A new community has been proposed for construction with an ultimate population of 10,000. Due to the danger of groundwater pollution from the tanks, the community is building a sewer system and a new sewage treatment plant will handle the sewage and discharge it to a river. A critical part of the design is to determine the allowable BOD discharges from the system.

**SOLUTION OPTIONS:** The problem as outlined below can be solved fairly easily using a conventional “paper and pencil” set up with solution via handheld calculator. Alternatively, you may find it interesting to try some simple free modeling software to solve the problem (EnviroLand software).

The links to the software and a description of its use are found in the Course Syllabus under the same cell as this assignment. You must have a PC (not Mac) to run the software. You might be able to load it onto PSU computers and then run it since the download is just a set of .exe files that you can store on your own drive space. (To actually install a program requires Administrator privileges on that PC, but I don’t think that’s required here). In any case, if you can load and run it on a PC, it is quite easy to use.

It’s about the same amount of work to do the problem either way, although once you learn the software set up, there are other fun things you can do with it. It’s up to you; I’ll accept either form of solution. If you use EnviroLand, just make sure you set up all the parameters as given here and do not accidentally substitute values from the example problem that comes with the software.

**HINT:** If you use EnviroLand, you still must compute a few parameters, such as the stream velocity and the reaeration by hand. For temperature conversion coefficients, use the values suggested in the reading.

**Data:**
Average sewage produced per person: 100 gallons/day
Mean flow in the river during the warmest months of the summer: 0.44 m$^3$/s
Mean temperature of river during warmest summer period: 22°C
Assume the waste discharge is about the same temperature as the receiving river (22°C)
River width (mean) = 5 m
Mean river depth = 2 m
River upstream of discharge is assumed to be saturated with DO.
Typical BOD$_5$ (20°C) of a raw wastewater from the community: 150 mg/L
Reaction rate at 20°C: $k = 0.23$ d$^{-1}$
Assume the worst case where the wastewater discharge has DO = 0 mg/L

(Cont’d)
Questions:

1. What is the ultimate BOD ($L_o$) of the raw waste?

2. If what is the critical time (point of minimum DO)?

3. If raw waste were to be discharged, what is the minimum DO in the river (at the critical time)?

4. If water quality standards call for a minimum of 5 mg/L DO, what is the minimum percent removal of BOD that the wastewater treatment plant must achieve? In other words, if raw sewage discharge results in a minimum DO of < 5 mg/L, what (lower) concentration of BOD in the discharge would meet that standard and by what percentage must you reduce the strength of the raw waste to meet that level?

(By the way, Federal standards typically require a treatment plant to achieve 80% BOD removal, regardless of DO impact, so you can see here how the amount you require above compares to that.)