CITY OF MIAMI BEACH
STORMWATER MANAGEMENT MASTER PLAN

In 1997, The City Developed Its First Stormwater Management Master Plan.

Old Plan determined needs by:

- Water quality
- Flooding potential
- Citizen complaints
- City staff ranking

New Plan determines needs by:

- Data collection
- Flooding model analysis
- Flood control
- Water quality

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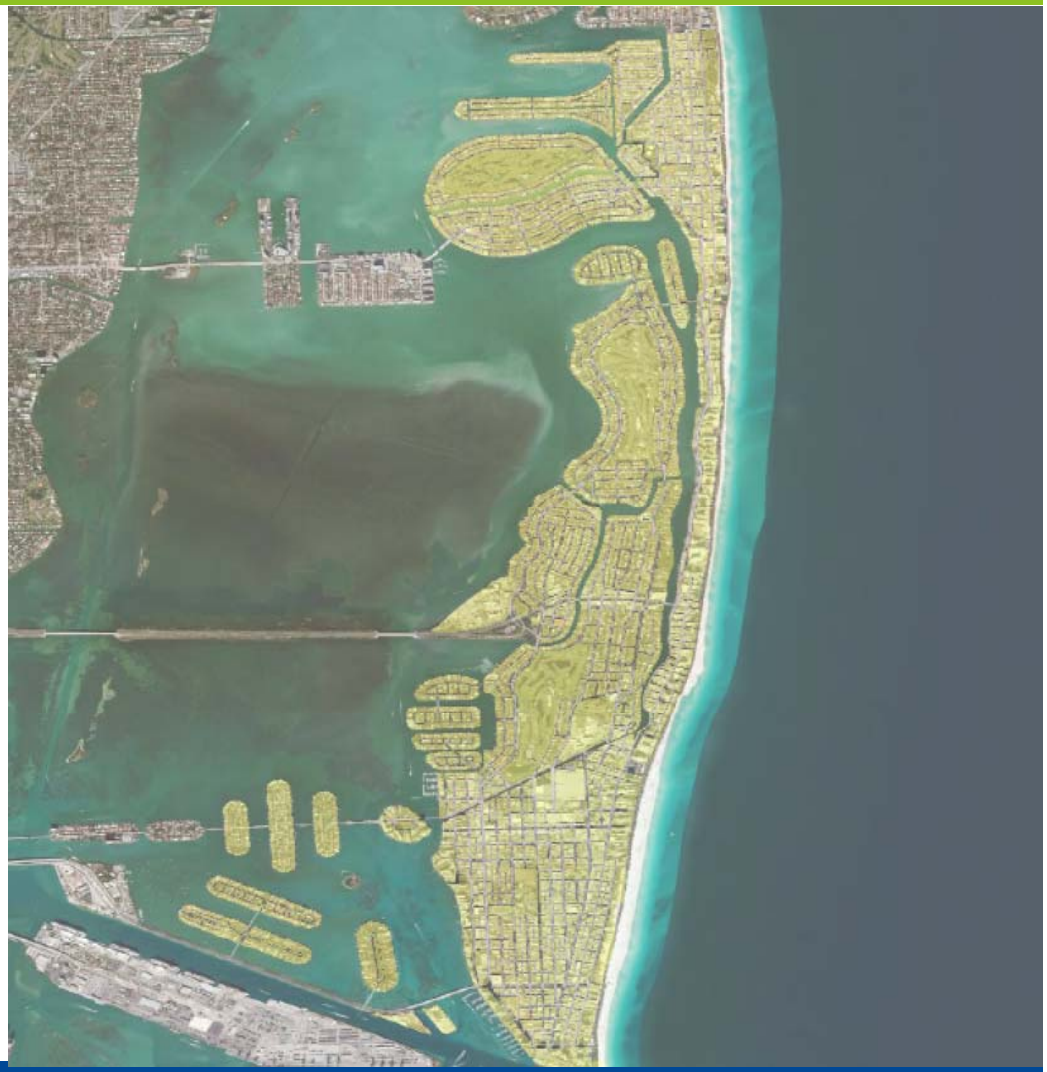
CITY OF MIAMI BEACH
STORMWATER MANAGEMENT MASTER PLAN

New Draft Stormwater Management Master Plan

- Accounts for sea level rise
- Makes recommendations for 20-year capital improvements
- Provides flexibility for various rates of sea level rise
- Provides drainage analysis using modeling



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BEFORE - AFTER

CITY OF MIAMI BEACH
STORMWATER MANAGEMENT MASTER PLAN

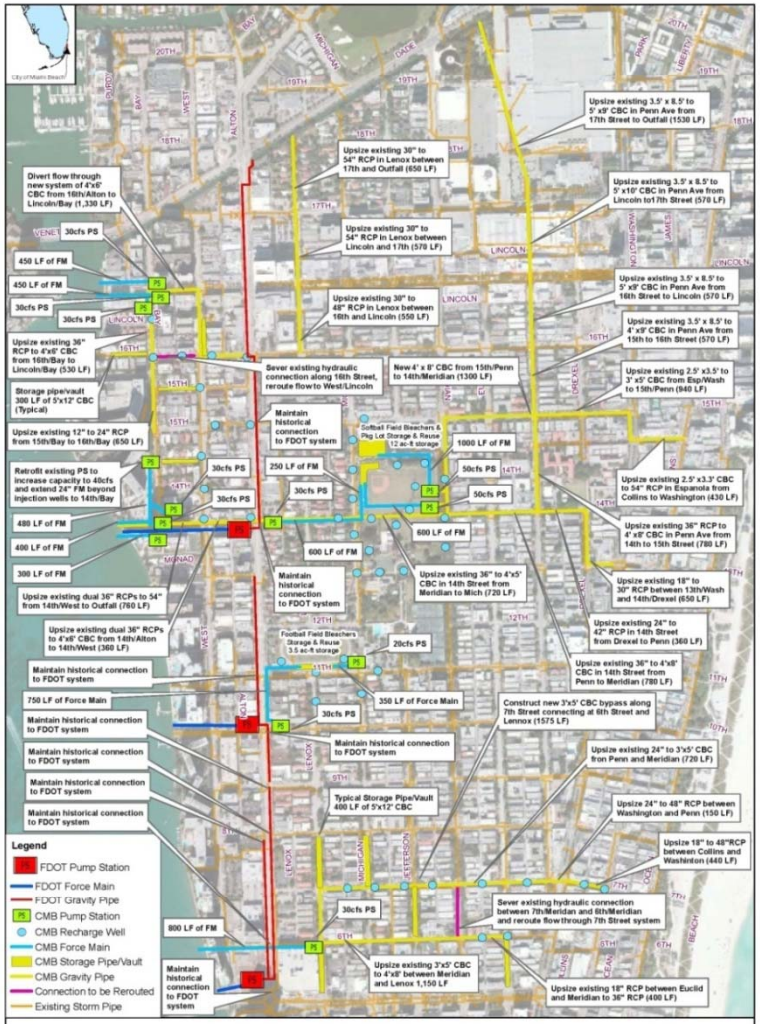
GOING FORWARD

Implement Stormwater System Improvements

- Install backflow preventers at outfalls
- Construct new stormwater pump stations
- Add pumps to gravity systems
- Create storage for stormwater
- Raise seawalls to mandated heights

Monitor change in sea level rise;

Modify programmed stormwater improvements



MIAMIBEACH

COASTAL SYSTEMS INTERNATIONAL, INC.

Coastal Engineering

Waterfront & Marinas

Civil Engineering

Regulatory Permitting

Site Investigations

Marine Environmental

Construction

Destination Development

Tidal Boundary Conditions – Coastal Systems International

- Introduction
- Role of Coastal Systems on CDM Smith Team
- Review of Key Terms and Definitions
- Drainage Outfall Design Criteria
- Reference Tidal Datums
- Historical Tidal Data Analysis
- Sea Level Rise Trends
- Recommendations to CDM Smith Team

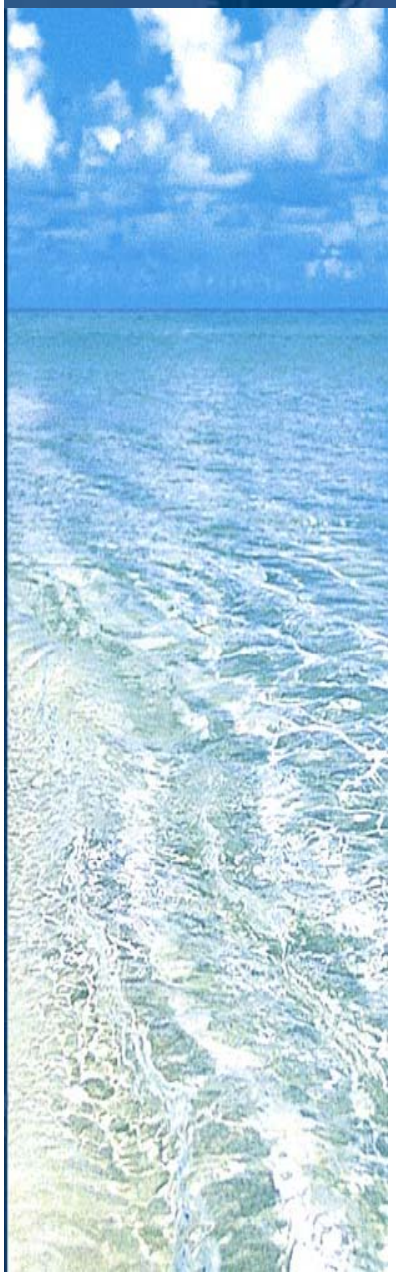
Tim Blankenship, P.E. – Coastal Systems International

Coastal Systems International – www.coastalsystemsint.com

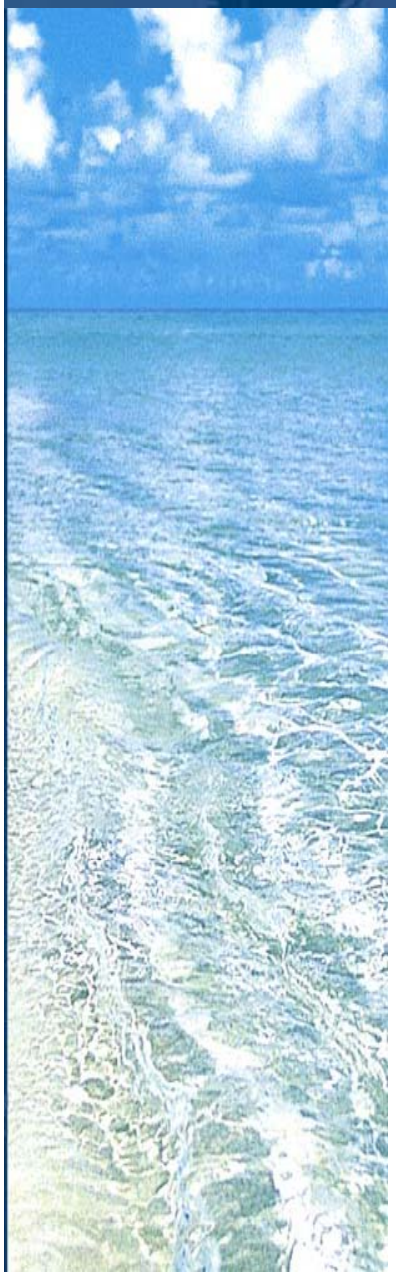
- Established consulting firm specializing in Coastal and Waterfront Projects
- Over 20 Years as consulting firm in South Florida
- Projects in Florida, Caribbean, and Central America

Tim is Director of Engineering for Coastal Systems

- With firm for over 12 years
- 20 Years of Experience – coastal, civil, marine structural engineering
- Beach Management Projects – Miami-Dade County
- Tidal Hydraulic Studies – Biscayne Bay and S. Florida
- Stormwater Management Design – Miami Beach
- ASCE Florida Infrastructure Report Card Committee – Coastal Areas – 2008



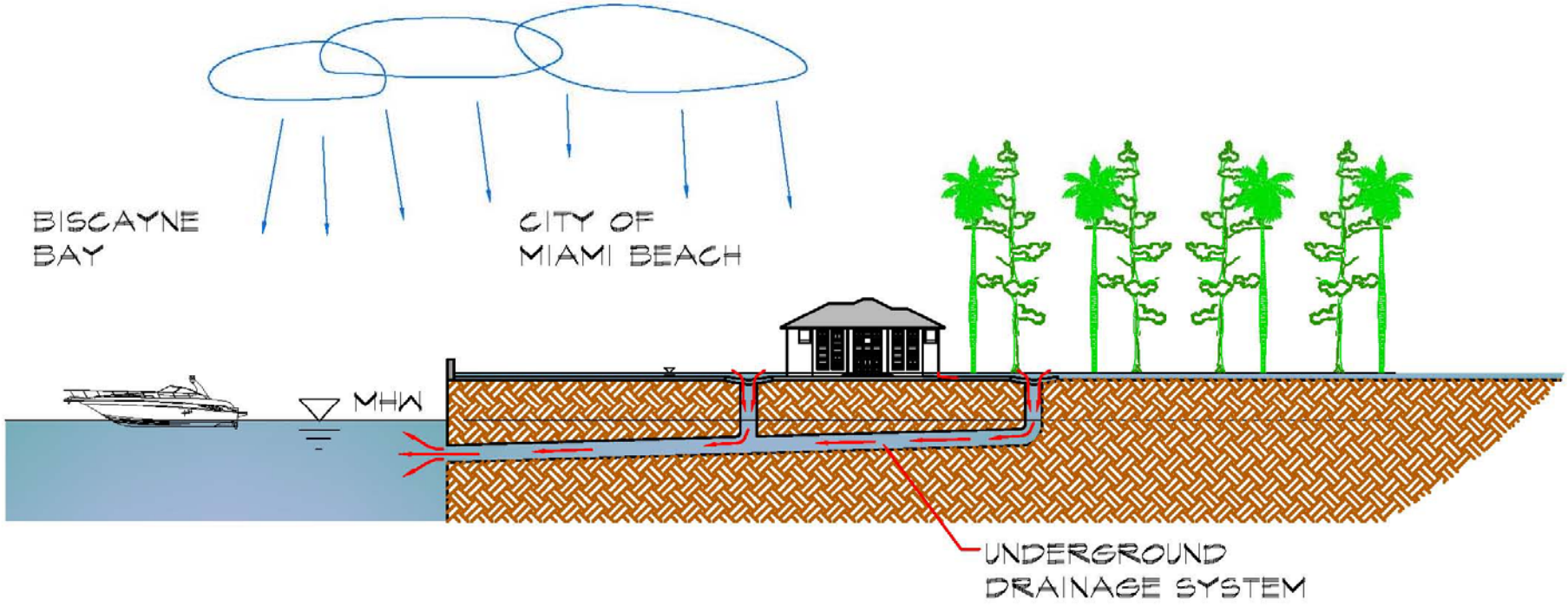
- Subconsultant to CDM Smith – Coastal Engineering
- Tidal Boundary Conditions – Design tidal elevation at Biscayne Bay for drainage outfall hydraulic analysis
- Biscayne Bay and Effect on Drainage
- Tidal Data Analysis



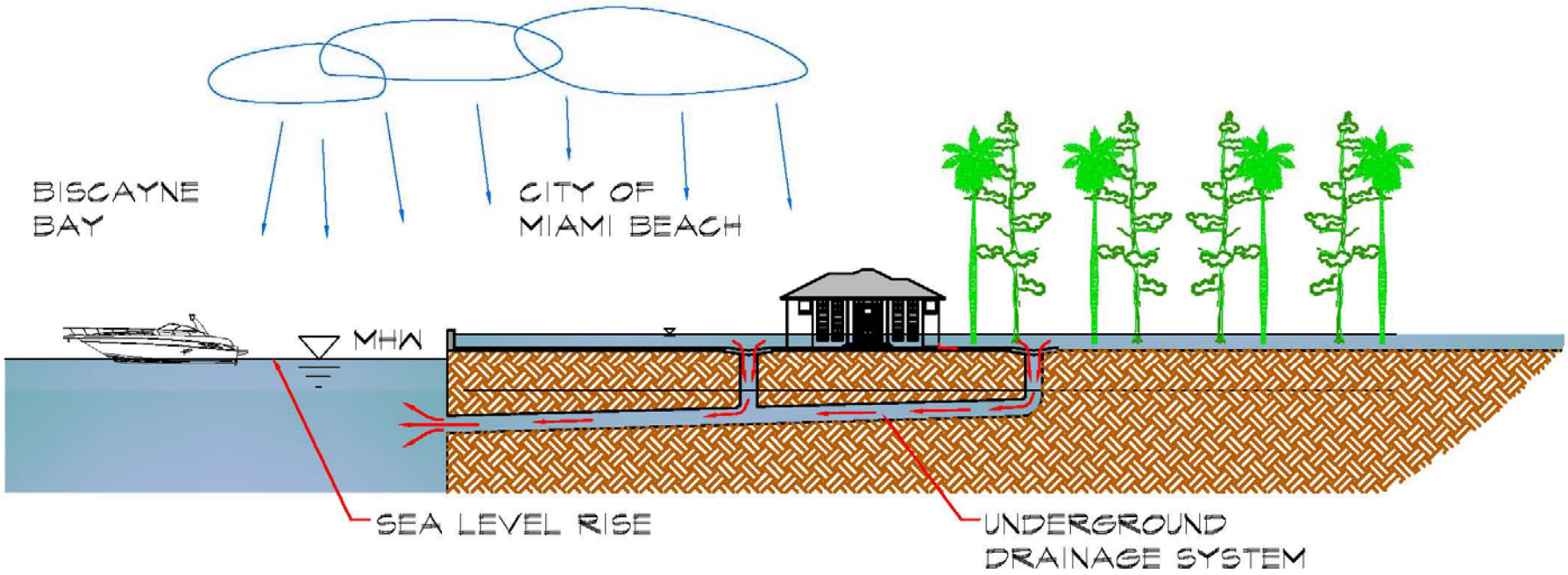
- Definitions included in workshop handouts
- Visit NOAA web site www.tidesandcurrents.noaa.gov
- Tidal Boundary Conditions – Design tidal elevation at Biscayne Bay for drainage outfall hydraulic analysis
- NOAA – National Oceanic and Atmospheric Administration
- NAVD – North American Vertical Datum of 1988 – geodetic vertical datum
- MHW – Mean High Water – The average of all the high water heights observed over the National Tidal Datum Epoch
- Current Tidal Epoch – based on data from 1983-2001

- Drainage in Miami Beach Relies on Biscayne Bay and Interior Canals
- Waterways are Tidal
- Tidal Boundary Conditions – Design tidal elevation at Biscayne Bay for drainage outfall hydraulic analysis

Tidal Boundary Conditions:



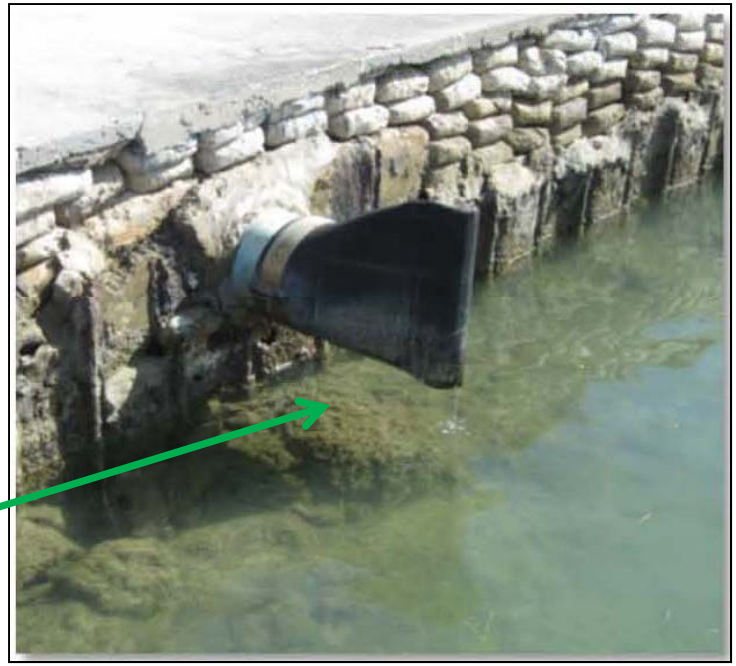
Tidal Boundary Conditions:



Tide Just Below Outfall

- The Florida Department of Transportation (FDOT, 2012) requires the use of MHW for culvert drainage design
- Sea Level rise trend

Tide Below Outfall




Tide Submerged Outfall

Trident Pier

Virginia Key

Vaca Key

NOAA Tide Stations on the East Coast of Florida with water level data

TABLE 2.1
Tidal Elevations Published by NOAA

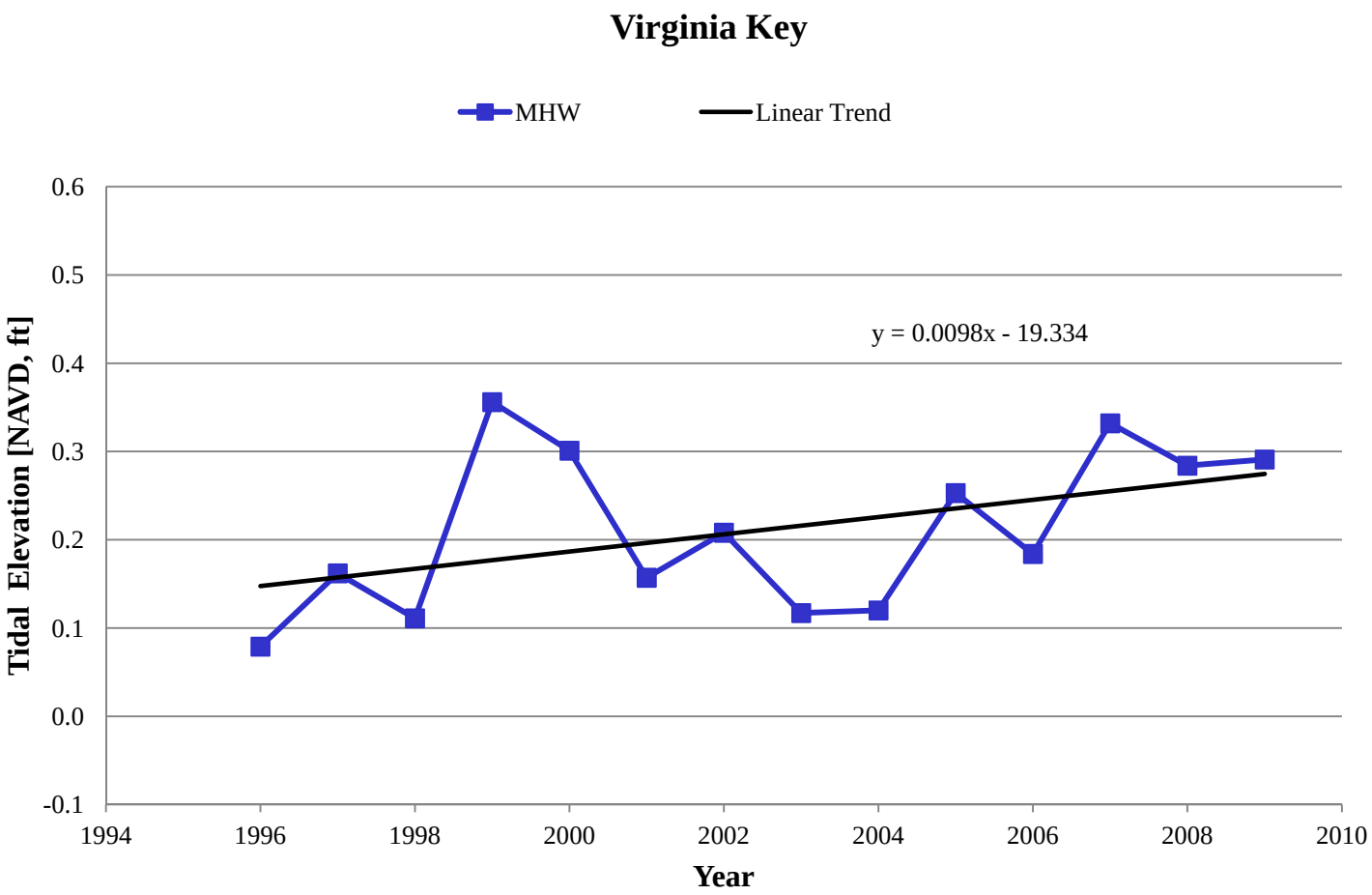
Location	Station ID	Mean High Water, [NAVD, ft]	Mean Sea Level, [NAVD, ft]	Mean Low Water [NAVD, ft]
Virginia Key	8723214	**0.16**	-0.88	-1.86
Vaca Key	8723970	-0.47	-0.82	-1.18
Trident Pier	8721604	0.59	-1.14	-2.88

- Current Tidal Epoch – based on data from 1983-2001

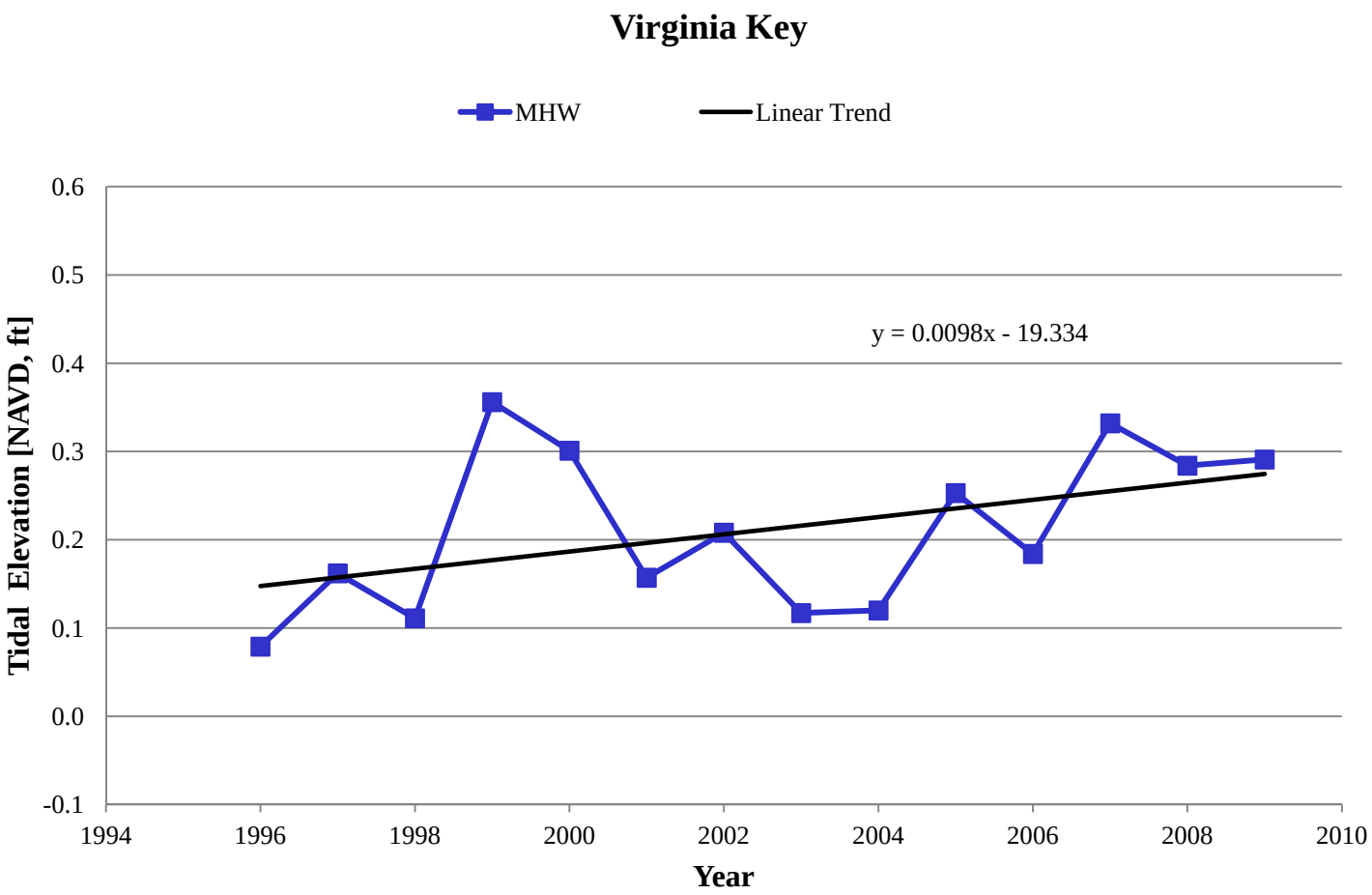
TABLE 3.1
Analyzed Tidal Elevations

Year	Annual Mean High Water, [NAVD, ft]			Annual Mean Tide Elevation, [NAVD, ft]		
	Virginia Key	Trident Pier	Vaca Key	Virginia Key	Trident Pier	Vaca Key
1996	0.08	0.62	-0.61	-0.97	-1.14	-0.93
1997	0.16	0.77	-0.49	-0.89	-1.00	-0.79
1998	0.11	0.62	-0.53	-0.94	-1.15	-0.82
1999	0.36	0.92	-0.26	-0.69	-0.83	-0.62
2000	0.30	0.84	-0.27	-0.75	-0.90	-0.65
2001	0.16	0.72	-0.39	-0.87	-0.99	-0.77
2002	0.21	0.76	-0.30	-0.81	-0.94	-0.69
2003	0.12	0.66	-0.33	-0.89	-1.02	-0.74
2004	0.12	0.60	-0.32	-0.88	-1.07	-0.75
2005	0.25	0.84	-0.24	-0.75	-0.80	-0.67
2006	0.18	0.65	-0.31	-0.82	-0.99	-0.73
2007	0.33	0.81	-0.19	-0.68	-0.82	-0.60
2008	0.28	0.73	-0.21	-0.72	-0.92	-0.62
2009	0.29	0.83	-0.22	-0.73	-0.85	-0.63
2010	0.29	0.75	-0.26	-0.76	-0.97	-0.61
2011	0.27	0.79	-0.31	-0.78	-0.94	-0.66

- How do the observed averages compare with the MHW datum?



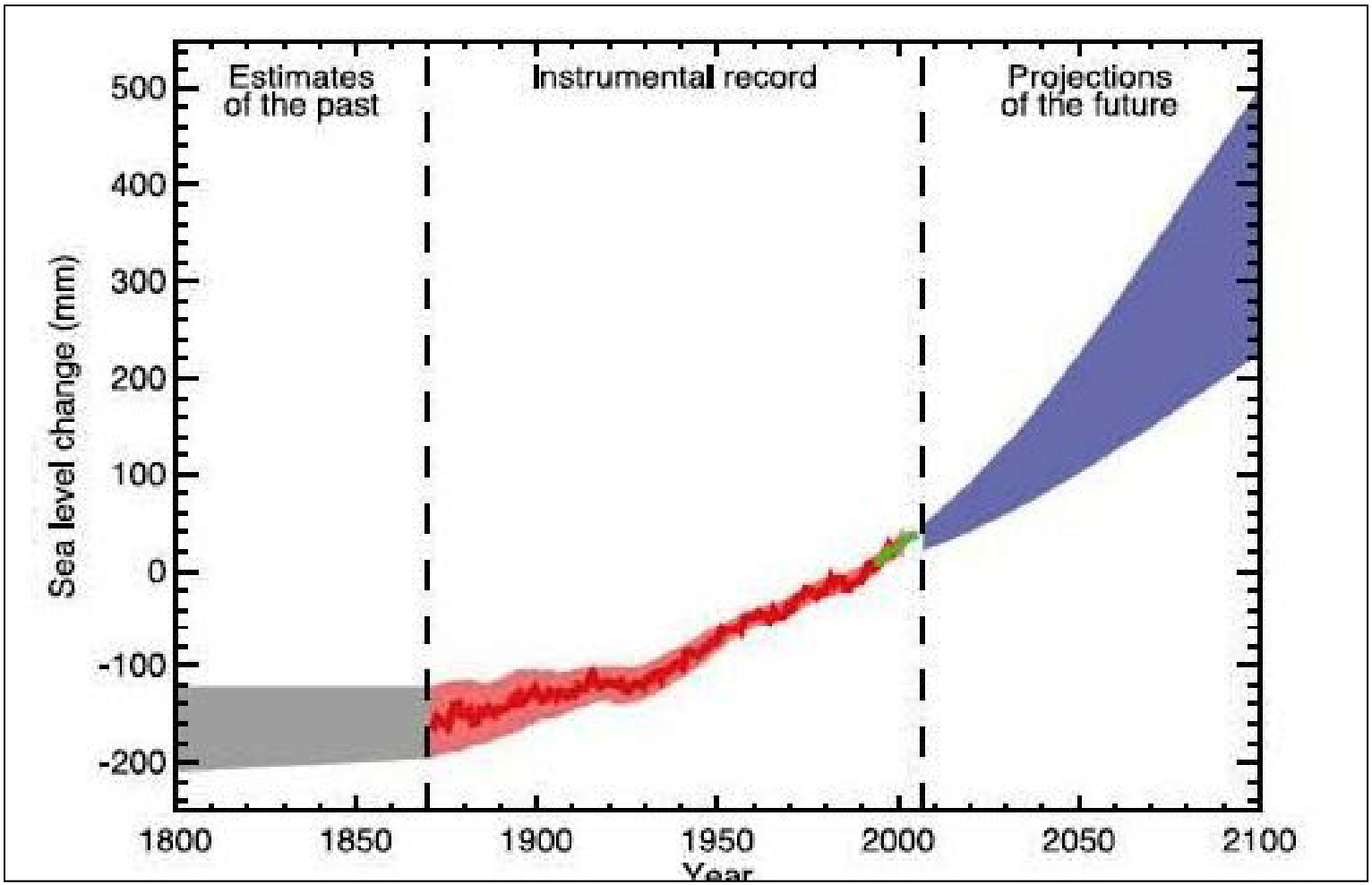
Trend from observed data is 0.118 inches/year



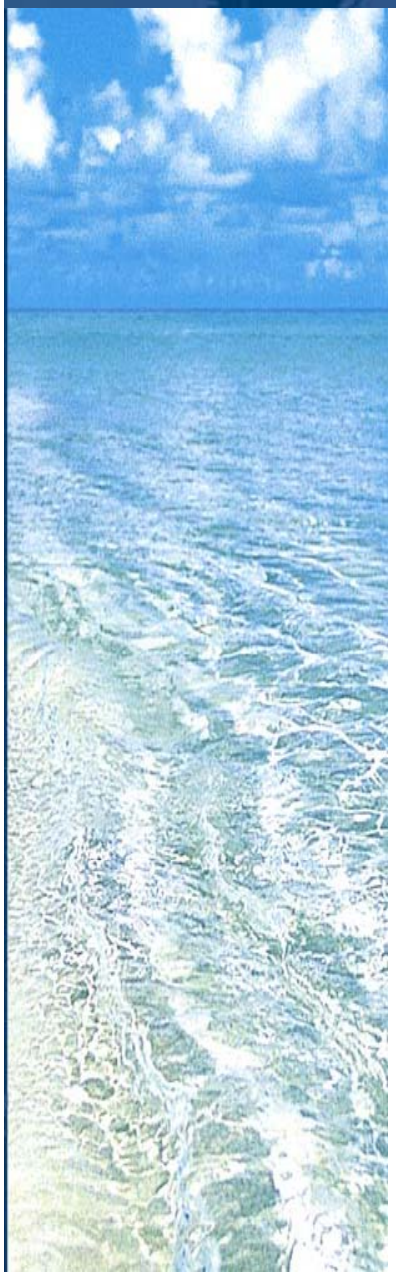
Trend from observed data is 0.118 inches/year

TABLE 6.1
Potential Water Future Levels at Virginia Key [NAVD, ft]

Mean Sea Level			**Mean High Water**			**Mean Spring Tidal Water**		
25-year	50-year	100-year	25-year	50-year	100-year	25-year	50-year	100-year
-0.68	-0.49	-0.10	0.41	0.65	1.14	0.60	0.85	1.34



Source: IPC, 2007



- Minimum Design Criteria 0.36' NAVD for Boundary Condition based on highest annual water levels observed at Virginia Key. This statistic was from 1999 data.
- 25-Year Projection is 0.41' NAVD
- Iterative Analysis to evaluate practicality and cost-effectiveness of stormwater management system planning and design that accounts for these minimum and projected MHW levels
- Sea Level Trends: 0.65' to 1.66' MHW Elevation in 50 Years (CSI Projection, 2011 and CCATF Recommendation, 2008)
- Shoreline Elevations should be Reviewed

City of Miami Beach Citywide Comprehensive Stormwater Management Master Plan

Sea Level Rise Public Workshop

Jason A. Johnson, P.E.-
Senior Project
Manager/Principal Engineer

Michael F. Schmidt, P.E., BCEE-
Senior Vice President

August 2012

CDM Smith

CDM Smith Presenters

Michael F. Schmidt, P.E., BCEE

- Senior Vice President for CDM Smith
- Water Resources Technical Market Leader with 27 years experience on +80 stormwater programs across Florida
- Managed /directed +160 water resource management programs

Jason A. Johnson, P.E.

- Senior Project Manager
- Principal Water Resources Engineer
- 15 years of international and domestic water resources/ stormwater management experience

Stormwater Master Plan Goals

- Flood Control
- Water Quality Protection
- Aquifer Recharge and Water Supply
- Conservation and Reuse
- Operation and Maintenance
- Long Term Financing
- Community Acceptance

Adaptability

Levels of Service

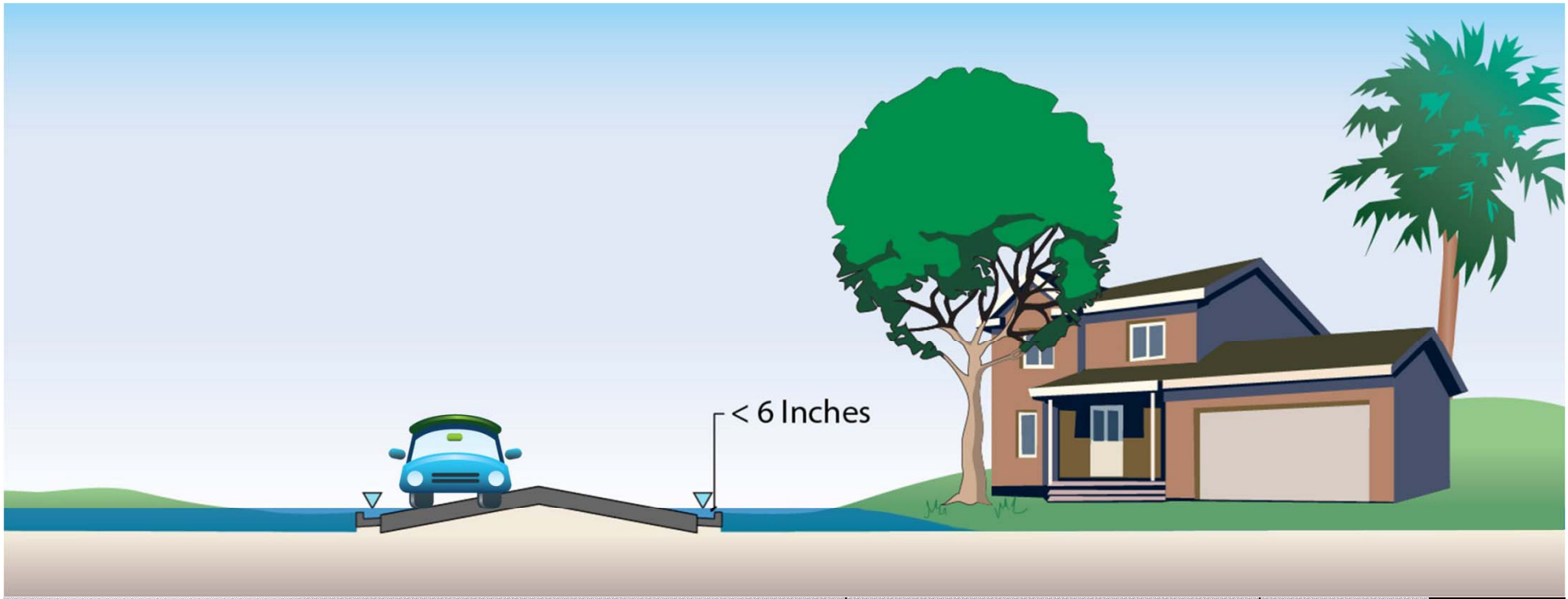
Sustainability

Terms and Definitions

- Design Storm
- Boundary Condition
- Level of Service (LOS)
- Pervious/Impervious
- Best Management Practice (BMP)
- Backflow Preventer
- Outfall
- Recharge Well
- Reuse
- IPCC
- USACE

Level of Service

- Keep flooding below homes and buildings
- Keep roads passable for emergency traffic as practicable



City of Miami Beach Stormwater Issues

- Low and relatively flat terrain
- Limited pervious area
  - Existing development
  - New construction
- Tidal constraints and backflow
- High groundwater table
- Aging infrastructure in corrosive conditions

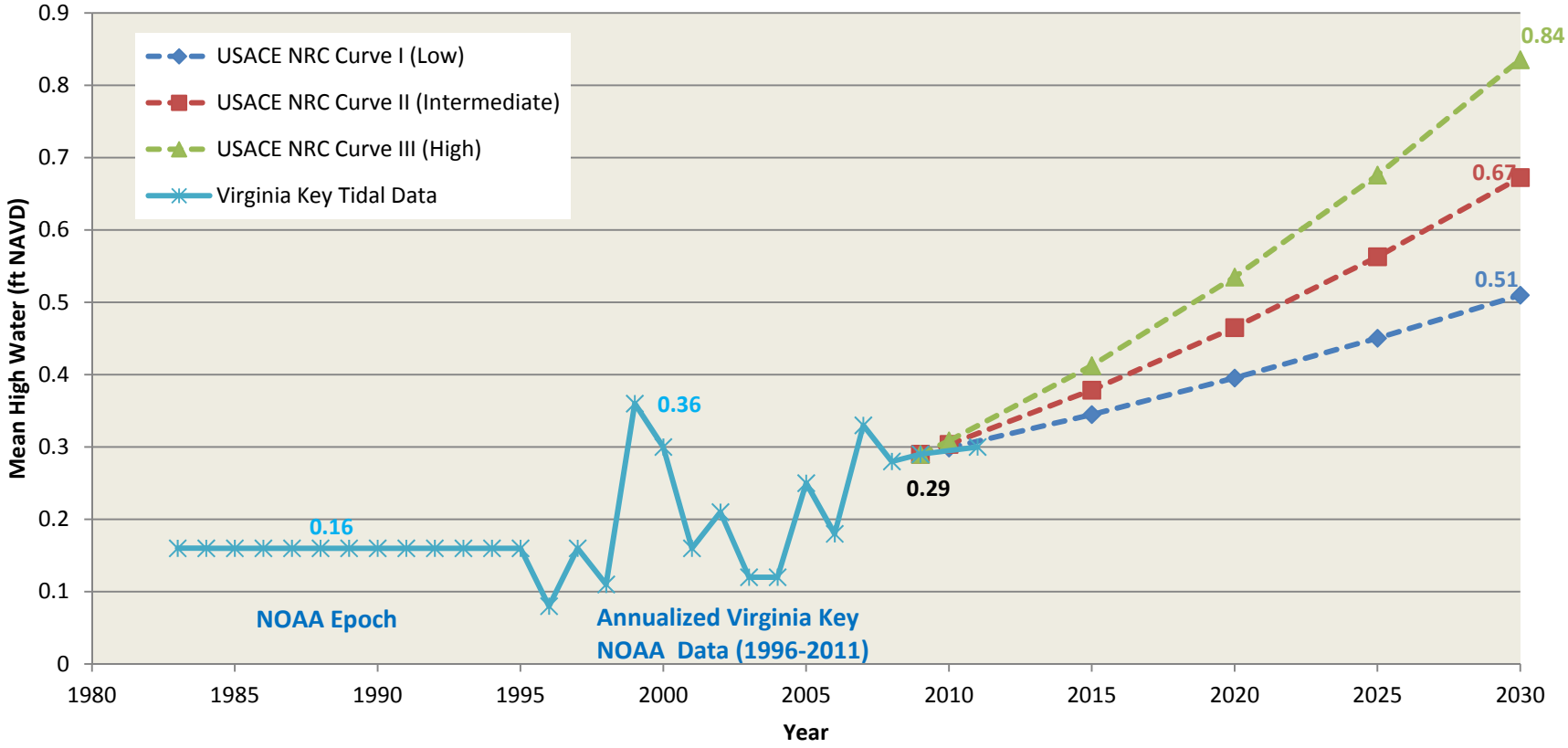
Incorporating Sea-Level Rise into Stormwater Planning

- Evaluate current tidal guidelines and requirements by other Government agencies:

Federal	State of Florida
• USACE • NOAA • USGS • FEMA	• SFWMD • FDEP • FDOT • Miami-Dade County

- Evaluate 20 year projections for sea level rise
  - Use local data, when possible (i.e. Virginia Key)
  - Sensitivity analysis to tidal and rainfall conditions
  - Adaptability to varied sea-level rise projections (i.e. USACE guidance document)

Historic and Projected Mean High Water Levels at Virginia Key



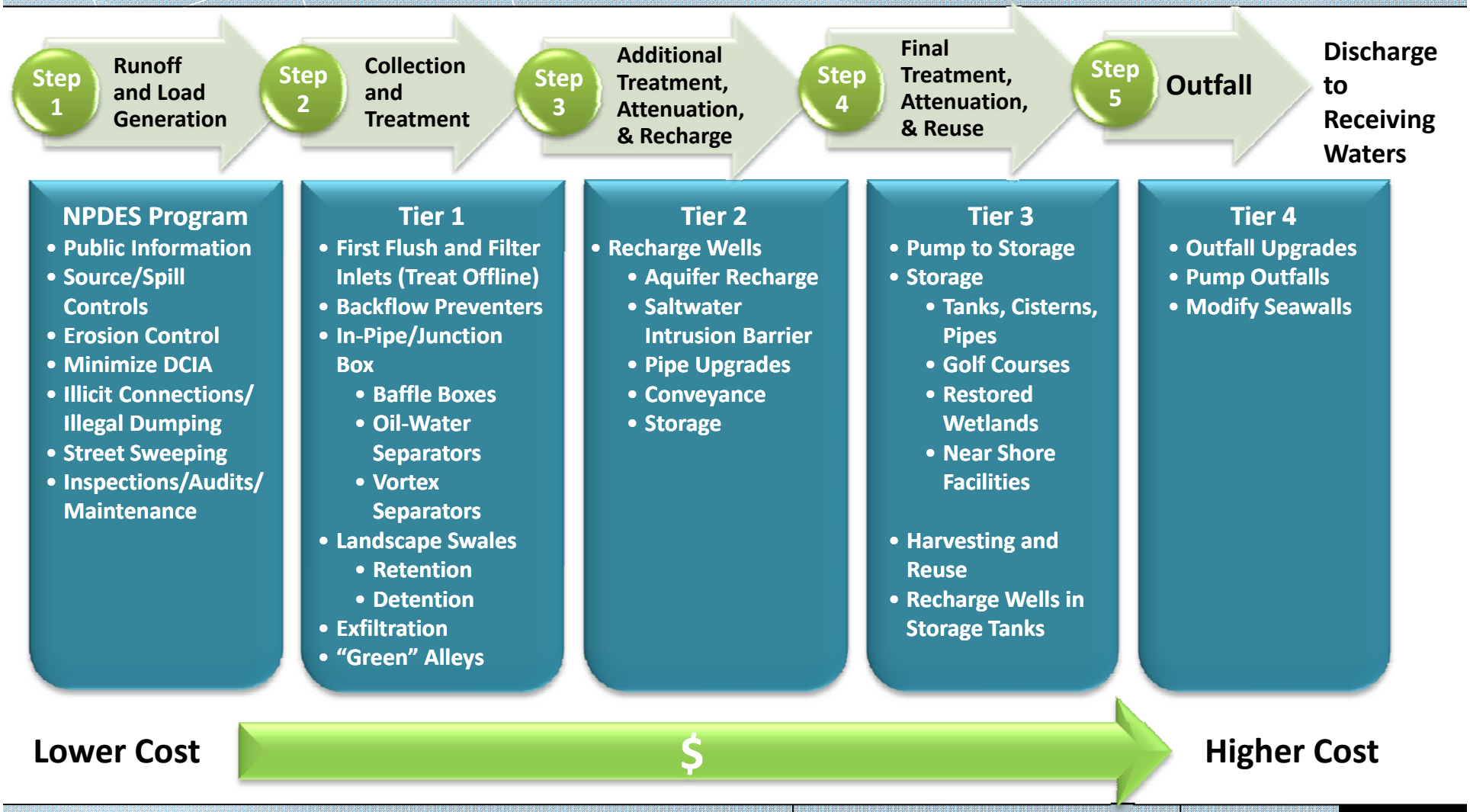
USACE curves are based on the Engineering Circular EC 1165-2-212, published on October 1, 2011 and expires September 30, 2013.

Stormwater Management Master Plan Capital Improvement Program (in Million $)

Location	Estimated Capital Cost ($M)
Biscayne Point	$11
North Shore	$7
North Shore (72nd Street)	$10
Normandy Isle	$20
Upper LaGorce	$12
Lower LaGorce	$14
LaGorce/Allison Island	$9
Oceanfront	$0.3
Nautilus	$4
Sunset Islands 3 & 4	$3
Flamingo+	$106M
SUBTOTAL	$196M
Adjustment for highest sea level rise projection	$10M
TOTAL	**$206M**

jaj2

Tiered Best Management Practice (BMP) Treatment Train Approach Provides Adaptability



Slide 32

jaj2 separate steps into separate slides. keep the full slide and then add the steps in subsequent slides
Jason A. Johnson, 8/16/2012

Tiered Best Management Practice (BMP) Treatment Train Approach Provides Adaptability (cont.)

NPDES Program

- Public Information
- Source/Spill Controls
- Erosion Control
- Minimize DCIA
- Illicit Connections/ Illegal Dumping
- Street Sweeping
- Inspections/Audits/ Maintenance

Tiered Best Management Practice (BMP) Treatment Train Approach Provides Adaptability (cont.)

Step 2

Collection and Treatment

Tier 1

- First Flush and Filter Inlets (Treat Offline)
- Backflow Preventers
- In-Pipe/Junction Box
  - Baffle Boxes
  - Oil-Water Separators
  - Vortex Separators
- Landscape Swales
  - Retention
  - Detention
- Exfiltration
- "Green" Alleys

Tiered Best Management Practice (BMP) Treatment Train Approach Provides Adaptability (cont.)

Step 3

Additional Treatment, Attenuation, & Recharge

Tier 2

- **Recharge Wells**
  - **Aquifer Recharge**
  - **Saltwater Intrusion Barrier**
  - **Pipe Upgrades**
  - **Conveyance**
  - **Storage**

Tiered Best Management Practice (BMP) Treatment Train Approach Provides Adaptability (cont.)

Tier 3

- Pump to Storage
- Storage
  - Tanks, Cisterns, Pipes
  - Golf Courses
  - Restored Wetlands
  - Near Shore Facilities
- Harvesting and Reuse
- Recharge Wells in Storage Tanks

Tiered Best Management Practice (BMP) Treatment Train Approach Provides Adaptability (cont.)

Tier 4

- **Outfall Upgrades**
- **Pump Outfalls**
- **Modify Seawalls**

Recommendations from SWMP Related to Sea-Level Rise

- Monitor and participate in future regional recommendations related to sea level rise
- Follow USACE Civil Works and FEMA guidance in planning and design
- Monitor pending IPCC recommendations regarding sea-level rise that are scheduled to be released to the public within the next three years
- Review tidal data every five years and adapt the SWMP as appropriate

Historic and Projected Mean High Water Levels at Virginia Key

USACE curves are based on the Engineering Circular EC 1165-2-212, published on October 1, 2011 and expires September 30, 2013.