CE 3372 WATER SYSTEMS DESIGN

DRINKING WATER STORAGE PART 2 (FALL 2020)

STORAGE

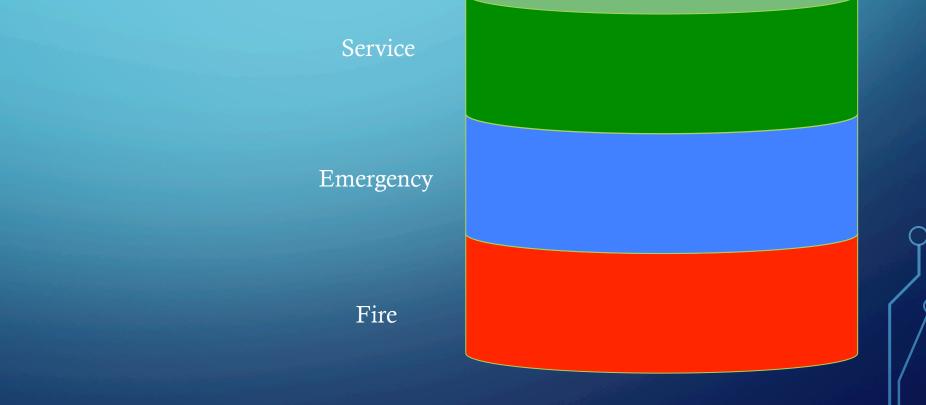
Purpose of storage reservoirs
Types of reservoirs
Calculating storage requirements

STORAGE RESERVOIRS

- Equalizing or Operating Storage
 - Equalize pumping rate into reservoirs
 - Provide storage for peak demand times
 - Provide system pressure without booster pumping
- Fire and emergency pressures
- Types
 - Surface reservoirs
 - Standpipes
 - Elevated tanks

STORAGE COMPARTMENTS

- Service storage
- Emergency storage
- Fire Storage



FLOW-EQUALIZATION

 Flow-equalization storage is sufficient storage to account for peak demands in the system without having to exceed supply capacity.
 A desirable volume is 1-2 days of average daily demand.



Fire storage is sufficient storage to allow the system to meet routine uses plus substantial fire flow.

The desirable volume is based on expected fire flow rates multiplied by the required fire flow duration.

EMERGENCY STORAGE

Emergency storage to allow the system to operate without external supply sources for a period of time to allow for repairs or other unusual circumstances.

Without emergency storage, every upset will lead to a "boil-water" order or substantial interruption of service — these kinds of interruptions should be rare if the system is well engineered.

A desirable volume is 1-2 days of average daily demand.



Engineering would tend to choose for the larger volumes
 Economics will argue for the smaller volumes
 The engineer will have to balance these competing choices in a design.

RESIDENCE TIME

- Additionally, residence times in any storage reservoir for TREATED water should not exceed a reasonable amount disinfection residual contact time.
 - For chlorine/chloramine disinfection time is on the order of 6-10 days Hydraulic retention time of any such reservoir should be no longer than 8 days (as a reasonable rule of thumb).



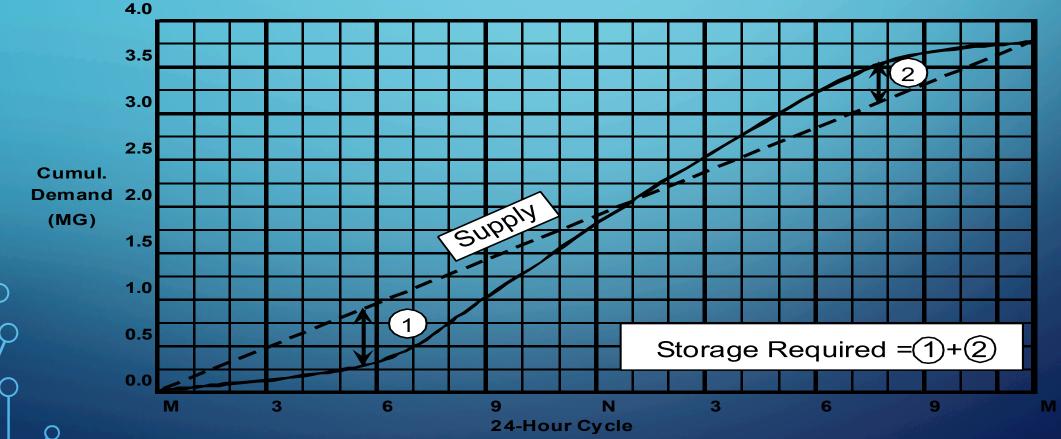
 Hydraulic retention time is the ratio of storage volume to average discharge through the reservoir

 $HRT = \frac{V_{\text{tank}}}{Q_{\text{average-daily}}}$

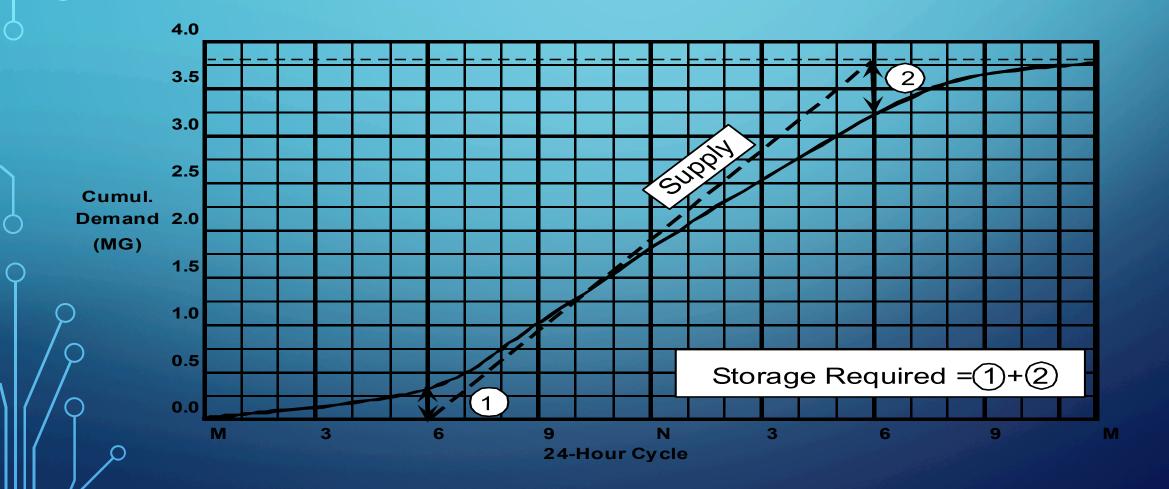
OPERATING STORAGE

- Determine hourly demand for design day
- Calculate cumulative draft
- Plot cumulative draft vs. time (24 hr)
- Draw diagonal line representing constant pumping
- Read required storage as sum of two maximum ordinates

MASS DIAGRAM (24-HR PUMPING)



MASS DIAGRAM (12-HR PUMPING)



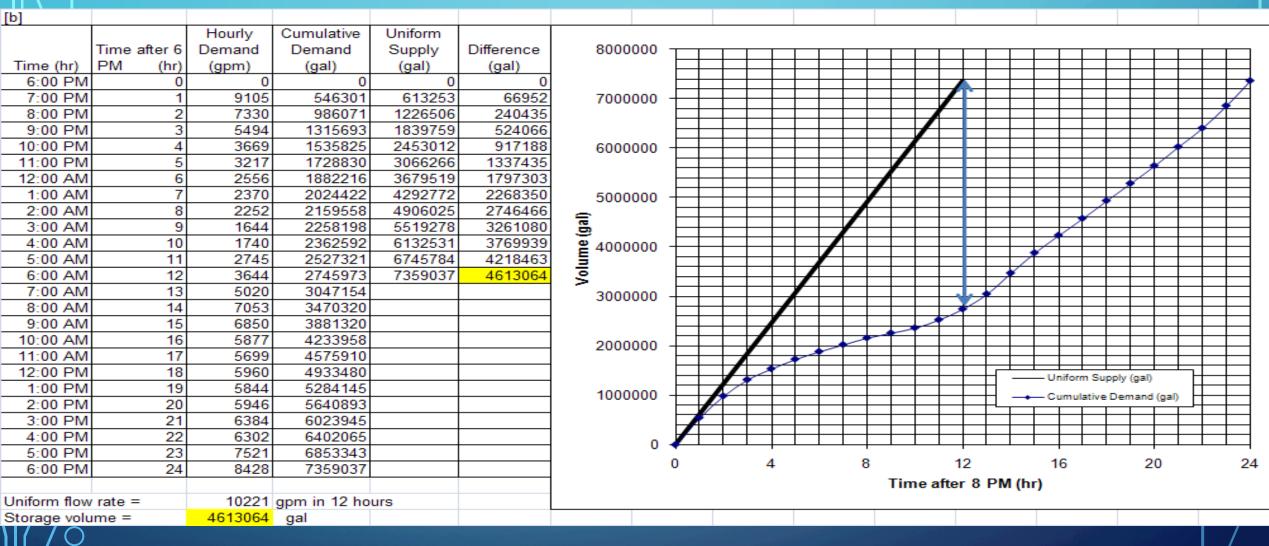
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Example Service Storage Problem Average hourly demands in the table below. Find: Uniform pumping rate (gm) and required storage (gallons). Time (thr) Cumulative (gal) Uniform (gal) Uniform (gal) 12:00 AM 0 0 0 0 10:00 AM 12:200 AM 0 0 0 0 10:00 AM 22:25 277343 613253 336910 10:00 AM 22:25 277343 613253 336910 10:00 AM 22:25 277343 613253 336910 10:00 AM 22:25 277343 613253 368007 10:00 AM 1164293 1164393 2146380 976022 5:00 AM 6 36644 863758 1839759 976022 11:00 AM 11 26963 306145 864908 3000,000 5,000,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0														
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FLOW EQUALIZATION

• The engineer needs to decide which demand to use:

- Daily
- Peak
- These volumes are added to that needed for emergency and fire flow.
- Determines the tank volume required
- Tank type (elevated, at-grade, buried) determines shape elevation, diameter, min-level, max-level.
 - Elevated tanks have substantial structural considerations