HARRIMAN WASTEWATER TREATMENT FACILITY ENERGY REDUCTION CASE STUDY

in Harriman, TN

BACKGROUND

Beginning in 2016, the Harriman Wastewater Treatment Plant took initiative to learn and pursue innovative low-cost approaches to optimizing water quality and reducing energy consumption at its aging wastewater treatment plant through voluntary participation in TDEC's Wastewater Nutrient Plant Optimization Project. Harriman has continued using techniques learned through its participation to achieve significant environmental and operational savings, including cost savings; nitrogen and phosphorus removal prior to discharge to surface waters; reduced electricity consumption; and improved biological treatment. A few years before additional changes were made (in 2020), energy and nutrient data was collected and used as a baseline (monthly averages August 2017 – July 2019) for this case study.

ENERGY SAVINGS

In 2016 and 2017, Harriman Wastewater Treatment staff made operational changes made by recommendations from the University of Tennessee and University of Memphis. The process developed for this facility involved using less aeration time[1]. With reducing the use of aeration equipment, Harriman Wastewater Treatment Facility reduced their average monthly kilowatt-hour usage by 33.4%[2]. This change alone reduced energy costs by 24.9%[3] while the cost of electricity increased by 16.1%[4] during the same time.

NUTRIENT REDUCTION

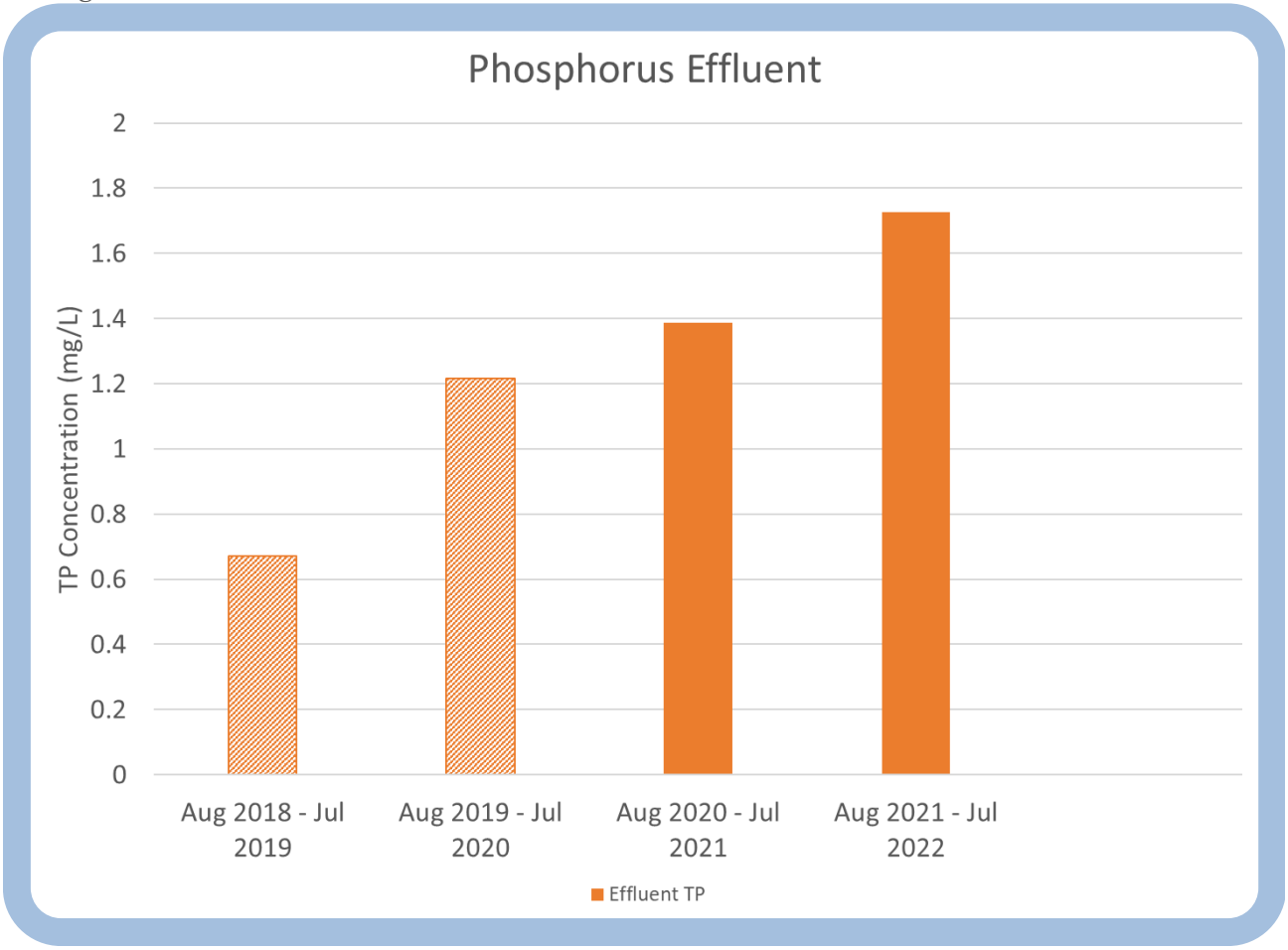
With the changes made in aeration processes, nutrient effluent for nitrogen has decreased while total phosphorus effluent has increased.

1. Starting in 2016 aeration rotors were cycled on and off (4 rotors total: 2 rotors on 1 hr, off 4 hr, 2 rotos on 1 hr, off 3 hr)
2. Average kWh/month percent change from baseline (Aug 2017 – Jul 2019) and Aug 2019 – Jul 2021
3. Monthly energy cost percent change from baseline (Aug 2017 – Jul 2019) and Aug 2019 – Jul 2021
4. Cost of electricity ($/kWh) from baseline (Aug 2017 – Jul 2019) and Aug 2019 – Jul 2021

PHOSPHORUS

In 2021, additional changes were made to reduce effluent phosphorous and was noted that Biological Total Phosphorus removal takes time. Although changes have been made, phosphorous effluent has increased during this time. With sludge dewatering equipment being repaired and updated during this time, effluent phosphorous levels are expected to decrease over time.

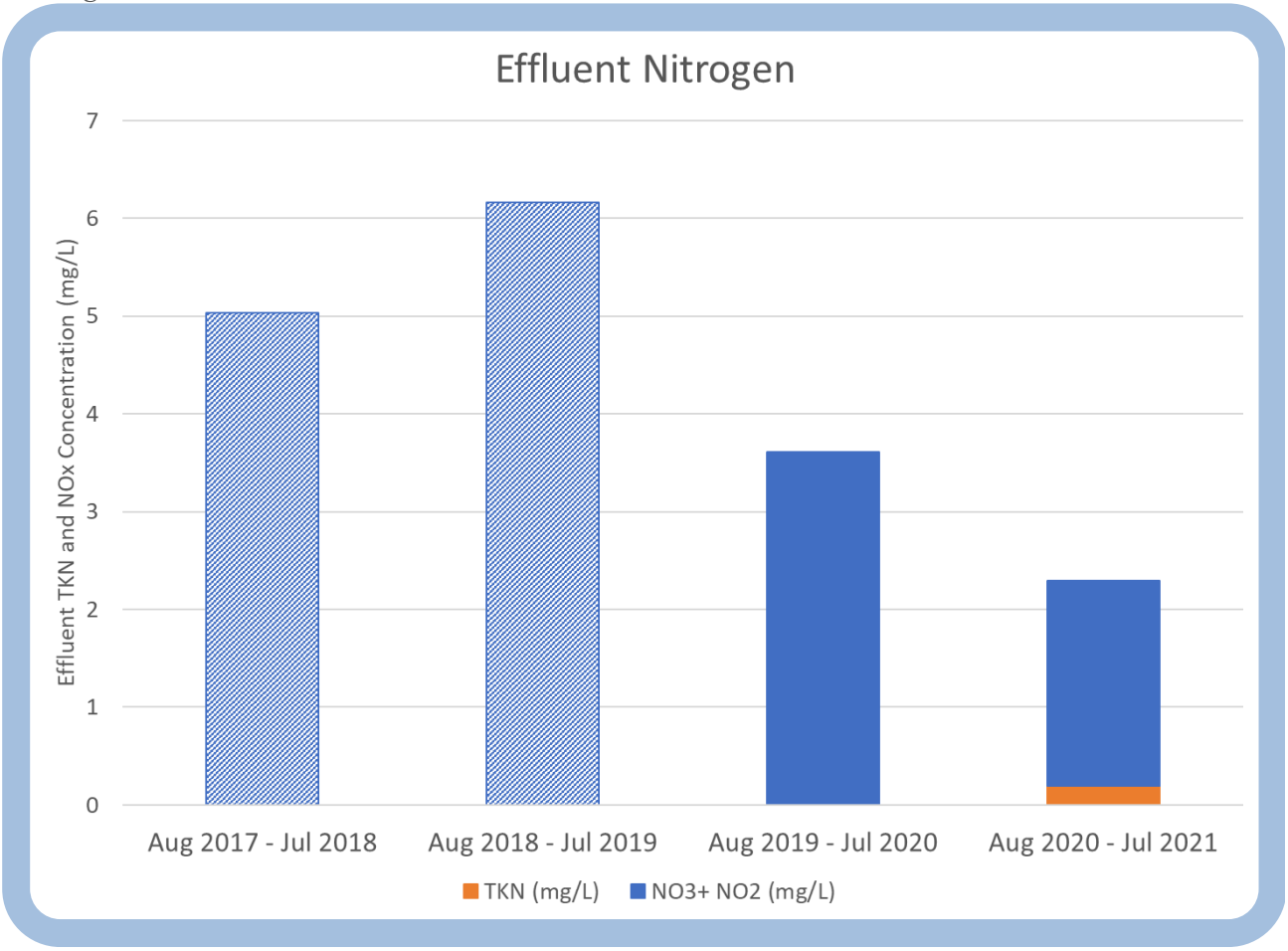
Figure 1



TOTAL NITROGEN

Average effluent compared to the baseline year has dropped by 47.6% [5]. Figure 2 below shows the reduction of effluent total nitrogen from years 2017 to 2020. The hashed bars in the graph below indicate baseline years before any changes were made.

Figure 2



5. Average effluent NO3+NO@ (mg/L) from baseline (Aug 2017 – Jul 2019) and Aug 2019 – Jul 2021

LESSONS LEARNED

By operating four aerator rotors in an on/off pattern energy reduction was observed while reducing nutrient effluence. Additionally, changes and repairs to sludge dewatering equipment should reduce phosphorus effluent. Additional data and confirmation of equipment updates should reflect additional nutrient reductions.

CONCLUSION

The Harriman wastewater treatment operators were able to reduce nitrogen effluent by nearly 48% and maintain levels of TKN below 1.5 mg/L while reducing energy consumption. Achievement of these results would not have been possible without the commitment of Harriman City leadership and plant operator's dedication to the voluntary Tennessee Plant Optimization Program. This success story is a great example of how even small systems can improve nutrient reduction while reducing energy costs.

CONTACT INFORMATION

TN Plant Optimization Program

Karina Bynum, Division of Water Resources
email: Karina.Bynum@tn.gov
tel: 931-217-6638

Jordan Fey, Division of Water Resources
email: Jordan.Fey@tn.gov
tel: 615-306-3494