DeNova Homes

Montaldo Apartments Project

Soil Analysis Report

Attn: Kerri Watt, Trent Sanson, **DeNova Homes**

From: Andrew Marasco, Environmental Compliance Associate, Surf to Snow Environmental Resource Management (S2S)

CC: Rob Stiving, Vice President, Technical Services, S2S, **Don Triplett**, Principal Regulatory Specialist, S2S, **Elizabeth Frantz**, Founder/COO/CSO, S2S

Date: September 21st, 2022

Prepared by

2246 Camino Ramon, San Ramon, CA 94583

(925) 362-3041

Introduction:

In accordance with your authorization, we have performed a soil analysis survey for the proposed DeNova Homes Montaldo Apartments project site located at 19320 Highway 12, Sonoma, CA **(Attachment A)**. Per the City of Sonoma's Ordinance No. 02-2017 (**Attachment C)**, Section 14.32.035, Soil Analysis Report, DeNova Homes is required to produce a soil analysis report to identify infiltration rates, reduce runoff, and encourage healthy plant growth. This information is used to support the Landscape Plan. This report provides the methodology for sample collection, the analysis from the soil samples collected, and recommendations for soil preparation.

Project Setting:

DeNova Homes proposes to construct the *Montaldo Apartments* project located at 19320 Highway 12 within the City of Sonoma. The project will include grubbing and grading earthwork and phase into vertical construction for a proposed condominium development consisting of 50 living units, distributed amongst seven buildings, on approximately 2.1 acres. Land between structures will contain permanent roadways, parking areas, pedestrian pathways, common areas, and residential landscaping. Bare, exposed areas will be final stabilized and landscaped per the Overall Landscape Site Plan prepared for the project which provides general notes, construction plans, layouts and details, vegetation planting and irrigation plans. Part of identifying suitable planting locations and species includes soil sampling and testing to understand site-specific characteristics and recommendations to accommodate selected species identified in the Overall Landscape Site. DeNova Homes and S2S identified four unique locations within the proposed landscape areas representative of the total project area where S2S performed composite soil sample collection (See **Attachment A and B**, and Table 1 below):

Table 1: Montaldo Apartment Soil Sampling Locations	
Location #	**Location Lat/Lon (Decimal Degrees)**
1	38.297786°, -122.474878°
2	38.297617°, -122.474878°
3	38.297439°, -122.474058°
4	38.297250°, -122.473564°

Methods:

Soil samples were collected at four designated locations following the below protocol as specified by the approved laboratory:

1. Sampling areas grouped into management zones, irrigation zones, soil types, plant types, plant varieties, topography.

    a. Sampling zones were designated by pre-approved locations selected with DeNova Homes and S2S.
    b. Sampling zones were marked/submitted for an Underground Service Alert (USA) prior to any excavation or sampling.

2. The sample consisted of random composite sample of the sampling area.

    a. S2S dug holes to the required depths and acquired samples from multiple depth profiles to ensure each location was representative of various soil horizons and their respective characteristics.

3. Each sample submitted for testing was representative of the root zone of the plants being grown from the selected locations. Due to possible contamination, the surface 1” – 2” layer was scraped away and excluded from the composite sample.

    a. Holes were excavated to approximately 18” – 24” depth and samples collected from 4 – 5 vertical profiles at about 4”, 8”, 12”, 16”, 18”.

4. Samples were collected within new, individual plastic buckets, secured with waterproof lids, properly labeled at the time of sampling, and transported to the S2S office.

5. Samples were subsequently transferred into individual one-gallon plastic bags, labeled with the location latitude/longitude, collection date, and pertinent information for laboratory services. Upon arrival at the laboratory, these samples were transferred into laboratory-provided paper soil sample bags for examination and testing.

6. Laboratory testing was conducted (**Attachment D**) to identify the values of each characteristic required per the attached City of Sonoma’s Ordinance No. 02-2017, Section 14.32.035 (**Attachment C**). The following characteristics were tested:

    a. Soil texture
    b. **Infiltration rate using the soil texture infiltration rate table**[1].

        1. S2S used the soil texture defined for each location to determine infiltration rates for each location. Per **Attachment D and E**, all locations fall within the texture triangle near **loam**, **sandy loam, and sandy clay loam** soils. Using Table 3 within **Attachment E**, infiltration rates were selected. Those rates are listed below under Results.

    c. pH
    d. Total soluble salts
    e. Sodium
    f. Percent organic matter
    g. Recommendations

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1 Infiltration rates based on values reported in Attachment E, Page 3, Table 3 of Soil Infiltration, produced by the Natural Resources Conservation Service, United States Department of Agriculture

Results:

Laboratory (**Attachment D)** and post-laboratory analyses (**Attachment E)** of the soil samples are summarized below in Table 2 per the City of Sonoma Ordinance No. 02-2017, Section 14.32.035 (**Attachment C)**:

Table 2: Soil Sample Results Summary						
Location #	**Sample ID**	**Lab #**	**Soil Texture (Ord.2a)**	**Infiltration (inches per hour) (Ord.2b)**	**Soil Characteristics* (Ord.2c-e)**	**% Organic Matter* (Ord. 2f)**
1	**SMPL1**	**57527**	**LOAM** 38.1% Sand, 36.9% Silt, 25.0% Clay	**0.4**	**Na (ppm):** 21 (VL) **pH:** 5.4 **Total Soluble Salts, E.C. (dS/m):** 0.2 (Low)	**1.6% (L)**
2	**SMPL2**	**57528**	**LOAM** 39.4% Sand, 38.1% Silt, 22.5% Clay	**0.4**	**Na (ppm):** 17 (VL) **pH:** 6.5 **Total Soluble Salts, E.C. (dS/m):** 0.3 (Low)	**2.0% (L)**
3	**SMPL3**	**57529**	**LOAM** 35.6% Sand, 41.9% Silt, 22.5% Clay	**0.4**	**Na (ppm):** 28 (VL) **pH:** 5.2 **Total Soluble Salts, E.C. (dS/m):** 0.2 (Low)	**1.8% (L)**
4	**SMPL4**	**57530**	**LOAM** 35.6% Sand, 38.1% Silt, 26.3% Clay	**0.4**	**Na (ppm):** 18 (VL) **pH:** 5.2 **Total Soluble Salts, E.C. (dS/m):** 0.1 (Low)	**1.6% (L)**

* Code to Rating: Very Low (VL), Low (L), Medium (M), High (H), Very High (VH)

Recommendations (Ord.2g)

The following is verbatim from **Attachment D** and establishes the guidelines for landscape planting as recommended by the City of Sonoma's approved A&L Western Laboratories Inc. for all four sampling locations:

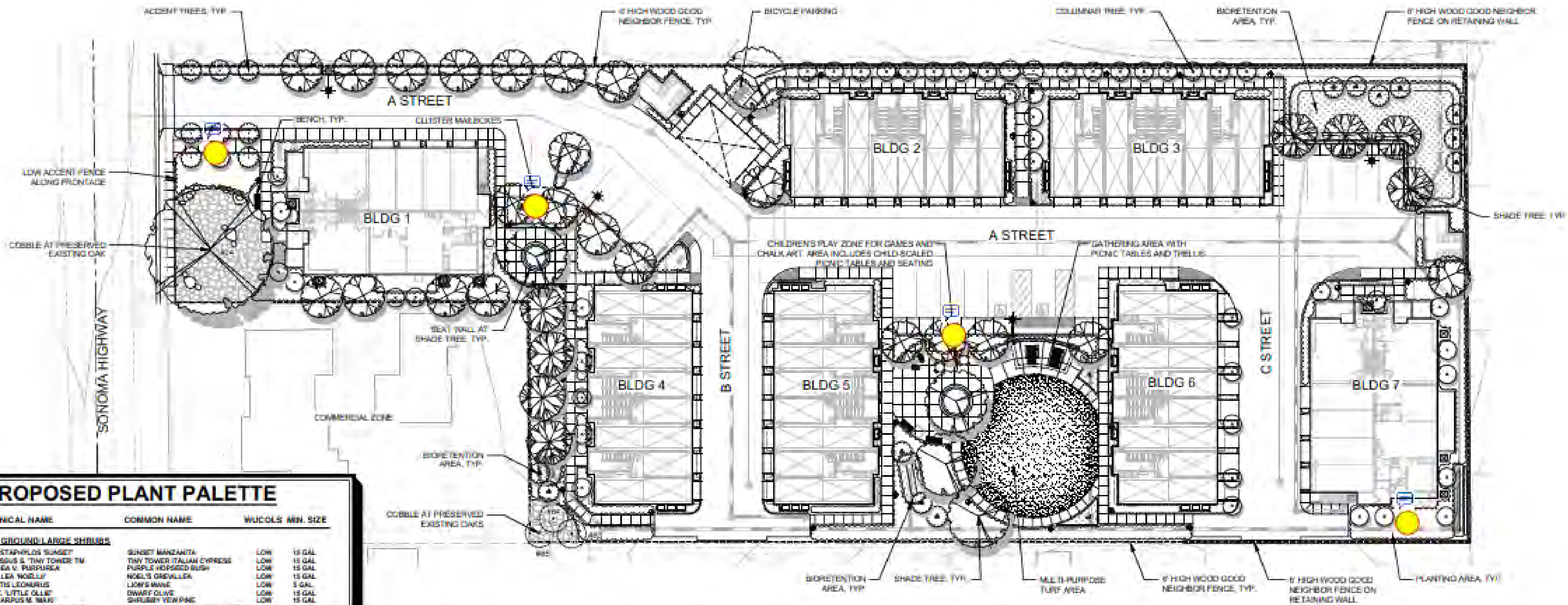
- QUICK CONVERSION: Divide fertilizer grader on the bag by 10, IF applying 10 lb/1,000 sq ft. (e.g., 10 lb. of a "triple 15" fertilizer would provide 1.5 lb each of nitrogen, phosphate, and potash).
-
- PRIOR TO PLANTING: Spread the above requirements per 1,000 sq ft and mix into the top 6-8 inches of soil. Initially, limit nitrogen to 1.5 lb/1,000 sq ft or 25-30 ppm NO3-N to avoid salt damage. SPLIT extra nitrogen as necessary over the active growing season. Adjust rate according to local conditions and requirements. Allow for adequate establishment first (up to 30 days).
- MAINTENANCE: Split the above amount over the year at a time according to local conditions and requirements. Choose a source that best fits this combination and avoid applications in winter.
- *BORON may not necessarily be deficient in the soil, and it is hard to correct an excessive application. Therefore, apply boron only if confirmed deficient through a leaf analysis.
- CHLORIDE: Levels appear safe; at least AT the depth of sampling. Levels may be higher at lower depths. Consider deeper sampling or a tissue analysis if still a concern.
- INCORPORATE well into the top six inches up to three yards per 1,000 sq ft (one-inch layer) of nitrified/composted organic amendment where soil organic matter level is a little low.
- GENERAL LANDSCAPE: It is best to start fertilizing in early spring as soon as new growth begins to develop. Apply according to growth habit, avoiding applications during winter months.
- *ZINC: Where levels are low, apply according to label instructions. Consider fertilizer brands that also contain zinc, although they may not be sufficient to correct a severe deficiency.
- MICRONUTRIENTS: Where levels appear to be high, avoid any further applications for the time being. Very high (VH) levels may not necessarily be toxic but avoid. Maintain correct soil pH.
- PLEASE NOTE, the above guidelines are in lb/1,000 sq ft. Reduce accordingly for smaller areas. An ounce volume measure (2 tablespoons) will generally hold about an ounce of most fertilizers.

References

- United States Department of Agriculture, Natural Resources Conservation District. “Soil Texture Calculator.” *USDA, NRCS*. Accessed December 1st, 2021. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167

- United State Department of Agriculture, Natural Resources Conservation District. “Soil Infiltration, Soil Quality Kit– Guides for Educators.” *USDA, NRCS*. Accessed December 1st, 2021. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051576.pdf

ATTACHMENT A



PROPOSED PLANT PALETTE

BOTANICAL NAME	COMMON NAME	WUCOLS	MIN. SIZE
BACKGROUND LARGE SHRUBS			
ARCTOSTAPHYLOS 'SUNSET'	SUNSET MANZANITA	LOW	15 GAL.
CUPRESSUS S. 'TINY TOWER' TM	TINY TOWER ITALIAN CYPRESS	LOW	15 GAL.
DODONEA V. 'PURPUREA'	PURPLE HOPSEED BUSH	LOW	15 GAL.
GREVILLEA 'NOELLII'	NOEL'S GREVILLEA	LOW	15 GAL.
LEONOTIS LEONURUS	LION'S MANE	LOW	5 GAL.
OLEA E. 'LITTLE OLLIE'	DWARF OLIVE	LOW	15 GAL.
PODOCARPUS M. 'MAKI'	SHRUBBY YEW PINE	LOW	15 GAL.
PRUNUS C. 'BRIGHT 'N TIGHT' TM	BRIGHT 'N TIGHT CAROLINA LAUREL	MOD	15 GAL.
FOUNDATION/CONTRAST SHRUBS			
CALAMAGROSTIS X A. 'KARL FOERSTER'	FEATHER REED GRASS	MOD	5 GAL.
CALLISTEMON V. 'LITTLE JOHN'	DWARF BOTTLEBRUSH	LOW	5 GAL.
LOROPETALUM C. 'EMERALD SNOW'	EMERALD SNOW FRINGE FLOWER	LOW	5 GAL.
NANDINA D. 'LEMON LIME'	LEMON LIME NANDINA	LOW	5 GAL.
PHORMIUM 'YELLOW WAVE'	FLAX	LOW	5 GAL.
PITTOSPORUM C. 'NANA'	DWARF KARO	MOD	5 GAL.
RHAPHIOLEPIS I. 'PINKIE'	DWARF INDIAN HAWTHORN	LOW	5 GAL.
WESTRINGIA F. 'BLUE GEM'	COAST ROSEMARY	LOW	5 GAL.
SMALL ACCENT SHRUBS			
ACACIA C. 'COUSIN ITT'	RIVER WATTLE	LOW	1 GAL.
BOUTELOUA G. 'BLONDE AMBITION'	BLUE GRAMA GRASS	LOW	1 GAL.
FESTUCA MAIREI	ATLAS FESCUE	LOW	1 GAL.
KNIPHOFIA UVARIA	RED HOT POKER	LOW	1 GAL.
LIRIOPE MUSCARI	LILY TURF	MOD	1 GAL.
LOMANDRA L. 'BREEZE'	DWARF MAT RUSH	LOW	1 GAL.
PENSTEMON H. 'MARGARITA BOP'	DWARF PENSTEMON	LOW	1 GAL.
ROSA X 'FLOWER CARPET WHITE'	WHITE FLOWER CARPET ROSE	MOD	2 GAL.
SALVIA M. 'HOT LIPS'	HOT LIPS SAGE	LOW	1 GAL.
GROUNDCOVERS			
ARCTOSTAPHYLOS 'EMERALD CARPET'	EMERALD CARPET MANZANITA	MOD	1 GAL. @ 3' O.C.
BACCHARIS P. 'PIGEON POINT'	DWARF COYOTE BUSH	LOW	1 GAL. @ 4' O.C.
HELIANTHEMUM N. 'HENFIELD BRILLIANT'	HENFIELD BRILLIANT ROCK ROSE	LOW	1 GAL. @ 3' O.C.
MYOPORUM P. 'PUTAH CREEK'	MYOPORUM	LOW	1 GAL. @ 4' O.C.
SCAEVOLA 'MAUVE CLUSTERS'	PURPLE FAN FLOWER	LOW	1 GAL. @ 3' O.C.
BIORETENTION AREA*			
CAREX PANSA	DUNE SEDGE	MOD	1 GAL.
IRIS DOUGLASIANA	DOUGLAS IRIS	LOW	1 GAL.
JUNCUS PATENS 'ELK BLUE'	QUARTZ CREEK SOFT RUSH	MOD	1 GAL.
MIMULUS AURANTIACUS	STICKY MONKEY-FLOWER	V. LOW	1 GAL.
MUHLENBERGIA RIGENS	DEERGRASS	LOW	1 GAL.

* BIORETENTION AREA PLANT PALETTE AS APPROVED PER BASMAA GUIDELINES.

SOIL SAMPLE COLLECTION POINT

PROPOSED TREE PALETTE

BOTANICAL NAME	COMMON NAME	WUCOLS	MIN. SIZE
TREES			
ACER RUBRUM 'OCTOBER GLORY'	OCTOBER GLORY RED MAPLE	MOD	24" BOX
ARBUTUS 'MARINA'	STRAWBERRY TREE	LOW	24" BOX
CARPINUS BETULUS 'FASTIGIATA'	EUROPEAN HORNBEAM	MOD	24" BOX
CERCIS CANADENSIS 'FOREST PANSY'	PURPLE LEAF EASTERN REDBUD	MOD	15 GAL.
GINKGO BILOBA 'PRINCETON SENTRY'	MAIDENHAIR TREE	MOD	24" BOX
LAGERSTROEMIA I. 'MUSKOGEE'	LAVENDER CRAPE MYRTLE	LOW	24" BOX
LAURUS X 'SARATOGA'	SARATOGA SWEET BAY	LOW	24" BOX
QUERCUS LOBATA	VALLEY OAK	LOW	24" BOX
EXISTING TREE TO REMAIN - SEE ARBORIST'S REPORT FOR INFORMATION			

COMMON OPEN SPACE:

REQUIRED	15,000 SF
PROVIDED	20,242 SF

LANDSCAPE AREA:

	SQUARE FOOTAGE	PERCENT OF LANDSCAPE
TOTAL LANDSCAPE AREA	22,873 SF	27%
TOTAL SITE AREA	83,538 SF	100%

DeNova Homes
1500 WILLOW PASS COURT
CONCORD, CALIFORNIA 94520
(925)685-0110

MONTALDO APARTMENTS
Sonoma, California

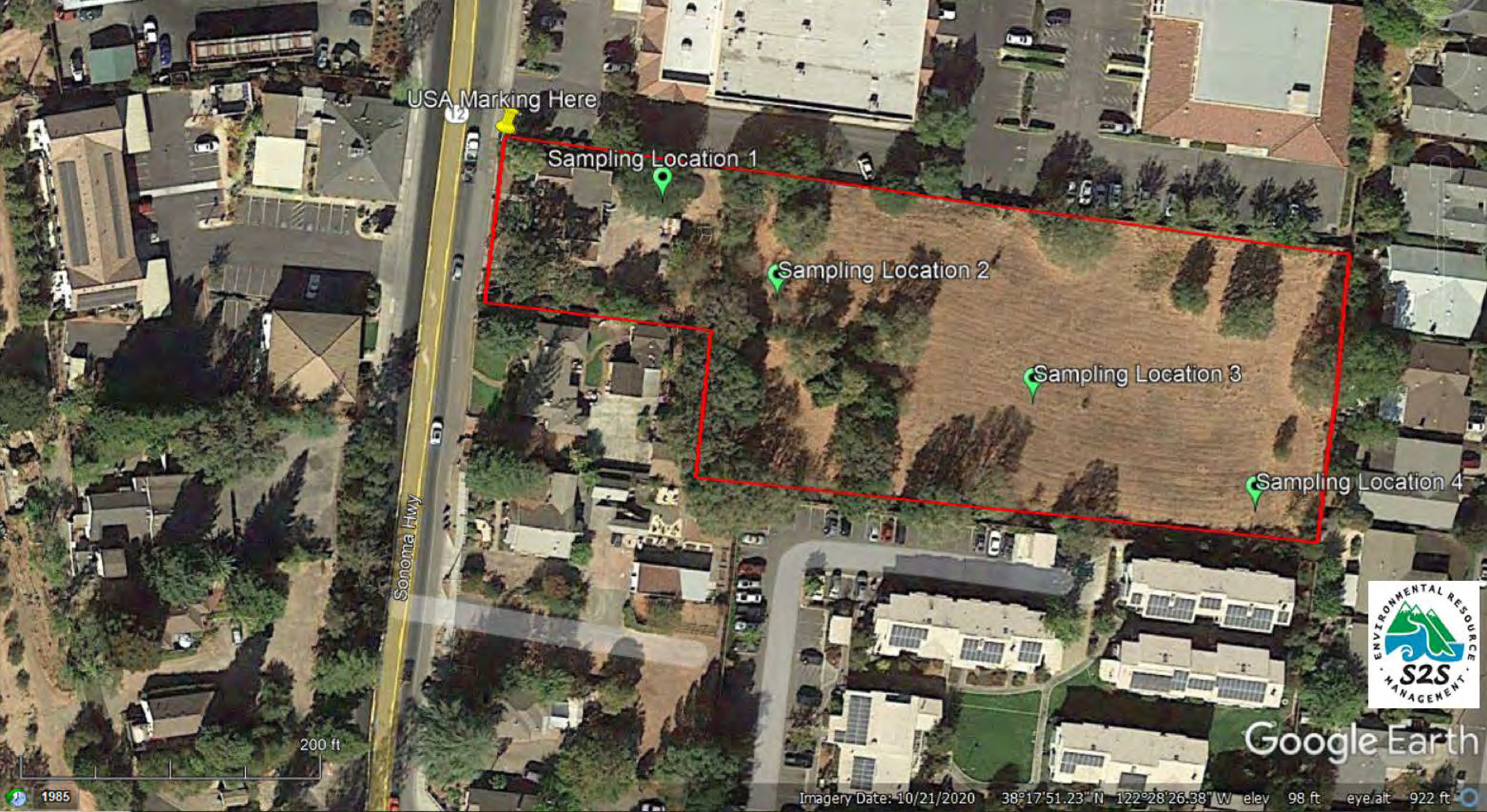
OVERALL SITE PLAN
CONCEPTUAL LANDSCAPE PLAN
JUNE 7, 2022

VTA

SCALE: 1" = 20'-0"
NORTH

L-1

ATTACHMENT B: AERIAL PHOTO WITH SOIL SAMPLE LOCATIONS



14.32.035 Soil analysis report.

(A) In order to identify infiltration rates, reduce runoff, and encourage healthy plant growth, a soil analysis report shall be completed by the project applicant, or his/her designee, as follows:

(1) Submit soil samples to a laboratory for analysis and recommendations.

(a) Soil sampling shall be conducted in accordance with laboratory protocol, including protocols regarding adequate sampling depth for the intended plants.

(2) The soil analysis shall include:

(a) Soil texture;

(b) Infiltration rate determined by laboratory test or soil texture infiltration rate table;

(c) pH;

(d) Total soluble salts;

(e) Sodium;

(f) Percent organic matter; and

(g) Recommendations.

(3) In projects with multiple landscape installations (i.e. production home developments) a soil sampling rate of 1 in 7 lots or approximately 15% will satisfy this requirement. Large landscape projects shall sample at a rate equivalent to 1 in 7 lots.

(4) The soil analysis report shall be made available to the professionals preparing the landscape design plans and irrigation design plans prior to submitting for Landscape Design Review, or prior to submitting a building permit (if a grading permit is required) to make any necessary adjustments to the design plans.

(5) If a grading permit is required, the soil analysis report shall be submitted to the City with the Certificate of Completion. If a grading permit is not required, the soil analysis report shall be submitted to the City with the Landscape Documentation Package.

(6) The project applicant, or his/her designee, shall submit documentation verifying implementation of soil analysis report recommendations to the City with Certificate of Completion."

14.32.040 Landscape design plan.

(A) The landscape design plan, at a minimum, shall:

(1) Delineate and label each hydrozone by number, letter, or other method;

(2) Identify each hydrozone as very low, low, moderate, high water, or mixed water use;

(3) Identify new and existing trees, shrubs, groundcovers, turf, and any other planting areas;

(4) Identify plants by botanical name and common name;

ATTACHMENT D

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 22-243-062 **CLIENT:** 91167

SUBMITTED BY:

SEND TO: SURF 2 SNOW ERM
2246 CAMINO RAMON
SAN RAMON, CA 94583

GROWER: ANDREW MARASCO

DATE OF REPORT: 09/12/22

SOIL PHYSICAL CHARACTERISTICS

Sample ID	Lab Number	% Sand	% Silt	% Clay	Soil Texture	Moisture @ 1/3 Bar	Moisture @ 15 Bar	Available Water %
SMPL1	57527	38.1	36.9	25.0	LOAM			
SMPL2	57528	39.4	38.1	22.5	LOAM			
SMPL3	57529	35.6	41.9	22.5	LOAM			
SMPL4	57530	35.6	38.1	26.3	LOAM			

NOTES:

Joe O'Brien

Joe O'Brien, CCA
A & L WESTERN LABORATORIES, INC.

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 ● MODESTO, CALIFORNIA 95351 ● (209) 529-4080 ● FAX (209) 529-4736

REPORT NUMBER: 22-243-062 AMENDED **CLIENT:** 91167

SUBMITTED BY:

SEND TO: SURF 2 SNOW ERM
2246 CAMINO RAMON
SAN RAMON, CA 94583

GROWER: ANDREW MARASCO

DATE OF REPORT: 09/09/22

SOIL SALINITY ANALYSIS REPORT

Sample ID	Lab Number	SAR	ESP	Na meq/L	Ca meq/L	Mg meq/L	pH	CO_3 meq/L	HCO_3 meq/L	E.C. dS/m	Cl meq/L	B ppm	Saturation %
SMPL1	57527	0.7	0.7	0.4	0.5	0.3	5.4	0.0	0.6	0.2	0.1	0.1	33.7
SMPL2	57528	0.2	0.2	0.2	1.7	0.6	6.5	0.0	1.4	0.3	0.2	0.1	48.0
SMPL3	57529	0.6	0.6	0.4	0.4	0.2	5.2	0.0	1.9	0.2	0.1	0.1	35.0
SMPL4	57530	0.4	0.4	0.2	0.3	0.2	5.2	0.0	0.1	0.1	0.1	0.1	39.5

NOTES:

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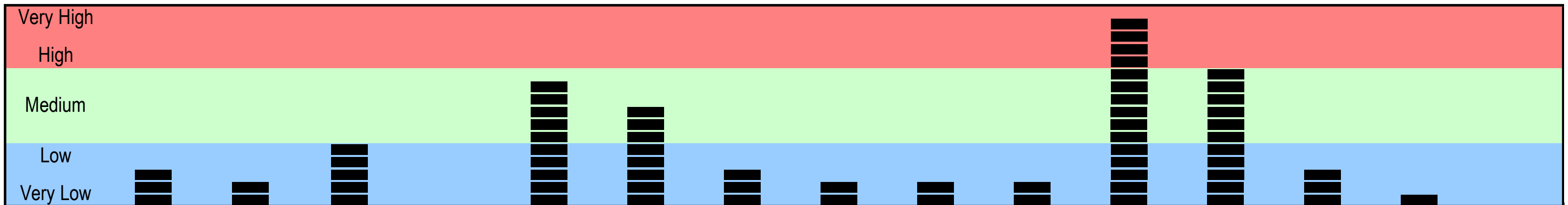
SAN RAMON, CA 94583

GROWER: ANDREW MARASCO

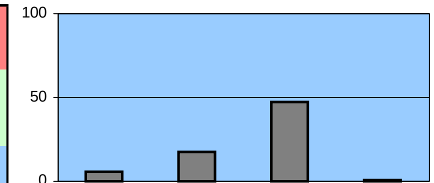
SUBMITTED BY:

Graphical Soil Analysis Report

DATE OF REPORT: 09/09/22 **LAB NO:** 57527 **SAMPLE ID:** SMPL1 **PAGE:** 1



Percent Cation Saturation (computed)



Analyte	Organic Matter %	Nitrogen NO_3-N ppm	Phosphorus Weak Bray ppm	Phosphorus $NaHCO_3$-P ppm	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Chloride Cl ppm
Results	1.6	2	18	7	231	213	950	21	4	0.6	46	19	0.6	0.1	

Potassium K %	Magnesium Mg %	Calcium Ca %	Sodium Na %
5.9	17.5	47.2	0.9

LOW AVERAGE HIGH

ECe dS/m	CEC meq/100g	Ex. Lime	pH
0.2	10.0	L	5.4

INCREASING SALINITY →

ACIDIC BASIC

← INCREASING NEED FOR LIME

Buffer pH: 6.7

NaHCO3-P unreliable at this soil pH

Soil Fertility Guidelines

CROP: LANDSCAPE **RATE:** lb/1000 sq ft **NOTES:**

Dolomite (70 score)	Lime (70 score)	Gypsum	Elemental Sulfur	Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B	
	70			3.6	2.5			0.6	*				*	

COMMENTS

QUICK CONVERSION: Divide fertilizer grade on the bag by 10, IF applying 10 lb/1,000 sq ft. (e.g. 10 lb of a "triple 15" fertilizer would provide 1.5 lb each of nitrogen, phosphate and potash).
PRIOR TO PLANTING: Spread the above requirements per 1,000 sq ft and mix into the top 6-8 inches of soil. Initially, limit nitrogen to 1.5 lb/1,000 sq ft or 25-30 ppm NO3-N to avoid salt damage.
SPLIT extra nitrogen as necessary over the active growing season. Adjust rate according to local conditions and requirements. Allow for adequate establishment first (up to 30 days).
MAINTENANCE: Split the above amount over the year at a time according to local conditions and requirements. Choose a source that best fits this combination and avoid applications in winter.

Joe O'Brien
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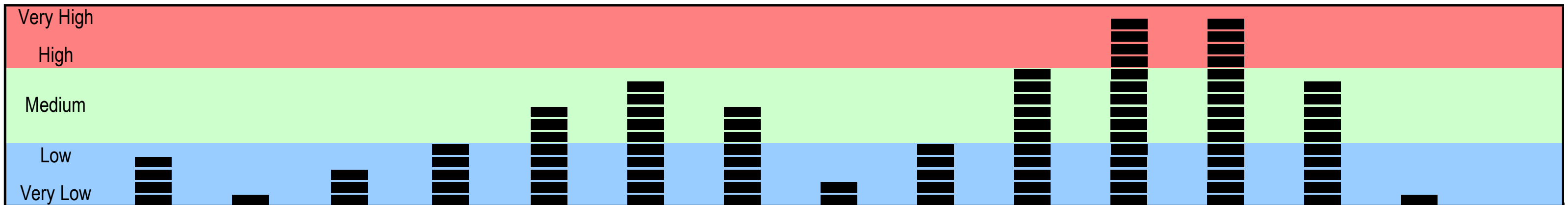
SAN RAMON, CA 94583

GROWER: ANDREW MARASCO

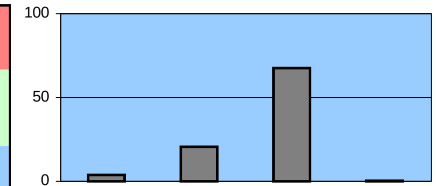
SUBMITTED BY:

Graphical Soil Analysis Report

DATE OF REPORT: 09/09/22 **LAB NO:** 57528 **SAMPLE ID:** SMPL2 **PAGE:** 2



Percent Cation Saturation (computed)



Analyte	Organic Matter %	Nitrogen NO_3-N ppm	Phosphorus Weak Bray ppm	Phosphorus $NaHCO_3$-P ppm	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Chloride Cl ppm
Results	2.0	2	12	14	237	394	2130	17	11	4.8	44	49	1.2	0.1	

Potassium K %	Magnesium Mg %	Calcium Ca %	Sodium Na %
3.9	20.6	67.6	0.5

LOW AVERAGE HIGH

ECe dS/m	CEC meq/100g	Ex. Lime	pH
0.3	15.7	L	6.5

INCREASING SALINITY →

ACIDIC BASIC

← INCREASING NEED FOR LIME

Buffer pH:

Soil Fertility Guidelines

CROP: LANDSCAPE **RATE:** lb/1000 sq ft **NOTES:**

Dolomite (70 score)	Lime (70 score)	Gypsum	Elemental Sulfur	Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B	
				3.6	2.0			0.5					*	

COMMENTS

* ZINC: Where levels are low, apply according to label instructions. Consider fertilizer brands that also contain zinc, although they may not be sufficient to correct a severe deficiency.
MICRONUTRIENTS: Where levels appear to be high, avoid any further applications for the time being. Very high (VH) levels may not necessarily be toxic, but avoid. Maintain correct soil pH.
* BORON may not necessarily be deficient in the soil, and it is hard to correct an excessive application. Therefore, apply boron only if confirmed deficient through a leaf analysis.
CHLORIDE: Levels appear safe; at least AT the depth of sampling. Levels may be higher at lower depths. Consider deeper sampling or a tissue analysis if still a concern.

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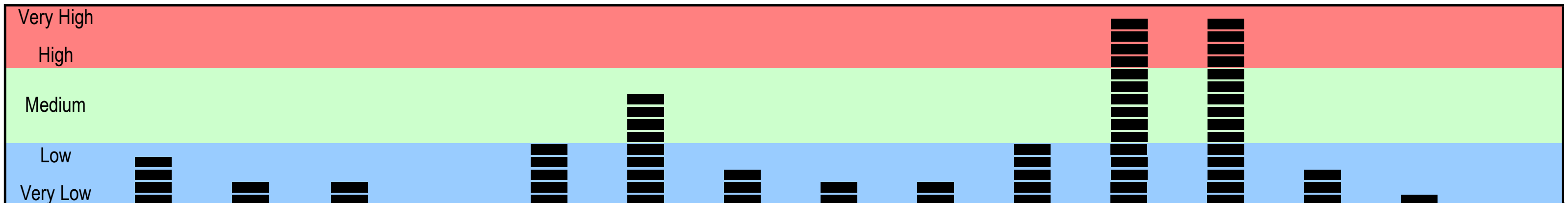
SAN RAMON, CA 94583

GROWER: ANDREW MARASCO

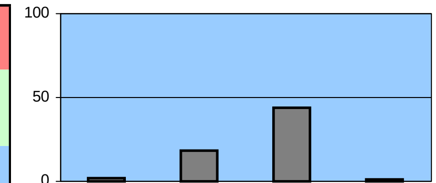
SUBMITTED BY:

Graphical Soil Analysis Report

DATE OF REPORT: 09/09/22 **LAB NO:** 57529 **SAMPLE ID:** SMPL3 **PAGE:** 3



Percent Cation Saturation (computed)



Analyte	Organic Matter %	Nitrogen NO_3-N ppm	Phosphorus Weak Bray ppm	Phosphorus $NaHCO_3$-P ppm	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Chloride Cl ppm
Results	1.8	2	6	5	88	252	984	28	4	1.2	47	38	0.6	0.1	

Potassium K %	Magnesium Mg %	Calcium Ca %	Sodium Na %
2.0	18.5	43.9	1.1

LOW AVERAGE HIGH

ECe dS/m	CEC meq/100g	Ex. Lime	pH
0.2	11.2	L	5.2

INCREASING SALINITY →

ACIDIC BASIC

← INCREASING NEED FOR LIME

Buffer pH: 6.6

NaHCO3-P unreliable at this soil pH

Soil Fertility Guidelines

CROP: LANDSCAPE **RATE:** lb/1000 sq ft **NOTES:**

Dolomite (70 score)	Lime (70 score)	Gypsum	Elemental Sulfur	Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B	
	90			3.6	4.5	3.5		0.6					*	

COMMENTS

INCORPORATE well into the top six inches up to three yards per 1,000 sq ft (one-inch layer) of nitrified/composted organic amendment where soil organic matter level is a little low.
LIME REQUIREMENT: Liming may be necessary if buffer index is less than 6.9. Guidelines are based upon common agricultural lime (70-score) per six-inch depth to raise SOIL pH to about 6.5.
GENERAL LANDSCAPE: It is best to start fertilizing in early spring as soon as new growth begins to develop. Apply according to growth habit, avoiding applications during winter months.
PLEASE NOTE, the above guidelines are in lb/1,000 sq ft. Reduce accordingly for smaller areas. An ounce volume measure (2 tablespoons) will generally hold about an ounce of most fertilizers.

Joe O'Brien
Joe O'Brien, CCA
A & L WESTERN LABORATORIES, INC

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 22-243-062 **CLIENT NO:** 91167

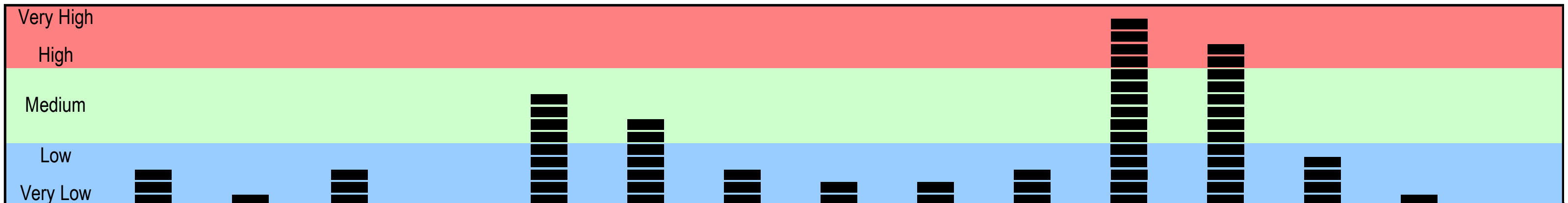
SEND TO: SURF 2 SNOW ERM
2246 CAMINO RAMON
SAN RAMON, CA 94583

SUBMITTED BY:

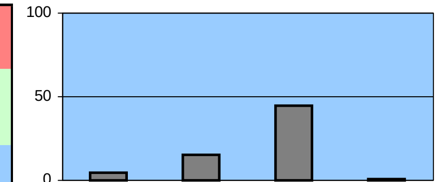
GROWER: ANDREW MARASCO

Graphical Soil Analysis Report

DATE OF REPORT: 09/09/22 **LAB NO:** 57530 **SAMPLE ID:** SMPL4 **PAGE:** 4



Percent Cation Saturation (computed)



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Results	1.6	2	11	6	201	203	974	18	3	0.7	66	26	0.7	0.1	

Potassium K %	Magnesium Mg %	Calcium Ca %	Sodium Na %
4.7	15.4	44.7	0.7

ECe dS/m	CEC meq/100g	Ex. Lime	pH	Buffer pH
0.1	10.9	L	5.2	6.6

LOW AVERAGE HIGH — INCREASING SALINITY →

ACIDIC BASIC — ← INCREASING NEED FOR LIME

NaHCO3-P unreliable at this soil pH

Soil Fertility Guidelines

CROP: LANDSCAPE **RATE:** lb/1000 sq ft **NOTES:**

Dolomite (70 score)	Lime (70 score)	Gypsum	Elemental Sulfur	Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B	
	90			3.6	3.5	2.5		0.7	*				*	

COMMENTS

Joe O'Brien
Joe O'Brien, CCA
A & L WESTERN LABORATORIES, INC

soil Infiltration

Soil Health – Guides for Educators

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United States Department of Agriculture
Natural Resources Conservation Service

Soil infiltration refers to the ability of the soil to allow water to move into and through the soil profile. Infiltration allows the soil to temporarily store water, making it available for use by plants and soil organisms. The infiltration rate is a measure of how fast water enters the soil, typically expressed in inches per hour. For initial in-field assessments; however, it is more practical to express the infiltration rate as the minutes needed for a soil to absorb each inch of water applied to the surface. If the rate is too slow, it can result in ponding in level areas, surface runoff, and erosion in sloping areas and can lead to flooding or inadequate moisture for crop production. Sufficient water must infiltrate the soil profile for optimum crop production. Water that infiltrates through porous soils recharges groundwater aquifers and helps to sustain the base flow in streams.

Unless properly managed, a high infiltration rate can lead to leaching of nitrate nitrogen or pesticides and loss of phosphorus from soils that have a high level of phosphorus. Management practices such as use of no-till cropping systems and use of high residue crops and cover crops can improve infiltration by increasing the soil organic matter content.

Inherent Factors Affecting Soil Infiltration

Soil texture, or the percentage of sand, silt, and clay in a soil, is the major inherent factor affecting infiltration. Water moves more quickly through the large pores in sandy soil than it does through the small pores in clayey soil, especially if the clay is compacted and has little or no structure or aggregation.

Depending on the amount and type of clay minerals, some clayey soils develop cracks from shrinkage as they become dry. The cracks are direct conduits for water to enter the soils. Thus, clayey soils can have a high infiltration rate when dry and a slow rate when moist (cracks close). Clayey soils that do not crack have a slow infiltration rate unless they have a high content of iron oxide (red clayey soils) or they formed in volcanic ash. Management practices that improve soil organic matter content, soil aggregation, and porosity can improve infiltration.

Infiltration Management

Management practices such as using diverse high-residue crops, maintaining residue on the soil surface, using cover crops, and managing equipment traffic to avoid compaction affect infiltration by minimizing surface crusting and compaction and increasing soil organic matter content and porosity. Unless the soil is protected by plant or residue cover, the direct impact of raindrops dislodges soil particles, resulting in runoff and erosion. The rainfall simulator in figure 1 shows that more runoff occurs where there is less residue on the surface, increasing the risk of erosion. Dislodged soil particles fill in the surface pores, contributing to the development of a surface crust, which restricts the movement of water into the soil. Equipment use, especially on wet soils, and tillage can result in compaction. Compacted or impervious soil layers have less pore space, which restricts water movement through the soil profile.

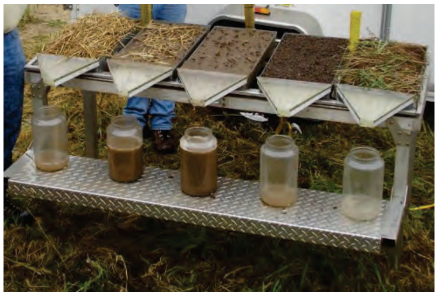

Figure 1.—Rainfall simulator.

As soil moisture content increases, the infiltration rate decreases. Soil moisture is affected by evaporation, water use by plants, residue on surface and plant cover, irrigation, and drainage. Dry soils tend to have pores and cracks that allow water to enter faster. As a soil becomes wet, the infiltration rate slows to a steady rate based on how fast water can move through the saturated soil; the most restrictive layer, such as a compacted layer; or a dense clay layer.

Soil organic matter binds soil particles together into stable aggregates, increasing porosity and infiltration. Soils that have a high content of organic matter also provide good habitat for soil biota, such as earthworms. Soil biota increase pore space and create continuous pores that link the upper soil layer to subsurface layers.

Long-term solutions for maintaining or improving soil infiltration include practices that increase organic matter content and aggregation and minimize runoff, disturbance, and compaction. A higher content of organic matter results in better soil aggregation and improved soil structure, increasing the soil infiltration rate.

To improve the soil infiltration rate:

- Avoid soil disturbance and equipment use when the soils are wet.
- Use equipment only on designated roads or between rows.
- Limit the number of times equipment is used on a field.
- Subsoil to break up compacted layers.
- Use a continuous, no-till cropping system.
- Apply solid manure or other organic material.
- Use rotations that include high-residue crops, such as corn and small grain, and perennial crops, such as grass and alfalfa.
- Plant cover crops and green manure crops.
- Farm on the contour.

Problems Related to Infiltration and Relationship of Infiltration to Soil Function

When rainfall is received at a rate that exceeds the infiltration rate of a soil, runoff moves downslope or ponds on the surface in level areas. Runoff on bare or sparsely vegetated soil can result in erosion. Runoff removes nutrients, chemicals, and sediment, resulting in decreased soil productivity, offsite sedimentation of bodies of water, and diminished water quality.

To determine whether runoff is likely to occur, refer to rainfall data from the nearest location that reflects the amount and duration of rainfall in the sampled area. Compare it to the infiltration rate of the area to determine whether the rate is adequate to minimize runoff. For example, tables 1 and 2 show the likely frequency (1 to 100 years) and duration of rainfall events and the amount of rainfall received during each event at two locations in Nebraska.

Table 1.—Rainfall intensity and duration patterns for Mead, NE*

Frequency of rainfall event	Duration of rainfall event and total rainfall (in)		
	30 minutes	1 hour	2 hours
1 year	1.2	1.1	1.8
2 years	1.3	1.7	1.9
5 years	1.7	2.1	2.4
10 years	2.0	2.5	2.8
100 years	2.8	3.7	4.2

Table 2.—Rainfall intensity and duration patterns for North Platte, NE*

Frequency of rainfall event	Duration of rainfall event and total rainfall (in)		
	30 minutes	1 hour	2 hours
1 year	0.9	1.1	1.2
2 years	1.1	1.4	1.5
5 years	1.5	1.9	2.1
10 years	1.8	2.2	2.5
100 years	2.6	3.4	3.7

* D.M. Herschfield; 1961; *Rainfall Frequency Atlas of the United States*; U.S. Weather Bureau.

Restricted infiltration and ponding result in poor soil aeration. This leads to poor root function, poor plant growth, nitrogen volatilization, reduced availability of nutrients for plant use, and reduced cycling of nutrients by soil organisms.

The soil infiltration rate is most affected by conditions near the soil surface, and the rate can change drastically as a result of management.

Infiltration is rapid through large continuous pores at the soil surface, and it slows as pores become smaller. Steady-state infiltration rates typically occur when the soil is nearly saturated. These rates are given for various textural classes in table 3. They are average values and should not be generalized for all soil types.

SELECTED INFILTRATION
VALUE BASED ON TABLE 3 BELOW

Table 3.—Steady-state infiltration rates*

(Soils are wet deep into the profile. Values should be used only for comparing to the infiltration rate of the second inch of water applied.)

Soil type	Steady-state infiltration rate (in/hr)
Sand	>0.8
Sandy and silty soils	0.4-0.8
Loam	0.2-0.4
Clayey soils	0.04-0.2
Sodic clayey soils	<0.04

*Hillel, 1982.

What practices are being used that affect the infiltration rate?______________________________

____

____

Do these practices increase or decrease the infiltration rate? Why or why not?

____

____

____

Measuring Infiltration

Materials needed to measure infiltration:

____ 3- or 6-inch-diameter aluminum ring

____ Rubber mallet or weight

____ Block of wood or plastic insertion cap

____ Plastic wrap

____ Plastic bottle marked at 107 mL (3-inch ring) or 444 mL (6-inch ring) for 1 inch of water, or graduated cylinder

____ Distilled water or rainwater

____ Stopwatch or timer

Considerations:

Select representative test locations. For comparison, select locations under different management. For example, select an area where wheeled equipment has been used and one where it has not been used. For greater accuracy, make multiple measurements (3 or more) at each representative location.

The test should not be conducted when the surface layer is unusually dry. If needed, add water and then allow the water to soak into the soil before conducting the test. The measurement can also be taken after the soil has been moistened by rain or irrigation water. The infiltration rate will vary depending on the initial moisture content; therefore, the estimated initial moisture state should be documented. Avoid areas that are not typical of the area, such as animal burrows.

Infiltration test:

1. Clear all residue from the soil surface. Drive the ring into the soil to a depth of 3 inches using a rubber mallet or weight and a plastic insertion cap or block of wood. Take care to drive the ring downward evenly and vertically. Gently tamp down the soil inside the ring to eliminate gaps.
2. Cover the inside of the ring with plastic wrap, and drape it over the rim.
3. Pour 107 or 444 mL of distilled water or rainwater into the plastic-lined ring (fig. 2).

Figure 2.—Water is poured into plastic-lined ring.

4. Gently pull plastic wrap away. Record the time it takes for the water to infiltrate the soil. Stop timer when the soil “glistens.”
5. Repeat steps 2, 3, and 4 to determine the steady-state infiltration rate. Several measurements may be needed.
6. Record the results in table 4.
7. Remove the ring with the soil intact. This intact soil core can be used indoors for the respiration and bulk density tests.

Interpretations

In table 4, record the infiltration rate for the first and second inches of water applied and record the steady-state infiltration rate. Answer discussion questions. The infiltration rate is an indication of the susceptibility of the soil to runoff or ponding. Compare the rate for soils in different fields, soils of different types, and soils under different management systems.

Table 4.—Infiltration data sheet

Date: May 1, 2012									
Location	**Soil texture**	**First inch of water applied**		**Infiltration time for first inch (minutes)**	**Infiltra-tion rate (in/hr)**	**Second inch of water applied**		**Infiltration time for second inch (minutes)**	***Steady state (in/hr)**
		Start time	**End time**			**Start time**	**End time**		
Area tracked by wheeled equipment	Silty clay loam	2:00	5:00	180	0.33	5:00	8:20	200	0.30
Area not tracked by wheeled equipment	Silty clay loam	2:00	2:01	1	N/A	2:02	4:02	120	0.5
Notes:									

*Three or more measurements (inches of water) may be needed to achieve steady-state infiltration rate.

Did the infiltration rate change from the first inch of water applied to the second inch applied? Why or why not? Would a steady-state infiltration rate be achieved if a third inch of water was applied?

___

___

___

Determine the rainfall patterns for your specific geographical area (tables 1 and 2 are example rainfall patterns for two locations in Nebraska and thus should not be used for all areas). How does the infiltration time compare to the expected amount of rainfall in your geographical area? Is the soil susceptible to runoff?

___

___

___

How do the infiltration rates compare to the steady-state infiltration rates given in table 3? Are the rates higher, lower, or similar to those for a similar soil type? Explain.

___

___

___

Glossary

Infiltration rate.—Measure of how fast water enters the soil. It typically is expressed as inches per hour, but it is recorded as minutes needed for each inch of water applied at the surface to move into the soil.

Restrictive layer.—Compacted layer or layer of dense clay, bedrock, or other restrictive material that limits infiltration below the surface of the soil.

Sodic soil.—Soil that has a high sodium content and thus a very low infiltration rate.

Soil aggregates.—Soil particles held together by organic matter and related substances. Well aggregated soils have a higher infiltration rate and a lower risk of erosion.

Soil porosity.—Amount of pore space in the soil. Soils with higher porosity have more pore space and a higher infiltration rate than those with lower porosity.

Steady-state infiltration.—The condition in which the infiltration rate does not increase or decrease as more water is added. It typically occurs when the soil is nearly saturated.

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Soil Texture Calculator

Use this online tool to calculate a single point texture class based on percent sand, silt, and clay. Including the optional sand fractions will refine the calculation.

Or download a Microsoft Excel Macro-enabled spreadsheet to develop total sand, silt, and clay low, representative, and high values using an interactive texture triangle with textures that toggle on and off.

Download Interactive Texture Triangle Excel Version (XLSM; 6.11 MB)

Percent Sand:
38.1

*Very Coarse Sand:
0

*Coarse Sand:
0

*Medium Sand:
0

*Fine Sand:
0

*Very Fine Sand:
0

Percent Clay:
25

Graph Color:
Red

Get Type Reset

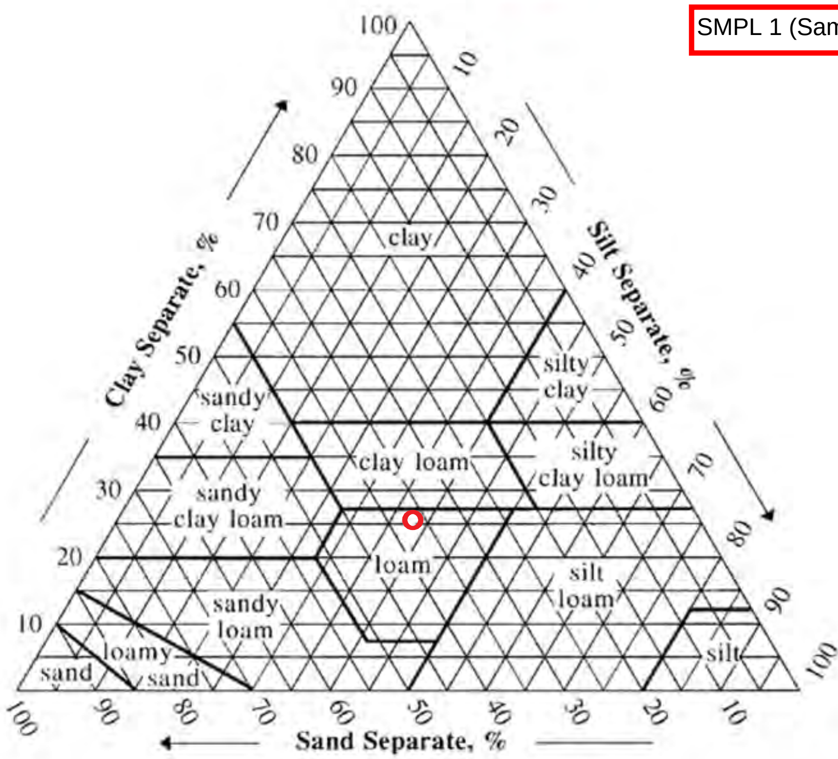
Percent Silt:
36.9

Texture:
Loam

Clear Graph

*Optional

SMPL 1 (Sampling Location 1)



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39.4

*Very Coarse Sand:
0
*Coarse Sand:
0
*Medium Sand:
0
*Fine Sand:
0
*Very Fine Sand:
0

Percent Clay:
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Graph Color:
Red

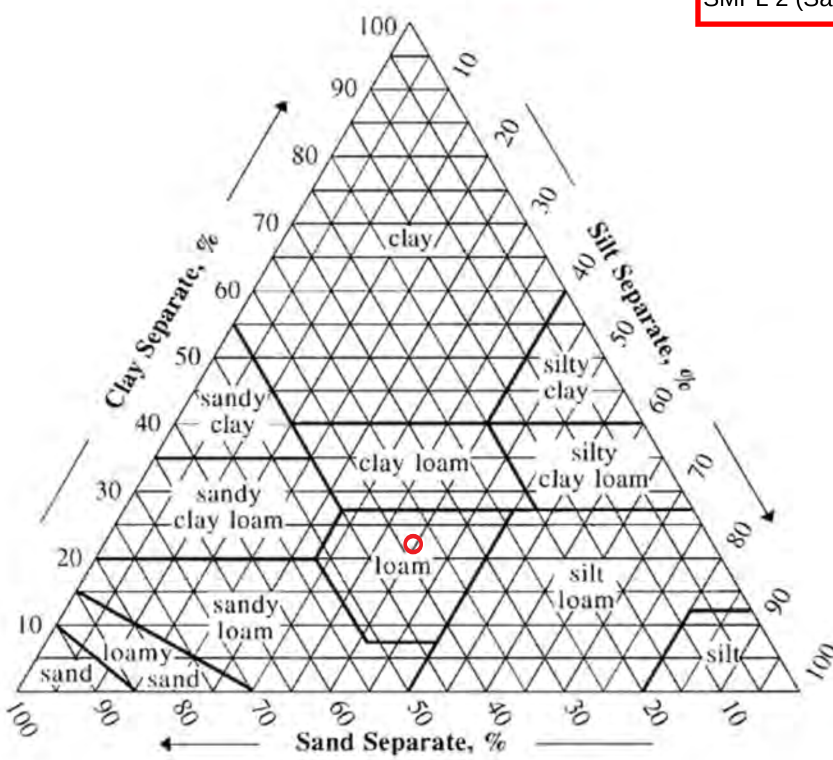
Get Type Reset

Percent Silt:
38.1
Texture:
Loam

Clear Graph

Optional

SMPL 2 (Sampling Location 2)



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Percent Sand:
35.6

Percent Clay:
22.5

*Very Coarse Sand:
0

Graph Color:
Red

*Coarse Sand:
0

Get Type Reset

*Medium Sand:
0

Percent Silt:
41.900000000000006

*Fine Sand:
0

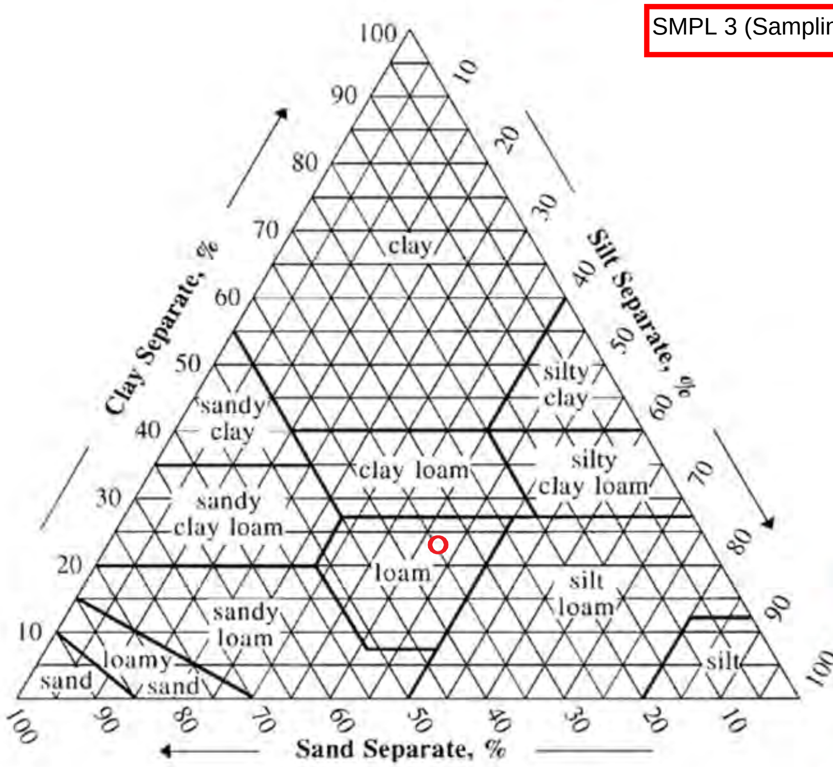
Texture:
Loam

*Very Fine Sand:
0

Clear Graph

*Optional

SMPL 3 (Sampling Location 3)



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0
*Coarse Sand:
0
*Medium Sand:
0
*Fine Sand:
0
*Very Fine Sand:
0

Percent Clay:
26.3

Graph Color:
Red

Get Type Reset
Percent Silt:
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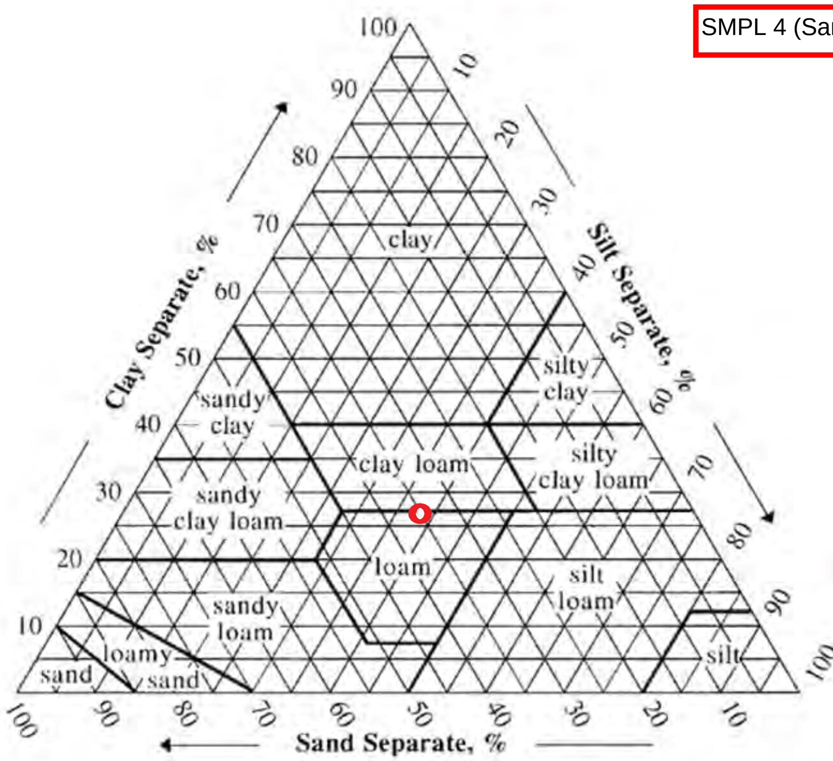
Texture:
Loam

Clear Graph

*Optional

SMPL 4 (Sampling Location 4)



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