Future Impacts on Biscayne Bay of Extended Operation of Turkey Point Cooling Canals

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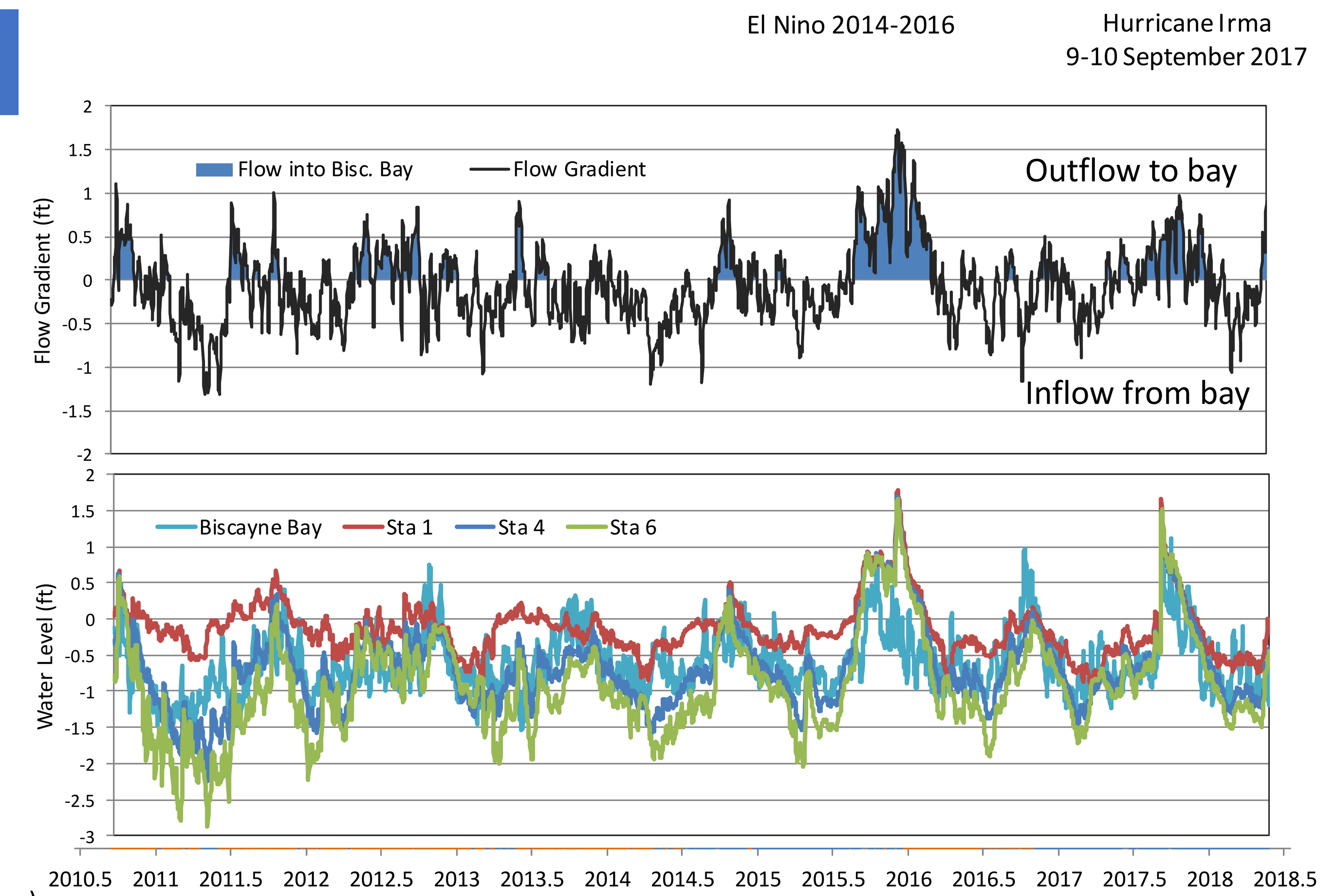
Background, Summary and Implications

The discharge of water from the cooling canal system (CCS) into Biscayne Bay occurs intermittently through multiple hydrological connections provided by the Biscayne aquifer and its transmissive bedrock. Changed operations of the CCS since 2012 have accelerated the seepage to Biscayne Bay. High concentrations of nutrients and tritium have been detected over a three year period in Biscayne Bay immediately adjacent to the CCS in deep canals and cave sites.

The highest nutrient levels occur during periods of sustained high-water levels in the CCS when the volume of water is at or near its maximum and Biscayne Bay tides are at a minimum, this occurs approximately 30% of the time. Due to current changes and planned future changes in operations to try to decrease the salinity and temperature of the CCS, these conditions are expected to worsen as more water is added to the CCS from a planned waste water treatment plant. Current seagrass species composition and abundance data collected by ongoing seagrass monitoring programs show that Turtle Grass biomass offshore from the CCS is unusually dense and dominated by fast growing and nutrient loving *Halodule Sp*. compared to other areas in southern Biscayne Bay, likely as a consequence of increased P availability in the near-shore area. P concentrations in the deeper canals offshore of the CCS and in caves offshore of Turkey Point are 10-20 times higher than the median concentrations (0.03 µM) of inorganic phosphorus in Biscayne Bay waters (Caccia and Boyer 2005)

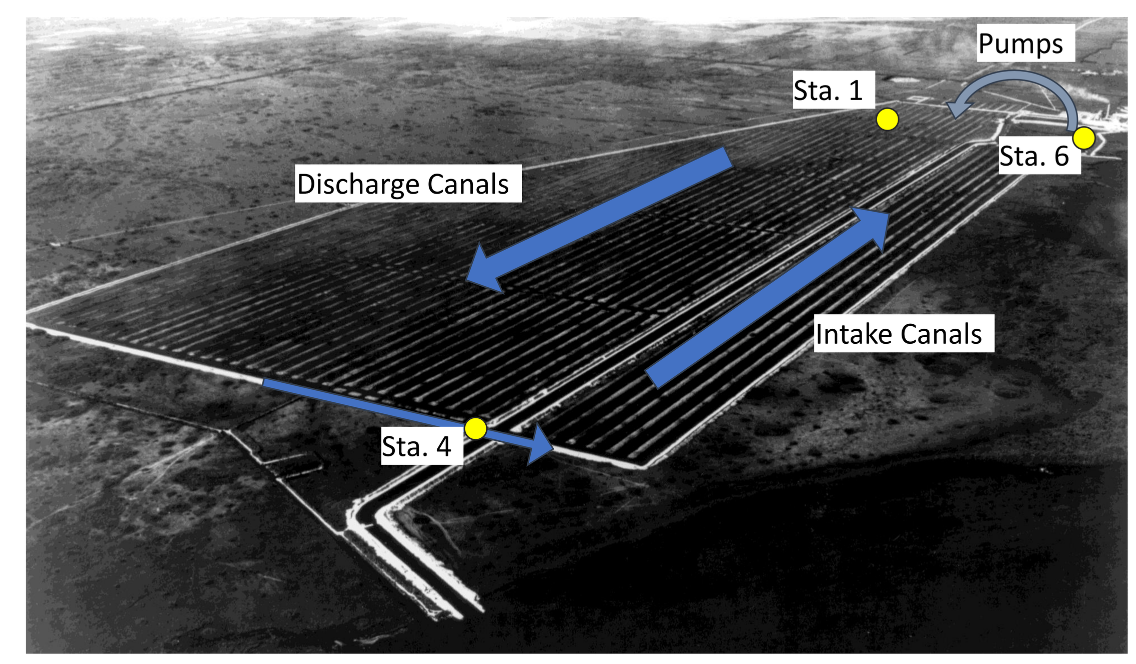
Operation of the CCS have likely 1) carried phosphorus-polluted groundwater to near-shore surface waters through the highly porous bedrock and 2) has dissolved carbonates in that bedrock, releasing additional phosphorus that had been incorporated into that rock. As this phosphorus reaches the seagrass meadows offshore in Biscayne Bay, it will continue to degrade the ecosystem and cause an imbalance and change the nature of the surrounding marine environment. An imbalance of the seagrasses that form the near-shore habitat adjacent to the CCS in Biscayne Bay and provide the food at the base of the food chain harms the fish and wildlife that depend on these habitats and therefore impact fishing, and other recreational activities such as birdwatching based on that habitat changes and eventual loss. The high salt and nutrient concentrations reaching the bay and the competing demand for water are in direct conflict with Everglades Restoration projects.



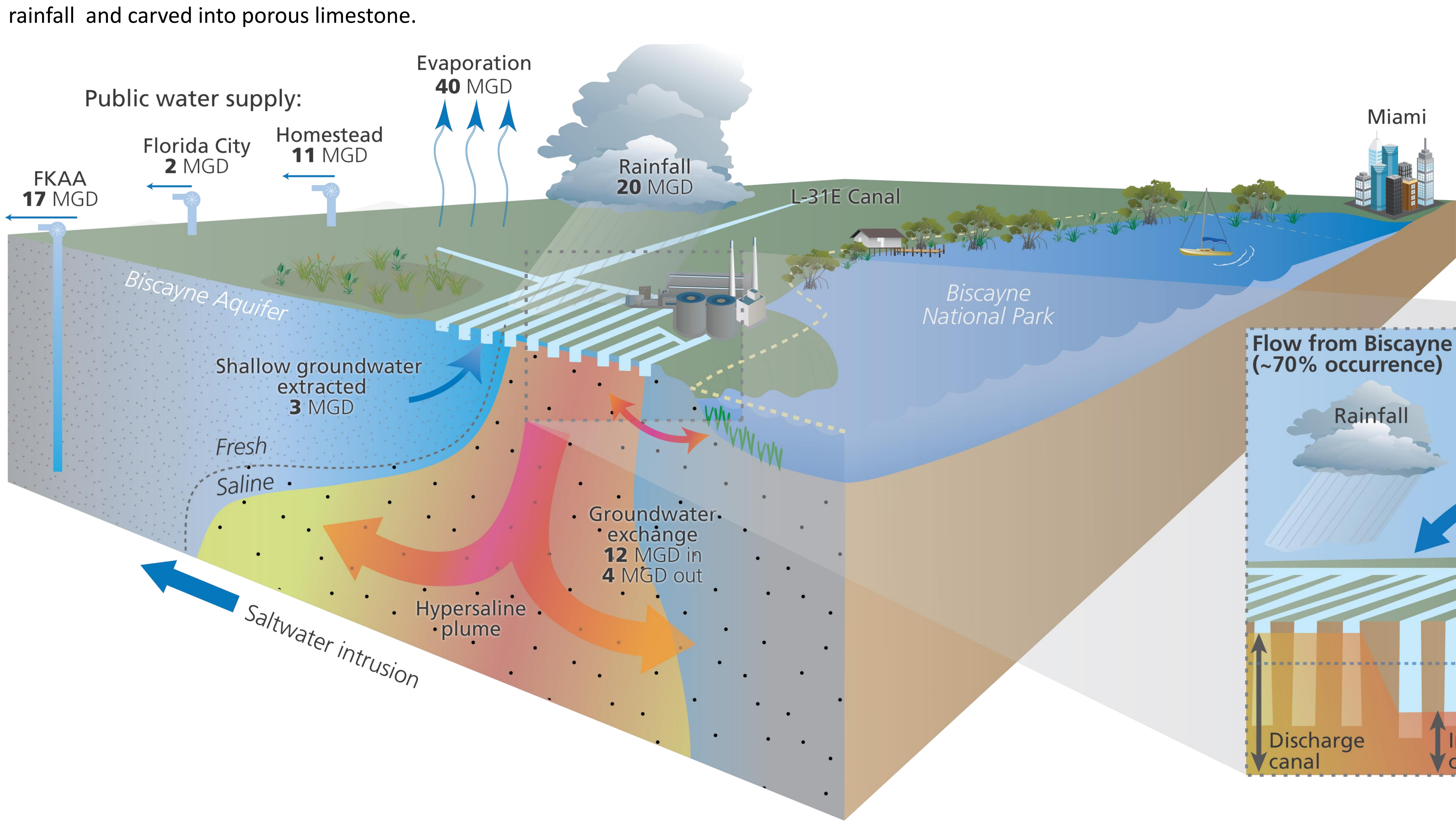
Right: Intermittent flow from the CCS toward Biscayne Bay shown by the calculated flow gradient (upper) and supporting data (lower)

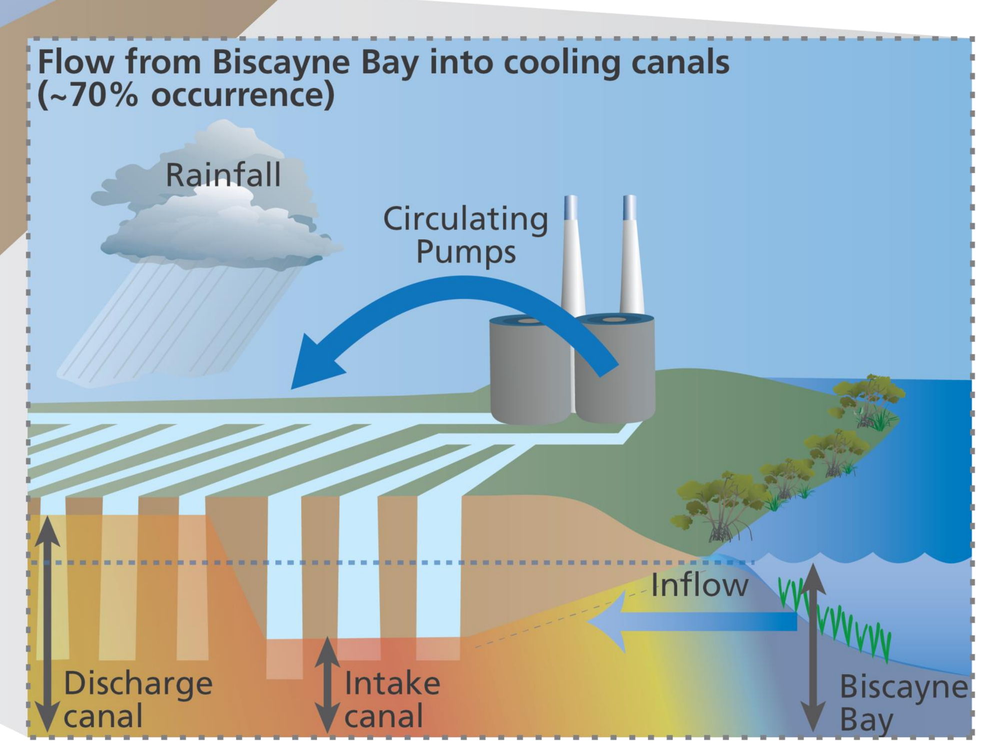
Water Quality and Salt Budgets Reveal Flows Between the Cooling Canals and Biscayne Bay 30% of the Time

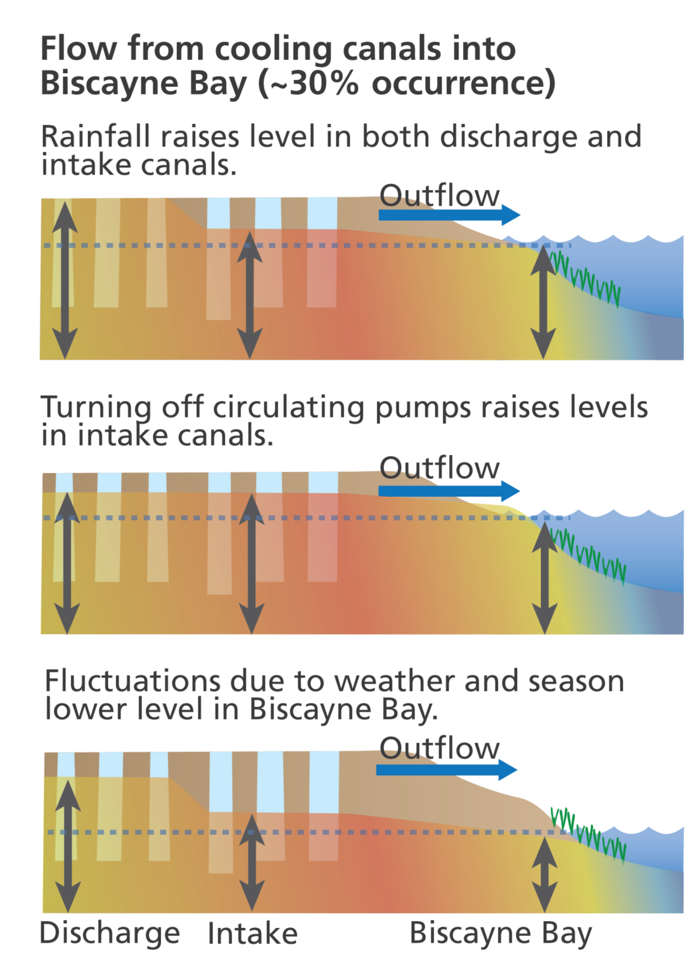
Detailed information on the water quality and salt budgets, the result of 10 years of in-depth monitoring by multiple agencies, reveals how the cooling canals interact with the Biscayne aquifer and Biscayne Bay. Miami Dade DERM's multi-year water quality monitoring data revel that discharge from the CCS into the surface waters of Biscayne Bay is occurring and those high levels of nutrient are violating Numeric Nutrient Standards as well as narrative water quality standards meant to protect Biscayne Bay, a historically nutrient poor system. On average, there is a net inflow of groundwater into the canals to help balance water loss due to high rates of evaporation. However, significant outflows of water from the cooling canals also occurs in response to the variation in water levels in space and over time. Under normal operations, pumps circulate water through the power plants. This draws down water level in the intake canals (Sta. 6) and raises water level where the pumps discharge into the canals (Sta. 1). The difference in water level between Sta. 1 and Sta. 6 drives flow down the discharge canals and up the intake canals back to the plants. Elevated water level at Sta. 1 drives the outflow of hypersaline water down into the aquifer. Most of the time lowered water level (Sta. 6) drives inflow to the intake canals. Outflow from the CCS toward Biscayne Bay occurs intermittently, about 30% of the time, in response to heavy rainfall, plant operations, and fluctuations in Biscayne Bay water levels, which occur in response to weather and seasonal changes in sea level. This open system is completely dependent upon weather patterns and is vulnerable in the future because it is at sea-level, dependent on rainfall and carved into porous limestone.



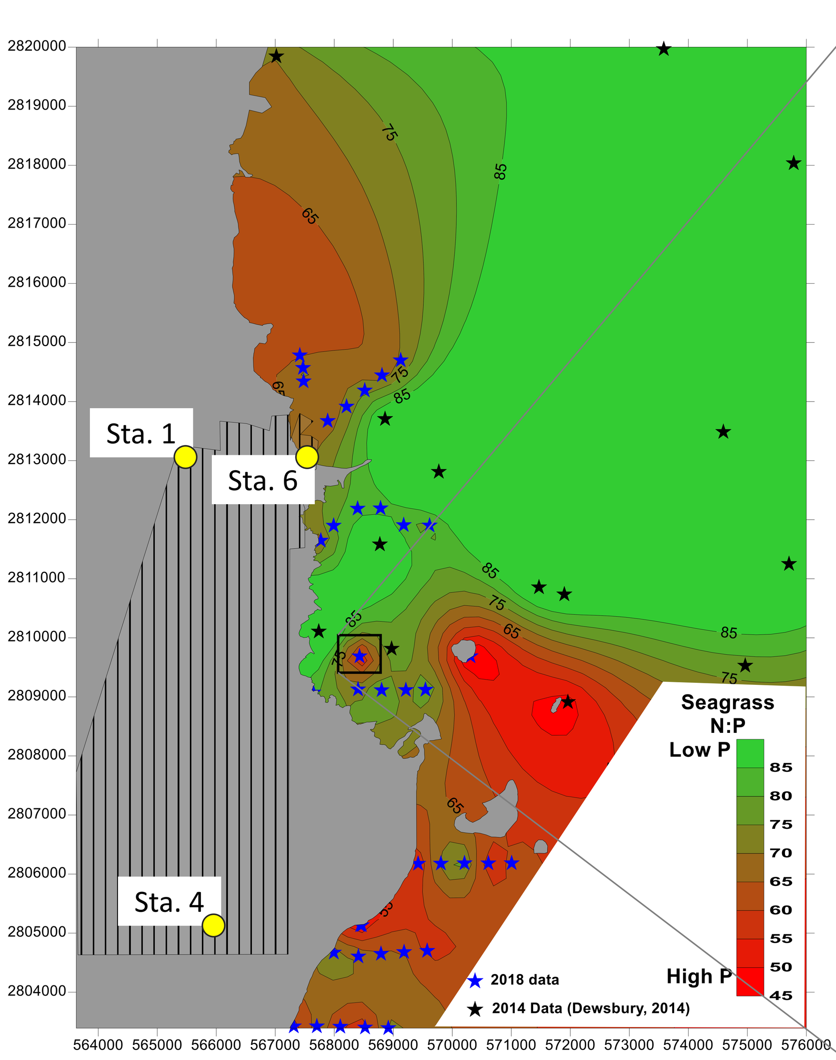
Cooling canals showing general circulation and locations of water level data.
[Image source: https://commons.wikimedia.org/wiki/File:HD.6B.314_(11842469035).jpg]





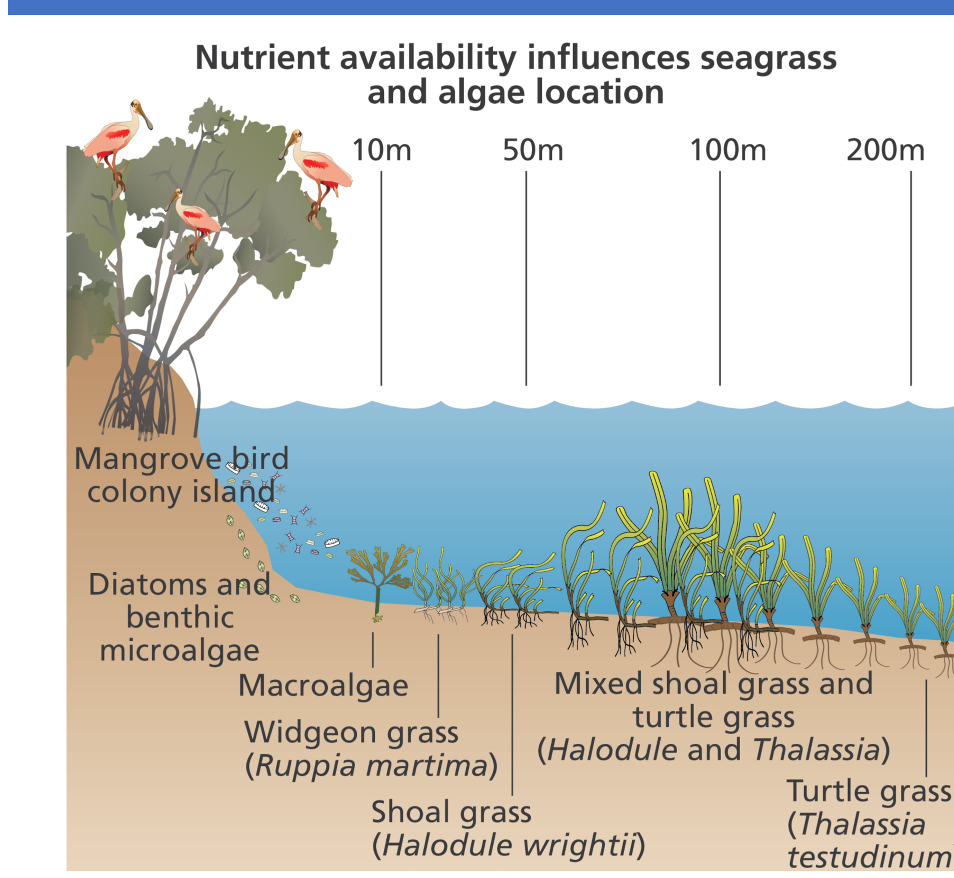


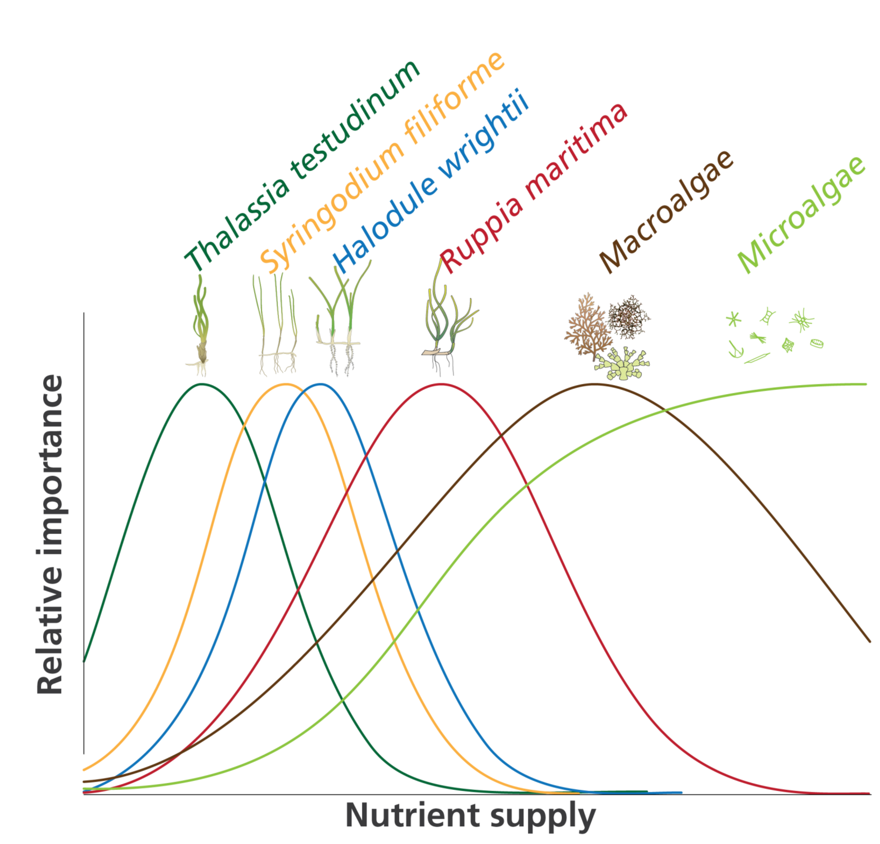
Seagrasses Response to Nutrient Availability Near Turkey Point



Biscayne Bay is a phosphorus-limited ecosystem, consequently the ratios of N to P in seagrass leaves is generally greater then 85. Immediately offshore from the CCS, seagrass N:P suggests that P availability is much higher than normal Biscayne Bay background levels. And time series aerials show that high P in this area is related to very dense seagrasses that collapsed over the period 2010-2014. Under P pollution, normally P-limited turtlegrass (Thalassia testudinum) first increase in density (see dark patch in 2010 aerial), then gets displaced by progressively faster-growing species until no benthic vegetation is left at the highest P pollution levels. Note the opening up of bare areas in the dense patch by 2017.

Increases in Phosphorus Availability Drive Ecosystem Change





The patterns we see near Turkey Point are consistent with the predictions made by this model of the relationships between nutrient availability and seagrass status in south Florida under conditions of nutrient pollution. In the figure above those inputs come from a bird rookery, but adjacent to the CCS the P sources are likely to be the result of CCS operations within the CCS that includes chemical components added for cleaning, biomass death that occurred within the CCS in 2014, and any nutrient pulled into the system from the surrounding environment that has been concentrated overtime as the freshwater evaporates away.