Appendix E Other Supporting Information

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	TX	DAM	Escondido Creek FRS No. 1	BY	SS	DATE	4/22/2024	
		YEAR BUILT	1954	DESIGN HAZARD CLASS	L	DRAINAGE AREA	3.22	mi^2
		WORK PLAN DATE	6/1/1954	CURRENT HAZARD CLASS	H	DAM HEIGHT	38	ft
sht 1 of 5	CONSEQUENCES OF DAM FAILURE (ver. 2021-01)					NID ID	TX02032	

POTENTIAL DAM FAILURE:

Total Failure Index		156	A

POTENTIAL LOSS OF LIFE:

Maximum Population-at-Risk [PAR]	(number)	6	B
Total Risk Index		7	C

POTENTIAL LOSS OF PROPERTY:

Identify major community affected by breach and rate impact as High (H), Medium (M), Low (L) or None(blank)

Community		(H,M,L,-)	-	D
Number of homes, businesses, major buildings		(number)	0	E

POTENTIAL LIFELINE DISRUPTION:

Water supply, identify community disrupted by dam failure, and estimate number/amount

Municipal sole source		Users	(number)	0	F
Supplemental source		Users	(number)	0	G
Irrigation water		Storage	(Ac-Ft)	0	H

POTENTIAL INFRASTRUCTURE DISRUPTION:

Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number

Major/Interstate	SH 72	Roads	(number)	1	I
Secondary/County	CR 163	Roads	(number)	1	J

POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT:

Describe impacts and rate each as High (H), Medium (M), Low (L), or None (blank)

Threatened & endangered species	Federally and state-listed species with the potential to	(H,M,L,-)	L	K
Sensitive riparian areas	Riparian areas are present on site.	(H,M,L,-)	L	L
Contaminated reservoir sediment	Area upstream appears to be largely undeveloped pa	(H,M,L,-)	L	M
Wetland and wildlife habitat	Wildlife habitat is present on site. No wetlands are pre	(H,M,L,-)	L	N
Other		(H,M,L,-)		O

POTENTIAL ADVERSE SOCIAL IMPACTS:

Describe impacts and rate each as High (H), Medium (M), Low (L) or None(blank)

Known cultural resources		(H,M,L,-)	L	P
Historic preservation issues		(H,M,L,-)	L	Q
Socially disadvantaged community	Site is located in primarily rural area.	(H,M,L,-)	L	R

POTENTIAL ADVERSE ECONOMIC IMPACTS:

Average annual benefits attributed to this dam, updated workplan value	($)	29,959	S
Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)	(I,NC,D)	I	T
Low income families impacted	(number)	51	U

INPUT BY STATE DAM SAFETY AGENCY:

State dam safety order issued for repair, modification, removal issued, Yes(Y), No(N)	(Y,N)	N	V
State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank)	(H,M,L,-)	L	W

OTHER CONSIDERATIONS:

Identify any other considerations and rate as High(H), Medium(M), Low(L) or None(blank)

	(H,M,L,-)		X
	(H,M,L,-)		Y

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	**DAM**	Escondido Creek FRS No. 1	**BY**	SS	**DATE**	4/22/2024

FAILURE & RISK INDEXES

Adopted from Bureau of Reclamation "Risk Based Profile System"
see attached worksheet tab.

LIFE LOSS:

Population-at-Risk [PAR], see NRCS dams inventory definition (number of people)

Estimate PAR for static loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway	6	A
Estimate PAR for hydrologic loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway	6	B
Estimate PAR for seismic loading failure; typically assume water at or above invert of the lowest non-gated spillway (sunny day failure)	0	C

Fatality Rates [FR] from dam breach
Adopted from BuRec "A Procedure for Estimating Loss of Life Caused by Dam Failure" DSO-99-06
see: http://www.usbr.gov/research/dam_safety/documents/dso-99-06.pdf
Flood Severity/Lethality [DV] is the average depth [D] times velocity [V] across flood plain (ft2/sec)
DV= (breach discharge - bank full discharge) / breach floodplain width
Warning Time [T] between failure warning and flood wave at population (minutes)
Flood Severity Understanding [U] of the warning issuer of the likely flooding magnitude

Scenario	Breach Discharge	Bankfull Discharge	Breach Floodplain Width	DV	Warning Time, T	Understanding, U
	(cfs)	(cfs)	(ft)	(ft2/sec)	(minutes)	(N/A or Vague)
Static	28,600	14	967	30	14	Vague
Hydrologic	28,600	14	905	32	27	Vague
Seismic	2,060	14	313	7	0	N/A

For DV≥50	T≤60	U=vague	FR=0.04
	T>60		FR=0.03
For DV<50	T≤60	U=vague	FR=0.007
	T>60		FR=0.0003

Estimate FR for static loading failure scenario	0.007	D
Estimate FR for hydrologic loading failure scenario	0.007	E
Estimate FR for seismic loading failure scenario	0.007	F

Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index
Static	1	78	78	0.007	6	3
Hydrologic	*	*	78	0.007	6	3
Seismic	0.00	#DIV/0!	0	0.007	0	0
		TOTAL=	156		TOTAL=	7

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	TX	DAM	Escondido Creek FRS No. 1	BY	SS	DATE	4/22/2024	
sht 3 of 5	STATIC FAILURE INDEX							

PRINCIPAL SPILLWAY SYSTEM (60 points max): (total points)	30		A
Downstream filter or filter zone around conduit (yes=0 or no=10)		10	B
Conduit trench deep (>2d) and narrow (<3d) and steep sideslope (<2:1) (no=0 or yes=10)		0	C
Principal spillway system (inlet, pipe, or outlet) in deteriorated condition (no=0 or yes=10)		0	D
Conduit has seepage cutoff collars or other compaction adverse features (no=0 or yes=10)		10	E
Conduit contains open joints, open cracks, steady seepage (no=0 or yes=10)		0	F
Conduit founded on competent bedrock (yes=0 or no=10)		10	G
Reservoir control gate located at outlet of conduit (no=0 or yes=10)		0	H
RESERVOIR FILLING HISTORY (75 points max): (total points)	10		I
Reservoir has filled to x% of effective height (earth spillway crest minus original streambed)		95	J
(<50%=75 or 51-75%=50 or 76-90%=25 or 91-95%=10 or 96-100%=5 or >100%=0)		10	K
SEEPAGE AND DEFORMATION (85 points max): (total points)	12		L
Seepage carrying fines, or seepage increases with reservoir elevation increases, or sinkholes/jugholes exist in embankment (no=0 or yes=80)		0	M
Large amounts of seepage (no=0 or yes=6)		0	N
Visible and significant slope movement or sloughing (no=0 or yes=6)		6	O
Longitudinal or transverse embankment cracking greater than one foot in depth (no=0 or yes=6)		0	P
Sinkholes/depressions within two times effective height of the dam, either face (no=0 or yes=6)		0	Q
Poor top of dam condition, eroded, trees, rodent holes, settlement (no=0 or yes=6)		6	R
Abnormally wet areas at downstream toe/groin of embankment (no=0 or yes=6)		0	S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)		0	T
FOUNDATION GEOLOGY (41 points max): (total points)	6		U
Highly fractures rock under core (no=0 or treated=3 or untreated=30)		0	V
Karst terrain and soluble rock (gypsum or limestone) (no=0 or treated=3 or untreated=30)		0	W
Collapsible soils (no=0 or treated=3 or untreated=30)		0	X
Significant stress relief fractures in abutments (no=0 or treated=3 or untreated=30)		0	Y
History of underground mining under embankment area (no=0 or treated=3 or untreated=30)		0	Z
Coarse grained and highly permeable soils (no=0 or yes=3)		3	AA
Presence of weak layers/conditions diminishing embankment stability (no=0 or yes=3)		0	AB
Erodible soils (sandy/silty materials) or weakly cemented rock (no=0 or yes=3)		3	AC
Reservoir area prone to landslides that could cause overtopping (no=0 or yes=3)		0	AD
EMBANKMENT DESIGN AND CONSTRUCTION (24 points max): (total points)	12		AE
Filters for core or foundation or compatibility between zones (no=4 or yes=0)		4	AF
Embankment or foundation drainage system (yes=0 or no=4)		0	AG
Erodible core material (sands, silts, dispersive clays) (no=0 or yes=4)		0	AH
Incomplete or no foundation cutoff of shallow permeable layers (no=0 or yes=4)		4	AI
Poorly placed earthfill, inadequate density (no=0 or yes=4)		0	AJ
Gate features to drain reservoir (yes=0 or no=4)		4	AK
EMBANKMENT MONITORING (15 points max): (total points)	8		AL
Instruments (except surficial survey points) installed at dam (yes=0 or no=4)		4	AM
Installed instruments routinely read and evaluated (yes=0 or no=4)		4	AN
Visual inspection of dam by engineer less often than yearly (no=0 or yes=4)		0	AO
Good physical/visual access to downstream groin/toe for inspection (yes=0 or no=4)		0	AP
STATIC FAILURE INDEX: A+I+L+U+AE+AL		78	AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	DAM	Escondido Creek FRS No. 1	BY	SS	DATE	4/22/2024
sht 4 of 5	HYDROLOGIC FAILURE INDEX						ver 2021-01

HYDROLOGIC LOADING:

Total Spillway Capacity (PS&ES) for 6hr storm [Pfb], Work Plan Tbl 3 (rainfall inches)					24.3	A
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings						
100 year, 6hr rainfall [P100] (inches)					8.32	B
Probable Maximum Precipitation [PMP] (inches)					29.5	C
if Pfb <=	P100	=	8.3	enter 40		
if Pfb =	P100+0.2(PMP-P100)	=	12.6	enter 25		
if Pfb =	P100+0.4(PMP-P100)		16.8	enter 15		
if Pfb =	P100+0.6(PMP-P100)	=	21.0	enter 7		
if Pfb =	P100+0.8(PMP-P100)	=	25.3	enter 3		
if Pfb =>	PMP	=	29.5	enter 1		
Enter interpolated value					4	D

HYDROLOGIC UNCERTAINTY:

Drainage Area [DA] (square miles)	3.22	E
DA<10 enter 1.5 ; 10<DA<20 enter 1.4 ; 20<DA<50 enter 1.3 ; DA=>50 enter 1.2	1.5	F
PIPE SPILLWAY PLUGGING:		
Pipe Diameter [D] (inches)	12.0	G
D<12 enter 1.1; 12<=D<24 enter 1.0; 24<=D enter 0.9	1.0	H
Riser & trash rack type:		
Non-standardized inlet enter 1.1, Open Top riser enter 1.0; Covered or Baffle Top enter 0.9	1.0	I
EARTH SPILLWAY FLOW:		
Earth spillway flow depth [Des] from the spillway crest to top of dam (feet)(10' max)	5.0	J
DAM EROSION RESISTANCE:		
Non-plastic (PI<10) fill enter 2.0 ; Plastic core enter 1.7 ; Overtopping armoring enter 0.8	1.7	K
Vegetal Cover Factor [Cf], see NEH-Part 628-Chapter 51, Earth Spillway Erosion Model.	0.7	L
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8	0.9	M
EARTH SPILLWAY EROSION RESISTANCE:		
Low, can be excavated with hand tools, enter 2.0		
PI>10 and SPT blows<8, PI<10 and SPT blows>8, Kh<0.10, seismic velocity<2000fps		
Moderate, can be excavated with construction equipment, easy ripping, enter 1.2		
PI>10 and SPT blows>8, PI<10 and SPT blows>30, Kh<10, seismic velocity<7000fps		
High, very hard ripping, requires drilling and blasting, enter 0.2		
moderately hard rock, Kh>10, seismic velocity>7000fps	2	N
Vegetal Cover Factor [Cf], see NEH-Part 628-Chapter 51, Earth Spillway Erosion Model.	0.7	O
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8	0.9	P
HYDROLOGIC FAILURE INDEX:		
dam overtopping breach: (2)(D)(F)(H)(I)(K)(M)	18	Q
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)	78	R
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300	78	S

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	**DAM**	Escondido Creek FRS No. 1	**BY**	SS	**DATE**	4/22/2024
sht 5 of 5	**SEISMIC FAILURE INDEX**						ver 2021-01

SEISMIC LOADING:

Latitude (degrees.decimal)	28.778	A
Longitude (degrees.decimal)	-97.895	B
See "http://https://earthquake.usgs.gov/hazards/interactive/index.php" (MAP LINK)		
PGA [peak ground acceleration] for 2% chance in 50 years, see NSHM maps (%g)	0.00	C
if PGA is less than 10% g, enter 0		
if PGA is between 10% g and 19% g, enter 0.15		
if PGA is between 20% g and 39% g, enter 0.30		
if PGA is between 40% g and 59% g, enter 0.65		
if PGA is greater than 60% g, enter 1.0	0.00	D
FOUNDATION LIQUEFACTION:		
Select the following foundation conditions which best represents the site		
Loose alluvium, lacustrine, loess materials, enter 10		
Bedrock, glacial till, highly clayey materials, enter 5	5	E
EMBANKMENT FREEBOARD FOR FOUNDATION LIQUEFACTION:		
Dam height (ft)	38.1	F
Freeboard - Elevation difference from top of dam to assumed pool surface (ft)	16.1	G
Freeboard percent of dam height (%)	42	H
if Freeboard is less than 25% of dam height, enter 10		
if Freeboard is 25% to 50% of dam height, enter 5		
if Freeboard is more than 50% of dam height, enter 1	5	I
EMBANKMENT FREEBOARD FOR EMBANKMENT CRACKING:		
Freeboard is less than or equal to 15 feet (no=0 or yes=1)	0	J
EMBANKMENT CRACKING:		
Embankment contains self-healing filter zones (no=4 or yes=0)	4	K

SEISMIC FAILURE INDEX:

IF E=10, L=(D)(E)(I) ; IF E=5, L=(D)(E)(J+1)(K+1)); but less than 100	0	L

State Conservation Engineer's Signature

concurring with technical content of sheets 2 thru 5

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX		**BY**	SS	**DATE**	4/22/24
DAM	Escondido Creek FRS No. 1		**CHECKED BY**	MW	**DATE**	
YEAR BUILT	1954	**DESIGN HAZARD CLASS**	L	**DRAINAGE AREA**	3.22	mi^2
WORK PLAN DATE	6/1/1954	**CURRENT HAZARD CLASS**	H	**DAM HEIGHT**	38	ft
sht 1 of 3	**STATIC FAILURE SCENARIO (ver. 2013-01)**				**NID ID**	TX02032
Structures (Elevated) Impacted by Potential Breach	**Number of Structures**			**PAR per Exposure with Inundation Depths >=2.0 Ft.**		**PAR**
	Inundation Depth Above Natural Ground		**Total**			
	<2.0 Ft	**>=2.0 Ft.**				
Mobile Homes				3		
Seasonal Use RV's				2		
Other						
Structures (With Foundations) Impacted by Potential Breach	**Number of Structures**			**PAR per Exposure with Inundation Depths >=1.0 Ft.**		**PAR**
	Inundation Depth Above Natural Ground		**Total**			
	<1.0 Ft	**>=1.0 Ft.**				
Homes	1		1	3		0
Seasonal Use Homes and Cabins				1.5		
Duplexes				5		
Apartments						
Commercial Buildings						
Schools (In Use)						
Schools (Not in Use)						
Hospitals						
Other						
Highways and Railroads	**Number of Roads, Highways and Railways**			**PAR per Exposure with Inundation Depths >=1.0 Ft.**		**PAR**
	Road Overflow Depth		**Total**			
	<1.0 Ft	**>=1.0 Ft.**				
Main Local Roads and Minor State Highways						
CR 163		1	1	2		2
Name(s) (if applicable)				2		
Major State and Minor Federal Highways						
TX-72		1	1	4		4
Highway Name(s) or Number(s)				4		
Major Federal and Interstate Highways						
Highway Name(s) or Number(s)				8		
Highway Name(s) or Number(s)				8		
Railroads						
UPSF Freight Traffic Only				3		
Passenger Traffic				20		
TOTAL NUMBER OF PEOPLE AT RISK (PAR)						**6**

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX	BY	SS	DATE	4/22/24
DAM	Escondido Creek FRS No. 1	CHECKED BY	MW	DATE	

YEAR BUILT	1954	DESIGN HAZARD CLASS	L	DRAINAGE AREA	3.22	mi^2
WORK PLAN DATE	6/1/1954	CURRENT HAZARD CLASS	H	DAM HEIGHT	38	ft
sht 2 of 3	HYDROLOGIC FAILURE SCENARIO (ver. 2013-01)				NID ID	TX02032

Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<2.0 Ft	>=2.0 Ft.			
Mobile Homes				3	
Seasonal Use RV's				2	
Other					

Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<1.0 Ft	>=1.0 Ft.			
Homes				3	
Seasonal Use Homes and Cabins				1.5	
Duplexes				5	
Apartments				0	
Commercial Buildings				1	
Schools (In Use)				2	
Schools (Not in Use)				3	
Hospitals				4	
Other				5	

Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Road Overflow Depth		Total		
	<1.0 Ft	>=1.0 Ft.			
Main Local Roads and Minor State Highways					
CR 163	0	1	1	2	2
Name(s) (if applicable)	0	0		2	
Major State and Minor Federal Highways					
TX-72	0	1	1	4	4
Highway Name(s) or Number(s)	0	0		4	
Major Federal and Interstate Highways					
Highway Name(s) or Number(s)				8	
Highway Name(s) or Number(s)				8	
Railroads					
UPSF Freight Traffic Only				3	
Passenger Traffic				20	
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					**6**

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX		BY	SS	DATE	4/22/24
DAM	Escondido Creek FRS No. 1		CHECKED BY	MW	DATE	
YEAR BUILT	1954	DESIGN HAZARD CLASS	L	DRAINAGE AREA	3.22	mi^2
WORK PLAN DATE	6/1/1954	CURRENT HAZARD CLASS	H	DAM HEIGHT	38	ft
sht 3 of 3	SEISMIC FAILURE SCENARIO (ver. 2013-01)				NID ID	TX02032

Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<2.0 Ft	>=2.0 Ft.			
Mobile Homes				3	
Seasonal Use RV's				2	
Other					

Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<1.0 Ft	>=1.0 Ft.			
Homes				3	
Seasonal Use Homes and Cabins				1.5	
Duplexes				5	
Apartments					
Commercial Buildings					
Schools (In Use)					
Schools (Not in Use)					
Hospitals					
Other					

Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Road Overflow Depth		Total		
	<1.0 Ft	>=1.0 Ft.			
Main Local Roads and Minor State Highways					
CR 163	1	0	1	2	0
Name(s) (if applicable)				2	
Major State and Minor Federal Highways					
TX-72	1	0	1	4	0
Highway Name(s) or Number(s)				4	
Major Federal and Interstate Highways					
Highway Name(s) or Number(s)				8	
Highway Name(s) or Number(s)				8	
Railroads					
UPSF Freight Traffic Only				3	
Passenger Traffic				20	
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					**0**

Federal and State Listed Threatened and Endangered Species Assessment

Escondido Creek Watershed Floodwater Retarding Structure No. 1 Supplemental Planning Project

Karnes County, Texas

Natural Resources Conservation Service

Project number: 60707486

August 2024

Delivering a better world

Prepared for:

Natural Resources Conservation Service

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Table of Contents

Figures

Tables

1. Background

1.1 Project description

AECOM Technical Services, Inc. (AECOM) conducted a federal and state listed threatened and endangered species habitat assessment for the proposed Escondido Creek Watershed Floodwater Retarding Structure (FRS) No. 1 Supplemental Planning Project (Project). The proposed Project is located in Karnes County, approximately 3.7 miles southwest of Kenedy, Texas (**Appendix A, Figure 1**). A literature search and field investigations were conducted for the Project within a potential impact area encompassing approximately 131 acres (Study Area).

1.2 Purpose

The purpose of this assessment is to comply with Section 9 of the Endangered Species Act (ESA), Chapters 67 and 68 of the Texas Parks and Wildlife (TPW) Code, and Sections 65.171 - 65.176 of Title 31 of the Texas Administrative Code (TAC) to avoid 'take' of federal or state listed threatened or endangered species.

A list of the current United States (U.S.) Fish and Wildlife Service (USFWS) and Texas Parks and Wildlife Department (TPWD) threatened and endangered (T&E) species and their associated habitat requirements are described within this document.

2. Methodology

A literature search was conducted to identify federal, and state listed T&E species of concern with the potential to occur within the Study Area. Species lists were accessed through the USFWS's Environmental Conservation Online System (ECOS) Information for Planning and Consultation (IPaC) tool and through TPWD's Rare, Threatened, and Endangered Species list for Karnes County. The literature search also included a review of studies and reports related to the ecology of the area as well as a review of TPWD's Texas Natural Diversity Database (TXNDD), which was obtained via email request. The TXNDD was reviewed on July 13, 2023, to report if any rare and/or listed threatened or endangered species have been previously observed within or adjacent to the Study Area.

Field investigations were conducted on June 14, 2023, to verify previously reviewed information, document the presence of federal and state listed species and/or suitable habitat, and characterize habitat and vegetation types.

3. Regulations

3.1 U.S. Fish and Wildlife Service

3.1.1 Endangered Species Act

USFWS has legislative authority to list and monitor the status of species whose populations are considered to be imperiled. The federal legislative authority for the federal protection of threatened and endangered species issues from the ESA of 1973 and its subsequent amendments. Regulations supporting this Act are codified and regularly updated in Title 50 Code of Federal Regulations (CFR) Sections 17.11 and 17.12.

The ESA process stratifies potential candidates based upon the species' biological vulnerability. Species listed as endangered or threatened by the federal government are provided full protection under the law. This protection not only prohibits the direct possession (take) of a protected wildlife species, but also includes a prohibition of indirect take, such as destruction of habitat. Listed plant species are not protected from take, although it is illegal to collect or maliciously harm them on federal land. The ESA and accompanying regulations provide the necessary authority and incentive for individual states to establish their own regulatory vehicle for the management and protection of threatened and endangered species.

3.1.2 Migratory Bird Treaty Act

USFWS has legislative authority to prohibit, unless permitted by regulations, the kill, capture, collection, possession, buying, selling, trading, or transport of any migratory bird, nest, young, feather, or egg in part or in whole. The Migratory Bird Treaty Act (MBTA) and its subsequent amendments (16 U.S. Code [USC] 703-712) give the federal legislative authority for protection of migratory bird species. Regulations supporting the MBTA are codified and regularly updated in Title 50 CFR Parts 10 and 21.

3.2 Texas Parks and Wildlife Department

TPWD prohibits the take, possession, transportation, or sale of any of the animal or plant species designated by state law as endangered or threatened without the issuance of a permit (per Chapters 67 [Nongame Species] and 68 [Endangered Species] of the TPW Code and Sections 65.171 - 65.176 [Threatened and Endangered Nongame Species] of Title 31 of the TAC. “Take” is defined in the TPW Code as to “collect, hook, net, shoot, or snare, by any means or device, and includes an attempt to take or to pursue in order to take”.

Unlike federally listed species, there is no protection of habitat afforded to species that are only listed by the state.

4. Environmental Setting

Publicly available data was reviewed to identify aquatic features, soil types, and vegetation types within the Study Area. Data resources reviewed included the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD), the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey, USGS 7.5' quadrangle sheets, and recent aerial photography. This data review was used to describe the site-specific information below.

4.1 Land Use

The Study Area consisted of an open water reservoir, a dam structure, and undeveloped land. Based on the NHD, Panther Creek, an intermittent stream; one unnamed intermittent stream; and one open water feature, Escondido Creek FRS No. 1 Reservoir, were mapped within the Study Area (USGS 2023). Land use surrounding the Study Area is used for livestock hay cultivation.

4.2 Topography

The USGS 7.5-minute quadrangle map for Lenz, TX displays the topography of the Study Area (**Appendix A, Figure 2**). Topography within the Study Area is shaped by the current reservoir and dam system, as well as Panther Creek. The surface gradient slopes downward from the southwest and northeast to the central portion of the Study Area with the highest elevation located along the northeast boundary at approximately 402 feet above mean sea level (MSL [National Geodetic Vertical Datum of 1929]). The lowest elevation is located near Panther Creek at the west central portion of the Study Area boundary at approximately 344 feet above MSL (USGS 1987).

4.3 Soils

According to the USDA NRCS Web Soil Survey Report, the Study Area was mapped as being underlain by six map units (as shown on **Table 1** below and within **Appendix A, Figure 3**) (USDA NRCS 2021).

Table 1. NRCS Soil Mapping Units

Mapping Unit	Soil Type	Listed as Hydric by NRCS
CoB	Coy clay loam, 1 to 3 percent slopes	Yes
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	No
PtC	Pettus loam, 2 to 5 percent slopes	No
W	Water	No
WaC	Weesatche fine sandy loam, 2 to 5 percent slopes	No
WeB	Weesatche sandy clay loam, 1 to 3 percent slopes	No

4.4 Vegetation

4.4.1 Historically Mapped and Documented Vegetation Types

According to TPWD's Ecoregion data, the Study Area falls within the East Central Texas Plains Level 3 Ecoregion and the Southern Post Oak Savanna Level 4 Ecoregion (TPWD 2011).

The Study Area lies within one Land Resource Region (LRR I) and one Major Land Resource Area (MLRA 83A). LRR I denotes the Southwest Plateaus and Plains Range and Cotton Region, and vegetation consists mainly of mesquite and juniper savannas. MLRA 83A is the Northern Rio Grande Plain which can be characterized as areas of grass, cropland, and pasture interspersed with tall, thick shrubs on nearly level and gently rolling hills and valleys. More information on LRR I and MLRA 83A can be read within USDA's Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, Handbook 296 (NRCS 2022).

According to TPWD's Ecological Mapping System of Texas (EMST), the vegetation mapped within the Study Area includes Central Texas: Riparian Live Oak Forest; Central Texas: Riparian Deciduous Shrubland; Central Texas: Riparian Herbaceous Vegetation; South Texas: Clayey Mesquite Mixed Shrubland; South Texas: Clayey Blackbrush Mixed Shrubland; South Texas: Sandy Live Oak Motte and Woodland; South Texas: Sandy Mesquite Woodland and Shrubland; South Texas: Sandy Mesquite Savanna Grassland; Marsh; Native Invasive: Deciduous Woodland; South Texas: Disturbance Grassland; and Urban Low Intensity. (**Appendix A, Figure 4**) (Elliott et al 2014).

4.4.2 Existing Conditions

Field investigations documented vegetation types throughout the Study Area. The majority of the Study Area consisted of undeveloped grassland and deciduous woodlands. Common species observed within the tree and sapling/shrub stratum include cedar elm (*Ulmus crassifolia*), sugarberry (*Celtis laevigata*) and privet (*Ligustrum sp.*). Common herbaceous species observed within the Study Area include inland sea oats (*Chasmanthium latifolium*), prickly pear cactus (*Opuntia engelmannii*), and Bermuda grass (*Cynodon dactylon*). See **Appendix B** for representative photographs of the Study Area.

5. Federal and State Listed T&E Species Review

A literature search and database review were conducted to identify federal, and state listed T&E species of concern with the potential to occur within the Study Area. Species lists were accessed through the USFWS ECOS IPaC tool and through TPWD's Rare, Threatened, and Endangered Species of Texas (**Appendix C**). Additionally, the literature search included a review of studies and reports related to the ecology of the area.

One species, the whooping crane (*Grus americana*), was listed by the USFWS and TPWD as federally and state endangered in Karnes County; while two species, the piping plover (*Charadrius melodus*) and the red knot (*Calidris canutus rufa*), were listed as federally and state threatened (USFWS 2024a; TPWD 2024).

The monarch butterfly (*Danaus plexippus*) was listed by the USFWS as federal candidate species in Karnes County. However, candidate species receive no statutory protection under the ESA (USFWS 2024a).

Eight species were listed as only state threatened in Karnes County by TPWD. These include sheep frog (*Hypopachus variolosus*), swallow-tailed kite (*Elanoides forficatus*), white-faced ibis (*Plegadis chihi*), white-tailed hawk (*Buteo albicaudatus*), wood stork (*Mycteria americana*), white-nosed coati (*Nasua narica*), Texas horned lizard (*Phrynosoma cornutum*), and Texas tortoise (*Gopherus berlandieri*) (TPWD 2024).

One species, the ocelot (*Leopardus pardalis),* was listed by TPWD as only state endangered and one species, the black rail (*Laterallus jamaicensis*) was listed by TPWD as only state threatened in Karnes County, Texas (TPWD 2024).

A summary of federal and state listed species for Karnes County, their habitat requirements, and suitable habitat determinations are shown in **Table 2**.

Table 2. Listed Threatened and Endangered Species in Karnes County, Texas

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
Amphibians						
Sheep Frog	*Hypopachus variolosus*	NL	T	Terrestrial and aquatic: Predominantly grassland and savanna; largely fossorial in areas with moist microclimates.	Yes	Savanna and grasslands are present in the Study Area; therefore, suitable habitat may be present for this species.
Birds						
Black Rail	*Laterallus jamaicensis*	NL**	T	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh; nest usually hidden in marsh grass or at the base of *Salicornia* spp.	No	Species may occur as a migrant/transient; however, marsh habitats large enough for the species are not present within the Study Area. In addition, the Study Area is located outside of this species known breeding range.
Piping Plover	*Charadrius melodus*	T	T	Sand and gravel shores of rivers and lakes. Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore islands.	No	Species may occur as a migrant/transient; however, no sand or gravel shores of rivers or lakes are present within the Study Area.
Red Knot	*Calidris canutus rufa*	T	T	Prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters.	No	Species may occur as a migrant/transient; however, coastal/bay shorelines and mudflats are not present within the Study Area.
Swallow-tailed Kite	*Elanoides forficatus*	NL	T	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees.	No	Species may occur as a migrant/transient; however, the Study Area is located outside of this species known breeding range.

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
White-faced Ibis	*Plegadis chihi*	NL	T	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.	No	Species may occur as a migrant/transient; however, freshwater marshes, sloughs, irrigated rice fields, and brackish habitats are not present within the Study Area.
White-tailed Hawk	*Buteo albicaudatus*	NL	T	Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May.	Yes	Mesquite savannas are present in the Study Area; therefore, suitable habitat may be present for this species.
Whooping Crane	*Grus americana*	E	E	Small ponds, marshes, and flooded grain fields for both roosting and foraging. Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.	No	Species may occur as a rare migrant/transient; however, marshes and flooded grain fields are not present within the Study Area.
Wood Stork	*Mycteria americana*	NL	T	Prefers to nest in large tracts of bald cypress (*Taxodium distichum*) or red mangrove (*Rhizophora mangle*); forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.	No	Species may occur as a migrant/transient; however, no large tracts of bald cypress or red mangrove are present within the Study Area. In addition, this species currently does not nest in Texas.

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
Insects						
Monarch Butterfly	*Danaus plexippus*	C	NL	Monarch butterflies are habitat generalists but require milkweed species (*Asclepias* spp.) as larval hosts and a nectar source for adults (TPWD 2016). Monarch butterflies complete a multi-generational migration from Mexico northward starting in Spring. Monarch butterflies fly to Texas from Mexico beginning in March and lay their eggs on milkweed species present in the state. Those monarch butterflies have completed their journey and reproduction. The eggs and resulting larvae present on milkweeds in Texas then use the milkweed as a food source to prepare for metamorphosis to their butterfly form. Those butterflies then mate and continue to lay eggs on milkweed species as they move north for the summer. In the fall, monarch butterflies start moving into the panhandle of Texas during migration to overwintering grounds in Mexico. In Texas, monarch butterflies and their eggs and larvae are present from March-June and September- October (TPWD 2016).	Yes	Milkweed species (*Asclepias spp.*), a host plant for this species, as well as other nectar plants were observed throughout the Study Area. This species is a habitat generalist and suitable habitat may be present throughout the Study Area where nectar plants and/or various species of host plants in the milkweed (*Asclepiadaceae*) family occur.
Mammals						
Ocelot	*Leopardus pardalis*	NL**	E	Restricted to mesquite-thorn scrub and live oak mottes; avoids open areas. Dense mixed brush below four feet; thorny shrublands; dense chaparral thickets; breeds and raises young June-November.	No	There is not enough required habitat of mesquite-thorn scrub, live oak mottes, or dense brush below four feet present for this species to occur in the Study Area.
White-nosed Coati	*Nasua narica*	NL	T	Woodlands, riparian corridors, and canyons. Most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade.	Yes	Woodlands and riparian corridors are present in the Study Area; therefore, suitable habitat may be present for this species.
Reptiles						
Texas Horned Lizard	*Phrynosoma cornutum*	NL	T	Arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive.	No	No suitable habitat, including sparse vegetation, scattered brush, or scrubby trees in sandy or rocky areas, is present within the Study Area.

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
Texas Tortoise	*Gopherus berlandieri*	NL	T	Terrestrial: Open scrub woods, arid brush, lomas, grass-cactus association; often in areas with sandy well-drained soils. When inactive occupies shallow depressions dug at base of bush or cactus, sometimes in underground burrow or under object. Eggs are laid in nests dug in soil near or under bushes.	No	No suitable habitat, including open scrub woods or arid brush on sandy well-drained soils are present within the Study Area.

NL- Not Listed, T- Threatened, E- Endangered, C-Candidate

Source: USFWS 2024a; TPWD 2024

**Status as returned in a county specific query, not a statewide listing*

***Species are federally protected; however, are not included on the USFWS IPaC list for the focused Study Area and therefore, not considered as part of the federal analysis within this evaluation.*

Four listed species have the potential to occur within the Study Area: the sheep frog, white-tailed hawk, monarch butterfly, and white-nosed coati. These species are described in further detail below.

Sheep Frog

Suitable habitat for the state threatened sheep frog was identified around the aquatic features that contribute to the presence of moist microhabitats as well as within the grasslands and savannas of the Study Area. Based on field investigations, grasslands and savannas occur throughout the Study Area while moist microhabitats were present in the areas surrounding the Escondido Creek FRS. No. 1 reservoir. Therefore, suitable habitat for the sheep frog may be present within these portions of the Study Area.

White-tailed Hawk

Suitable habitat for the state threatened white-tailed hawk was identified in the grasslands and savannas throughout the Study Area. Based on field investigations, grasslands and savannas are present surrounding the Escondido Creek FRS No. 1 reservoir as well as northeast and southwest of the dam structure within the Study Area. Therefore, suitable habitat for the white-tailed hawk may be present within the Study Area.

Monarch Butterfly

The monarch butterfly is currently considered a candidate species for listing by USFWS and does not yet have federal protection; however, habitat was assessed as a matter of due diligence. Monarch butterflies are habitat generalists but require milkweed species as larval hosts and a nectar source for adults. The presence of milkweed indicates suitable monarch butterfly habitat. In Texas, monarch butterflies and their eggs and larvae are present from March-June and September-October (TPWD 2016). Milkweeds and nectar plants are known to occur along roadsides and in other disturbed and open areas. Milkweed species were observed within the Study Area. Therefore, suitable habitat for the monarch butterfly may be present throughout the Study Area where milkweed and nectar plants are present.

White-nosed Coati

Suitable habitat for the state threatened white-nosed coati was identified in the woodland and riparian corridors throughout the Study Area. Based on field investigations, woodlands and riparian corridors were found in the southwest portion of the Study Area. Therefore, suitable habitat for the white-nosed coati may be present within the Study Area.

5.1 TXNDD Element Occurrence Review and Critical Habitat

A review of USFWS Critical Habitat was performed for the vicinity of the Study Area. No critical habitat for federally listed species was mapped within or immediately adjacent to the Study Area (USFWS 2023b).

Additionally, TPWD's TXNDD was reviewed on July 13, 2023, to assess if any rare and/or listed endangered and threatened species have been previously observed within or adjacent to the Study Area. One element of occurrence (EO) for the Burridge greenthread (*Thelesperma burridgeanum*) was reported within the northeastern limits of the Study Area in 1958 (TPWD 2023).

Several EOs for state threatened species were reported within five miles of the Study Area (**Appendix A, Figure 5**). Three EOs for the Texas horned lizard (*Phrynosoma cornutum)* ranging from 3.1 to 3.3 miles from the Study Area, four EOs for the Tamaulipan spot-tailed earless lizard (*Holbrookia subcaudalis*) ranging from 1.7 to 4.6 miles from the Study Area, one EO for the Texas tortoise (*Gopherus berlandieri*) 3 miles from the Study Area, and one EO for the sheep frog (*Hypopachus variolosus)* 4.2 miles from the Study Area were reported. No other EOs were reported within five miles of the Study Area (TPWD 2023).

No recorded EOs for species does not mean that there is an absence of endangered, threatened, or rare species and should not be solely used for presence/absence determinations.

6. Conclusions

This assessment found that suitable habitat for one federal candidate species, the monarch butterfly, is present within the Study Area and that this species may be affected by Project activities. In addition, suitable habitat for three state threatened species including the sheep frog, white-tailed hawk, and white-nosed coati may be found within the Study Area. No additional federal or stated listed T&E species were determined to have suitable habitat within the Study Area and are not likely to be impacted by the proposed Project. Coordination with USFWS and TPWD may be required to avoid potential impacts to protected species and comply with general requirements under federal and state protected species regulations.

No USFWS Critical Habitat was mapped within the Study Area. Three EOs were recorded for the Texas horned lizard, one EO was recorded for the Texas tortoise, and one EO was recorded for the sheep frog within 5 miles from the Study Area.

Depending on the timing of construction and amount of tree/shrub clearing required for construction activities, migratory birds could potentially be impacted by the Project. If clearing of trees and shrubs is necessary, then AECOM recommends conducting nest surveys prior to clearing activities. In accordance with the MBTA, construction activities and any vegetation clearing should be conducted outside peak-nesting seasons (March-August) to avoid any adverse effects to migratory birds and their habitats. Should construction and vegetation clearing occur from March through August, active bird nest surveys should be conducted by a biologist no more than 5 days prior to construction.

7. References

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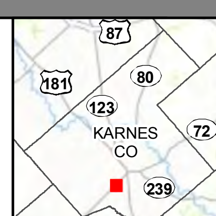
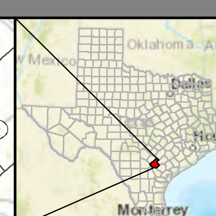
Appendix A Figures

Study Area





Project Location Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N
W E
S
0 200 400
Feet

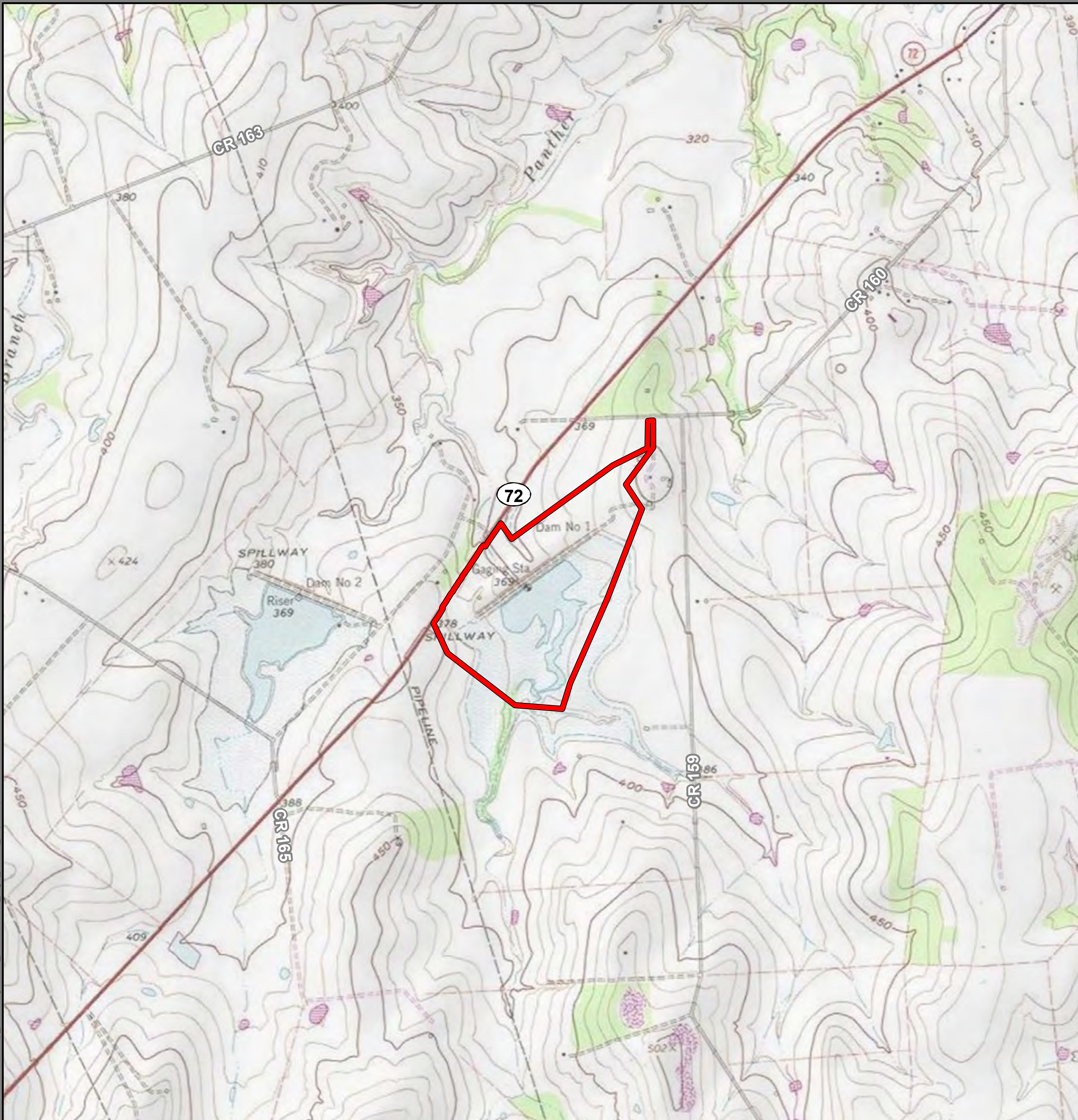
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

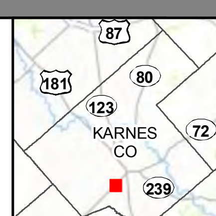
July 2024

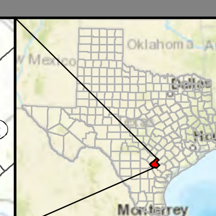
Figure 1

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig1_ProjectLocationMap.mxd



Study Area





USGS Topographic Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

0 1000 2000
Feet

Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: USGS 7.5-minute Topographic Maps: Lenz Quadrangle

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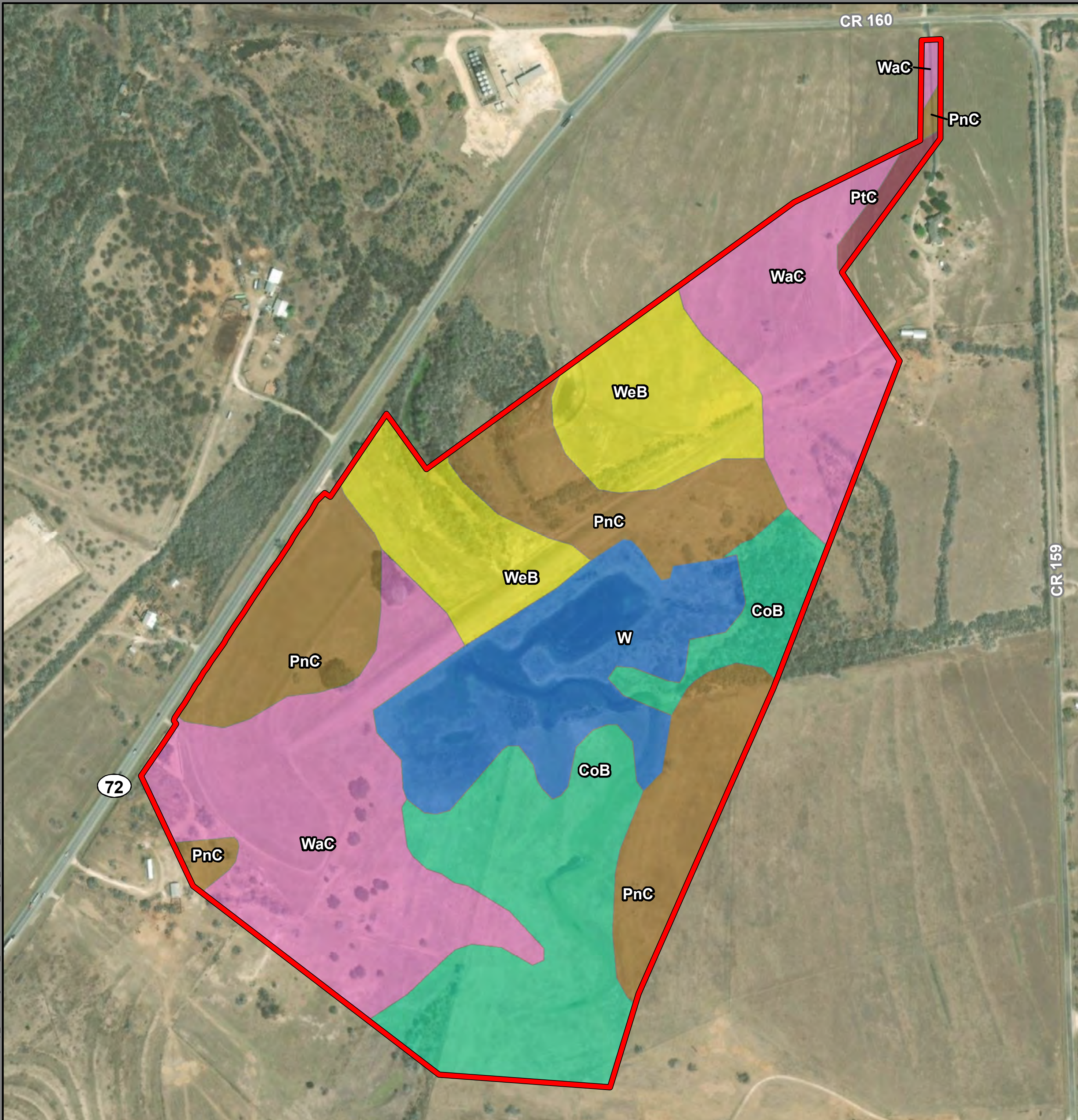
July 2024

Figure 2

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig2_USGS_TopoMap.mxd



Study Area

NRCS Soil Types

- CoB - Coy clay loam, 1 to 3 percent slopes
- PnC - Pernitas sandy clay loam, 2 to 5 percent slopes
- PtC - Pettus loam, 2 to 5 percent slopes
- W - Water
- WaC - Weesatche fine sandy loam, 2 to 5 percent slopes
- WeB - Weesatche sandy clay loam, 1 to 3 percent slopes

NRCS Soils Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N W E S

0 200 400
Feet

Data Sources: Soils - USDA NRCS 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 3

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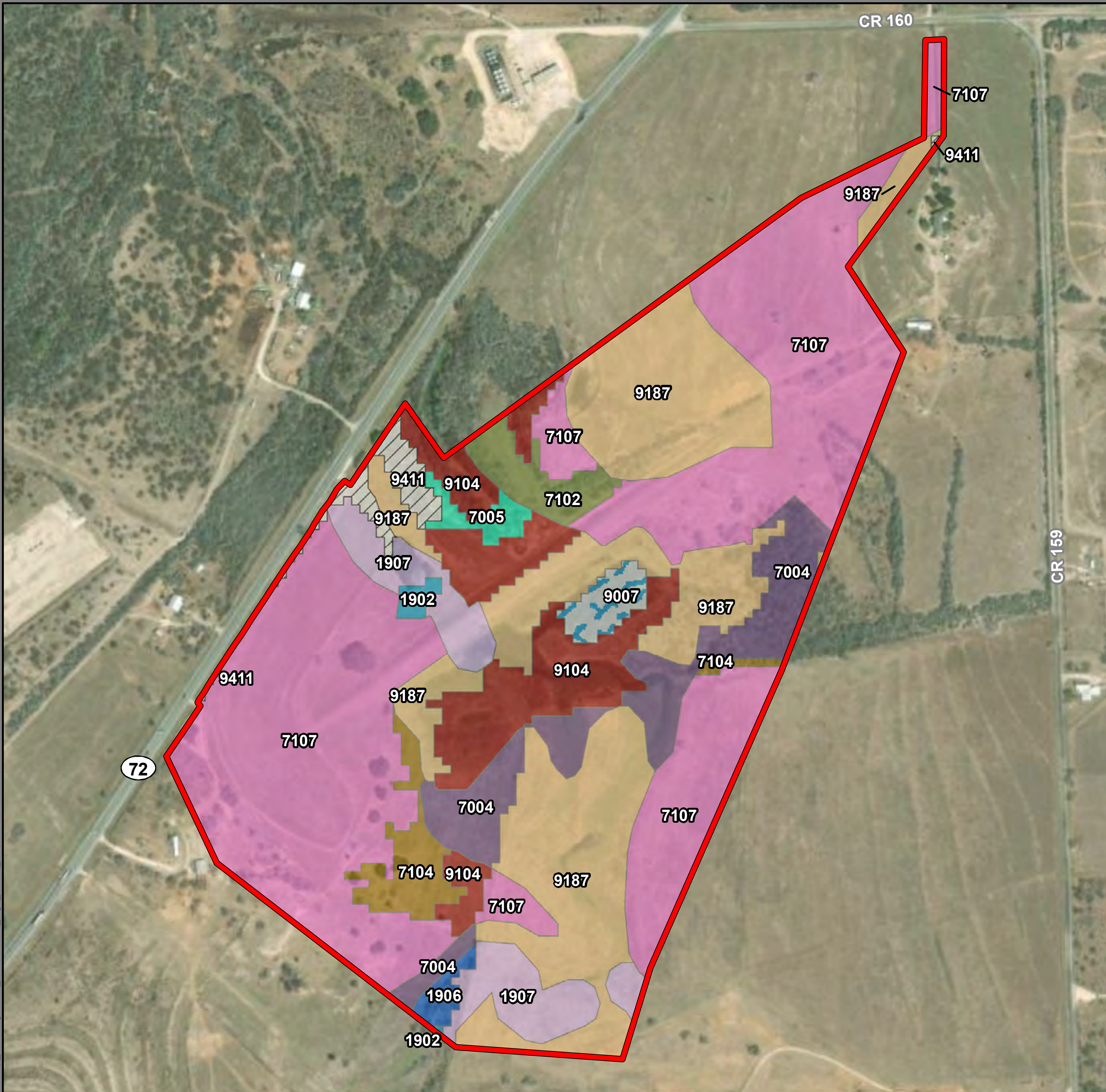


Study Area

EMST Vegetation Types

1902 - Central Texas: Riparian Live Oak Forest

1906 - Central Texas: Riparian Deciduous Shrubland

1907 - Central Texas: Riparian Herbaceous Vegetation

7004 - South Texas: Clayey Mesquite Mixed Shrubland

7005 - South Texas: Clayey Blackbrush Mixed Shrubland

7102 - South Texas: Sandy Live Oak Motte and Woodland

7104 - South Texas: Sandy Mesquite Woodland and Shrubland

7107 - South Texas: Sandy Mesquite Savanna Grassland

9007 - Marsh

9104 - Native Invasive: Deciduous Woodland

9187 - South Texas: Disturbance Grassland

9411 - Urban Low Intensity

Ecological Mapping Systems of Texas (EMST) Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N W E S

0 200 400
Feet

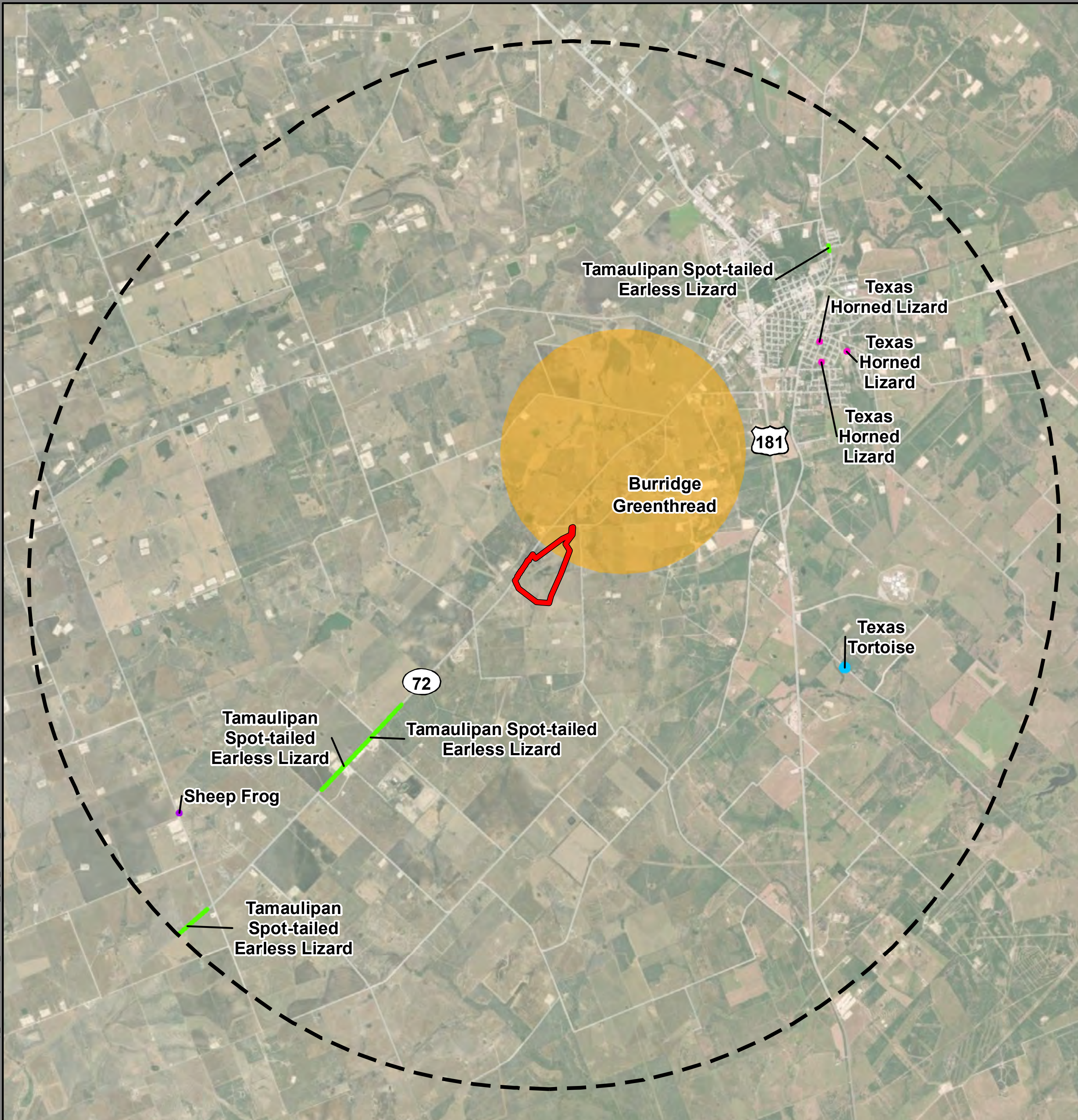
Data Sources: EMST - TPWD 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 4

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig4_EMST_Map.mxd



Study Area

TXNDD Element Occurrence Record

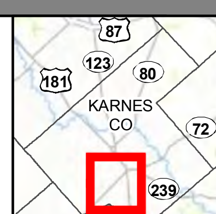
Burridge Greenthread

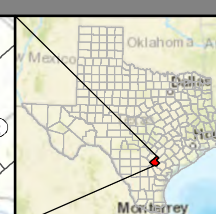
Tamaulipan Spot-tailed Earless Lizard

Texas Horned Lizard

Texas Tortoise

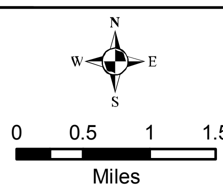
Sheep Frog





Texas Natural Diversity Database (TXNDD) Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas



Data Sources: TXNDD - TPWD 6/26/2023; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 5

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig5_TXNDD_Map.mxd

Appendix B Photographic Log

PHOTOGRAPHIC LOG

Client Name: **Texas Water Conservation Board**	**Site Location:** **Karnes County, TX**	**Project Number:** **60707486**

Photo No. 1	**Date: 6/14/23**
Direction Photo Taken: Northwest	
Description: View of Escondido Creek Flood Retarding Structure (FRS) No. 1 reservoir and hay cultivation near the northeastern boundary of the Study Area.	

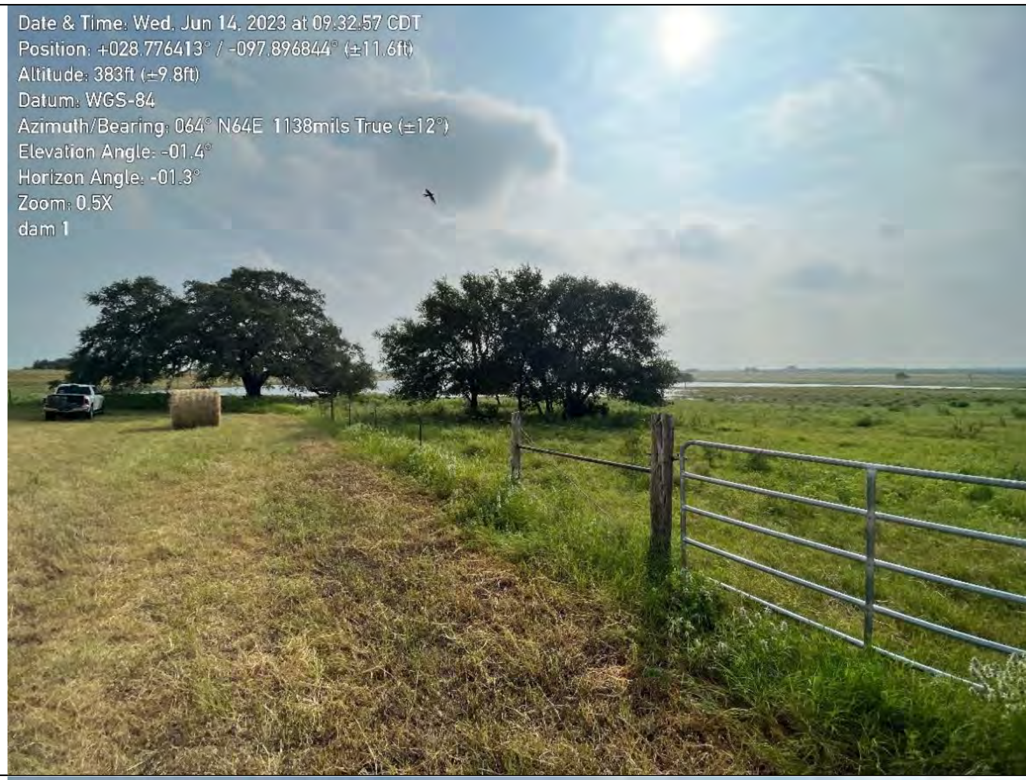


Photo No. 2	**Date: 6/14/23**
Direction Photo Taken: Northeast	
Description: View of Escondido Creek FRS No. 1 reservoir near the southwestern boundary of the Study Area.	

AECOM	**PHOTOGRAPHIC LOG**

Client Name: Texas Water Conservation Board	**Site Location:** Karnes County, TX	**Project Number:** 60707486

Photo No. 3	**Date:** 6/14/23	
Direction Photo Taken: Northeast		
Description: View of Escondido Creek FRS No. 1 reservoir and the range land used for hay cultivation. This picture was taken from the dam in the Study Area.		

Photo No. 4	**Date:** 6/14/23	
Direction Photo Taken: Southwest		
Description: View of marshland located northeast of Escondido Creek FRS No.1 reservoir.		

PHOTOGRAPHIC LOG

Client Name: Texas Water Conservation Board	Site Location: Karnes County, TX	Project Number: 60707486

Photo No.	Date:
5	6/14/23

Direction Photo Taken:

Southeast

Description:

View of Escondido Creek FRS No. 1 reservoir from the dam taken at the northwestern boundary of the Study Area.

Appendix C Federal and State Database Review

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Karnes County, Texas

Local office

Texas Coastal & Central Plains Esfo

(281) 286-8282
(281) 488-5882

MAILING ADDRESS
17629 El Camino Real, Suite 211
Houston, TX 77058-3051

PHYSICAL ADDRESS
17629 El Camino Real
Houston, TX 77058-3051

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Birds

NAME	STATUS
Piping Plover Charadrius melodus This species only needs to be considered if the following condition applies: • Wind related projects within migratory route. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/6039	Threatened
Rufa Red Knot Calidris canutus rufa Wherever found This species only needs to be considered if the following condition applies: • Wind Related Projects Within Migratory Route There is **proposed** critical habitat for this species. https://ecos.fws.gov/ecp/species/1864	Threatened

Whooping Crane Grus americana There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/758	Endangered

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

Bald & Golden Eagles

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are likely bald eagles present in your project area. For additional information on bald eagles, refer to Bald Eagle Nesting and Sensitivity to Human Activity

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Jul 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence ( )

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season ( )

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

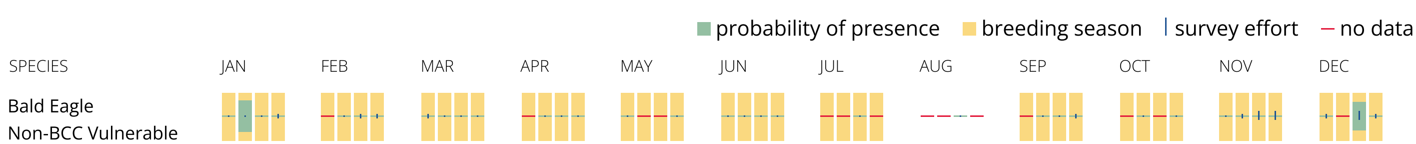
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply). To see a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs of bald and golden eagles in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur. Please contact your local Fish and Wildlife Service Field Office if you have questions.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/ documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Jul 31

Lesser Yellowlegs Tringa flavipes — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9679

Little Blue Heron Egretta caerulea — Breeds Mar 10 to Oct 15

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Pectoral Sandpiper Calidris melanotos — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Prairie Loggerhead Shrike Lanius ludovicianus excubitorides — Breeds Feb 1 to Jul 31

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/8833

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

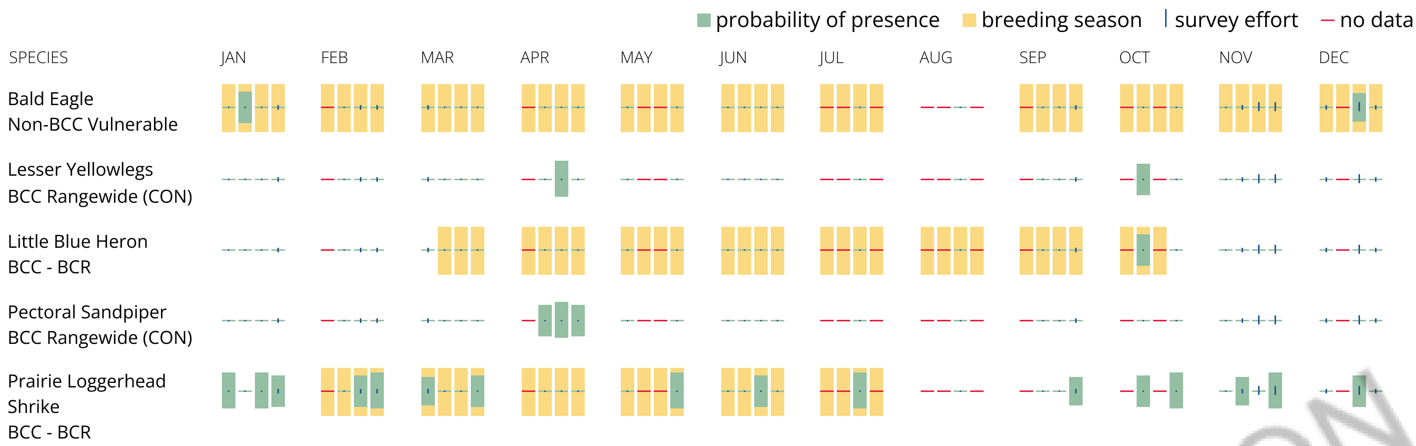
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

Wildlife refuges and fish hatcheries

Refuge and fish hatchery information is not available at this time

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

- PEM1Ch
- PEM1Ah

FRESHWATER FORESTED/SHRUB WETLAND

- PSS1Ah

FRESHWATER POND

- PUBFh

RIVERINE

- R4SBC
- R5UBH

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Last Update: 9/1/2023

KARNES COUNTY

AMPHIBIANS

sheep frog *Hypopachus variolosus*

Terrestrial and aquatic: Predominantly grassland and savanna; largely fossorial in areas with moist microclimates.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S4

Strecker's chorus frog *Pseudacris streckeri*

Terrestrial and aquatic: Wooded floodplains and flats, prairies, cultivated fields and marshes. Likes sandy substrates.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3

Woodhouse's toad *Anaxyrus woodhousii*

Terrestrial and aquatic: A wide variety of terrestrial habitats are used by this species, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: SU

BIRDS

bald eagle *Haliaeetus leucocephalus*

Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3B,S3N

black rail *Laterallus jamaicensis*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mat of previous years dead grasses; nest usually hidden in marsh grass or at base of Salicornia

Federal Status: T State Status: T SGCN: Y

Endemic: N Global Rank: G3 State Rank: S2

Franklin's gull *Leucophaeus pipixcan*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. This species is only a spring and fall migrant throughout Texas. It does not breed in or near Texas. Winter records are unusual consisting of one or a few individuals at a given site (especially along the Gulf coastline). During migration, these gulls fly during daylight hours but often come down to wetlands, lake shore, or islands to roost for the night.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S2N

KARNES COUNTY

BIRDS

lark bunting *Calamospiza melanocorys*

Overall, it's a generalist in most short grassland settings including ones with some brushy component plus certain agricultural lands that include grain sorghum. Short grasses include sideoats and blue gramas, sand dropseed, prairie junegrass (Koeleria), buffalograss also with patches of bluestem and other mid-grass species. This bunting will frequent smaller patches of grasses or disturbed patches of grasses including rural yards. It also uses weedy fields surrounding playas. This species avoids urban areas and cotton fields.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4B

mountain plover *Charadrius montanus*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S2

piping plover *Charadrius melodus*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore islands. Also spoil islands in the Intracoastal Waterway. Based on the November 30, 1992 Section 6 Job No. 9.1, Piping Plover and Snowy Plover Winter Habitat Status Survey, algal flats appear to be the highest quality habitat. Some of the most important aspects of algal flats are their relative inaccessibility and their continuous availability throughout all tidal conditions. Sand flats often appear to be preferred over algal flats when both are available, but large portions of sand flats along the Texas coast are available only during low-very low tides and are often completely unavailable during extreme high tides or strong north winds. Beaches appear to serve as a secondary habitat to the flats associated with the primary bays, lagoons, and inter-island passes. Beaches are rarely used on the southern Texas coast, where bayside habitat is always available, and are abandoned as bayside habitats become available on the central and northern coast. However, beaches are probably a vital habitat along the central and northern coast (i.e. north of Padre Island) during periods of extreme high tides that cover the flats. Optimal site characteristics appear to be large in area, sparsely vegetated, continuously available or in close proximity to secondary habitat, and with limited human disturbance.

Federal Status: LT	State Status: T	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S2N

rufa red knot *Calidris canutus rufa*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore. Bolivar Flats in Galveston County, sandy beaches Mustang Island, few on outer coastal and barrier beaches, tidal mudflats and salt marshes.

Federal Status: LT	State Status: T	SGCN: Y
Endemic: N	Global Rank: G4T2	State Rank: S2N

KARNES COUNTY

BIRDS

Sprague's pipit *Anthus spragueii*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Habitat during migration and in winter consists of pastures and weedy fields (AOU 1983), including grasslands with dense herbaceous vegetation or grassy agricultural fields.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G3G4 State Rank: S3N

swallow-tailed kite *Elanoides forficatus*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S2B

western burrowing owl *Athene cunicularia hypugaea*

Open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4T4 State Rank: S2

white-faced ibis *Plegadis chihi*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; currently confined to near-coastal rookeries in so-called hog-wallow prairies. Nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S4B

white-tailed hawk *Buteo albicaudatus*

Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G4G5 State Rank: S4B

whooping crane *Grus americana*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Small ponds, marshes, and flooded grain fields for both roosting and foraging. Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.

Federal Status: LE State Status: E SGCN: Y

Endemic: N Global Rank: G1 State Rank: S1S2N

KARNES COUNTY

BIRDS

wood stork *Mycteria americana*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers to nest in large tracts of baldcypress (Taxodium distichum) or red mangrove (Rhizophora mangle); forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G4 State Rank: SHB,S2N

FISH

river darter *Percina shumardi*

In Texas limited to eastern streams including Red River southward to the Neches River, and a disjunct population in the Guadalupe and San Antonio river systems east of the Balcones Escarpment. Confined to large rivers and lower parts of major tributaries; usually found in deep chutes and riffles where current is swift and bottom composed of coarse gravel or rock.

Federal Status: State Status: SGCN: Y

Endemic: Global Rank: G5 State Rank: S4

INSECTS

Manfreda giant-skipper *Stallingsia maculosus*

Most skippers are small and stout-bodied; name derives from fast, erratic flight; at rest most skippers hold front and hind wings at different angles; skipper larvae are smooth, with the head and neck constricted; skipper larvae usually feed inside a leaf shelter and pupate in a cocoon made of leaves fastened together with silk

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G1 State Rank: S1

MAMMALS

big free-tailed bat *Nyctinomops macrotis*

Habitat data sparse but records indicate that species prefers to roost in crevices and cracks in high canyon walls, but will use buildings, as well; reproduction data sparse, gives birth to single offspring late June-early July; females gather in nursery colonies; winter habits undetermined, but may hibernate in the Trans-Pecos; opportunistic insectivore

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3

cave myotis bat *Myotis velifer*

Colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4G5 State Rank: S2S3

KARNES COUNTY

MAMMALS

eastern red bat *Lasiurus borealis*

Red bats are migratory bats that are common across Texas. They are most common in the eastern and central parts of the state, due to their requirement of forests for foliage roosting. West Texas specimens are associated with forested areas (cottonwoods). Also common along the coastline. These bats are highly mobile, seasonally migratory, and practice a type of "wandering migration". Associations with specific habitat is difficult unless specific migratory stopover sites or wintering grounds are found. Likely associated with any forested area in East, Central, and North Texas but can occur statewide.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3G4	State Rank: S4

eastern spotted skunk *Spilogale putorius*

Generalist; open fields prairies, croplands, fence rows, farmyards, forest edges & woodlands. Prefer wooded, brushy areas & tallgrass prairies. S.p. ssp. interrupta found in wooded areas and tallgrass prairies, preferring rocky canyons and outcrops when such sites are available.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G4	State Rank: S1S3

hoary bat *Lasiurus cinereus*

Hoary bats are highly migratory, high-flying bats that have been noted throughout the state. Females are known to migrate to Mexico in the winter, males tend to remain further north and may stay in Texas year-round. Commonly associated with forests (foliage roosting species) but are found in unforested parts of the state and lowland deserts. Tend to be captured over water and large, open flyways.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3G4	State Rank: S3

long-tailed weasel *Mustela frenata*

Includes brushlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub. Usually live close to water.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S5

mountain lion *Puma concolor*

Generalist; found in a wide range of habitats statewide. Found most frequently in rugged mountains & riparian zones.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S2S3

northern yellow bat *Lasiurus intermedius*

Occurs mainly along the Gulf Coast but inland specimens are not uncommon. Prefers roosting in spanish moss and in the hanging fronds of palm trees. Common where this vegtation occurs. Found near water and forages over grassy, open areas. Males usually roost solitarily, whereas females roost in groups of several individuals.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4

KARNES COUNTY

MAMMALS

ocelot *Leopardus pardalis*

Restricted to mesquite-thorn scrub and live-oak mottes; avoids open areas. Dense mixed brush below four feet; thorny shrublands; dense chaparral thickets; breeds and raises young June-November.

Federal Status: LE State Status: E SGCN: Y

Endemic: N Global Rank: G4 State Rank: S1

swamp rabbit *Sylvilagus aquaticus*

Primarily found in lowland areas near water including: cypress bogs and marshes, floodplains, creeks and rivers.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S5

tricolored bat *Perimyotis subflavus*

Forest, woodland and riparian areas are important. Caves are very important to this species.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G3G4 State Rank: S2

western hog-nosed skunk *Conepatus leuconotus*

Habitats include woodlands, grasslands & deserts, to 7200 feet, most common in rugged, rocky canyon country; little is known about the habitat of the ssp. telmalestes

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4 State Rank: S4

western spotted skunk *Spilogale gracilis*

Brushy canyons, rocky outcrops (rimrock) on hillsides and walls of canyons. In semi-arid brushlands in U.S., in wet tropical forests in Mexico. When inactive or bearing young, occupies den in rocks, burrow, hollow log, brush pile, or under building.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S5

white-nosed coati *Nasua narica*

Woodlands, riparian corridors and canyons.Most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S1

REPTILES

eastern box turtle *Terrapene carolina*

Terrestrial: Eastern box turtles inhabit forests, fields, forest-brush, and forest-field ecotones. In some areas they move seasonally from fields in spring to forest in summer. They commonly enters pools of shallow water in summer. For shelter, they burrow into loose soil, debris, mud, old stump holes, or under leaf litter. They can successfully hibernate in sites that may experience subfreezing temperatures.

Federal Status: State Status: SGCN: Y

KARNES COUNTY

REPTILES

Endemic: N Global Rank: G5 State Rank: S3

slender glass lizard *Ophisaurus attenuatus*

Terrestrial: Habitats include open grassland, prairie, woodland edge, open woodland, oak savannas, longleaf pine flatwoods, scrubby areas, fallow fields, and areas near streams and ponds, often in habitats with sandy soil.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3

Tamaulipan spot-tailed earless lizard *Holbrookia subcaudalis*

Terrestrial: Habitats include moderately open prairie-brushland regions, particularly fairly flat areas free of vegetation or other obstructions (e.g., open meadows, old and new fields, graded roadways, cleared and disturbed areas, prairie savanna, and active agriculture including row crops); also, oak-juniper woodlands and mesquite-prickly pear associations (Axtell 1968, Bartlett and Bartlett 1999).

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: GNR State Rank: S2

Texas horned lizard *Phrynosoma cornutum*

Terrestrial: Open habitats with sparse vegetation, including grass, prairie, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive. Occurs to 6000 feet, but largely limited below the pinyon-juniper zone on mountains in the Big Bend area.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G4G5 State Rank: S3

Texas indigo snake *Drymarchon melanurus erebennus*

Terrestrial: Thornbush-chaparral woodland of south Texas, in particular dense riparian corridors.Can do well in suburban and irrigated croplands. Requires moist microhabitats, such as rodent burrows, for shelter.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5T4 State Rank: S4

Texas tortoise *Gopherus berlandieri*

Terrestrial: Open scrub woods, arid brush, lomas, grass-cactus association; often in areas with sandy well-drained soils. When inactive occupies shallow depressions dug at base of bush or cactus; sometimes in underground burrow or under object. Eggs are laid in nests dug in soil near or under bushes.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G4 State Rank: S2

western box turtle *Terrapene ornata*

Terrestrial: Ornate or western box trutles inhabit prairie grassland, pasture, fields, sandhills, and open woodland. They are essentially terrestrial but sometimes enter slow, shallow streams and creek pools. For shelter, they burrow into soil (e.g., under plants such as yucca) (Converse et al. 2002) or enter burrows made by other species.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3

KARNES COUNTY

REPTILES

PLANTS

Billie's bitterweed *Tetraneuris turneri*

Grasslands on shallow sandy soils and caliche outcrops (Carr 2015).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S3

Burridge greenthread *Thelesperma burridgeanum*

Sandy open areas; Annual; Flowering March-Nov; Fruiting March-June

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G3	State Rank: S3

Drummond's rushpea *Hoffmannseggia drummondii*

Open areas on sandy clay; Perennial

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S3

low spurge *Euphorbia peplidion*

Occurs in a variety of vernally-moist situations in a number of natural regions; Annual; Flowering Feb-April; Fruiting March-April

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G3	State Rank: S3

Welder machaeranthera *Psilactis heterocarpa*

Grasslands , varying from midgrass coastal prairies, and open mesquite-huisache woodlands on nearly level, gray to dark gray clayey to silty soils; known locations mapped on Victoria clay, Edroy clay, Dacosta sandy clay loam over Beaumont and Lissie formations; flowering September-November

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G2G3	State Rank: S2S3

Wright's trichocoronis *Trichocoronis wrightii var. wrightii*

Most records from Texas are historical, perhaps indicating a decline as a result of alteration of wetland habitats; Annual; Flowering Feb-Oct; Fruiting Feb-Sept

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G4T3	State Rank: S2

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Investigation of Potentially Jurisdictional Waters of the United States

Escondido Creek Watershed Floodwater Retarding Structure No. 1 Supplemental Planning Project

Karnes County, Texas

Natural Resources Conservation Services

Project number: 60707486

August 2024

Delivering a better world

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1. Introduction

AECOM Technical Services, Inc. (AECOM) conducted an investigation of potentially jurisdictional waters of the United States (U.S.) (WOTUS), including wetlands, for the proposed Escondido Creek Watershed Floodwater Retarding Structure (FRS) No. 1 Supplemental Planning Project (Project). The proposed Project is located in Karnes County, approximately 3.7 miles southwest of Kenedy, Texas (**Appendix A, Figure 1**). A literature search and field investigations were conducted for the Project within a potential impact area encompassing approximately 131 acres (Study Area).

The purpose of the investigation was to identify and delineate water resources within the Study Area that exhibit characteristics meeting the regulatory definition of WOTUS. These resources were then assessed for their potential to be considered jurisdictional WOTUS subject to regulation by the U.S. Army Corps of Engineers (USACE) Fort Worth District under jurisdiction of Section 404 of the Clean Water Act (CWA).

2. Environmental Setting

Publicly available data was reviewed to identify potentially jurisdictional streams, waterbodies, wetlands, soil types, and vegetation types within the Study Area. Data resources reviewed included the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD), the U.S. Department of Agriculture (USDA) NRCS Web Soil Survey, USGS 7.5' quadrangle sheets, Federal Emergency Management Agency (FEMA) floodplain maps, and recent aerial photography. This data review was used to describe the site-specific information below.

2.1 Land Use

The Study Area consisted of an open water reservoir, a dam structure, and undeveloped land. Based on the NHD, Panther Creek, an intermittent stream; one unnamed intermittent stream; and one open water feature, Escondido Creek FRS No. 1 Reservoir, were mapped within the Study Area (USGS 2023). Land use surrounding the Study Area is used for livestock hay cultivation **Appendix A, Figure 1**).

2.2 Topography

The USGS 7.5-minute quadrangle map for Lenz, TX displays the topography of the Study Area (**Appendix A, Figure 2**). Topography within the Study Area is shaped by the current reservoir and dam system, as well as Panther Creek. The surface gradient slopes downward from the southwest and northeast to the central portion of the Study Area with the highest elevation located along the northeast boundary at approximately 402 feet above mean sea level (MSL [National Geodetic Vertical Datum of 1929]). The lowest elevation is located near Panther Creek at the west central portion of the Study Area boundary at approximately 344 feet above MSL (USGS 1987).

2.3 Soils

According to the USDA NRCS Web Soil Survey Report, the Study Area is mapped as being underlain by six map units (as shown on **Table 1** below and within **Appendix A, Figure 3**) (USDA NRCS 2021).

Table 1. NRCS Soil Mapping Units

Mapping Unit	Soil Type	Listed as Hydric by NRCS
CoB	Coy clay loam, 1 to 3 percent slopes	Yes
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	No
PtC	Pettus loam, 2 to 5 percent slopes	No
W	Water	No
WaC	Weesatche fine sandy loam, 2 to 5 percent slopes	No
WeB	Weesatche sandy clay loam, 1 to 3 percent slopes	No

2.4 Hydrology

The Study Area lies within the Lower San Antonio watershed (8-Digit Hydrologic Unit Code [HUC] 12100303) and the Doe Branch-Escondido Creek subwatershed (12-Digit HUC 121003030402).

The USGS NHD was reviewed to gather information on the potential location of areas that may exhibit characteristics of WOTUS. Panther Creek, an intermittent stream; one unnamed intermittent stream; and one open water feature, Escondido Creek FRS No. 1 Reservoir, were identified by the NHD within the Study Area and are shown on **Appendix A, Figure 4**.

USFWS NWI maps and associated geographic information system (GIS) data were reviewed to gather information on the potential location of areas that may exhibit characteristics of wetlands. According to the NWI data, several features associated with Panther Creek and Escondido Creek FRS No. 1 Reservoir are located within the Study Area (**Appendix A, Figure 4**). Documented NWI types include Riverine, Intermittent, Streambed, Seasonally Flooded (R4SBC); Riverine, Unknown Perennial, Unconsolidated Bottom, Permanently Flooded (R5UBH); Palustrine, Emergent, Persistent, Seasonally flooded, Diked/Impounded (PEM1Ch); Palustrine, Emergent, Persistent, Temporarily Flooded, Diked/Impounded (PEM1Ah); Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Temporarily Flooded, Diked/Impounded (PSS1Ah); and Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Diked/Impounded (PUBFh).

2.4.1 Floodplain

Based on a review of the FEMA digital flood insurance rate map (dFIRM) panel number 48255C0375C (effective October 19, 2010), one flood zone designation, Zone A, was identified within the Study Area. Zone A is mapped throughout the Study Area encompassing the streams above and below the reservoir, and the reservoir area as shown in **Appendix A, Figure 4**.

Zone A includes areas that have a 1% annual chance of flooding and where no depths or base flood elevations have been determined.

2.4.2 Vegetation

Historically Mapped and Documented Vegetation Types

According to TPWD’s Ecoregion data, the Study Area falls within the East Central Texas Plains Level 3 Ecoregion and the Southern Post Oak Savanna Level 4 Ecoregion (TPWD 2011).

The Study Area lies within one Land Resource Region (LRR I) and one Major Land Resource Area (MLRA 83A). LRR I denotes the Southwest Plateaus and Plains Range and Cotton Region, and vegetation consists mainly of mesquite and juniper savannas. MLRA 83A is the Northern Rio Grande Plain which can be characterized as areas of grass, cropland, and pasture interspersed with tall, thick shrubs on nearly level and gently rolling hills and valleys. More information on LRR I and MLRA 83A can be read within USDA’s Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, Handbook 296 (NRCS 2022).

According to TPWD’s Ecological Mapping System of Texas (EMST), the vegetation mapped within the Study Area includes Central Texas: Riparian Live Oak Forest; Central Texas: Riparian Deciduous Shrubland; Central Texas: Riparian Herbaceous Vegetation; South Texas: Clayey Mesquite Mixed Shrubland; South Texas: Clayey Blackbrush Mixed Shrubland; South Texas:

Sandy Live Oak Motte and Woodland; South Texas: Sandy Mesquite Woodland and Shrubland; South Texas: Sandy Mesquite Savanna Grassland; Marsh; Native Invasive: Deciduous Woodland; South Texas: Disturbance Grassland; and Urban Low Intensity. (**Appendix A, Figure 5** (Elliott et al 2014).

Existing Conditions

Field investigations documented vegetation types throughout the Study Area. The majority of the Study Area consisted of undeveloped grassland and deciduous woodlands. Common species observed within the tree and sapling/shrub stratum include cedar elm (*Ulmus crassfolia*), sugarberry (*Celtis laevigata*) and privet (*Ligustrum sp.*). Common herbaceous species observed within the Study Area include inland sea oats (*Chasmanthium latifolium*), prickly pear cactus (*Opuntia engelmannii*), and Bermuda grass (*Cynodon dactylon*). See **Appendix B** for representative photographs of the Study Area.

3. Potentially Jurisdictional Waters of the U.S.

3.1 USACE Regulatory Authority

The USACE, acting under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899, regulates certain activities occurring within WOTUS. Under Section 404 of the CWA, authorization must be obtained from the USACE for discharges of dredged and fill material into jurisdictional WOTUS, including wetlands. The USACE's regulatory authority over WOTUS includes jurisdictional determinations and permitting under Section 404 of the CWA. In addition, under Section 10 of the Rivers and Harbors Act of 1899, the USACE regulates any work in or affecting navigable WOTUS (Environmental Protection Agency [EPA], 2015). The proposed project is regulated in accordance with the CWA by the Fort Worth District of the USACE.

3.2 Field Delineation Methodology

In accordance with the pre-2015 regulatory regime and Supreme Court's decision in *Sackett*, the USACE asserts jurisdiction over the following categories of water bodies: 1) traditionally navigable waters (TNWs); 2) wetlands adjacent to TNWs; 3) relatively permanent waters (RPWs) (i.e., waters that typically flow year round or have continuous flow at least seasonally); 4) wetlands adjacent to RPWs; intrastate lakes and ponds; and 5) impoundments of waters. Adjacent means having a continuous surface connection (USACE, 2008; EPA, 2023).

The limit of jurisdiction for non-tidal jurisdictional WOTUS extends to the ordinary high-water mark (OHWM), the limit of adjacent wetlands, or the limit of other special aquatic sites (SAS). SAS include sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes (40 CFR Section 230.10(a)(3) of the CWA). The OHWM is determined by signs of natural lines impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, presence of litter and debris, wracking, vegetation matted down, bent, or absent, sediment sorting, leaf litter disturbed or washed away, scour, deposition, multiple observed flow events, bed and banks, water staining, change in plant community; and/or other appropriate means that consider the characteristics of the surrounding areas.

The USACE's determination of a jurisdictional wetland is based on the wetland criteria of the 1987 Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987), as amended by USACE memoranda dated August 23 and 27, 1991, and March 6, 1992; Questions and Answers to the 1987 Manual (October 7, 1991); and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0, March 2010) (USACE 2010). Wetlands are based on three criteria: hydrophytic vegetation, hydric soils, and wetland hydrology. All three criteria must be present for an area to qualify as a wetland; however, some exceptions can occur in disturbed areas or in newly formed wetlands, where one indicator (such as hydric soils) might be lacking.

Field investigations were conducted on June 14, 2023. AECOM used a Trimble Geo7X Global Positioning System (GPS), capable of sub-meter accuracy, to collect geographically-referenced features, such as OHWMs, wetland boundaries, and soil station data points. The field data was then transferred to GIS software (ESRI ArcMap 10.5) to analyze identified features, calculate areas and lengths, and generate **Appendix A, Figure 6.**

Appendix B contains a detailed photo log showing conditions of each feature as documented within the Study Area.

3.3 Potentially Jurisdictional WOTUS (Non-Wetland)

Escondido Creek FRS No. 1 Reservoir (WB01) is approximately 28.31 acres in areal extent within the Study Area. This reservoir captures hydrologic flow from Panther Creek then discharges below the dam (via spillway) to connect Panther Creek back to its previous channel bank. Panther Creek then leaves Escondido Creek FRS No. 1 Reservoir flowing approximately 3.84 miles northeast before discharging into Escondido Creek, followed by the San Antonio River, an RPW, flows into the Guadalupe River, and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on NHD, desktop investigations, and field investigations, this is a perennial water feature that maintains year-round flow from groundwater and upstream hydrologic flow. This feature has a significant nexus to a RPW and jurisdictional feature, therefore, can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 1-3** for conditions documented during the field investigation.

Stream 01 (S01) (below the Escondido Creek FRS No. 1) spans approximately 150 linear feet (LF) (0.01 acres in areal extent) within the Study Area. The average OHWM width was approximately one foot. OHWM indicators observed include bed and bank, shelving, natural lines impressed on the bank, litter disturbed or washed away, and scour. Stream 01 discharges below the dam (via discharge pipe). Stream 01 leaves Escondido Creek FRS No. 1 Reservoir flowing approximately 0.18 miles northeast before discharging into Panther Creek. Panther Creek flows approximately 3.84 miles northeast before discharging into Escondido Creek, followed by the San Antonio River, and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on NHD, desktop investigations, and field investigations, Panther Creek can be considered an intermittent stream as a result of groundwater, upstream hydrologic contribution, and supplemental rainfall. This feature has a significant nexus to a RPW and jurisdictional feature, therefore, can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 4-6** for conditions documented during the field investigation.

Panther Creek (S02) spans approximately 490 (LF (0.36 acres in areal extent) within the Study Area. The average OHWM width was approximately 34 feet. OHWM indicators observed include bed and bank, shelving, natural lines impressed on the bank, litter disturbed or washed away, and scour. Panther Creek discharges below the dam (via principal spillway). Panther Creek leaves Escondido Creek FRS No. 1 Reservoir flowing 0.18 miles then discharges downstream into Panther Creek. Panther Creek then flows approximately 3.84 miles northeast before discharging into Escondido Creek, followed by the San Antonio River, and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on NHD, desktop investigations, and field investigations, Panther Creek can be considered an intermittent stream as a result of groundwater and upstream hydrologic contribution, and supplemental rainfall. This feature has a significant nexus to a RPW and jurisdictional feature, therefore, can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 7-8** for conditions documented during the field investigation.

Table 2 below summarizes potentially jurisdictional WOTUS (non-wetlands) within the Study Area.

Table 2. Potentially Jurisdictional WOTUS (Non-Wetlands) within the Study Area

Name	USACE Classification	Flow Regime	Length (LF)	Average Width (feet)	Area within Study Area (acre)
Escondido Creek FRS No. 1 Reservoir (WB01)	Potentially Jurisdictional	Perennial	N/A	N/A	28.31
Stream 01 (S01)	Potentially Jurisdictional	Intermittent	150	1	0.01
Panther Creek (S02)	Potentially Jurisdictional	Intermittent	490	34	0.36
Total			640	--	28.68

3.4 Potentially Jurisdictional Wetlands

No potentially jurisdictional wetlands were observed within the Study Area.

3.5 Non-Jurisdictional Features

One potentially non-jurisdictional feature, a pond, was identified within the Study Area (see **Appendix A, Figure 6**)

WB02 was mapped northwest of the Escondido Creek FRS No. 1 Reservoir within the Study Area. This feature was identified as an isolated stock pond, approximately 0.56 acres in areal extent. This feature appears to receive hydrologic flow from surrounding agricultural land only after excessive rain events. This pond has no connection to an intermittent stream or TNW and only receives hydrologic flow from rain events. This feature can be considered potentially non-jurisdictional per USACE WOTUS classification.

4. Conclusions

In AECOM's professional opinion, potentially jurisdictional WOTUS identified within the Study Area include Escondido Creek FRS No. 1 Reservoir (WB01), Panther Creek/Stream 01 (S01), and Stream 02 (S02).

Based on the findings from data analysis and field investigations, three potentially jurisdictional WOTUS (non-wetland) totaling 640 LF (28.68 acres) were identified and mapped within the Study Area (as shown on **Table 3** below, and within **Appendix A, Figure 6**).

Table 3. Potentially Jurisdictional WOTUS within the Study Area

Name	USACE Classification	Flow Regime	Length (LF)	Area within Study Area (acres)
Waterbodies				
Escondido Creek FRS No. 1 Reservoir (WB01)	Potentially Jurisdictional	Perennial	N/A	28.31
Stream 01 (S01)	Potentially Jurisdictional	Intermittent	150	0.01
Panther Creek (S02)	Potentially Jurisdictional	Intermittent	490	0.36
Total			640	28.68

These features are subject to regulation by the USACE, Fort Worth District, under Section 404 of the CWA and would require permit authorization if proposed project activities involve the discharge of dredged or fill material into these identified WOTUS.

The USACE is the official regulatory agency to make the final jurisdictional determination of WOTUS and associated wetlands.

5. References

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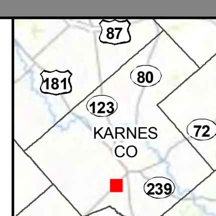
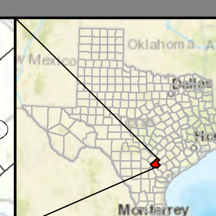
Appendix A Figures

Study Area





Project Location Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N
W E
S
0 200 400
Feet

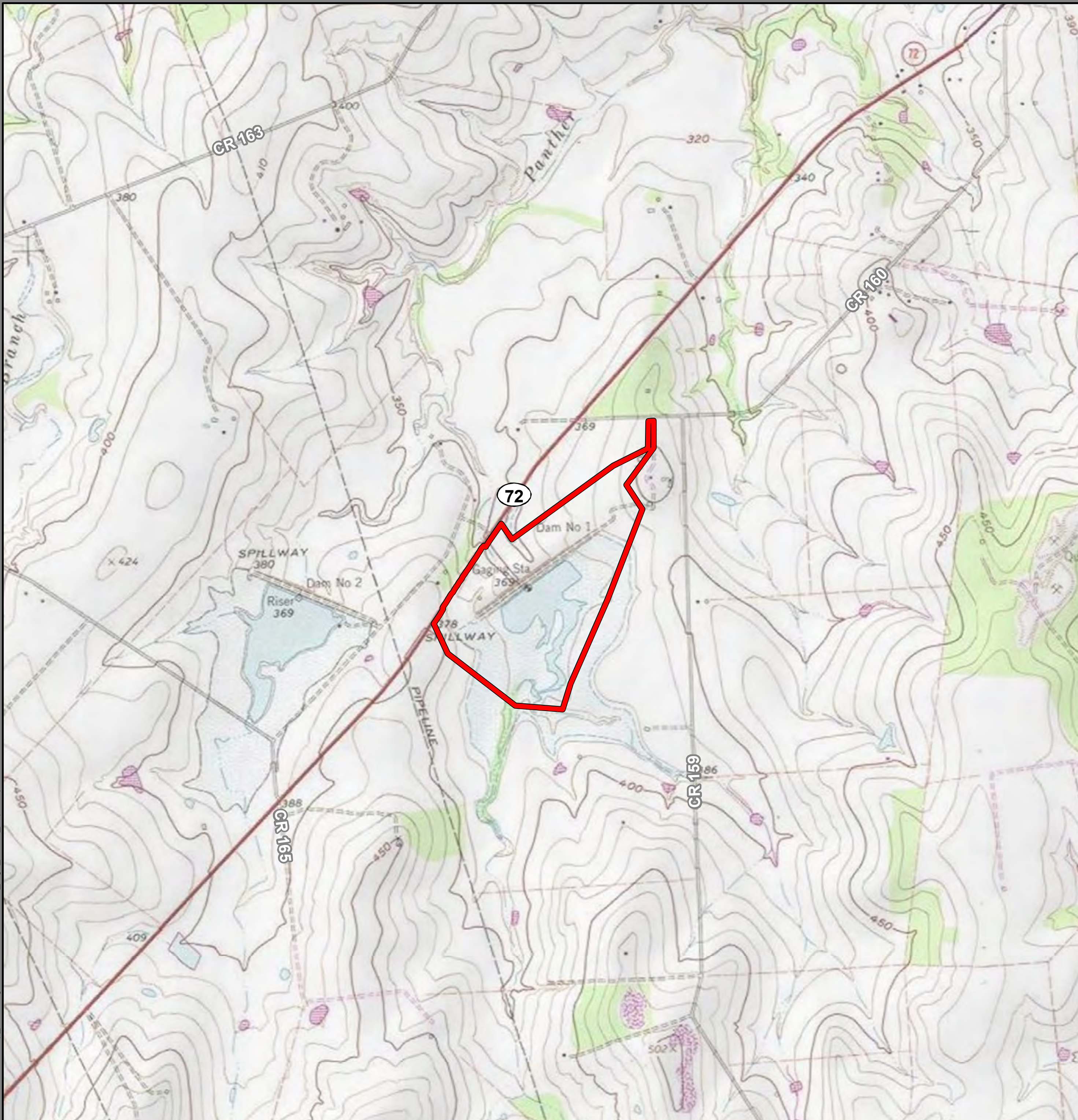
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

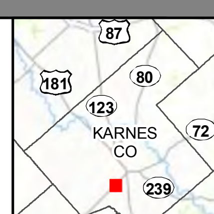
July 2024

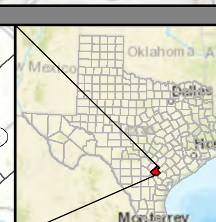
Figure 1

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig1_ProjectLocationMap.mxd



Study Area





USGS Topographic Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N W E S

0 1000 2000
Feet

Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: USGS 7.5-minute Topographic Maps: Lenz Quadrangle

AECOM

July 2024

Figure 2

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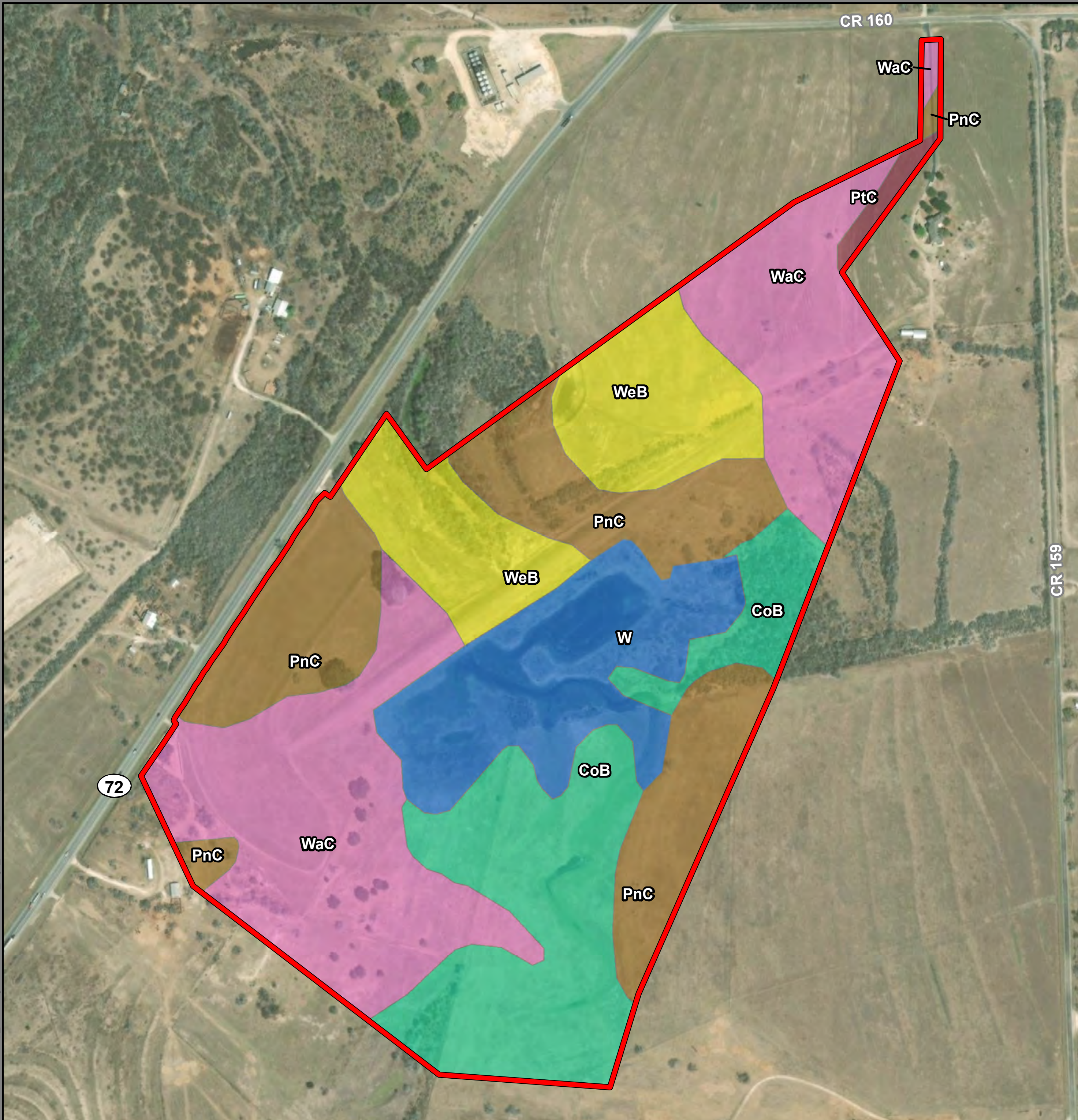


Study Area

NRCS Soil Types

CoB - Coy clay loam, 1 to 3 percent slopes

PnC - Pernitas sandy clay loam, 2 to 5 percent slopes

PtC - Pettus loam, 2 to 5 percent slopes

W - Water

WaC - Weesatche fine sandy loam, 2 to 5 percent slopes

WeB - Weesatche sandy clay loam, 1 to 3 percent slopes

NRCS Soils Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N W E S

0 200 400
Feet

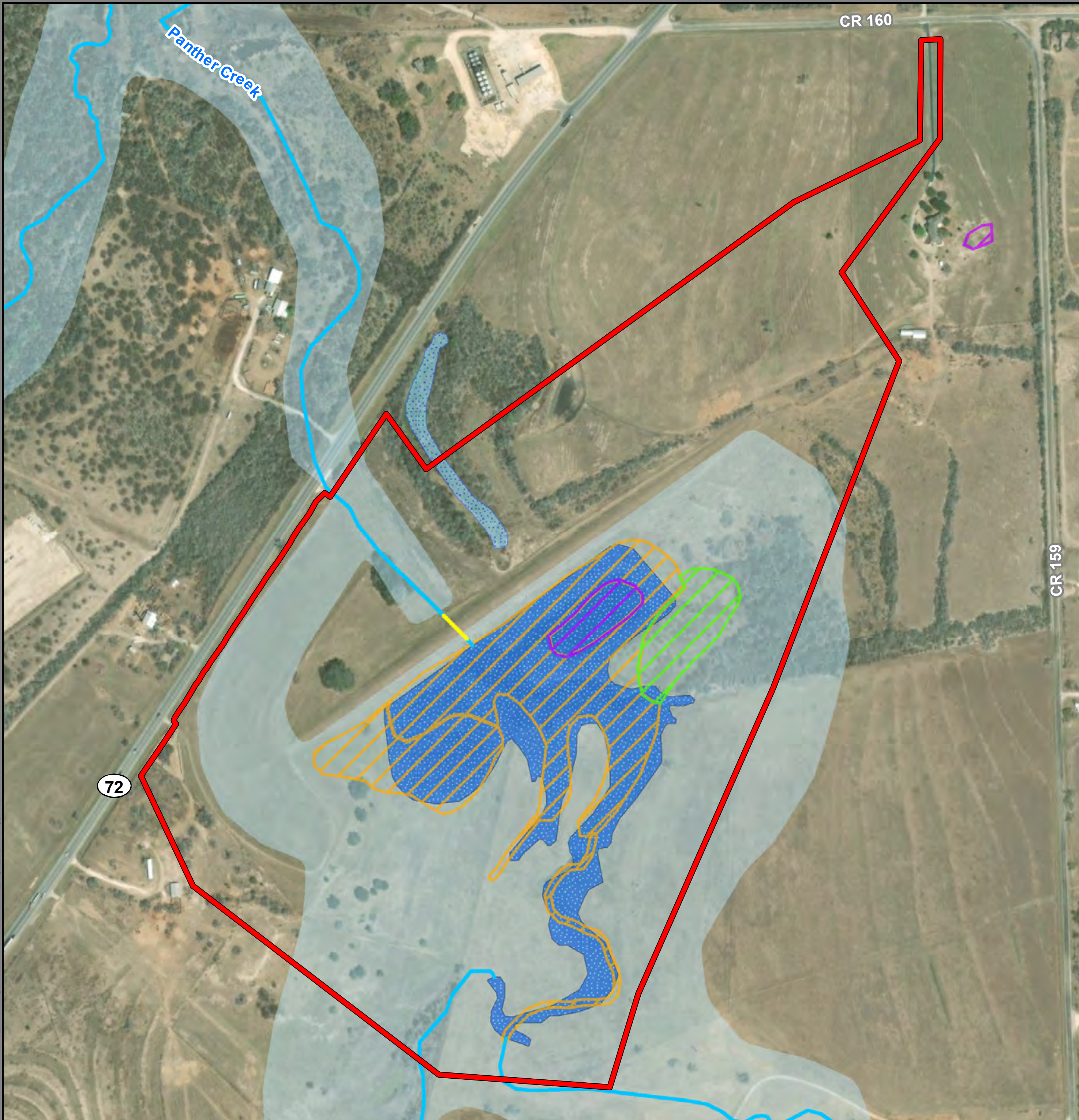
Data Sources: Soils - USDA NRCS 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 3

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig3_NRCS_SoilsMap.mxd



Study Area

National Wetlands Inventory (NWI)

Freshwater Pond

Freshwater Forested/Shrub Wetland

Freshwater Emergent Wetland

National Hydrography Dataset (NHD)

Stream/River: Intermittent

Connector

Lake/Pond: Perennial

Lake/Pond: Intermittent

FEMA Flood Zones

A (100-Year Flood Zone)

Hydrology Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N W E S

0 200 400
Feet

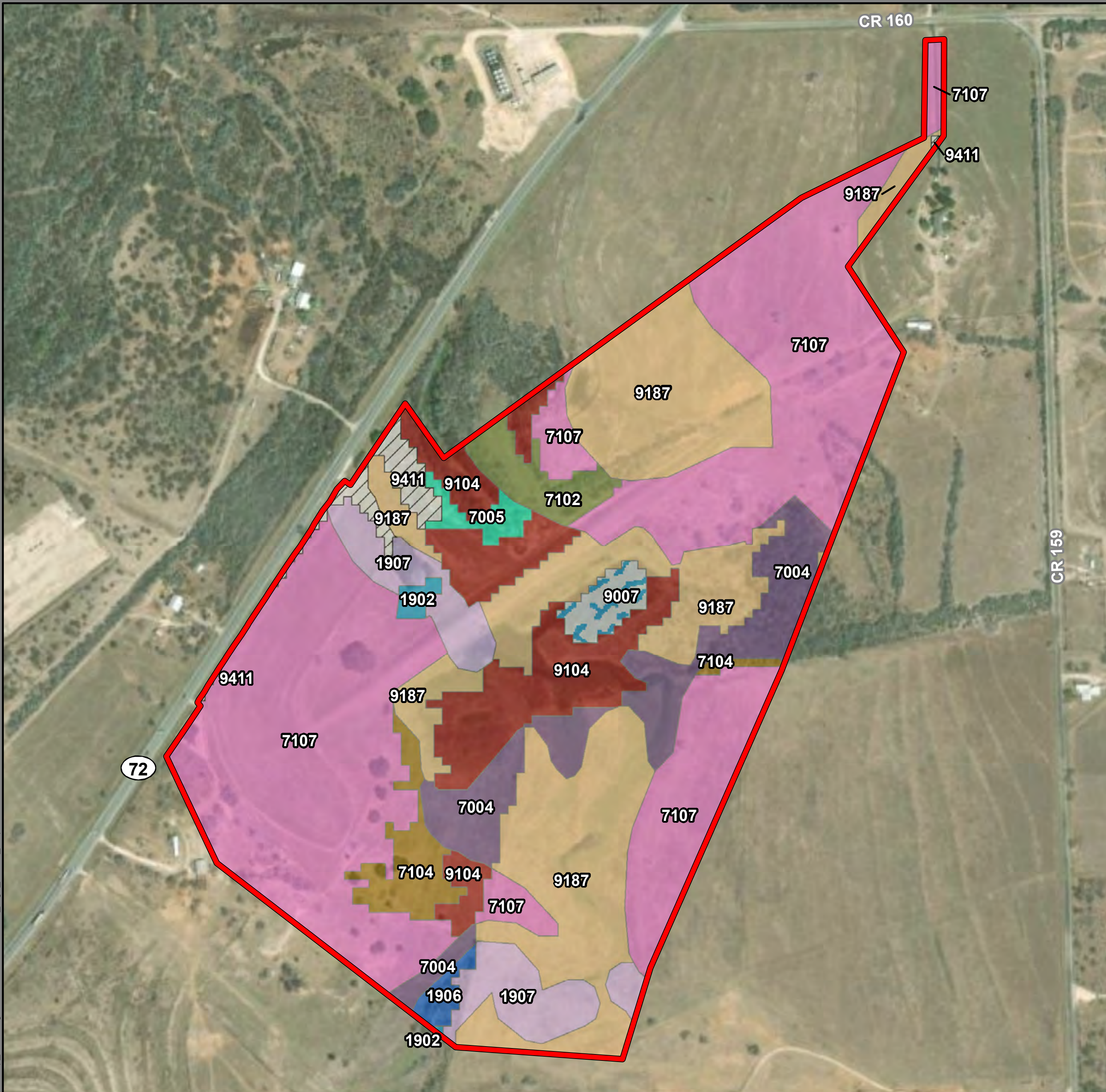
Data Sources: NHD - USGS 2023; NWI - USFWS 2023; Flood Zones - FEMA 2023; Roads - TxDOT 2023
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 4

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig4_HydrologyMap.mxd



- Study Area
- **EMST Vegetation Types**
- 1902 - Central Texas: Riparian Live Oak Forest
- 1906 - Central Texas: Riparian Deciduous Shrubland
- 1907 - Central Texas: Riparian Herbaceous Vegetation
- 7004 - South Texas: Clayey Mesquite Mixed Shrubland
- 7005 - South Texas: Clayey Blackbrush Mixed Shrubland
- 7102 - South Texas: Sandy Live Oak Motte and Woodland
- 7104 - South Texas: Sandy Mesquite Woodland and Shrubland
- 7107 - South Texas: Sandy Mesquite Savanna Grassland
- 9007 - Marsh
- 9104 - Native Invasive: Deciduous Woodland
- 9187 - South Texas: Disturbance Grassland
- 9411 - Urban Low Intensity

Ecological Mapping Systems of Texas (EMST) Map

Escondido Creek Watershed FRS No. 1
Karnes County, Texas

N W E S
0 200 400
Feet

Data Sources: EMST - TPWD 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 5

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig5_EMST_Map.mxd

Appendix B Photographic Log

Site Name: Escondido FRS No. 1	Site Location: Karnes County, TX	Project No. 60707486

Photo No. 1	Date: 06/14/23
Direction Photo Taken: Southeast	
Description: View of Escondido Creek Flood Retarding Structure (FRS) No. 1 reservoir (WB01) in the central portion of the Study Area.	

Photo No. 2	Date: 06/14/23
Direction Photo Taken: Southwest	
Description: View of Escondido Creek FRS No. 1 reservoir (WB01) in the central portion of the Study Area.	

Site Name: Escondido FRS No. 1	Site Location: Karnes County, TX	Project No. 60707486

Photo No. 3

Date: 06/14/23

Direction Photo Taken:

Southeast

Description:

View of Escondido Creek FRS No. 1 reservoir (WB01) in the central portion of the Study Area.

Photo No. 4

Date: 06/14/23

Direction Photo Taken:

Southeast

Description:

Downstream view of Stream 01 (S01) at the outflow, downstream ofthe dam structure.

AECOM

PHOTOGRAPHIC LOG

Site Name: Escondido FRS No. 1	Site Location: Karnes County, TX	Project No. 60707486

Photo No.	Date:
5	06/14/23

Direction Photo Taken:

Northwest

Description:

Downstream view of Stream 01(S01) at the outflow, downstream ofthe dam structure.

Photo No.	Date:
6	06/14/23

Direction Photo Taken:

Northwest

Description:

Downstream view of Stream 01 (S01) at the outflow, downstream ofthe dam structure.

PHOTOGRAPHIC LOG

Site Name: Escondido FRS No. 1	Site Location: Karnes County, TX	Project No. 60707486

Photo No. 7	Date: 06/14/23

Direction Photo Taken:

Southeast

Description:

Upstream view of Stream 02/Panther Creek (S02) downstream of the dam structure.

Photo No. 8	Date: 06/14/23

Direction Photo Taken:

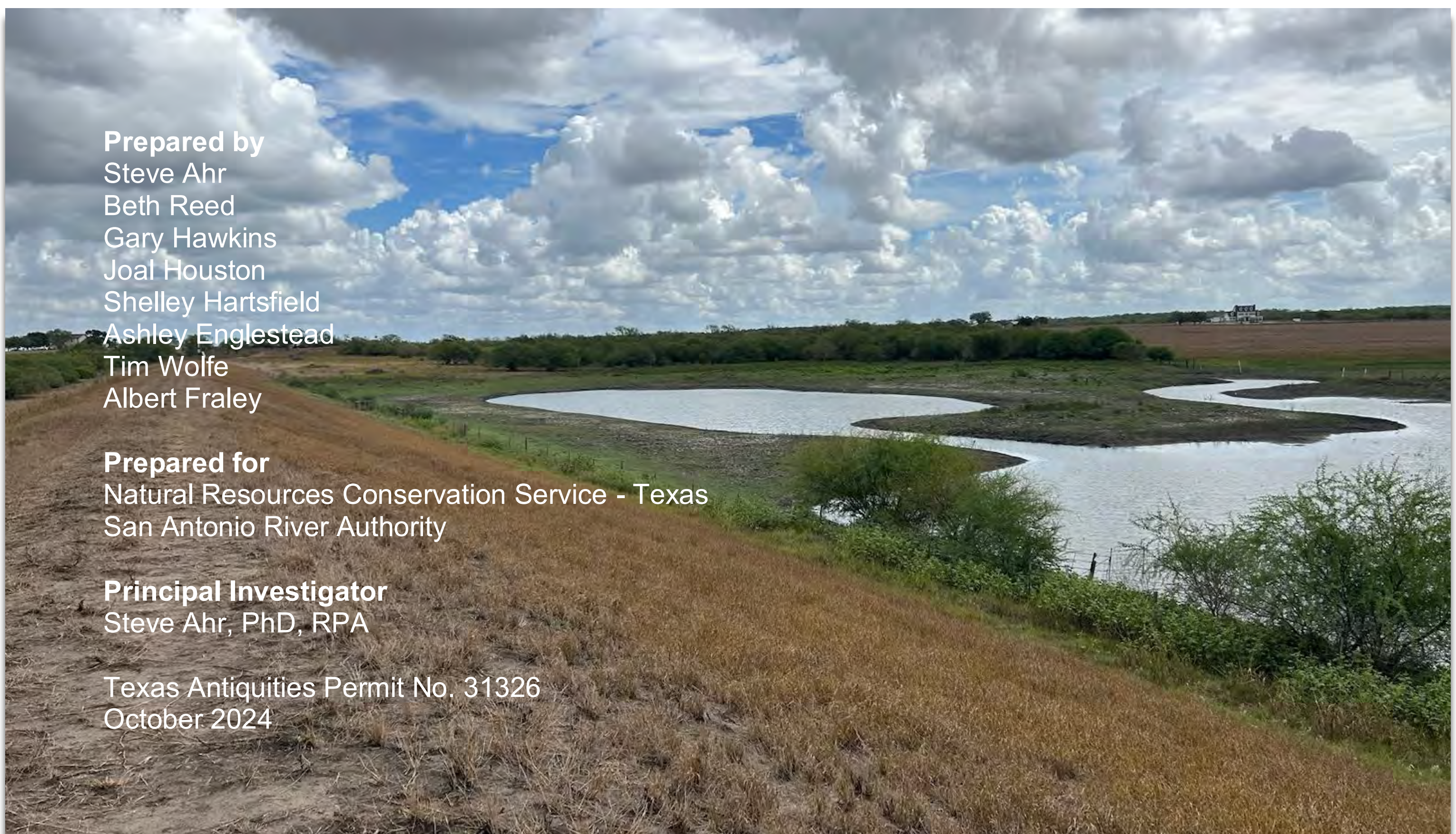
Northwest

Description:

Downstream view of Stream 02 (S02)/Panther Creek downstream of the dam structure.

AECOM

Cultural Resources Survey for the Rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 1, Karnes County, Texas



Prepared by
Steve Ahr
Beth Reed
Gary Hawkins
Joal Houston
Shelley Hartsfield
Ashley Englestead
Tim Wolfe
Albert Fraley

Prepared for
Natural Resources Conservation Service - Texas
San Antonio River Authority

Principal Investigator
Steve Ahr, PhD, RPA

Texas Antiquities Permit No. 31326
October 2024

Cultural Resources Survey for the Rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 1, Karnes County, Texas

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Steve Ahr, PhD, RPA

Texas Antiquities Permit No. 31326

October 2024

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Management Summary

AECOM Technical Services, Inc. (AECOM) conducted a cultural resources survey on behalf of the Natural Resources Conservation Service (NRCS) - Texas in support of a Supplemental Watershed Plan for the rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 1 (FRS 1), located in Karnes County, Texas. The project is sponsored locally by the Karnes-Goliad Soil Water Conservation District, Escondido Watershed District, City of Kenedy, and the San Antonio River Authority. The survey was carried out under Texas Antiquities Permit No. 31326.

The direct Area of Potential Effects (APE) for cultural resources consists of an alternatives evaluation area of 130 acres, which was surveyed through pedestrian walkover supplemented with the excavation of 69 shovel tests. No archeological sites were identified during the survey. However, one aboveground historic-age resource site (Site 001), consisting of the FRS 1 dam structure and related components constructed in 1954, was evaluated by an architectural historian. Based on background review and field investigations, Site 001 is recommended as Not Eligible for listing in the National Register of Historic Places (NRHP) or for designation as a State Antiquities Landmark (SAL).

A geomorphic assessment determined that the APE is not likely to contain deeply buried and intact archeological deposits. This conclusion is based on a combination of observations, including the age and lithology of the soil parent materials, the shallow depths of anticipated construction activities, prior disturbances from dam construction, and a lack of buried archeological materials. No backhoe trenching is recommended.

AECOM recommends that the proposed project should have No Effect on properties included in, or eligible for inclusion in, the NRHP, or that merit designation as SALs. If the dimensions of the project area change, additional archeological and historical investigations may be warranted. In the event that previously undiscovered sites are found during construction, appropriate actions should be taken in accordance with the Prototype Programmatic Agreement between the United States Department of Agriculture, Texas NRCS State Office, and the Texas State Historic Preservation Officer (SHPO), as well as the National Programmatic Agreement among NRCS, the National Conference of SHPOs, and the Advisory Council on Historic Preservation, and NRCS General Manual 420, Part 401 guidance.

If any unmarked prehistoric or historic human remains or burials are encountered at any point during the project, the area of the remains is considered a cemetery under current Texas law and all construction activities must cease immediately to avoid impacting the remains. The Texas Historical Commission must be notified immediately by contacting the Archeology Division at (512) 463-6096. All cemeteries are protected under State law and cannot be disturbed. Further protection is provided in Section 28.03(f) of the Texas Penal Code, which provides that intentional damage or destruction inflicted on a human burial site is a state jail felony.

No artifacts were collected during the survey. Project notes, maps, photographs, and other documentary records were prepared for permanent curation at the Texas Archeological Research Laboratory.

1 Introduction

The Natural Resources Conservation Service (NRCS) - Texas, along with several local sponsors, including the Karnes-Goliad Soil Water Conservation District, Escondido Watershed District, City of Kenedy, and the San Antonio River Authority, are evaluating plans to rehabilitate the Escondido Creek Watershed Floodwater Retarding Structure No. 1 (FRS 1), located in Karnes County, Texas (**Figure 1**). AECOM Technical Services, Inc. (AECOM) conducted a cultural resources survey in support of the Supplemental Watershed Plan (SWP) for the rehabilitation of FRS 1.

FRS 1 was constructed in 1954 as a low hazard dam on a tributary to Panther Creek, approximately 4.2 miles southwest of Kenedy, Texas. The National Inventory of Dams Identification Number is TX02032 (URS Corporation 2014). The dam is a filled earthen embankment that is 2,606 feet (ft) long with a maximum height of 36 ft. The detention pool is 112 acres. The principal spillway is a 30x30-inch drop inlet with 132 ft of 12-inch diameter, reinforced concrete pipe and 80 ft of 12-inch diameter corrugated steel metal pipe. The auxiliary spillway is a vegetated earthen channel 250 ft wide. The existing dam does not meet the current dam design and safety criteria for a High Hazard dam (URS Corporation 2014). The purpose of the rehabilitation would be to mitigate identified dam safety deficiencies associated with the dam's reclassification as a High Hazard dam.

Area of Potential Effects

As defined in 36 Code of Federal Regulations (CFR) 800.16(d), the Area of Potential Effects (APE) is the geographic area within which an undertaking may directly or indirectly cause changes in the character or use of historic properties if such properties exist. The APE is influenced by the scale and nature of the undertaking and may be different for different kinds of effects caused by the undertaking. The direct APE for cultural resources for this project consists of all areas where construction and other potential ground disturbances such as erosion, exposure, or other related factors or activities, would occur.

Detailed design plans for the structural rehabilitation of FRS 1 are not yet available. However, to meet high hazard criteria, dam rehabilitations often entail some combination of various modifications, including but not limited to raising the dam embankment, extending the dam abutments, modifying or replacing the existing principal spillway, and/or increasing the capacity of the auxiliary spillway.

All potential rehabilitation modifications would take place within a 130-acre Limits of Construction, which is currently considered to be the direct APE for archeological resources (**Figure 2**). Engineering calculations have not yet determined whether the peak water surface elevation could increase due to any proposed modifications. Should there be a net increase in the peak water surface elevation, then the direct APE would be adjusted as appropriate to accommodate this change. The project depth for most impacts would likely be limited to the upper 1 meter (m) of deposits. Potential borrow areas on the upland margins may be excavated to greater depths (e.g., 5 to 10 ft deep).

The indirect APE is the area in which all other impacts may be caused by the implementation of the project and are often those that occur later, or which are farther removed from the immediate project area, including visual, audible, atmospheric, or hydrologic changes. An indirect APE of 600 ft beyond the direct APE was used to assess potential visual effects on historic-age resources and the viewshed.

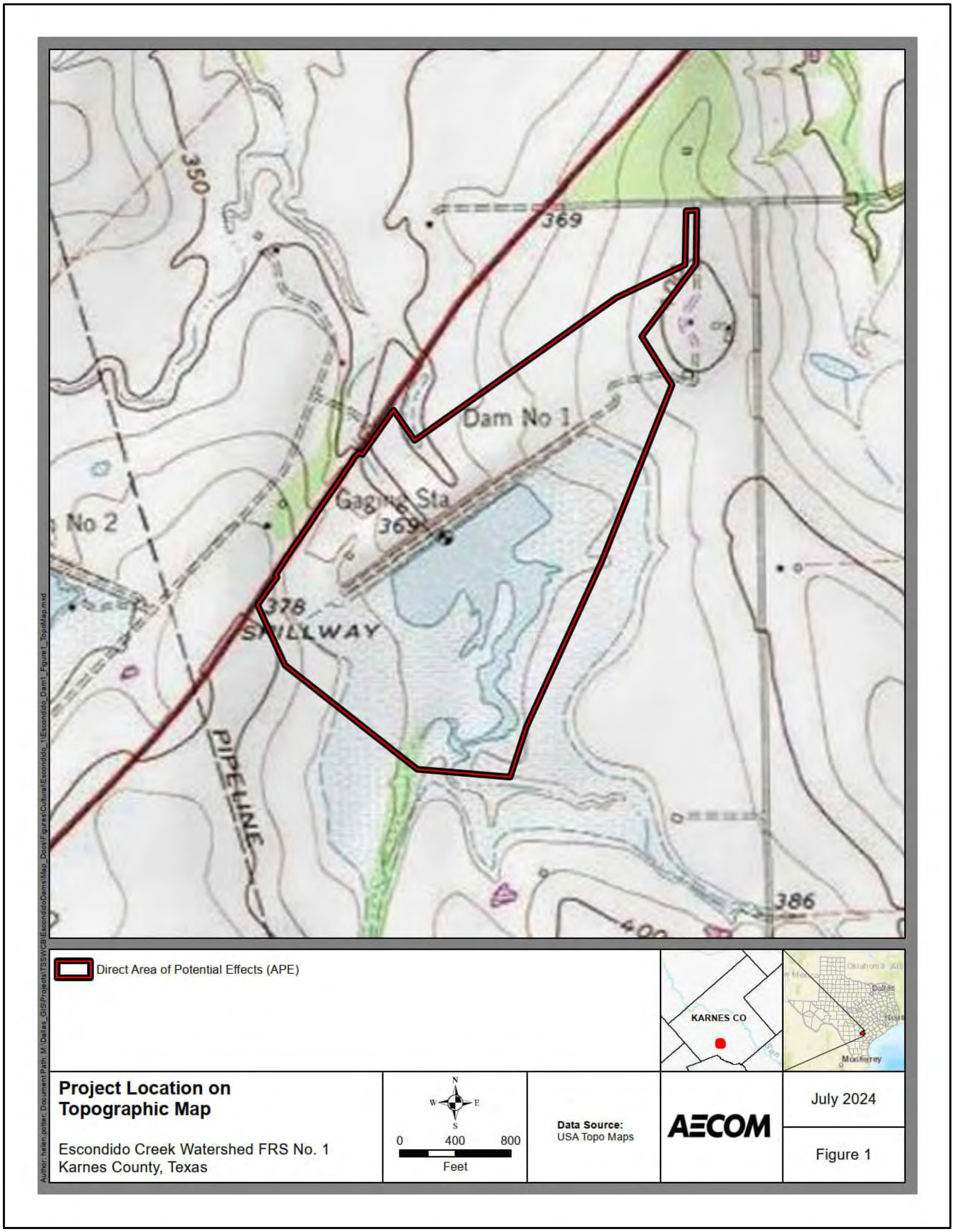

Figure 1. Escondido FRS 1 Project Location

Figure 2. Direct and Indirect APE for FRS 1

The SWP will be prepared in accordance with standard engineering principles that comply with NRCS programmatic requirements. In addition, the SWP will be reviewed, concurred, and approved by NRCS, which is the lead federal agency. Consequently, the project falls under the purview of Section 106 of the National Historic Preservation Act of 1966, as amended. In accordance with Advisory Council on Historic Preservation regulations pertaining to the protection of historic properties (36 CFR 800), federal agencies are required to assess the effects of their undertakings on historic properties prior to issuing permits or funding. Historic properties are defined as those properties that are included in, or are eligible for inclusion in, the National Register of Historic Places (NRHP). Therefore, the project is subject to review by the Texas State Historic Preservation Office, which is formally known as the Texas Historical Commission (THC).

United States Army Corps of Engineers (USACE) permitting may also be required for this project. USACE regulations 33 CFR Part 325, Appendix C are the USACE's Regulatory Program's implementing regulations for Section 106 compliance. They provide a process for the review of all proposed USACE permit actions and are commensurate with the level of impacts. For example, a project area includes the entire area of work, including all construction, staging, and access areas, and may be larger than the USACE permit area. The permit area is determined by the USACE, but typically comprises the waters of the U.S. that will be directly affected by the proposed undertaking, and uplands directly affected because of authorizing the work or structures. The USACE evaluates permit applications on a case-by-case basis to determine a project's potential to affect historic properties.

The project will be located on lands owned and/or controlled by the Escondido Watershed District, which is a political subdivision of the State of Texas. As such, it falls within the purview of the Antiquities Code of Texas. Regulations pertaining to the code can be found within Title 13, Part 2, Chapter 26 of the Texas Administrative Code (TAC). The code requires the THC to review actions that have the potential to disturb prehistoric and historic sites within the public domain. The THC issues Antiquities Permits that stipulate the conditions under which survey, discovery, excavation, demolition, restoration, or scientific investigations can occur.

AECOM conducted a cultural resources survey of the APE from October 2 – 3, 2023, and December 5 – 6, 2023, under Texas Antiquities Permit No. 31326, requiring approximately 104 person hours to complete. Steve Ahr served as Principal Investigator and was assisted in the field by AECOM archeologists Gary Hawkins, Tim Wolfe, Joal Houston, and Ashley Englestead. AECOM Architectural Historian Beth Reed performed a field survey for aboveground historic resources.

2 Environmental Setting

2.1 Physiography

The APE is within the South Texas Brush Country, located within the greater West Gulf Coastal Plain physiographic province (Gould 1975). This area is dominated by hackberry and elm hardwoods, woodlands of mesquite, and shrublands of blackbrush and fern acacia (Gould 1975). The study area is within the south-central climate region, which is characterized as humid subtropical, with hot summers, and peak precipitation in May and September.

2.2 Topography

The APE is located within the United States Geological Survey (USGS) Lenz, TX topographic quadrangle in Karnes County, Texas. The APE ranges in elevation from 400 ft above mean sea level (amsl) within the upland margins, to approximately 340 ft amsl within the creek/drainage channel.

2.3 Geology

The APE is underlain by the Miocene-age Oakville Sandstone Formation, which is characterized by sandstone, clay, and mud (Bureau of Economic Geology [BEG] 1987). No Holocene-age alluvial deposits are mapped within the limits of the APE.

2.4 Soils

Five soil mapping units are present within the APE (**Table 1; Figure 3**). Approximately 45 percent of the soils in the APE are comprised of the Weesatch series, which formed in residuum weathered from Pliocene-age sandstone deposits (NRCS 2023). These soils are mapped on sloping summits, backslopes, and footslopes of interfluves. Pettus and Pernitas soils comprise approximately 22 percent of the APE and are found on summits, backslopes, shoulders, and footslopes of ridges. Coy soils are located on ancient terraces and make up nearly 20 percent of the APE. Approximately 13 percent of the APE is normally inundated by the reservoir.

Table 1. Soils within the APE

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Typical Pedon	Parent Material
CoB	Coy clay loam, 1 to 3 percent slopes	19.5	Very deep, well drained, slowly permeable soils on moderately sloping terrace remnants and broad flats along drainageways	Ap-Bt1-Bt2-Btk-bk-Bky	Ancient Alluvium
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	20.8	Very deep, well drained, moderately permeable soils on summits, backslopes, and footslopes of ridges	A-Bt1-Bt2-Bk1-Bk2	Ancient Alluvium

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Typical Pedon	Parent Material
PtC	Pettus loam, 2 to 5 percent slopes	0.9	Very deep, well drained soils on shoulders on hillslopes	a-bk-BCk1-BCk2	Fluviomarine deposits
W	Water	13.5	N/A	N/A	N/A
WaC	Weesatch fine sandy loam, 2 to 5 percent slopes	31.1	Very deep, well drained, moderately permeable soils on sloping summits, backslopes, and footslopes of interfluves	A-Bt1-Bt2-Bk1-Bk2-bCk	Residuum
WeB	Weesatch sandy clay loam, 1 to 3 percent slopes	14.2	Very deep, well drained, moderately permeable soils on sloping summits, backslopes, and footslopes of interfluves	A-Bt1-Bt2-Bk1-Bk2-BCk	Residuum

Source: (NRCS 2023)

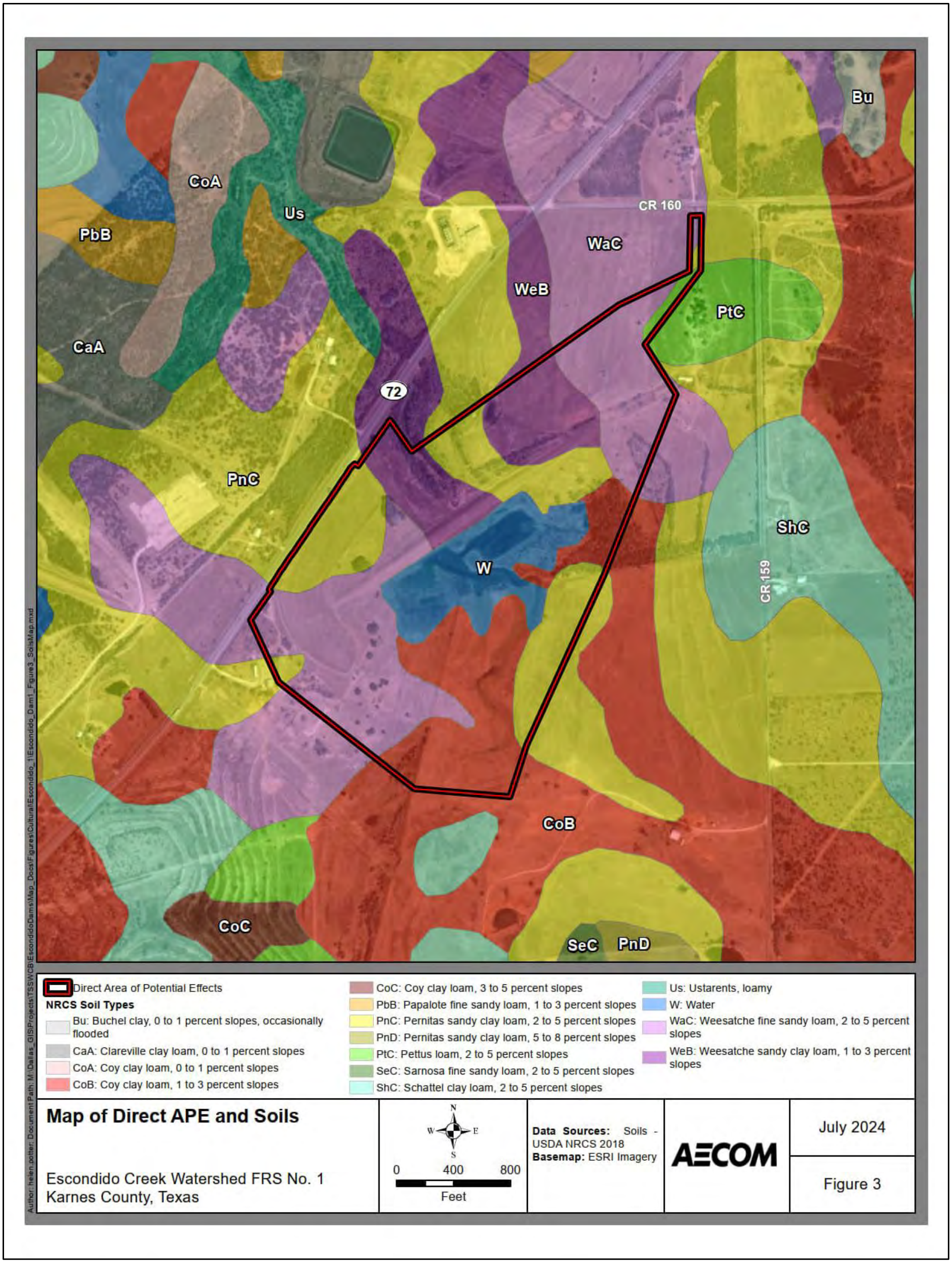

Figure 3. Project Soils

3 Cultural History

3.1 Paleoindian Period (11,500 – 8800 Years Before Present [B.P.])

The traditional view of the Paleoindian Period is one that is characterized by small groups of highly mobile hunter-gatherers who hunted mega-fauna such as mammoth, bison, and horse. A more recent interpretation of this period, however, suggests that diverse resources were exploited, including smaller animals, such as turtle, alligator, raccoon, and waterfowl, and a diverse range of plants (Collins 2002, 2004). The defining characteristics of Paleoindian lithic assemblages include lanceolate points with straight or concave bases, scrapers, and notched tools. The earliest part of the Paleoindian Period is represented by Clovis and Folsom cultures, which are identifiable by diagnostic projectile points bearing the same names.

Evidence of big game hunting (e.g., mammoth and bison) is represented by several sites containing Clovis and Folsom spear points (Black 1989; Hester 1995). Few deeply buried and preserved sites from this period have been intensively investigated in south Texas. One notable example includes the Richard Beene Site, located in south San Antonio (Thoms and Mandel 1992; Thoms and Mandel 2007).

3.2 Archaic Period (8800 – 1200 B.P.)

During the Archaic Period, plant food gathering became an increasingly important part of overall subsistence in response to increasingly arid climate conditions. This shift is represented archeologically by a wide array of stone tools geared toward plant processing (e.g., grinding implements), and varied projectile point styles. Three subperiods are recognized in south Texas, including the Early Archaic, Middle Archaic, and Late Archaic Periods (Black 1989).

The Early Archaic Period (8800 – 6000 B.P.) is characterized by greater emphasis on exploitation of riverine settings. This period is recognized archeologically by the presence of corner- and basal- notched projectile points (Hester 1995). Early Archaic sites are relatively rare in south Texas, which may be attributed to warmer and drier climates that had been seen previously (Black 1989; Collins 1995). Commonly exploited biomass during this period includes freshwater mussel, deer, rabbit, and antelope (Thoms and Mandel 1992, 2007).

The Middle Archaic Period (6000 – 4000 B.P.) saw a population increase, with a subsistence focused on locally available plants and roots, such as mesquite beans and acacias (Hester 1995). Tortugas, Abasolo, and Carrizo points are diagnostic artifacts for this period (Hester 1995; Turner and Hester 1993). Evidence of prehistoric cemeteries was found at the Bering Sink Hole in Central Texas (Bement 1994) and the Loma Sandia Site in Live Oak County (Taylor and Highley 1995).

The Late Archaic Period (4000 – 1200 B.P.) witnessed continued reliance on hunting along with an increase in gathering. Evidence suggests that cemeteries continued to be used during this time. Bison hunting also took place (Hester 1995), and a wider variety of smaller mammals such as rabbits and rodents may have been exploited with greater intensity, as well as the use of mesquite and acacia. Numerous sites from this period contain large fire-cracked rock features and include seed processing implements such as manos and metates.

3.3 Late Prehistoric Period (1200 – 350 B.P.)

The Late Prehistoric Period is divided into Austin and Toyah phases. During the Austin Phase, the bow and arrow was introduced (Black 1989; Hester 1995; Prewitt 1981). Scallorn arrow points are diagnostic of this period, as well as other side-notched varieties. Use of Clear Fork gouges and bifaces is also common, as well as grinding stones and scrapers, which represents a diverse range of subsistence activities. Deer, freshwater mussels, and snails have been suggested as important food resources during the Austin Phase (Prewitt 1981).

The subsequent Toyah Phase is represented by distinct Perdiz arrow points and other contracting stem varieties. Also commonly found in Toyah sites are bone-tempered pottery, beveled-edge bifacial knives, perforators, and end-scrapers. This artifact assemblage is attributed to widespread deer and bison exploitation (Black 1989; Creel 1991; Dillehay 1974; Hester 1995; Huebner 1991; Johnson 1994; Prewitt 1981). Although Toyah lifeways likely persisted into the earliest historic times, sites from this period are difficult to distinguish from pre-contact sites. Furthermore, ceramics such as Leon Plain were used extensively throughout the Toyah Phase and are similar to historic period Goliad wares (Black 1986, 1989; Hester 1995).

3.4 Historic Period (Post-350 B.P.)

Karnes County is bounded on the north by Wilson County, on the east by Gonzales and DeWitt counties, on the south by Goliad and Bee counties, and on the west by Atascosa and Live Oak counties. The county seat is Karnes City, which is fifty-two miles southeast of San Antonio. Other communities situated in Karnes County include Kenedy, Runge, Panna Maria, Helena, Czestochowa, Pawelekville, Falls City, Hobson, Ecleto, Gillett, Coy City, and Lenz. Most of the land in the county is prime farmland and major crops include grain sorghum, corn, hay, and vegetables. Livestock includes beef cattle, dairy cattle, and poultry (Long 2023).

During the mid-eighteenth century, the region became the center for ranching activity in the area between San Antonio de Béxar and La Bahía, which is now Goliad. The first land grants in present-day Karnes County were issued on April 12, 1758, to Hernández and Luis Antonio Menchaca, who established ranches near the San Antonio River and Cibolo Creek. To protect local ranches from Indian raids, a fort was established by the Spanish on Cibolo Creek named Fuerte de Santa Cruz del Cíbolo in approximately 1770, near the site of the present-day community of Czestochowa. In 1783, after repeated Indian attacks, the fort and many ranches were abandoned. By the mid-1780s only six ranches and 85 Spanish settlers remained (Long 2023).

During the early nineteenth century the heirs of the original Hernández and Menchaca ranches divided the land and sold some to other families, including the Veramendi, Cassiano, Flores, Navarro, and Carillo. By the 1840s, the first Anglo-American settlers arrived in the region. The first settlement was in 1852, at the site of an earlier Mexican settlement called Alamita, located on a bend of the San Antonio River at the intersection of the Chihuahua Trail and the wagon road from Gonzales to San Patricio. Settlers, led by Thomas Ruckman and Lewis S. Owings, founded the community of Helena, which was an important stop between San Antonio and Goliad when a stage line began operation from San Antonio to the coast (Long 2023).

In the 1850s, residents of the area petitioned the state legislature to form a new county from portions of Bexar, Gonzales, DeWitt, Goliad, and San Patricio counties. On February 4, 1854, the legislature established the new county, named Karnes for Texas revolutionary leader Henry Wax Karnes, with Helena as the county seat. In 1854, immigrants from the Upper Silesia area of Poland arrived in Karnes County. Led by Franciscan priest Leopold Moczygemba, they settled the community of Panna Maria. The community, located near the junction of the San Antonio River and Cibolo Creek, was the first Polish colony in the United States. Subsequent groups of Polish immigrants formed communities at Czestochowa and Falls City. The Polish arrivals aided agricultural diversification and planted a wide range of crops, including corn, melons, potatoes, cucumbers, and pumpkins. However, during this period the Karnes County economy remained based on livestock ranching. In 1858, Karnes County tax assessment rolls listed 50,000 cattle, valued at $6 per head, and 2,000 horses worth $2.50 per head (Long 2023).

In 1860, prior to the start of the Civil War, Karnes County had a population of 2,170 and residents voted for secession. Militia companies including the Helena Guards and Escondido Rifles were organized in the county. The Polish settlers formed a unit named the Panna Maria Grays. Following a period of economic decline after the Civil War the economy began to improve during the late 1860s and livestock remained the most key factor of the economy. Beginning in 1866, large numbers of cattle from Karnes County were driven to nearby DeWitt County and then up the Chisholm Trail to railroads and markets in Kansas. By 1882, county tax rolls recorded 7,961 horses and mules, 37,115 cattle, 21,461 sheep, 1,273 goats, and 2,898 hogs, worth a combined $511,099 (Long 2023).

In 1886, the first railroad, the San Antonio and Aransas Pass Railway, arrived in the county. The railroad improved access to markets and attracted new settlers. However, the railroad line did not extend through the town of Helena, the Karnes County seat. As a result, the county seat moved six miles west, to a location along the railroad tracks, and a new town named Karnes City was established. Between 1890 and 1930, the population of Karnes County increased from 3,637 to 23,316. The number of farms in the county also grew during this period. By the turn of the century, the principal crops grown in Karnes County included cotton, sorghum, and potatoes. Cotton farming had become particularly important to the county economy during the early twentieth century. Prior to 1900, most Karnes County farmers and ranchers owned their land. By 1930, tenant farmers worked more than half of the county's 2,400 farms. During the early 1930s, the cotton crop was severely diminished due to the boll weevil infestation and the drop in cotton prices as a result of the Great Depression. After 1930 the population of the county declined as tenant farmers left the county (Long 2023).

Since 1950, farming in Karnes County has shifted to larger farms worked by hired laborers. Crops included corn and sorghum, but flax became an important crop after World War II. By 1950, it was the leading crop in the county, with 65,000 acres planted. During the second half of the twentieth century, livestock ranching, particularly hogs and sheep, accounted for 86 percent of the agricultural income of Karnes County. Other natural resources present in Karnes County include oil and uranium. During the 1930s, the discovery of oil in the county has contributed to the economy to the present. By 2002, Karnes County had 1,157 farms and ranches covering 474,806 acres. Fifty-six percent of these properties were pastureland for beef cattle and 35 percent was utilized for crops such as hay, wheat, corn, and sorghum (Long 2023).

4 Methods

4.1 Antiquities Permit

A Texas Antiquities Permit application and research design was submitted to the THC prior to fieldwork. The THC approved the application and issued Antiquities Permit No. 31326 on August 17, 2023. Steve Ahr served as Principal Investigator.

4.2 Background Review

Prior to fieldwork, AECOM conducted an archeological background review of the Texas Archeological Sites Atlas (TASA 2023) to identify previously recorded archeological sites, cemeteries, and previous surveys within 1,000 m of the direct APE. AECOM also conducted a background review of the Texas Historic Sites Atlas (THSA 2023) and the Texas Department of Transportation’s (TxDOT’s) Historic Resources Aggregator (TxDOT 2023) to identify properties listed in, or eligible for listing in, the NRHP, National Historic Landmarks, State Antiquities Landmarks (SALs), Recorded Texas Historic Landmarks, and Official Texas Historical Markers within 1,300 ft of the direct APE. The background reviews also utilized historic aerial photographs and topographic maps.

4.3 Archeological Survey

The objectives of the archeological survey were to identify and record archeological resources within the APE, evaluate their potential for inclusion in the NRHP and for designation as SALs, and determine whether additional investigations were warranted. AECOM conducted an intensive archeological survey of the APE in conformance with the Council of Texas Archeologists (CTA) *Intensive Terrestrial Survey Guidelines*. All work was supervised by AECOM cultural resources staff meeting the United States Secretary of the Interior’s *Professional Qualification Standards for Archeology and Historic Preservation* (Title 36 CFR Part 61), and Texas’ professional qualification requirements for Principal Investigator (13 TAC 26.4).

All exposed ground surfaces within the direct APE were closely examined for archeological materials. Shovel tests were 30 centimeters (cm) in diameter and were dug in 20-cm levels. In depositional areas, shovel tests were dug either to the bottom of the Holocene deposits, to 80 cm below surface, or to a restrictive, sterile layer. In upland areas, shovel tests were dug to subsoil or bedrock. Excavated soils were screened through ¼-inch mesh unless high clay or water content required that they be troweled through. All shovel tests were backfilled upon completion. Shovel testing was precluded in upland or erosional settings with exposed bedrock; on slopes greater than 20 percent; and areas with significant ground disturbance. Except for the earthen fill embankment and inundated areas, at least one shovel test was excavated for each excluded area to assess the potential for buried deposits and demonstrate the nature and extent of significant ground disturbance. For each shovel test, the location, depth, soil description, and the presence/absence of cultural materials was recorded. The geomorphology of the APE was also assessed by a qualified geoarcheologist to determine whether deeply buried and intact cultural materials could be present and whether deep mechanical prospection (e.g., backhoe trenching) was necessary.

4.4 Site Recording and Assessment

A site was defined by the presence of at least five or more artifacts. Isolated farm/ranch equipment was not considered as sites. According to the CTA's *Intensive Terrestrial Survey Guidelines*, any cultural materials greater than 50 years of age were minimally designated as isolated finds. Any artifact scatters were delineated as sites through shovel testing and field observations.

In the event of a positive shovel test, additional radials were excavated in a cruciform pattern at intervals no greater than 15 m until two negative shovel tests were found in each direction, or until topographic limits (e.g., landform boundaries, streams) were reached. All sites were photographed from a minimum of two angles. Any cultural features and natural features of interest were also photographed, along with representative overviews. Site boundaries and the locations of all subsurface excavations, cultural features, photographs, individual artifacts, artifact clusters, and other relevant natural or landscape features (e.g., roads, buildings) were recorded with a handheld GPS.

No artifacts were collected during the survey. The quantities of artifacts or estimates of materials in surface scatters were recorded and the locations of artifact concentrations plotted on site maps. Any artifacts from shovel tests or other sub-surface investigations were photographed. Any diagnostic artifacts and a representative sample of non-diagnostic materials from the surface was documented in the field. TexSite forms for all new sites were prepared and submitted to the Texas Archeological Research Laboratory (TARL) for assignment of a permanent trinomial designation.

All cultural resources sites were assessed for their eligibility for listing in the NRHP according to the National Register criteria for evaluation (36 CFR Part 60.4 [a-d]), which states that "[t]he quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
b) that are associated with the lives of persons significant in our past; or
c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
d) that have yielded, or may be likely to yield, information important in prehistory or history.

All cultural resource sites were also assessed for SAL eligibility. Under 13 TAC 26.10, an archeological site under the ownership or control of the State of Texas may merit official designation as a SAL if one of the following criteria applies:

1. The site has the potential to contribute to a better understanding of the prehistory and/or history of Texas by the addition of new and important information;
2. The site's archeological deposits and the artifacts within the site are preserved and intact, thereby supporting the research potential or preservation interests of the site;
3. The site possesses unique or rare attributes concerning Texas prehistory and/or history; or
4. The study of the site offers the opportunity to test theories and methods of preservation, thereby contributing to new scientific knowledge.

4.5 Curation

The survey employed a non-collection strategy. Correspondence, field records, and photographs generated during archeological investigations were prepared for permanent curation at TARL.

4.6 Historic Resources Methods

Historic resources refer to any buildings, structures, objects, sites, and potential historic districts that are, or will be, 45 years of age or older at the date of project construction, which is currently estimated to be 2026. Therefore, buildings, structures, objects, sites, or potential historic districts dating to 1981 or earlier were evaluated as historic resources.

A historic resources reconnaissance survey was conducted on October 2, 2023, by AECOM Architectural Historian, Beth Reed. All identified historic-age resources within the indirect APE (i.e., within 600 ft of the direct APE) were identified, documented with digital photography, and evaluated for NRHP eligibility. The condition, materials, alterations, and other features for evaluating significance and integrity of any historic-age resources were noted.

5 Results

5.1 Background Review Results

A review of the TASA (2023) found no previous archeological surveys, recorded archeological sites, historic properties, historical markers, SALs, or cemeteries within 1,000 m of the APE. A review of the THSA and TxDOT's Historic Resources Aggregator found no previously designated resources within 1,300 ft of the APE.

5.2 Survey Results

The APE encompasses a mixture of open pasture, rangeland, natural short and tall grasses, and wooded areas (**Figure 4**). Prior disturbances include construction of the current earthen dam, reservoir, auxiliary spillway, drainage outlet, impact basin, channel modifications, and berms (**Figures 5-9**).

A total of 69 shovel tests were excavated within the direct APE, which ranged in depth from 8 to 59 cm below surface, with an average depth of 37 cm. Soils generally consisted of a brown (10YR 4/3), grayish brown (10YR 3/2, 4/2), and yellowish brown (10YR 3/3, 4/6) sandy loam A and E horizons overlying a compacted dark grayish brown (10YR 4/2) and dark yellowish brown (10YR 4/6), mottled, sandy clay subsoil argillic (Bt) horizon (**Figure 10; Appendix A**). Shovel tests were distributed to avoid inundated areas and the most heavily disturbed portions of the project, such as the dam embankment and apron and a natural gas pipeline corridor. Overall ground surface visibility across the APE ranged from 20 to 50 percent. None of the shovel tests were positive for cultural materials and no archeological sites were identified during the survey.

One aboveground historic-age resource site (Site 001) was identified in the indirect APE (**Figures 11-12**) and evaluated by an architectural historian.

Figure 4. Overview of APE, facing northwest

Figure 5. View downstream from dam, facing west

Figure 6. Drainage outlet, berms, impact basin, and modified outlet channel, facing northwest

Figure 7. Top of dam embankment, facing northeast

Figure 8. Auxiliary spillway, facing northeast

Figure 9. Reservoir area, facing southeast

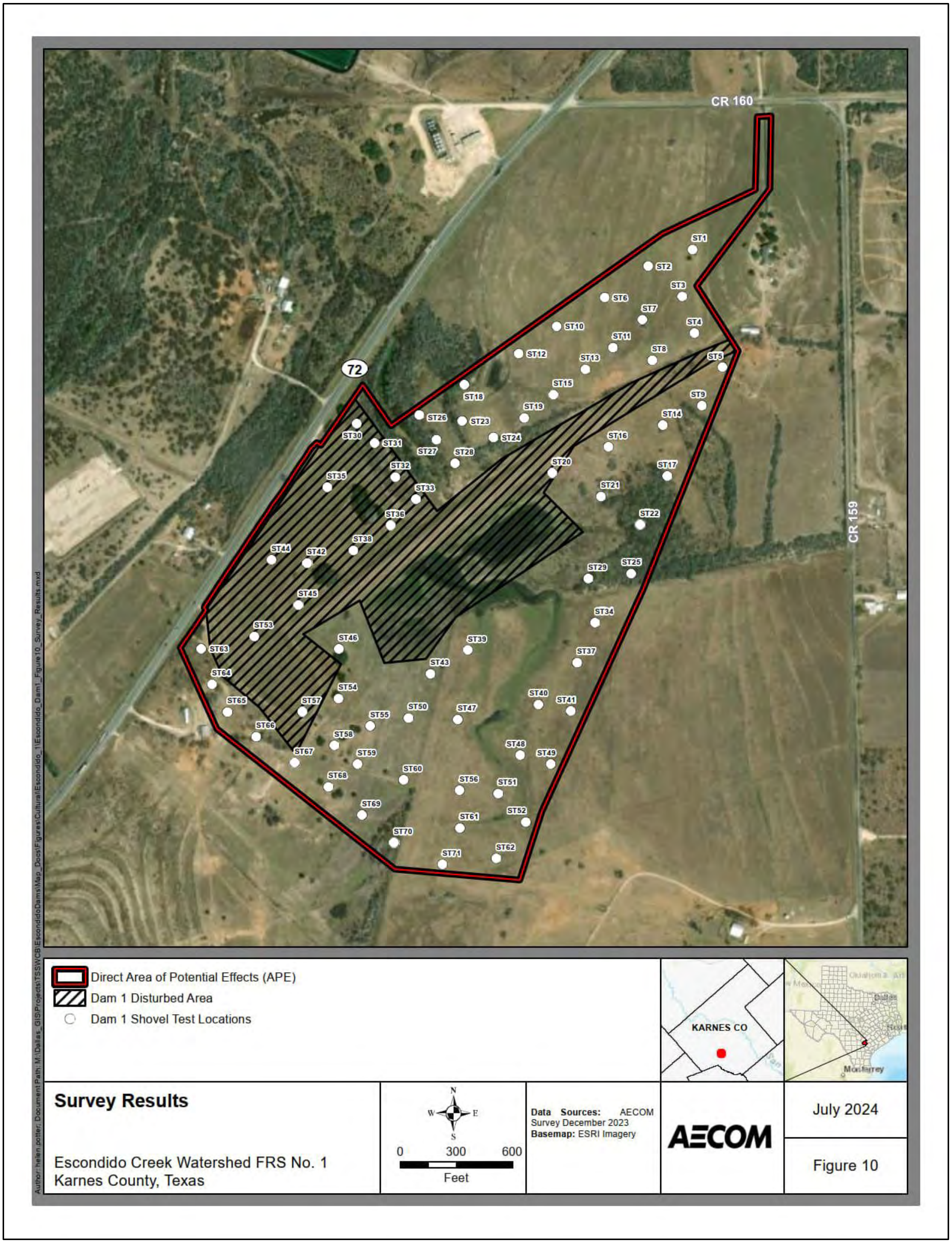

Figure 10. Map showing shovel test locations

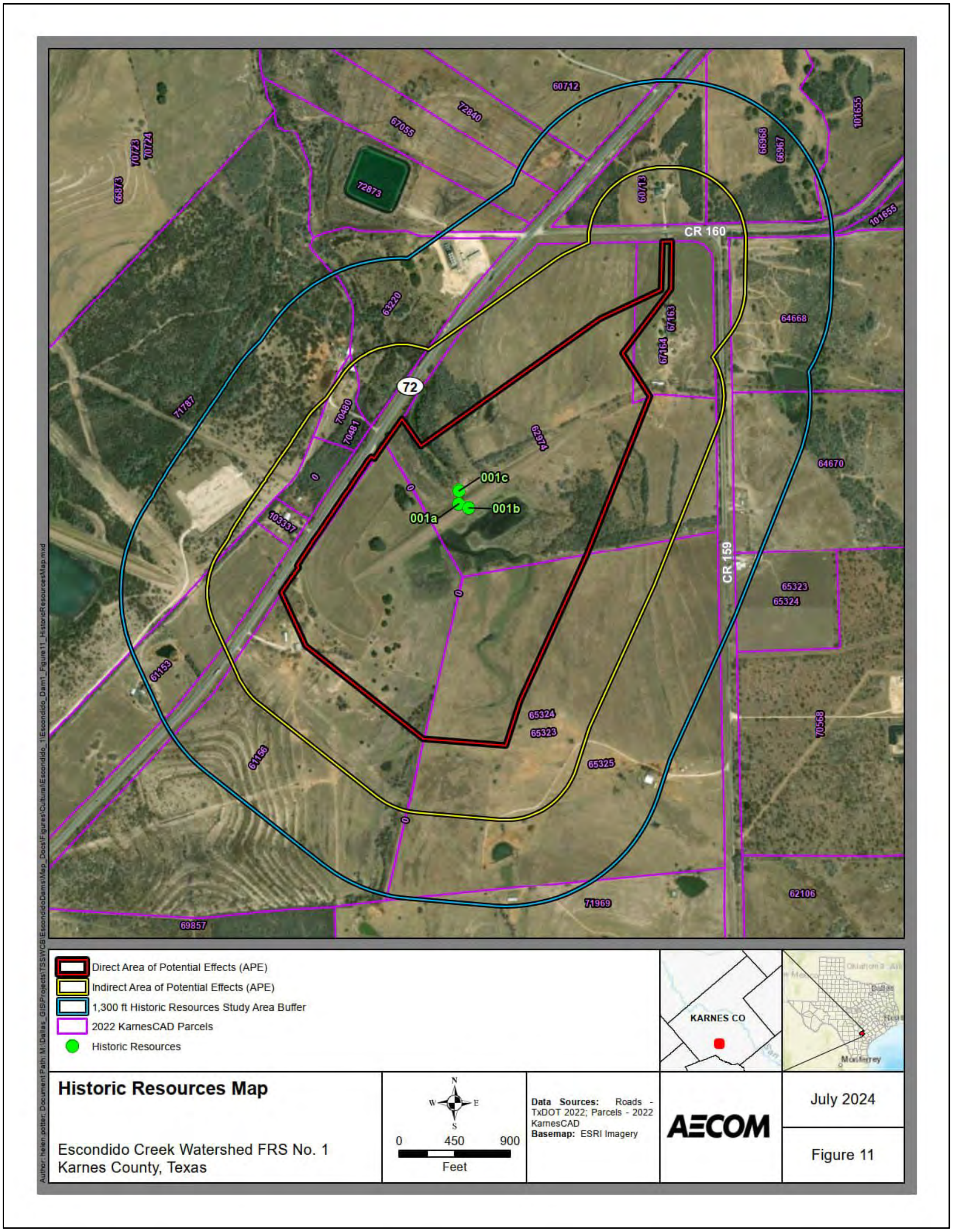

Figure 11. Historic Resource Site 001

Figure 12. Historic Resources Site 001 location map

Site 001

Site 001 consists of the Escondido Creek Watershed FRS 1, located on a tributary to Panther Creek. The site contains three historic-age resources: Resource 001a - earthen dam structure; Resource 001b - principal spillway inlet structure; and Resource 001c - principal spillway outlet drainage pipe and basin (see **Figures 11-12**). The site was constructed as part of the Escondido Creek Watershed Work Plan under the authority of the Soil Conservation Act of 1935 as implemented by the Watershed Protection item in the Department of Agriculture Appropriation Act of 1954. The National Inventory of Dams ID number for this dam is TX02032 and records a 1954 construction date for Resources 001a-c. Research indicates that Site 001 is situated on a large Spanish land grant originally consisting of 66,426 acres. The title was issued to Carlos Martinez on June 7, 1788, and the land was recorded in Texas GLO records as Patent #149, Volume 30, File 000130:2 on November 6, 1839.

Resource 001a

Resource 001a consists of an earthen-filled embankment dam designed for flood control (**Figure 13**). The resource is grass-covered and measures 2,606 feet in length with an embankment height of 36 ft. The dam structure is oriented southwest to northeast. Resource 001a appears to retain all aspects of integrity. However, the resource is a common example of its type and does not exhibit exceptional architectural or engineering merit, or historical significance and is recommended Not Eligible for NRHP listing.

Figure 13. View of the top of Resource 001a, facing northeast

Resource 001b

Resource 001b is a Principal Spillway Inlet Riser and functions to convey water so that outflow from the reservoir can be regulated (**Figure 14**). Resource 001b displays a rectangular plan and consists of metal grating on the southwest, southeast, and northeast sides. A metal grating is also present on the top of the structure and a metal turn-wheel valve extends through the grating on the southeast side of the structure. The northwest side of the structure consists of a concrete headwall facing into the slope of the dam. Resource 001b is set on the base of the reservoir and is typically surrounded by water. However, reservoir waters have receded due to current drought conditions and the resource is situated on the dry bank of the reservoir.

Resource 001b appears to retain all aspects of integrity. However, the resource is a common example of its type and does not exhibit exceptional architectural or engineering merit, or historical significance and is recommended Not Eligible for NRHP listing.

Figure 14. View of Resource 001b, facing east

Resource 001c

Resource 001c is a Principal Spillway Outlet drainage structure (**Figure 15**). The structure functions to alleviate flooding when there is overflow from the principal reservoir. Water from the reservoir is carried through the Principal Inlet Structure (Resource 001b), into the outlet pipe under the dam (Resource 001a) and empties into an earthen spillway. The pipe was obscured from view during the survey and a photograph was not possible due to the steep incline on the back side of the dam, fencing, and brush.

Resource 001c appears to retain all aspects of integrity. However, the resource is a common example of its type and does not exhibit exceptional architectural or engineering merit, or historical significance and is recommended Not Eligible for NRHP listing.

Figure 15. View of Resource 001c, facing northwest

In sum, Resources 001a-c appear to retain integrity of location, design, materials, workmanship, setting feeling, and association and the site remains functioning as originally intended. However, the resources are typical of their type and do not represent distinctive architectural or engineering merit. Therefore, Resources 001a-c are recommended Not Eligible for listing in the NRHP.

5.3 Geomorphic Assessment

A geomorphic field assessment was performed to determine whether deeply buried and intact cultural materials could be present in the APE and could be impacted by the project. The assessment evaluated the soil-geomorphic setting, depositional environments, the age and lithology of the soil parent materials, the types of active pedogenic site formation processes, and the anticipated depth of impacts from the project.

The project would take place primarily within areas underlain by Weesatch soils consisting of sandy loam and sandy clay loam soils formed on summits, backslopes, and footslopes of interfluves. They formed in residuum weathered from Miocene-age sandstone, clay, and mud. Shovel tests within these soils revealed shallow (avg. 37 cm) brown, grayish brown, and yellowish-brown sandy loam A and E horizons overlying a compacted grayish brown and dark yellowish brown sandy clay argillic (Bt) horizon.

The well-developed argillic subsurface horizon encountered in the APE meets the central requirements of Alfisol classification, wherein weathering and translocation of phyllosilicate clays from upper soil horizons contributes to the Bt horizons in the lower profile (Soil Survey Staff 2010). Depending on local conditions, such as mean annual precipitation and parent materials, the formation of an argillic horizon is time-dependent and can require thousands to tens of thousands of years for such pedogenic features to form (e.g., clay skins, strong prismatic structure, reddish [rubified] soils (Hallmark and Franzmeier 1999). As such, these types of soils are generally considered too old to contain archeological materials in their original systemic context. These findings are consistent with the soil parent materials reported for the APE, which include residuum weathered from Miocene-age deposits, along with ancient (pre-Holocene) alluvium, including fluvio-marine deposits. Within the APE these shallow Alfisols have been previously impacted by excavations of the auxiliary spillway during dam construction, as well as other ongoing ranching activities. Based on the age, genesis, and geomorphic setting of these soils, the potential for buried and intact archeological materials is low.

These soils adjacent to the outlet channel within the APE are confined to an extremely shallow and low-gradient erosional drainageway. No floodplain morphological features or deep soils were observed within this drainage that would suggest an active depositional environment capable of deeply burying archeological materials. Inspection of the stream channel below the dam further revealed disturbed sediment berms flanking the channel margin, which was clearly modified during dam construction and maintenance (see **Figure 6**).

Due to the lack of active sediment deposition and prior impacts to this disturbed, narrow, and low relief outlet channel, there is no potential for deep artifact burial and preservation. Based on the foregoing observations, it is our assessment that the project is not likely to impact deeply buried and/or intact archeological deposits within the APE. Therefore, no backhoe trenching is recommended.

6 Summary and Recommendations

AECOM conducted a cultural resources survey in support of a SWP for the rehabilitation of the Escondido Creek Watershed FRS 1, within a 130-acre direct APE, located in Karnes County, Texas. The survey was performed under Texas Antiquities Permit No. 31326 and included a 100 percent pedestrian survey supplemented with 69 shovel tests.

No archeological sites were identified during the survey. However, one aboveground historic-age resource site (Site 001) was identified and evaluated by an architectural historian. Based on background review and field investigations, Site 001 is recommended as Not Eligible for listing in the NRHP or designation as a SAL.

A geomorphic assessment determined that the project is not likely to impact deeply buried and intact archeological deposits within the APE. This conclusion is based on a combination of observations, including the age and lithology of the soil parent materials, the shallow depths of anticipated construction activities, prior disturbances from dam construction, and a lack of buried archeological materials. No backhoe trenching is recommended for this project.

AECOM recommends that the proposed project should have No Effect on properties included in, or eligible for inclusion in, the NRHP, or that merit designation as SALs, and that construction should proceed without further cultural resources investigations. However, if the dimensions of the project area change, additional archeological and historical investigations may be warranted.

If previously undiscovered sites are found during construction, appropriate actions should be taken in accordance with the Prototype Programmatic Agreement between the United States Department of Agriculture, Texas NRCS State Office, and the Texas SHPO, as well as the National Programmatic Agreement among NRCS, the National Conference of SHPOs, and the Advisory Council on Historic Preservation, and NRCS General Manual 420, Part 401 guidance.

If any unmarked prehistoric or historic human remains or burials are encountered at any point during the project, the area of the remains is considered a cemetery under current Texas law and all construction activities must cease immediately to avoid impacting the remains. The THC must be notified immediately by contacting the Archeology Division at (512) 463-6096. All cemeteries are protected under State law and cannot be disturbed. Further protection is provided in Section 28.03(f) of the Texas Penal Code, which provides that intentional damage or destruction inflicted on a human burial site is a state jail felony.

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APPENDIX A – SHOVEL TEST LOG

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
1	0-33	10YR 4/3	Brown	Sandy loam		Terminated at argillic subsoil
	33-45	10YR 4/2	Dark grayish brown	Sandy clay loam		
2	0-31	10YR 4/3	Brown	Sandy loam		Terminated at argillic subsoil
	31-41	10YR 4/2	Dark grayish brown	Sandy clay loam	>2% Caliche	
3	0-37	10YR 4/3	Brown	Sandy loam		Terminated at argillic subsoil
	37-52	10YR 4/2	Dark grayish brown	Sandy clay loam		
4	0-33	10YR 4/3	Brown	Sandy loam		Terminated at argillic subsoil
	33-43	10YR 4/2	Dark grayish brown	Sandy clay loam		
5	0-24	10YR 4/4	Dark yellowish brown	Sandy loam		Terminated at argillic subsoil
	24-40	10YR 4/3	Brown	Sandy clay loam		
6	0-32	10YR 3/1	Very dark gray	Sandy loam		Terminated at argillic subsoil
	32-42	10YR 3/2	Very dark grayish brown	Sand		
7	0-43	10YR 3/1	Very dark gray	Sandy loam		Terminated at argillic subsoil
	43-59	10YR 3/2	Very dark grayish brown	Sand		
8	0-22	10YR 4/3	Brown	Sandy loam		Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	22-41	10YR 4/2	Dark grayish brown	Sandy clay loam		
9	0-34 34-44	10YR 4/3 10YR 4/4	Brown Dark yellowish brown	Sandy clay loam Sandy loam		Terminated at argillic subsoil
10	0-34 34-45	10YR 3/3 10YR 3/3	Dark yellowish brown Dark brown	Sandy loam Sand		Terminated at argillic subsoil
11	0-39 39-52	10YR 3/3 10YR 3/4	Dark yellowish brown Dark brown	Sandy loam Sandy loam	>1% Caliche	Terminated at argillic subsoil
12	0-38 38-48	10YR 4/6 10YR 3/3	Dark yellowish brown Dark brown	Sand Sandy clay loam		Terminated at argillic subsoil
13	0-38 38-48	10YR 3/3 10YR 3/4	Dark yellowish brown Dark brown	Sandy loam Sand		Terminated at argillic subsoil
14	0-32 32-42	10YR 4/3 10YR 4/4	Brown Dark yellowish brown	Sandy clay loam Sandy loam		Terminated at argillic subsoil
15	0-36 36-46	10YR 3/3 10YR 3/4	Dark yellowish brown Dark brown	Sandy loam Sand		Terminated at argillic subsoil
16	0-8 8-25	10YR 6/3 10YR 5/3	Pale brown Brown	Sandy loam Sandy clay loam	>5% Caliche	Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
17	0-33 33-43	10YR 3/2 10YR 4/6	Vary dark grayish brown Dark yellowish brown	Sandy clay loam Sandy loam		Terminated at argillic subsoil
18	0-36 36-42	10YR 3/3 10YR 4/3	Dark brown Brown	Sandy loam Sandy clay loam	>1% Caliche >5% Caliche	Terminated at argillic subsoil
19	0-27 21-44	10YR 3/3 10YR 3/4	Dark yellowish brown Dark brown	Sandy loam Sand		Terminated at argillic subsoil
20	0-25 25-45	10YR 4/4 10YR 4/6	Dark yellowish brown Dark yellowish brown	Sandy loam Sand		Terminated at argillic subsoil
21	0-30 30-42	10YR 4/4 10YR 4/6	Dark yellowish brown Dark yellowish brown	Sandy loam Sand		Terminated at argillic subsoil
22	0-33 33-45	10YR 3/2 10YR 4/6	Vary dark grayish brown Dark yellowish brown	Sandy clay loam Sandy loam		Terminated at argillic subsoil
23	0-35 35-47	10YR 3/3 10YR 4/4	Dark brown Dark yellowish brown	Sandy loam Sandy clay loam	 >3% Caliche	Terminated at argillic subsoil
24	0-29 29-39	10YR 3/2 10YR 3/3	Very dark grayish brown	Sandy loam	 >5% Caliche	Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
			Dark brown	Sandy clay loam		
25	0-36 36-46	10YR 4/3 10YR 4/3	Brown Brown	Sandy loam Sandy clay loam		Terminated at argillic subsoil
26	0-39 39-49	10YR 3/3 10YR 4/4	Dark brown Dark yellowish brown	Sandy loam Sandy clay loam	>3% Caliche	Terminated at argillic subsoil
27	0-43 43-54	10YR 3/3 10YR 4/4	Dark brown Dark yellowish brown	Sandy loam Sandy clay loam		Terminated at argillic subsoil
28	0-35 35-48	10YR 3/2 10YR 3/3	Very dark grayish brown Dark brown	Sandy loam Sandy clay loam	>1% Caliche	Terminated at argillic subsoil
29	0-28 28-38	10YR 4/4 10YR 4/6	Dark yellowish brown Dark yellowish brown	Sandy loam Sand	>2% Caliche	Terminated at argillic subsoil
30	0-34 34-45	10YR 4/2 10YR 3/1	Dark grayish brown Very dark gray	Sandy clay loam Sandy clay		Terminated at argillic subsoil
31	0-40 40-51	10YR 3/3 10YR 3/2	Dark brown Very dark grayish brown	Sandy loam Sandy clay loam	>1% Caliche	Terminated at argillic subsoil
32	0-35	10YR 3/3	Dark brown	Sandy loam		Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	35-47	10YR 3/2	Very dark grayish brown	Sandy clay loam	>1% Caliche	
33	0-38 38-48	10YR 3/2 10YR 3/3	Very dark grayish brown Dark brown	Sandy loam Sandy clay loam		Terminated at argillic subsoil
34	0-19 19-26	10YR 5/2 10YR 5/4	Grayish brown Yellowish brown	Sandy clay loam Sandy clay	>3% Caliche	Terminated at argillic subsoil
35	0-5 5-15	7.5YR 2.5/2 7.5YR 2.5/2	Very dark brown Very dark brown	Silty clay Silty clay	- <1% Caliche	Terminated at argillic subsoil
36	0-15 15-25	7.5YR 2.5/2 7.5YR 2.5/2	Very dark brown Very dark brown	Silty clay Silty clay	- <15% Caliche	Terminated at argillic subsoil
37	0-23 23-33	10YR 5/2 10YR 5/4	Grayish brown Yellowish brown	Sandy clay loam Sandy clay	- <3% Caliche	Terminated at argillic subsoil
38	0-12 12-24	7.5YR 2.5/2 7.5YR 2.5/2	Very dark brown Very dark brown	Silty clay Silty clay	- <2% Caliche	Terminated at argillic subsoil
39	0-18 18-28	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy clay Sandy clay	- <2% Caliche	Terminated at argillic subsoil
40	0-24 24-33	10YR 3/2 10YR 4/3	Very dark grayish brown Brown	Sandy clay loam Sandy clay	- <2% Caliche	Terminated at argillic subsoil
41	0-26 26-35	10YR 3/2 10YR 4/3	Very dark grayish brown Brown	Sandy clay loam Sandy clay	- <2% Caliche	Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
42	0-5 5-15	7.5YR 2.5/2 7.5YR 2.5/2	Very dark brown Very dark brown	Silty clay Silty clay	- <1% Caliche	Terminated at argillic subsoil
43	0-23 23-30	10YR 2/2 10YR 4/2 mottle w/ 10YR 4/6	Very dark brown Dark grayish brown m/ Dark yellowish brown	Sandy loam Sandy clay	- <5% Caliche	Terminated at argillic subsoil
44	0-8 8-19	7.5YR 2.5/2 7.5YR 2.5/2	Very dark brown Very dark brown	Silty clay Silty clay	- <5% Caliche	Terminated at argillic subsoil
45	0-10 10-20	10YR 3/4 10YR 3/4	Dark yellowish brown Dark yellowish brown	Sandy clay loam Sandy clay	- <5% Caliche	Terminated at argillic subsoil
46	0-10 10-20	10YR 3/4 10YR 3/4	Dark yellowish brown Dark yellowish brown	Sandy clay Sandy clay	- <1% Caliche	Terminated at argillic subsoil
47	0-40 40-55	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy clay Sandy clay	- <2% calcium carbonate	Terminated at argillic subsoil
48	0-33 33-36	10YR 3/2 10YR 4/3	Very dark grayish brown Brown	Sandy clay loam Sandy clay	- <2% Caliche	Terminated at argillic subsoil
49	0-33 33-39	10YR 4/2 10YR 3/2		Sandy clay loam Sandy clay	<2% Caliche	Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
50	0-42 42-50	10YR 2/2 10YR 4/2 mottle w/ 10YR 4/6	Very dark brown Dark grayish brown m/ Dark yellowish brown	Sandy loam Sandy clay	- <5% Caliche	Terminated at argillic subsoil
51	0-25 25-35	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy clay loam Sandy clay	- <2% calcium carbonate	Terminated at argillic subsoil
52	0-28 28-34	10YR 2/2 10YR 4/2 mottle w/ 10YR 4/6	Very dark brown Dark grayish brown m/ Dark yellowish brown	Sandy loam Sandy clay	- <5% Caliche	Terminated at argillic subsoil
53	0-8 8-25	10YR 3/4 10YR 3/4	Dark yellowish brown Dark yellowish brown	Sandy clay loam Sandy clay	- <5% Caliche	Terminated at argillic subsoil
54	0-16 16-25	10YR 3/4 10YR 3/4	Dark yellowish brown Dark yellowish brown	Sandy clay loam Sandy clay	- <2% Caliche	Terminated at argillic subsoil
55	0-21 21-31	10YR 2/2 10YR 5/1	Very dark brown Gray	Sandy loam Sandy clay loam	- >1% Caliche	Terminated at argillic subsoil
56	0-35 35-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy clay Sandy clay	-	Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
					<2% calcium carbonate	
57	0-12	10YR 3/4	Dark yellowish brown	Sandy clay	-	Terminated at argillic subsoil
58	0-24 24-35	10YR 2/2 10YR 5/1	Very dark brown Gray	Sandy loam Sandy clay loam	- >1% Caliche	Terminated at argillic subsoil
59	0-25 25-35	10YR 2/2 10YR 5/1	Very dark brown Gray	Sandy loam Sandy clay loam	- >1% Caliche	Terminated at argillic subsoil
60	0-25 25-35	10YR 2/2 10YR 5/1	Very dark brown Gray	Sandy loam Sandy clay loam	- >1% Caliche	Terminated at argillic subsoil
61	NE	NE	NE	NE	NE	Existing PPL
62	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy clay loam Sandy clay	- <1% calcium carbonate	Offset due to PPL Terminated at argillic subsoil
63	0-7 7-17	10YR 3/4 10YR 3/4	Dark yellowish brown Dark yellowish brown	Sandy clay loam Sandy clay	- <2% Caliche	Terminated at argillic subsoil
64	0-20 20-30	10YR 3/4 7.5YR 4/3	Dark yellowish brown Brown	Sandy clay Sandy clay	- <2% Caliche	Terminated at argillic subsoil
65	0-14 14-30	10YR 4/2 10YR 4/3	Dark grayish brown	Sandy clay loam	- <3% Caliche	Terminated at argillic subsoil

Shovel Test	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
			Brown	Sandy clay		
66	0-8	7.5YR 4/3	Brown	Sandy clay	<5% gravel	Terminated at gravel
67	0-5 5-19	10YR 3/2 10YR 4/2	Very dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <3% Caliche	Terminated at argillic subsoil
68	0-15 15-25	10YR 3/4 10YR 3/4	Dark yellowish brown Dark yellowish brown	Sandy clay Sandy clay	- <2% Caliche	Terminated at argillic subsoil
69	0-50 50-59	10YR 3/2 10YR 4/2	Very dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <3% Caliche	Terminated at argillic subsoil
70	0-20 20-35	10YR 3/4 10YR 3/4	Dark yellowish brown Dark yellowish brown	Sandy clay Sandy clay	- <2% Caliche	Terminated at argillic subsoil
71	NE	NE	NE	NE	NE	Existing PPL

TEXAS HISTORICAL COMMISSION

ANTIQUITIES PERMIT APPLICATION FORM ARCHEOLOGY

GENERAL INFORMATION

I. PROPERTY TYPE AND LOCATION

Project Name (and/or Site Trinomial) Cultural Resources Survey for the Rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 1
County (ies) Karnes County
USGS Quadrangle Name and Number Lenz, Texas
UTM Coordinates Zone 14 E 607895 m N 3183987 m
Location Karnes County, Texas
Federal Involvement **X** Yes ❑ No
Name of Federal Agency Natural Resources Conservation Service
Agency Representative Angela Moody

II. OWNER (OR CONTROLLING AGENCY)

Owner Escondido Watershed District
Representative Joe Ponish, Board Chair
Address 491 North Sunset Strip, Suite 103
City/State/Zip Kenedy, Texas 78119-2721
Telephone (include area code) 830.583.3224 Email Address karnescountywatersheddistricts@gmail.com

III. PROJECT SPONSOR (IF DIFFERENT FROM OWNER)

Sponsor
Representative
Address
City/State/Zip
Telephone (include area code) Email Address

PROJECT INFORMATION

I. PRINCIPAL INVESTIGATOR (ARCHEOLOGIST)

Name Steve Ahr, PhD, RPA
Affiliation AECOM
Address 13355 Noel Road, Suite 400,
City/State/Zip Dallas, TX 75240
Telephone (include area code) 830.538.4804 Email Address steve.ahr@aecom.com

ANTIQUITIES PERMIT APPLICATION FORM (CONTINUED)

II. PROJECT DESCRIPTION

Proposed Starting Date of Fieldwork August 7, 2023
Requested Permit Duration 10 Years 0 Months (1 year minimum)
Scope of Work (Provided an Outline of Proposed Work) See attached research design

III. CURATION & REPORT

Temporary Curatorial or Laboratory Facility AECOM, 13355 Noel Road, Suite 400, Dallas, TX 75240,
Permanent Curatorial Facility Texas Archeological Research Laboratory

IV. LAND OWNER'S CERTIFICATION

I, Joe Ponish, as legal representative of the Land Owner, Escondido Watershed District, do certify that I have reviewed the plans and research design, and that no investigations will be performed prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Owner, Sponsor, and Principal Investigator are responsible for completing the terms of the permit.
Signature Joe E. Ponish Date 8-7-2023

V. SPONSOR'S CERTIFICATION

I, ________, as legal representative of the Sponsor, ________, do certify that I have review the plans and research design, and that no investigations will be performed prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Sponsor, Owner, and Principal Investigator are responsible for completing the terms of this permit.
Signature ________ Date ________

VI. INVESTIGATOR'S CERTIFICATION

I, Steven Ahr, as Principal Investigator employed by AECOM (Investigative Firm), do certify that I will execute this project according to the submitted plans and research design, and will not conduct any work prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Principal Investigator (and the Investigative Firm), as well as the Owner and Sponsor, are responsible for completing the terms of this permit.

Signature Steven Ahr Date 7/18/23

Principal Investigator must attach a research design, a copy of the USGS quadrangle showing project boundaries, and any additional pertinent information. Curriculum vita must be on file with the Archeology Division.

FOR OFFICIAL USE ONLY

Reviewer ________ Date Permit Issues ________
Permit Number ________ Permit Expiration Date ________
Type of Permit ________ Date Received for Data Entry ________

Texas Historical Commission
Archeology Division
P.O. Box 12276, Austin, TX 78711-2276
Phone 512-463-6096
thc.texas.gov

RESEARCH DESIGN

CULTURAL RESOURCES SURVEY FOR THE REHABILITATION OF THE ESCONDIDO CREEK WATERSHED FLOODWATER RETARDING STRUCTURE NO. 1

KARNES COUNTY, TEXAS

Prepared by

Steve Ahr, PhD, RPA
AECOM

July 2023

Project Description

AECOM Technical Services, Inc. (AECOM) prepared this research design and Antiquities Permit Application to conduct a cultural resources survey in support of the Supplemental Watershed Plan (SWP) for the rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 1 (FRS 1), located in Karnes County Texas (**Exhibit 1**). The project is sponsored by the Texas State Soil and Water Conservation Board (TSSWCB), the Natural Resources Conservation Service (NRCS), and Sponsoring Local Organizations, including the Karnes-Goliad Soil Water Conservation District (SWCD), Escondido Watershed District, City of Kennedy, and the San Antonio River Authority.

FRS 1 was constructed in 1954 as a low hazard dam on a tributary to Panther Creek, approximately 4.2 miles southwest of Kennedy, Texas. The National Inventory of Dams Identification Number is TX02032 (URS 2014). The dam is a filled earthen embankment that is 2,606 feet long with a maximum height of 36 feet. The detention pool is 112 acres. The principal spillway is a 30x30-inch drop inlet with 132 feet of 12-inch diameter, reinforced concrete pipe and 80 feet of 12-inch corrugated steel metal pipe. The auxiliary spillway is a vegetated earthen channel 250 feet wide. The existing dam does not meet the current dam safety design criteria for a High Hazard dam (URS 2014). The purpose of the rehabilitation would be to mitigate identified dam safety deficiencies associated with the dam's reclassification as a High Hazard dam.

Detailed design plans for structural rehabilitation of FRS 1 are not yet available. However, to meet high hazard criteria, dam rehabilitations typically entail some combination of various modifications, including raising the dam embankment, modifying or replacing the existing principal spillway, and/or increasing the capacity of the auxiliary spillway.

All potential rehabilitation modifications would take place within the 130-acre Limits of Construction, which is currently considered to be the direct Area of Potential Effects (APE) for cultural resources (**Exhibits 2 and 3**). Engineering calculations have not yet determined whether the top-of-dam elevation would increase due to any proposed modifications. Should there be a net increase in the maximum pool elevation, then the direct APE and the resulting survey would be adjusted as appropriate to accommodate this change. An indirect APE is recommended to extend 600-ft from the direct APE. The indirect APE would be used to assess potential effects on historic-age resources and the viewshed.

Regulatory

The SWP will be prepared in accordance with standard engineering principles that comply with NRCS programmatic requirements. In addition, the SWP will be reviewed, concurred, and approved by NRCS. Consequently, the project falls under the purview of Section 106 of the National Historic Preservation Act of 1966, as amended. In accordance with Advisory Council on Historic Preservation regulations pertaining to the protection of historic properties (36 CFR 800), federal agencies are required to assess the effects of their undertakings on historic properties prior to issuing permits or funding. Historic properties are defined as those properties that are included in, or are eligible for inclusion in, the National Register of Historic Places (NRHP). Therefore, the project is subject to review by the Texas State Historic Preservation Office, which is formally known as the Texas Historical Commission (THC).

United States Army Corps of Engineers (USACE) permitting may also be required for this project. USACE regulations 33 CFR Part 325, Appendix C are the USACE's Regulatory Program's implementing regulations for Section 106 compliance. They provide a process for the review of all proposed USACE permit actions and are commensurate with the level of impacts. For example, a project area includes the entire area of work, including all construction, staging, and access areas, and may be larger than the USACE permit area. The permit area is determined by the USACE, but typically comprises the waters of the U.S. that will be directly affected by the proposed undertaking, and uplands directly affected because of authorizing the work or structures. The USACE evaluates permit applications on a case-by-case basis to determine a project's potential to affect historic properties.

The project will be located on lands owned and/or controlled by the Escondido Watershed District, which is a political subdivision of the State of Texas. As such, it falls within the purview of the Antiquities Code of Texas. Regulations pertaining to the code can be found within Title 13, Part 2, Chapter 26 of the Texas Administrative Code (TAC). The code requires the THC to review actions that have the potential to disturb prehistoric and historic sites within the public domain. The THC issues Antiquities Permits that stipulate the conditions under which survey, discovery, excavation, demolition, restoration, or scientific investigations can occur. AECOM is submitting this Antiquities Permit application and research design to perform an intensive archeological survey in advance of the proposed rehabilitation.

Natural Setting

The APE is underlain by the Miocene-age Oakville Sandstone Formation, which is characterized by sandstone, clay, and mud (Bureau of Economic Geology [BEG] 1987). No Holocene-age deposits are mapped within the APE. Five soil mapping units are present within the APE (**Table 1**). Approximately 45 percent of the soils in the APE are comprised of the Weesatch series, which formed in residuum weathered from Pliocene-age sandstone deposits (NRCS 2023). These soils are mapped on sloping summits, backslopes, and footslopes of interfluves. Pettus and Pernitas soils comprise approximately 22 percent of the APE and are found on summits, backslopes, shoulders, and footslopes of ridges. Coy soils are located on ancient terraces and make up nearly 20 percent of the APE. Approximately 13 percent of the APE consists of impounded water.

Table 1. Soils within the APE

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Pedon	Parent Material
CoB	Coy clay loam, 1 to 3 percent slopes	19.5	Very deep, well drained, slowly permeable soils on moderately sloping terrace remnants and broad flats along drainageways	Ap-Bt1-Bt2-Btk-Bk-Bky	Alluvium
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	20.8	Very deep, well drained, moderately permeable soils on summits, backslopes, and footslopes of ridges	A-Bt1-Bt2-Bk1-Bk2	Alluvium

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Pedon	Parent Material
PtC	Pettus loam, 2 to 5 percent slopes	0.9	Very deep, well drained soils on shoulders on hillslopes	A-Bk-BCk1-BCk2	Fluviomarine deposits
W	Water	13.5	N/A	N/A	N/A
WaC	Weesatch fine sandy loam, 2 to 5 percent slopes	31.1	Very deep, well drained, moderately permeable soils on sloping summits, backslopes, and footslopes of interfluves	A-Bt1-Bt2-Bk1-Bk2-BCk	Residuum
WeB	Weesatche sandy clay loam, 1 to 3 percent slopes	14.2	Very deep, well drained, moderately permeable soils on sloping summits, backslopes, and footslopes of interfluves	A-Bt1-Bt2-Bk1-Bk2-BCk	Residuum

Source: (NRCS 2023)

Texas Archeological Sites Atlas Review

A review of the Texas Archeological Sites Atlas (TASA 2023) found no previous archeological surveys, recorded archeological sites, historic properties, historical markers, State Antiquities Landmark (SALs), or cemeteries within 1,000 meters (m) of the APE.

Field Survey Methods

AECOM proposes to conduct an intensive archeological survey of the APE that will conform to the Council of Texas Archeologists (CTA) *Intensive Terrestrial Survey Guidelines* (March 30, 2020).

Objectives of the survey are to identify and record archeological resources within the APE, evaluate their eligibility for inclusion in the NRHP and for designation as SALs, and determine whether any additional cultural resources investigations are warranted. In addition, historic buildings, structures, objects, and potential historic districts that are 45 years of age or older and fall within 600 ft of the direct APE (including FRS 1 that was constructed in 1954) will be evaluated by a qualified architectural historian. All work will be performed by qualified AECOM archeologists and architectural historians meeting United States Secretary of the Interior's Professional Qualification Standards for Archeology and Historic Preservation.

Survey transects will not exceed 30 m and all exposed ground surfaces will be examined for evidence of archeological materials. Shovel tests will be excavated in settings that have the potential for shallowly buried cultural materials. Shovel tests will be 30 centimeters (cm) in diameter and will be dug in 20-cm levels. In depositional areas, shovel tests will be dug either to the bottom of the Holocene deposits, or to 80 cm below surface. In upland areas, shovel tests will be dug to subsoil. Hand-excavated soils will be screened through ¼-inch mesh unless high clay or water content requires that they be troweled through. Shovel tests will be precluded in upland or erosional settings with exposed bedrock; on slopes greater than 20 percent; and/or settings with evidence of significant ground disturbance. These areas will be delineated on maps, photo-documented, and discussed in the report. A minimum of one shovel test will be excavated and photo-documented for each excluded area to assess the potential for buried deposits and demonstrate the nature and extent of significant ground disturbance. Location, depth, soil strata, and the presence/absence of cultural materials will be recorded for each shovel test. All shovel tests will be backfilled upon completion.

The need for deep mechanical prospection (e.g., backhoe trenching) will be evaluated during the survey to determine if deeply buried archeological deposits could be impacted by the project. If deep, potential artifact bearing soils are identified in the APE and would be impacted, backhoe trenching would be conducted. Backhoe trenches would be approximately 4 m in length, 1 m wide, and dug to the anticipated depths of impacts. In accordance with the Texas Utility Code, at least 48 hours of prior notification would be given to the Texas Excavation Safety System (Texas811) damage prevention service before any trench excavations occur. During the trenching, one five-gallon bucket from every third excavator bucket would be screened. Entry into trenches would be limited to the upper 4 feet, in accordance with Occupational Health and Safety Administration trench safety standards. A 1-m wide wall section would be selected for detailed soil profile description. All trenches would be photographed and then backfilled.

Site Recording and Assessment

A site will be defined by the presence of at least five or more artifacts. According to the CTA's *Intensive Terrestrial Survey Guidelines*, any cultural materials identified during survey greater than 50 years of age would at least minimally be designated as an isolated find.

All archeological sites will be delineated through a combination of shovel testing and in-field observations, as outlined in CTA's *Intensive Terrestrial Survey Guidelines*. Positive shovel tests will be excavated in a cruciform pattern at intervals no greater than 15 m until two negative shovel tests are found in each direction, or until topographic limits (e.g., landform boundaries, streams) or project limits are reached. Typically, most sites will require at least six shovel tests to define site boundaries, with more shovel tests for larger sites. Each site will be photographed from a minimum of two angles. All cultural and natural features of interest will be photographed, along with representative overviews. Site boundaries and the locations of all subsurface excavations, cultural features, individual artifacts, or artifact clusters, and other relevant natural or landscape features, will be recorded with a GPS.

The survey will employ a non-collection strategy. For all sites identified during the survey, the quantities of artifacts or estimates of materials in surface scatters will be recorded and the locations of artifact concentrations will be plotted on site maps. Any artifacts recovered from shovel tests or other sub-surface investigations will be photographed and returned to their original provenience. All diagnostic artifacts, and a representative sample of non-diagnostic materials from the surface, will be documented in the field. TexSite forms for all new sites will be prepared and submitted to the Texas Archeological Research Laboratory for assignment of a permanent trinomial designation. All sites and historic structures in the APE (including the FRS 1 dam) will be assessed for NRHP and SAL eligibility.

Report

AECOM will prepare and submit a draft technical report that summarizes the findings of the survey. The report will provide recommendations for further work or no further work, with appropriate justifications, and will conform to CTA guidelines. The draft report will be submitted to the project sponsor, NRCS, and THC for review. After addressing comments, AECOM will furnish the THC two printed copies of the unredacted final report, one bound and one unbound, and a bound printed copy of a redacted version will be submitted to the Texas State Library and Archive Commission. In addition, two tagged PDF copies of the final report will be submitted electronically via the THC's eTRAC portal. One of the tagged PDFs will included the plotted location of all sites recorded, and the other will not include the site location data.

Curation

Correspondence, field records, and photographs generated during archeological investigations will be prepared for permanent curation at an approved Texas curatorial facility after acceptance of the final report by the THC.

References

Bureau of Economic Geology. 1987. *Geologic Atlas of Texas, Beeville-Bay City Sheet*. Bureau of Economic Geology, The University of Texas at Austin.

Natural Resources Conservation Service (NRCS)
2023. *Web Soil Survey*. Electronic database, http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, accessed July 6, 2023.

Texas Archeological Sites Atlas (TASA). 2023. Electronic database, https://atlas.thc.state.tx.us/Map, accessed July 6, 2023.

URS Corporation, Inc.
2014 *Dam Assessment Report*. Escondido Creek Watershed Floodwater Retarding Structure No. 1, Karnes County, Texas.

EXHIBITS

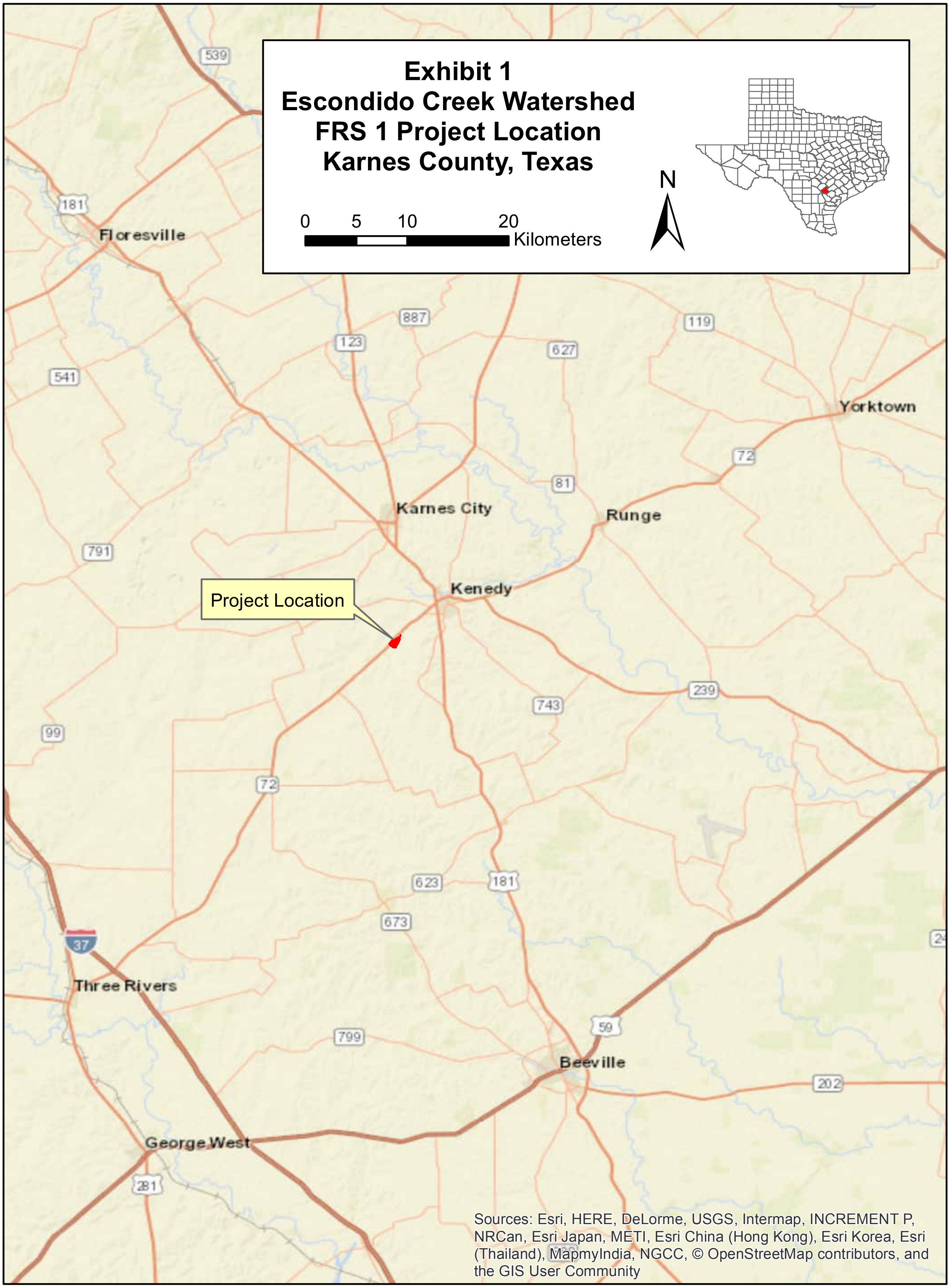


Exhibit 1
Escondido Creek Watershed
FRS 1 Project Location
Karnes County, Texas
0
5
10
20
Kilometers
N
Project Location
Floresville
Karnes City
Kenedy
Runge
Yorktown
Three Rivers
Beeville
George West
539
181
541
887
123
627
119
72
81
791
99
239
743
623
181
673
37
799
59
202
281
Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

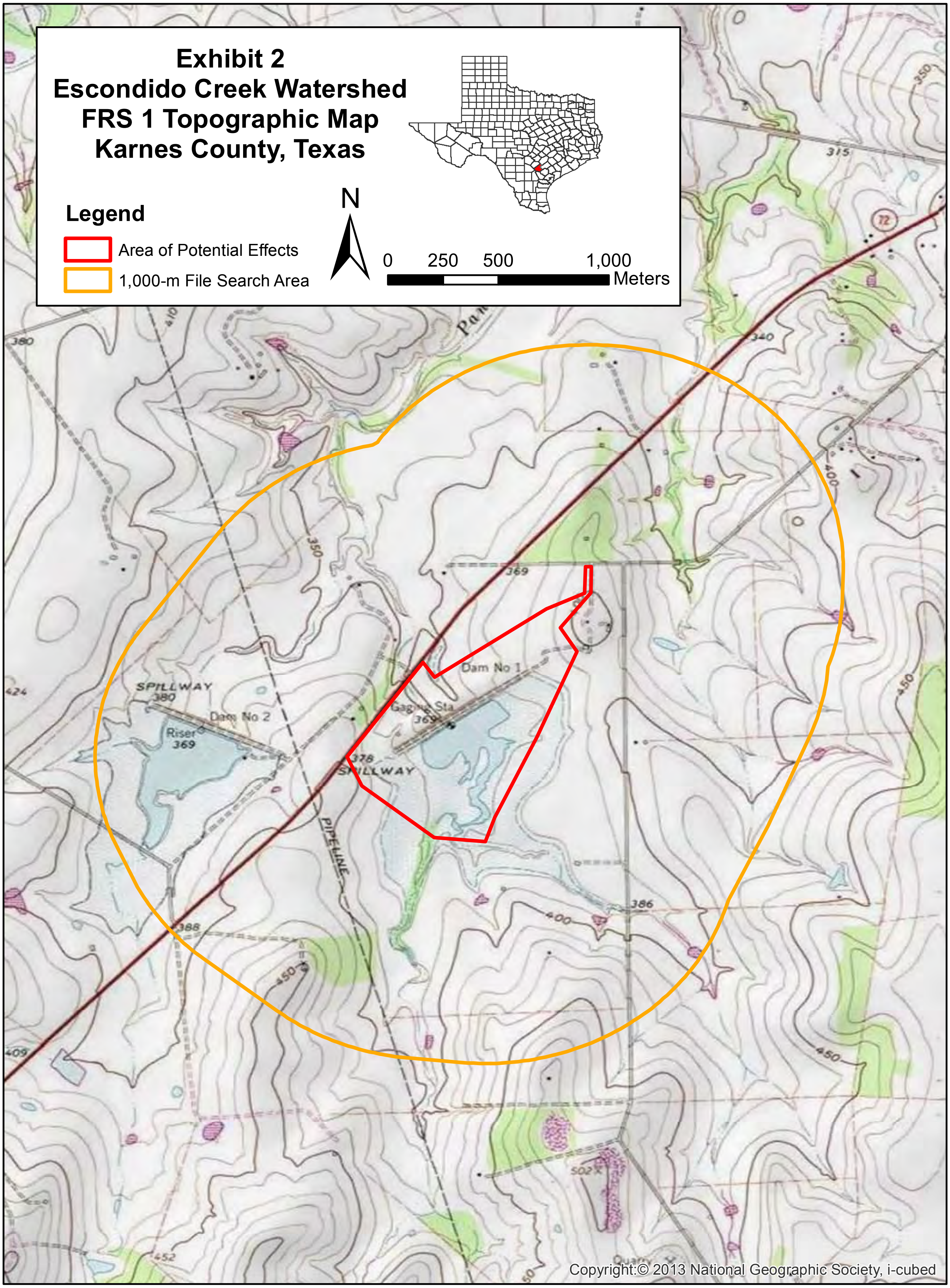


Exhibit 2
Escondido Creek Watershed
FRS 1 Topographic Map
Karnes County, Texas
Legend
Area of Potential Effects
1,000-m File Search Area
N
0
250
500
1,000
Meters
SPILLWAY
380
Dam No 2
Riser
369
Dam No 1
Gaging Sta
369
378
SPILLWAY
PIPELINE
Copyright:© 2013 National Geographic Society, i-cubed

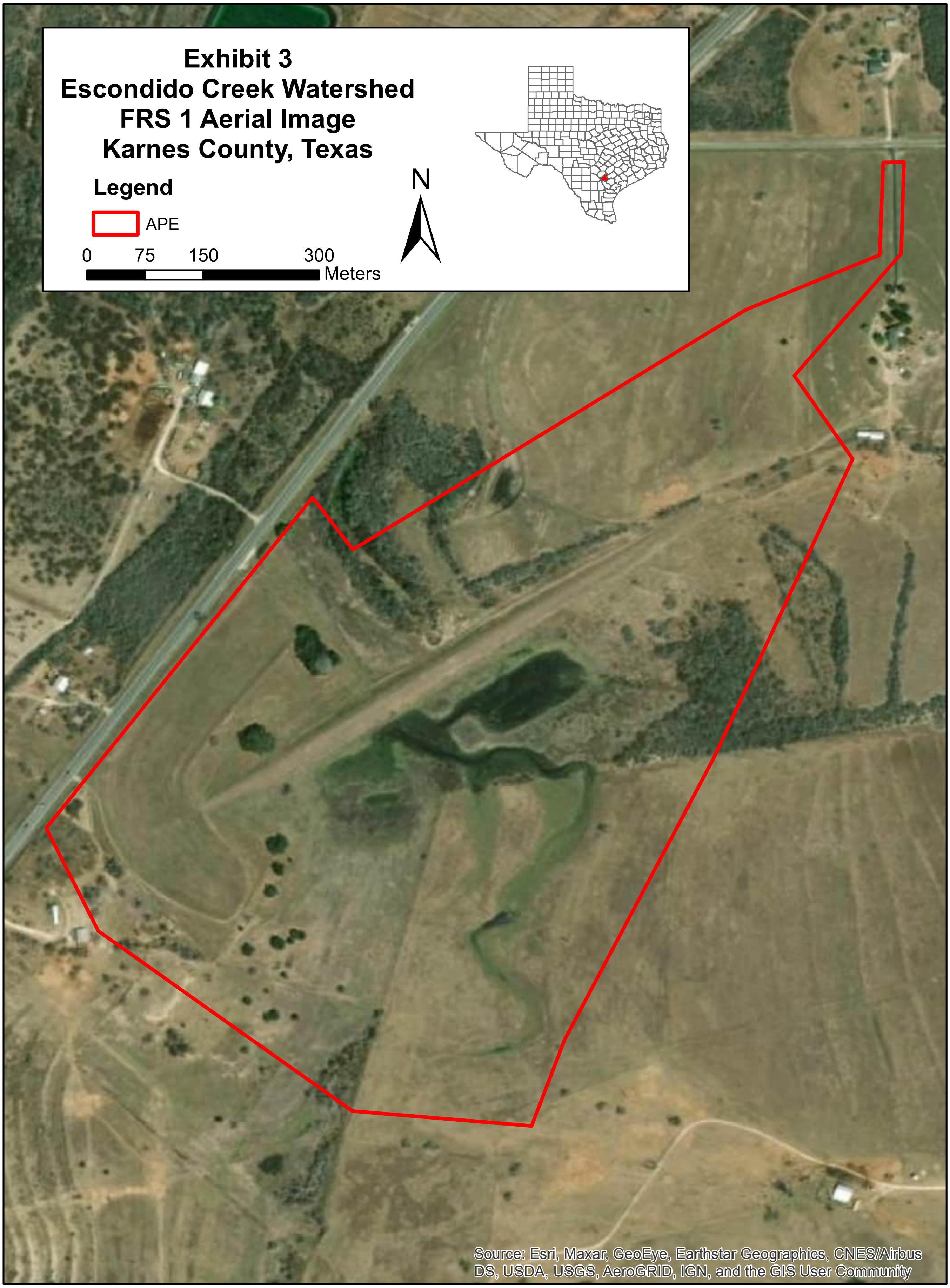


Exhibit 3
Escondido Creek Watershed
FRS 1 Aerial Image
Karnes County, Texas
Legend
APE
0 75 150 300
Meters
N
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

From: noreply@thc.texas.gov
Sent: Thursday, August 17, 2023 1:47 PM
To: Ahr, Steven; karnescountywatersheddistricts@gmail.com; karnescountywatersheddistricts@gmail.com; Laney.Fisher@thc.texas.gov; Jeff.Durst@thc.texas.gov
Subject: 31326 - Cultural Resources Survey for the Escondido Creek Watershed FRS No. 1 Rehabilitation
Attachments: AntiquitiesPermit-31326-08172023.pdf; ArcheologyPermitRequirements.docx

TEXAS HISTORICAL COMMISSION
real places telling real stories

Re: Project Application under the Antiquities Code of Texas
Permit for: Cultural Resources Survey for the Escondido Creek Watershed FRS No. 1 Rehabilitation
Texas Antiquities Permit 31326

Dear Colleague:

Thank you for your Antiquities Permit Application for the above referenced project. This letter presents the final copy of the permit from the Executive Director of the Texas Historical Commission (THC), the state agency responsible for administering the Antiquities Code of Texas.

Please keep this copy for your records. The Antiquities Permit investigations requires the production and submittal of one bound and one unbound paper final report, a completed Abstracts in Texas Contract Archeology online form, a shape file of the project area surveyed, a curation form, and complete and redacted tagged PDF copies of the final report for the above referenced permit. The abstract form and shapefile may be submitted via the tabs in eTRAC. For questions on how to submit these, please visit our video training series at:
https://www.youtube.com/playlist?list=PLONbbv2pt4cog5t6mCqZVaEAx3d0MkgQC

If you have any questions concerning our review or if we can be of further assistance, please email the contact reviewer: Jeff Durst at Jeff.Durst@thc.texas.gov.

Sincerely,
Laney Fisher
Antiquities Permit Coordinator
512 463-1858

Please do not respond to this email.

State of Texas

TEXAS ANTIQUITIES COMMITTEE

Archeology Permit # 31326

This permit is issued by the Texas Historical Commission, hereafter referred to as the Commission, represented herein by and through its duly authorized and empowered representatives.The Commission, under authority of the Texas Natural Resources Code, Title 9, Chapter 191, and subject to the conditions hereinafter set forth, grants this permit for:

Intensive Survey

To be performed on a potential or designated landmark or other public land known as:
Title: Cultural Resources Survey for the Escondido Creek Watershed FRS No. 1 Rehabilitation
County: Karnes
Location: Karnes County

Owned or Controlled by: (hereafter known as the Permittee):
Escondido Watershed District
491 North Sunset Strip, Suite 103
Kenedy, Texas 78119

Sponsored by (hereafter known as the Sponsor):
Escondido Watershed District
491 North Sunset Strip, Suite 103
Kenedy, Texas 78119

The Principal Investigator/Investigation Firm representing the Owner or Sponsor is:
Steven Ahr
AECOM
1950 N Stemmons Freeway, Ste 6000
Dallas, TX 75207

This permit is to be in effect for a period of:
10 Years and 0 Months

And will expire on:
8/17/2033

During the preservation, analysis, and preparation of a final report or until further notice by the Commission, artifacts, field notes, and other data gathered during the investigation will be kept temporarily at:
AECOM-Dallas

Upon completion of the final permit report, the same artifacts, field notes, and other data will be placed in a permanent curatorial repository at:
Texas Archeological Research Laboratory

Scope of Work under this permit shall consist of:
An intensive pedestrian archaeological survey that meets or exceeds the State Archeological Survey Standards for Texas. This includes subsurface shovel testing of pedestrian survey transects and mechanical testing in appropriate alluvial areas. For details, see scope of work submitted with permit application.

This permit is granted on the following terms and conditions:

1. This project must be carried out in such a manner that the maximum amount of historic, scientific, archeological, and educational information will be recovered and preserved and must include the scientific, techniques for recovery, recording, preservation and analysis commonly used in archeological investigations.All survey level investigations must follow the state survey standards and the THC survey requirements established with the projects sponsor(s).
2. The Principal Investigator / Investigation Firm, serving for the Owner/ Permittee and / or the Project Sponsor, is responsible for insuring that specimens, samples, artifacts, materials and records that are collected as a result of this permit are appropriately cleaned, and cataloged for curation.These tasks will be accomplished at no charge to the Commission, and all specimens, artifacts, materials, samples, and original field notes, maps, drawings, and photographs resulting from the investigations remain the property of the State of Texas, or its political subdivision, and must be curated at a certified repository.Verification of curation by the repository is also required, and duplicate copies of any requested records shall be furnished to the Commission before any permit will be considered complete.
3. The Principal Investigator / Investigation Firm serving for the Owner/ Permittee, and / or the Project Sponsor is responsible for the publication of results of the investigations in a thorough technical report containing relevant descriptions, maps, documents, drawings, and photographs.A draft copy of the report must be submitted to the Commission for review and approval. Any changes to the draft report requested by the Commission must be made or addressed in the report, or under separate written response to the Commission. Once a draft has been approved by the Commission, one(1) printed, unbound copy and one bound copy of the final report containing at least one map with the plotted location of any and all sites recorded and two copies of the report in tagged PDF format shall be furnished to the commission. One PDF copy must include the plotted location of any and all sites recorded and the other should not include the site location data.An electronic copy of the completed Abstracts in Texas Contract Archeology Summary Form must also be submitted with the final report to the Commission.
4. If the Owner / Permittee, Project Sponsor or Principal Investigator / Investigation Firm fails to comply with any of the Commission's Rules of Practice and Procedure or with any of the specific terms of this permit, or fails to properly conduct or complete this project within the allotted time, the permit will fall into default status.A notification of Default status shall be sent to the Principal Investigator/ Investigation Firm and the Principal Investigator will not be eligible to be issued any new permits until such time that the conditions of this permit are complete or, if applicable, extended.
5. The Owner/ Permittee, Project Sponsor, and Principal Investigator/ Investigation Firm, in the conduct of the activities hereby authorizes, must comply with all laws, ordinances and regulations of the State of Texas and of its political subdivisions including, but not limited to, the Antiquities Code of Texas; they must conduct the investigation in such a manner as to afford protection to the rights of any and all lessees or easement holders or other persons having an interest in the property and they must return the property to its original condition insofar as possible, to leave it in a state which will not create hazard to life nor contribute to the deterioration of the site or adjacent lands by natural forces.
6. Any duly authorized and empowered representative of the Commission may, at any time, visit the site to inspect the fieldwork as well as the field records, materials, and specimens being recovered.
7. For reasons of site security associated with historical resources, the Project Sponsor(if not the Owner/ Permittee), Principal Investigator, Owner, and Investigation Firm shall not issue any press releases, or divulge to the news media, either directly or indirectly, information regarding the specific location of, or other information that might endanger those resources, or their associated artifacts without first consulting with the Commission and the State agency or political subdivision of the State that owns or controls the land where the resource has been discovered.
8. This permit may not be assigned by the Principal Investigator/ Investigation Firm, Owner / Permittee, or Project Sponsor in whole, or in part to any other individual, organization, or corporation not specifically mentioned in this permit without the written consent of the Commission.
9. Hold Harmless: The Owner/ Permittee hereby expressly releases the State and agrees that Owner / Permittee will hold harmless, indemnify, and defend(including reasonable attorney's fees and cost of litigation) the State, its officers, agents, and employees in their official and/or individual capacities from every liability, loss, or claim for damages to persons or property, direct or indirect of whatsoever nature arising out of, or in any way connected with, any of the activities covered under this permit.The provisions of this paragraph are solely for the benefit of the State and the Texas Historical Commission and are not intended to create or grant any rights, contractual or otherwise, to any other person or entity.
10. Addendum: The Owner/Permittee, Project Sponsor and Principal Investigator/Investigation Firm must abide by any addenda hereto attached.

Upon a finding that it is in the best interest of the State, this permit is issued on 8/17/2023

Mark Wolfe

Brad Jones,
Archeology Division Director

Mark Wolfe,
Executive Director

USDA United States Department of Agriculture

Farm Production and Conservation

Natural Resources Conservation Service

USDA NRCS
W.R. Poage Federal Building
101 South Main Street
Temple, TX 76501

February 23, 2024

Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
108 West 16th Street
Austin, Texas 78701

RE: The Texas State Soil and Water Conservation Board and Natural Resources Conservation Service – Escondido Creek Watershed Floodwater Retarding Structure No. 1 Rehabilitation, Karnes County, Texas, **THC Permit #31326**

Dear Mr. Wolfe:

In accordance with the National Historic Preservation Act of 1966, as amended, and our 2015 Prototype Programmatic Agreement with State Historic Preservation Officer (SHPO), this letter is to authorize contractors for identification studies in preparation of the Escondido Creek Watershed Floodwater Retarding Structure (FRS) No. 1 Rehabilitation Supplemental Watershed Plan and Environmental Assessment, Karnes County, Texas (36 CFR Part 800.1.(3).

Escondido FRS No. 1 (National Inventory of Dams ID: TX02032) was constructed by the Soil Conservation Service in 1954 on a tributary to Panther Creek, approximately 4.2 miles southwest of Kenedy, Texas. The dam is an earthen embankment that is 2,606 feet (ft) long with a maximum height of 36 ft. Escondido FRS No. 1 is maintained by the Escondido Watershed District and the San Antonio River Authority and currently does not meet Federal safety standards for a High Hazard Potential dam. Therefore, the project sponsors and the United States Department of Agriculture - Natural Resources Conservation Service (NRCS) are evaluating alternatives to meet the current performance and safety criteria. AECOM has coordinated with your office on this project and performed a cultural resources survey; refer to THC Permit #31326. With this letter our administrative record will reflect that NRCS used the contractor's enclosed identification study and recommendations to determine the eligibility and effect to archaeological and historic-age resources within the Area of Potential Effect (APE). As the responsible agency official, I concur with AECOM's proposal of determination of eligibility and effect.

In summary of the initial cultural resources review, no archaeological sites were identified during the cultural resources survey of the APE, which has been disturbed from past construction activities associated with the construction of the existing earthen dam, auxiliary spillway, and reservoir construction. Based on the previous disturbance and the ubiquitous or ordinary construction of the dam, our findings are that the Escondido FRS No. 1 dam is ineligible for inclusion in the National Register of Historic Places (NRHP) and there will be no effect to historic properties with the proposed work.

The point of contact for reply or further information is Angela Moody, Archaeologist/Cultural Resource Specialist at angela.moody@usda.gov, at 254-742-9834, or by mail at 101 South Main Street, Temple, Texas 76501. Your prompt reply to this request is greatly appreciated and we thank you for your assistance.

Sincerely,

Kristy Oates
KRISTY OATES
State Conservationist

Ahr, Steven

From: NoResponse@thc.state.tx.us
Sent: Friday, March 01, 2024 2:59 PM
To: Ahr, Steven
Subject: Project Review Submission

Thank you for submitting project: Escondido FRS 1 Cultural Resources Survey

Tracking Number: 202406903

Due Date: 3/31/2024 2:58:57 PM (30 days)

TEXAS HISTORICAL COMMISSION

Ahr, Steven

From:	noreply@thc.state.tx.us
Sent:	Monday, April 01, 2024 3:07 PM
To:	Ahr, Steven; reviews@thc.state.tx.us
Subject:	Escondido FRS 1 Cultural Resources Survey

TEXAS HISTORICAL COMMISSION

real places telling real stories

Re: Project Review under Section 106 of the National Historic Preservation Act
THC Tracking #202406903
Date: 04/01/2024
Escondido FRS 1 Cultural Resources Survey (Permit 31326)
Karnes County
Kenedy,TX

Description: Draft report for Escondido FRS 1 Cultural Resources Survey

Dear Steven Ahr:
Thank you for your submittal regarding the above-referenced project. This response represents the comments of the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission (THC), pursuant to review under Section 106 of the National Historic Preservation Act.

The review staff, led by Caitlin Brashear and Mary Galindo, has completed its review and has made the following determinations based on the information submitted for review:

Above-Ground Resources

- No historic properties are present or affected by the project as proposed. However, if historic properties are discovered or unanticipated effects on historic properties are found, work should cease in the immediate area; work can continue where no historic properties are present. Please contact the THC's History Programs Division at 512-463-5853 to consult on further actions that may be necessary to protect historic properties.

Archeology Comments

- No historic properties affected. However, if cultural materials are encountered during construction or disturbance activities, work should cease in the immediate area; work can continue where no cultural materials are present. Please contact the THC's Archeology Division at 512-463-6096 to consult on further actions that may be necessary to protect the cultural remains.
- THC/SHPO concurs with information provided.
- This draft report is acceptable. To facilitate review and make project information and final reports available through the Texas Archeological Sites Atlas, we appreciate submission of tagged pdf copies of the final report including one restricted version with all site location information (if applicable), and one public version with all site location information redacted; an online abstract form submitted via the abstract tab on eTRAC; and survey area shapefiles submitted via the shapefile tab on eTRAC. For questions on how to submit these please visit our video training series at: https://www.youtube.com/playlist?list=PLONbbv2pt4cog5t6mCqZVaEAx3d0MkgQC Please note that these steps are required for projects conducted under a Texas Antiquities Permit.

We look forward to further consultation with your office and hope to maintain a partnership that will foster effective historic preservation. Thank you for your cooperation in this review process, and for your efforts to preserve the irreplaceable heritage of Texas. If the project changes, or if new historic properties are found, please contact the review staff. If you have any questions concerning our review or if we can be of further assistance, please email the following reviewers: caitlin.brashear@thc.texas.gov, Mary.Galindo@thc.texas.gov.

This response has been sent through the electronic THC review and compliance system (eTRAC). Submitting your project via eTRAC eliminates mailing delays and allows you to check the status of the review, receive an electronic response, and generate reports on your submissions. For more information, visit http://thc.texas.gov/etrac-system.

Sincerely,

for Bradford Patterson
Chief Deputy State Historic Preservation Officer

Please do not respond to this email.

AECOM
13640 Briarwick Drive
Austin, TX 78729
aecom.com

Project name:
Escondido Creek FRS No. 1 SWP-EA,
Karnes County, TX

Project ref:
60707486

To:
Monica Wedo, PE (AECOM)

CC:

Sergio Teran, PG (AECOM)

From:
Charlie Krolikowski, PE (AECOM)
Lance Finnefrock, PE, GE (AECOM)

Date:
October, 2024

Technical Memorandum

Subject: Recommended Geologic Input Parameters for SITES Analysis

1. Project Information

1.1 Project Information

A dam assessment report was prepared in 2014 for Escondido Floodwater Retarding Structure (FRS) No. 1 (Escondido 1) by AECOM. As a result of that study, the dam was reclassified as a high hazard dam. The existing dam does not meet current NRCS criteria for high hazard performance and dam safety standards.

The 2014 assessment included several potential rehabilitation alternatives to meet high hazard performance and safety standards ranging from decommissioning to repair/rehabilitation of the dams. The San Antonio River Authority (River Authority) contracted with AECOM to further evaluate these alternatives (and other potential alternatives given review of current conditions) in a Supplemental Watershed Plan and Environmental Assessment (SWP-EA).

1.2 Purpose and Scope

Alternatives evaluations typically require analysis of the existing vegetated auxiliary spillway(s) (ASW) for hydraulic capacity and erodibility/potential breaching during design storm event. Hydraulic analysis and design of vegetated earthen spillways for dams are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event.

The purpose of this memorandum is to provide recommendations for geologic input parameters to be used in hydraulic and erodibility analyses of the existing vegetated ASW channel using SITES software for this project.

2. Site Description

Escondido 1 is located on a tributary to Panther Creek, approximately 4.2 miles southwest of downtown Kennedy, Texas. Global positioning system (GPS) coordinates for the site are near latitude 28.777561° and longitude -97.893748°.

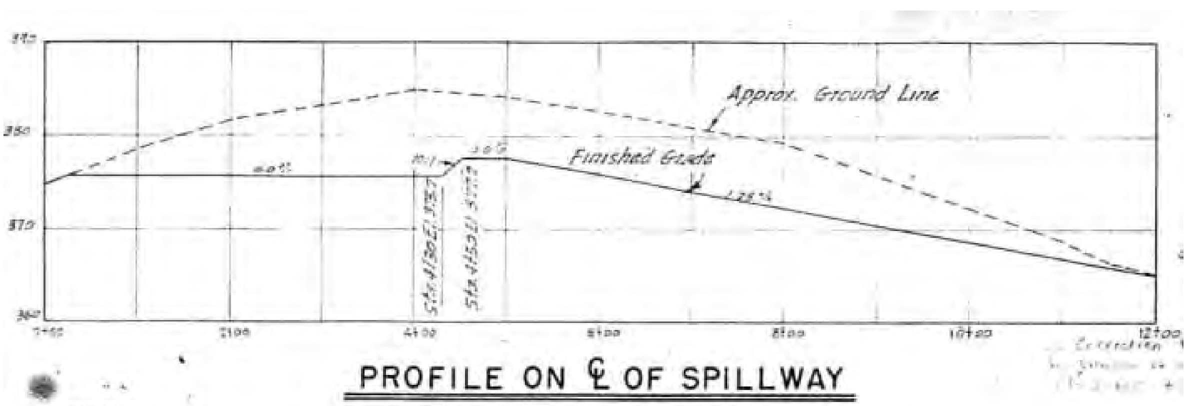
Site access is available via an unpaved dirt road off State Highway 72, approximately 0.6 miles southwest of the intersection of CR 160 and State Highway 72 in Kenedy, Texas. Within the site, access is primarily via pastures and dirt roads. A site map and plan of the geologic investigations is provided as **Figure 1**.

2.1 Existing Dam and Spillway

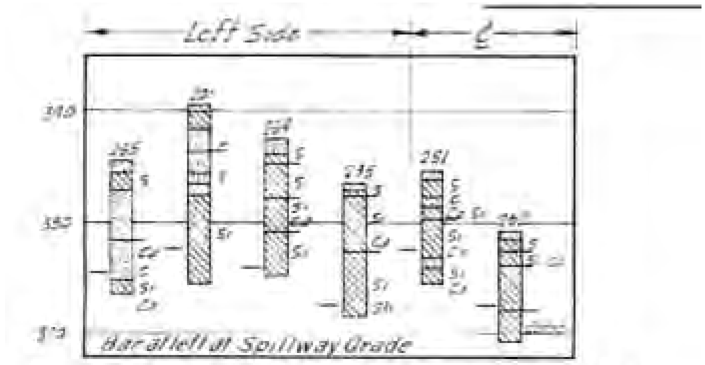
Escondido is an FRS that was designed and constructed as a low hazard dam. Escondido 1 was constructed in 1954. The dam has an estimated drainage area of approximately 1,819 acres and a total reservoir capacity estimated at 1,076 acre-feet (maximum storage). Escondido 1 does not meet the current dam design and safety requirements, and per the NRCS, the current classification of the structure is high hazard.

According to the as-built drawings, the dam is approximately 36 feet tall at the maximum section and 2,606 feet long. The upstream slopes of the embankment were constructed at an inclination of 3H:1V (horizontal:vertical) while the downstream slopes were constructed at 2H:1V. A 10 foot wide berm was constructed on the upstream slope. Following the 1954 construction, several shallow slides occurred on the downstream slope and a 12 foot wide berm with 2.5H:1V slopes was constructed across the downstream slope. The width of the embankment crest is approximately 14 feet. The dam features a vegetated ASW at the left abutment, and a principal spillway (PSW) consisting of a low-level inlet upstream separate from the inlet riser, the inlet riser, conduit under the dam, and an unlined downstream plunge pool (expanded in 1961 following original construction and during the repair of the downstream slope).

The existing ASW channel is 250 feet wide. The ASW crest is 50 feet long and at Elevation (El.) 377.87[1] feet according to the North American Vertical Datum of 1988 (NAVD88). The entrance channel slope was excavated nearly flat (0% per the as-built drawings) to about El. 357.87 at maximum depths of about 9 feet below pre-construction ground surface along the spillway centerline. The as-built drawings (see Attachment 1) indicate the crest was excavated into interbedded layers of native clay and sand. The exit channel was similarly excavated out of the native clay and sand layers at a 1.75% grade, with excavation depths ranging from 0 to 8 feet, thinning in excavation depth going downstream from the crest. For reference, the as-built spillway profile is shown in the image below as well as the stick logs provided in the as-built drawings for the auxiliary spillway.



[1] Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29). Conversion to NAVD88 is +0.17 feet.



LOG OF BORINGS OF SPILLWAY

SEE PLAN OF EMBANKMENT AND SPILLWAY

2.2 Historical Performance of Spillway

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2021 and 2022 annual inspections (River Authority 2021, TCEQ for River Authority 2022) reported that the spillway was in good condition. The 2021 inspection noted sparse vegetation in some areas while the 2022 inspection also noted some sparse vegetation areas as well as an ATV trail going across the control section. A harvester ant bed was also noted on the inside berm at the left end of the dam. No other adverse conditions were noted.

2.3 Proposed Improvements

The Supplemental Watershed Plan and Environmental Assessment (SWP-EA) (AECOM 2024) performed at Escondido 1 offered several alternatives to mitigate identified dam safety deficiencies associated with the reclassification of the dam as a high hazard structure. These included controlled dam breach and decommissioning, relocation of the at-risk downstream facilities out of the breach impact area, and dam rehabilitation. The preferred dam alternative from the SWP-EA is the federally supported plan and the recommended plan. The preferred alternative is dam rehabilitation that consists of the following components:

- Remove the existing principal spillway system;
- Install a new principal spillway system consisting of a standard inlet tower with crest at elevation 368.20 feet and a 42-inch RCP conduit discharging into an impact basin;
- Regrade inlet and outlet channel of the existing 250-feet wide vegetated auxiliary spillway and raise crest to the 100-year PSH elevation of 380.4 feet (2.53 feet raise),
- Line lower portion of auxiliary spillway from station 13+00 to station 15+78 with ACB,
- Flatten downstream embankment slope to 3H:1V,
- Install chimney drain within dam embankment,
- Install upstream slope riprap, and
- Raise top of dam elevation to 386.0 feet (3.13 feet raise) and extend cutoff trench below extended dam embankment.

3. Subsurface Information

3.1 Site Geology

The ASW is mapped as underlain exclusively by the Oakville Sandstone (designated as “Mo”). The Oakville Sandstone (designated as “Mo”) consists of sandstone and clay with a total thickness of 300 to 500 feet (Adams et. al 1981 and Baker 1979). Per the geologic map, the sandstone intervals are described as thickly bedded, medium grained, and calcareous with some crossbedding while the clay intervals are described as yellow-gray and calcareous. Anders (1962) describes the Oakville Sandstone as cross-bedded medium to fine grained sand and sandstone and sandy, ashy, and bentonitic clay beds with the base of the Oakville dipping gulfward at an average of 85 feet per mile. The Oakville Sandstone contains fossil wood, chert, and quartz gravels, with some vertebrate fossils and reworked Cretaceous invertebrate fossils (Adams et. al 1981 and Baker 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is the montmorillonite mineral with variable amounts of kaolinite and subordinate illite.

Alluvium (Qal) of the Holocene Epoch is mapped along the remainder of the site. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Deposits are typically organized as point bars, natural levees, stream channels, backswamps, coastal marshes, mud flats, clay dunes, sand dunes, and oyster reef deposits.

3.2 Soil Maps

The NRCS Survey database (NRCS, 2023) was examined to identify near-surface soil mapping of the site (i.e., approximately upper 7 feet). The mapped soil types in the vicinity of the dam are largely described as alluvium and residuum resulting from in-place weathering of the parent bedrock. The alluvium is generally mapped to the south (upstream) of the site within the low-lying areas of the valley, at the downstream segment of the ASW, and alternating north (downstream) of the dam with the residuum. Residuum is mapped where the principal spillway is located and is adjacent to alluvium on either side. Residuum is also found on the upstream section of the ASW near the inlet. Note that the ASW was excavated approximately 5 to 9 feet along the centerline for over 700 feet of the ASW channel removing surficial soils.

3.3 Previous Investigations

3.3.1 Soil Conservation Service – 1954 Work Plan and As-Built Drawings

The original geologic investigation (GI) for the design of Escondido 1 was conducted by the former Soil Conservation Service (SCS, presently known as the NRCS) in 1954 prior to construction of the existing dam as a part of the overall watershed management. A single investigation was conducted covering several dam sites in the watershed as part of the work plan. No standalone site-specific investigation was prepared for Escondido 1.

The 1954 Escondido Creek Watershed Work Plan (SCS 1954) describes the foundation of the Escondido Creek Watershed dams (including Escondido 1) as exclusively in the Oakville Sandstone formation, which is further described as containing interbedded silts and clays as well as sand. In addition, the 1954 Work Plan states that chalk and caliche outcrops are expected to occur on the surface, especially on the tops of hills. Valley slopes are described as principally residual silty clays and sandy clays and underlain by beds of clay and sand. An additional generalization for the dams was made regarding preliminary recommendations. The concern was for clays along the dam’s centerline and in the abutments as being underlain by a sandy member of the Oakville formation. The report also mentioned varying deposits of loose sands with small amounts of gravel being found, but the report also states that these materials should be removed during construction.

The as-built drawings for Escondido 1 provided subsurface profiles of the site with boring “stick” logs from the pre-construction investigation with generalized soil types. The investigation consisted of the following:

- 16 borings along the dam centerline (Hole numbers not legible/provided on the as-built drawings)
- 6 borings along the auxiliary spillway (Hole Nos. 201, 235, 251, 252, 254 and 255); and
- 30 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 180)

The complete investigation report containing the Escondido 1 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1954 by the SCS were the only source of site-specific geologic information available to AECOM and were used to develop a generalized understanding of the subsurface conditions at Escondido 1. Based on this documentation, the existing dam foundation consists of calcareous, sandy to silty clay with trace marl (identified near the principal spillway conduit only) and moist to saturated, clayey to silty sand with trace gravel.

The as-built drawings indicate that the embankment was to be constructed of fine-grained materials, but little information is available for the single-zoned homogeneous embankment except for the borings from the original borrow area. The stick logs indicate clay layers of varying thickness from 2 to 10 feet thick underlain and/or interspersed with sand layers. The stick logs indicate the clay contained sand, silt, and calcareous inclusions with no indication of percentages.

Based on review of Escondido 1 as-built drawings and the available geologic stick logs of borings in the ASW, the spillway channel invert was excavated to a maximum depth of about 9 feet below original grade, exposing sandy to silty calcareous clays interbedded with calcareous sands and clayey sands estimated to be 0.5 feet to 8 feet thick.

3.3.2 NRCS – 2022 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on February 22, 2022, by the NRCS part of the routine dam safety inspections. The inspection identified several deep animal burrows along the dam embankment as well as the possible slope slide in the very early stages over the principal spillway alignment on the downstream slope. In addition, a tree has taken root in the embankment. The PSW and ASW were noted as being in good condition. The ASW was noted as having generally good vegetative cover with some sparse areas.

Photographs in the inspection report depicted good vegetative coverage with native grasses throughout the dam.

The 2022 inspection concluded that Escondido 1 was performing as designed, but due to urban encroachment and updated TCEQ hydraulic criteria, it qualifies for assistance through the watershed rehabilitation program intended to bring this dam to safety standard for high hazard dams.

3.4 AECOM Preliminary Geologic Investigation

AECOM conducted a preliminary geologic investigation (GI) of the site to support hydraulic evaluation of the auxiliary spillway and alternatives analysis for the SWP-EA. The GI was conducted February of 2023 in general accordance with the Field Investigation and Testing Plan submitted to TSSWCB prior to field mobilization. Geologic investigation of the existing ASW was performed to develop recommended geologic input parameters for SITES erodibility analysis. The ASW investigation included four (4) borings in the existing channel designated as 201-23 through 204-23. Borings logs, boring locations, and detailed discussion of procedures, findings, and interpretations from the geologic investigation are provided in the preliminary Geologic Investigation Report (GIR) (AECOM 2024a) prepared as part of the scope of this project.

Laboratory testing was performed on select samples recovered from the existing auxiliary spillway. Testing included natural moisture content, natural unit weight, Atterberg limits, sieve and hydrometer, unconfined compression (UC) testing, and dispersion testing including crumb and double hydrometer. A summary of the laboratory test methods and results is provided in the Preliminary Soil Mechanics Report (SMR) (AECOM 2024b).

3.4.1 Generalized Subsurface Stratigraphy

Subsurface conditions encountered in the borings were generally consistent with the published geology, the stick logs included on the as-built drawings, and the geological descriptions provided in the Escondido Watershed workplan (SCS 1954a). The borings encountered interbedded clays, silts, and sands generally overlying interbedded sand and sandstones. The generalized stratigraphy included clay layers (an upper layer and a lower layer) overlying the sand and sandstone layer. The overlying clay layers are consistent with the description of the soils on the valley slopes as being "residual silty clays and sandy clays" while the interbedded sands and sandstone layers are consistent with the Oakville Sandstone Formation literature descriptions (SCS 1954a).

While the NRCS soil survey mapping shows alluvium and residuum soils within the ASW channel, it is possible the excavation of the ASW channel during dam construction may have likely removed the alluvial soils. As-built drawings (SCS, 1954b) indicate that the existing ASW forebay and channel were excavated approximately 5 to 9 feet along the centerline for over 700 feet of the ASW channel removing surficial soils, and at shallower depths the remaining length of the ASW channel. Based on this information and the observed and measured characteristics of the recovered soil samples, AECOM did not consider the soils to be alluvial in nature. AECOM's interpretation is that the clayey materials encountered in the investigation are residual soils, which is consistent with the work plan description of the silty clays and sandy clays that make up the valley slopes where the ASW is located. It is noted that since other sections of the site have not been excavated to the extent of the ASW, alluvium may be present at other locations which were not included in AECOM's investigation.

A geologic profile of the field data along the existing ASW profile is presented in **Figure 2**. The profile illustrates abridged boring logs indicating field USCS classification, pocket penetrometer values, SPT N-values, and measured groundwater levels. For the purposes of spillway erodibility analysis, the following generalized subsurface stratigraphy was assigned for the ASW channel:

1. Upper Clay (Residuum)
2. Lower Clay (Residuum)
3. Sand and Sandstone (Oakville Sandstone Formation)

The Upper Clay layer was described as fat clay to sandy fat clays with iron oxide staining and calcareous inclusions, generally light gray to light brownish gray, stiff to hard, dry to moist, and strong to no reactions to hydrochloric acid (HCL). The Lower Clay layer was described as generally lean clay to clayey sands with iron oxide staining and calcareous inclusions, light brownish gray to light yellowish brown, stiff to hard, dry to moist, and weak to strong reactions to HCL. The Sand and Sandstone layer encountered had varying degrees of uncemented sandy soils and cemented sandstones. The sandy soils encountered were described as clayey sand and well graded sand. The sandstone was generally described as medium grained quartz sandstone, fractured, thinly bedded, slightly to moderately weathered, medium strong to weakly cemented, slightly calcareous, and light gray to light brownish gray in color.

The borings encountered approximately 10 to 20 feet of clay, except boring 202-23 which terminated in clay at 40 feet bgs. The SPT N-values in the clay layers ranged from 8 to 60 bpf, increasing with depth, with an average of 33 bpf. Pocket penetrometer readings were generally greater than 4.5 tsf with a single recorded reading of 4.0 tsf on a shallow push sample recovered from boring 203-23. The SPT N-values in the sandy soils ranged from 18 to 62 bpf and had an average of 40 bpf (only two SPT tests were conducted in the Sand and Sandstone layer). Bedrock, defined as SPT and/or Shelby Tube refusal or visual determination, was encountered in borings 201-23, 203-23, and 204-23. In 201-23, bedrock was identified at 15 feet bgs (El. 360.5 feet), in 203-23 at 22 feet bgs (El. 348.5 feet) and in 204-23 at 14 feet bgs (El. 343). Bedrock was not encountered in borings 202-23.

Recovery of bedrock ranged from 13% to 82% (average 37%), and RQD ranged from 0 to 70% (average 26%). The attempt was made to core softer materials based on visual determination versus solely relying on SPT or Shelby tube refusal. However, the soft rock was difficult to core without disturbance and/or washout, and as a result, recovery and RQD of the bedrock material was low. In the case of boring 203-23, the recovery was 0% for Run 2, so an SPT test was completed after the coring attempt. Recovery for that sample was 100% and an SPT

N-value of 62 bpf. This sample had visual evidence of weak cementation, so the classification of sandstone was maintained, although the behavior of the material could be considered as more soil-like.

3.4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were added to the borings for the rock coring intervals. Boreholes were backfilled with cement bentonite grout at the end of drilling; as a result, subsequent delayed readings were not recorded. The preliminary geologic investigation did not include the installation of piezometers for monitoring groundwater levels over time.

4. Geotechnical Analysis of Auxiliary Spillway Erodibility

4.1 Analysis Methodology

Development of recommended material parameters for SITES analysis was performed according to the guidance provided in the *National Engineering Handbook, 210-VI-NEH, Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index* (NRCS, 2001) and the accompanying *DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons* (NRCS, 2011).

The primary SITES input parameter is the empirical headcut erodibility index (K_h). The K_h is calculated based on Equation 1:

$$K_h = M_S \cdot K_b \cdot K_d \cdot J_S \qquad [Equation\ 1]$$

where:

M_s = material strength number of the earth material

K_b = block or particle size number

K_d = discontinuity or interparticle bond shear strength number

J_s = relative ground structure number

For soil-like materials, the program also requires representative soil index properties as input parameters. The index properties used directly in the SITES model include the following parameters:

- USCS Soil Type
- Dry Unit Weight, γ_{dry} (pounds-per-cubic-foot, pcf)
- Plasticity Index, PI
- Clay Fraction, CF (% finer than 0.002 millimeter diameter)
- Representative Diameters, D_{75} and D_{50} (millimeters [mm])

Note that for the representative particle size, the D_{75} is typically used for soil-like materials, and D_{50} is typically used for rock-like materials.

4.2 Material Parameters Development

Development of estimated Kh was completed using the two reference documents cited above for the Upper Clay and Lower Clay, assuming all parameters except Ms are held constant and equal to 1.0. The Sand and Sandstone layer was conservatively considered as “soil-like”, and thus followed the Kh estimation procedure for cohesionless soil.

Materials considered in the evaluation included those encountered beginning near the proposed finished-grade elevation of the ASW channel surface and extending down below the valley bottom elevation at the downstream exit channel. Material parameters were developed for each of the generalized strata units described previously, as well as for potential proposed fill material from on-site sources that may be needed with proposed rehabilitation spillway modifications. In summary, these included the following: 1) Upper Clay, 2) Lower Clay 3) Sand and Sandstone and 4) Proposed Fill (ASW Borrow). Representative values for each stratum were selected on an approximate best fit between the 33rd and 50th percentile values, as is consistent with typical geotechnical engineering practice.

4.2.1 Index Properties

Results of laboratory testing performed as part of the current GIR and preliminary SMR prepared by AECOM for this project were used to evaluate index properties of the various materials. The laboratory test results summary for the ASW borings is provided in the SMR (AECOM 2023). A tabulated summary of the minimum, maximum, and average test data values for each general stratum is provided in **Table 1.**

The D_{75} has been summarized in a graph by depth in **Attachment 2**. Note that D_{75} is typically used in analysis of soil-like materials and D_{50} is typically used for rock-like materials. The D_{50} is not presented since all materials were considered to behave like soils.

Plots of γ_{dry}, CF, LL, PI, Su, UCS, N_{60}, and D_{75}, versus depth, annotated to illustrate the selected representative values, are provided in **Attachment 2**. The selected representative values pertinent to the SITES analysis are also summarized in **Table 2**. Recommended values were developed based on results of laboratory index tests from the 2023 investigation and experience with similar materials.

4.2.2 Material Strength Number, Ms

Estimates of Ms are based on relative density for cohesionless soils (i.e., PI≤10 per NRCS 2001), and unconfined compressive strength for both cohesive soils (i.e., PI > 10) and rock materials. Typical ranges of Ms are presented in tabular format in NRCS 2001 and 2011 correlated with Standard Penetration Test (SPT) and relative density for cohesionless soils; with SPT, consistency, unconfined compressive strength (UCS), undrained shear strength (Su), and liquidity index (LI) for cohesive soils; and with UCS and field strength tests for rock.

The Ms values for cohesionless soils and rock are estimated predominantly using the methods in NRCS (2001). The Ms (=Kh) values for cohesive soils were estimated by comparing results from both methods in NRCS (2001) and NRCS (2011) and using engineering judgment to select recommended values. See **Attachment 2** for the plots used to sub-divide the generalized strata and develop representative values (note the undrained shear strength from laboratory unconfined compression testing was given the heaviest weighting). The two methods used for developing Kh are presented in **Attachment 3**. Note, only the undrained strength computed from correlation with the Liquidity Index is used for the NRCS 2011 method. Supporting calculations for the Ms value are also provided in **Attachment 3**.

Plots of Su, N_{60}, Su, Pocket Pen, and γ_{dry} data versus depth, with representative values also plotted, are provided in **Attachment 3**. Calculations for the derived Ms values are provided in **Attachment 3**. Discussion of Ms development for each of the various geologic strata is provided in the following subsections.

The Upper Clay and Lower Clay were considered "cohesive" soil for the purposes of estimating the Ms parameter, whereas the Sand and Sandstone was treated as "cohesionless" soil in analyses. The material designated as Proposed Fill was obtained from samples of the Upper Clay, and thus was also considered as "cohesive" soil. However, while the Proposed Fill would have similar gradation and plasticity, the fill will be excavated and recompacted in the field during construction which will change the density and strength properties from that of the natural in-place material. As such, the proposed fill material was analyzed separately.

It is noted that NRCS (2001) Table 52-3 indicates that soils with SPT blow counts greater than 30 bpf or UCS greater than 625 kPa (13,053 psf) should be treated as rock (NRCS, 2001). While many of the SPT values in the Lower Clay exceeded 30 bpf, the laboratory UCS values indicate the material is borderline and should still be considered soil like in analysis. Similarly, the Sand and Sandstone was also considered soil-like since the one unconfined compression test resulted in an Su value equal to 4000 psf, which is a strength more associated with a soil, and the difficulty in retrieving viable core samples due to the interbedded nature. For all materials, engineering judgement was applied to the results based on published ranges in Chapter 52 (NRCS 2001), and the final selected Kh values were adjusted accordingly. As discussed in following paragraphs, all other parameters were equal to 1 so the only value that affected Kh was the Ms number.

The field SPT N-values were corrected to equivalent 60% hammer efficiency (N_{60}) based on the hammer energy calibration report provided by the driller. While an SPT hammer energy calibration report was not available, the driller provided a hammer energy calibration report for the Texas Cone Penetrometer hammer on the same drill rig which indicated 89% hammer efficiency. Based on AECOM's experience, an energy correction of 80% hammer efficiency is typical for SPT autohammers like that used on this project, and thus 80% efficiency was adopted for analysis.

<u>Upper Clay and Lower Clay</u>

SITES parameters for the two clay stratums were estimated based on the results of 19 field standard penetration tests, which were correlated to obtain an estimated Su value, correlations from liquidity indices, 6 unconfined compression tests (UC) and 2 unconsolidated-undrained tests (UU). The use of the liquidity indices was used as a check to correlate the strength of the soils in a saturated state.

The NRCS 2011 Appendix 52D method was used as a check on the Su values, which correlates Su with the LI of saturated clay. Reference **Attachment 3** to see Su values for comparison of the two procedures, and the calculated MS values for NRCS 2001.

<u>Sand and Sandstone</u>

As mentioned above, the Sand and Sandstone was considered more soil like in analyses, and SITES parameters were estimated primarily based on the results of 2 standard penetration tests and 1 uniaxial compressive strength test.

<u>Proposed Fill (ASW Borrow)</u>

The Ms value for Proposed Fill materials is typically estimated by performing laboratory UC or UU tests on remolded samples compacted to target moisture content and density that simulate typical values of earthfill construction compaction specifications. It is common to conservatively remold samples to the minimum acceptable density and upper range of allowable moisture content (i.e., 95% of maximum dry density and +2% of optimum moisture relative to Standard Proctor energy). However, sufficient quantity of material was not available to complete the remolded strength tests. Consequently, the strength of the Proposed Fill was estimated based on experience from prior projects for similar soils remolded to similar moisture/density, informed by the maximum dry density and optimum moisture content from site-specific Standard Proctor test results and One undisturbed UC test result in the Upper Clay layer. The Ms values was then estimated from the assumed strength value.

4.2.3 Block or particle size number, Kb

The value of K_b is 1.0 for each analysis case per NRCS 2001 and NRCS 2011. The clay layers and proposed fill are considered as "massive, unjointed cohesive" soil materials, and the sand and sandstone was considered a cohesionless soil where the average particle size diameter is less than 0.1 meters.

4.2.4 Discontinuity / Interparticle Bond Shear Strength Number, Kd

According to NRCS 2001, the value of K_d is estimated based on the tangent of the residual friction angle (ϕ'_r) of the soil, which can be estimated by correlation with values of LL and CF using the following formulas:

$$\text{For} \le 20\% \text{ clay}, \quad \phi'_r = 169.58\,(\text{LL})^{-0.4925} \qquad [52\text{–}7]$$
$$\text{For } 25 - 45\% \text{ clay}, \quad \phi'_r = 329.56\,(\text{LL})^{-0.7100} \qquad [52\text{–}8]$$
$$\text{For} \ge 50\,\% \text{ clay}, \quad \phi'_r = 234.73\,(\text{LL})^{-0.6655} \qquad [52\text{–}9]$$

Plots of LL and CF versus depth, with interpreted lower and upper bounds, are provided in **Attachment 3**.

Based on feedback received from NRCS geologists at the NDCSMC (email dated April 7, 2020), the method presented in NRCS 2001 has often produced overly conservative values for K_d. The email indicated that internal NRCS guidance is to assume $K_d = 1.0$ for soil-like materials. This assumption is supported by McCook (2005) and the Draft Appendix 52D (NRCS, 2011). Consequently, $K_d = 1.0$ was adopted for all materials since they are considered “soil-like”.

4.2.5 Relative Ground Structure Number, Js

The value of J_S is 1.0 per NRCS 2001. The clay layers and proposed fill materials are considered as “cohesive” materials, while the sand and sandstone layer is considered a “cohesionless” material.

4.2.6 Adjustment for High-Plasticity, Blocky Soils

The Draft Appendix 52D (NRCS 2011) and McCook (2005) cautions that very stiff, high-plasticity fat clays (CH) with plastic limits (PL) > 25 often have blocky or fissured secondary structure and such deposits may be more erodible than indicated by the unconfined compressive strength on intact samples typically used to obtain the Ms value. While the document states that no case history is available, interim guidance is to apply a reduction factor of 0.5 to the calculated Ms and thus Kh value.

The Upper Clay layer had PL values ranging from 18 to 22 (average 20). The Lower Clay layer had PL values ranging from 12 to 30 (average 17) with one sample at 34 feet bgs with a PL value equal to 30 (note – this sample was from a deep fat clay layer only found in boring 202-23). Fissures were noted for boring 202-23, and these were typically infilled with calcium. However, due to the lack of fissures being noted on the other borings, and the PL for the site being below the threshold, the blocky soil reduction factor was not applied to the Kh values for the Upper and Lower Clay soils.

4.3 Recommendations

Recommended parameters for SITES analyses are presented in **Table 2**. Supporting calculations are provided in **Attachment 3**. Based on the assumption stated herein, the estimated K_h ranges of unfavorable and favorable values for the existing ASW are as follows:

- Proposed Fill (ASW Excavation Borrow): Kh = 0.10
- Upper Clay: Kh = 0.30
- Lower Clay: Kh = 0.30
- Sand and Sandstone: Kh = 0.15

The recommended values for the cohesive soil-like materials are generally in agreement with those recommended for very stiff cohesive soils according to the typical range of values below (from NRCS 2011):

Table 52D–3 Values shown in NEH628.52 relating saturated consistency to unconfined compressive strength

Relative density	Description	SPT	q_u, lb/ft^2	M_s
Very soft	• Exudes between fingers when squeezed in hand	< 2	< 835	< 0.02
Soft	• Easily molded with fingers • Point of geologic pick easily pushed into shaft of handle	2–4	835–1,670	0.02–0.05
Firm	• Penetrated several centimeters by thumb with moderate pressure • Molded by fingers with some pressure	4–8	1,670–3,130	0.05–0.10
Stiff	• Indented by thumb with great effort • Point of geologic pick can be pushed in up to 1 centimeter • Very difficult to mold with fingers • Just penetrated with hand spade	8–15	3,130–6,265	0.10–0.20
Very stiff	• Indented only by thumbnail • Slight indentation by pushing point of geologic pick • Requires hand pick for excavation	15–30	> 6,265	0.20–0.45

The recommended Kh value for sand and sandstone is also in agreement with those recommended for dense cohesionless soils (from NRCS 2011):

Table 52D–2 Material strength number, M_s for cohesionless soil

Relative density	Description	SPT	M_s
Very loose	• Particles loosely packed • High percentage of voids • Very easily dislodged by hand • Matrix crumbles easily when scraped with point of geologic pick • Raveling often occurs on excavated faces	< 5	< 0.02
Loose	• Particles loosely packed • Some resistance to being dislodged by hand • Large number of voids • Matrix shows low resistance to penetration by point of geologic pick	5–10	0.02–0.05
Medium dense	• Particles closely packed • Difficult to dislodge individual particles by hand • Voids less apparent • Matrix has considerable resistance to penetration by point of geologic pick	10–30	0.05–0.10
Dense	• Particles very closely packed and occasionally very weakly cemented • Cannot dislodge individual particles by hand • The mass has very high resistance to penetration by point of geologic pick • Requires many blows of geologic pick to dislodge particles	30–50	0.10–0.20
Very dense	• Particles very densely packed and usually cemented together • Mass has high resistance to repeated blows of geologic pick • Requires power tools for excavation	> 50	0.20–0.45

(210–VI–NEH, draft, October 2011) 52D–9

5. Limitations

This memorandum was prepared by AECOM using the degree of care and skill ordinarily exercised under similar circumstances by responsible engineers and geologists practicing in the same general location. No other warranty or representation, either expressed or implied, is made as to the findings and professional advice in this memorandum.

The opinions and conclusions contained in this memorandum are based on interpretations of limited subsurface information. Soil and geologic conditions can vary greatly between or beyond the exploration sites, and different conditions may be found during subsequent investigations.

The conclusions and recommendations contained herein are based in part upon information provided by others (including the NRCS) and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information provided to AECOM has not been independently verified by AECOM, unless otherwise stated.

There is no intention that this memorandum addresses any environmental issues (for example, environmentally affected soil or groundwater, or historic site uses) related to this site. Such evaluations are outside the scope of this work and should be addressed in separate studies.

6. References

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7. Attachments

Table 1. Summary of Laboratory Test Results by Stratum for ASW Borings
Table 2. Recommended SITES Parameters

Figure 1. Site Map and Plan of Geologic Investigations
Figure 2. Subsurface Profile for the Existing ASW

Attachment 1. As-built Drawings
Attachment 2. Laboratory Test Data Plots for ASW Borings
Attachment 3. Headcut Erodibility Index (Kh) Calculations

TABLES

Table 1. Summary of Laboratory Test Data by Stratum for Borings in Existing ASW Channel [1]

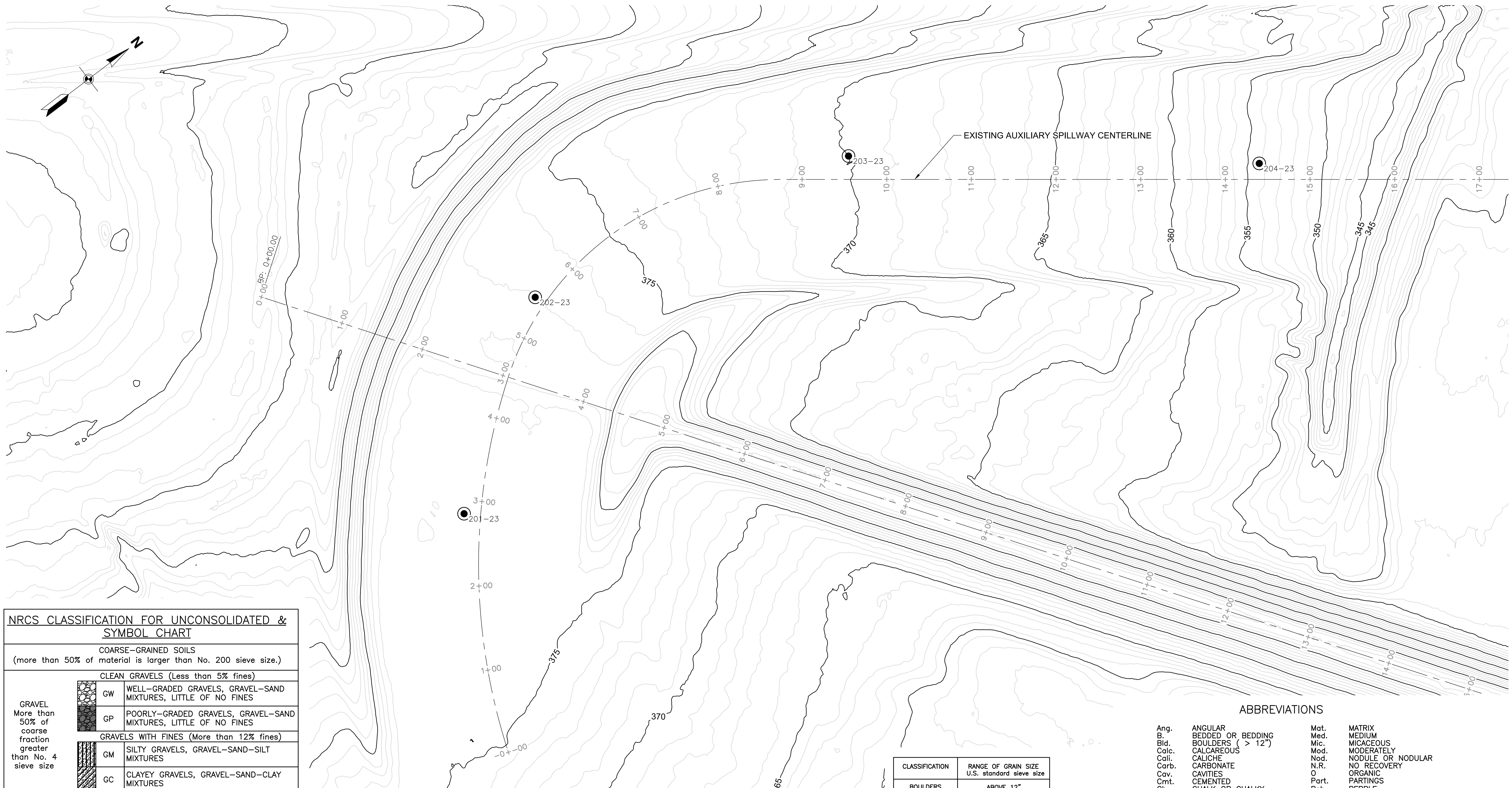
Stratum Description (USCS)	Thick-ness (ft)	USCS	N_{60} (bpf) [2]	Pocket Pen. (tsf)	Undrained Shear Strength, S_u (psf)	Unconfined Compressive Strength, UCS (psf)	Dry Unit Weight (pcf)	LL	PI	LI	Fines (%)	CF (%)	D_{75} (mm)	Crumb
Upper Clay	10-12	CH	11-80 (39)	4.0-4.5 (4.5)	2,260-9,820 (6,405)	4,520-19,640 (12,810)	102-112 (106)	43-68 (57)	24-47 (37)	-0.250 to 0.051 (-0.108)	50-94 (77)	30-33 (31)	0.075 – 0.141 (0.110)	1 – 4 (2)
Lower Clay	4-6	CL	20-69 (53)	2.5-4.5 (4.3)	4,580-10,140 (6,608)	9,160-20,280 (14,720)	111-120 (116)	27-64 (39)	15-34 (22)	-0.682 to 0.158 (-0.219)	49-86 (69)	11-22 (18)	0.070-0.265 (0.169)	2 – 4 (3)
Sand and Sandstone	10 – 20+	SC (partially cemented)	24-83	1.3	4,003	8,006	118-119	36	23	-0.130	14-27	3	0.276-0.458	---[3]
Proposed Fill (ASW Borrow)	TBD	CH	---[3]	---[3]	---[3]	---[3]	94-110 (103)	30-63 (50)	16-43 (32)	-0.875 to (-)0.465 (-0.606)	48-91 (67)	11-60 (32)	---[3]	---[3]

Notes:
(1) Format of reported values is Minimum – Maximum (Average). Average value not reported when two or fewer results are available.
(2) Raw SPT N-values converted to N_{60} based on 80% hammer efficiency.
(3) "---" No test results available from current ASW borings.

Table 2. Recommended Material Parameters for SITES Analysis of Existing ASW

SITES inputs	Proposed Fill (ASW Borrow)	Upper Clay	Lower Clay	Sand and Sandstone
USCS - Soil Type (Predominant)	CH - Fat Clay	CH - Fat clay	CL - Sandy Lean Clay	SC – Clayey Sand [partially cemented]
PI – Representative	35	35	20	15
LL – Representative	55	50	35	25
Dry Density (lbs/ft3) – Representative	100	105	110	117
Kh – Representative	0.10	0.30	0.30	0.15
Clay % – Representative	30	30	20	3
Rep. Diam. D_{75} (mm) – Representative	0.15	0.15	0.10	0.25
Rep. Diam. D_{75} (in) – Representative	0.006	0.006	0.004	0.010
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---

FIGURES



PLAN

0 30 60 120
SCALE IN FEET

NRCS CLASSIFICATION FOR UNCONSOLIDATED & SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
	CLEAN GRAVELS (Less than 5% fines)		
GRAVEL More than 50% of coarse fraction greater than No. 4 sieve size		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
		GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	GRAVELS WITH FINES (More than 12% fines)		
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	CLEAN SAND (Less than 5% fines)		
SAND More than 50% of coarse fraction smaller than No. 4 sieve size		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
		SP	POORLY-GRADED SANDS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	SAND WITH FINES (More than 12% fines)		
		SM	SILTY SAND, SAND-SILT MIXTURE
		SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS (more than 50% of material is smaller than No. 200 sieve size.)			
SILTS & CLAYS Liquid limit less than 50%		ML	INORGANIC SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAY WITH LOW OR MEDIUM PLASTICITY, LEAN CLAY
SILTS & CLAYS Liquid limit Greater than 50%		MH	INORGANIC SILTS WITH ELASTICITY
		CH	INORGANIC CLAY WITH HIGH PLASTICITY, FAT CLAY.

NRCS CLASSIFICATION FOR CONSOLIDATED & SYMBOL CHART

Low Plasticity Clay
Clayey Sand
High Plasticity Clay
Well Graded Sand
Sandstone

OTHER SYMBOLS

HOLE LOGGED ONLY
STRIKE AND DIP
HOLE SAMPLED
PIT OR TRENCH

CLASSIFICATION	RANGE OF GRAIN SIZE U.S. standard sieve size
BOULDERS	ABOVE 12"
COBBLES	12" TO 3"
GRAVEL Course Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200
SILT & CLAY	Below No. 200

TEST HOLE NUMBERING SYSTEM

	COMBINA-TION RIG	POWER AUGER	HAND BORINGS	TRENCH OR PIT EXCAVA-TIONS	NATURAL OUTCROPS, STREAMBANKS, AND GULLIES
CENTERLINE OF DAM	1-49	51-99	1001-1099	2001-2099	3001-3099
BORROW AREA	101-149	151-199	1101-1199	2101-2199	3101-3199
AUXILIARY SPILLWAY	201-249	251-299	1201-1299	2201-2299	3201-3299
PRINCIPAL SPILLWAY	301-349	351-399	1301-1399	2301-2399	3301-3399
STREAM CHANNELS	401-449	451-499	1401-1499	2401-2499	3401-3499
EXPLORATORY BORINGS	501-549	551-599	1501-1599	—	—
FOUNDATION DRAIN	601-649	651-699	1601-1699	2601-2699	3601-3699
MISCELLANEOUS	701-749	751-799	1701-1799	2701-2799	3701-3799

ABBREVIATIONS

Ang.	ANGULAR	Mat.	MATRIX
B.	BEDDED OR BEDDING	Med.	MEDIUM
Bld.	BOULDERS (> 12")	Mic.	MICACEOUS
Calc.	CALCAREOUS	Mod.	MODERATELY
Cali.	CALICHE	Nod.	NODULE OR NODULAR
Carb.	CARBONATE	N.R.	NO RECOVERY
Cav.	CAVITIES	O	ORGANIC
Cmt.	CEMENTED	Part.	PARTINGS
Ch.	CHALK OR CHALKY	Peb.	PEBBLE
C	CLAY, CLAYEY	Per.	PERMEABLE
Cse.	COARSE	Po.	POORLY
Cbl.	COBBLES (3" - 12")	P.	POORLY GRADED
Cpt.	COMPACT	Rdd.	ROUNDED
Con.	CONCRETIONS	S	SAND, SANDY
Cng.	CONGLOMERATE	Ss.	SANDSTONE
Cs.	CLAYSTONE	Sat.	SATURATED
C.T.	CAVED TO	Sh.	SHALE, OR SHALY
Xln.	CRYSTALLINE	Sl/.	SLIGHTLY
Ds.	DENSE	Slo.	SLOWLY
Dip.	DIPPING	M	SILT, SILTY
D.S.	DOWNSTREAM	Sft.	SOFT
Fe. Stn.	Iron Stains	Sl.	SOME
Flg.	FLAGSTONE OR FLAGGY	Stf.	STIFF
Fn.	FINE	Str.	STREAKS
Frm.	FIRM	T.	THIN
Frac.	FRACTURED	T.B.	THIN - BEDDED
Frg.	FRAGMENTS	Tuff.	TUFFACEOUS
Fri.	FRIABLE	U.A.D.	UNABLE TO AUGER DEEPER
Grn.	GRAIN	U.D.B.D.	UNABLE TO DRY BARREL DEEPER
G	GRAVEL, GRAVELLY	U.E.D.	UNABLE TO EXCAVATE DEEPER
Gyp.	GYPSEOUS	U.S.	UPSTREAM
Hd.	ROCK HARDNESS	Var.	VARIABLE
H.	HIGHLY	V/.	VERY
Int.	INTERBEDDED	Vug.	VUGULAR
Lam.	LAMINATED	Wtr.	WATER LEVEL AS ENCOUNTERED DURING DRILLING PROCESS
Lay.	LAYER OR LAYERS	W	WELL GRADED
Len.	LENS OR LENSES	W/.	WITH
Lig.	LIGNITE	Wea.	WEATHERED
Ls.	LIMESTONE	▼	(DATE) STATIC WATER LEVEL
Lse.	LOOSE		
Ma.	MARL, OR MARLY		
Mas.	MASSIVE		

DRAWN ME DATE 9/15/23
CHECKED MJ DATE 9/15/23
APPROVED LF DATE 9/15/23

PLAN OF GEOLOGIC INVESTIGATIONS

FLOODWATER RETAINING STRUCTURE 1
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME:
GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 2

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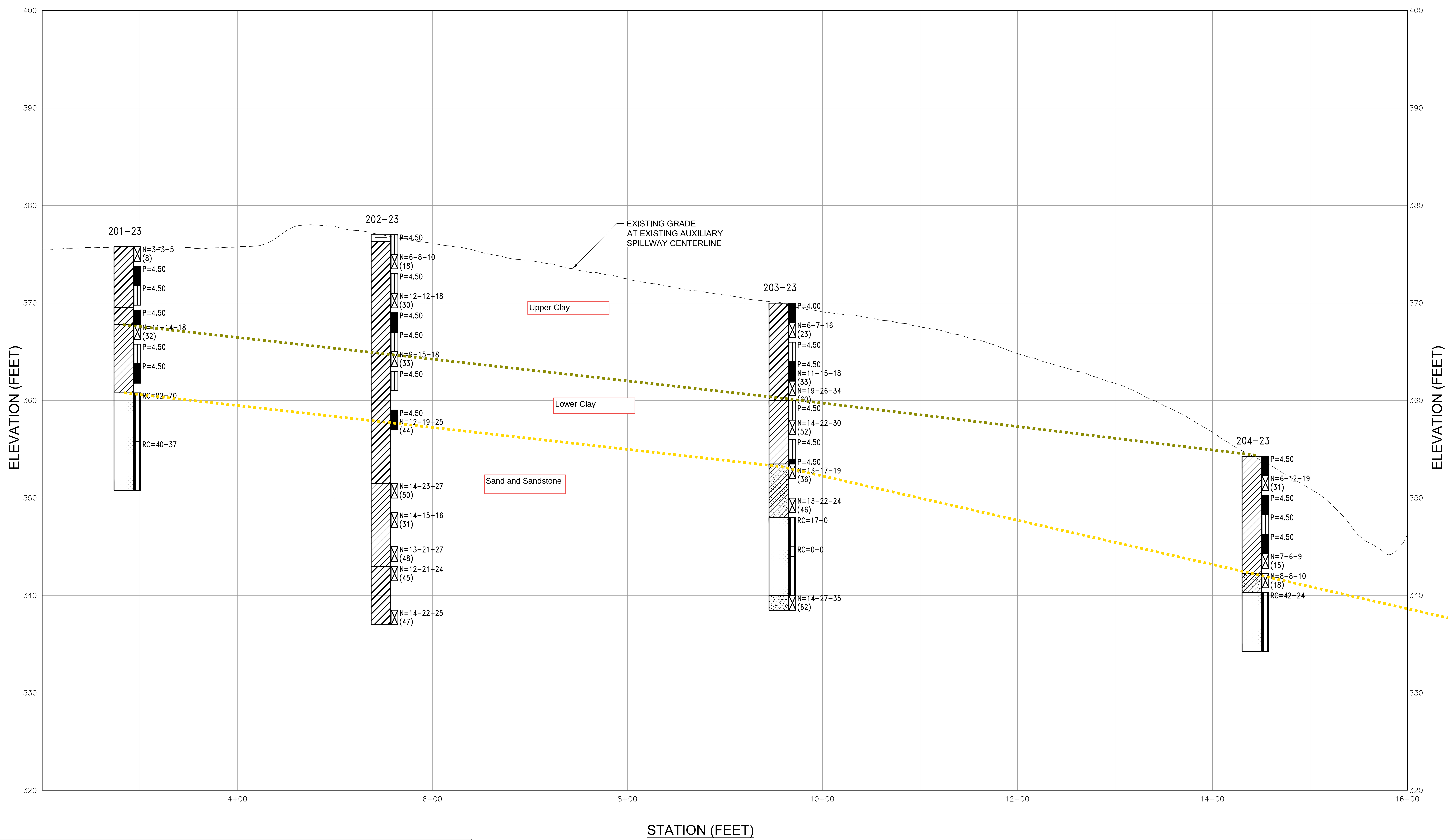

LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Well Graded Sand

-- Sample Top Depth

N= SPT blows per 6" increment (N-value, bpf)

P= Pocket Penetrometer (tsf)

RC= Core Recovery (%) – RQD (%)

▽ Water Level at Time Drilling, or as Shown

▼ Water Level at End of Drilling, or as Shown

▼ Water Level After 24 Hours, or as Shown

NOTES:

1. THE SOIL CLASSIFICATIONS SHOWN ON THIS SHEET ARE FIELD CLASSIFICATIONS. THEY MAY NOT IN ALL CASES AGREE WITH THE CLASSIFICATIONS MADE BY THE SOIL MECHANICS LABORATORY. REFER TO THE LABORATORY REPORT FOR FURTHER INFORMATION.

HORIZ. 0' 50' 100'

VERT. 0' 5' 10'

SCALE IN FEET

DRAWN	ME	DATE	9/15/23
CHECKED	MJ	DATE	9/15/23
APPROVED	LF	DATE	9/15/23

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETAINING STRUCTURE 1
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 2

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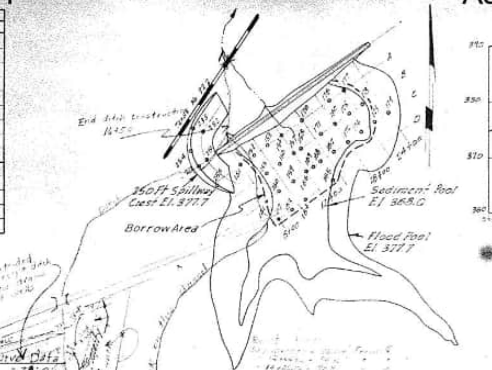
ATTACHMENT 1.

AS-BUILT DRAWINGS

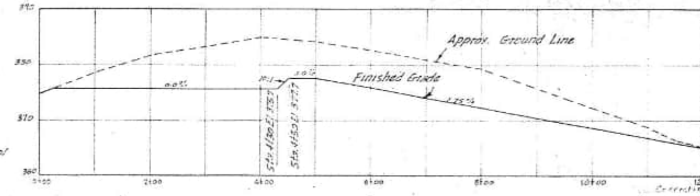
Elevation	Surface Acres	Storage * Acre Feet	Storage * Inches
366	46	200.00	1.32
368	52	275.05	1.97
369	57.4	352.30	2.35
373	79.6	626.80	4.14
377	106.9	999.80	6.60
377.7	112.0	1076.24	7.10
381	140.1	1492.20	9.84
383	153.7	1791.00	11.81

Top of Dam El. (effective)	382.7
Spillway Crest El.	377.7
Outlet Structure El.	366.0
Drainage Area	1819 Ac

* Volume of borrow not included

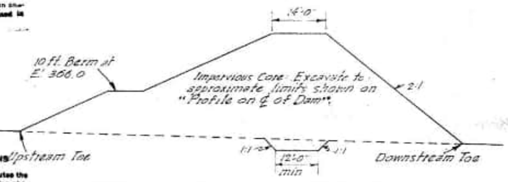


GENERAL PLAN OF RESERVOIR



PROFILE ON ℄ OF SPILLWAY

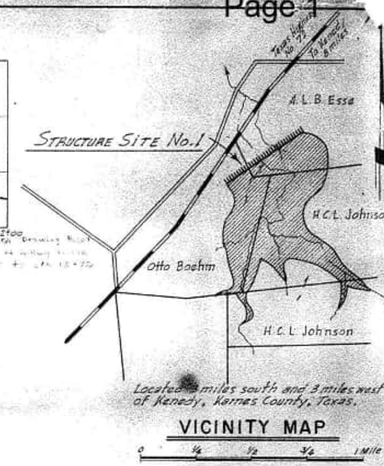
This set of plans constitutes the only record of construction changes and must be retained in Cartographic Files.



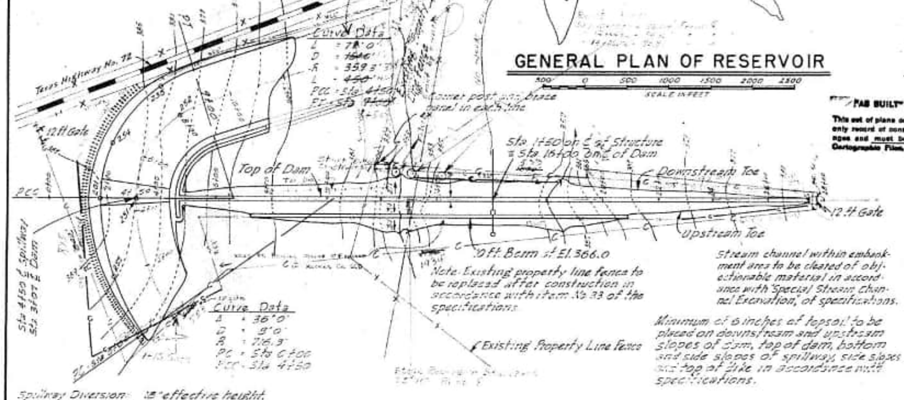
"AS BUILT" PLANS

This set of plans constitutes the only record of construction changes and must be retained in Cartographic Files.

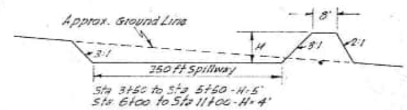
TYPICAL EMBANKMENT SECTION



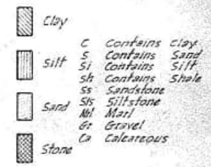
VICINITY MAP



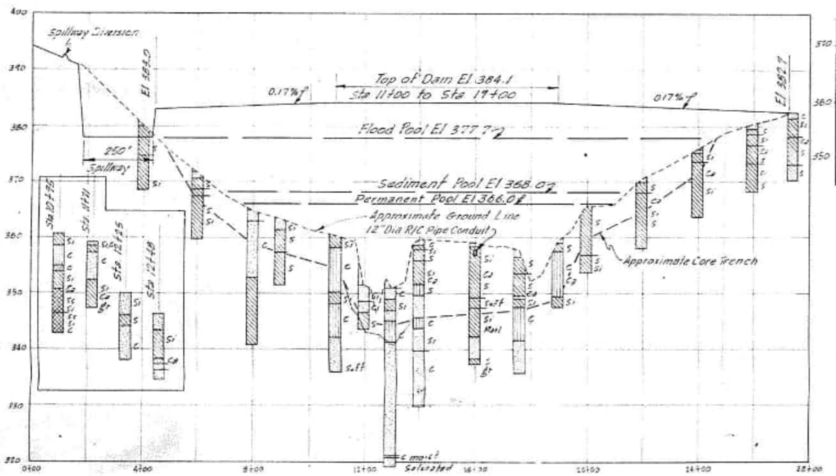
PLAN OF EMBANKMENT AND SPILLWAY



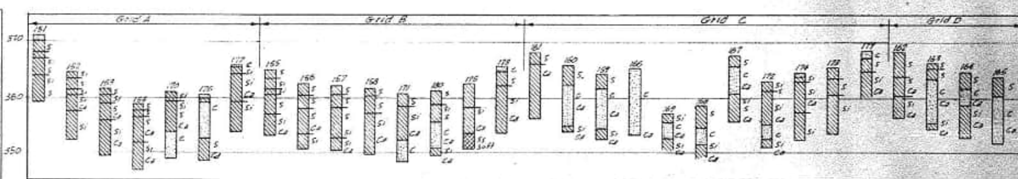
TYPICAL CROSS SECTION OF SPILLWAY AND DIKE



LEGEND OF BORINGS



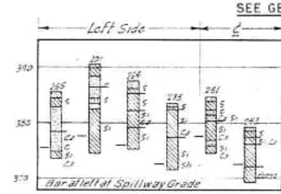
PROFILE ON ℄ OF DAM



LOG OF BORINGS OF BORROW AREA

SEE GENERAL PLAN OF RESERVOIR

Note: Revisions made in 1959 shown in green and explained in more detail on Correction Drawings Sheets 1 & 2.



LOG OF BORINGS OF SPILLWAY

SEE PLAN OF EMBANKMENT AND SPILLWAY

Revised 4-1-54

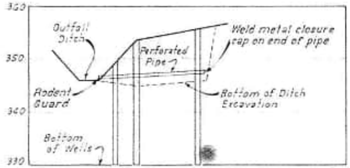
GENERAL PLAN AND PROFILES
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FORT WORTH, TEXAS

REFERENCE

CARTOGRAPHIC APPROVAL	TECHNICAL APPROVAL		
COMPILED	TRACED	CHECKED	
H.C.N.	D.S.	H.C.N.	3/2 4-R-8943-1

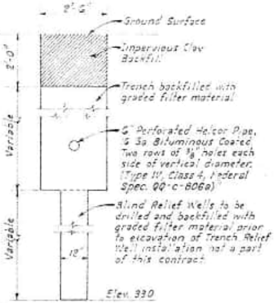
For in service use only

PLAN OF DRAINAGE SYSTEM
Site No. 1



Notes:
Perforated Pipe to be set on not less than 4" fall in 40 feet. Total pipe required = 70 ft.
Elevations indicated are approximate. Final elevations to be determined at time of installation.

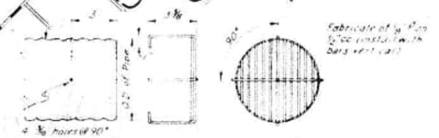
PROFILE OF NEW DRAIN

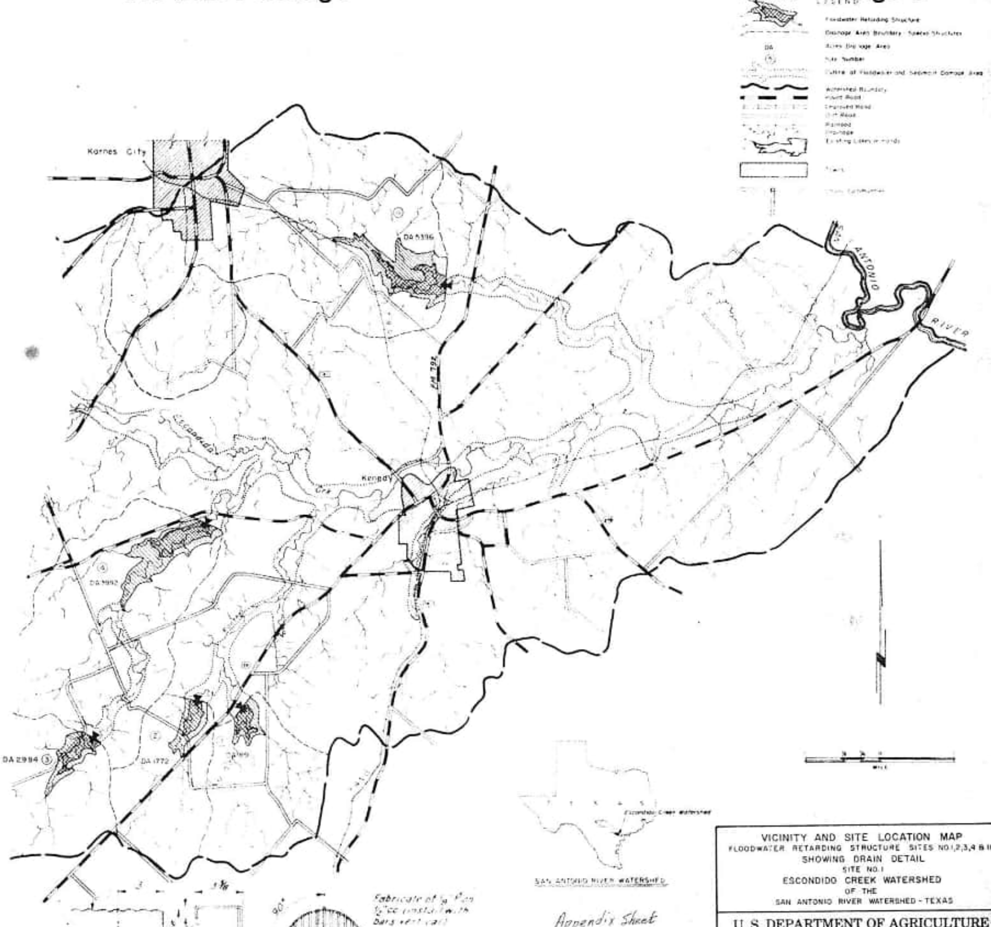


TRENCH DETAIL

FILTER GRADATION	
Screen Size	Percentage
1½"	100
1"	92-100
¾"	85-100
½"	74-94
⅜"	65-88
#4	45-71
#10	20-47
#20	6-25
#40	5-14
#60	< 10
#200	< 5

Approx 50 Cu yds of graded filter material required to backfill trench.





Appendix Sheet 1-A

Revised 7-5-61

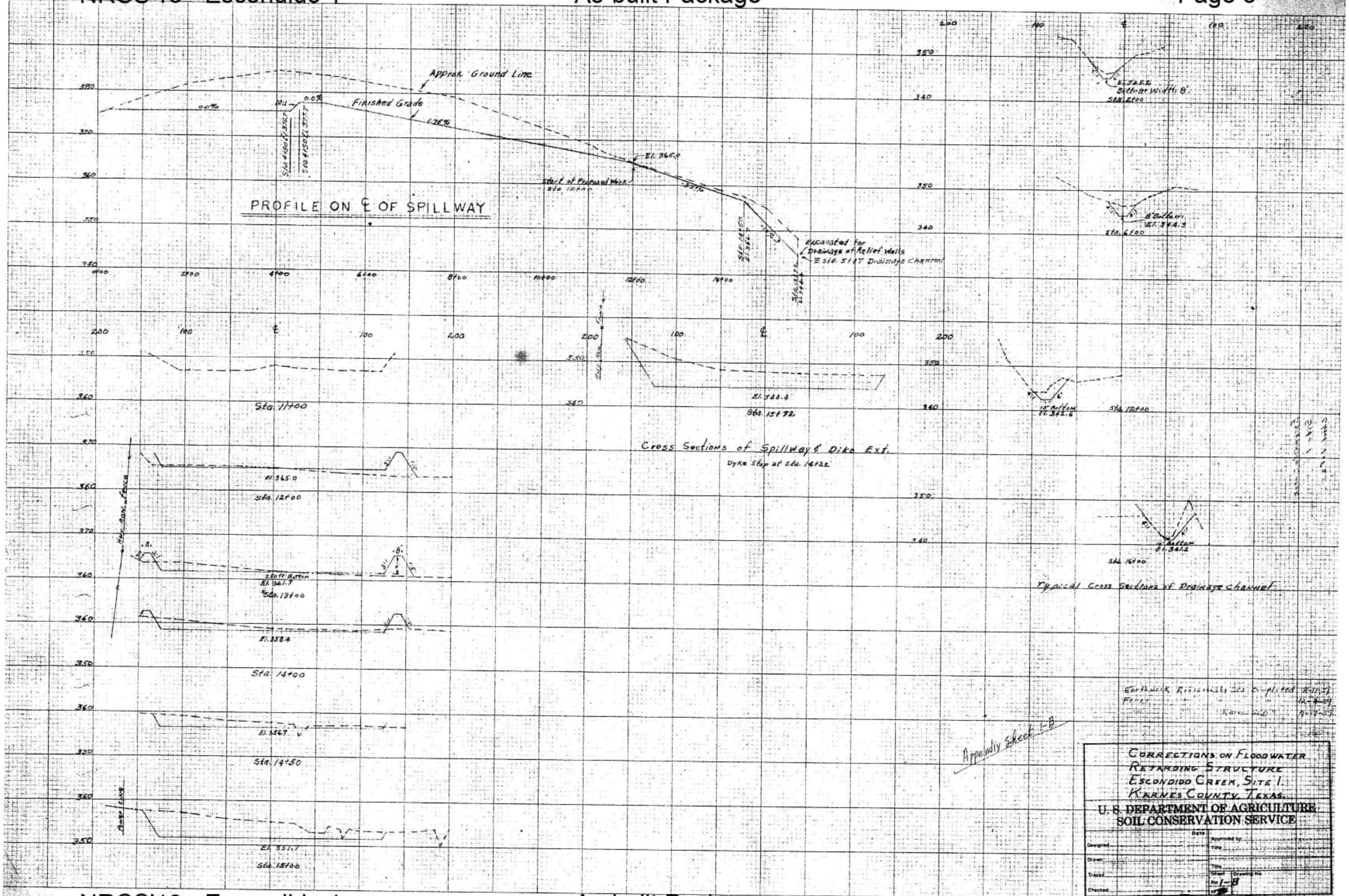
VICINITY AND SITE LOCATION MAP
FLOODWATER RETARDING STRUCTURE SITES NO 1,2,3,4 & 11
SHOWING DRAIN DETAIL
SITE NO. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

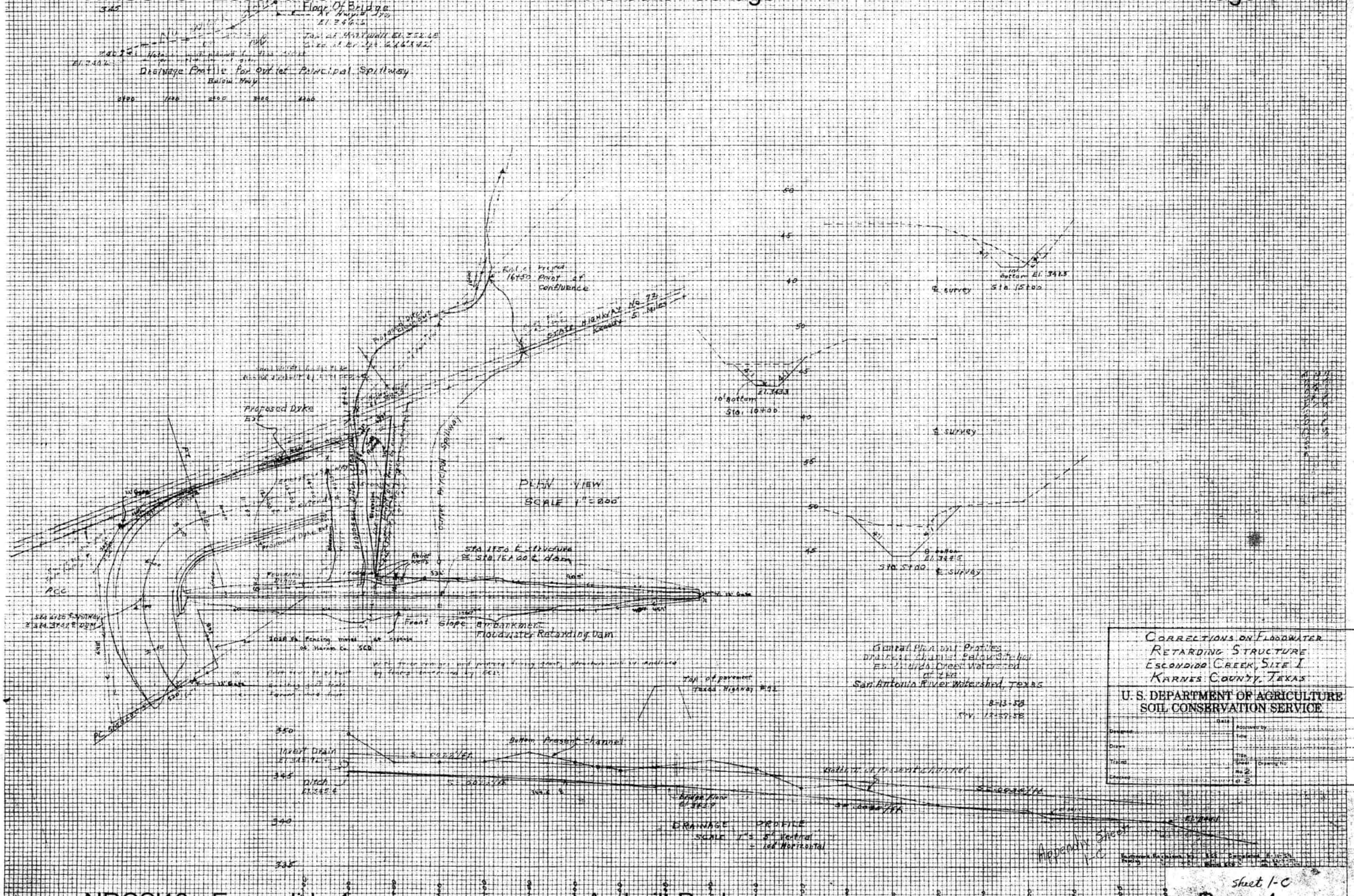
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

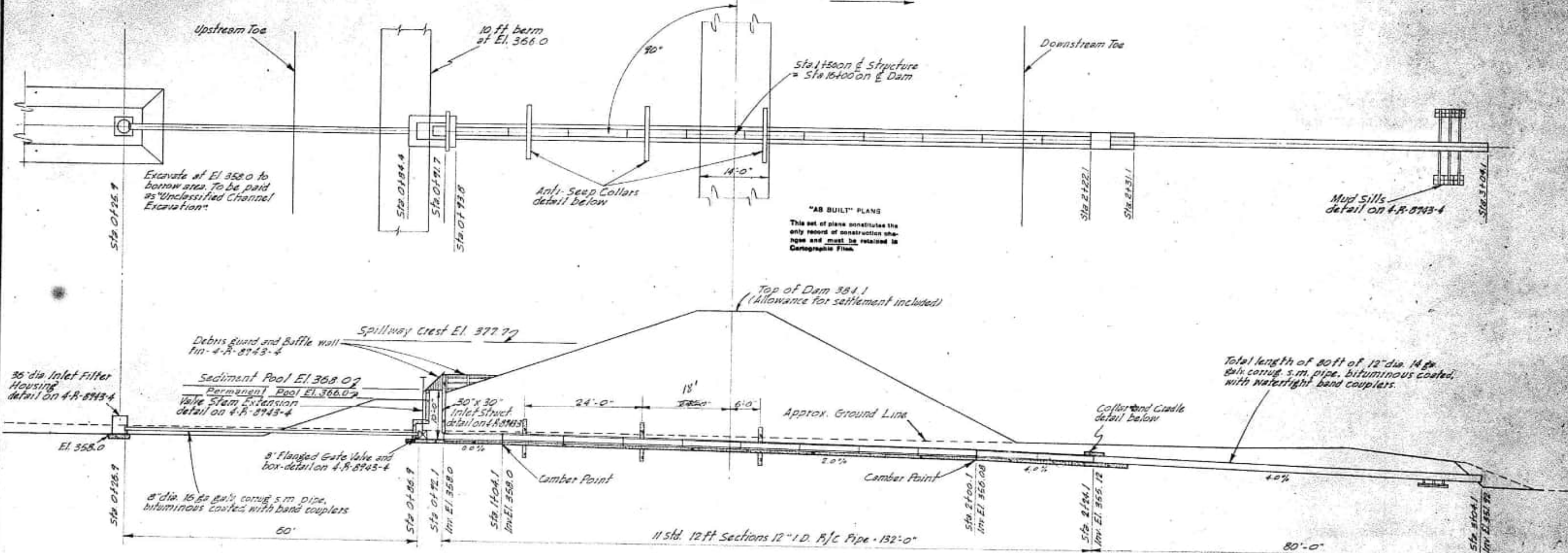
		Date
Designed	M. P. F.	5-61
Drawn	M. P. F.	5-61
Traced	C. V. C.	5-61
Checked	J. R. E.	5-61

Approved by Howard Matson
Sheet No. 1-A Drawing No. 4-E-15,565

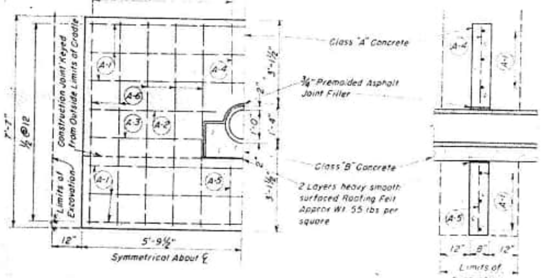
JUL 24 1961


Approx. Ground Line
Finished Grade
PROFILE ON ℄ OF SPILLWAY
Start of Proposed Work Sta. 10+00
El. 365.0
Excavated for Drainage of Relief Wells
℄ Sta. 5+17 Drainage Channel
El. 345.2 Bottom Width 8'
8' Bottom El. 344.3
Sta. 6+00
Sta. 11+00
El. 344.4
Sta. 15+72
10' Bottom El. 342.6
Sta. 12+00
Cross Sections of Spillway & Dike Ext.
Dyke Stop at Sta. 14+22
El. 365.0
Sta. 12+00
El. 361.7
Sta. 13+00
El. 358.4
Sta. 14+00
El. 356.7
Sta. 14+50
El. 351.7
Sta. 15+00
10' Bottom El. 342.2
Sta. 16+00
Typical Cross Sections of Drainage Channel
Appendix Sheet 1-B
Corrections on Floodwater Retarding Structure
Escondido Creek, Site 1.
Karnes County, Texas.
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
1-B

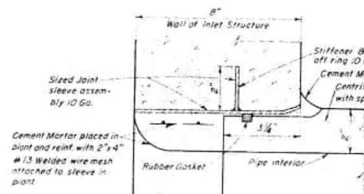

Floor Of Bridge
Drainage Profile for Outlet Principal Spillway
Below Hwy
Point of confluence
STATE HIGHWAY No. 72
Proposed Dyke
PLAN VIEW
SCALE 1" = 200'
Sta. 15+00
Sta. 10+00
E. survey
Front Slope Embankment
Floodwater Retarding Dam
Top of pavement
Texas Highway #72
Bottom Present Channel
Invert Drain
Ditch
Bridge Floor
DRAINAGE PROFILE
SCALE 1" = 8' Vertical
= 100' Horizontal
General Plan and Profiles
San Antonio River Watershed, Texas
CORRECTIONS ON FLOODWATER
RETARDING STRUCTURE
ESCONDIDO CREEK, SITE I
KARNES COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Appendix Sheet 1-C
Sheet 1-C



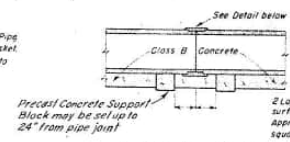
OUTLET STRUCTURE-PLAN & SECTION



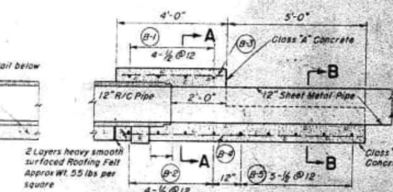
ANTI-SEEP COLLAR



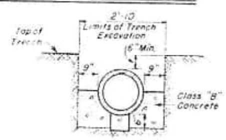
DETAIL OF PIPE CONNECTION TO INLET STRUCTURE



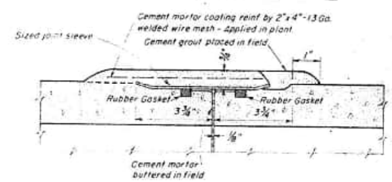
TYPICAL JOINT



LONGITUDINAL SECTION OF COLLAR & CRADLE



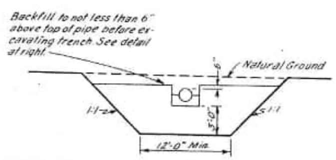
TRENCH DETAIL



JOINT DETAIL

No.	Location	Qty.	Lgth.	Total Length	Size	Type	A	B	G
For Typical Bar Types Refer To A.C.I. Standard 315-48									
A-1	Anti-Seep Collar	6	11-0	66-0	½	Str.			
A-2	" " "	2	4-6	9-0	½	"			
A-3	" " "	2	3-9	7-6	½	"			
A-4	" " "	2	2-7	5-2	½	"			
A-5	" " "	2	2-0	4-0	½	"			
A-6	" " "	10	7-0	70-0	½	"			
Total steel in one Anti-Seep Collar 161'-8" = 108.0 lbs.									
B-1	Collar & Cradle	4	3-8	14-8	½	2	0-7	2-6	0-7
B-2	" "	4	6-6	26-0	½	2	2-0	2-6	2-0
B-3	" "	6	3-8	22-0	½	Str.			
B-4	" "	6	8-8	52-0	½	"			
B-5	" "	5	4-2	20-10	½	2	0-10	2-6	0-10
Total steel in Collar & Cradle ½"-φ 135'-6" = 90.5 lbs									

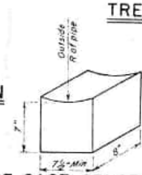
Class "A" Concrete in one Anti-Seep Collar ---------- 2.08 cu. yds.
Class "A" Concrete in Collar and Cradle ---------- 1.35 cu. yds.
Class "B" Concrete in Pipe Cradle ---------- 0.097 cu. yds. per lin. ft.



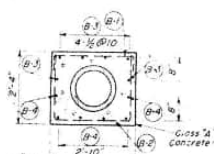
STRUCTURE FOUNDATION EXCAVATION

From Sta. 0+84 to Sta. 2+31

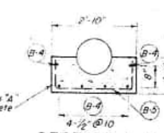
Note: Structure Foundation Excavation to be paid as "Unclassified Core Trench Excavation," and backfill prior to excavating trench to be paid as "Embankment"



PRE-CAST CONCRETE SUPPORT BLOCK



SECTION A-A



SECTION B-B

Revised 4-1-54

EMBANKMENT AND OUTLET STRUCTURE
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FT. WORTH, TEXAS

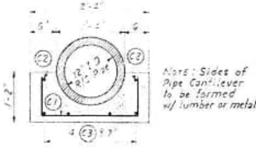
COMPILED H.C.N. TRACED D.S. CHECKED H.C.N. DATE 3/2/54 4-R-8943-2

FOR IN SERVICE USE ONLY

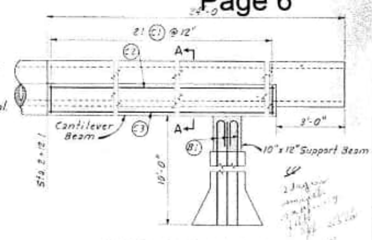
Site No.	Berm Elevation	Embankment to be removed - Cu yds.	Compacted Fill to be placed - Cu yds.	Fence to be removed and rebuilt - Lin. Feet
2	371.0	2,000	7,050	1,400
3	413.5	2,700	15,800	1,600
4	321.5	2,500	12,600	1,250
11	307.0	2,300	8,200	1,850

Note:
Berm Elevation given in table above is elevation of gutter at the midpoint of the berm. Gutter and Berm to be graded at not less than 3 inches and not more than 6 inches per 100 ft. toward each abutment.

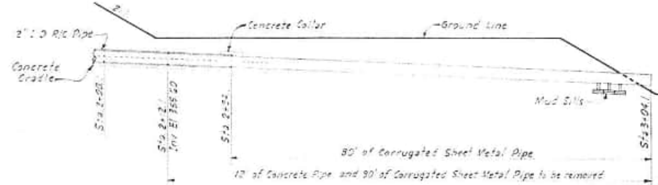
Borrow material for constructing berms to be obtained from designated areas downstream from each dam. Average haul distance 1000 feet or less, except on site No. 4 the average haul will be 1600 feet.



SECTION A-A

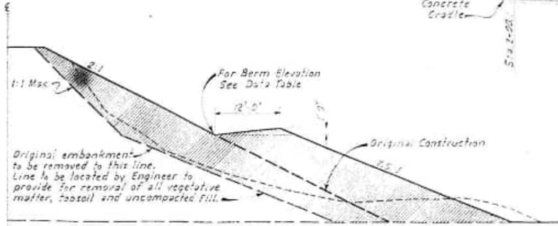


CANTILEVER OUTLET



EXISTING PIPE OUTLET

Site No. 1

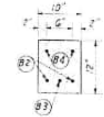


Original embankment to be removed to this line. Line to be located by Engineer to provide for removal of all vegetative matter, topsoil and uncompacted fill.

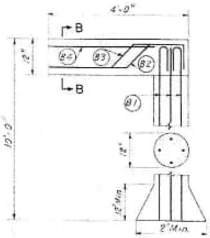
Crosshatched area below berm elevation to be placed as compacted earth fill. Areas above berm elevation not practical to compact with standard rollers shall be compacted by passing D-7 or heavier crawler type tractor not less than 3 passes over each lift.

WITHIN SLIDE AREAS

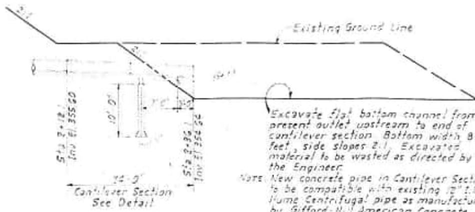
(For Sites 2, 3, 4 and 11)



SECTION B-B



CANTILEVER SUPPORT



Excavate flat bottom channel from present outlet upstream to end of cantilever section. Bottom width 8 feet, side slopes 2:1. Excavated material to be wasted as directed by the Engineer.

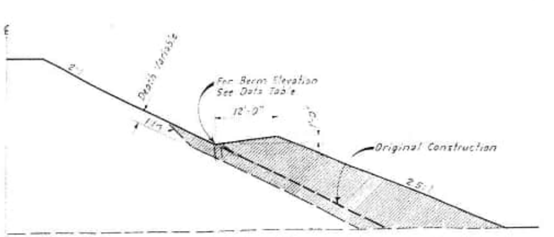
Note: New concrete pipe in Cantilever Section to be compatible with existing 12" I.D. Hume Centrifugal pipe as manufactured by Gifford-Hill American Concrete Pipe Co. Grand Prairie, Texas. Spec. AWWA C-302, 2000 lb D-Load

REVISED OUTLET

(For Site No. 1 only)

For Typical Bar Types Refer to A.C.I. Standard 315-48

Bar No.	Location	Qty	Lgth.	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
B1	Cantilever Sup.	8	10-6	84-0	4	1	0-9	9-9							0-4	
B2	" "	2	9-6	19-0	6	4	0-9	1-0	0-11	4-2	0-11	1-0	0-9	0-8		7-6
B3	" "	1	9-6	9-6	4	4	0-9	1-6	0-11	3-2	0-11	1-6	0-9	0-9		7-6
B4	" "	2	5-6	11-0	4	Str.										
		Total #4 Steel in Cantilever Support = 104'-6" = 69.81 lbs.														
		" #6 " " " " = 19'-0" = 28.54 lbs.														
		Class "B" Concrete in Cantilever Support = 0.85 cu.yds.														
C1	Cantilever Beam	21	3-6	73-6	4	5-10		0-10	1-10	0-10						
C2	" "	2	20-6	41-0	8	Str.										
C3	" "	4	20-6	82-0	4	Str.										
		Total #4 Steel in Cantilever Beam = 155'-6" = 103.87 lbs.														
		" #8 " " " " = 41'-0" = 109.47 lbs														
		Class "B" Concrete in Cantilever Beam = 1.58 cu.yds.														



Crosshatched Area to be placed as "Compacted Earth Fill". All vegetative matter and topsoil to be removed.

OUTSIDE OF SLIDE AREAS

(For Sites 2, 3, 4 and 11)

TYPICAL EMBANKMENT SECTIONS

Note:
Standing vegetation on slopes (within work areas) to be mowed or shredded and removed prior to commencing earth work operations. Cost of such mowing or shredding and removal to be subsidiary to other items of work.

As built changes, Oct. '61

Appendix Sheet 2-A

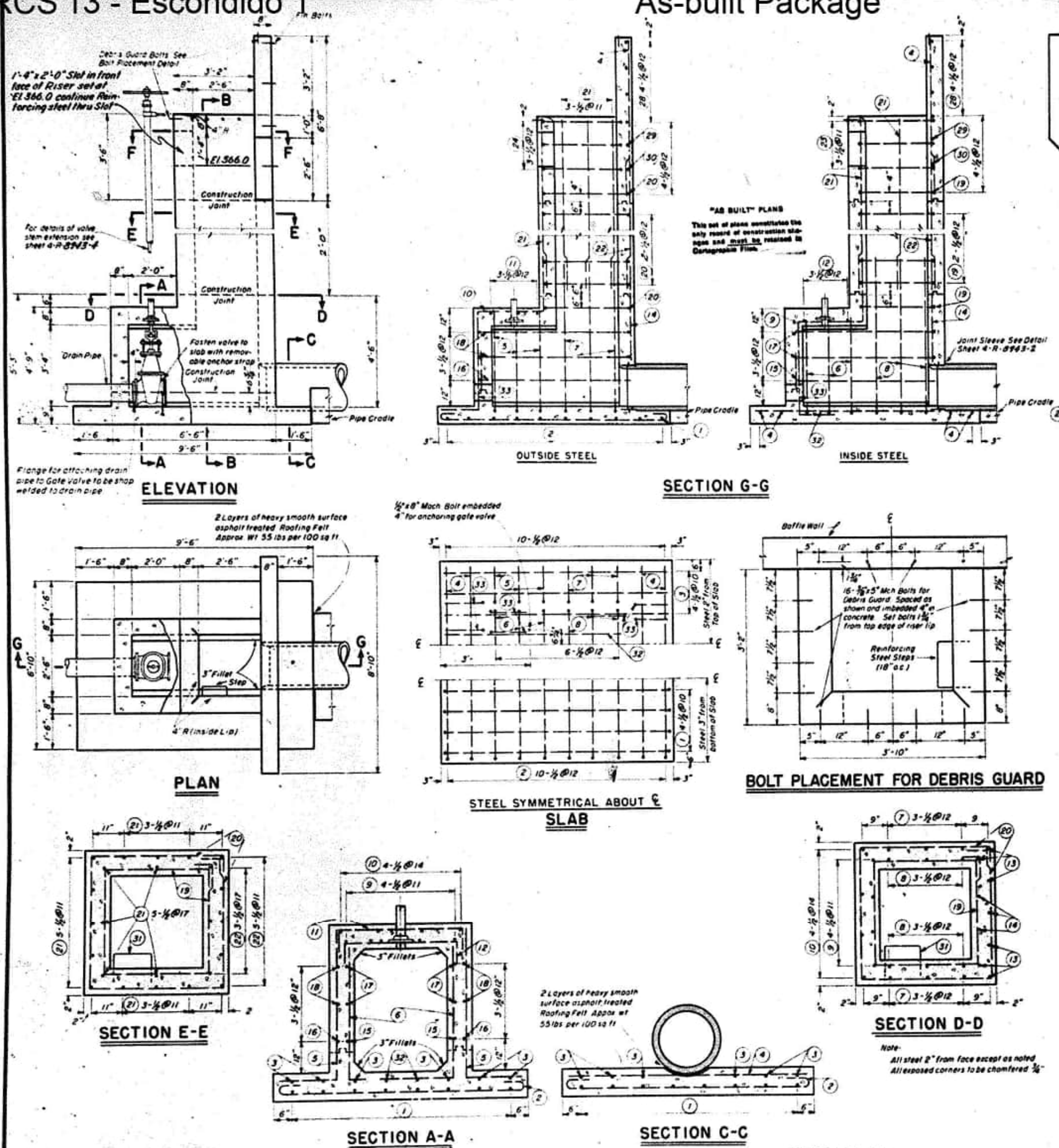
EMBANKMENT AND STRUCTURE REPAIRS
FLOODWATER RETARDING STRUCTURE SITES NO 1,2,3,4 & 11
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

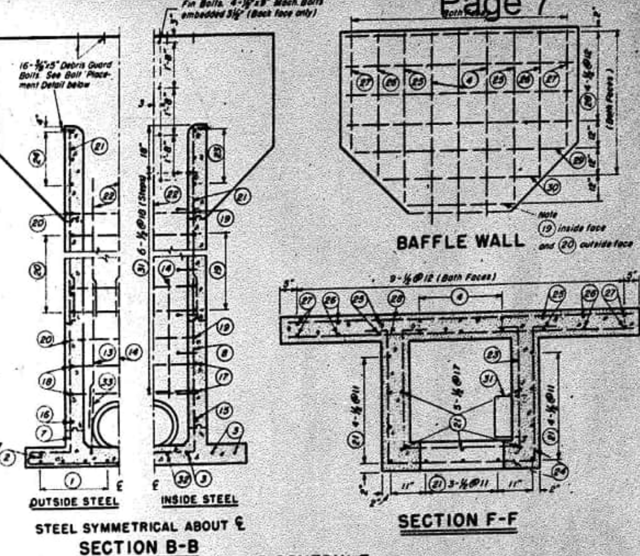
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	M. P. F.	5-61	Approved by
Drawn	M. P. F.	5-61	
Traced	C. V. C.	5-61	
Checked	J. R. E.		Drawing No. E-15,565

Revised 7-5-61

JUL 24 1961





BAR SCHEDULE

All Dimensions are out to out — For Typical Bar Types refer to ACI Standard 315-48

Bar No	No. Req'd	Size	Length	Total Length	Type	A	B	C	D	E	F	G	H	J	K	R	O
1	8	½	10-2	81-4	1	0-6	9-2					0-6		0-4			
2	10	½	7-6	75-0	1	0-6	6-6					0-6		0-4			
3	6	½	9-2	55-0	Str.												
4	10	½	6-6	65-0	Str.												
5	6	½	5-6	33-0	2	1-6	4-0										
6	3	½	10-2	30-6	2	3-8	2-10					3-8					
7	6	½	7-10	47-0	2	1-6	6-4										
8	3	½	15-6	46-6	2	6-4	2-10					6-4					
9	4	½	8-3	33-0	8	2-11	2-8					2-9					
10	4	½	8-3	33-0	8	3-3	2-8					2-4					
11	3	½	4-8	14-0	2	0-7	3-6					0-7					
12	3	½	4-0	12-0	2	0-7	2-10					0-7					
13	6	½	5-8	34-0	Str												
14	3	½	3-11	11-9	Str												
15	2	½	8-1	16-2	2	2-3	4-10										
16	2	½	8-9	17-6	2	2-7	8-2										
17	4	½	10-0	40-0	2	2-3	5-6					2-3					
18	4	½	11-4	45-4	2	2-7	6-2					2-7					
19	4	½	12-6	50-0	T-2	0-7	2-10	2-10	2-10	2-10		0-7					
20	4	½	15-2	60-8	T-2	0-7	3-6	3-6	3-6	3-6		0-7					
21	16	½	5-2	82-8	Str												
22	8	½	3-3	26-0	Str												
23	3	½	9-8	29-0	5-6	0-7	2-10	2-10	2-10			0-7					
24	3	½	11-0	33-0	5-4	0-7	3-2	3-6	3-2			0-7					
25	4	½	6-0	24-0	Str												
26	4	½	5-0	20-0	Str												
27	4	½	4-0	16-0	Str												
28	8	½	8-6	68-0	Str												
29	2	½	7-9	15-6	Str												
30	2	½	5-9	11-6	Str												
31	6	½	2-8	16-0	2	0-10	1-0					0-10					
32	2	½	7-0	14-0	Str												
33	14	½	3-10	53-8	2	1-6	2-4										

Total ½"Ø Steel in Structure Inlet = 1211'-5" = 809.23 lbs
Total Class "X" Concrete in Structure Inlet = 6.50 cu. yds.

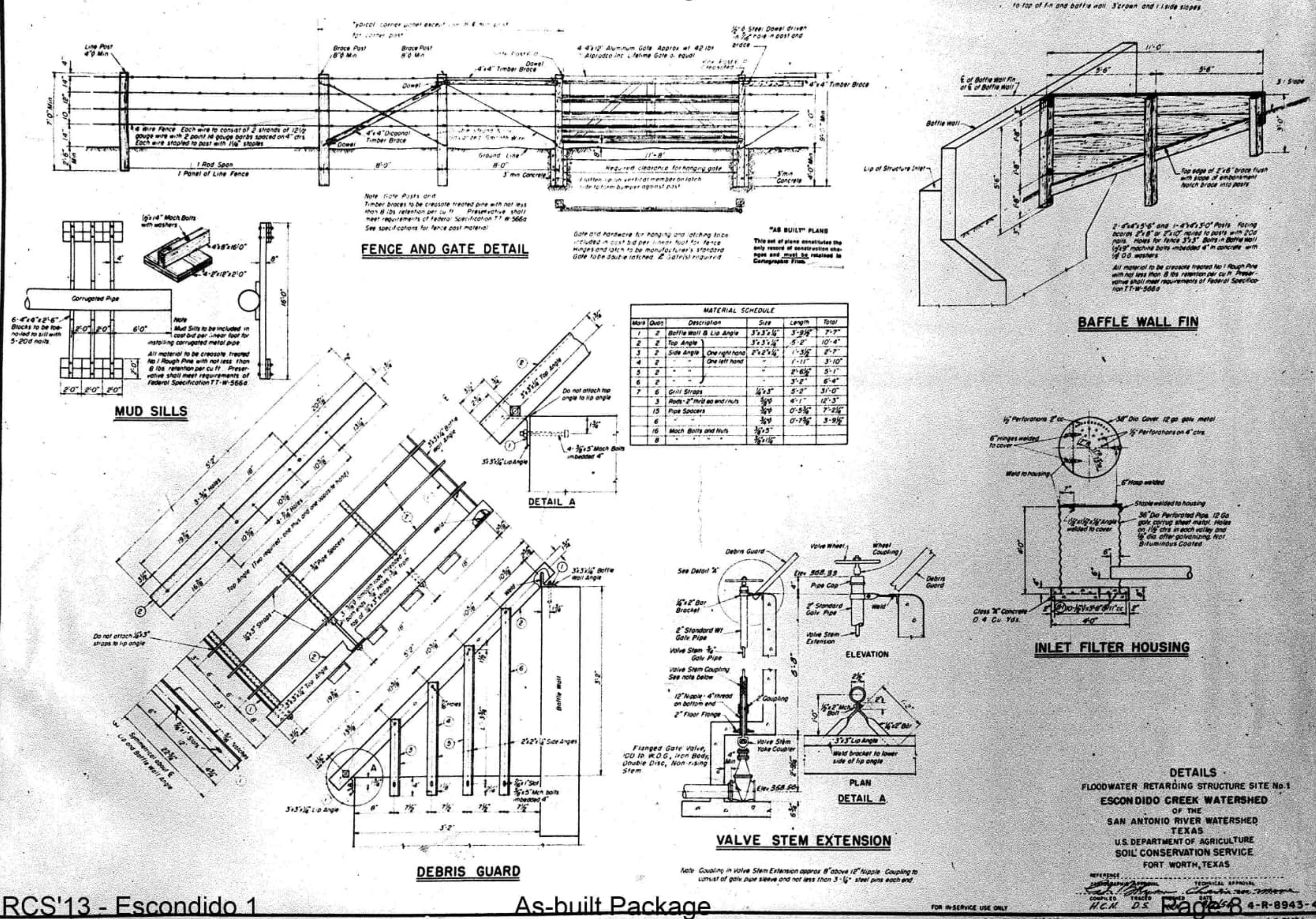
Revised 4-1-54

INLET STRUCTURE DETAILS
FLOODWATER RETARDING STRUCTURE SITE No.1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FT. WORTH, TEXAS

REFERENCE — TECHNICAL APPROVAL
COMPILED H.C.N. TRACED D.S. CHECKED H.C.N. DATE 3/2/54 4-R-8943-3

Revised - 9-21-53 R.D.B. Base for 30"x30" Standard Inlet Details 4-R-7437

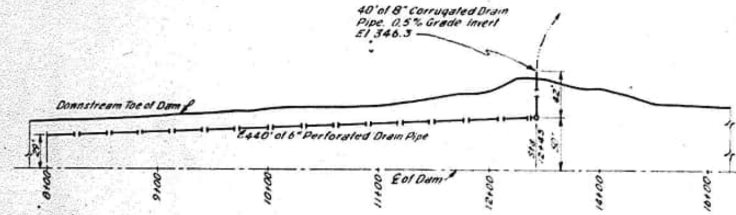
FOR IN SERVICE USE ONLY



MATERIAL SCHEDULE					
Mark	Quan	Description	Size	Length	Total
1	2	Baffle Wall & Lip Angle	3"x3"x1/4"	3'-9 1/2"	7'-7"
2	2	Top Angle	3"x3"x1/4"	5'-2"	10'-4"
3	2	Side Angle — One right hand	2"x2"x1/4"	1'-3 1/2"	2'-7"
4	2	" " — One left hand	"	1'-11"	3'-10"
5	2	" "	"	2'-6 1/2"	5'-1"
6	2	" "	"	3'-2"	6'-4"
7	6	Grill Straps	1/4"x3"	5'-2"	31'-0"
	3	Rods - 2" thrd ea end/nuts	5/8"Ø	4'-1"	12'-3"
	15	Pipe Spacers	3/4"Ø	0'-5 3/4"	7'-2 1/4"
	6	" "	3/4"Ø	0'-7 3/4"	3-9 1/2"
	16	Mach Bolts and Nuts	5/8"x5"		
	8	" " " "	5/8"x1 1/2"		

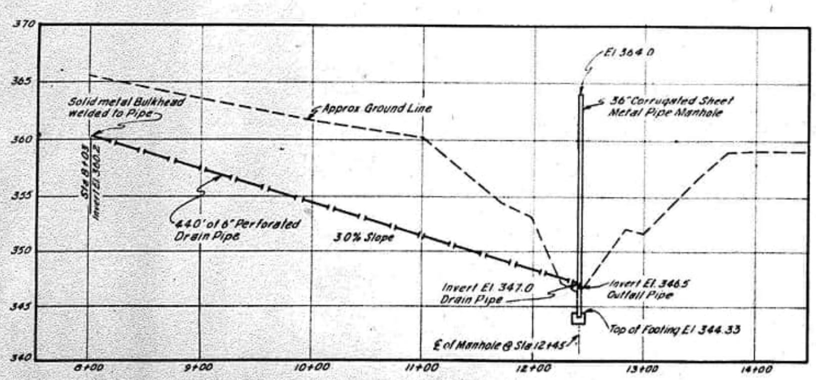
DETAILS
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FORT WORTH, TEXAS

REFERENCE
CARTOGRAPHIC APPROVAL / TECHNICAL APPROVAL
COMPILED H.C.H. TRACED D.S. 4-R-8943-4
FOR IN-SERVICE USE ONLY
Detail Sheet for 30"x30" Structure Inlet (Wire Fence) Base 4-R-7447



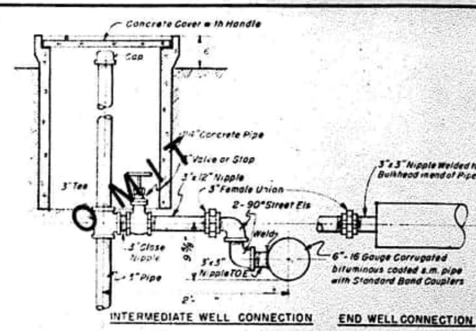
PLAN OF EMBANKMENT FOUNDATION DRAIN

"AS BUILT" PLANS

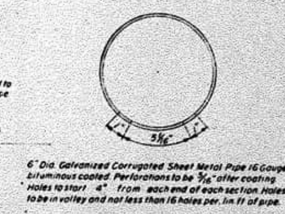


PROFILE ON ℄ OF EMBANKMENT FOUNDATION DRAIN

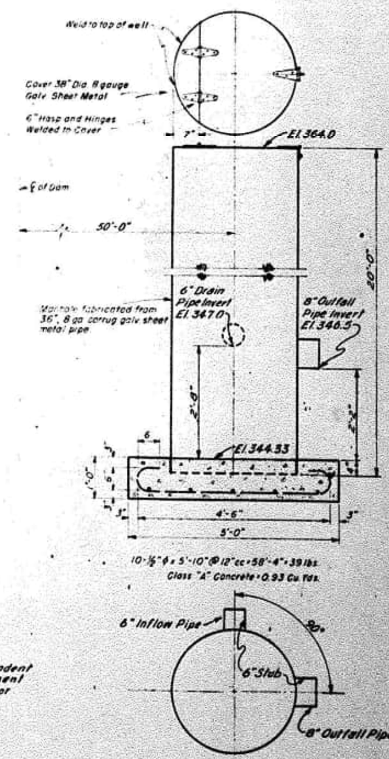
Note: All pipe, coupling, manhole and rodent guard to be furnished by the Government without additional cost to the contractor f.o.b. job site.



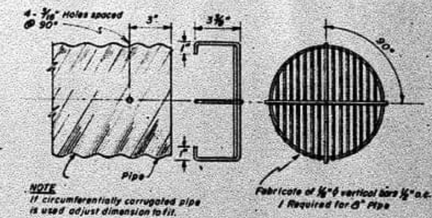
WELL CONNECTIONS



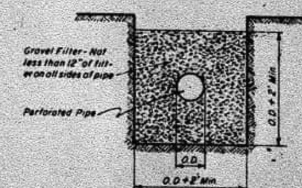
PERFORATED PIPE DETAIL



MANHOLE DETAILS



RODENT GUARD



TRENCH FOR PERFORATED PIPE

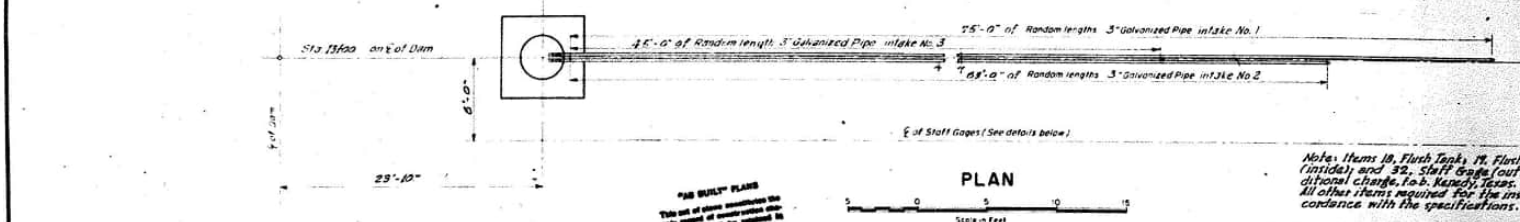
Note: The gravel filter shall grade within the following limits

EMBANKMENT FOUNDATION DRAIN
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FORT WORTH, TEXAS

Revised 4-8-56

FOR IN SERVICE USE ONLY

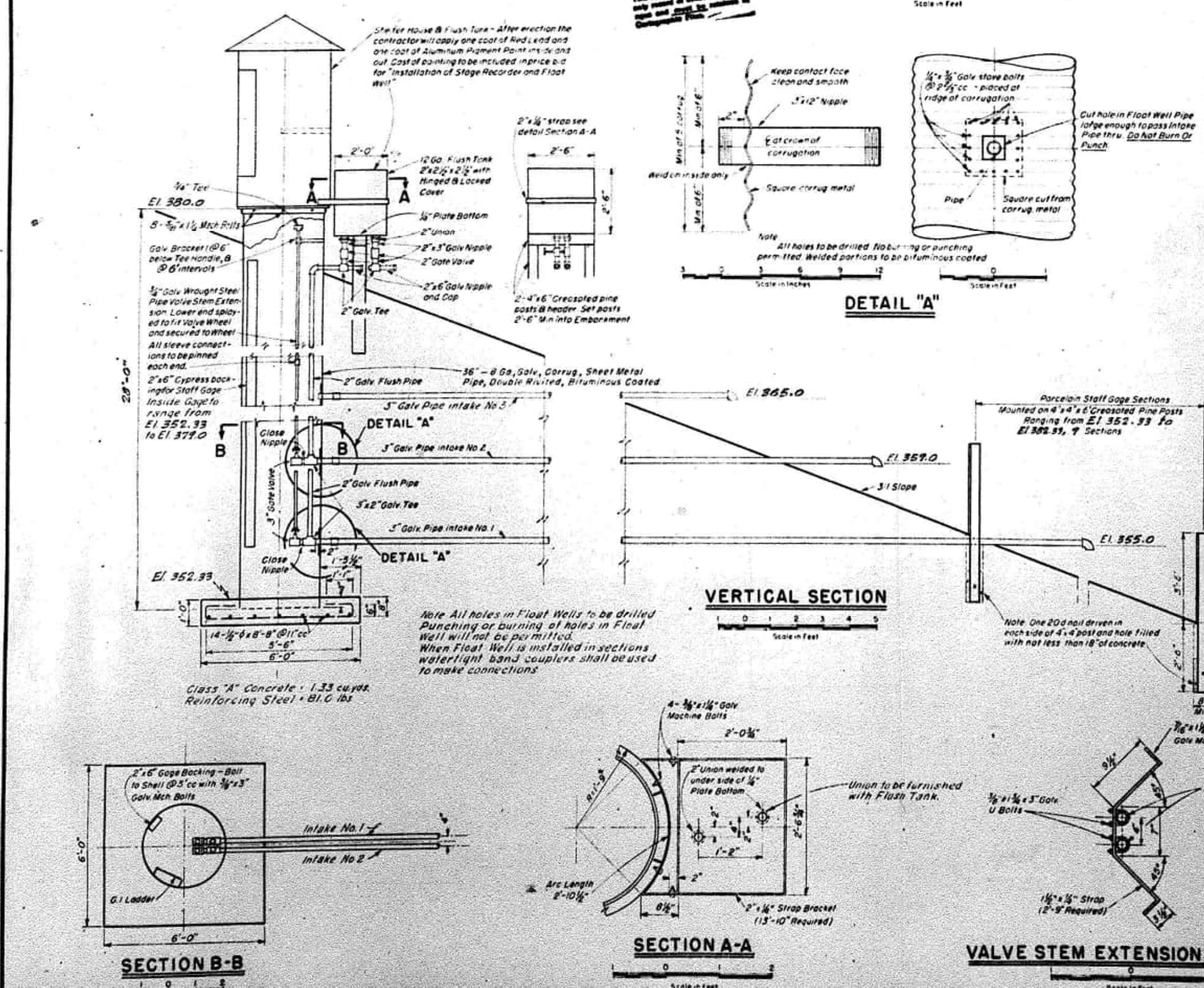
4-R-8948

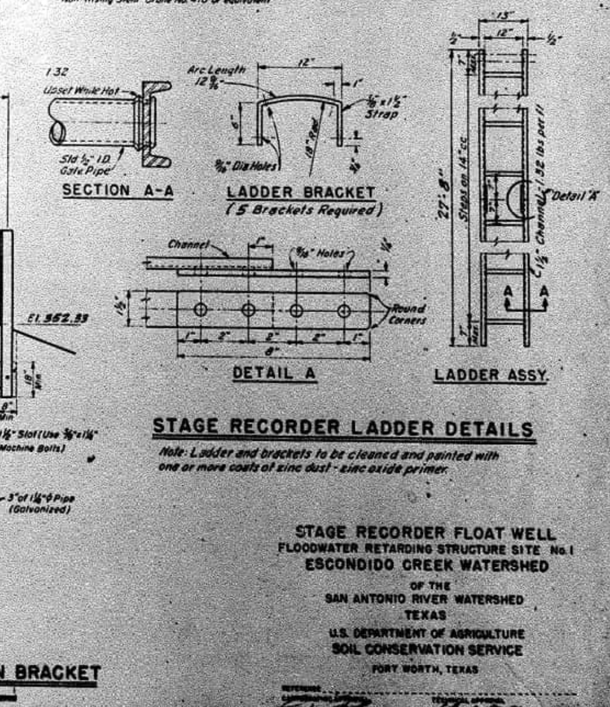


Note: Items 18, Flush Tank; 19, Flush Tank Bracket; 26, Shelter House; 27, Staff Gage (inside); and 32, Staff Gage (outside) to be furnished by the government without additional charge, f.o.b. Kenedy, Texas.
All other items required for the installation to be furnished by the contractor in accordance with the specifications.

	Item	Size	Quan	Unit		Item	Size	Quan.	Unit
1	Std Galv Steel Pipe (TBC)	3"	183	Lin Ft	21	Creosoted Post	4"x6"x4'-2"	2	Each
2	Std Galv Steel Elbow 90°	3"	3	Each	22	Creosoted Header	4"x6"x2'-6"	1	Each
3	" " " Tee	3"x2"	2	"	23	"Emsco" Galv Ladder (or equal)	See Detail	27⅔	Lin Ft
4	Gate Valve *	3"	2	"	24	Galv Ladder Bracket	-	5	Each
5	Std Galv Steel Nipple	3" Close	2	"	25	Corrug S M Pipe	36"	28	Lin Ft
6	Std Galv Steel Pipe	2"	42	Lin Ft	26	Shelter House	42"	1	Each
7	" " " Elbow 90°	2"	2	Each	27	Staff Gage (Inside)	3'-4"	8	Sections
8	" " " Nipple	2"x1'-0"	1	Each	28	" " (Cypress Back)	2"x6"	28	Lin Ft
9	" " " Pipe (T.B.E.)	2"x2'-2"	1	"	29	Concrete (Class A)		1.33	Cu Yds
10	" " " Tee	2"	2	"	30	Reinforcing Steel	½"-φ	81.0	Lbs
11	" " " Nipple	2"x0'-6"	2	"	31	Creosoted Post	4"x4"x6'	9	Each
12	" " " Cap	2"	2	"	32	Staff Gage (Outside Consec)	3'-4"	9	Section
13	" " " Nipple	2"x0'-3"	4	"	33	Galv Machine Bolts	⅜"x1¼"	12	Each
14	Gate Valve	2"	2	"	34	" " "	⅜"x3"	6	"
15	Std Galv Steel Tee	¾"	2	"	35	" " "	½"x1¼"	20	"
16	" " " Pipe (TBC)	¾"	45	Lin Ft	36	Galv Stove Bolts	¼"x¾"	48	"
17	Valve Stem Ext Bracket	See Detail	4	Each	37	Corrug Patch w/Nipple	See Detail	3	"
18	Flush Tank	-	1	"					
19	" " Bracket	-	1	"					

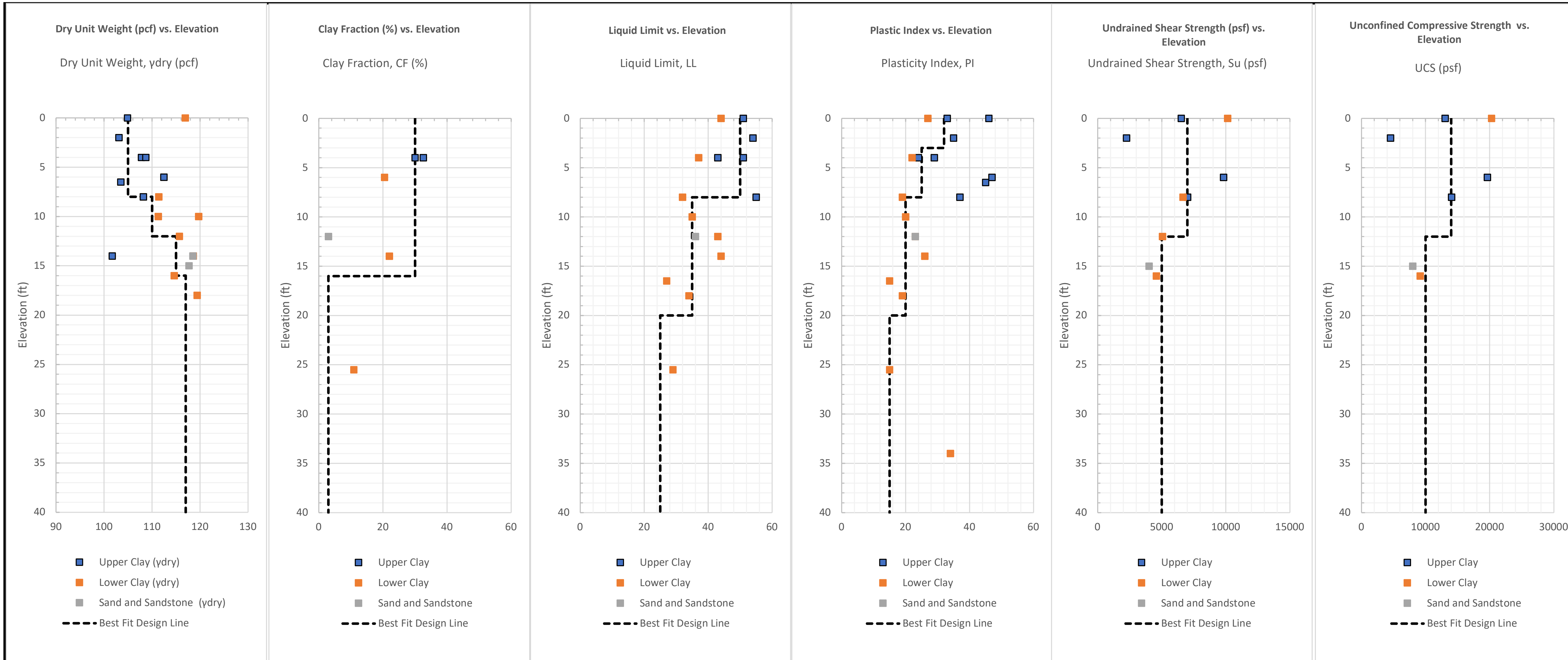
* Non-Rising Stem Crane No. 410 or equivalent



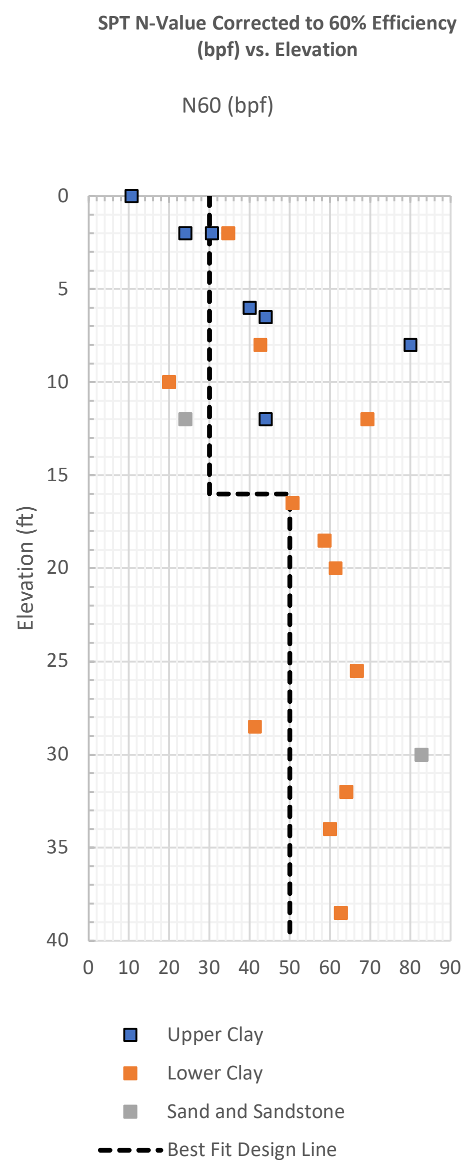


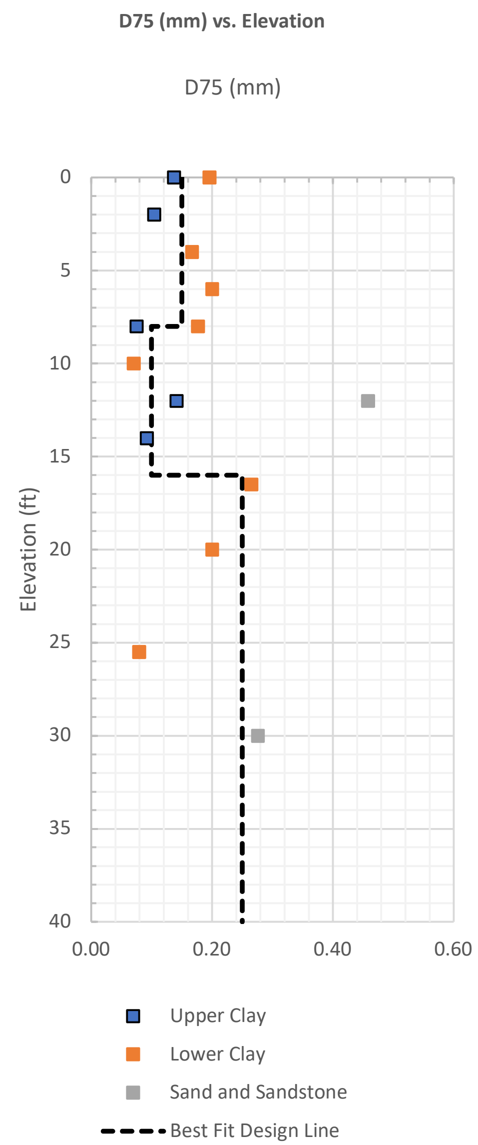
ATTACHMENT 2.

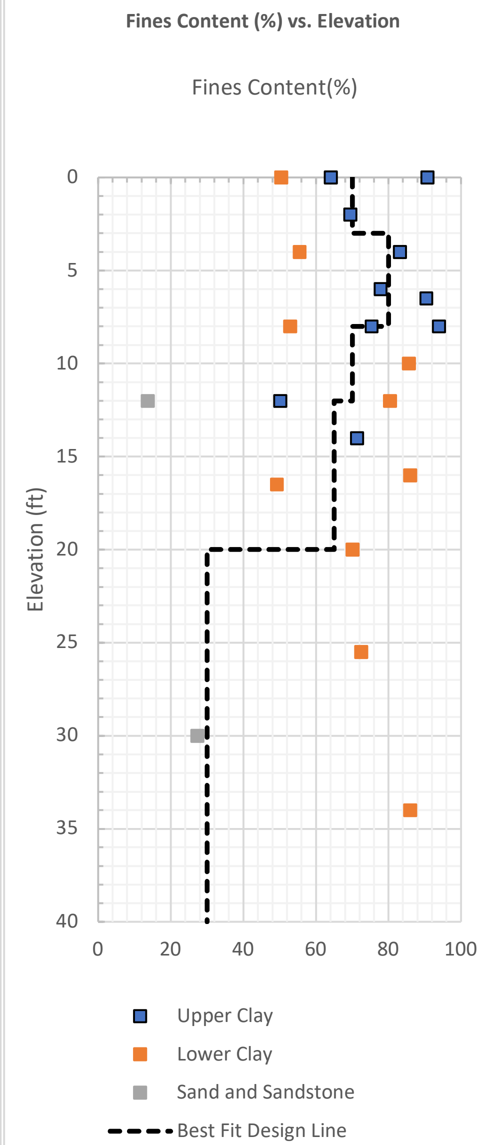
LABORATORY TEST DATA PLOTS FOR ASW BORINGS

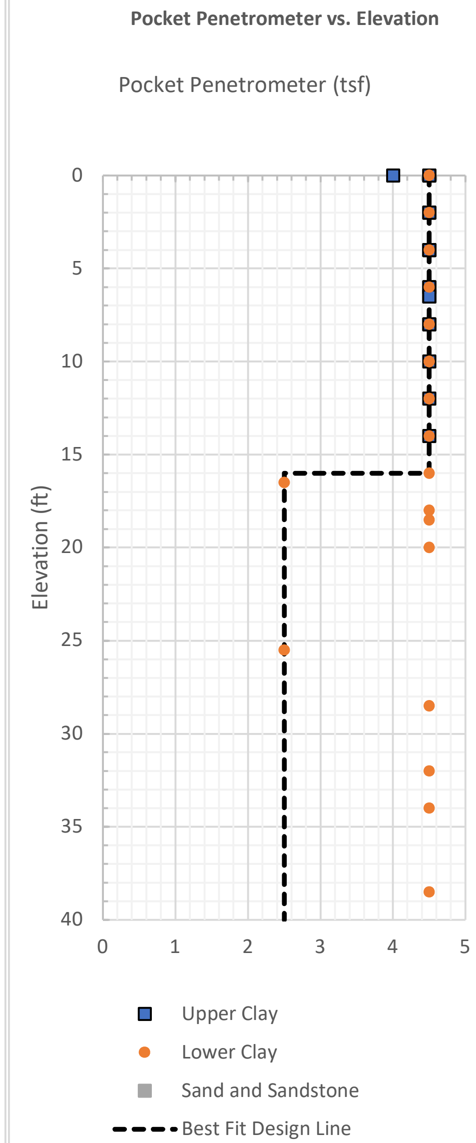


Escondido FRS No. 1 SWP-EA	Project No. 60707486
Geotechnical Laboratory Testing Summary Plots (Elevation)	
AECOM / September 2023	Attachment No. 1





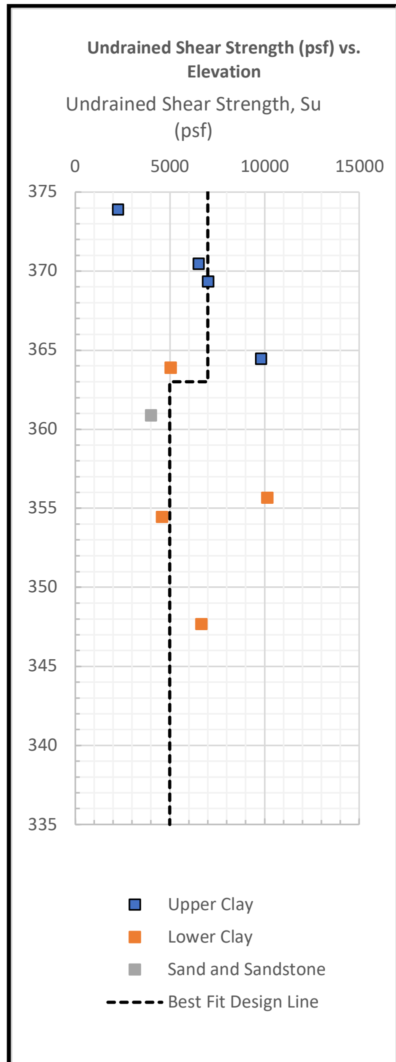


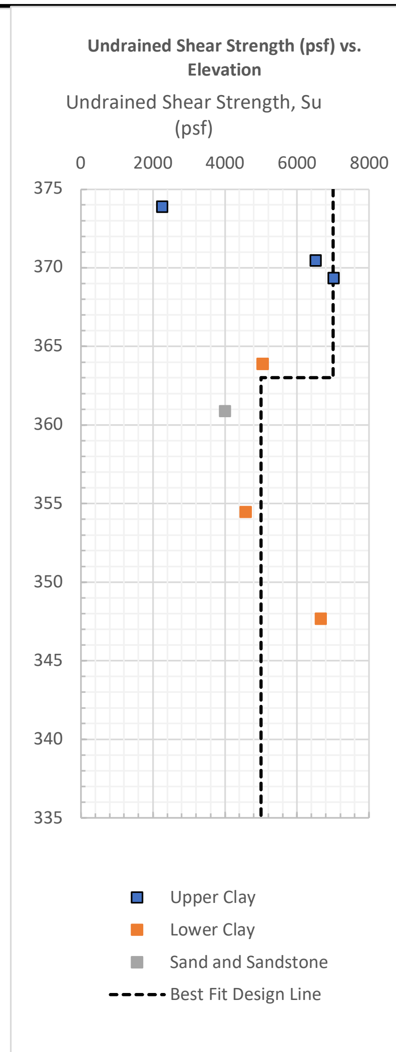


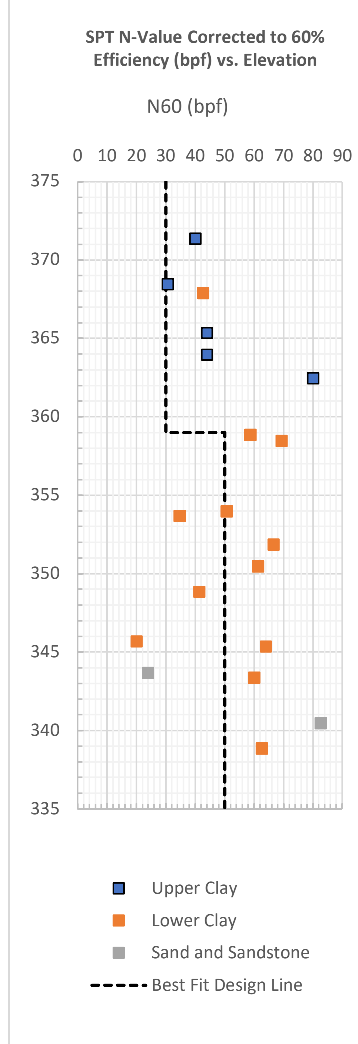
Escondido FRS No. 1 SWP-EA		Project No. 60707486
Geotechnical Laboratory Testing Summary Plots		
AECOM	September 2023	Attachment No. 1

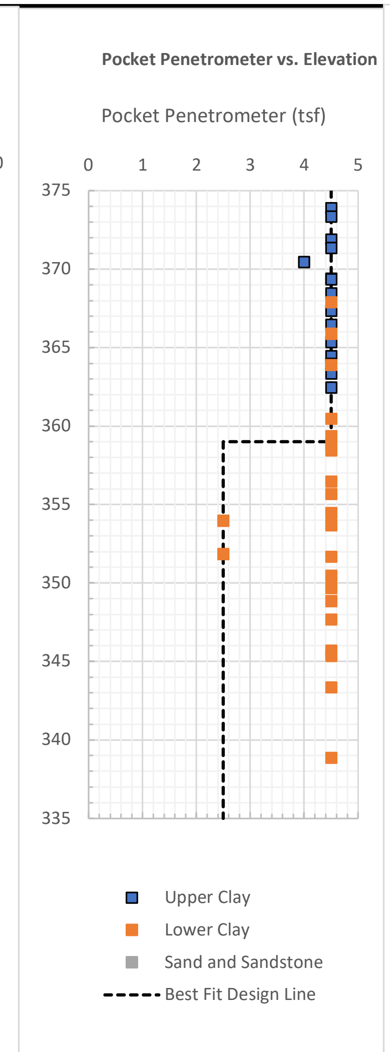
ATTACHMENT 3.

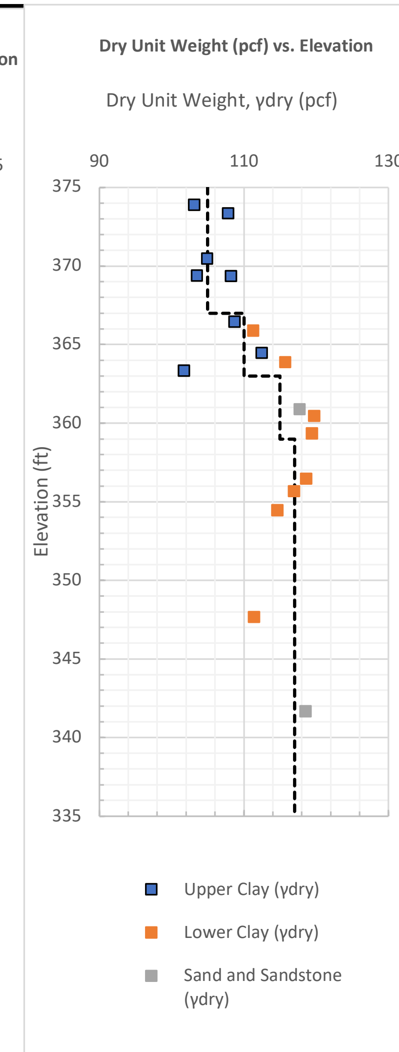
HEADCUT ERODIBILITY INDEX (Kh) CALCULATIONS











Best Fit Design Lines

Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
0	7000	30	4.5	105
3	7000	30	4.5	105
3	7000	30	4.5	105
8	7000	30	4.5	105
8	7000	30	4.5	110
12	7000	30	4.5	110
12	5000	30	4.5	115
16	5000	30	4.5	115
16	5000	50	2.5	117
20	5000	50	2.5	117
20	5000	50	2.5	117
40	5000	50	2.5	117

Estimated Kh Values

Depth(ft)	From Su1[1]	From Su2[2]	From N60[3]	From N60[4]	From PP1[1]	From PP1[2]	Avg
0	0.69	0.50	0.44	---	0.44	0.31	0.48
3	0.69	0.50	0.44	---	0.44	0.31	0.48
3	0.69	0.50	0.44	---	0.44	0.31	0.48
8	0.69	0.50	0.44	---	0.44	0.31	0.48
8	0.69	0.50	0.44	---	0.44	0.31	0.48
12	0.69	0.50	0.44	---	0.44	0.31	0.48
12	0.49	0.35	0.44	---	0.44	0.31	0.41
16	0.49	0.35	0.44	---	0.44	0.31	0.41
16	---	---	---	0.19	---	---	0.19
20	---	---	---	0.19	---	---	0.19
20	---	---	---	0.19	---	---	0.19
40	---	---	---	0.19	---	---	0.19

(1) Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4

(2) Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3

(3) Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3

Clay Layers - Summary of Lab Strength Tests

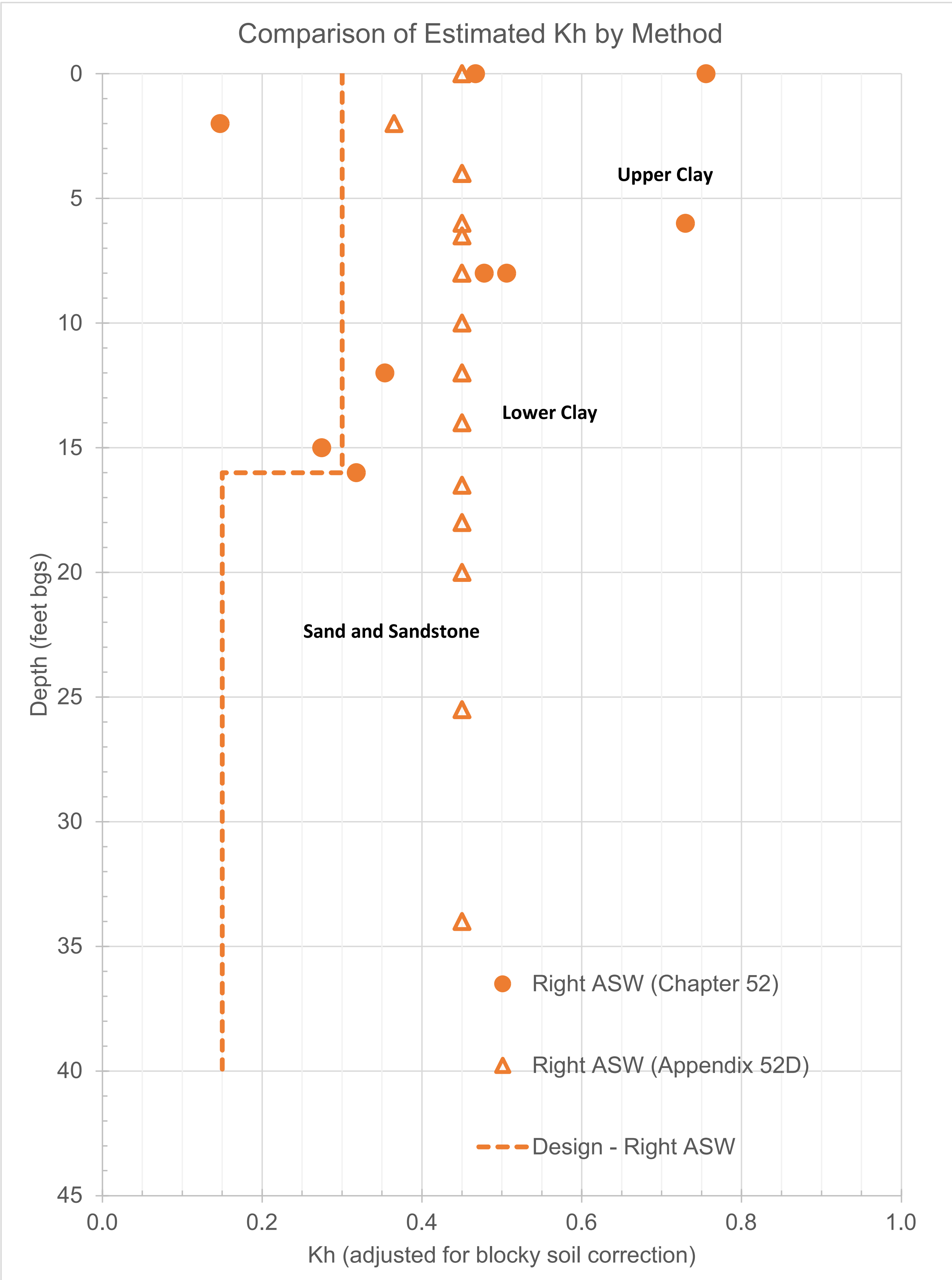
Boring ID	Depth (ft)	LL	PI	% Passing No. 200 Sieve	UU (natural moisture)			UC (natural moisture)		
					WCn (%)	DDn (pcf)	Su (psf)	WCn (%)	DDn (pcf)	Su (psf)
201-23	2	54	35	69.5	-	-	-	20.8	103.1	2,260
201-23	12	43	23	80.4	15.0	115.7	5,050	-	-	-
202-23	8	55	37	93.9	-	-	-	21.5	108.2	7,020
203-23	0	67	46	90.7	-	-	-	20.3	104.9	6,520
203-23	6	68	47	77.8	-	-	-	13.3	112.5	9,820
203-23	16	NT	NT	86	-	-	-	14.9	114.6	4,580
204-23	0	44	27	50.4	-	-	-	9.7	116.9	10,140
204-23	8	32	19	52.9	15.7	111.4	6,660	-	-	-
Average		51.9	33.4	75.2	15.4	113.6	5,855	16.8	110.0	6,723

Escondido FRS No. 1 SWP-EA	Project No. 60707486
Parameters for Kh Development (Depth)	
AECOM September 2023	Attachment No. 3

Attachment 2
Estimate of Kh for Cohesive Soils
Escondido FRS 1, Karnes County, TX

*Red values denote assumed values when lab values not available

																						NEH Part 628, Chapter 52 Correlation					NEH Part 628, Appendix 52D Correlation					
Boring ID	Top (ft bgs)	Bottom (ft bgs)	Sample ID	Stratum	Field USCS	Lab USCS	w-n (%)	DD (pcf)	TD (pcf)	Gravel (%)	Sand (%)	Fines (%)	Clay (%)	LL	PL	PI	Gs*	Test Type	$\varepsilon_{failure}$ (%)	Su (psf)	Blocky Clay Correction?	UCS (psf)	UCS (kPa)	UCS (Mpa)	Ms	Kh-adj	w-sat (%)	LI-n	LI-sat	Su-sat (psf)	Kh	Kh-adj
LEFT AUXILIARY SPILLWAY																																
201-23	0	0.5	SS-1A		CL	CH	10.0			0.0	35.9	64.1		51	18	33	2.7				NO	-	-	-	-	-	-	-0.24	-	-	0.45	0.45
	0.5	1.5	SS-1B		CL		9.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	2	4	ST-2		CL	CH	20.8	103.1	124.5	0.0	30.5	69.5		54	19	35	2.7	UC	6.8	2,260	NO	4,520	216	0.22	0.15	0.15	23.5	0.05	0.13	2,565	0.36	0.36
	4	6	P-3		CL		17.0						32.6				2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	6.5	8	ST-4		CL	CH	16.0	103.5	120.1	0.0	9.6	90.4		67	22	45	2.7				NO	-	-	-	-	-	23.3	-0.13	0.03	3,632	0.45	0.45
	8	9.5	SS-5		CL		16.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	10	12	P-6		CL		12.0	111.3	124.7								2.7				NO	-	-	-	-	-	19.0	-	-	-	-	-
	12	14	ST-7		CL	CL	15.0			0.4	19.2	80.4		43	20	23	2.7	UC	11.09	5,050	NO	10,100	484	0.48	0.35	0.35	-	-0.22	-	-	0.45	0.45
	15	20	RC-1		Sandstone		11.0	117.7	130.6			0.8	0.8				2.7	UC		4,003	NO	8,006	383	0.38	0.27	0.27	16.0	-	-	-	-	-
	20	25	RC-2		Sandstone		6.0							53	19	34	2.7				NO	-	-	-	-	-	-	-0.38	-	-	0.45	0.45
202-23	0	2	P-1		OL & CL		16.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	2	3.5	SS-2		CL		19.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	P-3		CL	CH	19.0	107.8	128.3	0.0	16.9	83.1		51	22	29	2.7				NO	-	-	-	-	-	20.8	-0.10	-0.04	4,000	0.45	0.45
	6	7.5	SS-4		CL		12.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	8	10	ST-5		CL	CH	18.0	108.2	127.7	0.0	6.1	93.9		55	18	37	2.7	UC	1	7,020	NO	14,040	672	0.67	0.51	0.51	20.6	0.00	0.07	3,125	0.45	0.45
	10	12	P-6		CL		20.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	12	13.5	SS-7		CL		14.0			0.0	49.8	50.2					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	14	16	P-8		CL		13.0	101.7	114.9	0.0	28.7	71.3					2.7				NO	-	-	-	-	-	24.3	-	-	-	-	-
	18	18.5	ST-9		CL	CL	12.0	119.4	133.7					34	15	19	2.7				NO	-	-	-	-	-	15.2	-0.16	0.01	3,840	0.45	0.45
	18.5	20	SS-10		CL		10.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	25.5	27	SS-11		SM & CL	CL	10.0			0.3	27.2	72.5	0.0	29	14	15	2.7				NO	-	-	-	-	-	-	-0.27	-	-	0.45	0.45
	28.5	30	SS-12		SM & CL		11.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	32	33.5	SS-13		CL		25.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	34	35.5	SS-14		CL	CH	22.0			0.0	14.0	86.0		64	30	34	2.7				NO	-	-	-	-	-	-	-0.24	-	-	0.45	0.45
	38.5	40	SS-15		CL		19.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	0	2	ST-1		CL	CH	20.3	104.9	126.2	0.0	9.3	90.7		67	21	46	2.7	UC	2.7	6,520	NO	13,040	624	0.62	0.47	0.47	22.4	-0.02	0.03	3,586	0.45	0.45
	2	3.5	SS-2		CL		21.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	P-3		CL		13.0	108.7	122.8					43	19	24	2.7				NO	-	-	-	-	-	20.4	-0.25	0.06	3,283	0.45	0.45
	6	6.5	ST-4		CL	CH	13.0			0.0	22.2	77.8		68	21	47	2.7	UC	1.51	9,820	NO	19,640	940	0.94	0.73	0.73	-	-0.17	-	-	0.45	0.45
	6.5	8	SS-5		CL		12.0	112.5	126.0								2.7				NO	-	-	-	-	-	18.4	-	-	-	-	-
	8	9.5	SS-6		CL		14.0			0.2	24.6	75.3					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	10	12	P-7		CL	CL	11.0	119.7	132.9	2.4	12.0	85.6	2.0	35	15	20	2.7				NO	-	-	-	-	-	15.1	-0.20	0.00	3,936	0.45	0.45
	12	13.5	SS-8		CL		13.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	14	16	P-9		CL		13.0	118.6	134.0					44	18	26	2.7				NO	-	-	-	-	-	15.6	-0.19	-0.09	4,000	0.45	0.45
	16	16.5	ST-10		SP		15.0			0.0	14.0	86.0					2.7	UC	1.91	4,580	NO	9,160	439	0.44	0.32	0.32	-	-	-	-	-	-
	16.5	18	SS-11		SP	SC	10.0	114.6	126.1	0.0	50.8	49.2		27	12	15	2.7				NO	-	-	-	-	-	17.4	-0.13	0.36	1,146	0.45	0.45
	20	21.5	SS-12		SP		13.0			0.6	29.3	70.1					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	22	25	RC-1		Sandstone		17.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	30	31.5	SS-13		SW		17.0			2.8	69.8	27.3					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	0	2	ST-1		CL	CL	9.7	116.9	128.2	0.0	49.6	50.4		44	17	27	2.7	UC	9	10,140	NO	20,280	971	0.97	0.76	0.76	16.3	-0.27	-0.02	4,000	0.45	0.45
	2	3.5	SS-2		CL		7.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	ST-3		CL	CL		127.8		0.0	44.5	55.5		37	15	22	2.7				NO	-	-	-	-	-	11.8	-0.68	-0.15	4,000	0.45	0.45
	6	8	P-4		CL		8.0						20.5				2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	8	10	ST-5		SC	CL		111.4		0.0	47.1	52.9		32	13	19	2.7	UC	2.46	6,660	NO	13,320	638	0.64	0.48	0.48	19.0	-0.68	0.31	1,343	0.45	0.45
	10	11.5	SS-6		SC	CL	11.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	12	13.5	SS-7		SC	SC	10.0			0.5	85.8	13.8	6.0	36	13	23	2.7				NO	-	-	-	-	-	-	-0.13	-	-	0.45	0.45
	14	20	RC-1		Sandstone		10.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
																	MIN			**2,260**						**0.15**			**MIN**	**1,146**	**0.36**	**0.36**
																	MAX			**10,140**						**0.76**			**MAX**	**4,000**	**0.45**	**0.45**
																	AVG			**6,228**						**0.45**			**AVG**	**3,266**	**0.45**	**0.45**


Comparison of Estimated Kh by Method
Upper Clay
Lower Clay
Sand and Sandstone
Depth (feet bgs)
0
5
10
15
20
25
30
35
40
45
0.0
0.2
0.4
0.6
0.8
1.0
Kh (adjusted for blocky soil correction)
Right ASW (Chapter 52)
Right ASW (Appendix 52D)
Design - Right ASW

AECOM Imagine it. Delivered.

Preliminary Geologic Investigation Report

Escondido Creek Floodwater Retarding Structure No. 1, Karnes County, Texas

Work Order Number: 12FPC320F0281
Project Reference: The River Authority MSA Contract C210002
AECOM Project number: 60707486

October 2024

Quality information

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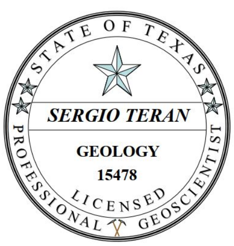

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1. Introduction

1.1 Project Overview

Escondido Creek Flood Retarding Structure (FRS) No. 1 (Escondido 1), National Inventory of Dams (NID) identification number TX02032, was built by the Soil Conservation Service (presently known as the National Resources Conservation Service, NRCS) as a low hazard flood retaining structure in 1954. Escondido 1 was constructed as a homogeneous earthen embankment with the primary purposes of watershed protection and flood prevention.

Construction of Escondido 1 was sponsored by the following Sponsoring Local Organizations (SLOs): Karnes-Goliad Soil Conservation District, the Escondido Watershed District, the City of Kennedy, and the San Antonio River Authority (the River Authority). Escondido 1 is currently owned, operated, and maintained by the SLOs. The NRCS provides periodic inspections of the dam.

A 2014 Dam Assessment Report prepared by AECOM concluded that the existing principal spillway does not meet drawdown requirements and that the auxiliary spillway will flow for the 100-year storm. Additionally, the probable maximum precipitation will cause the auxiliary spillway (ASW) to flow at depths exceeding capacity and overtopping of the dam will occur, leading to a breach in either the ASW or the embankment. The breach inundation map from the 2014 Dam Assessment Report indicates one structure is at risk from a catastrophic breach (AECOM 2014). Therefore, Escondido 1 meets the classification of high hazard. Because catastrophic failure of Escondido 1 could result in property and infrastructure damages and potential loss of life, the reclassification of the dam as high hazard supports rehabilitation efforts necessary for compliance with current performance and safety standards.

The River Authority contracted with AECOM Technical Services, Inc., (AECOM) to further evaluate the potential remediation measures presented in the 2014 Dam Assessment of Escondido 1, as well as to investigate additional potential alternatives based on review of current site conditions. The results of these evaluations will be compiled in a Supplemental Watershed Plan and Environmental Assessment (SWP-EA) to be submitted under separate cover. The geotechnical investigations described in this Preliminary Geologic Investigation Report (GIR) are intended to support the evaluations required for completion of the SWP-EA.

1.2 Proposed Improvements

The Supplemental Watershed Plan and Environmental Assessment (SWP-EA) (AECOM 2024) performed at Escondido 1 offered several alternatives to mitigate identified dam safety deficiencies associated with the reclassification of the dam as a high hazard structure. These included controlled dam breach and decommissioning, relocation of the at-risk downstream facilities out of the breach impact area, and dam rehabilitation. The preferred dam alternative from the SWP-EA is the federally supported plan and the recommended plan. The preferred alternative is dam rehabilitation that consists of the following components:

- Remove the existing principal spillway system;
- Install a new principal spillway system consisting of a standard inlet tower with crest at elevation 368.20 feet and a 42-inch RCP conduit discharging into an impact basin;
- Regrade inlet and outlet channel of the existing 250-feet wide vegetated auxiliary spillway and raise crest to the 100-year PSH elevation of 380.4 feet (2.53 feet raise),

- Line lower portion of auxiliary spillway from station 13+00 to station 15+78 with ACB,
- Flatten downstream embankment slope to 3H:1V,
- Install chimney drain within dam embankment,
- Install upstream slope riprap, and
- Raise top of dam elevation to 386.0 feet (3.13 feet raise) and extend cutoff trench below extended dam embankment.

1.3 Purpose and Scope of Work

AECOM was contracted to perform a site-specific field Preliminary Geologic Investigation (GI) of the auxiliary spillway and prepare a Preliminary GIR of the findings and interpretations. The purpose of the GI is to collect geologic and geotechnical information about the following aspects of design:

- Erodibility of the existing vegetated ASW channel.
- Confirm subsurface stratigraphy and evaluate soil/rock characteristics for use in SITES analysis.

Also included in AECOM's scope is soil mechanics laboratory testing on select soil and rock samples recovered during the GI, and preparation of a preliminary Soil Mechanics Report (SMR), which will be issued under separate cover.

1.4 Authorization

This Preliminary GIR was prepared by AECOM for the River Authority in accordance with the Project Scope of Work for the SWP-EA for Escondido FRS No. 1, Karnes County, Texas and executed under the terms and conditions of IDIQ Contract No. C210002, which was requested on August 3, 2020 and authorized on August 3, 2022.

2. Site Description

2.1 Site Location

Escondido 1 is located on a tributary to Panther Creek, approximately 4.2 miles southwest of downtown Kennedy, Texas. Global positioning system (GPS) coordinates for the site are near latitude 28.777561° and longitude -97.893748°.

Site access is available via an unpaved dirt road off State Highway 72, approximately 0.6 miles southwest of the intersection of CR 160 and State Highway 72 in Kenedy, Texas. Within the site, access is primarily via pastures and dirt roads. A vicinity map of the site is provided as **Figure 1**.

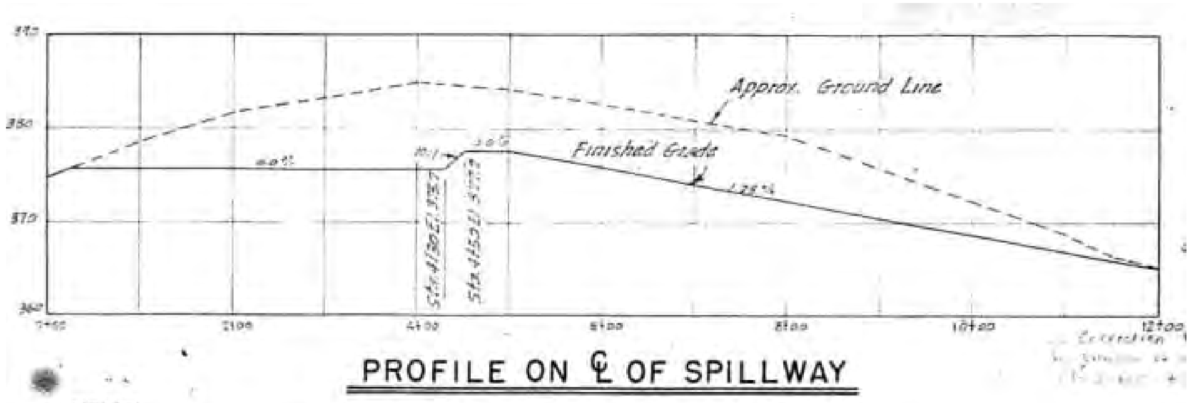
2.2 Existing Dam and Spillway

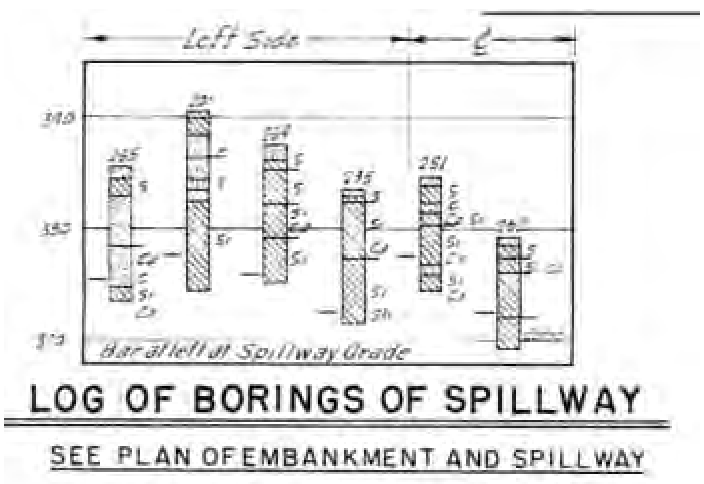
Escondido is an FRS that was designed and constructed as a low hazard dam. Escondido 1 was constructed in 1954. The dam has an estimated drainage area of approximately 1,819 acres and a total reservoir capacity estimated at 1,076 acre-feet (maximum storage). Escondido 1 does not meet the current dam design and safety requirements, and per the NRCS, the current classification of the structure is high hazard.

According to the as-built drawings, the dam is approximately 36 feet tall at the maximum section and 2,606 feet long. The upstream slopes of the embankment were constructed at an inclination of 3H:1V (horizontal:vertical) while the downstream slopes were constructed at 2H:1V. A 10 foot wide berm was constructed on the upstream slope. The width of the embankment crest is approximately 14 feet. The dam features a vegetated ASW at the left abutment, and a principal spillway (PSW) consisting of a low-level inlet upstream separate from the inlet riser, the inlet riser, conduit under the dam, and an unlined downstream plunge pool (expanded in 1961 following original construction and during the repair of the downstream slope).

The existing ASW channel is 250 feet wide. The ASW crest is 50 feet long and at Elevation (El.) 377.87[1] feet according to the North American Vertical Datum of 1988 (NAVD88). The entrance channel slope was excavated nearly flat (0% per the as-built drawings) to about El. 357.87 at maximum depths of about 9 feet below pre-construction ground surface along the spillway centerline. The as-built drawings (see Attachment 1) indicate the crest was excavated into interbedded layers of native clay and sand. The exit channel was similarly excavated out of the native clay and sand layers at a 1.75% grade, with excavation depths ranging from 0 to 8 feet, thinning in excavation depth going downstream from the crest. For reference, the as-built spillway profile is shown in the image below as well as the stick logs provided in the as-built drawings for the auxiliary spillway.

[1] Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29). Conversion to NAVD88 is +0.17 feet.





2.3 Historical Performance of Spillway

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2021 and 2022 annual inspections (River Authority 2021, TCEQ for River Authority 2022) reported that the spillway was in good condition. The 2021 inspection noted sparse vegetation in some areas while the 2022 inspection also noted some sparse vegetation areas as well as an ATV trail going across the control section. A harvester ant bed was also noted on the inside berm at the left end of the dam. No other adverse conditions were noted.

2.4 Physiography

Per the Physiographic Map of Texas (Wermund, 1996), Karnes County is located within the Interior Coastal Plains of the Gulf Coastal Plains of South Texas. The Interior Coastal Plain physiographic province consists of alternating beds of resistant uncemented sands among weaker shales that erode into long, sandy ridges, resulting in topography that is characterized by parallel ridges and valleys. Bedrock types are generally unconsolidated sands and muds. The regional bedding is tilted toward the Gulf of Mexico at approximately 2 degrees, with fault systems that trend nearly parallel to the coastline.

The interior coastal plain vegetation includes pine and hardwood forests in East Texas. Moving to the West and South, tree density declines, with pines disappearing altogether in Central Texas, and eventually turns into vegetation of chaparral brush and sparse grasses along the southwest boundary.

2.5 Geology

Most of the dam site and the entirety of the ASW is mapped as underlain by the Oakville Sandstone Formation (designated as “Mo”). The Oakville Sandstone Formation consists of sandstone and clay with a total thickness of 300 to 500 feet (Adams et. al 1981 and Baker 1979). Per the geologic map, the sandstone intervals are described as thickly bedded, medium grained, and calcareous with some crossbedding while the clay intervals are described as yellow-gray and calcareous. Anders (1962) describes the Oakville Sandstone as cross-bedded medium to fine grained sand and sandstone and sandy, ashy, and bentonitic clay beds with the base of the Oakville dipping gulfward at an average of 85 feet per mile. The Oakville Sandstone contains fossil wood, chert, and quartz gravels, with some vertebrate fossils and reworked Cretaceous invertebrate fossils (Adams et. al 1981 and Baker 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is the montmorillonite mineral with variable amounts of kaolinite and subordinate illite. A geologic map of the site is provided as **Figure 2**.

Alluvium (Qal) of the Holocene Epoch is mapped downstream of the principal spillway and along the banks of Panther Creek. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Deposits are typically organized as point bars, natural levees, stream channels, backswamps, coastal marshes, mud flats, clay dunes, sand dunes, and oyster reef deposits.

2.5.1 Soil Mapping

The NRCS Websoil Survey database was examined to identify near-surface soils mapping of the site (i.e., approximately upper 7 feet). The Websoil Survey report and data are provided in **Appendix A**.

The mapped soil types within the vicinity of the proposed dam are described as alluvium and residuum resulting from in-place weathering of the underlying sandstone parent bedrock.

The alluvium is generally mapped to the south (upstream) of the site within the low-lying areas of the valley, at the downstream segment of the ASW, and alternating north (downstream) of the dam with the residuum. Residuum is mapped where the principal spillway is located and is adjacent to alluvium on either side. Residuum is also found on the upstream section of the ASW near the inlet.

The alluvium onsite is described as consisting of the Pernitas and the Coy series soils. Mapped alluvial soil units are described below.

- Pernitas (PnC): Calcareous loamy alluvium derived from sandstone. Identified on the backslope and side slopes of interfluves. Described as well drained with moderately high to high ability to transmit water.
- Coy (CoB): Calcareous clayey alluvium derived from mudstone. Identified on terrace summits, shoulders, backslopes and side slopes. Described as well drained with very low to moderately high ability to transmit water.

The residuum mapped in the principal spillway and the upstream segment of the existing ASW is described as consisting primarily of the ridge forming, Pliocene age, Weesatche series (WaC) which includes fine sandy calcareous loam and sandy calcareous loam. The Weesatche series is described as having a moderately high to high capacity to transmit water, moderate permeability, and low runoff.

Typical index and physical properties indicate alluvial materials generally classify as lean to fat clays (CL, CH) and clayey sands (SC) according to the Unified Soil Classification System (USCS). The alluvium has Liquid Limit (LL) generally between 38 and 69 for the Coy series and 27 to 53 for the Pernitas series, and PI between 18 and 44 for the Coy series and 8 to 29 for the Pernitas series. Fines content (fraction finer than the U.S. No. 200 sieve) of the alluvium is on average about 80 percent and 55 percent for the Coy and Pernitas series, respectively. The residuum soils generally classify as sand with silt and clay (SC-SM), clayey sands (SC) and low plasticity clays (CL). The residuum has Liquid Limit (LL) generally between 21 and 46, and PI between 6 and 26. Fines content of the residuum is on average about 35 to 54 percent.

2.5.2 Structural Geology

The site is located near several prominent structural geologic features. Most broadly, the site lies within the northwestern edge of the Gulf of Mexico Basin (Ewing and Lopez, 1991). Other structural features are within the Gulf of Mexico Basin.

The Luling Fault Zone - also referred to as the combined Luling-Mexia-Talco (LMT) Fault Zone – is located to the north of the site according to Figure 9 from Woodruff and McBride (1979) included as **Figure 3**. The LMT strikes approximately northeast in the area near the site in the area of southern and southeastern Texas near the updip limit of Tertiary deposits (Hosman, 1996). The LMT then continues to extend into the northeastern corner of Texas where the trend turns eastward. The LMT runs parallel to the Balcones Fault Zone (BFZ), with the BFZ being just to the north and west of the LMT. The two fault zones are characterized by large Cretaceous to Tertiary normal faults with throws over 100 ft. (Collins et al., 1992). The belt of faults is likely associated with the sinking of the Guld Coast geosyncline, which is to the southeast of the site, generally running parallel to the coast where associated smaller faults with the downthrown side of the normal faults in the direction of the Gulf Basin marking extension along the margin of the Gulf Coastal Basin (Collins et al., 1992 and Hosman, 1996). The LMT is a system of en-echelon grabens several miles across and normal faults. The faulting has been reported as being active throughout the Cenozoic era, including the present day (Hosman, 1996).

The site also lies on the southwestern side of the San Marcos Arch. The San Marcos Arch is described as a southeast trending area of lesser subsidence than surrounding areas during the Mesozoic and Cenozoic eras (Ewing and Lopez, 1991). The Arch comes off the Llano uplift in central Texas towards the Gulf of Mexico and effectively separates the Rio Grande Salt basin in the southwest from the Houston Salt basin in the northeast (Bodziak et al., 2014). During the early Cretaceous period, carbonate platforms occupied the area and were responsible for several depositions, particularly the site directly overlies the deeper Edwards (Stuart City) shelf margin and the Sligo Shelf Margin (Van Simaeys, 2017). The deposition of the margins later influenced the Eagle Ford shale deposition, which is an important shale play for extraction of hydrocarbons (Bodziak et al., 2014). The deeper deposited Eagle Ford shale and surrounding geologic units (Buda Limestone below and Austin Chalk above) has most recently been a focus on studies relative to anthropogenic fault rupture (McKeighan, 2022). Additional discussion is provided in Faulting and Seismicity.

2.5.3 Faulting

Published geologic fault maps (see Figure 3 from Woodruff and McBride (1979) referenced above) indicate several regional faults with northeast-southwest trending normal faults. Most of these faults are rooted in the deeper subsurface at depths of 3,200 to 13,000 ft (Verbeek et al 1979). **Figure 4** was published from the faulting data from the Bureau of Economic Geology (University of Texas) and shows several faults located within about 15 miles to the north and west of the site. In addition to these faults, a recent publication (McKeighan, 2022) mapped several deep fault zones in the Eagle Ford shale play region in the vicinity of Escondido 1 (see **Figure 5**); these include the Karnes Trough Fault Zone (KTFZ), Northern Live Oak Fault Zone (NLOFZ), and the Southern Karnes County (SKC). As shown in Figure 5, the Escondido 1 site is approximately within the SKC, and the KTFZ and NLOFZ are located about 15 miles to the northwest and about 8 miles to the southwest, respectively.

McKeighan describes the KTFZ region as being 82 miles long, being bounded by large faults on the northern and southern flank, having a total of 75 parallel to sub parallel striking faults, and being mapped within the Buda Formation horizon. Dip is 51 degrees with an average length of 4.3 miles and an average throw of 167 ft. The SKC is also noted as having 49 faults mapped in the Buda Formation and runs parallel approximately 12.4 miles south of the KTFZ and extends 45 miles SW to NE (56 degree strike). Dip for the SKC is also 51 degrees with an average length of 2.5 miles and average throw of 80 feet. These individual faults are not in the Quaternary Faults and Folds database because of the age of the formation they are in (Buda formation is part of the lower Cretaceous). The faults were primarily considered inactive before the introduction of oil and gas production but have recently become active due to induced seismicity resulting from hydraulic fracturing operations (McKeighan 2022).

According to the U.S. Quaternary Faults and Folds Database, no Quaternary-active faults are present at the project site. The USGS database indicates the nearest quaternary-active faults are the Gulf-margin normal faults system. This system is considered as the “latest Quaternary” (active within the last 15,000 years) and consists of a compilation of numerous individual unmapped faults. The faults are decoupled from the underlying crust and assigned as Class B structures due to their low seismicity (Wheeler, 1999). The system is a belt of mostly seaward-facing normal faults that borders the northern Gulf of Mexico in westernmost Florida, southwestern Alabama, southern Mississippi, all of Louisiana and southernmost Arkansas, and eastern and southern Texas (Ewing and Lopez, 1991). The Gulf Coast faults are divided into four groups due to the large number of faults within this fault group and in order to better represent regional differences. The Texas portion of the Gulf-margin normal faults dips 0º - 90º to the southeast and northwest and display long term slip rate of less than 0.2 mm/year.

Based on the definition presented in TR-210-60 (NRCS, 2019a), faults associated with the KTFZ and SKC zones could be considered “active faults” due to recent induced seismicity resulting from hydraulic fracturing operations. However, published literature has not identified any surface expression from these faults resulting from the induced seismic events – that is, the faults are not visible at the surface even after an earthquake event.

The Quaternary Faults and Folds Database does not identify other active faults or fault zones within 100 miles of the project site.

2.5.4 Seismicity

As required by the current TR-210-60 (2019a), a map of recent and historic earthquakes within a 100-kilometer (approximately 62-mile) radius of the site is provided as **Figure 6**. Earthquakes are presented in terms of Moment Magnitude (M), which may have been estimated from historic earthquakes (United States Geological Survey [USGS] and University of Texas Institute for Geophysics [UTIG] et al. 2013). Most recorded earthquakes within the 100-kilometer radius were of relatively low magnitude with M≤4. The strongest recorded earthquake in the area occurred in 2011 in northwestern Karnes County, about 10 miles west-northwest of the site, with Magnitude 4.8. An additional 3 earthquakes (one in 1993 with M=4.1 and two in 2023 and 2018 both with M=4.0) were also recorded in Karnes County to the north and/or west of the site.

Prior to conducting the current field investigation, a screening-level analysis was performed to evaluate the potential need for special field investigation procedures to characterize seismic hazards (e.g., liquefaction, cyclic softening, potential for seismic loading). The screening procedure was conducted according to Table 2-5 of the *National Engineering Handbook (NEH), Part 631, Chapter 2, Engineering Geologic Investigations* (Natural Resources Conservation Service [NRCS] 2012a). Based on the inundation of 1 main highway and no loss of life for a sunny day, normal pool dam breach during a seismic event, the structure would fall into a significant consequence category; therefore, requiring design for the 2% probability of exceedance in 50 years (2,500-year return period) probabilistic peak ground acceleration (PGA), respectively. The 2% probability of exceedance in 50 years earthquake event (2,475-year return period) was estimated to provide a screening of the seismic evaluation.

Seismic hazard data for the site were obtained from the online USGS National Seismic Hazards Mapping Tool. Based on the deaggregation of seismic hazard, the PGA for a site underlain by "rock" (i.e., B-C boundary where the shear-wave velocity in the upper 30 meters of depth, V_{s30}, is approximately 2,500 feet per second with shear-wave velocity measurements) is 0.0282g for the 2% in 50 year earthquake event (2,475-year return period) and 0.0284 g for the 2% in 50 year earthquake event (2,500-year return period) at the project site. The deaggregation data are provided in **Appendix B**. Based on Table 2-5 of NEH, Part 631, Chapter 2 (NRCS 2012a) all dams regardless of hazard class and height with a PGA less than 0.10g for the 2,475-year event do not require additional seismic evaluation. Therefore, special seismic investigation measures (e.g., shear wave velocity measurements, evaluation of liquefaction potential, etc.) were not incorporated into the investigation plan.

For design-level evaluations of seismic hazard, analyses of site seismicity should be conducted in accordance with TR-210-60 (NRCS, 2019). This analysis includes an evaluation of the design PGA based on the seismic site class and consequences of seismic failure of the dam. Recommendations are presented in **Section 5**.

2.5.5 Expansive Clays

As anticipated for Central Texas, the project site is located in an area with high predominance of expansive soils. Expansive soils exhibit significant shrink and swell behavior with fluctuations in moisture content. Accordingly, soils with moderate to very high shrink-swell potential are anticipated to be underlying the site. This risk was noted in the 1954 SCS Work Plan which stated the clays are highly montmorillonitic and should be used only in the embankment center sections. This is consistent with the description of the primary formations (Oakville) as being composed of volcanic ash and bentonitic materials.

2.5.6 Dispersive Clays

No visible sign of dispersive clays such as erosion patterns that create a badland topography were noted in the site inspection.

2.5.7 Karst Hazard

The Oakville Sandstone is not susceptible to long-term dissolution, a chemical process that produces karst conditions. Accordingly, karst and soluble rock beneath the proposed site are not anticipated.

2.6 Previous Investigations

2.6.1 Soil Conservation Service – 1954 Work Plan and As-Built Drawings

The original geologic investigation (GI) for the design of Escondido 1 was conducted by the former Soil Conservation Service (SCS, presently known as the NRCS) in 1954 prior to construction of the existing dam as a part of the overall watershed management. A single investigation was conducted covering several dam sites in the watershed as part of the work plan. No standalone site-specific investigation was prepared for Escondido 1.

The 1954 Escondido Creek Watershed Work Plan (SCS 1954) describes the foundation of the Escondido Creek Watershed dams (including Escondido 1) as exclusively in the Oakville sand formation, which is further described as containing interbedded silts and clays as well as sand. In addition, the 1954 Work Plan states that chalk and caliche outcrops are expected to occur on the surface, especially on the tops of hills. Valley slopes are described as principally residual silty clays and sandy clays and underlain by beds of clay and sand. An additional generalization for the dams was made regarding preliminary recommendations. The concern was for clays along the dam's centerlines and in the abutments as being underlain by a sandy member of the Oakville formation. The report also mentioned varying deposits of loose sands with small amounts of gravel being found, but the report also states that these materials should be removed during construction.

The as-built drawings for Escondido 1 provided subsurface profiles of the site with boring "stick" logs from the pre-construction investigation with generalized soil types. The investigation consisted of the following:

- 16 borings along the dam centerline (Hole numbers not legible/provided on the as-built drawings)
- 6 borings along the auxiliary spillway (Hole Nos. 201, 235, 251, 252, 254 and 255); and
- 30 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 180)

The complete investigation report containing the Escondido 1 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1954 by the SCS were the only source of site-specific geologic information available to AECOM and were used to develop a generalized understanding of the subsurface conditions at Escondido 1. Based on this documentation, the existing dam foundation consists of calcareous, sandy to silty clay with trace marl (identified near the principal spillway conduit only) and moist to saturated, clayey to silty sand with trace gravel.

The as-built drawings indicate that the embankment was to be constructed of fine-grained materials, but little information is available for the single-zoned homogeneous embankment except for the borings from the original borrow area. The stick logs indicate clay layers of varying thickness from 2 to 10 feet thick underlain and/or interspersed with sand layers. The stick logs indicate the clay contained sand, silt, and calcareous inclusions with no indication of percentages.

Based on review of Escondido 1 as-built drawings and the available geologic stick logs of borings in the ASW, the spillway channel invert was excavated to a maximum depth of about 9 feet below original grade, exposing sandy to silty calcareous clays interbedded with calcareous sands and clayey sands estimated to be 0.5 feet to 8 feet thick.

No groundwater was encountered at any of the borings during the investigation. It should be noted that groundwater levels may vary over time and may have a significant impact on potential ASW modifications.

2.6.2 NRCS – 2022 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on February 22, 2022, by the NRCS part of the routine dam safety inspections for the River Authority (NRCS 2022). The inspection identified several deep animal burrows along the dam embankment as well as the possible slope slide in the very early stages over the principal spillway alignment on the downstream slope. In addition, a tree has taken root in the embankment. The PSW and ASW were noted as being in good condition. The ASW was noted as having generally good vegetative cover with some sparse areas.

Photographs in the inspection report depicted good vegetative coverage with native grasses throughout the dam.

The 2022 inspection concluded that Escondido 1 was performing as designed, but due to urban encroachment and updated TCEQ hydraulic criteria, it qualifies for assistance through the watershed rehabilitation program intended to bring this dam to safety standard for high hazard dams.

3. Field Geologic Investigation

3.1 Geologic Reconnaissance

A limited geologic reconnaissance was conducted by an AECOM Geologist in Training (GIT) on June 12, 2023. The limited reconnaissance included prior desktop review of available data (aerial photos, topography, geologic maps, etc.), and a visual walk-over of the dam site to document surficial geologic features at the site and to identify any signs of adverse dam performance, particularly along the ASW channel. The limited geologic reconnaissance was intended to aid in erodibility analyses of the ASW and to supplement preliminary viability studies of potential on-site borrow sources for possible rehabilitation purposes.

The visual walk-over did not identify surface evidence of slope instability (slumps, sloughs, scarps, desiccation cracks) along the dam embankment slopes. However, minor animal burrows and ruts were noted along the embankment crest and upstream slope face of the embankment, consistent with NRCS inspection reports. No areas of excessive wetness, or changes to vegetative growth as a result of excess and/or flowing water resulting from seepage through and/or underneath at the dam were observed. No erosion features typical of dispersive soils (e.g., jugholes or “badlands” surface erosion) were observed. Adequate vegetative cover was observed throughout the site.

Review of aerial images available on Google Earth Pro, dating back to 1995, indicate that significant changes to the dam site have not occurred since at least that year. The images also indicate that the reservoir storage is consistently below the intake tower, and at times is nearly dry. During the dryer years, the historic channel is visible and can be seen passing through the location of the existing foundation drain outlet and relief wells (2014, 2019, 2022 most recently).

3.2 Geologic Investigation Summary

Four (4) geotechnical test borings designated as 201-23 through 204-23 were drilled in the ASW channel located generally along the ASW centerline. The borehole locations are shown in **Figure 7** with depths summarized in **Table 1**.

The purposes of these borings were to support the characterization of the ASW subsurface conditions, including identification of potential for dispersive/erodible soils, characterizing the depth to bedrock for excavatability purposes, and developing estimates of headcut erodibility indices for SITES analysis of the ASW.

The rehabilitation alternative presented in the 2014 dam assessment (AECOM, 2014) was developed with historical data only, and the no-breach case for the ASW needs to be confirmed from the 2014 assessment since the alternative was assumed to be feasible because the model showed the ASW not breaching. As such, to develop estimates of the SITES analysis input parameters, representative samples of each geologic stratum were subjected to index testing (moisture content, Atterberg limits, sieve analysis with hydrometer), dispersion testing, natural density, and unconfined compression testing on relatively undisturbed Shelby tube samples.

A secondary purpose of the borings was to aid in evaluation of the suitability of materials from possible excavations in the auxiliary spillway for use as a borrow source for earthfill. Bulk samples were collected from auger cuttings and subjected to laboratory testing including index properties, moisture-density relationship (Standard Proctor compaction), and engineering properties on remolded samples (shear strength, etc.) for the purpose of rehabilitation fill suitability evaluation.

3.3 Staking, Utility Locates, and Survey

All boring locations were staked in the field by the AECOM GIT as part of the limited field geologic reconnaissance. Global Positioning System (GPS) coordinates were obtained by handheld unit by the AECOM field representative at the time of drilling. The final drilled locations were at approximately the same locations staked during the site visit.

Texas One Call (811) utility location service was contacted prior to drilling or ground disturbing activities. The utility locates did not identify the presence of buried utilities in close proximity to the boring locations. The local sponsors were responsible for notifying property owners affected by the field investigation.

3.4 Test Borings

3.4.1 Drilling and Sampling Methods

Drilling was performed by Texas Geobore, who was subcontracted by Arias & Associates, Inc. (ARIAS) of San Antonio, Texas, under subcontract to AECOM. An AECOM GIT (AECOM Site Supervisor) was present on site full-time during the field GI. The AECOM Site Supervisor was responsible for monitoring subcontractor drilling and sampling activities, classifying soil/rock samples, packaging samples, and preparing handwritten logs of borings. ARIAS transported soil/rock samples to their geotechnical testing laboratory. A truck mounted rig (Mobile B57) was used for the investigation.

Soil test borings were advanced through unconsolidated (soil-like) materials using a 3 7/8 inch Polycrystalline Diamond Compact (PDC) drill bit and air-rotary drilling methods. Soil samples were collected in 2-foot intervals in the upper 15 feet and at 5-foot intervals thereafter until bedrock was encountered. Rock coring was performed thereafter to completion. Primary sampling methods utilized are listed below; detailed sampling methodology is provided in the Field Investigation Plan (AECOM, 2023).

- Standard Penetration Test (SPT) split spoon sampler in general accordance with ASTM D1586 (ASTM Standard D1586 2018).
- Shelby Tubes (laboratory extruded) in accordance with ASTM D1587-08 (2012) e.1, *Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soil*.
- Push tubes (field extruded) generally consisting of Shelby tube samplers requiring field extrusion of samples. Push tube sampling was conducted according to ASTM D1587.
- Bulk Samples Large-volume bag samples were collected from auger cuttings in borings located in the auxiliary spillway, for the purposes of evaluating the suitability of excavated soils for use as borrow source.
- Rock cores were obtained in accordance with ASTM D5079, *Standard Practices for Preserving and Transporting Rock Core Samples*.

The number of blows required to advance the split spoon barrel sampler a depth of 18 inches was counted for each 6-inch interval. The number of blows required to drive the sampler the last 12 inches is referred to as the “N-value” and was reported in units of blows-per-foot. Practical refusal conditions were generally considered to be 50 blows or greater per 6 or less inches of penetration with an SPT split spoon sampler. An automatic trip hammer was used for the field investigation. While an SPT hammer energy calibration report was not available, the driller provided a hammer energy calibration report for the Texas Cone Penetrometer hammer on the same drill rig which indicated 89% hammer efficiency. Based on AECOM’s experience, an energy correction of 80%

hammer efficiency is typical for SPT autohammers like that used on this project, and thus 80% efficiency was adopted for analysis. The energy calibration report is provided in **Appendix C**.

Sampling with 4.5-inch OD, thin-wall Shelby tubes (ASTM Standard D1587 2015) was performed in select intervals of fine-grained soils to collect relatively undisturbed samples for advanced laboratory testing using a conventional open tube push sampler.

Bulk samples were collected from drill cuttings at the surface for the purposes of evaluating borrow source suitability from potential spillway excavation and to allow laboratory testing on remolded samples.

Upon reaching practical SPT refusal, rock coring methods were employed to advance borings to termination depth. Rock was sampled continuously in 5-foot runs using HQ-size, double-tube core barrel (NQ2) wireline coring techniques. The NQ2 coring produced 2-inch diameter core samples from a 3.5-inch diameter excavation. The core bit used was a diamond impregnated bit specifically manufactured for hard rock drilling.

3.4.2 Borehole Logging and Sample Preservation

An AECOM GIT provided full-time monitoring of field drilling and sampling activities. The geologist prepared field boring logs, classified soil and rock samples in the field, and labeled and packaged soil and rock samples for transport.

Each soil sample was classified in the field based on the observed texture and plasticity in general accordance with the USCS and NRCS guidelines. Pocket penetrometer testing was performed on the exposed end of Shelby tube samples. Logs of the borings are provided in **Appendix D**. Note that the final boring logs were updated to include index test results from the laboratory testing program.

Disturbed soil samples were placed in plastic bags to minimize moisture loss and labeled for subsequent identification and testing. Shelby tube samples were sealed with plastic end caps secured with electrical tape and were labeled for subsequent identification in the laboratory.

Rock samples were classified in the field in accordance with NRCS guidelines (NRCS, 2012b). Hydrochloric acid (HCl) was applied to select core sample intervals suspected of containing calcareous or carbonate components to check for reaction level. Rock core samples were placed in labeled corrugated, wax-coated cardboard core boxes and photographed in the field. Photographs of the rock core samples are provided in **Appendix E**. Following completion of the field investigation, ARIAS transported the soil and rock samples to their laboratory in San Antonio, Texas. An AECOM Professional Engineer reviewed the field borings logs and photos of the recovered rock core samples. An inventory of samples is provided in **Table 2**.

3.4.3 Groundwater Measurements

In the event water was encountered, test holes were to remain open for the remainder of the workday so that a more-stable groundwater level could be recorded with an electronic water level meter. If water was not encountered, “Not Encountered” is indicated on the boring log. Groundwater was not encountered at any of the boring locations and drilling fluid levels were not measured at borings where rock coring was attempted. A summary of groundwater measurements at the time of drilling is provided in **Table 1**. The geologic investigation did not include the installation of piezometers for monitoring groundwater levels over time.

3.4.4 Borehole Backfilling

The test holes were abandoned by backfilling with cement-bentonite grout mixture (5% bentonite by weight of cement) placed by tremie methods from the bottom of the drill hole to the ground surface. Excessive grout takes were not observed during backfilling.

3.5 Laboratory Testing

Soil and rock samples retrieved from the borings were packaged in the field to minimize moisture loss and were transported by ARIAS to their geotechnical laboratory in San Antonio, Texas. Based on the AECOM Professional Engineer's review, select soil and rock samples were identified for further classification, description, and testing. Laboratory test assignments for select samples were developed by AECOM and the results will be presented in the Preliminary Soil Mechanics Report (SMR) under separate cover.

4. Subsurface Conditions

The following subsections discuss soil stratigraphy and subsurface conditions encountered during the geologic investigation.

4.1 Generalized Stratigraphy

A geologic profile of the field data is presented in **Appendix F**. The profile illustrates the existing ground surface (from LIDAR data) and abridged boring (stick) logs indicating field USCS classification, pocket penetrometer values, SPT N-values, rock core recovery and RQD, and groundwater levels measured at time of drilling.

Subsurface conditions encountered in the borings was generally consistent with the published geology, the stick logs included on the as-built drawings, and the geological descriptions provided in the Escondido Watershed workplan. The borings encountered interbedded clays, silts, and sands generally overlying interbedded sand. The generalized stratigraphy included clay layers (an upper layer and a lower layer) overlying the Sand and Sandstone layer. The interbedded sands and clays, and sandstone layers are consistent with the Oakville Sandstone Formation literature descriptions.

While the NRCS soil survey mapping shows alluvium and residuum soils within the ASW channel, it is possible the excavation of the ASW channel during dam construction may have likely removed the alluvial soils. As-built drawings (SCS, 1954b) indicate that the existing ASW forebay and channel were excavated approximately 5 to 9 feet along the centerline for over 700 feet of the ASW channel removing surficial soils, and at shallower depths the remaining length of the ASW channel. Based on this information and the observed and measured characteristics of the recovered soil samples, AECOM did not consider the soils to be alluvial in nature. AECOM's interpretation is that the clayey materials encountered in the investigation are residual soils, which is consistent with the work plan description of the silty clays and sandy clays that make up the valley slopes where the ASW is located; however, the NRCS soil descriptions, typical index properties, and physical properties for the near surface residuum soil are not consistent across the entire stratigraphy encountered in this GI. AECOM, therefore, relied more extensively on the historical description from the SCS workplan (1954a) when determining the soils to be residuum. Furthermore, it is noted that since other sections of the site have not been excavated to the extent of the ASW, alluvium may be present at other locations which were not included in AECOM's investigation.

4.1.1 Upper Clay Layer (Residuum)

The geologic investigation encountered approximately 8 to 16 feet of fat clay (CH) below the surface in 3 out 4 borings. The Upper Clay materials were described as fat clay to sandy fat clays with iron oxide staining and calcareous inclusions. The Upper Clay soils encountered were generally light gray to light brownish gray, stiff to hard, dry to moist, and strong to no reactions to hydrochloric acid (HCL). It should be noted that the Upper Clay was classified in the field by the AECOM geologist as lean clay (CL); however, classifications shown on the boring logs were modified to fat clay (CH) to match laboratory testing results.

4.1.2 Lower Clay Layer (Residuum)

The geologic investigation encountered approximately 6 to 22 feet of lean clay (CL) below the upper fat clay layer. In boring 204-3 the Upper Clay layer was not encountered and in boring 202-23 the boring terminated in the Lower Clay layer. The Lower Clay materials were described generally as lean clay to clayey sands with iron oxide staining and calcareous inclusions. The Lower Clay soils were generally light brownish gray to light yellowish brown, stiff to hard, dry to moist, and weak to strong reactions to HCL. It should be noted that the Lower Clay was sometimes classified in the field by the AECOM geologist sometimes as clayey sand (SC) to poorly sand (SP); however, classifications shown on the boring logs were modified to lean clay (CL) or clayey sand (SC) to match laboratory testing results.

4.1.3 Sand and Sandstone (Oakville Sandstone)

The Sand and Sandstone layer encountered had varying degrees of uncemented sandy soils and cemented sandstones. Only one sand layer was sampled above the sandstone in boring 204-23 and was described as a clayey sand (SC). An additional sample was taken in boring 203-23 below an initial attempt to core the sandstone material, and this sample was classified as SC as well. Bedrock that consisted predominantly of sandstone was encountered below the clay layers. Sandy soils were encountered in all four borings drilled in the ASW, but sandstone bedrock was only identified in three of the borings. The sandstone was described as medium grained quartz sandstone, slightly to moderately weathered, medium strong to weakly cemented, slightly calcareous, fractured, thinly bedded, and light gray to light brownish gray in color. Characteristics of the bedrock such as the light gray color, medium grain size, quartz and chert content, and clay stringers that were observed in the recovered core samples matched published data descriptions of the Oakville Sandstone formation.

Further description of the stratigraphy at specific locations of the project site are provided in the following sections.

4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were added to the borings for the rock coring intervals. Drilling fluid levels were not measured after coring. This was due to the practice of waiting after a coring run was complete before pulling the drill string out of the boring to enhance core recovery. Boreholes were backfilled with cement bentonite grout at the end of drilling; as a result, subsequent delayed readings were not recorded.

4.3 Auxiliary Spillway

Borings 201-23 through 204-23 were drilled along the centerline on the auxiliary spillway. The existing ground surface elevation in the vicinity of the borings ranged from approximately 355 to 390 feet; note that the ASW was excavated approximately 5 to 9 feet along the centerline for over 700 feet of the ASW channel removing the surficial soils. The borings were drilled to depths ranging from 25 to 40 feet bgs. Groundwater was not encountered at the time of drilling in any of the borings.

The borings encountered approximately 10 to 20 feet of clay, except boring 202-23 which terminated in clay at 40 feet bgs. Clay materials were described generally light gray and light brownish gray to light yellowish brown, dry to moist, stiff to hard, lean clay to fat clay (CL to CH) and some sand clay (SC) with trace amounts of silt, gravel, and organics.

The SPT N-values in the clay layers ranged from 8 to 60 bpf, increasing with depth, with an average of 33 bpf. Pocket penetrometer readings were generally greater than 4.5 tsf with a single recorded reading of 4.0 tsf on a shallow push sample recovered from boring 203-23. The SPT N-values in the sandy soils ranged from 18 to 62 bpf and had an average of 40 bpf (only two SPT tests were conducted in the Sand and Sandstone layer).

Bedrock, defined as SPT and/or Shelby Tube refusal or visual determination, was encountered in borings 201-23, 203-23, and 204-23. In 201-23, bedrock was identified at 15 feet bgs (El. 360.5

feet), in 203-23 at 22 feet bgs (El. 348.5 feet) and in 204-23 at 14 feet bgs (El. 343). Bedrock was not encountered in borings 202-23.

The bedrock identified consisted primarily of sandstone believed to be of the Oakville Sandstone Formation. The bedrock was generally fresh to moderately weathered, fractured, thinly bedded, slightly calcareous with some iron oxidation visible. Bedding and joints were generally horizontal but ranged from 0 to 5°. Recovery of bedrock ranged from 13% to 82% (average 37%), and RQD ranged from 0 to 70% (average 26%). The attempt was made to core softer materials based on visual determination versus solely relying on SPT or Shelby tube refusal. However, the soft rock was difficult to core without disturbance and/or washout, and as a result, recovery and RQD of the bedrock material was low. In the case of boring 203-23, the recovery was 0% for Run 2, so an SPT test was completed after the coring attempt. Recovery for that sample was 100% and an SPT N-value of 62 bpf. This sample had visual evidence of weak cementation, so the classification of sandstone was maintained, although the behavior of the material could be considered as more soil-like (see Section 5.3). One UCS results from the cored sandstone had a strength value more closely associated with a very stiff soil than bedrock, reinforcing the consideration of the material as soil-like. The interbedded Sands and Sandstone layers are consistent with the Oakville formation literature descriptions.

5. Interpretations and Conclusions

5.1 Seismic Characterization

Seismic site characterization was performed according to the guidance in TR-210-60 (NRCS 2019a). The document specifies that conventional seismic analysis be performed for sites with PGA equal to or exceeding 0.07g for the seismic event associated with the dam's consequence of seismic failure (conservatively taken as the dam's hazard potential classification herein). Because this dam is designated as high hazard, the 0.5% probability of exceedance in 50-year earthquake event (10,000-year return period) is considered appropriate for design-level evaluations. Based on a deaggregation of seismic hazard using the online USGS National Seismic Hazards Mapping Tool, the PGA for this 10,000-year event is 0.0757g for the top of competent rock. The deaggregation output from the USGS website is provided in **Appendix B**.

The PGA obtained from the USGS National Seismic Hazards Mapping Tool is for general Site Class B/C (rock, Vs30 equals 2,500 feet per second). The mapped Class B/C PGA was corrected to site-specific conditions. Based on the weighted average N-values of the soil borings, the site was determined to be Seismic Site Class C. The PGA amplification factor of 1.2 was used to calculate the adjusted PGA following 210-NI-Part 302 Interim Guidance for Seismic Hazards (NRCS 2021). Therefore, the resulting design peak ground acceleration, PGA_{Design}, is 0.0908g.

The resulting PGA_{Design} is greater than 0.07g, and therefore future studies for rehabilitation final design should evaluate the potential for loss of shear strength due to liquefaction or cyclic failure of the foundation and embankment soils as noted in TR-210-60 (NRCS 2019a). Alternatively, future studies may determine if the site classifies as one with limited loss of strength (i.e., well-built embankment dam on rock or dense soil) which is exempt from seismic analysis per TR-210-60. The current investigation was limited in scope to only the auxiliary spillway, and as such, cannot determine if the site would classify as one with the potential for significant or limited loss of strength.

5.2 Auxiliary Spillway

The existing footprint of the auxiliary spillway is underlain by unconsolidated materials consisting of clays, sands, and sandstone. Sand and Sandstone layers are anticipated at depths of about 12 to 22 feet below existing grade. Groundwater was not encountered and is therefore not anticipated at to at least depths of 20 to 40 feet bgs. Uniform vegetative cover was generally observed throughout the existing auxiliary spillway.

Preliminary hydraulic evaluation of the leading rehabilitation design alternative developed as part of the present SWP-EA proposes raising the top of the dam by 3.13 feet, flattening the downstream slope to a 3H:1V, and replacing the existing principal spillway conduit with a 42-inch diameter conduit. While this alternative does not require changes to the existing footprint of the ASW, it results in increased flow velocities through the ASW channel which, in turn, requires armoring the lower portion of the auxiliary spillway channel with ACBs to mitigate erosion.

For planning purposes, the minimum depth of overexcavation to install ACBs will likely be approximately 1 foot for topsoil removal. Additional overexcavation may be required to install bedding layers for the ACBs, remove unsuitable subgrade materials, and/or to accommodate proposed final grading. Excavations up to 5 feet deep are not expected to encounter bedrock or groundwater. Accordingly, general excavation quantities will likely be classified as "common excavation" (except as noted).

Additional considerations regarding rehabilitation of the ASW include the re-establishment of robust vegetative cover following construction to improve spillway performance and reduce flows through the channel in case of ASW activation. Regular management of the ASW vegetative cover should be performed to prevent the growth of woody vegetation such as trees and shrubs which can disrupt flow in the channel (due to turbulence, for example). Design specifications should indicate types of grass seed that are well-suited to the local climate, and which will minimize soil exposure to erosion caused by rainfall, surface runoff, and spillway flows. Recommendations on material and placement criteria should be provided in a final design SMR, currently outside of AECOM's scope of work for this project.

5.2.1 Headcut Erodibility Index

Hydraulic analysis and design of vegetated earthen or rock spillways are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event. SITES input values include USCS soil type, soil dry unit weight, plasticity index, clay fraction, representative diameters D75 and D50, and the empirical headcut erodibility index (Kh).

Development of recommended material parameters for SITES analysis was performed according to the guidance provided in the *National Engineering Handbook, 210-VI-NEH, Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index* (NRCS, 2001) and the accompanying *DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons* (NRCS, 2011). SITES parameters presented herein were estimated based on field visual classification, SPT N-values, pocket penetrometer readings, available laboratory test data, NRCS Websoil Survey data, past experience, and professional judgement.

Materials considered in the evaluation included those encountered beginning near the proposed finished-grade elevation of the ASW channel surface and extending down below the valley bottom elevation at the downstream exit channel. Material parameters were developed for each of the generalized strata units described previously, as well as for potential proposed fill material from on-site sources that may be needed with proposed rehabilitation spillway modifications. In summary, these included the following: 1) Upper Clay, 2) Lower Clay 3) Sand and Sandstone and 4) Proposed Fill (ASW Borrow). Representative values for each stratum were selected on an approximate best fit between the 33rd and 50th percentile values, as is consistent with typical geotechnical engineering practice. Recommended parameters for preliminary analysis are presented in **Table 3**. Supporting calculations are provided in **Appendix G**.

All materials were considered to be soil-like in analyses. SITES parameters for the two clay stratums were estimated based on the results of 19 field standard penetration tests, which were correlated to obtain an estimated Su value, correlations from liquidity indices, 6 unconfined compression tests (UC), and 2 unconsolidated-undrained tests (UU).

Estimates for the Proposed Fill from the ASW excavation is typically estimated by performing laboratory UC or UU tests on remolded samples compacted to target moisture content and density that simulate typical values of earthfill construction compaction specifications. However, sufficient quantity of material was not available to complete the remolded strength tests. Consequently, the strength of the Proposed Fill was estimated based on experience from prior projects for similar soils remolded to similar moisture/density, informed by the maximum dry density and optimum moisture content from site-specific Standard Proctor test results and one undisturbed UC test result in the Upper Clay layer. The Ms values was then estimated from the assumed strength value.

As mentioned above, the Sand and Sandstone layer was considered more soil like in analyses and SITES parameters were estimated primarily based on the results of 2 standard penetration tests and 1 uniaxial compressive strength test. For all materials, engineering judgement was applied to the results based on published ranges in Chapter 52 (NRCS 2001), and the final selected Kh values were adjusted accordingly.

5.3 Earth Embankment Fill Sources

Desktop review of the topography in the vicinity of Escondido 1 suggests a shallow borrow area may be feasible upstream of the embankment within the reservoir. AECOM recommends that all borrow areas within the basin be located at least 200 feet upstream of the upstream toe of the embankment. Borings drilled in the ASW channel indicate the presence of 10 to 20 feet of unconsolidated clay soils that may be suitable as a borrow source for possible embankment fill. Fat clays and sandy fat clays (CH) with varying amounts of calcareous inclusions were identified between the existing ground surface and depths of up to 16 feet below existing grade. A lean to sandy lean clay (CL) layer was identified below the CH layer to depths of 20 to 40 feet. Because excavations (if any) would likely remain above the water table (not encountered in any of the borings), dewatering is not anticipated to be required. The historically low reservoir is anticipated to make identified borrow areas upstream within the reservoir footprint more accessible.

Classification testing, as well as engineering properties testing on remolded bulk samples from the ASW borings, were performed as part of the laboratory investigation for the preliminary SMR to confirm suitability of these materials. The estimated volume of cuts and fills is the responsibility of the project civil designer. Once this information is available, AECOM can provide guidance on estimated proportion of available borrow materials in any proposed excavation. In addition, AECOM can, then, evaluate whether soils from the ASW are suitable for use as borrow and determine if additional borrow sources may be required. It should be noted, however, that based on the borings drilled in the ASW as part of this field GI, materials available from possible excavation would provide some quantity of suitable material, although the higher plasticity of the shallower clay would possibly require some mitigation for an embankment raise. A raise of the zoned embankment would likely require identification of additional borrow sources outside of any ASW excavation to meet anticipated quantities.

According to the original workplan (SCS, 1954), the borrow materials were described as consisting of “principally fine-textured materials with occasional thin sandy zones”. The as-built drawings provided stick log borings of the upstream borrow area while current Google Earth imagery show what appears to be a borrow area approximately 200 by 400 feet to the right of the existing channel. The stick logs indicate clay layers of varying thickness from 2 to 10 feet thick underlain and/or interspersed with sand layers. The sticklogs indicate the clay contained sand, silt, and calcareous inclusions with no indication of percentages. Bedrock was not encountered, and groundwater levels were not shown on the plans.

5.4 Considerations for Further Study

This section describes evaluations that are outside of AECOM’s current scope but may be needed for final design of dam rehabilitation or decommission alternatives at Escondido 1.

5.4.1 Final Design of Dam Rehabilitation or Decommission

Final design recommendations for proposed dam rehabilitation or decommission alternatives should be provided under a final design SMR, which is outside of AECOM’s current scope of work. In addition, supplemental GI and preparation of a final design GIR may be necessary to support design evaluations, particularly for existing dam embankment and proposed modifications.

5.4.2 Seepage and Existing Foundation Drainage System

Investigation of the existing embankment and foundation were beyond the scope of this report. However, review of the historical borings from the as-built drawings indicated shallow sand layers underneath the dam embankment and at the downstream dam toe. The as-built drawings indicate that the embankment was to be constructed of fine-grained materials, but little information is available for the single-zoned homogeneous embankment except for the borings from the original borrow area. The borrow borings indicate also indicate there were locations of shallow sand in the borrow. Future investigations should evaluate the potential for under-seepage and/or through-seepage.

The as-built drawings indicate foundation drainage features were incorporated during the original construction in 1954, with supplement drainage features install in 1961. The 1954 drainage feature is a trench extends form Station 8+00 to 12+45. The 1961 drainage feature includes a trench and 3 relief wells from station 12+45 to approximately Station 13+15. The as-built drawings detail the drainpipe as a galvanized corrugated sheet metal pipe. Galvanized metal pipes typically have design lives less than 50 years. Combined with the elevated soil corrosion potential as indicated by the laboratory testing for the current study (see Preliminary SMR), the existing foundation drainpipe is likely beyond its useable life. Future investigations should evaluate the existing condition of the pipe material and assess whether it needs to be replaced.

Additionally, the filter material surrounding the 1954 drainpipe is detailed as a gravel filter and may not meet current filter criteria if the embankment is made of fine-grained materials. If filter criteria are not satisfied, the fine-grained embankment/foundation material may be susceptible to piping and erosion through the existing gravel drainage system. Future investigations should consider sampling the drain material and embankment and foundation materials to evaluate gradations and filter compatibility.

6. Limitations

This report was prepared by AECOM using the degree of care and skill ordinarily exercised under similar circumstances by responsible engineers and geologists practicing in the same general location. No other warranty or representation, either expressed or implied, is made as to the findings and professional advice in this report.

The opinions, conclusions, and recommendations contained in this report are based on the field observations and subsurface explorations, laboratory tests, and present understanding of the proposed improvements. The findings in this report are believed to describe site conditions to the extent practical given the scope of the investigation. However, this investigation, like all such investigations, can directly explore subsurface conditions only at the boring locations within the site. Soil and geologic conditions can vary greatly between or beyond the exploration sites, and different conditions may be found during subsequent investigations or project construction.

The conclusions and recommendations contained herein are based in part upon information provided by others (including our subcontractors) and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information provided to AECOM has not been independently verified by AECOM, unless otherwise stated.

There is no intention that this report addresses environmental issues (for example, environmentally affected soil or groundwater, or historic site uses) related to this site. Such evaluations are outside the scope of this work and should be addressed in separate studies by appropriate professionals. In the event that changes are made to the nature, design, or location of the proposed construction layout or design criteria, the conclusions and recommendations presented herein should not be considered valid, unless and until AECOM reviews the changes and addresses their impact to the recommendations provided.

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TABLES

Table 1. Summary of Borings

Test Hole No.	Estimated [1] [2] Ground Elev. (ft)	Northing (ft) [3]	Easting (ft) [3]	Total Depth (ft)	Depth to Bedrock (ft)	Bedrock Elevation (ft) [2]	Groundwater Depth at Time of Drilling (ft)	Drill Hole Completion [4]
201-23	375.89	13467941.2	2321604.3	25.0	15.0	360.89	NE [5]	Cement Bentonite Grout backfill
202-23	377.35	13468162.9	2321451.6	40.0	NE	--	NE	Cement Bentonite Grout backfill
203-23	370.46	13468558.5	2321542.8	31.5	30.0	340.46	NE	Cement Bentonite Grout backfill
204-23	355.67	13468939.3	2321843.4	20.0	14.0	341.67	NE	Cement Bentonite Grout backfill

Notes:

(1) Ground elevation estimated from LiDAR contours (https://datagateway.nrcs.usda.gov/GDGOrder.aspx)
(2) Elevations reported with respect to NAVD88 datum.
(3) GPS coordinates from Google Earth Pro; converted to Northing and Easting.
(4) Grout mix: 3 bags (90 lb/ bag) of Portland cement and 3/4 bag (50 lb/bag) of bentonite.
(5) NE- Not Encountered

Table 2. Sample Inventory

Boring ID	Top Depth (ft)	Bottom Depth (ft)	Sample ID	Sample Type - see legend	Recovery (inch)	Field Classification	Laboratory Classification
201-23	0	1.5	SS-1	Split-Spoon	14	CL	CH
"	2	4	ST-2	Shelby Tube	19	CL	CH
"	4	6	P-3	Push Tube	12.5	CL	--
"	6	8	ST-4	Shelby Tube	12.5	CL-ML	CH
"	8	9.5	SS-5	Split-Spoon	18	CL	--
"	10	12	P-6	Push Tube	14	CL	--
"	12	14	ST-7	Shelby Tube	8	CL	CL
"	15	20	RC-1	Rock Core	49	Sandstone	--
"	20	25	RC-2	Rock Core	24	Sandstone	--
"	0	3	B-1	Bulk	--	--	--
"	3	5	B-2	Bulk	--	--	--
202-23	0	2	P-1	Push Tube	16.5	OL	--
"	2	3.5	SS-2	Split-Spoon	12	CL	--
"	4	6	P-3	Push Tube	12	CL	CH
"	6	7.5	SS-4	Split-Spoon	12	CL	--
"	8	10	ST-5	Shelby Tube	14	CL	CH
"	10	12	P-6	Push Tube	9.5	CL	--
"	12	13.5	SS-7	Split-Spoon	14	CL	--
"	14	16	P-8	Push Tube	11	CL	--
"	18	18.5	ST-9	Shelby Tube	5.5	CL	CL
"	18.5	20	SS-10	Split-Spoon	8	CL	--
"	25.5	27	SS-11	Split-Spoon	18	SM	CL
"	28.5	30	SS-12	Split-Spoon	17.5	SM	--
"	32	33.5	SS-13	Split-Spoon	17	CL	--
"	34	35.5	SS-14	Split-Spoon	18	CL	CH
"	38.5	40	SS-15	Split-Spoon	18	CL	--
"	0	3	B-1	Bulk	--	Bulk	--
"	3	5	B-2	Bulk	--	Bulk	--
203-23	0	2	ST-1	Shelby Tube	18	CL	CH
"	2	3.5	SS-2	Split-Spoon	16	CL	--
"	4	6	P-3	Push Tube	19.5	CL	CL
"	6	6.5	ST-4	Shelby Tube	6	CL	CH
"	6.5	8	SS-5	Split-Spoon	16	CL	--
"	8	9.5	SS-6	Split-Spoon	14.5	CL	--
"	10	12	P-7	Push Tube	13.5	CL	CL
"	12	13.5	SS-8	Split-Spoon	15.5	CL	--
"	14	16	P-9	Push Tube	8.5	CL	CL
"	16	16.5	ST-10	Shelby Tube	6	SP	--
"	16.5	18	SS-11	Split-Spoon	18	SP	SC
"	20	21.5	SS-12	Split-Spoon	18	SP	--

“	22	22.5	RC-1	Rock Core	8	Sandstone	--
“	25	30	RC-2	Rock Core	--	--	--
“	30	31.5	SS-13	Split-Spoon	18	SW	--
“	0	3	B-1	Bulk	--	Bulk	--
“	3	5	B-2	Bulk	--	Bulk	--
204-23	0	2	ST-1	Shelby Tube	20	CL	CL
“	2	3.5	SS-2	Split-Spoon	11	CL	--
“	4	6	ST-3	Shelby Tube	13.5	CL	CL
“	6	8	P-4	Push Tube	17	CL	--
“	8	10	ST-5	Shelby Tube	9.5	SC	CL
“	10	11.5	SS-6	Split-Spoon	14.5	SC	--
“	12	13.5	SS-7	Split-Spoon	17.5	SC	SC
“	14	20	RC-1	Rock Core	30	Sandstone	--
“	0	3	G-1	Bulk	--	Bulk	--
“	3	5	G-2	Bulk	--	Bulk	--

Table 3. Recommended SITES Parameters for Proposed ASW Channel

SITES inputs	Proposed Fill (ASW Borrow)	Upper Clay	Lower Clay	Sand and Sandstone
USCS - Soil Type (Predominant)	CH - Fat Clay	CH - Fat clay	CL - Sandy Lean Clay	SC – Clayey Sand [partially cemented]
PI – Representative	35	35	20	15
LL – Representative	55	50	35	25
Dry Density (lbs/ft3) – Representative	100	105	110	117
Kh – Representative	0.10	0.30	0.30	0.15
Clay % – Representative	30	30	30	3
Rep. Diam. D_{75} (mm) – Representative	0.15	0.15	0.10	0.25
Rep. Diam. D_{75} (in) – Representative	0.006	0.006	0.004	0.010
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---

FIGURES

Figure 1. Site Vicinity Map

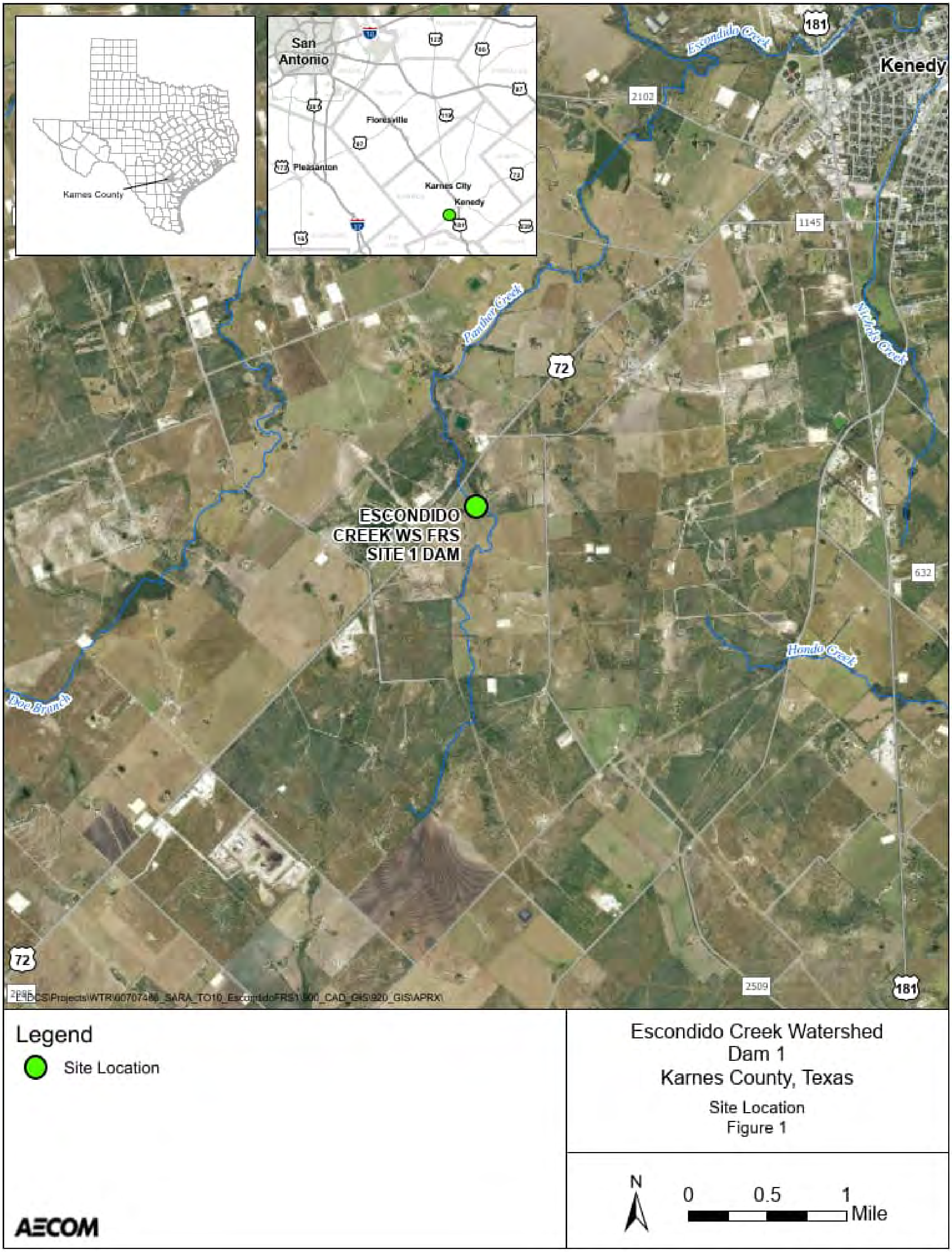


Figure 2. Geologic Map (Barnes et al., 1987)

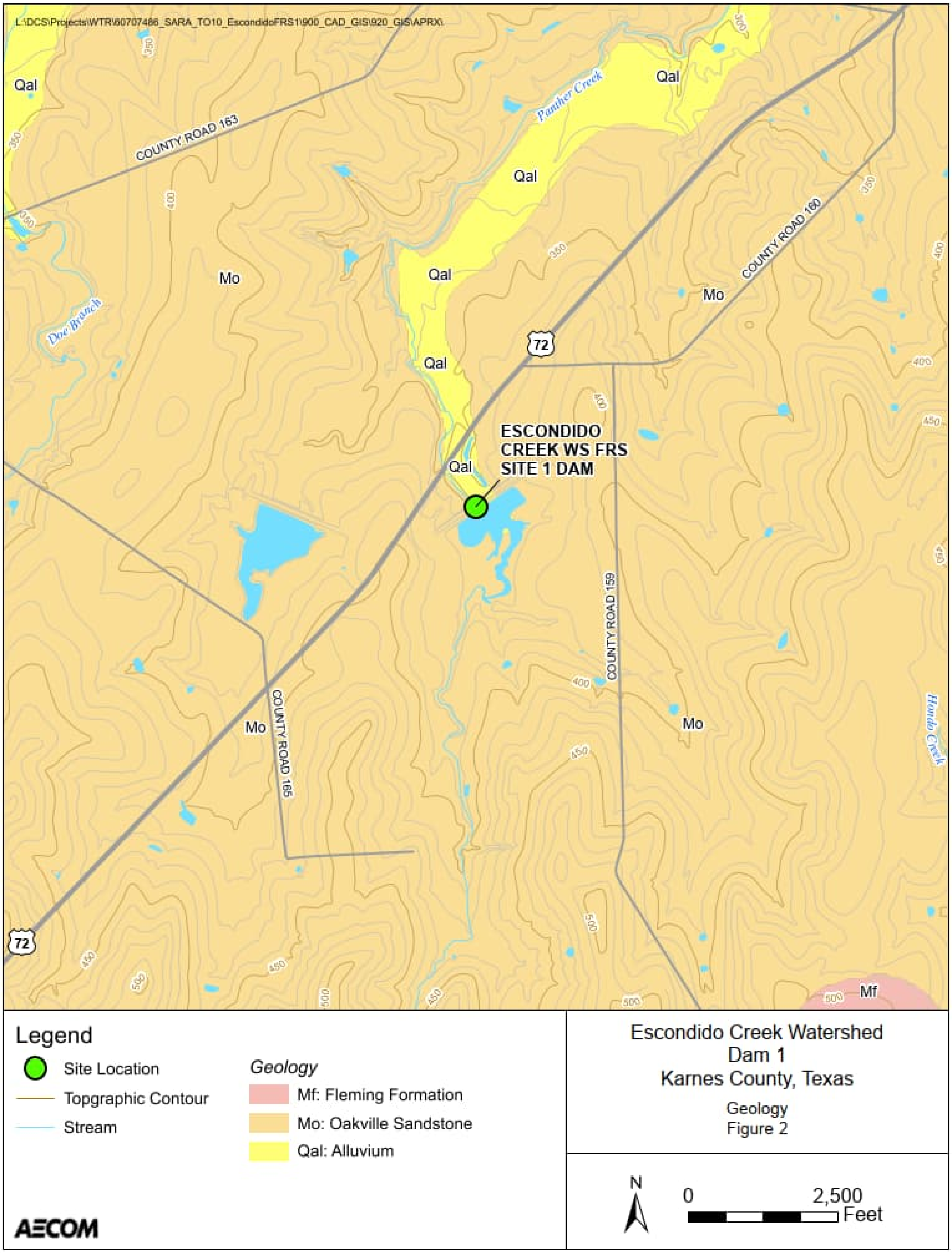
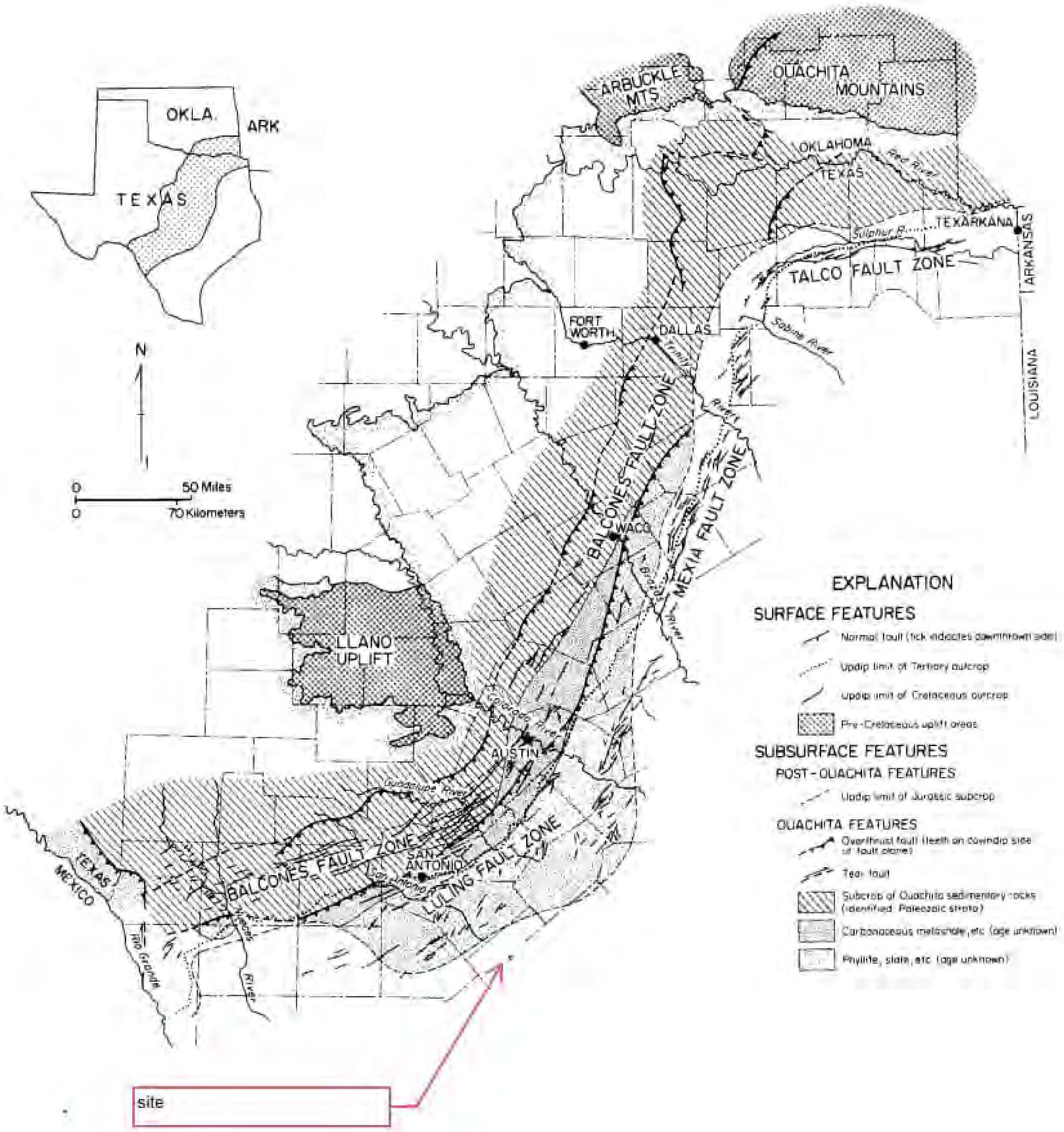


Figure 3. Regional Tectonic Features from Woodruff and McBride (1979)



Regional tectonic features (modified from Flawn and others, 1961, and Sellards and Hendricks, 1946).

Figure 4. Mapped Faults from Bureau of Economic Geology (University of Texas)

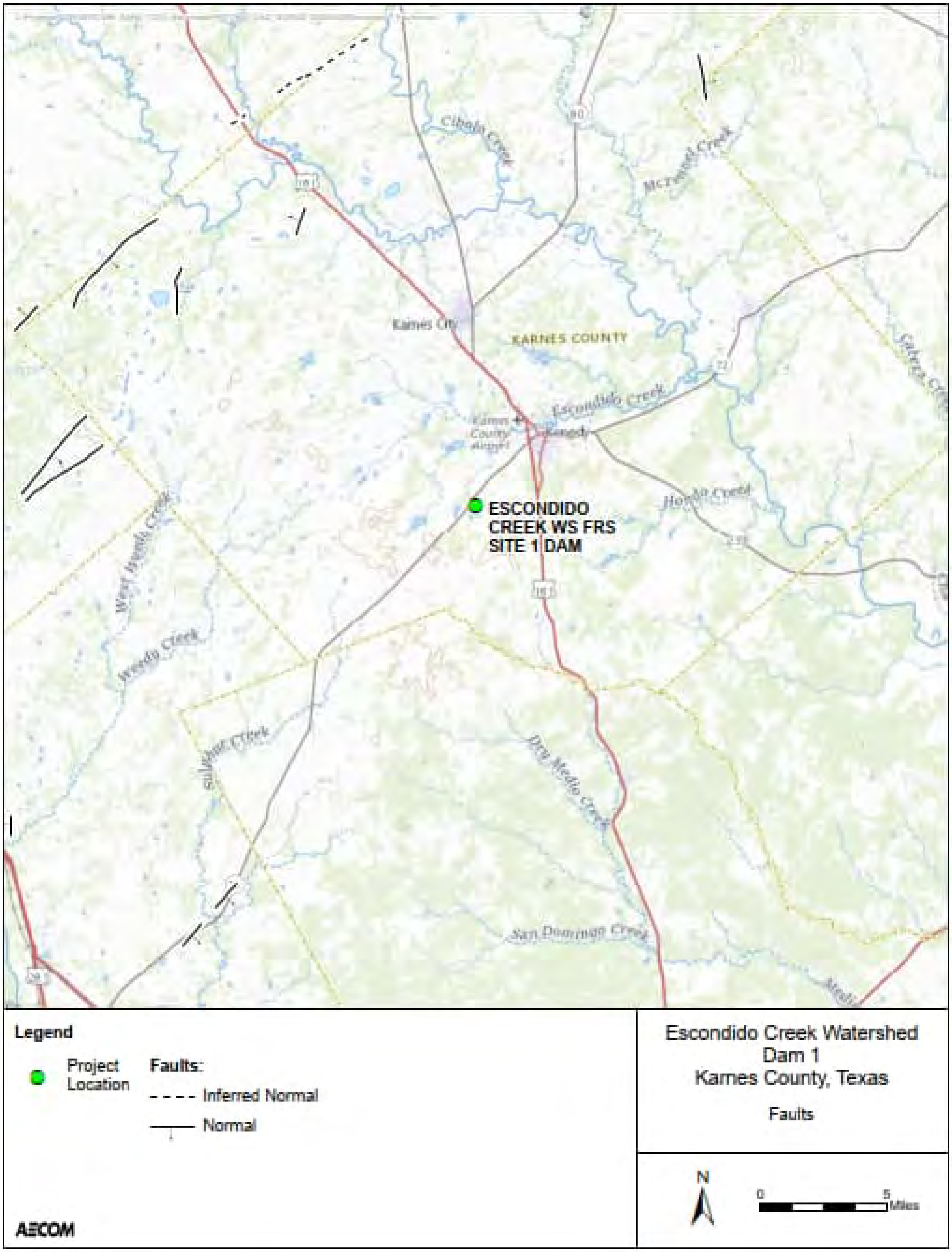


Figure 5. Regional Faults from McKeighan Thesis 2022

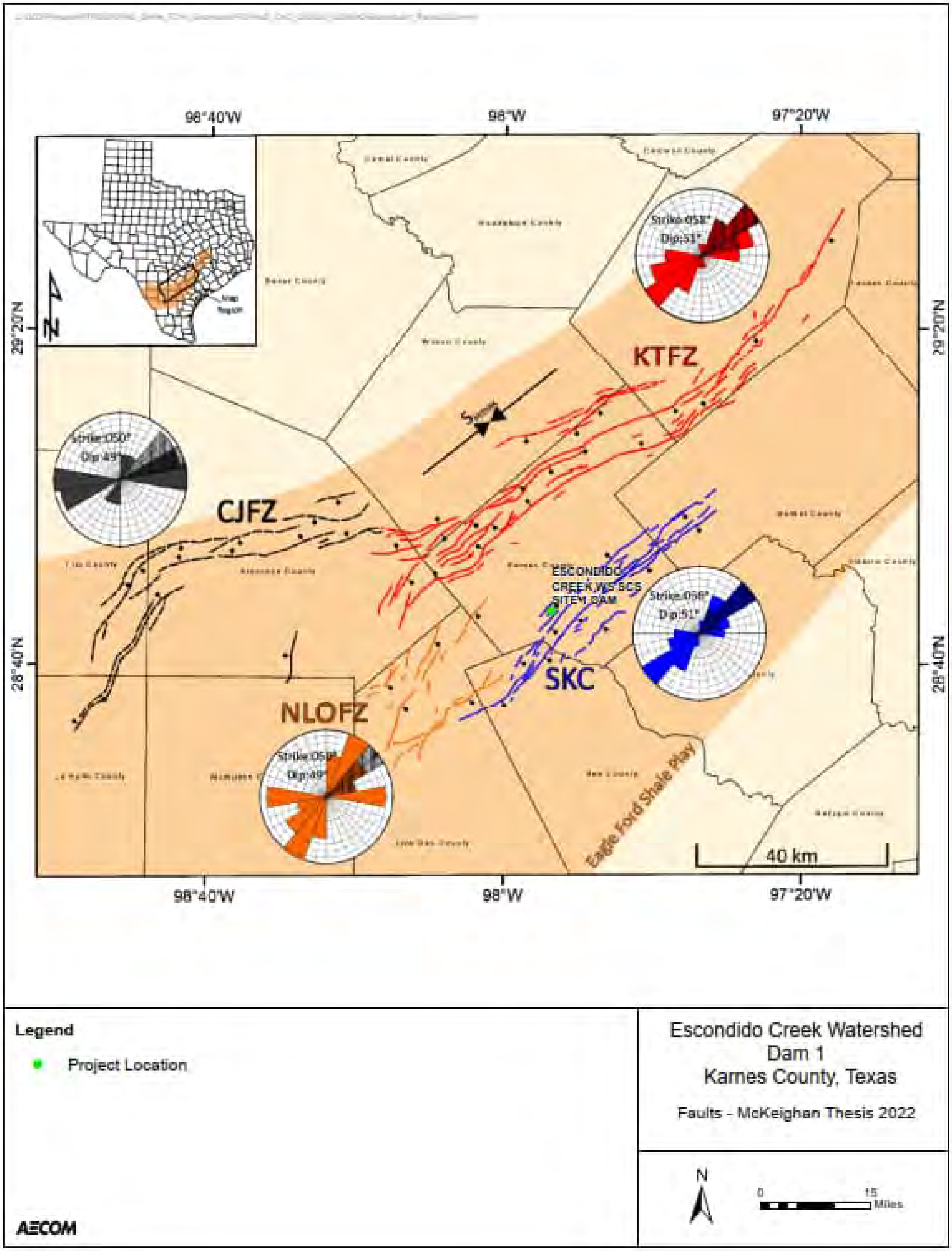


Figure 6. Recent and Historic Earthquakes

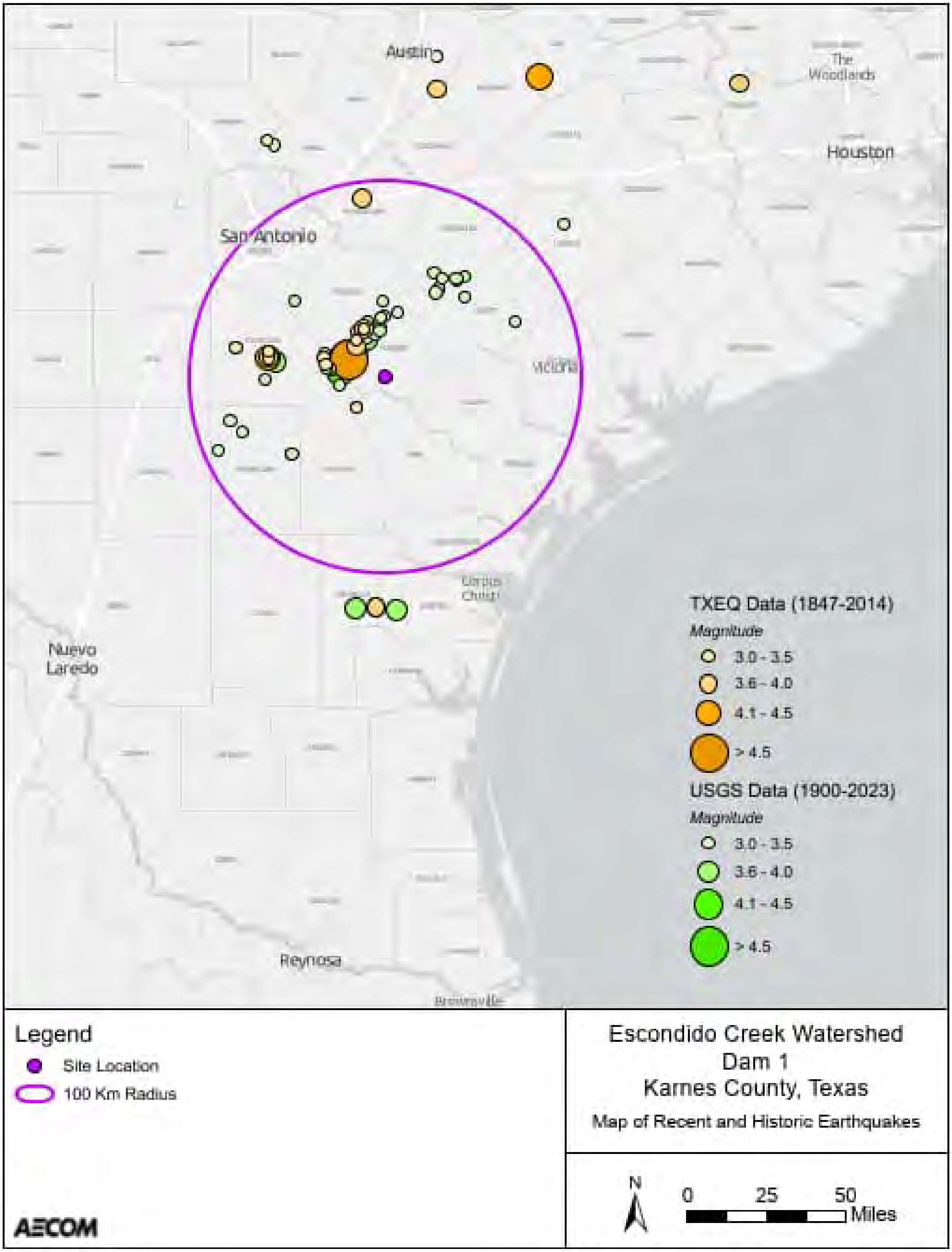
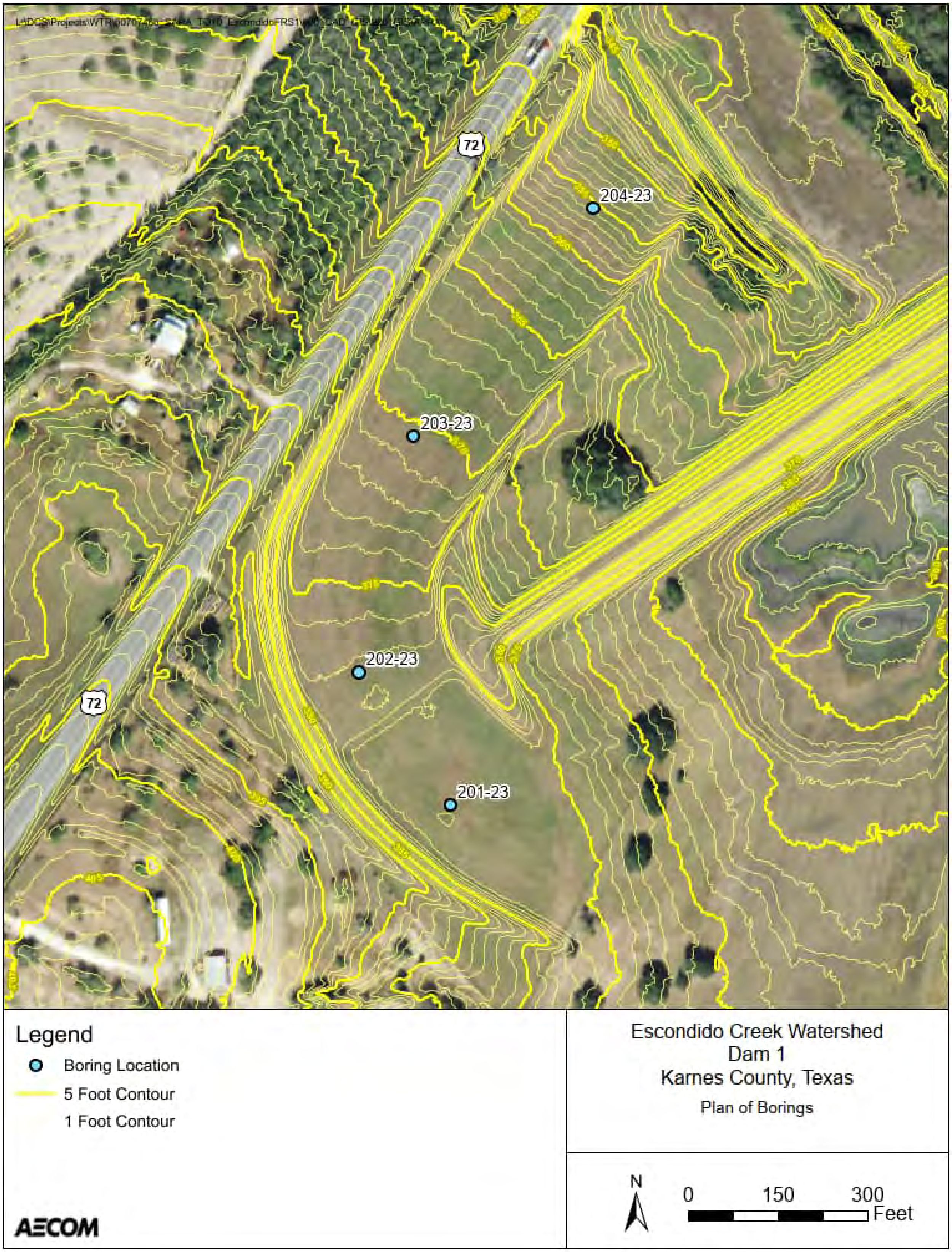
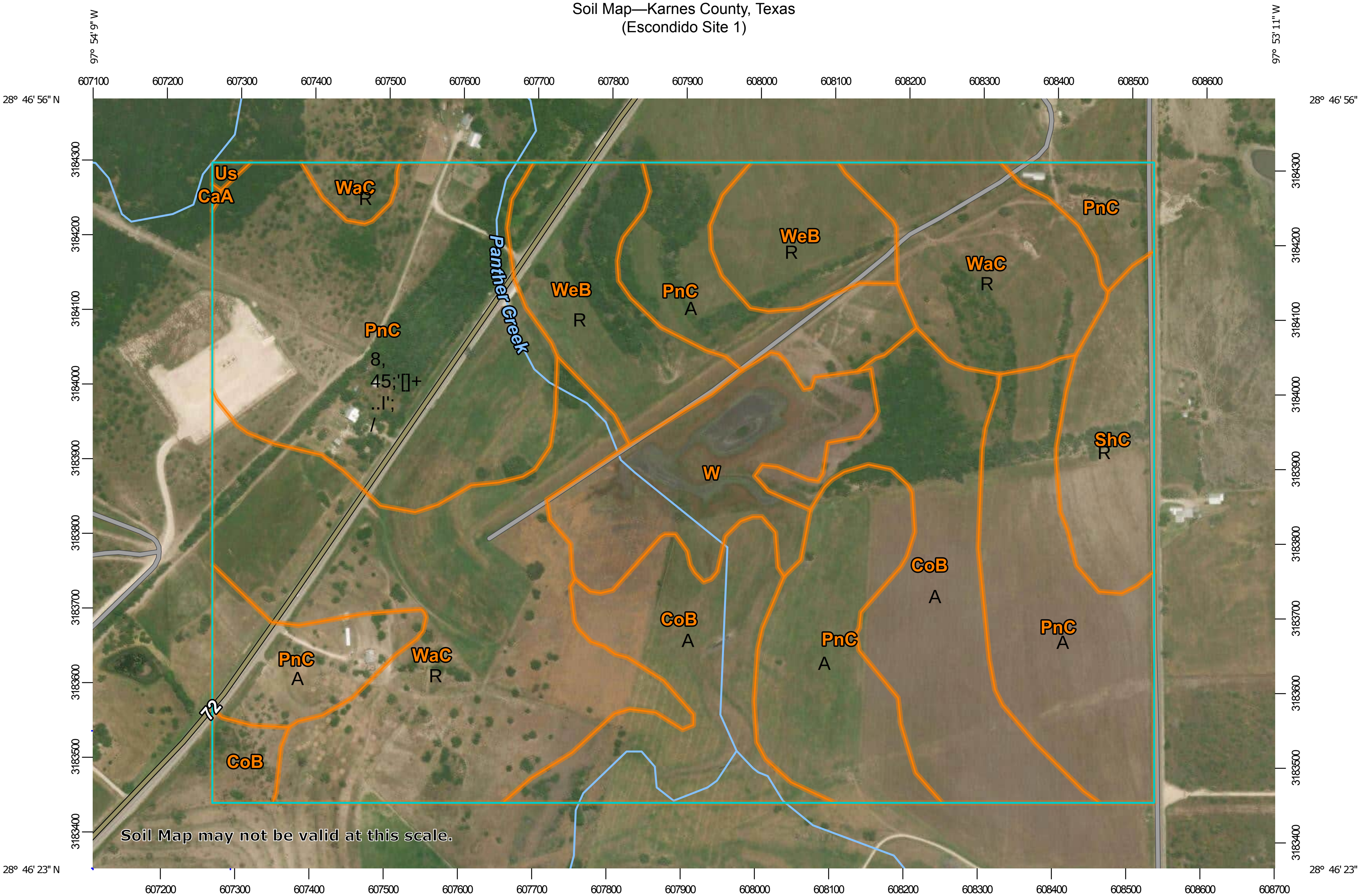


Figure 7. Plan of Borings



Appendix A NRCS Websoil Survey Data

Soil Map—Karnes County, Texas
(Escondido Site 1)



Map Scale: 1:7,280 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 350, 700, 1400, 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 23, 2013—Oct 29, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CaA	Clareville clay loam, 0 to 1 percent slopes	0.1	0.0%
CoB	Coy clay loam, 1 to 3 percent slopes	45.3	16.8%
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	106.3	39.4%
ShC	Schattel clay loam, 2 to 5 percent slopes	11.4	4.2%
Us	Ustarents, loamy	0.3	0.1%
W	Water	17.6	6.5%
WaC	Weesatche fine sandy loam, 2 to 5 percent slopes	65.1	24.1%
WeB	Weesatche sandy clay loam, 1 to 3 percent slopes	24.0	8.9%
Totals for Area of Interest		**269.9**	**100.0%**

Karnes County, Texas

CaA—Clareville clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2ymrw
Elevation: 180 to 580 feet
Mean annual precipitation: 26 to 32 inches
Mean annual air temperature: 69 to 72 degrees F
Frost-free period: 270 to 300 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Clareville and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clareville

Setting

Landform: Drainageways, flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 10 inches: clay loam
Bt - 10 to 43 inches: clay loam
Bk - 43 to 64 inches: clay loam
BCk - 64 to 80 inches: loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 2s

Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Minor Components

Sinton

Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY013TX - Loamy Bottomland
Hydric soil rating: No

Weesatche

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY023TX - Sandy Loam
Hydric soil rating: No

Miguel

Percent of map unit: 3 percent
Landform: Low hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY024TX - Tight Sandy Loam
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

CoB—Coy clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2wvwd
Elevation: 100 to 600 feet
Mean annual precipitation: 26 to 35 inches
Mean annual air temperature: 70 to 72 degrees F
Frost-free period: 270 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Coy and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coy

Setting

Landform: Terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous clayey alluvium derived from mudstone

Typical profile

Ap - 0 to 6 inches: clay loam
Bt - 6 to 25 inches: clay
Btk - 25 to 40 inches: clay
Bk - 40 to 80 inches: clay

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Minor Components

Pernitas

Percent of map unit: 6 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Schattel

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083AY016TX - Saline Clay Loam
Hydric soil rating: No

Monteola

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: R083BY017TX - Blackland
Hydric soil rating: No

Tiocano

Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R083AY007TX - Lakebed
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

ShC—Schattel clay loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: dcd0
Elevation: 250 to 650 feet
Mean annual precipitation: 26 to 32 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 265 to 295 days
Farmland classification: Not prime farmland

Map Unit Composition

Schattel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Schattel

Setting

Landform: Ridges
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Clayey residuum

Typical profile

H1 - 0 to 5 inches: clay loam
H2 - 5 to 55 inches: clay
H3 - 55 to 80 inches: clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Gypsum, maximum content: 30 percent
Maximum salinity: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R083AY016TX - Saline Clay Loam
Hydric soil rating: No

Minor Components

Unnamed
Percent of map unit: 15 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

Us—Ustarents, loamy

Map Unit Setting

National map unit symbol: dcd6
Elevation: 100 to 500 feet
Mean annual precipitation: 24 to 36 inches
Mean annual air temperature: 70 to 75 degrees F
Frost-free period: 270 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Ustarents and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ustarents

Setting

Parent material: Mine spoil or earthy fill

Typical profile

H1 - 0 to 6 inches: sandy clay loam
H2 - 6 to 60 inches: sandy clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

PnC—Pernitas sandy clay loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2s663
Elevation: 150 to 800 feet
Mean annual precipitation: 28 to 36 inches
Mean annual air temperature: 70 to 74 degrees F
Frost-free period: 270 to 295 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pernitas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pernitas

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous loamy alluvium derived from sandstone

Typical profile

A - 0 to 7 inches: sandy clay loam
Bt - 7 to 21 inches: sandy clay loam
Btk - 21 to 33 inches: sandy clay loam
Bk - 33 to 80 inches: sandy clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R083AY019TX - Gray Sandy Loam
Hydric soil rating: No

Minor Components

Pettus

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083AY003TX - Gravelly Ridge
Hydric soil rating: No

Olmedo

Percent of map unit: 3 percent
Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083CY002TX - Shallow Ridge
Hydric soil rating: No

Colibro

Percent of map unit: 3 percent
Landform: Stream terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY019TX - Gray Sandy Loam
Hydric soil rating: No

Coy

Percent of map unit: 1 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY026TX - Eastern Clay Loam

Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

WaC—Weesatche fine sandy loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t8c0
Elevation: 100 to 400 feet
Mean annual precipitation: 27 to 36 inches
Mean annual air temperature: 70 to 74 degrees F
Frost-free period: 275 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Weesatche and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Weesatche

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Calcareous loamy residuum weathered from sandstone

Typical profile

A - 0 to 11 inches: fine sandy loam
Bt - 11 to 36 inches: sandy clay loam
Bk - 36 to 56 inches: sandy clay loam
BCk - 56 to 80 inches: fine sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R083AY023TX - Sandy Loam
Hydric soil rating: No

Minor Components

Pernitas

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Parrita

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY004TX - Shallow Sandy Loam
Hydric soil rating: No

Olmedo

Percent of map unit: 1 percent
Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083CY002TX - Shallow Ridge
Hydric soil rating: No

Goliad

Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083AY026TX - Eastern Clay Loam

Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

WeB—Weesatche sandy clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2shw2
Elevation: 100 to 800 feet
Mean annual precipitation: 26 to 36 inches
Mean annual air temperature: 70 to 74 degrees F
Frost-free period: 275 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Weesatche and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Weesatche

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, footslope, toeslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous loamy residuum weathered from sandstone

Typical profile

A - 0 to 8 inches: sandy clay loam
Bt - 8 to 30 inches: sandy clay loam
Bk - 30 to 50 inches: sandy clay loam
BCk - 50 to 80 inches: loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 65 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0

Available water supply, 0 to 60 inches: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: R083AY023TX - Sandy Loam
Hydric soil rating: No

Minor Components

Clareville

Percent of map unit: 5 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Pernitas

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Papalote

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY024TX - Tight Sandy Loam
Hydric soil rating: No

Goliad

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083AY023TX - Sandy Loam
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
CaA—Clareville clay loam, 0 to 1 percent slopes														
Clareville	90	C	0-10	Clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	97-98-100	96-98-100	87-95-100	59-67-78	37-45-55	17-25-32
			10-43	Clay loam, clay, sandy clay	CH	A-7-6	0- 0- 0	0- 0- 0	96-98-100	96-98-100	88-96-100	64-72-81	51-53-61	29-30-37
			43-64	Clay loam, clay, sandy clay, sandy clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	97-98-100	96-98-100	86-96-100	61-73-83	46-53-61	25-30-37
			64-80	Clay loam, loam, sandy clay loam	CL	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	92-98-100	91-98-100	77-94-100	51-68-78	28-35-44	9-15-22
CoB—Coy clay loam, 1 to 3 percent slopes														
Coy	85	C	0-6	Clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	88-99-100	64-74-78	38-50-56	18-25-29
			6-25	Clay, clay loam, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	84-99-100	67-81-93	44-59-69	20-32-44
			25-40	Clay, clay loam, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	84-99-100	67-81-93	43-58-68	20-32-44
			40-80	Clay loam, clay, silty clay, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	86-99-100	68-81-88	40-55-65	18-31-39

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
PnC—Pernitas sandy clay loam, 2 to 5 percent slopes														
Pernitas	85	B	0-7	Sandy clay loam	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	98-100-100	90-95-100	44-48-57	32-37-48	9-15-22
			7-21	Sandy clay loam, clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	97-99-100	97-99-100	83-92-100	50-58-70	30-39-53	11-18-29
			21-33	Sandy clay, sandy clay loam, clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	96-99-100	96-99-100	81-91-99	50-58-65	31-41-49	12-19-26
			33-80	Clay loam, sandy clay loam	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	93-97-100	92-97-100	75-85-93	42-50-57	27-35-43	8-14-21
ShC—Schattel clay loam, 2 to 5 percent slopes														
Schattel	85	C	0-5	Clay loam	CL	A-6, A-7-6	0- 0- 0	0- 1- 1	96-98-100	96-98-100	70-85-100	55-68-80	36-42-48	16-21-25
			5-55	Clay, clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	96-98-100	96-98-100	70-85-100	65-80-95	43-53-62	21-29-36
			55-80	Clay, silty clay, clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	96-98-100	96-98-100	65-83-100	60-78-95	48-59-70	27-38-48
Us—Ustarents, loamy														
Ustarents	95	B	0-6	Sandy clay loam	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-99-100	85-92-99	40-58-75	35-42-48	15-20-25
			6-60	Sandy clay loam, clay loam	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-99-100	85-92-99	40-58-75	35-42-48	15-20-25

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	**Pct. of map unit**	**Hydrologic group**	**Depth**	**USDA texture**	**Classification**		**Pct Fragments**		**Percentage passing sieve number—**				**Liquid limit**	**Plasticity index**
					Unified	**AASHTO**	**>10 inches**	**3-10 inches**	**4**	**10**	**40**	**200**		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
WaC—Weesatche fine sandy loam, 2 to 5 percent slopes														
Weesatche	85	B	0-11	Fine sandy loam	SC-SM, SC	A-2-4, A-4, A-6	0- 0- 0	0- 0- 0	90-93-100	89-93-100	77-87-97	28-35-41	21-27-30	6-8 -14
			11-36	Sandy clay loam, clay loam	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	89-93-100	88-92-100	79-90-100	41-50-64	30-37-46	11-19-26
			36-56	Clay loam, sandy clay loam	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	90-93-100	89-92-100	78-90-100	43-54-64	23-31-43	9-16-22
			56-80	Loam, sandy clay loam, fine sandy loam	CL, SC	A-4, A-6	0- 0- 0	0- 0- 0	90-93-100	89-93-100	76-83-100	40-45-60	23-28-39	9-10-18
WeB—Weesatche sandy clay loam, 1 to 3 percent slopes														
Weesatche	85	B	0-8	Sandy clay loam	CL, SC	A-6	0- 0- 0	0- 0- 0	90-93-100	89-92-100	82-90-100	41-47-56	25-30-35	12-13-18
			8-30	Sandy clay loam, clay loam, sandy clay	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	89-93-100	88-92-100	79-90-100	41-51-64	30-37-46	11-19-26
			30-50	Clay loam, fine sandy loam, sandy clay loam, loam	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	90-93-100	89-92-100	64-75-88	41-52-62	23-31-43	9-16-22
			50-80	Sandy clay loam, clay loam, fine sandy loam, loam	CL, SC	A-4, A-6	0- 0- 0	0- 0- 0	90-93-100	89-93-100	80-90-100	47-67-80	23-32-40	9-14-23

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Appendix B Seismicity Data

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (4.2.0)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

28.7765

Time Horizon

Return period in years

2475

Longitude

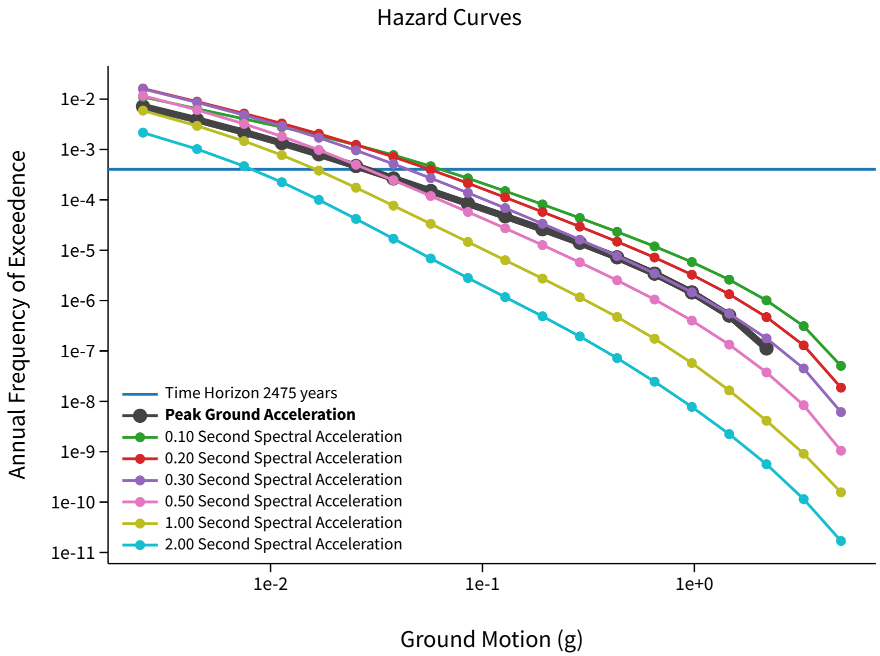
Decimal degrees, negative values for western longitudes

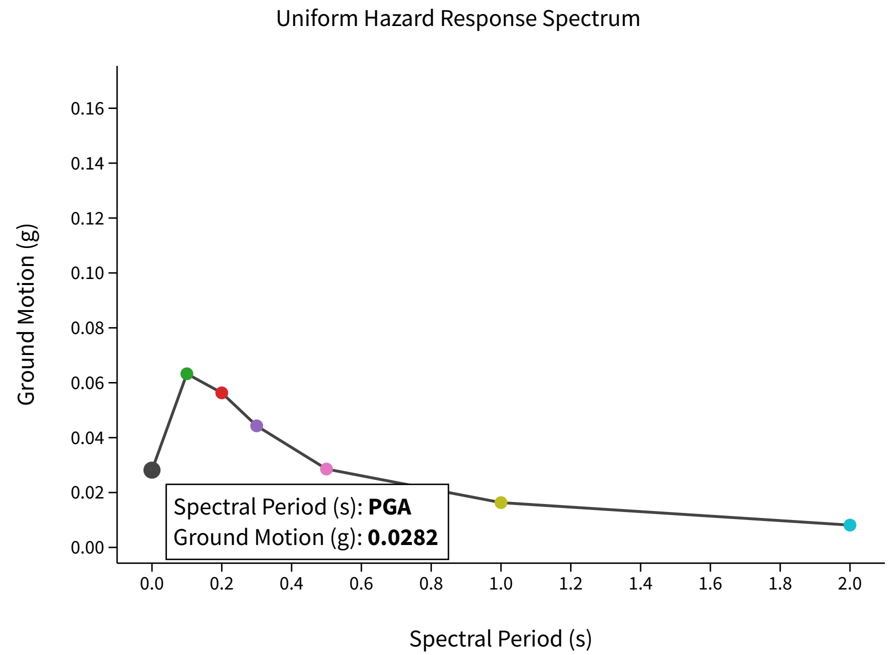
-97.897695

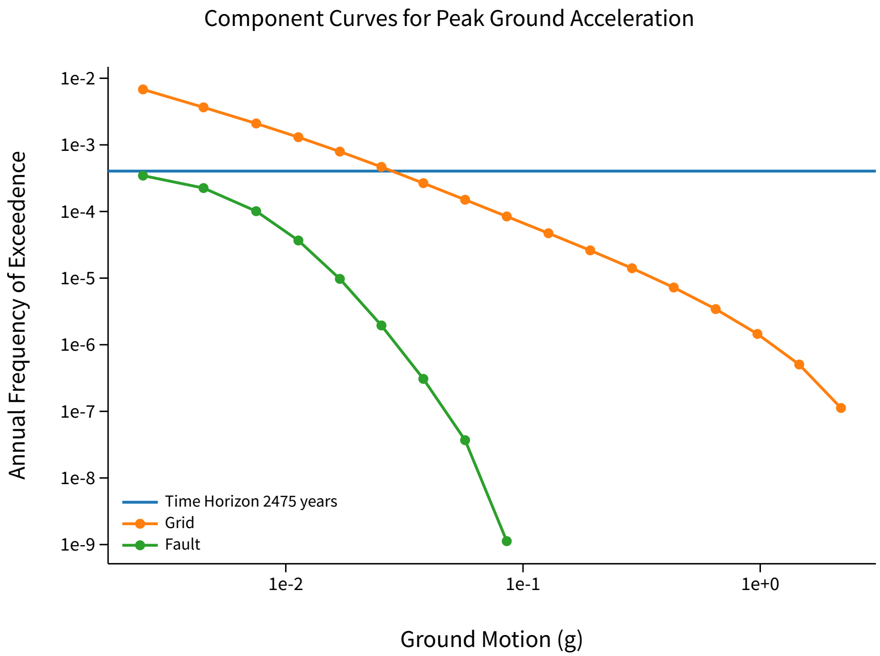
Site Class

760 m/s (B/C boundary)

Hazard Curve





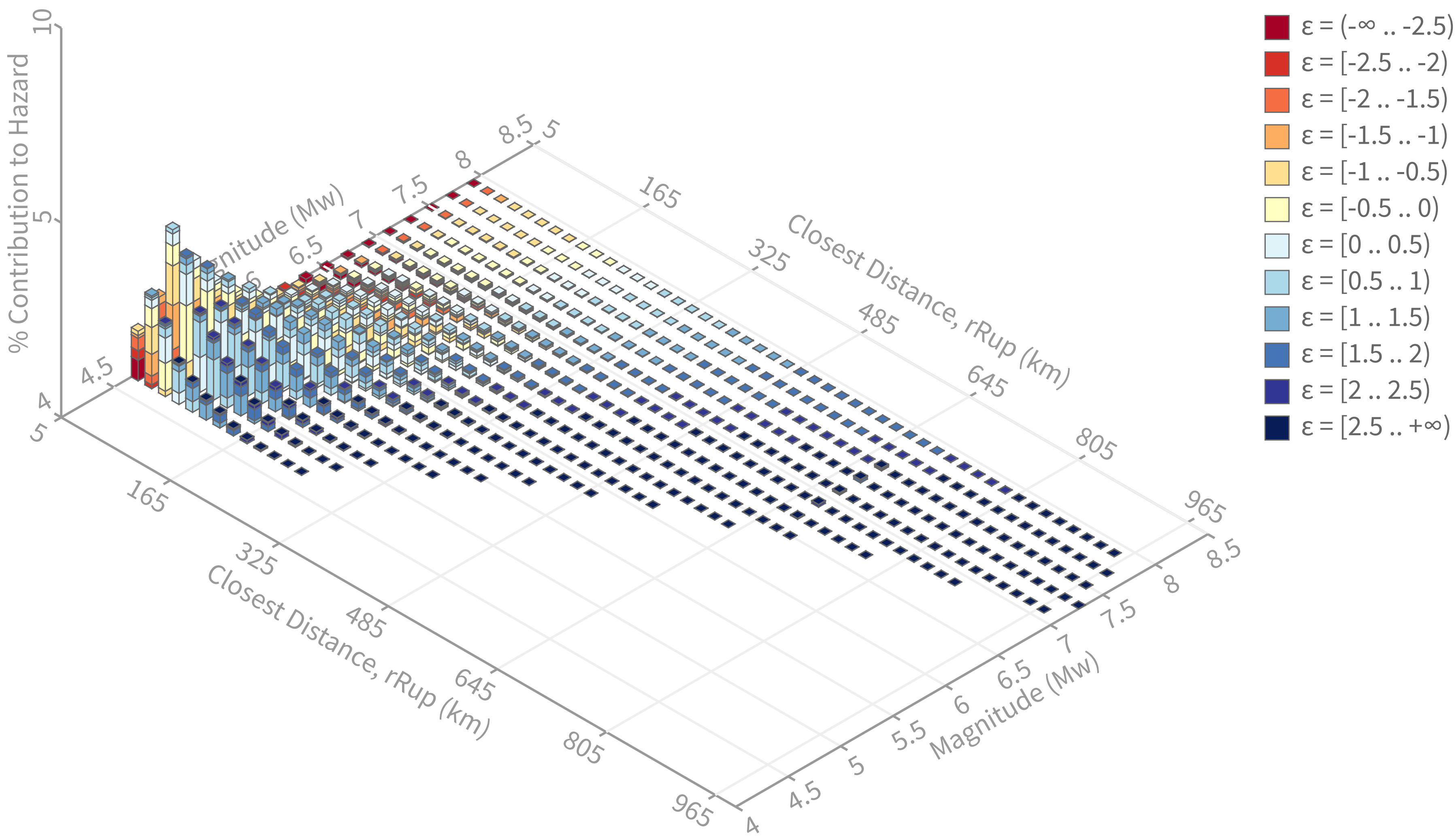


View Raw Data

Deaggregation

Component

Total



% Contribution to Hazard
10
5
Closest Distance, rRup (km)
165
325
485
645
805
965
Magnitude (Mw)
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
ε = (-∞ .. -2.5)
ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.028153982 g

Recovered targets

Return period: 2470.5675 yrs
Exceedance rate: 0.0004047653 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 2.64 %

Mean (over all sources)

m: 5.55
r: 103.24 km
ε_0: -0.21 σ

Mode (largest m-r bin)

m: 4.9
r: 30.76 km
ε_0: -0.91 σ
Contribution: 3.77 %

Mode (largest m-r-ε_0 bin)

m: 4.9
r: 48.9 km
ε_0: -0.23 σ
Contribution: 1.47 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)

ε5: [-0.5 .. 0.0)

ε6: [0.0 .. 0.5)

ε7: [0.5 .. 1.0)

ε8: [1.0 .. 1.5)

ε9: [1.5 .. 2.0)

ε10: [2.0 .. 2.5)

ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							27.81
PointSourceFinite: -97.898, 29.159		42.42	5.24	-0.76	97.898°W	29.159°N	0.00	1.26
PointSourceFinite: -97.898, 29.114		37.51	5.22	-0.95	97.898°W	29.114°N	0.00	1.26
PointSourceFinite: -97.898, 29.204		47.34	5.27	-0.59	97.898°W	29.204°N	0.00	1.22
PointSourceFinite: -97.898, 29.069		32.60	5.19	-1.19	97.898°W	29.069°N	0.00	1.13
PointSourceFinite: -97.898, 29.249		52.26	5.30	-0.45	97.898°W	29.249°N	0.00	1.06
PointSourceFinite: -97.898, 28.979		22.83	5.15	-1.85	97.898°W	28.979°N	0.00	1.04
SSCn Fixed Smoothing Zone 2 (opt)	Grid							27.79
PointSourceFinite: -97.898, 29.159		42.42	5.24	-0.76	97.898°W	29.159°N	0.00	1.26
PointSourceFinite: -97.898, 29.114		37.51	5.22	-0.95	97.898°W	29.114°N	0.00	1.26
PointSourceFinite: -97.898, 29.204		47.34	5.27	-0.59	97.898°W	29.204°N	0.00	1.22
PointSourceFinite: -97.898, 29.069		32.60	5.19	-1.19	97.898°W	29.069°N	0.00	1.13
PointSourceFinite: -97.898, 29.249		52.26	5.30	-0.45	97.898°W	29.249°N	0.00	1.06
PointSourceFinite: -97.898, 28.979		22.83	5.15	-1.85	97.898°W	28.979°N	0.00	1.04
USGS Adaptive Smoothing Zone 2 (opt)	Grid							17.82
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							17.80
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							2.05
USGS Adaptive Smoothing Zone 1 (opt)	Grid							2.04
SSCn Fixed Smoothing Zone 1 (opt)	Grid							1.96
USGS Fixed Smoothing Zone 1 (opt)	Grid							1.95

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (unknown)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

28.7765

Time Horizon

Return period in years

2500

Longitude

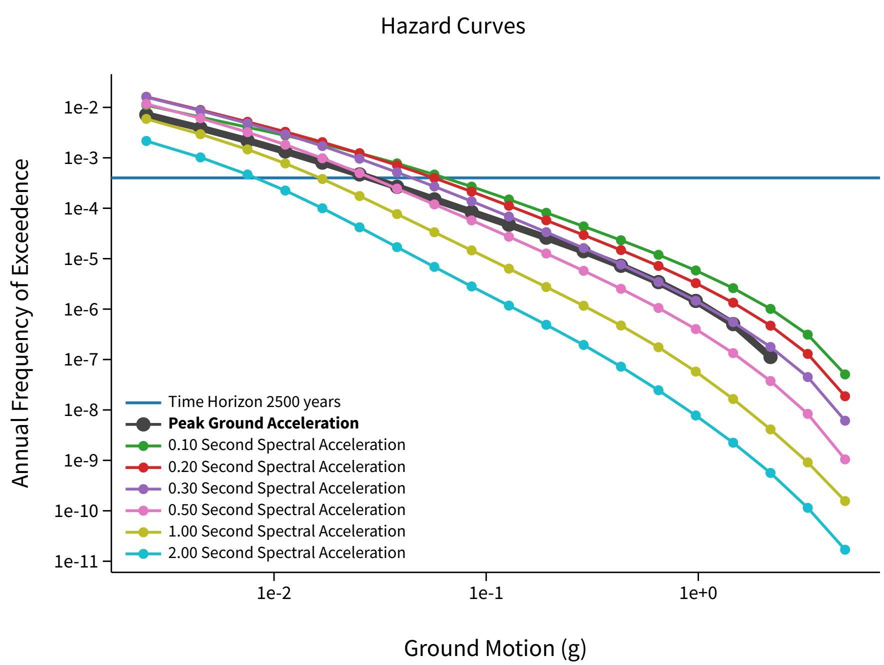
Decimal degrees, negative values for western longitudes

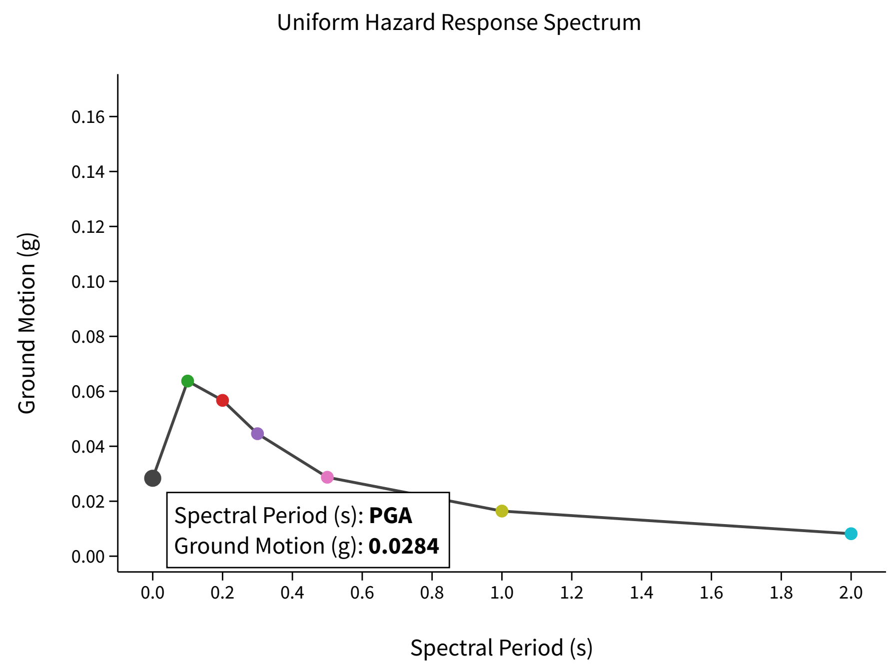
-97.897695

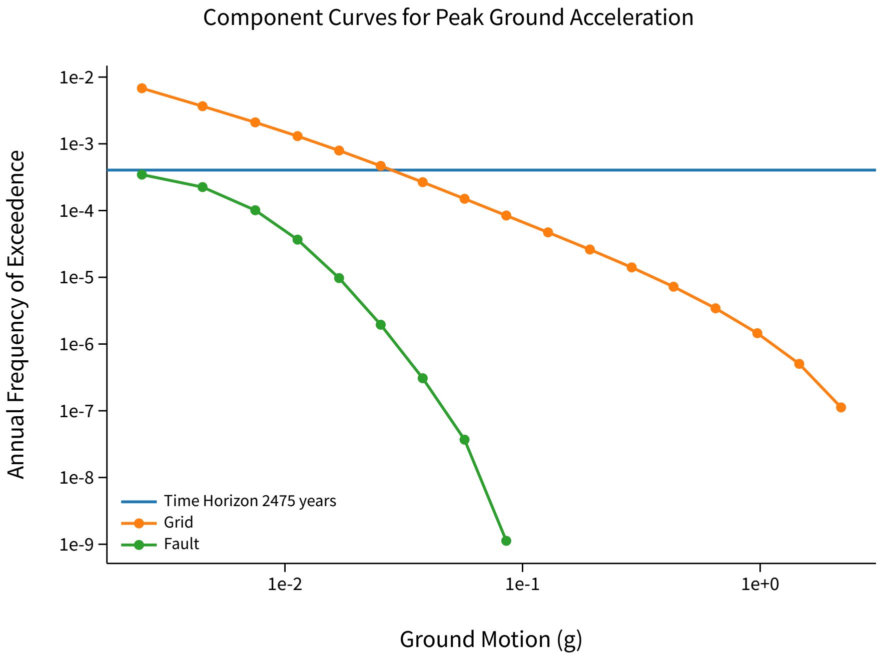
Site Class

760 m/s (B/C boundary)

Hazard Curve





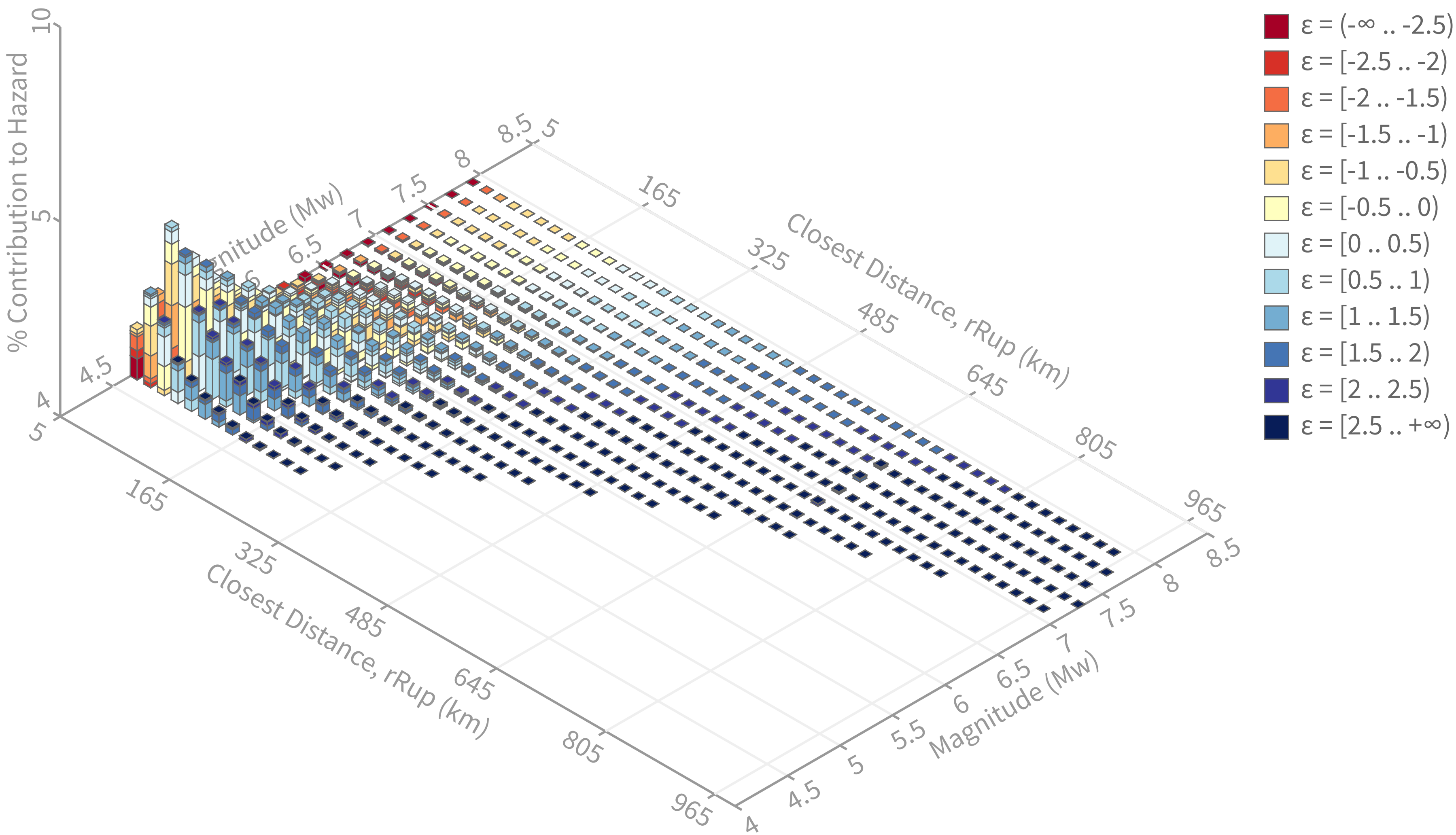


View Raw Data

Deaggregation

Component

Total



% Contribution to Hazard
Closest Distance, rRup (km)
Magnitude (Mw)
ε = (-∞ .. -2.5)
ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2500 yrs
Exceedance rate: 0.0004 yr^{-1}
PGA ground motion: 0.028358792 g

Recovered targets

Return period: 2495.3477 yrs
Exceedance rate: 0.00040074575 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 2.66 %

Mean (over all sources)

m: 5.55
r: 102.82 km
ε_0: -0.21 σ

Mode (largest m-r bin)

m: 4.9
r: 30.75 km
ε_0: -0.91 σ
Contribution: 3.79 %

Mode (largest m-r-ε_0 bin)

m: 4.9
r: 48.96 km
ε_0: -0.23 σ
Contribution: 1.41 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)

ε5: [-0.5 .. 0.0)

ε6: [0.0 .. 0.5)

ε7: [0.5 .. 1.0)

ε8: [1.0 .. 1.5)

ε9: [1.5 .. 2.0)

ε10: [2.0 .. 2.5)

ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							27.83
PointSourceFinite: -97.898, 29.159		42.42	5.25	-0.75	97.898°W	29.159°N	0.00	1.27
PointSourceFinite: -97.898, 29.114		37.51	5.22	-0.94	97.898°W	29.114°N	0.00	1.27
PointSourceFinite: -97.898, 29.204		47.34	5.27	-0.59	97.898°W	29.204°N	0.00	1.23
PointSourceFinite: -97.898, 29.069		32.60	5.19	-1.18	97.898°W	29.069°N	0.00	1.14
PointSourceFinite: -97.898, 29.249		52.25	5.30	-0.44	97.898°W	29.249°N	0.00	1.06
PointSourceFinite: -97.898, 28.979		22.83	5.15	-1.84	97.898°W	28.979°N	0.00	1.05
SSCn Fixed Smoothing Zone 2 (opt)	Grid							27.81
PointSourceFinite: -97.898, 29.159		42.42	5.25	-0.75	97.898°W	29.159°N	0.00	1.27
PointSourceFinite: -97.898, 29.114		37.51	5.22	-0.94	97.898°W	29.114°N	0.00	1.27
PointSourceFinite: -97.898, 29.204		47.34	5.27	-0.59	97.898°W	29.204°N	0.00	1.23
PointSourceFinite: -97.898, 29.069		32.60	5.19	-1.18	97.898°W	29.069°N	0.00	1.14
PointSourceFinite: -97.898, 29.249		52.25	5.30	-0.44	97.898°W	29.249°N	0.00	1.06
PointSourceFinite: -97.898, 28.979		22.83	5.15	-1.84	97.898°W	28.979°N	0.00	1.05
USGS Adaptive Smoothing Zone 2 (opt)	Grid							17.82
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							17.80
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							2.04
USGS Adaptive Smoothing Zone 1 (opt)	Grid							2.03
SSCn Fixed Smoothing Zone 1 (opt)	Grid							1.95
USGS Fixed Smoothing Zone 1 (opt)	Grid							1.94

Appendix C Hammer Energy Calibration Report

Jesus E Garcia
Texas Geo Bore Drilling LLC
100 Little Elm Way
Hutto, TX 78634

October 23, 2020

Re: Energy Measurement for Dynamic Penetrometers
Texas Cone Penetrometer (TCP)
Hutto, TX

GRL Job No. 2055075-1

Dear Mr. Garcia:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for four of Texas Geo Bore Drilling LLC's drill rigs located in Hutto, Texas. Four automatic hammer systems were monitored during Texas Cone Penetrometer (TCP) tests. Calibration testing summarized in this report was conducted on October 17, 2020.

The purpose in collecting the TCP energy measurements was to compute the energy transfer efficiency for four drill rig hammers. To meet this objective, an 8G Model, Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

TEST SEQUENCE

Using an instrumented AW-J rod, energy measurements were made at various sample depths for the drill rigs. For the rigs identified by serial number (SN) 90024, 668-10 and 172555, dynamic measurements were obtained for sample depths ranging from 10.0 feet to 31.5 feet. For the rig identified by NO SN, dynamic measurements were obtained for sample depths ranging from 8.5 feet to 30.0. Each sample depth consisted of energy measurements taken across 18 inches of driving. The drill rigs are summarized below.

Table 1: Calibrated Rig

TCP Rig	Serial Number
MOBILE B57	90024
GARDENER DENVER 1000	668-10
CME 55	172555
MOBILE B57	NO SN

ENERGY TRANSFER MEASUREMENTS

An 8G model Pile Driving Analyzer was used to take measurements of strain and acceleration. The strain and acceleration signals were conditioned and converted to force and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were also digitally stored for subsequent analysis.

The maximum energy transferred to the rod (EMX) was calculated by integrating both the force and velocity records over time as follows:

$$EMX = \int F(t)V(t)dt$$

Where:

F(t) = the force at time *t*
V(t) = the velocity at time *t*

The energy transfer ratio or efficiency is computed by dividing EMX by the theoretical TCP hammer energy of 340 lb-ft (computed from the product of the hammer weight, assumed to be the standard 170 lbs, and the fall height, assumed to be 2.0 ft). The TCP N values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where:

e_m = the measured transfer ratio (ETR)
N_m = the measured TCP “N” value

CONCLUSIONS

The tables below present a summary of the average transferred energy and the energy transfer ratio for each drill rig at each sample depth calculated using the EMX equation. Included in the tables are also average values of the hammer operating rate, maximum impact force and maximum velocity of the rod. The overall performance, which represents the average of data from all sample depths for each rig/rod type is also shown. Complete information, including the maximum, minimum and standard deviation for each sampling depth, is included in Appendix B.

As indicated in the tables in Appendix B, the average energy transfer ratio (ETR) from individual sample depths are summarized below.

Table 2: TCP transfer efficiency ranges and hammer operating rate

TCP Rig (*Serial Number*)	Overall Transfer Efficiency Range	Average Overall Transfer Efficiency	Average Hammer Operating Rate
MOBILE B57 (SN 90024)	83.7 – 92.0%	88%	45
GARDENER DENVER 1000 (SN 668-10)	82.2 – 89.7%	86%	44
CME 55 (SN 172555)	89.7 – 101.8%	97%	46
MOBILE B57 (NO SN)	82.2 – 95.1%	89%	49

N_{60} values presented in Appendix B do not account for any required corrections such as overburden or rod length.

CONCLUDING REMARKS

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Respectfully,
GRL ENGINEERS, INC.

Brandon Phetteplace, P.E.
Senior Engineer
TBPE Registration No. F-11426

Appendix A
Introduction to SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \, [E_m \, / \, (0.6E_r \,)] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \tag{5}$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \tag{6}$$

or strain

$$\epsilon = \sigma/E = v / c \tag{7}$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Appendix B

TCP Results

MOBILE B57 (SN 90024)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
13.83	**30-50-0**	10.00	11.50	**50**	**73**	28	11.8	32.9	284	340	83.7
18.83	**42-50-0**	15.00	16.50	**50**	**73**	33	11.0	43.7	287	340	84.5
24.83	**0-50-0**	20.00	21.50	**50**	**73**	35	12.4	46.9	307	340	90.4
28.83	**3-50-0**	25.00	26.50	**50**	**73**	34	13.4	46.8	306	340	90.1
33.83	**3-50-0**	30.00	31.50	**50**	**73**	37	13.3	52.4	313	340	92.0
					Overall Average Values:	34	12.4	44.6	300	340	88.1
					Standard Deviation:	3	1.0	7.3	13	0	3.9
					Overall Maximum Value:	39	14.0	52.9	322	340	94.8
					Overall Minimum Value:	25	10.3	1.9	252	340	74.0

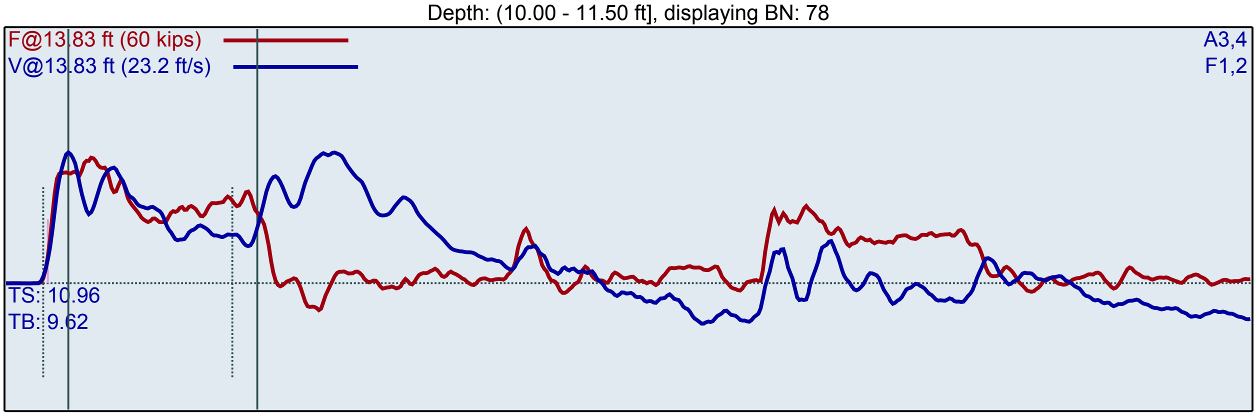
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 13.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 78



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	30	10.02	31	13.5	1.9	289	340	85.1
2	30	10.03	32	13.3	29.8	314	340	92.3
3	30	10.05	31	12.8	29.0	280	340	82.3
4	30	10.07	31	12.4	29.9	273	340	80.3
5	30	10.08	31	12.4	30.1	262	340	77.2
6	30	10.10	31	12.6	30.8	270	340	79.3
7	30	10.12	31	13.0	33.0	280	340	82.3
8	30	10.13	31	13.1	33.0	302	340	88.8
9	30	10.15	31	13.7	33.0	273	340	80.2
10	30	10.17	31	13.1	32.4	274	340	80.7
11	30	10.18	32	13.0	33.1	288	340	84.8
12	30	10.20	30	12.8	33.0	290	340	85.2
13	30	10.22	30	13.0	33.1	289	340	84.9
14	30	10.23	31	13.1	32.7	288	340	84.8
15	30	10.25	31	13.2	33.0	300	340	88.2
16	30	10.27	29	12.9	33.0	294	340	86.5
17	30	10.28	29	12.5	33.0	323	340	94.9
18	30	10.30	29	12.5	32.9	297	340	87.5
19	30	10.32	29	12.5	32.8	294	340	86.4
20	30	10.33	29	12.6	32.9	299	340	88.1
21	30	10.35	31	13.2	32.1	273	340	80.4
22	30	10.37	31	12.9	33.0	286	340	84.2
23	30	10.38	31	12.9	33.0	296	340	87.1
24	30	10.40	30	12.3	33.0	299	340	88.0
25	30	10.42	29	12.3	33.0	302	340	88.9
26	30	10.43	29	12.6	33.0	303	340	89.1
27	30	10.45	32	12.8	32.4	278	340	81.7
28	30	10.47	31	12.4	33.0	286	340	84.1

29	30	10.48	31	12.3	33.0	288	340	84.7
30	30	10.50	29	12.5	32.9	297	340	87.2
31	50	10.51	29	12.5	32.9	294	340	86.5
32	50	10.52	28	12.3	32.7	290	340	85.4
33	50	10.53	30	12.5	32.9	283	340	83.2
34	50	10.54	30	12.2	32.4	283	340	83.2
35	50	10.55	30	12.6	33.0	294	340	86.4
36	50	10.56	29	12.1	33.0	289	340	85.0
37	50	10.57	28	12.2	33.0	297	340	87.3
38	50	10.58	30	12.2	32.5	280	340	82.4
39	50	10.59	30	12.1	32.9	290	340	85.2
40	50	10.60	30	12.3	32.9	298	340	87.6
41	50	10.61	28	11.8	33.0	286	340	84.1
42	50	10.62	27	11.4	33.0	278	340	81.7
43	50	10.63	29	11.9	32.5	272	340	79.9
44	50	10.64	29	11.9	33.0	284	340	83.6
45	50	10.65	30	12.0	33.0	294	340	86.5
46	50	10.66	27	11.2	33.1	284	340	83.5
47	50	10.67	30	12.2	33.0	296	340	87.1
48	50	10.68	29	12.0	32.5	281	340	82.8
49	50	10.69	29	11.7	33.1	290	340	85.2
50	50	10.70	29	11.8	33.0	295	340	86.8
51	50	10.71	30	12.2	32.9	303	340	89.3
52	50	10.72	27	11.4	33.0	291	340	85.6
53	50	10.73	29	11.9	32.6	274	340	80.7
54	50	10.74	28	11.8	33.2	282	340	82.8
55	50	10.75	29	11.8	33.1	294	340	86.4
56	50	10.76	28	11.7	33.1	277	340	81.4
57	50	10.77	25	11.2	33.0	288	340	84.7
58	50	10.78	29	11.4	32.4	256	340	75.4
59	50	10.79	28	11.7	33.1	277	340	81.5
60	50	10.80	28	11.7	33.0	290	340	85.3
61	50	10.81	30	12.0	33.0	303	340	89.0
62	50	10.82	25	10.6	32.9	279	340	82.1
63	50	10.83	27	11.3	32.6	252	340	74.0
64	50	10.84	28	11.8	33.0	283	340	83.2
65	50	10.85	28	11.6	33.0	278	340	81.9
66	50	10.86	30	12.0	33.0	290	340	85.2
67	50	10.87	25	10.5	33.0	281	340	82.6
68	50	10.88	26	10.7	33.0	280	340	82.4
69	50	10.89	28	11.7	33.0	280	340	82.3
70	50	10.90	30	11.8	32.7	275	340	81.0
71	50	10.91	29	12.1	32.9	275	340	80.9
72	50	10.92	27	11.5	33.0	289	340	84.9
73	50	10.93	26	11.2	33.0	287	340	84.4
74	50	10.94	26	11.2	32.9	292	340	85.9
75	50	10.95	30	11.9	32.3	269	340	79.1
76	50	10.96	29	11.9	32.9	281	340	82.8
77	50	10.97	29	11.6	32.9	271	340	79.7
78	50	10.98	29	11.8	32.9	282	340	82.9
79	50	10.99	29	12.1	32.8	297	340	87.3
80	50	11.00	27	11.5	32.9	290	340	85.3
		Average	28	11.8	32.9	284	340	83.7
		Std Dev	1	0.5	0.2	10	0	3.0
		Maximum	30	12.6	33.2	303	340	89.3
		Minimum	25	10.5	32.3	252	340	74.0

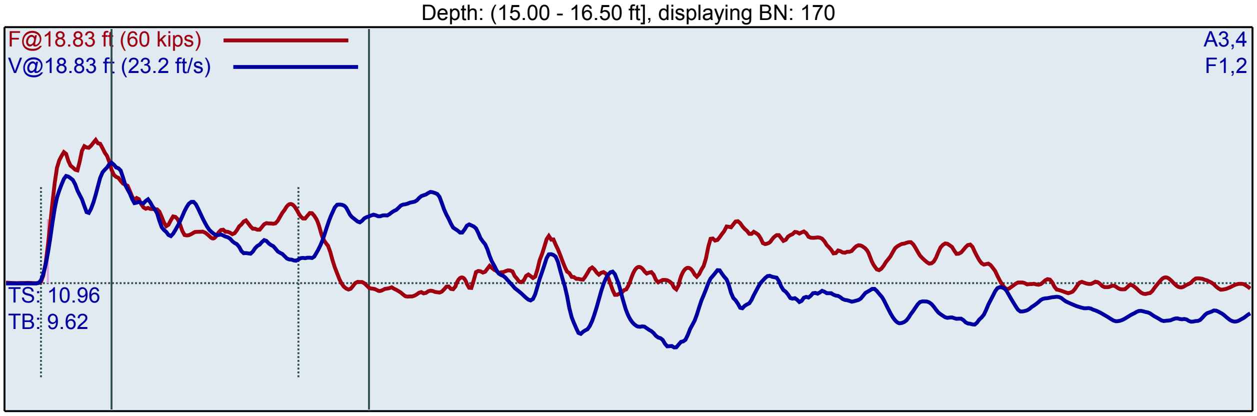
N-value: 50

Sample Interval Time: 145.02 seconds.

Texas Geo Bore Drilling 10.17.20 TCP 10-11.5
CM Interval start: 10/17/2020
TCP

AR: 1.45 in^2 SP: 0.492 k/ft3
LE: 18.83 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (15.00 - 16.50 ft], displaying BN: 170



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1
A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
81	42	15.01	34	14.2	1.9	290	340	85.3
82	42	15.02	34	13.8	37.8	298	340	87.5
83	42	15.04	34	12.9	43.5	299	340	88.0
84	42	15.05	35	12.7	43.7	302	340	88.7
85	42	15.06	34	12.5	43.4	298	340	87.6
86	42	15.07	35	12.8	44.7	300	340	88.2
87	42	15.08	35	12.7	45.7	300	340	88.1
88	42	15.10	35	13.0	45.8	297	340	87.4
89	42	15.11	34	12.7	45.4	297	340	87.3
90	42	15.12	35	12.5	45.2	296	340	87.1
91	42	15.13	34	12.6	44.9	294	340	86.4
92	42	15.14	34	12.7	45.0	297	340	87.3
93	42	15.15	34	12.6	44.6	298	340	87.7
94	42	15.17	33	12.4	44.6	293	340	86.3
95	42	15.18	33	12.3	44.3	294	340	86.4
96	42	15.19	33	12.1	44.1	289	340	85.0
97	42	15.20	32	12.0	44.1	292	340	86.0
98	42	15.21	32	11.9	43.8	289	340	85.1
99	42	15.23	32	11.9	43.6	294	340	86.4
100	42	15.24	32	12.0	43.5	292	340	85.8
101	42	15.25	32	11.6	43.1	288	340	84.7
102	42	15.26	31	11.6	42.9	283	340	83.2
103	42	15.27	32	12.1	42.7	293	340	86.0
104	42	15.29	32	12.0	42.7	290	340	85.3
105	42	15.30	32	12.1	43.6	291	340	85.7
106	42	15.31	32	11.9	45.8	293	340	86.1
107	42	15.32	32	11.9	46.6	293	340	86.1
108	42	15.33	32	11.7	46.5	295	340	86.9
109	42	15.35	33	11.9	46.6	301	340	88.4
110	42	15.36	33	12.1	46.3	301	340	88.4
111	42	15.37	33	12.1	46.1	301	340	88.5

112	42	15.38	33	12.0	46.1	299	340	87.8
113	42	15.39	33	11.7	45.9	301	340	88.6
114	42	15.40	32	11.4	45.8	293	340	86.0
115	42	15.42	33	11.7	45.8	299	340	87.9
116	42	15.43	33	11.7	45.6	297	340	87.2
117	42	15.44	33	11.7	45.6	299	340	87.8
118	42	15.45	33	11.8	45.5	298	340	87.5
119	42	15.46	33	11.8	45.4	297	340	87.2
120	42	15.48	33	11.8	45.4	300	340	88.1
121	42	15.49	33	11.9	45.2	297	340	87.4
122	42	15.50	33	12.0	45.0	299	340	88.1
123	50	15.51	33	11.9	45.0	303	340	89.0
124	50	15.52	33	11.8	45.1	295	340	86.9
125	50	15.53	33	11.8	44.8	295	340	86.8
126	50	15.54	33	11.7	44.7	295	340	86.8
127	50	15.55	33	11.8	44.7	297	340	87.5
128	50	15.56	33	11.7	44.6	297	340	87.3
129	50	15.57	33	11.4	44.5	292	340	86.0
130	50	15.58	33	11.1	44.5	292	340	85.9
131	50	15.59	33	10.9	44.2	292	340	85.9
132	50	15.60	33	10.7	44.4	282	340	82.9
133	50	15.61	33	10.5	44.1	283	340	83.3
134	50	15.62	33	10.3	43.9	283	340	83.4
135	50	15.63	33	10.7	43.8	287	340	84.5
136	50	15.64	33	10.5	43.9	292	340	85.8
137	50	15.65	33	10.6	43.8	289	340	85.0
138	50	15.66	34	10.8	43.6	294	340	86.4
139	50	15.67	33	10.7	43.6	291	340	85.5
140	50	15.68	33	10.7	43.6	286	340	84.2
141	50	15.69	33	10.6	43.5	282	340	83.0
142	50	15.70	33	11.1	43.5	287	340	84.5
143	50	15.71	33	11.0	43.4	284	340	83.5
144	50	15.72	33	11.1	43.1	286	340	84.1
145	50	15.73	33	11.1	43.0	287	340	84.4
146	50	15.74	32	11.1	43.3	284	340	83.6
147	50	15.75	33	11.0	43.3	285	340	83.7
148	50	15.76	32	10.9	43.3	280	340	82.5
149	50	15.77	33	11.1	43.1	285	340	83.9
150	50	15.78	33	11.1	43.1	284	340	83.6
151	50	15.79	32	11.0	43.2	284	340	83.4
152	50	15.80	33	11.0	43.0	287	340	84.4
153	50	15.81	34	10.9	42.8	288	340	84.8
154	50	15.82	33	10.9	42.7	283	340	83.3
155	50	15.83	33	10.9	42.6	282	340	82.9
156	50	15.84	33	10.7	42.5	283	340	83.2
157	50	15.85	33	10.8	42.5	283	340	83.4
158	50	15.86	33	10.9	42.5	284	340	83.5
159	50	15.87	33	10.6	42.3	283	340	83.1
160	50	15.88	33	10.9	42.1	284	340	83.6
161	50	15.89	32	11.2	41.9	283	340	83.2
162	50	15.90	32	11.0	41.8	281	340	82.6
163	50	15.91	32	11.2	41.7	281	340	82.6
164	50	15.92	32	11.1	41.7	284	340	83.7
165	50	15.93	33	11.1	44.1	290	340	85.2
166	50	15.94	33	11.1	45.4	286	340	84.0
167	50	15.95	33	11.1	45.5	289	340	85.1
168	50	15.96	33	11.2	45.7	290	340	85.2
169	50	15.97	33	10.9	45.5	289	340	85.0
170	50	15.98	34	10.9	45.9	287	340	84.4
171	50	15.99	33	10.9	45.7	286	340	84.1
172	50	16.00	33	11.0	45.8	290	340	85.3

Average	33	11.0	43.7	287	340	84.5
Std Dev	0	0.4	1.1	5	0	1.5
Maximum	34	11.9	45.9	303	340	89.0
Minimum	32	10.3	41.7	280	340	82.5

N-value: 50

Sample Interval Time: 123.80 seconds.

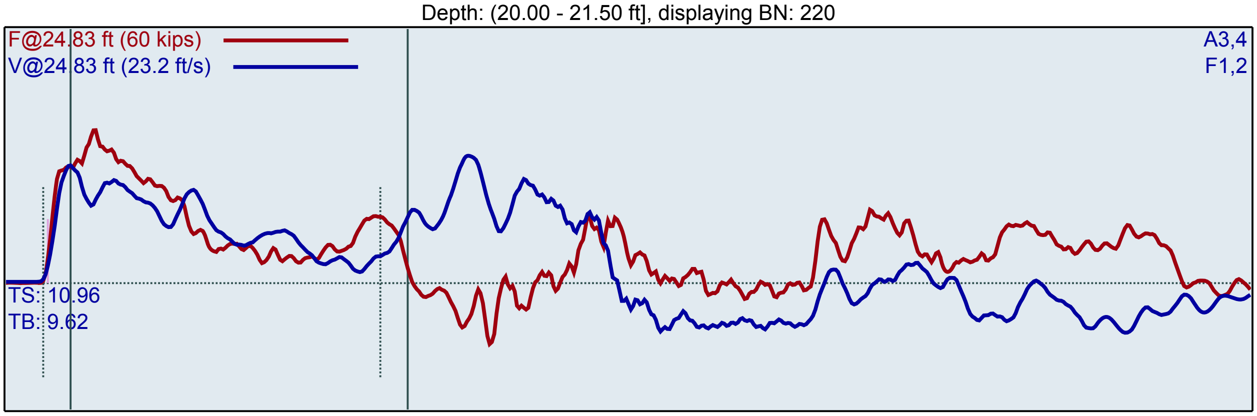
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 24.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (20.00 - 21.50 ft], displaying BN: 220



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
173	50	20.51	33	13.3	1.9	287	340	84.3
174	50	20.52	34	12.3	34.0	288	340	84.8
175	50	20.53	34	11.9	34.8	297	340	87.3
176	50	20.54	35	12.2	39.5	310	340	91.2
177	50	20.55	35	12.0	45.7	307	340	90.4
178	50	20.56	35	11.9	46.0	302	340	88.7
179	50	20.57	35	11.9	46.3	301	340	88.4
180	50	20.58	35	11.9	48.7	304	340	89.5
181	50	20.59	36	12.1	48.7	316	340	92.9
182	50	20.60	35	12.1	49.0	303	340	89.2
183	50	20.61	36	11.9	48.9	301	340	88.7
184	50	20.62	35	12.4	49.1	309	340	90.8
185	50	20.63	35	12.7	48.8	317	340	93.3
186	50	20.64	35	12.7	48.8	310	340	91.3
187	50	20.65	35	12.6	49.0	309	340	90.9
188	50	20.66	35	12.8	49.0	315	340	92.7
189	50	20.67	35	12.7	49.0	310	340	91.0
190	50	20.68	35	12.8	49.0	311	340	91.4
191	50	20.69	35	13.0	48.8	315	340	92.6
192	50	20.70	35	13.0	48.9	313	340	92.0
193	50	20.71	36	13.1	49.0	312	340	91.8
194	50	20.72	36	13.2	48.8	314	340	92.3
195	50	20.73	36	13.2	48.9	311	340	91.5
196	50	20.74	36	13.2	48.8	314	340	92.4
197	50	20.75	36	13.2	49.0	314	340	92.3
198	50	20.76	36	13.1	48.6	308	340	90.7
199	50	20.77	36	13.0	48.9	305	340	89.8
200	50	20.78	36	13.0	48.6	310	340	91.1
201	50	20.79	37	12.9	48.9	309	340	90.7
202	50	20.80	36	12.9	48.7	307	340	90.4
203	50	20.81	36	13.0	48.6	313	340	91.9

204	50	20.82	37	13.0	48.8	312	340	91.9
205	50	20.83	36	12.8	48.9	310	340	91.3
206	50	20.84	36	12.7	48.7	312	340	91.8
207	50	20.85	36	12.8	48.7	312	340	91.7
208	50	20.86	36	12.5	48.6	311	340	91.3
209	50	20.87	35	12.4	48.7	309	340	90.8
210	50	20.88	36	12.2	48.8	310	340	91.2
211	50	20.89	35	12.1	48.7	303	340	89.0
212	50	20.90	35	12.2	48.8	304	340	89.5
213	50	20.91	35	12.1	48.8	304	340	89.4
214	50	20.92	36	11.9	48.8	304	340	89.4
215	50	20.93	36	11.9	48.8	302	340	88.9
216	50	20.94	34	11.5	48.6	294	340	86.5
217	50	20.95	35	11.7	48.9	312	340	91.9
218	50	20.96	35	11.6	48.7	303	340	89.2
219	50	20.97	35	11.5	48.7	302	340	88.8
220	50	20.98	36	11.5	48.7	315	340	92.5
221	50	20.99	36	11.1	48.5	306	340	90.1
222	50	21.00	36	11.1	48.9	305	340	89.8
		Average	35	12.4	46.9	307	340	90.4
		Std Dev	1	0.6	7.1	6	0	1.9
		Maximum	37	13.3	49.1	317	340	93.3
		Minimum	33	11.1	1.9	287	340	84.3

N-value: 50

Sample Interval Time: 61.80 seconds.

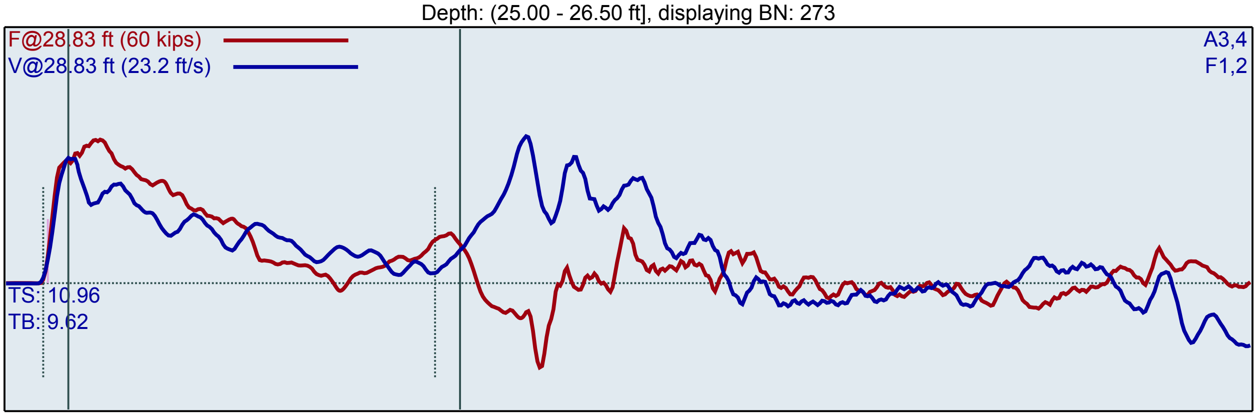
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 28.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 273



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
223	3	25.17	33	13.5	1.9	282	340	82.9
224	3	25.33	33	13.5	33.8	288	340	84.7
225	3	25.50	33	13.4	38.6	289	340	85.0
226	50	25.51	32	13.3	38.8	288	340	84.7
227	50	25.52	32	13.2	39.0	279	340	82.0
228	50	25.53	33	13.4	38.8	286	340	84.2
229	50	25.54	33	13.7	41.5	299	340	87.8
230	50	25.55	33	13.6	46.7	296	340	86.9
231	50	25.56	33	13.7	47.2	302	340	88.9
232	50	25.57	34	13.7	47.4	305	340	89.6
233	50	25.58	34	13.7	47.3	303	340	89.1
234	50	25.59	34	13.6	47.8	302	340	88.7
235	50	25.60	34	13.5	47.6	309	340	90.8
236	50	25.61	33	13.4	47.5	301	340	88.6
237	50	25.62	34	13.6	47.8	308	340	90.6
238	50	25.63	34	13.6	47.5	310	340	91.1
239	50	25.64	34	13.6	47.3	309	340	90.8
240	50	25.65	34	13.6	47.6	310	340	91.3
241	50	25.66	35	13.7	47.5	313	340	92.0
242	50	25.67	34	13.5	47.5	303	340	89.1
243	50	25.68	35	13.7	47.5	312	340	91.8
244	50	25.69	34	13.4	47.4	302	340	88.7
245	50	25.70	34	13.4	47.4	303	340	89.1
246	50	25.71	34	13.5	47.7	308	340	90.5
247	50	25.72	35	13.5	47.5	310	340	91.3
248	50	25.73	34	13.5	47.4	308	340	90.6
249	50	25.74	34	13.5	47.5	308	340	90.5
250	50	25.75	34	13.5	47.6	308	340	90.6
251	50	25.76	34	13.3	47.4	303	340	89.1
252	50	25.77	34	13.5	47.4	307	340	90.4
253	50	25.78	34	13.3	47.4	303	340	89.1

254	50	25.79	34	13.4	47.6	308	340	90.5
255	50	25.80	34	13.4	47.4	309	340	91.0
256	50	25.81	34	13.3	47.4	303	340	89.0
257	50	25.82	34	13.4	47.4	306	340	89.9
258	50	25.83	34	13.5	47.7	312	340	91.8
259	50	25.84	35	13.5	47.5	309	340	91.0
260	50	25.85	34	13.4	47.4	305	340	89.6
261	50	25.86	34	13.4	47.5	311	340	91.4
262	50	25.87	34	13.3	47.5	309	340	90.8
263	50	25.88	33	13.2	47.4	310	340	91.3
264	50	25.89	33	13.1	47.6	308	340	90.6
265	50	25.90	33	13.1	47.4	306	340	90.1
266	50	25.91	33	13.3	47.2	312	340	91.8
267	50	25.92	32	13.3	47.3	307	340	90.4
268	50	25.93	33	13.2	47.5	314	340	92.4
269	50	25.94	34	13.3	47.4	316	340	93.1
270	50	25.95	33	13.3	47.4	317	340	93.4
271	50	25.96	33	13.2	47.4	311	340	91.5
272	50	25.97	33	13.2	47.5	309	340	91.0
273	50	25.98	34	13.3	47.4	311	340	91.5
274	50	25.99	34	13.2	47.4	312	340	91.7
275	50	26.00	33	13.3	47.5	313	340	92.1
		Average	34	13.4	46.8	306	340	90.1
		Std Dev	1	0.2	2.2	7	0	2.1
		Maximum	35	13.7	47.8	317	340	93.4
		Minimum	32	13.1	38.8	279	340	82.0

N-value: 50

Sample Interval Time: 67.60 seconds.

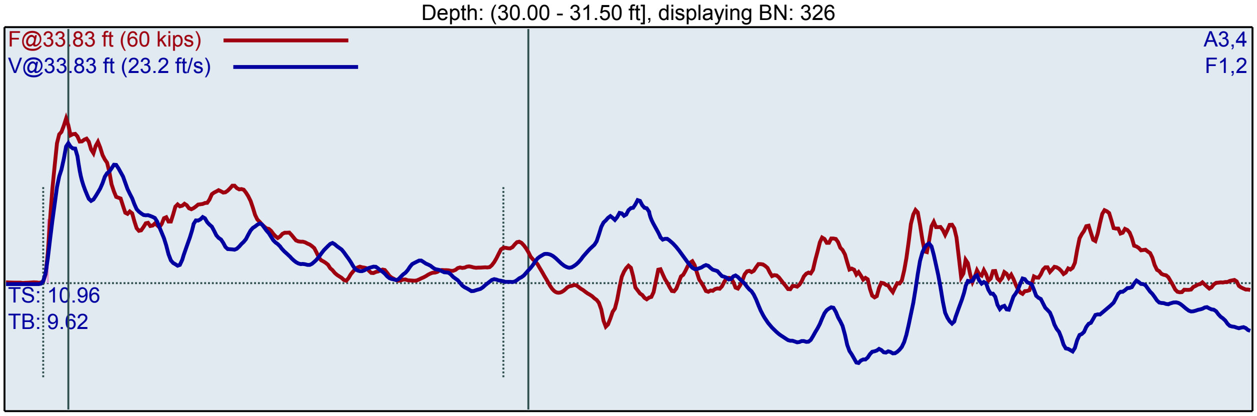
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 33.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (30.00 - 31.50 ft], displaying BN: 326



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
277	3	30.33	36	13.4	46.3	325	340	95.7
278	3	30.50	36	13.3	47.3	324	340	95.4
279	50	30.51	36	13.3	48.5	301	340	88.6
280	50	30.52	37	13.4	51.5	314	340	92.2
281	50	30.53	37	13.1	52.1	315	340	92.6
282	50	30.54	37	13.4	52.4	312	340	91.8
283	50	30.55	36	13.3	52.5	311	340	91.6
284	50	30.56	37	13.3	52.4	311	340	91.4
285	50	30.57	37	13.1	52.5	300	340	88.4
286	50	30.58	37	13.5	52.4	317	340	93.3
287	50	30.59	37	13.2	52.4	305	340	89.7
288	50	30.60	37	13.4	52.6	311	340	91.4
289	50	30.61	37	13.4	52.7	320	340	94.1
290	50	30.62	37	13.2	52.4	313	340	92.0
291	50	30.63	37	13.4	52.6	310	340	91.2
292	50	30.64	38	13.4	52.7	317	340	93.3
293	50	30.65	38	13.2	52.3	307	340	90.3
294	50	30.66	38	13.1	52.8	307	340	90.3
295	50	30.67	37	13.3	52.4	310	340	91.2
296	50	30.68	38	13.3	52.7	313	340	92.1
297	50	30.69	38	13.1	52.4	308	340	90.6
298	50	30.70	38	13.3	52.6	315	340	92.5
299	50	30.71	38	13.3	52.5	316	340	92.8
300	50	30.72	38	13.3	52.2	311	340	91.6
301	50	30.73	37	13.4	52.6	315	340	92.8
302	50	30.74	37	13.4	52.7	311	340	91.4
303	50	30.75	38	13.3	52.4	310	340	91.3
304	50	30.76	38	13.4	52.8	318	340	93.5
305	50	30.77	37	13.4	52.5	315	340	92.7
306	50	30.78	37	13.6	52.4	316	340	92.9
307	50	30.79	37	13.5	52.4	322	340	94.8

308	50	30.80	37	13.6	52.7	319	340	93.8
309	50	30.81	36	13.6	52.6	311	340	91.3
310	50	30.82	36	13.7	52.6	320	340	94.0
311	50	30.83	37	13.1	52.3	310	340	91.1
312	50	30.84	38	13.1	52.6	309	340	90.7
313	50	30.85	38	13.2	52.5	316	340	92.9
314	50	30.86	38	12.9	52.3	316	340	92.9
315	50	30.87	37	13.3	52.5	310	340	91.3
316	50	30.88	37	13.5	52.4	310	340	91.2
317	50	30.89	36	13.7	52.3	314	340	92.2
318	50	30.90	36	13.8	52.1	311	340	91.6
319	50	30.91	36	14.0	52.6	315	340	92.6
320	50	30.92	37	13.5	52.6	313	340	92.1
321	50	30.93	37	13.8	52.8	315	340	92.6
322	50	30.94	38	13.3	52.2	318	340	93.6
323	50	30.95	38	12.9	52.7	319	340	93.7
324	50	30.96	38	12.8	52.7	309	340	91.0
325	50	30.97	39	12.9	52.4	313	340	92.1
326	50	30.98	39	12.7	52.2	310	340	91.3
327	50	30.99	38	12.8	52.9	310	340	91.3
328	50	31.00	39	13.0	52.4	316	340	92.9
		Average	37	13.3	52.4	313	340	92.0
		Std Dev	1	0.3	0.6	4	0	1.3
		Maximum	39	14.0	52.9	322	340	94.8
		Minimum	36	12.7	48.5	300	340	88.4

N-value: 50

Sample Interval Time: 58.55 seconds.

GARDENER DENVER 1000 (SN 668-10)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
17.50	**25-50-0**	10.00	11.50	**50**	**72**	51	13.2	40.0	279	340	82.2
22.50	**11-50-0**	15.00	16.50	**50**	**72**	50	12.4	40.2	280	340	82.3
27.50	**2-50-0**	20.00	21.50	**50**	**72**	50	12.8	43.9	304	340	89.5
32.50	**3-50-0**	25.00	26.50	**50**	**72**	51	12.8	47.6	303	340	89.0
37.50	**2-50-0**	30.00	31.50	**50**	**72**	52	12.7	50.3	305	340	89.7
					Overall Average Values:	51	12.8	44.4	294	340	86.5
					Standard Deviation:	1	0.4	6.3	14	0	4.3
					Overall Maximum Value:	55	13.6	56.7	324	340	95.3
					Overall Minimum Value:	47	11.6	21.9	265	340	77.8

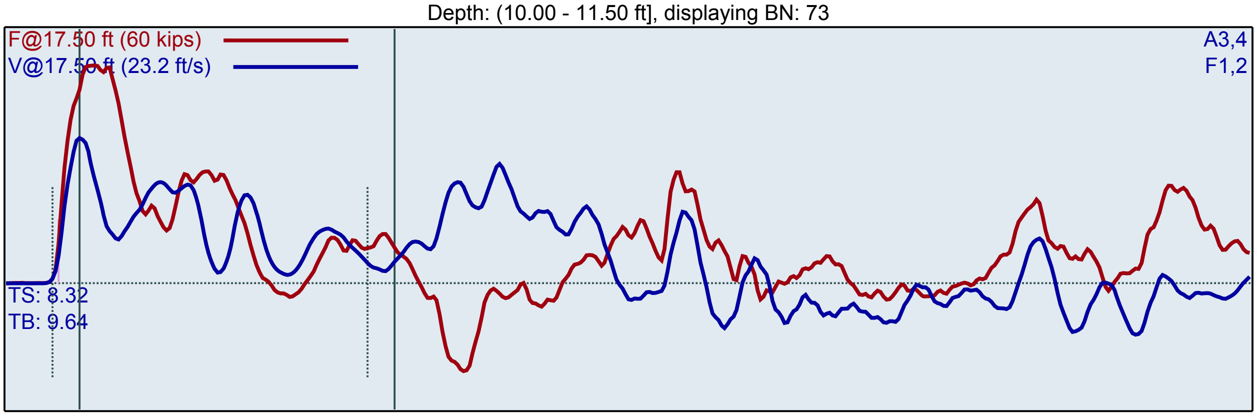
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 17.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 73



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	25	10.02	41	10.8	1.9	232	340	68.4
2	25	10.04	45	12.3	21.9	250	340	73.4
3	25	10.06	46	12.2	22.3	253	340	74.4
4	25	10.08	47	12.6	22.9	258	340	76.0
5	25	10.10	47	12.5	27.4	261	340	76.8
6	25	10.12	47	12.4	31.2	256	340	75.3
7	25	10.14	48	12.9	33.0	262	340	77.1
8	25	10.16	48	12.9	34.2	265	340	77.9
9	25	10.18	48	12.7	32.0	261	340	76.7
10	25	10.20	48	12.5	29.9	258	340	76.0
11	25	10.22	49	12.8	34.8	265	340	78.0
12	25	10.24	49	12.6	39.8	264	340	77.5
13	25	10.26	49	12.6	35.8	262	340	77.1
14	25	10.28	48	12.5	30.6	258	340	75.9
15	25	10.30	49	12.7	31.8	266	340	78.2
16	25	10.32	49	12.4	39.6	269	340	79.1
17	25	10.34	50	12.8	41.8	277	340	81.5
18	25	10.36	49	12.6	41.6	273	340	80.4
19	25	10.38	50	13.1	38.6	275	340	80.8
20	25	10.40	50	13.0	35.6	274	340	80.6
21	25	10.42	51	13.2	39.0	282	340	82.9
22	25	10.44	51	13.1	43.4	281	340	82.5
23	25	10.46	52	13.2	43.7	283	340	83.2
24	25	10.48	51	13.2	42.6	279	340	82.2
25	25	10.50	51	13.1	41.7	279	340	82.1
26	50	10.51	52	13.2	40.7	282	340	82.8
27	50	10.52	51	13.2	39.7	282	340	82.8
28	50	10.53	51	13.1	39.0	278	340	81.9

29	50	10.54	52	13.1	38.4	283	340	83.2
30	50	10.55	51	13.2	37.1	278	340	81.9
31	50	10.56	51	13.2	36.2	276	340	81.3
32	50	10.57	51	13.2	36.0	278	340	81.8
33	50	10.58	51	13.2	36.4	279	340	82.0
34	50	10.59	51	13.3	37.5	282	340	83.1
35	50	10.60	51	13.2	37.7	279	340	82.2
36	50	10.61	51	13.3	37.4	281	340	82.6
37	50	10.62	51	13.3	37.2	286	340	84.1
38	50	10.63	50	13.2	36.7	279	340	81.9
39	50	10.64	51	13.1	36.5	275	340	80.8
40	50	10.65	51	13.2	36.9	276	340	81.2
41	50	10.66	50	13.2	36.7	277	340	81.4
42	50	10.67	50	12.9	35.8	276	340	81.1
43	50	10.68	50	13.1	35.1	271	340	79.8
44	50	10.69	50	12.9	34.4	266	340	78.2
45	50	10.70	50	13.0	33.0	268	340	78.8
46	50	10.71	51	13.0	32.9	270	340	79.5
47	50	10.72	51	13.2	37.6	278	340	81.8
48	50	10.73	50	13.3	38.7	271	340	79.8
49	50	10.74	50	12.9	36.0	267	340	78.5
50	50	10.75	50	12.9	32.1	265	340	77.8
51	50	10.76	51	13.1	34.9	275	340	80.9
52	50	10.77	51	13.1	43.4	279	340	82.0
53	50	10.78	51	13.1	46.0	279	340	82.0
54	50	10.79	51	13.1	46.3	280	340	82.5
55	50	10.80	52	13.2	46.1	282	340	83.0
56	50	10.81	52	13.3	45.5	280	340	82.5
57	50	10.82	51	13.2	44.9	278	340	81.6
58	50	10.83	51	13.2	44.3	282	340	82.9
59	50	10.84	51	13.3	44.0	285	340	83.9
60	50	10.85	51	13.2	44.1	284	340	83.5
61	50	10.86	51	13.3	43.9	282	340	83.1
62	50	10.87	51	13.3	44.1	286	340	84.2
63	50	10.88	51	13.3	44.0	284	340	83.4
64	50	10.89	51	13.3	44.0	283	340	83.2
65	50	10.90	51	13.2	43.6	286	340	84.0
66	50	10.91	51	13.3	43.4	286	340	84.1
67	50	10.92	51	13.2	43.4	285	340	83.7
68	50	10.93	51	13.1	43.0	284	340	83.6
69	50	10.94	51	13.0	42.9	282	340	83.0
70	50	10.95	51	13.2	42.6	287	340	84.4
71	50	10.96	51	13.1	42.5	283	340	83.1
72	50	10.97	51	13.1	41.9	285	340	83.7
73	50	10.98	51	13.1	41.6	283	340	83.1
74	50	10.99	51	13.1	41.5	283	340	83.2
75	50	11.00	51	13.2	41.7	282	340	83.0
		Average	51	13.2	40.0	279	340	82.2
		Std Dev	1	0.1	4.0	5	0	1.6
		Maximum	52	13.3	46.3	287	340	84.4
		Minimum	50	12.9	32.1	265	340	77.8

N-value: 50

Sample Interval Time: 118.96 seconds.

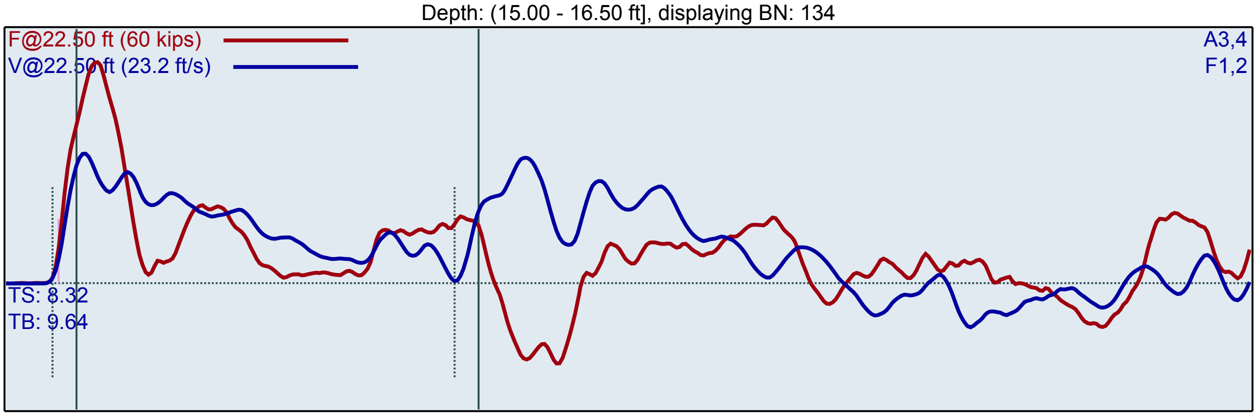
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 22.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 134



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
77	11	15.09	42	11.8	5.5	239	340	70.4
78	11	15.14	45	12.7	19.7	256	340	75.3
79	11	15.18	45	12.9	19.8	256	340	75.3
80	11	15.23	46	13.0	20.0	257	340	75.7
81	11	15.27	46	12.9	20.7	259	340	76.1
82	11	15.32	46	12.7	21.6	256	340	75.2
83	11	15.36	47	12.9	22.9	260	340	76.5
84	11	15.41	47	12.4	28.1	263	340	77.2
85	11	15.45	47	12.5	35.1	264	340	77.5
86	11	15.50	47	12.3	29.8	258	340	75.8
87	50	15.51	48	12.4	34.5	270	340	79.3
88	50	15.52	48	12.6	43.3	277	340	81.4
89	50	15.53	48	12.5	45.5	274	340	80.5
90	50	15.54	47	12.2	41.4	266	340	78.1
91	50	15.55	47	12.4	35.2	268	340	78.7
92	50	15.56	49	12.9	38.9	294	340	86.5
93	50	15.57	48	12.5	43.1	276	340	81.1
94	50	15.58	48	12.8	44.2	276	340	81.3
95	50	15.59	48	13.1	43.4	277	340	81.5
96	50	15.60	49	13.1	42.5	277	340	81.4
97	50	15.61	48	12.9	42.4	277	340	81.4
98	50	15.62	49	13.0	42.6	278	340	81.7
99	50	15.63	49	12.9	42.6	279	340	82.0
100	50	15.64	49	13.0	42.2	277	340	81.4
101	50	15.65	49	13.0	42.2	279	340	82.1
102	50	15.66	49	12.8	42.0	276	340	81.1
103	50	15.67	49	13.1	41.9	277	340	81.3
104	50	15.68	49	13.2	42.0	279	340	82.1
105	50	15.69	49	13.2	42.1	276	340	81.1
106	50	15.70	49	13.2	42.4	275	340	80.9
107	50	15.71	49	13.0	42.6	277	340	81.4

108	50	15.72	49	13.1	42.2	283	340	83.1
109	50	15.73	50	13.0	42.5	281	340	82.8
110	50	15.74	49	13.0	42.2	280	340	82.4
111	50	15.75	50	12.8	41.4	279	340	82.0
112	50	15.76	50	12.8	41.4	279	340	82.1
113	50	15.77	50	12.7	41.6	282	340	82.9
114	50	15.78	51	12.7	41.5	285	340	83.7
115	50	15.79	51	12.6	41.7	283	340	83.3
116	50	15.80	51	12.4	41.4	277	340	81.4
117	50	15.81	51	12.3	40.5	280	340	82.3
118	50	15.82	52	12.3	39.3	279	340	82.1
119	50	15.83	52	12.0	38.2	280	340	82.3
120	50	15.84	52	11.9	37.7	279	340	82.1
121	50	15.85	52	12.0	38.0	278	340	81.8
122	50	15.86	53	12.1	39.7	285	340	83.9
123	50	15.87	52	12.0	40.2	277	340	81.5
124	50	15.88	52	11.6	39.1	278	340	81.8
125	50	15.89	52	11.9	37.0	281	340	82.7
126	50	15.90	52	11.6	36.4	271	340	79.8
127	50	15.91	52	11.9	38.4	291	340	85.5
128	50	15.92	52	11.6	40.4	283	340	83.1
129	50	15.93	51	11.6	35.9	280	340	82.4
130	50	15.94	52	11.8	31.7	287	340	84.4
131	50	15.95	53	11.8	37.8	296	340	87.0
132	50	15.96	53	11.8	44.2	294	340	86.5
133	50	15.97	52	11.6	41.2	286	340	84.1
134	50	15.98	52	11.7	31.4	279	340	82.0
135	50	15.99	52	11.8	33.4	290	340	85.2
136	50	16.00	52	11.6	36.2	287	340	84.3
		Average	50	12.4	40.2	280	340	82.3
		Std Dev	2	0.5	3.2	6	0	1.8
		Maximum	53	13.2	45.5	296	340	87.0
		Minimum	47	11.6	31.4	266	340	78.1

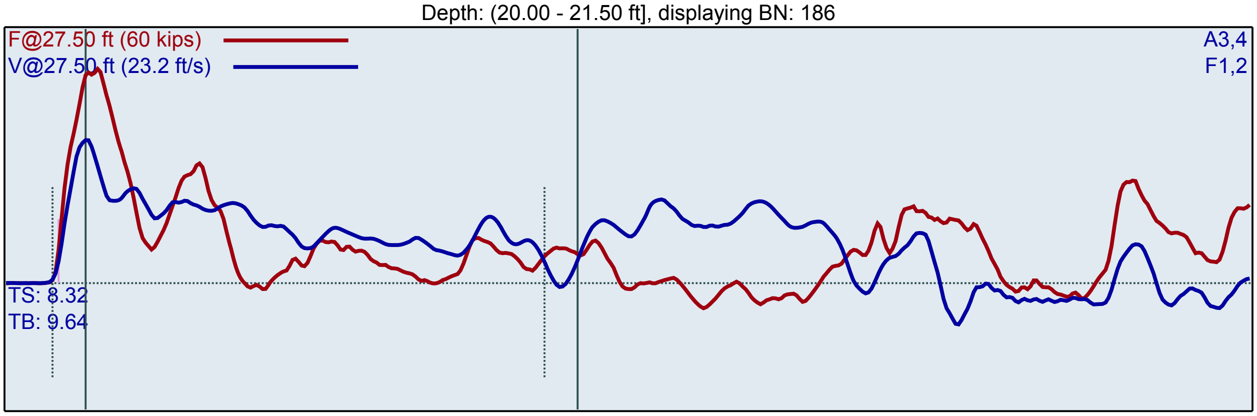
N-value: 50

Sample Interval Time: 98.41 seconds.

Texas Geo Bore Drilling 10.17.20 TCP   10-11.5
CM   Interval start: 10/17/2020
TCP

AR: 1.45 in^2   SP: 0.492 k/ft3
LE: 27.50 ft   EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (20.00 - 21.50 ft], displaying BN: 186



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1
A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
137	2	20.25	47	12.0	1.9	277	340	81.5
138	2	20.50	49	12.0	20.8	302	340	88.7
139	50	20.51	49	11.9	21.9	271	340	79.6
140	50	20.52	50	12.2	28.0	283	340	83.4
141	50	20.53	51	12.7	39.9	293	340	86.1
142	50	20.54	50	12.5	41.7	293	340	86.2
143	50	20.55	49	12.1	34.3	279	340	82.0
144	50	20.56	50	12.8	31.4	295	340	86.7
145	50	20.57	51	13.2	39.1	315	340	92.5
146	50	20.58	49	12.9	38.8	290	340	85.4
147	50	20.59	49	12.9	32.5	286	340	84.2
148	50	20.60	48	13.1	31.5	296	340	87.1
149	50	20.61	50	13.0	35.5	293	340	86.2
150	50	20.62	48	12.8	36.9	286	340	84.2
151	50	20.63	49	12.7	35.8	288	340	84.7
152	50	20.64	47	12.4	31.5	284	340	83.7
153	50	20.65	49	12.7	30.1	287	340	84.3
154	50	20.66	49	12.8	37.5	301	340	88.6
155	50	20.67	49	13.0	41.0	304	340	89.3
156	50	20.68	49	12.8	41.6	293	340	86.2
157	50	20.69	48	12.6	33.9	286	340	84.0
158	50	20.70	49	12.7	33.3	287	340	84.3
159	50	20.71	50	12.9	44.9	309	340	90.9
160	50	20.72	52	13.2	48.8	310	340	91.2
161	50	20.73	51	12.9	50.1	309	340	90.9
162	50	20.74	51	12.8	50.7	302	340	88.7
163	50	20.75	51	12.9	50.8	310	340	91.2
164	50	20.76	51	12.8	50.8	309	340	91.0
165	50	20.77	51	12.9	50.5	315	340	92.7
166	50	20.78	50	12.9	50.7	322	340	94.6
167	50	20.79	51	12.9	50.8	318	340	93.6

168	50	20.80	51	12.8	51.0	315	340	92.6
169	50	20.81	50	12.7	50.2	313	340	92.2
170	50	20.82	50	12.7	49.4	310	340	91.2
171	50	20.83	51	12.6	49.2	311	340	91.5
172	50	20.84	51	12.6	49.6	313	340	92.2
173	50	20.85	51	12.8	50.3	312	340	91.7
174	50	20.86	51	12.9	50.2	324	340	95.3
175	50	20.87	51	12.7	49.9	315	340	92.7
176	50	20.88	51	12.9	49.6	317	340	93.2
177	50	20.89	50	12.9	49.8	316	340	92.9
178	50	20.90	50	13.0	50.4	316	340	93.0
179	50	20.91	51	13.0	50.4	319	340	93.8
180	50	20.92	49	12.7	50.4	313	340	92.2
181	50	20.93	50	12.9	50.3	317	340	93.1
182	50	20.94	50	12.7	50.1	313	340	92.1
183	50	20.95	50	12.9	49.3	314	340	92.4
184	50	20.96	50	13.0	49.2	312	340	91.7
185	50	20.97	50	12.8	49.4	309	340	90.8
186	50	20.98	50	13.0	50.4	321	340	94.4
187	50	20.99	50	12.8	50.7	312	340	91.7
188	50	21.00	50	12.7	50.8	314	340	92.2
		Average	50	12.8	43.9	304	340	89.5
		Std Dev	1	0.2	8.1	13	0	3.9
		Maximum	52	13.2	51.0	324	340	95.3
		Minimum	47	11.9	21.9	271	340	79.6

N-value: 50

Sample Interval Time: 74.25 seconds.

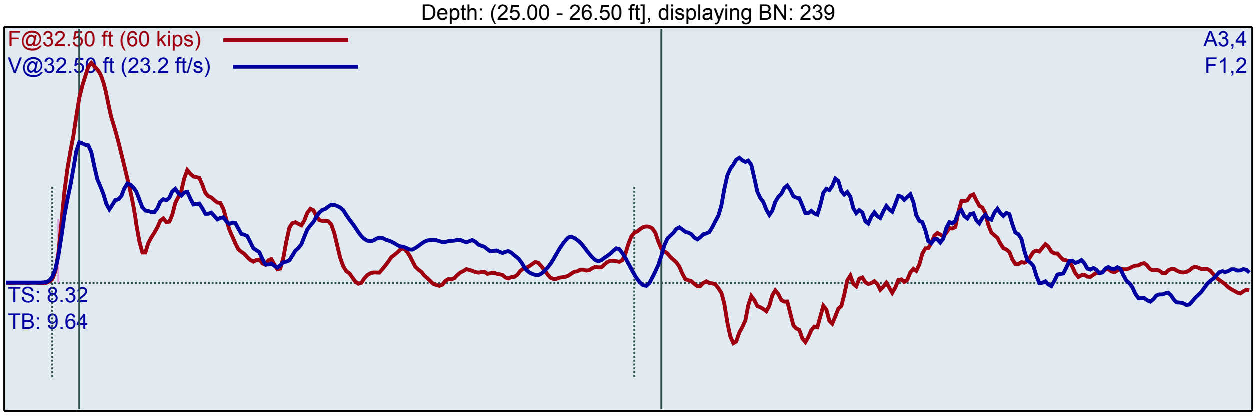
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 32.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 239



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
189	3	25.17	49	12.9	1.9	284	340	83.6
190	3	25.33	48	13.1	21.1	283	340	83.3
191	3	25.50	48	13.7	30.6	289	340	85.1
192	50	25.51	51	13.1	41.1	286	340	84.1
193	50	25.52	50	13.1	41.9	285	340	83.7
194	50	25.53	51	13.1	42.6	291	340	85.6
195	50	25.54	51	13.3	44.0	301	340	88.4
196	50	25.55	51	13.0	43.0	288	340	84.7
197	50	25.56	51	13.1	40.9	300	340	88.4
198	50	25.57	49	13.2	41.8	295	340	86.8
199	50	25.58	50	13.3	47.1	304	340	89.3
200	50	25.59	49	13.1	48.9	298	340	87.8
201	50	25.60	49	13.0	47.6	297	340	87.3
202	50	25.61	49	13.4	46.6	301	340	88.5
203	50	25.62	49	13.6	46.7	304	340	89.5
204	50	25.63	50	13.3	48.1	308	340	90.7
205	50	25.64	50	13.6	49.8	307	340	90.2
206	50	25.65	50	13.1	50.3	307	340	90.2
207	50	25.66	50	12.9	50.1	296	340	87.1
208	50	25.67	48	12.9	45.7	292	340	85.8
209	50	25.68	49	12.7	40.1	290	340	85.4
210	50	25.69	49	13.0	41.6	296	340	87.1
211	50	25.70	51	12.9	46.1	295	340	86.9
212	50	25.71	50	12.8	46.7	299	340	88.1
213	50	25.72	50	12.8	47.2	298	340	87.6
214	50	25.73	48	12.8	47.7	298	340	87.6
215	50	25.74	50	12.7	48.6	299	340	88.0
216	50	25.75	50	12.8	50.0	301	340	88.4
217	50	25.76	50	12.9	50.0	303	340	89.0
218	50	25.77	49	12.7	50.2	306	340	89.9
219	50	25.78	50	12.7	50.2	302	340	88.8

220	50	25.79	50	12.5	49.8	297	340	87.2
221	50	25.80	50	12.6	49.2	303	340	89.0
222	50	25.81	51	12.4	49.0	302	340	88.8
223	50	25.82	51	12.6	49.2	311	340	91.6
224	50	25.83	50	12.7	49.4	302	340	88.9
225	50	25.84	51	12.6	49.4	307	340	90.3
226	50	25.85	52	12.5	49.8	306	340	90.0
227	50	25.86	52	12.6	49.5	306	340	90.0
228	50	25.87	51	12.7	49.6	309	340	90.9
229	50	25.88	52	12.5	49.3	310	340	91.2
230	50	25.89	52	12.6	49.4	312	340	91.8
231	50	25.90	51	12.7	49.4	306	340	89.9
232	50	25.91	52	12.6	50.2	307	340	90.2
233	50	25.92	52	12.8	49.8	314	340	92.2
234	50	25.93	52	12.6	49.4	305	340	89.8
235	50	25.94	52	12.6	49.7	313	340	92.1
236	50	25.95	51	12.7	49.7	313	340	92.1
237	50	25.96	52	12.7	49.7	316	340	92.8
238	50	25.97	52	12.7	49.7	312	340	91.7
239	50	25.98	52	12.7	49.8	311	340	91.4
240	50	25.99	52	12.5	49.4	307	340	90.4
241	50	26.00	52	12.6	47.3	311	340	91.5
		Average	51	12.8	47.6	303	340	89.0
		Std Dev	1	0.3	3.0	7	0	2.2
		Maximum	52	13.6	50.3	316	340	92.8
		Minimum	48	12.4	40.1	285	340	83.7

N-value: 50

Sample Interval Time: 68.03 seconds.

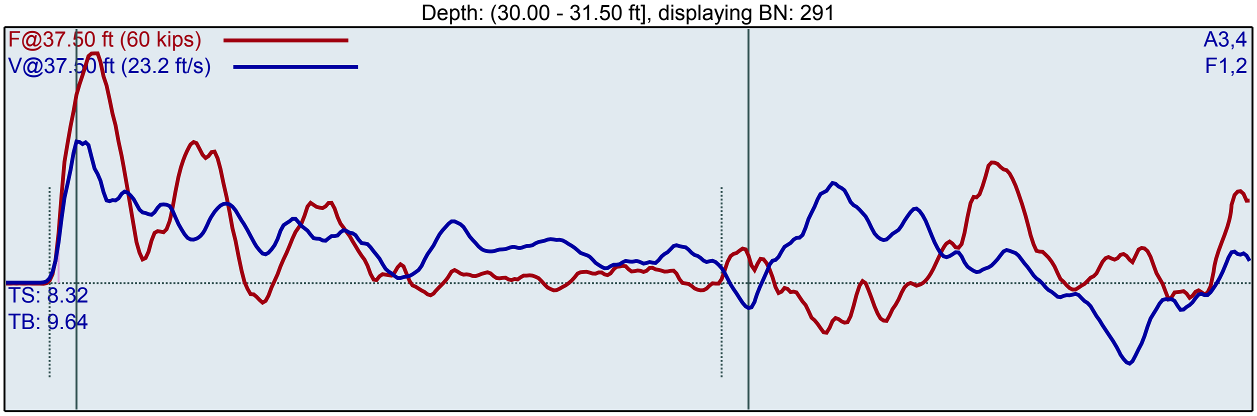
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 37.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (30.00 - 31.50 ft], displaying BN: 291



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
242	2	30.25	48	12.0	1.9	298	340	87.8
243	2	30.50	49	12.6	20.8	292	340	85.9
244	50	30.51	49	12.6	28.0	285	340	83.8
245	50	30.52	50	13.0	42.6	300	340	88.2
246	50	30.53	50	12.8	47.7	304	340	89.4
247	50	30.54	50	12.8	51.5	302	340	88.9
248	50	30.55	50	12.6	52.1	303	340	89.1
249	50	30.56	51	12.6	52.3	300	340	88.2
250	50	30.57	51	12.6	51.5	301	340	88.6
251	50	30.58	51	12.4	51.3	296	340	87.2
252	50	30.59	51	12.8	50.8	306	340	90.0
253	50	30.60	51	12.8	51.3	302	340	88.7
254	50	30.61	52	12.6	52.3	301	340	88.4
255	50	30.62	52	12.8	52.7	306	340	89.9
256	50	30.63	51	12.5	52.0	302	340	88.9
257	50	30.64	52	12.6	51.5	295	340	86.9
258	50	30.65	52	12.6	51.6	303	340	89.2
259	50	30.66	52	12.7	51.8	305	340	89.7
260	50	30.67	51	12.5	52.3	297	340	87.4
261	50	30.68	52	12.5	52.7	305	340	89.7
262	50	30.69	52	12.6	55.6	307	340	90.3
263	50	30.70	52	12.7	56.7	314	340	92.3
264	50	30.71	52	12.6	55.1	304	340	89.5
265	50	30.72	51	12.4	47.9	293	340	86.2
266	50	30.73	52	12.7	45.5	299	340	88.1
267	50	30.74	52	12.8	48.6	301	340	88.4
268	50	30.75	53	12.8	45.8	303	340	89.0
269	50	30.76	53	12.4	47.2	302	340	88.7
270	50	30.77	53	12.7	49.2	307	340	90.3
271	50	30.78	52	12.6	49.4	304	340	89.5
272	50	30.79	54	12.9	49.6	312	340	91.6

273	50	30.80	53	12.8	49.7	306	340	90.1
274	50	30.81	53	12.7	49.5	308	340	90.7
275	50	30.82	54	13.0	49.5	313	340	92.1
276	50	30.83	54	12.8	49.9	308	340	90.5
277	50	30.84	54	12.8	50.3	311	340	91.6
278	50	30.85	53	12.8	50.3	307	340	90.2
279	50	30.86	54	12.8	50.3	310	340	91.2
280	50	30.87	53	12.9	50.5	310	340	91.1
281	50	30.88	54	12.7	50.4	308	340	90.7
282	50	30.89	54	12.9	50.6	311	340	91.5
283	50	30.90	54	12.8	51.0	310	340	91.3
284	50	30.91	54	12.9	51.7	308	340	90.7
285	50	30.92	54	12.8	51.5	307	340	90.4
286	50	30.93	54	12.8	51.2	309	340	90.9
287	50	30.94	53	12.7	51.8	306	340	90.1
288	50	30.95	55	12.7	51.1	313	340	92.1
289	50	30.96	54	12.6	51.2	306	340	90.0
290	50	30.97	54	12.6	51.7	307	340	90.3
291	50	30.98	54	12.8	52.1	312	340	91.9
292	50	30.99	54	12.7	52.1	308	340	90.6
293	50	31.00	54	12.8	52.0	308	340	90.6
		Average	52	12.7	50.3	305	340	89.7
		Std Dev	1	0.1	4.0	6	0	1.6
		Maximum	55	13.0	56.7	314	340	92.3
		Minimum	49	12.4	28.0	285	340	83.8

N-value: 50

Sample Interval Time: 63.07 seconds.

CME 55 (SN 172555)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

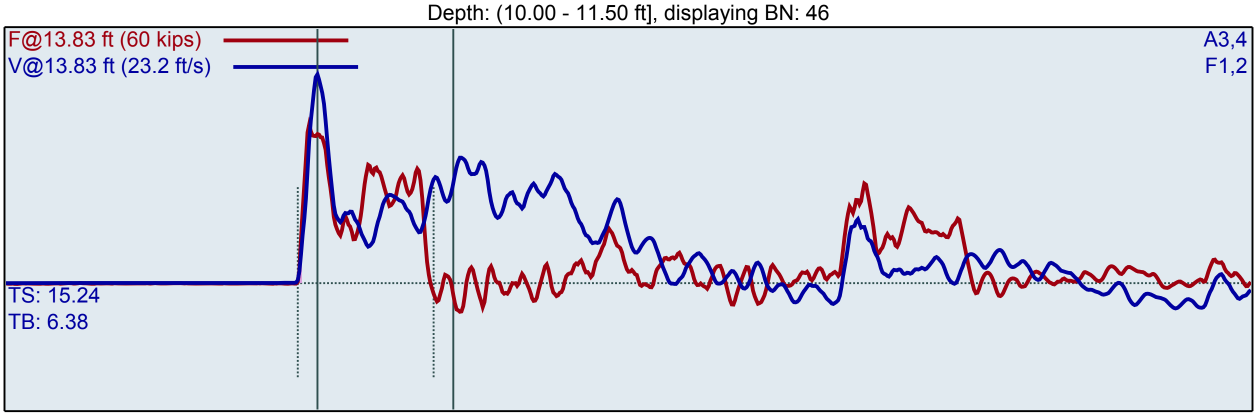
EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
13.83	**15-17-16**	10.00	11.50	**33**	**53**	36	18.7	47.6	333	340	98.0
18.83	**1-50-0**	15.00	16.50	**50**	**80**	34	18.0	39.9	305	340	89.7
23.83	**1-50-0**	20.00	21.50	**50**	**80**	34	19.0	47.2	331	340	97.3
27.83	**40-50-0**	25.00	26.50	**50**	**80**	37	18.1	47.2	337	340	99.1
32.83	**2-50-0**	30.00	31.50	**50**	**80**	37	18.5	50.0	346	340	101.8
					Overall Average Values:	36	18.5	46.3	330	340	97.1
					Standard Deviation:	1	0.5	3.5	17	0	5.0
					Overall Maximum Value:	40	19.3	50.7	364	340	107.1
					Overall Minimum Value:	33	17.1	37.7	281	340	82.7

Texas Geo Bore Drilling 10.17.20 TCP 10.0-11.5
CM Interval start: 10/17/2020
TCP

AR: 1.45 in^2 SP: 0.492 k/ft3
LE: 13.83 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (10.00 - 11.50 ft], displaying BN: 46



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1
A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	15	10.03	34	17.7	1.9	282	340	82.9
2	15	10.07	38	18.9	44.6	321	340	94.3
3	15	10.10	38	18.9	47.4	338	340	99.3
4	15	10.13	39	19.0	48.1	336	340	98.8
5	15	10.17	39	19.1	48.2	339	340	99.6
6	15	10.20	39	18.9	48.1	324	340	95.2
7	15	10.23	37	18.7	48.3	342	340	100.6
8	15	10.27	37	18.6	48.1	342	340	100.5
9	15	10.30	37	18.5	47.6	336	340	98.9
10	15	10.33	36	18.4	47.3	326	340	96.0
11	15	10.37	38	18.6	47.6	343	340	101.0
12	15	10.40	37	18.3	47.7	331	340	97.4
13	15	10.43	37	18.3	47.3	315	340	92.8
14	15	10.47	37	18.4	47.6	324	340	95.2
15	15	10.50	37	18.3	47.4	317	340	93.2
16	17	10.53	36	18.1	47.6	322	340	94.6
17	17	10.56	37	18.6	47.8	326	340	95.9
18	17	10.59	36	18.4	47.5	328	340	96.4
19	17	10.62	36	18.4	47.2	319	340	93.8
20	17	10.65	36	18.3	47.5	318	340	93.6
21	17	10.68	36	18.4	47.7	327	340	96.2
22	17	10.71	37	18.6	47.7	335	340	98.6
23	17	10.74	37	18.7	47.6	332	340	97.8
24	17	10.76	36	18.6	47.6	328	340	96.3
25	17	10.79	36	18.7	47.5	324	340	95.3
26	17	10.82	36	18.5	47.4	323	340	95.1
27	17	10.85	36	18.5	47.6	322	340	94.8
28	17	10.88	36	18.5	47.7	321	340	94.4

29	17	10.91	36	18.9	47.7	328	340	96.4
30	17	10.94	37	19.0	47.7	332	340	97.8
31	17	10.97	35	18.7	47.5	321	340	94.4
32	17	11.00	36	19.0	47.3	335	340	98.6
33	16	11.03	35	18.7	47.7	332	340	97.5
34	16	11.06	35	18.7	47.5	335	340	98.5
35	16	11.09	35	18.6	47.8	338	340	99.5
36	16	11.13	36	18.7	47.6	334	340	98.3
37	16	11.16	36	18.7	47.6	331	340	97.5
38	16	11.19	37	18.7	47.4	334	340	98.2
39	16	11.22	36	18.8	47.6	341	340	100.3
40	16	11.25	36	18.8	47.4	337	340	99.1
41	16	11.28	37	18.9	47.8	343	340	101.0
42	16	11.31	37	19.0	47.6	348	340	102.2
43	16	11.34	38	19.0	47.5	349	340	102.6
44	16	11.38	37	18.9	47.7	337	340	99.1
45	16	11.41	38	19.0	47.8	351	340	103.3
46	16	11.44	37	18.9	47.7	353	340	103.7
47	16	11.47	37	19.0	48.0	352	340	103.6
48	16	11.50	37	19.0	47.8	343	340	100.9
		Average	36	18.7	47.6	333	340	98.0
		Std Dev	1	0.2	0.2	10	0	2.9
		Maximum	38	19.0	48.0	353	340	103.7
		Minimum	35	18.1	47.2	318	340	93.6

N-value: 33

Sample Interval Time: 59.25 seconds.

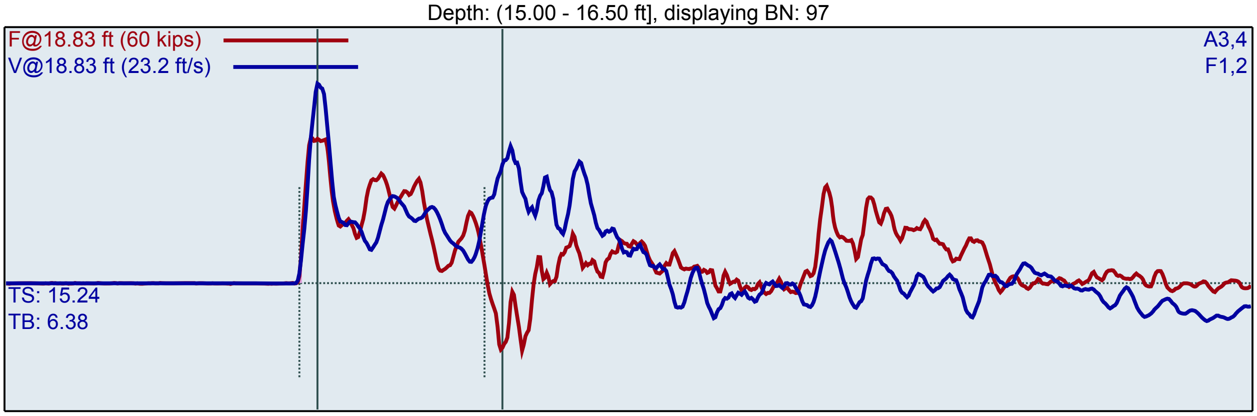
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 18.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 97



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
49	1	15.50	35	17.4	1.9	370	340	108.8
50	50	15.51	35	18.0	37.7	337	340	99.1
51	50	15.52	35	18.1	38.9	336	340	98.8
52	50	15.53	35	18.2	39.3	333	340	97.9
53	50	15.54	36	18.2	39.6	338	340	99.3
54	50	15.55	35	18.1	39.7	339	340	99.7
55	50	15.56	35	18.0	39.7	336	340	98.8
56	50	15.57	35	18.2	39.9	334	340	98.2
57	50	15.58	34	17.8	39.9	290	340	85.2
58	50	15.59	34	17.9	39.9	290	340	85.4
59	50	15.60	34	17.9	39.8	321	340	94.4
60	50	15.61	34	17.6	39.7	285	340	83.9
61	50	15.62	34	17.9	39.7	289	340	84.9
62	50	15.63	34	17.8	39.6	291	340	85.6
63	50	15.64	34	17.6	39.7	287	340	84.4
64	50	15.65	33	17.4	39.6	281	340	82.7
65	50	15.66	34	17.9	39.6	289	340	84.9
66	50	15.67	34	18.0	39.8	293	340	86.3
67	50	15.68	34	18.0	39.7	297	340	87.3
68	50	15.69	35	18.1	39.9	298	340	87.6
69	50	15.70	34	18.0	39.8	299	340	87.8
70	50	15.71	34	17.7	39.8	298	340	87.5
71	50	15.72	34	17.9	39.9	301	340	88.5
72	50	15.73	34	18.0	39.8	297	340	87.4
73	50	15.74	35	17.9	40.2	295	340	86.9
74	50	15.75	35	18.2	40.1	299	340	87.8
75	50	15.76	35	18.1	40.0	296	340	87.0
76	50	15.77	35	18.1	40.0	303	340	89.0
77	50	15.78	35	18.2	40.2	300	340	88.3
78	50	15.79	35	18.0	40.2	316	340	93.0
79	50	15.80	34	18.2	40.2	299	340	87.9

80	50	15.81	34	18.3	39.9	291	340	85.6
81	50	15.82	34	17.9	40.2	289	340	84.9
82	50	15.83	34	17.9	40.1	292	340	86.0
83	50	15.84	34	18.0	40.3	310	340	91.0
84	50	15.85	34	18.1	40.1	298	340	87.5
85	50	15.86	34	18.1	40.0	288	340	84.7
86	50	15.87	34	18.1	40.4	286	340	84.1
87	50	15.88	34	17.9	40.3	288	340	84.7
88	50	15.89	34	18.0	40.4	308	340	90.7
89	50	15.90	34	18.0	40.3	310	340	91.2
90	50	15.91	34	18.1	40.4	295	340	86.6
91	50	15.92	33	17.9	40.0	304	340	89.4
92	50	15.93	34	18.3	40.5	300	340	88.4
93	50	15.94	34	17.9	40.2	307	340	90.4
94	50	15.95	34	18.0	40.2	313	340	92.2
95	50	15.96	34	18.1	40.2	318	340	93.4
96	50	15.97	34	18.1	40.1	323	340	94.9
97	50	15.98	34	18.1	40.1	322	340	94.6
98	50	15.99	34	18.1	40.2	299	340	88.1
99	50	16.00	35	18.3	40.1	352	340	103.5
		Average	34	18.0	39.9	305	340	89.7
		Std Dev	0	0.2	0.4	17	0	5.1
		Maximum	36	18.3	40.5	352	340	103.5
		Minimum	33	17.4	37.7	281	340	82.7

N-value: 50

Sample Interval Time: 75.14 seconds.

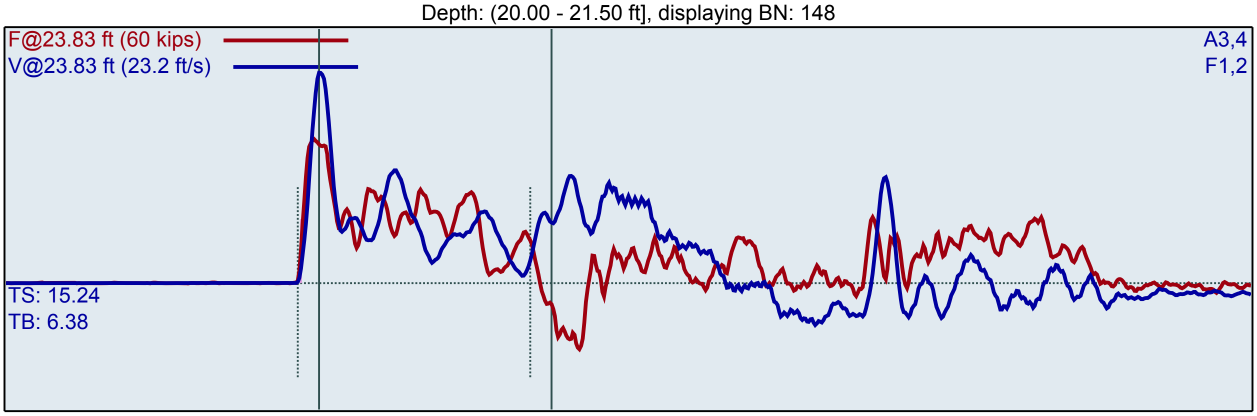
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 23.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (20.00 - 21.50 ft], displaying BN: 148



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
100	1	20.50	35	17.8	1.9	350	340	103.0
101	50	20.51	35	18.2	44.4	324	340	95.3
102	50	20.52	35	18.5	46.8	330	340	97.0
103	50	20.53	35	18.6	46.9	329	340	96.8
104	50	20.54	35	18.8	47.0	331	340	97.3
105	50	20.55	35	18.6	46.9	327	340	96.2
106	50	20.56	34	18.8	47.1	329	340	96.9
107	50	20.57	34	18.6	47.2	326	340	96.0
108	50	20.58	34	18.7	47.2	327	340	96.1
109	50	20.59	34	18.9	47.1	326	340	95.7
110	50	20.60	34	18.8	47.3	325	340	95.6
111	50	20.61	34	18.7	47.2	327	340	96.1
112	50	20.62	34	18.8	47.4	324	340	95.4
113	50	20.63	34	18.8	47.3	326	340	95.9
114	50	20.64	34	18.8	47.3	326	340	95.9
115	50	20.65	34	18.9	47.4	326	340	95.9
116	50	20.66	34	18.7	47.3	322	340	94.8
117	50	20.67	34	18.9	47.2	330	340	97.2
118	50	20.68	34	18.8	47.3	327	340	96.1
119	50	20.69	34	18.8	47.2	328	340	96.3
120	50	20.70	34	18.9	47.3	330	340	97.0
121	50	20.71	34	18.9	47.2	334	340	98.3
122	50	20.72	34	18.8	47.2	326	340	96.0
123	50	20.73	34	19.1	47.1	335	340	98.7
124	50	20.74	34	19.0	47.2	330	340	97.0
125	50	20.75	34	19.0	47.0	332	340	97.7
126	50	20.76	34	19.0	47.1	335	340	98.5
127	50	20.77	34	18.9	47.3	328	340	96.5
128	50	20.78	34	19.0	47.4	331	340	97.2
129	50	20.79	34	19.2	47.2	336	340	98.8
130	50	20.80	34	19.1	47.5	328	340	96.5

131	50	20.81	34	19.3	47.2	339	340	99.7
132	50	20.82	34	19.3	47.4	331	340	97.5
133	50	20.83	34	19.2	47.4	337	340	99.0
134	50	20.84	34	19.3	47.5	332	340	97.7
135	50	20.85	34	19.2	47.8	330	340	97.1
136	50	20.86	34	19.2	47.5	333	340	98.0
137	50	20.87	34	19.2	47.5	334	340	98.2
138	50	20.88	34	19.3	47.5	329	340	96.9
139	50	20.89	34	19.2	47.4	336	340	98.8
140	50	20.90	34	19.1	47.4	330	340	97.1
141	50	20.91	34	19.3	47.0	338	340	99.4
142	50	20.92	34	19.3	47.3	339	340	99.7
143	50	20.93	34	19.2	47.1	332	340	97.6
144	50	20.94	34	19.2	47.2	338	340	99.5
145	50	20.95	34	19.2	47.3	331	340	97.3
146	50	20.96	34	19.2	47.5	333	340	97.8
147	50	20.97	34	19.2	47.0	338	340	99.3
148	50	20.98	34	19.1	47.3	332	340	97.7
149	50	20.99	34	19.3	47.2	334	340	98.2
150	50	21.00	34	19.3	47.2	334	340	98.1
		Average	34	19.0	47.2	331	340	97.3
		Std Dev	0	0.3	0.4	4	0	1.2
		Maximum	35	19.3	47.8	339	340	99.7
		Minimum	34	18.2	44.4	322	340	94.8

N-value: 50

Sample Interval Time: 66.18 seconds.

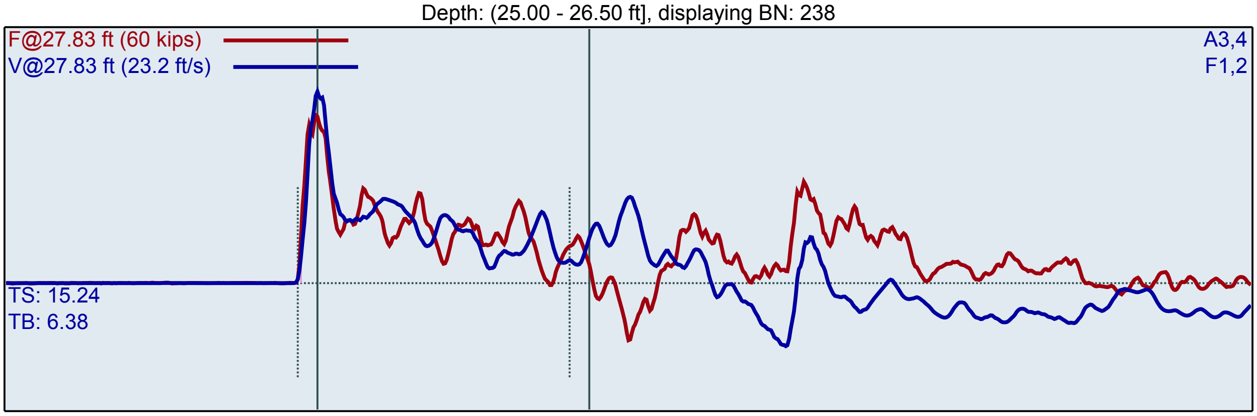
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 27.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 238



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
151	40	25.01	34	18.1	61.8	323	340	94.9
152	40	25.03	36	18.1	39.9	329	340	96.9
153	40	25.04	36	18.5	40.8	343	340	100.8
154	40	25.05	37	18.4	41.5	342	340	100.7
155	40	25.06	36	18.5	41.4	330	340	97.1
156	40	25.08	36	18.4	41.5	338	340	99.4
157	40	25.09	37	17.9	42.2	344	340	101.2
158	40	25.10	38	17.3	42.1	331	340	97.2
159	40	25.11	37	18.0	42.3	337	340	99.2
160	40	25.13	39	16.9	42.1	339	340	99.6
161	40	25.14	39	17.7	43.7	344	340	101.2
162	40	25.15	37	18.5	46.7	350	340	102.9
163	40	25.16	39	17.4	47.1	341	340	100.4
164	40	25.18	39	17.8	46.3	347	340	102.1
165	40	25.19	38	18.0	47.1	346	340	101.8
166	40	25.20	38	18.0	47.4	338	340	99.4
167	40	25.21	38	18.1	46.6	345	340	101.6
168	40	25.23	38	18.2	47.0	337	340	99.2
169	40	25.24	38	18.1	47.4	339	340	99.8
170	40	25.25	37	18.2	47.4	336	340	98.9
171	40	25.26	37	18.3	47.1	342	340	100.5
172	40	25.28	39	17.7	46.7	333	340	97.9
173	40	25.29	38	18.1	47.1	329	340	96.8
174	40	25.30	38	18.3	47.5	337	340	99.2
175	40	25.31	38	18.1	47.8	332	340	97.7
176	40	25.33	39	17.9	46.9	328	340	96.3
177	40	25.34	39	18.3	47.3	335	340	98.5
178	40	25.35	39	18.0	47.1	330	340	96.9
179	40	25.36	38	18.2	47.0	333	340	98.0
180	40	25.38	39	18.3	47.5	330	340	96.9
181	40	25.39	39	18.3	47.3	343	340	100.8

182	40	25.40	39	18.1	47.1	333	340	98.0
183	40	25.41	39	18.3	46.9	336	340	98.9
184	40	25.43	39	18.2	47.3	334	340	98.4
185	40	25.44	39	18.3	47.2	337	340	99.1
186	40	25.45	38	18.0	47.0	329	340	96.9
187	40	25.46	39	18.1	2.5	336	340	98.8
188	40	25.48	38	18.2	45.1	336	340	98.7
189	40	25.49	38	18.3	46.7	338	340	99.4
190	40	25.50	37	18.4	47.5	342	340	100.5
191	50	25.51	37	18.6	47.6	334	340	98.4
192	50	25.52	36	18.6	47.8	337	340	99.0
193	50	25.53	36	18.8	47.3	346	340	101.7
194	50	25.54	36	18.9	47.3	348	340	102.4
195	50	25.55	37	18.6	47.4	339	340	99.7
196	50	25.56	36	18.5	47.4	335	340	98.4
197	50	25.57	36	18.5	47.2	336	340	98.9
198	50	25.58	36	18.4	47.3	330	340	97.1
199	50	25.59	36	18.3	46.7	332	340	97.7
200	50	25.60	36	18.3	47.2	333	340	98.0
201	50	25.61	36	18.2	46.9	324	340	95.4
202	50	25.62	36	18.4	46.5	336	340	98.9
203	50	25.63	36	18.4	47.6	332	340	97.6
204	50	25.64	36	18.7	47.2	339	340	99.6
205	50	25.65	37	18.6	46.9	341	340	100.4
206	50	25.66	36	18.6	46.6	340	340	100.1
207	50	25.67	36	18.5	46.9	334	340	98.2
208	50	25.68	36	18.5	47.1	335	340	98.4
209	50	25.69	36	18.4	46.6	336	340	98.9
210	50	25.70	36	18.3	47.0	336	340	98.9
211	50	25.71	36	18.3	46.9	335	340	98.5
212	50	25.72	36	18.4	47.1	336	340	98.8
213	50	25.73	36	18.6	47.2	341	340	100.3
214	50	25.74	36	18.4	47.1	333	340	98.0
215	50	25.75	37	18.2	46.5	338	340	99.5
216	50	25.76	37	18.4	47.1	345	340	101.4
217	50	25.77	37	18.2	47.6	339	340	99.8
218	50	25.78	37	18.1	47.3	337	340	99.1
219	50	25.79	37	18.2	47.5	339	340	99.7
220	50	25.80	37	18.2	47.1	339	340	99.8
221	50	25.81	37	18.1	47.1	331	340	97.5
222	50	25.82	37	18.2	47.1	339	340	99.7
223	50	25.83	37	18.3	47.7	339	340	99.6
224	50	25.84	37	18.1	47.0	336	340	98.8
225	50	25.85	38	18.0	47.3	336	340	98.8
226	50	25.86	37	18.0	47.4	333	340	97.8
227	50	25.87	37	18.0	46.9	333	340	98.0
228	50	25.88	37	17.8	47.4	335	340	98.5
229	50	25.89	37	17.8	47.6	336	340	98.9
230	50	25.90	38	17.6	47.1	335	340	98.6
231	50	25.91	38	17.5	47.0	331	340	97.4
232	50	25.92	38	17.5	47.0	337	340	99.2
233	50	25.93	39	17.5	47.8	343	340	100.7
234	50	25.94	38	17.2	47.6	335	340	98.5
235	50	25.95	39	17.1	47.0	334	340	98.3
236	50	25.96	39	17.3	47.5	339	340	99.7
237	50	25.97	39	17.3	47.2	335	340	98.6
238	50	25.98	39	17.3	47.4	340	340	100.0
239	50	25.99	40	17.3	47.5	345	340	101.6
240	50	26.00	40	17.2	47.4	346	340	101.8

Average	37	18.1	47.2	337	340	99.1
Std Dev	1	0.5	0.3	4	0	1.3
Maximum	40	18.9	47.8	348	340	102.4
Minimum	36	17.1	46.5	324	340	95.4

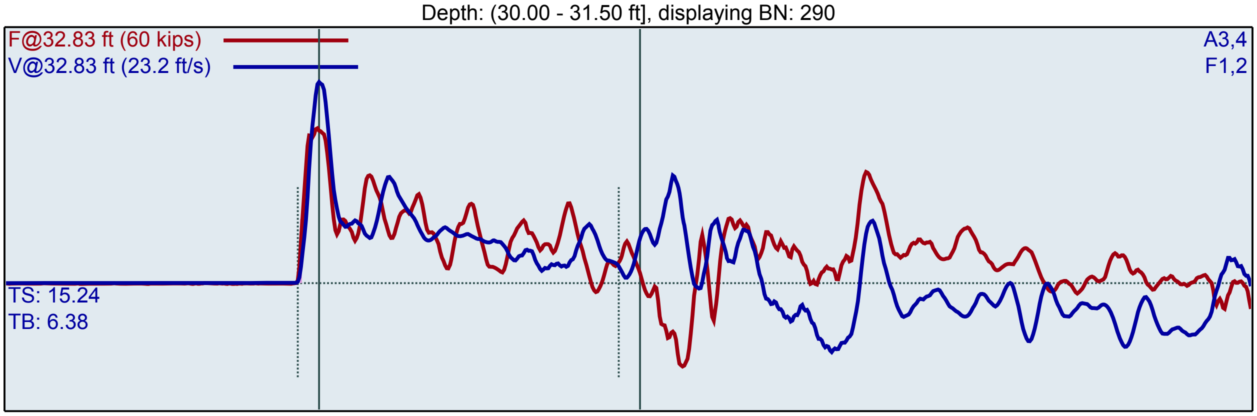
N-value: 50

Sample Interval Time: 137.90 seconds.

Texas Geo Bore Drilling 10.17.20 TCP 10.0-11.5
CM Interval start: 10/17/2020
TCP

AR: 1.45 in^2 SP: 0.492 k/ft3
LE: 32.83 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (30.00 - 31.50 ft], displaying BN: 290



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1
A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
241	2	30.25	34	18.3	1.9	344	340	101.1
242	2	30.50	36	18.6	47.2	361	340	106.2
243	50	30.51	37	19.0	48.3	355	340	104.5
244	50	30.52	36	18.6	49.8	347	340	102.0
245	50	30.53	37	18.8	50.0	352	340	103.7
246	50	30.54	37	18.8	49.8	351	340	103.2
247	50	30.55	37	18.9	50.4	351	340	103.4
248	50	30.56	37	18.9	49.8	350	340	103.1
249	50	30.57	37	18.8	49.8	346	340	101.8
250	50	30.58	37	18.9	49.7	345	340	101.5
251	50	30.59	37	18.7	49.9	346	340	101.9
252	50	30.60	37	18.9	50.1	346	340	101.8
253	50	30.61	37	18.7	49.8	343	340	100.8
254	50	30.62	37	18.8	49.9	345	340	101.6
255	50	30.63	37	18.8	50.0	346	340	101.8
256	50	30.64	37	18.7	49.9	345	340	101.4
257	50	30.65	37	18.9	50.0	343	340	100.8
258	50	30.66	37	18.7	49.9	344	340	101.2
259	50	30.67	37	18.8	50.5	348	340	102.4
260	50	30.68	38	19.1	50.0	364	340	107.1
261	50	30.69	37	18.7	50.1	347	340	102.1
262	50	30.70	38	18.9	49.7	352	340	103.4
263	50	30.71	37	18.8	50.1	350	340	102.9
264	50	30.72	37	18.8	49.9	346	340	101.8
265	50	30.73	37	18.6	50.0	350	340	103.0
266	50	30.74	37	18.7	49.9	347	340	102.1
267	50	30.75	37	18.6	50.2	348	340	102.3
268	50	30.76	37	18.7	50.2	354	340	104.0
269	50	30.77	37	18.5	49.9	354	340	104.2
270	50	30.78	37	18.4	50.3	352	340	103.4
271	50	30.79	37	18.4	50.2	353	340	103.7

272	50	30.80	37	18.3	50.1	350	340	103.0
273	50	30.81	36	18.2	50.0	348	340	102.2
274	50	30.82	37	18.3	49.9	342	340	100.7
275	50	30.83	36	18.3	50.0	349	340	102.5
276	50	30.84	37	18.4	50.4	348	340	102.2
277	50	30.85	36	18.3	50.7	345	340	101.6
278	50	30.86	36	18.3	50.3	346	340	101.9
279	50	30.87	36	18.3	50.3	346	340	101.7
280	50	30.88	36	18.3	50.1	336	340	98.8
281	50	30.89	36	18.2	50.0	339	340	99.8
282	50	30.90	36	18.4	50.1	345	340	101.5
283	50	30.91	36	18.3	49.8	347	340	102.0
284	50	30.92	36	18.2	50.0	340	340	100.1
285	50	30.93	36	18.2	49.5	341	340	100.3
286	50	30.94	36	18.1	49.8	337	340	99.2
287	50	30.95	36	18.1	49.9	334	340	98.3
288	50	30.96	36	18.2	50.2	339	340	99.7
289	50	30.97	36	18.1	49.9	336	340	98.9
290	50	30.98	36	18.2	50.0	340	340	99.9
291	50	30.99	36	18.1	49.9	337	340	99.1
292	50	31.00	36	18.1	49.9	343	340	100.8
		Average	37	18.5	50.0	346	340	101.8
		Std Dev	1	0.3	0.3	6	0	1.7
		Maximum	38	19.1	50.7	364	340	107.1
		Minimum	36	18.1	48.3	334	340	98.3

N-value: 50

Sample Interval Time: 61.25 seconds.

MOBILE B57 (NO SN)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
11.41	**18-19-18**	8.50	10.00	**37**	**55**	33	12.2	50.3	302	340	88.9
16.41	**1-50-0**	13.50	15.00	**50**	**74**	31	13.3	50.0	280	340	82.2
21.41	**10-50-0**	18.50	20.00	**50**	**74**	35	13.3	48.4	304	340	89.4
26.41	**2-50-0**	23.50	25.00	**50**	**74**	34	13.4	47.4	312	340	91.8
31.41	**2-50-0**	28.50	30.00	**50**	**74**	34	13.5	48.4	323	340	95.1
					Overall Average Values:	33	13.2	48.8	304	340	89.5
					Standard Deviation:	2	0.8	2.9	17	0	5.0
					Overall Maximum Value:	36	15.3	51.8	357	340	105.0
					Overall Minimum Value:	26	11.0	8.2	263	340	77.3

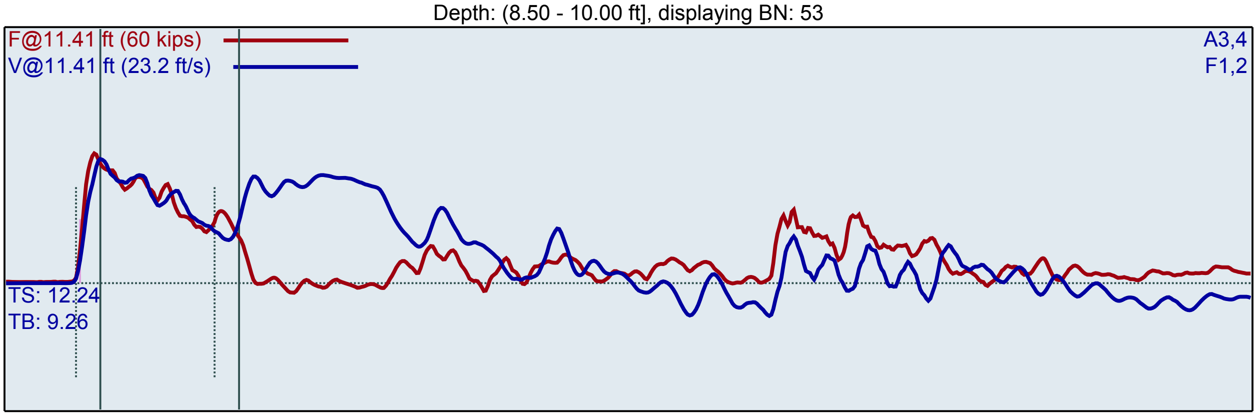
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 11.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (8.50 - 10.00 ft], displaying BN: 53



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	18	8.53	34	13.4	1.9	283	340	83.3
2	18	8.56	35	13.0	50.7	298	340	87.8
3	18	8.58	35	12.8	51.8	286	340	84.2
4	18	8.61	35	13.1	51.8	297	340	87.4
5	18	8.64	35	12.9	51.6	294	340	86.6
6	18	8.67	35	13.1	51.7	293	340	86.2
7	18	8.69	35	12.9	51.6	297	340	87.2
8	18	8.72	35	13.0	51.4	301	340	88.5
9	18	8.75	35	13.2	51.6	314	340	92.5
10	18	8.78	35	13.0	51.4	305	340	89.8
11	18	8.81	36	13.2	51.8	314	340	92.3
12	18	8.83	35	13.2	51.7	321	340	94.3
13	18	8.86	36	13.2	51.8	313	340	92.0
14	18	8.89	35	13.0	51.5	303	340	89.2
15	18	8.92	35	13.0	51.5	307	340	90.2
16	18	8.94	36	13.0	51.6	306	340	89.9
17	18	8.97	35	13.1	51.3	305	340	89.8
18	18	9.00	35	13.0	6.3	299	340	88.1
19	19	9.03	35	12.9	50.3	306	340	90.1
20	19	9.05	35	12.9	51.5	303	340	89.0
21	19	9.08	36	13.1	51.6	315	340	92.6
22	19	9.11	36	13.0	51.5	305	340	89.8
23	19	9.13	35	13.1	51.4	304	340	89.3
24	19	9.16	35	12.9	51.3	298	340	87.6
25	19	9.18	36	13.0	51.1	306	340	90.0
26	19	9.21	35	12.9	51.3	301	340	88.5
27	19	9.24	35	12.9	51.1	301	340	88.6
28	19	9.26	36	12.9	51.0	299	340	87.9

29	19	9.29	36	12.9	51.2	307	340	90.4
30	19	9.32	35	12.7	50.7	298	340	87.6
31	19	9.34	36	13.0	51.1	310	340	91.2
32	19	9.37	36	12.8	50.8	296	340	87.2
33	19	9.39	32	11.6	50.9	304	340	89.4
34	19	9.42	33	12.0	50.6	303	340	89.2
35	19	9.45	33	12.0	50.5	305	340	89.8
36	19	9.47	32	12.0	50.9	298	340	87.6
37	19	9.50	33	11.9	50.1	305	340	89.7
38	18	9.53	33	11.8	50.1	305	340	89.8
39	18	9.56	33	12.0	50.1	303	340	89.1
40	18	9.58	33	12.0	49.9	298	340	87.7
41	18	9.61	33	11.9	49.7	305	340	89.8
42	18	9.64	31	11.8	49.8	304	340	89.4
43	18	9.67	33	12.2	49.3	309	340	90.8
44	18	9.69	33	12.2	49.7	303	340	89.0
45	18	9.72	33	12.0	49.7	300	340	88.3
46	18	9.75	34	12.1	49.0	298	340	87.7
47	18	9.78	33	12.2	49.6	304	340	89.3
48	18	9.81	33	11.8	49.7	301	340	88.5
49	18	9.83	31	11.5	49.4	301	340	88.5
50	18	9.86	31	11.6	48.9	307	340	90.3
51	18	9.89	31	11.3	49.6	302	340	89.0
52	18	9.92	30	11.2	49.2	286	340	84.2
53	18	9.94	30	11.3	48.9	300	340	88.3
54	18	9.97	30	11.0	49.2	300	340	88.1
55	18	10.00	29	11.0	49.3	289	340	85.1
		Average	33	12.2	50.3	302	340	88.9
		Std Dev	2	0.6	0.8	5	0	1.5
		Maximum	36	13.1	51.6	315	340	92.6
		Minimum	29	11.0	48.9	286	340	84.2

N-value: 37

Sample Interval Time: 72.28 seconds.

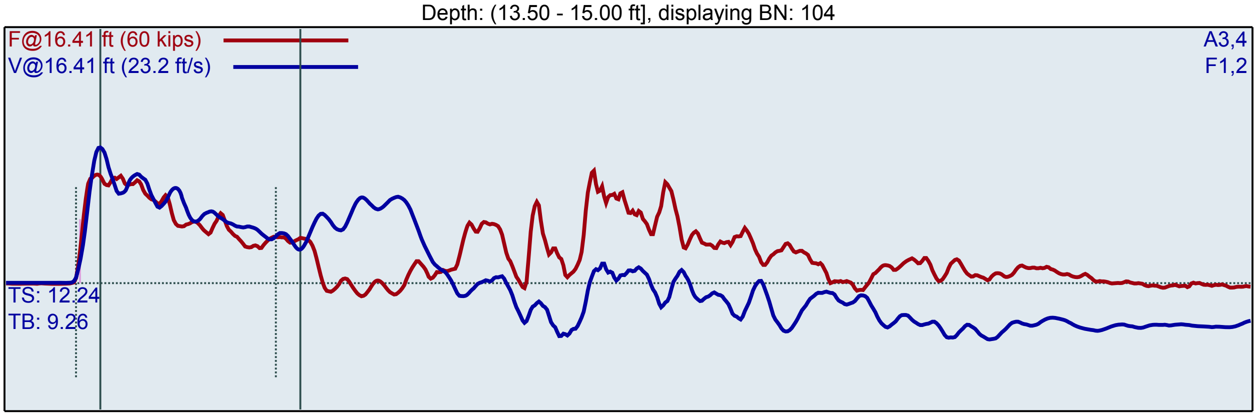
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 16.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (13.50 - 15.00 ft], displaying BN: 104



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
57	50	14.01	35	14.4	51.5	311	340	91.6
58	50	14.02	34	13.5	51.8	311	340	91.4
59	50	14.03	34	13.1	51.8	312	340	91.9
60	50	14.04	33	12.6	51.8	283	340	83.1
61	50	14.05	33	12.3	51.6	283	340	83.4
62	50	14.06	34	13.0	51.8	318	340	93.6
63	50	14.07	34	13.3	51.2	282	340	83.0
64	50	14.08	32	13.0	51.7	276	340	81.0
65	50	14.09	32	12.3	51.3	277	340	81.5
66	50	14.10	30	11.8	51.6	269	340	79.2
67	50	14.11	28	12.5	50.5	276	340	81.3
68	50	14.12	30	12.4	51.3	278	340	81.9
69	50	14.13	34	13.1	51.2	283	340	83.1
70	50	14.14	33	14.6	50.6	288	340	84.7
71	50	14.15	34	13.7	51.4	285	340	83.8
72	50	14.16	32	14.4	50.9	279	340	82.1
73	50	14.17	33	13.6	51.0	278	340	81.8
74	50	14.18	33	13.5	50.4	279	340	82.2
75	50	14.19	34	13.7	50.7	281	340	82.7
76	50	14.20	33	13.5	50.4	282	340	83.0
77	50	14.21	32	14.8	49.5	285	340	83.8
78	50	14.22	33	13.8	51.1	279	340	82.1
79	50	14.23	32	14.5	48.7	285	340	83.8
80	50	14.24	31	14.8	50.6	281	340	82.7
81	50	14.25	29	14.7	49.6	281	340	82.7
82	50	14.26	30	15.3	49.4	286	340	84.0
83	50	14.27	33	13.6	49.6	286	340	84.1
84	50	14.28	32	13.6	49.3	283	340	83.1
85	50	14.29	33	13.2	50.0	277	340	81.5
86	50	14.30	33	14.4	48.8	289	340	85.0
87	50	14.31	34	13.3	50.0	279	340	81.9

88	50	14.32	29	14.2	49.4	272	340	80.1
89	50	14.33	29	14.7	48.7	282	340	82.8
90	50	14.34	28	14.2	49.4	273	340	80.3
91	50	14.35	27	13.3	49.4	271	340	79.6
92	50	14.36	28	13.7	48.8	273	340	80.3
93	50	14.37	28	13.6	49.1	272	340	79.9
94	50	14.38	28	13.5	48.7	279	340	82.1
95	50	14.39	27	13.4	49.5	265	340	78.0
96	50	14.40	27	13.1	48.7	271	340	79.7
97	50	14.41	28	12.8	48.3	272	340	80.0
98	50	14.42	27	12.3	49.1	267	340	78.5
99	50	14.43	29	11.8	48.4	269	340	79.2
100	50	14.44	30	11.2	48.6	267	340	78.6
101	50	14.45	31	11.8	48.4	272	340	79.9
102	50	14.46	27	11.5	48.5	263	340	77.3
103	50	14.47	26	12.1	48.3	269	340	79.1
104	50	14.48	26	12.3	48.6	267	340	78.5
105	50	14.49	28	11.2	48.5	266	340	78.2
106	50	14.50	29	12.3	48.3	269	340	79.1
		Average	31	13.3	50.0	280	340	82.2
		Std Dev	3	1.0	1.2	12	0	3.5
		Maximum	35	15.3	51.8	318	340	93.6
		Minimum	26	11.2	48.3	263	340	77.3

N-value: 50

Sample Interval Time: 58.94 seconds.

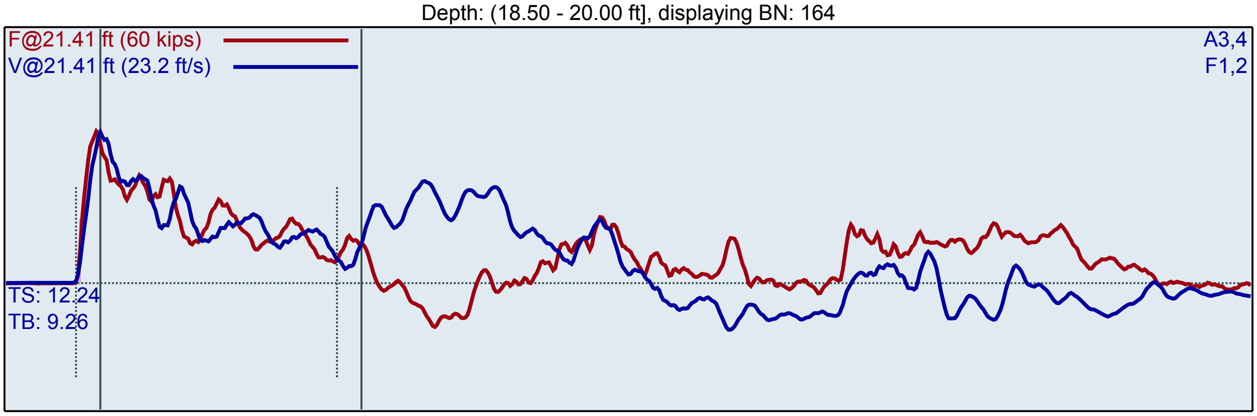
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 21.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (18.50 - 20.00 ft], displaying BN: 164



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
108	10	18.60	35	13.7	50.2	317	340	93.1
109	10	18.65	35	13.5	51.1	321	340	94.5
110	10	18.70	35	13.5	50.6	312	340	91.8
111	10	18.75	35	13.4	50.5	311	340	91.3
112	10	18.80	36	13.8	50.1	310	340	91.2
113	10	18.85	35	13.7	49.8	311	340	91.5
114	10	18.90	36	13.6	50.0	308	340	90.6
115	10	18.95	35	13.5	49.8	312	340	91.8
116	10	19.00	36	13.6	50.0	312	340	91.8
117	50	19.01	29	12.8	49.7	307	340	90.4
118	50	19.02	32	11.9	49.6	298	340	87.7
119	50	19.03	36	13.8	48.8	321	340	94.3
120	50	19.04	36	13.9	49.5	317	340	93.1
121	50	19.05	34	13.2	49.2	309	340	91.0
122	50	19.06	31	11.6	49.3	302	340	88.7
123	50	19.07	31	11.4	49.1	299	340	87.9
124	50	19.08	32	11.9	49.2	300	340	88.3
125	50	19.09	32	12.3	49.1	302	340	89.0
126	50	19.10	31	11.8	48.8	300	340	88.3
127	50	19.11	32	11.9	48.8	298	340	87.6
128	50	19.12	34	13.3	48.8	312	340	91.7
129	50	19.13	35	13.5	48.7	312	340	91.8
130	50	19.14	35	13.5	48.9	309	340	90.8
131	50	19.15	35	13.5	48.9	306	340	89.9
132	50	19.16	35	13.6	48.2	311	340	91.4
133	50	19.17	35	13.7	49.1	304	340	89.5
134	50	19.18	35	13.1	49.0	291	340	85.7
135	50	19.19	35	13.5	47.8	308	340	90.7
136	50	19.20	35	13.3	48.7	300	340	88.4
137	50	19.21	35	13.5	48.3	299	340	87.9
138	50	19.22	35	13.5	49.1	297	340	87.2

139	50	19.23	35	13.2	48.0	297	340	87.3
140	50	19.24	35	13.6	48.3	308	340	90.6
141	50	19.25	35	13.6	48.4	302	340	88.9
142	50	19.26	35	13.5	48.1	301	340	88.4
143	50	19.27	35	13.6	48.5	304	340	89.5
144	50	19.28	35	13.4	48.0	299	340	87.9
145	50	19.29	35	13.4	49.0	294	340	86.5
146	50	19.30	35	13.8	47.3	320	340	94.1
147	50	19.31	35	13.6	48.3	302	340	88.7
148	50	19.32	36	13.7	47.9	309	340	90.8
149	50	19.33	35	13.5	48.5	301	340	88.7
150	50	19.34	35	13.3	48.1	299	340	87.9
151	50	19.35	36	13.6	47.7	303	340	89.0
152	50	19.36	35	13.6	48.3	302	340	88.9
153	50	19.37	35	13.7	48.0	311	340	91.5
154	50	19.38	35	13.5	47.9	299	340	88.1
155	50	19.39	36	13.8	47.7	314	340	92.4
156	50	19.40	34	13.5	48.5	289	340	85.0
157	50	19.41	35	13.6	47.5	302	340	88.9
158	50	19.42	36	13.6	47.9	305	340	89.8
159	50	19.43	35	13.3	48.4	297	340	87.3
160	50	19.44	35	13.4	47.5	301	340	88.5
161	50	19.45	35	13.3	47.9	300	340	88.1
162	50	19.46	35	13.4	47.8	302	340	88.9
163	50	19.47	36	13.6	47.1	308	340	90.5
164	50	19.48	36	13.7	48.1	309	340	90.9
165	50	19.49	36	13.7	47.7	310	340	91.3
166	50	19.50	35	13.2	47.7	299	340	87.9
		Average	35	13.3	48.4	304	340	89.4
		Std Dev	2	0.6	0.6	7	0	1.9
		Maximum	36	13.9	49.7	321	340	94.3
		Minimum	29	11.4	47.1	289	340	85.0

N-value: 50

Sample Interval Time: 71.52 seconds.

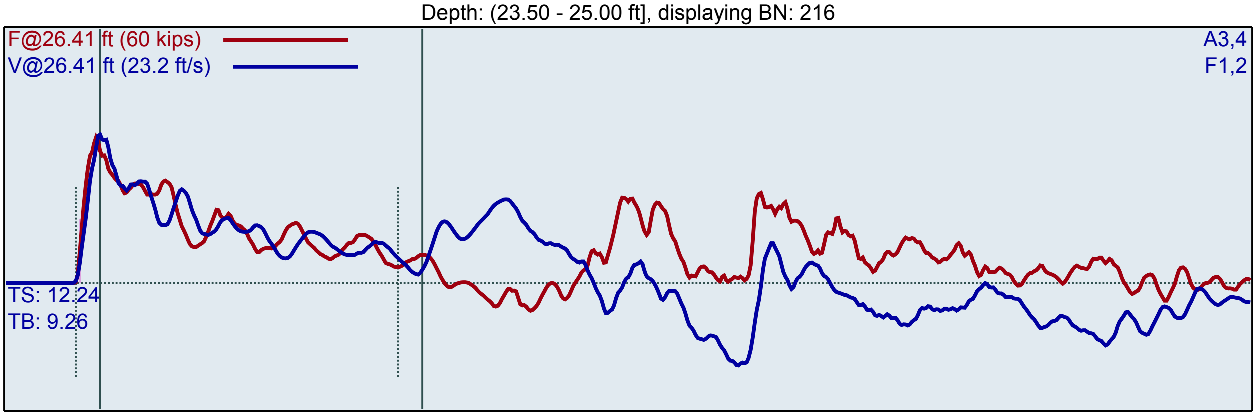
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 26.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (23.50 - 25.00 ft], displaying BN: 216



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
167	2	23.75	34	14.7	1.9	315	340	92.7
168	2	24.00	34	13.1	50.1	354	340	104.2
169	50	24.01	34	13.3	50.8	316	340	93.1
170	50	24.02	35	13.4	50.8	316	340	92.9
171	50	24.03	35	13.4	50.2	317	340	93.1
172	50	24.04	35	13.2	50.4	314	340	92.3
173	50	24.05	35	13.3	49.9	320	340	94.0
174	50	24.06	34	13.1	49.7	318	340	93.5
175	50	24.07	35	13.3	49.9	319	340	94.0
176	50	24.08	35	13.6	49.7	325	340	95.6
177	50	24.09	35	13.6	49.4	318	340	93.6
178	50	24.10	35	13.4	49.0	317	340	93.1
179	50	24.11	35	13.3	49.0	316	340	93.1
180	50	24.12	35	13.3	48.8	317	340	93.3
181	50	24.13	35	13.9	48.8	320	340	94.1
182	50	24.14	34	14.0	48.1	320	340	94.2
183	50	24.15	34	13.9	48.9	313	340	92.0
184	50	24.16	34	13.2	47.7	312	340	91.8
185	50	24.17	35	13.3	48.2	313	340	92.0
186	50	24.18	35	13.6	48.1	319	340	93.8
187	50	24.19	34	13.5	48.4	317	340	93.2
188	50	24.20	32	12.4	48.3	307	340	90.4
189	50	24.21	35	13.5	47.6	320	340	94.2
190	50	24.22	35	13.4	48.5	317	340	93.1
191	50	24.23	34	13.4	48.1	314	340	92.4
192	50	24.24	35	13.4	48.2	314	340	92.2
193	50	24.25	34	13.2	48.2	306	340	89.9
194	50	24.26	34	13.9	47.5	315	340	92.7
195	50	24.27	33	12.9	48.1	314	340	92.3
196	50	24.28	34	13.7	48.0	314	340	92.3
197	50	24.29	34	14.2	48.0	313	340	92.2

198	50	24.30	34	13.2	47.6	312	340	91.8
199	50	24.31	34	13.4	47.2	320	340	94.2
200	50	24.32	34	13.7	48.5	315	340	92.6
201	50	24.33	33	13.2	47.7	307	340	90.2
202	50	24.34	34	13.5	47.0	314	340	92.4
203	50	24.35	35	13.5	47.4	315	340	92.6
204	50	24.36	35	13.5	47.9	311	340	91.5
205	50	24.37	35	13.5	47.5	311	340	91.4
206	50	24.38	34	13.3	47.7	303	340	89.0
207	50	24.39	34	13.0	46.9	301	340	88.6
208	50	24.40	35	13.2	47.3	300	340	88.2
209	50	24.41	35	13.5	46.8	305	340	89.6
210	50	24.42	34	13.0	47.2	301	340	88.4
211	50	24.43	35	13.3	46.8	303	340	89.0
212	50	24.44	34	13.1	47.1	299	340	88.1
213	50	24.45	34	13.2	46.5	307	340	90.2
214	50	24.46	33	13.1	47.5	296	340	87.1
215	50	24.47	34	14.0	46.4	311	340	91.4
216	50	24.48	34	13.4	47.1	303	340	89.0
217	50	24.49	34	13.2	8.2	307	340	90.3
218	50	24.50	34	12.9	48.7	308	340	90.5
		Average	34	13.4	47.4	312	340	91.8
		Std Dev	1	0.3	5.7	7	0	1.9
		Maximum	35	14.2	50.8	325	340	95.6
		Minimum	32	12.4	8.2	296	340	87.1

N-value: 50

Sample Interval Time: 69.46 seconds.

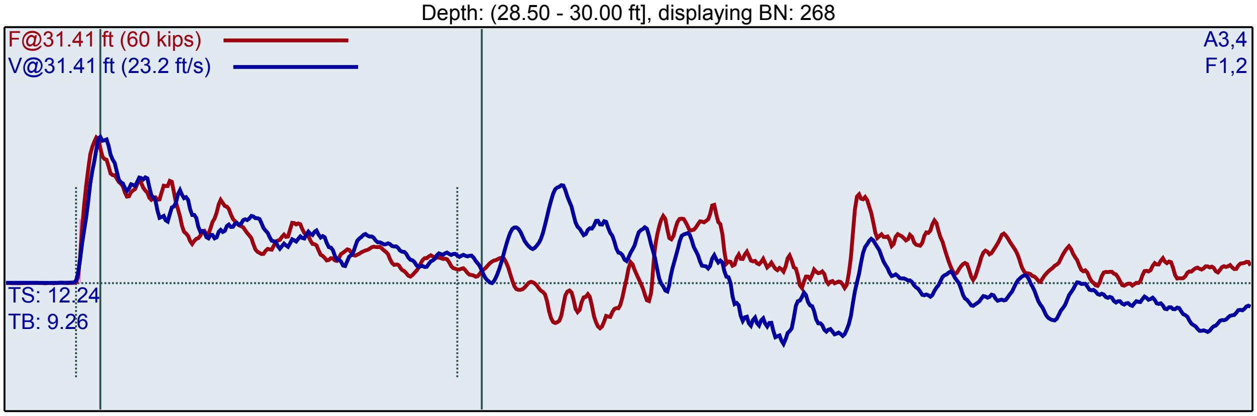
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 31.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (28.50 - 30.00 ft], displaying BN: 268



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
220	2	29.00	33	16.1	58.1	319	340	93.9
221	50	29.01	34	13.3	49.5	321	340	94.6
223	50	29.03	34	13.4	50.4	318	340	93.4
224	50	29.04	34	13.2	50.5	314	340	92.4
225	50	29.05	33	13.3	50.4	321	340	94.3
226	50	29.06	34	13.6	49.9	339	340	99.8
227	50	29.07	34	13.5	50.2	324	340	95.2
228	50	29.08	35	13.7	49.8	330	340	96.9
229	50	29.09	35	13.6	49.9	324	340	95.3
230	50	29.10	34	13.6	49.5	327	340	96.1
231	50	29.11	34	13.9	49.9	333	340	98.1
232	50	29.12	34	13.6	49.5	335	340	98.4
233	50	29.13	35	13.7	49.4	332	340	97.7
234	50	29.14	35	13.6	49.5	325	340	95.6
235	50	29.15	35	13.8	48.5	329	340	96.7
236	50	29.16	35	13.6	49.5	323	340	95.0
237	50	29.17	35	13.7	48.0	330	340	97.0
238	50	29.18	35	13.8	48.4	334	340	98.2
239	50	29.19	35	13.7	49.3	321	340	94.3
240	50	29.20	35	13.7	47.9	327	340	96.3
241	50	29.21	34	14.0	47.9	357	340	105.0
242	50	29.22	35	13.9	48.4	331	340	97.2
243	50	29.23	35	13.6	47.9	327	340	96.1
244	50	29.24	35	13.6	48.4	325	340	95.5
245	50	29.25	35	13.6	48.5	318	340	93.7
246	50	29.26	34	13.8	47.7	329	340	96.7
247	50	29.27	34	13.6	48.2	325	340	95.7
248	50	29.28	35	13.5	47.9	312	340	91.9
249	50	29.29	35	13.7	47.7	324	340	95.4
250	50	29.30	35	13.7	48.2	322	340	94.7
251	50	29.31	35	13.6	47.6	322	340	94.8

252	50	29.32	35	13.8	47.4	328	340	96.5
253	50	29.33	35	13.9	47.7	330	340	96.9
254	50	29.34	35	13.6	47.5	337	340	99.3
255	50	29.35	35	13.7	48.2	327	340	96.2
256	50	29.36	34	13.4	47.8	318	340	93.5
257	50	29.37	35	13.6	47.3	328	340	96.6
258	50	29.38	34	13.2	48.2	314	340	92.3
259	50	29.39	34	12.9	47.3	312	340	91.7
260	50	29.40	34	13.2	47.8	318	340	93.6
261	50	29.41	33	12.9	48.1	312	340	91.8
262	50	29.42	34	13.1	47.4	313	340	92.2
263	50	29.43	33	12.9	47.3	310	340	91.2
264	50	29.44	33	13.0	47.4	314	340	92.2
265	50	29.45	33	12.6	47.8	305	340	89.6
266	50	29.46	33	13.0	47.6	310	340	91.2
267	50	29.47	34	13.4	46.9	320	340	94.2
268	50	29.48	34	13.3	47.2	318	340	93.5
269	50	29.49	34	13.3	47.5	314	340	92.5
270	50	29.50	34	13.2	47.1	312	340	91.7
		Average	34	13.5	48.4	323	340	95.1
		Std Dev	1	0.3	1.0	9	0	2.7
		Maximum	35	14.0	50.5	357	340	105.0
		Minimum	33	12.6	46.9	305	340	89.6

N-value: 49

Sample Interval Time: 61.96 seconds.

Appendix D Boring Logs

D.1 Key to Terms and Descriptions

	SOIL SAMPLES							ROCK CORE				
DEPTH (ft)	SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (%)	STRATIGRAPHY	MATERIAL DESCRIPTION AND REMARKS	LITHOLOGY	BOX NUMBER	RUN NUMBER	RECOVERY (%)	RQD (%)	FRACTURES PER FOOT
1	2	3	4	5	6	7	8	9	10	11	12	13

COLUMN DESCRIPTIONS

1 **Depth:** Depth in feet below the ground surface.

2 **Sample Symbol:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

3 **Sample Type and Number:** Indicates the type of sampler used and identification number.

4 **Blow Counts:** Number of blows required to advance sampler each 6-inch interval, or length noted, using a 140-lb hammer falling 30-inches. N-value reported for SPT samples.

5 **Recovery:** Percentage of driven soil sample length actually recovered.

6 **Stratigraphy:** Abbreviation for soil depositional environment of rock formation name.

7 **Material Description and Remarks:** Description of material encountered; may include density/consistency, moisture, color, material type, grain size and other remarks.

8 **Lithology:** Graphic depiction of soil material or rock type encountered; typical symbols are explained below..

9 **Box Number:** Indicates core sample box number.

10 **Run Number:** Indicates core sample run number.

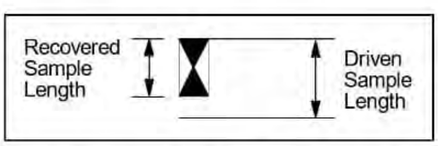
11 **Recovery:** Percentage of core run length actually recovered.

12 **RQD:** Rock Quality Designation; Percentage of intact rock core (pieces of sound core greater than 100 millimeters or about 4 inches long) in each core run.

13 **Fractures per Foot:** Approximate number of rock core fractures per foot.

WATER LEVEL LEGEND

- ▽ Water Level at Time of Drilling, or as Shown
- ▼ Water Level at End of Drilling, or as Shown
- ▼ Water Level After 24 Hours, or as Shown



ABBREVIATIONS

ATD: At Time of Drilling
NR: No Recovery
NA: Not Applicable
bgs: Below Ground Surface

Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

MINOR SOIL TYPE(s)

"trace" When the soil type's percentage is estimated, using visual/manual procedures, to be between 1 and 15 percent of the total sample.

"with" When the soil type's percentage is estimated, using visual/manual procedures, to be greater than 15 percent and less than 30 percent of the total sample.

"y" When the soil type's percentage is estimated, using visual/manual procedures, to be greater than 30 percent of the total sample.

AECOM

PROJECT NAME:	DATES DRILLED:	**Test Hole Log - Legend**
PROJECT NO:	SURFACE ELEVATION (FT):	
LOCATION:	TOTAL DEPTH (FT):	

DRILLING COMPANY:	INCLINATION (DEG):	LOGGED BY:
DRILLER:	AZIMUTH (DEG):	CHECKED BY:
DRILL EQUIP:	CASING DEPTH (FT BGS):	HOLE LOCATION:
DRILL METHOD:	GROUNDWATER (FT BGS):	LATITUDE (DEG) or NORTHING (FT):
BIT SIZE/TYPE:	COMPLETION (FT):	LONGITUDE (DEG) or EASTING (FT):

DEPTH (m)	ROCK CORE						ROCK DESCRIPTION AND REMARKS	LITHOLOGY	FRACTURE SKETCH	FRACTURE NUMBER	FRACTURES PER FT	DISCONTINUITY DESCRIPTION								
	BOX NUMBER	RUN NUMBER	RECOVERY (%)	RQD (%)	DRILL TIME (MIN)	STRATIGRAPHY						NUMBER	ANGLE	TYPE	SURFACE SHAPE	ROUGHNESS	SEPARATION	INFILL TYPE	INFILL AMOUNT	WEATHERING
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

COLUMN DESCRIPTIONS

1 **DEPTH:** DISTANCE (IN FEET) BELOW THE COLLAR OF THE BOREHOLE

2 **RUN NUMBER:** CORE RUN IDENTIFICATION NUMBER

3 **BOX NUMBER:** CORE BOX IDENTIFICATION NUMBER

4 **RECOVERY:** AMOUNT (IN PERCENT) OF CORE RECOVERED FROM THE CORING INTERVAL; CALCULATED AS LENGTH OF CORE RECOVERED DIVIDED BY LENGTH OF RUN

5 **RQD:** ROCK QUALITY DESIGNATION; PERCENTAGE OF INTACT CORE IN EACH CORING INTERVAL; CALCULATED AS THE SUM OF LENGTHS OF INTACT CORE DIVIDED BY LENGTH OF CORE RUN

6 **DRILL TIME:** TIME IN MINUTES TO DRILL THE INTERVAL SHOWN

7 **STRATIGRAPHY:** ABBREVIATION REPRESENTING THE FORMATION NAME OR GENERAL MATERIAL NAME

8 **ROCK DESCRIPTION AND REMARKS:** DESCRIPTION OF THE ROCK TYPE, STRENGTH, WEATHERING, FRACTURE AMOUNT, GRAIN SIZE, COLOR, SPECIAL MINERALS, AND OTHER DISTINGUISHING FEATURES

9 **LITHOLOGY:** GRAPHC SYMBOL REPRESENTING THE ROCK TYPE

10 **FRACTURE SKETCH:** FIELD SKETCH OF OBSERVED FRACTURES

11 **FRACTURE NUMBER:** NUMBER CORRELATED WITH TO DISCONTINUITY DESCRIPTIONS, MECHANICAL FRACTURES CAUSED BY CORING PROCESS ARE NOT INCLUDED

12 **FRACTURES PER FT:** APPROXIMATE NUMBER OF FACTURES PER FOOT

DISCONTINUITY DESCRIPTION

13 **NUMBER:** DISCONTINUITY NUMBER THAT REPRESENTS THE FRACTURE NUMBER LABEL IN THE FRACTURE NUMBER COLUMN

14 **ANGLE:** ANGLE OF DISCONTINUITY DIP (IN DEGREES) OF THE FRACTURE MEASURED RELATIVE TO HORIZONTAL

15 **DISCONTINUITY TYPE:**

F - FAULT
J - JOINT
SH - SHEAR
FO - FOLIATION
V - VEIN
B - BEDDING
H - HEALED
M - MECHANICAL

16 **DISCONTINUITY SURFACE SHAPE:**

WA - WAVY
PL - PLANAR
ST - STEPPED
IR - IRREGULAR

17 **DISCONTINUITY ROUGHNESS:**

SLK - SLICKENED (SURFACE APPEARS SMOOTH, A GLASSY FINISH WITH VISUAL EVIDENCE OF STRIATIONS)
S - SMOOTH (SURFACE APPEARS SMOOTH AND FEELS SO TO THE TOUCH)
SR - SLIGHTLY ROUGH (ASPERITIES ON THE DISCONTINUITY SURFACES ARE DISTINGUISHABLE AND CAN BE FELT)
R - ROUGH (SOME RIDGES AND SIDE ANGLE STEPS ARE EVIDENT; ASPERITIES ARE CLEARLY VISIBLE AND DISCONTINUITY SURFACE FEELS VERY ABRASIVE
VR - VERY ROUGH (NEAR VERTICAL STEPS AND RIDGES OCCUR ON THE DISCONTINUITY SURFACE)

18 **DISCONTINUITY SEPERATION:**

W - WIDE (10-50mm)
MW - MODERATELY WIDE (2.5-10mm)
N - NARROW (0.1-2.5mm)
VN - VERY NARROW (<1.0mm)
T - TIGHT (0mm)

19 **DISCONTINUITY INFILL TYPE:**

CL - CLAY
CA - CALCITE
CH - CHLORITE
FE - IRON OXIDE
GY - GYPSUM/TALC
H - HEALED
NO - NONE
PY - PYRITE
QZ - QUARTZ
SD - SAND

20 **DISCONTINUITY INFILL AMOUNT:**

SU - SURFACE STAIN
SP - SPOTTY
PA - PARTIALLY FILLED
FI - FILLED
NO - NONE

21 **DISCONTINUITY WEATHERING:**

HW - HIGHLY WEATHERED
MW - MODERATELY WEATHERED
SW - SLIGHTLY WEATHERED
F - FRESH

Rock Description Order: Formation & Rock Type, ISRM Strength, ISRM Weathering, Color, Grain Size, Structure, Staining etc.
Example: GRANITIC GNEISS [FRANCISCAN FORMATION], medium strong (R3), Highly Weathered(IV), grayish-red (10R 4/6), medium to coarse grained, moderately foliated (30°), iron oxide staining

ISRM Strength

Grade	Description	Field Identification	UCS (Approximate)
R0	Extremely Weak Rock	Indented by thumbnail.	36.3 – 145 lbs/in^2 0.25 – 1.0 Mpa
R1	Very Weak Rock	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	145 – 725 lbs/in^2 1.0 – 5.0 Mpa
R2	Medium Weak Rock	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	725 – 3,625 lbs/in^2 5.0 – 25 Mpa
R3	Medium Strong Rock	Specimen cannot be scraped or cut with a pocket knife, specimen can be fractured with single firm blow of geological hammer.	3,625 – 7,250 lbs/in^2 25 – 50 lbs/in^2
R4	Strong Rock	Specimen requires more than one blow of geological hammer to fracture it.	7,250 – 14,500 lbs/in^2 50 – 100
R5	Very Strong Rock	Specimen requires many blows of a geological hammer to break intact sample.	14,500 – 36,250 lbs/in^2 100 – 250 Mpa
R6	Extremely Strong Rock	Specimen can only be chipped with geological hammer	> 36,250 lbs/in^2 > 250 MPa
S1	Very Soft Clay	Easily penetrated several inches by fist	< 3.63 lbs/in^2
S2	Soft Clay	Easily penetrated several inches by thumb	3.63 – 7.25 lbs/in^2 0.025 – 0.05 Mpa
S3	Firm Clay	Can be penetrated several inches by thumb with moderate effort	7.25 – 14.5 lbs/in^2 0.05 – 0.10 Mpa
S4	Stiff Clay	Readily indented by thumb but penetrated only with great effort	14.5 – 36.25 lbs/in^2 0.10 – 0.25 Mpa
S5	Very Stiff Clay	Readily indented by thumbnail	36.25 – 72.5 lbs/in^2 0.25 – 0.50 Mpa
S6	Hard Clay	Indented with difficulty by thumbnail	> 72.5 lbs/in^2 (0.50 Mpa)

ISRM Weathering

Term	Description	Grade
Fresh (F)	No visible signs of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered (SW)	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.	II
Moderately Weathered (MW)	Less than ½ of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered (HW)	More than ½ of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as corestones.	IV
Completely Weathered (CW)	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil (R)	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Grain or Particle Size

Description	Grain Size
Coarse	>5mm
Medium	1-5 mm
Fine	0.10-1mm
Aphanitic	<0.10mm

Types of Rock Structure (Specify Dip Angle)

Type	Description
Foliation	Formed in metamorphic rocks when pressure squeezes the flat or elongate minerals so they become aligned.
Bedding	Individual layers or bedding planes found in sedimentary and volcanic rocks.
Flow Structures	Planar linear features that result from flowage of magma, forms distinctive layering
Textures	Massive, Blocky, Porphyritic, Pyroclastic, Glassy, Pegmatitic

Discontinuity Order: Number, Dip Angle, Type, Shape, Roughness, Aperture/Seperation, Infill Type, Infill Amount, Discontinuity Weathering, JRC Value

Discontinuity Type	
F - Fault	FO - Foliation
J - Joint	H - Healed
SH – Shear	M - Mechanical
B - Bedding	V - Vein

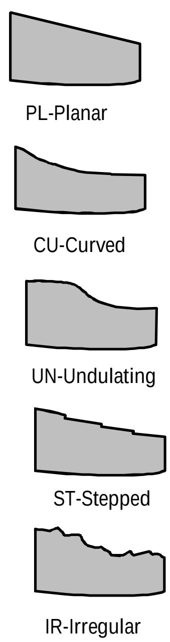
Shape	Roughness	Discontinuity Aperture (mm)
PL– Planar	SLK – Slickensided	T – Tight (0)
CU – Curved	S – Smooth	VN – Very Narrow (<1.0)
UN – Undulating	SR – Slightly Rough	N – Narrow (2.5-10)
ST – Stepped	R – Rough	MW – Moderately Wide (2.5-10)
IR - Irregular	VR – Very Rough	W – Wide (>10)

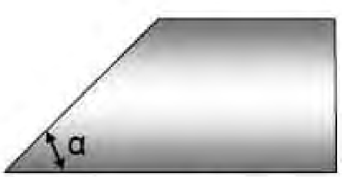
Infill Type		Infill Amount
No – None	Ca – Calcite	NO– None
H - Healed	Ta - Talc	SP – Spotty
Fe – Iron Oxide	Gy – Gypsum	PA – Partial
Mn – Manganese	Cl – Clay	CO – Coated
Qz - Quartz	Ch - Chlorite	FI – Filled
Py - Pyrite	Ep - Epidote	

Density/Spacing of Discontinuities	
Description	Criteria
Unfractured	> 6 ft. (> 1.83m)
Slightly Fractured	2 – 6 ft. (0.61 – 1.83m)
Moderately Fractured	8 in. – 2 ft. (203.20 – 609.60 mm)
Highly Fractured	2 – 8 in. (50.80 – 203.20 mm)
Intensely Fractured	< 2 in. (< 50.80 mm)

Discontinuity Weathering
HW – Highly Weathered
MW – Moderately Weathered
SW – Slightly Weathered
F - Fresh

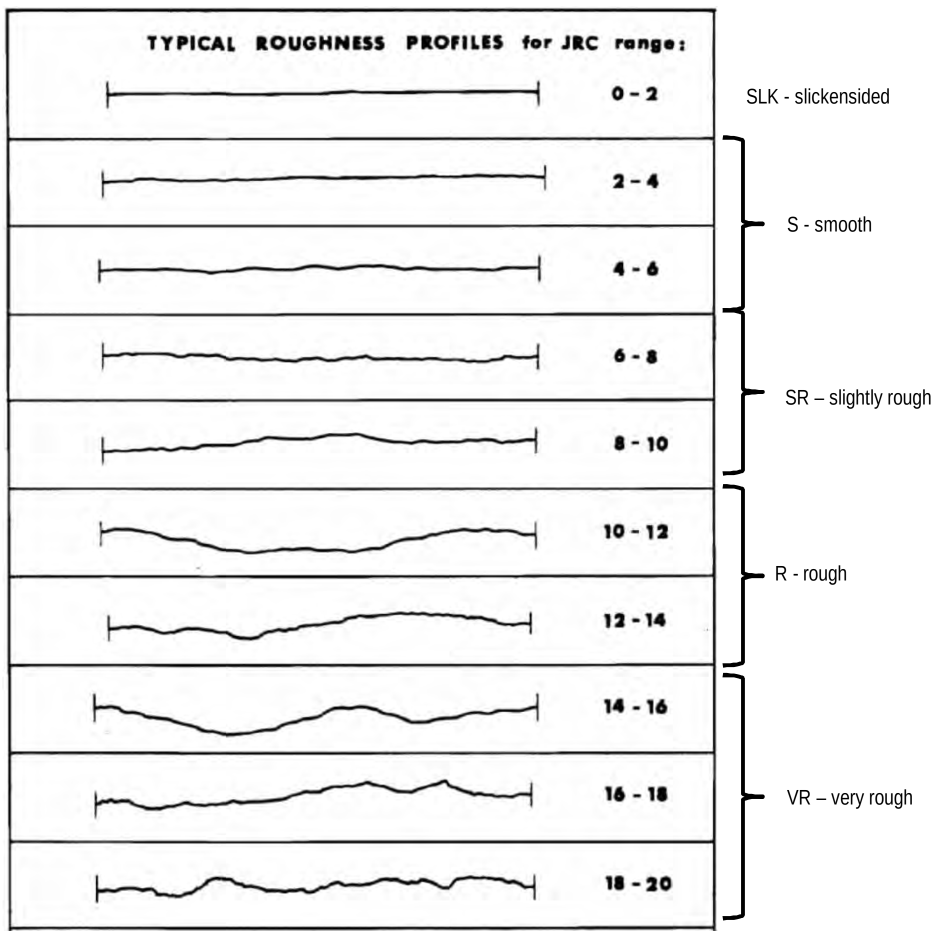
Discontinuity Surface Shapes



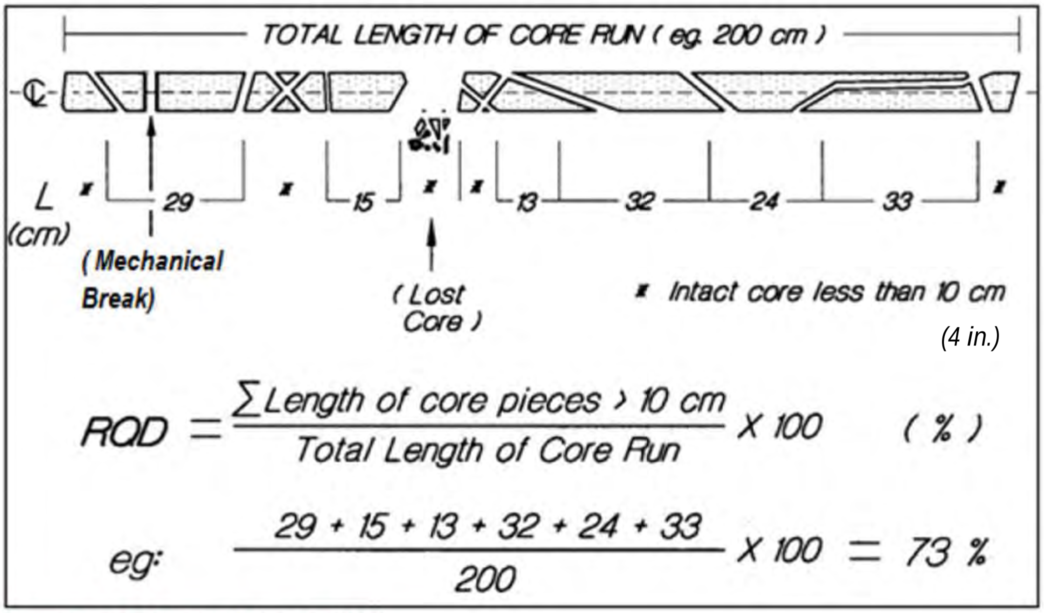


A IS THE MAXIMUM DIP OF THE JOINT/FEATURE, RELATIVE TO THE CORE AXIS

Joint Roughness Coefficient Values



$$RQD\,(\%) = 100\,x\,\frac{\text{the sum of the lengths of core in pieces equal to or longer than 4 inches}}{\text{length of core run}}$$

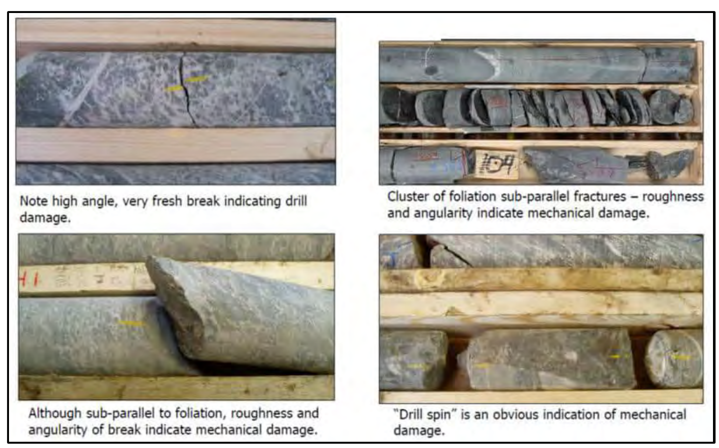


RQD Example (Hoek, 2007)

RQD %	Rock Quality
90-100%	Excellent
75-90%	Good
50-75%	Fair
25-50%	Poor
0-25%	Very Poor

- Sections of core with mechanical breaks or a single sub-parallel fracture are counted as intact rock and included in the RQD calculation.
- Sections of core weaker than R2 strength are omitted from the RQD calculation, it doesn't meet the soundness criteria.

Example of natural joint surfaces, note surface staining.



Example of mechanical breaks, note fresh jagged surfaces.

<u>Rubble Zones</u>

- Natural Rubble Zones (RZ) are assumed to have 4 joints per 4 in. (10 cm) of rubble zone.
  - Mechanical Rubble Zones (MRZ) are noted on the core log, but not counted.

Drilling Standards Reference Guide

Bits / **Reaming Shells**

Size	C.D. inch	C.D. mm	O.D. inch	O.D. mm	I.D. inch	I.D. mm	Reaming Shells O.D. inch	Reaming Shells O.D. mm
AQ	1.062	27.0	1.88	47.75	1.067	27.1	1.895	48.13
AQTK	1.197	30.40	1.885	48.13	1.207	30.66		
ATW	1.185	30.1	1.88	47.75	1.19	30.22		
BQ	1.432	36.5	2.35	59.69	1.438	36.52	2.365	60.07
BQ3	1.320	33.5	2.35	59.69	1.325	33.65		
BTW	1.656	42.0	2.35	59.69	1.659	42.13		
BQTK	1.596	40.54	2.355	59.82	1.606	40.79		
NQ	1.875	47.6	2.97	75.44	1.88	47.75	2.985	75.82
NQ2	1.990	50.5	2.97	75.88	2.0	50.80		
NQ3	1.775	45.0	2.97	75.88	1.78	45.21		
NTW	2.205	56.0	2.97	75.88	2.214	56.23		
HQ	2.50	63.5	3.77	95.76	2.505	63.63	3.790	96.27
HQ3	2.406	61.1	3.77	95.76	2.411	61.24		
HTW	2.792	70.92	3.77	95.76	2.797	71.04		
PQ	3.345	85.0	4.815	122.30	3.350	85.09	4.835	122.81
PQ3	3.270	83.0	4.815	122.30	3.275	83.18		
EXT	0.905	22.99	1.475	37.46	0.910	23.11	1.490	37.85
IEWS	1.0	25.40	1.475	37.46	1.00	25.40		
AXT	1.280	35.51	1.88	47.75	1.286	32.66	1.895	48.13
IAWS	1.385	35.18	1.88	47.75	1.394	35.40		

Casing Shoes

Size	O.D. inch	O.D. mm	I.D. inch	I.D. mm
AW	2.35	59.69	1.90	48.26
BW	2.97	75.44	2.377	60.38
NW	3.62	91.95	2.99	75.95
HW	4.632	117.65	3.980	101.09
PW	5.66	143.76	4.84	122.94
EW	1.880	47.75	1.497	38.02
AW	2.35	59.69	1.90	48.26

Casing

Size	O.D. inch	O.D. mm	I.D. inch	I.D. mm	Weight lbs./10 ft	Weight kg/10 ft	Weight lbs/3m	Weight kg/3 m	Threads/in
AW	2.750	57.1	1.805	48.4	38	17.24	37	17.2	4
BW	2.875	73	2.375	60.3	70	31.75	70	31.8	4
NW	3.5	88.9	3.0	76.2	86	39.01	84.5	38.4	4
HW	4.5	114.3	4.0	101.6	113	51.26	111	50.5	4
PW	5.5	139.7	5.0	127.0	140	63.5	141.75	64.3	3
SW	6.625	168.3	6.0	152.4	210.3	95.4	206.9	93.8	3
EW	1.813	46	1.5	38.1	29	13.2	28.5	12.9	4
AW	2.750	57.1	1.805	48.4	38	17.24	37	17.2	4

Drill Rods

Size	O.D. inch	O.D. mm	I.D. inch	I.D. mm	Weight lbs./10 ft	Weight kg/10 ft	Weight lbs/3m	Weight kg/3m	Threads/in
AQ	1.75	44.5	1.375	34.9	31	14.06	30.75	14	4
ATW	1.75	44.5	1.437	36.5	26	11.79	26	11.8	4.6
ARQLW	1.76	44.7	1.47	37.3	24	10.9	24.3	11	4
BQ	2.1875	55.6	1.8125	46	40	18.14	39.75	18	3
BTW	2.225	56.5	1.909	48.5	34.5	15.65	34.75	15.8	4.6
BRQLW	2.20	55.9	1.91	48.4	31.6	14.3	31	14.1	3.5
NQ	2.75	69.9	2.3750	60.3	52	23.59	51.5	23.4	3
NTW	2.875	73.3	2.525	64.2	50	22.68	61	27.7	4
HQ	3.50	88.9	3.0625	77.8	77	34.93	75.75	34.4	3
HTW	2.583	91.0	3.213	81.6	67	30.39	67	30.45	2
PQ	4.625	117.5	4.0625	103.2	106*	48.08*	104.06*	47.2*	3
EW-steel	1.375	34.9	0.438	11.1	31	14.06	29.5	13.4	3
EW-alum**					11	4.9	10.8	4.8	3
AW-steel	1.719	43.7	0.625	15.9	44	19.95	37.3	16.9	3
AW-alum**					14.5	6.5	14.2	6.4	3

Imperial Units   Metric Units   C.D. = Core Diameter, O.D. = Outside Diameter, I.D. = Inside Diameter, *with coupling, **either/or

D.2 Boring Logs

PROJECT NAME: Escondido 1	**DATES DRILLED:** 6/13/23 - 6/13/23	**LOG NO: 201-23**
PROJECT NO: 60707486	**SURFACE ELEVATION (ft):** 375.89	PAGE 1 OF 3
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 25	AECOM

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Air Rotary, 3 7/8 in. Rock Coring	**AT END OF DRILLING** --- Not Encountered	**HOLE LOCATION:** Auxiliary Spillway
BIT SIZE/TYPE: 3 7/8 in. Air Rotary, 3 7/8 in. Rock Coring	**AFTER DRILLING** ---	**LATITUDE (deg) or NORTHING (ft):** 28.7765 (deg) 13467941.2(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg) or EASTING (ft):** -97.897695 (deg) 2321604.3(ft)

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
	0					Hard, moist, very dark gray, sandy fat CLAY, trace organics, weak reaction to HCl, (CH), (RESIDUUM) - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs - 0.5 ft: Transitions to calcium carbonate rich caliche, strong reaction to HCl observed	10		51	33		35.9	64.1	
375	1	SS SS-1A/ SS-1B	3-3-5 (8)	4.5+	78		9							
374	2					- 2 ft: Light gray, trace organics, iron oxide staining	21		54	35		30.5	69.5	
373	3	ST ST-2		4.5+	79	- 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs								
372	4						17							
371	5	P P-3		4.5+	52									
370	6					Stiff to hard, moist, white, fat CLAY, with iron oxide staining, low plasticity fines, weak reaction to HCl, (CH), (RESIDDUM)	16		67	45		9.6	90.4	
369	7	ST ST-4		4.5+	69									
368	8					Stiff to hard, moist, pale brown, lean CLAY with sand, calcareous inclusions, mottled light yellowish brown, weak reaction to HCl, (CL), (RESIDUUM)	16							
367	9	SS SS-5	11-14-18 (32)	4.5+	100									
366	10													

(Continued Next Page)

PROJECT NAME: Escondido 1	**DATES DRILLED:** 6/13/23 - 6/13/23	**LOG NO: 201-23**
PROJECT NO: 60707486	**SURFACE ELEVATION (ft):** 375.89	PAGE 2 OF 3 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 25	

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
365–364	10–12	P P-6		4.5+	58	Stiff to hard, moist, pale brown, lean CLAY with sand, calcareous inclusions, mottled light yellowish brown, weak reaction to HCl, (CL), (RESIDUUM) *(continued)* - 10 ft: Dry, white, approximately 8% calcareous nodules, 5 to 8 % iron oxide staining, no reaction to HCl observed	12							
364–361	12–15	ST ST-7		4.5+	33	- 12 ft: Medium plasticity fines, trace calcareous gravel, no reaction to HCl observed	15		43	23		19.2	80.4	
361–356	15–20	RC 1			82	SANDSTONE: Slightly weathered, moist, light gray, calcareous, medium grained, iron oxide staining, quartz sand [OAKVILLE SANDSTONE] - 15.75 ft: bit score, heavily fractured to 16 ft	11							
356–355	20–21	RC 2			40		6							

(Continued Next Page)

PROJECT NAME: Escondido 1	DATES DRILLED: 6/13/23 - 6/13/23	LOG NO: 201-23
PROJECT NO: 60707486	SURFACE ELEVATION (ft): 375.89	PAGE 3 OF 3 AECOM
LOCATION: Kenedy, TX	TOTAL DEPTH (ft): 25	

ELEVATION (ft)	DEPTH (ft)	SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
354	22						SANDSTONE: Slightly weathered, moist, light gray, calcareous, medium grained, iron oxide staining, quartz sand [OAKVILLE SANDSTONE] *(continued)*		6							
353	23															
			RC 2			40										
352	24															
351	25															

Bottom of hole at 25.0 feet. Grout mix: 180 gal of water, 120 lbs of portland cement, 60 lbs of bentonite. Approximately 50 gallons of portland cement bentonite grout mix used as backfill.

PROJECT NAME: Escondido 1	DATES DRILLED: 6/14/23 - 6/14/23	LOG NO: 202-23
PROJECT NO: 60707486	SURFACE ELEVATION (ft): 377.35	PAGE 1 OF 4
LOCATION: Kenedy, TX	TOTAL DEPTH (ft): 40	AECOM

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	GROUNDWATER LEVELS:	LOGGED BY: Sergio Teran
DRILL EQUIP: B-57 Mobile	AT TIME OF: --- Not Encountered	CHECKED BY: Charlie Krolikowski
DRILL METHOD: Air Rotary, 3 7/8 in. Rock Coring	AT END OF DRILLING --- Not Encountered	HOLE LOCATION: Auxiliary Spillway
BIT SIZE/TYPE: 3 7/8 in. Air Rotary, 3 7/8 in. Rock Coring	AFTER DRILLING ---	LATITUDE (deg) or NORTHING (ft): 28.777113 (deg) 13468162.9(ft)
CASING DEPTH (ft bgs): N/A	COMPLETION: Cement Bentonite Grout	LONGITUDE (deg) or EASTING (ft): -97.898165 (deg) 2321451.6(ft)

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
377	0						Hard, moist, very dark gray, ORGANIC soil, (OL), (RESIDUUM) - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs		16							
376	1		P P-1		+4.5	69	Hard, moist, light brownish gray, fat CLAY, calcium carbonate filled fissures and nodules, trace organics, trace iron oxide staining, mottled, strong reaction to HCl, (CH), (RESIDDUM)									
375	2		SS SS-2	6-8-10 (18)	+4.5	67			19							
374	3						- 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs				59	40				
373	4		P P-3		+4.5	50	- 4 ft: Becoming sandier, weak reaction to HCl observed		19		51	29		16.9	83	
372	5															
371	6		SS SS-4	12-12-18 (30)	+4.5	67	- 6 ft: Strong reaction to HCl observed		12							
370	7															
369	8		ST ST-5		+4.5	58	- 8 ft: Weak reaction to HCl observed, becomes less sandy		18		55	37		6.1	93.9	
368	9															
	10															

(Continued Next Page)

PROJECT NAME: Escondido 1	DATES DRILLED: 6/14/23 - 6/14/23	LOG NO: 202-23
PROJECT NO: 60707486	SURFACE ELEVATION (ft): 377.35	PAGE 2 OF 4
LOCATION: Kenedy, TX	TOTAL DEPTH (ft): 40	AECOM

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
367, 366	10, 11	P P-6		+4.5	40	Hard, moist, light brownish gray, fat CLAY, calcium carbonate filled fissures and nodules, trace organics, trace iron oxide staining, mottled, strong reaction to HCl, (CH), (RESIDDUM) *(continued)* - 10 ft: 3% increase in iron oxide staining, weak reaction to HCl observed	20							
365, 364	12, 13	SS SS-7	9-15-18 (33)	+4.5	78	- 12 ft: Pale brown, approximately 30 percent sand, mottled, iron oxide staining, approximately 5% mafic minerals	14					49.8	50.2	
363, 362	14, 15	P P-8		+4.5	46	- 14 ft: Medium plasticity fines, moderate reaction to HCl observed	13					28.7	71.3	
361, 360	16, 17													
359	18	ST ST-9		+4.5	23	- 18 ft: White, dry, approximately 30-35% medium sand, low plasticity fines, strong reaction to HCl observed	12		34	19				
358	19	SS SS-10	12-19-25 (44)	+4.5	100		10							
357, 356	20, 21													

(Continued Next Page)

PROJECT NAME: Escondido 1	DATES DRILLED: 6/14/23 - 6/14/23	LOG NO: 202-23
PROJECT NO: 60707486	SURFACE ELEVATION (ft): 377.35	PAGE 3 OF 4 AECOM
LOCATION: Kenedy, TX	TOTAL DEPTH (ft): 40	

ELEVATION (ft)	DEPTH (ft)	SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
355	22						Hard, moist, light brownish gray, fat CLAY, calcium carbonate filled fissures and nodules, trace organics, trace iron oxide staining, mottled, strong reaction to HCl, (CH), (RESIDDUM) *(continued)*									
354	23															
353	24															
352	25															
351	26		SS SS-11	14-23-27 (50)	+4.5	100	Dense, moist, light gray, silty SAND alternating with lean CLAY with sand, medium grained sand, calcareous inclusions, iron oxide staining, low to medium plasticity fines, strong reaction to HCl, (CL), (RESIDDUM)		10		29	15	0.3	27.2	72.4	
350	27															
349	28															
348	29		SS SS-12	14-15-16 (31)	+4.5	97	- 28.5 ft: Iron oxide stained fissures		11							
347	30															
346	31															
345	32															
344	33		SS SS-13	13-21-27 (48)	+4.5	94			25							

(Continued Next Page)

ELEVATION (ft)	DEPTH (ft)	SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
	34															
343	35		SS SS-14	12-21-24 (45)	+4.5	100	Hard, moist, white and very dark brown, fat CLAY with sand, medium plasticity fines, trace iron oxide staining, weak reaction to HCl, (CH), (RESIDUUM)		22		64	34		14	86	
342	36															
341	37															
340	38															
339	39															
338	40		SS SS-15	14-22-25 (47)	+4.5	100	- 38.5 ft: Dry, light gray, sandy, trace iron oxide staining, medium grained sand, approximately 30 to 35% sand, approximately 3 to 5% calcareous inclusions, weak reaction to HCl observed		19							

Bottom of hole at 40.0 feet. Approximately 70 gallons of portland cement bentonite grout mix used as backfill.

PROJECT NAME: Escondido 1	DATES DRILLED: 6/14/23 - 6/14/23	LOG NO: 203-23
PROJECT NO: 60707486	SURFACE ELEVATION (ft): 370.46	PAGE 1 OF 3
LOCATION: Kenedy, TX	TOTAL DEPTH (ft): 31.5	AECOM

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	GROUNDWATER LEVELS:	LOGGED BY: Sergio Teran
DRILL EQUIP: B-57 Mobile	AT TIME OF: --- Not Encountered	CHECKED BY: Charlie Krolikowski
DRILL METHOD: Air Rotary, 3 7/8 in. Rock Coring	AT END OF DRILLING --- Not Encountered	HOLE LOCATION: Auxiliary Spillway
BIT SIZE/TYPE: 3 7/8 in. Air Rotary, 3 7/8 in. Rock Coring	AFTER DRILLING ---	LATITUDE (deg) or NORTHING (ft): 28.778199 (deg) 13468558.5(ft)
CASING DEPTH (ft bgs): N/A	COMPLETION: Cement Bentonite Grout	LONGITUDE (deg) or EASTING (ft): -97.897869 (deg) 2321542.8(ft)

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
370	0					Hard, moist, light gray, fat CLAY, mottled, trace iron oxide staining, trace organics, weak reaction to HCl, (CH), (RESIDUUM) - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs			67 63	46 43		9.3	90.7	
369	1	ST ST-1		4.0	75									
368	2	SS SS-2	6-7-16 (23)	+4.5	89	- 2 ft: Brownish yellow, 5 to 8% calcareous nodules, 10% iron oxide staining, weak reaction to HCl observed	21							
367	3					- 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs								
366	4					- 4 ft: Light gray, with sand, iron oxide staining throughout, low plasticity fines, mottled	13		43	24				
365	5	P P-3		+4.5	81									
364	6	ST ST-4		+4.5	25	- 6 ft: Approximately 5% increase in medium grained Quartz sand, weak reaction to HCl observed, fat CLAY with SAND	13		68	21		22.2	77.8	
						- 6.5 ft: Approximately 5% increase in iron minerals	12							
363	7	SS SS-5	11-15-18 (33)	+4.5	89									
362	8					- 8 ft: 3 to 5% calcareous inclusions, sand seams, weak to strong reaction to HCl observed	14					24.6	75.3	
361	9	SS SS-6	19-26-34 (60)	+4.5	81									
	10													

(Continued Next Page)

PROJECT NAME: Escondido 1	DATES DRILLED: 6/14/23 - 6/14/23	LOG NO: 203-23
PROJECT NO: 60707486	SURFACE ELEVATION (ft): 370.46	PAGE 2 OF 3
LOCATION: Kenedy, TX	TOTAL DEPTH (ft): 31.5	AECOM

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	LABORATORY TESTING RESULTS: Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
360 359	10 11		P P-7		+4.5	56	Hard, light yellowish brown, 3 to 5% calcareous inclusions, lean CLAY, weak to strong reaction to HCl observed (CL), (RESIDUUM)		11		35	20	2.4	12	85.7	
358	12 13		SS SS-8	14-22-30 (52)	+4.5	86			13							
357 356 355	14 15		P P-9		+4.5	35			13		44	18				
354	16		ST ST-10		+4.5	100			15					14	86	
353	17 18		SS SS-11	13-17-19 (36)	2.5 +4.5	100	Dense, moist, light gray, poorly graded clayey SAND, fine sand grains, iron oxide staining, non-plastic fines, strong reaction to HCl, (SC), (OAKVILLE SANDSTONE) - 17 ft: 6-inch-thick lense of lean clay, fine to very fine sand		10		27	15		50.8	49.2	
352 351	19															
350 349	20 21		SS SS-12	13-22-24 (46)		100	- 20 ft: Dry, light gray, well cemented, calcareous, iron oxide staining throughout		13							

(Continued Next Page)

PROJECT NAME: Escondido 1	**DATES DRILLED:** 6/14/23 - 6/14/23	**LOG NO: 203-23**
PROJECT NO: 60707486	**SURFACE ELEVATION (ft):** 370.46	PAGE 3 OF 3 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 31.5	

ELEVATION (ft)	DEPTH (ft)	SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
348	22		RC 1			17	SANDSTONE: Medium strong, fresh, moist, light brownish gray, medium grain OAKVILLE SANDSTONE) - 22 ft: Intensely fractured from 22 to 22.5 ft - 22.5 ft: Intensely fractured from 22 to 22.5 ft No recovery from 25 to 30 ft		17							
347	23															
346	24															
345	25		RC 2			0										
344	26															
343	27															
342	28															
341	29															
340	30		SS SS-13	14-27-35 (62)		100	Very dense, moist to dry, light gray, CLAYEY SAND, medium to coarse sand grains, calcareous, iron oxide staining, (SW), (OAKVILLE SANDSTONE)		17				2.8	69.8	27.3	
339	31															

Bottom of hole at 31.5 feet. Grout mix: 2 bags (90 lb/bag) of portland cement and 1/2 bag (50 lb/bag) of bentonite. Approximately 60 gallons of portland cement bentonite grout mix used as backfill.

AECOM-SMART-SOIL-LAB-ELEV_SOIL_PP+TV_GWR - URS_DENVER STD US LAB.GDT - 2/6/24 16:40 - C:\USERS\ATUL.SINGH\DOWNLOADS\ESCONDIDO1_MODIFIED_07.27.2023 - LABCLASSIFICATION.GPJ

PROJECT NAME: Escondido 1	DATES DRILLED: 6/14/23 - 6/14/23	LOG NO: 204-23
PROJECT NO: 60707486	SURFACE ELEVATION (ft): 355.67	PAGE 1 OF 2
LOCATION: Kenedy, TX	TOTAL DEPTH (ft): 20	AECOM

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Air Rotary, 3 7/8 in. Rock Coring	**AT END OF DRILLING** --- Not Encountered	**HOLE LOCATION:** Auxiliary Spillway
BIT SIZE/TYPE: 3 7/8 in. Air Rotary, 3 7/8 in. Rock Coring	**AFTER DRILLING** ---	**LATITUDE (deg) or NORTHING (ft):** 28.779239 (deg) 13468939.3(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg) or EASTING (ft):** -97.896919 (deg) 2321843.4(ft)

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
355	0	ST ST-1		+4.5	83	Hard, moist, light brownish gray, sandy lean CLAY, trace organics, 5 to 8% iron oxide staining, no reaction to HCl, (CL), (RESIDUUM) - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs			44 45	27 29		50	50	
354	1													
353	2	SS SS-2	6-12-19 (31)	+4.5	61	- 2 ft: Thinly bedded, mottled, 5% increase in iron oxide staining and iron minerals, calcareous nodules, no reaction to HCl observed	7							
352	3					- 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs								
351	4	ST ST-3		+4.5	56	- 4 ft: Medium grained sand			37	22		44.5	55.5	
350	5													
349	6	P P-4		+4.5	71		8							
348	7					- 7.5 ft: Becoming sandy, dry, light yellowish brown, medium grained sand, approximately 5% iron oxide staining and iron minerals								
347	8	ST ST-5		+4.5	40				32	19		47.1	52.9	
346	9													
	10													

(Continued Next Page)

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
345 – 344	10 – 12	SS SS-6	7-6-9 (15)	+4.5	81	Hard, moist, light brownish gray, sandy lean CLAY, trace organics, 5 to 8% iron oxide staining, no reaction to HCl, (CL), (RESIDUUM) *(continued)* - 10 ft: Becoming harder and more cemented	11							
343 – 342	12 – 14	SS SS-7	8-8-10 (18)	1.0 1.5	97	Medium dense, dry, light yellowish brown, clayey SAND, medium grained sand, approximately 5% iron oxide staining and iron minerals, trace chert, gravel up to 15 mm in diameter, no reaction to HCl observed, (SC), (OAKVILLE SANDSTONE)	10		36	23	0.5	85.8	13.7	
341 – 336	14 – 20	RC 1			42	SANDSTONE: Medium weak, fresh to slightly weathered, moist, medium grain size, 10 mm bedding on lower section of the core, and calcareous nodules (OAKVILLE SANDSTONE)	10							

Bottom of hole at 20.0 feet. Grout mix: 2 bags (90 lb/bag) of portland cement and 1/2 bag (50 lb/bag) of bentonite. Approximately 50 gallons of portland cement bentonite grout mix used as backfill.

D.3 Geologic Field Reconnaissance

AECOM

EARTH DAM INSPECTION CHECKLIST
San Antonio River Authority
Project No.: 60707486

NAME OF DAM: Escondido Creek FRS No. 1 **Age:** 69 years

LOCATION: 28.778471°, -97.895475° **County:** Karnes

CLASSIFICATION DATA: **Size:** ______ **Hazard:** High

PHYSICAL DATA:
Type of Dam: Earth Embankment **Height of Dam:** ______ **Normal Pool Storage Capacity:** ______

ELEVATIONS:
Normal Pool: ______ **Pool Level at Inspection:** ______ **Tailwater Level at Inspection:** ______

DAM OWNER: Larry Mixon, Heraldo Rodriguez **OPERATOR:** _____

ADDRESS: ______________________ ______________________

PHONE: (___)-___-____ **FAX NO.:** (___)-___-____ **E-MAIL ADDRESS:** ______________________

A completed and signed Dam Owners Notice Checklist is to accompany this Inspection Checklist.

PERSONS PRESENT AT INSPECTION:

Name	Title/Position	Representing
Sergio Teran	Geologist	AECOM
Ben Jarysek		The River Authority

DATE OF INSPECTION: 6/12/23

WEATHER: Partly Cloudy

TEMPERATURE: 85°

This is to certify that the above dam has been inspected and the following are the results of this inspection.

______________________________ ____________
Signature of Registered Professional Engineer Date

ITEM	CONDITION	COMMENTS	MONITOR	IVESTIGATE	REPAIR

EMBANKMENT: CREST

ITEM	CONDITION	COMMENTS	MONITOR	IVESTIGATE	REPAIR
1	Surface Cracking		☐	☐	☐
2	Sinkhole, Animal Burrow	Some animal burrows present	☐	☐	☐
3	Low Area(s)	Only where vehicles drive	☐	☐	☐
4	Horizontal Alignment		☐	☐	☐
5	Ruts and/or Puddles	Vehicle ruts ~3" - 4"	☐	☐	☐
6	Vegetation Condition	Overgrown, mowed on 6/12/23	☐	☐	☐
7	Warning Signs	NA	☐	☐	☐
8	Access Road	Clear	☐	☐	☐
9		Grass mowed over the	☐	☐	☐

Additional Comments (Refer to item number if applicable):

Grass was mowed over the weekend. Hay was still being bailed while onsite.

EMBANKMENT: UPSTREAM FACE

ITEM	CONDITION	COMMENTS	MONITOR	IVESTIGATE	REPAIR
10	Slide, Slough, Scarp	None	☐	☐	☐
11	Slope Protection	None	☐	☐	☐
12	Sinkhole, Animal Burrow	hay cutting on west end of embankment. Some burrows	☐	☐	☐
13	Emb.-Abut. Contact		☐	☐	☐
14	Erosion	Some from wave action	☐	☐	☐
15	Vegetation Condition	Overgrown, Mowed on 6/12/23	☐	☐	☐
16	Access Road	Clear	☐	☐	☐
17			☐	☐	☐

Additional Comments (Refer to item number if applicable):

ITEM	CONDITION	COMMENTS	MONITOR	INVESTIGATE	REPAIR
EMBANKMENT: DOWNSTREAM FACE					
18	Wet Area(s) (No Flow)	No flow, No Standing water on DS side	☐	☐	☐
19	Seepage	None	☐	☐	☐
20	Slide, Slough, Scarp	None	☐	☐	☐
21	Emb. - Abut. Contact		☐	☐	☐
22	Sinkhole, Animal Burrow	animal burrows	☐	☐	☐
23	Erosion	None	☐	☐	☐
24	Unusual Movement	None	☐	☐	☐
25	Vegetation Control	~~Some~~ Overgrown, NOT mowed	☐	☐	☐
26	Access Road		☐	☐	☐
27			☐	☐	☐

Additional Comments (Refer to item number if applicable):

2:1 Slope makes it difficult to mow

ITEM	CONDITION	COMMENTS	MONITOR	INVESTIGATE	REPAIR
EMBANKMENT: INSTRUMENTATION					
28	Piezometers/Observ. Wells	5 on-site	☐	☐	☐
29	Staff Gauge and Recorder	None	☐	☐	☐
30	Weirs	None	☐	☐	☐
31	Survey Monuments	2 on top of fencelines for elevation	☐	☐	☐
32	Drains	Just the one under the slope, good Condition ~10"	☐	☐	☐
33	Low Flow Release	Present ~8" Valve, working Condition	☐	☐	☐
34	Frequency of Readings	NA	☐	☐	☐
35	Location of Records	NA	☐	☐	☐
36			☐	☐	☐
37			☐	☐	☐

Additional Comments (Refer to item number if applicable):

ITEM	CONDITION	COMMENTS	MONITOR	IVESTIGATE	REPAIR
		DOWNSTREAM AREA			
38	Abutment Leakage	None	☐	☐	☐
39	Foundation Seepage	None	☐	☐	☐
40	Slide, Slough, Scarp	None	☐	☐	☐
41	Drainage System	" "	☐	☐	☐
42	Boils	" "	☐	☐	☐
43	Wet Areas	" "	☐	☐	☐
44	Reservoir Slopes	" "	☐	☐	☐
45	Access Roads	Good Condition	☐	☐	☐
46	Security Devices	None, lock on front gate	☐	☐	☐
47			☐	☐	☐
48			☐	☐	☐
49			☐	☐	☐

Additional Comments (Refer to item number if applicable):

AUXILLIARY SPILLWAY: ERODABLE CHANNEL

ITEM	CONDITION	COMMENTS	MONITOR	IVESTIGATE	REPAIR
50	Slide, Slough, Scarp	Good, None	☐	☐	☐
51	Erosion	None	☐	☐	☐
52	Vegetation Condition	Overgrown	☐	☐	☐
53	Debris	None	☐	☐	☐
54			☐	☐	☐
55			☐	☐	☐

Additional Comments (Refer to item number if applicable):

ITEM	CONDITION	COMMENTS	MONITOR	IVESTIGATE	REPAIR
AUXILLIARY SPILLWAY: NON-ERODABLE CHANNEL					
56	Sidewalls	Good Condition	☐	☐	☐
57	Channel Floor	" "	☐	☐	☐
58	Unusual Movement	None	☐	☐	☐
59	Approach Area	" "	☐	☐	☐
60	Weir or Control	None	☐	☐	☐
61	Discharge Channel		☐	☐	☐
62	Boils	None	☐	☐	☐
63			☐	☐	☐
64			☐	☐	☐

Additional Comments (Refer to item number if applicable):

Animal burrows

ITEM	CONDITION	COMMENTS	MONITOR	IVESTIGATE	REPAIR
PRINCIPAL SPILLWAY: DROP INLET					
65	Intake Structure	Good Condition	☐	☐	☐
66	Trashrack	Good Condition	☐	☐	☐
67	Stilling Basin		☐	☐	☐
68	Control Mechanism		☐	☐	☐
69			☐	☐	☐

Additional Comments (Refer to item number if applicable):

Painted every 5 yrs

ITEM	CONDITION	COMMENTS	MONITOR	INVESTIGATE	REPAIR
PRINCIPAL SPILLWAY: OUTLET WORKS					
70	Intake Structure		☐	☐	☐
71	Trashrack		☐	☐	☐
72	Stilling Basin		☐	☐	☐
73	Primary Closure		☐	☐	☐
74	Secondary Closure		☐	☐	☐
75	Control Mechanism		☐	☐	☐
76	Outlet Pipe	Some rip rap present to prevent erosion	☐	☐	☐
77	Outlet Tower		☐	☐	☐
78	Outlet Structure		☐	☐	☐
79	Seepage	Swampy area present	☐	☐	☐
80	Unusual Movement		☐	☐	☐
81	Toe Drain		☐	☐	☐
82			☐	☐	☐

Additional Comments (Refer to item number if applicable):

Sketches

Appendix E Sample Photographs

AECOM **PHOTOGRAPHIC LOG**

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
1	6/13/23

Description:

Boring: 201-23. SS-1.
Depths: 0-1.5 ft.

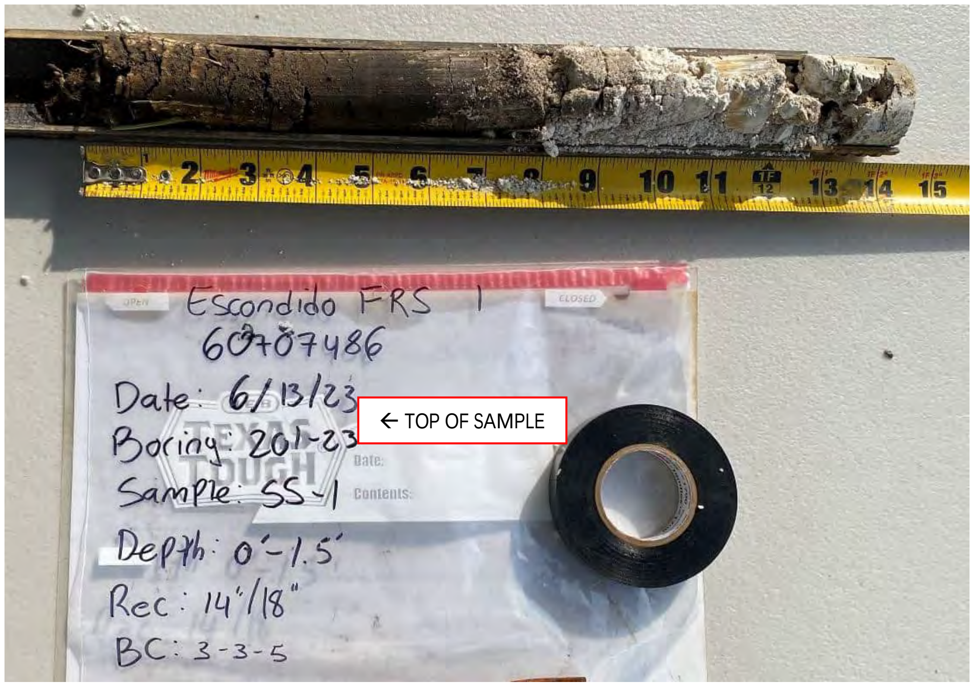


Photo No.	Date:
2	6/13/23

Description:

Boring: 201-23. ST-2.
Depths: 2-4 ft.

![AECOM logo]

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
3	6/13/23

Description:

Boring: 201-23. P-3.
Depths: 4-6 ft.

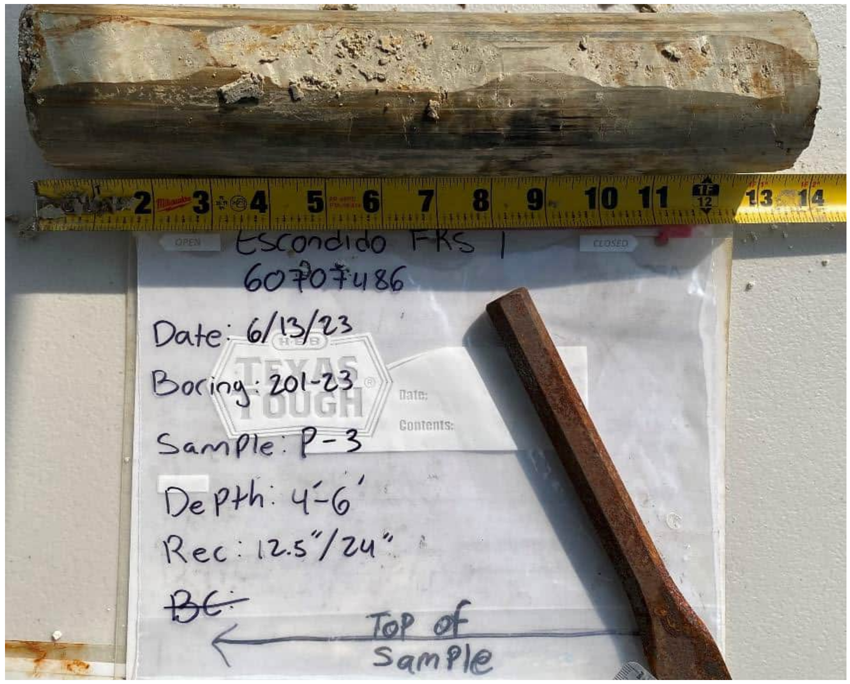


Photo No.	Date:
4	6/13/23

Description:

Boring 201-23. ST-4.
Depths: 6-8 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
5	6/13/23

Description:

Boring 201-23. SS-5.
Depths: 8-9.5 ft.

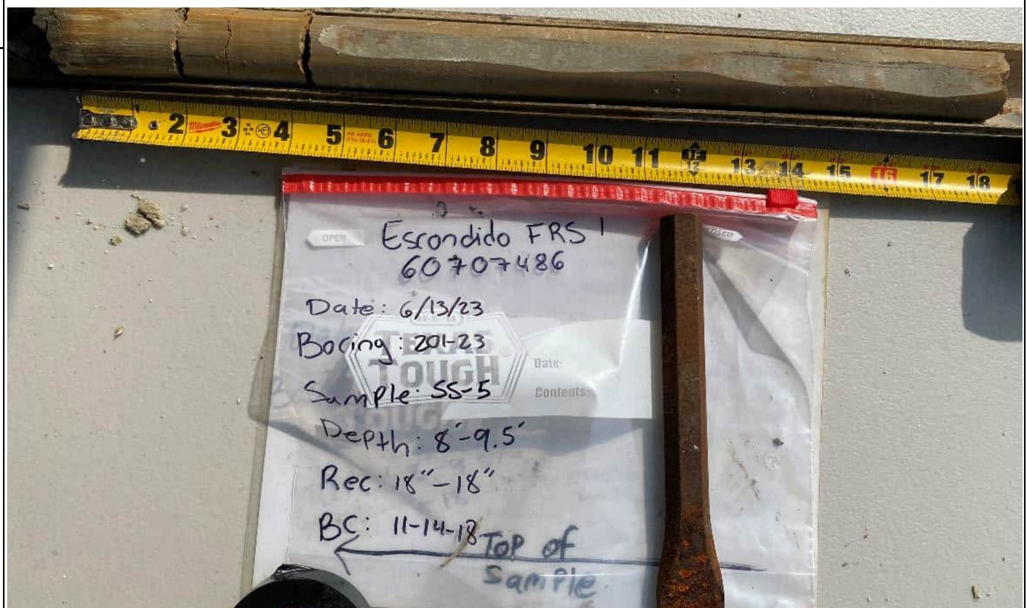
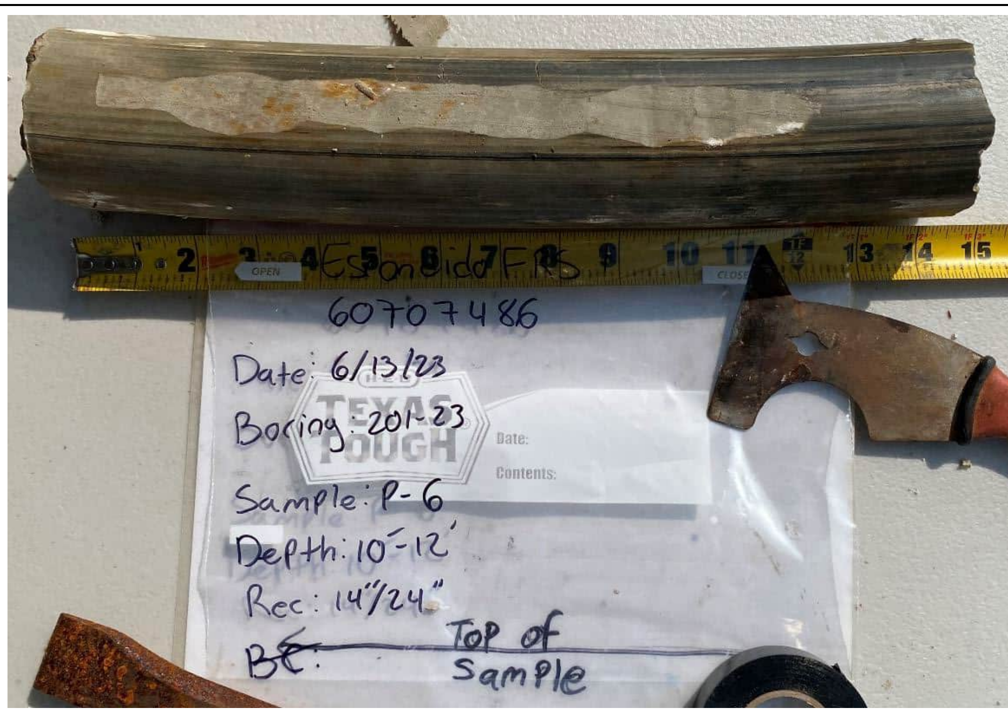


Photo No.	Date:
6	6/13/23

Description:

Boring 201-23. P-6.
Depths: 10-12 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
7	6/13/23

Description:

Boring 201-23. ST-7.
Depths: 12-14 ft.

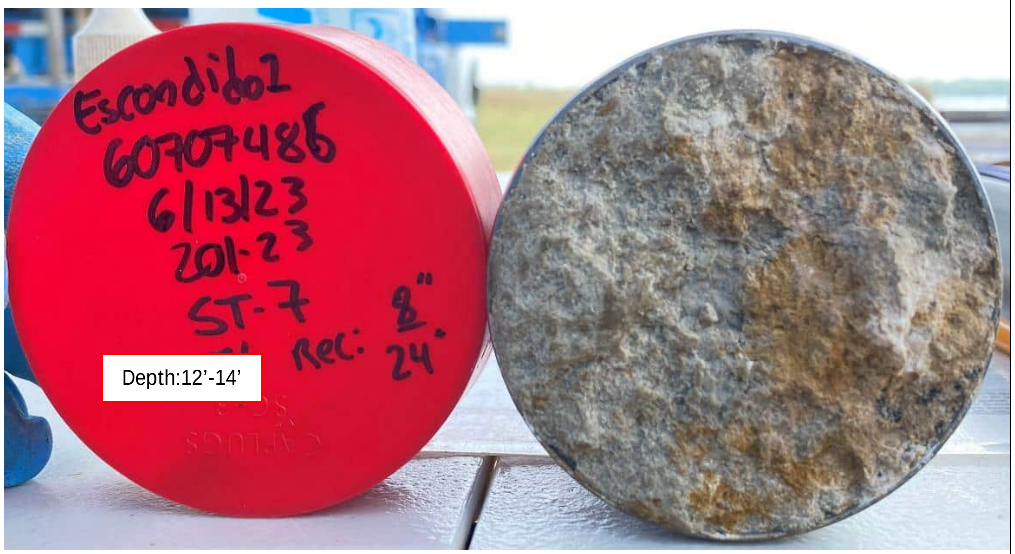


Photo No.	Date:
8	6/13/23

Description:

Boring 201-23. RC-1.
Depths: 15-20 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
9	6/13/23

Description:

Boring 201-23. RC-1.
Depths: 15-20 ft.

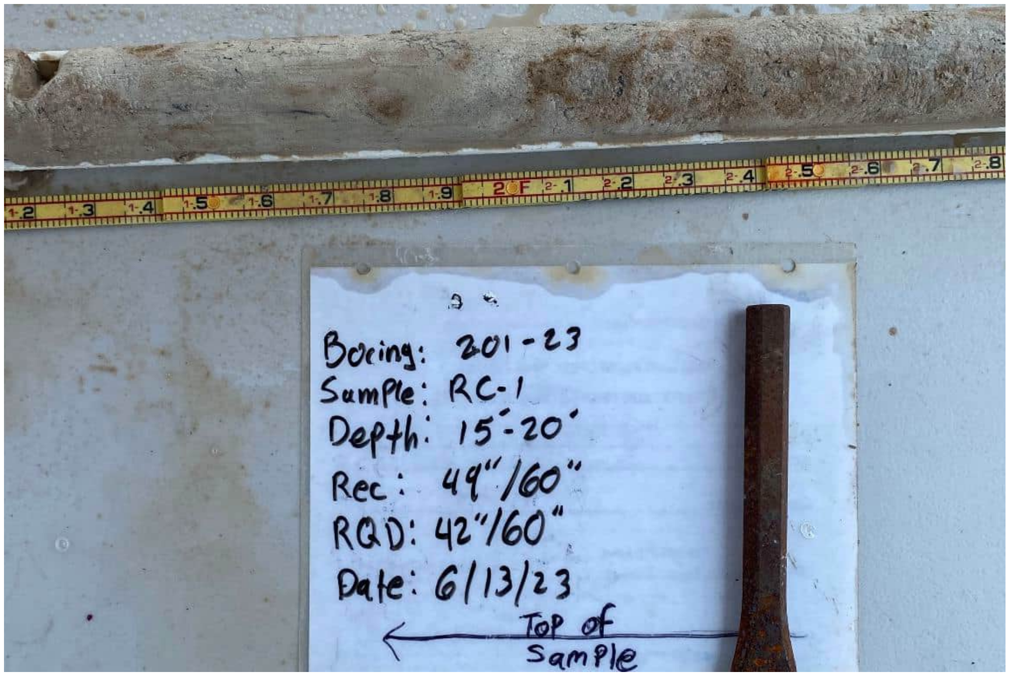


Photo No.	Date:
10	6/13/23

Description:

Boring 201-23. RC-1.
Depths: 15-20 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
11	6/13/23

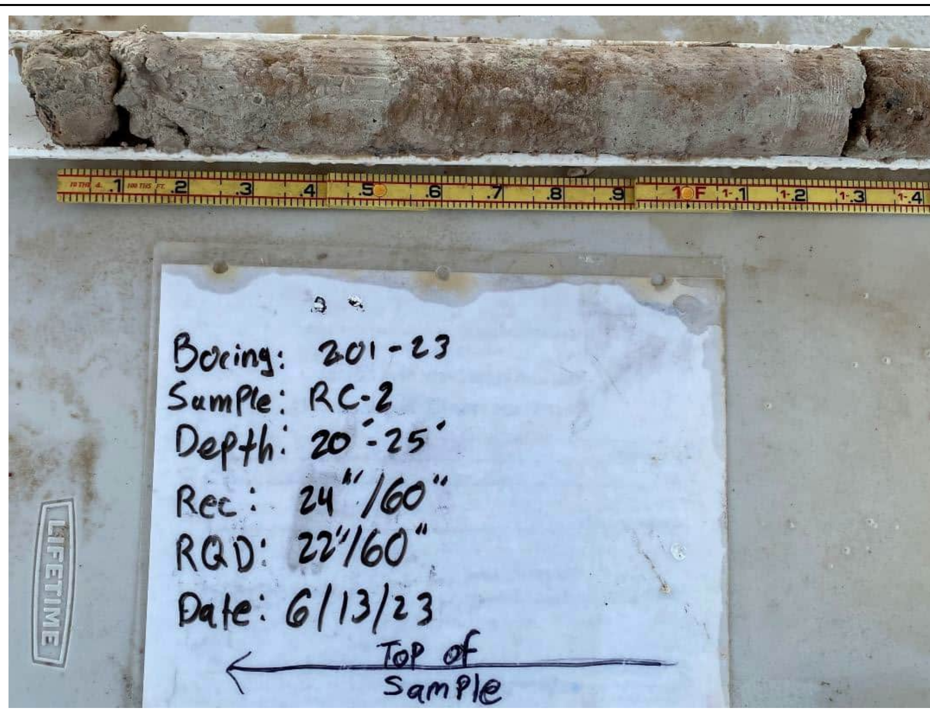
Description:

Boring 201-23. RC-1.
Depths: 15-20 ft.

Photo No.	Date:
12	6/13/23

Description:

Boring 201-23. RC-2.
Depths: 20-25 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
13	6/13/23

Description:

Boring 201-23. RC-2.
Depths: 20-25 ft.

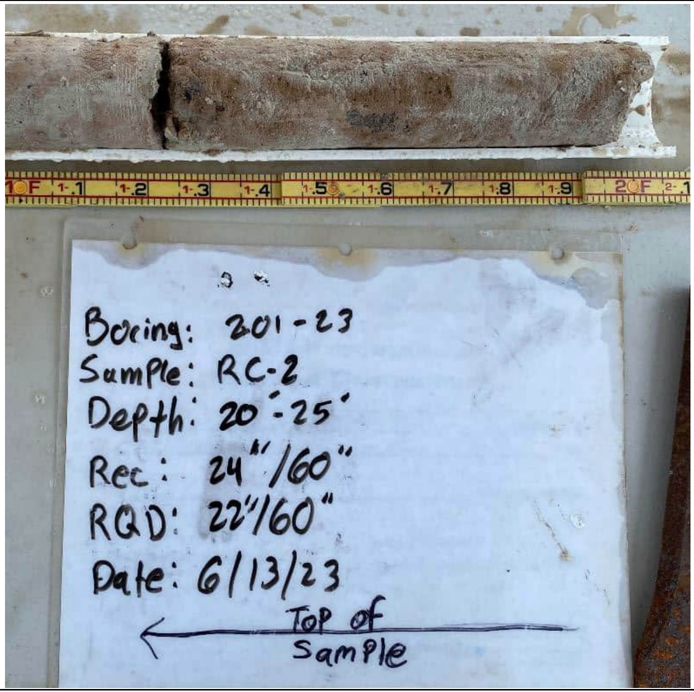


Photo No.	Date:
14	6/13/23

Description:

Boring 201-23. RC-1 & RC-2.
Depths: 20-25 ft.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
15	6/13/23

Description:

Boring 201-23. RC-1 & RC-2.
Depths: 20-25 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
1	6/13/23

Description:

Boring: 202-23. P-1.
Depths: 0-2 ft.

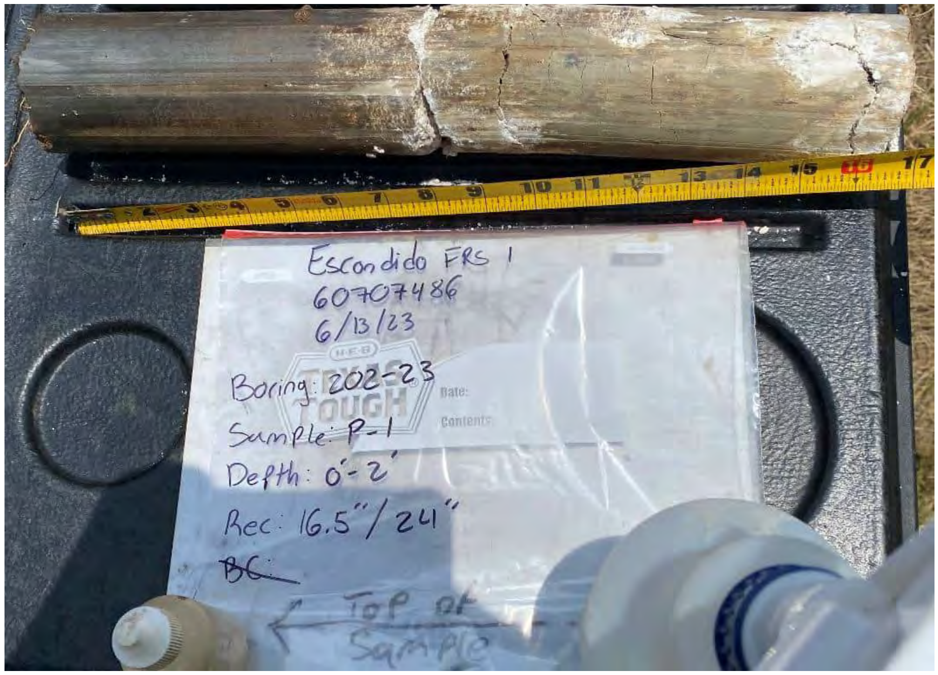
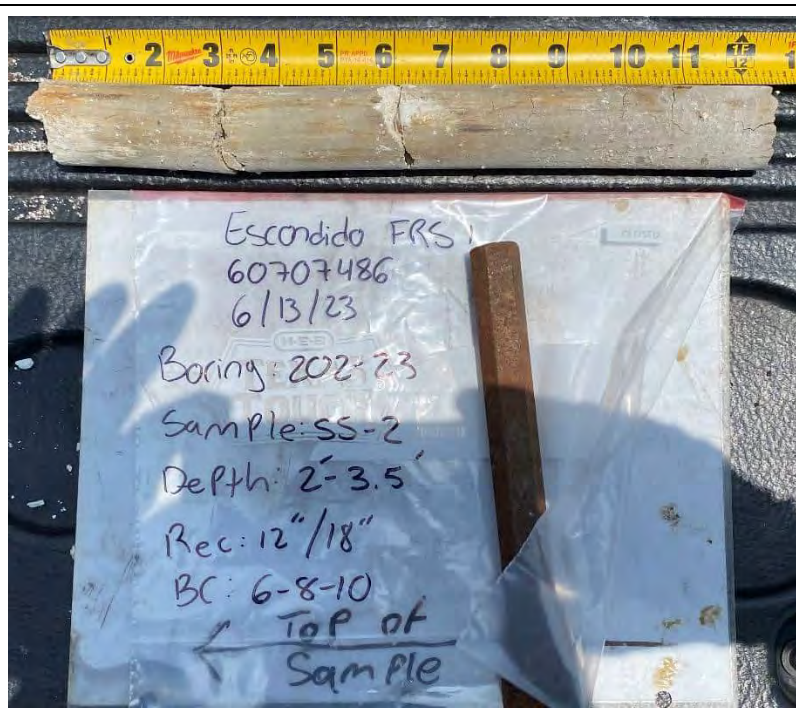


Photo No.	Date:
2	6/13/23

Description:

Boring: 202-23. SS-2.
Depths: 2-3.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
3	6/13/23

Description:

Boring: 202-23. P-3.
Depths: 4-6 ft.

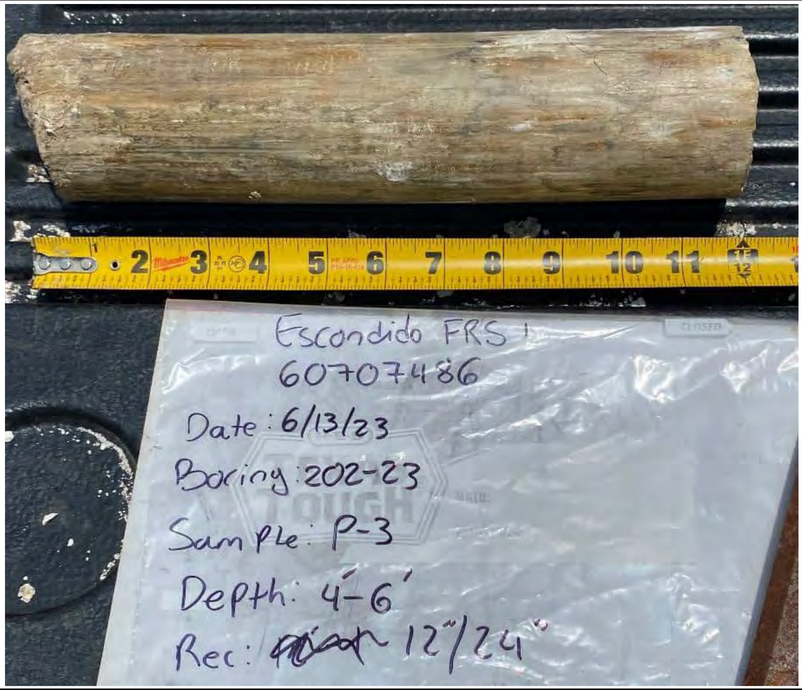
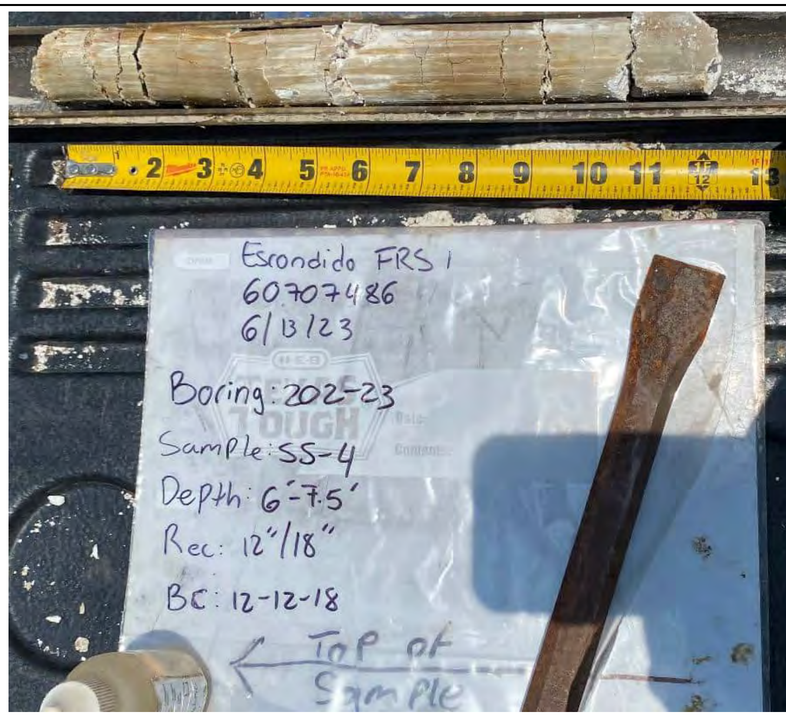


Photo No.	Date:
4	6/13/23

Description:

Boring 202-23. SS-4.
Depths: 6-7.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
5	6/13/23

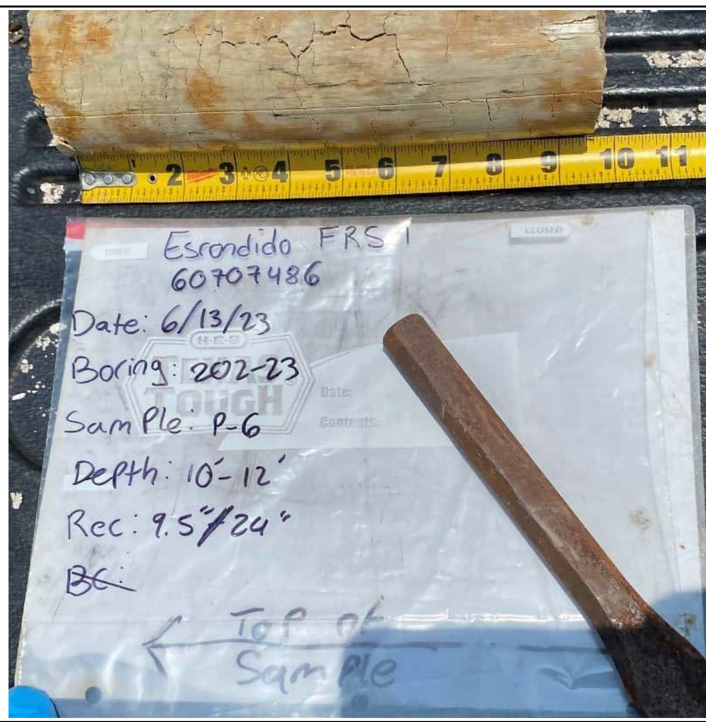
Description:

Boring 202-23. ST-5.
Depths: 8-10 ft.

Photo No.	Date:
6	6/13/23

Description:

Boring 202-23. P-6.
Depths: 10-12 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.**
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	**Date:**
7	6/13/23

Description:

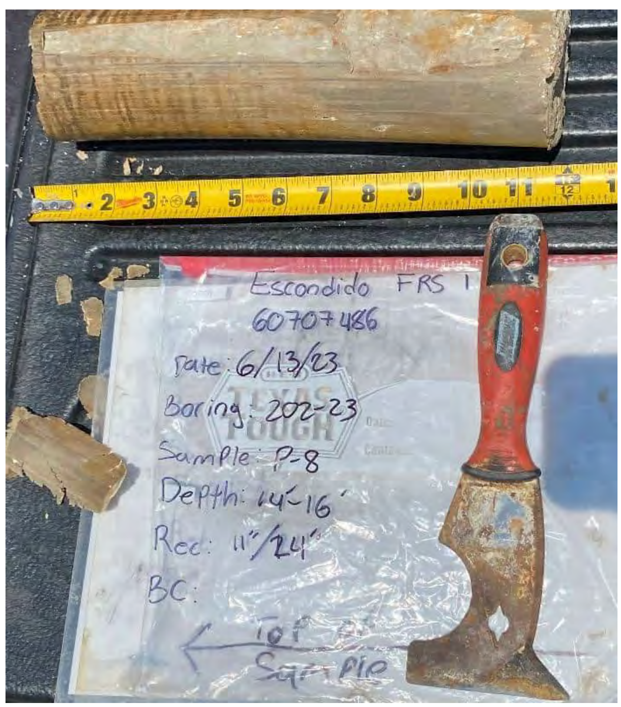
Boring 202-23. SS-7.
Depths: 12-13.5 ft.
Blow Counts: 9-15-18
Recovery: 14”/18”

No Photo

Photo No.	**Date:**
8	6/13/23

Description:

Boring 202-23. P-8.
Depths: 14-16 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
9	6/13/23

Description:

Boring 202-23. ST-9.
Depths: 18-18.5 ft.

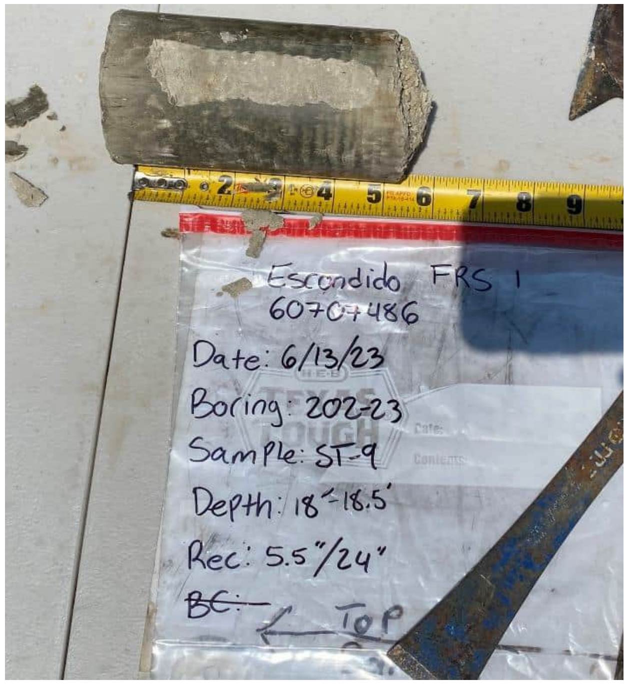


Photo No.	Date:
10	6/13/23

Description:

Boring 202-23. SS-10.
Depths: 18.5-20 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
11	6/13/23

Description:

Boring 202-23. SS-11.
Depths: 25.5-27 ft.

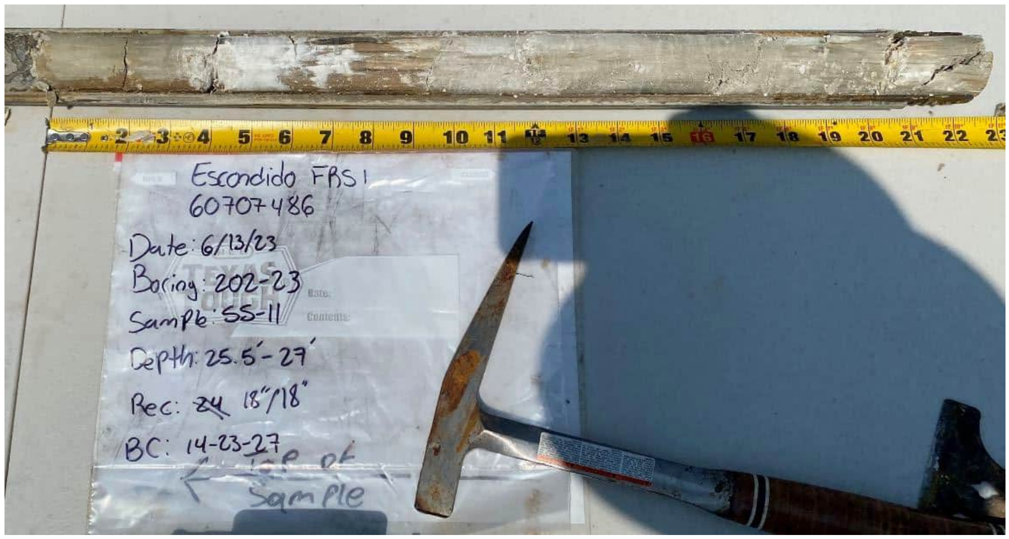
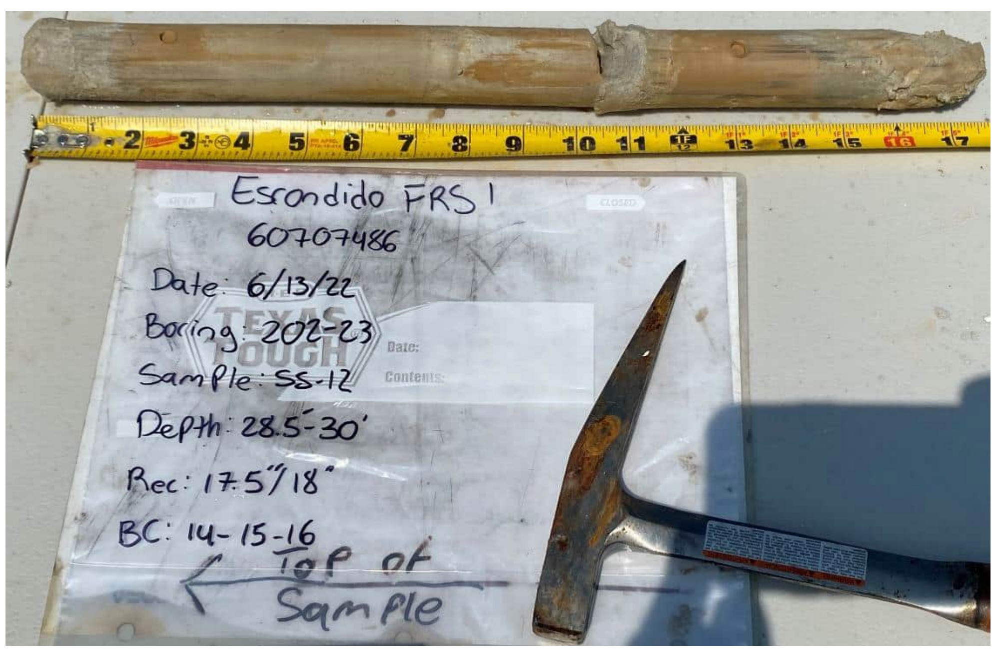


Photo No.	Date:
12	6/13/23

Description:

Boring 202-23. SS-12.
Depths: 28.5-30 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
13	6/13/23

Description:

Boring 202-23. SS-13.
Depths: 32-33.5 ft.

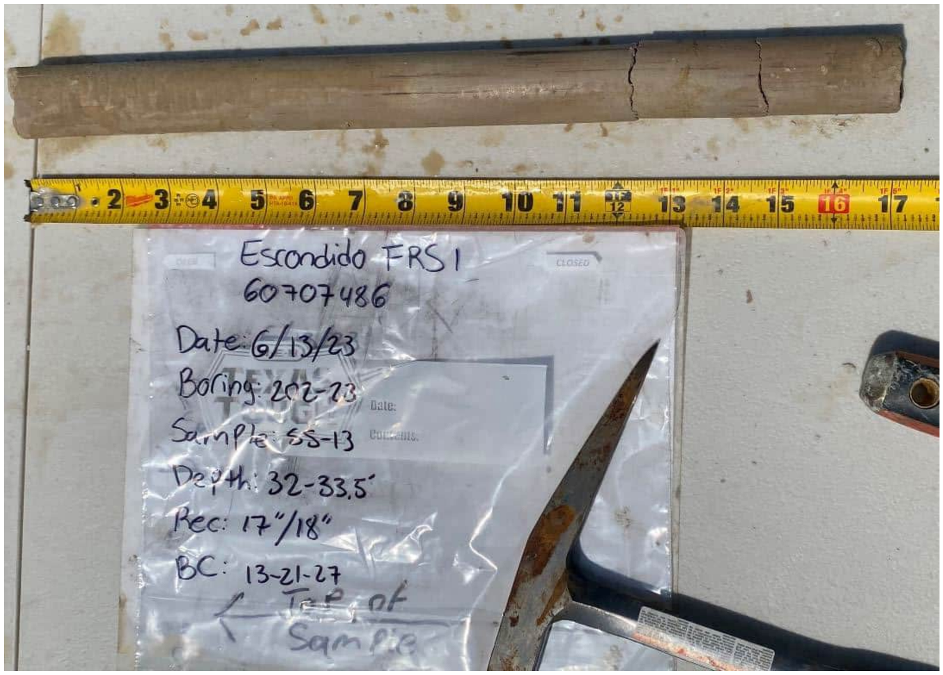
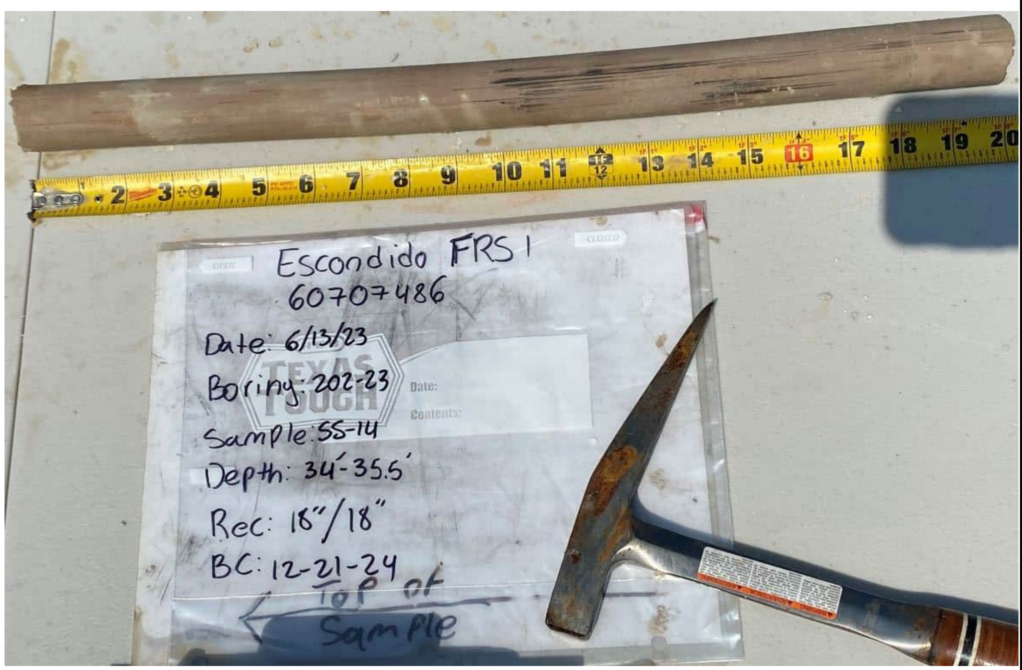


Photo No.	Date:
14	6/13/23

Description:

Boring 201-23. SS-14.
Depths: 34-35.5 ft.



PHOTOGRAPHIC LOG		
Client Name: San Antonio River Authority	**Site Location:** Escondido FRS No. 1: Karnes County, TX	**Project No.** 60707486

Photo No.	**Date:**
15	6/13/23

Description:

Boring 202-23. SS-15.
Depths: 38.5-40 ft.

AECOM		PHOTOGRAPHIC LOG
Client Name: San Antonio River Authority	**Site Location:** Escondido FRS No. 1: Karnes County, TX	**Project No.** 60707486

Photo No. 1	**Date:** 6/14/23

Description:

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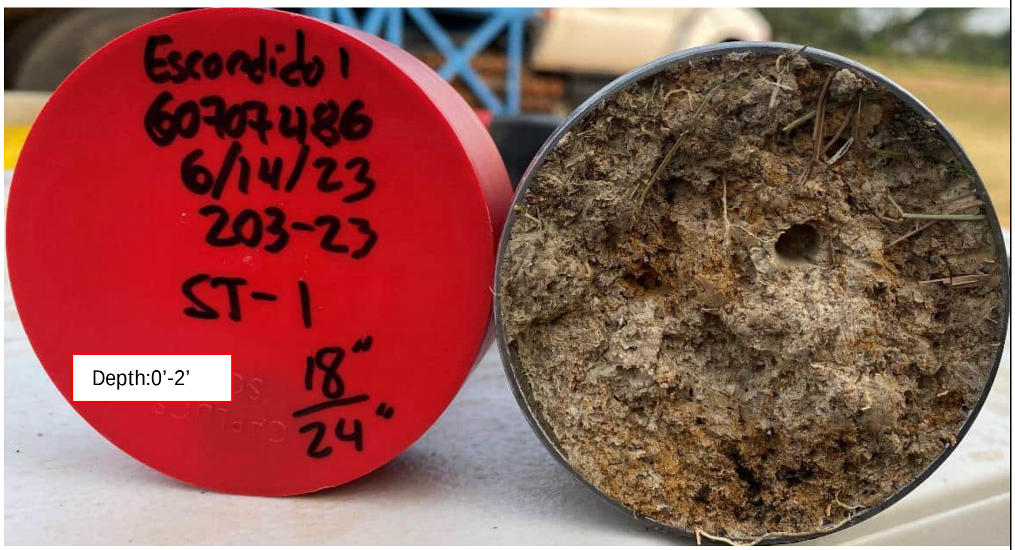

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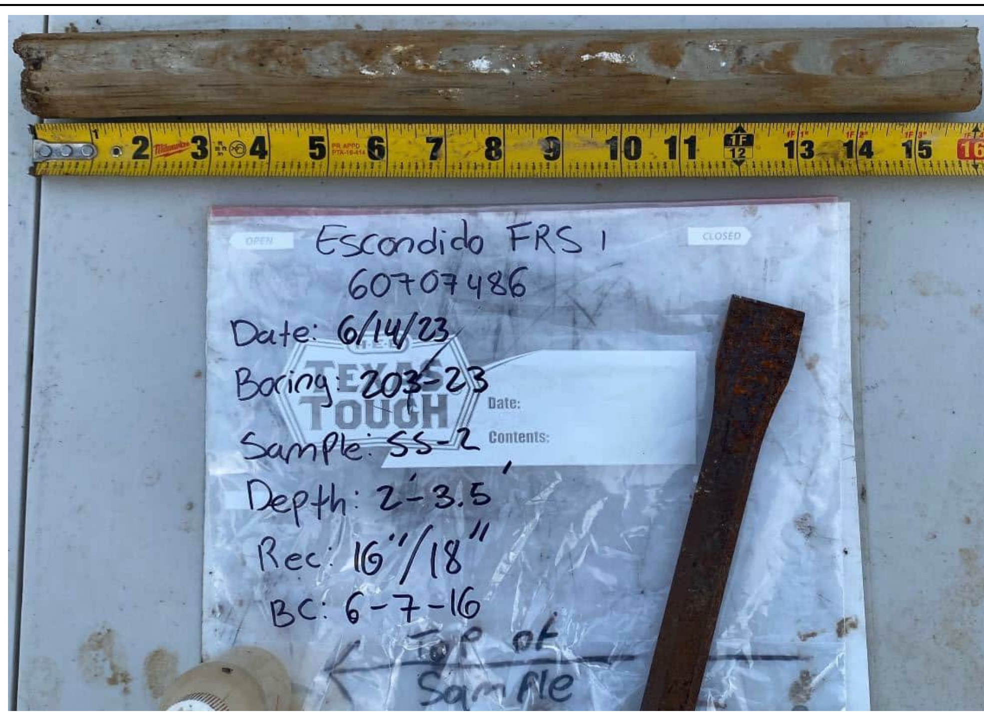

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
3	6/14/23

Description:

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Depths: 4-6 ft.

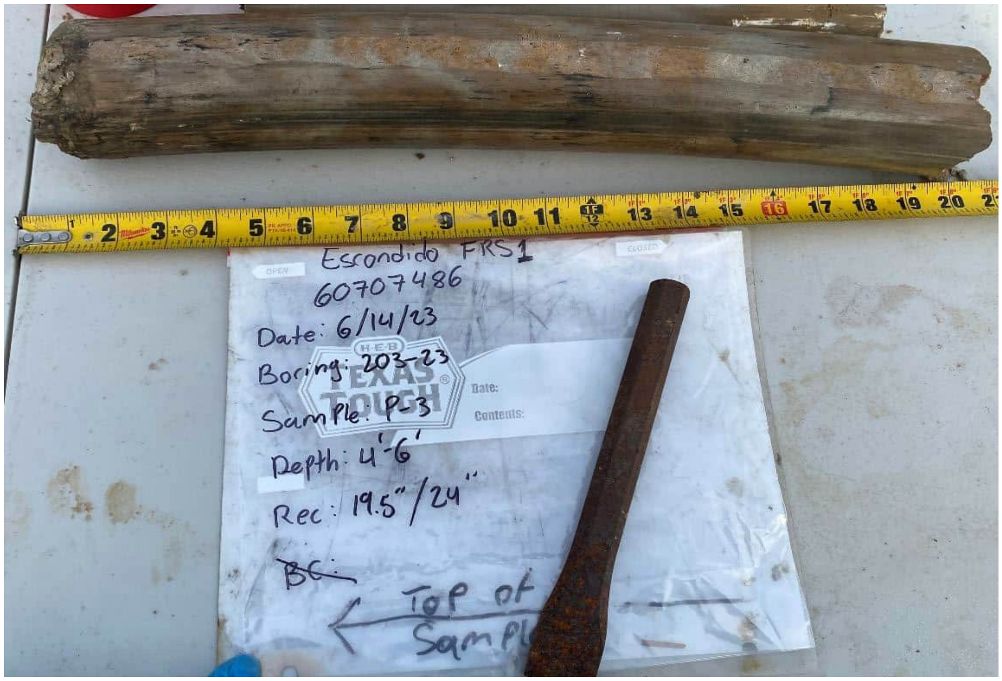

Photo No.	Date:
4	6/14/23

Description:

Boring 203-23.ST-4.
Depths: 6-6.5 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
5	6/14/23

Description:

Boring 203-23. SS-5.
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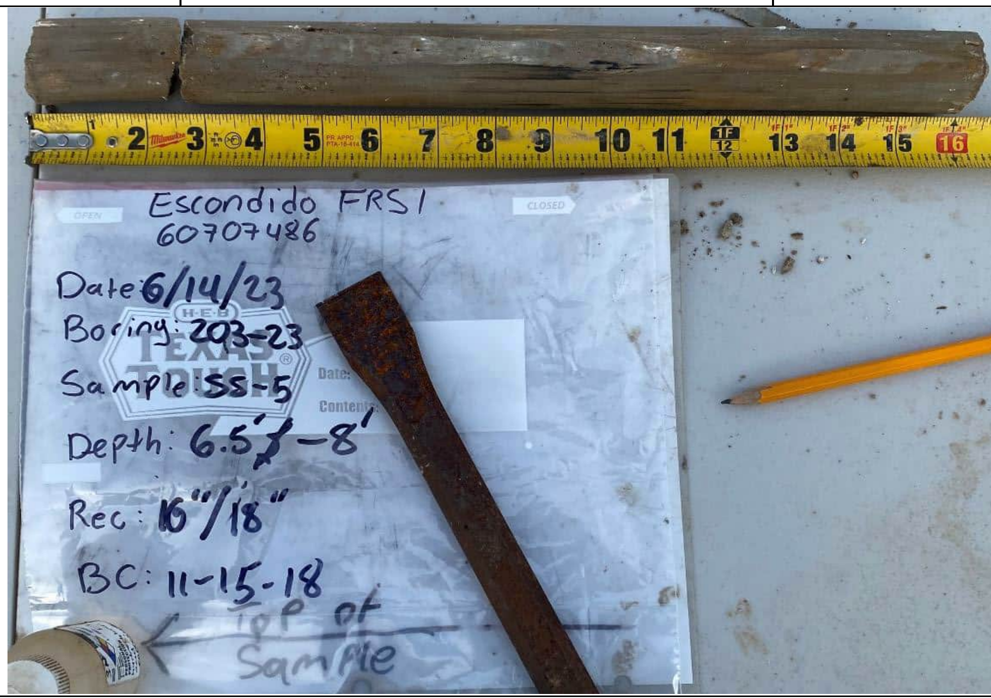
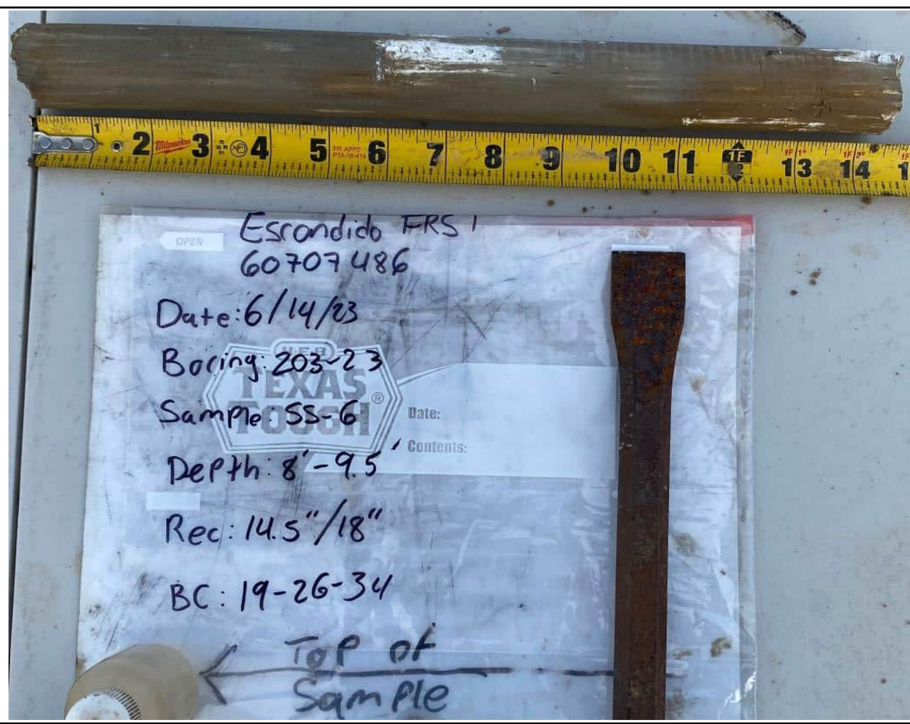


Photo No.	Date:
6	6/14/23

Description:

Boring 203-23. SS-6.
Depths: 8-9.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
7	6/14/23

Description:

Boring 203-23. P-7.
Depths: 10-12 ft.

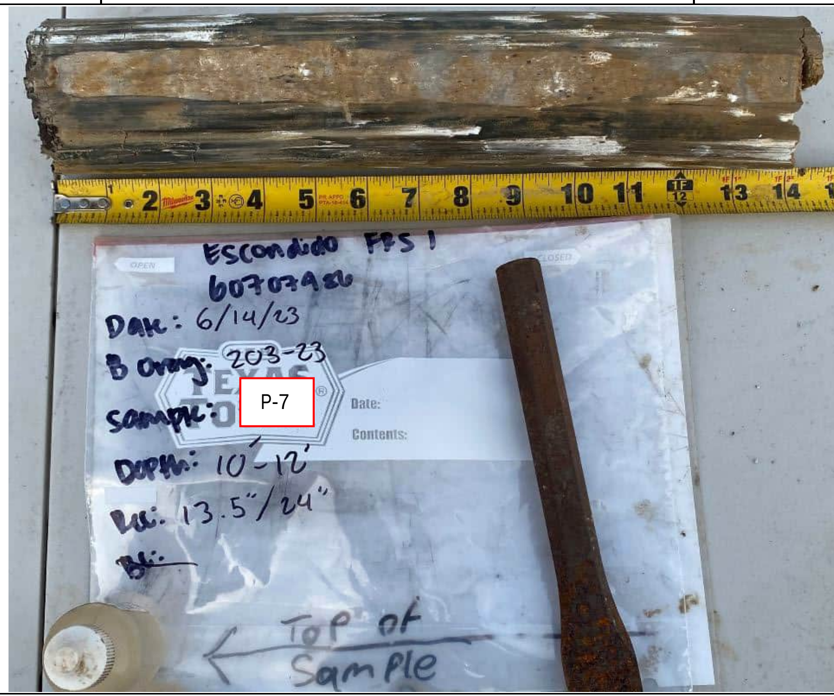


Photo No.	Date:
8	6/14/23

Description:

Boring 203-23. SS-8.
Depths: 12-13.5 ft.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
9	6/14/23

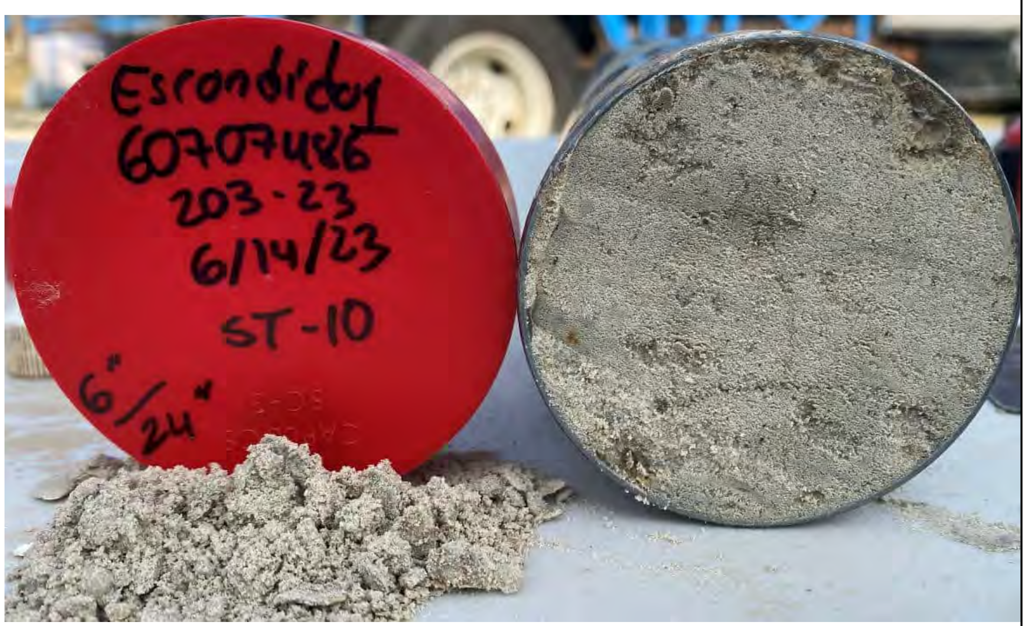
Description:

Boring 203-23. P-9.
Depths: 14-16 ft.

Photo No.	Date:
10	6/14/23

Description:

Boring 203-23. ST-10.
Depths: 16-16.5 ft.



AECOM	**PHOTOGRAPHIC LOG**	
Client Name: San Antonio River Authority	**Site Location:** Escondido FRS No. 1: Karnes County, TX	**Project No.** 60707486

Photo No. 11	**Date:** 6/14/23

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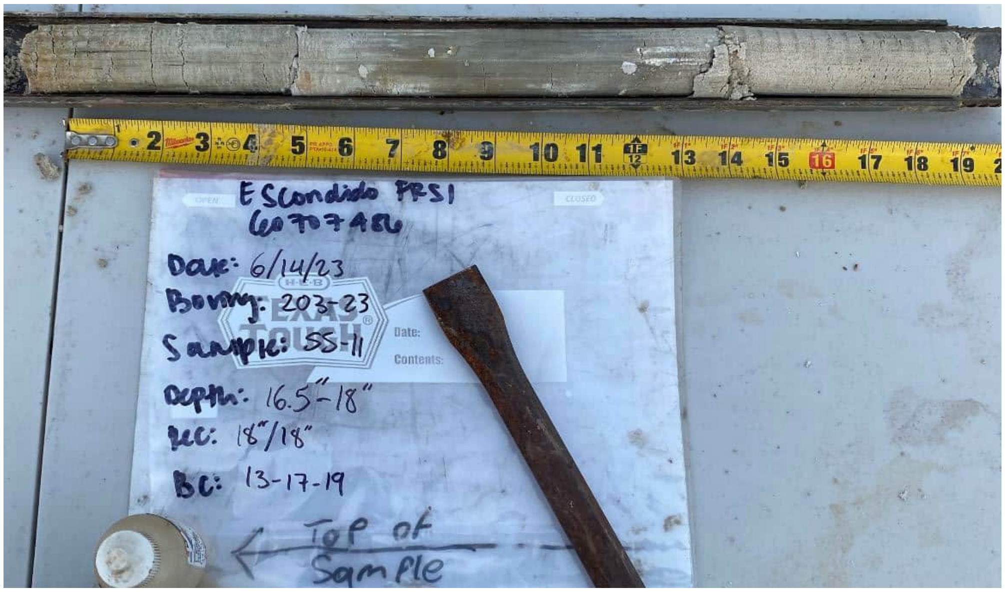

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Description:

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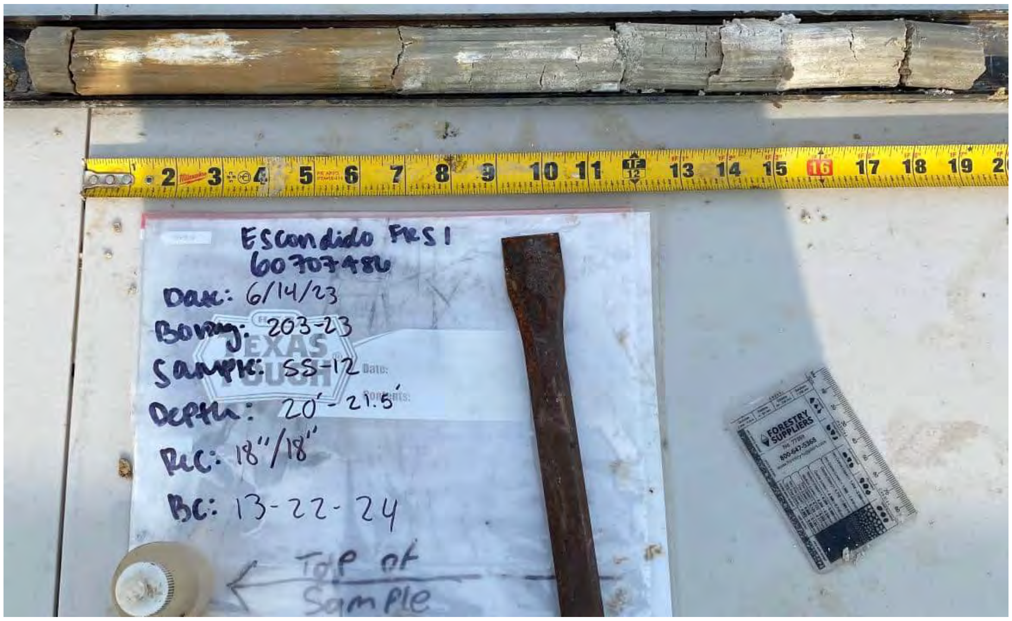
Depths: 20-21.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
13	6/14/23

Description:

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Depths: 30-31.5 ft.

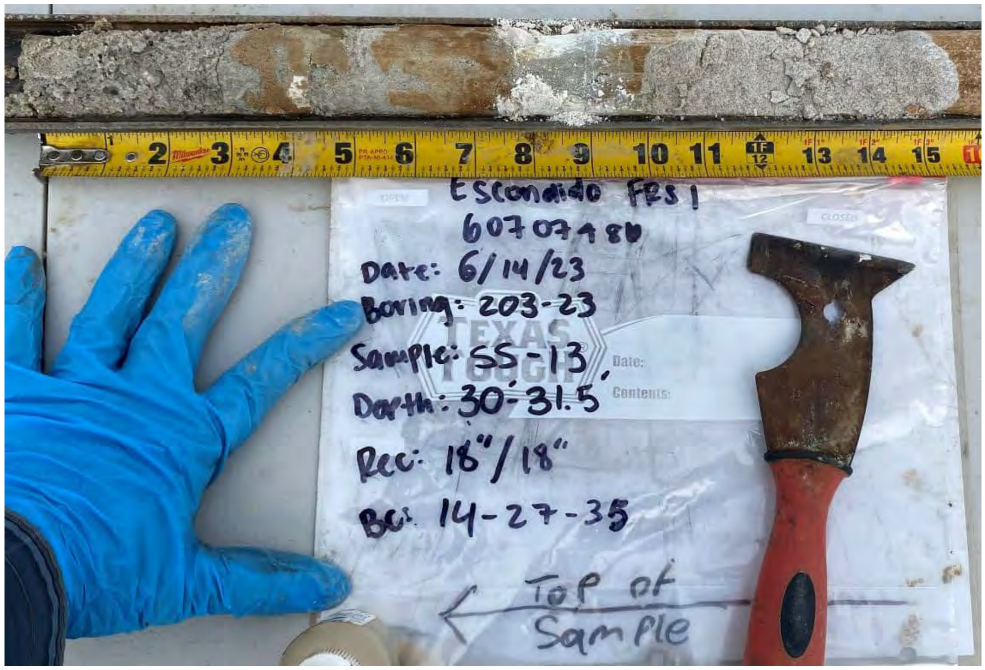
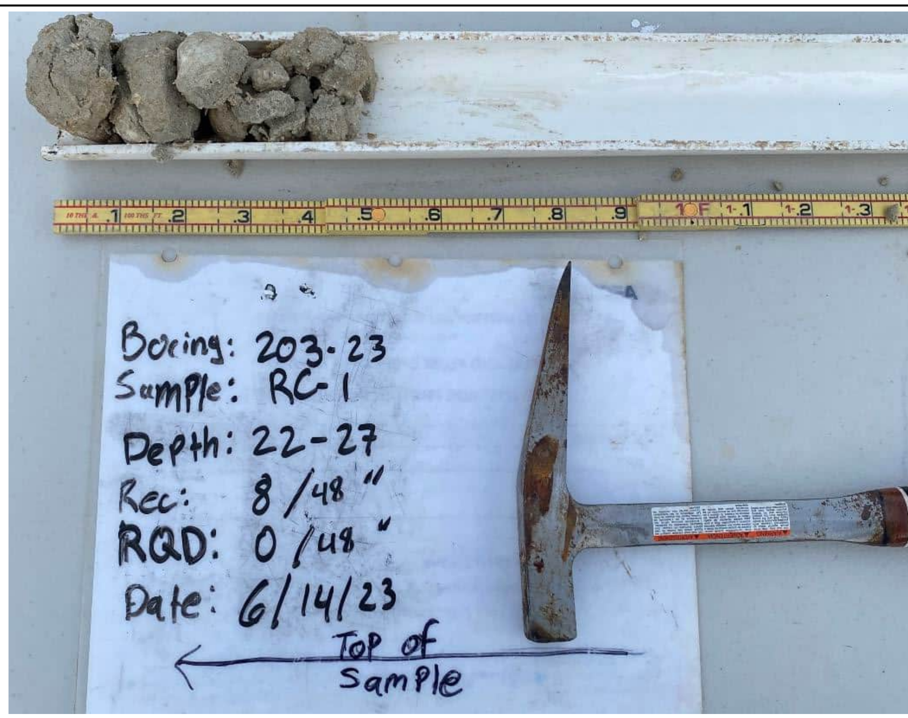


Photo No.	Date:
14	6/14/23

Description:

Boring 203-23. RC-1.
Depths: 22-27 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
15	6/14/23

Description:

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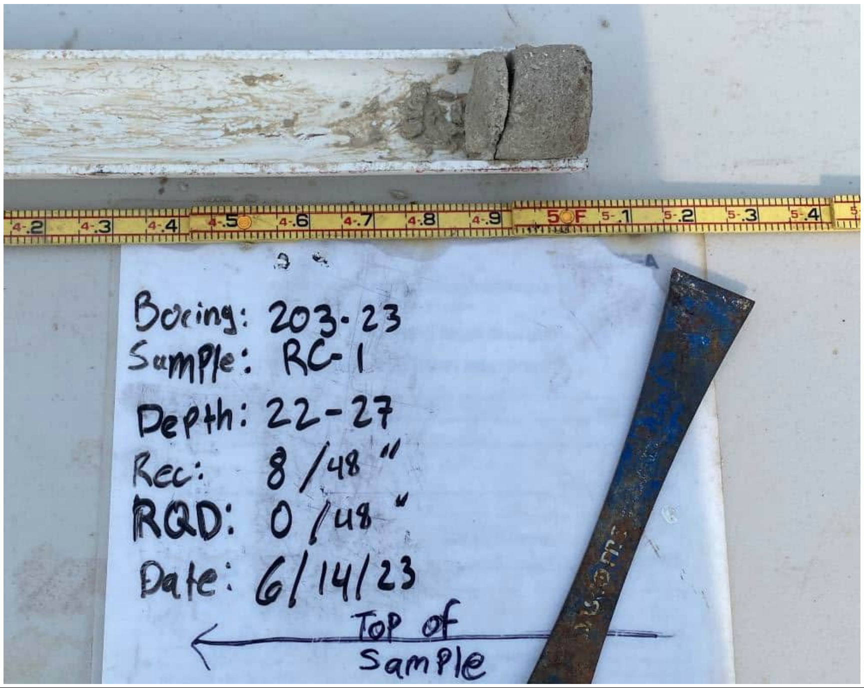
Depths: 22-27 ft.



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16	6/14/23

Description:

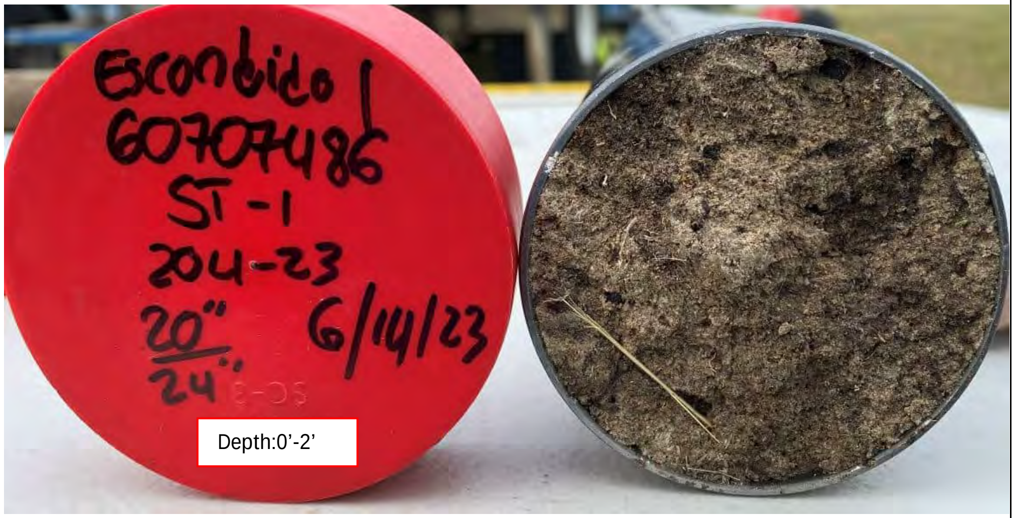
Boring 203-23. RC-1.
Depths: 22-27 ft.

PHOTOGRAPHIC LOG		
Client Name: San Antonio River Authority	**Site Location:** Escondido FRS No. 1: Karnes County, TX	**Project No.** 60707486

Photo No. 1	**Date:** 6/14/23

Description:

Boring: 204-23. ST-1.
Depths: 0-2 ft.



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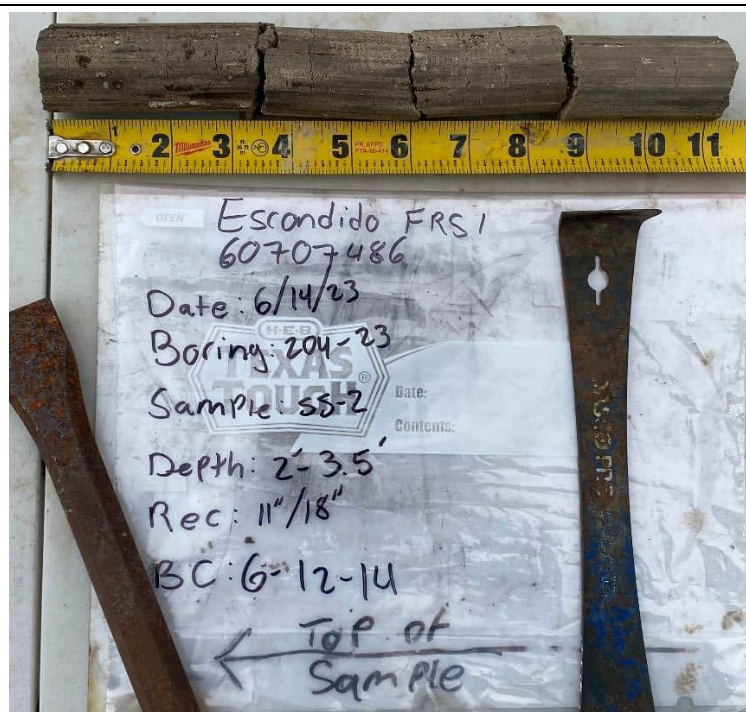
Description:

Boring: 204-23. SS-2.
Depths: 2-3.5 ft.



AECOM		PHOTOGRAPHIC LOG
Client Name: San Antonio River Authority	**Site Location:** Escondido FRS No. 1: Karnes County, TX	**Project No.** 60707486

Photo No.	**Date:**
3	6/14/23

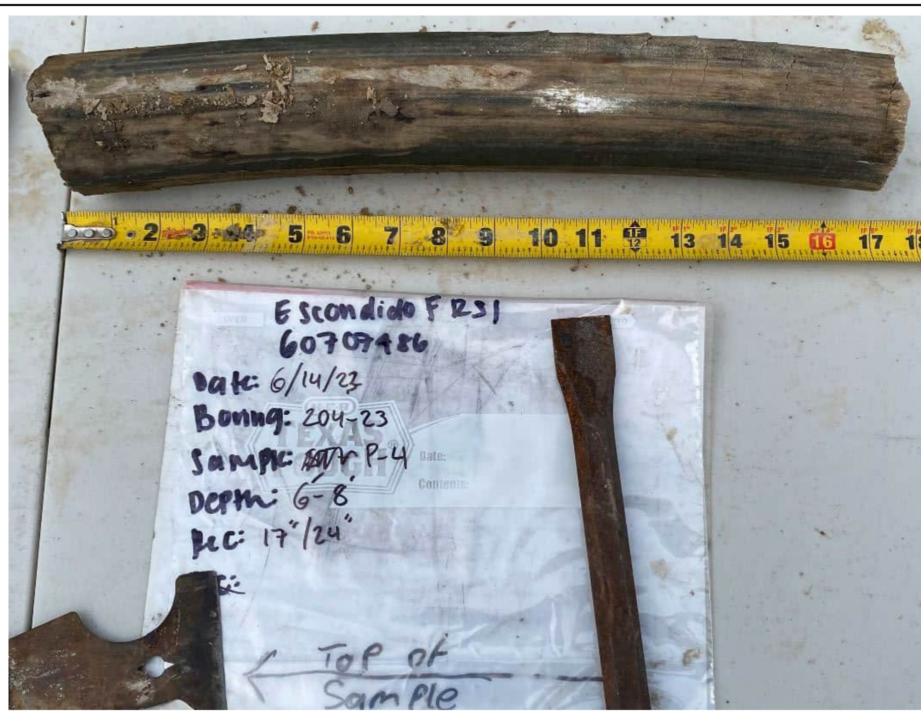
Description:

Boring: 204-23. ST-3.
Depths: 4-6 ft.

Photo No.	**Date:**
4	6/14/23

Description:

Boring 204-23.P-4.
Depths: 6-8 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
5	6/14/23

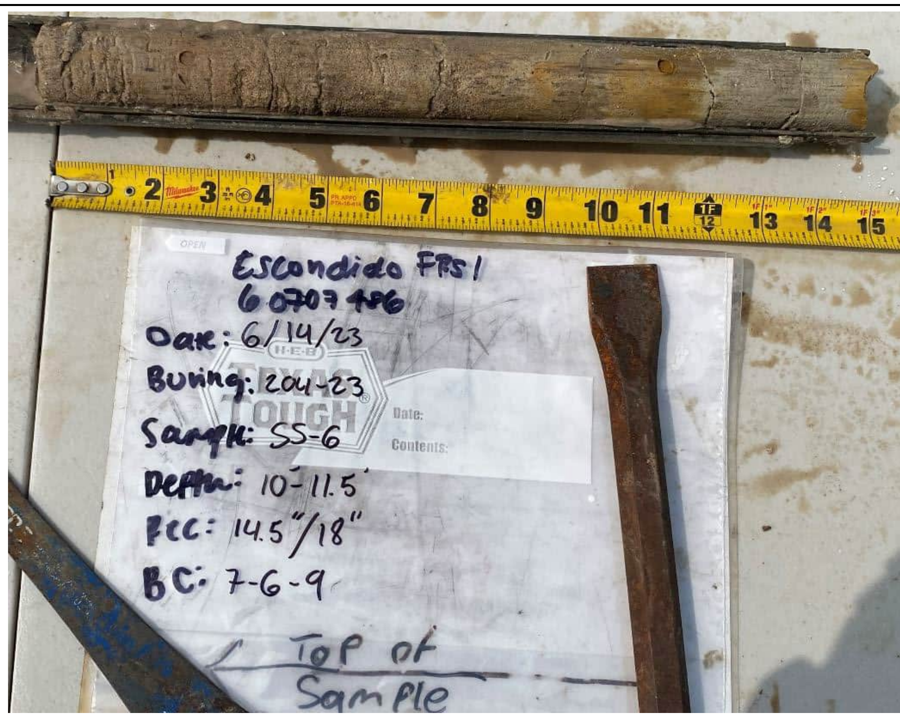
Description:

Boring 204-23. ST-5.
Depths: 8-10 ft.

Photo No.	Date:
6	6/14/23

Description:

Boring 204-23. SS-6.
Depths: 10-11.5 ft.



Client Name:	**Site Location:**	**Project No.**
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

PHOTOGRAPHIC LOG

Photo No.	**Date:**
7	6/14/23

Description:

Boring 204-23. SS-7.
Depths: 12-13.5 ft.

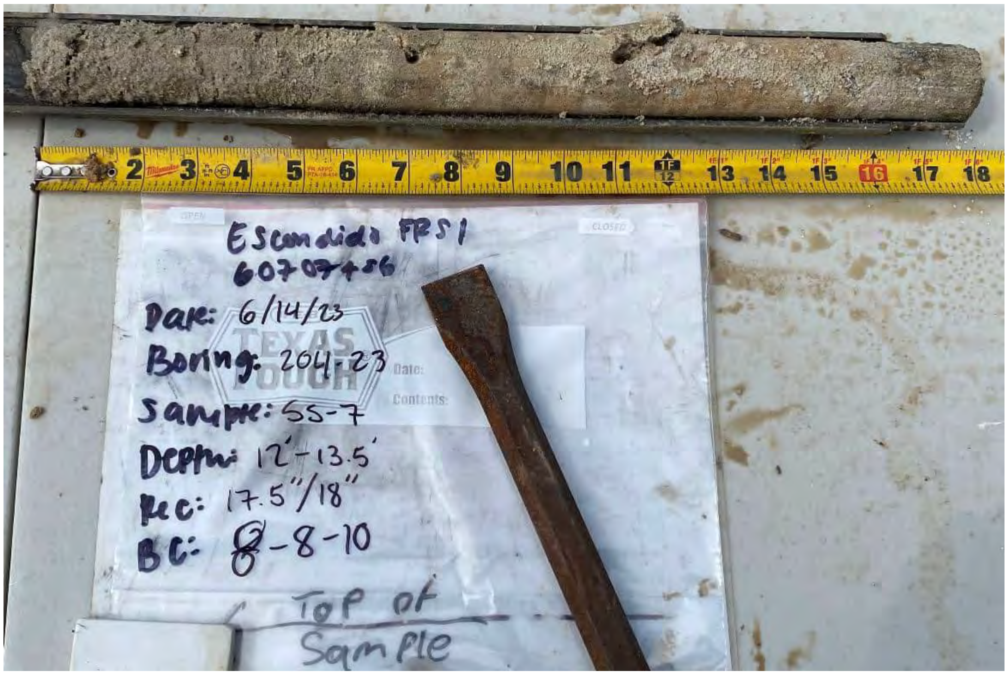
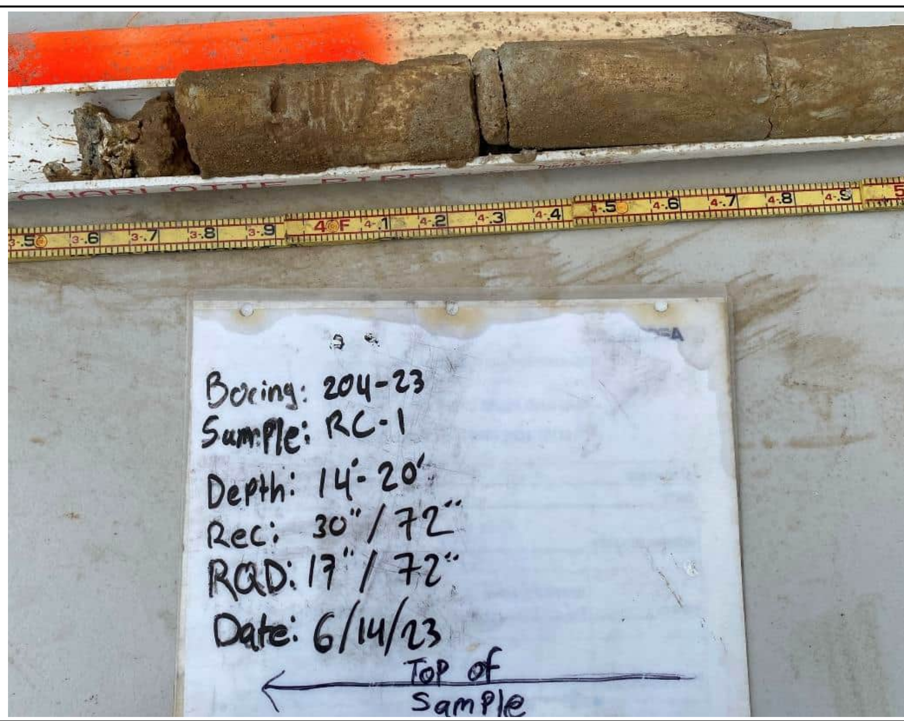


Photo No.	**Date:**
8	6/14/23

Description:

Boring 204-23. RC-1.
Depths: 14-20 ft.



AECOM	PHOTOGRAPHIC LOG	
Client Name: San Antonio River Authority	**Site Location:** Escondido FRS No. 1: Karnes County, TX	**Project No.** 60707486

Photo No. 9	**Date:** 6/14/23

Description:

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Depths: 14-20 ft.

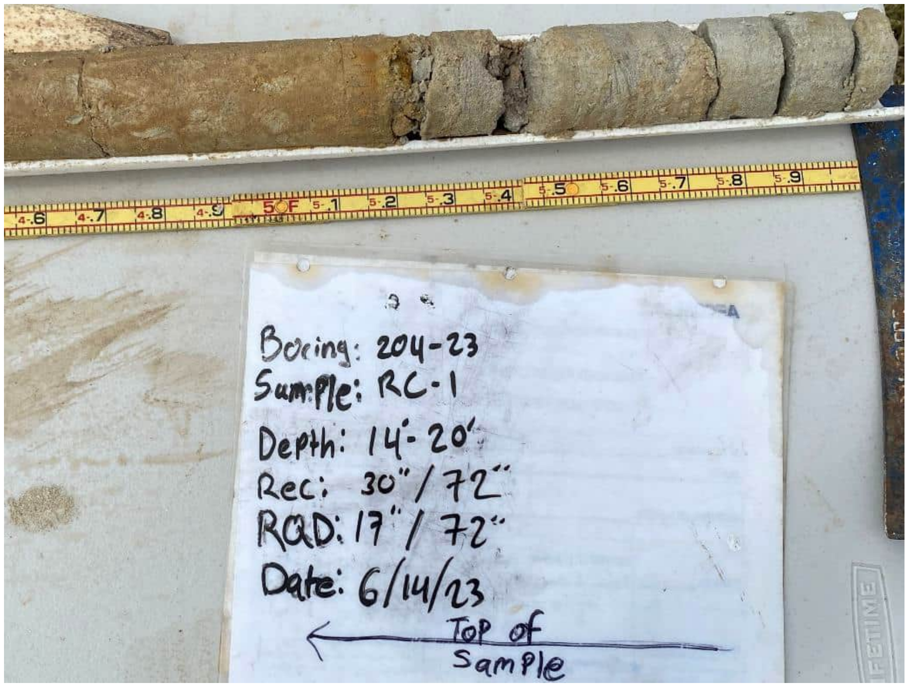


Photo No. 10	**Date:** 6/14/23

Description:

Boring 204-23. RC-1.
Depths: 14-20 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 1: Karnes County, TX	60707486

Photo No.	Date:
11	6/14/23

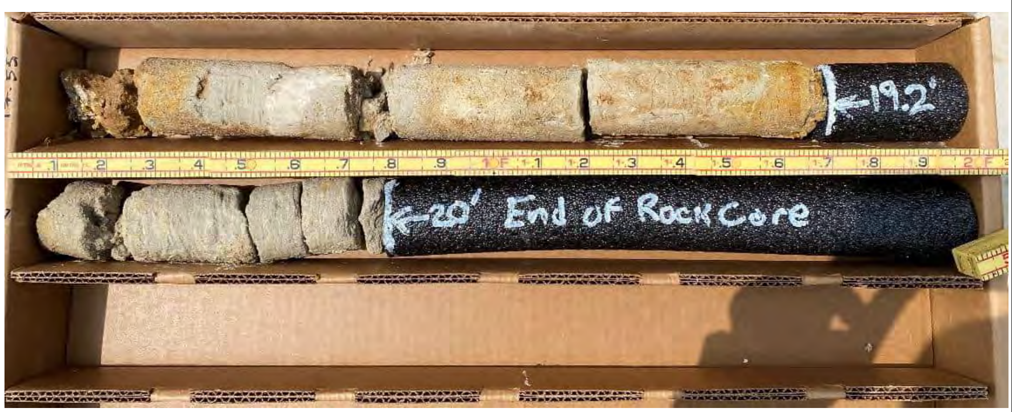
Description:

Boring 204-23. SS-11.
Depths: 16.5-18 ft.

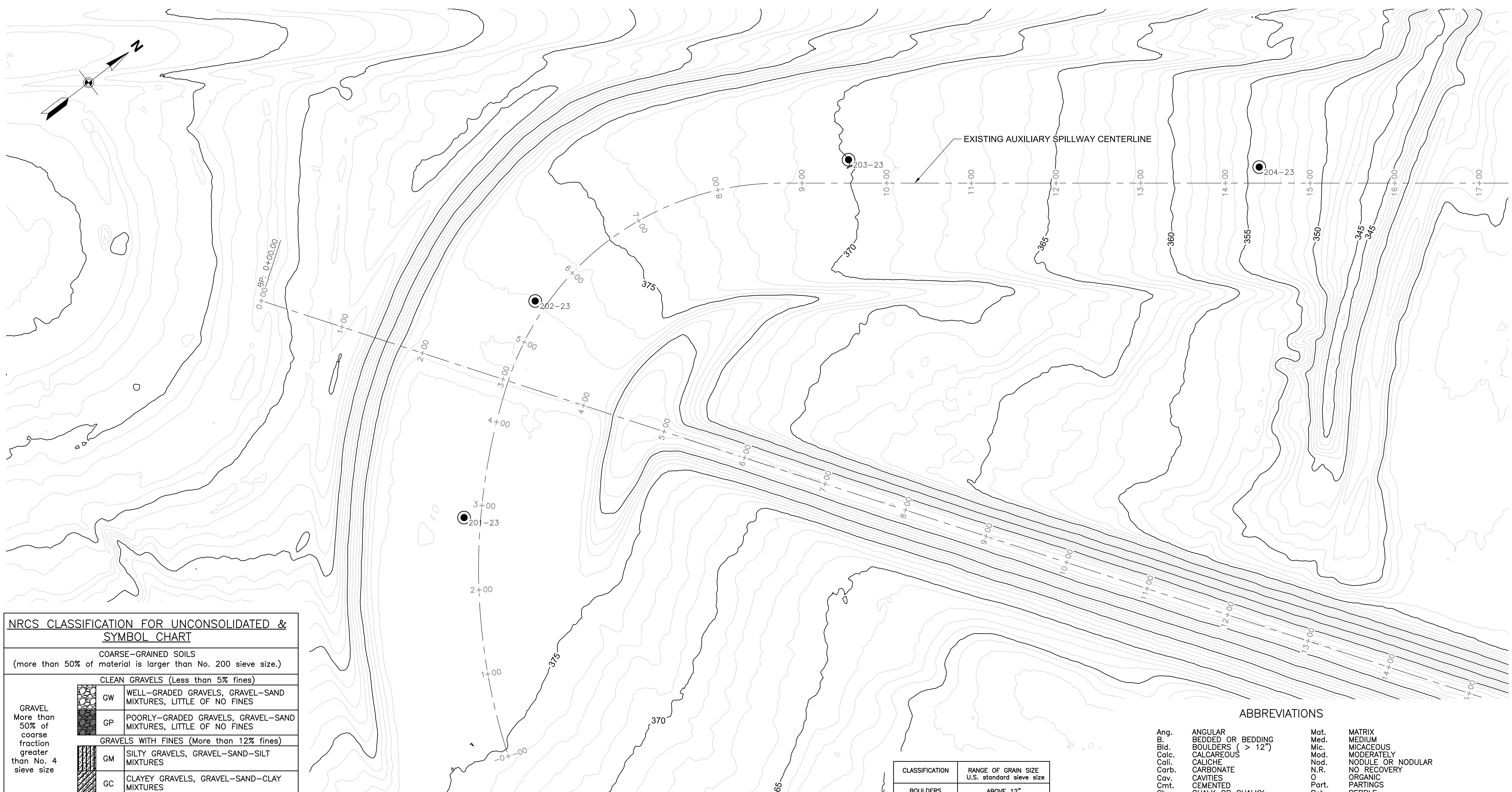
Photo No.	Date:
12	6/14/23

Description:

Boring 204-23. SS-12.
Depths: 20-21.5 ft.



Appendix F Geologic Profile



PLAN

0 30 60 120
SCALE IN FEET

NRCS CLASSIFICATION FOR UNCONSOLIDATED & SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
CLEAN GRAVELS (Less than 5% fines)		
GRAVEL More than 50% of coarse fraction greater than No. 4 sieve size	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
GRAVELS WITH FINES (More than 12% fines)		
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
CLEAN SAND (Less than 5% fines)		
SAND More than 50% of coarse fraction smaller than No. 4 sieve size	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
	SP	POORLY-GRADED SANDS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
SAND WITH FINES (More than 12% fines)		
	SM	SILTY SAND, SAND-SILT MIXTURE
	SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS (more than 50% of material is smaller than No. 200 sieve size.)		
SILTS & CLAYS Liquid limit less than 50%	ML	INORGANIC SILTS WITH SLIGHT PLASTICITY
	CL	INORGANIC CLAY WITH LOW OR MEDIUM PLASTICITY, LEAN CLAY
SILTS & CLAYS Liquid limit Greater than 50%	MH	INORGANIC SILTS WITH ELASTICITY
	CH	INORGANIC CLAY WITH HIGH PLASTICITY, FAT CLAY.

NRCS CLASSIFICATION FOR CONSOLIDATED & SYMBOL CHART

Low Plasticity Clay	Clayey Sand
High Plasticity Clay	Well Graded Sand
Sandstone	

OTHER SYMBOLS

- HOLE LOGGED ONLY
- STRIKE AND DIP
- HOLE SAMPLED
- PIT OR TRENCH

CLASSIFICATION	RANGE OF GRAIN SIZE U.S. standard sieve size
BOULDERS	ABOVE 12"
COBBLES	12" TO 3"
GRAVEL Course Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200
SILT & CLAY	Below No. 200

TEST HOLE NUMBERING SYSTEM

	COMBINA-TION RIG	POWER AUGER	HAND BORINGS	TRENCH OR PIT EXCAVA-TIONS	NATURAL OUTCROPS, STREAMBANKS, AND GULLIES
CENTERLINE OF DAM	1-49	51-99	1001-1099	2001-2099	3001-3099
BORROW AREA	101-149	151-199	1101-1199	2101-2199	3101-3199
AUXILIARY SPILLWAY	201-249	251-299	1201-1299	2201-2299	3201-3299
PRINCIPAL SPILLWAY	301-349	351-399	1301-1399	2301-2399	3301-3399
STREAM CHANNELS	401-449	451-499	1401-1499	2401-2499	3401-3499
EXPLORATORY BORINGS	501-549	551-599	1501-1599	—	—
FOUNDATION DRAIN	601-649	651-699	1601-1699	2601-2699	3601-3699
MISCELLANEOUS	701-749	751-799	1701-1799	2701-2799	3701-3799

ABBREVIATIONS

Ang.	ANGULAR	Mat.	MATRIX
B.	BEDDED OR BEDDING	Med.	MEDIUM
Bld.	BOULDERS (> 12")	Mic.	MICACEOUS
Calc.	CALCAREOUS	Mod.	MODERATELY
Cali.	CALICHE	Nod.	NODULE OR NODULAR
Carb.	CARBONATE	N.R.	NO RECOVERY
Cav.	CAVITIES	O	ORGANIC
Cmt.	CEMENTED	Part.	PARTINGS
Ch.	CHALK OR CHALKY	Peb.	PEBBLE
C	CLAY, CLAYEY	Per.	PERMEABLE
Cse.	COARSE	Po.	POORLY
Cbl.	COBBLES (3" - 12")	P.	POORLY GRADED
Cpt.	COMPACT	Rdd.	ROUNDED
Con.	CONCRETIONS	S	SAND, SANDY
Cng.	CONGLOMERATE	Ss.	SANDSTONE
Cs.	CLAYSTONE	Sat.	SATURATED
C.T.	CAVED TO	Sh.	SHALE, OR SHALY
Xln.	CRYSTALLINE	Sl/.	SLIGHTLY
Ds.	DENSE	Slo.	SLOWLY
Dip.	DIPPING	M	SILT, SILTY
D.S.	DOWNSTREAM	Sft.	SOFT
Fe. Stn.	Iron Stains	Sl.	SOME
Flg.	FLAGSTONE OR FLAGGY	Stf.	STIFF
Fn.	FINE	Str.	STREAKS
Frm.	FIRM	T.	THIN
Frac.	FRACTURED	T.B.	THIN - BEDDED
Frg.	FRAGMENTS	Tuff.	TUFFACEOUS
Fri.	FRIABLE	U.A.D.	UNABLE TO AUGER DEEPER
Grn.	GRAIN	U.D.B.D.	UNABLE TO DRY BARREL DEEPER
G	GRAVEL, GRAVELLY	U.E.D.	UNABLE TO EXCAVATE DEEPER
Gyp.	GYPSEOUS	U.S.	UPSTREAM
Hd.	ROCK HARDNESS	Var.	VARIABLE
H.	HIGHLY	V/.	VERY
Int.	INTERBEDDED	Vug.	VUGULAR
Lam.	LAMINATED	Wtr.	WATER LEVEL AS ENCOUNTERED DURING DRILLING PROCESS
Lay.	LAYER OR LAYERS	W	WELL GRADED
Len.	LENS OR LENSES	W/.	WITH
Lig.	LIGNITE	Wea.	WEATHERED
Ls.	LIMESTONE	▼	(DATE) STATIC WATER LEVEL
Lse.	LOOSE		
Ma.	MARL, OR MARLY		
Mas.	MASSIVE		

PLAN OF GEOLOGIC INVESTIGATIONS

FLOODWATER RETAINING STRUCTURE 1
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

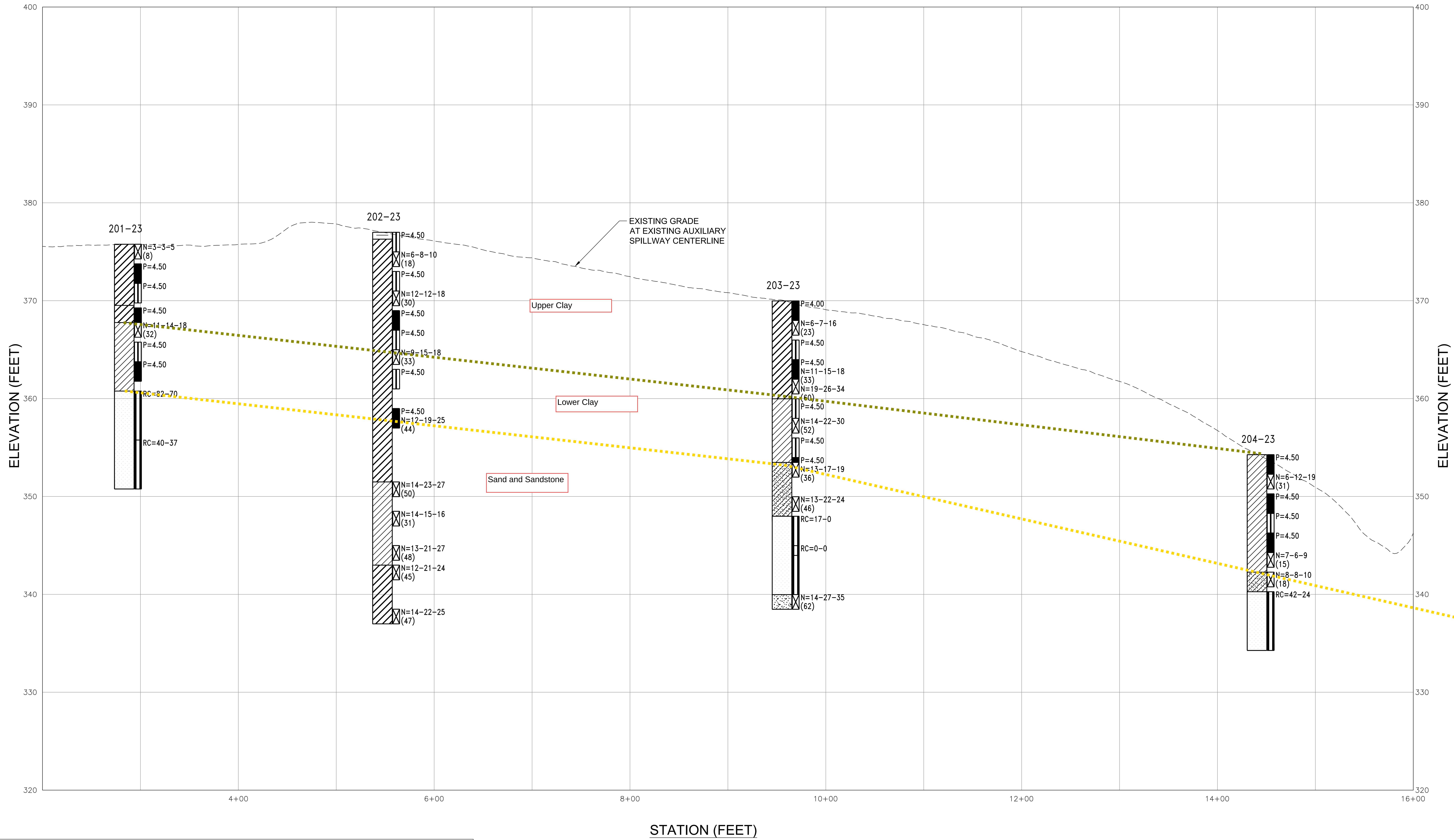
DRAWN	ME	DATE	9/15/23
CHECKED	MJ	DATE	9/15/23
APPROVED	LF	DATE	9/15/23

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 2

C:\Users\Matthew.Engel\OneDrive - AECOM\019-Escondido1\Plan_Sheets\EmSpill_GeologicSection.dwg



LEGEND

Low Plasticity Clay
High Plasticity Clay
Sandstone
Clayey Sand
Well Graded Sand

— Sample Top Depth
N= SPT blows per 6" increment (N-value, bpf)
P= Pocket Penetrometer (tsf)
RC= Core Recovery (%) – RQD (%)

Water Level at Time Drilling, or as Shown
Water Level at End of Drilling, or as Shown
Water Level After 24 Hours, or as Shown

NOTES:

1. THE SOIL CLASSIFICATIONS SHOWN ON THIS SHEET ARE FIELD CLASSIFICATIONS. THEY MAY NOT IN ALL CASES AGREE WITH THE CLASSIFICATIONS MADE BY THE SOIL MECHANICS LABORATORY. REFER TO THE LABORATORY REPORT FOR FURTHER INFORMATION.

HORIZ. 0' 50' 100'
VERT. 0' 5' 10'
SCALE IN FEET

C:\Users\Matthew.Engel\OneDrive - AECOM\019-Escondido\Escondido1\Plan_Sheets\EmSpill_GeologicSection.dwg

DRAWN ME DATE 9/15/23
CHECKED MJ DATE 9/15/23
APPROVED LF DATE 9/15/23

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETAINING STRUCTURE 1
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 2

Appendix G Headcut Erodibility Index Calculations

AECOM
13640 Briarwick Drive
Austin, TX 78729
aecom.com

Project name:
Escondido Creek FRS No. 1 SWP-EA,
Karnes County, TX

Project ref:
60707486

To:
Monica Wedo, PE (AECOM)

CC:

Sergio Teran, PG (AECOM)

From:
Charlie Krolikowski, PE (AECOM)
Lance Finnefrock, PE, GE (AECOM)

Date:
October, 2024

Technical Memorandum

Subject: Recommended Geologic Input Parameters for SITES Analysis

1. Project Information

1.1 Project Information

A dam assessment report was prepared in 2014 for Escondido Floodwater Retarding Structure (FRS) No. 1 (Escondido 1) by AECOM. As a result of that study, the dam was reclassified as a high hazard dam. The existing dam does not meet current NRCS criteria for high hazard performance and dam safety standards.

The 2014 assessment included several potential rehabilitation alternatives to meet high hazard performance and safety standards ranging from decommissioning to repair/rehabilitation of the dams. The San Antonio River Authority (River Authority) contracted with AECOM to further evaluate these alternatives (and other potential alternatives given review of current conditions) in a Supplemental Watershed Plan and Environmental Assessment (SWP-EA).

1.2 Purpose and Scope

Alternatives evaluations typically require analysis of the existing vegetated auxiliary spillway(s) (ASW) for hydraulic capacity and erodibility/potential breaching during design storm event. Hydraulic analysis and design of vegetated earthen spillways for dams are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event.

The purpose of this memorandum is to provide recommendations for geologic input parameters to be used in hydraulic and erodibility analyses of the existing vegetated ASW channel using SITES software for this project.

2. Site Description

Escondido 1 is located on a tributary to Panther Creek, approximately 4.2 miles southwest of downtown Kennedy, Texas. Global positioning system (GPS) coordinates for the site are near latitude 28.777561° and longitude -97.893748°.

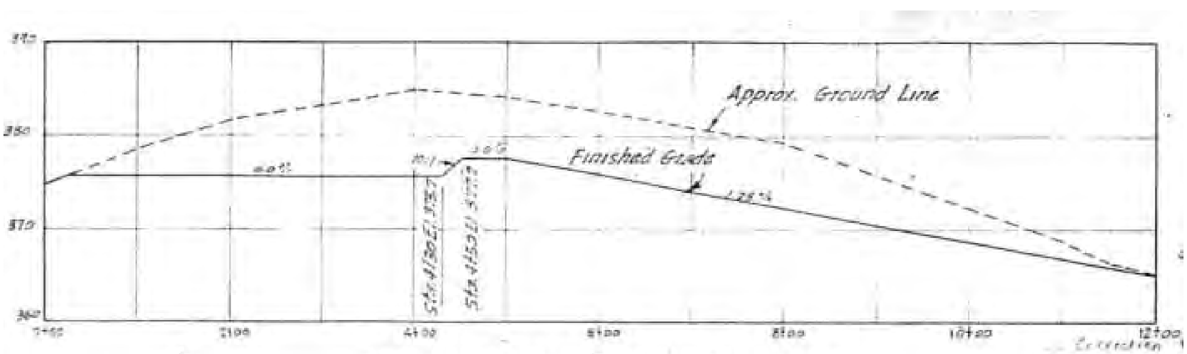
Site access is available via an unpaved dirt road off State Highway 72, approximately 0.6 miles southwest of the intersection of CR 160 and State Highway 72 in Kenedy, Texas. Within the site, access is primarily via pastures and dirt roads. A site map and plan of the geologic investigations is provided as **Figure 1**.

2.1 Existing Dam and Spillway

Escondido is an FRS that was designed and constructed as a low hazard dam. Escondido 1 was constructed in 1954. The dam has an estimated drainage area of approximately 1,819 acres and a total reservoir capacity estimated at 1,076 acre-feet (maximum storage). Escondido 1 does not meet the current dam design and safety requirements, and per the NRCS, the current classification of the structure is high hazard.

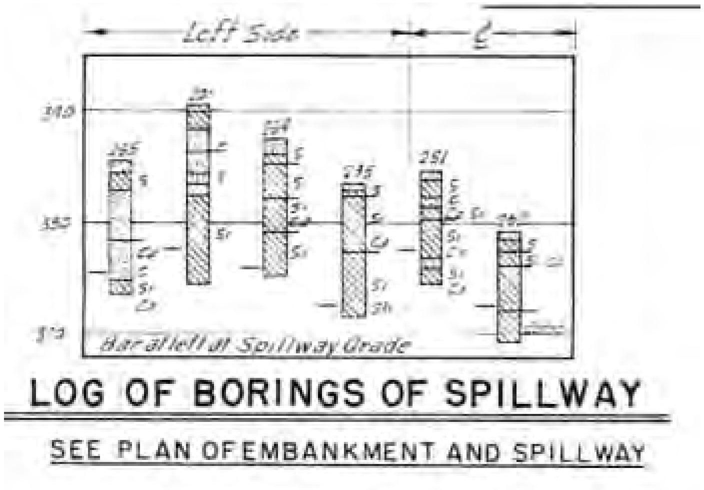
According to the as-built drawings, the dam is approximately 36 feet tall at the maximum section and 2,606 feet long. The upstream slopes of the embankment were constructed at an inclination of 3H:1V (horizontal:vertical) while the downstream slopes were constructed at 2H:1V. A 10 foot wide berm was constructed on the upstream slope. Following the 1954 construction, several shallow slides occurred on the downstream slope and a 12 foot wide berm with 2.5H:1V slopes was constructed across the downstream slope. The width of the embankment crest is approximately 14 feet. The dam features a vegetated ASW at the left abutment, and a principal spillway (PSW) consisting of a low-level inlet upstream separate from the inlet riser, the inlet riser, conduit under the dam, and an unlined downstream plunge pool (expanded in 1961 following original construction and during the repair of the downstream slope).

The existing ASW channel is 250 feet wide. The ASW crest is 50 feet long and at Elevation (El.) 377.87[1] feet according to the North American Vertical Datum of 1988 (NAVD88). The entrance channel slope was excavated nearly flat (0% per the as-built drawings) to about El. 357.87 at maximum depths of about 9 feet below pre-construction ground surface along the spillway centerline. The as-built drawings (see Attachment 1) indicate the crest was excavated into interbedded layers of native clay and sand. The exit channel was similarly excavated out of the native clay and sand layers at a 1.75% grade, with excavation depths ranging from 0 to 8 feet, thinning in excavation depth going downstream from the crest. For reference, the as-built spillway profile is shown in the image below as well as the stick logs provided in the as-built drawings for the auxiliary spillway.



PROFILE ON ℄ OF SPILLWAY

[1] Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29). Conversion to NAVD88 is +0.17 feet.



2.2 Historical Performance of Spillway

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2021 and 2022 annual inspections (River Authority 2021, TCEQ for River Authority 2022) reported that the spillway was in good condition. The 2021 inspection noted sparse vegetation in some areas while the 2022 inspection also noted some sparse vegetation areas as well as an ATV trail going across the control section. A harvester ant bed was also noted on the inside berm at the left end of the dam. No other adverse conditions were noted.

2.3 Proposed Improvements

The Supplemental Watershed Plan and Environmental Assessment (SWP-EA) (AECOM 2024) performed at Escondido 1 offered several alternatives to mitigate identified dam safety deficiencies associated with the reclassification of the dam as a high hazard structure. These included controlled dam breach and decommissioning, relocation of the at-risk downstream facilities out of the breach impact area, and dam rehabilitation. The preferred dam alternative from the SWP-EA is the federally supported plan and the recommended plan. The preferred alternative is dam rehabilitation that consists of the following components:

- Remove the existing principal spillway system;
- Install a new principal spillway system consisting of a standard inlet tower with crest at elevation 368.20 feet and a 42-inch RCP conduit discharging into an impact basin;
- Regrade inlet and outlet channel of the existing 250-feet wide vegetated auxiliary spillway and raise crest to the 100-year PSH elevation of 380.4 feet (2.53 feet raise),
- Line lower portion of auxiliary spillway from station 13+00 to station 15+78 with ACB,
- Flatten downstream embankment slope to 3H:1V,
- Install chimney drain within dam embankment,
- Install upstream slope riprap, and
- Raise top of dam elevation to 386.0 feet (3.13 feet raise) and extend cutoff trench below extended dam embankment.

3. Subsurface Information

3.1 Site Geology

The ASW is mapped as underlain exclusively by the Oakville Sandstone (designated as “Mo”). The Oakville Sandstone (designated as “Mo”) consists of sandstone and clay with a total thickness of 300 to 500 feet (Adams et. al 1981 and Baker 1979). Per the geologic map, the sandstone intervals are described as thickly bedded, medium grained, and calcareous with some crossbedding while the clay intervals are described as yellow-gray and calcareous. Anders (1962) describes the Oakville Sandstone as cross-bedded medium to fine grained sand and sandstone and sandy, ashy, and bentonitic clay beds with the base of the Oakville dipping gulfward at an average of 85 feet per mile. The Oakville Sandstone contains fossil wood, chert, and quartz gravels, with some vertebrate fossils and reworked Cretaceous invertebrate fossils (Adams et. al 1981 and Baker 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is the montmorillonite mineral with variable amounts of kaolinite and subordinate illite.

Alluvium (Qal) of the Holocene Epoch is mapped along the remainder of the site. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Deposits are typically organized as point bars, natural levees, stream channels, backswamps, coastal marshes, mud flats, clay dunes, sand dunes, and oyster reef deposits.

3.2 Soil Maps

The NRCS Survey database (NRCS, 2023) was examined to identify near-surface soil mapping of the site (i.e., approximately upper 7 feet). The mapped soil types in the vicinity of the dam are largely described as alluvium and residuum resulting from in-place weathering of the parent bedrock. The alluvium is generally mapped to the south (upstream) of the site within the low-lying areas of the valley, at the downstream segment of the ASW, and alternating north (downstream) of the dam with the residuum. Residuum is mapped where the principal spillway is located and is adjacent to alluvium on either side. Residuum is also found on the upstream section of the ASW near the inlet. Note that the ASW was excavated approximately 5 to 9 feet along the centerline for over 700 feet of the ASW channel removing surficial soils.

3.3 Previous Investigations

3.3.1 Soil Conservation Service – 1954 Work Plan and As-Built Drawings

The original geologic investigation (GI) for the design of Escondido 1 was conducted by the former Soil Conservation Service (SCS, presently known as the NRCS) in 1954 prior to construction of the existing dam as a part of the overall watershed management. A single investigation was conducted covering several dam sites in the watershed as part of the work plan. No standalone site-specific investigation was prepared for Escondido 1.

The 1954 Escondido Creek Watershed Work Plan (SCS 1954) describes the foundation of the Escondido Creek Watershed dams (including Escondido 1) as exclusively in the Oakville Sandstone formation, which is further described as containing interbedded silts and clays as well as sand. In addition, the 1954 Work Plan states that chalk and caliche outcrops are expected to occur on the surface, especially on the tops of hills. Valley slopes are described as principally residual silty clays and sandy clays and underlain by beds of clay and sand. An additional generalization for the dams was made regarding preliminary recommendations. The concern was for clays along the dam’s centerline and in the abutments as being underlain by a sandy member of the Oakville formation. The report also mentioned varying deposits of loose sands with small amounts of gravel being found, but the report also states that these materials should be removed during construction.

The as-built drawings for Escondido 1 provided subsurface profiles of the site with boring “stick” logs from the pre-construction investigation with generalized soil types. The investigation consisted of the following:

- 16 borings along the dam centerline (Hole numbers not legible/provided on the as-built drawings)
- 6 borings along the auxiliary spillway (Hole Nos. 201, 235, 251, 252, 254 and 255); and
- 30 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 180)

The complete investigation report containing the Escondido 1 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1954 by the SCS were the only source of site-specific geologic information available to AECOM and were used to develop a generalized understanding of the subsurface conditions at Escondido 1. Based on this documentation, the existing dam foundation consists of calcareous, sandy to silty clay with trace marl (identified near the principal spillway conduit only) and moist to saturated, clayey to silty sand with trace gravel.

The as-built drawings indicate that the embankment was to be constructed of fine-grained materials, but little information is available for the single-zoned homogeneous embankment except for the borings from the original borrow area. The stick logs indicate clay layers of varying thickness from 2 to 10 feet thick underlain and/or interspersed with sand layers. The stick logs indicate the clay contained sand, silt, and calcareous inclusions with no indication of percentages.

Based on review of Escondido 1 as-built drawings and the available geologic stick logs of borings in the ASW, the spillway channel invert was excavated to a maximum depth of about 9 feet below original grade, exposing sandy to silty calcareous clays interbedded with calcareous sands and clayey sands estimated to be 0.5 feet to 8 feet thick.

3.3.2 NRCS – 2022 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on February 22, 2022, by the NRCS part of the routine dam safety inspections. The inspection identified several deep animal burrows along the dam embankment as well as the possible slope slide in the very early stages over the principal spillway alignment on the downstream slope. In addition, a tree has taken root in the embankment. The PSW and ASW were noted as being in good condition. The ASW was noted as having generally good vegetative cover with some sparse areas.

Photographs in the inspection report depicted good vegetative coverage with native grasses throughout the dam.

The 2022 inspection concluded that Escondido 1 was performing as designed, but due to urban encroachment and updated TCEQ hydraulic criteria, it qualifies for assistance through the watershed rehabilitation program intended to bring this dam to safety standard for high hazard dams.

3.4 AECOM Preliminary Geologic Investigation

AECOM conducted a preliminary geologic investigation (GI) of the site to support hydraulic evaluation of the auxiliary spillway and alternatives analysis for the SWP-EA. The GI was conducted February of 2023 in general accordance with the Field Investigation and Testing Plan submitted to TSSWCB prior to field mobilization. Geologic investigation of the existing ASW was performed to develop recommended geologic input parameters for SITES erodibility analysis. The ASW investigation included four (4) borings in the existing channel designated as 201-23 through 204-23. Borings logs, boring locations, and detailed discussion of procedures, findings, and interpretations from the geologic investigation are provided in the preliminary Geologic Investigation Report (GIR) (AECOM 2024a) prepared as part of the scope of this project.

Laboratory testing was performed on select samples recovered from the existing auxiliary spillway. Testing included natural moisture content, natural unit weight, Atterberg limits, sieve and hydrometer, unconfined compression (UC) testing, and dispersion testing including crumb and double hydrometer. A summary of the laboratory test methods and results is provided in the Preliminary Soil Mechanics Report (SMR) (AECOM 2024b).

3.4.1 Generalized Subsurface Stratigraphy

Subsurface conditions encountered in the borings were generally consistent with the published geology, the stick logs included on the as-built drawings, and the geological descriptions provided in the Escondido Watershed workplan (SCS 1954a). The borings encountered interbedded clays, silts, and sands generally overlying interbedded sand and sandstones. The generalized stratigraphy included clay layers (an upper layer and a lower layer) overlying the sand and sandstone layer. The overlying clay layers are consistent with the description of the soils on the valley slopes as being "residual silty clays and sandy clays" while the interbedded sands and sandstone layers are consistent with the Oakville Sandstone Formation literature descriptions (SCS 1954a).

While the NRCS soil survey mapping shows alluvium and residuum soils within the ASW channel, it is possible the excavation of the ASW channel during dam construction may have likely removed the alluvial soils. As-built drawings (SCS, 1954b) indicate that the existing ASW forebay and channel were excavated approximately 5 to 9 feet along the centerline for over 700 feet of the ASW channel removing surficial soils, and at shallower depths the remaining length of the ASW channel. Based on this information and the observed and measured characteristics of the recovered soil samples, AECOM did not consider the soils to be alluvial in nature. AECOM's interpretation is that the clayey materials encountered in the investigation are residual soils, which is consistent with the work plan description of the silty clays and sandy clays that make up the valley slopes where the ASW is located. It is noted that since other sections of the site have not been excavated to the extent of the ASW, alluvium may be present at other locations which were not included in AECOM's investigation.

A geologic profile of the field data along the existing ASW profile is presented in **Figure 2**. The profile illustrates abridged boring logs indicating field USCS classification, pocket penetrometer values, SPT N-values, and measured groundwater levels. For the purposes of spillway erodibility analysis, the following generalized subsurface stratigraphy was assigned for the ASW channel:

1. Upper Clay (Residuum)
2. Lower Clay (Residuum)
3. Sand and Sandstone (Oakville Sandstone Formation)

The Upper Clay layer was described as fat clay to sandy fat clays with iron oxide staining and calcareous inclusions, generally light gray to light brownish gray, stiff to hard, dry to moist, and strong to no reactions to hydrochloric acid (HCL). The Lower Clay layer was described as generally lean clay to clayey sands with iron oxide staining and calcareous inclusions, light brownish gray to light yellowish brown, stiff to hard, dry to moist, and weak to strong reactions to HCL. The Sand and Sandstone layer encountered had varying degrees of uncemented sandy soils and cemented sandstones. The sandy soils encountered were described as clayey sand and well graded sand. The sandstone was generally described as medium grained quartz sandstone, fractured, thinly bedded, slightly to moderately weathered, medium strong to weakly cemented, slightly calcareous, and light gray to light brownish gray in color.

The borings encountered approximately 10 to 20 feet of clay, except boring 202-23 which terminated in clay at 40 feet bgs. The SPT N-values in the clay layers ranged from 8 to 60 bpf, increasing with depth, with an average of 33 bpf. Pocket penetrometer readings were generally greater than 4.5 tsf with a single recorded reading of 4.0 tsf on a shallow push sample recovered from boring 203-23. The SPT N-values in the sandy soils ranged from 18 to 62 bpf and had an average of 40 bpf (only two SPT tests were conducted in the Sand and Sandstone layer). Bedrock, defined as SPT and/or Shelby Tube refusal or visual determination, was encountered in borings 201-23, 203-23, and 204-23. In 201-23, bedrock was identified at 15 feet bgs (El. 360.5 feet), in 203-23 at 22 feet bgs (El. 348.5 feet) and in 204-23 at 14 feet bgs (El. 343). Bedrock was not encountered in borings 202-23.

Recovery of bedrock ranged from 13% to 82% (average 37%), and RQD ranged from 0 to 70% (average 26%). The attempt was made to core softer materials based on visual determination versus solely relying on SPT or Shelby tube refusal. However, the soft rock was difficult to core without disturbance and/or washout, and as a result, recovery and RQD of the bedrock material was low. In the case of boring 203-23, the recovery was 0% for Run 2, so an SPT test was completed after the coring attempt. Recovery for that sample was 100% and an SPT

N-value of 62 bpf. This sample had visual evidence of weak cementation, so the classification of sandstone was maintained, although the behavior of the material could be considered as more soil-like.

3.4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were added to the borings for the rock coring intervals. Boreholes were backfilled with cement bentonite grout at the end of drilling; as a result, subsequent delayed readings were not recorded. The preliminary geologic investigation did not include the installation of piezometers for monitoring groundwater levels over time.

4. Geotechnical Analysis of Auxiliary Spillway Erodibility

4.1 Analysis Methodology

Development of recommended material parameters for SITES analysis was performed according to the guidance provided in the *National Engineering Handbook, 210-VI-NEH, Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index* (NRCS, 2001) and the accompanying *DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons* (NRCS, 2011).

The primary SITES input parameter is the empirical headcut erodibility index (K_h). The K_h is calculated based on Equation 1:

$$K_h = M_S \cdot K_b \cdot K_d \cdot J_S \qquad [Equation\ 1]$$

where:

M_s = material strength number of the earth material

K_b = block or particle size number

K_d = discontinuity or interparticle bond shear strength number

J_s = relative ground structure number

For soil-like materials, the program also requires representative soil index properties as input parameters. The index properties used directly in the SITES model include the following parameters:

- USCS Soil Type
- Dry Unit Weight, γ_{dry} (pounds-per-cubic-foot, pcf)
- Plasticity Index, PI
- Clay Fraction, CF (% finer than 0.002 millimeter diameter)
- Representative Diameters, D_{75} and D_{50} (millimeters [mm])

Note that for the representative particle size, the D_{75} is typically used for soil-like materials, and D_{50} is typically used for rock-like materials.

4.2 Material Parameters Development

Development of estimated Kh was completed using the two reference documents cited above for the Upper Clay and Lower Clay, assuming all parameters except Ms are held constant and equal to 1.0. The Sand and Sandstone layer was conservatively considered as "soil-like", and thus followed the Kh estimation procedure for cohesionless soil.

Materials considered in the evaluation included those encountered beginning near the proposed finished-grade elevation of the ASW channel surface and extending down below the valley bottom elevation at the downstream exit channel. Material parameters were developed for each of the generalized strata units described previously, as well as for potential proposed fill material from on-site sources that may be needed with proposed rehabilitation spillway modifications. In summary, these included the following: 1) Upper Clay, 2) Lower Clay 3) Sand and Sandstone and 4) Proposed Fill (ASW Borrow). Representative values for each stratum were selected on an approximate best fit between the 33rd and 50th percentile values, as is consistent with typical geotechnical engineering practice.

4.2.1 Index Properties

Results of laboratory testing performed as part of the current GIR and preliminary SMR prepared by AECOM for this project were used to evaluate index properties of the various materials. The laboratory test results summary for the ASW borings is provided in the SMR (AECOM 2023). A tabulated summary of the minimum, maximum, and average test data values for each general stratum is provided in **Table 1.**

The D_{75} has been summarized in a graph by depth in **Attachment 2**. Note that D_{75} is typically used in analysis of soil-like materials and D_{50} is typically used for rock-like materials. The D_{50} is not presented since all materials were considered to behave like soils.

Plots of γ_{dry}, CF, LL, PI, Su, UCS, N_{60}, and D_{75}, versus depth, annotated to illustrate the selected representative values, are provided in **Attachment 2**. The selected representative values pertinent to the SITES analysis are also summarized in **Table 2**. Recommended values were developed based on results of laboratory index tests from the 2023 investigation and experience with similar materials.

4.2.2 Material Strength Number, Ms

Estimates of Ms are based on relative density for cohesionless soils (i.e., PI≤10 per NRCS 2001), and unconfined compressive strength for both cohesive soils (i.e., PI > 10) and rock materials. Typical ranges of Ms are presented in tabular format in NRCS 2001 and 2011 correlated with Standard Penetration Test (SPT) and relative density for cohesionless soils; with SPT, consistency, unconfined compressive strength (UCS), undrained shear strength (Su), and liquidity index (LI) for cohesive soils; and with UCS and field strength tests for rock.

The Ms values for cohesionless soils and rock are estimated predominantly using the methods in NRCS (2001). The Ms (=Kh) values for cohesive soils were estimated by comparing results from both methods in NRCS (2001) and NRCS (2011) and using engineering judgment to select recommended values. See **Attachment 2** for the plots used to sub-divide the generalized strata and develop representative values (note the undrained shear strength from laboratory unconfined compression testing was given the heaviest weighting). The two methods used for developing Kh are presented in **Attachment 3**. Note, only the undrained strength computed from correlation with the Liquidity Index is used for the NRCS 2011 method. Supporting calculations for the Ms value are also provided in **Attachment 3**.

Plots of Su, N_{60}, Su, Pocket Pen, and γ_{dry} data versus depth, with representative values also plotted, are provided in **Attachment 3**. Calculations for the derived Ms values are provided in **Attachment 3**. Discussion of Ms development for each of the various geologic strata is provided in the following subsections.

The Upper Clay and Lower Clay were considered “cohesive” soil for the purposes of estimating the Ms parameter, whereas the Sand and Sandstone was treated as “cohesionless” soil in analyses. The material designated as Proposed Fill was obtained from samples of the Upper Clay, and thus was also considered as “cohesive” soil. However, while the Proposed Fill would have similar gradation and plasticity, the fill will be excavated and recompacted in the field during construction which will change the density and strength properties from that of the natural in-place material. As such, the proposed fill material was analyzed separately.

It is noted that NRCS (2001) Table 52-3 indicates that soils with SPT blow counts greater than 30 bpf or UCS greater than 625 kPa (13,053 psf) should be treated as rock (NRCS, 2001). While many of the SPT values in the Lower Clay exceeded 30 bpf, the laboratory UCS values indicate the material is borderline and should still be considered soil like in analysis. Similarly, the Sand and Sandstone was also considered soil-like since the one unconfined compression test resulted in an Su value equal to 4000 psf, which is a strength more associated with a soil, and the difficulty in retrieving viable core samples due to the interbedded nature. For all materials, engineering judgement was applied to the results based on published ranges in Chapter 52 (NRCS 2001), and the final selected Kh values were adjusted accordingly. As discussed in following paragraphs, all other parameters were equal to 1 so the only value that affected Kh was the Ms number.

The field SPT N-values were corrected to equivalent 60% hammer efficiency (N_{60}) based on the hammer energy calibration report provided by the driller. While an SPT hammer energy calibration report was not available, the driller provided a hammer energy calibration report for the Texas Cone Penetrometer hammer on the same drill rig which indicated 89% hammer efficiency. Based on AECOM's experience, an energy correction of 80% hammer efficiency is typical for SPT autohammers like that used on this project, and thus 80% efficiency was adopted for analysis.

Upper Clay and Lower Clay

SITES parameters for the two clay stratums were estimated based on the results of 19 field standard penetration tests, which were correlated to obtain an estimated Su value, correlations from liquidity indices, 6 unconfined compression tests (UC) and 2 unconsolidated-undrained tests (UU). The use of the liquidity indices was used as a check to correlate the strength of the soils in a saturated state.

The NRCS 2011 Appendix 52D method was used as a check on the Su values, which correlates Su with the LI of saturated clay. Reference **Attachment 3** to see Su values for comparison of the two procedures, and the calculated MS values for NRCS 2001.

Sand and Sandstone

As mentioned above, the Sand and Sandstone was considered more soil like in analyses, and SITES parameters were estimated primarily based on the results of 2 standard penetration tests and 1 uniaxial compressive strength test.

Proposed Fill (ASW Borrow)

The Ms value for Proposed Fill materials is typically estimated by performing laboratory UC or UU tests on remolded samples compacted to target moisture content and density that simulate typical values of earthfill construction compaction specifications. It is common to conservatively remold samples to the minimum acceptable density and upper range of allowable moisture content (i.e., 95% of maximum dry density and +2% of optimum moisture relative to Standard Proctor energy). However, sufficient quantity of material was not available to complete the remolded strength tests. Consequently, the strength of the Proposed Fill was estimated based on experience from prior projects for similar soils remolded to similar moisture/density, informed by the maximum dry density and optimum moisture content from site-specific Standard Proctor test results and One undisturbed UC test result in the Upper Clay layer. The Ms values was then estimated from the assumed strength value.

4.2.3 Block or particle size number, Kb

The value of K_b is 1.0 for each analysis case per NRCS 2001 and NRCS 2011. The clay layers and proposed fill are considered as "massive, unjointed cohesive" soil materials, and the sand and sandstone was considered a cohesionless soil where the average particle size diameter is less than 0.1 meters.

4.2.4 Discontinuity / Interparticle Bond Shear Strength Number, Kd

According to NRCS 2001, the value of K_d is estimated based on the tangent of the residual friction angle (ϕ'_r) of the soil, which can be estimated by correlation with values of LL and CF using the following formulas:

$$\text{For} \leq 20\% \text{ clay,} \quad \phi'_r = 169.58\,(\text{LL})^{-0.4925} \qquad [52\text{–}7]$$
$$\text{For } 25 - 45\% \text{ clay,} \quad \phi'_r = 329.56\,(\text{LL})^{-0.7100} \qquad [52\text{–}8]$$
$$\text{For} \geq 50\,\% \text{ clay,} \quad \phi'_r = 234.73\,(\text{LL})^{-0.6655} \qquad [52\text{–}9]$$

Plots of LL and CF versus depth, with interpreted lower and upper bounds, are provided in **Attachment 3**.

Based on feedback received from NRCS geologists at the NDCSMC (email dated April 7, 2020), the method presented in NRCS 2001 has often produced overly conservative values for K_d. The email indicated that internal NRCS guidance is to assume $K_d = 1.0$ for soil-like materials. This assumption is supported by McCook (2005) and the Draft Appendix 52D (NRCS, 2011). Consequently, $K_d = 1.0$ was adopted for all materials since they are considered "soil-like".

4.2.5 Relative Ground Structure Number, Js

The value of J_S is 1.0 per NRCS 2001. The clay layers and proposed fill materials are considered as "cohesive" materials, while the sand and sandstone layer is considered a "cohesionless" material.

4.2.6 Adjustment for High-Plasticity, Blocky Soils

The Draft Appendix 52D (NRCS 2011) and McCook (2005) cautions that very stiff, high-plasticity fat clays (CH) with plastic limits (PL) > 25 often have blocky or fissured secondary structure and such deposits may be more erodible than indicated by the unconfined compressive strength on intact samples typically used to obtain the Ms value. While the document states that no case history is available, interim guidance is to apply a reduction factor of 0.5 to the calculated Ms and thus Kh value.

The Upper Clay layer had PL values ranging from 18 to 22 (average 20). The Lower Clay layer had PL values ranging from 12 to 30 (average 17) with one sample at 34 feet bgs with a PL value equal to 30 (note – this sample was from a deep fat clay layer only found in boring 202-23). Fissures were noted for boring 202-23, and these were typically infilled with calcium. However, due to the lack of fissures being noted on the other borings, and the PL for the site being below the threshold, the blocky soil reduction factor was not applied to the Kh values for the Upper and Lower Clay soils.

4.3 Recommendations

Recommended parameters for SITES analyses are presented in **Table 2**. Supporting calculations are provided in **Attachment 3**. Based on the assumption stated herein, the estimated K_h ranges of unfavorable and favorable values for the existing ASW are as follows:

- Proposed Fill (ASW Excavation Borrow): Kh = 0.10
- Upper Clay: Kh = 0.30
- Lower Clay: Kh = 0.30
- Sand and Sandstone: Kh = 0.15

The recommended values for the cohesive soil-like materials are generally in agreement with those recommended for very stiff cohesive soils according to the typical range of values below (from NRCS 2011):

Table 52D–3 Values shown in NEH628.52 relating saturated consistency to unconfined compressive strength

Relative density	Description	SPT	q_u, lb/ft²	M_s
Very soft	• Exudes between fingers when squeezed in hand	< 2	< 835	< 0.02
Soft	• Easily molded with fingers • Point of geologic pick easily pushed into shaft of handle	2–4	835–1,670	0.02–0.05
Firm	• Penetrated several centimeters by thumb with moderate pressure • Molded by fingers with some pressure	4–8	1,670–3,130	0.05–0.10
Stiff	• Indented by thumb with great effort • Point of geologic pick can be pushed in up to 1 centimeter • Very difficult to mold with fingers • Just penetrated with hand spade	8–15	3,130–6,265	0.10–0.20
Very stiff	• Indented only by thumbnail • Slight indentation by pushing point of geologic pick • Requires hand pick for excavation	15–30	> 6,265	0.20–0.45

The recommended Kh value for sand and sandstone is also in agreement with those recommended for dense cohesionless soils (from NRCS 2011):

Table 52D–2 Material strength number, M_s for cohesionless soil

Relative density	Description	SPT	M_s
Very loose	• Particles loosely packed • High percentage of voids • Very easily dislodged by hand • Matrix crumbles easily when scraped with point of geologic pick • Raveling often occurs on excavated faces	< 5	< 0.02
Loose	• Particles loosely packed • Some resistance to being dislodged by hand • Large number of voids • Matrix shows low resistance to penetration by point of geologic pick	5–10	0.02–0.05
Medium dense	• Particles closely packed • Difficult to dislodge individual particles by hand • Voids less apparent • Matrix has considerable resistance to penetration by point of geologic pick	10–30	0.05–0.10
Dense	• Particles very closely packed and occasionally very weakly cemented • Cannot dislodge individual particles by hand • The mass has very high resistance to penetration by point of geologic pick • Requires many blows of geologic pick to dislodge particles	30–50	0.10–0.20
Very dense	• Particles very densely packed and usually cemented together • Mass has high resistance to repeated blows of geologic pick • Requires power tools for excavation	> 50	0.20–0.45

(210–VI–NEH, draft, October 2011) 52D–9

5. Limitations

This memorandum was prepared by AECOM using the degree of care and skill ordinarily exercised under similar circumstances by responsible engineers and geologists practicing in the same general location. No other warranty or representation, either expressed or implied, is made as to the findings and professional advice in this memorandum.

The opinions and conclusions contained in this memorandum are based on interpretations of limited subsurface information. Soil and geologic conditions can vary greatly between or beyond the exploration sites, and different conditions may be found during subsequent investigations.

The conclusions and recommendations contained herein are based in part upon information provided by others (including the NRCS) and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information provided to AECOM has not been independently verified by AECOM, unless otherwise stated.

There is no intention that this memorandum addresses any environmental issues (for example, environmentally affected soil or groundwater, or historic site uses) related to this site. Such evaluations are outside the scope of this work and should be addressed in separate studies.

6. References

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7. Attachments

Table 1. Summary of Laboratory Test Results by Stratum for ASW Borings
Table 2. Recommended SITES Parameters

Figure 1. Site Map and Plan of Geologic Investigations
Figure 2. Subsurface Profile for the Existing ASW

Attachment 1. As-built Drawings
Attachment 2. Laboratory Test Data Plots for ASW Borings
Attachment 3. Headcut Erodibility Index (Kh) Calculations

TABLES

Table 1. Summary of Laboratory Test Data by Stratum for Borings in Existing ASW Channel [1]

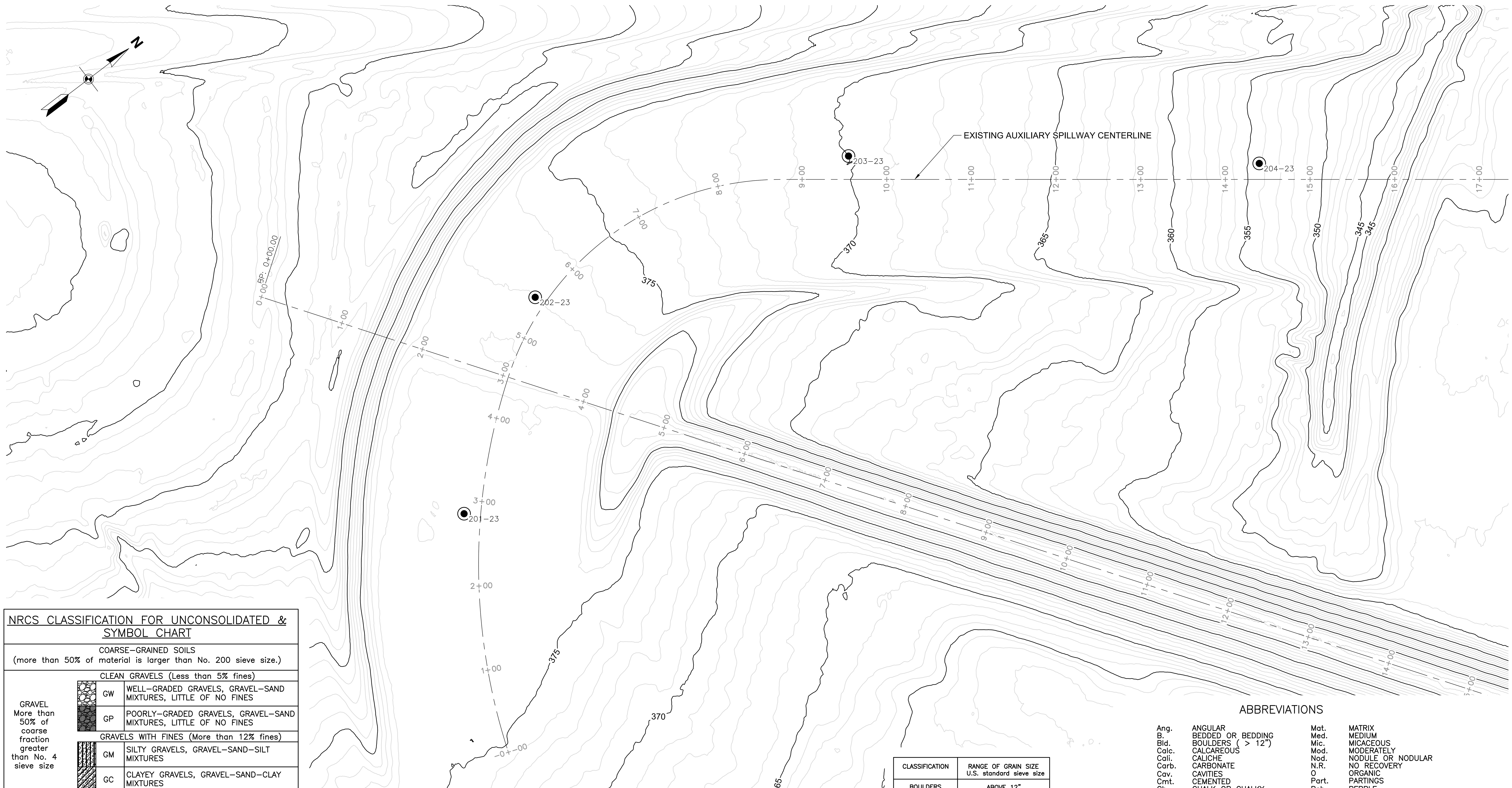
Stratum Description (USCS)	Thick-ness (ft)	USCS	N_{60} (bpf) [2]	Pocket Pen. (tsf)	Undrained Shear Strength, S_u (psf)	Unconfined Compressive Strength, UCS (psf)	Dry Unit Weight (pcf)	LL	PI	LI	Fines (%)	CF (%)	D_{75} (mm)	Crumb
Upper Clay	10-12	CH	11-80 (39)	4.0-4.5 (4.5)	2,260-9,820 (6,405)	4,520-19,640 (12,810)	102-112 (106)	43-68 (57)	24-47 (37)	-0.250 to 0.051 (-0.108)	50-94 (77)	30-33 (31)	0.075 – 0.141 (0.110)	1 – 4 (2)
Lower Clay	4-6	CL	20-69 (53)	2.5-4.5 (4.3)	4,580-10,140 (6,608)	9,160-20,280 (14,720)	111-120 (116)	27-64 (39)	15-34 (22)	-0.682 to 0.158 (-0.219)	49-86 (69)	11-22 (18)	0.070-0.265 (0.169)	2 – 4 (3)
Sand and Sandstone	10 – 20+	SC (partially cemented)	24-83	1.3	4,003	8,006	118-119	36	23	-0.130	14-27	3	0.276-0.458	---[3]
Proposed Fill (ASW Borrow)	TBD	CH	---[3]	---[3]	---[3]	---[3]	94-110 (103)	30-63 (50)	16-43 (32)	-0.875 to (-)0.465 (-0.606)	48-91 (67)	11-60 (32)	---[3]	---[3]

Notes:
(1) Format of reported values is Minimum – Maximum (Average). Average value not reported when two or fewer results are available.
(2) Raw SPT N-values converted to N_{60} based on 80% hammer efficiency.
(3) "---" No test results available from current ASW borings.

Table 2. Recommended Material Parameters for SITES Analysis of Existing ASW

SITES inputs	Proposed Fill (ASW Borrow)	Upper Clay	Lower Clay	Sand and Sandstone
USCS - Soil Type (Predominant)	CH - Fat Clay	CH - Fat clay	CL - Sandy Lean Clay	SC – Clayey Sand [partially cemented]
PI – Representative	35	35	20	15
LL – Representative	55	50	35	25
Dry Density (lbs/ft3) – Representative	100	105	110	117
Kh – Representative	0.10	0.30	0.30	0.15
Clay % – Representative	30	30	20	3
Rep. Diam. D_{75} (mm) – Representative	0.15	0.15	0.10	0.25
Rep. Diam. D_{75} (in) – Representative	0.006	0.006	0.004	0.010
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---

FIGURES



PLAN

0 30 60 120
SCALE IN FEET

NRCS CLASSIFICATION FOR UNCONSOLIDATED & SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVEL More than 50% of coarse fraction greater than No. 4 sieve size	CLEAN GRAVELS (Less than 5% fines)		
		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
		GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	GRAVELS WITH FINES (More than 12% fines)		
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
SAND More than 50% of coarse fraction smaller than No. 4 sieve size	CLEAN SAND (Less than 5% fines)		
		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
		SP	POORLY-GRADED SANDS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	SAND WITH FINES (More than 12% fines)		
		SM	SILTY SAND, SAND-SILT MIXTURE
		SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS (more than 50% of material is smaller than No. 200 sieve size.)			
SILTS & CLAYS Liquid limit less than 50%		ML	INORGANIC SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAY WITH LOW OR MEDIUM PLASTICITY, LEAN CLAY
SILTS & CLAYS Liquid limit Greater than 50%		MH	INORGANIC SILTS WITH ELASTICITY
		CH	INORGANIC CLAY WITH HIGH PLASTICITY, FAT CLAY.

NRCS CLASSIFICATION FOR CONSOLIDATED & SYMBOL CHART

Low Plasticity Clay
Clayey Sand
High Plasticity Clay
Well Graded Sand
Sandstone

OTHER SYMBOLS

HOLE LOGGED ONLY
STRIKE AND DIP
HOLE SAMPLED
PIT OR TRENCH

CLASSIFICATION	RANGE OF GRAIN SIZE U.S. standard sieve size
BOULDERS	ABOVE 12"
COBBLES	12" TO 3"
GRAVEL Course Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200
SILT & CLAY	Below No. 200

TEST HOLE NUMBERING SYSTEM

	COMBINA-TION RIG	POWER AUGER	HAND BORINGS	TRENCH OR PIT EXCAVA-TIONS	NATURAL OUTCROPS, STREAMBANKS, AND GULLIES
CENTERLINE OF DAM	1-49	51-99	1001-1099	2001-2099	3001-3099
BORROW AREA	101-149	151-199	1101-1199	2101-2199	3101-3199
AUXILIARY SPILLWAY	201-249	251-299	1201-1299	2201-2299	3201-3299
PRINCIPAL SPILLWAY	301-349	351-399	1301-1399	2301-2399	3301-3399
STREAM CHANNELS	401-449	451-499	1401-1499	2401-2499	3401-3499
EXPLORATORY BORINGS	501-549	551-599	1501-1599	—	—
FOUNDATION DRAIN	601-649	651-699	1601-1699	2601-2699	3601-3699
MISCELLANEOUS	701-749	751-799	1701-1799	2701-2799	3701-3799

ABBREVIATIONS

Ang.	ANGULAR	Mat.	MATRIX
B.	BEDDED OR BEDDING	Med.	MEDIUM
Bld.	BOULDERS (> 12")	Mic.	MICACEOUS
Calc.	CALCAREOUS	Mod.	MODERATELY
Cali.	CALICHE	Nod.	NODULE OR NODULAR
Carb.	CARBONATE	N.R.	NO RECOVERY
Cav.	CAVITIES	O	ORGANIC
Cmt.	CEMENTED	Part.	PARTINGS
Ch.	CHALK OR CHALKY	Peb.	PEBBLE
C	CLAY, CLAYEY	Per.	PERMEABLE
Cse.	COARSE	Po.	POORLY
Cbl.	COBBLES (3" - 12")	P.	POORLY GRADED
Cpt.	COMPACT	Rdd.	ROUNDED
Con.	CONCRETIONS	S	SAND, SANDY
Cng.	CONGLOMERATE	Ss.	SANDSTONE
Cs.	CLAYSTONE	Sat.	SATURATED
C.T.	CAVED TO	Sh.	SHALE, OR SHALY
Xln.	CRYSTALLINE	Sl/.	SLIGHTLY
Ds.	DENSE	Slo.	SLOWLY
Dip.	DIPPING	M	SILT, SILTY
D.S.	DOWNSTREAM	Sft.	SOFT
Fe. Stn.	Iron Stains	Sl.	SOME
Flg.	FLAGSTONE OR FLAGGY	Stf.	STIFF
Fn.	FINE	Str.	STREAKS
Frm.	FIRM	T.	THIN
Frac.	FRACTURED	T.B.	THIN - BEDDED
Frg.	FRAGMENTS	Tuff.	TUFFACEOUS
Fri.	FRIABLE	U.A.D.	UNABLE TO AUGER DEEPER
Grn.	GRAIN	U.D.B.D.	UNABLE TO DRY BARREL DEEPER
G	GRAVEL, GRAVELLY	U.E.D.	UNABLE TO EXCAVATE DEEPER
Gyp.	GYPSEOUS	U.S.	UPSTREAM
Hd.	ROCK HARDNESS	Var.	VARIABLE
H.	HIGHLY	V/.	VERY
Int.	INTERBEDDED	Vug.	VUGULAR
Lam.	LAMINATED	Wtr.	WATER LEVEL AS ENCOUNTERED DURING DRILLING PROCESS
Lay.	LAYER OR LAYERS	W	WELL GRADED
Len.	LENS OR LENSES	W/.	WITH
Lig.	LIGNITE	Wea.	WEATHERED
Ls.	LIMESTONE	▼	(DATE) STATIC WATER LEVEL
Lse.	LOOSE		
Ma.	MARL, OR MARLY		
Mas.	MASSIVE		

DRAWN ME DATE 9/15/23
CHECKED MJ DATE 9/15/23
APPROVED LF DATE 9/15/23

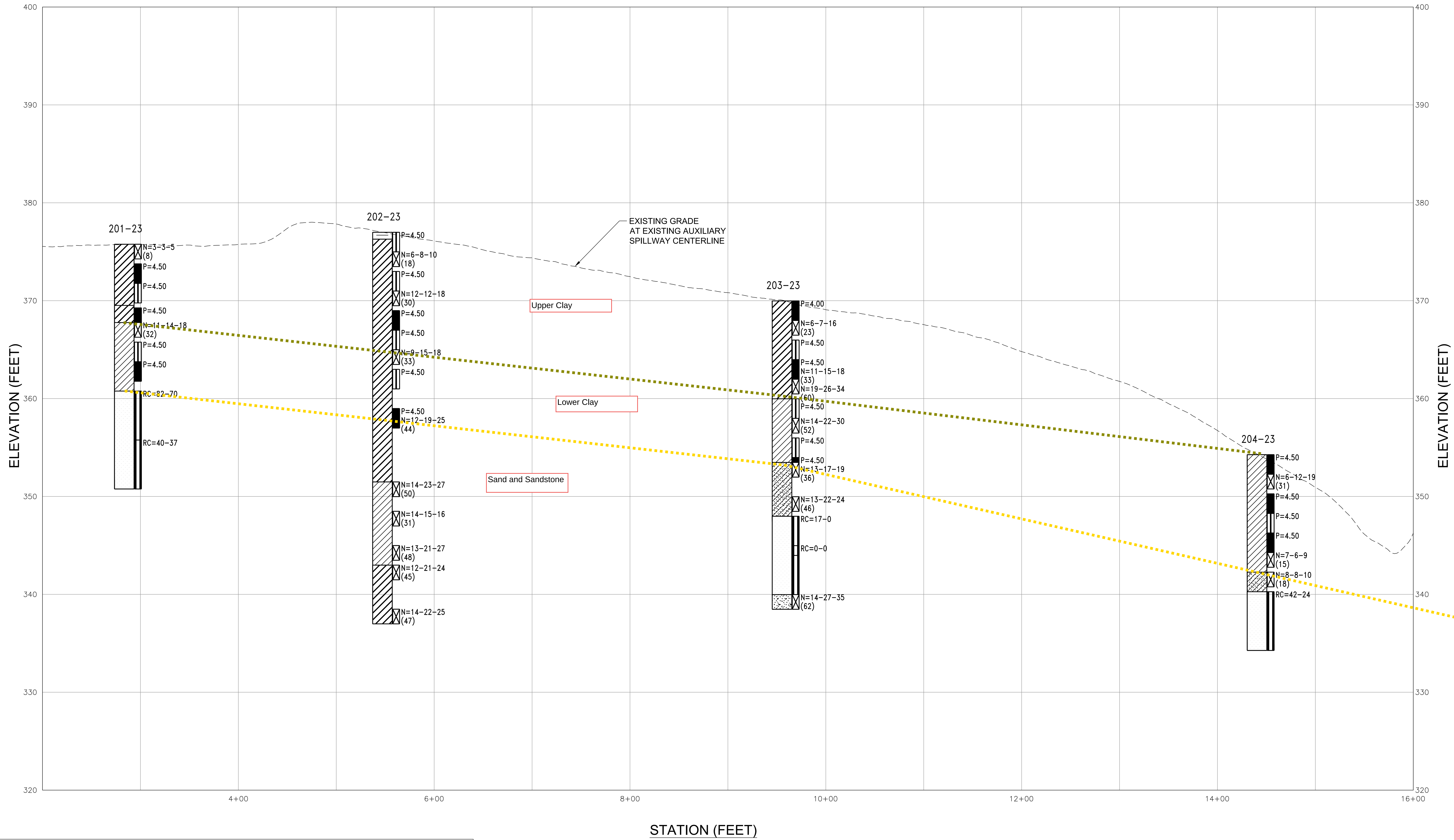
PLAN OF GEOLOGIC INVESTIGATIONS

FLOODWATER RETAINING STRUCTURE 1
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME:
GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 2



LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Well Graded Sand

—— Sample Top Depth

N= SPT blows per 6" increment (N-value, bpf)

P= Pocket Penetrometer (tsf)

RC= Core Recovery (%) – RQD (%)

Water Level at Time Drilling, or as Shown

Water Level at End of Drilling, or as Shown

Water Level After 24 Hours, or as Shown

NOTES:

1. THE SOIL CLASSIFICATIONS SHOWN ON THIS SHEET ARE FIELD CLASSIFICATIONS. THEY MAY NOT IN ALL CASES AGREE WITH THE CLASSIFICATIONS MADE BY THE SOIL MECHANICS LABORATORY. REFER TO THE LABORATORY REPORT FOR FURTHER INFORMATION.

HORIZ. 0' 50' 100'

VERT. 0' 5' 10'

SCALE IN FEET

DRAWN ME DATE 9/15/23

CHECKED MJ DATE 9/15/23

APPROVED LF DATE 9/15/23

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETAINING STRUCTURE 1

ESCONDIDO CREEK WATERSHED

IN

KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 2

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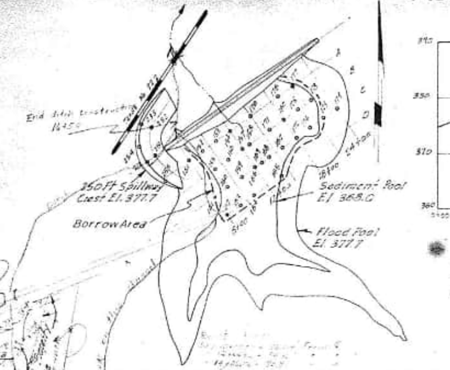
ATTACHMENT 1.

AS-BUILT DRAWINGS

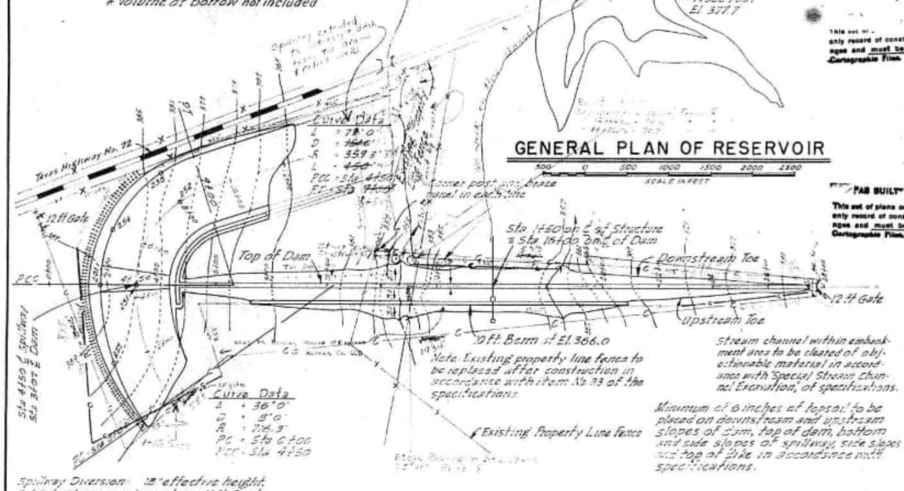
Elevation	Surface Acres	Storage * Acre Feet	Storage * Inches
366	46	200.00	1.32
368	52	275.05	1.97
369	57.4	352.90	2.35
373	79.6	626.80	4.14
377	106.9	999.80	6.60
377.7	112.0	1076.24	7.10
381	140.1	1492.20	9.84
383	158.7	1791.00	11.81

Top of Dam El (effective)	382.7
Spillway Crest El.	377.7
Outlet Structure El	366.0
Drainage Area	1819 Ac

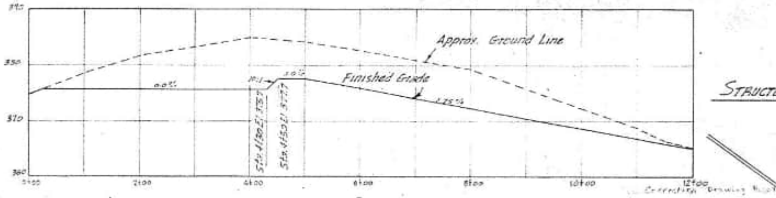
* Volume of borrow not included



GENERAL PLAN OF RESERVOIR



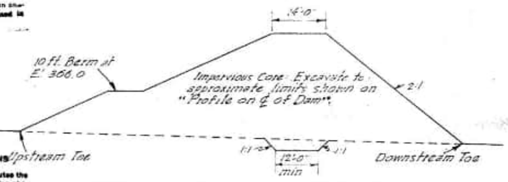
PLAN OF EMBANKMENT AND SPILLWAY



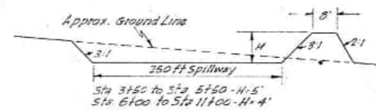
PROFILE ON ℄ OF SPILLWAY

This set of plans constitutes the only record of construction changes and must be retained in Cartographic Files.

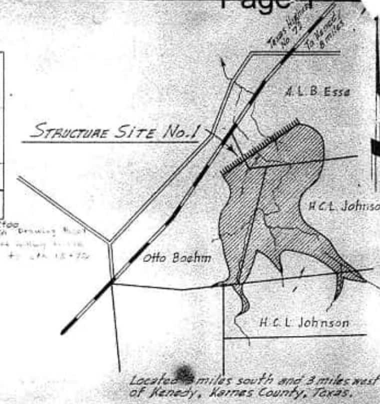
"AS BUILT" PLANS



TYPICAL EMBANKMENT SECTION



TYPICAL CROSS SECTION OF SPILLWAY AND DIKE

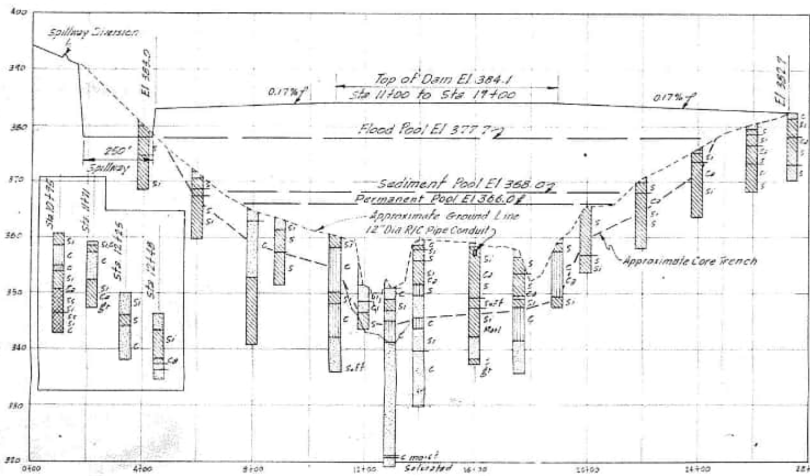


VICINITY MAP

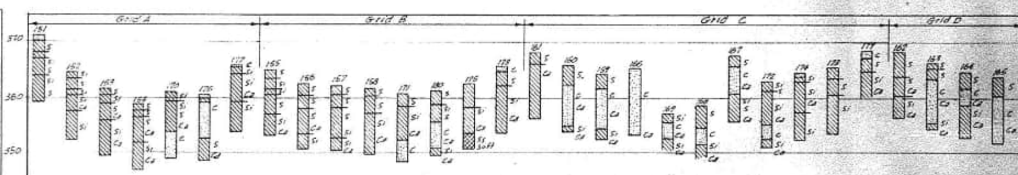
Clay
Silt
Sand
Stone

C Contains Clay
S Contains Sand
Si Contains Silt
Sh Contains Shale
Ss Sandstone
Sls Siltstone
Ml Marl
Gr Gravel
Ca Calcareous

LEGEND OF BORINGS

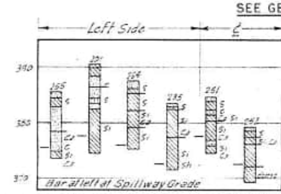


PROFILE ON ℄ OF DAM



LOG OF BORINGS OF BORROW AREA

SEE GENERAL PLAN OF RESERVOIR



LOG OF BORINGS OF SPILLWAY

SEE PLAN OF EMBANKMENT AND SPILLWAY

Note: Revisions made in 1957 shown in green and explained in more detail on Correction Drawings, sheets 1 & 2.

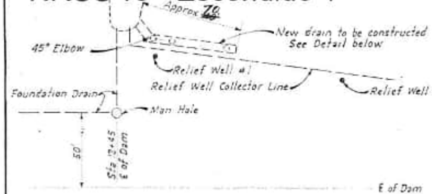
Revised 4-1-54

GENERAL PLAN AND PROFILES
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FORT WORTH, TEXAS

REFERENCE

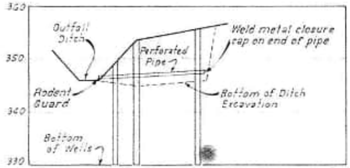
CARTOGRAPHIC APPROVAL	TECHNICAL APPROVAL		
COMPILED	TRACED	CHECKED	
H.C.N.	D.S.	H.C.N.	4-R-8943

For in service use only



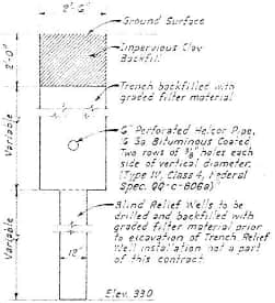
PLAN OF DRAINAGE SYSTEM

Site No. 1



Notes:
Perforated Pipe to be set on not less than 4" fall in 40 feet. Total pipe required = 70 ft.
Elevations indicated are approximate. Final elevations to be determined at time of installation.

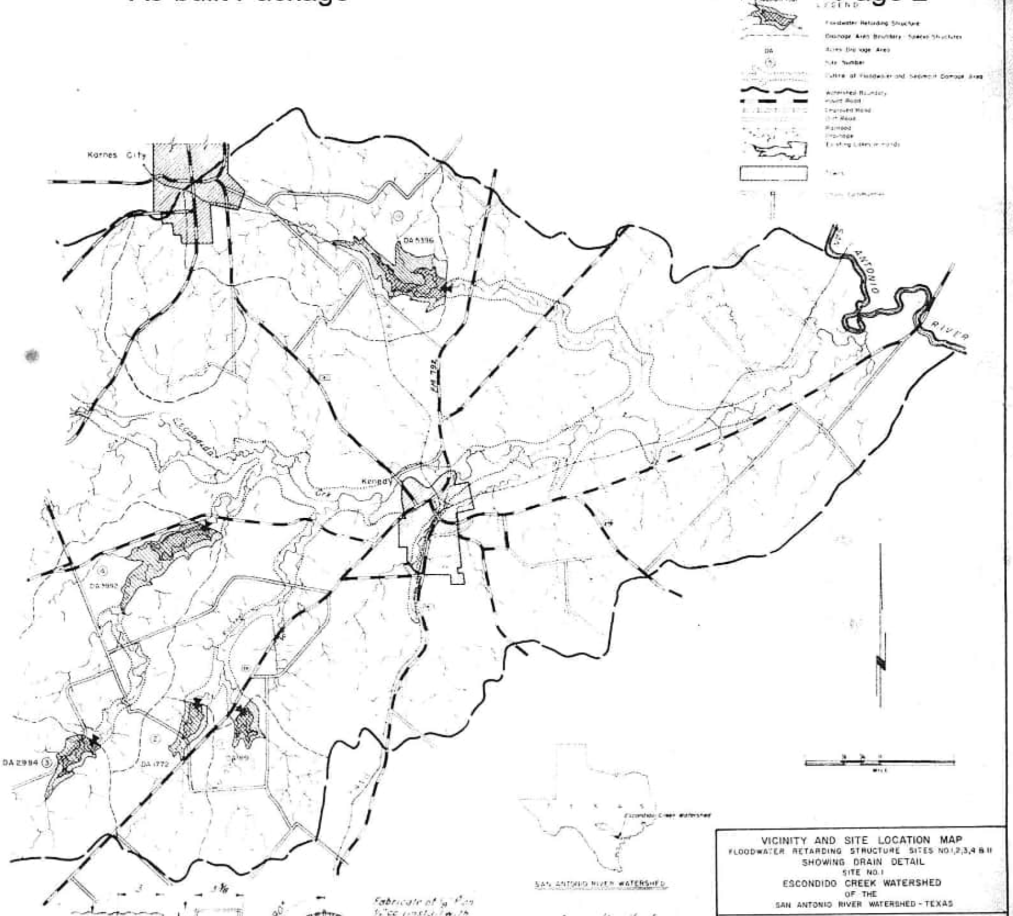
PROFILE OF NEW DRAIN



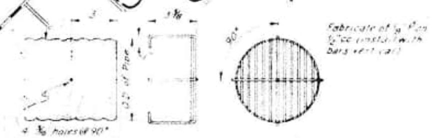
TRENCH DETAIL

FILTER GRADATION	
Screen Size	Percentage
1 1/2"	100
1"	92-100
3/4"	85-100
1/2"	74-94
3/8"	65-88
#4	45-71
#10	20-47
#20	6-25
#40	5-14
#60	< 10
#200	< 5

Approx 30 Cu yds of graded filter material required to backfill trench.



Appendix Sheet 1-A



RODENT GUARD (2 Required)

Revised 7-5-61

VICINITY AND SITE LOCATION MAP
FLOODWATER RETARDING STRUCTURE SITES NO 1,2,3,4 & 11
SHOWING DRAIN DETAIL
SITE NO. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

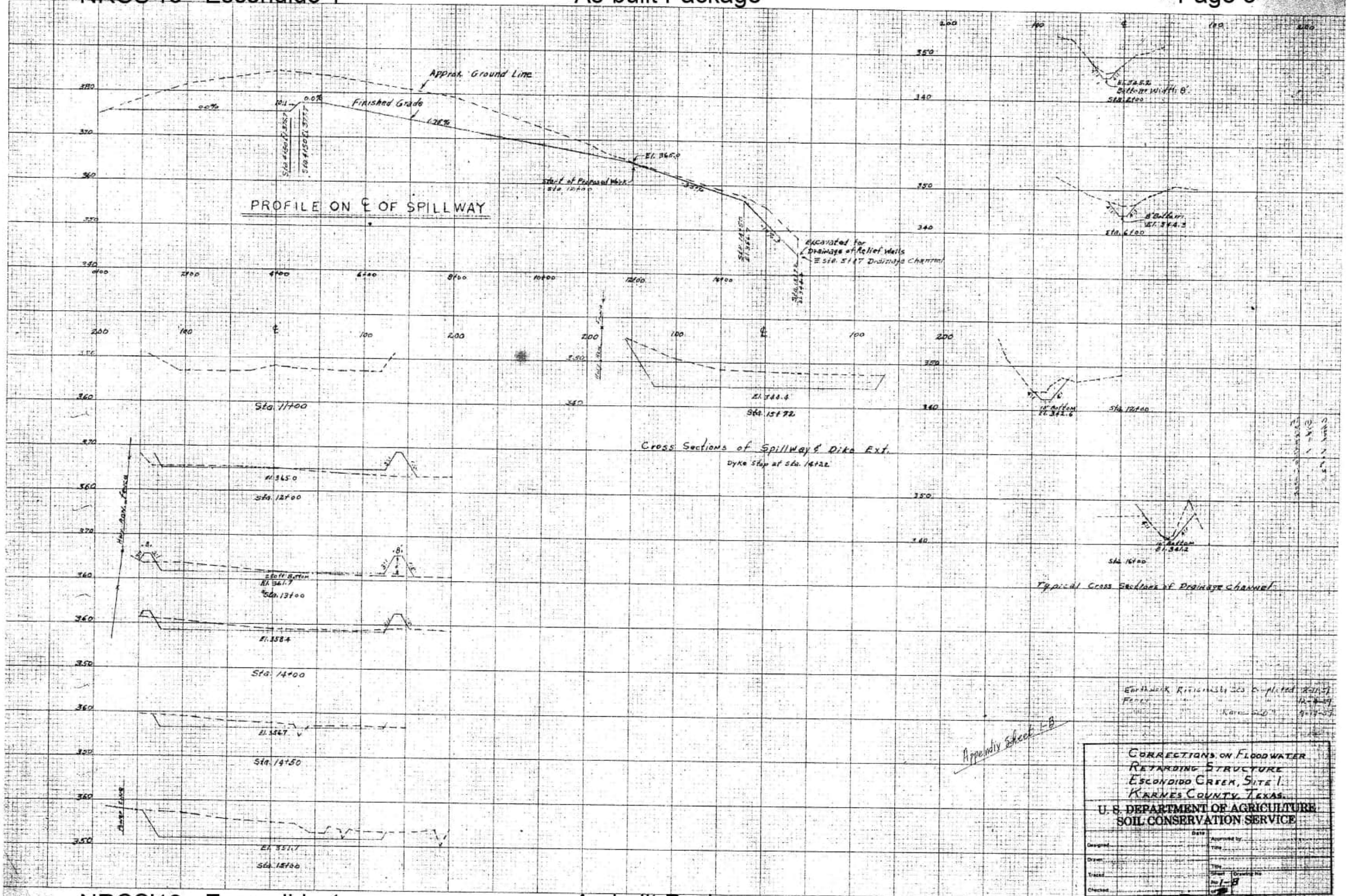
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

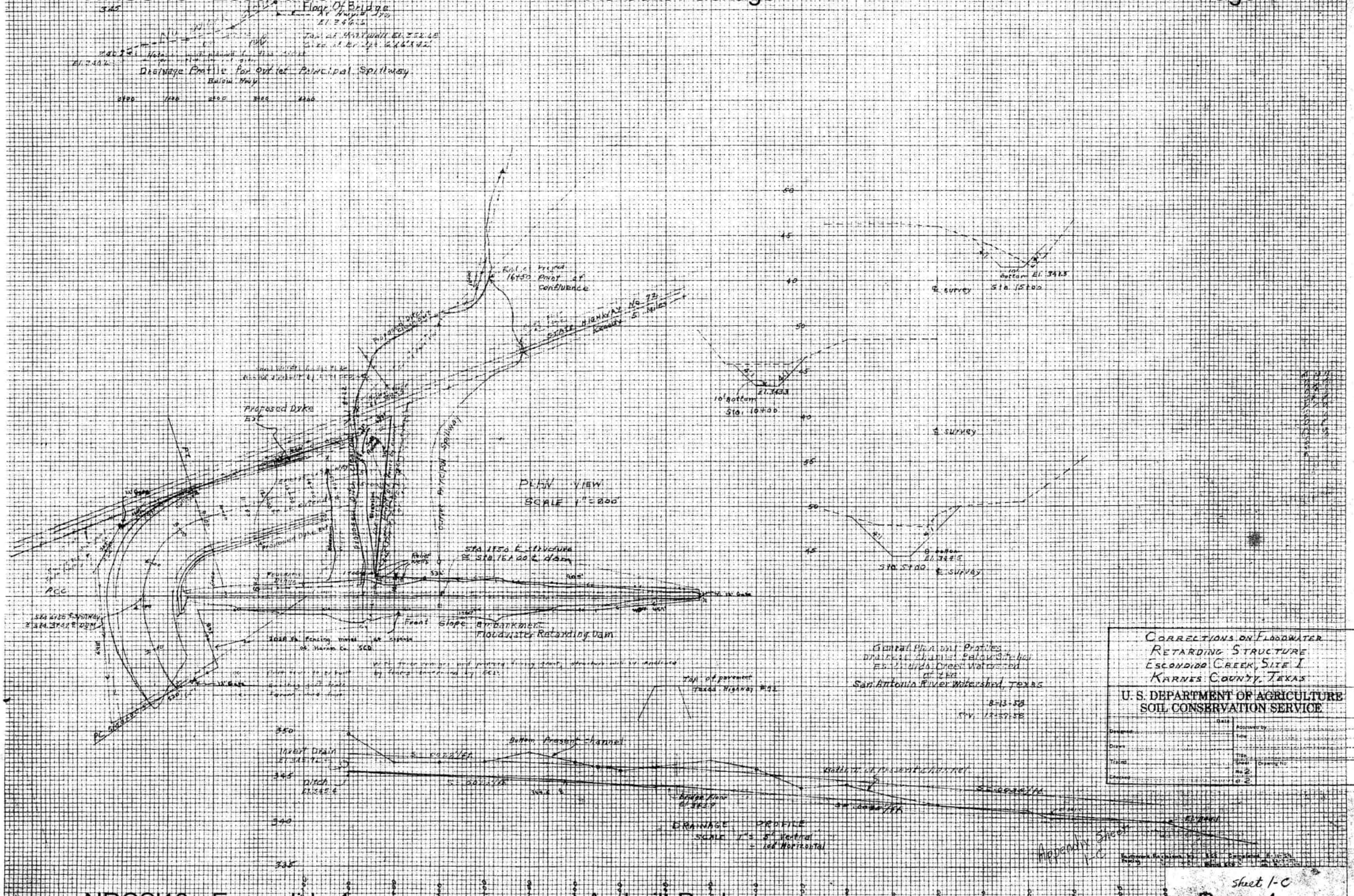
		Date
Designed	M. P. F.	5-61
Drawn	M. P. F.	5-61
Traced	C. V. C.	5-61
Checked	J. R. E.	5-61

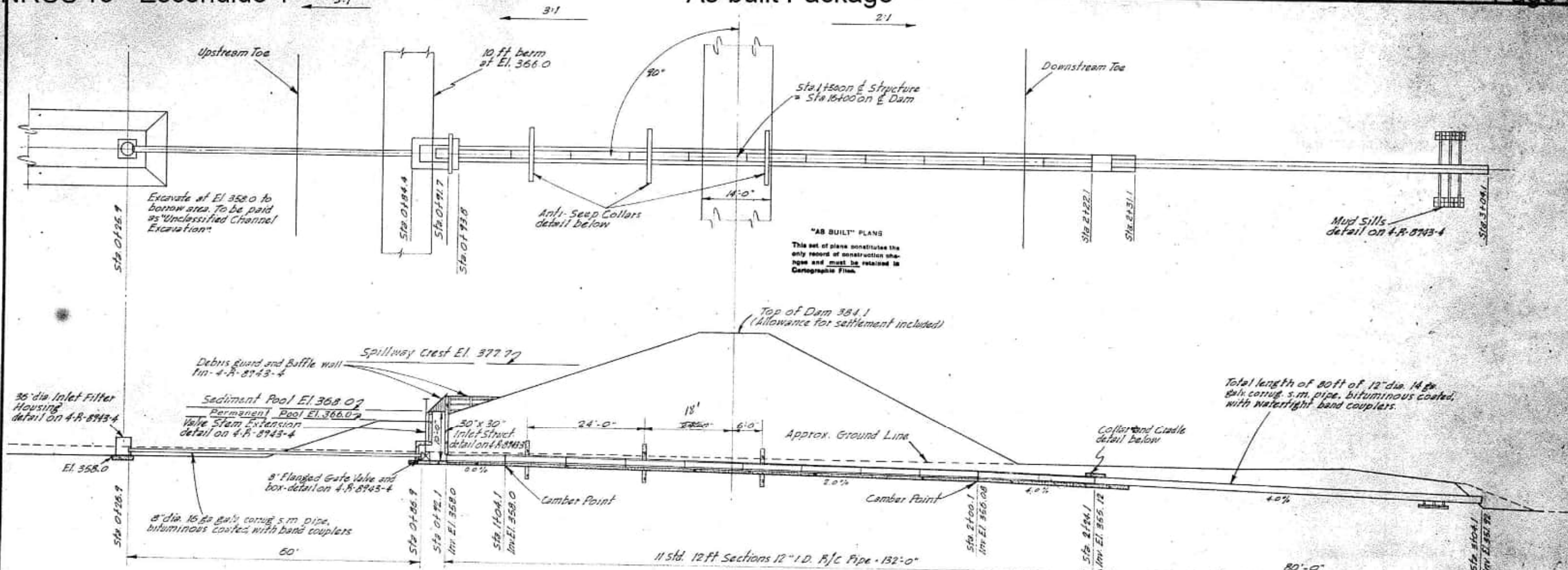
Approved by: [signature]

Sheet No. 1-A Drawing No. 4-E-15,565

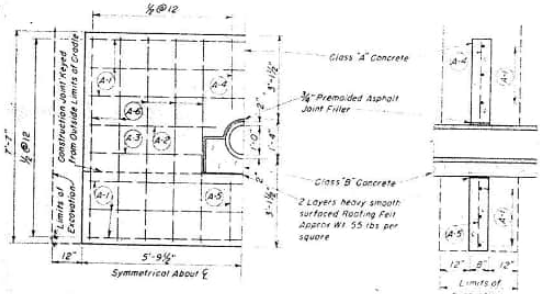
JUL 24 1961


PROFILE ON ℄ OF SPILLWAY
Approx. Ground Line
Finished Grade
El. 365.0
Start of Proposed Work
Sta. 12+00
Excavated for Drainage of Relief Wells
℄ Sta. 5+17 Drainage Channel
El. 344.4
Sta. 15+72
Sta. 11+00
Cross Sections of Spillway & Dike Ext.
Dyke Stop at Sta. 14+22
El. 365.0
Sta. 12+00
El. 361.7
Sta. 13+00
El. 358.4
Sta. 14+00
El. 356.7
Sta. 14+50
El. 351.7
Sta. 15+00
El. 345.2
Bottom Width 8'
8' Bottom
El. 344.3
Sta. 6+00
El. 342.6
Sta. 12+00
El. 344.2
Sta. 16+00
Typical Cross Sections of Drainage Channel
Appendix Sheet L-B
CORRECTIONS ON FLOODWATER RETARDING STRUCTURE
ESCONDIDO CREEK, SITE 1.
KARNES COUNTY, TEXAS.
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed
Drawn
Traced
Checked
Date
Approved by
Title
Sheet No.
Drawing No.
1-B

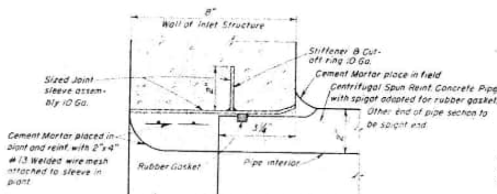

Floor Of Bridge
Drainage Profile for Outlet Principal Spillway
Below Hwy
Point of Confluence
State Highway No. 72
Proposed Dyke
PLAN VIEW
SCALE 1"=200'
Front Slope Embankment
Floodwater Retarding Dam
Top of pavement
Texas Highway #72
San Antonio River Watershed, Texas
8-13-58
Bottom Present channel
DRAINAGE PROFILE
E survey
CORRECTIONS ON FLOODWATER
RETARDING STRUCTURE
ESCONDIDO CREEK, SITE I
KARNES COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Appendix Sheet I-C
Sheet I-C



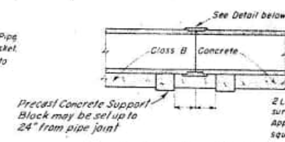
OUTLET STRUCTURE - PLAN & SECTION



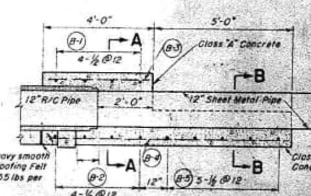
ANTI-SEEP COLLAR



DETAIL OF PIPE CONNECTION TO INLET STRUCTURE



TYPICAL JOINT

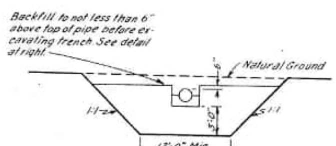


LONGITUDINAL SECTION OF COLLAR & CRADLE

For Typical Bar Types Refer To A.C.I. Standard 315-48

No.	Location	Qty.	Lgth.	Total Length	Size	Type	A	B	G
A-1	Anti-Seep Collar	6	11-0	66-0	½	Str.			
A-2	" " "	2	4-6	9-0	½	"			
A-3	" " "	2	3-9	7-6	½	"			
A-4	" " "	2	2-7	5-2	½	"			
A-5	" " "	2	2-0	4-0	½	"			
A-6	" " "	10	7-0	70-0	½	"			
Total steel in one Anti-Seep Collar 161'-8" = 108.0 lbs.									
B-1	Collar & Cradle	4	3-8	14-8	½	2	0-7	2-6	0-7
B-2	" "	4	6-6	26-0	½	2	2-0	2-6	2-0
B-3	" "	6	3-8	22-0	½	Str.			
B-4	" "	6	8-8	52-0	½	"			
B-5	" "	5	4-2	20-10	½	2	0-10	2-6	0-10
Total steel in Collar & Cradle ½"φ 135'-6" = 90.5 lbs									

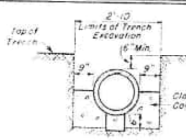
Class "A" Concrete in one Anti-Seep Collar .... 2.08 cu. yds.
Class "A" Concrete in Collar and Cradle .... 1.35 cu. yds.
Class "B" Concrete in Pipe Cradle .... 0.097 cu. yds. per lin. ft.



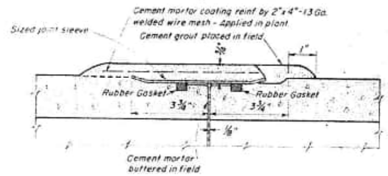
STRUCTURE FOUNDATION EXCAVATION

From Sta. 0+84 to Sta. 2+31

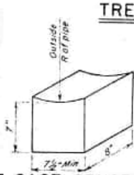
Note: Structure Foundation Excavation to be paid as "Unclassified Core Trench Excavation," and backfill prior to excavating trench to be paid as "Embankment"



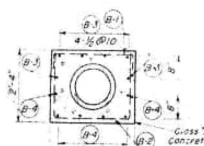
TRENCH DETAIL



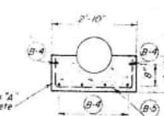
JOINT DETAIL



PRE-CAST CONCRETE SUPPORT BLOCK



SECTION A-A



SECTION B-B

Revised 4-1-54

EMBANKMENT AND OUTLET STRUCTURE
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FT. WORTH, TEXAS

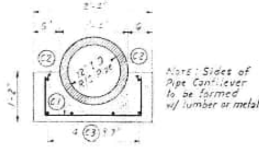
COMPILED H.C.N. TRACED D.S. CHECKED H.C.N. DATE 3/2/54 4-R-8943-2

FOR IN SERVICE USE ONLY

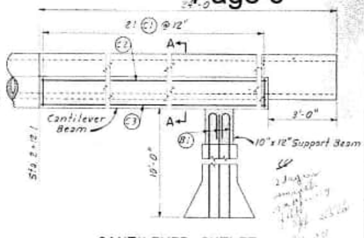
Site No.	Berm Elevation	Embankment to be removed - Cu yds.	Compacted Fill to be placed - Cu yds.	Fence to be removed and rebuilt - Lin. Feet
2	371.0	2,000	7,050	1,400
3	413.5	2,700	15,800	1,600
4	321.5	2,500	12,600	1,250
11	307.0	2,300	8,200	1,850

Note:
Berm Elevation given in table above is elevation of gutter at the midpoint of the berm. Gutter and Berm to be graded at not less than 3 inches and not more than 6 inches per 100 ft. toward each abutment.

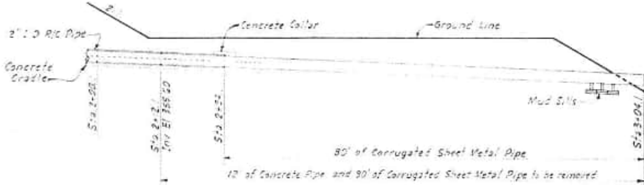
Borrow material for constructing berms to be obtained from designated areas downstream from each dam. Average haul distance 1000 feet or less, except on site No. 4 the average haul will be 1600 feet.



SECTION A-A

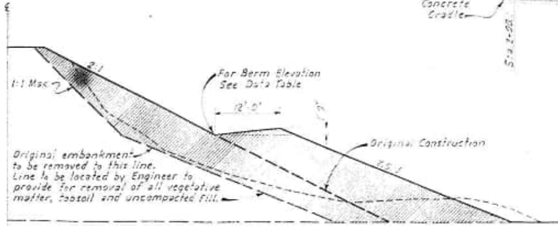


CANTILEVER OUTLET



EXISTING PIPE OUTLET

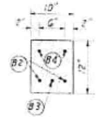
Site No. 1



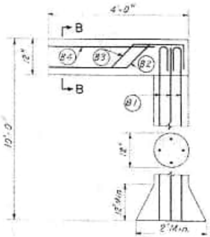
Crosshatched area below berm elevation to be placed as compacted earth fill. Areas above berm elevation not practical to compact with standard rollers shall be compacted by passing D-7 or heavier crawler type tractor not less than 3 passes over each lift.

WITHIN SLIDE AREAS

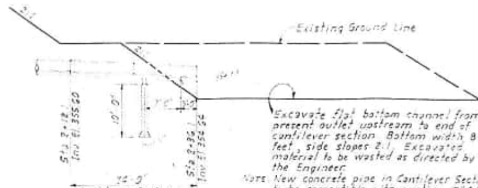
(For Sites 2, 3, 4 and 11)



SECTION B-B



CANTILEVER SUPPORT



Excavate flat bottom channel from present outlet upstream to end of cantilever section. Bottom width 8 feet, side slopes 2:1. Excavated material to be wasted as directed by the Engineer.

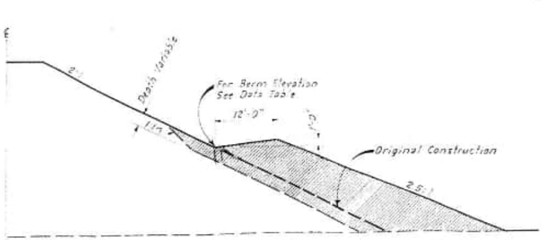
Note: New concrete pipe in Cantilever Section to be compatible with existing 12" I.D. Hume Centrifugal pipe as manufactured by Gifford-Hill American Concrete Pipe Co. Grand Prairie, Texas. Spec. AWWA C-302, 2000 lb D-Load

REVISED OUTLET

(For Site No. 1 only)

For Typical Bar Types Refer to A.C.I. Standard 315-48

Bar No.	Location	Qty	Lgth.	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
B1	Cantilever Sup.	8	10-6	84-0	4	1	0-9	9-9							0-4	
B2	" "	2	9-6	19-0	6	4	0-9	1-0	0-11	4-2	0-11	1-0	0-9	0-8		7-6
B3	" "	1	9-6	9-6	4	4	0-9	1-6	0-11	3-2	0-11	1-6	0-9	0-9		7-6
B4	" "	2	5-6	11-0	4	Str.										
		Total #4 Steel in Cantilever Support = 104'-6" = 69.81 lbs.														
		" #6 " " " " = 19'-0" = 28.54 lbs.														
		Class "B" Concrete in Cantilever Support = 0.85 cu. yds.														
C1	Cantilever Beam	21	3-6	73-6	4	5-10		0-10	1-10	0-10						
C2	" "	2	20-6	41-0	8	Str.										
C3	" "	4	20-6	82-0	4	Str.										
		Total #4 Steel in Cantilever Beam = 155'-6" = 103.87 lbs.														
		" #8 " " " " = 41'-0" = 109.47 lbs.														
		Class "B" Concrete in Cantilever Beam = 1.58 cu. yds.														



Crosshatched Area to be placed as "Compacted Earth Fill". All vegetative matter and topsoil to be removed.

OUTSIDE OF SLIDE AREAS

(For Sites 2, 3, 4 and 11)

TYPICAL EMBANKMENT SECTIONS

Note:
Standing vegetation on slopes (within work areas) to be mowed or shredded and removed prior to commencing earth work operations. Cost of such mowing or shredding and removal to be subsidiary to other items of work.

As Built Changes, Oct. '61

Appendix Sheet 2-A

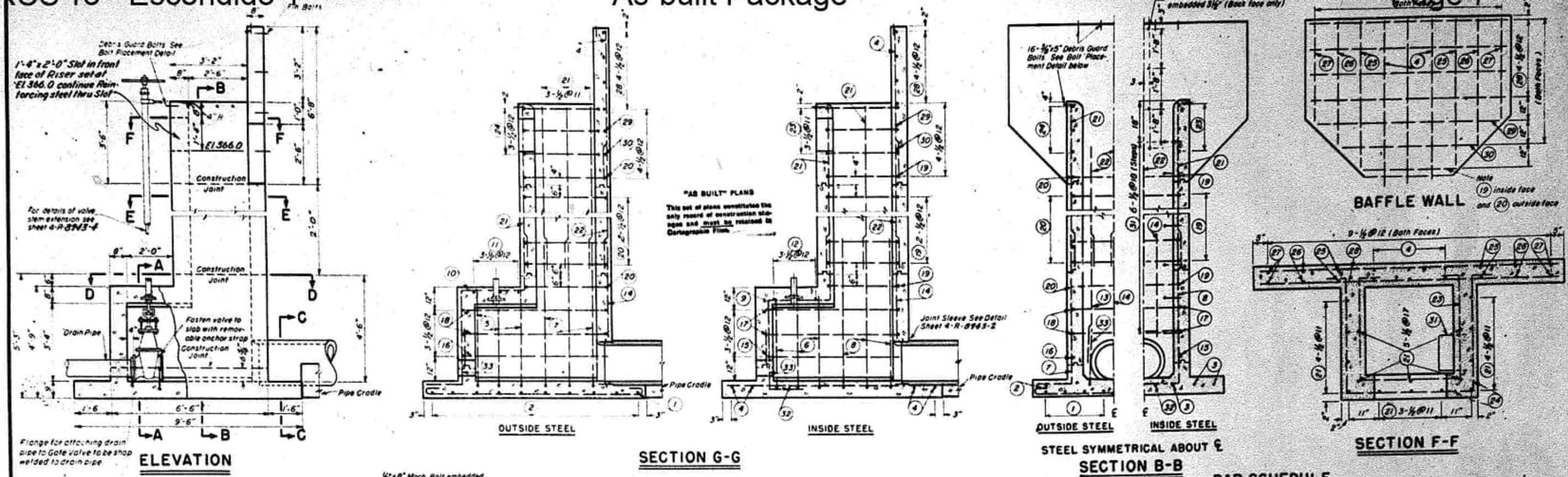
EMBANKMENT AND STRUCTURE REPAIRS
FLOODWATER RETARDING STRUCTURE SITES NO 1,2,3,4 & 11
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed M. P. F.	5-61	Approved by
Drawn M. P. F.	5-61	State Conservation Engineer
Traced C. V. C.	5-61	Drawing No.
Checked J. R. E.		E-15,565

Revised 7-5-61

JUL 24 1961

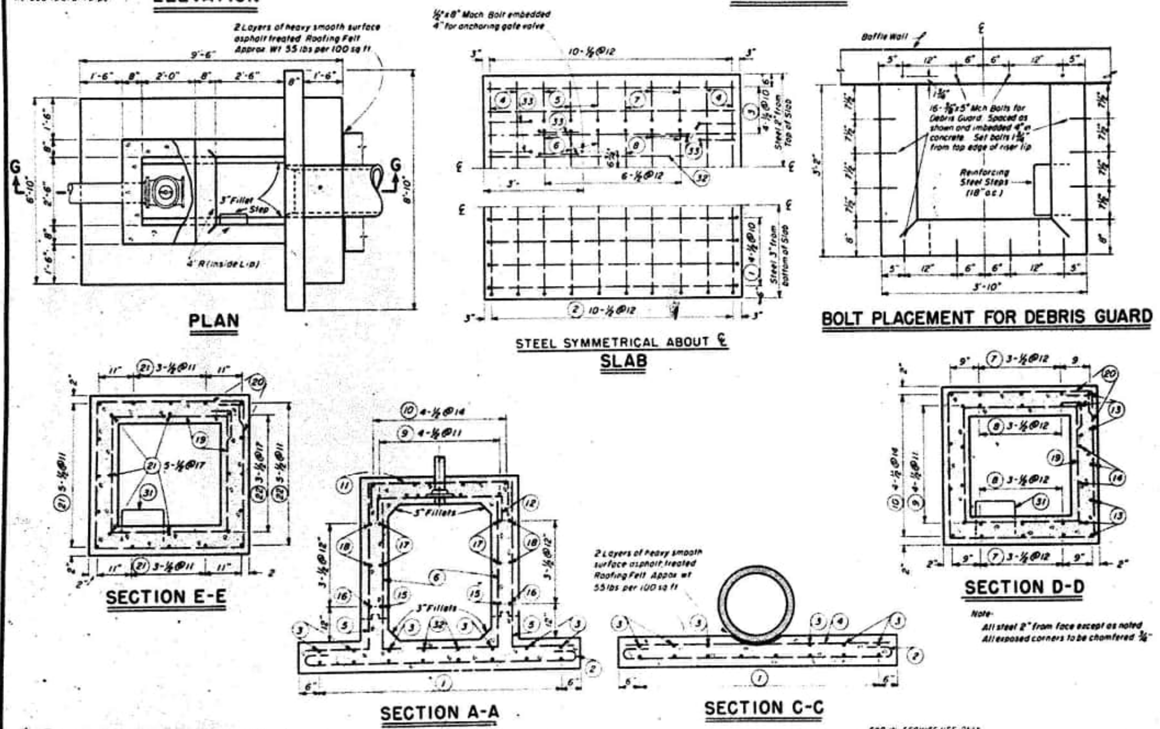


BAR SCHEDULE

Bar No	No. Req'd	Size	Length	Total Length	Type	A	B	C	D	E	F	G	H	J	K	R	O
1	8	½	10-2	81-4	1	0-6	9-2					0-6		0-4			
2	10	½	7-6	75-0	1	0-6	6-6					0-6		0-4			
3	6	½	9-2	55-0	Str.												
4	10	½	6-6	65-0	Str.												
5	6	½	5-6	33-0	2	1-6	4-0										
6	3	½	10-2	30-6	2	3-8	2-10					3-8					
7	6	½	7-10	47-0	2	1-6	6-4										
8	3	½	15-6	46-6	2	6-4	2-10					6-4					
9	4	½	8-3	33-0	8	2-11	2-8					2-9					
10	4	½	8-3	33-0	8	3-3	2-8					2-4					
11	3	½	4-8	14-0	2	0-7	3-6					0-7					
12	3	½	4-0	12-0	2	0-7	2-10					0-7					
13	6	½	5-8	34-0	Str												
14	3	½	3-11	11-9	Str												
15	2	½	8-1	16-2	2	2-3	4-10										
16	2	½	8-9	17-6	2	2-7	8-2										
17	4	½	10-0	40-0	2	2-3	5-6					2-3					
18	4	½	11-4	45-4	2	2-7	6-2					2-7					
19	4	½	12-6	50-0	T-2	0-7	2-10	2-10	2-10	2-10		0-7					
20	4	½	15-2	60-8	T-2	0-7	3-6	3-6	3-6	3-6		0-7					
21	16	½	5-2	82-8	Str												
22	8	½	3-3	26-0	Str												
23	3	½	9-8	29-0	S-6	0-7	2-10	2-10	2-10			0-7					
24	3	½	11-0	33-0	S-4	0-7	3-2	3-6	3-2			0-7					
25	4	½	6-0	24-0	Str												
26	4	½	5-0	20-0	Str												
27	4	½	4-0	16-0	Str												
28	8	½	8-6	68-0	Str												
29	2	½	7-9	15-6	Str												
30	2	½	5-9	11-6	Str												
31	6	½	2-8	16-0	2	0-10	1-0					0-10					
32	2	½	7-0	14-0	Str												
33	14	½	3-10	53-8	2	1-6	2-4										

All Dimensions are out to out. For Typical Bar Types refer to ACI Standard 315-48

Total ½"φ Steel in Structure Inlet = 1211'-5" = 809.23 lbs
Total Class "X" Concrete in Structure Inlet = 6.50 cu. yds.



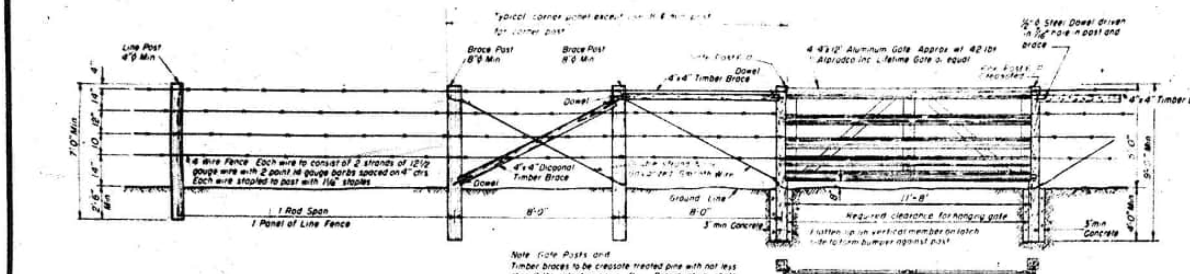
Revised 4-1-54

INLET STRUCTURE DETAILS
FLOODWATER RETARDING STRUCTURE SITE No.1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FT. WORTH, TEXAS

Compiled H.C.N. Traced D.S. Checked H.C.N. Date 3/2/54 4-R-8943-3

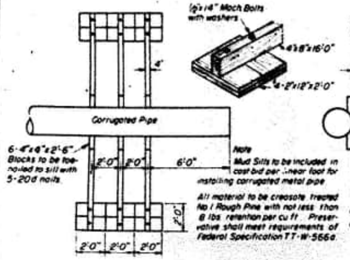
Revised 9-21-53 R.D.B. Base for 30"x30" Standard Inlet Details 4-R-7437

FOR IN-SERVICE USE ONLY

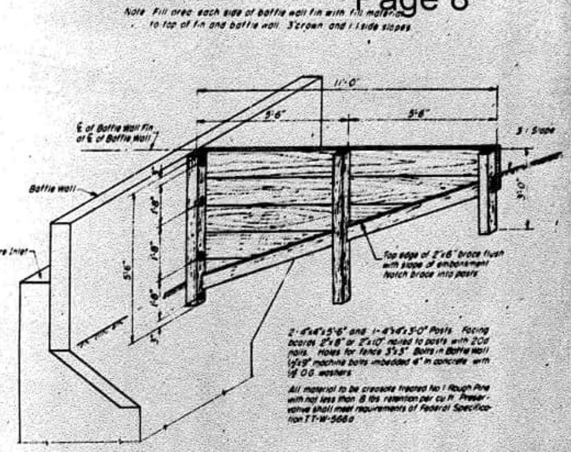


FENCE AND GATE DETAIL

"AS BUILT" PLANS
This set of plans constitutes the only record of construction changes and must be retained in Cartographic Files.

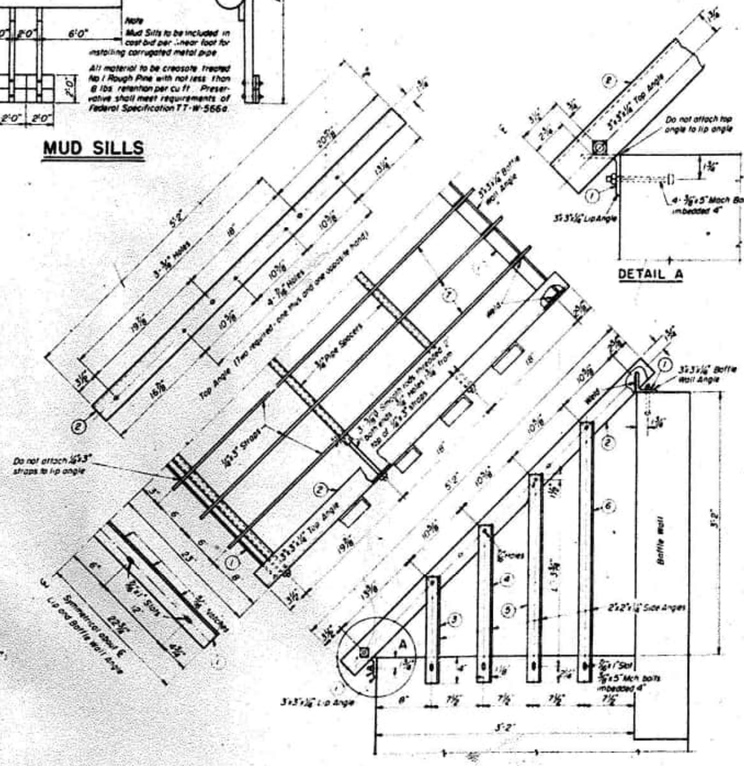


MUD SILLS

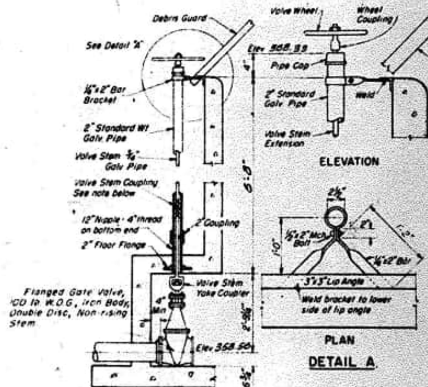


BAFFLE WALL FIN

MATERIAL SCHEDULE					
Mark	Quan	Description	Size	Length	Total
1	2	Baffle Wall & Lip Angle	3"x3"x¼"	3'-9½"	7'-7"
2	2	Top Angle	3"x3"x¼"	5'-2"	10'-4"
3	2	Side Angle — One right hand	2"x2"x¼"	1'-3½"	2'-7"
4	2	" " — One left hand	"	1'-11"	3'-10"
5	2	" "	"	2'-6½"	5'-1"
6	2	" "	"	3'-2"	6'-4"
7	6	Grill Straps	¼"x3"	5'-2"	31'-0"
	3	Rods - 2" thrd ea end/nuts	⅝"Ø	4'-1"	12'-3"
	15	Pipe Spacers	¾"Ø	0'-5¾"	7'-2¼"
	6	" "	¾"Ø	0'-7⅝"	3'-9½"
	16	Mach Bolts and Nuts	⅝"x5"		
	8	" " " "	⅝"x1½"		



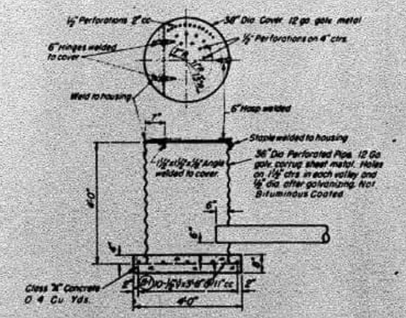
DEBRIS GUARD



DETAIL A

VALVE STEM EXTENSION

Note: Coupling in Valve Stem Extension approx 8" above 12" Nipple. Coupling to consist of galv pipe sleeve and not less than 3-¼" steel pins each end.



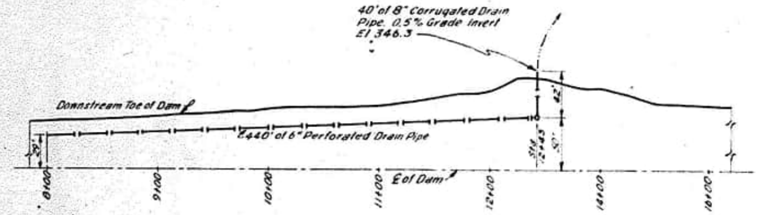
INLET FILTER HOUSING

DETAILS
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FORT WORTH, TEXAS

REFERENCE
CARTOGRAPHIC APPROVAL TECHNICAL APPROVAL
COMPILED H.C.N. TRACED D.S. 4-R-8943-4

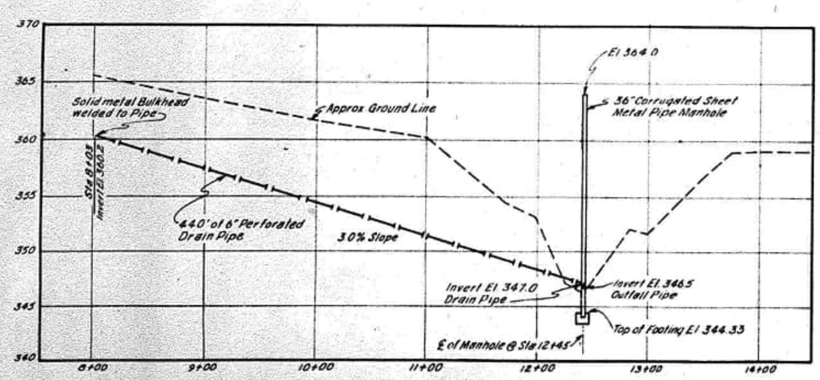
FOR IN-SERVICE USE ONLY

Detail Sheet for 30"x30" Structure Inlet (Wire Fence) Base 4-R-7447



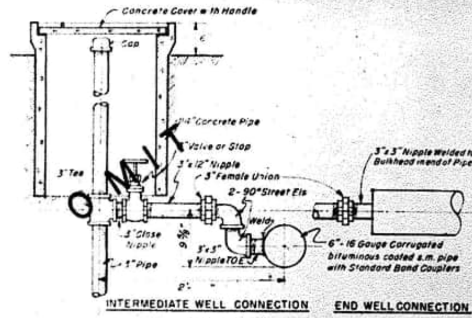
PLAN OF EMBANKMENT FOUNDATION DRAIN

"AS BUILT" PLANS

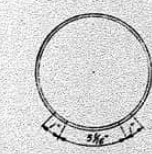


PROFILE ON ℄ OF EMBANKMENT FOUNDATION DRAIN

Note: All pipe, coupling, manhole and rodent guard to be furnished by the Government without additional cost to the contractor f.o.b. job site.

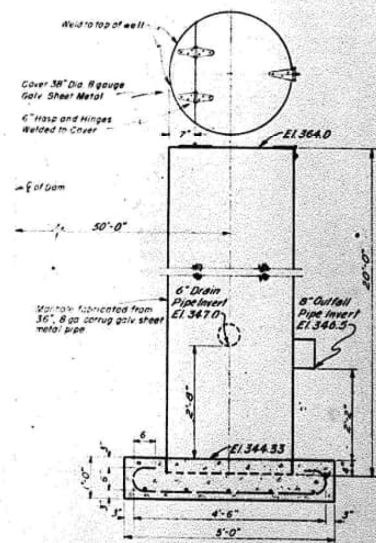


WELL CONNECTIONS

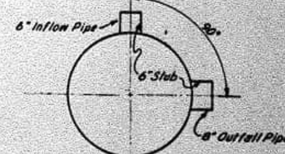


6" Dia. Galvanized Corrugated Sheet Metal Pipe 16 Gauge bituminous coated. Perforations to be 5/16" after coating. Holes to start 4" from each end of each section. Holes to be in volley and not less than 16 holes per. lin. ft. of pipe.

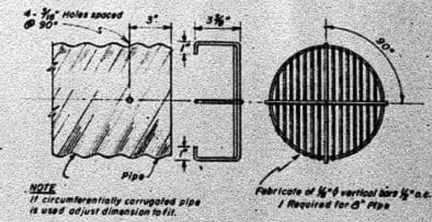
PERFORATED PIPE DETAIL



10-½" φ x 5'-10" @ 12" cc = 58'-4" = 39 lbs.
Class "A" Concrete = 0.93 Cu. Yds.

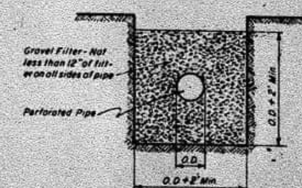


MANHOLE DETAILS



NOTE
If circumferentially corrugated pipe is used adjust dimension to fit.

RODENT GUARD



TRENCH FOR PERFORATED PIPE

Note: The gravel filter shall grade within the following limits

Screen Size	Percent Passing
½"	85-100
4	[illegible]
10	[illegible]
20	[illegible]
30	[illegible]
50	[illegible]

EMBANKMENT FOUNDATION DRAIN
FLOODWATER RETARDING STRUCTURE SITE No. 1
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Revised 4-8-56

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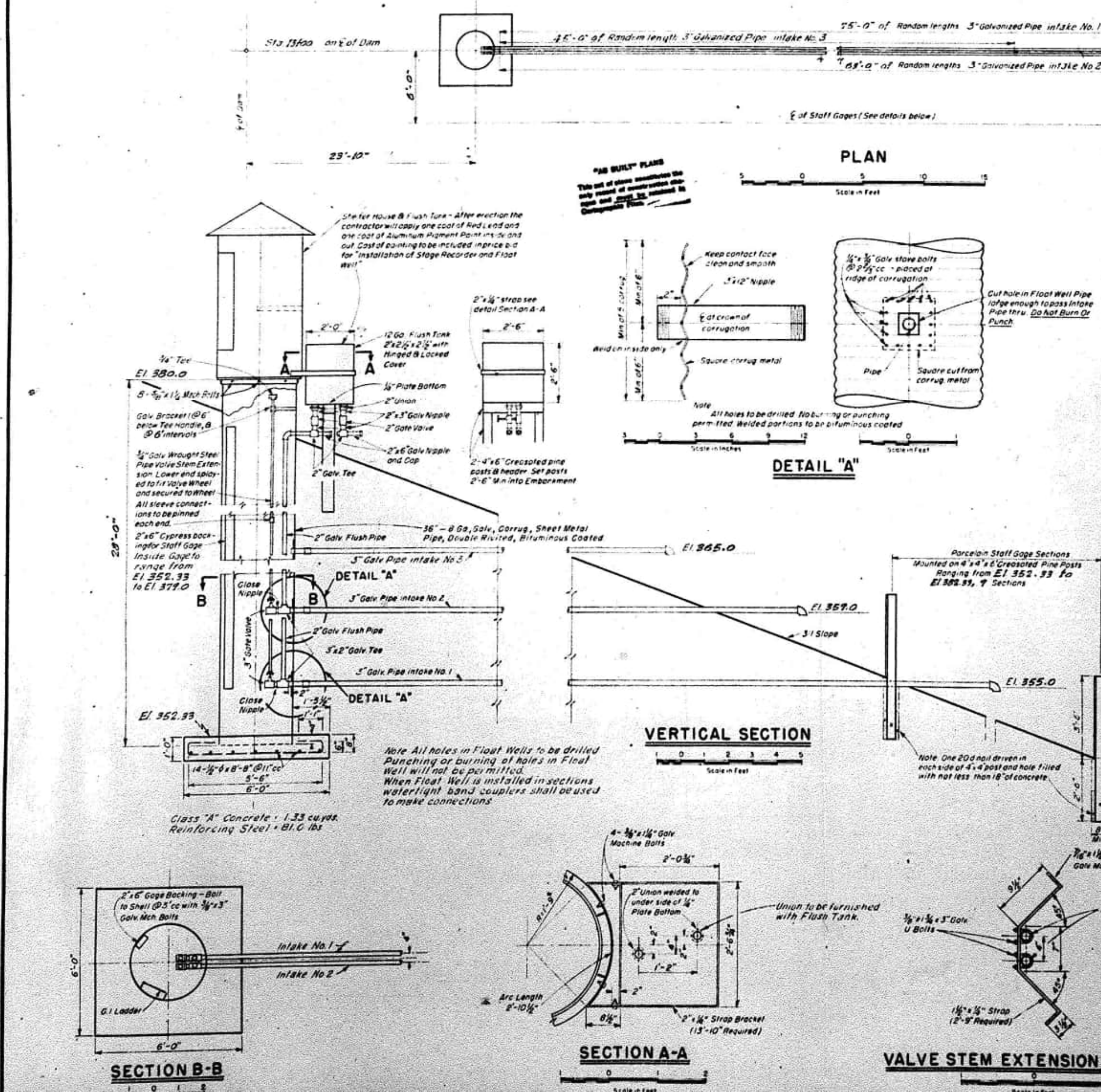
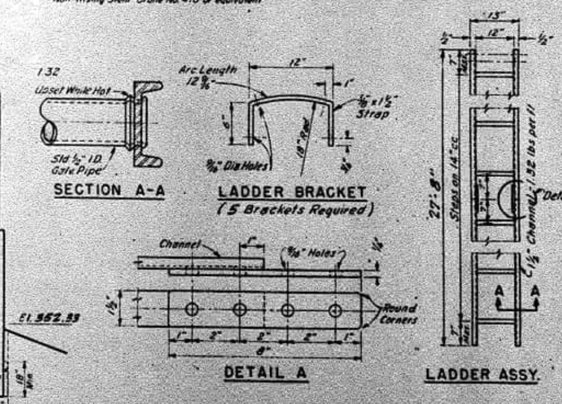
4-R-8943



Note: Items 18, Flush Tank; 19, Flush Tank Bracket; 26, Shelter House; 27, Staff Gage (inside); and 32, Staff Gage (outside) to be furnished by the government without additional charge, f.o.b. Kenedy, Texas.
All other items required for the installation to be furnished by the contractor in accordance with the specifications.

	Item	Size	Quan	Unit		Item	Size	Quan.	Unit
1	Std Galv Steel Pipe (TBC)	3"	183	Lin ft	21	Creosoted Post	4"x6"x4'-2"	2	Each
2	Std Galv Steel Elbow 90°	3"	3	Each	22	Creosoted Header	4"x6"x2'-6"	1	Each
3	" " " Tee	3"x2"	2	"	23	"Emsco" Galv Ladder (or equal)	See Detail	27 2/3	Lin Ft
4	Gate Valve *	3"	2	"	24	Galv Ladder Bracket	–	5	Each
5	Std Galv Steel Nipple	3" Close	2	"	25	Corrug S M Pipe	36"	28	Lin Ft
6	Std Galv Steel Pipe	2"	42	Lin Ft	26	Shelter House	42"	1	Each
7	" " " Elbow 90°	2"	2	Each	27	Staff Gage (Inside)	3'-4"	8	Sections
8	" " " Nipple	2"x1'-0"	1	Each	28	" " (Cypress Back)	2"x6"	28	Lin Ft
9	" " " Pipe (T.B.E.)	2"x2'-7"	1	"	29	Concrete (Class A)		1.33	Cu Yds
10	" " " Tee	2"	2	"	30	Reinforcing Steel	1/2-Φ	81.0	Lbs
11	" " " Nipple	2"x0'-6"	2	"	31	Creosoted Post	4"x4"x6"	9	Each
12	" " " Cap	2"	2	"	32	Staff Gage (Outside Consec)	3'-4"	9	Section
13	" " " Nipple	2"x0'-3"	4	"	33	Galv. Machine Bolts	3/8"x1 1/4"	12	Each
14	Gate Valve	2"	2	"	34	" " "	3/8"x3"	6	"
15	Std Galv Steel Tee	3/4"	2	"	35	" " "	1/2"x1 1/4"	20	"
16	" " " Pipe (TBC)	3/4"	45	Lin Ft	36	Galv Stove Bolts	1/4"x3/4"	48	"
17	Valve Stem Ext Bracket	See Detail	4	Each	37	Corrug Patch w/Nipple	See Detail	3	"
18	Flush Tank	–	1	"					
19	" " Bracket	–	1	"					

* Non-Rising Stem Crane No. 410 or equivalent



STAGE RECORDER LADDER DETAILS

Note: Ladder and brackets to be cleaned and painted with one or more coats of zinc dust - zinc oxide primer.

STAGE RECORDER FLOAT WELL
FLOODWATER RETARDING STRUCTURE SITE No. 1
ESCONDIDO CREEK WATERSHED
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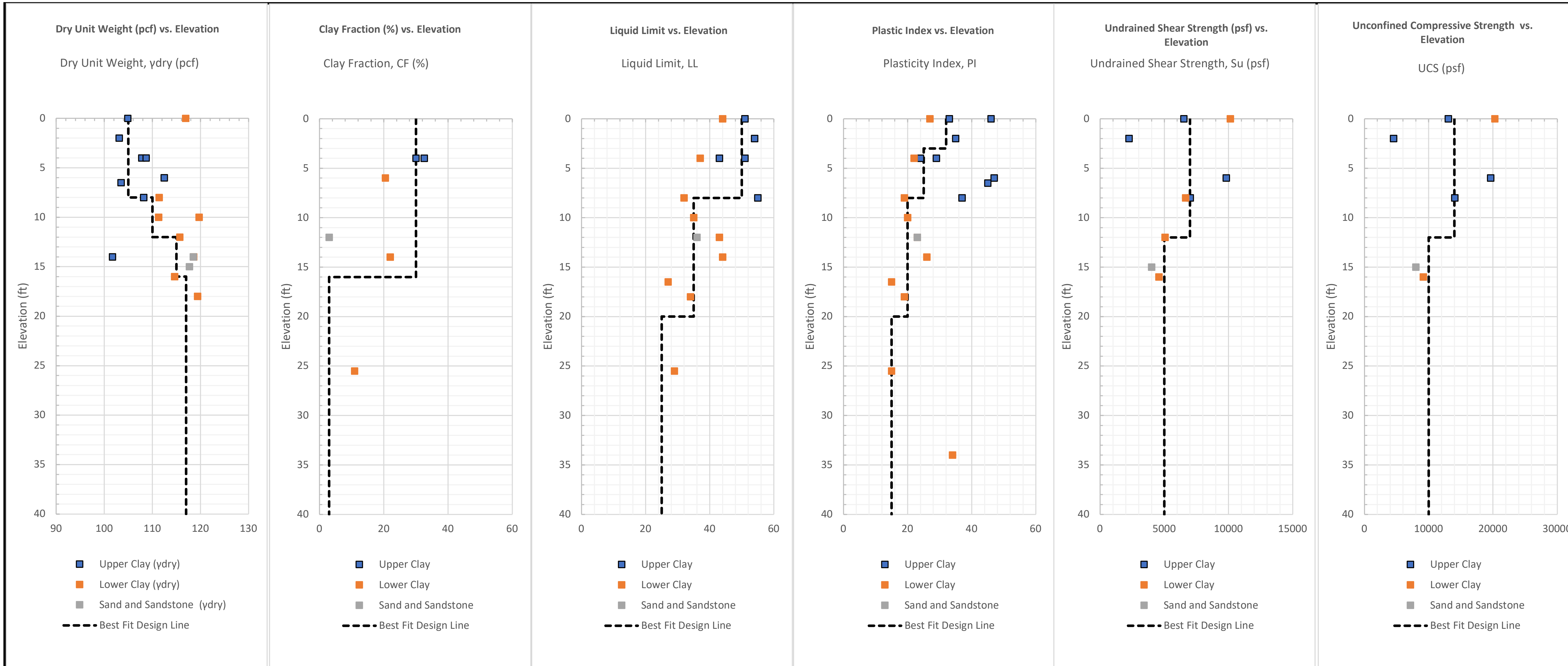
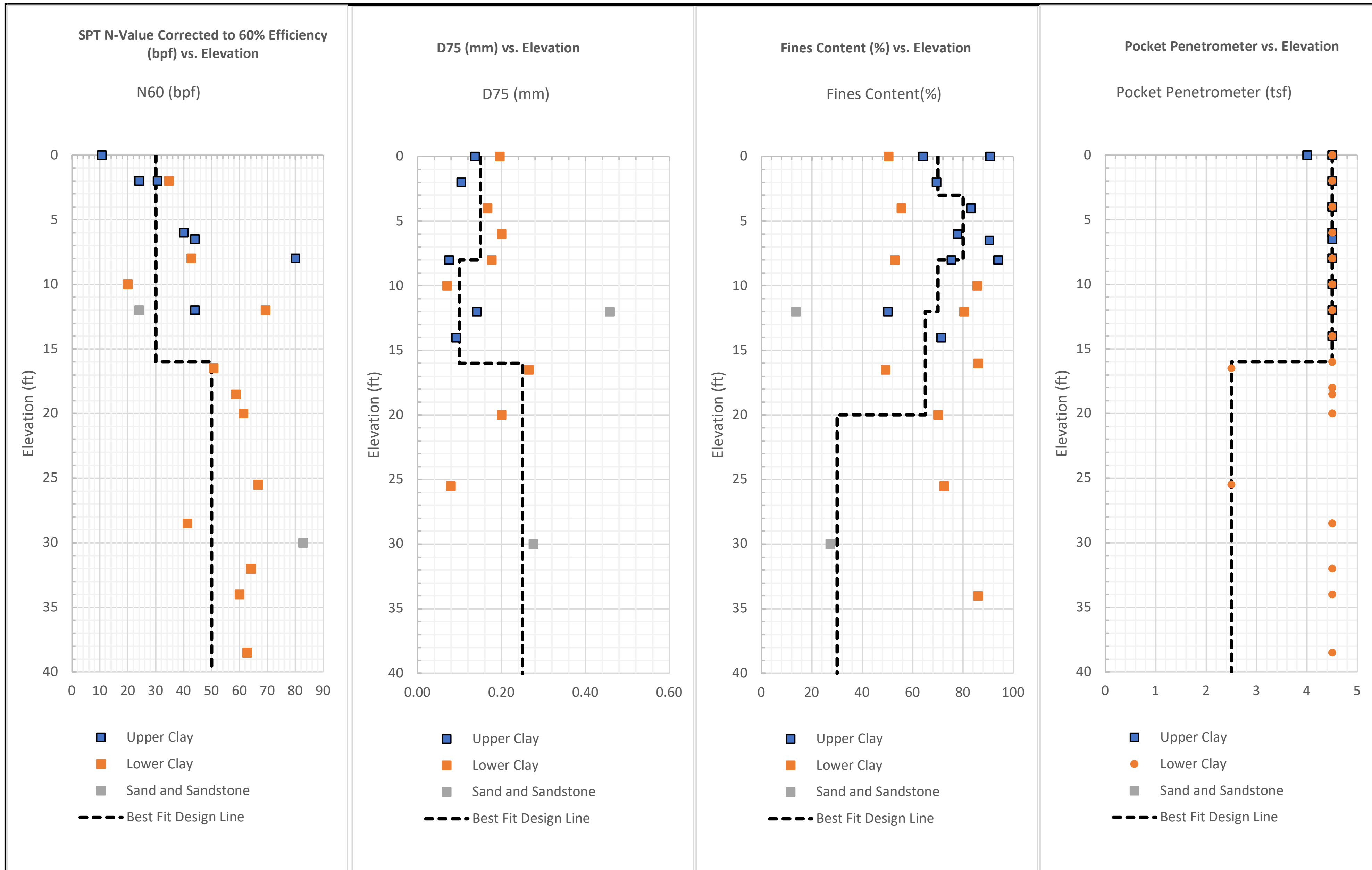
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FORT WORTH, TEXAS

ATTACHMENT 2.

LABORATORY TEST DATA PLOTS FOR ASW BORINGS



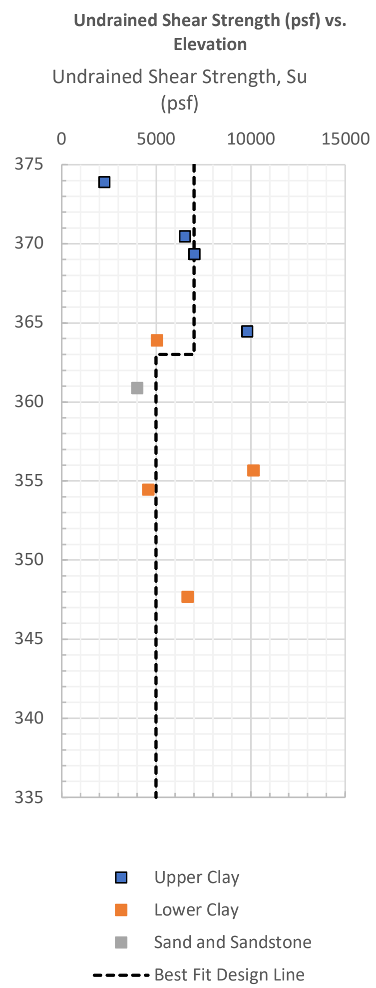
Escondido FRS No. 1 SWP-EA		Project No. 60707486
Geotechnical Laboratory Testing Summary Plots (Elevation)		
AECOM	September 2023	Attachment No. 1

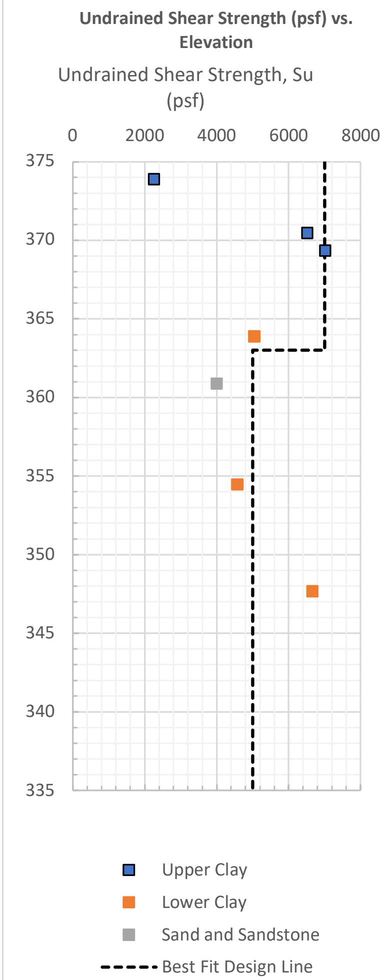


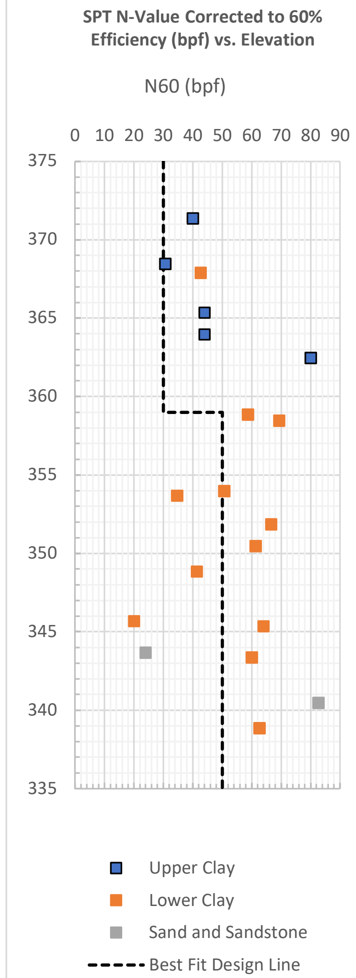
Escondido FRS No. 1 SWP-EA	Project No. 60707486
Geotechnical Laboratory Testing Summary Plots	
AECOM — September 2023	Attachment No. 1

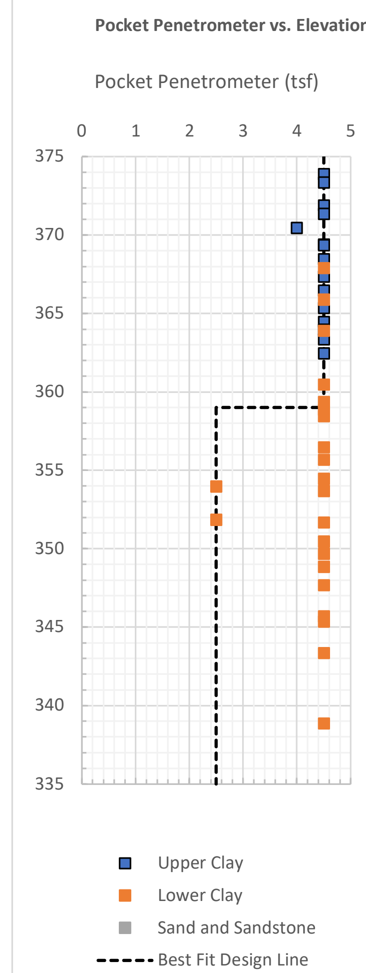
ATTACHMENT 3.

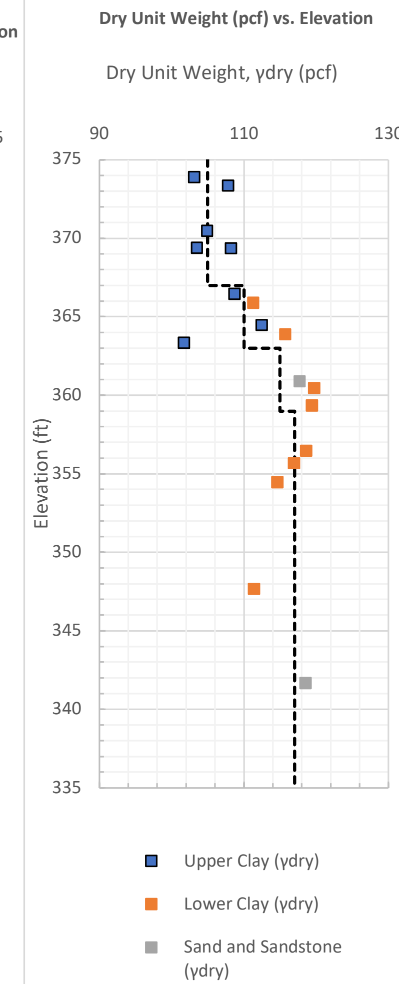
HEADCUT ERODIBILITY INDEX (Kh) CALCULATIONS











Best Fit Design Lines

Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
0	7000	30	4.5	105
3	7000	30	4.5	105
3	7000	30	4.5	105
8	7000	30	4.5	105
8	7000	30	4.5	110
12	7000	30	4.5	110
12	5000	30	4.5	115
16	5000	30	4.5	115
16	5000	50	2.5	117
20	5000	50	2.5	117
20	5000	50	2.5	117
40	5000	50	2.5	117

Estimated Kh Values

Depth(ft)	From Su1[1]	From Su2[2]	From N60[3]	From N60[4]	From PP1[1]	From PP1[2]	Avg
0	0.69	0.50	0.44	---	0.44	0.31	0.48
3	0.69	0.50	0.44	---	0.44	0.31	0.48
3	0.69	0.50	0.44	---	0.44	0.31	0.48
8	0.69	0.50	0.44	---	0.44	0.31	0.48
8	0.69	0.50	0.44	---	0.44	0.31	0.48
12	0.69	0.50	0.44	---	0.44	0.31	0.48
12	0.49	0.35	0.44	---	0.44	0.31	0.41
16	0.49	0.35	0.44	---	0.44	0.31	0.41
16	---	---	---	0.19	---	---	0.19
20	---	---	---	0.19	---	---	0.19
20	---	---	---	0.19	---	---	0.19
40	---	---	---	0.19	---	---	0.19

(1) Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4

(2) Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3

(3) Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3

Clay Layers - Summary of Lab Strength Tests

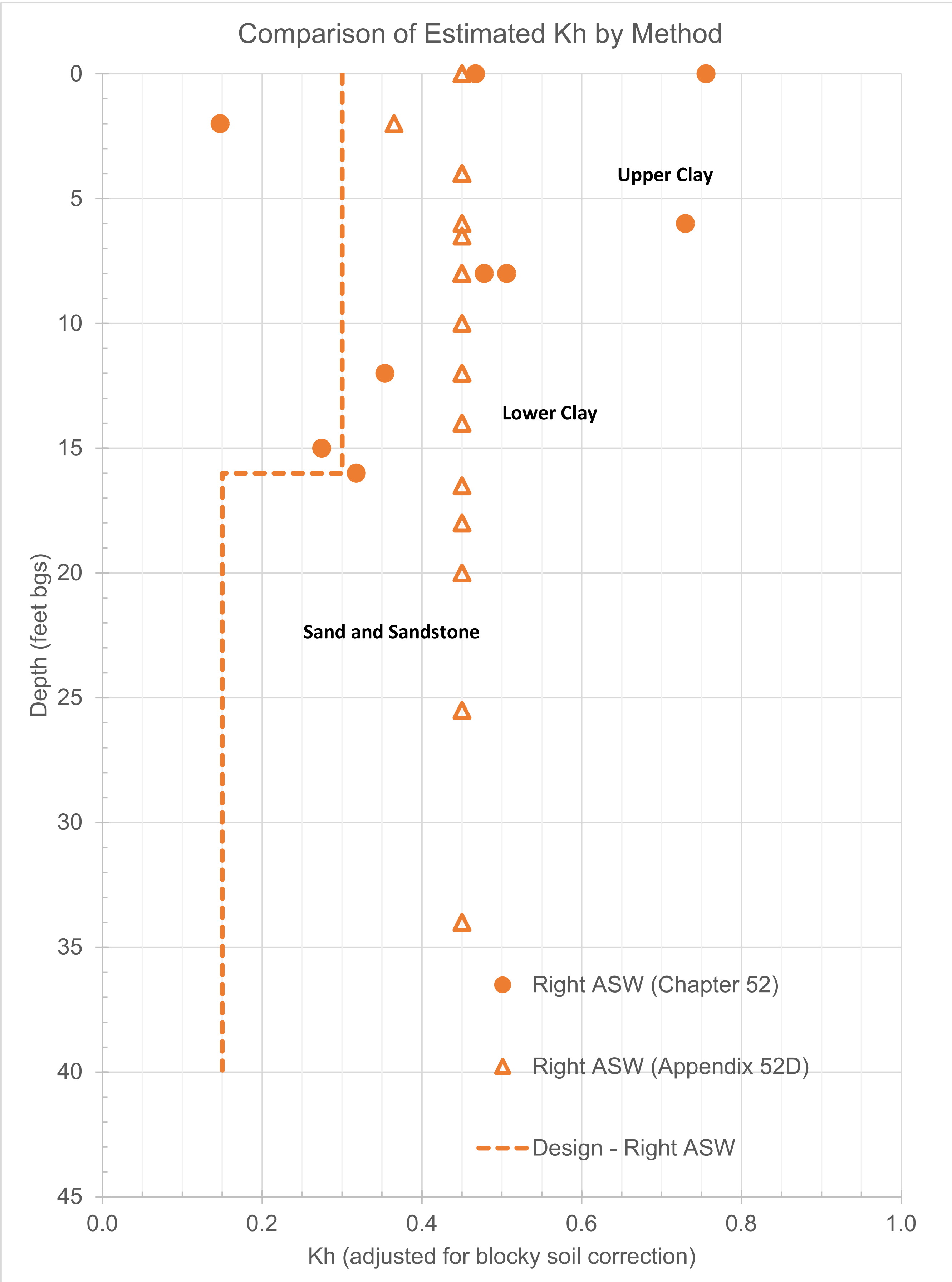
Boring ID	Depth (ft)	LL	PI	% Passing No. 200 Sieve	UU (natural moisture)			UC (natural moisture)		
					WCn (%)	DDn (pcf)	Su (psf)	WCn (%)	DDn (pcf)	Su (psf)
201-23	2	54	35	69.5	-	-	-	20.8	103.1	2,260
201-23	12	43	23	80.4	15.0	115.7	5,050	-	-	-
202-23	8	55	37	93.9	-	-	-	21.5	108.2	7,020
203-23	0	67	46	90.7	-	-	-	20.3	104.9	6,520
203-23	6	68	47	77.8	-	-	-	13.3	112.5	9,820
203-23	16	NT	NT	86	-	-	-	14.9	114.6	4,580
204-23	0	44	27	50.4	-	-	-	9.7	116.9	10,140
204-23	8	32	19	52.9	15.7	111.4	6,660	-	-	-
Average		51.9	33.4	75.2	15.4	113.6	5,855	16.8	110.0	6,723

Escondido FRS No. 1 SWP-EA	Project No. 60707486
Parameters for Kh Development (Depth)	
AECOM / September 2023	Attachment No. 3

Attachment 2
Estimate of Kh for Cohesive Soils
Escondido FRS 1, Karnes County, TX

*Red values denote assumed values when lab values not available

																						NEH Part 628, Chapter 52 Correlation					NEH Part 628, Appendix 52D Correlation					
Boring ID	Top (ft bgs)	Bottom (ft bgs)	Sample ID	Stratum	Field USCS	Lab USCS	w-n (%)	DD (pcf)	TD (pcf)	Gravel (%)	Sand (%)	Fines (%)	Clay (%)	LL	PL	PI	Gs*	Test Type	$\varepsilon_{failure}$ (%)	Su (psf)	Blocky Clay Correction?	UCS (psf)	UCS (kPa)	UCS (Mpa)	Ms	Kh-adj	w-sat (%)	LI-n	LI-sat	Su-sat (psf)	Kh	Kh-adj
LEFT AUXILIARY SPILLWAY																																
201-23	0	0.5	SS-1A		CL	CH	10.0			0.0	35.9	64.1		51	18	33	2.7				NO	-	-	-	-	-	-	-0.24	-	-	0.45	0.45
	0.5	1.5	SS-1B		CL		9.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	2	4	ST-2		CL	CH	20.8	103.1	124.5	0.0	30.5	69.5		54	19	35	2.7	UC	6.8	2,260	NO	4,520	216	0.22	0.15	0.15	23.5	0.05	0.13	2,565	0.36	0.36
	4	6	P-3		CL		17.0						32.6				2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	6.5	8	ST-4		CL	CH	16.0	103.5	120.1	0.0	9.6	90.4		67	22	45	2.7				NO	-	-	-	-	-	23.3	-0.13	0.03	3,632	0.45	0.45
	8	9.5	SS-5		CL		16.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	10	12	P-6		CL		12.0	111.3	124.7								2.7				NO	-	-	-	-	-	19.0	-	-	-	-	-
	12	14	ST-7		CL	CL	15.0			0.4	19.2	80.4		43	20	23	2.7	UC	11.09	5,050	NO	10,100	484	0.48	0.35	0.35	-	-0.22	-	-	0.45	0.45
	15	20	RC-1		Sandstone		11.0	117.7	130.6			0.8	0.8				2.7	UC		4,003	NO	8,006	383	0.38	0.27	0.27	16.0	-	-	-	-	-
	20	25	RC-2		Sandstone		6.0							53	19	34	2.7				NO	-	-	-	-	-	-	-0.38	-	-	0.45	0.45
202-23	0	2	P-1		OL & CL		16.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	2	3.5	SS-2		CL		19.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	P-3		CL	CH	19.0	107.8	128.3	0.0	16.9	83.1		51	22	29	2.7				NO	-	-	-	-	-	20.8	-0.10	-0.04	4,000	0.45	0.45
	6	7.5	SS-4		CL		12.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	8	10	ST-5		CL	CH	18.0	108.2	127.7	0.0	6.1	93.9		55	18	37	2.7	UC	1	7,020	NO	14,040	672	0.67	0.51	0.51	20.6	0.00	0.07	3,125	0.45	0.45
	10	12	P-6		CL		20.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	12	13.5	SS-7		CL		14.0			0.0	49.8	50.2					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	14	16	P-8		CL		13.0	101.7	114.9	0.0	28.7	71.3					2.7				NO	-	-	-	-	-	24.3	-	-	-	-	-
	18	18.5	ST-9		CL	CL	12.0	119.4	133.7					34	15	19	2.7				NO	-	-	-	-	-	15.2	-0.16	0.01	3,840	0.45	0.45
	18.5	20	SS-10		CL		10.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	25.5	27	SS-11		SM & CL	CL	10.0			0.3	27.2	72.5	0.0	29	14	15	2.7				NO	-	-	-	-	-	-	-0.27	-	-	0.45	0.45
	28.5	30	SS-12		SM & CL		11.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	32	33.5	SS-13		CL		25.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	34	35.5	SS-14		CL	CH	22.0			0.0	14.0	86.0		64	30	34	2.7				NO	-	-	-	-	-	-	-0.24	-	-	0.45	0.45
	38.5	40	SS-15		CL		19.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	0	2	ST-1		CL	CH	20.3	104.9	126.2	0.0	9.3	90.7		67	21	46	2.7	UC	2.7	6,520	NO	13,040	624	0.62	0.47	0.47	22.4	-0.02	0.03	3,586	0.45	0.45
	2	3.5	SS-2		CL		21.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	P-3		CL		13.0	108.7	122.8					43	19	24	2.7				NO	-	-	-	-	-	20.4	-0.25	0.06	3,283	0.45	0.45
	6	6.5	ST-4		CL	CH	13.0			0.0	22.2	77.8		68	21	47	2.7	UC	1.51	9,820	NO	19,640	940	0.94	0.73	0.73	-	-0.17	-	-	0.45	0.45
	6.5	8	SS-5		CL		12.0	112.5	126.0								2.7				NO	-	-	-	-	-	18.4	-	-	-	-	-
	8	9.5	SS-6		CL		14.0			0.2	24.6	75.3					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	10	12	P-7		CL	CL	11.0	119.7	132.9	2.4	12.0	85.6	2.0	35	15	20	2.7				NO	-	-	-	-	-	15.1	-0.20	0.00	3,936	0.45	0.45
	12	13.5	SS-8		CL		13.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	14	16	P-9		CL		13.0	118.6	134.0					44	18	26	2.7				NO	-	-	-	-	-	15.6	-0.19	-0.09	4,000	0.45	0.45
	16	16.5	ST-10		SP		15.0			0.0	14.0	86.0					2.7	UC	1.91	4,580	NO	9,160	439	0.44	0.32	0.32	-	-	-	-	-	-
	16.5	18	SS-11		SP	SC	10.0	114.6	126.1	0.0	50.8	49.2		27	12	15	2.7				NO	-	-	-	-	-	17.4	-0.13	0.36	1,146	0.45	0.45
	20	21.5	SS-12		SP		13.0			0.6	29.3	70.1					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	22	25	RC-1		Sandstone		17.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	30	31.5	SS-13		SW		17.0			2.8	69.8	27.3					2.7				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	0	2	ST-1		CL	CL	9.7	116.9	128.2	0.0	49.6	50.4		44	17	27	2.7	UC	9	10,140	NO	20,280	971	0.97	0.76	0.76	16.3	-0.27	-0.02	4,000	0.45	0.45
	2	3.5	SS-2		CL		7.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	ST-3		CL	CL		127.8		0.0	44.5	55.5		37	15	22	2.7				NO	-	-	-	-	-	11.8	-0.68	-0.15	4,000	0.45	0.45
	6	8	P-4		CL		8.0						20.5				2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	8	10	ST-5		SC	CL		111.4		0.0	47.1	52.9		32	13	19	2.7	UC	2.46	6,660	NO	13,320	638	0.64	0.48	0.48	19.0	-0.68	0.31	1,343	0.45	0.45
	10	11.5	SS-6		SC	CL	11.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
	12	13.5	SS-7		SC	SC	10.0			0.5	85.8	13.8	6.0	36	13	23	2.7				NO	-	-	-	-	-	-	-0.13	-	-	0.45	0.45
	14	20	RC-1		Sandstone		10.0										2.7				NO	-	-	-	-	-	-	-	-	-	-	-
																	MIN			**2,260**						**0.15**			**MIN**	**1,146**	**0.36**	**0.36**
																	MAX			**10,140**						**0.76**			**MAX**	**4,000**	**0.45**	**0.45**
																	AVG			**6,228**						**0.45**			**AVG**	**3,266**	**0.45**	**0.45**



Comparison of Estimated Kh by Method
Upper Clay
Lower Clay
Sand and Sandstone
Depth (feet bgs)
0
5
10
15
20
25
30
35
40
45
0.0
0.2
0.4
0.6
0.8
1.0
Kh (adjusted for blocky soil correction)
Right ASW (Chapter 52)
Right ASW (Appendix 52D)
Design - Right ASW

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October, 2024

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Preliminary Soil Mechanics Report

Escondido Creek Floodwater Retarding Structure No. 1 SWP-EA, Karnes County, TX

This letter provides geotechnical laboratory testing results which are herein submitted as the Preliminary Soil Mechanics Report (SMR) for the above referenced project. Results of the laboratory tests completed are intended to supplement the finding presented in the Geologic Investigation Report (GIR) dated October 2024, submitted by AECOM under separate cover. The purpose of this Preliminary SMR is to summarize the results of the laboratory testing. Geotechnical engineering analyses of the dam / ancillary structures or engineering recommendations for rehabilitation final design are beyond the scope of this Preliminary SMR.

This report was prepared by AECOM for the San Antonio River Authority in accordance with the Project Scope of Work for the SWP-EA for Escondido FRS No. 1, Karnes County, Texas Task Order #10 C230141, and executed under the terms and conditions of IDIQ Contract No. C210002, which was requested on August 3, 2020 and authorized on August 3, 2022.

Testing Summary and Results

Laboratory testing performed on select samples recovered from the geologic investigation included index properties, dispersion potential, corrosion potential, compressive strength and shear strength, and laboratory moisture-density (Proctor) according to the following standardized test methods:

- Moisture content (ASTM D2216)
- Atterberg Limit (ASTM D4318)
- Sieve analysis (ASTM D6913)
- Wash #200 sieve (D1140)
- Hydrometer (ASTM D7928)
- Dry unit weight (ASTM D7263)
- Unconfined compression – Soil ([ASTM D2166)
- Unconfined compression – Rock (ASTM D7012)
- Unconsolidated-undrained (UU) triaxial testing (ASTM D2850).
- Crumb test (ASTM D6572)
- Double hydrometer (ASTM D4221)
- Pinhole test (ASTM D4647)
- Standard Proctor moisture-density (ASTM D698)

The GIR presented the subsurface conditions according to the following generalized stratigraphy below (descending order relative to depth). The laboratory summary tables discussed in the following paragraphs of this report denote the stratum to which each sample belongs.

- Upper Clay (Residuum)
- Lower Clay (Residuum)

- Sand and Sandstone (Oakville Sandstone Formation)

The index tests have been summarized for each stratum in **Table 1**. The Upper Clay layer generally classifies as a fat clay (CH) with an average LL of 57 and PI of 37. The Lower Clay layer classifies as a lean clay (CL) with an average LL of 39 and PI of 22. The Sand and Sandstone layer classifies as a clayey sand (SC) on the basis of limited gradation and Atterberg limits testing, but also contains clay layers and moderately-cemented sandstone lenses.

A summary of the strength tests is provided in **Table 2**. The resulting undrained shear strengths (Su) are consistent with very stiff to hard cohesive soils. Discussion of the results and interpretation for use in the SITES program are provided under the SITES Technical Memorandum (AECOM 2024) submitted under separate cover.

The results of Standard Proctor testing on four bulk samples collected from the 5 feet of the spillway channel are summarized in **Table 3**. The purpose of this testing was to evaluate the moisture-density relationships of materials that may be excavated and re-used as earthfill material for potential rehabilitation improvements which include spillway channel grading.

The results of single rock compressive strength test performed on an intact sandstone sample are summarized in **Table 4**. The resulting compresive strength of 55.6 psi is consistent with a classification of Extremely Weak Rock (R0) according to the International Society of Rock Mechancis (ISRM) strength rating.

The dispersion test summary is provided in **Table 5**. One sample in the Upper Clay classified as dispersive based on the crumb test (Grade 4), but the double-hydrometer showed non-dsipersive (<30%). A pinhole test was also completed on this sample and was non-dispersive (ND1). Other crumb test results classified as non-dispersive in the Upper Clay. The Lower Clay layer had several crumb test of grade 4 and one double hydrometer that indicated the material was dispersive (>50%). Two pinholes tests were performed to confirm the dispersion potential of the Lower Clay: one test was on a sample adjacent to the sample with a grade 4 crumb test result, and the other test performed on the sample with the grade 4 crumb test results and double hydrometer result of >50%. Both pinhole results showed non-dispersive behavior (ND1).

Corrosivity testing was completed on the four bulk samples. These included the following test methods and results reported as minimum – maximum (average) below. Published thresholds for aggressive (corrosive) soil generally include electrical resistivity values less than 2,000 ohm-cm, soluble sulfate contents greater than 200 ppm, and soluble chloride contents greater than 100 ppm. Based on the results below, site soils should be considered aggressive with respect to potential corrosion of buried concrete and metal.

- pH analysis (ASTM G51): 7.5 – 7.9 (7.7)
- Electrical resistivity (ASTM G187): 895 – 1,790 (1,278) ohm-cm
- Soluble Sulfates (ASTM C1580): 100 – 1,320 (415) ppm
- Soluble Chlorides (ASTM D512): 120 – 1,100 (375) ppm

Borrow Assessment

Based on the test results presented above, excavations in the ASW are likely to produce a suitable borrow source of earthfill for an embankment raise and/or spillway grading. However, the higher PI clays will require relatively flat embankment slopes to maintain slope stability. Lime treatment of the high-PI clays could be considered if steeper slopes are desired, since the sulfate contents are within a range that is unlikely to pose issues with chemical amendment that would induce heaving or swelling (less than 3,000 ppm). However, the sulfate content and chloride content indicates the proposed fill could be corrosive to buried metal and concrete, while the measured low resistivity would also indicate buried metals would be in a corrosive environment.

Closure

AECOM appreciates the opportunity to be of service to the River Authority on this project. Should you have any questions concerning this Preliminary SMR, or if we may be of further service, please contact Charles Krolikowski or Lance Finnefrock.

Yours Sincerely,

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Attachments:

Table 1	Index Test Summary
Table 2	Soil Strength Testing Summary
Table 3	Proposed Fill Strength Testing Summary
Table 4	Rock Strength Summary
Table 5	Dispersion Test Summary
Attachment 1	Laboratory Test Results

Table 1 – Index Testing Summary

Stratum Description (USCS)	Thick-ness (ft)	USCS	Dry Unit Weight (pcf)	LL	PI	LI	Fines (%)	CF (%)
Upper Clay (Residuum)	10-12	CH	102-112 (106)	43-68 (57)	24-47 (37)	-0.250 to 0.051 (-0.108)	50-94 (77)	30-33 (31)
Lower Clay (Residuum)	4-6	CL	111-120 (116)	27-64 (39)	15-34 (22)	-0.682 to 0.158 (-0.219)	49-86 (69)	11-22 (18)
Sand and Sandstone (Oakville Sandstone Fm.)	10 – 20+	SC (partially cemented)	118-119	36	23	-0.130	14-27	3
Proposed Fill (ASW Borrow) (2)	Variable	CH	94-110 (103) (3)	30-63 (50)	16-43 (32)	-0.875 to (-)0.465 (-0.606)	48-91 (67)	11-60 (32)

Notes:

(1) Format of reported values is Minimum – Maximum (Average). Average value not reported when two or fewer results are available.
(2) Proposed Fill materials collected from the upper 5± feet of the ASW channel.
(3) Reported results reflect the maximum dry density from Standard Proctor testing.

Table 2 – Soil Strength Testing Summary

Boring ID	Depth (ft)	Stratum	LL	PI	% Passing No. 200 Sieve	UU Test (undisturbed samples at natural moisture)				UC Test (undisturbed sample at natural moisture)		
						WCn (%)	DDn (pcf)	Confining Pressure (psf)	Su (psf)	WCn (%)	DDn (pcf)	Su (psf)
201-23	2	Upper Clay (Residuum)	54	35	69.5	-	-	-	-	20.8	103.1	2,260
201-23	12	Lower Clay (Residuum)	43	23	80.4	15.0	115.7	1,656	5,050	-	-	-
202-23	8	Upper Clay (Residuum)	55	37	93.9	-	-	-	-	21.5	108.2	7,020
203-23	0	Upper Clay (Residuum)	67	46	90.7	-	-	-	-	20.3	104.9	6,520
203-23	6	Upper Clay (Residuum)	68	47	77.8	-	-	-	-	13.3	112.5	9,820
203-23	16	Lower Clay (Residuum)	NT	NT	86	-	-	-	-	14.9	114.6	4,580
204-23	0	Lower Clay (Residuum)	44	27	50.4	-	-	-	-	9.7	116.9	10,140
204-23	8	Lower Clay (Residuum)	32	19	52.9	15.7	111.4	1,656	6,660	-	-	-
Average			**51.9**	**33.4**	**75.2**	**15.4**	**113.6**	**1,656**	**5,855**	**16.8**	**110.0**	**6,723**

Table 3 – Proposed Fill Standard Proctor Test Summary

Boring ID	Depth (ft)	Stratum	LL	PI	% Passing No. 200 Sieve	Standard Proctor	
						Opt. WC (%)	Max DD (pcf)
201-23	0-3	Upper Clay (Residuum)	53	34	NT	16.2	109
202-23	3-5	Upper Clay (Residuum)	59	40	81.1	22.1	96.9
203-23	0-3	Upper Clay (Residuum)	63	43	90.8	21.5	94.4
204-23	0-3	Lower Clay (Residuum)	43	26	49.3	14.9	110.4
Average			**54.5**	**35.8**	**73.7**	**18.7**	**102.7**

Table 4 – Rock Strength Testing Summary

Boring ID	Depth (ft)	Stratum	UC (natural moisture)			
			WCn (%)	DDn (pcf)	Compressive Strength (psi)	Undrained Shear Strength (psf)
201-23	15	Oakville Sandstone Fm.	13.3	117.7	55.6	4,003

Table 5 – Dispersion Test Summary

Boring ID	Depth (ft)	Stratum	USCS	Dispersion		
				Crumb Test	Double Hydrometer	Pinhole
201-23	4	Upper Clay (Residuum)	CH	1	25.3	-
201-23	10	Lower Clay (Residuum)	CL	2	-	-
201-23	0-3	Upper Clay (Residuum)	CH	1	-	-
202-23	2	Upper Clay (Residuum)	CH	1	-	-
202-24	6	Upper Clay (Residuum)	CH	1	-	-
202-25	10	Upper Clay (Residuum)	CH	1	-	-
202-23	14	Upper Clay (Residuum)	CH	1	-	-
202-23	25.5	Lower Clay (Residuum)	CL	2	-	-
202-23	0-3	Upper Clay (Residuum)	CH	1	24.1	-
202-23	3-5	Upper Clay (Residuum)	CH	1	12	-
203-23	4	Upper Clay (Residuum)	CH	4	1.9	ND1
203-23	12	Lower Clay (Residuum)	CL	4	-	-
203-24	14	Lower Clay (Residuum)	CL	-	19.5	ND1
203-23	0-3	Upper Clay (Residuum)	CL	3	9.1	-
204-23	2	Lower Clay (Residuum)	CL	3	-	-
204-23	6	Lower Clay (Residuum)	CL	4	50.8	ND1
204-23	0-3	Lower Clay (Residuum)	CL	1	17.8	-

Attachment 1 – Laboratory Test Results

ARIAS

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November 10, 2023
Arias Job No. 2023-134

Via Email: lance.finnefrock@aecom.com

Mr. Lance Finnefrock, P.E., G.E
AECOM
13640 Briarwick Drive, Suite 200
Austin, TX 78729

RE: Geotechnical Data Report
Escondido Creek Watershed FRS No. 1
Karnes County, TX

Project Information

We understand that AECOM is assisting SARA with the Improvement of existing dam. A geotechnical study is needed to aid in the evaluation of the dam. As a part of the proposed improvements, Arias performed Laboratory Testing study for Dam 1 in Karnes County, Texas. The boring numbers, locations, depths and laboratory tests were provided/assigned by AECOM.

Purpose

The purpose of this Memorandum was to:

- perform geotechnical borings at the project site,
- conduct laboratory testing on recovered soil samples, and
- present the results of the laboratory test data in this memo.

SOIL BORINGS

Four (4) borings were drilled at locations staked by AECOM. Drilling was performed in general accordance with ASTM D1586 and D1587 sampling techniques. A truck-mounted drill rig using hollow stem augers together with the sampling tools noted were used to secure the subsurface soil samples and the borehole grouted following the completion of borings. Additional pinhole and double hydrometer tests were performed, as requested and the results are included in the Appendix.

AECOM field logger directed the sampling efforts, visually classified recovered samples and logged the borings on-site. Additionally, Arias's field technician was present during the entire drilling operation and transported the samples to the laboratory after the completion of drilling.

LABORATORY TESTING

Laboratory testing was performed on the retrieved samples. The laboratory tests were assigned by AECOM and were performed in accordance with the American Society for Testing and Materials (ASTM).

Remaining soil samples recovered from this exploration will be routinely discarded following submittal of this report. The following tests were performed in accordance with the ASTM guidelines:

- Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216)
- Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (ASTM D4318)
- Standard Test Methods for Determining the Amount of Material Finer than 75-μm (No. 200) Sieve in Soils by Washing (ASTM D1140)
- Standard Test Methods for Laboratory Determination of Density and Unit Weight of Soil Specimens (ASTM D7263)
- Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854).
- Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils (ASTM D2974)
- Standard Test Method for Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)
- Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils (ASTM D2850)
- Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (ASTM D7012)
- Standard Test Methods for Determining Dispersive Characteristics of Clayey Soils by the Crumb Test (ASTM D6572)
- Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM D6913)
- Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis (ASTM D7928)
- Standard Test Method for Dispersive Characteristics of Clay Soil by Double Hydrometer (ASTM D6913, D7928, & ASTM D4221)
- Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing (ASTM G51)
- Standard Test Method for Measurement of Oxidation-Reduction Potential (ORP) of Soil (ASTM G200)
- Standard Test Methods for Chloride Ion in Water (ASTM D512)
- Standard Test Method for Water-Soluble Sulfate in Soil (ASTM C1580)
- Standard Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method (ASTM G187)
- Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (ASTM D698)

- Standard Test Methods for Identification and Classification of Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

The summary of the results is appended with this letter.

Sincerely,

ARIAS & Associates, Inc.

TBPE Registration No: F-32

11/10/2023

Sandeep K. Malla, E.I.T.
Geotechnical Engineer

Mark O'Connor, P.E.
Senior Geotechnical Engineer

LABORATORY TEST SUMMARY

PROJECT: Escondido FRS No. 1
PROJECT LOCATION: Southwest of Karnes City, Texas
AECOM / JOB NO.: 60707486
PROJECT MANAGER: L. Finnefrock

Provided by AECOM				D4318			D1140	D2216	D7263	D6913	D854	D6913 & D7928	D2974	D2166	D2850	D7012 Method C	D7012 Method D	D6572	D4647	D4221	G51	G200	D152	C1580	G187	D698	
BORING No.	SAMPLE No.	DEPTH (feet)		INDEX TESTS										SOIL STRENGTH TESTS		ROCK		DISPERSION**			CORROSIVITY SUITE					BULK TESTS (STANDARD PROCTOR)**	
		Top	Bottom	ATTERBERG LIMITS (3 pt)**			Wash #200 SIEVE**	MOISTURE CONTENT	DRY UNIT WEIGHT	SIEVE THROUGH #200**	SPECIFIC GRAVITY	SIEVE + HYDROMETER**	ORGANIC CONTENT	UNCONFINED COMPRESSION**	UU TRIAXIAL**	Rock UC (Peak Stress Only)	Rock UC (Axial Stress-Strain)**	CRUMB TEST**	PINHOLE TEST	DISP. OF CLAY BY DOUBLE HYDRO.**	pH	REDOX	CHLORIDE	SULFATE	RESISTIVITY	Maximum Dry Density**	Optimum Moisture Content**
				LL	PL	PI	%	%	pcf				%	tsf			psi	Grade		% Dispersion		milivolts	mg/kg	ppm	ohms-cm	lb/ft^3	%
201-23	SS-1A	0.0	0.5	51	18	33	64	10																			
	SS-1B	0.5	1.5					9																			
	ST-2	2.0	4.0	54	19	35	70	21	103.1					2.26	--												
	P-3	4.0	6.0					17	*									Grade 1		25.3							
	ST-4	6.5	8.0	67	22	45	90	16	103.5					--													
	SS-5	8.0	9.5					16																			
	P-6	10.0	12.0					12	110.8									Grade 2									
	ST-7	12.0	14.0	43	20	23	80	15	115.7						5.05												
	RC-1	15.0	20.0					13	117.7								55.6										
	RC-2	20.0	25.0					6	*							*											
	G-1	0.0	3.0	53	19	34					*			*				Grade 1		*	7.45	3.52	140	120	1790	109.3	16.2
	G-2	3.0	5.0																								
202-23	P-1	0.0	2.0					16					1.8														
	SS-2	2.0	3.5					19										Grade 1									
	P-3	4.0	6.0	51	22	29	83	19	107.9																		
	SS-4	6.0	7.5					12										Grade 1									
	ST-5	8.0	10.0	55	18	37	94	21	108.2					7.02	--												
	P-6	10.0	12.0					20	*									Grade 1									
	SS-7	12.0	13.5				50	14		**																	
	P-8	14.0	16.0	*			71	13	111.1									Grade 1									
	ST-9	18.0	18.5	34	15	19		12	119.4																		
	SS-10	18.5	20.0					10																			
	SS-11	25.5	27.0	29	14	15	72	10				**						Grade 2									
	SS-12	28.5	30.0					11																			
	SS-13	32.0	33.5					25																			
	SS-14	34.0	35.5	64	30	34	86	22																			
	SS-15	38.5	40.0					19																			
	G-1	0.0	3.0	30	14	16												Grade 1		24.1	7.92	2.96	120	<100	1150		
	G-2	3.0	5.0	59	19	40					2.7			*				Grade 1		12	7.9	3.16	140	120	895	96.9	22.1

LABORATORY TEST SUMMARY

PROJECT: Escondido FRS No. 1
PROJECT LOCATION: Southwest of Karnes City, Texas
AECOM / JOB NO.: 60707486
PROJECT MANAGER: L. Finnefrock

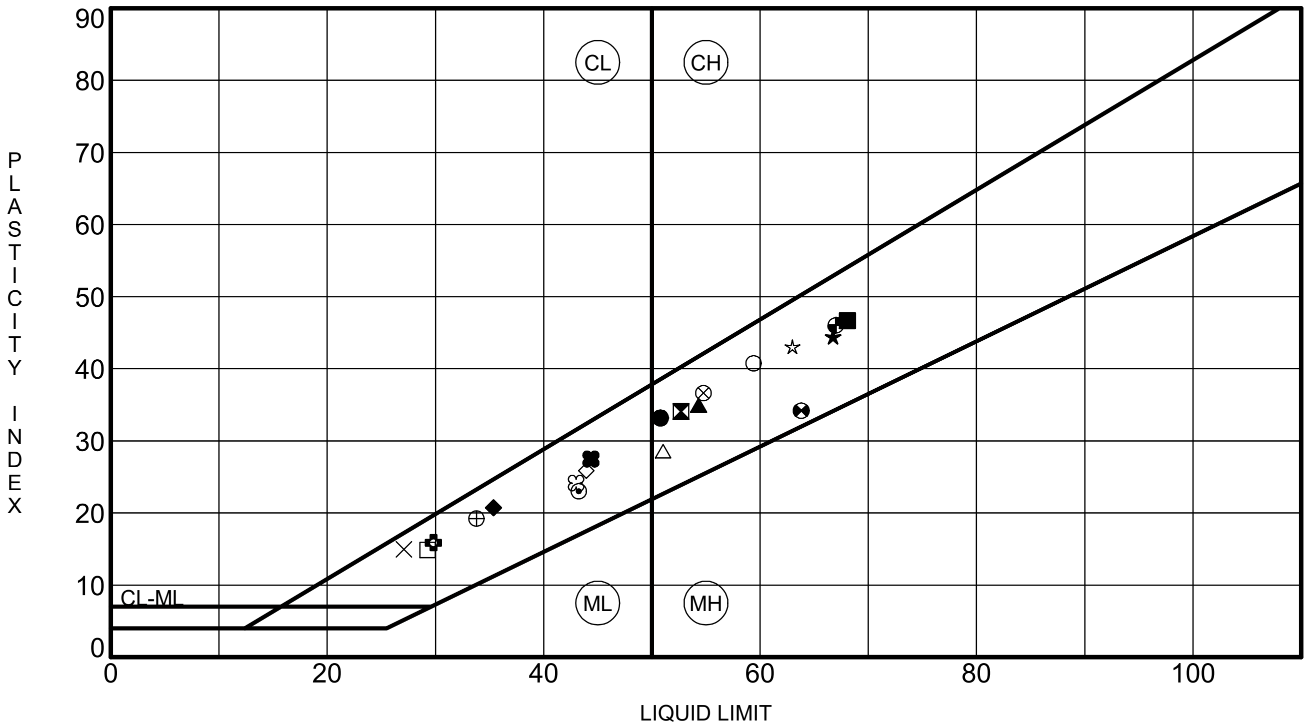
Provided by AECOM				D4318			D1140	D2216	D7263	D6913	D854	D6913 & D7928	D2974	D2166	D2850	D7012 Method C	D7012 Method D	D6572	D4647	D4221	G51	G200	D152	C1580	G187	D698	
		DEPTH (feet)		INDEX TESTS										SOIL STRENGTH TESTS		ROCK		DISPERSION**			CORROSIVITY SUITE					BULK TESTS (STANDARD PROCTOR)**	
BORING No.	SAMPLE No.	Top	Bottom	ATTERBERG LIMITS (3 pt)**			Wash #200 SIEVE**	MOISTURE CONTENT	DRY UNIT WEIGHT	SIEVE THROUGH #200**	SPECIFIC GRAVITY	SIEVE + HYDROMETER**	ORGANIC CONTENT	UNCONFINED COMPRESSION**	UU TRIAXIAL**	Rock UC (Peak Stress Only)	Rock UC (Axial Stress-Strain)**	CRUMB TEST**	PINHOLE TEST	DISP. OF CLAY BY DOUBLE HYDRO.**	pH	REDOX	CHLORIDE	SULFATE	RESISTIVITY	Maximum Dry Density**	Optimum Moisture Content**
				LL	PL	PI	%	%	pcf				%	tsf			psi	Grade		% Dispersion		milivolts	mg/kg	ppm	ohms-cm	lb/ft^3	%
203-23	ST-1	0.0	2.0	67	21	46	91	20	104.9					6.52	--												
	SS-2	2.0	3.5					21																			
	P-3	4.0	6.0	43	19	24		13	108.7									Grade 4	ND1	1.9							
	ST-4	6.0	6.5	68	21	47	78	13	112.5					9.82													
	SS-5	6.5	8.0					12																			
	SS-6	8.0	9.5				75	14																			
	P-7	10.0	12.0	35	15	20	86	11	119.7			**															
	SS-8	12.0	13.5					13										Grade 4									
	P-9	14.0	16.0	44	18	26		13	116.0										ND1	19.5							
	ST-10	16.0	16.5				86	15	114.6					4.58													
	SS-11	16.5	18.0	27	12	15	49	10		**																	
	SS-12	20.0	21.5				70	13		**																	
	RC-1	22.0	25.0					17	*							*											
	SS-13	30.0	31.5				27	17		**																	
	G-1	0.0	3.0	63	20	43					2.71			*				Grade 3		9.1	7.27	9.83	1100	1320	*	94.4	21.5
	G-2	3.0	5.0																								
204-23	ST-1	0.0	2.0	44	17	27	50	10	116.9					10.14	--		--										
	SS-2	2.0	3.5					7										Grade 3									
	ST-3	4.0	6.0	37	15	22	56							--													
	P-4	6.0	8.0					8										Grade 4	ND1	50.8							
	ST-5	8.0	10.0	32	13	19	53	16	111.4						6.66												
	SS-6	10.0	11.5					11																			
	SS-7	12.0	13.5	36	13	23	14	10				**															
	RC-1	14.0	20.0						118.5							*											
	G-1	0.0	3.0	43	17	26					2.63			--		*		Grade 1		17.8						110.4	14.9
	G-2	3.0	5.0																								

* Not Sufficient Material

** See Attached Graph

-- not enough sample to run UC/ was not possbile to meet given criteria to run UU, and cancled as per direction.

ATTERBERG LIMIT RESULTS



Boring	Depth	LL	PL	PI	Fines	Classification
● 201-23	0.0	51	18	33	64	SANDY FAT CLAY (CH)
⧗ 201-23 G-1	0.0	53	19	34		
▲ 201-23	2.0	54	19	35	70	SANDY FAT CLAY (CH)
★ 201-23	6.5	67	22	45	90	FAT CLAY (CH)
⊙ 201-23	12.0	43	20	23	80	LEAN CLAY with SAND (CL)
✿ 202-23 G-1	0.0	30	14	16		
○ 202-23 G-2	3.0	59	19	40		
△ 202-23	4.0	51	22	29	83	FAT CLAY with SAND (CH)
⊗ 202-23	8.0	55	18	37	94	FAT CLAY (CH)
⊕ 202-23	18.0	34	15	19		
□ 202-23	25.5	29	14	15	72	LEAN CLAY with SAND (CL)
202-23	34.0	64	30	34	86	FAT CLAY (CH)
203-23	0.0	67	21	46	91	FAT CLAY (CH)
☆ 203-23 G-1	0.0	63	20	43		
203-23	4.0	43	19	24		
■ 203-23	6.0	68	21	47	78	FAT CLAY with SAND (CH)
◆ 203-23	10.0	35	15	20	86	LEAN CLAY (CL)
◇ 203-23	14.0	44	18	26		
× 203-23	16.5	27	12	15	49	CLAYEY SAND (SC)
204-23	0.0	44	17	27	50	SANDY LEAN CLAY (CL)

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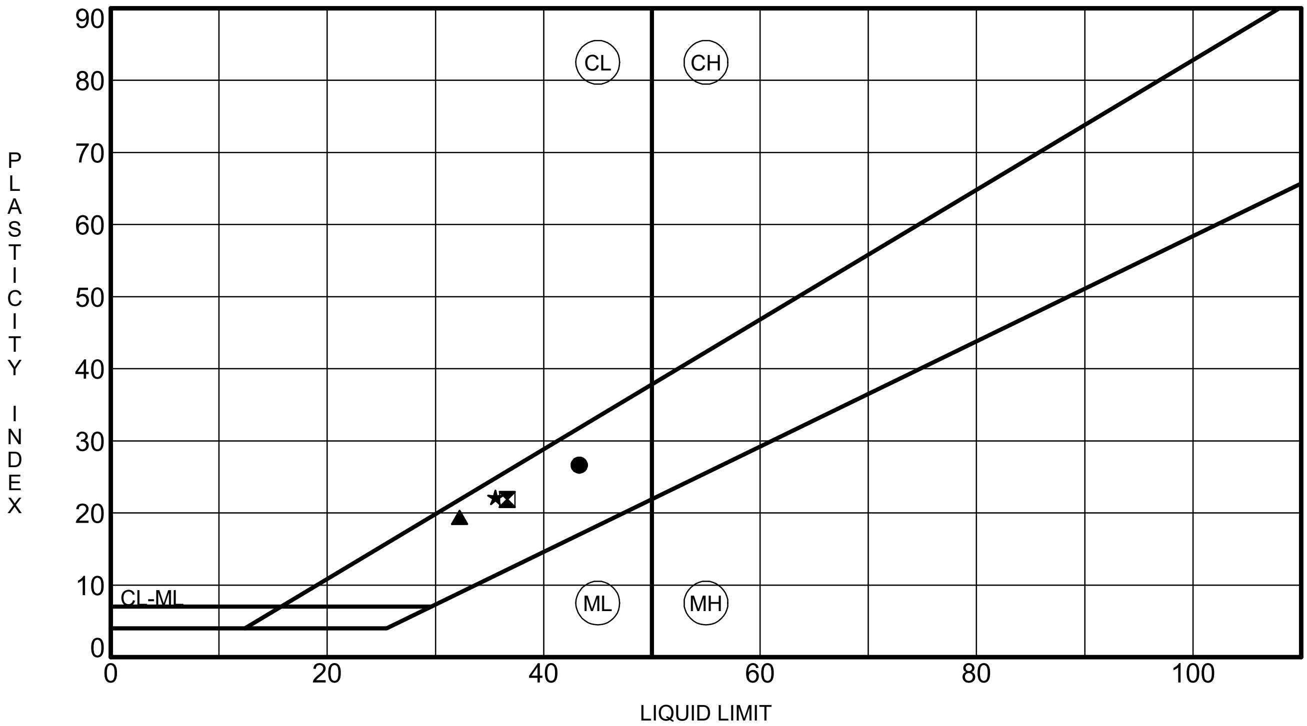
ATTERBERG LIMITS RESULTS

Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134

LAB DATA.GPJ 9/18/23 (ATTERBERG LIMITS SUMMARY GRAPH,US_LAB.GDT,LIBRARY2013-01.GLB)



	Boring	Depth	LL	PL	PI	Fines	Classification
●	**204-23 G-1**	**0.0**	**43**	**17**	**26**		
⧗	**204-23**	**4.0**	**37**	**15**	**22**	**56**	**SANDY LEAN CLAY (CL)**
▲	**204-23**	**8.0**	**32**	**13**	**19**	**53**	**SANDY LEAN CLAY (CL)**
★	**204-23**	**12.0**	**36**	**13**	**23**	**14**	**CLAYEY SAND (SC)**

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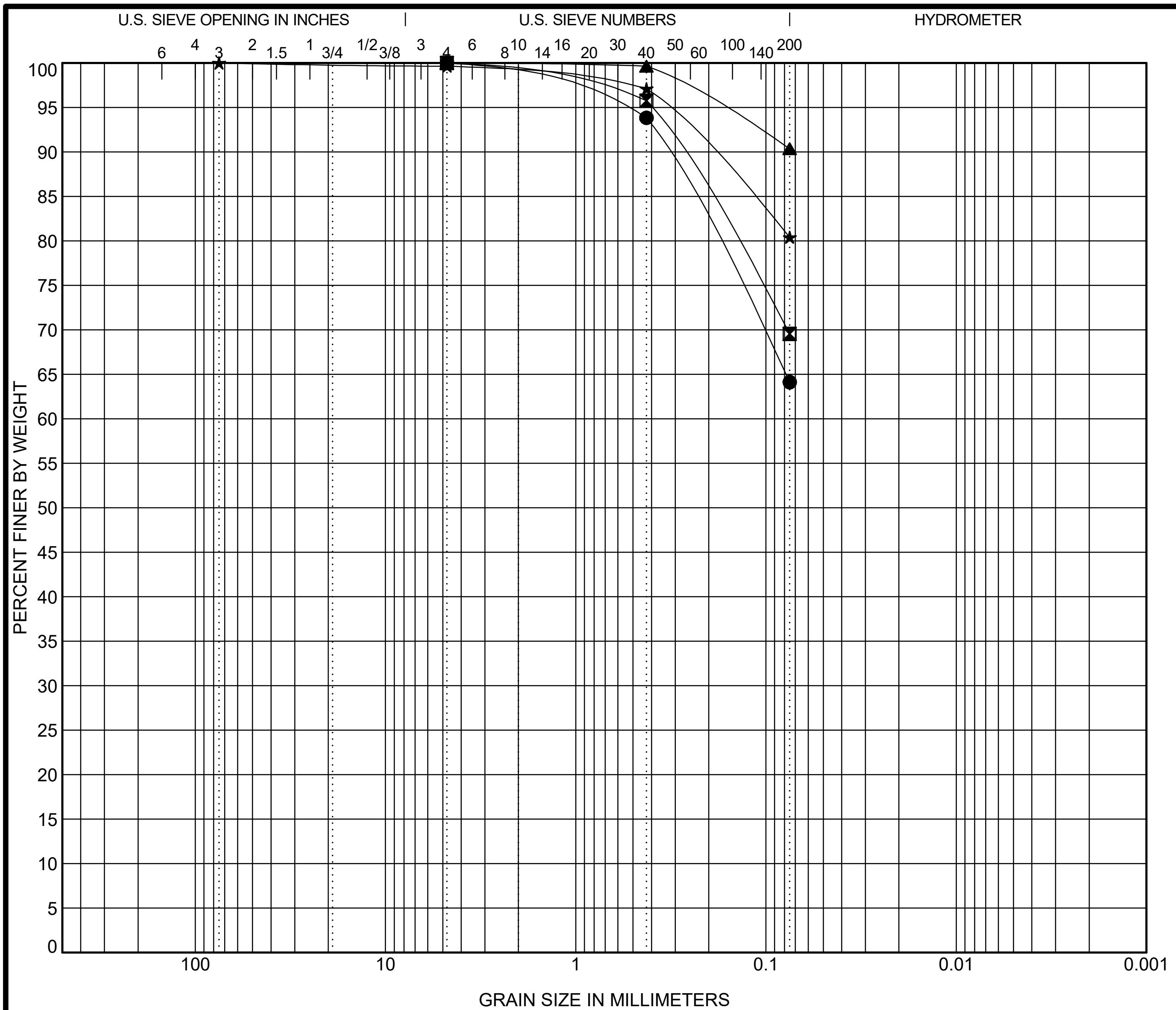
ATTERBERG LIMITS RESULTS

Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134

GRAIN SIZE DISTRIBUTION CURVE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**201-23**		**0.0**	**SANDY FAT CLAY (CH)**	**51**	**18**	**33**		
⊠	**201-23**		**2.0**	**SANDY FAT CLAY (CH)**	**54**	**19**	**35**		
▲	**201-23**		**6.5**	**FAT CLAY (CH)**	**67**	**22**	**45**		
★	**201-23**		**12.0**	**LEAN CLAY with SAND (CL)**	**43**	**20**	**23**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**201-23**	**0.0**	**4.75**				**0.0**	**35.9**	**64.1**	
⊠	**201-23**	**2.0**	**4.75**				**0.0**	**30.5**	**69.5**	
▲	**201-23**	**6.5**	**4.75**				**0.0**	**9.6**	**90.4**	
★	**201-23**	**12.0**	**75**				**0.4**	**19.2**	**80.4**	

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

LAB DATA.GPJ 9/18/23 (GRAIN SIZE ARIAS.US LAB.GDT,LIBRARY2013-01.GLB)

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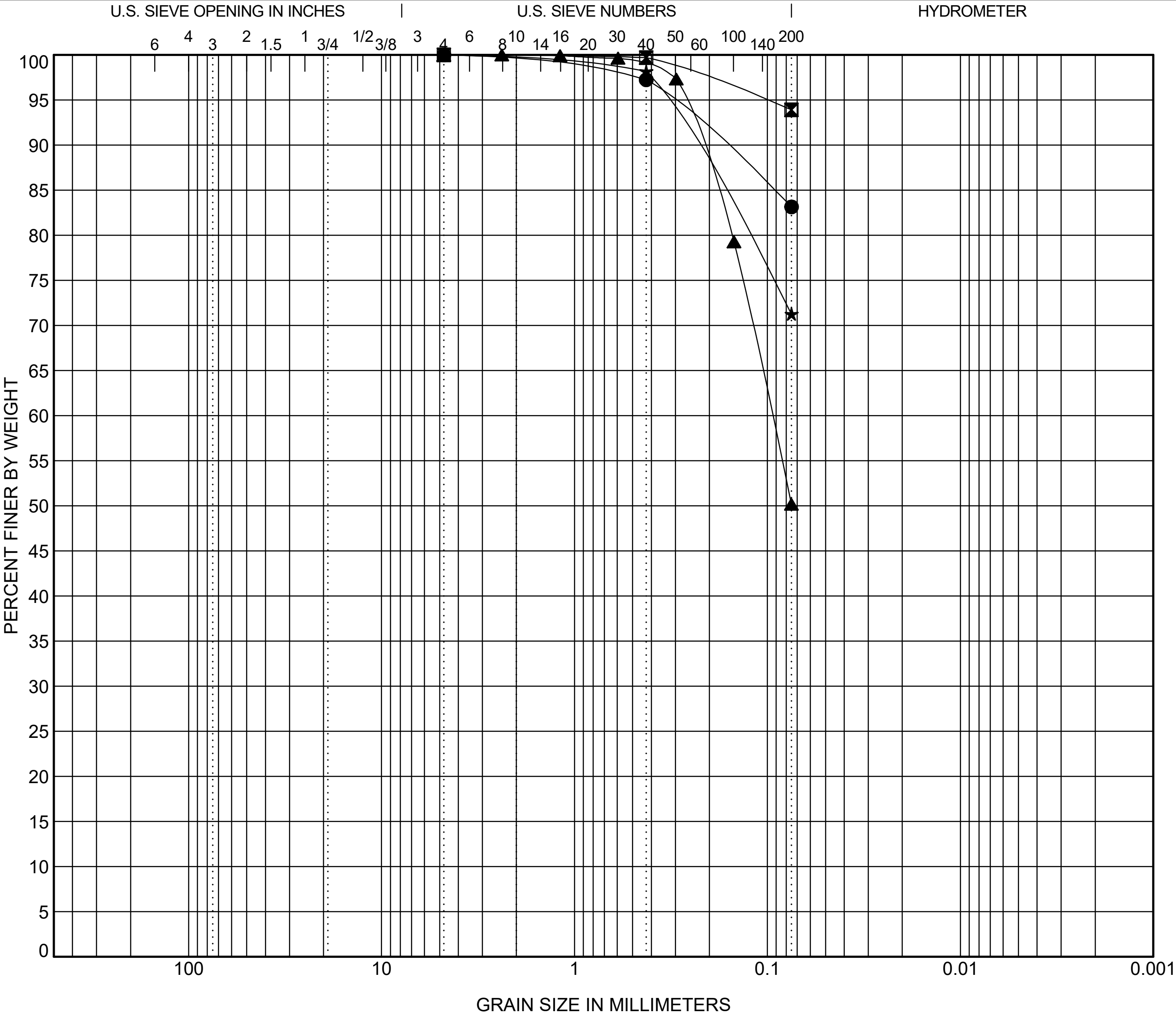
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**202-23**		**4.0**	**FAT CLAY with SAND (CH)**	**51**	**22**	**29**		
⧗	**202-23**		**8.0**	**FAT CLAY (CH)**	**55**	**18**	**37**		
▲	**202-23**		**12.0**						
★	**202-23**		**14.0**						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**202-23**	**4.0**	**4.75**				**0.0**	**16.9**	**83.1**	
⧗	**202-23**	**8.0**	**4.75**				**0.0**	**6.1**	**93.9**	
▲	**202-23**	**12.0**	**4.75**	**0.095**			**0.0**	**49.8**	**50.2**	
★	**202-23**	**14.0**	**4.75**				**0.0**	**28.7**	**71.3**	

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

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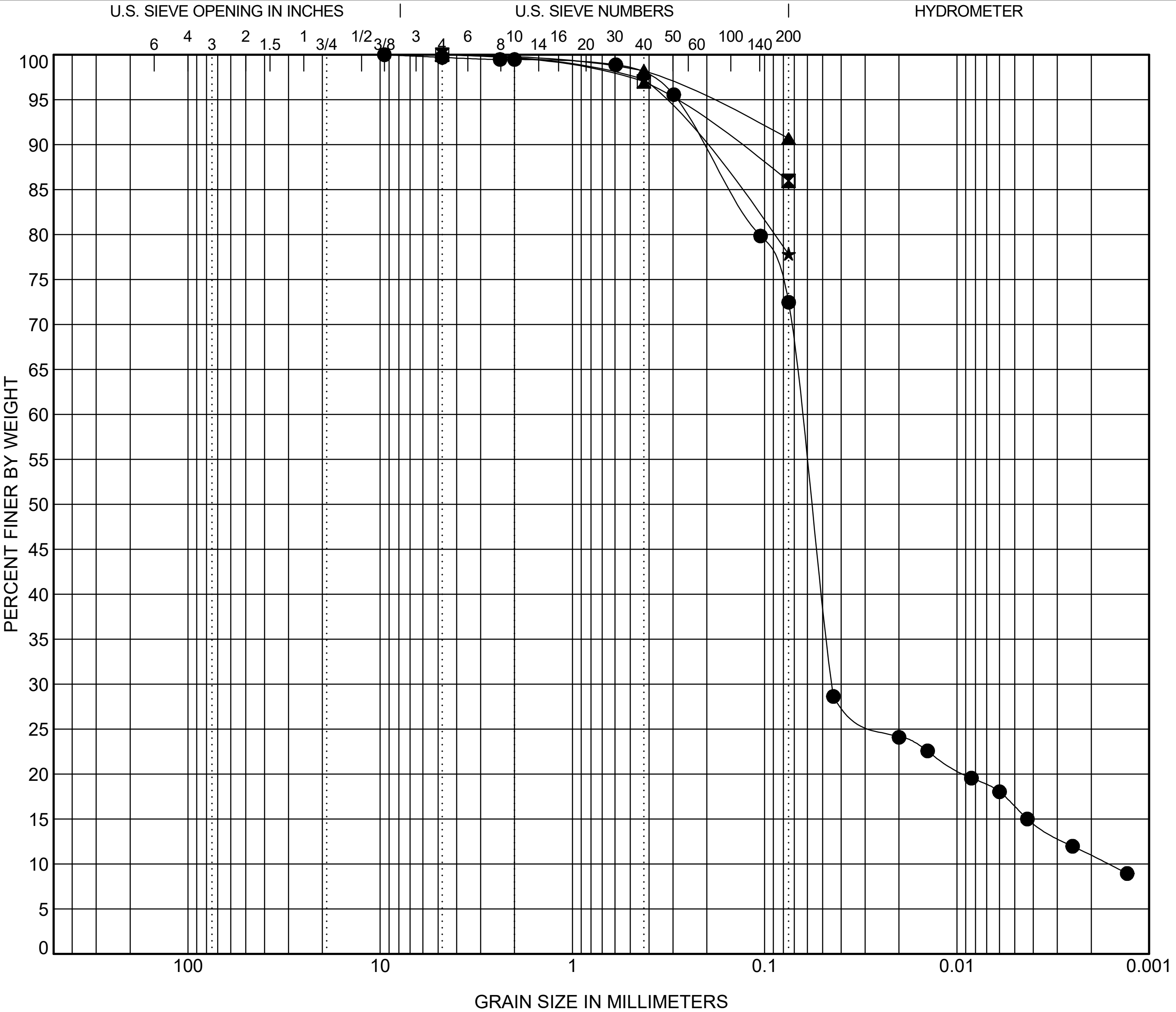
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**202-23**		**25.5**	**LEAN CLAY with SAND (CL)**	**29**	**14**	**15**	**18.93**	**39.40**
⧗	**202-23**		**34.0**	**FAT CLAY (CH)**	**64**	**30**	**34**		
▲	**203-23**		**0.0**	**FAT CLAY (CH)**	**67**	**21**	**46**		
★	**203-23**		**6.0**	**FAT CLAY with SAND (CH)**	**68**	**21**	**47**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**202-23**	**25.5**	**9.51**	**0.064**	**0.045**	**0.002**	**0.3**	**27.2**	**61.5**	**10.9**
⧗	**202-23**	**34.0**	**4.75**				**0.0**	**14.0**	**86.0**	
▲	**203-23**	**0.0**	**4.75**				**0.0**	**9.3**	**90.7**	
★	**203-23**	**6.0**	**4.75**				**0.0**	**22.2**	**77.8**	

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

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GRAIN SIZE DISTRIBUTION

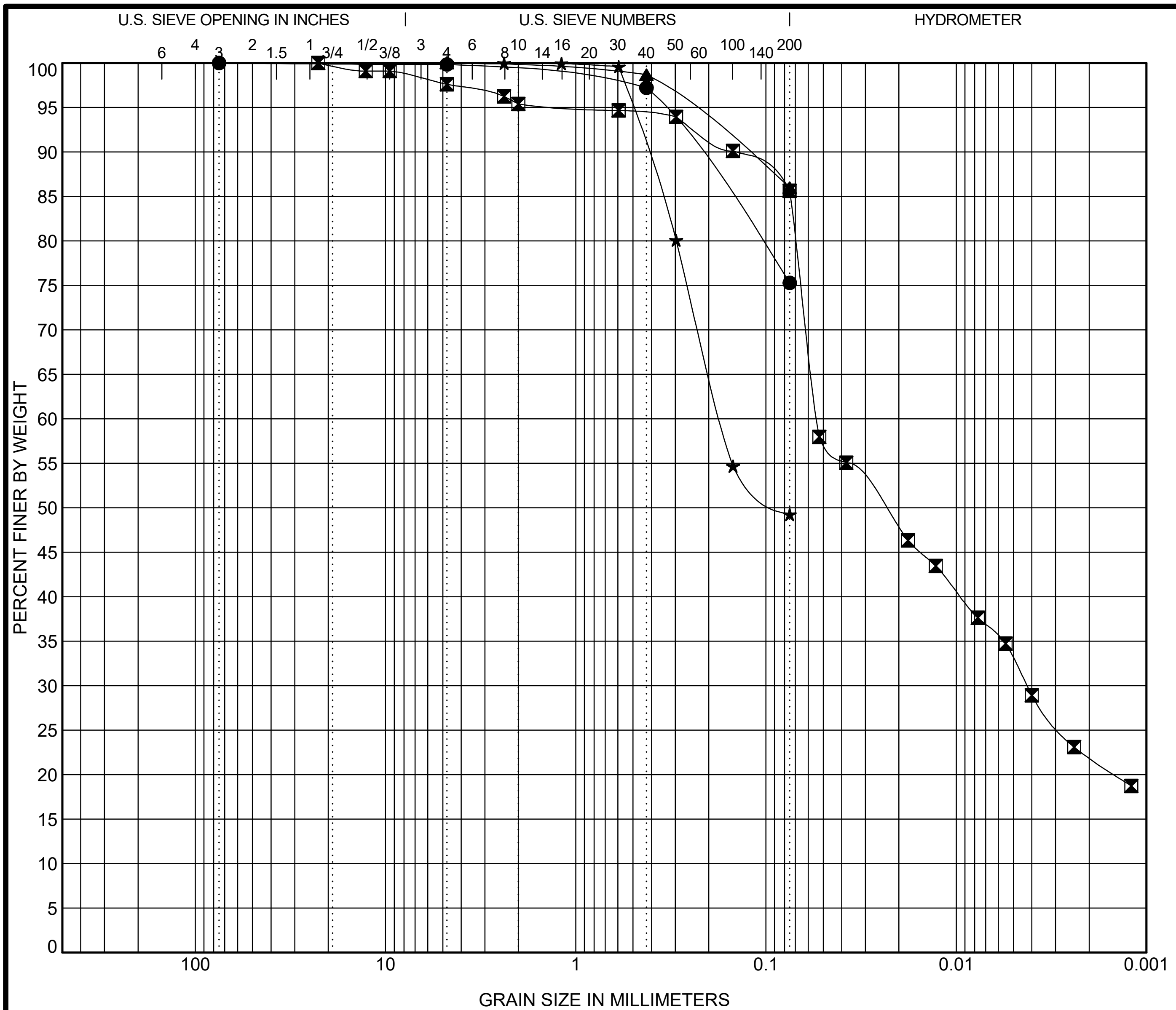
Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134

LAB DATA.GPJ 9/18/23 (GRAIN SIZE ARIAS.US LAB.GDT LIBRARY2013-01.GLB)

Arias Geoprofessionals



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**203-23**		**8.0**						
⧗	**203-23**		**10.0**	**LEAN CLAY (CL)**	**35**	**15**	**20**		
▲	**203-23**		**16.0**						
★	**203-23**		**16.5**	**CLAYEY SAND (SC)**	**27**	**12**	**15**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**203-23**	**8.0**	**75**				**0.2**	**24.6**	**75.3**	
⧗	**203-23**	**10.0**	**22.6**	**0.054**	**0.004**		**2.4**	**12.0**	**63.7**	**22.0**
▲	**203-23**	**16.0**	**4.75**				**0.0**	**14.0**	**86.0**	
★	**203-23**	**16.5**	**4.75**	**0.172**			**0.0**	**50.8**	**49.2**	

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

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

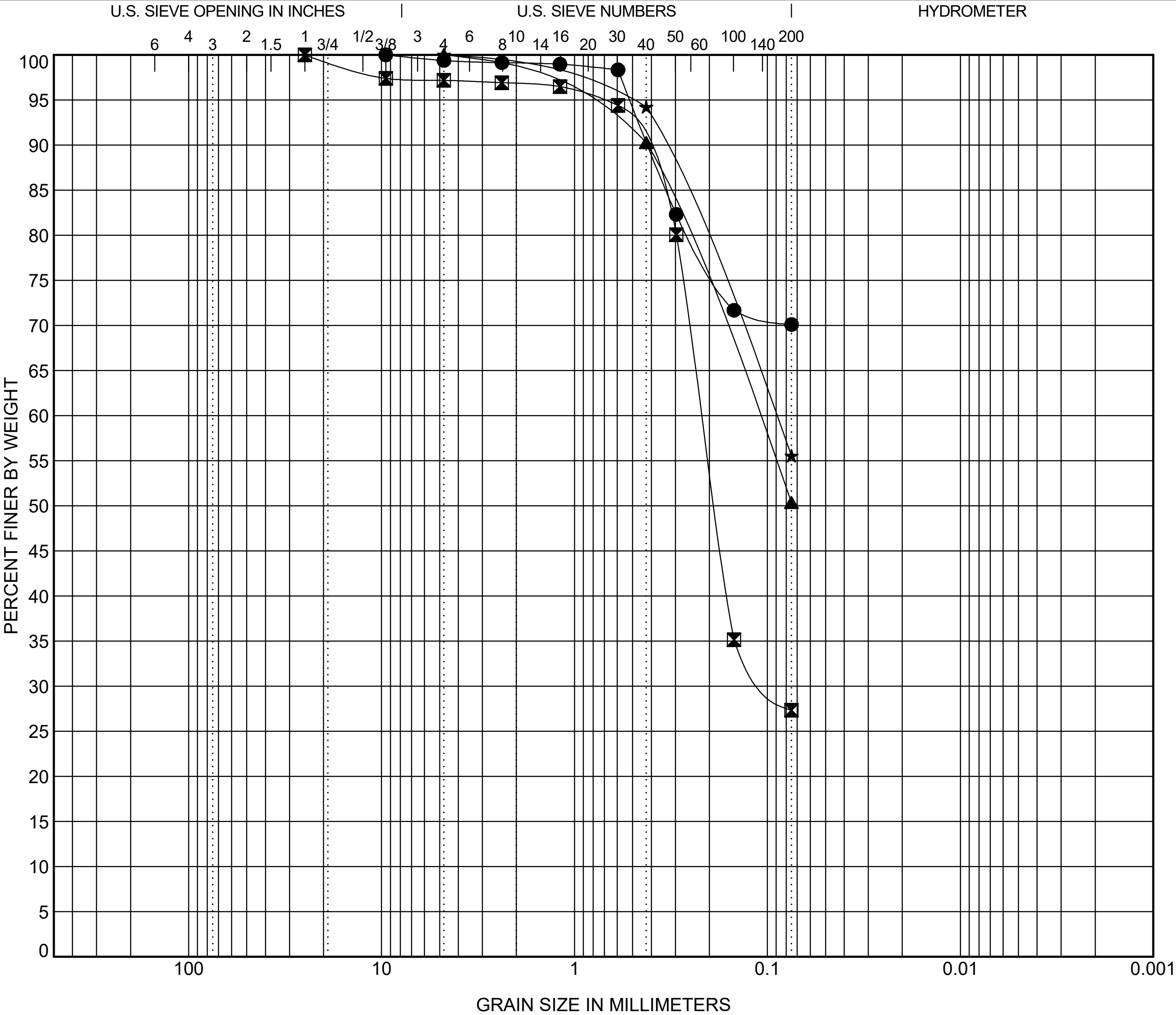
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134

Arias Geoprofessionals



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**203-23**		**20.0**						
⌧	**203-23**		**30.0**						
▲	**204-23**		**0.0**	**SANDY LEAN CLAY (CL)**	**44**	**17**	**27**		
★	**204-23**		**4.0**	**SANDY LEAN CLAY (CL)**	**37**	**15**	**22**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**203-23**	**20.0**	**9.51**				**0.6**	**29.3**	**70.1**	
⌧	**203-23**	**30.0**	**25**	**0.218**	**0.095**		**2.8**	**69.8**	**27.3**	
▲	**204-23**	**0.0**	**4.75**	**0.114**			**0.0**	**49.6**	**50.4**	
★	**204-23**	**4.0**	**4.75**	**0.092**			**0.0**	**44.5**	**55.5**	

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

142 Chula Vista
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Phone: (210) 308-5884
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GRAIN SIZE DISTRIBUTION

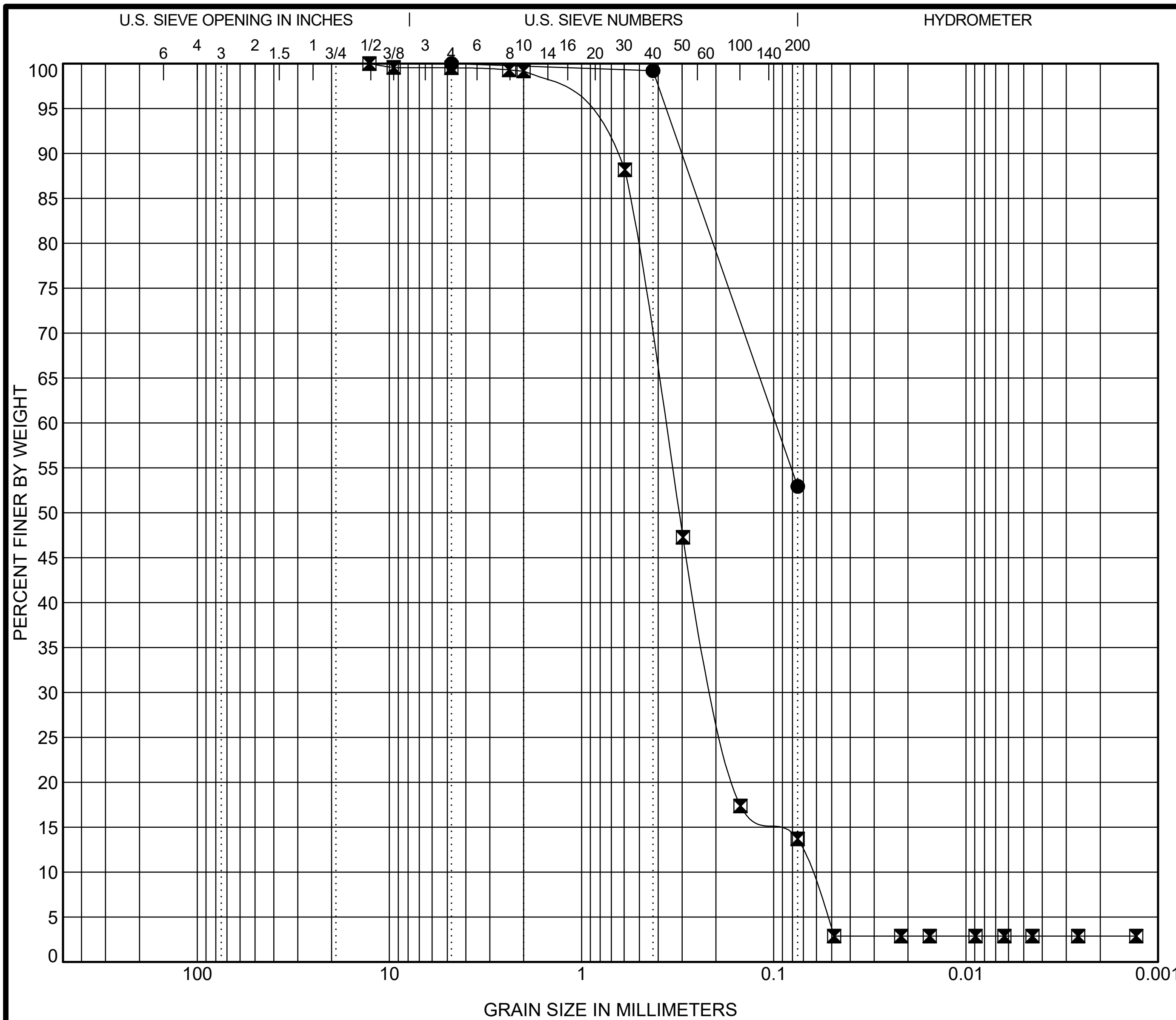
Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134

LAB DATA.GPJ 9/18/23 (GRAIN SIZE ARIAS.US LAB.GDT LIBRARY2013-01.GLB)

Arias Geoprofessionals



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	204-23		8.0	**SANDY LEAN CLAY (CL)**	32	13	19		
⊠	204-23		12.0	**CLAYEY SAND (SC)**	36	13	23	1.67	5.70

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	204-23	8.0	4.75	0.098			0.0	47.1	52.9	
⊠	204-23	12.0	12.7	0.369	0.199	0.065	0.5	85.8	10.8	2.9

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

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GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 1

Location: See Boring Location Plan

Job No.: 2023-134

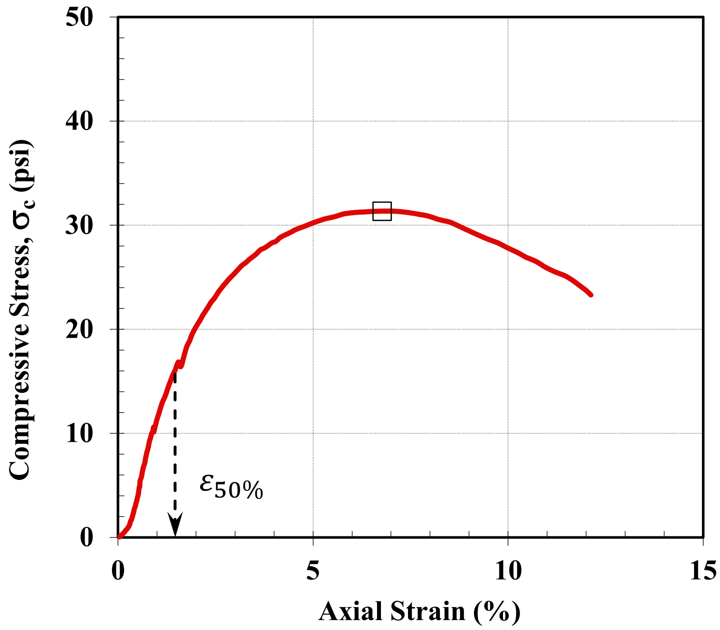
Arias Geoprofessionals

UNCONFINED COMPRESSTION TEST RESULTS

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

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client:	Arias & Associates, Inc.	Alpine Project No.:	2307257
Project Name:	Escondido FRS No.1 (PN: 2023-134)	Test Date:	08/10/23
Sample ID:	201-23, ST-2 (2-4 ft)	Tested By:	T.D.



Initial Conditions	
Avg. Diameter (in)	2.84
Avg. Height, H_0 (in)	5.68
Avg. Water Content (%)	20.8
Total Unit Weight, γ_{total} (pcf)	124.5
Dry Unit Weight, γ_{dry} (pcf)	103.1
Void Ratio, e_0	0.62
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	6.8
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	1.5
Unconfined Compressive Strength, q_u (psi)	31.4
Undrained Shear Strength, S_u (tsf)	1.13

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.

(a) After Test

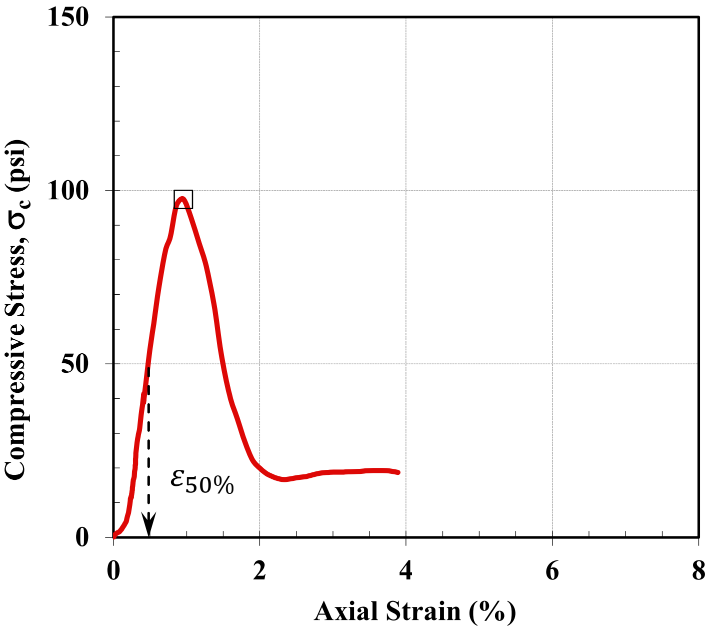
Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client:	Arias & Associates, Inc.
Project Name:	Escondido FRS No.1 (PN: 2023-134)
Sample ID:	202-23, ST-5 (8-10 ft)
Alpine Project No.:	2307257
Test Date:	08/10/23
Tested By:	T.D.



Initial Conditions	
Avg. Diameter (in)	2.85
Avg. Height, H_0 (in)	5.69
Avg. Water Content (%)	21.5
Total Unit Weight, γ_{total} (pcf)	131.5
Dry Unit Weight, γ_{dry} (pcf)	108.2
Void Ratio, e_0	0.55
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	1.0
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	0.5
Unconfined Compressive Strength, q_u (psi)	97.6
Undrained Shear Strength, S_u (tsf)	3.51

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.

(a) After Test

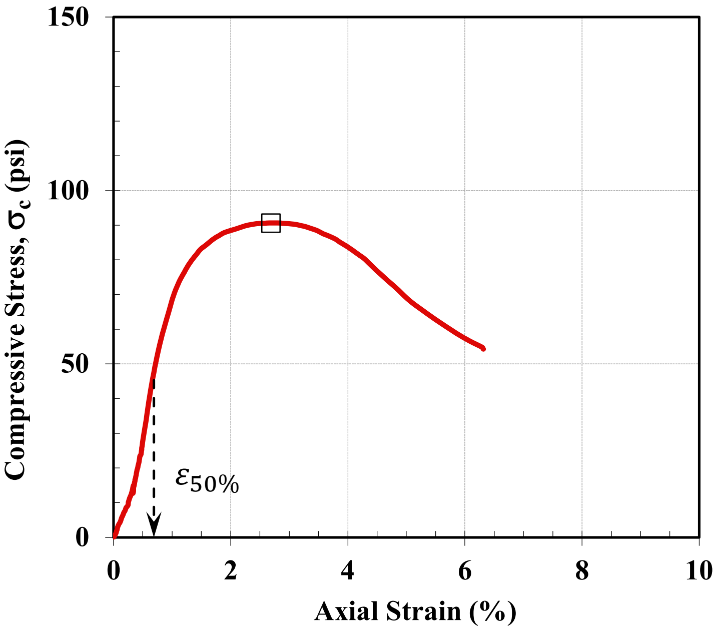
Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client:	Arias & Associates, Inc.	Alpine Project No.:	2307257
Project Name:	Escondido FRS No.1 (PN: 2023-134)	Test Date:	08/10/23
Sample ID:	203-23, ST-1 (0-2 ft)	Tested By:	T.D.



Initial Conditions	
Avg. Diameter (in)	2.83
Avg. Height, H_0 (in)	5.68
Avg. Water Content (%)	20.3
Total Unit Weight, γ_{total} (pcf)	126.2
Dry Unit Weight, γ_{dry} (pcf)	104.9
Void Ratio, e_0	0.59
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	2.7
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	0.7
Unconfined Compressive Strength, q_u (psi)	90.7
Undrained Shear Strength, S_u (tsf)	3.26

(a) After Test

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

Unconfined Compressive Strength Test
ASTM D2166

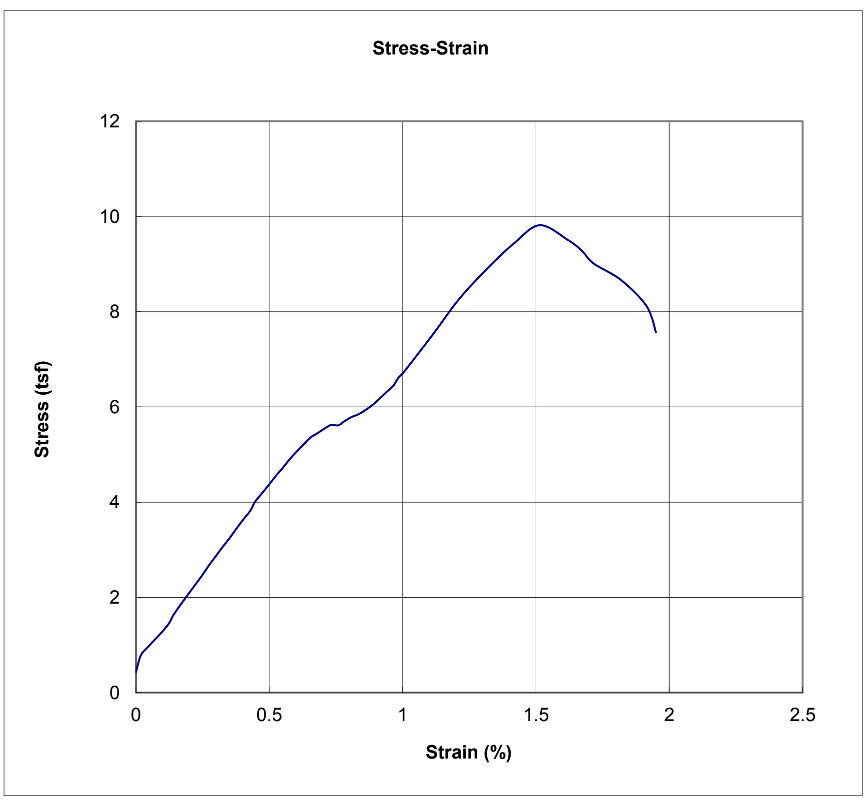
Customer: AECOM
888 SW 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 1
Kenedy, Texas

Project Number: 2023-134
Date of Test: 7/20/2023

Specimen and Testing Details

Borehole		203-23
Depth (ft)		6 - 6.5
Sample Date		6/14/2023
Soil Type		FAT CLAY (CH) with Sand
Specimen Height	inch	4.623
Specimen Diameter	inch	2.858
Moisture Content	%	13.3
Dry Density	pcf	112.46
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.51
Failure Stress	tsf	9.82



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Unconfined Compressive Strength Test
ASTM D2166

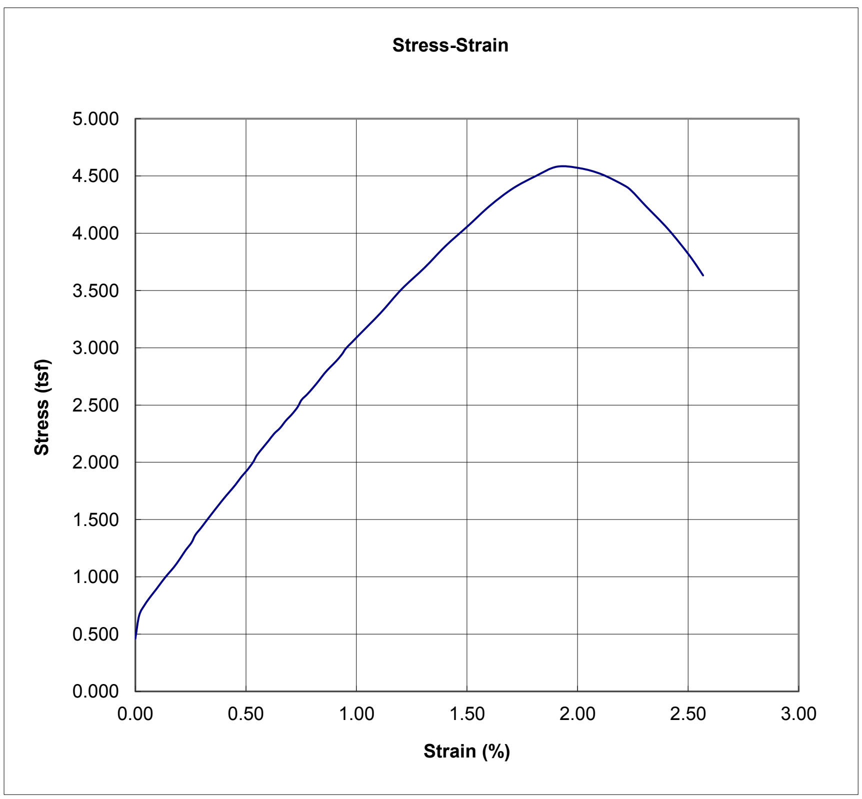
Customer: AECOM
888 SW 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 1
Kenedy, Texas

Project Number: 2023-134
Date of Test: 7/20/2023

Specimen and Testing Details

Borehole		203-23
Depth (ft)		16 - 16.5
Sample Date		7/20/2023
Soil Type		Clayey Sand (SC)
Specimen Height	inch	5.616
Specimen Diameter	inch	2.875
Moisture Content	%	14.9
Dry Density	pcf	114.61
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.91
Failure Stress	tsf	4.58

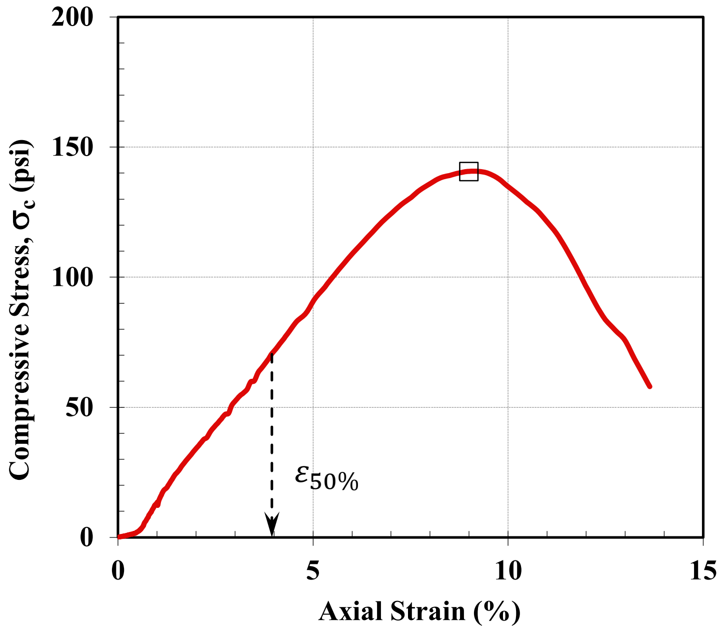


Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 204-23, ST-1 (0-2 ft)

Alpine Project No.: 2307257
Test Date: 08/10/23
Tested By: T.D.



Initial Conditions	
Avg. Diameter (in)	2.78
Avg. Height, H_0 (in)	5.68
Avg. Water Content (%)	9.7
Total Unit Weight, γ_{total} (pcf)	128.2
Dry Unit Weight, γ_{dry} (pcf)	116.9
Void Ratio, e_0	0.43
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	9.0
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	3.9
Unconfined Compressive Strength, q_u (psi)	140.7
Undrained Shear Strength, S_u (tsf)	5.07

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.

(a) After Test

Cheng-Wei Chen, Ph.D. 08/12/23
Reviewed By / Date

UNCOSOLIDATED UNDRAINED TRIAXIAL TEST

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

Unconsolidated Undrained Triaxial Compression Test
ASTM D2850

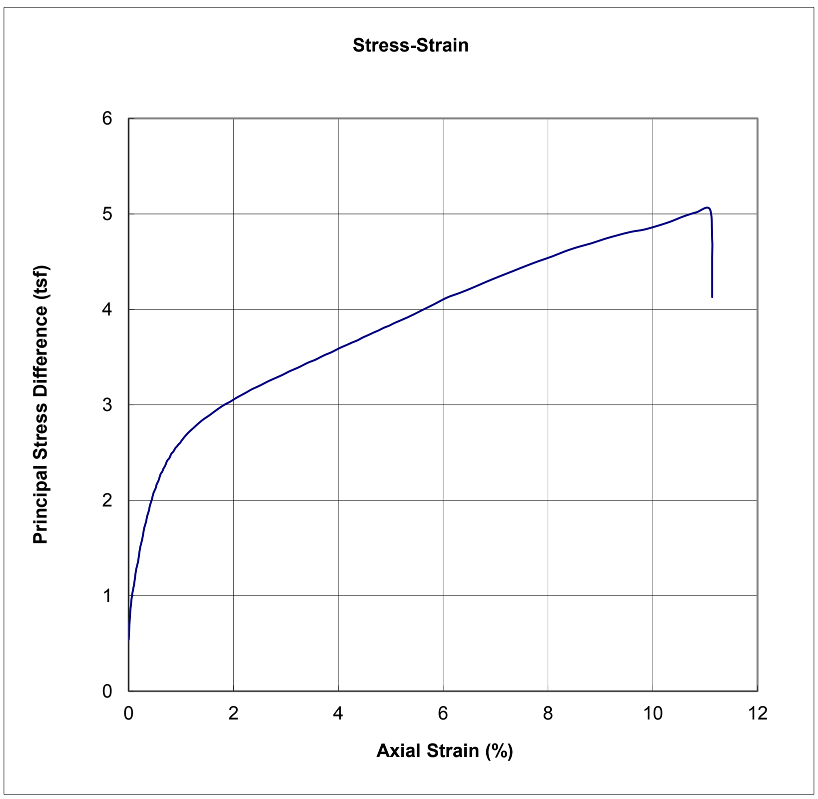
Customer: AECOM
888 SW 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido Dam 1
Kenedy, Texas

Project Number: 2023-134
Date of Test: 7/20/2023

Specimen and Testing Details

Borehole		201-23
Depth (ft)		12 - 14
Sample Date		6/13/2023
Soil Type		Lean Clay with Sand (CL)
Specimen Height	inch	5.17
Specimen Diameter	inch	2.79
Moisture Content	%	15
Dry Density	pcf	115.71
Confining Pressure	psi	11.5
Membrane Correction Used?	Y/N	N
Axial Strain	%	11.09
Failure Stress	tsf	5.05



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

Unconsolidated Undrained Triaxial Compression Test
ASTM D2850

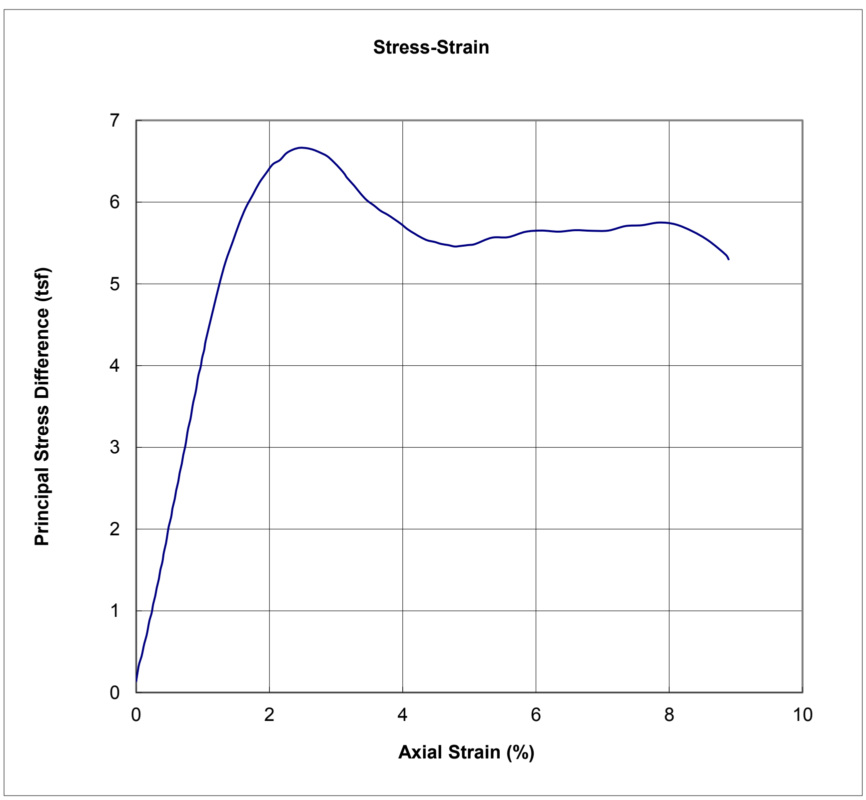
Customer: AECOM
888 SW 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido Dam 1
Kenedy, Texas

Project Number: 2023-134
Date of Test: 7/20/2023

Specimen and Testing Details

Borehole		204-23
Depth (ft)		8 - 10
Sample Date		6/14/2023
Soil Type		Sandy Lean Clay (CL)
Specimen Height	inch	5.23
Specimen Diameter	inch	2.86
Moisture Content	%	15.7
Dry Density	pcf	111.39
Confining Pressure	psi	11.5
Membrane Correction Used?	Y/N	N
Axial Strain	%	2.46
Failure Stress	tsf	6.66



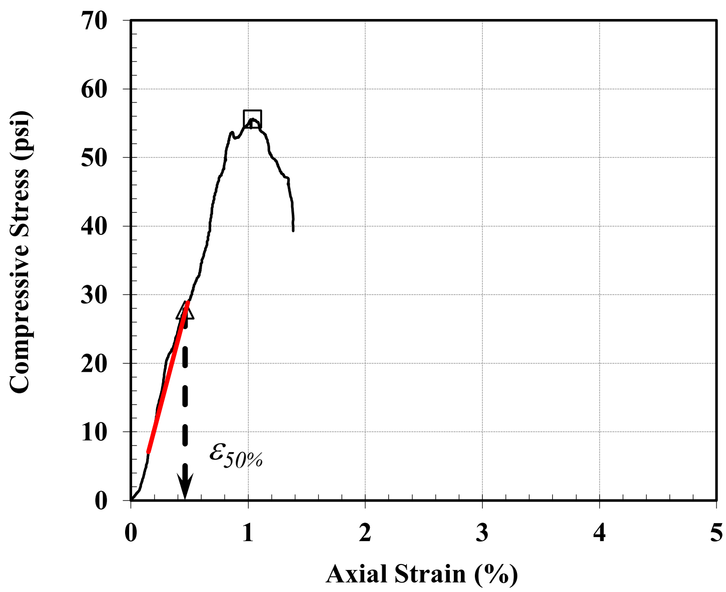
Uniaxial Compressive Strength of Intact Rock

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

Uniaxial Compressive Strength of Intact Rock Core
(ASTM D7012, Method D)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1
(PN: 2023-134)
Borehole ID: 201-23   Sample ID: RC-1 (15-20 ft)

Alpine Project No.: 2307257
Test Date: 08/01/23
Tested By: C.M.



Initial Conditions	
Avg. Diameter (in)	2.00
Avg. Height, H_0 (in)	4.26
Water Content at Shear (%)	13.3
Total Unit Weight, γ_{total} (pcf)	133.3
Dry Unit Weight, γ_{dry} (pcf)	117.7
Displacement Rate (in/min)	0.007

Stress at Failure	
Uniaxial Compressive Strength, σ_u (psi)	55.6
Time to Failure	6 mins 26 secs
Axial Strain at Failure (%)	1.04
Axial Strain at 50% of σ_u (%)	0.46
Avg. Modulus of Liner Portion (psi)*	6,481
Secant Modulus up to 50% of σ_u (psi)	6,015

*: The linear portion in red line was shown on the compressive stress versus axial strain curve.

Note: The testing specimen was not prepared in accordance with Practice ASTM D4543 on verifying conformance to dimensional and shape tolerances.

(a) As Received

(b) Before Test

(c) Fractured Specimen

Cheng-Wei Chen, Ph.D. 08/04/23
Reviewed By / Date

CRUMB TEST RESULTS

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

Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)

Alpine Project No.: 2307257
Test Date: 08/08/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, P-3 (4-6 ft)	2 minutes	21.3	1	Non-dispersive
	1 hour	21.4	1	Non-dispersive
	6 hours	21.9	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.

(a) Photo taken at 1 hour reading

(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

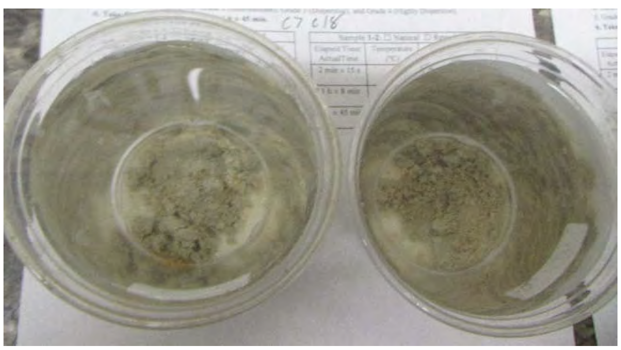
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)

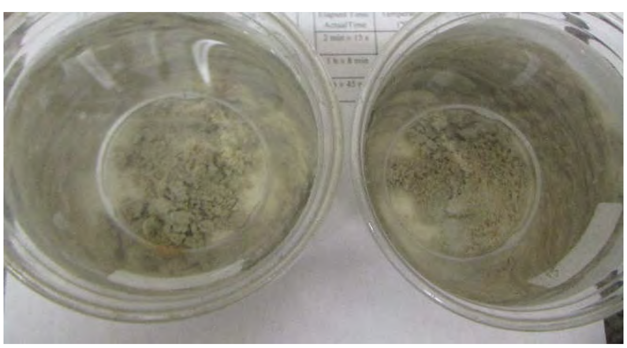
Alpine Project No.: 2307257
Test Date: 08/08/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, P-6 (10-12 ft)	2 minutes	21.3	1	Dispersive
	1 hour	21.4	2	Intermediate
	6 hours	21.9	2	Intermediate

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc. Alpine Project No.: 2307257

Project Name: Escondido FRS No.1 (PN: 2023-134) Test Date: 08/08/23

Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, G1 (0-3 ft)	2 minutes	21.3	1	Non-dispersive
	1 hour	21.4	1	Non-dispersive
	6 hours	21.9	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.

(a) Photo taken at 1 hour reading

(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

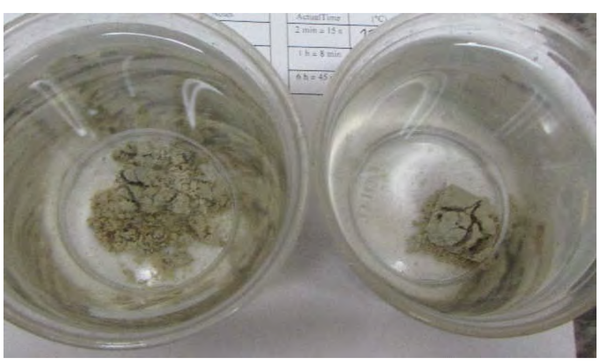
Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1
(PN: 2023-134)

Alpine Project No.: 2307257
Test Date: 09/07/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, SS-2 (2-3.5 ft)	2 minutes	22.5	1	Non-dispersive
	1 hour	22.6	1	Non-dispersive
	6 hours	23.2	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.

(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 09/08/23

Reviewed By / Date

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

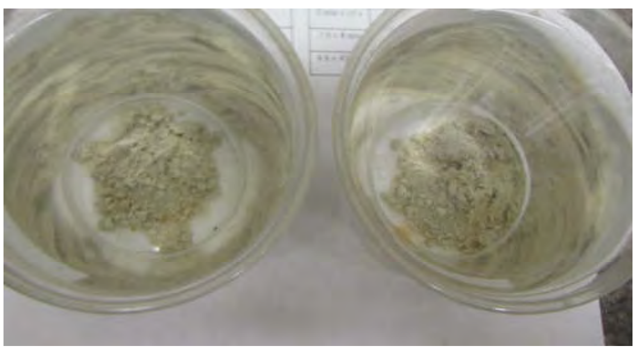
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1
(PN: 2023-134)

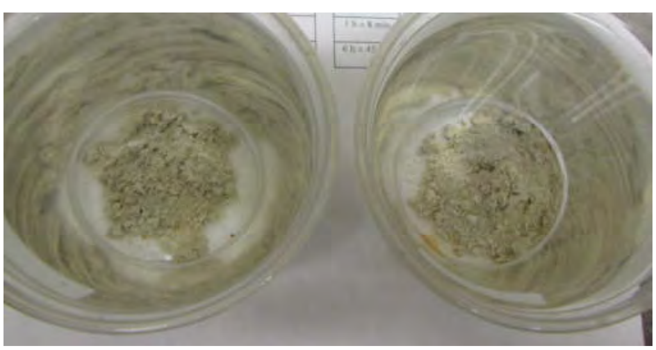
Alpine Project No.: 2307257
Test Date: 09/07/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, SS-4 (6-7.5 ft)	2 minutes	22.5	1	Non-dispersive
	1 hour	22.6	1	Non-dispersive
	6 hours	23.2	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 09/08/23

Reviewed By / Date

Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.

Project Name: Escondido FRS No.1 (PN: 2023-134)

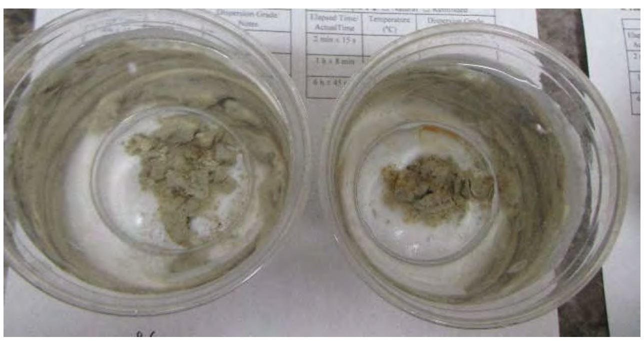
Alpine Project No.: 2307257

Test Date: 08/08/23

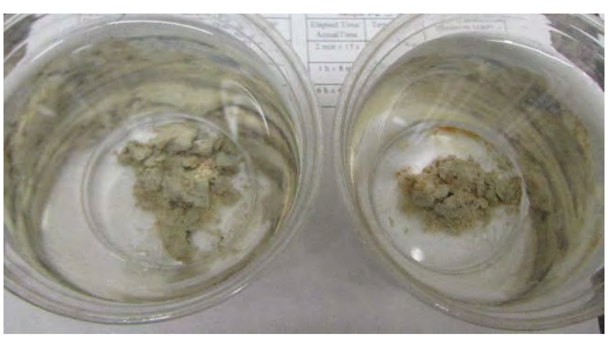
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, P-6 (10-12 ft)	2 minutes	21.3	1	Non-dispersive
	1 hour	21.4	1	Non-dispersive
	6 hours	21.9	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.

Project Name: Escondido FRS No.1 (PN: 2023-134)

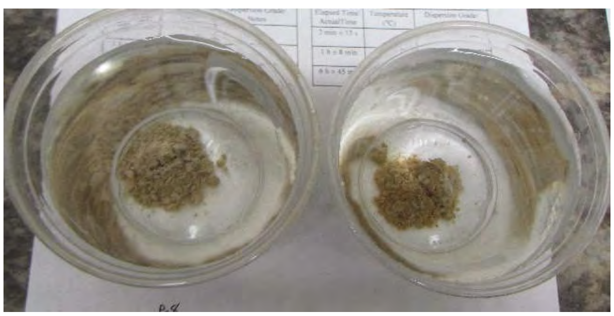
Alpine Project No.: 2307257

Test Date: 08/08/23

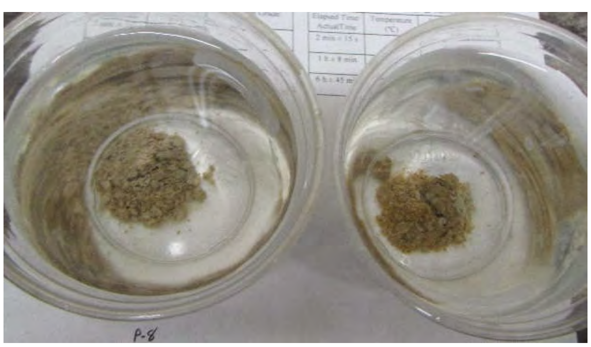
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, P-8 (14-16 ft)	2 minutes	21.3	1	Non-dispersive
	1 hour	21.5	1	Non-dispersive
	6 hours	21.9	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

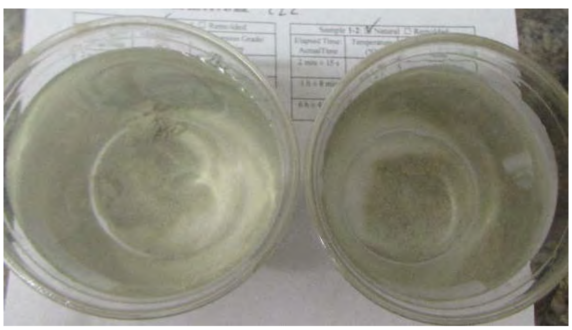
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)

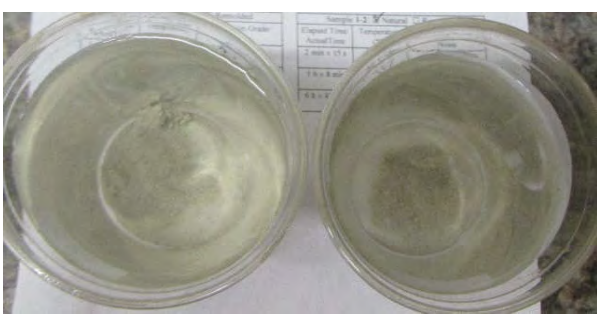
Alpine Project No.: 2307257
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, S-11 (25.5-27 ft)	2 minutes	21.7	1	Non-dispersive
	1 hour	21.7	2	Intermediate
	6 hours	21.8	2	Intermediate

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

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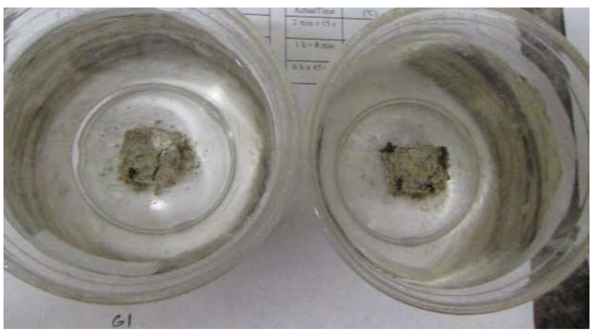
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1
(PN: 2023-134)

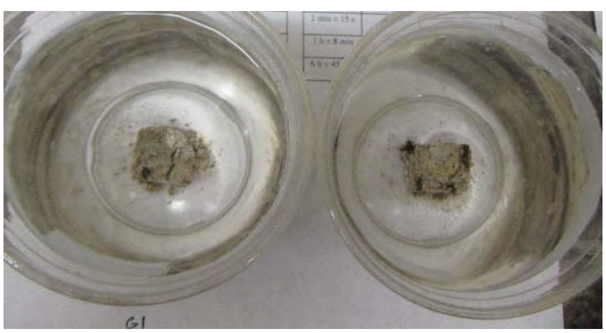
Alpine Project No.: 2307257
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, G1 (0-3 ft)	2 minutes	21.7	1	Non-dispersive
	1 hour	21.7	1	Non-dispersive
	6 hours	21.8	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
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Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.

Project Name: Escondido FRS No.1 (PN: 2023-134)

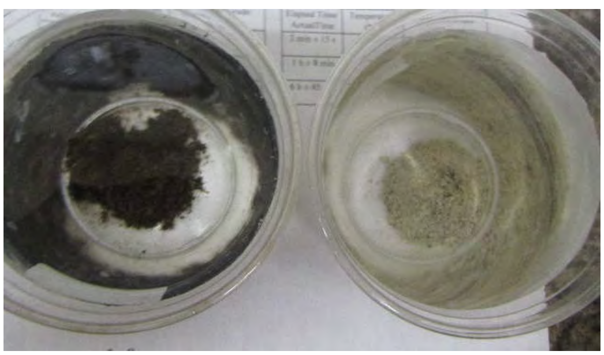
Alpine Project No.: 2307257

Test Date: 08/09/23

Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, G2 (3-5 ft)	2 minutes	21.6	1	Non-dispersive
	1 hour	21.7	1	Non-dispersive
	6 hours	21.8	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading

(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
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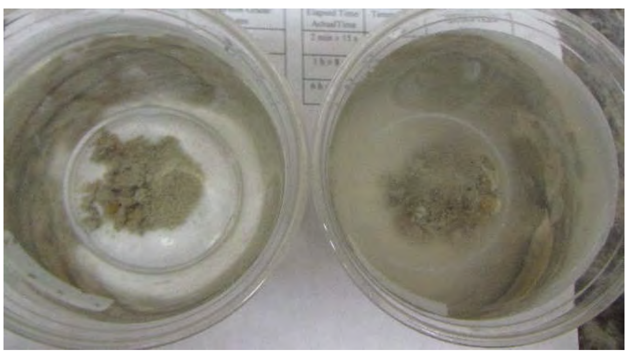
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)

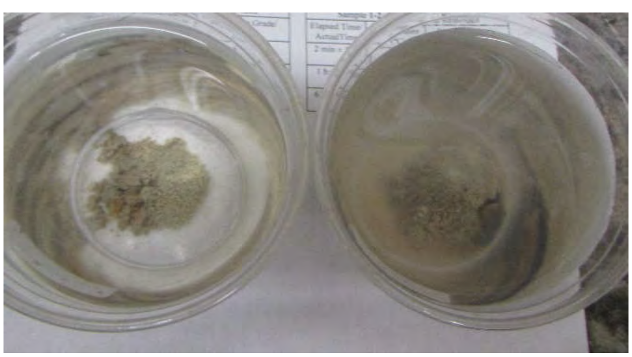
Alpine Project No.: 2307257
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, P-3 (4-6 ft)	2 minutes	21.6	1	Non-dispersive
	1 hour	21.7	4	Highly Dispersive
	6 hours	21.8	4	Highly Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

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Hutto, TX 78634
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Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

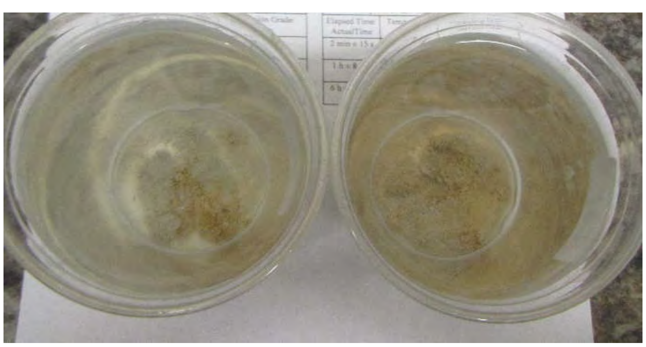
Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)

Alpine Project No.: 2307257
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, SS-8 (12-13.5 ft)	2 minutes	21.5	3	Dispersive
	1 hour	21.6	4	Highly Dispersive
	6 hours	21.8	4	Highly Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.

(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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Reviewed By / Date

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Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.

Project Name: Escondido FRS No.1 (PN: 2023-134)

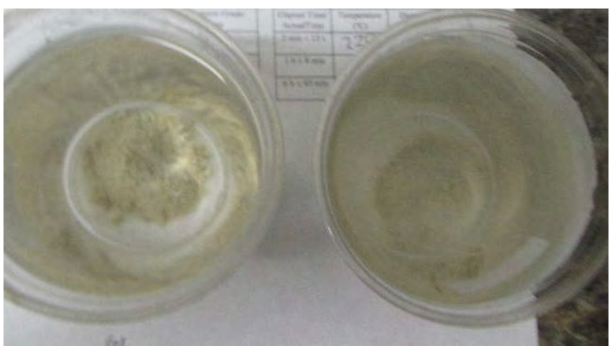
Alpine Project No.: 2307257

Test Date: 08/09/23

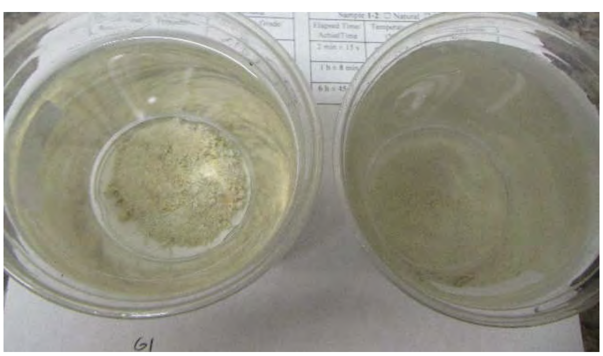
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, G1 (0-3 ft)	2 minutes	22.2	2	Intermediate
	1 hour	21.6	3	Dispersive
	6 hours	21.8	3	Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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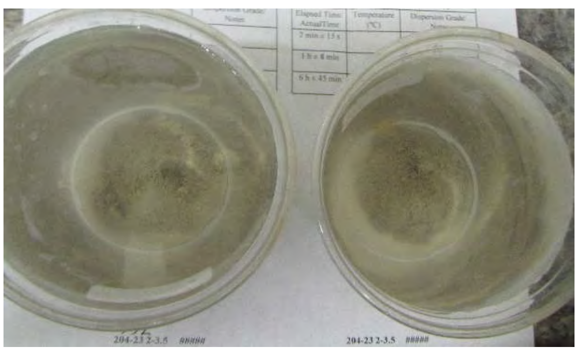
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)

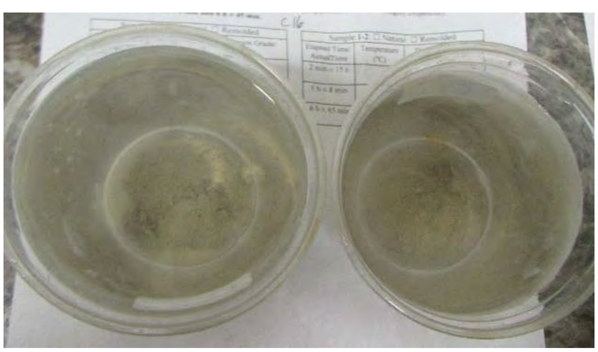
Alpine Project No.: 2307257
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, SS-2 (2-3.5 ft)	2 minutes	22.1	2	Intermediate
	1 hour	21.6	3	Dispersive
	6 hours	21.7	3	Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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Reviewed By / Date

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

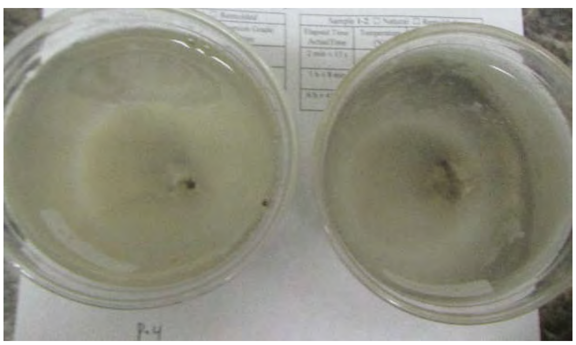
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1
(PN: 2023-134)

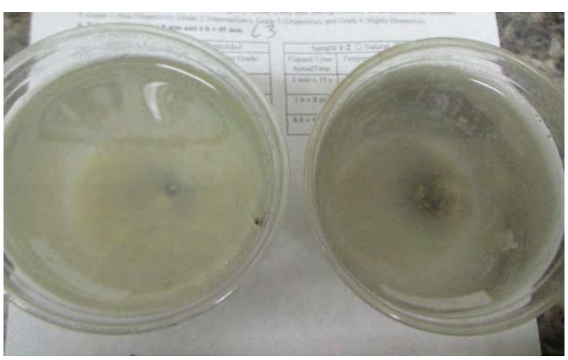
Alpine Project No.: 2307257
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, P-4 (6-8 ft)	2 minutes	22.0	2	Intermediate
	1 hour	21.6	4	Highly Dispersive
	6 hours	21.7	4	Highly Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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

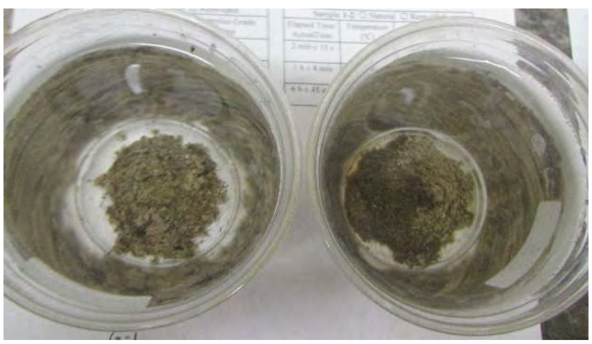
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)

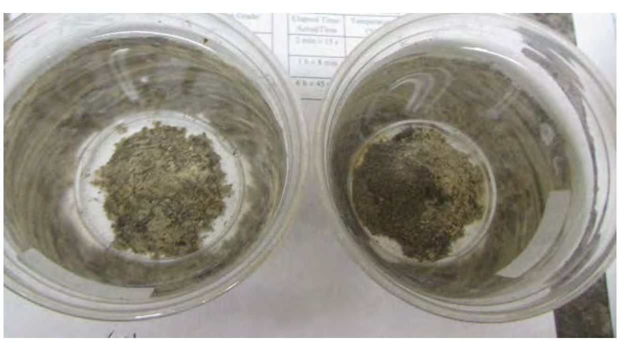
Alpine Project No.: 2307257
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, G1 (0-3 ft)	2 minutes	22.1	1	Non-dispersive
	1 hour	21.6	1	Non-dispersive
	6 hours	21.7	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

PINHOLE TEST RESULTS

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

Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 203-23, P-3 (4-6 ft)

Alpine Project No.: 2307257
Test Date: 11/01/23
Tested By: C.M.
Type of Pinhole Test: Method A

Note 1: Specimen remolded to 109.0 pcf dry density at 13.0 % water content.

Water Content of Specimen: 13.2%
Specimen Dry Unit Weight: 108.9 pcf
Distilled Water Used: ☒ Yes ☐ No

Head (in)	Flow		Flow Rate (*ml/sec*)	Turbidity from Visual						Completely Clear Top Down	Comments
	ml.	*sec.*		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		
2	28	120	0.2						√		Minimal flow at 2 in. head
2	30	120	0.3						√		
7	40	150	0.3						√		Minimal flow at 7 in. head
7	40	150	0.3						√		
7	41	150	0.3						√	√	
15	58	90	0.6						√	√	Minimal flow at 15 in. head
15	58	90	0.6						√	√	
15	57	90	0.6						√	√	
40	64	30	2.1						√	√	
40	64	30	2.1						√	√	

Note 2: Hole size after test ≤ 1.0 mm

Classification:	ND1, Nondispersive Clay

Cheng-Wei Chen, Ph.D. 11/02/23
Reviewed By / Date

Alpine Engineering Services, LLC
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Tel: (512) 387-1287

Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 203-23, P-9 (14-16 ft)

Alpine Project No.: 2307257
Test Date: 11/01/23
Tested By: C.M.
Type of Pinhole Test: Method A

Note 1: Specimen remolded to 119.0 pcf dry density at 13.0 % water content.

Water Content of Specimen: 13.1%
Specimen Dry Unit Weight: 119.1 pcf
Distilled Water Used: ☒ Yes ☐ No

Head (in)	Flow		Flow Rate (*ml/sec*)	Turbidity from Visual						Completely Clear Top Down	Comments
	ml.	*sec.*		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		
2	12	60	0.2						√		Minimal flow at 2 in. head
2	12	60	0.2						√		
7	23	60	0.4						√	√	Minimal flow at 7 in. head
7	24	60	0.4						√	√	
7	24	60	0.4						√	√	
15	45	60	0.8						√	√	Minimal flow at 15 in. head
15	45	60	0.8						√	√	
15	46	60	0.8						√	√	
40	102	60	1.7						√	√	
40	103	60	1.7						√	√	

Note 2: Hole size after test ≤ 1.0 mm

Classification:	ND1, Nondispersive Clay

Cheng-Wei Chen, Ph.D. 11/02/23
Reviewed By / Date

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

Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 204-23, P-4 (6-8 ft)

Alpine Project No.: 2307257
Test Date: 11/01/23
Tested By: C.M.
Type of Pinhole Test: Method A

Note 1: Specimen remolded to 115.0 pcf dry density at 8.0 % water content.

Water Content of Specimen: 8.3%
Specimen Dry Unit Weight: 114.8 pcf
Distilled Water Used: ☒ Yes ☐ No

Head (in)	Flow		Flow Rate (*ml/sec*)	Turbidity from Visual						Completely Clear Top Down	Comments
	ml.	*sec.*		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		
2	36	120	0.3						√		Minimal flow at 2 in. head
2	36	120	0.3						√		
7	34	60	0.6						√	√	Minimal flow at 7 in. head
7	34	60	0.6						√	√	
7	35	60	0.6						√	√	
15	62	60	1.0						√	√	Steady flow at 15 in. head
15	63	60	1.1						√	√	
15	63	60	1.1						√	√	
40	63	30	2.1						√	√	
40	63	30	2.1						√	√	

Note 2: Hole size after test ≤ 1.0 mm

Classification:	ND1, Nondispersive Clay

Cheng-Wei Chen, Ph.D. 11/02/23

Reviewed By / Date

HYDROMETER TEST RESULTS

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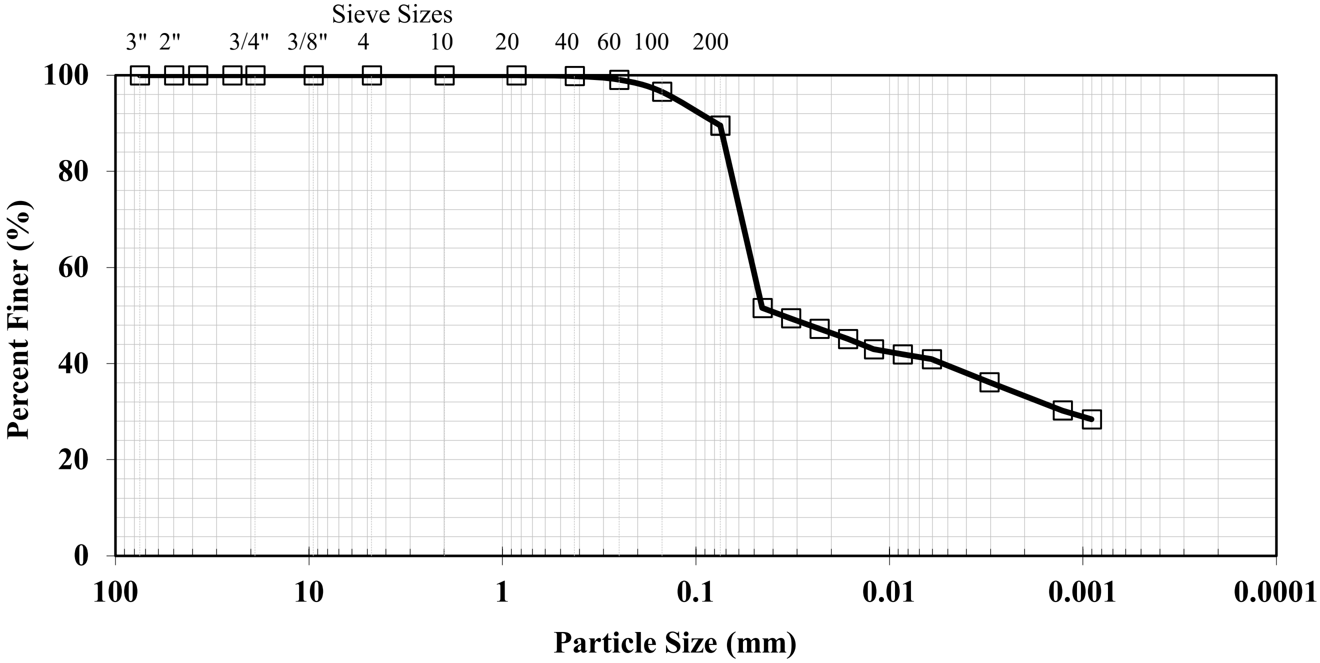
Tel: (512) 387-1287

Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 201-23, P-3 (4-6 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 µm)	100.0
No. 40 (425 µm)	99.8
No. 60 (250 µm)	99.1
No. 100 (150 µm)	96.6
No. 200 (75 µm)	89.5

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0455 mm	51.5
0.0324 mm	49.4
0.0230 mm	47.3
0.0164 mm	45.1
0.0121 mm	43.0
0.0086 mm	41.9
0.0061 mm	40.9
0.0031 mm	36.1
0.0013 mm	30.2
0.0009 mm	28.4

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 32.6

D60 (mm)	0.052
D30 (mm)	0.001
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

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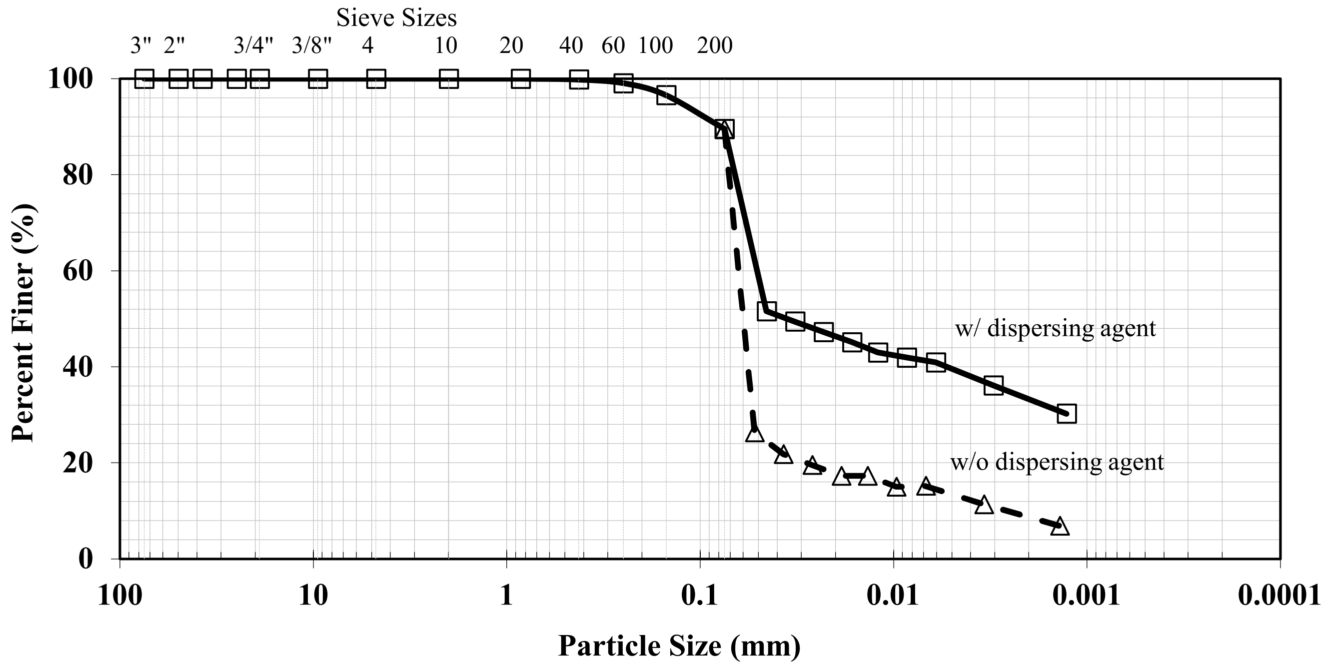
Tel: (512) 387-1287

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 201-23, P-3 (4-6 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 µm)	100.0
No. 40 (425 µm)	99.8
No. 60 (250 µm)	99.1
No. 100 (150 µm)	96.6
No. 200 (75 µm)	89.5

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0522 mm	26.3
0.0371 mm	21.8
0.0263 mm	19.5
0.0187 mm	17.3
0.0136 mm	17.3
0.0097 mm	15.0
0.0068 mm	15.2
0.0034 mm	11.4
0.0014 mm	6.9

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 8.2

% Dispersion = 25.3

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Alpine Engineering Services, LLC
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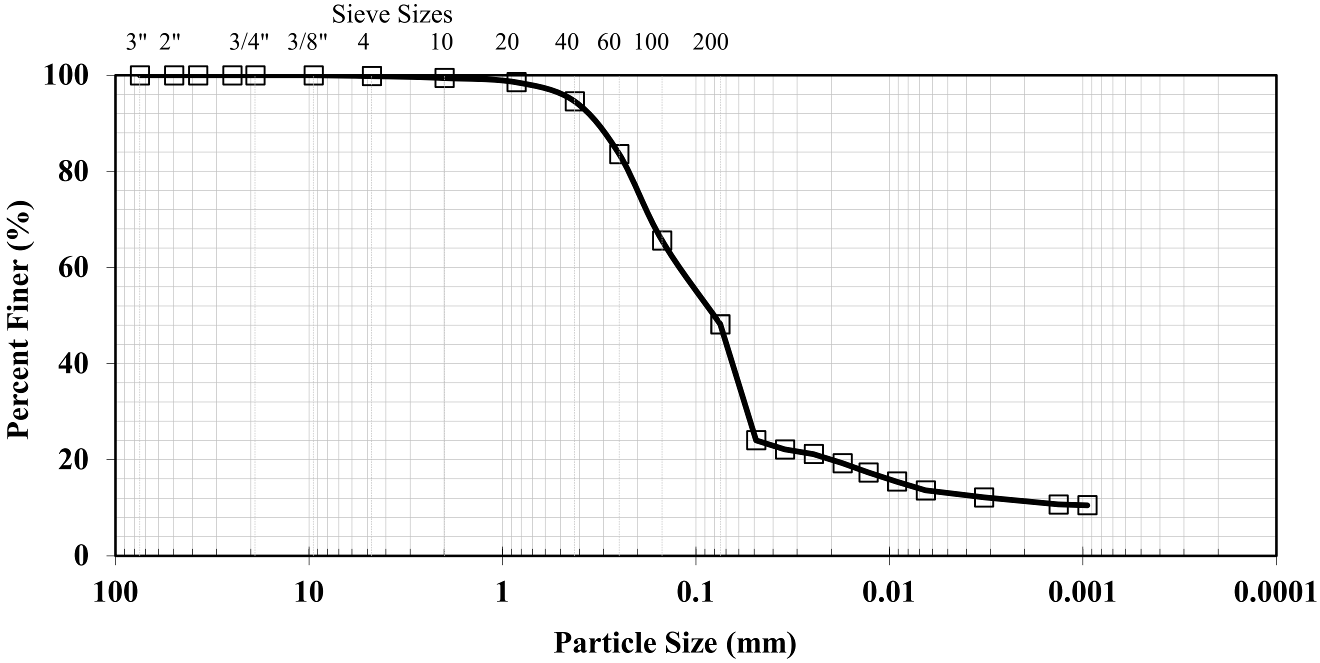
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 202-23, G1 (0-3 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.8
No. 10 (2.0 mm)	99.4
No. 20 (850 µm)	98.6
No. 40 (425 µm)	94.6
No. 60 (250 µm)	83.6
No. 100 (150 µm)	65.6
No. 200 (75 µm)	48.2

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0489 mm	24.0
0.0348 mm	22.1
0.0247 mm	21.2
0.0175 mm	19.3
0.0129 mm	17.4
0.0092 mm	15.5
0.0065 mm	13.6
0.0032 mm	12.1
0.0013 mm	10.7
0.0010 mm	10.6

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 11.2

D60 (mm)	0.126
D30 (mm)	0.055
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Alpine Engineering Services, LLC
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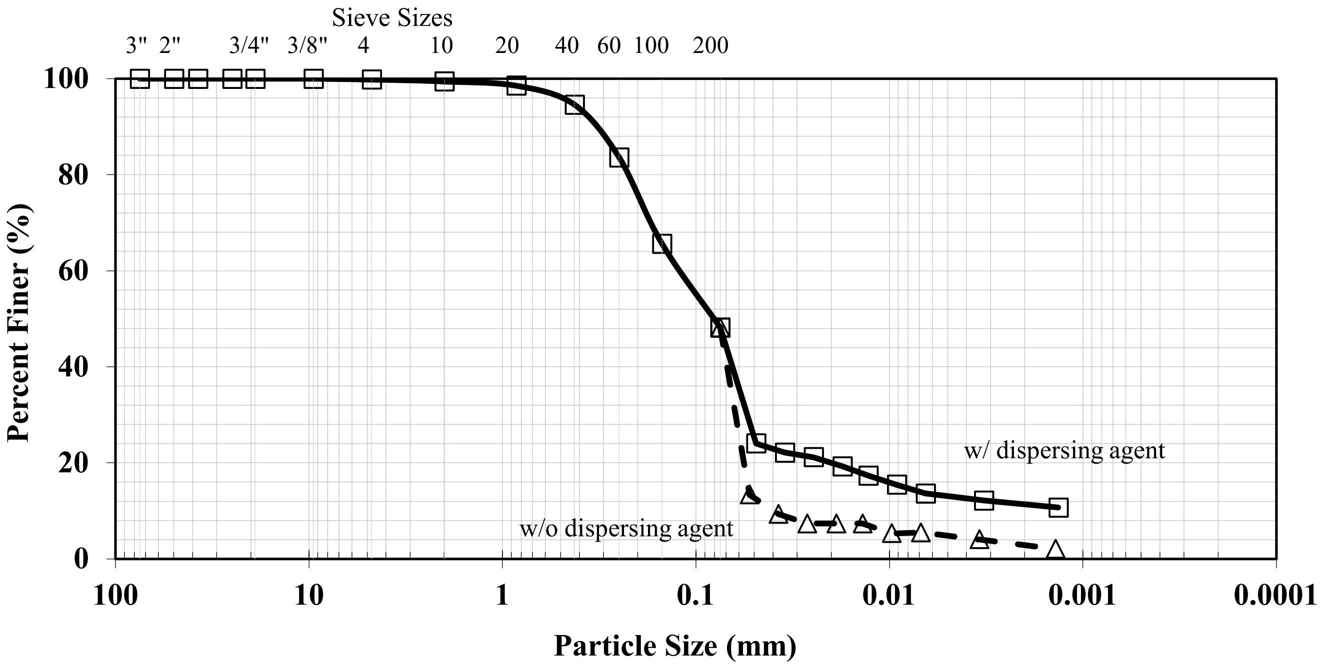
Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 202-23, G1 (0-3 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.8
No. 10 (2.0 mm)	99.4
No. 20 (850 µm)	98.6
No. 40 (425 µm)	94.6
No. 60 (250 µm)	83.6
No. 100 (150 µm)	65.6
No. 200 (75 µm)	48.2

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0529 mm	13.4
0.0376 mm	9.4
0.0266 mm	7.3
0.0188 mm	7.3
0.0138 mm	7.3
0.0098 mm	5.3
0.0069 mm	5.5
0.0034 mm	4.1
0.0014 mm	2.1

$N_{m,\,2\,\mu m,\,nd}$ (%) = 2.7

% Dispersion = 24.1

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

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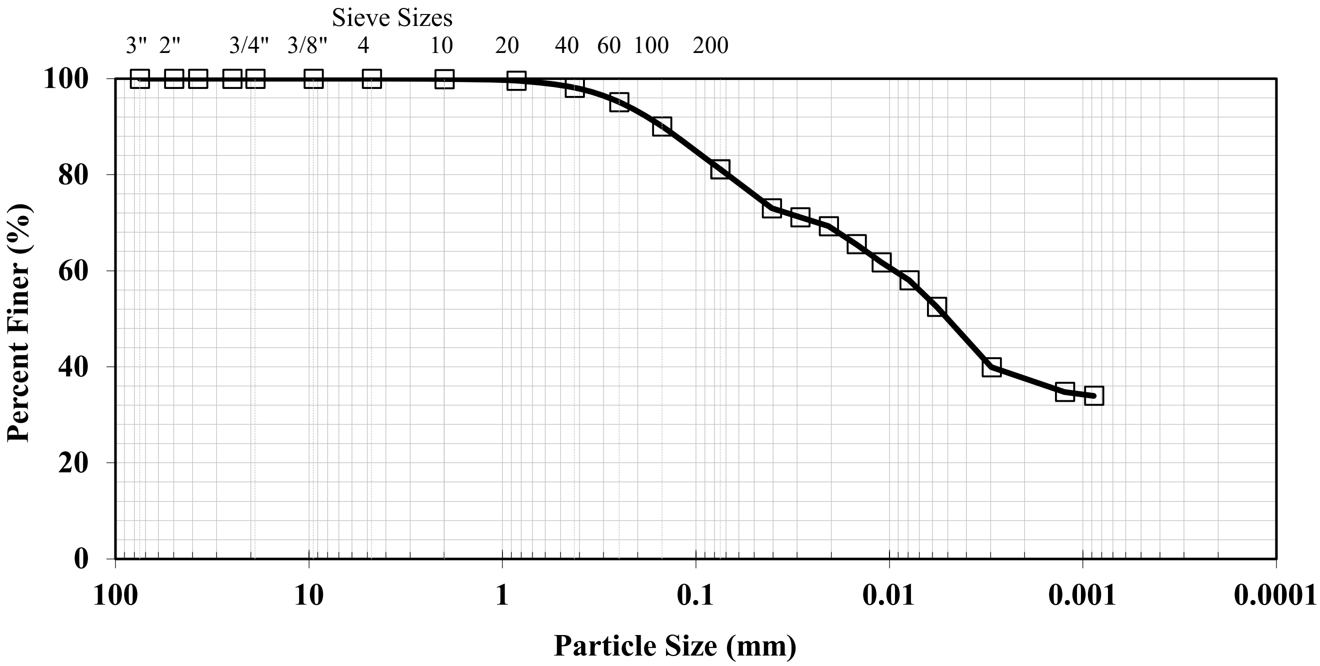
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 202-23, G2 (3-5 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 µm)	99.6
No. 40 (425 µm)	98.1
No. 60 (250 µm)	95.1
No. 100 (150 µm)	90.1
No. 200 (75 µm)	81.1

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0406 mm	73.0
0.0289 mm	71.1
0.0206 mm	69.3
0.0148 mm	65.5
0.0110 mm	61.8
0.0079 mm	58.1
0.0057 mm	52.5
0.0030 mm	39.9
0.0012 mm	34.8
0.0009 mm	34.0

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 37.0

D60 (mm)	0.010
D30 (mm)	- -
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Alpine Engineering Services, LLC
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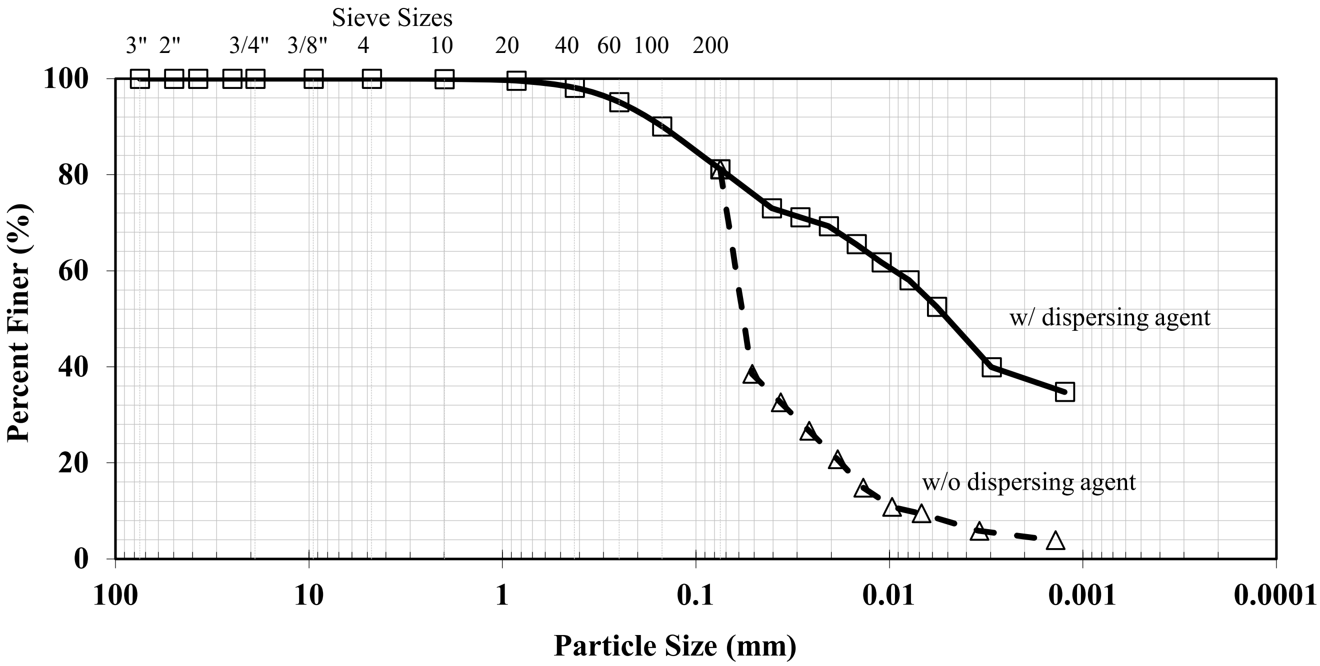
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 202-23, G2 (3-5 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 µm)	99.6
No. 40 (425 µm)	98.1
No. 60 (250 µm)	95.1
No. 100 (150 µm)	90.1
No. 200 (75 µm)	81.1

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0513 mm	38.5
0.0365 mm	32.6
0.0260 mm	26.7
0.0186 mm	20.7
0.0137 mm	14.8
0.0097 mm	10.9
0.0068 mm	9.5
0.0034 mm	5.8
0.0014 mm	3.9

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 4.5

% Dispersion = 12.0

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

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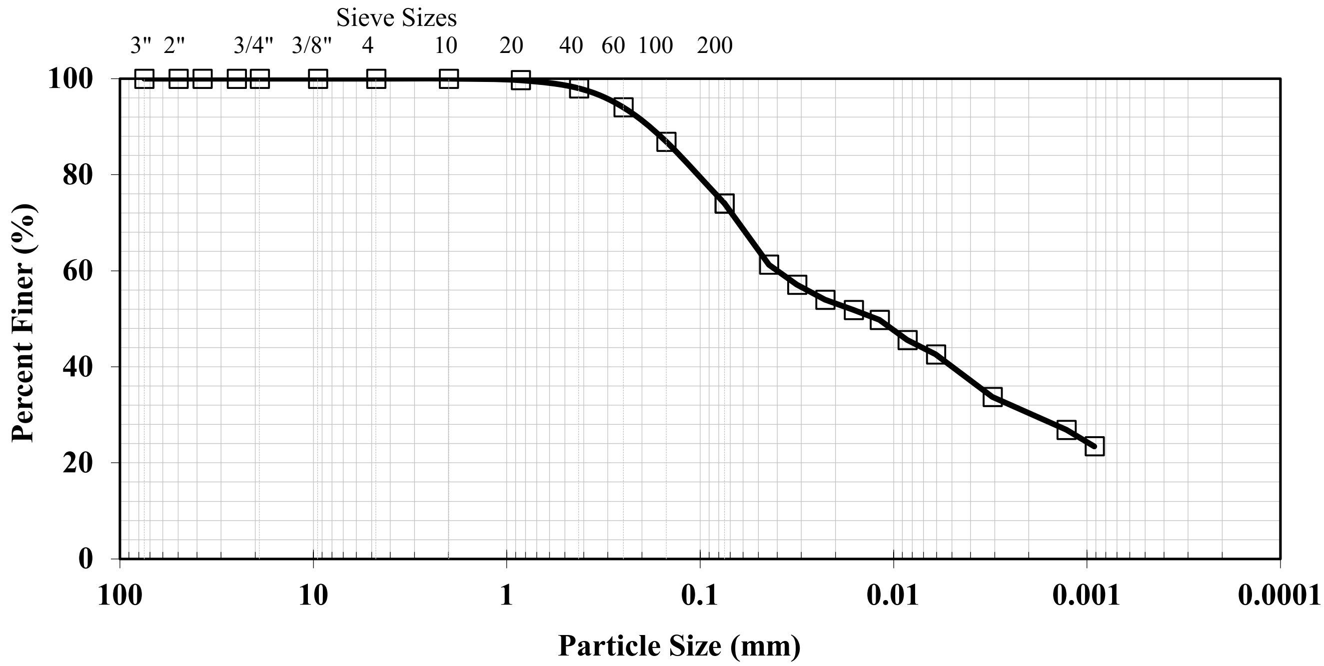
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 203-23, P-3 (4-6 ft)

Alpine Project No.: 2307257
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 µm)	99.7
No. 40 (425 µm)	98.0
No. 60 (250 µm)	94.0
No. 100 (150 µm)	86.9
No. 200 (75 µm)	74.0

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0441 mm	61.3
0.0317 mm	57.1
0.0226 mm	54.0
0.0161 mm	51.9
0.0119 mm	49.8
0.0085 mm	45.6
0.0061 mm	42.6
0.0031 mm	33.7
0.0013 mm	26.9
0.0009 mm	23.4

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 29.6

D60 (mm)	0.040
D30 (mm)	0.002
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

Particle-Size Distribution
& Double Hydrometer Analysis for Soils
(ASTM D6913 & D4221)

Alpine Engineering Services, LLC
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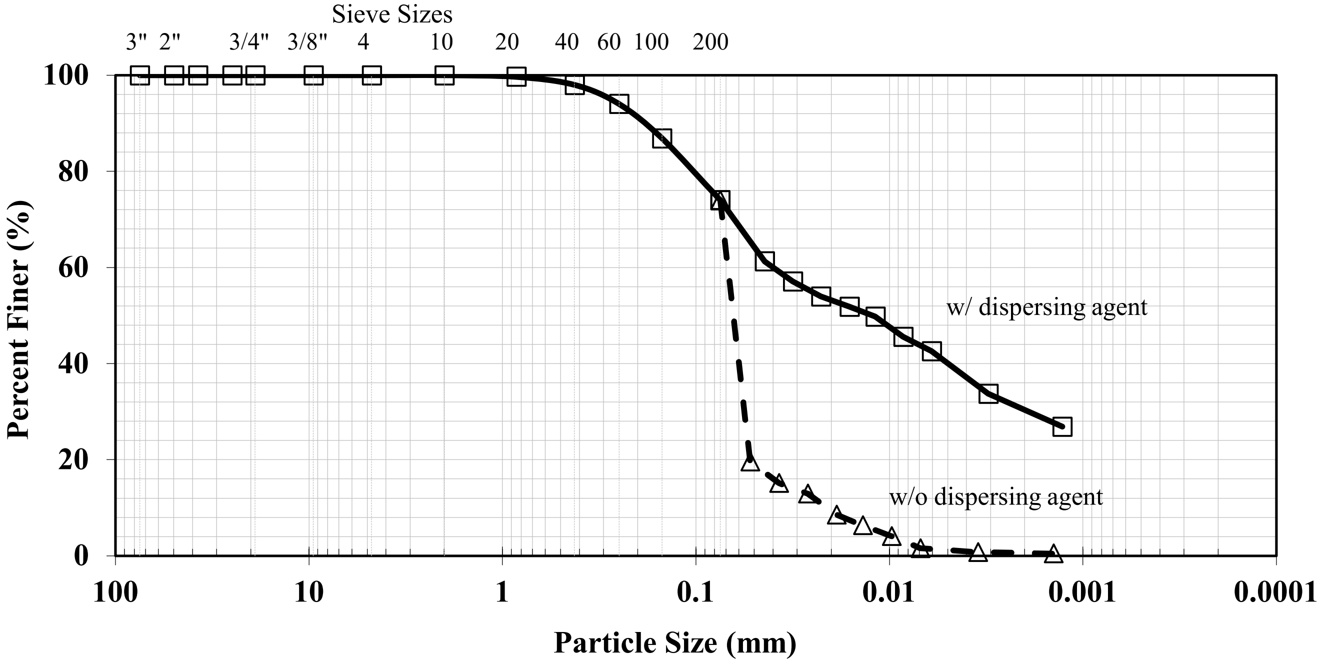
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 203-23, P-3 (4-6 ft)

Alpine Project No.: 2307257
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 µm)	99.7
No. 40 (425 µm)	98.0
No. 60 (250 µm)	94.0
No. 100 (150 µm)	86.9
No. 200 (75 µm)	74.0

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0524 mm	19.6
0.0373 mm	15.2
0.0264 mm	13.0
0.0188 mm	8.5
0.0137 mm	6.3
0.0097 mm	4.1
0.0069 mm	1.6
0.0035 mm	0.8
0.0014 mm	0.5

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 0.6

% Dispersion = 1.9

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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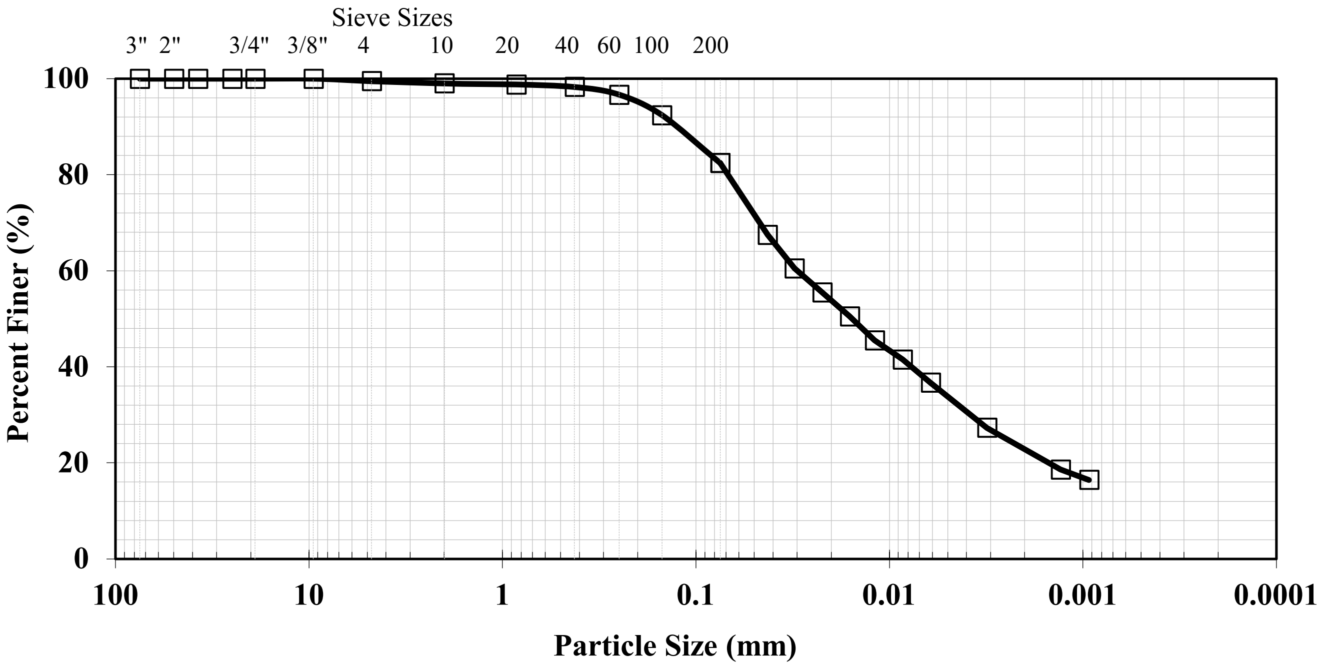
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 203-23, P-9 (14-16 ft)

Alpine Project No.: 2307257
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.5
No. 10 (2.0 mm)	99.0
No. 20 (850 µm)	98.8
No. 40 (425 µm)	98.3
No. 60 (250 µm)	96.7
No. 100 (150 µm)	92.4
No. 200 (75 µm)	82.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0427 mm	67.5
0.0310 mm	60.5
0.0223 mm	55.5
0.0161 mm	50.5
0.0119 mm	45.5
0.0086 mm	41.5
0.0061 mm	36.7
0.0031 mm	27.3
0.0013 mm	18.6
0.0009 mm	16.5

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 21.9

D60 (mm)	0.030
D30 (mm)	0.004
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

Particle-Size Distribution
& Double Hydrometer Analysis for Soils
(ASTM D6913 & D4221)

Alpine Engineering Services, LLC
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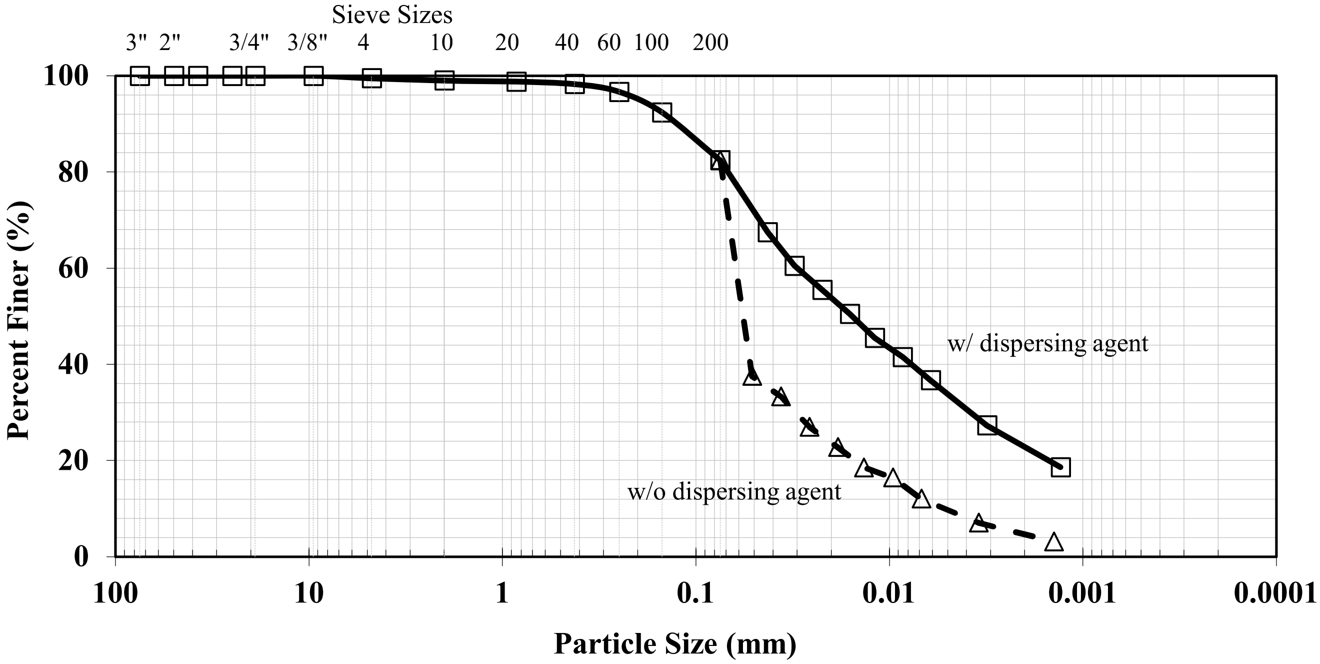
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 203-23, P-9 (14-16 ft)

Alpine Project No.: 2307257
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.5
No. 10 (2.0 mm)	99.0
No. 20 (850 µm)	98.8
No. 40 (425 µm)	98.3
No. 60 (250 µm)	96.7
No. 100 (150 µm)	92.4
No. 200 (75 µm)	82.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0513 mm	37.6
0.0365 mm	33.3
0.0260 mm	27.0
0.0185 mm	22.8
0.0136 mm	18.6
0.0096 mm	16.4
0.0068 mm	12.1
0.0035 mm	7.1
0.0014 mm	3.1

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 4.3

% Dispersion = 19.5

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

Particle-Size Distribution
& Hydrometer Analysis for Soils
(ASTM D6913 & D7928)

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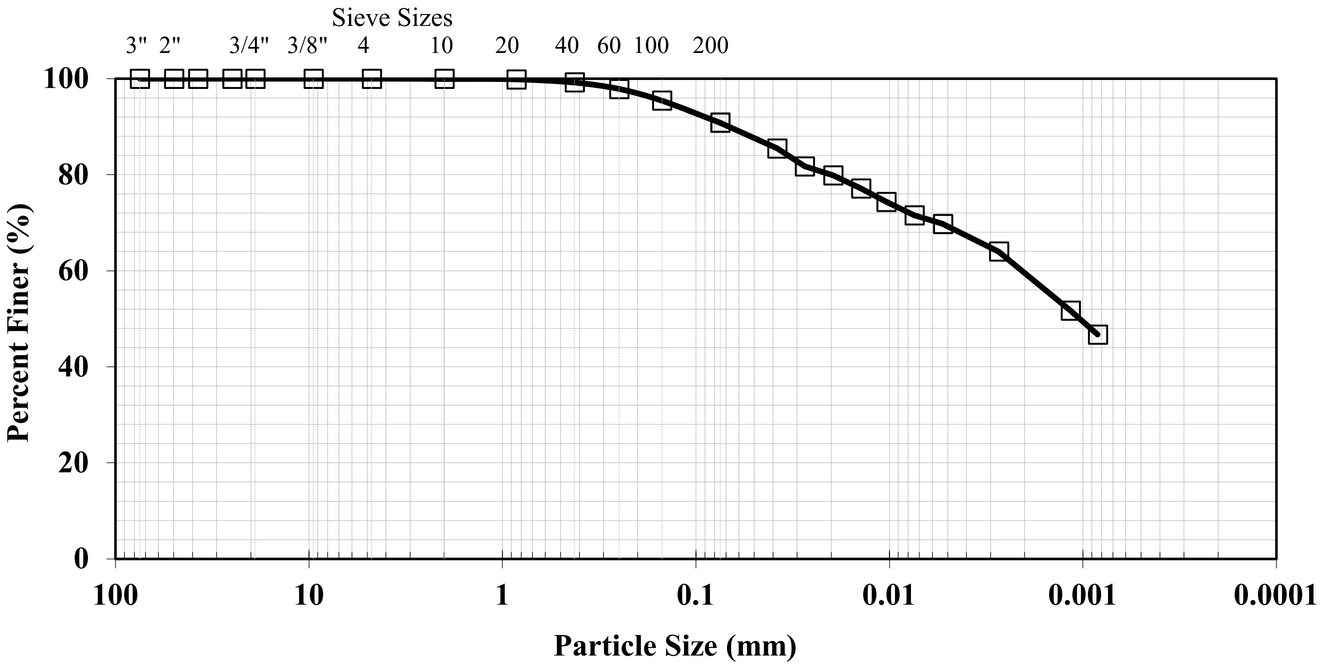
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1
(PN: 2023-134)
Sample ID: 203-23, G1 (0-3 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 µm)	99.9
No. 40 (425 µm)	99.2
No. 60 (250 µm)	97.9
No. 100 (150 µm)	95.4
No. 200 (75 µm)	90.8

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0381 mm	85.5
0.0274 mm	81.8
0.0196 mm	79.9
0.0140 mm	77.1
0.0104 mm	74.3
0.0074 mm	71.5
0.0053 mm	69.8
0.0027 mm	64.0
0.0012 mm	51.7
0.0008 mm	46.7

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 58.3

D60 (mm)	0.002
D30 (mm)	- -
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Particle-Size Distribution
& Double Hydrometer Analysis for Soils
(ASTM D6913 & D4221)

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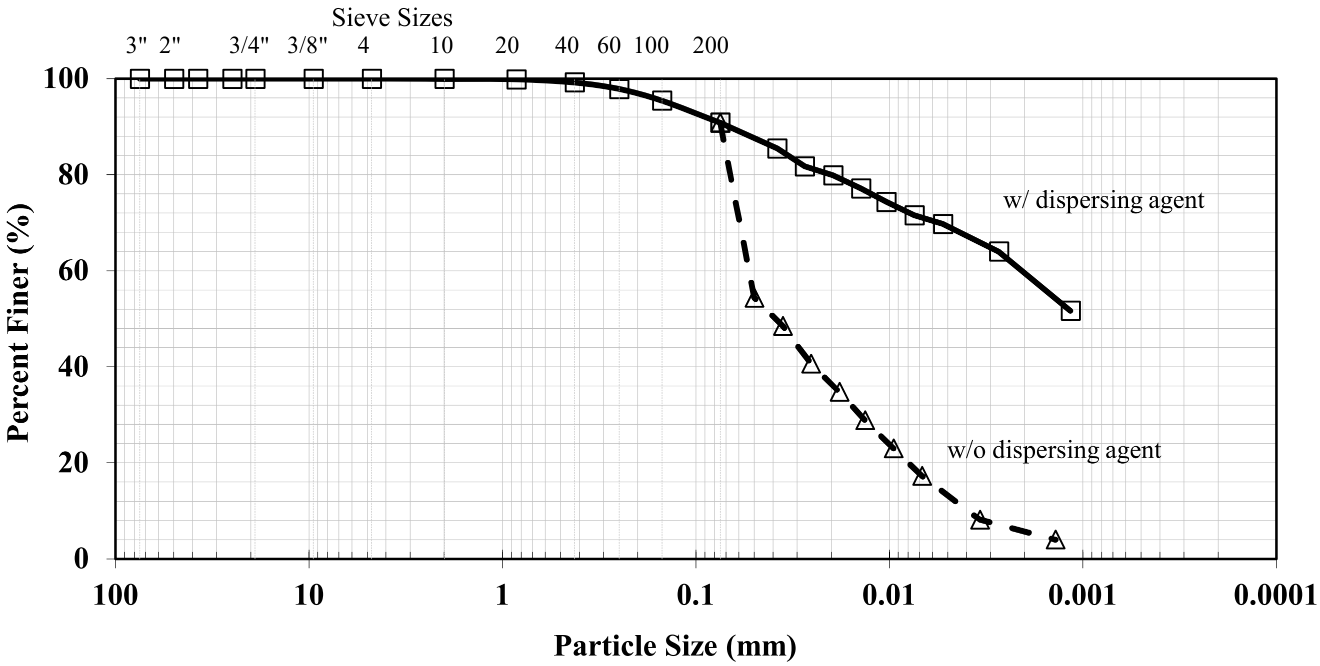
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 203-23, G1 (0-3 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 μm)	99.9
No. 40 (425 μm)	99.2
No. 60 (250 μm)	97.9
No. 100 (150 μm)	95.4
No. 200 (75 μm)	90.8

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0500 mm	54.4
0.0356 mm	48.5
0.0255 mm	40.6
0.0182 mm	34.8
0.0134 mm	28.9
0.0095 mm	23.0
0.0068 mm	17.3
0.0034 mm	8.2
0.0014 mm	4.0

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\ 2\,\mu m,\ nd}$ (%) = 5.3

% Dispersion = 9.1

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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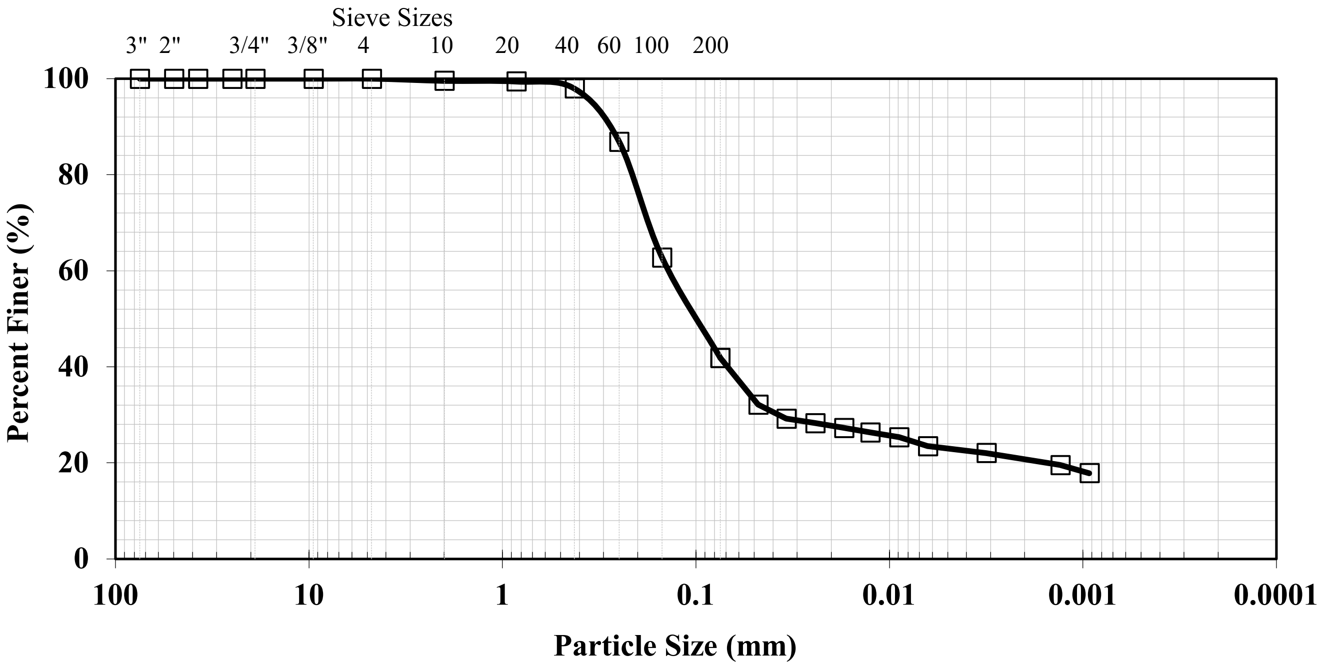
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 204-23, P-4 (6-8 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.6
No. 20 (850 µm)	99.4
No. 40 (425 µm)	98.0
No. 60 (250 µm)	86.9
No. 100 (150 µm)	62.8
No. 200 (75 µm)	41.8

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0478 mm	32.1
0.0341 mm	29.2
0.0242 mm	28.3
0.0172 mm	27.3
0.0126 mm	26.3
0.0089 mm	25.3
0.0063 mm	23.5
0.0032 mm	22.0
0.0013 mm	19.5
0.0009 mm	17.9

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 20.5

D60 (mm)	0.140
D30 (mm)	0.038
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Alpine Engineering Services, LLC
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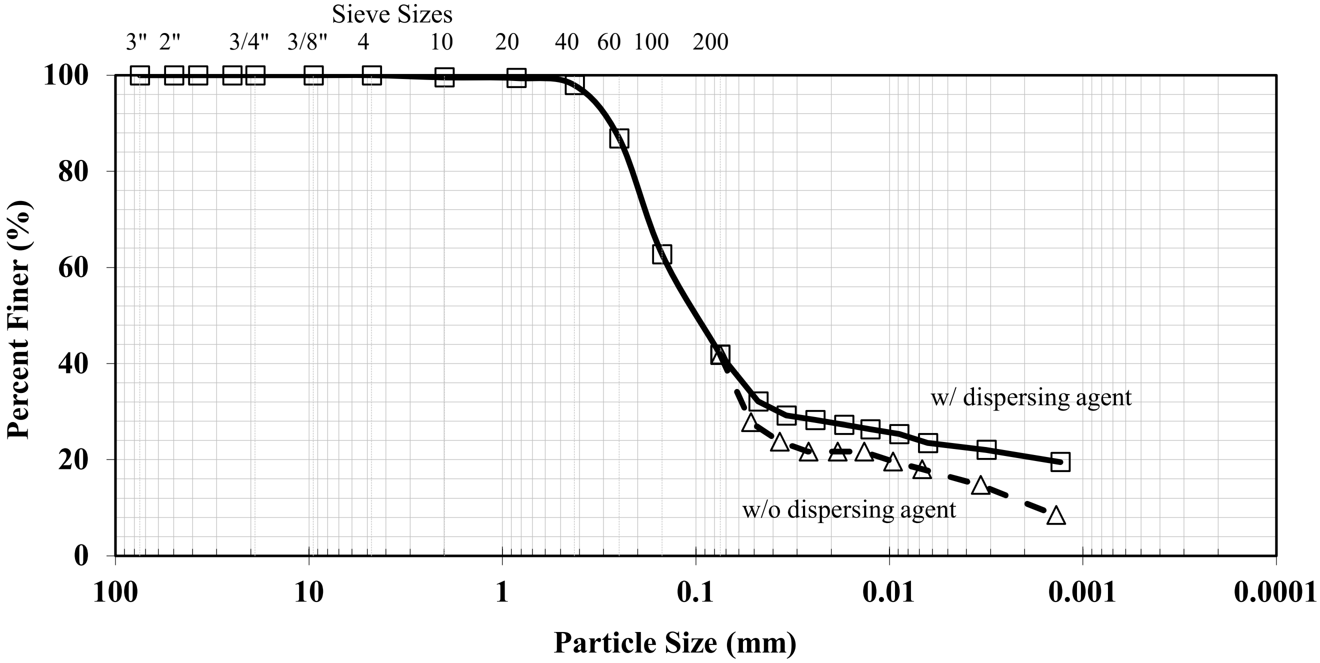
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 204-23, P-4 (6-8 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.6
No. 20 (850 µm)	99.4
No. 40 (425 µm)	98.0
No. 60 (250 µm)	86.9
No. 100 (150 µm)	62.8
No. 200 (75 µm)	41.8

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0520 mm	27.8
0.0370 mm	23.7
0.0262 mm	21.7
0.0185 mm	21.7
0.0135 mm	21.7
0.0096 mm	19.6
0.0068 mm	18.0
0.0034 mm	14.7
0.0014 mm	8.5

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\ 2\ \mu m,\ nd}$ (%) = 10.4

% Dispersion = 50.8

Note 2: The % dispersion is greater than 50 % - The soil is dispersive.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

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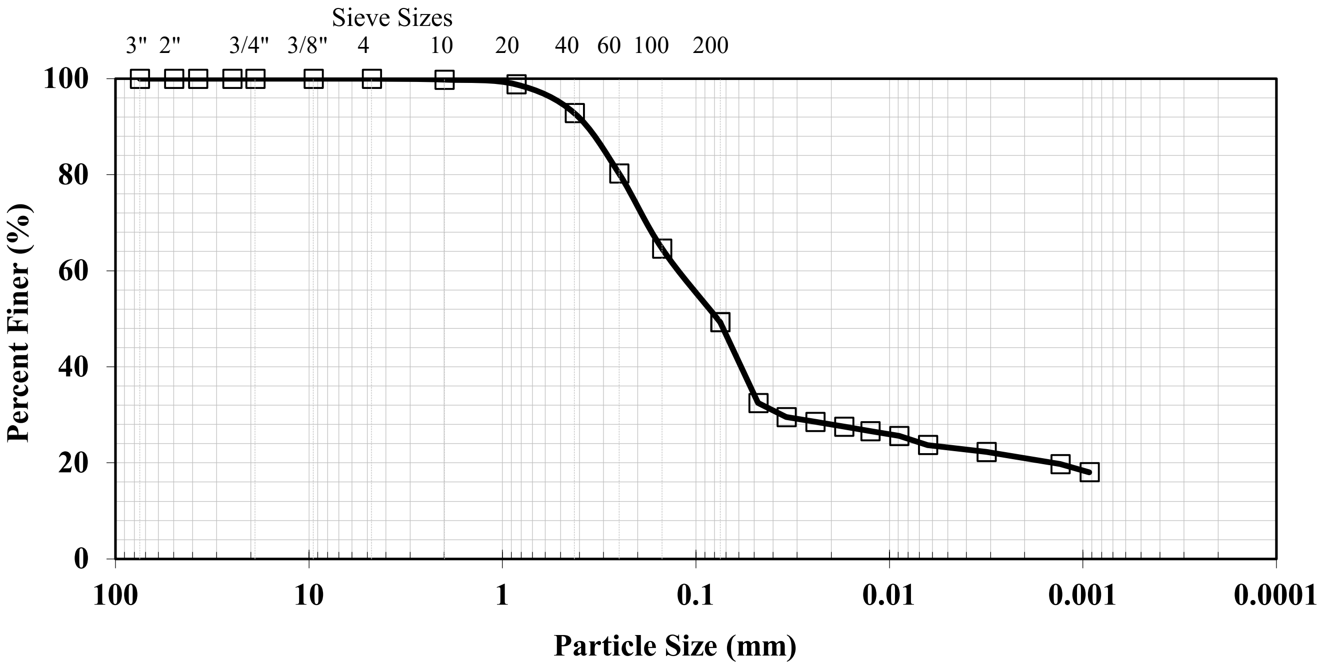
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 204-23, G1 (0-3 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.8
No. 20 (850 µm)	98.8
No. 40 (425 µm)	92.8
No. 60 (250 µm)	80.3
No. 100 (150 µm)	64.6
No. 200 (75 µm)	49.3

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0478 mm	32.5
0.0341 mm	29.5
0.0242 mm	28.5
0.0172 mm	27.6
0.0126 mm	26.6
0.0089 mm	25.6
0.0063 mm	23.7
0.0032 mm	22.3
0.0013 mm	19.7
0.0009 mm	18.1

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 20.7

D60 (mm)	0.127
D30 (mm)	0.036
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Particle-Size Distribution
& Double Hydrometer Analysis for Soils
(ASTM D6913 & D4221)

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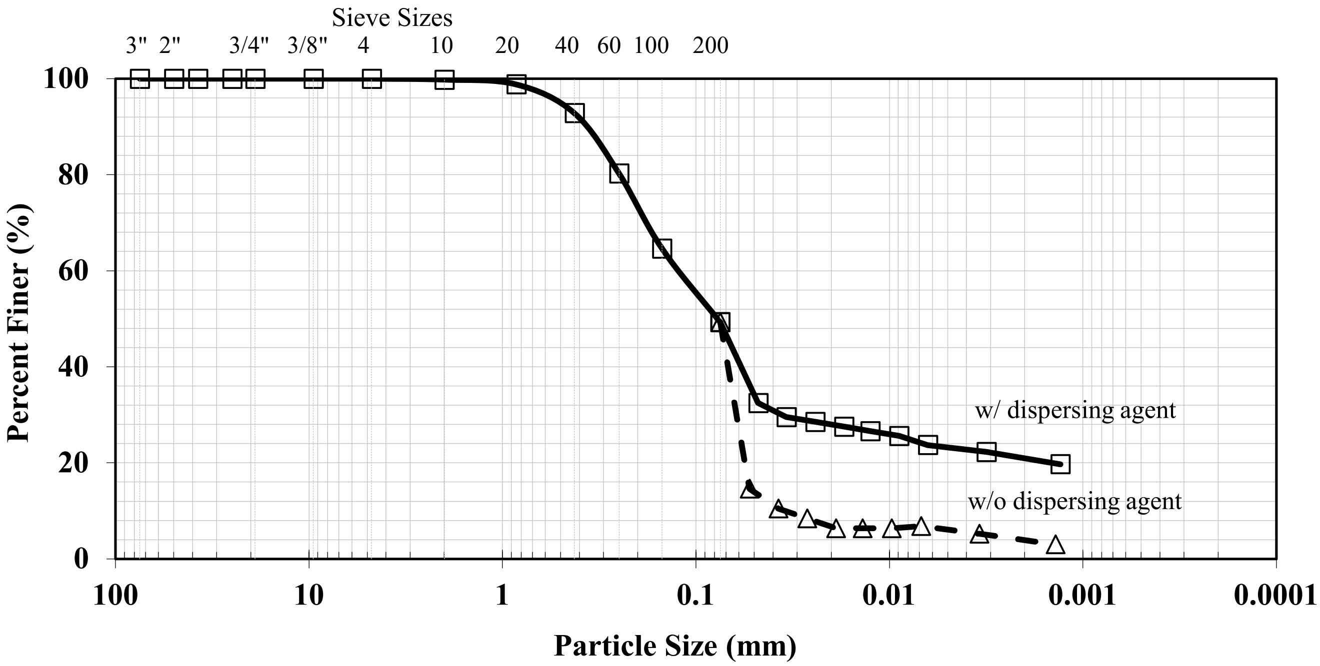
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.1 (PN: 2023-134)
Sample ID: 204-23, G1 (0-3 ft)

Alpine Project No.: 2307257
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.8
No. 20 (850 μm)	98.8
No. 40 (425 μm)	92.8
No. 60 (250 μm)	80.3
No. 100 (150 μm)	64.6
No. 200 (75 μm)	49.3

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0529 mm	14.6
0.0376 mm	10.5
0.0266 mm	8.4
0.0189 mm	6.4
0.0138 mm	6.4
0.0098 mm	6.4
0.0069 mm	6.8
0.0034 mm	5.2
0.0014 mm	3.0

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\ 2\ \mu m,\ nd}$ (%) = 3.7

% Dispersion = 17.8

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

STANDARD PROCTOR TEST RESULTS

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

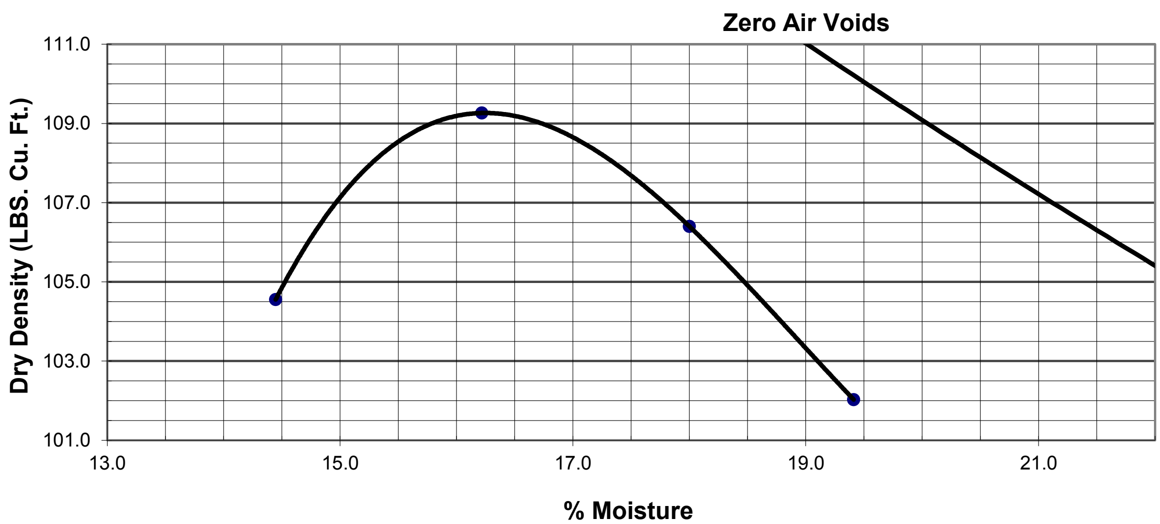
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Escondido Dam 1

Report Date: August 7, 2023 **Arias Report No.:** 2023-134

Soil Description:	Fat Clay
Material Origin:	201-23, G-1 0'-3'
Date Sampled:	June 14, 2023
Sampled By:	Evan Martinez
Test Method:	ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool
Application:	
Comments:	

Test results for sample I.D.:	23-0821
Maximum Dry Density(lb/ft3):	109.3
Optimum Moisture Content (%):	16.2
Liquid Limit:	53
Plasticity Index:	34
(Estimated) Specific Gravity:	2.7



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

Name
Name
XXX/xx

cc:

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

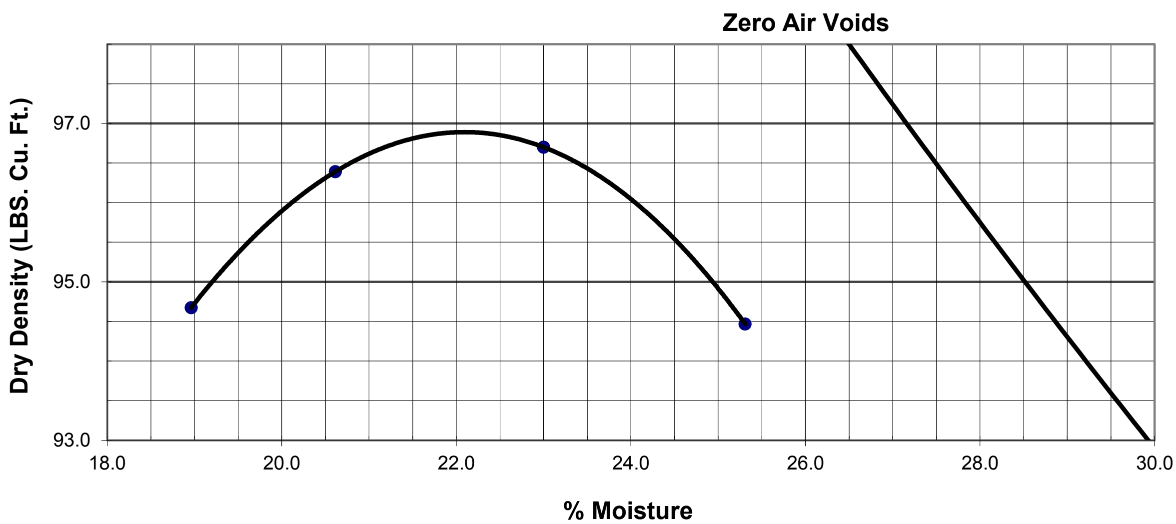
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Escondido Dam 1

Report Date: August 7, 2023 **Arias Report No.:** 2023-134

Soil Description:	Fat Clay, dark brown
Material Origin:	202-23 G-2 3'-5'
Date Sampled:	June 14, 2023
Sampled By:	Evan Martinez
Test Method:	ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool
Application:	
Comments:	

Test results for sample I.D.:	23-0822
Maximum Dry Density(lb/ft3):	96.9
Optimum Moisture Content (%):	22.1
Liquid Limit:	59
Plasticity Index:	40
(Estimated) Specific Gravity:	2.7



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

Name
Name
XXX/xx

cc:

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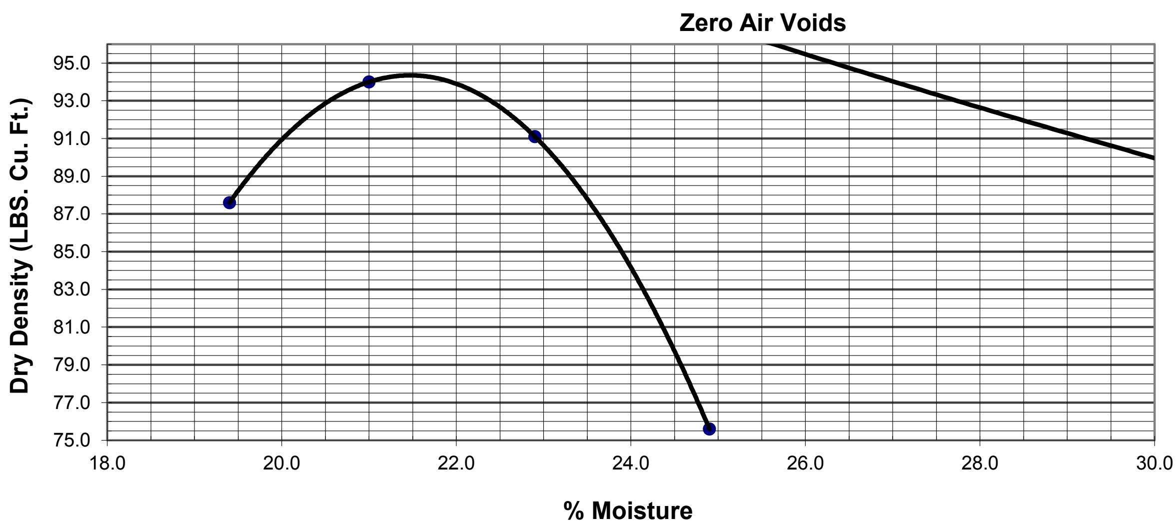
Moisture Density Relationship Test Report

Customer: AECOM **Project:** EscondidoDam 1

Report Date: August 7, 2023 **Arias Report No.:** 2023-134

Soil Description:	Fat Clay	Test results for sample I.D.:	23-0823
Material Origin:	203-23 G-1 0'-3'	Maximum Dry Density(lb/ft3):	94.4
Date Sampled:	June 14, 2023	Optimum Moisture Content (%):	21.5
Sampled By:	Evan Martinez	Liquid Limit:	63
Test Method:	ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool	Plasticity Index:	43
		(Estimated) Specific Gravity:	2.55
Application:			
Comments:			



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

Name
Name
XXX/xx

cc:

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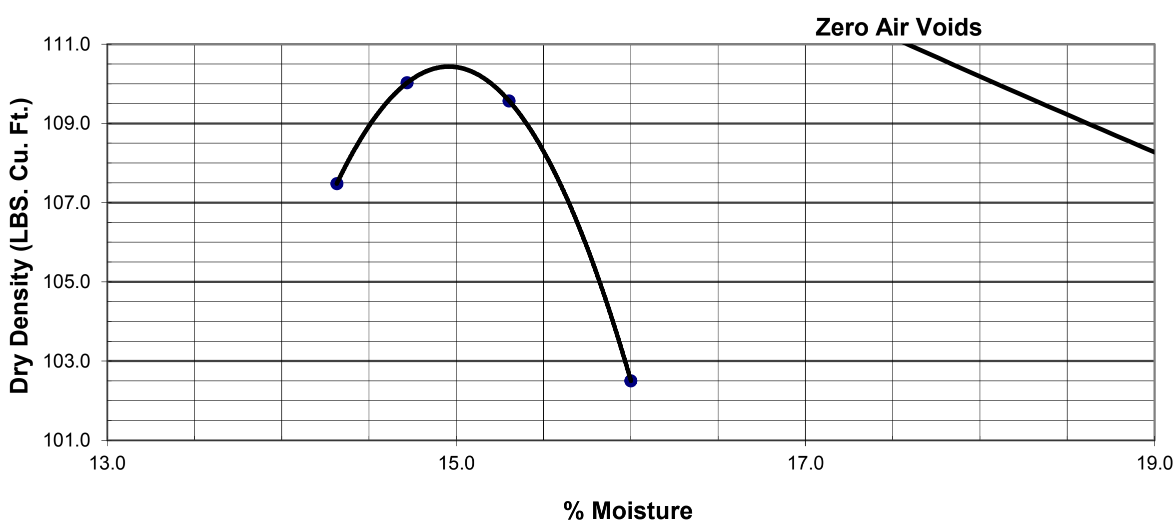
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Escondido Dam 1

Report Date: August 7, 2023 **Arias Report No.:** 2023-134

Soil Description: Lean Caly, dark brown
Material Origin: 204-23, G-1 0'-3'
Date Sampled: June 14, 2023
Sampled By: Evan Martinez
Test Method: ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool
Application:
Comments:

Test results for sample I.D.:	23-0824
Maximum Dry Density(lb/ft3):	110.4
Optimum Moisture Content (%):	14.9
Liquid Limit:	45
Plasticity Index:	29
(Estimated) Specific Gravity:	2.6



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

Name
Name
XXX/xx

cc:

CHLORIDE & REDOX RESULTS

Date: 04-Aug-23

ALAMO ANALYTICAL LABORATORIES, LTD.

Analytical Results Report

CLIENT: Arias & Associates
Lab Order: 2307096
Project: 2023-134 Escondido FRS1 (Kenedy Dam1)

Alamo Lab ID	Client ID	Collection Date	Analyses	Matrix	Result	MDL	PQL	Units	DF	Qua
TestName: CHLORIDE		**TestNo:** M4500-CL B	**Date Analyzed** 8/1/2023 9:40:00 AM				Initials: YK			
2307096-01A	201 - 23 G1 (0 - 3)	6/13/2023	Chloride	Solid	140	2.57	5	mg/Kg	1	
2307096-02A	202 - 23 G1 (0 - 3)	6/13/2023	Chloride	Solid	120	2.57	5	mg/Kg	1	
2307096-03A	202 - 23 G2 (3 - 5)	6/13/2023	Chloride	Solid	140	2.57	5	mg/Kg	1	
2307096-04A	203 - 23 G1 (0 - 3)	6/13/2023	Chloride	Solid	1100	2.57	5	mg/Kg	1	
TestName: OXIDATION-REDUCTION POTENTIAL		**TestNo:** D1498	**Date Analyzed** 8/1/2023 2:30:00 PM				Initials: YK			
2307096-01A	201 - 23 G1 (0 - 3)	6/13/2023	Oxidation-Reduction Potential	Solid	3.52	0	-180.	millivolts	1	
2307096-02A	202 - 23 G1 (0 - 3)	6/13/2023	Oxidation-Reduction Potential	Solid	2.96	0	-180.	millivolts	1	
2307096-03A	202 - 23 G2 (3 - 5)	6/13/2023	Oxidation-Reduction Potential	Solid	3.16	0	-180.	millivolts	1	
2307096-04A	203 - 23 G1 (0 - 3)	6/13/2023	Oxidation-Reduction Potential	Solid	9.83	0	-180.	millivolts	1	

H Holding times for preparation or analysis excceeded; J - Analyte detected below quanititation limits

* Non-NELAP Standards ** Sub Contracted

Approved by: Reddy Gosala, Laboratory Direc

Report of Laboratory Analysis