PERFORMANCE TEST REPORT

DATE: November 9, 2021

LOCATION: Richmond Sanitary District – Wm. E. Ross WWTP

Kokosing P.O. # 2506319

PHI Personnel: Larry L. Bell, VP Email: Larry@phiwater.com
Ben L. Bell, PHI Service
FACO Personnel: Jeremy VanErman, Sales Email: Jeremy@facollc.com

Equipment Tested: Section 11365- Big Bubble Mixing System
Anoxic Selector Cell (18) in Pass A of Aeration Banks 1-9

Test Equipment Used: Sensor Display – YSI Model DIQ/S 282 – (two channel)
TSS Sensor – YSI Model ViSolid 700IQ
Measurement Range – 1 mg/l to 300 g/l
D.O. Sensor – YSI Model FDO 700IQ
Measurement Range – 0.01 to 20 mg/l

Number of Field Tests: Field testing was completed in all 18 of the anoxic selector cells in Pass A of Aeration Banks 1-9. Testing was required on only 3 of the 9 aeration banks.

Field Test Procedure: The specification stated that testing was to be done at 4 corner locations in each cell tested. Four corner locations were not accessible for these tanks without endangering testing personnel and the testing equipment. Since engineering staff nor plant staff were available on the approved testing date to consult with on this issue, an alternative sampling location in the center of each selector cell was decided upon. Testing in the cell center is, in fact, representative of conditions in the rest of the cell because the two bubble forming plates in each cell (see figure 1) have zones of influence that cover the entire cell area. Also, the test location was sampled at three different depths per the specification which provides sufficient indication of solids distribution within each cell. See Table 1 on the next page for test data collected and pass / fail status at each location.

15 Oro Beach Drive, Oroville, WA 98844
Tel: 800-641-1726 Email: info@phiwater.com

RICHMOND SANITARY DISTRICT - WILLIAM E. ROSS WWTP -PERFORMANCE TEST OF 18 ANOXIC SELECTOR CELLS IN PASS A OF AERATION BANKS 1-9

TEST DATE: November 9, 2021

Selector Cell	Test Depth: 1 Foot		Test Depth: 8-9 Foot		Test Depth: 16-17 Foot		(Depth is Measured from Water Surface) (TSS & D.O. measurements are reported as mg/l)		
	TSS	**D.O.**	**TSS**	**D.O.**	**TSS**	**D.O.**	**TSS CV**	**(CV passing = <0.1)**	**(D.O. Passing = <0.2)**
				Mixing Panel 381-LCP-0730					
Tank 1-1	6,070	0.03	6,030	0.02	6,180	0.01	0.013	Pass	Pass
Tank 1-2	6,040	0.02	6,050	0.02	6,060	0.01	0.001	Pass	Pass
Tank 2-1	6,100	0.02	6,120	0.01	6,060	0.01	0.005	Pass	Pass
Tank 2-2	6070	0.02	6070	0.02	6,310	0.01	0.023	Pass	Pass
				Mixing Panel 351-LCP-0530					
Tank 3-1	6,040	0	6,060	0	6,040	0	0.002	Pass	Pass
Tank 3-2	6070	0.03	5,960	0.02	6,380	0.01	0.035	Pass	Pass
Tank 4-1	6,080	0	6,060	D.O.	5,990	0	0.008	Pass	Pass
Tank 4-2	6,120	0.1	5,590	0	6,480	0	0.074	Pass	Pass
Tank 5-1	5,940	0	5,900	0	5,710	0	0.021	Pass	Pass
Tank 5-2	6,050	0	5850	0	6,060	0	0.02	Pass	Pass
Tank 6-1	5,880	0	5,880	0	5,580	0	0.03	Pass	Pass
Tank 6-2	5,870	0.03	5,880	0	6,070	0	0.019	Pass	Pass
				Mixing Panel 321-LCP-0430					
Tank 9-1	6,050	0	6,010	0	6,130	0	0.01	Pass	Pass
Tank 9-2	5,870	0.03	5,830	0.02	5,950	0	0.01	Pass	Pass
Tank 8-1	6,000	0.03	5,880	0.03	6,150	0.02	0.023	Pass	Pass
Tank 8-2	6,080	0.05	6,050	0.04	5,990	0.02	0.008	Pass	Pass
Tank 7-1	5,870	0.05	5,920	0.04	5,850	0.03	0.006	Pass	Pass
Tank 7-2	6,040	0	6,050	0	6,020	0	0.003	Pass	Pass

NOTES:

1. During the testing, all panels were set to pulse 2 times per minute per valve with the pulse duration set at 0.6 seconds. This equates to 1.5 HP per 20' x 30 ' selector cell.
2. The TSS & D.O. sensor array was placed in the middle of the tank during testing. Measurements were taken at 1, 9 & 17 foot depths. SWD was 18 feet at the time of the testing.
3. All 18 anoxic selector cells were tested. Only 6 anoxic selector cells were required to be tested by the project's specifications.
4. The testing rig was located on the east side of each of the 20' x 30' anoxic cells during testing due to its size and accessibility limitations presented by the selector cells.
5. During the testing, influent flows to these tanks were affected by work being done by the contractor on gates in the flow splitting structure(s). Varying waste loading appears to not have affected performance of the mixing system.

TABLE 1

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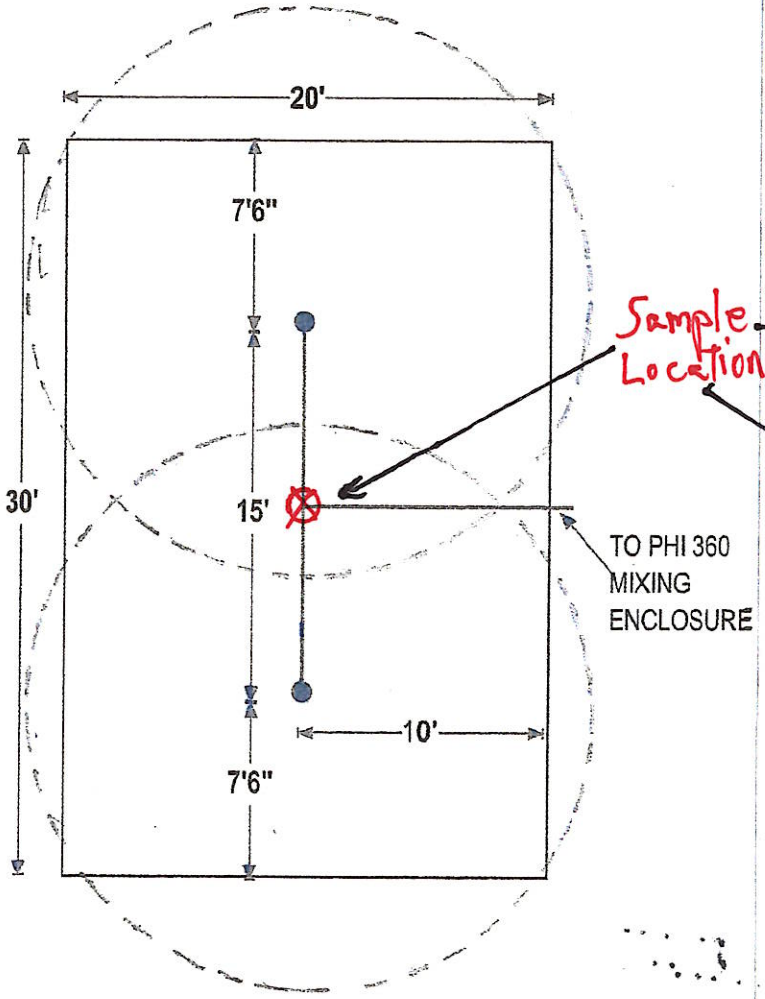
APPLICATION DRAWING



Sample Locations

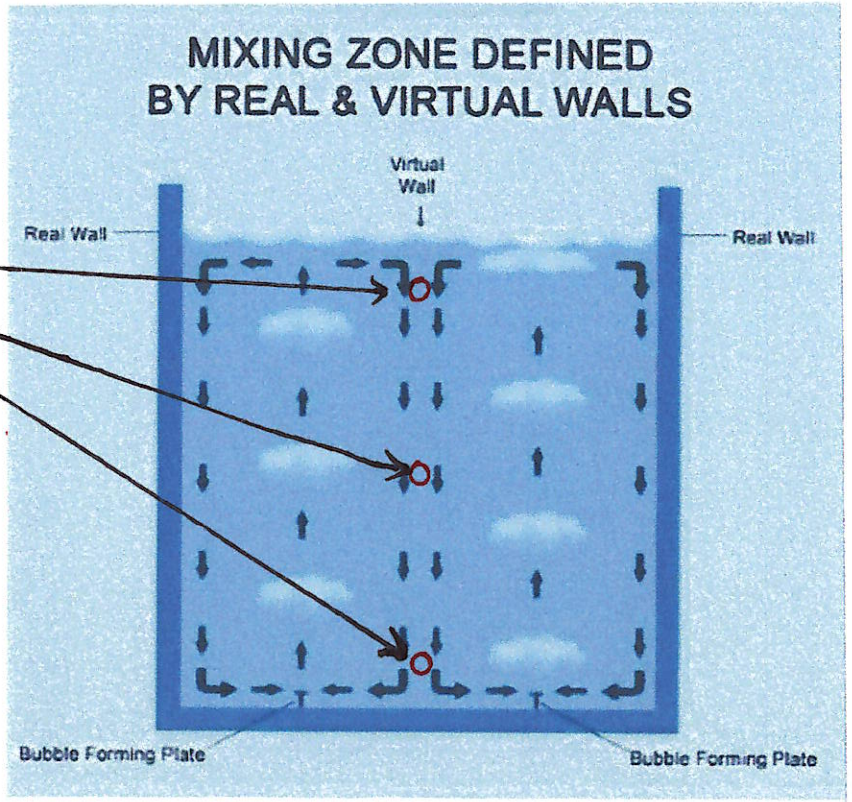


Fig. 1

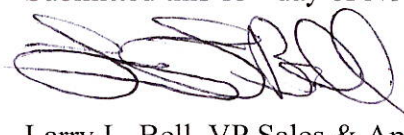
Discussion: Testing began at 9:30 AM on the morning of November 9th and continued without stopping until 3:30 PM on the same date. During that time interval, contractors were working with the gates in the flow splitter structure(s) which noticeably affected flows and, consequently, the waste loadings between the aeration basins immediately down flow which were being tested.

Despite the variable loading issues which cause treatment upsets in many waste treatment systems, the data indicates that the total suspended solids were evenly distributed within the anoxic selector cells with coefficient of variation (CV) values significantly lower than the 0.1 CV upper limit the project specification listed as an indication that the mixing system is working satisfactorily.

In addition to exceptional TSS CV values during this testing event, the dissolved oxygen measurements in all 18 selector cells were significantly lower than the 0.2 mg/l limit mentioned in the specification as the upper acceptable value for anoxic operation.

On the basis of this data, we are of the opinion that the large bubble mixing system is meeting the project requirements.

Submitted this 15th day of November, 2021 by:



Larry L. Bell, VP Sales & Application Engineering
Pulsed Hydraulics Inc.

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