APPLICATIONS & EXAMPLES OF FLOW BALANCING BEST PRACTICES

OOWA ONSITE TECHNICAL COMMITTEE

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TODAY'S AGENDA

- This presentation:
  - Applying the Best Practice
  - Examples
- Previous presentation:
  - Overview of OOWA's Flow Balance Best Practices document

FLOW BALANCING REFRESHER

- Flow balancing stores **predictable**, short-term **peak sewage flows** and **pumps it over several days** to the downstream components.
- A site with predictable peak flows and lower off-peak flows has good potential
- Advantages: smaller, lower cost
- Disadvantages: greater complexity

OK, I'VE DECIDED TO FLOW BALANCE, NOW WHAT???

1. Design peak day flow (per OBC)
2. Weekly flow pattern
   - Facility usage, future changes
3. Choose balanced flow
4. Balancing calculations
5. Select safety factor & tank size
6. Size the rest of the system
7. Choose pumps/controls

EXAMPLE #1: RESTAURANT

- John's Home Cookin' restaurant
- Moving existing restaurant to a new site down the road
- New septic required
- 60 seats
- Not 24 hour

1. DESIGN FLOW (PEAK DAY)

- OBC Table 8.2.1.3.B. Other Occupancies
- Restaurant, not 24 hr: 125 L/d

- Design peak day flow:
  - 125 L/d/seat x 60 seats = 7,500 L/d

- We know this restaurant will not be fully used 7 days per week

2. WEEKLY FLOW PATTERN

- Need information to figure out flow for every day of the week
- Ask questions of the owner to find out :
  - Nearly full on weekends
  - Closed Mon & Tues
  - Lunch only Wed to Fri, 25% of weekend

2. WEEKLY FLOW PATTERN

- Now we create a weekly flow pattern
  - Weekend vs weekday differences shows balancing is likely beneficial

Day of the Week	% of Peak Day	Sewage Volume, L
Monday	0%	0
Tuesday	0%	0
Wednesday	25%	1,875
Thursday	25%	1,875
Friday	25%	1,875
Saturday	100%	7,500
Sunday	100%	7,500

2. WEEKLY FLOW PATTERN

- However, in asking the owner about the future, he says he wants to open for lunch Mon & Tues as well, but no plans for more dinner
- The designer will want to account for this now in the system design
  - Create a 2nd weekly pattern

2. WEEKLY FLOW PATTERN

- Flow pattern including future lunch service on Mon & Tues

Day of the Week	% of Peak Day	Sewage Volume, L
Monday	25%	1,875
Tuesday	25%	1,875
Wednesday	25%	1,875
Thursday	25%	1,875
Friday	25%	1,875
Saturday	100%	7,500
Sunday	100%	7,500

3. CHOOSE BALANCED FLOW

- Balanced flow = $\frac{\text{weekly volume, L}}{\text{7 days}}$

Day of the Week	Current Use	Future Use (open Mon & Tues also)
Weekly Total, L	20,625	24,375
Average Daily Flow over 7 days, L/d	2,946	3,482

Lowest possible design flow

3. CHOOSE BALANCED FLOW

- Design balanced flow is the design flow for everything after the balancing tank, including leaching bed.
- It is the flow pumped out of the balancing tank each day (unless empty)
- As noted in Best Practice, designer can apply a safety factor

3. CHOOSE BALANCED FLOW

- Safety factor (SF) is the amount of extra treatment capacity to account for unknowns or changes in use
- Safety Factor =

$$\frac{\text{chosen design flow, L/d}}{\text{calculated balanced flow, L/d}}$$

3. CHOOSE BALANCED FLOW

- Various approaches:
  - Add a percentage, e.g. 30%
    - 3,482 x 1.3 = 4,527 L/d, round to 4,500 L/d
  - Adjust the weekly flow pattern for an unusual event
    - Assume 3rd day at 7,500 L/d (not 1,875 L/d)
    - 30,000 L/week or 4,286 L/d over 7 days
    - Round up to 4,300 or 4,500 L/d
- Just be sure to state your rationale in your design basis documentation

4. BALANCING CALCULATIONS

- Now estimate minimum storage volume with the balancing calc:

Volume at end of day =
Volume at start of day
+ Flow into tank during the day
– Flow pumped out during the day

4. BALANCING CALCULATIONS

- Do calculation for each day of the week, starting with peak day

Day	Start Vol., L	Flow In, L	Pumped Out, L	Ending Vol., L
Saturday	0	7,500	-4,500	3,000
Sunday	3,000	7,500	-4,500	6,000
Monday	6,000	1,875	-4,500	3,375
Tuesday	3,375	1,875	-4,500	750
Wednesday	750	1,875	-2,625	0
Thursday	0	1,875	-1,875	0
Friday	0	1,875	-1,875	0

5. CHOOSE TANK VOLUME

- Tank volume =
  - Pump Submergence Volume
  - + Minimum Balancing Storage
  - + Emergency Storage

5. CHOOSE TANK VOLUME

- Emergency storage volume is the designer's safety factor
- Many ways to determine emergency storage:
  - Add volume up to peak day
  - Assume no flow out on peak day
  - Add percentage of min. volume
  - Volume equal to response time

5. CHOOSE TANK VOLUME

Method	Resulting Balancing Tank Working Volume for Restaurant Example
Balancing tank can store the peak day volume	7,500 L
Assume there is no flow to treatment on a peak day	Sunday: 3,000 + 7,500 – 0 = 10,500 L
Add an additional percentage amount based on designer's experience	Say 50%, so 6,000 x 50% = 3,000 L 6,000 + 3,000 = 9,000 L
Emergency storage volume equal to response time for service or pump-out	Assume ½ day to get a septic pump truck. Half of the peak day = 7,500 / 2 = 3,750 L 6,000 + 3,750 = 9,750 L

5. CHOOSE TANK VOLUME

- 3 of 4 methods resulted in working volume of 9,000 – 11,000 L
- Choose a standard holding tank size from your local supplier that fits

6. SIZE THE REST OF THE SYSTEM

- BT before septic tank
  - Smallest overall system but BT may accumulate solids, grease & garbage
- BT after septic tank
  - Septic tank pre-treats & collects solids / grease before BT, bit higher cost
- BT after treatment unit (not typical)

7. CHOOSE PUMPS & CONTROLS

- Balancing requires a timer panel !!
  - Set timer to pump the design balanced volume (4,500 L)
  - Audible and visual alarms
  - Remote monitoring?
- Alarm should activate when normal storage is exceeded (6,000 L)
- # of floats & positioning?

7. CHOOSE PUMPS & CONTROLS

- Pumps are typically Alternating duplex for commercial sites
- Does high float or alarm float override pump?

- Also refer to OOWA Best Practice "Pump Chamber Guidance Document"

EXAMPLE #2: WEDDING VENUE

- 350 seat wedding venue
- Peak day: 12,600 L/d @ 36 L/d/seat
- Max. 650 guests per week:
  - 100 weekday business event
  - 200 Friday wedding
  - 350 Saturday wedding
  - Laundry on Sunday

EXAMPLE #2: WEDDING VENUE

- Potentially 65% smaller treatment & disposal compared to peak day

Day	Flow In, L	Flow Out, L	Start of day, L	End of day, L
Thursday	3,600	3,600	0	0
Friday	7,200	4,000	0	3,200
Saturday	12,600	4,000	3,200	11,800
Sunday	2,500	4,000	11,800	10,300
Monday	0	4,000	10,300	6,300
Tuesday	0	4,000	6,300	2,300
Wednesday	0	2,300	2,300	0

EXAMPLE #3: SCHOOL

- 332 students plus a new daycare
- Flow for existing students based on historical water use data
- Daycare infants & staff per OBC
- Design flows:
  - Average day: 6,026 L/d
  - Peak day: 13,057 L/d
  - Peak week: 40,175 L/d

EXAMPLE #3: SCHOOL

- Potentially 65% smaller treatment & disposal compared to peak day

Day	Start Vol., L	Added Daily Flow, L	Amount to Treatment, L	Ending vol., L	Balance Tank, % Full
Monday	0	13,057	-6,000	7,057	74%
Tuesday	7,057	6,026	-6,000	7,083	74%
Wednesday	7,083	6,026	-6,000	7,110	74%
Thursday	7,110	6,026	-6,000	7,136	74%
Friday	7,136	6,026	-6,000	7,162	75%
Saturday	7,162	3,013	-6,000	4,175	43%
Sunday	4,175	0	-4,175	0	0%

CONCLUSIONS

- Flow balancing can optimize size, cost and footprint
  - But requires predictable schedule of use & flows
- Designer has latitude to include safety factors to account for unknowns or unusual events
- Read the BP document and provide constructive comments!

QUESTIONS?

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