Joint Scenic Rivers Committee
February 5, 2014
9:00
Tulsa Community College Northeast Campus
Boardroom 1315, Main Academic Building
3727 East Apache Street
Tulsa, Oklahoma 74115

I. Call to Order and Approval of Minutes

TIME: 9:00
HAGGARD called to order and roll call

Members Present:

Arkansas Representatives	Oklahoma Representatives
Brian Haggard (HAGGARD)	Shellie Chard-McClary (CHARD-MCCLARY)
Marty Matlock (MATLOCK)	Shannon Phillips (PHILLIPS)
Thad Scott (SCOTT)	Derek Smithee (SMITHEE)

See sign-in sheet for public members present which is ATTACHMENT 4 to the minutes.

CHARD-MCCLARY presented minutes
MATLOCK requested minor typos be corrected

- **MOTION 1: To approve minutes as presented with the typographical errors corrected.**

Representative		Yes	No	Abstain	Absent
Shellie Chard-McClary		X			
Brian Haggard		X			
Marty Matlock	Motion	X			
Shannon Phillips		X			
Thad Scott	Second	X			
Derek Smithee		X			

Approved minutes and sign in sheet to be provided to PHILLIPS to be scanned and uploaded to the website

II. Interview of Selected Finalists

Walter Dodds/Kansas State Team

SCOTT due to weather Walter Dodds (DODDS) will call in.

DODDS on the telephone with HAGGARD advancing PowerPoint slides.

DODDS thanks the committee for allowing him to be part of this important process. Special thanks for allowing him to call in due to the significant snow

storm in Kansas. He has to ski in to the university this morning to make his presentation due to the weather conditions.

See presentation slides ATTACHMENT 1 to the minutes

The following is a summary of the information provided:
DODDS will use Sparrow models which allows for accounting for conditions downstream including land use and land cover. This is a method he developed. He will also use reference streams, if they can be found.

He will obtain information from USGS where available.

He will review and cull existing data and use where appropriate.

He reminded the committee of the existing Level III eco-regions for National Nutrient Strategy. This is Eco-region 11 and 9 which are very different eco-regions. This will impact baseline values.

DODDS pointed to a paper published by Oaks/Dodds which contained a graphic to illustrate the statistically significant impacts versus P. This information is from Kansas but this will be used to determine reference values. One weakness is extrapolating to get values.

Sparrow Model shown indicates 2 light areas which are watersheds in question. The gray is Arkansas River. This suggests 0.037 is sort of in the range of what to expect.

A brief discussion of the EPA stressor response model indicating the key factors are: response variables; algal mass; biodiversity; algal will be primary focus and invertebrate diversity will be included; the water quality concerns will be Oxygen excursions and pH; and then finally the productivity of the whole stream metabolism.

Important elements of the study will include the temporal and spatial grain of sampling, how frequent to sample; how to determine that frequency; the statistical analysis; necessity if increased intensity of sampling during critical times (summer low flow, extreme wet weather); and using existing sampling sites to gain additional data.

There is a lot of good USGS stream data; flood frequency, morphological data that can be considered.

The response variables threshold below no significant response would be evaluated. The threshold above conditions in these rivers similar to other areas would be considered.

The relationship algal biomass and nutrients has to be evaluated. The interaction between N and P is important. If you can't get P below a certain point, there will be no improvement. That range in general is 50 - 100

microgram/liter. The relationship is interactive. If N is high as well that is where public sees impact which is in the range of 100 micrograms/liter

If the relationships are linear it will be easy to set criteria. The reality demonstrated by the previous graphic, the using of regression prediction bands will be used. Likely between 180 and ?

Best case will use multiple methods to complete analysis and to make a recommendation.

He will also use other sampling like snails, grazers, rock rollers etc. It will be important to keep the hydrology in mind.

It is important to address the "Luxury" P. In the work for Kansas, it indicated 80% P runoff occurred in spring. Algae can store P during the times of excess P and continue to grow in later months. P can deposit in calcareous and release it later; pH conditions will impact; it will be rereleased into the water during low P times; this has been verified in everglades.

Proposed sampling would consist of 30 sites on the Illinois River; 8 on the Mountain Fork; will talk with committee to make sure it is balanced and appropriate.

He will reference Jan Stevenson's papers and will increase number of samples just in case there is a problem.

He will focus on diatoms and create an index of sensitive /less sensitive species. There will be an evaluation of the metabolism and DO. He will evaluate the invertebrates.

The field and lab work was discussed with a reading of material from the slides which included the QA/QC processed to be followed, etc.

The anticipated ddeliverables were discussed as presented on the slides.

There is funding for peer reviewed papers and for students to attend scientific meetings. There is funding for his summer salary, students, equipment including microscopes and cameras, travel, materials and supplies for a total of $590, 566.

SMITHEE the Oklahoma scenic river criteria is based on 1st order to 4th order street; are you confident you can take that into account?

DODDS relied yes. The canopy cover will be important in smaller to larger. He will consider this and should have been clearer in his presentation.

SCOTT you made reference to using multiple techniques to study and analyze the data. Will you recommend a range? If so, how will you account for inflow?

DODDS stated that he will provide the range but will stay out of the politics of this issue. He will measure flow at the time of sampling. He will have to look at if the algae will suck up the P later. He will also need to see if the flow washes the algae off rocks, etc.

MATLOCK asked how the reconciliation of the reference and WQ standard will occur.

DODDS stated that he will go through this process and reference condition is 20 microgram/l; the response variable is higher than desired he can't do any better than the reference then ask question of what are you willing to accept; this is probability of exceedance over time; data will be provided and people will have to make decision

MATLOCK if you use a confidence interval of 40-75; assume 90% confidence interval of 40-75; this which of these numbers would be the number?

DODDS replied that he would look at upper number and see how much of the time there was an exceedance; make a plot to determine the percentage of time the criteria was met.

HAGGARD with 30 sample sites over multiple seasons, how will you get high flow values to get P flux?

DODDS answered that the load and flux is not has important as instream concentrations; you don't have to catch them; for nutrient criteria, if you have the downstream data. This was what happened in Clark work. Loads are not is key need flow. If you are interested in looking at the low flow summer period he will not put out samplers and sample during storms. The discharge response has been calculated in previous work. It doesn't always turn out the way you think it will. He will use USGS back ground data and it will be important to this study.

PHILLIPS this work applies to 5th order streams and the reference is 2nd or 3rd order system. How will you do this?

DODDS replied that he will use two ways. The Sparrow model with the accumulation approach which allows you to use land use/land cover data. The part of the work with Oaks was to look at riparian streams in order to look at 1st order streams. This may be less of the problem than what we think. Second, he will test with actual data which he thinks we can get.

SMITHEE commented about the use of confidence intervals around a threshold and how that influences determining a single value for a standard. He asked if the work proposed by Dodds was right in terms of the blind approach (i.e. not considering the existing 0.037 mg/L)

DODDS responded that his work would not consider the current standard. Rather, it is designed to let the science show what number(s) would be relevant.

CHARD-MCCLARY asked how likely is it that we can get to an actual answer to make recommendation(s).

DODDS said that he thinks there is enough money to get answer. He can do the science and give us the numbers and then it is s a science based review to make decision by the management agency.

HAGGARD thanked Dodds for his presentation.

Ryan King/Baylor Team

HAGGARD welcomed and thanked Ryan King (KING) for making the presentation and for being flexible to change the time of his presentation.

See presentation slides ATTACHMENT 2 to the minutes

KING thanked the committee for the opportunity to make the presentation and to be considered for the project. He reviewed the specific guidelines spelled out in the Second Joint Principles document.

To determine what is statistically significant and results in undesirable change will be a challenge. He was part of the review on the EPA guidance, so he will definitely conform to that approach.

He is planning a field gradient study for P. He has done P in stream studies in the past. He also plans to incorporate experiments with actual field data.

The sampling needs to occur frequently in order to develop an appropriate gradient. He wants to avoid the clumping of data. The study needs to find similar environments to sample and to leverage existing data.

Looking at land use/land cover will be important. He needs to make sure the information is in eco-region Highlands Level III. He will use 25 stream reaches as minimum.

The biomass in stream is difficult. Looking at peaks and averages requires a lot of measuring. At this point he is proposing to sample 12 times over 2 years at 25 or more sites. He will try to have enough samples to have good average and maximum values.

For the field study he will look at dissolved oxygen. He will target low flow conditions.

He discussed the field study including methods, laboratory algae studies and C to P ration changes in order to indicate changes in filamentous algae.

He is proposing to use experiments to replicate the conditions in the field. He might want to do whole stream enrichment...one of the states would have to allow it and it would take about 60 days.

For the study, he will use ISCO auto samplers, maybe 4 or so. He will control temperature, light, and static variables. He will use stream water and take it back to Baylor, add rocks in and see what grows. He will seed to allow growth and collect species data. He will use field based benchmark method.

He thinks using 2 methods we should get close to the same result which will give more validity. He said that EPA used this method.

He will look at metrics. If he can't really clearly find a change point this method helps with WQS "where things get crazy."

He will look at the weight of the evidence in the derivation of numeric criterion. He will be able to suggest a number and will work with the committee.

His proposed budget is primarily personnel. There is no charge for vehicles; indirect cost rate is 26.5% which he was able to negotiate down from the university's higher rate. Baylor has agreed to match any other lower indirect cost rate.

SMITHEE stated that KING's approach "blurs his vision." He sees a 3 prong approach rather than old school and wonders how do you do this? Was it woven in since it is easy to understand?

KING said that this it is to beef up the science and make it more robust. He says this allows us to get information that we can't get in field. By taking water from the actual stream and looking at in lab in the controlled study at BU we get more useful data under controlled conditions. The Stream Enrichment Project would be the best and will do as much as possible to make this project successful within the budget.

CHARD-MCCLARY please explain more about how the stream enrichment would work.

KING replied that he would identify 2 stream reaches that are as similar as possible. They would be monitored constantly. He would dose the stream with N and P. The field study would look at where there was no P but N was high and algae are almost the same as a reference. The effects on the water bodies will be short lived.

CHARD-MCCLARY asked if he thought the amount of money for the study was adequate to generate a good outcome.

KING thought it was very likely. He already has a lot of equipment purchased from previous studies that will be utilized in this study.

SCOTT asked King to explain how we reconcile spatial differences to come up with standard on a larger river.

KING replied that scaling up to a river is a jump but without replicating a 5th or 6th order tributary it is the only way a field study can be done. A flow weighted estimate will be done.

SCOTT asked how a flow weighted estimate would be accomplished.

KING stated that samples, models, and assumptions would have to be used. He continued that he and the committee will have to really think about and think through that.

PHILLIPS thanked him for his work to get a low indirect rate and then asked if all three approaches will be used or if he will he pick one or two.

KING stated that he would like to do all three but is willing to do whatever the committee wants. He thinks the whole stream enrichment would be ideal but it will need to be a small area.

PHILLIPS asked if he was proposing to include other watersheds or only the Illinois River.

KING stated that he would consider the others watersheds as well and would work with the committee.

MATLOCK think the threshold of the P response is the key question. How much P is reasonable in these watersheds?

KING the amount of algal biomass has to be looked at. There are real numbers that represent real undesirable outcomes.

MATLOCK asked do you select based on your confidence interval.

KING stated that he would go with the lower end because that is where things turn into a problem.

HAGGARD asked if other contaminates would be separated out.

KING stated that yes; his study would separate algae from sediment. Algae could store P and see how it responds when P is not available in the water body.

Geosyntec

HAGGARD introduced Adrian Nemura (NEMURA) and Chris Zell (ZELL) from Geosyntec to make the presentation for their team with Song Qian on telephone.

See presentation slides ATTACHMENT 2 to the minutes

NEMURA stated that their team consisted of consultants and academics and that they had reviewed the methods and process used by several other states.

NEMURA described the workflow that the Geosyntec teams plans to utilize for this project. Task 3, the synthesis of available data is the most critical task.

NEMURA stated that they will look at mesocosms, statistical threshold analysis and process-based modeling. They will look at answering the question of "what is the condition the criterion seeks to protect?" They will have to determine if it is just the designated beneficial use or something else.

NEMURA described the technical approach they intend to use. They may have a public protection survey discussion at end. The 30 day average will be important since that is how long it takes to reach objectionable conditions.

NEMURA said there are key questions related to duration and magnitude of any rain even and they must determine how to judge compliance with criteria.

ZELL discussed the conceptual approach including change points; 4 study reaches in 2 streams, one with low and one with high nutrients; 2 samples each month for 1 year; and 1 wet weather event to be sampled.

ZELL said that they will collect benthic and suspend algae and perform statistical analysis followed by modeling.

ZELL discussed nutrient concentrations in the Illinois River and tributaries.

ZELL stated that shading levels impact results. Light is key.

ZELL discussed the impact of the magnitude and duration of wet weather.

ZELL discussed the monitoring program including both field and lab process. He stated they will look at N, P or if both appropriate.

NEMURA stated that the budget and schedule is hard to set at this point. The project can move forward quicker based on QAPP approval.

SMIITHEE commented that their presentation was very general and conceptual. He said that the standard applies 1st order up to 5th to 6th order and wanted to know what the Geosyntec vision would be.

ZELL stated that it is scalable and they would likely use a model.

NEMURA said she did a lot of models in the Chesapeake Bay.

HAGGARD stated that they were involved in the Chesapeake Bay activities and models. He continued to say that people like to poke holes in models and that he personally didn't see a lot of success in the models. He wanted to know how Geosyntec will help the committee get where we need to be and communicate the confidence level of the model(s).

NEMURA said that not all types of models were appropriate for load reduction. She continued on by saying, "all models are wrong but some are useful." She said you have to set the error bars correctly.

CHARD-MCCLARY asked about the proprietary method referenced.

ZELL responded that it is no longer proprietary and that it is now contained in Standard Methods. He meant to indicate that this method was specifically designed by a Geosyntec team member.

CHARD-MCCLARY asked if the amount of money available for the study was adequate to generate a good outcome.

NEMURA said that it was enough to study the environmental impacts.

ZELL added that he thought the approaches they would use should get a completed study with an acceptable result.

SCOTT asked about the study approach and what techniques they will use and about the relevancy of the generated data.

ZELL replied that they would collect data every other week in the 4 reaches, pool the data and run change point analysis. Based on the wet weather event(s) look at the data and then determine how to best use the data. The model will be strictly a numerical exercise

QIAN said that they will use modeling and using regional and local data to develop a more adaptive management approach.

SCOTT asked what he meant by local and regional data and if he intended to find this data to use with the data that their study would collect.

QIAN replied that they will have to do so. He continued to say that "local data is noisy" and that you have to expand the data set to get more information.

ZELL added that it is important to make sure that the study stream is comparable to the other sites where data is collected. He said that was very important.

SCOTT inquired about what are regional boundaries they would use.

QIAN replied that the Level 4 eco-region would be used. He thinks there are enough data points in EPA's data system.

PHILLIPS notes that they mention shading but asked how they planned to address the impacts of grazing in the watershed since these areas have significant grazing population.

ZELL stated that they would use models to take into account the grazers and may do individual studies to see outcomes.

MATLLOCK commented that large firms work with many cities, facilities, companies, etc. and wanted to know how Geosyntec would address the conflict of interest issues that will arise if they are selected since they work for other entities impacted by this study.

NEMURA stated that they would disclose who they work for and the nature of that work. She said that if there is some concern raised by other clients, "then let the chips fall where they may."

MATTOCK stated that sample intensity would be important and wanted to know how many samples would be collected and at how many sites.

ZELL replied that there would be 2 samples per month in 4 stream reaches for a 1 year period. They would also collect samples during a wet weather event in each study reach.

HAGGARD clarified that the field work being proposed is the 4 reaches

ZELL replied that at this time, it is. However, they are flexible and wants to maximize the funding.

HAGGARD asked if Jack Jones involved in one of lawsuits.

NAMURA replied that she didn't know but would check.

BREAK FOR LUNCH 12:02

RECONVENE 12:52

III. Discussion of Selected Finalist Interviews

HAGGARD we should start with the same process of going around the table to share comments, opinions, etc. and see where we stand afterward.

SMITHEE stated that he wished Dodds was present. He thought the Indirect Cost rate of 50% is high. He thinks the Study Dodds proposed is what he thought should happen because he is old school. He thinks King's study gets "more bang for the buck." He thinks the new approaches seem good but is skeptical of the enrichment of river approach. This is not a smoking gun; it is a dead animals. He was disappointed that Dodds and King made no reference to historically data, etc. He thought Geosyntec had a lot of history but wanted to use a lot of models. Their Indirect Cost rate was 41%. He is not sure what they are going to do. Seemed high level or conceptual. He thinks Geosyntec could do work but it would take a lot of work from the committee to get them where they needed to

be and what we want. His ranking would be Dodds and King at the top and would lean toward to King.

CHARD-MCCLARY stated that she would rank Geosyntec last, Dodds in the middle and King first. She didn't think there was much separation but just different approaches. She acknowledged there were definitely holes in all of the presentations. There are concerns about the models being proposed by Geosyntec and how the dosing study on the Illinois River would work that was proposed by King. She thought that King's study brought an additional level of validation to the study based on the experimental aspects it included with the field work.

SCOTT stated that he was pleasantly surprise by Dodds' presentation and that he "nailed the questions." He liked what Dodds had to say. Geosyntec brought the other aspects to the table. They were relied on duration and frequency. He feels it is a fatal flaw to have a stream study of only 4 reaches. He agrees King did a good job. However, he had concerns about him defaulting to the lower end of the confidence levels. He found it fascinating that all three quoted reference standards but were slightly different, Geosyntec 115, Dodds 100, and King 50. It will be the job of the committee to reign in some of that. He would be very happy with King or Dodd. He thinks Geosyntec played their way out due to the limited scope of their proposal.

PHILLIPS commented that Geosyntec was only going to sample1 year in 4 reaches, then rely on modeling. There is a lot of data in the water shed but there is not algae data available. It is too hard to model especially to extrapolate those results to other water bodies. She would be happy with either Dodds or King. She would be happy with King and the way he talked about the specific questions asked. She appreciated King's indirect rate and high number of sampling sites/events. She has a similar opinion like SMITHEE (more in tune with Dodds' methodology). Dodds addressed other limiting factors and his designed project considered those. She appreciated that Dodds felt d this was a great amount of money to get the work done. She said she was worried about King's mesocosm and in-stream dose response studies representing real dosing relationships and natural variability. King and Dodds have good proposals and could do a good job.

MATTOCK stated that his opinion was different from others. He thought that Geosyntec was the only one that presented a framework for establishing a standard. They discussed co-variables. He thought King set aside the co-variable and Dodds split the middle. Dodds Sparrow model is not appropriate. His rating would be Geosyntec, Dodds, and then King.

HAGGARD referred back to letter of invite for what the committee expected them to tell us. Based on that, Geosyntec did not do it. They did address the magnitude, frequency and duration. He is nervous about their reliance on models. The 2 academics did good jobs laying out broad based study. He thought Dodds did better layout of co-variables; but that King will do the same. He thought that King will give us 2 or 3 more times the amount of data. He was

providing additional information. His ranking would be that Geosyntec was out of contention and that King was ahead of Dodds due to amount of info to be gained. He thought that the committee will have to address some of the issues in the contract to ensure that King addresses what we need/want.

SMITHEE asked what the experimental aspect brings to the table

SCOTT replied that it is another level of information. It lies over the other layer of data. It verifies and can help overlay the experimental data over the actual data. The flip side is that he will enrich directly into the stream and nutrients enter in different forms.

SMITHEE/SCOTT discussed that it is not that different from field data.

MATLOCK stated that if you add more P water gets greener. It is self- evident. In this system how much P can we tolerate before bad things happen? Geosyntec replied based on their graphic's they provided; Dodd answered better than King but neither of them was very good.
SCOTT said that he thought King would say allow statistics to determine; but King "jumped in." He wished King would have talked about the biology and the statistical analysis.

SCOTT /MATTOCK noted the different approaches from the 2 academics versus the consultant.

HAGGARD summarized that it appears that 5 of 6 committee members felt Geosyntec was out of contention.

MATLOCK stated that he was not going to be swayed. He followed with that if not Geosyntec then Dodds was best because he doesn't want to be in the politics.

SMITHEE said he would take that approach that Dodds had taken but he did like King adding experimental processes.

MATLOCK thinks King is head and shoulders above when you look at what we can get from the study.

SCOTT asked what product we would get from Geosyntec?

MATLOCK said that we would have to spell it out in the contract. He thinks Geosyntec is better to move toward a criterion.

HAGGARD noted that the statistician from Geosyntec was a co-author with King and they were relying so heavily on modeling.

SCOTT said he didn't see the model put into place from Geosyntec.

MATLOCK stated that we agreed that 4 of 6 would have to agree in order to make a decision and that he is not trying to be difficult.

HAGGARD asked if we wanted to make a motion for something.

SCOTT asked if we could compare the two that seem to rising to the top.

SMITHEE asked if we could get the language in the contract to specify what we needed.

SCOTT said that we needed to look at who is closer to what we want and go from there.

PHILLIPS thought that Dodds was sampling over 2 years at 30 sites. Dodds also talks about algae and P. However, King mentions no invertebrates.

SCOTT commented that you can have high level of P a lot of the time but no impacts noticed due to snail population and activity.

MATLOCK/HAGGARD said it is possible that King would have to drop the experiments in order to add the invertebrates.

SCOTT noted that there needs to be river stem samples and include flow variability.

MATLOCK stated that if there is a difference in current standards and the outcome of the study, the states will have to go through rulemaking to set the new standard.

SMITHEE stated that his vision is a contract providing us not with an answer but with an error range, then the states would be going through the rulemaking process or not

HAGGARD read the language in the Second Joint Principles document; we will have specific recommendation of a number and scope at the end of this project.

SMITHEE noted that MATLOCK is contrarian; King and Dodds are the top but MATLOCK will not die on the hill on the issue.

SMITHEE is comfortable with Dodds' proposal but he thinks King would have to modify his to address invertebrates.

PHILLIPS noted that Dodds talked the Mountain Fork.

HAGGARD pointed out another conversation by the committee about Lee and Little Lee Creeks.

SMITHEE commented that to be fair, 95% or more of the issues are related to the Illinois River.

HAGGARD/PHILLIPS noted that the presentation shows that Dodds had looked at Scenic Rivers and had an understanding. The committee will have to make sure that selected contractor gets the data.

HAGGARD noted that Dodds seemed to relie on those he had worked with while King acknowledged that there were experts sitting around this table. Dodds didn't recognize the work that had been done locally.

MATLOCK if we shift from policy to budget efficiency, King is the more hungry of the three. We get more out of the project.

CHARD-MCCLARY is not set in stone and agrees with MATLOCK that she may have dissenting opinion. She really likes King's "out of the box" thinking. With that said, she could be very comfortable with Dodds or King if others feel strongly about Dodds.

HAGGARD after reading the charge from the Second Joint Principles document, frequency is the issue. King is better than Dodds; the committee will need to make sure the selected applicant know about all the active monitoring sites.

ALL agreed that the contract will have to get the response data. We don't have much of that. We can and should provide a lot of guidance.

MATLOCK agrees that we seem to have consensus. He will not object to any of the candidate because they are all good.

IV. Selection of Contractor to Conduct the Water Quality Study to address the Second Statement of Joint Principles and Actions under the supervision of this Committee

- **MOTION 2: The committee will contract with the Ryan King/Baylor University Team for work at a cost of $600,000 and would meet soon with Ryan King to work on updated work plan. The Revised work plan will include: synthesis of historical data and its analysis, addition of macro invertebrates and grazer biomass numbers including grazing fish, and simultaneous main stem of the river coincident with the co-monthly synoptic sampling. Letter of notification will be sent to the non-selected applicants.**

Representative		Yes	No	Abstain	Absent
Shellie Chard-McClary		X			
Brian Haggard	Second	X			
Marty Matlock		X			
Shannon Phillips		X			
Thad Scott		X			
Derek Smithee	Motion	X			

CHARD-MCCLARY will draft the needed letters and send to committee for review and comments and then finalize and send to the three teams.

SMITHEE wondered if we could talk to Ryan King about partnering with Dodds because he like the way Dodds proposed the key threshold analysis.

CHARD-MCCLARY said she was uncomfortable with the idea.
MATLOCK and SCOTT agreed that the committee should not do it.

COMMITTEE discussed that we should look at the all proposals and pull out all of what we need in order to get the best work plan possible.

SCOTT thought we should look at steams around the Illinois River, Flint Creek and the Baron Fork not just the tributaries. We will need biological response information in those areas.

SCOTT stated that the next meeting is March 6 at 10. Is that when we are going to sit down with Ryan King to discuss?

SMITHEE said yes.

SMITHEE and HAGGARD asked if Ryan King could to get draft or template contract from Baylor University and we will review it with the AGs, JD Strong for Oklahoma and Randy Young for Arkansas.

HAGGARD will encourage Ryan King to talk to the committee members to get a feel for each committee member's ideas, etc. to enlighten the discussion on March 6.

AUDIENCE asked if the data collected by Stevenson as part of the lawsuit will be included.

HAGGARD replied that any data available through state and federal agencies should be included. However, the analysis of that data (by Stevenson) is not to be part of the process. Data yes. Analysis no.

V. NEW BUSINESS

HAGGARD asked if any of the commit had any new business. There was none

AUDIENCE asked if the results of the meeting could go in the Trout Unlimited newsletter.

HAGGARD replied that he could publish that the committee is extending an invitation to Ryan King and his team. He will call Ryan King and Walter Dodds and let them know the outcome. Since the Geosyntec team stayed to listen to the discussions, they are aware of the outcome.

CHARD-MCCLARY will do formal notification ASAP to all three teams.

AUDIENCE – Springdale, AR is already anticipating $30M in plant upgrades to meet whatever standard comes out of this study. The committee deserves special thanks for all the work. Without the work of committee, the two states would clearly be involved in a long litigation process.

VI. Adjournment

- **MOTION 3: To adjourn**

Representative		Yes	No	Abstain	Absent
Shellie Chard-McClary	Motion	X			
Brian Haggard		X			
Marty Matlock		X			
Shannon Phillips	Second	X			
Thad Scott		X			
Derek Smithee		X			

Meeting adjourned

TIME 2:23

ATTACHMENT 1
Walter Dodds/Kansas State University Team Slides

Oklahoma Scenic Rivers Joint Phosphorus Criteria Study- Proposal

Walter K. Dodds Kansas State University
Matt R. Whiles Southern Illinois University, Carbondale
Rex Lowe Bowling Green State University

Outline

- Theory of approach
- Field and lab sampling- data analyses
- Budget

MANDATORY STUDY COMPONENTS

The primary purpose of the Joint Study is to determine the total phosphorous threshold response level at which any statistically significant shift occurs in algal species composition or algal biomass production resulting in undesirable aesthetic or water quality conditions in the Designated Scenic Rivers.

Putting functional relationships and nutrient criteria into context

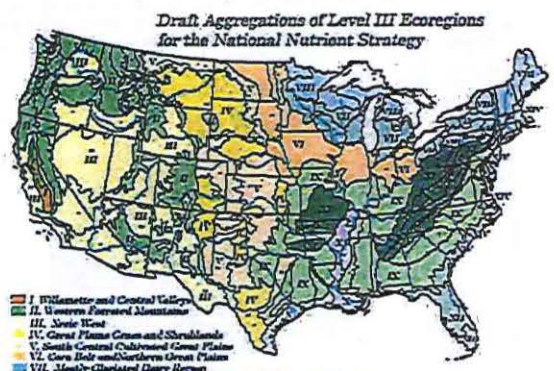
- What is best possible condition? (reference)
- What response variables are to be considered?
- How do response variables respond to nutrients (functional relationships)

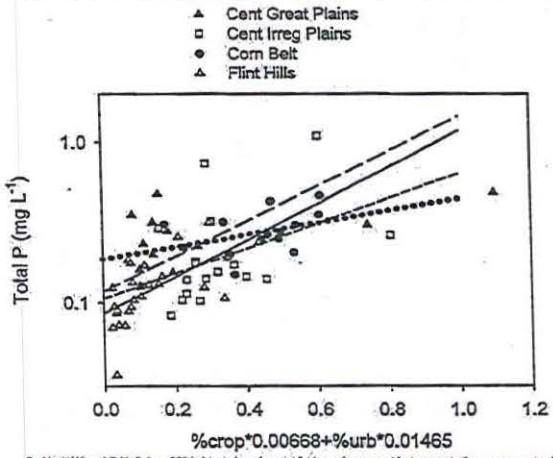
Reference nutrients

- What is the best possible condition?
- Sparrow models (account for downstream accumulation)
- Land use-land cover relationships (account for areas with few reference streams left)
- Reference streams (if they can be found, best indicators of low nutrients as well as local biological indicators)

Reference nutrients

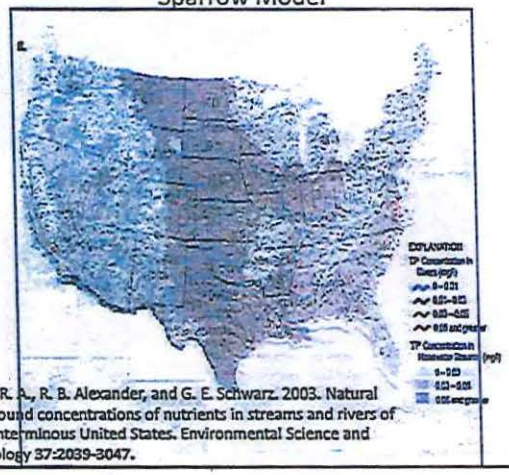
- Get regional results of Sparrow model
- Link land-use land-cover in watershed to nutrients across sub-basins of the scenic rivers
- Identify, cull existing data for, and sample current reference streams that feed into the designated scenic rivers (best of three approaches)





Dodds, W.K. and R.M. Oakes. 2004. A technique for establishing reference nutrient concentrations across watersheds impacted by humans. *Limnology and Oceanography Methods* 2:333-341.

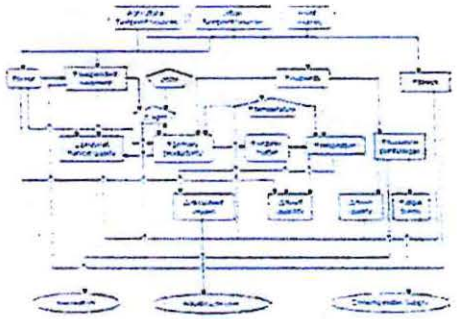
Sparrow Model



Smith, R. A., R. B. Alexander, and G. E. Schwarz. 2003. Natural background concentrations of nutrients in streams and rivers of the conterminous United States. Environmental Science and Technology 37:2039-3047.

9

Determining response variables: EPA stressor response model for Rivers and streams



10

Proposed response variables

- Algal biomass (aesthetics, potential water quality problems)
- Biological integrity
  - Algal (primary)
  - Invertebrate and vertebrate diversity (secondary)
- Water quality (extreme oxygen excursion, pH swings)
- System productivity (whole stream metabolism, primary production and respiration)

11

Temporal and spatial grain of sampling

- Assemble existing data- determine temporal autocorrelation scale
- Increased sampling intensity in critical times of year (e.g. summer low flow period vs spring high flow)
- Longitudinal sampling to reveal patterns downstream of point sources or high load confluences
- Take advantage of existing sampling sites/ prior data for context
  - USGS
  - Oklahoma and Arkansas DEQs
  - Stevenson et al. (Hydrobiologia (2012) 695:25–42)

12

Lots of good USGS Stream Gages

07194760 Illinois River Site 5 Near Viney Grove, ArK

07194800 Illinois River At Savoy, AR

07194880 Osage Creek Near Cave Springs, AR

07195000 Osage Creek Near Elm Springs, AR

07195400 Illinois River At Hwy. 16 Near Siloam Springs AR

07195430 Illinois River South Of Siloam Springs, AR

07195500 Illinois River Near Watts, OK

07195800 Flint Creek At Springtown, AR

07195855 Flint Cr Nr W Siloam Sprgs OK

07196000 Flint Creek Near Kansas, OK

07196090 Illinois River At Chewey, OK

07196500 Illinois River Near Tahlequah, OK

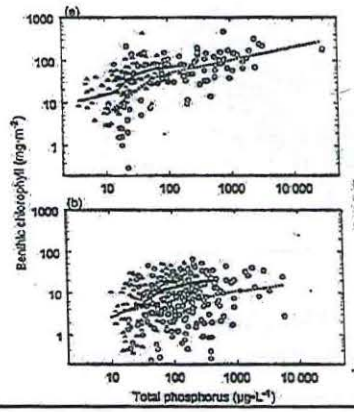
13

How do response variables respond to nutrients (functional relationships)

- Are there thresholds below which there is no significant response?
- Are there thresholds above which nutrient control is pointless?
- Do conditions in these scenic rivers line up with other areas?
  - how well will models generated over larger geographic areas transfer?
  - are there unusual controlling mechanisms in these watersheds?

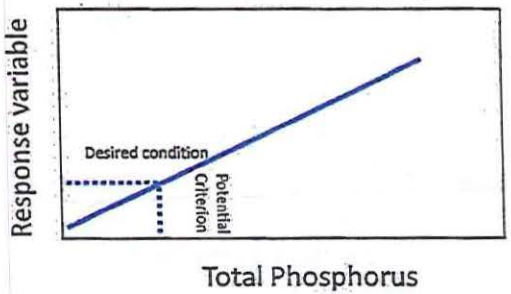
14

Relationship Between Algal Biomass and Nutrients in Streams- Interaction between N and P



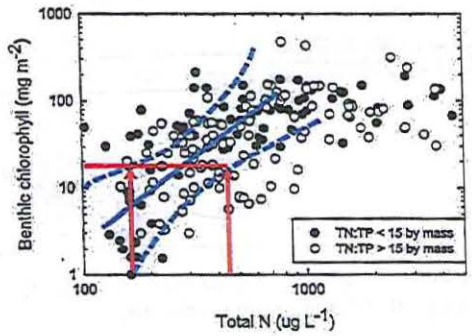
Dodds, W.K., V.H. Smith, and K. Lohman. 2002 Nitrogen and phosphorus relationships to benthic algal biomass in temperate streams. *Canadian Journal of Fisheries and Aquatic Science* 59: 865–874.

15



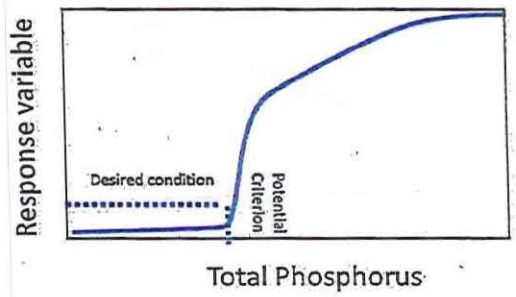
16

Relationship Between Algal Biomass and Nutrients in Streams



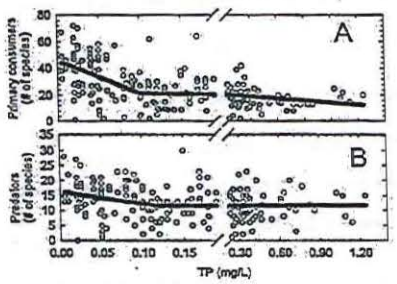
17

Best case scenario



18

Potential feedbacks with diversity of animals- additional information on biotic integrity



Variation in diversity of stream invertebrate primary consumers (A) and predators (B) from rivers and streams in Kansas, Missouri, and Nebraska in spring and autumn samples as a function of water phosphorus concentration. There were significant breaks in the relationships as denoted by the two lines, with the predator break occurring at greater total phosphorus than the primary consumers. *(Data from Evans-White et al., 2009).*

19

Breakpoints or thresholds determined using various methods . Take home message: need multiple methods and will not get one single answer

Method	breakpoint on x axis (mg/L TP)	significance of breakpoint	Confidence interval of breakpoint (95%)
Non-parametric change point analysis	0.041	<0.001	0.040-0.075
Quantile regression tree (10%, 50% and 90% quantiles, respectively)	0.041, 0.049, and 0.75	<0.001	-
Two dimensional Kolomgorov Smirnov	0.090	0.002	-
Breakpoint regression	0.100	0.001	0.0679 - 0.131
Cumulative frequency, point where half sites with more than 25 species had been reached	0.05	-	-
Regime shift detection, total P substituted for time	0.05	<0.001	-
SiZer (threshold estimated based on locally weighted polynomial regression using a bandwidth of h = 0.06)	0.15	-	-

Dodds, W.K., W.H. Clements, K. Gido, R.H. Hilderbrand, and R.S. King. 2010. Thresholds, breakpoints, and nonlinearity in freshwaters as related to management. *Journal of the North American Benthological Society* 29:988-997.

20

Factors that may de-couple response to phosphorus in streams

- Heavy shading (light limitation)
- Extensive grazing (snails common in high densities in limestone watersheds, herbivorous fishes might be locally abundant)
- Flooding/ high flow high turbidity
- Luxury P consumption- delayed response to increased P in water column

21

Luxury P consumption- need time-lagged analysis and sampling

- Most P runoff will occur in spring (90% in 20% of the events)
  - Banner, E. A. Stahl, and W.K. Dodds. 2009. Stream discharge and riparian land use influence in-stream concentrations and loads of phosphorus from Central Plains watersheds. *Environmental Management* 44:552–565.
- Algae can retain P in spring and grow through summer, particularly filamentous algae
  - Lohman, K. and J. C. Priscu. 1992. Physiological indicators of nutrient deficiency in Cladophora (chlorophyta) in the Clark Fork of the Columbia River, Montana. Journal of Phycology 28:443–448.
- P deposition in calcareous areas can store P as calcite for slow release later
  - Dodds, W.K. 2003. The role of periphyton in phosphorus retention in shallow freshwater aquatic systems. *Journal of Phycology* 39:830–840.

22

Sampling for Nutrients/ Algae

- 30 sites from a wide range of background concentrations in Illinois River basin, 8 sites in Upper Mountain Fork
  - TP, TN, chlorophyll, algal chemical composition and community assemblage
  - Habitat assessment, visual assessment of filamentous algal cover , macrophyte cover (if any)
- Samples in winter, summer low flow (2x), fall low flow and spring high flow (to catch luxury consumption of P)
- Note - 30 extra sites samples taken but not analyzed for summer unless needed
  - will not be able to tell how many samples will be needed to be counted for diatoms until preliminary data analysis

23

Diatom community as response variable

- Samples can be taken quickly from erosional habitats.
- Easy to preserve
- Substantial literature on relationship of stream diatoms to phosphorus
- Voucher specimens last indefinitely
- Rex Lowe world expert on their taxonomy will train in identifications, help with sampling protocol and check identifications

24

Creating diatom-based index

- Will start with published index approach from US rivers
  - Potapova, M. and D. F. Charles. 2007. Diatom metrics for monitoring eutrophication in rivers of the United States. Ecological Indicators 7:48-70.
- Will check that indicator species follow general US trends (e.g., are there ecoregion-specific differences)

25

Sampling for dissolved oxygen-metabolism

- Run DO and light loggers at 15 sites for 2 days
- Pick range of sites from lowest to highest nutrients
- Use USGS gaging stations when possible or state monitoring sites to put in historical perspective and provide physical data for models of metabolism
- Pick three times when low oxygen or high oxygen most likely (summer, spring and fall low-flow periods)

26

Sampling invertebrates

- Invertebrate sampling and sample processing methods standardized
- Predictable community responses to nutrient enrichment
- Assess potential confounding grazer effects
- Auxiliary biotic integrity data
- Collections at same time as nutrients, but two times per year (spring high flow, summer low flow)

27

Field and lab work

- Conform to field and lab EPA bioassessment protocols
- QA/ QC conform to EPA guidance
  - Digital records of diatom communities
  - Subset of diatom samples re-identified
  - Subset of invertebrate samples checked for picking accuracy and proper identifications
  - Nutrients based on standards at national level (USGS round-robin)
  - Light probes NIST traceable, oxygen probes regularly calibrated
- Best data handling procedures (backup, quality check etc.)

28

Assemble and explore data- and accuracy of models

- Look for stressor-response functional relationships with various statistical and graphical approaches
- Remove outliers
- Cumulative frequency plots- characterize distributions
- Regression confidence intervals for response variation
- Identify thresholds (e.g., non-parametric change point analyses, other methods)
- Evaluate precision

29

Deliverables

- Raw data for TN, TP, chlorophyll, dissolved oxygen, habitat mapping, and invertebrates
- Analysis of expected background nutrient level from existing data and added samples
- Functional relationships between response variables (algal biomass, algal communities, invertebrate communities, oxygen dynamics, system production) and phosphorus
- Corrections in functional relationships related to temporal patterns (luxury P effects), and interactions with nitrogen and invertebrate grazing communities
- Verification that QA/ QC procedures followed EPA guidance
- Threshold analyses of functional relationships, multiple comparative approaches
- Peer-reviewed publication (will eventually follow, though will take longer than final report). Final report will be in form of peer reviewed papers.
- Presentations of results at local and national meetings
- Participation as technical expert in future meetings
- Final report and required updates

30

		Base	Mos or %	Year 1	Year 2	Total
A. Faculty						
PI - Matt Whiles			Summer 1.00	0	0	0
Total Faculty				0	0	0
B. Other Personnel						
	Grad Students			19,800	17,500	37,300
	Post Doctoral			0	0	0
	Pat Staff			0	0	
	OS Staff			0	0	
	Labor (incl student)		undergrad (2)	9,000	9,000	18,000
	Total Salaries & Wages (A+B)			28,800	26,500	55,300
C. Fringe Benefits						
	grad	0.0%		0	0	0
	faculty	34.0%		0	0	0
	student	0.0%		0	0	0
	Subtotal Fringe			0	0	0
	Total Salaries, Wages & FB (A+B+C)			28,800	26,500	55,300

31

F. Travel - Domestic			7,000	7,000	14,000
F. Travel - Foreign			0	0	
G. Other Direct Costs					
Materials & Supplies		routine supplies	3,000	2,000	5,000
Publications Cost			0	2,000	2,000
Other		consult	0	0	0
Other (F&A Exempt)			0	0	0
		Subtotal Other Direct Costs	3,000	4,000	7,000
	Total Direct Costs		38,800	37,500	76,300
					0
H. Facilities & Administrative			10,088	9,750	19,838
					0
Total Direct + F&A			48,888	47,250	96,138
total less equip			38,800	37,500	76,300
					0
					0
	Total Project Costs		48,888	47,250	96,138
		MTDC Base	38,800	37,500	76,300
	F&A Rate (off campus)		26.00%	26.00%	

32

		Base	Mos or %	Year 1	Year 2	Total
A. Faculty						
PI - W.Dodds		Summer	1.00	13,000	14,000	27,000
Total Faculty				13,000	14,000	27,000
B. Other Personnel						
	Grad Students			25,000	20,000	45,000
	Post Doctoral Assoc	50,000		50,000	30,000	80,000
	Labor (incl student)	undergrad (2)		15,000	10,000	25,000
	Total Salaries & Wages (A+B)			103,000	74,000	177,000
C. Fringe Benefits			5.9%	1,475	1,180	2,655
			34.0%	21,420	14,960	36,380
			1.0%	150	100	250
		Subtotal Fringe		23,045	16,240	39,285
	Total Salaries, Wages & FB (A+B+C)			126,045	90,240	216,285

33

E. Equipment		microscope camera, vehicle	35,000	0	35,000
F. Travel - Domestic			20,000	14,000	34,000
F. Travel - Foreign			0	0	
G. Other Direct Costs					
Materials & Supplies		routine supplies, computer, backup, 15 oxygen probes	27,000	7,000	34,000
Publications Cost			0	2,000	2,000
Other		consult	12,000	8,000	20,000
Other (F&A Exempt)			0	0	0
		Subtotal Other Direct Costs	39,000	17,000	56,000
	Total Direct Costs		220,045	121,240	341,285
					0
H. Facilities & Administrative			92,523	60,620	153,143
					0
Total Direct + F&A			312,568	181,860	494,428
total less equip			185,045	121,240	306,285
					0
					0
	Total Project Costs		312,568	181,860	494,428
		MTDC Base	185,045	121,240	306,285
	F&A Rate		50.00%	50.00%	

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Summary of all costs	
Kansas State University	494,428
Southern Illinois State University	96,138
Total	590,566

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ATTACHMENT 2
Ryan King/Baylor University Team Slides

BAYLOR UNIVERSITY

Oklahoma Scenic Rivers Joint Phosphorus Study

Scope of Work

Proposed by:
Ryan S. King
Associate Professor, Department of Biology, Center for Reservoir and Aquatic Systems Research, Baylor University, Waco, TX 76798

www.baylor.edu/aquaticlab

CRASR Center for Reservoir & Aquatic Systems Research

Framework for Scope of Work

"to determine the Total Phosphorus threshold response level....at which any statistically significant shift occurs in

1. algal species composition OR
2. algal biomass production

...resulting in undesirable

1. aesthetic OR
2. water quality

...conditions in the Designated Scenic Rivers."

Second Statement of Joint Principles and Actions, p.2, Mandatory Study Components

Methodological Constraints on Scope of Work

"completed in accordance with.....

1. U.S. EPA Rapid Bioassessment Protocols
2. EPA Guidance on QA/QC
3. Using Stressor-Response Relationships to Derive Numeric Nutrient Criteria

and shall include....

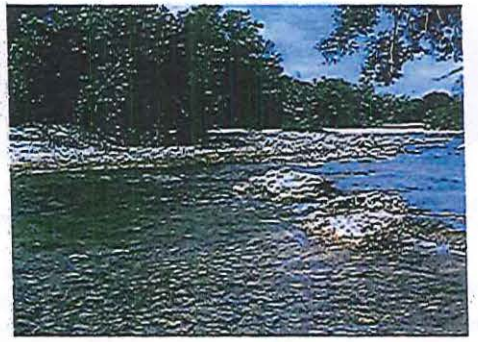
4. *a sampling population....adequate to determine the frequency and duration of the numeric criterion....and*
5. *limited to streams or rivers within the same EPA ecoregion and comparable to the streams in the designated Scenic River watersheds."*

Second Statement of Joint Principles and Actions, p.2, Mandatory Study Components

Outline of Scope of Work

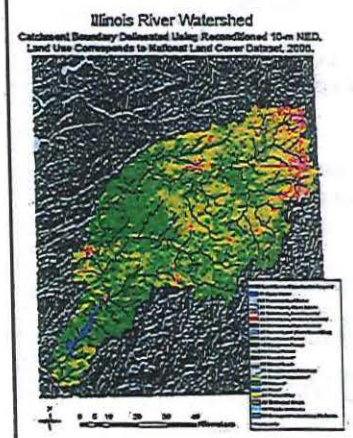
- Field gradient study
  - Spatial factors (e.g., number and method of site selection)
  - Temporal component (e.g. sampling frequency and duration)
- Experiments
  - Whole-stream enrichment*
  - Laboratory microcosm experiment
- Results and Reporting
  - Approaches to data analysis
  - Weight-of-evidence derivation of numeric criterion
- Budget

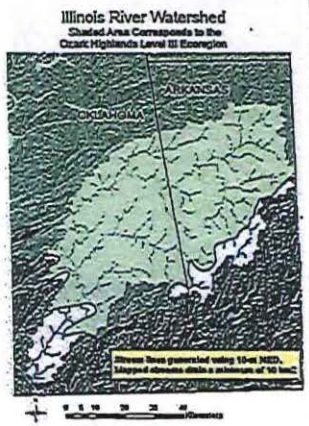
Field Gradient Study



Key elements of a field study

- Spatially extensive & intensive
- High temporal frequency of sampling over 2+ years
- Spans a ***gradient*** of conditions from reference to highly enriched. Probabilistic designs are not efficient and likely to fail.
- Minimizes contagion (clumping) between nutrients and locations in the basin and other confounding factors (sedimentation, geomorphology, light, catchment size)



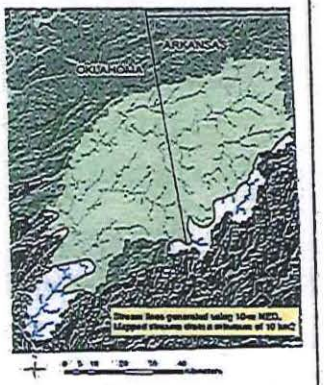


Field study: Spatial

- A minimum of 25 stream reaches will be selected for this study
- Sites will be located in upper Illinois River watershed and neighboring watersheds if necessary
- Sites will be located within and with majority of the catchment covered by the Ozark Highlands Level III Ecoregion (shaded region, right)

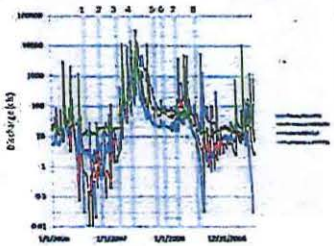
Field study: Spatial, page 2

- Sites will span a gradient from best available (minimum 6-8 "reference" sites) to >0.5 mg/L TP (or higher)
- Catchments: >5-10 km2 and between 2nd to 4th order *at the scale of a 5-10 km2 DA stream map* (blue lines, right)
- Existing data and field reconnaissance with new data to screen sites for final selection (April-July 2014)
- Sites must have riffles with cobble-gravel substrate



Field Study: Temporal

- Mean and max algal biomass is critical critical variable for derivation of this criterion.
- Bimonthly sampling is necessary to do this right



3 year hydrograph from 4 central Texas wadeable streams. Numbers indicate sampling periods from King et al. (2009).

Field Study: Sampling Frequency

Sampling will be scheduled bimonthly but adjusted for field crew safety and consistent field methods.

Proposed sampling will result in minimum of 12 events (at least 25 sites per event) in 2 years.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014				* Site screening, selection			X		X		X	
2015	X		X		X		X		X		X	
2016	X		X		X		X**	Final analyses & report writing				

*expected date of funding; **Jul 2016 desired but dependent upon remaining funds

Field Study: Sampling Methods, Algae

- EPA Rapid Bioassessment Protocols (1999). Required by ***Second Statement of Joint Principles*** document.
- Single habitat (riffle-run)
- 3 riffle-run channel units, 10-50 cm/sec
  - Perpendicular transect, wetted width
  - 5 equidistant points per transect, sample substrate
  - Composite sample of 15 substrate subsamples (also see King et al. 2009, etc).
- Sample immediately placed in dark bottle and on ice for processing in afternoon (filtering onto GFFs for CHLA and AFDM, preservation in M3 for species, remaining left for CNP analysis) and shipment to Baylor

Field Study: Methods, Water

- Water samples collected above 1st riffle upon visit to the site
- Duplicate TP, TN (unfiltered) and NH4-N, NO2NO3-N, and PO4-P (field filtered, 0.45 µm) samples collected in new 50 mL bottles
- Single 1-L seston (CHLA) sample, filtered same afternoon.
- Samples placed immediately on ice and prepared for shipment to Baylor
- Sample collection and analysis follows EPA Guidance on QA/QC and BU Center for Reservoir and Aquatic Systems Research (CRASR) protocols (e.g., Chain-of-Custody, trip blanks, field blanks, filtered blanks, duplicates, etc).
- Other monitoring to follow forms required by EPA RBP (1999).

Field Study, Diel Dissolved Oxygen

- Dissolved oxygen is a key variable that can bridge the "statistically significant shift" and "undesirable water quality" statements in the *Second Statement of Joint Principles* document.
- We propose to estimate minimum DO at least one time across all 25 sites using optical DO sensors and state-of-the-art YSI EXO1 data sondes (Baylor owns 13 brand-new units)
- We will target a low-flow period when streams are most susceptible to senescing algae, high respiration, and low reaeration

Field Study: Methods, Lab, Algae

- CHLA and AFDM determined in accordance with EPA RBP (1999)*, minimum 12 dates
- Species composition on 2 early spring and 2 late summer dates
  - Soft algae (300 cells) and diatoms (600 valves)
  - Dr. Barbara Winsborough, world-class taxonomist (see King et al., 2009a, b, Taylor et al. 2014)
  - Pattern among sites not likely to change markedly if P is driving changes. Not cost effective to analyze all dates.
- Periphyton nutrient content (not mandatory, but very strong indicator)
  - Ratios of % carbon, phosphorus, nitrogen in algal tissue (King and Richardson 2007, King et al. 2009, Taylor, King, et al. 2014)
  - C, N: CHNS autoanalyzer (combustion method)
  - P: colorimetric method

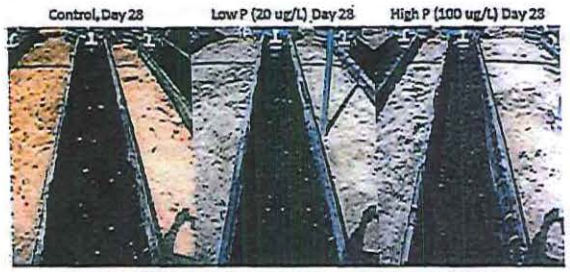
*acetone method is not preferred for CHLA. Hot ethanol is a safer, better extractant, and is more widely used for CHLA analysis (e.g., Biggs and Kilroy 2000)

Field Study: Methods, Lab, Water

- TP, TN, and dissolved nutrient samples run following APHA
- Dr. Jeffrey Back (9 years experience) will conduct nutrient chemistry analysis
- CRASR Lachat Quik-Chem Flow Injection Autoanalyzer
  - TP (MDL 0.001-0.002 mg/L)
  - TN (MDL 0.0025-0.001 mg/L)
  - NO2NO3-N (MDL 0.001-0.002 mg/L)
  - NH4-N (MDL 0.003-0.006 mg/L)
  - PO4-P (MDL 0.0005-0.002 mg/L)

*acetone method is not preferred for CHLA. Hot ethanol is a safer, better extractant, and is more widely used for CHLA analysis (e.g., Biggs and Kilroy 2000)

Experiments



Very little *Cladophora* — Dense *Cladophora* — Dense *Cladophora*

No difference between low and high P = threshold response

Experiments

- Causation requires multiple lines of evidence
- Field studies or experiments alone are insufficient, but when coupled can demonstrate causation
- Baylor Experimental Aquatic Research (BEAR) stream facility
  - not feasible with this budget
  - good alternatives, however

Experiment 1: Whole-stream enrichment

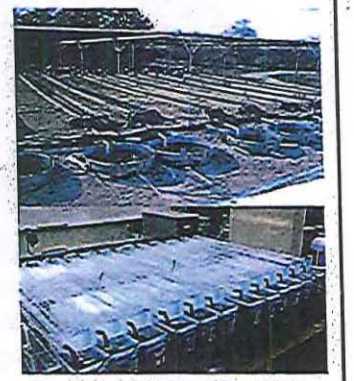
- Year 2 or 3, assuming permission granted
- Reference and treatment reaches
  - Same stream, nearly identical gradient, light, substrate, mean transit time, etc.
  - Monitor each reach for at least 30 days prior to dosing
  - Dose PO4-P as NaH2PO4 continuously for 60 d in treatment reach (12VDC low amp metering pumps)
  - Estimate mean TP:PO4-P in low-enriched streams near threshold zone
  - Supplement with NaNO3 or NH4NO3 to match balance of observed NO3-N, NH4-N, and PO4-P in enriched streams

Experiment 1: Whole-stream enrichment, page 2

- 2-4 ISCO samplers, daily integrated grab samples (Baylor owns 12 ISCOs)
- 4 YSI EXO1 sondes, two station GPP and CR pre and during dosing (propane evasion method)
- FMI VDC metering pumps (very reliable)
- Time series intervention analysis of GPP, CR, and benthic CHLA mg/m2 between reference and treatment reaches (Carpenter et al. 1989)
- Completed 2 whole-stream enrichments in Alaska in 2013 with great success—didn't miss a day of dosing, nailed our target for 10 weeks, both streams

Experiment 2: Laboratory streams

- "Baby BEAR"; Year 2 or 3
- 24 channels
  - 1 x 0.1 x 0.1 m
  - 5-8 L
  - temperature control via recirculating water in tubing submersed in FrigidUnits Living Stream
  - light: up to 1500 umol/m2/s via LED grow lights
  - static renewals via gravity feed and outflow stand pipe in sumps



The updated set-up is 2 levels with suspended LEDs

Experiment 2: Laboratory streams

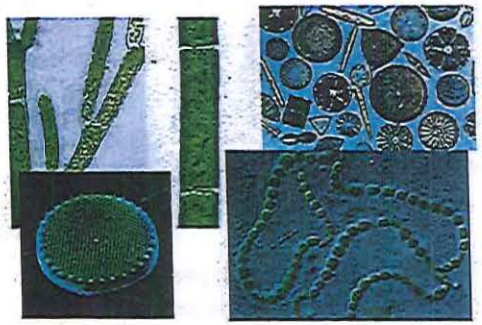
Experimental Design

- gradient of TP using stream water from field sites (6 sites)
- Sites will be chosen based on preliminary field results to target threshold zone
- 12 streams with cobble from reference stream
- 12 streams with cobble from most enriched stream
- 2 reps per field site per cobble type
- daily turnover of stream water
- 4 week study

Measured variables

- All nutrient analytes
- 0, 1, 2, 3, and 4 wk CHLA mg/m2 and AFDM g/m2
- % C, N, and P in periphyton at week 0, 2, and 4
- Dominant soft algal species
- GLM model with mean TP of source water as continuous predictor and cobble type as fixed discrete

Results and Reporting, Mandatory Study Component #1. Significant Shifts in Algal Species Composition



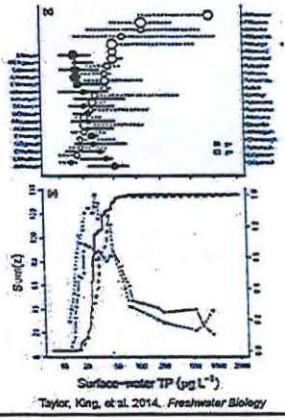
Results and Reporting, Algal Species: Threshold Indicator Taxa Analysis (TITAN)

TITAN will identify synchronous turnover from P-sensitive community to one dominated by eutrophic indicator taxa.

In this Texas example, significant turnover sharply peaked at 0.021 mg/L TP (Sum(z)), a strong indication of a community-level threshold

Consistent with *EPA Stressor-Response Guidance Document*

Mandatory Study Component #1. Significant Shifts in Algal Species Composition

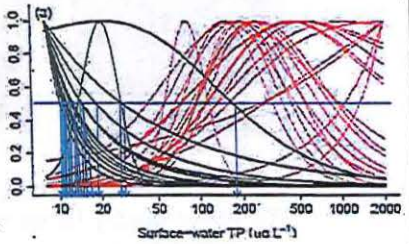


Taylor, King, et al. 2014. *Freshwater Biology*

Results and Reporting, Algal Species: EPA Field-Based Benchmark Method (2011)

- Negative binomial GAM or GLM, individual taxa responses
- "LD50"—50% reduction in population
- TP criterion should protect 95% of the taxa
- TP value where 5%* of taxa decline by 50%
- Fitted (mean) or CIs
- This example: 0.019 mg/L TP

Lines are fitted response curves for significant taxa



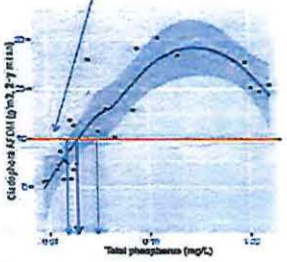
Mandatory Study Component #1.
Significant Shifts in Algal Species Composition

*limited to taxa in analysis data set

Results and Reporting, Algal Species: Algal community metrics

- Will follow US EPA RBP (Barbour et al. 1999) list. Analyze nutrient-relevant metrics in section 6
- GAM or GLM regression (Zuur et al. 2009)
- Fitted responses will be based on average densities over the duration of the study to reduce excessive numbers of tests and enhance signal:noise
- bivariate 95% prediction interval will be computed for reference sites for each metric; the extreme (upper or lower, depending upon metric) will be the basis determining y-axis threshold (figure, right).
- Intersection of fitted response corresponds to TP threshold (more detail in next section).

orange line = 95% prediction interval for reference sites



Mandatory Study Component #1.
Significant Shifts in Algal Species Composition

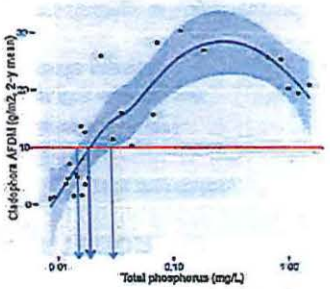
RESULTS AND REPORTING Mandatory Study Component #2. Significant Shifts in Benthic Algal Biomass

Results and Reporting: Algal biomass Fitted response intersection method

Level of TP where benthic algal biomass (mg/m2 chla or g/m2 AFDM) crosses criterion for excessive growth (long-term mean or maximum; USEPA 1999, Biggs 2000).

Use GAM or GLM with appropriate distribution. LOESS used here only for illustration.

Statistical "threshold" model inappropriate for this relationship. We DO NOT want to identify where algae hits the "ceiling" as the TP criterion!



Mandatory Study Component #2.
Algal biomass resulting in undesirably aesthetic

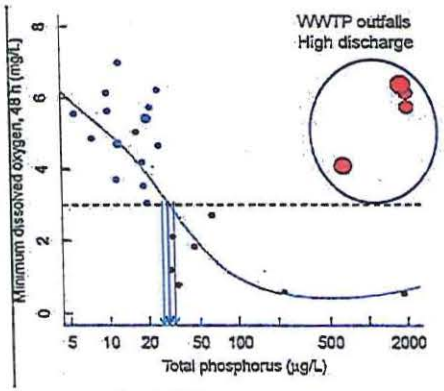
Data from King et al. (2009)

Results and Reporting: Algal biomass
Minimum DO as indicator of undesirable water quality

Fitted response intersection method.

Here, a GAM model with mean velocity and TP revealed that DO crashed in streams with low flow and elevated TP.

The partial fitted response (controlling for velocity) intersected the Texas DO criterion of 3 mg/L at 0.025 mg/L TP.



Data from King et al. 2009

Red=low carbon:chlorophyll ratio

Weight-of-evidence derivation of numeric criterion

- Final report will comprehensively address mandatory components and experimental results.
- Second Statement of Joint Principles document:
  - *"the committee and the scientific professionals employed....will be asked to make specific recommendations."*
  - This clearly indicates my team's findings will be discussed in collaboration with the committee to make a final recommendation
  - Weight-of-evidence approach will be strongly advocated by the Baylor team, including USEPA causal assessment and confounding factors analysis (Cormier et al 2013, Suter and Cormier 2013).

Personnel budget breakdown: All about data collection

Personnel	Sponsor funding, 2014	Sponsor funding, 2015	Sponsor funding, 2016	Breakdown of effort
Director (King)	None	1 mo. summer	1 mo. summer	25% data collection, 45% study design/data analysis, 30% report writing, presentations. Actual time 3-4 months per year. (BU cost).
Dr. Jeffrey Back	None	None	None	Fully funded by Baylor. Will facilitate field collections, oversee QA/QC, and run all water and periphyton chemistry samples in CRASR
Technician #1	Jun-Dec	Jan-Dec	Jan-Sep	MS level, field leader. Trained by King and Back. 100% data collection
Technician #2	Jun-Dec	Jan-Dec	Jan-July	BS level with experience. Trained by King and Back. 100% data collection
Grad student #1	Jun-Dec	Jan-Dec	Jan-Aug	PhD student in year 2 or 3; 100% data collection
Grad student #2	Jun-Dec	Jan-Dec	Jan-Aug	MS student with experience, 1st year. 100% data collection

Multiyear Budget

Category	Year 1 Apr-Dec 2014	Year 2 Jan-Dec 2015	Year 3 Jan-Dec 2016	Total
Personnel (salary+fringe)	73,545	152,580	111,052	$337,177
Consumable supplies	13,000	22,150	9,525	$45,500
Shipping	2,100	3,150	2,100	$7,350
Equipment	0	0	0	-0-
Algae species identifications (Dr. Barbara Winsborough)	7,500	15,000	7,500	$30,000
Water and periphyton CNP chemistry*	5,700	7,950	5,700	$13,350
Travel: lodging, food, incidentals	8,940	17,880	8,940	$35,760
Travel: Vehicle use and mileage**	0	0	0	-0-
Indirect costs (26.5% instead of BU std 38.5%)***	29,358	57,958	38,377	$125,693
Total	$140,143	$276,669	$183,162	$600,000

*CRASR will run at least 50% of samples in-kind (no charge)
**Included in IDC
***Baylor will match IDC rate of any proposal that beats 26.5%

References
(a very truncated list of literature reviewed)

- Baker, M. E.* and R. S. King*. 2010. A new method for detecting and interpreting biodiversity and ecological community thresholds. Methods in Ecology and Evolution 1:25-37.
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- Biggs, B. J. (2000). Eutrophication of streams and rivers: dissolved nutrient-chlorophyll relationships for benthic algae. *Journal of the North American Benthological Society*, 19(1), 17-31.
- Cormier, S. M., Suter, G. W., Yuan, L. L., & Zheng, L. (2013). *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams* (US Environmental Protection Agency, Washington) (Vol. 22). EPA/600/R-13.
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- King, R. S.* and M. E. Baker*. 2010. Considerations for analyzing ecological community thresholds in response to anthropogenic environmental gradients. Journal of the North American Benthological Society 29:998-1008
- King, R. S., B. W. Brooks, J. A. Back*, J. M Taylor*, and B.A Fulton*. 2009. Unlike Observational and Experimental Approaches for the Development of Regional Nutrient Criteria for Wadeable Streams. Section 104(b)(3) Water Quality Cooperative Agreement EPA-96[illegible]137-01. U.S. EPA Region 6, Dallas, TX.
- King, R. S., K. O. Winemiller, J.M Taylor*, J. A. Back* and A. Perez*. 2005. Development of biological indicators of nutrient enrichment for application in Texas streams. §106 Water Pollution Control Grant # 98[illegible]304, Texas Commission on Environmental Quality, Austin, TX
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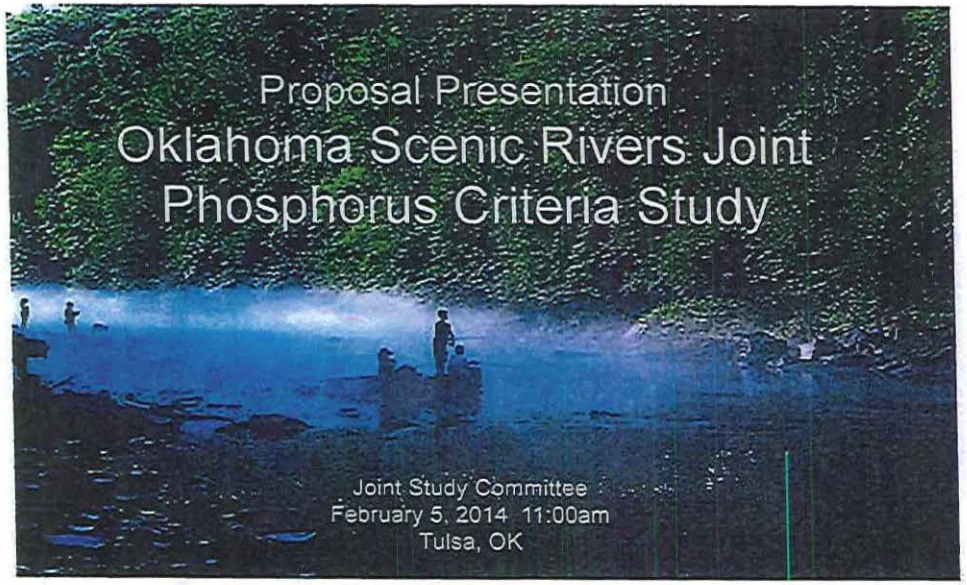
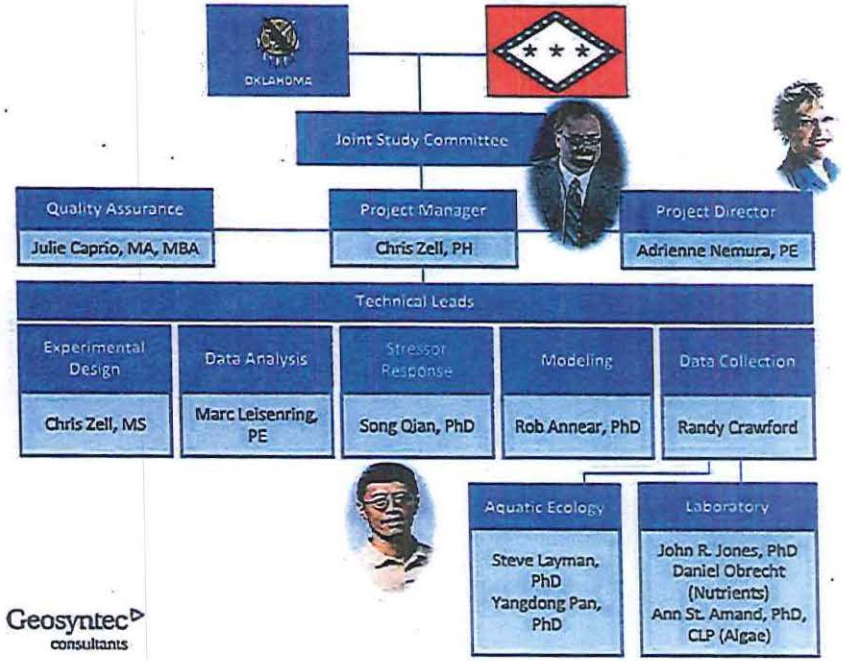
- Sutter, G. W., S. Cormier, S. M. (2013). A method for assessing the potential for sediments applied to toxic strength in central Appalachian streams.*Environmental Toxicology and Chemistry*, 32(1), 254-261.
- Taylor, J. M.*, J. A. Back*, and R. S. King. 2012. Grazing minnows increase benthic autotrophy and enhance the response of periphyton elemental composition to experimental phosphorus additions. Freshwater Science
- Taylor, J. M.*, R.S. King, A. Perez, and K.O. Winemiller. 2014. Nonlinear response in stream ecosystem structure to low level phosphorus enrichment. *Freshwater Biology* (in press)
- USEPA. 2010. Using Stressor-response Relationships to Derive Numeric Nutrient Criteria.
- Zuur, A. F. (2009). *Mixed effects models and extensions in ecology with R*. Springer.

Attachment 3
Chris Zell/Geosyntec Team Slides



Geosyntec consultants · PhycoTech, Inc. · Portland State University



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Team Collaboration

Geosyntec consultants · UT

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

Geosyntec consultants · Portland State University

- Nutrient lake management plan in Washington state

UT · Portland State University

- Publications and conference proceedings

Geosyntec consultants · MU

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

MU · PhycoTech, Inc.

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

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Proposed Workflow

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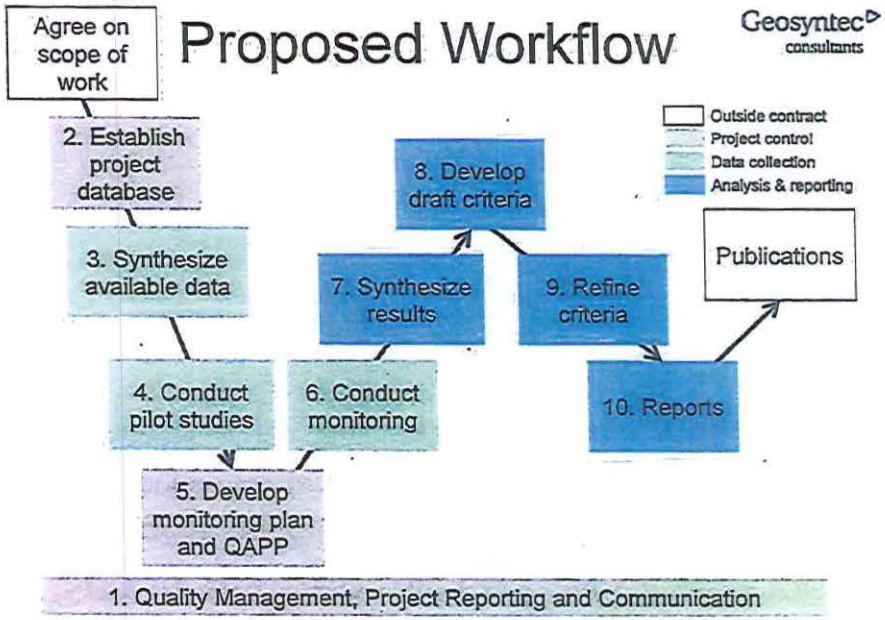

Available Approaches

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

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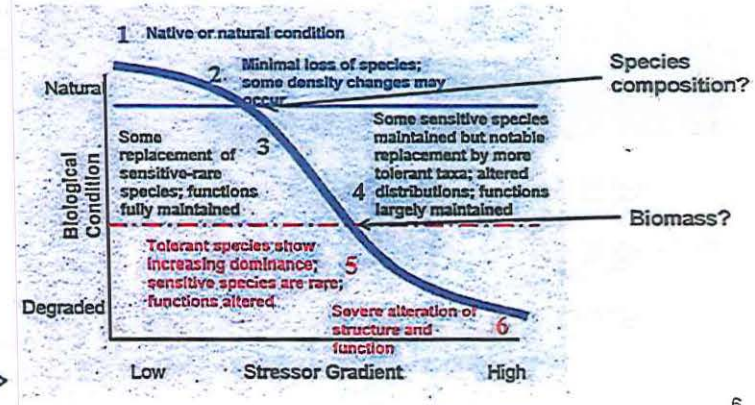
Scope will Depend on Key Questions

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



From (Davies 2002)

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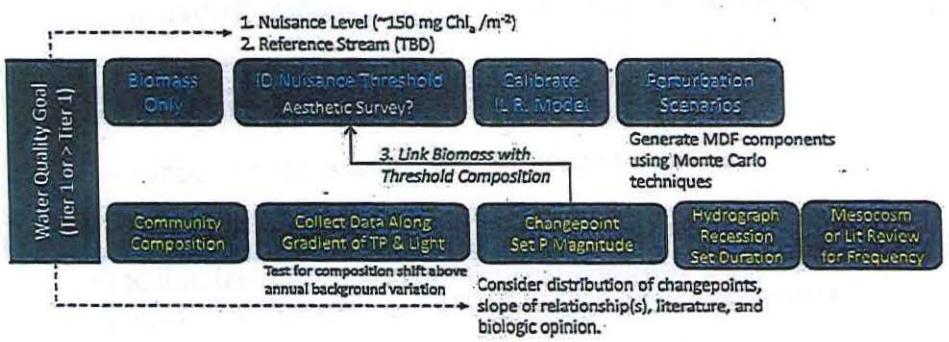
Technical Approach Pathways

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

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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)

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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

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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

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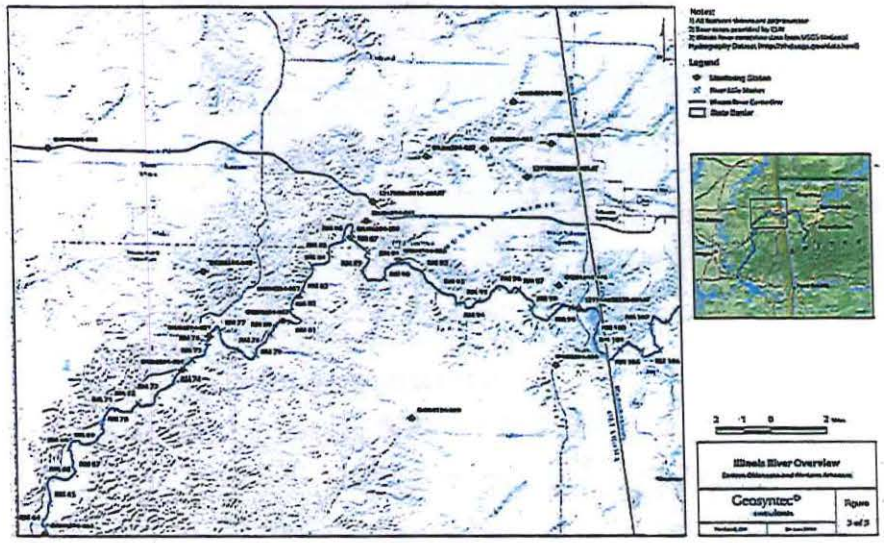
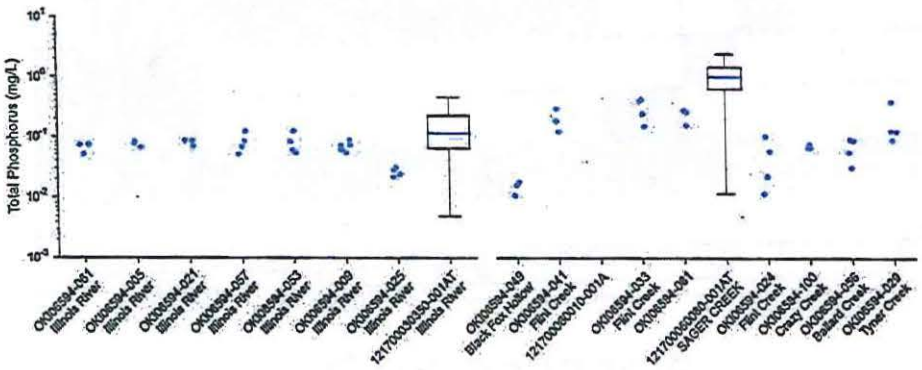
Example Data Analysis for Reach Selection



Nutrient Concentrations in the Upper Illinois River and Tributaries



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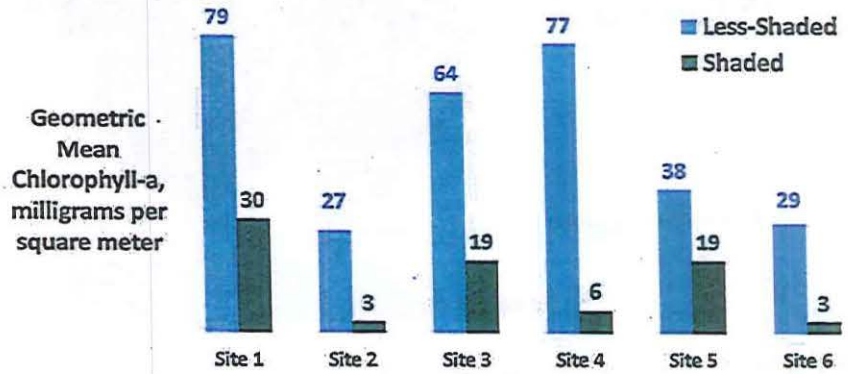
Why Shading Matters

Arkansas Ozarks Example



From Geosyntec (2012)

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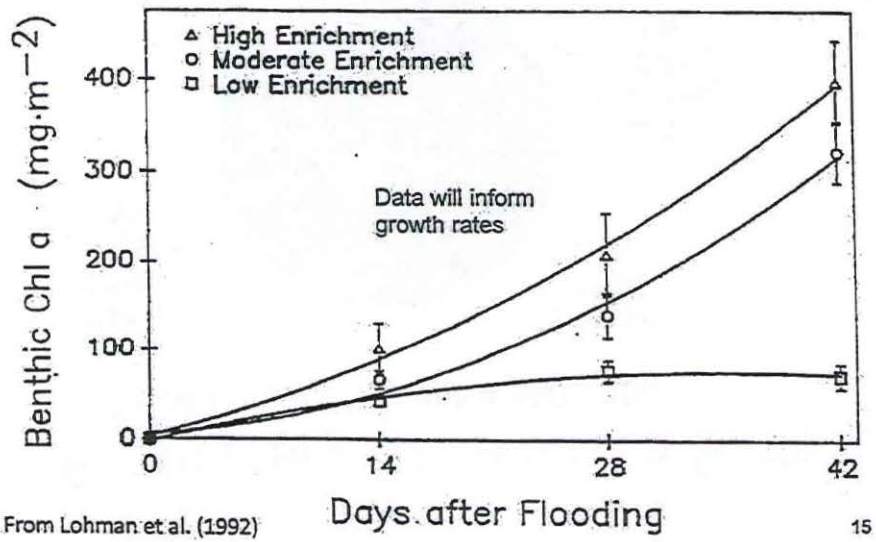
Why Wet Weather is Important

Missouri Ozarks Example



From Lohman et al. (1992)

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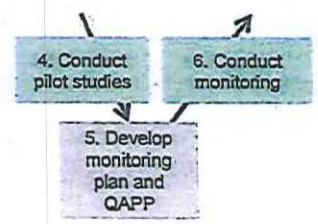
Recommended Monitoring Program

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

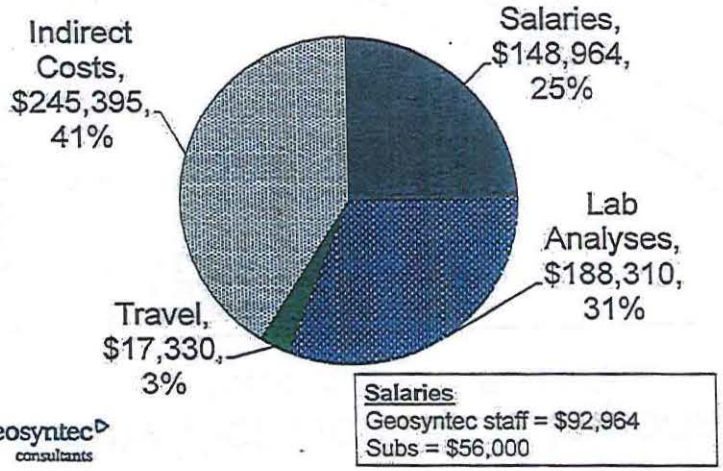


Laboratory Parameters

- 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



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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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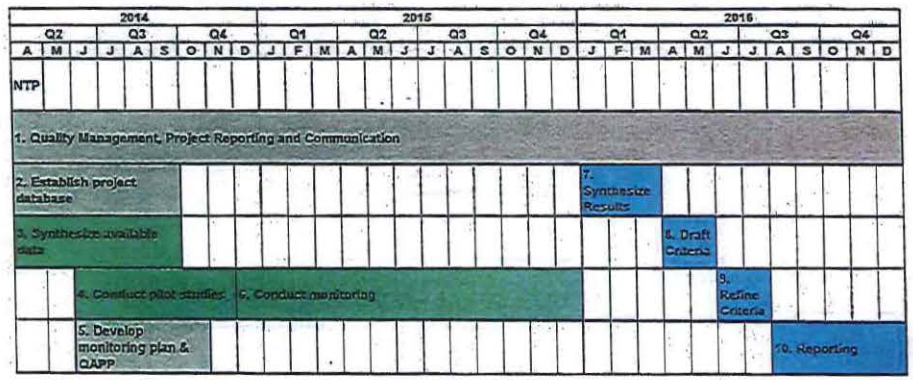
Project Schedule



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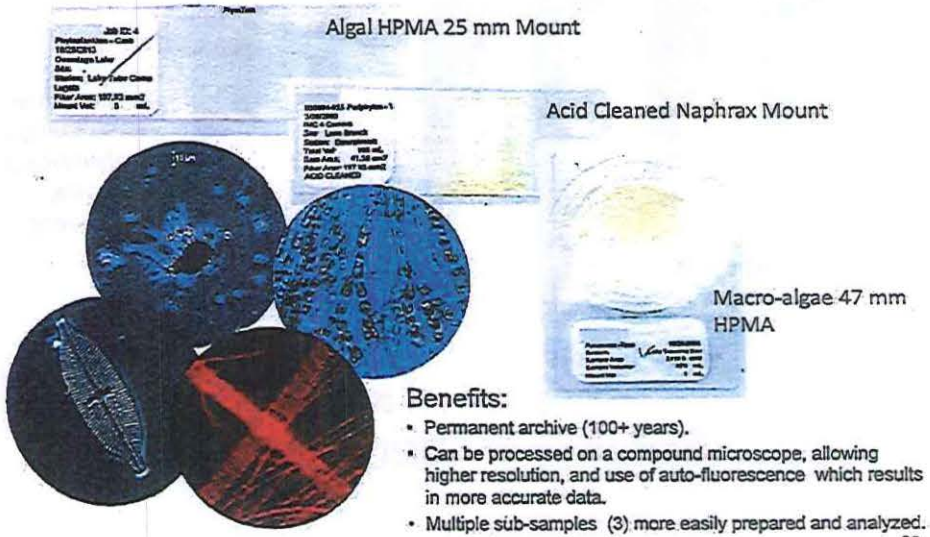
Archiving Samples Allows for Subsequent Analyses for Emerging Approaches



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

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

EPA United States Environmental Protection Agency | 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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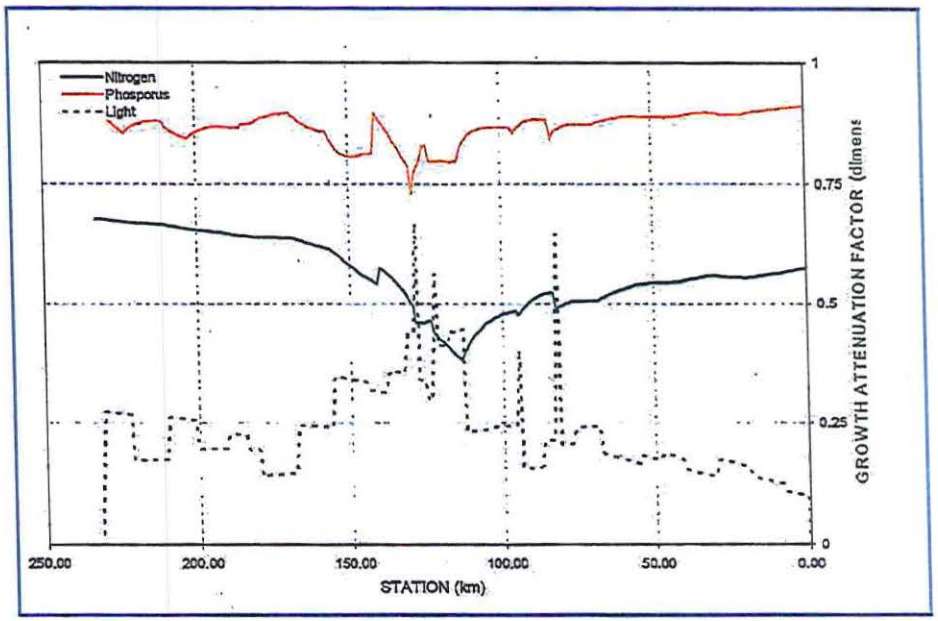
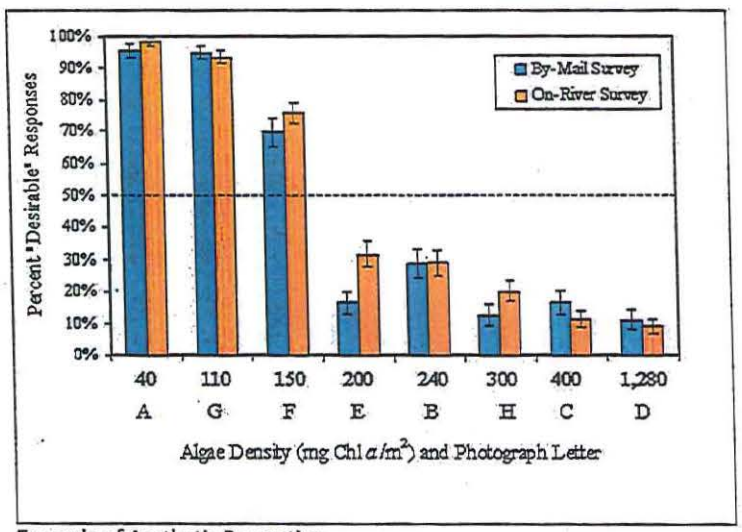


From Flynn and Suplee (2010)



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

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Attachment 4
Meeting Sign-in Sheet

SCENIC RIVERS JOINT STUDY COMMITTEE

FEBRUARY 5, 2014
9:00 AM
TULSA COMMUNITY COLLEGE NORTHEAST CAMPUS
BOARDROOM 1315, MAIN ACEDEMIC BUILDING
3227 EAST APACHE STREET
TULSA, OKLAHOMA 74115

NAME	ENTITY REPRESENTED	EMAIL
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Tom Elkins	CN	tom.elkins@cherokee.org
Pat Gwin	CN	pat.gwin@cherokee.org
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