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Rev. 2 (9/11/19)
Rev. 3 (2/18/20)
Rev. 4 (4/16/20)
Rev. 5 (2/03/21)

Wastewater Evaluation Report

Proposed Grandwood Subdivision

NE of Higby Road and Fairplay Drive

El Paso County, Colorado

VIVID Project No.: D18-2-175

PCD File No. SP195

VIVID Engineering Group

Only the client or it's designated representatives may use this document
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January 19, 2019
Revision 1- April 1, 2019
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Revision 3- February 18, 2020
Revision 4- April 16, 2020
Revision 5- February 3, 2021

Report prepared for:

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WASTEWATER EVALUATION REPORT
Proposed Grandwood Subdivision
NE of Higby Road and Fairplay Drive
El Paso County, Colorado
VIVID Project No. D18-2-175

Prepared by:

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2-3-21

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Table of Contents

1.0 INTRODUCTION

1.1 General

This report presents the results of a wastewater evaluation report performed for the proposed Grandwood Subdivision to be constructed northeast of Higby Road and Fairplay Drive in El Paso County, Colorado. An attached Vicinity Map (Figure 1) shows the general location of the project. Our evaluation was performed for Grandwood Enterprises, LLC, and was authorized by Mr. Bill Herebic**.**

1.2 Project Description

The proposed project includes the development of a 151-acre parcel into a residential subdivision. 48 lots are planned, that will be approximately 2.5 acres in size. The property has no current improvements and is in a generally native condition. The development will include construction of access roadways and utilities. Residential lots will require individual water well and septic systems. A preliminary site layout is shown on Figure 2, attached to this report.

1.3 Purpose and Scope

The purpose of this evaluation was to evaluate the site for general feasibility of the use of individual Onsite Wastewater Treatment Systems (OWTS) – a.k.a. septic systems. This report is part of the submittal of the Preliminary Development Plan for this proposed subdivision to El Paso County.

VIVID's scope of services included:

- A visual reconnaissance to observe surface and geologic conditions at the project site and locating the exploratory borings and test pit sites;
- Notification of the Utility Notification Center of Colorado (UNCC)/Colorado 811 to identify underground utility lines at the boring locations prior to our drilling;
- The drilling of seven exploratory borings (including percolation testing) and excavation of three test pits for tactile evaluation of the soils. This scope was previously discussed and approved by El Paso County Board of Health personnel who perform development reviews for the County for proposed OWTS facilities. These exploration were performed on 20 percent of the proposed lots at currently accessible locations across the proposed development area;
- Laboratory testing of selected samples obtained during the field exploration to evaluate relevant physical, geologic, and engineering properties of the soil; and
- Preparation of this report, which includes a description of the proposed project, a description of the surface and subsurface site conditions found during our investigation, and an evaluation of the feasibility of the use of OWTS for this development.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

A field exploration performed on December 20, 2018 included the drilling of seven exploratory borings (including percolation testing), and excavation of three test pits for tactile evaluation of the soils at the locations presented on Figure 2 – Exploration Location Plan. This exploration and some of the basic information are presented in Table 1, below.

Table 1
Summary of Subsurface Exploration

Boring Designation	Approximate Boring Depth [feet, below ground surface]	Approximate Depth to Groundwater [feet, below ground surface]	Approximate Depth to Weathered Bedrock [feet, below ground surface]	Approximate Depth to Competent Bedrock [feet, below ground surface]
B-1	25.0	23.0	None Encountered	None Encountered
B-2	14.5	None Encountered	4.0	12.0
B-3	25.0	19.0	None Encountered	None Encountered
B-4	20.0	17.0	-	12.0
B-5	14.5	None Encountered	8.0	None Encountered
B-6	25.0	19.0	25.0	None Encountered
B-7	20.0	14.0	14.0	None Encountered
TP-1	10.0	None Encountered	None Encountered	None Encountered
TP-2	10.0	None Encountered	None Encountered	None Encountered
TP-3	10.0	None Encountered	None Encountered	None Encountered

Borings were performed with a truck-mounted CME-45 drill rig equipped with 4-inch outside diameter, continuous-flight, solid-stem auger. Samples were taken with a 2.5-inch O.D./2.0-inch I.D., California-type sampler, standard penetration (SPT) sampler, and by bulk methods. Penetration tests were obtained at the various sample depths as well.

Test pits were performed with a rubber-tire backhoe. Tactile observation/evaluation of the soils exposed was performed during excavation. Bulk samples of the soils were obtained for laboratory testing purposes.

Appendix A to this report includes logs of the borings and test pits describing the subsurface conditions. The lines defining boundaries between soil and rock types on the logs are based upon drill behavior and interpolation between samples and are therefore approximate. Transition between soil and rock types may be abrupt or may be gradual.

2.2 Laboratory Testing

Laboratory tests were performed on selected soil samples to estimate their relative engineering properties. Tests were performed in general accordance with the following methods of ASTM or other recognized standards-setting bodies, and local practice:

- Description and Identification of Soils (Visual-Manual Procedure)

- Classification of Soils for Engineering Purposes
- Moisture Content
- Sieve Analysis of Fine and Coarse Aggregates
- Liquid Limit, Plastic Limit, and Plasticity Index
- Swell/Settlement

Results of the laboratory tests are included in Appendix B of this report. Selected test results are also shown on the boring logs in Appendix A.

2.3 General Geology

2.3.1 Site Description

The site is 151 acres and is currently covered with native grasses, trees, and shrubs. The parcel is a generally mild south and west sloping parcel with two shallow alluvial valleys separated by sandstone topographic highs. The site is bounded on the north, east and west by existing residential subdivisions. Higby Road borders the south.

2.3.2 Geologic Reconnaissance

A visual geologic reconnaissance of the site was performed by Mr. Jim Frohbieter, Professional Geologist, with J&K Geological Services. This reconnaissance was supported by the field drilling and test pit explorations, as well as geologic mapping and information from the following sources:

- CGS Geologic Map of the Monument Quadrangle, El Paso County, Colorado by Jon P. Thorson and Richard F. Madole, 2003
- Soil Survey of El Paso County Area, Colorado Soil Conservation Service, USDA, 1979
- El Paso County, Colorado: Potential Geologic Hazards and Surficial Deposits, Environmental and Engineering Maps and Tables for Land Use (Colorado Springs Quadrangle 1961), Charles S. Robinson and Associates, Inc. Cochran, D.M. (1977)
- Review of Available Geologic Hazard Studies in the surrounding area

Geologic maps are presented as Figures 3a-Regional Geology Map and Figure 3b-Site Specific Geology Map, attached to this report. An NRCS Soil Survey Map and associated Soil Descriptions are presented as Figures 4a, and 4b. A USGS Topographic Map is attached as Figure 5.

3.0 ON-SITE WASTEWATER TREATMENT

3.1 Evaluation

The site was evaluated for use of On-Site Wastewater Treatment Systems (OWTS); a.k.a. Septic Systems. For the purpose of submitting the Preliminary Development Plan, and after review of requirements listed in the El Paso County Land Development Code, the El Paso County Public Health Regulations, and written and verbal communication with both departments, a combination of profile borings/percolation testing (7 total), and tactile test pits (3 total) were performed. These explorations were performed at currently accessible locations across the development, and are shown on Figure 2. Logs of the borings and test pits are presented in Appendix A. Laboratory test results are presented in Appendix B, and select lab data is presented on the logs in Appendix A. Percolation test results and Long Term Acceptance Rate (LTAR) values are presented at the bottom of the logs in Appendix A as well. Figure 7 presents a Septic Suitability Map showing possible configurations of septic fields, residence, and water well locations for the evaluated lots. The final location of septic fields as well as the dwellings and water wells must be located outside of designated easements including drainage easements. For rough estimation of anticipated sewage flow, an assumed average 75 gallons per person per day is utilized from Section 8.4 of the El Paso County OWTS regulations. Assuming an average 4 people per dwelling the average flow per dwelling would be estimated at 300 gallons per day per dwelling. For all 48 lots this equates to 14,400 gallons per day.

3.2 NRCS Soil Survey Mapping

Mapping of the NRCS Soil Survey on this site is presented on Figure 4a with descriptions of the soil types presented on Figure 4b. The NRCS soil descriptions generally agree with the soils encountered in our investigation and the results of our laboratory soil testing.

3.3 Results of Evaluations

Soils encountered at the locations evaluated generally included Silty to Clayey SAND, to “cleaner” Well to Poorly-Graded SAND. These coincide with Sand, Loamy Sand, Sandy Loam, and Loam (Soil Types 1 and 2) per USDA Soil Type categories. These soils are generally considered to have favorable percolation rates for conventional septic system design and construction.

Percolation rates at our exploration locations ranged from approximately 5 to 23 minutes/inch. LTAR values based on tactile evaluations, and laboratory soil testing were estimated to range from 0.80 to 0.60 gallons/square foot/day.

Dawson Formation weathered to relatively un-weathered bedrock (mainly sandstone with minor clayey or claystone layers) was encountered in five of the ten explorations at approximate depths of 4, 8, 12, 14, and 24 feet below the existing ground surface. Groundwater was encountered in five of the ten explorations at approximate depths ranging from 14 to 23 feet below the existing ground surface. Table 1 presented in this report shows depth to bedrock and groundwater for each exploration in tabular format. This information is also presented on the individual exploration logs in Appendix A.

3.4 Conclusions

The locations evaluated as part of this study generally found soils and percolation rates that are favorable for conventional septic system construction. Geologic mapping as presented on Figures 3a and 3b indicate that shallower bedrock of the Dawson Formation (see areas of Tkd4 on Figure 3a) will be encountered at various locations that were outside accessible limits of this evaluation. These areas are anticipated to have higher occurrences of shallow bedrock and lower percolation rates that would require engineered systems.

3.5 Other Considerations

Existing Water Wells:
Two water wells are located within the eastern portion of the site adjacent the Jackson Creek drainage feature. The wells are 210 to 415 feet deep and uses are Domestic and Domestic Stock. A well field (no structure) is mapped adjacent the southern edge of the property. The residential communities adjacent and to the north, east, and south are on individual wells for domestic & household only use and septic systems.

Existing Lakes, Streams, Irrigation Ditches, etc.:
The nearest lakes (Lake Woodmoor and Monument Lake) are located 2 to 3 miles from the site at up or cross-gradient locations. Jackson Creek (1st order drainage) crosses the east portion of the site which is a perennial stream and flows to the south and west of the site. Several ponds associated with the Jackson Creek drainage are located on site and downstream that have historically been associated with livestock uses.

Availability of Central Sewage System:
The site is not within the boundaries of a water/sanitation district. Woodmoor Water & Sanitation District boundary is located adjacent the east and northeast site boundary and would be the closest connection if they allowed inclusion, which is unclear based on discussions to date. The estimated cost to tie into Woodmoor's sewage system is significant and includes the main items presented in the table below. In summary, connecting to Woodmoor's wastewater system results in an estimated cost on the order of $2.7 M versus $0.72 M for individual OWTS for full build out of the subdivision.

ITEM	AMOUNT	UNIT COST	TOTAL COST
Lift Station	2	$400,000	$800,000
8" Pipeline	14,000 Linear Feet (LF)	$64.00 per LF [1)]	$896,000
Manholes	30 (1 per 400 LF)	$4,386 [1)]	$131,580
Installation	14 (1,000 LF segments)	$1,402 [1)]	$19,628
Design/Drawings [2)]	1	$25,000	$25,000
Inclusion Fee [3)]	1	$400,000	$400,000
Tap fee	48	$9,228	$442,944
TOTAL COST ESTIMATE			**$2,715,152**

Notes:
1) Unit cost from 2019 El Paso County Financial Assurance charts
2) Design/Drawings include all system design, construction drawings, permits and financial assurances
3) Inclusion fee can vary widely

Other considerations:

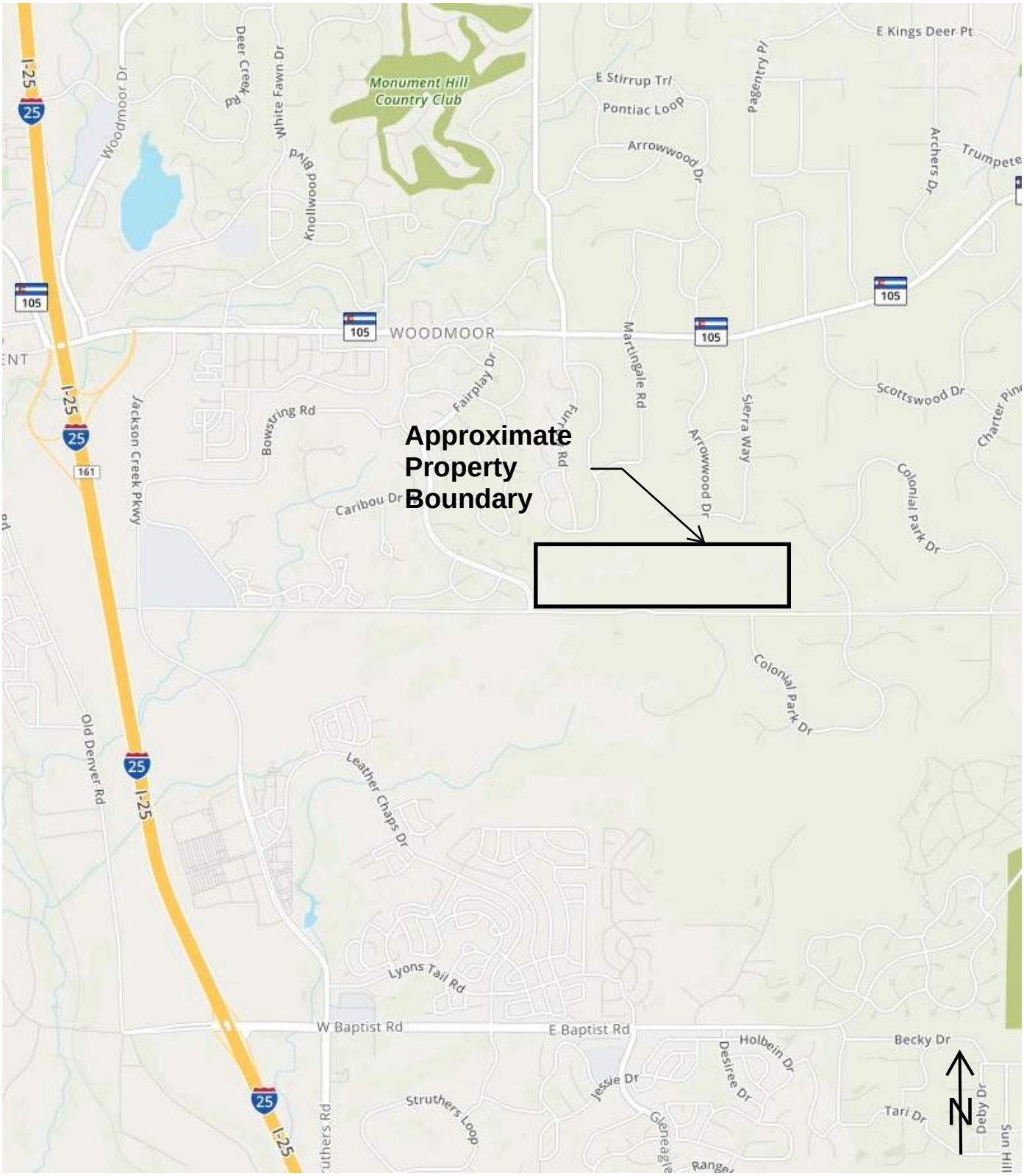
- Based on conversations with Woodmoor Water and Sanitation it is unlikely that they will service the site for wastewater only. If they require water service as well the above cost impact to the project will increase by at least 3 times.
- The return flows from the planned septic systems meets the State's augmentation requirements for pumping from the Dawson aquifer. Without those return flows Grandwood would have to purchase non-tributary augmentation water from another source. At $3,000 per acre foot this could be as much as $72,000 annually.

Based on our evaluation, inclusion into a special district would be cost prohibitive for the development.

4.0 LIMITATIONS

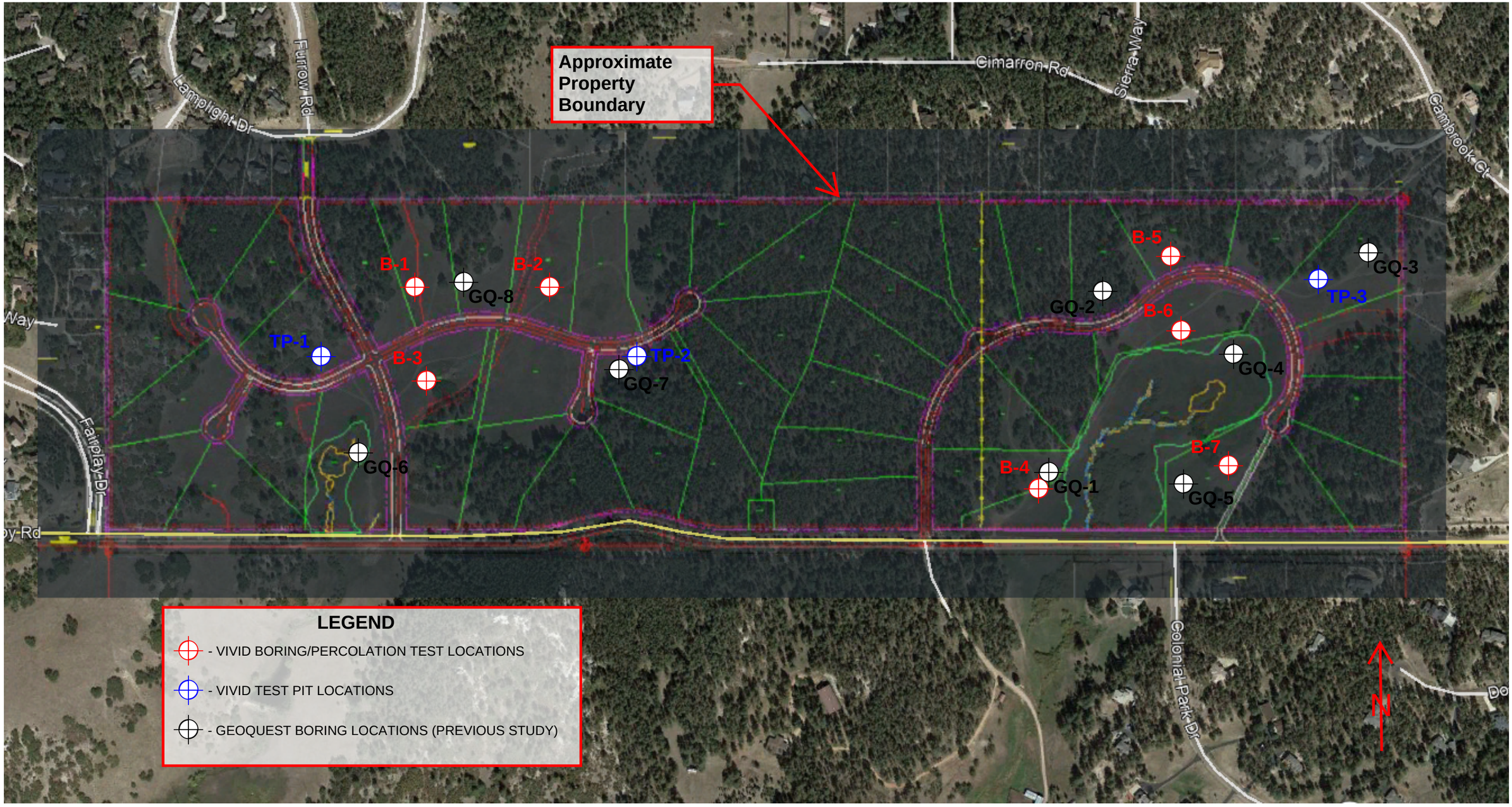
This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of VIVID's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. VIVID makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.



Not to Scale. Base image obtained from www.mapquest.com, 2019

VIVID Engineering Group	Project No: D18-2-175	**VICINITY MAP**	Figure
	Date: 1/15/19		**1**
	Drawn by: WJB	Grandwood Subdivision El Paso County, Colorado	
	Reviewed by: BTM		



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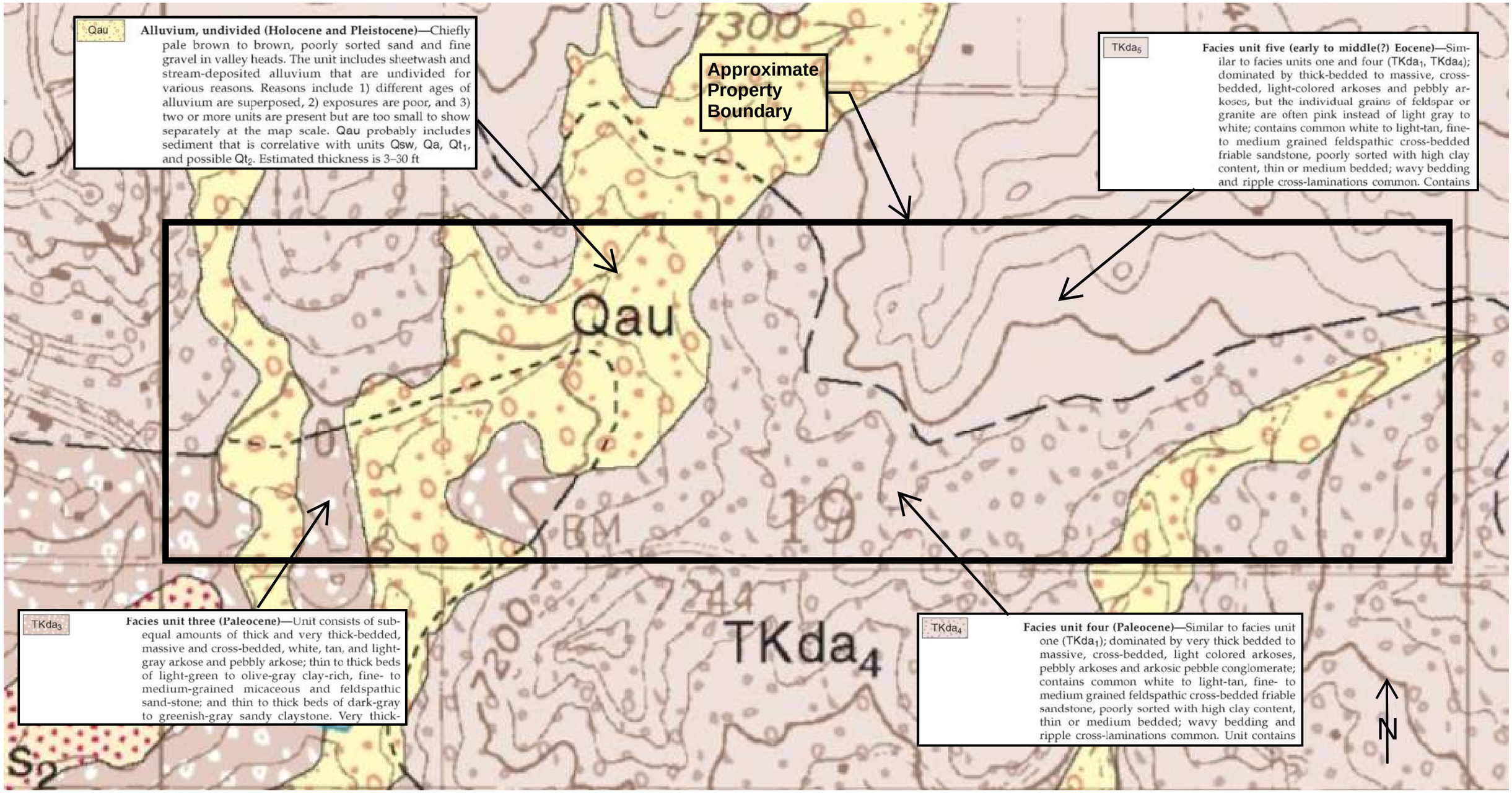
EXPLORATION LOCATION PLAN

Grandwood Subdivision
El Paso County, Colorado

Figure
2



Not to Scale. Base image from https://ngmdb.usgs.gov/Prodesc/proddesc_76327.htm (Geologic Map of the Monument Quadrangle, El Paso County, Colorado, 2003)

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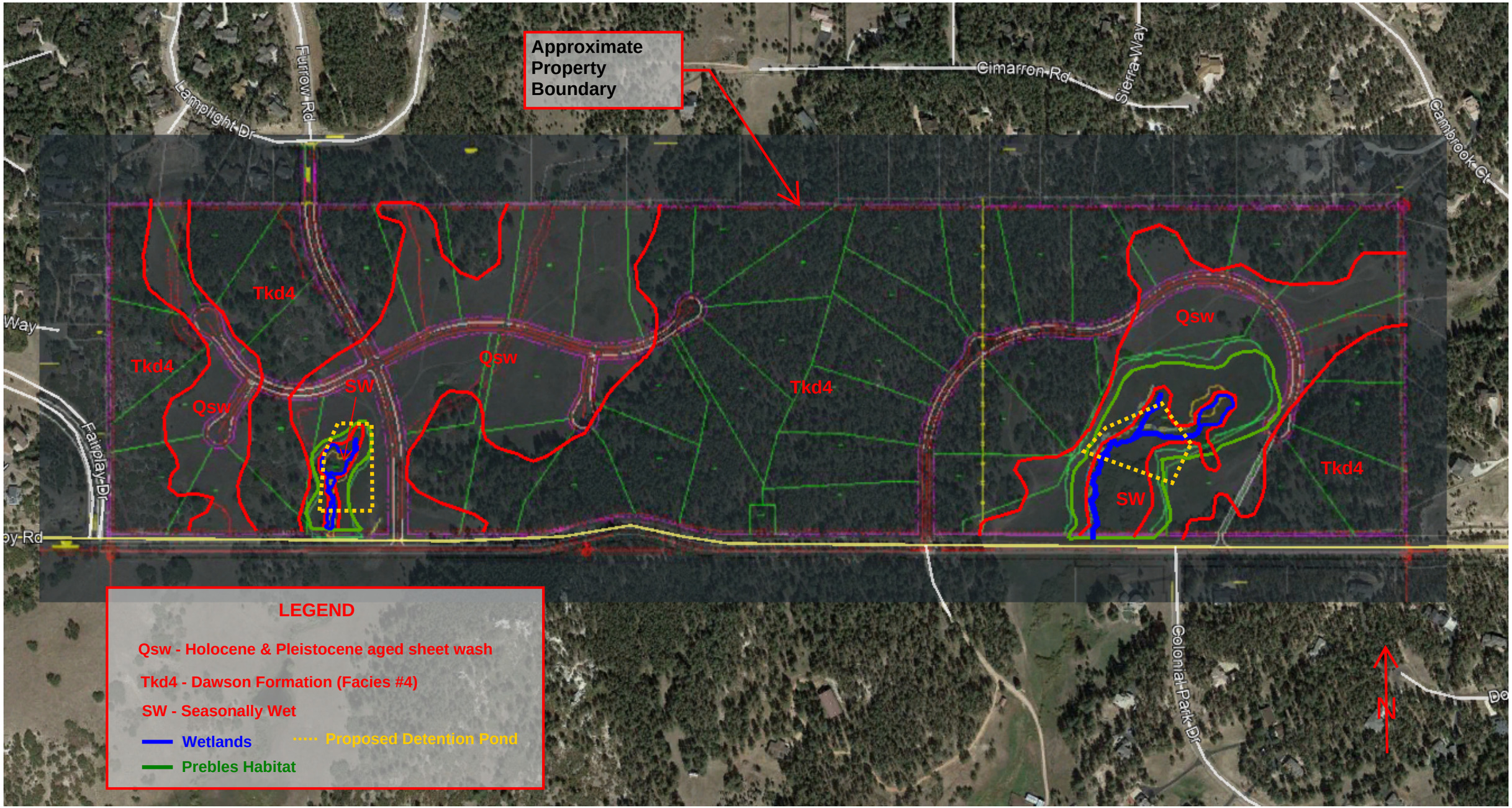
REGIONAL GEOLOGY MAP

Grandwood Subdivision
El Paso County, Colorado

Figure
3a



Not to Scale. Base image dated 06/09/2017 and obtained from Google Earth, 2019.
Site-specific Geology Mapping by Jim Frohbieter, Professional Geologist

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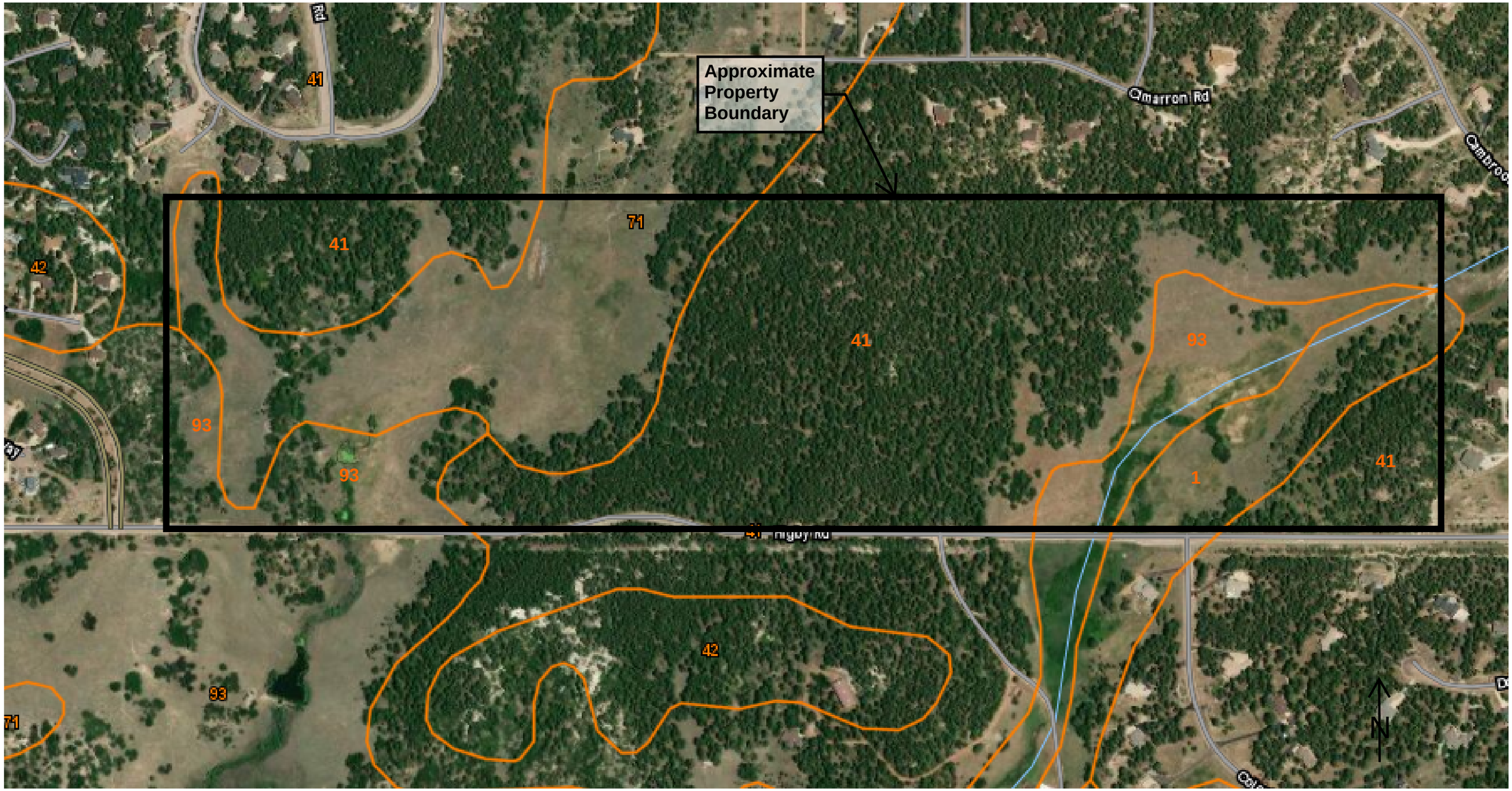
SITE-SPECIFIC GEOLOGY MAP

Grandwood Subdivision
El Paso County, Colorado

Figure
3b



Not to Scale. Base image from https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

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NRCS SOIL SURVEY MAP

Grandwood Subdivision
El Paso County, Colorado

Figure
4a

El Paso County Area, Colorado

1—Alamosa loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3670
Elevation: 7,200 to 7,700 feet
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Alamosa and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alamosa

Setting

Landform: Flood plains, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 6 inches: loam
Bt - 6 to 14 inches: clay loam
Btk - 14 to 33 inches: clay loam
Cg1 - 33 to 53 inches: sandy clay loam
Cg2 - 53 to 60 inches: sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Very slightly saline to strongly saline (2.0 to 16.0 mmhos/cm)
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: Mountain Meadow (R048AY241CO)
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

El Paso County Area, Colorado

41—Kettle gravelly loamy sand, 8 to 40 percent slopes

Map Unit Setting

National map unit symbol: 368h
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent

Estimates are based on observations, descriptions, and transec mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Park (R048AY222CO)
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

El Paso County Area, Colorado

93—Tomah-Crowfoot complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 36bb
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Not to Scale. Base image from https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

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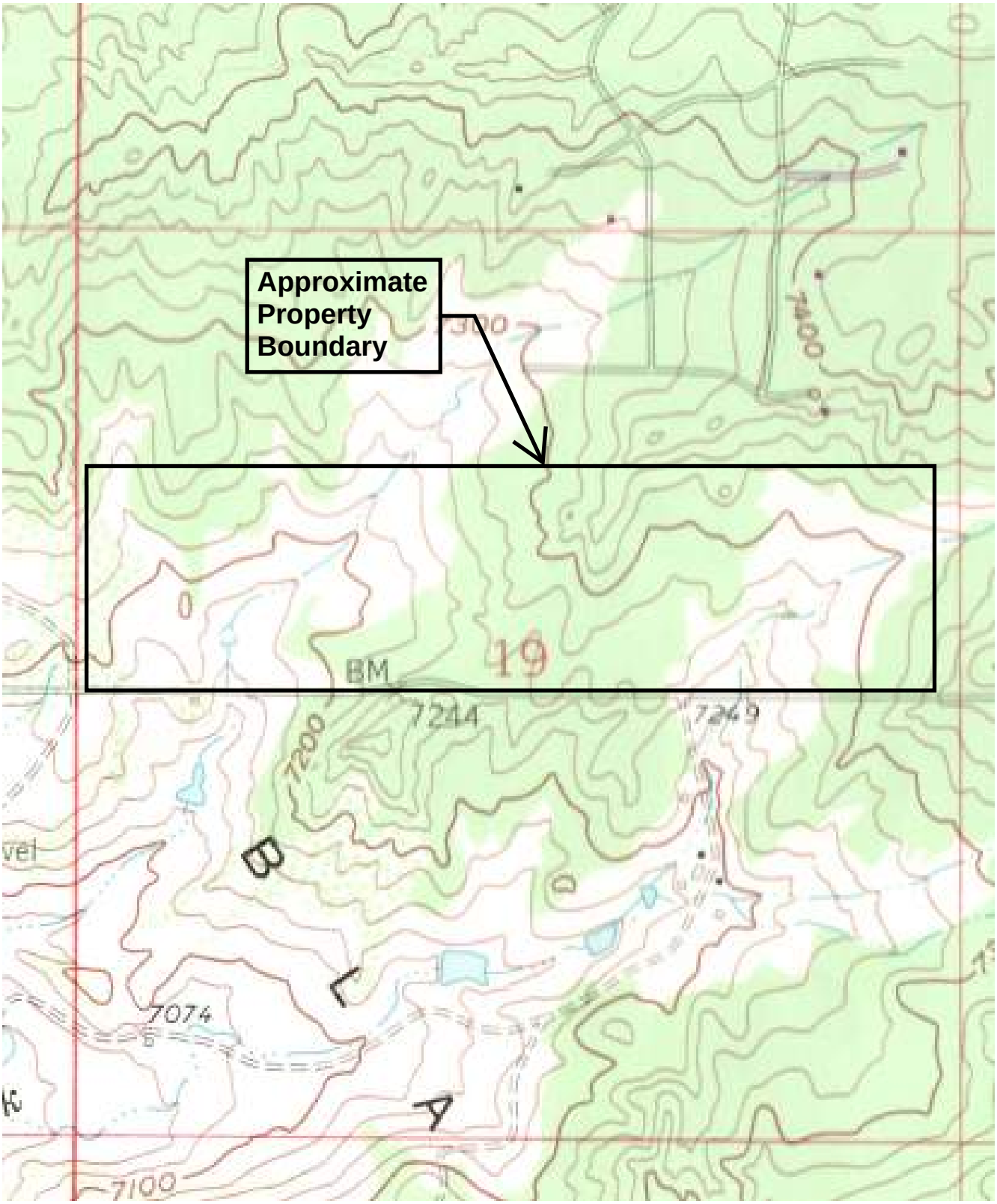
NRCS SOIL SURVEY MAP (Soil Descriptions)

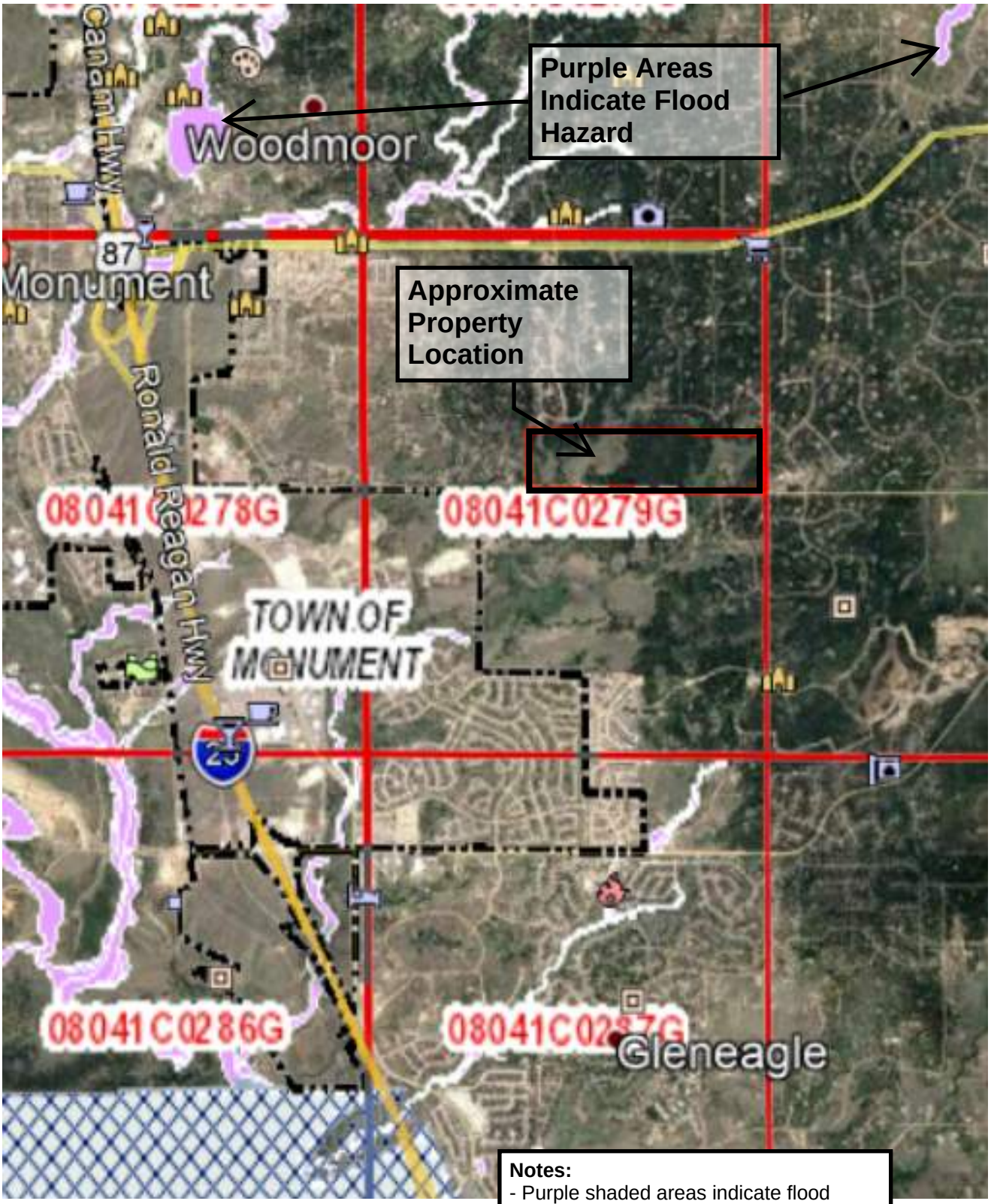
Grandwood Subdivision
El Paso County, Colorado

Figure
4b



Not to Scale. Base image obtained from USGS 7.5 Minute Quadrangle, 1961

VIVID Engineering Group	Project No: D18-2-175	TOPOGRAPHIC MAP	Figure
	Date: 1/15/19		5
	Drawn by: WJB	Grandwood Subdivision El Paso County, Colorado	
	Reviewed by: BTM		

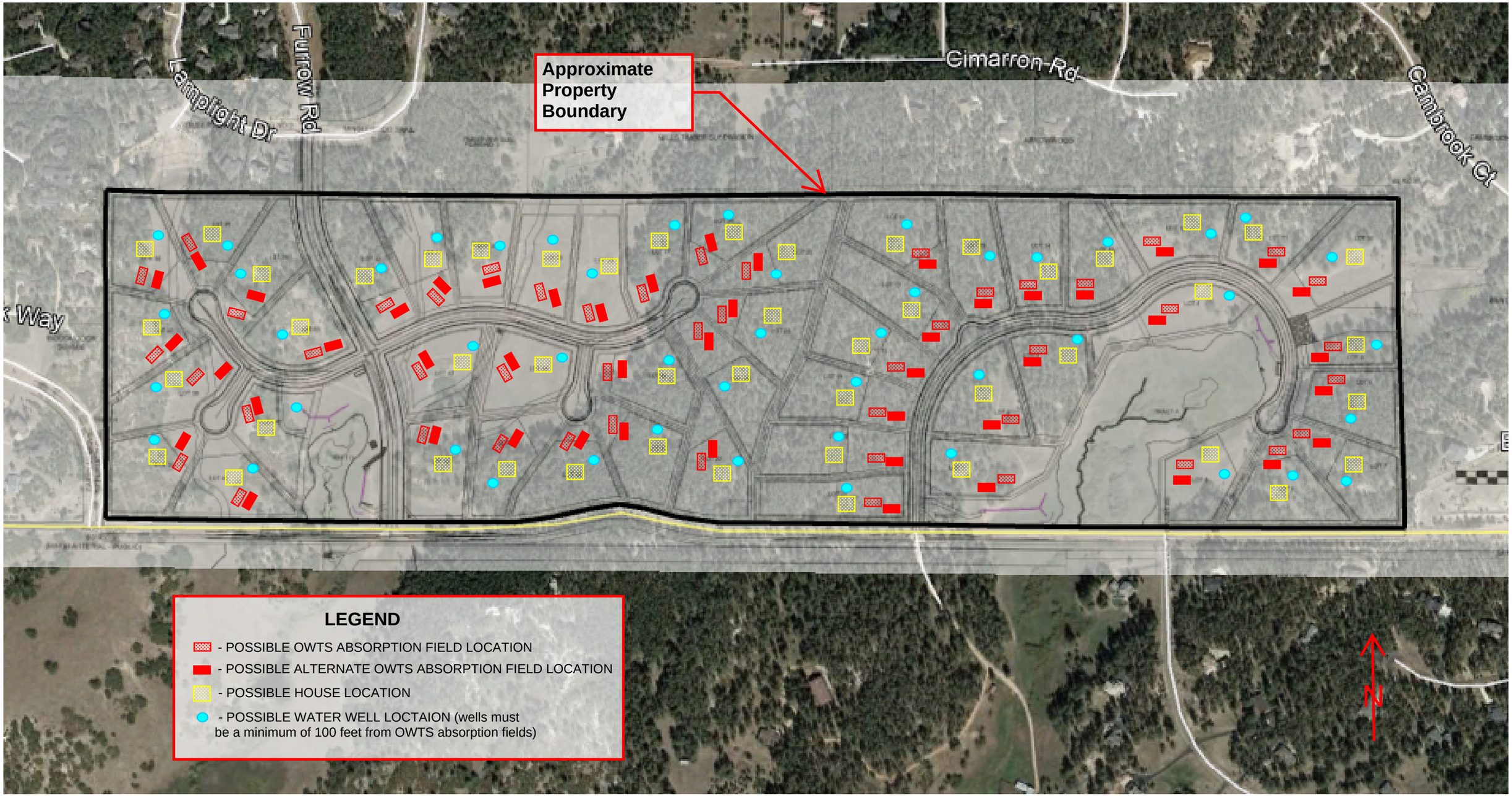


Notes:
- Purple shaded areas indicate flood hazard risk
- Site has no mapped flood hazards

Not to Scale. Base image obtained from https://dsat.services.femadata.com/arcgis/rest/services/FEMA_R8/RiskMAP_ElPasoCounty_Colorado/MapServer/legend, 2019

N

VIVID Engineering Group	Project No: D18-2-175	FLOOD HAZARD MAP	Figure
	Date: 1/15/19		6
	Drawn by: WJB	Grandwood Subdivision El Paso County, Colorado	
	Reviewed by: BTM		



Not to Scale. Base image dated 06/09/2017 and obtained from Google Earth, 2019.

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Date: 2/3/21
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Reviewed by: BTM

SEPTIC SUITABILITY MAP

Grandwood Subdivision
El Paso County, Colorado

Figure
7

Appendix A

Logs of Explorations

VIVID Engineering Group, Inc.
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Fax: 719-896-4357

BORING NUMBER B-1

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING 23.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	4-5			Silty to Clayey SAND, tan, dry to wet (below about 23 feet), loose to medium dense, fine to coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
5	SPT	7-5			
10	SPT	3-5	MC = 8.2% LL = NP PL = NP Fines = 14.0%		
15	SPT	5-5			
20	SPT	4-4			
25	SPT	5-5	MC = 17.3% LL = NP PL = NP		(25.0) Bottom of borehole at 25.0 feet.

Note:
Average Percolation Rate = 18 min./in.
LTAR = 0.60 gal./s.f./day

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 1/17/19 15:03 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

VIVID Engineering Group, Inc.
1053 Elkton Drive
Colorado Springs, CO 80907
Telephone: 719-896-4356
Fax: 719-896-4357

BORING NUMBER B-2

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	9-8			Silty to Clayey SAND, tan to light brown, dry, loose to medium dense, fine to coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2 (4.0)
5	SPT	7-15			**Dawson Formation** Weathered SANDSTONE with clayey zones, tan to light gray, dry to slightly moist, medium dense to very dense. USDA Soil Type: 3A, Structure Shape: 0, Structure Grade: 1
10	SPT	35-15/2"	MC = 10.6% LL = 43 PL = 26 Fines = 22.0%		(12.0)
	MC	50	MC= 17.0% Comp. = 0.7% Under 1ksf surcharge pressure		**Dawson Formation** CLAYSTONE, sandy, light gray, slightly moist, hard. USDA Soil Type: 4A, Structure Shape: 0, Structure Grade: 1 (14.5)

Bottom of borehole at 14.5 feet.

Note:
Average Percolation Rate = 23 min./in.
LTAR = 0.60 gal./s.f./day

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Fax: 719-896-4357

BORING NUMBER B-3

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
∇ **AT TIME OF DRILLING** 19.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	9-8			Well Graded to Silty to Slightly Clayey SAND, dark brown to tan and pink, dry to wet (below about 19 feet), medium dense to loose. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	SPT	4-4	MC = 2.1% LL = NP PL = NP Fines = 11.4%		
10	SPT	5-4			
15	SPT	5-5	MC = 4.4% LL = NP PL = NP Fines = 7.8%		
20	SPT	3-3			∇
25	SPT	5-5			(25.0)

Bottom of borehole at 25.0 feet.

Note:
Average Percolation Rate = 5 min./in.
LTAR = 0.80 gal./s.f./day

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BORING NUMBER B-4

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
∇ **AT TIME OF DRILLING** 17.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
				1.0	Poorly Graded to Silty/Slightly Clayey SAND, brown to tan to pinkish-tan, dry, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
	SPT	5-5	MC = 2.8% LL = NP PL = NP Fines = 19.0%		
5	SPT	5-6			
10	SPT	2-3			
				12.0	**Dawson Formation** SANDSTONE with clayey zones, tan to light gray, dry to slightly moist, very dense to hard, fine to coarse-grained, poorly cemented. USDA Soil Type: 3A, Structure Shape: 0, Structure Grade: 1
15	SPT	35-15/1"	MC = 11.7% LL = NP PL = NP Fines = 15.0%		∇
	SPT	25-25/2"		19.7	

Bottom of borehole at 19.7 feet.

Note:
Average Percolation Rate = 5 min./in.
LTAR = 0.80 gal./s.f./day

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VIVID Engineering Group, Inc.
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Colorado Springs, CO 80907
Telephone: 719-896-4356
Fax: 719-896-4357

BORING NUMBER B-5

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	2-3		Poorly Graded to Silty/Slightly Clayey SAND, brown to tan, slightly moist, loose. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	SPT	3-2		
				(8.0)
10	SPT	31-19/3"		**Dawson Formation** Weathered SANDSTONE, clean to slightly clayey, tan to pink, dry to slightly moist, dense to hard. USDA Soil Type: 3A, Structure Shape: 0, Structure Grade: 1
	SPT	50		(14.5)

Bottom of borehole at 14.5 feet.

Note:
Average Percolation Rate = 5 min./in.
LTAR = 0.80 gal./s.f./day

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Fax: 719-896-4357

BORING NUMBER B-6

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING 19.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	3-3			Well Graded to Silty/Slightly Clayey SAND, tan to pinkish-tan, dry to wet (below about 19 feet), loose. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	SPT	3-2			
10	SPT	2-2	MC = 10.1% LL = 25 PL = 19 Fines = 21.0%		
15					
	SPT	3-4			
20	SPT	1-2			
25	SPT	4-35			(24.5) **Dawson Formation** Weathered SANDSTONE, clean to slightly clayey, tan, moist, very dense (25.0)

Bottom of borehole at 25.0 feet.

Note:
Average Percolation Rate = 7 min./in.
LTAR = 0.80 gal./s.f./day

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VIVID Engineering Group, Inc.
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Colorado Springs, CO 80907
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Fax: 719-896-4357

BORING NUMBER B-7

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING 14.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	4-6		Silty to Slightly Clayey SAND, tan with some iron-oxide staining, dry to slightly moist, loose to medium dense, fine-grained to about 6 feet then coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
5	SPT	6-5	MC = 6.4% LL = NP PL = NP Fines = 30.0%	
10	SPT	6-6		
				(14.0 ▽)
15	SPT	6-25	MC = 22.1% LL = 33 PL = 24 Fines = 54.0%	**Dawson Formation** Weathered SANDSTONE to CLAYSTONE, tan to gray, moist to very moist, very dense to hard, poorly cemented, fine to coarse-grained
	SPT	30-20/2"		(19.7)

Bottom of borehole at 19.7 feet.

Note:
Average Percolation Rate = 6 min./in.
LTAR = 0.60 gal./s.f./day

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Telephone: 719-896-4356
Fax: 719-896-4357

TEST PIT NUMBER TP-1

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION ---
TEST PIT SIZE 60 X 120 inches
EXCAVATION CONTRACTOR Bush Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-Tire Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
	GB		1.0	Poorly Graded SAND with silt, brown, dry, loose to medium dense, coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
			2.0	Silty to Clayey SAND, brown, dry to moist, medium dense, fine to coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
5	GB	MC = 2.9% LL = NP PL = NP Fines = 16.5%		
10	GB		10.0	

Bottom of test pit at 10.0 feet.

Note:
Average Percolation Rate = N/A
LTAR = 0.60 gal./s.f./day

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 1/17/19 15:03 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

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Telephone: 719-896-4356
Fax: 719-896-4357

TEST PIT NUMBER TP-2

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION ---
TEST PIT SIZE 60 X 120 inches
EXCAVATION CONTRACTOR Bush Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-Tire Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
			1.0	
	GB			Well Graded SAND with silt and clay, light brown, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
			3.0	
				Well Graded SAND with silt and clay, tan, slightly moist, loose to medium dense. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	GB	MC = 5.7% LL = NP PL = NP Fines = 8.6%		
			6.5	
				Clayey SAND, brown, slightly moist, medium dense. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
	GB			
10			10.0	

Bottom of test pit at 10.0 feet.

Note:
Average Percolation Rate = N/A
LTAR = 0.60 gal./s.f./day

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 1/17/19 15:03 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

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Telephone: 719-896-4356
Fax: 719-896-4357

TEST PIT NUMBER TP-3

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION ---
TEST PIT SIZE 60 X 120 inches
EXCAVATION CONTRACTOR Bush Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-Tire Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
			1.0	Poorly Graded SAND with clay, light brown, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
	GB		2.0	Poorly Graded SAND with silt and clay, light brown, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
			4.0	Poorly Graded SAND with clay, tan, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5				
	GB	MC = 4.5% LL = NP PL = NP Fines = 11.6%		
10			10.0	

Bottom of test pit at 10.0 feet.

Note:
Average Percolation Rate = N/A
LTAR = 0.80 gal./s.f./day

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 1/17/19 15:03 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

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KEY TO SYMBOLS

CLIENT Herebic Homes

PROJECT NAME Grandwood Subdivision

PROJECT NUMBER D18-2-175

PROJECT LOCATION Higby Road, Monument, Colorado

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

- CLAYSTONE
- SANDSTONE
- SC: USCS Clayey Sand
- SC-SM: USCS Clayey Sand
- SM: USCS Silty Sand
- SP-SC: USCS Poorly-graded Sand with Clay
- SP-SM: USCS Poorly-graded Sand with Silt
- SW-SM: USCS Well-graded Sand with Silt
- TOPSOIL
- WEATHERED SANDSTONE

SAMPLER SYMBOLS

- Grab Sample
- 2" I.D. Modified California Sampler (MC)
- Standard Penetration Test (SPT)

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
MC - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
FINES- PERCENT PASSING NO. 200 SIEVE

∇ Water Level at Time Drilling, or as Shown

KEY TO SYMBOLS - GINT STD US LAB.GDT - 1/17/19 15:36 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

Appendix B

Laboratory Test Results

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SUMMARY OF LABORATORY RESULTS

CLIENT Herebic Homes **PROJECT NAME** Grandwood Subdivision

PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)		
B-1	9.0	NP	NP	NP	19	14	SM	8.2			
B-1	24.0	NP	NP	NP				17.3			
B-2	9.0	43	26	17	9.5	22	SC	10.6			
B-3	4.0	NP	NP	NP	19	11	SW-SM	2.1			
B-3	14.0	NP	NP	NP	25	8	SW-SM	4.4			
B-4	2.0	NP	NP	NP	12.5	19	SM	2.8			
B-4	14.0	NP	NP	NP	9.5	15	SM	11.7			
B-6	9.0	25	19	6	19	21	SC-SM	10.1			
B-7	4.0	NP	NP	NP	12.5	30	SM	6.4			
B-7	14.0	33	24	9	9.5	54	ML	22.1			
TP-1	2.0	NP	NP	NP	25	17	SM	2.9			
TP-2	3.0	NP	NP	NP	12.5	9	SW-SM	5.7			
TP-3	4.0	NP	NP	NP	25	12	SP-SM	4.5			

LAB SUMMARY - GINT STD US LAB.GDT - 1/17/19 09:33 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

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1053 Elkton Drive
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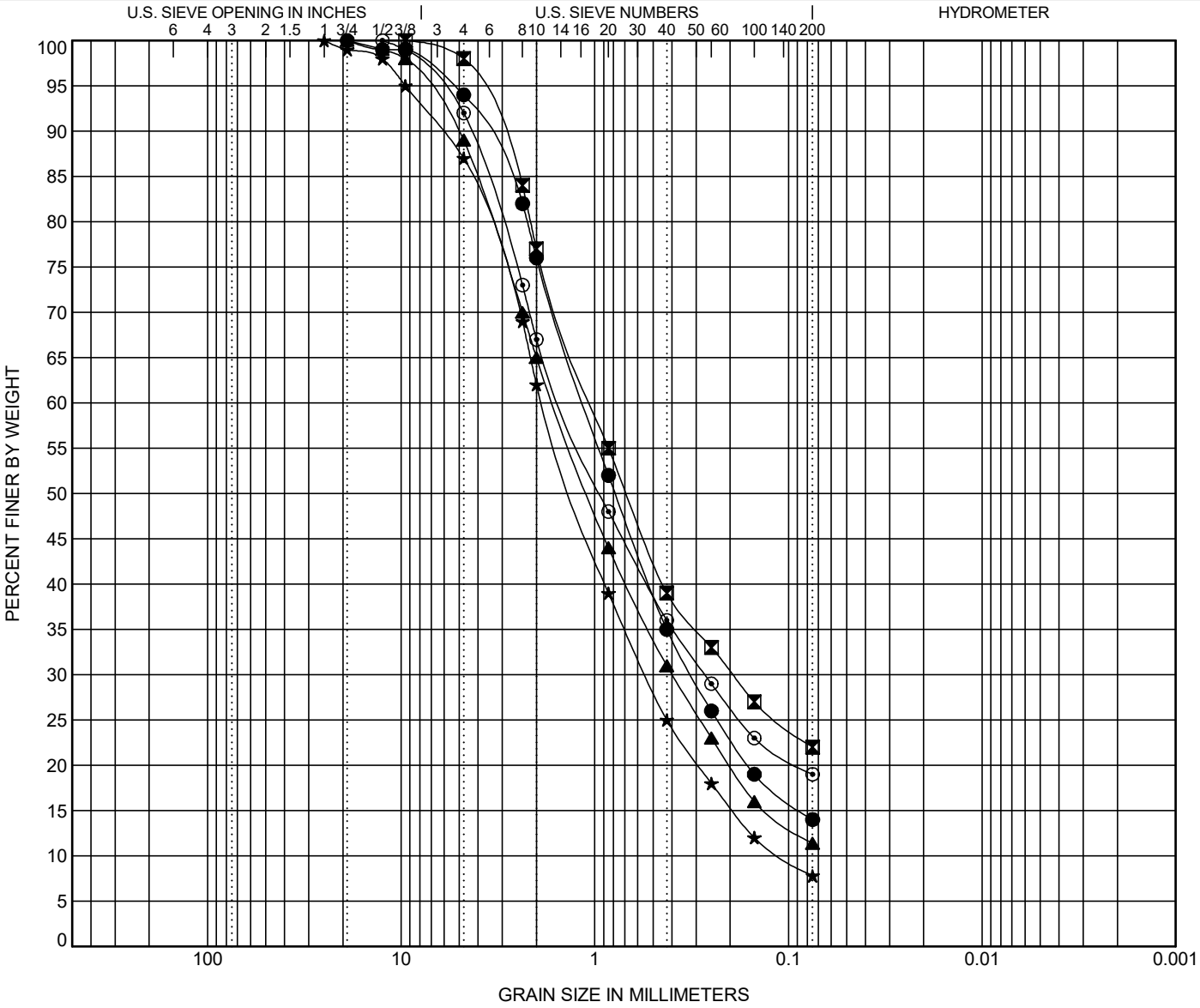
Fax: 719-896-4357

GRAIN SIZE DISTRIBUTION

CLIENT Herebic Homes **PROJECT NAME** Grandwood Subdivision

PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-1	9.0	SILTY SAND(SM)	NP	NP	NP		
⊠	B-2	9.0	CLAYEY SAND(SC)	43	26	17		
▲	B-3	4.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	1.60	26.86
★	B-3	14.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	1.48	17.22
⊙	B-4	2.0	SILTY SAND(SM)	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	9.0	19	1.131	0.316		6.0	80.0	14.0	
⊠	B-2	9.0	9.5	1.032	0.194		2.0	76.0	22.0	
▲	B-3	4.0	19	1.631	0.398		11.0	77.6	11.4	
★	B-3	14.0	25	1.857	0.544	0.108	13.0	79.2	7.8	
⊙	B-4	2.0	12.5	1.459	0.27		8.0	73.0	19.0	

GRAIN SIZE - GINT STD US LAB.GDT - 1/17/19 09:32 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

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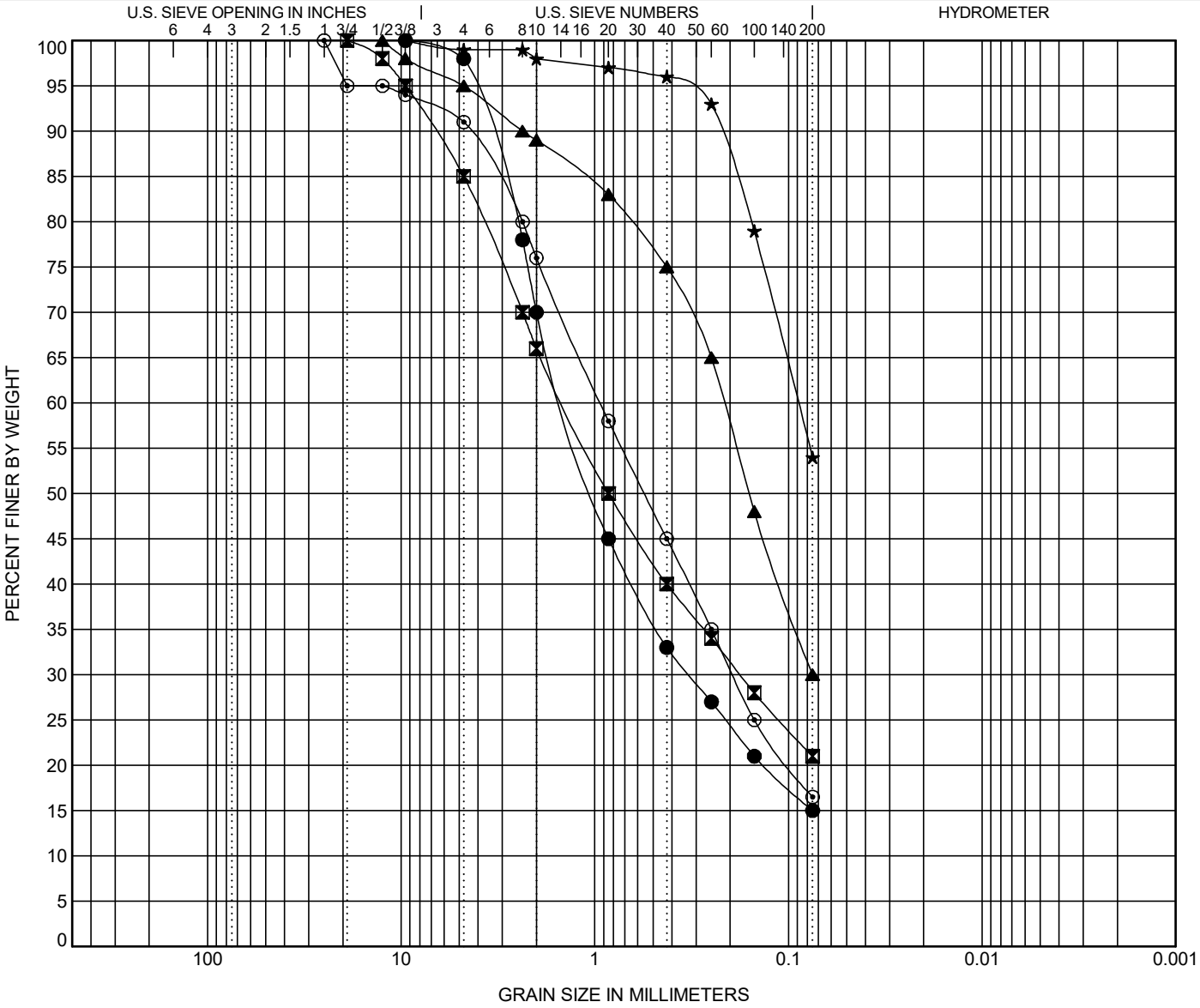
GRAIN SIZE DISTRIBUTION

CLIENT Herebic Homes **PROJECT NAME** Grandwood Subdivision

PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-4	14.0	SILTY SAND(SM)	NP	NP	NP		
⊠	B-6	9.0	SILTY, CLAYEY SAND with GRAVEL(SC-SM)	25	19	6		
▲	B-7	4.0	SILTY SAND(SM)	NP	NP	NP		
★	B-7	14.0	SANDY SILT(ML)	33	24	9		
⊙	TP-1	2.0	SILTY SAND(SM)	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-4	14.0	9.5	1.42	0.326		2.0	83.0	15.0	
⊠	B-6	9.0	19	1.451	0.178		15.0	64.0	21.0	
▲	B-7	4.0	12.5	0.215	0.075		5.0	65.0	30.0	
★	B-7	14.0	9.5	0.089			1.0	45.0	54.0	
⊙	TP-1	2.0	25	0.935	0.194		9.0	74.5	16.5	

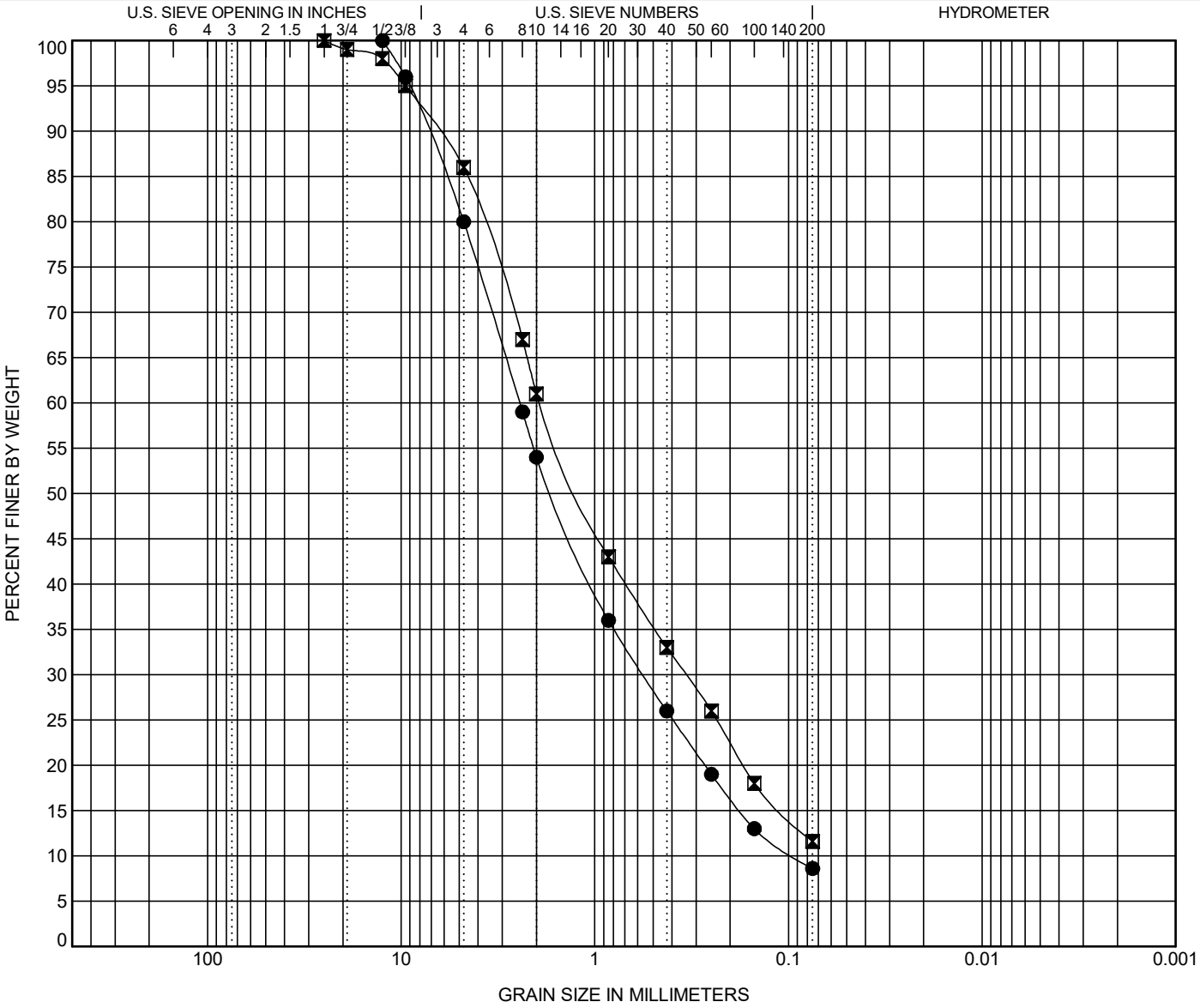
GRAIN SIZE - GINT STD US LAB.GDT - 1/17/19 09:32 - F:\VIVID PROJECTS\D18-2-175_GRANDWOOD SUBDIVISION\6 - DRAFTING\D18-2-175.GPJ

VIVID Engineering Group, Inc.
1053 Elkton Drive
Colorado Springs, CO 80907
Telephone: 719-896-4356
Fax: 719-896-4357

GRAIN SIZE DISTRIBUTION

CLIENT Herebic Homes **PROJECT NAME** Grandwood Subdivision

PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	TP-2	3.0	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP	1.38	26.09
⊠	TP-3	4.0	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.95	30.24

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-2	3.0	12.5	2.44	0.561	0.094	20.0	71.4	8.6	
⊠	TP-3	4.0	25	1.907	0.339		14.0	74.4	11.6	