FOR NEW OR REPLACEMENT

EFFLUENT PUMPS

RECOMMENDED GUIDELINES FOR SIZING EFFLUENT PUMPS

SSPMA CERTIFIED

SUMP & SEWAGE PUMP MANUFACTURERS ASSOCIATION • P.O. BOX 44071 • INDIANAPOLIS, IN 46244

SAFETY

Product labels and manufacturer's service and maintenance recommendations must be consulted prior to installation, service or maintenance to ensure that safe procedures are followed. Among potential hazards are the following:

WARNINGS: ELECTRICAL

A. To reduce the risk of shock

1. Always disconnect the pump from power source before handling.

2. Pumps furnished with a three-prong plug must connect to a properly grounded receptacle.

3. Do not remove ground pin on plug.

4. Three-phase (no plug provided) motor protection and grounding must be provided by installer.

5. See instruction manual for proper installation

B. Electrical installations must be in accordance with the National Electrical Code, Canadian Electrical Code and all applicable local codes and ordinances.

WARNING: HEALTH

Effluent and sewage pumps can present a health hazard and must be handled by qualified service personnel.

PURPOSE

To provide general and technical information regarding the selection and sizing of EFFLUENT PUMPS in on-site waste treatment systems. The systems described in this guide are examples only. Your system and site must be evaluated by a qualified on-site system designer.

CONTENTS

DEFINITIONS

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

EFFLUENT PUMP: A pump designed for the transfer of EFFLUENT.

There are many alternatives and variations presently in use. Systems that use pumps include septic tank effluent pump (STEP), enhanced flow STEP, drip irrigation, spray irrigation, recirculation, biofiltration, low–pressure pipe distribution (LPP), and supplemental pretreatment. Three (3) of the more common systems using EFFLUENT PUMPS are:

STEP (SEPTIC TANK EFFLUENT PUMP) SYSTEMS

An EFFLUENT PUMP transfers septic tank EFFLUENT, collected in the Pump Chamber, to a distribution box or manifold for gravity flow to an absorption field or sewer line. The advantage of this method compared to other gravity systems is that the distribution box, the absorption field, or sewer line can be located at a higher elevation than the septic tank. Disadvantages are common with all gravity systems, i.e., progressive plugging of drain holes and absorption areas and minimal effectiveness in hard soils or high water tables.

ENHANCED-FLOW STEP SYSTEMS

An EFFLUENT PUMP lifts a predetermined volume of collected septic overflow to a distribution box or manifold for gravity flow to an absorption field. Enhanced-Flow Systems have the advantage of flexibility in locating the absorption field as well as improved performance compared to strictly gravity flow systems. By pumping a predetermined volume each cycle, the absorption field has time to stabilize between cycles. Loss of effectiveness in hard soils and high water tables and progressive plugging of drain holes and absorption areas are disadvantages.

LPP (LOW-PRESSURE PIPE) DISTRIBUTION SYSTEMS

An EFFLUENT PUMP lifts a predetermined volume of collected septic overflow and distributes it throughout the absorption area at a uniform pressure. The advantage of flexibility in locating the absorption field is inherent. In addition, the uniform distribution minimizes plugging and is significantly more effective in hard soils and high water tables. LPP distribution fields may be smaller in area than those used in other types of septic systems. Absorption fields can be located on sloping ground or on uneven terrain that would be unsuitable for gravity flow systems. LPP Systems require planning, hydraulic design and layout unique to the terrain on which they are installed.

THIS DOCUMENT WILL DEAL WITH SIZING PUMPS FOR ENHANCED-FLOW STEP SYSTEMS AND LPP DISTRIBUTION SYSTEMS. SSPMA RECOMMENDS USE OF THESE SYSTEMS. CONVENTIONAL STEP SYSTEMS OFFER NO ADVANTAGE IN TERMS OF EFFICIENCY AND DRAINAGE FIELD LIFE COMPARED TO GRAVITY FLOW SYSTEMS AND WILL NOT BE ADDRESSED IN THIS MANUAL. HOWEVER, THE PRINCIPLES GOVERNING PIPE SIZE, SELECTION AND CONTROL SETTINGS AS DESCRIBED IN DETAIL FOR ENHANCED-FLOW STEP SYSTEMS AND LPP DISTRIBUTION SYSTEMS MAY BE APPLIED TO STEP SYSTEMS.

A. GENERAL

1. Daily Flow

Daily Flow for residential installations is generally accepted to be 150 gallons per day (GPD) per bedroom (three-bedroom house, 150 GPD X 3 Bedroom = 450 GPD). See TABLE 6 for typical Daily Flow volumes for other types of installations.

2. Location and Layout of System

The lateral drainage lines (laterals) should be located in suitable soil on the lot as determined by the local authority. All vertical separation from restrictive horizons, and setback requirements from wells, lot lines and waterways must be observed (check local codes). The exact location of the tank and pumping chamber as well as drainage and landscaping improvements must be considered. A repair or replacement space on suitable soil equal in area to the absorption field should be considered.

When selecting the best layout to fit the desired site, individual lateral lines must be level. Spacing between lateral lines must be 5 ft. or more to minimize field overloading.

B. GRAVITY OR ENHANCED-FLOW STEP

1. Loading Rate

Loading rate for gravity or Enhanced-Flow STEP systems is determined by the local authority using a combination of percolation rate, local loading rate, and/or a site evaluation.

EXAMPLE: (See TABLE 1) For a sandy clay loam, the soil permeability is 2.5 in./hr., resulting in a loading of 0.5 GPD/ft.^{2}.

2. Width and Depth of Lines

The width and depth are determined by local conditions.

EXAMPLE: The width of the lateral trench is two (2) feet.

3. Length of Laterals

The length of laterals is determined by local conditions.

EXAMPLE: The length of laterals for gravity or Enhanced-Flow STEP with 2 ft. trench width is obtained by using the loading rate from TABLE 1 (0.5 GPD/ft.^{2}) and a cross reference to linear feet per 100 gallons that is found in TABLE 3 (100 ft.), multiplied by the daily flow (450 GPD) divided by 100 (100 ft. x 450 GPD / 100 = 450 ft.).

C. LPP FIELDS

In a LPP system, the length and diameter of the manifold and lateral lines must be sized to minimize excessive friction losses.

1. Loading Rate

Loading Rate for LPP systems is determined by the local authority using a combination of percolation rate, local loading rate, and/or a site evaluation.

EXAMPLE: (See TABLE 2) A sandy clay loam, with a percolation rate of 2.5 in./hr. would result in a loading rate of 0.25 GPD/ft.^{2}.

2. Length of Laterals

   a. Compute the total area needed for the absorption field by dividing the daily flow by the loading rate.

      EXAMPLE: 450 GPD (determined in IIA1)/ loading rate of .25 GPD/ft.^{2} (from TABLE 2)= 1800 ft.^{2}

   b. Determine the total length of lateral lines by dividing the total area by the spacing used between lines.

      EXAMPLE: 1800 ft.^{2} (total area)/6 ft. (line spacing) =300 ft.

3. Number of Holes in Laterals

   The flow rate depends on the operating head, and the size and number of holes in the distribution lines.

   EXAMPLE: An operating head of 3 ft. will provide adequate performance in most instances. The holes will be 3/16 inches in diameter and the hole spacing can range from 3 to 6 ft. depending on soil permeability and available area. In this example, 6 ft. hole spacing and an operating head of 3 ft. will be used. The number of holes is determined by dividing the length of laterals (300 ft.) by the hole spacing selected (300 ft./ 6 ft. = 50 holes). For other flow rates with different hole sizes and different operating heads, See TABLE 8.

4. Width and Depth of Laterals for LPP system are specified by the local code or designer. Some typical dimensions are: 12-24 inches deep by 8-24 inches wide. The lateral line size, location in the ditch and amount of gravel under and over is also specified by the local code or designer.

5. Absorption fields located on sloping terrain.

   a. Lateral lines may be installed at different elevations. However, the elevation of each individual lateral line should be constant throughout its entire length.

   b. The operating head in each individual lateral line must be adjusted to the design operating head selected. Operating head can be adjusted as follows:

      1. Install a valve in each individual lateral line near its exit from the manifold.

      2. At the end of each lateral line, install a vertical section of pipe equal to the design operating head selected.

      3. Adjust each individual lateral line valve so that water just begins to overflow from the vertical section of pipe located at the end of the lateral.

      4. The sections of vertical pipe can be removed after adjustment of the operating head if necessary; however, when removed, the ends of the pipe must be capped and made accessible for future maintenance.

   NOTE: Other methods are available to balance the operating head of laterals such as adjusting the quantity and size of holes. This must be designed into the system by the engineer.

A. PUMP CAPACITY

PUMP CAPACITY is the rate of flow in gallons per minute (GPM) necessary to make the system function properly. For all but large commercial and industrial applications, pumps meeting minimum flow requirements are sufficient.

1. Select the discharge pipe size. Unless specified by local codes, select the smallest practical size. For the first approximation use 1-1/2" pipe.

2. Minimum PUMP CAPACITY is that rate of flow necessary to carry solids, if present. The rate of flow accepted by the industry is that which will ensure a velocity of 2 feet per second in the discharge line prior to the point where gravity flow begins. This flow rate equals:
   12 GPM in 1-1/2" pipe
   21 GPM in 2" pipe
   46 GPM in 3" pipe

B. TOTAL DYNAMIC HEAD (TDH)

TOTAL DYNAMIC HEAD (TDH) is a combination of two components, Static Head and Friction Head, and is expressed in feet. See FIGURE A.

1. Static Head (shown on FIGURE A) is the actual vertical distance measured from the minimum water level in the PUMP CHAMBER to the point of discharge into the manifold or distribution box.

CAUTION: The point of discharge may not be the highest point in the piping system. A pump must be selected that has a shut-off head greater than the highest point in the pipe system and the velocity of the water at the highest point must be at least 2 ft. per second.

2. 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 friction losses which depend on the flow rate and pipe size. Friction Head can be determined by the following steps:

   a. Measure the length of discharge pipe from the discharge opening of the pump to the point of discharge into the manifold or distribution box of the system, following all contours and bends.

   b. To determine the equivalent length of discharge piping represented by the various fittings and valves, refer to TABLE 4 and total all values. Add this value to the measured length of discharge pipe. Divide by 100 to determine the number of 100-ft. increments of pipe.

   c. Refer to TABLE 5 and find the required PUMP CAPACITY in the left column. Follow across to the number below the pipe size being used, which represents the Friction Head per 100 ft. of pipe. Multiply this value by the number of 100-ft. increments of pipe from Step b. The result is the Friction Head.

3. Add Static Head and Friction Head to determine TOTAL DYNAMIC HEAD (TDH). Evaluate TDH to determine whether another pipe size should be considered. Larger pipe sizes result in reduced Friction Head but require greater PUMP CAPACITIES (See III.A.2.).

C. PUMP SELECTION

Select a pump which can deliver the required PUMP CAPACITY at the calculated TOTAL DYNAMIC HEAD. In addition to knowing the required PUMP CAPACITY and TOTAL DYNAMIC HEAD, consideration must be given to the "solids handling requirements" of local codes before the proper pump selection can be made. Many codes and/or definitions interpret the term EFFLUENT as a pretreated liquid containing few solid particles; therefore, a "clear-water pump" could theoretically be used for EFFLUENT liquid transfer. However, SSPMA recommends that, unless the effluent is pre-filtered, the pump have the ability to pass at least one-half inch (1/2") diameter solids for improved flow and reliability. If the effluent is pre-filtered, effluent pumps of at least the solids size passage capability of the filter media may be used. Consult filter and pump manufacturers' specifications.

CAUTION: The point of discharge may not be the highest point in the piping system. A pump must be selected that has a shut–off head greater than the highest point in the pipe system and the velocity of the water at the highest point must be at least 2 ft. per second.

D. PUMP CHAMBER

The pump chamber is the tank where the pump is located, whether that be in the primary septic tank or a secondary pumping chamber. Check your local code.

E. PUMP CONTROLS

Several types of control devices are available to automatically operate EFFLUENT PUMPS.

Controls must be adjustable to pump the desired gallons per cycle. SSPMA recommends that the amount of EFFLUENT pumped per cycle to the field in an Enhanced-Flow Step System equals approximately 60% of the drainage piping volume. TABLE 7 shows the volume in gallons contained per foot of 1-1/4" through 4" diameter pipe. Total the discharge and 60% of the drainage piping volumes to determine the required pumping volume per cycle.*

Divide the PUMP CHAMBER volume (expressed in gallons) by its depth in inches to get the number of gallons per inch. Divide gallons per cycle by gallons per inch to determine the number of inches per pumping cycle. This number of inches per pumping cycle is the PUMP CONTROL DIFFERENTIAL and defines the ON and OFF control settings. Consult manufacturer's literature and/or local codes for pump submergence recommendations.

* *If a check valve is installed, the length of pipe from the pump to the point of gravity flow or to the manifold connection remains full. Therefore, eliminate this length from the above calculation. Consult the pump manufacturer's installation instructions for vent hole requirements. A check valve should only be used if the total volume of liquid capable of draining back into the pump chamber is greater than approximately 25% of the volume pumped per cycle.*

CAUTION: If a check valve is installed, all piping must be below the frost line. Consult local codes.

F. **EXAMPLE FOR ENHANCED–FLOW STEP SYSTEMS:** Refer to FIGURE A. Determine the required pump performance and CONTROL DIFFERENTIAL assuming that the illustrated system is serving a three-bedroom residence.

PUMP CAPACITY

1. For the first approximation, use a pipe size of 1-1/2".

2. The minimum PUMP CAPACITY is 12 GPM (See III.A.2.).

TOTAL DYNAMIC HEAD

1. The vertical distance from the pump turn-off level to the point of discharge into the distribution box is 6 ft. This is the Static Head.

2. The measured length of pipe from the pump discharge to the distribution box is approximately 170 ft.

   a. From TABLE 4, the equivalent length of discharge pipe resulting from fittings is:

	Quantity	Equivalent Length of Fittings	Total
Gate Valve	1	1.1	1.1
45 Elbow	2	3.0	6.0
90 Elbow	1	8.0	8.0
	Total Equivalent Feet 15.1		

   Adding this approximate 15 ft. to the 170 ft. discharge pipe length gives 185 ft. or 1.85 100-ft. increments.

   b. Refer to TABLE 5. Based on a flow rate of 12 GPM through 1-1/2" pipe, Friction Head is 1.1 ft. per 100 ft. of pipe. Multiply 1.1 by 1.85 (the number of 100-ft. increments) to get a Friction Head of 2.0 ft.

3. Adding the 6 ft. Static Head to the 2 ft. Friction Head results in an 8 ft. TDH.

PUMP SELECTION

The pump selected must be able to deliver at least 12 GPM at 8 ft. TDH and should be capable of handling 1/2" diameter solids.

CAUTION: The point of discharge may not be the highest point in the piping system. A pump must be selected that has a shut–off head greater than the highest point in the pipe system and the velocity of the water at the highest point must be at least 2 ft. per second.

PUMP CHAMBER

Based on the generally-accepted figure of 150 gallons per day (GPD) per bedroom, daily flow for this three-bedroom home will be 450 gallons. In this example local codes require a secondary pump chamber with a capacity of twice the daily flow. PUMP CHAMBER size is 450 gallons x 2 or 900 gallons.

PUMP CONTROLS

1. From FIGURE A and II B-3, there is approximately 170 ft. of 1-1/2" pipe and 450 ft. of 4" pipe in this installation. There is no check valve. From TABLE 7:*

Size	Length	Volume Per Ft.	Total Pipe Volume
1-1/2"	170 ft.	0.10	17.0 gallons
4"	450 ft.	0.65	293.0 gallons

2. The amount of effluent to be pumped per cycle is 60% of the drainage piping volume (.60 x 293 gallons) plus all of the discharge pipe volume (17 gallons) for a total of 193 gallons.

3. The number of gallons per inch of depth in the PUMP CHAMBER is its volume divided by its depth, (900 gallons/ 48 in.) which is 18.75 gallons per inch.

4. The PUMP CONTROL DIFFERENTIAL setting is determined by dividing gallons per cycle by gallons per inch (193 gallons / 18.75 gallons per inch). The PUMP CONTROL DIFFERENTIAL setting is approximately 10.3 in.

* ***Gravity flow distribution fields must be designed in accordance with local codes and authority.***

A. PUMP CAPACITY

PUMP CAPACITY is the rate of flow in gallons per minute (GPM) necessary to make the system function properly.

PUMP CAPACITY is determined by laying out the proposed distribution network as described in Section II. In our example, using 3/16" diameter holes, total the number of holes in the lateral line. From TABLE 8, at our selected 3' of operating head, the flow per hole is 0.72 GPM. Multiply the number of holes by the flow per hole to obtain the proper PUMP CAPACITY. For other flow rates at different operating heads and hole diameters, see TABLE 8.

B. TOTAL DYNAMIC HEAD

TOTAL DYNAMIC HEAD (TDH) is a combination of three components, Static Head, System Operating Head, and Friction Head and is expressed in feet. (See FIGURE B).

1. Static Head is the actual vertical distance measured from the minimum water level in the PUMP CHAMBER to the point of discharge into the manifold.

2. In this example, the System Operating Head is 3 feet. If the elevation of the piping system upstream of the manifold is greater than the elevation of the manifold connection, pressure in excess of the recommended operating head (3 ft.) may result at the holes. A control valve may be required to adjust system operating head to 3 ft. See II.C.5

3. 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 friction losses which depend on the flow rate and pipe size. Friction Head can be determined by the following steps:

   a. Determine the discharge pipe size. In order to ensure a sufficient rate of flow to carry solids, if present, an industry-accepted velocity of 2 ft. per second in the discharge line is required. These rates equal:
   12 GPM in 1-1/2" pipe
   21 GPM in 2" pipe
   46 GPM in 3" pipe

   b. The length of discharge pipe is measured from the discharge opening of the pump to the point of discharge into the manifold following all contours and bends.

   c. To determine the equivalent length of discharge piping represented by the various fittings and valves, refer to

TABLE 4 and total all values. Add this value to the measured length of discharge pipe. Divide by 100 to determine the number of 100-ft. increments of pipe.

d. Refer to TABLE 5 and find the required PUMP CAPACITY in the left column. Follow across to the number below the pipe size being used, which represents the Friction Head per 100 ft. of pipe. Multiply this number by the number of 100-ft. increments of pipe from Step c. This value is the Friction Head.

4. Add the Static Head, System Operating Head and Friction Head to determine TOTAL DYNAMIC HEAD (TDH).

C. PUMP SELECTION

Select a pump which can deliver the required PUMP CAPACITY at the calculated TOTAL DYNAMIC HEAD. In addition to knowing the required PUMP CAPACITY and TOTAL DYNAMIC HEAD, consideration must be given to the "solids handling requirements" of local codes before pump selection can be made. Many codes and/or definitions interpret the term EFFLUENT as a pretreated liquid containing few solid particles; therefore, a "clear-water pump" could theoretically be used for EFFLUENT liquid transfer. However, SSPMA recommends that, unless the effluent is pre-filtered, the pump have the ability to pass at least one-half inch (1/2") diameter solids for improved flow and reliability. If the effluent is pre-filtered, effluent pumps of at least the solids size passage capability of the filter media may be used. Consult filter and pump manufacturers' specifications.

CAUTION: The point of discharge into the manifold may not be the highest point in the piping system. A pump must be selected that has a shut-off head greater than the highest point in the pipe system and the velocity of the water at the highest point must be at least 2 feet per second.

D. PUMP CHAMBER

The pump chamber is the tank where the pump is located, whether that be in the primary septic tank or a secondary pumping chamber. Check your local code.

E. PUMP CONTROLS

Several types of control devices are available to automatically operate EFFLUENT PUMPS. Controls must be adjustable to pump the desired gallons per cycle.

1. The amount of effluent to be pumped each cycle is equal to the discharge and manifold line volumes plus a multiple of the lateral line volume (subject to local codes). TABLE 7 shows the volume contained per foot of 1-1/4" through 4" diameter pipe.*

2. Divide the PUMP CHAMBER volume (expressed in gallons) by its depth in inches to get the number of gallons per inch. Divide gallons per cycle by gallons per inch to determine the number of inches per pumping cycle. This number of inches per pumping cycle is the PUMP CONTROL DIFFERENTIAL and defines the ON and OFF control settings.

3. Timed dosing can be used in LPP systems by dividing required gallons per cycle by gallons per minute (GPM) calculated in IV.A.2. Timed dosing provides protection during surges but may result in partial doses during low-use periods.

Consult manufacturer's literature and/or local codes for pump submergence recommendations and their recommendations on switch differential and time dosing.

If a check valve is installed, the length of pipe from the pump to the point of gravity flow or to the manifold connection remains full. Therefore, eliminate this length from the above calculation. Consult the pump manufacturer's installation instructions for vent hole requirements. A check valve should only be used if the total volume of liquid capable of draining back into the pump chamber is greater than approximately 25% of the volume per cycle.
CAUTION: If a check valve is installed, all piping must be below the frost line. Consult local codes.

F. **EXAMPLE:** Refer to FIGURE B. Determine the required pump performance and control differential assuming that the illustrated system is serving a three-bedroom residence.

PUMP CAPACITY

1. Referring to Section II and FIGURE D, the number of 3/16" diameter holes required to adequately serve the absorption area is 50.

2. Multiply 50 holes by the flow rate per 3/16" diameter hole of 0.72 GPM. The resulting PUMP CAPACITY is 36 GPM.

TOTAL DYNAMIC HEAD

1. The vertical distance measured from the pump turn-off level to the point of discharge into the manifold is 5 ft. This is the Static Head.

2. The System Operating Head is 3 ft.

3. The PUMP CAPACITY of 36 GPM requires a discharge pipe size of 2" diameter or less to maintain a 2 ft. per second minimum velocity (See IV.B.2).

a. Referring to FIGURE B, the length of the discharge pipe to the point of discharge into the manifold is approximately 88 ft.

b. From TABLE 4, the equivalent length of 2" discharge pipe resulting from fittings is:

	Quantity	Equivalent Length of Fitting	Total
Control (Gate) Valve	1	1.4	1.4
90 Elbow	1	9.0	9.0
45 Elbow	2	4.0	8.0
Tee	1	11.0	11.0
Total Equivalent Feet 29.4			

Adding this approximate 29 ft. to the 88 ft. discharge pipe length gives 117 ft. or 1.17 100-ft. increments.

c. From TABLE 5 a rate of flow of 36 GPM (use 40 GPM) through 2" pipe results in a Friction Head of 3.1 ft. per 100 ft. of pipe. Multiply 3.1 by 1.17 (the number of 100-ft. increments) to get a Friction Head of 4.0 ft.

4. Adding the 5 ft. Static Head to the 4 ft. Friction Head and the 3 ft. System Operating Head results in 12 ft. TDH.

PUMP SELECTION

The pump selected must be able to deliver at least 36 GPM at 12 ft. TDH and should be capable of handling 1/2" diameter solids.

PUMP CHAMBER

Based on the generally-accepted figure of 150 gallons per day (GPD) per bedroom, daily flow for this three bedroom home will be 450 gallons. In this example, local codes require a secondary PUMP CHAMBER with a capacity of twice the daily flow. PUMP CHAMBER size is 450 gallons X 2 or 900 gallons.

PUMP CONTROLS

1. The dosing amount is equal to discharge and manifold line volumes plus, in this example, five times the total lateral line volume. From FIGURES B and D and II.C.2, there is a total of 112 ft. of 2" pipe and 300 ft. of 1-1/4" pipe. There is no check valve. From TABLE 7:

	Size	Length	Volume Per Ft.	Total Volume
Discharge	2"	88 ft.	0.17	15 gallons
Manifold	2"	24 ft.	0.17	4 gallons
Laterals	1-¼"	300 ft.	0.07	21 gallons

In this example, dosing amount is 5 times the 21 gallons lateral line volume plus, the 19 gallons discharge and manifold line volume for a total of 124 gallons per cycle.

2. The number of gallons per inch of depth in the PUMP CHAMBER is its volume divided by its depth, (900 gallons/48 in.), which equals 18.75 gallons per inch.

3. The PUMP CONTROL DIFFERENTIAL is determined by dividing gallons per cycle by gallons per inch. (124 gallons /18.75 gallons per inch). The PUMP CONTROL DIFFERENTIAL setting is approximately 6.6 inches

4. A timed dose is calculated by dividing gallons per cycle by gallons per minute (GPM) (124 gallons per cycle/36 GPM). The timed dose is approximately 3.4 minutes.

A. DUPLEX SYSTEMS

Local codes and/or the type of installation may require the use of a duplex system. In general, the following guidelines can be used:

1. Public or industrial use: Duplex systems are essential to ensure uninterrupted sanitary drainage.
2. Commercial use: Duplex systems are optional depending on the type of business and the need for uninterrupted sanitary drainage.
3. Domestic use: Simplex systems are adequate in most instances.

Duplex systems offer several advantages over Simplex systems: The pumps alternate and therefore share the load; the lag pump can be activated along with the lead pump if inflow is unusually high; if one of the pumps fails, the second pump can handle the inflow until the first unit can be repaired and placed back in service. Duplex systems need not be used in installations where Simplex systems are adequate.

B. ALARMS

Local codes vary in their requirements for alarms for use with Effluent Pumping Systems. Where local codes specify or recommend the type and function of the alarm device, those specifications or recommendations should be followed. In the absence of local codes, SSPMA recommends that a HIGH LEVEL ALARM be installed. In simplex systems, the alarm should be set at a level just above the "ON" level of the pump control switch. In duplex systems, the alarm level should be coincident with or just above the "ON" level of the lag pump. The alarm should be connected to a separate circuit so that the alarm will function in the event of a short in the pump circuit. Battery-powered alarms are available to provide the alarm function in the case of power failure. Other alarms such as ***"POWER FAILURE,"*** ***"PUMP FAILURE,"*** or alarms unique to the installation may be added. Alarms are avail able as audible devices, as visual devices, or as a combination of the two.

C. SERVICE AND MAINTENANCE

The pump manufacturer's service and maintenance recommendations should be followed to ensure proper life and function of the equipment. In some cases, improper service or maintenance may affect the pump warranty. SSPMA recommends that in addition to the manufacturer's service and maintenance instructions, the pump should be removed annually for cleaning and inspection. Submersing the pump in a container filled with a chlorine bleach solution will minimize the danger of disease or infection. All foreign material should be removed and the pump should be inspected for signs of oil leakage, worn or broken components, or other signs of damage. Damaged or worn parts should be replaced. Upon reinstallation, check level switches to ensure proper operation.

SAFETY

Product labels and manufacturer's service and maintenance recommendations must be consulted prior to installation, service or maintenance to ensure that safe procedures are followed. Among potential hazards are the following:

WARNINGS: ELECTRICAL

A. To reduce the risk of shock

1. Always disconnect the pump from power source before handling.

2. Pumps furnished with a three-prong plug must connect to a properly grounded receptacle.

3. Do not remove ground pin on plug.

4. Three-phase (no plug provided) motor protection and grounding must be provided by installer.

5. See instruction manual for proper installation

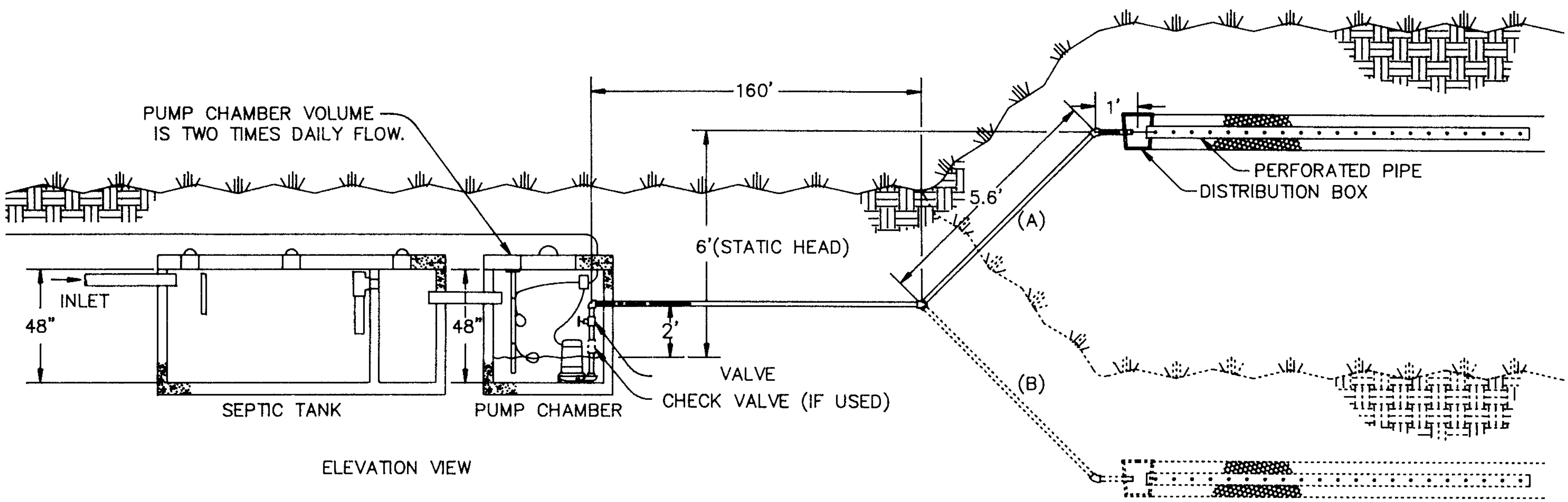
B. Electrical installations must be in accordance with the National Electrical Code, Canadian Electrical Code and all applicable local codes and ordinances.

WARNING: HEALTH

Effluent and sewage pumps can present a health hazard and must be handled by qualified service personnel.

VI APPENDIX

A

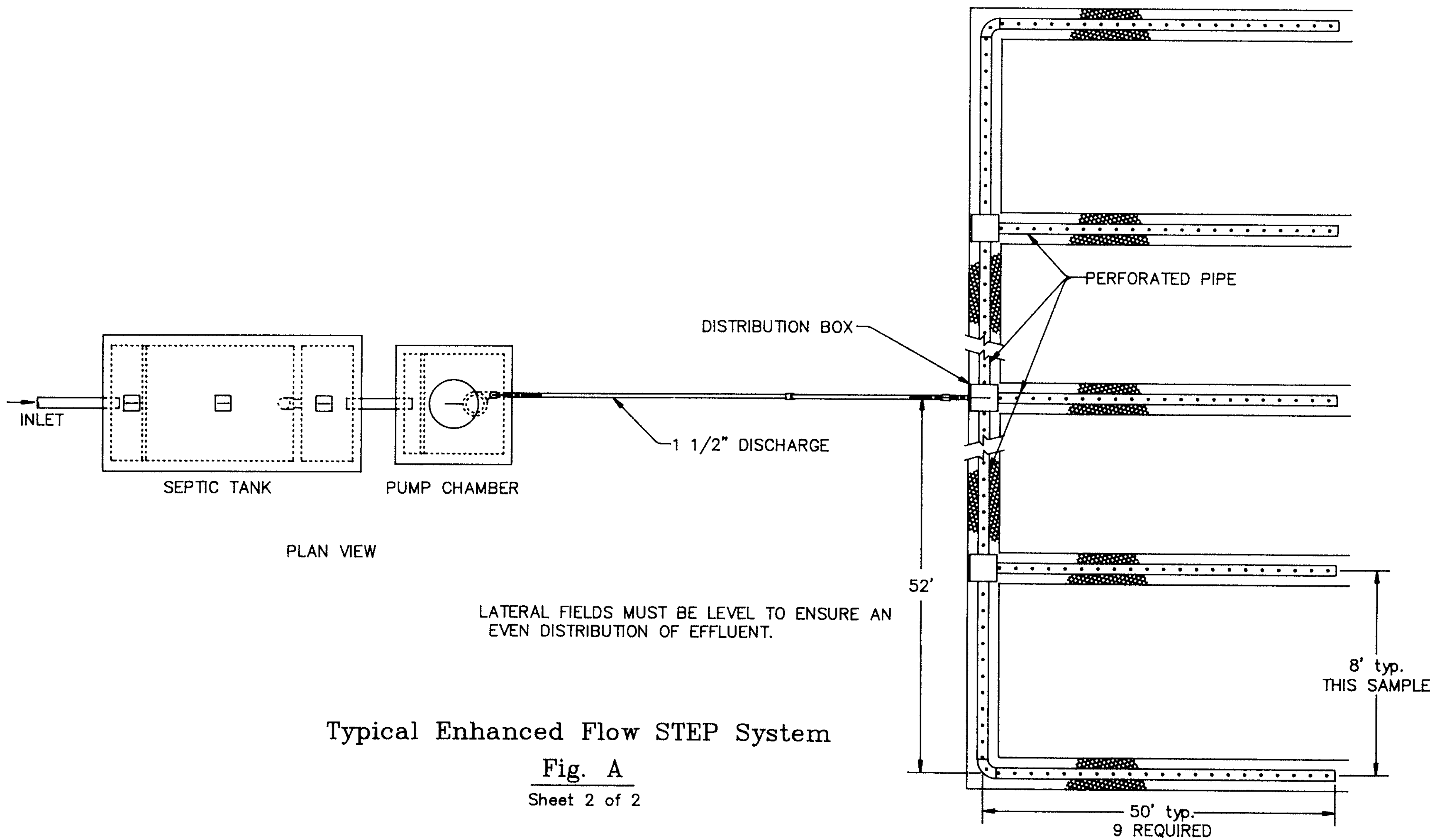


Enhanced Flow Step Systems can be used for Absorption Fields Located at an Elevation Above (A), or Below (B) the Septic Tank.

Typical Enhanced Flow STEP System

Fig. A
Sheet 1 of 2

Septic Tank & Pump Chamber, with Lateral Field Artwork. 6/5/86 DG SKC-672
sheet 1 of 2
880610 Rmc



Typical Enhanced Flow STEP System

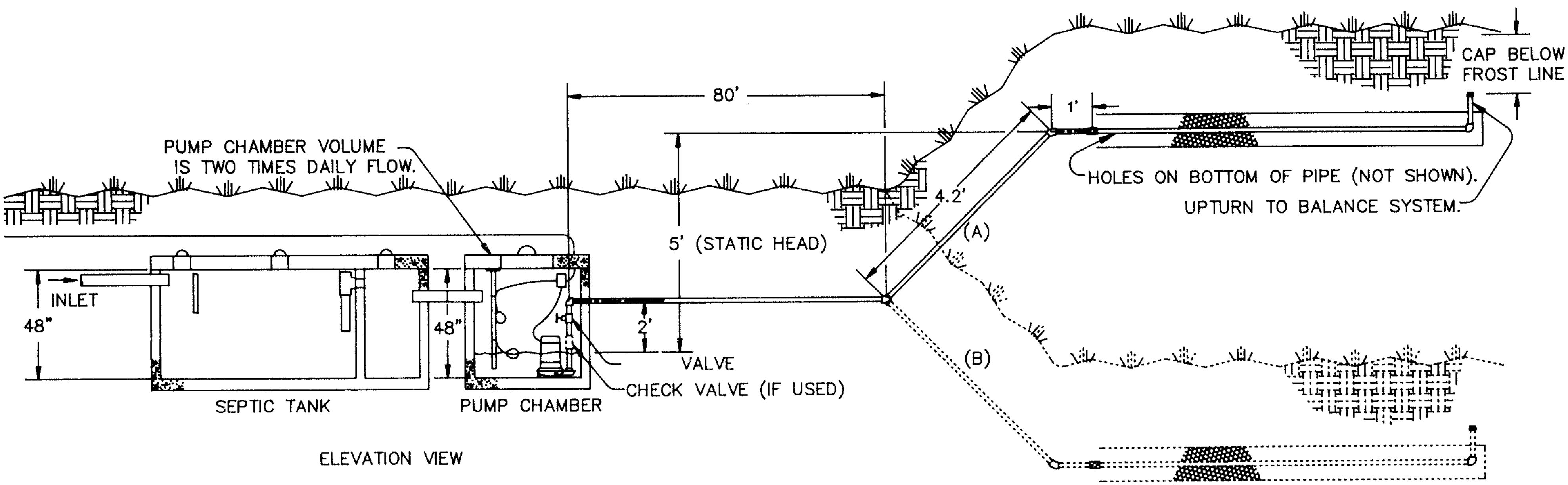
Fig. A

Sheet 2 of 2

Septic Tank & Pump Chamber, with Lateral Field Artwork. 6/6/86 DG SKC-673
sheet 2 of 2
880610 Rmc

A

B



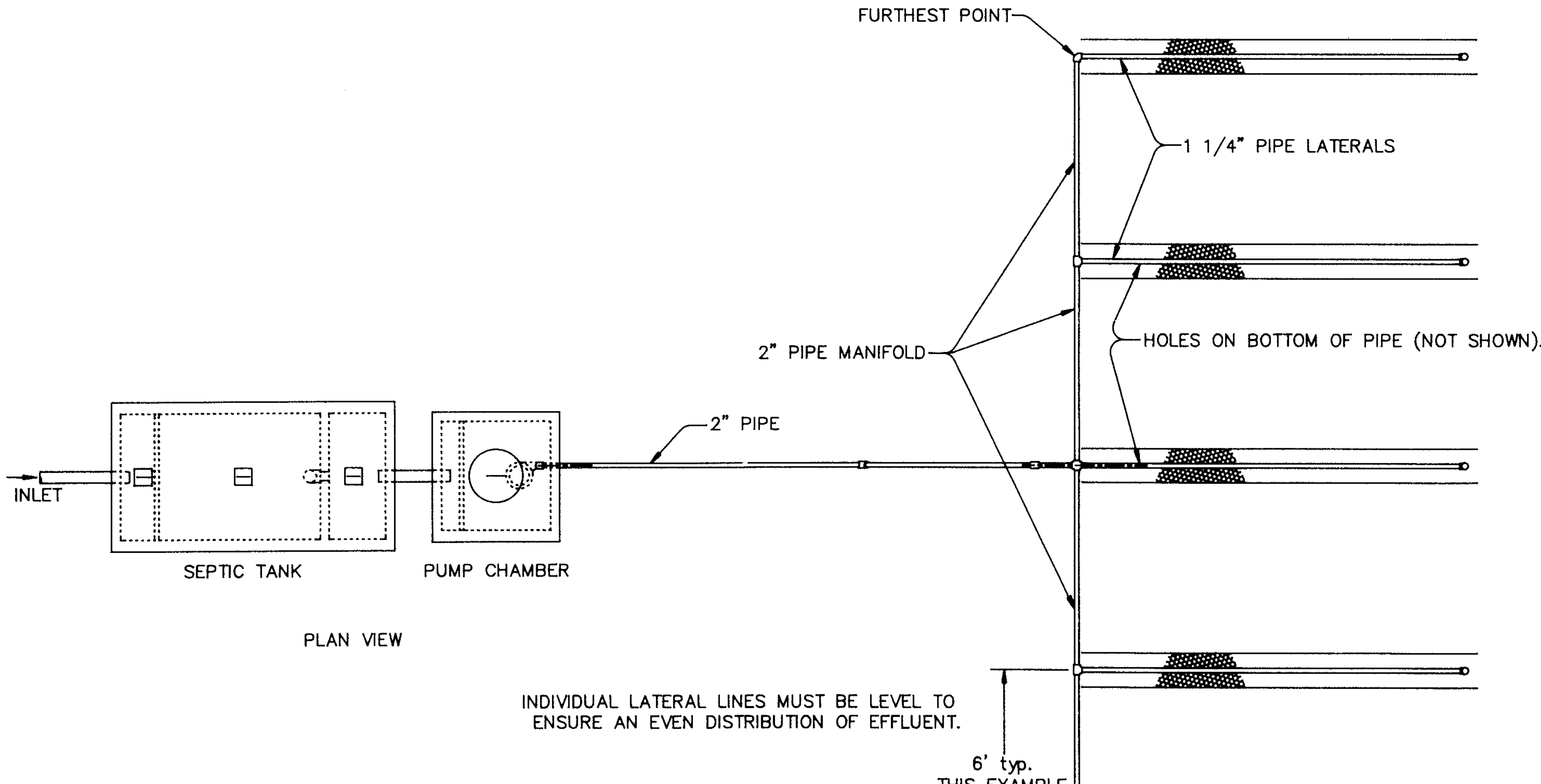
Low–Pressure Pipe Systems can be used for Absorption Fields
Located at an Elevation Above (A), or Below (B) the Septic Tank.

Typical LPP System

Fig. B

Sheet 1 of 2

Septic Tank & Pump Chamber, with Carlisly style Lateral Field. 12/22/86 DG SKC–725
sheet 1 of 2
880610 Rmc



Typical LPP System

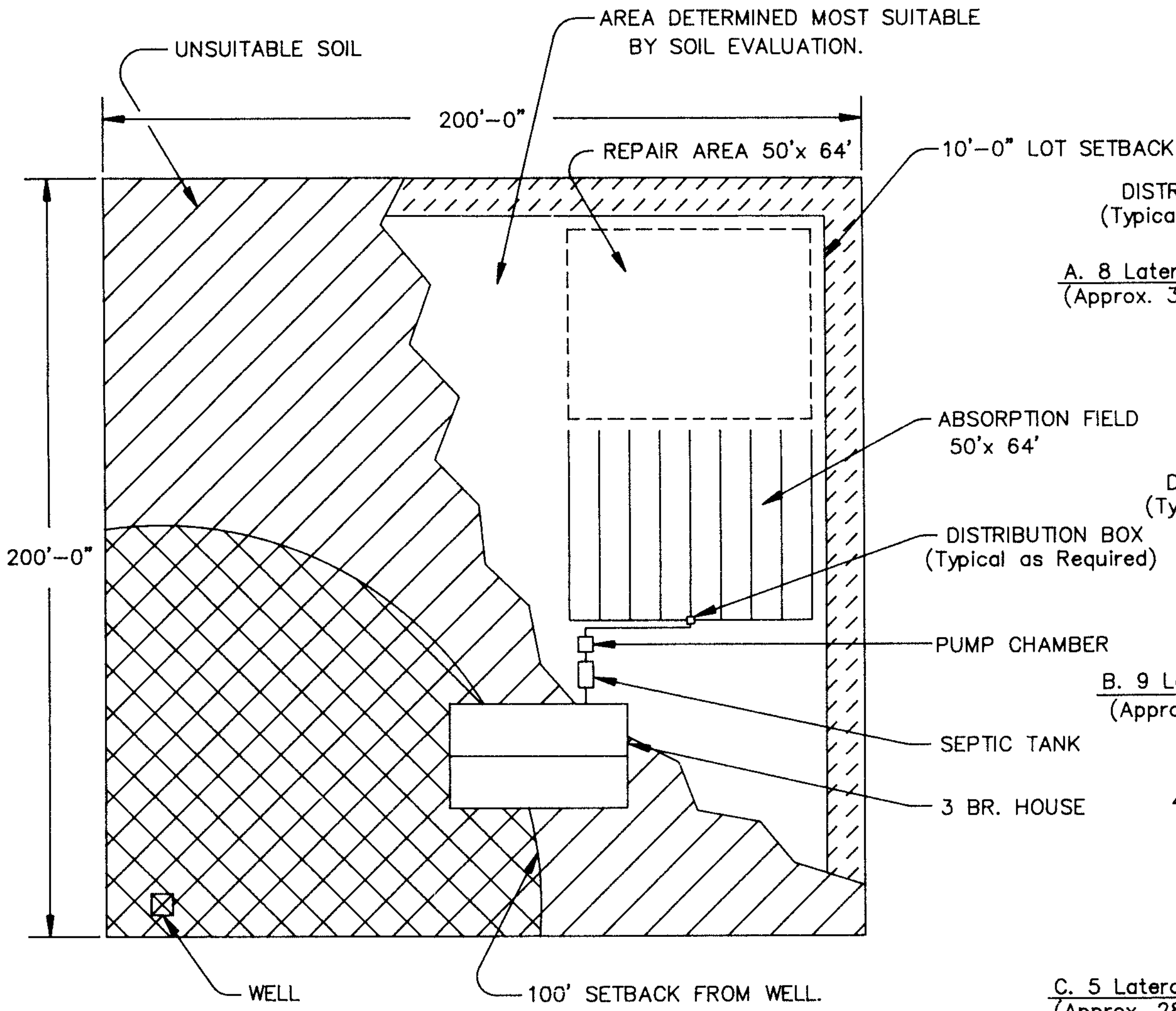
Fig. B

Sheet 2 of 2

B

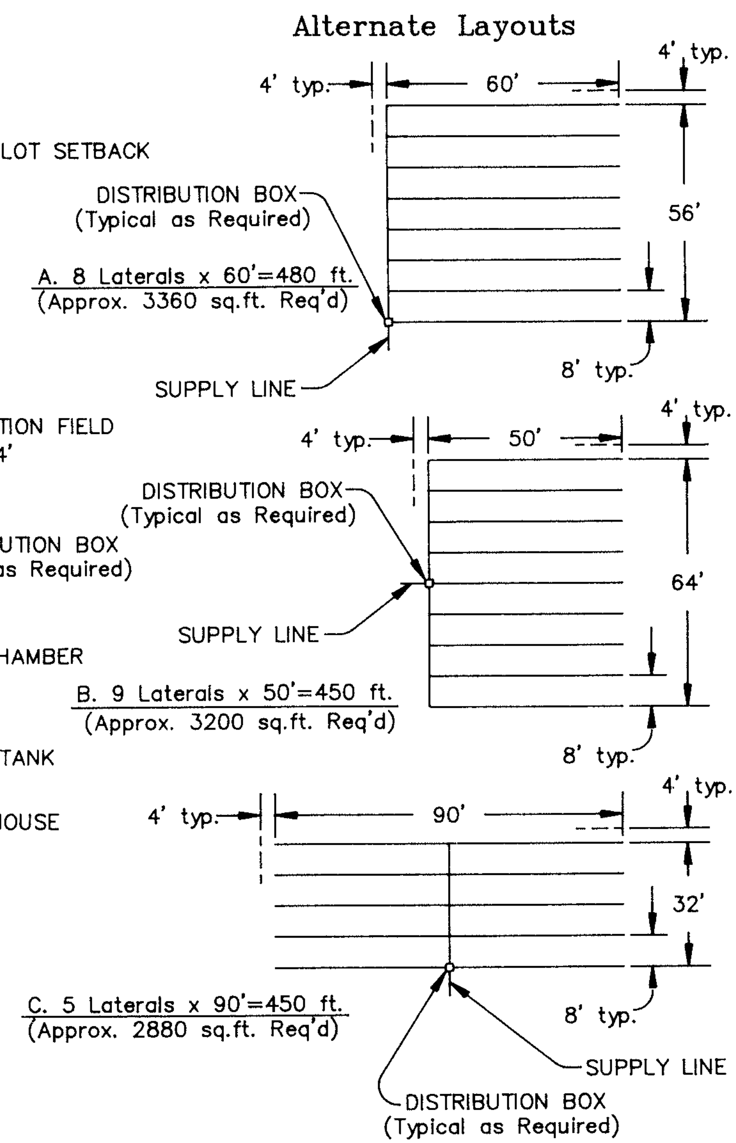
Septic Tank & Pump Chamber, with Carlisly style Lateral Field. 12/23/86 DG SKC-726 sheet 2 of 2 880610 Rmc

C

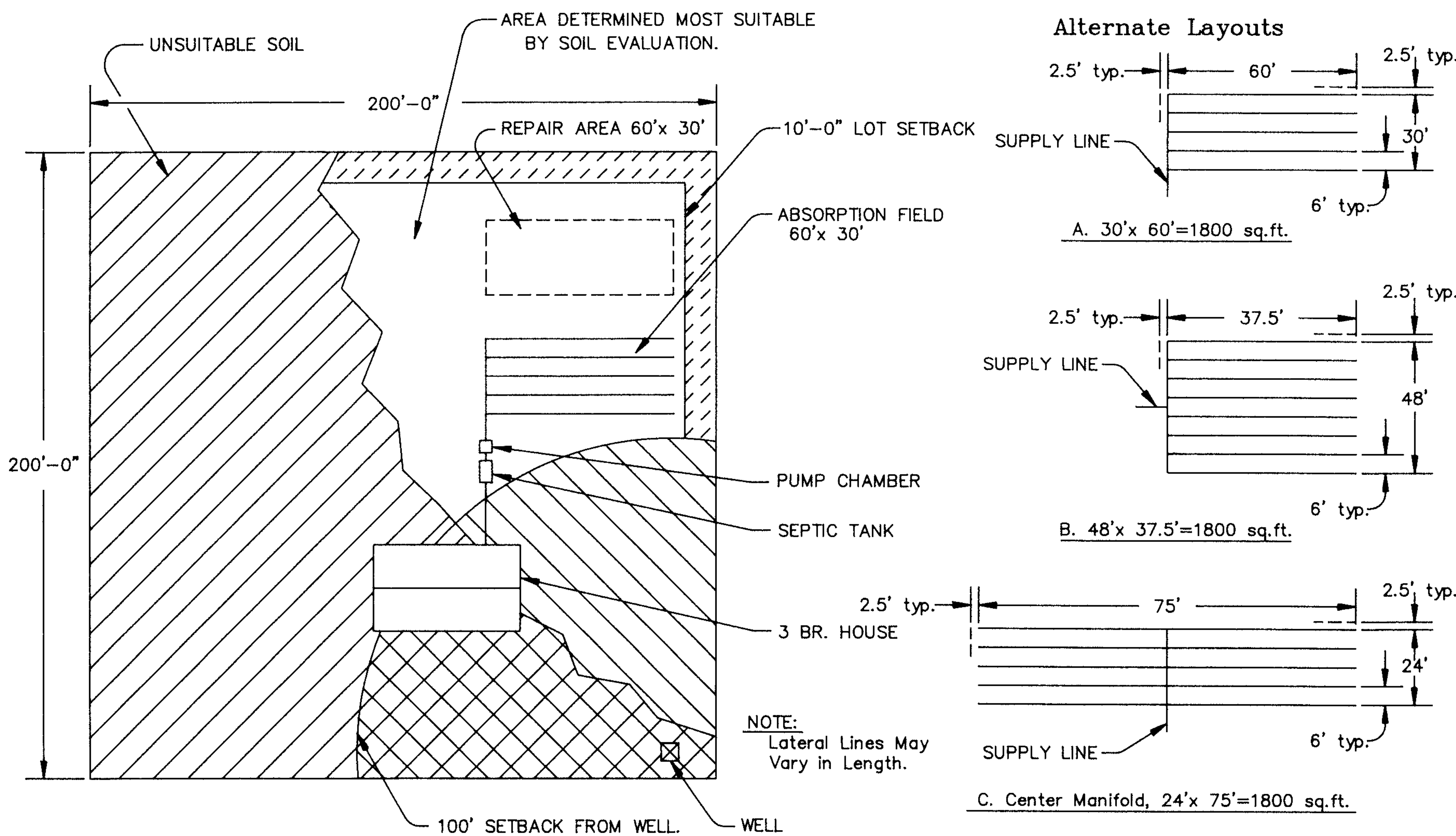


LAYOUT of a Gravity or Enhanced Flow System

Fig. C



SKB-780 "Septic System Layout" DG 6/30/87 880602 Rmc



D

LAYOUT of Sample LPP System

Fig. D

SKB–734 "Septic System Layout" DG 3/3/87 880602 Rmc

TABLE 1

Typical Application Rates for Gravity Distribution Lateral Fields		
Soil Texture	Soil Permeability in./hr.	Loading Rate GPD/ft.^{2}
Sand	6 to 12	1.20
Loamy Sand	4 to 5-7/8	0.90
Sandy Loam Loam	3 to 3-7/8	0.70
Sandy Clay Loam Silt Loam	2 to 2-7/8	0.50
Clay Loam Silty Clay Loam	1 to 1-7/8	0.37
Sandy Clay Silty Clay Clay	1/2 to 7/8	0.27

NOTE: Waste flow and loading rates must be determined in accordance with local authorities' regulations before the system can be designed.

TABLE 2

Typical Application Rates for LPP Distribution Lateral Fields		
Soil Texture	Soil Permeability in./hr.	Loading Rate GPD/ft.^{2}
Sand Loamy Sand	6 to 12 4 to 5-7/8	0.4 to 0.5
Sandy Loam Loam	3 to 3-7/8	0.3 to 0.4
Sandy Clay Loam Silt Loam	2 to 2-7/8	0.2 to 0.3
Clay Loam Silty Clay Loam	1 to 1-7/8	0.1 to 0.2
Sandy Clay Silty Clay Clay	1/2 to 7/8	0.05 to 0.1

NOTE: Waste flow and loading rates must be determined in accordance with local authorities' regulations before the system can be designed.

TABLE 3

Typical Lateral Trench Length Requirements for Gravity Distribution Systems Based on Two Foot Trench Width. (SEE NOTE)*	
Load Rate GPD/ft.^{2}	Linear Feet Per 100 Gallons
0.27	185.0
0.37	135.0
0.50	100.0
0.70	71.5
0.90	55.5
1.20	41.3

* NOTE: Check local codes for other trench widths and length requirements

NOTE: Waste flow and loading rates must be determined by the local health department before the system can be designed.

TABLE 4

Friction Losses Through Plastic Fittings in terms of Equivalent Lengths of Plastic Pipe

Type of Fitting	Nominal Size Fitting & Pipe 1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
	Equivalent Length of Pipe - Feet					
90° STD. Elbow	7.0	8.0	9.0	10.0	12.0	14.0
45° Elbow	3.0	3.0	4.0	4.0	6.0	8.0
STD. Tee (Diversion)	7.0	9.0	11.0	14.0	17.0	22.0
Check Valve	11.0	13.0	17.0	21.0	26.0	33.0
Coupling or Quick Disconnect	1.0	1.0	2.0	3.0	4.0	5.0
Gate Valve	0.9	1.1	1.4	1.7	2.0	2.3

TABLE 5

Friction Loss per 100 Feet of Plastic Pipe							
Flow Rate GPM	Pipe Size (IN.) 1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
2	0.3						
3	0.6						
4	1.0	0.3					
5	1.5	0.4	0.2				
6	2.1	0.6	0.3				
7	2.9	0.8	0.4				
8	3.6	1.0	0.5				
9	4.6	1.2	0.6				
10	5.5	1.5	0.7	0.2			
12		2.1	1.1	0.3			
14		2.7	1.3	0.4			
16		3.5	1.7	0.5	0.2		
18		4.4	2.1	0.6	0.3		
20		5.2	2.5	0.9	0.3		
25			3.8	1.3	0.5		
30			5.2	1.8	0.6		
35				2.4	0.8		
40				3.1	1.0	0.4	
45				3.8	1.3	0.6	
50				4.7	1.6	0.7	
60					2.2	0.9	0.2
70					2.9	1.2	0.3
80					3.7	1.5	0.4
90					4.6	1.9	0.5
100						2.3	0.6

TABLE 6

Type of Establishment	Daily Flow for Design*
Airports (Also R.R. Stations, Bus Terminals - not including food service facilities)	5 gal/passenger
Barber Shops	50 gal/chair
Bars, Cocktail Lounges (Not including food service)	20 gal/seat
Beauty Shops (Style Shops)	125 gal/chair
Bowling Alleys	50 gal/lane
Camps	
Construction or Work Camps	60 gal/person
Summer Camps	60 gal/person
Campgrounds	150 gal/campsite
Churches	5 gal/seat
Country Clubs	
Resident Members	60 gal/resident member
Nonresident Members	20 gal/person
Day Care Facilities	15 gal/person
Factories (Exclusive of Industrial Waste)	25 gal/person/shift
Add for Showers	10 gal/person/shift
Hospitals	300 gal/bed
Marina	10 gal/boat slip
With Bathhouse	30 gal/boat slip
Motels/Hotels	120 gal/room
With Cooking Facilities	175 gal/room
Offices (Per Shift)	25 gal/person
Residence	150 GPD/bedroom
Residential Care Facilities	60 gal/person
Restaurants (whichever is greater)	40 gal/seat or
	40 gal/15 $ft.^2$ of dining area
Rest Homes and Nursing Homes	
With Laundry	120 gal/bed
Without Laundry	60 gal/bed
Schools	
Day Schools	
With Cafeteria, Gym and Showers	15 gal/student
With Cafeteria Only	12 gal/student
With Neither Cafeteria nor Showers	10 gal/student
Boarding Schools	75 gal/person
Service Stations	250 gal/water closet or urinal
Stores, Malls, Shopping Centers (Exclusive of Food Service)	200 gal/1000 $ft.^2$
Stadium, Auditorium, Theater, Drive-In	5 gal/seat or space
Swimming Pools and Bathhouses	10 gal/person
Travel Trailer Parks	120 gal/space

*Check Local Codes

TABLE 7

Pipe Size SCH. 40	Volume in Gallons per Foot of Pipe
1-1/4"	0.07
1-1/2"	0.10
2"	0.17
2-1/2"	0.24
3"	0.38
4"	0.65

TABLE 8

Flow Rate as a Function of Pressure Head and Hole Diameter in Drilled PVC Pipe

Operating Head		Hole Diameter (in.)					
		3/32	1/8	5/32	3/16	7/32	1/4
Ft.	PSI	-Flow Rate (GPM) -					
1	0.43	0.10	0.18	0.29	0.42	0.56	.74
2	0.87	0.15	0.26	0.41	0.59	0.80	1.05
3	1.30	0.18	0.32	0.50	0.72	0.98	1.28
4	1.73	0.21	0.37	0.58	0.83	1.13	1.48
5	2.16	0.23	0.41	0.64	0.94	1.26	1.65

Sump and Sewage Pump
Manufactures Association

P.O. Box 44071, Indianapolis, IN 46244
Email: hdqtrs@sspma.org
Website: www.SSPMA.org
(317) 636-0278

SSPMA CERTIFIED