



Miami-Dade Sea Level Rise Task Force

STORMWATER MASTERPLAN PLANNING PROCEDURES

PROBLEM STATEMENT

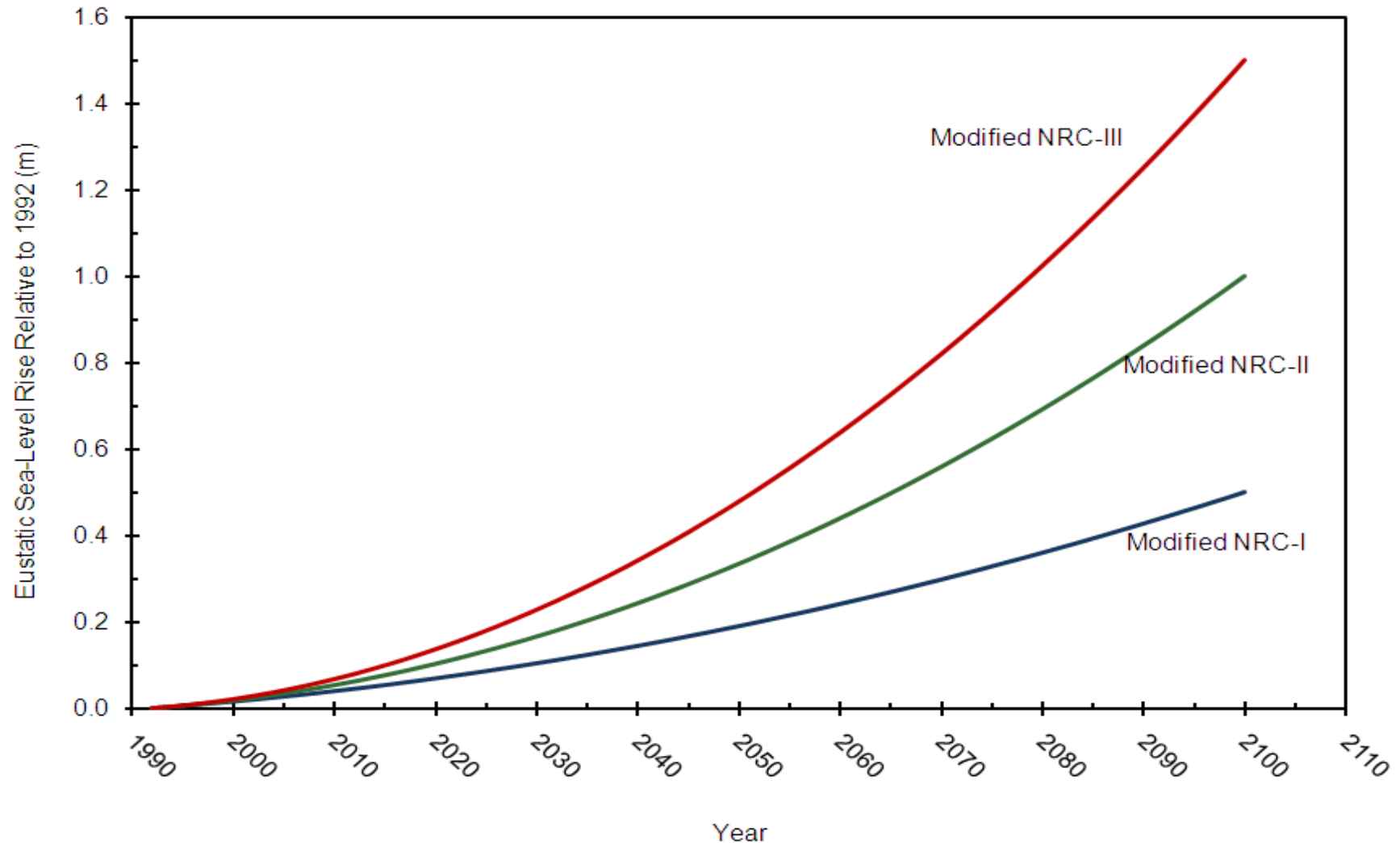
How do we incorporate different climate scenarios predictions, scientific/political disputes, and risk assessment tools into a practical design criteria for cost effective and resilient civil works?

MIAMI-DADE COUNTY'S PLANNING PROCEDURES

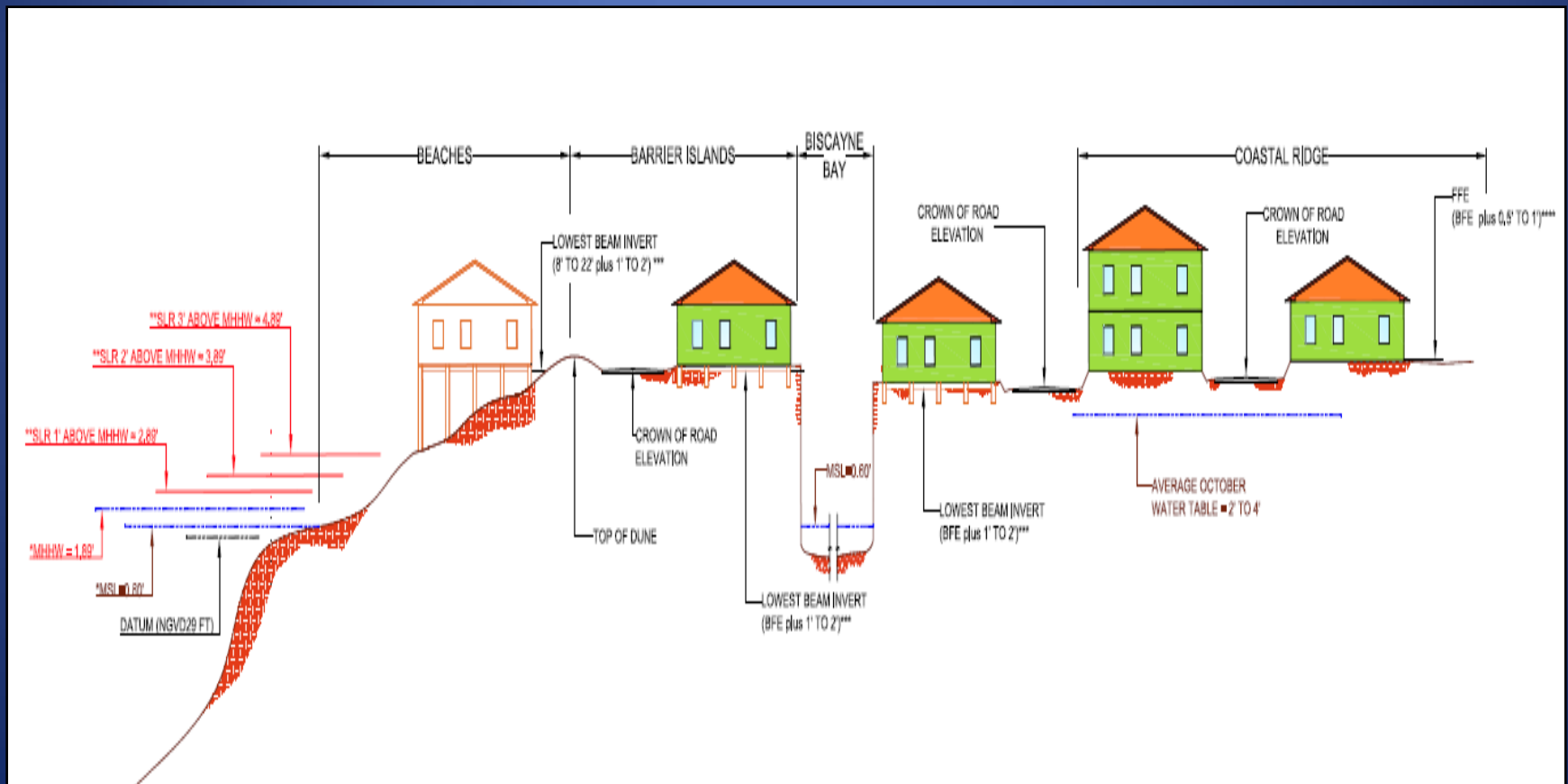
- HOW DO WE TRANSLATE THE NRC SCENARIOS INTO FLOOD LEVELS OF SERVICE?
- HOW DO THE STORMWATER MASTERPLAN PLANNING PROCEDURES AND CURRENT REGULATIONS COMPARE TO THE NRC SEA LEVEL SCENARIOS FOR YEAR 2113?
- ARE THE CURRENT REGULATION SUFFICIENT?
- HOW CAN THEY BE IMPROVED?

Scenarios for GMSL Rise (based on updates to NRC 1987 equation)

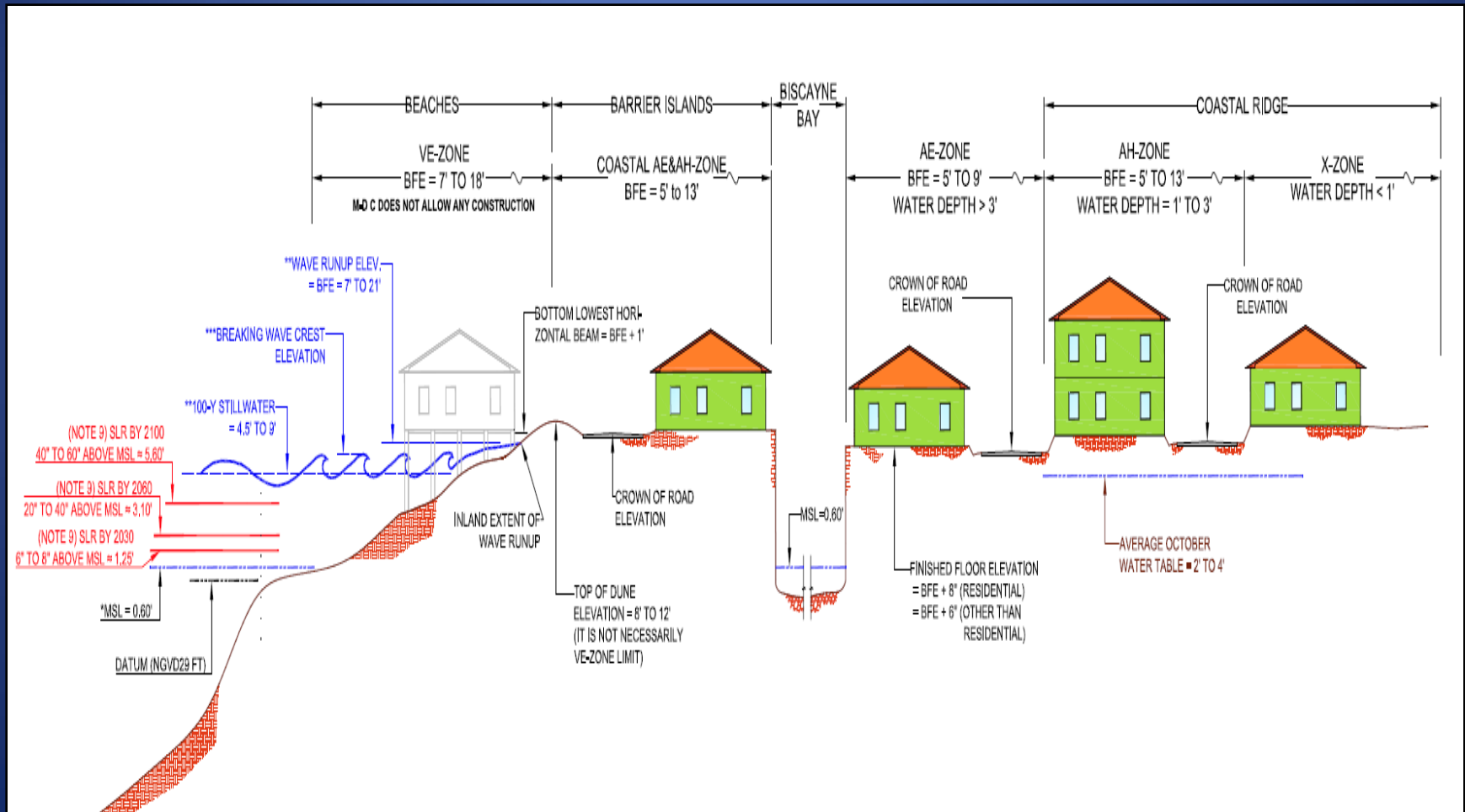
Source: Engineer Circular 1165-2-212: Sea-Level Change Considerations for Civil Works Programs (2011)\USACE



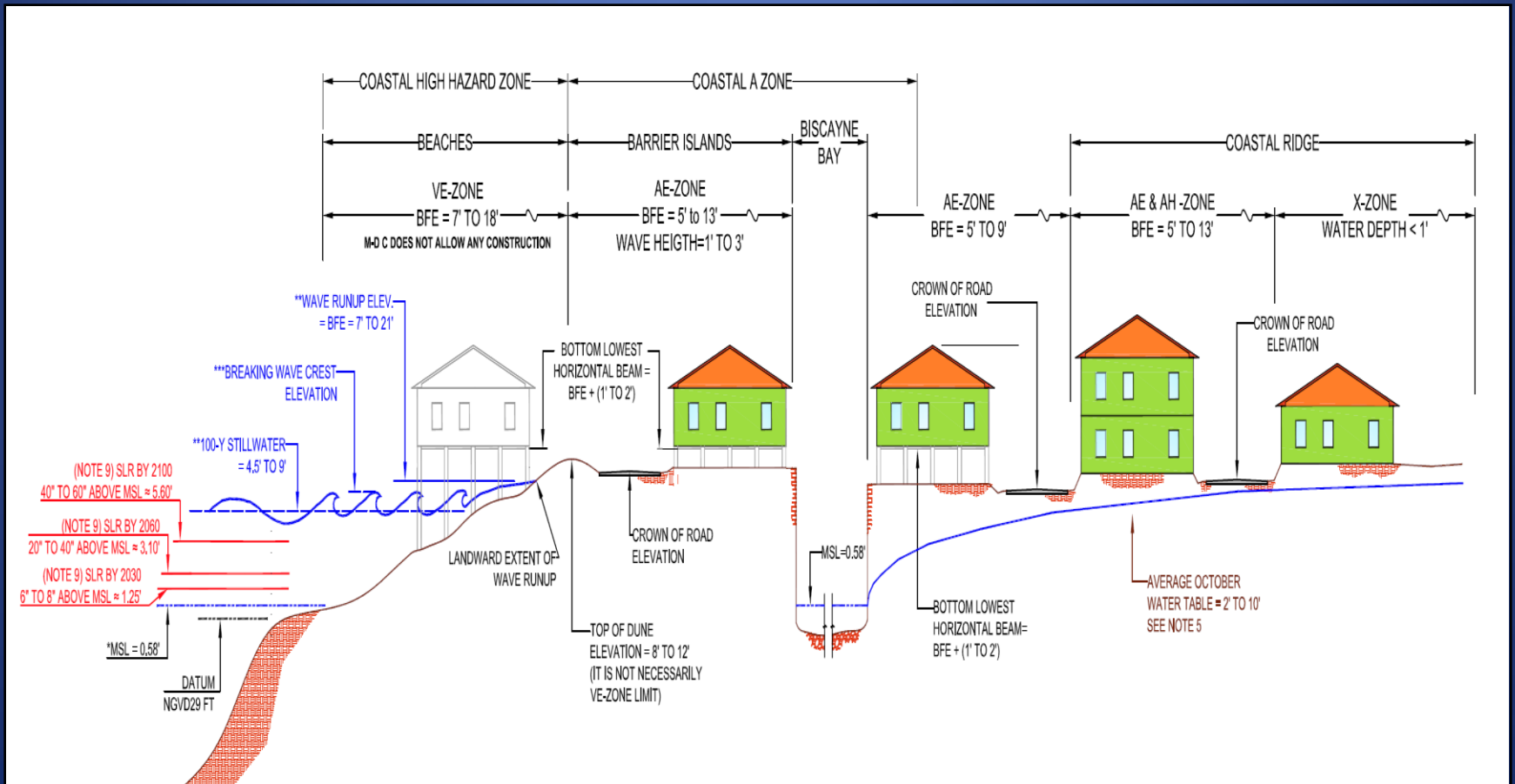
OVERVIEW OF REQUIREMENTS ELEVATING ABOVE SEA LEVEL RISE PROJECTIONS (BATH TUB)



OVERVIEW OF ELEVATION REQUIREMENTS BEFORE FBC 2010



OVERVIEW OF ELEVATION REQUIREMENTS AFTER FBC 2010 - CURRENT



STORMWATER MASTERPLAN

TRADITIONAL PLANNING PROCEDURES
BASED ON HISTORICAL DATA AND
STATISTICAL TRENDS

STORMWATER MASTERPLAN

MEAN SEA LEVEL TRENDS

+

MHHW

+

100-YEAR TIDE

+

100-YEAR RAINFALL

NOAA provides information on the 4
components

SEA LEVEL RISE = TIDAL TRENDS

In Feet/100 years

Source: NOAA – Tides & Currents website

Linear mean sea level (MSL) trends and 95% confidence intervals in feet/century

Station Name	First Year	P.O.R., years	For all data to 2006		Previously Published Trends	
			MSL Trend, FT	+/- 95% Confidence Interval	MSL Trend, FT	+/- 95% Confidence Interval
Fernandina Beach	1897	110	0.66	0.07	0.67	0.08
Mayport	1928	79	0.79	0.10	0.80	0.12
Miami Beach	1931	51	0.78	0.14	0.78	0.14
Vaca Key	1971	36	0.91	0.20	0.85	0.28
Key West	1913	94	0.73	0.05	0.74	0.06
Naples	1965	42	0.66	0.20	0.68	0.28
Fort Myers	1965	42	0.79	0.21	0.75	0.29
St. Petersburg	1947	60	0.77	0.10	0.79	0.12
Clearwater Beach	1973	34	0.80	0.26	0.91	0.42
Cedar Key	1914	93	0.59	0.06	0.61	0.07
Apalachicola	1967	40	0.45	0.29	0.50	0.38
Panama City	1973	34	0.25	0.27	0.10	0.41
Pensacola	1923	84	0.69	0.09	0.70	0.10

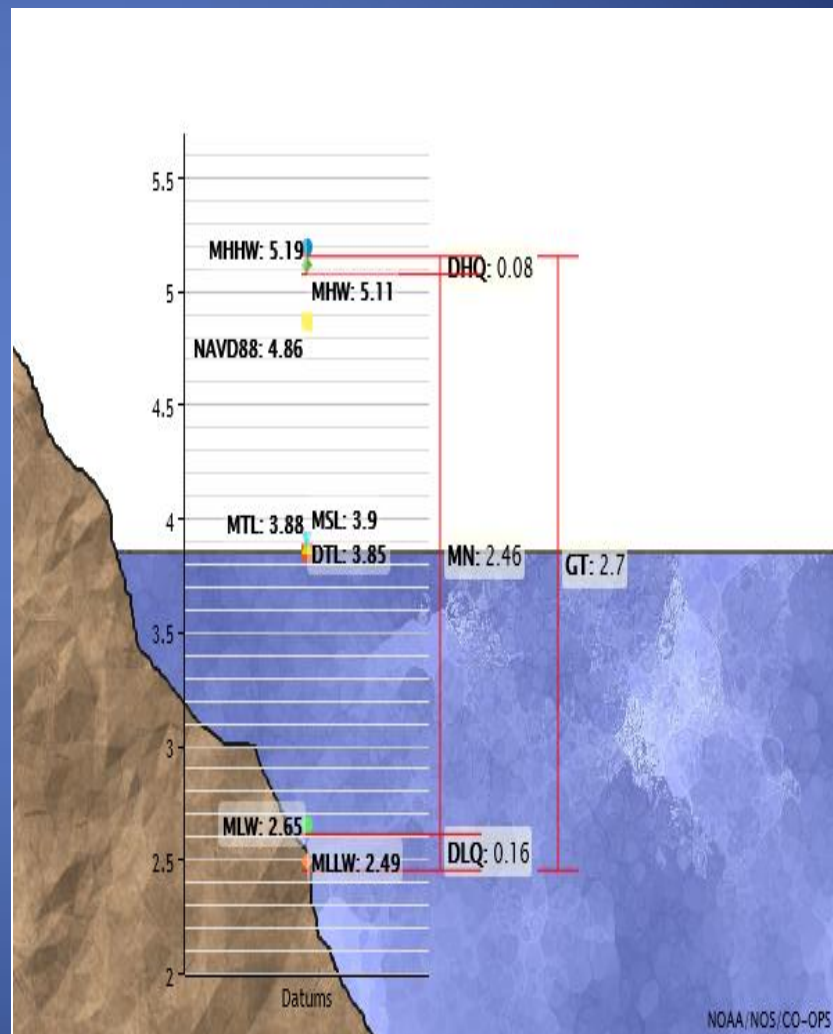
MHHW – MIAMI BEACH No. 8723170

T.M.: 75 W Epoch: 1983-2001

Datum: STND

Elevations on Station Datum

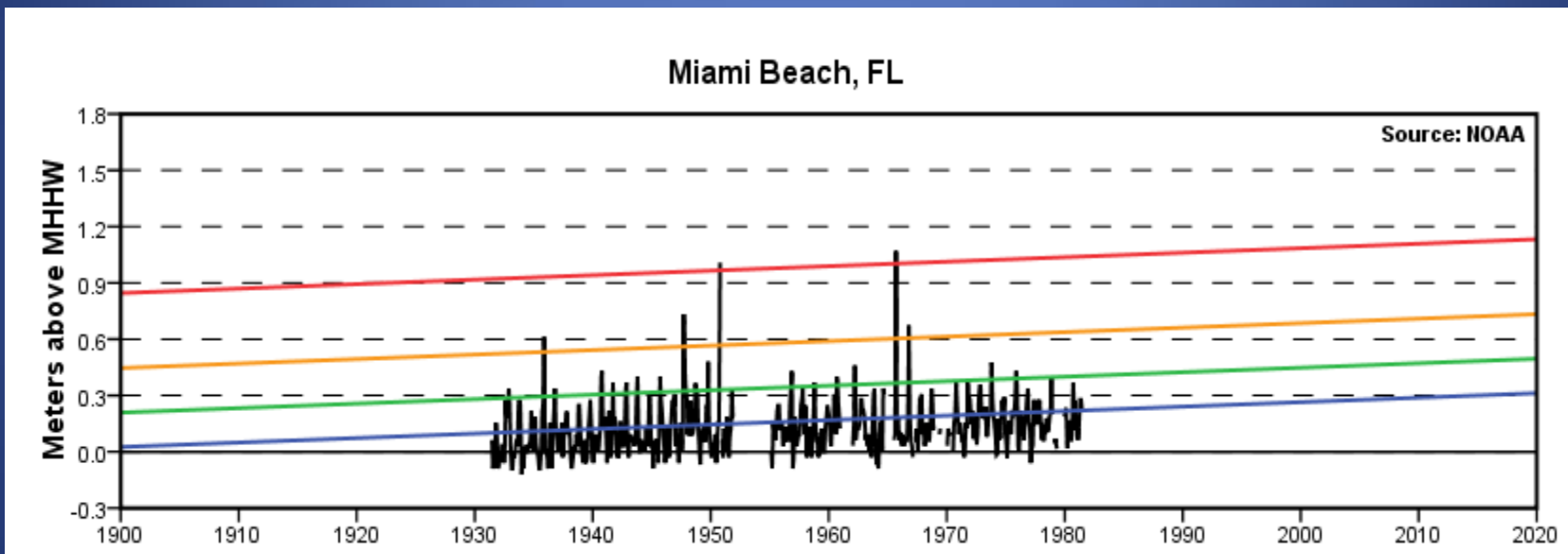
Datum	Value	Description
MHHW	5.19	Mean Higher-High Water
MHW	5.11	Mean High Water
MTL	3.88	Mean Tide Level
MSL	3.90	Mean Sea Level
DTL	3.85	Mean Diurnal Tide Level
MLW	2.65	Mean Low Water
MLLW	2.49	Mean Lower-Low Water
NAVD88	4.86	North American Vertical Datum of 1988
STND	0.00	Station Datum
GT	2.70	Great Diurnal Range
MN	2.46	Mean Range of Tide
DHQ	0.08	Mean Diurnal High Water Inequality
DLQ	0.16	Mean Diurnal Low Water Inequality
HWOI	0.78	Greenwich High Water Interval (in hours)
LWOI	6.93	Greenwich Low Water Interval (in hours)
Maximum	8.70	Highest Observed Water Level
Max Date & Time	09/08/1965 05:12	Highest Observed Water Level Date and Time
Minimum	0.70	Lowest Observed Water Level
Min Date & Time	03/24/1936 14:42	Lowest Observed Water Level Date and Time
HAT	6.39	Highest Astronomical Tide
HAT Date & Time	10/16/1993 13:24	HAT Date and Time
LAT	1.58	Lowest Astronomical Tide
LAT Date & Time	02/08/1997 07:18	LAT Date and Time



SEA LEVEL RISE = TIDAL TRENDS

MONTHLY HIGHEST WATER LEVELS

- RED: 1% level, estimated to be exceeded ONCE in 100 YEARS
- ORANGE: 10% level estimated to be exceeded TEN TIMES in 100 YEARS,
- GREEN: 50% level, estimated to be exceeded TWICE in 100 YEARS
- BLUE: 99% level, estimated to be exceeded 99 TIMES in 100 YEARS

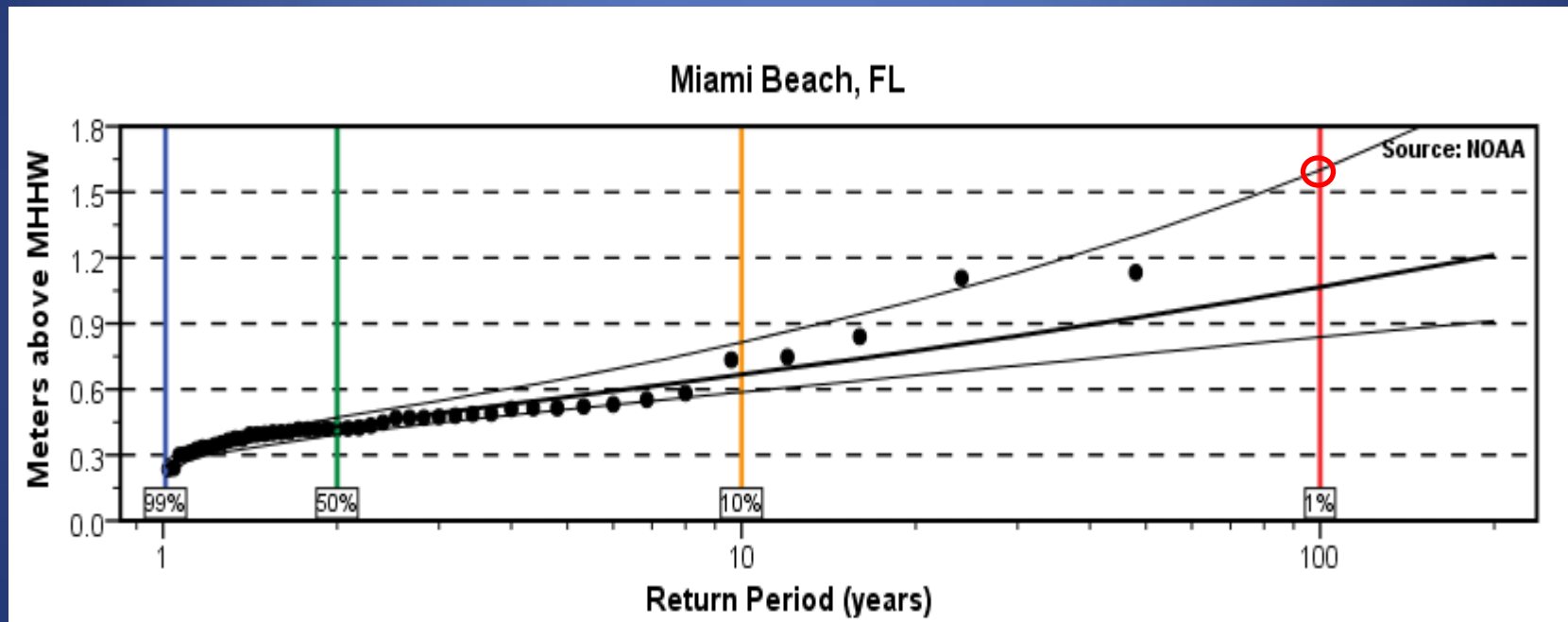


The plotted values are in meters relative to the National Tidal Datum Epoch (1983-2001) Mean Higher High Water (MHHW) datum established by CO-OPS (1 foot = 0.3 meters). The monthly extreme water levels include a Mean Sea Level (MSL) trend of 2.39 millimeters/year with a 95% confidence interval of +/- 0.43 millimeters/year based on monthly MSL data from 1931 to 1981 which is equivalent to a change of 0.78 feet in 100 years

Source: <http://tidesandcurrents.noaa.gov/est/curves.shtml?stnid=8723170>

100-YEAR TIDE ABOVE MHHW

- The plot shows the annual exceedance probability curves with 95% confidence intervals, representing highest levels as a function of return period in years.
- The dots indicate the annual highest water levels after the Mean Sea Level trend was removed.



The levels are in meters relative to the Mean Higher High Water (MHHW) datum established by CO-OPS (1 foot = 0.3 meters). The position of the rightmost dot indicates the number of years of data used in the calculation.

Source: <http://tidesandcurrents.noaa.gov/est/curves.shtml?stnid=8723170>

SFWMD CONTRL STRUCTURES

- Source: DBHYDRO, Masterplan trend line analysis of mean daily data

TAILWATER RISE TRENDS, BASED ON DBHYDRO MEAN DAILY WATER LEVELS			
Station, at tailwater	TAILWATER RISE TREND, inches/ 100 years	TAILWATER RISE TREND, feet/100 years	LOCATION
S-29	10	0.87	S-29 STRUCTURE ON SNAKE CREEK CANAL (C-9) AT NORTH MIAMI BEACH, FL (TAILWATER)
S-28	8	0.69	S-28 STRUCTURE ON BISCAYNE CANAL (C-8) AT TIDEWATER (TAILWATER)
S-27	11	0.93	S-27 STRUCTURE ON LITTLE RIVER CANAL (C-7) AT TIDEWATER (TAILWATER)
S-26	12	0.99	S-26 STRUCTURE ON MIAMI CANAL (C-6) AT TIDEWATER (TAILWATER)
S-25	14	1.13	S-25 CULVERT ON COMFORT CANAL (C-5) AT TIDEWATER (TAILWATER)
S-22	11	0.91	S-22 STRUCTURE ON SNAPPER CREEK CANAL (C-2) NEAR SOUTH MIAMI, FL (TAILWATER)
S-21	10	0.81	S-21 STRUCTURE ON BLACK CREEK (C-1) CANAL NEAR GOULDS, FL (TAILWATER)
S-123	8	0.70	S-123 STRUCTURE ON CUTLER DRAIN CANAL (C-100) AT TIDEWATER (TAILWATER)
S-20F	10	0.81	S-20F STRUCTURE ON MOWRY CANAL (C-103) NEAR TIDEWATER (TAILWATER)
S-21A	8	0.70	S-21A STRUCTURE ON PRINCETON CANAL (C-102) AT TIDEWATER (TAILWATER)

C-8 MODEL TIDAL BOUNDARY

Miami Beach Station

TIDE BOUNDARY – 100Y

MB	100Y + MHHW	3.61 NAVD88	
	100Y	3.28 Above MHHW	
	MSL	3.9 STND	
	NAVD88	4.86 STND	
MRT	2.46 MEAN RANGE OF TIDE		
T	PERIOD		
GT	2.7		
MHHW	5.19 STND		
MHHW	0.33 NAVD88		
MHW	5.11 STND		
MHW	0.25 NAVD88		
MLLW	2.49 STDN		
MLLW	-2.37 NAVD88		
MLW	2.65 STDN		
MLW	-2.21 NAVD88		
	REGULAR	100Y	
MHHW	0.33 NAVD88		3.61
MHW	0.25 NAVD88		3.53
MLLW	-2.37 NAVD88		0.91
MLW	-2.21 NAVD88		1.07

TIDE BOUNDARY 100Y+SLR

MB	MHHW + SLR+100Y	6.36 NAVD88	
	100Y	5.25 Above MHHW	
	MSL+SLR	4.68 STND	
	NAVD88	4.86 STND	
	SLR (NOAA)	0.78 ABOVE CURRENT MSL	
MRT	2.46 MEAN RANGE OF TIDE		
T	PERIOD		
GT	2.7		
MSL	3.9		
MHHW	5.19 STND		
MHHW	0.33 NAVD88		
MHW	5.11 STND		
MHW	0.25 NAVD88		
MLLW	2.49 STDN		
MLLW	-2.37 NAVD88		
MLW	2.65 STDN		
MLW	-2.21 NAVD88		
	REGULAR	SLR-100	
MHHW	0.33 NAVD88		6.36
MHW	0.25 NAVD88		6.28
MLLW	-2.37 NAVD88		3.66
MLW	-2.21 NAVD88		3.82

USACE PLANNING COMMUNITY TOOLBOX

<http://planning.usace.army.mil/toolbox/>

Engineer Circular 1165-2-212: Sea-Level Change Considerations for Civil Works Programs (2011) Expiration: September 30, 2013

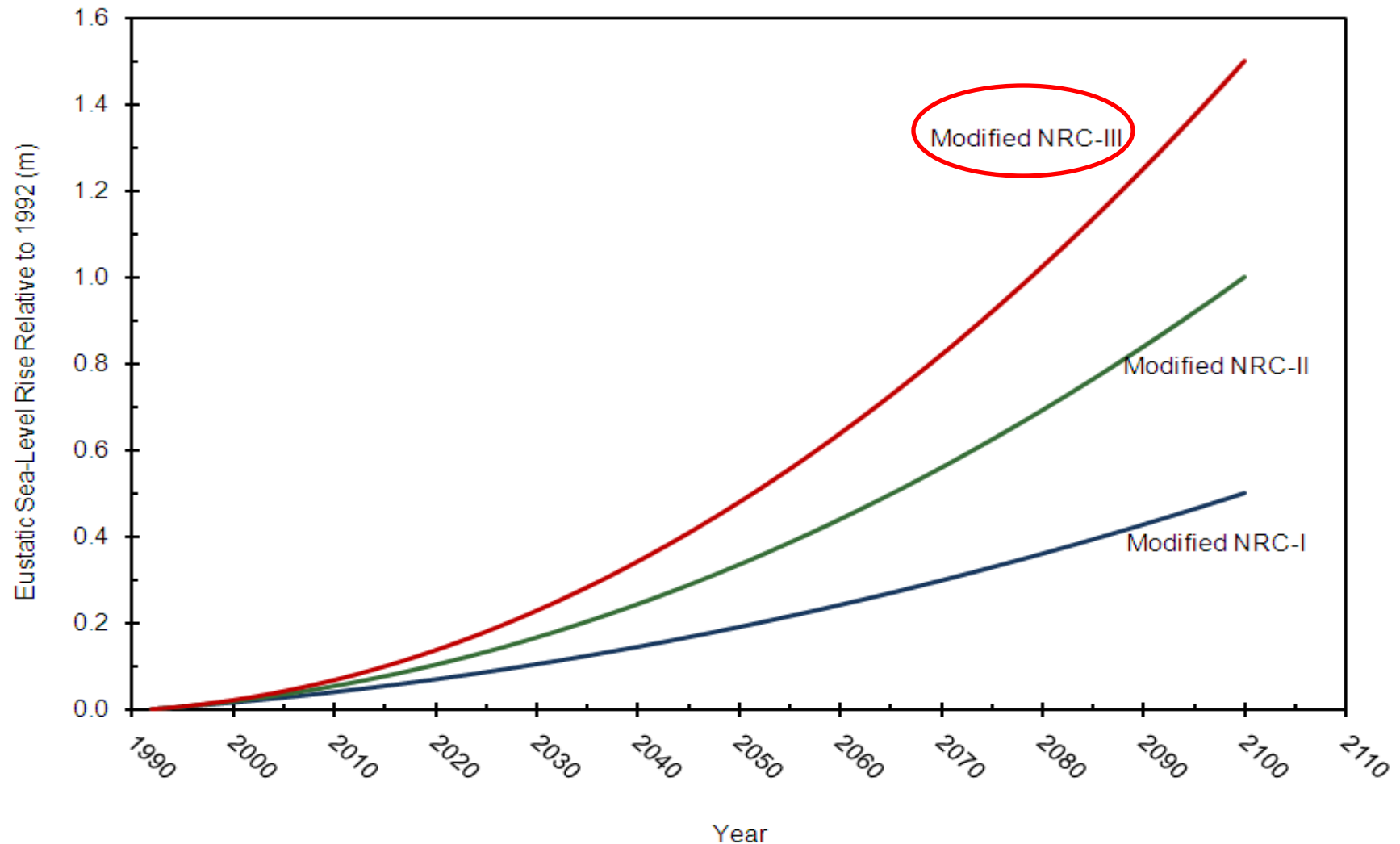
Engineer Circular 1165-2-211: Water Resource Policies and Authorities; Incorporating Sea-Level Change Considerations in Civil Works Programs (2009 Expiration: July 1, 2011)

HOW DO THESE FIGURES COMPARE TO THE SEA LEVEL SCENARIOS?

- THEY MATCH THE MODIFIED NRC III SCENARIO, WHICH IS THE MOST CONSERVATIVE

Scenarios for GMSL Rise (based on updates to NRC 1987 equation).

Source: Engineer Circular 1165-2-212: Sea-Level Change Considerations for Civil Works Programs (2011)\USACE



PROJECTIONS

USACE Circular No. 1165-2-212

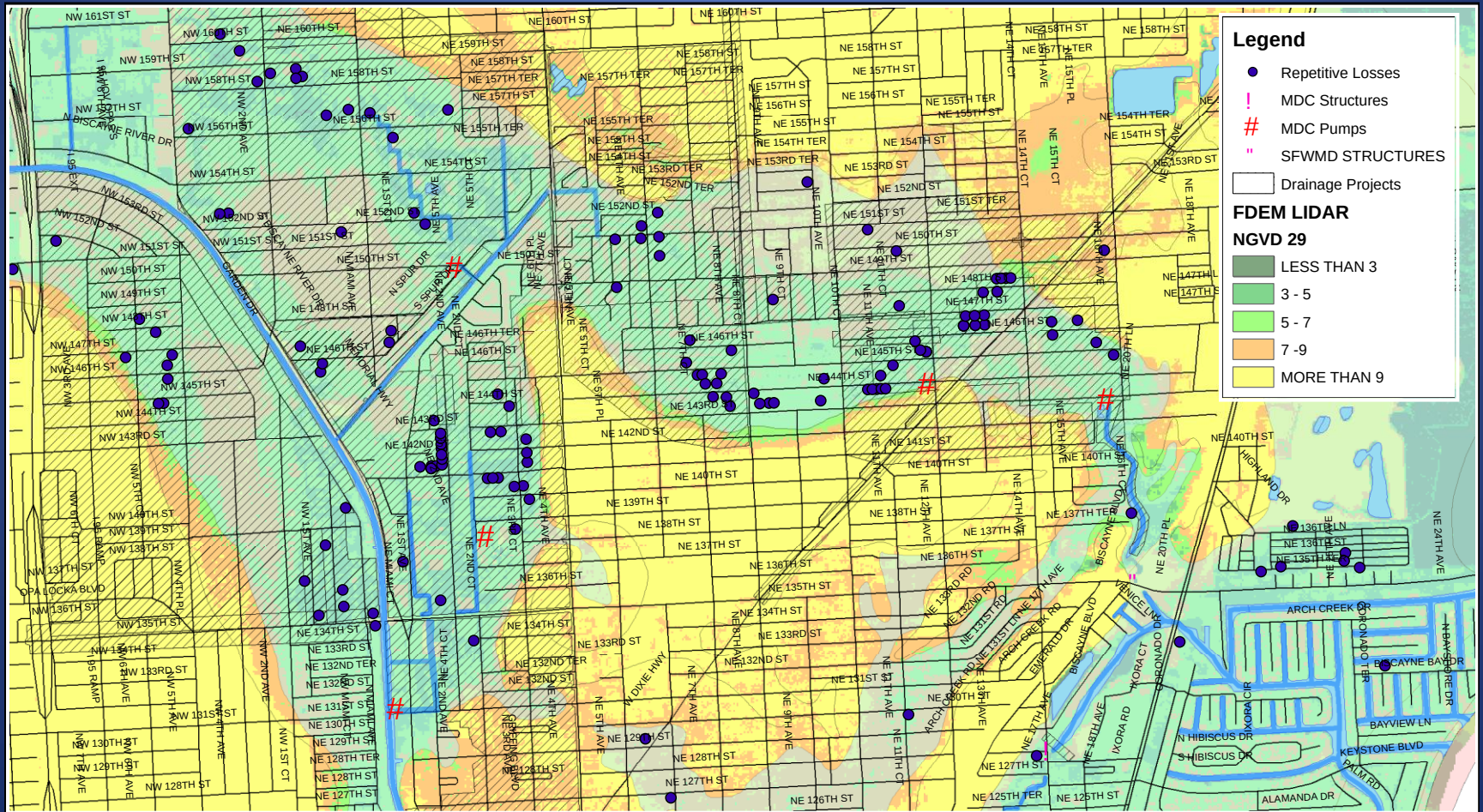
for year 2113 – Miami Beach

SCENARIO	Meters	Rise above current MSL, feet	Rise above current MSL, inches	2013 MSL IN NAVD88	2113 MSL, IN NAVD88	2113 MHHW, in NAVD88
NRC-I	0.60	1.96	23	-0.96	1.00	2.29
NRC-II	1.22	3.99	48	-0.96	3.03	4.32
NRC-III	1.84	6.03	72	-0.96	5.07	6.36

MASTERPLAN/ MITIGATION EXAMPLE

A neighborhood developed in the
1940's

ARCH CREEK GROUND ELEVATIONS



Legend

2009_DFIRM

FLD_ZONE

- VE
- AE
- AH
- X (Shaded)
- X

Flood Event 6/7/2013, NE Miami-Dade County



Source: MDC PWWM

NE 144th ST and 145th ST, between NE 12th AVE and NE 13th AVE

Flood Event 6/7/2013, NE Miami-Dade County



NE 2ND CT, LOOKING NORTH, BETWEEN NE 135TH AND NE 141ST ST

Source: City of North Miami

Flood Event 6/7/2013, NE Miami-Dade County



Source: MDC PWWM

NE 144th ST and 145th ST, between NE 12th AVE and NE 13th AVE

PROPERTY AGE – SEA LEVEL CHANGE

FOLIO	ADDRESS	YEAR BUILT	AGE OF BUILDING, years	ESTIMATE FOR THE MEAN SEA LEVEL RISE, ft (NOAA CO-OPS 2.39 mm/Yr)	* ESTIMATE FOR THE LOCAL RISE IN THE WATER TABLE, ft
3022200022341	1511- 1513 NE 146TH ST	1970	43	0.31	1.5
3022200022840	1285 NE 144TH ST	1970	43	0.31	1.5
3022200023340	1246 NE 144THST	1952	61	0.44	1.5
3022200022590	1370 NE 146TH ST	1952	61	0.44	1.5
3022200023330	1254 NE 144TH ST	1952	61	0.44	1.5
3022200022320	1471- 1473 NE 146TH ST	1969	44	0.32	1.5
3022200023302	1290 NE 144TH ST	1969	44	0.32	1.5
3022200022342	1510- 1512 NE 147TH ST	1973	40	0.29	1.5
3022200024270	1660 NE 146TH ST	1959	54	0.39	1.5
3022200023320	1276 NE 144TH ST	1952	61	0.44	1.5
3022200021530	1563 NE 148TH ST	1952	61	0.44	1.5
3022200021870	1331 NE 147TH ST	1940	73	0.53	1.5
3022200022310	1470 NE 147TH ST	1949	64	0.46	1.5
3022200022333	1491- 1493 NE 146TH ST	1973	40	0.29	1.5
3022200022541	1391 NE 145TH ST	1969	44	0.32	1.5
3022200021520	1573 NE 148TH ST	1954	59	0.43	1.5
3022200021490	1543 NE 148TH ST	1952	61	0.44	1.5
3022200024170	1751 NE 145TH ST	1949	64	0.46	1.5
3022200022850	1310 NE 145TH ST	1967	46	0.33	1.5
3022200023303	1280 NE 144TH ST	1969	44	0.32	1.5
3022200021601	1540- 1542 NE 148TH ST	1972	41	0.30	1.5
3022200380030	1697- 1699 NE 146TH ST	1970	43	0.31	1.5
3022200022570	1383- 1385 NE 145TH ST	1950	63	0.46	1.5

MODELING OF STORM EVENTS

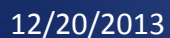
- 10-FOOT CEL DEM, PUBLISHED BY THE SFWMD
- ELEVATIONS IN NAVD 88
- CURRENT LAND USE
- CURRENT INFRASTRUCTURE
- NOAA RAINFALL RETURN PERIOD ANALYSIS:

http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=fl

MODELING SCENARIO

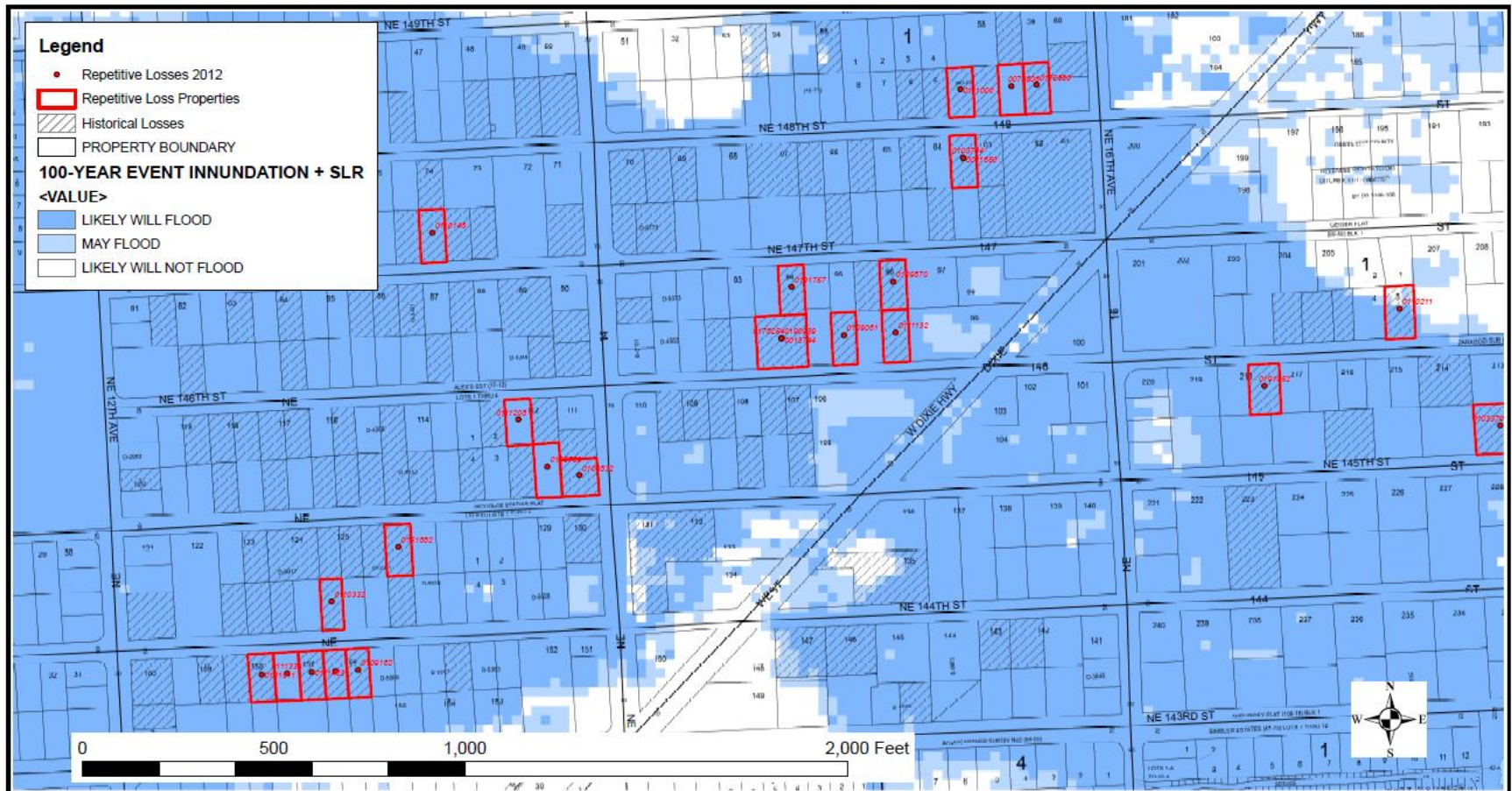
- XP-SWMM MODELS CONSIDERS THE 1% CHANCE PROBABILITY OF EXCEEDENCE PLUS TIDAL TRENDS AND MHHW;
- TIDE FORECASTS ARE AVAILABLE (NOAA);
- FORECASTS FOR STORM SURGE ELEVATIONS WITH SEA LEVEL RISE SCENARIOS IS NOT YET AVAILABLE FROM NOAA.

**MIAMI-DADE COUNTY STORMWATER MASTERPLAN - ARCH CREEK BASIN
INNUNDATION LIMITS FOR THE 100-YEAR EVENT MAXIMUM STAGE OF 6.58 FEET NGVD
FEMA MAP BASE FLOOD ELEVATION IS 7 FEET NGVD**



ARCH CREEK BASIN MITIGATION PLAN

MIAMI-DADE COUNTY STORMWATER MASTERPLAN - ARCH CREEK BASIN
 INNUNDATION LIMITS FOR THE 100-YEAR EVENT WITH SEA LEVEL RISE FORECAST FOR 2113 (+0.78')
 MAXIMUM STAGE OF 7.63 FEET NGVD
 FEMA STILLWATER ELEVATION IS 7 FEET NGVD



MS for MBP amd MA on 10/11/13

SOLUTION

- ❑ Recognize uncertainty to determine level of detail and accuracy required with respect to potential risks and consequences;
- ❑ Flexible planning and engineering, incorporating in the design of all civil works, a range of likely changes and safety factors for unknown possibilities.
- ❑ Understanding that periodic adjustments must be made over a longer planning horizon

RECOMENDATIONS

- ☐ SAME STANDARDS FOR ALL AREAS (SFHA OR NOT)
- ☐ MINIMUM FREEBOARD OF 12"
- ☐ UPDATE OF THE COUNTY FLOOD CRITERIA
- ☐ CRITICAL FACILITIES MINIMUM STANDARD - ABOVE 500-YEAR FLOOD PLAIN