State of the Bays 2022
Summary of Indicators

STAC Meeting April 13, 2022
Today’s Goals

● Summarize the results of indicator analyses, including status and trends
  ○ Most were reviewed in subcommittee
  ○ Tech reports/presentations available for additional reviews

● Discuss conclusions, record additional feedback

● Concurrence from STAC on current status and LT/ST trends for each indicator and each chapter as a whole

● Presentation to the Board on June 10th

● Report publication at end of summer
Indicator Status and Trends

- 2106: Gave an overall status/trend to each chapter - based on ‘best professional judgement’
- Consider status/trends for each indicator this time and derive an overall summary for the chapter

**Watershed Condition**
- Trend: Negative
- Development driven by rapid population growth is increasing the acreage of impervious surface coverage, adding to urban pollution sources, and stressing habitats. Agricultural pollution is decreasing as land uses change. Increased flushing at the inlet has improved water quality in open Bay waters.

**Managing Nutrient Pollution**
- Trend: Positive
- The remaining two point sources of nutrients should soon be removed from the Bays. Nonpoint source pollution remains above healthy limits. Septic conversions to central sewer have exceeded goals set in the Pollution Control Strategy, but other management progress has stagnated since 2011.

**Water Quality**
- Trend: Positive
- 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.
Discussion Agenda

- Fengyan Shi – Indian River inlet tidal prism model
- Water quality and nutrient load indicators - decisions on trend analyses
- Remaining indicators: watershed condition, living resources, human health risks, climate
- Concurrence from STAC on indicators, status and trends
- Next steps
Prof. Fengyan Shi
University of Delaware
Department of Civil and Environmental Engineering
Center for Applied Coastal Research
Indian River Inlet Tidal Flushing

- Until 1928, inlet moved along a two-mile stretch of the coast.
- Stabilized by USACE 1938.
- Five bridges. Scouring first noticed in 1980s. Deepened over time.
- Greater volumes → LT salinity increase and contributes to marsh degradation
- Also flushes more pollutants
IR Tidal Prism

- Last physical measurement was 2004 by the USACE
- Scour huge issue with the previous inlet bridge
- No funding to re-do measurement
- STAC/USACE recommended a modeling approach

“Tidal Prism” = Volume of water leaving an estuary at ebb tide (or volume of incoming tide + river discharge)
MANAGING NUTRIENT POLLUTION
Human Population Growth

- Planning for growth impacts
- Data: U.S. Census, DE Pop. Consortium (projections), Office of State Planning Coord (TAZs)
- FT densities highest in developed coastal areas
Human Population Growth - Summary

STATUS - FAIR
● 42.4% of Sussex residents live in the IB w.s.

TREND - DEGRADING
● LT – Sharp increase since 1990, with coincident changes in LU
● ST – Continued growth in full-time residents and development (*13% increase since 2010 - higher than projected*); current development signals ongoing trend
Land Use Change

- Land use directly affects water quality
- LULC data 1992-2017
- Six-categories to match previous reports
Land Cover
- Developed/Developed
- Agriculture
- Upland Forest
- Open Water
- Wetland
- Other

Inland Bays Watershed

Proposed Development

2017 Land Cover

2017 Land Cover with Proposed Developments Projects (PLUS)
Land Use Change

- Agric. still the largest LU; but forest and agric. being converted to development
- On average, agric. lands contribute highest nutrient loads/ac

1992 to 2017:
- 18% loss in forest
- 6% loss in wetlands
- 19% loss in agriculture
- 78% increase in developed/developing
Land Use Change

Land Cover Changes 1992-2017
Inland Bays Watershed

Square Miles

-25
-15
-5
5
15
25
35

Developed +32.02 sq mi
Open Water +2.30 sq mi
Other +2.13 sq mi
Wetlands -3.92 sq mi
Upland Forest -9.94 sq mi
Agriculture -22.26 sq mi

Land Cover Changes 2012-2017
Inland Bays Watershed

Square Miles

-25
-15
-5
5
15
25
35

Developed +3.84 sq mi
Open Water +0.46 sq mi
Other +2.45 sq mi
Wetlands -0.88 sq mi
Upland Forest -1.65 sq mi
Agriculture -4.02 sq mi
Land Use Change - Summary

STATUS - FAIR
● Developed land is replacing agriculture and forested Habitat; much of the development is near waterways (quantify)

TREND - NEGATIVE (loss of forest, lack of buffers, infrastructure/habitats)
● LT – Direction of losses/gains consistent over time
● ST – Changes 2012-2017 slowed slightly compared to previous years. But large uptick in construction began around 2016/2017
● Emphasizes the need for land conservation and buffers
Impervious Surface Coverage

- Correlated with development; increased 22.5% since 1992
- Concentrated near the Bays. Rises to 60-80% in urban areas
- 10% IC generally cited as a threshold for watershed health impact, >25% non-supporting
- Likely not relevant for our watershed; WQ impacts unknown
Impervious Surface Coverage

STATUS - FAIR

- Current overall estimate 10.44%; MUCH higher and impactful in more urbanized areas of the Watershed

TREND - NO TREND

- **LT** – Since 1992, percentage IC in watershed increased by 22.5%
- **ST** – Overall, IC increased by only 144 acres between 2010 and 2016; but larger increases in certain smaller areas of development
Water Quality Buffers Width

Buffers:
- Improve/protect water quality
- Provide habitat
- Enhance/maintain flood plain storage
- Allow marsh migration with SLR

Mean width of forest/wetland buffers on croplands used as an indicator in 2016.

To be dropped in 2022, due to irreconcilable data conflicts.

Provide information on importance and connect to forest loss.
Salt Marsh Acreage and Condition

- Critical for: habitat, carbon storage, coastal resiliency
- Threatened by SLR, erosion, barriers to migration
- Two indicators (based on 1992-2017 aerial imagery):
  - Total acreage of tidal wetlands
  - Interior open water ponding, or ‘fractured pooling’
Areas of Greatest Acreage Change, 1992-2017
Salt Marsh Acreage and Condition

STATUS - FAIR
- Lost 3,200 acres, or 30% since 1938. Area of interior open water increased 770% (from 86 acres to 661 acres).
- LT monitoring results show some areas holding, for now.

TREND - DEGRADING
- ST – Overall acreage fairly stable, but clear increase in open water ponding, indicating a loss of marsh integrity and function. Changes especially pronounced in LAB and western RB.
Natural Habitat Protection and Restoration

- Tracks progress in addressing habitat loss and degradation
- Acres added, by year: lands/habitat permanently conserved, restored, or enhanced
- NEPORT database source

Includes land acquisition, conservation easements, wetland and shoreline restorations, reforestation, baygrass restoration, reef creation, invasives control, etc.
Natural Habitat Protected/Restored in the Inland Bays

Cumulative Acres

- Total Restored
- Total Protected
Total added each year

- **Restored**
- **Protected**

**Protected**
- Upland Forest: 79%
- Freshwater Wetland: 13%
- Open Field/Cropland: 5%
- Freshwater: 3%
- Salt Marsh: 3%
Natural Habitat Protection/Restoration

STATUS - GOOD to FAIR

- 873 acres added 2016-2020, 819 ac of which was forest.
- >8.5 x more funding put toward land conservation in past five as in previous twelve years.

TREND - IMPROVING

- LT – Pace of land protection stalled between 2010 and 2015.
- ST – Pace increased since 2016. Current focus on land conservation by many partners likely to accelerate even more.
Indian River Inlet Tidal Flushing

STATUS - ??
- Scouring mitigated by removing bridge piers
- Current estimated max tidal prism ~2,150 million ft$^3$, likely has stabilized

TREND - NO TREND
- **LT** – Large increase over last 80 years, impacting the Bays
- **ST** – No significant change since 2004; volume may increase with SLR
Overall Status and Trends - Watershed Condition, 2016

WATERSHED CONDITION

TREND: NEGATIVE

Development driven by rapid population growth is increasing the acreage of impervious surface coverage, adding to urban pollution sources, and stressing habitats. Agricultural pollution is decreasing as land uses change. Increased flushing at the inlet has improved water quality in open Bay waters.
## Overall Status and Trends - Watershed Condition, 2021

**Indicator** | **Status** | **Trend (last 5 yrs)**
--- | --- | ---
Human Population Growth | Fair | Degrading
Land Use Change | Fair | Degrading
Impervious Surface Coverage | Fair | No Trend or Slightly Degrading
Salt Marsh Acreage and Condition | Fair | Degrading
Natural Habitat Protection and Restoration | Fair to Good | Improving
Indian River Tidal Flushing | ? | No Trend
LIVING RESOURCES
Baygrasses

- Critical habitat for a healthy estuary
- Water quality, blue carbon benefits
- Indicator of excellent water quality when present (esp. eelgrass)
- Declines from natural disease, eutrophication, lack of seed source – severely depleted in Inland Bays
- Surveyed by CIB 2020-2021

Areas Surveyed
Baygrasses

- 10.69 acres total
- Estuaries to north and south support thousands of acres
- Mostly near seed sources
Baygrasses

STATUS – VERY POOR
- Current acreage VERY low when compared to similar systems
- Eelgrass suitability index moved here

TREND - SLIGHTLY IMPROVING
- LT - No trend, has been below 11 acres since the 70’s
- ST - Improving slightly. Seeing signs of widgeon grass in LAB with some major bloom years
Eagle and Osprey Nesting

- Last survey 2018
- 14 active nests
- Stable trend
Eagle and Osprey Nesting

- 2021 - Volunteer survey completed
- 279 nests in 2021 (vs 92 in 2014) - level of effort, definition of active?
Eagle and Osprey Nesting

STATUS - VERY GOOD
● Stable or increasing breeding populations of both Bald Eagles and Ospreys
● Both species now seen commonly around the Bays

TREND - IMPROVING
● LT - Active nests have increased over time, with significant trend upward since early 2000’s
● ST - Active osprey nests increased; but change in survey protocol makes comparison challenging; No trend in eagle nests
Commercial Clam Harvests

- Hard clams harvested by both recreational and commercial clammers
- Like oysters, clams improve water clarity via filtration
Commercial Clam Harvests

- Low numbers reflect the state of the fishery, not the state of the clam population
- Fewer harvesters
- Different fishing methods
- Catch per unit effort varies among harvesters
Commercial Clam Landings

STATUS - FAIR
- Current numbers close to historic low, but landings per day stable
- Reflects low numbers of harvesters and clamming methods

TREND - NO TREND
- LT - landings per day have been relatively stable, harvesters declining
- ST - landings per day similar to last reporting period
Shellfish Farming - new indicator

Annual statistics on commercial shellfish farming in the Inland Bays

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Lessees(^1)</th>
<th>Total Acres Leased(^1)</th>
<th>No. Shellfish Planted</th>
<th>No. Shellfish Harvested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oysters</td>
<td>Clams</td>
</tr>
<tr>
<td>2018(^2)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2019(^3)</td>
<td>10</td>
<td>43</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>2020(^3)</td>
<td>13</td>
<td>37</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>

1 The CIB leased one acre for scientific research. Only commercial leases are included in these statistics.
2 Data confidential and not reported due to fewer than three growers.
3 August through December harvest data only. No data available for January to July, due to DNREC’s “rule of three” confidentiality in reporting, and fewer than three growers reported harvest these months.
4 Does not include the 75,000 oysters purchased by Delaware Sea Grant.
Shellfish Farming

Estimates of total nitrogen and phosphorus, incorporated in tissue, removed from the Inland Bays through harvest of farmed oysters (Chesapeake Bay protocol)

<table>
<thead>
<tr>
<th>Year</th>
<th>Size Class Midpoint (inches)</th>
<th>Total Oysters Harvested</th>
<th>Content in Tissue, Default Value (g/oyster)</th>
<th>Total Nutrient Content Removed Annually (g)</th>
<th>Total Nutrients Removed, All Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>TN</td>
<td>TP</td>
<td>TN</td>
</tr>
<tr>
<td>2019</td>
<td>3&quot;</td>
<td>49,127</td>
<td>0.13</td>
<td>0.01</td>
<td>6,387</td>
</tr>
<tr>
<td></td>
<td>4&quot;</td>
<td>58,059</td>
<td>0.26</td>
<td>0.03</td>
<td>15,095</td>
</tr>
<tr>
<td></td>
<td>5&quot;</td>
<td>4,466</td>
<td>0.44</td>
<td>0.05</td>
<td>1,965</td>
</tr>
<tr>
<td>2020&lt;sup&gt;1&lt;/sup&gt;</td>
<td>3&quot;</td>
<td>113,440</td>
<td>0.13</td>
<td>0.01</td>
<td>14,747</td>
</tr>
<tr>
<td></td>
<td>4&quot;</td>
<td>134,065</td>
<td>0.26</td>
<td>0.03</td>
<td>34,857</td>
</tr>
<tr>
<td></td>
<td>5&quot;</td>
<td>10,313</td>
<td>0.44</td>
<td>0.05</td>
<td>4,538</td>
</tr>
<tr>
<td>Total All Years</td>
<td>--</td>
<td>369,470</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

<sup>1</sup> Includes oysters purchased by Delaware Sea Grant that were moved to Delaware Bay.

<sup>2</sup> Default values for triploid oysters from Cornwell et al. (2016).

If all SADA’s are farmed at normal stocking rates, would translate to reductions:
- 4,630 lb TN
- 485 lb TP
Shellfish Farming

STATUS - GOOD
● Aquaculture leases are being farmed, numbers still low

TREND - LIKELY IMPROVING
● LT - N/A
● ST - No stats yet for 2021. Slow increase in farming, demand is there. Hit hard by COVID.
Winter Waterfowl Counts

- Three sensitive species used as indicators: CANV, ABDU, ATBR
- Mid-Winter Survey data (January) from DE compared with the Atlantic Flyway
- Comparisons help understand responses to changes in the Inland Bays
Canvasback

- Very low numbers (hundreds); downward LT trend
- Most DE CANV counted are in the Inland Bays, mostly Silver Lake
- No significant change since 2016 (needs testing)
American Black Duck

- IB has both year-round and migratory pops of ABDU
- Sharp Atl. Flyway decreases mid-century (loss of marsh habitat, hunting pressure, interbreeding w/ MALL)
- Numbers low but stable
Atlantic Brant

- Pop. declines followed declines in eelgrass; adaptation to other diets
- 80-90% of ATBR winter in NY/NJ; about half of DE pops are in the IB
- Atl. flyway pops stabilized
- IB pops declined, but maybe show a slight upturn since 2016
Winter Waterfowl Counts

STATUS - FAIR
● Numbers lower than historically but currently stable

TREND - NO TREND
● LT - declines in all three species
● ST - no significant change since 2016
Blue Crab Abundance

- Large interannual variation typical
- No commercial harvest in the IB
- Popular recreational fishery, but no data on catch
- Trawl survey data: Past few years - average or below average recruitment, but good overall abundance (good survivorship?)
- STAC suggestion - YOY might be more meaningful indicator
Blue Crab Abundance

STATUS - FAIR
- Abundance increased over last five years, with average recruitment
- WQ problems in some nursery areas

TREND - IMPROVING
- **LT** - No apparent LT trend in mean catch per tow
- **ST** - Average recruitment but good overall abundance
Fish Abundance

- Marine fisheries species typically have large interannual, with pulses of good recruitment mixed with years of low recruitment.

- Changes in abundance driven by many different factors (external - ocean currents, weather patterns, food availability; internal - land use, habitat changes).
Fish Abundance

- Four indicator species used
- Had good recruitment pulses during this report period
Fish Abundance

STATUS - FAIR to GOOD
- Most trawl species have had above average recruitment years recently

TREND - IMPROVING
- LT - No long term trends apparent
- ST - Last five years, many species had strong recruitment years
Shorezone Fish - new indicator

- Nearshore an important nursery area for YOY of many spp. and many important forage spp.
- Inland Bays shorezone dominated by four species: Mummichog, Atl. Silverside, Sheepshead Minnow, Striped Killifish
- Now have 10 years of data
Shorezone Fish - new indicator

- Last ten years Mummichog and Sheepshead Minnow have declined
- Possibly due to increased predator abundances or habitat changes due to shoreline hardening and marsh deterioration
Shorezone Fish

STATUS - FAIR?
- Uncertain how to set this

TREND - DEGRADING
- LT - Mummichog and Sheepshead Minnow significantly declining
- ST - Declining or no trend?
Horseshoe Crab Spawning
- new indicator

- Annual volunteer survey data
- Keystone species - supports not only Red Knots, but many other parts of ecosystem
- Tagging: IB HSCs important component of regional DE Bay population
- Spawning densities in IB comparable to DE Bay
Horseshoe Crab Spawning

**STATUS - FAIR**

- Loss of sandy beaches

**TREND - NO TREND**

- **LT** - Numbers stable, but remain far below historic levels
- **ST** - no trend
Recreational Fishing Statistics

- Major drop in Striped Bass harvest
- Continued minimal harvest of Weakfish
- Typical harvest of Summer Flounder
- No estimates available for no. of trips or overall pounds caught
Recreational Fishing Statistics - Summary

**STATUS - FAIR**
- Harvest lower than expected (especially considering above average recruitment for Weakfish and Summer Flounder)

**TREND - DEGRADING**
- **LT** - Weakfish and Striped Bass harvests show clear long-term declines
- **ST** - Striped Bass show major drop off
Number of Fish Kills

- Indicator of stress in bay environment, usually caused by a combination of nutrient pollution and/or weather conditions
- Most kills happen in summer when algae are abundant, high temperatures, low DO
- Majority of kills reported in the Bays involve Atlantic Menhaden
Number of Fish Kills

Fish Kills in the Inland Bays
1981 to 2020

STAC Review:
- Include number of fish/kill; can the kills be weighted?
- Consistency in defining ‘an event’
- Increase maybe related to increase in reporting?
Number of Fish Kills

Fish Kill Events by Month, All Years

Fish Kill Events by Waterbody Type
All Years

- Tidal Creeks (56%)
- Residential Canals/Lagoons (35%)
- Open Bay (2%)
Number of Fish Kills - Summary

STATUS - POOR to FAIR
● 2021 had high no. of fish kills - will be added to plot

TREND - Possibly DEGRADING?
● LT - number of kills reported varies greatly from year to year
● ST - Increase in reported kills; possibly due to degrading WQ, or other factors
Eagles and ospreys are commonly seen around the Bays. Clams and some fish populations are stable. Other species such as Blue Crabs and waterfowl have declined. Oysters and bay grasses are rare in the Bays.
## Overall Status and Trends - Living Resources, 2021

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Status</th>
<th>(ST) Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baygrasses</td>
<td>Very Poor</td>
<td>Slightly Improving</td>
</tr>
<tr>
<td>Eagle/Osprey Nesting</td>
<td>Very Good</td>
<td>Improving</td>
</tr>
<tr>
<td>Hard Clam Landings</td>
<td>Poor</td>
<td>No Trend</td>
</tr>
<tr>
<td>Shellfish Farming</td>
<td>Fair</td>
<td>Improving</td>
</tr>
<tr>
<td>Winter Waterfowl Counts</td>
<td>Fair</td>
<td>No Trend</td>
</tr>
<tr>
<td>Blue Crab Abundance</td>
<td>Fair</td>
<td>Improving</td>
</tr>
<tr>
<td>Fish Abundance</td>
<td>Fair to Good</td>
<td>Improving</td>
</tr>
<tr>
<td>Shorezone Fish</td>
<td>Fair</td>
<td>Degrading</td>
</tr>
<tr>
<td>Recreational Fishing</td>
<td>Poor</td>
<td>No Trend</td>
</tr>
<tr>
<td>HSC Spawning</td>
<td>Fair</td>
<td>No Trend</td>
</tr>
<tr>
<td>No. of Fish Kills</td>
<td>Poor</td>
<td>Possibly Degrading?</td>
</tr>
</tbody>
</table>

(Weighted toward fish indicators)
HUMAN HEALTH RISKS
Fecal Indicator Bacteria

- Many trib sites routinely fail primary contact standard (for swimming)
- Most areas of the Bays do routinely meet secondary contact standard (for uses like kayaking)
- Sources of Enterococcus can be wildlife, don’t necessarily indicate human source; distinguishing between sources not done at baywide scale.
- Monitoring sites shore-based; bacteria tend to be higher than even a few hundred meters into the water; therefore may not be representative of open waters in some areas.
Fecal Indicator Bacteria

- Multiple stations have failed the primary contact standard more often than previously reported in the 2016 report (RB80, RB16M, RB44, IR36, LA03).
- New stations have come online close to former stations and are reporting worse % failing than the older stations (RWPMV, RWPMVII, IR51, IR03).
- Only improvements in % groups appears in LAB (LA09, Fenwick Island)
- Two stations RB06a and RB34 also have significantly worsening trends.
Fecal Indicator Bacteria

STATUS

- Canals/tributaries remain above recommended swimming standards, though some meet secondary standards.
- Open waters largely met swimming standard most of the time last reporting period. 2016-2020, many sites failed >25% of the time, and not meeting primary contact std over LT (but largely meeting secondary contact std)

TREND

- **LT** - Trend site specific; RB06a and RB34 degrading
- **ST** - Fewer sites meet standard than in previous report
- **STAC review note**: Some changes may reflect changes in sampling effort
Approved Shellfish Growing Waters

- Classification based primarily on proximity to potential pollution sources
- High fecal bacteria may result in add’l temporary closures
- Only change, config. Of marina closure in Beach Cove 2016; no change in acreage

![Shellfishing Area Designation Changes](image)
Approved Shellfish Growing Waters

STATUS - FAIR
- 61% approved, 7% seasonally approved, 32% prohibited
- Rehoboth outfall removed from canal, but unlikely to change approved area

TREND - NO TREND
- LT - Some fluctuations, no real trend
- ST - no change since 2016
Fish Consumption Advisories

- Continuing advisories for Bluefish & Striped Bass
- Both are migratory, pick up these contaminants outside of the Inland Bays
- Indicator of PCB and Hg levels in Delaware waterways as a whole, rather than in the Inland Bays specifically.
Fish Consumption Advisories - Summary

STATUS - FAIR
- Advisories currently for Bluefish and Striped Bass

TREND - NO TREND
- LT - Some advisories are being lifted statewide due to lower PCBs and Hg
- ST - no change in IB advisories since 2016

OUTLOOK
- Potential future advisories for PFAS?
- Call-out box on emerging contaminants
Overall Status and Trend - Human Health Risks, 2016

Most tributaries and canals are unsafe for swimming or for the harvest of shellfish. Consumption advisories for Striped Bass and Bluefish caught in the Bays remain in effect.
## Overall Status and Trend - Human Health Risks, 2021

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Status</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fecal Bacteria</td>
<td>Fair</td>
<td>Degrading or no trend</td>
</tr>
<tr>
<td>Approved Shellfish Waters</td>
<td>Fair</td>
<td>No trend</td>
</tr>
<tr>
<td>Fish Consumption Advisories</td>
<td>Fair</td>
<td>No trend</td>
</tr>
</tbody>
</table>
CLIMATE
Atmospheric CO$_2$ Concentration

**STATUS - POOR**
- Monthly average concentration 418.81 ppm in March 2022
- Preindustrial value 280 ppm

**TREND - DEGRADING**
- **LT** - Increased 101 ppm (32%) since 1960; rate of growth accelerating
- **ST** - Increased ~14 ppm since 2016
Sea Level Rise

STATUS - POOR

- Already leading to nuisance flooding; more vulnerable when hit by big storms

TREND - DEGRADING

- LT - 15.7 in increase since 1900
- ST - Continued trend

The data are noisy, but the trend is clear!

15.7 in. since 1900
Air Temperature - Southern Delaware

STATUS - FAIR to POOR
- $3^\circ$F since late 1890s

TREND - DEGRADING
- LT - Increase of $\sim 0.25^\circ$F/decade
- ST - Two highest recorded mean annual temps since 1895 occurred in the last ten years
Growing Season Length

Lewes, DE Growing Season Length (32°F)

Trend = 7.92 days / decade
Annual Days Below Freezing

Lewes, DE Days $\leq 32^\circ$F

Trend = -6.93 days / decade
Annual Days Above 90 Degrees

- Increasing trend beginning ~1990s (DE Climate Projections Portal)
- Rate of increase modeled to increase through 2100
Annual Precipitation

STATUS - FAIR

- ~3” increase in precipitation over 12 decades

TREND - DEGRADING

- LT - 0.262”/decade increase; large interannual variability
- ST -
Coastal Storm Frequency

STATUS - FAIR?
- Coastal storms most common in March, least common in November.
- However, some of most damaging storms occur in Autumn.

TREND - NO TRENDS?
- LT - Frequency of coastal storms has varied greatly from year-to-year, with a minimum during the 1980s
- ST - Larger numbers during the last decade
Ocean Acidification

STATUS - FAIR

- Oceans absorbing ~1/4 of the CO$_2$ emitted to atmosphere annually, becoming more acidic
- Concerns about intensifying impacts on marine and estuarine ecosystems

TREND - DEGRADING

- LT - Increase in oceanic CO$_2$ over last 17 years consistent with atmospheric increase
- ST - Increasing trend

Time series of atmospheric CO$_2$ at Mauna Loa (ppmv) and surface ocean pH and pCO$_2$ (μatm) at Ocean Station Aloha in the subtropical North Pacific Ocean.
Overall Status and Trend - Climate, 2016

CLIMATE

TREND: NEGATIVE

Sea level rise and warming temperatures are a growing challenge for watershed communities, residents and Bay ecosystems. Increased flooding and wetlands loss can be expected.
## Overall Status and Trend - Climate, 2021

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Status</th>
<th>Trend (last 5 yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric CO$_2$ Conc.</td>
<td>Poor</td>
<td>Degrading</td>
</tr>
<tr>
<td>Mean Annual Air Temp</td>
<td>Poor</td>
<td>Degrading</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>Poor</td>
<td>Degrading</td>
</tr>
<tr>
<td>Growing Season Length, Days Below Freezing, Days &gt;90º</td>
<td>Fair to Poor</td>
<td>Degrading</td>
</tr>
<tr>
<td>Annual Precipitation</td>
<td>Fair</td>
<td>Degrading</td>
</tr>
<tr>
<td>Climatology</td>
<td>Fair to Poor</td>
<td>TBD</td>
</tr>
<tr>
<td>Ocean Acidification</td>
<td>Fair</td>
<td>Degrading</td>
</tr>
</tbody>
</table>
Next Steps

● Concurrence of STAC on indicator analyses, status, trends
  ○ General agreement, understanding not everything is finalized
  ○ All comments will be placed on record and addressed
  ○ Tech reports/presentations available for additional reviews

● Presentation to the Board on June 10th

● Report writing/design continues through June

● Future STAC review points

● Release target is end of summer