What is a Complete Design?

University of Minnesota

Onsite Sewage Treatment Program

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A Complete Design will Avoid Permitting Delays!

Use most up to date design forms. Current available version is dated 6/13/13, but a new one is coming.

http://septic.umn.edu/formsandsheets
What type of design can YOU design?

- **Designer levels**
  - **Basic:** Type I-III up to 2,500 gpd
  - **Intermediate:** + Type IV up to 2,500 gpd
  - **Advanced:** >2,500 gpd and high strength waste (HSW)
Permit Determination - ISTS

- If the SSTS is designed to:
  - receive 5,000 gpd or less,
  - the system is classified as an Individual SSTS (ISTS)
  - regulated by a local ordinance in compliance with chapter 7080
Permit Determination - MSTS

- If the SSTS is designed to
  - receive 5,001 gpd to 10,000 gpd
  - the system is classified as a mid-sized SSTS (MSTS)
  - regulated by a local ordinance in compliance with chapter 7081
Nitrogen Removal

- **2500 - 5,000 gpd**
  - If discharging to an aquifer, need BMP’s
  - List of BMP’s from MPCA

- **5,000 – 10,000 gpd**
  - If discharging to an aquifer, need to meet 10 mg/l Total N at nearest well or property boundary
  - If not discharging to an aquifer, BMP’s
Permit Determination - LSTS

- If a single SSTS or group of SSTS
- Under single ownership
- Within one-half mile of each other
- Designed to treat an average design flow greater than 10,000 gallons per day
- The system requires is a LSTS and requires a SDS permit from the MPCA
**Who can design & review?**

<table>
<thead>
<tr>
<th></th>
<th>&lt; 2,500 gpd Domestic Strength</th>
<th>2,501 to 5,000 gpd</th>
<th>5,001 to 10,000 gpd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type I, II or III</strong></td>
<td>Designer/Inspector</td>
<td>Advanced Designer/Inspector</td>
<td>Advanced Designer</td>
</tr>
<tr>
<td><strong>Type IV</strong></td>
<td>Intermediate Designer/Inspector</td>
<td>Advanced Designer/Inspector</td>
<td>Advanced Designer</td>
</tr>
<tr>
<td><strong>Type IV for HSW</strong></td>
<td>Advanced Designer/Inspector</td>
<td>Advanced Designer/Inspector</td>
<td>Advanced Designer/Inspector</td>
</tr>
<tr>
<td><strong>Type V</strong></td>
<td>PE/PSS w/ ID</td>
<td>PE/PSS w/ AD</td>
<td>PE/PSS w/ AD</td>
</tr>
</tbody>
</table>
Class V injection well

- Class V Wells
  - All single family dwellings which discharge non-sewage
  - All multiple family dwellings
  - Establishments that have the capacity to serve over 20 people that have subsurface discharges
Class V Injection Well

- Requirements:
  - submit basic inventory information (on website or in manual)
  - operate the well such that an underground source of water is not endangered

- If met, the operation of the Class V well is authorized by rule
Assistance available to help those gaining “Advanced Certifications”

1. Customized tutoring
2. Field day with CEUs
   - July 23rd
   - Near Marshall
3. Audit class again for free if you do not pass on first try
Design, installation and inspection of the building sewers?

- Plumbing code
- Inspection? Local plumbing inspector?
- Commercial project – State plumbing inspector
- As SSTS Inspector you can look at this pipe but can not perform an official plumbing inspection
- Pipelayer card/bond required to install
- This may change in the future
Overall design requirements

- 2 Sites
- Site protection
- Maintenance route
- Design
  - Site evaluation
  - Site map
  - Design
- Cert. Statement
  - Designer
  - Homeowner (Carver County)
    - New Condensed Summary Sheet for Homeowner to sign - # of Bedrooms, Garbage Disposal, Lift in the Basement, Property Lines,)
Two Soil Treatment Areas

- Newly-platted Lots
  - > 1 / 23 / 96
- 7082.0100
- Type I sizing
- Does not apply to existing lots
- Does not dictate what is installed
Site Protection

- Lack of adequate fencing → Delays Building Permit
- “Protect from disturbance, compaction, other damage by staking, fencing, posting or other effective method.”
- New Construction
  - Snow fencing recommended with sign
  - Stakes at corners
- Future
  - Include in design
  - Inform homeowner

FUTURE DRAINFIELD
NO TRESPASSING
Field Evaluation Requirements

- See Soil Observation Log
- Lot lines
- Surface Features
  - the percent and direction of the slope at the proposed system location;
  - vegetation types;
  - any evidence of cut or filled areas or disturbed or compacted soil;
  - the flooding or run-on potential; and
  - a geomorphic description.
How Many Soil Observations?

- **Minimum**
  - Code - 3 per Site within borders of system
  - Required - understand the site
  - One in the worst location
  - Exposed pit or by hand auguring or probing
  - Minimum depth = to the periodically saturated layer, to the bedrock, or three feet below the proposed depth of the system

- **Recommended**
  - 3-5 per Site
  - Variation = More observations
Fragments and Sands

- Sandy soil with 35% or greater coarse fragments is equal to a percolation rate of less than 0.1 MPI
- Effluent moves through these soils too fast for effective treatment to occur.
Limited Treatment Layers

Sand with coarse fragments provides less treatment due to low surface area and short residence time.
Limited Treatment Layers

- Any sandy soil layers in which has 35 to 50% percent coarse fragments is credited at 50% treatment value.
- Any soil layers in which has greater than 50% percent coarse fragments is not credited for treatment value.
### Rapidly Permeable Soils - Treatment

<table>
<thead>
<tr>
<th>% Coarse Fragments</th>
<th>Non-sandy Textures</th>
<th>All sandy textures</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 35%</td>
<td>100% T</td>
<td>100% T</td>
</tr>
<tr>
<td>36 - 50%</td>
<td>100% T</td>
<td>50% T</td>
</tr>
<tr>
<td>&gt;50%</td>
<td>NT</td>
<td>NT</td>
</tr>
</tbody>
</table>

100% T = Full Treatment  
50% T = ½ Treatment Credit  
NT = No Treatment
Example

40% Coarse Fragments

1 foot = 6”

1.5 feet

Must be less than 7 feet
Example
More than 50% Coarse Fragments

1 foot = 0”

1 foot

Must be less than 7 feet

2 feet
Can you reuse components?

- Be careful
- Identify who is responsible to confirm water tightness of tanks
  - Designer or Installer
  - Tanks pumped?
Drainage

- Identify natural drainage patterns on site
  - Flow
  - Floodplain and floodway
- Where does stormwater from improvements go?
  - Downspouts, impervious cover
- Treatment systems: runoff from fields
  - Water shedding
  - Multiple zones: drainage paths between zones
Complete Plan

- Date of field evaluation and design (and revision date of needed)
- All components specified
- Component size specified
- Component location specified
- Maintainability of components
What should be on a site plan?

- Site features
  - Existing
  - Proposed
- Topographic plan
- Bench mark
- Drainage plan
- 100-year flood plain
- Water wells
- Property lines
- Replacement areas?
- Location of soil evaluation

- Features needing horizontal separation
  - Water supply lines
    - Public and private
  - Water features
    - Streams, ponds, lakes, rivers, creeks, salt water, retention ponds
  - Surface improvements
  - Easements
    - Underground and overhead
  - Steep slopes & drainage
Site plan

- Graphical representation of site
  - Existing features
  - Proposed features
  - Horizontal setbacks
    - Water bodies
    - Property lines
    - Wells
    - Others
Topographic plan

- Map representing the changes in elevation on a site
- Contour lines are the representation, on the plan, of the variation in elevation
- Elevation in landscape is relative to a known point - bench mark
Elevations required on every design

- Soil observations
- System depth
- Benchmark
  - A fixed point of known elevation in the landscape set at a reasonable distance from the installation site
  - It can be referenced to a national or local datum or it can be set arbitrarily
  - Without a bench mark, the installer cannot accurately set elevations at the site
- Label these on your map!
Topographic plan

- Contour lines: lines with the same elevation
  - Need to note the elevation change
  - Distance between contour lines shows slope
- Drainage paths can be inferred
Old School Versus New
Bench mark: Nail on tree (2’ up)
Elevation: 100.00 (assumed)

Bench mark: Top of bound
Elevation: 96.82 (assumed)
Scale

Represents the relative size of the objects on the site plan to the size of the objects in real life.

Engineers’ scales such as 20 scale (1” = 20’) mean that every inch in the scale represents 20 feet in real life.
North Arrow helps the reviewer orientate him/herself

North arrow on site plan
Dwelling Estimates

- Bedrooms
- *Look at the house plans, Assessor’s Records-Carver County GIS available*
- Area
- Watch for
  - Unfinished space
    - 1 bedroom
  - Multi-generation families
    - More than 2 people per bedroom
  - In-home businesses or hobbies
Clear water

- Groundwater
- Cooling water
  - Ice makers
- Pool water
- Water conditioners
  - Ion exchange
    - Water softener
    - Iron filter
  - Membrane
    - Reverse osmosis
What is Domestic versus High Strength Wastewater (HSW)?

1) Influent having
   - \( \text{BOD}_5 \) > 300 mg/L,
   - and/or \( \text{TSS} \) > 200 mg/L,
   - and/or fats, oils, and grease (FOG) > 50 mg/L entering a pretreatment component

2) Effluent from a septic tank or other pretreatment component that has:
   - \( \text{BOD}_5 \) > 170 mg/L,
   - and/or \( \text{TSS} \) > 60 mg/L,
   - and/or (FOG) > 25 mg/L and is applied to an infiltrative surface
Restaurants and Facilities with Food Preparation

- Rule REQUIRES domestic strength waste prior to soil treatment with either sufficient detention time or pretreatment
- Design Guidance
  - “Additional septic tank capacities or equalization tanks with pretreatment may be necessary for high strength waste sources”
  - Product registration for HSW aerobic treatment units (on line)

**PRETREATMENT = TYPE 4 OR 5**

**AD DESIGNER & INSPECTION**
Chisago County Adult Care Facility Evaluation

Funding Source: Chisago County, Karcher Foster Services, Inc. and UMN
Completed Research—Chisago County

- Evaluation of adult care facilities
  - Sample and evaluate 6 systems experiencing issues serving adults with various physical challenges
  - High flows, chemicals and pharmaceuticals are creating VERY challenging waste stream
- Recommend design and management updates
# Flow Results

<table>
<thead>
<tr>
<th>Site</th>
<th>Flow, gpd</th>
<th>Mean Ave.</th>
<th>Operating</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>321 ± 13</td>
<td>525</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>462 ± 6</td>
<td>420</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>326 ± 22</td>
<td>420</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>630 ± 19</td>
<td>525</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>521 ± 6</td>
<td>840</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>491 ± 23</td>
<td>525</td>
<td>750</td>
<td></td>
</tr>
</tbody>
</table>

# Organic loading Result

<table>
<thead>
<tr>
<th>Site</th>
<th>BOD₅, mg/L</th>
<th>Mean Ave.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>143 ± 31.0</td>
<td>80.8</td>
<td>166</td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>129 ± 12.4</td>
<td>110</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>193 ± 34.2</td>
<td>159</td>
<td>235</td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>144 ± 41.5</td>
<td>93.4</td>
<td>195</td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>182 ± 49.9</td>
<td>119</td>
<td>244</td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>132 ± 64.9</td>
<td>48.7</td>
<td>191</td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>64 ± 30.7</td>
<td>38.6</td>
<td>114</td>
<td></td>
</tr>
</tbody>
</table>
Other Factors

- Found **Many** other chemicals

### Surfactants

<table>
<thead>
<tr>
<th>Concentration (mg/L MBAS)</th>
<th>Potential Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1.0</td>
<td>Risk of long-term accumulation of surfactants in soil, leading to decreased hydraulic conductivity and increased water repellence</td>
</tr>
<tr>
<td>10</td>
<td>Inhibition of hydrolysis, leading to greater accumulation of solids in anaerobic sewage treatment systems</td>
</tr>
<tr>
<td>30</td>
<td>Direct degradation of soil structure and decrease in hydraulic conductivity</td>
</tr>
</tbody>
</table>

### Table: Anionic Surfactants (MBAS), mg/L

<table>
<thead>
<tr>
<th>Site</th>
<th>Anionic Surfactants (MBAS), mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>2.0</td>
</tr>
<tr>
<td>B.</td>
<td>0.76</td>
</tr>
<tr>
<td>C.</td>
<td>3.8</td>
</tr>
<tr>
<td>D.</td>
<td>8.6</td>
</tr>
<tr>
<td>E.</td>
<td>1.5</td>
</tr>
<tr>
<td>F.</td>
<td>3.4</td>
</tr>
<tr>
<td>G. Control Site</td>
<td>2.7</td>
</tr>
</tbody>
</table>
Recommendations

- Install water saving devices (showers, sinks, laundry)
- Limit use of cleaners and sanitizers to the minimal amount needed
- Use natural cleaners whenever possible
- Educate staff and residents on proper disposal of non-organic materials
- Update systems with code compliant systems with increased hydraulic capacity
- Consider installing advanced treatment units to break down pharmaceuticals and personal care products prior to soil
Minnesota Department of Transportation (MnDOT) Rest Stop Evaluation

Funding Source: MnDOT and University of Minnesota
Research Background

- Minnesota Department of Transportation (MnDOT) owns and operates 51+ septic systems serving the rest stops, truck garages and scales across Minnesota
- Little information exists or has been evaluated regarding
  - Flows
  - Waste strength
  - Chemical usage
- Many systems are 30+ years old
- Majority only have pretreatment in a septic tank
- Difficult site conditions
  - Compaction, fill soils, setbacks, etc
More in-depth research

- 2 sites selected where new system are being installed this spring/summer
- Evaluating contaminant fate and transport
- Groundwater mounding
Project status

- Have inspected 25 of 51 systems
- Remainder will be assessed in 2014
## Preliminary Data – Rest Stops

<table>
<thead>
<tr>
<th>Site</th>
<th>BOD</th>
<th>COD</th>
<th>COD: BOD</th>
<th>TSS</th>
<th>Phos.</th>
<th>Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>97</td>
<td>366</td>
<td>4</td>
<td>23</td>
<td>8.8</td>
<td>38</td>
</tr>
<tr>
<td>#4</td>
<td>99</td>
<td>275</td>
<td>3</td>
<td>60</td>
<td>7.6</td>
<td>111</td>
</tr>
<tr>
<td>#5</td>
<td>123</td>
<td>615</td>
<td>5</td>
<td>54</td>
<td>15.6</td>
<td>123</td>
</tr>
<tr>
<td>#7</td>
<td>226</td>
<td>615</td>
<td>3</td>
<td>60</td>
<td>17.2</td>
<td>130</td>
</tr>
<tr>
<td>#8</td>
<td>117</td>
<td>269</td>
<td>2</td>
<td>49</td>
<td>10.6</td>
<td>77</td>
</tr>
<tr>
<td>#9</td>
<td>&lt;60</td>
<td>147</td>
<td>44</td>
<td>10.6</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>
## Data continued

<table>
<thead>
<tr>
<th>Site</th>
<th>BOD</th>
<th>COD</th>
<th>COD: BOD</th>
<th>TSS</th>
<th>Phos.</th>
<th>Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>303</td>
<td>776</td>
<td>2.6</td>
<td>60</td>
<td>23.8</td>
<td>256</td>
</tr>
<tr>
<td>12</td>
<td>328</td>
<td>732</td>
<td>2.2</td>
<td>53</td>
<td>24.3</td>
<td>217</td>
</tr>
<tr>
<td>13</td>
<td>398</td>
<td>710</td>
<td>1.8</td>
<td>72</td>
<td>22.6</td>
<td>242</td>
</tr>
<tr>
<td>14</td>
<td>164</td>
<td>525</td>
<td>2.6</td>
<td>37</td>
<td>21.2</td>
<td>209</td>
</tr>
<tr>
<td>16</td>
<td>264</td>
<td>526</td>
<td>2.0</td>
<td>42</td>
<td>13.9</td>
<td>146</td>
</tr>
</tbody>
</table>
## Data – advanced treatment

<table>
<thead>
<tr>
<th>Site</th>
<th>BOD</th>
<th>COD</th>
<th>COD: BOD</th>
<th>TSS</th>
<th>Phos.</th>
<th>Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>#10, septic</td>
<td>254</td>
<td>472</td>
<td>2</td>
<td>34</td>
<td>13.6</td>
<td>98</td>
</tr>
<tr>
<td>#10, recirc</td>
<td>ND</td>
<td>63.8</td>
<td>ND</td>
<td>12.3</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>#17, septic</td>
<td>355</td>
<td>650</td>
<td>1.8</td>
<td>67</td>
<td>18.6</td>
<td>192</td>
</tr>
<tr>
<td>#17, pump tank</td>
<td>ND</td>
<td>235</td>
<td>38</td>
<td>38</td>
<td>19.4</td>
<td>193</td>
</tr>
<tr>
<td>#15, pump tank</td>
<td>28</td>
<td>119</td>
<td>4.3</td>
<td>4.3</td>
<td>18.4</td>
<td>110</td>
</tr>
</tbody>
</table>
Further data analysis needed

- Get full data set
- Resample outliers
- Coorelations with?
  - Flow
  - Tank capacity
  - Management
Tank Burial

- Tanks “must” not have more than 4 feet cover (unless otherwise allowed by LGU) for new dwellings

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At A Glance Listing Of Registered Sewage Tanks
Subsurface Sewage Treatment Systems

<table>
<thead>
<tr>
<th>Sewage tank manufacturers name and location of manufacturers</th>
<th>Type of material</th>
<th>Maximum depth of burial (feet)*</th>
<th>Smallest size (gallons)</th>
<th>Largest size (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrian Tile Company Adrian, MN</td>
<td>Concrete</td>
<td>4 to 5</td>
<td>750</td>
<td>1600</td>
</tr>
<tr>
<td>AK Industries Plymouth, IN</td>
<td>Polyethylene</td>
<td>4</td>
<td>1000</td>
<td>1300</td>
</tr>
<tr>
<td>Alpen Concrete Cloquet, MN</td>
<td>Concrete</td>
<td>4</td>
<td>500</td>
<td>1500</td>
</tr>
<tr>
<td>AP's Concrete La Crescent, MN</td>
<td>Concrete</td>
<td>5 to 7</td>
<td>750</td>
<td>3000</td>
</tr>
<tr>
<td>Amcon Block and Precast St. Cloud, MN</td>
<td>Concrete</td>
<td>7</td>
<td>600</td>
<td>2000</td>
</tr>
<tr>
<td>Bakker Bros. Construction Rumson, MN</td>
<td>Concrete</td>
<td>8 to 9</td>
<td>1000</td>
<td>2500</td>
</tr>
<tr>
<td>Belle Plaine Block &amp; Tile Belle Plaine, MN</td>
<td>Concrete</td>
<td>2 to 10</td>
<td>500</td>
<td>2500</td>
</tr>
<tr>
<td>Brown Willert Fargo, ND</td>
<td>Concrete</td>
<td>4 to 8</td>
<td>600</td>
<td>2500</td>
</tr>
<tr>
<td>Brown Willert Lakeville, MN</td>
<td>Concrete</td>
<td>4 to 8</td>
<td>600</td>
<td>2500</td>
</tr>
</tbody>
</table>
Tank Insulation

- If the top tank is less than two feet from final grade, insulate to R-value of 10
- Maintenance hole covers shall be insulated to an R-value of 10
Insulation options
Avoid joints in excavated area
Risers - Watertight
Water tight seals

- Boot may be cast into the tank or pressed into a smooth hole with an expanding clamp.
- Stainless steel hose clamp seals boot to pipe
- Flexible – allows some pipe movement but maintains sealed
Plastic pipe penetration seals

- Cast-in plastic fitting
- Flexible – allows some pipe movement
PVC pipe penetration seal

- Cast-in PVC fitting
- Connecting pipe cements into fitting
- Inflexible connection
- Pipe will need support during backfill
- Stress created if any settling occurs
Questionable seals
Type III Systems - (old term “other”)

- Type I systems modified to meet unusual soil systems
- For fill and disturbed soils
- Perc rates over 120 mpi [0.1 gpd/sqft]
- Downsized soil treatment area with flow equalization
- Less than 12” of unsaturated soils
  - Be careful of wetlands
Fill Soils

- Fill soils commonly have mixed colors and textures
- Typically soil is placed on top of wet locations
- Destroys soil structure

Figure 4.14
Cut Areas

- Areas where top soil and/or subsoil has been removed exposing parent material
  - Compaction due to machinery
  - Loss of soil structure
  - Redox features may have been removed

(Top soils maybe added to establish vegetation)

- A restrictive condition likely occurs at this interface, slowing the movement of water
Cut/Fill Solutions

- All type III systems
  - Not natural soil
- Perc test only determines sizing
- Fill soils- assume wet to the surface
  - Redox features have not had time to form
- Cut-assuming compaction at surface
- Solution - mound with 3 ft of sand lift
Management Plans and Operating Permits
Requirements for Local Programs

- **Management Plans**
  - Required for new and replacement systems
  - Prepared by designer
  - Submitted to LGU before construction permit is pulled
Management Plans

- Owners taking responsibility for their systems!
- A plan that specifies performance expectations for systems including:
  - periodic examination,
  - adjustment,
  - testing, and
  - other operational requirements
Management Plans

- Provides information to the owner on O/M
- Information for the Maintainer and Service Provider, too
- Communication tool among the owner and practitioners
Content of Management Plans

- Maintenance requirements
- Operational requirements
- Monitoring requirements
- Owner required to notify LGU when Plan not met
- Location of reserve area
- Other local requirements
Management Plan Templates

- See website
- Type I
- Type IV
  - Proprietary treatment products
Who is MOWA?

- MOWA is the association representing everyone in the decentralized wastewater industry in Minnesota
  - Including: Licensed onsite professionals, engineers, soil scientists, educators, state and local regulators, suppliers and manufacturers.
- Founded in 1975, MOWA has over 500 members and is a non-profit business association whose primary objective is the betterment of public health through sound principles and procedures.
What does MOWA do?

30+ years of positive effect on the Industry through active involvement in:

- Education
- Legislation
- Government relations
- Better rules and regulation
2014 MOWA training

- Summer Seminar
  - Belle Plaine Block and Tile hosting
  - Soils CE track
  - Inspection and hands-on track
  - July 11th
Winter Convention
Jan 26-28, 2015
Bloomington

- Local and National speakers
- Rotated around the state
- Business Tracks
- See new products at the Vendor show
• Visit MOWA-MN.com for more information
  • Click on applications & renewal from membership application
  • Sign up for email notification
  • View the calendar of events
  • View presentations from previous MOWA events
• Board members are always available to talk to you about issues, concerns, or questions you may have
  • View board member listing on website
Questions
septic.umn.edu

MY SEPTIC TANK IS OVERFLOWING!

TRY TO LOOK ON THE BRIGHT SIDE.

SOON YOUR GRASS WILL BE THE ENVY OF THE NEIGHBORHOOD.