Job: Date:
Designer: Design number: Option number:

Worksheet for pressure distribution system design

Short form *Rev. August 2007*

This is an iterative process, so each step may have to be repeated before final design. To be used with the ***Design Inputs Worksheet*** *and the* ***Long Form Worksheet (LFW)*** *instructions and tables.*
Units: Worksheet and tables are in US gallons. See page 10 for conversions.

A. Design of the Distribution Network:

1 Establish Field length

Refer to Design Inputs Worksheet and enter appropriate values below.

SOIL TYPE = _____

DESIGN **HLR** = _____ LPD/SQM **x 0.0245** = _____GPD/SQFT

DESIGN **LLR** = _____ LPD/M **x 0.0805** = _____GPD/FT

DAILY DESIGN FLOW (Q) = _____LPD **x 0.264** = _____GPD

AVERAGE FLOW = _____LPD **x 0.264** = _____GPD

SYSTEM LENGTH GUIDE, L minimum = FIELD DESIGN FLOW (Q) ÷ LLR

= _____ gal per day ÷ _____gal per foot = _____FEET **MINIMUM**

AIS = FIELD DESIGN FLOW / HLR = _____SQUARE FEET
Remember AIS for seepage beds multiply x 1.35

TOTAL LENGTH OF TRENCHES/BED = _____FEET

WIDTH OF TRENCH/BED = _____FEET
Use decimal feet. Is AIS divided by length

NETWORK TYPE (dispersal system piping) = _____ (eg trench, bed)

2 Establish initial trench layout, Determine lateral lengths

Ensure system length meets minimum needed.

MANIFOLD TYPE = _____

LATERAL LENGTH = _____ _____

NUMBER OF LATERALS = _____ _____
SKETCH:

3 Determine orifice size, spacing, position.

ORIFICE SIZE = _____FRACTIONAL INCHES _____

ORIFICE SPACING = _____FEET _____

4 Determine lateral pipe diameter and pipe class
Using tables *LATERAL DESIGN TABLES* (Page 17 *LFW* onward).

LATERAL DIAMETER = _____INCHES _____

LATERAL PIPE CLASS = _____ _____

5 Determine number of orifices per lateral

Divide orifice spacing from (A 3) above into lateral length from (A 2) above, and round to nearest whole number.

(_____ ft ÷ _____ft) + _____ = _____

ORIFICES PER LATERAL = _____ _____

6 Determine lateral discharge rate

Select distal pressure (pressure at last orifice of longest lateral), minimum is 3 feet for 3/16" and larger or 5 feet for 1/8 and 5/32" orifices. This is the **"Squirt Height"**.

DISTAL PRESSURE = _____FEET _____

Orifice discharge from *ORIFICE DISCHARGE RATE DESIGN TABLE* (page 13 *LFW*), or calculation.

ORIFICE DISCHARGE = _____GPM _____

Orifice discharge x number of orifices per lateral from (A 5) above to give

LATERAL DISCHARGE = _____GPM _____

CENTER OR END FEED? = _____ _____

NUMBER OF LATERALS = _____ _____

7 Select spacing between laterals and determine manifold length

Use information in (A 2) above.

SPACING BETWEEN LATERALS = _____FEET

MANIFOLD LENGTH = _____ FEET _____

8 Calculate manifold size

Using information from (A 2) and (A 7) determine manifold length and then use *MAXIMUM MANIFOLD LENGTHS* tables (pages 22 and 23 *LFW*) to select minimum manifold size, using lateral discharge from (A 6) above, Orifice size from (A 3) above and lateral spacing from (A 7) above. For center feed, flow per lateral on either side of manifold is used in table.

MANIFOLD SIZE = _____INCHES _____

MANIFOLD PIPE CLASS _____

9 Determine distribution network discharge rate

Multiply lateral discharge rate from (A 6) above x number of laterals from (A 6) above, check against total number of orifices X orifice discharge rate.

NETWORK DISCHARGE RATE = _____GPM _____

TOTAL NUMBER OF ORIFICES (γ) = _____ X _____gpm = _____GPM

B. Design of the Force Main, Pressurization Unit (Pump or Siphon), Dose Chamber and Controls.

1. Develop a system performance curve.

Distal pressure (from (A 6) above) X 1.31 _____FEET X 1.31 =

NETWORK HEAD REQUIREMENT = _____FEET _____

Determine static head
STATIC HEAD (Indicate if anti siphon required) = _____FEET SIPHON?_____

NETWORK DISCHARGE (from (9) above) = _____GPM

NETWORK 2 DISCHARGE (if more than 1 sub area or zone 2) = _____GPM

NETWORK 3 DISCHARGE (if more than 1 sub area or zone 3) = _____GPM

NETWORK 4 DISCHARGE (if more than 1 sub area or zone 4) = _____GPM
Add more as required.

ANTI SIPHON/PRIMING ORIFICE DISCHARGE (if used) = _____GPM

PUMP DISCHARGE Required = _____GPM

Determine friction loss in force main (transport line to field), first select initial force main sizing, use pipe velocity guide (page 16 *LFW*) to select forcemain initial size Base on maximum **network** discharge.

Check that flow velocity is over 2 and under 10 feet per second using table *FRICTION LOSS IN PLASTIC PIPE* (page 14 *LFW*) assuming use of PVC Sch 40, then use that table to provide head loss for force main based on system discharge and length,. Add equivalent length for fittings as needed from *EQUIVALENT LENGTHS OF FITTINGS* Tables (page 15 *LFW*). **OR** use other friction loss/flow velocity calculation. Note that for end suction pumps it is necessary to also consider losses in the suction piping and fittings, using the same methods.

FORCE MAIN LENGTH α = _____FEET

FORCE MAIN DIAMETER = _____ INCHES

FORCE MAIN TRUE INTERNAL DIAMETER = _____ INCHES
Only required if not using Sch 40 pipe and the table.

Fittings used, including size.	Number	Equivalent length per fitting	Total equivalent length

FITTINGS EQUIVALENT LENGTH β = _____ FEET

TOTAL EQUIVALENT LENGTH (α + β) / 100 = **L** = _____ FEET / 100

HEAD LOSS PER 100' (from table) = _____ Ft/100ft

FRICTION LOSS IN FORCE MAIN = _____ FEET
This is Head loss per 100' times Total Equivalent Length (L).

SUCTION HEAD LOSS (if applicable) = _____FEET

SUCTION LIFT (if applicable) = _____FEET

NET POSITIVE SUCTION HEAD REQUIRED (NPSH) = _____FEET
Add lift plus suction head losses.

CHECK FLOW VELOCITY = _____FEET PER SECOND
If not using PD table

TOTAL DYNAMIC HEAD REQUIREMENT
TDHR = _____FEET
This is Static Head + Network Head requirement + Friction Loss in Forcemain + NPSH

PUMP DISCHARGE/HEAD = _____GPM AT _____FEET HEAD
Develop more than one option if required, to examine impact of changes to network, piping, pump type etc.

ADDITIONAL SECTIONS OF FORCEMAIN, ZONE VALVES, EXTRA ORIFICES

NOTES

2 System curve

NUMBER OF ORIFICES = _____(γ) From (A 9) above.

TOTAL EQUIVALENT PIPE LENGTH (**L**) = _____FT/100 From (B 1) above.

Squirt height (Distal Head)	Orifice flow at squirt height	Network discharge = (flow per orifice x γ)	Pump/anti siphon orifice discharge, if used	Friction factor (ft loss per 100')	Force main(s) head loss (ft) = friction factor x **L**	Network head required (1.31 X squirt ht.) (ft)	Static head (ft) plus other losses	TDHR (ft)	Total flow (gpm) = network discharge + pump orifice (if used)

Static head stays the same for all cases except for if using an anti siphon orifice. Add NPSH if necessary, use separate sheet for zone valves, extra forcemains etc.

3 Select pump (or siphon)

ITERATE UNTIL PUMP AND FORCEMAIN ARE ECONOMIC.

PUMP SELECTED = _____Voltage and max. current: _____

Discharge diameter: _____ Height: _____ ft Minimum water level:_____ ft
(Recommended is full pump ht, often min. is ½ pump motor submerged).

OPERATING POINT = _____ GPM at _____ FT head.

4 Determine dose volume

Based on soil type select type of dosing and minimum/desired dose frequency.

Dosing frequency (**minimum**)	Soil type
Timed dosing	Coarse sand, gravels, sand mounds etc, certain clays
4 X per day	Medium sand, fine sand, loamy sand, Sandy Clay, silty clay or clay
2 X per day	Sandy loam, Loam, Silt Loam, Clay Loam

TYPE OF DOSING (demand or timed) = _____

DOSE FREQUENCY = minimum_____ times per day

Determine draining volume, use *VOLUME OF PIPE* table, page 16.:

VOLUME OF LATERALS (if draining) = _____ft x _____gallons per ft = _____g
Total length of laterals x volume per foot.

VOLUME OF MANIFOLD (if draining) = _____ft x _____gallons per ft = _____g

VOLUME OF PART OF FORCEMAIN = _____ft x _____gallons per ft = _____g
(if draining)
TOTAL DRAINING VOLUME = _____GALLONS

Determine dose volume, two possible methods:

> **Method 1**; Determine dose volume based on dose frequency, and then check against draining volume of network and any part of force main that drains.
>
> Dose volume is determined by dividing frequency into DAILY DESIGN flow (from A(1)). For more conservative design, use AVERAGE flow
>
> _____ gpd ÷ _____ times per day

DOSE VOLUME = _____GALLONS

Then, ensure dose volume is minimum 5 x the draining volume. If not, consider constraints (soil type etc) and redesign manifold location etc to achieve this.

DOSE VOL. ÷ TOT DRAINING VOL. = _____G ÷ _____G = _____ (min. 5)

Method 2; Determine minimum dose volume as 5 times the draining volume of network and any part of force main that drains, then check that this meets minimum number of doses per day.

TOT DRAINING VOLUME X 5 = _____ G Minimum dose volume

DESIGN FLOW ÷ MINIMUM DOSE VOLUME = _____ Doses per day at minimum dose volume. Check that this is greater than minimum needed.

Check pump run time per dose.

PUMP RUN TIME = Dose volume ÷ Pump flow rate

= _____G ÷ _____GPM = ____ MINS

Use smallest dose/most frequent dosing possible.

Notes: For lateral hole positions, draining and distribution:

5. Size pump vault

Timed dosing worksheet is also available.

DESIGN FLOW = _____ GPD From section (A 1), peak flow

DOSE VOLUME = _____ GAL From (B 4)
For time dose this is the timer allow volume.

RESERVE VOLUME = _____ GAL To alarm float from pump on float level. Minimum 15% of peak flow for demand dosed systems, per design for timed dose (Minimum 67% peak flow with timed dose for small systems with lag/override operation).

*RESERVE VOLUME TO LAG FLOAT = _____ GAL For **timed** dose systems only.*

ALARM RESERVE VOLUME = _____GAL Above alarm float to highest allowable liquid level. Minimum 50% of peak flow.

DEPTH REQUIRED FOR PUMP SPACER = _____INCHES
With effluent filter spacer is only required to prevent rock chips etc from entering pump. Some pumps have suitable legs.

Use this information and the **float setting worksheet** (below) or timed dosing worksheet to determine float

or other control setpoints. Ensure the above volumes will fit in the vault, iterate until satisfactory.

PUMP CONTROL FLOAT = _____
If direct control, ensure float is of sufficient capacity.

FLOAT TETHER LENGTH = _____ INCHES

SEPTIC TANK SURCHARGE FOR ALARM VOL. _____(If used)

PUMP CHAMBER "**V**" VALUE = _____ INCHES/USGAL

After installation check that the floats switch as designed. Mark "**V**", float types, heights, ranges (including tether lengths if required) and dose volume on headworks for future reference.

NOTES:

Calculating the Dose Volume For Systems Designed to Drain Back to Pump Chamber:

When draining system back to pump chamber, the volume of effluent in the manifold and transport pipe should be added to the dose volume and considered when sizing the pump chamber Use *VOLUME OF PIPE* table, page 16.

If only part of the system drains back, use appropriate pipe lengths.

Volume in manifold = manifold length x volume in gallons per foot

Volume in manifold = _____ GAL

Volume in Transport Pipe = Transport pipe length x volume in US gallons per foot

Volume in transport pipe = _____ GAL

Total drain back volume = Manifold volume + Transport pipe volume

TOTAL DRAINBACK VOLUME = _____ GAL
Add this volume to dose volume and use per dose volume in worksheet.

TANK FLOAT SETTING WORKSHEET JOB NAME _____ DATE _____

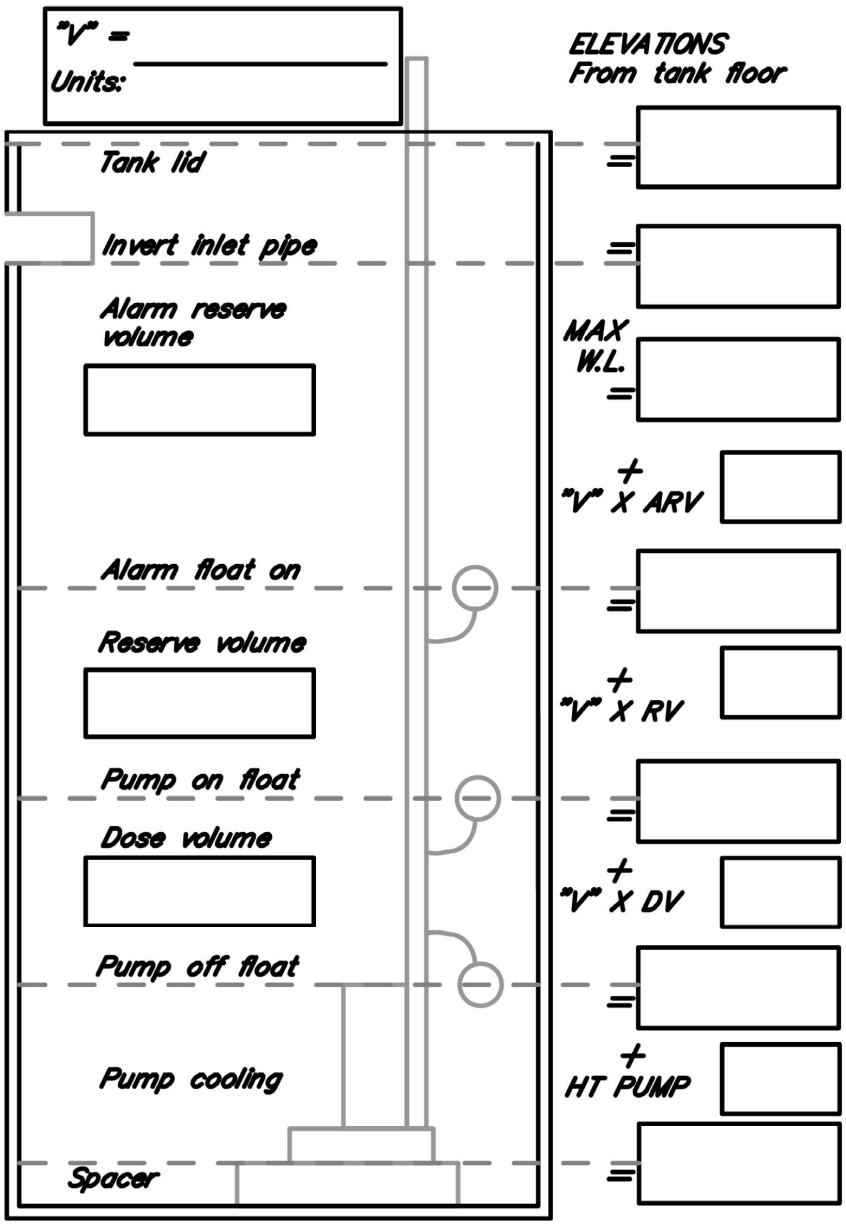
TANK SELECTED _____ UNITS us gal / inch

INTERNAL FLOOR AREA = (L - 2 X wall thickness) X (W - 2 X wall thickness) = _____ SQ IN

VOLUME IN ONE INCH OF DEPTH =_____ CU IN X 0.00433 = _____US G PER IN

"V" = 1 ÷ VOLUME PER INCH = 1 ÷ _____ = _____ FEET PER US GALLON

"V" X VOLUME = HEIGHT HEIGHT ÷ "V" = VOLUME



CU FT X 7.48 = US GALS ~ CU IN X 0.00433 = US GALS
CU METERS X 1000 = LITERS ~ INCHES X 0.0254 = METERS

Tank dimensions:

HT:_____

L: _____

W: _____

Wall thickness: _____

Lid thickness: _____

Base thickness: _____

Inlet invert: _____

Internal heights:

Inlet invert: _____

Tank lid: _____

NOTES

NOTES

Conversions

Gallons in this worksheet are US unless shown as “IG”.

US unit	X	= Metric Unit	X	= US Unit	X	= secondary unit
Gallons	3.785412	Litres	0.264172	Gallons	0.8326738	Imperial Gal.
feet	0.3048	meter	3.28083	ft of head	0.4329004	PSI
Atmosphere	101.325	Kpa	0.1450377	PSI	0.06894757	Bar (=100 Kpa)
				Gallons	0.1336806	cu ft
		Cu m	35.31467	cu ft	7.480519	gallons
GPD/sqft	40.74648	Lpd/sqm	0.024542	GPD/sqft		
GPD/ft	12.418	Lpd/m	0.080528	GPD/ft		
Sq ft	0.0929	Sq m	10.76391	Sq ft		
Inches	0.0254	Meters	39.36996	Inches		
Feet	0.3048	Meters	3.28083	Feet		

References

This worksheet developed by Ian Ralston, TRAX Developments Ltd. Based on *Pressure Distribution Network Design By James C. Converse January, 2000* and *Recommended Standards and Guidance For Pressure Distribution, by Washington State Department of Health*.
See also
http://www.traxdev.com/
For the most current version of this worksheet, the Design Inputs Worksheet, Timed Dosing Worksheet, and for the long form version of this worksheet, with tables and instructions.