



**AQUATOX Model Calibration for the LBR TP TMDL**  
Lower Boise Watershed Council  
March 13, 2014



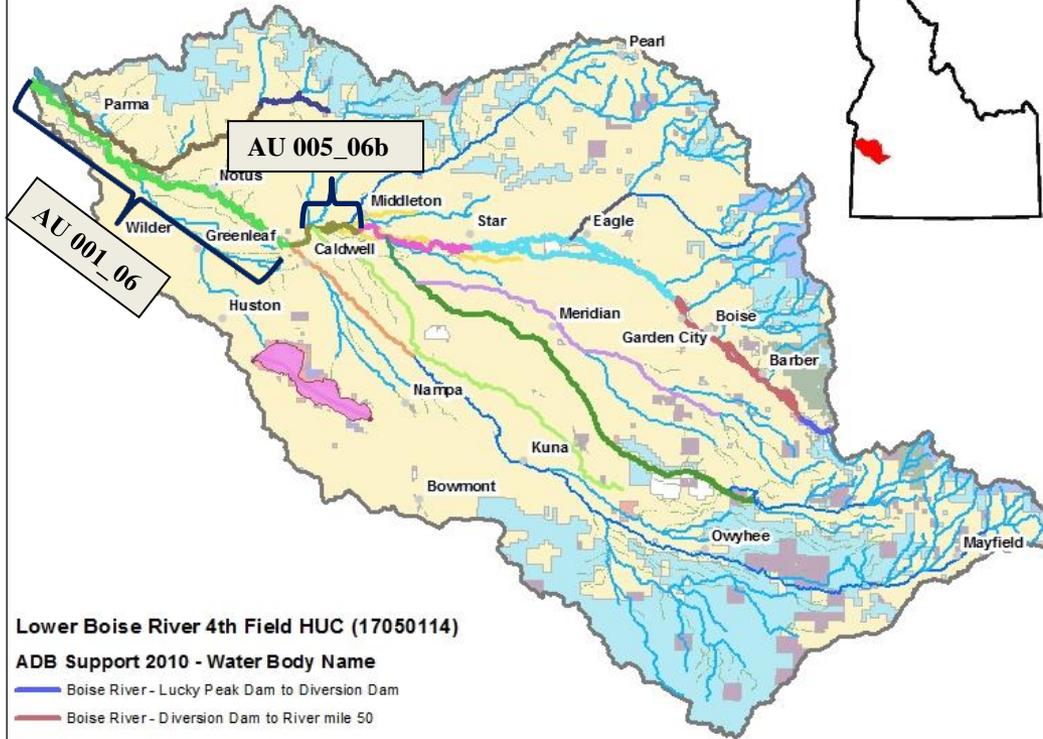
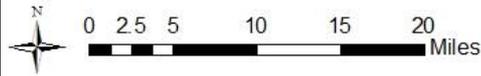
IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY



# DEQ RESPECTFULLY REQUESTS...

- The LBWC vote to support the AQUATOX model calibration “*2014\_0203\_ATX\_LBR\_Linked\_Existing\_Conditions\_DDS.als*”
- As an appropriate tool to help:
  - Evaluate periphyton-phosphorus relationships, among other pertinent environmental and anthropogenic factors in the lower Boise River (LBR), and
  - Develop appropriate phosphorus allocations in the LBR TP TMDL, designed to achieve the mean benthic chlorophyll a target of  $\leq 150$  mg/m<sup>2</sup> in the impaired AUs of the LBR

# Lower Boise River Subbasin (HUC 17050114)



## Lower Boise River 4th Field HUC (17050114)

### ADB Support 2010 - Water Body Name

- Boise River - Lucky Peak Dam to Diversion Dam
- Boise River - Diversion Dam to River mile 50
- Boise River - River Mile 50 to Star Bridge
- Boise River - Star to Middleton
- Boise River - Middleton to Indian Creek
- Boise River - Indian Creek to mouth
- Dry Creek - 4th order (Spring Valley Creek to mouth)
- Fifteenmile Creek - 4th order (Fivemile Creek to mouth)
- Fivemile Creek - 3rd order
- Indian Creek - 4th order below 11th Ave. in Nampa
- Lake Lowell
- Mason Creek - entire watershed
- Mill Slough and Phyllis Slough
- Sand Hollow Creek (C-Line Canal to I-84)
- Sand Hollow Creek - I-84 to Sharp Road
- Sand Hollow Creek - Sharp Road to Snake River
- Tenmile Creek - 3rd order below Blacks Creek Reservoir

### Landstatus OWNER TYPE

- BLM
- BOR
- NWR
- OTHER
- PRIVATE
- STATE
- STATEFG
- USFS



# TMDL MODELING

## AQUATOX Model

- Quantify chlorophyll a and phosphorus relationships
- Allocation tool to meet the chlorophyll-a target of  $150 \text{ mg/m}^2$

## USGS Mass Balance Model and Duration Curves

- Quantify current TP loads
- Allocation tools to meet the May-September  $0.07 \text{ mg/L}$  TP target at the mouth.





# WAG CONSULTATION

## Core Group

- Ben Cope – EPA
- Bill Stewart – EPA
- Kate Harris – Boise
- Robbin Finch – Boise
- Tom Dupuis – HDR
- Michael Kasch – HDR
- Matt Gregg – Brown and Caldwell
- Jack Harrison - HyQual
- Lee Van de Bogart – Caldwell

## Consultants

- Jonathan Clough – Warren Pinnacle
- Dick Park – Eco Modeling

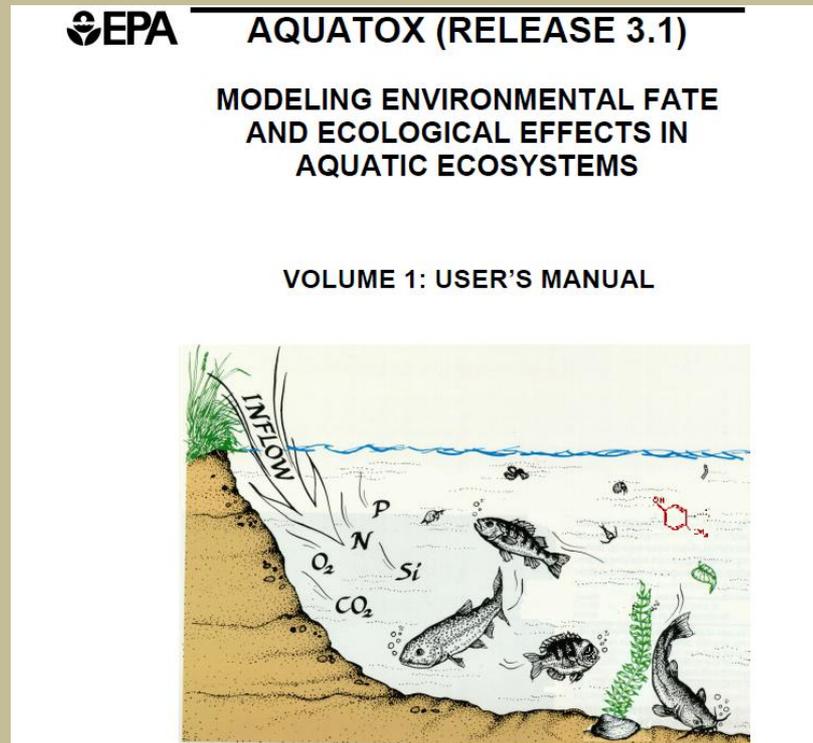
## Additional Assistance

- Alex Etheridge, Dorene MacCoy, Chris Mebane – USGS
- Clifton Bell – Brown and Caldwell
- ❖ 4 Model TAC Meetings
- ❖ 29 Model Workgroup Meetings
- ❖ 3 TAC Meetings – Model Calibration

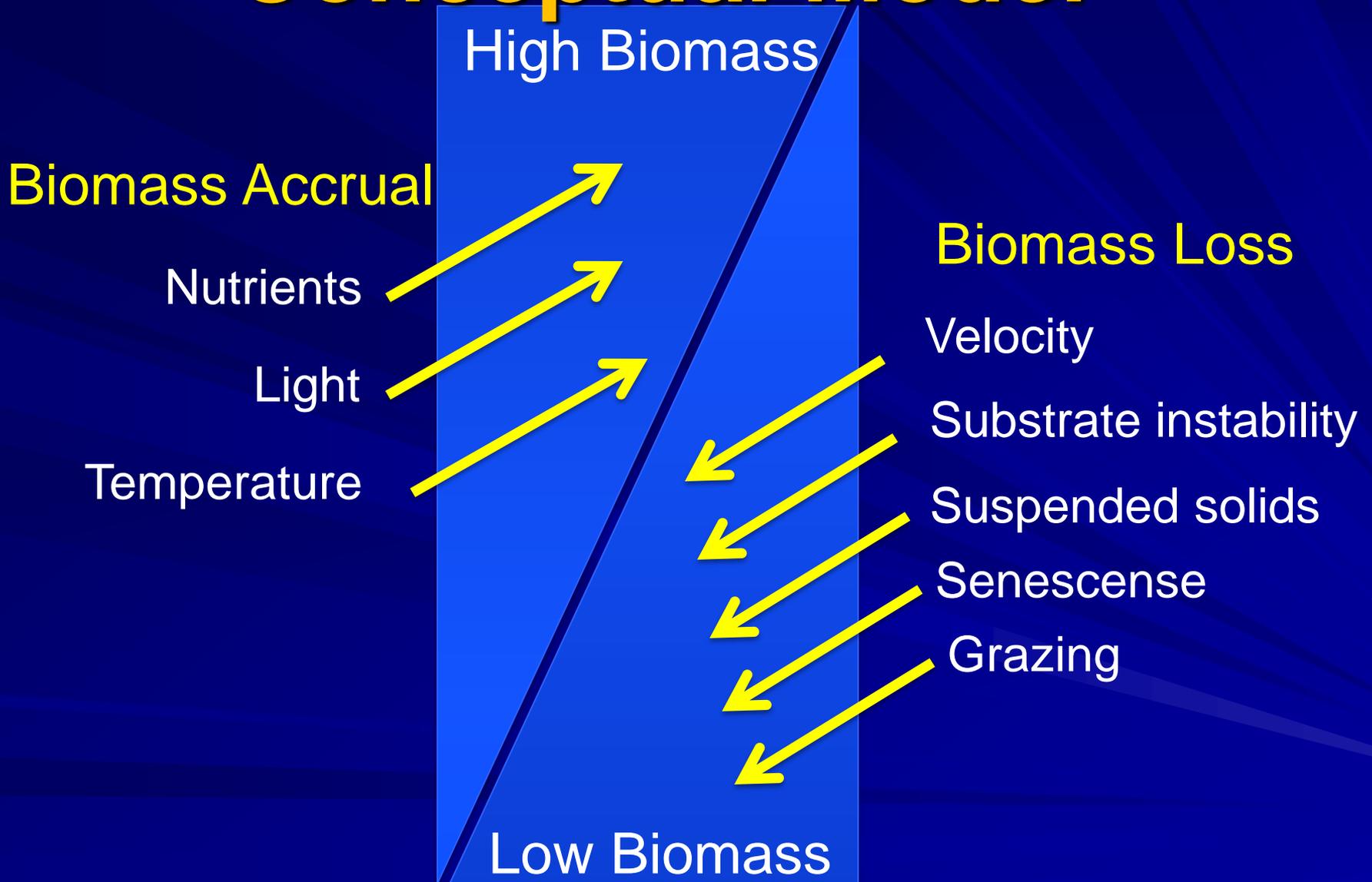


# AQUATOX MODELING EFFORT

- AQUATOX as a tool to help:
  - Identify conditions that achieve benthic chlorophyll a target
  - Translate nutrient-periphyton relationships into numeric nutrient allocations



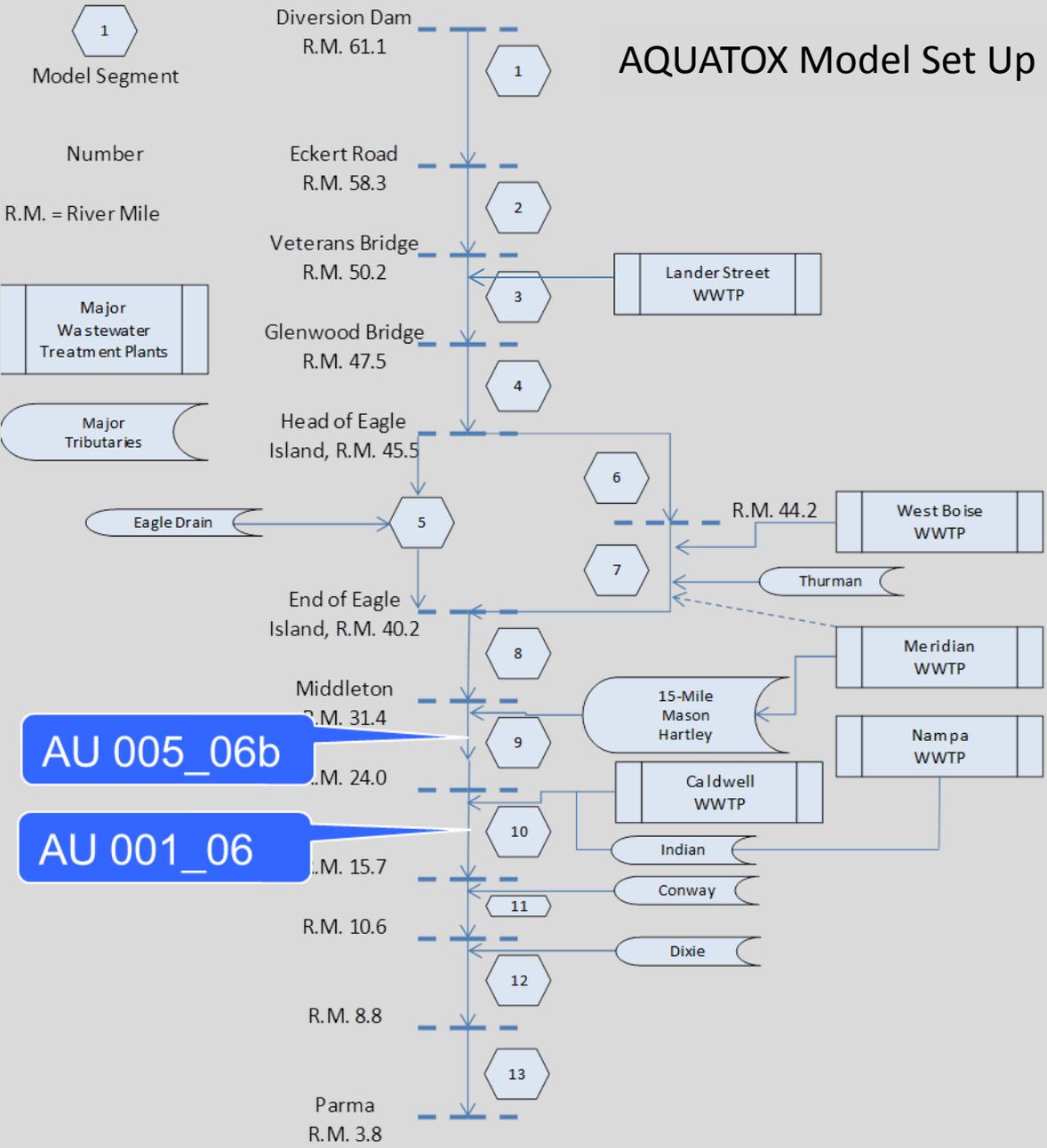
# Conceptual Model



Modified from  
Biggs 1996

\*\*Figure modified from Kate Harris slide 2013 (City of Boise).

# AQUATOX Model Set Up





# MODEL ACCURACY

## Simulation Accuracy

### Absolute Mean Error (AME)

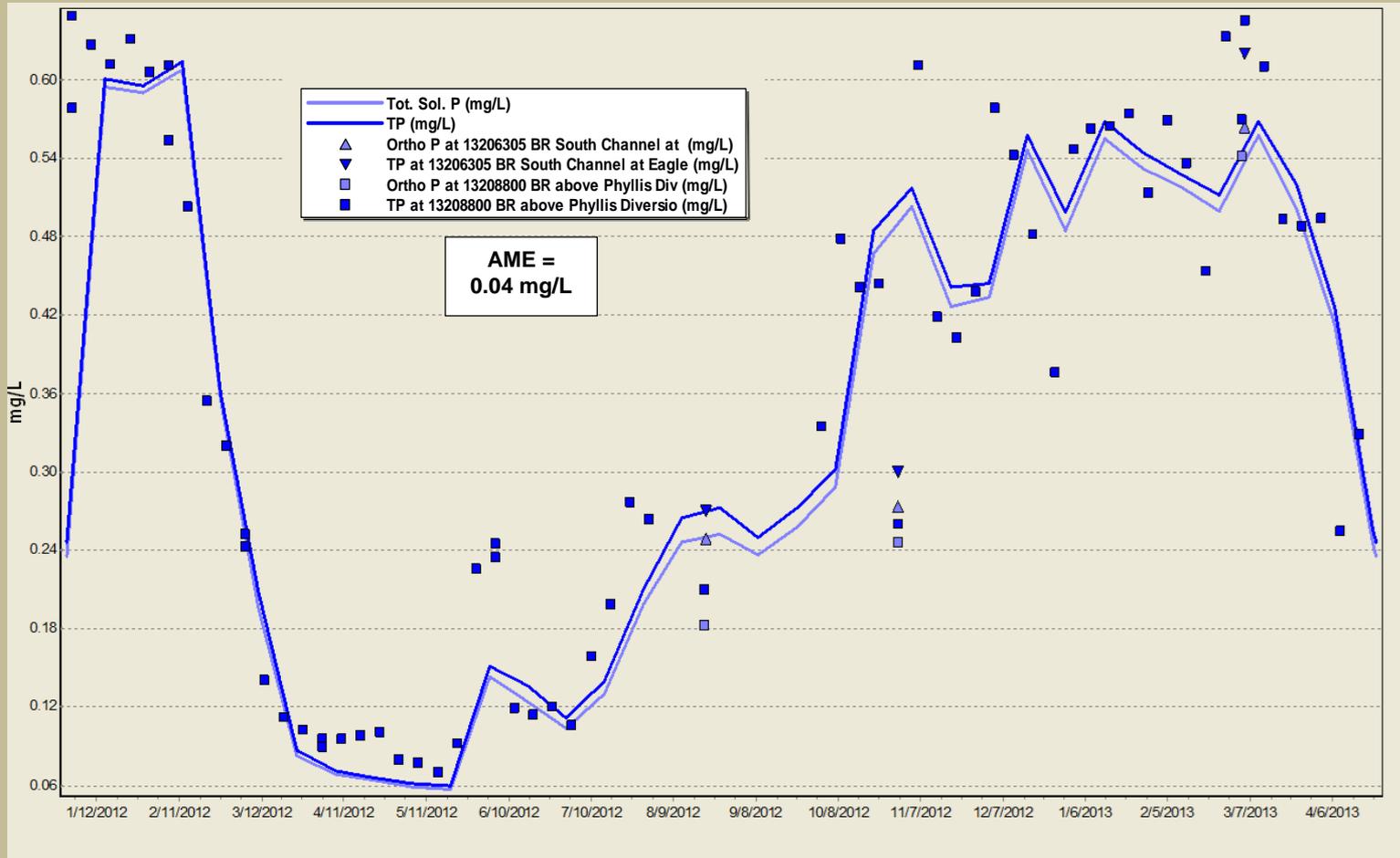
$$AME = \frac{\sum |x_{sim} - x_{obs}|}{n}$$

Segment 13			
Date	Modeled	Measured	Absolute difference
2/22/2012	0.23	0.32	0.09
4/20/2012	0.09	0.10	0.01
5/10/2012	0.07	0.12	0.05
6/21/2012	0.16	0.24	0.08
7/17/2012	0.20	0.30	0.10
8/20/2012	0.24	0.30	0.06
8/21/2012	0.24	0.29	0.05
8/22/2012	0.24	0.31	0.07
8/23/2012	0.24	0.29	0.05
8/24/2012	0.24	0.29	0.05
10/29/2012	0.38	0.28	0.09
10/30/2012	0.37	0.28	0.09
10/31/2012	0.37	0.27	0.10
11/1/2012	0.37	0.29	0.08
11/29/2012	0.37	0.27	0.10
12/11/2012	0.39	0.34	0.05
1/8/2013	0.40	0.35	0.05
2/20/2013	0.37	0.41	0.04
3/7/2013	0.36	0.34	0.02
Average absolute difference =			<b>0.07</b>



# PHOSPHORUS ACCURACY

Overall phosphorus calibration was within 0.05 mg/L of observed data





# PERIPHYTON ACCURACY

Periphyton Accuracy Goal  $\leq 71$  AME

2014\_0203\_DDS

**Absolute Mean Error (AME) for 15-day rolling model mean vs. measured data:**

Segment	Eckert 1	Glenwood 3	Middleton 8	Caldwell 9	Parma 13	Overall
August	0.6	52.2	153.2	46.1	43.1	59.0
October	54.0	23.3	21.9	86.3	54.9	48.1
March	3.6	180.6	23.8	72.6	74.4	71.0
Overall	19.4	96.2	66.3	68.3	57.5	61.5



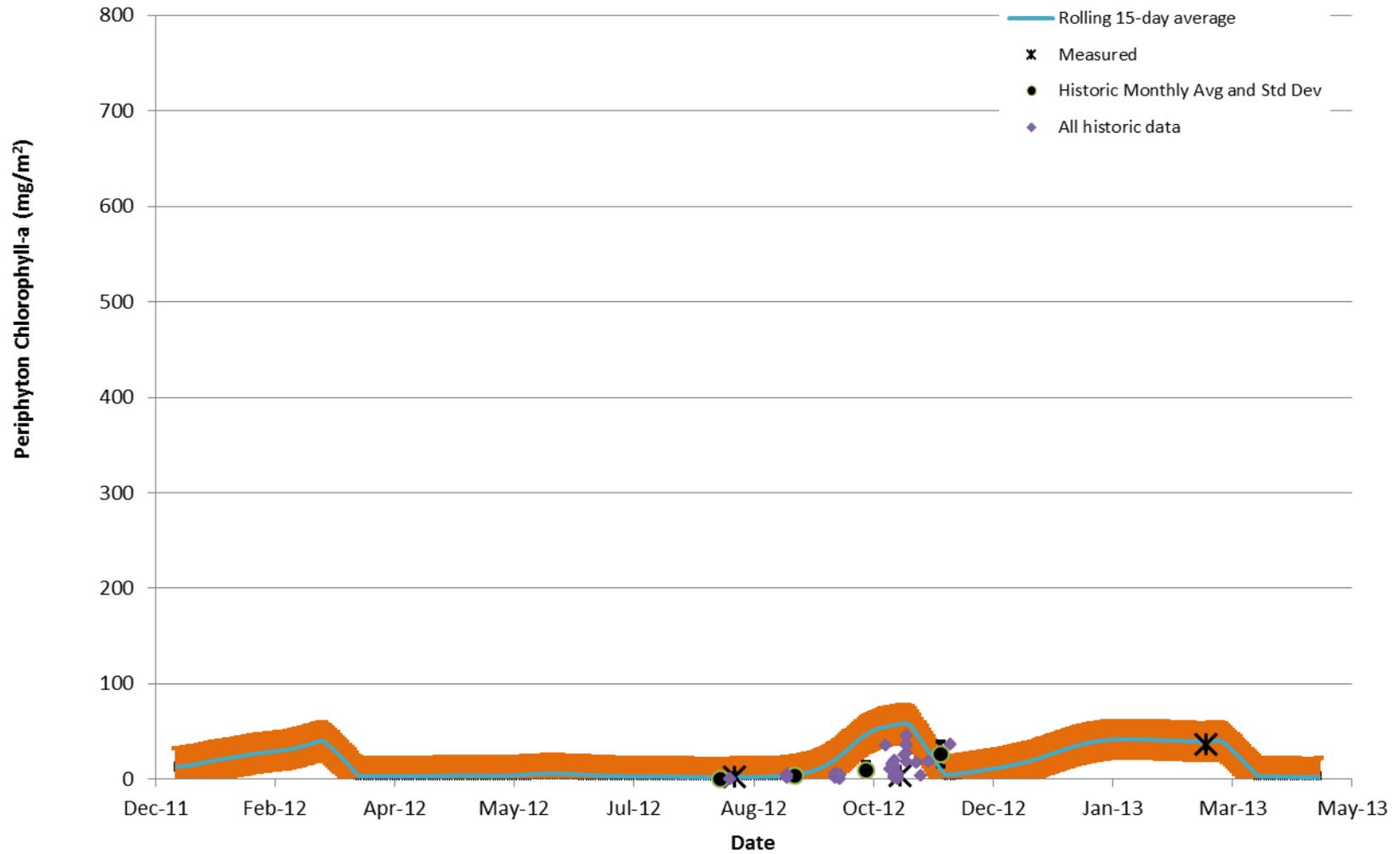
# PERIPHYTON ACCURACY

## Periphyton Accuracy Goal $\leq 71$ AME

Model Version	<u>AME for each Model Segment</u>					Overall AME
	Eckert 1	Glenwood 3	Middleton 8	Caldwell 9	Parma 13	
2001 Parameters	23.3	133.1	106.7	127.1	62.7	<b>90.6</b>
2013_0925_DDS	28.1	86.8	83.7	105.2	42.7	<b>69.4</b>
2013_1209_RAP	38.2	108.5	74.8	50.2	116.2	<b>77.6</b>
2014_0103_DDS	29.0	123.0	75.8	52.0	117.9	<b>79.5</b>
2014_0203_DDS	19.4	96.2	66.3	68.3	57.5	<b>61.5</b>

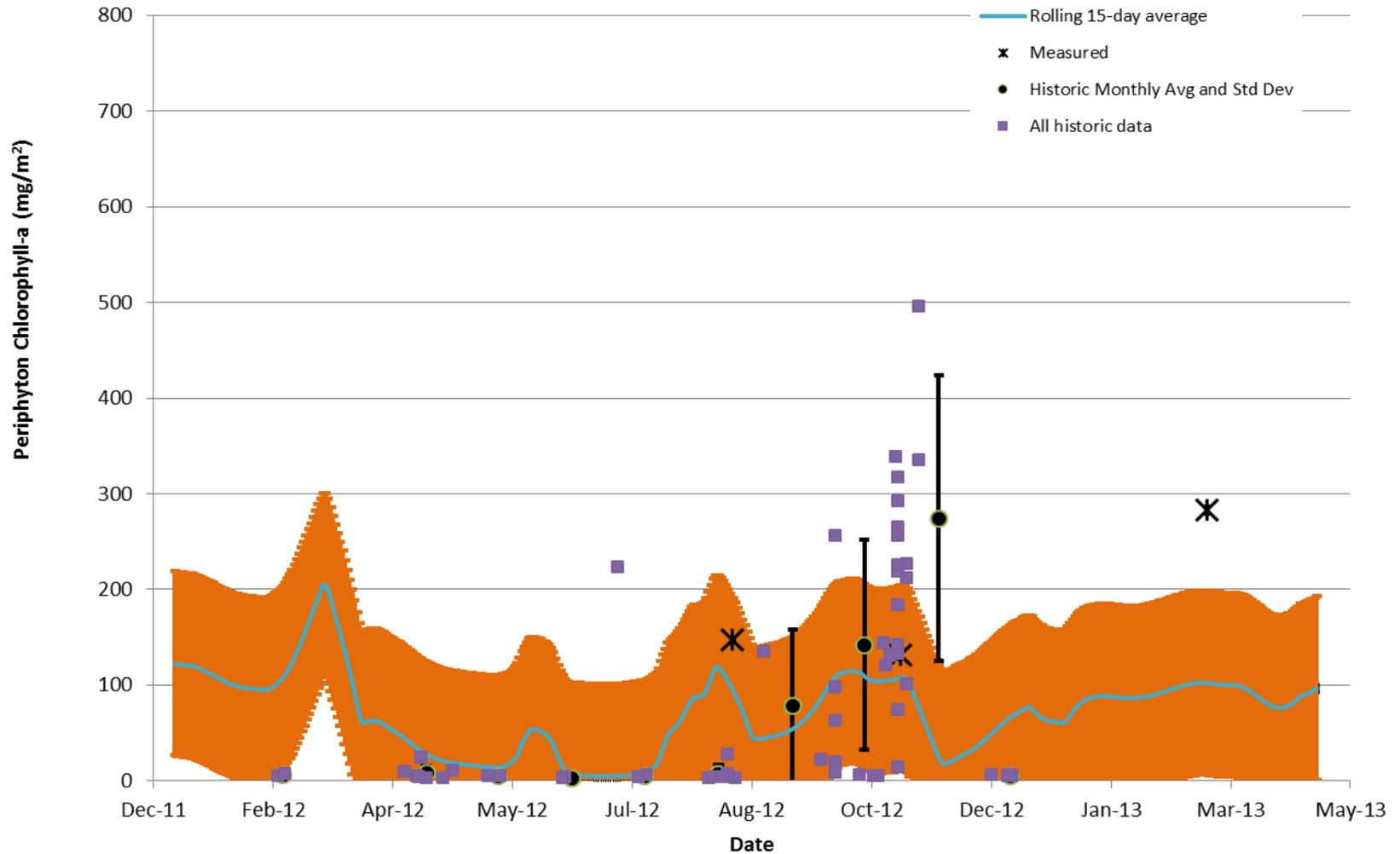
Periphyton biomass 15-day rolling mean simulation vs. measured data.

### Segment 1 Periphyton Model Fit - 2014\_0203 Parameters Measured and Historic Data at USGS 13203760 Eckert



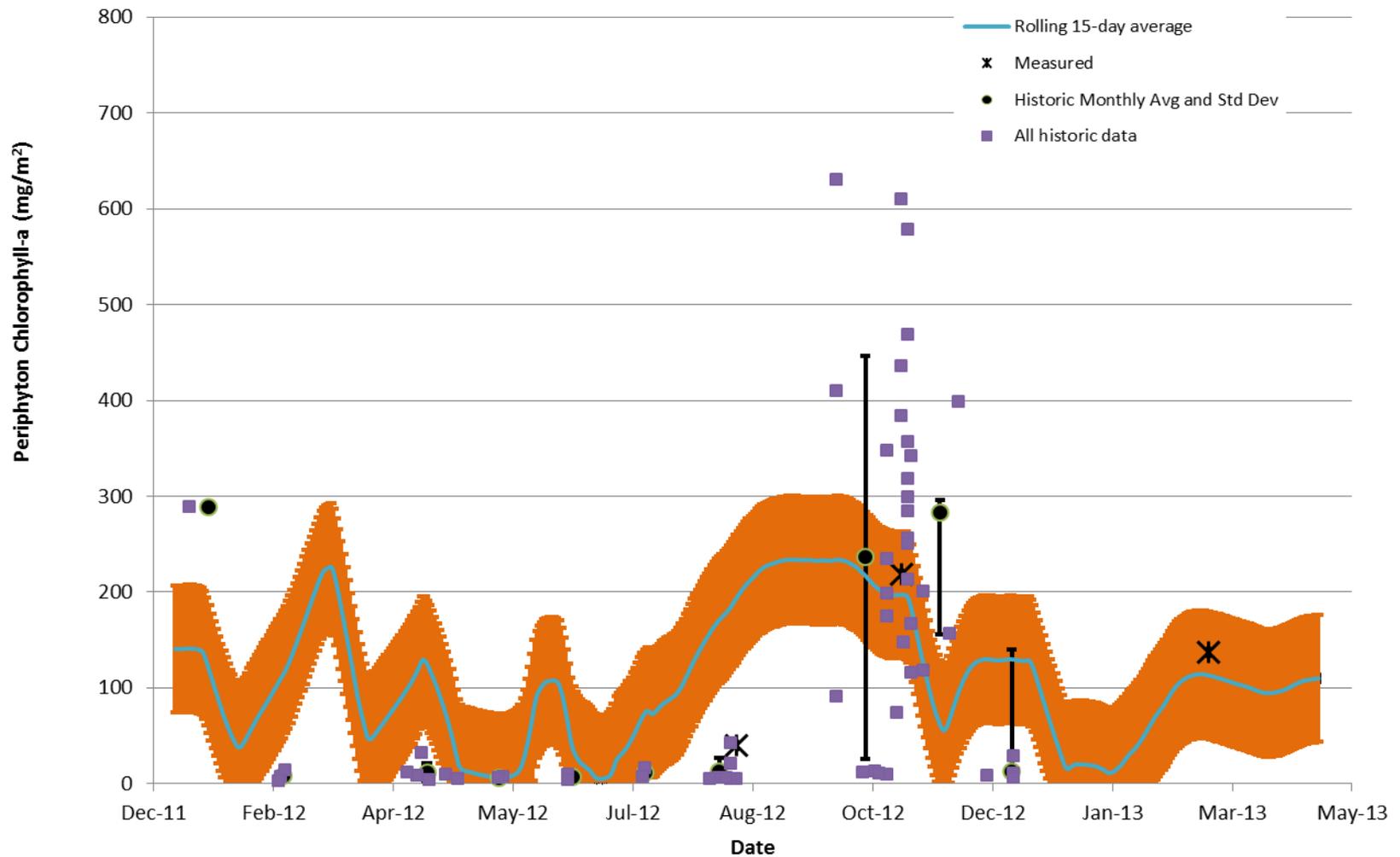
15-day rolling mean simulation bound with AME error bars = 19.4

### Segment 3 Periphyton Model Fit - 2014\_0203 Parameters Measured and Historic Data at USGS 13206000 at Glenwood



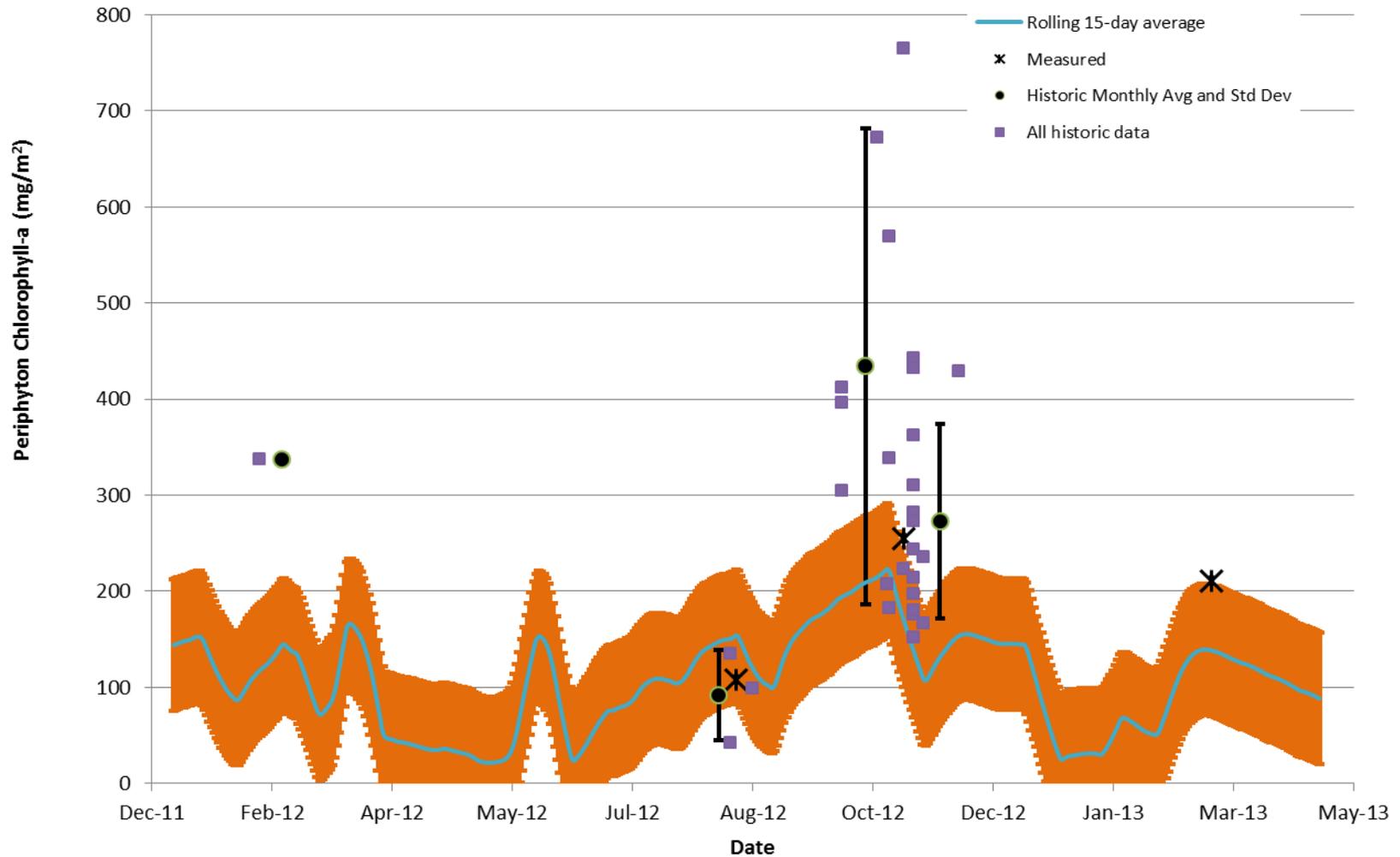
15-day rolling mean simulation bound with AME error bars = 96.2

## Segment 8 Periphyton Model Fit - 2014\_0203 Parameters Measured and Historic Data at USGS 13210050 at Middleton



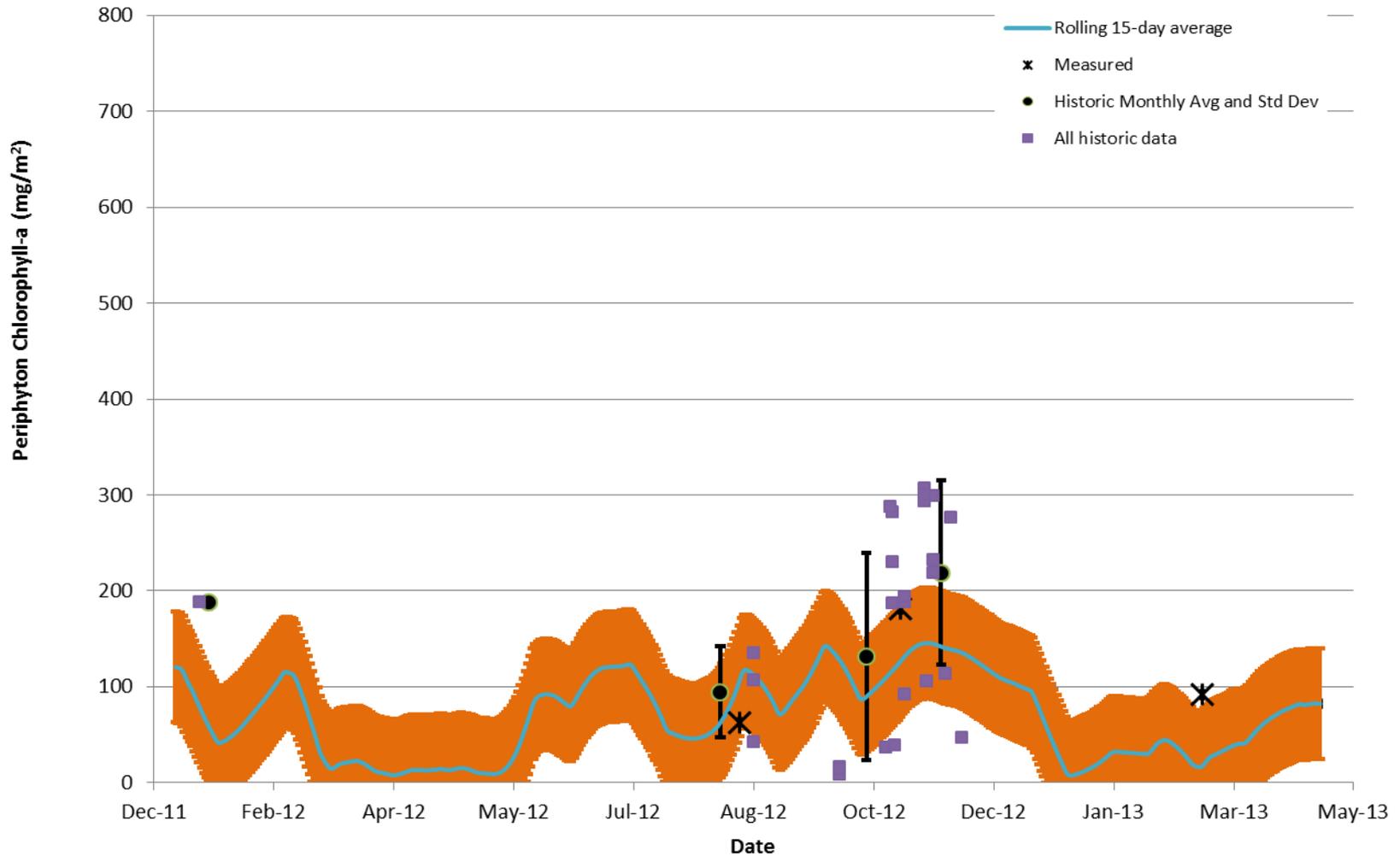
15-day rolling mean simulation bound with AME error bars = 66.3

# Segment 9 Periphyton Model Fit - 2014\_0203 Parameters Measured and Historic Data at USGS 13211000 at Hwy 20-26



15-day rolling mean simulation bound with AME error bars = 68.3

### Segment 13 Periphyton Model Fit 2014\_0203 Parameters Measured and Historic Data at USGS 13213000 at Parma



15-day rolling mean simulation bound with AME error bars = 57.5



# PERIPHYTON ACCURACY

## Periphyton biomass correlations ( $R^2$ ):

Segment	1	3	8	9	13
measured	-0.0022	+0.1085	+0.1467	+0.2171	+0.1533
historical	+0.1569	+0.0204	+0.0096	+0.1650	+0.0682

## Mean monthly simulated periphyton biomass, and measured and historical data:

Segment	1	3	8	9	13	Overall
measured	14	187	132	191	112	<b>636</b>
simulation	22	101	168	157	72	<b>520</b>
% difference	<b>57%</b>	<b>-46%</b>	<b>27%</b>	<b>-18%</b>	<b>-36%</b>	<b>-18%</b>
historical	10	53	78	284	158	<b>583</b>
simulation	19	59	101	149	94	<b>422</b>
% Difference	<b>90%</b>	<b>11%</b>	<b>29%</b>	<b>-48%</b>	<b>-41%</b>	<b>-28%</b>

## Simulated periphyton ranges relative to measured and historical data:

Segment	1	3	8	9	13
January			underpredicts		underpredicts
February		overpredicts	overpredicts	underpredicts	
March	in range	underpredicts	in range	in range	underpredicts
April		in range	in range		
May		in range	in range		
June		in range	in range		
July		in range	in range		
August	in range	in range	overpredicts	in range	in range
September	in range	in range			
October	overpredicts	in range	in range	in range	in range
November	in range	in range	in range	in range	in range
December		in range	in range		

*\*Model simulations were within range of measured and historical data during 28 of 37 (76%) month-segment combinations.*



# MODEL WORKGROUP PERCEPTIONS

- “...Model is really good...”
- “...Model is as good as it could be...”
- “...Tables and plots are very strong, matches data very well...”
- “...Documentation and application are transparent...”
- “...Model can provide multiple scenarios with excellent potentials for trading...”
- “...The most open and transparent modeling effort witnessed...”



# OTHER MODEL CONSIDERATIONS?

- Approximate representation of reality
  - Error and variability are inherent
- Calibration utilizes available data, literature values, and best professional judgment
  - Number of segments, timeframe, parameters, coefficients, etc.
  - Numerous other ways to set-up model calibrate model
- Simulation and measured data scales not identical
  - Site specific vs. segment average
- Calibration of 2012-2013 conditions
  - Inter-annual variation, historical, critical conditions, etc.



# WHAT DOES THE MODEL PROVIDE?

- It is a tool, not a panacea
- Predictive capabilities to evaluate potential scenarios and implications
  - Magnitudes of change in response to changing environmental conditions
- Mechanism to quantify complex environmental inter-relationships

# Lower Boise River Phosphorus

## AQUATOX Model Report



State of Idaho  
Department of Environmental Quality

February 2014

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## Lower Boise River Watershed Advisory Group (WAG)

Watershed advisory groups (WAGs) are groups of interested citizens that provide local public input and guidance to DEQ during the development of water quality improvement plans or "Total Maximum Daily Loads" (TMDLs) for water bodies that fail to meet water quality standards. TMDLs are designed to reduce the levels of pollutants, such as bacteria and sediment, in impaired water bodies.

The Lower Boise River WAG was formed to develop and implement TMDLs to improve water quality in the Lower Boise River. DEQ will consult with WAG participants on a regular basis throughout the TMDL development and/or five-year review process.

» [Lower Boise Watershed Council Website](#)

### Upcoming Meetings

**Lower Boise Watershed Council TAC Meeting**  
Wednesday, February 26, 2014, 9 to 11 a.m.  
Meridian City Hall  
33 East Broadway Ave., Meridian

**Lower Boise Watershed Council Meeting**  
Thursday, March 13, 2014, 7 p.m.  
DEQ State Office  
1410 N. Hilton, Boise

**Lower Boise Watershed Council Modeling Workgroup - Work Session**  
To be determined

### Review Documents

#### Phosphorus

- » [Draft Lower Boise River Subbasin 2014 Total Phosphorus Addendum](#) (February 2014)
- » [Lower Boise River Phosphorus: AQUATOX Model Report - Draft](#) (February 2014)
- » [Draft Lower Boise River Subbasin 2013 Total Phosphorus Addendum](#) (November 2013)

#### Sediment/Bacteria

- » [Draft Lower Boise River Tributaries TMDL: 2013 Addendum](#) (June 2013)

### Previous Meetings

#### Modeling Work Session Meetings

- » [AQUATOX Modeling Data](#)
- » [AQUATOX Model Files](#) - Use "public" for the username and password when prompted to log in.
- » [Watershed Council and TAC Meetings](#)

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### Staff Contacts

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### Related Pages

Total Maximum Daily Loads (TMDLs): Water Quality Improvement Plans

Watershed Advisory Groups



# MODEL APPLICATION

- A tool among multiple lines of evidence
- Refine target duration, location, frequency
- Other adjustments
  - Parma TP load  $\leq 0.07$  mg/L, May – Sept?
  - Reduce sediment (37%)?
  - Critical conditions? Flow tiers?
  - Other environmental and anthropogenic factors
- Techno-Policy group to advise model application
- Adaptive management approach



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# iTHANK YOU!

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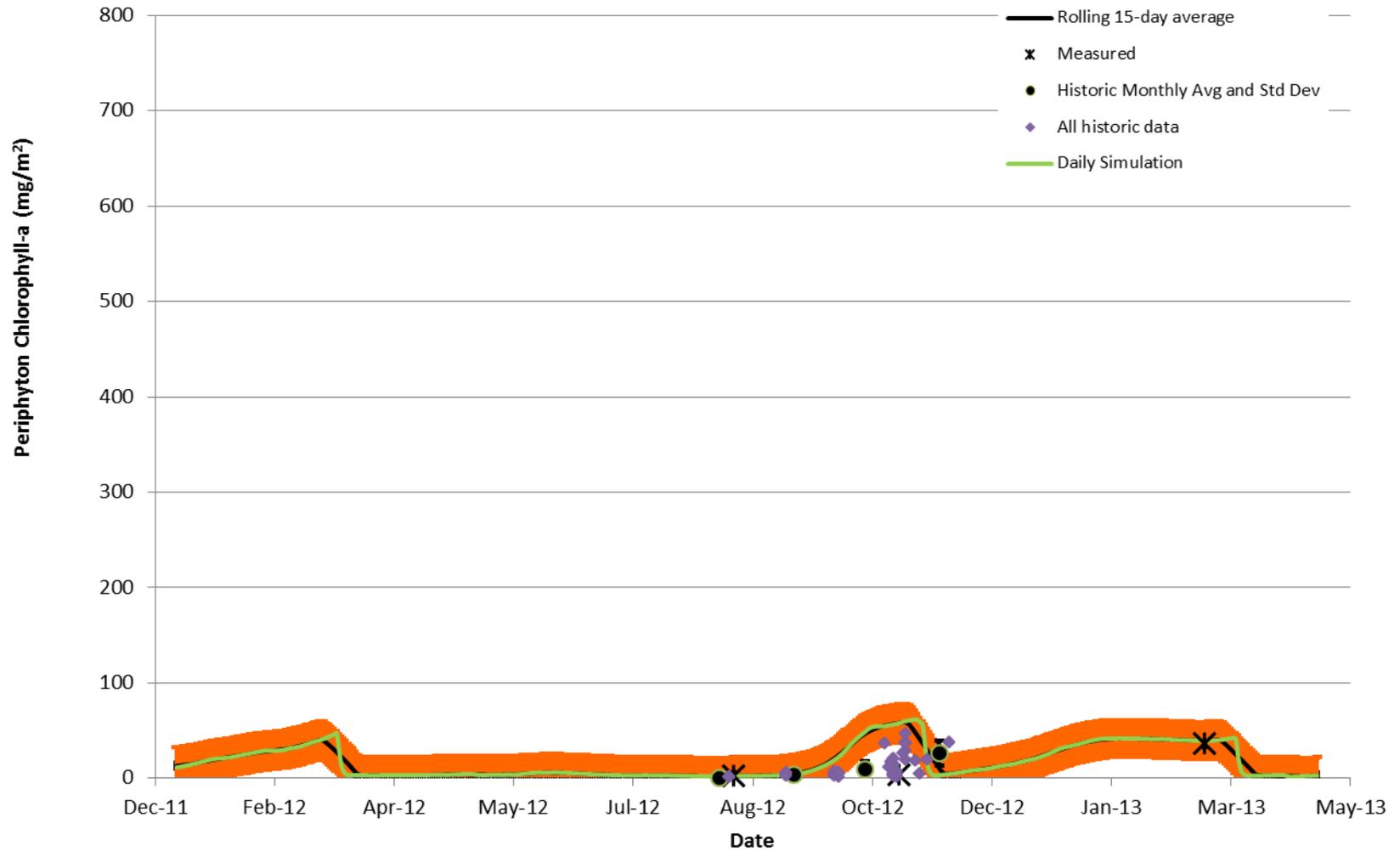
# NUISANCE AQUATIC GROWTHS

Address impairment of the 303d listed segments, Middleton to the mouth

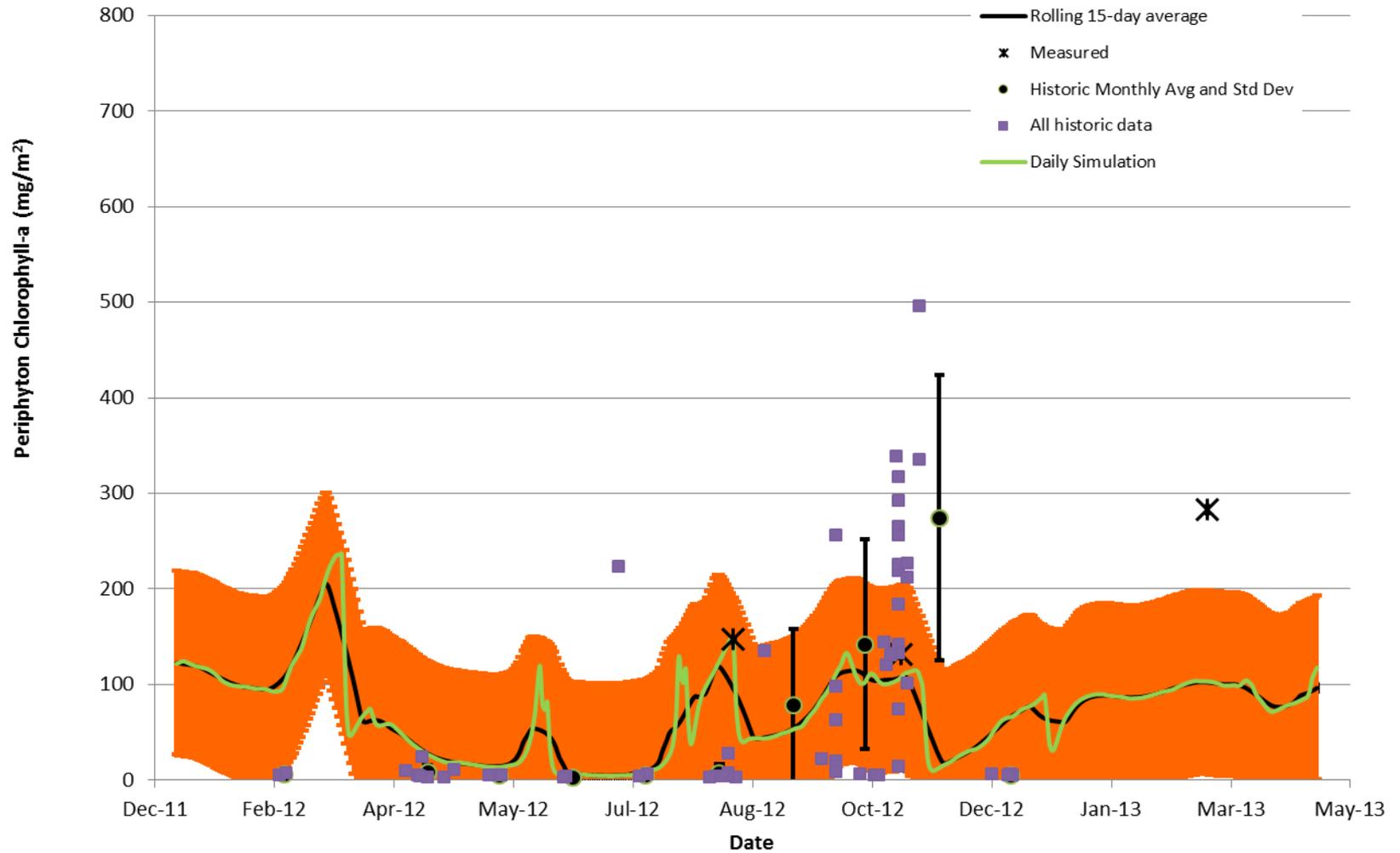
- DEQ and the LBWC identified:  
Nuisance algae impairment as a mean benthic chlorophyll a biomass of  $\leq 150 \text{ mg/m}^2$



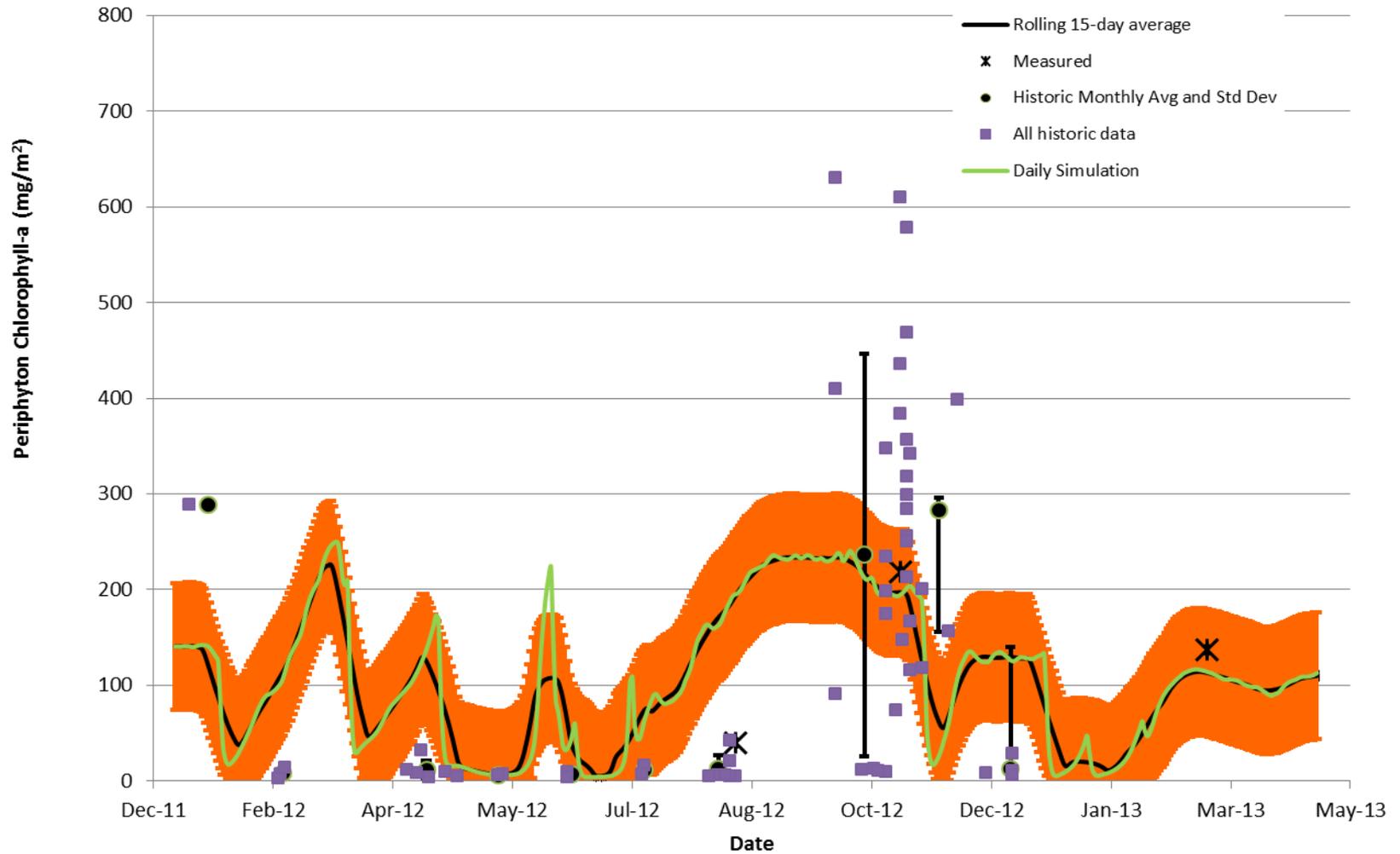
# Segment 1 Periphyton Model Fit - 2014\_0203 Parameters Measured and Historic Data at USGS 13203760 Eckert



### Segment 3 Periphyton Model Fit - 2014\_0203 Parameters Measured and Historic Data at USGS 13206000 at Glenwood

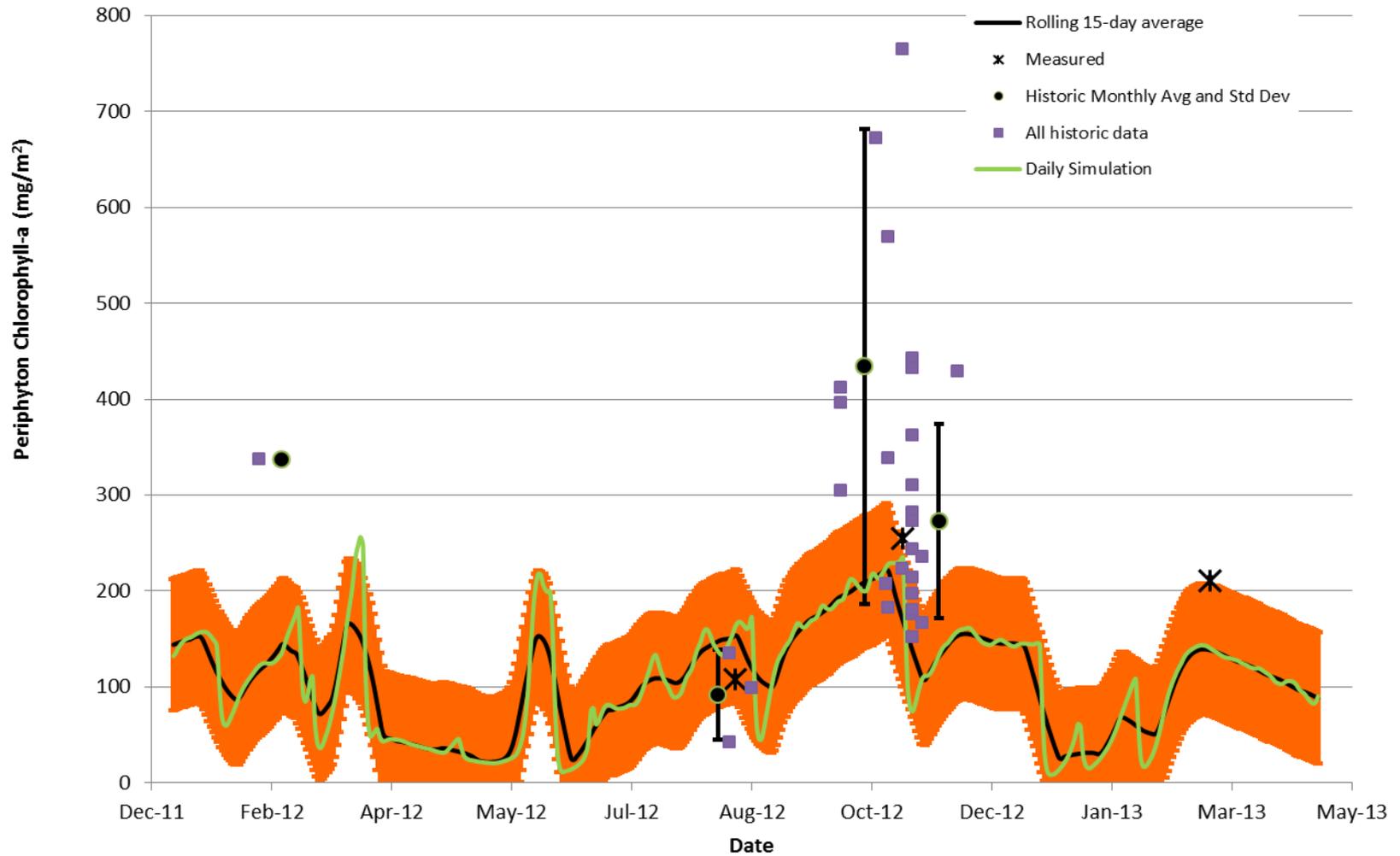


## Segment 8 Periphyton Model Fit - 2014\_0203 Parameters Measured and Historic Data at USGS 13210050 at Middleton



# Segment 9 Periphyton Model Fit - 2014\_0203 Parameters

## Measured and Historic Data at USGS 13211000 at Hwy 20-26



### Segment 13 Periphyton Model Fit 2014\_0203 Parameters Measured and Historic Data at USGS 13213000 at Parma

