

## Kalamazoo Water Reclamation Plant (KWRP) Drone Project

This project deployed the DR2000/DJI Inspire 2 drone with a Photoionization Detector (PID) to measure total VOC in areas around the plant and a Tedlar bag sampling port to perform whole air samples for offline analysis at the EGLE laboratory. On 23 and 24 May, 2022 we were able fly KWRP, and did find some VOC hot spots. The biggest challenges as well as the biggest gain was to have the Pilot in Command (PIC), ground control, and visual observers get used to flying manually close to buildings. Figure 1 shows flight paths at the Fine Screen (north) and Biosolids (south) buildings.

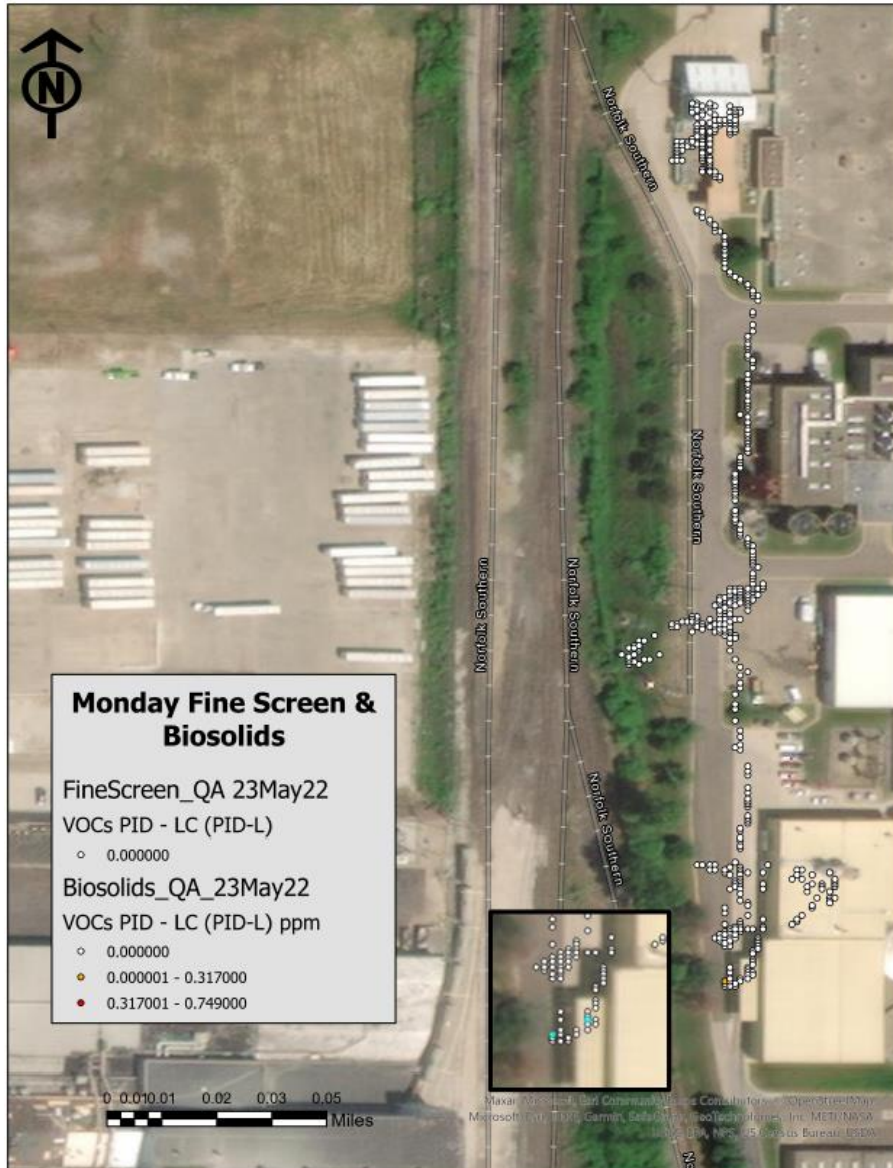


Figure 1: KWRP flight paths at Fine Screen (North) and Biosolids (South), Inset is the two points where VOCs were detected.

The secondary clarifier flights were combined into one feature class as displayed as one flight in Figure 2. The bag sample flight over the first clarifier tank is represented in Figure 3.

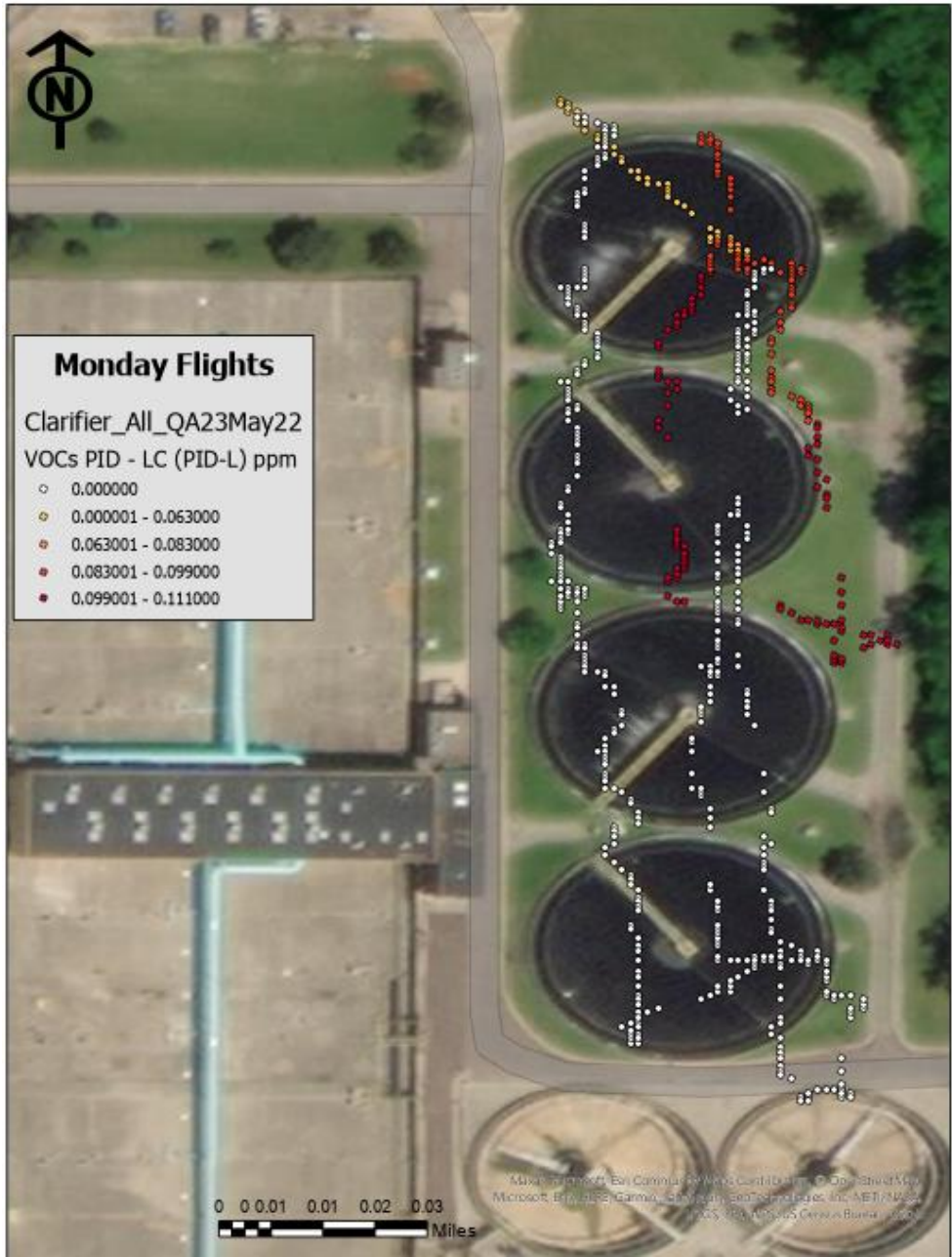


Figure 2: Monday's combined secondary clarifier flights

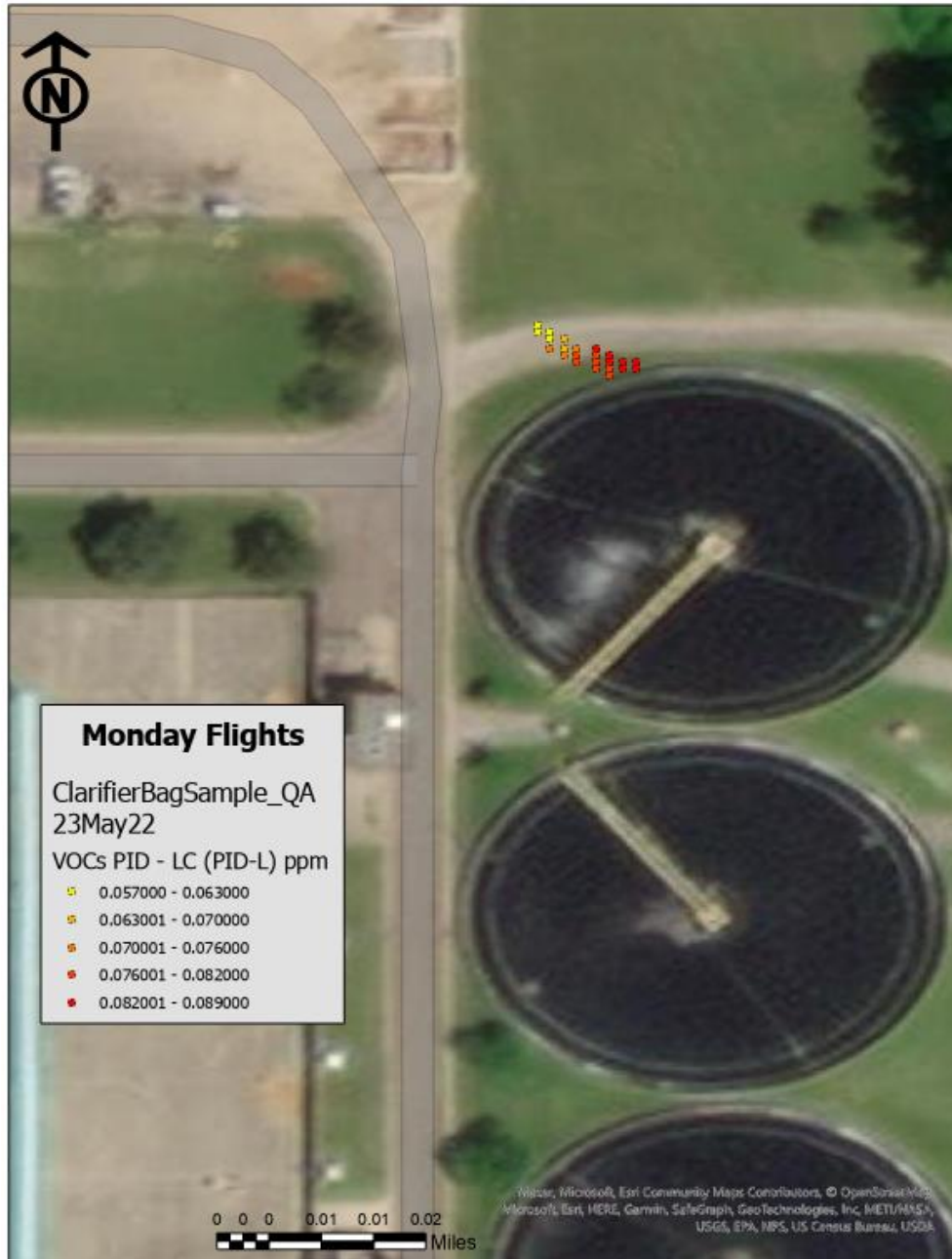


Figure 3: Secondary clarifier bag sample test flight

The aeration building flight was flown from the roof, where we also held the drone at the opening where water was falling to the next level of the building. This is shown in Figure 4.

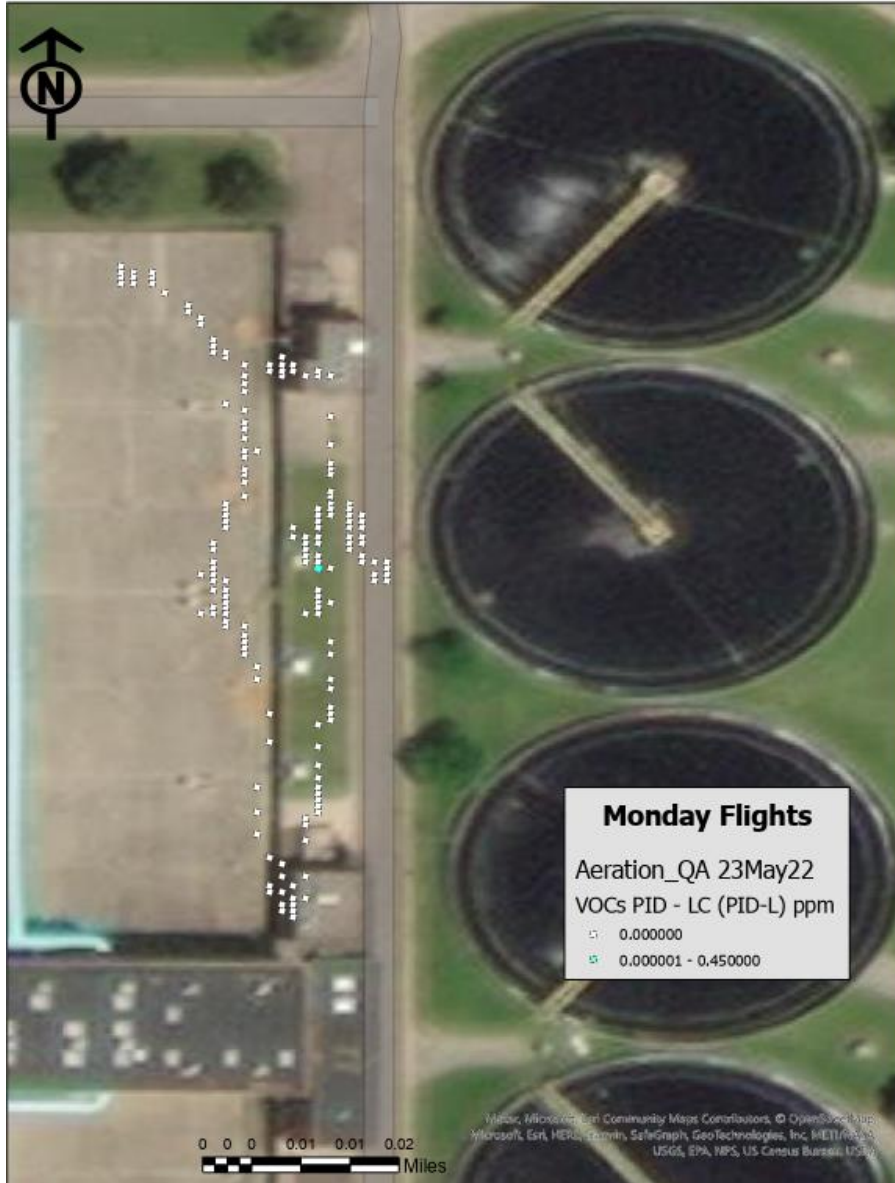


Figure 4: Monday aeration building flight. Highlighted is the one VOC reading for the flight. That value was .45 ppm total VOC.

One of the flights on Tuesday was over the entire Aeration Building (Figure 5), with the intention of identifying any other high emission points. Flight data were combined into one data set.

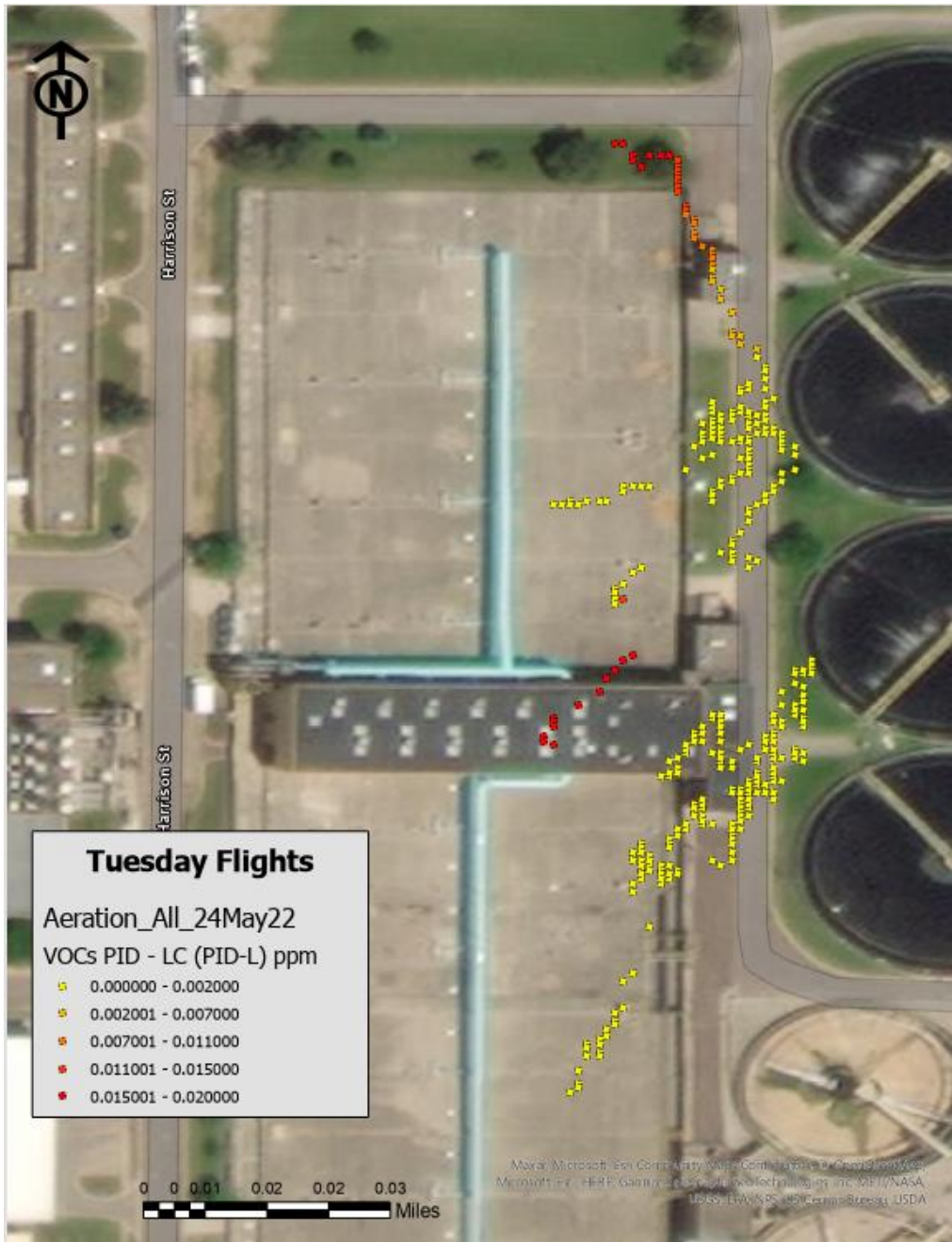


Figure 5: Aeration Building, all Tuesday flights combined.

The methodology we tested on Tuesday was to see if higher VOC concentrations could be detected by flying the drone level with the side opening or above the opening. There does seem to be an indication that flying level with the side opening is better than than flying above it. Due to obstructions and obstacles, the DR2000 was handheld at some parts of the flight.

The secondary clarifier tank flight also had a good response to VOCs as shown in Figure 6.



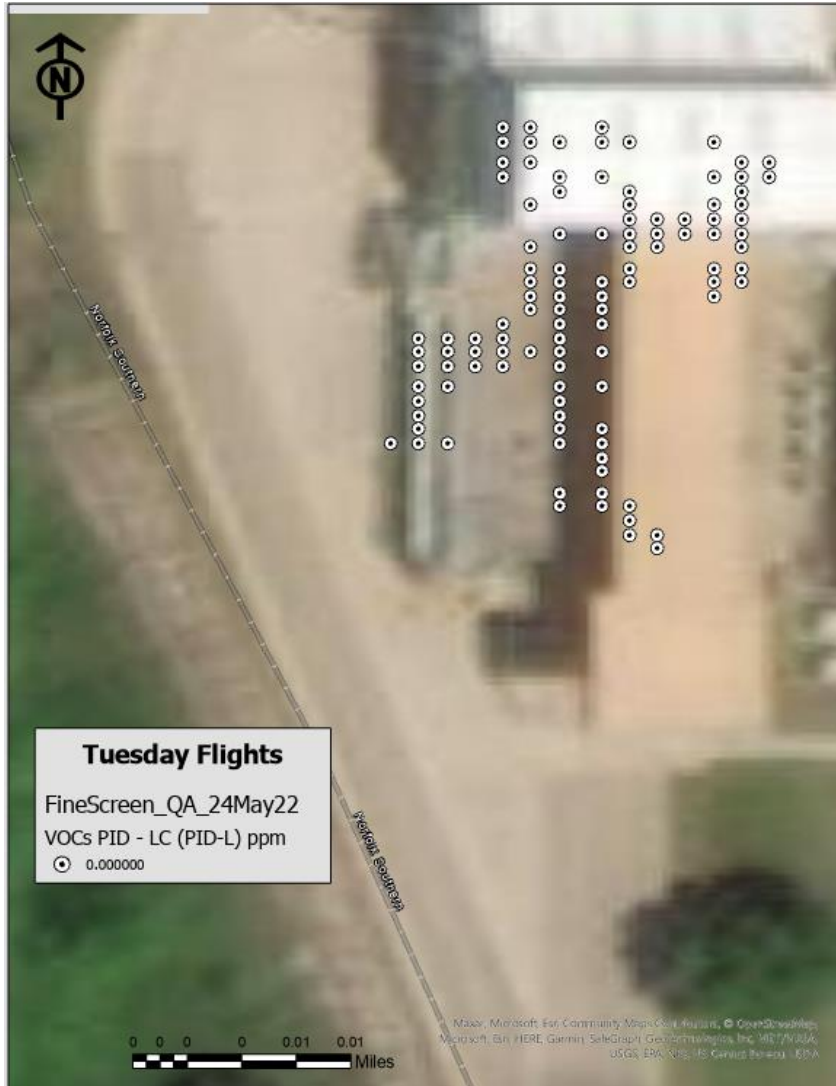


Figure 7: Tuesday flight of the Fine Screen. The flight at the Fine Screen on Tuesday did not show any VOC readings.

By flying the Fine Screen again with the horizontal crane not operating, we can understand the effects of the crane and waste removal truck. We flew the Biosolids building again for the same reason and here too, we did not have any VOC readings (Figure 8, left). The Thickener tanks were a new flight and are represented on the right side of Figure 8. We did not see VOC readings there either.



Figure 8: Biosolids building readings are on the left side of the figure. Right side is the Thickener readings.

Unfortunately, none of the Tedlar bag samples had sufficient sample volume to pass the detection limits of the EGLE laboratory. This was one of the important lessons learned during this phase of the study. In the future, we may hire a different laboratory to perform VOC samples. It is also important to do calibration runs to ensure that we know the volume of the bags and if the sensors are reading correctly. There was also the issue of whether or not the speed at which we flew the drone was faster than would be optimal for the 3 second time response of the PID. In the future, we hope to be able to repeat this experiment at KWRP applying the lessons we learned from this first set of flights. We hope to do this sometime in the fall of 2022.