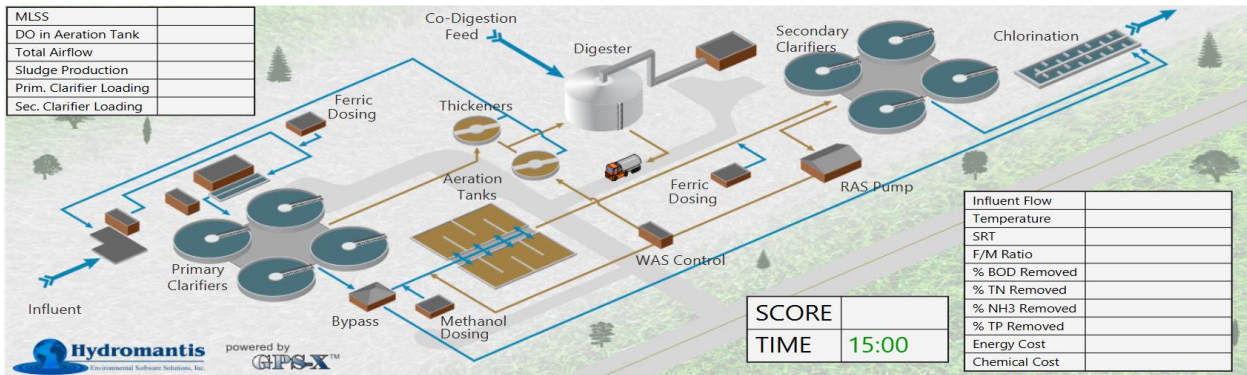


Operations Challenge Process Control Event – Simulator Question Background Information

The Plant

The wastewater treatment plant operations simulator (OpTool) contains a mathematical model of the conventional wastewater treatment plant shown below:



The plant consists of:

- an influent pumping station
- 4 circular primary clarifiers
- 2 parallel plug-flow activated sludge aeration tanks (4 zones in series)
- 4 circular secondary clarifiers
- 2 chemical dosage points (for iron addition for chemical phosphorus precipitation)
- a methanol dosage point (for denitrification)
- a recycled activated sludge (RAS) pumping station
- a waste activated sludge (WAS) pumping station
- 2 gravity sludge thickeners
- an anaerobic digester (with co-digestion feed point)
- a chlorine disinfection tank

The Challenge Questions

Teams will be presented with a total of 11 challenge questions. Teams can answer the questions in any order they like, and can do any question over as many times as needed. Make sure to click on the red SUBMIT button to register your answer each time you complete the question. Clicking on the SUBMIT button erases the previous answer for that question, so if you do a question several times, it will only remember the last answer that you submitted.

The questions cover a wide range of operational situations, and require teams to make operational changes to the plant to achieve a given set of targets. See special notes about Question 11 at the end of the document.

Please note that Question 11 involves running a 5-day dynamic simulation, which takes approximately 2 minutes to complete. Please make sure to leave enough time to complete the simulation before clicking on the SUBMIT button.

The following aspects of the plant can change from question to question:

- Sizes of the aeration tanks
- Surface areas of the clarifiers
- Number of primary clarifiers in service
- Number of aeration tanks in service
- Number of secondary clarifiers in service
- Influent loading (flow, COD, BOD₅ ammonia, temperature, pH)
- Starting pumped flow settings (RAS flow, WAS flow)
- Starting aeration conditions (airflow, DO controllers, etc.)
- Starting chemical addition settings (methanol, ferric, chlorine)

In each question, the teams will receive 25 points per target achieved. Some questions have more targets than others. The table below summarizes the points for each question:

#	Question	Maximum Possible Points
1	High Strength Wastewater	100
2	SRT Management	50
3	Biological Phosphorus Removal	50
4	Aeration Control	75
5	Chemical Cost Management	125
6	Digester Gas Production	50
7	Cold Weather Operation	50
8	Total Nitrogen Removal	50
9	Sludge Production Management	50
10	Nutrient Removal	100
11	Dynamic Wet Weather	300

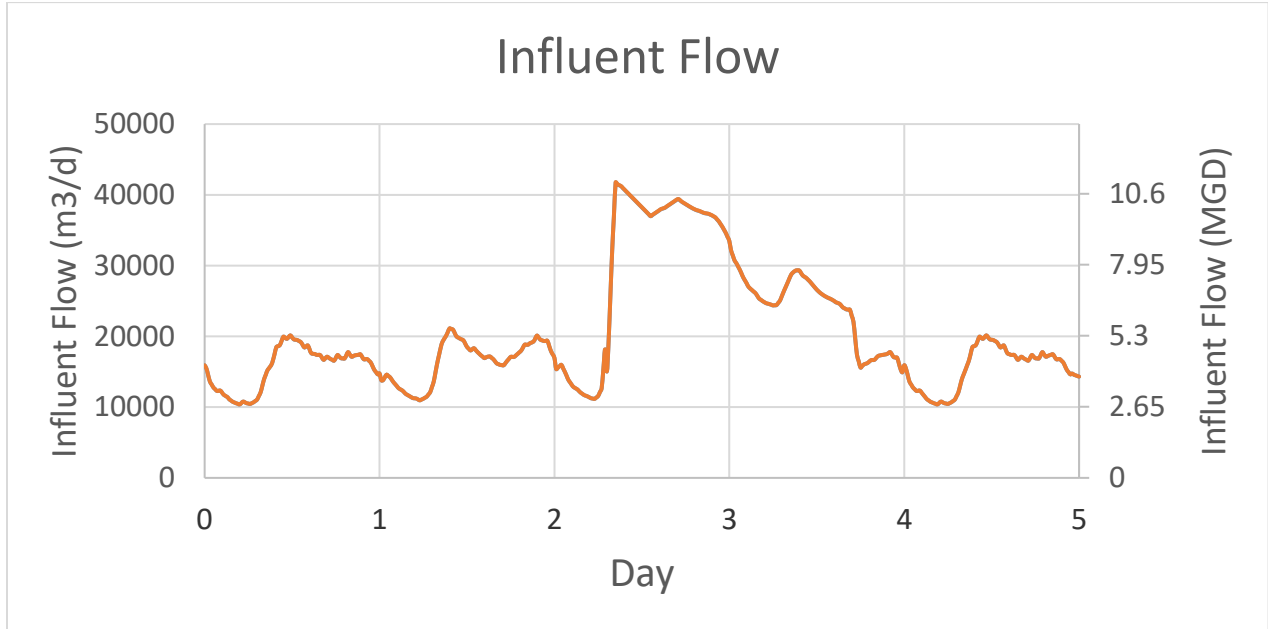
Notes for All Questions

Please note that all Food-to-Microorganism (F/M) ratio calculations are calculated as lbBOD₅/lbVSS/d (or in SI units, gBOD₅/gVSS/d).

The input settings are bounded. If you set the value outside of the respective input range, the simulator will set it back to the limit.

Special Notes for Question 11: Dynamic Wet Weather

In Question 11, you will run a 5-day dynamic simulation where the influent flow changes during the 5-days, as shown in the graph below:



Note that a large wet weather event happens on day 3. All influent concentrations will be kept constant – only the flow rate changes over time.

During the 5-day simulation, a 24-hour composite sample (one sample taken each hour) will be reported at the end of each day in the table in the lower-right corner of the screen. The red or green background will indicate whether the sample meets the specified target:

Day Number	Nutrients		
	Effluent TSS <15.0 mg/L	Effluent BOD5 <10.0 mg/L	Effluent Ammonia <2.0 mg/L
1	✓ 12.3	92.3	29.9
2	✓ 12.8	93.2	29.9
3	21.8	90.2	29.6
4	22.4	109	29.9
5	15.2	139	30.7

Target: Effluent BOD5 <10.0 mg/L

Composite Sample Concentration: Effluent Ammonia 29.9 mg/L

In order to score points, **all 5 composite samples must meet the target** (for one particular parameter, such as TSS). If the target is met for all 5 days, 100 points are scored. For example,

all 5 TSS composite samples must be below 15 mg/L in the example above, and since the samples on days 3,4 and 5 do not meet the target, zero points would be score for TSS.

The three different parameters (in the above example, TSS, BOD5 and ammonia) are scored independently, so it is possible to get 0, 100, 200 or 300 points on this question, depending on the operational choices made.

Additional Data for Question 11:

Parameter	Value
Influent Concentrations:	
COD	700 mg/L
TKN	42 mg/L
Ammonia	28 mg/L
Total Phosphorus	12 mg/L
Soluble OrthoP	10 mg/L
pH	7 mg/L
Influent Temperature	68 °F 20 °C
Aeration Tank Volume	2 tanks @ 0.792 MGal (3000 m3) each
Clarifier Surface Area	
Primary Clarifiers	4 clarifiers @ 3230 ft2 (300 m2) each
Secondary Clariifers	4 clarifiers @ 4300 ft2 (400 m2) each

Final Scoring

When the timer expires, the team’s final score will be displayed. The final score will be the sum of all the points earned in all questions. **A perfect score is 1000 points.** There are no penalties for trying questions.