Homework
Take Home Answers and New Assignments

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ONSITE SEWAGE TREATMENT PROGRAM
University of Minnesota
Driven to Discover™

and the

Minnesota Pollution Control Agency

More information is available at our website: http://septic.umn.edu
2009-2010 Key Contact Information
Contact the appropriate organization to get your questions answered faster!

University of Minnesota Onsite Sewage Treatment Program
Water Resources Center • 1985 Buford Avenue, 173 McNeal Hall • St. Paul, MN 55108
(800) 322-8642 • FAX: (612) 624-6434 • Email: septic@umn.edu • Web site: http://septic.umn.edu

OSTP Staff can answer questions about workshops, U of MN Publications, soils, designs, forms, small community issues and technical assistance.

<table>
<thead>
<tr>
<th>Staff Person</th>
<th>Telephone</th>
<th>Email</th>
<th>Area of expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nick Haig</td>
<td>612-625-9797</td>
<td><a href="mailto:haigx003@umn.edu">haigx003@umn.edu</a></td>
<td>Workshop questions, UMN publications</td>
</tr>
<tr>
<td>Jessica Wittwer</td>
<td>612-624-7460</td>
<td><a href="mailto:wittw001@umn.edu">wittw001@umn.edu</a></td>
<td>Workshops, soils, landscaping</td>
</tr>
<tr>
<td>Sara Heger Christopherson</td>
<td>612-625-7243</td>
<td><a href="mailto:shc@umn.edu">shc@umn.edu</a></td>
<td>Technical information, design forms</td>
</tr>
<tr>
<td>Dave Gustafson</td>
<td>612-625-1774</td>
<td><a href="mailto:gusta002@umn.edu">gusta002@umn.edu</a></td>
<td>Technical information</td>
</tr>
<tr>
<td>Dan Wheeler</td>
<td>612-625-8791</td>
<td><a href="mailto:wheel027@umn.edu">wheel027@umn.edu</a></td>
<td>Soils, mapping, soil survey</td>
</tr>
<tr>
<td>Laurie Brown</td>
<td>218-726-6475</td>
<td><a href="mailto:brow1198@umn.edu">brow1198@umn.edu</a></td>
<td>Northern MN – Small community, management, or homeowner issues, soils</td>
</tr>
<tr>
<td>Doug Malchow</td>
<td>507-280-5575</td>
<td><a href="mailto:malch002@umn.edu">malch002@umn.edu</a></td>
<td>Southern MN – Small community, management, or homeowner issues</td>
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Minnesota Pollution Control Agency SSTS Contact Information
520 Lafayette Road North St. Paul MN 55155 – Email: ssts-info@pca.state.mn.us – 651-296-6300 or 800-657-3864

The MPCA can answer questions about your business license, professional certification, state rule interpretation, local ordinance assistance, and business complaints.

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<tr>
<td>Clarence Manke</td>
<td>651-757-2550, <a href="mailto:clarence.manke@state.mn.us">clarence.manke@state.mn.us</a></td>
<td>Metro Area: Ordinance &amp; Technical Assistance, SSTS Business Complaints, Tank fee, Rule Interpretation</td>
</tr>
<tr>
<td>Pat Shelito</td>
<td>218-316-3853, <a href="mailto:pat.shelito@state.mn.us">pat.shelito@state.mn.us</a></td>
<td>Central MN and Temporary North East MN: Ordinance &amp; Technical Assistance, SSTS Business Complaints, Rule Interpretation</td>
</tr>
<tr>
<td>Brian Green</td>
<td>507-206-2610, <a href="mailto:brian.green@state.mn.us">brian.green@state.mn.us</a></td>
<td>South East MN: Ordinance &amp; Technical Assistance, SSTS Business Complaints, Rule Interpretation</td>
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<tr>
<td>Nick Reishus Marshall</td>
<td>507-476-4272, <a href="mailto:nicholas.reishus@state.mn.us">nicholas.reishus@state.mn.us</a></td>
<td>South West MN: Ordinance &amp; Technical Assistance, SSTS Business Complaints, Rule Interpretation</td>
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<tr>
<td>Heidi Lindgren</td>
<td>218-846-8134, <a href="mailto:heidi.lindgren@state.mn.us">heidi.lindgren@state.mn.us</a></td>
<td>North West MN: Ordinance &amp; Technical Assistance, SSTS Business Complaints, Rule Interpretation</td>
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<tr>
<td>Ron Swenson</td>
<td>218-316-3862, <a href="mailto:ron.swenson@state.mn.us">ron.swenson@state.mn.us</a></td>
<td>Statewide: Enforcement Supervisor</td>
</tr>
<tr>
<td>Mary West St. Paul</td>
<td>651-757-2818, <a href="mailto:mary.west@state.mn.us">mary.west@state.mn.us</a></td>
<td>Statewide: Program Administration; Technical, Soils and General Ordinance Assistance (backup to regional staff); Annual Report</td>
</tr>
<tr>
<td>Barb McCarthy Duluth</td>
<td>218-302-6647, <a href="mailto:barbara.mccarthy@state.mn.us">barbara.mccarthy@state.mn.us</a></td>
<td>Statewide: SSTS Tank and Product Registration, Soils and Technical Assistance (backup to regional staff)</td>
</tr>
<tr>
<td>Mark Wespetal St. Paul</td>
<td>651-757-2817, <a href="mailto:mark.wespetal@state.mn.us">mark.wespetal@state.mn.us</a></td>
<td>Statewide: Program Administration, Technical Assistance (backup to regional staff)</td>
</tr>
<tr>
<td>Gretchen Sabel St. Paul</td>
<td>651-757-2686, <a href="mailto:gretchen.sabel@state.mn.us">gretchen.sabel@state.mn.us</a></td>
<td>Statewide: Program Administration, Legislative Issues, General Ordinance Assistance (backup to regional staff), South West MN Ordinance and Technical Assistance</td>
</tr>
<tr>
<td>Bill Priebe St. Paul</td>
<td>651-757-2658, <a href="mailto:bill.priebe@state.mn.us">bill.priebe@state.mn.us</a></td>
<td>Statewide: SSTS Program Policy and Planning Supervisor</td>
</tr>
<tr>
<td>Jane Seaver St. Paul</td>
<td>651-757-2201 ext. 2-1; 800-657-3659, <a href="mailto:jane.seaver@state.mn.us">jane.seaver@state.mn.us</a></td>
<td>Statewide: Individual Certification &amp; Business Licensing</td>
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Heggy's Golf Course

**Take Home Homework**

**Design flow**
- 30 Seat Restaurant with 10 employees
  - 30 seats \times 30 \text{ gallons/seat} = 900 \text{ gallons}
  - 10 employees \times 15 \text{ gallons per employee} = 150 \text{ gallons}
- 20 Seat Bar with 6 employees
  - 20 seats \times 36 \text{ gal/seat} = 720 \text{ gallons}
  - 6 employees \times 15 \text{ gallons per employee} = 90 \text{ gallons}
- Locker room with 20 showers per day
  - 20 showers \times 11 \text{ gallons/shower} = 210 \text{ gallons}
- Meeting room the holds 130 seats for events
  - 130 seats \times 4.5 \text{ gallons/seat} = 585 \text{ gallons}
- Total = 900 + 150 + 720 + 90 + 210 + 585 = 2,655 \text{ gpd}

**BOD Loading**
- Flow in GPD \times \text{BOD in mg/l} \times 8.35 \div 1,000,000
- 2,655 gpd \times 1,100 \text{ mg/l} \times 8.35 \div 1,000,000
- 24.4 pounds of BOD

**Grease Trap Required**
- 70\% of flow from restaurant and bar
- 0.70 \times (1050 \text{ gpd} + 790 \text{ gpd})
- = 1,288 \text{ gallons}
Collection System Take Home Problem Solution

Problem: Design a gravity collection system for 3 Type I (3 bedroom) and 3 Type I (4 bedroom) homes. Each home connects to the gravity collection system directly (no septic tank or effluent screen). The home lots are in line along Eagle Road and have a front lot dimension of 170 feet. Assume there is 170 feet between individual home connections and the treatment site is 600 feet from the last home connection. Use minimum slope.

1. What type and size pipe should be used for this collection system?

The minimum allowable diameter for the gravity collection sewer is 6” standard dimension ratio (SDR) 35 PVC pipe. The 6” minimum diameter pipe is used because the gravity collection system connects each individual residential service directly to the gravity collection sewer main.

2. Determine the design flow of the collection system.

From Minn. R. 7080.1860:
Type I 3 bedroom home: 450 gpd
Type I 4 bedroom home: 600 gpd

3 homes x 450 gpd/home = 1350 gpd
3 homes x 600 gpd/home = 1800 gpd

Wastewater flow from homes = 3150 gpd

Also need to incorporate inflow and infiltration (I/I) calculation.

From Minn. R. 7081.0140, need to allow for 200 gpd/inch/mile of collection sewer.

<table>
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<tr>
<th>Treatment site</th>
<th>Lot 1</th>
<th>Lot 2</th>
<th>Lot 3</th>
<th>Lot 4</th>
<th>Lot 5</th>
<th>Lot 6</th>
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<tbody>
<tr>
<td>600’</td>
<td>170’</td>
<td>170’</td>
<td>170’</td>
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<td>170’</td>
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</table>

Need to determine the length of the collection system.

Length = 600 + 170 + 170 +170 + 170 +170 = 1450 feet
1450 feet x (1 mile/5280 feet) = 0.27 miles

I/I = 200 gpd/in/mile x 6 in x 0.27 mi = 324 gpd

Total design flow of the collection system = 3150 gpd + 324 gpd = 3474 gpd

3. Will a 6 inch diameter gravity collection pipe have capacity to carry 50% of the daily flow in 1 hour?

50% of the daily design flow = 0.5 x 3474 gpd = 1737 gpd
Need to convey this flow in 1 hour = need to carry 1737 gallons per hour
1737 gph x (1 hour/60 min) = 29 gallons per minute

The capacity of the collection system is found using Q=VA and the Manning Equation

Manning Equation

\[ V = \frac{k}{n} \left( \frac{A}{P} \right)^{2/3} S^{1/2} \]

where: \( k = 1.486 \)
\( n \) = Manning coefficient
\( A \) = area of pipe (ft) = \( \pi D^2/4 = \pi r^2 \)
\( P \) = wetted perimeter (ft) = \( 2\pi r = \pi D \)
\( S \) = slope (ft/ft)

Area of pipe:
\[ A = \frac{\pi D^2}{4} = \frac{3.14 \times 6^2}{4} = 28.26 \text{ in}^2 \]

28.26 in\(^2\) x (1 ft\(^2\)/144 in\(^2\)) = 0.196 ft\(^2\)

Wetted perimeter:
\[ P = \pi D = 3.14 \times 6 = 18.84 \text{ in} \]

18.84 in x (1 ft/12 in) = 1.57 ft

Slope:
\( S = 0.01 \text{ ft/ft} \) (minimum allowable slope)

Using \( n = 0.009 \):

Using the Manning Equation:

\[ V = \frac{1.486}{0.009} \left( \frac{28.26}{18.84} \right)^{2/3} \times 0.01^{1/2} \]

\[ V = 167.37 \times 0.535 \times 0.01 \]

\[ V = 0.894 \text{ ft/min} \]

0.894 ft/min x (60 min/hour) = 53.64 gpm

53.64 gpm < 29 gpm

Therefore, the 6 inch diameter pipe does not have sufficient capacity to carry 50% of the daily flow in 1 hour.
\[
V = k \left( \frac{A}{n} \right)^{2/3} S^{1/2} = 1.486 \left( \frac{0.196 \text{ ft}^2}{1.57 \text{ ft}} \right)^{0.67} 0.01^{1/2} = 4.1 \text{ ft/s}
\]

\[
Q = VA = 4.1 \times 0.196 = 0.8 \text{ ft}^3/\text{s}
\]

\[
0.8 \text{ ft}^3/\text{s} \times (7.48 \text{ gal/ft}^3) \times (60 \text{ s/min}) = 359 \text{ gpm}
\]

**359 gpm > 29 gpm therefore, the collection system has the capacity to convey 50% of the design flow in 1 hour.**

**Using n = 0.013:**

\[
V = k \left( \frac{A}{n} \right)^{2/3} S^{1/2} = 1.486 \left( \frac{0.196 \text{ ft}^2}{1.57 \text{ ft}} \right)^{0.67} 0.01^{1/2} = 2.8 \text{ ft/s}
\]

\[
Q = VA = 2.8 \times 0.196 = 0.55 \text{ ft}^3/\text{s}
\]

\[
0.55 \text{ ft}^3/\text{s} \times (7.48 \text{ gal/ft}^3) \times (60 \text{ s/min}) = 247 \text{ gpm}
\]

**247 gpm > 29 gpm therefore, the collection system has the capacity to convey 50% of the design flow in 1 hour.**

4. If this project were in St. Louis County, what is the minimum depth the gravity collection pipe can be without insulation?

From the map in the Design Guidance, the minimum burial depth in St. Louis County is 9 feet.

5. Assume the gravity pipe is placed at minimum depth at the first home connection. What is the depth of the gravity pipe at the treatment site using the minimum allowable slope?

The minimum depth is 9 feet from the previous question. The minimum slope if 0.01 ft/ft. The length of the collection system is 1450 feet from a previous question.

\[
\text{Depth} = 9 \text{ feet} + (0.01 \times 1450 \text{ ft}) = 23.5 \text{ feet}
\]
Subdivision Collection

Design steps
Example 1

Development- Wheelerville Heights

- 16 home sites
  - 4 @ 5 bedroom [13,14,15,17]
  - 7 @ 4 bedroom [1,2,4,5,6,7,8,9]
  - 5 @ 3 bedroom [10,11,12,16,18]
- 1 acre lots
- 1,675 ft of road and sewer piping
- Lot 3 is the site for the cluster

Set Home sizes or use

- 5 bedroom (750 gpd)
  - 4
- 4 bedroom (600 gpd)
  - 7
- 3 bedroom (450 gpd)
  - 5

Calculate flows

- Homes
  - 5 bedroom (750 gpd)
    - 4 x 750 gpd = 3,000 gpd
  - 4 bedroom (600 gpd)
    - 6 x 600 gpd = 3,600 gpd
    - 1 x 600 gpd = 600 gpd = 4,200 gpd
  - 3 bedroom (450 gpd)
    - 5 x 450 gpd = 2,250 gpd
- Other use
  - None
- Permit? (+ I&I)
**Total flow {Collection Design}**
- 3,000 gpd + 4,200 gpd + 2,250 gpd = 9,450 gpd

**Permit flow {System Design}**
- 3,000 gpd + 3,600 gpd + [0.45 x 600 gpd] + [0.45 x 2,250 gpd] = 7,883 gpd

**Determine pipe length & Size**
- Total length:
  - 550’ + 300’ + 425’ + 350’
  - 1,675 ft
- Sizing
  - Gravity: 6 inch
  - STAG: 4 inch
  - Pressure: 2 inch

**Calculate I & I**
- I&I = L(ft) x d(in) x 200 gal/in-mile
- Gravity: 6 inch
  - = 1,675 ft x 6 in x 200 g/i-m ÷ 5,280 ft/mi
  - = 381 gpd
- STAG: 4 inch
  - = 1,675 ft x 4 in x 200 g/i-m ÷ 5,280 ft/mi
  - = 254 gpd
- Pressure: 2 inch
  - = 1,675 ft x 2 in x 200 g/i-m ÷ 5,280 ft/mi
  - = 127 gpd

**Flows**
- Collection 9,450 gpd
- Permit 7,883 gpd
- 6 inch = 9,831 gpd  6 INCH = 8,264 GPD
- 4 inch = 9,704 gpd  4 INCH = 8,137 GPD
- 2 inch = 9,577 gpd  2 INCH = 8,010 GPD

**Peak flow**
- 50% of daily flow in 1 hr
- 4 inch
  - 9,704 x 0.5 [50%] ÷ 60 min
  - 81 gpm
- 2 inch
  - 9,577 x 0.5 [50%] ÷ 60 min
  - 80 gpm
### Required tank capacity

- **Gravity:** Flow x 3 days
  - 8,264 gpd x 3 days = 24,792 gal
  - 8,137 gpd x 3 days = 24,411 gal
- **Pressure:** Flow x 4 Days
  - 8,010 gpd x 4 days = 32,040 gal
- **Provided in the system**
  - Zero
  - 16 x 1,500 gal = 24,000 gal

### Size Stilling Tank

- Required tank – Provided Tank
  - 32,040 gal – 24,000 gal
  - **8,040 gal**

1 day ~ 8,010 gal

### Find elevations:

<table>
<thead>
<tr>
<th>Point</th>
<th>Station</th>
<th>Elevation</th>
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### Set pipe elevations

- **Start at 7' [A:0+00]**
- 80' – 7' = 73'
- **Gravity**
  - **Slope 1" in 8' or 1 %**
- **Pressure**
  - **Slope 0 % for Pressure**

### Find pipe grade

- Check depth
- Limitations [Water, Rock.....]
- > 20’ requires Lift Station

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Gravity {STAG}

Septic tank and gravity
Find elevations:

- Right of way
- Homes
- Connections

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Profile A to I

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Profile E to I

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Set pipe elevations

- Start at 7'
- Slope 1" in 8' or 1%
- AB: 300 ft x .01 = 3 ft of drop
- 7 ft + 3 ft = 10 ft at the end

**Elevation 80' - 10 ft = 70 ft**

- Cut 90' – 70' = 20' cut

Set pipe elevations at D

- Start at 7'
- Slope 1" in 8' or 1%
- AD: 700 ft x .01 = 7 ft of drop
- 7 ft + 3 ft = 14 ft at the end

**Elevation 80' - 14 ft = 66 ft**

- Cut 98' – 66' = 32' cut

Hole with Lift
Determine size

- Size pumps
  - 75 gpm at Lift required
- Lift station requirements
  - See guidance
- Determine manhole locations
  - 400'
- Required thrust blocks

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Lift station requirements

See guidance

Determine manhole locations

400'

Find elevations:

4' 150' x 100 = 2.7%

STEP Design

Septic tank effluent pumping

Determine legs

- Two
  - ABCFGHI
  - EDCFGHI
  - Find length
    - AI: 550' + 425' + 350' = 1,325 ft
    - EI: 300' + 425' + 350' = 1,075 ft

Find elevations:

Set N

- 16 Homes
Determine $Q_{\text{max}}$

- 50% of the flow in 1 hr
- 5 Bedroom
- 750 gpd x 0.5 + 60 min/hr
- 6.25 gpm
- 4 Bedroom
- 600 gpd x 0.5 + 60 min/hr
- 5 gpm

Determine $Q_m$

- 9 homes ~ 3 pumps
- 4 x 6.25 gpm = 25 gpm
- 4 x 10 gpm = 40 gpm

Determine Area

- 2 inch pipe
- $A_{2\text{in}} = \pi \times r^2$
- $= 3.14 \times (0.08)^2$
- $A_{2\text{in}} = 0.02 \text{ sqft}$

Calculate Velocity ($> 1 \text{ ft/sec}$)

- $V = Q / A$
- $= 25 \text{ gpm divided by Area of 2" pipe}$
- $= [25 \text{ gpm} \times 0.0022 \text{ fps}] / 0.02 \text{ sqft}$
- $2.75 \text{ fps} \ (> 1 \text{ fps OK})$

Calculate $H_f$

- Slope = $(10.5 + d^{4.87}) \times (Q + C)^{1.85}$
- $= (10.5 + 2^{4.87}) \times (25 \text{ gpm})^{1.85}$
- $= (10.5 + 29.2) \times (0.19)^{1.85}$
- $= 10.5 + 29.2 \times 0.05$
- $= 0.018$
- $H_f = \text{Slope} \times \text{Length}$
- $0.018 \times 1.325' = 24'$

40 gpm

52 ft

Calculate static head

- From diagram
- 73 ft to 95 ft
- About [22 ft]

- TOTAL HEAD (TDH [Hs+Hf])
- 22' + 24' = 46'
- 22' + 52' = 74'
Pump selection $Q_m : TDH \ [H_s + H_f]$
- 6.25 gpm @ 46' of head
- 10 gpm @ 74' of head

Layout:
- Thrust blocks
  - Each connection
  - Change of direction
- STEP specs
  - 1,500 tanks
- Cleanouts
- Air Release locations
  - Highest point

Pressure sewer

Determine legs
- One

Find length
- 1.675'

Set N
- 16 homes
Determine Qm

- 16 homes
- 4 pumps operating
- $4 \times 11 \text{ gpm} = 44 \text{ gpm}$

Calculate Velocity $\geq 2 \text{ ft/sec}$

- $V = \frac{Q}{A}$
- $= 33 \text{ gpm}$ divided by Area of 2” pipe
- $= \left[ 44 \text{ gpm} \times 0.0022 \frac{\text{ fps}}{\text{ ft}} \right] \div 0.02 \text{ sqft}$
- $4.8 \text{ fps} \geq 2 \text{ fps OK}$

Calculate Hf

- Slope = $(10.5 \div d^{4.87}) \times (Q + C)^{1.85}$
- $= (10.5 \div 2^{4.87}) \times (44 \text{ gpm} + 130)^{1.85}$
- $= (10.5 \div 29.2) \times (0.34)^{1.85}$
- $= 0.047$
- $Hf = \text{Slope} \times \text{Length}$
- $0.047 \times 1,325' = 62'$

Calculate static head

- $95 \text{ ft} - 73 \text{ ft} = 22 \text{ ft}$

Pump selection

- $Qm : \text{TDH} [Hs+Hf]$
- $11 \text{ gpm} \times (22 + 62) = 84 \text{ ft}$ of head

Layout:

- Thrust blocks
  - Each connection
  - Change of direction
- Sump Specs
- Cleanouts
- Air Release locations
1. **Rectangle area** = Length (L) X Width (W)
   \[ \text{ft} \times \text{ft} = \text{ft}^2 \]

2. **Circle area** = 3.14r^2 (3.14 X radius X radius)
   \[ 3.14 \times (2 \text{ ft})^2 = \text{ft}^2 \]

3. **Tank model and manufacture (optional):**
   \[ \text{Get area from manufacturer} \text{ ft}^2 \]

4. **Get gallons per inch from manufacture**
   \[ 20.0 \text{ Gallons per inch} \]

2. Calculate **Gallons Per Inch**:
   \[ \frac{\text{Area} \times 7.48 \text{ gallons/ft}^3}{12 \text{ in/ft}} = \text{Gallons per inch} \]

   \[ \frac{\text{ft}^2 \times 7.48 \text{ gal/ft}^3}{12 \text{ in/ft}} = \text{Gallons per inch} \]

**TANK CAPACITY**

3. Enter the **Pump Tank Capacity (minimum provided in the table below):**
   \[ 1200 \text{ Gallons} \]

4. Calculate **Total Tank Volume**
   \[ \text{A. Depth from bottom of inlet pipe to tank bottom: } \]
   \[ 60 \text{ in} \]

   \[ \text{B. Total Tank Volume} = \text{Depth from bottom of inlet pipe} \times \text{Gallons/Inch} \]
   \[ 60 \text{ in} \times 20.0 \text{ Gallons Per Inch} = 1200 \text{ Gallons} \]

5. Calculate **Volume to Cover Pump** (The inlet of the pump must be at least 4-inches from the bottom of the pump tank & 2 inches of water covering the pump is recommended)
   \[ (\text{Pump and block height} + 2 \text{ inches}) \times \text{Gallons Per Inch} \]
   \[ (10 \text{ in} + 2 \text{ inches}) \times 20.0 \text{ Gallons Per Inch} = 240 \text{ Gallons} \]

<table>
<thead>
<tr>
<th>Design Flow (Gallons Per Day)</th>
<th>Minimum Pump Tank Capacity (Gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-600</td>
<td>500</td>
</tr>
<tr>
<td>601-4,999</td>
<td>100% of the Design Flow</td>
</tr>
<tr>
<td>5,000-9,999</td>
<td>50% of the Design Flow</td>
</tr>
</tbody>
</table>

**DOSING VOLUME**

6. **Minimum Pumpout Volume** - 5 X Volume of Distribution Piping:
   \[ 96.9 \text{ Gallons} \]

   - Line 17 of the Pressure Distribution or Line 11 of Non-level
7. Calculate Maximum Pumpout Volume (25% of Design Flow)
   Design Flow: 600 GPD \times 0.25 = 150 \text{ Gallons}

8. Select a pumpout volume that meets both items above (Line 6 & 7): 100 \text{ Gallons}

9. Calculate Doses Per Day = Design Flow ÷ Dosing Volume
   \[ \frac{600 \text{ gpd}}{100 \text{ gal}} = 6.0 \text{ Doses} \]

10. Calculate Drainback:
    A. Diameter of Supply Pipe = 2 inches
    B. Length of Supply Pipe = 100 feet
    C. Volume of Liquid Per Lineal Foot of Pipe = 0.170 Gallons/ft
    D. Drainback = Length of Supply Pipe \times Volume of Liquid Per Lineal Foot of Pipe
       \[ 100 \text{ ft} \times 0.170 \text{ gal/ft} = 17.0 \text{ Gallons} \]

11. Total Dosing Volume = Dosing Volume (Line 8) plus Drainback (Line 10.D)
    \[ 100 \text{ gal} + 17.0 \text{ gal} = 117.0 \text{ Gallons} \]

12. Minimum Alarm Volume = Depth of alarm (2 or 3 inches) \times gallons per inch of tank (Line 1 or 2)
    \[ 3 \text{ in} \times 20 \text{ gal/in} = 60 \text{ Gallons} \]

### Volume of Liquid in Pipe

<table>
<thead>
<tr>
<th>Pipe Diameter (inches)</th>
<th>Liquid Per Foot (Gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.045</td>
</tr>
<tr>
<td>1.25</td>
<td>0.078</td>
</tr>
<tr>
<td>1.5</td>
<td>0.110</td>
</tr>
<tr>
<td>2</td>
<td>0.170</td>
</tr>
<tr>
<td>3</td>
<td>0.380</td>
</tr>
<tr>
<td>4</td>
<td>0.661</td>
</tr>
</tbody>
</table>

**TIMER or DEMAND FLOAT SETTINGS**

Select Timer or Demand Dosing: ○ Timer  ○ Demand Dose

A. Timer Settings

13. Required Flow Rate:
    A. From Design (Line 11 of Pressure Distribution or Line 10 of Non-Level*):
       \[ 29 \text{ GPM} \]
    B. Or calculated: \[ \text{GPM} = \frac{\text{Change in Depth (in)} \times \text{Gallons Per Inch (Line 1 or 2)}}{\text{Time Interval in Minutes}} \]
       \[ \frac{20.0 \text{ in} \times 20.0 \text{ gal/in}}{\text{min}} = 30.0 \text{ GPM} \]

    \[ 30 \text{ GPM} \]

15. Calculate TIMER ON setting:
    \[ \frac{117.0 \text{ gal}}{30.0 \text{ gpm}} = 3.9 \text{ Minutes ON} \]

16. Calculate TIMER OFF setting:
    \[ \frac{1440 \text{ min}}{6.0 \text{ doses/day} - 3.9 \text{ min}} = 236.1 \text{ Minutes OFF} \]

17. Pump Off Float - Measuring from bottom of tank:
    \[ \text{Distance to set Pump Off Float=Galons to Cover Pump (Line 5)} \times \text{Gallons Per Inch (Line 1 or 2)}: \]
    \[ 240 \text{ gal} \div 20.0 \text{ gal/in} = 12 \text{ Inches} \]

18. Alarm Float - Measuring from bottom of tank:
    \[ \text{Distance to set Alarm Float = Tank Depth(4A) \times Alarm Depth (Line 13)}: \]
    \[ 60 \text{ in} - 3 \text{ in} = 57 \text{ in} \]

B. DEMAND DOSE FLOAT SETTINGS

18. Calculate Float Separation Distance using Dosing Volume.
OSTP Pump Tank Sizing, Dosing and Float and Timer Setting Design Worksheet

Total Dosing Volume (Line 12)/Gallons Per Inch (Line 2)

\[
\text{gal ÷ gal/in = inches}
\]

19. Measuring from bottom of tank:

A. Distance to set Pump Off Float = Pump Height + Block Height (Line 5) + Alarm Depth (Line 13)

\[
\text{in + in = inches}
\]

B. Distance to set Pump On Float = Distance to Set Pump-Off Float (Line 19.A) + Float Separation Distance (Line 18)

\[
\text{in + in = inches}
\]

C. Distance to set Alarm Float = Distance to set Pump-On Float (19.B) + Alarm Depth (2-3 inches)

\[
\text{in + in = inches}
\]

FLOAT SETTINGS

<table>
<thead>
<tr>
<th>DEMAND DOSING</th>
<th>TIMED DOSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm Depth</td>
<td>Alarm Depth</td>
</tr>
<tr>
<td>Pump On</td>
<td>57 in</td>
</tr>
<tr>
<td>Pump Off</td>
<td>12 in</td>
</tr>
<tr>
<td></td>
<td>60 Gallons</td>
</tr>
<tr>
<td></td>
<td>117 Gallons</td>
</tr>
<tr>
<td></td>
<td>240 Gallons</td>
</tr>
</tbody>
</table>

I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

__________________________ (Designer)  ______________________________ (Signature)  ___________________________ (License #)  ______________________ (Date)
1. Select Number of Perforated Laterals in system/zone: 3
   (2 feet is minimum and 3 feet is maximum spacing)

2. Select Perforation Spacing: 3.0 ft

3. Select Perforation Diameter Size: 1/4 inch

4. Length of Laterals = Media Bed Length - distance from edge
   (1 or 2 feet depending on manifold location as perf can not be closer then 1 foot from edge)
   40 ft - 2 ft = 38 ft

5. Determine the Number of Perforation Spaces. Divide the Length of Laterals (Line 4) by the Perforation Spacing (Line 2) and round down to the nearest whole number.
   Number of Perforation Spaces = 38 ft ÷ 3 ft = 12 Spaces

6. Number of Perforations per Lateral is equal to 1.0 plus the Number of Perforation Spaces (Line 5).
   Perforations Per Lateral = 12 Spaces + 1 = 13 Perfs. Per Lateral

   Check Table I to verify the number of perforations per lateral guarantees less than a 10% discharge variation. The value is double if a center manifold is used.

7. Total Number of Perforations equals the Number of Perforations per Lateral (Line 6) multiplied by the Number of Perforated Laterals (Line 1).
   13 Perf. Per Lateral X 3 Number of Perf. Laterals = 39 Total Number of Perf.

8. Calculate the Square Feet per Perforation. Recommended value is 4-10 ft² per perforation.
   Does not apply to At-Grades
   Bed Area = Bed Width (ft) X Bed Length (ft)
   0 ft² X 40 ft = 0 ft²

   Square Foot per Perforation = Bed Area divided by the Total Number of Perforations (Line 7).
   0 ft² ÷ 39 perforations = 0.0 ft²/perforations

9. Select Minimum Average Head: 1.0 ft

10. Select Perforation Discharge (GPM) based on Table III: 0.74 GPM per Perforation

11. Determine required Flow Rate by multiplying the Total Number of Perforations (Line 7) by the Perforation Discharge (Line 10).
   39 Perforations X 0.74 GPM per Perforation = 29 GPM

12. Select Type of Manifold Connection (End or Center): ☑️ Center
14. Select Lateral Diameter based on Table I: \[ \text{2.00 in} \]

15. Volume of Liquid Per Foot of Distribution Piping: \[ 0.170 \text{ Gallons/ft} \]

16. Volume of Distribution Piping =
   \[ \text{[Number of Perforated Laterals (Line 1) X Length of Laterals (Line 4) X (Volume of Liquid Per Foot of Distribution Piping (Line 15)]} \]
   \[ 3 \times 38 \text{ ft} \times 0.170 \text{ gal/ft} = 19.4 \text{ Gallons} \]

17. Minimum Dose = Volume of Distribution Piping (Line 17) X 5
   \[ 19.4 \text{ gals} \times 5 = 96.9 \text{ Gallons} \]

---

I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

_________________________  ___________________________  ______________________  ______________________
(Designer)  (Signature)  (License #)  (Date)
**Homework Assignment using a Registered Treatment Product**

ECOPOD Registered with and without UV Disinfection

Single Family Home Preliminary Concept Design

**Site**
Assume there are no real space limitations, open grassy site; south facing slope; lot has 1-2% slope. However, the homeowner does not want a mound. It is a year-round residence.

**Basic information**
4 bedroom home; design flow 600 gallons per day, 2,100 ft² home, 3 Bedrooms, unfinished basement with egress, Dishwasher, Washer, Garbage Disposal, Large Bathtub

**Soils on the site**
There is 36 inches of loam soil, blocky, week, friable.

Use the rules and the MPCA website on Product Registration located at – [http://www.pca.state.mn.us/programs/ists/productregistration.html](http://www.pca.state.mn.us/programs/ists/productregistration.html) to determine the following:

<table>
<thead>
<tr>
<th><strong>Treatment level required</strong></th>
<th>Treatment Level A or B, it depends on the chosen soil dispersal system selected by AD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trash tank sizing</strong></td>
<td>per manufacturer’s recommendations, minimum 600 gallon tank</td>
</tr>
<tr>
<td><strong>Ecopod Model</strong></td>
<td>One E60 unit</td>
</tr>
<tr>
<td><strong>UV disinfection needed?</strong></td>
<td>One Salcor 3G UV disinfection unit</td>
</tr>
<tr>
<td><strong>Housing for UV device</strong></td>
<td>Pump tank for soil dispersal will house the UV disinfection unit</td>
</tr>
<tr>
<td><strong>Size of pump tank for soil dispersal</strong></td>
<td>1000 gallon (need to check what the answer really is)</td>
</tr>
<tr>
<td><strong>Soil dispersal (type and depth)</strong></td>
<td>Trenches, maximum depth 24 inches (Treatment Level A)</td>
</tr>
<tr>
<td><strong>Applicable soil loading rate tables to use</strong></td>
<td>Use 7080.2350 - Tables XI and XII</td>
</tr>
<tr>
<td><strong>Soil loading rate</strong></td>
<td>0.45 gpd/ft²</td>
</tr>
<tr>
<td><strong>Soil dispersal system design</strong></td>
<td>1333 square feet; pressure trenches 3 ft wide; total 445 lineal ft trench; 3 trenches each 149 ft long</td>
</tr>
</tbody>
</table>
In the operation of wetlands, nitrogen and phosphorous may be assimilated by plant uptake, yet they both cannot be counted upon as being removed from the wastewater. Explain.

The uptake of nitrogen and phosphorous by plants occurs during the growing season, but during senescence in the fall and winter, plant death occurs and unless harvested and removed, the nutrients are recycled right back into the system.

Explain why normal non-pathogenic organisms known as coliforms are used to identify the presence of pathogens in wastewater.

It is very difficult and expensive to isolate and identify pathogens in wastewater, and since coliform organisms are excreted in large numbers by warm blooded animals and are relatively easy to identify and enumerate, their presence is taken as presumptive, but not definite evidence of pathogens.

Although most species of animals are probably harmless or even beneficial to the function of a constructed wetland, there are a few nuisance species. Name and describe two species and their impact on the wetland.

Burrowing rodents may disrupt berms and dikes and consume emergent vegetation, and water fowl in large numbers may stir up sediments and add excessive nutrients from their droppings.

In general does the climate have any influence on the functioning of a wetland? Explain.

Since wetlands rely partly on biological decomposition, the warmer climates are preferable. In addition if ice covers the open water surface, it will impede the transfer of oxygen.

Wetlands may not be an appropriate option for small communities where land and skilled labor are scarce and expensive. They should not be suggested if nitrogen and phosphorous removal are required.

At the present time wetland design is based upon current and reliable information. True or False? Discuss your answer.

False. At the present time wetland design is based upon a limited amount of observed data rather than scientific theories, and thus the design is still empirical.

A constructed wetland is 2000 ft² is area. Assume the surface edges of the constructed wetland are nearly vertical. The media depth is 24 inches with the effluent level maintained at 6 inches below the surface. The overall porosity (or void %) of the media surrounding the open surface area is 0.4 (40%).

How much flow (total volume) would have to enter the wetland to increase the water surface by 0.5 inches? (Assume no outflow during this period.)
Aerobic Treatment of Wastewater and Aerobic Treatment Units

1. Name and explain two problems that severely complicate the proper functioning of an aerobic treatment unit.

The extreme daily fluctuations in wastewater organic strength and flow are particularly troublesome. The two to three hour period without nutrients stress the organisms and the two peak flows increase the surface overflow rate.

2. The national Sanitation Foundation (NSF) Standard 40 has some significant omissions when used to properly define the water quality of ATU effluents. Explain.

There should be standards for nitrogen, phosphorous, fecal coliform and possibly viruses.

3. Although there are two different operational schemes used in small aerobic treatment units, there is one fundamental principle that remains the same for each scheme. Explain the fundamental process.

The fundamental process is to provide oxygen transfer to the wastewater with intimate contact between the microbes and water.

4. Explain a good way to judge the quality of activated sludge in an aerobic treatment unit.

A good-quality activated sludge will have a golden brown color and an earthy smell if kept aerated.

5. Why is it likely that data from laboratory testing of aerobic treatment units should be viewed with caution?

Usually, typical residential wastewater is not used, conditions in the laboratory are ideal and the unit is not likely to be subjected to unattended operational problems.

6. Unless modifications are made to the aerobic treatment unit, no significant nitrogen removal can be expected. Explain why.

While the organic nitrogen in the influent to the aeration chamber will be in the ammonium form, it will be quickly oxidized to nitrate. Any biological conversion of nitrate to nitrogen gas will be limited by the lack of sufficient carbonaceous matter and an anaerobic environment.

7. In the ATU a very small insignificant amount of phosphorous may be removed by sedimentation. If more removal is desired, what would have to be done?

Most likely, addition of a chemical coagulant.
1. Recirculation Ratio for Textile Filter

- Design flow = 500 gpd
  - Dose rate = 50 gpm
  - Dose frequency is every 10 minutes
  - Does run time is 30 seconds
- Dose volume = 50 gpm X 0.1 minutes = 25 gallons/dose
- Doses per day = 1400 minutes / 10 minutes = 140 doses per day
- 140 doses per day X 25 gallons per dose = 3500 gpd
- 3500 gpd/500 = 7 = 6:1 recirculation ratio

---

Media Filter Take Home

---

Design for MSTS – Wheelerville Heights

- Small Subdivision
- 16 home sites – Class I
- 4 @ 5 bedroom
- 750 gpd x 4 = 3000 gpd
- 7 @ 4 bedroom
- 600 gpd x 6 = 3600 gpd
- 600 gpd x 1 = 0.45 = 270 gpd
- 5 @ 3 bedroom
- 450 x 5 x .45 = 1015 gpd
- 7,885 gpd

- 1675 feet of 2" collection pipe
- 1675 feet / 5280 feet/mile x 2 inch x 200 gallons/in = 127 gpd
- 8,012 gpd with BOD of 175 mg/L

---

RSF Surfacing loading rate

- Flows over 5,000 gpd
- require two cells
- at least two zones per cell and
- two separate pumps for each cell (minimum of four pumps).
- By using sequencing valves, each pair of pumps can serve several zones.

- 8,012 gpd x 0.2 ft²/gpd = 1,603 ft²
- Organic loading
  - 175 mg/L x 8,012 gpd x 0.34 = 1,000,000 = 11.7 lbs BOD
  - 11.7 lbs BOD / 1,602 ft² = 0.007 lbs/ft²
  - 11.7 lbs = 0.005 lbs/ft² = 2.339 ft²
  - 2,339 ft² + 2 cells = 1,190 ft²/cell

---

Tank design

- Minimum septic tank size
  - 8,012 gpd x 4 = 32,048 gallons
  - Multiple tanks/compartments
  - Alarmed effluent screen
- Minimum recirculation tank = 8,012 gallons

---

Area per cell

- 1,190 ft² / 2 ft = 595 per zone
- 24 ft wide = 3 sheet by 8 feet long
- Length = 1,190 ft² / 24 ft = 48 ft = 6 sheet by 8 feet long
Piping per cell and total drainage media

- One 4” pipe drainage pipe per zone
  - Minimum = 2 zones → 2 drainage pipes or every twenty feet
  - 48 feet + 20 feet = 3 drainage pipes
  - More are recommended to facilitate system recovery
- One inspection port to drainage pipe per zone
- 1.5 ft drainage media (1 foot is minimum sloped @ 1%)
  - 6 inches = 0.5 foot of drainfield rock x 2,339 ft² = 1,169 + 27 ft³/yd³ = 44 yd³
  - 12 inches = 1 foot of pea gravel x 2,339 ft² = 2,339 ft³ + 27 ft³/yd³ = 88 yd³

Treatment media quantities

- 1.5 ft drainage
- 2 ft media
  - 2’ x 2,339 ft² = 4,677 ft³
  - 4,677 ft³ ÷ 27 ft³/yd³ = 173 yd³

Distribution media

- Drainfield rock
- Minimum depth is 0.67 feet = 8 inches + 6 inches below the lateral and 2 inches above
- 0.67 ft x 4,677 ft² = 1,567 ft³
- 1,567 ft³ ÷ 27 ft³/yd³ = 58 yd³

Distribution design per zone

- 24’ + 3’ = 8 laterals @ 1.25 inches
- 8 @ [24” - 2”] or 22’
- 22’ + 3’ = 7 perfs
- 22 + 1 = 8 perfs
- 8 x 8 = 64 perfs
- 576 ÷ 64 = 9 ft²/perf

Liner/ container design

- Total system height is sum of depth of drainage + treatment + distribution = 1.5 feet + 2 feet + 0.7 foot = 4.2 feet
- Width of liner = Design width + (2 x system height) + 2 feet (for constructability) = 24 feet + (2 x 4.2 feet) + 2 feet = 34.4 feet
- Length of liner = the design length + 2 x the total system height plus two additional feet for constructability: ≈ 48 ft + (4.2 x 2) + 2 = 58.4 ft
- 35 ft x 59 ft = 2,065 ft² of liner
- Assumes vertical walls. If sloped additional liner & material will be needed.

Dose Volume

- Amount pumped [4:1 ratio]
- 8,012 gpd x 0.5 X 5 = 20,030 gpd
- 48 doses per day = 20,030 ÷ 48 = 418 gallons/dose
- Max dose [25% of daily flow]
  - 8012 gpd x 0.25 x 2 cells x 2 zones = 500 gal
- Min dose
  - Fill laterals 5 times
  - [8 x 24” x .078] x 5 = 75 gal
Disinfection

1. What is the goal of disinfection?
The goal of disinfection is to reduce the number of pathogens in the treated effluent so that the risk of disease is minimized.

2. Name 4 general categories of pathogens
   1. Bacteria
   2. Viruses
   3. Protozoa
   4. Helminths

3. Calculate the volume of the chlorine contact chamber required to provide 30 minutes of contact time for an average daily flow of 15,000 gallons per day.

   Flow rate = 15,000 gallons per day ÷ 1440 minutes per day = 10.42 gallons per minute

   Volume = 10.42 gallons per minute x 30 minutes = 312.5 gallons of chlorine x 1000 gallons x 1 gram/1000 mg = 0.033 gallons of liquid bleach

4. Disadvantages
   • The chlorine residual, even at low concentrations, is toxic to aquatic life and treated wastewater discharging to aquatic environments may require dechlorination.
   • All forms of chlorine are highly corrosive and toxic. Thus storing, shipping, and handling pose a risk, requiring special safety regulations.
   • Chlorine oxidizes certain types of organic matter in wastewater, creating more hazardous compounds (e.g. trihalomethanes – THM’s).
   • The level of total dissolved solids is increased in the effluent
   • The chlorine content of the wastewater is increased
   • Chlorine residual is unstable in the presence of high concentrations of chlorine-demanding materials, thus requiring higher doses to effect adequate disinfection.
   • Some parasitic species have shown resistance to chlorination, including oocysts of Cryptosporidium parvum, Endamoeba histolytica, and Giardia lamblia and eggs of parasitic worms.
   • Long-term effects of discharging dechlorinated compounds into the environment are unknown

5. Under what conditions would you recommend the use of UV disinfection? Why?
Sites where fecal removal is needed and your registered product of choice requires UV to meet Treatment Level A or B.
Homework - New Assignments
Using this example graph the system curve of the given pump curves on page 29.

Pump Example

3 bedroom Class I home = _____ gpd

Total pipe length: 170 ft of 2” Sch 40 PVC pipe

Required pump:

29 gpm

_______ ft tdh

TDH = Total Dynamic Head
1. Pumping to Gravity Distribution
   A. Minimum discharge is 10 GPM (15 GPM recommended) GPM
   B. Maximum discharge is 45 GPM.

2. Pressure Distribution - See Pressure Distribution Worksheet
   ○ Individual SSTS ○ Collection System
   Required Flow Rate (Line 12 of Pressure Distribution Worksheet) GPM
   C. Distribution to: □ Soil Treatment □ Media Filter □ ATU □ Other

3. Elevation Difference between pump and point of discharge: ft

4. Distribution Head Loss: ft
   Additional Head Loss: ft
   (due to special equipment, etc.)

5. Friction Loss in Plastic Pipe per 100 ft (C=130)

<table>
<thead>
<tr>
<th>Flow Rate (GPM)</th>
<th>1</th>
<th>1¼</th>
<th>1½</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>9.11</td>
<td>3.08</td>
<td>1.27</td>
<td>0.31</td>
<td>---</td>
</tr>
<tr>
<td>12</td>
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<td>1.78</td>
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<tr>
<td>14</td>
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<td>6.92</td>
<td>1.71</td>
<td>0.24</td>
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<td>30</td>
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<td>7.35</td>
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<td>---</td>
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<td>---</td>
<td>10.01</td>
<td>1.39</td>
</tr>
<tr>
<td>70</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>11.48</td>
<td>1.60</td>
</tr>
</tbody>
</table>

Friction Loss = ft per 100 ft of pipe

6. Based on Friction Loss in Plastic Pipe per 100ft from Table I:

   - Based on Friction Loss in Plastic Pipe per 100ft from Table I:

Friction Loss = ft per 100 ft of pipe

7. Determine Equivalent Pipe Length from pump discharge to soil dispersal area discharge point. Estimate by adding 25% to supply pipe length for fitting loss. Supply Pipe Length (5.B) X 1.25 = Equivalent Pipe Length

   ft X 1.25 = ft

8. Calculate Supply Friction Loss by multiplying Friction Loss Per 100ft (Line 6) by the Equivalent Pipe Length (Line 7) and divide by 100.

   Supply Friction Loss = ft per 100 ft X ft + 100 = ft
9. Equivalent length of pipe fittings.

Section 9 is for Collection Systems ONLY and does NOT need to be completed for individual subsurface sewage treatment systems.

Quantity X Equivalent Length Factor = Equivalent Length

<table>
<thead>
<tr>
<th>Fitting Type</th>
<th>Quantity</th>
<th>Equivalent Length Factor</th>
<th>Equivalent Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Valve</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 Deg Elbow</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 Deg Elbow</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tee - Flow Thru</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tee - Branch Flow</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Swing Check Valve</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Angle Valve</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Globe Valve</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butterfly Valve</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve 10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve 11</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Sum of Equivalent Length due to pipe fittings: \[
\text{ft}
\]

B. Total Pipe Length = Supply Pipe Length (5.B) + Equivalent Pipe Length (9.A.)

\[
\text{feet}
\]

C. Friction loss due to pipe fittings and supply pipe (h):

\[
\frac{0.128 \times L \times Q^{1.852}}{100 \times D^{4.8655}} + \frac{0.128 \times \text{Flow Rate}^{1.852}}{100 \times \text{Pipe Diameter}^{4.8655}} = \text{ft}
\]

10. Total Head requirement is the sum of the Elevation Difference (Line 3), the Distribution Head Loss (Line 4), Supply Friction Loss (Line 8), and Friction Loss from the Supply Pipe and Pipe Fittings-if collection system (Line 9.C)

NOTE: Supply Friction Loss (Line 8) need ONLY be used if NOT a collection system.

NOTE: Friction Loss from the Supply Pipe and Pipe Fittings (Line 9.C) need ONLY be used if system is a collection system.

\[
\text{ft} + \text{ft} + \text{ft} + \text{ft} = \text{ft}
\]

3. PUMP SELECTION

A pump must be selected to deliver at least \(\text{GPM (Line 1 or Line 2)}\) with at least \(\text{feet of total head.}\)

I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

(Designer) (Signature) (License #) (Date)
Pump Curves

Model # 827

Model # 857
1. T. F. The nitrogen requirement for SSTS starts at 1,500 gallons per day.

2. T. F. One problem with larger SSTS is that the nitrate plume will be larger in length and width.

3. T. F. Due to the low concentration of total nitrogen in sewage, it does not cause a nitrate threat to drinking water.

4. T. F. A MSTS in a sensitive aquifer area needs to only use a nitrogen reduction BMP.

5. Fill in the following chart with the compliance criteria for nitrogen:

<table>
<thead>
<tr>
<th></th>
<th>Non Sensitive Aquifer</th>
<th>Sensitive Aquifer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2501 to 5,000 gpd)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MSTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5,001 to 10,000 gpd)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


7. T. F. An AELSLAGID board professional must conduct an aquifer assessment for a MSTS.

8. T. F. An AELSLAGID professional can be called to “overturn” the desktop assessment that the site has a sensitive aquifer.

9. T. F. A mound system placed on a heavier textured soil with adequate organic matter can be used as a nitrogen BMP.
Nitrogen and Phosphorus Homework

1. Name two problems with excess nitrogen in the environment?

2. According to MN rules Chapter 7080-7083 when does Nitrogen assessment need to be part of the design process for SSTS?

3. In biological nitrogen removal, where does the nitrogen go when it leaves the wastewater?

4. What is a typical value of nitrogen in septic tank effluent?

5. What laboratory test(s) would you have run on sewage if you wanted to know the amount of oxygen needed to both break down the organic material and nitrify the effluent?

6. What level of TN removal do registered products need to meet to be listed in Minnesota?

7. List five compounds that may inhibit nitrification:

8. What is the biggest concern with excess phosphorus in the environment?

9. List three nitrogen BMPs:

10. In biological phosphorus removal, where does the phosphorus go when it leaves the wastewater?

11. Which is likely to have a higher absorption capacity for phosphorus a loamy sand or a sandy loam? Explain why.

12. How does soil pH affect the forms of phosphorus in the soil?

13. What level of TP removal do registered products need to meet to be listed in Minnesota?

14. According to MN rules Chapter 7080-7083 when does Phosphorus assessment need to be part of the design process for SSTS?
1. For the small subdivision recommend the collection system options:
- STEG
- STEP
- Pressure sewer

---

### U of MN Onsite Sewage Treatment Program Soil Boring Log

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>Texture</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Redox Kind(s)</th>
<th>Saturated Soil Indicator(s) (see back)</th>
<th>Shape</th>
<th>Grade</th>
<th>Consistency</th>
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</thead>
<tbody>
<tr>
<td>0-12</td>
<td>l</td>
<td>10YR 3/2</td>
<td>N/A</td>
<td>Concentrations Dipslation Glazed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-45</td>
<td>l</td>
<td>10YR 4/4</td>
<td>N/A</td>
<td>Concentrations Dipslation Glazed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-76</td>
<td>cl</td>
<td>7.5YR 4/6</td>
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<td>Concentrations Dipslation Glazed</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>77-88</td>
<td>l</td>
<td>7.5YR 4/6</td>
<td>7.5YR 5/8</td>
<td>Concentrations Dipslation Glazed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.5YR 6/2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments: System at 17”
For the Soil observation Logs on Pages 34-36

1. What is the limiting condition?
   Page 34~
   Page 35~
   Page 36~

2. What would the design for a type 1 system be?
   What is the SHLR?

3. What options would be available for a Type 4 System?
   What is the SHLR?
<table>
<thead>
<tr>
<th>Depth Range</th>
<th>Texture</th>
<th>Color</th>
<th>Parent Material</th>
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<tbody>
<tr>
<td>0-18&quot;</td>
<td>10YR 6/2</td>
<td>N/A</td>
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<td>18-24&quot;</td>
<td>10YR 5/8</td>
<td>N/A</td>
<td></td>
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<tr>
<td>24-38&quot;</td>
<td>2.5Y 6/2</td>
<td>N/A</td>
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<tr>
<td>38-60&quot;</td>
<td>2.5Y 6/3</td>
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<tr>
<td>60-70&quot;</td>
<td>2.5Y 4/6</td>
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Calcium carbonates also found at 38". Comments:

Advanced Design and Inspection II • Homework • 05/1034
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Texture</th>
<th>Motte Color(s)</th>
<th>Redox Color(s)</th>
<th>Kind(s)</th>
<th>Saturated Soil Structure</th>
<th>Pore Network</th>
<th>Siltstone</th>
<th>Bedrock</th>
<th>Organic Matter</th>
<th>Slope Shape</th>
<th>Soil Survey Map Unit(s):</th>
<th>Landscape Position:</th>
<th>Back/Side Slope</th>
<th>Shoulder</th>
<th>Slope Shape:</th>
<th>Weather conditions/Time of Day:</th>
<th>Soil Parent Material(s):</th>
<th>Till (circle all that apply):</th>
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<td>Loose</td>
<td>Firm</td>
<td>Loess</td>
<td>Massive</td>
<td>LC</td>
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<td>Hardwoods, ferns</td>
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<td>Sunny, 2 PM</td>
<td>LC</td>
<td>LC</td>
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<tr>
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<td>sil</td>
<td>10YR 4/3</td>
<td>Concentrations</td>
<td>Depletions</td>
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<td>Massive</td>
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<td>Sunny, 2 PM</td>
<td>Hardwoods, ferns</td>
<td>0-10</td>
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<td>LC</td>
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<tr>
<td>14-68</td>
<td>c</td>
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<td>Depletions</td>
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<td>Loose</td>
<td>Firm</td>
<td>Loess</td>
<td>Massive</td>
<td>LC</td>
<td>Sunny, 2 PM</td>
<td>Hardwoods, ferns</td>
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<td>fsl</td>
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<td>Firm</td>
<td>Loess</td>
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<td>LC</td>
<td>Sunny, 2 PM</td>
<td>Hardwoods, ferns</td>
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<td>LC</td>
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<tr>
<td>81-</td>
<td>fs</td>
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<td>Depletions</td>
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<td>Firm</td>
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<td>LC</td>
<td>Sunny, 2 PM</td>
<td>Sunny, 2 PM</td>
<td>LC</td>
<td>LC</td>
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</tbody>
</table>
Complete the Drip System Worksheet for Haig’s Residence. Use the “Example Site Specifics” for more information if needed.

**#1 Dwelling – Haig’s**

- Example:
  - 2,100 ft² home
  - 3 Bedrooms
  - Dishwasher, Washer, Garbage Disposal, Large Bathtub
  - Unfinished basement with egress

## Haig’s location

- Our Site
- 2 closest wells 1/3 mile

### OSTP Soil Boring Log

<table>
<thead>
<tr>
<th>Sample</th>
<th>Texture</th>
<th>Coarse</th>
<th>Frag. %</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Soil Color</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Soil Color</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Soil Color</th>
<th>Matrix Color(s)</th>
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<th>Soil Color</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Soil Color</th>
</tr>
</thead>
</table>

Comments:
- 4A USW, Mountain air of sand and clay layers.
### OSTP Drip Distribution Design Worksheet

#### 1. FLOW
A. Design Flow: __________ GPD

#### 2. SOILS
A. Depth to restricting layer: __________ in.
B. Depth of System: __________ in.
C. Soil Hydraulic Loading Rate (SHLR): __________ GPD/ft²
D. Contour Loading Rate: __________ GPD/ft
E. Land Slope: __________ %

#### 3. SYSTEM SIZING
A. System Area = Design Flow (1.A) ÷ SHLR (1.D) GPD ÷ GPD/ft² = __________ ft²
B. Select spacing of emitters: __________ ft
C. Total Length = System Area (3.A) ÷ Spacing (3.B) (Round UP to nearest thousands place) to the foot
D. __________ ft² ÷ __________ ft = __________ lineal feet
E. Minimum Lateral Length = Design Flow (1.A) ÷ Contour Loading Rate (2.D) GPD ÷ GPD/ft = __________ ft Maximum Lateral Length [300ft]
F. Design Length: __________ ft *Length must be divisible by 300*
G. Number of Laterals = Total Length (3.C) ÷ Design Length (3.F)
H. Number of Zones: __________
I. Length per Zone = Total Length (3.C) ÷ Number of Zones (3.H)
J. Percent of Flow in Each Zone = 100% ÷ Number of Zones (2.F): __________
   *Note: Uniform zone sizing*
K. Flow in Each Zone = Design Flow (1.A) X Percent of Flow in Each Zone (3.J)
L. Flush Volume = Minimum Dose Volume = Tubing Volume (0.01) X Length (3.I) X 5
   __________ X __________ X 5 = __________ Gal
M. Flush on time = Gal (3.L) ÷ GPM (4.L) = __________ min
N. Design Dose Volume—Number between Flush Volume (3.L) and Maximum Dose Volume (4.B) __________ Gal

I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

______________________________  ______________________________  ___________________  __________________
(Designer) (Signature) (License #) (Date)
4.1 ZONE 1 SPECS

If all zones are uniform, only Zone 1 specs need to be completed. All zones should meet Zone 1 specs. If zones have varying lengths, a separate section must be completed for each Zone.

A. Zone 1 Flow = Percent of System X Design Flow (1.A) = % X GPD

B. Maximum Dose Volume = Maximum Depth of System (2.B) ÷ 12 X 1 ÷ 12 X Length of Zone 1 X 0.5 (50%) X 7.5

\[ \quad \div 12 \times 1 \div 12 \times \text{Length of Zone 1} \times 0.5 \times 7.5 = \text{Gal} \]

C. Number of Doses = Flow in Zone 1 (4.1.A) ÷ Design Dose (3.N) (Round to nearest whole number)

\[ \quad \div = \]

D. Off Time = 1440 ÷ Number of Doses (4.1.C) = minutes

E. Supply Pipe Diameter (in) & Length (ft):

\[ \quad \text{in} \quad \text{ft} \]

F. Return Pipe Diameter (in) & Length (ft):

\[ \quad \text{in} \quad \text{ft} \]

G. Drainback = Length of Supply & Return Pipe (4.1.E & 4.1.F) X Gal/ft

\[ \quad \times = \text{Gal} \]


I. Number of Emitters = Length ÷ spacing of emitters = 

J. Dosing = Number of Emitters (4.1.I) X Flow (0.61 gph) ÷ 60 min

\[ \quad \times 0.61 \quad \text{gph} \div 60 \quad \text{min} = \text{GPM} \]

K. Number of Connections

L. Flushing = Connections (4.1.K) X 1.6 gpm = X 1.6 GPM = GPM

M. Total Capacity = Dosing (4.1.J) + Flushing (4.1.L) = += GPM

N. Zone 1 Minutes On = Design Dose (3.N) ÷ Total Capacity (4.1.M) = ÷= min

\[
\]
4.3 ZONE 3 SPECS

A. Zone 3 Flow = Percent of System X Design Flow (1.A) = \[ \text{%} \times \text{GPD} \]

B. Maximum Dose Volume = Maximum Depth of System (2.B) ÷ 12 X 1 ÷ 12 X Length of Zone 1 X 0.5 (50%) X 7.5
\[ \frac{\text{GAL}}{\text{GAL}} \]

C. Number of Doses = Flow in Zone 1 (4.3.A) ÷ Design Dose (3.N) (Round to nearest whole number)
\[ \frac{\text{GPD}}{\text{GAL}} \]

D. Off Time = 1440 ÷ Number of Doses (4.3.C)
\[ \frac{\text{MIN}}{\text{MIN}} \]

E. Supply Pipe Diameter(in) & Length (ft):
\[ \text{in} \times \text{ft} \]

F. Return Pipe Diameter (in) & Length (ft):
\[ \text{in} \times \text{ft} \]

G. Drainback = Length of Supply & Return Pipe (4.3.E & 4.3.F) X Gal/ft
\[ \frac{\text{GAL}}{\text{GAL}} \]

\[ \frac{\text{GAL}}{\text{GAL}} \]

I. Number of emitters = Length ÷ spacing of emitters
\[ \frac{\text{FT}}{\text{FT}} \]

J. Dosing = Number of Emitters (4.3.I) X Flow (0.61 gph) ÷ 60 min
\[ \frac{\text{GAL}}{\text{GAL}} \]

K. Number of Connections

L. Flushing = Connections (4.3.K) X 1.6 gpm
\[ \frac{\text{GPM}}{\text{GPM}} \]

M. Total Capacity = Dosing (4.3.J) + Flushing (4.3.L)
\[ \frac{\text{GPM}}{\text{GPM}} \]

N. Zone 1 Minutes On = Design Dose (3.N) ÷ Total Capacity (4.3.M)
\[ \frac{\text{MIN}}{\text{MIN}} \]

4.4 ZONE 4 SPECS

A. Zone 4 Flow = Percent of System X Design Flow (1.A) = \[ \text{%} \times \text{GPD} \]

B. Maximum Dose Volume = Maximum Depth of System (2.B) ÷ 12 X 1 ÷ 12 X Length of Zone 1 X 0.5 (50%) X 7.5
\[ \frac{\text{GAL}}{\text{GAL}} \]

C. Number of Doses = Flow in Zone 1 (4.4.A) ÷ Design Dose (3.N) (Round to nearest whole number)
\[ \frac{\text{GPD}}{\text{GAL}} \]

D. Off Time = 1440 ÷ Number of Doses (4.4.C)
\[ \frac{\text{MIN}}{\text{MIN}} \]

E. Supply Pipe Diameter(in) & Length (ft):
\[ \text{in} \times \text{ft} \]

F. Return Pipe Diameter (in) & Length (ft):
\[ \text{in} \times \text{ft} \]

G. Drainback = Length of Supply & Return Pipe (4.4.E & 4.4.F) X Gal/ft
\[ \frac{\text{GAL}}{\text{GAL}} \]

\[ \frac{\text{GAL}}{\text{GAL}} \]

I. Number of emitters = Length ÷ spacing of emitters
\[ \frac{\text{FT}}{\text{FT}} \]

J. Dosing = Number of Emitters (4.4.I) X Flow (0.61 gph) ÷ 60 min
\[ \frac{\text{GAL}}{\text{GAL}} \]

K. Number of Connections

L. Flushing = Connections (4.4.K) X 1.6 gpm
\[ \frac{\text{GPM}}{\text{GPM}} \]

M. Total Capacity = Dosing (4.4.J) + Flushing (4.4.L)
\[ \frac{\text{GPM}}{\text{GPM}} \]

N. Zone 1 Minutes On = Design Dose (3.N) ÷ Total Capacity (4.4.M)
\[ \frac{\text{MIN}}{\text{MIN}} \]
<table>
<thead>
<tr>
<th>Proprietary Product Name and Model</th>
<th>Treatment Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantex; AX-20 Series AX20, AX20-2, AX20-3, AX20-4, AX20-5</td>
<td>X X</td>
</tr>
<tr>
<td>Advantex; AX-20 Series AX20, AX20-2, AX20-3, AX20-4, AX20-5 with Salcor 3G UV disinfection</td>
<td>X X X X</td>
</tr>
<tr>
<td>ECOFLO Biofilter; Closed Bottom; STB Models: <em>Fiberglass shell:</em> STB-500, STB-500-2, STB-650, STB-650-2, STB-650-3</td>
<td>X X X</td>
</tr>
<tr>
<td><em>Concrete shell (gravity discharge):</em> STB-650B, STB-650B-2, STB-650B-3</td>
<td></td>
</tr>
<tr>
<td><em>Concrete shell (pump discharge):</em> STB-650BR, STB-650BR-2, STB-650BR-3</td>
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</tr>
<tr>
<td>ECOPOD Series E50, E60</td>
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<td>ECOPOD Series E50, E60 with Salcor 3G UV disinfection</td>
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</tr>
<tr>
<td>Hoot H-Series H-500, H-600, H-750, and H-1000</td>
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<tr>
<td>Hoot H-Series H-500, H-600, H-750, and H-1000 with Salcor 3G UV disinfection</td>
<td>X X X</td>
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<tr>
<td>MicroFAST 0.5, 0.75, 0.9, and 1.5</td>
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<td>MicroFAST 0.5, 0.75, 0.9, and 1.5 with Salcor 3G UV disinfection</td>
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</tr>
<tr>
<td>Puraflo Peat Filter Biofilter; Open and Closed Bottom Open Bottom 1A to 10A</td>
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<tr>
<td>Closed Bottom 1B to 10B</td>
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</tr>
<tr>
<td>RetroFAST 0.15, 0.25, and 0.375</td>
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<tr>
<td>RetroFAST 0.15, 0.25, and 0.375 with Salcor UV disinfection</td>
<td>X X X</td>
</tr>
</tbody>
</table>
Subdivision Design steps

1. Layout lots
2. Set Home sizes or use
3. Calculate flows from the homes (other use)
   a. Permit?
4. Find elevations:
   a. Right of way
   b. Homes
   c. Connections
5. Set pipe elevations
6. Determine pipe length & Size
   a. Calculate I&I
7. Determine flow rate per section
8. Verify pipe velocity
9. Gravity
   a. Find pipe grade
   b. Check depth
      i. Limitations [Water, Rock.....]
      ii. > 20' requires Lift Station
      iii. Determine size
      iv. Size pumps
      v. Lift station requirements
   c. Determine manhole locations
   d. Required thrust blocks
10. STEP
    a. Determine legs
       i. Find length
    b. Set N
    c. Determine Q
       i. Determine Am
    d. Calculate Hf
    e. Calculate Velocity (> 1ft/sec)
    f. Calculate static head
    g. Pump selection Qm : TDH [Hs+Hf]
    h. Layout :
       i. Thrust blocks
       ii. STEP specs
       iii. Cleanouts
       iv. Air Release locations
11. Pressure sewer
    a. Determine legs
       i. Find length
    b. Set N
    c. Determine Q
       i. Determine Qm
    d. Calculate Hf
    e. Calculate Velocity (> 1ft/sec)
    f. Calculate static head
    g. Pump selection Qm : TDH [Hs+Hf]
    h. Layout :
       i. Thrust blocks
       ii. STEP specs
       iii. Cleanouts
       iv. Air Release locations
12. Size Stilling Tank

<table>
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<th># dwellings</th>
<th># pumps on at a time</th>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2~3</td>
<td>2</td>
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<tr>
<td>4~9</td>
<td>3</td>
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<tr>
<td>10~18</td>
<td>4</td>
</tr>
<tr>
<td>19~30</td>
<td>5</td>
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<td>31~50</td>
<td>6</td>
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<td>51~80</td>
<td>7</td>
</tr>
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<td>81~113</td>
<td>8</td>
</tr>
<tr>
<td>114~146</td>
<td>9</td>
</tr>
<tr>
<td>146~179</td>
<td>10</td>
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</tbody>
</table>

page 353: Small Systems: Crites & Tchobanglous
Homework - Collection System Design

Use the subdivision on page 45 to answer the following questions.

General questions:

1. Calculate the flows for the collection system design value and the permit value?

2. For a gravity collection system what would the peak flow for the lift station design?

3. What is the required septic tank capacity?

4. If the minimum bury depth of the pipe is 7 feet: what would its beginning pipe elevation be on at point A?

5. What would be elevation be of the piping at the corner using 4” pipe?

6. What would the elevation be at the discharge point using 4” pipe?
   a. Using 2” pipe?
   b. Using 8” pipe?

Gravity Sewer

1. Would you recommend a lift station with 4” piping? Why/why not?

2. How many manholes would be required with this design?

3. For a gravity system would it require any thrust blocks?
STEP System

1. If a STEP system is used on each properties, what would the stilling tank capacity for the system?

2. What is the estimated number of pumps that will be operating at any one time?

3. Assuming a flow of 6.25 gallons per minute; what would the design flow for the friction loss be in the system?

4. What would the estimated friction loss be in the system?

5. What would the required pump sizing be for these homes?

6. Where would thrust blocks be required?

7. Where would clean outs be required?

Pressure System with Grinder pumps

1. What is the estimated number of pumps that will be operating at any one time?

2. Assuming a flow of 11 gallons per minute what would the design flow for the friction loss be in the system?

3. What would the estimated friction loss be in the system?

4. What would the required pump sizing be for these homes?

5. Where would thrust blocks be required?

6. Where would clean outs be required?
1. Using the Soil boring log what would the system SHLR be for the site using treatment level C? Using treatment level A?

Lay out a system on page 47 for a 2 bedroom class 1 home with an unfinished loft area? What if the lot was only 75’ wide?

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>Texture</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Redox Kind(s)</th>
<th>Saturated Soil Indicator(s)</th>
<th>Structure</th>
<th>Grade</th>
<th>Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12</td>
<td>l</td>
<td>10YR 3/2</td>
<td>N/A</td>
<td>Concentration Deposition Gleyed</td>
<td>Weak Moderate Strong Lower</td>
<td>Loose</td>
<td>N/A</td>
<td>Firm Extremely Firm Firm</td>
</tr>
<tr>
<td>13-45</td>
<td>sI</td>
<td>10YR 4/4</td>
<td>N/A</td>
<td>Concentration Deposition Gleyed</td>
<td>Weak Moderate Strong Lower</td>
<td>Loose</td>
<td>N/A</td>
<td>Firm Extremely Firm Firm</td>
</tr>
<tr>
<td>46-56</td>
<td>l</td>
<td>7.5YR 4/6</td>
<td>N/A</td>
<td>Concentration Deposition Gleyed</td>
<td>Weak Moderate Strong Lower</td>
<td>Loose</td>
<td>N/A</td>
<td>Firm Extremely Firm Firm</td>
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<tr>
<td>57-88</td>
<td>scl</td>
<td>7.5YR 4/6</td>
<td>N/A</td>
<td>Concentration Deposition Gleyed</td>
<td>Weak Moderate Strong Lower</td>
<td>Loose</td>
<td>N/A</td>
<td>Firm Extremely Firm Firm</td>
</tr>
</tbody>
</table>

Comments: System at 22”

2. Using the Soil boring log what would the estimated mounding be for the site using treatment level C? Using treatment level A?
1. Using the Soil boring log what would the system SHLR be for the site using treatment level C? Using treatment level A?

Layout the system on page 49 for an Office building with 40 employees? What if the lot was only 95’ wide?

---

U of MN Onsite Sewage Treatment Program Soil Boring Log

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>Texture</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Redox Kind(s)</th>
<th>Saturated Soil Indicator(s)</th>
<th>Shape</th>
<th>Grade</th>
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<td>0-12</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-45</td>
<td>fs</td>
<td>10YR 4/4</td>
<td>N/A</td>
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<td></td>
</tr>
<tr>
<td>46-56</td>
<td>I</td>
<td>7.5YR 4/6</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57-88</td>
<td>sid</td>
<td>7.5YR 4/6</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Comments: System at 17” Perc rate @ 58” 58 mpi

4. Using the Soil boring log what would the estimated mounding be for the site using treatment level C? Using treatment level A?
1. T. F. The amount of water added to the soil from a SSTS is much greater than normal rainfall recharge, however the rate is relatively light.

2. T. F. You cannot use the standard absorption area loading rates found in 7080 for larger SSTS.

3. T. F. Aquifers and the periodically saturated soil are typically different zones of saturation.

4. T. F. At this time, Advanced Designers cannot determine groundwater mounding for MSTS.

5. T. F. Infiltration/absorption loading rate is the same thing as the contour loading rate.

6. A system with a flow of 3,500 gpd whose length is 300 feet has a lineal loading rate of: _____________________________.

1. What is the SHLR for this soil evaluation form for a 4 bedroom class II home?

What is the Mound absorption ratio?

If the site is limited to an area 11’ x 44’; what is the size of the system? How many gpd can the system treat?

Using a pressure distribution system with 2 laterals and 1/4” perforations spaced at 2.5’. What should the timer ON & OFF be set to deliver 7 doses per day?
Design the pressure distribution system for the site.

3. Using the Soil boring log what would the system SHLR be for the site using treatment level C? Using treatment level B?

2. A small resort has:
   - 6 Permanent Mobile Homes
   - 10 Campsites with hookups
   - 700 ft of 4” piping for the collection systems
   - A dump station
   - 2 employees for check in
   - A small store serving 120 customers with a public restroom
   - 3 employees in the store
   - A Laundromat with 1 machine
   - 1 employee for the laundry

Using the Soil boring log what would the system SHLR be for the site using treatment level C? Using treatment level B?

Lay out the system on page 53. What would the recommended tank volumes be for the system?

---

### U of MN Onsite Sewage Treatment Program Soil Boring Log

**Client/Address:**
205 West Minnesota Ave. Gilbert, MN

**Legal Description/GPS:**
Pit #1 south side of house

**Date:**
7/15/07

**Soil Parent Material(s):**
Outwash, Lacustrine, Alluvium, Loess, Organic Matter, Bedrock

**Landscape Position:**
Summit, Shoulder, Back/Side Slope, Foot Slope, Toe Slope

**Vegetation:**
Pines

**Soil Survey Map Unit(s):**
74B

**Slope (%):**
2-4%

**Slope Shape:**
Linear-linear

<table>
<thead>
<tr>
<th>Depth (in)</th>
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<th>Matrix Color(s)</th>
<th>Motile Color(s)</th>
<th>Redox Kind(s)</th>
<th>Saturated Soil Indicators</th>
<th>Structure</th>
<th>Grade</th>
<th>Consistency</th>
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</thead>
<tbody>
<tr>
<td>0-10</td>
<td>l</td>
<td>10YR 3/2</td>
<td>N/A</td>
<td>Concentrations Depletions Glayed</td>
<td>Weak Moderately Strong Loose</td>
<td>Loose</td>
<td>gravel-firm</td>
<td>Extremely Firm Rapid</td>
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<td>11-35</td>
<td>fs</td>
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<td>N/A</td>
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<td>Weak Moderately Strong Loose</td>
<td>Loose</td>
<td>gravel-firm</td>
<td>Extremely Firm Rapid</td>
</tr>
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<td>l</td>
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<td>7.5YR 5/8</td>
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<td>Loose</td>
<td>gravel-firm</td>
<td>Extremely Firm Rapid</td>
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<td>scl</td>
<td>10 YR 6/2</td>
<td>S1</td>
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<td>Weak Moderately Strong Loose</td>
<td>Loose</td>
<td>gravel-firm</td>
<td>Extremely Firm Rapid</td>
</tr>
</tbody>
</table>

**Comments:**

Treatment Level A at 14”
Monitoring Device Homework

1. Based on the soil boring log form, at what depth would it be most appropriate to install a monitoring device to determine groundwater mounding on the site? (assume a Type IV mound)

________________________________________________________________________

2. What type of instrument would you use?

________________________________________________________________________

3. Complete the diagram in the Well Installation Sheet for B-42 showing the proper depths and materials for your recommended installation from above (questions 1 & 2)

4. Explain why the monitoring data from B-44 is not accurate.
# U of MN Onsite Sewage Treatment Program Soil Boring Log

**Client/ Address:**
Roland Sigurdson Cloquet, MN

**Legal Description/GPS:**
Pit 1 NW ¼ of the SW 1/2

**Date:**
3/19/03

<table>
<thead>
<tr>
<th>Soil Parent Material(s):</th>
<th>Alluvium</th>
<th>Loess</th>
<th>Organic Matter</th>
<th>Bedrock</th>
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<tbody>
<tr>
<td>(circle all that apply)</td>
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<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Landscape Position:</th>
<th>Summit</th>
<th>Shoulder</th>
<th>Back/Side Slope</th>
<th>Foot Slope</th>
<th>Toe Slope</th>
<th>Slope Shape:</th>
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</thead>
<tbody>
<tr>
<td>(circle one)</td>
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</table>

**Vegetation:**
Hardwoods, ferns

**Soil Survey Map Unit(s):**

**Slope (%):**
5%

**Weather conditions/Time of Day:**
Sunny, 2 PM

**Elevation:**

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>Texture</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Redox Kind(s)</th>
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<td></td>
<td>Concentrations Depletions Gleyed</td>
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<td>Moderate</td>
<td>Firm</td>
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</tr>
<tr>
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<td></td>
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<td>Strong</td>
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<td>Moderate</td>
<td>Firm</td>
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<td>Platy</td>
<td>Moderate</td>
<td>Strong</td>
<td>Loose</td>
<td>Extremely Firm Rigid</td>
</tr>
</tbody>
</table>

**Comments:**
Jay Cooke State Park

**Installation Data Sheet**

- **Project Name**: Jay Cooke State Park
- **Project Location**: Cloquet, MN
- **Date of Installation**: 3/19/03
- **Personnel**: Nick Jacobson

**Type of Instrument**
- **Source of instrument / well stock**: Gooden Company
- **Material of well stock**: Schedule 40 PVC
- **Diameter of pipe**: ¾ inch
- **Slot size**: 0.010 inch
- **Slot spacing**: 0.5 inch
- **Kind of well cap**: Homemade PVC cap with vent
- **Kind of well point / end plug**: ¾ inch plug, vented
- **Nature of Installation Materials**: Playground sand
- **Nature of packing sand**: Native soil
- **Kind of bentonite**: chips
- **Depth of backfill**: N/A
- **Was bentonite installed below groundwater depth at installation?**: NO
- **Was water added to bentonite for expansion?**: YES
- **Method of measuring water levels in instrument**: ½" tubing and tape measure
- **How was instrument checked for clogging after installation?**: Water poured down hole and monitored

**Instrument Diagram**

<table>
<thead>
<tr>
<th>Soil Characteristics</th>
<th>Texture</th>
<th>Structure</th>
<th>Roots</th>
<th>Consistency</th>
<th>Redox Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>sil</td>
<td>granular</td>
<td>Few/fine</td>
<td>Friable</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
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<td>blocky</td>
<td>Few/fine</td>
<td>Friable</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>platy</td>
<td>Few/fine</td>
<td>Firm</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>fsl</td>
<td>blocky</td>
<td>Few/medium</td>
<td>Friable</td>
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<td>blocky</td>
<td>Friable</td>
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</table>
Installation Data Sheet

Project Name: Jay Cooke State Park
Project Location: Cloquet, MN
Well Identification Code: B-44

Type of Instrument: Schedule 40 PVC ¾ inch
Material of well stock: ¾ inch holes and geotextile
Diameter of pipe: ¾ inch
Slot size: 3/16" holes and geotextile
Slot spacing: 1 inch

Kind of well cap: Homemade PVC cap with vent
Kind of well point / end plug: ¾ inch plug, vented

Nature of Installation Materials:
- Nature of packing sand: Native soil
- Nature of backfill: Native soil
- Was bentonite installed below groundwater depth at installation? No
- Was water added to bentonite for expansion? No

Method of measuring water levels in instrument: ½" tubing and tape measure
How was instrument checked for clogging after installation? N/A

Instrument Diagram
- mounded fill at surface
- backfilled with native soils
- slotted pipe
- 81" to bottom

Soil Characteristics

<table>
<thead>
<tr>
<th>Texture</th>
<th>Structure</th>
<th>Roots</th>
<th>Consistency</th>
<th>Redox Features</th>
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<td>Friable</td>
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<td>platy</td>
<td>Few/fine</td>
<td>Firm</td>
<td>N/A</td>
</tr>
<tr>
<td>fsl</td>
<td>blocky</td>
<td>Few/medium</td>
<td>Friable</td>
<td>N/A</td>
</tr>
<tr>
<td>sl</td>
<td>blocky</td>
<td>Friable</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>fs</td>
<td>single grain</td>
<td>Loose</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>
### Water Level Record

**Project Name:** Jay Cooke State Park

**Well ID Code:** B-42

<table>
<thead>
<tr>
<th>Date / Time</th>
<th>Height of Riser Above Ground</th>
<th>Depth to Water From Top of Riser</th>
<th>Water Level Below Ground</th>
<th>Comments (pipe checked for clogging? pipe checked for movement? vandalism? well cap missing? raining? etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/19/03-noon</td>
<td>24&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/8/03-2PM</td>
<td>24&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/01/03-1PM</td>
<td>24&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/8/03-noon</td>
<td>24&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/26/03-11AM</td>
<td>24&quot;</td>
<td>34&quot;</td>
<td>10&quot;</td>
<td></td>
</tr>
<tr>
<td>5/13/04-2PM</td>
<td>24&quot;</td>
<td>48&quot;</td>
<td>24&quot;</td>
<td></td>
</tr>
<tr>
<td>6/02/04-3PM</td>
<td>24&quot;</td>
<td>31&quot;</td>
<td>7&quot;</td>
<td></td>
</tr>
<tr>
<td>7/8/04-11AM</td>
<td>24&quot;</td>
<td>42&quot;</td>
<td>18&quot;</td>
<td></td>
</tr>
<tr>
<td>8/12/04-noon</td>
<td>24&quot;</td>
<td>41&quot;</td>
<td>17&quot;</td>
<td></td>
</tr>
<tr>
<td>5/23/04-2PM</td>
<td>24&quot;</td>
<td>34&quot;</td>
<td>10&quot;</td>
<td></td>
</tr>
</tbody>
</table>

---

**Figure 7.** Sample water level record
### Water Level Record

**Project Name:** Jay Cooke State Park

**Well ID Code:** B-44

<table>
<thead>
<tr>
<th>Date / Time</th>
<th>Height of Riser Above Ground</th>
<th>Depth to Water From Top of Riser</th>
<th>Water Level Below Ground</th>
<th>Comments (pipe checked for clogging? pipe checked for movement? vandalism? well cap missing? raining? etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/19/03-noon</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/8/03-2PM</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/01/03-1PM</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/8/03-noon</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/26/03-11AM</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/13/04-2PM</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6/02/04-3PM</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/8/04-11AM</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/12/04-noon</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/23/04-2PM</td>
<td>12&quot;</td>
<td>dry</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Figure 7.** Sample water level record
Homework - Collection System Design

Use the subdivision on page 63 to answer the following questions.

General questions:

1. Calculate the flows for the collection system design value and the permit value?

2. For a gravity collection system what would the peak flow for the lift station design?

3. What is the required septic tank capacity?

4. If the minimum bury depth of the pipe is 7 feet: what would its beginning pipe elevation be on at point A?

5. What would be elevation be of the piping at the corner using 4” pipe?

6. What would the elevation be at the discharge point using 4” pipe?
   a. Using 2” pipe?
   b. Using 8” pipe?

Gravity Sewer

1. Would you recommend a lift station with 4” piping? Why/why not?

2. How many manholes would be required with this design?

3. For a gravity system would it require any thrust blocks?
STEP System

1. If a STEP system is used on each properties, what would the stilling tank capacity for the system?

2. What is the estimated number of pumps that will be operating at any one time?

3. Assuming a flow of 6.25 gallons per minute; what would the design flow for the friction loss be in the system?

4. What would the estimated friction loss be in the system?

5. What would the required pump sizing be for these homes?

6. Where would thrust blocks be required?

7. Where would clean outs be required?

Pressure System with Grinder pumps

1. What is the estimated number of pumps that will be operating at any one time?

2. Assuming a flow of 11 gallons per minute what would the design flow for the friction loss be in the system?

3. What would the estimated friction loss be in the system?

4. What would the required pump sizing be for these homes?

5. Where would thrust blocks be required?

6. Where would clean outs be required?
For the Wheelerville Heights Subdivision design a drip system Lay out on Lot 3, page 68. Use the “Example Site Specifics” for more information if needed.

#3 Development- Wheelerville Heights

- 16 home sites
  - 4 @ 5 bedroom [13,14,15,17]
  - 7 @ 4 bedroom [1,2,4,5,6,7,8,9]
  - 5 @ 3 bedroom [10,11,12,16,18]
- 1 acre lots
- 1675 ft of road and sewer piping
- Lot 3 is the site for the cluster
### OSTP Drip Distribution Design Worksheet

#### 1. FLOW

| A. Design Flow: | GPD |

#### 2. SOILS

| A. Depth to restricting layer: | in. |
| B. Depth of System: | in. |
| C. Soil Hydraulic Loading Rate (SHLR): | GPD/ft² |
| D. Contour Loading Rate: | GPD/ft |
| E. Land Slope: | % |

#### 3. SYSTEM SIZING

| A. System Area = Design Flow (1.A) ÷ SHLR (1.D) GPD ÷ GPD/ft² = ft² |
| B. Select spacing of emitters: | ft |
| C. Total Length = System Area (3.A) ÷ Spacing (3.B) (Round UP to nearest thousands place) to the foot |
| D. ft² ÷ ft = lineal feet |
| E. Minimum Lateral Length = Design Flow (1.A) ÷ Contour Loading Rate (2.D) GPD ÷ GPD/ft = ft |
| F. Design Length: | ft |
| G. Number of Laterals = Total Length (3.C) ÷ Design Length (3.F) |
| H. Number of Zones: |
| I. Length per Zone = Total Length (3.C) ÷ Number of Zones (3.H) |
| J. Percent of Flow in Each Zone = 100% ÷ Number of Zones (2.F): |

Note: Uniform zone sizing

| K. Flow in Each Zone = Design Flow (1.A) X Percent of Flow in Each Zone (3.J) |
| L. Flush Volume = Minimum Dose Volume = Tubing Volume (0.01) X Length (3.I) X 5 |
| M. Flush on time = Gal (3.L) ÷ GPM (4.L) |
| N. Design Dose Volume-Number between Flush Volume (3.L) and Maximum Dose Volume (4.B) |

I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

(Designer) (Signature) (License #) (Date)
4.1 ZONE 1 SPECS

If all zones are uniform, only Zone 1 specs need to be completed. All zones should meet Zone 1 specs. If zones have varying lengths, a separate section must be completed for each Zone.

A. Zone 1 Flow = Percent of System X Design Flow (1.A) = \[ \frac{\text{Percentage}}{100} \times \text{GPD} \]

B. Maximum Dose Volume = Maximum Depth of System (2.B) \( \times \) 12 \( \times 1 \) \( \times \) 12 \( \times \) Length of Zone 1 \( \times \) 0.5 (50%) \( \times \) 7.5

\[ \frac{\text{Gallons}}{12 \times 1 \times 12 \times \text{Length of Zone 1} \times 0.5 \times 7.5} \]

C. Number of Doses = Flow in Zone 1 (4.1.A) \( \div \) Design Dose (3.N) (Round to nearest whole number)

\[ \frac{\text{Flow in Zone 1}}{\text{Design Dose}} \]

D. Off Time = 1440 \( \div \) Number of Doses (4.1.C) = \[ \frac{1440}{\text{Number of Doses}} \]

E. Supply Pipe Diameter (in) & Length (ft):

F. Return Pipe Diameter (in) & Length (ft):

G. Drainback = Length of Supply & Return Pipe (4.1.E & 4.1.F) \( \times \) Gal/ft

\[ \frac{\text{Length}}{\text{Gal/ft}} \]


\[ \frac{\text{Design Dose} + \text{Drainback}}{} \]

I. Number of emitters = Length \( \div \) spacing of emitters = \[ \frac{\text{Length}}{\text{Spacing}} \]

J. Dosing = Number of Emitters (4.1.I) \( \times \) Flow (0.61 gph) \( \times \) 60 min

\[ \frac{\text{Number of Emitters} \times \text{Flow} \times 60 \text{ min}}{60 \text{ min}} \]

K. Number of Connections

L. Flushing = Connections (4.1.K) \( \times \) 1.6 gpm

\[ \frac{\text{Connections} \times 1.6 \text{ gpm}}{} \]


\[ \frac{\text{Dosing} + \text{Flushing}}{} \]

N. Zone 1 Minutes On = Design Dose (3.N) \( \div \) Total Capacity (4.1.M)

\[ \frac{\text{Design Dose}}{\text{Total Capacity}} \]

4.2 ZONE 2 SPECS

A. Zone 2 Flow = Percent of System X Design Flow (1.A) = \[ \frac{\text{Percentage}}{100} \times \text{GPD} \]

B. Maximum Dose Volume = Maximum Depth of System (2.B) \( \times \) 12 \( \times 1 \) \( \times \) 12 \( \times \) Length of Zone 1 \( \times \) 0.5 (50%) \( \times \) 7.5

\[ \frac{\text{Gallons}}{12 \times 1 \times 12 \times \text{Length of Zone 1} \times 0.5 \times 7.5} \]

C. Number of Doses = Flow in Zone 1 (4.2.A) \( \div \) Design Dose (3.N) (Round to nearest whole number)

\[ \frac{\text{Flow in Zone 1}}{\text{Design Dose}} \]

D. Off Time = 1440 \( \div \) Number of Doses (4.2.C) = \[ \frac{1440}{\text{Number of Doses}} \]

E. Supply Pipe Diameter (in) & Length (ft):

F. Return Pipe Diameter (in) & Length (ft):

G. Drainback = Length of Supply & Return Pipe (4.2.E & 4.2.F) \( \times \) Gal/ft

\[ \frac{\text{Length}}{\text{Gal/ft}} \]


\[ \frac{\text{Design Dose} + \text{Drainback}}{} \]

I. Number of emitters = Length \( \div \) spacing of emitters = \[ \frac{\text{Length}}{\text{Spacing}} \]

J. Dosing = Number of Emitters (4.2.I) \( \times \) Flow (0.61 gph) \( \times \) 60 min

\[ \frac{\text{Number of Emitters} \times \text{Flow} \times 60 \text{ min}}{60 \text{ min}} \]

K. Number of Connections

L. Flushing = Connections (4.2.K) \( \times \) 1.6 gpm

\[ \frac{\text{Connections} \times 1.6 \text{ gpm}}{} \]

M. Total Capacity = Dosing (4.2.J) + Flushing (4.2.L)

\[ \frac{\text{Dosing} + \text{Flushing}}{} \]

N. Zone 1 Minutes On = Design Dose (3.N) \( \div \) Total Capacity (4.2.M)

\[ \frac{\text{Design Dose}}{\text{Total Capacity}} \]
4.3 ZONE 3 SPECS

A. Zone 3 Flow = Percent of System X Design Flow (1.A) = ____% X ____ GPD = ____

B. Maximum Dose Volume = Maximum Depth of System (2.B) ÷ 12 X 1 ÷ 12 X Length of Zone 1 X 0.5 (50%) X 7.5 = ____ Gal

C. Number of Doses = Flow in Zone 1 (4.3.A) ÷ Design Dose (3.N) (Round to nearest whole number) = ____

D. Off Time = 1440 ÷ Number of Doses (4.3.C) = ____ minutes

E. Supply Pipe Diameter (in) & Length (ft):

F. Return Pipe Diameter (in) & Length (ft):

G. Drainback = Length of Supply & Return Pipe (4.3.E & 4.3.F) X Gal/ft = ____ Gal


I. Number of emitters = Length ÷ spacing of emitters = ____ ft = ____

J. Dosing = Number of Emitters (4.3.I) X Flow (0.61 gph) ÷ 60 min = ____ GPM

K. Number of Connections

L. Flushing = Connections (4.3.K) X 1.6 gpm = ____ X 1.6 GPM = ____ GPM

M. Total Capacity = Dosing (4.3.J) + Flushing (4.3.L) = ____ GPM

N. Zone 1 Minutes On = Design Dose (3.N) ÷ Total Capacity (4.3.M) = ____ min

4.4 ZONE 4 SPECS

A. Zone 4 Flow = Percent of System X Design Flow (1.A) = ____% X ____ GPD = ____

B. Maximum Dose Volume = Maximum Depth of System (2.B) ÷ 12 X 1 ÷ 12 X Length of Zone 1 X 0.5 (50%) X 7.5 = ____ Gal

C. Number of Doses = Flow in Zone 1 (4.4.A) ÷ Design Dose (3.N) (Round to nearest whole number) = ____

D. Off Time = 1440 ÷ Number of Doses (4.4.C) = ____ minutes

E. Supply Pipe Diameter (in) & Length (ft):

F. Return Pipe Diameter (in) & Length (ft):

G. Drainback = Length of Supply & Return Pipe (4.4.E & 4.4.F) X Gal/ft = ____ Gal


I. Number of emitters = Length ÷ spacing of emitters = ____ ft = ____

J. Dosing = Number of Emitters (4.4.I) X Flow (0.61 gph) ÷ 60 min = ____ GPM

K. Number of Connections

L. Flushing = Connections (4.4.K) X 1.6 gpm = ____ X 1.6 GPM = ____ GPM

M. Total Capacity = Dosing (4.4.J) + Flushing (4.4.L) = ____ GPM

N. Zone 1 Minutes On = Design Dose (3.N) ÷ Total Capacity (4.4.M) = ____ min
Lot #3
- 3’ contours
- 2 domestic wells within 200’ of lot
- ~1 ac lot
Using Site 2: Heggy’s Golf Course and the Recommended Management plans for the Howdy ATU:

What would the frequency be for O&M?

What would the monitoring requirements be?

What would you do if the BOD reading was 330 mg/L?

What would do if the BOD was 3 mg/L?
Wastewater Treatment and Dispersal Operating Permit
Operating Permit No. ____________

Facility Information
Permittee name: Barb & Ken Mattel
Mailing address:__________________________________________
City: King State: Mn Zip code: 54321
Property ID number (GPS location): 1122334

King County authorizes the Permittee to operate a wastewater treatment and dispersal system
at the address named above in accordance with the requirements of this operating permit. The attached Management Plan is
hereby incorporated as part of the requirements of this operating permit.

Issuance date: 7/1/09 Expiration date: 7/1/10
System type: Type 4 Treatment level: Level B
System design flow: 450 gpd [3 bedroom class I] Residential/Commercial: Res
System components: 3 bedroom home with GD, 500 gal trash trap [TT], 500 gpd H. Gustagator [ATU], 1000 gal Pumptank [PT]
to 2 3x50' pressure trenches [unlevel]
Sampling frequency: based on 'Net risk score' of 2 ~ 3 months

Monitoring Requirements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target limits</th>
<th>Frequency</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>315 gpd (450 gpd)</td>
<td>3 months</td>
<td>PT</td>
</tr>
<tr>
<td>CBOD</td>
<td>25 mg/l</td>
<td>3 months</td>
<td>PT</td>
</tr>
<tr>
<td>TSS</td>
<td>30 mg/l</td>
<td>3 months</td>
<td>PT</td>
</tr>
<tr>
<td>Fecal Coliform bacteria</td>
<td>&lt; 10,000 cfu</td>
<td>3 months</td>
<td>PT</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

Field Tests:
Temperature and Dissolved Oxygen
- temp. > 40 degrees,
- pH 7-7.5,
- *DO > 2 mg/l
- 3 months  TT, ATU*

Ponding/Surfacing in soil treatment
- none
- 3 months  STA

CBOD = Carbonaceous Biochemical Oxygen Demand  TSS = Total Suspended Solids

Maintenance Requirements
Maintenance requirements shall be performed as specified in the Management Plan as prepared by the system’s Advanced Designer.

<table>
<thead>
<tr>
<th>System component</th>
<th>Maintenance</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic tank/Trash tank</td>
<td>Pumping</td>
<td>WRBM</td>
</tr>
<tr>
<td>Pump tank and controls</td>
<td>Recording</td>
<td></td>
</tr>
<tr>
<td>Effluent screen</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Advanced treatment product</td>
<td>Pumping</td>
<td>WRBM</td>
</tr>
<tr>
<td>UV light disinfection device</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Soil treatment and dispersal</td>
<td>Flushing</td>
<td></td>
</tr>
<tr>
<td>Ponding/Surfacing in soil treatment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UV = Ultra Violet Light
**Monitoring Protocol**

Any sampling and laboratory testing procedures shall be performed in accordance with the proprietary treatment product’s protocol, Standard Methods, and at a Minnesota Department of Health approved laboratory. Results shall be submitted to the permitting authority at: King County.

**Contingency Plan**

In the event the wastewater treatment system does not meet required performance requirements as contained in this operating permit, the owner shall notify the local unit of government within 30 days of non-compliance. The owner is responsible to obtain the services of a Minnesota Pollution Control Agency (MPCA)-licensed Service Provider to complete the required corrective measures.

**Authorization**

This permit is effective on the issuance date identified above. This permit and the authorization to treat and disperse wastewater shall expire in 1 year(s). The Permittee is not authorized to discharge after the above date of expiration. The Permittee shall submit monitoring information and forms as required by King County no later than sixty (60) days prior to the above date of expiration for operating permit renewal. This permit is not transferable.

The owner is required to obtain the services of a Minnesota Pollution Control Agency (MPCA) licensed Service Provider to provide ongoing system operation, maintenance, and monitoring and a Maintainer to pump the system’s sewage tanks and components. The owner is responsible to provide the name of the Service Provider business prior to the issuance of this operating permit. The owner has secured the services of as the Service Provider for this system (signed Service Provider contract attached).

I hereby certify with my signature as the Permittee that I understand the provisions of the wastewater treatment and dispersal system operating permit including maintenance and monitoring requirements. I agree to indemnify and hold King County harmless from all loss, damages, costs and charges that may be incurred by the use of this system. If I fail to comply with the provisions of this operation permit, I understand that penalties may be issued. If I sell this property during the life of the permit, I will inform the new owner(s) of the permit requirements and the need to renew the operating permit.

**The Operating Permit is hereby granted to:** Ken & Barbie

<table>
<thead>
<tr>
<th>Permittee (please print):</th>
<th>Permitting Authority (please print):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title: ___________________ Date: __________</td>
<td>Title: ___________________ Date: __________</td>
</tr>
<tr>
<td>Signature: __________________________</td>
<td>Signature: __________________________</td>
</tr>
</tbody>
</table>

www.pca.state.mn.us • 651-296-6300 • 800-657-3864 • TTY 651-282-5332 or 800-657-3864 • Available in alternative formats
Instructions for Completing an Operating Permit

The following instructions provide an explanation for local units of government to complete the operating permit template. This is intended to provide guidance to local units of governments (LGU) in developing operating permits for Type IV and Type V systems, including both residential and commercial systems. The template could be modified for holding tanks. Since the Management Plan is considered part of the operating permit, it needs to be attached to the operating permit. A signed contract, between the owner and Service Provider, should be attached to the operating permit to help ensure the owner has made the necessary arrangements to have the system maintained and monitored.

LGU Name, Department and Address – fill in the name, department and address of local unit of government at the top of the operating permit.

Wastewater Treatment and Dispersal Operating Permit No. – assign an operating permit number to be able to track the system over the years.

Permittee Name, Telephone Number, and Address – fill in the name, address and phone number of the owner.

Property Id. Number (GPS Location) – these are simply identifiers used by local units of government in the event the property address changes over time.

Name of Local Unit of Government – fill in the name of the local unit of government. This authorizes the Permittee to operate the wastewater treatment system at the address named above, according to the operating permit, attached Management Plan and contract with the Service Provider.

Issuance Date – fill in the date the operating permit is issued. The operating permit should not be issued until all required information is submitted.

Expiration Date – fill in the date when this operating permit expires. The first time an operating permit is issued to an owner, it should be issued for one (1) year. This helps ensure the owner actually does the required maintenance and monitoring during the first year. If the owner complies, the operating permit can then be issued for a longer period of time as determined by the local unit of government (typically 3 to 5 years). However, if the owner does not comply the first year, the second operating permit could, again, be issued for a period of one (1) year.

System Type – fill in as Type IV or Type V system. Holding tanks also require operating permits (Type II system).

Treatment Level – specify Treatment Level A, B, C, TN or TP. Treatment Level A = Carbonaceous Biochemical Oxygen Demand (CBOD) 15 milligrams per liter (mg/L), Total Suspended Solids (TSS) 15 mg/L, Fecal Coliform Bacteria 1000 per 100 ml; Treatment Level B = CBOD 25 mg/L, TSS 30 mg/L, Fecal Coliform Bacteria 10,000 per 100 ml; Treatment Level C = CBOD 125 mg/L, TSS 80 mg/L, Oil and Grease 20 mg/L; TN = 20 mg/L, or TP = 2 mg/L.

System Design Flow – fill in the design flow specified on the construction permit for the system. You may want to note both design flow and average daily flow, if applicable.

Residential/Commercial – specify if the system is residential or commercial. You may specify additional information, such as classification of dwelling, number of bedrooms; or type of commercial establishment.

System Components – provide a brief description of the system components. An example would be the following: 600 gallon trash tank, 600 gallon ECOPOD treatment device, 1 Salcor Ultra Violet (UV) light disinfection unit, 500-gallon pump tank, pump, floats and controls, and 250-foot shallow trenches using pressure distribution.

Monitoring Requirements (Table)

The monitoring requirements specified in an operating permit are unique to the site and soil conditions of the property (its environmental sensitivity) and system complexity. The monitoring requirements include specific parameters to be monitored, target limits and the frequency and location of monitoring. The monitored parameters, at a minimum, would include: 1) wastewater flow - the most basic parameter to know in understanding system performance, 2) ponding in the soil treatment system and 3) surfacing of the soil treatment system. Monitoring for CBOD, TSS, fecal coliform bacteria and nitrogen are unique to the site, its receiving environment and complexity of the wastewater system. Field tests for temperature, pH and dissolved oxygen can be performed by the Service Provider to serve as general indicators of system performance.

1. Flow – flow to each system needs to be determined as specified in the Management Plan or as determined by the local unit of government. Flow can be determined several ways, using water meters, event counters, and running time clocks. Telemetry can also be used and has the advantage that flow can be determined continually. The determination for the frequency of flow measurement is done on a case-by-case basis. At first, daily flow monitoring may be needed to determine average flow and peak flows to a system. After a period of time, weekly or monthly flow determination may be acceptable. Flow determinations once a year generally provide limited information.
2. **CBOD** – monitoring for CBOD is not typically required for the majority of wastewater systems used for single-family homes generating typical domestic strength effluent. However, monitoring for CBOD may be needed periodically. For example, there may be a need to audit systems as part of the product registration process in Minnesota or if the Service Provider is trying to troubleshoot a system. For commercial systems, monitoring for CBOD is generally necessary to determine CBOD removal efficiencies of proprietary treatment devices and/or organic loading rates to the soil’s infiltrative surface.

3. **TSS** – monitoring for TSS is not typically required for most residential wastewater systems that generate typical domestic strength effluent. However, turbidity measurements may be taken in the field by Service Providers. Monitoring for TSS may be needed periodically as part of an audit process for the registration of proprietary treatment products in Minnesota. For commercial systems, monitoring for TSS may be necessary.

4. **Fecal Coliform Bacteria** – monitoring for fecal coliform bacteria will generally be required for systems listed as Treatment Level A and Treatment Level B systems where reduced vertical soil separation is used.

5. **Total Nitrogen and Total Phosphorus** – monitoring for Total Nitrogen (TN) may be needed in areas identified as nitrogen sensitive environments. Monitoring for Total Phosphorus (TP) may be required in phosphorus sensitive lake environments.

6. **Field Tests** – these are tests performed by the Service Provider to help ‘monitor’ system performance and identify problems (troubleshooting a system). Although field tests are not a strict monitoring requirement, they are appropriate to list in the operating permit if specified in the Management Plan or in the product’s Operation and Maintenance Manual. The local unit of government will determine if the permittee is required to report field test results as part of the operating permit.

7. **Ponding/Surfacing in Soil Treatment** – all systems should be monitored periodically as specified in the Management Plan to determine extent and frequency of ponding in soil treatment systems. A check for surfacing is needed.

**Maintenance Requirements (Table)**

This table lists some of the basic maintenance requirements for each major component of the wastewater system. Since you can’t possibly list all the maintenance requirements in this table, it is best to reference the Management Plan. You could reference the proprietary product’s Operation and Maintenance Manual.

1. **System Component** – list each system component, including the septic tank, trash tank, effluent screen, pump tank and controls, proprietary treatment product, disinfection device, and soil treatment and dispersal system.

2. **Maintenance** – briefly identify the maintenance requirements of each major system component. For additional information, you could also reference the proprietary product documents listed on the MPCA Web site at [http://www.pca.state.mn.us/programs/ists/productregistration.html](http://www.pca.state.mn.us/programs/ists/productregistration.html).

3. **Frequency** – briefly identify the frequency of maintenance as per the systems Management Plan and Operation and Maintenance Manual.

**Monitoring Protocol** – this section of the operating permit states that testing needs to be performed in accordance with approved methods and the results submitted to the local unit of government.

**Contingency Plan** – briefly describes requirements if the system does not function as intended. The owner must notify the local unit of government when non-compliance occurs. The Management Plan may identify some of the corrective actions required or you will need to consult your Service Provider. The owner is responsible to obtain the services of a MPCA-licensed Service Provider to complete the required corrective measures. More detail could be added here by the local unit of government.

**Authorization** – fill in the length of time of the operating permit; this is typically one to five years. Fill in the name of the local unit of government in the second blank space. Next, fill in the name of the MPCA licensed Service Provider identified by the owner in contract; this is needed to help ensure the owner has made the necessary arrangements to have the system maintained and monitored.

**The Operating Permits Hereby Granted to** – print the name of the owner who signed the operating permit.

**Signature of Permittee (and date of signature)** – the owner signs and dates the operating permit.

**By Order of** – signature of the permitting authority, title, and date.
Example:

Facility Information

Permittee name: George Hamilton
Mailing address: 9346 Sand Lake Road
City: King City
State: MN
Zip code: 12345
Property ID number (GPS location): PIN = 10693064

King County authorizes the Permittee to operate a wastewater treatment and dispersal system at the address named above in accordance with the requirements of this operating permit. The attached Management Plan is hereby incorporated as part of the requirements of this operating permit.

Issuance date: 07/26/09
Expiration date: 07/26/10
System type: Type IV
Treatment level: Level A
System design flow: 450 gpd
Residential/Commercial: Residential, 3 bedroom, Class I
System components: 500 gallon trash tank, ECOPOD E50 (500 gpd unit), UV disinfection unit
500 gallon pump tank, pump and controls, 200 ft drainfield with pressure distribution

Monitoring Requirements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target limits</th>
<th>Frequency</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>450 gallons per day</td>
<td>Per Management Plan</td>
<td>Event counter and running time clock</td>
</tr>
<tr>
<td>CBOD</td>
<td>15 mg/L</td>
<td>Allow access for sampling when audited</td>
<td>End of treatment device</td>
</tr>
<tr>
<td>TSS</td>
<td>15 mg/L</td>
<td>Allow access for sampling when audited</td>
<td>End of treatment device</td>
</tr>
<tr>
<td>Fecal Coliform bacteria</td>
<td>1,000 colony forming units/100 ml</td>
<td>Sample 2 times per year every 6 months: 1) before bulb is cleaned; 2) before bulb is replaced at 2 years</td>
<td>Discharge pipe following UV disinfection device</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Tests: Temperature and Dissolved Oxygen</td>
<td>Per Management Plan</td>
<td>Treatment device</td>
<td></td>
</tr>
<tr>
<td>Ponding/Surfacing in soil treatment</td>
<td>Minimal trench ponding; no surfing</td>
<td>Annually</td>
<td>Drainfield trenches</td>
</tr>
</tbody>
</table>

CBOD = Carbonaceous Biochemical Oxygen Demand  TSS = Total Suspended Solids
Maintenance Requirements

Maintenance requirements shall be performed as specified in the Management Plan as prepared by the system’s Advanced Designer.

<table>
<thead>
<tr>
<th>System component</th>
<th>Maintenance</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash tank</td>
<td>Pump as needed</td>
<td>Per Management Plan or Use</td>
</tr>
<tr>
<td>ECOPOD treatment product</td>
<td>Per Delta Environmental Products documents</td>
<td>Every 6 months; not less than Management Plan</td>
</tr>
<tr>
<td>UV light disinfection device</td>
<td>Clean and replace UV bulb</td>
<td>Every 6 months clean bulb, replace bulb every 2 years, as per Management Plan</td>
</tr>
<tr>
<td>Pump tank and controls</td>
<td>Pump to remove solids, check floats, and controls</td>
<td>Every 3 year; not less than Management Plan</td>
</tr>
<tr>
<td>Soil treatment and disposal</td>
<td>Check squirt height, clean distribution network as needed. Maintain cover.</td>
<td>Every 3 year; not less than Management Plan</td>
</tr>
</tbody>
</table>

UV = Ultra Violet Light

Monitoring

Any sampling and laboratory testing procedures shall be performed in accordance with the proprietary treatment product’s protocol, Standard Methods, and at a Minnesota Department of Health approved laboratory. Results shall be submitted to the permitting authority at:  
King County Environmental Services, 123 King Street, King, MN 12345

Contingency Plan

In the event the wastewater treatment system does not meet required performance requirements as contained in this operating permit, the owner shall notify the local unit of government within 30 days of non-compliance. The owner is responsible to obtain the services of a Minnesota Pollution Control Agency (MPCA)-licensed Service Provider to complete the required corrective measures.

Authorization

This permit is effective on the issuance date identified above. This permit and the authorization to treat and disperse wastewater shall expire in one year(s). The Permittee is not authorized to discharge after the above date of expiration. The Permittee shall submit monitoring information and forms as required by  
King County Environmental Services
no later than sixty (60) days prior to the above date of expiration for operating permit renewal. This permit is not transferable.

The owner is required to obtain the services of a Minnesota Pollution Control Agency (MPCA) licensed 1) Service Provider to provide ongoing system operation, maintenance, and monitoring and 2) Maintainer to pump the system’s sewage tanks and components. The owner is responsible to provide the name of the Service Provider business prior to the issuance of this operating permit. The owner has secured the services of  
SSTS Services, Inc.  as the Service Provider for this system (signed Service Provider contract attached).

I hereby certify with my signature as the Permittee that I understand the provisions of the wastewater treatment and dispersal system operating permit including maintenance and monitoring requirements. I agree to indemnify and hold  
King County  harmless from all loss, damages, costs and charges that may be incurred by the use of this system. If I fail to comply with the provisions of this operation permit, I understand that penalties may be issued. If I sell this property during the life of the permit, I will inform the new owner(s) of the permit requirements and the need to renew the operating permit.

The Operating Permit is hereby granted to:  
George Hamilton

<table>
<thead>
<tr>
<th>Permittee (please print):</th>
<th>George Hamilton</th>
<th>Permitting Authority (please print):</th>
<th>Alice Johnson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title:</td>
<td>Homeowner</td>
<td>Date: 07/25/09</td>
<td>Date: 07/26/09</td>
</tr>
<tr>
<td>Signature:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This Management Plan identifies some basic requirements for proper operation and maintenance of the HOWDY Aerobic Treatment System for residential use. Refer to the manufacturer’s Operation and Maintenance Manual for detailed instructions on proper system operation and maintenance.

The HOWDY Aerobic Treatment Manual, submitted by the manufacturer (HOWDY Systems as part of the registration of this product in Minnesota can be found at the Minnesota Pollution Control Agency’s website http://www.pca.state.mn.us/programs/ists/productregistration.html.

<table>
<thead>
<tr>
<th>SYSTEM COMPONENT</th>
<th>TASK</th>
<th>FREQUENCY*</th>
<th>RESPONSIBLE PARTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOWDY aerobic treatment unit</td>
<td>Monitor alarm</td>
<td>On-going</td>
<td>Homeowner</td>
</tr>
<tr>
<td></td>
<td>Check and clean air filter on the air pump</td>
<td>Every three months</td>
<td>Homeowner or Service Provider</td>
</tr>
<tr>
<td></td>
<td>Check mechanical and electrical components</td>
<td>Every three months</td>
<td>Service Provider</td>
</tr>
<tr>
<td></td>
<td>Check effluent quality odor, color, turbidity, and dissolved oxygen</td>
<td>Every three months</td>
<td>Service Provider</td>
</tr>
<tr>
<td></td>
<td>Sample effluent as required in the local Operating Permit</td>
<td>Annually</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check sludge level in all sewage tanks; follow manufacturers</td>
<td>Every three months</td>
<td>Service Provider &amp; Maintainer</td>
</tr>
<tr>
<td></td>
<td>recommendations for solids removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For seasonal use, follow manufacturers guidelines</td>
<td>As required based on seasonal usage</td>
<td>Service Provider</td>
</tr>
</tbody>
</table>

* Based on a 0-1 Risk Level

**Items not permitted** in the HOWDY wastewater systems are specified in the HOWDY Manual for Minnesota.

**Sampling requirements** are specified in local operating permits. The protocol for collection of wastewater samples is specified in the HOWDY Manual for Minnesota.
Form 7.1 Fast food restaurants

Survey completed by: _____________________________ Reference #: ________________________________

Client contact information

Facility name: _____________________________ Time: ___________ Date: ___________ Yes No
Facility address: ___________________________________________________
Owners name: _____________________________ Phone #: _____________________________
Mailing address: ___________________________________________________
Designer: ___________________________________ Installer: _____________________________
Design flow: ___________________________________ Date of last pumpout: ___________
Is the facility in a rural setting? □ □

A. Facility operation

A.1 Type of menu (Check all that apply):
Hamburger: □ BBQ: □ Oriental: □ Mexican: □
Seafood: □ Chicken: □ Italian: □ Breakfast: □
Other: _______________________________________________________________

A.2 Hours of operation:
  a. Peak season:
    Mon ____ Tue ___ Wed ____ Thu ___ Fri ___ Sat ___ Sun ___
  b. Off season (if applicable):
    Mon ____ Tue ___ Wed ____ Thu ___ Fri ___ Sat ___ Sun ___

A.3 Number of meals served:
  a. Peak season:
    Breakfast: ___________ Lunch: ___________ Dinner: ___________
  b. Off season (if applicable):
    Breakfast: ___________ Lunch: ___________ Dinner: ___________

A.4 Average number of meals served or transactions per day (indicate meals or transactions):
  a. Peak season:
    Mon ____ Tue ___ Wed ____ Thu ___ Fri ___ Sat ___ Sun ___
  b. Off season (if applicable):
    Mon ____ Tue ___ Wed ____ Thu ___ Fri ___ Sat ___ Sun ___
  c. Please list any special occasions (with dates) where meals served exceeds the number listed above:
    Event: ___________________________________________ Meals: _______
    Event: ___________________________________________ Meals: _______
    Event: ___________________________________________ Meals: _______

A.5 Square footage of establishment: _________

A.6 Number of employees: _______ (total) _______ (per shift) _______ (shifts/day)

A.7 Do you use septic tank additives?
  a. If “yes”, what products? ______________________________________________________________

A.8 Water supply:
  Private well: □ Centralized system: □ Other: □

A.9 Are there public restrooms? □ □

A.10 Is the facility located off of a freeway exit? □ □

A.11 Seating:
  Total: _______ Indoor: _______ Deck/patio: _______ Kids’ play area: ______

A.12 Drive-up window:
  a. Peak season:
    Mon ____ Tue ___ Wed ____ Thu ___ Fri ___ Sat ___ Sun ___
  b. Off season (if applicable):
    Mon ____ Tue ___ Wed ____ Thu ___ Fri ___ Sat ___ Sun ___
B. Water use habits

B.1 Salad bar: ☐ ☐
B.2 Buffet: ☐ ☐
B.3 Self serve soft-drinks: ☐ ☐
B.4 Ice cream or frozen yogurt machine: ☐ ☐
B.5 Deep fat fryer: ☐ ☐
B.6 Type of cooking oils/fat used (check all that apply):
   - Animal: ☐
   - Vegetable: ☐
   - Liquid: ☐
   - Solid: ☐

B.7 Use of preservatives in foods: ______________________________________________________________

B.8 Garbage disposal used: ☐ ☐

B.9 Tableware
   a. Washable: ☐ Disposable: ☐

B.10 Is a dishwasher used?
   a. Hot water rinse: ☐ Chemical rinse: ☐ Temperature: __________ °F
   b. Detergent Liquid: ☐ Powder: ☐ Concentrate: ☐
   c. Detergent name brand: ______________________________________________________________
   d. Are plates and dishes scraped into garbage prior to rinsing or washing? ☐ ☐
   e. Is there an open screen installed after the sink or dishwasher? ☐ ☐
   f. If yes, how often is it cleaned? ______________________ day _____________________ week

B.11 Are dishes hand-washed?
   a. How often is sink water changed? __________________ per day

B.12 Are foods thawed under running water? ☐ ☐

B.13 Are drain cleaners used? ☐ ☐

B.14 Does after-hours cleanup result in wash-water going down a floor drain?
   a. Are floor strippers used? ☐ ☐
   b. Are degreasers used? ☐ ☐
   c. Are hood cleaning products used? ☐ ☐
   d. Are the floor mats cleaned in the dishwasher? ☐ ☐
   e. List any other products used in clean-up: ________________________________________________

B.15 Does the facility have a laundry machine to wash floor mats, tablecloths, and other items? ☐ ☐

B.16 Does the facility serve coffee? ☐ ☐

C. Onsite wastewater treatment system

C.1 Actual water use (GPD)
   a. Average: __________ Peak: __________ Low: __________
   b. Reading this date from:
      - Cycle counter: __________
      - Elapsed time meter: __________
      - Water meter: __________
      - Other: __________

C.2 What is the water pressure? __________ psi
   a. Are bathroom fixtures or any other water-using devices rated as low flush? ☐ ☐
   b. If yes, please list:
      ______________________________________________________________
   c. Are there automatic flush fixtures? ☐ ☐

C.3 Water treatment device:
   a. Is a water softener used? ☐ ☐
      i. Back-flushes to:
      ii. Reverse osmosis:
         i. Discharges to:
   b. Condensate drains to:

C.4 Air conditioner unit(s):
   a. Condensate drains to: ___________________________
C.5 Commercial ice machine:
   a. Condensate drains to: _______________________________________________________________

C.6 Footing drains or sump pumps connected into the wastewater treatment system: □  □

C.7 Does facility utilize a grease trap inside the building? □  □
   a. If yes, how often is trap cleaned? ____________________month

C.8 Flows from facility are commingled:
   Inside: □  Outside: □

C.9 Monthly water readings for one year period:
   Inside:
   Jan ___  Feb ___  Mar ___  Apr ___  May ___  Jun ___  Jul ___  Aug ___  Sep ___  Oct ___  Nov ___  Dec ___

C.10 Location of sampling point: ______________________________________________________________
   (Attach sampling Form B.1)

Additional Comments:__________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
### Onsite Sewage Treatment Program Soil Observation Log

<table>
<thead>
<tr>
<th>Client/ Address</th>
<th>Legal Description/GPS</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Soil Parent Material(s): Till Outwash Lacustrine Alluvium Loess Organic Matter Bedrock</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(circle all that apply)</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Landscape Position: Summit Shoulder Back/Side Slope Foot Slope Toe Slope Slope Shape</th>
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</thead>
<tbody>
<tr>
<td>(circle one)</td>
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</table>

<table>
<thead>
<tr>
<th>Vegetation:</th>
<th>Soil Survey Map Unit(s):</th>
<th>Slope (%):</th>
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</thead>
<tbody>
<tr>
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<table>
<thead>
<tr>
<th>Weather conditions/Time of Day:</th>
<th>Observation /# /Location:</th>
<th>Elevation:</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>Texture</th>
<th>Coarse Frag %</th>
<th>Matrix Color(s)</th>
<th>Mottle Color(s)</th>
<th>Redox Kind(s)</th>
<th>Saturated Soil Indicator(s) (see back)</th>
<th>Structure Shape</th>
<th>Structure Grade</th>
<th>Consistence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Concentrations Depletions Gleyed</td>
<td>Granular Platy</td>
<td>Blocky</td>
<td>Loose Firm Extremely Firm Rigid</td>
</tr>
<tr>
<td></td>
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<tr>
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</tr>
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<table>
<thead>
<tr>
<th>Certified Statement: I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Designer)</td>
</tr>
<tr>
<td>(Signature)</td>
</tr>
<tr>
<td>(License #)</td>
</tr>
<tr>
<td>(Date)</td>
</tr>
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<tbody>
<tr>
<td>Soil Parent Material(s):</td>
<td>Till</td>
<td>Outwash</td>
</tr>
<tr>
<td>Landscape Position:</td>
<td>Summit</td>
<td>Shoulder</td>
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<td>Slope (%):</td>
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<td></td>
<td></td>
<td></td>
<td>Concentrations Depletions Gleyed</td>
<td>Granular Platy Blocky Prismatic Single Grain Massive</td>
<td>Weak Moderate Strong Loose</td>
<td>Loose Friable Firm Extremely Firm Rigid</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
</tbody>
</table>

**Comments:**

Certified Statement: I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

(Designer) (Signature) (License #) (Date)