Geotechnical Data Report

San Antonio Water System
Silver Mountain Pump Station Improvements
Bexar County, Texas

Arias Job No. 2022-982

Prepared For
Kimley-Horn & Associates, Inc.

December 12, 2024

142 Chula Vista, San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

FINAL REVIEW

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF FINAL REVIEW UNDER THE AUTHORITY OF

December 12, 2024

JAMES R MURPHREE, P.E. **DEXTER BACON, P.E.**

GEOTECHNICAL DATA REPORT

FOR

San Antonio Water System
Silver Mountain Pump Station Improvemnets

TABLE OF CONTENTS

Page

Table

INTRODUCTION

The results of our Geotechnical Field Operations and Laboratory Testing Program for the San Antonio Water System (SAWS) Silver Mountain Pump Station Improvements Project are presented in this Geotechnical Data Report (GDR). This project was authorized via the agreement for the subcontractor services between Kimley-Horn & Associates Inc. (KHA) and Arias & Associates, Inc. (Arias) dated March 24, 2023. Our scope of work was performed in general accordance with the services outlined in the proposal dated September 7, 2022.

SCOPE OF SERVICES

The scope of services for this Project was to:

- perform geotechnical borings to obtain soil/material samples for subsequent laboratory testing, as well as to characterize subsurface stratigraphic and groundwater conditions at the site,
- perform laboratory testing on recovered soil/material samples to evaluate engineering properties of the subgrade soils/materials, as well as for subsurface soil/material characterization, and,
- present the results of the field and laboratory test data in this GDR.

Environmental services or studies of any kind as well as analyses of slopes and/or retaining walls and the preparation of a Geotechnical Baseline Report (GBR) were beyond our authorized scope of services for this project. A Geotechnical Design Memorandum (GDM) will be presented in another subsequent report.

PROJECT DESCRIPTION

We understand that Kimley-Horn & Associates is assisting SAWS with improvements to the Silver Mountain Pump Station. The project is proposed to include a ground storage tank with an inside diameter of 39 feet. Ancillary structures including an electrical equipment building, pump station pad, and backup generator pad are planned as part of the improvements as well. Concrete pavements will be used for vehicle navigation. Approximately 4,000 feet of 12-inch water lines planned are to be installed along Silver Mountain Road. The pump station site is located south of San Antonio in Bexar County, Texas. The approximate site locations are presented on the Vicinity Map included as Figure 1 in Appendix A.

Based on our desktop review of Google Earth imagery, we understand that the existing pump stations consists of a pump pad and associated equipment.

FIELD EXPLORATION

A total of ten (10) borings were drilled for this project at the proposed locations. The borings were drilled to depths between ten (10) feet to sixty (60) feet below the existing ground surface. The approximate locations of the borings are shown on the Boring Location Plan included as Figure 2 in Appendix A. Boring details are summarized in Table 1 below.

Table 1: Boring Locations and Depths

Site	Boring No.	Proposed Structure	GPS Locations		Approximate Boring Depth (feet)	Date Drilled
			Latitude	Longitude		
Silver Mountain Pump Station	B-1	Ground Storage Tank	29° 11' 41.39"	-98° 32' 33.81"	60	8/29/2024
	B-2	Ground Storage Tank	29° 11' 41.26"	-98° 32' 33.63"	30	8/29/2024
	B-3	Ground Storage Tank	29° 11' 41.60"	-98° 32' 33.77"	30	8/29/2024
	B-4	Ground Storage Tank	29° 11' 41.31"	-98° 32' 34.04"	30	8/29/2024
	B-5	Pump Station	29° 11' 40.53"	-98° 32' 33.83"	40	7/3/2024
	B-6	Electrical Building	29° 11' 40.56"	-98° 32' 34.14"	40	7/3/2024
	B-7	Concrete Pavement	29° 11' 40.06"	-98° 32' 31.82"	10	7/1/2024
	B-8	Concrete Pavement	29° 11' 40.85''	-98° 32' 33.76"	10	7/3/2024
Silver Mountain Drive	B-9	Water Line	29° 11' 33.44''	-98° 32' 31.56"	15	7/1/2024
	B-10	Water Line	29° 11' 29.88"	-98° 32' 7.27"	15	7/1/2024

Notes:
1. GPS coordinates were taken using a hand-held GPS unit during drilling.
2. Boring depths are approximate and were measured relative to the existing surface at the time of drilling.

The borings were drilled with a truck-mounted drilling rig using continuous flight augers. Samples of encountered materials at the boring locations were obtained by either using a split-barrel sampler while performing the Standard Penetration Test (ASTM D 1586) as described in Appendix C. The sample depth interval and type of sampler used is included on the boring logs. Arias' field representative, working under the supervision of the project Geotechnical Engineer visually logged each recovered sample and placed a portion of the recovered sample into a plastic bag for transport to our laboratory. After completion of drilling, the boreholes were backfilled using cuttings generated during the drilling process mixed with bentonite.

Final classifications, as seen on the attached boring logs, were determined by the project Geotechnical Engineer based on laboratory and field test results and applicable ASTM procedures.

LABORATORY TESTING

As a supplement to the field exploration, laboratory testing was conducted to determine water content, Atterberg Limits, percent passing the US Standard No. 200 sieve, sulfates, California Bearing Ratio (CBR), corrosion potential and direct shear testing. The laboratory results are reported in the boring logs at the respective sample depths, which are included in Appendix B along with a key to the terms and symbols used on the logs. The laboratory testing for this project was done in general accordance with applicable ASTM and TxDOT procedures with the specifications and definitions for these tests listed in Appendix C. Partial grain size distribution curves are included in Appendix D. Remaining samples recovered from this exploration will be routinely discarded following submittal of this report.

Soluble Sulfate Test Results

Laboratory testing was conducted on two (2) selected samples recovered from the borings drilled at the site to determine the soluble sulfate content. Testing was performed in general accordance with TxDOT test method Tex-145-E “Determining Sulfate Content in Soils.” The results indicate that the soluble sulfate contents of the samples tested ranged from about 180 to 280 parts per million (ppm). The results are indicative of low soil sulfate content at this site. Therefore, lime or cement treatment of the onsite soils may be considered for this project. A summary of the sulfate test results is provided below in Table 2.

Table 2: Soluble Sulfate Test Results

Boring No.	Depth, feet	Description	Soluble Sulfate, ppm
B-7	0 – 2	Poorly-graded Sand with Silt (SP-SM)	280
B-8	2 – 4	Poorly-graded Sand with Silty Clay (SP-SC)	180

California Bearing Ratio Test

One (1) composite soil sample was obtained during field exploration. Laboratory testing performed on the composite sample included moisture-density relationship and California Bearing Ratio (CBR) testing. The moisture-density relationship, using the Standard Proctor (ASTM D 698) method, was performed to establish the optimum moisture content and the maximum dry density of the composite sample when subjected to a specified compactive effort.

A laboratory CBR test was performed using the three-point method. The test results are summarized below in Table 3 and included in Appendix D.

Table 3: CBR Test Results

Sample Location	Composite Sample
Sample Classification	Poorly-graded Sand with Silt (SP-SM)
Plasticity Index (PI)	Non-Plastic
Maximum Dry Density (pcf)	104.8
Optimum Moisture Content (%)	5.0
CBR	3.5

Corrosivity Testing

As a part of the corrosion potential testing, Sulfate, Chloride, pH, Electrical Resistivity, and Oxidation-Reduction Potential tests were conducted in accordance with Tex-145-E, Tex-620-J, Tex-128-E, Tex-129-E, and ASTM D1498 standard methods, respectively. Analytical test results are presented in Table 4 subsequently.

Table 4: Analytical Test Results

Boring No.	Depth, feet	Sulfate, ppm	Chloride, mg/Kg	pH	Electrical Resistivity, Ohm-cm	Oxidation-Reduction Potential, (mV)
B-2	4 – 8	200	20	7.51	12000	261
B-3	0 – 2	180	20	7.44	11500	312

Consolidated Drained Direct Shear Test Results

Consolidated drained direct shear tests were performed on recovered samples from borings B-1 and B-3. The testing was performed on three (3) separate specimens for each sample (i.e., multi-sample tests). Laboratory results for the testing are included in Appendix E and are summarized subsequently in Table 5.

Table 5: Multi-Sample Consolidated Drained Direct Shear Results

Test Type	3 Specimens			3 Specimens		
Condition	Remolded			Remolded		
Boring	B-1			B-3		
Depth, feet	6-10			10-12		
Description	Clayey Sand (SC)			Clayey Sand (SC)		
Index Properties						
Fines content, %-200	9			14 – 26*		
Liquid limit, LL	20			16 – 19*		
Plastic limit, PL	10			8 – 9*		
Plasticity index, PI	10			8 – 10*		
Test Density, Water Content, Specific Gravity, and Void Ratio						
Initial Dry density, $\gamma_{d\ (pcf)}$	104.3	104.6	104.7	104.3	104.7	104.7
Initial Water content, $w_{c\ (\%)}$	5.1	5.2	5.1	5.1	5.0	5.0
Specific gravity, G_s	2.68 (assumed)			2.68 (assumed)		
Initial Void ratio, e_o	0.60	0.60	0.60	0.60	0.60	0.60
Drained Strength Parameters						
Effective cohesion, c' Peak (Post Peak)	144 psf	(144) psf		0 psf	(0) psf	
Effective angle of internal friction, ϕ' Peak (Post Peak)	24.6 deg.	(23.7) deg.		30.7 deg.	(30.2) deg.	

***** Material quantities at the Direct Shear testing depth were not available for index property testing for B-3. The ranges shown are properties from adjacent sample intervals (6'–8') and (13'–15'), respectively.

SUBSURFACE CONDITIONS

Geology, generalized stratigraphy, and groundwater conditions at the project site are discussed in the following sections. The subsurface and groundwater conditions are based on the conditions encountered at the boring locations to the depths explored.

Geology

The project site is found over the ***Carrizo Sands (Ec).*** The Carrizo Sand, which dates to the Eocene, consists of a medium to coarse grained sandstone and becomes finer grained near the surface. The sands are friable and noncalcareous. The material is light yellow to orange and brown and weathers to a yellowish brown with iron oxide stains and deposits. A Geologic Map for the project site is presented on Figure 3 in Appendix A.

Subsurface Condition Encountered in the Boring

The subsurface stratigraphy at the Silver Mountain site is predominantly comprised of sands with varying amounts of fines contents. The general stratigraphic conditions at the boring locations for each site are summarized subsequently in Tables 6.

Table 6: Generalized Subsurface Conditions –

Material Type	Material Type	PI Range PI Avg	No. 200 Range No. 200 Avg	N-value Range N-value Avg
Cohesive	SANDY FAT CLAY (CH), LEAN CLAY (CL), LEAN CLAY with SAND (CL) – Very stiff to very hard – tan and gray – with ferrous stains *(in B-8 & B-10 only)*	23 – 31	59 – 91	15 – 50/4
		26	78	42
Granular	CLAYEY SAND (SC), SILTY SAND (SM), Poorly graded SAND with SILT (SP-SM), Poorly graded SAND with SILTY CLAY (SP-SC), GRAVEL with SAND (GP) – Very Loose to Very dense – dark brown, brown, tan	NP – 31	5 – 28	2 – **50/3”
		9	15	--

Where: Depth - Depth from existing pavement/ground surface, feet, as applicable
PI - Plasticity Index, %
No. 200 - Passing #200 sieve, %
N - Standard Penetration Test (SPT) value, blows per foot or inches if noted
* - Only one test performed
** - Blow Counts During Seating Penetration
-- - No Test
NP - Non-Plastic

The presence and thickness of the various subsurface materials can be expected to vary away from the exploration locations. The descriptions conform to the Unified Soils Classification System.

Groundwater

A dry soil sampling method was used to obtain the soil samples at the project site. Groundwater was not observed during drilling operations between July 1, 2024, to August 29, 2024.

Subsurface water levels will often change significantly over time and should be verified immediately prior to construction. Water levels in open boreholes may require several hours to several days to stabilize depending on the permeability of the soils.

It should be noted that groundwater levels at the time of construction may differ from the observations obtained during the field exploration because perched groundwater is subject to seasonal conditions, recent rainfall, flooding, drought, or temperature affects. Granular soils such as sandy soils can readily transmit subsurface water. Groundwater levels should be verified immediately prior to construction. *Should dewatering become necessary, it is considered “means and methods” and is solely the responsibility of the Contractor.*

GENERAL COMMENTS

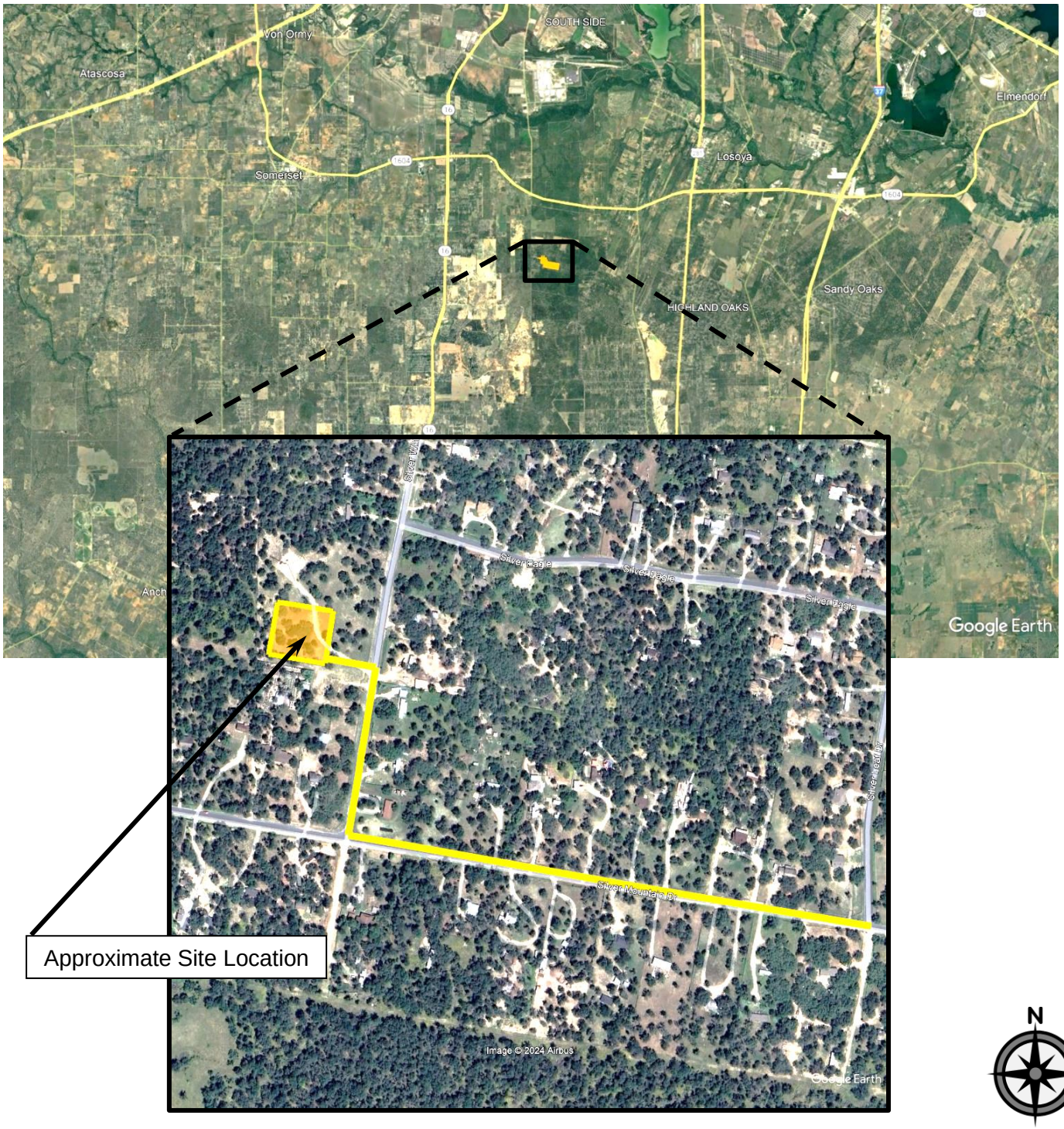
Subsurface Variations

Soil/material and groundwater conditions may vary between and away from the sample boring locations. Transition boundaries or contacts, noted on the boring logs to separate soil/material types, are approximate. Actual contacts may be gradual and vary at different locations.

Standard of Care

Subject to the limitations inherent in the agreed scope of services as to the degree of care and amount of time and expenses to be incurred, and subject to any other limitations contained in the agreement for this work, Arias has performed its services consistent with that level of care and skill ordinarily exercised by other professional engineers practicing in the same locale and under similar circumstances at the time the services were performed.

APPENDIX A: FIGURES



ARIAS
142 Chula Vista, San Antonio, Texas 78232
Phone: (210) 308-5884 • Fax: (210) 308-5886

VICINITY MAP

SAWS Silver Mountain Pump Station
Bexar County, Texas

Date: September 3, 2024	Job No.: 2022-982
Drawn By: MEB	Checked By: JRM
Approved By: MJO	Scale: N.T.S.

Figure 1

ARIAS
142 Chula Vista, San Antonio, Texas 78232
Phone: (210) 308-5884 • Fax: (210) 308-5886

BORING LOCATION PLAN

SAWS Silver Mountain Pump Station
Bexar County, Texas

Date: September 27, 2024	Job No.: 2022-982
Drawn By: MEB	Checked By: JRM
Approved By: MJO	Scale: N.T.S.

REVISIONS:

No.:	Date:	Description:

Figure 2

ARIAS
142 Chula Vista, San Antonio, Texas 78232
Phone: (210) 308-5884 • Fax: (210) 308-5886

BORING LOCATION PLAN

SAWS Silver Mountain Pump Station
Bexar County, Texas

Date: September 27, 2024	Job No.: 2022-982
Drawn By: MEB	Checked By: JRM
Approved By: MJO	Scale: N.T.S.

REVISIONS:

No.:	Date:	Description:

Figure 2

ARIAS
142 Chula Vista, San Antonio, Texas 78232
Phone: (210) 308-5884 • Fax: (210) 308-5886

REVISIONS:

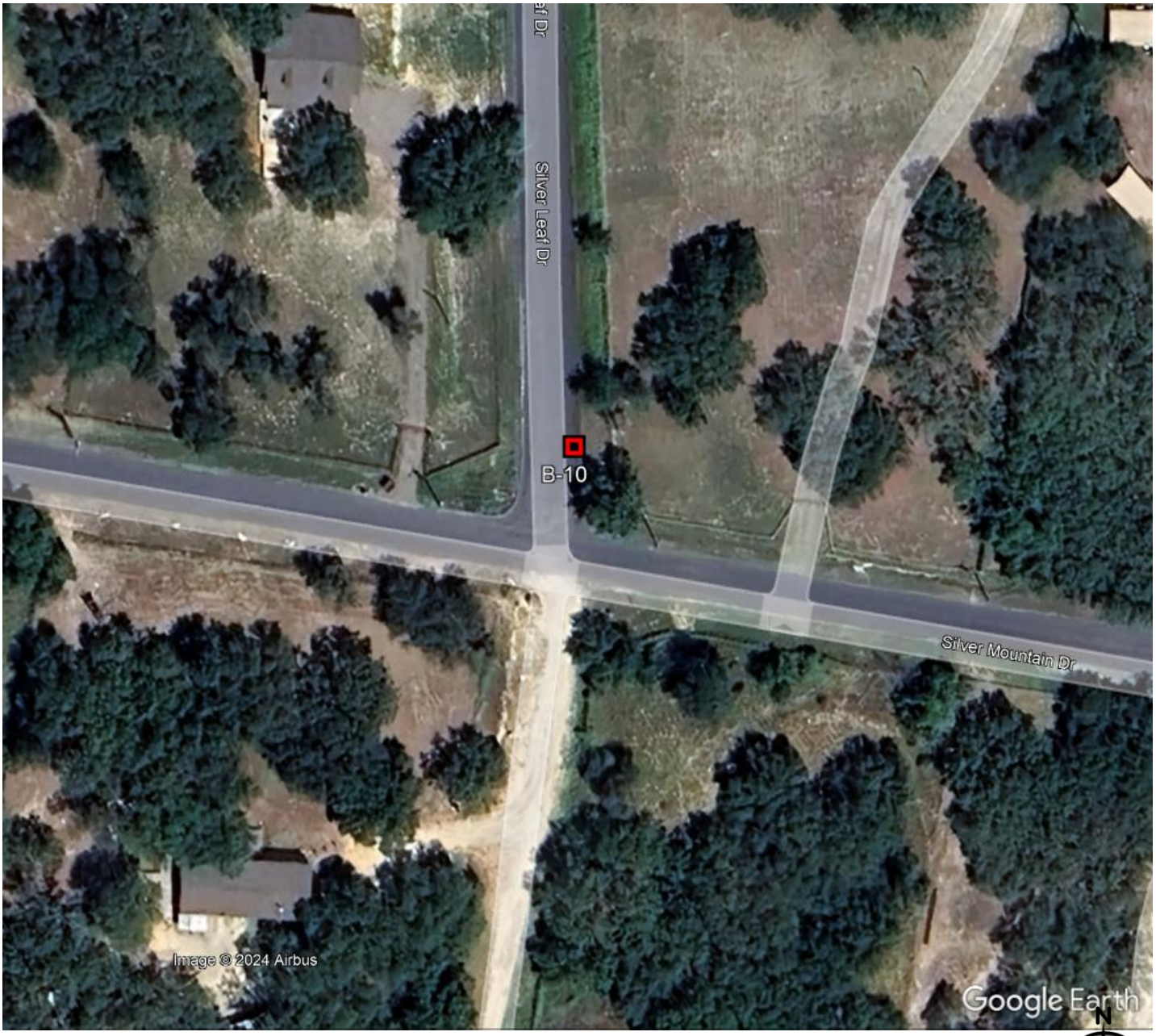
No.:	Date:	Description:

BORING LOCATION PLAN

SAWS Silver Mountain Pump Station
Bexar County, Texas

Date: September 27, 2024	Job No.: 2022-982
Drawn By: MEB	Checked By: JRM
Approved By: MJO	Scale: N.T.S.

Figure 2



ARIAS
142 Chula Vista, San Antonio, Texas 78232
Phone: (210) 308-5884 • Fax: (210) 308-5886

REVISIONS:

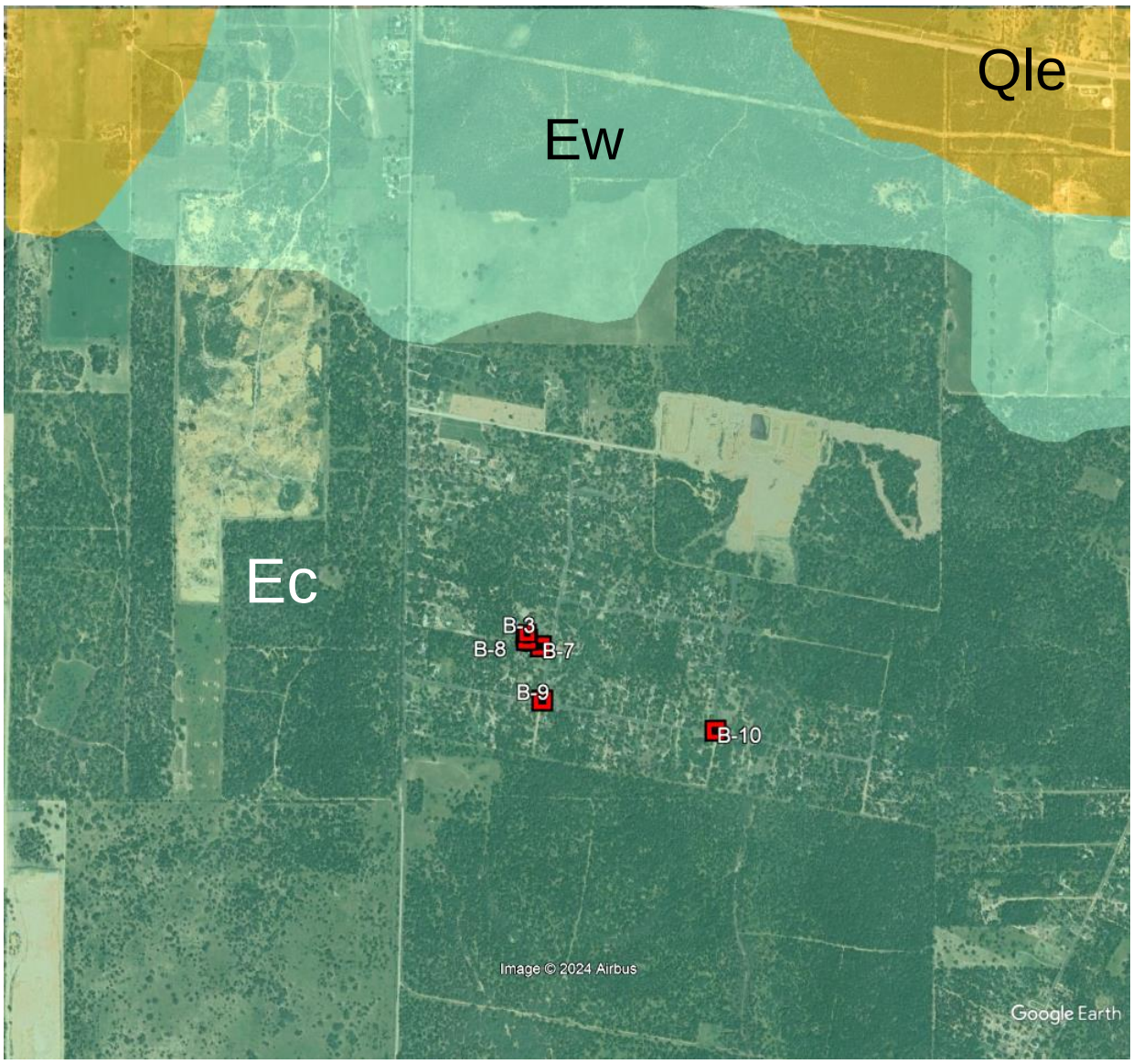
No.:	Date:	Description:

BORING LOCATION PLAN

SAWS Silver Mountain Pump Station
Bexar County, Texas

Date: September 27, 2024	Job No.: 2022-982
Drawn By: MEB	Checked By: JRM
Approved By: MJO	Scale: N.T.S.

Figure 2



LEGEND

Symbol	Name	Age
Ec	Carrizo Sand	Tertiary Period / Eocene
Ewi	Wilcox Group	Tertiary Period / Eocene
Qle	Leona Formation	Quaternary Period / Pleistocene

N

ARIAS
142 Chula Vista, San Antonio, Texas 78232
Phone: (210) 308-5884 • Fax: (210) 308-5886

GEOLOGIC MAP

SAWS Silver Mountain Pump Station
Bexar County, Texas

Date: September 3, 2024	Job No.: 2022-982
Drawn By: HDB / MEB	Checked By: JRM
Approved By: MJO	Scale: N.T.S.

Figure 3

APPENDIX B: BORING LOGS AND KEY TO TERMS

Boring Log No. B-1

Project: **SAWS Silver Mountain Pump Station Improvements** Sampling Date: 8/29/24
2111 Silver Mountain Dr
Bexar County, Texas

Location: See Boring Location Plan

Coordinates: N29°11'41.39" W98°32'33.81"

Backfill: Cuttings/bentonite

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
CLAYEY SAND (SC), very loose to very dense, dark brown to reddish brown		SS	7				3	15
		SS	9	13	26	13	3	28
- light brown, with ferrous stains from 4'-10'	5	SS	2				16	12
- dense from 6'-18'		SS	3	10	20	10	35	
		SS	0				42	9
	10	SS	2	9	18	9	26	17
		SS	1				30	
	15							
		SS	3				50/6"	
	20							
		SS	4	9	20	11	80/2"	18
	25							
		SS	3				50/1"	
	30							

(continued)

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Texas Geo Bore Drilling, LLC
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 18 ft
Air rotary: 18 - 60 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-1 (continued)

Project: **SAWS Silver Mountain Pump Station Improvements**
2111 Silver Mountain Dr
Bexar County, Texas

Sampling Date: 8/29/24

Coordinates: N29°11'41.39" W98°32'33.81"

Location: See Boring Location Plan

Backfill: Cuttings/bentonite

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
CLAYEY SAND (SC), very loose to very dense, dark brown to reddish brown *(continued)*								
		SS	4				**50/6"	
	35							
		SS	3				50/5"	
	40							
		SS	4	10	20	10	50/6"	15
	45							
		SS	4				50/6"	
	50							
SILTY SAND (SM), very dense, orangish tan								
		SS	4				68	
	55							
		SS	3	NP	NP	NP	50/6"	14
	60							
Borehole terminated at 60 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Texas Geo Bore Drilling, LLC
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 18 ft
Air rotary: 18 - 60 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
NP = Non-plastic

Boring Log No. B-2

Project: **SAWS Silver Mountain Pump Station Improvements** Sampling Date: 8/29/24
2111 Silver Mountain Dr
Bexar County, Texas

Coordinates: N29°11'41.26" W98°32'33.63"

Location: See Boring Location Plan

Backfill: Cuttings/bentonite

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silt (SP-SM), loose, dark brown		SS	4	NP	NP	NP	7	10
SILTY, CLAYEY SAND (SC-SM), loose to medium dense, light brown		SS	1				9	
	5	SS	1				23	
		SS	2	9	15	6	27	12
		SS	1				28	
	10	GB						
SILTY SAND (SM), dense, light brown		SS	1	NP	NP	NP	37	19
	15							
CLAYEY SAND (SC), very dense, reddish brown		SS	4				50/6"	
	20							
		SS	3	10	21	11	**50/3"	
	25							
		SS	3				**50/3"	
	30							

Borehole terminated at 30 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Texas Geo Bore Drilling, LLC
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 30 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-3

Project: **SAWS Silver Mountain Pump Station Improvements**
2111 Silver Mountain Dr
Bexar County, Texas

Sampling Date: 8/29/24

Coordinates: N29°11'41.6" W98°32'33.77"

Location: See Boring Location Plan

Backfill: Cuttings/bentonite

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silty Clay (SP-SC), loose, dark brown		SS	2				7	
Poorly-graded SAND with Silt (SP-SM), loose to medium dense, brown		SS	1	NP	NP	NP	7	11
	5	SS	1				15	
CLAYEY SAND (SC), medium dense to very dense, light brown to reddish brown - with ferrous nodules from 6'-13'		SS	2	8	16	8	28	14
		SS	1				19	
	10	SS	1				19	
		SS	3	9	19	10	50/3"	26
	15							
		SS	3				50/6"	
	20			8	18	10		25
		SS	3				50/3"	
	25							
		SS	2				50/6"	
	30							
Borehole terminated at 30 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Texas Geo Bore Drilling, LLC
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 30 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-4

Project: **SAWS Silver Mountain Pump Station Improvements**
2111 Silver Mountain Dr
Bexar County, Texas

Sampling Date: 8/29/24

Coordinates: N29°11'41.31" W98°32'34.04"

Location: See Boring Location Plan

Backfill: Cuttings/bentonite

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silty Clay (SP-SC), loose, dark brown		SS	4	10	17	7	5	10
Poorly-graded SAND with Silt (SP-SM), loose to medium dense, brown		SS	1				5	
	5	SS	1	NP	NP	NP	14	10
CLAYEY SAND (SC), dense to very dense, light brown to reddish brown - with ferrous nodules from 6'-10'		SS	2				48	
		SS	1				76	
	10	GB	2	9	19	10		16
		SS	3				50/5"	
	15							
		SS	3				50/3"	
	20							
		SS	2				**50/6"	
	25							
		SS	3	9	19	10	50/2"	18
	30							
Borehole terminated at 30 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Texas Geo Bore Drilling, LLC
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 30 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-5

Project: **SAWS Silver Mountain Pump Station Improvements** Sampling Date: 7/3/24
2111 Silver Mountain Dr
Bexar County, Texas

Coordinates: N29°11'40.53" W98°32'33.83"

Location: See Boring Location Plan

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silt (SP-SM), very loose to loose, brown to light brown		SS	1				2	
		SS	2	NP	NP	NP	3	7
	5	SS	1				4	
		SS	2				6	
		SS	4				6	
	10							
CLAYEY SAND (SC), medium dense to very dense, reddish brown		SS	4	11	28	17	16	12
		SS	4				16	
	15							
- light tan from 18'-25'		SS	2				50	
	20							
- very dense below 23'		SS	2				**50/5"	
	25							
		SS	4	10	26	16	50/2"	16
	30							
		SS	5				**50/5"	
	35							
		SS	5	9	22	13	**50/4"	22
	40							

Borehole terminated at 40 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 40 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-6

Project: **SAWS Silver Mountain Pump Station Improvements** Sampling Date: 7/3/24
2111 Silver Mountain Dr
Bexar County, Texas

Coordinates: N29°11'40.56" W98°32'34.14"

Location: See Boring Location Plan

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silt (SP-SM), very loose to loose, brown		SS	1				2	8
		SS	3				3	
	5	SS	1				5	
CLAYEY SAND (SC), medium dense to very dense, reddish brown		SS	5	10	24	14	18	18
		SS	6				23	19
	10	SS	5				27	
- very dense below 13'		SS	4	12	39	27	81/8"	19
	15							
		SS	4				50/4"	
	20							
		SS	6				50/2"	
	25							
		SS	2				**50/4"	
	30							
		SS	7	11	28	17	50/3"	19
	35							
		SS	5				50/2"	
	40							

Borehole terminated at 40 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 40 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-7

Project: **SAWS Silver Mountain Pump Station Improvements**
2111 Silver Mountain Dr
Bexar County, Texas

Sampling Date: 7/1/24

Coordinates: N29°11'40.06" W98°32'31.82"

Location: See Boring Location Plan

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silt (SP-SM), loose to very loose, brown		SS	2				5	
		SS	3	NP	NP	NP	2	8
CLAYEY SAND (SC), loose to medium dense, reddish brown	5	SS	3				4	
		SS	6	14	27	13	16	19
		SS	4				26	
	10							
Borehole terminated at 10 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: H. Bowman
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 10 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-8

Project: **SAWS Silver Mountain Pump Station Improvements**
2111 Silver Mountain Dr
Bexar County, Texas

Sampling Date: 7/3/24

Coordinates: N29°11'40.85" W98°32'33.76"

Location: See Boring Location Plan

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silty Clay (SP-SC), loose to medium dense, tan		SS	1	NP	NP	NP	6	10
		SS	3				19	
LEAN CLAY with Sand (CL), very stiff to very hard, tan and red, with ferrous stains	5	SS	7	15	39	24	27	85
		SS	5				76	
		SS	7				50/4"	
	10							
Borehole terminated at 10 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: L. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 10 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-9

Project: **SAWS Silver Mountain Pump Station Improvements**
2111 Silver Mountain Dr
Bexar County, Texas

Sampling Date: 7/1/24

Coordinates: N29°11'33.44" W98°32'31.56"

Location: See Boring Location Plan

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
Poorly-graded SAND with Silt (SP-SM), medium dense to loose, brown		SS	4				12	
		SS	4				6	
	5	SS	4	NP	NP	NP	3	9
		SS	5				4	
		SS	5				6	
	10							
CLAYEY SAND (SC), loose, reddish brown		SS	6	15	36	21	10	18
		SS	6				8	
	15							
Borehole terminated at 15 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: H. Bowman
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 15 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
-200 = % Passing #200 Sieve
NP = Non-plastic

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

Boring Log No. B-10

Project: **SAWS Silver Mountain Pump Station Improvements**
2111 Silver Mountain Dr
Bexar County, Texas

Sampling Date: 7/1/24

Coordinates: N29°11'29.88" W98°32'7.27"

Location: See Boring Location Plan

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
GRAVEL with Sand (GP), loose, brown		SS	1				8	5
CLAYEY SAND (SC), loose to very loose, brown to light brown		SS	4				5	
	5	SS	7				3	
SANDY FAT CLAY (CH), very stiff to hard, reddish tan		SS	20	22	53	31	15	59
		SS	16				23	
	10	SS	17				33	
LEAN CLAY (CL), very stiff, gray and tan		SS	17	17	40	23	24	91
	15							
Borehole terminated at 15 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: H. Bowman
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 15 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
NP = Non-plastic

N = SPT Blow Count
-200 = % Passing #200 Sieve

GINT.GPJ 10/1/24 (BORING LOG SA13-02.ARIASSA13-02.GDT.LIBRARY2023.GLB)

Arias & Associates, Inc.

Job No.: 2022-982

APPENDIX C: FIELD AND LABORATORY EXPLORATION

FIELD AND LABORATORY EXPLORATION

The field exploration program included drilling at selected locations within the site and intermittently sampling the encountered materials. The boreholes were drilled with single flight augers. Samples of encountered materials were obtained using a split-barrel sampler while performing the Standard Penetration Test (ASTM D 1586). The sample depth interval and type of sampler used is included on the boring log. Arias' field representative visually logged each recovered sample and placed a portion of the recovered samples into a plastic bag for transport to our laboratory.

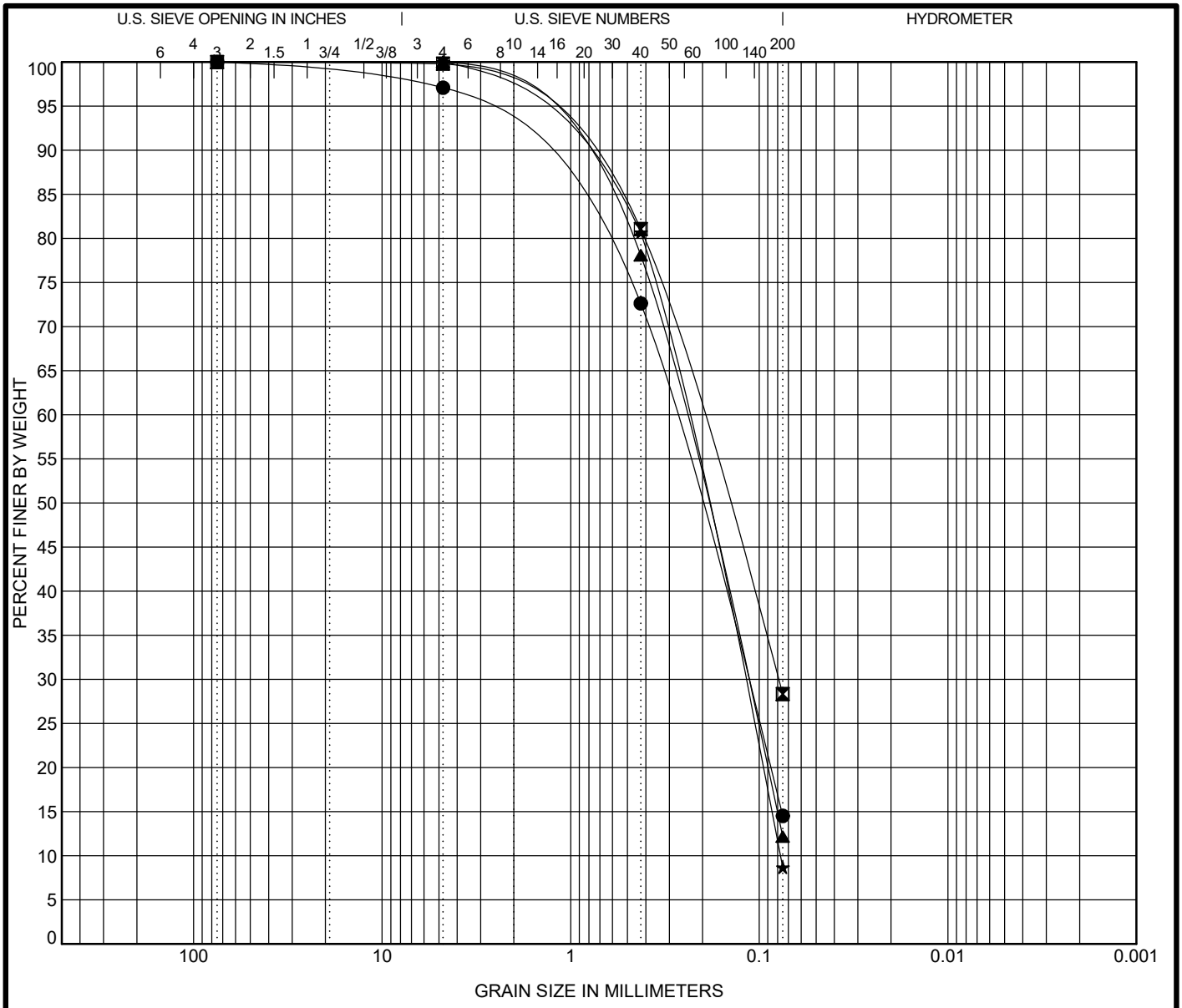
SPT N-values and blow counts for those intervals where the sampler could not be advanced for the required 18-inch penetration are shown on the boring log. If the test was terminated during the 6-inch seating interval or after 10 hammer blows were applied and no advancement of the sampler was noted, the log denotes this condition as blow count during seating penetration.

Arias performed laboratory tests on selected samples to aid in soil/material classification and to determine engineering properties. Tests commonly used in geotechnical exploration, the method used to perform the test, and the column designation on the boring log where data are reported are summarized as follows:

Test Name	Test Method	Log Designation
Water (moisture) content of soil and rock by mass	ASTM D2216	WC
Liquid limit, plastic limit, and plasticity index of soils/materials	ASTM D4318	PL, LL, PI
Amount of material in soils/materials finer than the No. 200 sieve	ASTM D1140	-200
Soluble Sulfate Content	Tex-145-E	na
California Bearing Ration (CBR)	ASTM D1883	na
Chloride Content in Soils	Tex-620-J	na
pH of Soils	Tex-128-E	na
Electrical Resistivity of Soils	Tex-129-E	na
Oxidation-Reduction Potential	ASTM D1498	na
Direct Shear Consolidated Drained Test	ASTM D3080	na

Laboratory test results for index properties are shown on the boring logs in Appendix B. Sulfate contents are shown in Table 2, CBR results are shown in Table 3, Analytical test results are shown in Table 5, and Direct Shear test results are shown in Table 6.

APPENDIX D: PARTIAL GRAIN SIZE DISTRIBUTION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	1		0.0	CLAYEY SAND (SC)					
⊠	1		2.0	CLAYEY SAND (SC)	26	13	13		
▲	1		4.0	CLAYEY SAND (SC)				0.77	3.73
★	1		8.0	CLAYEY SAND (SC)				0.79	3.34

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	0.0	75	0.292	0.119		2.9	82.6	14.5	
⊠	1	2.0	75	0.213	0.079		0.2	71.5	28.3	
▲	1	4.0	4.75	0.264	0.12		0.0	87.8	12.2	
★	1	8.0	4.75	0.258	0.125	0.077	0.0	91.3	8.7	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

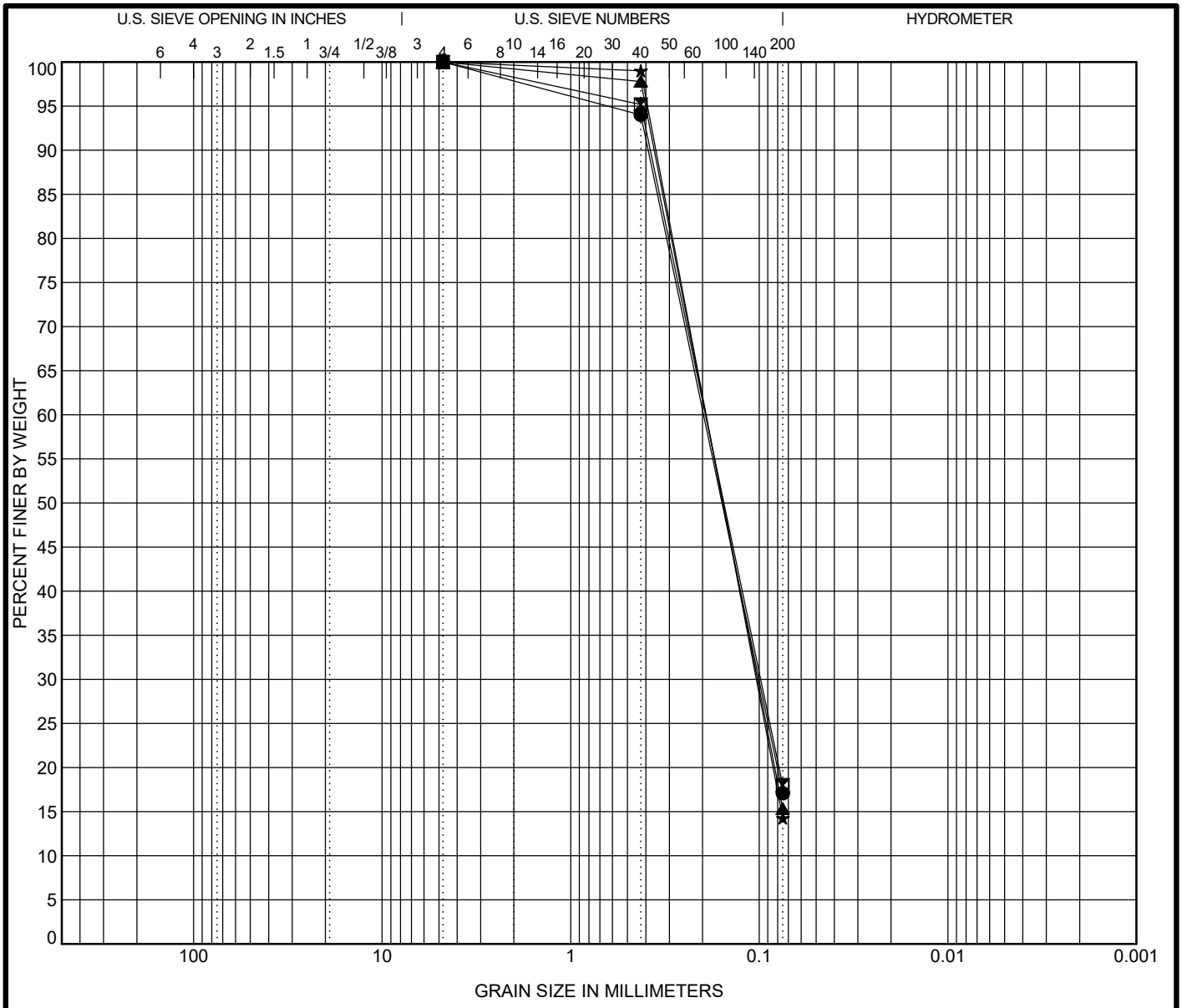
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	1		10.0	CLAYEY SAND (SC)	18	9	9		
⊠	1		23.0	CLAYEY SAND (SC)	20	9	11		
▲	1		43.0	CLAYEY SAND (SC)	20	10	10		
★	1		58.0	SILTY SAND (SM)	NP	NP	NP		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	10.0	4.75	0.197	0.1		0.0	82.9	17.1	
⊠	1	23.0	4.75	0.193	0.098		0.0	82.0	18.0	
▲	1	43.0	4.75	0.192	0.102		0.0	84.7	15.3	
★	1	58.0	4.75	0.191	0.104		0.0	85.7	14.3	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

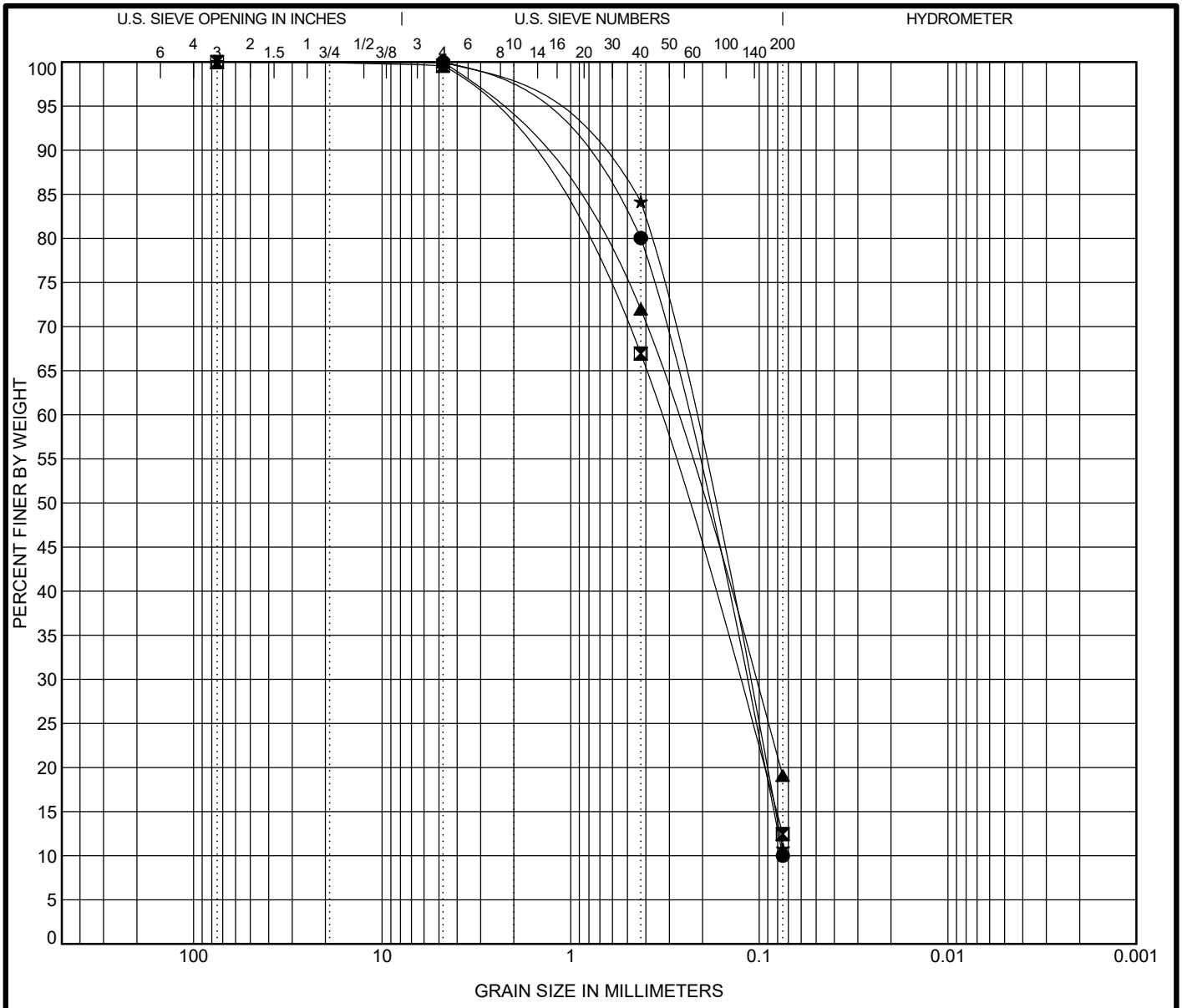
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	2		0.0	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.78	3.45
⊠	2		6.0	SILTY, CLAYEY SAND (SC-SM)	15	9	6	0.73	4.91
▲	2		13.0	SILTY SAND (SM)	NP	NP	NP		
★	3		2.0	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.79	3.26

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2	0.0	4.75	0.259	0.123		0.0	90.0	10.0	
⊠	2	6.0	75	0.341	0.131		0.4	87.1	12.5	
▲	2	13.0	4.75	0.287	0.107		0.0	80.9	19.1	
★	3	2.0	75	0.24	0.118		0.1	89.1	10.8	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

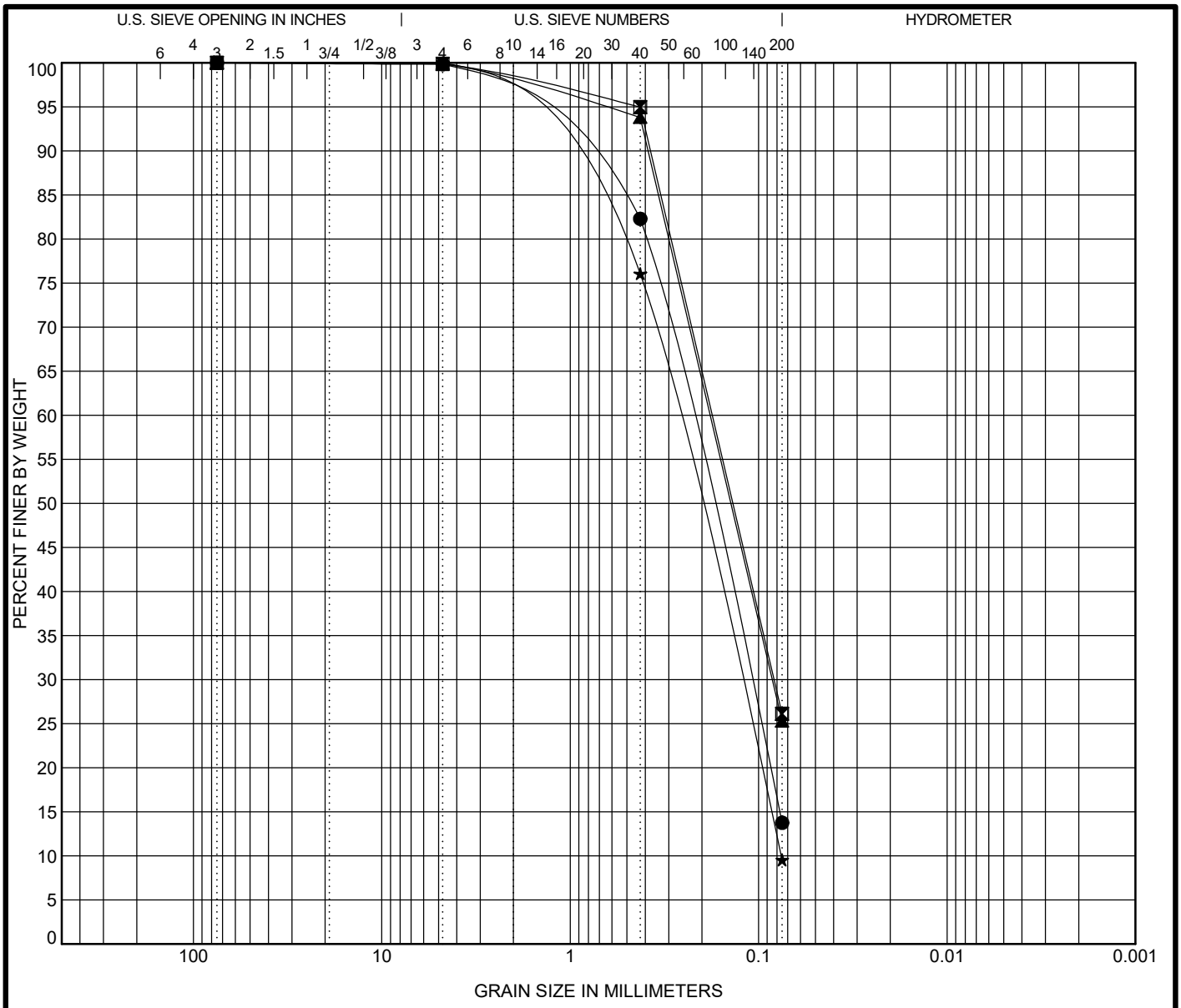
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	3		6.0	**CLAYEY SAND (SC)**	16	8	8		
⊠	3		13.0	**CLAYEY SAND (SC)**	19	9	10		
▲	3		22.0	**CLAYEY SAND (SC)**	18	8	10		
★	4		0.0	**POORLY GRADED SAND with SILTY CLAY (SP-SC)**	17	10	7	0.77	3.68

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	3	6.0	75	0.242	0.113		0.1	86.1	13.8	
⊠	3	13.0	75	0.176	0.083		0.1	73.7	26.1	
▲	3	22.0	75	0.181	0.085		0.1	74.6	25.3	
★	4	0.0	4.75	0.28	0.128	0.076	0.0	90.5	9.5	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

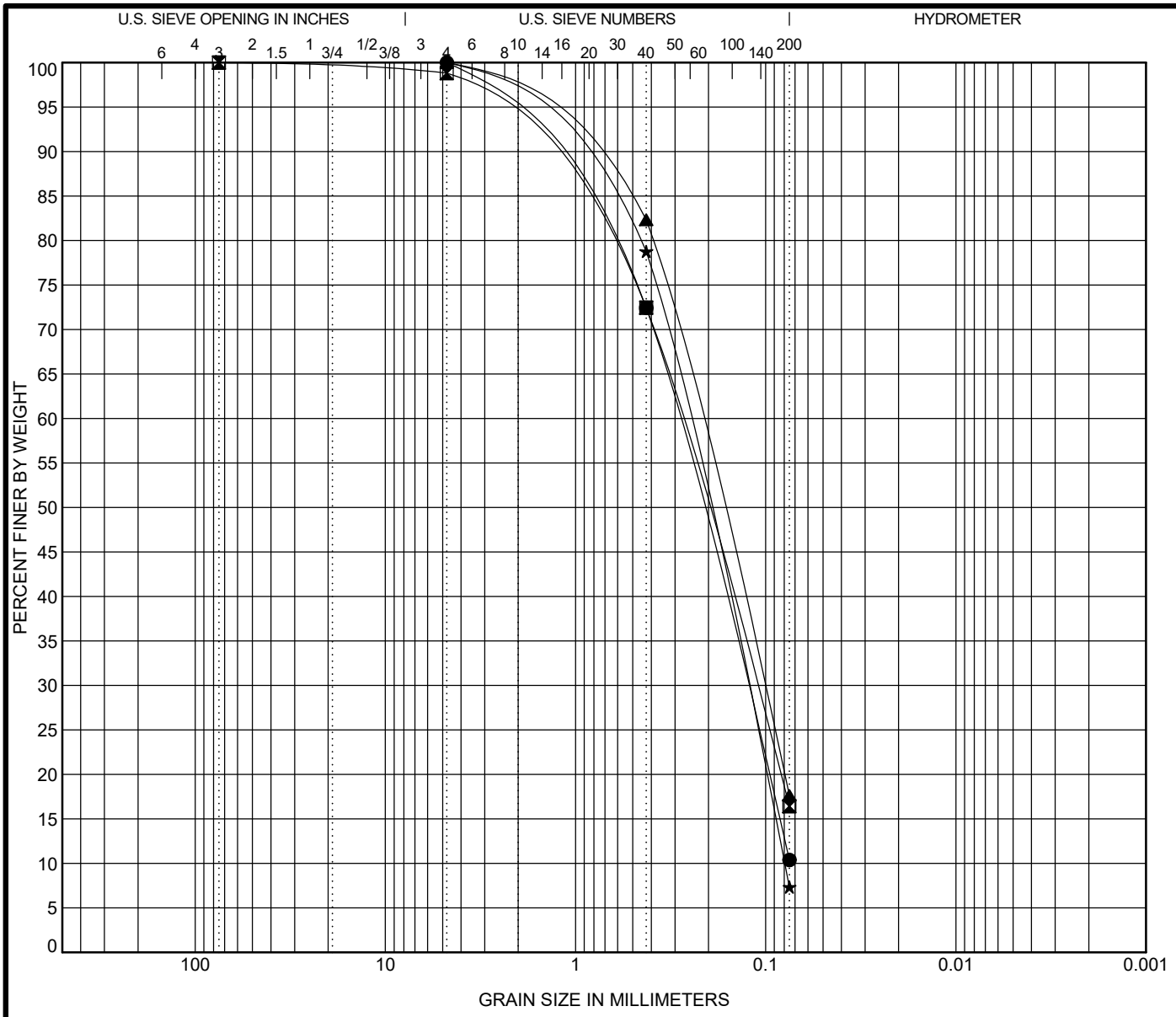
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	4		4.0	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.76	4.05
⊠	4		10.0	CLAYEY SAND (SC)	19	9	10		
▲	4		28.0	CLAYEY SAND (SC)	19	9	10		
★	5		2.0	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.78	3.37

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	4	4.0	4.75	0.3	0.13		0.0	89.6	10.4	
⊠	4	10.0	75	0.289	0.114		1.2	82.4	16.4	
▲	4	28.0	4.75	0.233	0.104		0.0	82.3	17.7	
★	5	2.0	4.75	0.269	0.13	0.08	0.0	92.7	7.3	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

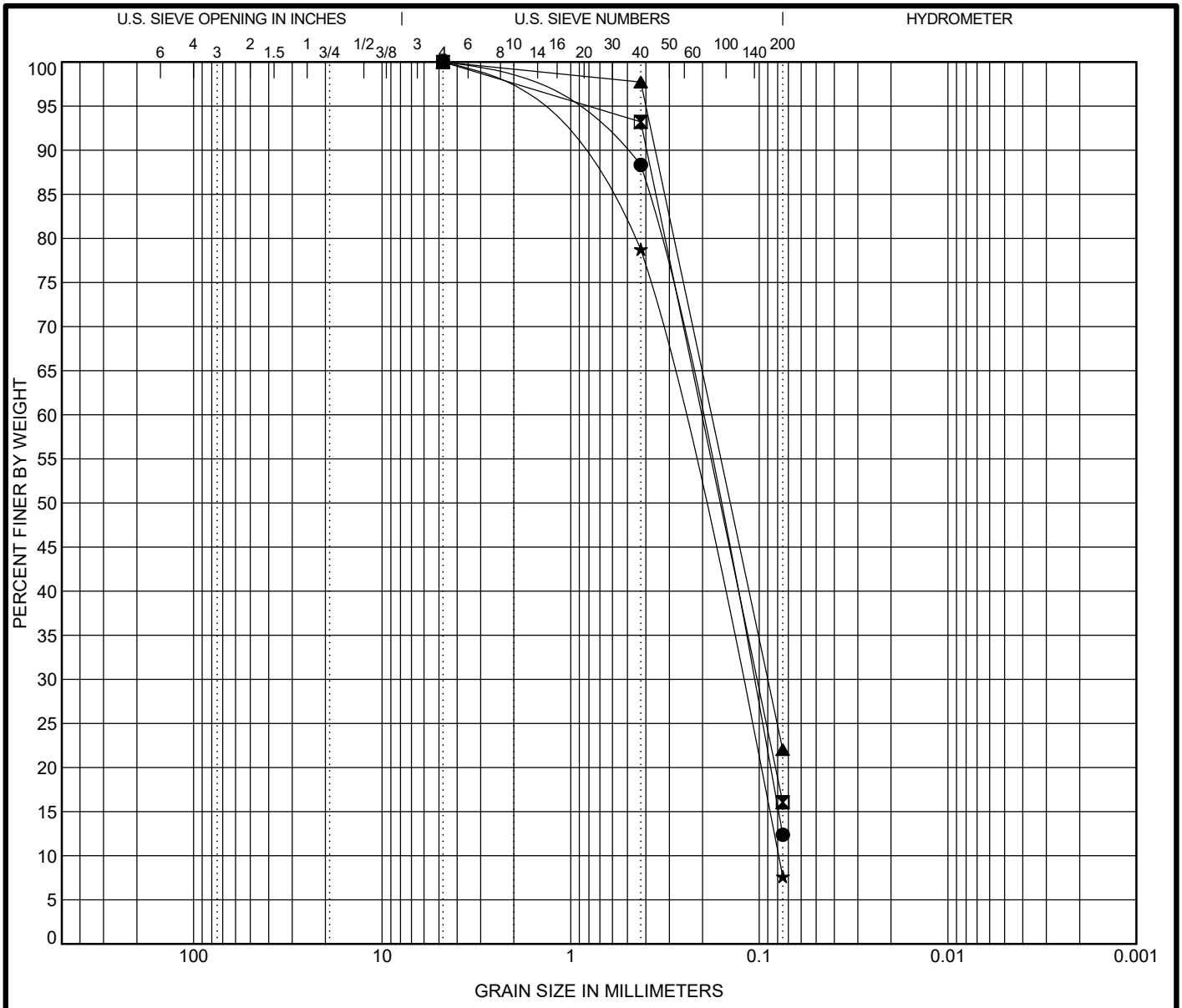
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	5		10.0	CLAYEY SAND (SC)	28	11	17	0.80	3.13
⊠	5		28.0	CLAYEY SAND (SC)	26	10	16		
▲	5		38.0	CLAYEY SAND (SC)	22	9	13		
★	6		0.0	POORLY GRADED SAND with SILT (SP-SM)				0.78	3.38

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	5	10.0	4.75	0.223	0.112		0.0	87.6	12.4	
⊠	5	28.0	4.75	0.201	0.103		0.0	83.9	16.1	
▲	5	38.0	4.75	0.179	0.09		0.0	78.0	22.0	
★	6	0.0	4.75	0.269	0.129	0.079	0.0	92.4	7.6	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

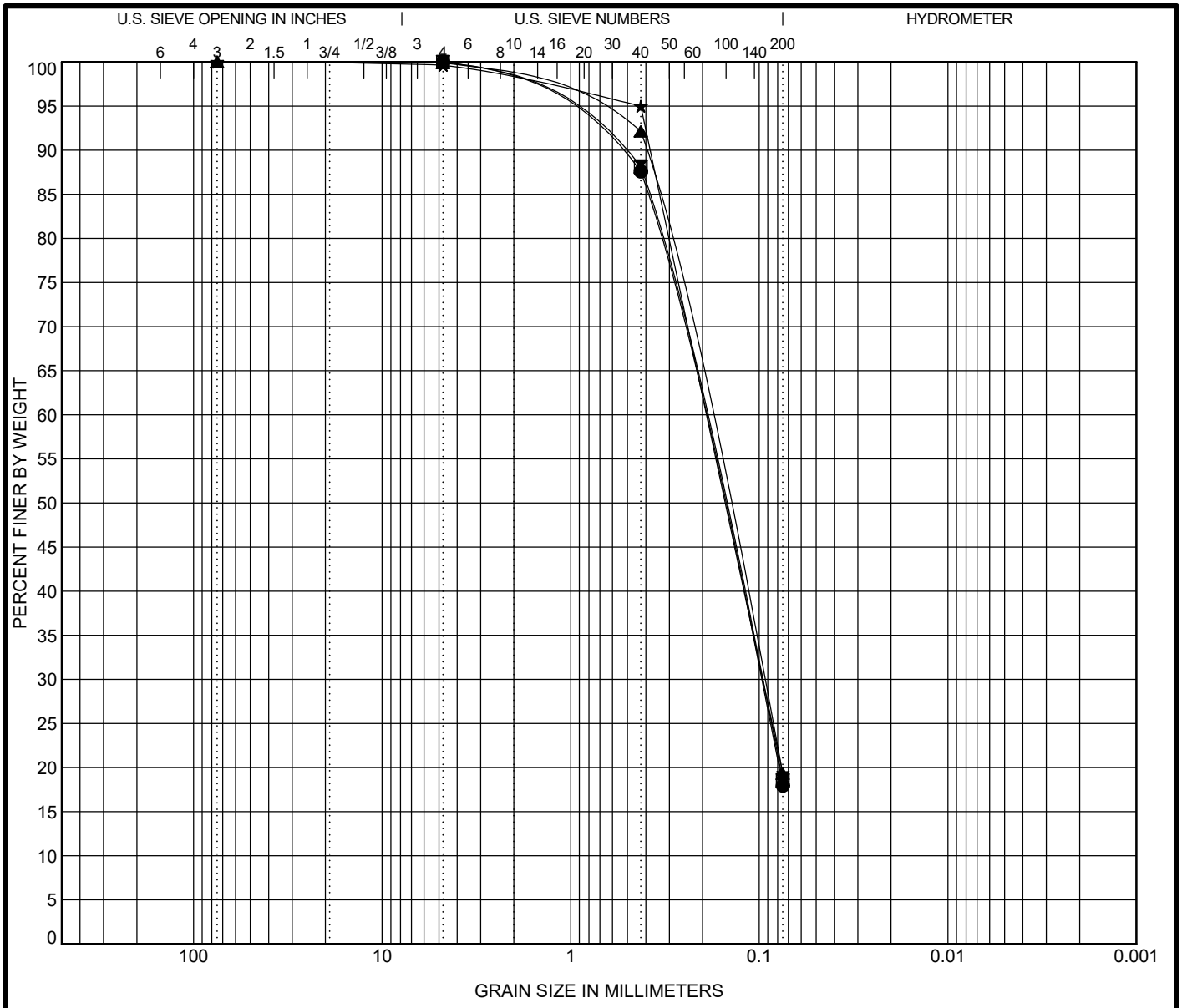
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	6		6.0	CLAYEY SAND (SC)	24	10	14		
⊠	6		8.0	CLAYEY SAND (SC)					
▲	6		13.0	CLAYEY SAND (SC)	39	12	27		
★	6		33.0	CLAYEY SAND (SC)	28	11	17		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	6	6.0	4.75	0.214	0.101		0.0	82.0	18.0	
⊠	6	8.0	4.75	0.211	0.1		0.0	81.4	18.6	
▲	6	13.0	75	0.198	0.097		0.1	80.6	19.3	
★	6	33.0	75	0.19	0.096		0.4	80.3	19.4	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

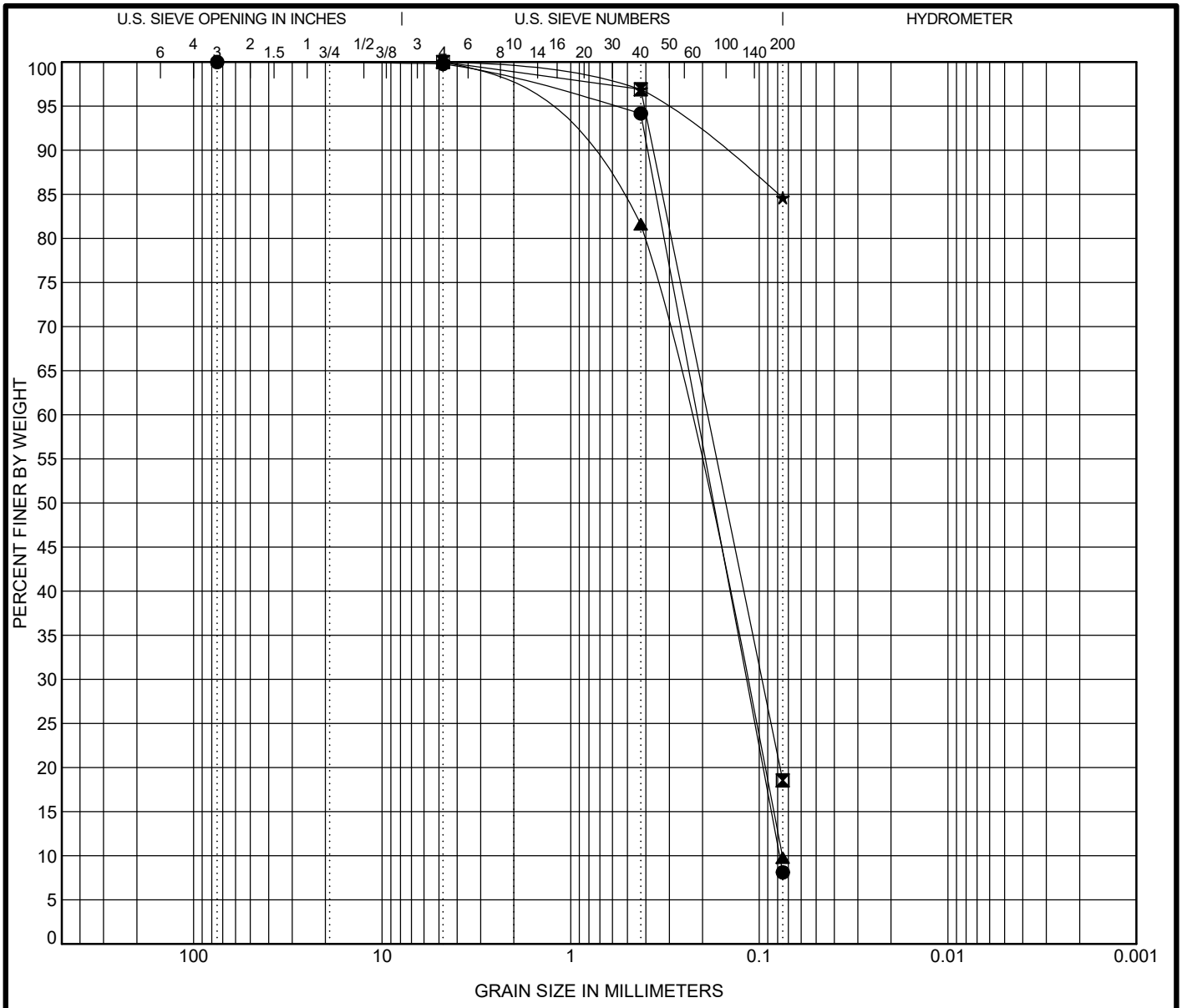
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	7		2.0	**POORLY GRADED SAND with SILT (SP-SM)**	NP	NP	NP	0.82	2.74
⊠	7		6.0	**CLAYEY SAND (SC)**	27	14	13		
▲	8		0.0	**POORLY GRADED SAND with SILT (SP-SM)**	NP	NP	NP	0.79	3.34
★	8		4.0	**LEAN CLAY with SAND (CL)**	39	15	24		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	7	2.0	75	0.213	0.117	0.078	0.2	91.7	8.1	
⊠	7	6.0	4.75	0.188	0.097		0.0	81.5	18.5	
▲	8	0.0	4.75	0.252	0.122	0.075	0.0	90.2	9.8	
★	8	4.0	4.75				0.0	15.4	84.6	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

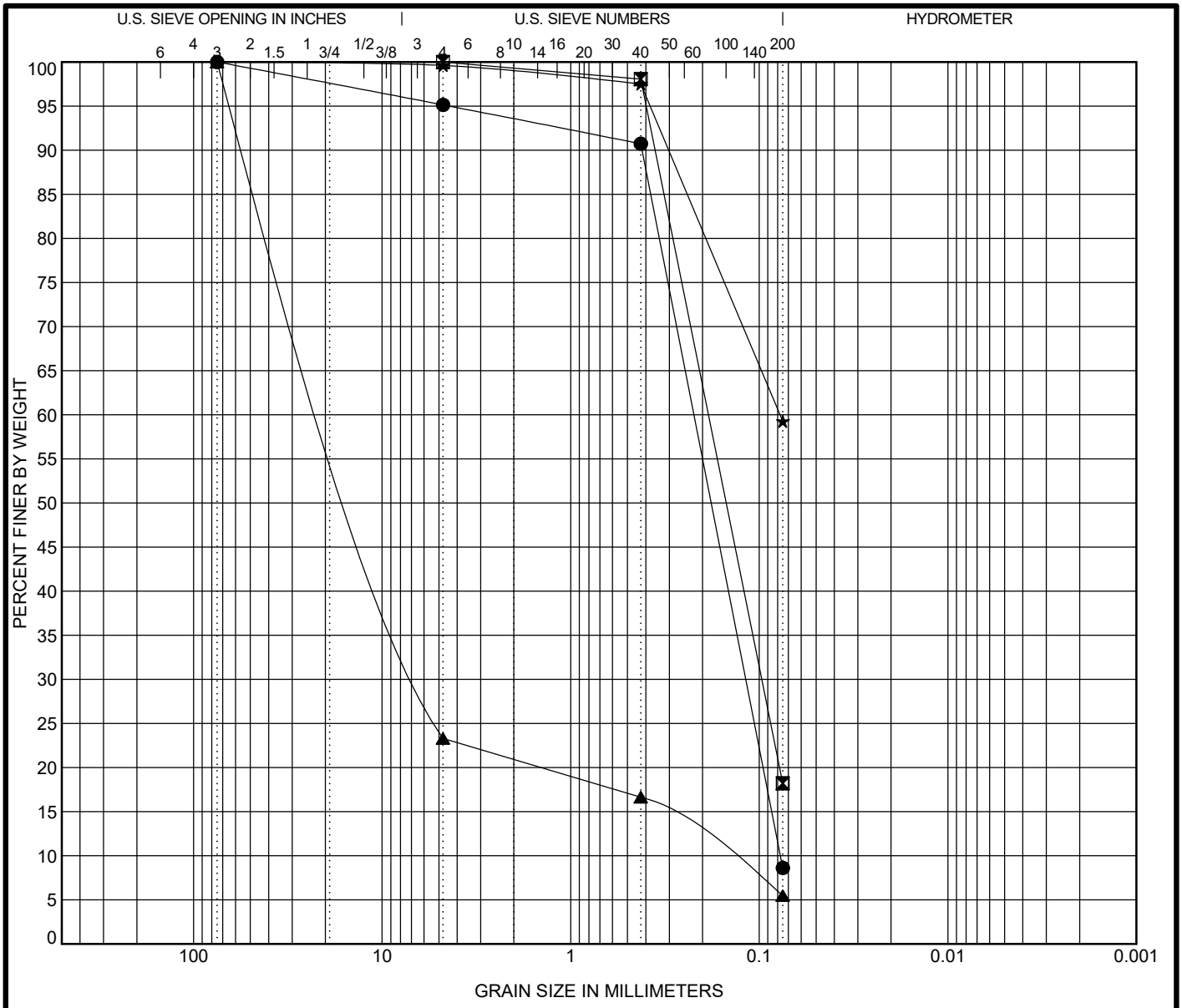
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	9		4.0	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.81	2.88
⊠	9		10.0	CLAYEY SAND (SC)	36	15	21		
▲	10		0.0	GRAVEL with Sand (GP)				13.55	117.32
★	10		6.0	SANDY FAT CLAY (CH)	53	22	31		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	9	4.0	75	0.222	0.118	0.077	4.9	86.5	8.6	
⊠	9	10.0	4.75	0.186	0.097		0.0	81.8	18.2	
▲	10	0.0	75	17.791	6.047	0.152	76.7	17.8	5.5	
★	10	6.0	75	0.078			0.4	40.4	59.3	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

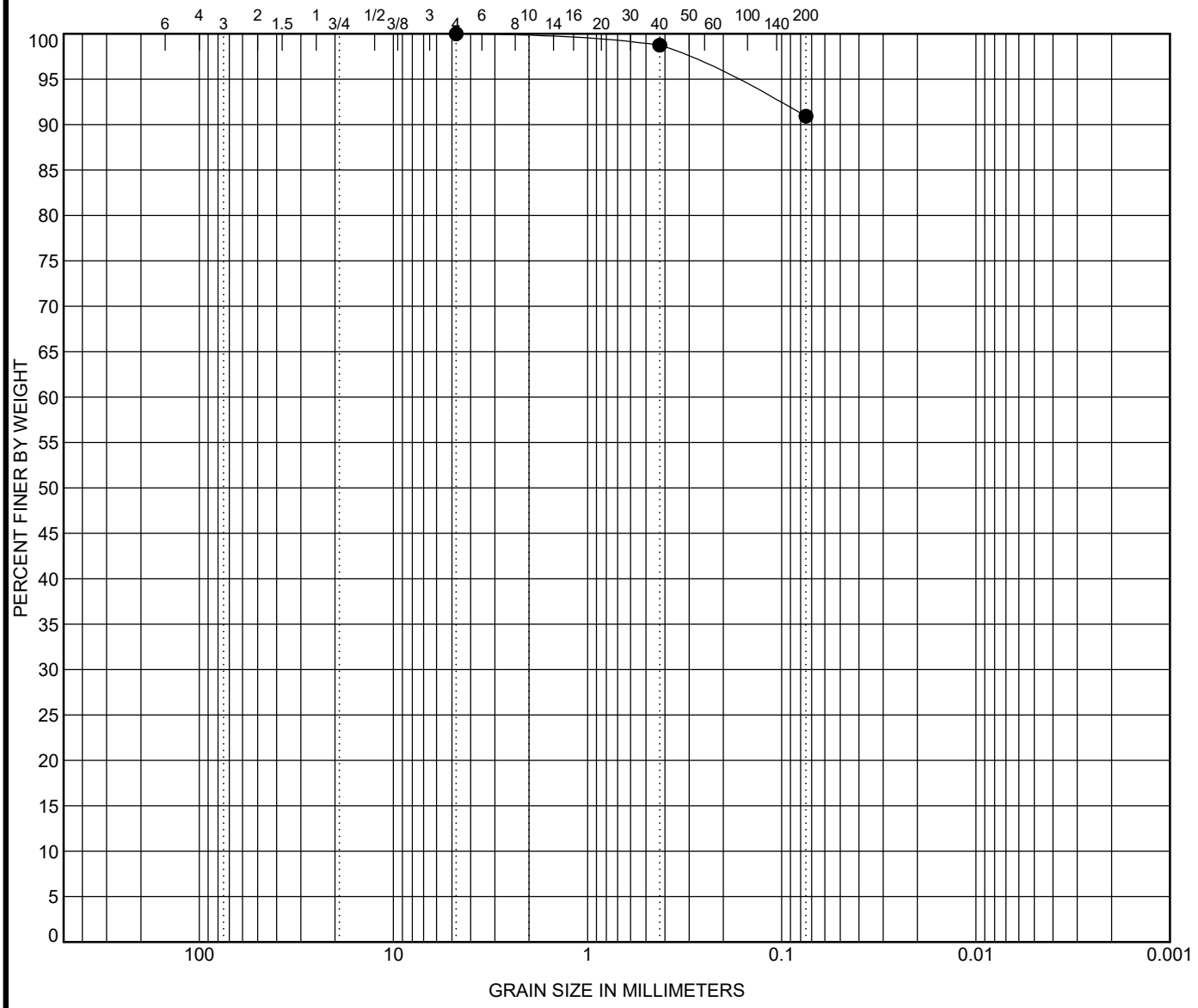
GRAIN SIZE DISTRIBUTION

Project: SAWS Silver Mountain Pump Station Improvements

Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**10**		**13.0**	**LEAN CLAY (CL)**	**40**	**17**	**23**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**10**	**13.0**	**4.75**				**0.0**	**9.1**	**90.9**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

ARIAS

GRAIN SIZE DISTRIBUTION

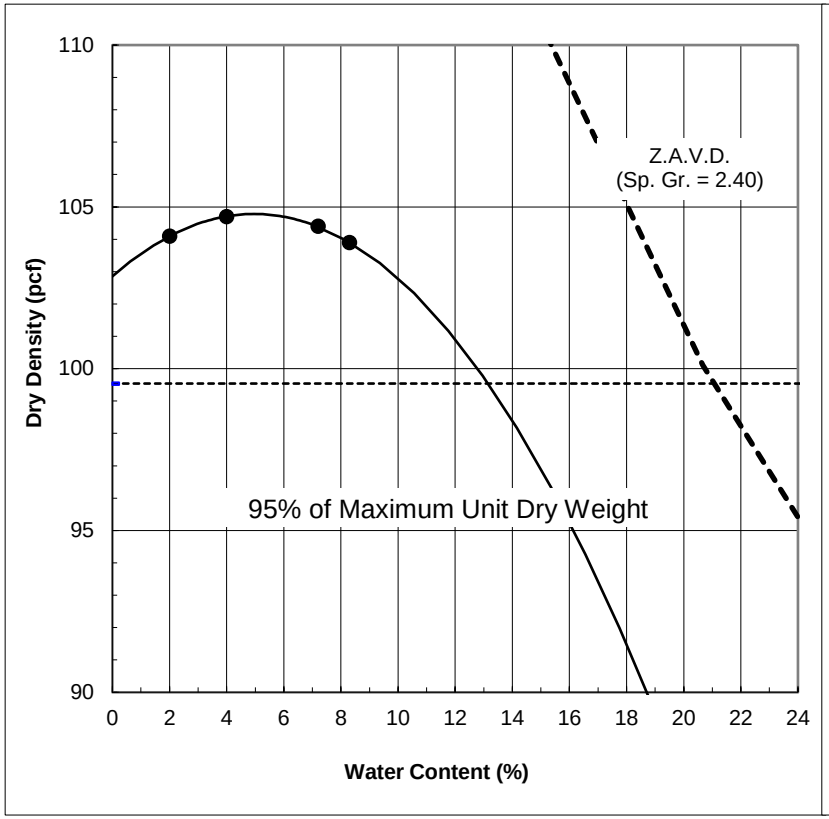
Project: SAWS Silver Mountain Pump Station Improvements

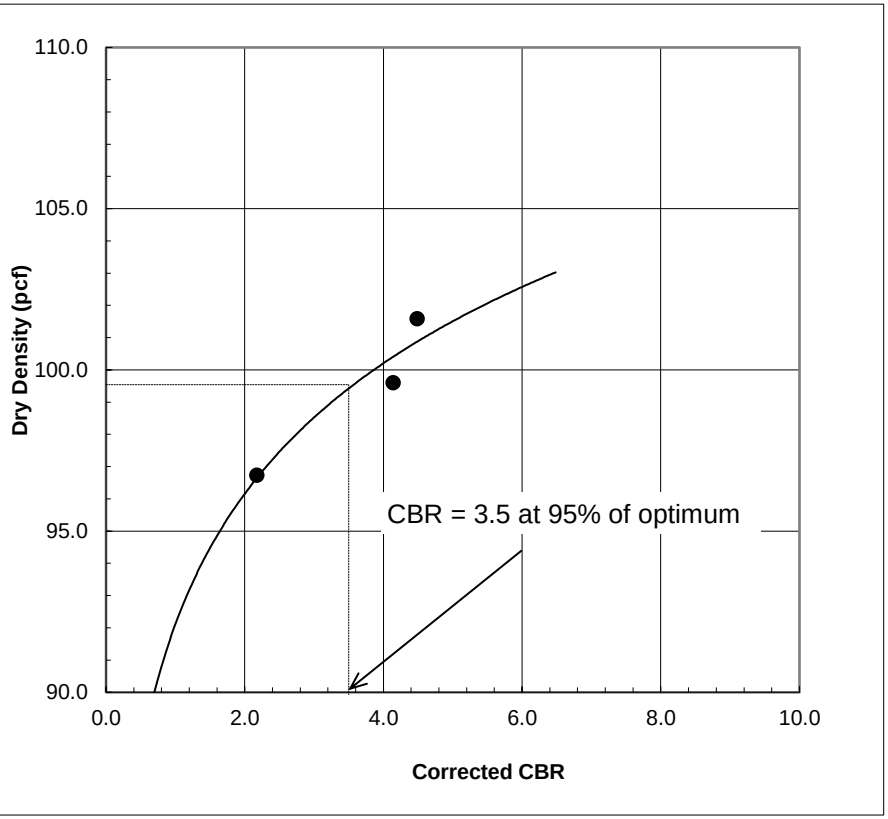
Location: See Boring Location Plan

Job No.: 2022-982

GINT.GPJ 9/26/24 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)

APPENDIX E: CBR RESULTS





Sample: 24-0923
Test Method: D698 C
Material: Poorly-graded Sand with Silt (SP-SM), Tan

Optimum Water Content:	5.0 %
Maximum Unit Dry Weight:	104.8 pcf
Liquid Limit:	NP
Plasticity Index:	NP
% Passing #200 Sieve:	9

% SWELL	
56 blows:	0.1
25 blows:	0.0
10 blows:	0.0

MOISTURE-DENSITY AND CBR TEST RESULTS
SAWS Silver Mountain Pump Station
SAN ANTONIO, TEXAS

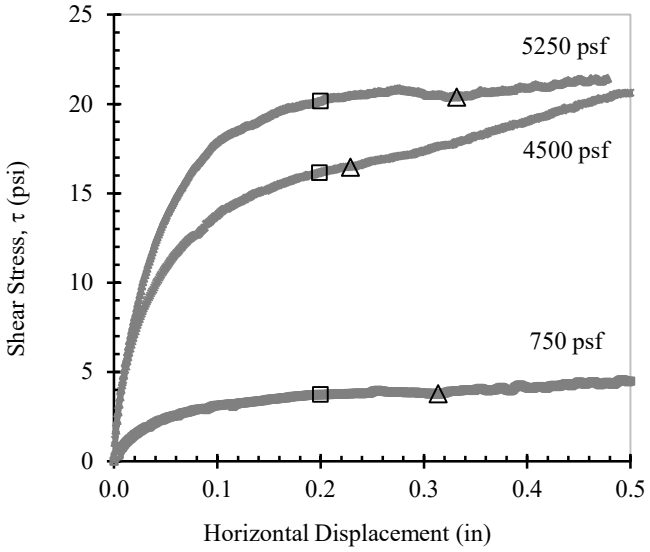
APPENDIX F: DIRECT SHEAR RESULTS

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

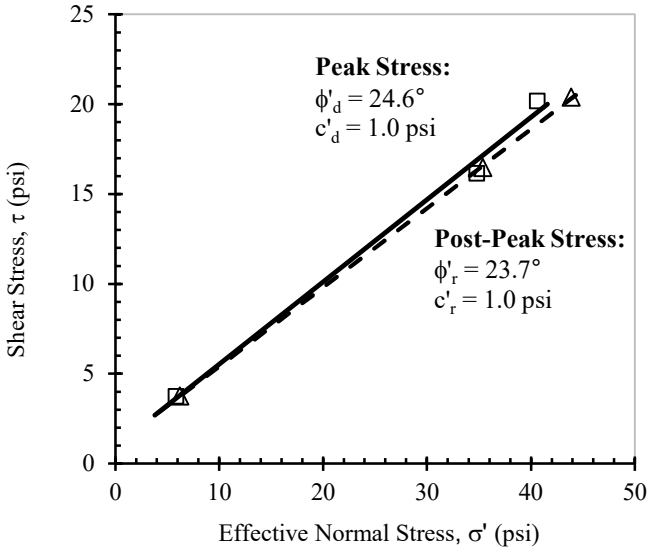
Direct Shear Consolidated Drained Test (ASTM D3080)

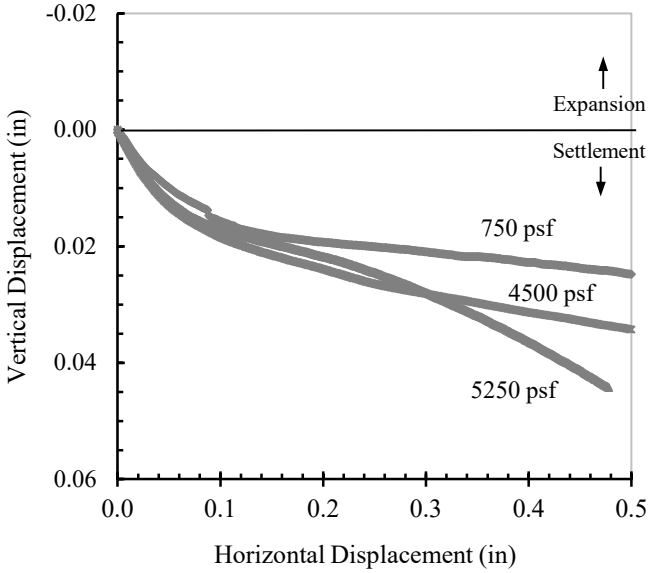
Client: Arias & Associates, Inc.
Project Name: SAWS Silver Mountain Pump Station (PN: 2022-982)
Sample ID: B-1 (6-10 ft)

Alpine Project No.: 2409330
Test Date: 09/16/24
Tested By: T.D.
Method of Preparation: *Remolded*



Note: Area Correction Has Been Applied





Specimen Number		1	2	3
Initial Condition	Diameter, in	2.51	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	5.1	5.2	5.1
	Degree of Saturation, %	22.4	23.1	22.7
	Dry Unit Weight, pcf	104.3	104.6	104.7
	Void Ratio, e_0	0.60	0.60	0.60
After Consolidation	Height, in (prior to shear)	1.00	0.97	1.01
	Final Water Content, %	15.9	15.8	15.3
	Dry Unit Weight, pcf	104.2	107.6	103.4
	Void Ratio, e_f	0.61	0.55	0.62
Peak Normal Stress, σ' (psi)		5.8	34.8	40.6
Peak Shear Stress, τ (psi)		3.7	16.1	20.2
Displacement at Failure (in)		0.20	0.20	0.20
Displacement Rate (in/min)		0.0004		
Peak Strength Parameters	ϕ'_d, degree			**24.6**
	c'_d, psi			**1.0**
Post-Peak Strength Parameters	ϕ'_r, degree			**23.7**
	c'_r, psi			**1.0**

Note: The soil was air dried and passed through a No. 5 sieve to eliminate any over sized particles. Testing specimens remolded to 104.8 pcf dry unit weight at 5.0 % water content. The specific gravity of 2.68 was assumed.

Cheng-Wei Chen, Ph.D. 09/19/24
Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Direct Shear Consolidated Drained Test
(ASTM D3080)

Client: Arias & Associates, Inc.
Project Name: SAWS Silver Mountain Pump Station (PN: 2022-982)
Sample ID: B-1 (6-10 ft)

Alpine Project No.: 2409330
Test Date: 09/16/24
Tested By: T.D.
Method of Preparation: *Remolded*

(1) Normal Load = 750 psf

(2) Normal Load = 4500 psf

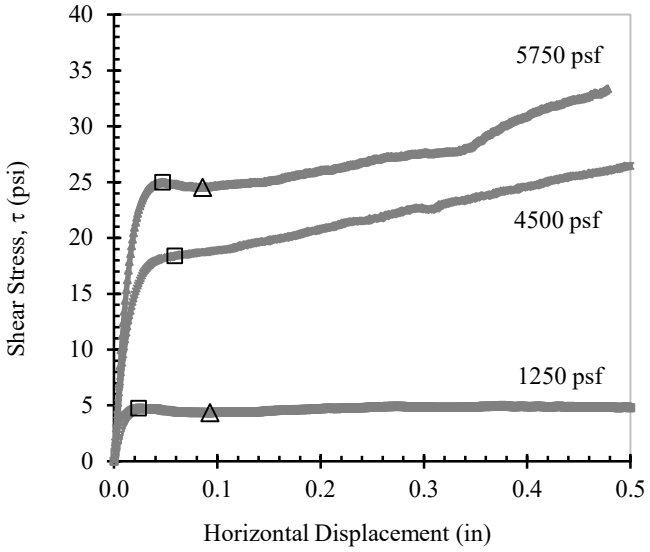
(3) Normal Load = 5250 psf

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

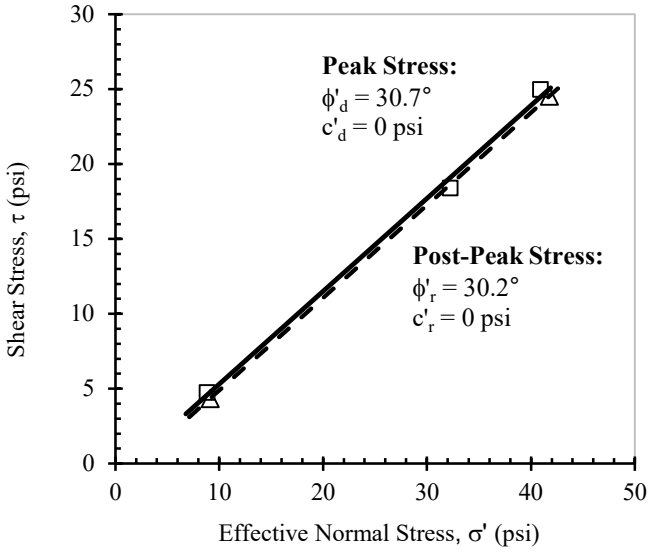
Direct Shear Consolidated Drained Test (ASTM D3080)

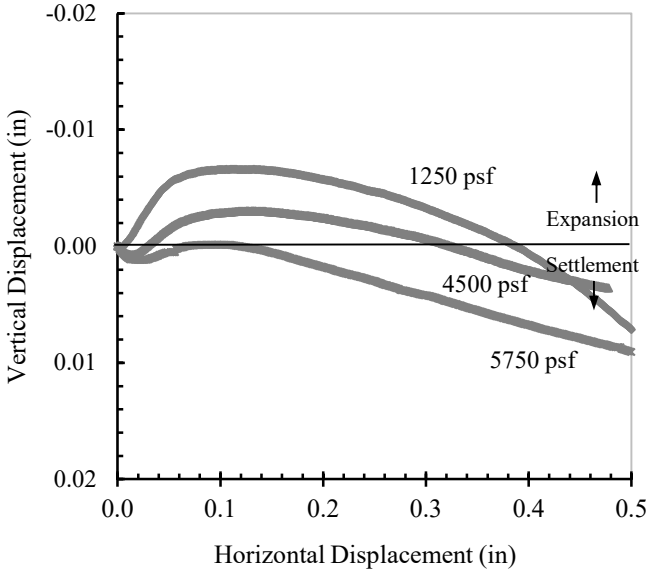
Client: Arias & Associates, Inc.
Project Name: SAWS Silver Mountain Pump Station (PN: 2022-982)
Sample ID: B-3 (10-12 ft)

Alpine Project No.: 2409330
Test Date: 09/16/24
Tested By: T.D.
Method of Preparation: *Remolded*



Note: Area Correction Has Been Applied





Specimen Number		1	2	3
Initial Condition	Diameter, in	2.51	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	5.1	5.0	5.0
	Degree of Saturation, %	22.4	22.5	22.5
	Dry Unit Weight, pcf	104.3	104.7	104.7
	Void Ratio, e_0	0.60	0.60	0.60
After Consolidation	Height, in (prior to shear)	1.00	1.00	1.01
	Final Water Content, %	18.0	17.4	17.3
	Dry Unit Weight, pcf	104.2	104.5	103.3
	Void Ratio, e_f	0.61	0.60	0.62
Peak Normal Stress, σ' (psi)		8.8	32.2	40.9
Peak Shear Stress, τ (psi)		4.7	18.4	25.0
Displacement at Failure (in)		0.02	0.06	0.05
Displacement Rate (in/min)		0.0004		
Peak Strength Parameters	ϕ'_d, degree			**30.7**
	c'_d, psi			**0**
Post-Peak Strength Parameters	ϕ'_r, degree			**30.2**
	c'_r, psi			**0**

Note: The soil was air dried and passed through a No. 5 sieve to eliminate any over sized particles. Testing specimens remolded to 104.8 pcf dry unit weight at 5.0 % water content. The specific gravity of 2.68 was assumed.

Cheng-Wei Chen, Ph.D. 09/19/24
Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Direct Shear Consolidated Drained Test
(ASTM D3080)

Client: Arias & Associates, Inc.
Project Name: SAWS Silver Mountain Pump Station (PN: 2022-982)
Sample ID: B-3 (10-12 ft)

Alpine Project No.: 2409330
Test Date: 09/16/24
Tested By: T.D.
Method of Preparation: *Remolded*

(1) Normal Load = 1250 psf

(2) Normal Load = 4500 psf

(3) Normal Load = 5750 psf