WORK IN PROGRESS

HDR

Lower Boise Watershed Phosphorus TMDL Technical Advisory Meeting

Perspectives on Selecting Water Quality Targets and Allocations

September 27, 2012

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Disclaimer: Any opinions, findings, statements, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of Lower Boise Watershed stakeholders.

Outline

- Overview of 303(d) Listing
- Monitoring Data
  - River Conditions Assessment
- TMDL Targeting
  - Cause and Effect Variables
- Models and Modeling
  - Total Phosphorus Spreadsheet Model
- Management Scenarios
  - Linking Targeting with Management
- Next Steps

Overview of 303(d) Listing

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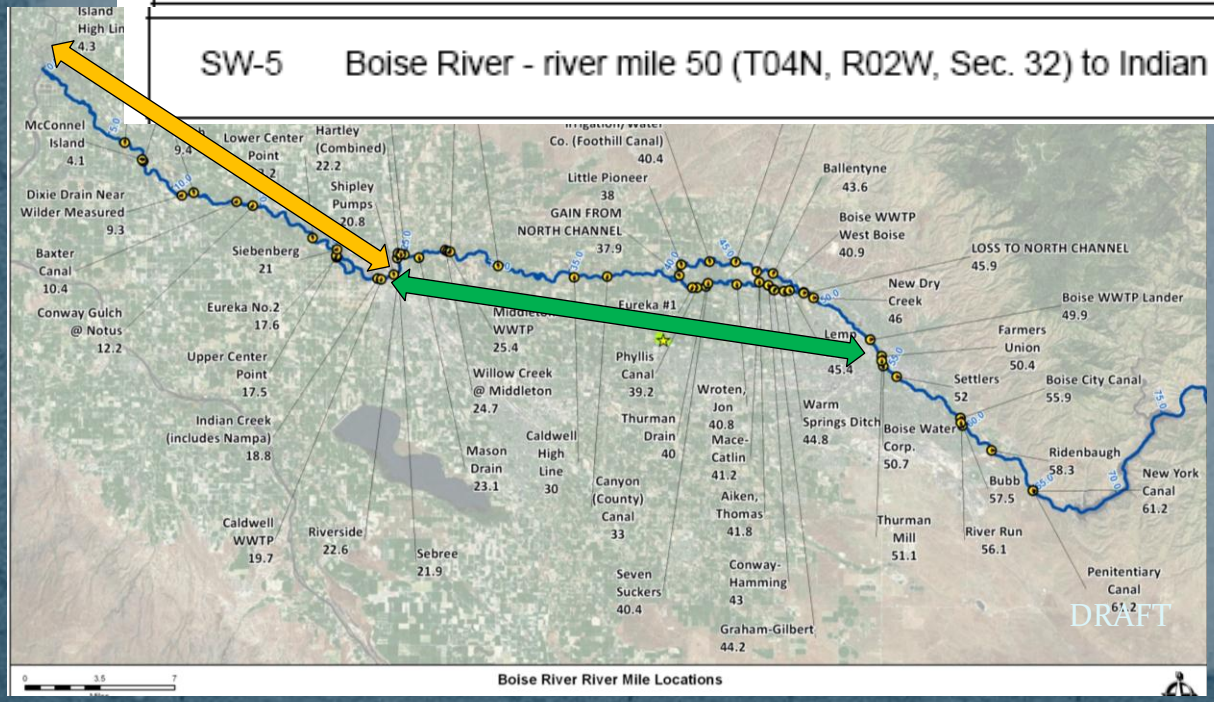
Lower Boise River Beneficial Uses

- IDAPA 58.01.02 Water Quality Standards

12. Lower Boise Subbasin. The Lower Boise Subbasin, HUC 17050114, is comprised of seventeen (17) water body units

Unit	Waters	Aquatic Life	Recreation	Other
SW-1	Boise River- Indian Creek to mouth	COLD	PCR	
SW-5	Boise River - river mile 50 (T04N, R02W, Sec. 32) to Indian Creek	COLD SS	PCR	



03. Abbreviations.

a. COLD -- Cold Water Communities.

b. SS -- Salmonid Spawning.

c. SC -- Seasonal Cold Water Communities.

d. WARM -- Warm Water Communities.

e. MOD -- Modified Communities.

f. PCR -- Primary Contact Recreation.

g. SCR -- Secondary Contact Recreation.

h. DWS -- Domestic Water Supply.

Applicable Standards for Assigned Beneficial Uses

- IDAPA 58.01.02 Water Quality Standards

200. GENERAL SURFACE WATER QUALITY CRITERIA.
The following general water quality criteria apply to all surface waters of the state, in addition to the water quality criteria set forth for specifically designated waters. (4-5-00)

05. Floating, Suspended or Submerged Matter. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities. (8-24-94)

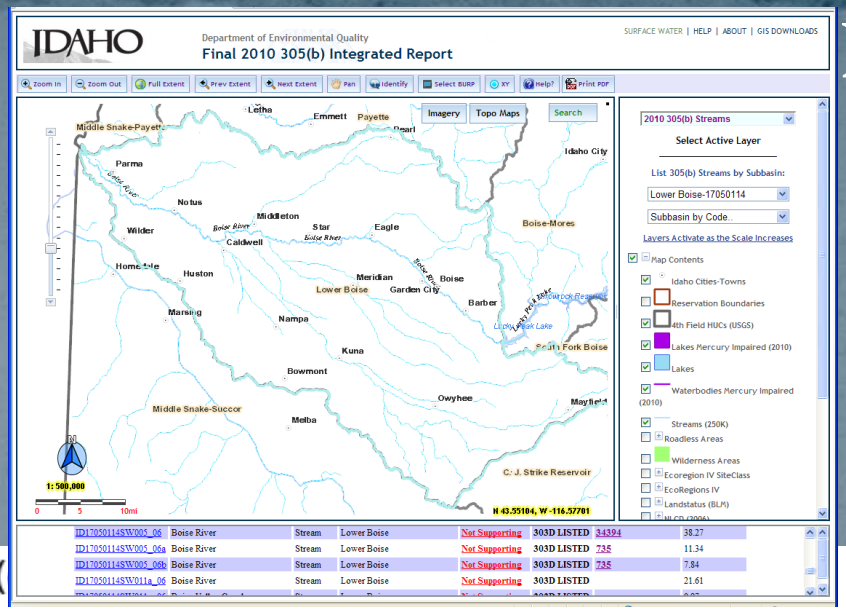
06. Excess Nutrients. Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. (8-24-94)

07. Oxygen-Demanding Materials. Surface waters of the state shall be free from oxygen-demanding materials in concentrations that would result in an anaerobic water condition. (7-1-93)

08. Sediment. Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Section 350. (4-5-00)

Lower Boise River

- 303(d) listed as impaired needing TMDL



2010 Integrated Report: Category 5 (§303(

ID17050114SW005 06b	Boise River-Middleton to Indian Creek	7.84	MILES

Phosphorus (Total)

Temperature, water

Assessment unit listed for temperature impairment based on City of Boise temperature logger data, submitted in the 2010 integrated report call for data. HS

2010 Integrated Report: Category 5 (§303(d))

ID17050114SW001 06	Boise River - Indian Creek to mouth	45.43	MILES

Temperature, water

Phosphorus (Total)

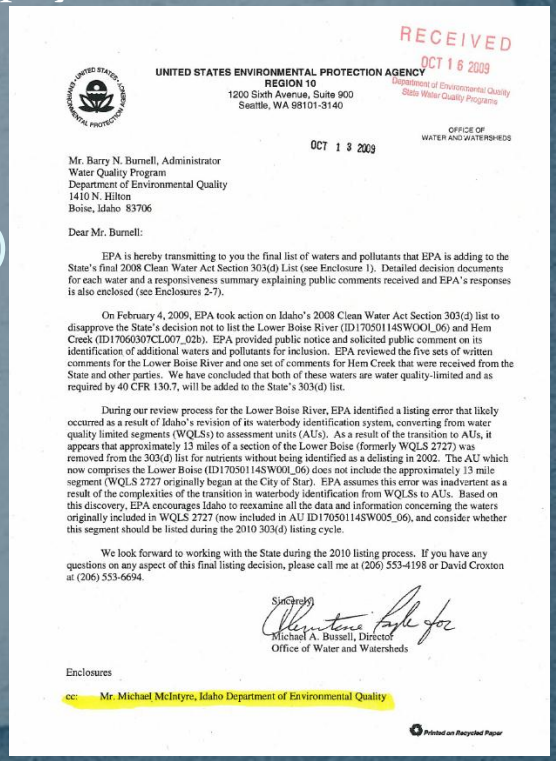
2/05/2009 (NED) - Per EPA's Partial Approval/Partial Disapproval of Idaho's Final 2008 303(d) List letter dated 2/04/2009, EPA disapproved delisting of the Lower Boise River for nutrients (total phosphorus) because DEQ did not demonstrate good cause to delist, and that DEQ provided insufficient rationale to justify the exclusion of all existing and readily available data. EPA subsequently took public comment on this reversal that ended May 15, 2009.

5/3/2010 (NED) - EPA concluded in their final decision letter dated October 13, 2009 that the Lower Boise River is water quality-limited and mandated that DEQ add the Lower Boise River back to the 303(d) list. Refer to the following link to review EPA's final determination on the Lower Boise River:

http://www.deq.idaho.gov/media/773615-2008-ir-epa-response-lower-boise-river-hem-creek-101309.pdf

Lower Boise River was listed as impaired by EPA

- EPA concluded that the Lower Boise River is water quality-limited for nutrients (October 13, 2009)
- Basis:
  - Data on indicators for interpreting narrative criteria
    - Primary: phosphorus, nitrogen, periphyton chlorophyll a
    - Additional: turbidity, dissolved oxygen, pH, macrophytes
- Comparison Criteria:
  - Ecoregion criteria of 43 µg/L total phosphorus
  - Gold Book criteria of 100 µg/L total phosphorus
  - Reference literature (Welch, Dodds, VNRP, et.al)
    - 10 to 90 µg/L total phosphorus
    - 3 to 60 µg/L soluble reactive phosphorus (SRP)
    - 100 to 200 mg/m² chlorophyll *a*
  - DEQ's listing/delisting rationale for other waterbodies
    - However, metrics were applied on a site-specific basis



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OCT 16 2009
Department of Environmental Quality
State Water Quality Programs

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
WATER AND WATERSHEDS

OCT 13 2009

Mr. Barry N. Burnell, Administrator
Water Quality Program
Department of Environmental Quality
1410 N. Hilton
Boise, Idaho 83706

Dear Mr. Burnell:

EPA is hereby transmitting to you the final list of waters and pollutants that EPA is adding to the State's final 2008 Clean Water Act Section 303(d) List (see Enclosure 1). Detailed decision documents for each water and a responsiveness summary explaining public comments received and EPA's responses is also enclosed (see Enclosures 2-7).

On February 4, 2009, EPA took action on Idaho's 2008 Clean Water Act Section 303(d) list to disapprove the State's decision not to list the Lower Boise River (ID17050114SW00I_06) and Hem Creek (ID17060307CL007_02b). EPA provided public notice and solicited public comment on its identification of additional waters and pollutants for inclusion. EPA reviewed the five sets of written comments for the Lower Boise River and one set of comments for Hem Creek that were received from the State and other parties. We have concluded that both of these waters are water quality-limited and as required by 40 CFR 130.7, will be added to the State's 303(d) list.

During our review process for the Lower Boise River, EPA identified a listing error that likely occurred as a result of Idaho's revision of its waterbody identification system, converting from water quality limited segments (WQLSs) to assessment units (AUs). As a result of the transition to AUs, it appears that approximately 13 miles of a section of the Lower Boise (formerly WQLS 2727) was removed from the 303(d) list for nutrients without being identified as a delisting in 2002. The AU which now comprises the Lower Boise (ID17050114SW00I_06) does not include the approximately 13 mile segment (WQLS 2727 originally began at the City of Star). EPA assumes this error was inadvertent as a result of the complexities of the transition in waterbody identification from WQLSs to AUs. Based on this discovery, EPA encourages Idaho to reexamine all the data and information concerning the waters originally included in WQLS 2727 (now included in AU ID17050114SW005_06), and consider whether this segment should be listed during the 2010 303(d) listing cycle.

We look forward to working with the State during the 2010 listing process. If you have any questions on any aspect of this final listing decision, please call me at (206) 553-4198 or David Croxton at (206) 553-6694.

Sincerely,

Michael A. Bussell, Director
Office of Water and Watersheds

Enclosures

cc: Mr. Michael McIntyre, Idaho Department of Environmental Quality

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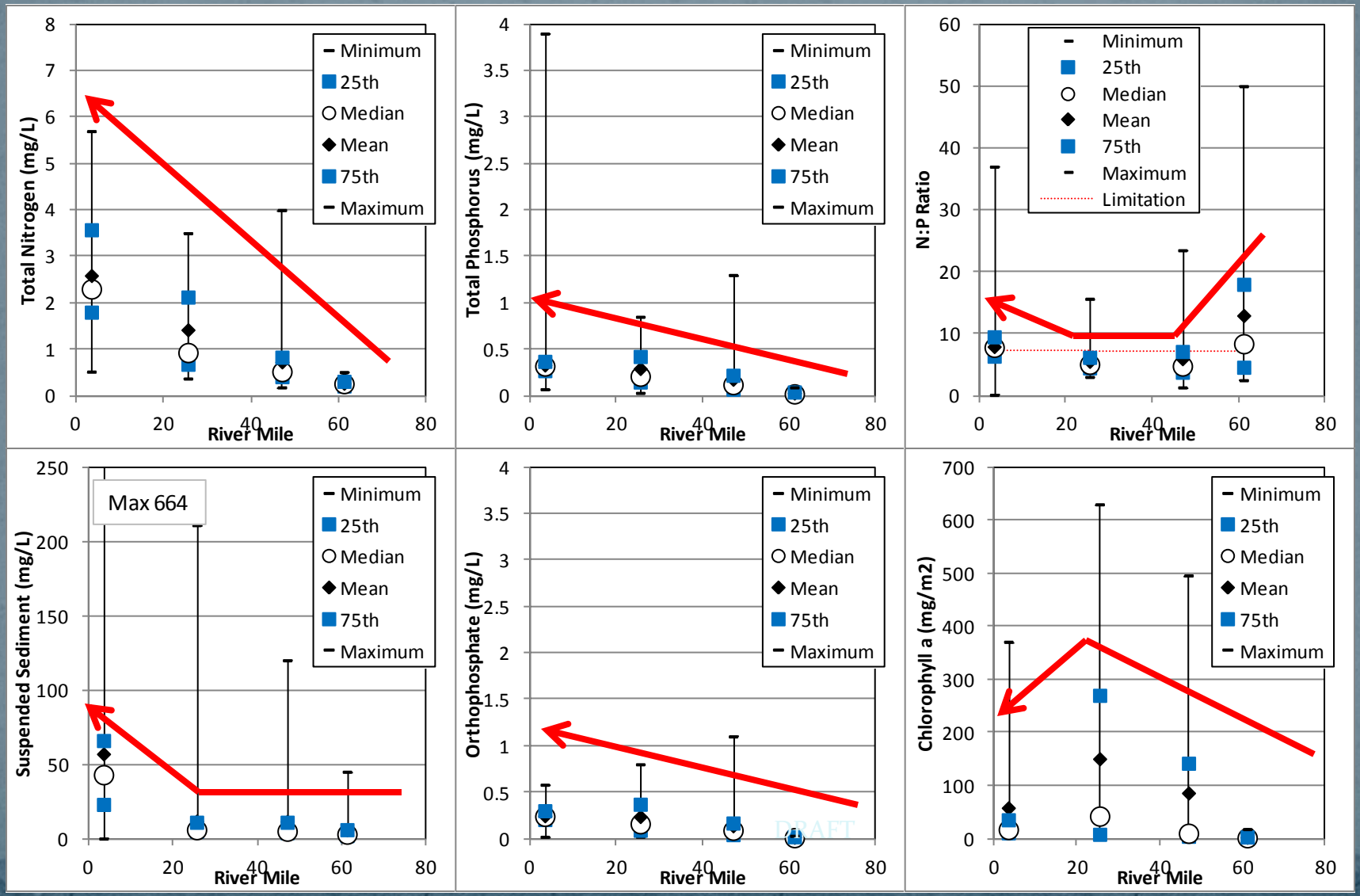
Monitoring Data

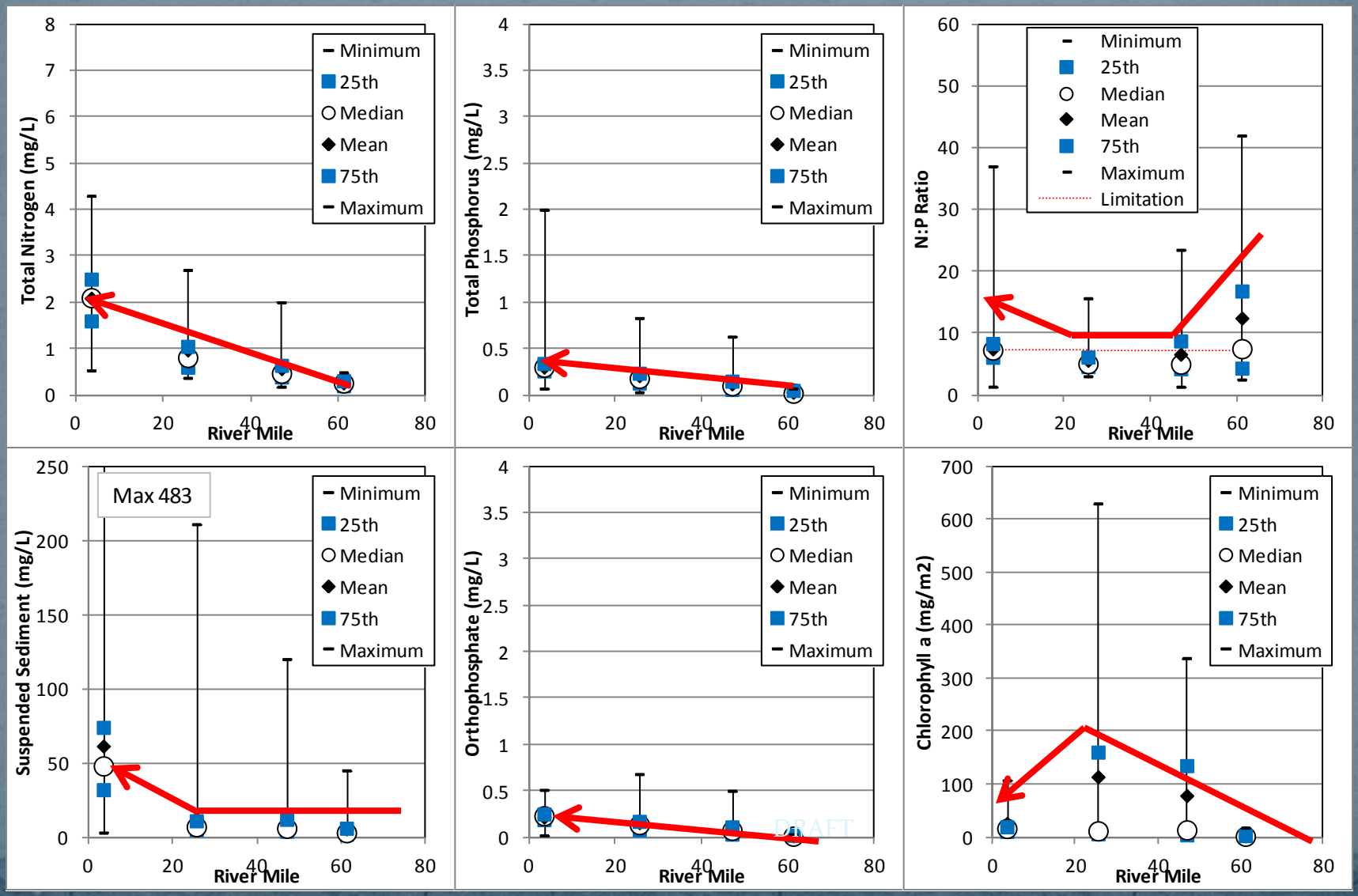
USGS Monitoring Data

- Four locations
  - # USGS 13203510 BOISE R BL DIVERSION DAM NR BOISE ID
  - # USGS 13206000 BOISE RIVER AT GLENWOOD BRIDGE NR BOISE ID
  - # USGS 13210050 BOISE RIVER NR MIDDLETON ID
  - # USGS 13213000 BOISE RIVER NR PARMA ID
- Period of Record Data
  - Total Nitrogen, Total Phosphorus, N:P Ratio
  - Suspended Sediment, Orthophosphate, Chlorophyll a

USGS Monitoring Data Period of Record

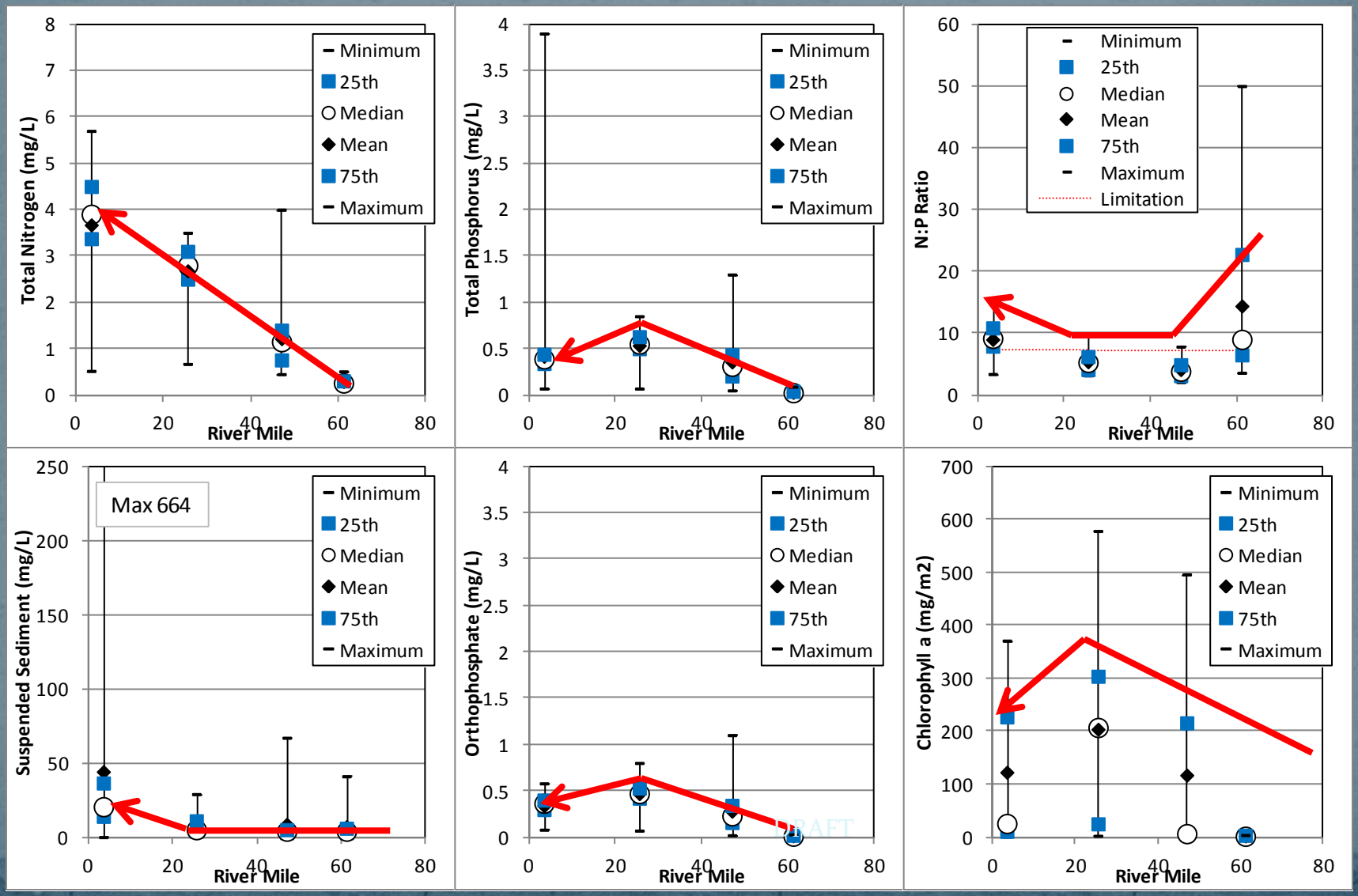


USGS Monitoring Data
Irrigation Season (March 15 – October 31)



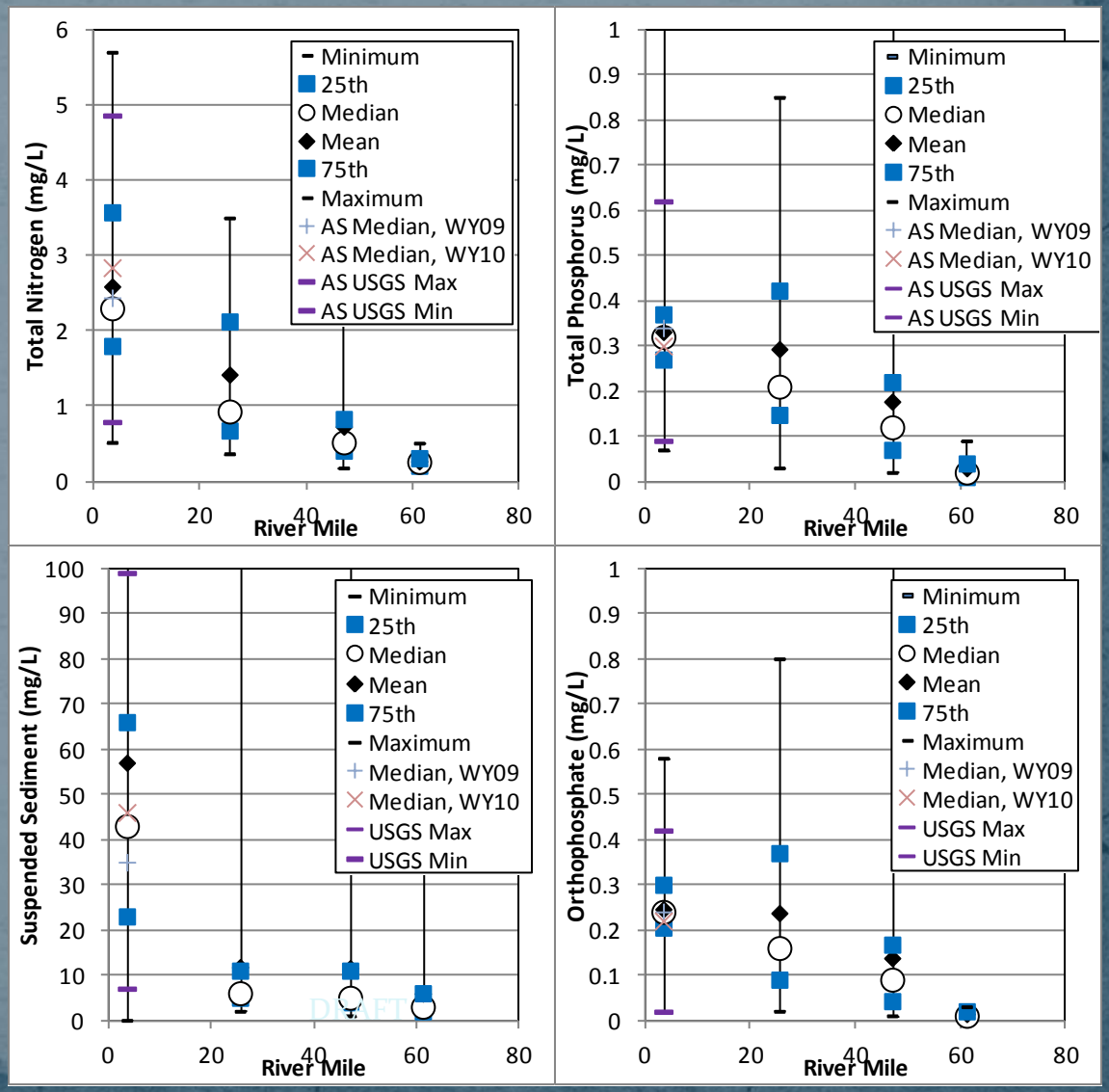
USGS Monitoring Data

Non-Irrigation Season (November 1 – March 14)

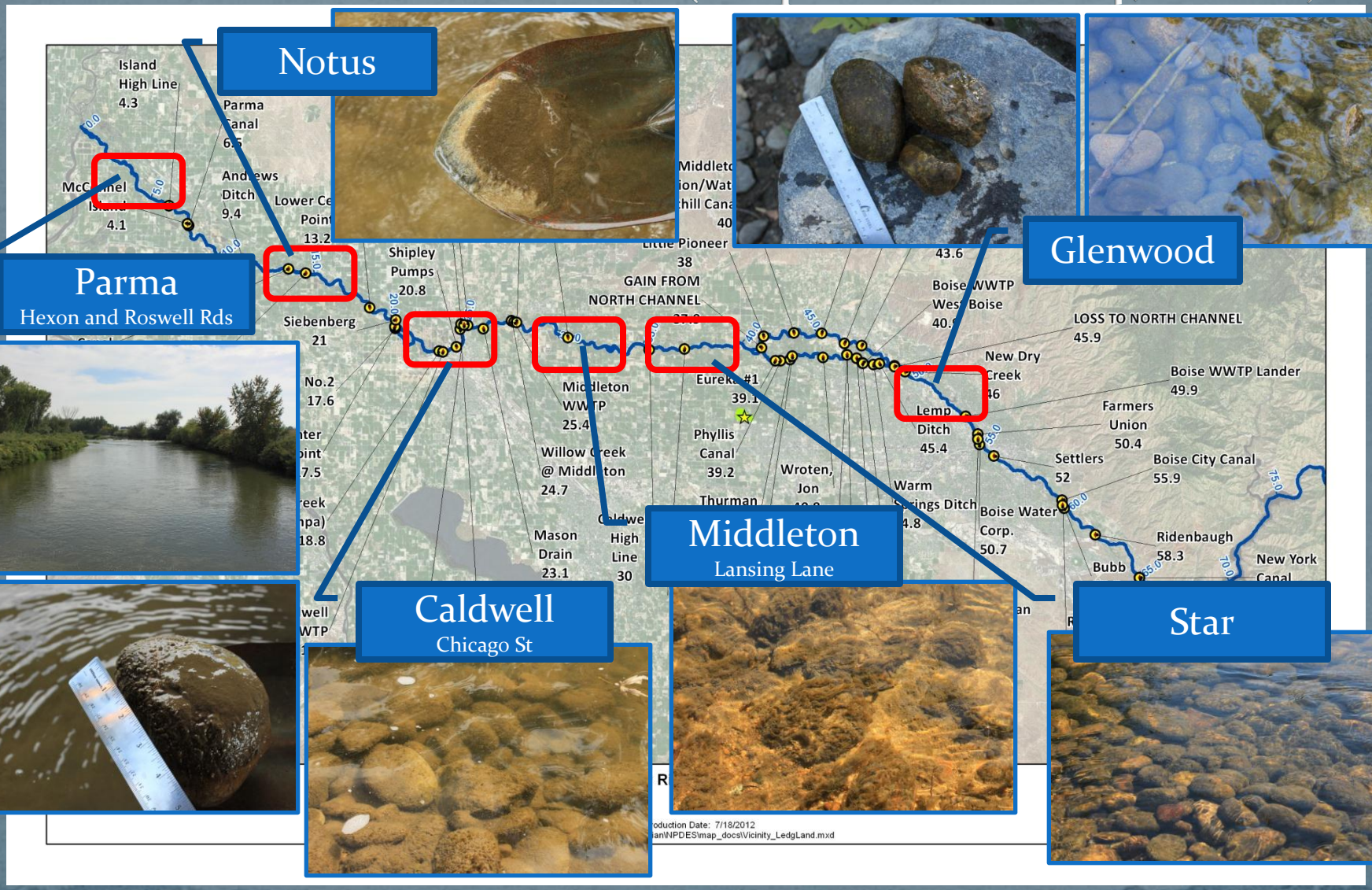


USGS Monitoring Data Reported 2011 Study

- Median of 2011 Study data are similar to the long-term dataset at Parma



Lower Boise River
Visual Examination (September 14, 2012)



TMDL Targeting

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Interpretation of narrative standards by EPA for 303(d) Listing

- EPA interpreted the narrative standards for
  - Floating, Suspended or Submerged Matter
  - Excess nutrients
- EPA stated phosphorus levels exceed ecoregional and Gold Book criteria and therefore constitute a violation of the excess nutrient narrative criterion
- EPA used 100 to 200 mg/m^2 periphyton chlorophyll *a* and 43 to 100 µg/L for total phosphorus
  - Narrative standard "…free from excess nutrients that can cause visible slime growth or other nuisance growths…"
  - EPA stated that periphyton appears to be the best measure of whether excess nutrients are impairing beneficial uses

Link Target to Impairment Cause and Effect Relationship

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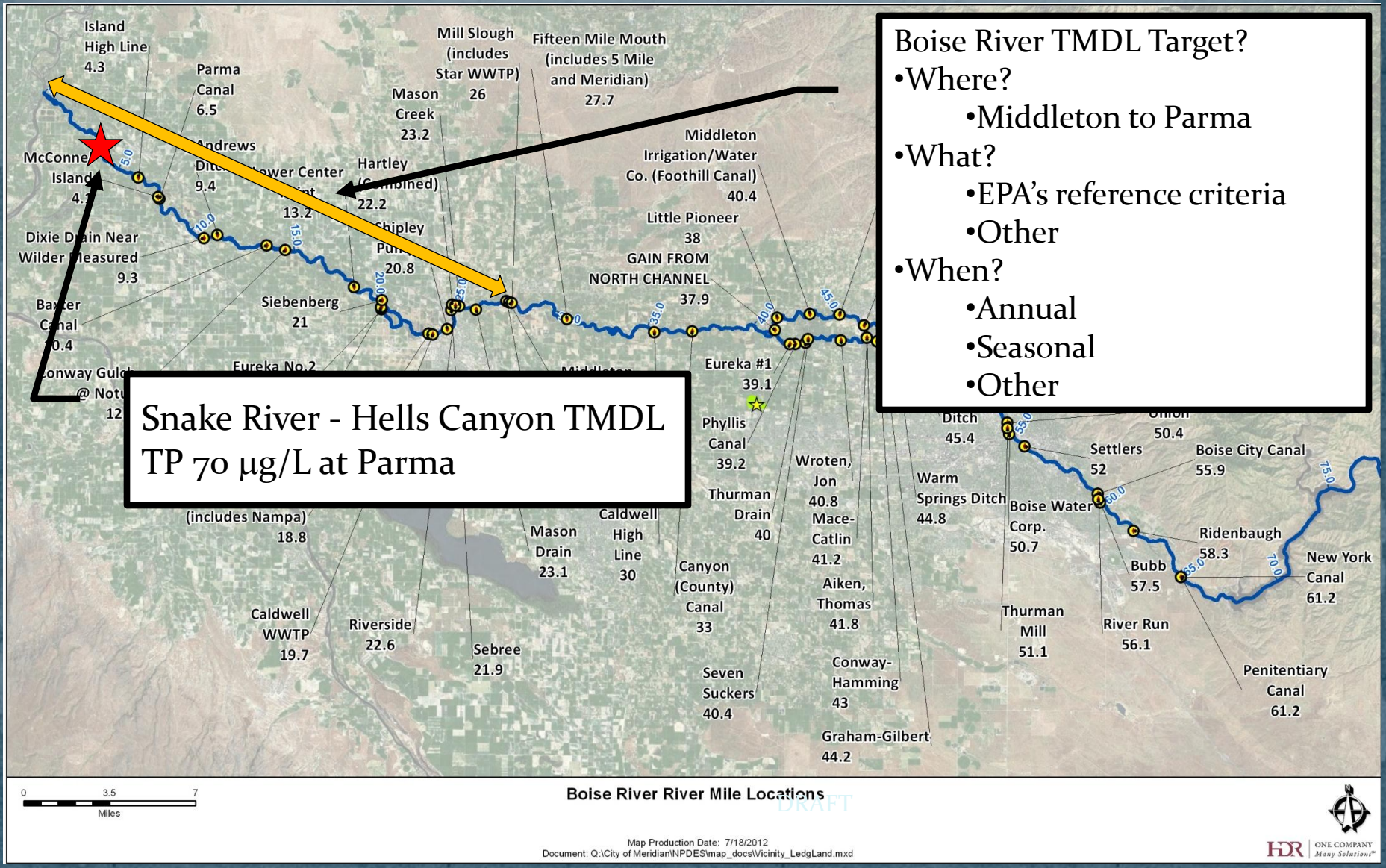
- Impairment is nuisance algae (EPA)
  - Visual inspection and complaints indicate nuisance algae
  - Comparisons of in-stream data and reference criteria indicate nuisance algae
- Cause(s) of nuisance algae
  - Inferred cause is total phosphorus
  - Evidence: Comparison of in-stream data and reference criteria suggests nuisance algae
- Argument
  - Reduce total phosphorus = reduced nuisance algae
- Connection
  - Not established in EPA letter
    - Need a site specific analysis to determine the levels of phosphorus in the particular water body that cause nuisance aquatic growths at levels impairing designated beneficial uses.

Impaired Reach Middleton to Mouth



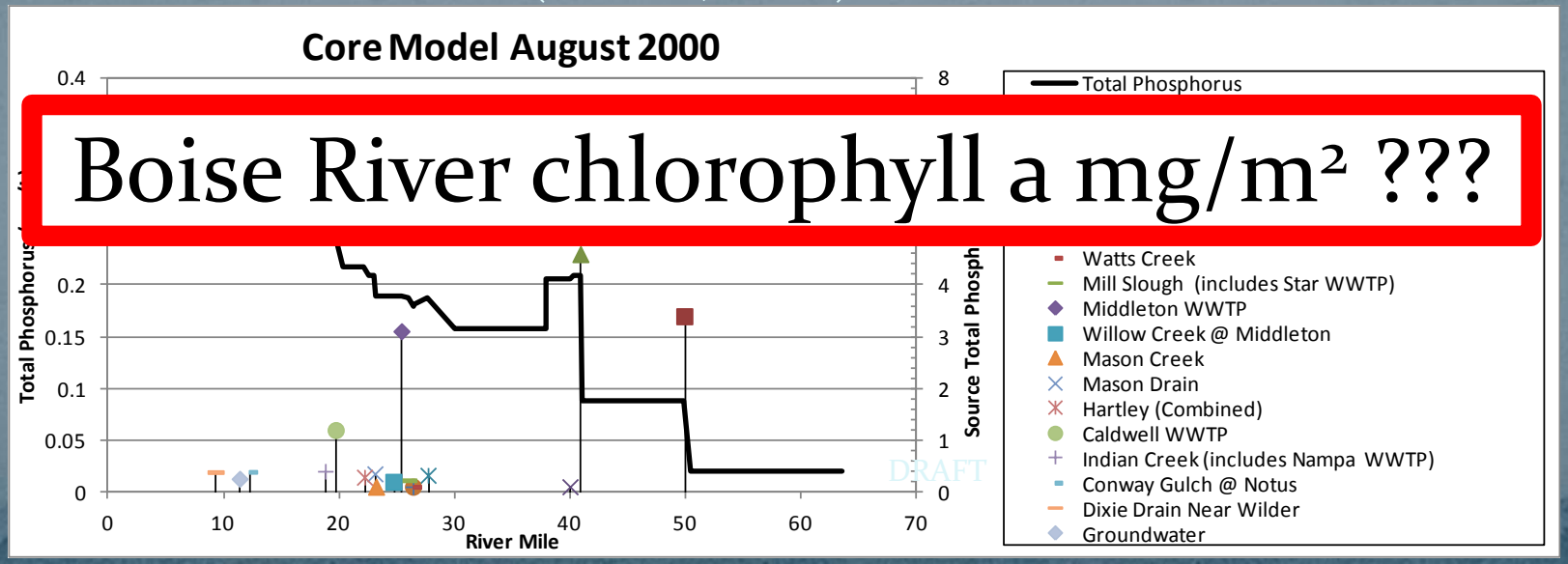
Boise River TMDL Target?

- Where?
  - Middleton to Parma
- What?
  - EPA's reference criteria
  - Other
- When?
  - Annual
  - Seasonal
  - Other

Snake River - Hells Canyon TMDL
TP 70 µg/L at Parma

Consideration
Chlorophyll a Response

- Phosphorus loading spreadsheet does not provide a prediction of Boise River chlorophyll a response
  - Potential cause [phosphorus] not linked to response [nuisance algae]
  - "…relations between chlorophyll-*a* and other water-quality parameters at Parma have not been well characterized…" (USGS, 2011)



Boise River chlorophyll a mg/m² ???

Models and Modeling

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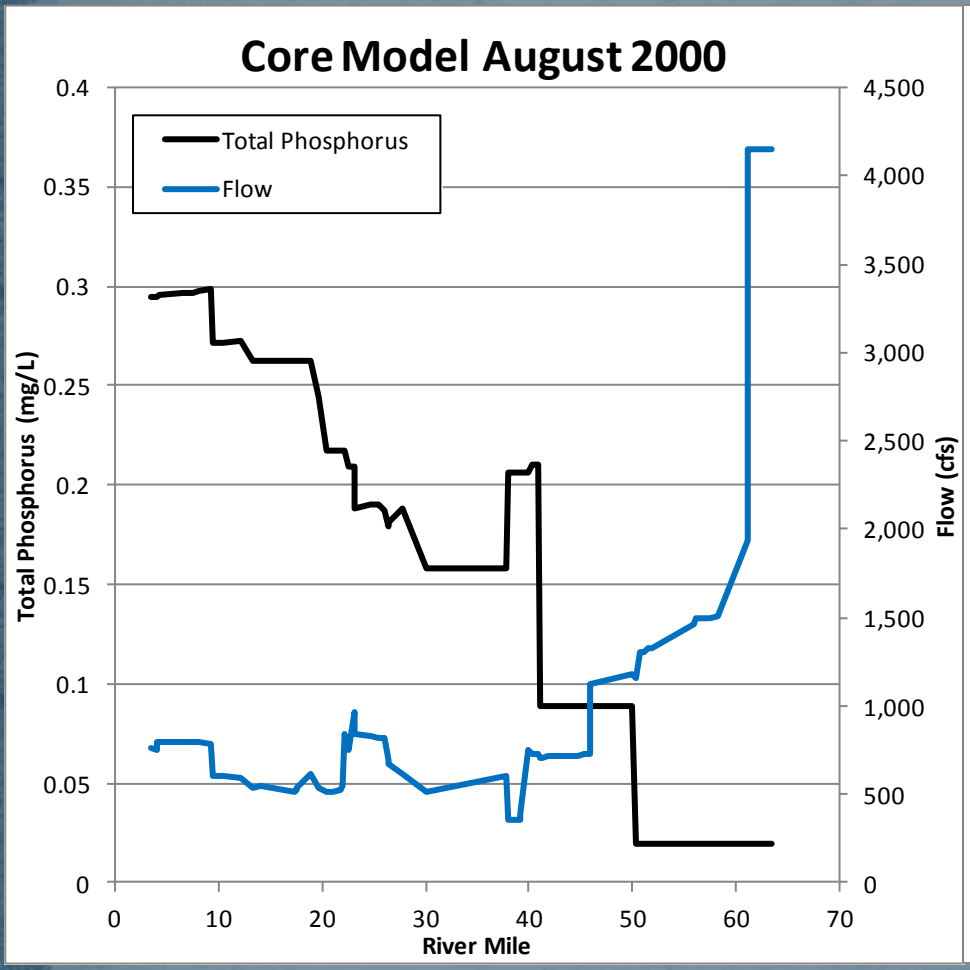
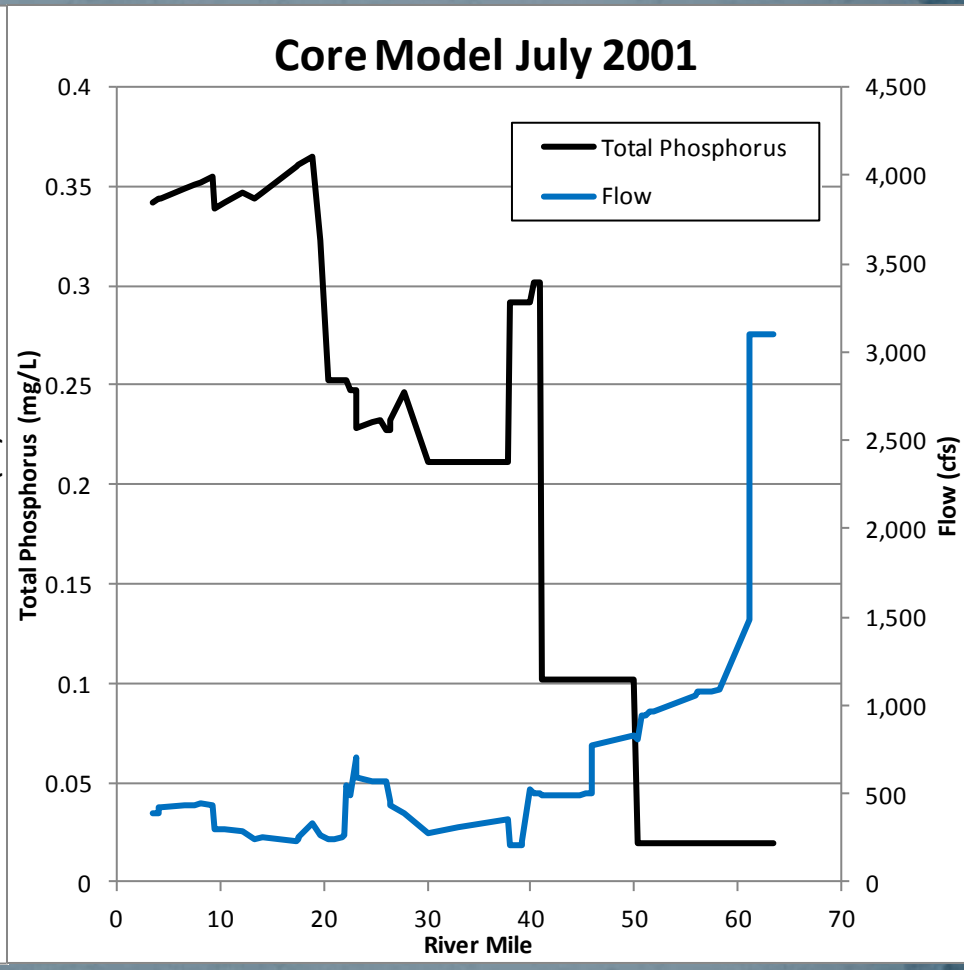
EPA Core Models

- Spreadsheet of Boise River inputs and diversions
- Representing conditions from:
  - August 2000 (medium to low flow year)
  - July 2001 (low flow year)

- Considerations
  - Use the Core Models to increase understanding of the system
  - Use the Core Models to investigate potential implications of EPA's criteria

EPA Core Models
Boise River Flow and Total Phosphorus





Downstream Upstream Downstream Upstream

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EPA Core Models River and Source TP

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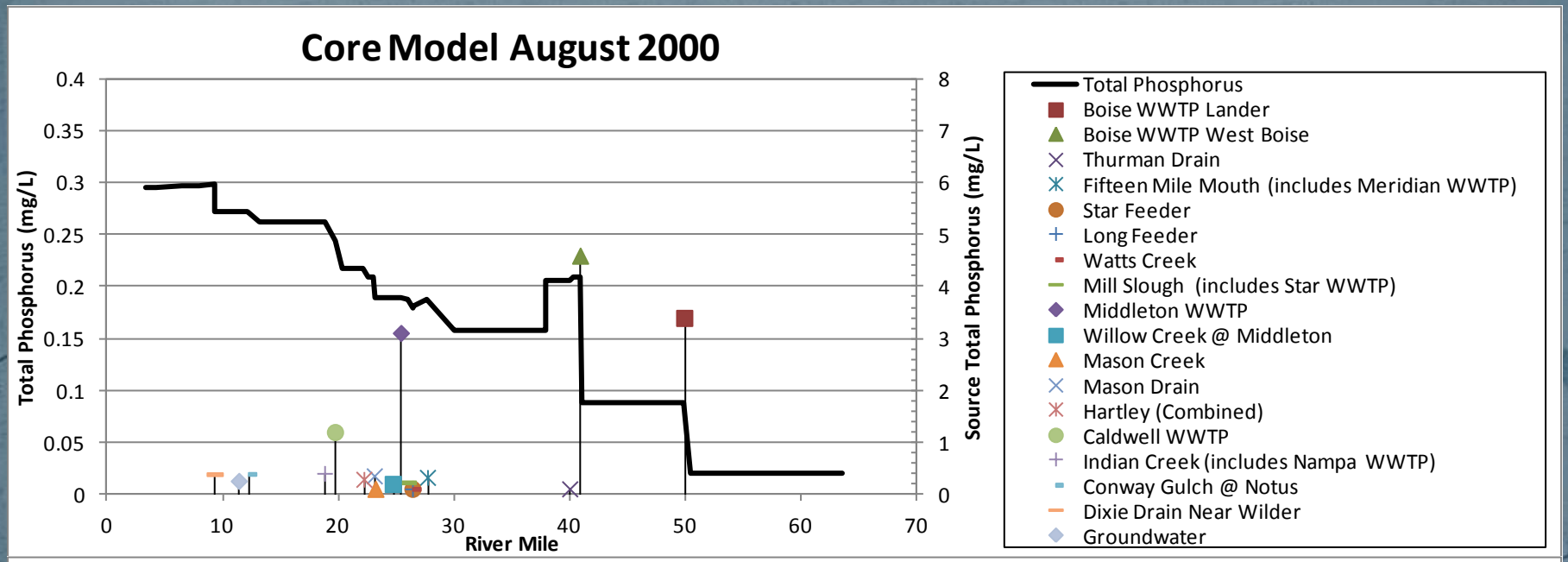
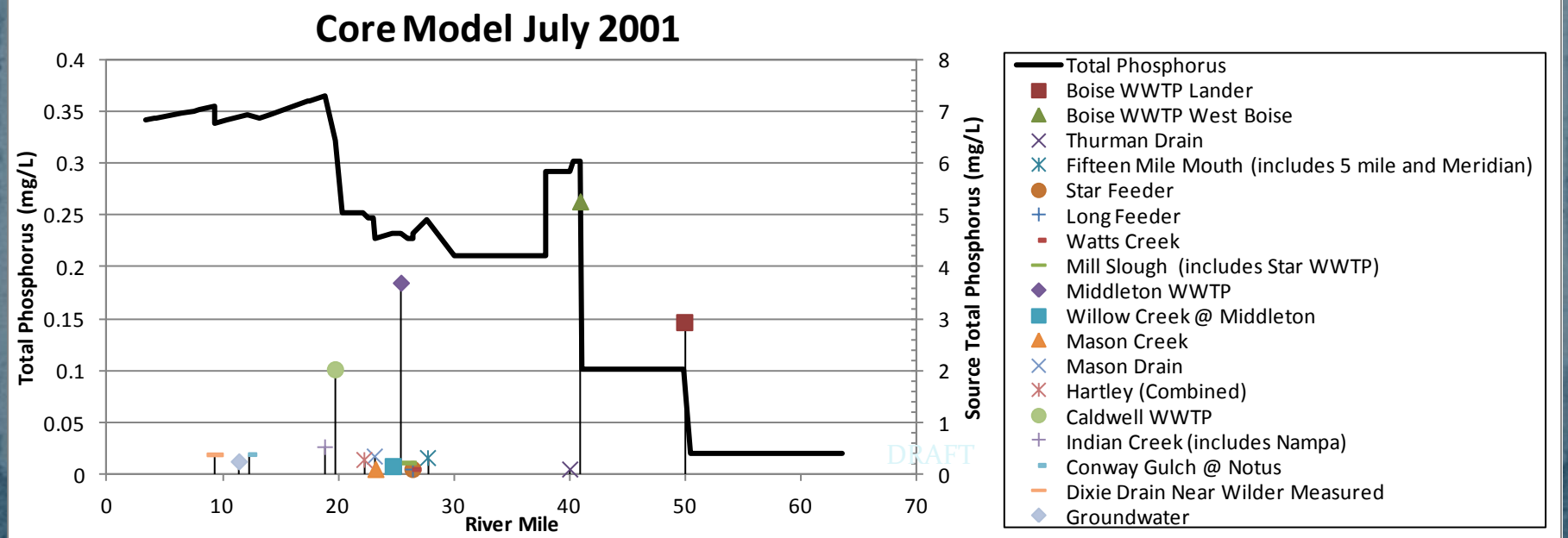
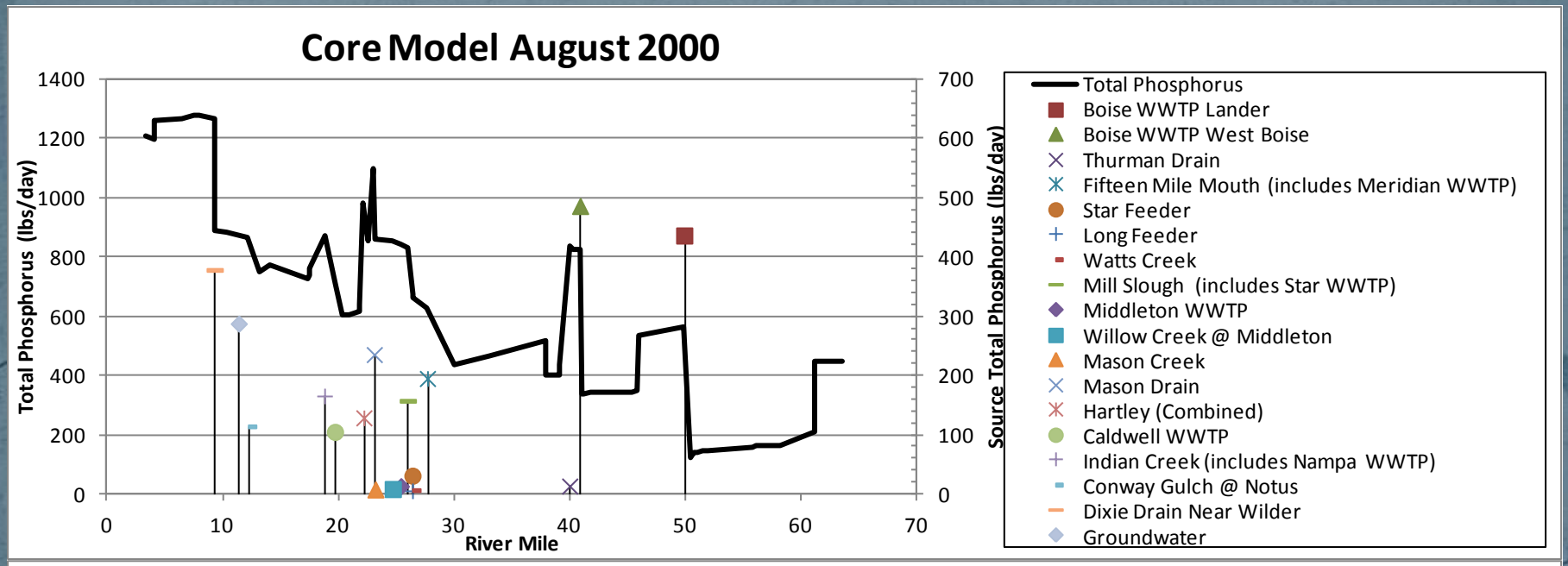
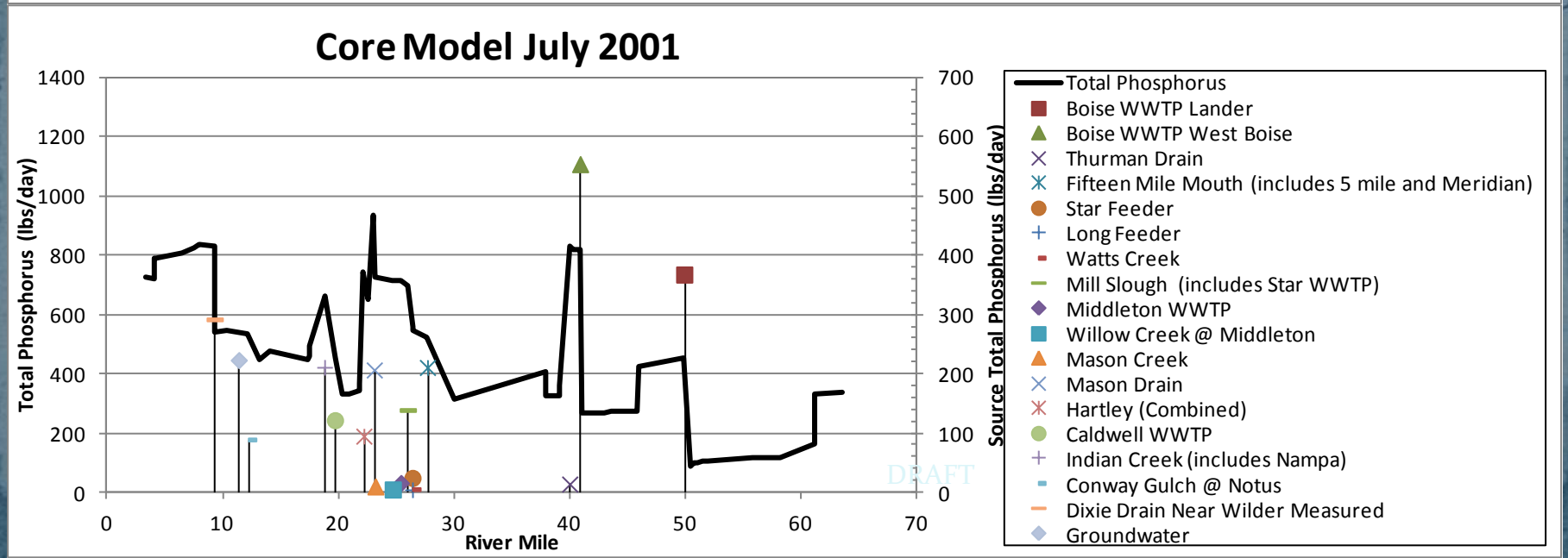




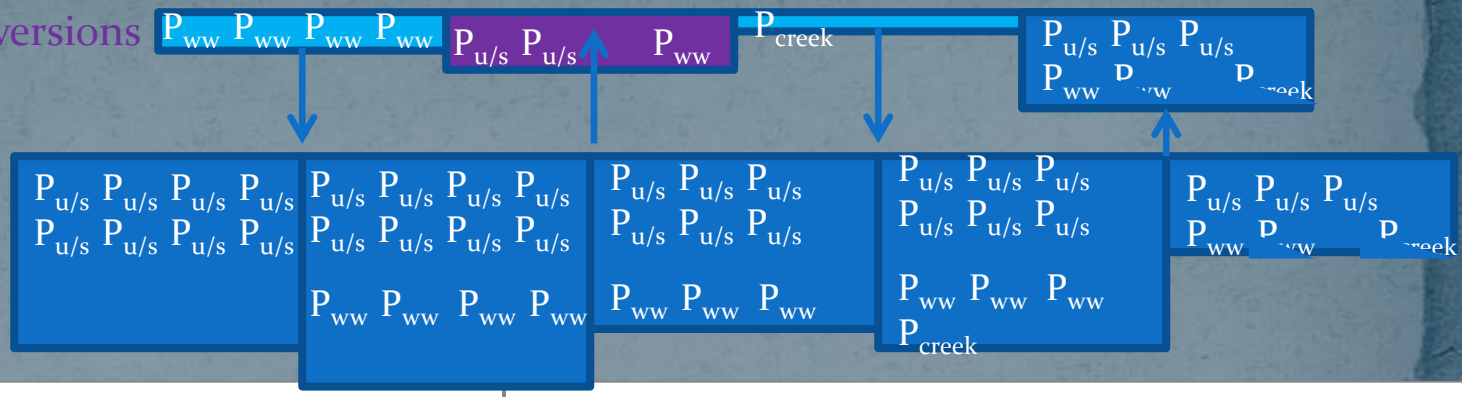
EPA Core Models River and Source TP Load

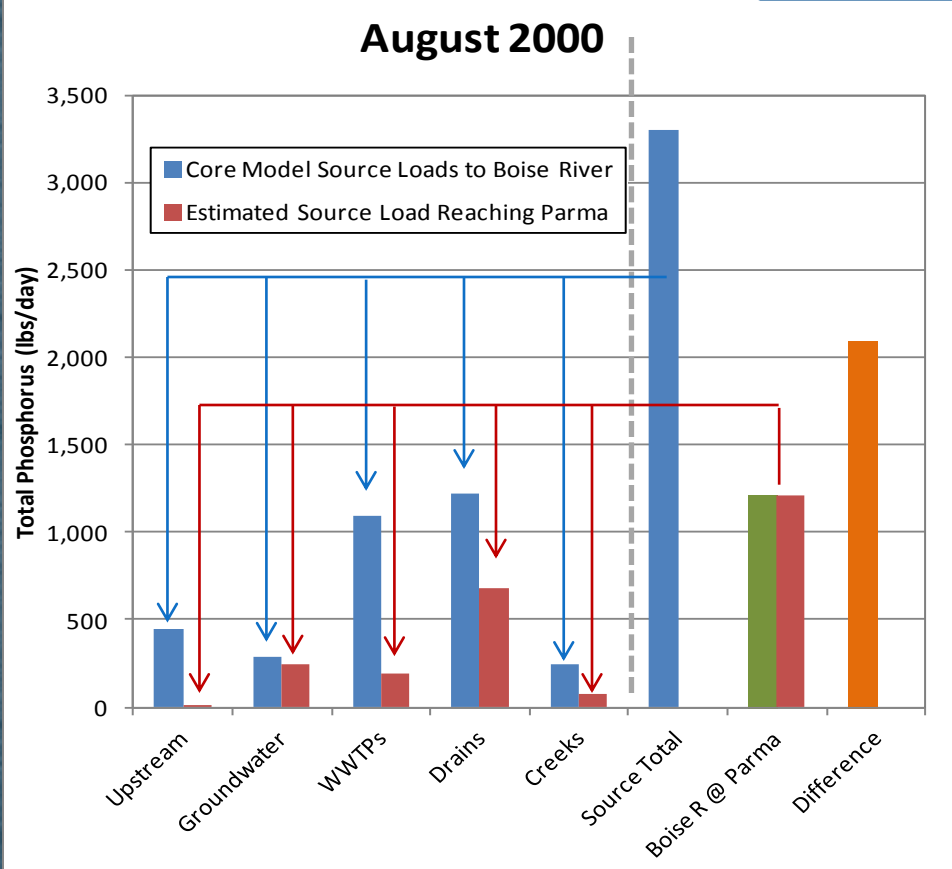


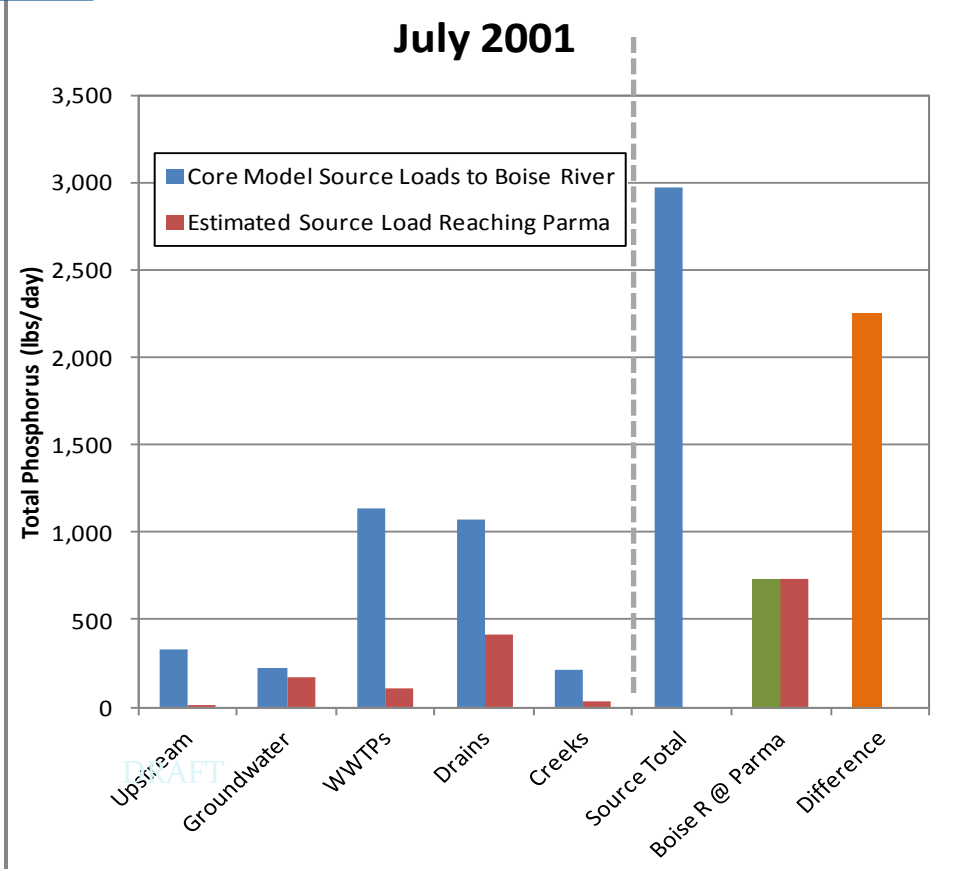


Core Model Loads by Source Consideration: Source Loads at Parma

Conceptual Example of Accounting Process

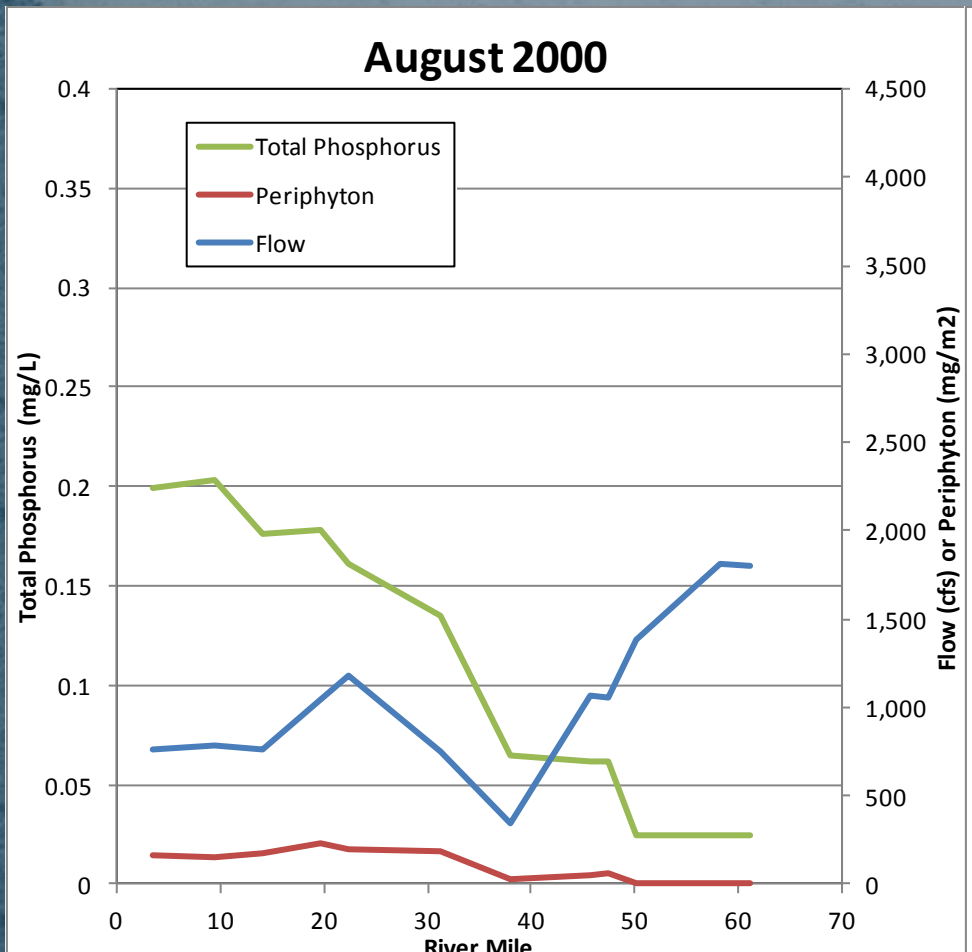


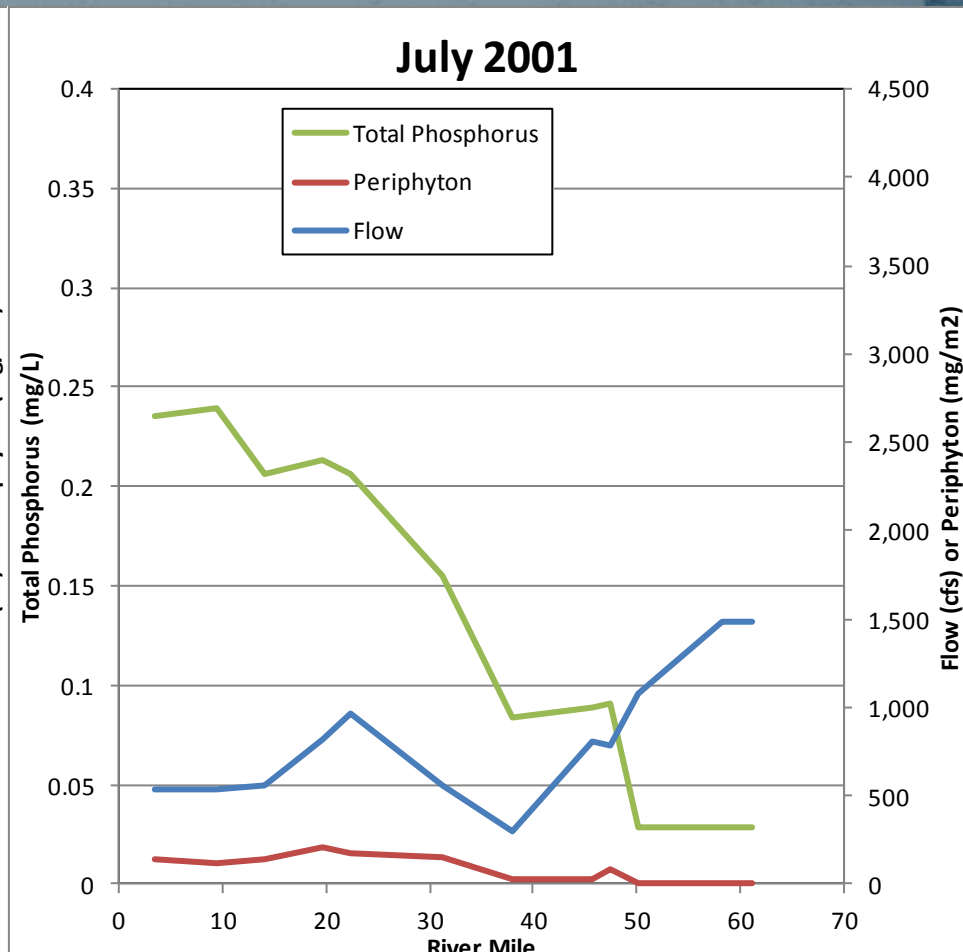




AQUATOX Model

- Ecosystem model that is a standalone program
- Represents conditions from Jan 1999 through Dec 2001





Modeling

- EPA Core Model
  - Does not provide connection between cause and effect variables
- AQUATOX Model
  - Acceptance?
- Other Models
  - Models available that could be applied

Management Scenarios

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Management Scenarios
Investigate Allocations and Targets

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- Source Allocations:
  - WWTP Treatment Levels
    - 500 µg/L sustainable BNR w/o effluent filtration
    - 300 µg/L sustainable BNR w/ filtration (not membranes)
    - 70 µg/L sustainable BNR w/ membranes or enhanced filtration
  - Equity Basis
    - Concentration
    - Load
    - Percent reductions
  - Other
- River Response:
  - Need to perform model simulations

Numeric Nutrient Endpoints and Limits of Wastewater Treatment Technology[1]

Parameter	Typical Municipal Raw Wastewater, mg/l	Secondary Effluent (No Nutrient Removal), mg/l	Advanced Wastewater Treatment			Reference Criteria, mg/l	Boise River Ambient, mg/l
			Typical Advanced Treatment Nutrient Removal (BNR), mg/l	Enhanced Nutrient Removal (ENR), mg/l	Limits of Treatment Technology, mg/l		
Total Phosphorus	4 to 8	4 to 6	1	0.25 to 0.50	0.05 to 0.07	0.043 to 0.100	0.01 to 0.37
Total Nitrogen	25 to 35	20 to 30	10	4 to 6	3 to 4	0.300 to 0.380	0.21 to 3.58
Approximate Cost Range for 10 mgd[2]		$90 to $120M	$130 to $170M	$160 to $200M	$200 to $250M		

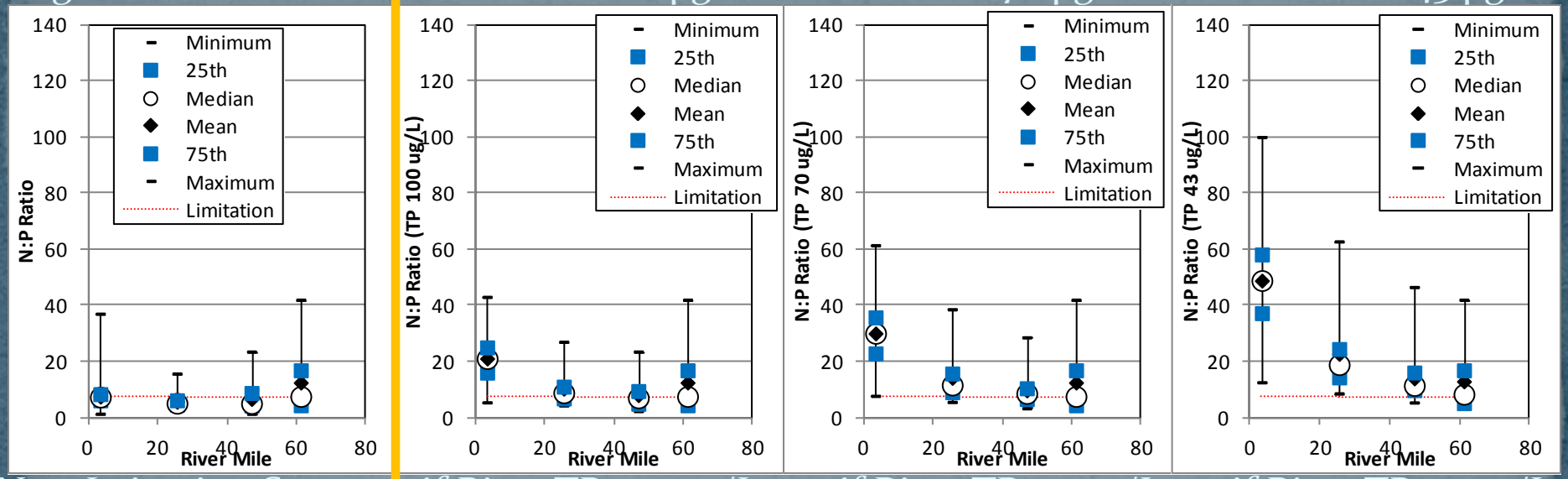
TP Boise River WWTPs 2 to 5 mg/L

[1] *Ignoring Considerations of Variability and Reliability of Wastewater Treatment Performance*
[2] *WERF Striking the Balance Between Nutrient Removal in Wastewater Treatment and Sustainability. Costs for new facility. Total Present Worth Cost includes Operations*

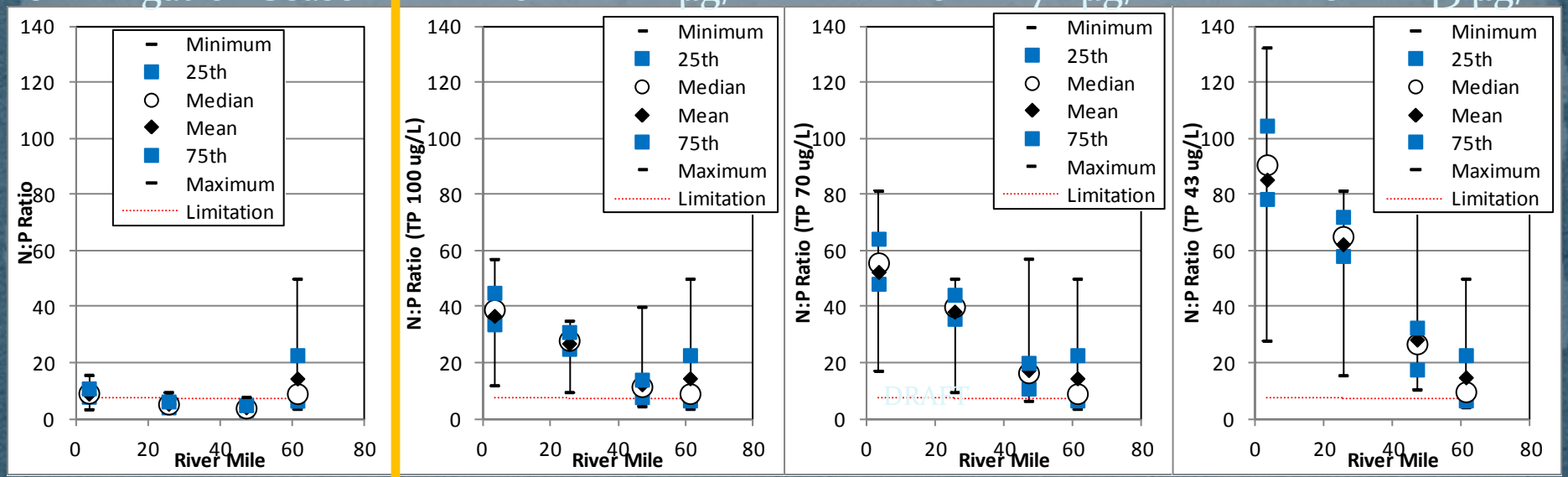
Consideration: Phosphorus Management

Phosphorus Reductions change N:P Ratio

Irrigation Season | if River TP 100 µg/L | if River TP 70 µg/L | if River TP 43 µg/L

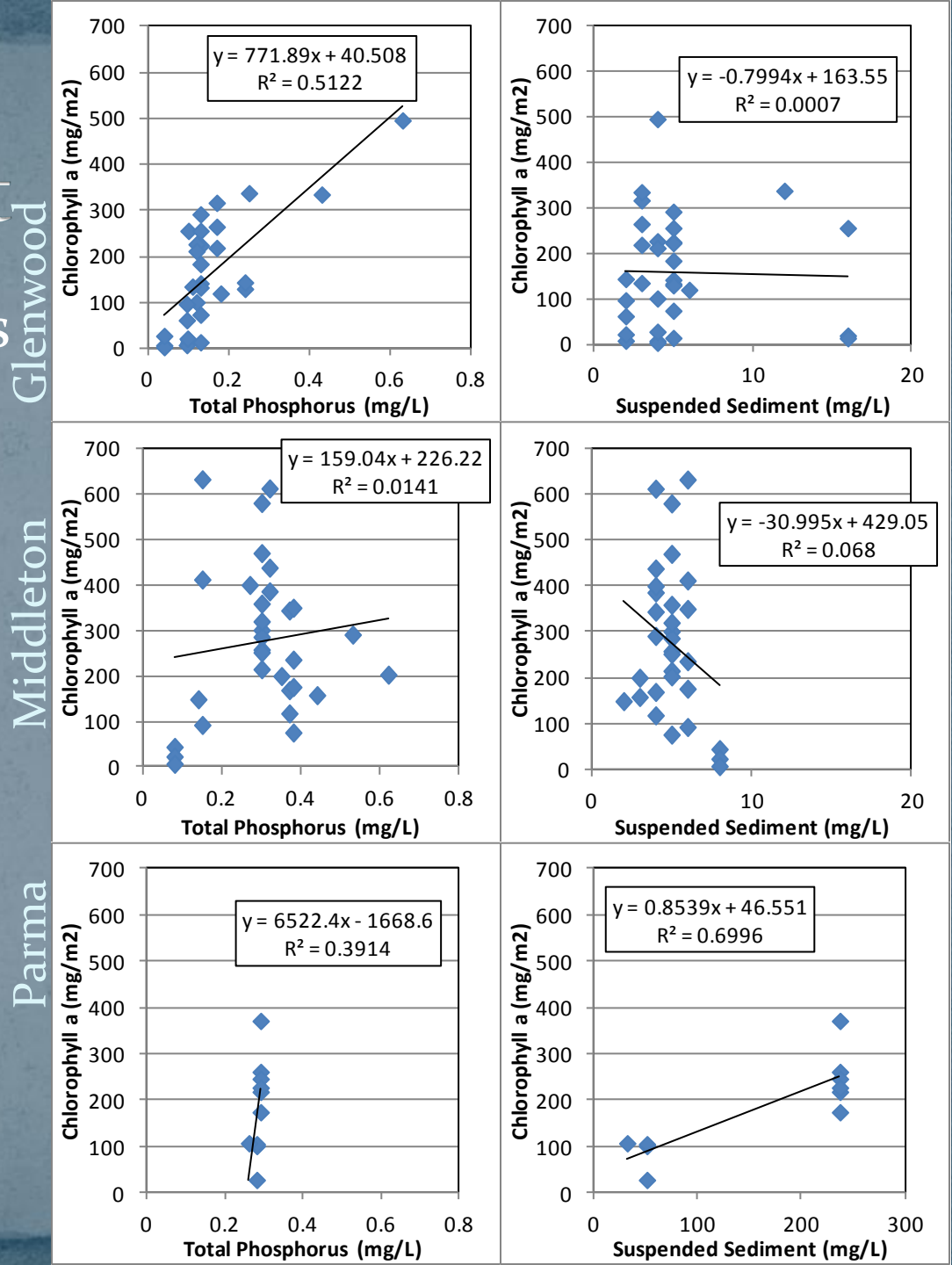


Non-Irrigation Season | if River TP 100 µg/L | if River TP 70 µg/L | if River TP 43 µg/L



Consideration: River Management

- Phosphorus reductions
  - TMDL TP values?
- Sediment reductions
  - TMDL TSS targets
    - 50 mg/L no more than 60 days
    - 80 mg/L no more than 14 days
- Nuisance Algae Growth Response?
  - No simple correlation



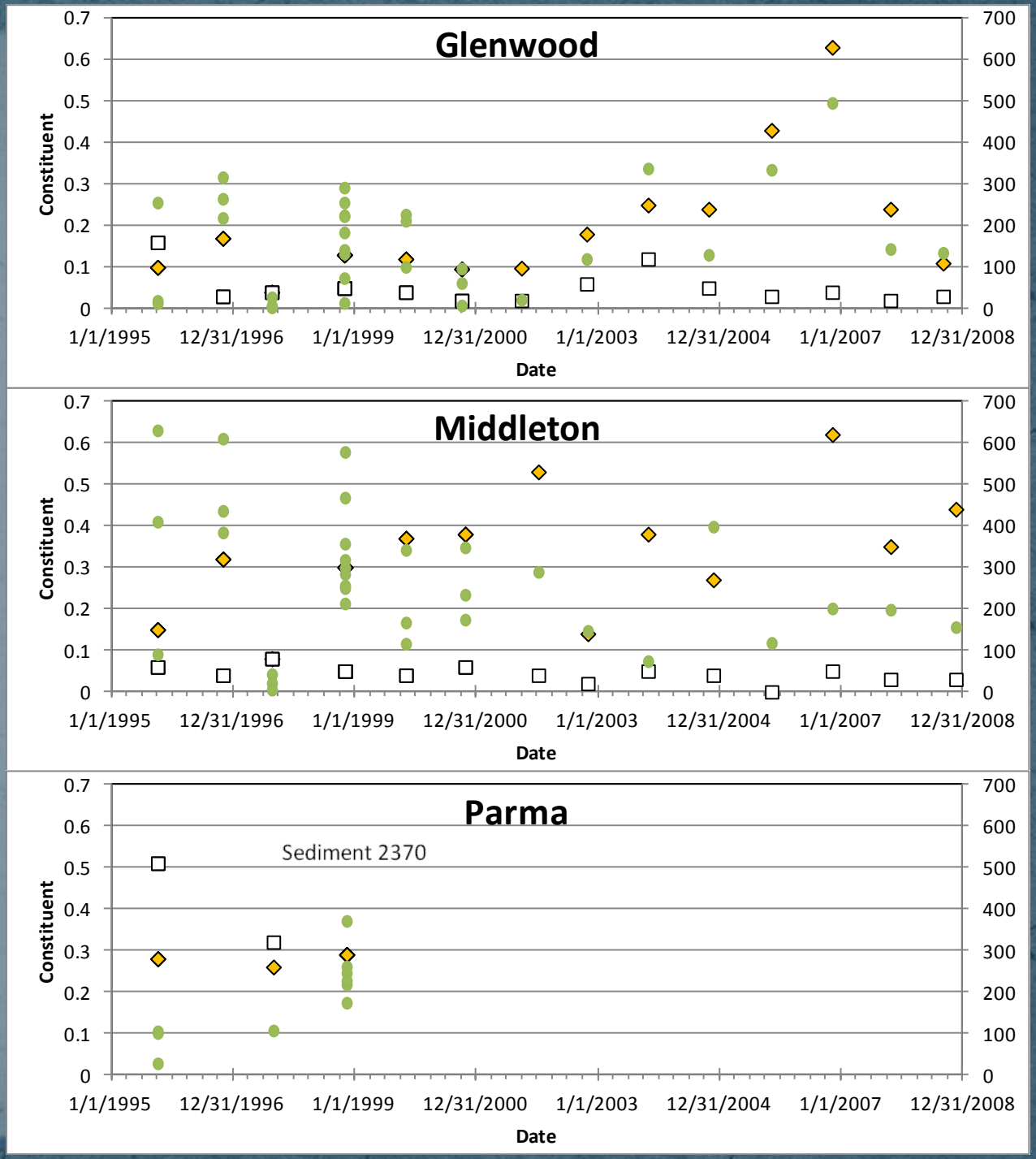
Data Cont'd

- Times Series

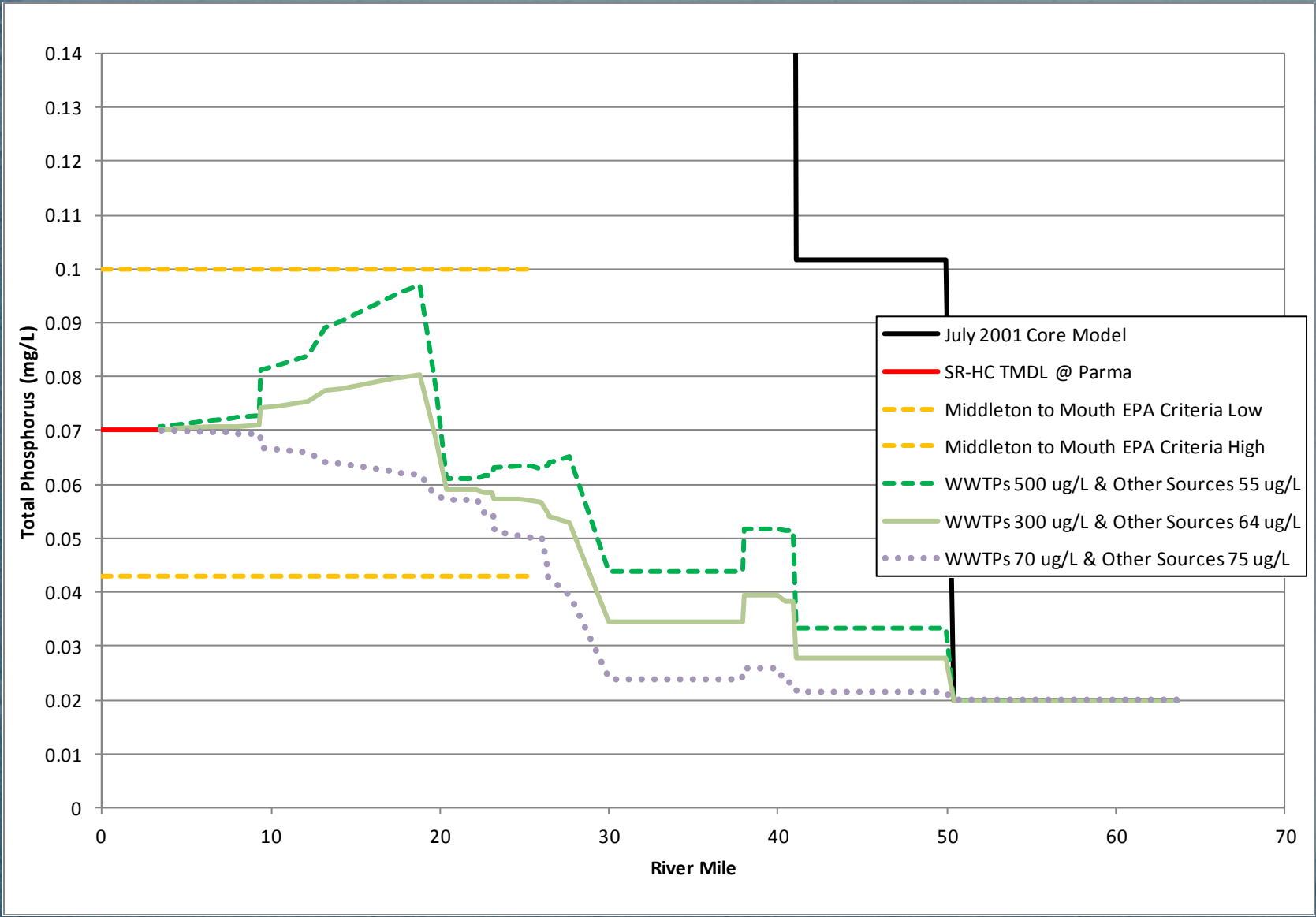
◆ Total Phosphorus (mg/L)

□ Suspended Sediment (mg/L) x10

● Chlorophyll a (mg/m2)



Core Model with Scenarios July 2001 Model



AQUATOX Model with Scenarios July 2001 Results

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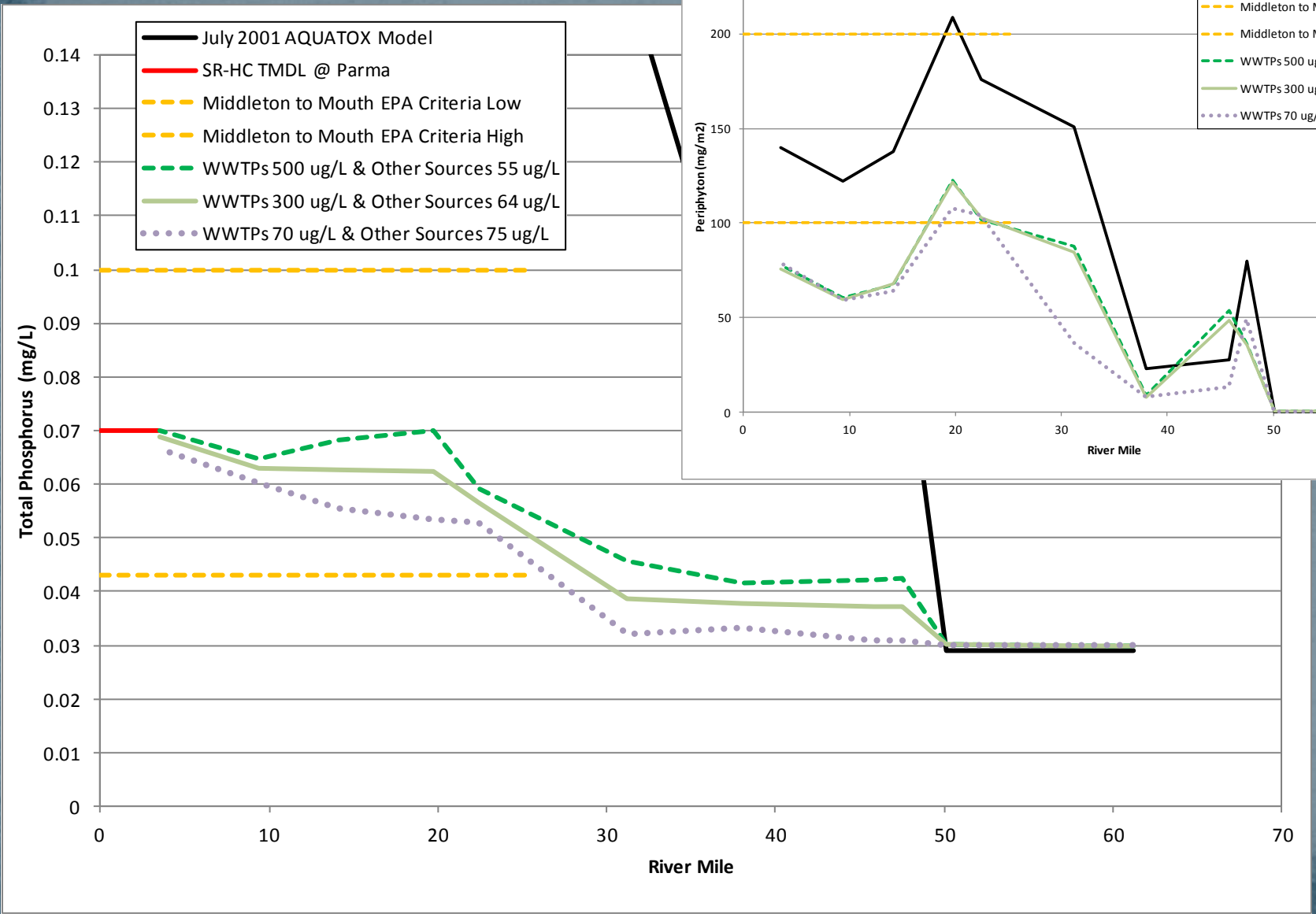
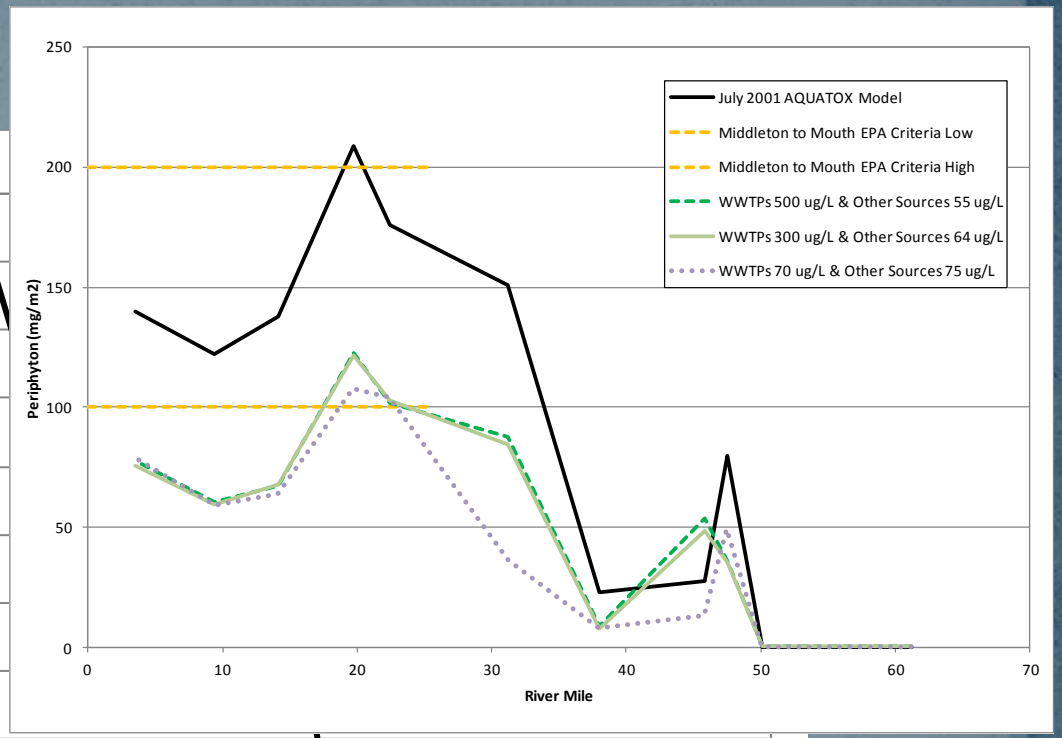
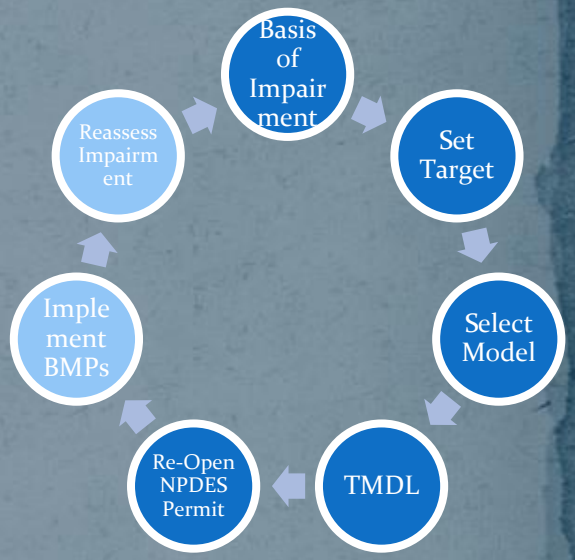




Next Steps?

- Long term management vision for the Boise River
- Select interim target(s) (Fall 2012?)
- Select modeling tool(s) (Winter 2013?)
- Select management scenarios (Winter 2013?)
- Assess compatibility of
  - Target to Beneficial Use
  - Beneficial Use to Understanding of River
  - Understanding of River to Model Representation
  - Representation to Management Scenarios
  - Management Scenarios to Targets
- Iterate until draft TMDL allocations (Fall 2012 through Fall 2013)



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Stepping stones to establishing water quality goals

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- What is it that we are trying to accomplish? (Target)
  - Phosphorus concentration?
  - Algae density?
  - Macrophyte index?
  - Habitat?
  - Fishery or recreation?
  - Other?
- When trying to achieve conditions? (Target Monitoring)
  - Seasonally?
  - Flow conditions?
- Where are we right now and according to who? (Data & Assessment)
  - Data on river water quality conditions
- Where are we going and how will we know when we get there? (TMDL)
  - How can progress be tracked so that adaptive management approaches can be used to adjust and improve?
  - Continue moving in positive direction
  - Provide incremental steps for reductions with achievable goals and structure in TMDL to not result in over-specified restrictive effluent limitations