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Division of Surface Water

Design Standards:

**Wastewater Treatment Plants
& Collection Systems
≤ 100,000 gpd**



2025 Version

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Chapter 3 – Pump Stations

3.1 Introduction

Pump stations provide a means for transporting sewage when topography and geology are not favorable for gravity sewer construction. Pump stations can be sited in the collection system or at the wastewater treatment plant. When located at the wastewater treatment plant, influent pump stations are incorporated into flow equalization basins (see Chapter 5: Flow Equalization).

However, the use of a pump station can be avoided by placing the sewers at a shallow depth, or by locating the treatment plant at a lower elevation. When shallow sewers are used, the wastewater generated on the floors of buildings, which are located below grade, may need to be pumped. Pump stations shall be located beyond 50 ft from an occupied building or 35 ft from a surface water of the state.

3.2 General Requirements

All pump stations should include¹⁰:

- A) At least two pumps.
- B) Each pump capable of passing 3-inch solids or be a grinder pump.
- C) Each pump capable of pumping the design peak flow (supported by a pump curve for the selected pumps).
- D) Independent controls for each pump.

Helpful Tip #1

The influent sewer tributary to the wet well should enter the wet well above the “pump on” float setting to avoid surcharging the influent sewer during normal operation.

- E) Automatic alternators.
- F) Security fencing and access hatches with locks, when necessary.
- G) Flow measurement per Section 42.8 of *Ten States Standards* and Section 10.

3.3 Alarms

A visual and/or audible alarm system shall be provided. The alarm will be activated when:

- A) High water levels are detected in the wet well.
- B) The standby pump is activated (high water level alarm to be activated at or below the standby pump on level).
- C) Loss of power to the pump station or pump failure occurs.

Once activated, the alarm will remain on until manually deactivated by a qualified operator. The alarm shall have a light atop the control box and have a battery back-up in case of power failure. An audible alarm or automatic dialer system may also be included along with a visual alarm system. If the pump station is remotely located, an automatic dialer system would be appropriate¹¹.

¹⁰ No overflows or bypasses will be permitted.

¹¹ See Section 46 of *Ten States Standards*.

3.4 Alternate Power Sources

Alternate sources of power, standby pumping, or generating equipment shall be provided as follows for the appropriate average daily design flow:

Table 7 – Alternate Source of Power Options

≤ 20,000 gpd	Hook-up available
20,001 – 40,000 gpd	Portable generator available
> 40,000 gpd	Permanent power or second feed

If an onsite generator is not an option being utilized, an emergency plan to secure a portable generator/gasoline pump should be developed. This emergency plan should be kept onsite in case of emergency. Pump stations should also have emergency bypass pumping capabilities.

3.5 Pumping Rates

Pump stations on small wastewater treatment plants produce hydraulic surges which may affect the treatment effectiveness at the wastewater treatment plant. To reduce this surging effect, the pumped influent to the wastewater treatment plant should produce a peak surface overflow rate not to exceed 500-800 gpd/ft² on the clarifier.

Pumping rates that will exceed the peak surface overflow rates on the clarifier shall be returned to the wet well or a flow equalization basin.

Helpful Tip #2

For pump stations that do not discharge to flow equalization basins, care shall be given to the effect of high pumping rates on the clarifier design. A pump station that pumps at a greater rate than the acceptable clarifier surface overflow rate could wash out the clarifier every time the pump runs.

Unless the pump is controlled by a variable frequency drive, the clarifier would need to be sized so that the peak pumping rate and the acceptable clarifier surface overflow rate is maintained.

Helpful Tip #3

Acceptable peak surface overflow rates for clarifiers will depend on the type of clarifier. For hopper type clarifiers in package plants, the peak overflow rate would be on the low end of the range (500 – 600 gpd/ft²). For clarifiers with mechanical sludge collectors, acceptable peak overflow rates would be on the higher end of the range (600 – 800 gpd/ft²).

Example – Pump Station Influence Calculation

Assumptions

ADF	=	25,000 gpd
Run-off Time	=	16-hour Peaking Factor = $3.33 * 24 \text{ (hours)} \div 16 \text{ (hours)} = 5.0$
Pump Station	=	2 pumps @ 100 gpm each
Clarifier Size	=	2 hopper clarifiers @ 8' x 14' each

Step 1: Determine peak flow

Peaking Flow	=	Peaking Factor * ADF
	=	$(5.0) * (25,000 \text{ gpd})$
	=	125,000 gpd peak flow

Step 2: Determine surface overflow rate

SOR	=	peak overflow rate ÷ clarifier surface area
	=	$125,000 \text{ gpd} \div 2 * (8 \text{ ft.}) * (14 \text{ ft.})$
	=	558 gpd ÷ ft ² (acceptable SOR)

Step 3: Determine pump station pumping rate

Q_{pump}	=	100 gpm * 1,440 min/day
	=	144,000 gpd

Step 4: Determine pumping impact on clarifier

SOR_{pump}	=	$Q_{\text{pump}} \div \text{clarifier surface area}$
	=	$144,000 \text{ gpd} \div 224 \text{ ft}^2$
	=	643 gpd ÷ ft ²

The pump flow rate exceeds the acceptable clarifier SOR. Therefore, either a flow equalization basin should be considered, pump station pumps downsized, or the clarifier size (surface area) be increased.

Explanation: Upstream processes like pump stations can have unanticipated consequences on downstream processes like clarifiers. By checking how pump station pumping rates can influence clarifiers, potential design-based problems can be avoided.

3.6 Acceptable Types of Pump Stations

All sewage pump stations shall be equipped with rails, hoists, and other means for lifting the pump, motor, or pump motor units above ground without entering the wet well.

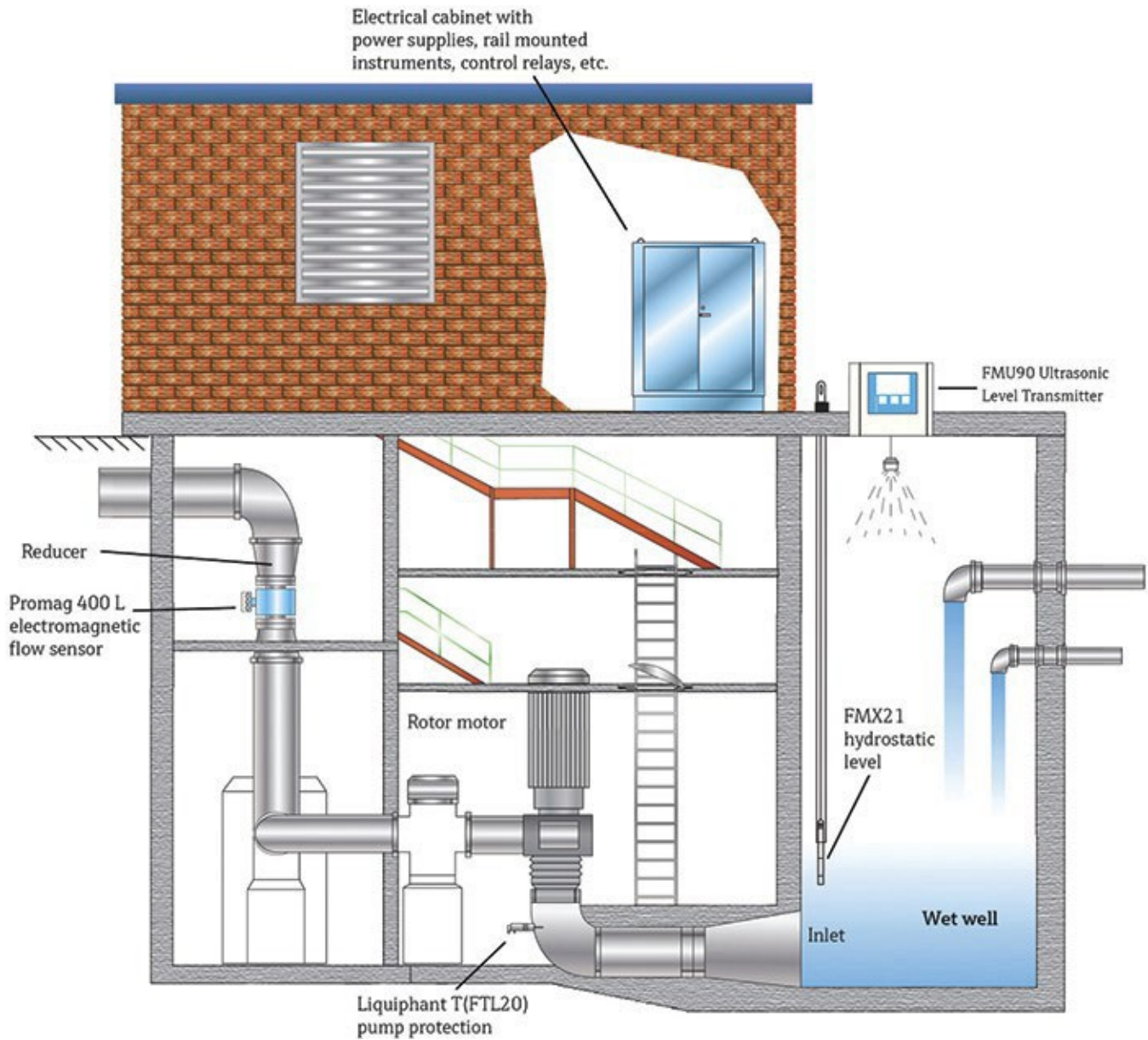
3.6.1 Wet Well/Dry Well Pump Stations

Wet Well/Dry Well pump stations are normally located in the collection system or serve as the influent pump station. General requirements are:

- A sump pump equipped with dual check valves shall be provided in the dry well to remove leakage or drainage with discharge above the maximum high-water level of the wet well.
- Where the dry well is below the ground surface, mechanical ventilation is required.
- Covered wet wells shall have provisions for air displacement to the atmosphere, such as an inverted "j" tube.

- D) Suitable shutoff valves shall be placed on the suction line. Shutoff and check valves shall be placed on the discharge line of dry well pumps.

Figure 4 – Wet Well/Dry Well Pump Station Schematic



3.6.2 Submersible Pump Stations

Submersible pump stations are the most common type of pump station used in smaller installations. Grinder pumps are considered acceptable for submersible pump station applications. These pump stations shall have:

- A) A pump and motor unit that can be removed and installed from above ground without dewatering or having an operator enter the wet well.
- B) Valves installed in an enclosure outside the wet well. Valves shall be in a separate valve pit easily accessible to allow maintenance to be performed. Valve pits may be dewatered to a wet well through a check valve without using a manually operated valve or liquid seal. Check valves that are integral to the pump need not be in a separate valve pit provided that the valve can be removed from the wet well without entering the wet well.
- C) Electrical controls installed in a NEMA 4X enclosure outside the wet well. All electrical equipment and installation shall meet all current NEC regulations. It is strongly recommended that the control panel is sealed to prevent gas intrusion. Wet wells should be vented such as with an inverted “J” tube.
- D) Access opening, hand crane, or crane base should be provided, sized, and located to allow easy removal of pumps and equipment.
- E) Explosion-proof submersible pumps used for sewage.
- F) Stainless steel slide rails and connection (linkage) components be installed.
- G) Pumps attached with stainless steel chains or cables for maintenance and/or replacement.

Helpful Tip #4

Over time, the blades within grinder pumps become dull and lose their effectiveness to properly grind solids. Special consideration should be made for annual/quarterly maintenance of grinder pump and checking with the manufacturer regarding required blade sharpening or replacement of cutters.

3.9 Pressure (STEP and Grinder Pump) and Gravity (STEG) Sewer Systems

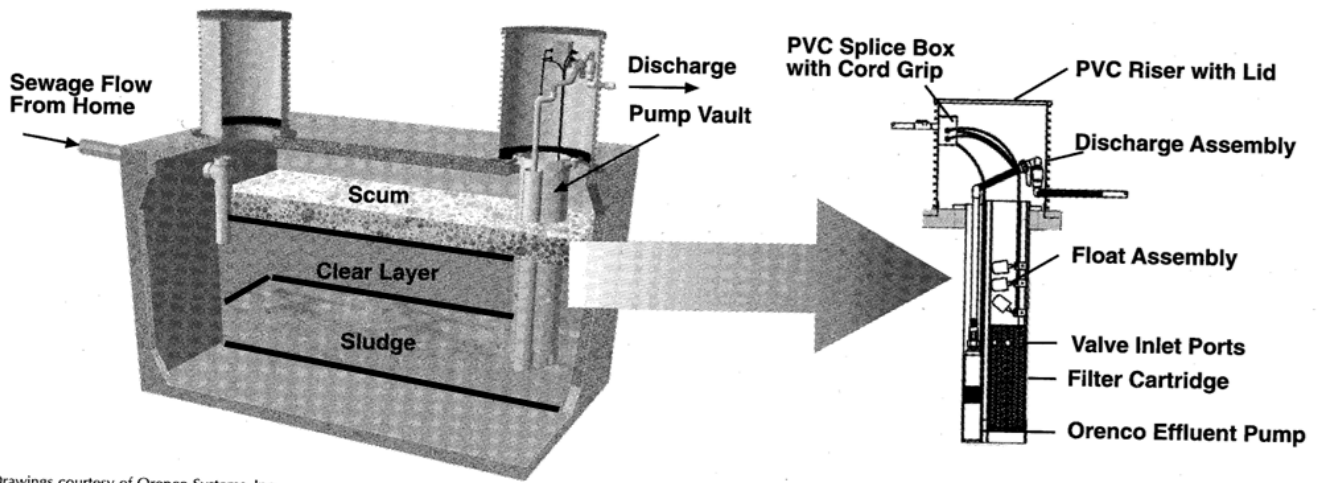
Pressure and gravity sewers are adaptable for rural or semi-rural communities where public contact with effluent from failing soil absorption structures presents a substantial health concern. Since mains for pressure sewers are, by design, watertight, the pipe connections ensure minimal leakage of sewage. This can be an important consideration in areas subject to groundwater contamination. Two major types of pressure sewer systems are the septic tank effluent pump (STEP) system and the grinder pump (GP). Septic tank effluent gravity (STEG) systems discharge by gravity from the septic tank. None of the three requires any modification to plumbing inside the house.

In STEP and STEG systems, wastewater flows into a conventional septic tank to capture solids. The liquid effluent in a STEP system flows to a holding tank containing a pump and control devices. The effluent is then pumped and transferred for treatment (Note that some STEP systems may have the pump inside the septic tank and not utilize a holding tank). In a STEG system, the liquid effluent flows by gravity to the downstream collector sewer. Retrofitting existing septic tanks in areas served by septic tank/soil absorption structure systems can be done, but a large number (often a majority) must be replaced or expanded over the life of the system because of insufficient capacity, deterioration of concrete tanks, or leaks. In a GP system, sewage flows to a vault where a grinder pump eviscerates the solids and discharges the sewage into a pressurized pipe system. GP systems do not require a septic tank but may require more horsepower than STEP systems because of the grinding action. Schematics of typical STEP and GP Pump Stations appear on the following pages.

Four big concerns may be encountered with STEP and GP Systems:

- 1) Use of Simplex Units – these units have only one pump. Ohio EPA will allow simplex units subject to the condition of a backup pump being readily available if the operating pump fails. Please note that, if maintenance of a single pump cannot be performed within 24 hours, the homeowner may be at risk of backflow into their home.
- 2) Isolation of the lateral from the STEP or GP system – check valves are required in the lateral prior to entering into the force main so that the homeowner unit can be isolated for servicing. Consideration should also be given to installing valves and cleanouts within the force main to isolate sections experiencing clogging and requiring maintenance.
- 3) Homeowner or HOA Maintenance – Some grinder pumps are not easily serviced. These include progressive cavity pumps that use pressure switches instead of float switches for pump control and require more skill to remove and repair. With many homeowners not being familiar with pump station servicing, it is recommended that they be provided with a detailed maintenance manual that they or a qualified contractor can use for servicing. The qualified contractor should have access to a spare pump for immediate switching with inoperable ones. Semi-annual system service is recommended.
- 4) Maintenance by Municipality: Municipalities servicing a group of simplex units should have in stock an adequate supply of spare pumps and parts to perform repairs and maintenance

Figure 7 – Typical Septic Tank Effluent Pump (STEP) System (Source: Lakes Region Septic Services)



Drawings courtesy of Orenco Systems, Inc.

Figure 8 – Typical Grinder Pump Installation with Lateral to Force Main (The City of Goshen, IN)

