

Presented to the DRBC Water Management Advisory Committee on Feb. 23, 2017. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

Delaware River Basin Commission

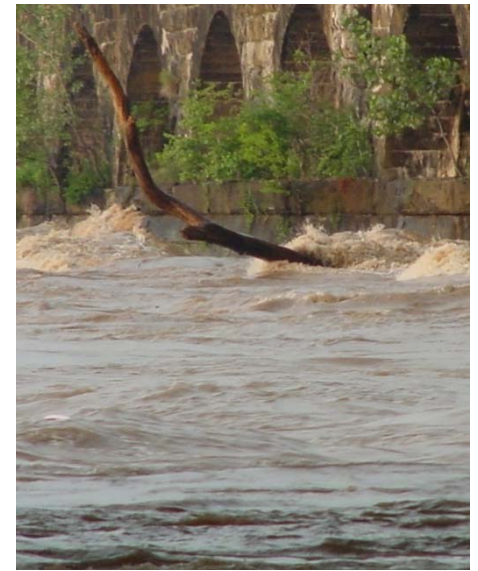
Modeling Hydrology for WS Planning

Amy L. Shallcross, PE

Manager, Water Resource
Operations

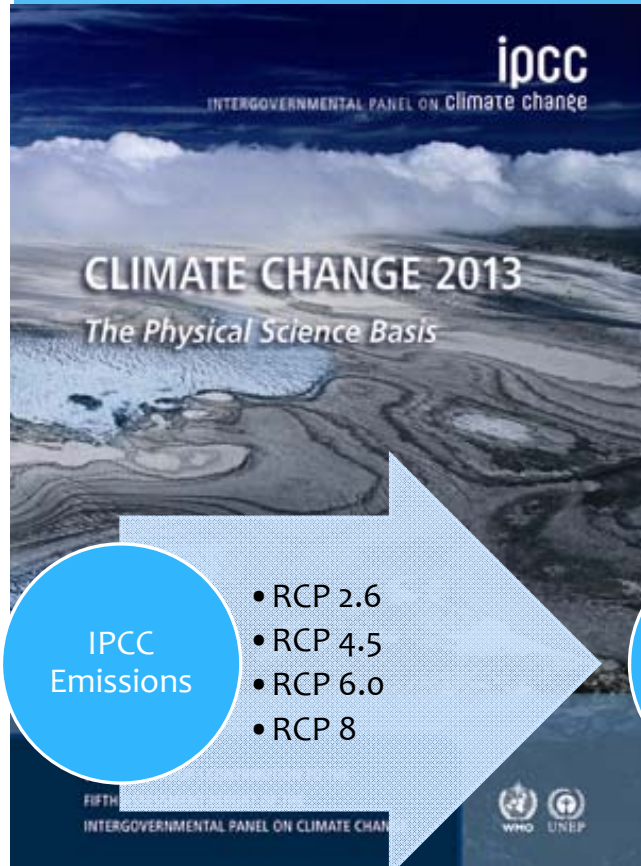
WMAC

February 23, 2017



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Climate Scenarios



IPCC Emissions

- RCP 2.6
- RCP 4.5
- RCP 6.0
- RCP 8

Scenarios related to GHG emissions

Four GCMs
NCAR, GFDL,
GISS, CanES

 **WATER**

Global Circulation Models

- Precipitation
- Temperature
- Evaporation

Alternate Hydrology

Planning Support Tool – PST

1D Salinity Model

DRBC Planning Support Tool

- Water Availability
- Drought Resiliency

Basinwide Management Plans

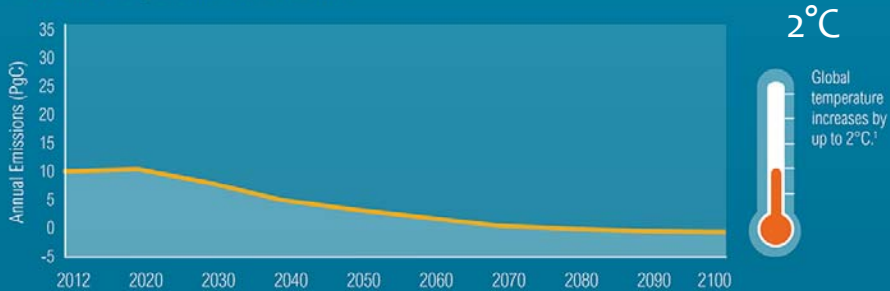
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Representative Concentration Pathways – RCPs a.k.a. Scenarios

LOW EMISSIONS PATHWAY

RCP 2.6

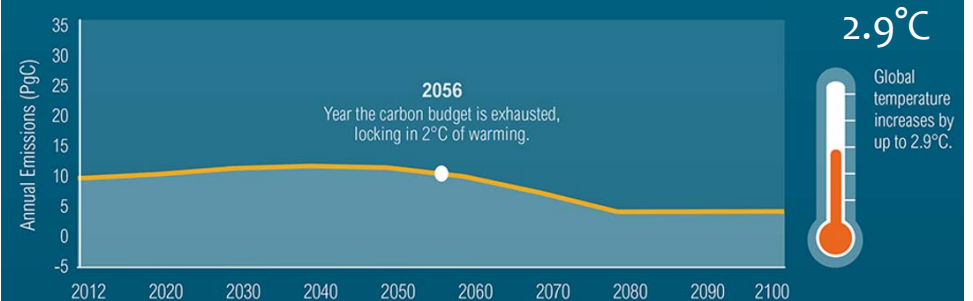
Carbon dioxide emissions peak by 2020 and then drop 66 percent below 2010 levels by 2050. While the world will still experience some climate impacts under this pathway, they grow exponentially worse under higher emissions scenarios.



RCP 4.5

MEDIUM EMISSIONS PATHWAY

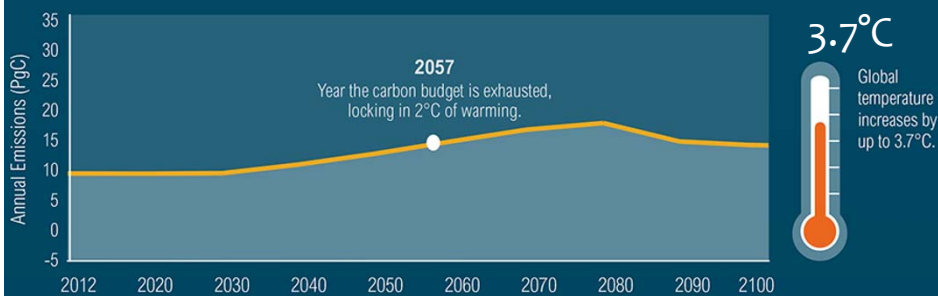
Carbon dioxide emissions peak by 2040, but still rise 19 percent above 2010 levels by 2050.



HIGH EMISSIONS PATHWAY

RCP 6.0

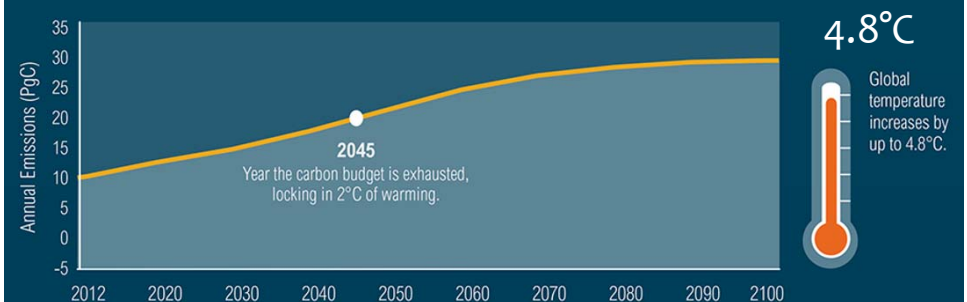
Carbon dioxide emissions peak by 2080, but still rise 34 percent above 2010 levels by 2050.



RCP 8.5

HIGHEST EMISSIONS SCENARIO

Annual carbon dioxide emissions continue to rise through 2100, rising 108 percent above 2010 levels by 2050.



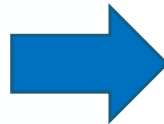
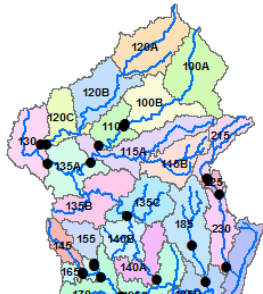
<http://www.wri.org/ipcc-infographics>

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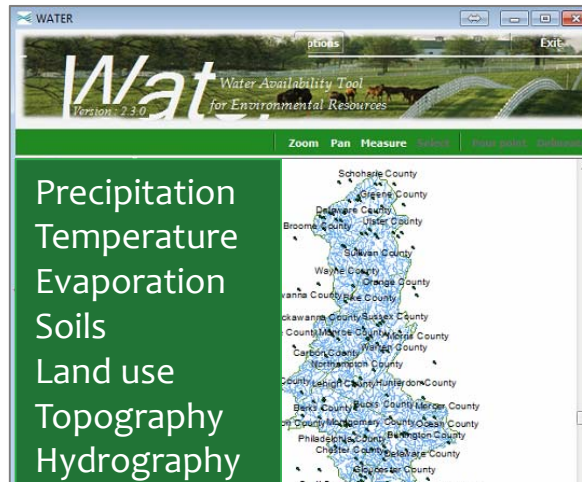
Global Climate Models (GCMs)

- * Multiple models are used to address and assess uncertainty and bias
- * Four chosen from Coupled Model Intercomparison Project, Phase 5 (CMIP5)
 - * Research Institute (Abbreviation/Model)
 - * NOAA –Geophysical Fluid Dynamics Laboratory (GFLD/ESM2G)
 - * NASA – Goddard Institute for Space Studies (GISS/E2-H)
 - * National Center for Atmospheric Research, Community Climate System Model (**NCAR/CCSM4 – today's example output**)
 - * Canadian Centre for Climate Modelling and Analysis (CanESM2/CGM4)

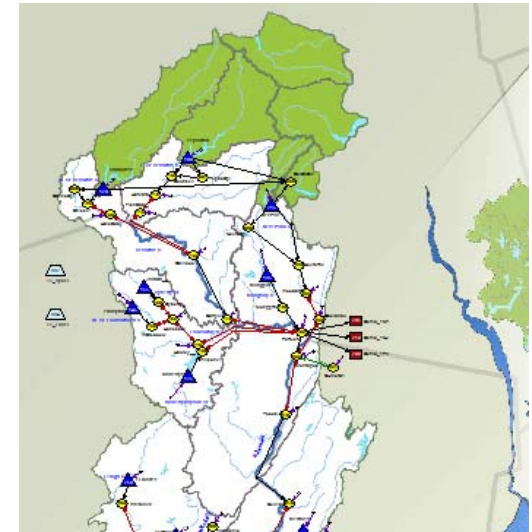
Tributary Areas to Nodes in DRB-PST, Water Supply Planning Support Tool



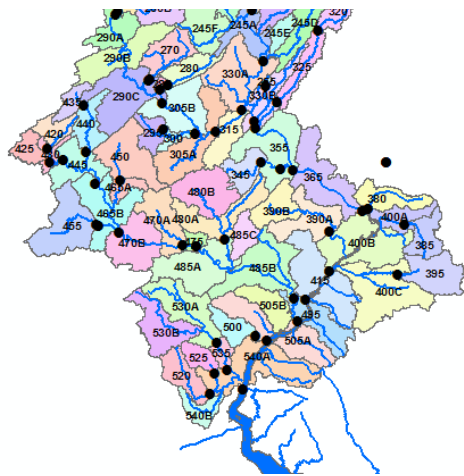
Water Availability Tool for Environmental Resources



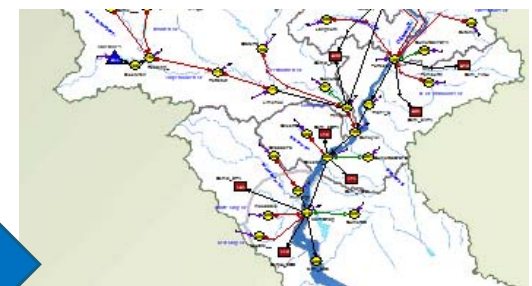
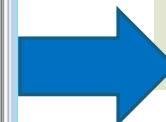
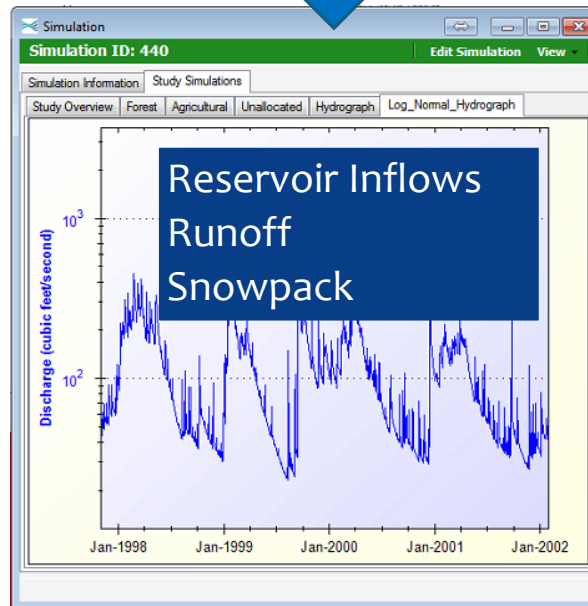
DRB-PST



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95 sub-basins



Water Supply Sustainability Planning



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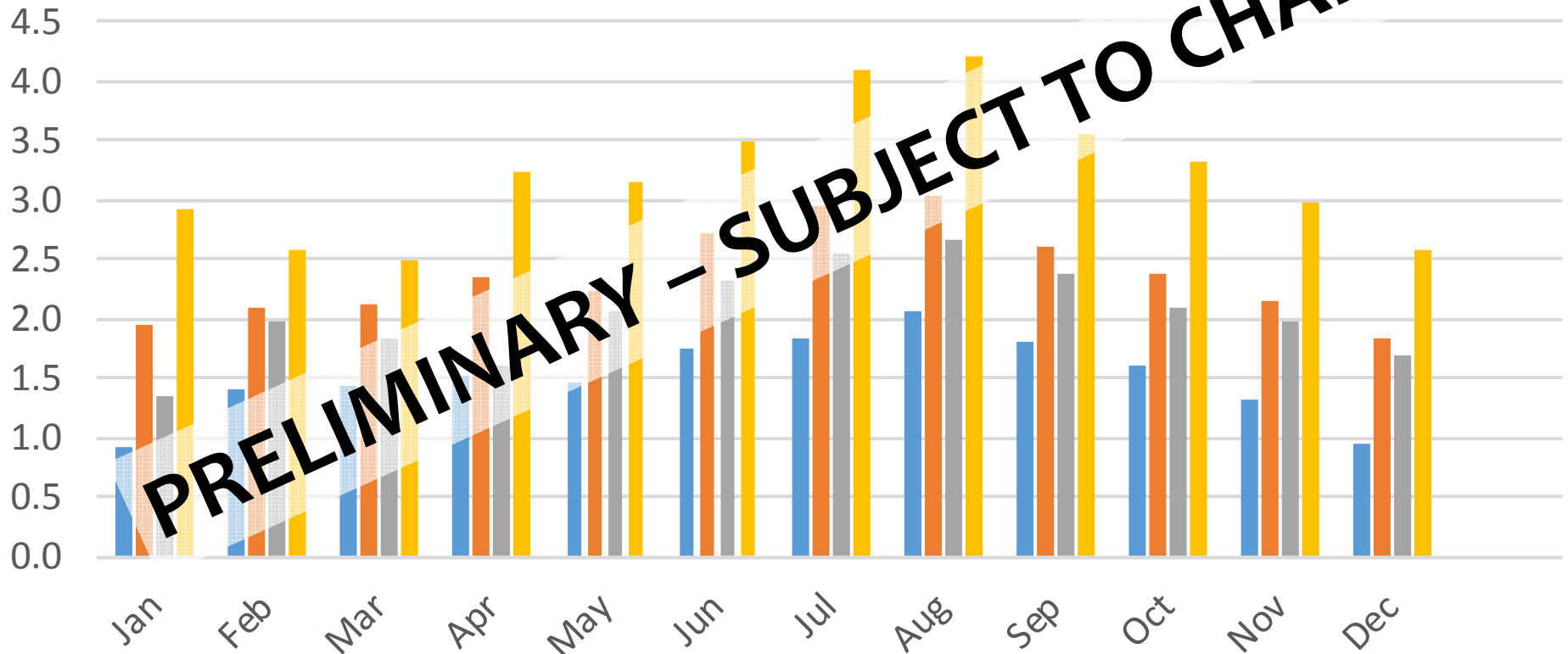
Temperature

GCM: NCAR – CCSM4

Year: 2060

Landuse: 2011

Potential Changes above Pepacton Reservoir



Emissions: Low Medium High Highest

■ RCP 2.6 ■ RCP 4.5 ■ RCP 6.0 ■ RCP 8.5

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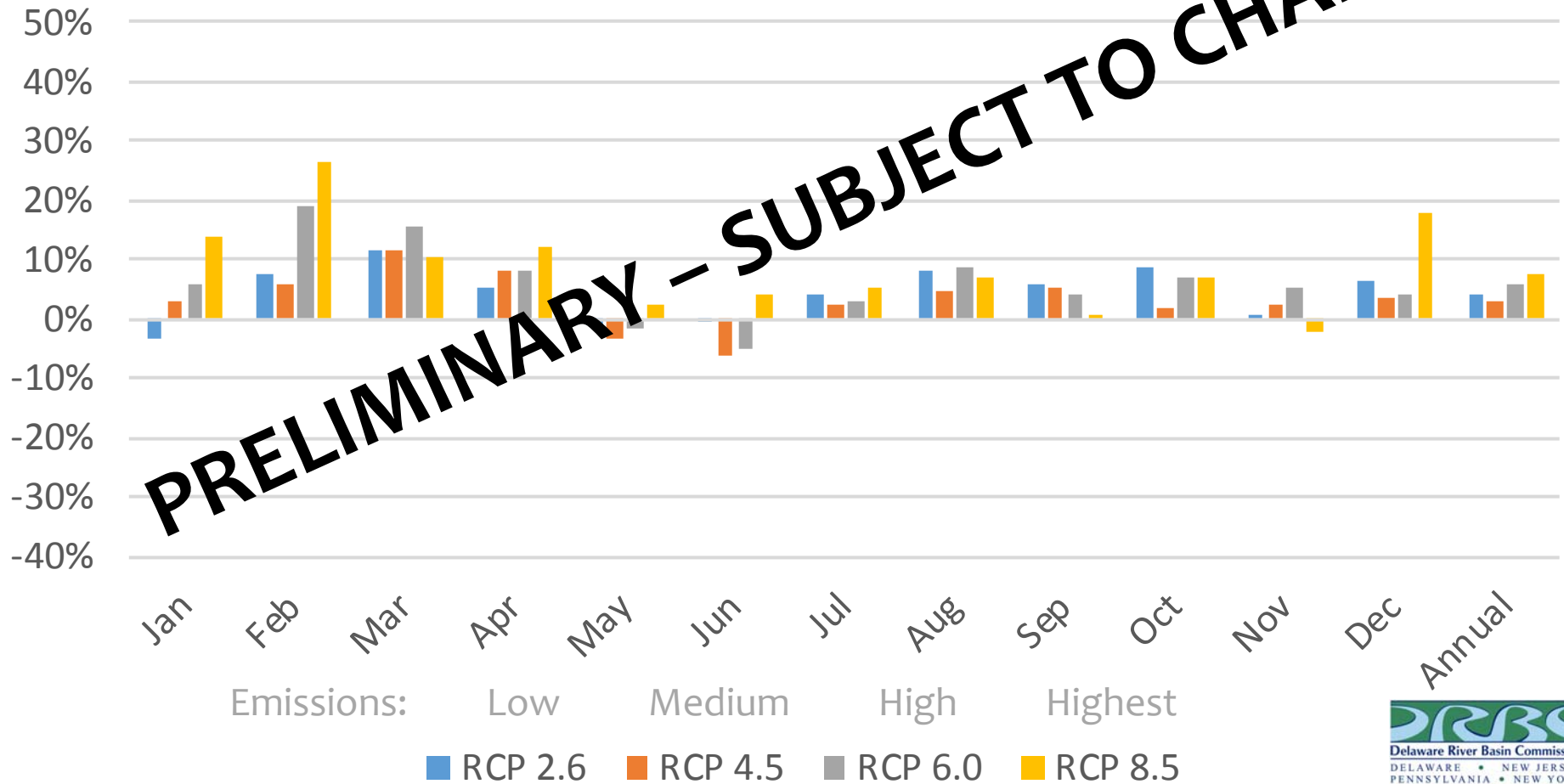
Precipitation

GCM: NCAR – CCSM4

Year: 2060

Landuse: 2011

Potential Changes above Pepacton Reservoir



PRELIMINARY - SUBJECT TO CHANGE

Emissions: Low Medium High Highest
■ RCP 2.6 ■ RCP 4.5 ■ RCP 6.0 ■ RCP 8.5



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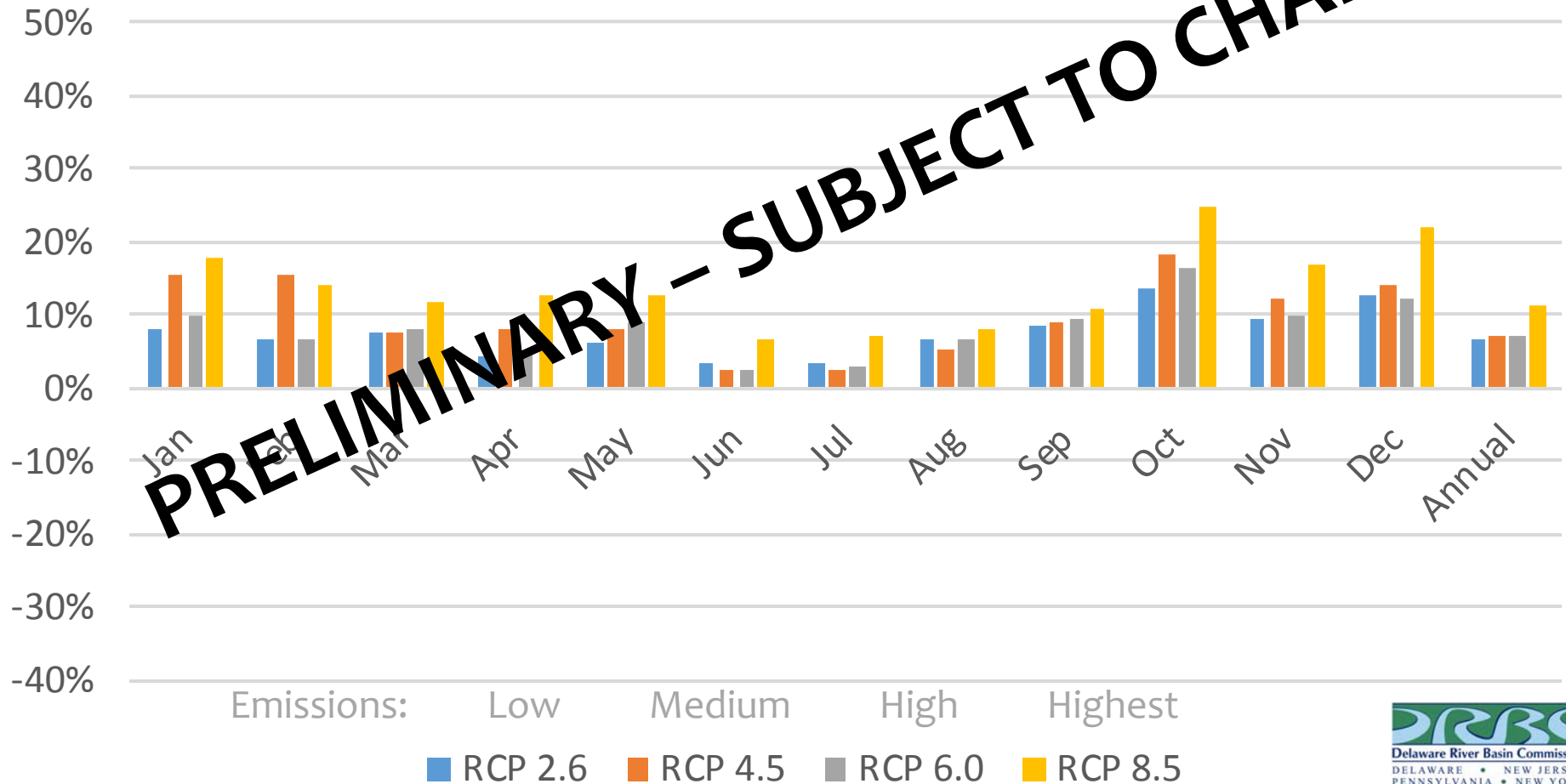
Actual Evapotranspiration

GCM: NCAR – CCSM4

Year: 2060

Landuse: 2011

Potential Changes above Pepacton Reservoir



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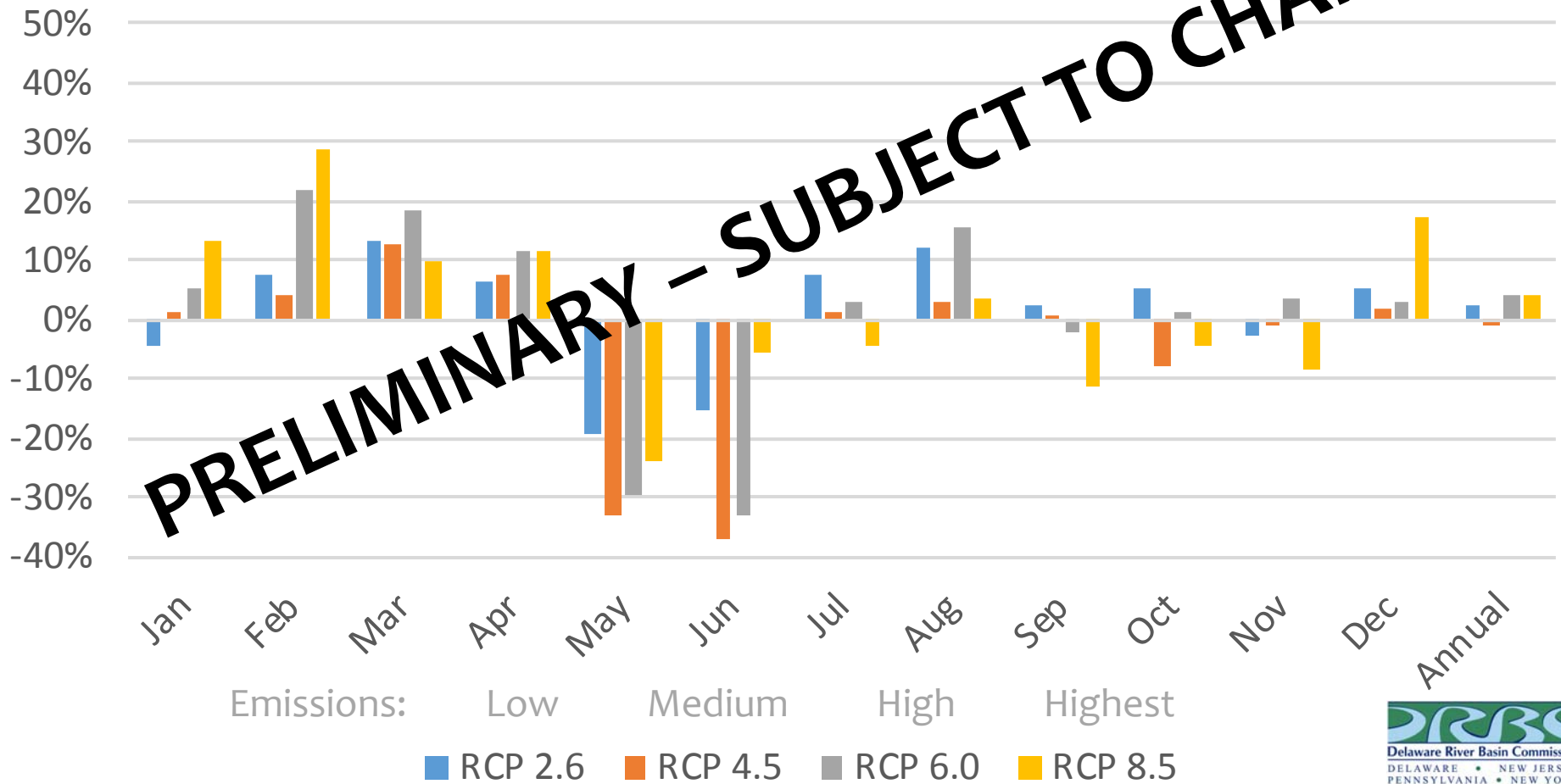
Available Water (PPT-AET)

GCM: NCAR – CCSM4

Year: 2060

Landuse: 2011

Potential Changes above Pepacton Reservoir



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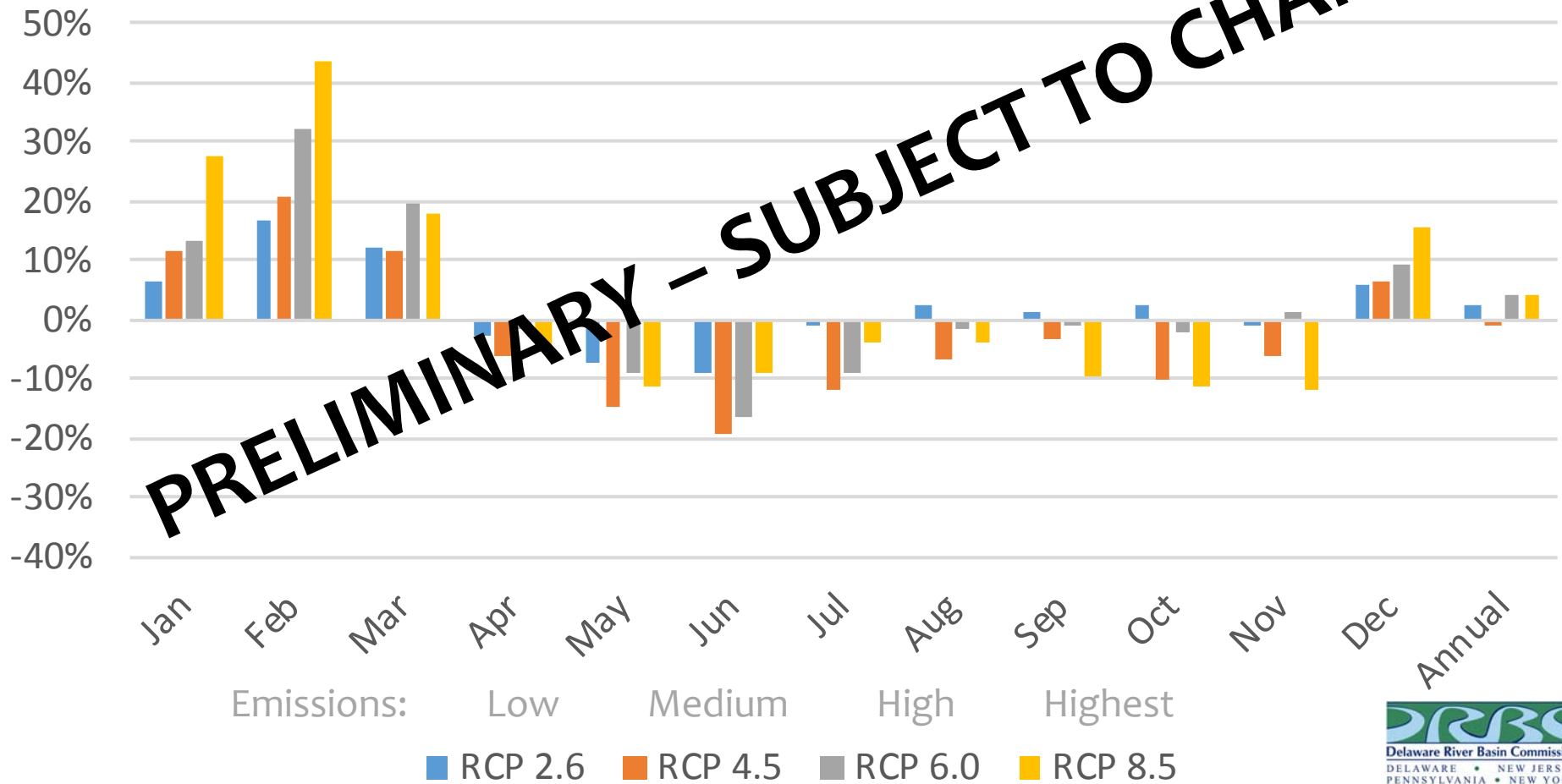
Reservoir Inflow

GCM: NCAR – CCSM4

Year: 2060

Landuse: 2011

Potential Changes above Pepacton Reservoir



Emissions:

Low

Medium

High

Highest

■ RCP 2.6

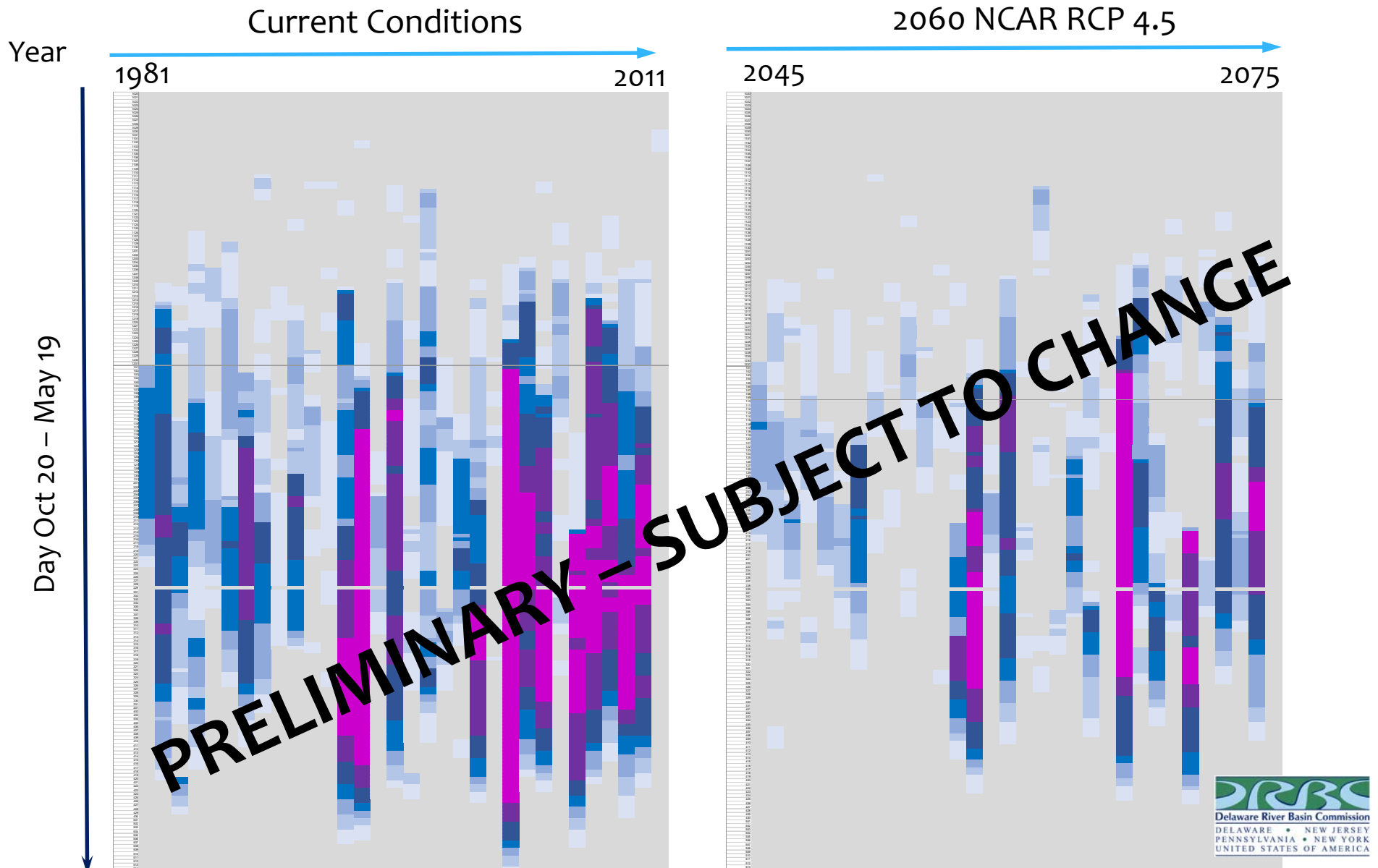
■ RCP 4.5

■ RCP 6.0

■ RCP 8.5

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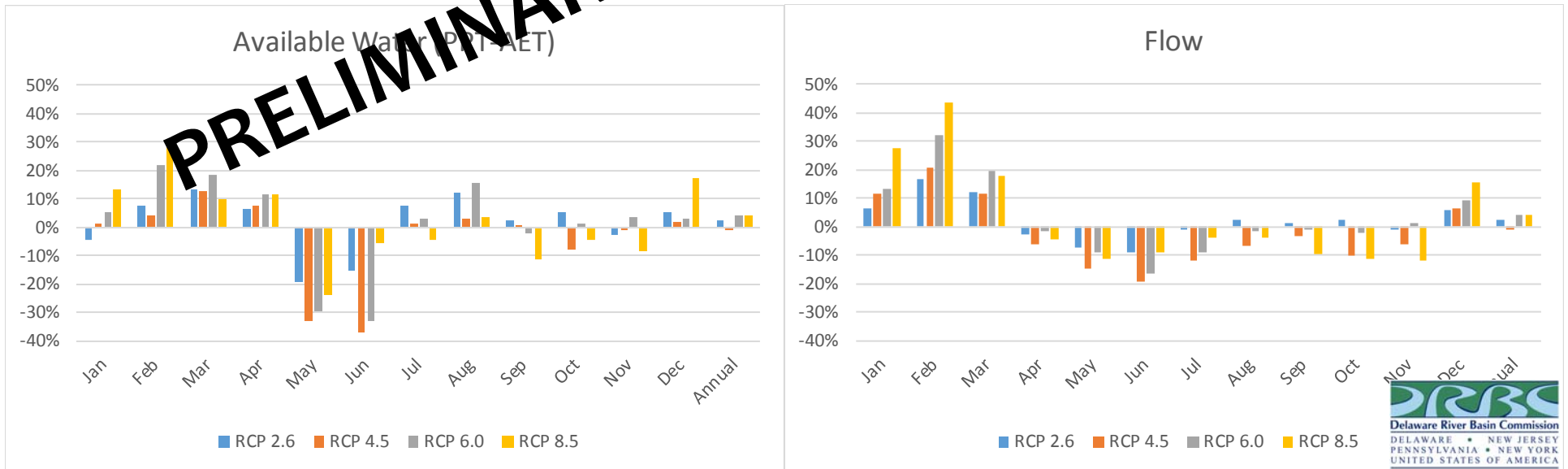
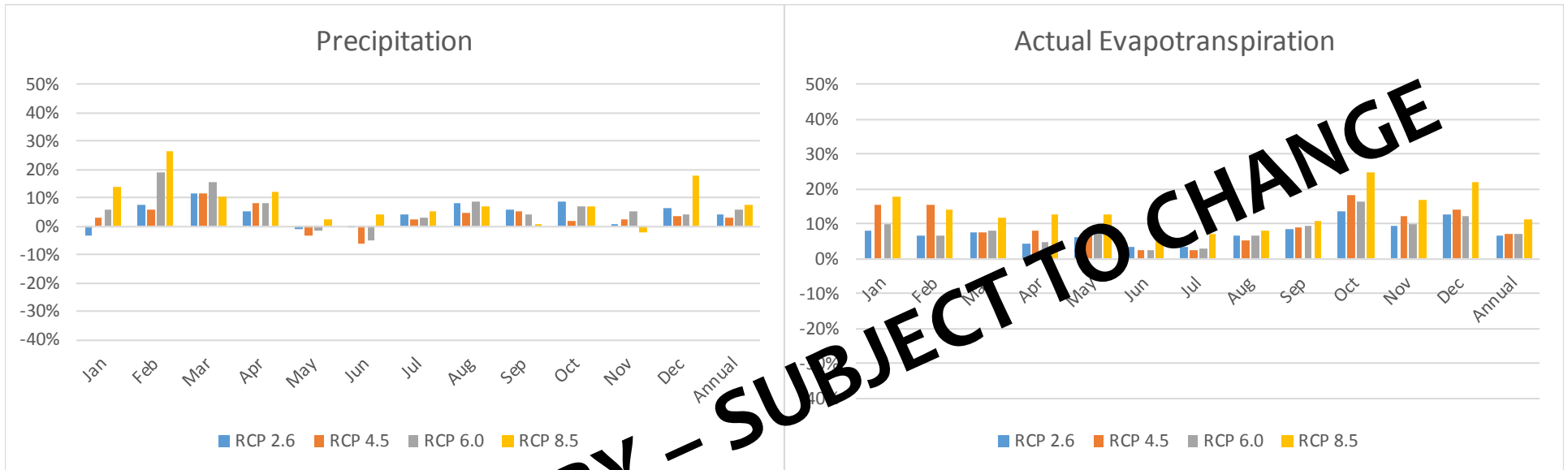
Potential Changes to Snowpack above Pepacton



GCM: NCAR – CCSM₄
 Year: 2060
 Landuse: 2011

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Potential Changes above Pepacton Reservoir



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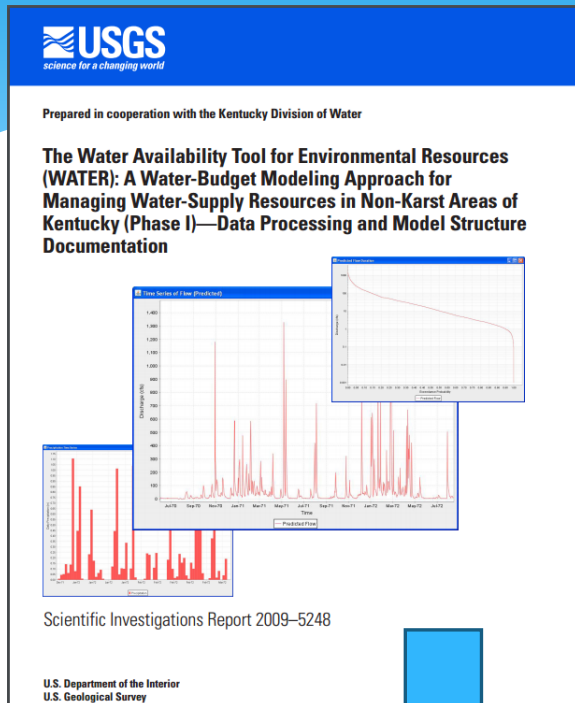
Summary

- * USGS-WATER is being used to generate flows for DRB-PST
- * Multiple GCM-RCP Combinations are being evaluated
- * For 2060, NCAR and RCPs generally indicate these trends:
 - * **Increases** in:
 - * Temperature
 - * Evapotranspiration
 - * Precipitation
 - * Annual Flow (slight)
 - * **Reductions** in available water (evaporation outpaces precipitation)
 - * **Shifts** in the monthly rainfall pattern
 - * **Decreases** in snowpack

PRELIMINARY – SUBJECT TO CHANGE

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References



Google

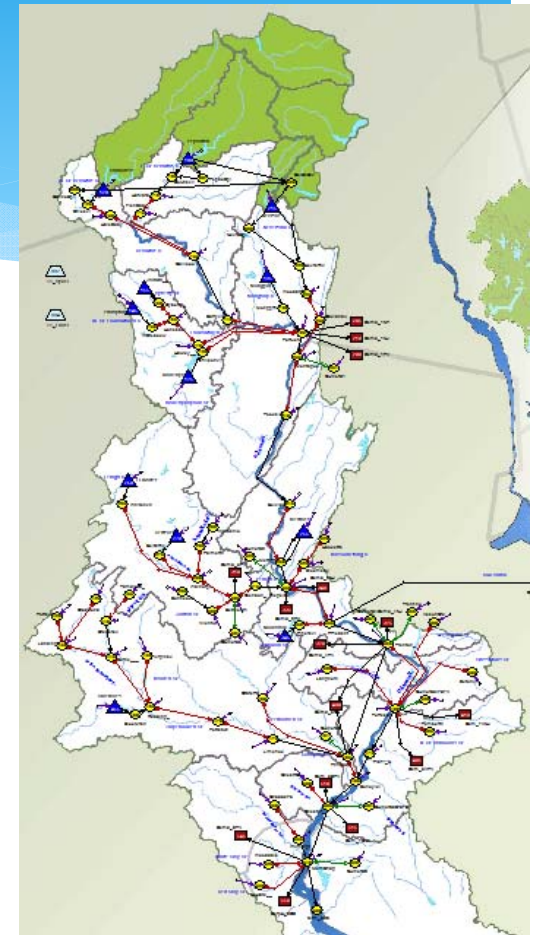
USGS

Scientific Investigations
Report 2009-5248

DRB Planning
Support Tool:



<http://www.nj.gov/drbc/programs/flow/drbspst.html>



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Delaware River Basin Commission

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