will be incorporated in the design and construction of new and renovated structures at these WWT plants to reduce the potential for damage from recurring hazard events and ensure the continuity of function of these plants and the entire collection, transmission, and pumping system during the projected service life of these projects once they are completed. In view of the absence of protective measures, **we have one critical question**: How will WASD certify to the BOCC, the EPA, Fla. DEP, the Court and the Public that its sewage collection and treatment system will meet legally-required performance criteria under the impact of recurring hazards and expected, future exacerbation of sea level rise and, even more critical, in their aftermath?

37. Previous studies by the authors and others have demonstrated the need to assess current and future risk and provide appropriate adaptation especially in structures with projected lifetimes in the order of 20-40 years. For example, the United States Army Corps of Engineers, issued USCAE Circular (1165-2-211 7011) in 2009 and renewed in 2011, which directs incorporation of: “Direct and indirect physical effects of projected future sea level change in managing, planning, engineering, designing, constructing, operation, and monitoring USACOE

projects and systems of projects. Impacts to coastal and estuarine areas caused by sea level change **must be considered in all phases of civil works programs.** (USACOE 2009-2111).”

(Emphasis added)

38. In 2010, the Florida Atlantic University’s Florida Center for Environmental Studies was contracted by FDOT to (amongst other objectives): “Develop recommendations for which method of forecasting sea level rise and related impacts should be used by FDOT”. After a comprehensive review of the literature, we recommended that FDOT use the USACE guidance as the sea level rise model most appropriate for South Florida. That guidance recommended use of a 3-4” rise by 2030 and a 9-24” rise by 2060 in planning road infrastructure in Florida. The guidance would equally apply to other infrastructure such as utilities (including sewage collection and treatment systems), which in many cases creates greater vulnerability to people. (Berry, L. Development of a Methodology for the Assessment and Mitigation of Sea Level Rise Impacts on Florida’s Transportation Modes and Infrastructure. FDOT Contract #B BDK79 - 977-01. 114pp. 2011.)

39. Among the final report recommendations are:

“Develop a no-regrets and gradual adaptation strategy in the planning, design, construction, and maintenance of transportation infrastructure.”

“...Risk assessment analysis will need to be conducted to evaluate different alternatives.”

Again, these equally apply to wastewater utilities.

40. Similarly, a June 2011 workshop on Water Utilities and Climate Change sponsored by the Water Research Federation and including involvement of many South Florida Water Utility personnel. Findings included that the most important climate change issues for Florida utilities are sea level rise, saltwater intrusion and salinization of the aquifers, and changing patterns of

precipitation, with substantial drought periods followed by intense rainfall periods. These issues currently have an impact which is expected to grow in the future.

41. The potential impact of sea level rise on drainage and flooding can have a significant secondary impact on utility demand forecasting, which is now largely a function of demographic forecasts provided by State and County agencies.

42. Any further development of utilities must take sea level rise and salinization issues into account and focused particularly on coastal utilities. This may require engagement with State and County agencies that provide population scenarios, which may not incorporate the impacts of climate change on drainage and flooding patterns. Utilities should organize their climate change adaption in a consistent framework such as that discussed in the workshop.

43. Regarding these important issues of vulnerability, risk, and potential for damage, it is important to note that here in Florida, and especially in Miami-Dade County, there is a history of innovation, leading efforts, and cutting-edge education, research and practical application initiatives in the field of hazard mitigation. Florida, Miami-Dade County in particular, has been recognized as a leader and national example in the fields of Mitigation Planning, Hazard Mitigation and Risk Assessment. Equally, leadership and solution-oriented initiative have been demonstrated in the field of climate change adaptation and mitigation, especially in Southeast Florida where the *Four-County Climate Change Compact (Monroe, Miami-Dade, Broward and Palm Beach Counties)* and the *Seven50 Program for a Sustainable Future (Monroe, Miami-Dade, Broward, Palm Beach, Martin, Lake and St. Lucie counties)* provide ample evidence of such leadership and solutions-oriented approach. This leadership is being tested now in that the WASD Capital Plan to re-build the sewage collection and treatment system pursuant to a federal court consent decree does not utilize the USACE sea level rise model or storm surge data in its



plan, which is contrary to the 4-County Climate Compact and the advice of many of the experts who assisted the Counties' staff to develop the Compact including the undersigned.

44. We submit that WASD would benefit from and should take advantage of the existing expertise and knowledge available locally at the major academic institutions that have been studying and publishing on these very issues.

45. In this regard, we prescribe herein a methodology to be used by WASD to enhance and strengthen its Capital Improvement program in order to ensure that its WWTPs operate within the legal requirements of the federal Clean Water Act during their useful life and even improve the performance of its WWTPs and related infrastructure, as it confronts current and future natural hazards we have identified herein. The methodology that we propose is designed to support timely critical decision-making by WASD and design/engineering teams responsible for capital improvement projects by using information and knowledge acquired in each step as a foundation for the next. This methodology includes the following specific steps:

45A. Starting immediately, in "step one", WASD should conduct a system-wide and WWTP site-specific Vulnerability Assessment that also includes the collection, transmission and pumping components, as well as all support infrastructure such as access roads, electrical utility installations and supply, (see, VULNERABILITY ASSESSMENT schematic.pdf, attached as Exhibit "C") to define the magnitude, frequency and causes of damage associated with the specific natural hazards discussed herein, and to immediately characterize impacts at each WWTP, in terms of external forces (loads) generated by each hazard through their projected interaction with the site of each WWTP and also with each building, structure or facility therein.

(mitigat.com/wp-content/uploads/2010/08/Characterization-ofImpact1.pdf),

(mitigat.com/writings-and-publications/characterizing-the-impact-of-natural-hazards);

45B. Based on such characterization of impacts, WASD would proceed to “step two” to establish design criteria, such as values for optimal structural capacity, integrity, stability, redundancy, continuity of load paths, safety factor, integrity of connections, anchorage and serviceability, based on actual expected external loads, rather than on minimum requirements of applicable codes, to be used in the design and construction of capital improvement projects, in order to ensure effective performance and continuity of function during the impact of expected hazards and in their aftermath;

45C. Once the previous steps have been completed, WASD would proceed to “step three” to identify hazard mitigation alternatives by comparing previously-defined design criteria with the minimum requirements of applicable building codes and standards to be incorporated into the design of each capital improvement project;

45D. As “step four” WASD would conduct and complete benefit-cost analysis of each of the identified hazard mitigation alternatives in terms of potential damage–reduction to be achieved during the projected 50-year service life of each project;

45E. As “step five”, WASD would evaluate and compare all identified hazard mitigation alternatives on the basis of their cost-effectiveness, technical merits, and associated timelines and planning horizons, including the alternative of relocating a given WWTP to a site that will be beyond the reach of storm surge exacerbated by sea level rise for the useful life of the plant (as defined by professional engineering standards in the wastewater treatment construction industry – usually 50-years), at a minimum, counting from the projected date of completion of the capital improvement project.

45F. “Step six” would entail prompt decision-making by WASD and the BOCCC with necessary approvals by the EPA and the Fla. DEP and possibly the Court, as appropriate. The decision-making would involve selection of preferred hazard mitigation alternatives for each WWTP, on the basis of cost-effectiveness and technical aspects to be incorporated into the design and construction of capital improvement projects. Based on such decisions and approvals and criteria established in steps 45A through 45F design teams can then promptly proceed to develop and complete engineering plans and specifications, and bid documents.

46. We also recommend that simultaneously with initial implementation of the prescribed process that WASD continues exploring the effectiveness of various alternatives for the disposal of effluent at each WWTP, in order to have solutions in place by the required phase-out of ocean outfalls and the North and Central WWTPs by 2025. This includes assessment of various water reclaiming alternatives for irrigation or other uses. In all likelihood, the planning process required by the Ocean-outfall Phase-Out Law (Section 403.086(9) F.S.) will involve critical interactions with the process that we are recommending, above, and should be appropriately integrated into our recommended methodology.

47. We estimate the completion of prescribed steps 45A through 45F can reasonably be completed in a diligent and professional manner in 12 to 18 months. It is important to emphasize that completion of steps 45A through 45F be achieved before preparation of relevant architectural and engineering plans is started, in order to **ensure informed and timely decision-making** and the incorporation of appropriate design criteria and the preferred mitigation alternatives in engineering plans and specifications before each capital improvement project is set out for bids.

48. Aside from workshops and studies, municipalities and county administrations in South Florida have been addressing the issue of sea level rise and other current and projected future impacts of climate change. Miami- Dade County has been a leader in this field and has for a long time worked on reducing emissions and planning for climate change impacts and should continue that leadership now, by following these recommendations and not denying sea level rise and climate impacts in its multi-billion dollar re-build of its wastewater collection and treatment system.

49. Following up on this initiative, Miami-Dade was a founding member of the Four County Compact (Monroe, Miami-Dade, Broward and Palm Beach), which was formed to co-ordinate planning on responses to sea level rise and adaptation to this and other climate change impacts. To implement this compact, a working group was formed to agree on a uniform set of projections of future sea level rise to be used in the four-county region. After more than 20 hours of group analysis of the literature and discussion, it was agreed to recommend the use of the USACE guidelines for 2030 and 2060. This model, as stated previously, identifies a sea level rise of 9 to 24 inches by 2060. More recent studies (NOAA 2012; Wanless and Soden 2013) indicate that the upper end of these projections is more likely. The workshop recommendations were accepted by the Four-County Compact and, the counties agreed to take these into account as they planned for the future. (Southeast Florida Regional Climate Change Compact Technical Ad hoc Work Group, "A Unified Sea Level Rise Projection for Southeast Florida," a document prepared for the Southeast Florida Regional Climate Change Compact Steering Committee. 34 p 2011).

50. The appropriate alternatives selections and engineering designs (and, of course, funding) for the required re-build of the Miami-Dade County WASD sewage collection and treatment

system pursuant to a federal court consent decree demands a rigorous methodology, as we have described above, and implementation on a very tight time line, with defined outputs and timely decisions (and review) by all parties. In order to accomplish this, it is our strong opinion and recommendation that the County and WASD (with the participation of the EPA, Fla. DEP, the Public and judicial oversight) constitute a "Blue Ribbon Panel" to oversee and guide this whole process. We see the role of the "Blue Ribbon Panel" as an independent and objective body essentially helpful to all concerned. This panel would work closely with Miami-Dade BOCC and WASD. The Panel's mission would to guide critical decisions and timelines, ensure full compliance with planning process and the consent decrees, to respond and redirect to new issues and new information over time, and to regularly report its finding and status to the parties, the Court and the Public.

51. Suggested types of expertise needed for panel membership are:

**Chair:** A person of standing in the South Florida community with a background in public life, law, and with an understanding of utilities.

**Membership:** (one or more persons with the following areas of expertise/experience) Risk Assessment; Vulnerability Assessment; Hazard Mitigation; Climate Change Adaptation; Cost-Benefit and Cost-Effectiveness Analysis; Economics and Public Finance; Sea Level Rise and extreme events; Engineering with public works background; Private Citizen; Coastal Systems Analyst; Former Public Administrator or County Commissioner.

52. Finally, it is important to repeat part of Dr. Berry's recent testimony to the United States Senate Committee on Energy and Natural Resources (April 19th 2012):

**"The Cost of Inaction:** It is important to note that:

1. For every dollar spent on hazard mitigation, society saves four dollars in the long term.

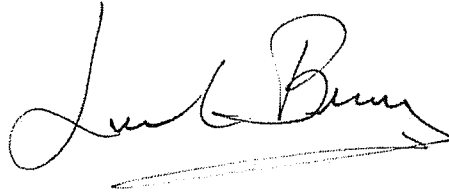


2. When the mitigation efforts have been on flooding hazards, it is a five to one return on investment.
3. The largest return on investment occurs when mitigation projects focus on reducing business interruption from loss of utilities. Most of Florida's utility infrastructure is underground, situated directly on the coast, and at risk.
4. Building resilience now will pay off tomorrow.
5. New coastal infrastructure and large scale, long term restoration projects... may not be successful and may be a waste of resources and time if sea level rise is not accounted for in the planning and implementation. ”

I declare under penalty of perjury that the foregoing is true and correct.

Date: February 5, 2013

DECLARANT:

A handwritten signature in black ink, appearing to read "Leonard Berry". The signature is written in a cursive style with a long horizontal stroke at the end.

Executed in Accord with 10 CFR 2.304(d)  
Leonard Berry, Ph.D.  
Director, Florida Center for Environmental Studies  
Distinguished Research Professor, Co-coordinator  
FAU Climate Change Initiative  
Florida Atlantic University  
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Jupiter, Florida 33458

I declare under penalty of perjury that the foregoing is true and correct.

Date: February 5, 2013

DECLARANT:

A handwritten signature in black ink, appearing to read "R. Alvarez". The signature is written in a cursive style with a long horizontal stroke at the end.

Executed in Accord with 10 CFR 2.304(d)  
Ricardo A. Alvarez  
Private Consultant, Research Associate  
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## EXHIBIT A

**Leonard Berry**

**Current Position:** Director, Center for Environmental Studies  
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**EDUCATION:** Ph.D. University of Bristol, England, July 1969  
M.Sc. University of Bristol, England, 1956  
B.Sc. (Hons) in Geography, University of Bristol, England, 1951

**PROFESSIONAL ACADEMIC INTERESTS:**

My early university training was in the earth sciences, linking physical geography with geology, and I pursued a full undergraduate program in each of these fields. After three years of military service, 1951-1954, for ten years, 1955-1965, I studied physical aspects of tropical environments, carrying out research in South-east Asia and Malaysia and in the dry areas of Africa especially Sudan. I lived in these two areas for all this period. A flow of publications resulted from this work, many of them on technical aspects of tropical environments, with a number on the applied aspects of the scientific work, and with an increasing interest in the human and development issues involved.

My interests in the environment and development problems of the tropics were further sharpened by six years work and residence in Tanzania (1965-1971). I worked with colleagues on a wide-ranging analysis of soil erosion processes and problems in Tanzania and on water development, rural land use, and on a range of other topics. At the same time, I established the Bureau of Resource Assessment and Land Use Planning (BRALUP) as an applied institute, linking its work to development planning and execution. I directed the institute for two years, 1969-1971, and in this period worked closely with several ministries within the Tanzanian Government. Under my supervision, the Bureau carried out detailed planning work in several rural areas including Mbea Region, Tabora Region and parts of Arusha and Tanga Regions, and produced a steady flow of publications. This institution is still functioning well and remains unique in Africa in the scope and character of its work. Several hundred reports and publications have been produced by BRALUP, now renamed Institute for Resource Assessment (IRA), over the years of its existence. Due to the sudden death of a key Ministry of Planning Officer, I took over the regional planning aspect of the 1969-1974 national plan assuming responsibility for Volume III of the Five Year Plan for Tanzania. I was one of three appointed members of the National Water Committee in Tanzania during 1968-1970 (the four remaining members were ministers). Since 1971, I have maintained and expanded my interest in development research and practice especially as related to environment, and the Third World in general. Together with colleagues, I have worked on the particular problems of developing countries and carried out detailed studies in Sudan, Ethiopia, Kenya, Tanzania, Zambia, Botswana, Somalia and Zimbabwe. The range of topics studied included soil erosion and other environmental problems, and the use of LANDSAT imagery as a tool for development research and mapping techniques. The theme of these studies was the better management of natural resources for sustainable development and improved well being of people. As a result of this work, Clark University was awarded grants and contracts for research and training totaling over \$12 million from USAID, the Rockefeller Foundation, and other agencies. In addition, in 1981, as a result of my work, Clark University was designated a center of strength in area studies, a cooperative agreement was made with USAID, which has since been funded at a level of \$1-2 million each year, 1981-1992.

While maintaining some involvement with the Clark group, I have, after moving to FAU in 1987, continued to be involved with environment and development work in Africa and the Third World, through field visits and membership on national and international committees and working groups as well as consultancies. In 1988, together with L. Lewis, I published the standard work on environment and development in Africa. I completed an analysis of Tanzania's environmental issues and, working with local people, drafted a National Environmental Action Plan which was approved by the President of Tanzania in June 1994. I have also worked with colleagues in Luxembourg and at Michigan State University, among others, on the issues of better information systems for natural resource management with reference to the Third World and to Eastern Europe and the C.I.S. countries. I have been particularly involved with a study of information systems for natural resource management in Rwanda. Several international agencies have used this data system in the ongoing crisis in that region.

Since 1994, I have been involved in the creation of a statewide Center for Environmental Studies, focusing on tropical and sub-tropical wetland systems. The Center has been active in water issues in South Florida and has developed close working relationships with the South Florida Water Management District and with the other agencies working on Everglades restoration. We have been centrally involved with the Inter American Water Resources Network and with the planning and execution of water hemispheric dialogues in Buenos Aires, Panama, Brazil and Guatemala respectively. The Center has also carried out applied work in Venezuela and Guatemala and is very active in electronic information exchange. I have been a consultant with the World Bank, The Global Environment Facility, UNEP, UNDP, UNESCO and other agencies working on issues of water resources, sustainability, land degradation and information systems in tropical areas. The Center has many partnerships across the globe including Hong Kong, China, India and Africa. I am also co-coordinator of FAU's Climate Change Initiative.

This summer I was afforded a particular honor that occurred at an auspicious time. As FAU is becoming positioned and recognized as a research leader in Climate Change research, our 50th anniversary was celebrated. At the same time, the University of Dar es Salaam celebrated 50 years and I was personally invited by the Vice Chancellor to deliver the keynote address and to appoint the Mwalimu Julius Nyerere Professorial Chair in Environment and Climate Change. It was gratifying to see a program that I had started not only successful, but flourishing.

#### **UNIVERSITY ADMINISTRATIVE RESPONSIBILITIES:**

During most of my career I've also been involved with University and Center administration as outlined below:

1994-Present Director, and Distinguished Professor Florida Center for Environmental Studies, Florida Atlantic University and SUS. Coordinator, FAU Climate Change Initiative  
1994-1997 Co-Director, Center for Information Transfer, FAU.  
1993-1994 Director, Environmental Initiative, Florida Atlantic University  
1987-1993 Provost and Vice President for Academic Affairs, Florida Atlantic University.  
1983-1987 Provost and Vice President for Academic Affairs, Clark University.  
1981-1982 Chairman of Faculty, Clark University  
1979-1983 Director, Graduate School of Geography, Clark University.  
1978-1979 Acting Director, Graduate School of Geography, Clark University  
1975-1978 Dean, Graduate School, Clark University  
1974-1975 Director of Academic Planning, Clark University  
1973-1983 Director, International Development Program, Clark University. Over 10 years we built up a set of research and training activities directly involving over 100 people in a complex international network and with a budget of around \$2 million a year.  
1971-1972 Acting Director, Graduate School of Geography, Clark University.

- 1969-1971 Director of BRALUP Tanzania. Responsible for a staff of 20-30 including 10-15 professionals and a growing applied research activity.
- 1967-1969 Dean, Faculty of Arts and Social Science, University of Dar es Salaam(130 Faculty and wide range of planning tasks in a new University - handed over to a Tanzanian at the end of this period).
- 1965-1969 Head of Department of Geography, University of Dar es Salaam.
- 1964 Acting Head, Department of Geography, Khartoum.
- 1959-1962 Hydrobiological Research Officer, University of Khartoum. Responsible for research vessel,staff of 8, and for the research program of a wider group.

Many boards and committees during the whole period.

#### **MEMBERSHIP IN SOCIETIES, AND OTHER BOARDS AND BODIES:**

- Founding Member and Executive Board Branch Director, Florida Climate Institute
- Fellow, Royal Geographical Society.
- Member, Association of American Geographers.
- Member of Institute of British Geographers.
- Corresponding Member of International Geographical Union Sub-Commission of Geomorphological Maps.
- Member of International Geographical Union Commission of Hydrological Decade, 1964-1978.
- Past Secretary of the Sudan Philosophical Society.
- Past Vice President of the Sudan Philosophical Society.
- Past President, Sudan National Committee for Geography.
- Member of Council, University College, Dar es Salaam, 1966-1969.
- Member of Senate, University of East Africa, 1967-1969.
- Member of Council, University of East Africa, 1967-1969.
- Member of East African Examination Council, 1967-1971.
- Appointed Member of National Water Resources Council, Tanzania, 1969-1971.
- Member of Tanzania National Committee on Hydrological Decade, 1965-1971.
- President, Tanzania Geographical Association, 1968-1969.
- Member of Planning and Budget Review Committee, Clark University, 1980-1983.
- Chairman of Faculty, Clark University, 1981-1982.
- Member of Steering Committee, Clark University, 1981-1983.
- Committee on Personnel, Clark University, 1973-1974.
- Graduate Board, Clark University, 1972-1983.
- Undergraduate Academic Board, Clark University, 1973-1979.
- National Academy of Sciences, Member, Panel on Man, Materials and Environment, 1972-1973.
- National Academy of Sciences, Panel on Remote Sensing for Development, 1975-1976.
- National Academy of Sciences, Member, Panel on U.S. Strategy for 1979 UN Conference on Technology Transfer, 1978.
- Chairman, Office of Technology Assessment of the Congress Committee on Tropical Forests, 1981-1983.
- Member, Office of Technology Assessment Committee on Low Resource Agriculture, 1986-1988.
- Chairman of National Academy of Sciences, BOSTID Committee on Sahel, 1982-1985.
- Chairman, World Bank Committee on Environmental Information Systems in Africa 1990-92.
- Chairman, National Research Council/BOSTID Committee on Soil and Water Research for Sustainable Development 1990-1992.
- Chairman, National Research Council/BOSTID Committee on Sustainable Agriculture CRISP (SANREM) 1991-1992.
- Chairman, Senior Advisors to Global Climatic Change Project (Central Africa) World Wildlife Fund/World Resources Institute/NASA 1992-94.
- Member of Scientific Council CEPS/INSTEAD, Luxembourg, 1990-2002.



- Member, Executive Committee, Inter-American Dialogue on Water Management, OAS., 1994-present.
- Member, Executive Committee Foundation for IWRN, 1998-Present
- Member, Council for Wetlands of the Americas, 1997-2002.
- Chair, External Evaluation Committee SANREM, 1999-2005.
- Member, World Bank Committee on Environmental Information services in Sub-Saharan Africa.
- Alternate Member, Water Resources Advisory Council, South Florida Water Management District, 2002 - Present
- Chair, Water Web Consortium
- Member Secretariat Inter American Water Resources Network 2006
- Planning Committee for National Council for Science and the Environment (NCSE) Climate Change Conference, Washington, D.C. 2007 - 2008
- Planning Committee Fish and Wildlife Conference. Florida's Wildlife: On the Frontline of Climate Change. September 2008.
- Century Commission for a Sustainable Florida "2008 Water Congress", Orlando FL, Delegate.
- Planning Committee for National Council for Science and the Environment (NCSE) Biodiversity Conference, Washington, D.C. December 2008.
- Chair United Nations Commission to Combat Desertification (UNCCD) Committee on Economic Indicators. 2009.
- Florida Atlantic University Sustainability Committee.
- Co-Director FAU Integrated Collaborative Climate and Energy Initiative 2009—present.

#### **SELECTED CONSULTANCIES:**

2009-2010	Consultant to UNCCD. Bonn.
2008-2009	Consultant to UNCCD. Bonn.
2008-2009	UNESCO-OAS ISARM – Transboundary Aquifers.
2007-2008	Consultant to World Bank on Mali and Niger.
2007	Advisory Committee for NSF/Michigan State University, Climate Change Project.
2007	External Evaluation of Centers of Excellence Proposals. Universities in Saudi Arabia.
2006-2008	Consultant to GEF Land Degradation.
2006	Consultant to Global Mechanism (IFAD) Rome.
2005	Consultant to United Nations Convention to Combat Desertification (UNCCD)
2005	Consultant to United Nations Environmental Programme (UNEP) and Third World Academy of Sciences
2003-2005	Consultant to World Bank on Sustainable Land Management
2002-2003	Advisor on the Economic Impact of Land Degradation to the Global Mechanism, Rome.
2001-2003	External Advisor to GEF Land Use Change in Development Project (LUCID) linking MSU (US) and universities and agencies in Uganda, Tanzania and Kenya.
2000-2002	External Evaluation of GEF Dryland Degradation Linkage Projects
1999-2000	World Bank. Biodiversity/Land Degradation in Ghana
1999	UNEP Caribbean Natural Resource Conservation
1999	World Bank. Dryland Policy Development Workshop. Washington D.C. June
1999	GEF. STAP Expert Workshop on Land Degradation, Bologna, Italy
1998-1999	World Bank. Human Dimensions, Nile Basin Initiative
1998-1999	UNDP. Use of G.I.S. technology in UNDP information systems
1996-1997	World Bank Member Land Quality Indicators Group
1996-1997	GEF Consultant on Dryland Degradation Programs in GEF.
1996-1997	UNDP/UNEP Development of A Joint Program on Monitoring, Assessment and Information System Development for Global Drylands.
1995	UNSO/UNDP Desertification Indicators for Sustainable Development
1995	UNDP/UNEP/Habitat Development Plan for the Great Lakes Region of Africa

1995 United Nations Development Program. Development of Indicators to Assess Desertification.

1995 United Nations Commission on Human Settlement. A Strategic Action Plan for the Great Lakes Region of Africa.

1994 World Bank National Environmental Action Plan for Tanzania.

1992-1994 Duke University Review of Environmental Programs.

1992-1993 TaxWatch Advisory Committee, Economic Council of Palm Beach County, Inc.

1991-1994 Michigan State University Environmental Issues and Resource Information Systems

1991-1994 Chair, Senior Advisory Committee Biodiversity Support Program. Impacts of Global Climatic Change on Development in Central Africa.

1991 UNDP/UNSO Alternative Development Strategies for Dry Lands of Africa.

1991 Chair, SANREM Committee, NRC/BOSTID.

1991 Chair, National Academy of Science Committee on International Soil & Water Research for Sustainable Agriculture.

1990-1992 Chair, World Bank Program Committee on Environmental Information Systems in Sub-Saharan Africa.

1990 UNEP: Desertification in Africa

1989 World Bank: Environmental Issues, Remote Sensing for Information Systems.

1988-1989 World Bank: National Resource Information in Africa.

1988 USAID: River Basin Planning.

1988 African Development Bank Agricultural Planning.

1986-1987 USAID: Drought Issues in Africa. World Resources Institute: Environmental Policy in Sudan.

1985-1986 Joint Committee of Foreign Relations Council & Overseas Development Corporation: African Development Strategies.

1985 USAID/Asian Institute of Technology Bangkok: Remote Sensing Program Planning

1985 African Development Bank Republic of Congo. Desertification Issues.

1983-1984 UNSO/UNEP: Review of progress of program to combat desertification.

1981-1983 Chair Advisory Panel; Technologies to Sustain Tropical Forest Resources. Office of Technology Assessment: U.S. Congress.

1981-1982 Dames & Moore: Regional Planning in Egypt.

1980 UNEP: High Level Committee on Desertification Unit.

1980 Executive Branch, White House, Planning of International Institute for Science and Technology.

1979-1982 USAID: Consultant to Mission Directors of East Africa.

1978 USAID: Environmental Issues Related to Malaria in Pakistan.

1977 USAID: Monitoring of Desertification (in preparation for World Conference on Desertification).

1976-1978 USAID: Rural Development in Sudan (Science and Technology in Sudan).

1976 Harvard Institute for International Development Arid Lands Planning in Kenya

1976 UNESCO: Transnationals and the Environment.

1975-1976 USAID: Environmental Issues in Development in Tanzania and Kenya

1974 USAID: Development Assistance Plan, West Africa

1973 UNESCO: Man and Biosphere Program on Sahel.

1973 UNESCO: The Government of Bangladesh on Environmental Issues

1972 US member NAS/LIPI Consultancy Indonesia

1972-1973 IDRC (Canada): Rural Water Supply.

**DETAILED PUBLICATION LIST (Author/Edit 28 books – over 250 papers and reports):**

**BOOKS**

2013 Berry L, Bloetscher F, Moody K, Hammer N. 2013. Climate change and transportation in the Southeast USA. Chapter 6 In. Ingram KT, Carter L, and

- 2012 Dow K (eds) Climate of the Southeast United States: Variability, Change, Impacts, and Vulnerability. Island Press, Washington, DC. (*in pre-press*).  
Berry L, Bloetscher F, Hammer N, Romah, T. 2012. Identification of Physical Transportation Infrastructure Vulnerable to Sea Level Rise. Journal of Sustainable Development, Vol. 5, No. 12, 2012. Published by Canadian Center of Science and Education.
- 2011 Berry, L., L.A. Lewis. African Environment and Resources. Routledge. London and New York. 424pp.
- 2007 Berry, L. The Republic of Sudan: An environmental overview. Pp 221-236 in the Kenanu Handbook of Sudan. Ed. P.G. Hopkins. Kegan-Paul, London.
- 2007 Berry, L. and W. Lusigi. Sustainable Land and Water Management. GEF. Washington, D.C. 60 pp.
- 2006 Berry, L. Olson and L. Boukerrou. Resource Mobilization and the Status of Funding of Activities Related to Land Degradation. GEF and GM. 56 pp.
- 2005 Berry, L., E. Esikuri. Sustainable Land Management Activities within the World Bank(OP15). World Bank. Washington, D.C. 2005.
- 2005 Berry, L., A. Bassole, J. Ruhombe, L. Boukerrou, J. Olson, Mainstreaming the NAP into the PRSP process. Implementation on the Ground. UNCCD Publication. 2005.
- 2004 Berry, L., D. Campbell, G. Jewitt, Community-Based Integrated Land and Water Management in Africa. UNEP/GEF. 2004. 188 pp.
- 2003 Berry, L. Capacity Building to Sustainably Use Biodiversity in Dryland Regions of Latin America and the Caribbean. Ch 29. In: Conserving Biodiversity in Arid Regions. Ed. J. Lemons, R. Victor and D. Schaffer. Kluwer Academic Pub. 2003.
- 1996 Berry, L. Water Resources Update: Water The Emerging Crisis. Ed. Universities Council on Water Resources, Issue No. 102. Winter 1996.
- 1994 Berry, L. et al. Tanzania National Environment Action Plan. NEAP. June, 1994. Gov. of Tanzania and World Bank. 60 pp.
- 1992 Berry, L., D. Campbell and J. Olson. Systems Alternatifs et durables de production et de Subsistance pour les terres marginales. UNSO/UNDP, 106 pp.
- 1991 Alternative and Sustainable Systems of Production and Livelihood in Marginal Lands. UNSO/UNDP, 88 pp.
- 1991 Soil and Water Research Priorities for Developing Countries. (in French also) National Research Council Committee Report. 64 pp.
- 1988 Lewis, L. and Berry, L. African Environment and Resources. London: Allen & Unwin. Revised 2010.
- 1984 Berry, L., Ford, R., and Stewart, H. Renewable Resource Trends in East Africa. Clark University.
- 1983 Environmental Change in the West African Sahel. Committee Report. N.A.S. Washington.
- 1983 Agroforestry in the Western African Sahel. Committee Report. N.A.S. Washington.
- 1983 Sahel Regional Aid Planning and Coordination End-of-Contract Statement. N.A.S. Washington
- 1983 Assessment of the Implementation of the Plan of Action to Combat Desertification in the Sudano-Sahelian Region 1977-1984. UNESCO, New York. 185 pp. Also in French.
- 1981 Berry, L. and Ford, R. People, Places and Change. Holt, Rinehart and Winston. New York. (Revised Edition.)
- 1980 Berry, L. (ed.) and Kates, R.W. Making the Most of the Least: Alternative Ways to Development. Holmes and Meier. New York. 282 pp.
- 1976 Berry, L. and Ford, R. People, Places and Change. Holt, Rinehart and Winston, New York, 450 pp.

- 1973 Rapp, A., Berry, L., and Temple, P.H. (ed.). Soil Erosion and Conservation in Tanzania. Special Publication Geografiska Annaler Series B, Vol. 54.
- 1972 Berry, L. and Berry, E. "Agriculture in Tanzania," a volume of World Atlas of Agriculture. Rome, Italy, 104 pp.
- 1971 Berry, L., (ed.). Tanzania in Maps, L.U.P., London, 172 pp.
- 1970 Berry, L. Five Year Development Plan in Tanzania. Volume III. Regional Perspectives. 344 pp. Gov. Printer DSM.
- 1963 Berry, L. and Battersby, J. Geographical Fieldwork, a Handbook for Teachers. Institute of Education, DSM. Tanzania, 86 pp.
- 1959 Tregear, T.R. and Berry, L. The Development of Hong Kong and Kowloon in Maps. Hong Kong University Press and The MacMillan Company, 31 pp. 30 maps.

#### **PAPERS AND CONTRIBUTIONS TO BOOKS:**

- 2012 L. Berry, H. Bâki Iz, and M. Koch. Modeling regional sea level rise using local tide gauge data. Research Article, Journal of Geodetic Science, accepted.
- 2012 Zhang, C., Z. Xie, C. Roberts, L. Berry, and G. Chen. Salinity Assessment in Northeast Florida Bay Using Landsat TM Data. Southeastern Geographer, accepted.
- 2012 Xie, Z., C. Zhang, and L. Berry. Geographically Weighted Modeling of Surface Salinity in Florida Bay Using Landsat TM Data. Remote Sensing Letters, in review.
- 2011 Press Release for "Southeast Florida's Resilient Water Resources," and the case study titled "Improving the Resilience of a Municipal Water Utility"
- 2011 Berry, L., Influence of Sea Level Rise on Natural Systems of the Greater Everglades. USGS Fact Paper.
- 2011 Zhang, C., Z. Xie, C. Roberts, and L. Berry. Salinity Assessment in Northeast Florida Bay Using Landsat TM Data. Southeastern Geographer, in revision.
- 2011 Bloetscher, F., L. Berry, J. Rodriguez-Seda, N. Hernandez Hammer. Methodology for the Identification of Transportation Physical Infrastructure Vulnerable to Sea Level Rise. Journal of Environmental Science and Engineering. In Review
- 2011 Berry, L., Bloetscher, F., Hernández Hammer, N., Koch-Rose, M., Mitsova-Boneva, D., Restrepo, J., Root, T., Teegavarapu, R.: Florida Water Management and Adaptation in the Face of Climate Change, Florida Climate Change Task Force. [Available online at <http://floridaclimate.org/whitepapers/>]
- 2011 Southeast Florida Regional Climate Change Compact Technical Ad hoc Work Group. A Unified Sea Level Rise Projection for Southeast Florida. A document prepared for the Southeast Florida Regional Climate Change Compact Steering Committee. 27 p.
- 2011 Berry, L.. A Tale of Two Cities and Climate Change Presentation. July 2011. Also paper in press.
- 2011 Berry, L., H.B. Iz, and M. Koch. Reducing Uncertainty in Regional Sea Level Rise Projections with Multiple Station Local Tide Gauge Data. Presentation. July 2011. Also paper in press.
- 2011 Berry, L., Roberts, R., Z. Xie, C. Zhang. Salinity Assessment in the Northeastern Florida Bay Using Landsat TM Data. Department of Geosciences, FAU. 20pp.
- 2009 Berry, L., Koch, M and J. Murley. White Paper on Adaptation to Climate Change, FAU.
- 2009 Berry, L., Gritzner, J. and G. Milan. The Earth Restoration Project. An Overview in Stanley D. Brunn, Ed. Engineering Earth: The Impacts of Megaengineering. Springer Science.
- 2009 Berry, L., Essahli, W. and E. Abraham. Minimum Set of Indicators to Measure Effectiveness of Objectives 1, 2 and 3. Report to UNCCD. 105 pp.
- 2009 Berry, L., Koch, M and J. Murley. White Paper on Adaptation to Climate Change.
- 2007 Berry, L. and W. Lusigi. Sustainable Land and Water Management. Global Environmental Facility Pub. Washington D.C. 60 pp.

- 2007 Berry, L., S. Pfirman, P. Martin, M. Fletcher, M. Hempel, R. So, D. Hornbach, B. Morehouse. Interdisciplinary Hiring, Tenure and Promotion: Guidance for Individuals and Institutions. Council of Environmental Deans and Directors. National Council for Science and Environment pub. <http://www.ncseonline.org/CEDD/cms.cfm?id=2042>
- 2007 Berry, L. The Republic of Sudan: an Environmental Overview. P 221-236 in the Kenana Handbook of Sudan. Ed. P.G. Hopkins. Kegan Paul. London.
- 2006 Berry, L., L. Boukerrou and J. Olson. Resource Mobilization and the Status of Funding Related to the Issues of Land Degradation. Report to the Global Environment Facility and the Global Mechanism. May 2006. pp55.
- 2006 Berry, L., J. Jolley. Climate Change Workshop Summary. Practical Issues Related to Climate Change in Florida. January 12-13,2006.
- 2005 Berry, L. and L. Boukerrou. Climate Information Needs for Decision Makers: Special Reference to water. Climate Science in Support of Decision-Making Workshop (poster). 2005
- 2005 Berry, L., A. Bassolé, J. Ruhombe, J. Olson and L. Boukerrou. Mainstreaming of National Action Programmes and their Contribution to Overall Poverty Reduction. UNCCD. (report).
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- 2004 Berry, L. A. Bassolé, J. Ruhombe, J.M. Olson and L. Boukerrou. Mainstreaming the National Action Programme (NAP) into the Poverty Reduction Strategy Paper (PRSP) Process and Implementation on the Ground . Paper prepared for the United Nations Convention to Combat Desertification (UNCCD). Translated into 7 languages. Described on [www.iisd.ca/download/pdf/enb04175e.pdf](http://www.iisd.ca/download/pdf/enb04175e.pdf).
- 2004 Berry, L, J. Olson and D. Campbell. Assessing the Extent, Cost and Impact of Land Degradation at the National Level: Findings and Lessons Learned from Seven Pilot Case Studies" by L. Berry, J. Olson, and D. Campbell. 2004. The Global Mechanism of the United Nations Convention to Combat Desertification and the World Bank. Full report available on [http://www.google.com/url?sa=t&source=web&cd=1&ved=0CBIQFjAA&url=http%3A%2F%2Fglobal-mechanism.org%2Fdynamic%2Fdocuments%2Fdocument\\_file%2Fcost-of-land-degradation-case-studies.pdf&ei=vfpGTPGPJIGB8gaQwJScBQ&usq=AFQjCNFpblfgfHsGxgUJeSq\\_kljvY8IWdQ](http://www.google.com/url?sa=t&source=web&cd=1&ved=0CBIQFjAA&url=http%3A%2F%2Fglobal-mechanism.org%2Fdynamic%2Fdocuments%2Fdocument_file%2Fcost-of-land-degradation-case-studies.pdf&ei=vfpGTPGPJIGB8gaQwJScBQ&usq=AFQjCNFpblfgfHsGxgUJeSq_kljvY8IWdQ)
- 2003 Berry, L, J. Olson and D. Campbell. Assessing the Extent, Cost and Impact of Land Degradation at the National Level: Overview - Findings and Lessons Learned from Seven Pilot Case Studies. Global Mechanism. Rome. 2003. pp 28.
- 2002 Land Degradation: a local issue with Global Reach. GEF Workshop. Beijing, China.
- 2002 Institutional Development for dryland Biodiversity Management. TWNSO/GEF. Conference papers. Cairo, Egypt.
- 2000 Berry, L. J. Olson. Land Degradation Linkage Study. GEF Working Paper 6. Global Environment Facility, The World Bank, Washington, D.C. December 2000. Available on <http://www.gm-unccd.org/FIELD/Multi/GEF/pub.htm> and [http://www.thegef.org/Documents/Council\\_Documents/GEF\\_C17/gef\\_c17.html](http://www.thegef.org/Documents/Council_Documents/GEF_C17/gef_c17.html).
- 1996 Berry, L., L.A. Lewis and C. Williams. East African Highlands. P 533-542. in The Earth as Transformed by Human Action. Ed. B.L. Turner et al. Cambridge. University Press and Clark University.
- 1996 Berry, L. Water Resource Issues in the Humid Tropics and Sub-Tropics: An Agenda for the next two decades Water Resources Update. Issue #102 Winter 1996.
- 1996 Berry, L. Strategies to Share Knowledge and Experience in Water Resource Management. Keynote Address to Inter America Water Resources Dialogue. Buenos Aires Sept 1996.
- 1996 Berry, L. (with M. Mehallis) Impact of Technology on Water Resources Management and Information. Presented to 32nd Annual Conference America Water Resources Association. Ft Lauderdale Sept. 22-26 1996.



- 1996 Berry, L. The role of the Global Environmental Facility in Drylands. Presentation to a World Bank Roundtable Meeting on Sustainable Development in Drylands. 4th Annual World Bank Meeting on Sustainable Development Washington D.C. Sept 1996.
- 1996 Berry, L. Environmental Resource Inventory. State University System of Florida. Jan. 1996. 44 pp.
- 1996 D. G. Brown, J. Olson, D. Campbell, and L. Berry. 1996."A hierarchical approach to the Integration of social and physical data sets." Human Dimensions Quarterly, 1, 4:14-17.
- 1995 Berry, L. Natural Resource Information and Managed Change: developing information systems for informed policy decisions. Prepared for CEPS/INSTEAD, Eurostat International Seminar on Integrated Local Information Systems. Oct. 1995.
- 1995 Berry, L. Ecosystem Management in Florida. Report of a symposium. Center for Environmental Studies. FAU. 52 pp.
- 1995 Berry, L., J. Olson and D. Brown. Towards an Environmental Information System for the East African Region in the 21st Century. Report of the MSU Society-Environment and Development Project presented at the CIESIN Board of Trustees Annual Retreat, East Lansing, Michigan, August 1995.
- 1995 Berry, L. D.G. Brown, D.J. Campbell and J. Olson. A hierarchical approach to the integration of social and physical data sets: the case of the Rwanda Society-Environment Project. First Open Meeting of the Human Dimensions of Global Environmental Change Community, Duke University, June 2 1995.
- 1994 Berry, L. D.G. Brown, D.J. Campbell and J. Olson. Basic data systems for natural resource management: findings of the Rwanda case study. The East-West Regional Structural Change Workshop, Walferdange, Luxembourg, November 11-16 ,1994.
- 1994 Berry, L., Olson, J.M., Campbell, D.J. and Brown, D.G. The Rwanda Society - Environment Project: A Pilot Study to Link Socio-economic and Physical Data within an Environmental Information System. pp. 53-164 in CIESIN: Sharing Data Through the Information Co-operative Workshop, Proc. 2nd Workshop, Atlanta. Pub. June 1994.
- 1994 Berry, L. and Mehallis, M. Understanding Structural Change: First Steps. Report on FAU/CEPS-INSTEAD Workshop. (FAU)
- 1993 Berry, L. D.J. Campbell and J.M. Olson. 1993 Population Pressure, Agricultural Productivity and Land Degradation in Rwanda: An Agenda for Collaborative Training, Research and Analysis. Rwanda Society-Environment Project Working Paper 1. Department of Geography, Michigan State University.
- 1993 Berry, L. and T.E. Downing. Drought and Famine in Africa 1981-86. A Comparison of Impacts and Responses In Six Countries. USAID Report.
- 1993 Berry, L. and J. Osgood Field. The Challenge of Famine. Kumarian Press.
- 1991 Berry, L., D.J. Campbell and J. M. Olson. Alternative and Sustainable Systems of Production and Livelihoods in Marginal Lands and J.M. Olson. Background Document of the United Nations Sudano-Sahelian Office for the United Nations Conference on Environment and Development. 1991. Included in Report of the Secretary-General of UNCED on Combatting Desertification and Drought (A/CONF.151/PC/62).
- 1991 Berry, L. D.J Campbell, J. Olson and S. Migot-Adholla. Understanding the Interaction Between Society and Environment in the Development Process. Panel of the 1991 International Development Conference. Presenters David Campbell, Jennifer Olson, Len Berry and Shem Migot-Adholla. Washington, D.C., January 24, 1991.
- 1991 Berry, L. Toward Sustainability. A plan for Collaborative Research on Agriculture and Natural Resource Management. National Research Council (BOSTID). Washington, D.C. 36 pp.
- 1989 Berry, L., T.E. Downing, S. Lezberg, C. Williams. Population Change and Environment in Central and Eastern Kenya. Environmental Conservation. 45 pp.
- 1986 Berry, L. and D.L. Johnson. Geographical Approaches to Environmental Change: Assessing Human Impacts on Global Resources, pp 67-105 in Dahlberg K.A. and J.W. Bennet. Conceptual Issues in Interdisciplinary Research. Westview Press. Boulder, Co.

- 1986 Berry, L. Environmental Natural Resource Case Study on Africa. 62 pp. Contribution for Council for Environmental Quality Annual Report. White House. Washington, D.C.
- 1985 Berry, L. Assessment of Desertification in the Sudan-Sahelian region. 1977-84. UNSO. New York. 146 pp.
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- 1978 Berry, L. and Ford, R. Report to US-AID on Environment and Development in Eastern and Southern Africa. Clark University.
- 1978 Berry, L. and Berry, E. Report to the Government of Kenya Task Force on Arid and Semi-Arid Lands. Nairobi, Ministry of Agriculture, Kenya.
- 1977 Berry, L. and Ford, R. Monitoring Desertification - A Report to the U.S. Delegation to the UN Desertification Conference. Clark University, pp. 128.
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- 1976 Berry, L. Identification of Key Long-Term Development Problems in East and Central Africa; An Exploratory Study. Clark University
- 1975 Berry, L. River Basin Development in West Africa. AID DAP Report, Washington, pp. 55.
- 1975 Berry, L. Chad Basin Development. AID DAP Report, Washington, pp. 20.
- 1975 Berry, L. Environmental Issues and Projects for Rural Progress in Kenya. Report for USAID. 60 pp.
- 1975 Berry, L. Environmental Impact of Agricultural Development in Tanzania. Report for USAID, 55 pp.
- 1973 Berry, L., Campbell, D., Emker, I., Kates, R.W., et al. Delimitation of Groups of Least Developed Nations on the Basis of Socio-Economic, Political and Environmental Data. Environment & Development Mimeo, Clark University, pp. 86.
- 1973 Berry, L., Bakker, A. and Junk, W. Applied Research in Bangladesh. UNESCO Report.
- 1972 Berry, L. Rural Water Supply and Sanitation - The East African Experience in Research and Development. IDRC Paper, Ottawa, p. 42.
- 1971 Berry, L. Nzega Planning Project Final Report. BRALUP Research Paper 10b, DSM.
- 1971 Berry, L. and McKay, J. Water Development and Rural Development in Kharumwa. BRALUP Research Report No. 24, DSM.
- 1971 Berry, L., Claesson, C., et al. The Extension of the Kisitwi-Rubelo Pipeline - A Planning Study. BRALUP Research Report No. 15, DSM.
- 1971 Berry, L. Population Density and Land Use in Dodoma. BRALUP Reserch Report No. 42, DSM.
- 1970 Berry, L. and Kates, R.W. Planned Irrigated Settlement - A Study of Four Villages in Dodoma and Singida Regions. BRALUP Research Paper No. 10, Dar es Salaam.
- 1970 Berry, L. Water Development in Tanzania. A Critical Review of Research. BRALUP Research Paper No. 12, Dar es Salaam.
- 1970 Berry, L. Recommendations for the Development of Mwambili and Wembere Plains. BRALUP Research Report 6/9. Dar es Salaam.
- 1970 Berry, L. Integrated Planning and Water Development. BRALUP Research Report 6/10, DSM.
- 1968 Berry, L. and Berry, E. A preliminary subdivision of districts into rural economic zones. Bureau of Resource Assessment and Land Use Planning. Research Notes 4, pp. 1-14, 1 map.
- 1969 Berry, L. and Berry, E. Land Use in Tanzania. Bureau of Resource Assessment and Land Use Planning. Research Notes 6.
- 1969 Berry, L. and Heijnen, J. Soils of Northeast Nzega. BRALUP Research Report 6/8.
- 1958 Berry, L., L. Chang and U.K. Tomb. A Geographical Background. MS in Journal of Oriental Studies (10,000 words 8 fig. & plates).

**POSTERS:**

- 2012 Xie, Z., C. Zhang, and L. Berry. Geographically Weighted Modeling of Surface Salinity in Florida Bay Using Landsat TM Data. To be presented at INTERCOL International Wetlands Conference, Orlando, FL.



- 2011 Bloetscher, F., L. Berry, J. Rodriguez-Seda, N. Hernandez Hammer, R. Teegavarapu. Development of a Methodology for the Assessment and Mitigation of Sea Level Rise Impacts of Florida's Transportation Modes and Infrastructure. Presented at the State University System Climate Change Workshop, Gainesville, FL.
- 2011 L. Berry, N. Hernandez Hammer, M. Mehallis. Florida Atlantic University's Role in Developing a National Climate Change Curriculum. Presented at the State University System Climate Change Workshop, Gainesville, FL.
- 2011 L. Berry, M. Koch, M. Mehallis. Overview of FAU Research Priority Area: Climate Change Research, Engineering and Adaptation to a Changing Climate. Presented at the State University System Climate Change Workshop, Gainesville, FL.

## CURRICULUM VITAE

*Ricardo A. Alvarez*

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### FIELDS OF EXPERTISE

Ricardo Alvarez is recognized as an expert, educator, researcher and consultant in the fields of:

- (a) Vulnerability Assessment,
- (b) Hazard Mitigation,
- (c) Risk Analysis and Risk Management,
- (d) Emergency Management, and
- (e) Adaptation of the Built Environment to Climate Change and Extreme Events.

This expertise has been developed over more than twenty years working on projects related to damage caused by natural hazards such as hurricanes, floods and earthquakes, and the potential for damage from climate change viewed as a slow acting hazard, in several countries. In addition Ricardo Alvarez has professional experience and academic background in architectural design, environmental design, city planning and in construction project management, with expertise in industrialized building construction systems.

In May 2007 Ricardo Alvarez introduced the concept of *Adapting the Built Environment to Climate Change through Building Design Criteria* at a climate change conference in Tampa, Florida hosted by the Florida Center for Environmental Studies. This concept was reinforced at the 8<sup>th</sup> Annual National Conference on Science, Policy and Environment – Climate Change Science and Solutions hosted by the National Council on Science and Climate Education in Washington D.C. in January 2008. The main objective of this effort is to use building design criteria and new approaches to building design, especially in coastal and other vulnerable locations, as tools for risk management. Another objective is to highlight the need to give adaptation to climate change attention that is at least equal to that placed on mitigation.

In November/December 2005 Ricardo Alvarez lead a team that conducted an assessment of damage in the aftermath of hurricane Wilma's impact in Cancun and the surrounding tourism region in Mexico, at the invitation of the Governor and Civil Protection authorities. Based on findings from this effort Mr. Alvarez and his team delivered a report and recommendations for mitigating the potential for damage from future impacts to this critically important tourism

destination. Prior to this Mr. Alvarez had conducted studies and related projects, including workshops for the tourism and emergency management sectors, in Cancun, Cozumel and Chetumal in 1998, 1999 and 2001 as well as in 1988 in the aftermath of hurricane Gilbert.

Ricardo Alvarez has been involved in more than 1,200 actual hazard mitigation projects, valued at over \$350 million, over the past 15 years both as a private consultant and under contract with the Federal Emergency Management Agency [FEMA]. These projects involve numerous facilities ranging from hospitals, schools, housing projects, marinas, roadways, bridges, communications towers and many others type of buildings and structures throughout Florida and abroad.

In 1997 initiated research on climate change and potential linkages to tropical cyclones and other extreme events. Ricardo was principal investigator, managing director and author of the white paper for the *Regional Workshop on Climate Change Impact on the South Atlantic and U.S. Caribbean Region of the United States*, one of several similar conferences held around the country as part of the National Assessment of Climate Change Impact in the United States required by the U.S. Congress and led by the U.S. Global Change Research Program (USCGRP). Following this Mr. Alvarez contributed to the National Assessment Report submitted to the Congress in 2000. Since 1999 Mr. Alvarez has focused on climate change as a slow acting hazard that has the capability for damaging the built environment in coastal locations.

In 1996 Ricardo Alvarez completed a Vulnerability Assessment study for Mount Sinai Medical Center in Miami Beach, Florida that lead to his pioneering proposal of the concept of *Sheltering in Place* for major hospitals. This assessment was used by the hospital to obtain a hurricane evacuation-waiver from Miami-Dade County through a Category 4 hurricane. This led to the establishment of "Sheltering-in-Place Requirements and Guidelines" by the Miami-Dade County Office of Emergency Management. Said Vulnerability assessment was complemented by a comprehensive hazard mitigation project, coordinated by Mr. Alvarez, where the hospital implemented more than \$3 million worth of hurricane mitigation measures to protect its facility. Mr. Alvarez has also provided vulnerability and mitigation expertise to several other hospitals including Baptist Hospital of Miami, Mercy Hospital, South Miami Hospital, Children's Hospital, Tampa General Hospital and Holmes Medical Center [Health First] in Melbourne.

Mr. Alvarez practical expertise in these fields is complemented by an academic background and professional experience in architecture/city planning, construction project management and advanced business administration, with a solid background of applied scientific research focusing on the development of hurricane loss mitigation methods and techniques involving improvements in building design criteria and methods of construction. Also his work and expertise extends to the mitigation of other natural hazards such as earthquakes and flooding. In addition Mr. Alvarez has taught on these topics continuously from 1994 through 2009 at the graduate level at FIU and FAU.

## **PROFESSIONAL AND ACADEMIC BACKGROUND**

- Private Consultant: Vulnerability Assessment; Hazard Mitigation; Emergency Management; Climate Change Impacts 1995 to the present.

- Research Affiliate: Florida Center for Environmental Studies (CES) at Florida Atlantic University (FAU), Boca Raton, Florida
- Degree in Architecture and Environmental Design/City Planning. California State Polytechnic University, San Luis Obispo, California
- Undergraduate studies: College of Architecture, University of California at Berkeley
- Advanced Business Management (MBA). Central American Institute of Business Administration, Managua, Nicaragua
- Certificate in Management of Information Systems (MIS ) from the IBM Systems Science Institute, Beverly Hills, California
- Certificate in NEPA (National Environmental Protection Agency) Documentation, FEMA and EPA
- Adjunct Professor – Master in Construction Management Program, Dept. of Construction Management, College of Engineering, Florida International University – Teaching Vulnerability Assessment, and Hazard Mitigation, 1995 – 2009
- Visiting Professor – Crisis Management MBA, Dept. of Finance, College of Business, Florida Atlantic University – Teaching Risk Analysis and Risk Management, 2003 – 2006
- Research Associate – College of Engineering, Florida International University (2004)
- Deputy Director International Hurricane Center, Florida International University 1998-2004
- Director and Founder Laboratory for Structural Mitigation at Florida international University 2000-2004
- Consultant (SDATE Contract) to FEMA in charge of the Hazard Mitigation [both 404 and 406 programs] Program 1993-1995

#### **PARTIAL LIST OF PUBLICATIONS, PAPERS, POSTERS AND PRESENTATIONS**

- *The Coastal Built Environment in Southeast Florida and Sea Level Rise: Prognosis for Potential Damage and Needed Change* paper presented as a panelist in the “Risk and Response: Sea Level Rise Summit” sponsored by CES in Boca Raton, Florida, June 2012.

- ***Mitigation through Hurricane Resistant Building Design*** conference given during event at the **Universidad del Caribe**, Cancun, QROO, Mexico on 21 May, 2012, to officially launch the book **Paraiso Protegido: Hacia una Cultura de Mitigacion** [*Paradise Protected: Toward a Culture of Mitigation*], by Ricardo A. Alvarez [ISBN 978-607-401-556-0]. Event was organized by **Grupo Quintana Roo**.
- ***STORM SURGE: A Dangerous and Neglected Hazard*** presentation as a panelist in the workshop **Current Trends in Mitigation of Essential Facilities** during the 26th Annual Governor's Hurricane Conference, May 13-18, 2012 in Fort Lauderdale, Florida.
- ***Paraiso Protegido ["Paradise Protected"]*** Ricardo A. Alvarez, 2012 Miguel Angel Porrúa Publishers, Mexico DF, Mexico, 243 pp. ISBN 978-607-401-556-0.
- ***Proposing an empirical approach to risk management focusing on damage reduction.*** Ricardo A. Alvarez, 2012, article in *Territorium 18 – 2011* pp 5-22, journal of the Portuguese Association on Risk, Preparedness and Safety. ISBN 978-989-96253-2-7; ISSN 1647-7723
- ***Characterization of Site and Impacts: Practical tools for hurricane-resistant design.*** Keynote address during general assembly at the First National Conference of the Mexican Federation of Associations of Civil Engineers. March 1-3, 2012, Playa del Carmen, QROO, Mexico.
- ***Storm Surge and Climate Change: the forgotten factor.*** Poster presentation at the State University System of Florida Climate Change Taskforce workshop. November 14-15, 2011, Emerson Alumni Hall, University of Florida, Gainesville, FL.
- ***Sand, Wind and Water.*** Keynote address at the Installation of Operational Committee in Case of Hurricanes for the Municipality of Solidaridad, Quintana Roo, Mexico. June 2, 2011, Playa del Carmen, QROO, Mexico
- ***Buildings and Climate Change: Adaptation or Consequences:*** Poster presented at the Climate Change Symposium, Tuesday, October 26, 2010, Florida Atlantic University, Live Oak Pavilion, Boca Raton, Florida on the occasion of the inauguration of Dr. Mary Jane Saunders as FAU Sixth President.
- ***Synergy under Climate Change: the Coupled Everglades-Urban Coastal Florida System.*** Paper presented at the Greater Everglades Ecosystem Restoration Annual Conference 2010. Sponsored by U.S. Army Core of Engineers, U.S. Geological Survey, U.S. Fish and Wildlife Service, U.S. National Park Service, South Florida Water Management District, and University of Florida – IFAS. Naples, Florida. July 2010
- ***Characterization of Impact: A Tool for designing for Disasters.*** Paper presented at the Tour of the Disaster-Survival House: American Institute of Architects (AIA) 2010 Annual Convention, Miami Beach, Florida, June 2010



- ***Proposing an Empirical Approach to Emergency Management Focusing on Damage Reduction.*** Paper presented as the keynote address, II International Congress on Risks, and VI National Meeting on Risks. Sponsored by Portuguese Association of Risks, Prevention and Safety. Hosted at the University of Coimbra, Coimbra, Portugal. May 2010
- ***A Climate Change Primer.*** A special report of the Florida Oceans and Coastal Council for the Florida Climate and Energy Commission. Contributing author (Section on Sea Level Rise and Coastal Infrastructure) Alvarez, R., April 2010
- ***The Effects of Climate Change on Florida's Ocean and Coastal Resource – A Special Report to the Florida Energy and Climate Commission and the People of Florida.*** Florida Oceans and Coastal Council, Tallahassee, Florida. Contributing author Alvarez, R., June 2009
- ***Do We Need a New Hurricane Impact Index:*** Presentation to the National Safety Council – Monthly Breakfast Meeting – South Florida Chapter, Deerfield Beach, FL, August 2009
- ***Characterizing the Impact of Hurricanes – Role of the Media:*** Presentation at the Disaster Survival House – Hurricane Warning Media day, Deerfield Beach, FL, July 2009
- ***There is a Link Between Climate Change and Hurricanes:*** Letters – Natural Hazards Observer, Vol XXXIII – Number 5, May 2009
- ***Adapting the Built Environment to the Impact of Climate Change:*** Presentation to the Florida Engineering Society – Quarterly Meeting, Deerfield Beach, FL, January 2009
- ***Climate Change Adaptation through Building Design Criteria:*** Poster presented at the 8<sup>th</sup> National Conference on Science, Policy and Environment – Climate Change, Science and Solutions; Washington DC, January 2008
- ***Building Design Criteria for Climate Change in Florida:*** Presentation to the Miami-Dade County Local Mitigation Strategy – Working Group Quarterly Meeting, Miami Beach, FL, June 2007
- ***Climate Change, Global Warming, Sea Level Rise: We Must Take Action Now!:*** Poster presented at the Climate Change Conference, Florida Center for Environmental Studies, Tampa, Florida 2007
- ***Protecting our Vulnerable Communities from the Impact of Climate Change:*** Presentation – Built Environment Adaptation Subcommittee – Miami-Dade County Climate Change Task Force; July 2007

- ***Hazard Events and the 2008 Summer Olympics:*** Alvarez, R.A., Problem Contribution for the 2007 TEAMS Competition, Junior Engineering Technical Society (JETS)
- ***Characterizing Hurricane Impact on the Central Oxygen Supply Facility at Tampa general Hospital:*** Alvarez, R. Principal Investigator. 2006 Tampa general Hospital, 2 Columbus Dr., Tampa, FL 33606
- ***Mitigation Alternatives for the Central Oxygen Supply Facility at Mercy Hospital:*** Alvarez, R., Principal Investigator. 2006 Mercy Hospital, 3663 S. Miami Ave., Miami, FL 33133
- ***Mitigation Alternatives at the Tampa General Hospital:*** Alvarez, R., Goodridge, S., Principal Investigators. 2006 Tampa General Hospital, 2 Columbus Dr., Tampa, FL 33606
- ***Assessing the Potential Impact of Flying debris on the De Hirsch-Meyer Building at Mount Sinai Medical Center Based on As-Built and proposed Retrofit Conditions:*** Alvarez, R., Reinhold, T. 2006 Mount Sinai Medical Center, 4300 Alton Rd., Miami Beach, FL 33140
- ***Characterizing the Impact of Hurricanes:*** Alvarez, R.A., Problem Contribution for the 2006 TEAMS Competition, Junior Engineering Technical Society (JETS)
- ***Characterizing Hurricane Impact on the West Pavilion 2<sup>nd</sup> Floor Bridge to the Rehabilitation Center at Tampa general Hospital:*** Alvarez, R. Principal Investigator. 2006 Tampa general Hospital, 2 Columbus Drive, Tampa, FL 33606
- ***Wind Pressure Tests on Opening Protected by the 'Storm Shield' Perforated Steel Hurricane Barrier:*** Alvarez, R., Reinhold, T., Rodriguez, L., principal investigators. 2005 Exeter Architectural Products, Inc. Wyoming, PA 18644
- ***Preliminary Report- The Impact of Hurricane Wilma in Cancun*** – December 2005: Office of the Governor, State of Quintana Roo, Mexico
- ***Vulnerability Assessment – Report of Visual Inspection at the Eden Springs Facility:*** Alvarez, R. Principal Investigator. 2005 DOS Healthcare Inc. – 4679 Crawfordville Hwy., Crawfordville, FL 32327
- ***Research and Education in Mitigation*** – Role of the Public Universities in Florida; 2004 Governor's Hurricane Conference, Tampa, Florida
- ***Report of Visual Inspection to assess Hurricane Vulnerability at the Tampa General Hospital:*** Alvarez, T., Rodriguez, L., Principal Investigators. 2004 Tampa general Hospital, 2 Columbus Dr., Tampa, FL 33606

- ***Building Location and Design in Hurricane Mitigation:*** Alvarez, R.A., Problem Contribution for the 2003 TEAMS Competition, Junior Engineering Technical Society (JETS)
- ***Vulnerability Assessment as a Tool for Hazard Mitigation,*** SUBMARINE LANDSLIDES AND TSUNAMIS pp 303-313, Alvarez, R.A., Williams, A.; 2003 Kluwer Academic Publisher
- ***Mitigation from Regulation to Practice – A historical Perspective:*** 2003 South Florida Hurricane Conference, Fort Lauderdale, Florida
- ***The Storms of '98: Hurricanes Georges and Mitch: IMPACTS, INSTITUTIONAL RESPONSE AND DISASTER POLITICS IN THREE COUNTRIES:*** Alvarez, R.A., Baird, B.P., Estrada, A., Gawronski, V.T., Olson, R.S., Sarmiento., J.P. Special Publication #38, 2001 Natural Hazards Research and Applications Information Center
- ***Hurricane Loss Reduction for Residences and Mobile Homes in Florida,*** Final Reports for fiscal years ending June 30<sup>th</sup> of 2001, 2002, 2003 and 2004, submitted to the Florida Department of Community Affairs (DCA).
- ***Improving Roof Performance under Hurricane Winds,*** Alvarez, R.A., Mitrani, J.D., Reinhold, T.A., Sutt Jr., E.G.; 2002 Governor's Hurricane Conference, Tampa, Florida.
- ***Developing a Culture of Mitigation through Education:*** 2002 Hurricane Andrew 10<sup>th</sup> Anniversary Summit & South Florida Hurricane Conference
- ***Trouble in Paradise – The Impact of Climate Change of Florida's Environment and Ecosystems,*** Alvarez, Ricardo reviewer. 2001 World Wild Life Federation.
- ***Feeling the Heat in Florida – Global Warming on the Local level.*** Alvarez, Ricardo contributing author. National Resources Defense Council, Florida Climate Alliance. October 2001
- ***Assessment of Vulnerability to Hurricanes at St. Gabriel Catholic Church Campus:*** Alvarez, R., Principal Investigator. 2000 St. Gabriel Catholic Church, 713 N. Ocean Blvd., Pompano Beach, FL 33062
- ***Tropical Cyclone – HYDROMETEOROLOGICAL HAZARDS: NATURAL DISASTER MANAGEMENT*** pp 34-37, Alvarez, R. contributing author 1999 Tudor Rose Holdings Ltd., Leicester, England. ISBN 0 9536140 0 X
- ***Report of Visual Inspection to Assess Hurricane Vulnerability at the Miami Children's Hospital:*** Alvarez, R., Principal Investigator. 1999 Miami Children's Hospital, 3100 SW 62<sup>nd</sup> Ave., Miami, FL 33155

- *Hurricane Vulnerability in the Northeastern USA*: Alvarez, R.A., Boston Society of Civil Engineers Annual Conference, 1999 Coastal Storms in New England – Impact and Protection
- *Alternatives for Hurricane Hazard Mitigation on the 1986-1992 Building*: Alvarez, R., Rodriguez, L., Principal Investigators. 1999 Miami Children’s Hospital, 3100 SW 62<sup>nd</sup>. Ave., Miami, FL 33155
- *Climate Change and Extreme Events* – A Concept Paper for the “Climate Change and Extreme Events” conference funded by NOAA OGP, July 1998. Alvarez, Ricardo author.
- *Preliminary Hurricane Impact Study for Mount Sinai Medical Center*: Alvarez, R., Goebel, J., Brill, L., Bray, N., Granata, M. Principal Investigators. 1996 Mount Sinai Medical center, 4300 Alton Rd., Miami Beach, FL 33140

#### **PARTIAL LIST OF RELEVANT PROJECTS**

- Pre-Disaster Mitigation Program proposal –State of Florida Division of Emergency Management – Federal Emergency Management Agency: Surgical Mechanical penthouse – Wind Retrofit, Mercy Hospital, Miami, Florida, 2010
- Pre-Disaster Mitigation Program proposal –State of Florida Division of Emergency Management – Federal Emergency Management Agency: South Wing Building – Wind Retrofit, Mercy Hospital, Miami, Florida, 2010
- Pre-Disaster Mitigation Program proposal –State of Florida Division of Emergency Management – Federal Emergency Management Agency: St. Lawrence Day Care Center Hardening of Building Envelope, North Miami Beach, Florida, 2010
- Launched BLOG: *www.mitigat.com* on hazard mitigation, adaptation to climate change and related topics April 2010.
- Launched Twitter service: *“IMITIGATE”* offering timely commentary relative to current natural hazards, climate change and related topics June 2010.
- Vulnerability Assessment and Hazard Mitigation consultant – Mercy Hospital, Miami, Florida, 2006 – 2011.
- Pre-disaster Mitigation Program proposal – State of Florida/Division of Emergency Management – Federal Emergency Management Agency: South Wing Bldg., Mercy Hospital, Miami, FL 2009
- Vulnerability Assessment – Hazard Mitigation Planning – Florida Atlantic University Main Campus, Boca Raton, Florida 2008-2009

- Project Director –“Residential Construction Mitigation through Demonstration and Outreach”. Hurricane Warning, Deerfield Beach, Florida. 2007-2008
- Recommendations for Mitigating the Impact of Hurricanes on the Built Environment in Cancun, Mexico – Grupo Quintana Roo, Cancun, Mexico. 2006-2007
- Hurricane Vulnerability, Mitigation, Loss Reduction, Science and Education consultant – Hurricane Warning Project, Deerfield Beach, FL. 2006
- Vulnerability Assessment/Hazard Mitigation consultant – Mount Sinai Medical Center. Miami Beach, FL. 2006 – 2008
- Preliminary Assessment of Vulnerability – Conceptual Mitigation Plan. Various Hotels in Cancun and the Mayan Riviera region, Quintana Roo state, Mexico. Grupo Nacional provincial (GNP), Mexico D.F., Mexico. 2005.
- Preliminary Damage Assessment and Identification of Mitigation Opportunities for the tourism infrastructure in Cancun and the Mayan Riviera, Quintana Roo state, Mexico – By invitation from the Office of the State Governor. 2005.
- EMPA and Mitigation Grants writing support for Memorial Healthcare System, South Broward Hospital District, Broward County, FL.
- PDM Grant writing support – Florida Atlantic University, Boca Raton, FL. November 2005.
- Vulnerability Assessment – Hazard Mitigation – Tampa General Hospital, Davis Island, Tampa, FL, 2004-2006
- Vulnerability Assessment and Hazard Mitigation study for DOS Health Care, Inc. – ALF and Senior Housing project in Crawfordville, Wakulla County, FL, 2005
- Hazard Mitigation – Holmes Medical Center, Melbourne, FL 2004-2005.
- Vulnerability Assessment/Hazard Mitigation consultant – Miami Children Hospital, Miami, FL 2002-2004 Developed “Encapsulation” Concept of hazard mitigation for this facility.
- Vulnerability Analysis – Hazard Mitigation Study – St. Gabriel Catholic Church, Pompano Beach, FL (1999-2000)
- Vulnerability Assessment – Hazard Mitigation – Mercy Hospital, Miami, FL 1997-1999
- Vulnerability Assessment – Hazard Mitigation – Baptist Hospital of Miami, Miami, FL 1996-1998



- Vulnerability Assessment – Hazard Mitigation – Mount Sinai Medical Center, Miami Beach, FL 1996-1997
- Hazard Mitigation Consultant – South Miami Hospital, South Miami, FL 1997
- Hazard Mitigation Analysis Homestead General Hospital , Homestead, FL 1994
- Hazard Mitigation Manager at Miami-Dade DFO (1993-1996) – responsible for both 404 and 406 Hazard Mitigation programs. Directed and/or participated in more than 1,200 mitigation projects worth \$350+ million throughout the state under four declared major disasters. SDATE contract with FEMA.

#### **APPLIED RESEARCH WORK AND RELATED ACTIVITIES**

- Participant *4<sup>th</sup> Annual Southeast Florida Regional Climate Leadership Summit*. Sponsored by the 4 County Climate Change Compact, Jupiter Beach Resort, Jupiter, Florida December 6-7, 2012.
- Invited Participant. *Sea Level Rise Strategy Meeting* hosted by the Florida Center for Environmental Studies, Elinor and Bernon Rosenthal Lifelong Learning Center, Florida Atlantic University, Jupiter Campus, Jupiter, Florida, December 6, 2012.
- Participant in *FLASH Annual Meeting 2012* sponsored by Federal Alliance for Safe Homes (FLASH), Disney’s Contemporary Resort, Lake Buena Vista, Florida October 31 – November 2, 2012.
- Invited participant. *FACING THE CHALLENGE LEADERSHIP FORUM – Meeting America’s Growing Risk Burden*. By invitation only conference sponsored by RenaissanceRe Risk Sciences Foundation, Inc., supported by FLASH – Federal Alliance for Safe Homes, IBHS – Institute for Business and Home Safety, and by Weather Predict Consulting, Inc. Disney’s Contemporary Resort, Lake Buena Vista, FL October 30-31, 2012.
- Applied Research: *Characterization of Wind Impact on Sailing Cruise Ship*. For MALTZMAN & PARTNERS, PA, Coral Gables, FL 33134. 27 February 2012 – 27 March 2012.
- Invited Participant: *Hydrology of the Everglades in the Context of Climate Change*. Workshop sponsored by: United States Geologic Survey [USGS], Florida Sea Grant Program, and Florida Center for Environmental Studies [CES] at FAU. Florida Atlantic University Davie Campus, 29-30 March 2012.
- Participant and presenter: *“Synergy under Climate Change – The Coupled Everglades-Urban Coastal Florida System”*. Concurrent sessions: 2010 Greater Everglades Ecosystem Restoration Conference (GEER 2010). Naples, Florida, July 2010.

- Invited presenter and tour guide *American Institute of Architects (ALA) 2010 Annual Convention*, Miami Beach, Florida. June 2010.
- Invited participant. *Developing a Sea Level Rise Vulnerability Framework for South Florida: Indicators, Metrics and Models*. Workshop sponsored by Florida Atlantic University; FAU Visual Planning Technology Lab; United States geological Survey (USGS). Fort Lauderdale, FL, June 2, 2010.
- Keynote Speaker *Second International Conference on Risk* held at the University of Coimbra, in Coimbra, Portugal, May 22-25, 2010.
- Invited participant *Sea Level Rise Workshop*: Florida Atlantic University, Boca Raton, Florida. Sponsored by Sea Grant Florida, the U.S. Geological Survey, Florida Center for Environmental Studies, FAU College of Architecture, Urban & Public Affairs, Camp Dresser & McKee Inc., Balfour Beatty Construction, Inc., February 16-17, 2010.
- Member *Miami-Dade County Local Mitigation Strategy Steering Committee*, 2009 – PRESENT
- Member *Integrative and Collaborative Climate and Energy Research Program (ICCE)*, Florida Atlantic University, 2009 – PRESENT
- Member Google Discussion Group on “*Are We Ready for a New Hurricane Impact Index*” organized and managed by the Natural Hazards Center, University of Colorado: 2009
- Panelist: “*Climate Change Mitigation, Adaptation, or Preparedness*”; Concurrent Session, C Cutting Across Disciplines and Cultures Track – 34<sup>th</sup> Annual Natural Hazards Research and Applications Workshop, Broomfield, CO, July 2009
- Panelist: “*Are We Ready for a Hurricane Impact Index*”; Concurrent Session, Characterizing and Assessing Risk Track – 34<sup>th</sup> Annual Natural Hazards Research and Applications Workshop, Broomfield, CO, July 2009
- Panelist: “*Urban Response to Climate Change in Coastal Cities*” – Concurrent Workshop – 8<sup>th</sup> Annual National Conference on Science, Policy and Environment – Climate Change Science and Solutions, Washington DC, January 2008
- Member Florida Dept. of Environmental Protection *Technical Work Group on Adaptation to Climate Change* in support of the Governor’s Climate Action Team. 2008 – 2009
- Board Advisor – *Hurricane Warning Project* a 501 (c3) organization based in Deerfield Beach, Florida. 2007-2008

- Panelist: “*Adaptation to Climate Change*” – Climate Change Conference – Florida Center for Environmental Studies, Tampa, Florida, May 2007
- Keynote Speaker: “*The Impact of Climate Change*”; The Catholic Coalition on Climate Change – A Briefing, Diocese of Orlando, March 2007
- Serves on the Florida Dept. of Emergency Management *State Hazard Mitigation Advisory Committee* (since April 2003)
- Member the Miami-Dade County *Task Force on Climate Change*, constituted by resolution of the Miami-Dade County Commission. 2006 – PRESENT
- Member Florida *State Hazard Mitigation Plan Advisory team (SHMPAT)* working with the State Division of Emergency Management in designing the Enhanced Mitigation Plan. (2003-2005)
- Serves on the Miami-Dade County *Local Mitigation Strategy Working Group*, 1998 – PRESENT
- Served on the Miami-Dade County *LMS Terrorism Mitigation Committee* since 2002-2007
- Served on the Board of Directors of the City of Deerfield Beach *Hurricane Warning Project* 2003-2007
- Has served on the Broward County *South Florida Hurricane Conference Steering Committee*.
- Lead researcher for the “*Researching Needs for Emergency Response Coverage in Remote Schools*” project funded by DCA through the Florida Department of Education with funds from the Department of Homeland Security: 2004-2006
- Principal Investigator and Project Director for the *Hurricane Loss Mitigation Program* research project, funded by DCA from July 1, 2000 through June 30, 2004. This project covered the following three specific areas of research: a) Eliminating State and Local Barriers to Upgrading Existing Mobile Homes and Communities, b) Research and Develop Program for the Recycling if Existing Older Mobile Homes, c) Program of Research and Development Relating to Hurricane Loss Reduction Devices and Techniques for Site-built Housing, and d) Total funding provided reached \$3 million.
- Principal Investigator at FIU’s *Laboratory for Structural Mitigation*, which he founded and directed, that lead to the modification of the Florida Building Code/High Velocity Hurricane Zone prescribing the ring-shank nail as the new standard for roof sheathing effective as of January 1, 2005. This new roofing standard improves the performance of roof sheathing under hurricane loads by a factor of up to 130% without increasing the cost of construction.

- Project Director and Principal Investigator for the “*Developing a Culture of Mitigation through Education*” an educational program focusing on K-12 schools in Florida. Program was launched in 2002 and continues today. The program was recognized as an example of “Best Practices in Mitigation” by FEMA and the State Division of Emergency management at the 2005 Governor’s Hurricane Conference. (Total funding of \$230,000 over 3 years)
- Managing Director and Principal Investigator for the “*Hurricane Andrew 10<sup>th</sup> Anniversary Summit*” conference hosted by FIU in May 2002. (Funding \$100,000 from U.S. Office of Naval Research through USF’s Center for Emergency Management and Humanitarian Assistance, the International Hurricane Research Center, the Broward County Office of Emergency Management, and SWISS RE Insurance)
- Managing Director for the “*National Hurricane Hazard Reduction Act – Working Meeting*” hosted by FIU in February 2001.
- Keynote speaker and panelist *Climate Change and the Vulnerability of Small Island Nations* conference, East-West Center, University of Hawaii, Honolulu, Hawaii. November 2000.
- Contributor [author and reviewer] “*National Assessment of Climate Change in the United States* [NAS]”, U.S. Global Change Research Program [USGCRP]: 1998-2000
- Managing Director and Principal Investigator for the “*Climate Change and Extreme Events Workshop*” hosted by FIU in July 1998, funded by NOAA (Office of Global Programs \$100,000) and sponsored by the USGCRP and the White House Office of Technology.
- Developed and launched the “*Emergency Management and Hazard Mitigation certificate Program*” as a continuing education effort through a joint venture with FIU Division of University Outreach. This program consisted of five two-day seminars offered over a period of approximately 90 days. The program ran successfully three times, “graduated” fifteen individuals and saw more than 200+ participants enroll in one or more seminars. The program was 100% self-sustained through tuition receipts and in-kind donations of time by invited faculty from public and private agencies.
- Managing Director for the “*Hemispheric Congress on Disaster Mitigation*” hosted by FIU in November of 1996.
- Frequently invited speaker or workshop chair at the Governor’s Hurricane Conference, the South Florida Hurricane Conference and the National Hurricane Conference from 1996 to the present.
- Developed and introduced “*Topics in Vulnerability Analysis*” (BCN 5906) as a 3-credit hour special topics course for the Master in Construction management program at FIU

College of Engineering. This course was later taught under FIU Catalogue # 5588 as "*Vulnerability Assessment*"

- Developed and introduced "*Topics in Hazard Mitigation*" (BCN 5906) as a 3-credit hour special topics course for the Master in Construction management program at FIU College of Engineering. This course was later taught under FIU Catalogue # 5589 as Hazard Mitigation.
- Frequently interviewed by the electronic and printed media on the topics of hurricane mitigation, housing construction, vulnerability, hurricane, flooding and earthquake disaster events, and others.



## Schematic of Vulnerability Assessment Process

