DELAWARE CENTER FOR THE
INLAND BAYS
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2021 State of the Bays

Review of Draft Water Quality Indicator Data

STAC Subcommittee Meeting
04/13/2022

Agenda

- Overview of WQ indicator status and meeting purpose

- WQ indicators
  - Analytical methods
    - Main analyses
    - Trends (seasonal Mann Kendall, GAM), Need to Pick One!
    - Report Card style
  - Results
  - Messaging
  - Status Bar and Trend

- Feedback and Next Steps

Analysis Methods – Determining Status and Trend

- Only data March-November (eelgrass growing season)
- In order for a year to qualify it needed at least 3 observations
- Last valid year needed to be between 2016-2020
- Median of the medians from 2016-2020 is the station's status
- For trends, only stations with 10 or more years were analyzed

Analysis Methods – Determining Status and Trend

- Trends assessed two ways

1. Seasonal Mann Kendall on yearly medians over time (alpha = 0.05)
   - Approach used in previous report

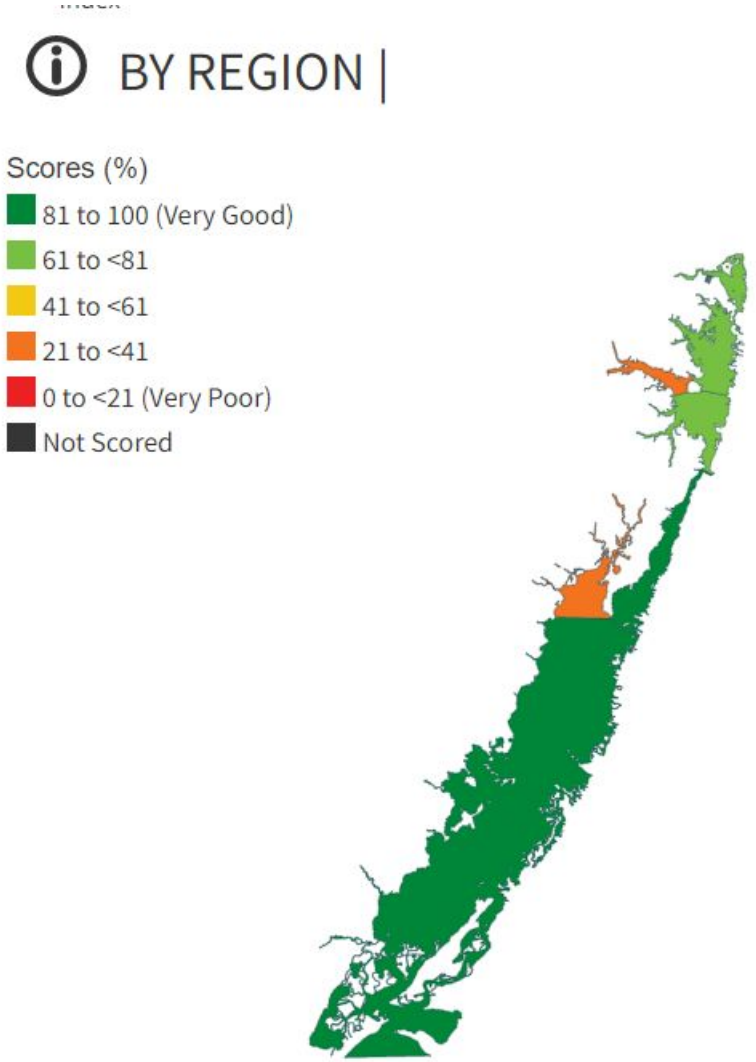
2. Generalized additive model on all samples from qualifying years (alpha = 0.05, deviance >= 10%, r^2 >= 0.1)
   - Attempt to match DNREC approach in 305(b) report
   - Attempt to better handle the non linear relationships seen at multiple stations

Mann Kendall vs GAM

Mann Kendall	GAM
non parametric	non parametric
non linear (but looking for consistent increase or decrease over time)	non linear (better able to handle complex non linear data)
used on medians	used on actual observations
standard used by many agencies and in previous reports	“newer” method for WQ trend tests, used in DNREC 305(b) report for Inland Bays

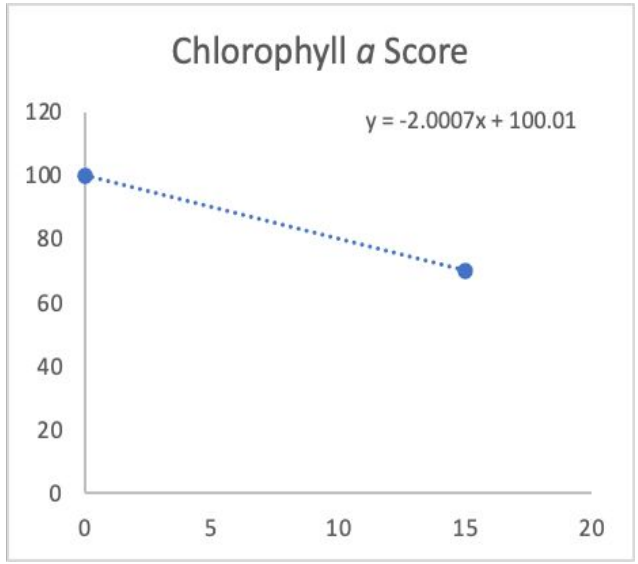
Analysis Methods – Report Card Style

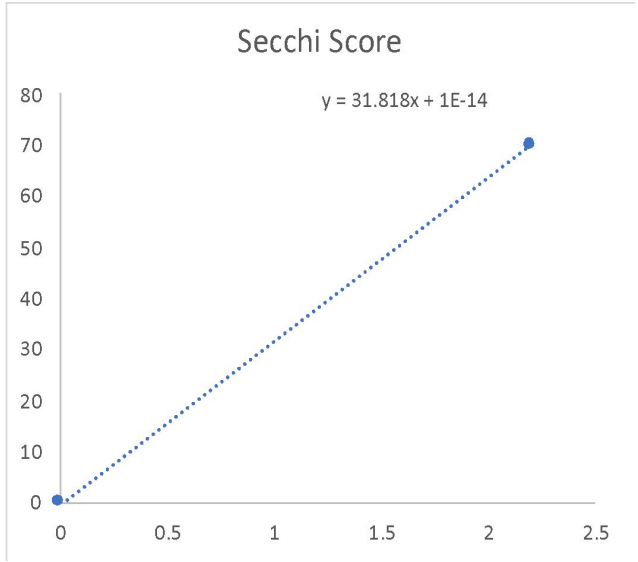
- ecoreportcard.org
- We assign scores to sites, not to bay segments



Analysis Methods – Report Card Style

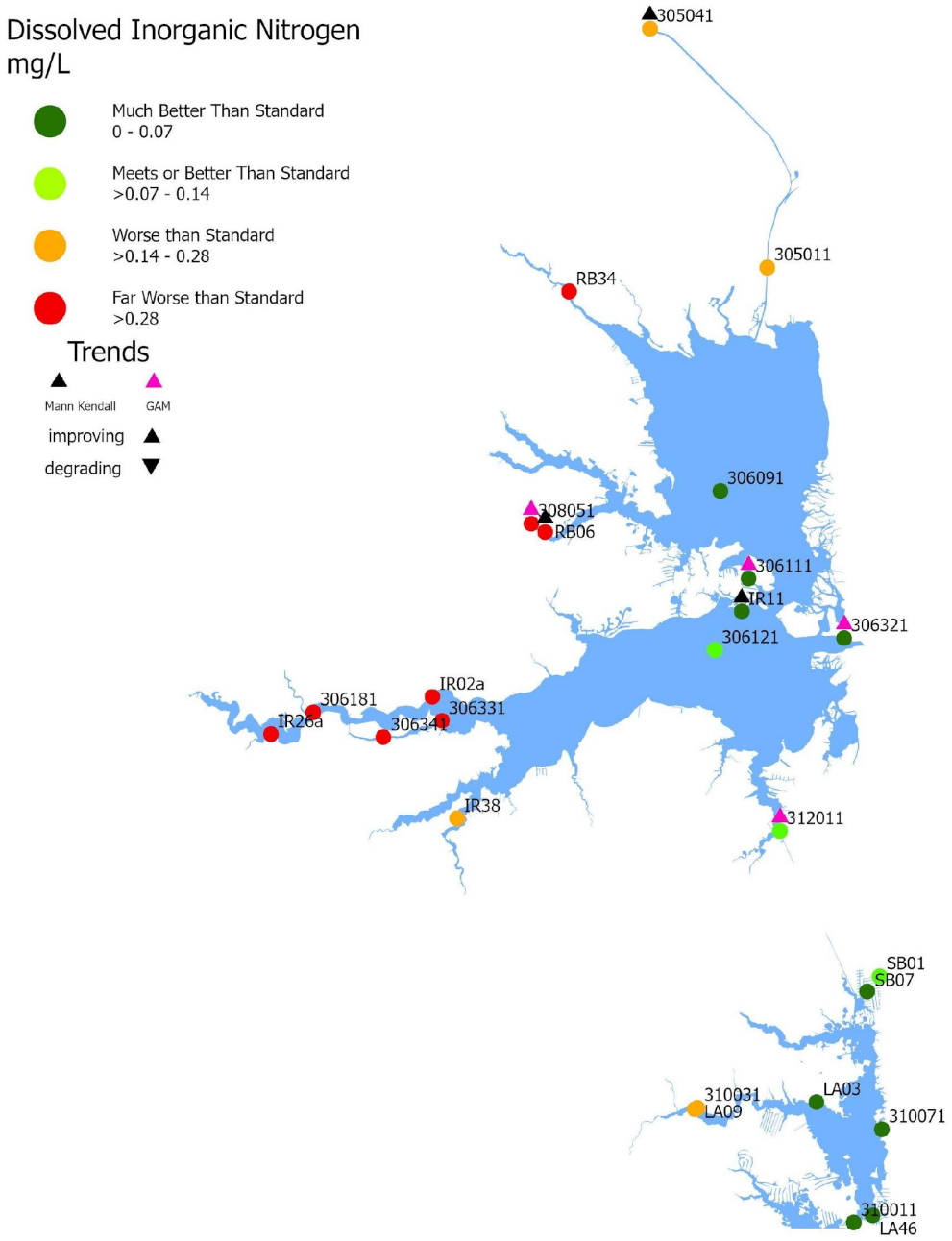
- wq standard was set to a score of 70%, and the low detection limit was set to a score of 100% (opposite for Water Clarity)
- All yearly median concentrations were than scored based on the equation
- These scores will only appear on the website in conjunction with the actual concentrations, and in the new WQI index
- System used ensures that if a site met the standard it received at minimum a grade of a C (70%)





WQ Status and Trends

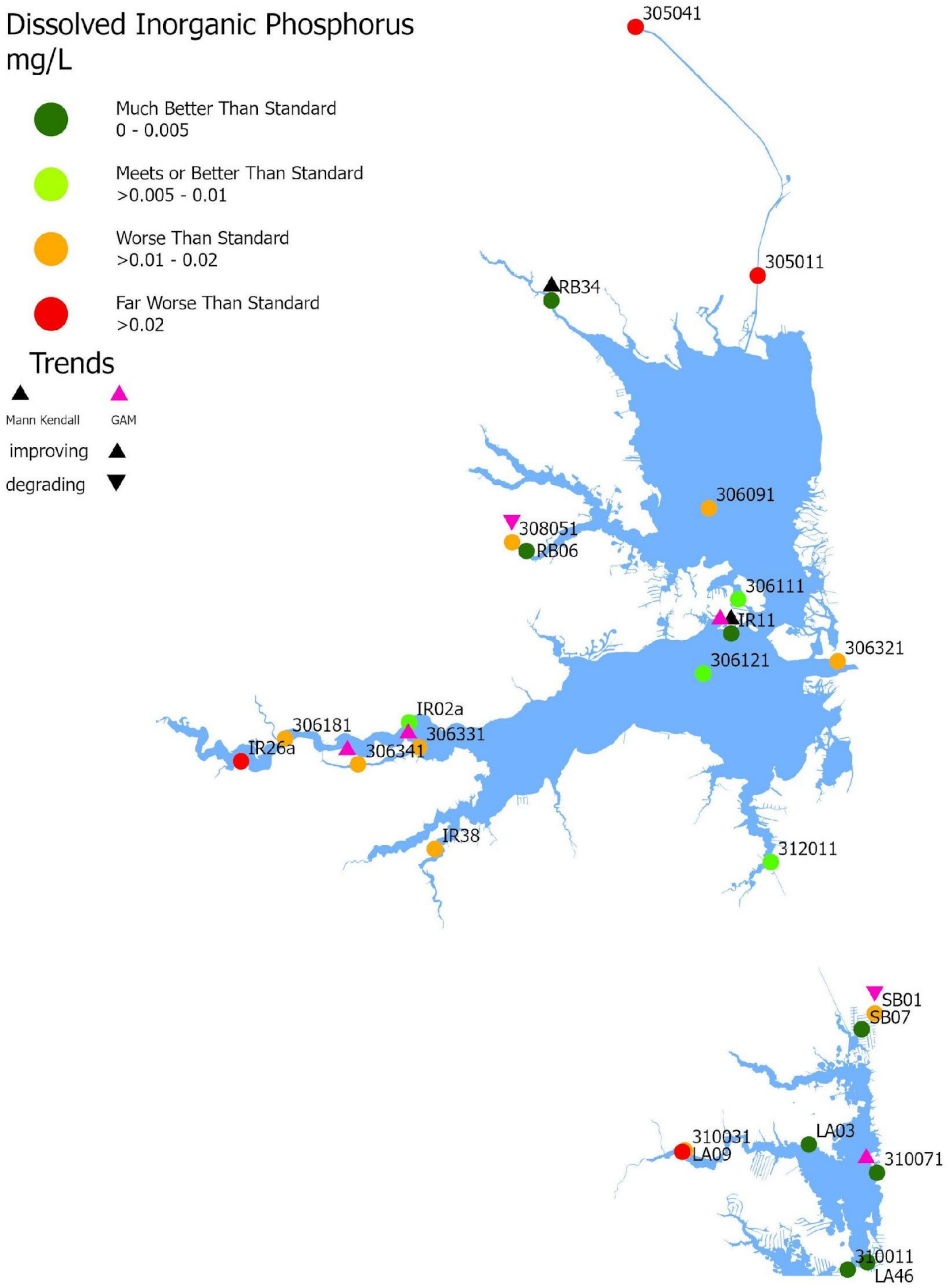
- The color of the station is the five year status (median of the medians from 16’-20’)
- Black arrow = Mann Kendall trend
- Pink arrows = GAM trend
- After the maps there are brief notes on the messaging the CIB takes away from the data



DIN Results

- 48% of stations meet threshold (previously 55%)
- Sig trends for GAM at IR11 and RB06, but deviance and r sq were just under thresholds
- Indian river still very bad
- LAB maintained success shown in last report

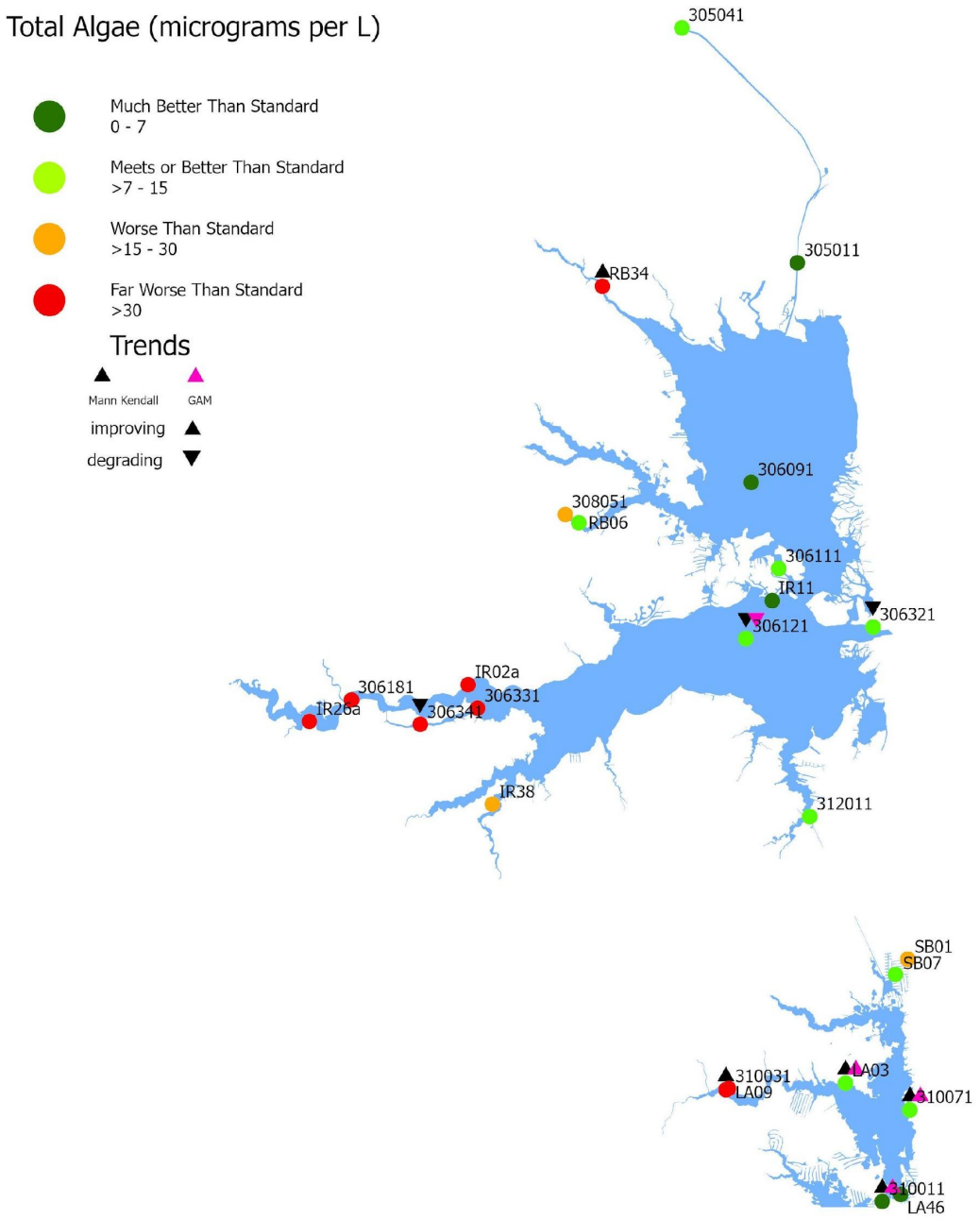
Status	Trend
Poor to Fair	no trend



DIP Results

- 48% of stations meet threshold (previously 36%)
- not a lot of agreement between Kendall and GAM
- River looks better here than DIN, but this is likely uptake from all the algae, still largely not meeting standard
- Inlet also not meeting standard. Possible explanations? Median at inlet is 0.013 (standard is 0.01, so it was just over)
- Continued success at LAB sites

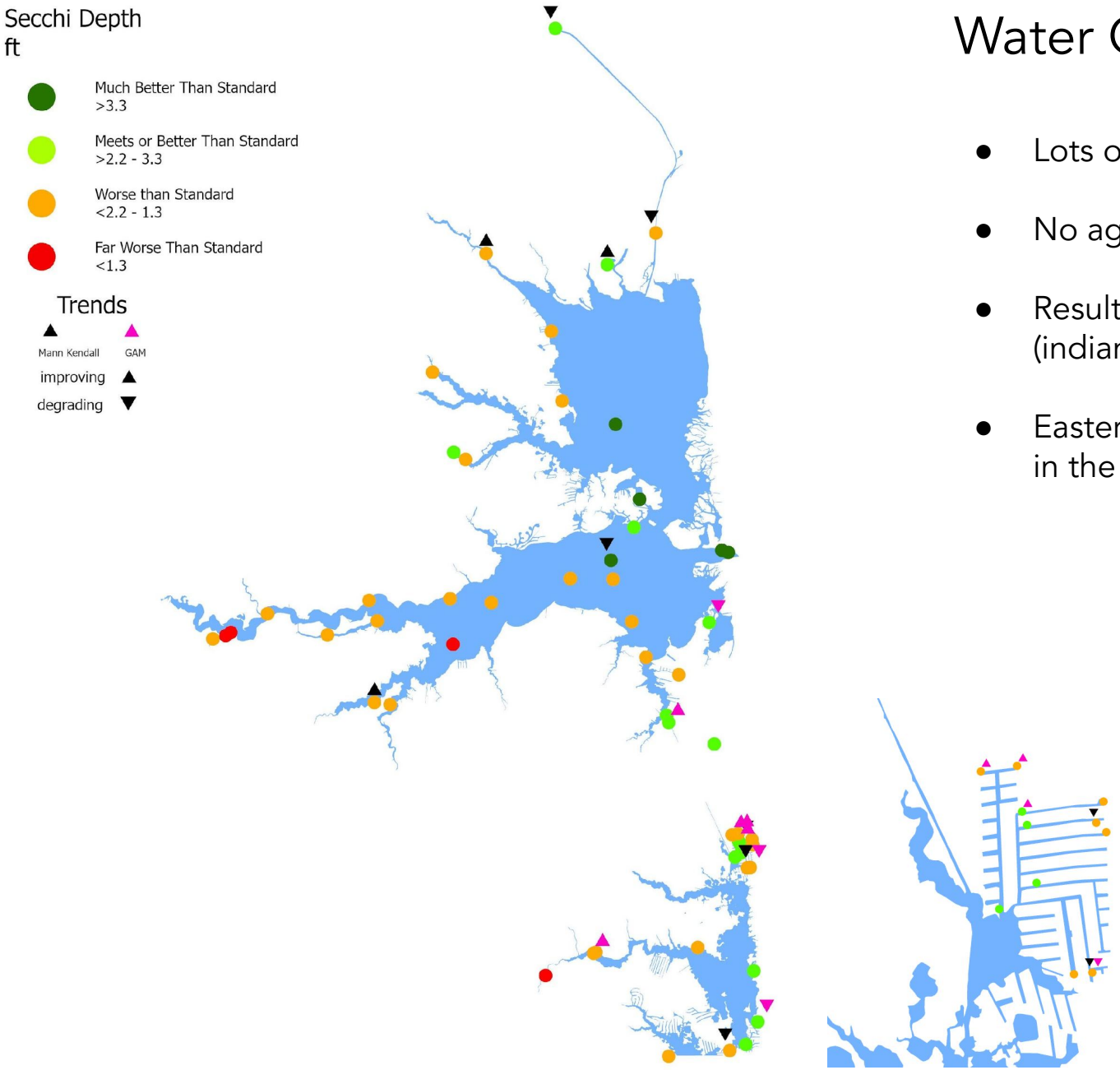
Status	Trend
Poor to Fair	no trend



Chlorophyll Results

- 56% of stations meet threshold (previously 64%)
- 5 getting sig better 3 getting sig worse per Mann Kendall
- 4/8 agreement between Mann Kendall and GAM (Marginal sig at two of those 4)
- River is very bad, inlet area also showing some increasing trends, possible accumulation of upstream effects?
- Of note is that DIN and DIP has been good in LAB for two reports in a row, and now we are seeing improvements in algae in that bay at 3 or 4 different sites

Status	Trend
Fair	no trend



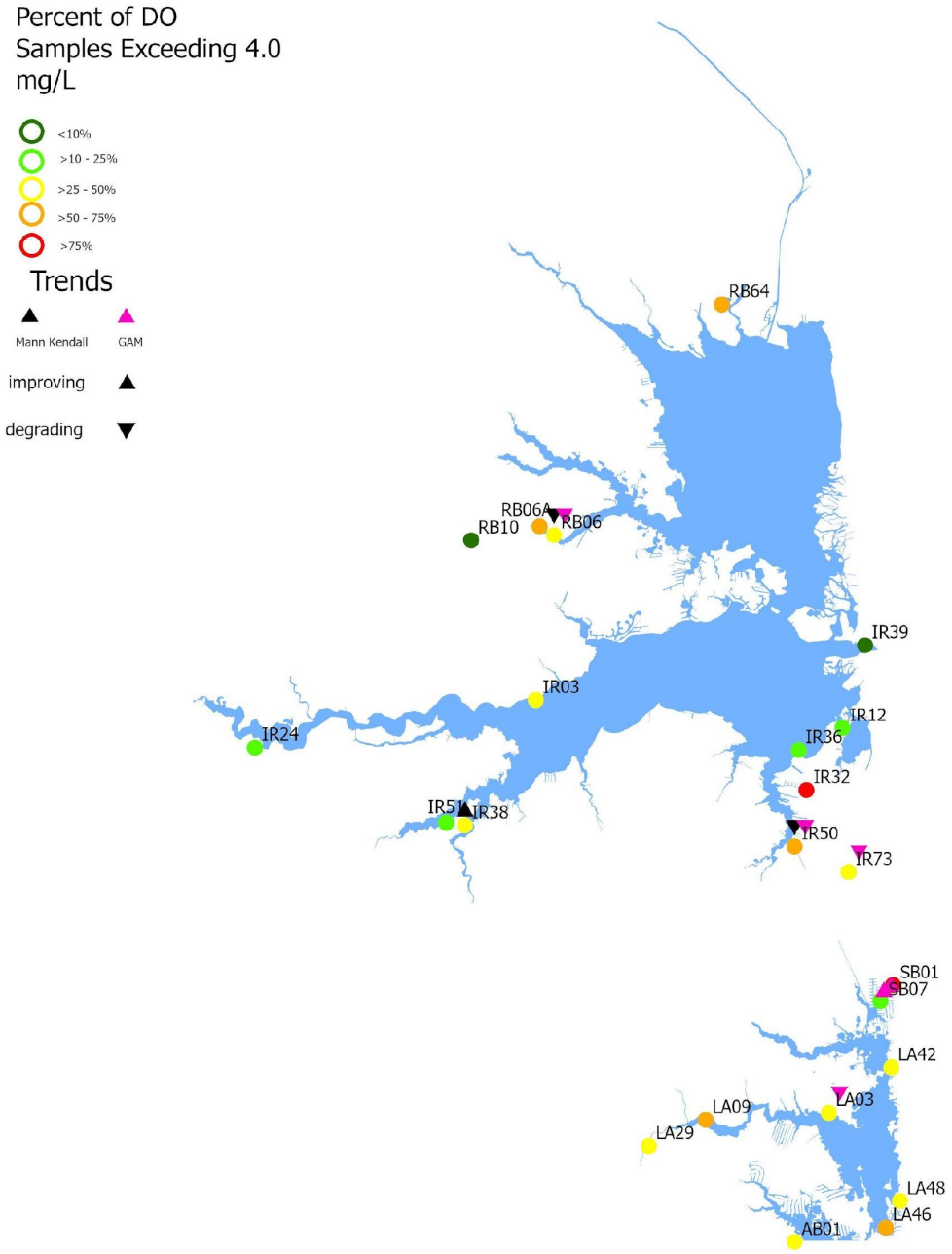
Water Clarity Results

- Lots of variability
- No agreement between Mann Kendall and GAM
- Results indicate majority of the bays do not meet secchi criteria (indian river notably poor)
- Eastern LAB has a widgeon bed and clarity appears pretty good in the area

Status	Trend
Poor	no trend

Analysis Methods – Determining Status and Trend

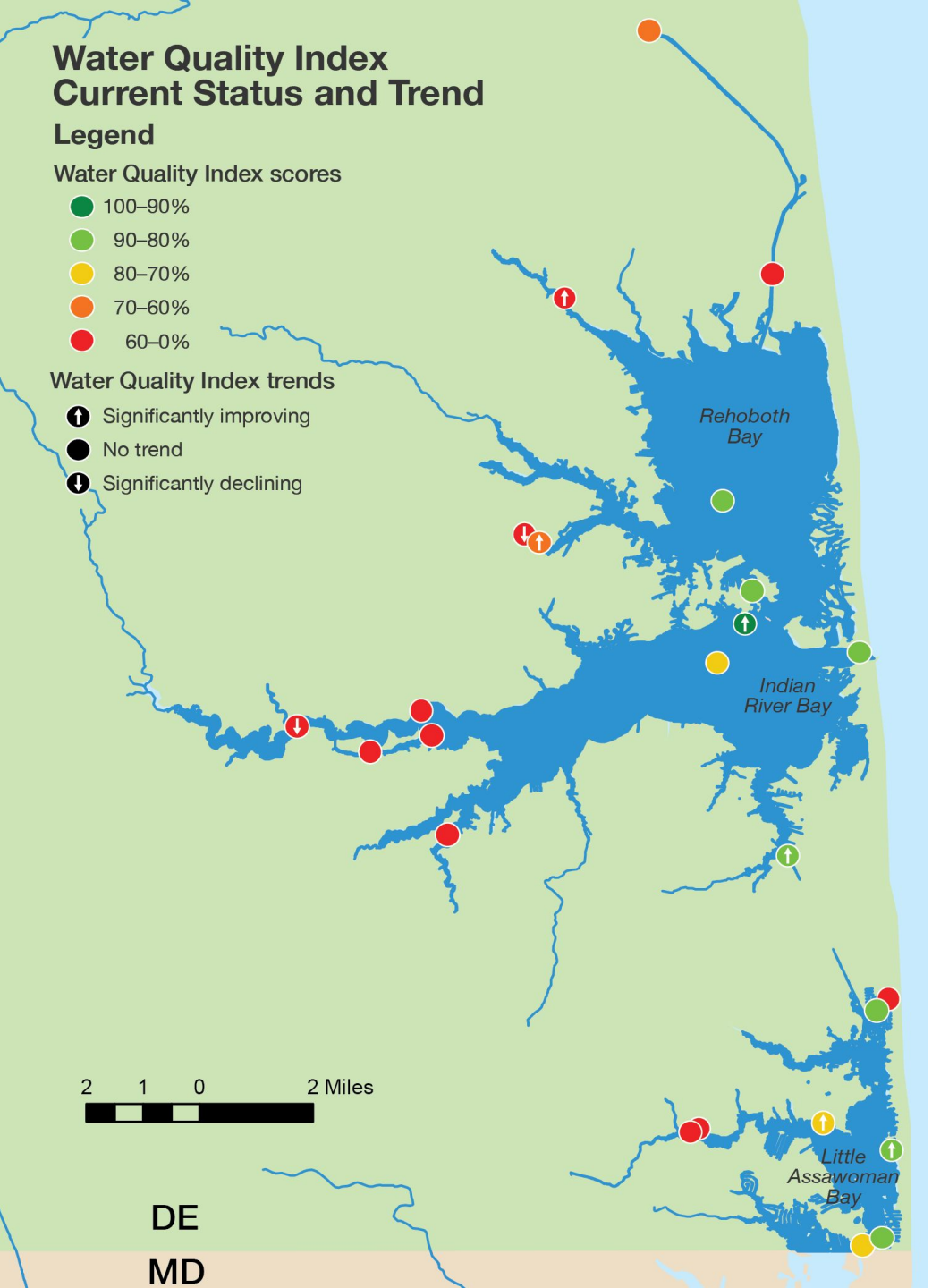
- For DO, only data from June through September, 5 AM till 8:59:59 AM
- Percent of Mornings where DO was less than 4 mg/L calculated for each year
- Trends on yearly percent of mornings failing (seasonal Mann Kendall)
- Trends on raw data from qualifying years (GAM)



DO Results

- Only a few stations are regularly failing standard
- Doesn't really fit with what our continuous data show
- A little surprising that LAB has a lot of 25% or greater occurrences given that the nutrient and chla criteria look pretty good

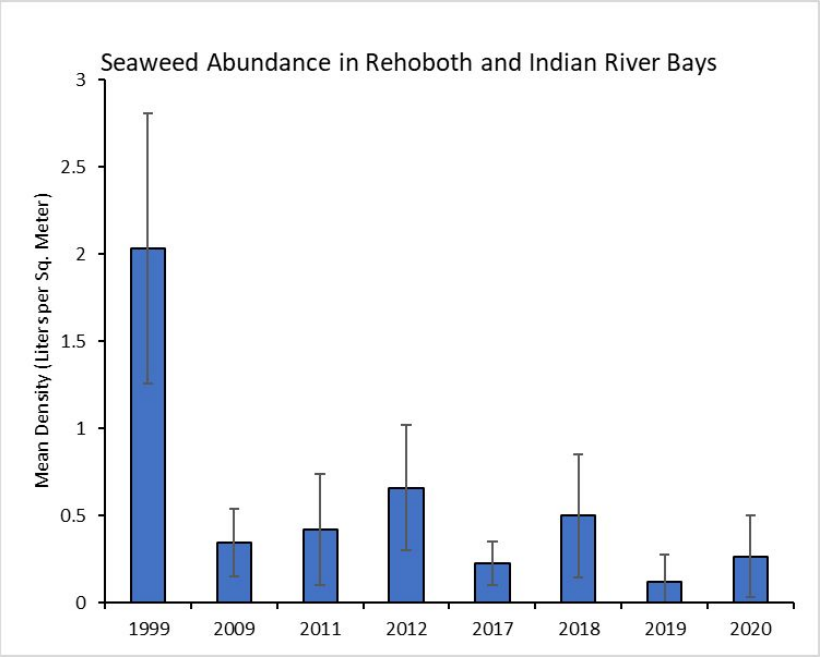
Status	Trend
Fair	no trend



New WQI

- Average of Chla, DIN, DIP, and Secchi report card scores
- Public friendly way to assign a single score to a site
- Matches the eye test pretty well
- Upper Indian river and trib sites are poor, inlet is better, LAB is pretty good and showing continued signs of improvement

Status	Trend
Fair	no trend



Seaweed Abundance Results

- Decline in seaweed compared to 1999 has held steady
- # of blooms large enough to hard hard clams dropped from 29.4% in 1999 to 0% in past two years, and hasn't exceeded 6.7% since 1999
- Drift algae still a problem in some places, but large blooms declined

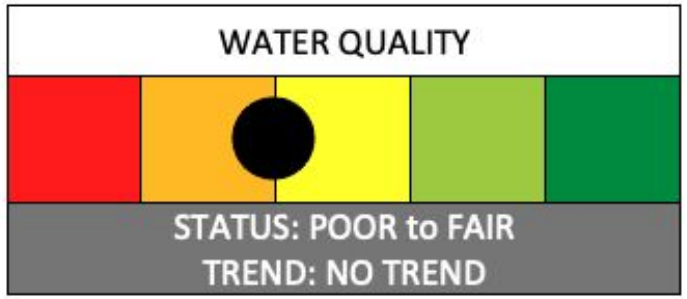
Year	# of Heavy Blooms	# of samples	% of samples that were heavy blooms
1999	5	17	29.4
2009	0	30	0.0
2011	2	30	6.7
2012	2	30	6.7
2017	0	30	0.0
2018	2	30	6.7
2019	0	30	0.0
2020	0	24	0.0

Status	Trend
Good	no trend

Overall Status and Trends - Water Quality, 2016

Water quality is improving in Little Assawoman Bay and in open waters near the Indian River Inlet. Algae and seaweed blooms have improved in some areas, but tributaries and canals are still murky and oxygen-starved.

Overall Status and Trends - Water Quality, 2021



Indicator	Status	Long-Term Trend
DIN	Poor to Fair	No trend
DIP	Poor to Fair	No trend
Chlorophyll a	Fair	No trend
Water Clarity	Poor	No trend
DO	Fair	No trend
Seaweed	Good	No trend