MEMORANDUM

TO: DR. EILEEN CASHMAN
FROM: ERIK KENTFIELD
SUBJECT: ENGR 351- NUTRIENT ANALYSIS OF WASTEWATER FROM AWWTP
DATE: FEBRUARY 27, 2017
CC: KYLE SIPES

Introduction

The objective of this memo is to discuss a nutrient analysis of wastewater from the Arcata Wastewater Treatment Plant (AWWTP). The nutrients analyzed were: ammonia (NH_3), nitrate (NO_3), and total/dissolved reactive phosphate (PO_4). Wastewater contains human waste which results in a high concentration of NH_3 and small amounts of NO_3 initially. PO_4 is sticky which results in its filtration throughout the treatment. My group analyzed a sample from right after the first oxidation pond. This analysis helps assess nutrient dissolution in wastewater at AWWTP.

Materials and Methods

Three wastewater samples were taken from AWWTP in the morning of February 14, 2017: one from right after the primary clarifier, one from right after the first oxidation pond, and another near the treatment wetland effluent. Our sample was from right after the first oxidation pond. Procedures for determination of NH_3, NO_3, and PO_4 were followed in accordance with *Standard Methods* procedures 4500-NH_3 D., 4500-NO_3 D., and 4500-P E. respectively (APHA et al 2005).

Results

The analyzed nutrient, location of the sample, and averaged results from the class' concentration data are presented in Table 1. Standard deviations for each nutrient, at each location, are presented in Table 2. My group's/the class' raw data and calibration curves for each nutrient are available in the Appendix.

Table 1: Analyzed nutrient, location of sample, and averaged results of class' nutrient concentration.

	Location		
Nutrient	**Primary (mg/L)**	**Ox Ponds (mg/L)**	**Trtmnt Marsh (mg/L)**
Ammonia (NH_3)	15.0	15.0	15.0
Nitrate (NO_3)	0.23	3.40	0.50
Phosphate (PO_4)	3.27	0.93	0.35

Table 2: Standard deviations for each nutrient, at each location.

	Location		
Nutrient	**Primary (σ)**	**Ox Ponds (σ)**	**Trtmnt Marsh (σ)**
Ammonia (NH_3)	0.000	0.000	0.000
Nitrate (NO_3)	0.006	21.80	0.000
Phosphate (PO_4)	0.842	0.062	0.003

Discussion

Our sample was from right after the first oxidation pond. Our NH_3 concentration was 15.0 mg/L, our NO_3 concentration was 10.0 mg/L, and our PO_4 concentration was 1.20 mg/L.

Total Kjeldahl nitrogen (TKN) measures organic and ammonia nitrogen in domestic wastewater. Typical values of TKN in domestic wastewater are 20 mg/L for a weak concentration, 40 mg/L for a medium concentration, and 80 mg/L for a strong concentration. Total phosphorus (P) may appear as many forms in domestic wastewater; orthophosphates, polyphosphates, and organic phosphate. Typical values of P in domestic wastewater are 5 mg/L for a weak concentration, 10 mg/L for a medium concentration, and 20 mg/L for a strong concentration (Davis 2013 et al). Our sample's concentration of NH_3 matches the typical weak concentration of TKNs in domestic wastewater. Also, our sample's concentration of PO_4 matches the typical weak concentration of P in domestic wastewater.

There are no consistent standards when dealing with nitrogen and phosphorus for effluents from wastewater. Regulatory agencies should begin to regulate NH_3, but it has yet to be implemented. Most treatment plants lack nutrients as part of their permits, unless they discharge into ecologically sensitive areas (Cashman 2017).

These analyzed values of concentration for each nutrient coincide with what is expected based on their relative location in the treatment process. Wastewater contains human waste which results in a high concentration of NH_3 initially. Throughout the treatment process, this concentration of NH_3 remains relatively constant because organic matter has an internal load that forces it to continually decompose. This results in a slight increase of NO_3 as the wastewater moves through the treatment. Nitrite (NO_2) moves to NO_3 quickly, so there is very little NO_2 present. NO_2 and NO_3 are water soluble. PO_4 is sticky and gets filtered out as the wastewater moves through the treatment process, reducing its concentration (Cashman 2017).

When measuring our NO_3 concentration, we did not use the set-up in lab with the double probe to determine the potential mV. This skewed our NO_3 mV results which resulted in an inaccurate determination of concentration when comparing to the calibration curve. My group was only responsible for determining the calibration curve for NH_3. It is possible that there was an error in determining any of the three curves. This would result in an inaccurate determination of any of the three nutrient concentrations.

Conclusion

There are no standards to compare our nutrient concentrations to, but we can compare these analyzed concentrations to typical concentrations of domestic wastewater. The nutrient concentrations in wastewater from AWWTP prove to be weak when compared to typical values of domestic wastewater. This analysis helps track the dissolution of nutrients in wastewater throughout the treatment at AWWTP.

References

APHA, ET. AL. (2005). *Standard Methods for the Examination of Water and Wastewater* – 21st Ed.
Cashman, Eileen, (2017). Personal Communication. February 24, 2017. Arcata, Ca.
Davis, M. L., ET. AL. (2013). *Principles of Environmental Engineering and Science* – 2nd Ed.

Appendix:

Table 3: Group's raw data of nutrient concentration.

	Ox Ponds Nutrient Concentration (mg/L)
Ammonia (NH_3)	15.0
Nitrate (NO_3)	10.0
Phosphate (PO_4)	1.20

Table 4: Class' raw data of nutrient concentration.

	Location		
	Primary (mg/L)	**Ox Ponds (mg/L)**	**Trtmnt Marsh (mg/L)**
Ammonia (NH_3)	15.0	15.0	15.0
	N/A	15.0	N/A
	N/A	15.0	N/A
Nitrate (NO_3)	0.3	0.1	0.5
	0.2	0.1	N/A
	N/A	10.0	N/A
Phosphate (PO_4)	2.3	1.0	0.3
	3.0	0.6	0.4
	4.5	1.2	N/A

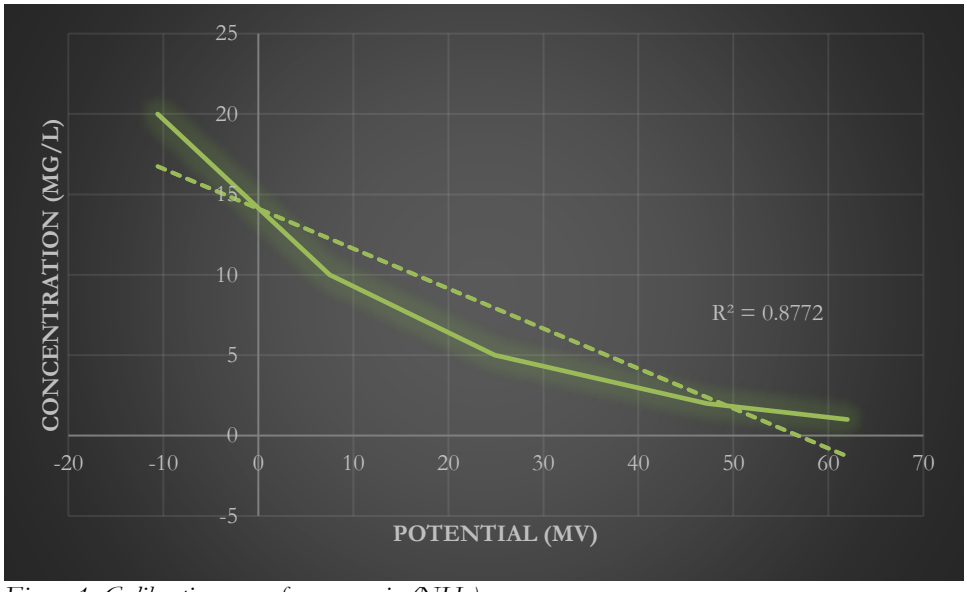

Figure 1: Calibration curve for ammonia (NH_3).

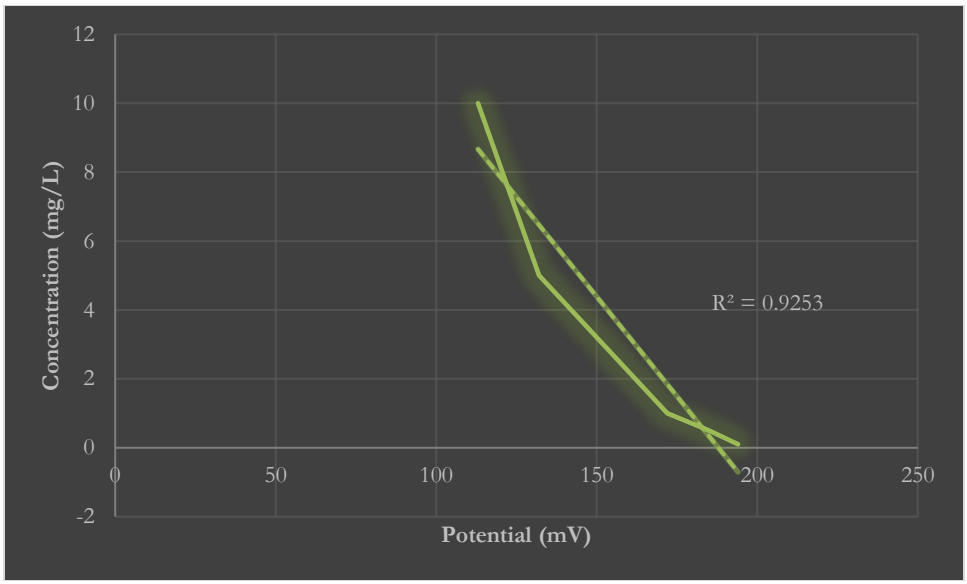

Figure 2: Calibration curve for nitrate (NO_3).

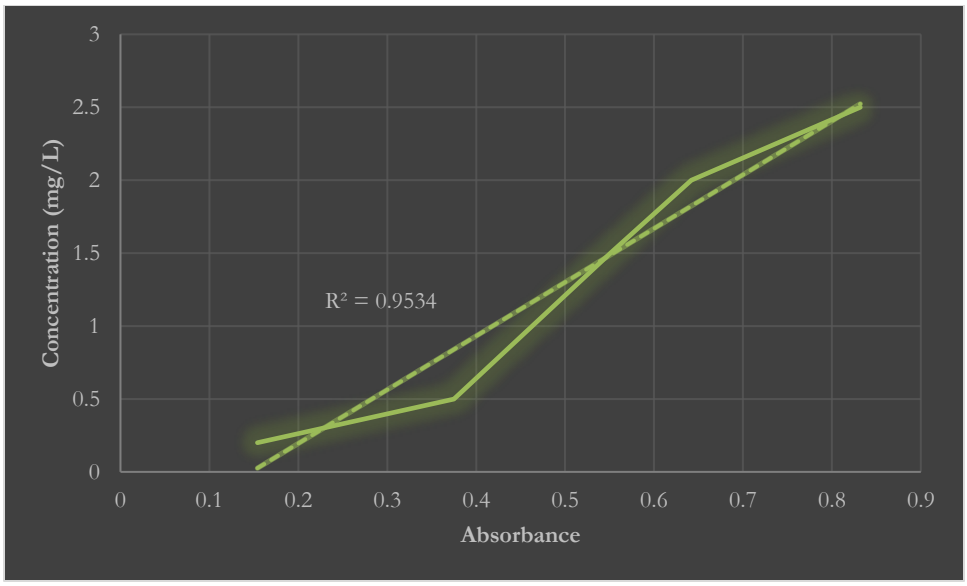

Figure 3: Calibration curve for phosphate (PO_4).