

**NORTH CAROLINA DEPARTMENT OF ENVIRONMENT
AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL HEALTH
ON-SITE WASTEWATER SECTION**

INNOVATIVE WASTEWATER SYSTEM APPROVAL

INNOVATIVE WASTEWATER SYSTEM NO: IWWS-2004-01
FOR: Flow Equalization System

APPROVAL DATE: July 6, 2004

In accordance with NCGS 130A-343 and 15A NCAC 18A .1969, a flow equalization system has been found to meet the standards of an innovative system and is approved for use, subject to the conditions of this innovative approval. A notice of this proposed approval has been published in the North Carolina Register and the Department has received public comment on the application for over 30 days after the date of publication in the Register. This approval, including the specifications of circumstances in which use of a flow equalization system is appropriate and conditions and limitations related its use, reflects the Department's consideration of all public comment received.

I. Permitting:

Flow Equalization systems may be used for *non-residential* facilities that regularly and predictably operate at less than full capacity. Examples of applicable facilities include:

- Churches,
- Schools,
- Offices,
- Flea Markets, and
- Stadiums

Other facilities may be permitted for flow equalization when specifically approved by the State on a case-by-case basis.

This approval does not include flow equalization prior to pre-treatment devices.

The local health department shall issue an Improvement Permit or Construction Authorization allowing for the use of the proposed innovative system upon a finding that all provisions of this approval and all other applicable rules shall be met. The Construction Authorization shall contain conditions regarding the design, installation, and use of the flow equalization system. The Operation Permit shall specify system components, requirements for O&M, and restrictions on operation of the facility.

Use of flow equalization in systems that have a design flow exceeding 3000 gallons per day or when the criteria of this innovative approval are proposed not to be followed may be considered for review and approval by the State on a case-by-case basis, prior to permitting by the local health department.

II. Flow Equalization Terms:

- a. Equalized Daily Flow (EQ) - The total volume of wastewater generated by flow events at the facility during the flow equalization cycle divided by the number of days in the cycle.
- b. Flow Equalization Cycle – The time period in which wastewater will be stored and dosed. Ex. 7day cycle, 14 day cycle, etc.
- c. Flow Event – An event in the flow equalization cycle in which wastewater will be generated. Ex/ church service, sporting event, day of operation, etc.
- d. Orifice Control Device – A calibrated flow restriction placed in the supply line prior to the nitrification field that allows the flow to be controlled.
- e. Flow Balance – A daily account of the amount of stored effluent in the equalization tank which is derived from the incoming flow, residual storage, and the outgoing flow. The flow balance shows the day of the week, the amount of wastewater generated, the amount of wastewater dosed, and the residual amount of effluent left in the dosing tank each day. At the end of the flow equalization cycle, the sum of the incoming flow should equal the sum of the amount dosed.

III. System Description:

- a. Minimum pretreatment by septic tank and effluent filter as required in 15A NCAC 18A .1952.
- b. Grease Trap as required in 15A NCAC 18A .1955(k)
- c. Equalization/Pump Tank
- d. Timer Control Panel
- e. Pump
- f. Pressure Manifold, LPP distribution system, other pressure dispersal devices, or an Orifice Control Device when serial distribution is utilized
- g. Nitrification Field

IV. Siting Criteria:

The Flow Equalization System with timed dosing may be utilized on sites that meet the following criteria.

- a. Sites classified suitable or provisionally suitable in accordance with rules .1939 .1948;
- b. Sites reclassified provisionally suitable in accordance with Rule .1956;
- c. Sites meeting the criteria for low pressure pipe systems in accordance with Rule .1957(a)(2); or

- d. Sites meeting the criteria for Innovative Systems set forth in Rule .1969, or other sites meeting the requirements for systems specifically approved by the State.

V. System Sizing and Design Criteria:

- a. Septic Tank & Effluent Filter: The septic tank and effluent filter shall be designed and constructed in accordance with Rule .1952, .1953, and .1954 and sized in accordance with .1952 (b) (2) where “Q” is the largest projected 24 hour waste flow in the flow equalization cycle.
- b. Grease Traps: The grease trap shall be designed and constructed in accordance with Rules .1952, .1953, .1954 and .1955 (k)(3) and (k)(4). Grease traps at churches with kitchens shall be sized at a minimum of 1 gallon/seat [in the dining area]. The minimum liquid capacity of any grease trap shall be 1,000 gallons.
- c. Equalization/Pump Tank: The pump dosing tank shall be sized to allow for:
 - i. Pump submergence: Effluent volume that covers the pump and the motor housing, or in accordance with pump manufacturer’s suggestions, but in no case shall less than 12 inches of effluent remain in the tank at all times. The pump intake shall be at least 5” from the interior bottom of the tank;
 - ii. Minimum Dose Volume: Minimum dose required based on the size of the nitrification field (see below);
 - iii. Equalization Volume: The highest cumulative volume of effluent as indicated by the flow balance calculation;
 - iv. High-Water Level Alarm: The high-water alarm shall be set to activate at or above the equalization volume; and
 - v. Emergency Storage Volume: Effluent volume that equals Q as defined in V(a).
- d. Pump: In addition to the applicable requirements of 1952(c)(2), (3) and (4) the pump shall be sized to deliver the minimum required flow at the total dynamic head. The pump shall also deliver a flow that meets or exceeds a scour velocity of 2 feet/second, using $Q = (V) (2.45d^2)$, where V = scour velocity = 2 feet/second and d = inside pipe diameter in inches. The minimum delivery rate at a residual operating pressure of 2 feet shall be at least:
 - i. 13 GPM for 1-½ inch Sch 40 pipe,
 - ii. 21 GPM for 2 inch Sch 40 pipe,
 - iii. 46 GPM for 3 inch Sch 40 pipe
- e. Control Panel: The control panel shall meet State approval and meet the specifications set forth in Rule .1952 (c)(6) with the additional requirements of:
 - i. High-water level alarm event counter
 - ii. Timer over-ride counter

- iii. Pump event counter
- iv. Pump elapsed time meter
- v. Magnetic motor contactor
- vi. HOA switch
- vii. Control circuit fuse
- viii. Alarm circuit fuse
- ix. Float switch terminal block
- x. For each pump, either a:
 - Programmable timer with variable controls for setting the on and off times from .05 seconds to 30 hours, or
 - a repeat cycle timer that afford the amount of control needed for pump run time and off time.
- xi. Circuit breaker for each pump
- xii. Circuit breaker for the alarm /control circuit
- xiii. NEMA 4X Alarm strobe beacon
- xiv. NEMA 4X Alarm Horn (83 decibels @ 3' minimum) w/ auto reset
- xv. NEMA 4X Exterior Horn Test/ Normal/Silence Switch
- xvi. Ground lug
- xvii. 2 Lockable Hasps or one lockable hasp & 2 captive screws opposite the hinges of the NEMA 4X enclosure
- xviii. Pump Run light

Controls shall require the pump enable float switch to be activated (minimum dose volume present) before the start of any pump cycle. Cycles shall be shut off by the run timer or the low-water cut-off float (not by deactivation of the enable float).

Approved flow equalization panel models shall be listed on the On-Site Wastewater Section web page. (<http://www.deh.enr.state.nc.us/oww>).

- f. Alternating duplex or sequencing multiplex pumps are required for any system with 3000 gallons or more per any 24-hour flow period ($Q > 3000$ gallons), the system requires 2000 linear feet or more of nitrification line, or the equalized daily flow is 1500 gallons or greater. The control panel shall meet the additional requirements of .1952 (c)(7) and include a programmable timer for each pump. The control panel shall be designed to sequence dosing events between pumps. The HOA switches in duplex and multiplex panels shall enable the operator to shut off one or more fields with the fields remaining in service dosed automatically, sequentially and uniformly.
- g. Remote alarms and telemetry may be specified on a system-specific basis.
- h. The control panel shall be mounted within 10 feet of the pump tank and at a height to allow the Operator in Responsible Charge (ORC) to easily adjust and observe the timer control device and other appurtenances of the control panel (e.g., center of box to be 3 to 5 feet above finished grade).

- i. Pressure manifold, low-pressure pipe distribution or drip distribution shall be required for all flow equalization systems. Serial distribution may be used for retrofitting existing serial distribution systems if the effluent flows through an orifice control device before the flow becomes gravity (orifice shall be minimum of 3/4-inch for 1-1/2-inch supply line, 1-inch for 2-inch supply line in order to achieve minimum 2-fps scour velocities). An accessible turn-up with a threaded cap and regulating valve shall be provided prior to the orifice control device to allow regulation of the flow (note: do not adjust flow to be less than necessary to achieve 2-fps scour velocity).
- j. Floats: The following floats shall be provided and shall meet the requirements of Rule .1952 (c)(5)
 - i. A low - level / redundant-off switch shall prevent the pump from running in the event the level in the tank is below the pump intake.
 - ii. A timer-enabling switch shall be set at or above the pump submergence level and shall not allow for partial doses.
 - iii. A high-level alarm shall activate after the equalization volume is exceeded. If there is a controlled delay before alarm activation, the delay shall be no more than 5 minutes. After being silenced, the alarm horn shall automatically reset and shall be audible with each high level event. The alarm event counter shall record each activation of the alarm.
 - iv. A timer override switch located at or above the alarm shall dose no more than a designed dose event to the drainfield. The alarm shall re-activate at each override event. The timer override float may be integral with the alarm float.

Other sensor devices may be utilized as approved by the State but must meet all four float actions.

- k. Dosing Volume: The dosing volume shall be calculated based on the size of the nitrification fields and the number and frequency of the dosing events desired per day. The minimum and maximum pump run times shall be in accordance with pump manufacturer's recommendations. The dosing volume shall be calculated based on 40 to 80 percent of the drainline pipe volume for conventional systems and 5 to 8 times the lateral volume for low-pressure pipe or drip systems.
- l. Drain field: The equalized daily flow (EQ) shall be calculated by adding the design daily flow for each event as determined by Rule .1949 in the flow equalization cycle and then dividing by the number of days in the cycle. Under this approval, the maximum number of equalization days is 14 unless otherwise approved by the State on a case by case basis. The nitrification field shall be sized by dividing the equalized daily flow (EQ) by the LTAR as determined in .1955, .1956 and 1957.

Example #1 (Church):

Assume: 200-seat church with a kitchen. The daily design flow is 5 gallons/seat. The site has a clay (Group IV) soil. The church has services on Sunday and Wednesday with extracurricular events (weddings, reunions, suppers, etc.) on Saturdays. Sunday attendance: 200 members; Wednesday attendance: 100 members and Saturday events: 200 members.

<u>Day</u>	<u>Attendance</u>	<u>Daily Flow</u>
Sunday	200 members	1000 gallons
Wednesday	100 members	500 gallons
Saturday	200 members	<u>1000 gallons</u>
Weekly Total:		2500 gallons

Equalization cycle is 1 week (7 days)

Equalized Daily Flow: 2500 gallons/7 days = 358 gallons/day

The drainfield is sized for a daily waste flow of 358 GPD.

Trench bottom area is: 358 gpd/0.25 LTAR = 1432 ft².

Linear footage: 1432 ft²/3 feet wide trenches = 477 ft.

Dose Volume: 179 gallons (58% of 4" corrugated drainline capacity)

Flow Balance:

<u>Day</u>	<u>In</u>	<u>Out</u>	<u>Residual</u>
Saturday	1000 gal.*	358 gal.	642 gal
Sunday	1000 gal.	358 gal.	1284 gal.**
Monday	0	358 gal	926 gal.
Tuesday	0	358 gal	568 gal.
Wednesday	500	358 gal	710 gal
Thursday	0	358 gal	352 gal
<u>Friday</u>	<u>0</u>	<u>358 gal</u>	<u>0</u>
Total:	2500 gal.	2506 gal	0 gal

Pump Tank Sizing

Assuming a pump height of 18" and a tank with 30 gallons per inch:

Pump submergence volume = 540 Gallons

Dose Volume = 179 Gallons

Equalization Volume = 1284 Gallons **
 Emergency Storage Volume = 1000 Gallons *(highest daily flow)
 Adding the volumes yields a required dosing /equalization tank volume of 3003 Gallons.

Dosing Regime: 179 gallons every 12 hours. Given a measured pump delivery rate of 40 gpm, the repeat cycle timer would be set at 4.5 minutes “on” and 12 hours (or 11.9 hours) “off”.

Example #2 (Day School):

Assume: 200-student day school (no food service or gym). The daily design flow is 10 gallons/student. The site has a clay (Group IV) soil. The school has classes Monday through Friday

<u>Day</u>	<u>Attendance</u>	<u>Daily Flow</u>
Monday	200 students	2000 gallons
Tuesday	200 students	2000 gallons
Wednesday	200 students	2000 gallons
Thursday	200 students	2000 gallons
Friday	200 students	<u>2000 gallons</u>
Weekly Total:		10,000 gallons

Equalization cycle is 1 week (7 days)

Equalized Daily Flow: 10,000 gallons/7 days = 1429 gallons/day

The drainfield is sized for a daily waste flow of 1429 GPD.

Trench bottom area is: 1429 gpd/0.3 LTAR = 4763 ft².

Linear footage: 4763 ft²/3 feet wide trenches = 1588 ft.

Dosing Volume: 714.5 gallons (69% of 4” corrugated drainline capacity)

Flow Balance:

<u>Day</u>	<u>In</u>	<u>Out</u>	<u>Residual</u>
Monday	2000*	1429 gal	571 gal.
Tuesday	2000	1429 gal	1142 gal
Wednesday	2000	1429 gal	1713 gal
Thursday	2000	1429 gal	2284 gal
Friday	2000	1429 gal	2855 gal**
Saturday	0	1429 gal.	1426 gal
Sunday	0.	1429 gal	0 gal.
Total:	10,000 gal.	10,003 gal	0 gal

Pump Tank Sizing

Assuming a pump height of 20" and a tank with 125 gallons per inch:

Pump submergence volume = 2500 Gallons
Dosing Volume = 715 Gallons
Equalization Volume = 2855 Gallons **
Emergency Storage Volume = 2000 Gallons *(highest daily flow)
Adding the volumes yields a required dosing / equalization tank volume of 8070 Gallons.

Dosing Regime: 714.5 gallons every 12 hours. Given a measured pump delivery rate of 62 gpm, the repeat cycle timer would be set at 11.5 minutes "on" and 12 hours (or 11.8 hours) "off".

Example #3 (Flea Market):

Assume: A 200-vendor flea market with 25,000 square feet of covered floor space (120 gpd/1000 sq.ft. of covered floor space). The site has a clay (Group IV) soil. The flea market operates on Friday, Saturday, and Sunday.

<u>Day</u>	<u>Daily Flow</u>
Friday	3000 gallons
Saturday	3000 gallons
Sunday	3000 gallons
Weekly Total:	9000 gallons

Equalization cycle is 1 week (7 days)

Equalized Daily Flow: 9000 gallons/7 days = 1286 gallons/day

The drainfield is sized for a daily waste flow of 1286 GPD.

Trench bottom area is: 1286 gpd/0.3 LTAR = 4287 ft².

Linear footage: 4287 ft²/3 feet wide trenches = 1429 ft.

Dosing Volume: 429 gallons (46% of 4" corrugated drainline capacity)

Flow Balance:

<u>Day</u>	<u>In</u>	<u>Out</u>	<u>Residual</u>
Friday	3000 gal.*	1286 gal.	1714 gal
Saturday	3000 gal.	1286 gal.	3428 gal
Sunday	3000 gal	1286 gal	5142 gal**
Monday	0	1286 gal	3856 gal.
Tuesday	0	1286 gal	2570 gal.
Wednesday	0	1286 gal	1284 gal
Thursday	0	1286 gal	0 gal
Total:	9000 gal.	9002 gal	0 gal

Pump Tank Sizing

Assuming a pump height of 20" and a tank with 125 gallons per inch:

Pump submergence volume = 2500 Gallons

Dosing Volume = 429

Equalization Volume = 5142 Gallons **

Emergency Storage Volume = 3000 Gallons *(highest daily flow)

Adding the volumes yields a required dosing / equalization tank volume of 11,071 Gallons.

Dosing Regime: 429 gallons every 8 hours. Given a measured pump delivery rate of 50 gpm. The repeat cycle timer would be set at 8.6 minutes "on" and 8 hours (or 7.86 hours) "off".

VI. Installation and Testing Procedures:

- a. A pre-construction conference shall be required to be attended by the system designer, installer, local health department, licensed soil scientist and registered professional engineer, as applicable, prior to beginning construction of the flow equalization system.
- b. The septic tank, dosing tank, risers, and pipe penetrations shall be demonstrated to be watertight by a 24-hour leak test (no measurable leakage in 24 hours). The test shall be run with risers and inlet/outlet pipes installed.
- c. Care shall be taken during system installation to prevent extraneous debris from entering the tanks, supply lines or distribution network. Supply lines, manifolds and orifice control devices shall be flushed out prior to system startup.
- d. A pump delivery rate shall be measured and the timer control device adjusted according to the measured delivery rate to achieve the equalized daily flow. The time dosing control panel manufacturer's recommendations shall be followed for system start-up. The timer control device shall be setup per the system design specifications in accordance with the measured pump delivery rate by the operator in responsible charge (ORC). All floats, counters, meters, timers, and alarms shall be tested for functionality. If needed the control panel manufacturer's representative shall be present during system start-up.
- e. All other mechanical components, pump(s), pump cycling, filters, etc., as applicable must be demonstrated to be fully operable in accordance with their design.

VII. Operation, Maintenance and Monitoring Requirements

- a. System management entity shall be comparable to a Type V system in Rule .1961(b), Table V (b). Inspection/maintenance and reporting frequency requirements shall be as (unless more frequent visits are required based on the pretreatment or effluent distribution system and specified in the Operation Permit):

<u>Equalized Flow</u>	<u>ORC Insp. Interval</u>	<u>LHD Insp. Interval</u>
<1500 gpd	2/year	1/year
1500 – 3000 gpd	4/year	1/year
3000 – 10000 gpd	12/year	1/year
> 10000 gpd	1/week	1/year

If telemetry is provided and the ORC response time is 2 hours or less per the maintenance contract, the inspection frequency may be reduced as follows (unless more frequent visits are required based on the pretreatment or effluent distribution system and specified in the Operation Permit):

<u>Equalized Flow</u>	<u>ORC Insp. Interval</u>	<u>LHD Insp. Interval</u>
<1500 gpd	1/year	1/year
1500 – 3000 gpd	2/year	1/year
3000 – 10000 gpd	6/year	1/year
> 10000 gpd	1/14 days	1/year

- b. The Operator in Responsible Charge (ORC) shall provide monitoring reports to the local health department within 30 days of each required inspection. The ORC shall maintain a log of all malfunction incidences/notifications, observations, maintenance activities, and meter readings of pump run events, pump run times, override events, and high-level alarm events at each visit. Minimum maintenance during each required inspection shall include visual observation of the drainfield, checking/cleaning filter screen(s), measuring delivery rate, and recording flow meter reading, pump run times, cycle counts, high-level events, and water meter readings where applicable. At least once per year, orifice control devices shall be flushed, pressure head measurements made, and solids accumulation in the tanks shall be measured and recorded. Necessary adjustments to timer settings shall be pre-approved by the local health department, and adjustment times noted in the monitoring log and reports.
- c. The ORC shall also conduct other additional observations, measurements, monitoring, and maintenance activities as specified in the Operation Permit and as recommended by the timer control panel manufacturer.

VIII. Responsibilities and Permitting Procedures:

- a. An application for a Flow Equalization system shall include everything as required in Rule .1937 and at least the following information:
 - i. A floor plan of the facility with a plumbing fixture schedule,
 - ii. Days of operation,
 - iii. Frequency of regular and special events,
 - iv. Number of employees,
 - v. Number of people in attendance at events,
 - vi. Trips per day,
 - vii. Parking capacity,
 - viii. Building code occupancy limits for the structures, and
 - ix. Any other information required to calculate an accurate design flow.

- b. All systems shall be designed by a North Carolina registered professional engineer; local health department authorized agent or by an individual with advanced pump system training. The system shall be designed by a professional engineer when:
 - i. pretreatment components have not received prior state approval, or
 - ii. daily event flow (or Q) is 3,000 gallons per day or greater, or
 - iii. duplex pumps are otherwise required per Rule .1952 (duplex pumps are required if linear footage of nitrification trenches exceeds 2000 feet) or this approval (equalized daily flow is 1500 gallons per day, or greater),
 - iv. when either the septic tank or equalization tank volume exceeds 6000 gallons, or
 - v. at any site proposed for flow equalization if so specified by the local health department.

When required, plans and specifications shall be prepared, reviewed and approved in accordance with Rules .1938 (e) and (f).

- c. Prior to the issuance of an Authorization to Construct for a Flow Equalization system with time dosing, site specific plans and specifications shall include:
 - i. Septic tank, effluent filter, grease tank (if applicable), and dosing tank specifications including the specification that all tanks shall be state approved.
 - ii. Preparation of a Flow Balance spreadsheet.
 - iii. Level sensing devices (float) elevation (feet above sea level or in relation to the interior bottom of the tank) detail showing redundant “off”, timer enable, high-level “on” and timer over-ride settings.
 - iv. Specific plans and specifications for the control panel, with preliminary pump run time and pump off time specified.
 - v. Effluent Pump specifications: (gpm @ TDH).

- vi. Flow specifications for the distribution device (Pressure manifold, LPP network, drip network, or orifice control device if serial distribution is used).
- d. The system shall be installed by a contractor who is registered to install systems in the county of the installation. The contractor shall coordinate the installation with the designer and the local health department.
- e. Prior to issuance of an operation permit a contract for operation and maintenance shall be executed between the system owner and an ORC as required in accordance with Rule .1961(b). A condition of the operation permit shall be that a contract for operation and maintenance with an ORC shall remain in effect for as long as the system is to remain in use.
- f. The Operation Permit shall contain conditions such as:
 - 1. Maximum flow (includes)
 - i. Equalized Daily Flow
 - ii. Flow Equalization Cycle
 - iii. Flow Event
 - 2. Number of events per equalization period,
 - 3. Limitations on attendance or usage of the facility,
 - 4. Hours of operation,
 - 5. Number of days between events,
 - 6. Initial timer settings,
 - 7. Measured pump delivery rate,
 - 8. Other contingencies such as a contract with a certified pumper, and
 - 9. The Operator in Responsible Charge may reset the timer settings only after approval from the Local Health Department.
- g. For systems required to be designed by a professional engineer or by an individual with advanced pump system training, the designer must certify in writing that the system was installed in accordance with the approved plans and specifications prior to Operation Permit issuance.

IX. Repair of System:

The provisions of 15A NCAC 18A .1961 shall govern the use of the Flow Equalization System for repairs to existing malfunctioning wastewater systems.

Approved by: _____

Date: _____