Pollution Diagnosis of Wolf Creek

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Abstract

Monthly analysis of Wolf Creek in Lawton, Oklahoma has been collected over the course of two years, where the vitality of the creek is diagnosed through chemical and biological monitoring in collaboration with The Blue Thumb Program of the Oklahoma Conservation Commission. Invertebrate diversity in Wolf Creek at Gore Boulevard and Lee Road illustrated that, diversity in Wolf Creek was very low at Gore Blvd. and significantly higher in Lee Road. The purpose of this research is to determine if point pollution done by heavy metals or hydrocarbons are affecting aquatic life in Gore Blvd., through chemical oxygen demand and atomic absorbance determination of heavy metals in the water. Results showed that COD throughout Wolf Creek were below toxic levels. Heavy metal levels in Wolf Creek were also below toxic levels.

Table 1. Blue Thumb Program Great Plains

Summer 2015 Macroinvertebrates

	Gore Blvd.	Lee Rd.
Raw Results		
Taxa Richness	5	12
EPT Taxa Richness	1	3
EPT Abundance	0.01	0.47
HBI Score	7.6	5.72
% Contribution Dominants	0.92	0.74
Shannon-Weaver Diversity	0.63	1.63
Raw Scores		
Taxa Richness	0.31	0.75
EPT Taxa Richness	0.17	0.5
EPT Abundance	0.01	0.47
HBI Score	0.6	0.8
% Contribution Dominants	0.92	0.74
Shannon-Weaver Diversity	0.63	1.63
Metric Scores		
Taxa Richness	0	4
EPT Taxa Richness	0	0
EPT Abundance	0	6
HBI Score	2	4
% Contribution Dominants	0	2
Shannon-Weaver Diversity	0	2
Total Score	2	18
Comparison to Reference	0.06	0.56
Condition	D	B

Table 2. Blue Thumb Dissolved Oxygen, pH, Nitrate, Nitrite, Ammonia, Phosphorous, and Chloride at Gore Blvd.

DATE (Month-Year)	DO (mg/L)	pH	Nitrate (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	Phosphorous (mg/L)	Chloride (mg/L)
Sep-14	11.0	7.8	0	0	0.05	0.030	50.0
Nov-14	9.5	7.3	0	0	0.20	0.113	57.5
Jan-15	15.5	8.0	0	0	0.00	0.000	70.0
Mar-15	12.0	7.8	0	0	0.00	0.013	97.5
May-15	9.0	8.0	0	0	0.15	0.044	45.0
Jun-15	9.5	7.7	0	0	0.00	0.018	150.0
Jul-15	5.5	7.3	0	0	0.00	0.027	150.0
Sep-15	5.0	7.5	0	0	0.00	0.017	85.0
Oct-15	9.5	7.5	0	0	0.00	0.033	65.0
Nov-15	10.0	7.3	0	0	0.00	0.100	25.0
Jan-16	15.0	7.3	0	0	0.00	0.000	50.0
Feb-16	12.5	7.3	0	0	0.00	0.013	102.5
Mar-16	11.0	7.8	0	0	0.00	0.017	85.0
Apr-16	9.5	7.8	0	0	0.00	0.050	22.5
Jun-16	9.0	7.9	1	0	0.00	0.024	65.0
MEAN	10.2	7.6	0.1	0	0.03	0.033	74.7

Experimental

Chemical Oxygen Demand Analysis

Chemical Oxygen Demand (COD) was analytically quantified in order to determine the level of hydrocarbon in the water and determine if a possible pipe leak could be the source of pollution in Wolf Creek.[3] The study was done in a 3-mile stretch of Wolf Creek that lies between Rodger's Lane and Lee Rd. Site 1 was at Roger's Ln. right before any water enters any residential or commercial areas. Site 2 was one mile downstream at Cache Rd. where it lies in between commercial and residential zones. Site 3 was at Gore Blvd. one mile downstream from Cache Rd. Site 4 was at Lee Rd. one mile down from Gore Blvd. A tributary to Wolf Creek that feeds from the west part of Lawton that we believe had some impact on Site 3. Samples were taken before and after the Lawton Country Club.

COD analysis was done with an open reflux for two hours according to EPA Standard Method 410.1. Potassium Dichromate Standard was provided by Cameron University purchased from Thorn Smith which was dried for two hours at 110 °C. Samples were collected in glass containers and immediately analyzed. Potassium Dichromate was further standardized with Standard KHP of an calculated COD value of 500 mg/L.

Atomic Absorbance Spectrophotometry of Heavy Metals

Determination of total dissolved Lead, Copper, Zinc, and Potassium heavy metals in Wolf Creek was performed with Shimadzu Atomic Absorbance Spectrophotometer (AA-7000). The selected metals were chosen according to the EPA Environmental Assessment, which explains that these are some of the common metal pollutants in streams near residential and commercial areas. We focused the analysis of heavy metals on Gore Blvd. and Lee Road to help indicate which metal (if any) was abundant in Gore compared to Lee, and help pinpoint to a possible source of pollution.

Standards for the calibration curve for Lead, Zinc, and Copper were made from no lower than 99.99% metal dissolved with concentrated nitric acid and heat. The stock standards were then diluted to a concentration of 1g/L and then furthermore diluted to concentrations of 5ppm, 0.05ppm and 0.0005ppm due to concentrations of metals that were expected to be at that range. Standard for Potassium was made from Potassium Chloride heated at 600 °C for one hour and cooled down to be later dissolved with concentrated HCl and diluted to 1 g/L then was furthermore diluted to concentrations of 5ppm and 0.05ppm. Blanks for the calibration curve were deionized water.

Table 3. Averages of Chemical Oxygen Demand on Wolf Creek.

Sample Site	mg/L O_2	Standard Deviation
Site 1 (Roger's Ln.)	11.43	1.90
Site 2 (Cache Rd.)	10.56	1.73
Meadowbrook before golf course	35.97	8.03
Meadowbrook after golf course	17.07	2.68
Site 3 (Gore Blvd.)	7.66	5.11
Site 4 (Lee Rd.)	8.57	1.35

Table 4. Average Concentration of Metals (mg/L) at Gore Blvd. and Lee Blvd.

Metal	Gore Blvd.	Lee Rd.
Lead (Pb)	0.0880±0.06	0.1140±0.06
Zinc (Zn)	0.0033±0.0988	Below Detection
Copper (Cu)	0.0071±0.0087	0.0071±0.0086
Potassium (K)	4.0535±0.16	4.0502±0.19

Results and Discussion

Blue Thumb Program Results

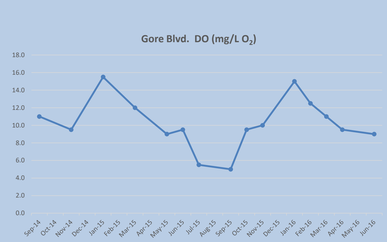
The measurements taken from Blue Thumb Program since September 2014 on Gore Blvd. were compiled on Table 2 to illustrate the seasonal trends and possible correlation to a chronic contamination in the creek.

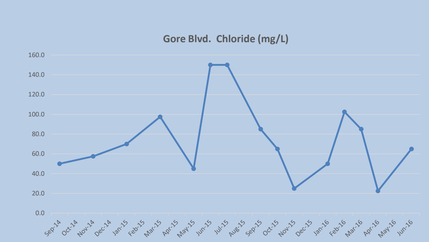
Chemical Oxygen Demand Results

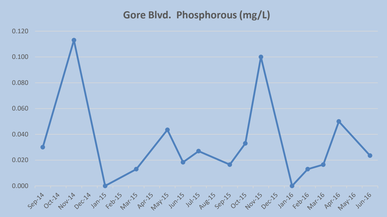
Average measurements of COD of the samples collected during the month of June of 2016 are shown in Table 3 where it showed all levels of COD below 36 ppm in all Sites. Highest concentrations of COD were found in the tributary that came from the east side of Cache Rd. where an average of 35.97(±8.03) ppm before the country club and 17.07(±2.68) ppm after the country club. COD in Site 1 was 11.43(±1.90) ppm and Site 2 was 10.56(±1.73) ppm which were higher than Site 3 as expected but not at toxic levels.[4] Site 3 and 4 were 7.66(±5.11) ppm and 8.57(±1.35) respectively.

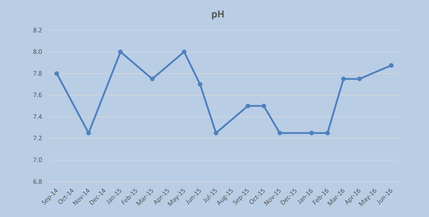
Atomic Absorbance Spectrophotometry

In conclusion, the levels of all of the metals tested showed no significant difference between Gore Blvd. and Lee Rd. and can be said that one of the four metals are not what is causing the large difference in species diversity between the sites. The levels of Lead in, both, Gore Blvd. and Lee Rd. are above the safe concentration for freshwater of 0.05 mg/L Pb.[4] This may have been because of an acute incident and further analysis of Lead needs to be taken in order to assess whether it is a chronic problem in the area.









Acknowledgements

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