Improving Influent Screen Washing for a Fraction of the Estimated Cost

The use of Vaughan's self-priming chopper pump and nozzles upstream of the influent screens is increasing the amount of fecal matter passing through the influent screens, which in turn improves plant efficiency and greatly increases the amount of co-generated electricity from digester gas.

By Glenn R. Dorsch, P.E, VP/Chief Engr, Vaughan Co. Inc.

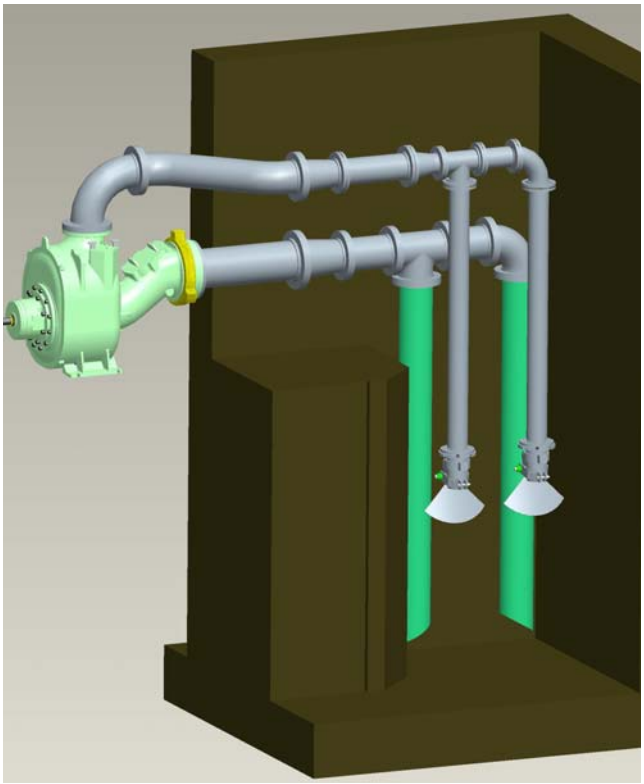
Eastern Municipal Water District's (EMWD) Moreno Valley Regional Water Reclamation Facility receives all of its sewage by gravity flow. Because the sewage fecal matter is not broken up by any pumps, a significant portion of it was being caught up with the debris on the influent screens, preventing it from being processed. This was not only creating an unpleasant situation for incoming debris disposal, including odors, but it also meant that the digesters were not generating enough gas for making electricity. Too little co-generated electricity was jeopardizing a $3.25 Million rebate from Southern California Edison.

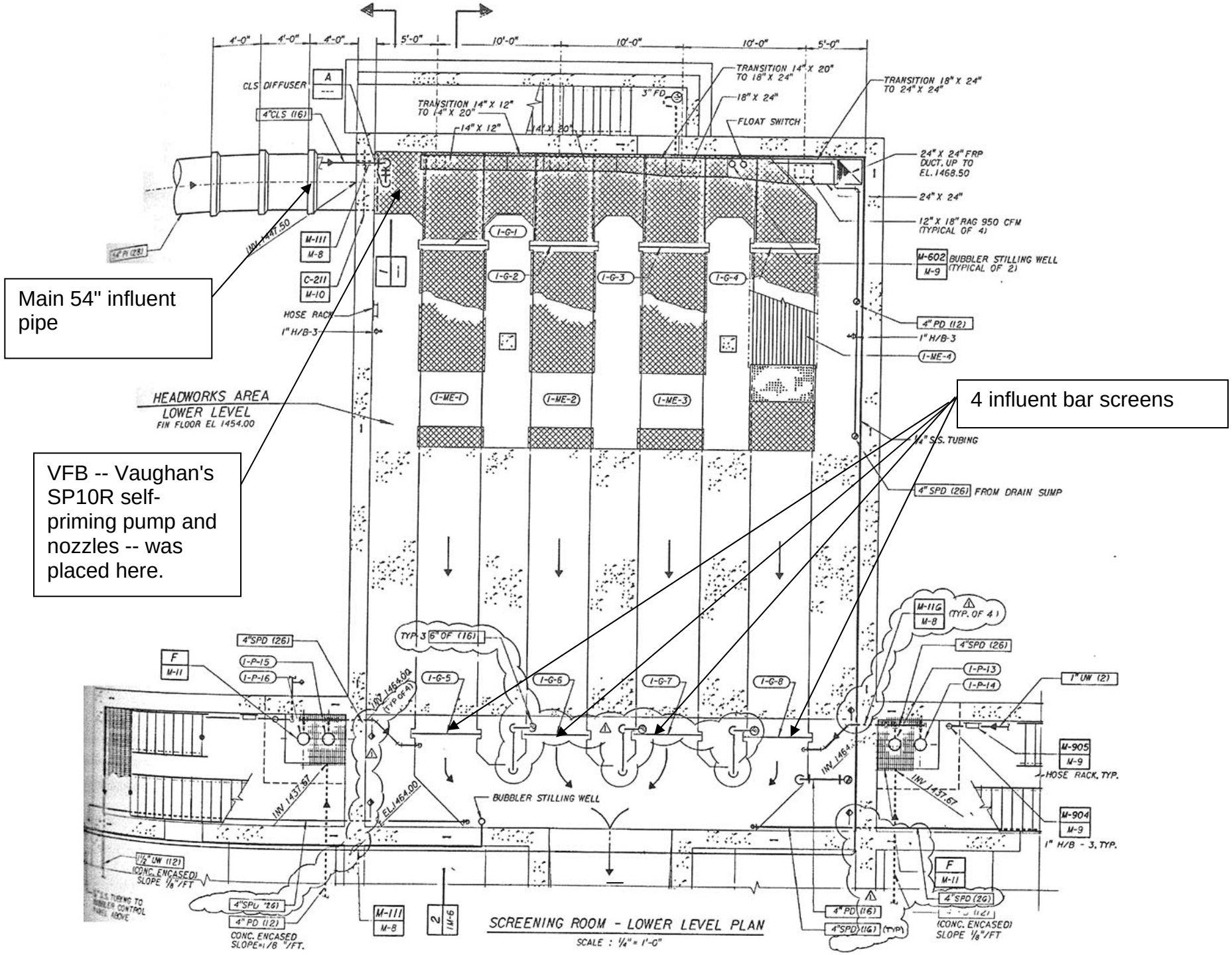
EMWD Director of Water Reclamation John Jannone, and the maintenance manager, Stephen Moore, reacting to an estimated $2 Million cost for revamping the influent screens, asked Kent Rockwell (Rockwell Engineering & Equipment Co, Vaughan's sales representative) if Vaughan Co. might have a more cost-effective solution. The final result is a simple system that solves the district's problems, including assuring the $3.25 Million electrical rebate, all for less than $75,000 installed cost.

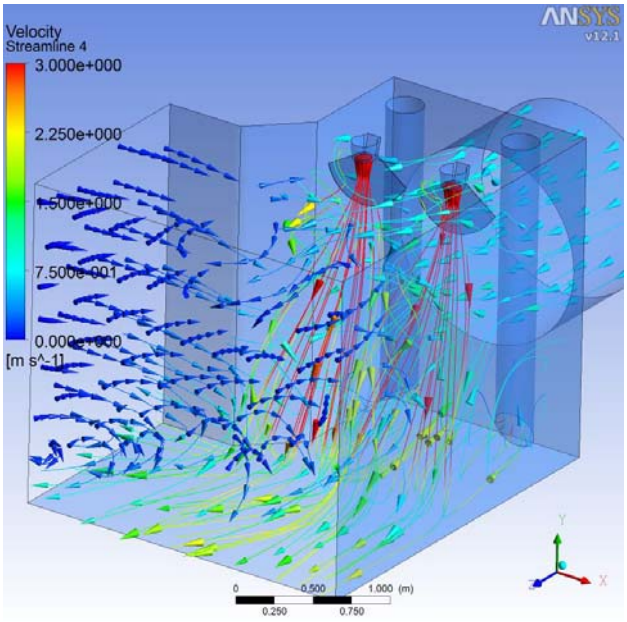
The solution? Install Vaughan's "VFB" ("Vaughan FecalBuster") system in the main influent channel. The "VFB" system works by pulling influent up from the channel through twin suction pipes, through the chopper pump. The chopper pump cuts up debris and fecal matter and then discharges back to the influent channel through 2 high velocity nozzles with splashplates to further break up fecal matter in the channel.

The next page shows a drawing of the plant influent channels and screens. The main channel is 5 ft wide x 8 ft deep, with typically 3 to 6 ft. of fluid depth. Minimum plant flow is 5 MGD (3,472 US GPM), while maximum is 22 MGD (15,278 US GPM). A 50 HP, 870-RPM Vaughan model SP10R pump provides about 3500 US GPM at about 30 ft TDH to keep up with minimum plant flow and to generate enough pressure to drive the two discharge nozzles. These nozzles further break up fecal material in the channel downstream of the chopper pump. After discussions with Moreno Valley, we decided to use only one pump in the main channel rather than multiple pumps in front of each screen. An isometric of the suction and discharge piping for this system, located in the main influent channel, is shown below. The main chopper pump is shown at left without the drive motor.

Vaughan 50-HP Self-Priming Chopper Pump drawing about 3500 GPM up 2 pipes from the main influent channel and discharging back into the channel through dual nozzles to create a shearing wall of velocity through which fecal material must flow. Whatever the chopper pump misses, the dual nozzles help to break up.




Main 54" influent pipe
VFB -- Vaughan's SP10R self-priming pump and nozzles -- was placed here.
4 influent bar screens
HEADWORKS AREA
LOWER LEVEL
FIN FLOOR EL 1454.00
SCREENING ROOM - LOWER LEVEL PLAN
SCALE : 1/4" = 1'-0"
BUBBLER STILLING WELL
TRANSITION 14" X 20" TO 18" X 24"
TRANSITION 18" X 24" TO 24" X 24"
TRANSITION 14" X 12" TO 14" X 20"
FLOAT SWITCH
24" X 24" FRP DUCT, UP TO EL. 1468.50
12" X 18" RAG 950 CFM (TYPICAL OF 4)
M-602 BUBBLER STILLING WELL (TYPICAL OF 2)
4" PD (12)
1" H/B-3
1-ME-4
1/4" S.S. TUBING
4" SPD (26) FROM DRAIN SUMP
HOSE RACK
CLS DIFFUSER
4"CLS (16)
3" FD
M-905
M-9
HOSE RACK, TYP.
M-904
M-9
1" H/B - 3, TYP.
1" UW (2)
4"SPD (26)
1-P-13
1-P-14
1-P-15
1-P-16
1-G-1
1-G-2
1-G-3
1-G-4
1-G-5
1-G-6
1-G-7
1-G-8
1-ME-1
1-ME-2
1-ME-3
M-111
M-8
C-211
M-10
M-116
M-8
(TYP. OF 4)
TYP. 3 6" OF (116)
INV 1447.50
INV 1437.67
EL 1464.00
1/2" UW (12) (CONC. ENCASED) SLOPE 1/8"/FT
4" PD (12)
CONC. ENCASED SLOPE=1/8"/FT.
4" PD (116)
4"SPD (116) (TYP)
4"SPD (26)
(CONC. ENCASED) SLOPE 1/8"/FT



Above is shown a streamline plot from the results of Vaughan's Computational Fluid Dynamics (CFD) simulation of the fluid system in the channel. Plant influent flows in through the large circular, horizontal pipe on the right; flow to the chopper pump suction goes through the two vertical pipes on either side of the main channel. The chopper pump breaks down debris and fecal matter into smaller particles, and chopper pump discharge flow, shown in red, indicating higher velocity, returns to the influent channel to break up more fecal matter after the pump. Notice that the downstream flow is recirculating back towards the nozzle discharge, increasing the chances that fecal matter will be struck multiple times by the high-velocity nozzle streams. Part of the fecal breakup is achieved by pumping high-velocity flows through the nozzles and splashplates, and another part of the fecal breakup occurs because of the shear wall of velocity created in the channel across which fecal matter missed by the pump must flow.

The photo above shows the actual piping installation with the discharge pipes in the foreground and the suction pipes in the back. The plant used steel pipe to try this idea out, but intends to change to stainless steel now that they know this concept works well.

Stephen Moore, Moreno Valley's maintenance manager, commented that at startup, they decided to run this system only during the 8-hour day shift for the first week or so to keep an eye on it. But since the system "has run flawlessly," it now operates continuously, 24/7.

The measurable results? Plant Manager Dean Mathes commented that the weight being hauled to the landfill has been reduced by 10.3% after installation of Vaughan's FecalBuster (VFB), but that a visual before-and-after comparison suggests that about 70% fecal reduction has taken place. Noticeable odors are now gone.

Gas production from the digesters has increased from 120,000 ft^3/day to 170,000 ft^3/day. Not all of this increase can be attributed to the installation of the VFB, as other plant changes were made at the same time. Dean Mathes estimates that about a third of that increased gas volume, at least 15,000 ft^3/day, is the result of the VFB. The VFB is very effective at breaking up fecal material so that the large majority of this material will easily flow through the influent bar screens to the rest of the plant.

Eastern Municipal Water District is a longtime user of Vaughan chopper pumps going back to 1991. Moreno Valley RWRF, for example, uses Vaughan Rotamix mixing systems in their 4 anaerobic digesters, vertical pedestal pumps for digester heat exchanger recirculation, and a variety of submersible chopper pumps for scum and lift station service.

Stephen Moore notes that they came to Vaughan Co. looking for a solution to this influent screening problem because of the long history of success with Vaughan's equipment and because of Vaughan's excellent technical support over the years. Avoiding a $2 Million expense for revamping their influent screens in exchange for the $75,000 installed cost of Vaughan's "VFB" while also assuring their $3.25 Million electrical cogeneration rebate is a pretty good success story.

Vaughan Company Inc, Montesano, WA, 360-249-4042; www.chopperpumps.com.