

# Characterizing Water Level Trends at South Florida Coastal Structures

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H&H Bureau  
SFWMD

## Outline

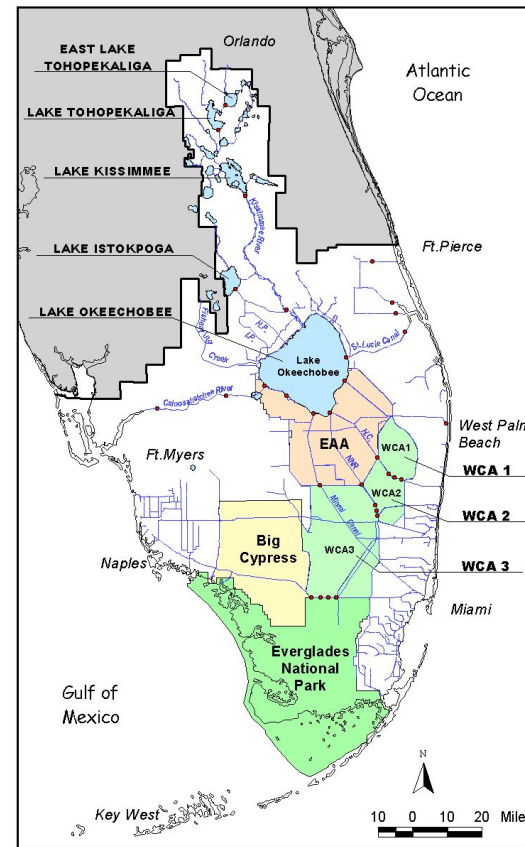
- South Florida Water Management System
- Coastal Structures Functions
  - Operations of coastal structures
- Global Mean Sea Level
- Trend on Relative Sea Level
- Water Level Trend at Coastal Structures – Resiliency Metric
- Summary & Conclusion



# Background



- South Florida Water Management District
  - The largest of five water management Districts in Florida
  - Serves about 9.1 million people in 16 counties
  - Covers area from Orlando to Key West
  - Mission includes flood control, water supply, environmental restorations
  
- South Florida Water Management System
  - Low relief & flat topography
  - Delicate balance between rainfall and evapotranspiration
  - High ground and surface water interaction
  - Urbanized areas along the coast
  - Significant agricultural areas
  - Protected natural areas such as the Everglades
  - Lake Okeechobee
  - 2,200 miles of canals, 2,100 miles of levees/berms, 900 water control structures, 85 pump stations and 625 project culverts

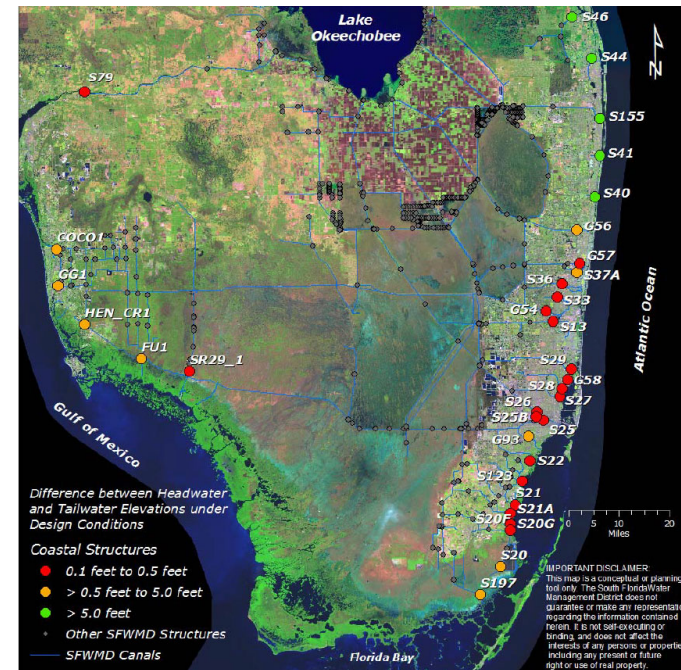
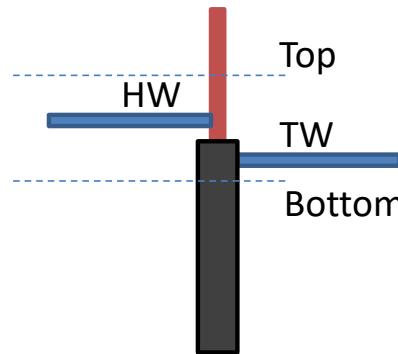


# Coastal Structures Functions



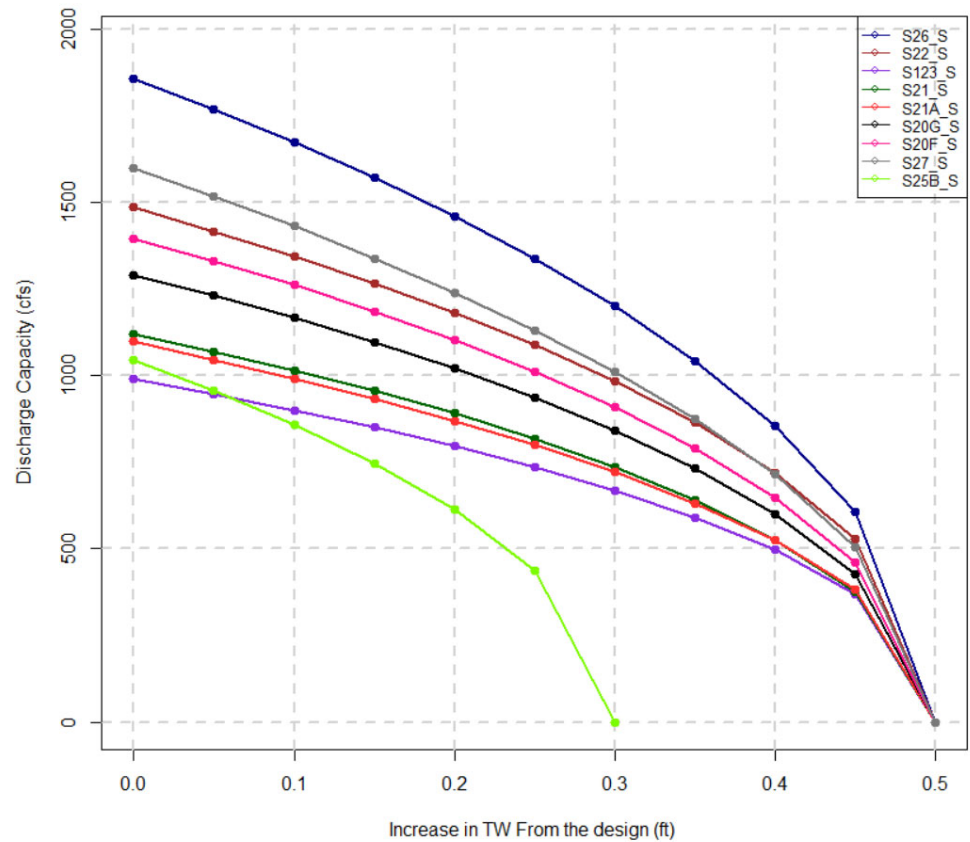
- Coastal structures
  - Terminal water control structures in the primary system
  - Critical for flood control and prevention of saltwater intrusion
  - Gravity driven
  - Require positive hydraulic gradient
  - Reduced discharging capacity at high tide level
- Coastal Structures Operations
  - Utilize seasonal operating ranges
  - Gates open
    - HW > Top Level and
    - HW > TW
  - Gates close
    - HW < Bottom Level or
    - HW < TW

HW: Landside water level  
 TW: Oceanside water level



# Coastal Structures Discharge Capacities

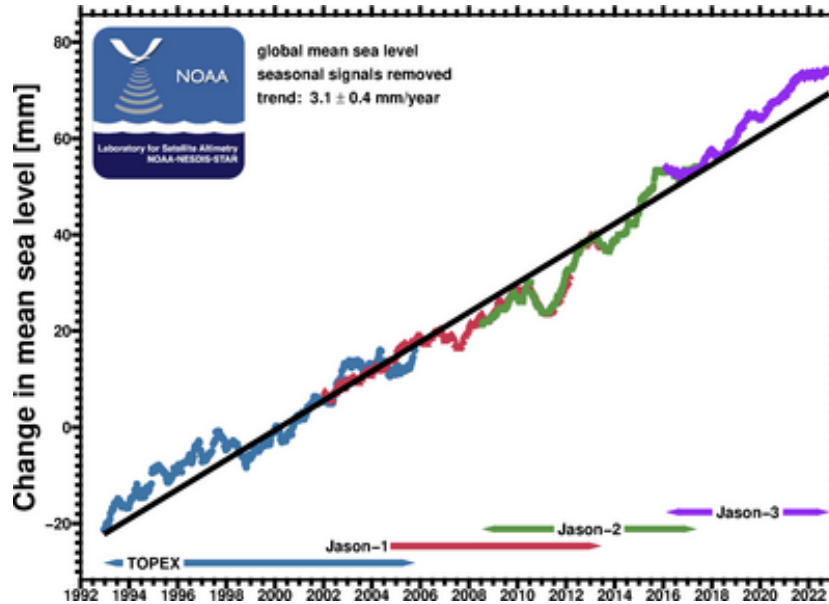
- Coastal structures discharge capacity
  - Depends on available head
  - Reduces with increase in TW





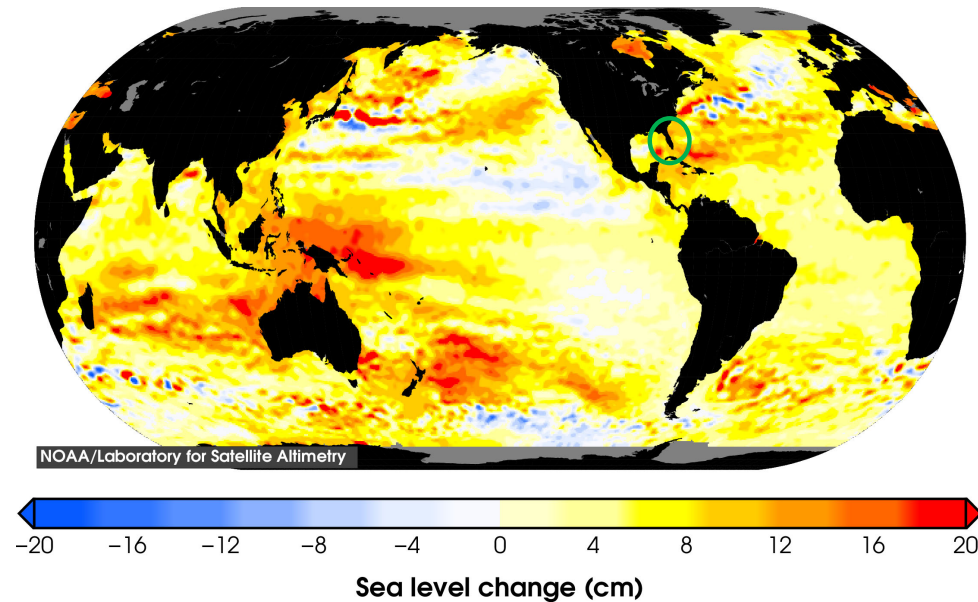
# Global Mean Sea Level

- Global Mean Sea Level
  - Average rate 3.1 +/- 0.4 mm/year



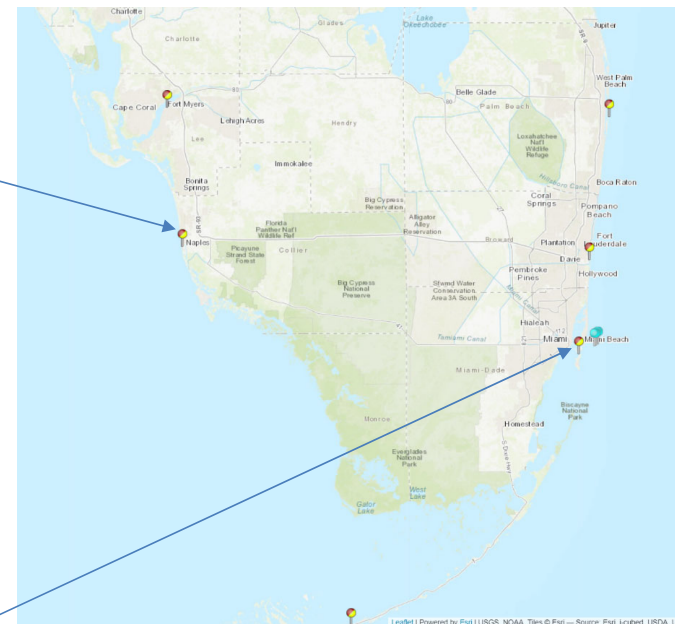
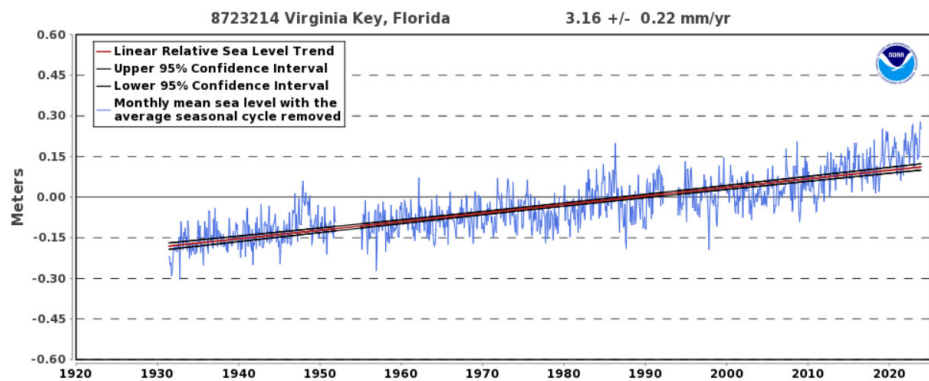
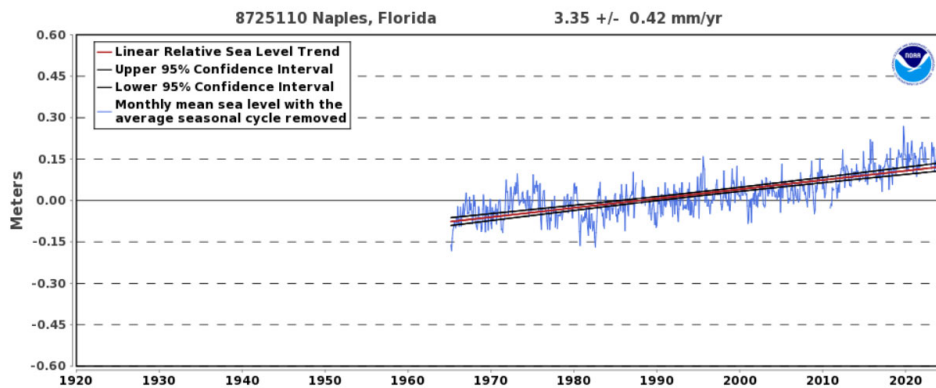
<https://www.star.nesdis.noaa.gov/socd/lsa/SeaLevelRise/>

Total regional sea level change since 1993



# Relative Sea Level Rise

## NOAA Tidal Gauges in the Region



<https://tidesandcurrents.noaa.gov/map/index.html?region=Florida>

# Water Level Trends – Resiliency Metric

## Water and Climate Resilience Metrics

As part of our ongoing resilience initiatives, the District has developed a set of Water and Climate Resilience Metrics to document trends and track shifts in District managed water and climate observed data. These efforts support the assessment of current and future climate conditions, modeling scenario formulation and adaptation planning, operational decisions, and the determination of District resiliency priorities.

### Learn More

The District's commitment to resilience includes informing stakeholders, the public, and partner agencies to support local resiliency strategies.

Visit the [Resilience Metrics Hub](https://www.sfwmd.gov/our-work/water-and-climate-resilience-metrics) to learn more about the data driving the District's resiliency efforts.

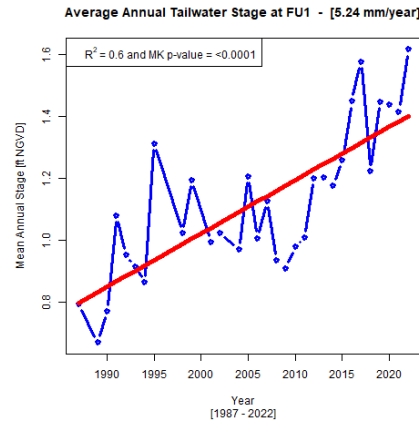
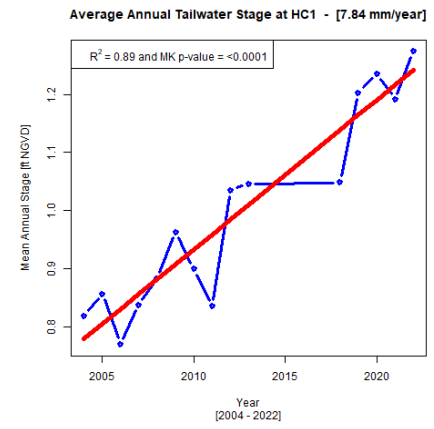
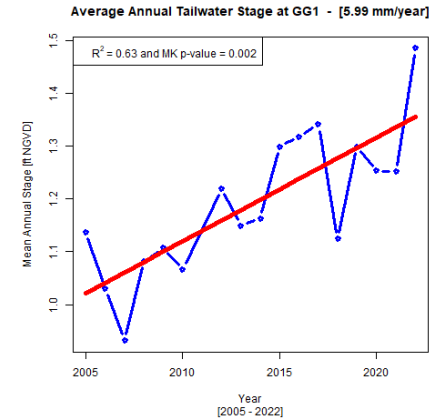
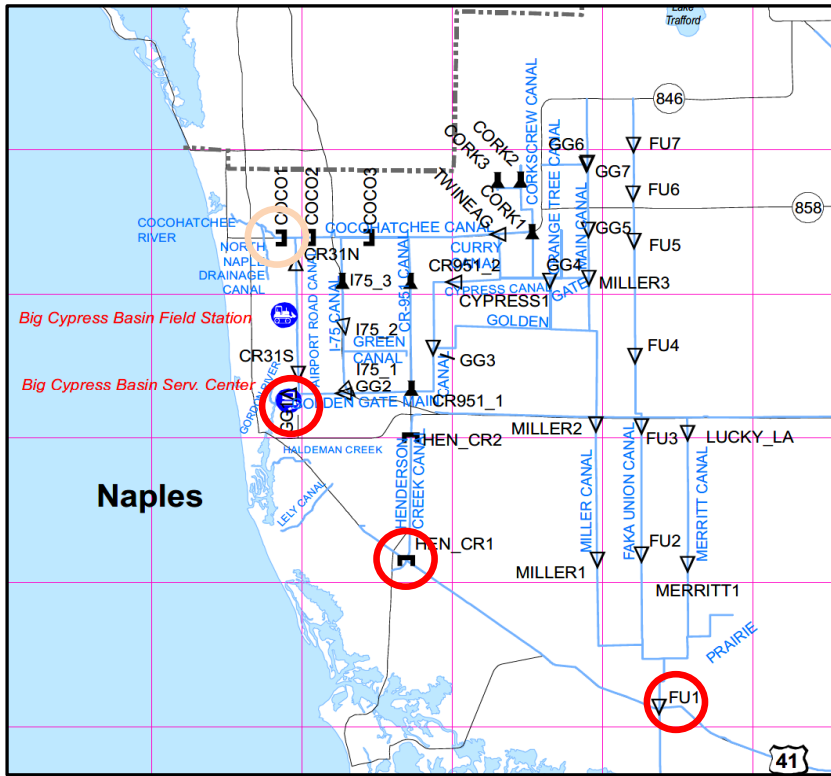


<https://www.sfwmd.gov/our-work/water-and-climate-resilience-metrics>



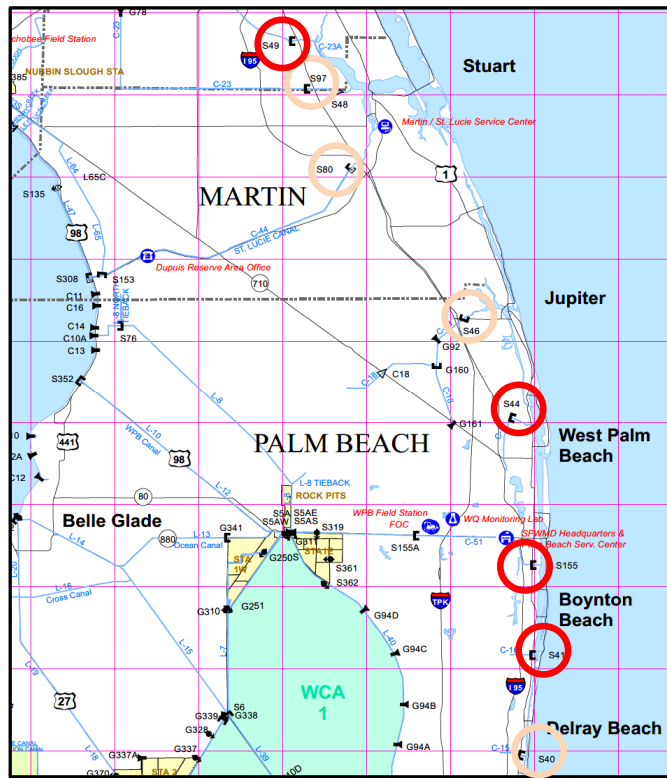
# Water Level Trends – Resiliency Metric

## West Coast of District

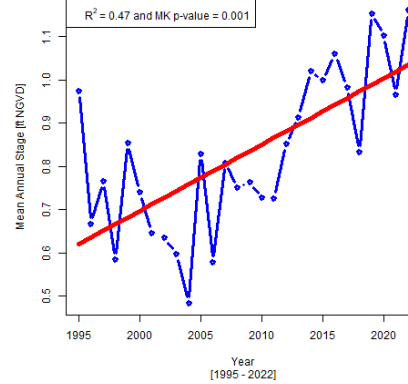


# Water Level Trends – Resiliency Metric

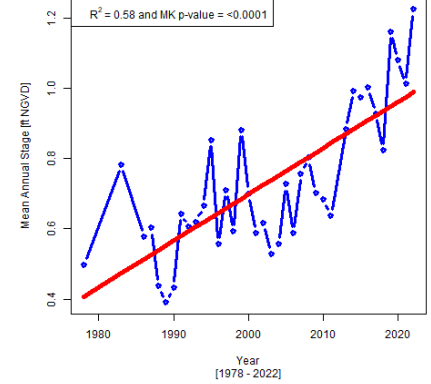
## Northeast of District



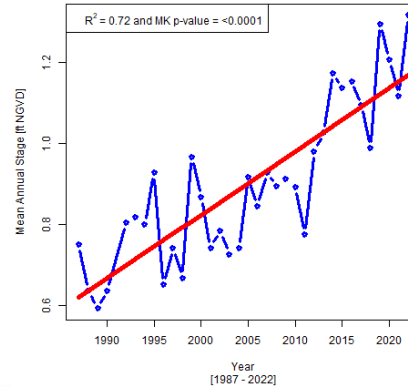
Average Annual Tailwater Stage at S49 - [4.67 mm/year]



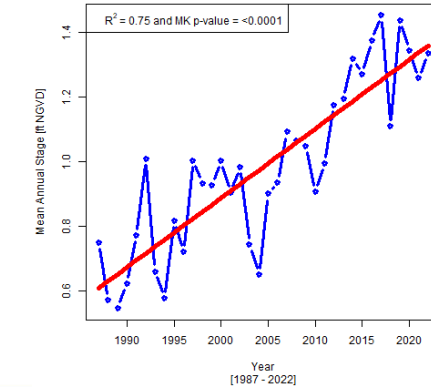
Average Annual Tailwater Stage at S44 - [4.02 mm/year]



Average Annual Tailwater Stage at S155 - [4.79 mm/year]



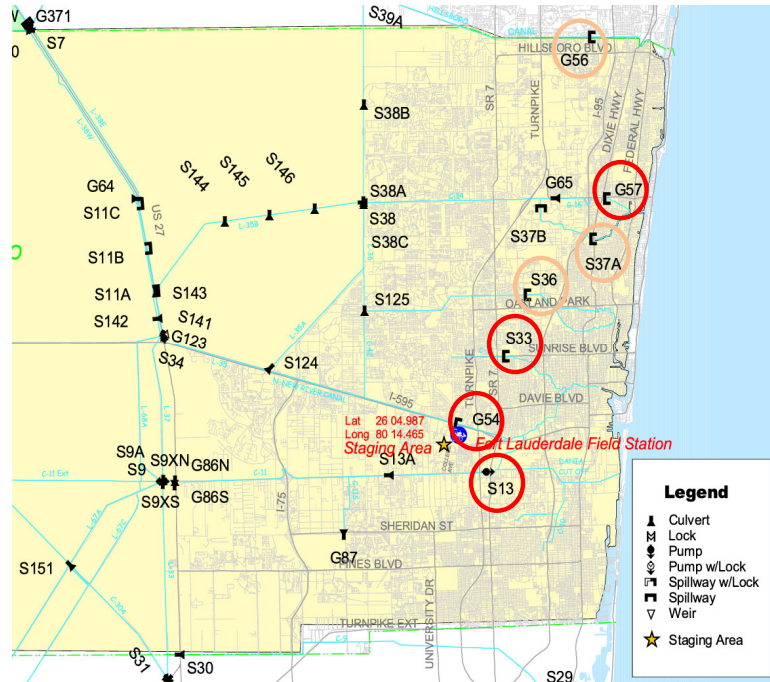
Average Annual Tailwater Stage at S41 - [6.52 mm/year]



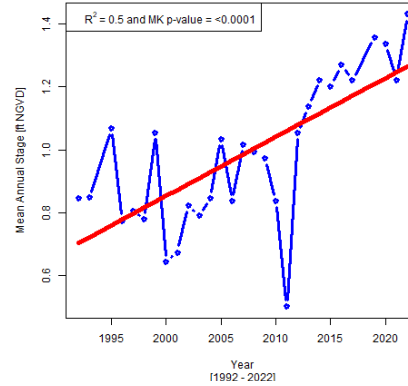


# Water Level Trends – Resiliency Metric

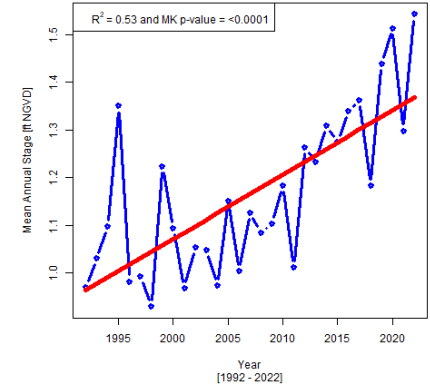
## Broward County



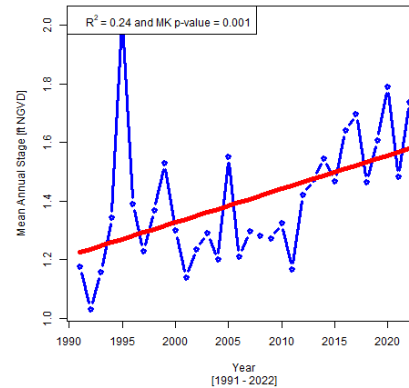
Average Annual Tailwater Stage at G57 - [5.69 mm/year]



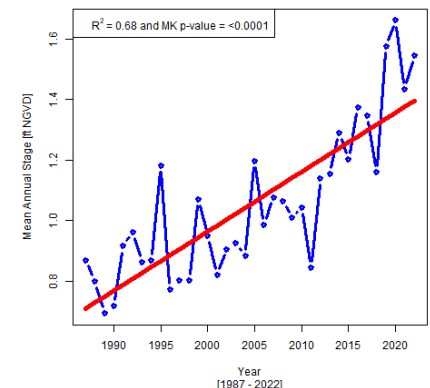
Average Annual Tailwater Stage at S33 - [4.11 mm/year]



Average Annual Tailwater Stage at G54 - [3.48 mm/year]

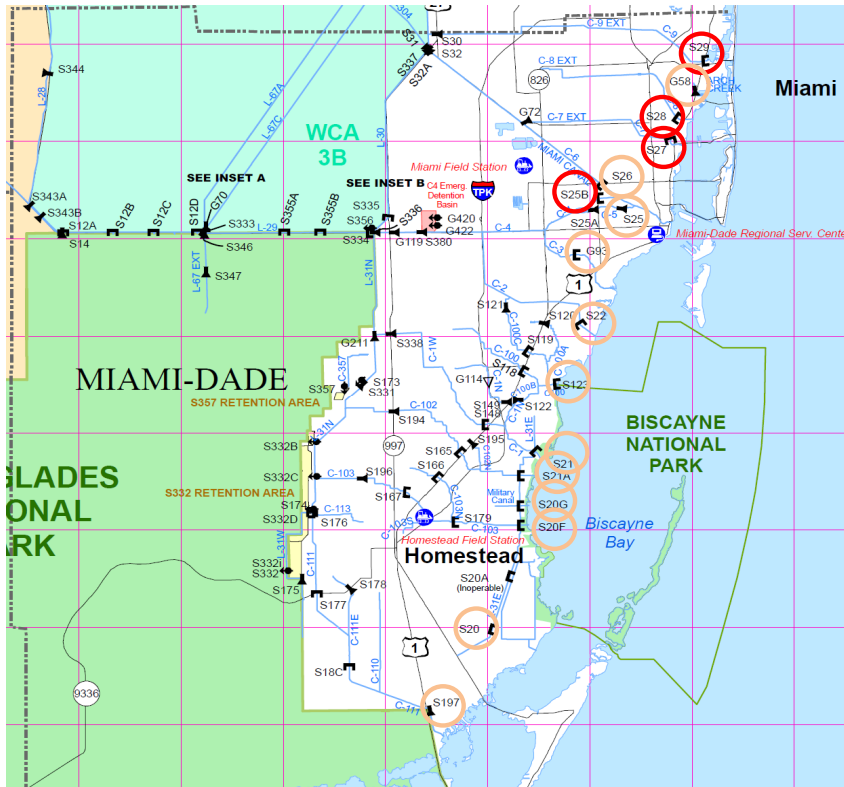


Average Annual Tailwater Stage at S13 - [5.96 mm/year]

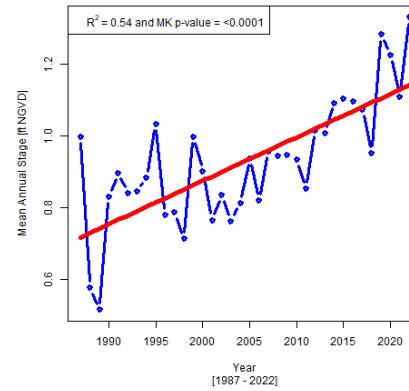


# Water Level Trends – Resiliency Metric

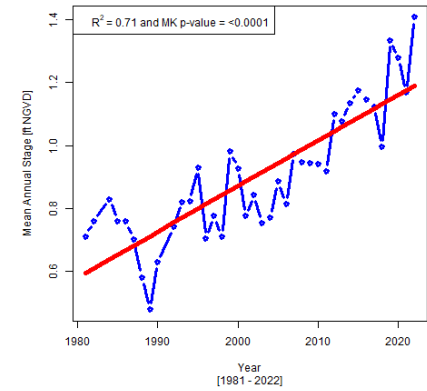
## ➤ Miami-Dade County



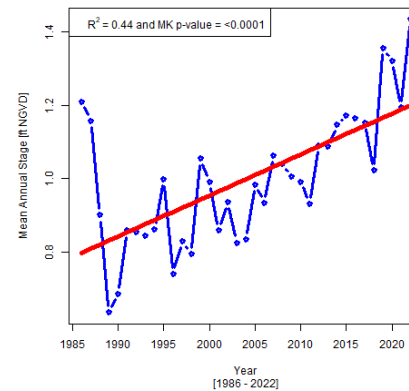
Average Annual Tailwater Stage at S29 - [3.7 mm/year]



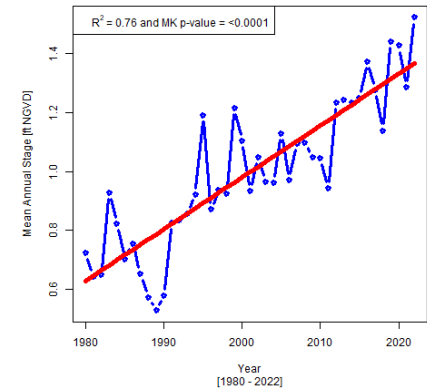
Average Annual Tailwater Stage at S28 - [4.43 mm/year]



Average Annual Tailwater Stage at S27 - [3.4 mm/year]



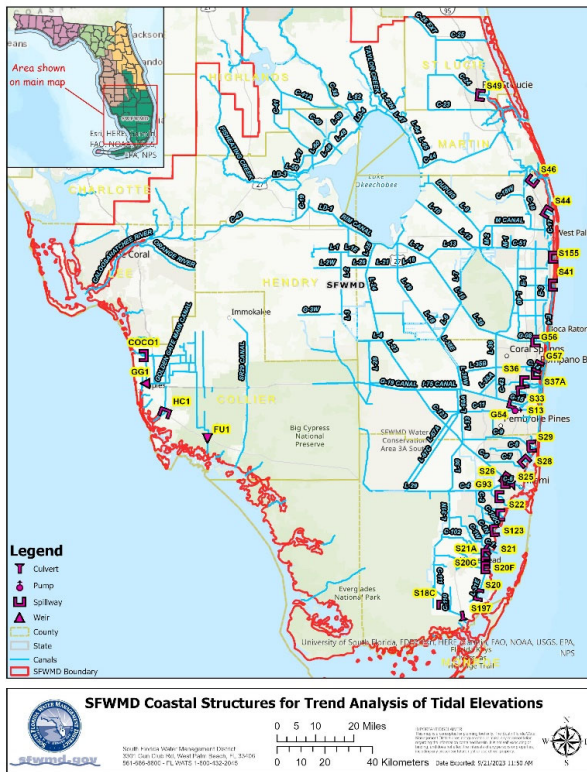
Average Annual Tailwater Stage at S25B - [5.36 mm/year]



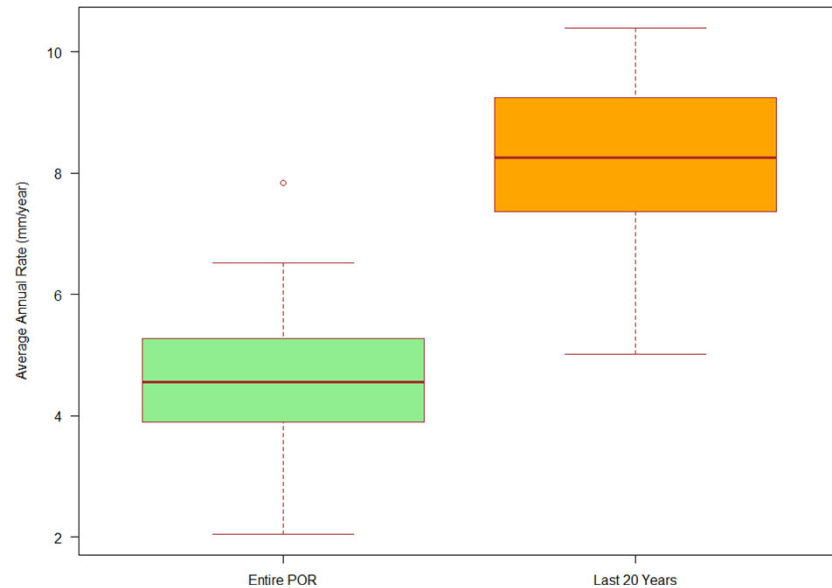


# Water Level Trends – Resiliency Metric

## ➤ All Coastal Structures



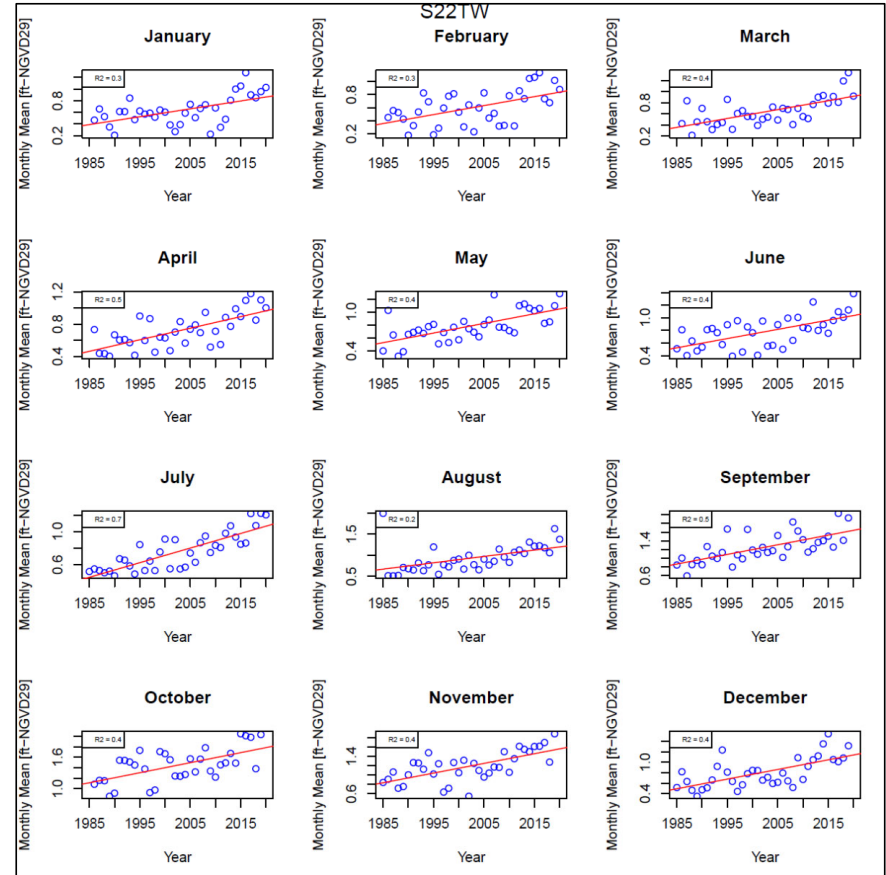
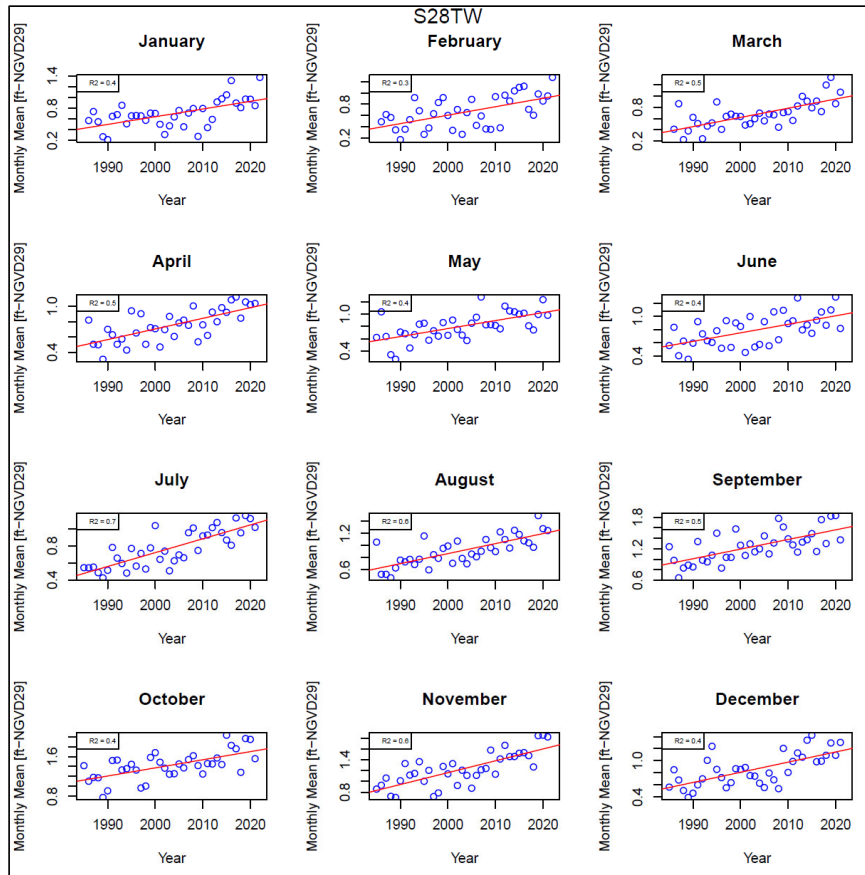
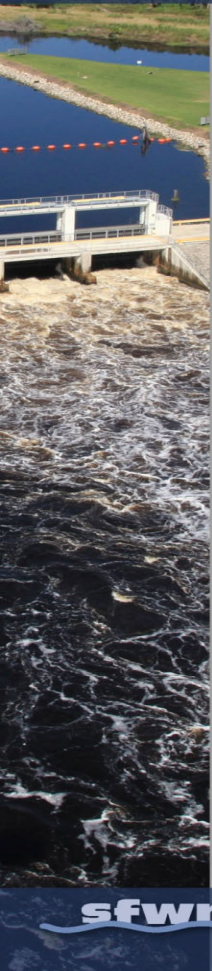
Average Annual Water Level Change Distribution - Period of Record vs Last 20 Years



Summary Statistic of Acceleration Rates	Water Level (mm/yr)
Lowest acceleration rate in annual average tidal water level	5
Average acceleration rate in annual average tidal water level	8.2
Highest acceleration rate in annual average tidal water level	10.4

Table 1 – Summary of statistics of acceleration rates of annual average tidal water level data at SFWMD’s 32 coastal structures for the past 20 years (2003-2022).

# Water Level Trends – Monthly Mean

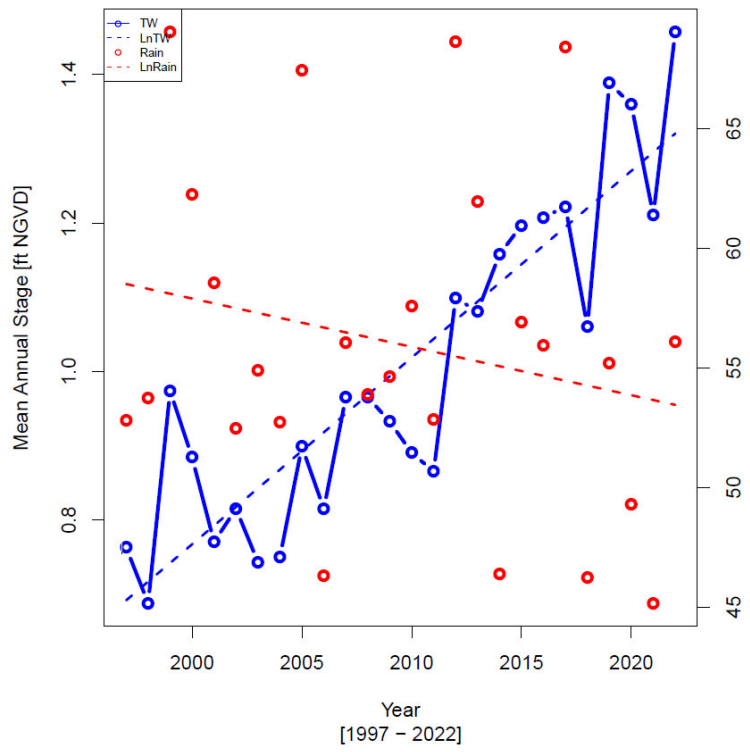




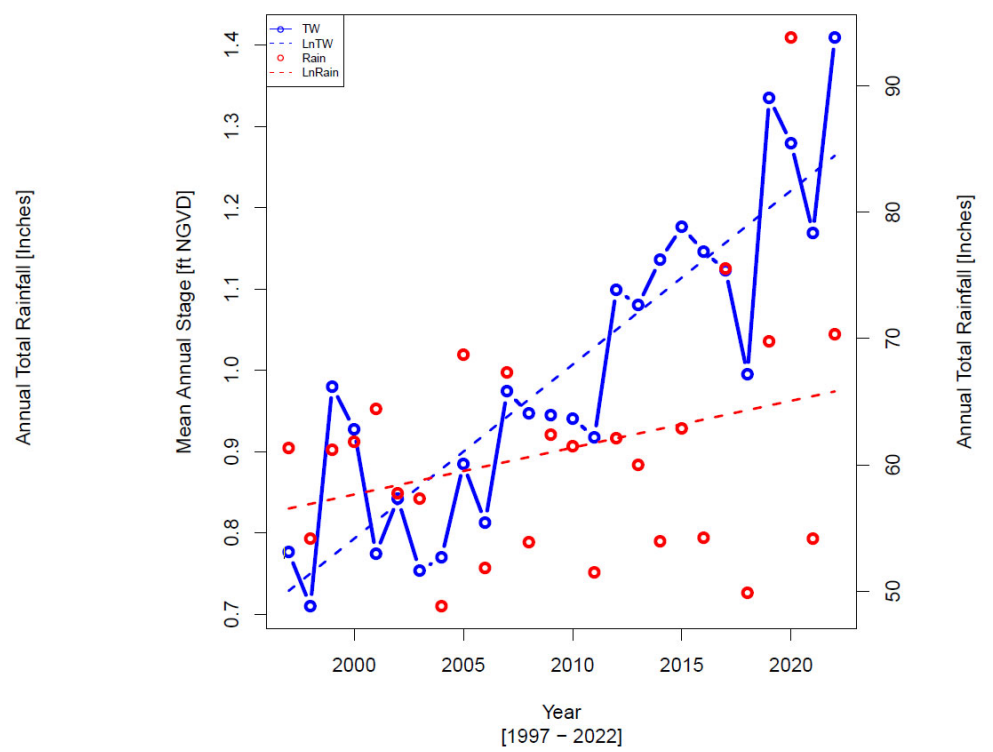
# Water Level Trends



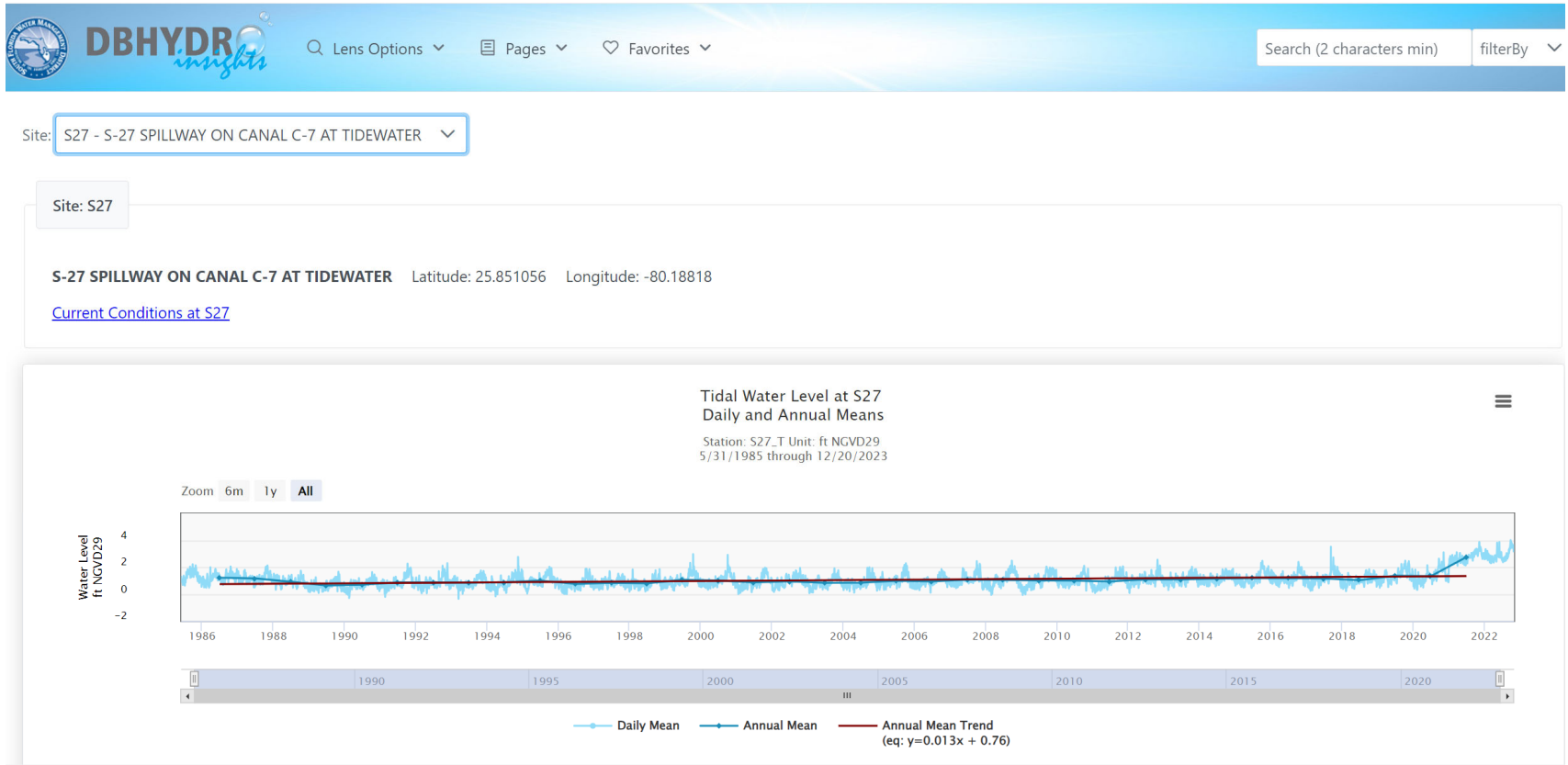
S22-T/C-2



S28-T/C-8



# Automation of Resiliency Metric



<https://apps.sfwmd.gov/dbhydroInsights/#/resiliency/sealevel/sites>

## Summary & Conclusions

- Coastal structures are critical in the management of the South Florida system
- Gravity coastal structures discharge capacity reduces with increased ocean side water level
- Observed water levels at coastal structures in south Florida have increasing trend
- Continuation of level of service in flood protection requires additional infrastructure (such as forward pumps)
- District actively working to mitigate impacts through its Resiliency and Flood Protection Level of Service Programs



Thank You!

Questions...