

**GUIDELINES FOR DESIGN
INSTALLATION & OPERATION
OF
SMALL FLOW SEWAGE TREATMENT FACILITIES**



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**Department of Environmental Protection
Bureau of Water Quality Protection**

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Commonwealth of Pennsylvania
Department of Environmental Protection

SMALL FLOWS FACILITIES DESIGN MANUAL

The attached Small Flows Facilities Design Manual has been prepared as a guide for persons responsible for the design, installation and operator of small flows sewage treatment (<2000 gpd) of facilities. The manual is also available to download from the DEP web site at: www.dep.state.pa.us.

The manual may be revised from time to time as the need arises. If you have suggestions for improvement to this manual or desire that future revisions be sent to you, please return this letter to us with the following completed information.

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Send to: Chief, Permits Section
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DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF WATER QUALITY PROTECTION

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Authority Act 537 of 1966, the Pennsylvania Sewage Facilities Act (as amended), and the Clean Streams Law (35 P.S. §§691.1-691.1001) 25 PA Code Chapter 91.

Policy: To improve and preserve the purity of the waters of the Commonwealth for the protection of public health, animal and aquatic life and for recreation.

Purpose: To amend and clarify the existing 8/91 guidance regarding the design and construction of domestic wastewater treatment facilities.

Applicability: This policy provides minor amendments to the 1/1/92 guidance regarding the design and construction of small flow treatment facilities.

Disclaimer: The policies and procedures outlined in this guidance are intended to supplement existing requirements. Nothing in the policies or procedures shall affect regulatory requirements.

The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of DEP to give the rules in these policies that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

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Definitions: Sewerage System: A system of sewage collection, conveyance, treatment and disposal which will prevent the discharge of untreated or inadequately treated sewage or other wastes into waters of the Commonwealth or otherwise provide for the safe and sanitary treatment and disposal of sewage.

Small Flow Treatment Facility: An individual or community sewerage system designed to adequately treat sewage flows not greater than 2,000 gpd.

I. INTRODUCTION

The purpose of this Manual is to provide guidelines for the design, installation and operation of Small Flow Sewage Treatment Facilities (SFSTF). These facilities are intended to serve single family residences, duplexes and small commercial establishments with domestic type sewage (BOD consistent with Appendix A) not exceeding 2000 gallons per day. For new building sites small flow sewage treatment facilities are used to serve residential dwellings only if on-lot systems cannot be used (See 25 Pa. Code, Chapter 71, Section 71.64). For small commercial establishments with domestic type sewage they may also be used only to repair or replace malfunctioning systems. Small flow treatment facilities must be capable of producing an effluent suitable for discharge without violating NPDES permit limits or polluting groundwaters of the Commonwealth. They may not be used to discharge to any stream which is rated as Exceptional Value under Chapter 93 and may only discharge to High Quality Streams when used to repair a malfunctioning system.

The treated sewage from a small flow treatment facility may be discharged to a stream, dry stream, or applied to land by spray irrigation. A number of sewage disposal alternatives for small flow situations exist and should be evaluated in the following order of preference.

1. Connection to a public sewer system.
2. On-lot disposal system.
3. Treatment facility with spray irrigation.
4. Treatment facility with stream discharge.
5. Treatment facility with dry stream discharge.

Small flow treatment facilities may only be used when on-lot disposal systems do not and cannot be expected to function satisfactorily because of soil, geologic and groundwater conditions.

Approval in the form of a permit (or permits where discharge to surface waters is involved) must be obtained from the Department prior to construction. Before any permits are issued sewage planning approval is also required. This manual will assist you in preparing the necessary information for your submission(s) to the Regional Office of the Department which serves the County in which the project is located. Department staff is available to assist you should any questions arise.

IF YOU DECIDE TO PURSUE INSTALLATION OF A SMALL FLOW SEWAGE TREATMENT FACILITY, YOU SHOULD KNOW THAT THE APPROVAL PROCESS IS VERY TIME CONSUMING. IT IS HIGHLY RECOMMENDED THAT YOU ALLOW AMPLE TIME FOR YOU TO SECURE NECESSARY APPROVALS.

II. PROCEDURE FOR APPROVAL

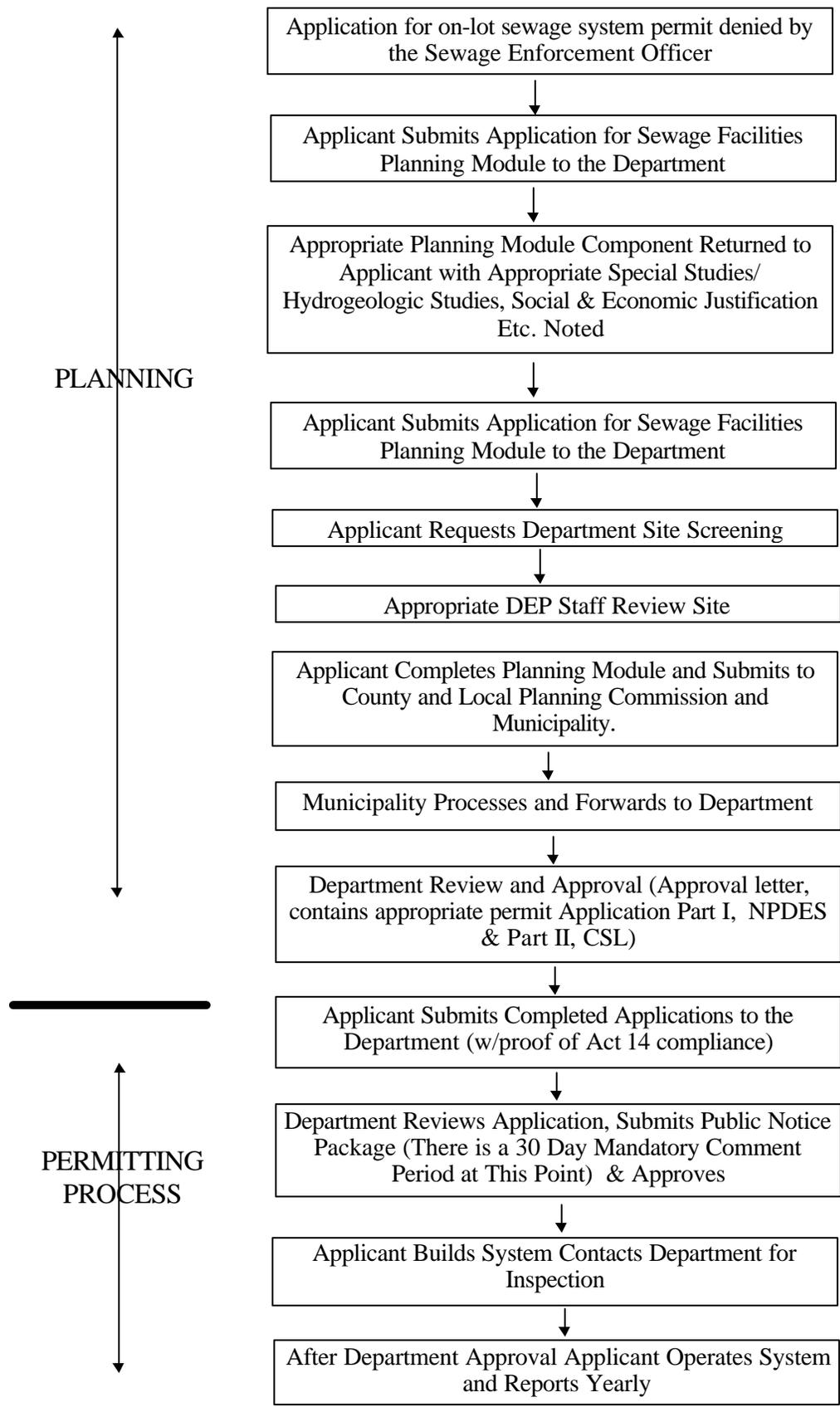
THE DEPARTMENT MUST APPROVE THE SPECIFIC PROJECT AND ISSUE PLANNING APPROVALS AND THE APPROPRIATE PERMIT(S) BEFORE THE FACILITY IS CONSTRUCTED AND OPERATED.

The first step in this process is the approval of the proposed method of sewage disposal by the municipality as a revision to its Official Sewage Plan. The Department must review and approve this revision. If Department approval has not already been obtained, the applicant may initiate the process by completing an Application For Sewage Facility Planning Module (Application) (see back page of this manual) and returning it to the local or Regional Office of the Department as instructed on the Application. The planning for a small flow facility can take as long as 180 days from the time the complete module is submitted to the municipality for processing.

At the planning stage, the project sponsor must show the municipality and the Department the site meets the minimum suitability requirements and that adequate assurances that the system will be properly operated and maintained are in place. (See Chapter 71, Sections 71.64 and 71.72).

Once conceptual planning is approved, permit(s) to construct and operate the system are required. A National Pollutant Discharge Elimination System (NPDES) Permit for Discharge and a Water Quality Management (WQM) Permit for design, construction and operation of the facility must be obtained from the Department. The WQM Permit application must be prepared by a professional engineer registered in Pennsylvania. Permit applications may be obtained by contacting the Regional Office of the Department. See the next page for a chart which more fully explains the approval processes.

SMALL FLOW SEWAGE TREATMENT FACILITY APPROVAL PROCESS



III. DESIGN REQUIREMENTS

A. GENERAL

1. A small flow treatment facility must be capable of continuously producing a suitable effluent without causing water pollution or public health nuisances. Minimum (30 day average) treatment requirements for any discharge is 25 mg/l C-BOD₅ and suspended solids of 30 mg/l with effective disinfection. Since this is a minimum, however, some streams, dry streams, or spray sites may have more stringent effluent limits. These are determined by the Department as part of the approval process. The technology utilized must be relatively fail safe and simple to operate and maintain by an unskilled individual. (General Design details are found in Appendix B.) All SFSTF's must include, at minimum, an initial treatment unit, (septic tanks system or aerobic treatment tank), a buried sand filter, disinfection unit (erosion chlorinator and contact tank), and a discharge unit (outfall sewer or spray field).
2. The design capacity for the small flow treatment facility shall be based on the following:
 - a. A single family residence shall be designed based on a minimum flow of 400 gpd and a minimum organic load of 1.02 lbs. BOD₅ per day for a residence with three bedrooms or less; the flow shall be increased by 100 gpd and the organic load shall be increased by 0.34 lbs. BOD₅ per day for each additional bedroom over the minimum. The flow indicated provides for the use of garbage grinders, automatic washing machines, dishwashers and water softeners.
 - b. Single family residences served by a community sewage system, and apartments or non-residential establishments served by an individual or community sewage system shall be designed based on flows and organic loads as noted in Appendix A for the type of facility to be served. Actual flow data obtained by daily record keeping or metering for any establishment indicating peak daily flows over a one year period may be accepted in lieu of the estimated sewage flows listed in Appendix A. For non-residential establishments, 200 gpd is the minimum volume used in calculating the size of the small flow treatment facility.
3. All piping for a SFSTF must be marked NSF-Drain - Waste-Vent (DWV). Only liquid wastes, including kitchen and laundry wastes and water softener backwash, shall be discharged to the small flow treatment facility. Roof gutters, foundation drainage, surface runoff and cooling water shall not discharge to the small flow treatment facility; nor shall such discharges be permitted to flow over any underground treatment units.
4. A properly sized exterior grease trap is required for pretreatment of kitchen waste from a restaurant or any other commercial kitchen where small flow treatment system is used.
5. Good water conservation practices are important in minimizing the volume of wastewater requiring treatment, ensuring the availability of adequate water supplies in the future, and reducing energy costs. Water conservation fixtures (e.g. 1.6 gallon flush toilets, faucet and shower flow restrictors and front loading washing machines) must be provided for any new buildings.
6. The small flow treatment facility shall be located where it is readily accessible for inspection and maintenance.
7. Visual and audible type alarms are mandatory for mechanical equipment, such as aerobic treatment units, pumps, etc. to alert the responsible individual in the event of malfunction. These alarms, when electrically operated, must be connected to a circuit separate from the circuit serving the alarmed equipment or device.

8. The following minimum horizontal isolation distances shall be maintained between all components of the small flow treatment facility and the features itemized. Where conditions warrant, greater isolation distances may be required.
 - a. Property line, easement or right-of-way - 10 feet
 - b. Occupied buildings, swimming pools and driveways - 10 feet
 - c. Individual water supply or water supply system suction line - 50 feet. (A water supply suction line shall never pass under a building sewer.) The discharge point for the small flow treatment facility must be at least 100 feet away.
 - d. Water supply line under pressure - 10 feet (including building sewer).
 - e. Streams, watercourses, lakes, ponds, delineated wetlands or other surface waters - 25 feet (The discharge pipe need not be isolated from the receiving water body.)
9. The small flow treatment facility shall not be located where:
 - a. The area is identified by-completed Federal Flood Insurance mapping as a floodway.
 - b. Completed flood mapping is not available but the soil has been mapped or identified as floodplain soil or a floodprone area.
 - c. The area has been delineated as a wetland; however, a discharge to a wetland may be considered by the Department.
10. If the small flow treatment facility is located in an area identified as flood fringe by Federal flood insurance mapping, an encroachment permit may be required.

B. BUILDING SEWER

1. FUNCTION.

To convey the wastewater from the building served to the small flow treatment facility.

2. SPECIFICATIONS.

- a. Building sewers shall be constructed of a durable material acceptable to the Department (DWV schedule 40 or better) and as specified by local plumbing or building codes.
- b. When the average daily flow of sewage from an establishment is 1000 gallons or less, all building sewers shall be at least three inches in diameter (or larger if specified by local plumbing or building codes). When the average daily flow exceeds 1000 gallons per day, all building sewers shall be at least six inches in diameter (or larger if specified by local plumbing or building codes).
- c. Cleanouts shall be provided at the junction of the building drain and building sewer.
- d. Cleanouts shall be provided every 50 feet on solids carrying lines of four-inch diameter or less, and every 100 feet for larger pipes.

- e. House or building sewers should be installed with as straight alignment as possible. Bends ahead of the small flow treatment facility shall be limited to 45° or less where possible. If 90° bends cannot be avoided, they shall be made with two 45° bends. A clean-out shall be provided at each change of direction in solids carrying lines.
- f. The grade of the building sewer shall be at least 1/8 inch per foot; however, the grade of the ten feet of building sewer immediately preceding the small flow treatment facility shall not exceed 1/4 inch per foot.
- g. All building sewers shall be constructed with watertight joints and shall be of sufficient strength to withstand imposed loads.
- h. The building sewer shall be installed to allow continuous venting of any underground treatment tank through the main building stack unless otherwise specified by local plumbing or building codes.

C. RAW SEWAGE PUMPING

1. FUNCTION:

- a. To lift wastewater from the source to the small flow treatment system.
- b. Pumping of raw sewage should be avoided if possible due to potential clogging, added maintenance and electrical usage.

2. TYPE OF UNIT:

The pump should be designed for pumping of sewage or sewage effluent. In some instances grinder pumps may be necessary.

3. CAPACITY:

The pump shall have a discharge rate, at design head conditions, of at least two times the estimated peak flow but not less than five gallons per minute.

4. ALARM FEATURE:

When a lift station is used, an alarm system (audible and visual) to indicate sewage level in excess of maximum height in the wet well must be provided. The alarm system shall be on a separate electrical circuit from the pump circuit.

5. WET WELL:

The minimum storage capacity of the wet well shall be 50 gallons in order to accommodate normal peak flows and emergency storage during a short power outage. The pump must be capable of being serviced without dewatering the wet well.

6. VALVES:

Check and shut off valves shall be used to isolate the pump from the wet well and force main.

7. LOCATION:

If the pump unit is installed outside the structure served, provisions must be made for access, as well as protection from weather and vandalism. Inside installations shall be quiet and free from electrical and/or health hazards and shall be certified by nationally recognized independent testing laboratories, such as the Underwriter’s Laboratories, Inc. and the National Sanitation Foundation.

8. VENTILATION:

The wet well must be properly vented to the outside. Inside installations must be completely air tight and vented to avoid buildup of odorous and hazardous gases. The completed installation shall be pressure tested prior to operation.

9. FORCE MAIN:

The force main piping associated with the pump unit(s) shall have water tight joints, and meet or exceed DWV schedule 40 specifications.

D. SEPTIC TANK(S)

1. FUNCTION:

To provide the initial treatment of sewage by the removal of settleable and floatable solids, and anaerobic bacterial decomposition of stored sludge.

2. CAPACITY:

- a. The required septic tank capacity shall be provided through use of a multiple chamber septic tank or two septic tanks connected in series.
- b. The minimum liquid capacity of a septic tank system for any installation shall be 900 gallons.
- c. For a single family residence, the minimum capacity of a septic tank system shall be based on the number of bedrooms in the dwelling as shown in the following table:

NO. OF BEDROOMS	MINIMUM TANK CAPACITY (gallons)
3 or less	900
4	1250
5	1400

- d. The minimum capacity of a septic tank system for other than a single family residence shall be calculated from the following table and estimated sewage flows listed in Appendix A.

DESIGN FLOW (gallons per day)	MINIMUM TANK CAPACITY (gallons)
0-400	900
400-500	3.5 x flow exceeding 400 gpd) + (900)
500-2000	(1.50 x flow exceeding 500 gpd) + (1250)

- e. An outlet baffle device to reduce suspended solids in the septic tank effluent must be provided on each tank or compartment.

3. CONSTRUCTION:

- a. Tanks shall be watertight and constructed of sound and durable material not subject to excessive corrosion or decay.
 - (1) Precast concrete tanks shall have a minimum wall thickness of two and one-half inches and be adequately reinforced.
 - (2) Precast slabs used as covers shall have a thickness of at least three inches and be adequately reinforced.
 - (3) Tanks shall not be constructed of blocks, bricks, or similar masonry construction.
 - (4) Steel tanks shall meet United States Department of Commerce Standards 177-62.
 - (5) Tanks constructed of polyethylene, fiberglass or similar material may be used, provided that the manufacturer has submitted data to the Department showing that the unit meets design requirements. Installation instructions for stability and puncture protection must be included with the design and each unit sold.
- b. The depth of liquid in any tank or its compartment shall be not less than 3 feet nor more than 7 feet.
- c. No tank or compartment shall have an inside horizontal dimension less than 36 inches. Each tank shall have a length to width ratio not less than 2.5 to 1 nor greater than 3 to 1. The long dimension shall be measured perpendicular to the sides containing the inlet and outlet. Vertical round tanks shall be at least 5 ft. in diameter.
- d. The capacity of the first compartment or tank of a septic tank system shall at least equal the capacity of the second. Tanks or compartments shall be connected in series and shall not exceed four in number in any one installation.

4. INLET AND OUTLET CONNECTIONS:

- a. The inlet invert shall be a minimum of three inches above the outlet invert.
- b. Inlet baffles shall be made using vented tees and shall extend below the liquid level at least six (6) inches. In no case shall penetration of the inlet device exceed that of the outlet device.
- c. The outlet baffles shall extend below the liquid surface to a distance equal to 40% of the liquid depth. Penetration of outlet baffles in horizontal cylindrical tanks shall be equal to 35% of the liquid depth. Outlet baffles from each compartment or tank shall be equipped with a device to deflect buoyed solids (Solids retainer units).
- d. The inlet and outlet baffles or vented tees shall extend above liquid depth to approximately one inch from the top of the tank. Venting shall be provided between compartments and tanks.

5. TREATMENT TANK ACCESS:

Access to each tank or compartment of the tank shall be provided by an opening of at least twenty (20) inches square or in diameter, with a removable cover. The top of the tank containing the manhole or the top of a manhole extension shall not be more than twelve (12) inches below grade level. If access is extended to grade, the access cover shall be airtight. Grade level access covers shall be secured by bolts, or a locking mechanism or have sufficient weight to prevent access by children. If access is not extended to grade the location of the manhole shall be permanently marked at grade.

The ground shall slope away from any access extended to grade level.

6. INSPECTION PORT:

A maximum four (4) inch diameter inspection port with sealed cover shall be installed to grade level above the inlet and outlet.

When access openings of at least 20 inches square or in diameter and meeting all other requirements in §5, Treatment Tank Access, are provided over the inlet and outlet baffles, additional manholes and the inspection ports in §(6) are not required.

E. AEROBIC TREATMENT TANK

1. FUNCTION:

Provides for aerobic biochemical stabilization of sewage by bacteria (i.e. reduction of BOD₅ and suspended solids) through the mechanical introduction of air into the sewage during the detention period provided in the aeration unit.

2. LIMITS OF USAGE:

Local conditions may limit the use of an aerobic treatment unit under the following circumstances:

- a. Where intermittent use will adversely affect the functioning of the aerobic treatment unit.
- b. Where dependable maintenance service is not available.
- c. Where electrical service is unreliable.
- d. Where the waste characteristics are stronger than normal domestic sewage (e.g. restaurants, bakeries, etc.).

3. CAPACITY

- a. The rated treatment capacity of an aerobic treatment tank shall be specified by the manufacturer. Said manufacturer's data shall be in conformance with the approved test sequence and protocol provided under the following section entitled Testing and Approval.
- b. Minimum liquid and organic capacity of an aerobic treatment unit utilized for a single family residence shall be in accordance with the following table

NO. OF BEDROOMS	CAPACITY OF UNIT (gallons)	ORGANIC LOAD (lbs./day)
3 or less	400	1.02

4	500	1.36
5	600	1.70

- c. Aerobic treatment units to serve establishments other than a single family residence shall have sufficient capacity to accommodate the estimated daily hydraulic and organic loading in accordance with Appendix A but in no case shall the manufacturers rated treatment capacity be less than 400 gpd.

4. TESTING AND APPROVAL

Aerobic treatment units shall comply with one of the following testing and approval requirements.

- a. Aerobic treatment units serving a single family residence or an establishment with flows of 1500 gpd or less shall bear the seal of the National Sanitation Foundation (NSF) indicating testing and approval by that agency under Standard No. 40; or
- b. Aerobic treatment units serving establishment with flows exceeding 1500 gpd shall:
 - (1) Have NSF Certification under Criteria C-9;
 - (2) Have performance data certified by NSF under the provisions of that agency's standard Performance Evaluation Method; or
 - (3) Have performance data certified by a testing agency other than NSF using test procedures equivalent to that of NSF Criteria C-9 or Standard Performance Evaluation Method.
- c. The testing agency and the testing procedures specified in subsection b(3) of this section must be approved by the Department prior to commencement of the test.
- d. Manufacturers, retailers or other persons seeking approval of aerobic treatment units under subsection b(1), b(2) or b(3) of this section shall submit to the Department for its approval two (2) copies of the complete test procedures and results conducted by the testing agency certifying that such units proposed for installation meet or exceed either Class I or Class II Effluent Standards as established in NSF Standard No. 40.
- e. Electrical and Mechanical Components
 - (1) Electrical components and all wiring shall comply with the requirements of the National Electrical Code.
 - (2) Mechanical components, such as motors, pumps, grinders, compressors and aerators, shall be of sufficient capacity to provide adequate treatment and shall be capable of continuous operation with minimal requirements for lubrication and other maintenance. All mechanical components shall be readily accessible for inspection and maintenance.
 - (3) No unit will be designed or constructed in a manner which will allow waste water to discharge from the unit without passing through the full treatment process.

5. DESIGN FEATURES

- a. Multiple aerobic treatment units connected for the purpose of achieving required hydraulic capacity shall only be permitted where such units are connected in parallel. All units shall have equal capacity and receive equal loading/flow.
- b. Every aerobic sewage treatment unit shall be equipped with a visual and audible alarm system which shall be designed to respond to any electrical or mechanical failure or malfunction of the unit or any component. Electrical alarm systems shall be provided with a separate circuit from the alarmed unit or component.
- c. The effluent from an aerobic unit must be subsequently treated by a sand filter and effective disinfection. This requirement is applicable for all aerobic units.

F. DISTRIBUTION SYSTEM.

1. Function - Delivers the effluent from the septic or aerobic tank uniformly over the area of the sand filter for further treatment.
 - a. Dosing Tank
 - (1) Dosing tanks shall be constructed of materials to the specifications outlined in Section D, Septic Tanks.
 - (2) The dosing tanks shall be designed so that the estimated daily flow shall be discharged to the sand filter in two or more doses. Dose volume shall be two times the internal liquid capacity of the delivery pipe, manifold and distribution laterals or 125 gallons whichever is greater.
 - (3) The dosing tanks shall have a minimum liquid capacity equal to two times the designed dose volume.
 - (4) Sufficient space shall be provided for electrical connections and proper pump control operation.
 - (5) All electrical connections must be moisture resistant and must be located outside of the dosing tank proper. If placed in the dosing tank manhole extension an effective moisture seal between the manhole and the dosing tank must be provided.
 - (6) A water tight man hole at least twenty (20) inches square or in diameter, extended to grade, shall be provided for access to the dosing tank. Manhole covers shall meet the specification in Section B "Septic Tanks".
 - b. Dosing Pumps and Siphons
 - (1) The pump or siphon shall be sized to deliver a flow in gallons per minute (gpm) equal to or greater than the combined flows from all discharge holes in the laterals at total dynamic head and shall be rated by the manufacture for handling sewage effluent. An operating head of 0.25 ft. shall be maintained at the terminal end of the laterals. Total dose volume shall fully discharge within 3 to 5 minutes.
 - (2) The intake of the dosing pump shall be at least 12 inches from the bottom of the tank.
 - (3) Pumps shall not be suspended above the bottom of the tank by chains or similar equipment.
 - (4) A disconnect shall be incorporated into the piping within the dosing tank for ease of pump removal. This shall be located so entering the tank to remove the pump is not necessary.

- (5) An effective warning device shall be installed in the dosing tank to indicate failure of the pump or siphon. Warning devices requiring electricity shall be provided with a circuit separate from the pump circuit.
- (6) A siphon may be substituted for a pump where site conditions permit the use of a gravity flow device.
- (7) A copy of the performance curve of the pump or discharge specifications for the siphon to be used shall be included in the design specification attached to the permit application form.
- (8) Where an aeration tank or other batch type treatment process is used which results in a periodic pump discharge from the treatment tank, the discharge mechanism may be substituted for a dosing tank and pump.
- (9) When an establishment produces more than 50% of its total daily flow during a peak flow period, the minimum dose volume shall equal the anticipated flow during that peak period.
- (10) Check valves in the dosing tank or delivery pipe are not permitted.
- (11) All delivery and manifold piping in pump systems shall be sloped to allow drainage back to the dosing tank.
- (12) The low water level in the dosing tank shall be high enough to keep the pump motor submerged at all times.
- (13) When a siphon is used, a ball valve and observation port shall be provided in the delivery line between the dosing tank and the manifold. Access to the observation port and ball valve shall be extended to grade, capped and secured to prevent entry by children.

c. Distribution Manifold

- (1) An unperforated pipe manifold shall be provided to distribute the sewage uniformly to all distribution pipes within the subsurface sand filter.
- (2) The line leading from the dosing tank to the manifold shall be a watertight line, sized to minimize head loss due to friction.
- (3) All bends shall be made with standard fittings. The manifold shall be installed level to provide equal distribution of treatment tank effluent to each line.

d. Distribution Piping

- (1) All piping in the subsurface sand filter system shall be marked N.S.F. Drain waste and Vent (DWV) or equal.
- (2) Distribution and underdrain piping shall be a minimum of three inches in diameter.
- (3) Distribution of effluent to the individual laterals shall be by a central manifold, extending across the surface of the sand filter from the delivery pipe. Laterals of equal length shall be extended from both sides of the manifold.
- (4) The manifold shall feed each lateral from beneath.

- (5) Distribution laterals shall be level.
- (6) Distribution laterals shall be placed from four to six feet on center and from two to five feet from side walls.
- (7) Distribution laterals shall have one (1) one-half inch diameter hole drilled per twenty-five to thirty-six square feet of sand filter surface area. These shall be located in the bottom of the pipe with the final hole in the lateral end cap.
- (8) Discharge holes shall be equal in number and spacing between lateral halves. The ends of the laterals shall be capped.
- (9) A minimum of two distribution laterals shall be provided.

G. SUBSURFACE SAND FILTER

1. FUNCTION:

To provide further treatment of the effluent from the initial treatment unit (i.e. septic tank system or aerobic treatment unit) through filtration and biochemical treatment in the sand media.

2. LOCATION.

- a. A subsurface sand filter shall not be installed in areas where bedrock is encountered, or where the seasonal high groundwater table rises above the bottom of the sand filter unless a concrete bottom and sides are used. Provided, however, that a suitable alternative liner which will prevent sewage exfiltration or groundwater infiltration may be approved by the Department.
- b. A subsurface sand filter shall not be constructed in unstabilized fill.

3. SIZE.

- a. The size of the sand filter shall be determined on the basis of the appropriate application rate and the estimated daily sewage flow in accordance with Appendix A, but in no case shall the sand filter area be less than 300 square feet for either an aerobic unit or dual chamber septic tank with solids retainer units (minimum sewage flow of 200 gpd).
- b. For a single family residence, the minimum sand filter area shall be in accordance with the following table.

NO. OF BEDROOMS	FILTER AREA (SQ. FT.)
3 or less	600
4	750
5	900

- c. When using a small flow sewage treatment facilities as a repair or replacement system to abate a public health hazard at a commercial facility the application rate for effluent shall not exceed 1.50 square feet of filter area per gallons per day.

4. MEDIA.

- a. Gravel (Coarse Aggregate): At least 2 inches of clean gravel or crushed stone shall surround underdrains and distribution pipes. The gravel or crushed stone shall have Type A or C characteristics as described in Pennsylvania Department of Transportation specifications, Form 408, Section 703.3(a) and (b) and uniform size and grading equivalent to A.A.S.H.T.O. No. 3 or 5 or 57. A layer of porous geotextile material (e.g. polypropylene, polyester, nylon) shall be placed on top of both layers of coarse aggregate to prevent migration of soil or sand into the aggregate.

- b. Sand: At least 24 inches of clean sand must be provided. The sand shall meet the following gradation and quality specifications:

Sieve Size	Maximum Percentage Passing Sieve
3/8"	100
No. 4	90-100
No. 30	20-65
No. 100	0-15

The sand shall not contain more than 15% by weight deleterious material as determined by Pennsylvania Test Method No. 510, AASHTO-104 or ASTM-3-88.

- c. The minimum depth of earth cover over the coarse aggregate in all installations shall be 12 inches. Where the top of the aggregate is less than 12 inches from the undisturbed soil surface, the soil cover must extend beyond the filter area by at least three feet on all sides. The soil over the sand filter must be so graded that surface water will runoff, consist of soil suitable for the growth of vegetation, and be seeded to control erosion.

5. UNDERDRAIN PIPING

- a. Underdrain piping shall be layed on a grade of three to six inches per one hundred feet sloped to the outfall pipe.
- b. Underdrain piping shall be positioned between the distribution laterals to maximize effluent travel through the filter sand.
- c. Underdrain piping holes shall be equal or greater in number and size to the distribution piping holes.
- d. Underdrain piping shall have two rows of holes placed at approximately 45 degree angle from each other along the bottom half of the pipe.
- e. The outfall pipe from the underdrain header shall have an anti-seep collar and bentonite clay plug, or a leak proof boot sealed as per manufacturers instructions to the subsurface sand filter liner.

6. FILTER BASE AND LINER

The base of the filter shall be sloped to the underdrain pipe (1% maximum). An impervious liner of hyplon, polyvinyl chloride or polyethylene sheeting of 20 mil thickness or equal must be installed on a tamped earth base to prevent seepage to the groundwater unless a concrete bottom and sides are used. A two inch layer of sand or a layer of 10 oz. porous geotextile material must be provided on each side of the liner to prevent punctures and tears. Seams must be made according to manufacturers specifications.

H. DISINFECTION

1. FUNCTION:

To reduce the concentration of bacteria in the treated effluent for public health and water quality protection.

2. REQUIREMENT:

Disinfection of the effluent is required prior to discharge or spray. Chlorination is the normal method of disinfection. The chlorine residual must be maintained at a range of 0.3 ppm to 1.5 ppm.

3. CHLORINE FEED EQUIPMENT:

- a. Equipment providing for erosion of chlorine tablets is preferred for small discharges, although a hypochlorite solution feeder may be used.
- b. Chlorine shall be applied at the inlet end of the chlorine contact tank.

4. CHLORINE CONTACT TANK:

- a. Volume of the chlorine contact tank must be equivalent to 50% of the estimated daily sewage flow in accordance with Appendix A.

For a single family residence, the minimum capacity of the chlorine contact tank shall be in accordance with the following table.

NUMBER OF BEDROOMS	Minimum Liquid Capacity of the Chlorine Contact Tank
3 or less	200 gallons
4	250 gallons
5	300 gallons

- b. The chlorine contact tank shall be constructed of a durable, impervious material.
- c. Baffles shall be used within the tank to minimize short circuiting.
- d. The chlorine contact tank shall be equipped with a sturdy lockable cover and shall have provision for access to allow maintenance and inspection. **CHLORINE CONTACT TANKS CONTAIN HAZARDOUS GASES AND CONSTITUTE A CONFINED SPACE. THE HOMEOWNER SHOULD NOT ENTER A CHLORINE CONTACT TANK.**
- e. The influent line shall be of a sound, durable material of watertight construction and have a minimum diameter of three inches unless otherwise specified by local plumbing or building codes. The line shall be laid on a firm foundation, sloping toward the chlorine contact tank, at a minimum grade of 1/4 inch per foot. All bends shall be made with standard fittings.

I. OUTFALL SEWER

1. FUNCTION:

To convey the treated sewage to a watercourse, stream, or other discharge point.

2. DESIGN ASPECTS:

- a. The outfall sewer must be extended to a stream or watercourse where streamflow is available for dilution and not terminated in a roadside ditch or swale which is normally dry unless the requirements for hydrogeologic studies in Chapter 71, Section 71.64(c)(3) have been met.
- b. The outfall sewer shall be of a sound durable material (DWV, Schedule 40 or better) and have a minimum diameter of three inches. The outfall sewer shall be laid on a firm foundation sloping toward the point of discharge at a minimum grade of 1/4 inch per foot. All bends shall be made with standard fittings.
- c. An easement for the outfall sewer through other property to reach the receiving stream must be obtained when the stream is not directly accessible.
- d. Consideration shall be given to using a perforated outfall sewer and surrounding the outfall sewer with crushed stone to maximize exfiltration particularly in the summer and fall months when stream flow is reduced.
- e. The treated effluent shall be discharged in such a manner to ensure rapid mixing and dispersion in the receiving stream and minimize potential for human contact.
- f. Encroachment permits for headwalls at receiving streams are require in many cases.
- g. In some cases properly treated effluent may be discharged by spray irrigation. (See Section J, Spray Irrigation, for details). Effluent is conveyed to a spray field through a delivery line from a pumping chamber. There is no true outfall sewer.

J. SPRAY IRRIGATION

1. FUNCTION:

To further treat and use sewage effluent by application to the land surface. The following guidelines have been developed for a small flow sewage treatment facility using spray irrigation only. These design guidelines only apply to residential uses with total flows not exceeding 2000 gpd.

2. MINIMUM PROPERTY SIZE:

This will depend upon required spray area, buffer zones, lot configuration, location of the house, well, etc. In most cases it can be expected that the required property size for a single family residence will be a minimum of 2 acres.

3. SEWAGE TREATMENT PLANT:

- a. Provide a degree of pretreatment equal to or better than 25 mg/l C BOD₅ and suspended solids of 30 mg/l (30 day average).
- b. Provide effective disinfection of treated sewage prior to spray irrigation.
- c. Avoid entry of surface water into treatment plant.

- d. Provide a minimum treated effluent storage capacity of 3 days flow (based upon Appendix A) to allow for cessation of spraying during maintenance services and adverse conditions (heavy rainfall, extreme cold, high winds, deep snow). This may be increased to 7 days for areas where climatic conditions are more severe or when spray fields are located in floodways or flood prone areas..

4. SOILS:

SFSTF Spray irrigation is not permitted on:

- a. Soils with evidence of water table at less than 10" from the surface.
- b. Soils with rock formations at less than 16" from the surface.
- c.. Floodways as mapped by completed Flood Insurance Mapping for the municipality (This does not prevent the installation of a spray field in a floodway as long as the treatment tanks and filters are located out of the floodway).

5. SLOPES:

- a. Opened grassed areas - limited to 8% (unless modified application procedures and rates are used).
- b. Wooded areas - limited to 25%
- c. Agricultural areas-limited to 4% slope.

6. BUFFER ZONES:

In addition to isolation distances in III a.8 (page 6) following minimum horizontal isolation distances shall be maintained from all parts of the spray field. Unusual circumstances may cause the Department to increase this distance.

- a. Property boundaries - 25 feet
- b. Roads/Driveways - 25 feet
- c. Occupied dwellings - 100 feet
- d. Unoccupied buildings - 25 feet
- e. Streams, watercourses, lakes, ponds, delineated wetlands and other surface waters - 25 feet
- f. Wells, springs and other water supplies - 100 ft.
- g. Keep as far as practical, from obvious high use areas such as play areas, picnic area, patios, etc. - 50 ft.
- h. Mine subsidence areas, mine bore holes, or sink holes - 100 feet.
- i. Rock outcrop or identified shallow pinnacle - 25 feet.

7. **SPRAY IRRIGATION SITE:**

- a. Use low trajectory nozzles or other acceptable application methods to minimize misting/aerosol drift.
- b. Divert the upland drainage from the spray site and provide a berm to retain drainage from leaving the spray site in critical locations.
- c. Monitoring well and ground water sampling is not required, although it may be desirable to sample homeowner's and neighbor's private wells occasionally.
- d. Fencing of spray site is highly desirable to limit access by children and animals.
- e. Keep spray area in vegetative cover designed to limit the effects of erosion and provide maximum nutrient uptake. (e.g. reed canary grass; alfalfa etc.)
- f. It is desirable to provide evergreens (trees/bushes) along the downwind side of the spray irrigation site to minimize wind drift.
- g. Spray during period of low use and low traffic using a timer to reduce the chance of contact with animals/people.

8. **SPRAY FIELD APPLICATION RATES**

Application rates for spray field shall be based upon the following table:

Maximum Soil Characteristics	Slope	Application Rate	Spray* Area
Soil greater than 40" deep; shallowest indication of water table at 10" to 20".	<12%	0.25 in/week	(0.5 Ac)
	>12%	0.10 in/week	(1 Ac)
Soil greater than 40" deep; shallowest indication of water table between 20" and 40"	<12%	0.25 in/week	(0.5 Ac)
	>12%	0.25 in/week	(0.5Ac)
Soil 20" to 40", shallowest indication of water table between 20" and 40"	<12%	0.10 in/week	(1 Ac)
	>12%	0.05 in/week	(2 Ac)
Soil 16" to 20"; limiting zone rock formations; no indication of water table to 40"	<12%	0.40 in/week	(0.25 A)
	>12%	0.25 in/week	(0.5 Ac)
Soil 16" to 20"; shallowest indication of water table between 20" and 40"	<12%	0.10 in/week	(1 Ac)
	>12%	0.05 in/week	(2 Ac)
Soil 16 to 20" to rock; 10" to 20" to water table	<12%	0.05 in/week	(2 Ac)
	>12%	0.025 in/week	(4 Ac)

*Based on a residential flow of 400 gpd, the approximate required land area is noted as (Acres)

IV. INSTALLATION

Installation of small flow sewage facilities should be performed by a competent, experienced individual to ensure that the treatment units/structures are constructed in accordance with the guidelines in this Manual and any manufacturer's recommendations.

The Department must be notified prior to construction and at the completion of construction so inspections can be scheduled. All subsurface facilities such as sand filters must be inspected prior to backfilling.

Extreme care shall be exercised in the operation of machinery and vehicles during or after installation to prevent damage to the system.

V. OPERATION & MAINTENANCE

Any person receiving permit(s) to construct and operate a small flow treatment facility to treat and discharge sewage is responsible for the operation and maintenance of the facilities and for any health nuisances or pollution problems which may result.

Several key factors with respect to operation and maintenance follow:

1. It is crucial that adequate disinfection of the sewage be continuously provided on a year around basis to minimize public health risk. Therefore, regular and routine attention must be given to insure that disinfection equipment is operational (e.g. adding chlorine tablets to erosion feed system, filling chlorine solution crock, etc). A small chlorine residual (approximately 0.5 mg/l) must be maintained in the treated discharge. Note: Erosion chlorinators are prone to “bridging” of the tablets which results in no Cl₂ contact. Regular maintenance is necessary to identify and correct this problem.
2. The depth of sludge and scum in the septic tank should be measured at least once a year. When, the top of the sludge layer in the tank or any compartment of the tank is found to be less than twelve inches below the bottom of the outlet baffle, or if the bottom of the scum layer is within three inches of the outlet baffle, the tank must be pumped. Annual pumping may be substituted for measurement. Such cleaning is recommended to minimize plugging of the sand filter with solids and avoid deterioration of the treated effluent. Failure to pump treatment and dosing tanks often results in costly repairs or replacement. (Note: following septic tank cleaning, all interior surfaces of the tank should be inspected for leaks and cracks using a strong light. Pumped-out septic tanks contain toxic gases; therefore, only a properly equipped, trained and experienced person should attempt to enter or repair a septic tank if this should become necessary. **THE HOMEOWNER SHOULD NOT ENTER A SEPTIC TANK**)
3. The use of biological or chemical additives in the septic tank is not recommended or necessary.
4. Dosing tanks should be opened at least once a year and settled solids removed as necessary.
5. Aerobic treatment plants shall be maintained in accordance with manufacturer’s instructions or pumped at least once a year to remove excess solids in order to minimize plugging of the sand filter and avoid deterioration of the discharge.
6. An operation and maintenance manual for the owner’s use is to be provided by the designer.
7. For mechanical equipment (i.e. aerobic treatment units, spray nozzles, etc.) a service contract with the equipment representative must be executed so periodic inspection and ”as needed” services are provided.
8. To minimize water usage, water conservation fixtures are required in the house (e.g. 1.6 gal. flush toilets, shower and faucet restrictors and front loading washers).

VI. MONITORING AND REPORTING REQUIREMENTS

The permittee is required to perform certain routine testing of the treated sewage. This includes a monthly chlorine residual test and an annual fecal coliform test (between June 1 and August 30). This information along with any maintenance activities performed and operational problems experienced must be submitted in an annual report to the Department and local municipality by September 20. (See Appendix D for a sample annual report form).

APPENDIX A

Sewage Flows

- (a) The sewage flows from single family dwellings served by a community sewage system or from apartments, rooming houses, hotels and motels served by small flow sewage treatment facility shall be determined from the following table:

Type of Establish	Gallons/Person/Day	
	Lbs. 5 Day BOD/Person/Day (unless otherwise noted)	
Apartments (per 1 or 2 bedroom units)	300/unit/day	.17
Hotels and motels with private bath (per single unit)	100/unit/day	.17
Rooming houses (per unit)	200/unit/day	.17
Single family residences ¹ (including duplexes or townhouses) served by a community system:	400/unit/day	

¹For units of three bedrooms or less; for each bedroom over three, add 100 gallons.

- (b) The sewage flow for nonresidential establishments served by an individual or community sewage system shall be determined from the following table:

Type of Establishment	Gallons/Person/Day	
	Lbs. 5 Day BOD/Person/Day (unless otherwise noted)	
Non Residential	Gal.	BOD
Airline catering per meal served	3	.03
Airports (per passenger - not including food)	5	.06
Airports (per employee)	10	.06
Beauty shops (per operator chair)*	200	-
Bus service areas not including food	5	.02
Country clubs not including food	30	.02
Drive-in theaters (not including food - per space per day)	10	.06
Factories and plants (exclusive of industrial wastes)	35	.08
Mobile home parks, independent (per space)	250	.60
Movie theaters (not including food, per auditorium seat)	5	.03
Offices (per employee)	10	.06
Restaurants (toilet and kitchen wastes per patron)	10	.06
(Additional for bars and cocktail lounges)	2	.02

Restaurants (kitchen and toilet wastes, single-serve utensils/person)

8.5

.03

Type of Establishment	Gallons/Person/Day	
	Lbs. 5 Day BOD/Person/Day (unless otherwise noted)	
	Gal.	BOD
Non Residential		
Restaurants (kitchen waste only, single-service utensils/patron)	3	.01
Stores (per public toilet)	400	2.0
Warehouses	35	-
Work or construction camps (semi-permanent) with flush toilets	50	.17
Work or construction camps (semi-permanent) without flush toilets	35	.02
Churches (per seat)	3	-
Churches (kitchen waste per meal served)	3	-
Churches (with paper service per meal served)	1.5	-
Hospitals (per bed space, with laundry)	300	.20
Hospitals (per bed space, without laundry)	220	-
Institutional food service (per meal)	20	-
Institutions other than hospitals (per bed space)	125	.17
Schools, boarding	100	.17
Schools, day (without cafeterias, gyms or showers)	15	.04
Schools, day (with cafeterias, but no gym or showers)	20	.08
Schools, day (with cafeterias, gym and showers))	25	.10
Organized Camps, day (no meals served)	10	.12
Organized Camps (night and day) with limited plumbing including water carried toilet wastes	50	.12
Campgrounds, with individual sewer and water hookup (per space)	100	.50
Campgrounds with water hookup only and/or central comfort station which includes water-carried toilet wastes (per space)	50	.50
Fairgrounds and parks, picnic -- with bathhouses, showers and flush toilets	15	.06
Fairgrounds and parks, picnic (toilet wastes only)	5	.06
Swimming pools and bathhouses	10	.06

*Exclusive of industrial waste.

(c) Actual flow data for any establishment indicating peak daily flows over a one-year period may be accepted for use in sizing the Small Flow Sewage Treatment Facility.

APPENDIX B

The Small Flow Sewage Treatment System Manual contains 7 pages of drawings that are not available electronically. For hard copies, call 717-787-8184.

APPENDIX C

Materials for Small Flow Sewage Treatment Facility (Single Family Home - 400 gpd)

The materials listed below are the minimum required to build a Small Flow Sewage Treatment Facility to serve a three (3) bedroom (or less) home (400 gpd) discharging to surface waters. Additional materials are necessary for spray irrigation discharge, additional bedrooms above three (3) and lot conditions which require longer pipe runs.

TANKAGE

Quantity	Item	Use
1	1000 gal. Septic Tank	1st Septic Tank
3	500 gal Septic Tanks	2nd Septic Tank Dosing tank, chlorine contact tank
4	Manhole Extension w/lids	Extensions to grade
2	Septic solids Retainers (or 4-1/8 bends)	Outlet baffles

DOSING SYSTEM

Quantity	Item	Use
1	Submersible Sewage Effluent Pump 1/3 HP or larger (See Calculations)	
1	Pump control kit	
1	High water alarm kit	
2	Splice kits (Heat shrink or equivalent)	Electrical connections
100 ft	#12 UF 2 conductor w/ground	Circuits for pump and alarm

PIPING

Quantity	Item	Use
70 ft.	3" solid NSF (DWV) Pipe	Distribution system
10 ft.	3" solid NSF (DWV) Pipe	Building Sewer
10 ft.	3" solid NSF (DWV) Pipe	Tank connections
10 ft.	3" solid NSF (DWV) Pipe	Outfall to chlorinator
50 ft.	3" solid NSF (DWV) Pipe	Outfall run
	2" & 3" couplings elbows, end caps and tee's as needed;	
65 ft.	3" Perforated PVC Pipe	Collection Pipe
35 ft.	3" Perforated PVC Pipe	Outfall Pipe
20 ft.	2" solid NSF (DWV) Pipe	Delivery Line

SAND FILTER

Quantity	Item	Use
1000 ft ²	20 mil. PVC, Hypalon, polyethylene sheeting, or equal	liner
1200 ft ²	Geotextite textile material	aggregate covers
44.5 cu. yd. (70 tons)	Filter Sand	Filter Media
12.5 cu. yd. (20 tons)	Bank Sand	Liner Cushion
28 cu. yd. (45 tons)	AASHTO #3, #5 or #57 Aggregate	Pipe Bedding
2	Pipe seals (antiseep collars)	Watertight liner penetration
1-50 lb. bag	Bentonite Clay	Watertight liner penetration
1	1/2" Drill Bit	Perforated Distribution Pipe

CHLORINATOR

Quantity	Item	Use
1	Plastic Meter box w/ lid (or Plastic sump box w/ lid)	Housing
1	4" Solid PVC pipe (18 in.) with 1-Solid cap & one slotted cap	Tablet tubes
16	Concrete Blocks	Baffle Supports
128 sq. ft. (4 sheets)	Rigid Corrugated Plastic Sheeting (4 x 8 ft.)	Baffles

APPENDIX D

SAMPLE ANNUAL REPORT FORM

**ANNUAL MAINTENANCE REPORT
SMALL FLOW TREATMENT FACILITY**

Name: _____
Address: _____
Address: _____

Permit Number: _____
Treatment Plant Location: _____
Township: _____ County: _____

Completion and submittal of this Report by September 30 of each year is a requirement of the discharge permit for your sewage disposal system. Reports are to be mailed to:

Department of Environmental Protection
Bureau of Water Quality Protection
(See Regional Offices on page 34.)

I. Total Residual Chlorine - sample the discharge after chlorination and fill in the reading from the test kit (color comparator). All readings must be in parts per million (ppm) residual chlorine.

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
required												
monthly												
sample*												
Resample												
I												
Resample												
2												

* The chlorine residual must be maintained at a range of 0.3 ppm to 1.5 ppm. If the initial test for chlorine residual is less than the required minimum level, corrective action and resampling must be conducted until the proper residual is attained.

II. Fecal Coliform organism - sample after chlorination between June 1 and August 30. A copy of the laboratory report must be attached to this report.

If the report from the laboratory shows concentrations of fecal coliform greater than 200 organisms/100 ml of sample:

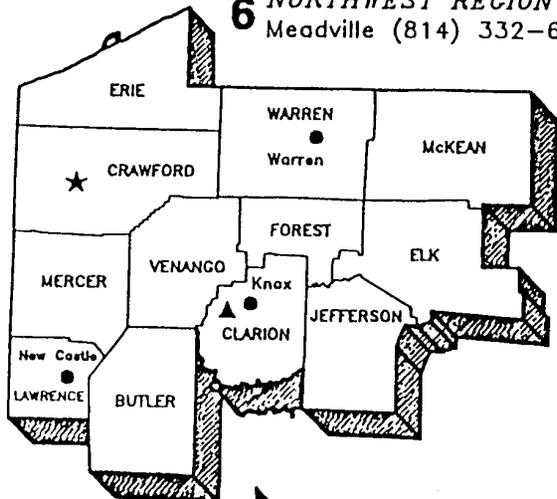
A. Describe corrective action taken _____

B. Attach Fecal Coliform resamples taken to document that the problem was corrected.

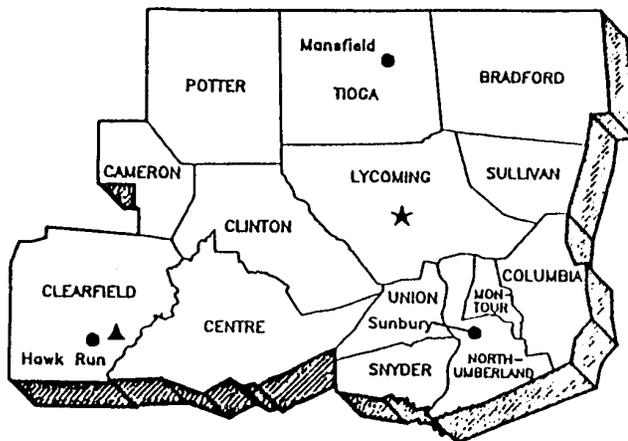
III. Maintenance activities - describe any additional maintenance required and performed during the report period (Sept. to Sept.).

COMMONWEALTH OF PENNSYLVANIA
 DEPARTMENT OF ENVIRONMENTAL PROTECTION
REGIONAL OFFICES

6 *NORTHWEST REGION OFFICE*
 Meadville (814) 332-6945



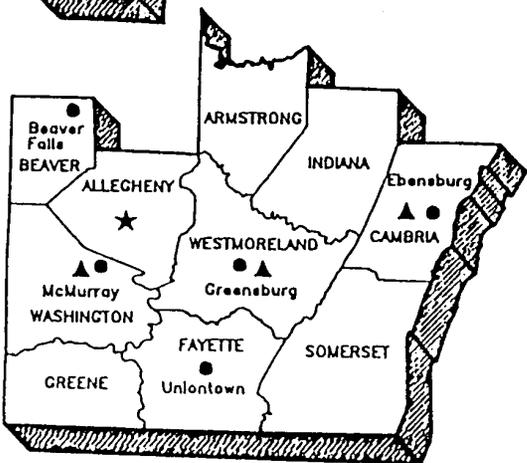
4 *NORTHCENTRAL REGION OFFICE*
 Williamsport (717) 327-3636



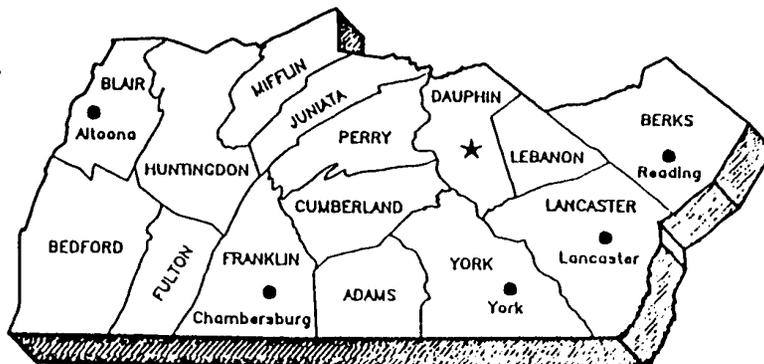
2 *NORTHEAST REGION OFFICE*
 Wilkes-Barre (717) 826-2511



5 *SOUTHWEST REGION OFFICE*
 Pittsburgh (412) 442-4000



3 *SOUTHCENTRAL REGION OFFICE*
 Harrisburg (717) 705-4700



1 *SOUTHEAST REGION OFFICE*
 Conshohocken (610) 832-6000



LEGEND: ★ REGIONAL OFFICES ● DISTRICT OFFICES ▲ MINING OFFICES