Proposal Presentation
Oklahoma Scenic Rivers Joint Phosphorus Criteria Study

Joint Study Committee
February 5, 2014 11:00am
Tulsa, OK

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UT

PhycoTech, Inc.

MU

Portland State UNIVERSITY

Joint Study Committee

Quality Assurance	Project Manager	Project Director
Julie Caprio, MA, MBA	Chris Zell, PH	Adrienne Nemura, PE

Technical Leads

Experimental Design	Data Analysis	Stressor Response	Modeling	Data Collection
Chris Zell, MS	Marc Leisenring, PE	Song Qian, PhD	Rob Annear, PhD	Randy Crawford

Aquatic Ecology	Laboratory
Steve Layman, PhD Yangdong Pan, PhD	John R. Jones, PhD Daniel Obrecht (Nutrients) Ann St. Amand, PhD, CLP (Algae)

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Team Collaboration

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- "Review of Connecticut Methodology to Establish Phosphorus Limits for Municipal POTWs" (see Statement of Qualifications, paper #1)
- Water quality uncertainty analysis

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- Nutrient lake management plan in Washington state

- Publications and conference proceedings

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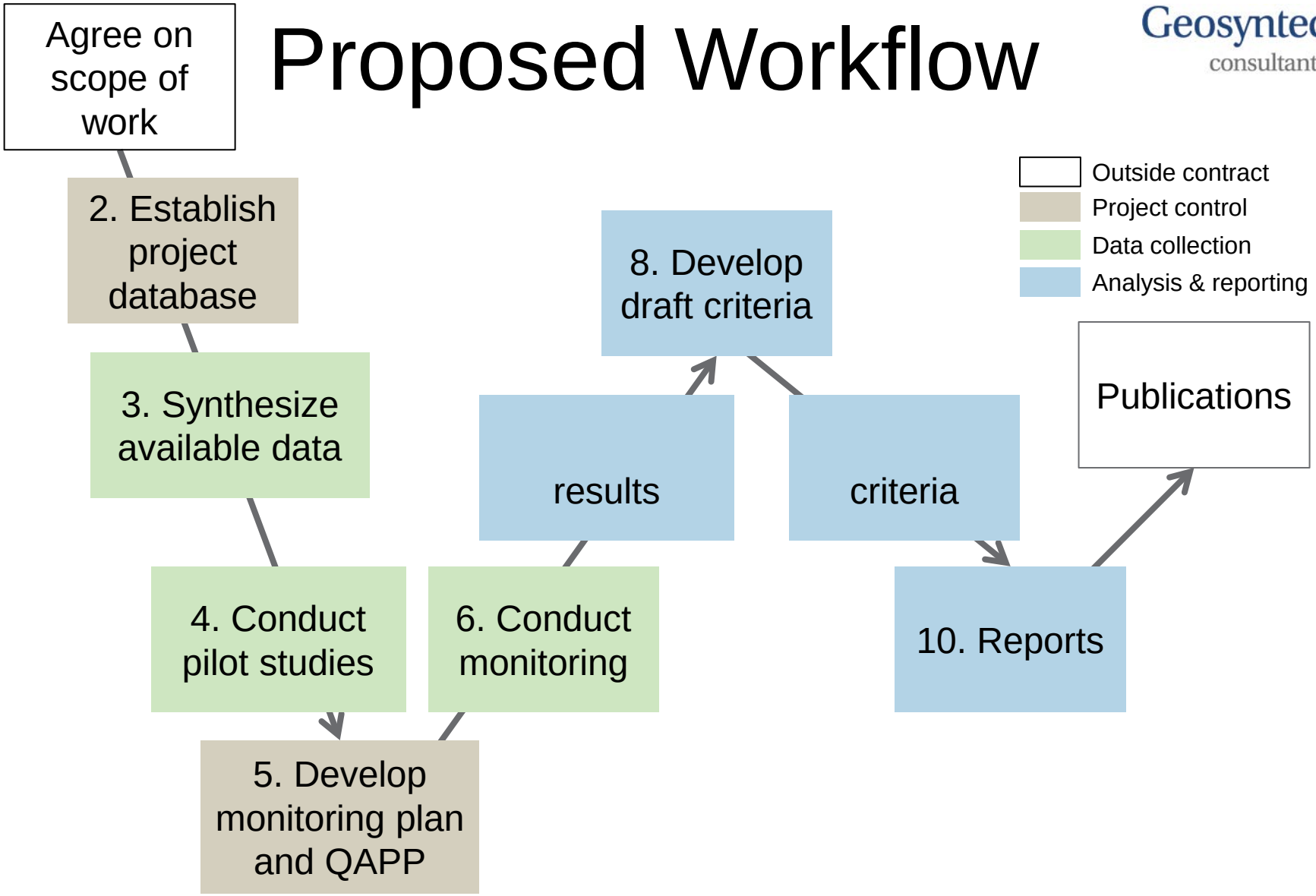
- Two-Mile Prairie Stream Evaluation, Ozark Plateau, Missouri

- Statewide Lake Assessment Program, Study of Temporal Patterns in Northern Missouri Reservoirs

Proposed Workflow

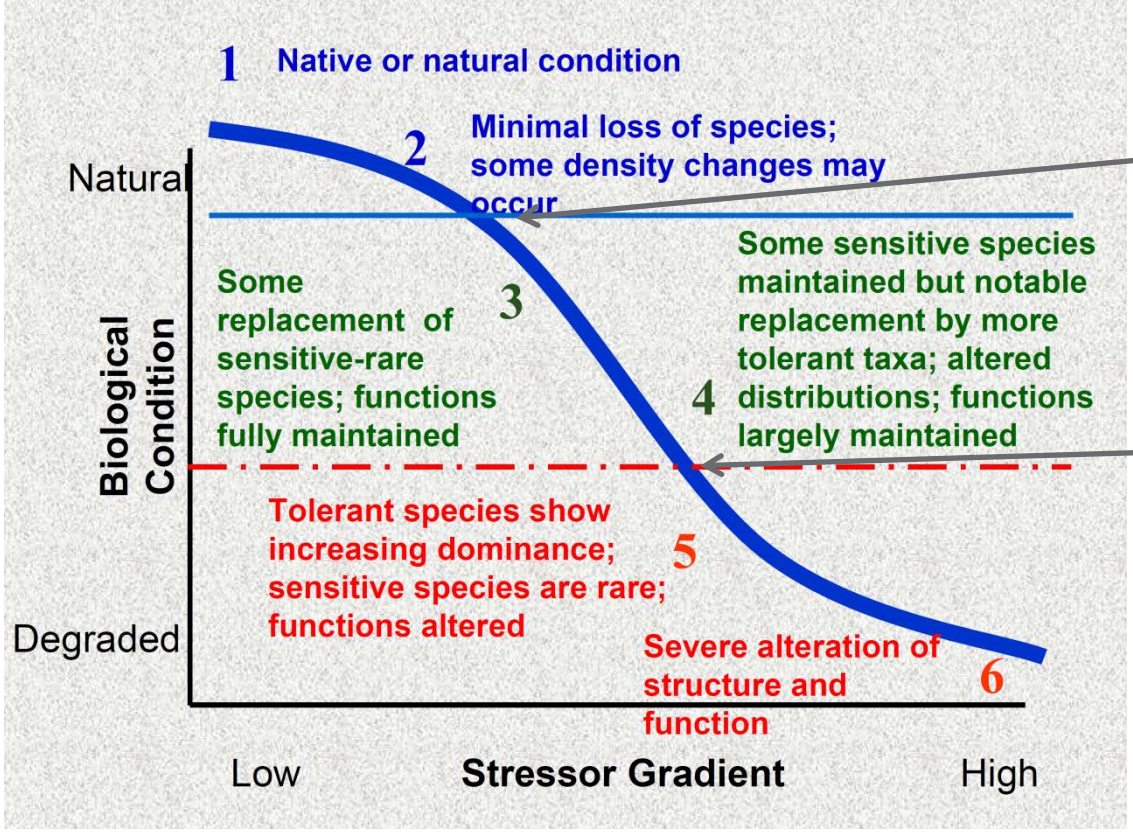


Available Approaches

Mesocosms	Advantage - direct manipulation of nutrient regime can be used (theoretically) to derive all criteria components. Disadvantage- (1) set-up time is costly, especially w/replication (2) may not represent field conditions (nutrient form, pulse vs. continuous [N] supply, long stabilization time, difficult to control all confounding variables).
Statistical Threshold Analysis (also applies to most methods included in EPA Stressor Response Manual)	Advantage - transparent means of identifying shifts or changes in response to perturbation or stress. Disadvantage- (1) typically produces magnitude component only, (2) change point is influenced by model form, (3) a mathematical change point may not be biologically meaningful.
Process-Based Modeling	Advantage - reliable means to produce all three criterion components following calibration and scenario modeling. Can be refined over time, used to orient future research, and couple with TMDL model. Disadvantage- (1) simulation typically limited to biomass, (2) can be resource intensive,(3) can be viewed as too complex by stakeholders

Scope will Depend on Key Questions

- Biological condition to be protected?
  - Scenic River (antidegradation)
  - Beneficial use attainment



From (Davies 2002)

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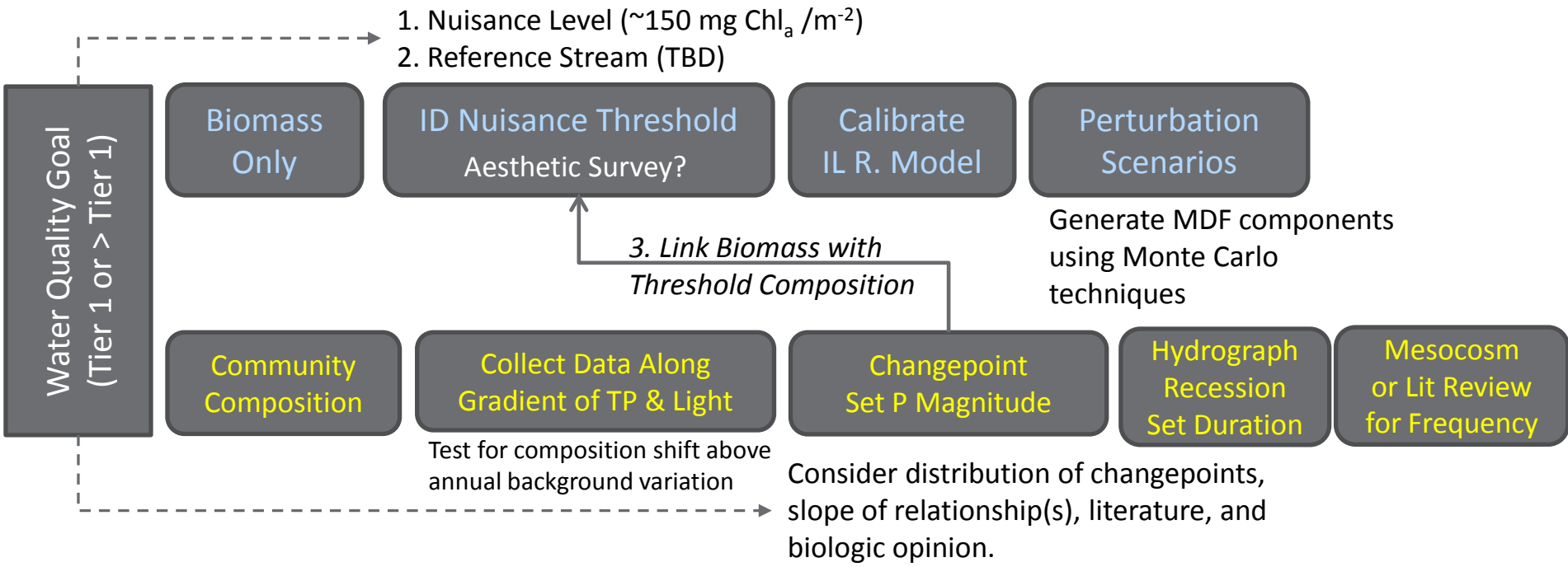
Technical Approach Pathways

Balanced Preliminary Approach

Most Reliable (less research risk)



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Key Questions (2)

- Appropriate measure of response to phosphorus?
  - Joint Study principles focused on algal response
  - Algal community composition
  - Nuisance biomass
- Advise committee on appropriate phosphorus criteria
  - Magnitude (frequently derived)
  - Duration (less common)
  - Frequency (mostly theoretical)
- Help identify state assessment procedures and expectations
  - Best way to assess compliance with criteria and sampling procedures
  - Response time and hysteresis, bistability and reversibility will inform this

Conceptual Approach (Preliminary)

- Discuss key questions with committee and develop scope of work
- Collect additional information to address some questions about species composition and biomass
  - Broad-based sampling design
  - Incorporates one or more analysis methods
- Evaluate information to identify
  - Potential change points
  - Potential relationships (e.g., correlate biomass with changes in composition; statistical relationships to identify shifts in magnitude)

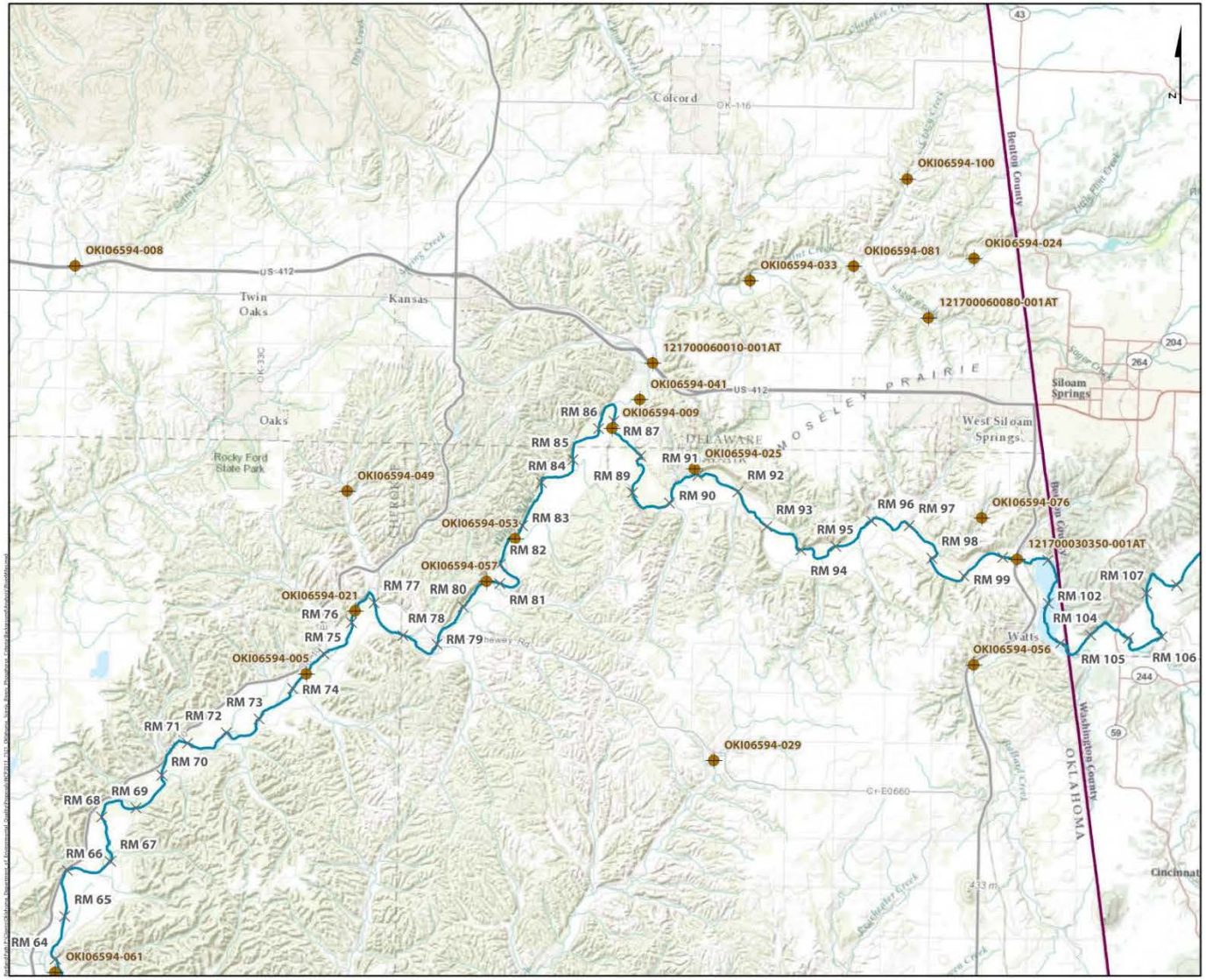
Conceptual Approach (2)

- Identify 4 study reaches
  - Existing data, supplement with pilot study
  - 2 nutrient regimes (low, high)
  - x 2 light regimes (shaded, unshaded)
- Baseline sampling (twice a month for 1 year)
- Wet-weather (minimum of 1 event per reach)
  - net growth rates, duration component
- Optional - discrete nutrient source manipulation using mesocosms
  - rate of recovery following source removal, frequency component, reversibility

Conceptual Approach (3)

- Attached (benthic) and suspended algae
  - Benthic: species composition and biomass
  - Suspended: collect and preserve
- Statistical analyses to
  - Evaluate potential change points along Biological Condition Gradient
  - Correlate biomass with changes in species composition
  - Select magnitude of proposed criteria
- Modeling of biomass to inform frequency and duration

Example Data Analysis for Reach Selection



Notes:
1) All features shown are approximate
2) Base maps provided by ESRI
3) Illinois River centerline data from USGS National Hydrography Dataset (http://nhd.usgs.gov/data.html)

Legend

- Monitoring Station
- River Mile Marker
- Illinois River Centerline
- State Border

2 1 0 2 Miles

Illinois River Overview
Eastern Oklahoma and Western Arkansas

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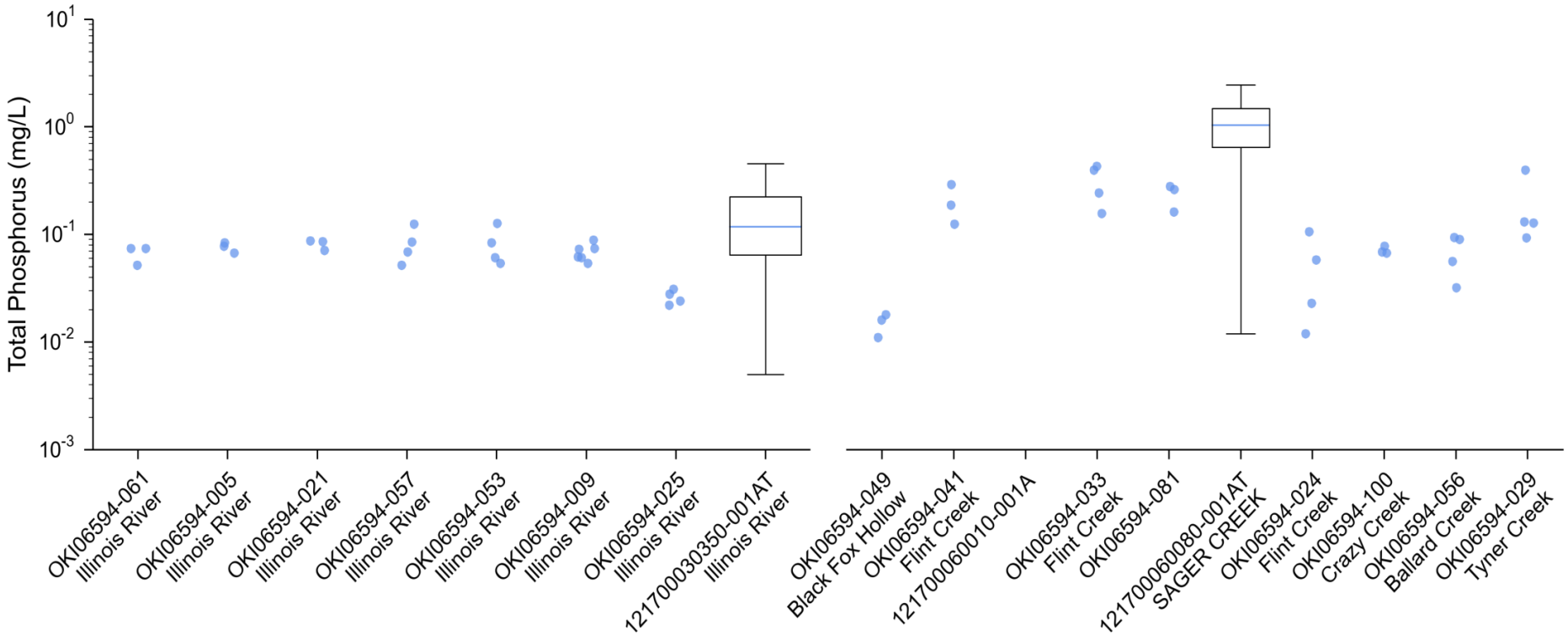
Portland, OR | 31-Jan-2014

Figure 3 of 5

Nutrient Concentrations in the Upper Illinois River and Tributaries



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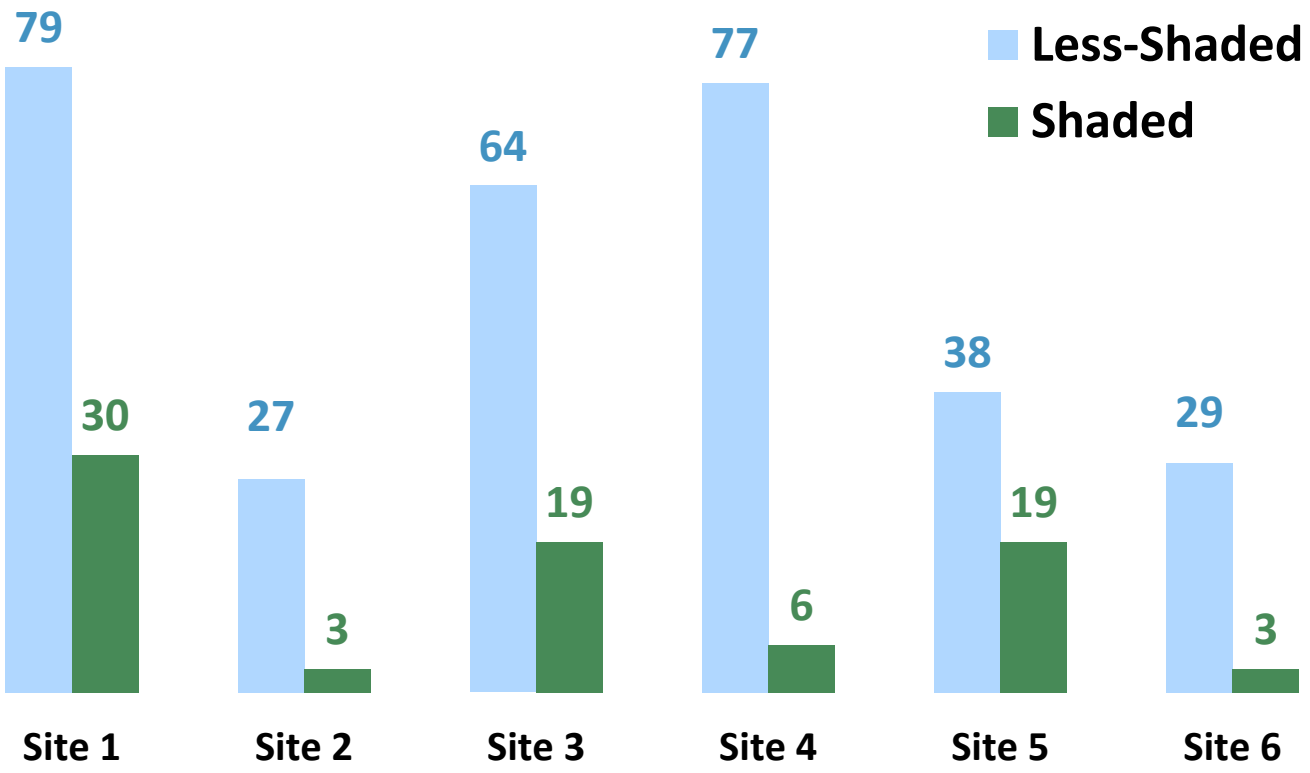
Why Shading Matters

Arkansas Ozarks Example

Geometric Mean Chlorophyll-a, milligrams per square meter



From Geosyntec (2012)

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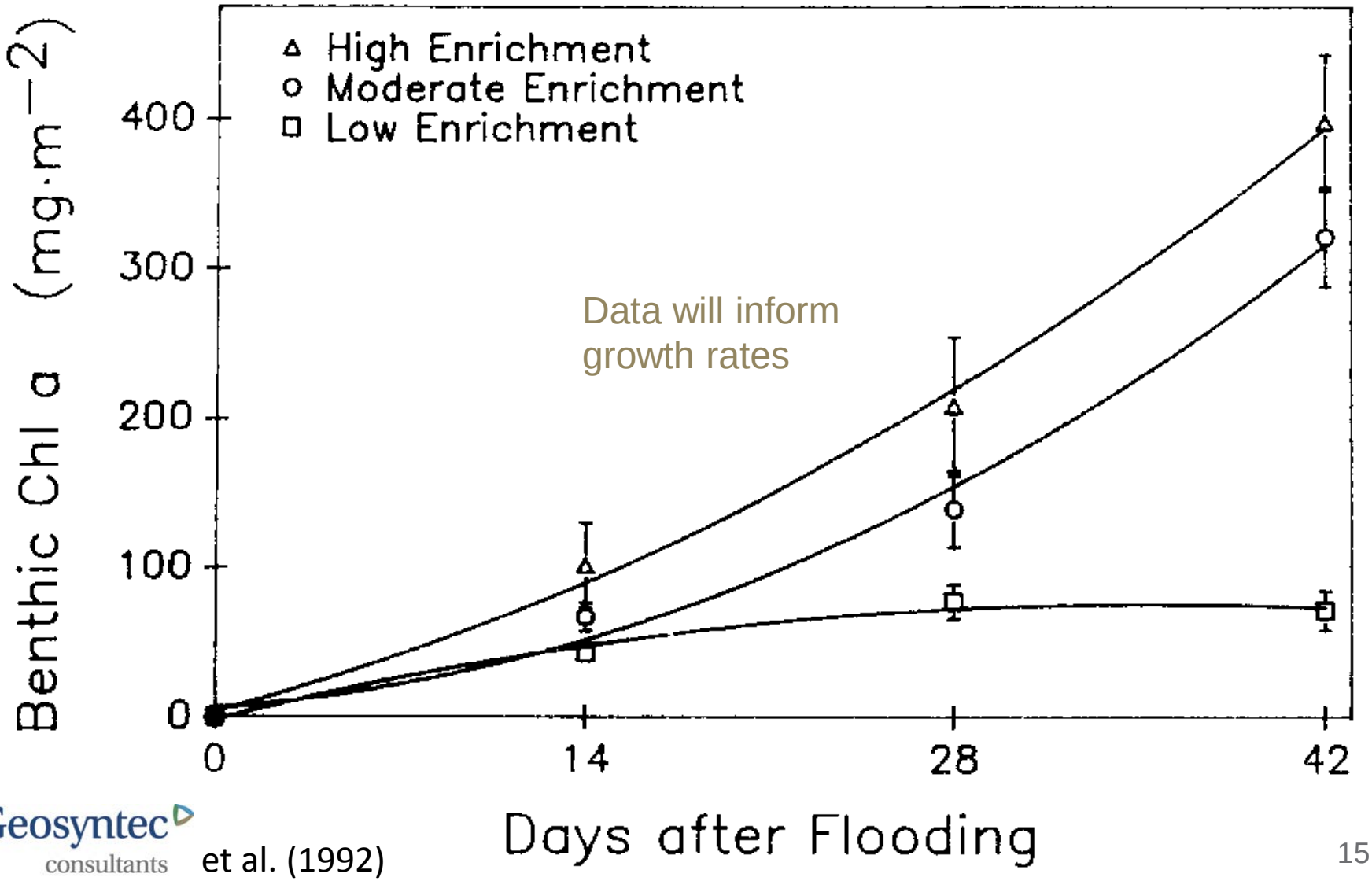
Why Wet Weather is Important

Missouri Ozarks Example



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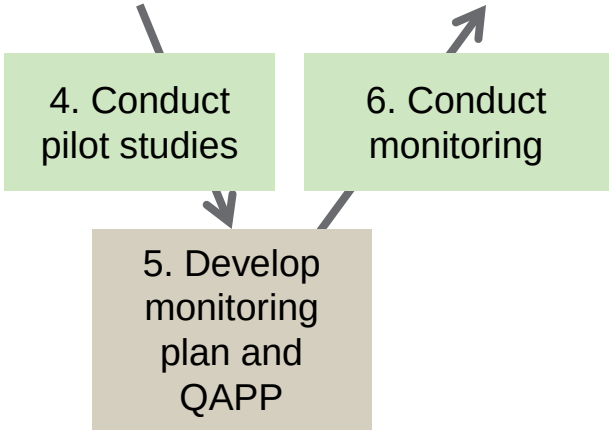
et al. (1992)

Recommended Monitoring Program

Field Program

- Grab sampling for baseline
- Discrete aliquot autosampling for wet-weather events
- Continuous level
- Dissolved oxygen, Temperature, Specific Conductance, pH, Streamflow, Photosynthetic Active Radiation
- Field periphyton, shade, and hydrogeometry surveys

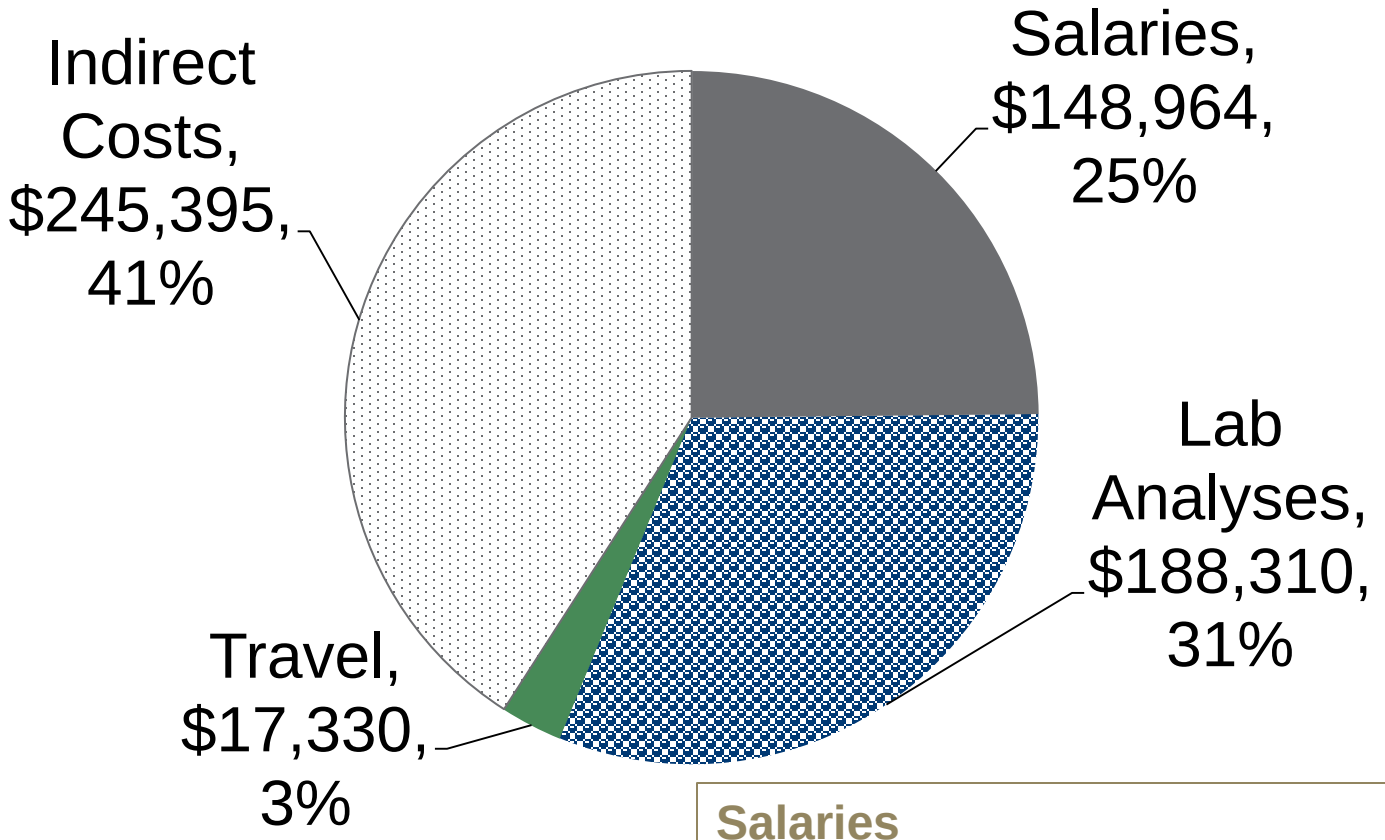


Laboratory Parameters

- Algal community, biovolumes, AFDW
- Nutrient stoichiometry of benthic algae DW
- Total phosphorus (TP)
- Soluble reactive phosphorus (SRP)
- Total nitrogen (TN)
- Nitrate-nitrite (NO23)
- Ammonia (NH4)
- Total suspended solids (TSS)
- Dissolved organic carbon (DOC)
- Chlorophyll-a, planktonic
- Chlorophyll-a, benthic

Preliminary Generalized Budget

Total Project Budget = $600,000



Salaries
Geosyntec staff = $92,964
Subs = $56,000

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Preliminary Generalized Budget by Task

Task	Salaries	Lab Analyses	Travel	Indirect Costs	Total
1. Mgmt, rpting, comm.	$ 9,118		$1,811	$22,548	$ 33,477
2. Project database	$ 4,126			$10,150	$14,276
3. Synthesize avail. data	$ 9,334			$10,571	$19,905
4. Pilot studies	$12,230	$28,360	$3,654	$16,235	$60,479
5. Monitoring plan/QAPP	$17,696			$15,213	$32,909
6. Monitoring	$31,754	$159,950	$11,865	$87,305	$290,875
7. Synthesize results	$16,559			$19,201	$35,760
8. Draft criteria	$22,897			$25,059	$47,956
9. Refine criteria	$ 7,203			$8,870	$16,073
10. Reports	$18,048			$30,241	$48,289
Total	**$148,964**	**$188,310**	**$17,330**	**$245,395**	**$600,000**

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Project Schedule

	2014									2015													2016												
	Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
NTP																																	
1. Quality Management, Project Reporting and Communication																																	
2. Establish project database																						7. Synthesize Results											
3. Synthesize available data																									8. Draft Criteria								
		4. Conduct pilot studies								6. Conduct monitoring																	9. Refine Criteria							
		5. Develop monitoring plan & QAPP																												10. Reporting				

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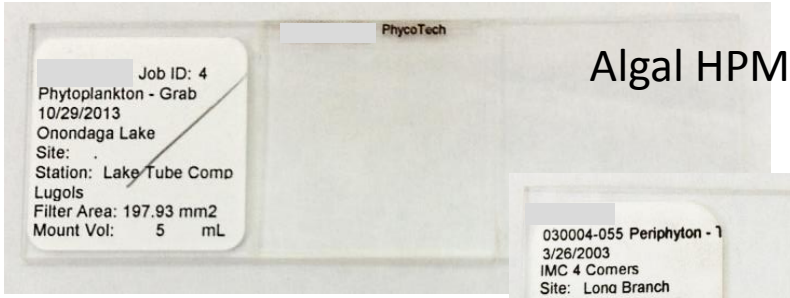
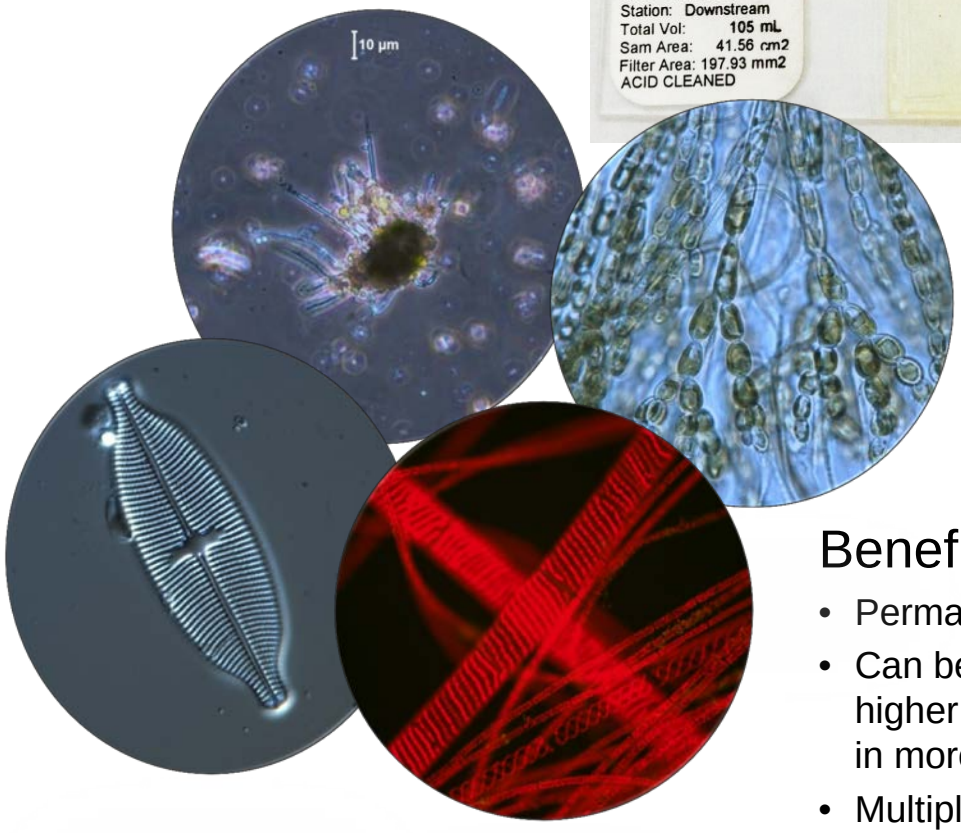
Archiving Samples Allows for Subsequent Analyses for Emerging Approaches



Algal HPMA 25 mm Mount

eaned Naphrax Mount



cro-algae 47 mm
HPMA

Benefits:

- Permanent archive (100+ years).
- Can be processed on a compound microscope, allowing higher resolution, and use of auto-fluorescence which results in more accurate data.
- Multiple sub-samples (3) more easily prepared and analyzed.

University of Missouri Limnology Laboratory

- **Total Phosphorus** – Spectrometric color analysis following oxidative digestion
- **Total Nitrogen** – 2nd derivative spectroscopy following oxidative digestion
- **Chlorophyll** – Fluorometric analysis following extraction in ethanol

The MU Limnology Laboratory has been using these same methods for over 20 years. Analyzing thousands of samples in that time, including low-level nutrient samples from Alaska, Minnesota and Missouri's Ozark Streams.

Dr. Song Qian

- Environmental and ecological data analysis and modeling for research and management
- Will direct change point analyses

Leadership / Advisory Role:

T3. Synthesize available data

T4. Conduct pilot studies

T5. Monitoring plan and QAPP

T7. Synthesize results (monitoring and modeling)

T8. Draft criteria

T9. Refine criteria

T10. Reports

Dr. Yangdong Pan

- River aquatic ecologist expert
- Periphyton and field study expert
  - Use of algal assemblages to monitor and assess
    - Ecosystem response to nutrients
    - Ecological risk
  - Leading role in EPA surface water quality programs
    - Algal indicators development

Advisory Role:

T3. Synthesize available data

T4. Conduct pilot studies

T5. Develop monitoring plan & QAPP

T7. Synthesize results (monitoring and modeling)

Our Team is Committed to Continued Research and Publications

Geosyntec Features	
Total technical staff	939
Adjunct faculty	17 (2%)
PhDs	150 (16%)
Masters	484 (52%)

- Research panels
  - NRC committees
  - EPA peer review committees
  - State committees
- Environmental textbooks
- Peer-reviewed publications

Personnel	Features
Song Qian, The University of Toledo	Textbook on environmental & ecological statistics; 60 publications, 20 proceedings & book chapters
Jack Jones, Missouri University	125 publications Editor of Inland Waters – peer reviewed journal of the International Society of Limnology
Ann St. Amand PhycoTech	28 publications JTG Chair, Plankton Section, Part Coordinator, Part 10000, Standard Methods Counted over 33,000 samples
Yangdong Pan, Portland State University	40 publications, 12 with R.J. Stevenson

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In Closing…

- Collaborative team focusing on advancing environmental science and regulatory decision-making regarding nutrients
- Emphasis on in situ data collection for stream specific phosphorus criteria
- Experienced personnel conducting the laboratory analyses
- Early and often quality assurance and project planning and communication
- Commitment to delivering work product on time and within budget
- Commitment to delivering peer-reviewed publications

Extra Slides If Needed

Criteria Derivation Approach

Office of Water
Mail code 4304T

EPA-820-S-10-001
November 2010

Using Stressor-response Relationships to Derive Numeric Nutrient Criteria

- Limited to magnitude component
- Duration & frequency are elusive

Criteria Derivation Approach

- If algal composition:
  - Magnitude via statistical change points
  - Duration and frequency via disturbance data and literature review
- If biomass:
  - Literature is more mature
  - Same as above, but modeling can be used!
  - With minor modification, our preliminary approach could support derivation via numerical modeling

The Value of Modeling

- 'What if' scenarios, normalization to confounding variables or processes
- Component and sensitivity analyses
  - what are the drivers for biomass?
  - attenuation coefficients
- Once calibrated, arguably the best tool for deriving duration and frequency components
  - Monte Carlo engine for nutrient inputs (including timing)

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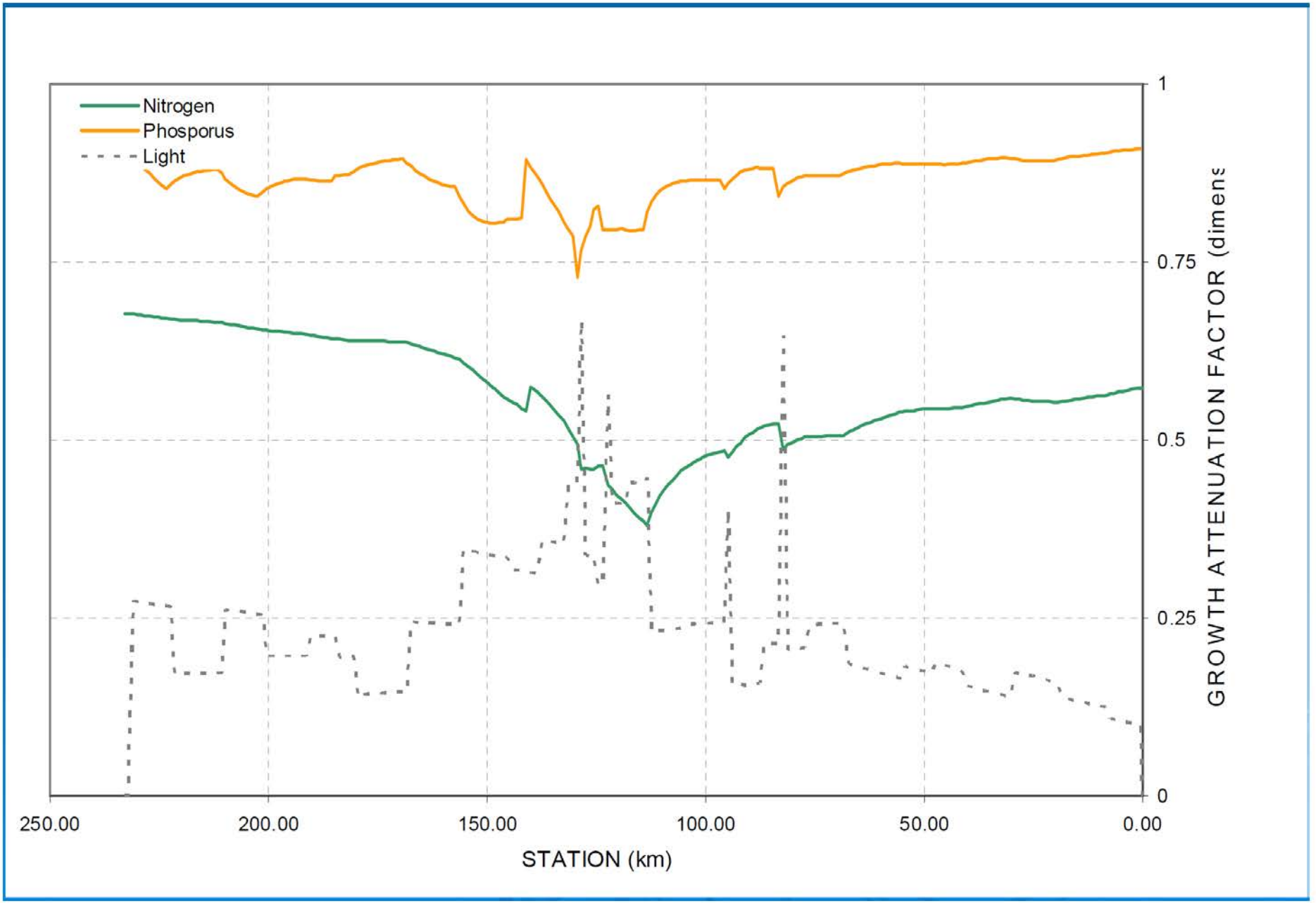
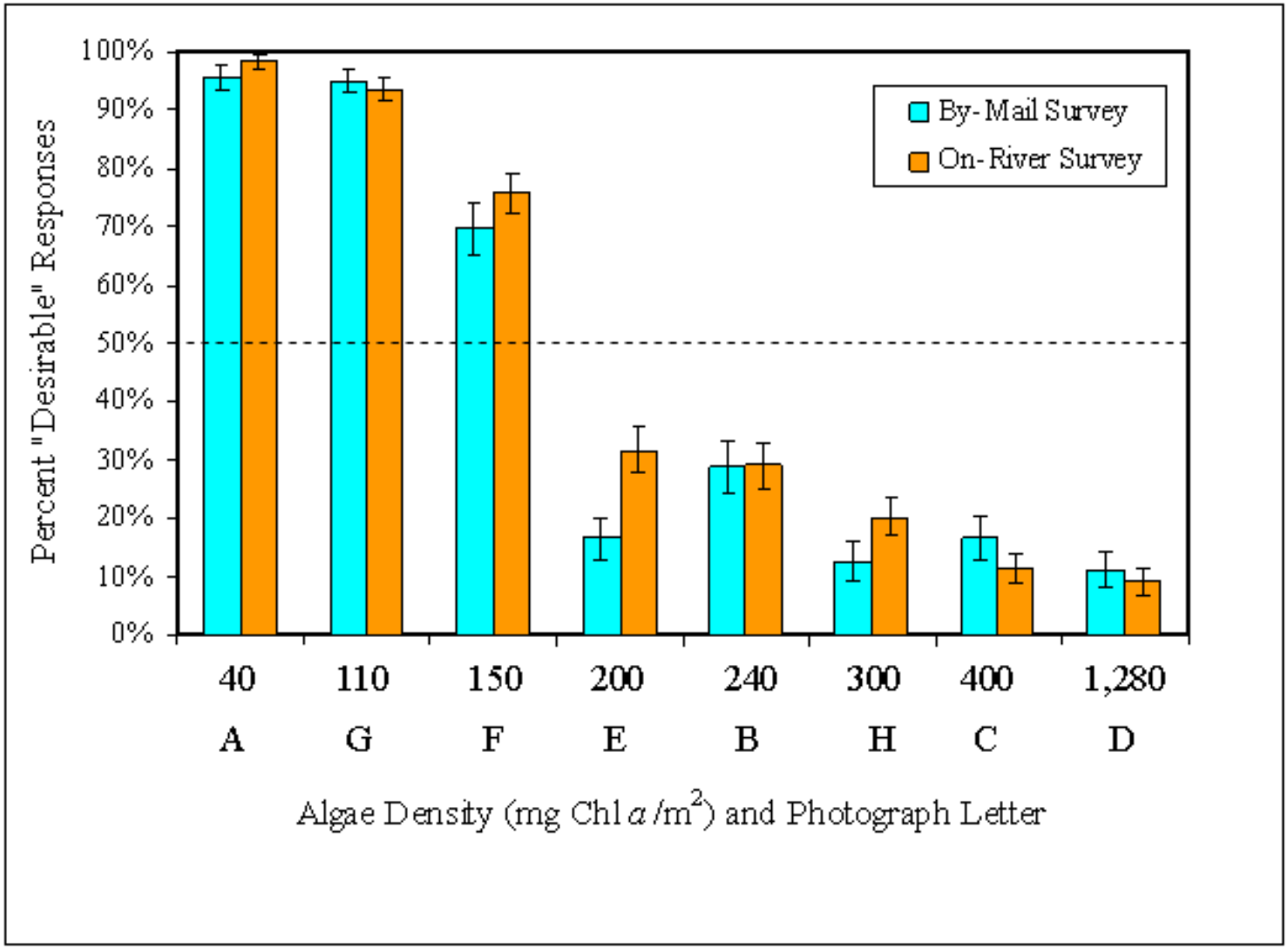


From Flynn and Suplee (2010)



Example of Aesthetic Perception Survey From McKee et al. (2007)

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