NORTH CAROLINA DEPARTMENT
OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL HEALTH
ON-SITE WATER PROTECTION SECTION

INNOVATIVE WASTEWATER SYSTEM APPROVAL

INNOVATIVE WASTEWATER SYSTEM NO: IWWS-2000-2R

ISSUED TO: Geoflow, Inc.
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FOR: Geoflow's Subsurface Drip System

APPROVAL DATE: August 29, 2000
May 17, 2007

In accordance with 15A NCAC 18A .1969, an application by Karen Ferguson, Geoflow, Inc., of Corte Madera, California, for modification to the approval of their subsurface wastewater drip system has been reviewed, and the system has been found to meet the standards of an innovative system when the following conditions for use, monitoring and operation are met:

I. System description:

a. Collection system: conventional gravity, pressure sewer fed by grinder pumps or individual septic tank effluent pumping units.

b. Pretreatment: Aerobic System: DEH-approved Pressure Dosed Sand Filter, Peat Biofilter, Aerobic Treatment Unit, or approved equal.

c. Filtration: Automatic, appropriately sized self-cleaning screen filter(s) or disc filters capable of screening particles larger than or equal to 130 microns.

d. Manifold: Common line (Schedule 40 PVC) to connect all the dripline in a single field at the start of the field and the distal ends of the dripline (flush end).

e. Air vent: Air Vacuum Breaker(s) installed at the high point(s) of each dripfield to keep soil from being sucked into the drip emitters due to back siphoning or backpressure.

f. Dripline: Geoflow's Wasteflow PC dripline with pressure-compensating emitters spaced uniformly in the tubing (24-inch, 18-inch, 12-inch, or 6-inch centers). The tubing consists of three layers; the inside layer is an anti-bacterial protector, the middle layer is black and the outside layer is purple-striped for easy identification. The emitters are impregnated with Treflan® to inhibit root intrusion.

g. Field flushing valve: An automatic valve used to enable accumulated debris and sediment to be flushed from the dripline back to the pretreatment unit.

h. System Controls: Control/software package controlling all functions, including filter flushing, system dosing and flushing, audible/visible alarms, and for larger systems, telemetry (> 600 gpd), and flow monitoring and self diagnostics (>3000 gpd) capabilities.

II. Siting criteria:

a. The Geoflow Subsurface Drip System may be utilized on sites that meet the following criteria:

i. Sites classified suitable or provisionally suitable in accordance with Rules .1939-.1948;

ii. Sites reclassified to be provisionally suitable in accordance with Rules .1956(1), (2), (4), (5) or (6a);

iii. Sites meeting the criteria for low pressure pipe systems in accordance with Rule .1957(a)(2); or

iv. Sites meeting the criteria for new or existing fill, in accordance with Rule .1957(b). The system is considered a fill system when all or part of the drip tubing shall be installed in fill material. For existing fill systems, the minimum vertical separation distance between the drip tubing or installed trench bottom and any soil wetness condition or any soil horizon unsuitable as to soil structure, clay mineralogy, organic soil, rock or saprolite shall be 18 inches.

b. Required vertical separation requirements shall be measured from the bottom of the drip tubing, or the installed trench bottom, whichever is deeper. All reductions in vertical separation allowed in the Rules and for other Approved Systems, including for Advanced Pretreatment systems approved in accordance with Rule .1970, based on the use of low pressure pipe or drip distribution systems shall apply (per recommendation of an NC Licensed Soil Scientist, as applicable).

c. The minimum horizontal setback requirements of Rule .1950(a) shall be met, except as allowed for in conjunction with an Advanced Pretreatment System as allowed pursuant with Rule .1970.

III. System sizing:

a. The following table shall be used in determining the long-term acceptance rate (LTAR) for the Geoflow Subsurface Drip System. The LTAR shall be based on the most hydraulically limiting soil horizon within 18 inches of the naturally occurring ground surface or to a depth of one foot below drip tubing, whichever is deeper.

Soil Group	Soil Textural classes (USDA classification)	Soil Textural Classes (USDA Classification)	LTAR (area basis) (gpd/ft^2)*
I.	Sands (with S or PS structure and clay mineralogy)	Sand Loamy Sand	1.0 - 0.6
II.	Coarse Loams (with S or PS structure and clay mineralogy)	Sandy loam Loam	0.6 - 0.4
III.	Fine Loams (with S or PS structure and clay mineralogy)	Sandy Clay Loam Loam Silt Loam Clay loam Silty Clay Loam Silt	0.4-0.15
IV.	Clays (with S or PS structure and clay mineralogy)	Sandy Clay Silty Clay Clay	0.15-0.05

***In conjunction with an approved Innovative, Controlled Demonstration, or Experimental Pretreatment System meeting TS-I or TS-II performance standards or better, the same LTAR may be used as would apply to an LPP system as long as all the conditions of the Innovative, Controlled Demonstration, or Experimental Approval for the pretreatment system are met, including the requirements for a site-specific hydraulic assessment, which may allow use of higher LTARs than those delineated in this table. These reductions shall apply to area only, and not to the required total linear feet of tubing. The linear feet of tubing shall be maximized utilizing reduced tube spacing as the site and this Innovative Approval permit. The minimum zone size and linear feet of tubing in each zone shall also adhere to the manufacturer's recommendations.**

When any reductions are taken in vertical separations or horizontal setbacks pursuant to the use of a TS-I or TS-II system approved in accordance with Rule .1970, the long-term acceptance rate shall not exceed 0.6, 0.4, 0.15 and 0.10 gallons per day per square foot for Soil Groups I, II, III, or IV, respectively.

b. The following table shall be used in determining the LTAR for Geoflow Subsurface Drip Systems installed in saprolite pursuant to Rule .1956(6). The LTAR shall be based on the most hydraulically limiting, naturally occurring saprolite to a depth of two feet below the drip tubing.

Saprolite group	Saprolite Textural Classes	Saprolite Textural Classes	LTAR *(areal basis)* (gpd/ft^2)
I.	Sands	Sand Loamy sand	0.6 - 0.4 0.5 - 0.3
II.	Loams	Sandy Loam Loam Silt Loam	0.4 - 0.25 0.3 - 0.2 0.20 - 0.07
III*	Fine Loam	Sandy Clay Loam	0.10 – 0.05

*Use of Group III Saprolite requires TS-I or TS-II pretreatment

c. In calculating the minimum number of square feet for the drainfield, the design daily sewage flow rate shall be

divided by the long-term acceptance rate determined from the appropriate table, above

d.. In calculating the minimum length of drip tubing to be used, the total square footage of drainfield as derived in Section III(c) shall be divided by two feet.

IV. Design criteria:

a. Pretreatment:

The drip emitter system shall be preceded by a pretreatment process designed to reduce the wastewater biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations to a maximum of 30 milligrams per liter (mg/1), each. This level of pretreatment may be achieved by properly designed Aerobic Treatment Units (ATUs) approved in accordance with Rule .1957(c), Approved Innovative Pretreatment Systems, or approved equal.

b. Dosing tank:

i. The dosing tank and dosing system shall meet the design and construction criteria of Rules .1952-.1954, except that the minimum liquid capacity shall not be less than the total liquid capacity of the septic tank that would be required for this system.

ii. Level control floats in the dosing tank shall be adjustable and replaceable from the ground surface without requiring entrance into the tank.

iii. The requirement for a separate high water alarm that is audible and visible by system users shall be met, in conjunction with any required self monitoring features of the Geoflow system.

c. Pumps:

Unit shall include effluent rated high head submersible pump(s), or effluent rated suction lift self-priming centrifugal pump(s), in accordance with Rule .1952(c)(2). For a suction lift pump, the intake pipe shall contain a screen and foot valve as specified by Geoflow, Inc. Pump, controls, intake pipe and screen, as applicable, shall be easily accessible by the system operator for routine operation, maintenance, monitoring and servicing.

d. Filters:

Self-cleaning filter(s) capable of screening particles larger than or equal to 130 microns shall be used. Self-cleaning process shall be automatic. Geoflow Filters, or approved equal, shall be used. Filter flushing residuals shall be pumped into the upstream end of the pretreatment system, with provisions made to minimize disturbance of any solids in the septic tank or settling chamber (where applicable). Filter number and size shall be at least as necessary to have flow rate during both irrigation and flushing conditions to be within filter manufacturer-specified acceptable operating range.

e. Geoflow processing and control unit:

i. Controls shall provide for delivery of designer-specified preprogrammed volumes of effluent to each field zone (adjustable and variable between zones) at designer-specified time intervals (flow equalization); automatic flushing of integral unit filters (filter flushing), initiated by a timer (adjustable duration); automatic flushing (at least weekly) of the drip laterals (field flushing) with filtered effluent for designer-specified duration; and monitor pump cycles and run times (for each pump and field zone) and flow (with totalizing flow meter, or equal). For systems designed for over 3000 gallons per day, controls shall also monitor alarm conditions (high water, power outage), flow volume to each zone and flow variance indication when flow is + or - 20% of design.

ii. Controls and float levels shall be synchronized to assure the minimum dose is available prior to initiating a dosing cycle to a zone or subfield. Minimum dose volume per zone shall be set as needed so that at least 80-percent of each does is delivered when the minimum pressure in the field network is at least 10 pounds per square inch (pipe-full conditions). This shall be approximated by using five times the liquid capacity of the drip laterals plus the liquid capacity of the supply and return lines (only the portions which drain between doses), unless a smaller volume is field determined to meet this performance criteria. For example, the minimum dose-time can be field-determined as follows:

-When zone is "dry", measure the time from pump-start until the Top of Return pressure is >10 psi. This time shall be designated "Ti". Also measure the total gallons it took to reach 10 psi. This "fill" volume is designated "Gi"
-Determine minimum additional dose time, as: (4xGI)/(irrigation flow rate) = "Tf"
-Total adjusted minimum dose time can be reduced to "Ti" plus "Tf", and adjusted dose volume is 5x "Gi"

Minimum automatic field flushing volume per zone shall be <u>two</u> times the liquid capacity of the drip laterals plus the liquid capacity of supply and return and manifold lines that drain between doses.

Unless alternately provided with the Advanced Pretreatment System, the drip system control panel shall enable the daily, 7-day and 30-day monitoring requirements of Rule .1970 to be met, such as by data logging the field dosing times or field flow meter readings.

iii. Duplex pump dosing system shall be provided whenever the design flow rate exceeds 3000 gallons per day or when the total length of drip lines exceeds 10,000 feet.

iv. A telemetry system shall be provided for systems with a design flow greater than 600 gallons per day, whereby the operator shall be notified immediately of alarm conditions (high water and power outage). In addition for design flows greater than 3000 gpd the operator shall be notified immediately of flow variance (+/-20%). Telemetry system and alarm shall include automatically rechargeable battery backup power supply

v. Floats, pump and control circuits, and the control panel shall meet the requirements of Rule .1952(c). Panel and control equipment shall include lightning protection, be protected from unauthorized access, and remain accessible at all times to the system operator.

f. Geoflow Subsurface Drip System Field Design (See Section VII for designer responsibilities):

i. The field network shall utilize 16mm, 18mm, or 20mm nominal size WASTEFLOW PC polyethylene dripline containing bactericide incorporated into the inner lining and Treflan® root intrusion inhibitor bound into the pressure-compensating emitters. Manufacturer guarantees roots shall be effectively inhibited by this product for a minimum period of ten years. Pressure compensating emitters shall be spaced uniformly along the dripline on a maximum of two foot centers and designed to deliver 0.53 or 1.02 gallons per hour per emitter (+ or - 5%) at internal tubing pressures of 7 to 60 pounds per square inch.

ii. Individual drip lines shall be designed and installed level, following the naturally occurring ground contour (allow maximum variance of + or - two inches within any linear segment), on two-foot centers. In order to keep all laterals on-contour, lines or portions of lines may be installed on greater than two-foot centers, requiring additional total application area. Minimum spacing between laterals may also be reduced to 1-1/2 feet for short segments as needed to avoid field obstructions. Furthermore, laterals may be spaced uniformly on less than 2-foot centers to handle site-specific situations, as long as the total area requirement remains unreduced. Solvent welded heavy duty nonperforated flexible PVC pipe shall be used to connect the supply and return manifolds with the driplines, or to connect common driplines

installed at varying depths or locations (e.g.: in stepdowns or to connect looped drip line segments). The connection lines shall be made to the driplines by solvent welded Geoflow compression adapters or Geoflow Lockslip fittings, or approved equal. Connection lines shall be conveyed over earthen dams constructed at least 2-inches higher than the driplines served, to retain effluent in the lines at the end of each dose cycle.

iii. The field shall consist of a minimum of two separately and automatically dosed and valved zones whenever the total length of dripline exceeds 5000 linear feet, or as otherwise needed to meet irrigation and/or flushing requirements.

iv. The hydraulic design shall be based on achieving the following conditions:

- No more than a 10 percent variation in flow between any individual emitters anywhere within a separately dosed zone, including any drain back.

- When the slope exceeds 10 percent, check valves shall be used in the supply and return manifolds, or other acceptable means identified to minimize disproportionate amount of drainage into the lowest area of the zone.

- Maintenance of scour velocity of at least 1.2 feet per second in the supply line from the dosing tank to the beginning of the drip field during normal dosing cycles.

- Maintenance of flushing velocities of at least 1.2 feet per second in each supply manifold segment during field flushing, and maximum flushing velocities less than 10 feet per second in each supply and return manifold segment.

- Minimum pressure in the dripline of 10 pounds per square inch during flushing flows and a maximum of 60 pounds per square inch during normal dosing flows.

- Maintenance of flushing velocities of at least one foot per second at the distal end of each dripline during field flushing, with valving provided to enable flushing velocities of at least two feet per second at the distal end of each dripline to be achieved with manual flushing.

v. Field appurtenances include an air vent at the high point(s)/outlet of each zone; check valve at the high point/outlet of each zone (when there are more than one zone); solenoid valve with separate isolation valves on each side at the low point/inlet to each zone (or by an appropriate alternative method which enables all valves to be serviced without effluent discharge from supply/return lines); cleanout at each end of the supply and return manifolds; a separate cleanout at the distal end of the supply line to each zone; and pressure monitoring fittings at the field inlet and outlet points and at both ends of the supply and return manifolds. The operator must be able to service all solenoid valves and air vents and check pressures without effluent discharging from the network in preparation for these maintenance/testing procedures. Valves and cleanouts shall be provided with protective vaults or boxes.

V. Installation and Testing Procedures:

a. A preconstruction conference shall be required to be attended by the systems designer (Geoflow-authorized), installer (Geoflow-authorized), local health department, and licensed soil scientist and registered professional engineer, as applicable, prior to beginning construction of the Geoflow Subsurface Drip System and any associated pretreatment system components.

b. Dosing tank and septic tank shall be demonstrated to be watertight by a 24-hour leakage test (maximum of 1/2-inch rise or fall in 24 hours) or vacuum test. Test shall be run with risers/and inlet/outlet pipes in place.

c. Drainfield area shall be prepared in a manner that minimizes site disturbance. No equipment shall cross the field areas during rainfall events, or when the fields are above field capacity (□too wet to plow□). Lightweight equipment only shall be used to remove trees, roots, and rocks, with hand incorporation of select fill material used to eliminate weak spots where roots or boulders must be removed. Field shall be prepared as needed to enable a grass cover to be established and maintained prior to line installation.

d. Field laterals shall be staked out by use of an engineer's or laser level and tape to assure conformation with natural contours and design requirements for sizing, location and separations. Maximum drip line depth shall be in accordance with permit conditions.

e. When a trencher is used, trench bottoms shall be hand cleaned and drip tubing shall be secured to the center of the trench bottom prior to backfilling.

f. Fields shall be installed in accordance with manufacturer's recommendations for each site. A vibratory plow, static plow or trencher is most typically used and soil moisture must be dry enough so that soil compaction will not occur.

g. Minimum soil cover over drip tubing shall be six inches, to finished grade. Cover material shall be free of rocks or debris. Minimum depth of valves in protective vaults or boxes shall be at least 18 inches below grade.

h. Extreme care must be taken during system installation to assure no extraneous debris enters the tankage, supply lines, and drip line network. Supply lines and manifolds shall be flushed out prior to system startup.

i. Manufacturer's recommendations shall be followed for system startup. All leaks in pipe network or from emitters exhibiting excessive emission rates as evidenced by wet spots during dosing cycles comparable to normal operating conditions shall be repaired. Normal dosing and flushing flow rates and flushing pressure at the ends of each zone supply and return manifold shall be measured and determined to be in accordance with design criteria.

j. Fields shall be finished graded to shed surface water and in a matter which facilitates easy maintenance with standard mowing equipment. Provisions shall be made to establish and maintain a vegetative cover so as to prevent erosion and to allow for effective system inspection.

k. All mechanical components, pumps, pump cycling, filters, flushing, high water alarm and telemetry systems, as applicable, must be demonstrated to be fully operable in accordance with their design.

VI. Operation, Maintenance and Monitoring Requirements:

a. System management entity, inspection/maintenance and reporting frequency requirements shall be comparable to at least Type V(a) systems in Rule .1961(b), Table V(b), except that the maximum inspection interval for systems shall be quarterly for the first year of operation. During the first operational inspection after system start-up, a Geoflow appointed representative will meet with the Operator in Responsible Charge (ORC) and the property owner. In the event any system is found to be out of compliance, Geoflow will assist in development of an action plan to bring the system back in compliance. The maximum inspection/maintenance/inspection frequency shall revert to quarterly for a period of one year after a system found to be out of compliance is repaired.

b. The ORC shall provide monitoring reports to the health department which include a log of all malfunction incidences/notifications and maintenance activities. Minimum maintenance during each required inspection shall include visual observation of the dripfield(s), checking/cleaning filter(s), measured dosing flow rate to each zone and recording of flow meter reading, pump run times and cycle counts. Flushing flow rates and pressure head measurements during flushing at the inlet and outlet of each field zone shall be taken at least once per year.

c. For systems with a design flow rate of over 600 gallons per day, the operator in responsible charge (ORC) shall be telemetrically notified of high water and power outage. For systems with a design flow rate of over 3000 gallons per day, the ORC shall also be telemetrically notified of flow variance (+ or – 20%) and catastrophic failure (+or– 50%) conditions.

d. The ORC shall also conduct other additional observations, measurements, monitoring, and maintenance activities as specified in the Operation Permit and as recommended by the manufacturer of the Geoflow system and as required for any applicable advanced pretreatment system that may also be present.

VII. Responsibilities and Permitting Procedures:

a. All systems shall be designed by a professional engineer or by individuals authorized in writing by Geoflow, Inc.. The system shall be designed by a professional engineer when pretreatment components have not received prior state approval, when the approved treatment system requires a professional engineer, when the system design flow exceeds 600 gpd, or when duplex pumps are required in accordance with section IV(e)(iii) above. Plans and specifications shall be prepared, reviewed and approved in accordance with Rules .1938(e) and (f).

b. The system shall be installed by a contractor authorized in writing by Geoflow's appointed representative, who shall coordinate the installation with the designer and the manufacturers appointed field representative. Geoflow's appointed field representative and designer shall provide written confirmation of their acceptance of the system installation prior to operation permit issuance.

c. 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), who is authorized in writing by the manufacturer to operate and maintain the system. 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.

VIII.Repair of System:

The provisions of 15A NCAC 18A .1961(c) shall govern the use of the Geoflow Subsurface Wastewater Drip System for repairs to existing malfunctioning wastewater systems.

Approved by:_____Date:_____