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Seasonal Flow Equalization Design Guidance

SCOPE - This design guidance is intended to detail the treatment and dispersal solution for a facility with weekly and annually variable flows. The proposal provides a brief background of understandings achieved regarding seasonal flow variances and proposed instrumentation and flow schematics with a "Sequence of Operation" detailing an operational plan with design calculations for sizing. A proposed Operation and Maintenance Plan Summary with contingency options is also discussed.

BACKGROUND - A preliminary investigation of the facility should be performed in order to estimate required capacity and to provide for economic sustainability. For existing facilities, a "draw down test" should be performed to determine the pump system capacity and dose volumes. Pump system counters and elapsed time meter (ETM) records should be kept for a sufficient time (up to a year) to determine usage.

A preliminary engineering proposal should be submitted to the owner and regulatory agency. The understanding with the regulatory agency should be to work toward obtaining a design that upgrades necessary components that do not fit prescriptive solutions in the typical Regulation.

DESIGN PROPOSAL - The design criteria of the treatment and dispersal facility is to include the following:

1. Flow Equalization
2. Secondary Treatment
3. Management of system through alternating gravity drain fields or drip dispersal systems.
4. Monitoring system monthly through peak summer season and quarterly during non-peak.
5. Maximum weekly flow not to exceed stipulated gallons per week.
6. Maximum daily flow not to exceed stipulated gallons per week.
7. Third party maintenance, monitoring and reporting.
8. Contingency plan.
9. Other considerations which may be negotiated during the pre-design meetings.

SEQUENCE OF OPERATION FOR TREATMENT - Wastewater will flow through the primary treatment septic tanks and into the time dosed pump chamber. The "Large Flow Equalization" pump tank will hold several days of peak flow and meter wastewater to the treatment unit at the most appropriate average rate. In the event of a peak flow condition as sensed by the "Peak float" in the Large Flow Equalization pump tank, the control will reduce the rest time to enable the design flow or "Peak" rate to be discharged to the treatment unit. In no event will more than the "Peak Design" flow be allowed to be discharged to the treatment unit.

OPTIONAL ENHANCED CONTROL - This "Large Flow Equalization" pump tank will have "restricted peak capacity". There will be a routine in the PLC (Programmable Logic Controller) controlled pump system that will interrupt the peak flow capacity if the peak float has been enabled for more than two days in any 7 day period (adjustable). This control feature will prevent more than stipulated gallons per week from being discharged. In the event that the Peak Float has been enabled for more than 2 days in any 7-day period, then the controller will operate as in the standard enable mode and dose at the reduced rate to prevent excess flow from being discharged to the drain field.

In the event of excess wastewater being generated and delivered to the Large Flow Equalization pump tank, a high level alarm will sound to notify the owner. The operator should be called to manage this excess flow. There will be however a minimum amount of additional flow equalization capacity above the high level alarm for peak flow management.

GRAVITY DISCHARGE SYSTEMS - Wastewater will discharged from the secondary treatment unit by gravity to the top of the drainfield where it will pass through a flow diversion valve and be directed to either the upper or lower half of the drainfield. (See "Gravity Seasonal Equalization Schematic"). Observation wells will be placed in the uppermost and lowermost trench bottoms of each drain field half to monitor ponding. The operator will monitor ponding depths in the sections under use and determine the appropriate alternating schedule. The resting sequence may be as short as alternating drain fields at each visit or as long as annually for enhanced rejuvenation. In the event that ponding is observed during an operational visit then the diversion valve shall be re-directed to flow to the opposite drain field.

DRIP DISPERSAL DISCHARGE SYSTEMS - Wastewater is discharged from the secondary treatment unit by gravity to the invert of the Drip Dispersal pump tank (See "Drip Seasonal Equalization Schematic"). The Treatment Unit effluent drains into the final dose tank where the drip dispersal pumps periodically dose the drip fields for preset times at preset intervals. The pump control panel is equipped with eight float switches, which control the timed doses to both the pretreatment and drip dispersal system. If the design flow is exceeded for any extended period a high water alarm will sound. If the high water alarm in the final pump tank is activated the treatment unit feed pump will become disabled. This is to prevent the liquid level in the final pump tank from rising due to accumulation excess effluent. If flows are less than designed, the control will halt the pretreatment dose and drip dosing cycles until enough effluent has accumulated for a treatment and/or final disposal dose. This provides resting for the both the absorption area and treatment unit. The dosing time may be altered to accommodate observed variance of historic water use as obtained from the flow meter. The system can be "tuned" for sewage flows at the site to insure that the absorption area is dosed at the proper interval.

SEASONAL FLOW VARIANCES - The Secondary Treatment system shall be constructed using pre manufactured treatment units in two halves (see “Seasonal Equalization Schematic”). The discharge of the "Large Flow Equalization" pump tank shall be delivered through an "H" connection which will allow each pump to deliver to only one treatment unit or the other. This type of connection will allow the operator to take one treatment stream out of service during the very slow off-season while continuing to maintain the duplex pump operation.

The discharge of the Treatment units shall have a bypass valve configuration such that during the seasonal startup of the unused treatment unit, the entire effluent stream can be recirculated back to the pump tank until sufficient water quality is achieved for discharge.

DESIGN CALCULATION EXAMPLE – In our example the data collected shows a wide range of usage annually (300-1750 gpd). The peak season is in the summer from Memorial Day to Labor Day, with holiday spikes such as Easter. The organic loadings tested from 320 mg/L BOD to 700 mg/L BOD. The average BOD sample value was 550 mg/L. Fats, Oils and Grease tested less than 50 mg/L. If the wastewater is sized to treat to a level of 30 mg/L BOD and SS then the treatment process will accommodate the FOG (<30mg/L). The Treatment system is proposed to be sized for 10 pounds of BOD per day maximum design.

DESIGN LOADING EXAMPLE

1750 gpd X 700 mg/L X 8.34 #/gal / 1,000,000 = 10.22 use 10 #/day max BOD

The estimated minimum usage could be as low as 300 gpd at 320 ppm BOD. The design shall provide for the splitting of the flow in half and operate only half the treatment system for winter operation. This will allow the treatment process to still operate at an acceptable capacity. The design capacity of each side would then be 5# BOD. The minimum loading would then be:

MINIMUM LOADING EXAMPLE

300 gpd X 320 mg/L X 8.34 #/gal / 1,000,000 = 0.8 use #/day min BOD

Onsite wastewater treatment systems need to operate over a range of capacity demands. The treatment system for this facility should be specified to handle flows as low as (0.8#/5#) 16%. The dual line capacity will provide for the treatment system to operate one side at 16% of daily design capacity over the winter months. Typically treatment systems operating at somewhat less than this percent of rated capacity will loose substantial water quality.

FLOAT SETTINGS - The tables below show float switch settings and a typical summer peak week flow. The maximum weekly discharge is 8400 gallons. Using a typical 5000-gallon pump tank (13' long X 6' wide X 9' deep inside dimensions) the overall depth is 108 inches (48.6 gpi). Setting the max water height at 8.5 feet provides 102 inches of working Depth.

This example shows that with an empty flow equalization tank on Saturday, the tank can receive in excess of a 6500-gallon weekend event plus a cleanup day and still not exceed the maximum daily flow to the drainfield or the average weekly flow. This is achieved while pumping less than the average daily flow that is proposed to be permitted (1200 gpd).

FLOAT SETTING FOR EQUALIZATION

*Note: Units are inches above bottom of tank.

Storage		1069 gallons above alarm
Alarm	80	
Peak	50	
Enable	22	(disable @ 18)
Off	16	
Bottom	0	

ONE WEEK FLOW EQUALIZATION (Example)

	day	Gallons Influent	Gallons Effluent	Gallons Storage Required	18 inch Minimum water level
1	Sat	3050	1000	2050	60
2	Sun	1950	1750	2250	64
3	Mon	1550	1750	2050	60
4	Tue	750	1000	1800	55
5	Wed	0	1000	800	34
6	Thu	500	1000	300	24
7	Fri	600	900	0	18
	Weekly Gal.	8400	8400		

OPERATION AND MAINTENANCE SCHEDULE EXAMPLE

The peak season for the restaurant in this example is from Memorial Day to Labor Day. The O&M frequency should be monthly from the middle of May (a time to prepare system for peak season) through the first weekend of September. During this four-month period the operator should visit the site monthly to check operation, usage and the condition of the trenches.

Starting in May the operator can startup the resting treatment system and recirculate 100% of its' effluent in order to acclimate the process. Then after Memorial Day, place it on-line for the peak season. Through August the operator should perform monthly visits. After this peak season the operator should visit once in December and once in late February. The operator in consultation with the restaurant owner can determine when to reduce capacity for the winter. This plan would give four monthly visits in a row for the peak summer season and two quarterly visits thereafter.

The third party operator should inspect the system for being in good repair, check trenches for ponding and inspect water quality for clarity, color and suspended solids content. If the water quality looks and smells like secondary effluent, then there should be no need to sample. The operator should report to the regulatory agency the calculated flows based on counters and ETM's along with the status of the trenches and the general system condition. Annual BOD tests may be required for reporting the treatment system's ability to achieve secondary quality effluent.

The pretreatment septic tanks in series will perform as grease traps in addition to primary settling and typical septic tank pre treatment. These tanks should still be pumped on a regular basis in order to prevent kitchen FOGs from degrading the performance of the selected treatment system. Pumping of the tanks should be coordinated with the operator and owner and done in consideration of the peak flow weekends. Additionally this will help minimize peak flow events.

CONTINGENCY PLAN

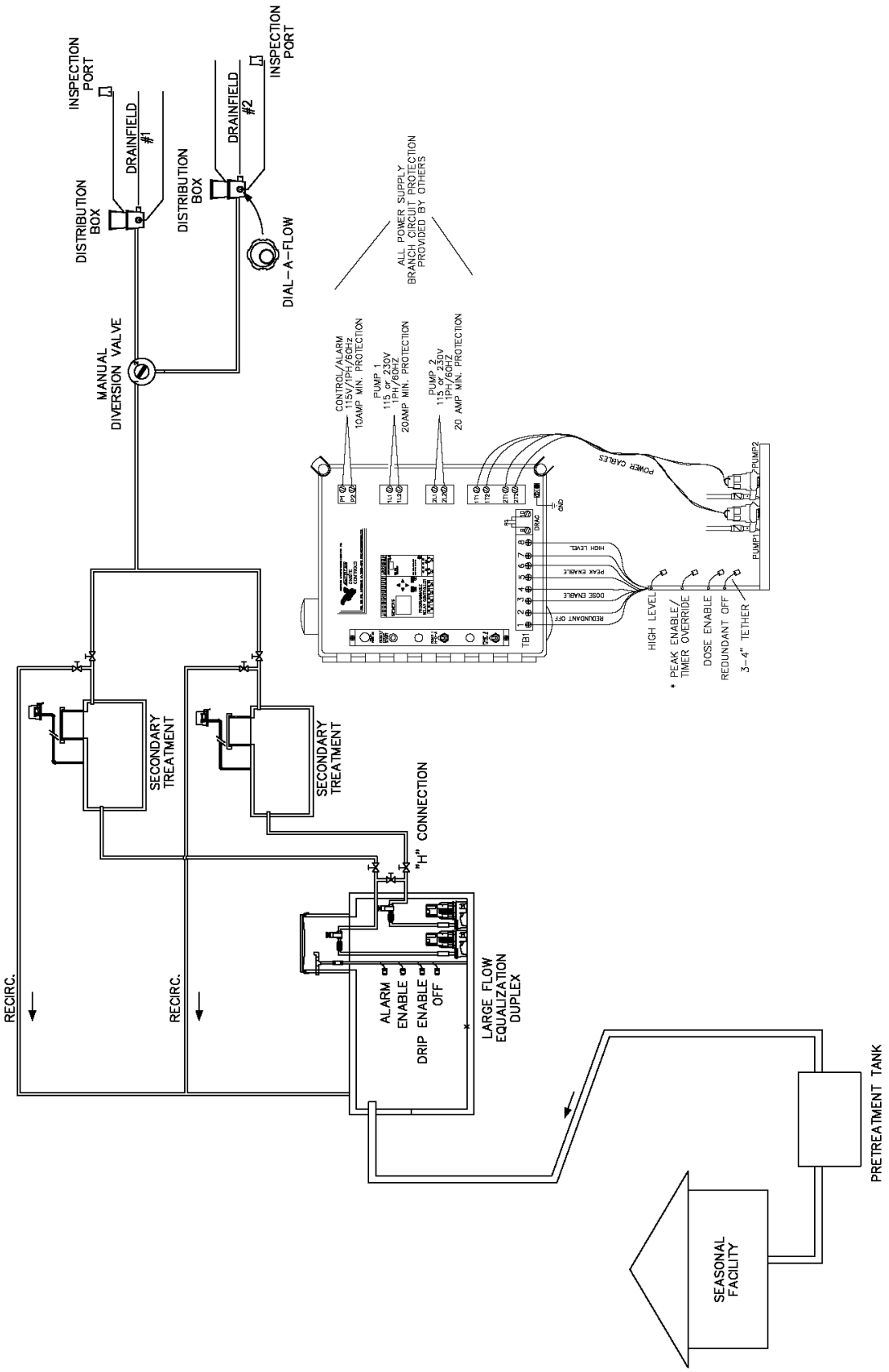
The facility could be a commercial restaurant, convenience store or bingo parlor, which is servicing the local or tourist population for convenience and recreation. In the event of a catastrophic surface failure the facility can be shut down to address the situation. This proposed design should be inherently stable and a catastrophic failure would be highly unlikely.

With regular operational monitoring and maintenance, typical wastewater treatment system situations can easily be dealt with. In the event of a pump failure, the controls may be operated as simplex systems giving time to repair the pump. There is storage for excess peak flows. In the event of a serious malfunction, which will take time to repair, pumping of the tanks will allow the facility to temporarily remain in operation. Regular pumping of the "grease traps" is still necessary.

In the event of excessive ponding of the trenches, the owner should be informed and reduced flows should be achieved by changing operation and/or adjusting the days closed in conjunction with an increase in monitoring frequency. Further, if a major malfunction occurs such as extreme ponding of the trenches or catastrophic mechanical failure and continued temporary pump and haul is required, then the owner should apply for a temporary pump and haul permit from the regulatory agency. The duration of this permit should be evaluated at that time in consultation with an engineer.

SEASONAL EQUALIZATION SCHEMATIC GRAVITY

Instrumentation & Flow Schematic



SEASONAL EQUALIZATION SCHEMATIC DRIP

Instrumentation & Flow Schematic