

# City of Bel Aire, Kansas Wastewater Sampling Status

December 3, 2024

To meet objectives to implement a wastewater monitoring and pollutant control program, the City of Bel Aire has been monitoring the levels of conventional pollutants since August 2023. Conventional pollutants are the pollutants that are found in domestic, nonindustrial wastewater, and which municipal wastewater plants are designed to remove. Because of the impact from the wastewater plant effluent to the aquatic community in the receiving stream (Chisholm Creek), KDHE issues Wastewater Discharge Permits (NPDES) effluent limits for these parameters. If wastewater influent pollutant concentrations increase, the cost for the wastewater treatment facility to remove these parameters also increases. The CCUA Cost Of Service Agreement (COSA) recommends that strength loading include Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) concentrations from each municipality (Bel Aire and Park City) to determine the pollutant loading strength from each municipality for cost allocation.

## PARAMETER ASSESSMENT

The following parameters are collected via a 24-hour time composite autosampler on a weekly basis at the two main lift stations in Bel Aire. These two lift stations located at 3800 N Harding and 5859 E 53<sup>rd</sup> Street N, collect all of the wastewater generated in Bel Aire before entering a force main which delivers the wastewater to the Chisholm Creek Utility Authority (CCUA) wastewater treatment facility located in Park City at 53<sup>rd</sup> St N and Broadway.

**BOD – Biochemical Oxygen Demand**: A measure of the amount of oxygen in milligrams per liter required to remove the waste organic matter from water in the process of decomposition by aerobic bacteria in a wastewater treatment plant. A high Biochemical Oxygen Demand (BOD) in wastewater significantly impacts the activated sludge process by requiring more oxygen to break down organic matter, potentially leading to poor treatment efficiency, and reduced effluent quality if not properly managed through increased aeration and process adjustments.

**TSS – Total Suspended Solids:** Refers to waterborne particles that exceed 2 microns in size. The majority of total suspended solids comprise of inorganic materials; however, algae and bacteria may also be considered TSS. TSS could be anything that floats or "suspends" in water, including sand, sediment, and plankton. High TSS can impact the efficiency of the treatment plant clarifiers and if allowed to pass through to the Ultra-Violet disinfection system, the water will be too turbid to remove pathogens. Extremely high TSS can cause blockages in the sanitary sewer lines and clog pumps.

**NH3-N – Ammonia Nitrogen:** Nitrogen in the form of free ammonia and ionic ammonium, mainly from the decomposition of nitrogen-containing organic matter in domestic sewage, including proteins, amino acids, and urea found in human waste (urine and feces), animal waste, food processing waste, and certain industrial effluents industrial wastewater, as well as drainage from heavily fertilized land areas. Ammonia is toxic to aquatic life and therefore, KDHE includes ammonia permit discharge limits at wastewater treatment plants. Through a series of zones, the beneficial microorganisms in the wastewater biological nutrient removal plant convert the ammonia to gaseous nitrogen.



**TKN - Total Kjehldahl Nitrogen:** A measurement of the total amount of organic and ammonia nitrogen in a sample. The Kjeldahl method is used to measure the nitrogen content that is directly associated with organic matter and the biological treatment process. It does not include the inorganic compounds of Nitrate or Nitrite. The organic nitrogen is typically a significant portion of the organic waste that is related to the BOD concentration. Excess levels of organic nitrogen in a plant discharge can result in algae blooms in a stream, depleting oxygen and resulting in fish kills.

**TP – Total Phosphorus:** The measure of all phosphorus found in a sample, whether that phosphorus is dissolved or particulate. This is commonly used when sampling in wastewater treatment and is notably used to determine the health of the water body. Phosphorus in wastewater can be removed biologically or through chemical addition. Excess levels of phosphorus in a plant discharge can result in algae blooms in a stream, depleting oxygen and resulting in fish kills.

Table 1 provides typical concentrations of the parameters found in untreated domestic sewage.\*

	Concentrations - milligrams per Liter (mg/L)		
Parameters	Low	Moderate	High
BOD	110	220	500
TSS	250	500	850
NH3-N	12	30	50
TKN	20	40	85
TP	4	8	15

#### Table 1 Raw Wastewater Characteristics

\* National Institute of Health (NIH.gov) February 2012

Table 2 includes averages of the parameters collected from the two Bel Aire Lift Stations. These are averages from sample results collected weekly from January to October 2024. While samples have been collected on a weekly basis since August 2023, the Harding Lift Station sample results collected prior to May were not used in these averages as it was determined that the samples collected at the Harding lift station were not representative of the actual contribution, as the sample collection point was located too close to the wastewater pump intake. The collection point has been relocated to an area where better mixing of the wastewater is available.

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	Concentrations – milligrams per Liter (mg/L)		
Parameters	Harding Lift Station (May to	53 <sup>rd</sup> Street Lift Station	
	October 2024)		
BOD	373	317	
TSS	359	374	

#### Table 2: Bel Aire Lift Station YTD 2024 Average Concentrations



Ammonia - NH3-N	46	41
Total Organic Nitrogen -TKN	56	52
Total Phosphorus - TP	8	7

The BOD, Ammonia, and Total Organic Nitrogen at both Lift Stations range from the moderate to high literature values. The TSS ranges between the low and moderate levels. The Total Phosphorus average remains at moderate levels. Potential reasons for the result values vary, but may be attributed to the drought, minimizing groundwater infiltration, increased installation of low water use fixtures in building structures, or increased activity from food service businesses such as restaurants, schools, care homes and churches.



In wastewater treatment, BOD (Biochemical Oxygen Demand) is closely related to TSS (Total Suspended Solids), where high levels of TSS often indicate a high BOD, meaning more organic matter is present for bacteria to decompose and consume oxygen; pH plays a crucial role in the activity of these bacteria, while nutrients like nitrogen and phosphorus are necessary for their growth, impacting the overall efficiency of the biological treatment process.

#### **Recommendations:**

Appendix 1 includes graphs of each pollutant sampled in 2024. Since May 1, 2024, results at both stations have been consistent with a few outliers that could be contributed to maintenance activities in the collection system or the lift station, high strength discharges from food preparation or cleaning activities at area businesses or residents, or an analytical anomaly.

The CCUA Cost of Service Agreement (COSA) between Bel Aire and Park City includes using BOD and TSS results to calculate the strength loading from each City. This will be calculated by multiplying the average BOD and TSS concentration in milligrams per liter by the municipality's total wastewater flow in million gallons per day.



The remaining parameters, Ammonia, Total Kjehldahl Nitrogen, and Total Phosphorus are analyzed in anticipation that discharge limits may become more restrictive and the cost by the Utility to treat these pollutants may increase. The collected data may also be useful to assist the wastewater design engineering team when upgrading the plant to achieve current and future discharge requirements.

Weekly monitoring, sampling, and analysis of these parameters offers critical data points that will assist in allocating accurate treatment costs for Bel Aire. The weekly analyses and resources needed to collect the samples is a notable expense for the City. Based on the 2024 data, analytical data is consistent, and reduced monitoring could be considered. Table 3 provides suggested alternatives with cost considerations for each alternative.

Monitoring Frequency	Parameters Analyzed	2024 Lab Analytical Cost	2025 Lab Analytical Cost
Weekly	BOD and TSS	\$3,036.80**	\$3,120.00**
Weekly	BOD, TSS, NH3-N, TKN, TP	\$7,675.20**	\$7,280.00**
Monthly	BOD and TSS	\$700.80**	\$720.00**
Monthly	BOD, TSS, NH3-N, TKN, TP	\$1,771.20**	\$1,680.00**
Quarterly	BOD and TSS	\$233.60	\$240.00
Quarterly	BOD, TSS, NH3-N, TKN, TP	\$590.40	\$560.00
Quarterly	NH3-N, TKN, TP	\$356.80	\$360.00

## Table 3 - Monitoring Alternatives

\*\* Assumes 52 weekly sampling events/ 12 monthly sampling events/ 4 quarterly sampling events Sampling costs also include the following charges added to each invoice:

	<u>2024</u>	2025
Transportation:	\$58.50	\$75.00
Environmental Impact Fee:	\$30.00	\$30.00
Sample Disposal Fee:	\$ 7.00	\$ 7.00



The City is commended for initiating a proactive approach to determine loading factors for the COSA. This data is also beneficial for the Utility in determining treatment efficiencies as well as design criteria for plant upgrades. When this monitoring program was approved in August 2022, City Council recommended that staff initiate a weekly monitoring program until sample results were somewhat stable. While sampling results after May 2024, display a few outliers, it is believed that sufficient data is available to warrant a reduced monitoring frequency. Table 3 offers alternatives to consider. It is recommended that the City consider using one or a combination of two or more alternatives to best utilize existing resources. An acceptable option may include weekly or monthly BOD and TSS combined with Quarterly nutrient parameters. (NH3-N, TKN, TP)

The City has replaced the wastewater flow meters at both the Harding and 53<sup>rd</sup> Street N Lift Stations. It is recommended that the meter be programed to measure and record daily total flows in gallons per day to assist with loading calculations. Currently pump run times are recorded on a daily basis, which can be used to calculate daily flow volumes, by multiplying the run times by the maximum gallons per minute rated for the specific pump. Using this computation can result in inaccuracies as pump curves can change over time. Using the actual wastewater meter flow readings will assure loading calculation accuracies.

The analytical data collected over the last year and a half with the Council adoption of a comprehensive pretreatment code assures that the City has a procedure to protect the municipal sanitary sewer system and the wastewater treatment plant from harmful pollutants. The data will be used to accurately calculate the pollutant loading impact at the CCUA wastewater treatment plant, facilitating the Cost-of-Service Agreement and annual True-up. Evaluating the frequency of the data collection at the lift stations and applying the City's pretreatment program requirements will continue to enhance the program for this community.



# Appendix 1 – City of Bel Aire Lift Stations 2024 Conventional Pollutant Graphs

















