

Sea Level Rise and other Extreme Events

Planning for the Unthinkable

Thinking about the Un-plan-able

**Doug Yoder, Deputy Director
Miami-Dade Water and Sewer**

Goodbye, Miami

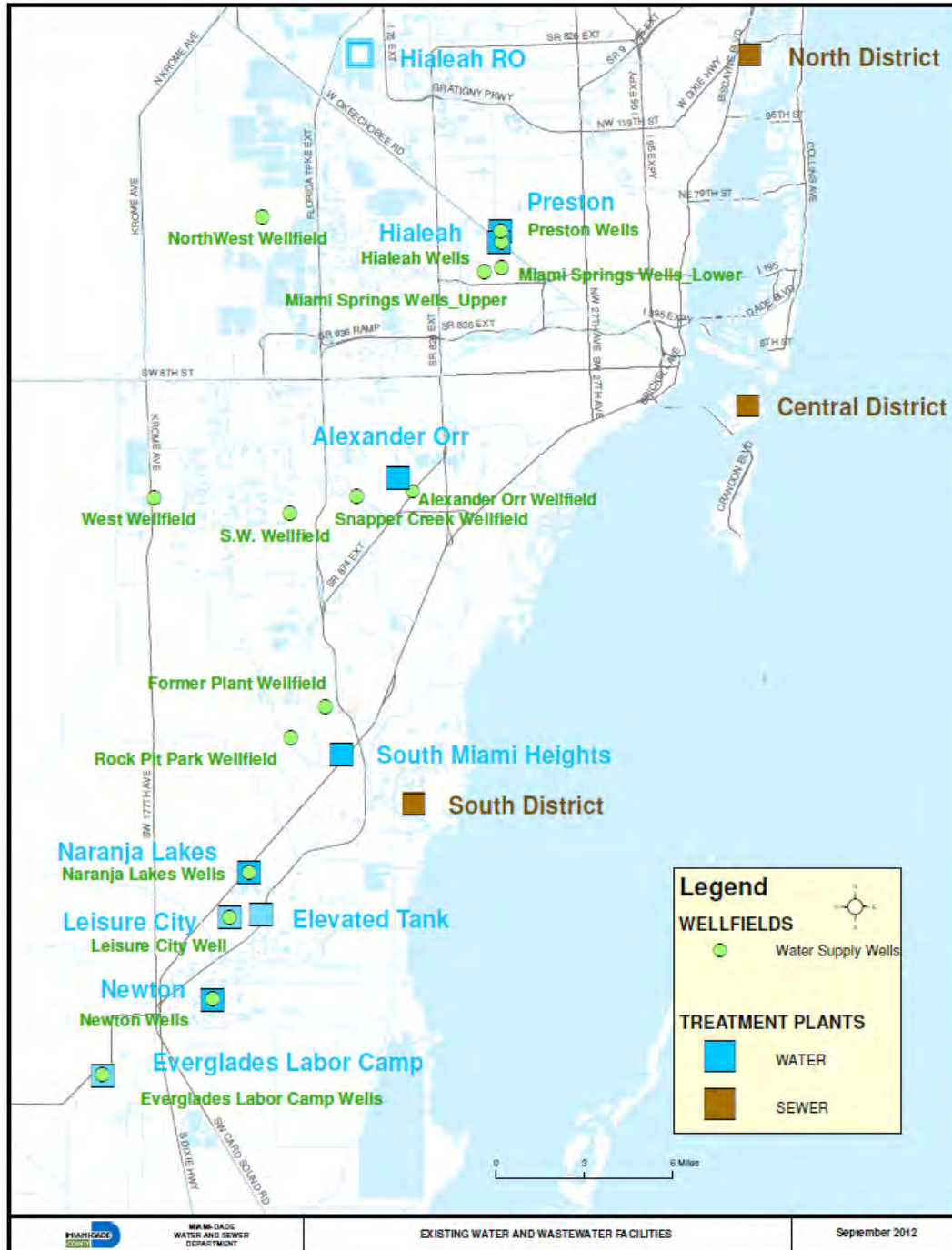
By century's end, rising sea levels will turn the nation's urban fantasyland into an American Atlantis. But long before the city is completely underwater, chaos will begin



Read more: <http://www.rollingstone.com/politics/news/why-the-city-of-miami-is-doomed-to-drown-20130620#ixzz2eUmdbTE0>

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WASD's Water & Wastewater Major Facilities

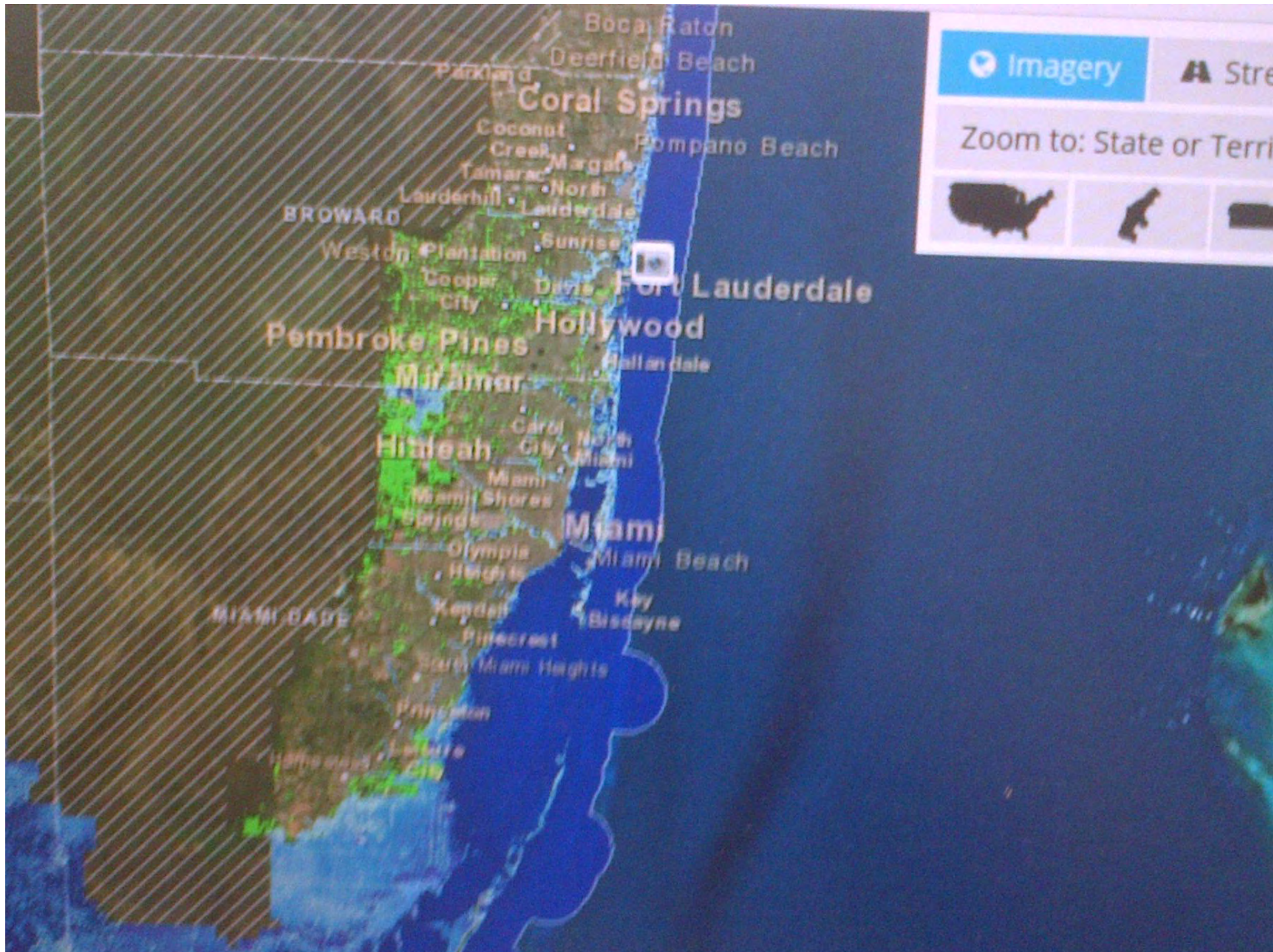


Sea Level Rise/Climate Change Issues

- Storm Surge
- Ground Water Rise/Drainage System Failure
- Salt Water Intrusion
- Rainfall Quantity, Intensity, and Distribution
- Inflow/Infiltration; Drainfield Failures
- Future Demand Forecasts:Quantity, Location

Adaptive Management for Storm Surge

- Abandon facilities and recreate capacity?
- Isolate entire facilities?
- Harden the most vulnerable parts of facilities?
- Useful life vs. additional risk vs. future demand

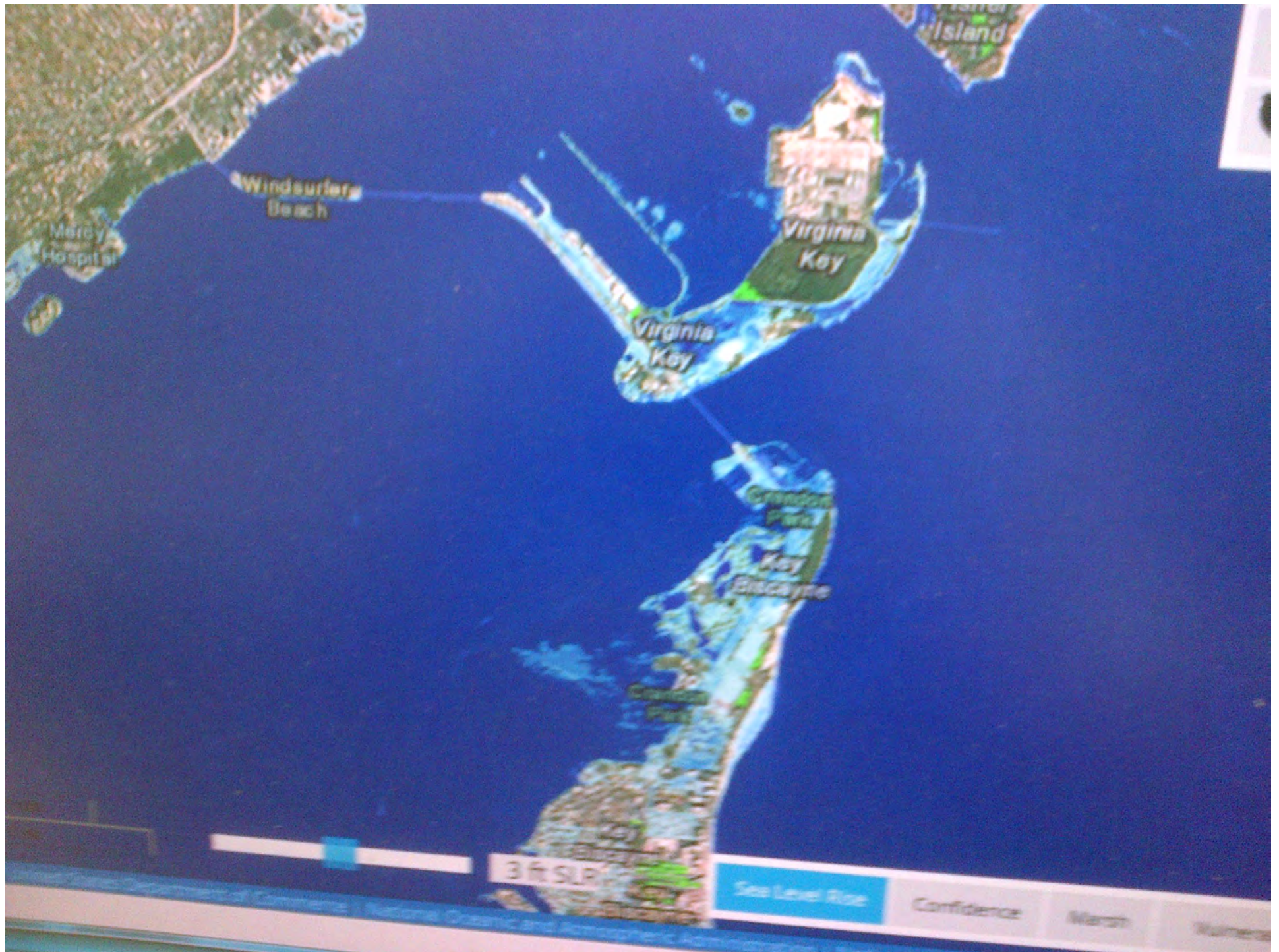


Imagery

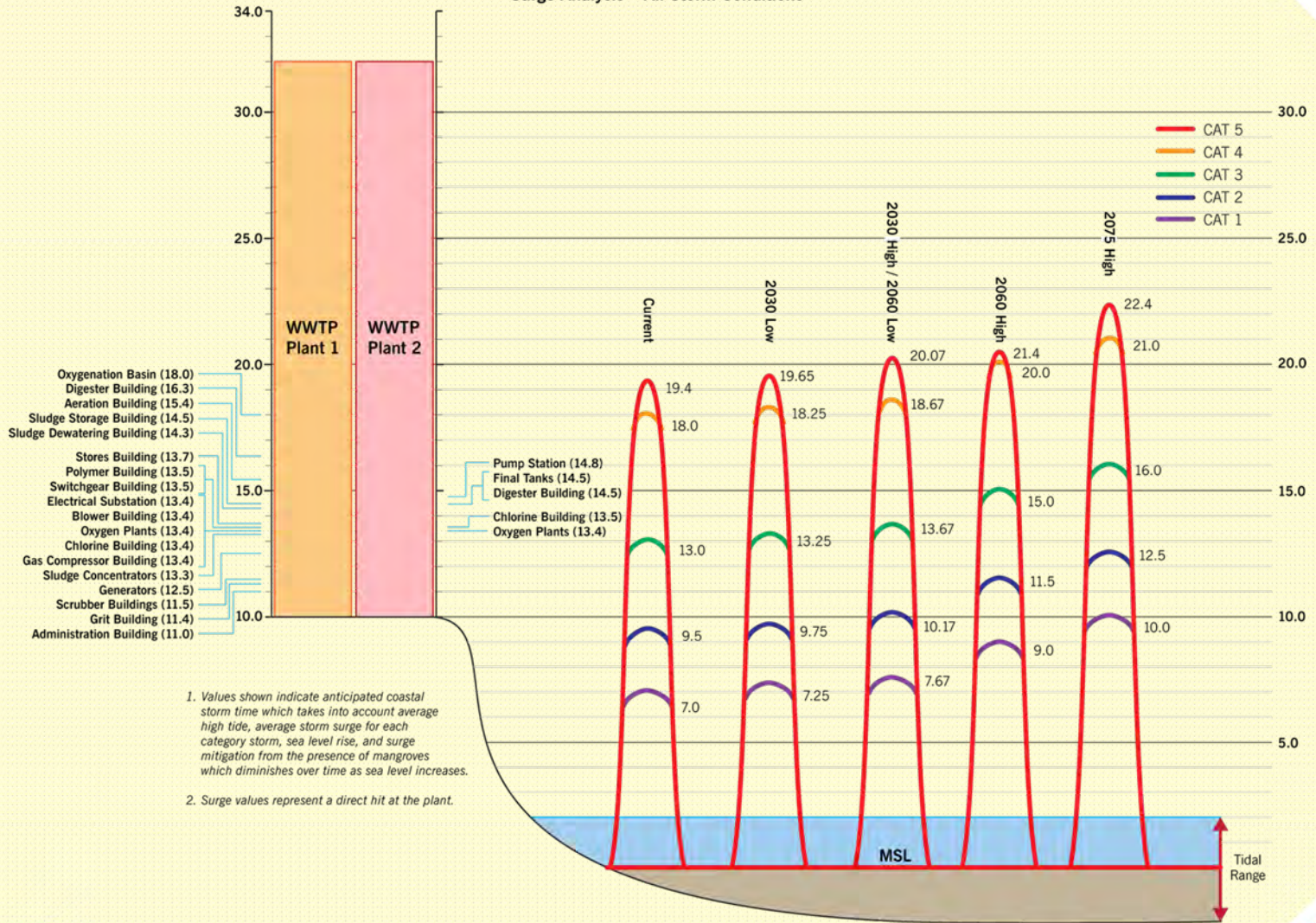
Streets

Zoom to: State or Territory





Central District Wastewater Treatment Plant Surge Analysis – All Storm Conditions



1. Values shown indicate anticipated coastal storm time which takes into account average high tide, average storm surge for each category storm, sea level rise, and surge mitigation from the presence of mangroves which diminishes over time as sea level increases.
2. Surge values represent a direct hit at the plant.

Cost Impacts of Storm Surge

- Assumptions
 1. Plant Structures Are Not Destroyed
 2. Mechanical Equipment is Not Destroyed
 3. 90% of Affected Electrical is Destroyed
 4. 100% of Affected Instrumentation is Destroyed

Mitigation Alternatives

- Large Scale Surge Barriers
- Move the WWTP
- Plant Level Barriers
- Asset Level Barriers/Mitigation
- Raise Equipment Levels
- Plug Drains, Sanitary Sewers, Wall Penetrations, Electrical Conduits

Plant Level Barriers – Estimated Costs

STATIC BARRIER						
Plant	Unit	Qty	Unit Cost	TOTAL	With 30%	
NDWWTP	lf	6,646	\$ 1,500	\$ 9,969,000	\$	12,959,700.0
CDWWTP	lf	7,940	\$ 1,500	\$ 11,910,000	\$	15,483,000.0
SDWWTP	lf	14,628	\$ 1,500	\$ 21,942,000	\$	28,524,600.0
Stormwater Pump Station	ea	3	\$ 15,000,000	\$ 45,000,000	\$	58,500,000.0
TOTAL					\$	115,467,300.0

Building Specific – Estimated Costs

BUILDING/AREA HARDENING					
NDWWTP	Unit	Qty	Unit Cost	TOTAL	With 30%
Concrete Walls	lf	1190	\$ 1,500	\$ 1,785,000	\$ 2,320,500
Flood Logs	sf	3100	\$ 170	\$ 527,000	\$ 685,100
Watertight Doors	ea	74	\$ 10,000	\$ 740,000	\$ 962,000
Installation of flood logs and doors (40% of cost)				\$ 506,800	\$ 658,840
SUB TOTAL					\$ 4,626,440
CDWWTP	Unit	Qty	Unit Cost	TOTAL	With 30%
Concrete Walls	lf	1920	\$ 1,500	\$ 2,880,000	\$ 3,744,000
Flood Logs	sf	4550	\$ 170	\$ 773,500	\$ 1,005,550
Watertight Doors	ea	160	\$ 10,000	\$ 1,600,000	\$ 2,080,000
Installation of flood logs and doors (40% of cost)				\$ 949,400	\$ 1,234,220
SUB TOTAL					\$ 8,063,770
SDWWTP	Unit	Qty	Unit Cost	TOTAL	With 30%
Concrete Walls	lf	1440	\$ 1,500	\$ 2,160,000	\$ 2,808,000
Flood Logs	sf	6816	\$ 170	\$ 1,158,720	\$ 1,506,336
Watertight Doors	ea	139	\$ 10,000	\$ 1,390,000	\$ 1,807,000
Installation of flood logs and doors (40% of cost)				\$ 1,019,488	\$ 1,325,334
SUB TOTAL					\$ 7,446,670
				TOTAL	\$ 20,136,880

National Policy Issues

- EPA approach through Climate Ready Utilities has been encouragement, information, and tech tools
- No consent decrees include climate change provisions
- Should utility responses to CC remain an engineering best practices approach?
- Should EPA enact prescriptive regs?

Timing Matters

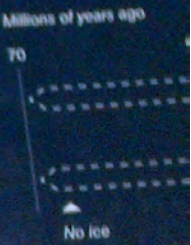
If you have a 10 year old car with a flat tire and you know that in 20 years you will need a boat instead of a car, should you buy a new tire or a boat?

Misery Loves Company:

- An August 13 Huffington Post column identified 14 US Cities at risk from Sea Level Rise:
- Miami, Ft. Lauderdale, Boston, New York, Atlantic City, Honolulu, New Orleans, Sacramento, San Diego, Los Angeles, Charleston, Virginia Beach, Seattle, Savannah



A HISTORY OF ICE
The last time Earth was free of ice was 70 million years ago, in the Eocene epoch. The planet was covered in swamps. But the planet slowly cooled from the air and was locked up in ice sheets formed first in Antarctica. In the next 100,000 years they've repeatedly surged. We're living in a warm interglacial period. Chicago, New York, and



Port-au-Prince