What are Our Options for Factoring in Consideration of Climate Change into the Phase III WIPs

Presented to:
Water Quality Goal Implementation Team
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Chesapeake Bay Program
Science. Restoration. Partnership.

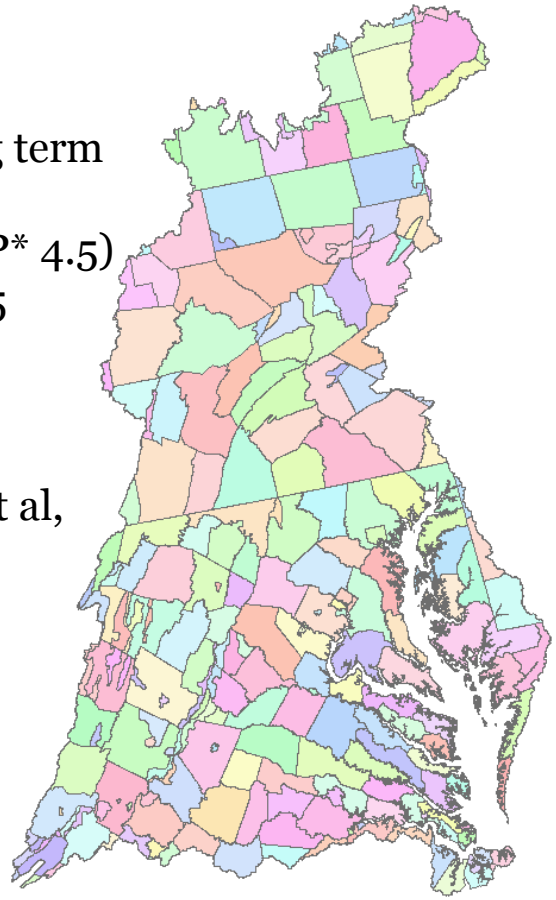
Key Messages

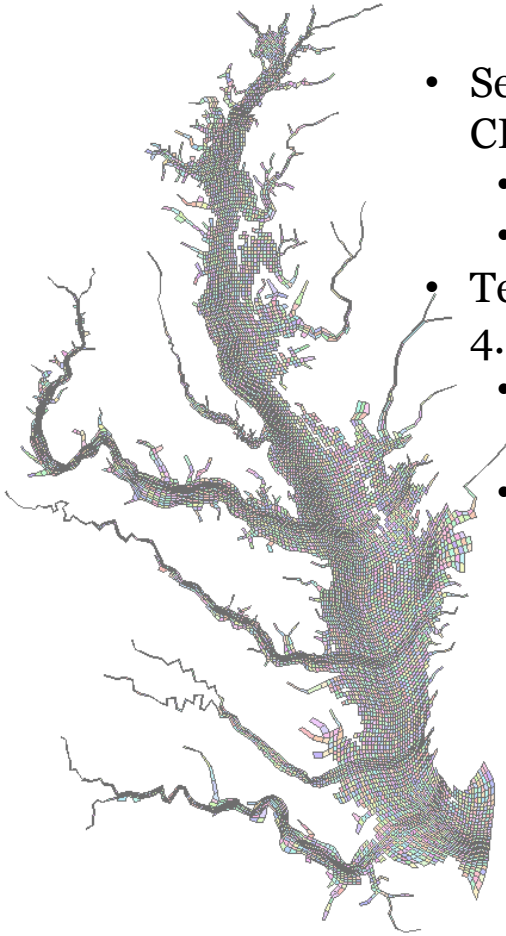
- Assessment approach informed by sound science.
  - Next Steps: Scientific peer reviews of the representation of climate change by the CBP models will be conducted by the CBP Scientific and Technical Advisory Committee (STAC).
- Current efforts are to frame initial future climate change scenarios based on estimated 2025 (potential TMDL application) and 2050 conditions (future condition scoping scenario application).
  - Next Steps: 1) Seek input and approval on the climate assessment approach; 2) decisions on using a 2025 and/or 2050 climate change analysis; and, 3) if additional scenarios should be run.
- The CBP Models are under development, with the current (*Beta* 3) version to be replace by *Beta* 4 in December 2016 (*Beta* 4) and a final version in March 2017.
  - Next Steps: The results presented today will be refined going forward with 2025 estuarine model hydrodynamics and 2050 Watershed Model Scenarios, which are underway. Additional model runs will be informed by partnership input and decisions.
- Range of options have been developed for how and when climate considerations could be addressed within Phase III WIPs.
  - Next Steps: Consideration of full range of options and partnership decision for how and when to factor climate considerations into the Phase III WIPs

Model Climate Inputs

Model inputs were consistent with STAC Workshop and Climate Resiliency Workgroup Guidance

- Precipitation Volume
  - 2025: +3.1% (long term trends)
  - 2050: +7.3% (RCP* 4.5)
- Temperature: RCP 4.5
  - 2025: +1.05 ^{0}C
  - 2050: +2.08 ^{0}C
- CO_2 Concentration: Meinhausen, Malte, et al, (2011)
  - 2025: 427 ppm
  - 2050: 487 ppm



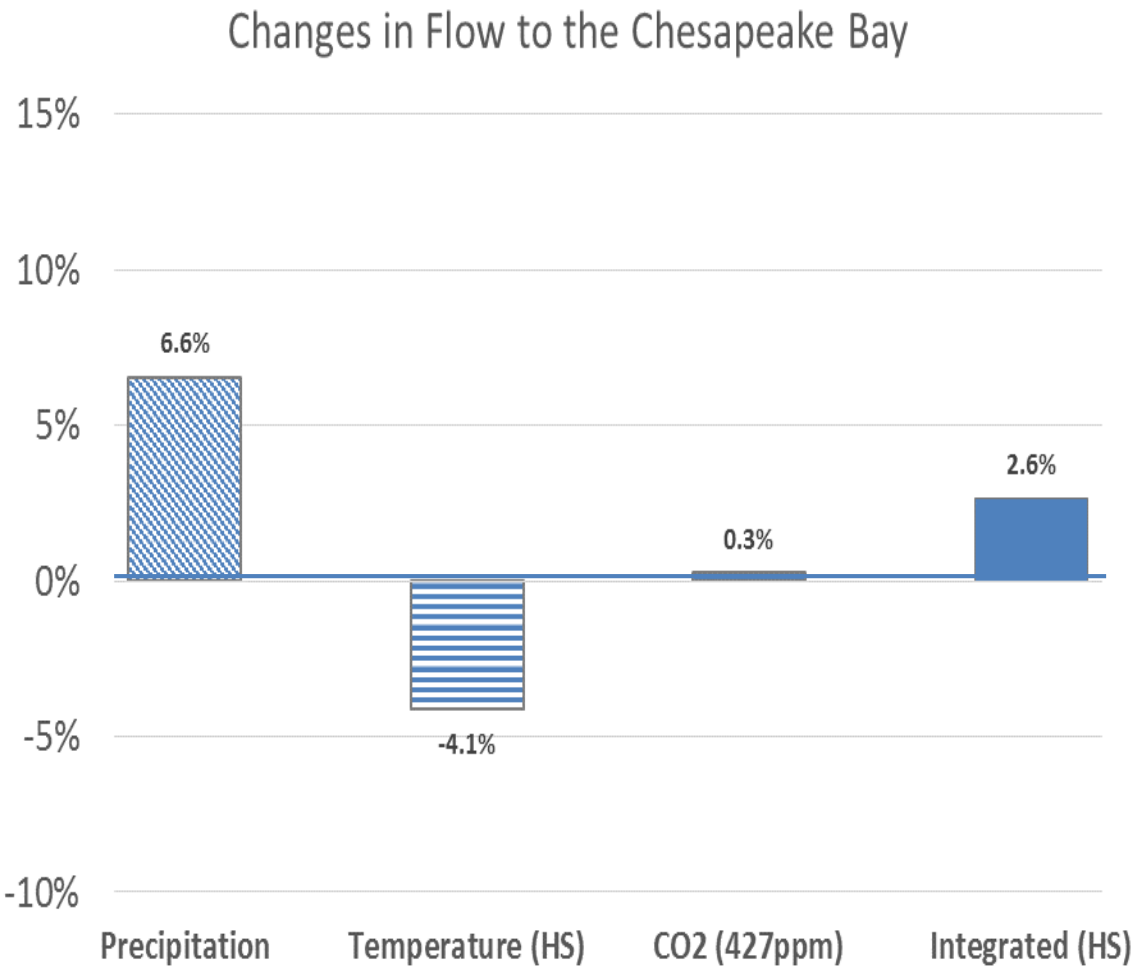


- Sea Level Rise: CRWG**
  - 2025: +0.3 m
  - 2050: +0.5 m
- Temperature: RCP 4.5
  - 2025: +0.95 ^{0}C
  - 2050: +1.86 ^{0}C

*RCP 4.5 signifies a specific Representative Concentration Pathway scenario as defined by the Intergovernmental Panel on Climate Change

**Based upon guidance provided by the Climate Resiliency Workgroup

Estimated Influence of 2025 Increased Precipitation Volume & Intensity on Flow



The influence of estimated precipitation increase alone on Chesapeake flow is a 7% increase.

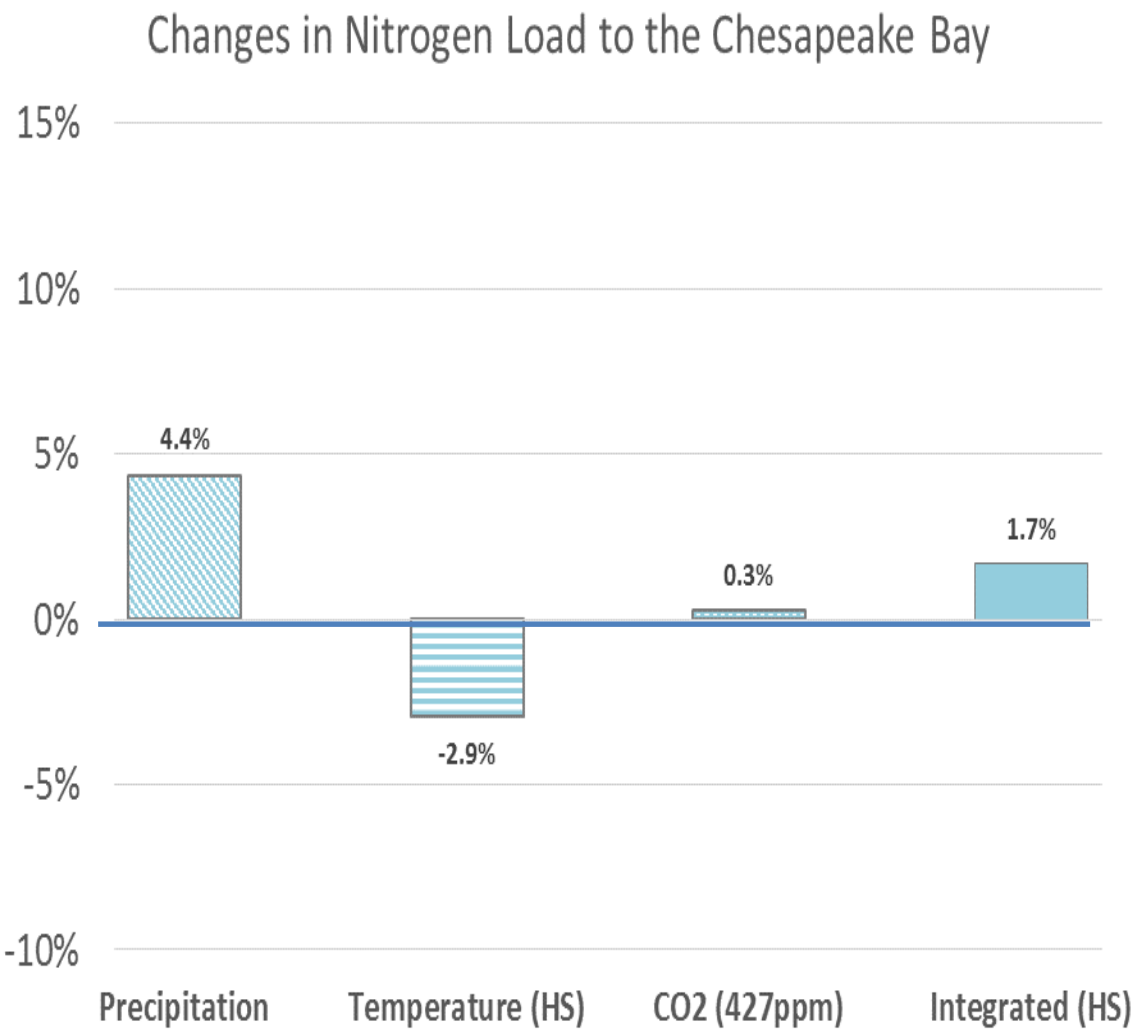
The influence on flow due to the estimated 2025 temperature increase (evapotranspiration via Hargreaves method) is an overall flow decrease of 4%.

The sole influence of CO_2 is to increase flow by 0.3%.

Overall the combined influence of estimated climate change on flow is an increase of 3%.

Source: Gopal Bhatt, Penn State; Kyle Hinson, CRC; and Andrew Sommerlot, UMCES

Estimated Influence of 2025 Increased Precipitation Volume & Intensity on Total Nitrogen Loads



The influence of estimated precipitation increase alone on nitrogen loads is a 4% increase.

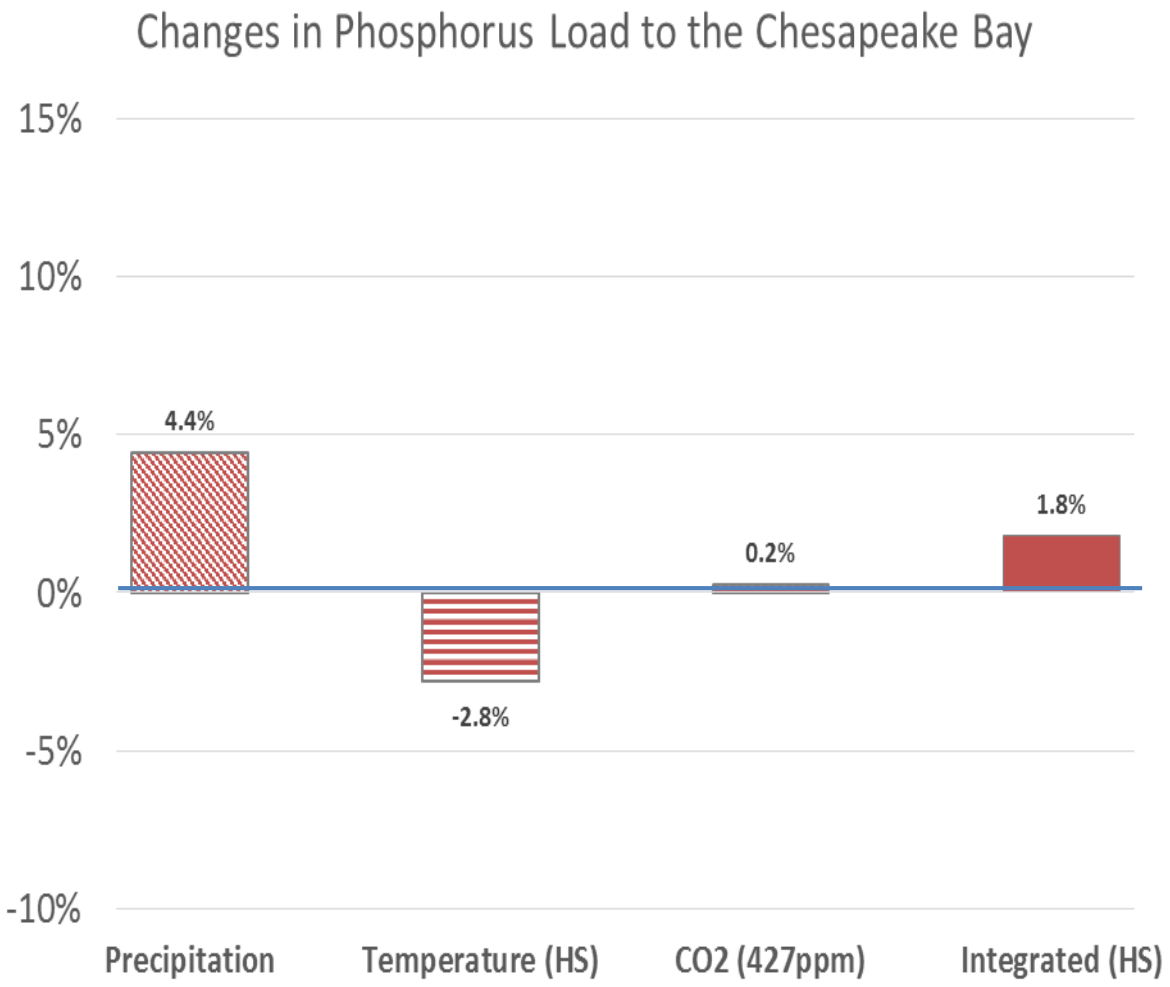
The influence of the estimated 2025 temperature increase on evapotranspiration (Hargreaves method) alone results in an overall nitrogen load decrease of 3%.

The sole influence of CO_2 is to increase nitrogen loads by 0.3%

Overall the combined influence of estimated climate change on nitrogen loads is an increase of 2%.

Source: Gopal Bhatt, Penn State; Kyle Hinson, CRC; and Andrew Sommerlot, UMCES

Estimated Influence of 2025 Increased Precipitation Volume & Intensity on Total Phosphorus Loads



The influence of estimated precipitation increase alone on phosphorus loads is a 4% increase.

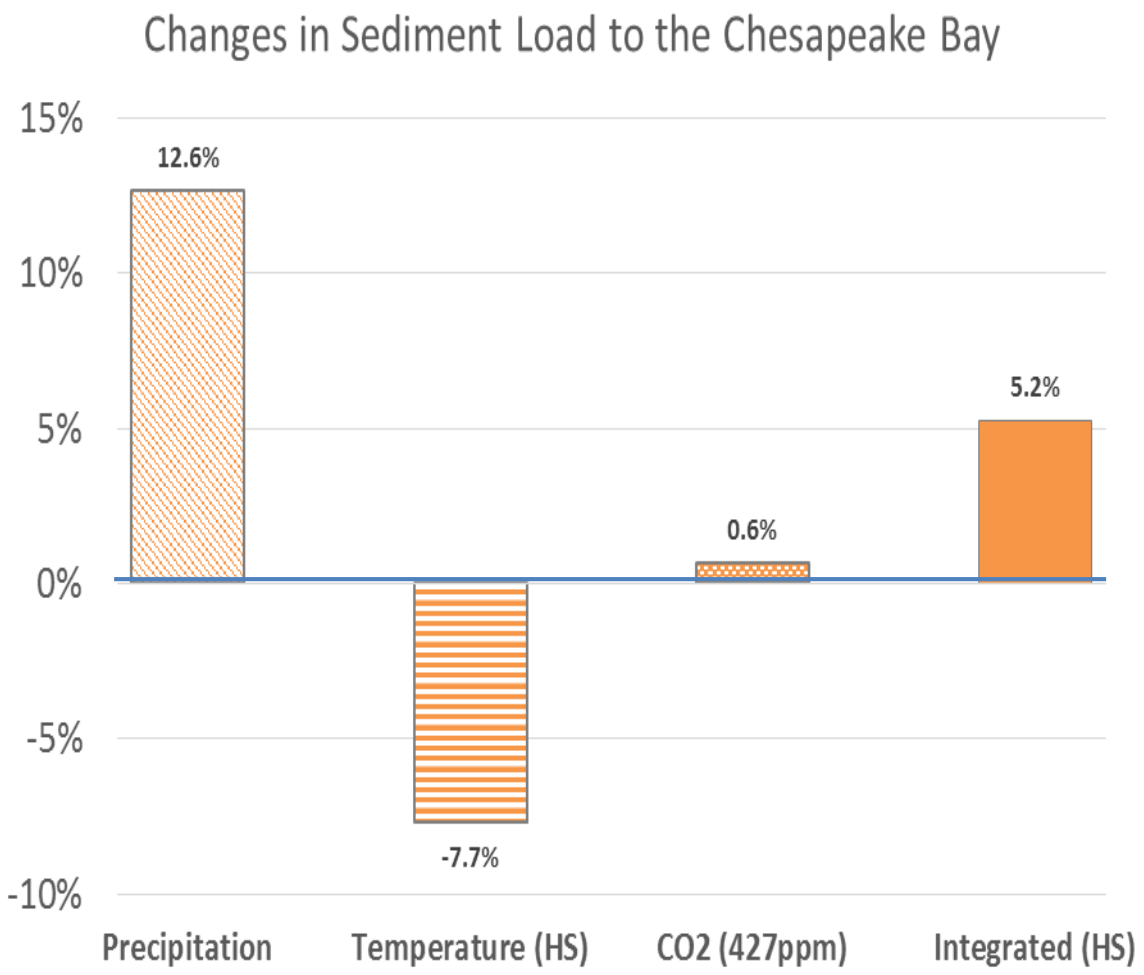
The influence of the estimated 2025 temperature increase on evapotranspiration (Hargreaves method) alone is an overall phosphorus load decrease of 3%.

The sole influence of CO_2 is to increase phosphorus loads by 0.2%

Overall the combined influence of estimated climate change on phosphorus loads is an increase of 2%.

Source: Gopal Bhatt, Penn State; Kyle Hinson, CRC; and Andrew Sommerlot, UMCES

Estimated Influence of 2025 Increased Precipitation Volume & Intensity on Sediment Loads



The influence of estimated precipitation increase alone on sediment loads is a 13% increase.

The influence of the estimated 2025 temperature increase on evapotranspiration (Hargreaves method) alone is an overall sediment load decrease of 8%.

The sole influence of CO_2 is to increase phosphorus loads by 0.6%

Overall the combined influence of estimated climate change on phosphorus loads is an increase of 5%.

Source: Gopal Bhatt, Penn State; Kyle Hinson, CRC; and Andrew Sommerlot, UMCES

Modeling Summary:

- Estimated influence of changes in tidal wetland attenuation is small in 2025 and 2050 because of little change in overall tidal wetland area, but wetland type changes and tidal wetland loss is estimated to increase beyond 2050.
- The range of the influence of estimated watershed loads in future climate change conditions using observed (87 year) increase of precipitation volume (Karen Rice) and precipitation intensity (Karl and Knight) depends on the evapotranspiration method chosen.
- The estimated 2025 range of nutrient (nitrogen & phosphorus) and sediment loads are 0% to 2% and 0% to 5%, respectively.

Modeling Summary:

- Scientific peer reviews of the representation of climate change by the CBP models will be conducted by the CBP Scientific and Technical Advisory Committee (STAC).

- This is a work in progress. Still to come are 13 other Phase 6 Watershed Model climate change scenarios that are in the queue.
- Likewise, the hydrodynamic simulation of the 2025 sea level rise is still underway.

Describing the Range of Policy Options for Addressing Climate Change in the Jurisdictions' Phase III WIPs

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CBP Climate Change Coordinator

Packages and Alternatives

Quantitative/Most Comprehensive		Qualitative/ Comprehensive	
Option 1: Assimilative Capacity	**Option 2:** Base Conditions	**Option 5:** BMP Optimization	**Option 6:** Adaptively Manage
Quantitative/ Comprehensive		**Qualitative/ Least Comprehensive**	
Option 3: Commit with Deferred Imp.	**Option 4:** Margin of Safety	**Option 7:** Programmatic with Set Expectations	**Option 8:** Programmatic with No Set Expectations

2017 Midpoint Assessment
Climate Integration Timeline

Key Upcoming Partnership Decisions:

- **December 2016*:** Proposed climate change assessment procedures.
- **December 2016*:** Proposed ranges of options for when and how to factor climate change considerations into the jurisdictions Phase III WIPs with decisions in spring 2017 informed by the outcomes of the proposed climate change assessment procedures.
- **May 2017*:** When and how to incorporate climate change considerations into the Phase III WIPs as the partners work on the draft Phase III WIP planning targets due in June 2017.
- **December 2017**: Final Phase III WIP planning targets fully reflect partnership decision regarding how and when to incorporate climate change considerations.

* Date of PSC approval – WQGIT and MB recommendations will be made in preceding months