October 2, 2019

Jan & Andy Janes
c/o Chandler Deimund
Vertical Arts Architecture
690 Marketplace Plaza, Suite 1
Steamboat Springs, Colorado 80487

Re: On-Site Wastewater Treatment System Design
Proposed Janes Residence
Lot 9, Murphy Larson Ranch Subdivision
Routt County, Colorado
WSG Project # 19-1035

Dear Jan & Andy,

Western Slope Geotech (WSG) has completed the On-Site Wastewater Treatment System (OWTS) design you requested for your proposed residence to be constructed within Lot 9 of the Murphy Larson Ranch Subdivision, Routt County, Colorado. The results of our site and soil evaluations, design calculations, schematic system design drawings and other pertinent information is included with this report.

PROPOSED CONSTRUCTION

Based on communications with the project architect and building contractor, WSG understands the proposed residence will be constructed with a total of three (3) bedrooms. No other future building additions or other wastewater generating features are anticipated at this time. Potable water will be supplied by the existing Murphy Larson Ranch subdivision water supply system.

SITE CONDITIONS

The property consists of approximately 50 acres of rural land located off the south side of Hannah's Way in the Murphy Larson Ranch Subdivision, Routt County, Colorado.

The proposed OWTS Soil Treatment Area (STA) site consists of vacant, undisturbed land located approximately 60 to 100 feet east of the east side of the proposed residence

building site. The site was well vegetated with grasses, weeds, deciduous brush and scattered aspen trees.

Site topography was somewhat variable and generally sloped gently to moderately down to the east-southeast on the order of 5 to 10 percent. Existing and proposed site features are shown on the OWTS Vicinity Plan, Figure 1.

SOIL EVAULATION

A soil evaluation program consisting of the drilling and excavation and observation of four test holes and two profile pits was conducted at the project site on August 19 and September 2, 2019 to provide subsurface information at the proposed building site and STA location. The approximate test hole and profile pit locations are shown on both Figures 1 and 2. Graphic logs are presented on Figures 4 and 5 and associated legend and notes are also presented on Figure 5.

The subsurface conditions encountered in the test and profile pits were somewhat variable and generally consisted of a layer of topsoil and vegetation overlying natural sandy silt loam, and natural clay to the maximum depth explored at the STA, 7 feet. Natural lean to fat clay was encountered at depths of approximately 42 and 30 inches in profile pits 1 and 2, respectively.

Groundwater seepage was not encountered in the test or profile pits at the time of drilling or excavation. No other indications of a seasonal high groundwater condition were observed in the profile pits. Groundwater levels will vary seasonally and over time based on weather conditions, site development, irrigation practices and other hydrologic conditions.

LTAR Determination: Based on WSG personnel evaluation of soil types encountered in the profile pits, the Long Term Acceptance Rate (LTAR) values, depths and associated percolation rate ranges for the natural soils are summarized in Table A below. Based on our experience, WSG recommends the sandy silt loam be considered the limiting layer and be classified as Soil Type 2A. Soil types, LTARs, and average percolation rates are shown below are reproduced from Table 10-1 of the Routt County Department of Environmental Health OWTS Regulation (2014).

TABLE A

Soil Type	**Depth** (in)	**Avg. Perc Rate** (mpi)	**LTAR** (gpd/ft^2)
Sandy Silt Loam- (Type 2A)	12-42	26-40	0.50

OWTS DESIGN ANALYSIS AND RECOMMENDATIONS

The site and soil evaluations indicate suitable conditions for wastewater disposal at depths between 12 and 18 inches below existing grades. Based on proposed construction and WSG's experience with similar sites and conditions in this area of Routt County, we recommend the OWTS consist of a gravity-fed septic tank and Soil Treatment Area (STA) sized using TL-1 treatment levels. The recommended STA design consists of infiltration chambers (Standard Quick 4 Infiltrators®) installed in a trench configuration.

Based on anticipated lateral shallow groundwater (effluent) flow direction (similar to site topography), WSG believes the underlying natural clay does not represent a restrictive layer to efficient wastewater treatment and no future effluent surfacing will occur based on topography and final site grading. Additionally, proposed Contour Loading Rates (CLR) are estimated at approximately 2.1 gallon per day/linear foot (gpd/lf), representing a favorable loading rate according to recognized (NAWT – National Association of Wastewater Technicians) design standards.

Based on the sandy silt loam soils encountered in the profile pits and WSG's experience with similar soils and site conditions, an LTAR of 0.50 gpd/ft^2 (Soil Type 2A) was used in system sizing. Pertinent system components are summarized below, and associated design calculations are provided in Appendix A. Regulatory, inspection and system component specifications are provided in Appendix B.

Septic Tank: 1,000-gallon concrete with effluent filter.
Transmission Piping: 4-inch solid PVC, gravity discharge, 1% min. grade.
Distribution Box: Min. 4 outlet with Speed Levelers®.
Infiltration Chambers: 53 - Infiltrator® Standard Quick 4 chambers.
Infiltrative Surface: Elevation Varies - establish at 12-18 inches below existing ground surface.

*Chamber Protective Underlayment: ¼-inch galvanized steel mesh.

Topsoil Cover: Provide all absorption field areas with minimum 18 inches topsoil cover.

Marking and Protection: Septic tank and distribution box locations marked with metal T posts. Absorption field fenced off to prevent machinery, livestock and wildlife damage.

*Please note that infiltration chambers must be protected from rodent excavating and backfilling activity by the placement of ¼-inch galvanized steel mesh that completely covers the open base area of the chamber. Mesh should be secured to chamber base using an approved method and frequency. Schematic OWTS site plan and typical absorption field cross section are shown on Figures 2 and 3, respectively.

OWTS OPERATION AND MAINENANCE

Proper OWTS operation and maintenance is crucial for satisfactory long-term system performance. WSG recommends the following operation and maintenance criteria be observed by the owner/operator.

1. Regular inspection and pumping of the septic tank and effluent filter located at the tank outlet should be conducted by a qualified service provider. A recommended frequency of 3 to 5 years is typical for normal usage. More frequent pumping and filter cleaning may be required based on higher usage.

   Seasonal or periodic use facilities may also require additional pumping and maintenance due to inconsistent hydraulic and biological loading.

2. Inspection of STA for signs of surfacing effluent should be conducted on a yearly basis.
3. The installation of water conserving plumbing fixtures, judicious use of water and minimization of solid waste directed to the OWTS is strongly recommended to extend system life.
4. Leaking plumbing fixtures should be repaired immediately. The additional hydraulic loading can permanently damage the STA.

5. Discharge from spas, pools and water treatment systems should not be directed to the OWTS. The chemical and hydraulic loading from these features can permanently damage the STA.
6. The OWTS treatment process is based on naturally occurring biological processes. Discharge of various harsh chemicals, solvents, excessive oil and grease and non-organic wastes to the system can damage or limit biological treatment processes, reducing system performance and life. These materials should not be directed to the OWTS.

LIMITATIONS

Site and soil evaluations and design report were conducted and prepared by Harold Schlicht (Colorado P.E. No. 30299). This report and design are based on the evaluations and were completed in accordance with the Routt County On-Site Wastewater Treatment System Regulations (2014) and using currently accepted OWTS design procedures and standard of care for the profession at the time of service.

This report has been prepared for the exclusive use of WSG's client for the specific application indicated. No warranties express or implied, are made. Changes to the stated proposed construction and usage or addition of wastewater generating features may require changes to the OWTS.

Please be advised that construction or alteration of an OWTS requires a valid permit from the Routt County Department of Environmental Health ((970)-870-5588).

WSG appreciates the opportunity to be of service to you on this project. If you have any questions concerning the enclosed information or if we can be of further service to you in any way, please do not hesitate to contact us.

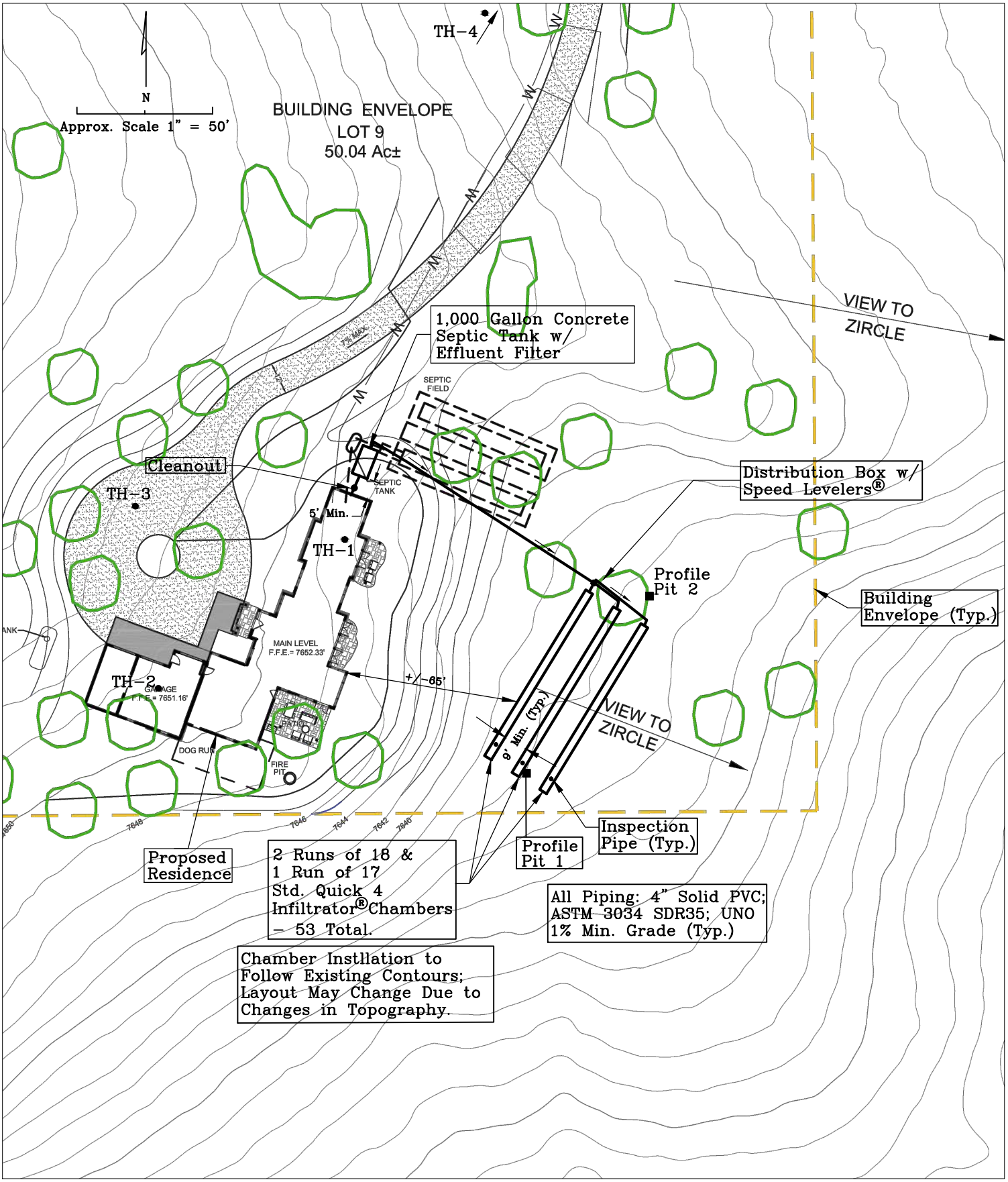
Very Truly Yours,
Western Slope Geotech, Inc.

Harold Schlicht, PE
Principal Engineer

Cc: Al Leiser – Vertical Arts
Ron Davies – Fair & Square Construction

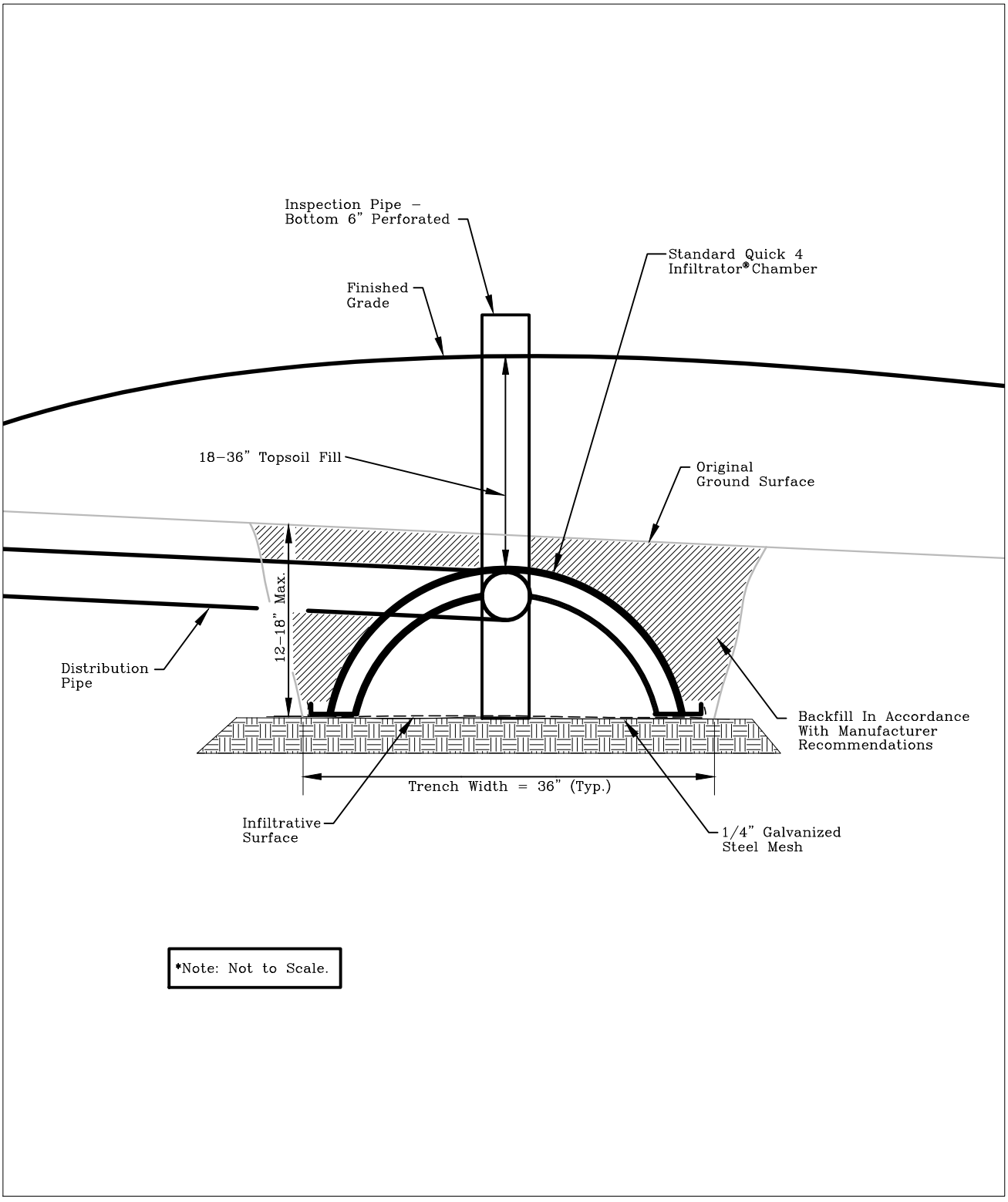
OWTS VICINITY PLAN

Project Name: Proposed Janes Residence	WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO	
Location: Lot 9, Murphy Larson Ranch, Routt County, CO	Project No.: 19-1035	Drawn/Checked:HS
	Date: 10/2/19	Figure No.: 1



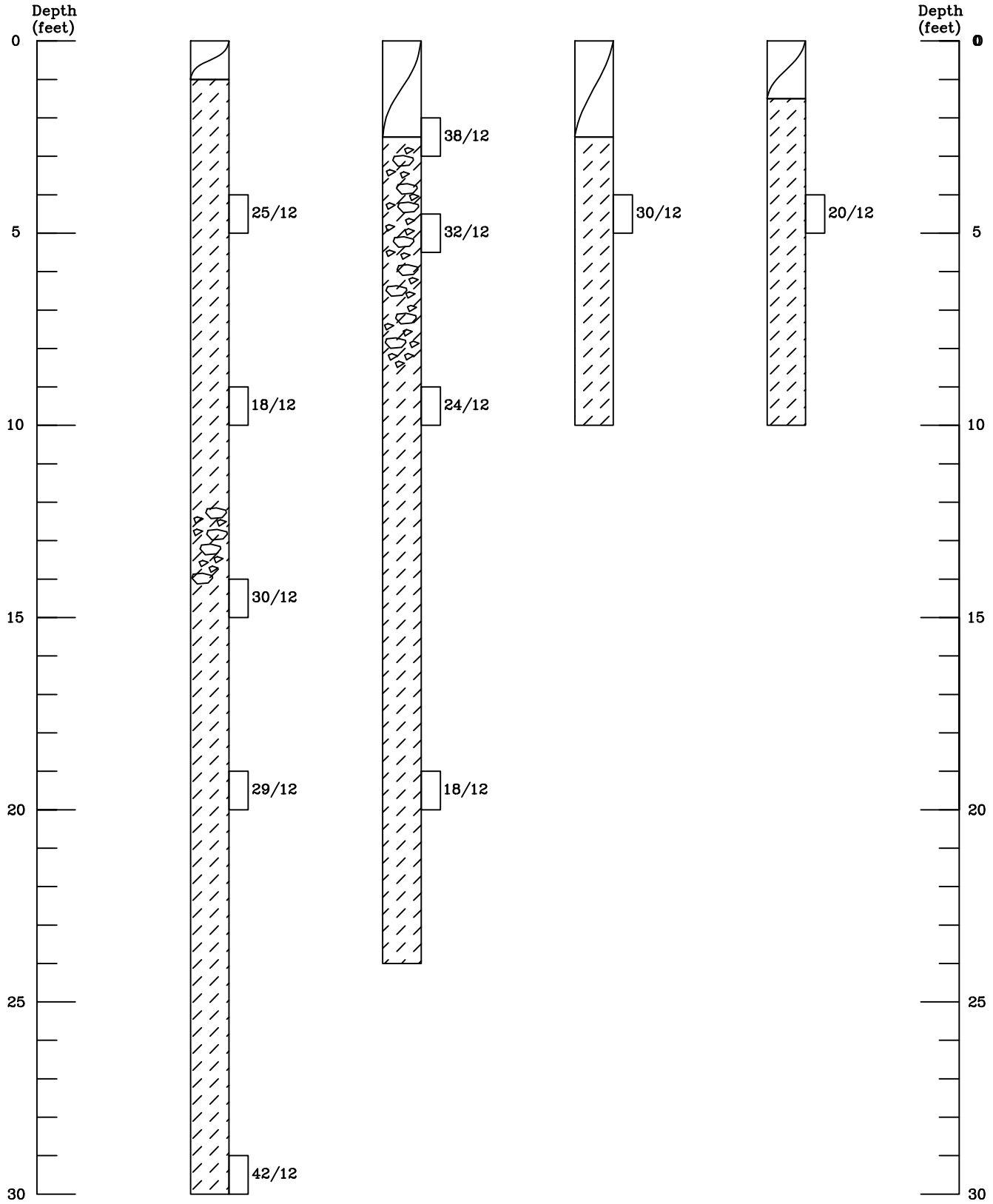
OWTS SITE PLAN

Project Name: Proposed Janes Residence	Western Slope Geotech, Steamboat Springs Colorado
Location: Lot 9, Murphy Larson Ranch, Routt County, CO	Project No.: 19-1035 | Drawn/Checked:HS
	Date: 10/2/19 | Figure No.: 2



INFILTRATION CHAMBER SYSTEM – TYPICAL CROSS SECTION

Project Name: Proposed Janes Residence	WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO	
Location: Lot 9, Murphy Larson Ranch, Routt County, CO	Project No.: 19–1035	Drawn/Checked:HS/HS
	Date: 10/2/19	Figure No.: 3



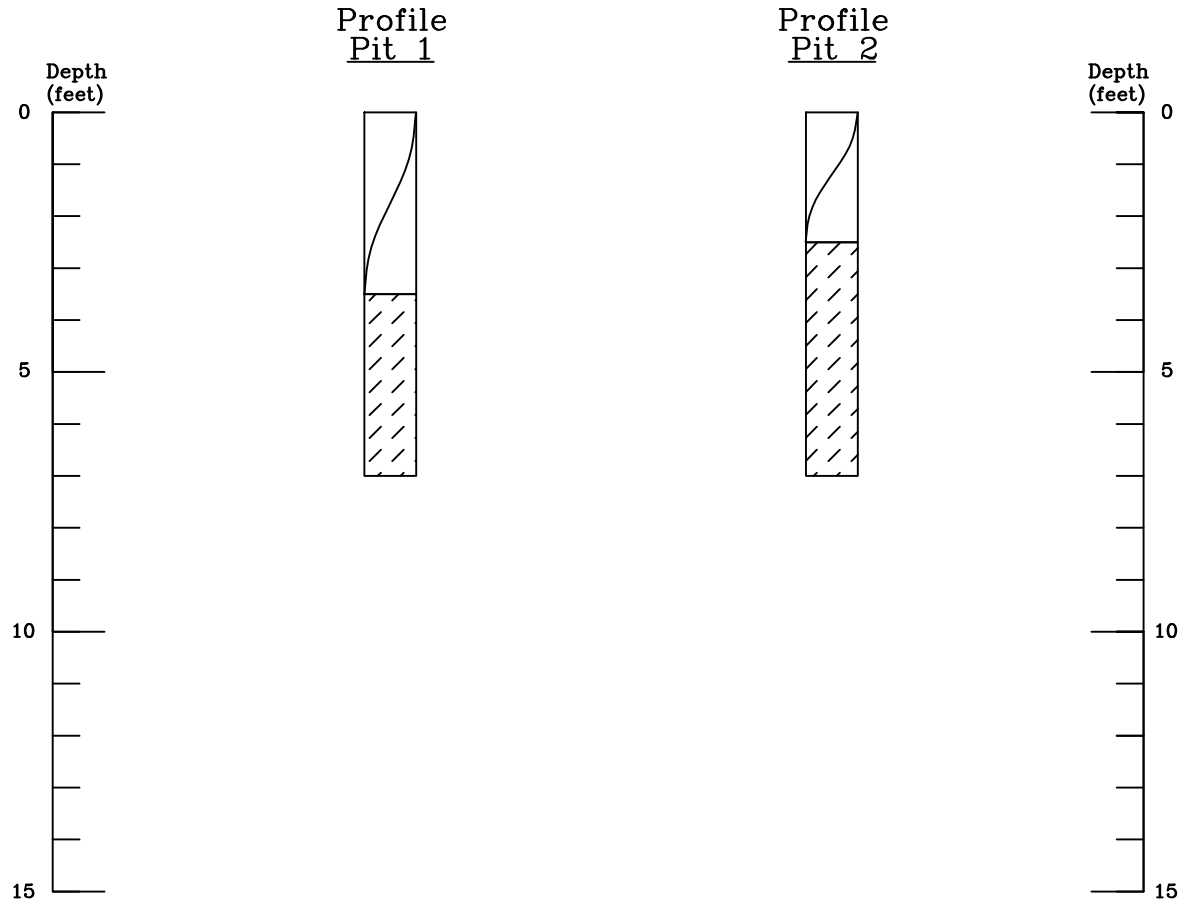
LOGS OF EXPLORATORY TEST HOLES

Project Name: Proposed Janes Residence

Location: Lot 9, Murphy Larson Ranch, Routt County, CO

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

Project No.: 19-1035	Drawn/Checked:HS/HS
Date: 10/2/19	Figure No. 4



Legend:

TOPSOIL/ORGANICS OVER SANDY SILT–LOAM

LEAN TO FAT CLAY: Slightly sandy to sand and clay with scattered gravel, moderately to highly plastic, stiff to hard, moist to very moist and light brown.

Notes:

1) Test pits were excavated on 9/9/19 with a Bobcat E55 trackhoe.
2) Test holes were drilled on 8/19/19 with a CME 45 drill rig using 4" Dia. continuous flight augers.
3) Locations of test pits were determined by pacing from staked building corners and building envelope corners.
4) Test pit elevations were not determined and logs are drawn to the depths explored.
5) Lines between materials types are approximate and transitions may be gradual.
6) Groundwater measurements were made at the time of excavation and levels may vary.

LOGS, LEGEND & NOTES

Project Name: Proposed Janes Residence

Location: Lot 9, Murphy Larson Ranch, Routt County, CO

WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO

Project No.: 19–1035	Drawn/Checked:HS/HS
Date: 10/2/19	Figure No. 5

APPENDIX A

DESIGN CALCULATIONS & SETBACK REQUIREMENTS

A. Sewage Volume Calculations

1. Residence – 3 Bedrooms: 450 gpd (per Table 6-1[1])
2. Design Flow: Q = 450 gpd

B. . System Sizing

1. Treatment Level: TL-1
2. Soil Treatment Area (STA) Sizing
    a. Soil Type 2A
    b. LTAR: 0.50 gpd/ft^2 (per Table 10-1[1])
    c. STA = Q/LTAR = 450/0.5 = 900 ft^2
    d. Adjustment Factor – Chambers = 0.70
    e. Adjustment Factor – Gravity Flow - Trench = 1.0
    f. STA (Adjusted) = 900 ft^2 x 0.70 x 1.0 = 630 ft^2
    g. Number of Chambers = 630 ft^2 /12.0 ft^2/chamber = 53
    h. Contour Loading Rate (CLR) = 450 gpd/212 lf = 2.1 gpd/lf
    i. Septic Tank – 3-Bedroom Residence): 1,000 gallon minimum, concrete
    j. Effluent Filter: Yes
3. STA Setback Requirements
    a. Property Line: 10 ft.
    b. Dry Gulch: 25 ft.
    c. Water Supply Line: 25 ft.

[1] Routt County On-Site Wastewater Treatment System Regulations (2014)

APPENDIX B

SPECIFICATIONS

A. Installer and owner must comply with all requirements contained in Routt County On-Site Wastewater Treatment System Regulations. Plumbing shall meet current plumbing codes.

B. OWTS components shall be installed at the approximate locations, depths and grades as indicated on the plans. Variations from the plans may be required due to variations in topography, building site location and elevation. If variations are necessary, WSG must be contacted for approval. A preconstruction meeting is strongly recommended to discuss system layout, construction and inspection requirements and to reduce potential changes to OWTS plans.

C. Engineer (WSG) must be contacted at least 24 hours in advance for necessary inspections/observations of installed OWTS components including:
    1. Building sewer, tank discharge and distribution piping;
    2. Septic tank, inlet and outlet Ts and effluent filter;
    3. Distribution piping, chambers and/or washed rock;
    4. Pressurized piping shall be pressure tested as directed by engineer;
    5. Approved mound fill – classification, depth and dimensions (when applicable);
    6. Approved pumping components and testing (when applicable);
    7. Approved mechanical filter units, automatic distribution valves and other mechanical components (when applicable);
    8. Contractor shall assist engineer in compiling as-constructed system information including product information and 2-point ties to permanent component and/or site features.

D. All system gravity piping shall consist of 4-inch solid or perforated PVC meeting or exceeding ASTM 3034/SDR35 requirements. Joints shall be watertight, cemented/bonded or gasketed.
    1. All piping shall be bedded and shaded with fine grained on-site or imported material. Bedding and shading will be installed such that it shall provide uniform support and protection to piping.
    2. Trenching and component backfill shall be uniformly compacted to at least 95% of the standard Proctor density near optimum moisture content, unless noted otherwise.
    3. Provide minimum 24 inches soil cover over all piping and components, unless otherwise noted. Provide cleanouts at min. 100’ intervals.

E. Infiltration chambers shall consist of Infiltrator® Quick 4 or other approved product. Manufacturer’s recommendations for installation and backfill shall be observed for all components. Inspection pipes shall be provided one per trench located near end of trench.

F. Septic tank inlet and outlet piping shall be supported by compacted (Min. 80% Relative density (ASTM D4253/4254)) screened or washed rock fill (or other suitable structural fill) where piping enters and leaves the tank excavation limits. Risers and securable access ports shall be watertight and extend to or be exposed at final grades.

G. Absorption (STA) areas shall be fenced off from construction or other activity that contributes to disturbance or soil compaction. Absorption field (STA) construction shall not be commenced during periods of high soil moisture content to minimize disturbance and smearing of infiltrative surfaces.

H. Finished grading shall be sloped to provide positive drainage away from all STA surfaces. Surface and subsurface runoff, foundation drains and other sources of water located upslope of the absorption field shall be directed away from absorption field areas by grading, ditching, piping or use of subsurface drainage collection and discharge systems.

I. Pumping, mechanical systems and electrical systems and controls shall be installed by qualified installers and shall meet all applicable local plumbing and electrical code requirements.

J. Imported fill materials used for seepage beds and trenches, mound fill or other seepage and distribution related components shall be approved by WSG prior to transportation to the site.

K. It is the responsibility of the installer and owner to comply with and maintain all setback requirements throughout the life of the system.