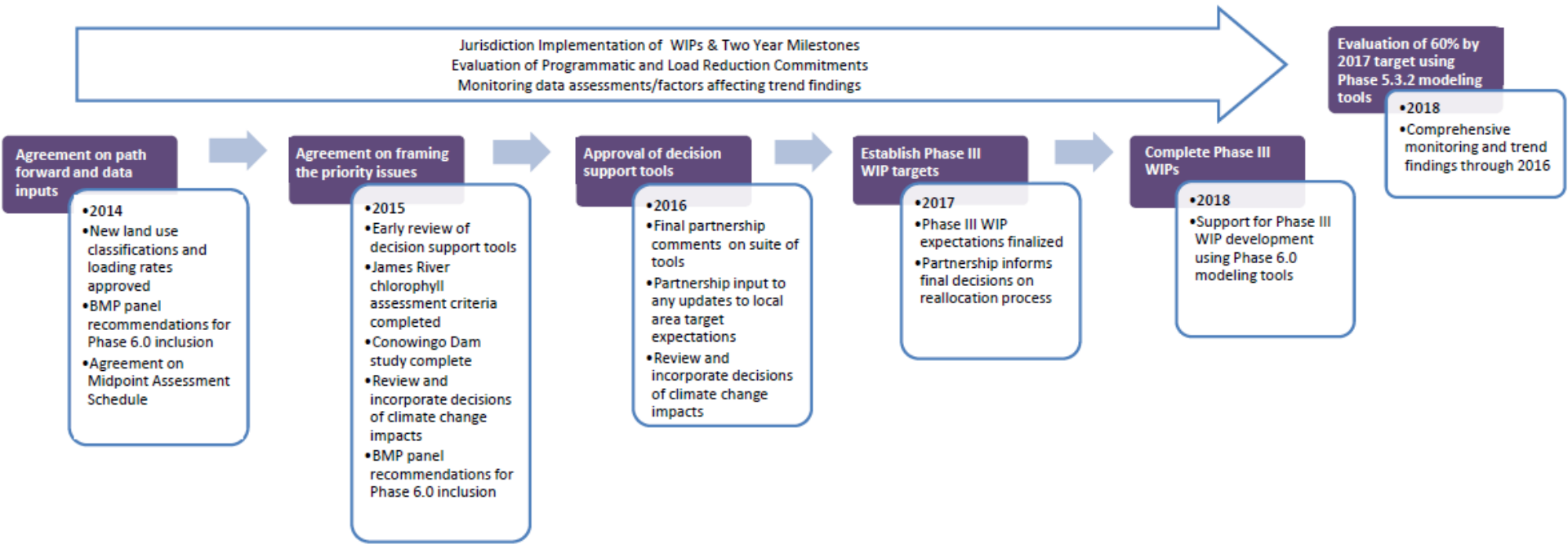
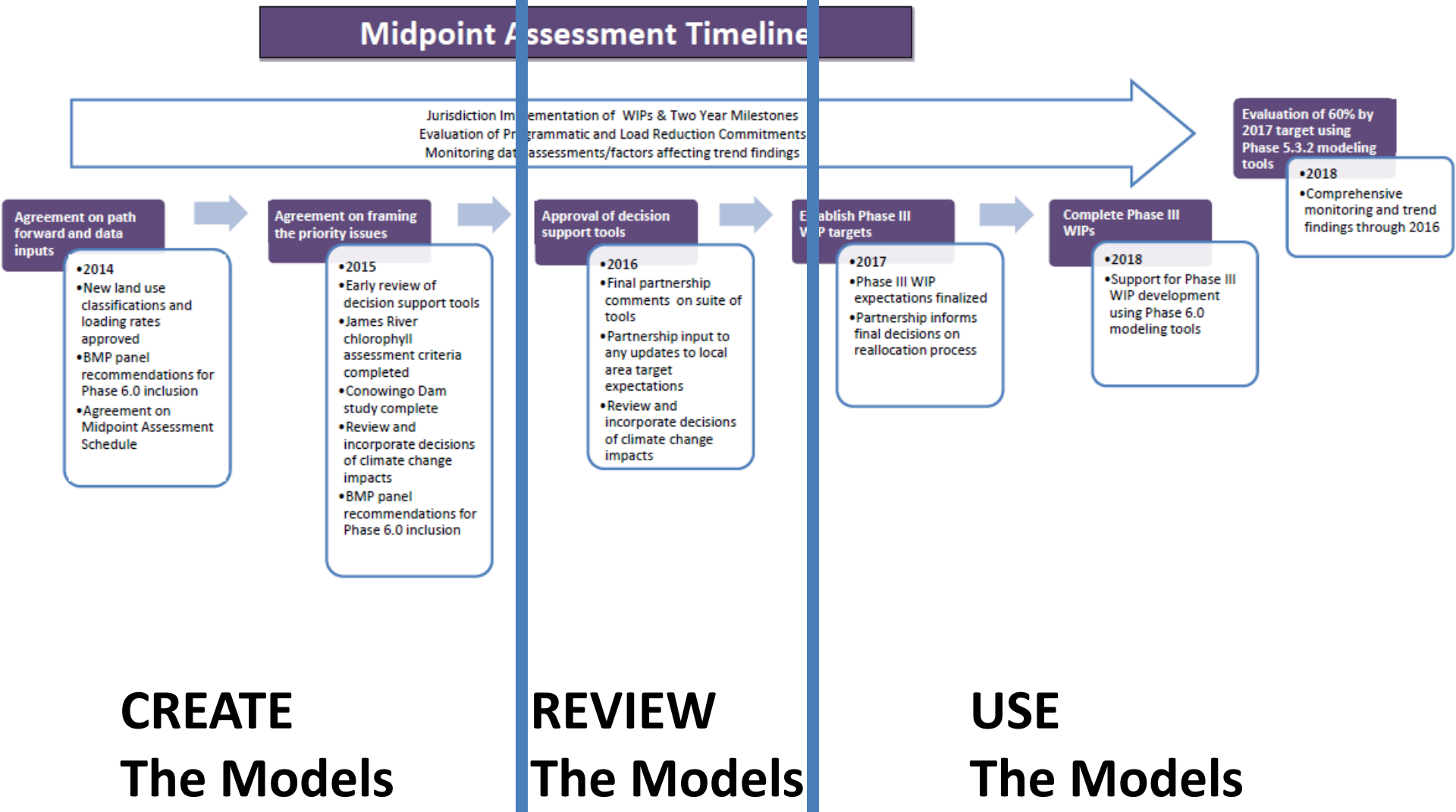
# Scenario Builder and Watershed Model Progress toward the MPA

Gary Shenk  Modeling Workgroup 7/22/14

# Midpoint Assessment Timeline






**CREATE The Models**

**REVIEW The Models**

**USE The Models**

# Draft Modeling Schedule for MPA

Dec 20, 2016 - All models are final. The partnership decision-making process begins to discuss how these new models will be used in the WIP3 process

**REVIEW**
**The Models**

September 2016 – Final comments on the draft Phase 6 model

Dec 20, 2015 - Phase 6 draft model is complete. Evaluation followed by fine tuning during this year

Oct 20, 2015 – All inputs are final and delivered to the WSM by the scenario builder team for the final calibration run

March 20, 2015 – All major partnership decisions are made on changes to scenario builder processing and data. Scenario builder final modifications begin.

Oct 20, 2014 – Rough Draft of major changes to nutrient processing in Scenario Builder will need to be complete. (Examples: land use types and manure application rules)

**CREATE**
**The Models**

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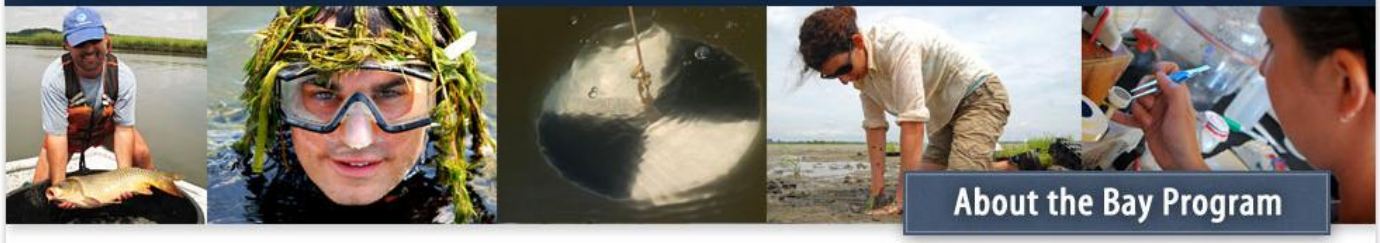





Who We Are
How We Work
How We're Organized
Chesapeake Executive Council
Principals' Staff Committee
Management Board
Citizens Advisory Committee
Local Government Advisory Committee
Scientific and Technical Advisory Committee
Communications Workgroup
Scientific and Technical Analysis and Reporting

# Water Quality Goal Implementation Team (GIT 3)

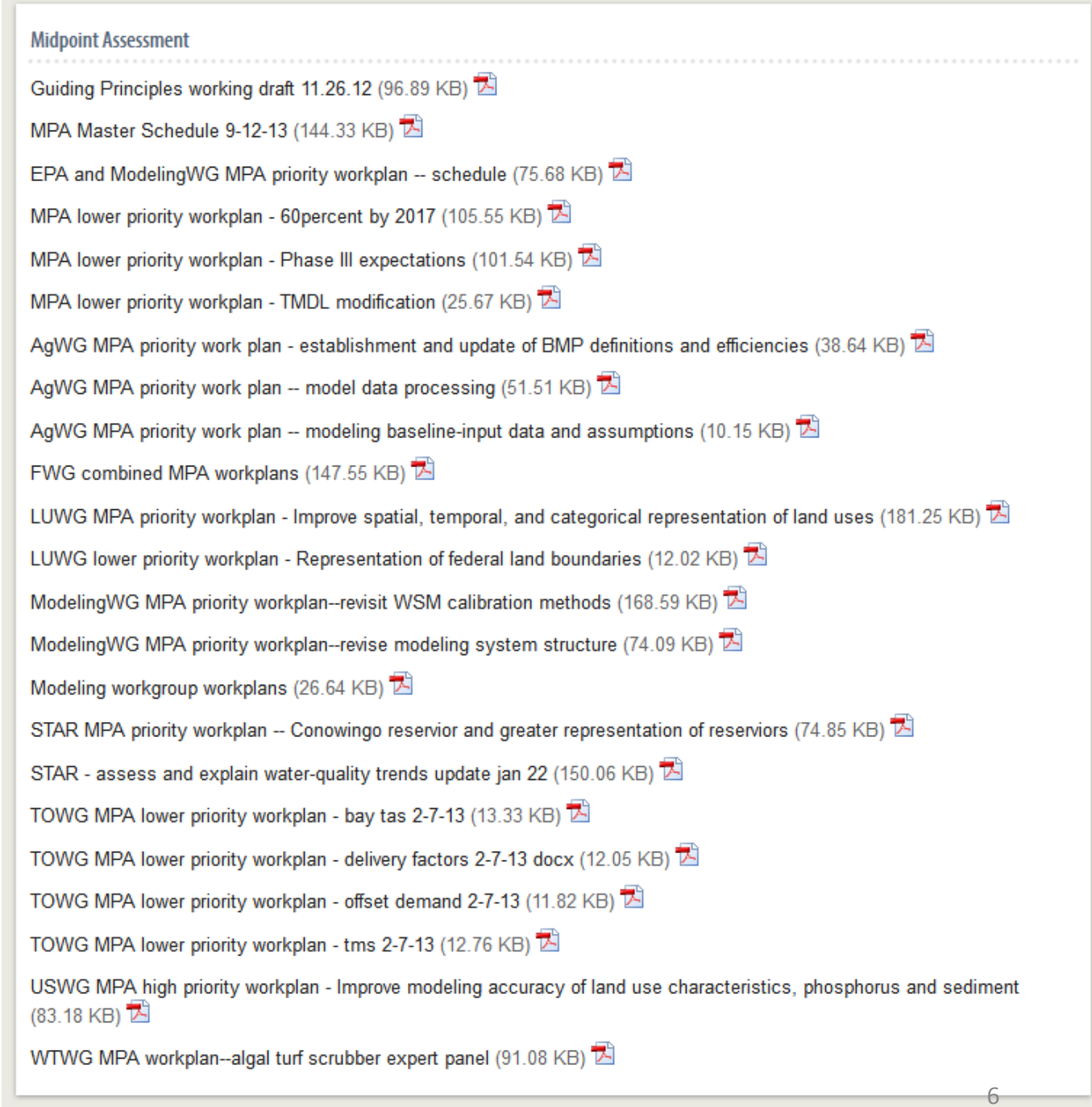
## Scope and Purpose

The charge of the Water Quality Goal Implementation Team (WQGIT) is to evaluate, focus, and accelerate the implementation of practices, policies, programs that will restore water quality in the Chesapeake Bay and its tributaries to conditions that support living resources and protect human health. The Team reports to the Management Board and Principals' Staff Committee. Functions include:

- Provide a forum for discussion, exchange of information, and evaluation among federal, state, and local agencies, river basin commissions, industry groups, universities, and other interested parties on water quality goals, data, modeling, authorities, and restoration efforts.
- Evaluate and promote strategies to reduce nutrient, sediment, and chemical contaminant loads from municipal, industrial and onsite wastewater; agricultural lands and animal operations; urban and suburban stormwater; forested lands; tidal and in-stream sediment; and air emissions.
- Promote consistent, uniform and transparent processes to model, track, report, and verify water quality restoration efforts.
- Identify, define, quantify, and incorporate pollutant reduction and conservation practices into the Chesapeake Bay Program decision support system.
- Provide technical expertise and leadership to support the development, implementation, and tracking of the Chesapeake Bay TMDL, Watershed Implementation Plans, and two-year milestones that support long-term Bay restoration goals.

Members | Meetings | Workgroups & Task Groups | Projects & Resources | Publications

Already Here, but Partnership needs to be able to get the whole picture "at a glance"



Midpoint Assessment

Guiding Principles working draft 11.26.12 (96.89 KB)

MPA Master Schedule 9-12-13 (144.33 KB)

EPA and ModelingWG MPA priority workplan -- schedule (75.68 KB)

MPA lower priority workplan - 60percent by 2017 (105.55 KB)

MPA lower priority workplan - Phase III expectations (101.54 KB)

MPA lower priority workplan - TMDL modification (25.67 KB)

AgWG MPA priority work plan - establishment and update of BMP definitions and efficiencies (38.64 KB)

AgWG MPA priority work plan -- model data processing (51.51 KB)

AgWG MPA priority work plan -- modeling baseline-input data and assumptions (10.15 KB)

FWG combined MPA workplans (147.55 KB)

LUWG MPA priority workplan - Improve spatial, temporal, and categorical representation of land uses (181.25 KB)

LUWG lower priority workplan - Representation of federal land boundaries (12.02 KB)

ModelingWG MPA priority workplan--revisit WSM calibration methods (168.59 KB)

ModelingWG MPA priority workplan--revise modeling system structure (74.09 KB)

Modeling workgroup workplans (26.64 KB)

STAR MPA priority workplan -- Conowingo reservior and greater representation of reserviors (74.85 KB)

STAR - assess and explain water-quality trends update jan 22 (150.06 KB)

TOWG MPA lower priority workplan - bay tas 2-7-13 (13.33 KB)

TOWG MPA lower priority workplan - delivery factors 2-7-13 docx (12.05 KB)

TOWG MPA lower priority workplan - offset demand 2-7-13 (11.82 KB)

TOWG MPA lower priority workplan - tms 2-7-13 (12.76 KB)

USWG MPA high priority workplan - Improve modeling accuracy of land use characteristics, phosphorus and sediment (83.18 KB)

WTWG MPA workplan--algal turf scrubber expert panel (91.08 KB)

Not Quite “At a glance”

# Major Topics - WQGIT

- Land use
- Fertilizer and Manure Applications
- BMP effectiveness
- BMP implementation accounting
- Scenario Builder Development and Code Versioning

# Major Topics – Modeling WG

- Watershed Model Development and Code Versioning
- Calibration Methodology
- Land use Loading Rates (with WQGIT and WGs)
- Sensitivities to inputs
- Fine Scale Processes (with LUWG)
- Lag Time
- Atmospheric Data
- Climate Change
- Conowingo and other Reservoirs

# BMP effectiveness

***CBP Oversight: WQGIT***

***Lead: Jenn Volk, James Davis-Martin, Brian Benham***

***CBPO Contact: Lucinda Power***

***Midpoint Assessment Priorities:***

establishment and update of BMP definitions and efficiencies: AgWG

***Component Efforts:***

None

***Brief Description:***

The WQGIT is evaluating new BMPs, and improving their definitions and associated effectiveness values through the partnership approved BMP protocol process.

***Progress:***

The panels have been very active and continue to deliver BMP recommendations to the partnership. A consortium of universities under the leadership of Virginia Tech has received funding to help coordinate BMP expert panels as a supplement to the CBP process. In addition, Tetra Tech is providing technical and logistical support.

Completed panel reports are listed on ChesapeakeStat.

A separate web page for BMP panel reports is being prepared.

***Documents:*** WQGIT BMP Review Protocol

***Presentations:***

***Next Steps:***

***Expected Completion Date:*** Oct 1, 2015

# Summary

- Document / Web site being prepared to keep the Partnership up-to-date on model development
- Hierarchical structure allows
  - At-a-glance overview
  - Drill down to detailed information
- Continual updates
- Your name is on the page
  - You own the content.

# Major Topics – Modeling WG

- Watershed Model Development and Code Versioning
- Calibration Methodology
- Land use Loading Rates (with WQGIT and WGs)
- Sensitivities to inputs
- Fine Scale Processes (with LUWG)
- Lag Time
- Atmospheric Data
- Climate Change
- Conowingo and other Reservoirs

# Watershed Model Development and Code Versioning

***CBP Oversight: Modeling Workgroup***

***Lead: Lee Currey and Dave Montali***

***CBPO Contact: Gopal Bhatt, Gary Shenk***

***Priorities:***

Revise Modeling Structure: MWG

Cross-cutting priority as necessary for all changes to the modeling structure

***Description:***

Make incremental changes to the watershed model code as data or processes from other parallel paths become available. A new calibration will be performed for each version to see the resulting incremental changes in model results.

***Progress:***

Phase 5.3.2

NLDAS rainfall data set rather than the XYZ data set. Available past 2005

Made changes to the calibration routine to make the winter and summer bias better behaved

Land Sediment Calibration

Modified the calibration method to go to a four-parameter optimization versus 2-parameter

PQUAL-only simulation

PQUAL with draft sensitivities (7/2014)

***Presentations:***

Modeling Work Group 6/24/14

Modeling Work Group Gopal Bhatt 4/1/14

Modeling Work Group Gopal Bhatt 7/23/13

***Next Steps:***

PQUAL run with draft sensitivities

***Expected Completion Date:*** Oct 1, 2015

## Calibration Methodology

***CBP Oversight: Modeling Workgroup***
***Lead: Lee Currey, Dave Montali, and Ross Mandel***
***CBPO Contact: Gopal Bhatt, Gary Shenk***
***Priorities:***

Revisit watershed model calibration methods: MWG

***Description:***
Work to improve the calibration process, particularly in the area of PQUAL calibration and regional factors.
***Progress:***
***Improvements in hydrology and land sediment processes – Gopal***
Incremental changes have been made to the calibration procedures that produce better seasonal balance with the new rainfall data set in use for phase 6.
***Complete:***
Presented at MWG MM/YYYY
***PQUAL calibration methods – Ross and Gopal***
Calibration method exists from previous phases of the WSM. Possible improvements include using baseflow-separated in-stream observations to set seasonal variations in concentration, and basing seasonal variability on application and uptake schedules.
***Next Steps:***
Investigate concentrations relative to monitoring data
Develop Method of relating input timing to output concentration
***Expected Completion Date:***
Oct 1, 2015
***River calibration method – Ross***
Modifications to the calibration routines to take flow into account rather than matching the CFD
***Next Steps:***
Coding of trial calibration methods
***Expected Completion Date:***
Oct 1, 2015
***Regional Factors – Ross***
Working on methods to reduce or eliminate regional factors by using *a priori* data in setting land use target loading rates. The USGS Sparrow team is running targeted analyses that may be used in this effort.
***Next Steps:***
Investigation of sparrow output
***Expected Completion Date:***
Oct 1, 2015

# Calibration Methodology page 1

***CBP Oversight: Modeling Workgroup***

***Lead: Lee Currey, Dave Montali, and Ross Mandel***

***CBPO Contact: Gopal Bhatt, Gary Shenk***

***Priorities:***

Revisit watershed model calibration methods:  MWG

***Description:***

Work to improve the calibration process, particularly in the area of PQUAL calibration and regional factors.

***Progress:***

***Improvements in hydrology and land sediment processes – Gopal***

Incremental changes have been made to the calibration procedures that produce better seasonal balance with the new rainfall data set in use for phase 6.

***Complete:***

Modeling Work Group Gopal Bhatt 4/1/14

***PQUAL calibration methods – Ross and Gopal***

Calibration method exists from previous phases of the WSM.  Possible improvements include using baseflow-separated in-stream observations to set seasonal variations in concentration, and basing seasonal variability on application and uptake schedules.

***Next Steps:***

Investigate concentrations relative to monitoring data

Develop Method of relating input timing to output concentration

***Expected Completion Date:***

Oct 1, 2015

# Calibration Methodology page 2

***CBP Oversight: Modeling Workgroup***

***Lead: Lee Currey, Dave Montali, and Ross Mandel***

***CBPO Contact: Gopal Bhatt, Gary Shenk***

***Priorities:***

Revisit watershed model calibration methods:  MWG

***Description:***

Work to improve the calibration process,

***Progress:***

***River calibration method – Ross***

Modifications to the calibration routines to take flow into account rather than matching the CFD

***Presentations:***

***Modeling Work Group Ross Mandel 4/1/14***

***Modeling Work Group Ross Mandel 12/11/13***

***Regional Factors – Ross***

Working on methods to reduce or eliminate regional factors by using *a priori* data in setting land use target loading rates.  The USGS Sparrow team is running targeted analyses that may be used in this effort.

***Next Steps:***

Investigation of sparrow output

***Expected Completion Date:***

Oct 1, 2015

## Land Use Loading Rates

***CBP Oversight: Modeling Workgroup***
***Lead: Lee Currey and Dave Montali***
***CBPO Contact: Tetra Tech, Gary Shenk***
***Priorities:***

Improve Spatial, temporal, and categorical representation of land uses: LUWG
Revisit watershed model calibration methods: MWG
Improve modeling accuracy of land use characteristics land uses: USWG

***Description:***

Land use loading targets will be based on multiple lines of evidence. Different types of modeling and monitored information will be incorporated from many sources. The MWG will oversee the process, but will welcome input from the WQGIT and its workgroups, particularly for relationships between different sub-classes within a large class. TetraTech will oversee the process as follows:

Set overall loading ratios between different broad land use types using large scale analyses.
Develop relationships between land use sub-classifications using literature and modeling
Apply relationships developed through other tracks
- Sensitivity to inputs
- Regional delivery differentiation
- Small scale effects

Final adjustments through Calibration to water quality data

***Presentations:***

Modeling Work Group 6/24/14

***Progress:***

***Broad Scale Analysis – USGS***

The USGS will be using the Sparrow model with the CBP land use classifications to determine the overall ratio of loading rate between different large land use classifications in the Chesapeake Bay Watershed.

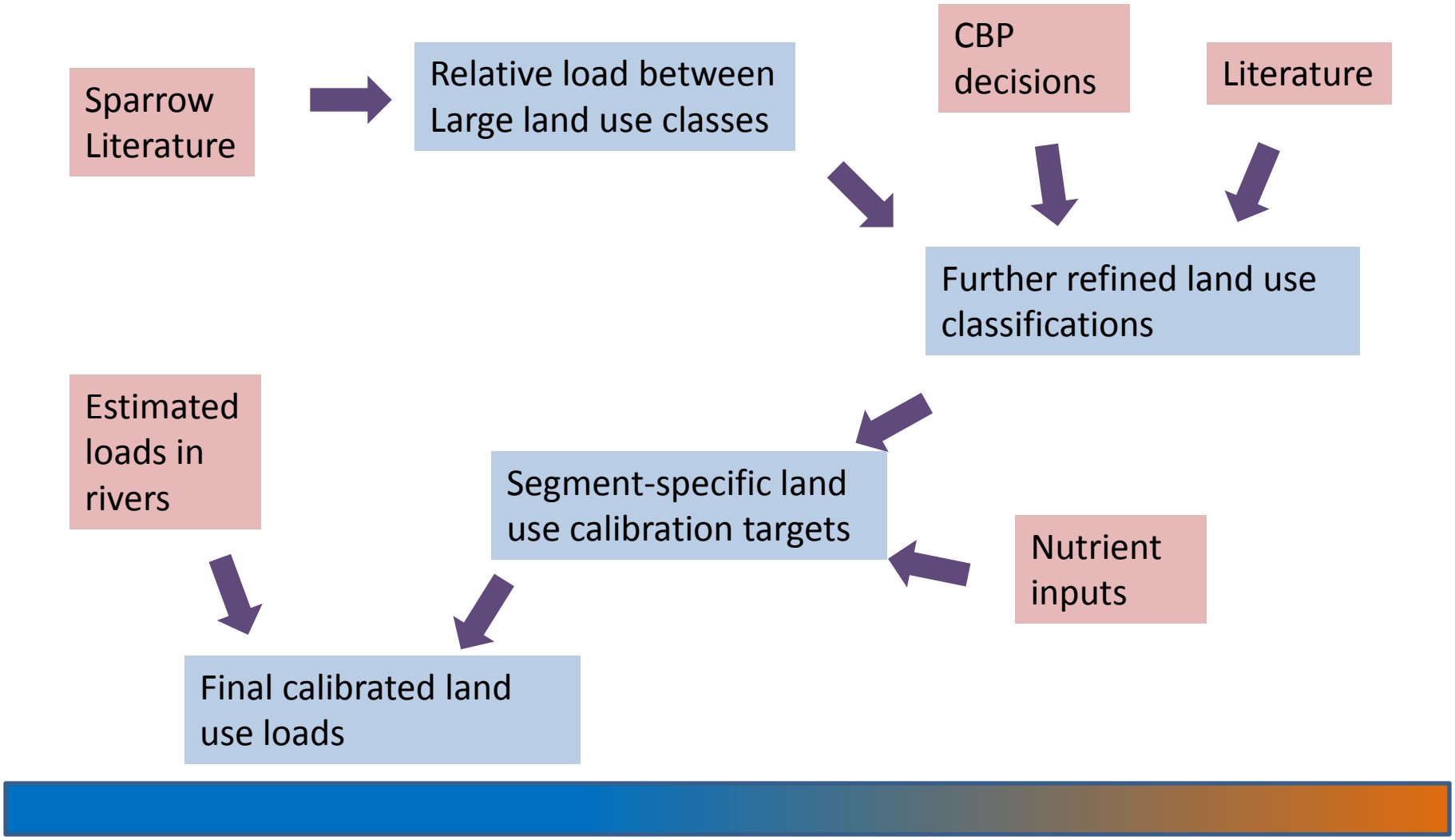
***Literature reviews - TetraTech***

TetraTech has already completed a literature review of urban land uses and will be conducting one on agricultural land uses. Several literature reviews already exist, which should be incorporated as well.

***Peculiarities of Pervious Workshop – STAC***

STAC will be delivering a workshop report that will have recommendations for urban land classifications and

# Land Use Load Decisions – Phase 6



# Sensitivities to inputs

***CBP Oversight: Modeling Workgroup***

***Lead: Lee Currey and Dave Montali***

***CBPO Contact: Guido Yactayo***

***Priorities:***

Revise Modeling Structure: MWG

***Description:***

The major structural change to phase 6 is the incorporation of multiple model estimates for sensitivity to nutrient inputs. Rather than relying on a single model estimate of load response to changes in inputs of atmospheric deposition, fertilizer, and manure, the phase 6 model will use evidence from multiple sources, including HSPF and other mechanistic models, sparrow and other statistical methods, and literature.

***Progress:***

Draft documentation is available on the source will be described with relative merits weighed.

***Next Steps:***

Continue to bring new information to each modeling quarterly review and update the documentation

***Expected Completion Date:***

Oct 1, 2015

## Fine-scale Processes

***CBP Oversight: Land Use Workgroup and Modeling Workgroup***
***Lead: Jenny Tribo and Karl Berger***
***CBPO Contact: Peter Claggett***
***Priorities:***

Revisit watershed model calibration methods: MWG
Improve Spatial, temporal, and categorical representation of land uses: LUWG

***Description:***

Increasingly, research is showing that sources and transport mechanisms of nutrients and sediment have high variability at fine spatial scales. The scale of the watershed model segmentation is coarse relative to hillslope and small-order stream processes. Efforts are underway to describe fine-scale effect in ways that can be applied at the scale of the CBP partnership's watershed model.

***Progress:***

Progress is occurring along several parallel tracks. Implementation of the findings of these efforts in the Phase 6 watershed model is likely to improve the model, however not all areas of active research may be available in time for incorporation.

***Small-stream delivery – Center for Watershed Protection***

Streams contribute to the loading from the watershed as both a source and a sink. Generally at the size of a CBP segment, the stream network acts as a net sink. The CBP partnership has expressed interest in modifying the current method of attributing the entire delivered sediment load to land-based sources. **The CWP will make recommendations for considering both land and in-stream sources with the in-stream sink terms applying to both sources.**

***Small-Scale processes – Land Data Team***

The CBP Land Data Team, led by Peter Claggett, are investigating methods to **map and evaluate the nutrient and sediment effects of impervious surface connectivity, urban stream corridors, riparian forests, riverine wetlands, and urban tree canopy**. Incorporating stream corridors (channel, banks, and floodplains) as sources and sinks for nutrients and sediments has potential for addressing the issue of impervious surface connectivity. Research conducted by Matt Baker (UMBC) and Don Weller (SERC) is under review to parameterize the nutrient effects of riparian forests. Researchers at West Virginia University, operating under a grant from USGS, are investigating options for mapping floodplains and parameterizing their sediment deposition potential. The US Forest Services' iTree Hydro program is being evaluated for parameterizing the hydrologic effects of urban tree canopy. If these factors can be adequately described, they may be utilized to differentiate loading effects between land uses within a segment, or from segment to segment.

***Next Steps:***

…

***Expected Completion Date:***

# Lag Time – Gopal Bhatt

***CBP Oversight: Modeling Workgroup***
***Lead: Lee Currey and Dave Montali***
***CBPO Contact: Gopal Bhatt and Gary Shenk***
***Priorities:***

Revisit watershed model calibration methods:  MWG

***Description:***

Groundwater lag times may be simulated for calibration through a simple Continuously Stirred Tank Reactor model.  To parameterize this model, the lag time will have to be estimated from outside sources for all areas of the watershed.  More sophisticated models may be generated through collaboration with academic partners.  STAC has asked the CBP to include this capability on multiple occasions, notably:

*Incorporating Lag-Times Into the Chesapeake Bay Program*
*Understanding "Lag Times" Affecting the Improvement of Water Quality in the Chesapeake Bay*
*Chesapeake Bay Watershed Model Phase Five Review*

***Progress:***

None to date

***Next Steps:***

Coding of groundwater module

***Expected Completion Date:***

Oct 1, 2015

# Atmospheric Data

***CBP Oversight: Modeling Workgroup***

***Lead: Lee Currey and Dave Montali***

***CBPO Contact: Lewis Linker and Gopal Bhatt***

***Priorities:***

Revisit watershed model calibration methods: MWG

Shallow Water Simulation and Conowingo Refinement

***Description:***

The Phase 5 precipitation, meteorology, and atmospheric deposition data covered the period 1984-2005. In order to take advantage of the intensive shallow water estuarine data, new watershed stations, and recent Conowingo data with, the watershed simulation will need to be extended.

***Progress:***

***Precipitation and meteorology***

Gopal Bhatt has shown that the NLDAS-2 data set calibrates the WSM hydrology as well as the previous USGS XYZ data set. NLDAS-2 is preferred because of longer term availability. An automated download method has been created so that these data can be updated each year.

***Atmospheric Deposition – Lewis Linker***

The CBPO will look for a reanalysis of rainfall, NADP, CASTNET and other data sources. It is likely that this will be done externally.

***Next Steps:***

***Expected Completion Date:*** Jan 1, 2015

# Climate Change

***CBP Oversight: Modeling Workgroup***
***Lead: Lee Currey and Dave Montali***
***CBPO Contact: Lewis Linker, Climate Change Coordinator (to be hired)***
***Priorities:***

Influence of climate Change on WQS and TMDL

***Description:***

The partnership has agreed to address climate change during the 2017 MPA. The motivation is expressed in the 2014 Bay Agreement, 2011 and 2008 STAC workshops, 2010 TMDL, and the 2009-2010 executive order and accompanying strategy. In order to effectively evaluate the influence of climate in the MPA, climate change must be included within the partnership's suite of models.

***Progress:***

The CBP will be hiring a climate change coordinator to head the climate change workgroup under STAR. Climate change is already being addressed in the modeling through several collaborative efforts already underway.
Several collaborative studies have been completed with more on the way.

***Presentations:***

Modeling Workgroup Sarah Ahmed et al 7/23/13
Modeling Workgroup Susan Julius 7/23/13
Modeling Workgroup Maria Herrmann 7/23/13
Modeling Workgroup Dano Wilusz 7/23/13
Modeling Workgroup Robin Dennis 7/23/13

***Next Steps:***

***Expected Completion Date:*** Oct 1, 2015

# Conowingo and other Reservoirs

***CBP Oversight: Modeling Workgroup***

***Lead: Lee Currey and Dave Montali***

***CBPO Contact: Lewis Linker***

***Priorities:***

Conowingo reservoir and greater representation of reservoirs

***Description:***

There are three primary objectives:

Develop and assess options for addressing increased amounts of sediment and nutrients from the Lower Susquehanna Reservoirs

Better characterize trapping of sediment in reservoirs

Develop an approach to simulate effect of impoundments in the Bay watershed.

***Progress:***

The Conowingo reservoir is being studied through the Lower Susquehanna River Watershed Assessment, led by the Corps of Engineers and MDE.

***Next Steps:***

…

***Expected Completion Date:***

Oct 1, 2015

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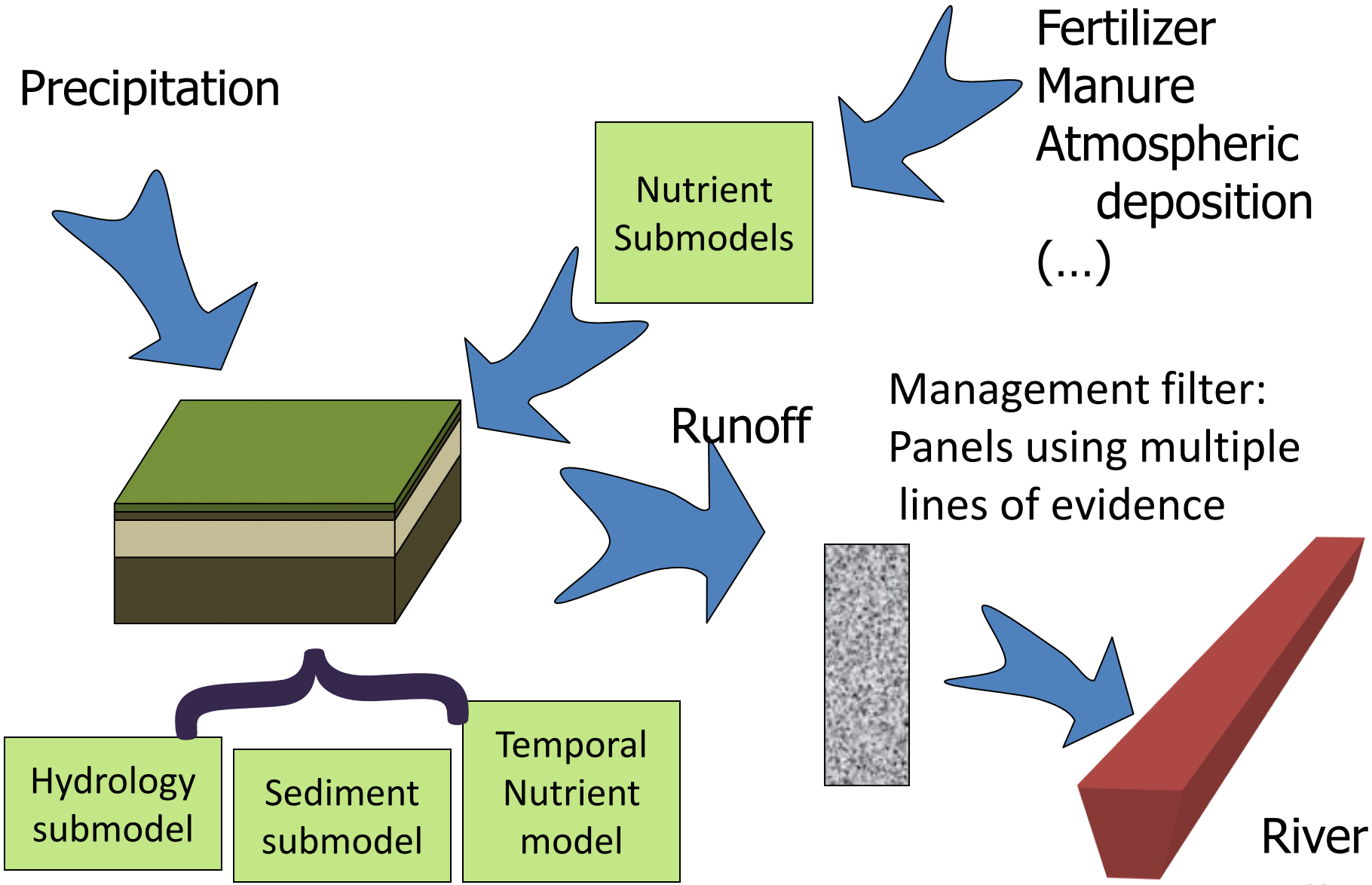
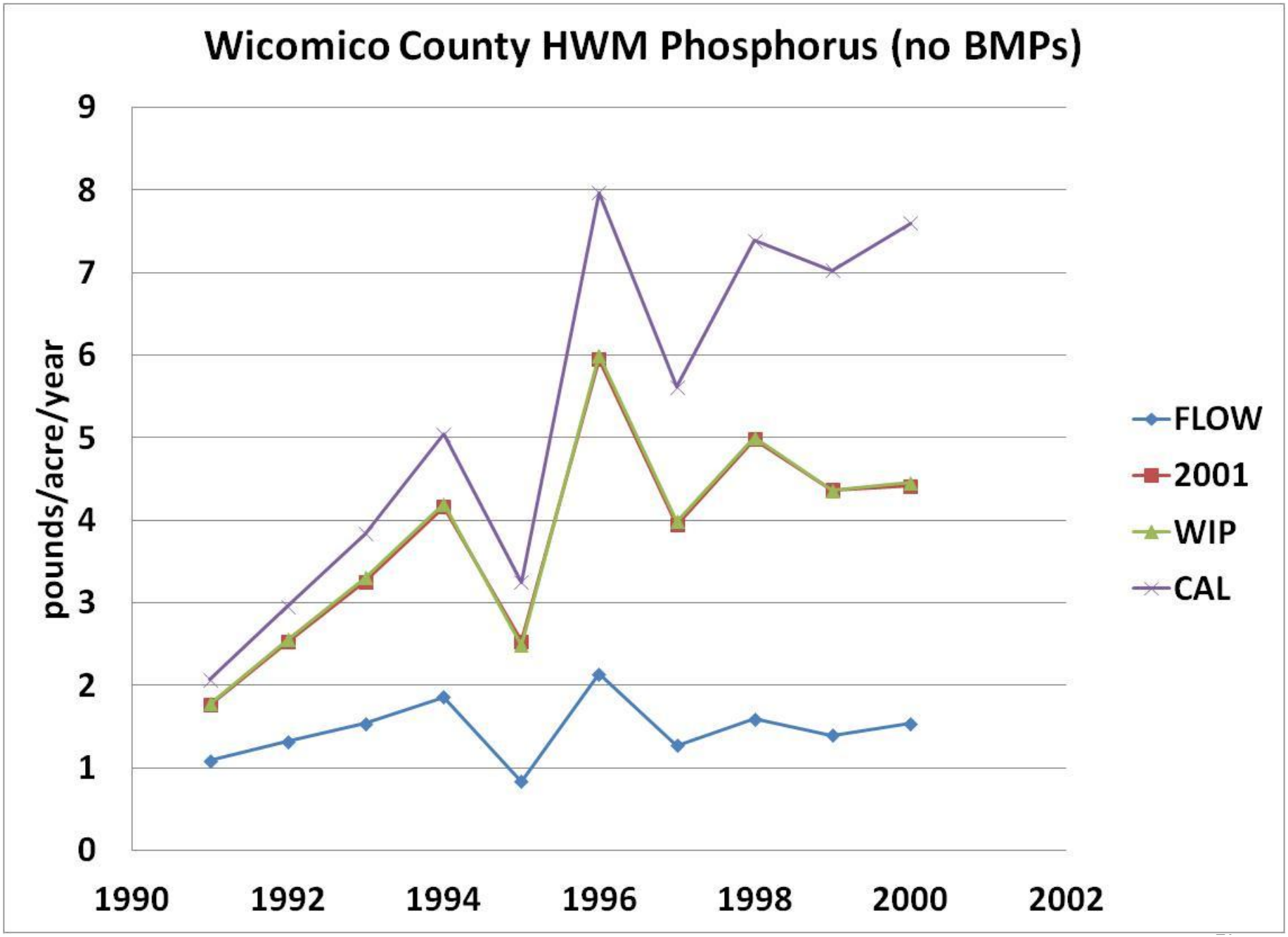
# Phase 6


Precipitation
Fertilizer
Manure
Atmospheric deposition
(…)
Nutrient Submodels
Runoff
Management filter:
Panels using multiple lines of evidence
Hydrology submodel
Sediment submodel
Temporal Nutrient model
River


Wicomico County HWM Phosphorus (no BMPs)
pounds/acre/year
0
1
2
3
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1992
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