# Factoring Climate Change into the Phase III WIP: *CBP Programmatic Update*

Climate Resiliency Workgroup

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# Climate Change
# Decision-Making Timeline

Three Key Sets of Partnership Decisions:

- **December 2016**: Agreement on 1) climate change assessment procedures, 2) guiding principles, and 3) a range of options for how and when to factor climate change considerations into the jurisdictions' Phase III WIPs

- **May 2017**: How and when 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 reflecting partnership decisions regarding how and when to incorporate climate change considerations

# Principals' Staff Committee Decisions

- Approval of Guiding Principles
- Approval of Climate Assessment Procedures as recommended by the WQGIT and Management Board
- Narrowed down the current range of 7 options for factoring climate change into the Phase III WIPs

# WQGIT and Management Recommended Climate Change Assessment Procedures

- Partition the influence of climate change into separate elements:

<u>Estuary</u>

- Increased estuarine temperatures
- Sea level rise
- Loss of tidal wetlands

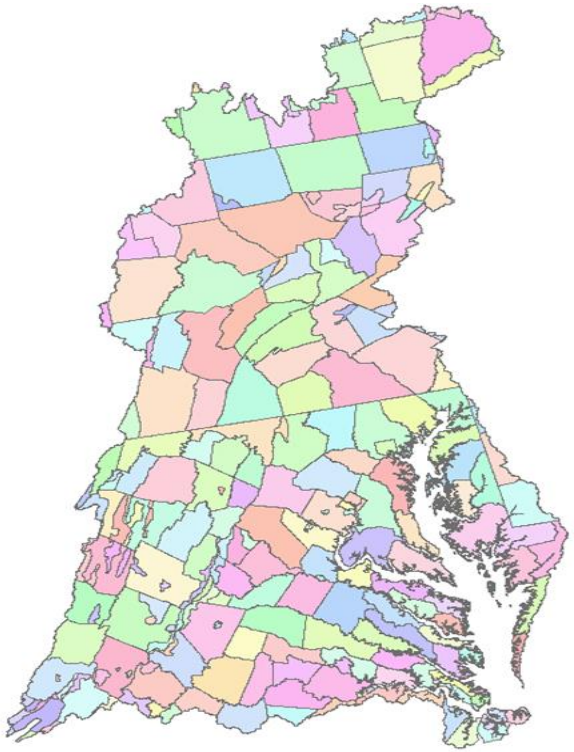
<u>Watershed</u>

- Increased temperatures/ evapotranspiration
- Precipitation change
- Storm intensity

- Run climate change scenarios based on estimated 2025 and 2050 conditions to assess impact on water quality standards (estuary) and watershed flows and loads (watershed)
- Run a range of scenarios to bound the range of uncertainty

# Model Climate Inputs – Initial Scenario Runs

- Precipitation Volume
  - 2025: +3.1% (long term trends)
  - 2050: +7.3% (RCP* 4.5)
- Temperature: RCP 4.5
  - 2025: +1.05 ºC
  - 2050: +2.08 ºC
- $CO_2$ 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 ºC
  - 2050: +1.86 ºC

*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

# Early Climate Change Assessment Findings

**Partition Climate Change Effects**

## Estuary

- Increased estuarine temperatures
- Sea level rise
- Loss of tidal wetlands

**Early Findings**:

- Little change in tidal wetlands until beyond 2050
- Water temperature increase effect on low dissolved oxygen offset by higher sea level, more mixing
- No strong evidence that climate change impacts the Bay's assimilative capacity

## Watershed

- Storm intensity
- Increased temperatures/Evapotranspiration
- Precipitation change
- Watershed flows and loads

**Early Findings**:

- Increased in precipitation (+) and increased temperature (-) leads to an estimated 3% increase in river flows
- Currently estimating up to a 2% increase in nutrient loads and 5% increase in sediment loads by 2025

# 2025 Climate Inputs – Proposed Approach

| Year | Variable | Input | Parameter | Sensitivity | Used for Uncertainty |
|---|---|---|---|---|---|
| 2025 | $CO_2$ | 427 ppm | Stomatal resistance | very low | no |
| | Potential Evapotranspiration | Hamon Method | PET with high temperature response | high | yes |
| | | Hargreaves Method | PET with moderate temperature response | high | yes |
| | Temperature | RCP 2.6 | Monthly median of 32 member ensemble of climate change models | low in tidal water; moderate as influence on PET | yes |
| | | RCP 4.5 | Monthly median of 32 member ensemble of climate change models | low in tidal water; moderate as influence on PET | yes |
| | | RCP 8.5 | Monthly median of 32 member ensemble of climate change models | low in tidal water; moderate as influence on PET | yes |
| | Precipitation | Historical | With Observed Intensity | moderate | yes |
| | | Historical | Without Intensity | moderate | yes |
| | Sea Level Rise | 0.2 m | Bay Hydro Model | low | no |
| | | 0.3 m | Bay Hydro Model | low | no |
| | | 0.4 m | Bay Hydro Model | low | no |

Key:
Recommended approach
Useful to examine range of uncertainty
Full uncertainty approach

# 2050 Climate Inputs - Proposed Approach

| Year | Variable | Input | Parameter | Sensitivity | Used for Uncertainty |
|---|---|---|---|---|---|
| 2050 | $CO_2$ | 487 ppm | Stomatal resistance | very low | no |
| | Potential Evapotranspiration | Hamon Method | PET with high temperature response | high | yes |
| | | Hargreaves Method | PET with moderate temperature response | high | yes |
| | Temperature | RCP 2.6 | Monthly median of 32 member ensemble of climate change models | low in tidal water; moderate as influence on PET | yes |
| | | RCP 4.5 | Monthly median of 32 member ensemble of climate change models | low in tidal water; moderate as influence on PET | yes |
| | | RCP 8.5 | Monthly median of 32 member ensemble of climate change models | low in tidal water; moderate as influence on PET | yes |
| | Precipitation | RCP 2.6* | 10 percentile of precip w/ observed intensity | moderate | yes |
| | | | 10 percentile of precip w/o observed intensity | moderate | yes |
| | | | median precip w/ observed intensity | moderate | yes |
| | | | median precip w/ observed intensity | moderate | yes |
| | | | 90 percentile of precip w/ observed intensity | moderate | yes |
| | | | 90 percentile of precip w/o observed intensity | moderate | yes |
| | | RCP 4.5* | With Observed Intensity | moderate | yes |
| | | | Without Intensity | moderate | yes |
| | | RCP 8.5* | With Observed Intensity | moderate | yes (w/90 percentile) |
| | | | Without Intensity | moderate | yes |
| | Sea Level Rise | 0.3 m | Bay Hydro Model | low | no |
| | | 0.5 m | Bay Hydro Model | low | no |
| | | 0.8 m | Bay Hydro Model | low | no |

Key: Recommended approach Useful to examine range of uncertainty Full uncertainty approach

* Each 2.6, 4.5, and 8.5 RCP scenario for 2050 is generated from a 32 member ensemble of climate change models with assessments of the 10 percentile precipitation, median precipitation, and 90 percentile precipitation.

# 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 additional Phase 6 Watershed Model climate change scenarios that can be used to inform decision making and develop the uncertainty analysis.

- The Bay Model hydrodynamic simulation of the 2025 sea level rise has just been competed.

# Guiding Principles

**WIP Development:**

- Capitalize on “Co-Benefits”
- Account for and integrate planning and consideration of existing stressors
- Align with existing climate resiliency plans and strategies
- Manage for risk and plan for uncertainty
- Engage local agencies and leaders

**WIP Implementation:**

- Reduce vulnerability
- Build in flexibility and adaptability
- Adaptively manage

# Three Categories of Options

Quantitative

Qualitative

Deferred implementation

# Quantitative Options

Option 1: Assimilative capacity

Option 2: Base conditions

Option 4: Margin of safety

# Qualitative Options

Option 5: BMP optimization (WIP development)

Option 6: Adaptively manage (2-year milestones)

Option 7: Programmatic with set expectations

# Deferred Implementation Option

Option 3: Commit with deferred implementation

# Quantitative Options – PSC Decision

~~Option 1: Assimilative capacity~~

Option 2: Base conditions

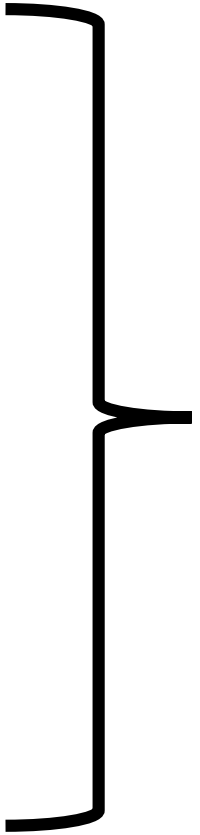
~~Option 4: Margin of safety~~

# Qualitative Options – PSC Decision

Option 5: BMP optimization (WIP development)

Option 6: Adaptively manage (2-year milestones)

Option 7: Programmatic with set expectations



**Combined Option**

# Options 5,6 & 7: Revised Language

- During each two-year milestone development period, jurisdictions would consider new information on the performance of BMPs and the programs that support them, including the contribution of seasonal, inter-annual climate variability and weather extremes on BMP performance.
- When there is a detectable impact on the effectiveness of a BMP or programmatic performance, jurisdictions would use this information to re-prioritize their actions to implement in the Phase III WIPs that will better mitigate the anticipated increased in nitrogen, phosphorus or sediment.

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