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Public Health
Seattle & King County

MEMORANDUM

July 16, 1999

TO: Wastewater Program Staff, Certified Designers, Master Installers and Interested Persons

FROM: Jim Henriksen, Supervisor, Wastewater Program

SUBJECT: Intermittent sand filters: Best methods and practices for design, construction and inspection

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Purpose

To protect public health by:

- Improving the quality control of Intermittent Sand Filter (ISF) systems.
- Establishing a consistent standard for design, installation and inspection.
- Assuring ISF are designed and constructed using best methods and practices.
- Preventing premature system failure from design or construction related problems.
- Establishing installation inspection criteria based upon critical control points.

The methods and practices provided in this document are the product of conclusions and consensus reached during the King County On-Site Industry Meetings held in January 1999. This information augments and strengthens the DOH Sand Filter Design Standards and Guidance, which in addition to Title 13, is the basis for design, construction and use of ISF. The collation of information and votes received from all attendees, for each category, is attached to this document.

Note: All illustrations in this document are only examples used to clarify design and construction requirements. Designers are expected to provide their own drawings, illustrations and notes with design submissions. Designs should not be submitted with copies of these example drawings. Additionally, all drawings, illustrations, notes and calculations included in a design submission are to be consistent and not contradictory.

Drawings

- **Design Cross Section.** Sand filter drawing detail is to include: depth of cover not to exceed 12 inches with 3-5% grade cover soil crown, drain rock, sand media, pea gravel, underdrain, pump basin pressure distribution system, inspection ports, aeration vents, pump float switch locations, pump specifications, liner and liner placement, liner bedding, liner support framework, dimensions and construction notes. In addition, how the pumpline, transport line and electrical conduit are to pass over the top edge of the liner. See diagram below.

- **Design Plan View.** Show PD layout and underdrain configuration. Underdrain must be calculated to provide adequate return flow rates to the pumpwell based on the pump's capacity. Include specifications for lateral spacing, lateral sidewall spacing, orifice spacing

and diameter, orifice shields or chambers, air vents, inspection ports and overall dimensions.

- **Construction Details.** Sufficient details are to be specified so that the Installer can, from the approval plan, construct the sand filter for a specific site location. For example, ground slope in a sand filter area must be accommodated by the design. In addition, the ISF containment vessel construction must be clearly detailed.

Sand Filter anatomy

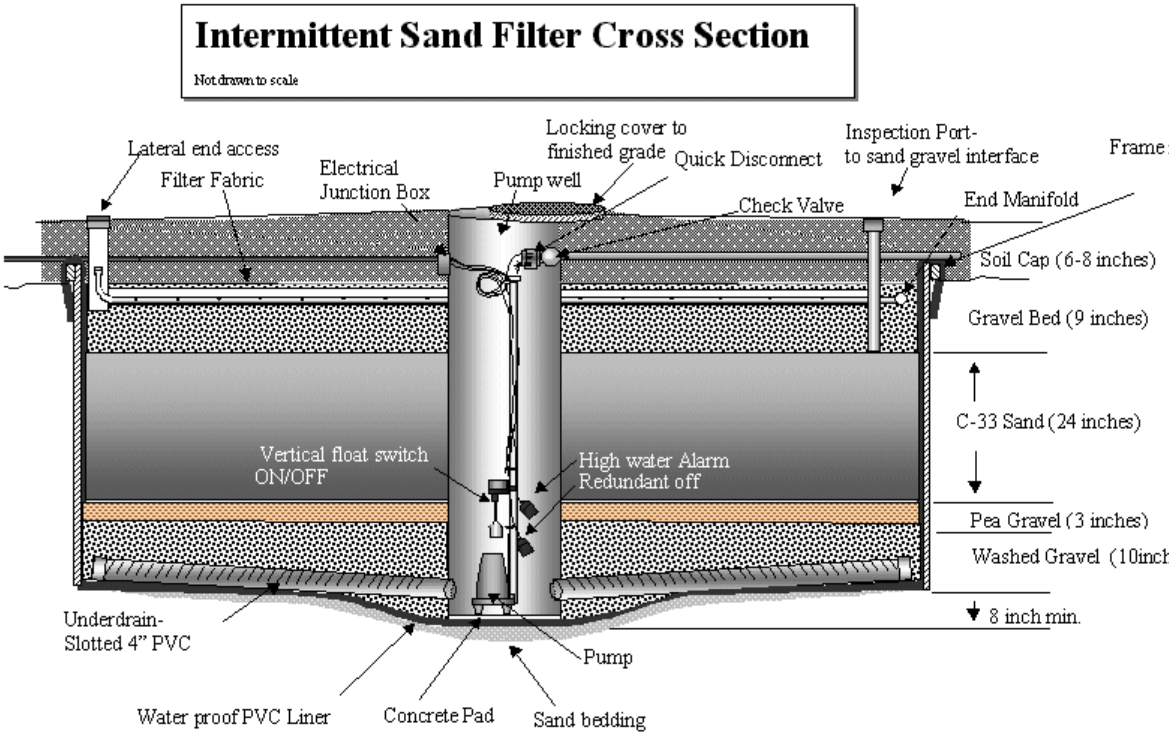

Photo of sand filter on property

Best design practices

The April 5, 1999, DOH ISF Recommended Standards and Guidance includes these suggestions:

- Reducing loading rates applied to intermittent sand filters and sand-lined trench systems to no more than 0.8 - 1.0 gal/ft2/day.

- Incorporating into the system design, methods of improving oxygen exchange within the filter such as, increasing the dose frequency and/or including a venting system in the filter with vents extended to the atmosphere. Vents may need to include an odor scouring device such as an activated carbor filter installed on the end of the vent.

- Quality control of the sand media such as frequent testing of the media to ensure that the media used consistently meets the STM C-33 specification.

The above reinforces the following conclusions and consensus reached during our industry-regulator meetings. Therefore, these specifications will be incorporated into the design and construction of ISF.

- **Increased Frequency Dosing** (greater than 4 times per day) to promote unsaturated flows and better oxygen exchange. Small volume-increased frequency dosing improves the opportunity for exposing sand particle surfaces to oxygen, thus promoting an aerobic environment that in turn reduces probability of ponding and saturated flows.

- **Aeration.** Air vents improve oxygen exposure at the gravel aggregate sand surface. Vents connected to channels that cover each lateral, end to end, are one method to accomplish this. This feature is especially important if cover material is misapplied or is of poor quality.

- **Increased Filter Bed Sizing** (4 or more bedrooms). Sand filters may be enlarged by either increasing the loading rate or increasing the gallons per day design flow figure used in calculations. The April 19, 1999, revised Title 13 now increases gpd for 4 or more bedroom residences by requiring a 120 gpd design volume to be added for each bedroom over 3. For example, this factor now increases the filter bed size for a 4-bedroom system by 75sq. ft., to 475 sq. ft. minimum. *Additionally, since the 4-or-more bedroom design is already upsized by an increase in gpd calculations it is concluded that for the present time, a reduced maximum loading rate for the 4 plus bedroom systems will not be mandated*.

- **Increased Filter Bed Sizing** (3 bedroom). As noted previously, DOH guidance is to decrease the filter loading rate to no more than 0.8 - 1.0 gal/ft2/day. The more oxygen that is present at the gravel sand interface a better environment for aerobic organisms is established, resulting in a more efficient treatment process. Covering a sand filter, depending on the depth and quality of cover, can restrict oxygen flow with increased probability that air is consumed and anaerobic conditions develop. A reduction in loading rates for oxygen restricted (covered) systems increases the size of the filter thus reducing overall stress on the system. By applying a lower (1.0 gal/ft2/day) application rate for a 3-bedroom design the size of the filter bed increases by 75 sq. ft. Therefore a 3 bedroom ISF design becomes 450 sq.ft. I**t was concluded that a 3-bedroom size ISF is to be designed based on not more than 1.0 gal/ft2/day loading rate resulting in a minimum 450 sq. ft. ISF**.

- **Timed dosing for all intermittent sand filters**. Timed dosing prevents the system from receiving peak loads which may pond the filter bed. By timed dosing effluent applications over a 24-hour period, protection from ponding is provided. Prolonged ponding leads to oxygen depravation thus promoting anaerobic conditions with bio-mat formation and resultant longer ponding periods and eventual system failure.

- **Design for surge or peak flows.** Is especially important for large houses (3000 sq. ft and up). Houses with capacity to entertain large groups or increased potential of higher than average peak flows should be designed for these conditions. A 1500-1750 gal. surge tank capacity, along with timed dosing and increased bed for the sand filter can better manage these flows or lifestyle habits. Waste strength concerns may also now be addressed by additional treatment components such as ATU's (aerobic treatment units, in which case a smaller SF component may be justifiable) or designing the system as a recirculating gravel filter.

- **Watertightness of Wastewater Tanks.** Stub out elevations are to be held as high as possible. **Water tables must be below the bottom of the inverts.** Where this is absolutely not possible, additional specific measures to prevent water infiltration must be included in the design. For example, using liners around the tanks to prevent infiltration. Tanks must not be located where ponding or drainage is a concern. Tank location and demonstrated watertightness is considered a major critical control point for all OSS. In addition, consult the tank manufacturer's specifications for installation and maximum cover requirements.

- **Sand Filter Location.** Must be selected to keep the filter protected from surface or ground water influences and in a location that is practical for installation and maintenance. The design must include site specific information for proper construction of the filter on the selected location.

- **Construction and siting details to be included in the design.** Sloping sites are to be adequately addressed in the design. Notes, drawings and illustrations are to address all site-specific conditions.

- **Redesign at Pre-construction Inspection (Stub-out).** Should an originally approved design no longer be appropriate for the project under construction, a redesign will be required. Tank and sand filter locations must be carefully evaluated at the pre-construction inspection to verify proper location. Designs that cannot be implemented for example, due to altered site conditions or house size, must be redesigned at this point.

Construction

- **Pre-construction conferences.** Recommended for all sites and required for those projects having site restrictions which may impact the approved design. Pre-construction conferences may include the Designer, Installer, Builder and Regulator. The Health Department may require a Pre-Con by stating this as a condition of approval on the site design application. However, the designer and installer are encouraged to meet on site preliminary to all sand filter installations.

- **Clean media.** Double washed rock is available upon request. Some gravel pits will provide, at additional charge, rock that has been washed a second time to remove as many fines as possible. Gravelless technology is also now an option. As a presumptive field test, sand

media may be tested on-site using the jar method (see enclosure). This does not replace the necessity of providing results of sieve testing to verify C-33 sand specifications.

- **Sand Filter Frame Support for all 30ml PVC liners.** In order to maintain a smooth and supported sand filter box, the sand filter design and installation shall include a perimeter support frame to hold the liner in place during construction. Plywood or an alternative material with 2x4 framing support is the minimum standard. All corners are to be connected top and bottom. All nails or other attachments must have sharp ends pointed away from the liner. Details are to be provided on the designs. A 3-inch (min.) bedding layer of sand beneath the liner must be placed to protect the liner.

- **Sand Filter Liner.** The sand filter liner must be supported and extend at least 6 inches above natural grade. Sloping sites may require the low end of the containment box to have additional support to prevent sidewall blow out and must be addressed in the design. When placing media into the filter containment box, even lifts must be placed on both sides of the box to prevent blow out. An elongated configuration following the contours is preferable to a square box. These considerations must be detailed in the design. No holes are to be cut in the liner for pipe access. All pump lines and conduit must run up and over the top of the filter containment box frame. The liner must never be folded back over the top of the filter, all liner ends are to be tucked back over and around the outside of the filter box frame.

- **Float Switch Locations.** The sand filter pump basin high water alarm float must be set below the bottom of the filter sand layer to prevent the sand from being flooded. In addition, this alarm float must be wired into the dosing tank pump controls so that any high water event within the sand filter basin (i.e. flooding into the filter sand layer) will automatically de-energize the sand filter dosing pump. This wiring configuration will prevent effluent from flooding the filter sand layer. The control ON/OFF float must be sensitive enough to properly dose the designed flow to the drainfield (i.e., vertical float switches or dual ON/ OFF floats). In addition, floats should be positioned so as to cycle ON/OFF at the level of the of the under drain pipes (see diagram for details). The pump basin must have an indicator line clearly marked on the inside, from which to measure the distance to the bottom of the sand layer. This measurement, in inches, is to be permanently marked on the underside of the pumpwell lid for future reference.

- **Underside construction** of the filter vessel is to include a minimum 3-inch sand layer under the liner for bedding. The bottom of the pump well is to be placed upon a concrete or plastic pad that is of a larger diameter (see diagram). This will prevent any groundwater hydrostatic pressure from pushing the liner up and into the pump well. There must be a sufficient number of under-drain pipe laterals to allow sufficient drain back into the filter pump well so as to prevent the pump from "chattering" by exceeding the return capacity of the under drains. A sloping grade to the pump basin is to be provided to increase the return rate to the pump. All under-drain piping must be slotted pipe. Perf pipe is not to be used due to the tendency of intake holes to become blocked and thus not providing sufficient return capacity. Should effluent return be insufficient, the pump will cycle on and off repeatedly during a dosing phase. If this is observed during the performance test the filter must be disassembled and then correctly rebuilt.

- **Flooded Sand Filters.** Sand filters left uncovered and open to the elements for prolonged periods of time are susceptible to flooding and therefore special precautions are to be taken to prevent this condition. Surface drainage into the filter is to be prevented. Sand filters which are flooded up into the sand layer are not to be pumped out using the sand filter pump alone since the sand layer may be sucked down into the pea gravel. A small sump pump is

to be used to slowly lower the level below the sand layer before triggering the sand filter pump. Sand filters flooded up into the sand from below and pumped out rapidly will often have sand in the bottom of the pump basin and throughout the PD disposal network. In addition, when lowering the level in a flooded sand filter precautions are to be taken to avoid overloading the drainfield.

Post-construction inspections

Inspections of ISF will focus on critical control points, which are those specifications affecting proper functioning of the filter.

- **Siting**
    - Sand filter location does not promote accumulation of surface water
    - Sloping sites utilize elongated configurations running with the contours (to be clarified in the design)
    - Sand filter liner placed at least 6 inches above original grade
    - Setbacks maintained
    - Wastewater tanks held out of water table, watertightness maintained
- **General Construction**
    - Filter vessel of correct dimensions
    - Liner bedded in sand layer (3 inches minimum)
    - Liner supported with frame and siding (box construction) corners connected
    - Pumpwell construction conforms to approved design - underdrains are sufficient to allow for adequate return, pumpwell basin is deep enough to keep pump submerged and prevent sand from being flooded when alarm float is activated.
    - Pumpwell base placed on oversized pad to prevent uplift of liner into pumpwell from hydrostatic groundwater pressure (see diagram)
    - Electrical conduit and pumpline runs up and over the top of the filter box frame
    - Electrical conduit equipped with proper seal-off
    - Clean aggregate used in sand filter (double washed rock method or gravelless technology)
    - Sand depth 24 inches- Installer to indicate measurement from the top of the pumpwell to the bottom of the sand on the underside of the pumpwell lid with a permanent marker.
    - Sand meets C-33 specifications (coarse side of specifications with fewer fines preferable)
    - Separate float tree for float switches attached so that float locations will not slip
    - Vertical float switch or dual ON/OFF floats for accurate dosing to drainfield
    - Seals on all wastewater tank inlets and outlets
    - Orifice and lateral spacing correct
    - Orifices clean free of particles
    - Cover material on-site for sand filter cover- sandy loam or loamy sand
    - System complies with design for inspection ports, aeration, and maintenance access
    - At least one observation port to the land/gravel interface
    - Electrical systems hard wired
- **Performance Testing**

- System meets all performance testing standards (see On-Site System Performance Demonstration Test form)

- **Final cover Inspection**

  - Sand filter properly covered with sandy loam or loamy sand 6-12 inches 3-5% grade cover soil crown
  - Pumpwell access to grade
  - Maintenance access to grade
  - Air vents and observation ports to grade
  - Surface water directed away from sand filter
  - All systems functional
  - Alarm system located and verified on as-built