

DEQ Guidelines for Design of Septic Tank Effluent Pump or Gravity (STEP/STEG) Sewer Projects Involving Common Sewers



State of Oregon
Department of
Environmental
Quality



STEP/ STEP Design Guidelines

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

STEP / STEG Design Guidelines

This document provides general instructions for design and construction of septic tank gravity and pumped effluent wastewater disposal systems. This information is intended as guidance for wastewater collection owners and should be interpreted and used in a manner fully consistent with the state's environmental cleanup laws and implementing rules. This document does not constitute rulemaking by the Oregon Environmental Quality Commission and may not be relied on to create a right or benefit, substantive or procedural, enforceable at law or in equity, by any person, including Oregon Department of Environmental Quality (ODEQ) employees.

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1. APPLICABILITY

These criteria apply to STEP (septic tank effluent pump) units discharging to pressurized common sewers, and to STEP or STEG (septic tank effluent gravity-draining) units discharging to small-diameter common collector sewers. Pressurized and small-diameter collectors have interactive hydraulic effects and solids handling limitations which warrant a comprehensive engineering design.

Approval of these designs, unlike gravity sewers, has not been delegated under OAR 340-52-045.

These criteria do not apply to the following:

1. Individual or single-dwelling septic tank or grinder pump units discharging directly to a conventional common gravity sewer. Their design, review, inspection, and approval are subject to regulations of the State Building Codes Agency.
2. Tanks discharging to a drainfield or other on-site disposal system. They are subject to design, review, inspection, and approval as established in our on-site sewage disposal rules (OAR 340-71, 72, & 73).
3. Vacuum sewer collection systems. Technical features should conform with recommendations in the literature. Administrative requirements for vacuum sewers are similar to those listed below for STEP systems.

2. TYPES OF STEP SYSTEMS

In a typical STEP system, household sewage is pretreated in a septic tank where gross solids and grease are held back. A "clear" effluent from the mid-depth of the tank is conveyed to a common sewer. Usually the effluent is pumped from the septic tank under pressure to a small-diameter, pressurized collector sewer.

Effluent may also flow by gravity, where terrain allows, to small-diameter gravity collector lines. This type of STEP system is often called a STEG (septic tank effluent gravity) or STED (septic tank effluent drain) system to distinguish it from pumped systems. However, these guidelines and criteria apply to both.

3. SCOPE

A STEP/STEG system is considered to include all of its components beginning with the septic tanks, and ending at the point(s) of discharge into a conventional gravity sewer or treatment plant. Building drains discharging into tanks are regulated under the Oregon State Plumbing Code, and are not considered part of a STEP system.

4. ADMINISTRATIVE REQUIREMENTS

All additions and extensions to existing STEP (or STEG) systems, as well as new systems, are subject to review and approval per OAR 340-52. Submittals should document fulfillment of administrative requirements by the sewer system Owner.

The OWNER is defined as the municipality, sanitary district, private sewage utility, or sanitary authority which is responsible for the operation of the system. The property being served is defined as the USER.

Legal title to tanks, pumps, or other components should preferably be "owned" by the OWNER. The objective of vesting title in the OWNER instead of the USER is to avoid potential for cost disputes over equipment selection and repair methods. Having the USER "own" title to any of the system components may be considered on a case-by-case basis, but is not recommended.

Regardless of where title is vested, the OWNER shall completely control all tanks, pumps, service lines, and other components of the system on private property. This requirement is essential to assure operable hydraulics and overall system reliability. The administrative requirements are:

1. The OWNER shall maintain ultimate responsibility and authority for design, equipment and materials selection, installation, operation, and maintenance of the entire STEP/STEG system including tanks, controls, and other appurtenances on private property. The OWNER may contract these services with qualified contractors. Assigning any of them to a USER is not acceptable.
2. The OWNER shall possess a recorded general easement or deed restriction to enter the private property being served, and to access the system and its components. Access must be guaranteed to operate, maintain, repair, restore service, and remove sludge.
3. No system shall be operated without the direct field supervision of a certified operator, in accordance with OAR 340-49. An operations and maintenance manual shall be submitted for review prior to startup. In accordance with OAR 340-52, no STEP/STEG system shall be operated without an approved manual.
4. OWNERS shall maintain and operate STEP/STEG facilities without any interruption, sewage spills on the ground, sewage backup into buildings, or other unhealthy conditions. OWNERS shall establish operating procedures and maintain certified staff to assure:
 - Timely response to outages and trouble calls.
 - Adequate spare parts on hand including spare pumps, piping, electrical controls, and valves. Equipment should be standardized to reduce spares. Inventory shall include, at a minimum:
 - 1 spare of each type of pumping unit per 15 customers served.
 - 1 spare control panel per 30 customers.

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- 1 spare set of level controls per 30 customers.
 - 1 spare effluent screen per 100 customers
 - Annual inspection of each tank and sludge removal every five years, or as experience dictates.
5. The OWNER's sewer use ordinance shall contain special provisions regulating STEP/STEG systems. Essential provisions include:
- Exclusion of infiltration and inflow, including a ban on connection of non-sewage wastewaters.
 - Prohibition of and establishment of penalties for modifications, repairs, or tampering by the USER.
 - Control of materials and workmanship through adoption of technical specifications and construction standards.
 - Regulations and procedures for connection to a STEP/STEG system of new USERS, including signing of easements as a condition of service. Assessment of differential user fees is optional.
 - Regulations for adding new STEP/STEG systems and extending existing systems to serve new areas, including submittal of plans as outlined below.
 - Record-keeping for all installed STEP/STEG tanks by lot number, tank number, and address.

5. DESIGN SUBMITTALS

Plans and specifications shall be submitted for prior approval in accordance with OAR 340-52. Submittals shall include:

1. Engineer's design calculations covering hydraulics and the sizing of STEP/STEG tanks, pumps, and lines. In general, system design shall conform with recommendations published in Manual of Practice FD-12, Alternative Sewer Systems, Water Pollution Control Federation, 2008 and with applicable Oregon Administrative Rules.
2. Technical standards and specifications for STEP systems to be installed, including acceptance testing.
3. Copy of current ordinance allowing use of STEP/STEG systems within the OWNER's service area. This may be in the form of an amendment to the OWNER's Sewer Use Ordinance.
4. Copy of access easement form to be signed by USER.

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5. Engineer's evaluation of hydrogen sulfide production from the STEP mainlines and design of control measures to protect gravity sewer system against corrosion.
6. List of spares and repair materials to be supplied to the OWNER to assure reliable operation of the system.
7. Copy of the current approved construction, design, and equipment standards that have been adopted by the OWNER.
8. For each new system or extension, a Land Use Compatibility Statement in accordance with OAR 340-18.
9. A copy of the Proposal form or similar itemized list of quantities involved in the project.
10. The name and address of the OWNER, developer, and engineer shall be shown on the plans. Easements shall also be shown. Blanket easements may be indicated by note.

6. TANKS AND INLET PIPING

- Single tanks serving multiple lots under separate ownership will not normally be allowed. Each residence or site should have a separate tank. The rare exception will be considered case-by-case.
- Systems serving facilities such as RV parks, mobile home parks, apartments, and unit developments are usually under the control of a single customer or responsible association. At the discretion of the engineer, such systems may be designed with shared tanks, subject to requirements of the Oregon State Plumbing Code.
- Tanks shall be sized according to flow per criteria published in OAR 340-71-220(3). Minimum tank capacity shall be 1000 gallons.
- Construction details and configuration of tanks shall generally conform with OAR 340-73-050, Dosing Tank Construction. All tanks shall feature inlet and outlet risers with lockable covers. Covers shall be designed for H-20 loading in traffic areas. Inlet riser shall be minimum 8" diameter. Outlet risers shall be sized to accommodate and access the equipment installed, with 24" diameter as a minimum. Intermediate 8" risers will be required on large tanks over 3000 gallons.
- Tanks shall be designed for all anticipated structural loads, including soil backfill. Where vehicle access is allowed, the tank shall be protected with an appropriate structural slab. All designs shall be stamped per OAR 34-052.
- To assure retention of solids and grease in the tank, all tanks shall feature a plastic effluent screen. Screens shall conform with the standard published in OAR 340-73-056. No unscreened discharges will be allowed.

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- Flotation of tanks in areas of high groundwater shall be anticipated in system design. Structural design features and operational procedures shall be employed to prevent flotation. Equalization of buoyancy through hydrostatic pressure-relief valves installed in a STEP tank will not be allowed. Normally a tank should be filled immediately after installation and, on passing the leakage test, should not be pumped down more than 3' thereafter.
- Existing septic tanks should be removed or abandoned in place. Existing tanks which fully meet the requirements, including leakage test, may be considered for use in the STEP/STEG system. However, to retrofit the effluent screen, flow controls, access risers, and other specified features is usually impractical.
- Existing watertight tanks in good condition may occasionally be allowed, on a case-by-case basis, to remain in service and under the customer's private control as pretreatment units discharging to a new tank meeting the approved specifications.
- Existing building drains should be replaced and inspected per code. Alternatively, a cleanout shall be installed adjacent to the building and the drain shall be tested in accordance with the Oregon State Plumbing Code. Only watertight drains in good condition may be connected to a STEP/STEG tank.
- Pipe connections to tanks shall be made with an approved commercial waterstop manufactured for the intended purpose. Field improvised waterstops or adapters will not be approved.
- All sewage from the building including kitchen, laundry, and bath wastes shall be intercepted and conveyed to the STEP/STEG tank.
- Prior to start-up, tanks shall be smoke-tested to confirm that all connected plumbing is properly vented through external house stacks, in accordance with Oregon Building Code Agency regulations. Internal venting into attics will not be allowed.

7. PUMPS AND OUTLET PIPING

- To maintain the efficiency of the specified screen, each individual pump discharge and gravity outlet shall be limited to 10 gpm maximum flow rate by means of a flow-control orifice, regardless of influent flowrate or downstream head conditions. Flows exceeding 10 gpm tend to blind the screen over time, requiring them to be cleaned. Flows shall generally be controlled between 5 and 10 gpm.
- Effluent pumps shall be submersible turbine pumps and shall generally comply with the provisions of OAR 340-73-055, sized as appropriate for head/capacity conditions of the design. Installed pumps shall be capable of passing a 24-hour wet test in constant operation against shutoff head. Conventional centrifugal sewage pumps are usually less satisfactory for STEP system service because of their flat characteristic curve, but may be considered case-by-case for extremely low-head installations. Grinder pumps are unacceptable for discharge to STEP systems because of solids and grease.

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- Pressurized service lines from a STEP tank to the common collector sewer shall be minimum 1" diameter. A shutoff valve (gate, plug, or ball) shall be installed in a tamperproof valve vault at property line. Unless otherwise approved, a swing check valve shall be installed in the same vault, and an additional swing check valve shall be installed at the tank outlet. Valves shall be full-port type and constructed of non-corrodible materials such as plastic and stainless steel.
- Gravity-flow service lines from STEG tanks to small-diameter gravity sewers shall be minimum 2" diameter. All service lines shall have a minimum capacity of 10 gpm flowing half full, based on Manning's $n = 0.013$. Each service line shall be vented at the upper end. Venting shall be continuous through the tank and building stack.

8. PUMP CONTROLS

- Power is normally furnished by the USER. Pump control panels should be energized through a dedicated breaker in the building served.
- Control panels shall be NEMA-4X with a locked door. Panels shall be exterior mounted and should be visible to OWNER's service personnel from public right of way. Electrical conduits shall be sealed gas-tight at the tank and the panel.
- Installations shall contain a high-water alarm switch, activating a user-cancellable buzzer and an alarm light. Access to the light reset button shall be restricted to OWNER's service personnel. Alarms shall separately fused so that trip of pump breaker shall not disable an alarm.
- Pump control panels shall be equipped with elapsed time meters, and may also be equipped with event counters at the option of the OWNER. Operational controls shall be HAND/OFF/AUTO. Dual pumping units shall have operator-cancellable automatic alternators and event counters.

9. COMMON PRESSURE SEWERS

- Common pressure sewers shall be minimum 2" diameter PVC or polyethylene pressure pipe, installed with toning wire or detectable tracer tape.
- Pipe sizing and layout shall generally conform with recommended practices in WFCP Manual of Practice FD-12, Alternative Sewer Systems, Chapter 4.
- Isolation valves, flushing connections, vacuum release valves, air release valves, and pig launching stations are optional. Such appurtenances shall be at the discretion of the engineer and the OWNER, subject to OAR 340-52 approval.

10. COMMON SMALL-DIAMETER GRAVITY SEWERS

- Sewers shall be minimum 4" diameter, installed with tracer tape or toning wire.
- Sewers shall be designed to flow half full, based on 1 gpm per dwelling and Manning's $n = 0.013$. Minimal velocities are acceptable. However, low-velocity and flooded sections may require sulfide controls.
- Subject to a 4" minimum diameter, inverted siphons shall be designed to flow at a velocity of 0.5 feet per second or greater, based on a Hazen-Williams coefficient of 100.
- Cleanouts shall be sealed with a screwed cap or plug secured under a tamperproof (bolt-down) cover. Cleanout spacing shall be approximately 300'. Conventional open-channel manholes will not be allowed except where desired to site a flume for flow measurement.

11. SULFIDE CONTROL

The normal hydrogen sulfide content of gravity sewers in the Pacific Northwest is approximately zero. The hydrogen sulfide content of septic tank effluent from the specified withdrawal zone is also generally negligible.

However, effluent sulfate readily reduces to sulfide during periods of detention in the STEP service piping, pressure sewers, and inverted siphons. These systems reduce all available sulfate over time, resulting in hydrogen sulfide concentrations well exceeding 10 mg/l.

Because of corrosion, odor, and safety concerns, STEP discharges into unarmored gravity sewers shall not exceed 0.1 mg/l hydrogen sulfide content.

1. Common Pressure Sewers

- STEP system designs shall include effective controls to prevent the development of hydrogen sulfide in flooded service lines, pressure sewers, and flooded sections of small-diameter gravity sewers.
- Pressure sewers shall be oxygenated by means of air injection into the head (low point) of each common sewer collector line. End-of-pipe chemical oxidation systems are relatively expensive and will not usually be approved.
- Air injection rate shall be 2 scfm per inch diameter. Air supply shall be a receiver-mounted compressor rated at the static head on the system at the point of injection. Static head shall be computed as the sum of all ascending segments in the line being aerated.

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- No automatic air release valves shall be installed. Manual air release valves and automatic vacuum release valves may be installed where warranted in the judgement of the engineer.
- Air injectors shall be 1" copper tubing and saddle-mounted corporation stop. Adjacent to the corporation stop, injector piping shall contain a suitable check valve, needle valve, airflow meter with pressure gauge, and an isolation valve and pressure reducer at the receiver, along with necessary unions and drip legs for condensate. All fittings shall be suitable for air service at the rated pressure of the compressor.
- Airflow meters shall be calibrated in cfm, with range suitable for the computed acfm (actual cu. ft. per min). Flowmeters sized for scfm are usually too large and will not be approved. Pressure-adjusted meters should not be used as the installed working pressure cannot be predicted with sufficient accuracy.
- Compressor and injector assembly shall be secured in a locked vault. Compressors and vaults should be muffled, silenced, and soundproofed. Compressors may be installed below grade in noise-sensitive areas. Receivers shall be fitted with automatic drain valves for condensate purge.
- Spare or standby compressors will not be required for STEP systems.
- End-of-pipe aeration alone, or air-stripping alone, is generally unable to reduce the sulfide content of STEP sewers to 0.1 mg/l, and shall not be relied on for sulfide control. However, an approved commercial air-stripper vented through an activated carbon filter may be installed as a polishing process. This process may be installed prior to discharge into any gravity sewer where odor and safety may be a concern, at the engineer's or OWNER's discretion.
- New sulfide control methods will be considered and evaluated on their merits.

2. Unflooded Sections of Common Small-Diameter Gravity Sewers

Development of hydrogen sulfide in small-diameter sewers is minimal, assuming sufficient fall or grade to provide surface turbulence, continuous venting through connected house stacks, and the absence of flooded sections. In such systems, sulfide controls may be limited to pumped STEP services connected to the sewer.

- Pressurized STEP services connected to small-diameter gravity sewers shall be back-drained between pump cycles to purge the entire service. A vacuum release valve shall be installed at the high point of the service and a backdrainage solenoid valve shall be installed on a tee at the pump in place of the check valve. Valve shall be 1", full port, explosion-proof, wired to close when the pump is on. Vacuum release valve shall be installed in a tamperproof vault readily accessible to OWNER's service personnel.
- To assure against sulfide formation in slow-moving lines, small-diameter sewers should be sized to flow no more than half-full at average daily flow and to provide at least 0.5 fps velocity when flowing half-full. Minimum grades should be based on Manning's $n = 0.013$:

2" @ 0.16%

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3" @ 0.08%

4" @ 0.05%

6" @ 0.03%

8" @ 0.02%

Adverse grades and inverted siphons will create flooded sections, and shall be aerated as described above.

- Alternatively, the downstream conventional sewer and manholes shall be armored with approved acid-proof coatings for a sufficient distance to dissipate the hydrogen sulfide. The required distance shall be determined case-by-case by the engineer, depending on sewer turbulence and anticipated initial sulfide strength. Normally a requirement to armor approximately 2000' should be anticipated.

12. CONSTRUCTION

1. Construction should comply with applicable provisions of the 2002 Oregon APWA Standard Specifications, or the most recent standards, for sanitary sewer construction. All mechanical and electrical equipment should be subjected to performance testing prior to acceptance by the OWNER. Contractor's and supplier's warranties should be obtained.
2. Septic tanks shall be tested hydrostatically after installation and after all pipe penetrations have been completed.
3. Tanks shall be filled to a marked point 4" above the base of the risers. Leakage shall not exceed 50 gallons per day. Existing building drains and vent stacks being reconnected shall be tested as described above.
4. All piping shall be pressure tested. Because of shallow burial and the strength of pressure-rated piping, there is often little potential for pipe deflection, and testing for deflection is optional. The engineer and OWNER should determine whether installed piping should be tested for deflection case-by-case, and should specify the design of mandrel to be used.

13. CERTIFICATION

The engineer (or his authorized agent per OAR 345-52-040) shall inspect the construction and, on completion, shall certify proper construction in accordance with the approved plans per OAR 340-52, including any change orders subsequently approved.

14. INQUIRIES

Inquiries about these guidelines should be directed to DEQ regional water-quality plan review engineers.

MLP:STEP.4

Orig. IX.91

Rev. IX.14