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EZflow Elevated Sand Mound Design Manual

This manual is based upon the provisions of Indiana State Department of Health (ISDH) Rule 410 IAC 6-8.3, *Residential On-Site Sewage Systems*, and ISDH Rule 410 IAC 10.1, *Commercial On-Site Sewage Systems*. It provides information on the procedures for the design of elevated sand mound (ESM) systems utilizing EZflow™ bundled expanded polystyrene (EZflow ESM) for one- and two-family dwellings. It also applies to commercial facilities with daily wastewater flows that do not exceed 750 gallons for which review has been delegated in writing to the local health department. It does not include design criteria for systems that deviate from those documents, such as Type II mounds. Prior to the design of an EZflow ESM system, the provisions of Residential Rule 410 IAC 6-8.3 or Commercial Rule 410 IAC 6-10.1, whichever is applicable, must be followed to determine site suitability for the application of this technology. For EZflow systems described herein, EZflow bundled synthetic aggregate replaces the natural aggregate component of the ESM system approved for use by ISDH. Other specifications in the ESM system remain unchanged.

The intent of this manual is to provide design criteria for all common ESM-system widths. Much of the following information is directed toward the design of 5- and 6-foot-wide EZflow ESM systems based upon sizing equations presented in the above-referenced ISDH rules. Design criteria and equations for use with EZflow ESM systems in other widths are provided herein as well. For these other widths, the on-site system designer will be able to design an entire residential or small commercial EZflow ESM system when starting at the beginning and proceeding through this manual.

This manual is divided into six sections. Refer to the table of contents on Page 2.

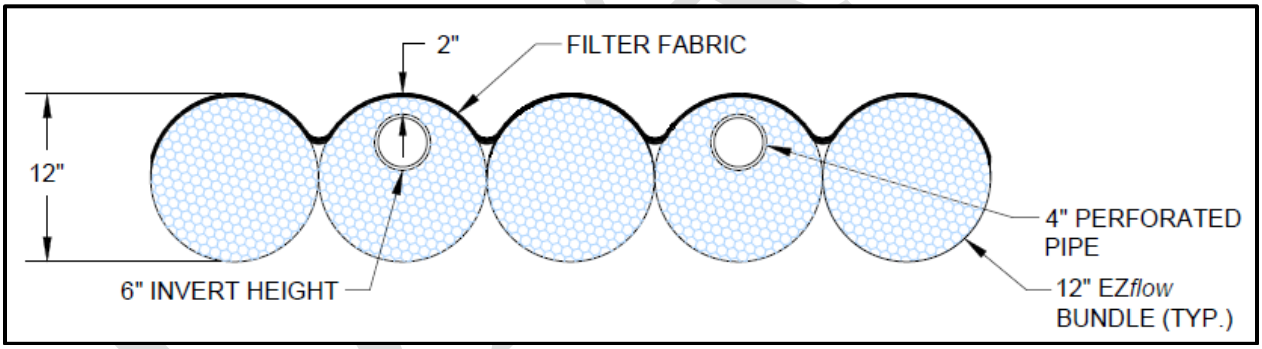

Figure 1. 5-Foot-Wide EZflow ESM System

Notes:

1. EZflow bundles are 12-inches in diameter and are available in 5- and 10-foot lengths.
2. EZflow bundles may be comprised of expanded-polystyrene-bead aggregate only (EZ 1201A), or with an integrated 4-inch diameter distribution pipe within the beads running the length of the bundle (EZ 1201P).
3. EZflow bundles may or may not include an integrated geotextile. This does not supersede the need to install ISDH Rule-compliant geotextile material over the entire width and length of the EZflow ESM bed.
4. Generic PVC internal couplers and end caps are used to connect consecutive EZflow bundles and end distribution pipe lengths. End cap and coupler parts shall conform to ASTM F667. Pressure distribution laterals shall comply with ISDH Rules and be placed on a level plane with the 4-inch distribution pipe within the EZflow bundles.

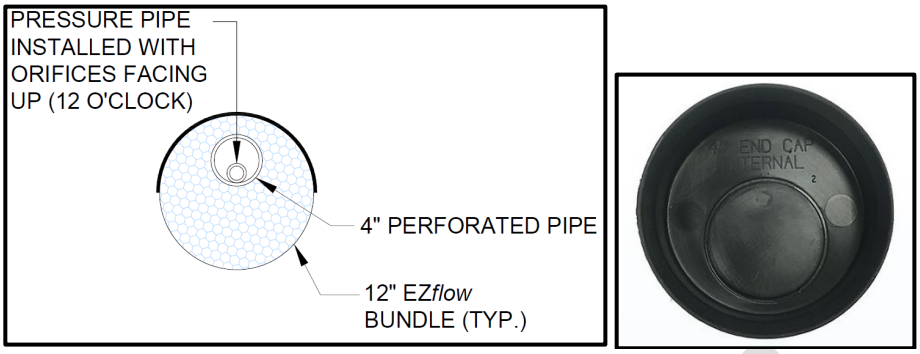

Figure 2: Pressure Distribution Lateral Position

Notes:

1. Reference Section 3 for pressure distribution lateral requirements.
2. The 4" end cap may be custom-cut with a hole saw to match the pressure distribution lateral outer diameter or may be a pre-engineered end cap with a knockout hole as shown in Figure 2.
3. The pressure distribution lateral hole and pipe shall be placed at the bottom of the 4" end cap.

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EZflow ESM system sizing has been calculated for 5- and 6-foot-wide beds and a 12-inch sand depth in Tables 1 and Table 2, respectively. Sizing is calculated using the equations and design criteria shown in Section 2. The lookup tables in Section 1 can be used to determine the system size using a minimum amount of information. This information includes:

- ✓ ***The Daily Design Flow (DDF) expressed as gallons per day (gpd). For residential systems, it is determined by the number of bedrooms (and bedroom equivalents) in the home [Rule 410 IAC 6-8.3-12],***
- ✓ ***The Soil Loading Rate (SLR) expressed as gallons per square foot per day (gpd/ft^2) to be used for system design for the site [For residential systems: Table V, Rule 410 IAC 6-8.3-72(b)(7), and***
- ✓ ***The percent slope in the area proposed for the system.***

See Sections 2 through 6 for additional required location, dimensional, and design information.

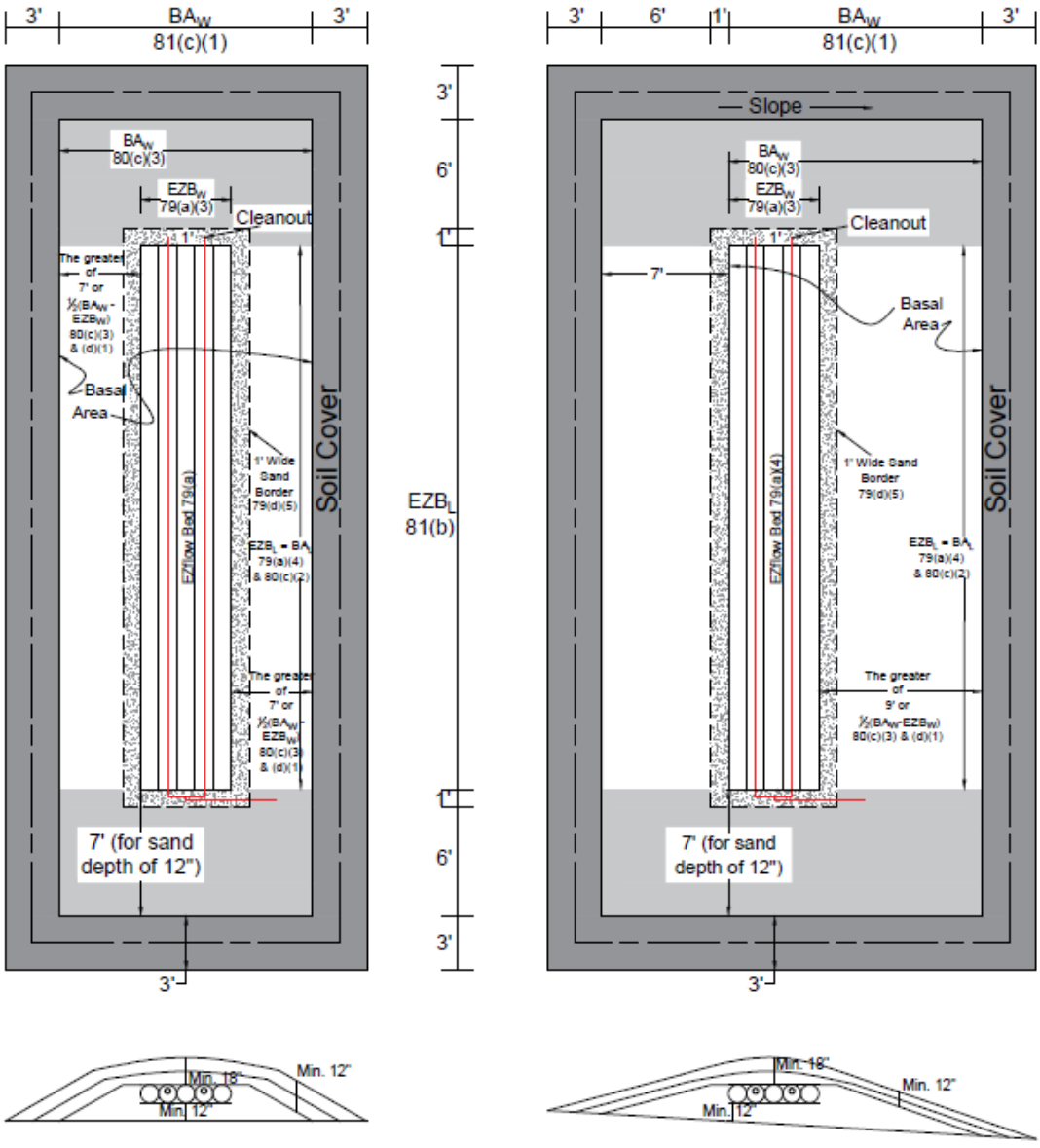
Section 1: EZflow 5- and 6-Foot-Wide ESM System Sizing

Table 1
5-Foot-Wide EZflow ESM Dimensions
(Based on Maximum Bed Width Formula and Sand Depth of 12 inches)[a]

Number of Bedrooms & Equivalents	Daily Design Flow DDF (gpd)	Soil Loading Rate SLR (gpd/ft²)	EZflow Bed			Basal Area[f]			
			Area (ft²)	Width (ft)	Minimum Length (ft)[c]	Minimum Area (ft²)	Min. Width (ft) Slope ≤½%[d] (Centered EZflow Bed)	Min. Width (ft) Slope >½%[e] (Upslope EZflow Bed)	Minimum Length (ft)
2[b]	300	0.25	NA	NA	NA	NA	NA	NA	NA
2	300	0.50	250	5	50	600	19	14	50
2	300	0.60	250	5	50	500	19	14	50
2	300	1.20	250	5	50	250	19	14	50
3	450	0.25	375	5	75	1,800	24	24	75
3	450	0.50	375	5	75	900	19	14	75
3	450	0.60	375	5	75	750	19	14	75
3	450	1.20	375	5	75	375	19	14	75
4	600	0.25	500	5	100	2,400	24	24	100
4	600	0.50	500	5	100	1,200	19	14	100
4	600	0.60	500	5	100	1,000	19	14	100
4	600	1.20	500	5	100	500	19	14	100
5	750	0.25	625	5	125	3,000	24	24	125
5	750	0.50	625	5	125	1,500	19	14	125
5	750	0.60	625	5	125	1,250	19	14	125
5	750	1.20	625	5	125	625	19	14	125
6	900[g]	0.25	750	5	150	3,600	24	24	150
6	900	0.50	750	5	150	1,800	19	14	150
6	900	0.60	750	5	150	1,500	19	14	150
6	900	1.20	750	5	150	750	19	14	150

[a]The sand mound should be designed as long and narrow as possible.
[b]EZflow bed width is less than 5' and/or does not meet lateral spacing requirements.
[c]Minimum length is rounded up to the next 5-foot interval. Beds with lengths greater than 55 feet require center-feed manifolds.
[d]The greater of BA Min. Area/BA Min. Length or EZflow Bed Width + 14'.
[e]The greater of BA Min. Area/BA Min. Length or EZflow Bed Width + 9'.
[f]Sideslopes of the INDOT Spec 23 sand on each side of the EZflow bed must have a minimum grade of three-to-one (3:1).
[g]Commercial systems above 750 gpd are not reviewed by local health departments.
[h]Only 12-inch-diameter EZflow bundles shall be used in EZflow ESM systems.
[i]The final bed length shall be rounded up to the nearest multiple of 5 or 10. See Figure 3-1 for illustration.

Figure 3-1
Plan View of 5-ft-Wide EZflow Sand Mound



Legend: EZB = Area of EZflow Bed, EZB_L = Length of EZflow Bed, EZB_W = Width of the EZflow Bed, BA = Area of the Basal Area, BA_L = Length of the Basal Area, BA_W = Width of the Basal Area. Schematic is for a sand depth of 12 inches below the EZflow bed.

Notes:

1. Haunches below and between EZflow bundle rows shall remain open.
2. Pressure distribution laterals shall be placed in the second and fourth rows of EZflow bundles in the 5-foot-wide EZflow ESM.

Table 2
6-Foot-Wide EZflow ESM Dimensions
(Based on Maximum Bed Width Formula and Sand Depth of 12 inches)[a]

Number of Bedrooms & Equivalents	Daily Design Flow DDF (gpd)	Soil Loading Rate SLR (gpd/ft²)	EZflow Bed			Basal Area[f]			
			Area (ft²)	Width (ft)	Minimum Length (ft)[c]	Minimum Area (ft²)	Min. Width (ft) Slope ≤½% [d] (Centered EZflow Bed)	Min. Width (ft) Slope >½%[e] (Upslope EZflow Bed)	Minimum Length (ft)
2[b]	300	0.25	NA	NA	NA	NA	NA	NA	NA
2[b]	300	0.50	NA	NA	NA	NA	NA	NA	NA
2	300	0.60	250	6	45	500	20	15	45
2	300	1.20	250	6	45	250	20	15	45
3[b]	450	0.25	NA	NA	NA	NA	NA	NA	NA
3	450	0.50	375	6	65	900	20	15	65
3	450	0.60	375	6	65	750	20	15	65
3	450	1.20	375	6	65	375	20	15	65
4[b]	600	0.25	NA	NA	NA	NA	NA	NA	NA
4	600	0.50	500	6	85	1,200	20	15	85
4	600	0.60	500	6	85	1,000	20	15	85
4	600	1.20	500	6	85	500	20	15	85
5	750	0.25	625	6	105	3,000	29	29	105
5	750	0.50	625	6	105	1,500	20	15	105
5	750	0.60	625	6	105	1,250	20	15	105
5	750	1.20	625	6	105	625	20	15	105
6	900[g]	0.25	750	6	125	3,600	29	29	125
6	900	0.50	750	6	125	1,800	20	15	125
6	900	0.60	750	6	125	1,500	20	15	125
6	900	1.20	750	6	125	750	20	15	125

[a]The sand mound should be designed as long and narrow as possible.

[b]EZflow bed width is less than 6' and/or does not meet lateral spacing requirements.

[c]Minimum length is rounded up to the next 5-foot interval. Beds with lengths greater than 55 feet require center-feed manifolds.

[d]The greater of BA Min. Area/BA Min. Length or EZflow Bed Width + 14'.

[e]The greater of BA Min. Area/BA Min. Length or EZflow Bed Width + 9'.

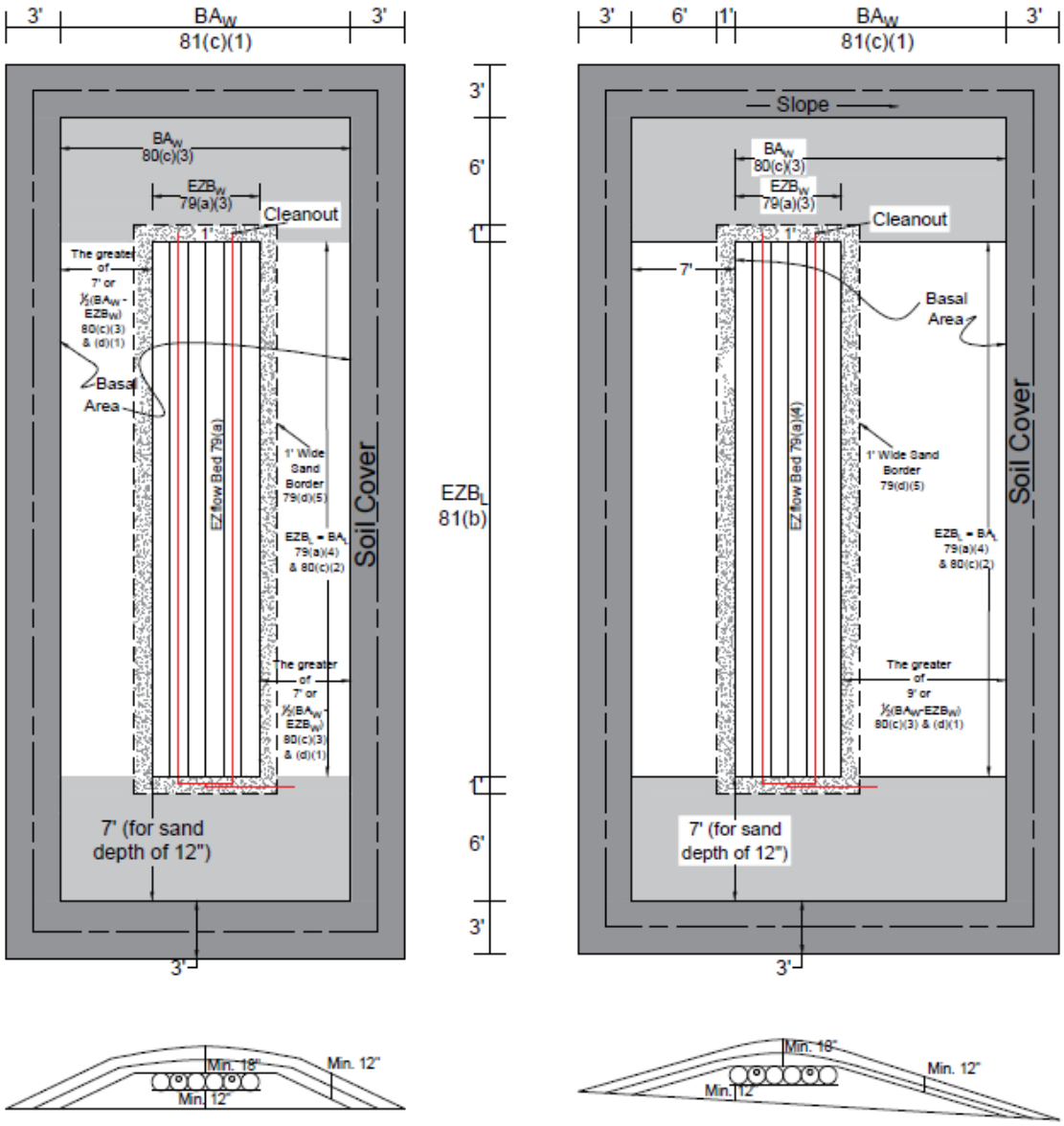
[f]Sideslopes of the INDOT Spec 23 sand on each side of the EZflow bed must have a minimum grade of three-to-one (3:1).

[g]Commercial systems above 750 gpd are not reviewed by local health departments.

[h]Only 12-inch-diameter EZflow bundles shall be used in EZflow ESM systems.

[i]The final bed length shall be rounded up to the nearest multiple of 5 or 10. See Figure 3-2 for illustration.

Figure 3-2
Plan View of 6-ft-Wide EZflow Sand Mound



Legend: EZB = Area of EZflow Bed, EZB$_L$ = Length of EZflow Bed, EZB$_W$ = Width of the EZflow Bed, BA = Area of the Basal Area, BA$_L$ = Length of the Basal Area, BA$_W$ = Width of the Basal Area. Schematic is for a sand depth of 12 inches below the EZflow bed.

Notes:

1. Haunches below and between EZflow bundle rows shall remain open.
2. Pressure distribution laterals shall be placed in the second and fifth rows of EZflow bundles in the 6-foot-wide EZflow ESM.

For systems not contemplated in Section 1, an EZflow ESM system can also be designed for other geometries based on the equations and design criteria provided in the second section in this manual. In either case, a minimum amount of information is necessary to ensure accuracy of the design. This information includes:

- ✓ ***The Daily Design Flow (DDF) expressed as gallons per day (gpd). For residential systems, it is determined by the number of bedrooms (and bedroom equivalents) in the home [Rule 410 IAC 6-8.3-12]; for commercial systems, it is reported in the technical data sheet provided by the department for each commercial system.***
- ✓ ***The Soil Loading Rate (SLR) expressed as gallons per square foot per day (gpd/ft^2) to be used for system design for the site [For residential systems: Table V, Rule 410 IAC 6-8.3-72(b)(7); for commercial systems: Table VI, Rule 410 IAC 6-10.1-80(b)(7)], and***
- ✓ ***The percent slope in the area proposed for the system.***

See Figures 3-1 and 3-2 for dimensional information referenced in the equations. Note that other configurations must conform with the effluent lateral spacing specifications in Section 3. Lateral spacing must take into account the EZflow bundle dimensions and pipe position within the bundle.

Section 2: Other-Width EZflow ESM System Sizing Equations

(a) EZflow Bed

(1) The **size** of the EZflow bed shall be determined from the following:

(A) The minimum area of the EZflow bed shall be calculated as:

$$\text{Minimum EZflow bed area (ft}^2\text{)} = \frac{\text{Daily Design Flow (DDF)}}{1.2 \text{ gpd/ ft}^2}$$

(B) The dimensions of the EZflow bed shall be as long and narrow as site conditions permit and shall be located with the long axis along the contour of the site.

(C) The maximum width of the EZflow bed, is calculated as:

$$\text{Maximum bed width (ft)} = 0.83\sqrt{\frac{(\text{DDF})(\text{SLR})}{3}}$$

where 0.83 is a conversion factor expressed in ft^2/gpd, DDF is daily design flow in gallons (not to exceed 1500), and where SLR is the soil loading rate.

(D) The minimum bed width shall not be less than five (5) feet and the maximum bed width shall not be more than ten (10) feet. Any bed width value from the bed width equation which is outside of these parameters must be adjusted to the minimum or maximum bed width.

(E) The minimum length of the EZflow bed is calculated as:
min. length (EZB_L) = min. EZflow bed area / max. EZflow bed width (EZB_W).

(F) The final bed length shall be rounded up to the nearest multiple of 5 or 10.

(G) EZflow bundles may not be cut to achieve a length other than the manufactured length.

(2) The **location** of the EZflow bed shall be:

(A) for sites with slopes of one-half (1/2) percent or less, in the center of the basal area; and

(B) for sites with slopes greater than one-half (1/2) and less than or equal to six (6) percent, at the upslope side of the basal area**.**

(C) hydraulically isolated from one another in accordance with the Rule when multiple beds are located on a slope. The position of sand mounds for projects which are designed utilizing multiple beds shall meet the following:

(i) when any portion of an EZflow ESM is up gradient of another EZflow ESM, they must be hydraulically isolated from one another; and
(ii) no EZflow ESM shall utilize sizing less than 300 gallons per day (DDF).

Figures 3-1 and 3-2 present visual depictions of the location of the EZflow bed within the basal area.

(3) The **design** of EZflow bed shall comply with the following:
(A) The bottom of the EZflow bed shall be level along its length and width.
(B) Only 12-inch-diameter EZflow bundles shall be used in the design and construction of the EZflow ESM system.
(C) The EZflow bed shall be installed in INDOT Specification 23 sand in the basal area [For residential systems, see Table XV, Rule 410 IAC 6-8.3-80(j); for commercial systems, see Table XVI, Rule 410 IAC 6-10.1-88(j)].
(D) A one (1) foot wide border of INDOT Specification 23 sand, level with the top of the EZflow bed, shall surround the EZflow bed. (See Figures 3-1 and 3-2).

(b) Basal Area

(1) The dimensions of the basal area and sand mound shall be as long and narrow as site conditions permit [For residential systems, see Rule 410 IAC 6-8.3-79(a)(2) and 80(a); for commercial systems, see Rule 410 IAC 6-10.1-87(a)(2) and 88(a)].

(2) Numerical dimensions provided in this section for basal area and sand mound sizes are rounded up to the nearest whole number. Numerical dimensions for the soil material cover from the edge of the basal area to the edge of the sand mound are based on a final grade of three-to-one (3:1) (on level sites). The plan views and numerical dimensions are for a simple slope (i.e., slopes that form a plane). Sand mounds sited on complex slopes are more difficult to design and construct on contour.

(3) The **size** of the basal area shall be determined from the following:
(A) The **minimum size** of the basal area shall be calculated as:

$$\text{minimum basal area } (ft^2) = \frac{\text{design daily flow}}{\text{soil loading rate}} = \frac{DDF}{SLR}$$

using the soil loading rate [see Rule 410 IAC 6-8.1-72(b)(7), Table V, for residential systems and Rule 410 IAC 6-10.1-80(b)(7), Table VI for commercial systems].
(B) The **length** (L) of the basal area shall equal the length of the EZflow bed.
(C) The minimum **width** of the basal area shall be calculated as the **GREATER** of:

(i) $$\text{Width (ft)} = \frac{\text{minimum basal area in } ft^2}{\text{length of EZflow bed in ft}}$$

OR

(ii)

Slope	Min. Basal Area Width
0% ≤ slope ≤ ½%	EZflow bed width + 14 ft
½% < slope ≤ 6%	EZflow bed width + 9 ft

The dimension determined from (i) or (ii) shall maintain a minimum sideslope grade of three-to-one (3:1).

(4) The **location** of the basal area within the sand mound shall be:

(A) on sites with slopes of one-half (1/2) percent or less, the area under the EZflow bed and extending an equal distance from each side along the length of the EZflow bed;
(B) on sites with slopes greater than one-half (1/2) percent and less than or equal to six (6) percent, the area under the EZflow bed and extending directly downslope from the EZflow bed.

Figures 3-1 and 3-2 present visual depictions of the location of the basal area within the sand mound.

(5) The **design** shall meet the following:
(A) The design shall be for:
(i) A site with a slope one-half (1/2) percent or less; OR
(ii) A site with a slope greater than one-half (1/2) and less than or equal to six (6) percent.
(B) A site where the area within the sand mound perimeter will be plowed parallel to the contour of the site.
(C) The long axis of the basal area and sand mound shall be oriented parallel to the contour of the absorption field site.
(D) The minimum depth of the INDOT Spec. 23 sand under the EZflow bed shall be twelve (12) inches.
(E) The INDOT Spec. 23 sand shall have a minimum final grade on all sides of three-to-one (3:1).
(F) The soil material cover shall have a minimum final grade on all sides of three-to-one (3:1).

(c) Dimensions of the EZflow ESM

(1) The **minimum length** of a sand mound shall be the sum of the following:
(A) The length of the EZflow bed (L).
(B) Plus fourteen (14) feet, representing the two side-slopes of INDOT Specification 23 sand at both ends of the EZflow bed [including the one (1) foot level borders], and shall maintain a minimum sideslope grade of three-to-one (3:1).
(C) Plus a minimum of six (6) feet, representing the soil material cover at both ends of the EZflow bed.

(2) The **minimum width** of the sand mound shall be the sum of the following:
(A) On sites with slopes one-half (1/2) percent or less, the minimum width of a sand mound is the sum of the following:
(i) The width of the EZflow bed (EZB_W).
(ii) Plus the greater of either:
a) the total width of basal area minus the width of EZflow bed; or
b) fourteen (14) feet.
The dimension from (a) or (b) shall maintain a minimum sideslope grade of three-to-one (3:1).
(iii) Plus a minimum of six (6) feet, representing the soil material cover on both sides of the EZflow bed.
(B) On sites with slopes greater than one-half (1/2) percent and less than or equal to six (6) percent, the minimum width of a sand mound shall be the sum of the following:
(i) The width of the EZflow bed (EZB_W).
(ii) Plus seven (7) feet, representing the side-slope of INDOT Specification 23 sand on the upslope side of the EZflow bed [including the one (1) foot level border], and shall maintain a minimum sideslope grade of three-to-one (3:1).
(iii) Plus the greater of either:
a) the total width of basal area minus the width of EZflow bed; or
b) nine (9) feet,

representing the side-slope of INDOT Specification 23 sand on the downslope side of the EZflow bed [including the one (1) foot level border] and shall maintain a minimum sideslope grade of three-to-one (3:1),

(iv) Plus a minimum of six (6) feet, representing the soil material cover on both sides of the EZflow bed.

The third section in this manual assists with the design of the pressure distribution network for an EZflow ESM. A minimum amount of information is necessary to ensure accuracy of the design. This information includes:

- ✓ ***The diameter of the effluent force main, and***
- ✓ ***The dimensions of the proposed EZflow ESM bed.***

Section 3: Effluent Force Main and Pressure Distribution Network

(a) The design of the pressure distribution network shall comply with the requirements of Rule 410 IAC 6-8.3-82 for residential systems, Rule 410 IAC 6-10.1-90 for commercial systems, and the following:

(1) The **effluent force main** leading up to the pressure distribution network shall approach the EZflow and mound as follows:

(A) On sites with slopes of one half (1/2) percent or less, from either end, the effluent force main must be positioned to minimize disturbance of the basal area plow layer. Therefore:

i) The effluent force main from the dosing tank to the ESM should run perpendicular to the EZflow rows at the bottom of the EZflow bed. See Figures 4-1 and 4-2 below.

ii) A vertical effluent force main segment should be installed at the center of the 4-inch distribution network piping located in the EZflow bed rows. The vertical effluent force main will be connected to the effluent force main at the base of the EZflow bed elevation.

iii) A manifold segment should be installed perpendicular to the distribution laterals in the EZflow rows. This manifold shall elbow or tee into the individual EZflow rows per the design.

iv) Pressure distribution laterals shall:

a. enter through the end cap on the 4-inch distribution piping within the EZflow bundles;
b. run the entire length of the EZflow row;
c. exit the distal end of the EZflow row through an end cap on the 4-inch distribution piping within the EZflow bundles; and
d. elbow up and extend into a valve box at the surface to serve as a clean out (See Figures 4-1 and 4-2).
e. enter and exit the 4" PVC EZflow distribution pipe through custom cut holes in the end cap and shall be sealed to keep sand out.

(v) The effluent force main must drain between doses unless it is installed below the frost line and is designed so that no effluent remains in any portion of the effluent force main located above the frost line. [See Rule 410 IAC 6-8.3-76(d), Table VIII, for residential systems and Rule 410 IAC 6-10.1-84(d), Table IX, for commercial systems.]

(B) On sites with slopes greater than one half (1/2) percent and less than or equal to six (6) percent, from the upslope side, the effluent force main must be positioned to minimize disturbance of the basal area plow layer. Therefore:

i) Installation of the effluent force main through the downslope basal area plow layer and the down slope dispersal area must be avoided.

ii) The preferred route of installation is from the upslope side of the basal area plow layer. If an upslope delivery is not possible the effluent force main may be installed at the end of the basal area plow layer.

iii) For an upslope effluent force main installation, the effluent force main segment from the dosing tank to ESM should not extend into the basal area plow layer.

iv) For upslope effluent force main installations, a vertical effluent force main segment should be connected directly to the pressure distribution network manifold. For end effluent force main installations, the vertical effluent force main segment should be connected to the manifold between the pressure distribution laterals. The vertical effluent force main will connect to a horizontal effluent force main segment at the base of the EZflow bed elevation.

v) The effluent force main must drain between doses unless it is installed below the frost line and is designed so that no effluent remains in any portion of the effluent force main located above the frost line. [See Rule 410 IAC 6-8.3-76(d), Table VIII, for residential systems and Rule 410 IAC 6-10.1-84(d), Table IX, for commercial systems.]

(2) A **manifold** shall comply with the requirements of Rule 410 IAC 6-8.3-82(g) for residential systems, or Rule 410 IAC 6-10.1-90(g) for commercial systems, and be installed between the effluent force main and the pressure distribution laterals as follows:

(A) The manifold pipe for an ESM:

(i) with a design daily flow of seven-hundred and fifty (750) gallons per day or less, shall have a diameter of two (2) inches; or

(ii) with a design daily flow of greater than seven-hundred and fifty (750) gallons per day, shall have the same diameter as the effluent force main, or a diameter of two (2) inches, whichever is greater.

(B) In end-feed pressure distribution, the manifold shall be located outside of the EZflow bundles and within the sand border (79(d)(5)).

(C) In center-feed pressure distribution, the manifold shall be located in the space between continuous EZflow bundle lengths. Manifold piping shall enter the EZflow ESM bed at the correct elevation to enter the 4" PVC end caps through the custom-cut inlet holes.

(3) The **pressure distribution laterals** shall comply with the requirements of Rule 410 IAC 6-8.3-82(h) for residential systems, or 410 IAC 6-10.1-90(h) for commercial systems, and meet the following requirements:

(A) Each pressure distribution lateral connects to the manifold.

(B) Position the horizontal effluent manifold as close as possible to the EZflow bundles.

(C) The design head must be a minimum of three (3) feet.

(D) The diameter of the pressure distribution laterals shall be determined from Table 3.

Table 3
Pressure Distribution Lateral Diameter for ESMs *

Lateral Length, L (ft.)	L ≤ 25 ft.	25 ft. < L ≤ 40 ft.	40 ft. < L ≤ 55 ft.
Diameter (in.)	1 in.	1 1/4 in.	1 1/2 in.
* Distribution lateral diameters for ¼ in. holes spaced at 3 ft. on centers.			

(E) Pressure distribution laterals shall be laid out as shown in Figures 4-1 and 4-2 as follows:

(i) The separation distance between laterals shall be no less than twenty-four (24) and no more than thirty-six (36) inches.

(ii) Laterals shall be located no less than twelve (12) and no more than eighteen (18) inches from the sides of the EZflow bed along the length of the lateral.

(iii) Holes in pressure distribution laterals shall be one-quarter (1/4) inch in diameter and spaced at three (3) feet on centers.

(iv) The first hole shall be eighteen (18) inches from the center of the manifold.

(v) The spacing for the last hole in the lateral before the endcap shall be at no less than eighteen (18) inches and no more than thirty-six (36) inches.

(vi) All holes shall be positioned facing up (per EZ140112ISI-0) except for the last hole in the lateral which will be positioned facing down to allow for drainage.

(vii) Laterals connected by center-fed manifolds shall be attached using a cross-tee fitting or two (2) tee fittings located side-by-side, as illustrated in Figures 4-1 and 4-2.

(viii) Laterals connected by end feed manifolds may be attached using 90˚ elbows or tee fittings.

(ix) All laterals shall enter and exit the EZflow bundles through an endcap on the 4-inch diameter distribution pipe. Endcap hole shall be drilled to meet pressure distribution lateral outside diameter specification.

(x) Burrs shall be removed from the edges of all holes and from the interiors of all laterals.

Figure 4-1 - Plan View of Pressure Distribution Laterals in a 5-ft-Wide EZflow Bed of an Elevated Sand Mound

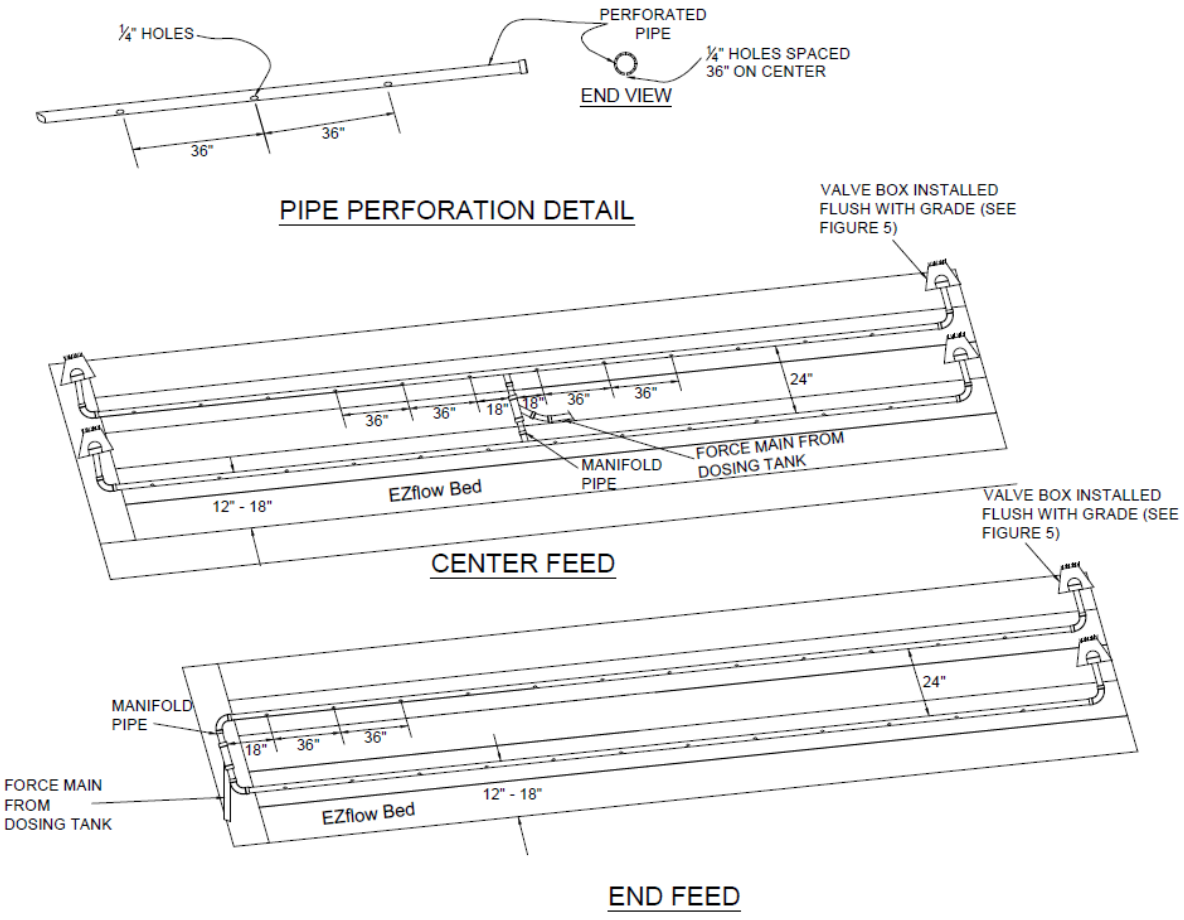
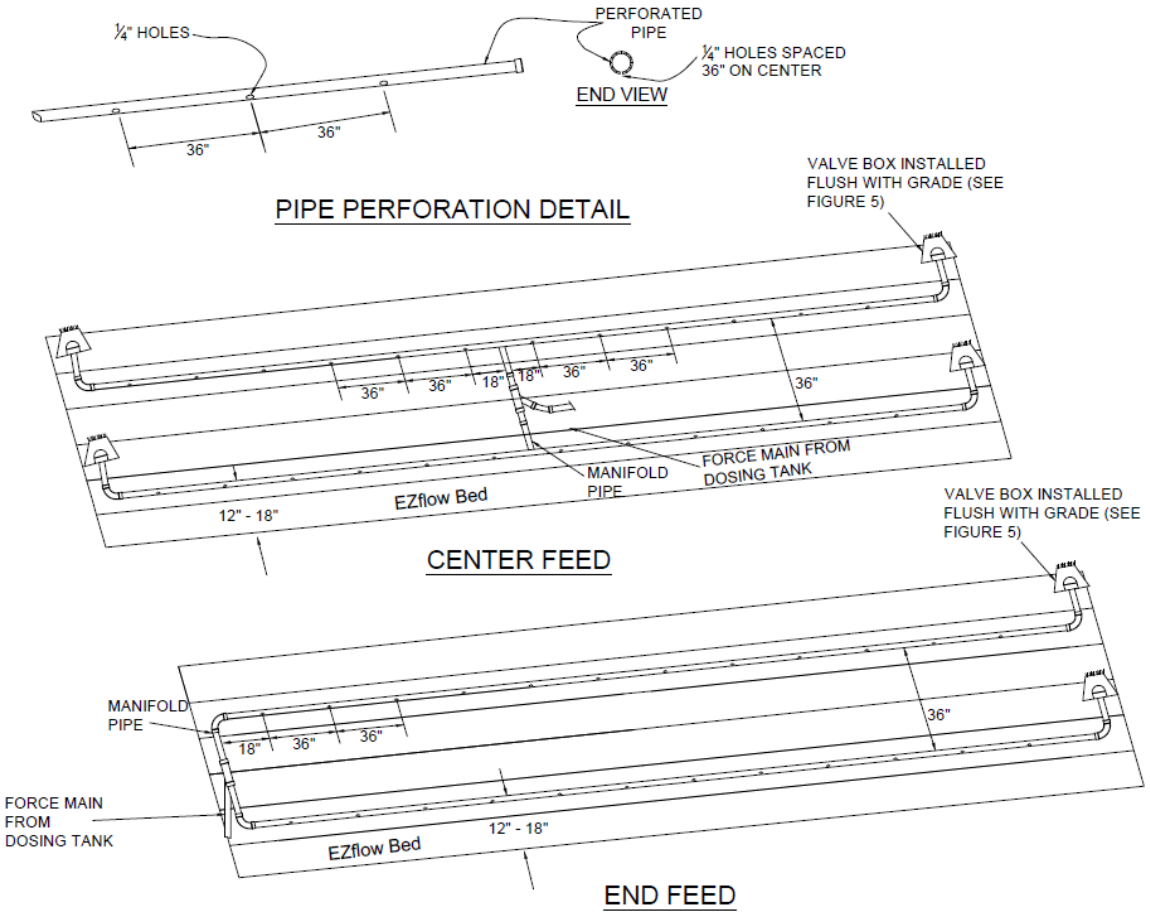


Figure 4-2 - Plan View of Pressure Distribution Laterals in a 6-ft-Wide EZflow Bed of an Elevated Sand Mound



(F.) Determine the positioning of the ¼-inch holes in the pressure distribution lateral. Draw a pressure distribution lateral and identify the location of the holes (in feet) along the length of the distribution lateral including the end cap hole. Holes shall be facing up except for most distant hole, which shall be facing down. (Figures 4-1 and 4-2)

Figure 5 - Manifold Tee-To-Tee Connection & Lateral Hole Location

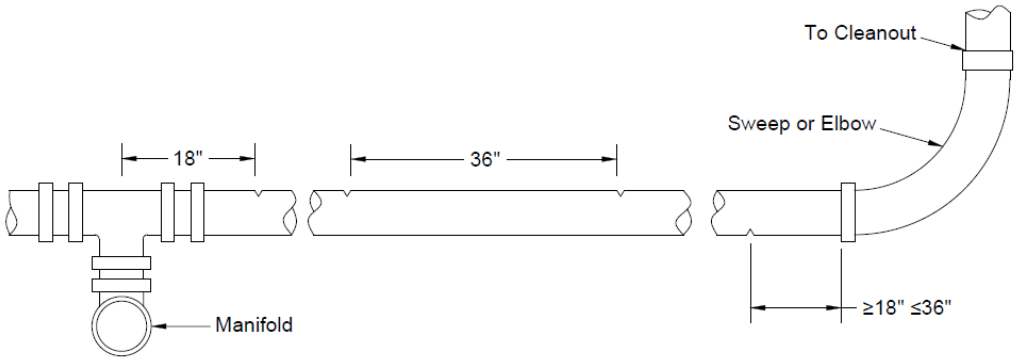
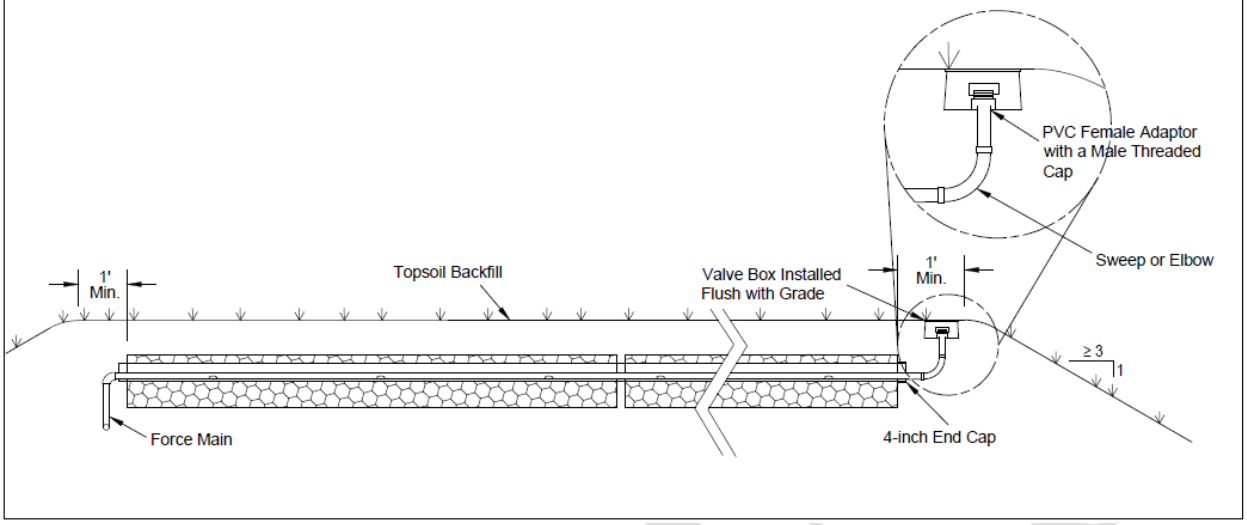


Figure 6 - Pressure Distribution Lateral Cross Section Detail



(b) Design check of Pressure Network design

(1) Calculate the total number of feet of pressure distribution lateral pipe used in the system.

(2) Use Table 4 to determine the volume (in gallons) for the pressure distribution laterals used in the system. Total Volume of pressure distribution laterals = the volume per foot (Table 4) times the total number feet of pressure distribution lateral pipe in the system.

Table 4
Pipe Volume (gal/ft) for Various Diameter Pipes

Pipe Diameter (in)	1	1 1/4	1 1/2	2*	3*	4*
Volume (gal/ft)	.045	.078	.106	.174	.384	.650

*These diameters and pipe volumes are for calculating the total volume of the effluent force main. They are not used for calculating volumes of pressure distribution laterals.

(3) The **dose volume** shall be calculated as follows:

(A) If the effluent force main and manifold do not drain to the dosing tank, the controls for the pressure distribution network shall be set to deliver one-quarter (1/4) of the design daily flow (Dose = 1/4 DDF).

(B) If the effluent force main and manifold drain to the dosing tank, the controls for the pressure distribution network shall be set to deliver one-quarter (1/4) of the design daily flow (DDF) plus the volume of the effluent force main (Dose = 1/4 DDF + drain back). The volume of the effluent force main is calculated the same way as the volume of the laterals [See Subsection (b)(2), above].

(C) The dose volume (1/4 DDF) must be at least 7 times the volume of the pressure distribution laterals.

The fourth section in this manual assists with the proper size of an effluent pump for an EZflow ESM project. There is a minimum amount of information necessary to ensure accuracy of your design. This information includes:

- ✓ ***Length of the effluent force main,***
- ✓ ***The static head loss,***
- ✓ ***The friction loss for the effluent force main, and***
- ✓ ***The gallon per minute requirement for the proposed pressure distribution network.***

Section 4: Correct Sizing of the Effluent Pump

(a) Determine the Total Discharge Rate (**TDR**) of the pump in Gallons per Minute **(GPM)** and the Total Dynamic Head **(TDH)** requirements for the Pressure Distribution Network

(1) Determine the TDR:
The total discharge rate of the pump is the total number of one-quarter (1/4) inch holes in all laterals (including the holes in the end caps) multiplied by one and twenty-eight hundredths (1.28) gallons per minute (GPM) for 3 feet of design head.

(2) Determine the size of the **effluent force main**. The effluent force main shall not be less than one and one-half (1 ½) inches nor more than four (4) inches. The effluent force main diameter is dependent on total discharge rate (GPM). From Table 6, select a pipe diameter that will have a low friction loss at the calculated total discharge (flow) rate. For on-site sewage systems with a DDF of seven hundred fifty (750) gallons per day or less, the manifold pipe shall have a diameter of two (2) inches. For on-site sewage systems with a DDF of greater than seven hundred fifty (750) gallons per day, the manifold pipe shall have the same diameter as the effluent force main or a diameter of two (2) inches, whichever is greater, but no greater than four (4) inches.

(3) Determine the **Total Dynamic Head**. Total Dynamic Head is the sum of Static head, Friction Loss Head and Design / Residual Head.
(A) **Elevation / Static Head:** The elevation difference in the pressure distribution system, measured from "pump off" elevation to the highest elevation in the pressure distribution network.
(B) **Friction Loss Head:** The amount energy spent as the effluent flows through the effluent force main. The length and diameter of the effluent force main is needed as well as the TDR of the pressure distribution network. Table 6 (See Appendix) can be used to determine the actual friction loss in the effluent force main.
(C) **Design/Residual Head:** The constant operating head of the pressure distribution system. It is a constant requirement of 3 feet. This can be confirmed during inspection in the field.

(b) Using Table 6, calculate the Friction Loss Head (H_f) in the effluent force mains and manifold plastic piping. First, locate the column with the correct diameter of the effluent force main or manifold pipe. Then find the calculated GPM and identify the corresponding H_f. Values outside of the recommended flow velocities are highlighted in grey.

(c) Perform a squirt test to check the Design/Residual Head. Drill a ¼" diameter hole on the top of the cleanout cap. Run the pump and measure the elevation of the squirt. The squirt elevation must be at least 3 feet higher than the elevation of the EZflow distribution lateral invert. Replace end cap.

The fifth section in this manual addresses proper sizing of the dosing tank for an EZflow ESM project. A minimum amount of information is necessary to ensure accuracy of the design. This information includes:

- ✓ ***The daily design flow (DDF),***
- ✓ ***Cross section of the dosing tank, and***
- ✓ ***The volume per inch (gal/in) for the proposed dosing tank.***

Section 5: Dosing Tank Specifications and Volume

(a) The volume in gallons per inch of the dosing tank should be obtained from the tank manufacturer.

(b) Generate float settings on a cross-section drawing of dosing tank (See Appendix, Figure 8):

(1) Pump-OFF float set at a level to keep effluent pump submerged.

(2) Pump-ON float set at a level to provide a dose volume is ¼ DDF + drainback, if applicable [See Section 3(b)(3) of this document].
Drainback = length of the effluent force main (in feet) times pipe volume (in gallons per foot). See Table 4.

(3) The high-water alarm should be set to activate within 4 inches of the pump "on" level. Adequate freeboard shall be provided for proper operation of alarm float.
(A) All dosing tanks shall have a properly functioning high-water alarm.
(B) The alarm shall be audible and visible by the system users and must meet the requirements of the current Indiana Electrical Code. The alarm circuit should be provided with a manual disconnect in a watertight, corrosion-resistant outside enclosure.
(C) Alarm circuits shall be on a separate circuit from the pump and shall be supplied ahead of any overload or short circuit protective devices.
(D) Only switches comparable to mercury float level switches shall be used for controls and alarms.

(4) A minimum of 150 gallons of freeboard capacity in the tank should be provided between the high-water alarm activation elevation and the invert elevation of the dosing tank inlet.

(c) Calculate the used volume in the dosing tank to insure proper tank capacity. This is the total volume calculated from the bottom of the tank to the level of the alarm float (from items 1 thru 3, above). This calculated volume plus the volume required for freeboard (item 4, above) must be less than the liquid capacity of the dosing tank below the inlet invert.

The sixth section in this manual addresses EZflow ESM-specific installation specifications. This information includes:

- ✓ ***General installation requirements,***
- ✓ ***Use of geotextile, and***
- ✓ ***Location of effluent manifold.***

Section 6: EZflow ESM-Specific Installation Requirements

(a) Refer to the document titled "Installation Instructions for EZflow in Indiana" (EZ140112ISI-0) and Rule 410 IAC 6-8.3. for general installation specifications. These references address geotextile material and placement requirements, bed preparation requirements and recommendations, distribution piping assembly and positioning, and loadbearing capabilities.

(b) Ensure that all plastic wrapping materials are removed from the EZflow bundles before installation. No plastic wrapping materials shall remain within the mound following installation.

(c) EZflow bundles may not be cut to achieve a length other than the manufactured length.

(d) Voids between EZflow bundles must remain open for flow of effluent. The integrity for the height and position of the EZflow bundles shall be maintained during installation to ensure that the voids are maintained.

(e) Both ends of the EZFlow 4" pipe and each end of a lateral off a manifold shall be capped to prevent sand intrusion. A hole shall be drilled in the 4" EZFlow end cap to facilitate the installation of the pressure distribution lateral.

(f) Geotextile barrier material shall meet Rule 410 IAC 6-8.3-69 requirements and shall be installed across all EZflow bundles.

(g) For center-fed configurations, geotextile barrier material shall span the location where the horizontal effluent manifold is located to prevent backfill material from entering the area where the manifold is installed.

(h) Geotextile barrier material shall cover the EZflow ESM bed from side to side and from end to end and shall be placed in such a method to protect against the backfill of soil material into the EZflow ESM bed.

(i) The horizontal effluent manifold shall be installed as close as possible to the 4-inch distribution pipe at the ends of the EZflow bundles.

The seventh section in this manual addresses an EZflow ESM design example.

Section 7: EZflow ESM Design Example

- 3 Bedroom (450 GPD)
- 0.25 SLR
- Sloping Site (5% slope)
- 5-ft-Wide Bed

Steps:

1. For a 5-foot-wide EZflow ESM, refer to Table 1. For a 6-foot-wide EZflow ESM, refer to Table 2. If other widths are desired, refer to Section 2 of this manual.
2. Based on the number of bedrooms, daily design flow, and soil loading rate of the EZflow ESM design, identify the table row of reference. For this example, the table row of reference is highlighted in green.
3. Identify the referenced EZflow bed and basal area specifications.

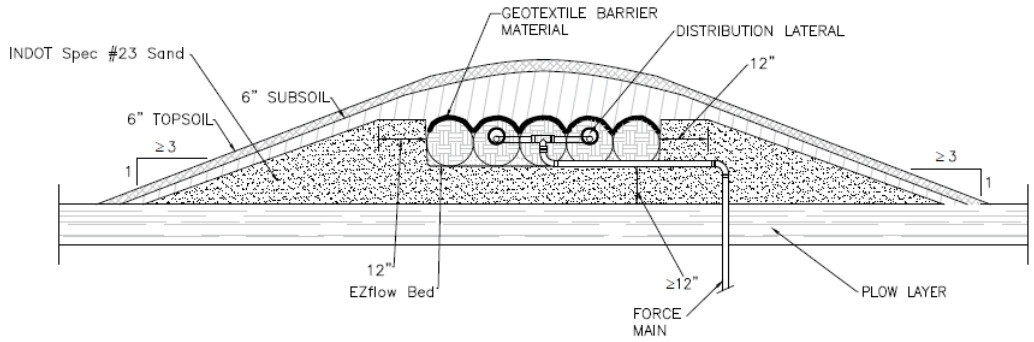
Table 1 (Shortened)
5-Foot-Wide EZflow ESM Dimensions
(Based on Maximum Bed Width Formula and Sand Depth of 12 inches)[a]

Number of Bedrooms & Equivalents	Daily Design Flow DDF (gpd)	Soil Loading Rate SLR (gpd/ft²)	EZflow Bed			Basal Area[f]			
			Area (ft²)	Width (ft)	Minimum Length (ft)[c]	Minimum Area (ft²)	Min. Width (ft) Slope ≤½%[d] (Centered EZflow Bed)	Min. Width (ft) Slope >½%[e] (Upslope EZflow Bed)	Minimum Length (ft)
2	300	1.20	250	5	50	250	19	14	50
3	450	0.25	375	5	75	1,800	24	24	75
3	450	0.50	375	5	75	900	19	14	75
3	450	0.60	375	5	75	750	19	14	75
3	450	1.20	375	5	75	375	19	14	75
4	600	0.25	500	5	100	2,400	24	24	100
4	600	0.50	500	5	100	1,200	19	14	100
4	600	0.60	500	5	100	1,000	19	14	100
4	600	1.20	500	5	100	500	19	14	100
5	750	0.25	625	5	125	3,000	24	24	125
5	750	0.50	625	5	125	1,500	19	14	125
5	750	0.60	625	5	125	1,250	19	14	125
5	750	1.20	625	5	125	625	19	14	125
6	900[g]	0.25	750	5	150	3,600	24	24	150

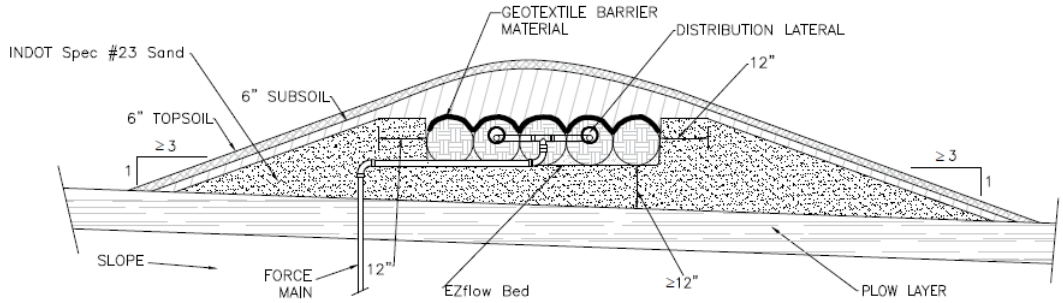
[a]The sand mound should be designed as long and narrow as possible.
[b]EZflow bed width is less than 5' and/or does not meet lateral spacing requirements.
[c]Minimum length is rounded up to the next 5-foot interval. Beds with lengths greater than 55 feet require center-feed manifolds.
[d]The greater of BA Min. Area/BA Min. Length or EZflow Bed Width + 14'.
[e]The greater of BA Min. Area/BA Min. Length or EZflow Bed Width + 9'.
[f]Sideslopes of the INDOT Spec 23 sand on each side of the EZflow bed must have a minimum grade of three-to-one (3:1).
[g]Commercial systems above 750 gpd are not reviewed by local health departments.
[h]Only 12-inch-diameter EZflow bundles shall be used in EZflow ESM systems.
[i]The final bed length shall be rounded up to the nearest multiple of 5 or 10. See Figure 3-1 for illustration.

Appendix

Figure 7–1
Cross Sections of 5–ft–Wide EZflow Elevated Sand Mounds for Level and Sloping Sites

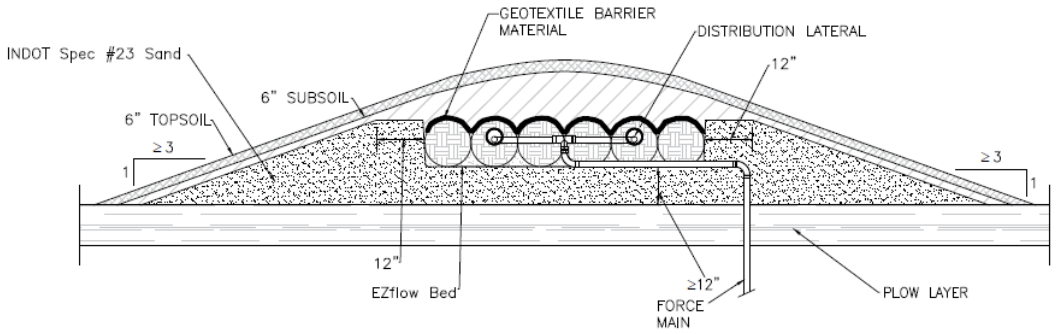


Mound on Level Site
(≤ 1/2 %)

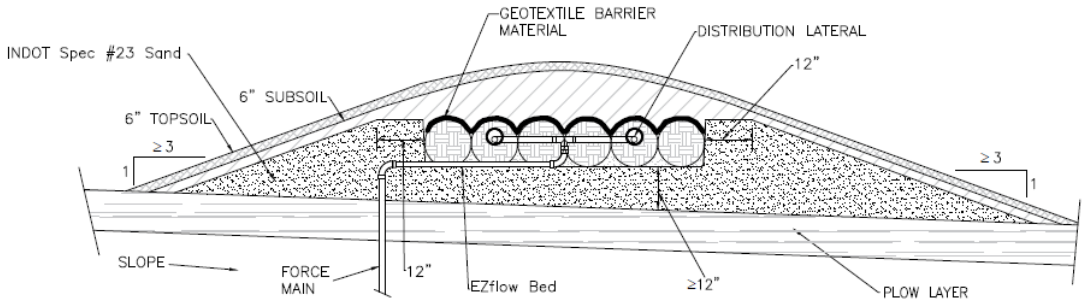


Mound on Sloping Site
(1/2% <Slope≤ 6 %)

Figure 7–2
Cross Sections of 6–ft–Wide EZflow Elevated Sand Mounds for Level and Sloping Sites



Mound on Level Site
(≤ 1/2 %)



Mound on Sloping Site
(1/2% <Slope≤ 6 %)

Table 5
INDOT* Specification 23 Sand

Sieve Sizes		Percent (%) Passing Sieve (by Weight)
3/8 in	(9.50 mm)	100
No.4	(4.75 mm)	95 – 100
No. 8	(2.36 mm)	80 – 100
No. 16	(1.18 mm)	50 – 85
No. 30	(600 µm)	25 – 60
No. 50	(300 µm)	5 – 30
No. 100	(150 µm)	0 – 10
No. 200	(75 µm)	0 – 3

* INDOT: Indiana department of transportation. The sand shall not have more than forty-five (45) percent retained between any two (2) consecutive sieves.

Table 6 – Friction Losses in Plastic Pipe (per 100 feet of pipe)
Pipe Diameter, Flow (gpm), Velocity (v)[2], and Friction Loss Head (H_f)[1]

Flow (gpm)	1"		1 1/4"		1 1/2"		2"		2 1/2"		3"		4"	
Q	v	H_f	v	H_f	v	H_f	v	H_f	v	H_f	v	H_f	v	H_f
1	0.37	0.11												
2	0.74	0.38	0.43	0.10										
3	1.11	0.78	0.64	0.21	0.47	0.10								
4	1.49	1.31	0.86	0.35	0.63	0.16								
5	1.86	1.92	1.07	0.52	0.79	0.24								
6	2.23	2.70	1.29	0.71	0.95	0.33	0.57	0.10						
8	2.97	4.59	1.72	1.19	1.26	0.56	0.77	0.17						
10	3.71	6.90	2.15	1.78	1.58	0.83	0.96	0.25	0.67	0.11				
15	5.57	14.7	3.22	3.76	2.37	1.74	1.43	0.52	1.01	0.22				
20	7.43	25.2	4.29	6.42	3.16	2.96	1.91	.87	1.34	0.37	0.87	0.13		
25	9.28	38.6	5.37	9.74	3.94	4.46	2.39	1.29	1.68	0.54	1.09	0.19		
30			6.44	13.6	4.73	6.27	2.87	1.81	2.01	0.76	1.30	0.26		
35			7.51	18.2	5.52	8.40	3.35	2.42	2.35	1.01	1.52	0.35	0.88	0.10
40			8.59	23.6	6.30	10.7	3.83	3.12	2.68	1.28	1.74	0.44	1.01	0.12
45					7.09	13.5	4.30	3.85	3.02	1.54	1.95	0.55	1.13	0.15
50					7.88	16.5	4.78	4.68	3.35	1.93	2.17	0.67	1.26	0.18
60					9.47	23.6	5.74	6.62	4.02	2.72	2.60	0.94	1.51	0.25
70							6.70	8.86	4.69	3.67	3.04	1.25	1.76	0.33
80							7.65	11.5	5.36	4.69	3.47	1.59	2.02	0.42
90							8.60	14.3	6.03	5.83	3.91	1.99	2.27	0.52
100									6.70	7.13	4.34	2.42	2.52	0.63
125									8.38	10.9	5.43	3.72	3.15	0.96
150											6.51	5.16	3.78	1.34
175											7.60	6.90	4.41	1.79
200											8.68	8.93	5.04	2.27
225													5.67	2.84
250													6.30	3.37
275													6.93	4.13
300													7.56	4.87
325													8.19	5.70

[1] This figure is based on flows for PVC Schedule 40 pipe (flow coefficient: C-150). Other values for friction loss may be used if documentation from the pipe manufacturer is provided with the plan submittal. Calculations using the Hazen-Williams equation may be used if provided with the plan submittal.

[2] Flow velocity must be at least 2 fps; flow velocities above 5 fps should be avoided.

Table 7
Plastic Pipe Fittings: Friction Loss – Equivalent Length of Straight Pipe (ft)*

Fitting:	1”	1 ¼”	1 ½”	2”	2 ½”	3”	4”
90° elbow, standard sharp, inside radius	5.3	6.7	7.5	8.6	9.3	11.1	13.1
90° elbow, long sweep radius	2.5	3.8	4.0	5.7	6.9	7.9	12.0
45° elbow, standard	1.4	1.8	2.1	2.6	3.1	4.0	5.1
Tee flow (run flow)	1.7	2.3	2.7	4.3	5.1	6.2	8.3
Tee flow (branch flow)	6.0	7.0	8.0	12.0	15.0	16.0	22.0
Gate valve	0.6	0.8	1.0	1.5	1.6	2.0	3.0
Male/Female adapter	2.0	2.8	3.5	4.5	5.5	6.5	9.0

*Assigned values. Other values for friction loss may be used if documentation from the pipe manufacturer is provided with the plan submittal.

Figure 8
Dosing Tank for an ESM

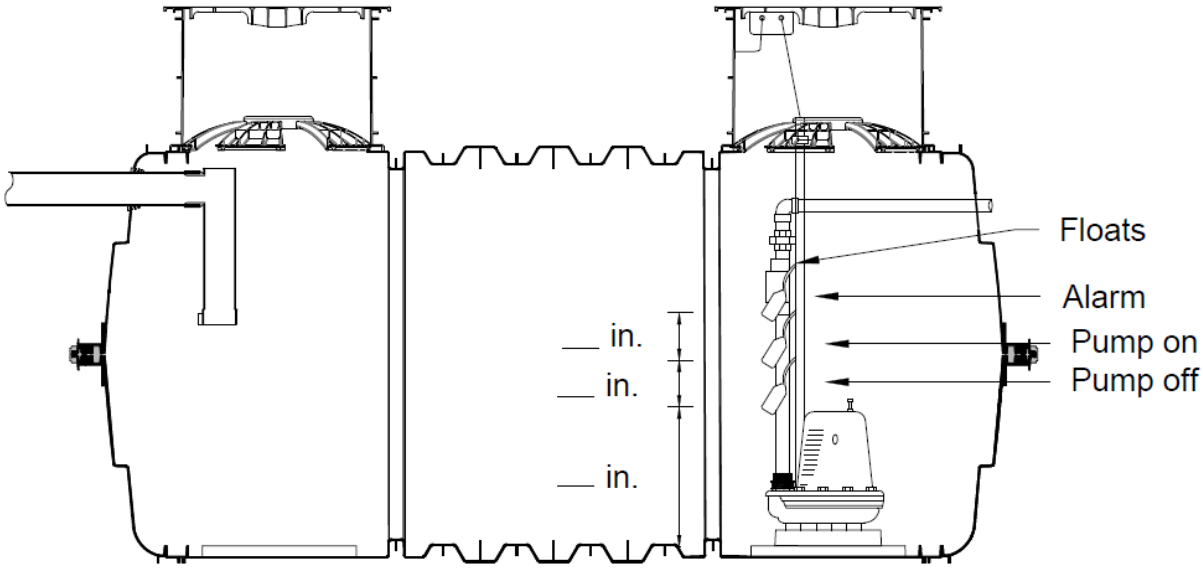


Table 8 Frost Penetrations in Indiana (in inches)							
Adams	60	Allen	60	Bartholomew	48	Benton	60
Blackford	60	Boone	54	Brown	48	Carroll	60
Cass	60	Clark	36	Clay	54	Clinton	54
Crawford	36	Daviess	48	Dearborn	48	Decatur	48
DeKalb	60	Delaware	60	Dubois	42	Elkhart	60
Fayette	54	Floyd	36	Fountain	60	Franklin	48
Fulton	60	Gibson	42	Grant	54	Greene	54
Hamilton	54	Hancock	54	Harrison	36	Hendricks	54
Henry	54	Howard	60	Huntington	60	Jackson	48
Jasper	60	Jay	60	Jefferson	42	Jennings	48
Johnson	54	Knox	48	Kosciusko	60	LaGrange	60
Lake	60	LaPorte	60	Lawrence	48	Madison	60
Marion	54	Marshall	60	Martin	48	Miami	60
Monroe	48	Montgomery	60	Morgan	48	Newton	60
Noble	60	Ohio	42	Orange	42	Owen	54
Parke	60	Perry	36	Pike	42	Porter	60
Posey	42	Pulaski	60	Putnam	54	Randolph	54
Ripley	48	Rush	54	St. Joseph	60	Scott	36
Shelby	54	Spencer	36	Starke	60	Steuben	60
Sullivan	54	Switzerland	42	Tippecanoe	60	Tipton	60
Union	48	Vanderburgh	36	Vermillion	60	Vigo	60
Wabash	60	Warren	60	Warrick	36	Washington	36
Wayne	54	Wells	60	White	60	Whitley	60