MEETING NOTES
of the
STORMWATER STAKEHOLDER ADVISORY COMMITTEE (SSAC)
Lexington-Fayette Urban County Government (LFUCG)

Meeting: December 5, 2025
Time of Meeting: 9:00 a.m.
Location of Meeting: Phoenix Building – 3rd Floor Conference Room

Attendees:

COMMITTEE MEMBERS

Doug Burton – LFUCG Division of Engineering
Jennifer Carey – LFUCG Division of Environmental Services
Amy Clark - Town Branch Watershed At Large
Ken Cooke – Friends of Wolf Run
Amy Sohner – Chair, Bluegrass Greensource
Scott Southall - West Hickman Watershed At Large
Russ Turpin – Wolf Run Watershed At-Large

LFUCG STAFF AND REPRESENTATIVES

Hal Baillie, Division of Planning
Denice Bullock – LFUCG Division of Water Quality
Chris Chaney – LFUCG Division of Planning
Jason Drew – LFUCG Division of Water Quality
Becky Irwin – LFUCG Division of Water Quality
Chase Jones – LFUCG Division of Water Quality
Frank Mabson - – LFUCG Division of Water Quality
Craig Morgan – LFUCG Division of Water Quality
Jennifer Myatt – LFUCG Division of Environmental Services
Angela Poe - LFUCG Division of Environmental Services
Mark Sanders – LFUCG Division of Water Quality
Abby Terry – Tetra Tech, LFUCG MS4 Program Management
Bailee Young – LFUCG Division of Water Quality

OTHER ATTENDEES

Eileen Burk – Kentucky American Water
Ross Boggess, Carto Commercial
Erin Brennan, Resource Environmental Solutions
Jerry Davis – Friends of Wolf Run
Andrea Drayer – UK KWRI
Pace Cook Emmons – WaterwaysLex
Steve Evans, University of Kentucky
Al Gross, EA Partners
Tom Hatfield, EA Partners
Jon Hathaway, University of Tennessee
Don Hill – Fayette County Neighborhood Council
Ken Johnson – Citizen
Nathan Krebs – Stantec
David Lowe, Water Quality Fees Board
Doug McClaren – McConnell Springs
Richard McClure – UK FM
John McMaine, University of Kentucky
Eddie Mesta, Advanced Drainage Systems, Inc.
Tiffany Messer, University of Kentucky
John Pike – Palmer/HCC
Francois Pomerleau, Pensacola Park Neighborhood Association
Lillian Schlaug, Stantec
Ian Simpson, University of Tennessee
Brian Stephens, Ball Homes
Russ Turpin, EcoGro
Jason Unrine, University of Kentucky

Steve Vogel – Strand Associates
Mike Woolum, Strand Associates
Rebecca Stacy, Strand Associates

Opening Remarks
Amy Sohner opened the March meeting at 9:02 a.m. and asked those in attendance to introduce themselves and their organization when speaking.

Approval of 09/05/2025 Minutes
Ms. Sohner asked if there were any additions or corrections to the September 5th minutes. There were none.

A motion was made by Ken Cooke, seconded by Eileen Burk, and carried unanimously to approve the minutes of the September 5, 2025, meeting with attachments.

Wetland Solutions –Tiffany Messer, Ph.D., EIT, Assistant Professor at the University of Kentucky presented an overview on Wetland Solutions.

One of the project objectives was to observe rivers throughout the Commonwealth to determine the effects of wetland solutions as a potential solution for water quality impairments. Evaluating the presence of a suite of potential water quality impairments was important to determine the primary focus for designing nature-based solutions.

Over the past few years, studies have been done, but there is one by Dr. Emily Byers that focused on four (4) different watersheds around Kentucky, each one with different land use. The land use included Urban Watershed which is a mixture of low intensity development to high intensity development. Oil and Gas Watershed, which consists of natural gas production, brine disposal, oil and gas producers, terminated permits and unknowns. Agricultural Watershed has a mixture of forests, scrubs, crops, woody wetlands and emergent herbaceous wetlands. Mining Watershed consists of active and inactive mines, reclaimed land. For this presentation, the focus will be on Urban Watershed in Lexington, KY.

Another study focused on the emerging contaminant exposure at two wastewater treatment plants (WWTP) over two periods during 2022.

Each wastewater treatment plant was monitored:
- Upstream (Water and Sediment)
- WWTP Influent
- Biosolids
- WWTP Effluent
- Downstream (Water and Sediment)

How samples were collected through the following:
- Grab Samples:
  - Trace Elements
  - Nutrients
  - Total Organic Carbon
- Polar Organic Chemical Integrative Sampler (POCIS) measured:
  - Human Use Pharmaceuticals Personal Care Products
  - PFAS
  - Neonicotinoids & Strobilurin pesticides
- YSI portable handheld measured:
  - Temperature, discharge, pH, EC, DO

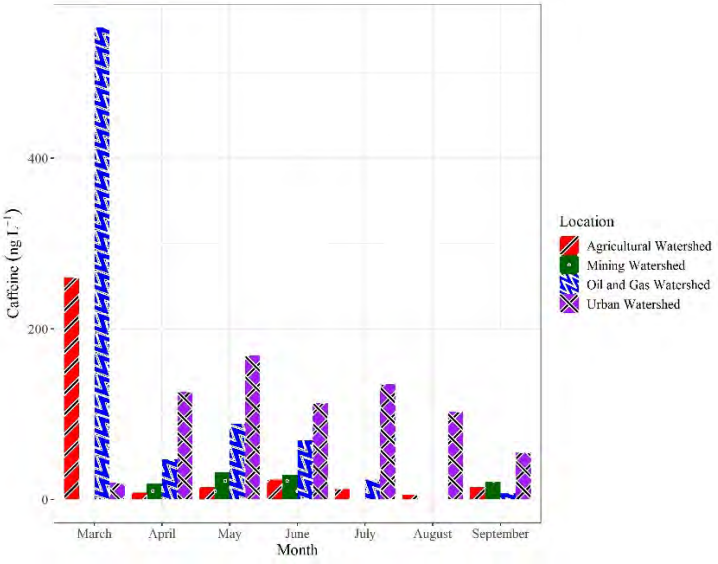
There is concern that the following items/pollutants found in our rivers may also be in our drinking water:
- Human Use Pharmaceuticals: Antibiotic resistance
- Personal Care Products: Growing human health concerns and impacts on ecosystems
- PFAS: Recent EPA requirements and growing human health concerns
- Neonicotinoids & Strobilurin Pesticides: Loss of honeybee diversity and growing human health concerns
- Metals: EPA requirements and growing human health concerns
- Nutrients: Harmful Algal Blooms (HABs)

Items that were observed in the different land uses:

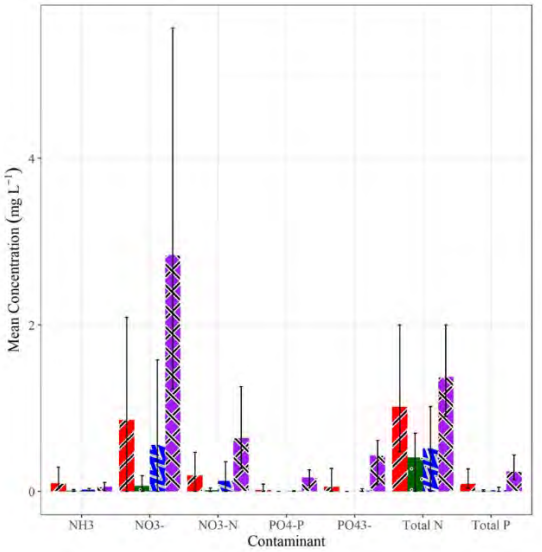
- Urban Site
  - High in nutrients (N and P), chloride imidacloprid, and caffeine
- Oil and Gas Site
  - High in PCPs such as caffeine due to older wastewater infrastructure
- Agricultural Site
  - High in trace elements during flood conditions and high in herbicides (e.g., atrazine, alachlor)
- Mining Site
  - High in SO_4^{2-} and glyphosate after a major flooding event

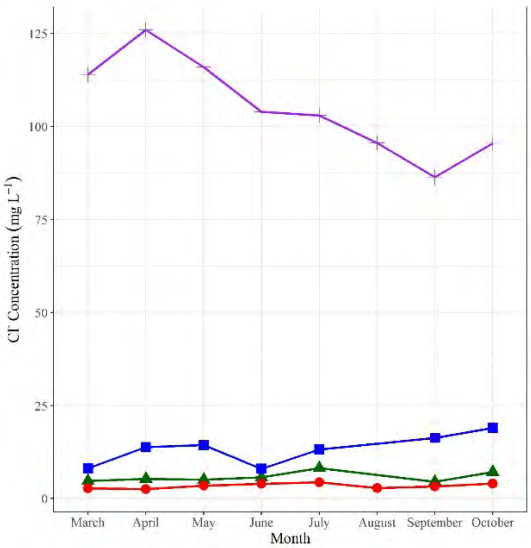
Dr. Messer briefly described what was observed in streams that were monitored.

Personal care products, including caffeine, were present in surface waters in rural watersheds, likely due to older wastewater infrastructure along with the urban watershed.

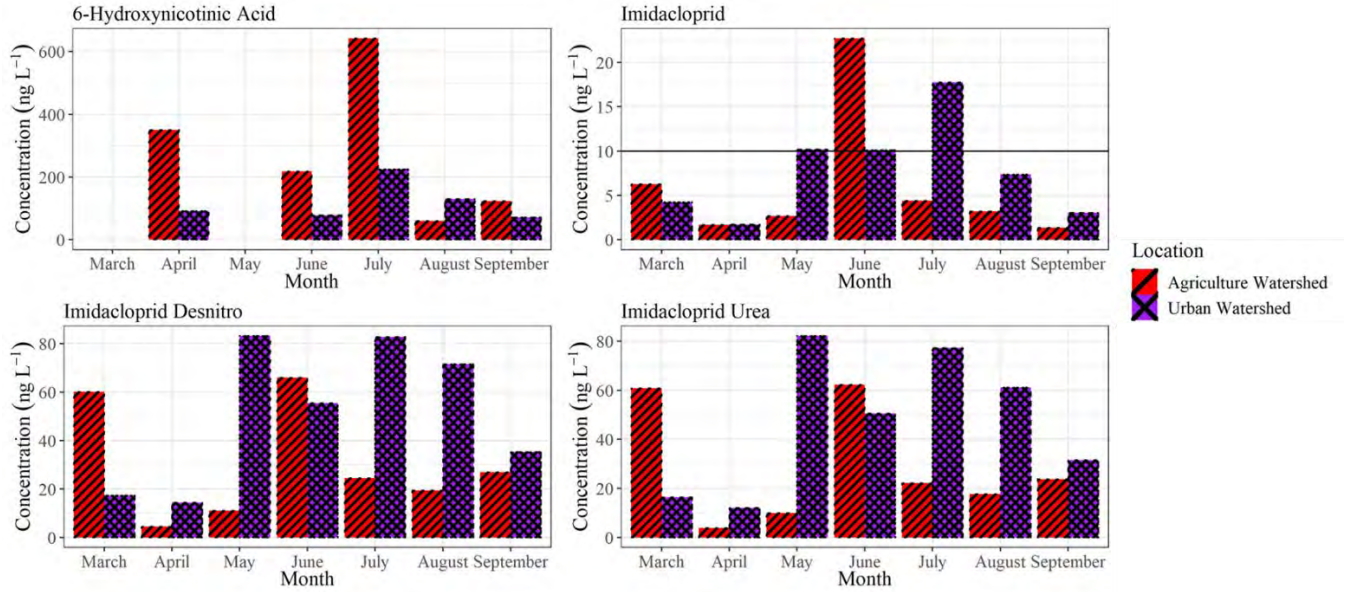


The urbanized watershed had the highest nutrient concentrations and loads particularly during spring months



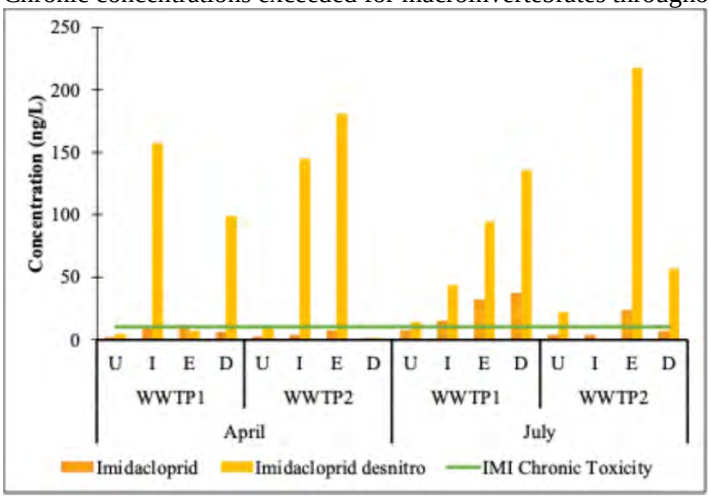


Imidacloprid and its by-products were consistently present in both the agricultural and urbanized watersheds



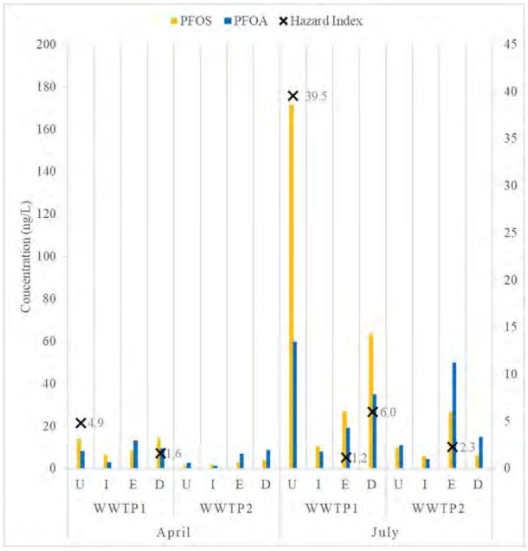
Dr. Messer briefly described what was observed at the WWTP and if there was anything coming out of those plants that might be of interest to utilize wetland solutions.

Chronic concentrations exceeded for macroinvertebrates throughout the study for imidacloprid



Hazard indexes set by the EPA for drinking water were exceeded

- Upstream to WWTP (U) likely due to firefighting training facility
- Downstream of WWTPs (D) in the more urban system
- In effluent (E) of the more urban system likely due to metabolite formations in the WWTP



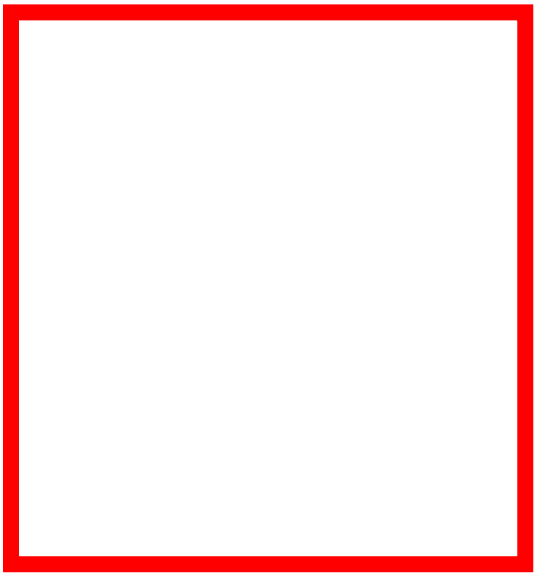
***Note this is not drinking water but can be potentially used by downstream communities as source water.*

Dr. Messer then explained how to utilize wetlands to potentially improve water quality impairments.

The depiction below illustrates four (4) types of wetlands that are used in wastewater treatment. Many other countries, primarily Europe and Asia, use them for a wide range of treatment applications, even the mining industry.

Free Water Surfaces - soil, aquatic plants and open water.

Floating Treatment Wetland - soil, open water and a man-made floating mat which allows the roots of the aquatic plants to dangle in the water. This design has been used on golf courses, and the homeowner association.

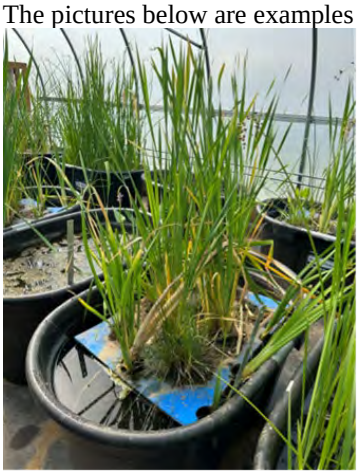


The Subsurface Flow Treatment Wetland and Vertical Flow Wetland have more to do with wastewater treatment.

The focus of this presentation will be Free Water Surface and Floating Treatment Wetland since those are more applicable for stormwater control.

To see if wetland solutions work, the objective was to determine if various designs of treatment wetlands could be utilized for improving water quality impairments observed in Kentucky; and identify which mechanisms are being utilized to remove various contaminants of interest to enhance designs.

The pictures below are examples of the Floating Treatment Wetland.



This design has soil at the bottom and a man-made mat floating in open water to allow the roots of the aquatic plants to dangle in the water.

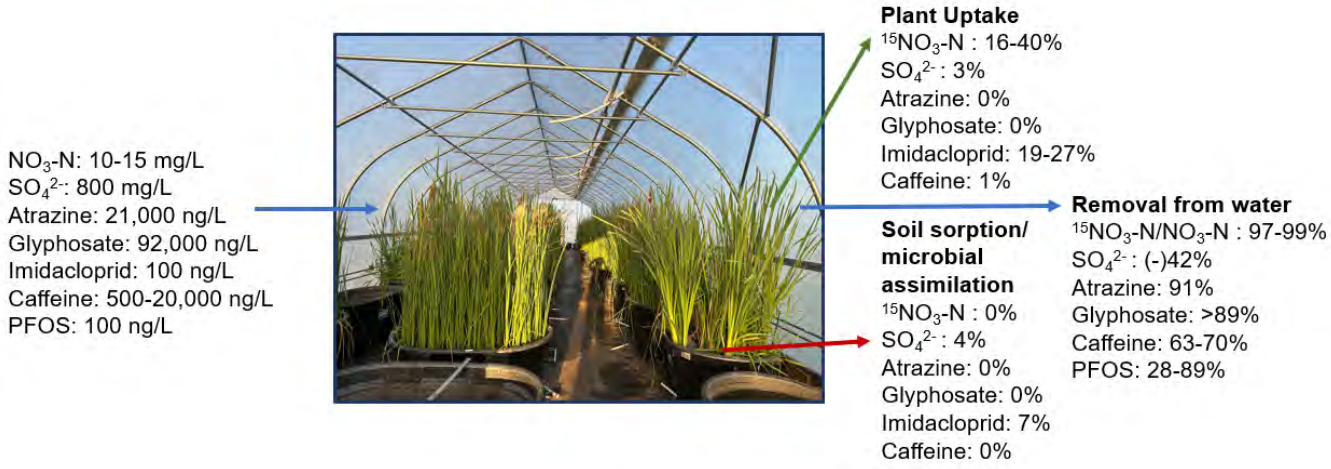
This design uses Soft-stem Bulrush, an exceptionally good plant that can filter pollutants and is more efficient in the removal process of the different contaminants.

Dr. Messer explained the differences between rural mix and urban mix.

Trial	Rural Mix	Urban Mix	Controls
5/22-6/1	NO_3-N (10 mg/L)	NO_3-N (10 mg/L)	NO_3-N (10 mg/L)
6/13-6/23	Atrazine (21,000 ng/L) + NO_3-N (10 mg/L)	Imidacloprid (100 ng/L) + NO_3-N (10 mg/L)	
6/26-7/6	Glyphosate (92,000 ng/L) + NO_3-N (10 mg/L)	Caffeine (550 ng/L) + NO_3-N (10 mg/L)	
7/31-8/10	SO_4^{2-} (800 mg/L) + NO_3-N (10 mg/L)	PFOS (100 ng/L) + NO_3-N (10 mg/L)	
8/13-8/23	Mixture of above contaminants + NO_3-N (10 mg/L)	Mixture of above contaminants+ NO_3-N (10 mg/L)	
9/8-9/18	Mixture of above contaminants +NO_3-N (15 mg/L)	Mixture of above contaminants +NO_3-N (15 mg/L)	NO_3-N (15 mg/L)

Sample	0	1	2	3	5	7	10
PFOS/Caffeine/Imidacloprid/Atrazine/Glyphosate/SO_4^{2-}		X			X		X
DOC		X			X		X
NO_3-N, NH_4-N, & PO_4^{3-}	X	X	X	X	X	X	X
pH, SPC, TDS, DO, T, ORP, & depth	X	X	X	X	X	X	X

The next illustration shows the concentrations that were used versus what was removed from the water, plant uptake by the plant and soil sorption/microbial assimilation over a 10-day period.

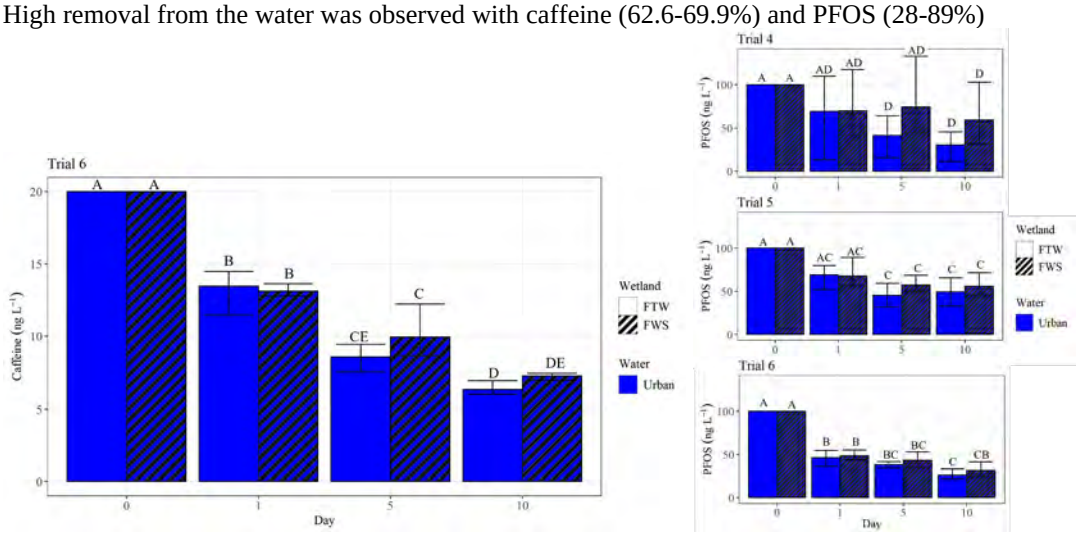


The overall impacts on the nitrate removal, include 97-99% of the NO_3-N were removed from the wetlands after 10 days. The vegetation had a positive effect on Nitrogen removal. The Floating Treatment Wetlands resulted in a higher rate of NO_3-N removal in the presence of the mixtures while the Fresh Water Surface were inhibited by the mixtures.

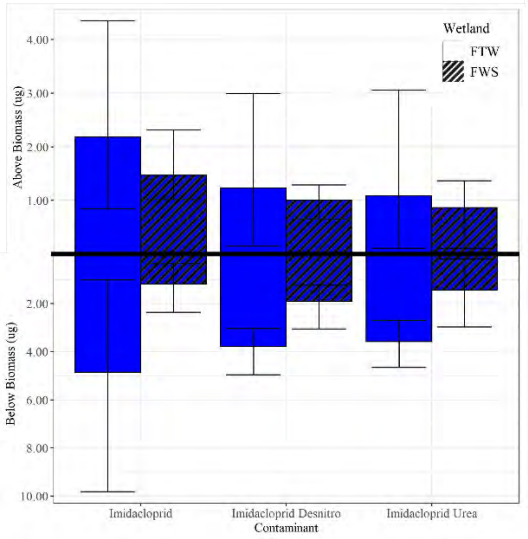
The Fresh Water Surface outperformed the Floating Treatment Wetlands earlier in the growing season (May-June), while the Floating Treatment Wetlands outperformed the Fresh Water Surface when mature plants were established (July-September). This is important because it provides guidance on which design would be better to use based on the issues that are occurring.

Dr. Messer illustrated graphs showing a reduction up to 89% for PFOS as well as 70% for caffeine, depending on the design that was used.

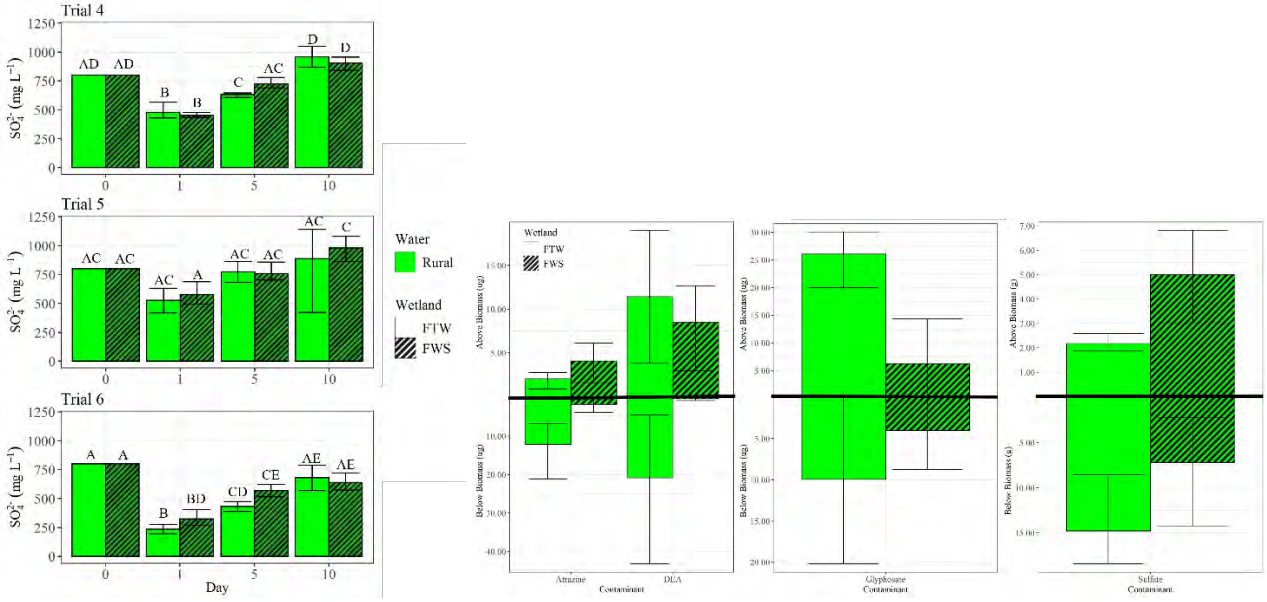
High removal from the water was observed with caffeine (62.6-69.9%) and PFOS (28-89%)



There was between 25-34% of the imidacloprid taken up by the plants or soil: 27% Floating Treatment Wetlands plants; 19% Free Water Surface plants and 6 to 7% Soil. This particular type of pesticide was primarily degraded through UV so the more UV penetration the more reduction will occur.

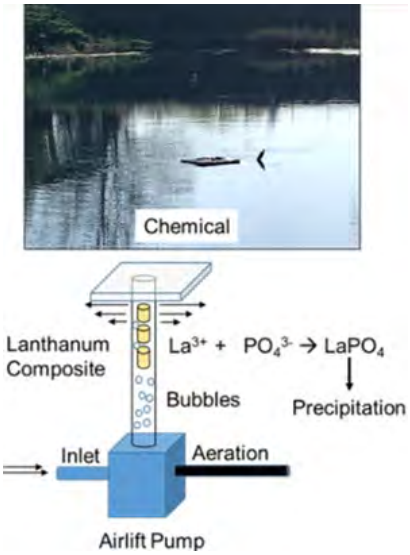


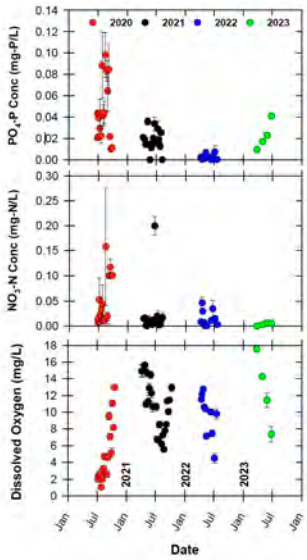
Given the challenges with glyphosate and atrazine there was over 90% removed from the water.



Dr. Messer indicated that the next objective was to determine if floating treatment wetlands could be used in a full-scale wetland environment with a history of algal blooms. During her time in Nebraska, the team installed floating treatment wetlands at two different ponds - one next to a YMCA and one at a golf course. The key was to cover the pond by about 10% to start seeing positive benefits for these systems. However, if there was already an existing problem, such as phosphate, more needed to be done to the pond other than placing a wetland on top of it. To address the phosphate problem, they used lanthanum composite to remove phosphate in wetlands by chemically binding to it, forming highly stable, insoluble lanthanum phosphate that algae and plants cannot use, effectively starving them and preventing harmful algal blooms.

When reviewing the data from a chemical approach, after the lanthanum composite were used there was a decrease in phosphate and nitrate levels, but not the dissolved oxygen levels between 2020 to 2023. This data shows that once the wetlands were installed there was an effective removal of these contaminants while maintaining a strong dissolved oxygen level for aquatic life.

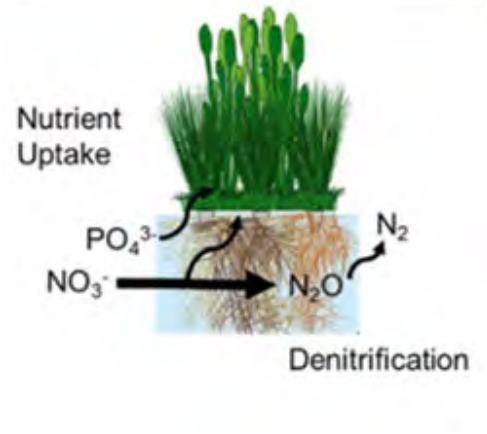


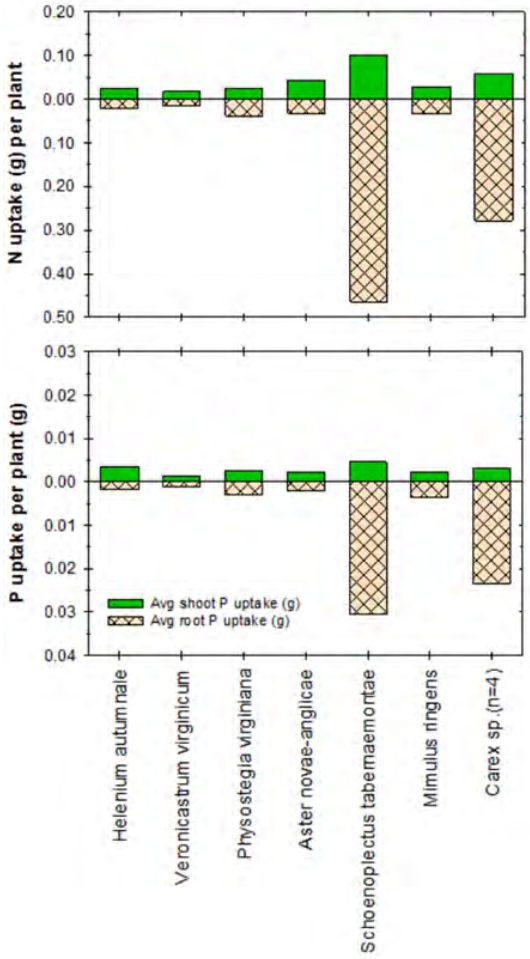


When reviewing the data from a biological approach, one of the challenges for this system was birds, typically geese because they were eating the plants. By placing fencing around the floating treatment wetland, it helped deter the birds from landing because they did not have a way to escape. Another challenge was the Nebraska climate in winter months. They used native species that were meant to survive, secured the wetland to the bank then pushed it back out in the spring.

To help have a better idea for management, one of the things that the students were looking at was how much nitrogen was being taken up into the plants. Nitrogen and phosphorus showed a strong amount below-ground biomass versus the minimal above ground biomass. Depending on the time of the year these results may change, but for this study the nitrogen and phosphorus levels shown in the below chart were at the end of the growing season when the plants started to assess and hold onto nutrients in their roots.

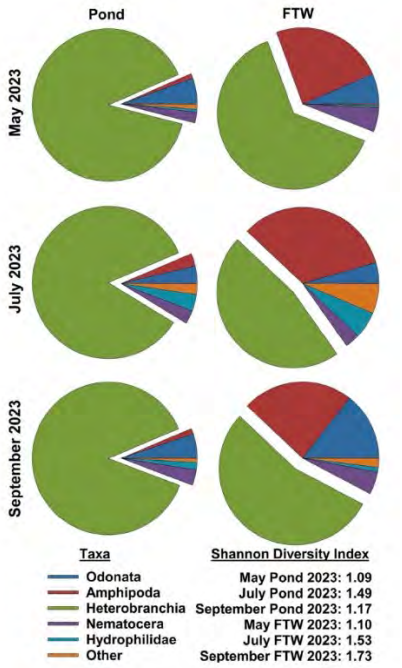
Another thing that was investigated was if the above ground biomass should be removed earlier in the season and if allowing it to regrow was an effective way to remove some nitrogen from the system. This can be done through maintenance throughout the year.





In Nebraska, the big concern was the overall ecosystem. A study was completed on macroinvertebrate diversity. The chart below shows a significant increase in diversity under the floating treatment wetland versus other areas of the pond. The study showed that even though the dissolved oxygen levels are lower beneath the floating treatment wetland, the fish preferred that location.

Another question that was asked was if lanthanum will destroy the fish. A fisheries expert performed a study that looked at how much lanthanum was accumulated into the fish tissue and how it would impact them. The results showed there was very minimal lanthanum found in the fish tissue over a two-year period.



The pictures below illustrate how the pond looked like from July 2020 to June 2022.

Dr. Messer acknowledged the team that made this study possible and the funding that made this possible.
NSF Grant #2042761 and #1922695
USGS 104(b)
Nebraska Department of Environment & Energy
Nebraska Environmental Trust
319 Funding Project 56-2186
USDA NEB-38-111 and W-5045
Co-Authors
*meso*Team

Comments and questions: Amy Clark asked if the floating treatment wetland is freestanding. Dr. Messer replied that they recommend anchoring the wetland because storms can lift and move them around in the pond. The best location to have the wetland is the inlet because this is where the highest chance of absorption, uptake and removal of nutrients occurs before the nutrients are diluted further out in the water.

Ross Boggess asked about dredging. Dr. Messer replied that she is not a fan of dredging, but sometimes the system needs to be restarted and reset. Removing a good portion of the phosphate can be exceedingly expensive, but as the system is being reset, phosphate is not being released every day creating an algae bloom. The system can only take so much and there are only so many absorption points. If your oxygen levels get low and the majority of the absorption locations are iron, that will release phosphate into the pond. If there is high iron and high phosphate, the recommendation may be to reset the system and use other managements as ways to keep the water clean. This method will not fix something that is already deteriorated but will help in maintenance.

Ken Cooke asked how many different papers were presented for this presentation. Dr. Messer replied six papers were presented, but there are five more papers primarily focusing on how to utilize the different types of other applications to enhance these systems to work more efficiently.

Mr. Cooke then asked if the papers are publicly accessible. Dr. Messer replied yes and those can be shared with the public. There are a couple of extension documents on wetlands in Kentucky that were just released as well as programs about wetlands and their importance available for a K-12 audience.

Mr. Cooke asked what research is being done for the Lexington area. Dr. Messer replied that the University of Kentucky received funds through the U.S. Geological Survey's 104(g) National Competitive Grants Program to primarily look at how to remove PFOS and would a floating treatment wetland, free water or subsurface be most efficient at removing PFOS, as well as to determine which mechanisms would be an improvement. There are others looking around the state at other different types of contaminants and how to utilize biochar to effectively absorb some of these contaminants that are present.

Frank Mabson asked about the cost. Dr. Messer replied there are several factors to consider such as the location, how much dirt will be moved, will a liner be used, how many plants will be needed, the cost of the plastic mat and so forth. A surface wetland will be exceedingly more expensive, but a floating treatment wetland might be more effective.

Russ Turpin asked about comparing the floating wetland island benefits versus planting a buffer along the bank. He noted Homeowner Association that own ponds may be approachable with having a floating wetland island but still want to mow right up to the edge of the water. Dr. Messer replied buffers are the cheapest option, but some Homeowner Association, distilleries, golf course and other locations want to see the edge of the pond. Particularly for phosphorus, if there is a buffer, it would help remove sediment resulting in less dredging. The bigger question is how we educate homeowners and property owners on when and how to apply fertilizer. Not everyone understands or knows how much fertilizer to put down and the repercussions of fertilizer on ponds.

Andrea Drayer asked about the life expectancy and maintenance required and expressed concerns about diminishing returns. Dr. Messer replied it’s going to be a cost benefit analysis based on the particular wetland. There are a couple of people who have done cost benefit analysis on floating treatment wetlands, but those are based on North Carolina.

Urban Growth Master Plan Overview

Hal Baillie, Division of Planning, Long Range Manager, presented an overview on the Urban Growth Master Plan.

Lexington, KY was the first to establish an Urban Service Area in the United States in 1958. This was specifically done to control urban growth sprawl to ensure that Lexington was growing in a fiscally responsible manner and it wasn't sprawling out in the way a lot of other communities were doing in the 1950s.

The Urban Service Area was expanded several times throughout the years, and it is now approximately 89 square miles. Lexington has been growing in a fairly efficient manner to ensure that the expansion is not beyond our financial needs or infrastructure establishment.

In the 1970s areas were added to the Urban Service Area to preserve some of our cultural identity as the Horse Capital of the World, as well as highlight the fact that the area has unique opportunities.

Lexington was the first to establish an Urban Service Area, but they were not the best with the sporadic expansions. Recently the Urban County Council has been feeling the pressure of needing more housing within the community. There are a lot of reports saying Lexington is behind in developing affordable housing and that is the case for a lot of areas in the United States. The prospect is if Lexington increases the supply of affordable housing, then it would level off the cost of housing.

In 2023, The Lexington-Fayette Urban County Council adopted the Goals and Objectives for the 2045 Comprehensive Plan with language stating that the Urban Service Area shall be expanded. The Division of Planning wanted to review the Expansion Area Master Plan looking at how the expansion would be done with a focus on housing and land use recommendations.

The Planning Commission recommended five (5) areas for expansion. Each of the below locations were based off the current Urban Services Area that were along major corridors to ensure the best road connectivity and to provide connection with sanitary sewer since those two items have the biggest cost impact and the potential to provide gateway moments into Lexington.
1. Parker's Mill and Man of War Blvd.
2. Winchester Road between I64 and I75.
3. Athens Boonesboro Road and Todd's Road adjacent to I75.

The last area to be developed will be Parker’s Mill due to the sanitary sewer capacity and how to increase the capacity at the Mint Lane Pump Station and the facilities needed for that region.

The focus of the Urban Growth Master Plan was to try to get the greatest amount of density, a mixture of land uses, a mixture of housing types to create the best development within our community. The 1996 expansion did not provide the necessary density for the community, the walkability aspect or the different level of housing.

Now, the goal of the Urban Growth Master Plan was to look at the different levels of housing, a mixture between single family, detached, attached, and multifamily. Having the diversity of land uses; amenities and things to do; more market support for retail, and jobs; a greater walkability and shorter trips and a sense of discovery (random encounter). Density should support a mixture of land uses in one space so there is less congestion on our roadway systems and allowing people to walk instead of driving to the different amenities around town. A well-designed gentle density means to have greater amounts of density but make it on a scale and in mass with what is adjacent to it. This allows people to live in different housing types, housing developments, and not be overshowed by a 10-story building.

Another aspect of the Urban Growth Master Plan is connectivity. The 1996 expansion did not do a good job within our community preparing for the future. The goal is to ensure that transitions from higher corridor roadways to local roadways for more intentional developments. When Hayes Boulevard area was developed, it was developed with a buffer between the back of the houses on Larkhill Lane and the adjacent land. The buffer created a lack of connection between existing and future developments; it created major traffic issues because it pushes vehicles onto Athens Boonesboro Road; it created no connection to existing infrastructure. It has essentially created two separate developments and has made it harder to provide some type of equity in this area.

Another aspect of the Urban Growth Master Plan is to provide a multimodal transportation network in a more holistic way rather than just moving people in vehicles. A transportation network would ensure the possibility of having mass transit in areas that bring future development of job producing, destination type developments as well as higher density residential.

Mr. Baillie presented several slides outlining the different types of land use and gave a brief description.

Low Density - 7-13 net dwelling units / acre
- Primarily single-family
- Single-family with ADU
- Low density multifamily
- Townhouses
- Corner stores

Medium Density - 11-25 net dwelling units/acre
- Primarily single-family
- Single-family with ADU
- Low density multifamily
- Townhouses
- Multiple family with up to 10 units
- Corner stores

High Density - 23+ net dwelling units/acre
- Multiple-family dwellings
- Commercial

Village Center - 20+ net dwelling units / acre
- Retail/restaurant, office, and residential uses.
- Single-family (less than 10% of units) Townhouses
- Multiple-family dwellings
- Mixed-use

Village center size: min. 10 contiguous acres

Town Center - 30+ net dwelling units/acre

Serving adjacent neighborhoods as well as other areas within a 10- to 20-minute drive.

- Retail or restaurant
- Office
- Residential uses

Town center size: minimum 20 contiguous acres

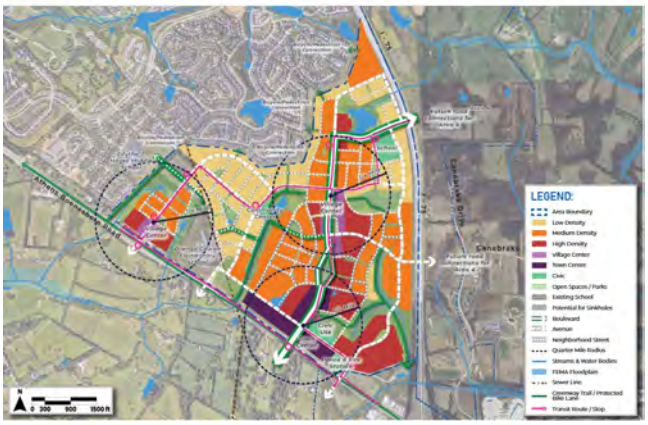
Flex Space - Density: n/a
- Retail or restaurant
- Office
- Industry
- Recreation
- Other regionally significant attractions
- Secondary uses include all residential uses

Mr. Baillie presented the slides below outlining the Initial Framework Planning and gave a brief description.

Regulating Plan - Area 1

Regulating Plan - Area 2

Regulating Plan - Area 3



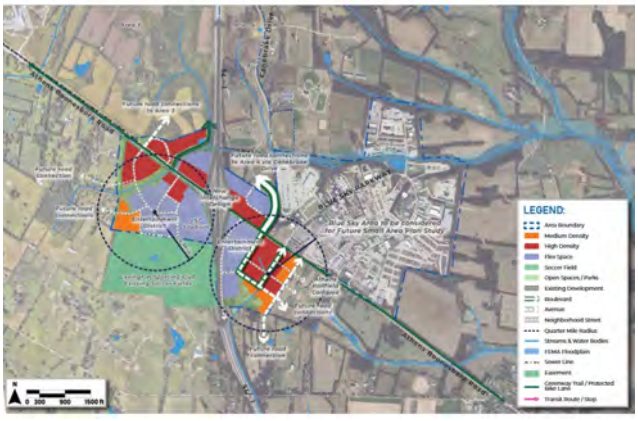
Regulating Plan - Area 4

Area 4 has the potential to provide another circulation option from Todds Road to Athens Boonesboro Road, while unlocking land for development in an area of Lexington that has seen steady growth.

Highlights of the Area 4 Regulating Plan

- A Town Center is located along Todds Road to continue the momentum and growth of the previous Expansion Area Master Plan along Polo Club Boulevard.
- Another Village Centers serving the surrounding neighborhood exists further into the site and has the potential to flourish if the connection across I-75 is accomplished.
- A main Boulevard spine connects from Athens Boonesboro Road to the south, to Todds Road to the north, following the general alignment of Canebrake Drive.
- A direct connection to Polo Club Boulevard is impeded by existing development.
- Two potential connections crossing I-75

Regulating Plan - Area 5



Mr. Baillie noted that the Council is currently reviewing the Lexington's Preservation & Growth Management Program (https://engage.lexingtonky.gov/lpgmp), and explained that LPGMP is a program that helps guide the Planning Commission and the Urban County Council on long-term land use decision to manage urban growth and preserve agricultural land.

Comments and questions: Pace Emmons said that there is already a lot of traffic on Parkers Mill Road and now the property at the intersection of Parkers Mill Road and Lane Allen Road is being developed. Mr. Baillie said that area has been a concern for some time, but there is an opportunity for the Division of Planning and the Metropolitan Planning Organization to review and upgrade that road. The Urban Growth Master Plan will give the opportunity to ensure that roads are planned for not only the urban areas but also the rural areas.

Ross Bogges asked whether the Urban Growth Master Plan was adopted by developers and landowners and about the process. Are people guided towards that or has that been adopted by developers and landowners? Mr. Baillie replied that the Urban Growth Master Plan is adopted by the Planning Commission and it used when there is an application to rezone a property. For the most part, the areas that were previously mentioned are zoned Agricultural Rural (A-R). When there is a request for a new development the applicant will need to apply for a zone change, which is then heard at the Planning Commission's public hearing.

There are three (3) options to choose from when a zone change application is submitted.
1. The proposed development agrees with the Comprehensive Plan, which means it agrees with the Urban Growth Master Plan.
2. There has been a change in socioeconomic or physical nature out in those areas.
3. The proposed development cannot meet the Comprehensive Plan, and there is something more appropriate.

There have been two (2) zone changes on Canebreak Drive, and it is anticipated there will be more in the future, which is why it is important that the infrastructure funding plan is set to ensure that the developers are meeting the goals as requests come in for pre-application meetings and feasibility meetings.

Jason Unrine asked if the Division of Planning was looking ahead over the next 50 – 100 years at floodplains and the amount of stormwater runoff. Mr. Baillie replied that a Comprehensive Plan Amendment does not review stormwater runoff enough. There needs to be a greater change in the Zoning Ordinance and the Stormwater Manuals to address stormwater runoff. The Zoning Ordinance currently lays out certain things that need to be done such as setbacks off blueline streams/floodplains. The Division of Planning is in the process of reviewing the floodplain regulations and they would like to have the public input as the process moves forward.

Ken Cooke said that it was mentioned that the 1996 Comprehensive Plan was more robust than now and asked for a comparison between 1996 and the most recent Comprehensive Plan. He then asked what is being done in terms of cost analysis and connectivity for stormwater systems for those kinds of plans. There was a great deal of pre-monitoring and study done before 1996. I have not seen that evaluated nor have I seen that compared to current data and asked if the Division of Planning has any plans. Mr. Baillie responded that the difference between 1996 Comprehensive Plan and the 2045 Comprehensive Plan is the 1996 version was targeted at a specific area; whereas the current Comprehensive Plan is utilizing Stormwater Manuals, which is not a focused study on one specific area. It is general rules and regulations that guide development. The word "robust" meant the 1996 version was developed at a slower pace so that each unique feature of areas of development was reviewed. Right now, the Stormwater Manual is being utilized, which the current regulatory framework.

The Division of Planning did not do pre- and post-flow or analyses on some of these things largely because the staff was told you have one-year to do develop the expansion plan.

Mr. Cooke commented that the Stormwater Manuals are alright for individual developments in terms of how hydrology affects things but the connectivity between these developments is not being reviewed or studied. He does not see the Comprehensive Plan being looked at in terms of the different disciplines connecting these developments. Mr. Baillie responded that the Division of Planning, Long Range Planning is not charged with that, but it would be an appropriate conversation among the Stormwater Stakeholder Advisory Committee as the Stormwater Manual is being reviewed. He explained that Long Range Planning would hope to conduct more studies and support those studies, but is focused on land use development. Developments that are next to developments get into private property rights within the State of Kentucky. The development process is controlled by property-by-property value.

Data-Driven Insights from Lexington's MS4 Monitoring Program

Dr. Ian Simpson and Dr. Jon Hathaway from the University of Tennessee presented an overview on the Data-Driven Insights from Lexington's MS4 Monitoring Program.

Dr. Simpson said that the Watershed Focus Monitoring Program used Third Rock Consultants, volunteers and Lexington-Fayette Urban County Government staff to collect water samples so data could be collected for wet stream chemistry, dry stream chemistry, wet outfall chemistry, dry/scheduled outfall chemistry, physical habitat – RBP, macroinvertebrates – MBI and fish – IBI. The chemical analytes that were reviewed included Total Suspended Solids; Nutrients such as Ammonia (NH_3), Nitrate/nitrite (NO_{2+3}), total Kjeldahl nitrogen (TKN), total nitrogen (TN); Dissolved phosphorous (DP), total phosphorus (TP); as well as *Escherichia coli* (*E. coli*).

The objectives for this data set included
1. Correlations of pollutants and stream assessments.
2. Quantify stream concentrations
   a) Wet vs dry weather
3. Identify watersheds with excessive pollution and locate hotspots.

Dr. Simpson said that they wanted to look at the more recent water quality, so the data provided was limited to January 2015 – December 2024. 2015 was when the Watershed Focus Monitoring Program was established. He gave a brief explanation of the graph below.

Pollutant	Sample Count - Streams				Sample Count - Outfalls			
	Label	Total	BDL	ADL	Label	Total	BDL	ADL
TSS	WQWet	325	33	0	WQWet	36	0	0
	WQDry	331	110	0	WQ	2234	0	0
E. coli	WQWet	357	1	16	WQWet	36	8	7
	WQDry	331	5	0	WQ	2234	63	1
NO_{2+3}*	WQWet	333	12	0	WQWet	36	3	0
	WQDry	331	0	0	WQ	2233	15	0
NH_3	WQWet	334	194	0	WQWet	36	1	0
	WQDry	331	265	0	WQ	2233	125	0
TKN	WQWet	334	208	0	WQWet	0	0	0
	WQDry	331	224	0	WQ	0	0	0
TN	WQWet	333	-	-	WQWet	0	-	-
	WQDry	331	-	-	WQ	0	-	-
DP	WQWet	334	16	0	WQWet	0	0	0
	WQDry	331	19	0	WQ	0	0	0
TP	WQWet	334	8	0	WQWet	32	3	0
	WQDry	331	10	0	WQ	2234	126	0

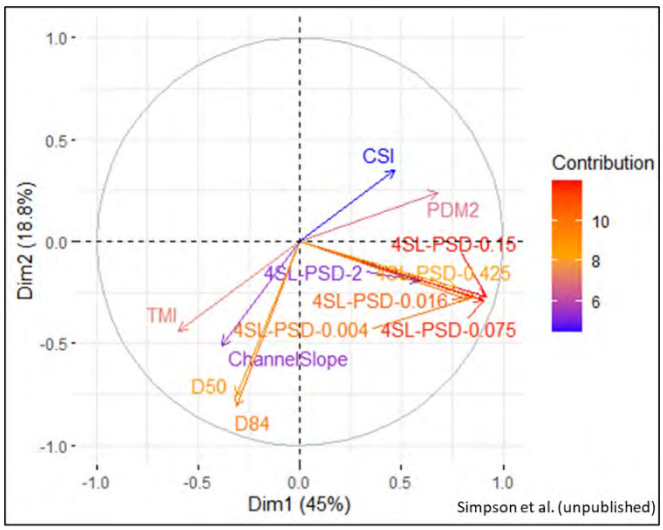
*Samples collected from outfalls were only analyzed for NO_3 not NO_{2+3}.
- Not represented since TN is the sum of TKN and NO_{2+3}.

Methods - Correlation

- Multiple factor analysis (MFA)
- Visualize multivariate relationships among datasets
- Similar to principal component analysis
- Results in a circular biplot of dim1 vs dim2, dim2 vs dim3, etc.
- Vectors – orientation, length

The first objective was to determine the Methods – Correlation analysis used a Multiple Factor Analysis (MFA), which is like a commonly known statistical test called Principal Component Analysis. The MFA is more sophisticated and can handle data sets that have different ranking schemes, different methods of quantification, and different periods of missing data versus when there is data.

The results showed the vectors of the different parameters such as the water quality, the fish scores, the macroinvertebrates and so forth. A cluster of vectors together shows a correlation between them and the longer the vector is the stronger the correlation is. The chart below was used when there is a lot of data and how they may relate to one another.

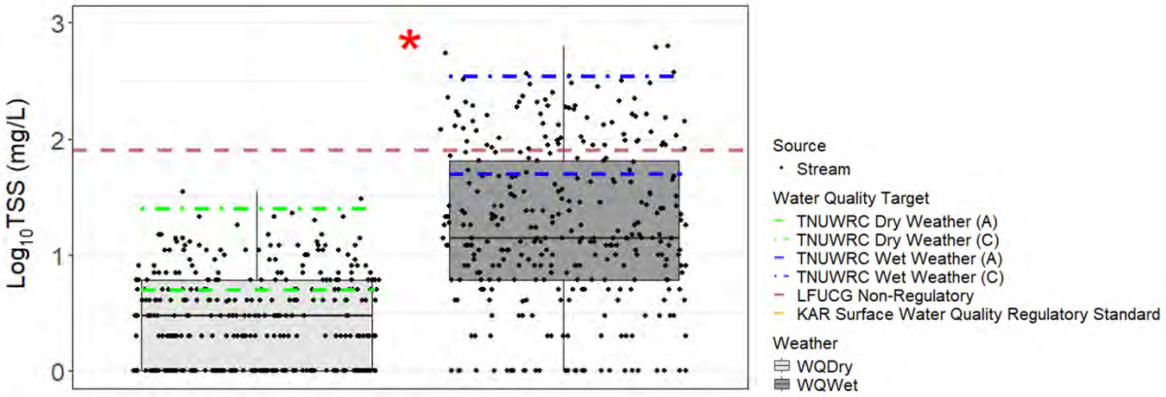


Methods - Quantification

- Stream chemistry
- Wet vs dry weather
- Wilcoxon rank sum test with Holm correction
- Ecological and human health thresholds
  - Tennessee urban waters report card
  - Lexington benchmarks
  - KAR surface WQ regulations

The second objective employed was to look at the distribution of data for chemistry in dry periods of time versus wet periods of time. Reviewing the chart below, he explained that the box to the left plots dry weather stream sample and the box to the right plots stream sample collected in wet weather.

The chart below illustrates two results that were related to distribution of samples to different references to different targets. He noted the location of KAR Surface Water Quality Regulatory Standards, the LFUCG Non-Regulatory Standards and the Tennessee Urban Waters Report Card Standards on the chart.



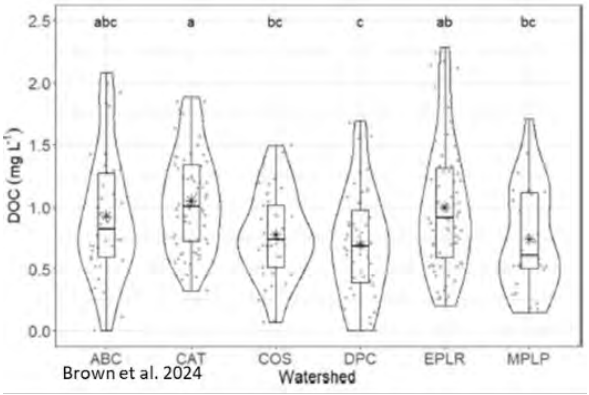
The Tennessee Urban Waters Report Card Standards creates thresholds for different chemical parameters that are often seen in Tennessee streams. Those thresholds were not based off solely Tennessee data, but rather it was based off Southeast United States data. There is some applicability to relate Lexington data to these. They collected reference stream data throughout Tennessee from online sources and from published materials and aggregated all the data to make a professional judgment breaks on where those would be. In the ranking scheme included grades for they considered A quality, B quality, C quality and DNF.

Methods – Watersheds & Hotspots

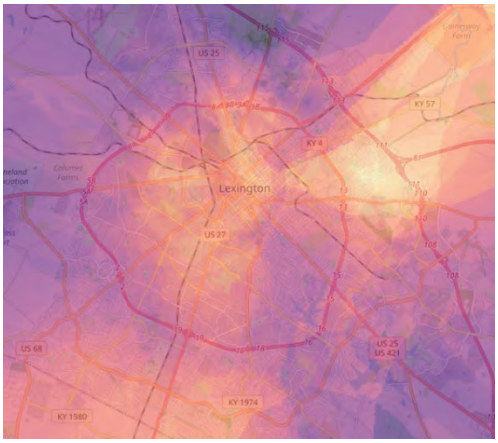
- Stream chemistry by watershed
  - Wet and dry weather
  - Tukey's honest significant difference test (wet)
  - Lettering system (wet)
- Interactive spatial analysis (TSS, TP, E. coli)
  - Plotting of sampling locations (wet stream, dry stream, dry outfall)
    - Color (median), size (exceedance of threshold), outer ring color (season)
  - Kriging – spatial analysis mapping technique

The third objective was a multiple comparison test to understand the difference between one watershed versus another watershed in wet weather and dry weather.

The diagram below shows a lettering scheme on the top or the bottom. If two watersheds have a similar letter that means, there was not a statistical difference. However, if two watersheds do not share a common letter then that watershed may have been problematic. It does not say where the problem was located within that watershed.



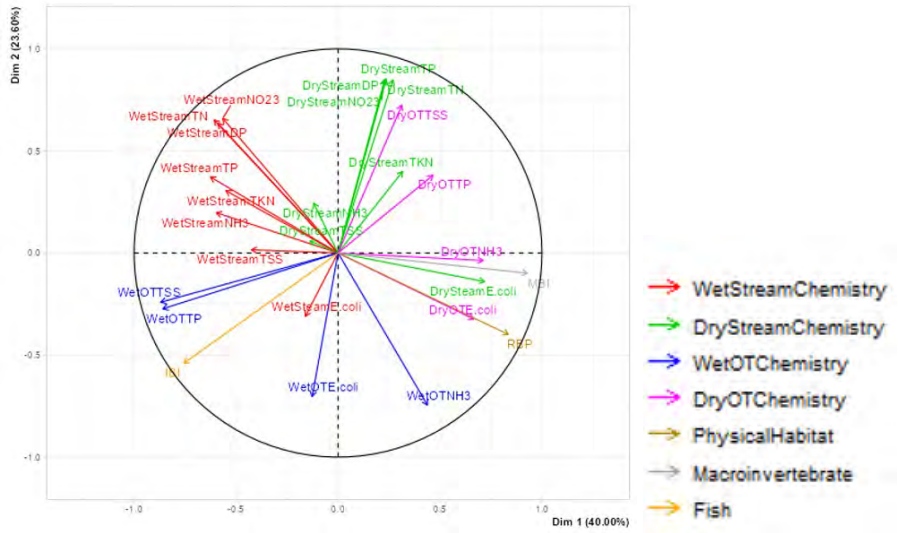
The next step was to create a coding platform using ArcGIS that illustrated statistical technique called Kriging. Kriging is a geostatistical interpolation technique used for spatial data to estimate values at unsampled locations. He explained that they plotted the wet stream concentrations, the dry stream concentrations, the outfall concentrations to create a map to overlap where the hot spots might be located.



Dr. Simpson presented the following slides and gave a brief description of each.

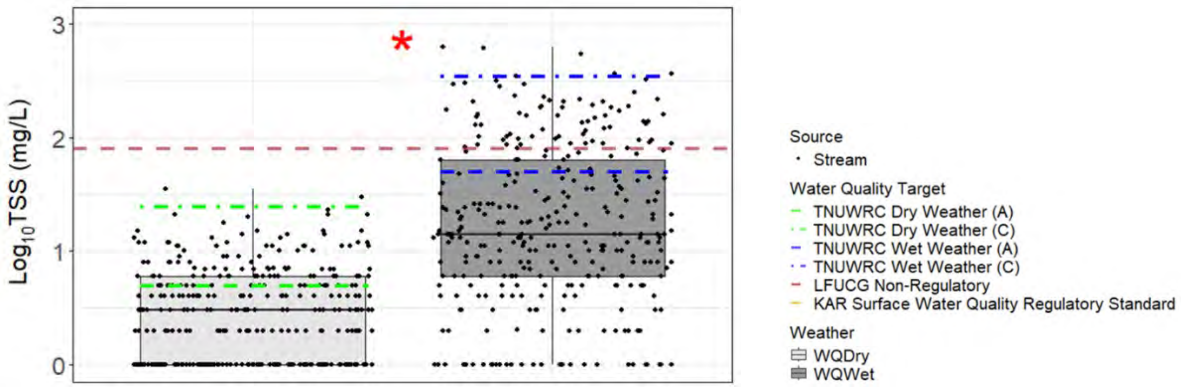
Correlations

- Dim1 degradation gradient
- Dry pollution in streams relates to poor MBI and RBP
- Wet pollution in streams related to fish
- Dim2 weather or season gradient
- No correlation between wet and dry pollution



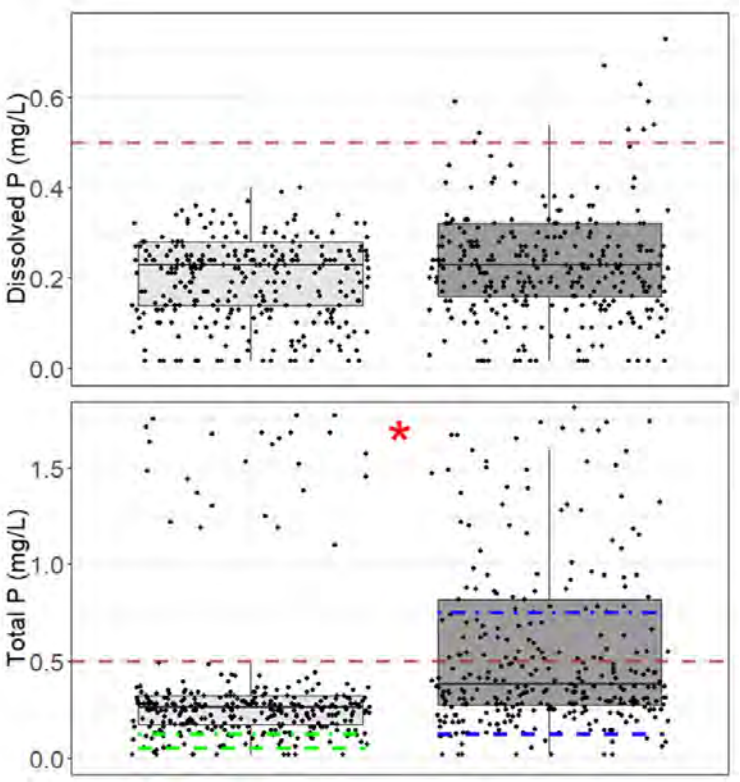
Wet vs Dry TSS

- Significant increase during wet weather
- Median 3 mg/L to 14 mg/L
- Dry weather – 0.6% exceedance
- Wet weather – 1.5% exceedance
- Sources of TSS



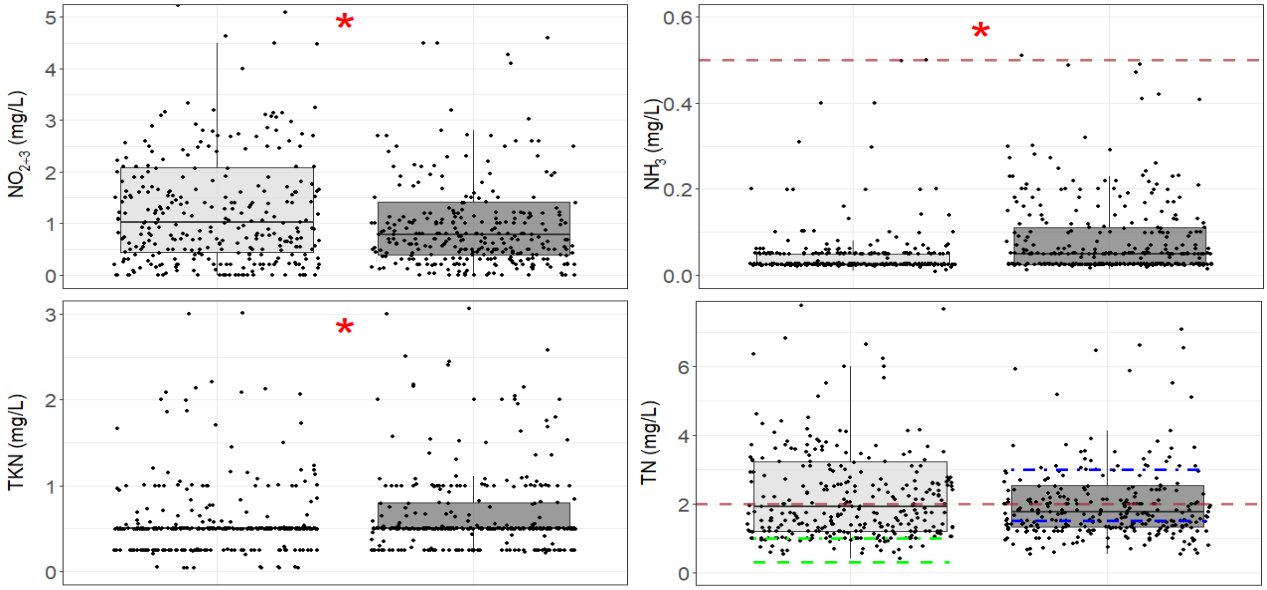
Wet vs Dry Phosphorus

- TP significant increase in wet weather
  - Correlation with TSS
- Dry weather – 86.4% exceedance
- Wet weather – 27.3% exceedance
- Dry weather pollution problematic
  - Confirmed from correlation analysis
- TP was 88.5 (dry) and 60.5 (wet) % DP
  - Control DP in dry conditions
- Sources of P



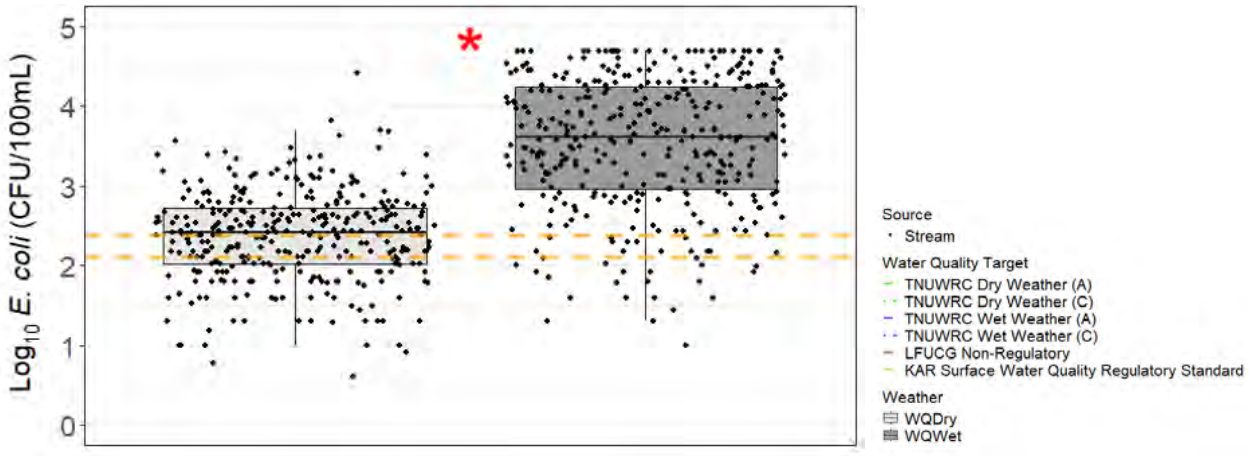
Wet vs Dry Nitrogen

- NH3 and TKN increased
  - BDLs
- NO2+3 decreased
- TN is largely OrgN
- Particulate vs dissolved
- Dry–91.5% exceedance
- Wet–20.7% exceedance
  - Confirmed correlation
- NO2+3, NH3 not ecologically relevant
- Dry OrgN
- OrgN sources



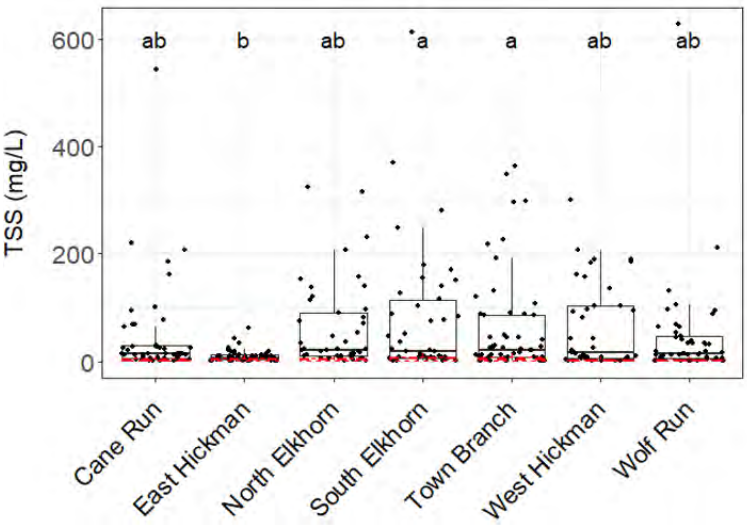
Wet vs Dry E. coli

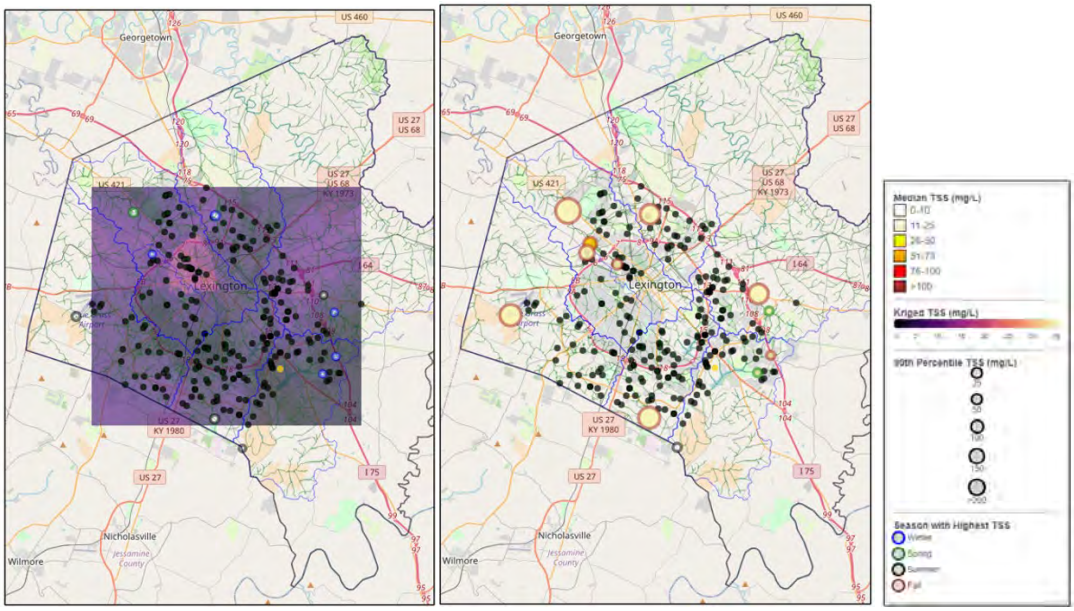
- Significant increase during wet weather
- Wet – 93.8 and 90.2% exceedance
- Dry – 69.2 and 54.4% exceedance
- Problematic in both wet and dry
- Sources of pathogens
  - Human sources mostly in wet (Bernard et al., 2022; Wu et al., 2011)
- Structural SCMs variable
  - Require biologic component – still variable
  - Soil amendments – potentially helpful
  - Source tracking



Spatial Analysis TSS

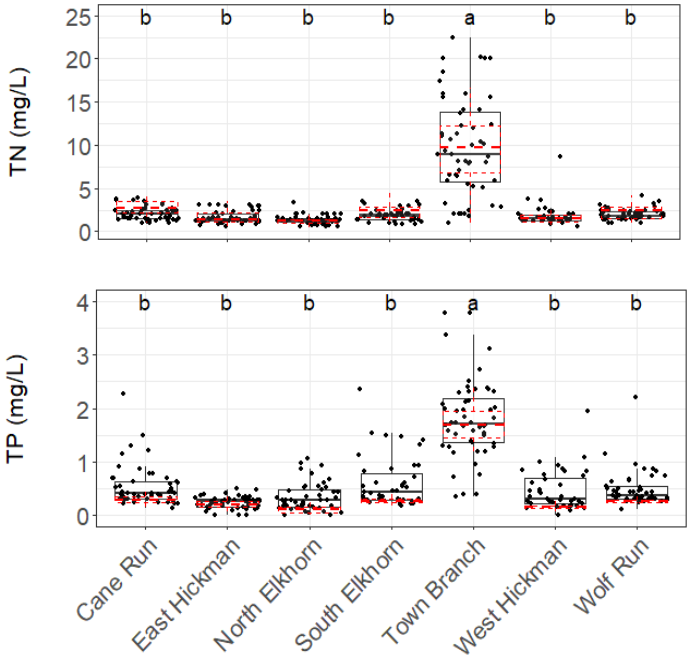
- Boxplots
- Town Branch & South Elkhorn > East Hickman
- Town Branch & South Elkhorn minimum sediment impairments
- Wet sediment pollution increased in all watersheds
  - North Elkhorn 3 to 22 mg/L
- Influence of rainfall intensity

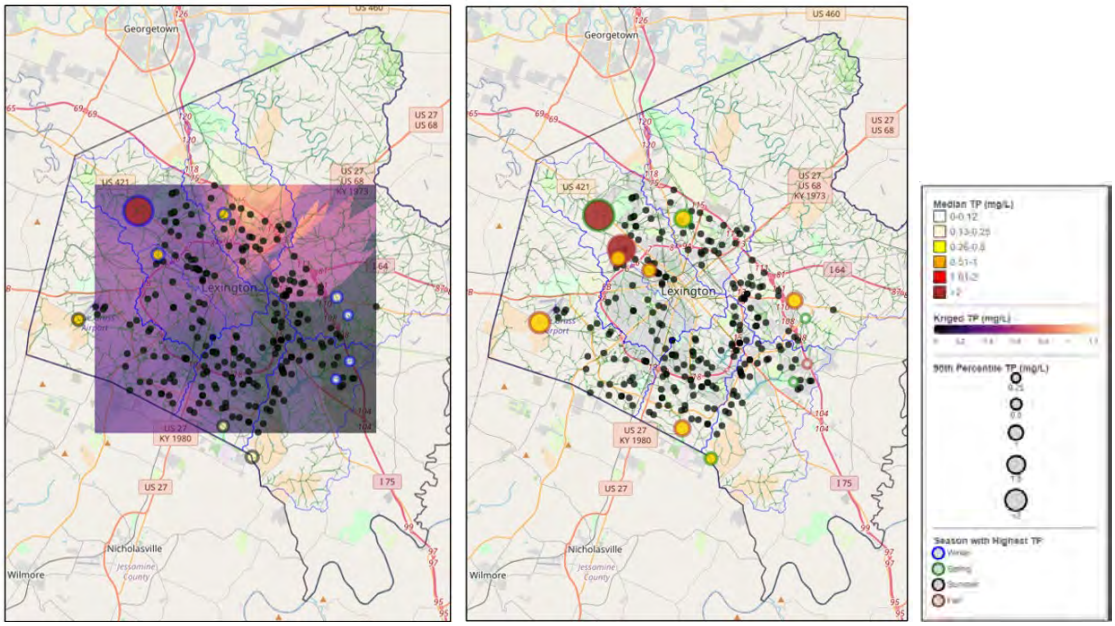




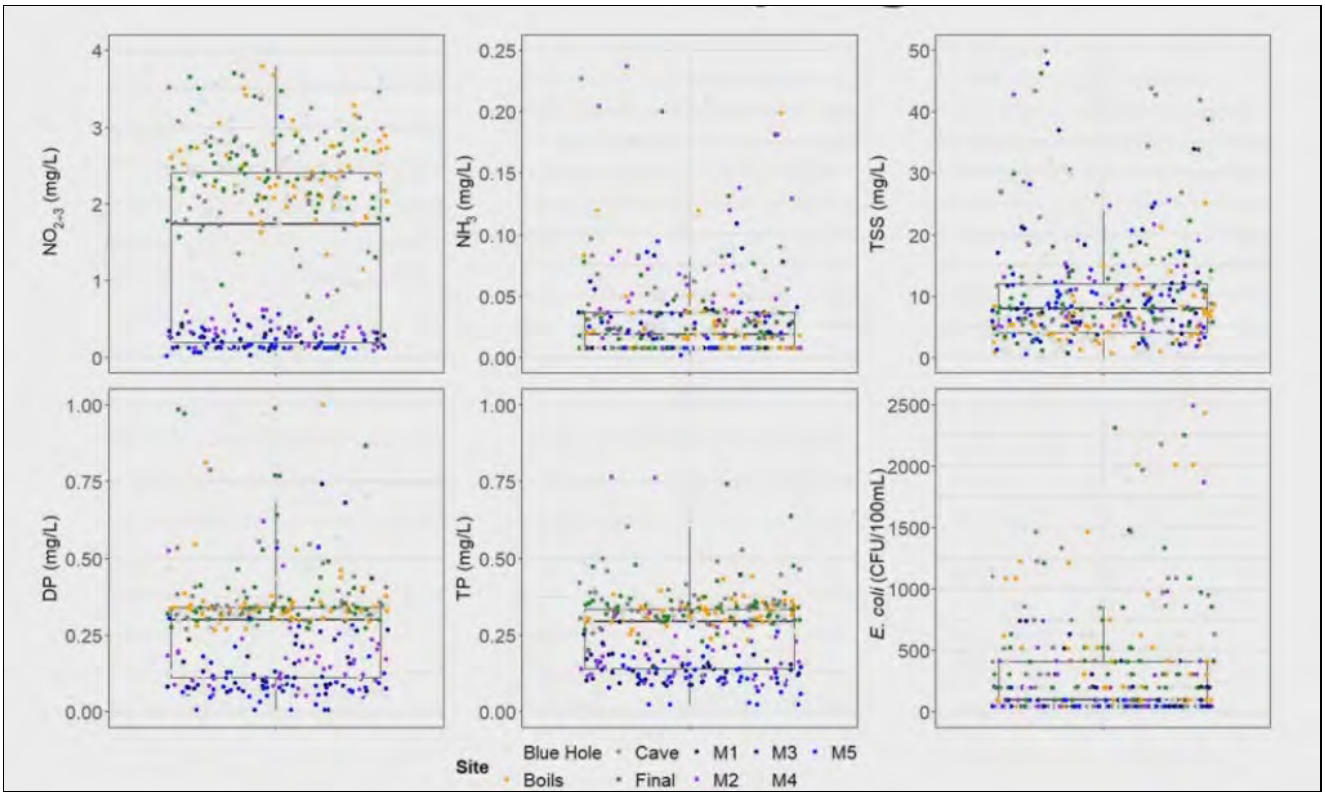
Spatial Analysis Nutrients

- Boxplots
- Town Branch significantly greater than all others
  - Exception NH3 in Cane Run
- Wet weather exceedances primarily from Town Branch
  - TP (27.3%) – 48 of 89 samples
  - TN (20.7%) – 43 of 67 samples
- Dry weather exceedances common in all watersheds
- Concentrations vs loads



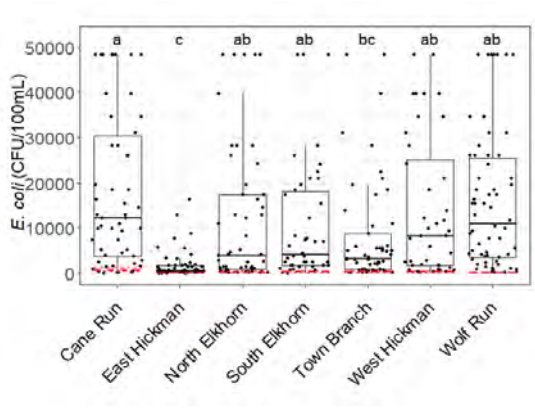


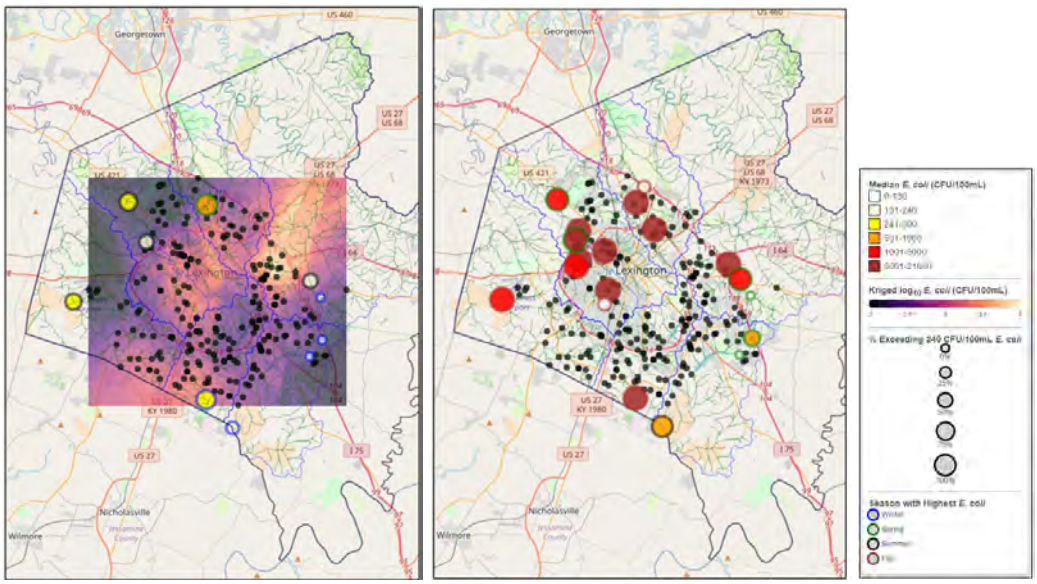
McConnell Springs



Spatial Analysis *E. coli*

- All watersheds: wet > dry
- Cane Run > East Hickman & Town Branch
- Median wet weather concs. from all watersheds >>>> regulations
- Median dry weather concs. From East Hickman & North Elkhorn <≈ regulations
- Sources always present but cross connections, leakages persistent in wet





Dr. Simpson noted that the key takeaways for each Objective include:

Objective I:

- Background/chronic pollution levels more threatening to ecological status
- Dry and wet pollution mostly unrelated

Objective II:

- TSS, NH3, TKN, E. coli significantly greater in wet weather
- OrgN and DP require treatment at their source, problematic in dry weather
- E. coli problematic in wet and dry, while TSS is not

Objective III:

- Nutrients problematic in Town Branch in wet weather (TBS1 to TBS2 and downstream)
- E. coli in Cane Run mostly infrastructure related, other watersheds infrastructure + other
- Major nutrient sources in Town Branch not likely a pathogen contributor

The limitations include:

- Sampling procedures
  - Water column depth
  - Size of stream
  - Recirculation zone
  - Positioned downstream
  - Hydrograph
  - Grab vs event mean concentration
- Laboratory procedures
  - NH3 = NH3 + NH4
  - Above/below detection limits
- Water quality non-stationarity?

Comments and questions: Ken Cooke asked if LFUCG staff have received a report on this information. Dr. Simpson replied that the paper has been given to the staff with the expectation that a few things may be tweaked, but he does not know if it is their plan to distribute the report.

Mr. Cooke then asked when the paper would be made available to the public. Ms. Young replied that the paper is still in draft form.

Mr. Cooke commented that part of the data collection effort included the United States Geological Surveys real time monitoring data. In other words, there are approximately 30,000 data points a year collected per parameter at these monitoring stations. For the Wolf Run Watershed between 2013 and 2023 there were several rounds of data points. He asked if the University of Tenneses can and what does it take to analyze that level of data. Dr. Simpson replied that the University of Tennessee can analyze that level of data. Computations aren't going to be much more difficult than what has been done here. What was presented today is the data from Third Rock Consultants, volunteers and Lexington-Fayette Urban County Government staff. The previously mentioned objective were the three questions they chose to dive into. The University of Tennessee can do more if desired. Dr. Jon Hathaway said that the USGS Centers is collecting real-time data such as temperature, conductivity, dissolved oxygen but they may not be covering the type of pollutants that they were doing with this analysis. Dr. Simpson said that samples are sent to the Laboratory for analysis.

Dr. Simpson noted that the interactive maps were provided to the LFUCG staff. The maps are a good resource to look at the different streams and if there are any hot spots and what is located within that area of the map.

Amy Clark asked if there were areas that were difficult getting samples and did it vary from dry to wet weather. Dr. Simpson replied that Third Rock Consultants, volunteers and Lexington-Fayette Urban County Government staff collected the samples. The dry weather to wet weather in Town Branch alone, the variations between total nitrogen and total phosphorus were not substantial. Looking at the Spatial Analysis Nutrients, Town Branch is significantly greater than all others. The wet weather exceedances primarily from Town Branch were Total Nitrogen and Total Phosphorus. He explained that the black boxplot is wet weather and the red dashed lined is dry weather. In both cases there is an overlap suggesting that all the sources of Nitrogen in the Town Branch are being generated continuously, but the transport mechanisms are not dependent on rainfall. There are always pollutants in Town Branch.

Mr. Cooke commented that it is known locally that McConnell Springs is a tributary of Wolf Run watershed. They had argued with USGS about their surface GIS coverage. He asked if the boxplot data for Town Branch included the McConnell Springs data or if that was separated out. Dr. Simpson replied that it was separated out since they did not have access to the McConnell Springs data. Using the interactive map, he zoomed in on the boxplot and noticed that McConnell Springs was on the watershed side of Town Branch and figured this was the constant source of nutrients to Town Branch, but it is mostly not.

iTree Site Assessment at Fayette County Public School Locations

Russ Turpin, EcoGro will be presenting the iTree Site Assessment at Fayette County Public School Locations at the March SSAC meeting.

Stormwater Manual Update

Abby Terry, Tetra Tech presented the following slides and gave a brief description of the Stormwater Manual.

Status Update
- Workgroup held on 8/29/25
- Green infrastructure questionnaires collected through 10/31/25

Only Changes After Workgroup & Questionnaires
- Chapter 1 – Stormwater Management Requirements
  - Any amendment to an existing development plan that affects hydrologic or hydraulic conditions must include updated hydrologic and hydraulic studies reflecting those changes.
- Chapter 10 – Post-Construction Stormwater Controls
  - Added a requirement for a Landscape Architect, Professional Wetland Scientist, or firm prequalified by KYTC for botany to provide a planting completion report and certification that plants were installed in accordance with the plans accepted by the Division of Engineering or equivalent native vegetation has established (throughout).
  - Updated the requirement that MTDs accepted for use in Fayette County shall be verified by the New Jersey Corporation for Advanced Technology (NJCAT) and certified by the New Jersey Department of Environmental Protection (NJDEP), per the ~~2013~~ 2021 laboratory protocol. (Section 10.4.1).
  - Updated the reference for suitable plant species for wetlands to the USACE National Wetland Plant List (Eastern Mountains and Piedmont Region) (Section 10.9.2).

Next Steps
- Present to Environmental Quality Public Works Committee in Spring 2026

Ms. Terry commented that even though there is no set timeline to get these changes approved, the staff wants input from the Stormwater Stakeholder Advisory Committee. She added that Ms. Young will be emailing the members the full red lined version and asked the members to review those changes. If anyone has any further comments or input, they can submit those to Director Burton or Bailee Young with MS4 section.

The proposed Stormwater Manual will be presented to the Urban County Council in Spring 2026 with the intent of having the new Stormwater Manual in the Summer 2026.

Comments and questions: Ken Cooke referenced Chapter 10 changes and asked about the Eastern Mountains and Piedmont region. He indicated that these are not Kentucky natives. Ms. Terry said that if you look at the US Army Corps of Engineers plant list it is divided by region and Kentucky falls within those Eastern Mountains and Piedmont region.

In response to a question from Al Gross, EA Partners regarding the added language to Chapter 10. Ms. Terry replied to get qualified you must have a set number of hours on wetland courses and the experience working with wetlands. There are websites that lists people who are certified. She added that a landscape architect, a professional wetland scientist or someone from a KYTC pre-qualified firm in botany can obtain the certification.

Ms. Terry agreed that landscape architects go through planting courses and many design bioretention rain gardens, so they are familiar and qualified for plantings. Professional Engineers are not.

Ms. Terry clarified that there is already a requirement in the Stormwater Manual to develop the planting plan which is only allowed to be developed by a Professional Engineer or Landscape Architect. The certification is separate and is done after planting regarding the plantings and green infrastructure.

Jason Unrine, University of Kentucky, said that the Eastern Mountains and Piedmont region on the US Army Corps of Engineers is divided into subregions. One is called Central and Eastern Mountains and Kentucky is only in that sub region so he was wondering if that would be more appropriate. Ms. Terry replied that they can take another look at that and see if we can zero in a little bit more.

Potential Topics for Next Meeting

Amy Clark requested a presentation on the Downtown Area Master Plan.

Scott Southall volunteered to give a presentation on Infill and Redevelopment.

Ms. Young said that Russ Turpin, EcoGro will be presenting the iTree Site Assessment at Fayette County Public School Locations.

Announcements

- December 11th - Wolf Run Watershed Council Meeting
- December 13th - Closing reception for the Art by Nature gallery at the Living Arts and Science Center.
- December 19th - Workshop with the Engineering, Development, and Construction Industry.
- December 25, 26 and January 1st – City Offices Closed
- January 8th - WQFB Meeting
- March 6th - Next SSAC Meeting
- March 21-27th - Seventh Annual Water Week.
- April 9th - WQFB Meeting
- On Black Friday, we collected 400 gallons of cooking oil from 111 cars at the Gobble Grease Toss. (This event allowed LFUCG to educate the public about proper waste disposal, such as not pouring cooking oil down drains or outside.)

Adjournment
The meeting concluded at 10:58 a.m.

STORMWATER STAKEHOLDER ADVISORY COMMITTEE

December 5, 2025

LEXINGTON

Meeting Agenda

1. Approval of 09/05/2025 Minutes
2. Wetland Solutions – Dr. Tiffany Messer, University of Kentucky
3. Urban Growth Master Plan Overview – Hal Baillie, LFUCG Division of Planning
4. Data-Driven Insights from Lexington's MS4 Monitoring Program – Dr. Ian Simpson and Dr. Jon Hathaway, University of Tennessee
5. iTree Site Assessment at Fayette County Public School Locations – Russ Turpin, EcoGro
6. Stormwater Manual Update - Abby Terry, Tetra Tech
7. Potential Topics for Next Meeting
8. Announcements

Wetland Solutions

Tiffany L. Messer, PhD, PE

Based on work completed by:
Dr. Emily Beyers, Levi McKercher, Matt Chaffee, Jenna McCoy, and Kyra Sigler

Department of Biosystems & Agricultural Engineering

Martin-Gatton
College of Agriculture,
Food and Environment

Overview

- What are we observing in rivers throughout the Commonwealth and Lexington?
- What are potential wetland solutions for water quality impairments?
- Do wetland solutions work?
  - If so, how?
- Are they being used at the full scale?

What are we observing in rivers throughout the Commonwealth and Lexington?

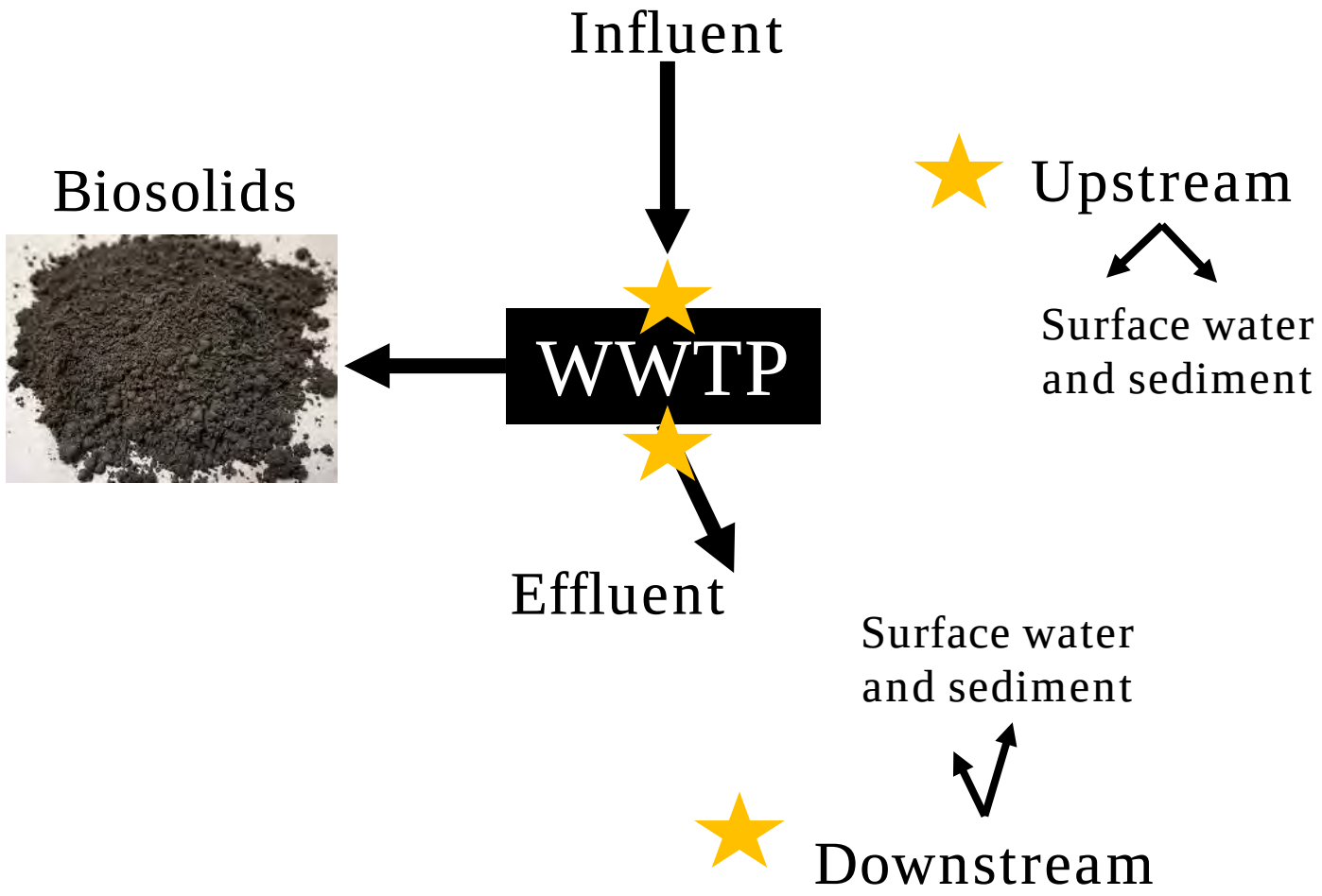
Objective:

Evaluate presence of a suite of potential water quality impairments to determine primary focus for designing nature-based solutions for water preservation and improvement.

What are in Kentucky streams?

- 7 months of baseline field monitoring from March 2022 to October 2022

What are in Kentucky streams?



- 2 WWTPs
  - (UV and chlorine disinfection)
- 2 months
  - April and July 2022
  - 2 weeks each

How were they monitored?

Grab Samples:
Trace Elements
Nutrients
Total Organic Carbon

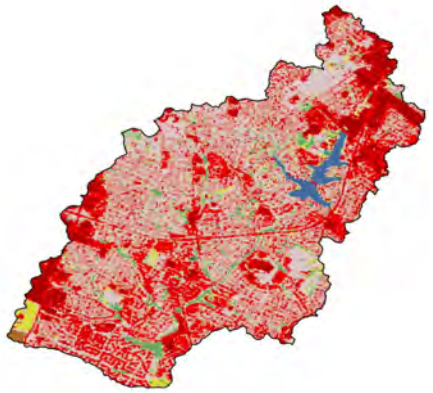
POCIS:
Human Use Pharmaceuticals
Personal Care Products
PFAS
Neonicotinoids & Strobularin
Pesticides

YSI Handheld:
Temperature,
discharge, pH, EC, DO

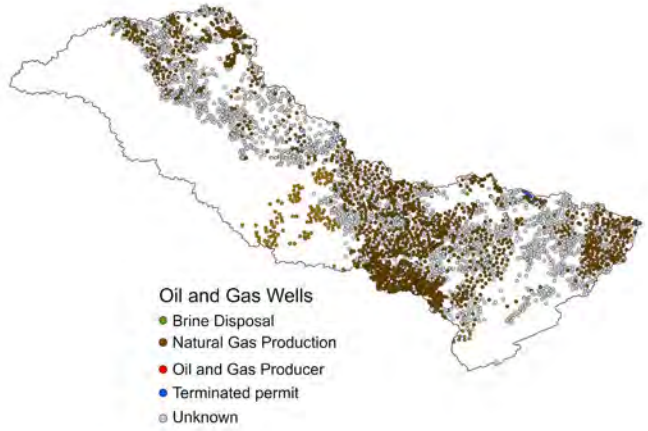
Why do we care about these?

Human Use Pharmaceuticals:	• Antibiotic resistance
Personal Care Products:	• Growing human health concerns and impacts on ecosystems
PFAS:	• Recent EPA requirements and growing human health concerns
Neonicotinoids & Strobularin Pesticides:	• Loss of honeybee diversity and growing human health concerns
Metals:	• EPA requirements and growing human health concerns
Nutrients:	• Harmful Algal Blooms (HABs)

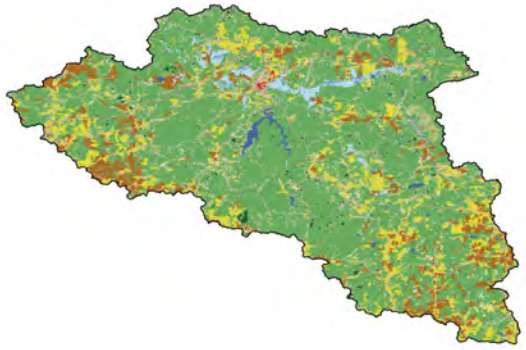
What did we observe?



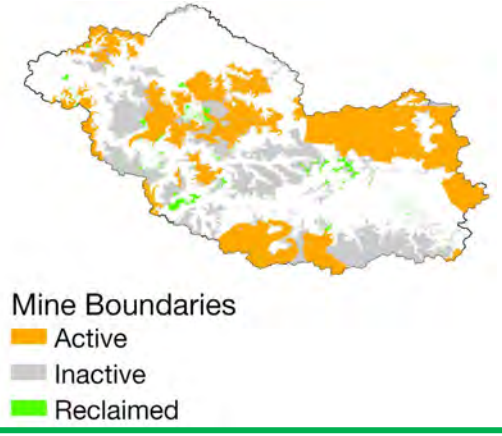
Urban Site:
High in nutrients (N and P), chloride imidacloprid, and caffeine.



Oil and Gas Site:
High in PCPs such as caffeine due to older wastewater infrastructure.



Agricultural Site:
High in trace elements during flood conditions and high in herbicides (e.g., atrazine, alachlor).



Mining Site:
High in SO_4^{2-} and glyphosate after a major flooding event.

Byers, E.N.[3,*], **Messer, T.L.**, Unrine, J., Barton, C., Agouridis, C., Miller, D.N. 2025. The occurrence and persistence of surface water contaminants across different landscapes. *Science of The Total Environment*. 287: 124294. doi: 10.1016/j.scitotenv.2024.177837

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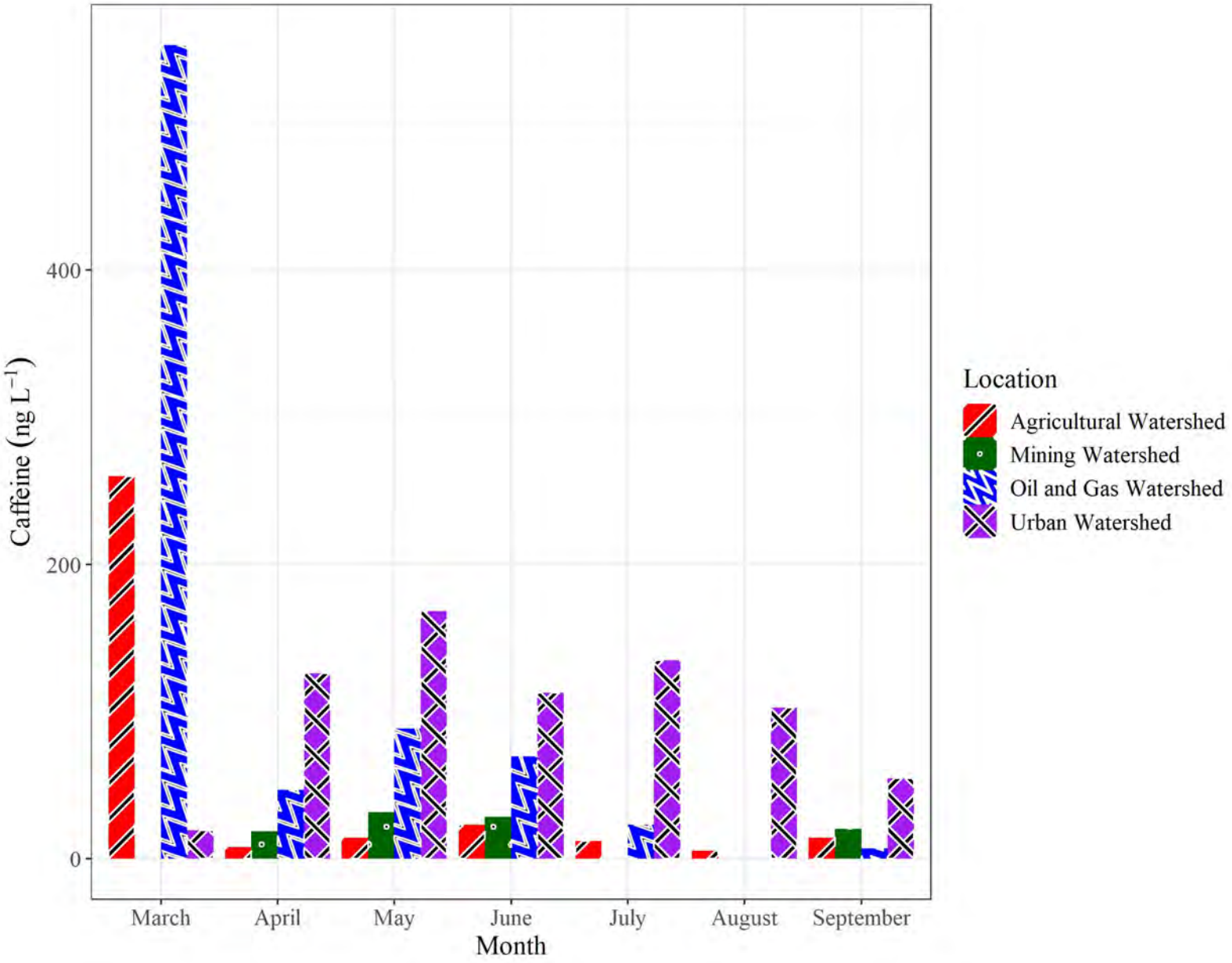
What did we observe?



- Personal care products, including caffeine, were present in surface waters in rural watersheds, likely due to older wastewater infrastructure along with with the urban watershed.

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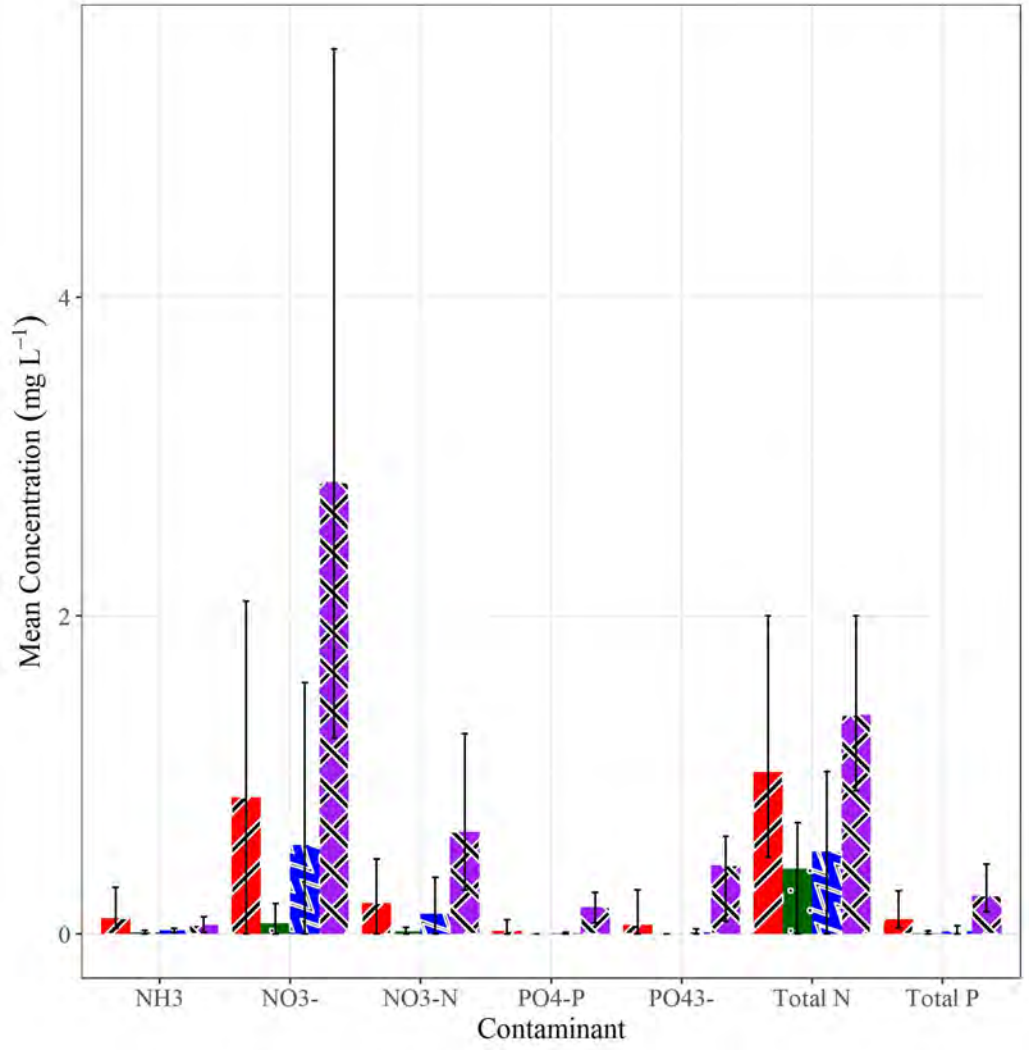
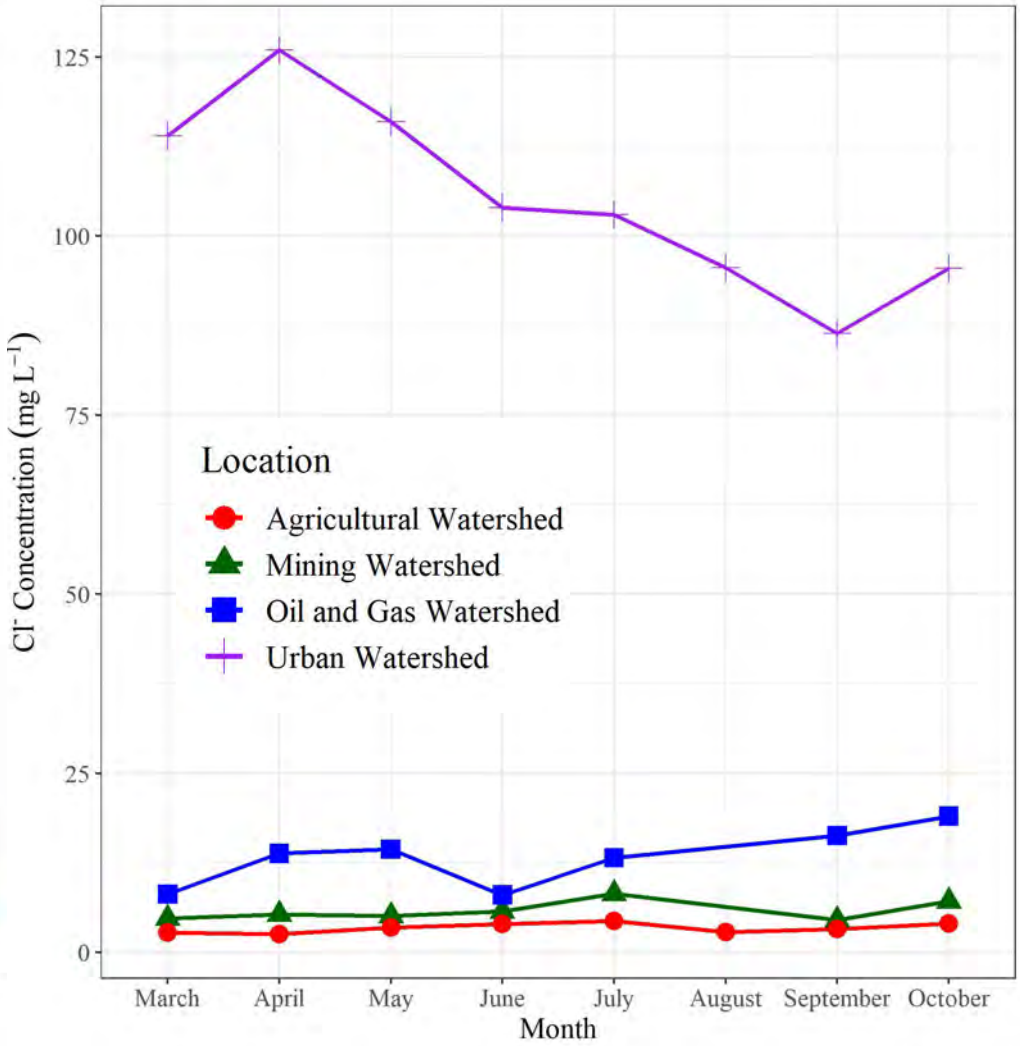
What did we observe?





- The urbanized watershed had the highest nutrient concentrations and loads particularly during spring months

Byers, E.N.[3,*], **Messer, T.L.**, Unrine, J., Barton, C., Agouridis, C., Miller, D.N. 2025. The occurrence and persistence of surface water contaminants across different landscapes. *Science of The Total Environment*. 287: 124294. doi: 10.1016/j.scitotenv.2024.177837

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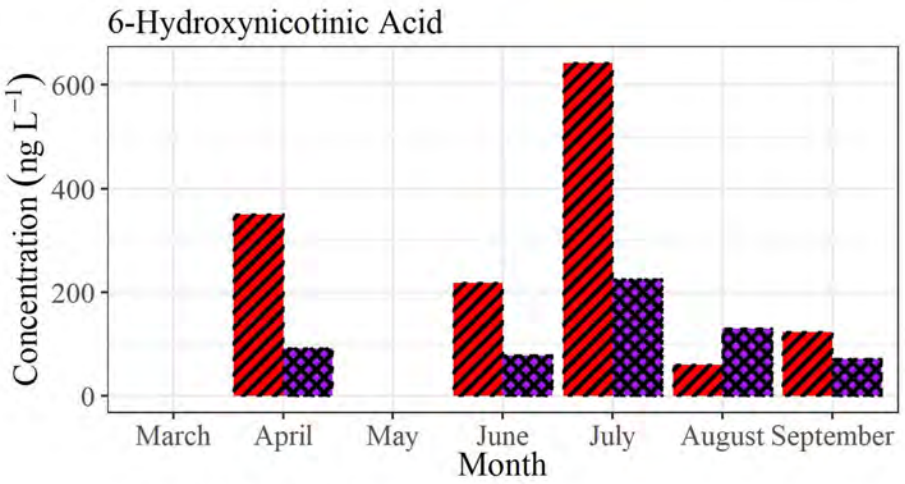
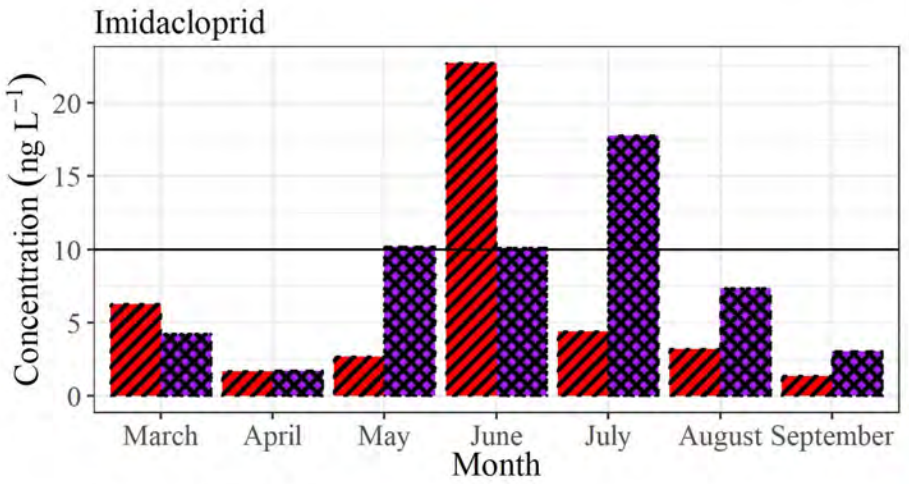
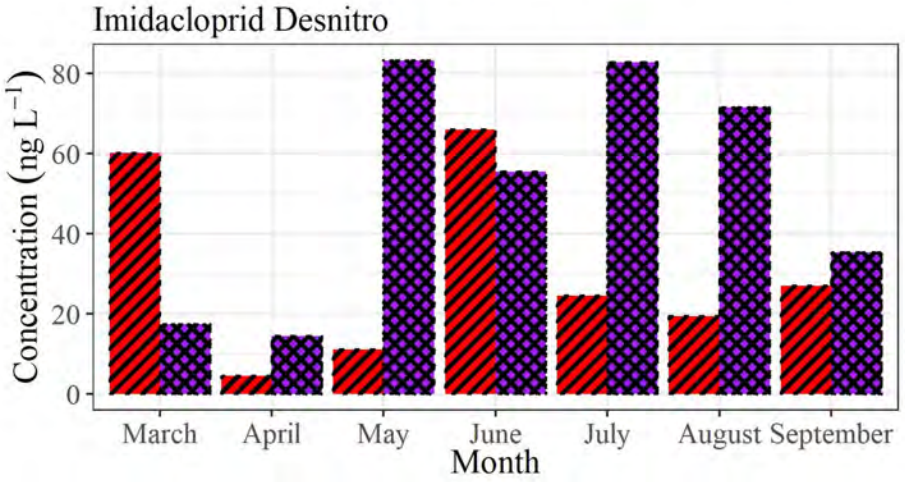
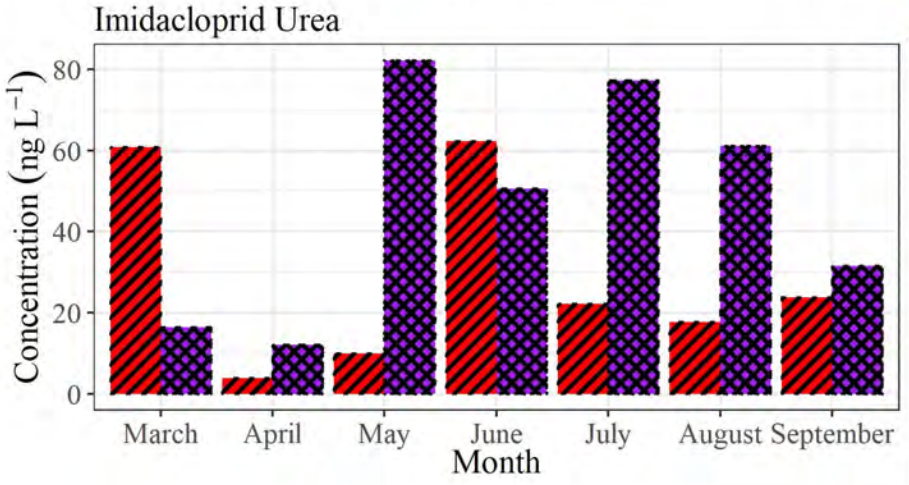
What did we observe?

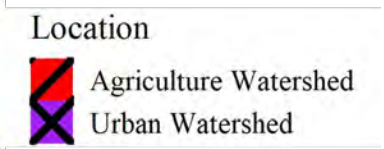








- Imidacloprid and its by-products were consistently present in the both the agricultural and urbanized watersheds



Byers, E.N.[3,*], **Messer, T.L.**, Unrine, J., Barton, C., Agouridis, C., Miller, D.N. 2025. The occurrence and persistence of surface water contaminants across different landscapes. *Science of The Total Environment*. 287: 124294. doi: 10.1016/j.scitotenv.2024.177837

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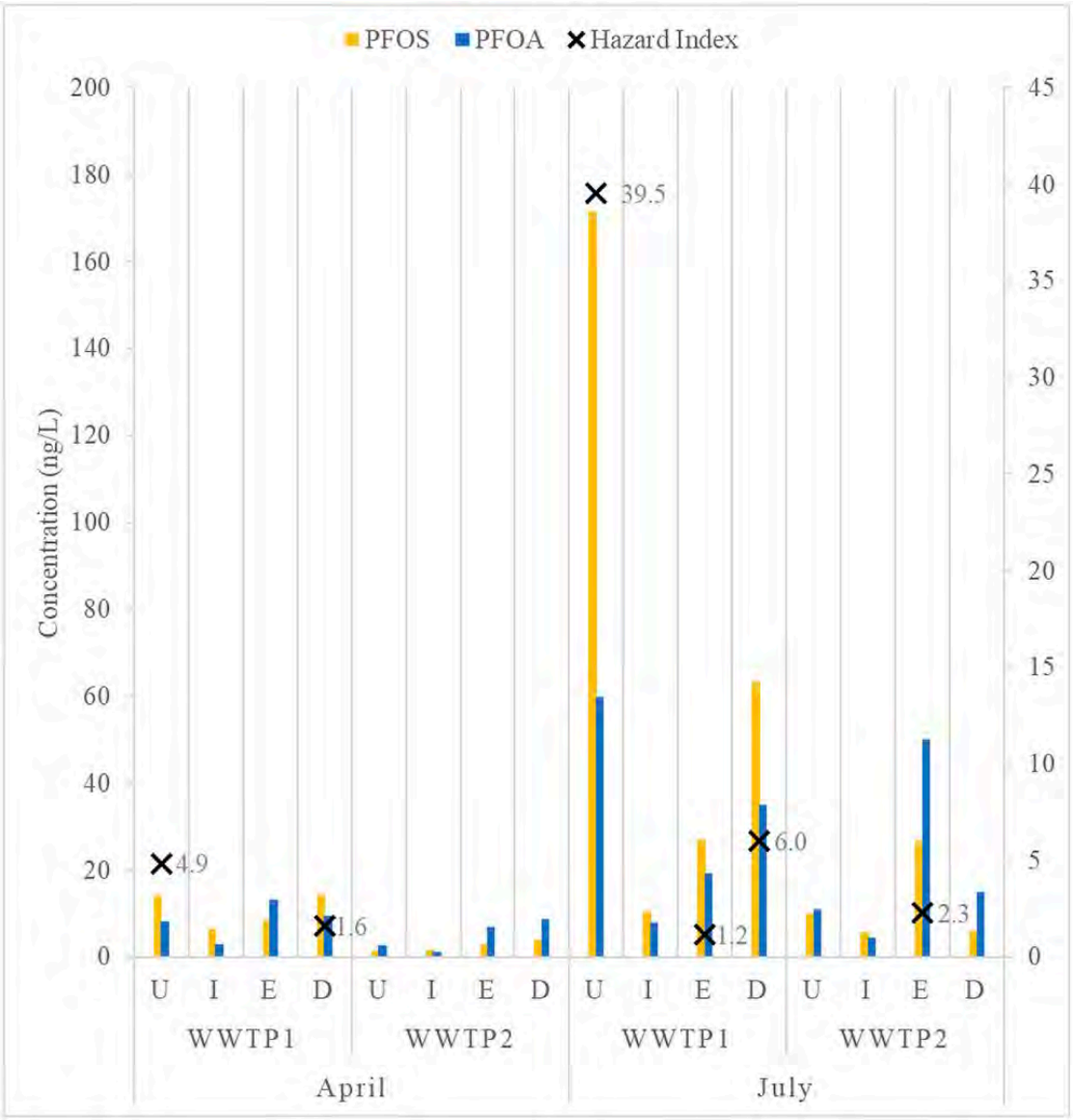
Were observations similar at WWTPs?

- Chronic concentrations were exceeded for macroinvertebrates throughout the study for imidacloprid

Sigler, K.[2], Messer, T.L.*, Russell, M., Ford, W., Sanderson, W. Occurrence, transformation, and transport of pesticides entering, leaving, and flowing past wastewater treatment plants with diverse land uses. *In Prep*.



Were observations similar at WWTPs?

Hazard indexes set by the EPA for drinking water were exceeded:

- Upstream to WWTP (U) likely due to fire fighting training facility
- Downstream of WWTPs (D) in the more urban system
- In effluent (E) of the more urban system likely due to metabolite formations in the WWTP

***Note this is not drinking water but can be potentially used by downstream communities as source water.*

Sigler, K.[2], Messer, T.L.*, Ford, W., Sanderson, W. 2024. Occurrence, transformation, and transport of PFAS entering, leaving, and flowing past wastewater treatment plants with diverse land uses. *Journal of Environmental Management*. doi: 10.1016/j.jenvman.2024.123129

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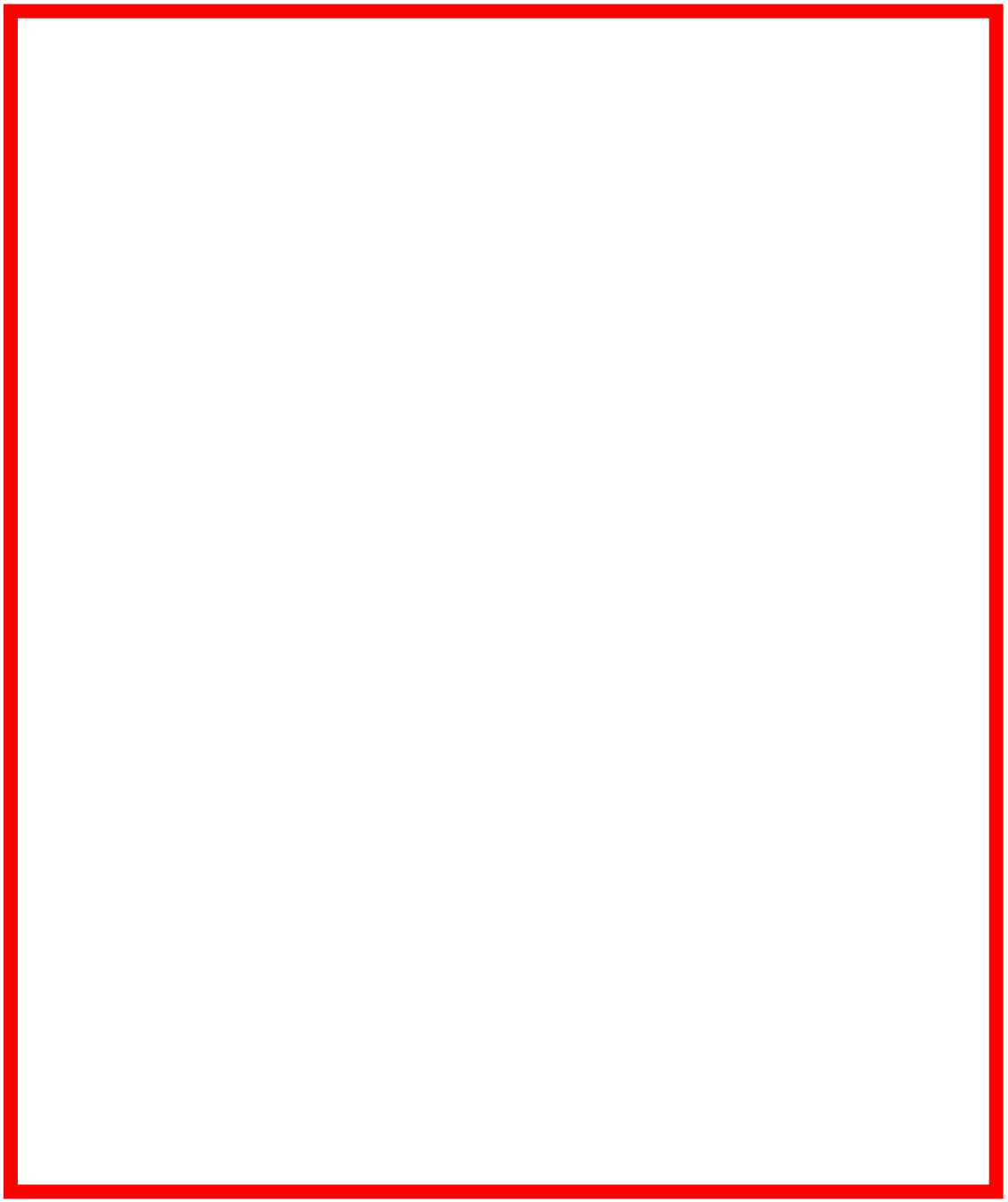
What are potential wetland solutions for water quality impairments?



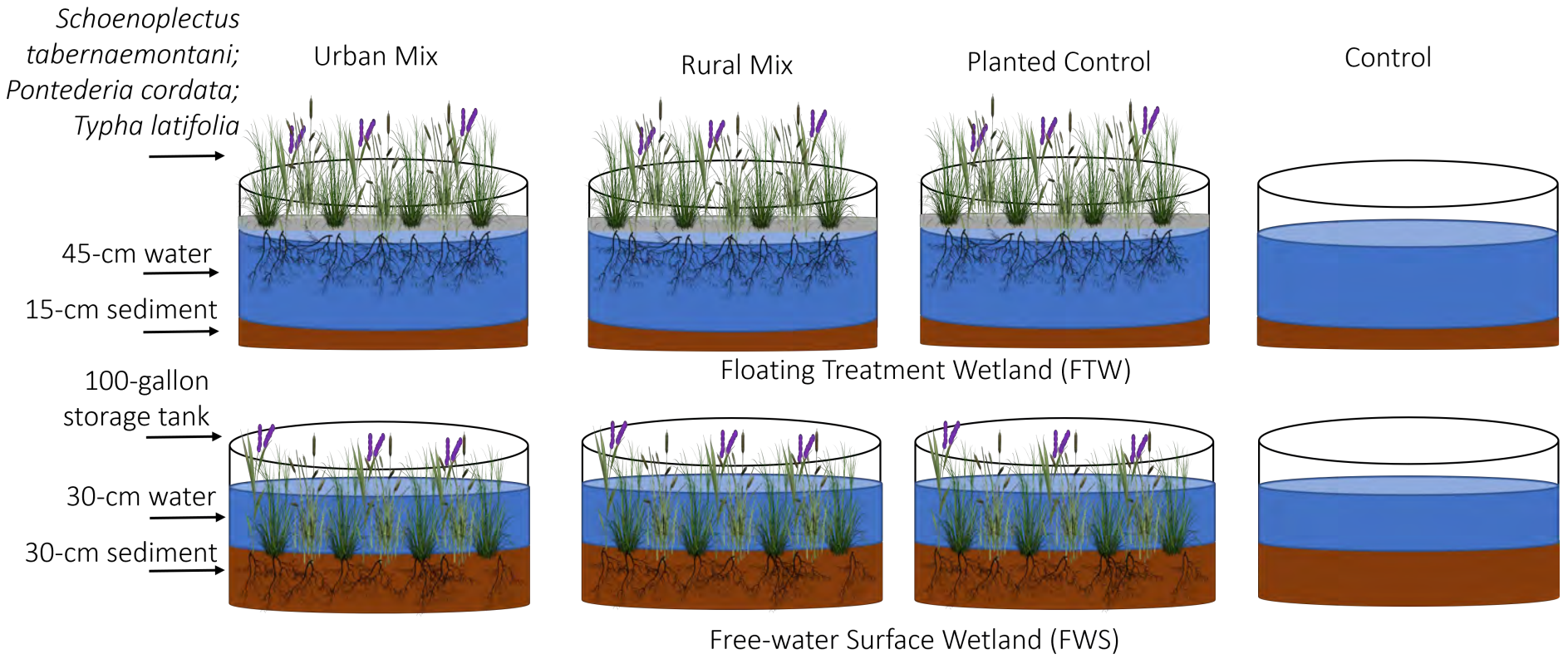
Do wetland solutions work? If so, how?

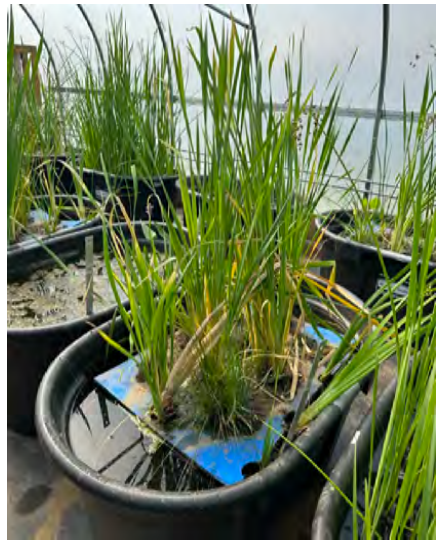
Objective:

1. Determine if various designs of treatment wetlands could be utilized for improving water quality impairments observed in Kentucky.

2. Identify which mechanisms are being utilized to remove various contaminants of interest to enhance designs.

Wetland Design Assessment





Byers, E.N.[3,*], Messer, T.L., Miller, D.N., Barton, C., Unrine, J., Agouridis, C. 2025. Contaminant mixtures and their impact on nitrate removal in wetlands: A mesocosm study. *Journal of Environmental Management*. 383: 125518. doi: 10.1016/j.jenvman.2025.125518

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Trial	Rural Mix	Urban Mix	Controls
5/22-6/1	NO_3-N (10 mg/L)	NO_3-N (10 mg/L)	NO_3-N (10 mg/L)
6/13-6/23	Atrazine (21,000 ng/L) + NO_3-N (10 mg/L)	Imidacloprid (100 ng/L) + NO_3-N (10 mg/L)	
6/26-7/6	Glyphosate (92,000 ng/L) + NO_3-N (10 mg/L)	Caffeine (550 ng/L) + NO_3-N (10 mg/L)	
7/31-8/10	SO_4^{2-} (800 mg/L) + NO_3-N (10 mg/L)	PFOS (100 ng/L) + NO_3-N (10 mg/L)	
8/13-8/23	Mixture of above contaminants + NO_3-N (10 mg/L)	Mixture of above contaminants+ NO_3-N (10 mg/L)	
9/8-9/18	Mixture of above contaminants +NO_3-N (15 mg/L)	Mixture of above contaminants +NO_3-N (15 mg/L)	NO_3-N (15 mg/L)

Sample	0	1	2	3	5	7	10
PFOS/ Caffeine/ Imidacloprid/ Atrazine/ Glyphosate/ SO_4^{2-}		X			X		X
DOC		X			X		X
NO_3-N, NH_4-N, & PO_4^{3-}	X	X	X	X	X	X	X
pH, SPC, TDS, DO, T, ORP, & depth	X	X	X	X	X	X	X

Byers, E.N.[3,*], Messer, T.L., Miller, D.N., Barton, C., Unrine, J., Agouridis, C. 2025. Contaminant mixtures and their impact on nitrate removal in wetlands: A mesocosm study. *Journal of Environmental Management*. 383: 125518. doi: 10.1016/j.jenvman.2025.125518

Wetland Design Assessment

NO_3-N: 10-15 mg/L
SO_4^{2-}: 800 mg/L
Atrazine: 21,000 ng/L
Glyphosate: 92,000 ng/L
Imidacloprid: 100 ng/L
Caffeine: 500-20,000 ng/L
PFOS: 100 ng/L

Plant Uptake
$^{15}NO_3$-N : 16-40%
SO_4^{2-} : 3%
Atrazine: 0%
Glyphosate: 0%
Imidacloprid: 19-27%
Caffeine: 1%

Soil sorption/ microbial assimilation
$^{15}NO_3$-N : 0%
SO_4^{2-} : 4%
Atrazine: 0%
Glyphosate: 0%
Imidacloprid: 7%
Caffeine: 0%

Removal from water
$^{15}NO_3$-N/NO_3-N : 97-99%
SO_4^{2-} : (-)42%
Atrazine: 91%
Glyphosate: >89%
Caffeine: 63-70%
PFOS: 28-89%

Byers, E.N.[3,*], Messer, T.L., Miller, D.N., Barton, C., Unrine, J., Agouridis, C. 2025. Contaminant mixtures and their impact on nitrate removal in wetlands: A mesocosm study. *Journal of Environmental Management*. 383: 125518. doi: 10.1016/j.jenvman.2025.125518

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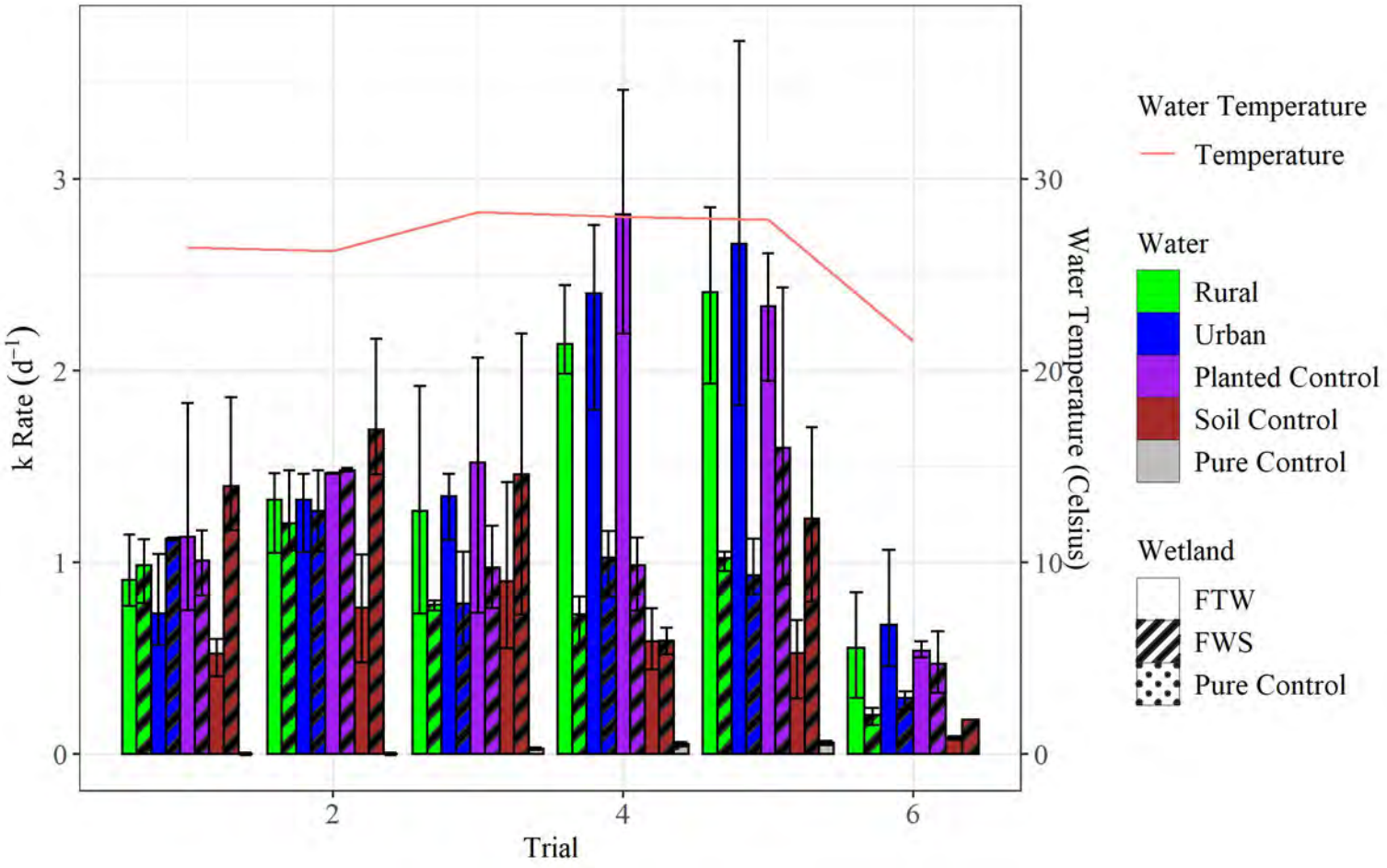
Impacts on Nitrate Removal



- 97-99% of the NO_3-N was removed from the wetlands after 10 days
- Vegetation had a positive effect on N removal
- FTWs resulted in a higher rate of NO_3-N removal in the presence of the mixtures while the FWSs were inhibited by the mixtures.
- The FWSs outperformed the FTWs earlier in the growing season (May-June), while the FTWs outperformed the FWSs when mature plants were established (July-September)

Byers, E.N.[3,*], Messer, T.L., Miller, D.N., Barton, C., Unrine, J., Agouridis, C. 2025. Contaminant mixtures and their impact on nitrate removal in wetlands: A mesocosm study. *Journal of Environmental Management*. 383: 125518. doi: 10.1016/j.jenvman.2025.125518

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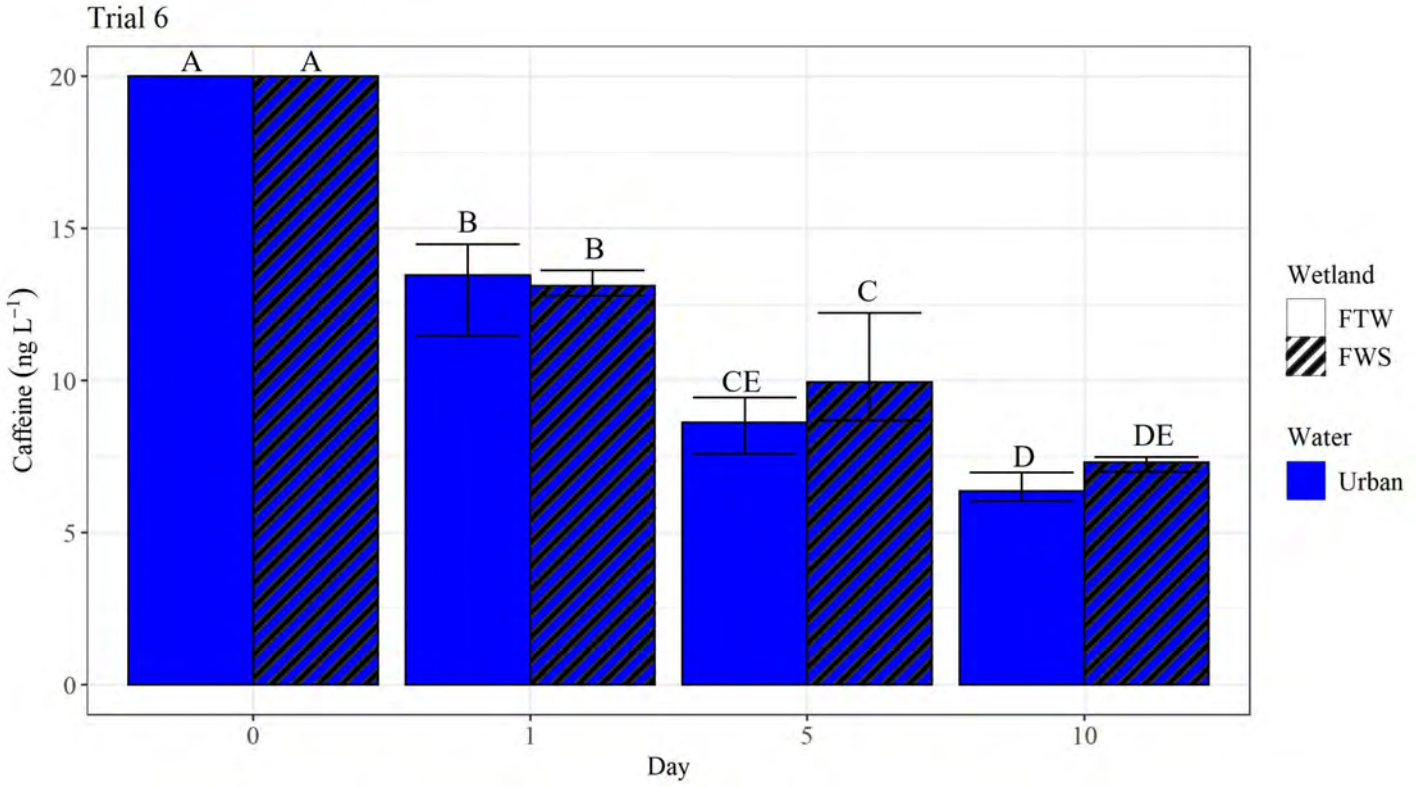
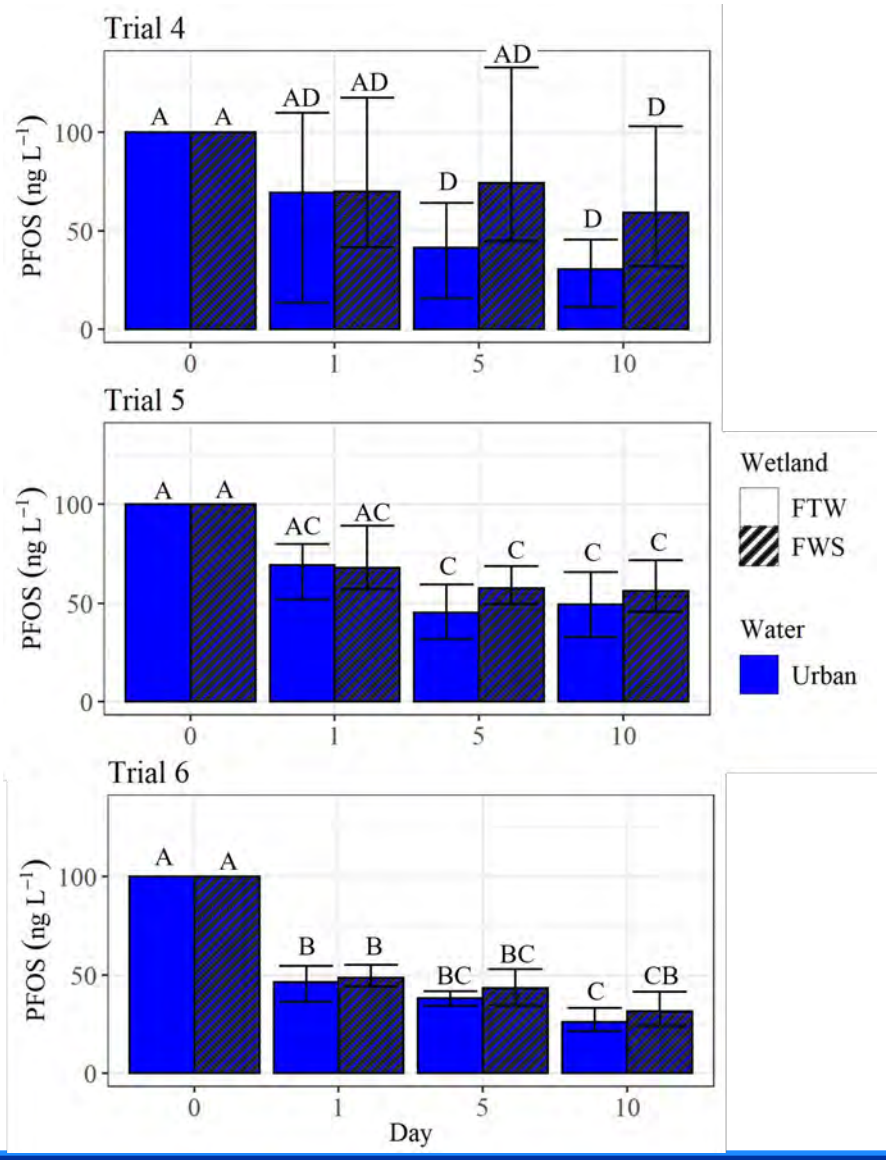
High removal from the water was observed with caffeine (62.6-69.9%) and PFOS (28-89%).





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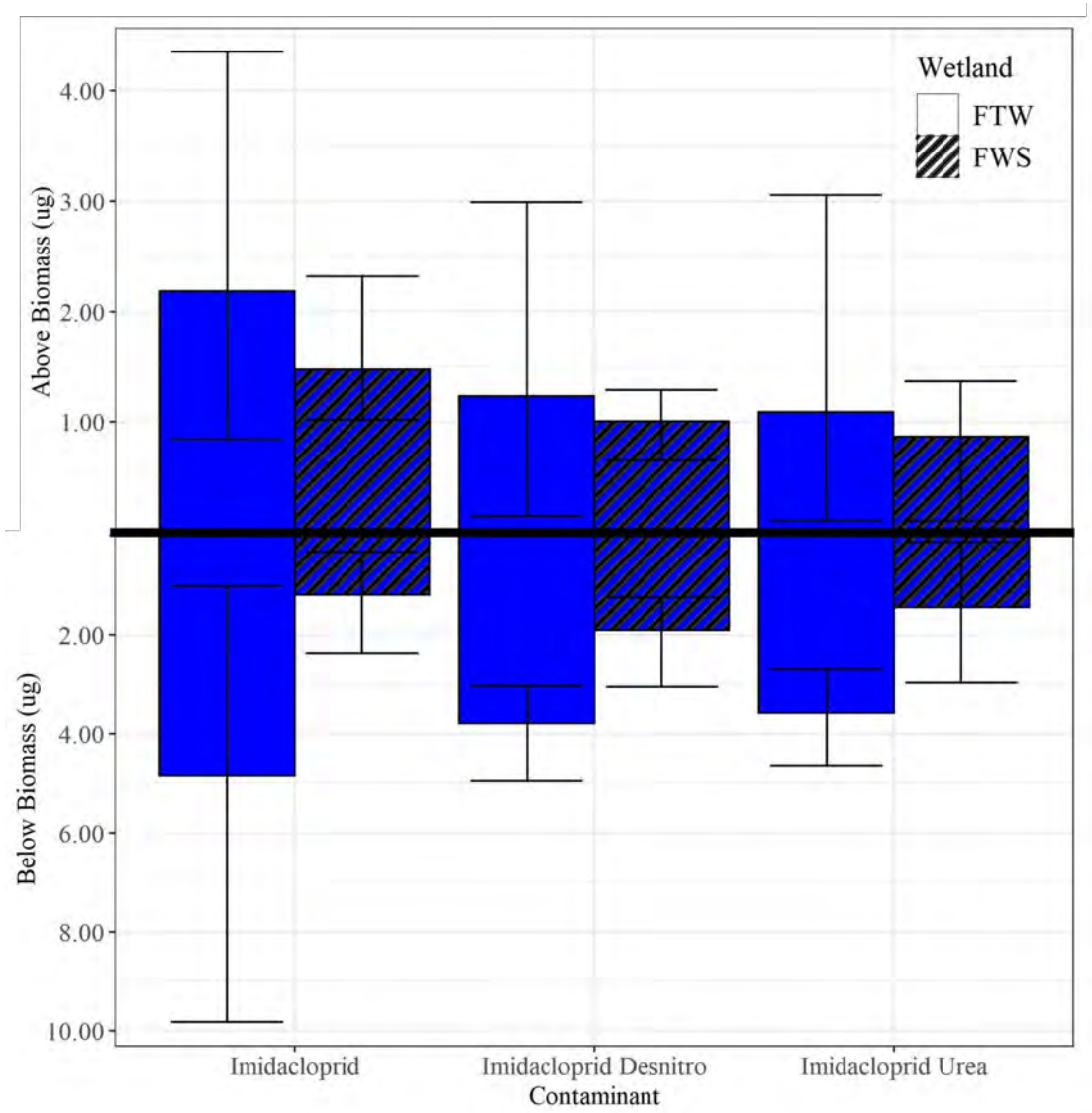

25-34% of the imidacloprid was taken up by the plants or soil

- FTW plants=27%
- FWS plants =19%
- Soil = 6 to 7%

Byers, E.N.[3,*], Messer, T.L., Miller, D.N., Barton, C., Unrine, J., Agouridis, C. 2025. Contaminant mixtures and their impact on nitrate removal in wetlands: A mesocosm study. *Journal of Environmental Management*. 383: 125518. doi: 10.1016/j.jenvman.2025.125518

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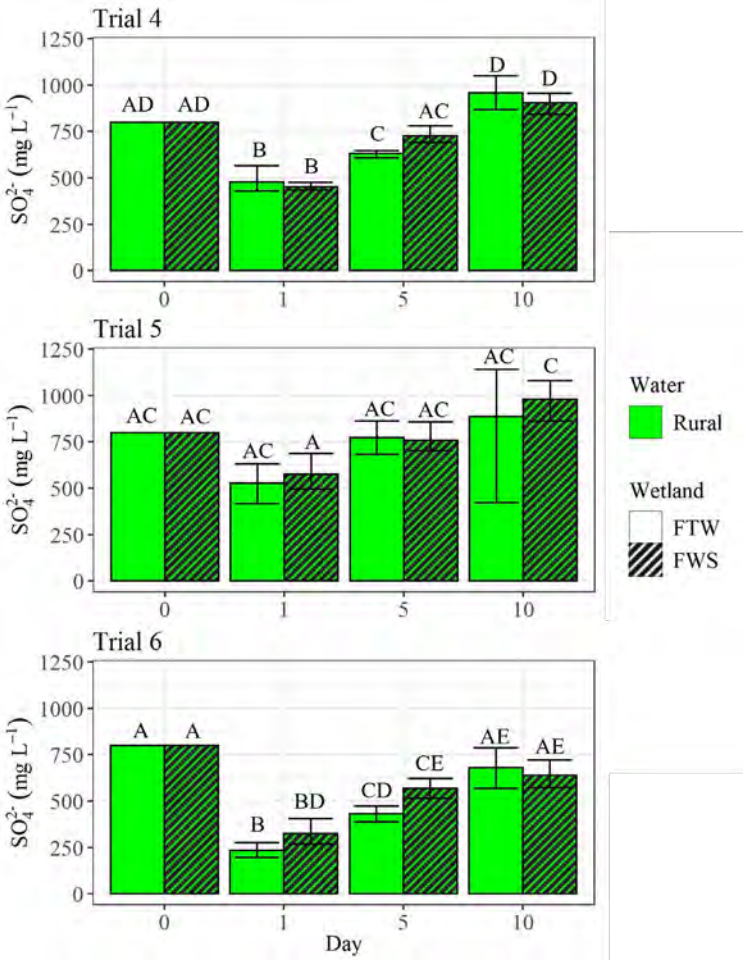
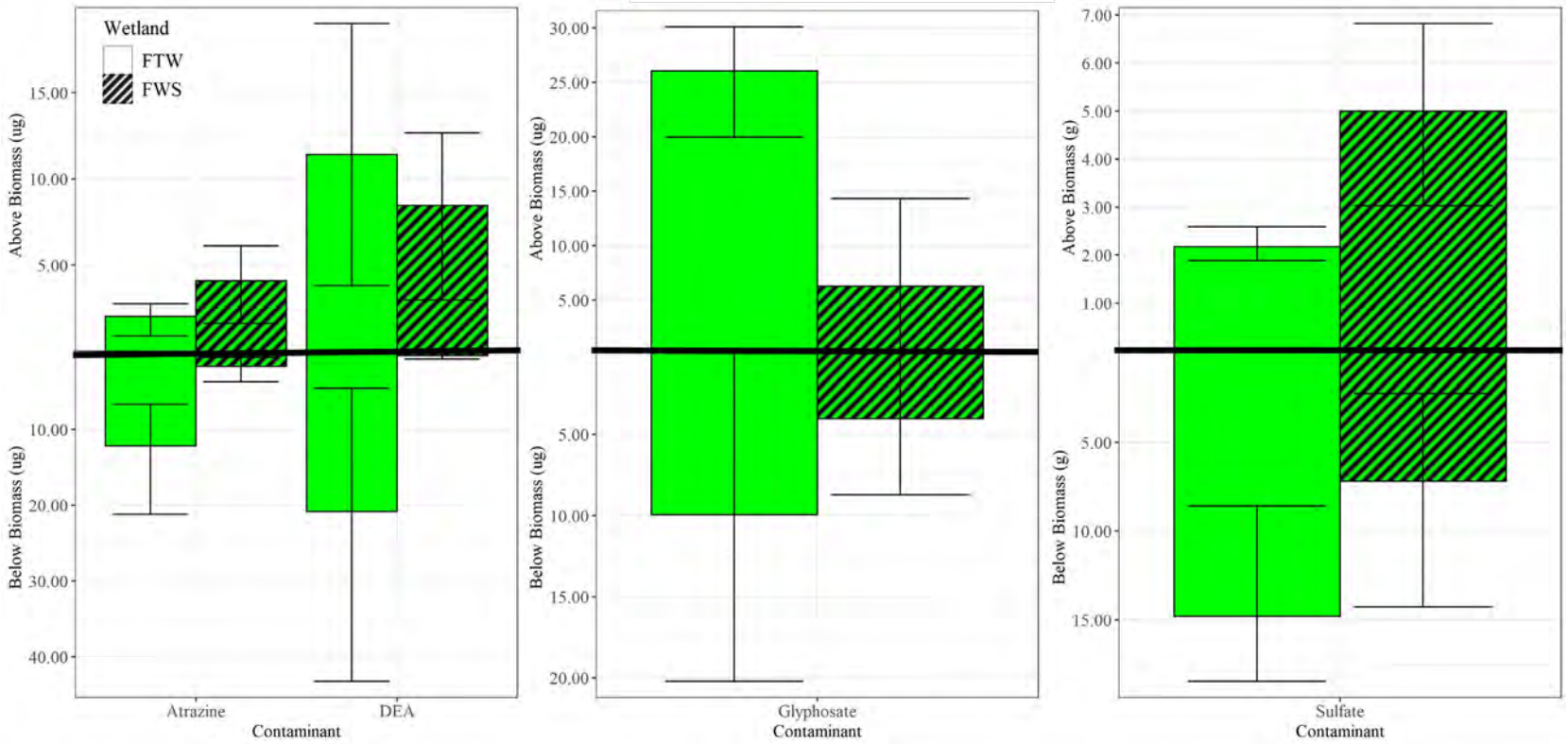
Over 90% of glyphosate and atrazine were removed from the water





Byers, E.N.[3,*], Messer, T.L., Miller, D.N., Barton, C., Unrine, J., Agouridis, C. 2025. Contaminant mixtures and their impact on nitrate removal in wetlands: A mesocosm study. *Journal of Environmental Management*. 383: 125518. doi: 10.1016/j.jenvman.2025.125518

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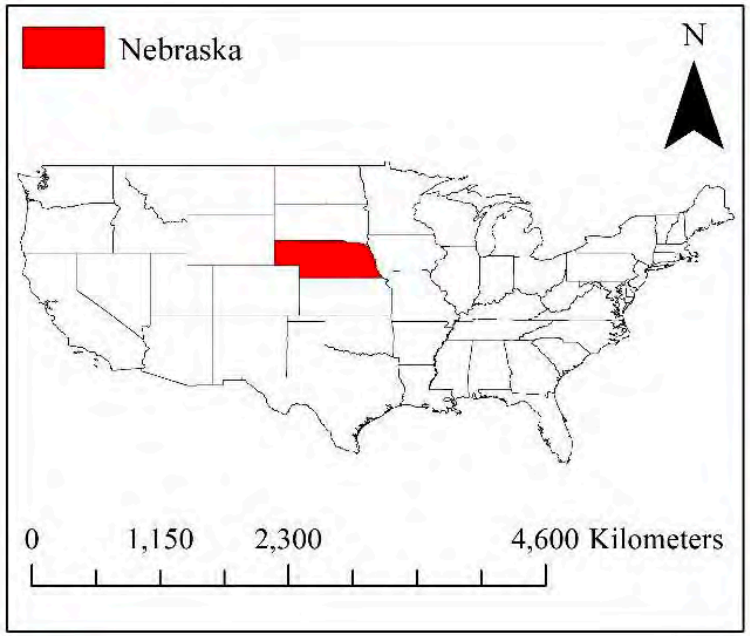
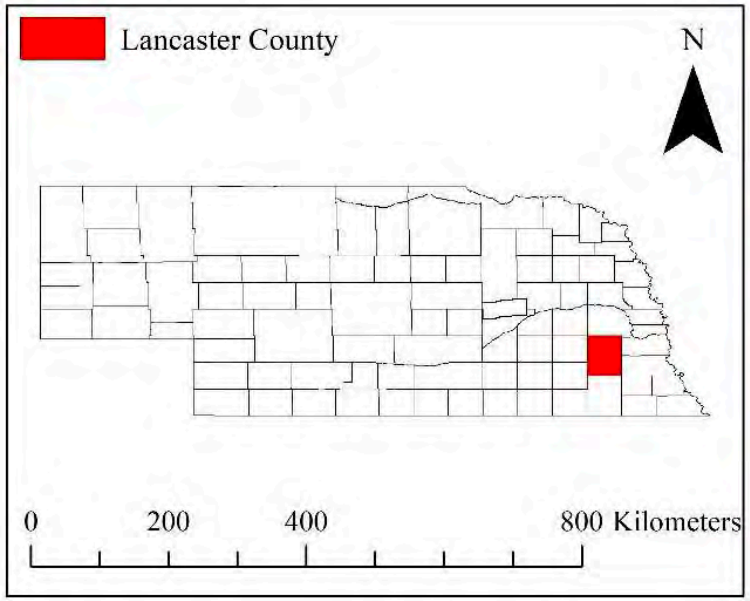
Are they being used at the full scale?

Objective:

Evaluate the use of floating treatment wetlands (FTWs) at full scale for prevention of algal blooms.





Field Sites

- 2 installation ponds
- 1 control site
- All sites had history of algal bloom occurrences

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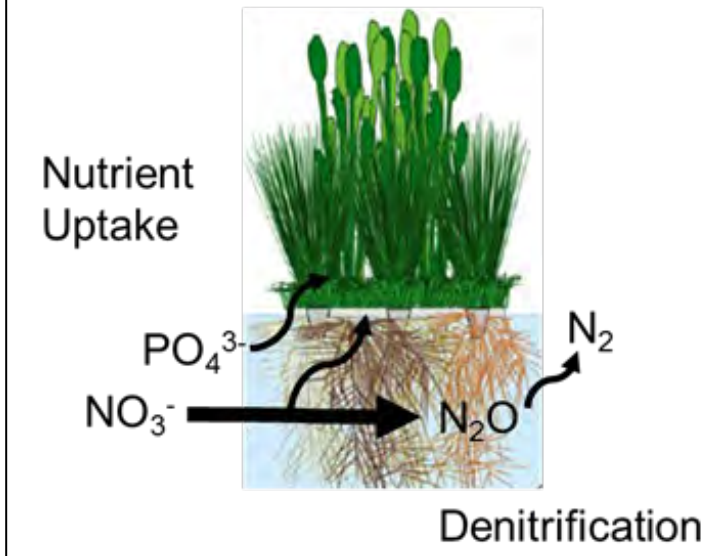
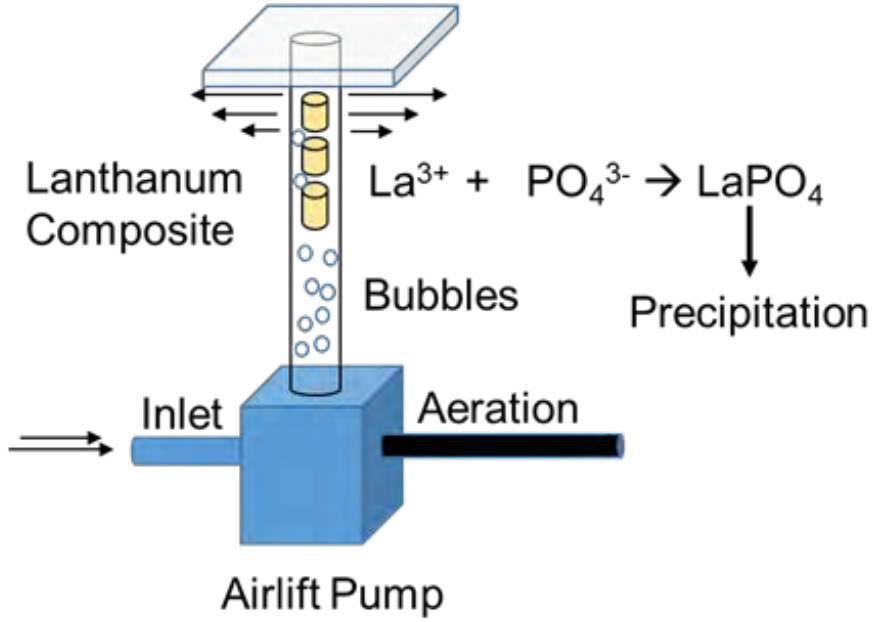
Biological and Chemical Approach





McCoy, J., Chaffee, M., Mittelstet, A., **Messer, T.L.,** Comfort, S. 2024. Nitrate removal by floating treatment wetlands aerated and unaerated conditions: Field and laboratory results. *Nitrogen*. doi: 10.3390/nitrogen5040053

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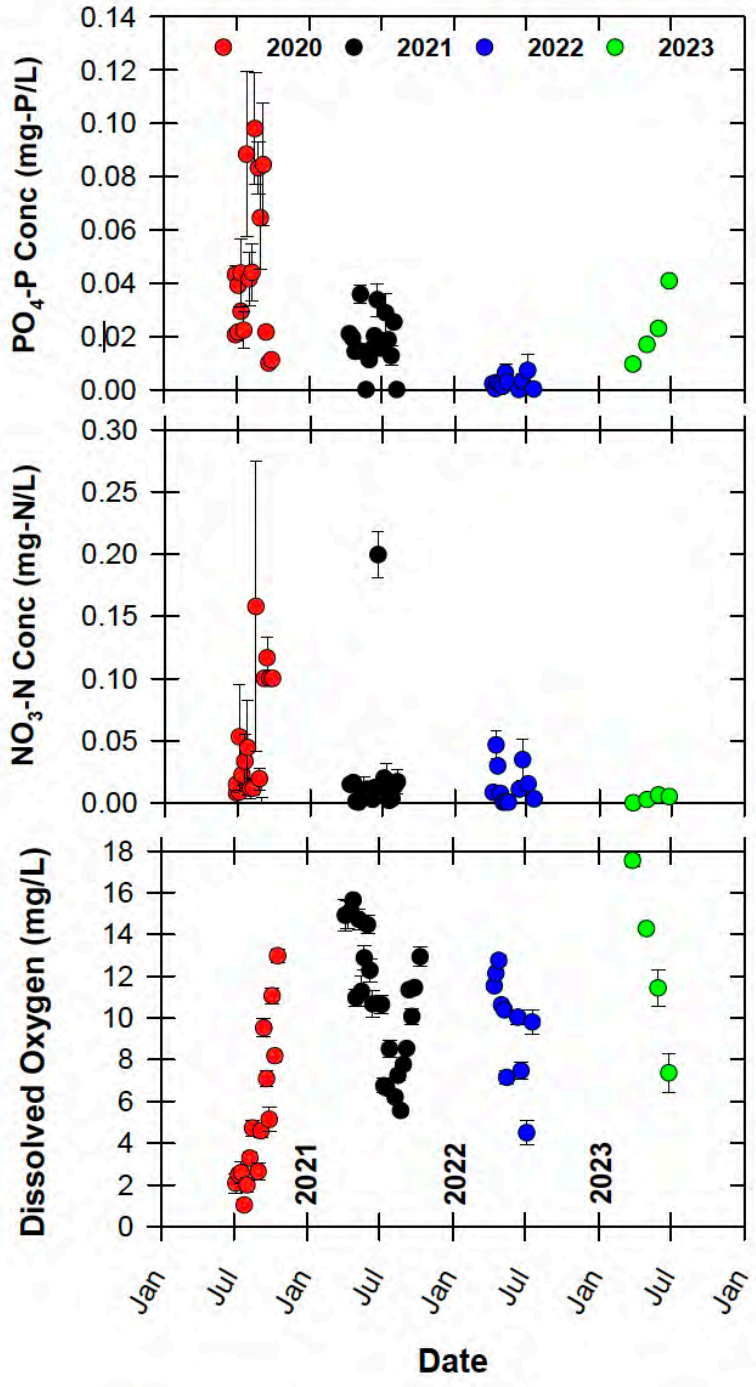
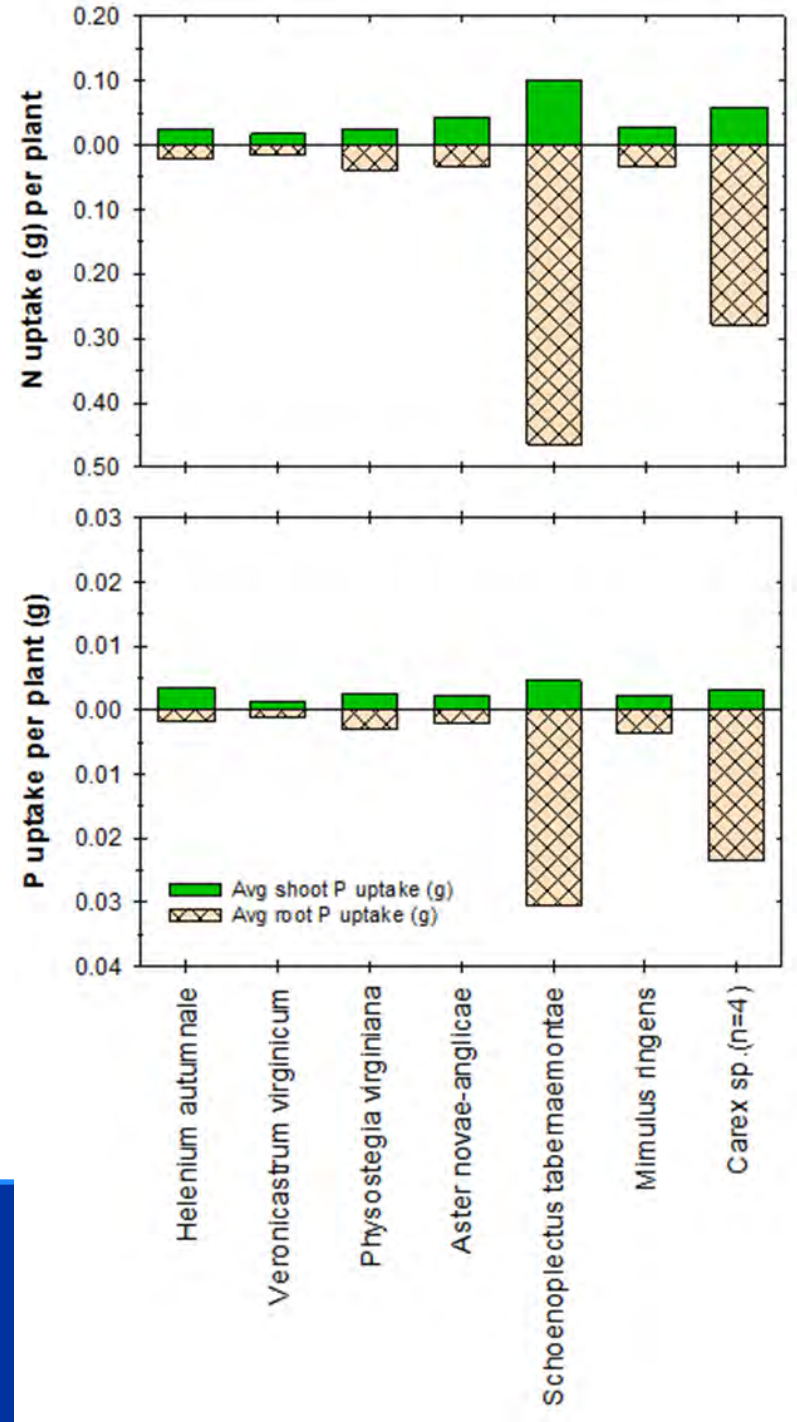
Chemical Approach



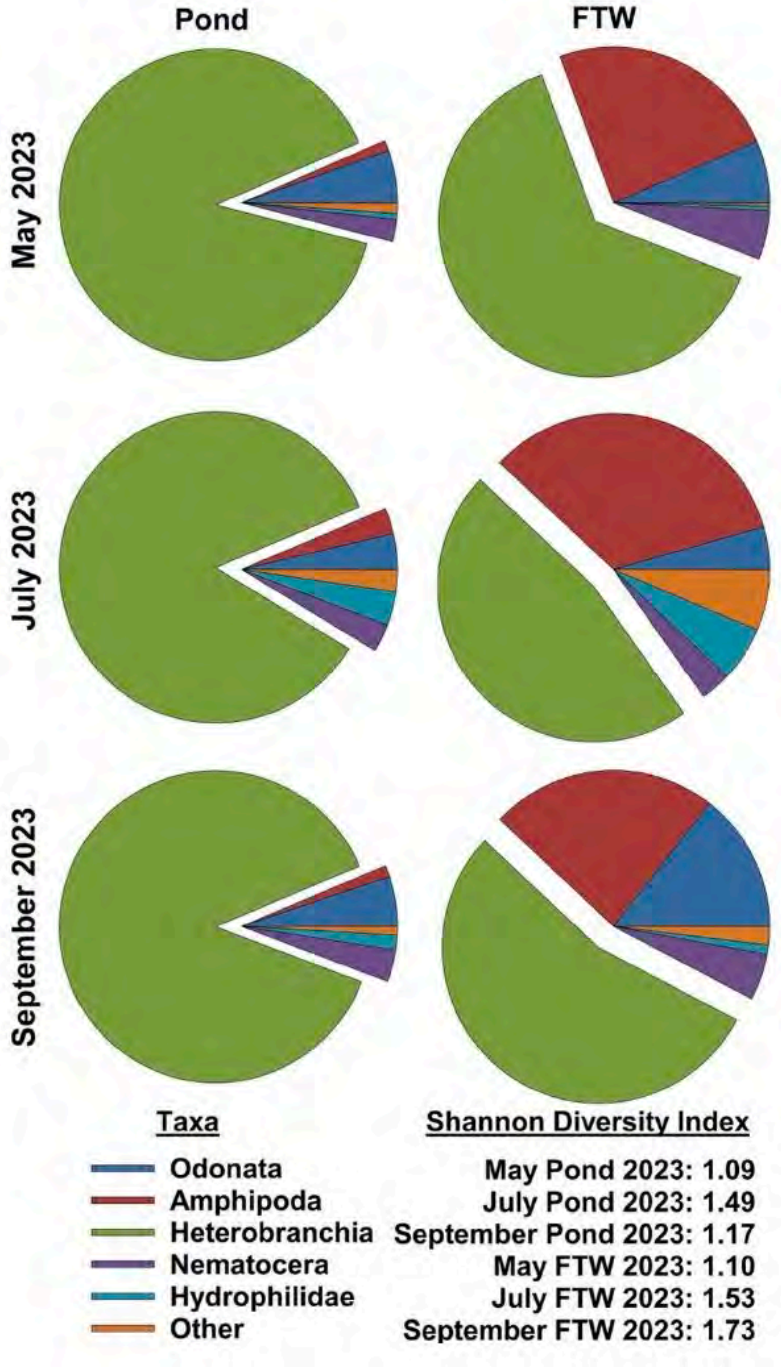
McCoy, J., Chaffee, M., Mittelstet, A., **Messer, T.L.,** Comfort, S. 2024. Nitrate removal by floating treatment wetlands aerated and unaerated conditions: Field and laboratory results. *Nitrogen*. doi: 10.3390/nitrogen5040053

Biological Approach



McKercher, L.J.[2], **Messer, T.L.*,** Mittelstet, A.R., and Comfort, S.D. 2022. A Biological and Chemical Approach to Restoring Water Quality: A Case Study in an Urban Eutrophic Pond. *Journal of Environmental Management.* 318: 115463. doi. 10.1016/j.jenvman.2022.11563

How are the macroinvertebrate communities impacted?



Chaffee, M., Mittelstet, A.*, Comfort, S., **Messer, T**., Uden, D., and McCoy, J. 2024. Context-Dependent Macroinvertebrate Responses to Prolonged Biological and Chemical Treatment in Urbanized Lentic Ecosystems. *Journal of Natural Resources and Agricultural Ecosysetms*, doi: 10.13031/jnrae.16057

Time Lapse Following Installation in 2020

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USDA NEB-38-111 and W-5045
Co-Authors
*meso*Team

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Urban Growth Master Plan:
Expanding Lexington's Urban Service Area

Hal Baillie – Manager, Long Range Planning

Stormwater Stakeholder Advisory Committee

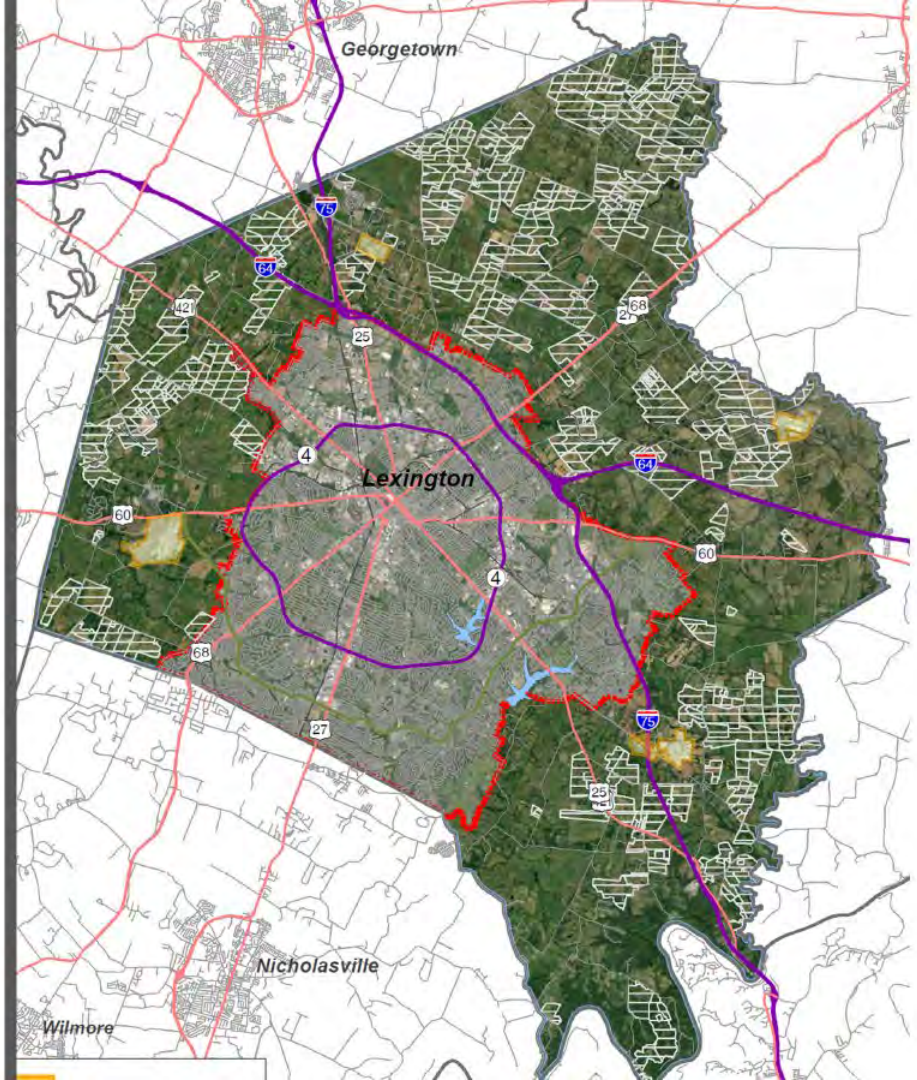
12.4.2025

LEXINGTON

TSW
TUNNELL, SPANGLER, WALSH & ASSOCIATES

URBAN SERVICE AREA

- Urban Service Area Modified Eight Times (1962, 1964, 1967, 1973, 1980, 1996, 1998, and 2001)
- Current Size: 85 square miles
- Grew just over 17 square miles since 1958
- 93% of Lexington's population occupies this space



Imagine Lexington 2045: Theme E, Goal #3

Council Adopts Goals and Objectives (June 15, 2023)

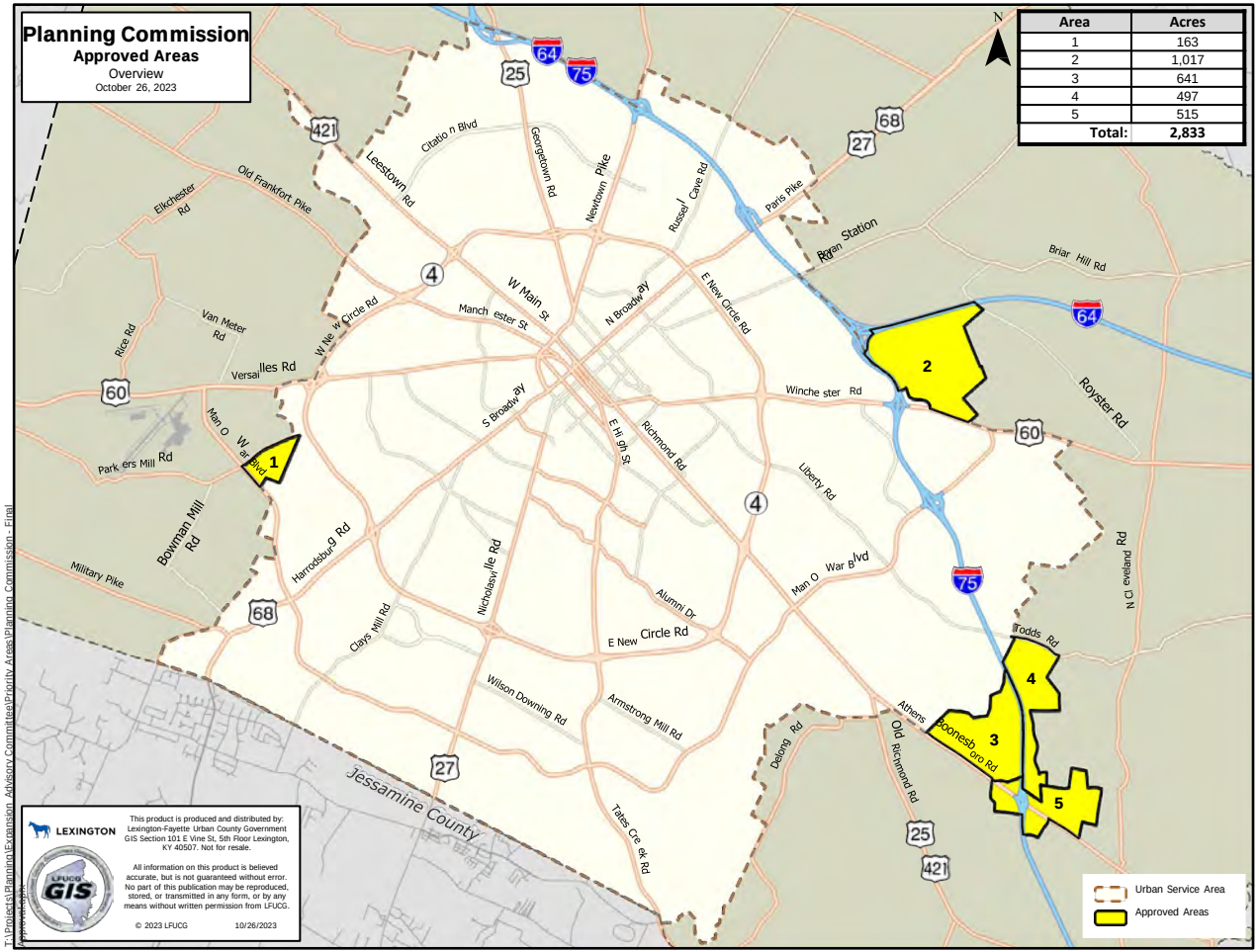
a. The Planning Commission, in carrying out the land use element of this Comprehensive Plan, shall identify no less than 2,700 acres but no more than 5,000 acres for inclusion within the Urban Service Area. Properties that are contiguous to the current Urban Service Area, or have existing frontage on corridors, arterials and collector roadways, or with common ownership of such parcels should be given priority for inclusion.

b. Plan growth along major transportation and federal highway corridors. The Planning Commission should consider for said acreage that which has been identified as capable of meeting infrastructure requirements for growth and is contained within Lexington's major transportation corridors. This area is also limited with the recognition of the community's desire to ensure Lexington remains the Horse Capital of the World.

c. By December 1, 2024, adopt a new Expansion Area Master Plan to ensure the above acreage is responsibly developed while balancing the integrity of our agricultural land and the clear need for additional acreage to address Lexington's housing and economic development requirements. To ensure coordinated development, the master plan should plan for infrastructure, community facilities, and land uses that include a variety of housing types, with a focus on low and middle income housing types, and a wide array of employment opportunities. It is the intention of the Urban County Council that the new Expansion Area Master Plan include provisions for the construction, creation and/or funding of additional affordable housing units, as defined by the Federal Department of Housing and Urban Development, and middle income housing. As such, the Planning Commission shall recommend to the Urban County Council mechanisms to create, construct and/or fund affordable housing units and middle income housing in correlation to the development provided for in the Expansion Area Master Plan. Completion of this master plan shall be the priority of the work of the Division of Planning to ensure timely adoption and implementation of critical needs identified.

Recommended Area

- Identified by Planning Commission on 10/26/23
- 2,840 acres
- 5 approved areas,
- Along major corridors
- Potential as 'gateway' moments into the city



MIX OF HOUSING TYPES

What does well-designed **mixed housing** achieve?

- Addresses different needs (own vs. rent, singles vs. families)
- Can promote affordability
- Provides visual diversity / interest

DIVERSITY OF USES

What does a **mix of uses** and a **diversity of uses** achieve?

- More plentiful amenities/things to do
- More market support for retail, jobs
- Greater walkability and shorter trips
- Greater sense of discovery ("random encounters")

GENTLE DENSITY

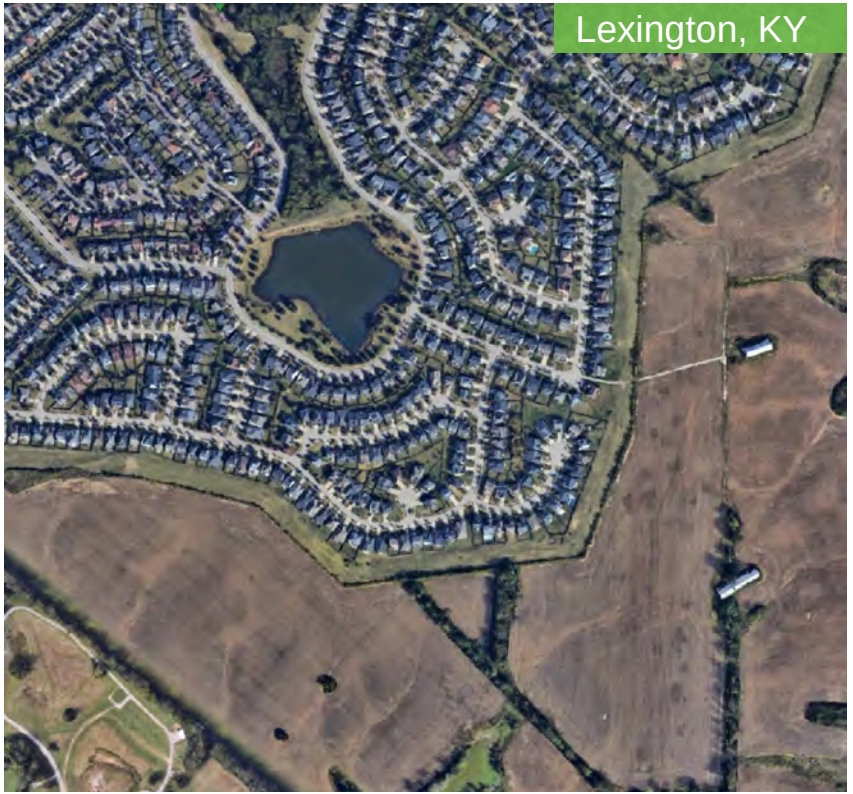
What does well-designed **gentle density** achieve?

- Net/gross density
- More connections with neighbors
- Collective open space
- A mix of uses (in some cases)
- Greater support for retail and other economic drivers
- Greater support for entertainment

CONNECTIVITY

What does greater **connectivity** achieve?

- Reduced isolation
- Reduced traffic congestion
- Greater transportation safety
- Greater flexibility/adaptability and change over time
- Greater opportunity for flexible transit service



MULTIMODAL TRANSPORTATION

What does **multimodal transportation** achieve?

- Provides a transportation network to serve ALL users
- Creates a shift in transportation equity
- Encourages active lifestyles and active transportation opportunities

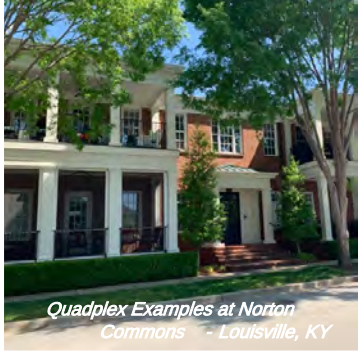
Land Use Types

Low Density

7-13 net dwelling units / acre

- Primarily single -family
- Single -family with ADU
- Low density multifamily
- Townhouses
- Corner stores

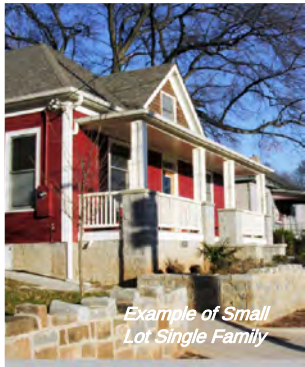

Example of Cottage Courts


Quadplex Examples at Norton Commons - Louisville, KY


Example of Small Lot Single Family


Norton Commons - Louisville, KY


Townhouses at Westside Station - Atlanta, GA


Example of Small Lot Single Family

Land Use Types

Medium Density

11-25 net dwelling units / acre

- Primarily single -family
- Single -family with ADU
- Low density multifamily
- Townhouses
- Multiple -family with up to 10 units
- Corner stores


Beaumont Farms Apartments - Lexington, KY


Norton Commons - Louisville, KY


Duplex Example - Atlanta, GA


Neighborhood Restaurant - Atlanta, GA


McDaniel Glenn Apts - Atlanta, GA

Low Density

Medium Density

High Density

Village Center

Town Center

Flex Space

Land Use Types

High Density

23+ net dwelling units / acre

- **Multiple -family dwellings**
- **Commercial**

Example of Multi -Family

Glenwood Park Townhomes - Atlanta, GA

Example of Multi -Family

Land Use Types

Village Center

20+ net dwelling units / acre

- Retail/restaurant, office, and residential uses.
- Single -family (less than 10% of units) Townhouses
- Multiple -family dwellings
- Mixed -use

Village center size: min. 10 contiguous acres


Example of neighborhood retail


Chevy Chase - Lexington, KY

Example of single story retail


Kentlands - Gaithersburg, MD

Low Density

Medium Density

High Density

Village Center

Town Center

Flex Space

Land Use Types

Town Center

30+ net dwelling units / acre

Serving adjacent neighborhoods as well as other areas within a 10 - to 20-minute drive.

- Retail or restaurant
- Office
- Residential uses

Town center size: minimum 20 contiguous acres

Vertical Mixed Use - Trilith, GA

Vertical Mixed Use - Atlanta, GA

Land Use Types

Flex Space

Density: n/a

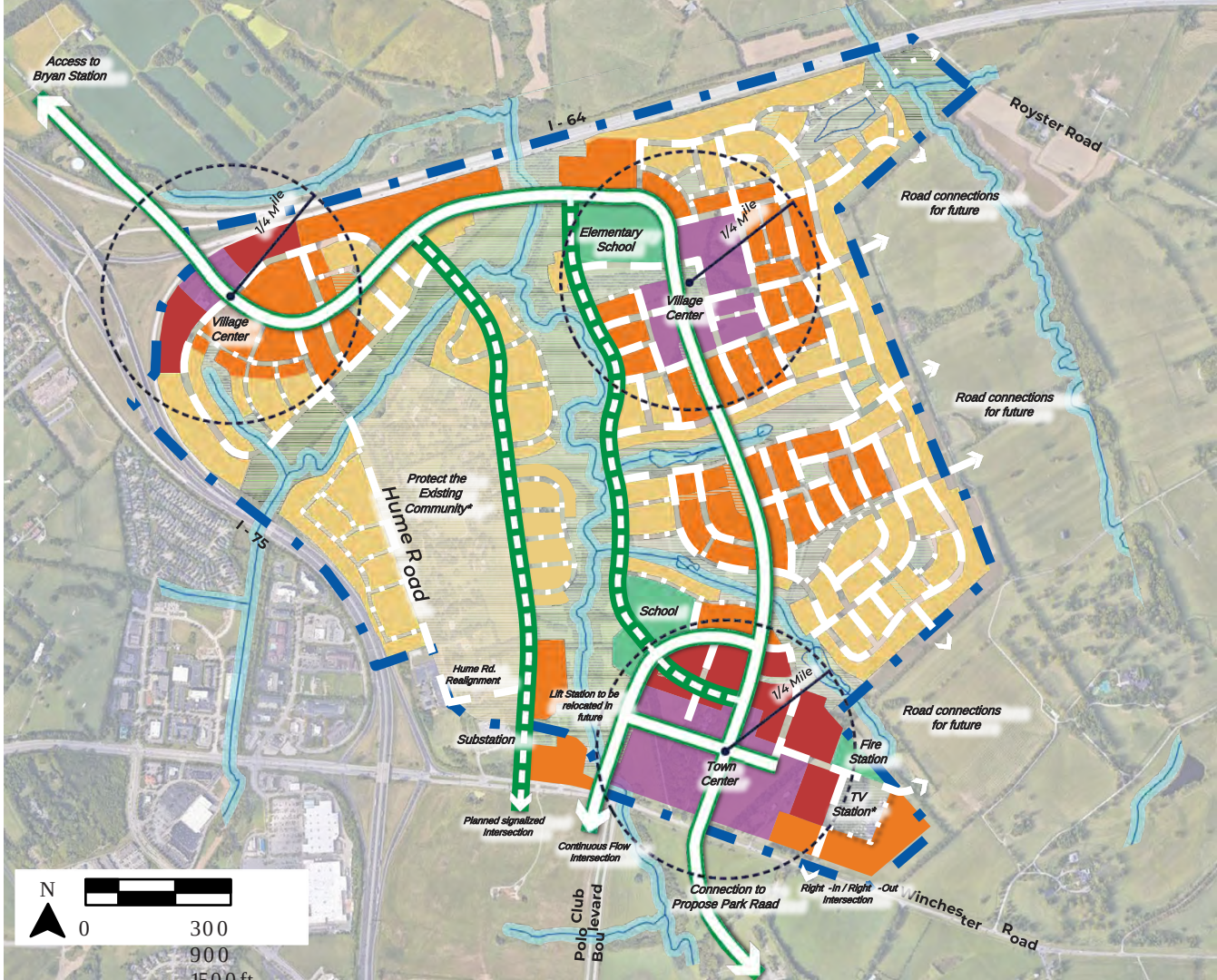
- Retail or restaurant
- Office
- Industry
- Recreation
- Other regionally significant attractions
- Secondary uses include all residential uses

Example of office use


Example of low density flex space

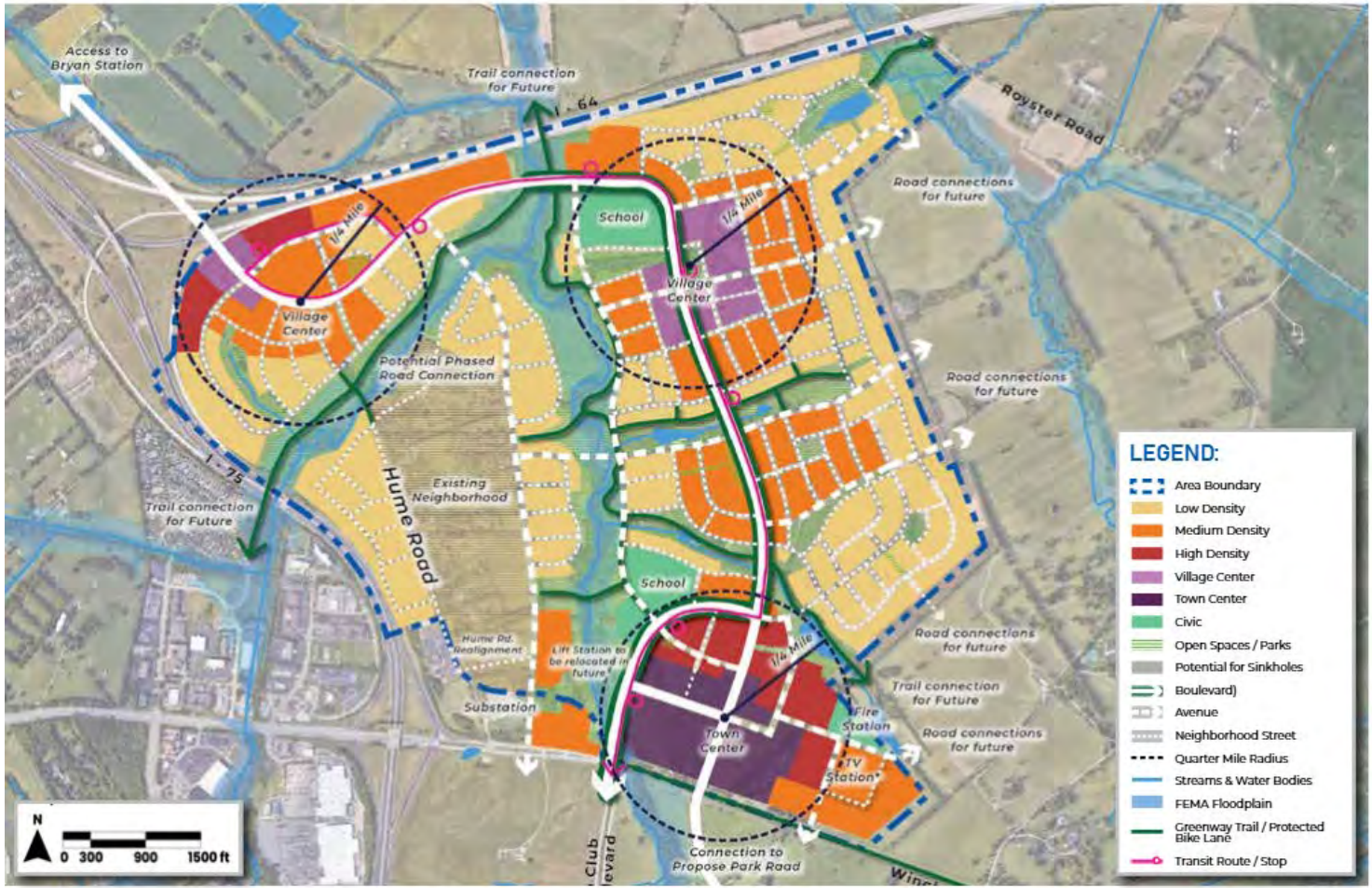

Westside Paper - Atlanta, GA

Initial Framework Planning

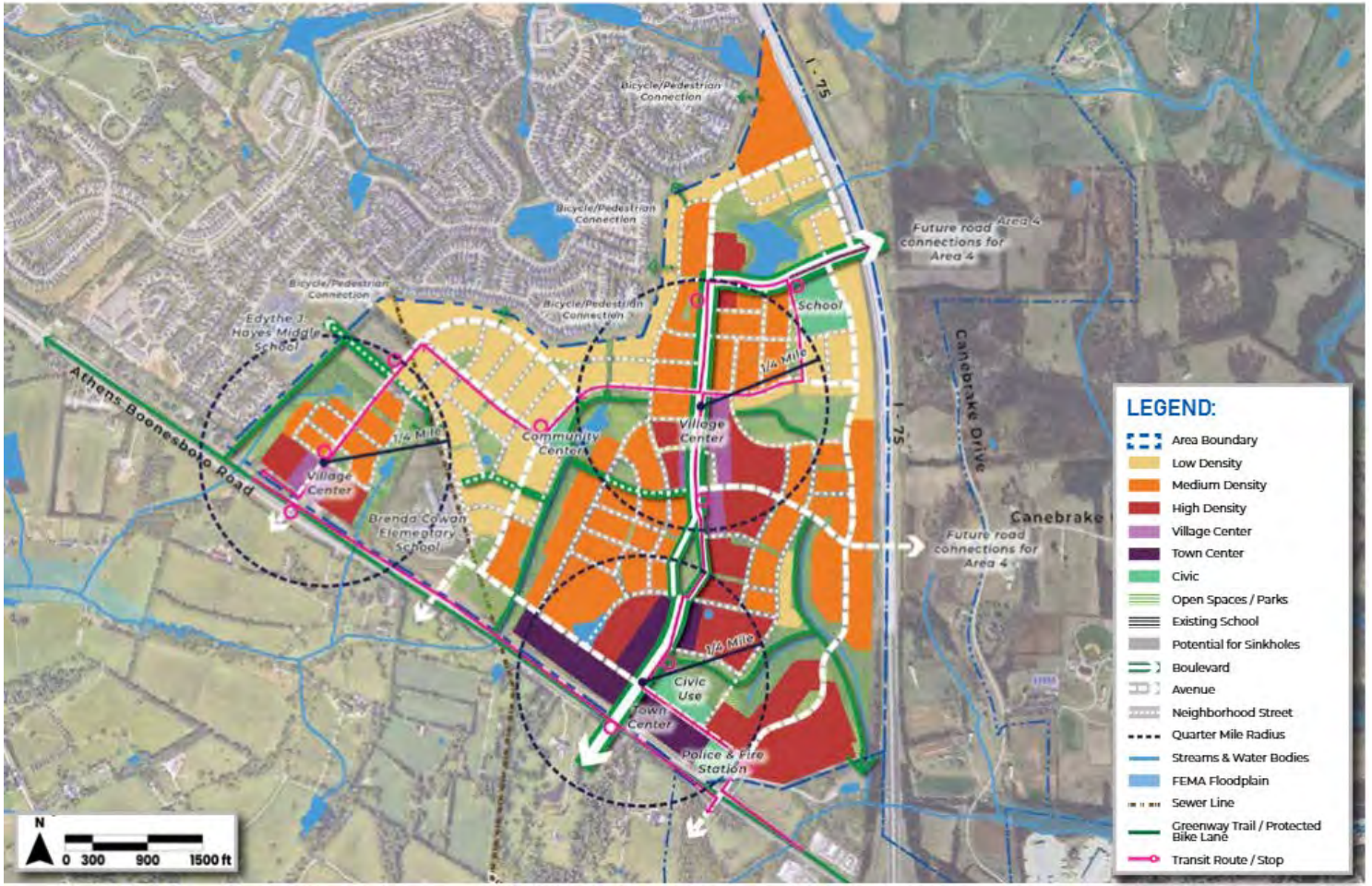


Regulating Plan - Area 1

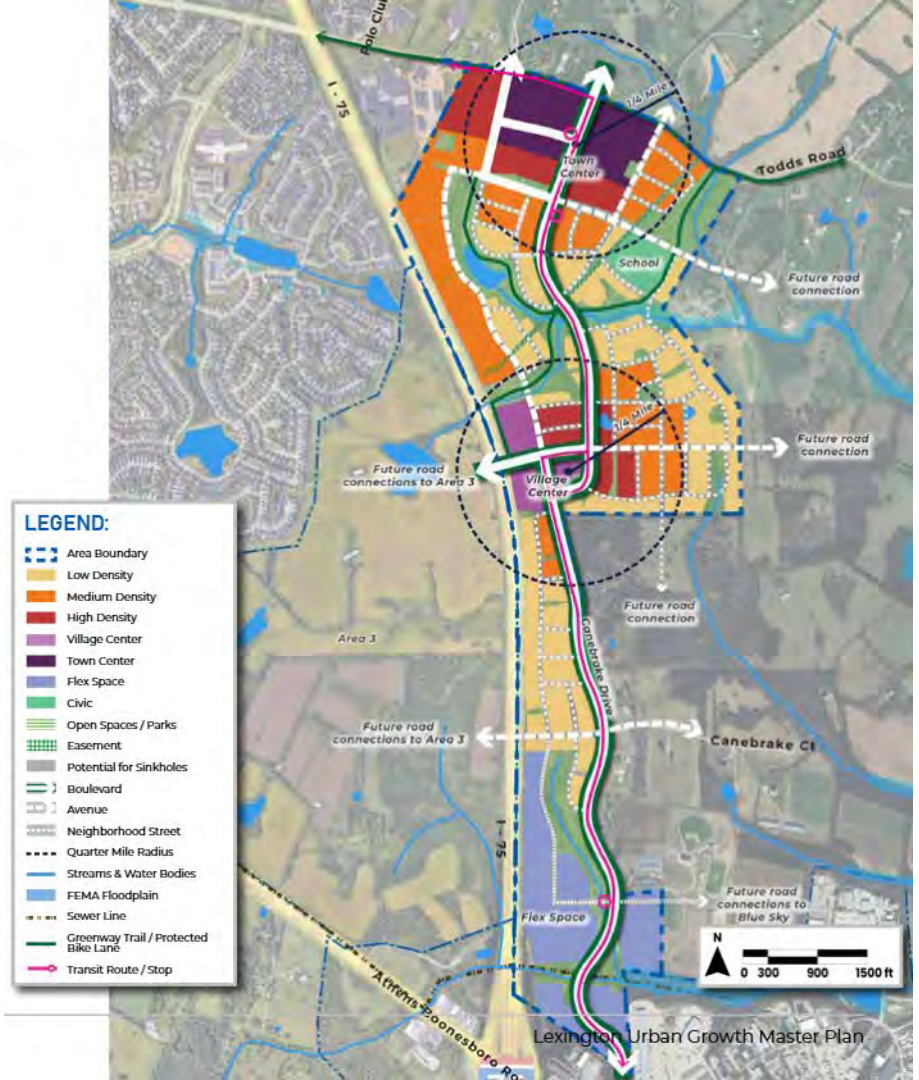
Regulating Plan - Area 2



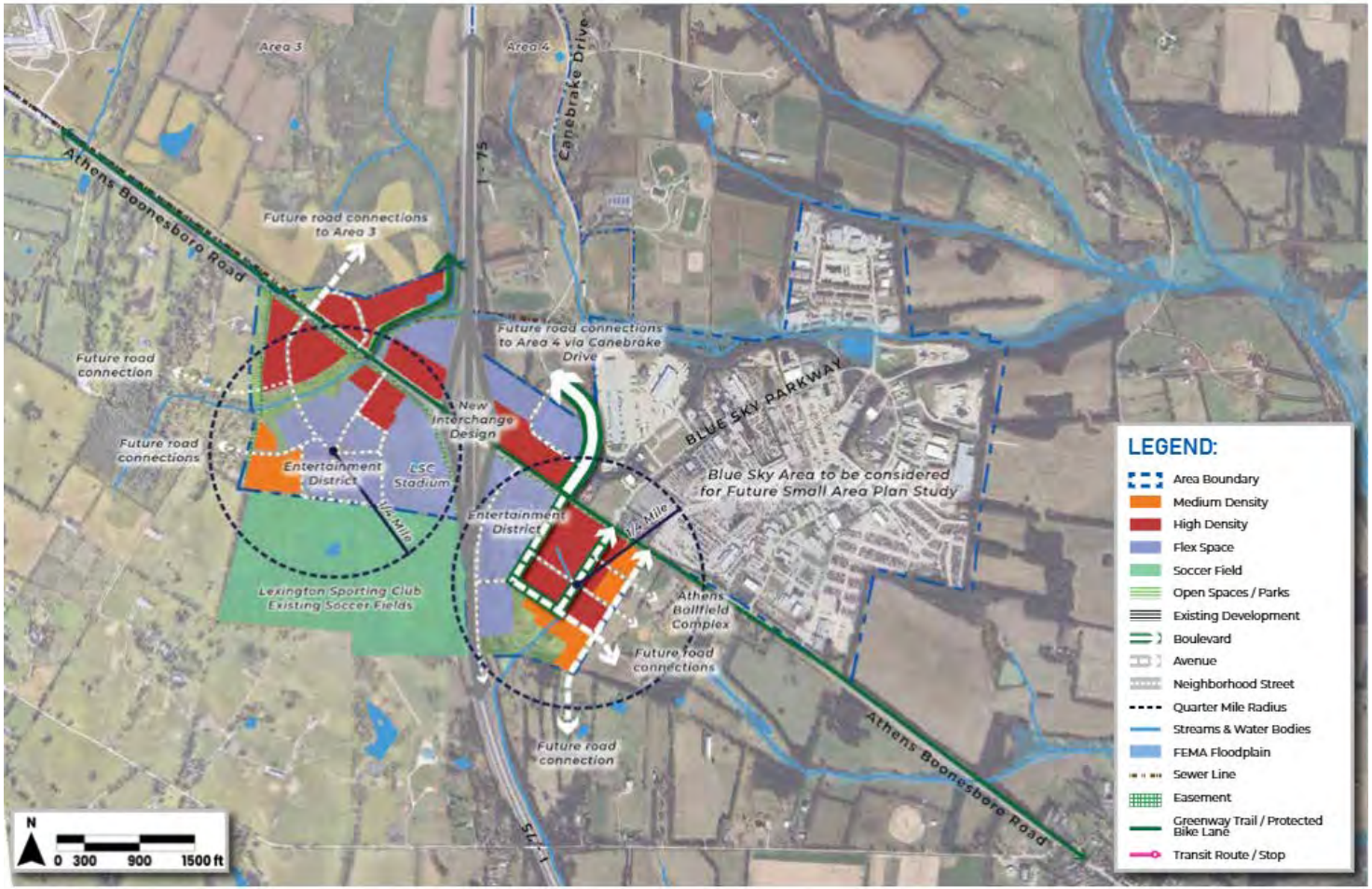
Regulating Plan - Area 3



Regulating Plan - Area 4



Regulating Plan - Area 5



BLUE SKY WORKS

About Project Updates

LET'S GET TO *WORK*

Help us plan and envision Lexington's Blue Sky Industrial District!

TAKE SURVEY

LEXINGTON
Urban County Council

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Home / Lexington's Preservation & Growth Management Program (LPGMP)

Questions?

TSW PLANNING ARCHITECTURE LANDSCAPE ARCHITECTURE | Gresham Smith | PES Partners for Economic Solutions | Southface | CivicLex

Informing LFUCG Stormwater Management Using Data-Driven Insights

Ian M. Simpson, PhD, E.I.
Jon M. Hathaway, PhD, P.E.

THE UNIVERSITY OF TENNESSEE KNOXVILLE
BIG ORANGE. BIG IDEAS.

Tennessee Water Resources Research Center

Storms 3S Streams
3S Sustainability 3S

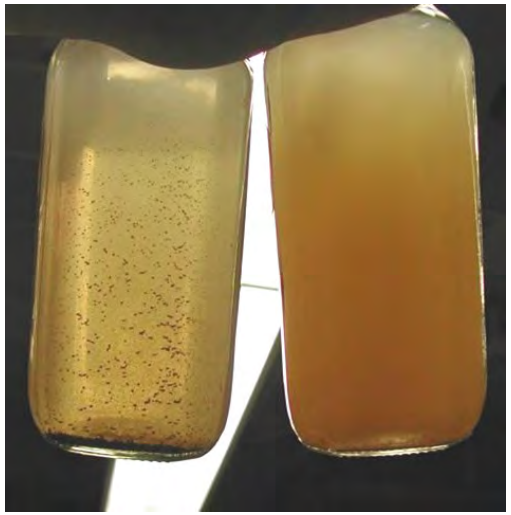
Data Collection

Third Rock, Volunteers, LFUCG

- Wet stream chemistry
- Dry stream chemistry
- Wet outfall chemistry
- Dry/Scheduled outfall chemistry
- Physical habitat - RBP
- Macroinvertebrates - MBI
- Fish – IBI

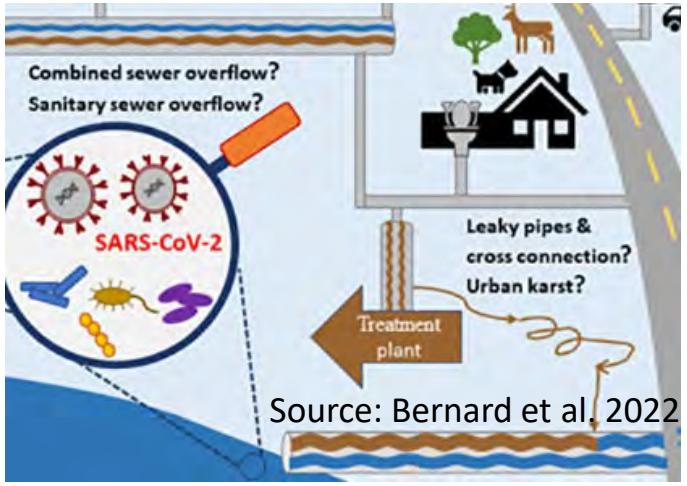
Chemical Analytes

- Total suspended solids (TSS)
- Nutrients
  - Ammonia (NH_3), Nitrate/nitrite (NO_{2+3}), total Kjeldahl nitrogen (TKN), total nitrogen (TN)
  - Dissolved phosphorous (DP), total phosphorus (TP)
- *Escherichia coli* (*E. coli*)



Objectives

1. Correlations of pollutants and stream assessments
2. Quantify stream concentrations
   a) Wet vs dry weather
3. Identify watersheds with excessive pollution and locate hotspots



Source: Bernard et al. 2022

Source: Waterwise Inc

Data Collection – General Knowledge

- Jan 2015 – Dec 2024
- WQWet, WQDry, WQ
- MDL, ADL, BDL
  - TSS, TKN, NH_3
- Managing ADLs
- Managing BDLs

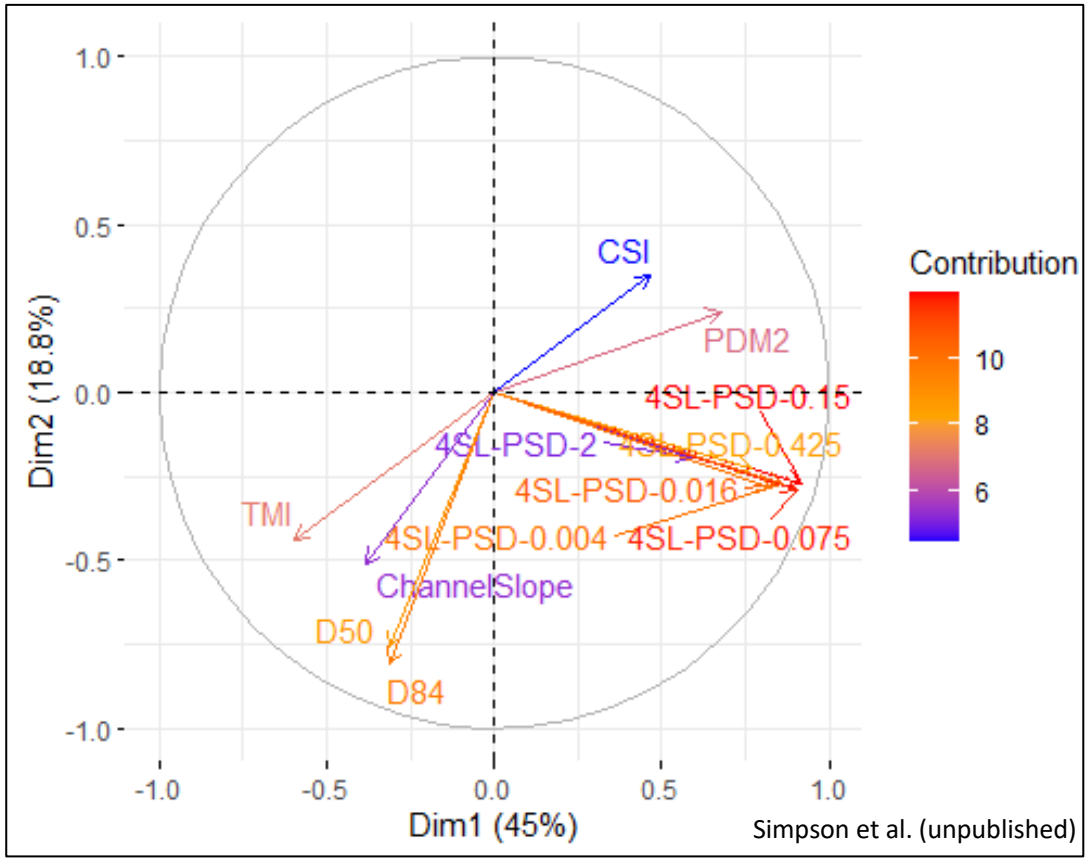
Pollutant	Sample Count - Streams				Sample Count - Outfalls			
	Label	Total	BDL	ADL	Label	Total	BDL	ADL
TSS	WQWet	325	33	0	WQWet	36	0	0
	WQDry	331	110	0	WQ	2234	0	0
E. coli	WQWet	357	1	16	WQWet	36	8	7
	WQDry	331	5	0	WQ	2234	63	1
NO_{2+3}*	WQWet	333	12	0	WQWet	36	3	0
	WQDry	331	0	0	WQ	2233	15	0
NH_3	WQWet	334	194	0	WQWet	36	1	0
	WQDry	331	265	0	WQ	2233	125	0
TKN	WQWet	334	208	0	WQWet	0	0	0
	WQDry	331	224	0	WQ	0	0	0
TN	WQWet	333	-	-	WQWet	0	-	-
	WQDry	331	-	-	WQ	0	-	-
DP	WQWet	334	16	0	WQWet	0	0	0
	WQDry	331	19	0	WQ	0	0	0
TP	WQWet	334	8	0	WQWet	32	3	0
	WQDry	331	10	0	WQ	2234	126	0

*Samples collected from outfalls were only analyzed for NO_3 not NO_{2+3}.

- Not represented since TN is the sum of TKN and NO_{2+3}.

Methods - Correlation

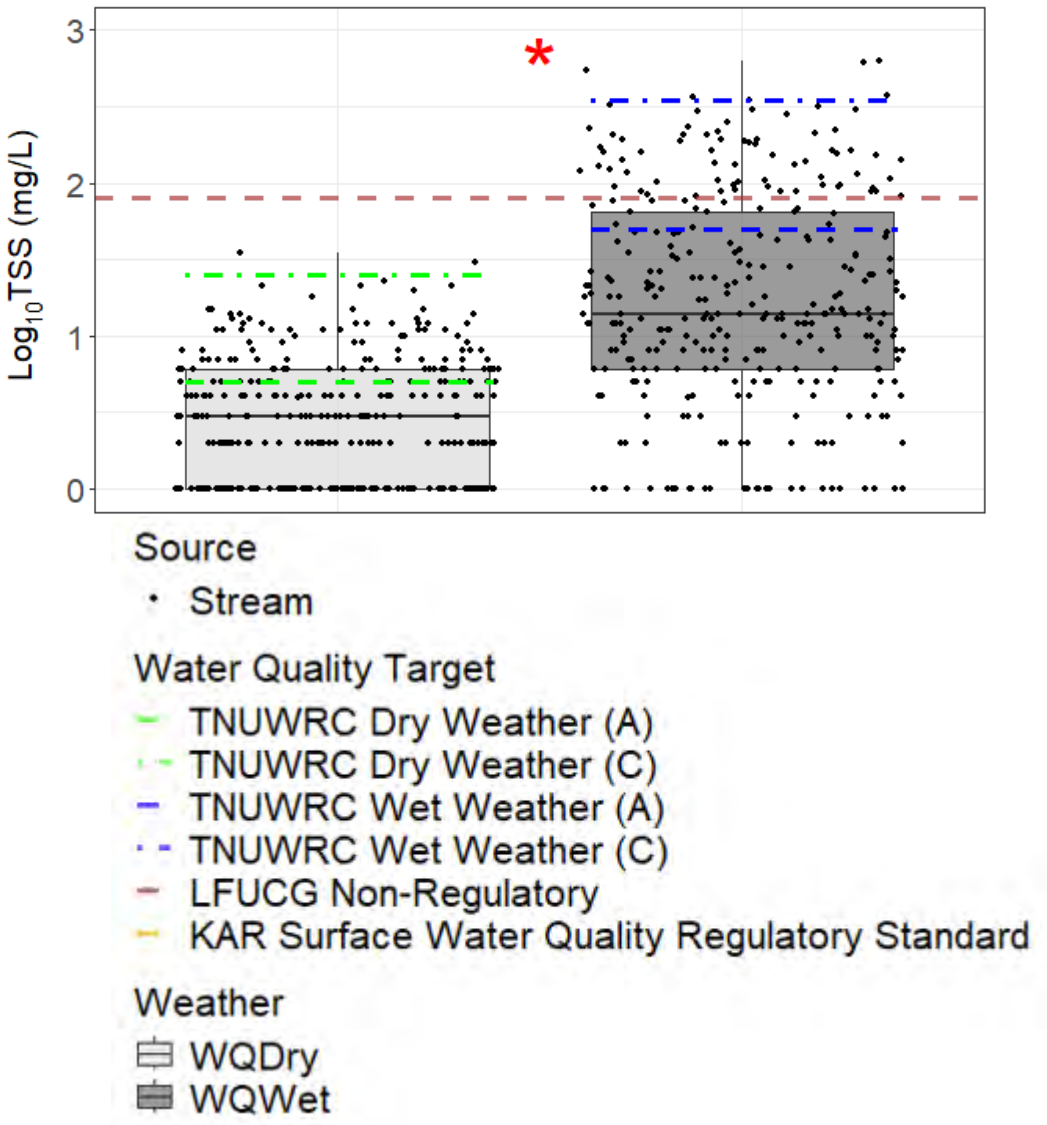
- Multiple factor analysis (MFA)
- Visualize multivariate relationships among dataset
- Similar to principal component analysis
- Results in a circular biplot of dim1 vs dim2, dim2 vs dim3, etc.
- Vectors – orientation, length



Simpson et al. (unpublished)

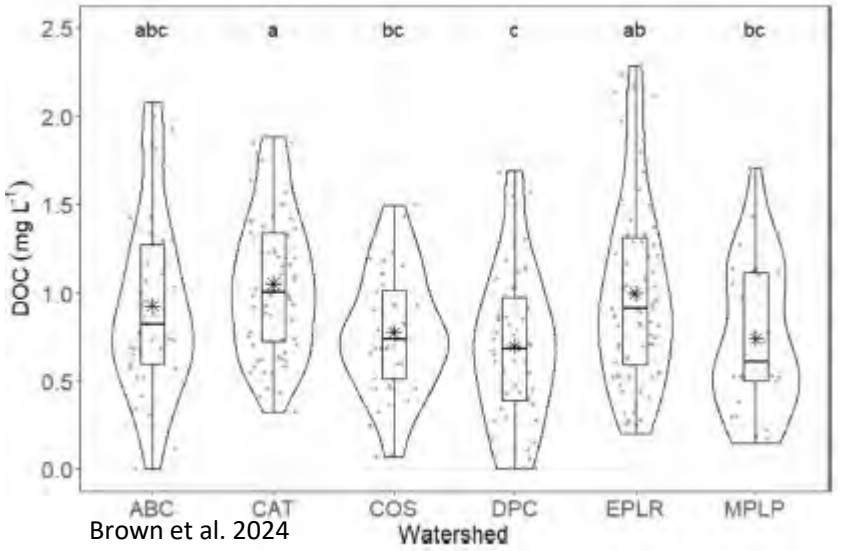
Methods - Quantification

- Stream chemistry
- Wet vs dry weather
- Wilcoxon rank sum test with Holm correction
- Ecological and human health thresholds
  - Tennessee urban waters report card
  - Lexington benchmarks
  - KAR surface WQ regulations

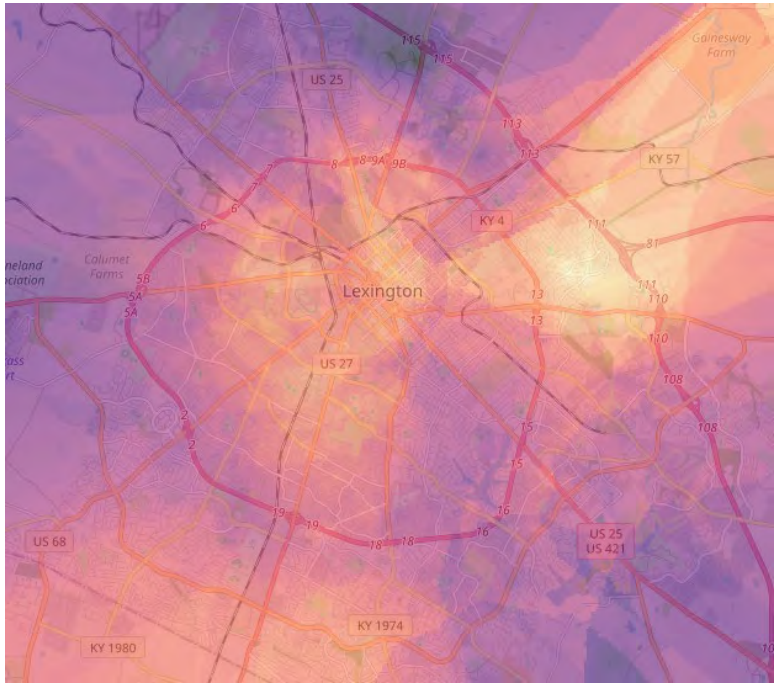


Methods – Watersheds & Hotspots

- Stream chemistry by watershed
  - Wet and dry weather
  - Tukey's honest significant difference test (wet)
  - Lettering system (wet)
- Interactive spatial analysis (TSS, TP, *E. coli)*
  - Plotting of sampling locations (wet stream, dry stream, dry outfall)
    - Color (median), size (exceedance of threshold), outer ring color (season)
  - Kriging – spatial analysis mapping technique

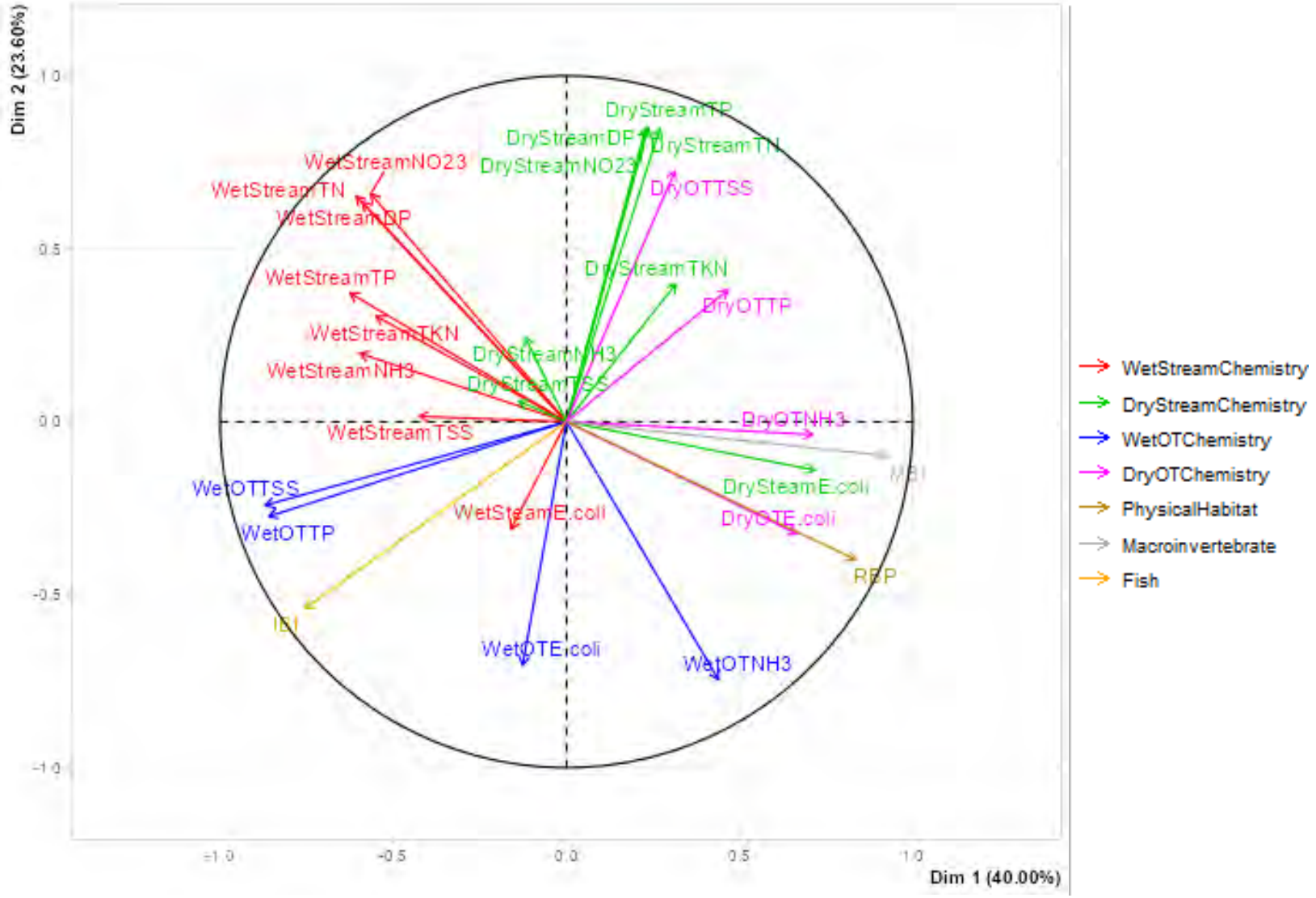


Brown et al. 2024



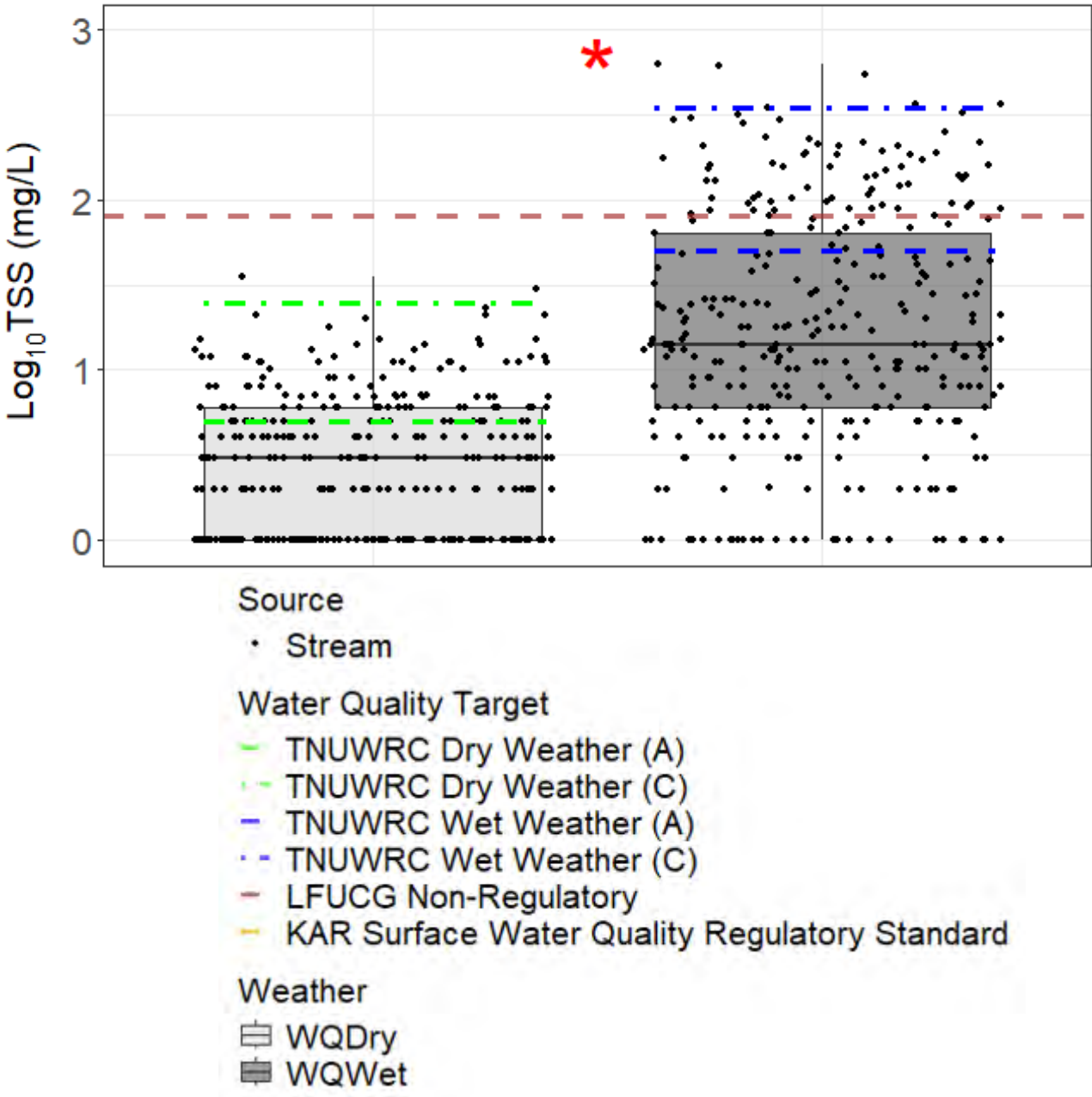
Correlations

- Dim1 degradation gradient
- Dry pollution in streams relates to poor MBI and RBP
- Wet pollution in streams related to fish
- Dim2 weather or season gradient
- No correlation between wet and dry pollution



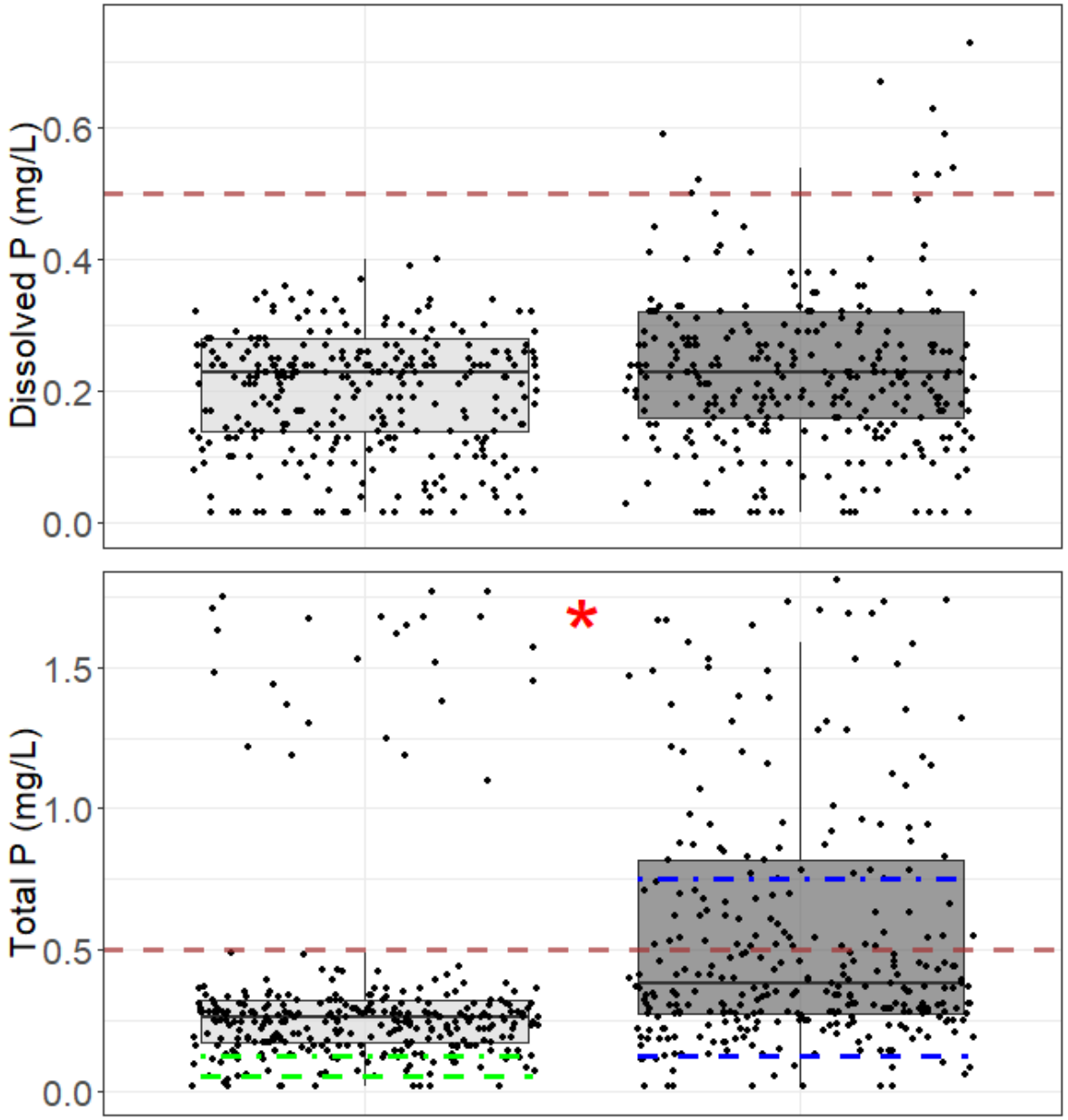
Wet vs Dry TSS

- Significant increase during wet weather
- Median 3 mg/L to 14 mg/L
- Dry weather – 0.6% exceedance
- Wet weather – 1.5% exceedance
- Sources of TSS



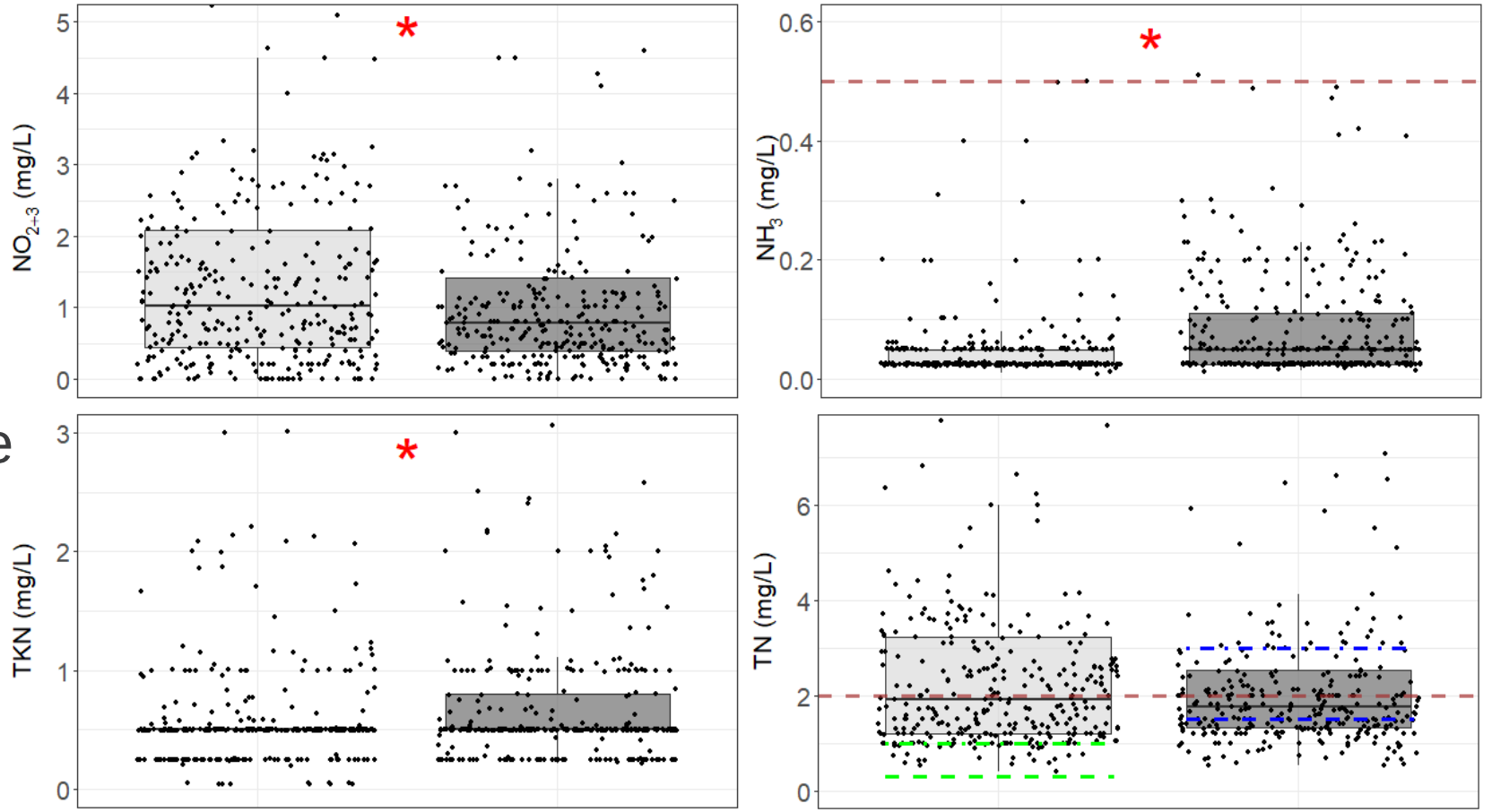
Wet vs Dry Phosphorus

- TP significant increase in wet weather
  - Correlation with TSS
- Dry weather – 86.4% exceedance
- Wet weather – 27.3% exceedance
- Dry weather pollution problematic
  - Confirmed from correlation analysis
- TP was 88.5 (dry) and 60.5 (wet) % DP
  - Control DP in dry conditions
- Sources of P



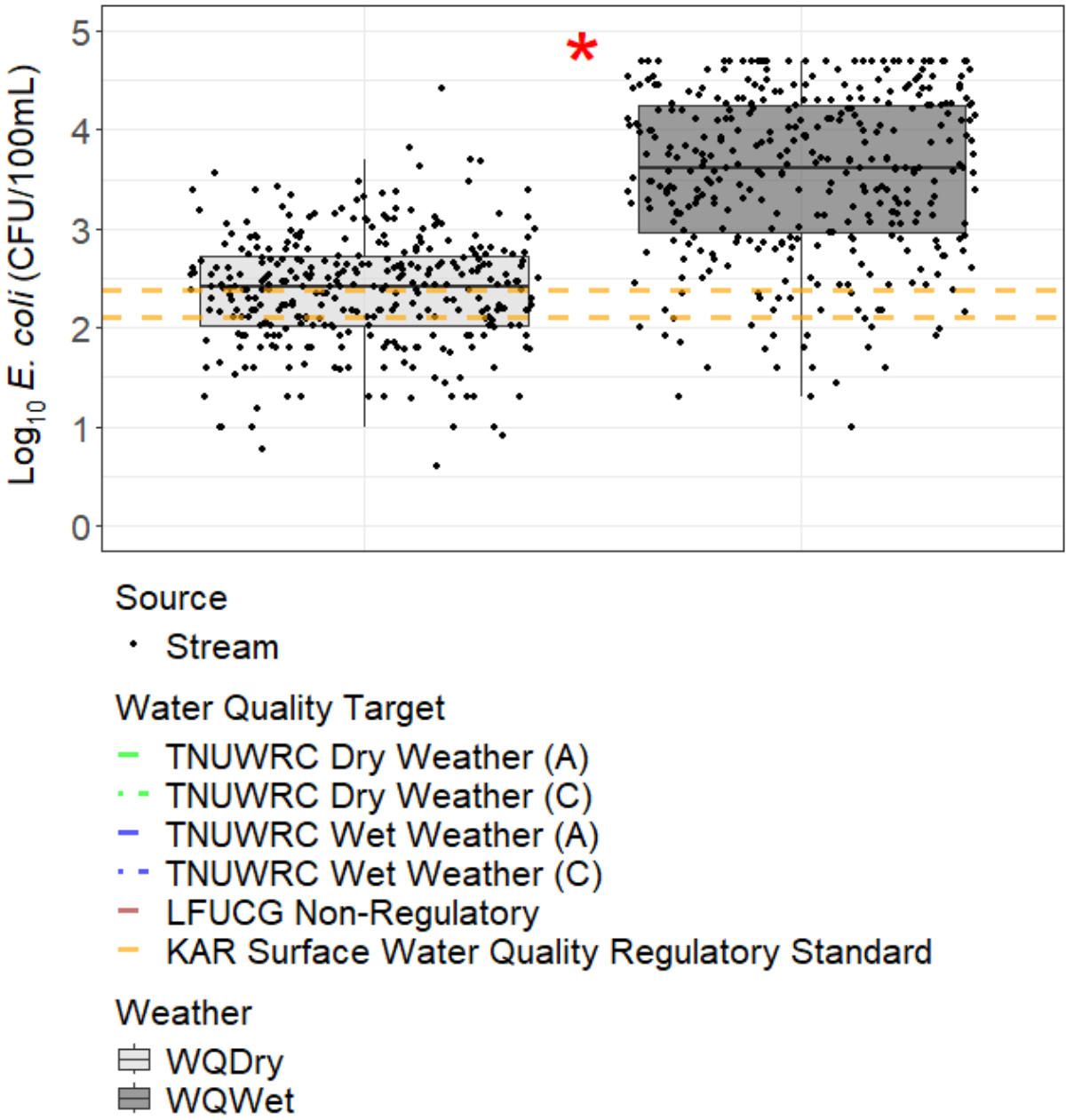
Wet vs Dry Nitrogen

- NH_3 and TKN increased
  - BDLs
- NO_{2+3} decreased
- TN is largely OrgN
- Particulate vs dissolved
- Dry–91.5% exceedance
- Wet–20.7% exceedance
  - Confirmed correlation
- NO_{2+3}, NH_3 not ecologically relevant
- Dry OrgN
- OrgN sources



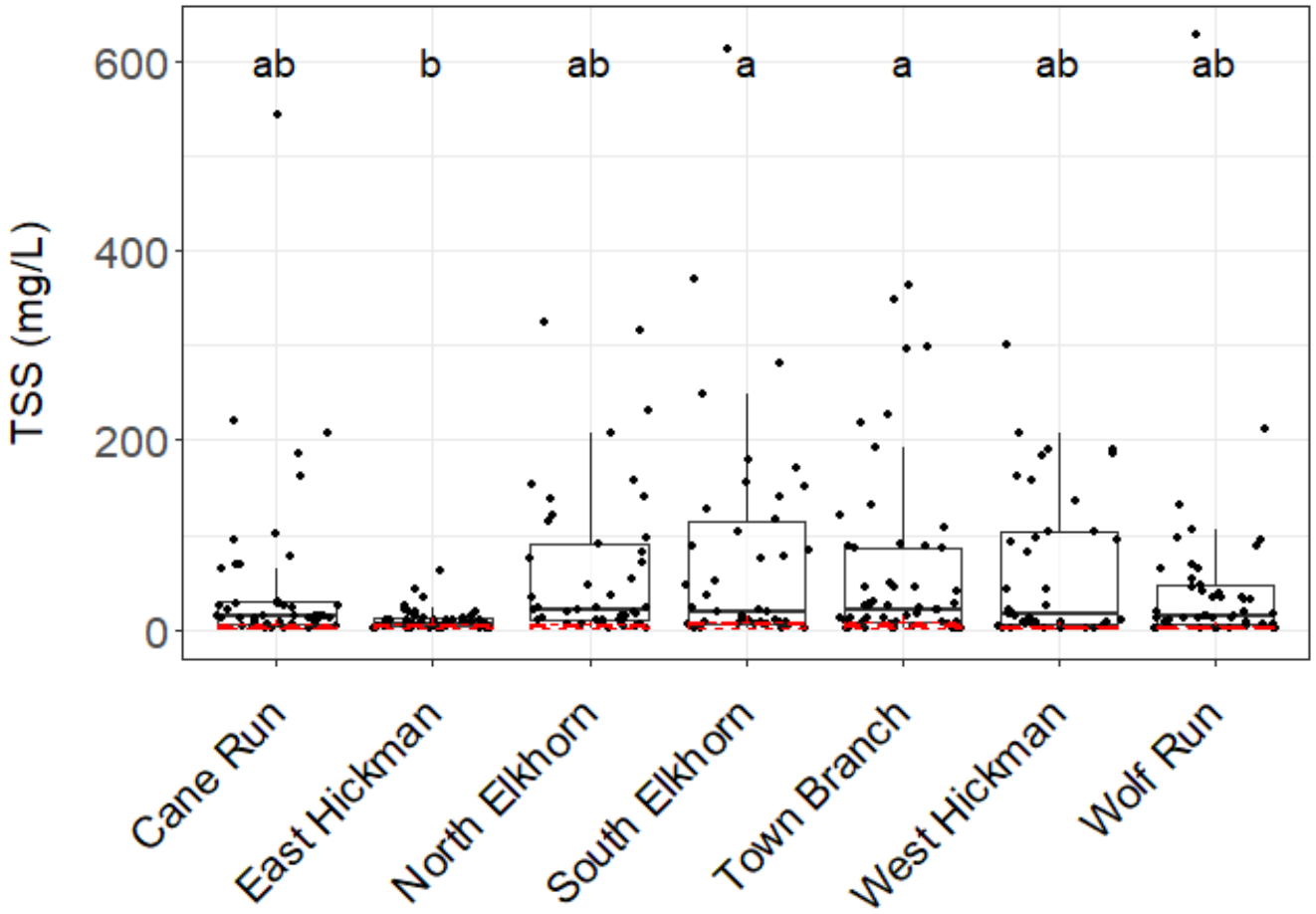
Wet vs Dry *E. coli*

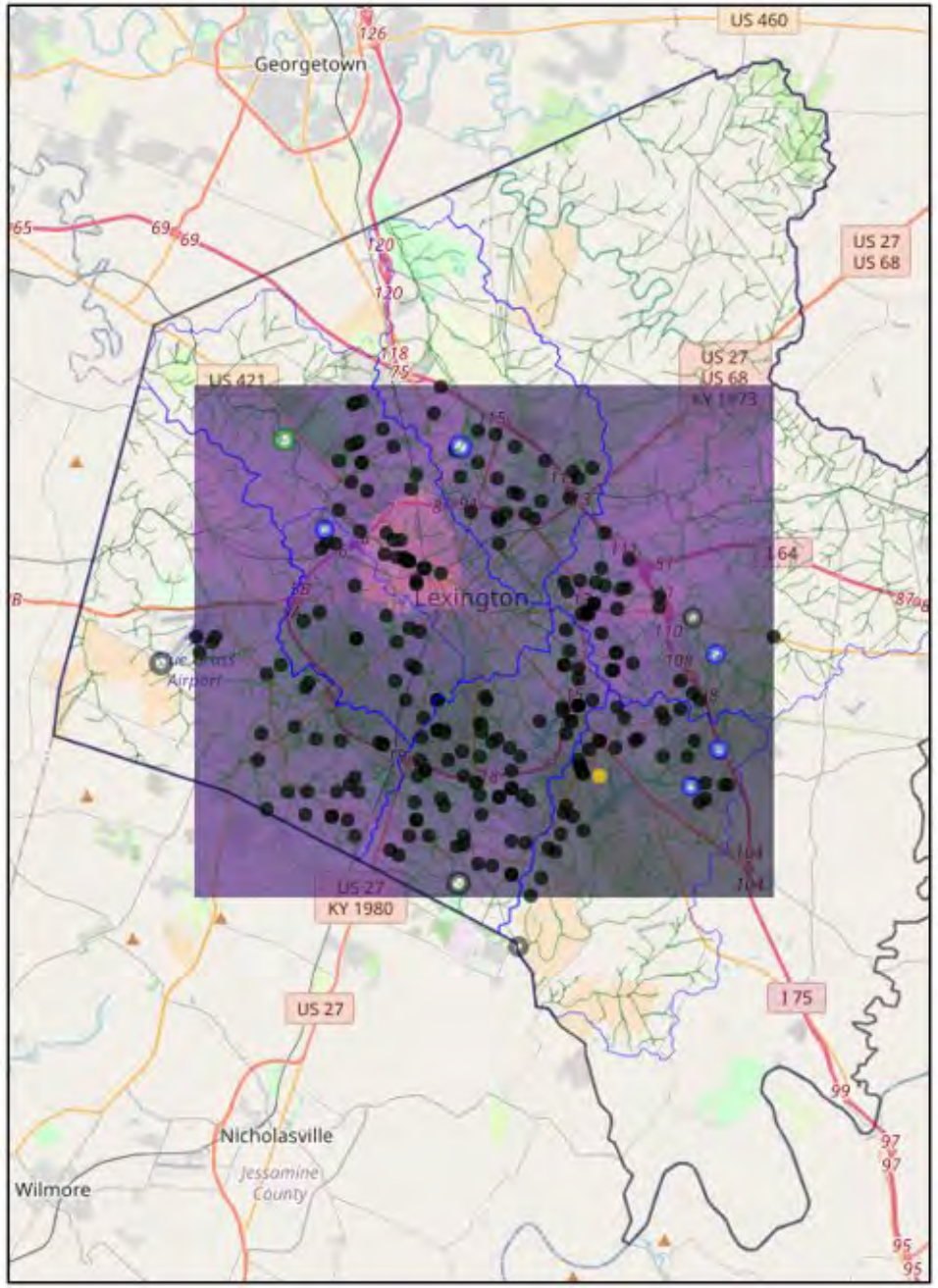
- Significant increase during wet weather
- Wet – 93.8 and 90.2% exceedance
- Dry – 69.2 and 54.4% exceedance
- Problematic in both wet and dry
- Sources of pathogens
  - Human sources mostly in wet (Bernard et al., 2022; Wu et al., 2011)
- Structural SCMs variable
  - Require biologic component – still variable
  - Soil amendments – potentially helpful
  - Source tracking

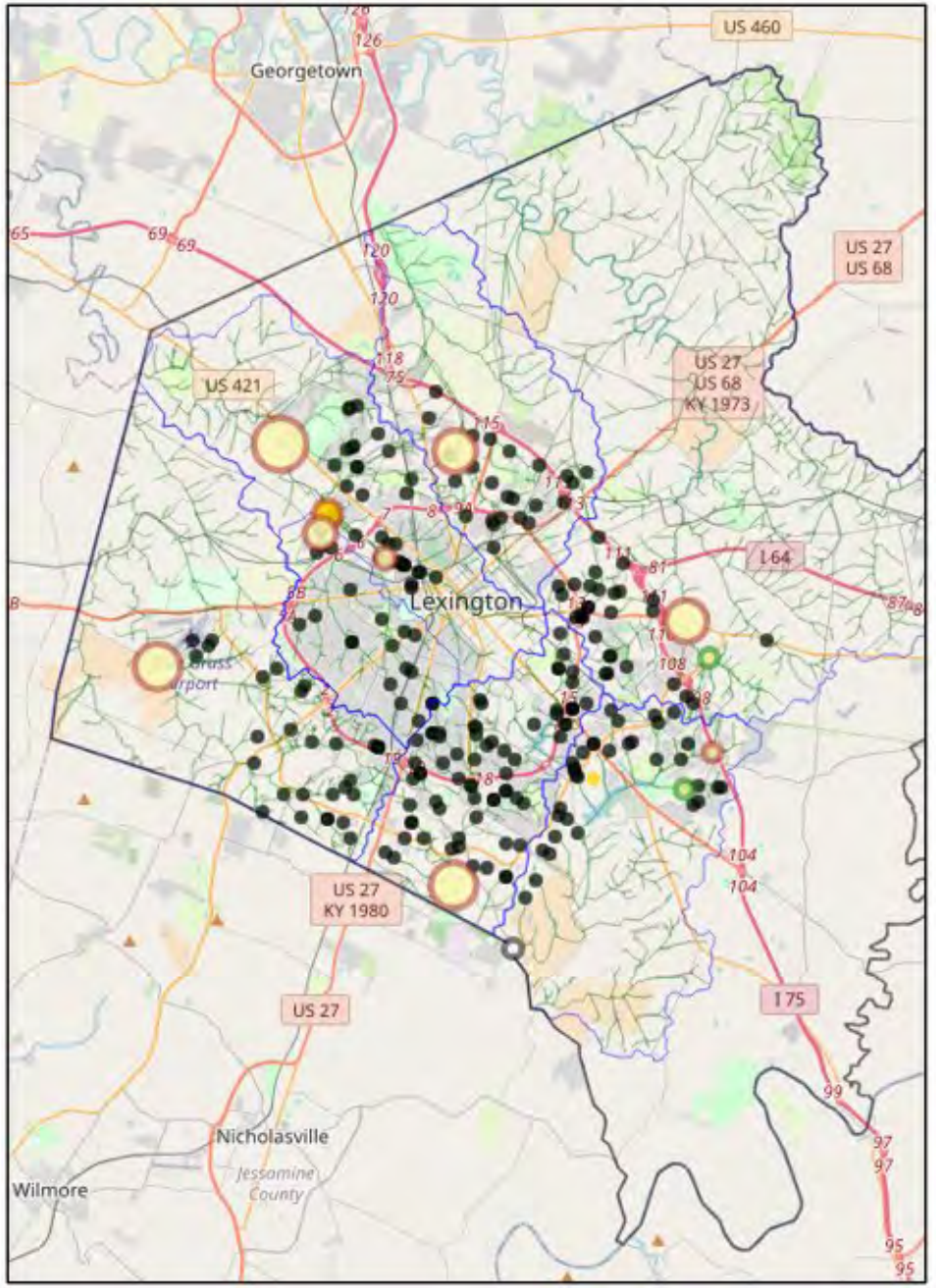


Spatial Analysis TSS

- Boxplots
- Town Branch & South Elkhorn > East Hickman
- Town Branch & South Elkhorn minimum sediment impairments
- Wet sediment pollution increased in all watersheds
  - North Elkhorn 3 to 22 mg/L
- Influence of rainfall intensity







Median TSS (mg/L)

- 0-10
- 11-25
- 26-50
- 51-75
- 76-100
- >100

Kriged TSS (mg/L)

0 5 10 15 20 25 30 35

90th Percentile TSS (mg/L)

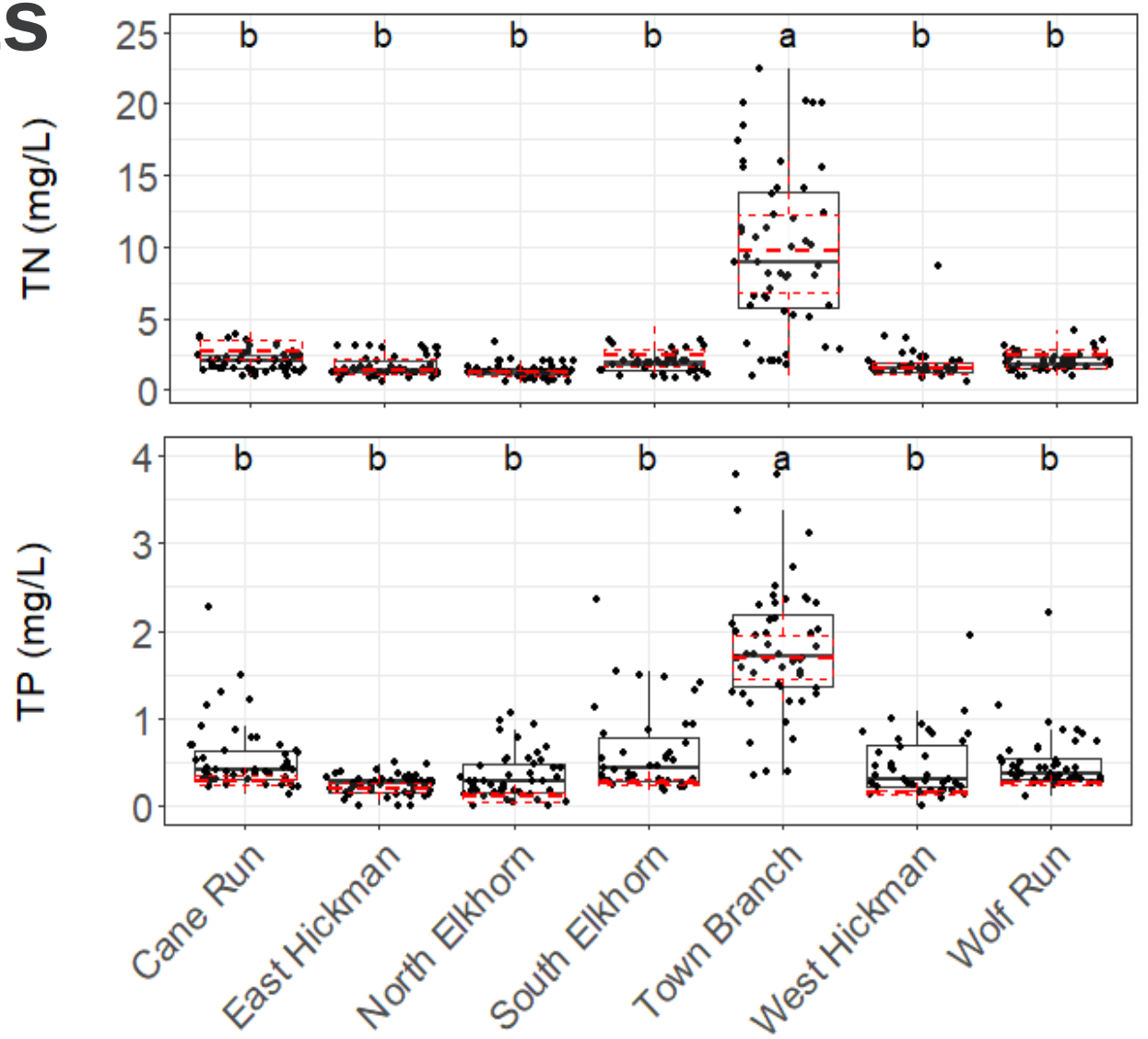
- 25
- 50
- 100
- 150
- >200

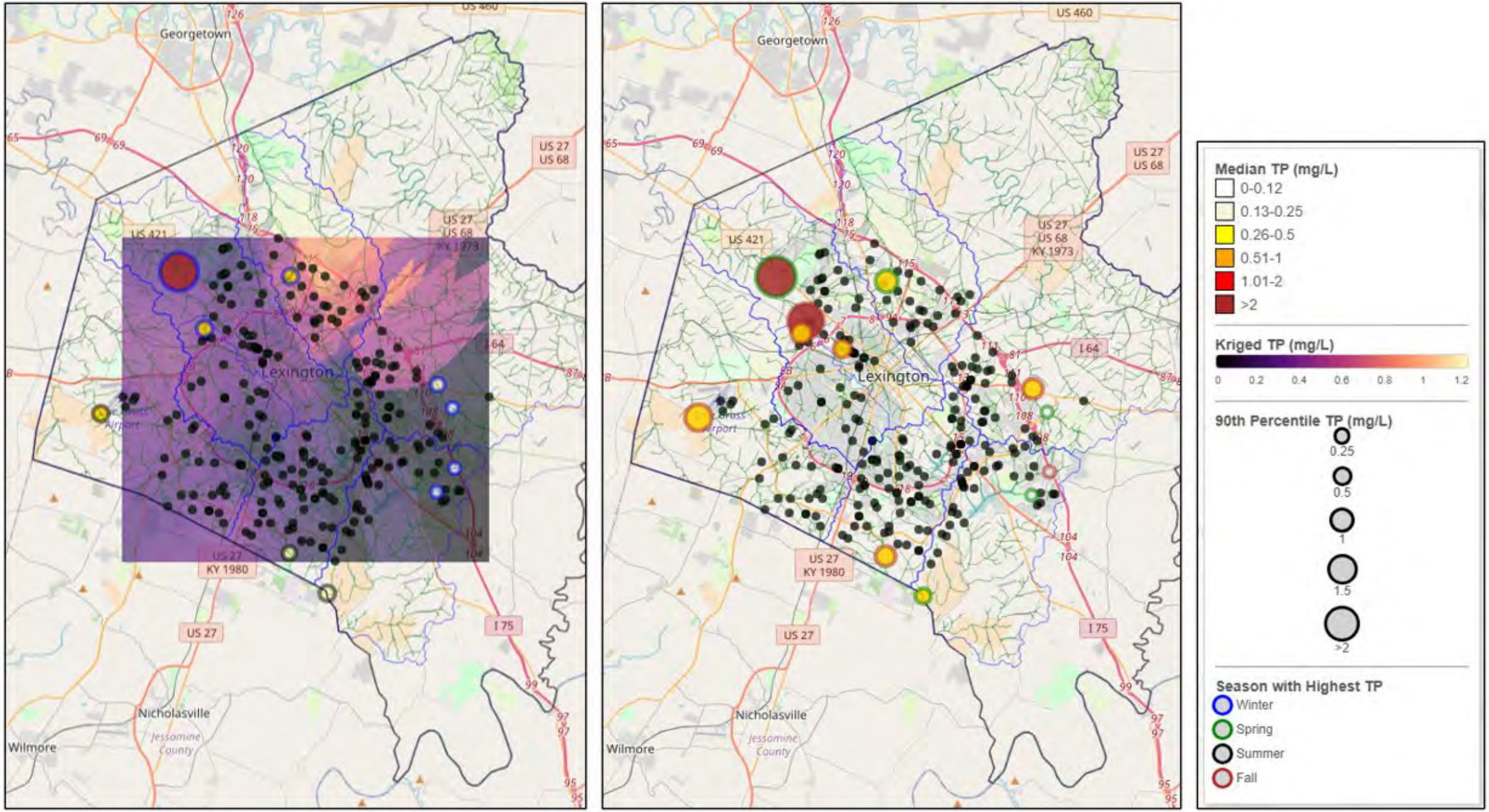
Season with Highest TSS

- Winter
- Spring
- Summer
- Fall

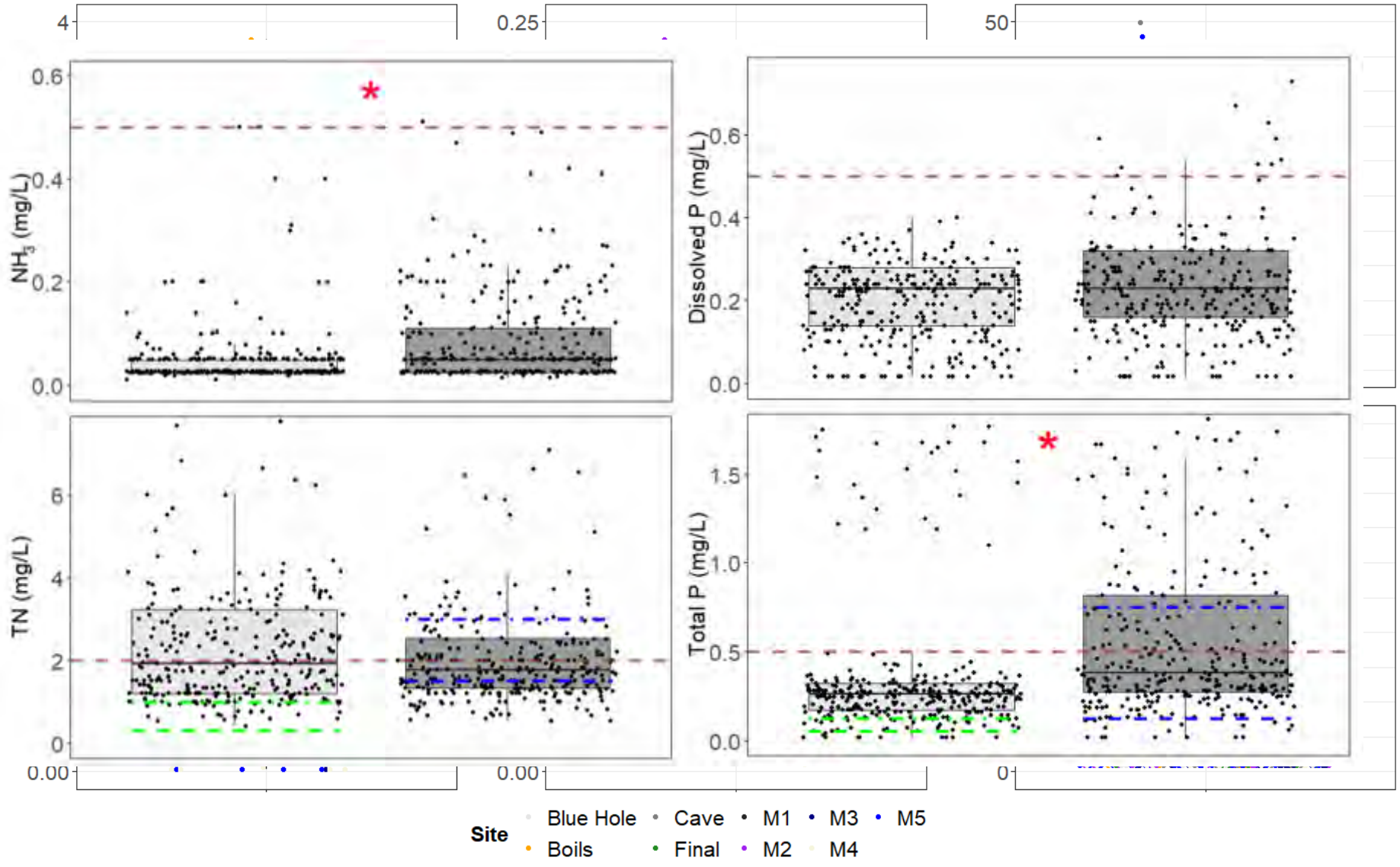
Spatial Analysis Nutrients

- Boxplots
- Town Branch significantly greater than all others
  - Exception NH_3 in Cane Run
- Wet weather exceedances primarily from Town Branch
  - TP (27.3%) – 48 of 89 samples
  - TN (20.7%) – 43 of 67 samples
- Dry weather exceedances common in all watersheds
- Concentrations vs loads



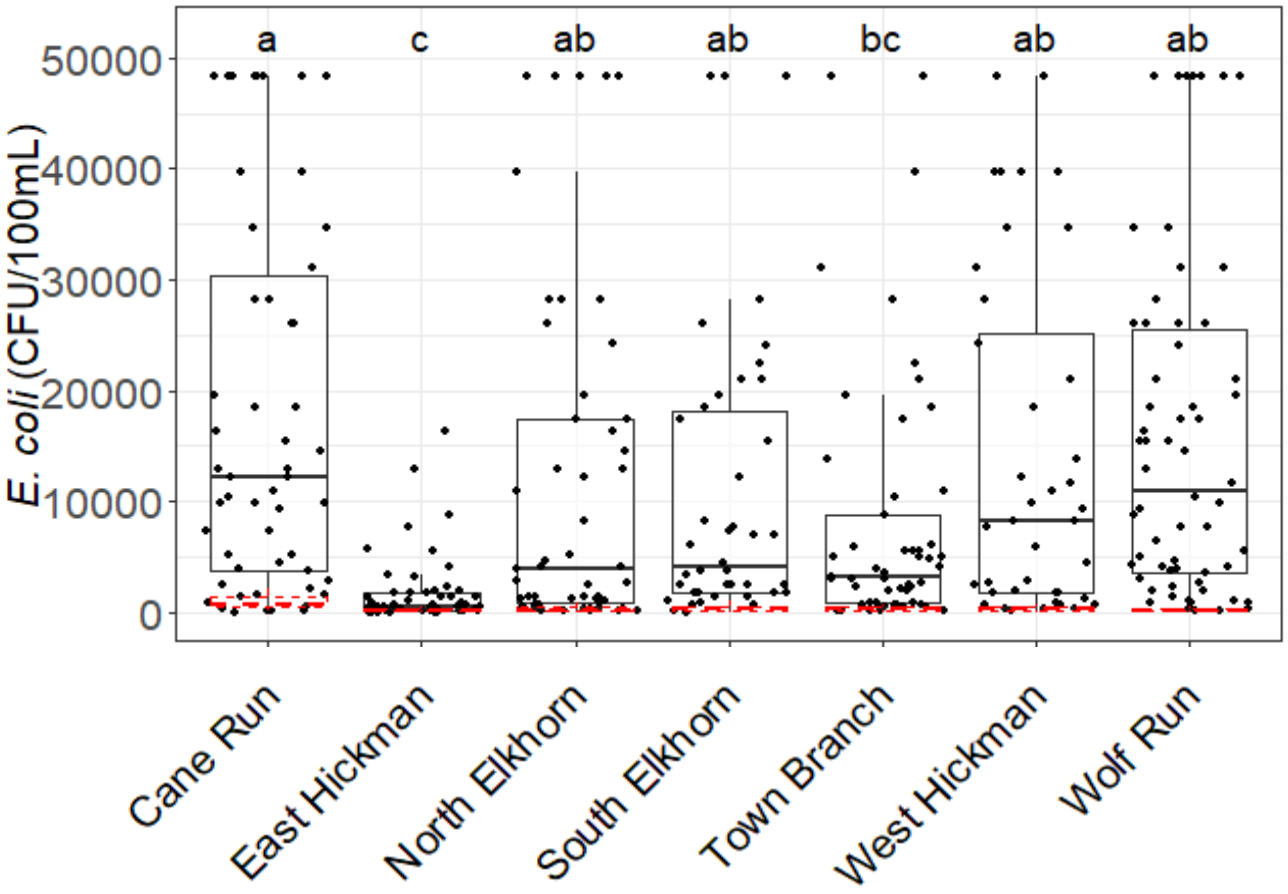

Georgetown
US 460
US 27
US 68
US 421
KY 1973
Lexington
I 64
US 27
KY 1980
US 27
I 75
Nicholasville
Jessamine County
Wilmore
Median TP (mg/L)
0-0.12
0.13-0.25
0.26-0.5
0.51-1
1.01-2
>2
Kriged TP (mg/L)
0
0.2
0.4
0.6
0.8
1
1.2
90th Percentile TP (mg/L)
0.25
0.5
1
1.5
>2
Season with Highest TP
Winter
Spring
Summer
Fall

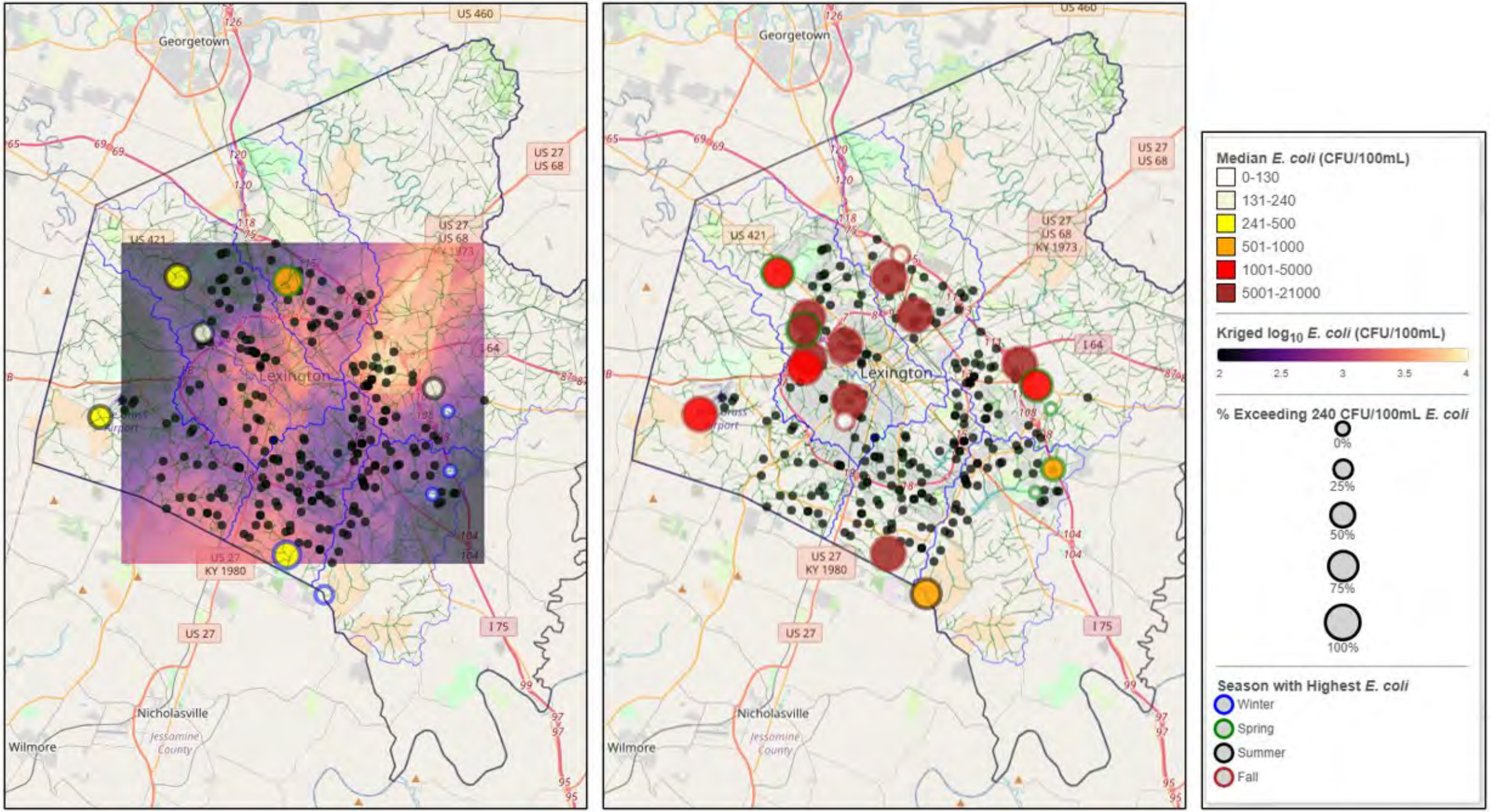
McConnell Springs



Spatial Analysis *E. coli*

- All watersheds: wet > dry
- Cane Run > East Hickman & Town Branch
- Median wet weather concs. from all watersheds >>>> regulations
- Median dry weather concs. From East Hickman & North Elkhorn <≈ regulations
- Sources always present but cross connections, leakages persistent in wet




Georgetown
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KY 1980
US 27
I 75
Nicholasville
Jessamine
County
Wilmore
Median E. coli (CFU/100mL)
0-130
131-240
241-500
501-1000
1001-5000
5001-21000
Kriged log10 E. coli (CFU/100mL)
2
2.5
3
3.5
4
% Exceeding 240 CFU/100mL E. coli
0%
25%
50%
75%
100%
Season with Highest E. coli
Winter
Spring
Summer
Fall

Key Takeaways

OBJ I:

- Background/chronic pollution levels more threatening to ecological status
- Dry and wet pollution mostly unrelated

OBJ II:

- TSS, NH_3, TKN, *E. coli* significantly greater in wet weather
- OrgN and DP require treatment at their source, problematic in dry weather
- *E. coli* problematic in wet and dry, while TSS is not

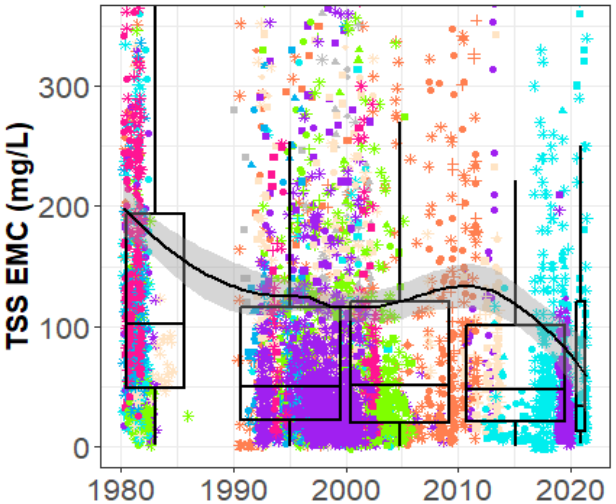
OBJ III:

- Nutrients problematic in Town Branch in wet weather (TBS1 to TBS2 and downstream)
- *E. coli* in Cane Run mostly infrastructure related, other watersheds infrastructure + other
- Major nutrient sources in Town Branch not likely a pathogen contributor

Limitations

- Sampling procedures
  - Water column depth
  - Size of stream
  - Recirculation zone
  - Positioned downstream
  - Hydrograph
  - Grab vs event mean concentration
- Laboratory procedures
  - $NH_3 = NH_3 + NH_4$
  - Above/below detection limits
- Water quality non-stationarity?

Photos from USGS



Simpson et al. 2023

Questions?

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Thank you!

LEXINGTON

Proposed Updates to the 2020 Stormwater Manual

Status Update

- Workgroup held on 8/29/25
- Green infrastructure questionnaires collected through 10/31/25

Changes After Workgroup & Questionnaires

- **Chapter 1 – Stormwater Management Requirements**
  - Any amendment to an existing development plan that affects hydrologic or hydraulic conditions must include updated hydrologic and hydraulic studies reflecting those changes.

Changes After Workgroup & Questionnaires

- **Chapter 10 – Post-Construction Stormwater Controls**
  - Added a requirement for a Landscape Architect, Professional Wetland Scientist, or firm prequalified by KYTC for botany to provide a planting completion report and certification that plants were installed in accordance with the plans accepted by the Division of Engineering or equivalent native vegetation has established (throughout).
  - Updated the requirement that MTDs accepted for use in Fayette County shall be verified by the New Jersey Corporation for Advanced Technology (NJCAT) and certified by the New Jersey Department of Environmental Protection (NJDEP), per the ~~2013~~ 2021 laboratory protocol. (Section 10.4.1).
  - Updated the reference for suitable plant species for wetlands to the USACE National Wetland Plant List (Eastern Mountains and Piedmont Region) (Section 10.9.2).

Next Steps

- Present to EQPW Committee in Spring 2026

Questions?

LEXINGTON

Potential Topics for Next Meeting

Announcements

- December 11th - Wolf Run Watershed Council Meeting
- December 13th - Closing reception for the Art by Nature gallery at the Living Arts and Science Center.
- December 19th - Workshop with the Engineering, Development, and Construction Industry.
- December 25, 26 and January 1st – City Offices Closed
- January 8th - WQFB Meeting
- March 6th - Next SSAC Meeting
- March 21-27th - Seventh Annual Water Week.
- April 9th - WQFB Meeting

- On Black Friday, we collected 400 gallons of cooking oil from 111 cars at the Gobble Grease Toss. (This event allowed LFUCG to educate the public about proper waste disposal, such as not pouring cooking oil down drains or outside.)