



**pennsylvania**  
DEPARTMENT OF ENVIRONMENTAL  
PROTECTION



Bureau of Clean Water

# **Pennsylvania At-grade Absorption Area: Siting, Design and Construction Manual**

## **Pre-Draft Version**

### **SAC Meeting**

June 17<sup>th</sup>, 2020

Tom Wolf, Governor

Patrick McDonnell, Secretary

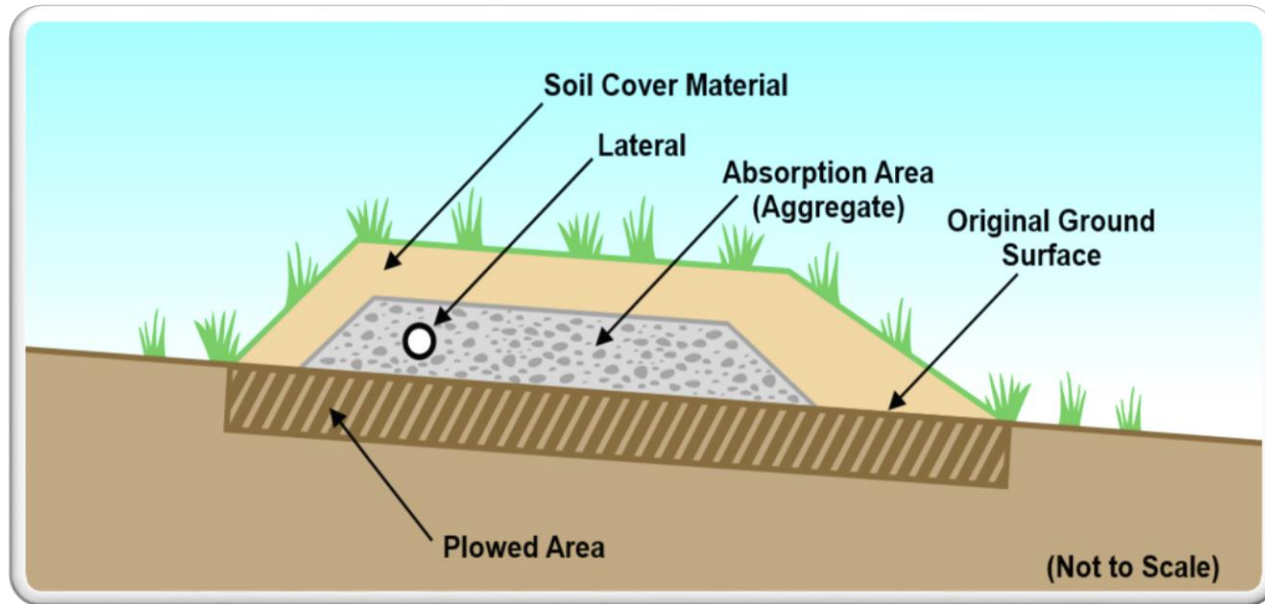
# Purpose and Previous Policies

- The purpose of this Technical Guidance Document (TGD) is to:
  - provide requirements for the siting, design, and construction of the At-grade component;
  - revise general requirements for planning, permitting and operation and maintenance of the on-lot system;
  - combine the two previous At-grade listings into one document.
- This TGD will replace the previous documents titled:
  - At-grade Absorption Area Alternate Technology (A2014-0019-0003);
  - Shallow Limiting Zone At-grade Absorption Area Alternate Technology (A2014-0025-0003).

# Applicability

- Planning for new land development;
- Permitting for new systems;
- Permitting for repair of malfunctioning systems;
  
- Use with primary treated effluent on sites with a depth to limiting zone (LZ) of 48" or greater; and
- Use on sites with a shallow limiting zone (SLZ) with additional pretreatment of the effluent.

# What is an At-Grade Bed?



- The main difference between an At-grade sewage system and other on-lot systems is that the At-grade component is constructed directly on top of chisel plowed soil at the original ground surface, instead of placing it on a bed of sand or in the bottom of an excavation.

# References

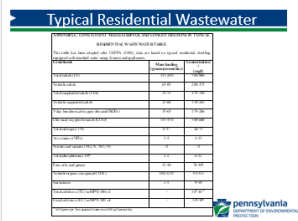
- At-grade On-lot Alternate Technology (OAT) criteria are based on field studies conducted by researchers at the University of Wisconsin - Madison within the Small Scale Waste Management Project.
  - *Some field studies:*
    - *Converse et al. (1991): 31 at-grade systems.*
    - *Converse et al. (1998): 39 modified mound and at-grade systems.*
    - *Penninger et al. (1998): 1 WI at-grade system.*
    - *Mote et al. (1994): 1 WI at-grade system*
- State of Wisconsin: regulations and guidance documents.

# Current Listings Vs. AGB TGD

- Current **At-Grade Absorption Area Listing** requires a percolation test to design the absorption area, similar to an elevated sand mound;
- Current **Shallow Limiting Zone At Grade Absorption Area Listing** uses a soil morphological evaluation to design the absorption area;
- Proposed **At-Grade Bed TGD** requires a soil morphological evaluation to design the absorption area on all soil types, shallow or otherwise.

# General Requirements

- Treatment of domestic strength wastewater (EPA 2002);
- Up to 10,000 gpd;
- Peak daily flow 400 gpd, and 100 gpd for each additional bedroom, for residential dwelling;
- Septic tank(s) requirements in 25 Pa. Code § 73.31;
- Aerobic treatment tank(s) requirements in 25 Pa. Code § 73.32. A Department permit is required for peak design flows in excess of 1,500 gallons per day (gpd).

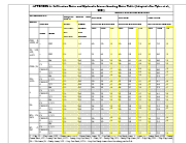


The table, titled "Typical Residential Wastewater", provides a detailed breakdown of wastewater characteristics for a residential dwelling. It lists various parameters such as flow rate, BOD5, SS, TSS, and nutrients, along with their respective units and values. The table is organized into columns for different parameters and their units. The Pennsylvania Department of Environmental Protection logo is visible in the bottom right corner of the table.

Typical Residential Wastewater	
Flow Rate	1.5 - 2.0 gpd
BOD5	100 - 150 mg/l
SS	100 - 150 mg/l
TSS	100 - 150 mg/l
Nitrogen	10 - 20 mg/l
Phosphorus	1 - 2 mg/l
Ammonia	1 - 2 mg/l
Chloride	100 - 150 mg/l
Sulfate	100 - 150 mg/l
Calcium	100 - 150 mg/l
Magnesium	100 - 150 mg/l
Total Solids	100 - 150 mg/l
Organic Solids	100 - 150 mg/l
Inorganic Solids	100 - 150 mg/l
Oil and Grease	100 - 150 mg/l
Trace Organics	100 - 150 mg/l
Pathogens	100 - 150 mg/l

# Proposed Site Requirements

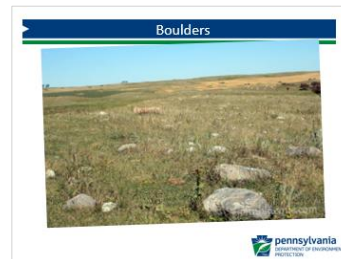
- Max. slope = 15% for the absorption area and the berm.
- Slopes are subdivided into 3 groups: 0-4%, 5-9%, and 10-15%.
- Based on the soil characteristics, slopes, and depth to the LZ, the hydraulic linear loading rate is given by Tyler (2001).
- Proposed TGD uses the full Tyler's table (including ILR for  $BOD_5 \geq 30$  mg/l, LZ depths  $\geq 20$ ), while current Listing (A2014-0025-0003) only partially.
- Proposed TGD uses design options based on the ground surface slopes (0-4% and 4%-15%) and not as in listing #A2014-0019-0003.





# Proposed Site Requirements

- The length of absorption area is placed on contour.
- Absorption areas are allowed on sites with slopes exceeding 4% with concave-shaped contours if the maximum deflection of the at-grade component does not exceed 10%;
- Sites with an excessive number of trees or boulders should be avoided. Appendix provides compensation for the lost infiltrative surface.

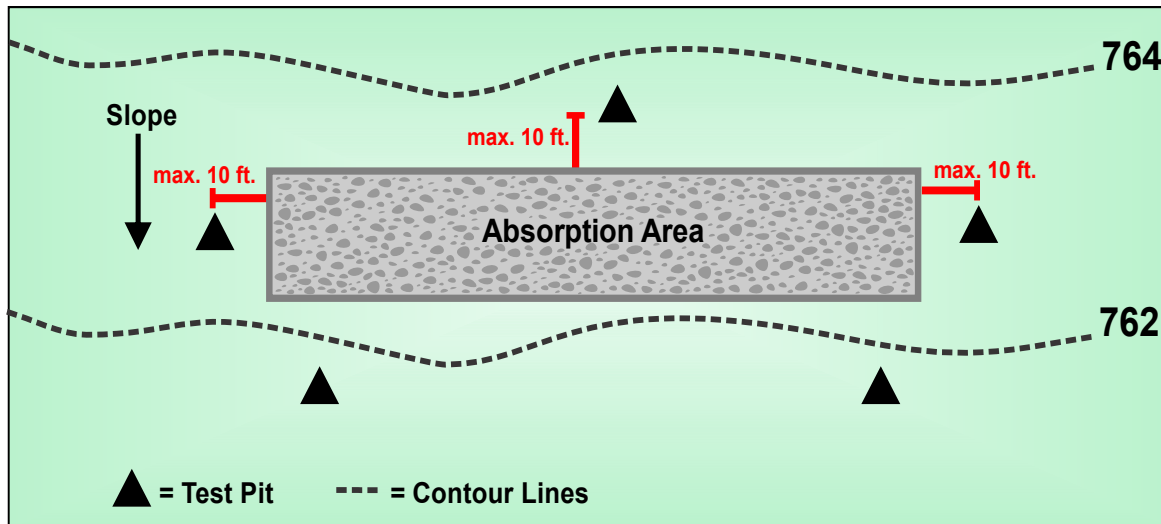


# Absorption Area

- A qualified soil scientist must perform all soil morphological testing.
- Updated definition of qualified soil scientist.
- Updated definition of SLZ (less than 20”).
- Primary and replacement absorption areas on all sites with SLZ.
- An area downgradient from the absorption area needs to be protected.

# Soil Requirements

- A minimum of four (4) soil test pits per absorption area.
- Test pits locations requirements:
  - outside the proposed absorption area;
  - if inside, the site may be considered disturbed;
  - at a distance no more than 10 ft from the proposed absorption area, excluding the downslope pits;
  - placed in a diamond shape;
  - and on-contour.





# Design

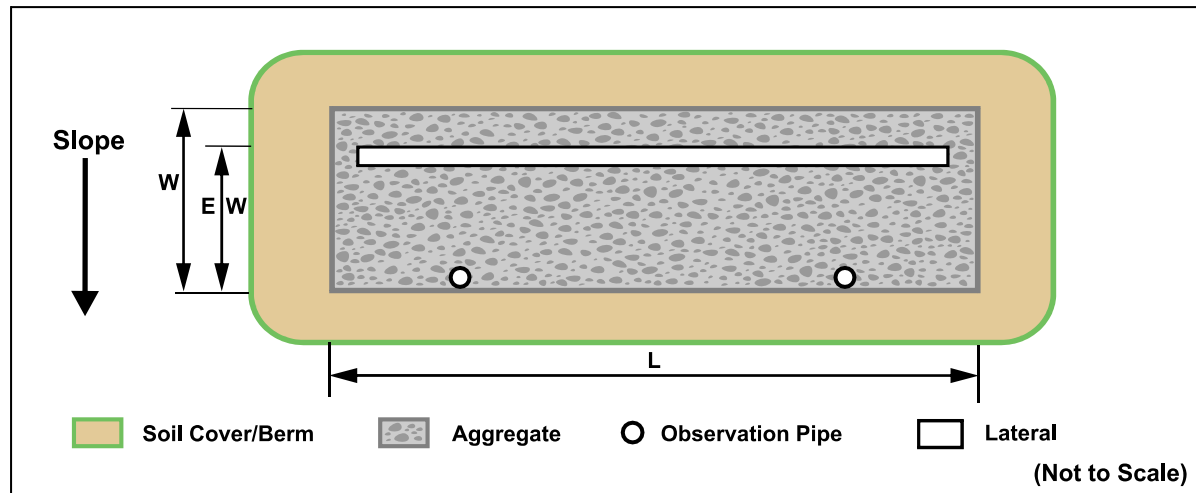
- Main design calculations of the absorption area follow the current Listing # A2014-0025-0003.
- Three design procedures:
  - Design procedure for sites with slopes  $> 4\%$  and  $\leq 15\%$ ;
  - Design procedure for sites with slopes  $> 4\%$  and  $\leq 15\%$  with concave contours;
  - Design procedure for sites with slopes between 0 and 4%.
- Width of absorption area: not exceeding 15ft.
- Cover material: 12" min. instead of 8" min.
- Slope of the berms: same criteria as current Listings.

# Aggregate

- The size and grading of the aggregate should meet AASHTO No. 57 requirements from a Pennsylvania Department of Transportation (PADOT) certified stockpile and shall be Type A or Type B quality requirements.

# Number and Placement of Laterals

Sites on slopes exceeding 4%



If only one effluent distribution pipe, the lateral is located 2 ft from up slope edge of the absorption area.

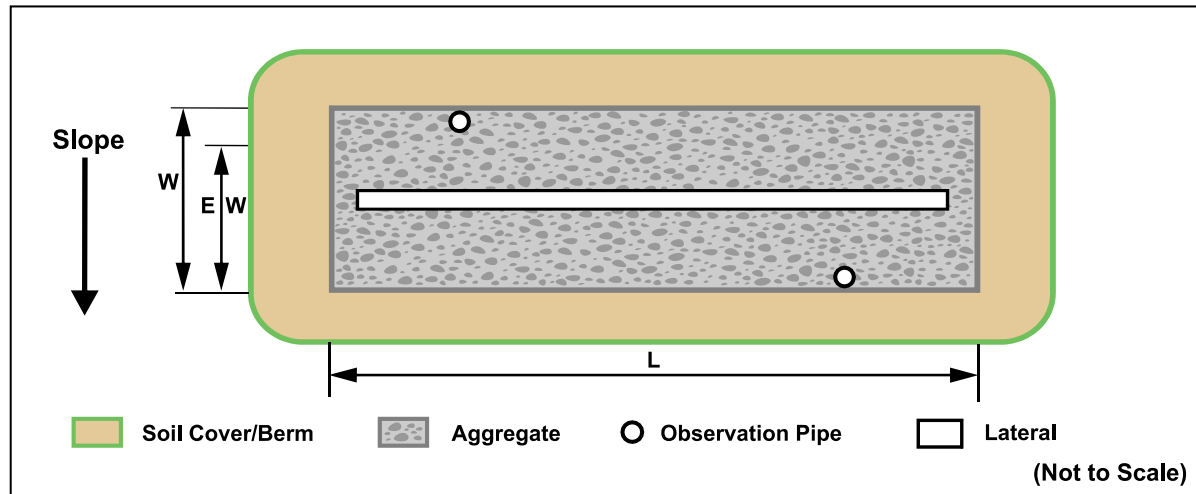
If more, one lateral is located 2 ft down slope as previously, and the others are down slope of the upper lateral, and up slope of the midpoint of the absorption area width.

## Suggested Number of Laterals based on absorption area widths

Width (ft)	# laterals
< 7	1
≥7 and ≤ 15	2

# Number and Placement of Laterals

Sites on slopes between 0-4%



If only one effluent distribution pipe, the lateral is in the center of the absorption area.

If more, the laterals are equally spaced apart.

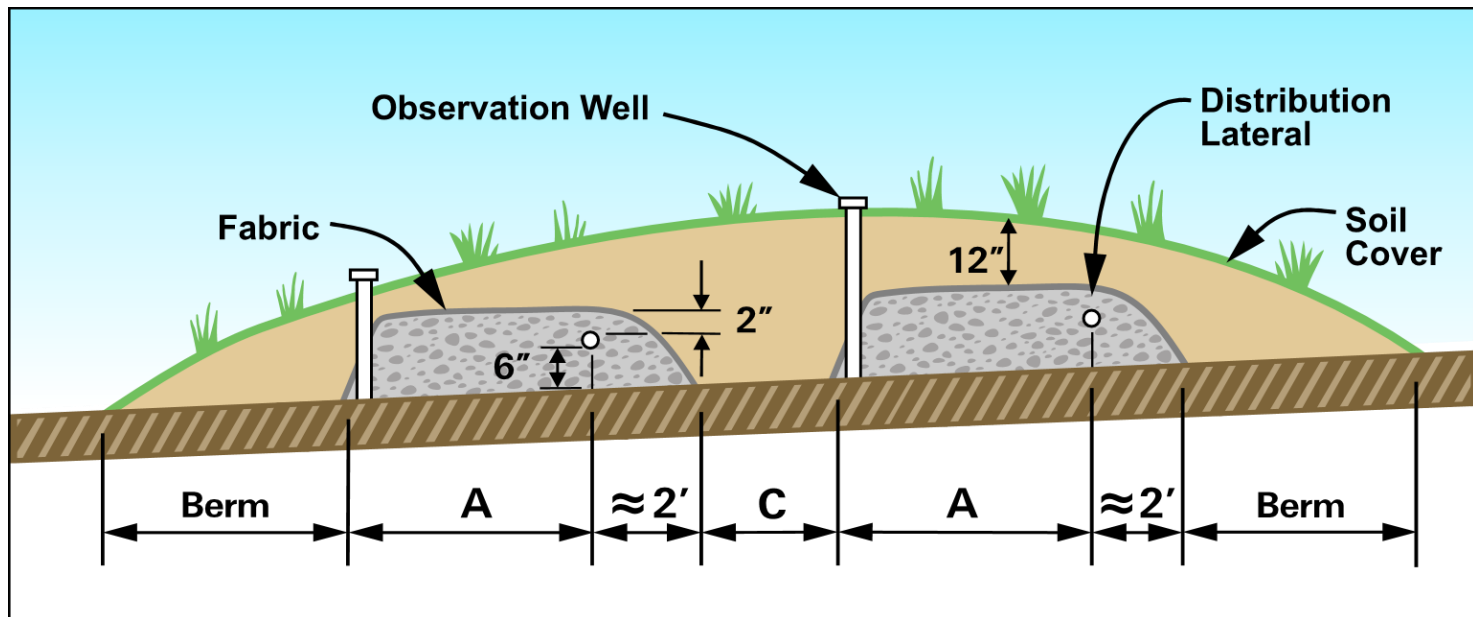
**Suggested Number of Laterals based on absorption area widths**

Width (ft)	# laterals
< 7	1
≥7 and ≤ 15	2



# Split Design

- A professional engineer will be required to design the system when multiple At-grade Absorption Areas (ie. split absorption areas) are necessary.



Adapted after Converse et al.,  
1990

# Construction Procedures

- Criteria to determine the moisture content of the soil.
- Compaction of the soil shall be avoided.
- Placement of the aggregate.
- Specifications for vehicular traffic.
- Scarification of the surface soil.
- Install a minimum of two observation pipes.

# ▶ Planning, Permitting, and O&M

- Section VI. Sewage Facility Planning
- Section VII. Permitting Requirements.
- For SLZ At-grade Absorption Area, a primary and replacement absorption areas will be sited for each lot and should be protected by deed restriction
- A detailed section in the TGD (Section VIII) is dedicated to the Operation and Maintenance of the at-grade systems.

# Pressure Distribution Network

- The At-grade TGD provides for alternate pressure distribution
- TGD provides detail in Appendix B based on USEPA's Design Manual (1980).
- What is Different?
  - Center feed manifold;
  - Lateral should end 6"-12" from the end of absorption area;
  - No required minimum hole diameter, only recommended; except for primary effluent (1/4")
  - No required hole spacing; recommended area per hole is 6ft<sup>2</sup>/hole;
  - Equilateral triangle placement of hole between adjacent laterals;
  - Lateral diameter varies with diameter/spacing hole and lateral length.

# Questions?

Thank you.

Annamaria Ether De Sanctis  
Municipal Facilities Division  
[andesancti@pa.gov](mailto:andesancti@pa.gov)  
717-787-0129

## APPENDIX A: Infiltration Rates and Hydraulic Linear Loading Rates Table (Adapted after Tyler et al., 2001)

Soil Characteristics			Hydraulic Liner Loading Rate, gal/ft/d										
			Infiltration Loading Rate, gal/ft <sup>2</sup> /d		Slope 0-4%			Slope 5-9%			Slope 10-15%		
Texture	Structure		CBOD <sub>5</sub> 25-125mg/l TSS 30-80 mg/l	CBOD <sub>5</sub> 0-25mg/l TSS 0-30 mg/l	Infiltration Distance, Inch			Infiltration Distance, Inch			Infiltration Distance, Inch		
					10-12	12-24	> 24	10-12	12-24	> 24	10-12	12-24	> 24
COS, S, LCOS, LS	--	0SG	0.8	1.6	4.0	5.0	6.0	5.0	6.0	7.0	6.0	7.0	8.0
FS, VFS, LFS, LVFS	--	0SG	0.4	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
COSL, SL	--	0M	0.2	0.6	3.0	3.5	4.0	3.6	4.1	4.6	5.0	6.0	7.0
	PL	1	0.2	0.5	3.0	3.5	4.0	3.6	4.1	4.6	4.0	5.0	6.0
		2, 3											
		PR/BK/G	1	0.4	0.7	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0
FSL, VFSL	R	2, 3	0.6	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1, 2, 3											
		1	0.2	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
L	R	2, 3	0.4	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1, 2, 3											
		1	0.4	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
SIL	R	2, 3	0.6	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
	--	0M	0.0	0.2	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	PL	1, 2, 3											
		1	0.4	0.6	2.4	2.7	3.0	2.7	3.0	3.3	3.0	3.5	4.0
SCL, CL, SICL	R	2, 3	0.6	0.8	2.7	3.0	3.0	3.0	3.5	4.0	3.3	3.8	4.3
	--	0M											
	PL	1, 2, 3											
		1	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
SC, C, SIC	R	2, 3	0.4	0.6	2.4	2.9	3.4	2.7	3.0	3.3	3.0	3.5	4.0
	--	0M											
	PL	1, 2, 3											
		1											
R	2, 3	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4	

C = Clay; CL = Clay Loam; COS = Coarse Sand; COSL = Coarse Sandy Loam; FS = Fine Sand; FSL = Fine Sandy Loam; L = Loam; LS = Loamy Sand; LCOS = loamy Coarse Sand; LFS = Loamy Fine Sand; LVFS = Loamy Very Fine Sand; S = Sand; SC = Sandy Clay; SCL = Sandy Clay Loam; SIC = Silty Clay; SICL = Silty Clay Loam; SIL = Silt Loam; SL = Sandy Loam; VFS = Very Fine Sand; VFSL = Very Fine Sandy Loam. Note: No value given for Silt.

Site Address:					Soil matches the Series in the Soil Survey: Y / N					Date:				
					Land Form:					Slope:				
					Land Use:					Limiting Zone Information				
Municipality / County:					Temperature ( °F / °C):					Depth:				
Described By:					Weather:					Type:				

Horizon					Moist Color (Hue, Value, Chroma)						Texture		Structure			Consistence	Comments	
Master sub	Boundary (inches)				Matrix	Concentrations			Depletions			CFM	USDA	Grade	Size	Type	Rupture Resistance	Roots, Seeps, Staining, Fill, Artifacts, ect.
	From	To	Dist	Topo		Abn	Size	Cont	Abn	Size	Cont							
	0																	
Bt1	18	26	A	S	10YR 4/6	-----			-----			CH	SiL	3	M	ABK	fi	Common medium roots
Bt2	26	38	C	W	10YR 4/6	7.5YR 5/6			10YR 6/2			VCH	SiCL	2	M	ABK	vfi	Few Large Roots, Mn staining
						M	M	F	C	CO	D							

Directions to the Site:														

GPS coordinates for the Site:							GPS coordinates for the Test Pit:							
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# Tree Stump





# Boulders



# Typical Residential Wastewater

## APPENDIX C: CONSTITUENT MASS LOADINGS AND CONCENTRATIONS IN TYPICAL

### RESIDENTIAL WASTEWATER TABLE

This table has been adapted after USEPA (2002); data are based on typical residential dwelling equipped with standard water-using fixtures and appliances.

Constituent	Mass loading (grams/person/day)	Concentration <sup>A</sup> (mg/l)
Total solids (TS)	115-200	500-880
Volatile solids	65-85	280-375
Total suspended solids (TSS)	35-75	155-330
Volatile suspended solids	25-60	110-265
5-day biochemical oxygen demand (BOD <sub>5</sub> )	35-65	155-286
Chemical oxygen demands (COD)	115-150	500-660
Total nitrogen (TN)	6-17	26-75
Ammonium (NH <sub>4</sub> )	1-3	4-13
Nitrites and nitrates (NO <sub>2</sub> -N, NO <sub>3</sub> -N)	<1	<1
Total phosphorous (TP) <sup>C</sup>	1-2	6-12
Fats, oils, and grease	12-18	70-105
Volatile organic compound (VOC)	0.02-0.07	0.1-0.3
Surfactants	2-4	9-18
Total coliforms (TC) in MPN/100 ml	-	10 <sup>8</sup> -10 <sup>10</sup>
Fecal coliforms (FC) in MPN/100 ml	-	10 <sup>6</sup> -10 <sup>8</sup>

<sup>A</sup> Milligram per liter, assumed water use of 60 gal/person/day

