Impact assessment of the proposed Lawrence waste water treatment plant on the Wakarusa River: a long –term monitoring/assessment strategy.

Submitted by
University of Kansas Center for Research, Inc. (KUCR)
On behalf of
Central Plains Center for BioAssessment (CPCB)
Kansas Biological Survey (KBS)

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Scope of Work

The Central Plains Center for BioAssessment (CPCB) proposes to perform chemical and biological monitoring of the Wakarusa River for the City of Lawrence, Kansas (City) upstream and downstream from a proposed wastewater treatment plant (WWTP) site in Douglas County. The objectives of this project are:

1. Monitor and assess the ecological health of the river during the pre- and post-construction periods of the WWTP along a river segment extending above and below the WWTP discharge site.
2. Monitor and assess the water quality of the river during the pre- and post-construction periods of the WWTP along a river segment extending above and below the WWTP discharge site.
3. Assess seasonal and hydrological influences on the effects of the WWTP discharge on ecology of the river.
4. Assess the observed and potential overall ecological impact(s) of the WWTP discharge to the river.

To accomplish these objectives relative to pre-construction conditions, CPCB will monitor two sites both monthly (chemistry) and during three distinct seasonal periods (macroinvertebrates) in 2013 and 2014 prior to the WWTP being built. Monitoring activities will include water quality testing and benthic macroinvertebrate sampling. Water samples will be analyzed for nutrients, non-metals, and other constituents as requested by the City and approved by CPCB. Data collected by CPCB will be analyzed using common descriptive, graphical, and statistical methods. An annual report on these findings will be prepared for the City both in electronic and hard-copy form. City support of a long-term project is necessary to assess post-construction conditions associated with objectives 1-3 and to accomplish objective 4.

Study Design

In order to fully assess the spatially and temporally occurring biological and water quality conditions associated with the Wakarusa River in the vicinity of the proposed WWTP discharge site, CPCB will sample two sites (i.e. river segments) along a river continuum between the E 1500 Road (Haskell Avenue) bridge and the E 1750 Road bridge. The upstream site will coincide with the KDHE monitoring just downstream of the E 1500 Rd bridge, while the downstream site will be between the discharge and KDHE's site at E 1750 Rd (Figure 1). However, if these sampling locations appear to be redundant with future KDHE sampling we will move these sampling locations nearer to the proposed plant site after consultation with the City of Lawrence and KDHE. Data from this study will be evaluated along with available KDHE data to identify possible changes associated with plant construction and operation.

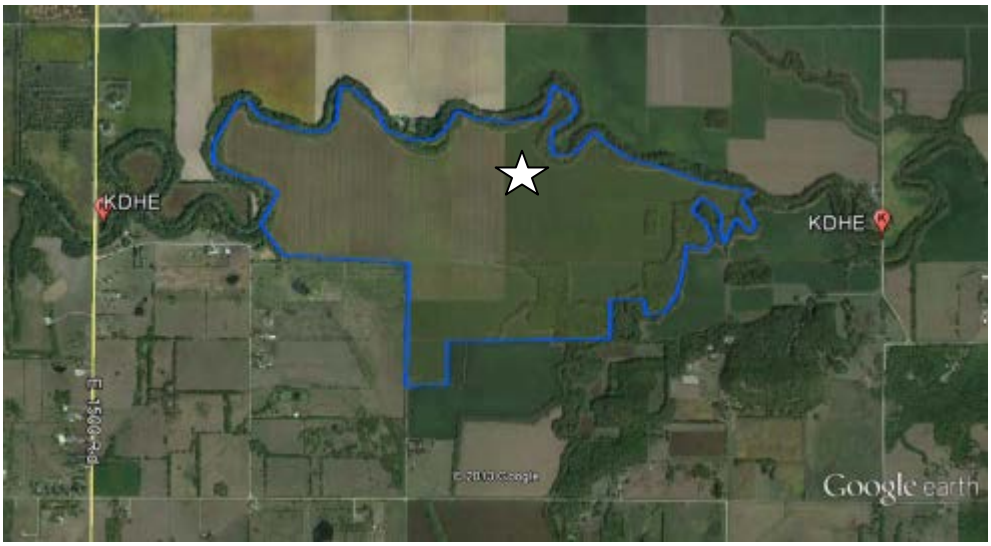

Figure 1. Approximate location of the proposed WWTP plant (star) along the Wakarusa River and locations of the two KDHE sites. City of Lawrence property is within the blue boundary.

Sampling Timeframe

CPCB proposes to sample the two sites once during each season of spring, summer, and fall from fall 2013 through summer 2015 (Table 1). This sampling scheme will allow for the general temporal assessment of the biology and chemistry associated with sites located both above and below the proposed discharge area. CPCB will also sample at base or "normal" flow to avoid possible episodic influences of large releases of water from Clinton Lake. Daily discharge information from US Army Corps of Engineers (USACE) personnel at Clinton Lake will be monitored to help establish actual sampling dates within each seasonal indexing period.

Table 1. Timeline for primary project tasks excluding chemical and biological sample analyses which will be accomplished within the seasonal unit the samples were collected.

Project tasks	2013 Fall	2014 Spring	2014 Summer	2014 Fall	2015 Spring	2015 Summer	Total samples
Biological sampling	Once a season	Once a season	Once a season	Once a season	Once a season	Once a season	12 samples (6/site)
Chemical sampling	Once a month 1 months	Once a month 3 months	Once a month 3 months	Once a month 3 months	Once a month 3 months	Once a month 2 months	30 samples (15/site)
Reporting activities	Progress Report	Progress report	Progress Report			Final report	Final Pre-const. report (60 days after final sample)

Water Quality

Using a Horiba U-10 or U-50 Water Checker, CPCB will record *in situ* measurements of the following parameters at each site: air temperature, water temperature, dissolved oxygen, pH, specific conductance, and salinity (Table 1.). CPCB will maintain and calibrate all testing tools and equipment to ensure their proper function for sampling activities.

CPCB will also collect from each site a one-liter, grab sample of water for analyses of nutrients, chlorophyll a, and other non-metals. Proposed analytes, detection limits, and proposed analytical methods are presented in Table 2. It is anticipated that all forms of nitrogen and phosphorus will be analyzed by Johnson Country Environmental Department's Water Quality Laboratory, a Kansas accredited laboratory facility. Nutrient samples will be collected by CPCB in 1-liter amber bottles, packed on wet ice and delivered to the Johnson County lab within the day of collection.

Table 2. Summary of analytical methods and instrument detection limits of *in situ* water-quality parameters to be analyzed by CPCB.

Parameter	Container	Instrument	Method Citation	Detection Limit
Flow Velocity	none	Swoffer® Model 2100 Flow Meter	Swoffer Model 2100 Operation Manual	0.01-0.03 m/sec
pH	none	Horiba U-10 Water Quality Checker	21st Ed. Standard Methods (APHA) 4500-H^+	0.1
Specific Conductance	none	Horiba U-10 Water Quality Checker	21st Ed. Standard Methods (APHA) 2510 A-B	0.001 mS/cm
Salinity	none	Horiba U-10 Water Quality Checker	21st Ed. Standard Methods (APHA) 4500-O G	0.01%
DO	none	Horiba U-10 Water Quality Checker	21st Ed. Standard Methods (APHA) 4500-O G	0.1 mg/L
Turbidity	none	Horiba U-10 Water Quality Checker	21st Ed. Standard Methods (APHA) 2130-B	1 NTU
Water and Air Temperature	none	Horiba U-10 Water Quality Checker	21st Ed. Standard Methods (APHA) 2550-B	0.1°C

Table 3. Summary of analytical methods, instrument detection limits, and sample holding time of additional water-quality parameters to be *possibly analyzed by CPCB.*

Parameter	Container	Instrument	Method Citation	Detection Limit	Holding Time	Preservation
Total Phosphorus	1L Amber Glass	Digestion + SEAL Automated Colorimetric	EPA 365.4	0.05 mg/L	28 days	4°C
Orthophosphate-P	1L Amber Glass	SEAL Automated Colorimetric	EPA 365.1	0.05 mg/L	48 hours	4°C
Total Nitrogen	1L Amber Glass	Digestion + SEAL Automated Colorimetric	EPA 351.2 (Kjeldahl)	0.5 mg/L	28 days	4°C

Parameter	Container	Instrument	Method Citation	Detection Limit	Holding Time	Preservation
Ammonia-N	1L Amber Glass	SEAL Automated Colorimetric	EPA 350.1	0.04 mg/L	48 hours	4°C
Nitrate-N	1L Amber Glass	SEAL Automated Colorimetric	EPA 353.2	0.02 mg/L	48 hours	4°C
Nitrite-N	1L Amber Glass	SEAL Automated Colorimetric	EPA 353.2	0.02 mg/L	48 hours	4°C
Periphyton chlorophyll *a*	40 mL vial	Optical Tech. Devices, Ratio-2 System Filter Fluorometer	21st Ed. Standard Methods (APHA) 10200-H	-	28 days	-20°C
Planktonic chlorophyll *a*	1L Amber Glass	Optical Tech. Devices, Ratio-2 System Filter Fluorometer	21st Ed. Standard Methods (APHA) 10200-H	1 µg/L	28 days	-20°C
Total Alkalinity	1L Amber Glass	-	21st Ed. Standard Methods (APHA) 2320B	2 mg $CaCO_3$/L	24 hours	4°C
Total Hardness	1L Amber Glass	-	21st Ed. Standard Methods (APHA) 2340C	2 mg $CaCO_3$/L	24 hours	4°C

Plant Pigments

CPCB will measure the chlorophyll and phaeophytin from algae that is suspended in the water column at each site. In addition, CPCB will collect periphyton samples at each of 3 - 5 edge of stream areas at the collection site using a delimiter, aspirator, brush, and deionized water (protocols available for download at http://www.cpcb.ku.edu/datalibrary/assets/library/reportspresentations/Periphyton.pdf). This will allow us to assess chlorophyll and phaeophytin *a* concentrations in both the water column and the stream bottom substrates (periphyton).

Macroinvertebrates

CPCB will use KDHE protocols to collect macroinvertebrate samples at each site. These methods can be found within KDHE's Quality Assurance Management Plan for the Stream Biological Monitoring Program (http://www.kdheks.gov/environment/qmp/download/Stream_Biological_Part_III.pdf). Sorted organisms will be placed into 80% alcohol for storage and later identification. The samples will be returned to the CPCB lab for identification using KDHE "lowest practical identification approach." That is specimens will be identified to the lowest practical taxonomic level as determined by specimen condition and developmental stage (Table 4). Merritt *et al.*

(2008), Needham *et al.* (2000), Westfall and May (1996), Stewart and Stark (2002), Wiggins (1996), and Epler (2001) will be the primary references used for the insect identifications. Wiederholm (1983) and (1986) will be used as supporting references for the Chironomidae identifications. Thorp and Covich (2001) will be the primary reference used for the crustacean identifications, and Smith (2001) and Pflieger (1996) will serve as supporting references. Mackie and Huggins (1983), Burch (1982) and Wu *et al.* (1997) will be used for snail and bivalve identifications.

Table 4. Taxonomic effort by CPCB for macroinvertebrate identifications.

Taxon	Common names	ID effort
Phylum Porifera	freshwater sponges	family
Phylum Cnidaria	hydroids, jellyfish	order
Phylum Platyhelminthes		
Class Turbellaria	free-living flatworms	
Order Tricladida	macroturbellarians (planarians)	order
Phylum Nemertea	proboscis worms, ribbon worms	genus
Phylum Nematomorpha	horsehair worms, gordian worms	order/family
Phylum Mollusca		
Class Gastropoda	snails, limpets	genus (except 1 family)
Class Bivalvia	clams,	genus
Phylum Annelida		
Subclass Oligochaeta	aquatic earthworms	subclass
Subclass Hirudinea	leeches	subclass
Phylum Arthropoda		
Class Arachnida		
Subclass Acarina	aquatic mites	subclass
Class Malacostraca		
Order Amphipoda	scuds, sideswimmers	genus
Order Isopoda	slaters, aquatic sowbugs	genus
Order Mysida	opossum shrimps	genus
Order Decapoda	freshwater shrimps, crayfish	genus
Class Entognatha		
Order Collembola	aquatic springtails	family/genus
Class Insecta		
Order Ephemeroptera	mayflies	genus
Order Odonata	damselflies, dragonflies	genus
Order Orthoptera	semiaquatic grasshoppers & crickets	genus
Order Plecoptera	stoneflies	genus
Order Hemiptera	aquatic & semiaquatic bugs	genus
Order Megaloptera	fishflies, alderflies, dobsonflies	genus
Order Neuroptera	spongillaflies	genus
Order Hymenoptera	aquatic parasitoid wasps	order
Order Coleoptera	aquatic beetles	genus
Order Diptera	aquatic flies	genus (except 5 families)
Order Trichoptera	caddisflies	genus
Order Lepidoptera	aquatic & semiaquatic moths	genus

Data Recording, Management, and Reporting

Data will be entered into one database, using a dual-entry system of one person entering the data from field and bench sheets, and another person checking all records for accurate entry.

Analyses will focus on determining potential changes in this area of the river using pre- and post-plant information as well as information from sites located above and below the plant discharge. Some metrics calculated from the macroinvertebrate data will include Taxa Richness,

Ephemeroptera/Plecoptera/Trichoptera Taxa Index (EPT), and Shannon Diversity Index (SDI). Those metrics frequently used by KDHE will also be calculated and used in data analyses.

Organization and Experience

Work will be performed by the CPCB, an aquatic ecology research unit of the Kansas Biological Survey (KBS). The senior scientist at CPCB, Dr. Donald Huggins, has 38 years experience in monitoring and bioassessment of water bodies of the U.S. CPCB's Assistant Director and Informatics Specialist, Debbie Baker, will oversee project organization, field logistics, and data entry. Dr. Barbara Hayford, an expert in chironomid identification, will determine all midge larvae found in samples. Ms. Lee Ann Bennett, a 14 year employee of KBS, will provide additional taxonomic expertise with the macroinvertebrates. Chemistry lab coordination and analyses will be supervised by Dr. Huggins who will also participate in most sample analyses. Resumes of all senior project personnel are available upon request (contact dbaker@ku.edu).

Budget

Budget Category	Year 1 (fall 2013, Spring and Summer 2014)	Year 2 (fall 2014, Spring and summer 2015)	Total
salary (+fringe)	$ 22,380	$ 35,358	$ 57,738
supplies (+service fees)	$ 12,615	$ 6,919	$ 19,534
travel	$ 333	$ 167	$ 500
indirect costs (26%)	$ 9,002	$ 10,844	$ 19,846
total	$ 44,330	$ 53,288	**$ 97,618**

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