Sizing Guidelines

FOR NEW OR REPLACEMENT EFFLUENT PUMPS

SSPMA

Sump and Sewage Pump Manufacturers Association

Since 1956, we are a North American trade organization of sump, effluent, and sewage pump manufacturers and their suppliers.

Working together to:

- train wastewater and plumbing professionals, and
- create product performance and safety standards.

SSPMA members collaborate with each other and government regulators to educate consumers and professionals on the latest products, their application, proper sizing techniques, safe installation and use, and good maintenance practices.

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Pumps bearing the "SSPMA-Certified" seal have been tested by the member manufacturer in accordance with SSPMA Industry Standards.

The Standards are designed to provide accurate performance data for sump, effluent and sewage pumping equipment, to assist in their proper application and selection.

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- Types of On-Site Treatment Systems
- Sizing for STEP and Enhanced-Flow STEP systems
- Sizing for Low-Pressure Pipe (LPP) Systems
- Design of Distributions Fields
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Definitions

On-Site Sewage Treatment: A system used to treat wastewater from a home or business and return treated wastewater back into the receiving environment. Commonly referred to as septic systems.

Effluent: The pretreated **liquid** waste discharge from an on-site sewage treatment system.

Effluent Pump: A pump designed for the transfer of effluent.

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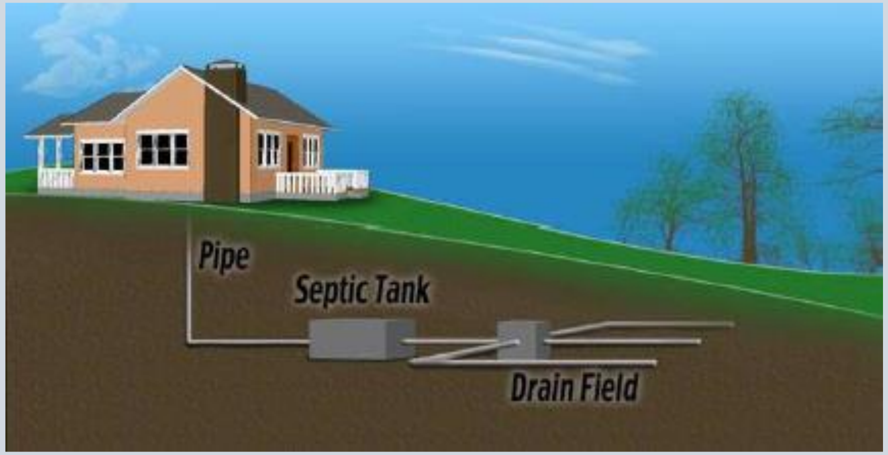
Types of Systems that use Effluent Pumps

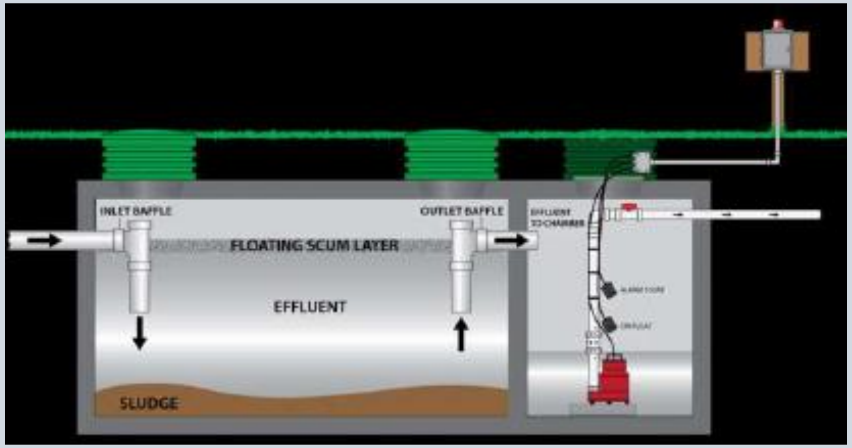
- STEP (Septic Tank Effluent Pump) Systems
- Enhanced-Flow STEP Systems
- LPP (Low-Pressure Pipe) Distribution Systems

STEP (Septic Tank Effluent Pump) Systems



All wastewater is collected in the septic tank. There is generally a separation wall or settling tank for solids.

An effluent pump transfers grey water, which is collected in a pump chamber, to a distribution box and then by gravity to a drain field.

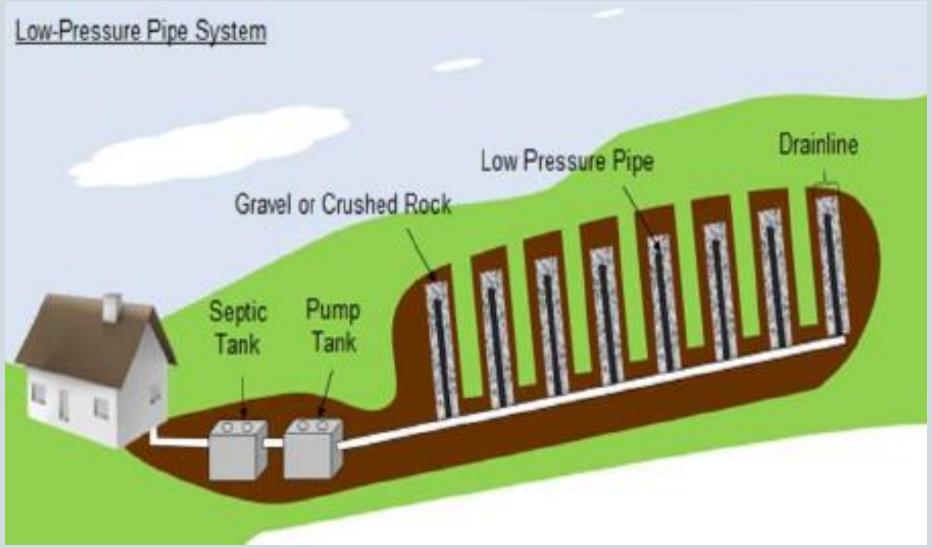


Enhanced-Flow STEP Systems

An effluent pump removes a predetermined volume of collected septic overflow to a distribution box. By pumping a predetermined volume each cycle, the absorption field has time to stabilize between cycles and allows flexibility in locating the absorption field.

LPP (Low-Pressure Pipe) Distribution System

An effluent pump removes a predetermined volume of collected septic overflow and distributes it throughout the absorption field at a uniform pressure. This allows even more flexibility in locating absorption fields because the absorption field can be located on sloping or uneven terrain that would be unsuitable for gravity flow systems.



Pump Capacity (GPM) for STEP and Advanced-Flow STEP systems

Pump Capacity is the rate of flow (GPM) necessary to make the system function properly. In onsite wastewater treatment, most commonly any pumps that meet the minimum scouring velocity are sufficient.

Minimum Scouring velocity is the rate of flow accepted by the industry to carry solids. A rate of 2 feet per second is commonly used in the pump industry.

This flow rate equals:

- 12 GPM in 1-1/2" pipe
- 21 GPM in 2" pipe
- 46 GPM in 3" pipe

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Total Dynamic Head (TDH)

Total Dynamic Head is combination of two components; Static Head and Friction Head and is expressed in feet of head.

Total Dynamic Head = Static Head + Friction Head

+ Operating Head (only in LPP systems)

Static Head

Static head is the actual vertical distance measured from the minimum water level in the pump chamber to the highest point in discharge pipe system.

CAUTION: The point of discharge may not be the highest point in the discharge pipe system.

Friction Head

- Friction Head is the additional head created in the discharge system due to resistance to flow within its components. All straight pipe, fittings, valves, etc. have a friction factor which must be considered.

- These friction factors are converted, and expressed as equivalent feet of straight pipe, which can be totaled and translated into feet of head.
- Step 1 – Determine discharge pipe size
- Step 2 - Calculate length of discharge
- Step 3 – Determine equivalent feet of pipe for any pipe fittings
- Step 4 – Reference minimum flow to find friction loss factor

Step 1 – Determine Discharge Pipe Size

In most effluent systems, 1-1/2” pipe is suggested.

For very long runs, it may be more economical to use 2” pipe, which cuts down on the friction losses. Note that the larger the pipe size inner diameter, the more flow is required to move solids.

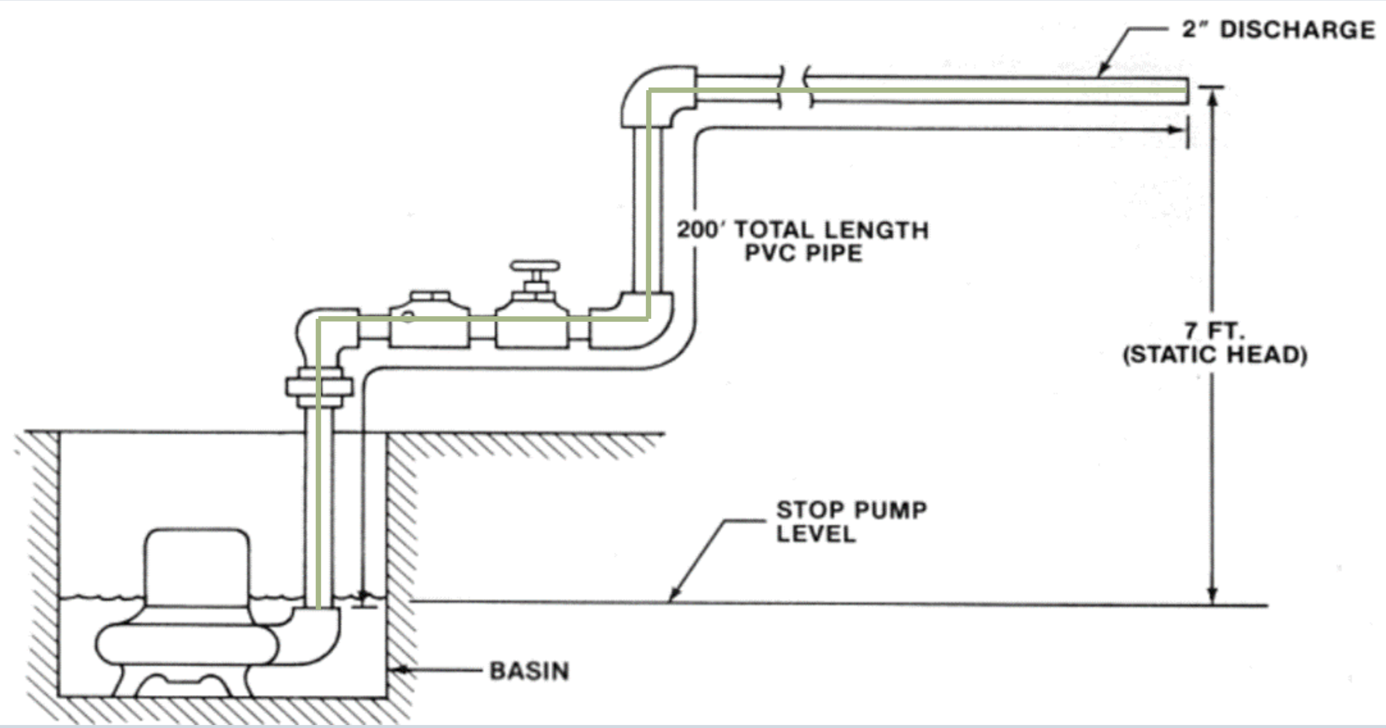
<u>MINIMUM FLOW REQUIREMENTS</u>

2 feet per second =

- 9 GPM through 1-1/4” pipe
- 12 GPM through 1-1/2” pipe
- 21 GPM through 2” pipe
- 46 GPM through 3” pipe

Step 2 – Calculate total length of pipe of discharge line

The length of discharge piping is measured from the opening of the pump to final discharge point, following all contours and bends.



Step 3 – Equivalent feet of pipe of fittings

Consider all fittings; elbows, gate valves, check valves used in the discharge pipe between pump and gravity.

Nominal Pipe Size	90 Elbow	45 Elbow	STD Tee (Diversion)	Check Valve	Coupling or Disconnect	Gate Valve
1-1/4”	7.0	3.0	7.0	11.0	1.0	0.9
1-1/2”	8.0	3.0	9.0	13.0	1.0	1.1
2”	9.0	4.0	11.0	17.0	2.0	1.4
3”	12.0	6.0	17.0	26.0	4.0	2.0

Add these values to your length of discharge piping for a total equivalent length of pipe.

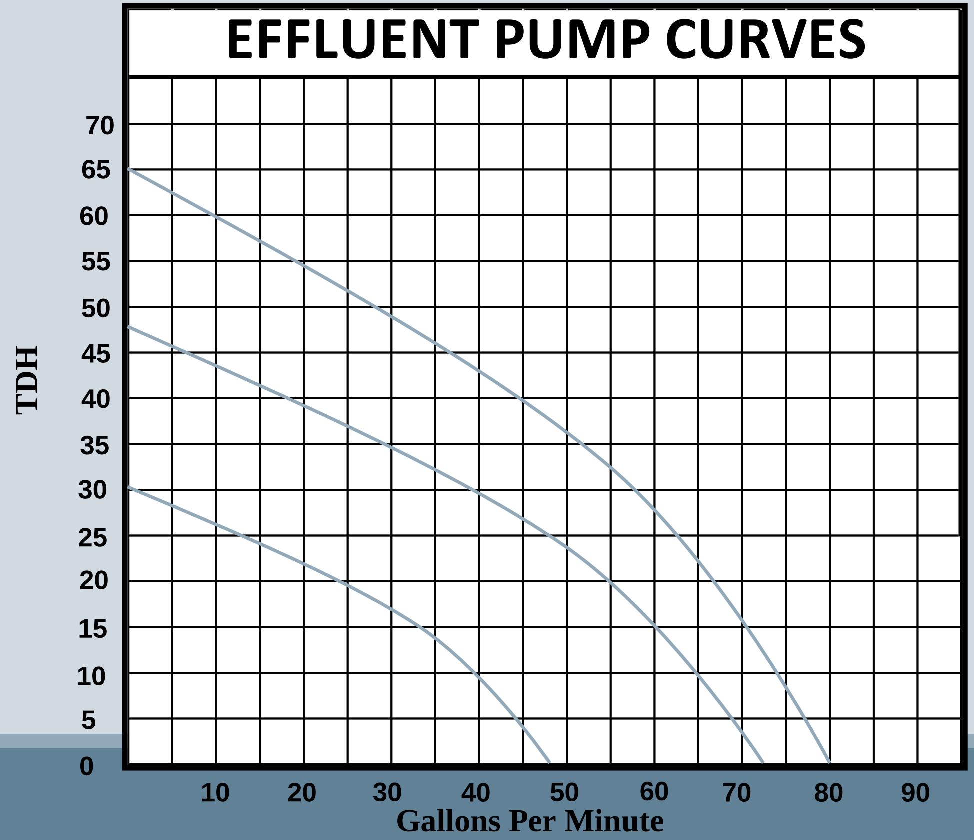
Step 4 – Determine Friction factor for pump capacity

Reference the chart below to find the resulting friction factor for the pump capacity. This factor represents the Friction Head for every 100 feet of equivalent pipe. Multiply this number by the number of 100 feet increments to determine your friction head.

GPM	1-1/4”	1-1/2”	2”	3”
10	1.5	0.7	0.2	
20	5.2	2.5	0.9	0.3
30	11.2	5.2	1.8	0.6
40	19.0	9.0	3.1	0.4
50		13.6	4.7	0.7
60		19.0	6.6	0.9
70			8.8	1.5
80			11.3	1.5
90				1.9
100				2.3

Pump Selection

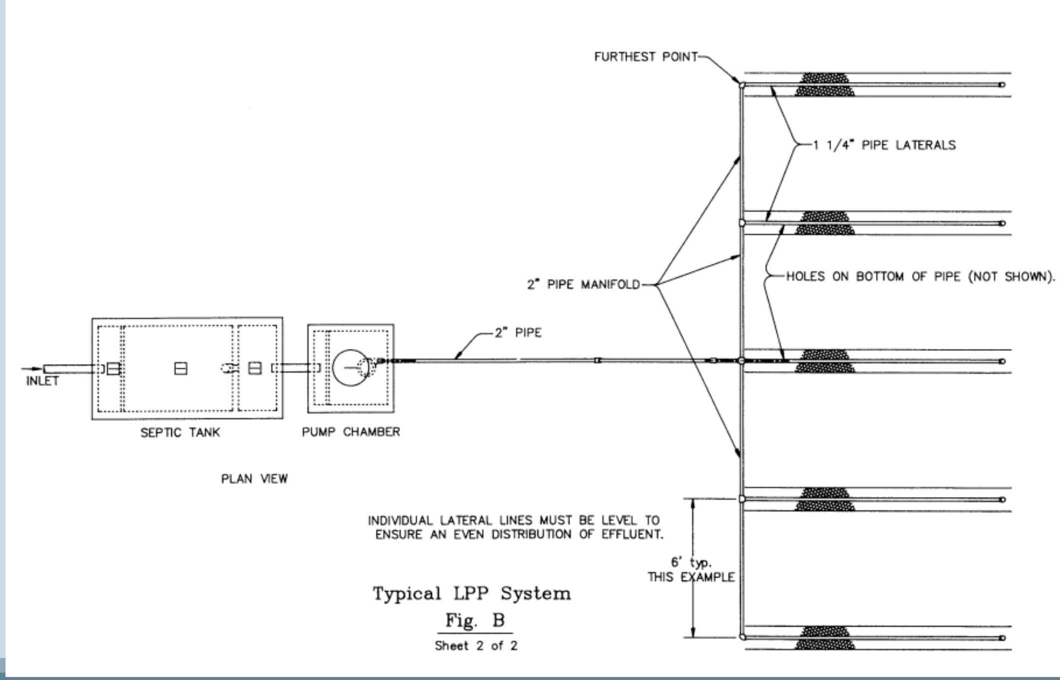
A correctly sized pump will be able to deliver the minimum required capacity (GPM) at the calculated Total Dynamic Head (feet). This can be determined by comparing these numbers to the performance chart or curve of the pump.



Low-Pressure Pipe (LPP) Systems

Pump capacity requirements of an LPP system will differ from that of the STEP and Enhanced-Flow STEP Systems.

Instead of using just the pipe diameter to determine flow, the number of holes, size of holes, and operating head* will all need to be considered.



*The operating head, also known as "squirt height" is the pressure required at each lateral hole to properly maintain the system. This head is added to the total dynamic head.

Low-Pressure Pipe (LPP) Systems

Use the chart below to find the appropriate flow rate per hole, cross referencing the hole diameter by the operating head (ft.)

Operating Head (ft.)	3/32”	1/8”	5/32”	3/16”	7/32”	1/4”
1	0.10	0.18	0.29	0.42	0.56	0.74
2	0.15	0.26	0.41	0.59	0.80	1.05
2.5	0.16	0.29	0.46	0.66	0.89	1.17
3	0.18	0.32	0.50	0.72	0.98	1.28
4	0.21	0.37	0.58	0.83	1.13	1.48
5	0.23	0.41	0.64	0.94	1.26	1.65

Multiply this number by the number of holes in the laterals to find the required flow of the pump.

Other Considerations

Solids Handling – Consideration must be given to the solids handling capability of an effluent pump. Many codes or definitions interpret effluent as pretreated liquid containing few solid particles; therefore a "clear water pump" could theoretically be used for effluent liquid. SSPMA recommends that unless effluent is pre-filtered, the pump should have the ability to pass at least ½" solids for improved flow and reliability.

Pump Controls – There are several types of control devices to automatically operate effluent pumps. Controls can be adjusted to pump the desired volume per cycle. For Enhanced-Flow STEP systems, SSPMA recommends a pump cycle equal to approximately 60% of the drainage piping volume.

Other Considerations

Pump Chamber – To create the proper pumping volume per cycle, divide the pump chamber total capacity by its height in inches to determine the gallons per inch. Then divide the gallons per cycle by gallons per inch to find the correct inches per pump cycle. This number is the Pump Control Differential – the distance between ON and OFF settings for the controls. i.e. floats should be set this many inches apart. [Note: Effluent pumps should remain submersed after pumping to protect the pump from corrosion]

Check Valve - If a check valve is installed, the discharge pipe between pump and point of gravity will remain full. A check valve should only be used if the total volume of liquid draining back to the pump chamber is greater than approximately 25% of the volume pumped per cycle. Please note that if a check valve is installed, all piping must be below the frost line. Consult local codes.

Example (scenario)

A customer is installing a Low-pressure pipe effluent system and requires an effluent pump to service this system.

The distance from pump chamber to manifold is 250 feet horizontally, through 2” pipe with two 90 elbows and one check valve. The total elevation change is 15 feet.

There are four laterals for this system, each lateral has twenty (20), 3/16” holes and the required operating head (“squirt head”) is designated to be 2 feet.

Find an appropriate effluent pump for this application.

Example (Capacity)

Because this is an LPP system, the capacity will be determined by the number of holes and flow rate through those holes.

There are a total of 80 holes, 4 laterals with 20 holes each.

Using the appropriate chart, we can find that each 3/16” hole requires 0.59 gallons per minute at 2 foot operating head.

Operating Head (ft.)	3/32”	1/8”	5/32”	3/16”	7/32”	1/4”
2	0.15	0.26	0.41	0.59	0.80	1.05

The total flow capacity required is 47.2 gpm.

Example (Total Dynamic Head)

The static head is just the elevation change in feet. For this example, 15 feet will be the static head.

To find the friction loss, we first need to identify the equivalent feet of pipe.
There are two (2) 90 degree elbows and one (1) check valve in the discharge piping. Both 2”.

The equivalent feet of pipe can be found on the fittings chart.

2” 90 degree elbow = 9.0 feet , 2” check valve = 17.0 feet

The total equivalent feet of pipe is 250 (straight pipe) + 9.0 X 2 (elbows) + 17.0 (check valve) =

285 feet of equivalent pipe.

Example (Total Dynamic Head)

Now that we have the total equivalent feet of head, we can find the friction loss in the piping system.

The required GPM is 47.2 and we will round that to 50 for this purpose. According to the Friction factor chart, for every 100 feet of equivalent pipe, it will add 4.7 feet of friction head.

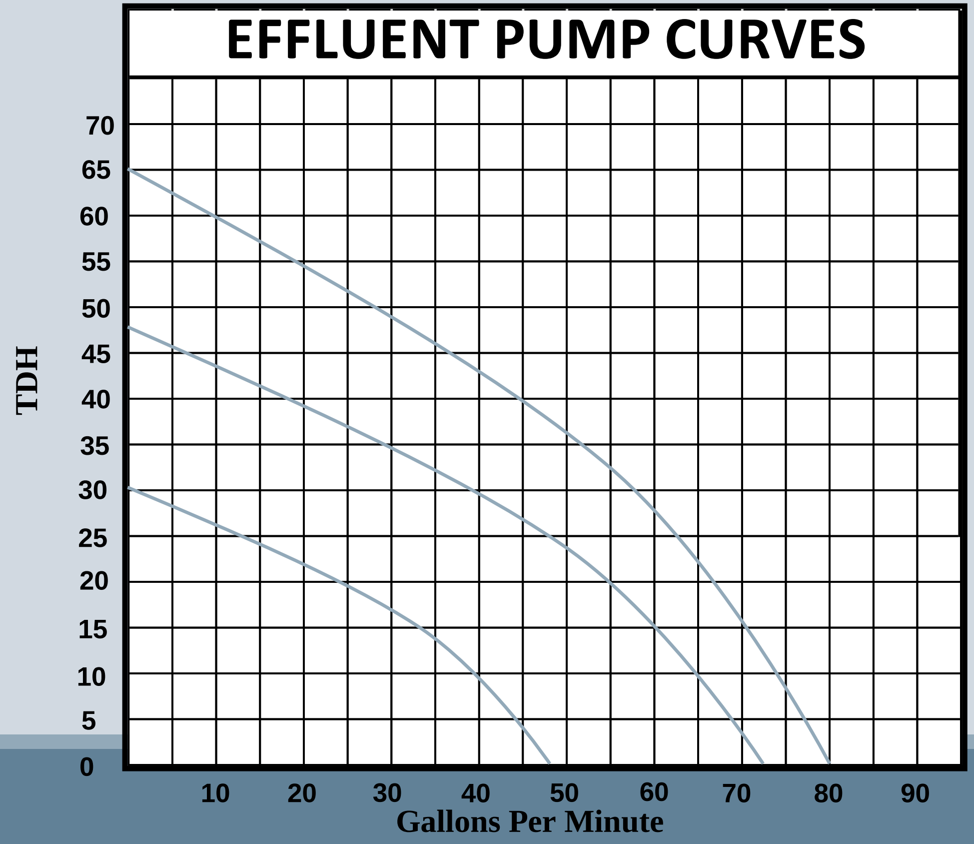
GPM	1-1/4”	1-1/2”	2”	3”	4”
50			4.7	0.7	

We multiply the equivalent feet by this friction factor to find the total friction head.
2.85 X 4.7 = 13.4 feet of friction head.

Total Dynamic head = 15 feet (static) + 13.4 (friction) + 2 (operating head) = 30.4’ TDH

Example (pump selection)

To determine the best pump for this application you would want an effluent pump, capable of pumping at least ½” solids, that can deliver 47.2 gpm at a total dynamic head of 30.4’ TDH. Only one curve below fits these requirements.



Appendix

Equivalent feet of straight pipe for pipe fittings by pipe size

Nominal Pipe Size	90 Elbow	45 Elbow	STD Tee (Diversion)	Check Valve	Coupling or Disconnect	Gate Valve
1-1/4”	7.0	3.0	7.0	11.0	1.0	0.9
1-1/2”	8.0	3.0	9.0	13.0	1.0	1.1
2”	9.0	4.0	11.0	17.0	2.0	1.4
3”	12.0	6.0	17.0	26.0	4.0	2.0

Appendix

Friction loss in feet of head per 100 ft increment of equivalent pipe

GPM	1-1/4”	1-1/2”	2”	3”
10	1.5	0.7	0.2	
20	5.2	2.5	0.9	0.3
30	11.2	5.2	1.8	0.6
40	19.0	9.0	3.1	0.4
50		13.6	4.7	0.7
60		19.0	6.6	0.9
70			8.8	1.5
80			11.3	1.5
90				1.9
100				2.3

Appendix

Gallons per hole by pipe size and operating head in LPP systems

Operating Head (ft.)	3/32”	1/8”	5/32”	3/16”	7/32”	1/4”
1	0.10	0.18	0.29	0.42	0.56	0.74
2	0.15	0.26	0.41	0.59	0.80	1.05
3	0.18	0.32	0.50	0.72	0.98	1.28
4	0.21	0.37	0.58	0.83	1.13	1.48
5	0.23	0.41	0.64	0.94	1.26	1.65

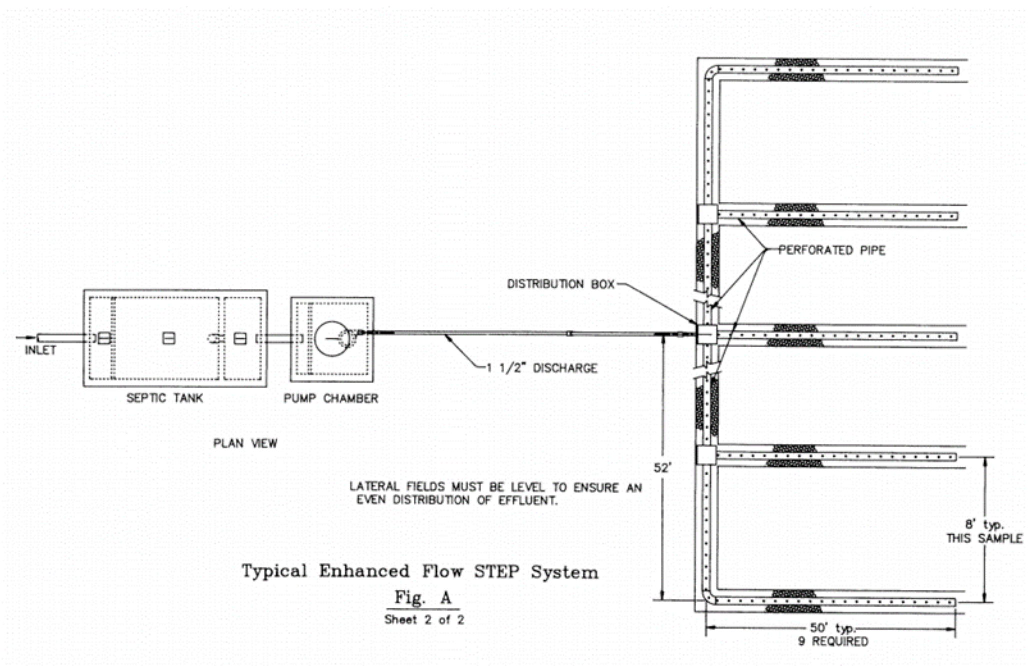
Appendix

Volume capacity per foot of pipe by pipe size

Pipe Size SCH 40	Volume in Gallons per foot of pipe
1-1/4”	0.07
1-1/2”	0.10
2”	0.17
3”	0.38
4”	0.65

Appendix

Typical Enhanced-Flow STEP system drawing



Appendix

Typical LPP (Low Pressure Pipe) system drawing