Appendix D Investigation and Analysis Report

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	TX	**DAM**	Escondido Creek FRS No. 4	**BY**	SS	**DATE**	11/15/2024	
YEAR BUILT	1956	**DESIGN HAZARD CLASS**	L	**DRAINAGE AREA**	6.3	mi^2		
WORK PLAN DATE	6/1/1954	**CURRENT HAZARD CLASS**	H	**DAM HEIGHT**	29	ft		
sht 1 of 5	**CONSEQUENCES OF DAM FAILURE (ver. 2021-01)**				**NID ID**	TX02035		

POTENTIAL DAM FAILURE:					
Total Failure Index				114	A
POTENTIAL LOSS OF LIFE:					
Maximum Population-at-Risk [PAR]			(number)	278	B
Total Risk Index				6	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	Kenedy, TX		(H,M,L,-)	H	D
Number of homes, businesses, major buildings			(number)	115	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	US 181, N 5th St	Roads	(number)	2	I
Secondary/County	FM2102, Helena Hwy	Roads	(number)	2	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 pas		(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,-)	M	R
POTENTIAL ADVERSE ECONOMIC IMPACTS:					
Average annual benefits attributed to this dam, updated workplan value			($)	65,835	S
Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)			(I,NC,D)	I	T
Low income families impacted			(number)	21	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. 4	**BY**	SS	**DATE**	11/15/2024
sht 2 of 5	**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	278	A
Estimate PAR for hydrologic loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway	50	B
Estimate PAR for seismic loading failure; typically assume water at or above invert of the lowest non-gated spillway (sunny day failure)	4	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	35,400	136	2592	14	171	Vague
Hydrologic	25,100	136	2315	11	184	Vague
Seismic	4,260	136	208	20	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	0.0003	D
Estimate FR for hydrologic loading failure scenario	0.0003	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	60	60	0.0003	278	5
Hydrologic	*	*	54	0.0003	50	1
Seismic	0.00	#DIV/0!	0	0.007	4	0
		TOTAL=	114		TOTAL=	6

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	TX	**DAM**	Escondido Creek FRS No. 4	**BY**	SS	**DATE**	11/15/2024	
sht 3 of 5	**STATIC FAILURE INDEX**							
PRINCIPAL SPILLWAY SYSTEM (60 points max):					(total points)	10		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)							0	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)							0	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)	18		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)							0	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)							6	S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)							6	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)	8		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)							0	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							60	AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	**DAM**	Escondido Creek FRS No. 4	**BY**	SS	**DATE**	11/15/2024
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)				22.3	A
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings					
100 year, 6hr rainfall [P100] (inches)				8.23	B
Probable Maximum Precipitation [PMP] (inches)				27.4	C
if Pfb <= P100	= 8.2	enter	40		
if Pfb = P100+0.2(PMP-P100)	= 12.1	enter	25		
if Pfb = P100+0.4(PMP-P100)	15.9	enter	15		
if Pfb = P100+0.6(PMP-P100)	= 19.7	enter	7		
if Pfb = P100+0.8(PMP-P100)	= 23.6	enter	3		
if Pfb => PMP	= 27.4	enter	1		
Enter interpolated value				4.3	D
HYDROLOGIC UNCERTAINTY:					
Drainage Area [DA] (square miles)				6.3	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)				28.0	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)				5.1	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.				0.6	L
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8				1	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				1.2	N
Vegetal Cover Factor [Cf], see NEH-Part 628-Chapter 51, Earth Spillway Erosion Model.				0.6	O
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8				1	P
HYDROLOGIC FAILURE INDEX:					
dam overtopping breach: (2)(D)(F)(H)(I)(K)(M)				22	Q
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)				54	R
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300				54	S

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	**DAM**	Escondido Creek FRS No. 4	**BY**	SS	**DATE**	11/15/2024
sht 5 of 5	**SEISMIC FAILURE INDEX**						ver 2021-01

SEISMIC LOADING:		
Latitude (degrees.decimal)	28.815	A
Longitude (degrees.decimal)	-97.902	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)	2.80	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	10	E
EMBANKMENT FREEBOARD FOR FOUNDATION LIQUEFACTION:		
Dam height (ft)	29	F
Freeboard - Elevation difference from top of dam to assumed pool surface (ft)	15.9	G
Freeboard percent of dam height (%)	55	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	1	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	11/15/24
DAM	Escondido Creek FRS No. 4		CHECKED BY	MW	DATE	11/15/24
YEAR BUILT	1956	DESIGN HAZARD CLASS	L	DRAINAGE AREA	6.30	mi^2
WORK PLAN DATE	6/1/1954	CURRENT HAZARD CLASS	H	DAM HEIGHT	29	ft
sht 1 of 3	STATIC FAILURE SCENARIO (ver. 2013-01)				NID ID	TX02035

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	15	8	23	3	24
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	23	52	75	3	156
Seasonal Use Homes and Cabins	1	0	1	1.5	0
Duplexes				5	
Apartments					
Commercial Buildings	7	8	15	5	40
Schools (In Use)					
Schools (Not in Use)		1	1	10	10
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					
5th Street, Old Helena Rd, W Live Oak St, W	0	12	12	2	24
E Butler St, Hyland Dr, Sunnyside Dr, Comanc	0	12	12	2	24
Major State and Minor Federal Highways					
Highway Name(s) or Number(s)				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)	278

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX		**BY**	SS	**DATE**	11/15/24
DAM	Escondido Creek FRS No. 4		**CHECKED BY**	MW	**DATE**	11/15/24
YEAR BUILT	1956	**DESIGN HAZARD CLASS**	L	**DRAINAGE AREA**	6.30	mi^2
WORK PLAN DATE	6/1/1954	**CURRENT HAZARD CLASS**	H	**DAM HEIGHT**	29	ft
sht 2 of 3	**HYDROLOGIC FAILURE SCENARIO (ver. 2013-01)**				**NID ID**	TX02035

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	8	2	10	3	6
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	11	4	15	3	12
Seasonal Use Homes and Cabins				1.5	
Duplexes				5	
Apartments					
Commercial Buildings	3	2	5	5	10
Schools (In Use)					
Schools (Not in Use)		1	1	10	10
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					
Branch Creek, Bellaire Blvd, 5th Street, W Liv	1	6	7	2	12
Butler St, Hyland Dr, Sunnyside Dr, Comanche	4	0	4	2	0
Major State and Minor Federal Highways					
Highway Name(s) or Number(s)				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)					**50**

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX		BY	SS	DATE	11/15/24
DAM	Escondido Creek FRS No. 4		CHECKED BY	MW	DATE	11/15/24
YEAR BUILT	1956	DESIGN HAZARD CLASS	L	DRAINAGE AREA	6.30	mi^2
WORK PLAN DATE	6/1/1954	CURRENT HAZARD CLASS	H	DAM HEIGHT	29	ft
sht 3 of 3	SEISMIC FAILURE SCENARIO (ver. 2013-01)				NID ID	TX02035

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				5	
Schools (In Use)					
Schools (Not in Use)				10	
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					
FM 2102, Private Road on Doe Branch Creek	0	2	2	2	4
Name(s) (if applicable)				2	
Major State and Minor Federal Highways					
Highway Name(s) or Number(s)				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)	4

AECOM

Federal and State Listed Threatened and Endangered Species Assessment

Escondido Creek Watershed Floodwater Retarding Structure No. 4 Supplemental Planning Project

Karnes County, Texas

Natural Resources Conservation Service

Project Number: 60707410

September 2023

Delivering a better world

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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. 4 Supplemental Planning Project (Project). The proposed Project is located in Karnes County, approximately 3.3 miles west 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 278 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 August 9, 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 August 8 and 9, 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, hay cultivation, and undeveloped land. Based on the NHD, Doe Branch, an intermittent stream, one unnamed intermittent stream, and one open water feature, Escondido Creek FRS No. 4 Reservoir, were mapped within the Study Area (USGS 2023).

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 Doe Branch. The surface gradient slopes generally from west-southwest to east-northeast with the highest elevation located along the southeast boundary of the Study Area at approximately 354 feet above mean sea level (MSL [National Geodetic Vertical Datum of 1929]). The lowest elevation is located in Doe Branch near the north-eastern boundary of the Study Area at approximately 296 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 11 soil 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
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	Yes
Bw	Buchel clay, 0 to 1 percent slopes, frequently flooded	Yes
CaA	Clareville clay loam, 0 to 1 percent slopes	No
MoA	Monteola clay, 0 to 1 perfect slopes	Yes
MoB	Monteola clay, 1 to 3 percent slopes	Yes
PbB	Papalote fine sandy loam, 1 to 3 percent slopes	Yes
PbC	Papalote fine sandy loam, 3 to 5 percent slopes	No
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	No

Mapping Unit	Soil Type	Listed as Hydric by NRCS
ShC	Schattel clay loam, 2 to 5 percent slopes	No
Us	Ustarents, loamy	No
W	Water	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: Floodplain Hardwood Forest, Central Texas: Floodplain Deciduous Shrubland; Central Texas: Floodplain Herbaceous Vegetation; Central Texas: Floodplain Herbaceous Wetland; Central Texas: Riparian Herbaceous Vegetation; South Texas: Clayey Live Oak Motte and Woodland; South Texas: Clayey Mesquite Mixed Shrubland; South Texas: Sandy Mesquite Woodland and Shrubland; South Texas: Sandy Mesquite Dense Shrubland; South Texas: Sandy Mesquite Savanna Grassland; Native Invasive: Deciduous Woodland; Native Invasive: Huisache Woodland or Shrubland; South Texas: Disturbance Grassland; and Urban Low Intensity. (**Appendix A, Figure 4**) (Elliot 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 floodplain herbaceous vegetation and disturbance grassland. Common species observed within the tree and sapling/shrub stratum include cedar elm (*Ulmus crassfolia*), sugarberry (*Celtis laevigata*), palo verde (*Parkinsonia aculeata*), mesquite (*Prosopis glandulosa*), and black willow (*Salix nigra*). Common herbaceous species observed within the Study Area include salvia species (Salvia spp.), spotted bee balm (*Monarda punctata*), common sunflower (*Helianthus annuus*), milkweed species (*Asclepias* spp.), prickly pear cactus (*Opuntia engelmannii*), and bermuda grass (*Cynodon dactylon*). Vines observed within the Study Area include grape vine (*Vitis vinifera*). 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 2023a; TPWD 2023a).

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 2023a).

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 2023a).

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 2023a).

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.

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
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.
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 2023a; TPWD 2023a

**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 southwest of the Escondido Creek FRS. No. 4 reservoir and its surrounding areas. 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. 4 reservoir as well as northeast and west to 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 northern areas downstream of the Escondido Creek FRS structure, as well as on the northern and southern portions of the reservoir within 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 August 9, 2023, to assess if any rare and/or listed endangered and threatened species have been previously observed within or adjacent to the Study Area (TPWD 2023b).

Several EOs for state threatened species were reported within five miles of the Study Area (**Appendix A, Figure 5**). Five EOs were recorded for the Texas horned lizard (*Phrynosoma cornutum)* ranging from 2.9-4.9 miles from the Study Area. Three EOs for the Tamualipan spot-tailed earless lizard (*Holbrookia subcaudalis*) occurred 3.1-4.0 miles from the Study Area, one

EO 4.6 miles from the Study Area was recorded for the Texas tortoise (*Gopherus berlandieri*), and one EO 0.2 miles from the Study Area was recorded for the Burridge greenthread (*Thelesperma burridgeanum*) (TPWD 2023b).

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. Five EOs for the Texas horned lizard and one EO for the Texas tortoise were recorded 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

Elliott, Lee F., Amie Treuer-Kuehn, Clayton F. Blodgett, C. Diane True, Duane German, and David D. Diamond. 2014. Ecological Systems of Texas: 391 Mapped Types. Phase 1 – 6, 10-meter resolution Geodatabase, Interpretive Guides, and Technical Type Descriptions. Texas Parks & Wildlife Department and Texas Water Development Board, Austin, Texas. Documents and Data Available at: http://www.tpwd.state.tx.us/gis/data/downloads#EMS-T (accessed August 16, 2023).

NRCS. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296 pp.

TPWD. Chapters 67 (Nongame Species) and 68 (Endangered Species) of the Texas Parks and Wildlife (TPW) Code and Sections 65.171 - 65.176 (Threatened and Endangered Nongame Species) of Title 31 of the Texas Administrative Code (T.A.C.).

—. 2011. Gould Ecoregions of Texas. https://tpwd.texas.gov/publications/pwdpubs/media/pwd_mp_e0100_1070ac_34.pdf (accessed August 16, 2023).

—. 2016. Management Recommendations for Native Insect Pollinators in Texas. Nongame and Rare Species Program. https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_1813.pdf (accessed August 9, 2023)

—. 2023a. Annotated County Lists of Rare Species, Karnes County. https://tpwd.texas.gov/gis/rtest/ (last revision 1/4/2023).

—. 2023b. Texas Natural Diversity Database. Data requested via email to <TexasNatural.DiversityDatabase@tpwd.texas.gov> (received June 26, 2023).

USDA NRCS, 2021. Custom Soil Resource Report for Karnes County, Texas. United States Department of Agriculture Soil Conservation Service and Natural Resources Conservation Service. http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx (accessed August 11, 2023).

USDA. 2022. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. United States Department of Agriculture, Agriculture Handbook 296. https://www.nrcs.usda.gov/sites/default/files/2022-10/AgHandbook296_text_low-res.pdf (accessed August 14, 2023).

USFWS. 2023a. *Environmental Conservation Online System (ECOS): Threatened and Endangered Species.* https://ecos.fws.gov/ecp/ (accessed August 8, 2023).

—. 2023b. Critical Habitat Portal. http://criticalhabitat.fws.gov/ (accessed August 8, 2023).

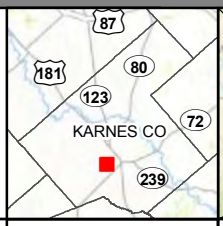
USGS. 2023. National Hydrography Dataset (NHD). http://nhd.usgs.gov/ (accessed August 9, 2023).

—. 1987. 7.5-Minute Quarter Quadrangle, Lenz, Texas. 1987

Appendix A Figures



Study Area





Project Location Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

N
W E
S

0 200 400 600 800
Feet

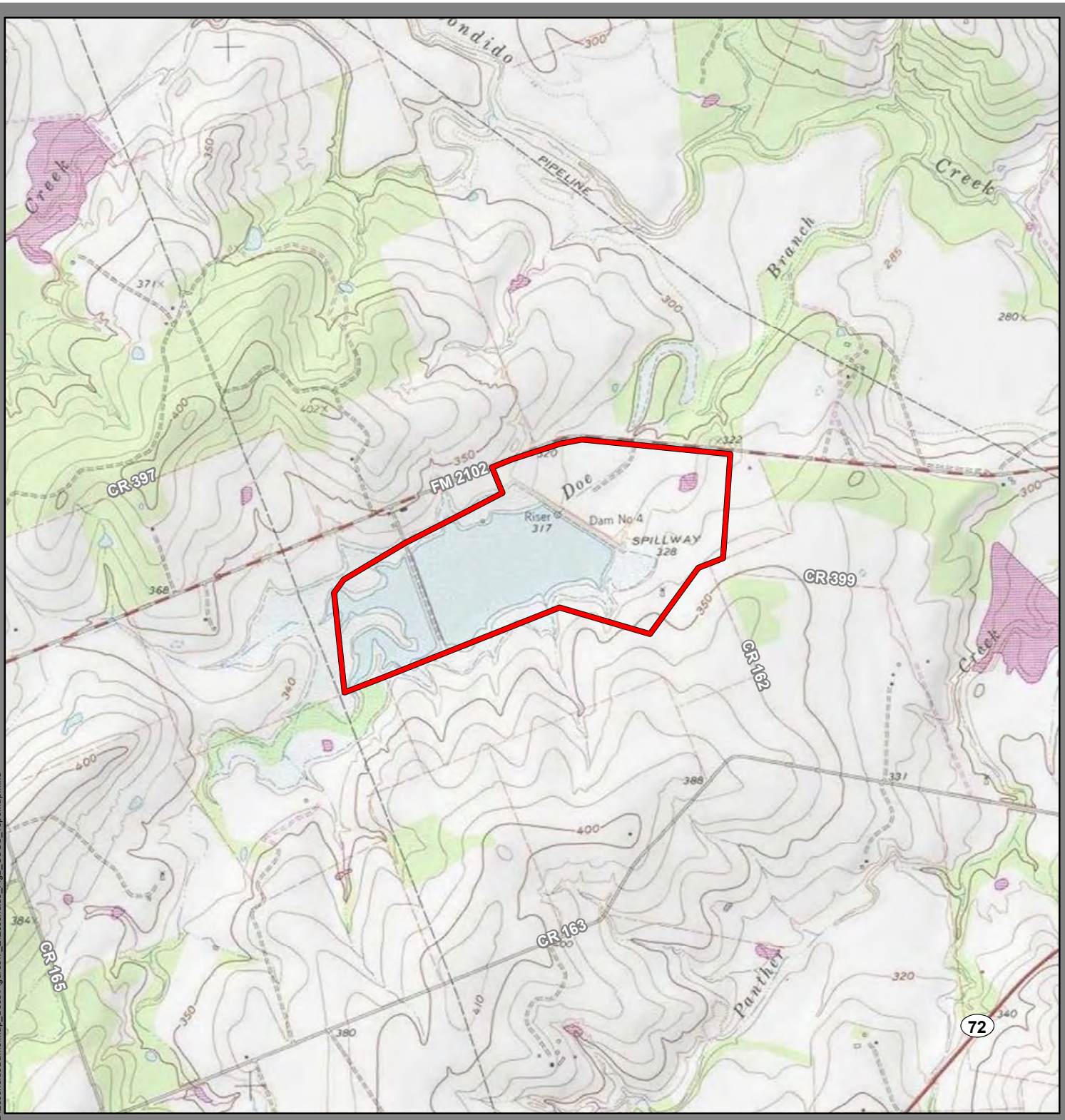
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Basemap: Maxar 3/22/2022

AECOM

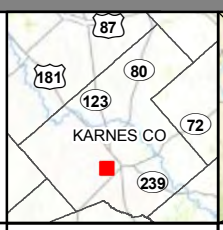
June 2023

Figure 1

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Study Area





USGS Topographic Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

N
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0 1000 2000
Feet

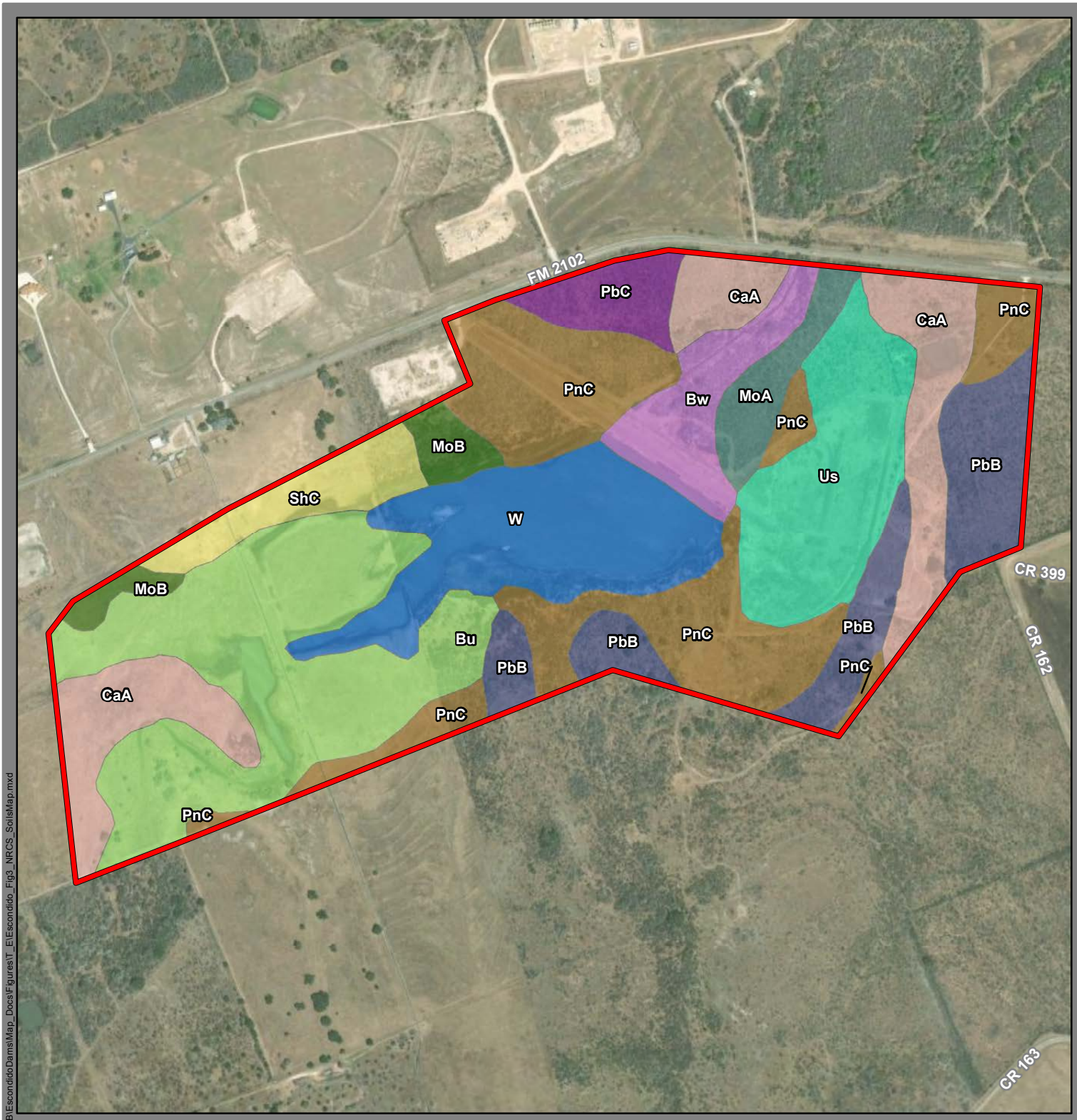
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: USGS 7.5-minute Topographic Maps: Lenz Quadrangle

AECOM

June 2023

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

- Bu - Buchel clay, 0 to 1 percent slopes, occasionally flooded
- Bw - Buchel clay, 0 to 1 percent slopes, frequently flooded
- CaA - Clareville clay loam, 0 to 1 percent slopes
- MoA - Monteola clay, 0 to 1 percent slopes
- MoB - Monteola clay, 1 to 3 percent slopes
- PbB - Papalote fine sandy loam, 1 to 3 percent slopes
- PbC - Papalote fine sandy loam, 3 to 5 percent slopes
- PnC - Pernitas sandy clay loam, 2 to 5 percent slopes
- ShC - Schattel clay loam, 2 to 5 percent slopes
- Us - Ustarents, loamy
- W - Water

NRCS Soils Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

N W E S

0 200 400 600 800

Feet

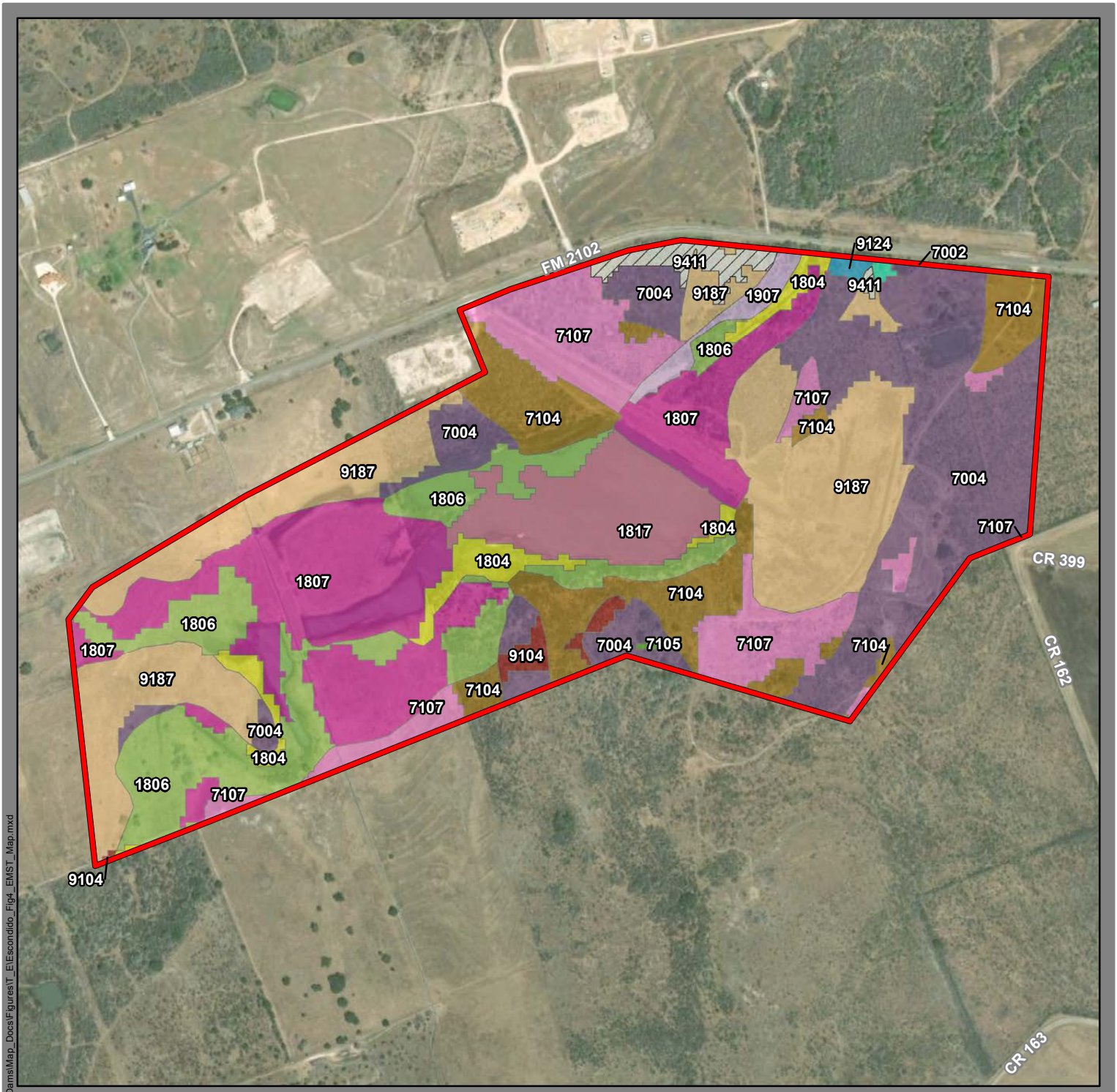
Data Sources: Soils - USDA NRCS 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

June 2023

Figure 3

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



Study Area

EMST Vegetation Types

- 1804 - Central Texas: Floodplain Hardwood Forest
- 1806 - Central Texas: Floodplain Deciduous Shrubland
- 1807 - Central Texas: Floodplain Herbaceous Vegetation
- 1817 - Central Texas: Floodplain Herbaceous Wetland
- 1907 - Central Texas: Riparian Herbaceous Vegetation
- 7002 - South Texas: Clayey Live Oak Motte and Woodland
- 7004 - South Texas: Clayey Mesquite Mixed Shrubland
- 7104 - South Texas: Sandy Mesquite Woodland and Shrubland
- 7105 - South Texas: Sandy Mesquite Dense Shrubland
- 7107 - South Texas: Sandy Mesquite Savanna Grassland
- 9104 - Native Invasive: Deciduous Woodland
- 9124 - Native Invasive: Huisache Woodland or Shrubland
- 9187 - South Texas: Disturbance Grassland
- 9411 - Urban Low Intensity

Ecological Mapping Systems of Texas (EMST) Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

N
W E
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0 200 400 600 800
Feet

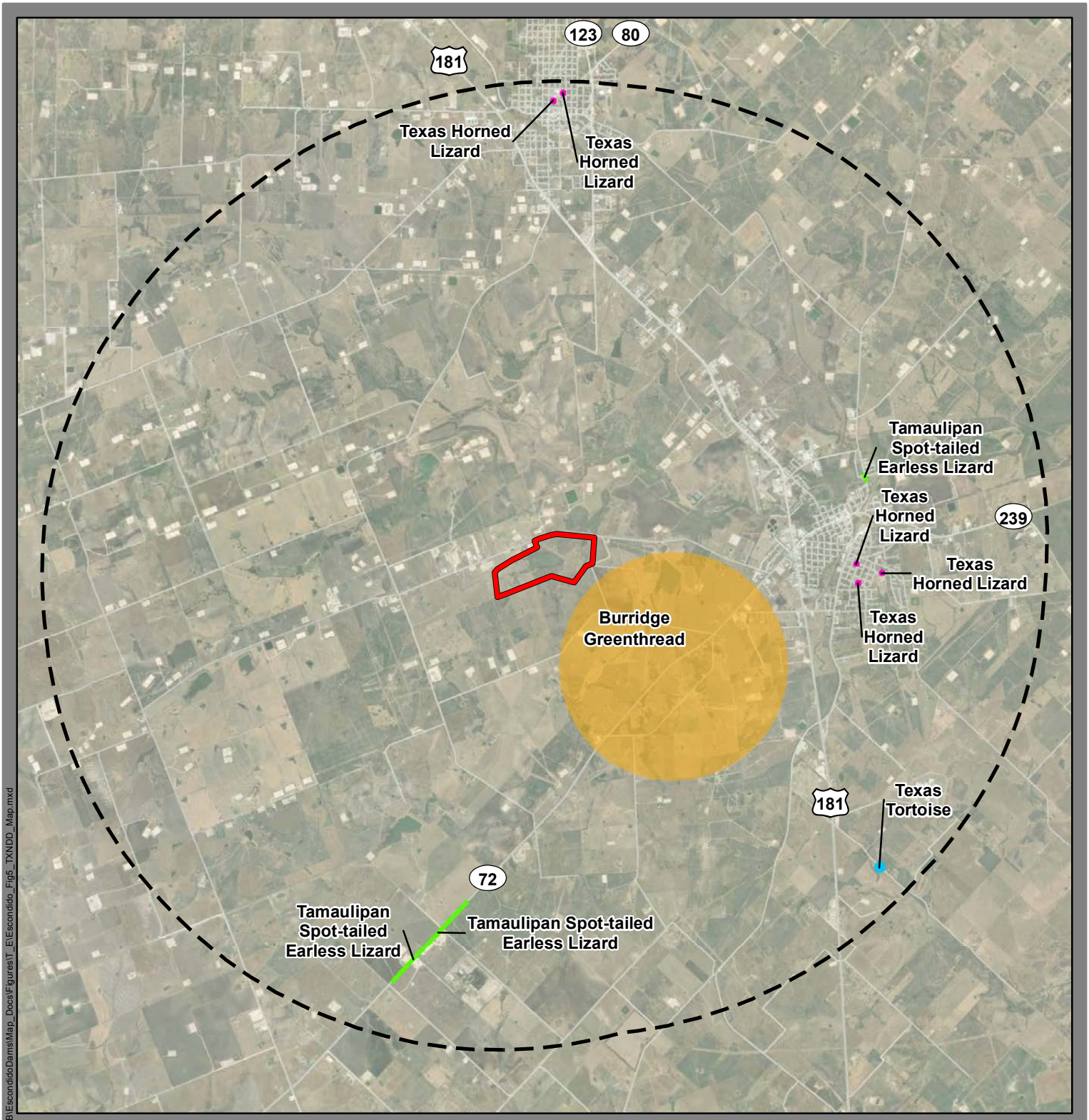
Data Sources: EMST - TPWD 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

June 2023

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

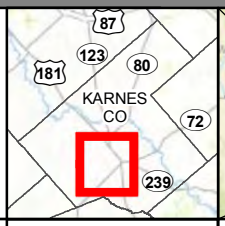
TXNDD Element Occurrence Record

Burridge Greenthread

Tamaulipan Spot-tailed Earless Lizard

Texas Horned Lizard

Texas Tortoise





Texas Natural Diversity Database (TXNDD) Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

N
W E
S

0 0.5 1 1.5
Miles

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

AECOM

June 2023

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:	Site Location:	Project Number:
Texas State Soil and Water Conservation Board	Karnes County, TX	60707486

Photo No.	Date:
1	8/8/2023

Direction Photo Taken:

Northwest

Description:

View of undeveloped land in the northeast portion of the Study Area.



Photo No.	Date:
2	8/8/2023

Direction Photo Taken:

Southwest

Description:

View of additional undeveloped land in the northeast corner of Study Area.



PHOTOGRAPHIC LOG

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

Photo No.	Date:
3	8/8/2023

Direction Photo Taken:

Northwest

Description:

View along the eastern portion of Escondido Creek Flood Retarding Structure (FRS) No. 4.



Photo No.	Date:
4	8/8/2023

Direction Photo Taken:

North

Description:

View of the southeast portion of Escondido Creek Flood Retarding Structure (FRS) No. 4 reservoir.



PHOTOGRAPHIC LOG

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

Photo No.	Date:
5	8/8/2023

Direction Photo Taken:

Southeast

Description:

View of hay cultivation on the east side of Escondido Creek Flood Retarding Structure (FRS) No. 4 in the northeast portion 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.

NOT FOR CONSULTATION

Location

Karnes County, Texas



Local office

Texas Coastal Ecological Services Field Office

(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

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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).

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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
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

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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 and the Migratory Bird Treaty Act.

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

Additional information can be found using the following links:

- Eagle Managment 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

There are bald and/or golden eagles in your project area.

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

NAME	BREEDING SEASON

NOT FOR CONSULTATION

Bald Eagle Haliaeetus leucocephalus — Breeds Sep 1 to Jul 31

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.

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 and understand the FAQ "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.

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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.

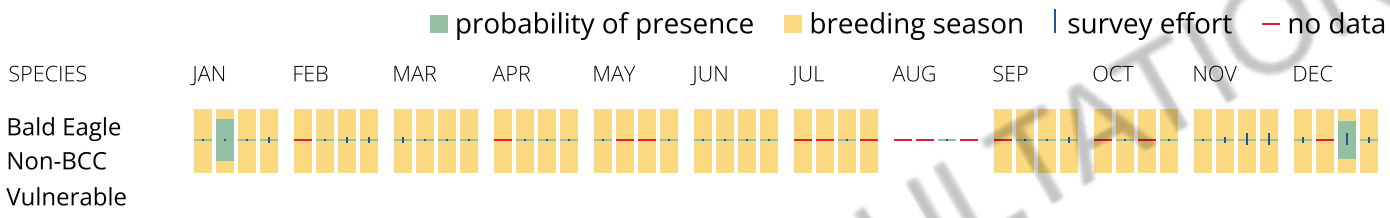
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

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.



NOT FOR CONSULTATION

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 should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- 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

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, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

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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.	Breeds Sep 1 to Jul 31
Lesser Yellowlegs Tringa flavipes This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Little Blue Heron Egretta caerulea This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Mar 10 to Oct 15

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 and understand the FAQ "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

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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.

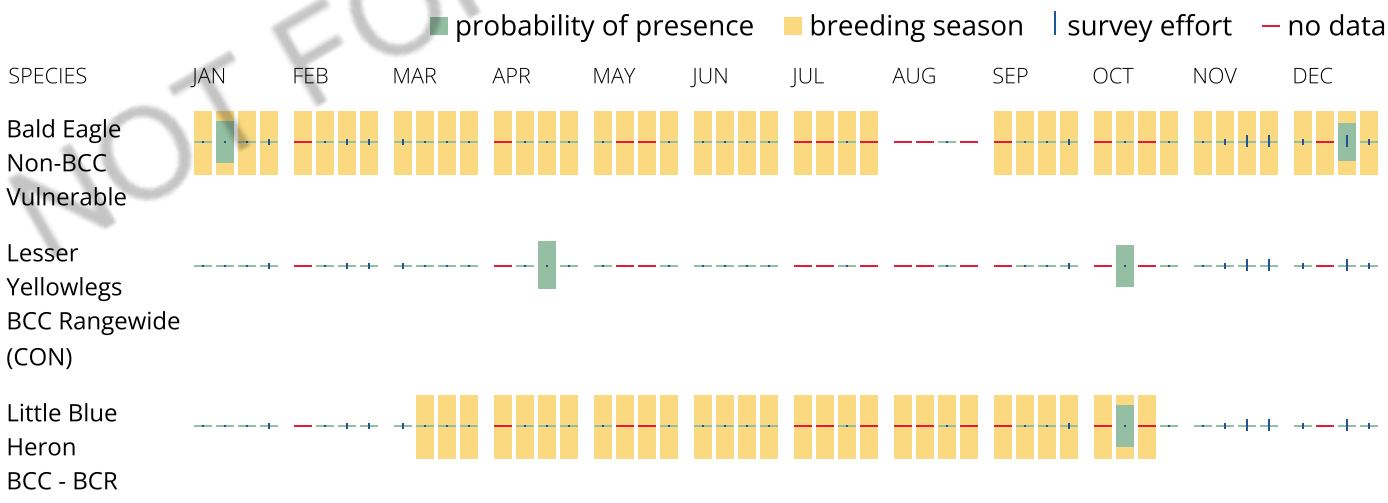
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

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.

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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

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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.

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Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

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.

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Wetland information is not available at this time

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

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.

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Last Update: 1/4/2023

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: LT 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

DISCLAIMER

The information on this web application is provided "as is" without warranty as to the currentness, completeness, or accuracy of any specific data. The data provided are for planning, assessment, and informational purposes. Refer to the Frequently Asked Questions (FAQs) on the application website for further information.

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

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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

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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

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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: S4

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

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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

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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

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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. 4 Supplemental Planning Project

Karnes County, Texas

Natural Resources Conservation Service

Project number: 60707410

October 2023

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. 4 Supplemental Planning Project (Project). The proposed Project is located in Karnes County, approximately 3.3 miles west 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 278 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, pastureland, and undeveloped land. Based on the NHD, Doe Branch, an intermittent stream; two unnamed streams; and one open water feature, Escondido Creek FRS No. 4 Reservoir, were mapped within the Study Area (USGS 2023) (**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 Doe Branch. The surface gradient slopes generally from west-southwest to east-northeast, with the highest elevation located along the southeastern boundary of the Study Area at approximately 354 feet above mean sea level (MSL [National Geodetic Vertical Datum of 1929]). The lowest elevation is located in Doe Branch near the north-eastern boundary of the Study Area at approximately 296 feet above MSL (USGS 1987).

2.3 Soils

According to the USDA NRCS Web Soil Survey Report, the Study Area was mapped as being underlain by 11 soil 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
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	Hydric
Bw	Buchel clay, 0 to 1 percent slopes, frequently flooded	No
CaA	Clareville clay loam, 0 to 1 percent slopes	No
MoA	Monteola clay, 0 to 1 percent slopes	Hydric
MoB	Monteola clay, 1 to 3 percent slopes	No

Mapping Unit	Soil Type	Listed as Hydric by NRCS
PbB	Papalote fine sandy loam, 1 to 3 percent slopes	No
PbC	Papalote fine sandy loam, 3 to 5 percent slopes	No
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	No
ShC	Schattel clay loam, 2 to 5 percent slopes	No
Us	Ustarents, loamy	No
W	Water	Hydric

2.4 Hydrology

The Study Area lies within the Lower San Antonio watershed (8-Digit Hydrologic Unit Code [HUC] 12100303) and the Headwaters Escondido Creek subwatershed (12-Digit HUC 121003030401).

The USGS NHD was reviewed to gather information on the potential locations of areas that may exhibit characteristics of WOTUS. Eight NHD features including; Doe Branch, two unnamed streams, two lake/ponds, one artificial path, one underground pipe, and Escondido Creek FRS. No 4 Reservoir were identified by the NHD data 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, fourteen features associated with Doe Branch and Escondido Creek FRS. No 4 Reservoir are located within the Study Area (**Appendix A, Figure 4**). Documented NWI wetland types include Riverine, Surface Flooding, Seasonal (R4SBC); Riverine, Intermittent, Streambed, Temporary Flooded (R4SBA); Palustrine, Emergent, Persistent, Temporarily Flooded, Diked/Impounded (PEM1Ah); Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Temporary Flooded, Diked/Impounded (PSS1Ah); Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Diked/Impounded (PUBFh); Lacustrine, Littoral, Unconsolidated Shore, Temporary Flooded, Diked/Impounded (L2USAh); Lacustrine, Littoral, Unconsolidated Shore, Seasonally Flooded, Diked/Impounded (L2USCh); and Lacustrine, Limnetic, Unconsolidated Bottom, Diked/Impounded (L1UBHh).

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 in the throughout the Study Area encompassing the streams below and above the reservoir, and the reservoir at the reservoir area **Appendix A, Figure 4**.

Zone A includes areas with a 1% annual chance of flooding where no depths or base flood elevations are shown.

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: Floodplain Hardwood Forest; Central Texas: Floodplain Deciduous Shrubland; Central Texas: Floodplain Herbaceous Vegetation; Central Texas: Floodplain Herbaceous Wetland; Central Texas: Riparian Herbaceous Vegetation; South Texas: Clayey Live Oak Motte and Woodland; South Texas: Clayey Mesquite Mixed Shrubland; South Texas: Sandy Mesquite Woodland and Shrubland; South Texas: Sandy Mesquite Dense Shrubland; South Texas: Sandy Mesquite Savanna Grassland; Native Invasive: Deciduous Woodland; Native Invasive: Huisache Woodland or Shrubland; South Texas: Disturbance Grassland; and Urban Low Intensity (**Appendix A, Figure 5)**(Elliot et al 2014).

Existing Conditions

Field investigations documented vegetation types throughout the Study Area. The majority of the Study Area consisted of undeveloped grassland/pasture and riparian woodlands. Common species observed within the tree and sapling/shrub stratum include:

- cedar elm (*Ulmus crassfolia*),
- sugarberry (*Celtis laevigata*),
- palo verde (*Parkinsonia aculeata*),
- mesquite (*Prosopis glandulosa*),
- and black willow (*Salix nigra*).

Common herbaceous species observed within the Study Area include:

- salvia species (*Salvia spp.*),
- spotted bee balm (*Monarda punctata*),
- common sunflower (*Helianthus annuus*),
- milkweed species (*Asclepias* spp.),
- prickly pear cactus (*Opuntia engelmannii*), and
- bermuda grass (*Cynodon dactylon*).

Vines observed within the Study Area include:

- grape vine (*Vitis vinifera*).

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 August 1 and 2, 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 the figures provided in **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. 4 Reservoir (WB02) is approximately 40.25 acres in areal extent within the Study Area. This reservoir captures hydrologic flow from Doe Branch then discharges below the dam (via spillway) to connect Doe Branch back to its natural channel. Doe Branch then flows away from the Escondido Creek FRS. No 4 Reservoir in a northeastern direction for approximately 1.48 miles before discharging into Escondido Creek, followed by the San Antonio River (a TNW), 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 TNW and can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 1-3** for conditions documented during the field investigation.

Doe Branch (S01) spans approximately 2,980 linear feet (LF) (0.35 acres in areal extent) within the Study Area. The average OHWM width was approximately 6 feet. OHWM indicators observed include bed and bank, shelving, natural lines impressed on the bank, litter disturbed or washed away, and scour. Doe Branch enters Escondido Creek FRS. No 4 Reservoir, then discharges downstream back into Doe Branch. Doe Branch leaves Escondido Creek FRS No. 4 Reservoir flowing approximately 1.48 miles northeast before discharging into Escondido Creek, followed by the San Antonio River (a TNW), and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on NHD, desktop investigations, and field investigations, Doe Branch can be considered an RPW with intermittent flow as a result of groundwater and upstream hydrologic contribution. This feature has a significant nexus to a TNW and can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 4-7** 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 4 Reservoir (WB02)	Potentially Jurisdictional	Perennial	N/A	N/A	40.25
Doe Branch (S01)	Potentially Jurisdictional	Intermittent	2,980	6	0.35
Total			2,980	6	40.60

3.4 Potentially Jurisdictional Wetlands

No potentially jurisdictional wetlands were observed within the Study Area.

3.5 Non-Jurisdictional Features

Two potentially non-jurisdictional features were identified within the Study Area, including one pond (WB01) and one wetland (WT01).

WB01 was mapped northeast of the Escondido Creek FRS No. 4 Reservoir (WB02) within the Study Area. This feature was identified as an isolated stock pond, approximately 1.29 acres in areal extent. This feature appears to receive hydrologic flow from surrounding 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. Refer to **Appendix B, Photo 8** for conditions documented during the field investigation.

WT01 was mapped northeast of the Escondido Creek FRS No. 4 Reservoir (WB02) within the Study Area. This feature was identified as a wetland and met wetland criteria of vegetation, hydrology, and soil types. The dominant vegetation type within the wetland was three-square bullrush (*Schoenoplectus pungens*). Wetland hydrology included the presence of surface water, visible high-water table, and soil saturation. Hydric soils were observed within the wetland with redox dark surface as the hydric soil indicator. This feature was approximately 0.58 acres in areal extent. This feature appears to receive hydrologic flow via a seep in underground pressure release piping from the dam embankment structure and surrounding hydrologic flow. This feature is not adjacent or adjoining to an RPW or TNW therefore can be considered potentially non-jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photo 9-16** for conditions documented during the field investigation.

4. Conclusions

In AECOM's professional opinion, potentially jurisdictional WOTUS identified within the Study Area include Escondido Creek FRS. No 4 Reservoir (WB02) and Doe Branch/Stream 01 (S01).

Based on the findings from data analysis and field investigations, two potentially jurisdictional WOTUS (non-wetland) totaling 2,980 LF (40.60 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 4 Reservoir (WB01)	Potentially Jurisdictional	Perennial	N/A	40.25
Doe Branch (S02)	Potentially Jurisdictional	Intermittent	2,980	0.35
Total			2,980	40.60

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.

Features identified as potentially non-jurisdictional will require an Approved Jurisdictional Determination (AJD) if impacts will occur to these features. If features can be avoided, no AJD would be required.

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

5. References

EPA. 2023. Clean Water Rule: Revised Definition of “Waters of the United States”; Final Rule. Federal Register, Volume 88, Number 3004. August 28, 2023.

FEMA. Digital Flood Insurance Rate Map for McLennan County, Texas and Incorporated Areas, Map Panel Number 48255C0375C (effective October 19, 2010).

NRCS. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296 pp.

TPWD. 2018. *Ecological Mapping Systems of Texas*. http://www.tpwd.state.tx.us/gis/data/ (accessed August 07, 2023).

USACE. 1987. 1987 Corps of Engineers Wetlands Delineation Manual, http://www.swg.usace.army.mil/Portals/26/docs/regulatory/Wetlands/wlman87.pdf. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A176 912.

—. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0) (ERDC/EL TR-101).

—. 2008. USACE Regulatory Guidance Letter 08-02 (RGL 08-02) Practices for Documenting Jurisdiction under Section 404 of the Clean Water Act and Sections 9 & 10 of the Rivers and Harbors Act (RHA) of 1899.

USDA, 2021. Custom Soil Resource Report for McLennan County, Texas. United States Department of Agriculture Soil Conservation Service and Natural Resources Conservation Service. http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx (accessed June 21, 2023).

USFWS. 1979. Classification of Wetlands and Deepwater Habitats of the United States, Cowardin, Lewis M. et al.

—. National Wetlands Inventory, Digital Data downloaded from https://www.fws.gov/wetlands/Data/Mapper.html (accessed August 07, 2023).

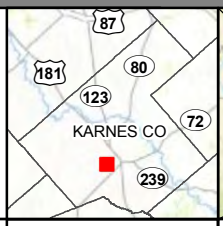
USGS. 2023. National Hydrography Dataset (NHD). http://nhd.usgs.gov/ (accessed August 07, 2023)

—. 1987. 7.5-Minute Quarter Quadrangle, Lenz, Texas. 1987

Appendix A Figures



Study Area





Project Location Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

N
W E
S

0 200 400 600 800
Feet

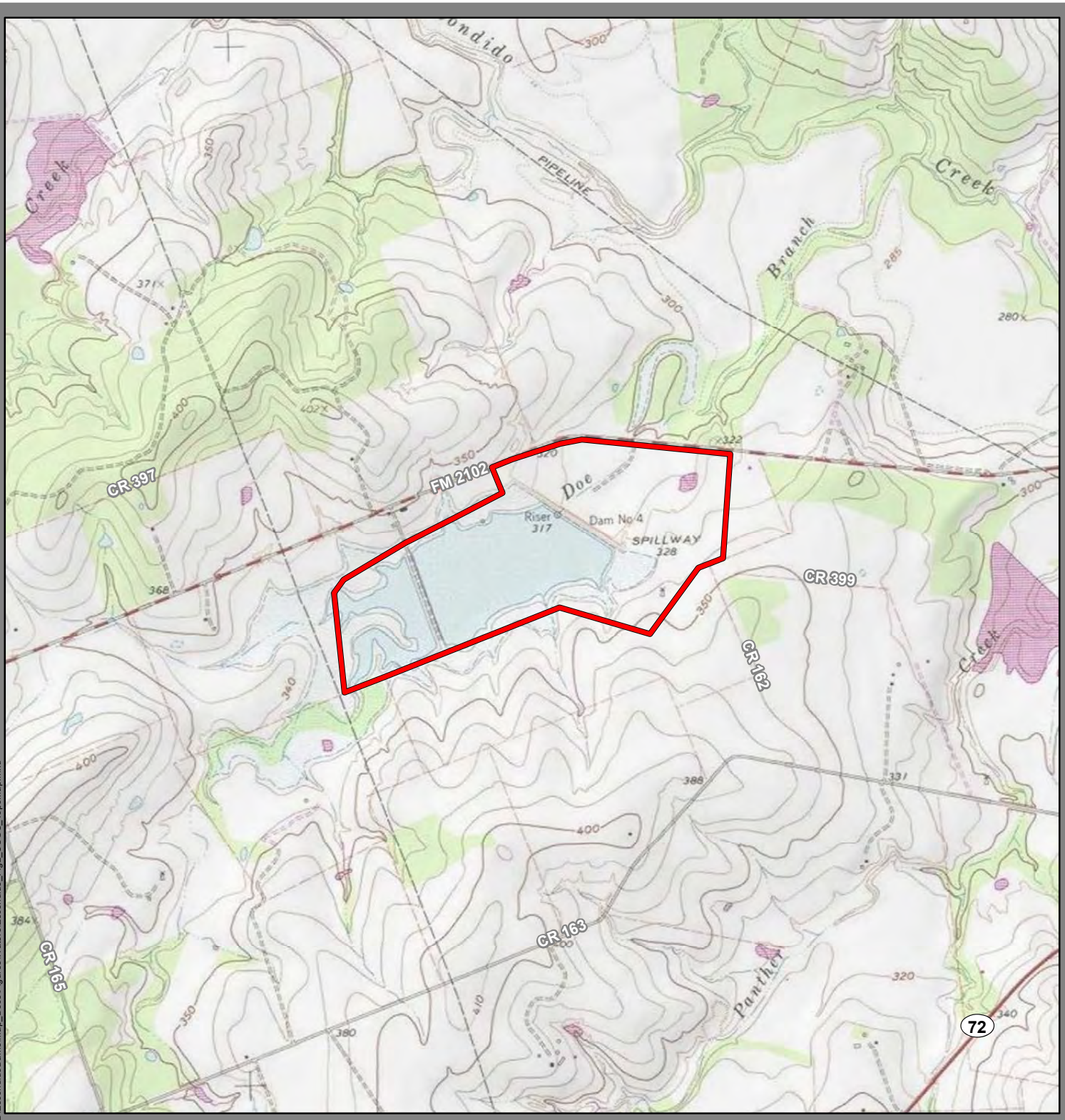
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

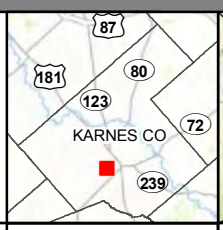
June 2023

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. 4
Karnes County, Texas

N
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Feet

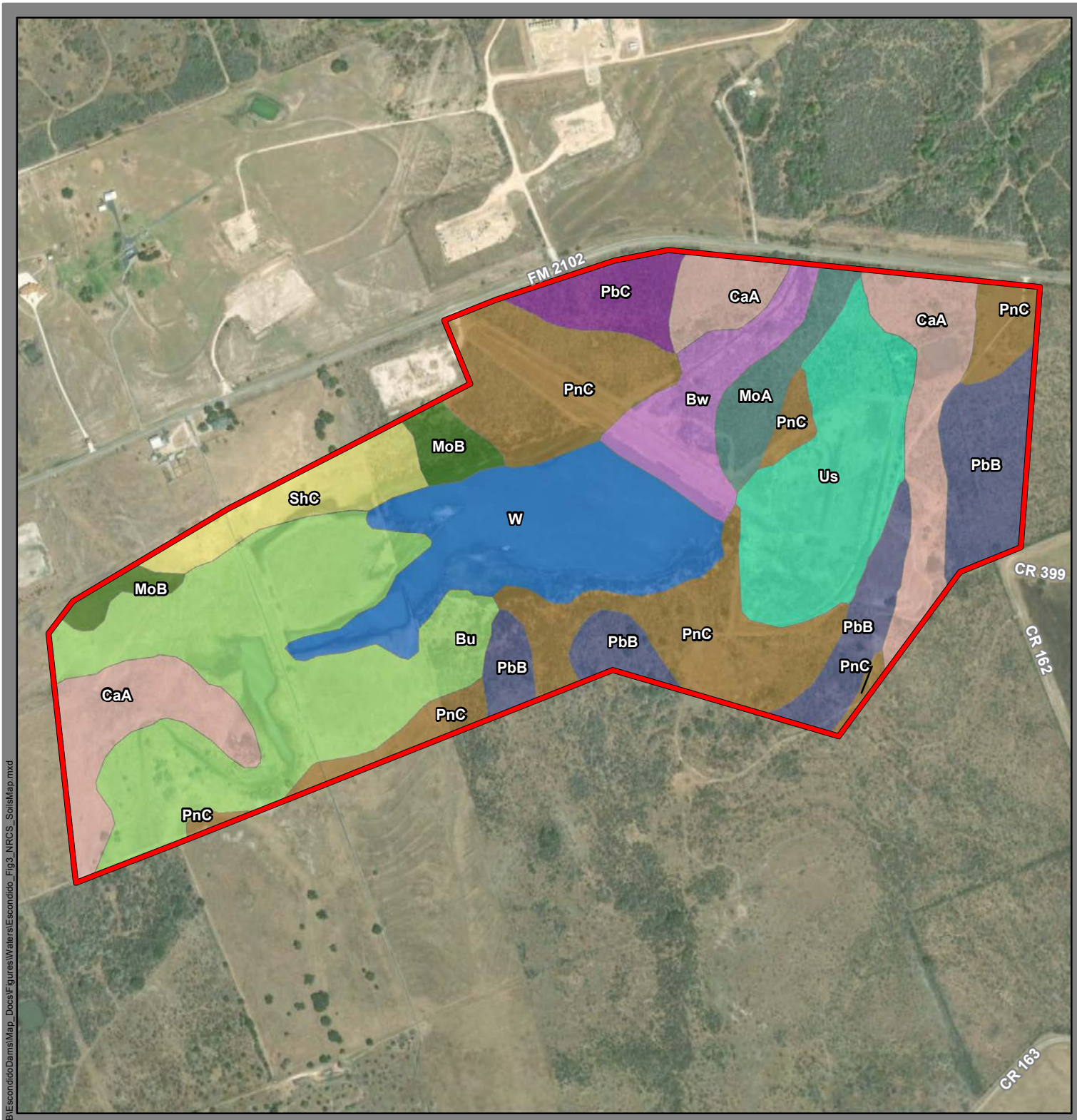
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: USGS 7.5-minute Topographic Maps: Lenz Quadrangle

AECOM

June 2023

Figure 2

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



Study Area

NRCS Soil Types

- Bu - Buchel clay, 0 to 1 percent slopes, occasionally flooded
- Bw - Buchel clay, 0 to 1 percent slopes, frequently flooded
- CaA - Clareville clay loam, 0 to 1 percent slopes
- MoA - Monteola clay, 0 to 1 percent slopes
- MoB - Monteola clay, 1 to 3 percent slopes
- PbB - Papalote fine sandy loam, 1 to 3 percent slopes
- PbC - Papalote fine sandy loam, 3 to 5 percent slopes
- PnC - Pernitas sandy clay loam, 2 to 5 percent slopes
- ShC - Schattel clay loam, 2 to 5 percent slopes
- Us - Ustarents, loamy
- W - Water

NRCS Soils Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

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Feet

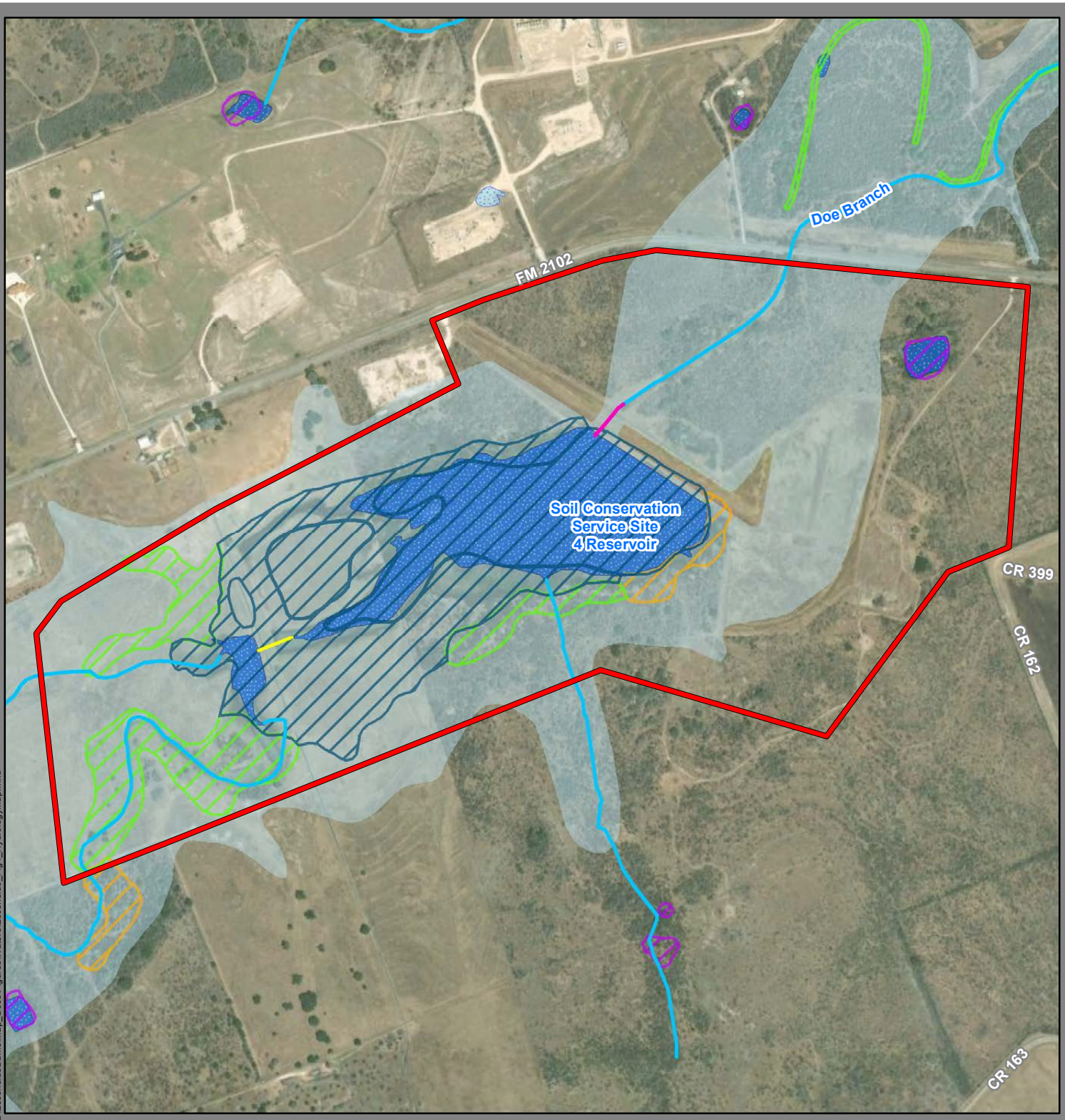
Data Sources: Soils - USDA NRCS 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

June 2023

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)
- Lake
- Freshwater Pond
- Freshwater Forested/Shrub Wetland
- Freshwater Emergent Wetland

National Hydrography Dataset (NHD)
- Stream/River: Intermittent
- Connector
- Underground Water Pipeline
- Lake/Pond: Perennial
- Lake/Pond: Intermittent

FEMA Flood Zones
- A (100-Year Flood Zone)

Hydrology Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

N W E S

0 200 400 600 800
Feet

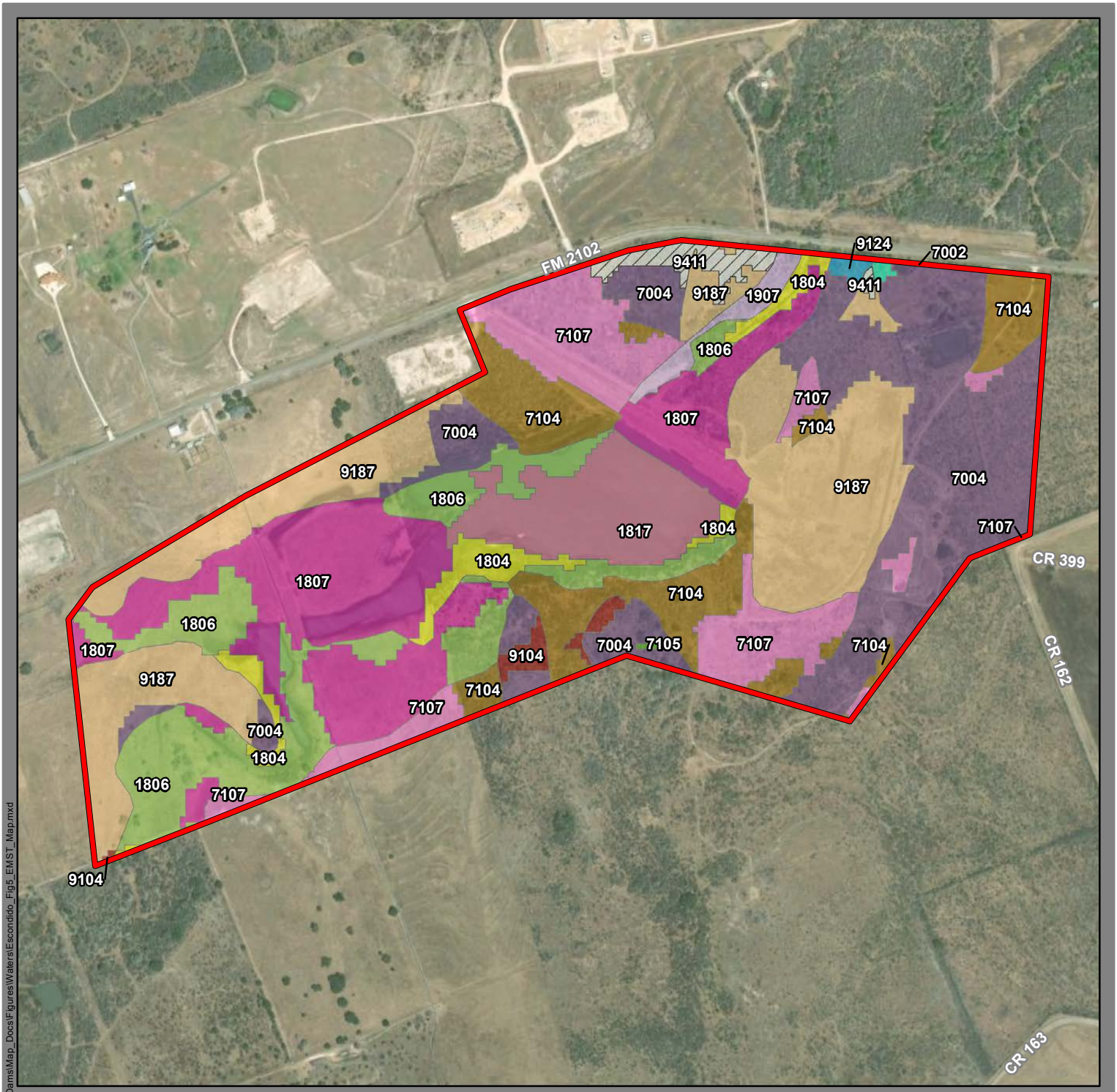
Data Sources: NHD - USGS 2023; NWI - USFWS 2023; Flood Zones - FEMA 2023; Roads - TxDOT 2023
Basemap: Maxar 3/22/2022

AECOM

June 2023

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

- 1804 - Central Texas: Floodplain Hardwood Forest
- 1806 - Central Texas: Floodplain Deciduous Shrubland
- 1807 - Central Texas: Floodplain Herbaceous Vegetation
- 1817 - Central Texas: Floodplain Herbaceous Wetland
- 1907 - Central Texas: Riparian Herbaceous Vegetation
- 7002 - South Texas: Clayey Live Oak Motte and Woodland
- 7004 - South Texas: Clayey Mesquite Mixed Shrubland
- 7104 - South Texas: Sandy Mesquite Woodland and Shrubland
- 7105 - South Texas: Sandy Mesquite Dense Shrubland
- 7107 - South Texas: Sandy Mesquite Savanna Grassland
- 9104 - Native Invasive: Deciduous Woodland
- 9124 - Native Invasive: Huisache Woodland or Shrubland
- 9187 - South Texas: Disturbance Grassland
- 9411 - Urban Low Intensity

Ecological Mapping Systems of Texas (EMST) Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

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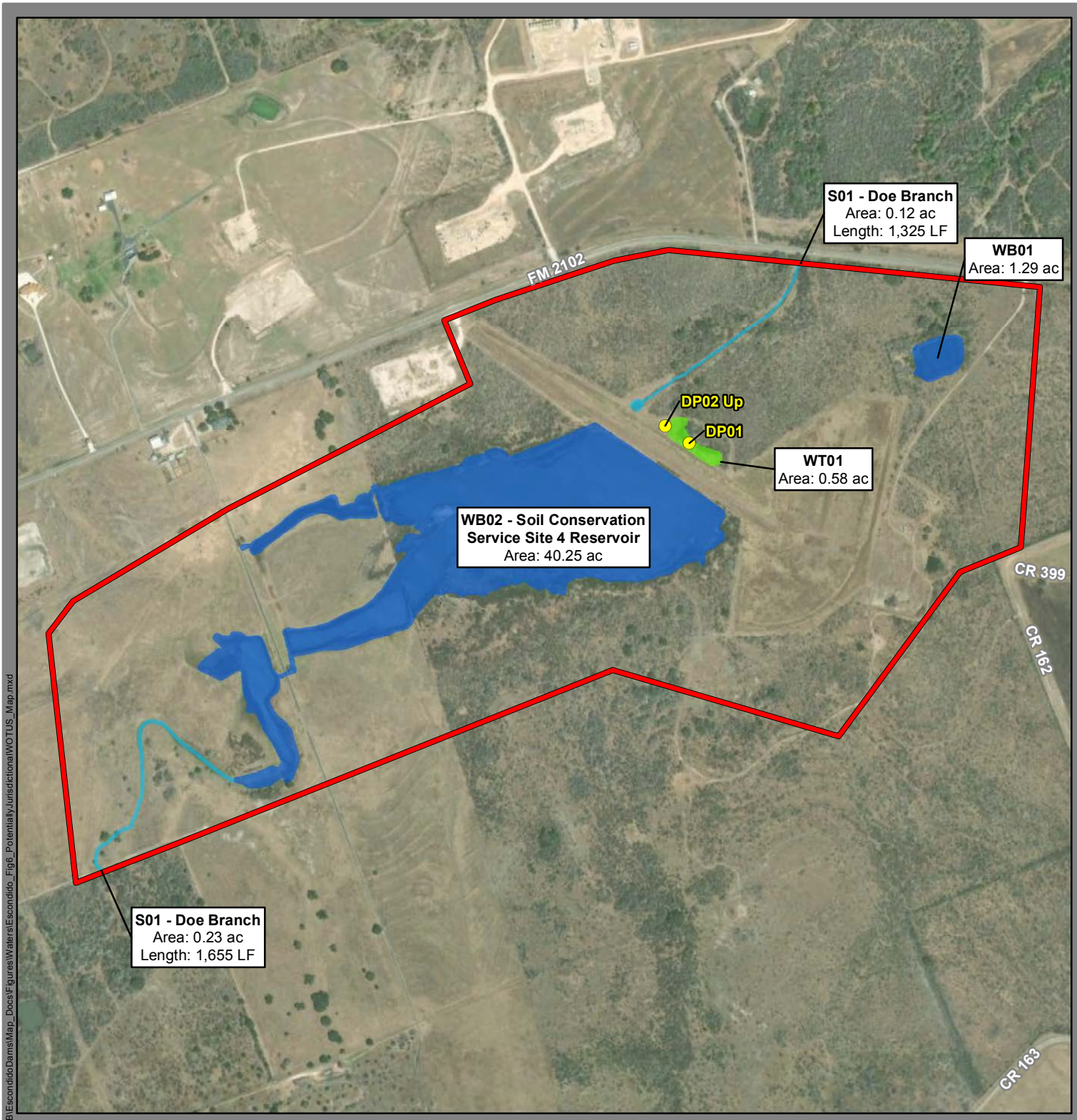
Data Sources: EMST - TPWD 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

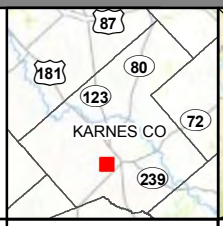
June 2023

Figure 5

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



Study Area
Field-Collected Features
Stream
Waterbody
Wetland
Data Point





Potentially Jurisdictional Waters of the U.S. Map

Escondido Creek Watershed FRS No. 4
Karnes County, Texas

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0 200 400 600 800
Feet

Data Sources: AECOM Field Surveys - June, July 2023; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

August 2023

Figure 6

Author: helen.potter: Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig6_PotentiallyJurisdictionalWOTUS_Map.mxd

Appendix B Photographic Log

AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
1	08/02/23

Direction Photo Taken:

Southeast

Description:

View of Escondido Creek Flood Retarding Structure (FRS) No. 4 reservoir (WB02) in the central portion of the Study Area.



Photo No.	Date:
2	08/02/23

Direction Photo Taken:

Southwest

Description:

View of Escondido Creek Flood Retarding Structure (FRS) No. 4 reservoir (WB02) in the central portion of the Study Area.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
3	08/02/23

Direction Photo Taken:

Southeast

Description:

View of Escondido Creek Flood Retarding Structure (FRS) No. 4 reservoir (WB02) in the central portion of the Study Area.



Photo No.	Date:
4	08/01/23

Direction Photo Taken:

Southeast

Description:

Upstream view of Stream 01/Doe Branch (S01) at the outflow, downstream of the dam structure.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
5	08/01/23

Direction Photo Taken:

Northwest

Description:

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



Photo No.	Date:
6	08/02/23

Direction Photo Taken:

Northwest

Description:

Downstream view of Stream 01/Doe Branch (S01) upstream of the dam structure.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
7	08/02/23

Direction Photo Taken:

Southeast

Description:

Upstream view of Stream 01/Doe Branch (S01) upstream of the dam structure.



Photo No.	Date:
8	08/01/23

Direction Photo Taken:

Northwest

Description:

View of stock pond WB01 in the northeastern portion of the Study Area.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
9	08/02/23

Direction Photo Taken:

Northeast

Description:

View of wetland (WT01) from the top of the Escondido FRS No. 4 Structure.



Photo No.	Date:
10	08/02/23

Direction Photo Taken:

Southwest

Description:

View of wetland (WT01) within the northeastern portion of the Study Area.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
11	08/02/23

Direction Photo Taken:

Southeast

Description:

View of wetland (WT01) within the northeastern portion of the Study Area.



Photo No.	Date:
12	08/02/23

Direction Photo Taken:

Northwest

Description:

View of wetland (WT01) within the northeastern portion of the Study Area.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
13	08/02/23

Direction Photo Taken:

Northwest

Description:

View of soil pit for the wetland (WT01) within the northeastern portion of the Study Area..



Photo No.	Date:
14	08/02/23

Direction Photo Taken:

Northeast

Description:

View of upland soil pit area associated with wetland (WT01) within the northeastern portion of the Study Area.



AECOM

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek FRS No. 4	Karnes County, TX	60707410

Photo No.	Date:
15	08/02/23

Direction Photo Taken:

Down

Description:

View of upland soil pit associated with wetland (WT01) within the northeastern portion of the Study Area.



Photo No.	Date:
16	08/02/23

Direction Photo Taken:

Southeast

Description:

View of upland soil pit area associated with wetland (WT01) within the northeastern portion of the Study Area.



Appendix C Wetland Forms

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Escondido Creek FRS No. 4 City/County: Kenedy/Karnes Sampling Date: 8/2/23

Applicant/Owner: Texas State Soil and Water Conservaton Board State: TX Sampling Point: DP01

Investigator(s): Joseph Jandle and Payton Prather Section, Township, Range: N/A

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR): LRR I, MLRA 83A Lat: 28.8814418 Long: -97.900896 Datum: WGS 1984

Soil Map Unit Name: NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes X No

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	**Is the Sampled Area within a Wetland?** **Yes** X **No**
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	

Remarks:
Freshwater emergent wetland is a product of seppage along the backside of the dam embankment. An underground releif pipe is also located in this area but discharges at the creek approximaltey 200 yards downstream of this embankment. Local employee stated that this area is usually fully inundated..

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30-ft Radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
		=Total Cover	
Sapling/Shrub Stratum (Plot size: 15-ft Radius)			
1.	0		
2.	0		
3.	0		
4.	0		
5.	0		
		=Total Cover	
Herb Stratum (Plot size: 5-ft Radius)			
1. *Schoenoplectus pungens*	90	Yes	OBL
2. *Eleocharis palustris*	20	No	OBL
3. *Pluchea odorata*	10	No	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	120	=Total Cover	
Woody Vine Stratum (Plot size: 30-ft Radius)			
1.	0		
2.	0		
		=Total Cover	

% Bare Ground in Herb Stratum

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	110	x 1 =	110
FACW species	10	x 2 =	20
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	120 (A)		130 (B)

Prevalence Index = B/A = 1.08

Hydrophytic Vegetation Indicators:

- 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- X 3 - Prevalence Index is ≤3.0[1]
- 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No**

Remarks:

SOIL

Sampling Point: DP01

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 2/1	100					Loamy/Clayey	
6-16	10YR 3/1	95	2.5YR 4/8	5	C	PL	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- X Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR I, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRR H outside of MLRA 72 & 73)**
- ? Reduced Vertic (F18)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: N/A

Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- X FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present?	Yes X	No ___	Depth (inches): 1		
Water Table Present?	Yes X	No ___	Depth (inches): 4		
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 12	**Wetland Hydrology Present?**	**Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Surface water was present in some areas. Water began entering the soil piit from below soon after excavation. Water in the pit rose to within 12" of the surface before backfilling. Saturation was present at soil depths from 4-16".

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Escondido Creek FRS No. 4 City/County: Kenedy/Karnes Sampling Date: 8/2/23

Applicant/Owner: Texas State Soil and Water Conservaton Board State: TX Sampling Point: DP02

Investigator(s): Joseph Jandle and Payton Prather Section, Township, Range: N/A

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR): LRR I, MLRA 83A Lat: 28.814708 Long: -97.901328 Datum: WGS 1984

Soil Map Unit Name: NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation____, Soil____, or Hydrology____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation____, Soil____, or Hydrology____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area within a Wetland?** **Yes** ____ **No** X
Hydric Soil Present?	Yes ____	No X	
Wetland Hydrology Present?	Yes ____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30-ft Radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Prosopis glandulosa*	15	Yes	FACU
2.	0		
3.	0		
4.	0		
	15	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15-ft Radius)			
1. *Vachellia farnesiana*	5	Yes	FACU
2.	0		
3.	0		
4.	0		
5.	0		
	5	=Total Cover	
Herb Stratum (Plot size: 5-ft Radius)			
1. *Cynodon dactylon*	100	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	100	=Total Cover	
Woody Vine Stratum (Plot size: 30-ft Radius)			
1.	0		
2.	0		
		=Total Cover	

% Bare Ground in Herb Stratum 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	120	x 4 =	480
UPL species	0	x 5 =	0
Column Totals:	120 (A)		480 (B)
Prevalence Index = B/A =			4.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ____ **No** X

Remarks:

SOIL

Sampling Point: DP02

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 2/1	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR I, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRR H outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: N/A

Depth (inches): ___

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

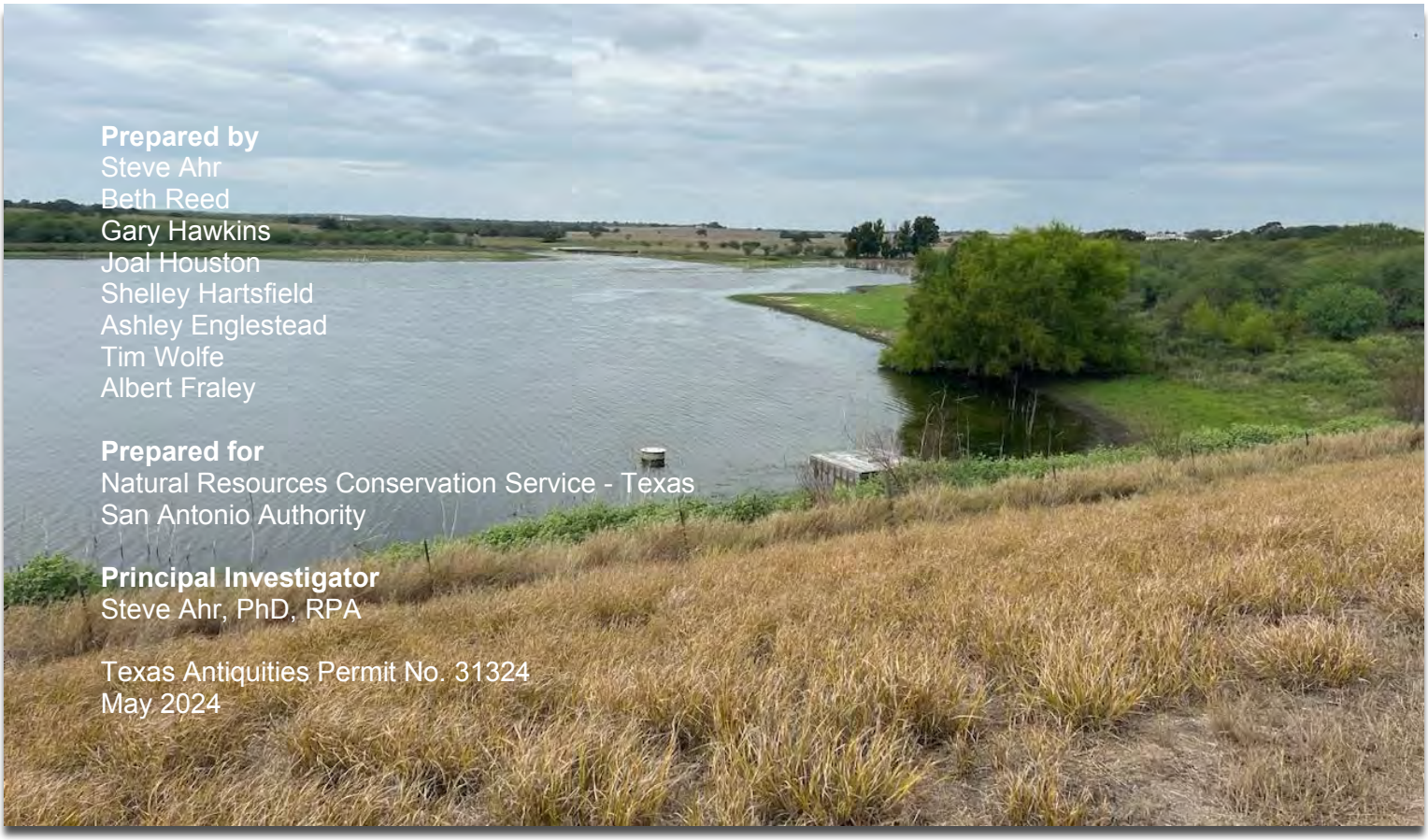
Wetland Hydrology Present? **Yes** ___ **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

AECOM

Cultural Resources Survey for the Rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 4, 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 Authority

Principal Investigator
Steve Ahr, PhD, RPA

Texas Antiquities Permit No. 31324
May 2024

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Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture. In addition, any reference to specific brands or types of products or services does not constitute or imply an endorsement by the U.S. Department of Agriculture for those products or services.

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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. 4 (FRS 4), 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. 31324.

The direct Area of Potential Effects (APE) for cultural resources consists of an alternatives evaluation area of 278 acres, which was surveyed through pedestrian walkover supplemented with the excavation of 100 shovel tests. No archeological sites were identified during the survey. However, the field survey identified and evaluated three aboveground historic-age resource sites (Sites 001-003) within the indirect APE. Based on background review and field investigations, Sites 001, 002, and 003 are recommended as Not Eligible for listing in the National Register of Historic Places (NRHP) or for designation as State Antiquities Landmarks (SALs).

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. 4 (FRS 4), located in Karnes County, Texas (**Figure 1**). AECOM Technical Services, Inc. (AECOM) conducted a cultural resources survey in support of a Supplemental Watershed Plan (SWP) for the rehabilitation of FRS 4.

FRS 4 was constructed in 1956 as a low hazard dam on Doe Branch, a tributary to Escondido Creek, approximately 3.2 miles west of Kenedy, Texas. The National Inventory of Dams Identification Number is TX02035 (URS Corporation 2014). The dam is a filled earthen embankment that is 2,900 feet (ft) long with a maximum height of 29 ft. The detention pool is 250.7 acres. The principal spillway is a 36x36-inch drop inlet with 144 ft of 28-inch diameter, reinforced concrete pipe and 40 ft of 30-inch diameter corrugated steel metal pipe. The auxiliary spillway is a vegetated earthen channel 500 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 structural rehabilitation of FRS 4 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 future rehabilitation modifications would take place within a 278-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 maximum pool 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. The project depth of most impacts would be limited to the upper 1 meter (m) of deposits; potential borrow areas on the upland margins could potentially 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.

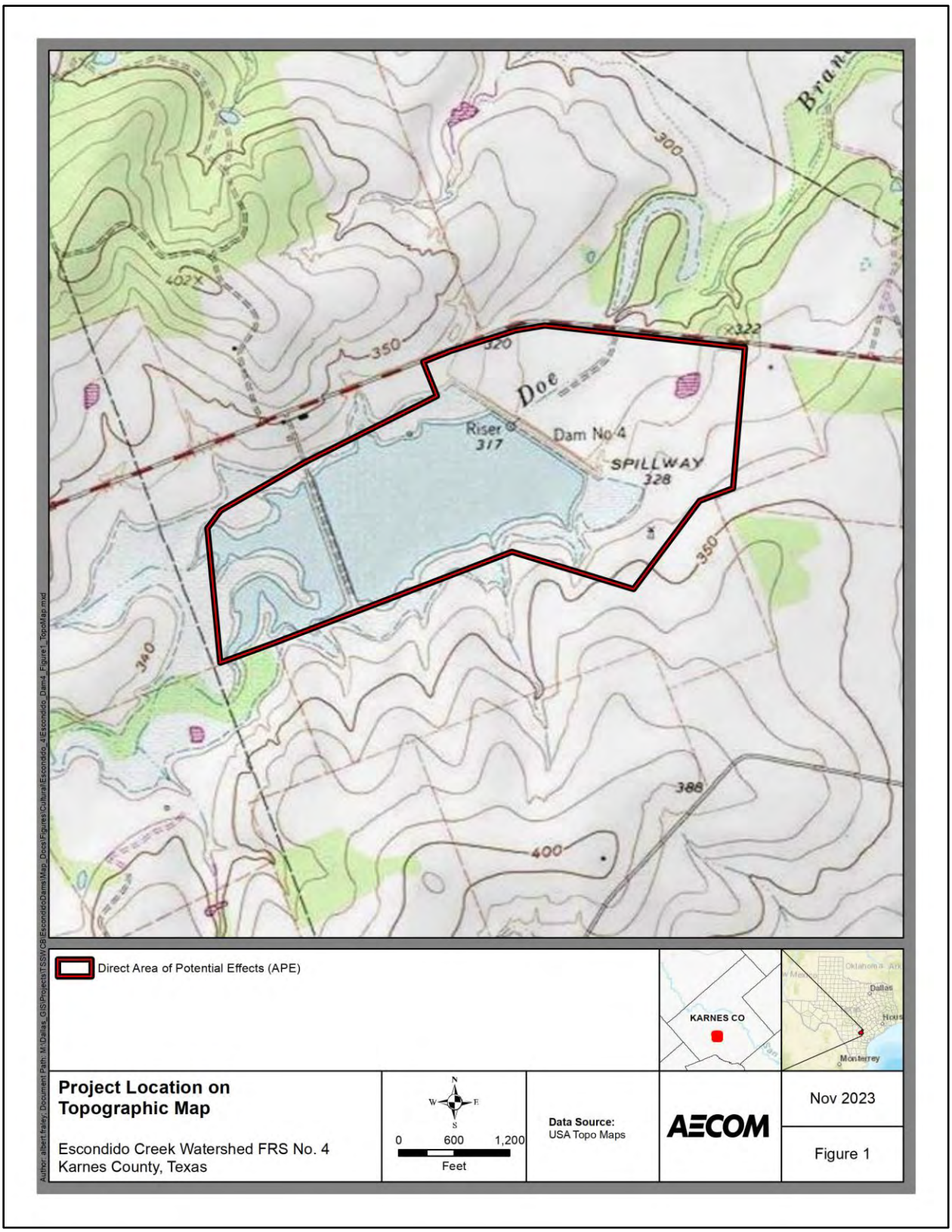


Figure 1. Escondido FRS 4 Project Location

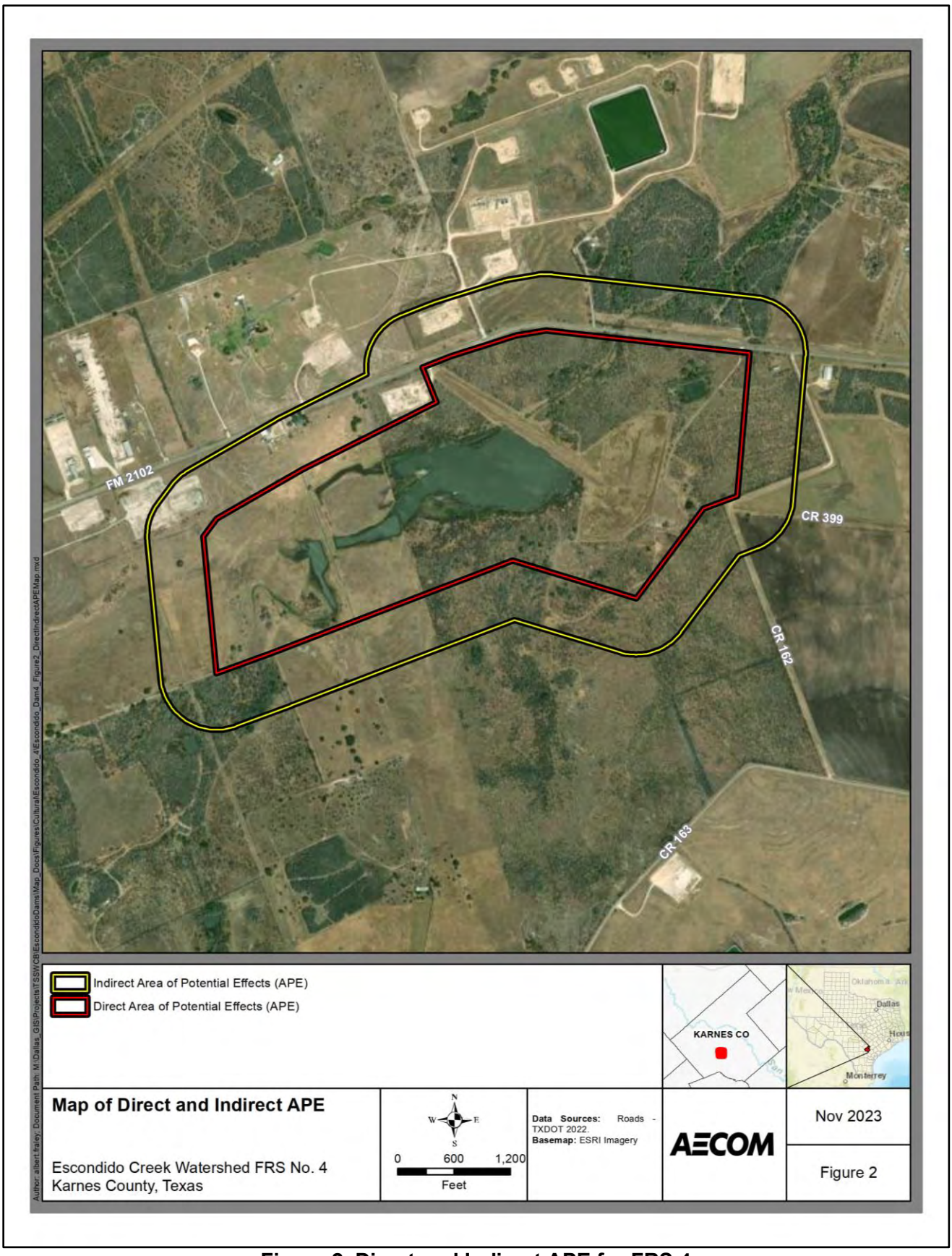


Figure 2. Direct and Indirect APE for FRS 4

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 September 29 – October 2, 2023, under Texas Antiquities Permit No. 31324, requiring approximately 110 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 project area 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 350 ft above mean sea level (amsl) within the upland margins, to approximately 310 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). Inset within this formation are Holocene alluvial deposits associated with Doe Creek (BEG 1987).

2.4 Soils

Ten soil mapping units are present within the APE (**Table 1; Figure 3**). Approximately 69 percent of the soils in the APE are described as having formed on floodplains and terraces, while 9 percent formed in residuum on upland hillslopes (NRCS 2023). The remaining 22 percent of the APE is classified as water or earthen spoil material.

Table 1. Soils within the APE

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Typical Pedon	Parent Material
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	20.5	Very deep, very slowly permeable, moderately well drained soils on nearly level floodplains	Ap-A-Bss1-Bss2-Bkss1-Bkss2	Recent (Holocene) Alluvium
Bw	Buchel clay, 0 to 1 percent slopes, ferequently flooded	4.9	Very deep, very slowly permeable, moderately well drained soils on nearly level floodplains	Ap-A-Bss1-Bss2-Bkss1-Bkss2	Recent (Holocene) Alluvium
CaA	Clareville clay loam, 0 to 1 percent slopes	12.6	Very deep, well drained soils on base slope on draws and drainageways	Ap-A-Bt1-Bt2-Btk-Bk1-Bk2-BCk	Recent (Holocene) Alluvium

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Typical Pedon	Parent Material
MoA	Monteola clay, 0 to 1 percent slopes	2.8	Very deep, well drained, very slowly permeable soils on hillslopes	Ap-A-Bss-Bkssy1-Bkssy2-BCkyz	Residuum
MoB	Monteola clay, 1 to 3 percent slopes	2.3	Very deep, well drained, very slowly permeable soils on hillslopes	Ap-A-Bss-Bkssy1-Bkssy2-BCkyz	Residuum
PbB	Papalote fine sandy loam, 1 to 3 percent slopes	9.9	Very deep, moderately well drained soils on high terraces	A-Bt1-Bt2-Bt3-Btk-BCk	Pliocene-Pleistocene Alluvium
PbC	Papalote fine sandy loam, 3 to 5 percent slopes	2.8	Very deep, moderately well drained soils on high terraces	A-Bt1-Bt2-Bt3-Btk-BCk	Pliocene-Pleistocene Alluvium
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	18.3	Very deep, well drained, moderately permeable soils on summits, backslopes, and footslopes of ridges	A-Bt1-Bt2-Bk1-Bk2	Ancient Alluvium
ShC	Schattel clay loam, 2 to 5 percent slopes	3.8	Deep, well drained soils on hillslopes	A-Bw-Bk-Bkyz-Cdkyz	Residuum
Us	Ustarents, loamy	10.0	Mine spoil, earth fill	N/A	Mine spoil
W	Water	12.1	N/A	N/A	N/A

Source: (NRCS 2023)

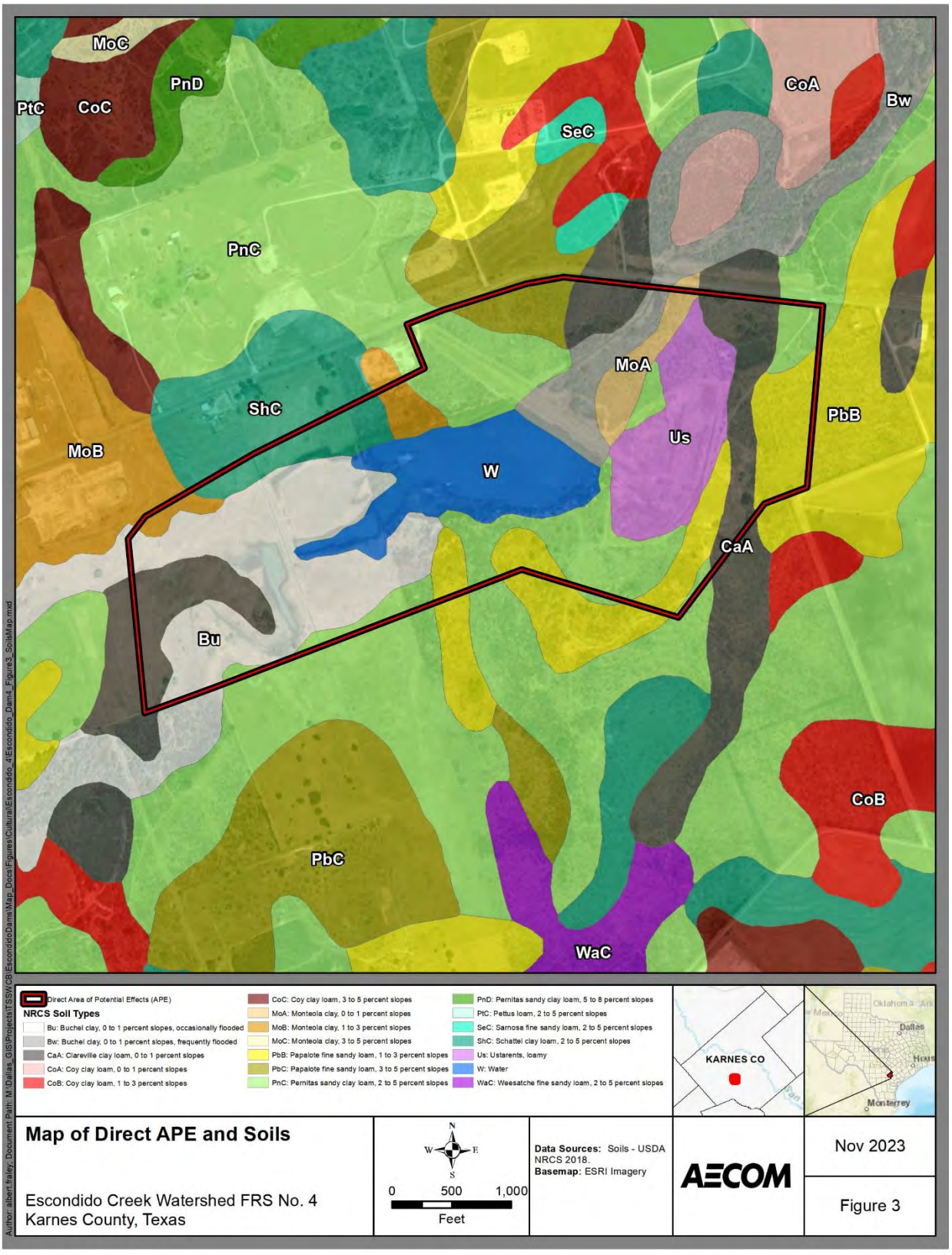


Figure 3. Project Soils

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 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 clans. 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 following 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 farmer 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. 31324 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 (NHLs), State Antiquities Landmarks (SALs), Recorded Texas Historic Landmarks (RTHLs), and Official Texas Historical Markers (OTHMs) 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. Artifact scatters were delineated as sites through shovel testing and field observations, as outlined in CTA's *Intensive Terrestrial Survey Guidelines*.

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 Toolkit 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, and 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, channelization, and berms (**Figures 5-9**).

A total of 100 shovel tests were excavated within the direct APE and revealed shallow (average of 30 centimeters below surface) light brownish gray and dark grayish brown sandy and silty clay loam soils overlying a compacted sandy clay subsoil/argillic 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. 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.

Three aboveground historic-age resource sites (Sites 001 - 003) were identified in the indirect APE and evaluated by an architectural historian during the survey (**Figure 11**). Each is discussed in the following sections.



Figure 4. Overview of APE, facing northwest



Figure 5. Berm disturbances below dam



Figure 6. Drainage outlet, berms, impact basin, and straightened outlet channel



Figure 7. Top of dam embankment



Figure 8. Auxiliary spillway



Figure 9. Dam inlet structure and reservoir area

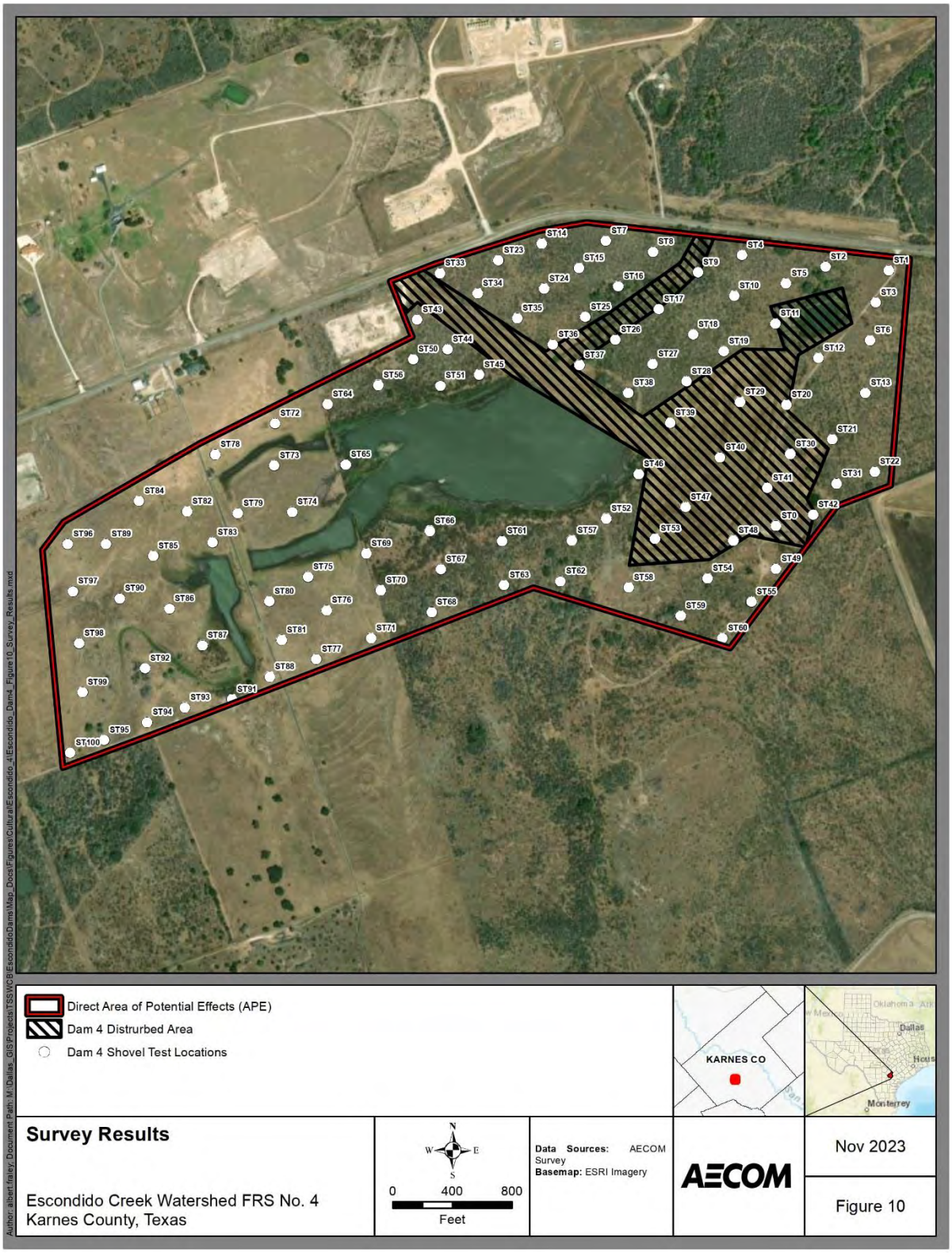


Figure 10. Map showing shovel test locations

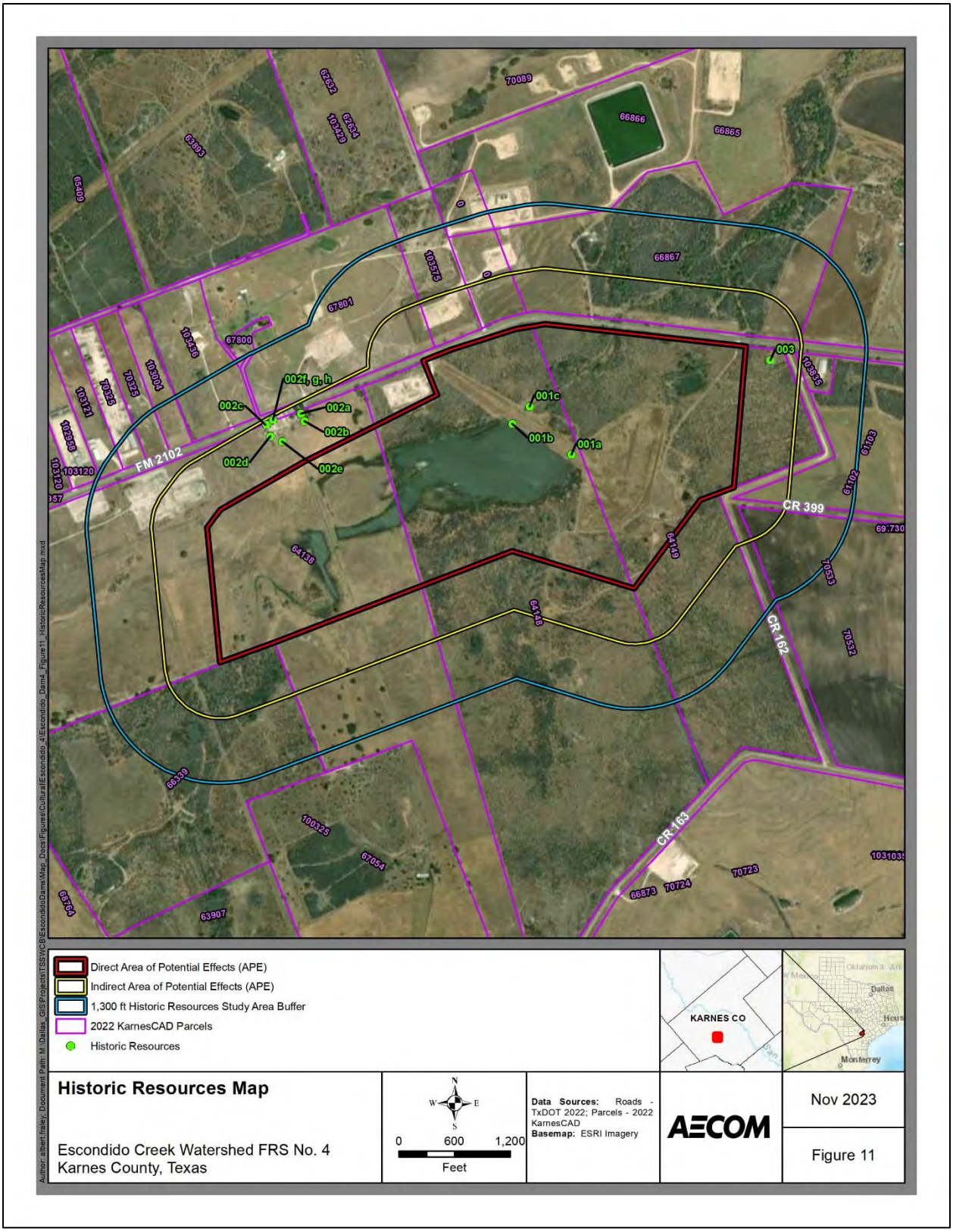


Figure 11. Historic Resource Sites identified during the survey

Site 001

Site 001 consists of the Escondido Creek Watershed FRS No. 4, located on Doe Branch. The site consists of three historic-age resources: Resource 001a - an earthen dam structure, Resource 001b - the principal spillway inlet structure, and Resource 001c - the principal spillway outlet drainage pipe and basin (**Figure 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 TX02035 and records a 1956 construction date for Resources 001a-c. A review of historic aerial photography shows that Resources 001a-c are not visible in a 1955 photograph but are visible in a 1981 photograph and therefore, the 1956 construction date is considered accurate.

Research indicates that Site 001 is situated on two original land grants. One grant of 1,920 acres was bestowed to B.H. Duvall as Abstract 97, in File 149 of the Texas General Land Office records. The land was patented by Duvall's heirs on April 15, 1858, under Patent No. 66, Patent Volume 9, Certificate 10075. The second grant of 2,969 acres was bestowed to Isaac Ticknor as Abstract 278, in File 247, of the Texas General Land Office records. The land was patented by Duvall's heirs on September 1, 1855, under Patent No. 244, Patent Volume 12, Certificate 17.

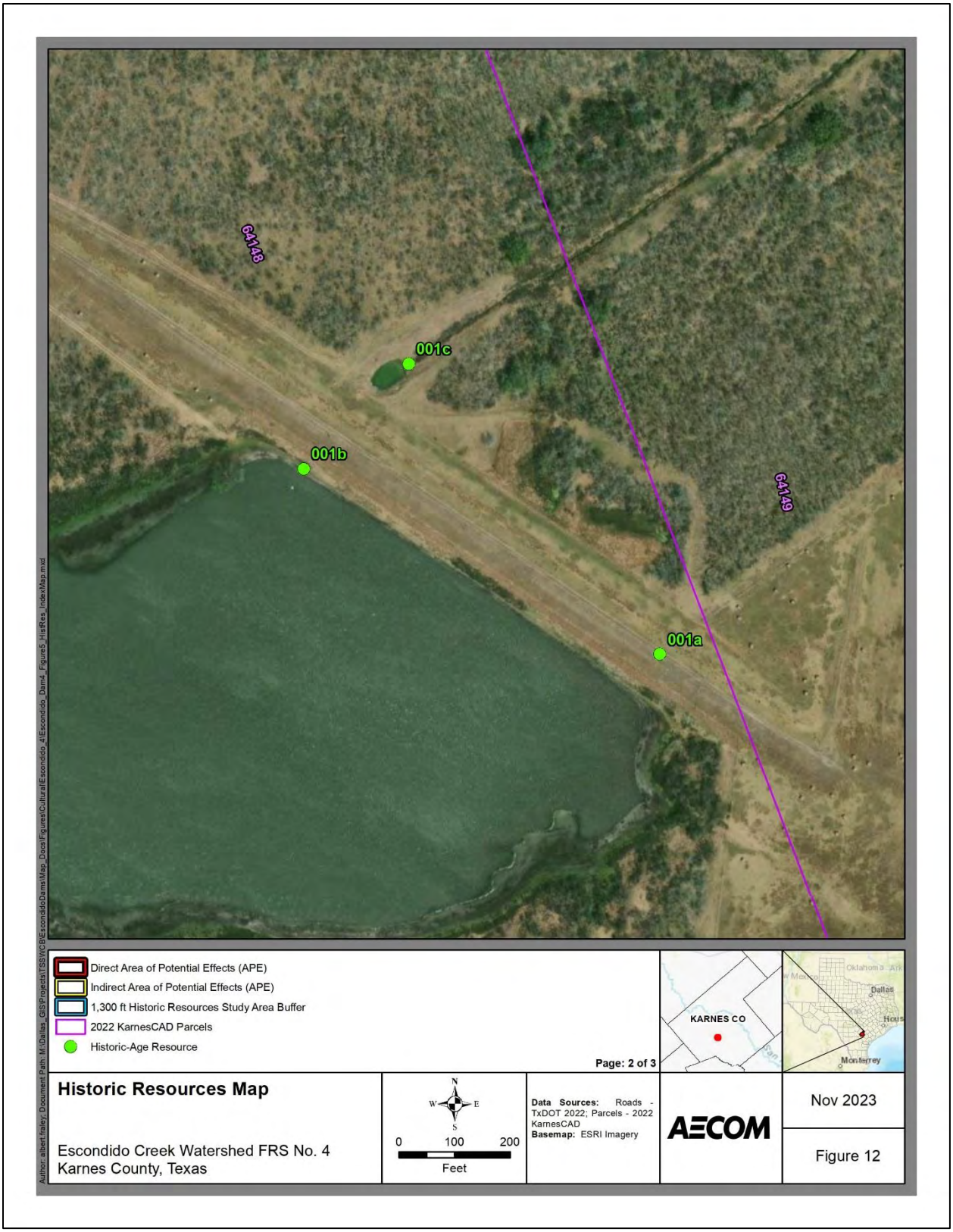


Figure 12. Historic Resources Site 001 location map

Resource 001a

Resource 001a consists of an earthen-filled embankment dam designed for flood control. The resource is grass-covered and measures 2,900 ft in length (**Figure 13**). 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

Resource 001b

Resource 001b is a Principal Spillway Inlet Riser and functions to convey water so that outflow from the reservoir can be regulated. Resource 001b is constructed of concrete and rises from the base of the reservoir on the southwest side of the embankment (**Figure 14**). The structure exhibits a concrete base with a square cap constructed of wooden boards.

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, looking northwest

Resource 001c

Resource 001c is a Principal Spillway Outlet drainage structure (**Figure 15**). The structure is 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, looking east

Site 001 appears 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, Site 001 is recommended Not Eligible for listing in the NRHP.

Site 002

Site 002 consists of a farmstead situated on approximately 473.94 acres. The site contains eight historic-age resources (Resources 002a-h) consisting of a residence and seven agricultural outbuildings and structures (**Figures 16-17**). The land is used as rangeland for livestock and cattle, observed on the property during the survey.

Site 002 is situated on an original land grant containing 1,920 acres bestowed to B.H. Duvall as Abstract 97, in File 149 of the Texas General Land Office records. The land was patented by Duvall's heirs on April 15, 1858, under Patent No. 66, Patent Volume 9, Certificate 10075.

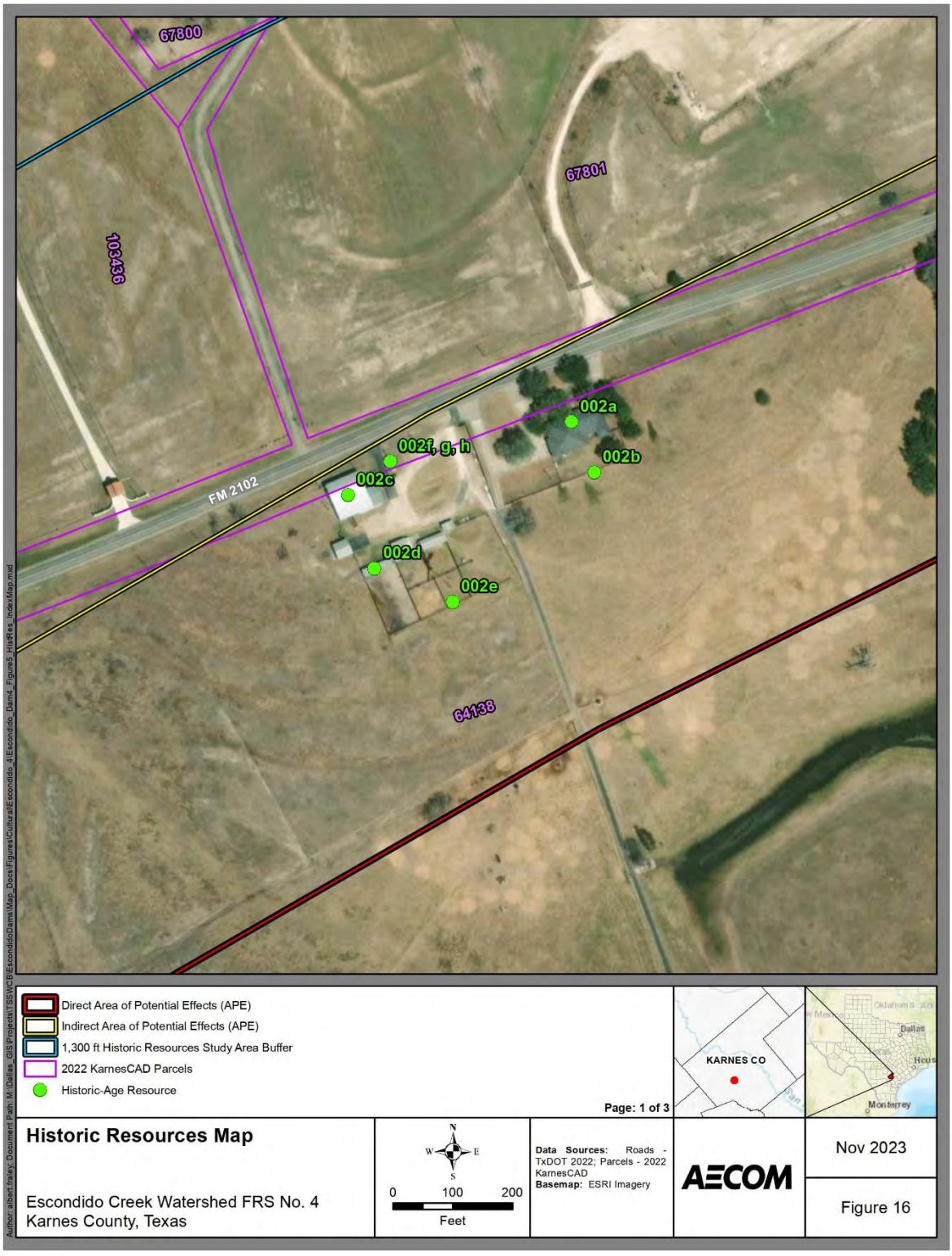


Figure 16. Historic Resources Site 002 location map



Figure 17. Aerial view of Site 002 and Resources 002a-h

Resource 002a

Resource 002a consists of a one-story, single-family residence with an irregular plan and Ranch stylistic influence (**Figure 18**). The house exhibits a complex multi-hipped roof with a shallow pitch and seamed metal cladding. Exterior walls are constructed of variegated light red brick. The house is surrounded by mature trees that obscured visibility of the east and south elevations.

The façade faces north, and a primary entry consisting of a single entry is located near the center of the façade. A portion of the east side of the house is recessed and contains the entry. The eave above the entry extends to create a partial-width ground-level open porch with one square support. A three-part aluminum-frame picture window is displayed to the west of the entry. The window exhibits a single fixed center pane flanked by 2/2 sash units. The façade also exhibits four small 1/1 aluminum sash units set high under the eave. An attached pair of aluminum 2/2 sash units are displayed at the east end of the façade. All visible window units exhibit decorative window shutters. The west elevation exhibits a secondary entry and a two-car integrated garage.

Karnes County Appraisal District (KCAD) does not record a date of construction for this resource. The house is not visible on a 1955 aerial photograph but is recorded on a 1963 topographic map and a 1981 aerial photograph. Therefore, the estimated date of construction for Resource 002a is ca. 1960.

Resource 002a retains integrity of location. Integrity of design, materials and workmanship appear to be original with the possible exception of replacement entry and garage doors. The resource retains integrity of setting, feeling and association. However, the resource is a common example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002a is recommended Not Eligible for the NRHP.



Figure 18. View of Resource 002a, looking southeast

Resource 002b

Resource 002b is a structure consisting of a wall constructed of light red brick (**Figure 19**). It is associated with the nearby residence, Resource 002a, and surrounds the house on the east, west, and south sides. The structure includes multiple solid brick panels separated by brick columns.

KCAD does not record a date of construction for this resource. The house is not visible on a 1955 aerial photograph but is recorded on a 1963 topographic map and a 1981 aerial photograph. Therefore, the estimated date of construction for Resource 002a is ca. 1960. Resource 002b retains integrity of location, design, materials, setting, feeling and association. However, the resource is a common example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002b is recommended Not Eligible for the NRHP.



Figure 19. View of Resource 002b, looking southeast (Google Imagery, July 2023)

Resource 002c

Resource 002c consists of a one-story, agricultural building with an irregular plan and no stylistic influence (**Figures 20-22**). The resource exhibits a section with an end-gabled roof and a portion with a shed roof extending from the south elevation. The roof exhibits metal cladding and exterior walls are constructed of corrugated metal sheathing. The building is in use as a barn.

A primary single entry located in the center of the east elevation and contains a pair of full-height side-hinged doors clad with corrugated metal. A smaller end-gabled section extends from the east elevation and exhibits painted concrete block construction, and a metal roof with gable ends.

KCAD records a 1970 date of construction for this resource. The resource is not visible on a 1955 aerial photograph but is visible on a 1981 photograph. Based on the design, materials, and workmanship of the building, the 1970 KCAD is considered accurate.

Resource 002c retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002c is recommended Not Eligible for the NRHP.



Figure 20. View of Resource 002c, looking southwest (Google Imagery July 2023)



Figure 21. View of Resource 002c, looking southeast (Google Imagery July 2023)



Figure 22. View of Resource 002c, with doors open, looking south

Resource 002d

Resource 002d consists of a one-story, agricultural building with a rectangular plan and no stylistic influence (**Figure 23**). The resource exhibits a shed roof clad with metal sheathing and exterior walls are clad with corrugated metal sheathing. The building appears to be in use as a barn.

A single entry is located on the northeast side of the northeast elevation and contains a standard, solid side-hinged door. KCAD records a 1970 date of construction for this resource. It is not visible on the 1955 aerial photograph but is visible on the 1981 photograph. Therefore, the KCAD date is considered accurate.

Resource 002d retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002d is recommended Not Eligible for the NRHP.



Figure 23. View of Resources 002d, looking southwest (Google Imagery July 2023)

Resource 002e

Resource 002e is a structure consisting of an animal corral. The resource exhibits a square plan constructed of metal piping and is divided into multiple pens. The resource is situated behind a barn (Resource 002d) and is used to corral the livestock on the property. The resource was obstructed so it was unable to be photographed from the public ROW.

KCAD does not record a date of construction for this resource. The structure is not visible in a 1955 aerial photograph but is visible in a 1981 photograph. Because it is associated with Resources 002c-d, an estimated construction date for the resource is ca. 1970.

Resource 002e retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002e is recommended Not Eligible for the NRHP.

Resource 002f

Resource 002f consists of a cylindrical concrete water tank with horizontal concrete ribbing (**Figures 24-25**). The tank has a concrete lid and is elevated on a thick concrete slab supported by multiple square concrete piers. This type of water tank is used to provide water to livestock and irrigate pastures.

KCAD does not record a date of construction for this resource, and the resource is not visible on a 1955 arial photograph. Resource 002f is recorded on a 1956 topographic map and the estimated construction date is ca. 1956.

Resource 002f retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002f is recommended Not Eligible for the NRHP.

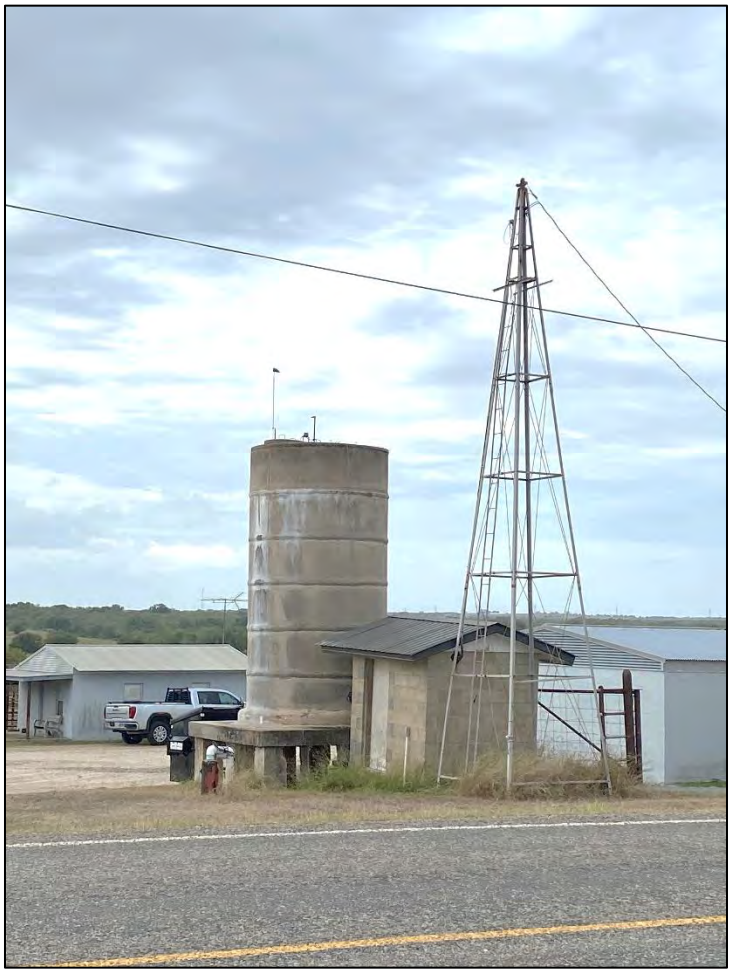


Figure 24. View of Resources 002f-h, looking southwest



Figure 25. View of Resource 002f, looking southwest (Google Imagery, July 2023)

Resource 002g

Resource 002g consists of a small, one-story, pump-house building with a rectangular plan and no stylistic influence (**Figure 26**). The resource exhibits an end-gabled roof with ribbed metal cladding. Exterior walls exhibit concrete block construction. The building is associated with the water tank (Resource 002f) and is attached by a pipe that extends from the south elevation. A single entry is located on the northeast elevation and contains a solid metal door.

KCAD does not record a date of construction for this resource. Because the structure is associated with Resources 002f and 002h, the estimated date of construction for this resource is ca. 1956.

Resource 002g retains integrity of location, design, materials, workmanship, setting, feeling and association although the roof cladding appears to be replacement. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002g is recommended Not Eligible for the NRHP.



Figure 26. View of Resource 002g, looking southwest (Google Imagery, July 2023)

Resource 002h

Resource 002h consists of the metal framework of a windmill tower (**Figure 27**). The structure consists of four metal supports with X-bracing and tapers to the top. A metal ladder is attached to the east side. The structure is associated with the pump house and water tank (Resources 002f-g) and was once used in the conveyance of water from an underground well to the pump house and tank. A cable extends from the north elevation of the pumphouse and attaches to the windmill framing. The windmill is missing all functional elements of its type including a pump rod and piping, and the entire top portion consisting of a bladed rotor, gearbox, and tail. As a result, Resource 002e is no longer functional as a windmill.

KCAD does not record the date of construction of the windmill. The resource is not visible in a 1955 historic aerial but is visible in a 1981 photograph. Because the structure is associated with Resources 002f and 002g, the estimated date of construction for this resource is c 1956.

Resource 002h retains integrity of location, but lacks integrity of design, materials, workmanship, setting, feeling and association due to the missing elements and loss of function. As a result, the resource does not display distinctive architectural or historical merit. Therefore, Resource 002h is recommended Not Eligible for the NRHP.



Figure 27. View of Resource 002h looking southwest (Google Imagery, July 2023)

Site 002 appears to retain integrity of location, design, materials, workmanship, setting feeling and association for Resources 002a-g, and the site remains functioning as originally intended. Resource 002h retains integrity of location. However, the resources are typical of their type and do not represent distinctive architectural or engineering merit. Therefore, Site 002 is recommended Not Eligible for listing in the NRHP.

Site 003

Site 003 consists of one historic-age resource, Resource 003 (**Figure 28**). The resource consists of an open steel structure with a rectangular plan (**Figure 29**). The structure exhibits a shallow rounded metal roof frame covered by metal sheathing with eight metal supports. This shed structure is used as a shelter for hay bales.

The resource is situated on KCAD property parcel 64149 on the original Isaac Ticknor land grant (Abstract 278, in File 247). KCAD does not record a date of construction for the resource. It is not visible on a 1955 aerial photograph but is visible on a 1981 photograph. Based on this information an estimated date of construction for Resource 003 is ca. 1980.

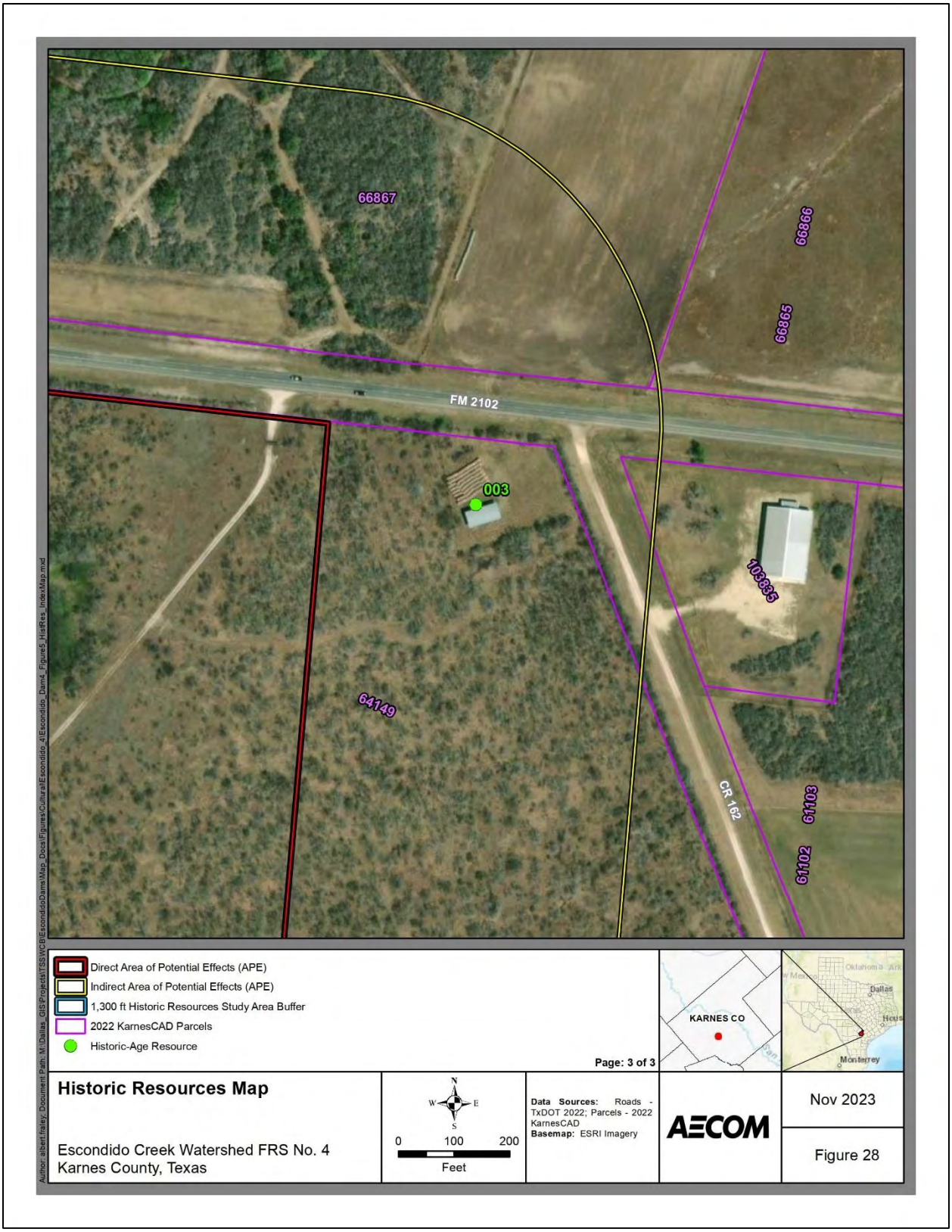


Figure 28. Historic Resources Site 003 location map



Figure 29. View of Resource 003, looking southwest (Google Imagery July 2023)

Site 003 appears to retain integrity of location, design, materials, workmanship, setting, feeling and association, and the site remains functioning as originally intended. However, the resource is a typical, utilitarian example of its type and does not represent distinctive architectural or engineering merit. Therefore, Site 003 is 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 the Monteola, Pernitas, and Schattel soil series. These soils are on uplands and hillslopes and flank the drainageway sideslopes; they formed in residuum weathered from Miocene-age sandstone, clay, and mud. Shovel tests within these soils revealed brown (10YR 4/2-4/3) and dark brown (10YR 3/3) sandy loam and sandy clay loam overlying a shallow compacted argillic horizon. These soils tend to be thin sandy to loam, frequently eroded to clay subsoil, and bioturbated. This was confirmed by numerous shovel tests throughout the APE, which encountered sandy clay Bt subsoil horizons at relatively shallow (<30 cm) depths.

The well-developed argillic subsurface horizons meet 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. Within the APE these shallow soils 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.

Also within the APE, Buchel and Clareville floodplain soils are described as recent, Holocene-age soils and are mapped below the dam drainage outlet channel and impact basin, and beneath the current reservoir area that was previously disturbed during dam construction. Papalote soils are found on the outer edges of the APE near the auxiliary spillway and formed in ancient Plio-Pleistocene alluvium. Shovel tests within these alluvial soils typically revealed calcareous and shallow (40 to 50 cm deep) dark gray (10YR 4/2) silty and sandy clay over compacted clay subsoil. These floodplain soils 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. Alluvial soils in the APE are relatively shallow (<1 m) and therefore fall within the range of shovel tests. Inspection of the stream channel below the dam further revealed disturbed sediment berms flanking the channel margin, which was clearly channelized (see **Figure 6**). These berms appear to consist of artificial levees made up of dredge spoil materials that were excavated during channel straightening.

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 Supplemental Watershed Plan for the rehabilitation of the Escondido Creek Watershed FRS 4, within a 278-acre APE, located in Karnes County Texas. The survey was performed under Texas Antiquities Permit No. 31324 and included a 100 percent pedestrian survey supplemented with 100 shovel tests.

No archeological sites were identified during the survey. However, three aboveground historic-age resource sites (Sites 001 – 003) were identified and evaluated by an architectural historian. Based on background review and field investigations, Sites 001, 002, and 003 are recommended as Not Eligible for listing in the NRHP or designation as SALs.

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.

7 References Cited

Bement, L.C.
1994 *Hunter-Gatherer Mortuary Practices During the Central Texas Archaic*. University of Texas Press, Austin.

Black, S.L.
1986 *The Clemente and Herminia Hinojosa Site, 41JW8: A Toyah Horizon Campsite in Southern Texas*. Special Report No. 18. Center for Archaeological Research, The University of Texas at San Antonio.

1989 South Texas Plains. In *From the Gulf of the Rio Grande: Human Adaptation in Central, South, and Lower Pecos Texas*, by Thomas R. Hester, Stephen L. Black, D. Gentry Steele, Ben W. Olive, Anne A. Fox, Karl J. Reinhard, and Leland C. Bement, pp. 39–62. Research Series No. 33. Arkansas Archeological Survey, Fayetteville.

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

Collins, M.B.
1995 Forty Years of Archeology in Central Texas. *Bulletin of the Texas Archeological Society* 66:361-400.

2002 The Gault Site, Texas, and Clovis Research. *Athena Review* 3(2).

2004 Archeology in Central Texas. In *The Prehistory of Texas*, edited by Timothy K. Perttula, pp. 101–126. Texas A&M University Press, College Station.

Creel, D.
1991 Bison Hides in Late Prehistoric Exchange in the Southern Plains. *American Antiquity* 56(1): 40-49.

Dillehay, T.D.
1974 Late Quaternary Bison Population Changes in the Southern Plains. *Plains Anthropologist* 19(1): 180-196.

Gould, F.W.
1975 Texas Plants: A Checklist and Ecological Summary. Texas A&M University System, Texas Agricultural Experiment Station, College Station.

Hallmark, C.T., and D.P. Franzmeier
1999 Alfisols. In M.E. Sumner (ed.), *Handbook of Soil Science*, CRC Press, Boca Raton, FL.

Hester, T. R.
1995 The Prehistory of South Texas. *Bulletin of the Texas Archaeological Society* 66(1): 427-459.

Historicaerials.com
2023 Aerial Photography and USGS Topographic Map Imagery. https://www.historicaerials.com/viewer, accessed October 2023.

Huebner, J.A.
1991 Late Prehistoric Bison Populations in Central and Southern Texas. *Plains Anthropologist* 36:343-358.

Johnson, L.
1994 *The Life and Times of Toyah-Culture Folk: The Buckhollow Encampment, Site 41KM16, Kimble County, Texas*. Office of State Archeologist Report 38. Texas Department of Transportation and Texas Historical Commission, Austin.

Karnes County Appraisal District (KCAD)
2023 Property Search. Karnes County (karnescad.org)

Long, C.
2023 "Karnes County," Handbook of Texas Online. https://www.tshaonline.org/handbook/entries/karnes-county, accessed October 16, 2023.

Natural Resources Conservation Service (NRCS)
2023 *Web Soil Survey*. Electronic database, http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, accessed July 20, 2023.

Prewitt, E. R.
1981 Culture Chronology in Central Texas. *Bulletin of the Texas Archaeological Society* 56(1): 65-89.

Soil Survey Staff
2010 *Keys to Soil Taxonomy*. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. Washington D.C.

Taylor, A.J., and C.L. Highley
1995 *Archeological Investigations at the Loma Sandia Site (41LK28): A Prehistoric Cemetery and Campsite in Live Oak County, Texas*. Studies in Archeology 20. Texas Archeological Research Laboratory, The University of Texas at Austin.

Texas Archeological Sites Atlas (TASA)
2023 Electronic database, https://atlas.thc.state.tx.us/Map, accessed July 20, 2023.

Texas Department of Transportation (TxDOT)
2023 Historic Resources Aggregator. https://txdot.maps.arcgis.com/apps/webappviewer/index.html?id=07710498767248 7b9b320cc424d588a2, accessed October 2023.

Texas Historic Sites Atlas (THSA)
2023 Electronic document, http://atlas.thc.state.tx.us/, accessed October 2023.

Thoms, A.V., and R. D. Mandel
1992 The Richard Beene Site: A deeply stratified Paleoindian to Late Prehistoric Occupation in South Central Texas. *Current Research in the Pleistocene* 9:42-44.

Thoms, A.V., and R.D. Mandel (editors)
2007 *Archaeological and Paleoecological Investigations at the Richard Beene Site, South-Central Texas.* Report of Investigations 8, Center for Ecological Archaeology, Texas A&M University, College Station.

Turner, E. S. and T. R. Hester
1993 *A Field Guide to Stone Artifacts of Texas Indians*. 2nd ed. Gulf Publishing, Houston.

URS Corporation, Inc.
2014 *Dam Assessment Report*. Escondido Creek Watershed Floodwater Retarding Structure No. 4, Karnes County, Texas.

APPENDIX A – SHOVEL TEST LOG

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
1	0-19 19-31	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
2	0-15	10YR 6/2	Light brownish gray	Silty clay	<1% calcium carbonate	Terminated at compaction
3	0-16 16-26	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
4	0-35 35-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
5	0-12	10YR 6/2	Light brownish gray	Silty clay	<1% calcium carbonate	Terminated at compaction
6	0-24 24-34	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
7	0-29 29-41	10YR 3/2 10YR 3/2	Very dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
8	0-39	10YR 3/2	Very dark grayish brown	Clay loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	39-49	10YR 3/2	Very dark grayish brown	Clay	<2% calcium carbonate	
9	0-30 30-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
10	0-40 40-55	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sand Sandy clay	- <1% Caliche	Terminated at Subsoil
11	0-15 15-25	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
12	0-20 20-30	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
13	0-31 31-39	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
14	0-24 24-30	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Silty clay Clay	- <2% calcium carbonate	Dry/ Compacted
15	0-10	10YR 4/3	Brown	Silt loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	10-27 27-50	10YR 3/2 10YR 3/1	Very dark grayish brown Very dark gray	Clay loam Clay loam	<2% calcium carbonate	
16	0-28 28-38	10YR 3/1 10YR 2/1	Very dark gray Black	Sandy clay clay	- <1% calcium carbonate	Terminated at subsoil
17	0-50 50-55	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
18	0-10 10-20	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <1% Caliche	Terminated at Subsoil
19	0-10	10YR 6/3	Pale Brown	Sandy Loam	<5% Caliche	Terminated at Subsoil
20	0-20 20-30	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
21	0-38 38-47	10YR 3/2 10YR 3/1	Very dark grayish brown Very dark gray	Sandy clay loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
22	0-18 18-28	10YR 3/2 10YR 3/1	Very dark grayish brown Very dark gray	Sandy clay loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
23	0-30 30-45	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Silty clay Clay	- <2% calcium carbonate	Dry/ Compacted
24	0-10 10-23	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy loam Sandy clay loam	- <2% calcium carbonate	Terminated at subsoil
25	0-33 33-46	10YR 4/2 10YR 4/1	Dark grayish brown Dark gray	Sandy loam Sandy clay	- <2% calcium carbonate	Terminated at subsoil
26	0-30 30-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
27	0-20 20-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <1% Caliche	Terminated at Subsoil
28	0-30 30-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <1% Caliche	Terminated at Subsoil
29	0-12 12-25	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
30	0-12 12-25	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
31	0-31 31-41	10YR 3/2 10YR 5/2	Very dark grayish brown Grayish brown	Sandy clay loam Sandy loam	- <% calcium carbonate	Terminated at subsoil
32	0-10 10-20	10YR 4/1 10YR 4/1	Dark gray Dark gray	Silty clay Silty clay	- <2% calcium carbonate	Dry/ Compacted
33	0-16 16-32	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
34	0-12 12-30	10YR 6/3 10YR 4/2	Pale brown Dark grayish brown	Sandy clay Clay	- <2% Caliche	Terminated at Subsoil
35	0-19 19-39	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay Clay	- <2% calcium carbonate	Terminated at subsoil
36	0-30 30-45	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay loam Sandy loam	- <2% calcium carbonate	Terminated at subsoil
37	0-25	10YR 4/2	Dark grayish brown	Silty clay	-	Terminated at Subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	25-35	10YR 4/2	Dark grayish brown	Silty clay	<2% Caliche	
38	0-15 15-25	10YR 2/2 10YR 2/2	Very dark brown Very dark brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
39	0-10 10-20	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <1% calcium carbonate	Very disturbed near man made levee / Terminated at subsoil
40	0-22 22-32	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
41	0-15	10YR 6/2	Light brownish gray	Silty clay	<1% Caliche	V. Disturbed / Terminated at compaction
42	0-5	10YR 5/2	Grayish brown	Sandy clay loam	<80% Gravel	Terminated due to gravelly soils
43	0-18	10YR 6/3	Pale brown	Sandy loam	<2% Caliche	Terminated at compaction
44	0-25 25-35	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Sandy clay loam Sandy clay	- <2% calcium carbonate	Terminated at subsoil
45	0-24	10YR 3/2	Very dark grayish brown	Clay loam	-	Terminated at compaction

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
46	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
47	0-10 10-20	10YR 2/2 10YR 2/2	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
48	0-12 12-20	7.5YR 2.5/1 10YR 2/2	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Very Disturbed / Terminated at subsoil
49	0-21 21-30	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay loam Sandy clay	-	Terminated at subsoil
50	0-15	10YR 6/3	Pale brown	Sandy loam	<2% Caliche	Terminated at compaction
51	0-14 14-34	10YR 3/2 10YR 3/2	Very dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
52	0-12 12-22	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <5% calcium carbonate	Very compact / Terminated at subsoil
53	0-8	10YR 2/2	Black	Sandy Clay	<2% Caliche	Terminated at compaction

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
54	0-26 26-38	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay loam Sandy clay loam	- <2% calcium carbonate	Terminated at subsoil
55	0-25 25-35	10YR 4/2 10YR 5/4 m/w 10YR 4/2	Dark grayish brown Yellowish brown & Dark grayish brown	Sandy clay loam Sandy clay loam	-	Terminated at subsoil
56	0-14 14-24	10YR 3/2 10YR 3/2	Very dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
57	0-12 12-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <4% calcium carbonate	Very compact / Terminated at subsoil
58	0-9 9-40	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay Sandy clay loam	- <3% calcium carbonate	Terminated at subsoil
59	0-13 13-26	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay loam Sandy clay loam	- <2% calcium carbonate	Terminated at subsoil
60	0-22 22-32	10YR 4/2 10YR 5/4 m/w 10YR 4/2	Dark grayish brown Yellowish brown & Dark grayish brown	Sandy clay loam Sandy clay loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
61	0-8 8-20	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy loam Sandy clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
62	0-5 5-15	10YR 6/3 10YR 5/2	Pale brown Grayish brown	Silty clay Silty clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
63	0-9 9-33	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay Sandy clay loam	- <3% calcium carbonate	Terminated at subsoil
64	0-8 8-28	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
65	0-20 20-30	10YR 6/2 10YR 3/2	Light brownish gray Very dark grayish brown	Sandy clay loam Sandy clay	- <3% Caliche	Terminated at Subsoil
66	0-8 8-22	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy loam Sandy clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
67	0-8 8-24	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy loam Sandy clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
68	0-14	10YR 4/2	Very dark gray	Clay loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	14-29	10YR 4/1	Dark gray	Sandy clay	<5% calcium carbonate	
69	0-15 15-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
70	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
71	0-5 5-15	10YR 4/2 10YR 4/2	Very dark gray Very dark gray	Sandy Clay loam Sandy clay	- <5% calcium carbonate	Terminated at subsoil
72	0-8	10YR 6/2	Light brownish gray	Sandy clay	<2% calcium carbonate	Terminated at subsoil
73	0-12 12-33	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
74	0-20 20-30	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
75	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
76	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
77	0-26 26-39	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy clay loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
78	0-8 8-30	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay loam	- <2% calcium carbonate	Terminated at subsoil
79	0-4 4-30	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
80	0-12 12-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
81	0-15 15-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
82	0-29 29-39	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil

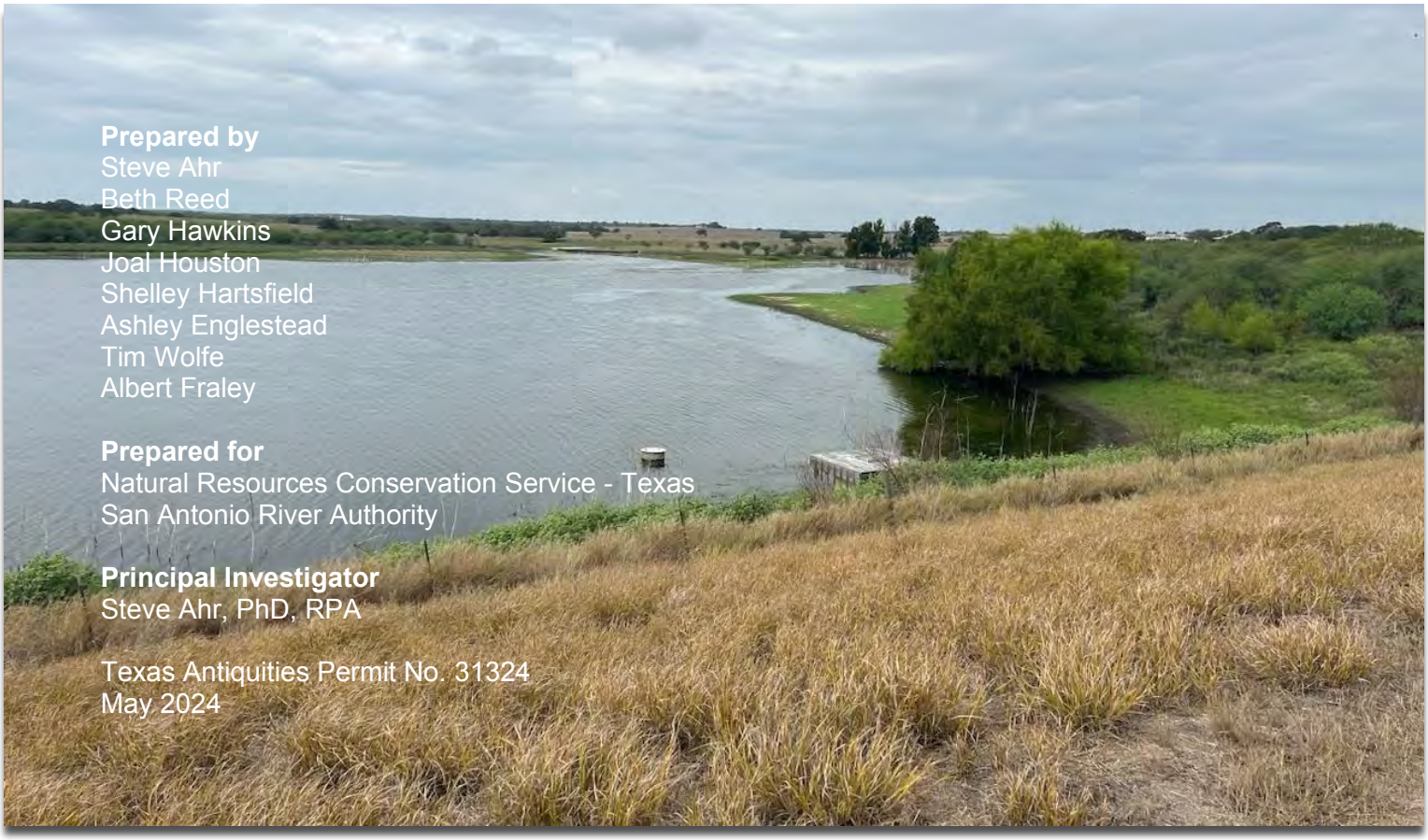
ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
83	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
84	0-24 24-34	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil
85	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
86	0-25 25-35	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
87	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
88	0-19 19-31	10YR 4/3 10YR 5/4	Brown Yellowish brown	Sandy clay loam Sandy clay	- <5% calcium carbonate	Terminated at subsoil
89	0-22 22-39	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
90	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
91	0-9 9-29	10YR 4/3 10YR 5/4	Brown Yellowish brown	Sandy clay loam Sandy clay	- <5% calcium carbonate	Terminated at subsoil
92	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
93	0-9 9-18	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Clay loam	- <5% calcium carbonate	Terminated at subsoil
94	0-25 25-37	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
95	0-3 3-23	10YR 3/2 10YR 4/2	Very dark grayish brown Dark grayish brown	Clay loam Clay	- <3% calcium carbonate	Terminated at subsoil
96	0-26 26-38	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
97	0-10 10-20	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
98	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
99	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
100	0-8 8-29	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil

AECOM

Cultural Resources Survey for the Rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 4, Karnes County, Texas



Prepared by
Steve Ahr
Beth Reed
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Prepared for
Natural Resources Conservation Service - Texas
San Antonio River Authority

Principal Investigator
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Texas Antiquities Permit No. 31324
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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. 4 (FRS 4), 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. 31324.

The direct Area of Potential Effects (APE) for cultural resources consists of an alternatives evaluation area of 278 acres, which was surveyed through pedestrian walkover supplemented with the excavation of 100 shovel tests. No archeological sites were identified during the survey. However, the field survey identified and evaluated three aboveground historic-age resource sites (Sites 001-003) within the indirect APE. Based on background review and field investigations, Sites 001, 002, and 003 are recommended as Not Eligible for listing in the National Register of Historic Places (NRHP) or for designation as State Antiquities Landmarks (SALs).

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. 4 (FRS 4), located in Karnes County, Texas (**Figure 1**). AECOM Technical Services, Inc. (AECOM) conducted a cultural resources survey in support of a Supplemental Watershed Plan (SWP) for the rehabilitation of FRS 4.

FRS 4 was constructed in 1956 as a low hazard dam on Doe Branch, a tributary to Escondido Creek, approximately 3.2 miles west of Kenedy, Texas. The National Inventory of Dams Identification Number is TX02035 (URS Corporation 2014). The dam is a filled earthen embankment that is 2,900 feet (ft) long with a maximum height of 29 ft. The detention pool is 250.7 acres. The principal spillway is a 36x36-inch drop inlet with 144 ft of 28-inch diameter, reinforced concrete pipe and 40 ft of 30-inch diameter corrugated steel metal pipe. The auxiliary spillway is a vegetated earthen channel 500 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 structural rehabilitation of FRS 4 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 future rehabilitation modifications would take place within a 278-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 maximum pool 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. The project depth of most impacts would be limited to the upper 1 meter (m) of deposits; potential borrow areas on the upland margins could potentially 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.

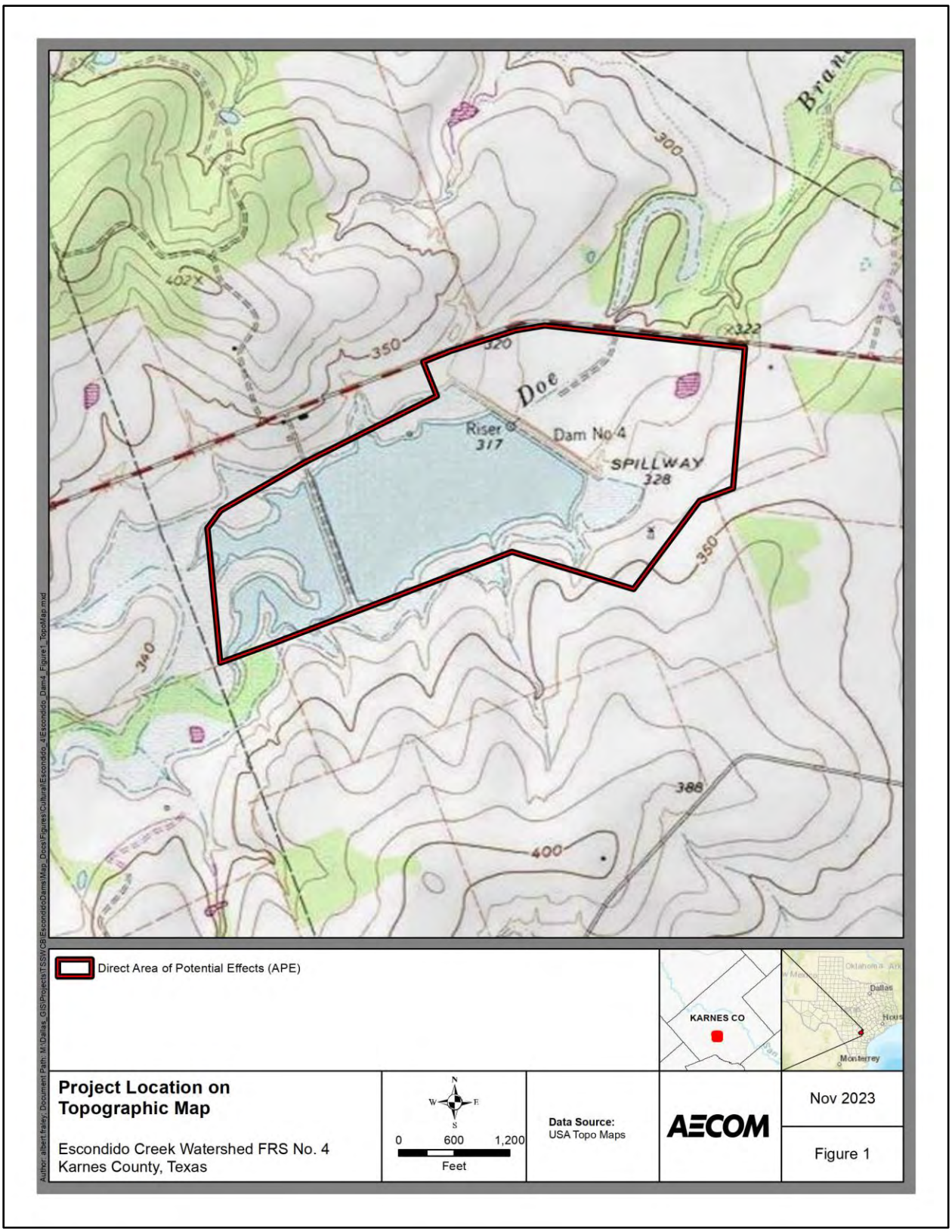


Figure 1. Escondido FRS 4 Project Location

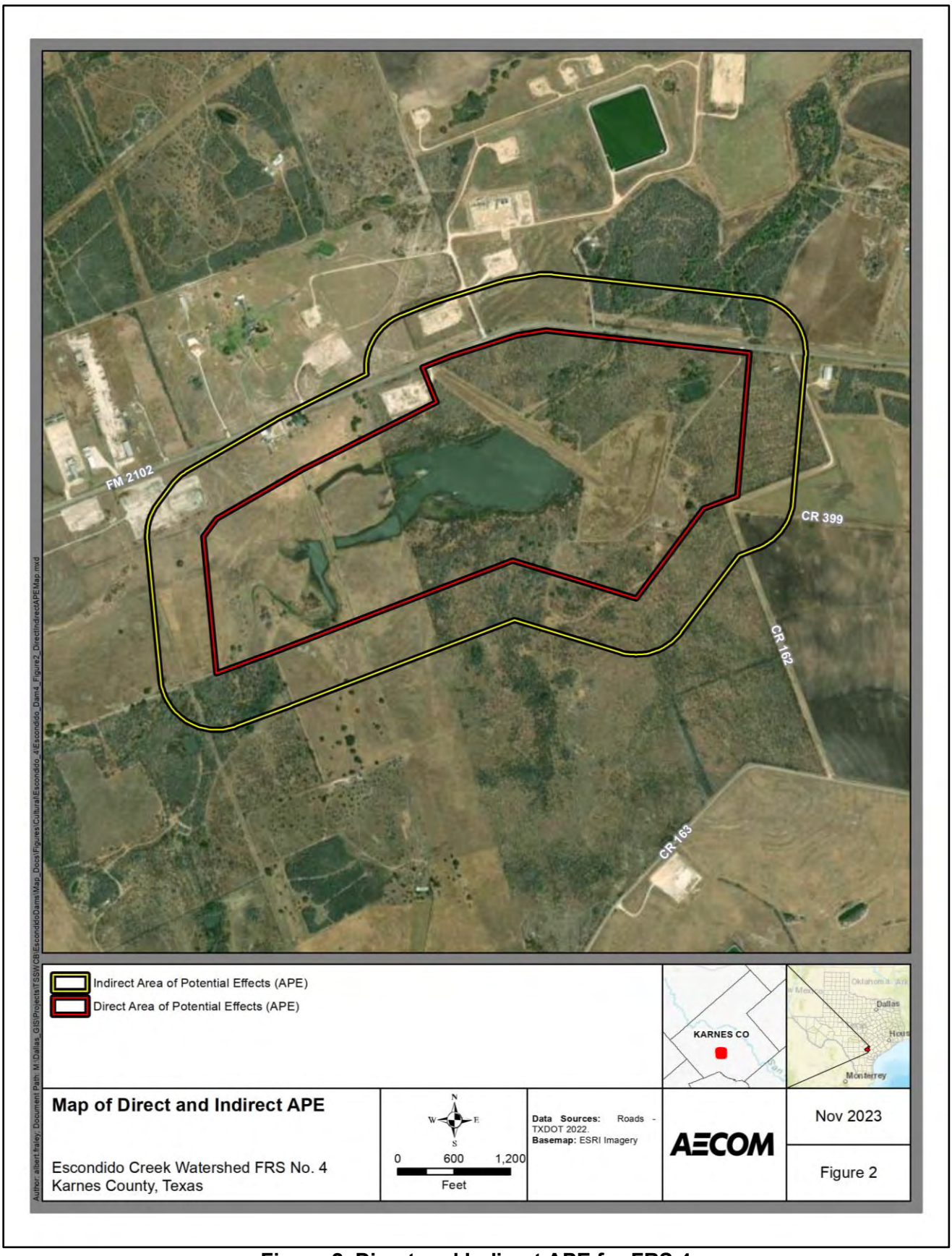


Figure 2. Direct and Indirect APE for FRS 4

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 September 29 – October 2, 2023, under Texas Antiquities Permit No. 31324, requiring approximately 110 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 project area 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 350 ft above mean sea level (amsl) within the upland margins, to approximately 310 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). Inset within this formation are Holocene alluvial deposits associated with Doe Creek (BEG 1987).

2.4 Soils

Ten soil mapping units are present within the APE (**Table 1; Figure 3**). Approximately 69 percent of the soils in the APE are described as having formed on floodplains and terraces, while 9 percent formed in residuum on upland hillslopes (NRCS 2023). The remaining 22 percent of the APE is classified as water or earthen spoil material.

Table 1. Soils within the APE

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Typical Pedon	Parent Material
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	20.5	Very deep, very slowly permeable, moderately well drained soils on nearly level floodplains	Ap-A-Bss1-Bss2-Bkss1-Bkss2	Recent (Holocene) Alluvium
Bw	Buchel clay, 0 to 1 percent slopes, ferequently flooded	4.9	Very deep, very slowly permeable, moderately well drained soils on nearly level floodplains	Ap-A-Bss1-Bss2-Bkss1-Bkss2	Recent (Holocene) Alluvium
CaA	Clareville clay loam, 0 to 1 percent slopes	12.6	Very deep, well drained soils on base slope on draws and drainageways	Ap-A-Bt1-Bt2-Btk-Bk1-Bk2-BCk	Recent (Holocene) Alluvium

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Typical Pedon	Parent Material
MoA	Monteola clay, 0 to 1 percent slopes	2.8	Very deep, well drained, very slowly permeable soils on hillslopes	Ap-A-Bss-Bkssy1-Bkssy2-BCkyz	Residuum
MoB	Monteola clay, 1 to 3 percent slopes	2.3	Very deep, well drained, very slowly permeable soils on hillslopes	Ap-A-Bss-Bkssy1-Bkssy2-BCkyz	Residuum
PbB	Papalote fine sandy loam, 1 to 3 percent slopes	9.9	Very deep, moderately well drained soils on high terraces	A-Bt1-Bt2-Bt3-Btk-BCk	Pliocene-Pleistocene Alluvium
PbC	Papalote fine sandy loam, 3 to 5 percent slopes	2.8	Very deep, moderately well drained soils on high terraces	A-Bt1-Bt2-Bt3-Btk-BCk	Pliocene-Pleistocene Alluvium
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	18.3	Very deep, well drained, moderately permeable soils on summits, backslopes, and footslopes of ridges	A-Bt1-Bt2-Bk1-Bk2	Ancient Alluvium
ShC	Schattel clay loam, 2 to 5 percent slopes	3.8	Deep, well drained soils on hillslopes	A-Bw-Bk-Bkyz-Cdkyz	Residuum
Us	Ustarents, loamy	10.0	Mine spoil, earth fill	N/A	Mine spoil
W	Water	12.1	N/A	N/A	N/A

Source: (NRCS 2023)

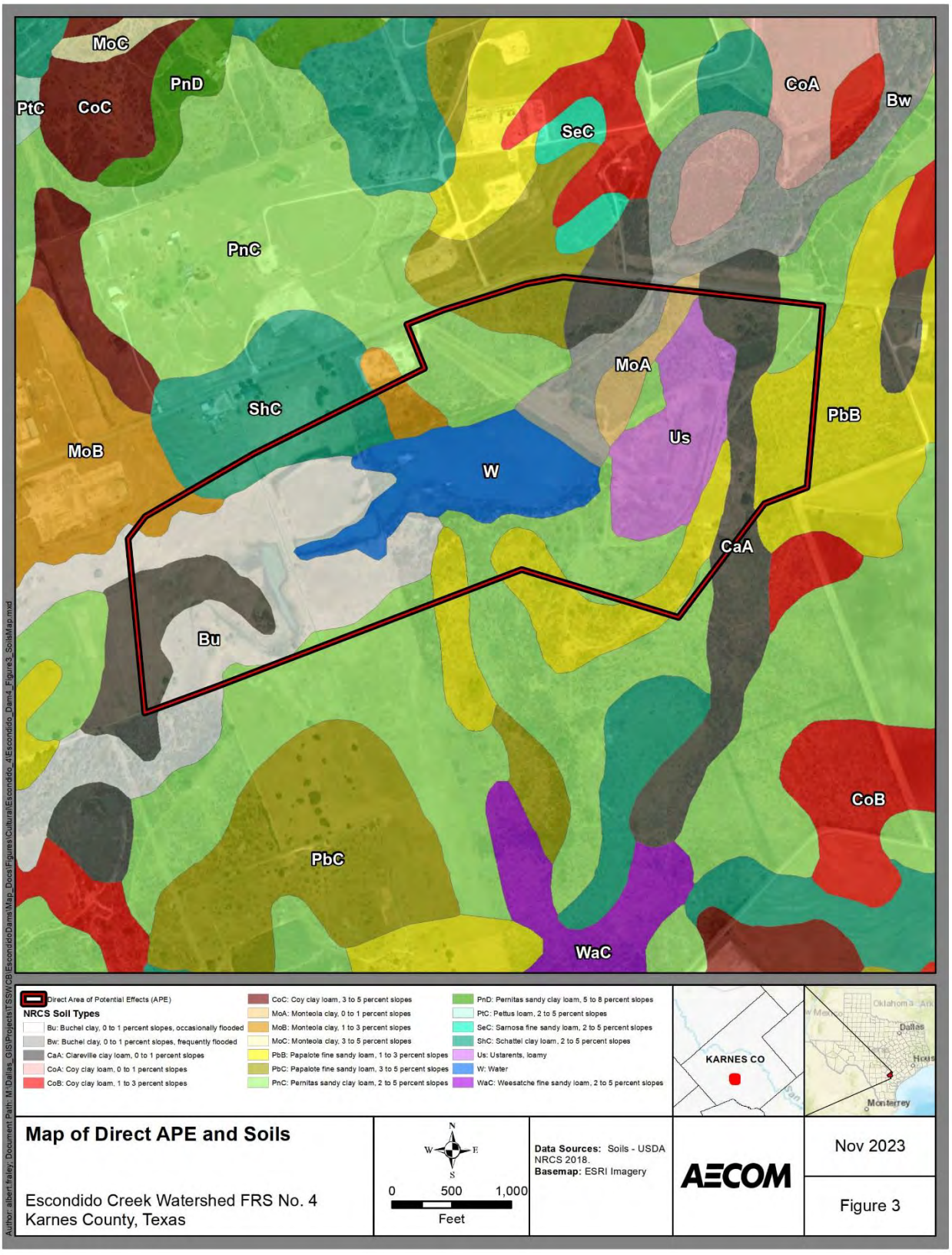


Figure 3. Project Soils

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 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 clans. 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 following 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 farmer 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. 31324 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 (NHLs), State Antiquities Landmarks (SALs), Recorded Texas Historic Landmarks (RTHLs), and Official Texas Historical Markers (OTHMs) 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. Artifact scatters were delineated as sites through shovel testing and field observations, as outlined in CTA's *Intensive Terrestrial Survey Guidelines*.

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 Toolkit 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, and 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, channelization, and berms (**Figures 5-9**).

A total of 100 shovel tests were excavated within the direct APE and revealed shallow (average of 30 centimeters below surface) light brownish gray and dark grayish brown sandy and silty clay loam soils overlying a compacted sandy clay subsoil/argillic 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. 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.

Three aboveground historic-age resource sites (Sites 001 - 003) were identified in the indirect APE and evaluated by an architectural historian during the survey (**Figure 11**). Each is discussed in the following sections.



Figure 4. Overview of APE, facing northwest



Figure 5. Berm disturbances below dam



Figure 6. Drainage outlet, berms, impact basin, and straightened outlet channel



Figure 7. Top of dam embankment



Figure 8. Auxiliary spillway



Figure 9. Dam inlet structure and reservoir area

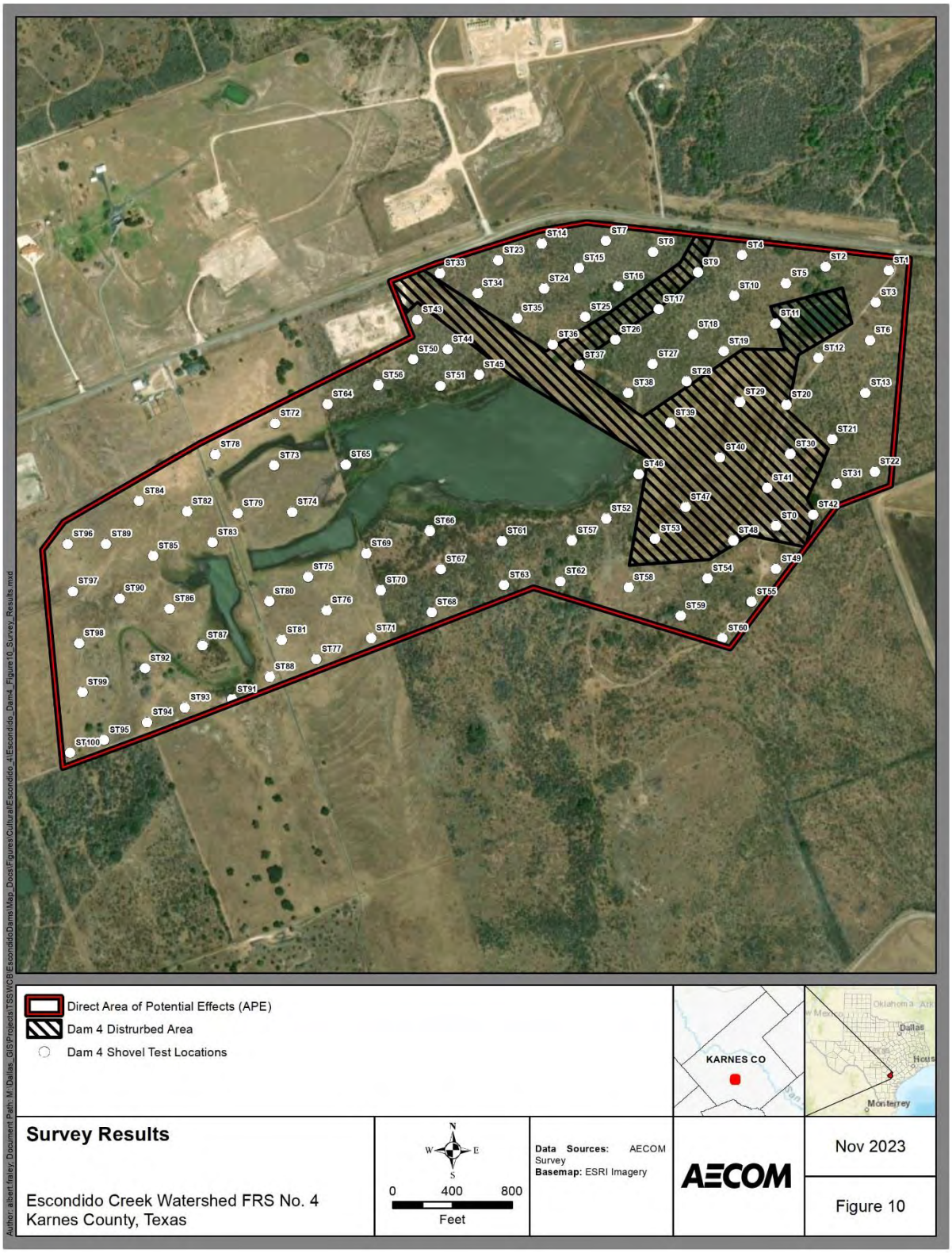


Figure 10. Map showing shovel test locations

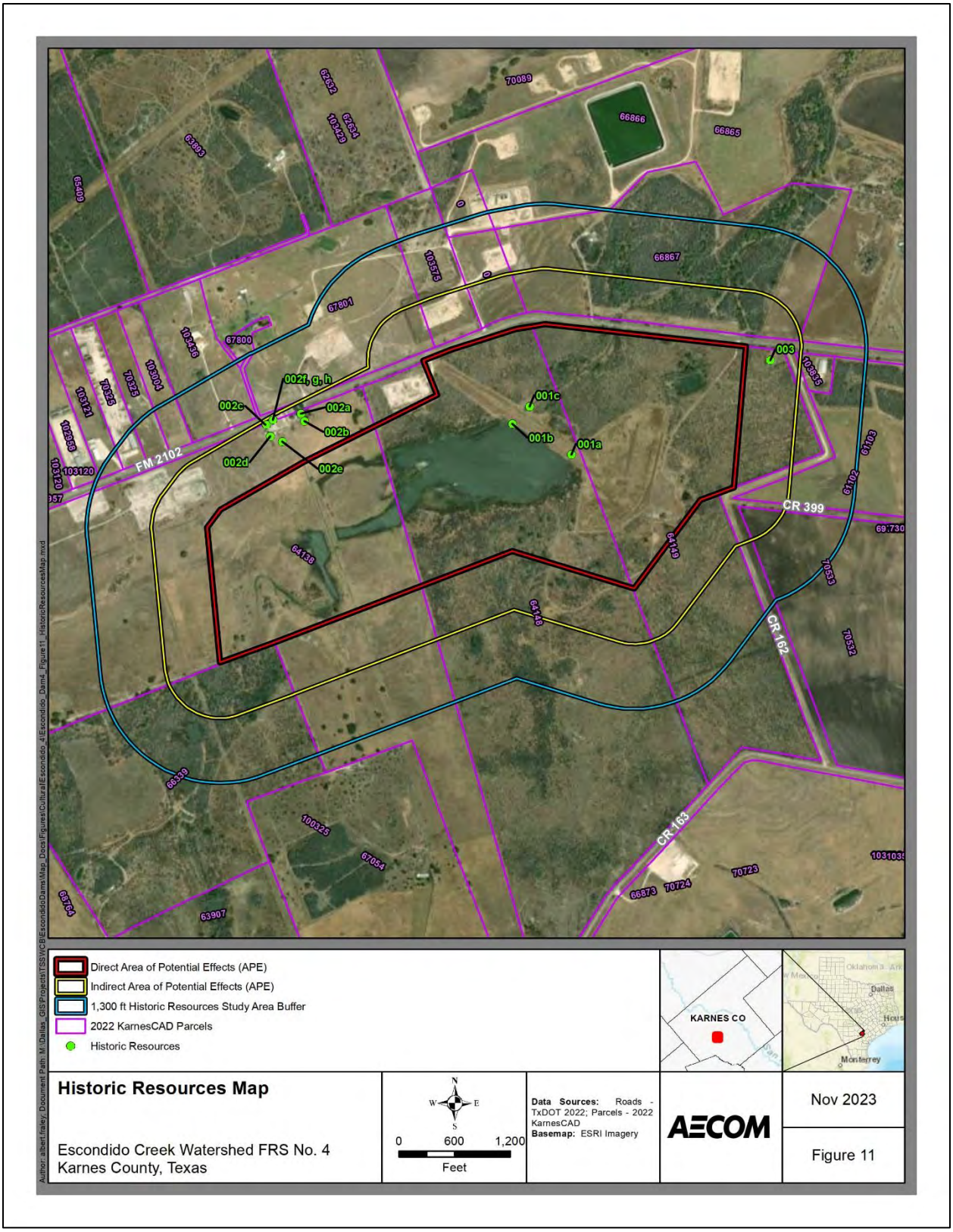


Figure 11. Historic Resource Sites identified during the survey

Site 001

Site 001 consists of the Escondido Creek Watershed FRS No. 4, located on Doe Branch. The site consists of three historic-age resources: Resource 001a - an earthen dam structure, Resource 001b - the principal spillway inlet structure, and Resource 001c - the principal spillway outlet drainage pipe and basin (**Figure 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 TX02035 and records a 1956 construction date for Resources 001a-c. A review of historic aerial photography shows that Resources 001a-c are not visible in a 1955 photograph but are visible in a 1981 photograph and therefore, the 1956 construction date is considered accurate.

Research indicates that Site 001 is situated on two original land grants. One grant of 1,920 acres was bestowed to B.H. Duvall as Abstract 97, in File 149 of the Texas General Land Office records. The land was patented by Duvall's heirs on April 15, 1858, under Patent No. 66, Patent Volume 9, Certificate 10075. The second grant of 2,969 acres was bestowed to Isaac Ticknor as Abstract 278, in File 247, of the Texas General Land Office records. The land was patented by Duvall's heirs on September 1, 1855, under Patent No. 244, Patent Volume 12, Certificate 17.

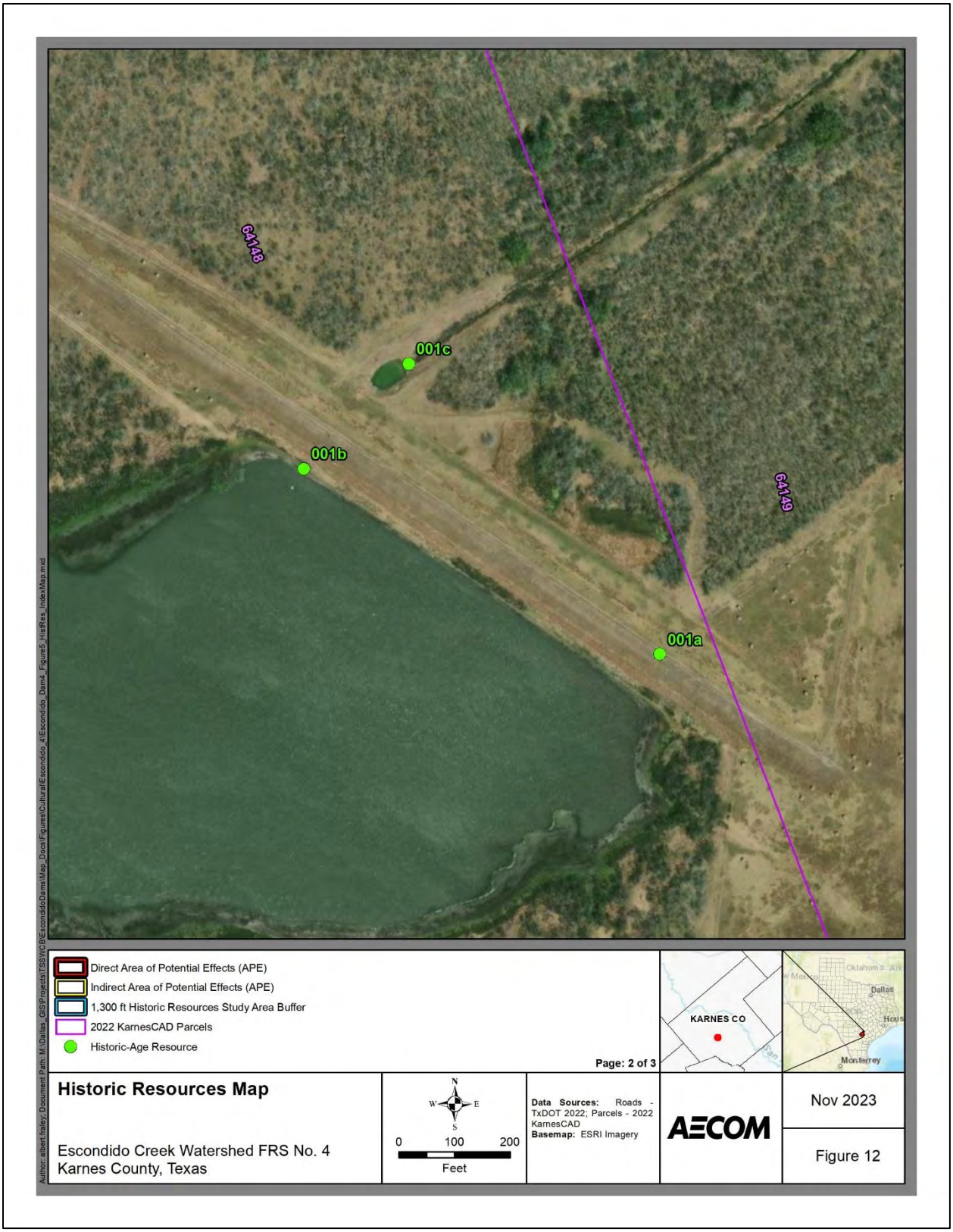


Figure 12. Historic Resources Site 001 location map

Resource 001a

Resource 001a consists of an earthen-filled embankment dam designed for flood control. The resource is grass-covered and measures 2,900 ft in length (**Figure 13**). 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

Resource 001b

Resource 001b is a Principal Spillway Inlet Riser and functions to convey water so that outflow from the reservoir can be regulated. Resource 001b is constructed of concrete and rises from the base of the reservoir on the southwest side of the embankment (**Figure 14**). The structure exhibits a concrete base with a square cap constructed of wooden boards.

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, looking northwest

Resource 001c

Resource 001c is a Principal Spillway Outlet drainage structure (**Figure 15**). The structure is 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, looking east

Site 001 appears 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, Site 001 is recommended Not Eligible for listing in the NRHP.

Site 002

Site 002 consists of a farmstead situated on approximately 473.94 acres. The site contains eight historic-age resources (Resources 002a-h) consisting of a residence and seven agricultural outbuildings and structures (**Figures 16-17**). The land is used as rangeland for livestock and cattle, observed on the property during the survey.

Site 002 is situated on an original land grant containing 1,920 acres bestowed to B.H. Duvall as Abstract 97, in File 149 of the Texas General Land Office records. The land was patented by Duvall's heirs on April 15, 1858, under Patent No. 66, Patent Volume 9, Certificate 10075.

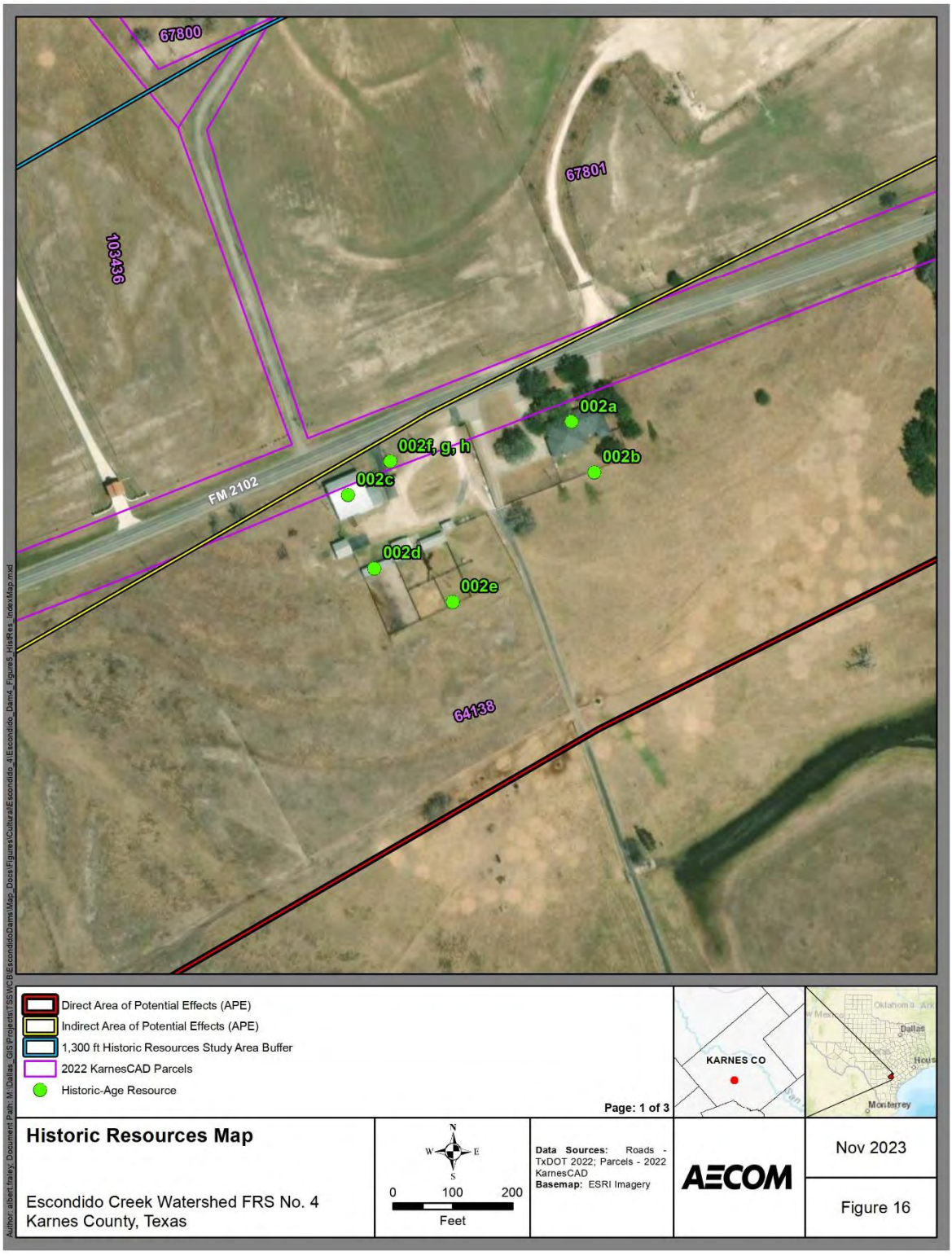


Figure 16. Historic Resources Site 002 location map



Figure 17. Aerial view of Site 002 and Resources 002a-h

Resource 002a

Resource 002a consists of a one-story, single-family residence with an irregular plan and Ranch stylistic influence (**Figure 18**). The house exhibits a complex multi-hipped roof with a shallow pitch and seamed metal cladding. Exterior walls are constructed of variegated light red brick. The house is surrounded by mature trees that obscured visibility of the east and south elevations.

The façade faces north, and a primary entry consisting of a single entry is located near the center of the façade. A portion of the east side of the house is recessed and contains the entry. The eave above the entry extends to create a partial-width ground-level open porch with one square support. A three-part aluminum-frame picture window is displayed to the west of the entry. The window exhibits a single fixed center pane flanked by 2/2 sash units. The façade also exhibits four small 1/1 aluminum sash units set high under the eave. An attached pair of aluminum 2/2 sash units are displayed at the east end of the façade. All visible window units exhibit decorative window shutters. The west elevation exhibits a secondary entry and a two-car integrated garage.

Karnes County Appraisal District (KCAD) does not record a date of construction for this resource. The house is not visible on a 1955 aerial photograph but is recorded on a 1963 topographic map and a 1981 aerial photograph. Therefore, the estimated date of construction for Resource 002a is ca. 1960.

Resource 002a retains integrity of location. Integrity of design, materials and workmanship appear to be original with the possible exception of replacement entry and garage doors. The resource retains integrity of setting, feeling and association. However, the resource is a common example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002a is recommended Not Eligible for the NRHP.



Figure 18. View of Resource 002a, looking southeast

Resource 002b

Resource 002b is a structure consisting of a wall constructed of light red brick (**Figure 19**). It is associated with the nearby residence, Resource 002a, and surrounds the house on the east, west, and south sides. The structure includes multiple solid brick panels separated by brick columns.

KCAD does not record a date of construction for this resource. The house is not visible on a 1955 aerial photograph but is recorded on a 1963 topographic map and a 1981 aerial photograph. Therefore, the estimated date of construction for Resource 002a is ca. 1960. Resource 002b retains integrity of location, design, materials, setting, feeling and association. However, the resource is a common example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002b is recommended Not Eligible for the NRHP.



Figure 19. View of Resource 002b, looking southeast (Google Imagery, July 2023)

Resource 002c

Resource 002c consists of a one-story, agricultural building with an irregular plan and no stylistic influence (**Figures 20-22**). The resource exhibits a section with an end-gabled roof and a portion with a shed roof extending from the south elevation. The roof exhibits metal cladding and exterior walls are constructed of corrugated metal sheathing. The building is in use as a barn.

A primary single entry located in the center of the east elevation and contains a pair of full-height side-hinged doors clad with corrugated metal. A smaller end-gabled section extends from the east elevation and exhibits painted concrete block construction, and a metal roof with gable ends.

KCAD records a 1970 date of construction for this resource. The resource is not visible on a 1955 aerial photograph but is visible on a 1981 photograph. Based on the design, materials, and workmanship of the building, the 1970 KCAD is considered accurate.

Resource 002c retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002c is recommended Not Eligible for the NRHP.



Figure 20. View of Resource 002c, looking southwest (Google Imagery July 2023)



Figure 21. View of Resource 002c, looking southeast (Google Imagery July 2023)



Figure 22. View of Resource 002c, with doors open, looking south

Resource 002d

Resource 002d consists of a one-story, agricultural building with a rectangular plan and no stylistic influence (**Figure 23**). The resource exhibits a shed roof clad with metal sheathing and exterior walls are clad with corrugated metal sheathing. The building appears to be in use as a barn.

A single entry is located on the northeast side of the northeast elevation and contains a standard, solid side-hinged door. KCAD records a 1970 date of construction for this resource. It is not visible on the 1955 aerial photograph but is visible on the 1981 photograph. Therefore, the KCAD date is considered accurate.

Resource 002d retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002d is recommended Not Eligible for the NRHP.



Figure 23. View of Resources 002d, looking southwest (Google Imagery July 2023)

Resource 002e

Resource 002e is a structure consisting of an animal corral. The resource exhibits a square plan constructed of metal piping and is divided into multiple pens. The resource is situated behind a barn (Resource 002d) and is used to corral the livestock on the property. The resource was obstructed so it was unable to be photographed from the public ROW.

KCAD does not record a date of construction for this resource. The structure is not visible in a 1955 aerial photograph but is visible in a 1981 photograph. Because it is associated with Resources 002c-d, an estimated construction date for the resource is ca. 1970.

Resource 002e retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002e is recommended Not Eligible for the NRHP.

Resource 002f

Resource 002f consists of a cylindrical concrete water tank with horizontal concrete ribbing (**Figures 24-25**). The tank has a concrete lid and is elevated on a thick concrete slab supported by multiple square concrete piers. This type of water tank is used to provide water to livestock and irrigate pastures.

KCAD does not record a date of construction for this resource, and the resource is not visible on a 1955 arial photograph. Resource 002f is recorded on a 1956 topographic map and the estimated construction date is ca. 1956.

Resource 002f retains integrity of location, design, materials, workmanship, setting, feeling and association. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002f is recommended Not Eligible for the NRHP.

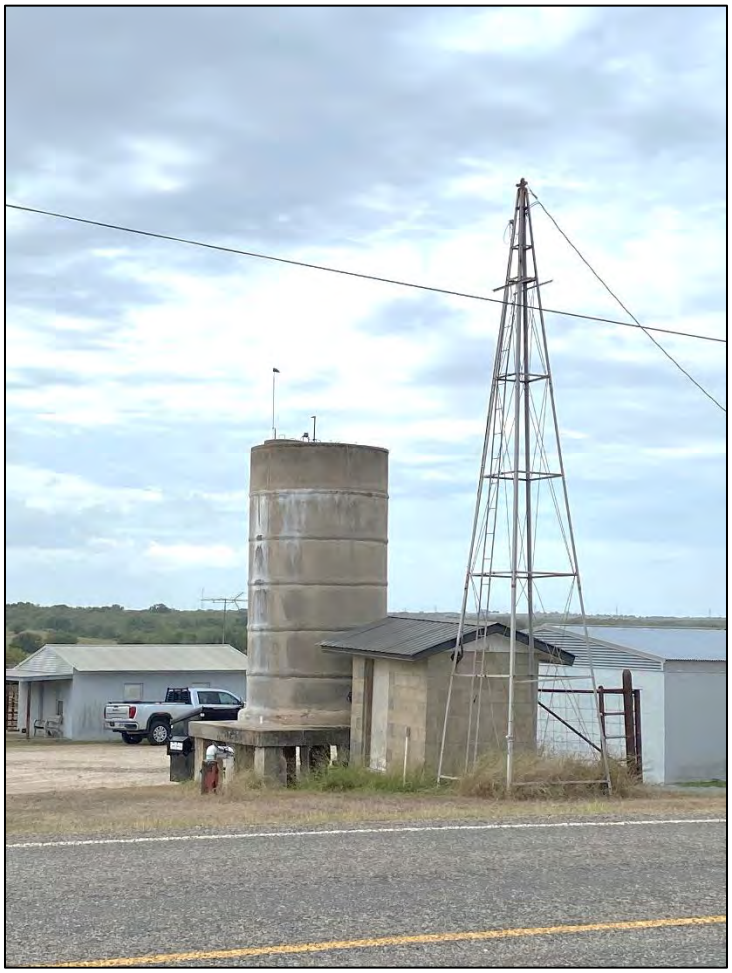


Figure 24. View of Resources 002f-h, looking southwest



Figure 25. View of Resource 002f, looking southwest (Google Imagery, July 2023)

Resource 002g

Resource 002g consists of a small, one-story, pump-house building with a rectangular plan and no stylistic influence (**Figure 26**). The resource exhibits an end-gabled roof with ribbed metal cladding. Exterior walls exhibit concrete block construction. The building is associated with the water tank (Resource 002f) and is attached by a pipe that extends from the south elevation. A single entry is located on the northeast elevation and contains a solid metal door.

KCAD does not record a date of construction for this resource. Because the structure is associated with Resources 002f and 002h, the estimated date of construction for this resource is ca. 1956.

Resource 002g retains integrity of location, design, materials, workmanship, setting, feeling and association although the roof cladding appears to be replacement. However, the resource is a common and utilitarian example of its type and does not display distinctive architectural or historical merit. Therefore, Resource 002g is recommended Not Eligible for the NRHP.



Figure 26. View of Resource 002g, looking southwest (Google Imagery, July 2023)

Resource 002h

Resource 002h consists of the metal framework of a windmill tower (**Figure 27**). The structure consists of four metal supports with X-bracing and tapers to the top. A metal ladder is attached to the east side. The structure is associated with the pump house and water tank (Resources 002f-g) and was once used in the conveyance of water from an underground well to the pump house and tank. A cable extends from the north elevation of the pumphouse and attaches to the windmill framing. The windmill is missing all functional elements of its type including a pump rod and piping, and the entire top portion consisting of a bladed rotor, gearbox, and tail. As a result, Resource 002e is no longer functional as a windmill.

KCAD does not record the date of construction of the windmill. The resource is not visible in a 1955 historic aerial but is visible in a 1981 photograph. Because the structure is associated with Resources 002f and 002g, the estimated date of construction for this resource is c 1956.

Resource 002h retains integrity of location, but lacks integrity of design, materials, workmanship, setting, feeling and association due to the missing elements and loss of function. As a result, the resource does not display distinctive architectural or historical merit. Therefore, Resource 002h is recommended Not Eligible for the NRHP.



Figure 27. View of Resource 002h looking southwest (Google Imagery, July 2023)

Site 002 appears to retain integrity of location, design, materials, workmanship, setting feeling and association for Resources 002a-g, and the site remains functioning as originally intended. Resource 002h retains integrity of location. However, the resources are typical of their type and do not represent distinctive architectural or engineering merit. Therefore, Site 002 is recommended Not Eligible for listing in the NRHP.

Site 003

Site 003 consists of one historic-age resource, Resource 003 (**Figure 28**). The resource consists of an open steel structure with a rectangular plan (**Figure 29**). The structure exhibits a shallow rounded metal roof frame covered by metal sheathing with eight metal supports. This shed structure is used as a shelter for hay bales.

The resource is situated on KCAD property parcel 64149 on the original Isaac Ticknor land grant (Abstract 278, in File 247). KCAD does not record a date of construction for the resource. It is not visible on a 1955 aerial photograph but is visible on a 1981 photograph. Based on this information an estimated date of construction for Resource 003 is ca. 1980.

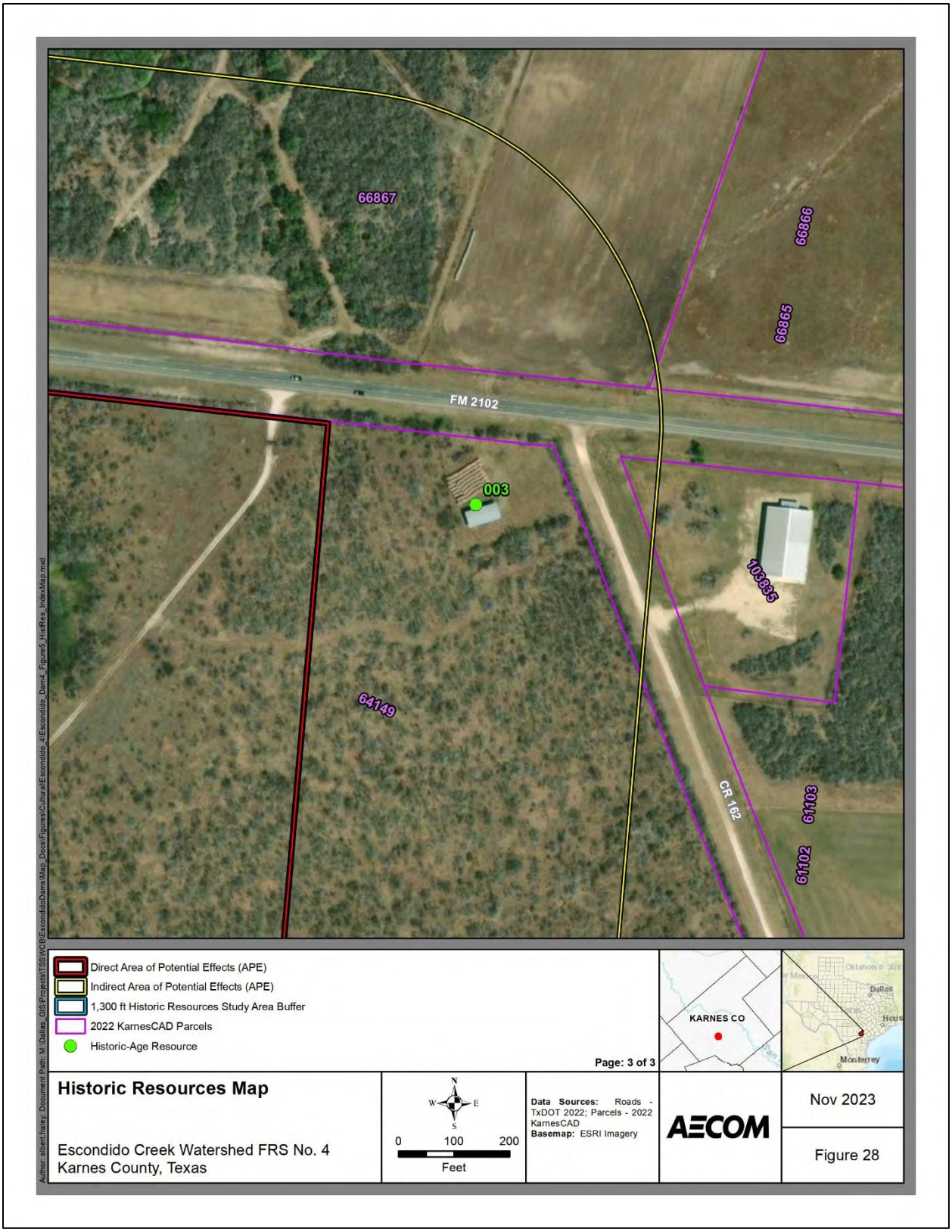


Figure 28. Historic Resources Site 003 location map



Figure 29. View of Resource 003, looking southwest (Google Imagery July 2023)

Site 003 appears to retain integrity of location, design, materials, workmanship, setting, feeling and association, and the site remains functioning as originally intended. However, the resource is a typical, utilitarian example of its type and does not represent distinctive architectural or engineering merit. Therefore, Site 003 is 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 the Monteola, Pernitas, and Schattel soil series. These soils are on uplands and hillslopes and flank the drainageway sideslopes; they formed in residuum weathered from Miocene-age sandstone, clay, and mud. Shovel tests within these soils revealed brown (10YR 4/2-4/3) and dark brown (10YR 3/3) sandy loam and sandy clay loam overlying a shallow compacted argillic horizon. These soils tend to be thin sandy to loam, frequently eroded to clay subsoil, and bioturbated. This was confirmed by numerous shovel tests throughout the APE, which encountered sandy clay Bt subsoil horizons at relatively shallow (<30 cm) depths.

The well-developed argillic subsurface horizons meet 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. Within the APE these shallow soils 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.

Also within the APE, Buchel and Clareville floodplain soils are described as recent, Holocene-age soils and are mapped below the dam drainage outlet channel and impact basin, and beneath the current reservoir area that was previously disturbed during dam construction. Papalote soils are found on the outer edges of the APE near the auxiliary spillway and formed in ancient Plio-Pleistocene alluvium. Shovel tests within these alluvial soils typically revealed calcareous and shallow (40 to 50 cm deep) dark gray (10YR 4/2) silty and sandy clay over compacted clay subsoil. These floodplain soils 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. Alluvial soils in the APE are relatively shallow (<1 m) and therefore fall within the range of shovel tests. Inspection of the stream channel below the dam further revealed disturbed sediment berms flanking the channel margin, which was clearly channelized (see **Figure 6**). These berms appear to consist of artificial levees made up of dredge spoil materials that were excavated during channel straightening.

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 Supplemental Watershed Plan for the rehabilitation of the Escondido Creek Watershed FRS 4, within a 278-acre APE, located in Karnes County Texas. The survey was performed under Texas Antiquities Permit No. 31324 and included a 100 percent pedestrian survey supplemented with 100 shovel tests.

No archeological sites were identified during the survey. However, three aboveground historic-age resource sites (Sites 001 – 003) were identified and evaluated by an architectural historian. Based on background review and field investigations, Sites 001, 002, and 003 are recommended as Not Eligible for listing in the NRHP or designation as SALs.

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.

7 References Cited

Bement, L.C.
1994 *Hunter-Gatherer Mortuary Practices During the Central Texas Archaic*. University of Texas Press, Austin.

Black, S.L.
1986 *The Clemente and Herminia Hinojosa Site, 41JW8: A Toyah Horizon Campsite in Southern Texas*. Special Report No. 18. Center for Archaeological Research, The University of Texas at San Antonio.

1989 South Texas Plains. In *From the Gulf of the Rio Grande: Human Adaptation in Central, South, and Lower Pecos Texas*, by Thomas R. Hester, Stephen L. Black, D. Gentry Steele, Ben W. Olive, Anne A. Fox, Karl J. Reinhard, and Leland C. Bement, pp. 39–62. Research Series No. 33. Arkansas Archeological Survey, Fayetteville.

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

Collins, M.B.
1995 Forty Years of Archeology in Central Texas. *Bulletin of the Texas Archeological Society* 66:361-400.

2002 The Gault Site, Texas, and Clovis Research. *Athena Review* 3(2).

2004 Archeology in Central Texas. In *The Prehistory of Texas*, edited by Timothy K. Perttula, pp. 101–126. Texas A&M University Press, College Station.

Creel, D.
1991 Bison Hides in Late Prehistoric Exchange in the Southern Plains. *American Antiquity* 56(1): 40-49.

Dillehay, T.D.
1974 Late Quaternary Bison Population Changes in the Southern Plains. *Plains Anthropologist* 19(1): 180-196.

Gould, F.W.
1975 Texas Plants: A Checklist and Ecological Summary. Texas A&M University System, Texas Agricultural Experiment Station, College Station.

Hallmark, C.T., and D.P. Franzmeier
1999 Alfisols. In M.E. Sumner (ed.), *Handbook of Soil Science*, CRC Press, Boca Raton, FL.

Hester, T. R.
1995 The Prehistory of South Texas. *Bulletin of the Texas Archaeological Society* 66(1): 427-459.

Historicaerials.com
2023 Aerial Photography and USGS Topographic Map Imagery. https://www.historicaerials.com/viewer, accessed October 2023.

Huebner, J.A.
1991 Late Prehistoric Bison Populations in Central and Southern Texas. *Plains Anthropologist* 36:343-358.

Johnson, L.
1994 *The Life and Times of Toyah-Culture Folk: The Buckhollow Encampment, Site 41KM16, Kimble County, Texas*. Office of State Archeologist Report 38. Texas Department of Transportation and Texas Historical Commission, Austin.

Karnes County Appraisal District (KCAD)
2023 Property Search. Karnes County (karnescad.org)

Long, C.
2023 "Karnes County," Handbook of Texas Online. https://www.tshaonline.org/handbook/entries/karnes-county, accessed October 16, 2023.

Natural Resources Conservation Service (NRCS)
2023 *Web Soil Survey*. Electronic database, http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, accessed July 20, 2023.

Prewitt, E. R.
1981 Culture Chronology in Central Texas. *Bulletin of the Texas Archaeological Society* 56(1): 65-89.

Soil Survey Staff
2010 *Keys to Soil Taxonomy*. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. Washington D.C.

Taylor, A.J., and C.L. Highley
1995 *Archeological Investigations at the Loma Sandia Site (41LK28): A Prehistoric Cemetery and Campsite in Live Oak County, Texas*. Studies in Archeology 20. Texas Archeological Research Laboratory, The University of Texas at Austin.

Texas Archeological Sites Atlas (TASA)
2023 Electronic database, https://atlas.thc.state.tx.us/Map, accessed July 20, 2023.

Texas Department of Transportation (TxDOT)
2023 Historic Resources Aggregator. https://txdot.maps.arcgis.com/apps/webappviewer/index.html?id=07710498767248 7b9b320cc424d588a2, accessed October 2023.

Texas Historic Sites Atlas (THSA)
2023 Electronic document, http://atlas.thc.state.tx.us/, accessed October 2023.

Thoms, A.V., and R. D. Mandel
1992 The Richard Beene Site: A deeply stratified Paleoindian to Late Prehistoric Occupation in South Central Texas. *Current Research in the Pleistocene* 9:42-44.

Thoms, A.V., and R.D. Mandel (editors)
2007 *Archaeological and Paleoecological Investigations at the Richard Beene Site, South-Central Texas.* Report of Investigations 8, Center for Ecological Archaeology, Texas A&M University, College Station.

Turner, E. S. and T. R. Hester
1993 *A Field Guide to Stone Artifacts of Texas Indians*. 2nd ed. Gulf Publishing, Houston.

URS Corporation, Inc.
2014 *Dam Assessment Report*. Escondido Creek Watershed Floodwater Retarding Structure No. 4, Karnes County, Texas.

APPENDIX A – SHOVEL TEST LOG

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
1	0-19 19-31	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
2	0-15	10YR 6/2	Light brownish gray	Silty clay	<1% calcium carbonate	Terminated at compaction
3	0-16 16-26	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
4	0-35 35-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
5	0-12	10YR 6/2	Light brownish gray	Silty clay	<1% calcium carbonate	Terminated at compaction
6	0-24 24-34	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
7	0-29 29-41	10YR 3/2 10YR 3/2	Very dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
8	0-39	10YR 3/2	Very dark grayish brown	Clay loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	39-49	10YR 3/2	Very dark grayish brown	Clay	<2% calcium carbonate	
9	0-30 30-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
10	0-40 40-55	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sand Sandy clay	- <1% Caliche	Terminated at Subsoil
11	0-15 15-25	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
12	0-20 20-30	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
13	0-31 31-39	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
14	0-24 24-30	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Silty clay Clay	- <2% calcium carbonate	Dry/ Compacted
15	0-10	10YR 4/3	Brown	Silt loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	10-27 27-50	10YR 3/2 10YR 3/1	Very dark grayish brown Very dark gray	Clay loam Clay loam	<2% calcium carbonate	
16	0-28 28-38	10YR 3/1 10YR 2/1	Very dark gray Black	Sandy clay clay	- <1% calcium carbonate	Terminated at subsoil
17	0-50 50-55	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
18	0-10 10-20	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <1% Caliche	Terminated at Subsoil
19	0-10	10YR 6/3	Pale Brown	Sandy Loam	<5% Caliche	Terminated at Subsoil
20	0-20 20-30	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
21	0-38 38-47	10YR 3/2 10YR 3/1	Very dark grayish brown Very dark gray	Sandy clay loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
22	0-18 18-28	10YR 3/2 10YR 3/1	Very dark grayish brown Very dark gray	Sandy clay loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
23	0-30 30-45	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Silty clay Clay	- <2% calcium carbonate	Dry/ Compacted
24	0-10 10-23	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy loam Sandy clay loam	- <2% calcium carbonate	Terminated at subsoil
25	0-33 33-46	10YR 4/2 10YR 4/1	Dark grayish brown Dark gray	Sandy loam Sandy clay	- <2% calcium carbonate	Terminated at subsoil
26	0-30 30-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
27	0-20 20-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <1% Caliche	Terminated at Subsoil
28	0-30 30-40	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Sandy clay	- <1% Caliche	Terminated at Subsoil
29	0-12 12-25	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
30	0-12 12-25	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
31	0-31 31-41	10YR 3/2 10YR 5/2	Very dark grayish brown Grayish brown	Sandy clay loam Sandy loam	- <% calcium carbonate	Terminated at subsoil
32	0-10 10-20	10YR 4/1 10YR 4/1	Dark gray Dark gray	Silty clay Silty clay	- <2% calcium carbonate	Dry/ Compacted
33	0-16 16-32	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
34	0-12 12-30	10YR 6/3 10YR 4/2	Pale brown Dark grayish brown	Sandy clay Clay	- <2% Caliche	Terminated at Subsoil
35	0-19 19-39	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay Clay	- <2% calcium carbonate	Terminated at subsoil
36	0-30 30-45	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay loam Sandy loam	- <2% calcium carbonate	Terminated at subsoil
37	0-25	10YR 4/2	Dark grayish brown	Silty clay	-	Terminated at Subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	25-35	10YR 4/2	Dark grayish brown	Silty clay	<2% Caliche	
38	0-15 15-25	10YR 2/2 10YR 2/2	Very dark brown Very dark brown	Silty clay Silty clay	- <2% Caliche	Terminated at Subsoil
39	0-10 10-20	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay Silty clay	- <1% calcium carbonate	Very disturbed near man made levee / Terminated at subsoil
40	0-22 22-32	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
41	0-15	10YR 6/2	Light brownish gray	Silty clay	<1% Caliche	V. Disturbed / Terminated at compaction
42	0-5	10YR 5/2	Grayish brown	Sandy clay loam	<80% Gravel	Terminated due to gravelly soils
43	0-18	10YR 6/3	Pale brown	Sandy loam	<2% Caliche	Terminated at compaction
44	0-25 25-35	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Sandy clay loam Sandy clay	- <2% calcium carbonate	Terminated at subsoil
45	0-24	10YR 3/2	Very dark grayish brown	Clay loam	-	Terminated at compaction

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
46	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
47	0-10 10-20	10YR 2/2 10YR 2/2	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
48	0-12 12-20	7.5YR 2.5/1 10YR 2/2	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Very Disturbed / Terminated at subsoil
49	0-21 21-30	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay loam Sandy clay	-	Terminated at subsoil
50	0-15	10YR 6/3	Pale brown	Sandy loam	<2% Caliche	Terminated at compaction
51	0-14 14-34	10YR 3/2 10YR 3/2	Very dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
52	0-12 12-22	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <5% calcium carbonate	Very compact / Terminated at subsoil
53	0-8	10YR 2/2	Black	Sandy Clay	<2% Caliche	Terminated at compaction

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
54	0-26 26-38	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay loam Sandy clay loam	- <2% calcium carbonate	Terminated at subsoil
55	0-25 25-35	10YR 4/2 10YR 5/4 m/w 10YR 4/2	Dark grayish brown Yellowish brown & Dark grayish brown	Sandy clay loam Sandy clay loam	-	Terminated at subsoil
56	0-14 14-24	10YR 3/2 10YR 3/2	Very dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
57	0-12 12-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <4% calcium carbonate	Very compact / Terminated at subsoil
58	0-9 9-40	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay Sandy clay loam	- <3% calcium carbonate	Terminated at subsoil
59	0-13 13-26	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay loam Sandy clay loam	- <2% calcium carbonate	Terminated at subsoil
60	0-22 22-32	10YR 4/2 10YR 5/4 m/w 10YR 4/2	Dark grayish brown Yellowish brown & Dark grayish brown	Sandy clay loam Sandy clay loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
61	0-8 8-20	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy loam Sandy clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
62	0-5 5-15	10YR 6/3 10YR 5/2	Pale brown Grayish brown	Silty clay Silty clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
63	0-9 9-33	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay Sandy clay loam	- <3% calcium carbonate	Terminated at subsoil
64	0-8 8-28	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
65	0-20 20-30	10YR 6/2 10YR 3/2	Light brownish gray Very dark grayish brown	Sandy clay loam Sandy clay	- <3% Caliche	Terminated at Subsoil
66	0-8 8-22	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy loam Sandy clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
67	0-8 8-24	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy loam Sandy clay	- <2% calcium carbonate	Very compact / Terminated at subsoil
68	0-14	10YR 4/2	Very dark gray	Clay loam	-	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	14-29	10YR 4/1	Dark gray	Sandy clay	<5% calcium carbonate	
69	0-15 15-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
70	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
71	0-5 5-15	10YR 4/2 10YR 4/2	Very dark gray Very dark gray	Sandy Clay loam Sandy clay	- <5% calcium carbonate	Terminated at subsoil
72	0-8	10YR 6/2	Light brownish gray	Sandy clay	<2% calcium carbonate	Terminated at subsoil
73	0-12 12-33	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
74	0-20 20-30	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
75	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
76	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
77	0-26 26-39	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy clay loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
78	0-8 8-30	10YR 4/2 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay loam	- <2% calcium carbonate	Terminated at subsoil
79	0-4 4-30	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil
80	0-12 12-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
81	0-15 15-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
82	0-29 29-39	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
83	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
84	0-24 24-34	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil
85	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at subsoil
86	0-25 25-35	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
87	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
88	0-19 19-31	10YR 4/3 10YR 5/4	Brown Yellowish brown	Sandy clay loam Sandy clay	- <5% calcium carbonate	Terminated at subsoil
89	0-22 22-39	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
90	0-20 20-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
91	0-9 9-29	10YR 4/3 10YR 5/4	Brown Yellowish brown	Sandy clay loam Sandy clay	- <5% calcium carbonate	Terminated at subsoil
92	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
93	0-9 9-18	10YR 4/2 10YR 4/2	Dark grayish brown Dark grayish brown	Sandy clay Clay loam	- <5% calcium carbonate	Terminated at subsoil
94	0-25 25-37	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay	- <1% calcium carbonate	Terminated at subsoil
95	0-3 3-23	10YR 3/2 10YR 4/2	Very dark grayish brown Dark grayish brown	Clay loam Clay	- <3% calcium carbonate	Terminated at subsoil
96	0-26 26-38	10YR 3/1 10YR 3/2	Very dark gray Very dark grayish brown	Clay loam Clay	- <1% calcium carbonate	Terminated at subsoil

ST ID	Depth (cmbs)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
97	0-10 10-20	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Terminated at subsoil
98	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <2% calcium carbonate	Terminated at subsoil
99	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Terminated at subsoil
100	0-8 8-29	10YR 3/1 10YR 2/1	Very dark gray Black	Clay loam Clay	- <2% calcium carbonate	Terminated at subsoil

Ahr, Steven

From: noreply@thc.state.tx.us
Sent: Friday, January 05, 2024 8:30 AM
To: Ahr, Steven; reviews@thc.state.tx.us
Subject: Archeological Survey for the Rehabilitation of Escondido Creek FRS No. 4

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Report Suspicious

TEXAS HISTORICAL COMMISSION
real places telling real stories

Re: Project Review under Section 106 of the National Historic Preservation Act and/or the Antiquities Code of Texas
THC Tracking #202404237
Date: 01/05/2024
Archeological Survey for the Rehabilitation of Escondido Creek FRS No. 4 (Permit 31324)
Karnes County
Kenedy,TX

Description: Rehabilitation of Escondido Creek Watershed Floodwater Retarding Structure No. 4

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 and the Antiquities Code of Texas.

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.

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 Mark Wolfe, State Historic Preservation Officer
Executive Director, Texas Historical Commission

Please do not respond to this email.

AECOM
13640 Briarwick Drive
Austin, TX 78729
aecom.com

Project name:
Escondido Creek FRS No. 4 SWP-EA,
Karnes County, TX

Project ref:
60707410

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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. 4 (Escondido 4) by AECOM. As a result of that study, the dam was reclassified as a high hazard dam. The existing dam does not meet current National Resources Conservation Service (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 rehabilitation of the dam. 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 Supplemental Watershed Plan No. III - Environmental Assessment (SWP-EA) which was submitted to the River Authority under separate cover.

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 the 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 the 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 channels using SITES software for this project.

2. Site Description

Escondido 4 is located on Doe Branch, a tributary of Escondido Creek, and a tributary to the San Antonio River, approximately 3.2 miles west of downtown Kenedy, Texas and 60 miles southeast of San Antonio, Texas. Global positioning system (GPS) coordinates for the site are near latitude 28.813794° and longitude -97.902410°.

Site access is available via an unimproved road off FM 2102, approximately 2.0 miles northwest of the intersection of FM 2102 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 4 was designed and constructed as a low hazard dam in 1956. The dam has an estimated drainage area of approximately 3,992 acres and a total reservoir capacity estimated at 2,229 acre-feet (floodwater and sediment storage). Escondido 4was recently reclassified as a high hazard structure, and does not meet the current dam design and safety requirements.

According to the as-built drawings, the dam is approximately 29-feet-tall at the maximum section and is approximately 2,900 feet long. The crest was built to maximum elevation (El). 334.5 feet in the central portion of the creek valley (including over-build to compensate for post-construction settlement), and tapered to El. 333.1 and El. 333.4 at the left and right abutments, respectively. The upstream slopes of the embankment were constructed at an inclination of 3H:1V (horizontal:vertical), and the downstream slopes were constructed at 2H:1V. A 10-foot-wide wave protection berm was constructed on the upstream slope at approximately El. 311.7[*] feet according to the North American Vertical Datum of 1988 (NAVD88). The width of the embankment crest is approximately 14 feet. The dam was constructed with an internal drainage system consisting of a toe drain trench filled with single-stage aggregate filter with a 6-inch-diameter perforated corrugated metal drain pipe (galvanized steel with bituminous coating). The specified gradation of the aggregate filter shown in the as-builts suggests a predominantly coarse- to medium-grained sand with about 5 to 25% fine gravel and less than 10% fines was used.

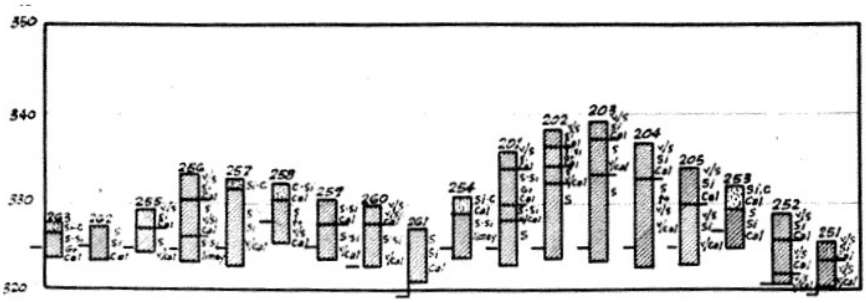
As-built drawings indicate at least two repair projects were made at Escondido Creek 4. The first repair project was completed in 1961 and included repair of slope failures on the downstream slope of the embankment. Slope repair included excavating beyond the slide surface to a uniform slope, and then reconstructing the downstream slope. The repair maintained the original 2H:1V slope angle in the upper part of the reconstructed downstream slope, but added a stability berm with top El. 321.6 in the lower half of the downstream slope. The stability berm had 12-foot-wide crest with back-sloped “gutter” to direct surface flow away from the slopes, and was constructed with a flatter downstream slope of 2.5H:1V. The second repair project was completed in 1968, and included repair gully erosion on the embankment between Station (STA.) 0+00 to 5+00. The gully repair consisted of excavating beyond the eroded surface and shaping gully banks to uniform slope, and backfilling with earthfill to the pre-erosion ground surface. The drawings do not specify the properties of the earthfill material or placement/compaction criteria used in the gully repairs.

The dam features a two-bay vegetated ASW with a splitter dike at the right abutment, and a principal spillway near the original creek alignment. The PSW consists of a drop inlet, two upstream low-level ports separate from the inlet riser, a conduit under the dam, and an unlined downstream plunge pool. Four (4) anti-seep collars spaced at 24 feet on center are also present.

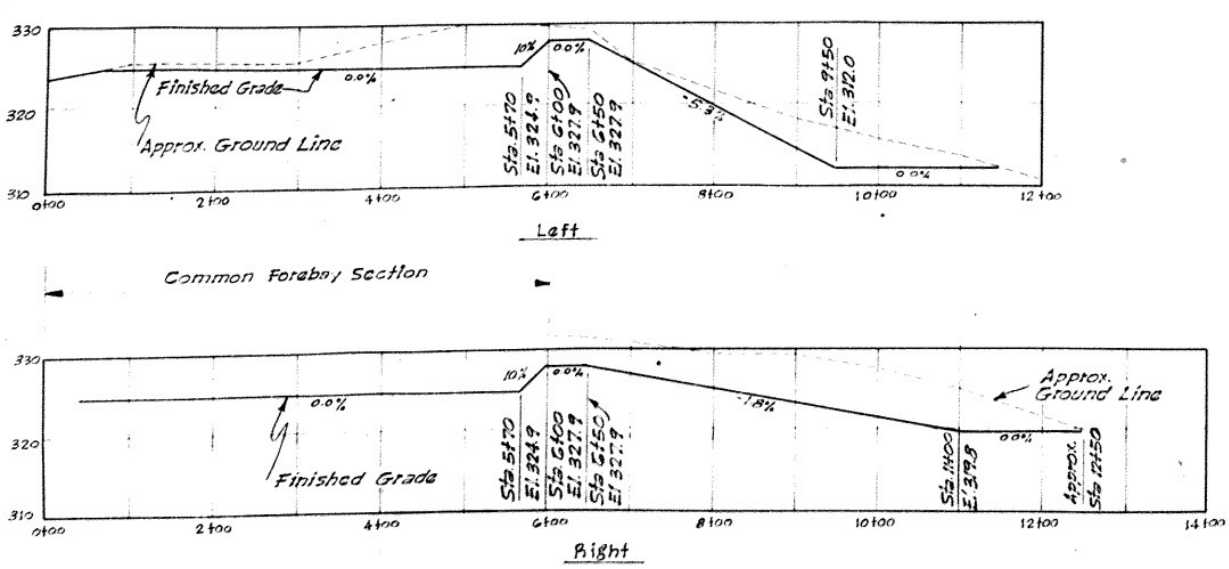
The ASW bays are designated as “left” and “right” in the as-built drawings. Each of the ASW bays has a 250 foot long channel. The left and right bays share a common 50-foot-long crest section set at El. 328.0 feet. The entrance channel slope, common to both ASW bays, was excavated nearly flat (0% per the as-built drawings) to about El. 325.0 at maximum depths of about 5 feet below pre-construction ground surface along the spillway centerline. The as-built drawings (see **Attachment 1**) indicate the ASW crest was excavated primarily into layers of native

[*] Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29), and were converted to NAVD88 for the purposes of this report. Conversion from NGVD29 to NAVD88 is +0.12 feet.

calcareous clay interbedded with sand and silt. Similarly, the exit channels were excavated out of the native calcareous clay and very silty to sandy layers. The exit channels of the two ASW bays were designed to vary in terms of length and slope angle to accommodate the pre-construction site topography while maintaining the same alignment. The left bay exit channel was originally built at a 5.3% grade over a 300-foot length, with excavation depths ranging from 0 to 5 feet. Excavation depths on the left bay increased between the crest and the ASW outlet. The right bay was built at a 1.8% grade over a 450-foot length, and the excavation depths varied from 0 to 6 feet. Excavation depths remained relatively constant throughout the right bay. For reference, the as-built spillway profiles of the ASW left and right bays are shown in the images below as well as the stick logs provided in the as-built drawings for the auxiliary spillways.



LOG OF SPILLWAY BORINGS
SEE PLAN OF EMBANKMENT AND SPILLWAY



PROFILE ON ℄ OF SPILLWAYS

2.2 Spillway Historical Performance

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2017, 2021, and 2022 annual inspections (San Antonio River Authority, 2017 and 2021; TCEQ for San Antonio River Authority, 2022) reported that the spillways were in good condition. The most recent dam safety inspection (TCEQ, 2022) noted adequate vegetative cover throughout the ASW with the exception of areas where harvester ant beds and hog related damage were observed. Hog damage was particularly of concern on the right half of the left bay and near the splitter dike on the right bay. Harvester ant beds were noted on the control section of the spillways. Furthermore, a 2-foot-deep burrow was noted at the left bay near the splitter dike toe and hay bales were also observed throughout both bays.

2.3 Proposed Improvements

The prior dam assessment (AECOM, 2014) performed at Escondido Creek 4 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 proposed improvements as part of the rehabilitation option from the 2014 Dam Assessment of Escondido 4, with elevations correct to NAVD88, included:

- Raising the crest elevation of the dam embankment by approximately 4.0 feet from elevation (El.) 333.0 feet to El. 337.0 feet,
- Flattening the downstream embankment slope from 2H:1V to a 3H:1V ratio (horizontal: vertical) ratio,
- Raising the auxiliary spillway crest approximately 1.1 feet from elevation (El.) 327.9 feet to El. 329.0 feet,
- Replacing the existing 28-inch principal spillway (PSW) conduit with a 42-inch-diameter conduit, and
- Replacing the PSW inlet/outlet structures.

The purpose of the SWP-EA (AECOM, 2024) was to further evaluate alternatives, including an alternative for watershed structure rehabilitation of Escondido Creek 4. As a result of this work, the proposed improvements recommended for the high hazard rehabilitation of the dam have been modified to include the following:

- Remove the existing principal spillway system;
- Install a new principal spillway system consisting of a standard inlet tower with crest at elevation 317.2 feet, two 10-inch by 10-inch low level ports at elevation 312.7 feet, and a 42-inch RCP conduit discharging into an impact basin;
- Install a 150-feet wide, five-cycle labyrinth weir structural spillway over the existing embankment with crest set above the 50-year PSH elevation at 328.7 feet and concrete chute discharging into a concrete stilling basin;
- Regrade inlet and outlet channel of the existing vegetated auxiliary spillway and raise left bay and right bay crests to the 100-year PSH elevation of 329.2 feet (1.18 feet raise from as-built);
- Flatten downstream embankment slope to 3H:1V;
- Abandon existing trench drain and install new toe drain at downstream toe;
- Install upstream dam embankment slope riprap; and
- Raise top of dam elevation to 335.3 feet (2.18 feet raise) and extend the cutoff trench below the 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; Baker, 1979). Per the geologic map (Brown et. al, 1975), 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; Baker, 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is montmorillonite with variable amounts of kaolinite and subordinate illite.

Alluvium (Qal) of the Holocene Epoch is mapped downstream of the principal spillway and along the banks of Doe Branch. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Alluvium deposits in Central Texas are typically organized as point bars, natural levees, stream channels, or backswamps.

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 either Alluvium, Residuum (resulting from in-place weathering of the parent bedrock), of Fill. Alluvium makes up the majority of the near-surface soils mapped at the dam site, and is identified along most of the dam embankment and upstream (south and southwest) of it. Residuum is mapped in two smaller zones located northwest of the auxiliary spillway and upstream of the dam embankment (north of the reservoir). Fill material is mapped within the auxiliary spillway channel, likely generalized to account for the fill berms/splitter dike. Note that the ASW bays were excavated approximately 5 to 7 feet below pre-construction grade along the centerline for over 800 feet of the ASW channel profile.

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 Creek 4 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 eleven dam sites in the watershed as part of the work plan. No standalone site-specific investigation was prepared for Escondido 4.

The 1954 Escondido Creek Watershed Work Plan (SCS, 1954) describes the foundation of the Escondido Creek Watershed dams (including Escondido 4) 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 4 provided subsurface profiles of the site with boring "stick" logs from the pre-construction investigation with generalized soil types. The investigation consisted of the consisted of the following:

- 16 borings along the dam centerline (Hole numbers not legible/provided on the as-built drawings)
- 10 borings along the shared auxiliary spillway forebay (Hole Nos. 201 through 205, 254 through 257, and 263);
- 7 borings along the right auxiliary spillway (Hole Nos. 251 through 253 and 258 through 261);
- 1 boring along the left auxiliary spillway (Hole No. 262);
- 24 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 174).

The complete investigation report containing the Escondido 4 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1956 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 Creek 4. Based on this documentation, the existing dam embankment is primarily underlain by clay and sand with some gravelly and silty zones. Clay was encountered in 15 of the 16 original dam embankment borings drilled and was described as hard, friable, moist to wet, silty to

sandy, and calcareous with calcium carbonate and trace limestone inclusions. Sand was encountered in 11 of the original embankment borings drilled and was described as silty to clayey sand with gravel.

Similarly, review of the available geologic stick logs of borings indicates the auxiliary spillway channel at Escondido Creek 4 was excavated up to about 7 feet below original grade, exposing sandy to silty calcareous clays in the upper half of the spillway channel. The second half of the channel does not appear to have been reached in the borings drilled during the original investigation. Groundwater was recorded in 6 of the borings drilled all of which were located between original centerline Sta. 10+00 and Sta. 18+00, near the original valley channel.

The as-built drawings indicate that the materials in the spillway excavations were suitable for use in forming the single-zoned homogeneous embankment. Additional borrow material was available in a borrow area located in the present-day reservoir; however, stick logs for the reservoir borrow area were not included in the as-built drawings and were not available to AECOM for review.

3.3.2 NRCS – 2022 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on February 23, 2022, by the NRCS part of the routine dam safety inspections for the River Authority (NRCS, 2022). The inspection identified several 1 to 4 feet deep animal burrows along the dam embankment and near the upstream and downstream toes. In addition, the inspection noted hog rooting at the embankment crest, upstream slope, auxiliary spillways, and downstream berm and indicated that poor vegetative cover was observed on the upstream slope, near the right abutment. Standing water was observed at the downstream berm toe in an area described as a natural low. While this area of standing water was not more distinctively identified in the 2022 inspection report, review of the as-built drawings (SCS, 1956) appears to suggest the presence of a remnant of the original stream channel between centerline Sta. 14+00 and Sta. 16+00. In addition, an area of ponded water at the downstream toe of the dam near Sta. 16+00 is visible through aerial images available on Google Earth which leads AECOM to the interpretation that the area of accumulated water reported in the 2022 inspection report is likely located in the vicinity of Sta. 14+00 to Sta. 16+00.

Several hay bales and harvester ant beds were noted along the ASW channel. Woody brush and a tree were noted in the vicinity of the PSW and the plunge pool was enlarged, causing discharge water to backup into the PSW conduit. Several repairs were recommended for the auxiliary and principal spillways. The ASW was noted as being in good dimensional condition, while the PSW was deemed to be in adequate condition.

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

The 2022 inspection concluded that Escondido 4 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 August of 2023 in general accordance with the approved Field Investigation and Testing Plan submitted to the River Authority prior to field mobilization. Geologic investigation of the existing ASW was performed to develop recommended geologic input parameters for SITES erodibility analysis. The investigation of the ASW bays included five (5) geotechnical test borings in the existing channel designated as 201-23 through 205-23. Boring locations are shown in **Figure 1**. 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 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. The generalized stratigraphy included undifferentiated clayey Alluvium/Fill and sandy Alluvium overlying a cohesive Residuum layer with sand lenses. Borings terminated in the Residuum layers and no bedrock layers were encountered.

The NRCS soil survey mapping shows fill material within the ASW channels, and alluvium and residuum materials upstream and downstream of the ASW channel. The 1954 as-built drawings (SCS) indicate that the left bay had fill placed on the inner half of the channel. Per the typical spillway sections, the remaining portion of the left bay and the entirety of the right ASW bay were excavated from in-situ materials. The approximate upper 1/4 to 1/3 of the splitter dike separating the left and right ASW bays and portion of the exterior training berms were also constructed of fill. The discrepancy between the as-built drawings location of fill and the NRCS soil survey mapping could partially be due to the resolution of the NRCS soil survey mapping influenced by the presence of the fill berms/dike. While an attempt was made to distinguish between the fill and alluvium during the AECOM field investigation, the scope of this study did not provide enough additional information to confirm the difference; as a result, no distinction was made between the fill and alluvium. However, the geologic description of the alluvium as consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter is consistent with the materials encountered. The residuum is consistent with the work plan description of the silty clays and sandy clays that make up the valley slopes (SCS, 1954a).

Subsurface profiles cut along the existing ASW left and right bay centerlines are presented in **Figure 2** and **Figure 3**, respectively. The profile includes abridged boring “stick” logs indicating field USCS classification, pocket penetrometer values, and SPT N-values. For the purposes of spillway erodibility analysis, the following generalized subsurface stratigraphy was assigned for the ASW channel:

1. Undifferentiated Clayey Fill/Alluvium
2. Sandy Alluvium
3. Residuum

The Undifferentiated Clayey Fill/Alluvium stratum was described as lean clay to sandy lean clays with trace roots and trace gravel and were generally very stiff to hard, dry, light brown to dark gray, and no to strong reactions to hydrochloric acid (HCl). Sandy Alluvium was encountered below and downstream from the Clayey Alluvium/Fill materials in borings 203-23 and 205-23 and were described as clayey sand (SC) and silty sand (SM) with calcareous inclusions. The Sandy Alluvium soils were generally medium dense to dense, dry, dark grayish brown to pale brown, fine to medium grained sand, and weak to strong HCl reactions. It should be noted that the Sandy Alluvium was identified directly at the surface in boring 205-23.

Residuum was encountered below the Fill/Alluvium strata. The Residuum was described as lean to fat clay with sand to sandy lean to fat clay (CL to CH). The unit was calcareous with calcium carbonate veins and trace iron oxide staining. The Residuum was generally stiff to hard, moist to dry, grayish brown to predominately light brown to brown, medium plasticity, and had weak to strong HCl reactions.

A sand lense within the Residuum was encountered in boring 203-23 on the left bay of the ASW, , approximately between elevations 300 feet and 310 feet (15.5 feet to 20.5 feet below the ground surface [bgs]). The lense was described as a medium dense to dense, moist, pale brown, clayey sand (SC) with no HCl reaction.

The borings generally encountered clayey soils from surface to a depth of approximately 30 feet, except borings 203-23 and 205-23 which encountered one or more intervals of sandy soils ranging from about 5 to 10 feet thick. A limited number of SPT tests was completed in the Clayey Fill/Alluvium and little variation was observed in the SPT N-values recorded which averaged approximately 14 blows/foot (bpf). In the Sandy Alluvium, SPT N-values

ranged from 21 to 41 bpf which generally increased with depth (average of 27 bpf). In the Residuum, N-values ranged from 13 to 48 bpf (average of 28 bpf). A single SPT test was performed in the sand lense observed with N-value of 33 bpf. Pocket penetrometer readings were generally greater than 4.5 tsf with only two recorded reading of 3.5 tsf, measured on a shallow split-spoon sample recovered from boring 204-23 and on a deeper sample (more than 20 feet bgs) obtained from boring 201-23. Bedrock, defined as SPT and/or Shelby Tube refusal or visual determination, was not encountered in the borings completed.

3.4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were not added to the borings as rock coring was not performed. 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 Clayey Fill/Alluvium and Residuum, assuming each of the parameters except Ms are held constant and equal to 1.0. Kh

estimations for the Sandy Alluvium followed the general procedure for cohesionless soils. Due to similarity of between Sandy Alluvium and the Sand Lense within the Residuum, a separate analysis was not performed for the Sand Lense and the same values developed for the Sandy Alluvium were adopted.

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) Undifferentiated Clayey Fill/ Alluvium,
2) Sandy Alluvium,
3) Residuum (of the Oakville Sandstone Formation),
4) Sand lense within Residuum in boring 203-23, and
5) Proposed Fill (ASW excavation 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, 2024). 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 Penetrometer readings, 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 Undifferentiated Clayey Fill/Alluvium and Residuum were considered "cohesive" soil for the purposes of estimating the Ms parameter, whereas the Sandy Alluvium (and Sand Lense) was conservatively treated as "cohesionless" soil in analyses although the PI was generally greater than 10. The material designated as Proposed Fill was obtained from samples collected in the upper 5 feet of the borings drilled which primarily classified as lean clays (CL), and thus was also considered as "cohesive" soil. While the Proposed Fill would have similar gradation and plasticity as the in-situ soils, 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 as a separate layer.

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 Residuum exceeded 30 bpf, the laboratory UCS values indicate the material is borderline and should still be considered soil like in analysis. Similarly, blow counts greater than 30 bpf were recorded in the Sandy Alluvium, which was also treated as a soil-like material. One unconfined compression test was completed in the Sandy Alluvium that indicated the material was soil-like (UCS=11,280 psf) 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 1.0 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.

Undifferentiated Clayey Fill/ Alluvium and Residuum

SITES parameters for this unit were estimated using several methods including the results of 19 field standard penetration tests correlated to an estimated Su value, correlations from liquidity indices (LI) to estimated Su, and 11 unconfined compression (UC) tests. Greater weight was given to the UC tests and LI correlation methods. The liquidity indices were 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.

Sandy Alluvium

SITES parameters for the Sandy Alluvium were estimated primarily based on the results of 5 standard penetration tests and 1 UC strength test.

Proposed Fill (ASW Borrow)

The Ms value for Proposed Fill materials is typically estimated by performing laboratory UC 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 as determined by ASTM D698). As such, the range of Ms values were estimated based on results of 3 UC tests on representative composite samples remolded from auger cuttings collected near the surface for each of the borings drilled.

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 Undifferentiated Clayey Fill/ Alluvium and Residuum layers and Proposed Fill are considered as "massive, unjointed cohesive" soil materials, and the Sandy Alluvium 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 clayey layers and proposed fill materials are considered as "cohesive" materials, while the Sandy Alluvium 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 Undifferentiated Clayey Fill/ Alluvium layer had PL values ranging from 12 to 23 (average 18). The Residuum layer had PL values ranging from 15 to 28 (average 20) with two samples (each recovered at 18 feet bgs in borings 202-23 and 205-23) with PL ≥ 25. Fissures were noted in the upper depths of all borings drilled, within the Undifferentiated Clayey Fill/ Alluvium stratum, except for 205-23. As such, the blocky soil reduction factor was applied to the Kh values for the Undifferentiated Clayey Fill/ Alluvium soils. In contrast, due to the lack of observed fissures and estimated PL values below the recommended threshold, the blocky soil reduction factor was not applied to the Kh values for the Residuum 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:

<u>Left Bay of ASW</u>

- Undifferentiated Clayey Fill/ Alluvium: Kh = 0.23

- Sandy Alluvium: Kh = 0.06
- Residuum: Kh = 0.15
- Proposed Fill (ASW Excavation Borrow): Kh = 0.10

Right Bay of ASW

- Undifferentiated Clayey Fill/ Alluvium: Kh = 0.23
- Sandy Alluvium: Kh = 0.06
- Residuum: Kh = 0.15
- Proposed Fill (ASW Excavation Borrow): Kh = 0.10

The recommended values for the cohesive soil-like materials are generally in agreement with those recommended for stiff to 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

AECOM. 2014. *Dam Assessment Report,* Escondido Creek Watershed Floodwater Retarding Structure No. 4. Karnes County, Texas, June.

AECOM. 2024a. *Preliminary Geologic Investigation Report, Escondido Creek Floodwater Retarding Structure No. 4,* Karnes County, TX prepared for San Antonio River Authority, October.

AECOM. 2024b. *Preliminary Soil Mechanics Report, Escondido Creek Floodwater Retarding Structure No. 4,* Karnes County, TX prepared for San Antonio River Authority, October.

Adams, S.S. and Smith, R.B., 1981. *Geology and Recognition Criteria for Sandstone Uranium Deposits in Mixed Fluvial-Shallow Marine Sedimentary Sequences, South Texas,* National Uranium Resource Evaluation, prepared for U.S. Department of Energy, Grand Junction Office, Colorado, January.

Anders, R.B. 1962.Groundwater *Geology of Karnes County, Texas,* Geologic Survey Water Supply Paper 1539-G, United States Government Printing Office, Washington, D.C.

Baker, E.T., 1979. *Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas*, Report 236, United States Geologic Survey, July.

Brown, T. E., Brewton, J. L., McGowen, J. H., Proctor, C. V., Aronow, S., and Barnes, V. E., 1975, Geologic Atlas of Texas, Beeville-Bay City Sheet: The University of Texas at Austin, Bureau of Economic Geology, Geologic Atlas Sheet, map scale 1:250,000.

McCook, D.K. 2005. *Guidance on the Selection of the Soil Erodibility Index, Kh for the NRCS/ARS Auxiliary Spillway Erosion Model (SITES)*.

Natural Resources Conservation Service (NRCS). 2001. *National Engineering Handbook (NEH) Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index*, March.

NRCS. 2011. *National Engineering Handbook (NEH) Part 628, DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons (Surface Detachment Coefficient and Headcut Erodibility Index)*. October.

NRCS. 2022. *Dam Safety Inspection Report,* Escondido Creek Site 4 (TX02035), prepared for San Antonio River Authority, February.

Soil Conservation Service (SCS). (1954a). *Work Plan, Escondido Creek Watershed of the San Antonio River Watershed*, Karnes County, June.

SCS. 1956. *As-Built Plans, Flood Prevention Dam No. 4, Escondido Creek Watershed,* Karnes County, Texas, May.

7. Attachments

Table 1. Summary of Laboratory Test Results by Stratum for ASW Borings
Table 2. Recommended SITES Parameters for Existing Left (Inner Bay) ASW
Table 3. Recommended SITES Parameters for Existing Right (Outer Bay) ASW

Figure 1. Site Map and Plan of Geologic Investigations
Figure 2. Geologic Profile of Auxiliary Spillway (Inner Bay)
Figure 3. Geologic Profile of Auxiliary Spillway (Outer Bay)

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
Undifferentiated Clayey Fill/ Alluvium	2-8	CL	19-20 (19)	3.5 - 4.5+ (4.3)	9,660	19,320	110	40 - 54 (46)	28 - 31 (29)	-0.43 to +0.32 (-0.14)	50 - 86 (60)	---[3]	0.18 – 0.30 (0.24)	1
Sandy Alluvium	8-13	SC, SM (partially cemented)	28-56 (36)	4.5 - 4.5+ (4.5)	5,640	11,280	109 - 115	30 - 47 (37)	17 - 29 (23)	-0.45 to-0.28 (-0.34)	26 - 48 (39)	20	0.20 - 0.45 (0.26)	1
Residuum	7 – 25+	CH	17-64 (38)	3.5 - 4.5+ (4.5)	520 - 12,400 (3,141)	1,040 - 24,800 (6,282)	83 - 120 (98)	32 - 66 (53)	15 - 44 (32)	-0.41 to +0.52 (+0.11)	58 - 85 (74)	22 - 41 (33)	0.05 - 0.48 (0.20)	1 - 4 (2)
Proposed Fill (ASW Borrow)	TBD	CL	---[3]	---[3]	---[3]	---[3]	98 - 113 (104)	35 - 57 (48)	20 - 37 (30)	-0.20 to -0.09 (-0.04)	36 - 82 (58)	21 - 40 (31)	---[3]	1 - 1 (1)

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.

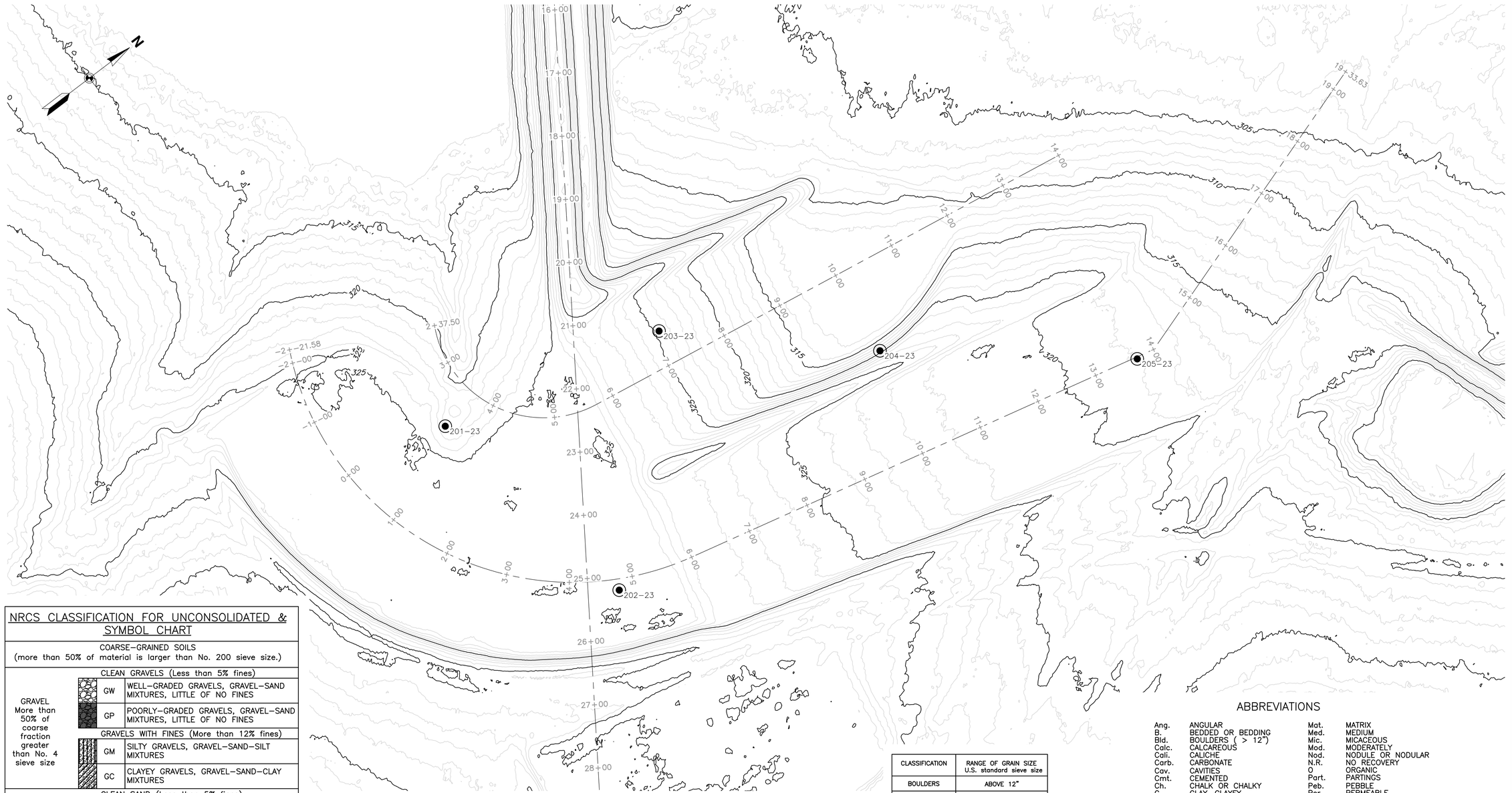
Table 2. Recommended Material Parameters for SITES Analysis of Existing Left (Inner) Bay of ASW

SITES inputs	Undifferentiated Clayey Fill / Alluvium	Sandy Alluvium & Sand Lense	Residuum	Proposed Fill (ASW Borrow)
USCS - Soil Type (Predominant)	CL - Lean clay	SC – Clayey sand	CH - Fat clay	CL - Lean clay
PI – Representative	30	15	35	30
LL – Representative	45	30	55	40
Dry Density (lbs/ft3) – Representative	105	110	90	100
Kh – Representative	0.23	0.06	0.15	0.1
Clay % – Representative	30	30	30	30
Rep. Diam. D_{75} (mm) – Representative	0.2	0.3	0.1	0.1
Rep. Diam. D_{75} (in) – Representative	0.008	0.012	0.004	0.004
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---

Table 3. Recommended Material Parameters for SITES Analysis of Existing Right (Outer) Bay of ASW

SITES inputs	Undifferentiated Clayey Fill/ Alluvium	Sandy Alluvium & Sand Lense	Residuum	Proposed Fill (ASW Borrow)
USCS - Soil Type (Predominant)	CL - Lean clay	SC – Clayey sand	CH - Fat clay	CL - Lean clay
PI – Representative	20	15	30	30
LL – Representative	40	30	50	40
Dry Density (lbs/ft3) – Representative	105	110	90	100
Kh – Representative	0.23	0.06	0.15	0.1
Clay % – Representative	30	30	30	30
Rep. Diam. D_{75} (mm) – Representative	0.2	0.3	0.1	0.1
Rep. Diam. D_{75} (in) – Representative	0.008	0.012	0.004	0.004
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---

FIGURES



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
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Silty Clay (half silt, half clay)
- Clayey Sand with Silt
- Well Graded Sand

OTHER SYMBOLS

- HOLE LOGGED ONLY
- STRIKE AND DIP
- HOLE SAMPLED
- PIT OR TRENCH

PLAN

0 40 80 160

SCALE IN FEET

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 2/27/24

CHECKED MJ DATE 2/27/24

APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (INNER BAY)

FLOODWATER RETAINING STRUCTURE 4

ESCONDIDO CREEK WATERSHED

IN

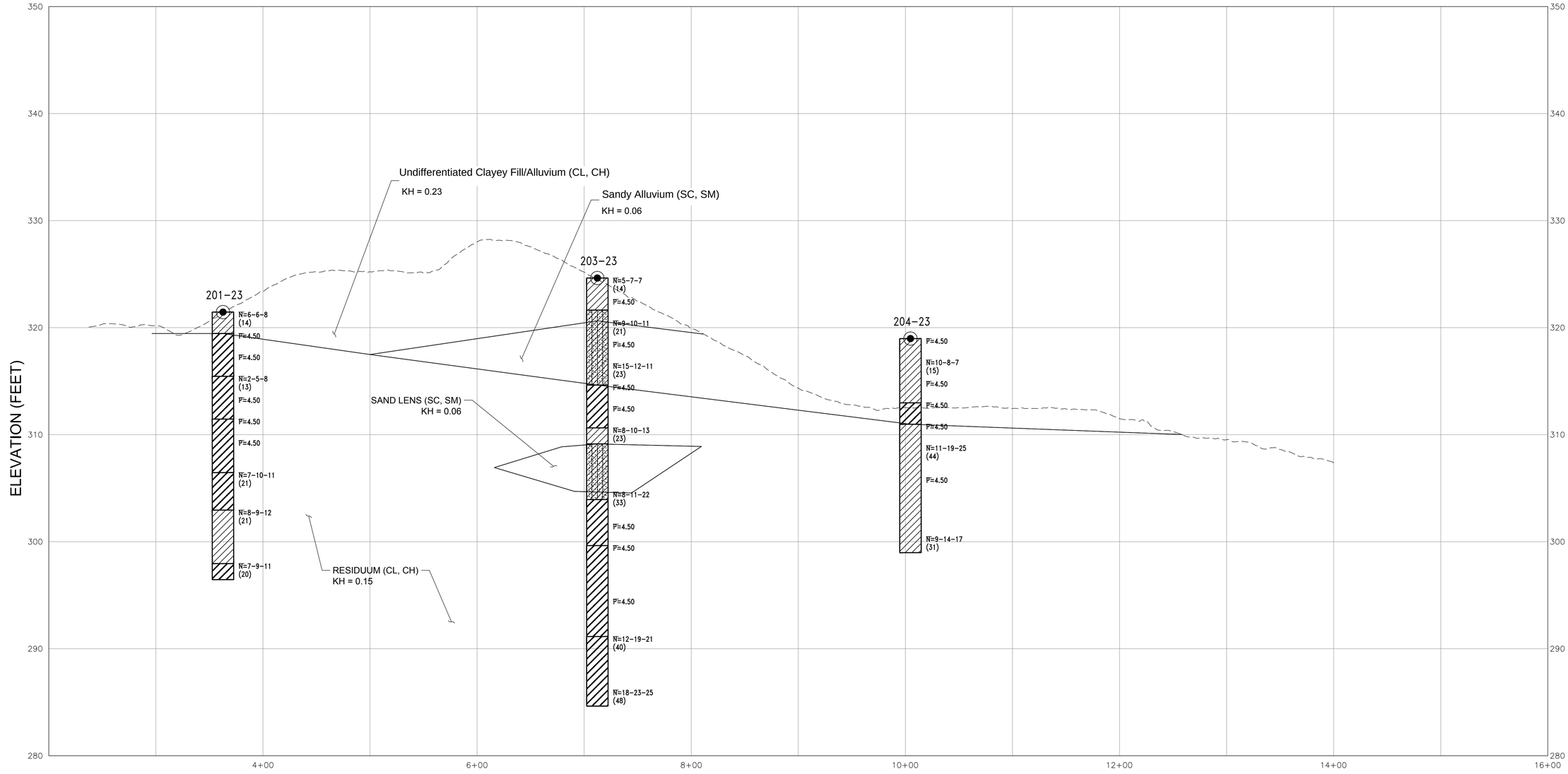
KARNES COUNTY, TEXAS

AECOM

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SHEET NO. 1 OF 3

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LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Well Graded Sand
- Silty Clay (half silt, half clay)
- Clayey Sand with Silt

-- 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 2/27/24
CHECKED MJ DATE 2/27/24
APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (INNER BAY)

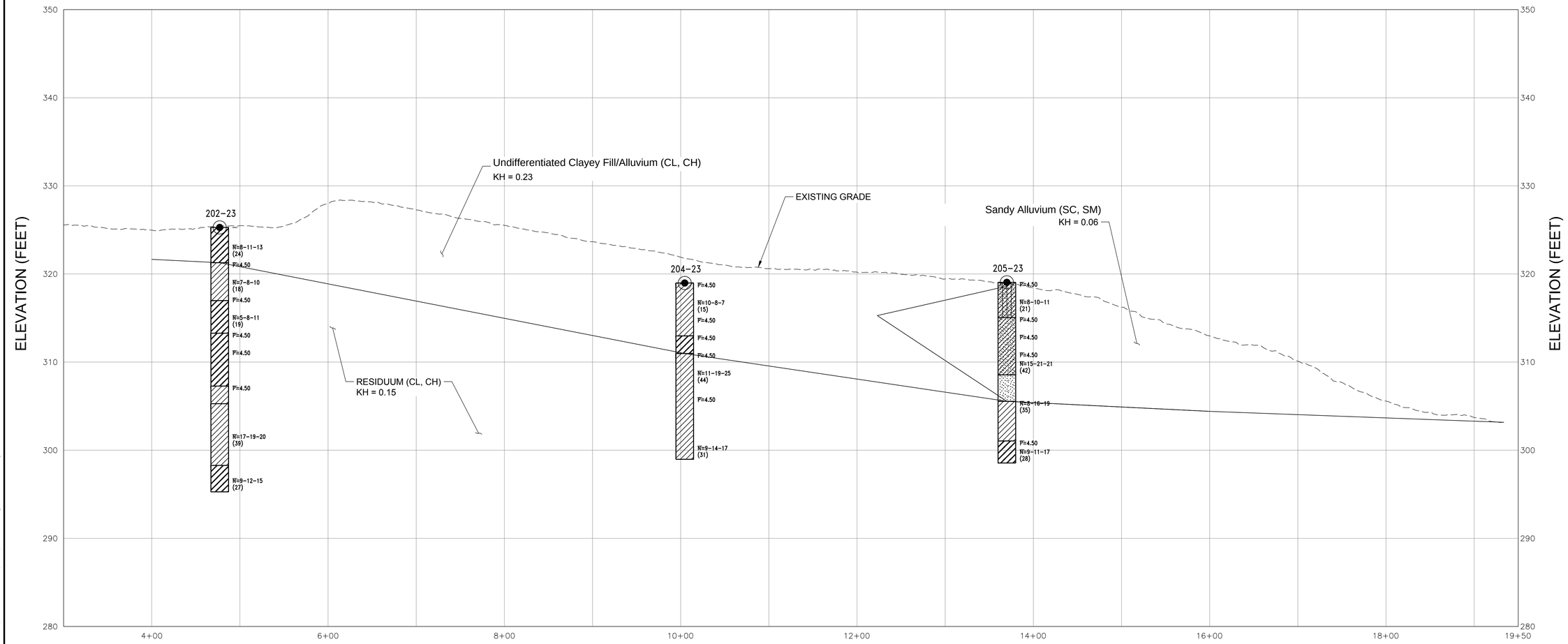
FLOODWATER RETAINING STRUCTURE 4
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 3

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LEGEND

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

-- 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 2/27/24
CHECKED MJ DATE 2/27/24
APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (OUTER BAY)

FLOODWATER RETAINING STRUCTURE 4
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME:
GEOLOGIC PROFILES.DWG

SHEET NO. 3 OF 3

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ATTACHMENT 1.

AS-BUILT DRAWINGS

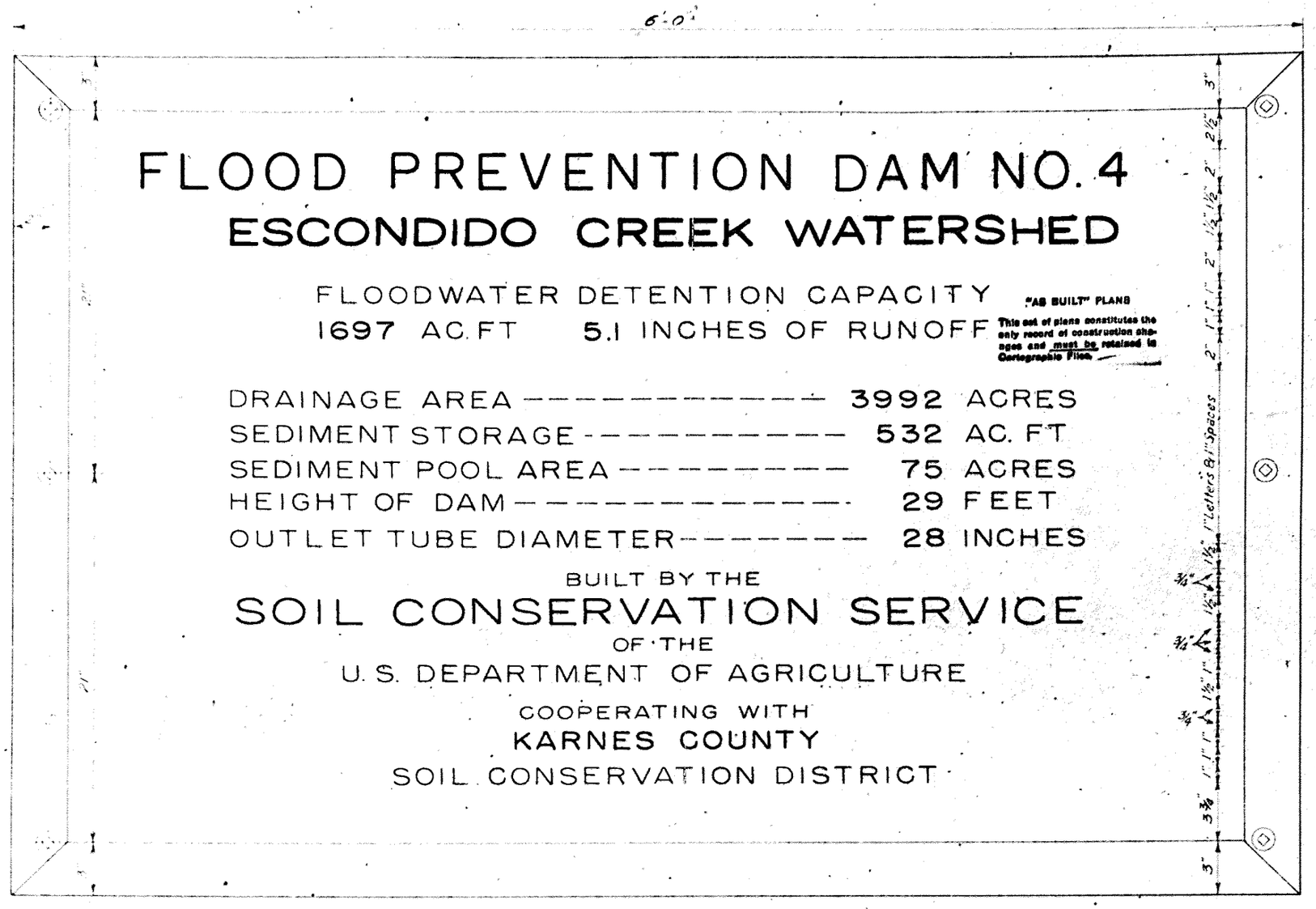
FLOOD PREVENTION DAM NO. 4
ESCONDIDO CREEK WATERSHED

FLOODWATER DETENTION CAPACITY
1697 AC. FT 5.1 INCHES OF RUNOFF

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

DRAINAGE AREA	3992 ACRES
SEDIMENT STORAGE	532 AC. FT
SEDIMENT POOL AREA	75 ACRES
HEIGHT OF DAM	29 FEET
OUTLET TUBE DIAMETER	28 INCHES

BUILT BY THE
SOIL CONSERVATION SERVICE
OF THE
U. S. DEPARTMENT OF AGRICULTURE
COOPERATING WITH
KARNES COUNTY
SOIL CONSERVATION DISTRICT

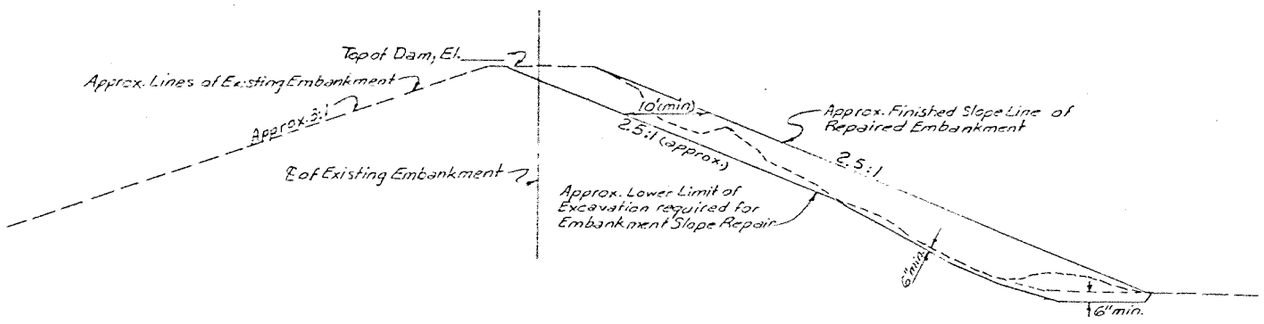


CONSTRUCTION DRAWINGS APPROVED

Howard Matson Con. 5/15/56
B. M. Price 5/15/56
TEMPLE TEXAS

Completed- November 17, 1956
Accepted- January 24, 1957

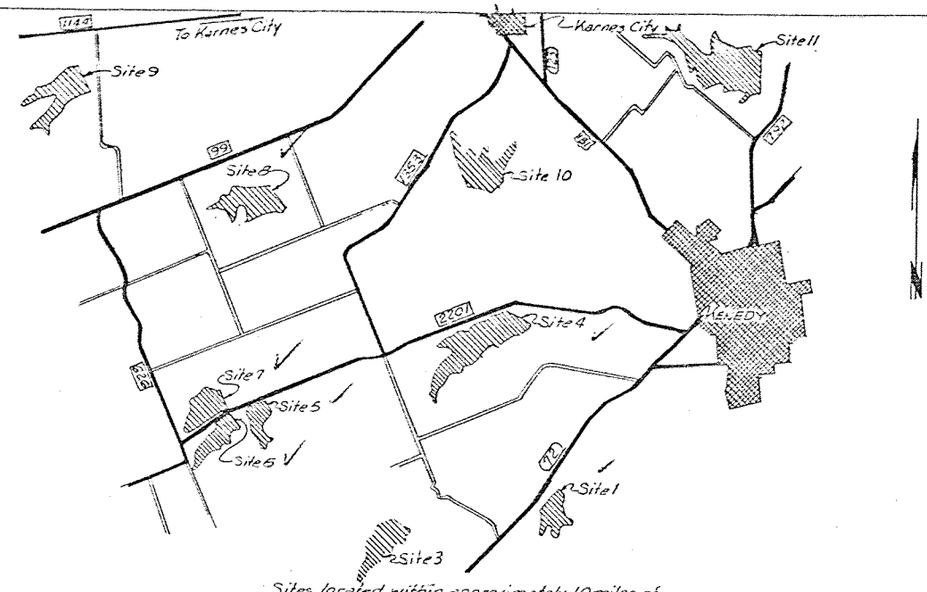
Dwg No. 4-E-10,440
Sheet No. 1 of 8
Revised



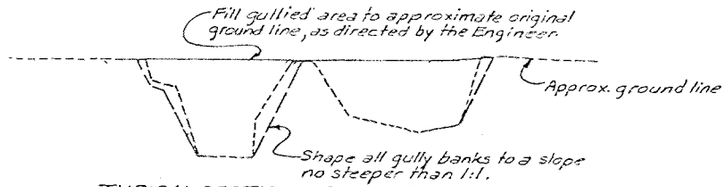
TYPICAL SECTION - EMBANKMENT SLOPE REPAIR
(Site Nos. 5, 6, 7 and 8)

NOTES:
1. Removal or stripping of soil materials for the slope repair shall include topsoil, displaced or low density embankment materials (if any) and such other materials as may be necessary to provide suitable working area for the operation of the construction equipment. The estimated limits of removal are shown; however, the final limits of removal will be determined by the Engineer based on his inspection of the materials exposed by the removal and on the minimum area (approx. 10 ft horizontal) required for operation of the construction equipment.
2. The slope repair shall consist of the removal of materials as specified above and of the construction of the 2.5:1 downstream slope as shown on the drawings.
3. Additional materials required for the completion of the slope repair shall be obtained from a borrow area or borrow areas designated at each site. The location and lateral limits of each borrow area shall be as directed by the Engineer. Borrow excavations are not included in the quantity estimates.

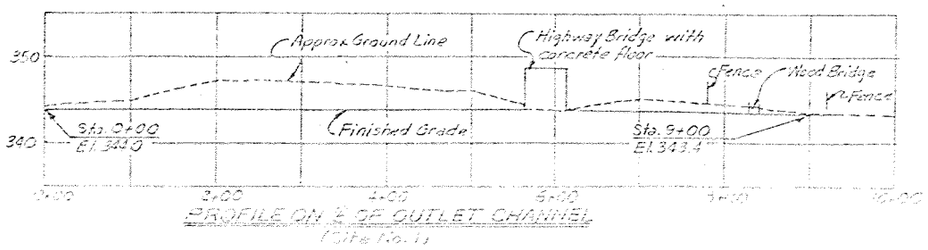
SITE No.	LIMITS OF REPAIR		ESTIMATED QUANTITIES	
	From	To	Excavation	Earth Fill
1	Sta 0+00	Sta. 9+00	1,010 cu.yds.	
4	Sta. 0+00	Sta. 5+00		2,980 cu.yds.
5	Sta. 5+00	Sta 20+00	4,240 cu.yds.	9,960 cu.yds.
6	Sta. 7+00	Sta. 26+00	7,150 cu.yds.	16,130 cu.yds.
7	Sta. 3+70	Sta. 19+00	6,530 cu.yds.	15,750 cu.yds.
8	Sta. 4+00	Sta. 22+00	5,910 cu.yds.	15,062 cu.yds.



These repairs were made in 1968. As-built plans were not prepared. However, this work was accomplished. This drawing documents changes in these structures.



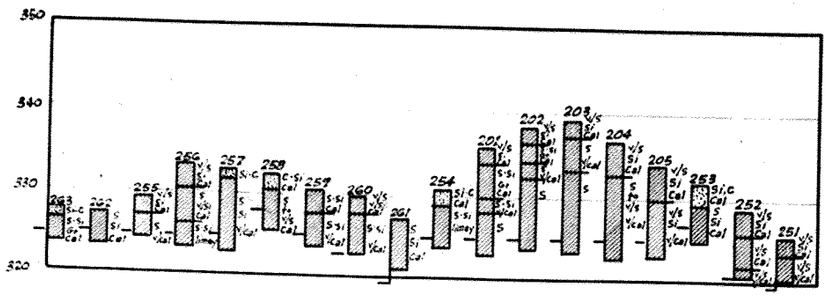
TYPICAL SECTION - GULLY FILL
(Site No. 4)



PROFILE ON ℄ OF OUTLET CHANNEL
(Site No. 1)

Note
1. The outlet channel below Site No. 1 shall have 12 ft. bottom width and 3:1 side slopes. Grade from Sta. 0+00 to Sta. 9+00 shall be as staked by the Engineer.

REPAIR DETAILS
FLOODWATER RETARDING STRUCTURES
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed M.D.K. 1-68
Drawn M.D.K. 1-68
Traced
Checked
Approved
Temple, Texas
Sheet 1 of 4 Sheets No.
4-E-25,837



Note: Bar at left of boring is at spillway grade.

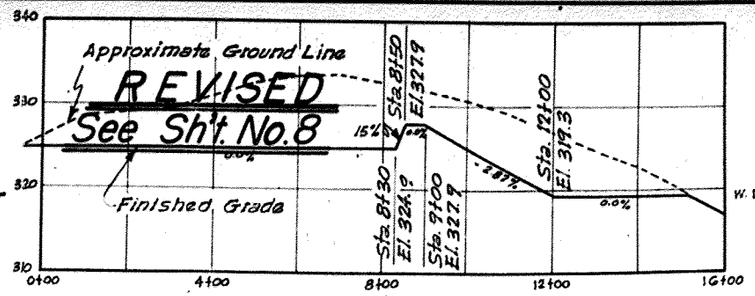
LOG OF SPILLWAY BORINGS

SEE PLAN OF EMBANKMENT AND SPILLWAY

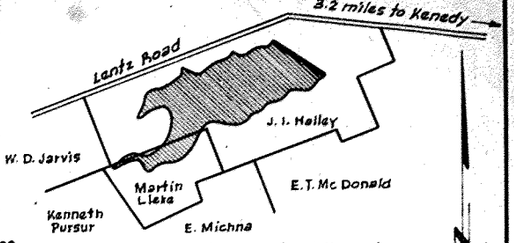
All material in spillway excavation is suitable for use in forming the embankment.

"AS BUILT" PLANS

This set of plans constitutes the only record of construction changes and must be retained in Contractor's files.



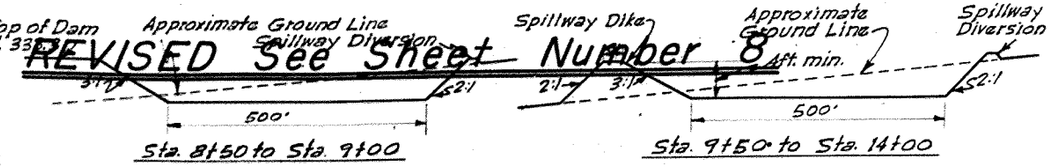
PROFILE ON ℄ OF SPILLWAY



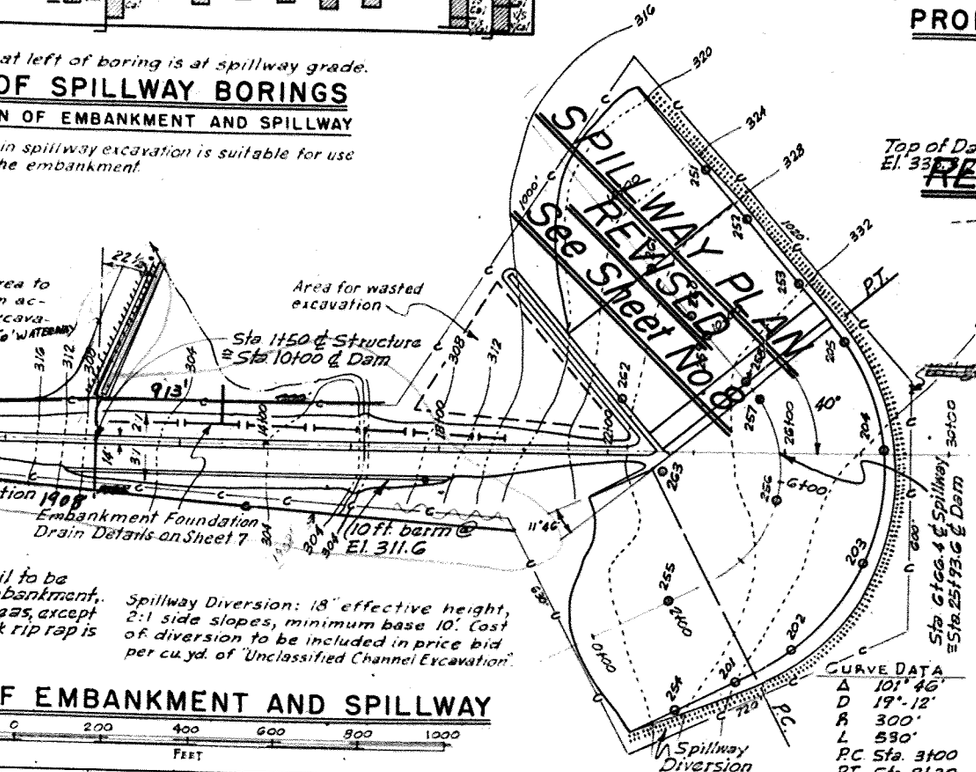
Located 3.2 miles west of Kenedy, Kerres County, Texas.

VICINITY MAP





TYPICAL SPILLWAY SECTIONS

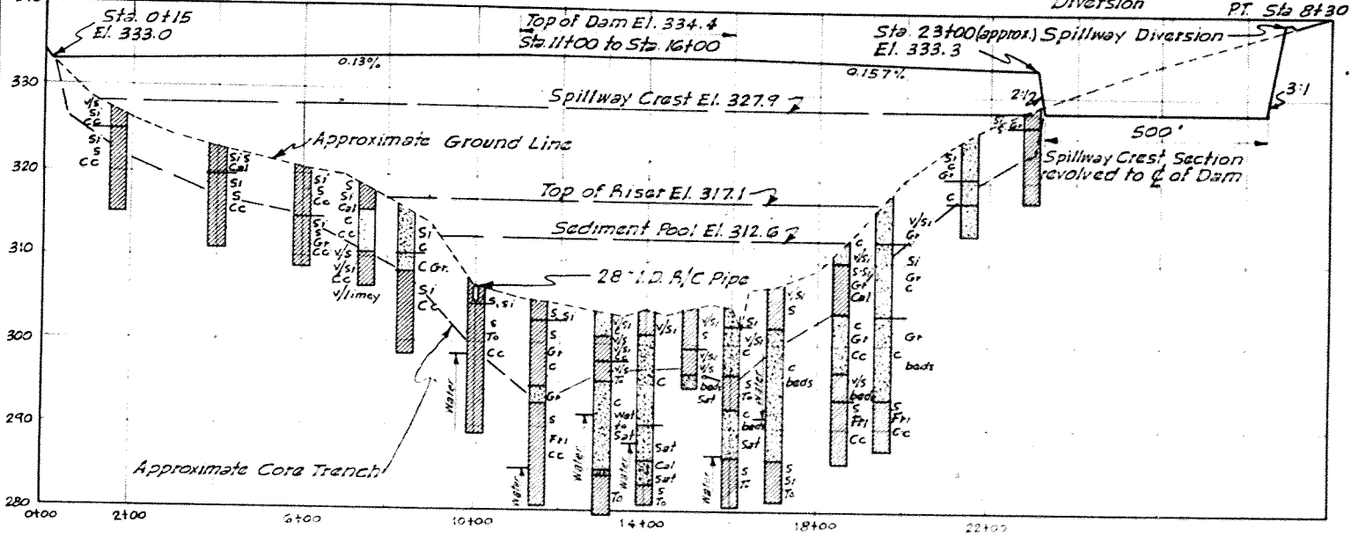


A minimum of 6 inches of topsoil to be placed in Spillway and on all Embankment, dike, spillway slopes and waste areas, except where rock is encountered or rock rip rap is placed. Refer to specifications.

Spillway Diversion: 18" effective height, 2:1 side slopes, minimum base 10'. Cost of diversion to be included in price bid per cu. yd. of "Unclassified Channel Excavation".

PLAN OF EMBANKMENT AND SPILLWAY



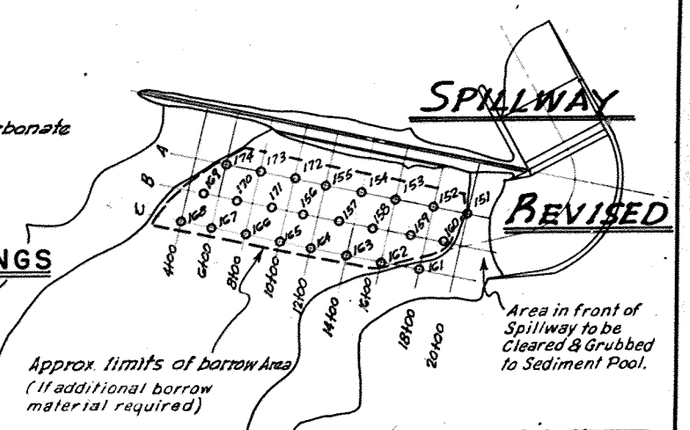


PROFILE ON ℄ OF DAM

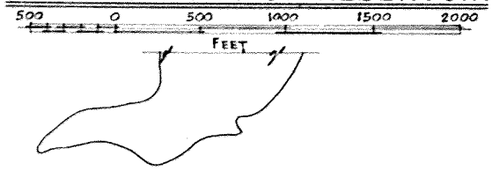
Sand, Clay, Gravel

C Clay
S Sand
Si Silt
Gr Gravel
Cal Calcareous
Cc Calcium Carbonate
Sat Saturated
V/ Very
To Tough
Fri Friable

LEGEND OF BORINGS



GENERAL PLAN OF RESERVOIR



Elevation	Surface Acres	Storage Acre Ft.	Storage Inches
312.6	51.5	200.0	0.60
315.0	75.3	352.2	1.06
317.1	95.9	532.0	1.60
319.0	109.2	721.2	2.17
323.0	151.7	1243.0	3.74
327.9	250.7	2229.0	6.70
331.0	300.8	3060.0	9.20

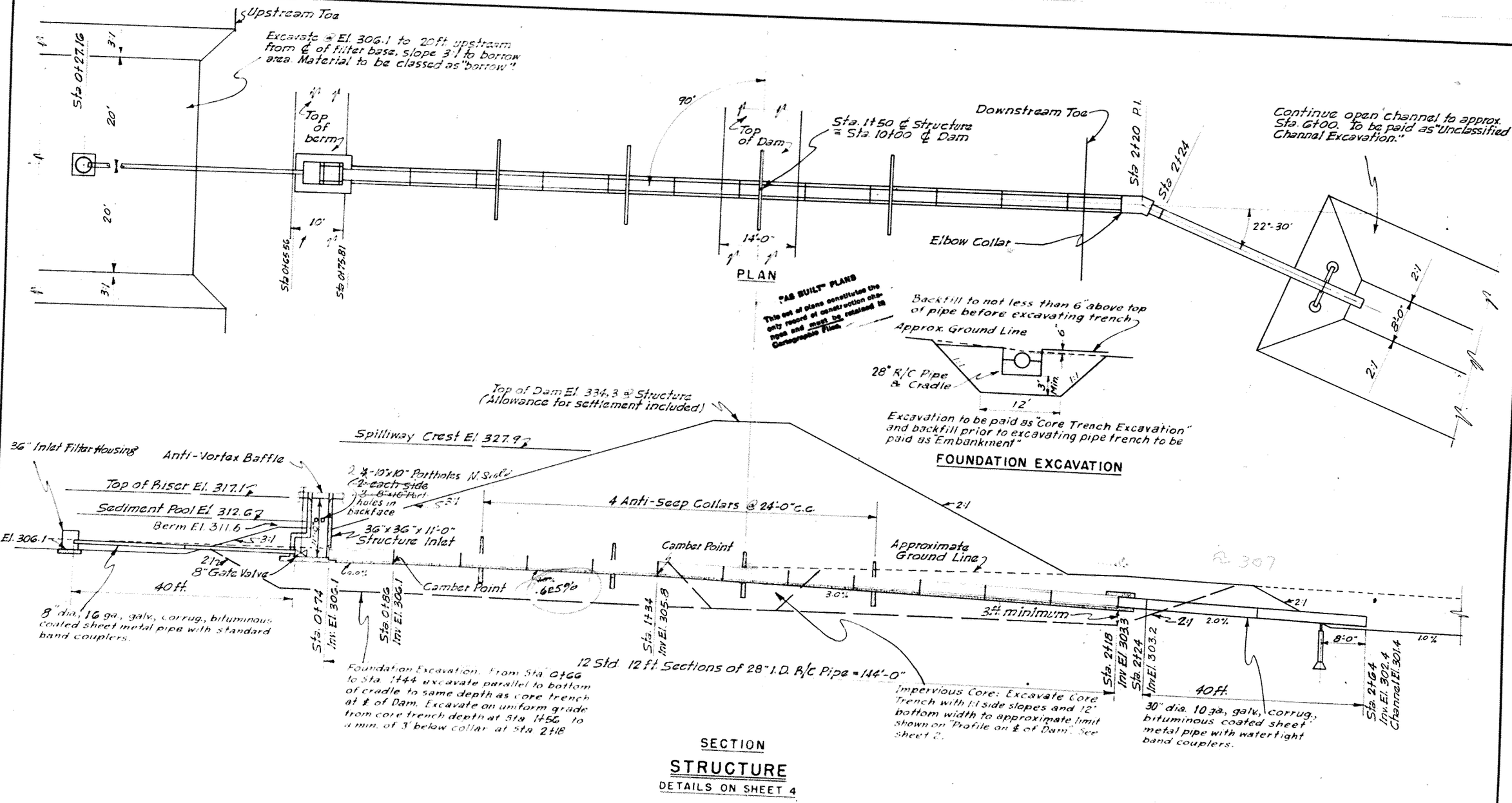
Top of Dam (Effective) Elev.	333.0
Spillway Crest Elev.	327.9
Top of Riser Elev.	317.1
Sediment Pool Elev.	312.6
Drainage Area, Acres	3992
Sediment Storage, Ac. Ft.	532
Floodwater Storage, Ac. Ft.	1697

Spillway Revised 5/56

GENERAL PLAN AND PROFILE
FLOODWATER RETARDING STRUCTURE SITE No. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED – TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed C.E.C.	Date 4/56	Approved by	
Drawn C.E.C. & D.S.	4/56		
Traced D.S.	4/56	Sheet No. 2 of 8	Drawing No. 4-E-10,440
Checked C.E.C.	4/56		



Spillway Revised 5/56

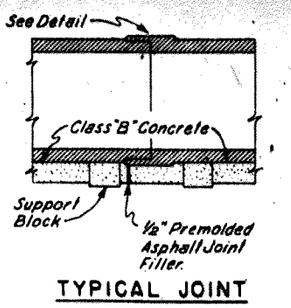
STRUCTURE — PLAN AND SECTION
FLOODWATER RETARDING STRUCTURE SITE No. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED — TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

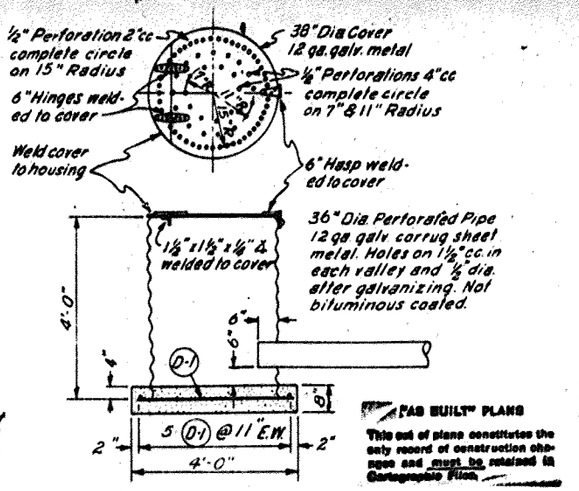
Designed C.E.C.	Date 4/56	Approved by	
Drawn C.E.C. & D.S.	4/56	AREA ENGINEERING & WATERSHED PLANNING UNIT, POST WORTH, TEXAS	
Traced D.S.	4/56	STATE CONSERVATION ENGINEER, TEMPLE, TEXAS	
Checked C.E.C.	4/56	Sheet No. 3	Drawing No.

FOR TYPICAL BAR TYPES REFER TO A.C.I. STANDARD 315-48

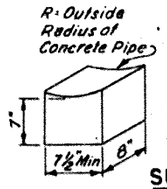
Bar No	Location	Qty.	Lgth	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
A-1	Anti-Seep Collar	6	16-2	97-0	4	Str										
A-2	" " "	12	9-2	110-0	4	"										
A-3	" " "	6	2-8	16-0	4	"										
A-4	" " "	4	5-6	22-0	4	"										
A-5	" " "	2	6-6	13-0	4	"										
A-6	" " "	2	4-0	8-0	4	"										
A-7	" " "	2	7-0	14-0	4	"										
A-8	" " "	2	3-0	6-0	4	"										
	Total Steel in One Anti-Seep Collar (Size 4) = 284'-0" = 189.7 lbs.															
	Class "A" Concrete in One Anti-Seep Collar = 3.12 cu. yds															
B-1	Outfall Pipe Support	8	8-6	68-0	4	1	0-9	7-9							0-6	
B-2	" " "	1	9-6	9-6	4	4	0-9	1-6	0-11	3-2	0-11	1-6	0-9	0-8		7-6
B-3	" " "	2	9-6	19-0	4	4	0-9	1-0	0-11	4-2	0-11	1-0	0-9	0-8		7-6
B-4	" " "	2	5-6	11-0	4	Str.										
	Total Steel in Outfall Pipe Support (Size 4) = 107'-6" = 71.81 lbs															
	Class "A" Concrete in Outfall Pipe Support = 0.68 lbs.															
C-1	Elbow Collar	8	5-9	46-0	4	14	4-2	1-7						0-7		
C-2	" "	2	5-3	10-6	4	14	3-11	1-4						0-7		
C-3	" "	4	5-0	20-0	4	14	3-9	1-3						0-6		
C-4	" "	2	4-9	9-6	4	14	3-7	1-2						0-5		
C-5	" "	8	4-6	36-0	4	14	3-6	1-0						0-4		
C-6	" "	10	9-3	92-6	4	2	2-7	4-1	2-7							
C-7	" "	10	7-9	77-6	4	2	2-3	3-3	2-3							
	Total Steel in Collar (Size 4) = 292'-0" = 195.1 lbs															
	Total Class "A" Concrete in Collar = 2.96 cu. yds															
	Class "A" Concrete in Pipe Cradle = 0.202 cu. yd per lin. ft.															
D-1	Inlet Filter Base	10	3-8	36-8	4	Str.										
	Total Steel in Inlet Filter Base (Size 4) = 36' 8" = 24.5 lbs.															
	Total Class "A" Concrete in Inlet Filter Base = 0.4 cu. yds.															



TYPICAL JOINT

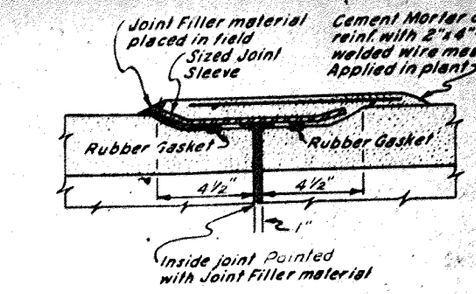


INLET FILTER HOUSING

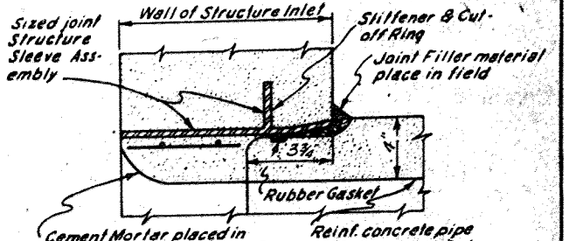


Precast Concrete Support Blocks may be set up to 24" from end of pipe joint. Use 2 blocks per joint of pipe.

SUPPORT BLOCK

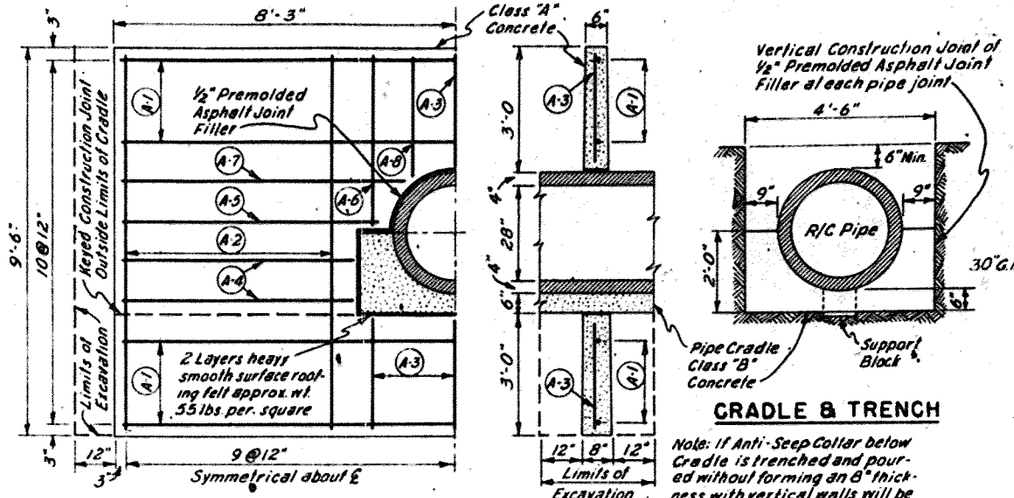


PIPE JOINT



STRUCTURE CONNECTION

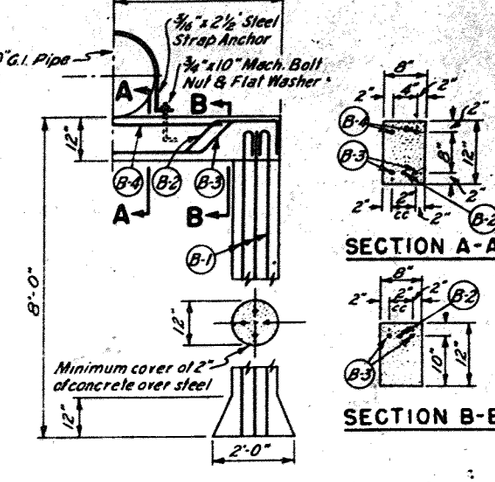
PIPE JOINT DETAILS



ANTI-SEEP COLLAR

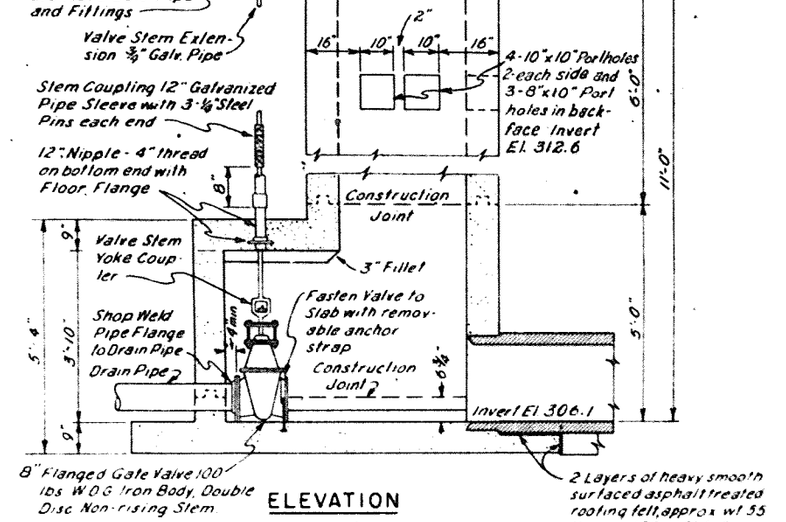
CRADLE & TRENCH

Note: If Anti-Seep Collar below Cradle is trenched and poured without forming an 8" thickness with vertical walls will be permitted, below Cradle

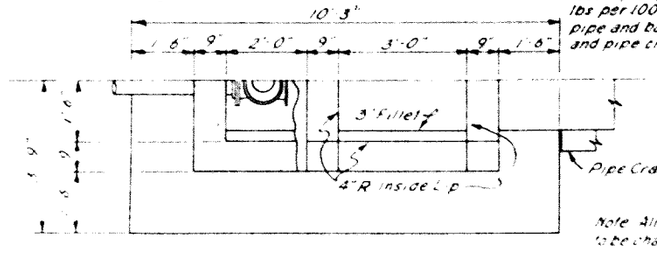


OUTFALL PIPE SUPPORT

Note Holes for supporting piers to be drilled or hand dug in natural ground



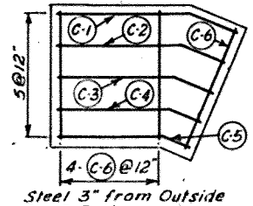
ELEVATION



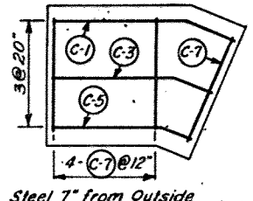
HALF PLAN

STRUCTURE INLET

Last joint of concrete pipe to have sized joint sleeve on both ends. Pack with Oakum between corrug. metal pipe and sized joint sleeve.

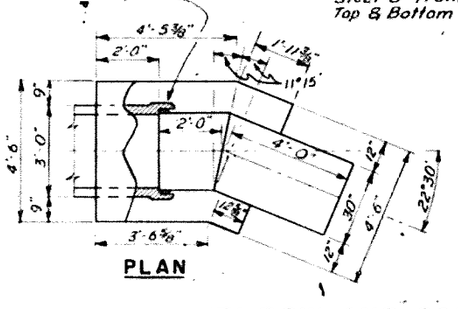


Steel 3" from Outside Top & Bottom

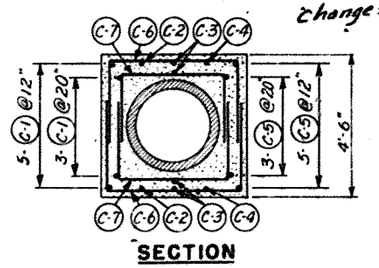


Steel 7" from Outside Top & Bottom

No Construction changes



PLAN



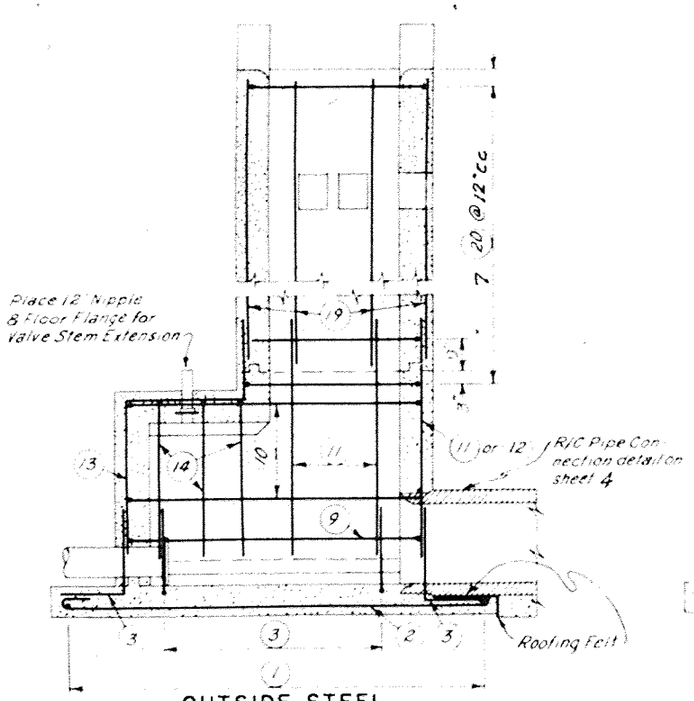
SECTION

ELBOW AND COLLAR DETAILS

Spillway Revised 5/56

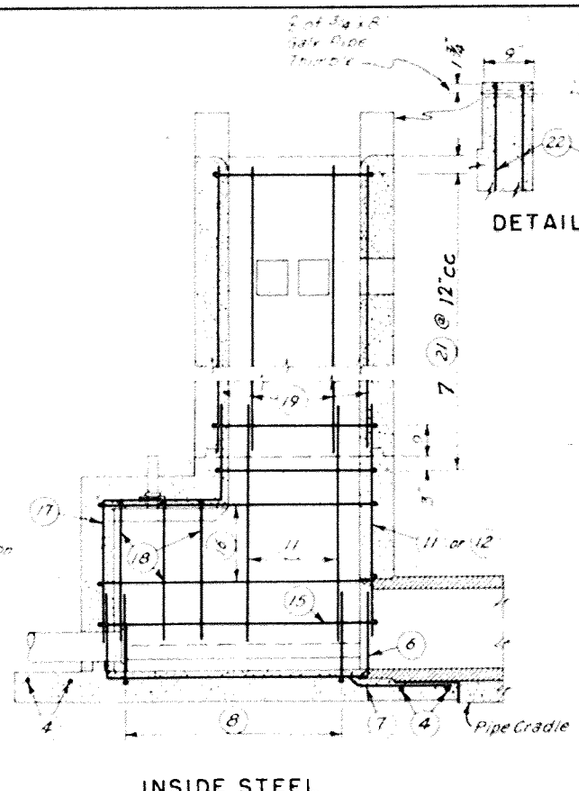
STRUCTURE DETAIL	
FLOODWATER RETARDING STRUCTURE SITE NO. 4	
ESCONDIDO CREEK WATERSHED	
OF THE	
SAN ANTONIO RIVER WATERSHED - TEXAS	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed C.E.C. date 4/56	Approved by
Drawn C.E.C. & R.D.B. date 4/56	
Traced R.D.B. date 4/56	
Checked C.E.C. date 5/56	Dwg. No. 4-E-10,440
	Sheet No. 4 of 8

le Valve & 48" Inlet Filter 28" R/C 4-E-10,081

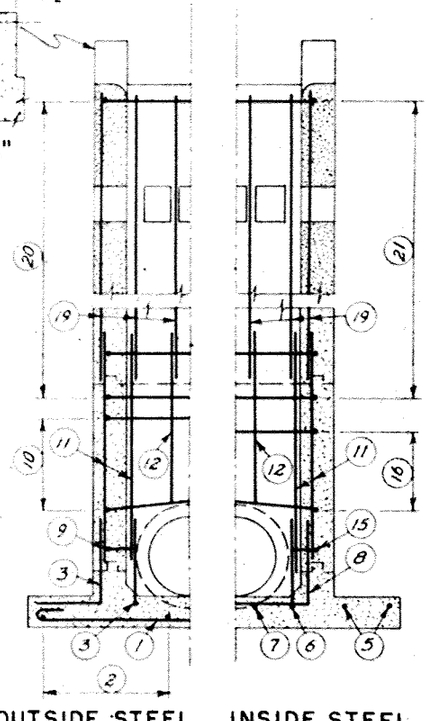


OUTSIDE STEEL

SECTION A-A



INSIDE STEEL



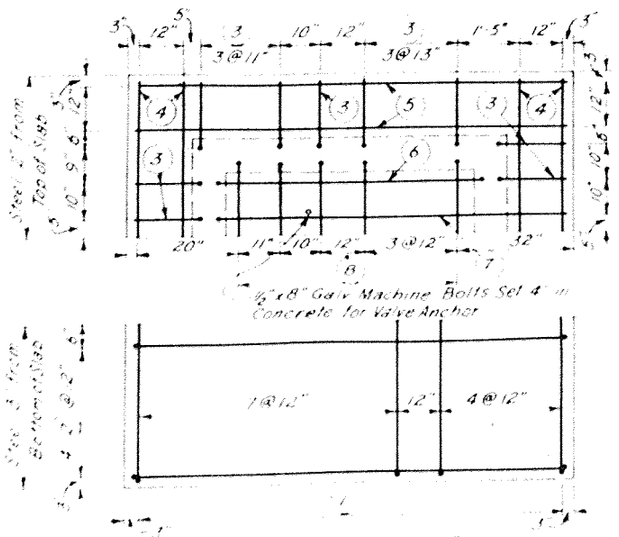
OUTSIDE STEEL INSIDE STEEL

SECTION B-B

FOR TYPICAL BAR TYPES REFER TO A.C.I. STANDARD 315-48														
Bar No.	Qty	Length	Total Length	Size	Type	A	B	C	D	E	G	H	J	O
1	11	8'-0	88'-0	4	1	0'-6	7'-0				0'-6		0'-4	
2	8	10'-9	86'-0	4	1	0'-6	9'-9				0'-6		0'-4	
3	22	3'-6	77'-0	4	2	1'-6	2'-0							
4	4	7'-0	28'-0	4	Str.									
5	4	9'-9	39'-0	4	Str.									
6	2	10'-1	20'-2	4	2	2'-0	6'-1				2'-0			
7	2	10'-0	20'-0	4	2	2'-0	8'-0							
8	6	7'-4	44'-0	4	2	2'-0	3'-4				2'-0			
9	2	10'-2	20'-4	4	2	2'-9	6'-10				0'-7			
10	6	12'-4	74'-0	4	2	2'-9	6'-10				2'-9			
11	18	5'-9	103'-6	4	Str.									
12	4	4'-0	16'-0	4	Str.									
13	6	8'-4	50'-0	4	8	3'-9	2'-9				1'-10			
14	3	11'-10	35'-6	4	2	3'-10	4'-2				3'-10			
15	2	9'-0	18'-0	4	2	2'-4	6'-1				0'-7			
16	6	10'-9	64'-6	4	2	2'-4	6'-1				2'-4			
17	4	8'-5	33'-8	4	8	3'-5	2'-9				2'-3			
18	3	10'-2	30'-6	4	2	3'-5	3'-4				3'-5			
19	32	5'-9	184'-0	4	Str.									
20	7	17'-10	124'-10	4	T2	0'-7	4'-2	4'-2	4'-2	4'-2	0'-7			
21	7	14'-6	101'-6	4	T2	0'-7	3'-4	3'-4	3'-4	3'-4	0'-7			
22	8	4'-3	34'-0	3	1	2'-0	2'-0						0'-3	
23	6	2'-8	16'-0	4	2	0'-10	1'-0				0'-10			

Total Size No 3 Steel in Inlet Structure = 36'-0" = 13.50 lbs.
" " - 4 " " " " = 1274'-6" = 851.37 lbs.
Total Steel = 864.87 lbs.
Class "A" Concrete in Inlet Structure = 7.47 cu. yds.
4-3/4" x 9" Galvanized Steel Pipe Thimbles

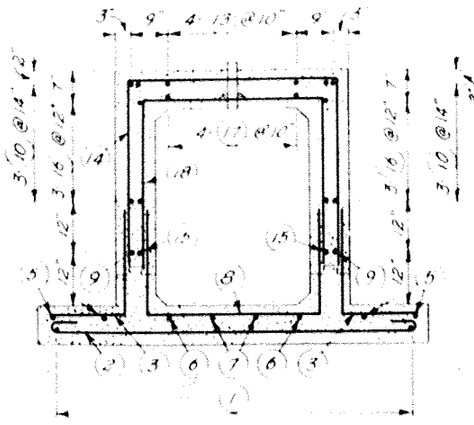
See Detail "A" for Bar No 22



SECTION C-C

SECTION E-E

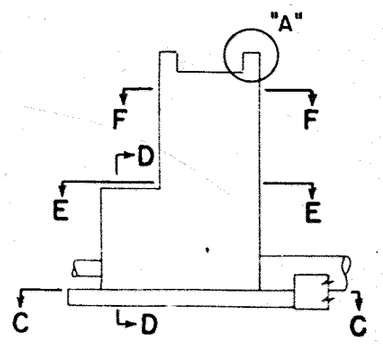
SECTION F-F



SECTION D-D

"AS BUILT" PLANS

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



No changes in construction

KEY TO SECTIONS
36" x 36" RISER

Spillway Revised 5/56

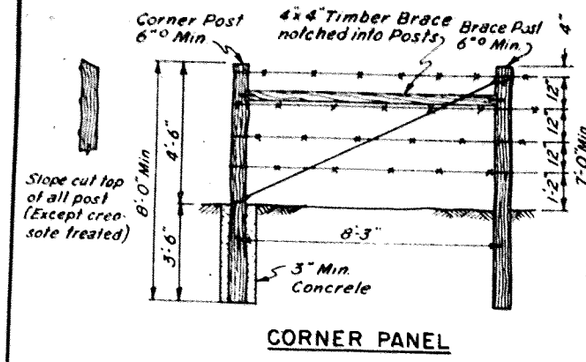
STRUCTURE INLET - STEEL PLACEMENT
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

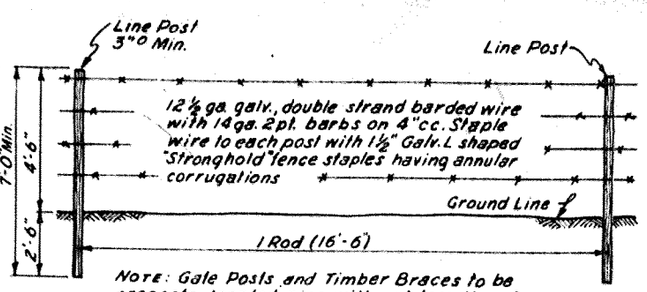
Designed	C.E.C.	date 4/56	Approved by W. M.
Drawn	C.E.C. & B.D.B.	date 4/56	HEAD, ENGINEERING WATERSHED PLANNING UNIT
Traced	B.D.B.	date 4/56	STATE CONSERVATION ENGINEER A. & M. COLLEGE, TEXAS
Checked	C.E.C.	date 5/56	Dwg. No. 4-E-10,440
			Sheet No. 5 of 8

Steel Placement, 36 x 36 Structure Inlet W/Valve Box.

Supp. 4-E-9741
3-1955

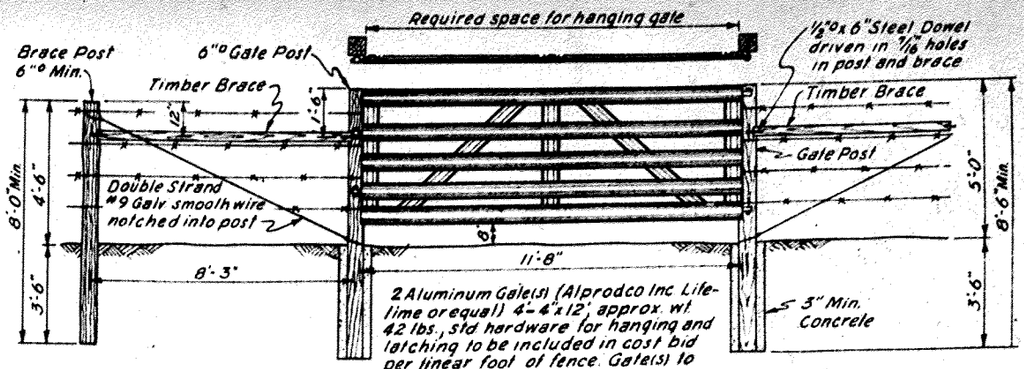


CORNER PANEL



Note: Gate Posts and Timber Braces to be creosote treated pine with not less than 8 lbs. retention per cu. ft. Preservative shall meet requirements of Federal Specifications TT-W-566a. See Specifications For Fence Post Material.

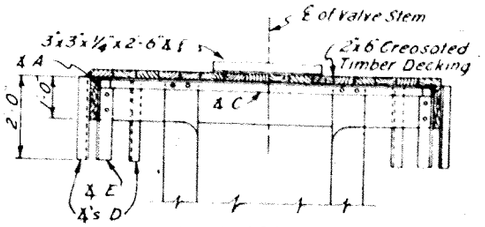
LINE PANEL



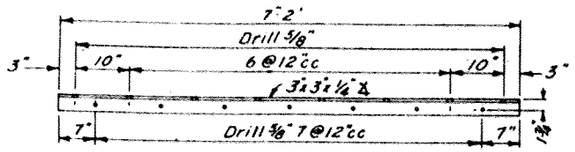
2 Aluminum Gate(s) (Alprodco Inc Lifetime or equal) 4'-4"x12', approx. wt. 42 lbs., std hardware for hanging and latching to be included in cost bid per linear foot of fence. Gate(s) to be DOUBLE LATCHED

GATE PANEL

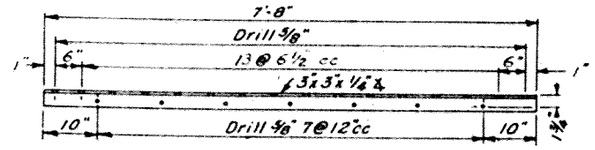
FENCE DETAILS



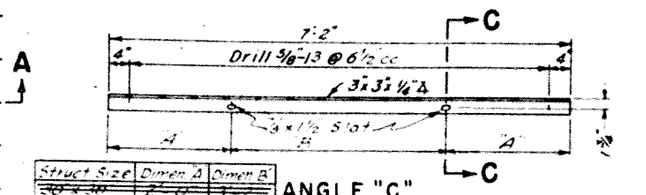
SECTION A-A



ANGLE "A"

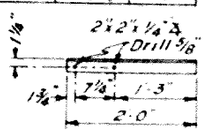


ANGLE "B"

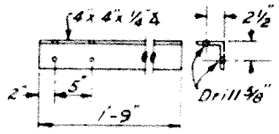


Struct Size	Dimen A	Dimen B
30" x 30"	2'-6"	3'-3"
36" x 36"	3'-0½"	3'-9"

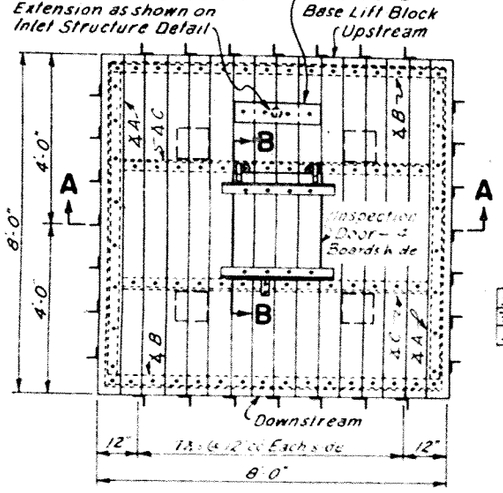
ANGLE "C"



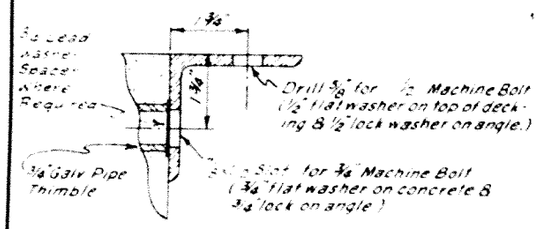
ANGLE "D"



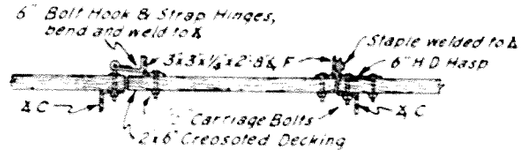
ANGLE "E"



PLAN



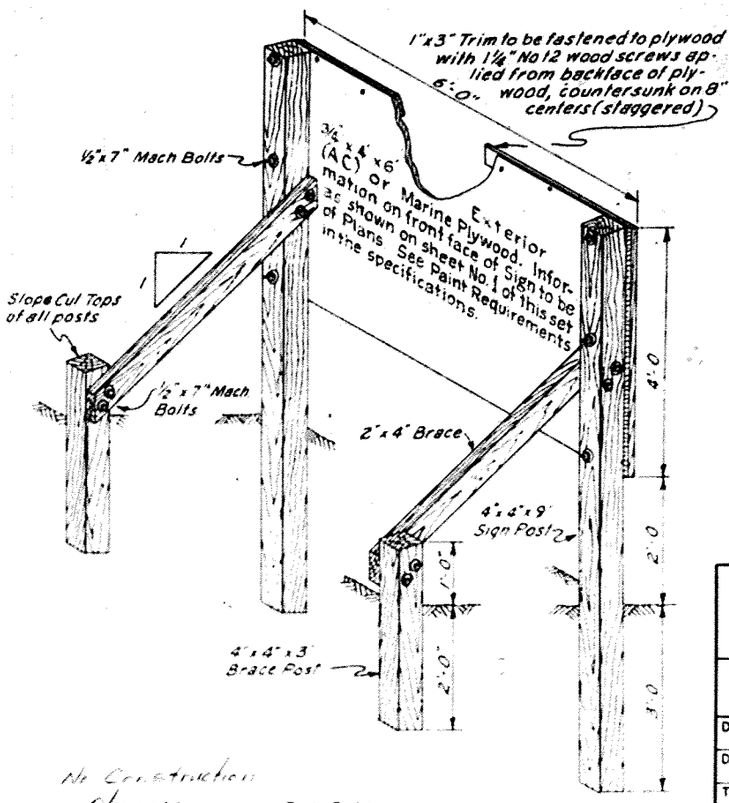
SECTION C-C



SECTION B-B

ANTI-VORTEX BAFFLE

"AS BUILT" PLANS
This set of plans constitutes the only record of construction changes and must be retained in Cartographic Files



SIGN

	Quan.	Item
Anti-Vortex Baffle	2	3"x3"x¼"x7'-2" ∠ A
	2	3"x3"x¼"x7'-8" ∠ B
	2	3"x3"x¼"x7'-2" ∠ C
	28	2"x2"x¼"x2'-0" ∠ D
	4	4"x4"x¼"x1'-9" ∠ E
	2	3"x3"x¼"x2'-8" ∠ F
	1	6" Heavy Duty Hinge Hasp
	1pr	6" Bolt Hook & Strap Hinge
	4	¾"x10½" Machine Bolts (Galvanized)
	4	¾" Flat Washers (Galvanized)
	4	¾" Lock Washers (Galvanized)
	141	½"x 4" Machine Bolts (Galvanized)
	10	½"x 4" Carriage Bolts (Galvanized)
	157	½" Flat Washers (Galvanized)
	155	½" Lock Washers (Galvanized)
	2	½"x5" Machine Bolts (Galvanized) *
	2	½"x6" Machine Bolts (Galvanized) *
	1	2"x6"x2'-0" No. 1 Rough Pine (Treated) *
	2	2"x12"x8'-0" No. 1 Rough Pine (Treated)
	2	2"x12"x7'-6" No. 1 Rough Pine (Treated)
	15	2"x6"x8'-0" No. 1 Rough Pine (Treated)
	4	¾" Lead Washers
Sign	2	4"x4"x9'-0" No. 1 Rough Pine (Treated)
	2	4"x4"x3'-0" No. 1 Rough Pine (Treated)
	2	2"x4"x6'-0" No. 1 Rough Pine (Treated)
	1	¾"x4'x6' Marine Plywood
	2	1"x3"x6'-0" No. 1 Pine S4S
	2	1"x3"x4'-0" No. 1 Pine S4S
	14	½"x 7" Machine Bolts (Galvanized
	28	½" Flat Washers (Galvanized)
	14	½" Lock Washers (Galvanized)
	38	1¼" No. 12 Wood Screws (Galvanized)

* Required only when Sluice Gate is used.

All angles to be shop painted with one coat of red lead. One field coat of red lead, and one coat of aluminum paint to be applied after baffle is assembled.

All treated wood material to be creosote with not less than 8 lbs retention per cu. ft. Preserative shall meet Federal Specifications TT-W-566-A

Where bearing is on wood, all bolt heads and nuts to be backed with flat washers. Use lock washer under each nut.

No changes in Construction

ANTI-VORTEX BAFFLE AND FENCE DETAIL
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

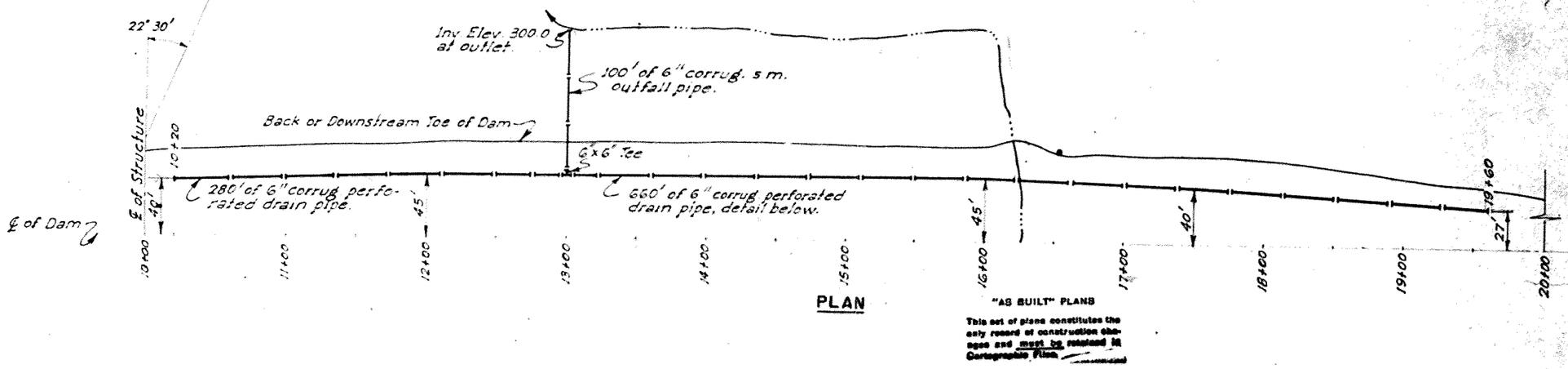
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	C.E.C.	date 4/56	Approved by W. M. HEAD, ENGINEERING & WATERSHED PLANNING UNIT
Drawn	C.E.C. & R.D.B.	date 4/56	
Traced	R.D.B.	date 4/56	STATE CONSERVATION ENGINEER, S.C.S. TEMPLE, TEXAS
Checked	C.E.C.	date 5/56	Dwg. No. 4-E-10,440
			Sheet No 6 of 8

No Construction Changes

Spillway Revised 5/56
(Revised 5-23-54)

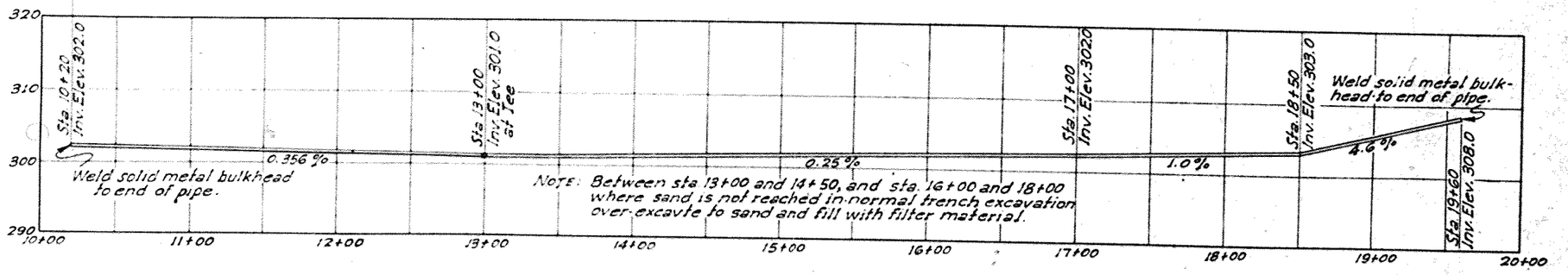
Anti-Vortex Baffle and Fence Detail Base 4-E-9672



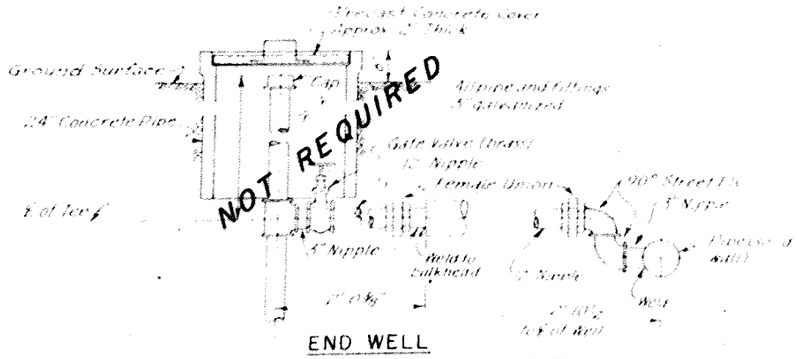
PLAN

"AS BUILT" PLANS

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



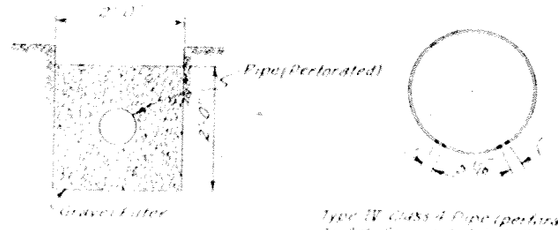
PROFILE



END WELL

INTERMEDIATE WELL

RELIEF WELL



TRENCH FOR PERFORATED PIPE

Gradation of Filter Material.

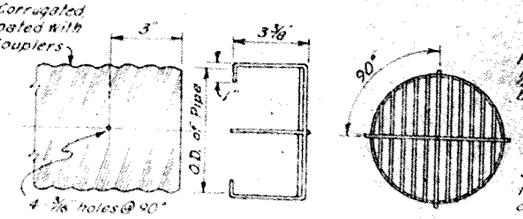
Screen Size	% Passing
1"	100
1/2"	95-100
No. 4	75-95
" 16	20-70
" 50	5-25
" 100	0-15
" 200	< 10

Type M Class 4 Pipe (perforated), 16 Ga. Galv. Corrugated S.M. Bituminous Coated with Standard Band Couplers. Perforations in valley to be No. after coating with not less than 4 holes per lineal ft. of pipe and beginning 4" from each end of each section.

PERFORATED PIPE

Cover perforations in pipe with not less than a 10" strip of #10 mesh copper screen. Wrap with wire at intervals close enough to assure complete coverage of all perforations.

Type 1, Class 4 Pipe (solid wall), 16 Ga., Galv. Corrugated S.M. Bituminous Coated with Standard Band Couplers



Fabricate of ½" ø on ½" cc (install with bars vertical)

Note: Adjust dimensions as necessary if circumferentially corrug. pipe is used.

OUTFALL PIPE (COLLECTOR LINE)

No Changes in Construction

RODENT GUARD

(1 REQUIRED EACH OUTFALL LINE)

No Construction Changes Spillway Revised 5/56

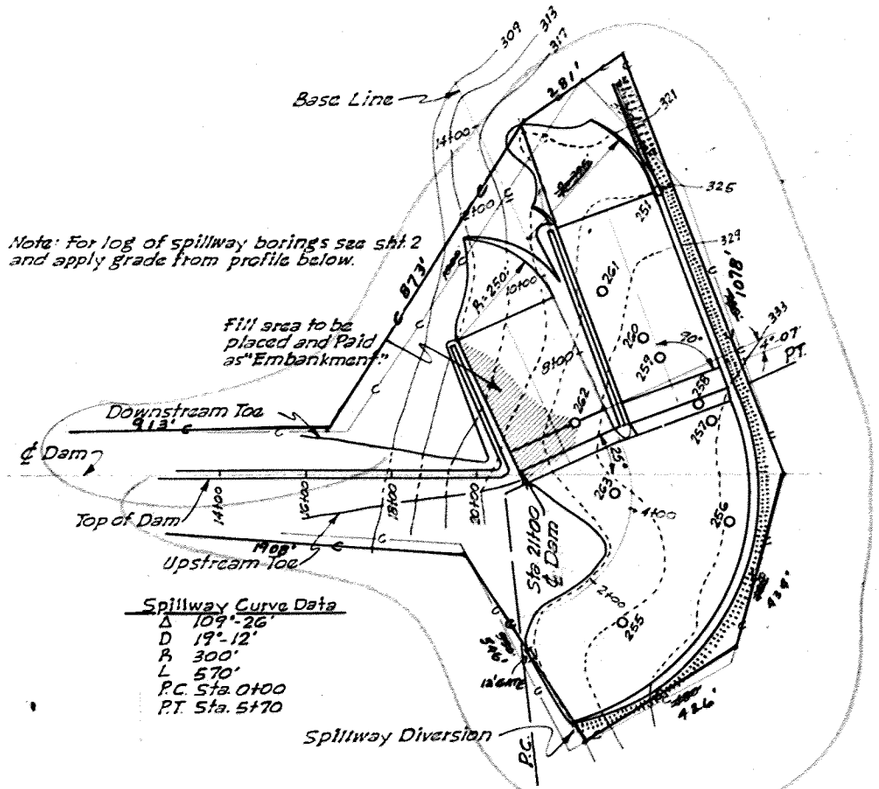
FOUNDATION DRAINAGE
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	C.E.C.	date 5-11-56	Approved by
Drawn	C.E.C.	date 5-11-56	
Traced	H.S.W.	date 5-14-56	
Checked	C.E.C.	date 5-56	Dwg. No. T-E-10,440
			Sheet No. 7 of 8

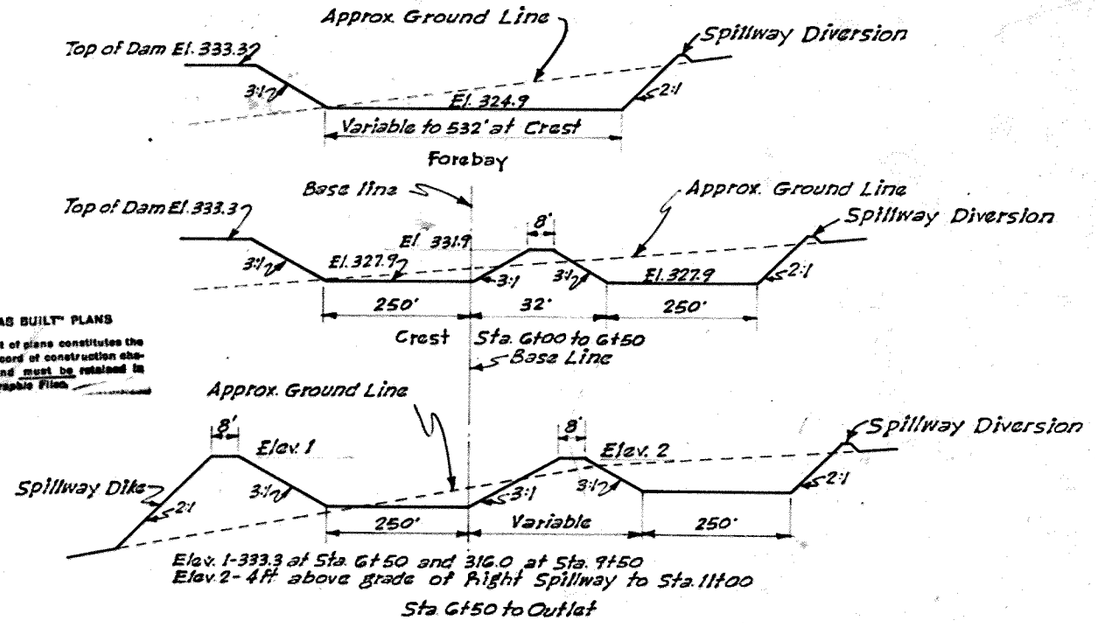
RELIEF WELL AND DRAIN PIPE DETAIL

Relief Well and Drain Pipe Detail

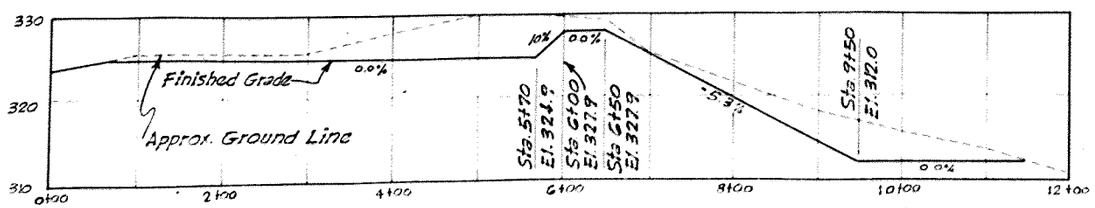


PLAN OF SPILLWAY

200 0 200 400 600
Feet

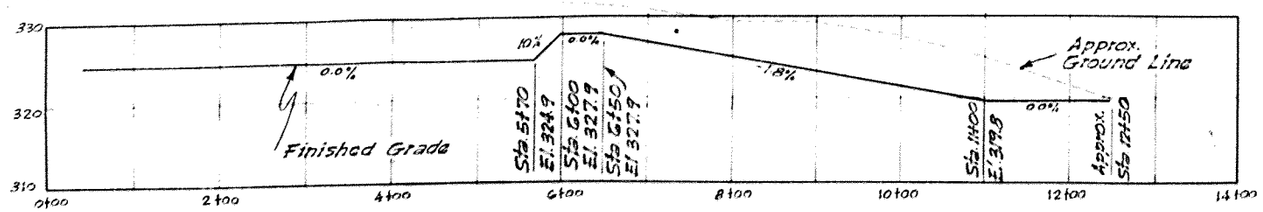


TYPICAL SPILLWAY SECTIONS



Left

Common Forebay Section



Right

PROFILE ON ℄ OF SPILLWAYS

REVISED SPILLWAY
FLOODWATER RETARDING STRUCTURE SITE No. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	C.E.C.	5/56
Drawn	C.E.C. & D.S.	5/56
Traced	D.S.	5/56
Checked	C.E.C.	5/56

Approved by [illegible] Regional Conservation Engineer, Fort Worth, Texas
State Conservation Engineer, Temple, Texas

Sheet No. 8 of 8
Drawing No. 4-E-10,440

Plan Of Proposed Outfall Channel & Pipe

Profile Of Proposed Outfall Channel & Pipe

Typical Diversion Cross Section

Typical Cross Section Of Proposed Outfall Channel & Dyke

Profile Of Stilling Basin

Typical Cross Section of Stilling Basin

Earthwork Revisions by SCS completed on 9-2-59
Fencing " " " " No Change
" " Harnes SCD " " 9-15-59

PROPOSED OUTFALL PIPE EXTENSION & CHANNEL
AND
EMBANKMENT FOUNDATION DRAIN
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

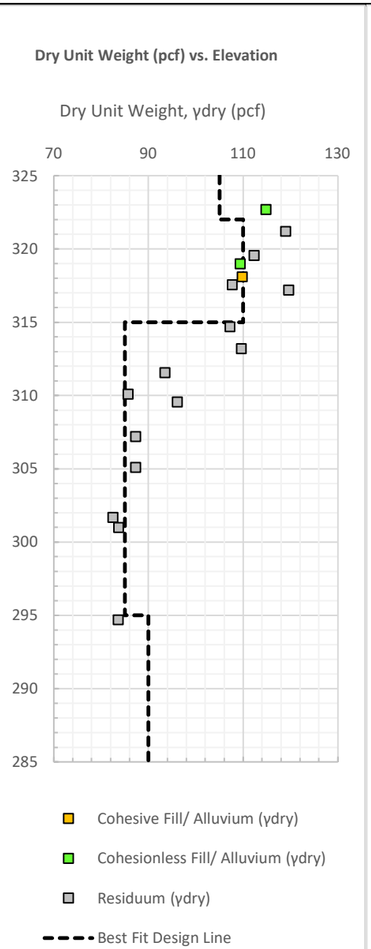
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

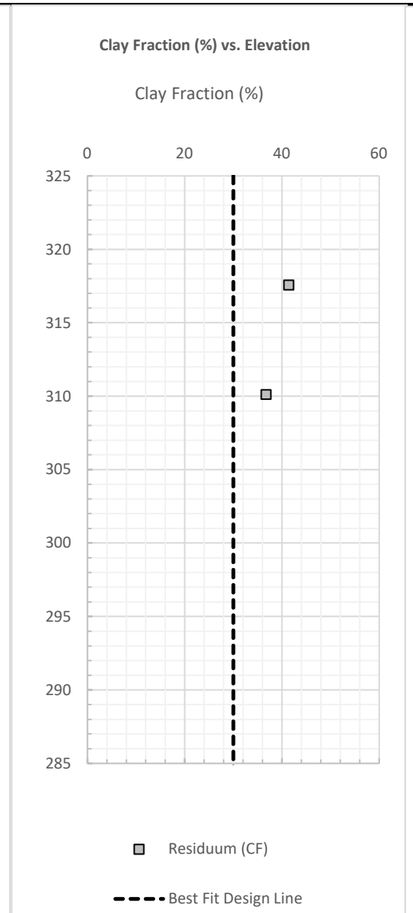
Designed
Drawn
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Checked
Date
Approved by
Title
Title
Sheet
Drawing No.
No.
of
4-F-10440

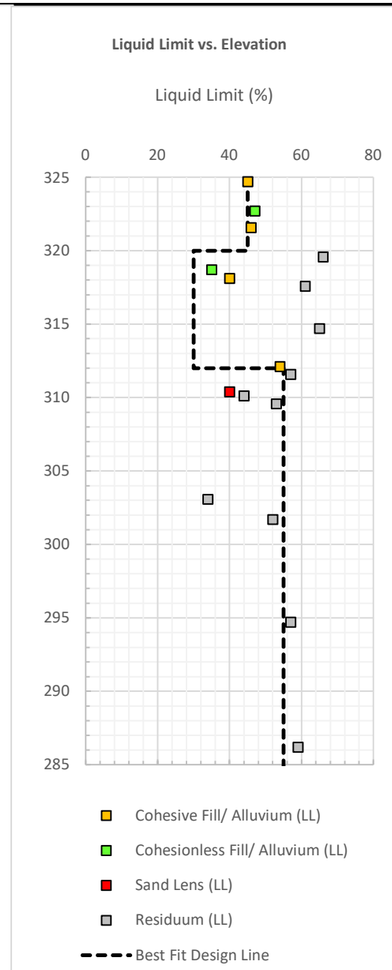
Appendix Sheet No. 2-A

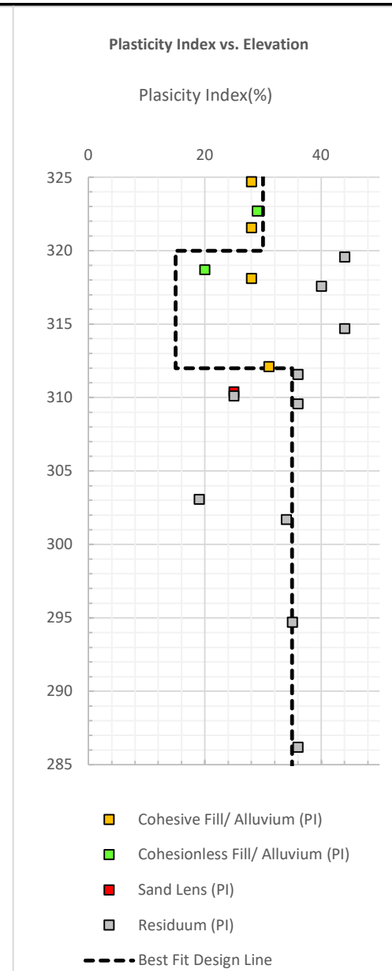
ATTACHMENT 2.

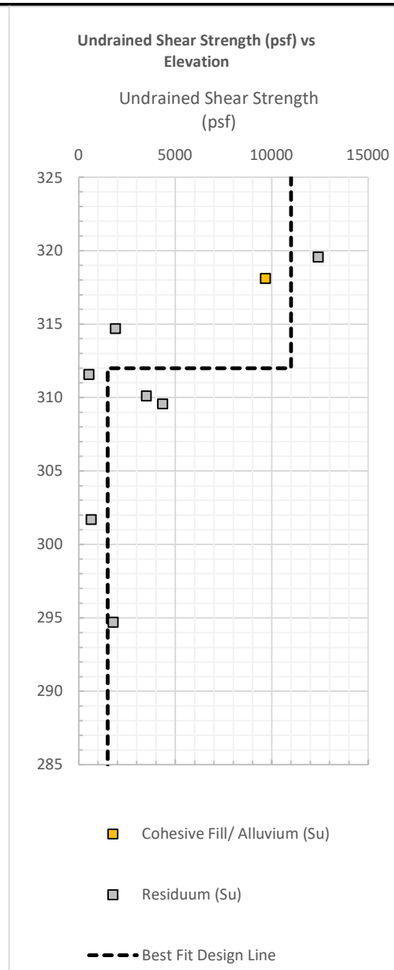
LABORATORY TEST DATA PLOTS FOR ASW BORINGS

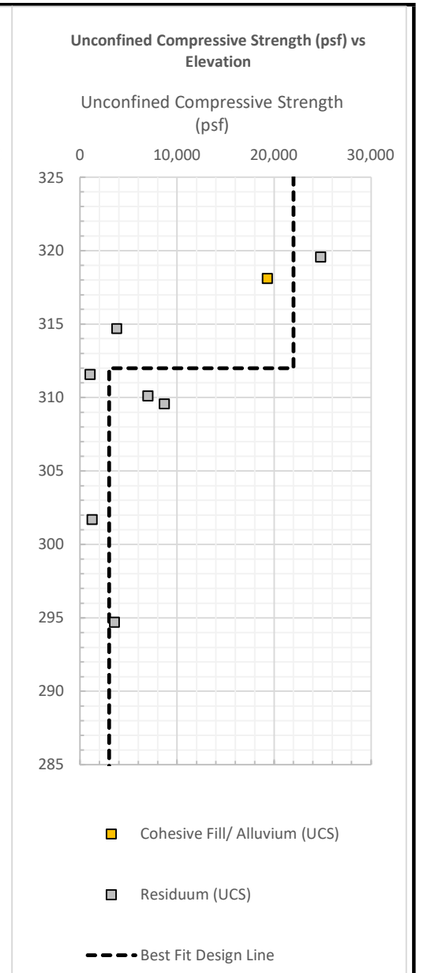




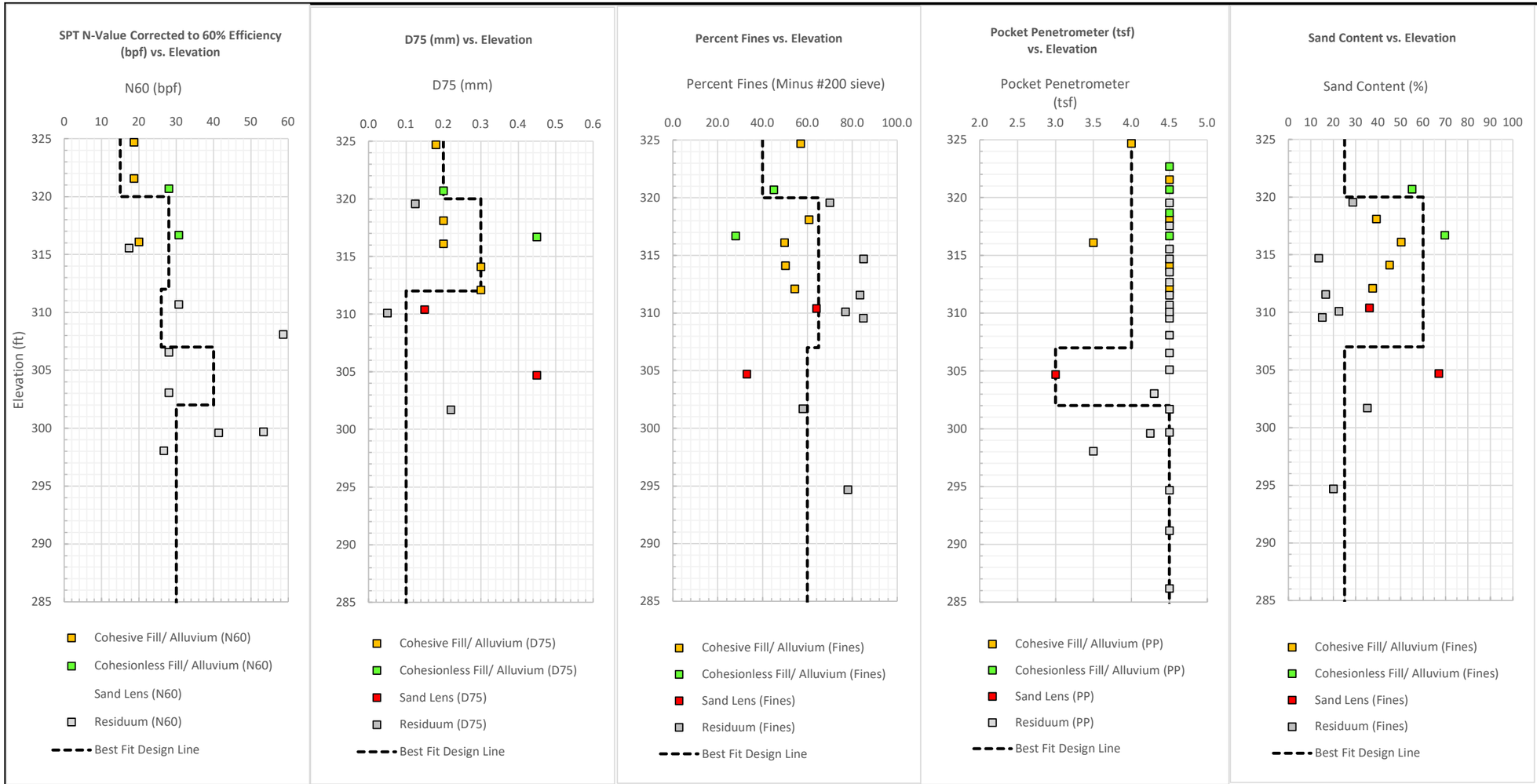




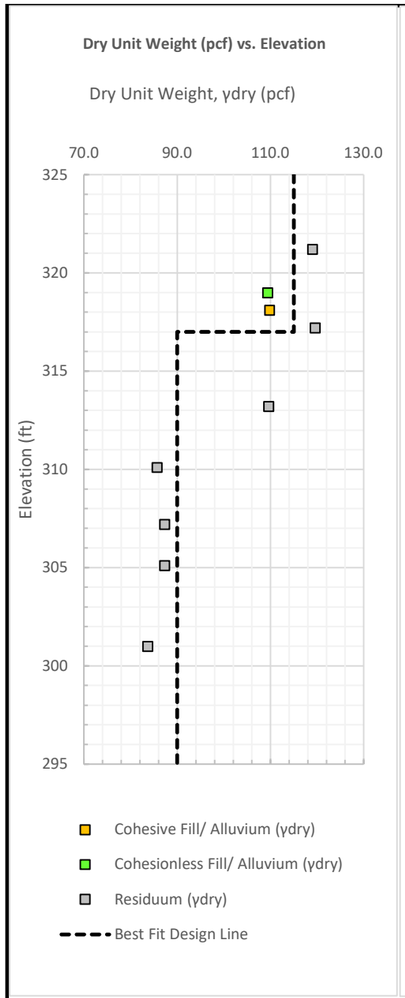


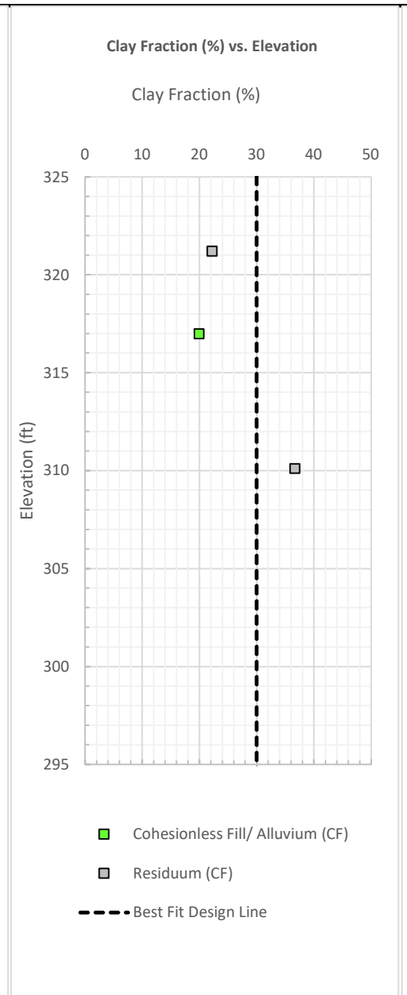


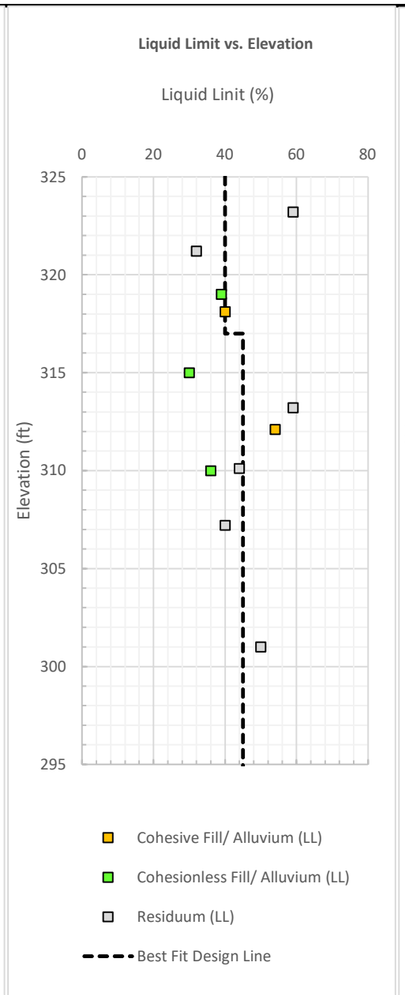
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Left ASW)	
AECOM	March 2024 / Attachment No. 1

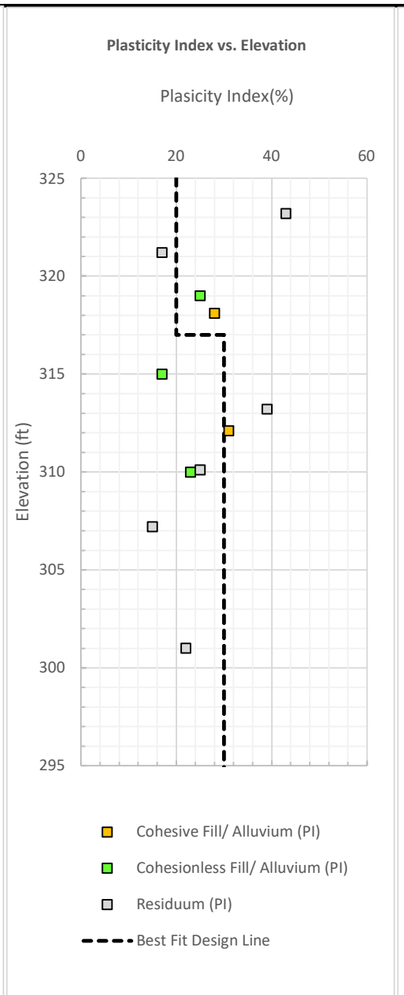


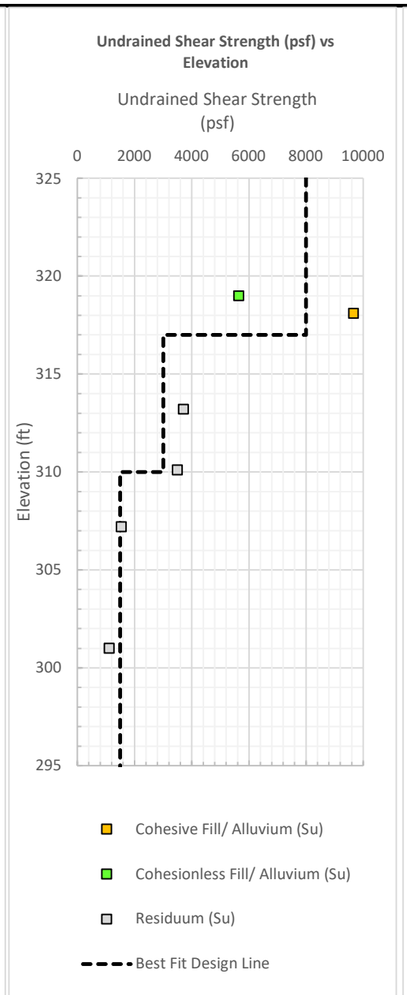
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Left ASW)	
AECOM	March 2024 / Attachment No. 2

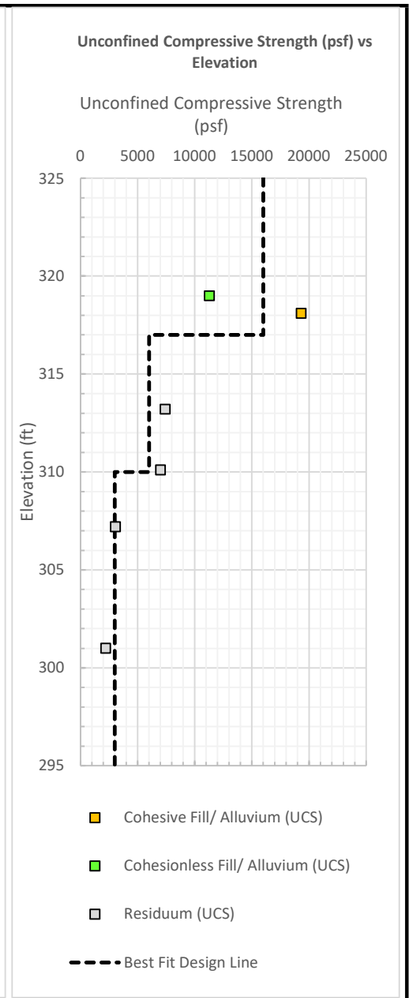




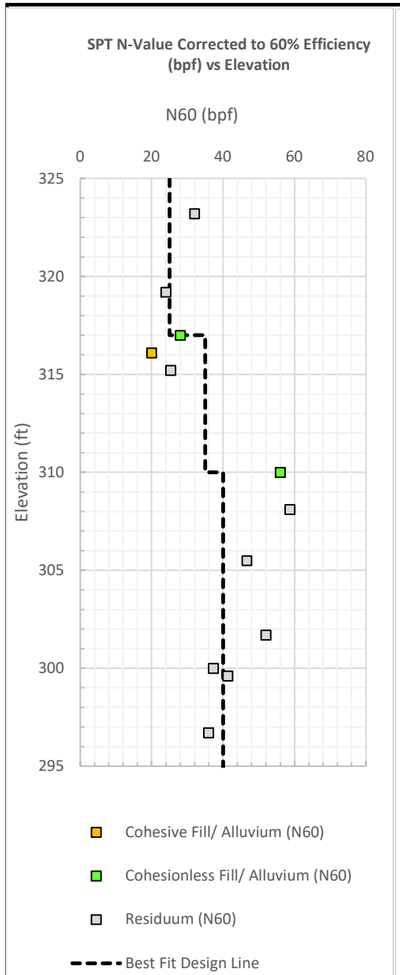


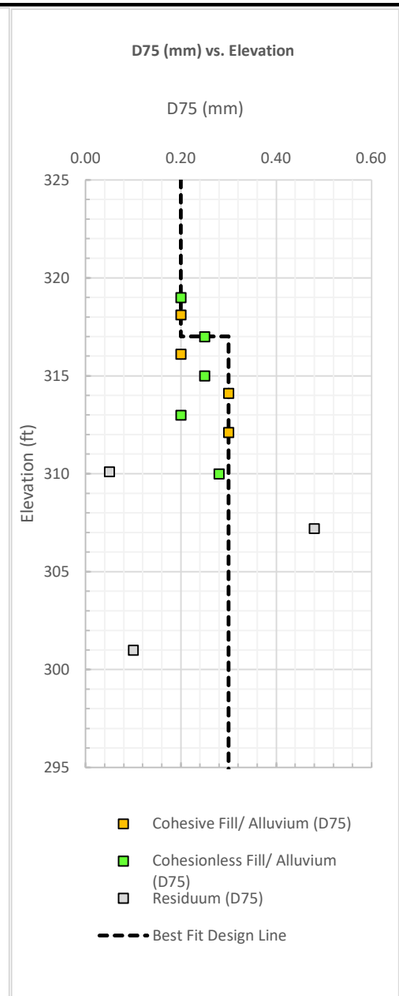


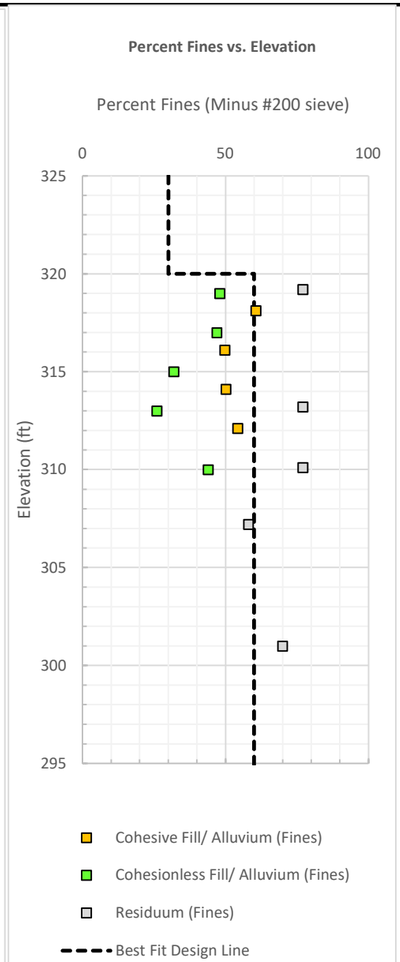


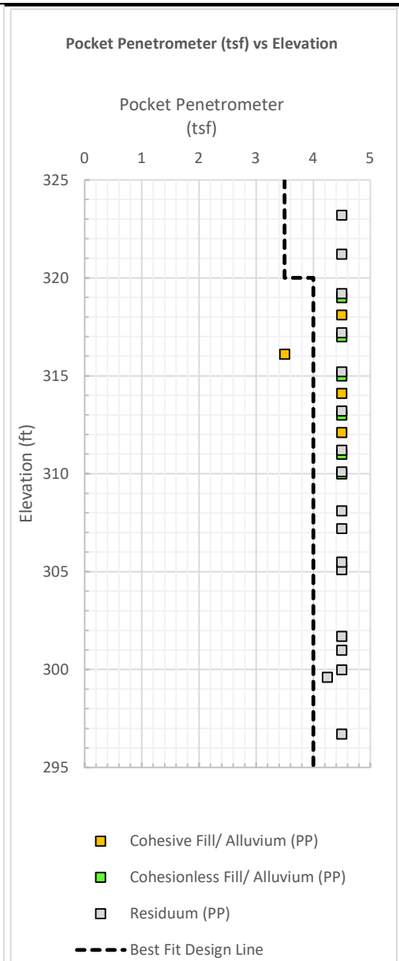


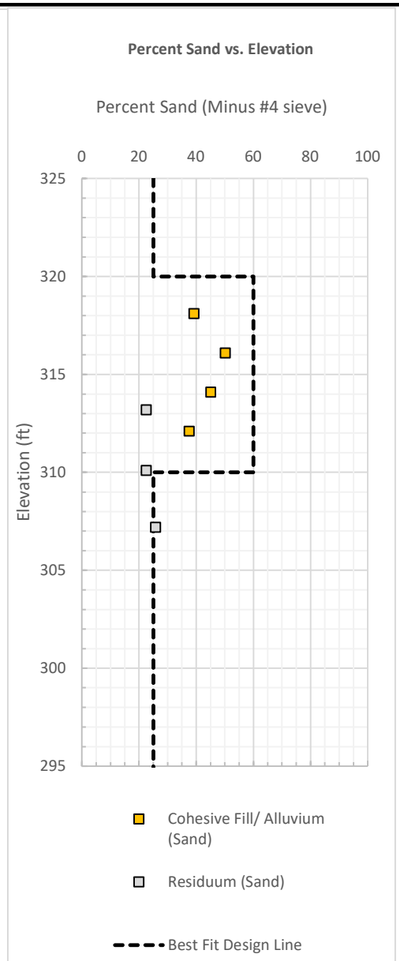
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Right ASW)	
AECOM	March 2024 / Attachment No. 2







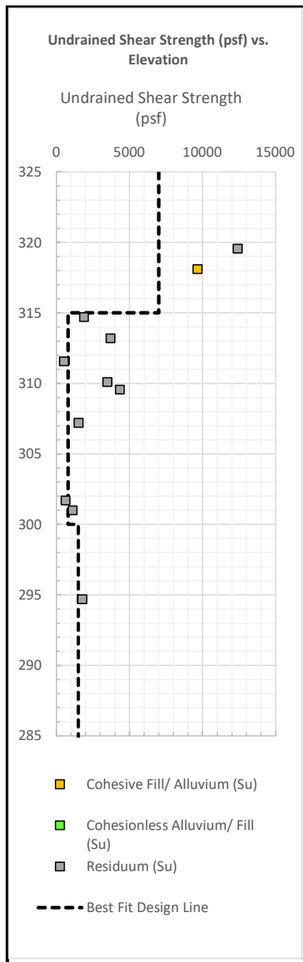


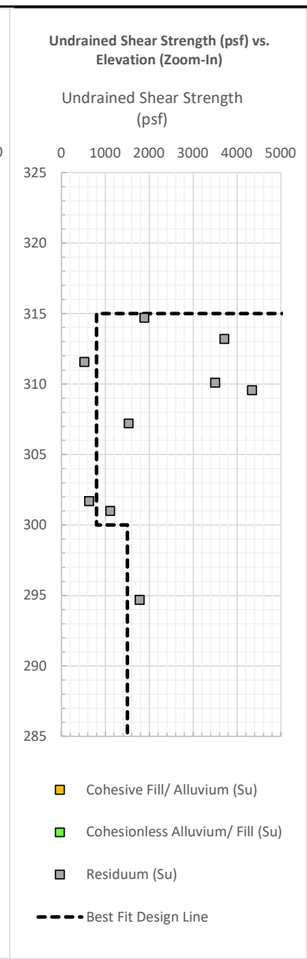


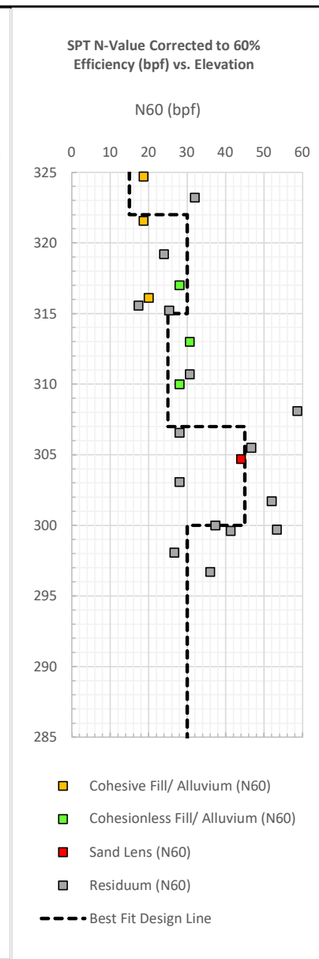
San Antonio River Authority Escondido FRS No. 4 SWP-EA		Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Right ASW)		
AECOM	March 2024	Attachment No. 2

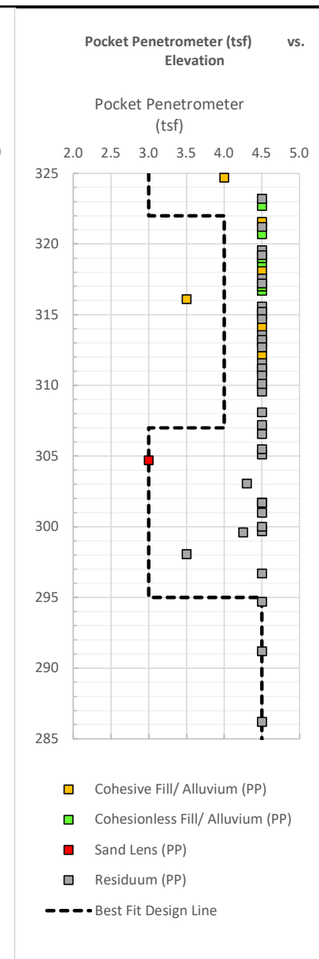
ATTACHMENT 3.

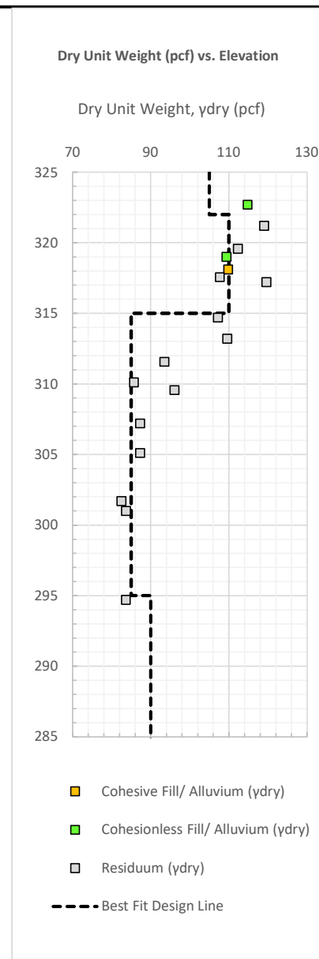
HEADCUT ERODIBILITY INDEX (Kh) CALCULATIONS











Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	LL	PI	% Passing No. 200 Sieve	UC (natural moisture)		
					WCn (%)	DDn (pcf)	Su (psf)
201-23	2	66	44	70	16	112	12400
201-23	10	57	36	83	26	94	520
203-23	10	65	44	85	18	107	1890
204-23	0	40	28	61	9	110	9660
204-23	8	44	25	77	32	86	3500
205-23	0	39	25	48	7	109	5640
Average		52	34	71	18	103	5602

Best Fit Design Lines

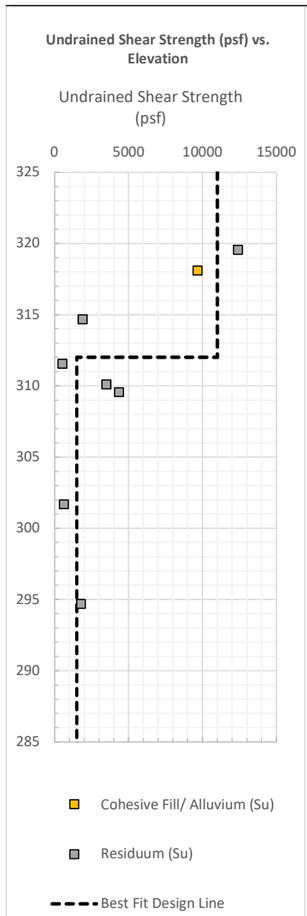
Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
0	7000	15	3	105
3	7000	15	3	105
3	7000	30	4	110
10	7000	30	4	110
10	800	25	4	85
18	800	25	4	85
18	800	45	3	85
25	800	45	3	85
25	1500	30	3	85
30	1500	30	3	85
30	1500	30	4.5	90
30	1500	30	4.5	90
40	1500	30	4.5	90
45	1500	30	4.5	90

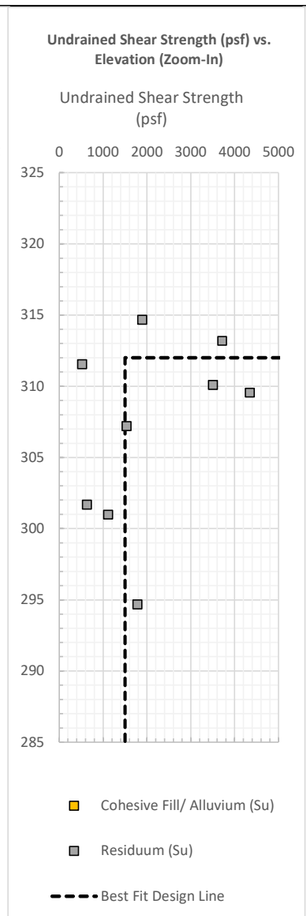
Estimated Kh Values

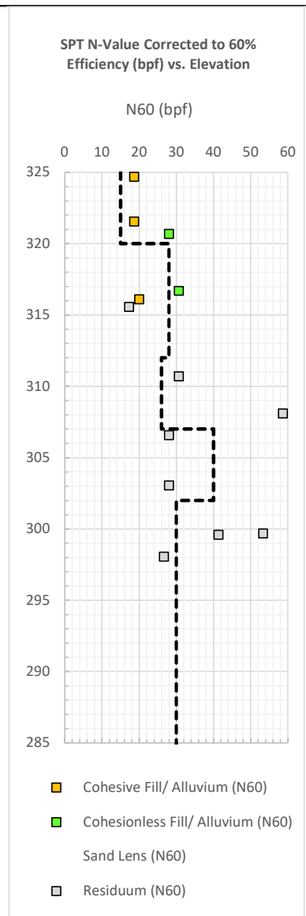
Depth(ft)	From Su1[(1)]	From Su2[(2)]	From N60[(3)]	From N60[(4)]	From PP1[(1)]	From PP1[(2)]	Avg
0	0.69	0.50	0.22	---	0.29	0.20	0.38
3	0.69	0.50	0.22	---	0.29	0.20	0.38
3	---	---	---	0.11	---	---	0.11
10	---	---	---	0.11	---	---	0.11
10	0.07	0.05	0.36	---	0.39	0.27	0.23
18	0.07	0.05	0.36	---	0.39	0.27	0.23
18	0.07	0.05	0.65	---	0.29	0.20	0.25
25	0.07	0.05	0.65	---	0.29	0.20	0.25
25	0.14	0.09	0.44	---	0.29	0.20	0.23
30	0.14	0.09	0.44	---	0.29	0.20	0.23
30	0.14	0.09	0.44	---	0.44	0.31	0.28
30	0.14	0.09	0.44	---	0.44	0.31	0.28
40	0.14	0.09	0.44	---	0.44	0.31	0.28
45	0.14	0.09	0.44	---	0.44	0.31	0.28

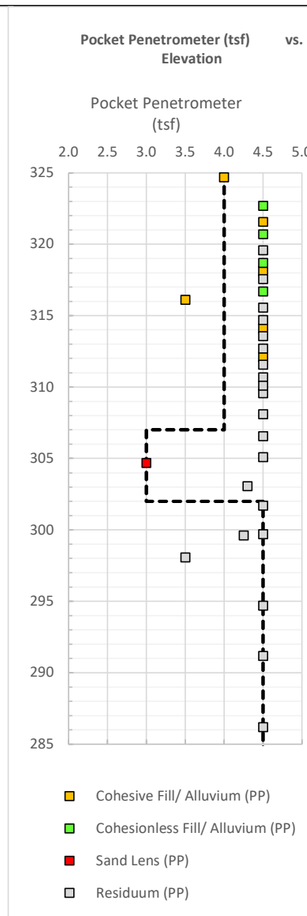
(1) Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4
(2) Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3
(3) Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3 (cohesive)
(4) Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2 (cohesionless)

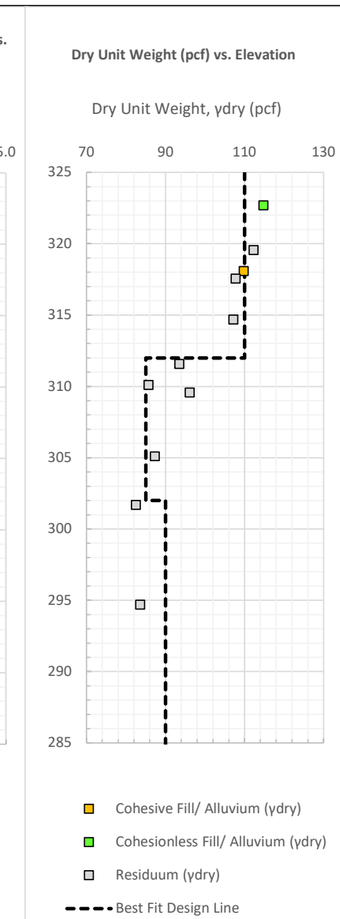
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Parameters for Kh Development (Depth)	
AECOM	March 2024
	Attachment No. 3











Best Fit Design Lines

Elevation(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
325	11000	15	4	110
320	11000	15	4	110
320	11000	28	4	110
312	11000	28	4	110
312	1500	26	4	85
307	1500	26	4	85
307	1500	40	3	85
302	1500	40	3	85
302	1500	30	4.5	90
295	1500	30	4.5	90
295	1500	30	4.5	90
295	1500	30	4.5	90
285	1500	30	4.5	90
280	1500	30	4.5	90

Estimated Kh Values

Elevation (ft)	From Su1[(1)]	From Su2[(2)]	From N60[(3)]	From N60[(4)]	From PP1[(1)]	From PP1[(2)]	Avg
325	1.09	0.83	0.22	---	0.39	0.27	0.56
320	1.09	0.83	0.22	---	0.39	0.27	0.56
320	---	---	---	0.10	---	---	0.10
312	---	---	---	0.10	---	---	0.10
312	0.14	0.09	0.38	---	0.39	0.27	0.26
307	0.14	0.09	0.38	---	0.39	0.27	0.26
307	---	---	---	0.15	---	---	0.15
302	---	---	---	0.15	---	---	0.15
302	0.14	0.09	0.44	---	0.44	0.31	0.28
295	0.14	0.09	0.44	---	0.44	0.31	0.28
295	0.14	0.09	0.44	---	0.44	0.31	0.28
295	0.14	0.09	0.44	---	0.44	0.31	0.28
285	0.14	0.09	0.44	---	0.44	0.31	0.28
280	0.14	0.09	0.44	---	0.44	0.31	0.28

Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	UC (natural moisture)		
		WCn (%)	DDn (pcf)	Su (psf)
201-23	2	16	112.3	12,400
201-23	10	26	93.5	520
203-23	10	18	107.2	1,890
204-23	0	9	109.8	9,660
204-23	8	32	85.7	3,500
	Average	20	102	5594

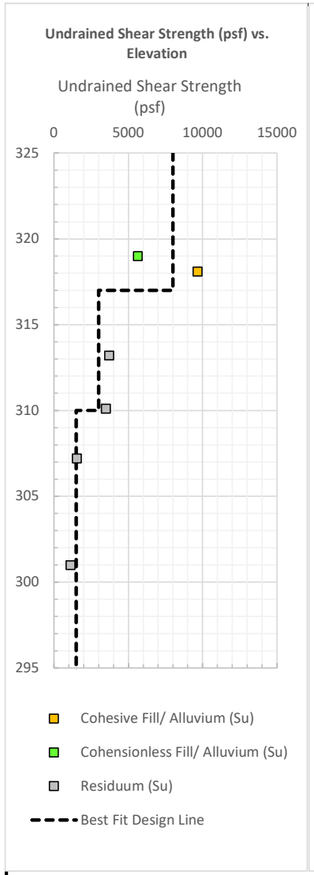
[(1)] Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4

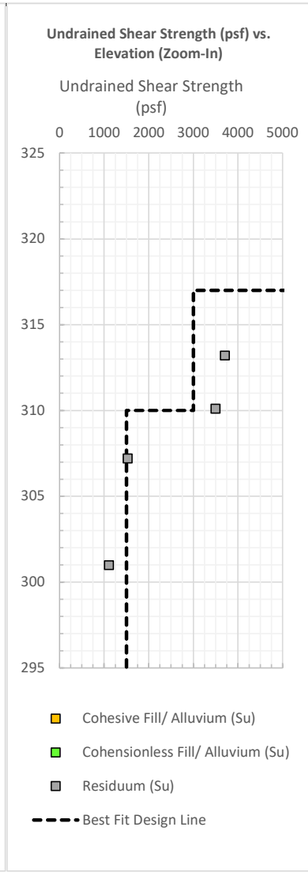
[(2)] Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3

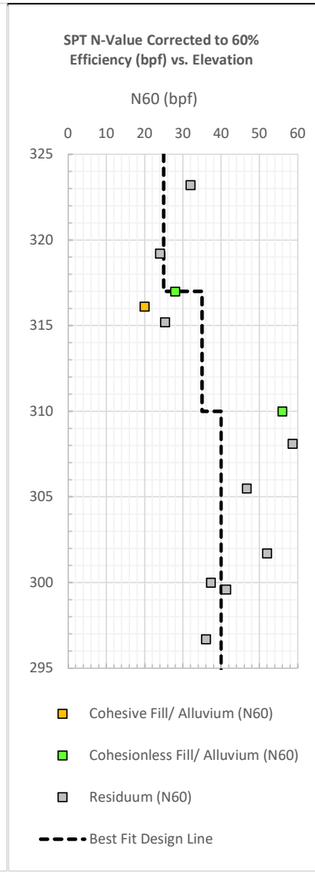
[(3)] Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3 (cohesive)

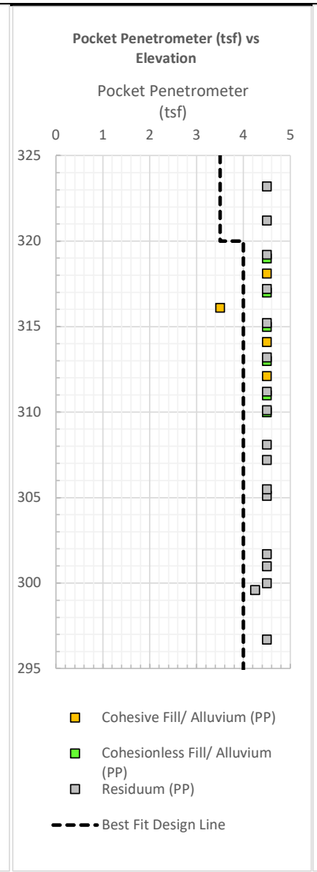
[(4)] Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2 (cohesionless)

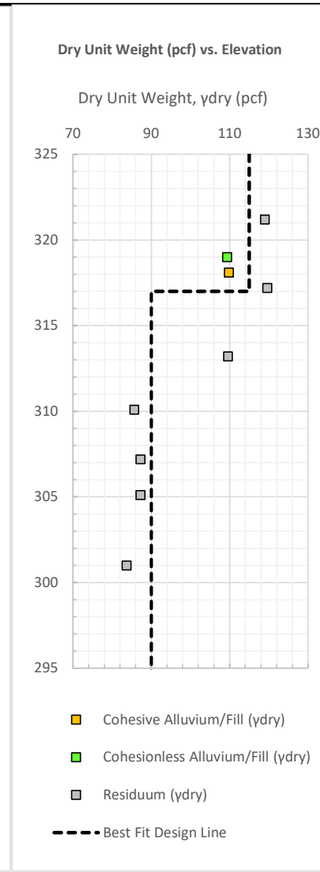
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Parameters for Kh Development (Left ASW)	
AECOM	March 2024
	Attachment No. 3











Best Fit Design Lines

Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
325	8000	25	3.5	115
320	8000	25	3.5	115
320	8000	25	4	115
317	8000	25	4	115
317	3000	35	4	90
310	3000	35	4	90
310	1500	40	4	90
290	1500	40	4	90
290	1500	40	4	90
290	1500	40	4	90

Estimated Kh Values

Depth(ft)	From Su1[(1)]	From Su2[(2)]	From N60[(3)]	From N60[(4)]	From PP1[(1)]	From PP1[(2)]	Avg
325	0.79	0.58	0.36	---	0.34	0.24	0.46
320	0.79	0.58	0.36	---	0.34	0.24	0.46
320	0.79	0.58	0.36	0.09	0.39	0.27	0.41
317	0.79	0.58	0.36	0.09	0.39	0.27	0.41
317	---	---	---	0.13	---	---	0.13
310	---	---	---	0.13	---	---	0.13
310	0.14	0.09	0.58	---	0.39	0.27	0.30
290	0.14	0.09	0.58	---	0.39	0.27	0.30
290	0.14	0.09	0.58	---	0.39	0.27	0.30
290	0.14	0.09	0.58	---	0.39	0.27	0.30

[(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 (cohesive)
[(4)] Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2 (cohesionless)

Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	UC (natural moisture)		
		WCn (%)	DDn (pcf)	Su (psf)
204-23	0	9.0	109.8	9,660
204-23	8	32.0	85.7	3,500
205-23	0	7.0	109.4	5,640
	Average	16.0	101.6	6266.7

San Antonio River Authority Escondido FRS No. 4 SWP-EA		Project No. 60707410
Parameters for Kh Development (Right ASW)		
AECOM	March 2024	Attachment No. 3

Attachment 3
Estimation of Erodibility Coefficient Index (Kh)
Escondido Creek FRS No. 4, 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)	Ground Surface El. (ft)	Top Elevation (ft)	Sample ID	Stratum	Field USCS	Lab USCS	w-n (%)	DD (pcf)	Ground Surface El. (ft)	Sample El. (ft)	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 (%)	Ll-n	Ll-sat	Su-sat (psf)	Kh	Kh-adj
201-23	0.0	1.5	321.6	321.6	SS-1	Cohesive Fill/ Alluvium	OL		6.0		321.6	321.6						46.0	18.0	28.0	2.62				YES	-	-	-	-	-	-	-0.43	-	-	0.45	0.23
201-23	2.0	4.0	321.6	319.6	ST-2	Residuum	CL	CH	16.0	**112.3**	**321.6**	319.6	130.0	1.3	28.7	70.0		66.0	22.0	44.0	2.62	UC	2.31	12400	YES	24,800	1,187	1.19	0.94	0.47	17.4	-0.14	-0.10	4,000	0.45	0.23
201-23	4.0	6.0	321.6	317.6	P-3	Residuum	CL		17.0	**107.7**	**321.6**	317.6	126.0				41.4	61.0	21.0	40.0	2.62				NO	-	-	-	-	-	19.8	-0.10	-0.03	4,000	0.45	0.45
201-23	6.0	7.5	321.6	315.6	SS-4	Residuum	CL		**24.0**		321.6	315.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	8.0	10.0	321.6	313.6	P-5	Residuum	CL		28.0		321.6	313.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	10.0	12.0	321.6	311.6	ST-6	Residuum	CL	CH	26.0	**93.5**	**321.6**	311.6	118.0	0.0	16.6	83.4		57.0	21.0	36.0	2.62	UC	0.61	520	NO	1,040	50	0.05	0.03	0.03	28.6	0.14	0.21	1,930	0.26	0.26
201-23	12.0	13.0	321.6	309.6	ST-7	Residuum	CL	CH	**24.0**	96.1	321.6	309.6	119.0	0.0	15.1	84.9		53.0	17.0	36.0	2.62	UC	1.0	4340	NO	8,680	416	0.42	0.30	0.30	26.8	0.19	0.27	1,562	0.21	0.21
201-23	15.0	16.5	321.6	306.6	SS-8	Residuum	CH		22.0		321.6	306.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	18.5	20.0	321.6	303.1	SS-9	Residuum	CH		17.0		321.6	303.1						34.0	15.0	19.0	2.62				NO	-	-	-	-	-	-	0.11	-	-	0.29	0.29
201-23	23.5	25.0	321.6	298.1	SS-10	Residuum	CH		20.0		321.6	298.1									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	0.0	3.0	322.6	322.6	G-1	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	3.0	5.0	323.6	320.6	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	0.0	2.0	325.2	325.2	ST-1	Cohesive Fill/ Alluvium	CL				325.2	325.2		0.2	13.5	86.0					2.62				YES	-	-	-	-	-	-	-	-	-	-	-
202-23	2.0	3.5	325.2	323.2	SS-2	Residuum	CL	CH	9		325.2	323.2						59	16	43	2.62				YES	-	-	-	-	-	-	-0.16	-	-	0.45	0.23
202-23	4.0	6.0	325.2	321.2	P-3	Residuum	CL		**8**	119.0	325.2	321.2	128.5			77.0	22.2	32	15	17	2.62				YES	-	-	-	-	-	14.3	-0.41	-0.04	4,000	0.45	0.23
202-23	6.0	7.5	325.2	319.2	SS-4	Residuum	SM		12		325.2	319.2									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	8.0	10.0	325.2	317.2	P-5	Residuum	CH		12	119.6	325.2	317.2	134.0								2.62				NO	-	-	-	-	-	14.0	-	-	-	-	-
202-23	10.0	11.5	325.2	315.2	SS-6	Residuum	CH		18		325.2	315.2		0.8	22.5	77.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	12.0	14.0	325.2	313.2	ST-7	Residuum	CH	CH	17	109.6	325.2	313.2	128.2					59	20	39	2.62	UC	1.43	3710	NO	7,420	355	0.36	0.25	0.25	18.8	-0.08	-0.03	4,000	0.45	0.45
202-23	14.0	16.0	325.2	311.2	P-8	Residuum	CH		29		325.2	311.2		15.8	25.8	58.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	18.0	20.0	325.2	307.2	ST-9	Residuum	CH	CL	29	87.3	325.2	307.2	112.6					40	25	15	2.62	UC	1.1	1530	NO	3,060	147	0.15	0.10	0.10	33.3	0.27	0.55	586	0.16	0.16
202-23	23.5	25.0	325.2	301.7	SS-10	Residuum	CL		17		325.2	301.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	28.5	30.0	325.2	296.7	SS-11	Residuum	CL		26.0		325.2	296.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	0.0	3.0	325.2	325.2	G-1	Remolded	Bulk										40.4				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	3.0	5.0	325.2	322.2	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	0.0	1.5	324.7	324.7	SS-1	Cohesive Fill/ Alluvium	ML	CL	7		324.7	324.7				57.0		45	17	28	2.62				YES	-	-	-	-	-	-	-0.36	-	-	0.45	0.23
203-23	2.0	4.0	324.7	322.7	P-2	Cohesionless Fill/ Alluvium	ML		8	114.8	324.7	322.7	124.0					47	18	29	2.62				YES	-	-	-	-	-	16.2	-0.34	-0.06	4,000	0.45	0.23
203-23	4.0	5.5	324.7	320.7	SS-3	Cohesionless Fill/ Alluvium	ML		7		324.7	320.7		0.0	55.1	45.0					2.62				YES	-	-	-	-	-	-	-	-	-	-	-
203-23	6.0	7.5	324.7	318.7	P-4	Cohesionless Fill/ Alluvium	SM		6		324.7	318.7						35	15	20	2.62				NO	-	-	-	-	-	-	-0.45	-	-	0.45	0.45
203-23	8.0	9.5	324.7	316.7	SS-5	Cohesionless Fill/ Alluvium	SW		3		324.7	316.7		2.1	69.6	28.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	10.0	11.0	324.7	314.7	ST-6	Residuum	CH	CH	18	107.2	324.7	314.7	126.5	1.5	13.5	85.0		65	21	44	2.62	UC	1.62	1890	NO	3,780	181	0.18	0.12	0.12	20.0	-0.07	-0.02	4,000	0.45	0.45
203-23	12.0	14.0	324.7	312.7	P-7	Residuum	CH		12		324.7	312.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	14.0	14.3	324.7	310.7	SS-8A	Residuum	SM		18		324.7	310.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	14.3	15.5	324.7	310.4	SS-8B	Sand/ Gravel Lens	SM	CL	13		324.7	310.4		0.0	36.1	64.0		40	15	25	2.62				NO	-	-	-	-	-	-	-0.08	-	-	0.45	0.45
203-23	20.0	20.7	324.7	304.7	SS-9A	Sand/ Gravel Lens	SM		16		324.7	304.7		0.0	67.0	33.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	20.7	21.5	324.7	304.0	SS-9B	Residuum	SP-SM		26		324.7	304.0									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	23.0	25.0	324.7	301.7	ST-10	Residuum	CL	CH	35	82.5	324.7	301.7	111.4	6.4	35.1	58.0		52	18	34	2.62	UC	1.31	630	NO	1,260	60	0.06	0.04	0.04	37.5	0.50	0.57	550	0.07	0.07
203-23	25.0	26.0	324.7	299.7	ST-11	Residuum	CL				324.7	299.7									2.62	UC	0.86	1780	NO	3,560	170	0.17	0.11	0.11	-	-	-	-	-	-
203-23	30.0	32.0	324.7	294.7	ST-12	Residuum	CL	CH	35	83.6	324.7	294.7	112.9	1.7	20.0	78.0		57	22	35	2.62				NO	-	-	-	-	-	36.5	0.37	0.41	954	0.11	0.11
203-23	33.5	35.0	324.7	291.2	SS-13	Residuum	CH		27		324.7	291.2									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	38.5	40.0	324.7	286.2	SS-14	Residuum	CH		30		324.7	286.2						59	23	36	2.62				NO	-	-	-	-	-	-	0.19	-	-	0.21	0.21
203-23	0.0	3.0	324.7	324.7	G-1	Remolded	Bulk									36.0	21.3				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	3.0	5.0	324.7	321.7	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	0.0	2.0	318.1	318.1	ST-1	Cohesive Fill/ Alluvium	SM	CL	9	109.8	318.1	318.1	119.7		39.2	60.7		40	12	28	2.62	UC	1.51	9660	YES	19,320	925	0.93	0.72	0.36	18.7	-0.11	0.24	1,753	0.45	0.23
204-23	2.0	3.5	318.1	316.1	SS-2	Cohesive Fill/ Alluvium	SW-SM		5		318.1	316.1			50.2	49.8					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	4.0	6.0	318.1	314.1	P-3	Cohesive Fill/ Alluvium	SW-SM		**29**		318.1	314.1		2.7	45.1	50.2					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	6.0	8.0	318.1	312.1	ST-4	Cohesive Fill/ Alluvium	CL	CH	33		318.1	312.1		8.2	37.5	54.3		54	23	31	2.62				NO	-	-	-	-	-	-	0.32	-	-	0.13	0.13
204-23	8.0	10.0	318.1	310.1	ST-5	Residuum	CL	CL	32	85.7	318.1	310.1	113.1	0.7	22.5	77.0	36.700	44	19	25	2.62	UC	1.3	3500	NO	7,000	335	0.34	0.24	0.24	34.6	0.52	0.63	457	0.07	0.07
204-23	10.0	11.5	318.1	308.1	SS-6	Residuum	CL		22		318.1	308.1									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	13.0	15.0	318.1	305.1	P-7	Residuum	CL		34	87.3	318.1	305.1	116.982								2.62				NO	-	-	-	-	-	33.3	-	-	-	-	-
204-23	18.5	20.0	318.1	299.6	SS-8	Residuum	CL		27		318.1	299.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	0.0	3.0	318.1	318.1	G-1	Remolded	Bulk				318.1	318.1					31.3				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	3.0	5.0	318.1	315.1	G-2	Remolded	Bulk				318.1	315.1									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	0.0	2.0	319.0	319.0	ST-1	Cohesionless Fill/ Alluvium	ML	SC	7	109.4	319.0	319.0	117.058			48		39	14	25	2.62	UC	1.12	5640	NO	11,280	540	0.54	0.40	0.40	18.9	-0.28	0.19	2,036	0.45	0.45
205-23	2.0	3.5	319.0	317.0	SS-2	Cohesionless Fill/ Alluvium	ML		5		319.0	317.0				47	19.9				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	4.0	6.0	319.0	315.0	ST-3	Cohesionless Fill/ Alluvium	SC	SC	8		319.0	315.0				32		30	13	17	2.62				NO	-	-	-	-	-	-	-0.29	-	-	0.45	0.45
205-23	6.0	8.0	319.0	313.0	P-4	Cohesionless Fill/ Alluvium	SC		9		319.0	313.0				26					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	8.0	9.0	319.0	311.0	ST-5	Cohesionless Fill/ Alluvium	SC		6		319.0	311.0									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	9.0	10.5	319.0	310.0	SS-6	Cohesionless Fill/ Alluvium	SC	SC	6		319.0	310.0				44		36	13	23	2.62				NO	-	-	-	-	-	-	-0.30	-	-	0.45	0.45
205-23	13.5	15.0	319.0	305.5	SS-7	Residuum	CL		26		319.0	305.5									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	18.0	19.0	319.0	301.0	ST-8	Residuum	CL	CH	34	83.7	319.0	301.0	112.158			70		50	28	22	2.62				NO	-	-	-	-	-	36.4	0.27	0.38	1,068	0.15	0.15
205-23	19.0	20.5	319.0	300.0	SS-9	Residuum	CL		31		319.0	300.0									2.62	UC	1.12	1110	NO	2,220	106	0.11	0.07	0.07	-	-	-	-	-	-
205-23	0.0	3.0	319.0	319.0	G-1	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	3.0	5.0	319.0	316.0	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
																								MIN	520				MIN	0.03				
																								MAX	12,400				MAX	0.47				
																								AVG	3,893				AVG	0.21				



Preliminary Geologic Investigation Report

Escondido Creek Floodwater Retarding Structure No. 4, Karnes County, Texas

Task Order No. 9 (C230133)
Project Reference: San Antonio River Authority MSA Contract C210002
AECOM Project Number: 60707410

October 2024

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1. Introduction

1.1 Project Overview

Escondido Creek Flood Retarding Structure (FRS) No. 4 (Escondido 4), National Inventory of Dams (NID) identification number TX02035, was built by the Soil Conservation Service (presently known as the National Resources Conservation Service, NRCS) as a low hazard flood retaining structure in 1956. Escondido 4 was constructed as a homogeneous earthen embankment with the primary purposes of watershed protection and flood prevention.

Construction of Escondido 4 was sponsored by the following Sponsoring Local Organizations (SLOs): Karnes-Goliad Soil Conservation District, the Escondido Watershed District, the City of Kenedy, and the San Antonio River Authority (the River Authority). Escondido 4 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 that approximately sixty residences and nine commercial structures are at risk from a catastrophic breach (AECOM, 2014). Therefore, Escondido 4 meets the classification of high hazard. Because catastrophic failure of Escondido 4 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 4, 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 prior dam assessment (AECOM, 2014) performed at Escondido 4 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 proposed improvements as part of the rehabilitation option from the 2014 Dam Assessment of Escondido 4, with elevations correct to NAVD88, included:

- Raising the crest elevation of the dam embankment by approximately 4.0 feet from elevation (El.) 333.0 feet to El. 337.0 feet;
- Flattening the downstream embankment slope from 2H:1V to a 3H:1V ratio (horizontal: vertical) ratio;
- Raising the auxiliary spillway crest approximately 1.1 feet from elevation (El.) 327.9 feet to El. 329.0 feet;

- Replacing the existing 28-inch principal spillway (PSW) conduit with a 42-inch-diameter conduit; and
- Replacing the PSW inlet/outlet structures.

The purpose of the SWP-EA (AECOM, 2024) was to further evaluate alternatives, including an alternative for watershed structure rehabilitation of Escondido Creek 4. As a result of this work, the proposed improvements recommended for the high hazard rehabilitation of the dam have been modified to include the following:

- Remove the existing principal spillway system;
- Install a new principal spillway system consisting of a standard inlet tower with crest at elevation 317.2 feet, two 10-inch by 10-inch low level ports at elevation 312.7 feet, and a 42-inch RCP conduit discharging into an impact basin;
- Install a 150-feet wide, five-cycle labyrinth weir structural spillway over the existing embankment with crest set above the 50-year PSH elevation at 328.7 feet and concrete chute discharging into a concrete stilling basin;
- Regrade inlet and outlet channel of the existing vegetated auxiliary spillway and raise left bay and right bay crests to the 100-year PSH elevation of 329.2 feet (1.18 feet raise from as-built);
- Flatten downstream embankment slope to 3H:1V;
- Abandon existing trench drain and install new toe drain at downstream toe;
- Install upstream dam embankment slope riprap; and
- Raise top of dam elevation to 335.3 feet (2.18 feet raise) and extend the cutoff trench below the 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 data that can be used to support assessments of the existing dam and proposed aspects of dam rehabilitation design, including:

- Erodibility of the existing vegetated auxiliary spillway (ASW) channel for use in SITES analysis.
- Subsurface stratigraphy, groundwater conditions, and soil/rock characteristics in the ASW channel.
- Preliminary borrow source evaluation for re-use of material from potential excavations in the ASW channel.

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. 4, Karnes County, Texas which was authorized as part of Task Order No. 9 (C230133) on April 12, 2023, and performed under the terms and conditions of IDIQ Contract No. C210002 effective August 3, 2020.

2. Site Description

2.1 Site Location

Escondido 4 is located on Doe Branch, a tributary to Escondido Creek, approximately 3.2 miles west of downtown Kenedy, Texas. Global positioning system (GPS) coordinates for the site are near latitude 28.813794° and longitude -97.902410°.

Site access is available via an unimproved road off FM 2102, approximately 2.0 miles northwest of the intersection of FM 2102 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 Spillways

Escondido 4 was designed and constructed as a low hazard dam in 1956. The dam has an estimated drainage area of approximately 3,992 acres and a total reservoir capacity estimated at 2,229 acre-feet (floodwater and sediment storage). Escondido 4 was recently reclassified as a high hazard structure, and does not meet the current dam design and safety requirements.

According to the as-built drawings, the dam is approximately 29 feet tall at the maximum section and is 2,900 feet long. The dam alignment crosses the main channel of the original creek tributary at approximate dam centerline station (STA.) 16+25 located just upstream of a sharp bend in the channel, from where the remnant channel continues leftward along the downstream toe to about STA 13+00 before again turning downstream to join the principal spillway outlet channel. The embankment crest was built to maximum elevation (El). 334.5 feet in the central portion of the creek valley (including over-build to compensate for post-construction settlement) and tapered to El. 333.1 and El. 333.4 at the left and right abutments, respectively.

The upstream slopes of the embankment were constructed at an inclination of 3H:1V (horizontal:vertical), and the downstream slopes were constructed at 2H:1V. A 10 foot wide wave protection berm was constructed on the upstream slope at approximately El. 311.7[1] feet according to the North American Vertical Datum of 1988 (NAVD88). The width of the embankment crest is approximately 14 feet. An excavated core trench was constructed below the centerline of the dam to typical depths of about 6 to 8 feet below pre-construction ground surface, with deeper sections of about 9 to 12 feet deep where the dam alignment crosses the two creek branches. The core trench had 1H:1V excavated side slopes and a 12-foot bottom width according to as-built drawings. The as-built drawings indicate that “all material in spillway excavation is suitable for use in forming the embankment”, suggesting the dam embankment may consist predominantly of calcareous sandy clays mixed with lesser amounts of silty to clayey sands. The lack of a typical embankment section or zoning in the as-built drawings suggests the dam is likely a homogeneous earthfill embankment.

The dam was constructed with an internal drainage system consisting of a toe drain trench filled with single-stage aggregate filter and with a 6-inch-diameter perforated corrugated metal drainpipe (galvanized steel with bituminous coating). Drainpipe perforations are shown as 3/16” diameter and covered with a #10 mesh copper screen in the as-built drawings. The specified gradation of the aggregate filter shown in the as-builts suggests a predominantly coarse- to medium-grained sand with about 5 to 25% fine gravel and less than 10% fines was used.

The dam features a two-bay vegetated ASW with a splitter dike at the right abutment, and a principal spillway near the original creek alignment. The PSW consists of a drop inlet, two

[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 +0.12 feet.

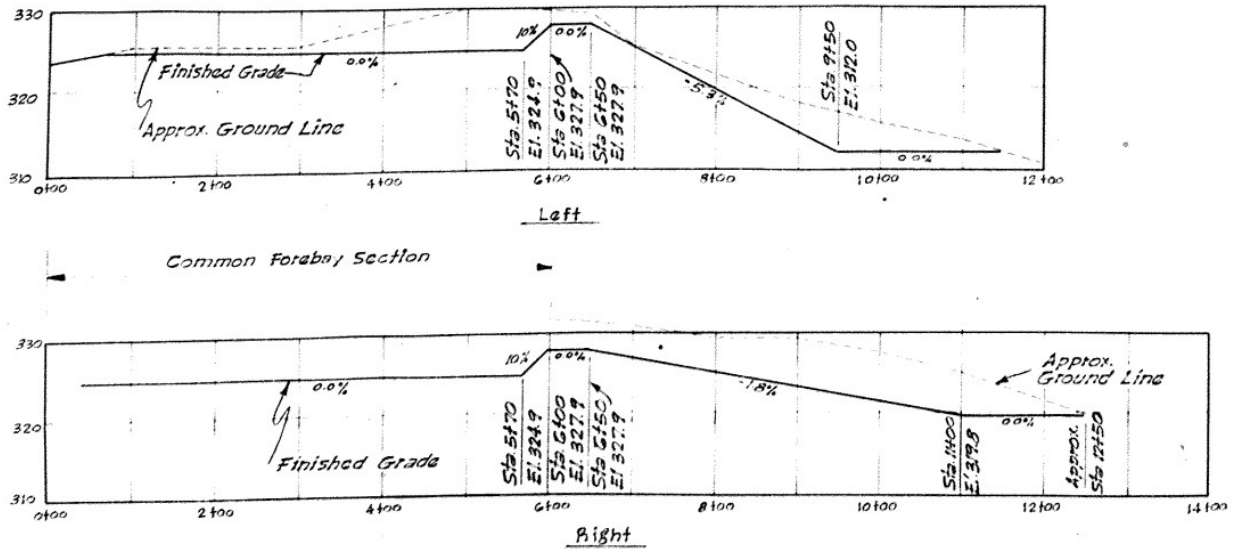
upstream low-level ports separate from the inlet riser, a conduit under the dam, and an unlined downstream plunge pool. Four (4) anti-seep collars spaced at 24 feet on center are also present.

The ASW bays are designated as “left” and “right” in the as-built drawings. Each of the ASW bays has a 250 foot long channel. The left and right bays share a common 50-foot-long crest section set at El. 328.0 feet. The entrance channel slope, common to both ASW bays, was excavated nearly flat (0% per the as-built drawings) to about El. 325.0 at maximum depths of about 5 feet below pre-construction ground surface along the spillway centerline. The as-built drawings (see Attachment 1 of **Appendix G**) indicate the ASW crest was excavated primarily into layers of native calcareous clay interbedded with sand and silt. Similarly, the exit channels were excavated out of the native calcareous clay and very silty to sandy layers. The exit channels of the two ASW bays were designed to vary in terms of length and slope angle to accommodate the pre-construction site topography while maintaining the same alignment. The left ASW bay’s exit channel was originally built at a 5.3% grade, with excavation depths ranging from 0 to 5 feet. Excavation depths on the left ASW bay increased between the crest and the outlet. The right ASW bay was built at a 1.8% grade and the excavation depths varied from 0 to 6 feet. Excavation depths remained relatively constant throughout the right ASW bay. For reference, the as-built spillway profiles are shown in the images below as well as the stick logs provided in the as-built drawings for the auxiliary spillway.

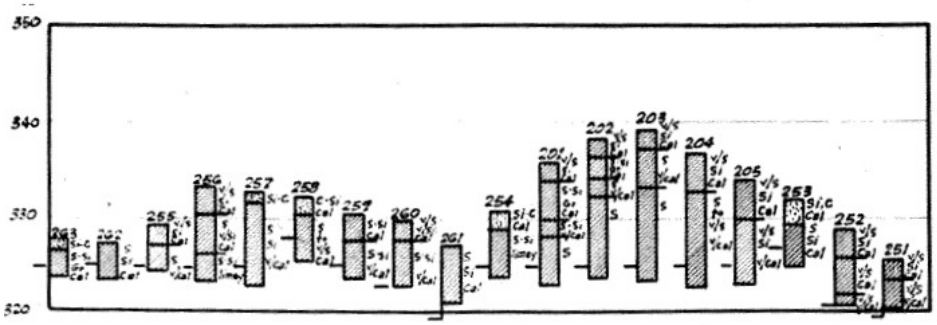
As-built repair drawings indicate at least two repair projects were made at Escondido Creek 4 following original construction in 1956. The first repair project was completed in October 1961 and included repair of several shallow slides which occurred on the downstream embankment slope. Slope repair included excavating beyond the slide surface to a uniform slope, and reconstructing the downstream slope. The repair maintained the original 2H:1V slope angle in the upper part of the reconstructed downstream slope, but added a stability berm with top El. 321.6 in the lower half of the downstream slope. The stability berm had 12-foot-wide crest with back-sloped “gutter” to direct surface flow away from the slopes, and was constructed with a flatter downstream slope of 2.5H:1V. The fill was specified to be compacted using a minimum of 3 passes per lift with a D-7 dozer or heavier crawler tractor. The as-built repair drawing (SCS, 1961) indicate the slope repairs at Escondido Creek 4 were to include removal of approximately 2,500 cubic yards (CY) from the downstream embankment slope, and the placement of 12,600 CY of earthfill sourced from a designated borrow area downstream of the dam (SCS, 1961). The actual repair limits are not defined in the as-built drawing, but appear to have included most of the downstream slope of the dam (approximately STA. 2+00 to 22+00) based on the observed limits of the stability berm documented in recent dam inspection photographs and visual observations of the site by AECOM.

The second repair project was completed in 1968, and included repair of gully erosion on the embankment slope between centerline Station (Sta.) 0+00 and Sta. 5+00 (SCS, 1968). The repair drawing indicates gully repair consisted of excavating beyond the eroded surface and shaping gully banks to uniform slopes, and then backfilling with earthfill to the pre-erosion ground surface. The drawing does not specify the properties of the earthfill material or placement/compaction criteria used in the gully repairs. The drawing suggests that approximately 2,980 cubic yards (CY) of earthfill sourced from on-site borrow areas were to be used in the repairs completed at Escondido 4 (SCS, 1968). The repair drawing notes the repairs were constructed in 1968, but explicitly states it is not an “as-built” drawing so actual quantities and repair limits may have

differed.



PROFILE ON ℄ OF SPILLWAYS



Note: Bar at left of boring is at spillway grade.

LOG OF SPILLWAY BORINGS

SEE PLAN OF EMBANKMENT AND SPILLWAY

2.3 Historical Performance of Spillway

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2017, 2021, and 2022 annual inspections (San Antonio River Authority, 2017 and 2021; TCEQ for San Antonio River Authority, 2022) reported that the spillways were in good condition. The most recent dam safety inspection (TCEQ, 2022) noted adequate vegetative cover throughout the ASW with the exception of areas where harvester ant beds and hog related damage were observed. Hog damage was particularly of concern on the right half of the left bay and near the splitter dike on the right bay. Harvester ant beds were noted on the control section of the spillways. Furthermore, a 2-foot-deep burrow was noted at the left bay near the splitter dike toe and hay bales were also observed throughout both bays.

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

Published geologic mapping indicates most of the dam site and the entirety of the ASW is 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 (Brown et. al, 1975), 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; Baker, 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is montmorillonite 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 Doe Branch. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Alluvium deposits in Central Texas are typically organized as point bars, natural levees, stream channels, and backswamps.

2.5.1 Soil Mapping

The NRCS Websoil Survey database (NRCS, 2023) 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 either flood-plain alluvium, residuum (resulting from in-place weathering of the underlying sandstone parent bedrock), and artificial fill.

Alluvium makes up the majority of the near-surface soils mapped at the dam site and is identified along most of the dam embankment and upstream (south and southwest) of it. Residuum is mapped in two smaller zones located northwest of the auxiliary spillway and upstream of the dam embankment (north of the reservoir). Fill material is mapped within the auxiliary spillway channels, likely based on generalization due to readily visible fill berms and splitter dike in this area. Unexpectedly, the soil survey does not distinguish the dam embankment as an area of fill.

The alluvium is described as consisting of the Pernitas, Papalote, and the Buchel clay 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.

- Papalote (PbB): These soils occur on high terraces, range from nearly level to gently sloping and are derived from loamy and clayey alluvium of Pleistocene and Pliocene age. The Papalote series are further described as moderately well drained with slow permeability.
- Buchel Clay (Bw): Calcareous clayey alluvium. Typically identified on flood plains, frequently flooded. Described as moderately well drained with very low to moderately low ability to transmit water.

The residuum mapped is described as consisting primarily of clays interbedded with sandstone and claystones that have resulted from weathering of the Oakville formation, and which form part of the Monteola clay (MoA and MoB) series. Monteola clays are gently to moderately sloping and have their permeability controlled by moisture conditions; as such, permeability and can be high when desiccation cracks are present.

The auxiliary spillway channel (where the borings drilled as part of the field GI were located) is mapped as being underlain by the Ustarents series (Us). This soil unit is described as sandy clay loams that are well-drained with moderately high to high capacity to transmit water. The parent material of the Ustarents soil series is described as mine spoil or earth fill, and soils are anticipated to have approximate maximum calcium carbonate content of 5%.

Typical index and physical properties for the soil units mapped at Escondido Creek 4 are summarized in the table below.

Series	Type	USCS Classification	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing No. 200 Sieve (Fines Content)
Buchel Clay (Bw)	Alluvium	CH	50-86	30-48	64-100
Papalote (PbB)	Alluvium	CL, CH, SC, SM, SC-SM	15-67	2-42	31-69
Pernitas (PnC)	Alluvium	CL, SC	27-53	9-29	42-70
Monteola (MoA and MoB)	Residuum	CH	50-75	25-48	66-93
Ustarents (Us)	Fill	CL, SC	35-48	15-25	40-75

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 up-dip 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 feet. (Collins et al., 1992). The belt of faults is likely associated with the sinking of the Gulf 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; 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 Sections 2.5.3 (Faulting) and 2.5.4 (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 13 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 4 (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 4 site is approximately within the SKC, and the KTFZ and NLOFZ are located about 13 miles to the northwest and about 10 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 forty-nine 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 for 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≤5. The strongest recorded earthquake in the area occurred in 2011 in Atascosa County, about 16 miles west of the site, with maximum magnitude of 4.8. In addition, a second earthquake with magnitude M of 4.3 was recorded in 1993 also in Atascosa County, in the town of Fashing.

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) which is based on the peak ground acceleration (PGA) corresponding to a seismic event with a 2% probability of exceedance in 50 years.

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) is 0.028g for the 2% in 50 year earthquake event (2,475-year return period). 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 or 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.

Given the dam’s recent reclassification as a high hazard structure, there may be a potential for loss of life from dam failure at permanent pool, in which case Table 2-6 of the NEH, Part 631, Chapter 2 (NRCS, 2012a) indicates a seismic event with 0.5% exceedance probably in 50 years (10,000-year return period) would govern. For reference, the PGA for the 10,000 year event is 0.075g for a site underlain by rock using similar approach as described in the paragraph above.

For design-level evaluations of seismic hazard, analyses of site seismicity should be conducted in accordance with the current 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 at normal pool level. A hydrological analysis is typically needed to evaluate the consequence of seismic failure for a normal pool dam breach, which differs from the dam hazard class which is typically defined based on a flood pool dam breach. Additionally, note that the design PGA requires adjustment from the “rock” site PGAs reported above to account for the damping or

amplification caused by the actual soil conditions underlying the site. Additional 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 geologic 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

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 Creek 4 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 eleven dam sites in the watershed as part of the work plan. No standalone site-specific investigation was prepared for Escondido 4.

The 1954 Escondido Creek Watershed Work Plan (SCS 1954) describes the foundation of the Escondido Creek Watershed dams (including Escondido Creek 4) 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 Creek 4 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)
- 10 borings along the shared auxiliary spillway forebay (Hole Nos. 201 through 205, 254 through 257, and 263);

- 7 borings along the right auxiliary spillway (Hole Nos. 251 through 253 and 258 through 261);
- 1 boring along the left auxiliary spillway (Hole No. 262);
- 24 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 174).

The complete investigation report containing the Escondido Creek 4 boring logs and summary text was not available to AECOM for review. Abbreviated “stick” logs of borings presented on the as-built drawings resulting from the original geologic investigation completed in 1956 by the SCS were the only source of site-specific geologic information available to AECOM, and thus were used to develop a generalized understanding of the subsurface conditions at Escondido Creek 4.

Based on this as-built drawings documentation, the existing dam embankment is primarily underlain by clay and sand with some gravelly and silty zones. Clay was encountered in 15 of the 16 original dam embankment borings drilled and was described as hard, friable, moist to wet, silty to sandy, and calcareous with calcium carbonate and trace limestone inclusions. Sand was encountered in 11 of the original embankment borings drilled and was described in the field as silty to clayey with gravel. Similarly, review of the available geologic stick logs of borings indicates the auxiliary spillway channel at Escondido 4 was excavated up to about 7 feet below original grade, exposing sandy to silty calcareous clays in the upper half of the spillway channel. The second half of the channel does not appear to have been reached in the borings drilled during the original investigation. Groundwater was recorded in 6 of the borings drilled all of which were located between original centerline Sta. 10+00 and Sta. 18+00, near the original valley channel.

2.6.2 NRCS – 2022 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on February 23, 2022, by the NRCS part of the routine dam safety inspections for the River Authority (NRCS, 2022). The inspection identified several 1- to 4-feet-deep animal burrows along the dam embankment and near the upstream and downstream toes. In addition, the inspection noted hog rooting at the embankment crest, upstream slope, auxiliary spillways, and downstream berm and indicated that poor vegetative cover was observed on the upstream slope, near the right abutment. Standing water was observed at the downstream berm toe in an area described as a natural low. While this area of standing water was not more distinctively identified in the 2022 inspection report, review of the as-built drawings (SCS, 1956) appears to suggest the presence of a remnant of the original stream channel between centerline Sta. 14+00 and Sta. 16+00. In addition, an area of ponded water at the downstream toe of the dam near Sta. 16+00 is visible through aerial images available on Google Earth which leads AECOM to the interpretation that the area of accumulated water reported in the 2022 inspection report is likely located in the vicinity of Sta. 14+00 to Sta. 16+00.

Several hay bales and harvester ant beds were noted along the ASWs. Woody brush and a tree were noted in the vicinity of the PSW and the plunge pool was enlarged, causing discharge water to backup into the PSW conduit. Several repairs were recommended for the auxiliary and principal spillways. The ASW was noted as being in good dimensional condition while the PSW was deemed to be in adequate condition.

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

The 2022 inspection concluded that Escondido Creek 4 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 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 feasibility studies of potential on-site borrow sources for possible rehabilitation purposes.

The visual walk-over identified some surface evidence of slope instability (sloughs) along the downstream dam embankment slope. According to dam operator personnel, the sloughs date back to major Hurricane Beulah, which made landfall near Brownsville, Texas in September 1967 as a category three hurricane and had far-reaching impacts along southern parts of Texas (NOAA, 2024). However, since repairs to much of the downstream slope was performed in 1968 (SCS, 1968), it is possible that some of these shallow slides have occurred more recently than 1968.

In addition, some surface erosion (rills), animal burrows, and rutting were noted along the embankment crest and upstream embankment slope face, consistent with NRCS inspection reports. Some areas of excessive wetness were observed at the downstream toe approximately between Sta. 14+00 and Sta. 16+00 (i.e., area of the remnant creek tributary channel). It was not clear at the time of the geologic reconnaissance if seepage was the cause of the standing water that was observed. The observed ponded water feature appeared to correspond roughly with the location of previously noted ponded water as reported in the NRCS Routine Dam Safety Inspection performed in 2022.While very little riprap was observed around the PSW plunge pool, the PSW and ASW were found to be in good condition. 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 the only significant changes to the dam site occurred around 2012 when two large adjacent sites and an access road were cleared. The sites are located near the left abutment (upstream) of the dam and to the right (east) of the ASWs. A large number of hay bales can be seen throughout the site in recent Google Earth Pro imagery (dated March 2022) particularly along the ASW and near the left abutment. The images also indicate that the reservoir pool level is frequently below the base of the PSW inlet tower, and the impoundment is nearly dry. During the dryer years (2012 most recently), the bottom of the PSW channel is visible. Surface expression of the historical creek tributary channel crossing of the embankment is visible about 600 feet to the right of the PSW; the remnant channel continues along the downstream toe of the dam towards the PSW for about 400 before again turning downstream. The March 2022 aerial imagery indicates ponded water present in the remnant channel downstream of the dam, and appears to correspond to observed wet areas noted in prior inspection reports and more recent site visits by AECOM.

3.2 Geologic Investigation Summary

Five (5) geotechnical test borings designated as 201-23 through 205-23 were drilled in the ASW channel. Borings 201-23 and 203-23 were drilled in the left bay, and borings 202-23, 204-23, and 205-23 were drilled in the right bay. The borehole locations are shown in **Figure 7** and are 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 and other index properties for SITES analysis of the ASW.

The rehabilitation alternative presented in the 2014 dam assessment (AECOM, 2014) was developed with limited historical data only. Accordingly, the no-breach results from the 2014 analysis of the ASW needs to be validated with site-specific detailed investigation data to confirm the alternative remains feasible (i.e., shows no breaching). As such, the geologic investigation included collection of both disturbed and relatively undisturbed Shelby tube samples of each geologic stratum. As documented in the SMR under separate cover (AECOM, 2024a) representative samples of each geologic stratum were subjected to index testing (moisture content, density, Atterberg limits, sieve analysis with hydrometer), dispersion testing, and unconfined compression testing to develop refined estimates of the SITES analysis input parameters,

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

Boring locations were staked in the field by the AECOM geologist 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 geologist was present on site full-time during the field GI. The AECOM geologist 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 4.25-inch ID hollow-stem auger (HAS) drilling methods. Soil samples were collected in 2-foot intervals in the upper 15 feet and at 5-foot intervals 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.

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 for reference 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.

3.4.2 Borehole Logging and Sample Preservation

An AECOM geologist provided full-time monitoring of field drilling and sampling activities. The geologist prepared field boring logs, classified soil samples in the field, and labeled and packaged soil 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**. The USCS classifications presented on the logs generally correspond to the field classifications (ASTM D2488), but were modified in some cases based on further review of samples and laboratory test results to present the laboratory-based classifications (ASTM D2487). The final boring logs include index test results tabulated at the corresponding depth 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.

Photographs of the soil samples are provided in **Appendix E**. Following completion of the field investigation, ARIAS transported the soil samples to their laboratory in San Antonio, Texas. An AECOM Professional Engineer reviewed the field borings logs and photos of the recovered soil samples. An inventory of samples is provided in **Table 2**.

3.4.3 Groundwater Measurements

Groundwater was not encountered at any of the boring locations at the time of drilling or prior to backfilling. 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 stabilized 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. Unusually high grout takes were not observed during backfilling.

3.5 Laboratory Testing

Soil 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 samples were identified for further classification, description, and testing. Laboratory test assignments for select samples were developed by AECOM and the results are 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, 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 generally encountered clays and sandy clays with some interbedded silty to clayey sands. The generalized stratigraphy, in descending order below ground surface, included the following:

1. Undifferentiated Clayey Alluvium/Fill;
2. Sandy Alluvium; and
3. Residuum, which consisted primarily of clay soils but included a prominent sand lense at boring 203-23.

Borings terminated in the Residuum layers and no lithified bedrock layers were encountered.

The NRCS soil survey mapping shows fill material within the ASW channels, and alluvium and residuum materials upstream and downstream of the ASW channels. The 1954 as-built drawings (SCS) indicate that the existing ASW inner bay channel had a fill placed on the inner half of the channel. Per the typical spillway sections, the remaining portion of the inner bay channel and the entirety of the outer bay channel were excavated from in-situ materials. The approximate upper ¼ to 1/3 of the splitter dike separating the inner and outer bay channels was also constructed of fill. Thickness of the fill ranged from about 1 to 5 feet thick, with the thickest of the fill being at the crest structure of the left bay, and gradually decreasing in thickness downstream in the channel. Only boring 203-23 is anticipated to be located in the fill. The discrepancy between the as-built drawings location of fill and the NRCS soil survey mapping could partially be due to the lower resolution of the NRCS soil survey mapping which was possibly influenced by the visible presence of the fill berms and splitter dike within the channel limits.

While an attempt was made to distinguish between the fill and alluvium, the scope of this study did not provide enough additional information to confirm the difference; as a result, no distinction was made between the fill and alluvium. However, the geologic description of the alluvium (Qal as mapped in Figure 2) as consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter is consistent with the materials encountered (note organic matter was only described in the first few feet of the borings as is consistent with typical topsoil). The residuum is consistent with the work plan description of the silty clays and sandy clays that make up the valley slopes (SCS 1954a).

The following sections provide descriptions of the generalized strata encountered in the investigation.

4.1.1 Undifferentiated Clayey Alluvium/Fill

The geologic investigation encountered approximately 2 to 8 feet of lean clay (CL) below the ground surface in each of the borings except 205-23 which was characterized as Undifferentiated Clayey Alluvium/Fill. These materials were described as light brown to dark gray, lean clay to sandy lean clays, with trace roots and trace gravel. The Undifferentiated Clayey Alluvium/Fill soils were generally very stiff to hard and dry. Reactions to hydrochloric acid (HCl) ranged from none to strong indicating variable content of calcareous materials.

4.1.2 Sandy Alluvium

Sandy Alluvium was encountered below and downstream from the Undifferentiated Clayey Alluvium/Fill materials in borings 203-23 and 205-23 (note that this material was encountered at the surface in boring 205-23). Thickness of the Sandy Alluvium ranged from 5.5 to 10.5 feet. These materials were described as dark grayish brown to predominately pale brown, clayey sand to silty sand (SC, SC/SM) with calcareous inclusions. The Sandy Alluvium soils were generally medium dense to dense, dry, fine to medium grained, and had weak to strong HCl reactions.

4.1.3 Residuum

Clayey Residuum derived from in-place weathering of the Oakville Sandstone Formation was encountered below the alluvium/fill layers. The Residuum was encountered at depths ranging from approximately 2 to 14 bgs, and each of the borings terminated in the Residuum. The material was described as grayish brown to light brown to brown, lean to fat clay with sand and sandy lean to fat clay (CL, CH). The unit was calcareous with calcium carbonate veins and trace iron oxide staining. The Residuum materials were generally stiff to hard, moist to dry, medium to high plasticity, and weak to strong HCl reactions.

A prominent sand lense was encountered in boring 203-23 from 15.5 feet to 20.5 feet bgs. The lens was described as a medium dense to dense, moist, pale brown, clayey sand (SC) with no HCl reaction.

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 not added to the borings as no rock coring was performed. Boreholes were backfilled with cement bentonite grout at the end of drilling; as a result, subsequent delayed readings were not recorded.

It should be noted that groundwater levels may vary over time, and may have a significant impact on potential dam modifications.

4.3 Auxiliary Spillway

Borings 201-23 through 205-23 were drilled within the auxiliary spillway. Borings 201-23, 203-23, and 204-23 were used to develop the subsurface profile for the Left (Inner) Bay while borings 202-23, 204-23 and 205-23 were used to develop the subsurface profile for the Right (Outer) Bay. Note that 201-23 and 202-23 were drilled in the forebay of the ASW while 204-23 was drilled approximately on the splitter dike separating the inner and outer bay. The existing ground surface elevation in the vicinity of the borings ranged from approximately 314 to 325 feet. The borings were drilled to depths ranging from 20 to 40 feet bgs, terminating in the Residuum. Groundwater was not encountered at the time of drilling in any of the borings.

4.3.1 Left (Inner) Bay of ASW

The borings drilled in the Left Bay channel encountered approximately 2 to 8 feet of Undifferentiated Clayey Alluvium/Fill at the surface. The Undifferentiated Clayey Alluvium/Fill was described generally as very stiff to hard, dry, light brown to dark gray, lean clay to sandy lean clays (CL) with trace roots and trace gravel, and no to strong reactions to HCl.

The Sandy Alluvium was approximately 7.5 feet thick and encountered below the Undifferentiated Clayey material in boring 203-23. The Sandy Alluvium was described as medium dense to dense, dry, dark grayish brown to predominately pale brown, fine to medium grained, clayey sand (SC) with calcareous inclusions. The elevations of the Sandy Alluvium in boring 203-23 (drilled near ASW crest) ranged from about El. 315 to 322, suggesting it may daylight into the ASW channel slope downstream of boring 203-23; additional borings would be needed to confirm whether this is the case.

The Residuum was encountered at depths ranged from 2 to 10 feet bgs and extended to boring termination. It was described as stiff to hard, moist to dry, grayish brown to light brown to brown, medium plasticity, lean to fat clay (CL and CH) with calcareous inclusions, calcium carbonate veins, and trace iron oxide staining with weak to strong HCl reactions. The sand lense within the Residuum was encountered in boring 203-23 from 15.5 feet to 20.5 feet bgs.

The SPT N-values in the Undifferentiated Clayey Alluvium/Fill ranged from 14 to 15 bpf (only three tests were completed in this layer). Pocket penetrometer readings ranged from 3.5 to 4.5+ tsf with an average of 4.3 tsf. The SPT N-values from two tests in the Sandy Alluvium were 21 and 23 bpf. The Residuum SPT N-values ranged from 13 to 48 bpf with an average of 29 bpf. Pocket penetrometer readings were predominantly over 4.5 tsf, with only one reading of 3.5 tsf at the bottom of boring 201-23. The sand lens had one SPT N-value of 33 bpf.

4.3.2 Right (Outer) Bay of ASW

Borings 202-23 and 204-23 drilled in the Right Bay channel encountered approximately 2 to 8 feet of Undifferentiated Clayey Alluvium/Fill at the surface and underlain directly with Residuum to boring termination. Sandy Alluvium was encountered in boring 205-23 (located at the downstream exit of the Right Bay channel) from the ground surface to a depth of 13.5 feet bgs, corresponding to El. 319 to 305 feet. The Sandy Alluvium/Fill was underlain directly by the Residuum to boring termination. Descriptions of both soil units are similar as described previously for the Left Bay.

The SPT N-value from one test in the Undifferentiated Clayey Alluvium/Fill was 15 bpf with pocket penetrometer readings ranged from 3.5 to 4.5 tsf with an average of 4.3 tsf. The SPT N-values from two tests in the Cohesionless Alluvium/Fill were 21 and 42 bpf. The Residuum SPT N-values ranged from 18 to 44 bpf with an average of 29 bpf. Pocket penetrometer readings were all 4.5 tsf.

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. The consequence of seismic failure is defined as failure of the dam at normal pool conditions (not at flood pool conditions like the dam's hazard potential classification), and

thus additional dam breach analysis at normal pool conditions will be required for final design to determine the applicable earthquake return period for design.

Because this dam is designated as high hazard, the consequence of seismic hazard for planning evaluations was conservatively taken to be the same as the dam's hazard potential classification (worst case). Accordingly, the design earthquake for a dam with high consequence of seismic failure is the 0.5% probability of exceedance in 50-year event (10,000-year return period) may be appropriate for preliminary design-level evaluations. Based on a deaggregation of seismic hazard using the online USGS National Seismic Hazards Mapping Tool, the PGA for a "rock" site (B/C boundary) for the 10,000-year event is 0.075g. 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 following 210-NI-Part 302 Interim Guidance for Seismic Hazards (NRCS 2021). Based on the weighted average N-values of the soil borings, the site was determined to be Seismic Site Class D. The PGA amplification factor of 1.6 was used to calculate the adjusted PGA per NRCS (2021). Therefore, the resulting design peak ground acceleration, PGA_{Design}, is 0.120g.

The resulting PGA_{Design} is greater than 0.07g, and therefore future studies for rehabilitation final design may be needed to evaluate the potential for loss of shear strength due to liquefaction or cyclic failure of the foundation and embankment soils and related effects (e.g., seismic deformation and/or slope instability) as noted in TR-210-60 (NRCS 2019a). Alternatively, additional hydrologic analysis for a dam breach at normal pool conditions may allow reduction in the consequence of seismic hazard to either significant consequence (governed by the 2,500-year seismic event) or low consequence (governed by the 1,000-year seismic event) and corresponding reduction in the design PGA. Additionally, 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 undifferentiated alluvium/fill and/or residuum. Lithified bedrock was not encountered during this GI, and therefore can be anticipated to be located at significant depths below the ASW channel based on geologic formations present at the site. Groundwater was not encountered and is therefore not anticipated to depths of 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 4.1 feet For planning purposes, the minimum depth of overexcavation in areas of proposed fill will likely be approximately 1 foot for topsoil removal. Additional overexcavation may be required to 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" according to NRCS standard Construction Specification 21, Excavation.

Additional considerations regarding rehabilitation of the ASW include 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 material layers:

1) Undifferentiated Clayey Alluvium/Fill,
2) Sandy Alluvium
3) Residuum (of the Oakville Sandstone Formation);
4) Sand Lense within the Residuum in boring 203-23; and
5) Proposed Fill (ASW excavation borrow source).

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 **Tables 3 and 4**. Supporting calculations are provided in **Appendix G**.

The materials were considered to be soil-like in analyses for estimating the value of Kh. SITES parameters for the two clayey strata were estimated using several methods including the results of 19 field standard penetration tests correlated to an estimated Su value, correlations from liquidity indices (LI) to estimated Su, and results of 11 unconfined compression (UC) tests presented in the SMR (AECOM, 2024). Greater weight was given to the UC tests and LI correlation methods.

SITES parameters for the Sandy Alluvium stratum were estimated primarily based on the results of 5 standard penetration tests and 1 UC strength test.

Estimates of the Kh for the Proposed Fill material (in this case assumed to be derived from the potential ASW excavation borrow source) are typically developed 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 as determined by ASTM D698). As such, the range of Ms values were estimated based on results of 3 UC tests on representative composite samples from auger cuttings collected at the surface for each of the borings drilled and remolded to targe moisture and density in the lab. Results are contained in the SMR (AECOM, 2024).

Subsurface profiles illustrating the recommended stratigraphy for SITES analysis are contained in **Appendix G**. As noted in the Section 4.3.1, there is some uncertainty in the extents of the Sandy Alluvium in the lower half of the Left Bay ASW channel. The layer is more erodible than the other units at the site, and was conservatively assumed to daylight into the lower channel slope and continue as a thin surficial layer toward the channel exist. One or more additional borings downstream of STA 8+00 would be needed to determine if actual conditions are more or less favorable for spillway erodibility.

5.3 Earth Embankment Fill Sources

Borings drilled in the ASW channel indicate predominantly clayey soils in the upper 30 feet, with interbedded layers of silty to clayey sand up to 10 feet thick. Classification testing and engineering properties testing on remolded bulk samples from the ASW borings were performed to further evaluate suitability of these materials, as presented in the SMR under separate cover (AECOM, 2024). The testing indicates the clays have moderate to high plasticity, and the sands have appreciable content of plastic clayey fines (typically greater than 30 percent). Based on prior project experience, dams have been successfully designed and constructed using similar materials. Potential excavations into these materials required by dam rehabilitation alternatives are likely to produce a suitable borrow source for low-permeability embankment fill, particularly since typical borrow source operations are likely to produce some level of mixing of sandy and clayey horizons. However, the relatively high plasticity of some clay soils may require relatively flat embankment slopes to mitigate the risk of wet-weather slides that frequently develop after repeated cycles of wetting and drying in these materials.

Because excavations in the ASW would likely remain above the water table (not encountered in any of the ASW borings), dewatering is not anticipated to be required. However, relatively dry zones were encountered in some of the soils, which may require addition of water during construction to reach acceptable moisture content for compaction as earthfill.

The estimated volumes of required 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 proposed excavations.

A raise of the dam embankment would likely require identification of additional borrow sources outside of any ASW excavation to meet anticipated quantities. Desktop review of the topography in the vicinity of Escondido Creek 4 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 to reduce risk of changing seepage characteristics of the dam embankment/foundation. Review of historic reservoir levels via Google Earth indicates that the reservoir level varies seasonally, with the reservoir nearly dry at times, which could make identified borrow areas upstream within the retained pool’s footprint more accessible..

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 Creek 4.

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 (and corresponding final design SMR) may be necessary to support design evaluations, particularly for existing dam embankment and proposed modifications. In particular, investigation of the downstream portion of the Left Bay of the ASW may be warranted to confirm the extents of the Sandy Alluvium.

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. In addition, because a foundation drain is present at the site, it is possible that shallow sand layers were also identified at the downstream dam toe during the original investigation; however, original downstream toe boring logs were not available to AECOM for review. The as-built drawings indicate that the embankment was to be constructed of materials obtained from spillway excavations, but little information is available about the embankment fill materials properties or zoning except for the borings from the original ASW investigation. The ASW borings also indicate identified shallow sand in select locations. As a result, 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 1956. The drainage feature consists of a trench drain which extends from Station 10+20 to 19+60. The as-built drawings detail the drainpipe as a galvanized corrugated sheet metal pipe. Galvanized metal pipes typically have design lives of less than 50 years. Combined with the elevated soil corrosion potential as indicated by the laboratory testing for the current study (see Preliminary SMR [AECOM, 2024]), 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 1956 drainpipe is detailed as single-stage a sand and gravel filter and may not meet current filter criteria if the embankment/foundation soils consist of fine-grained (clayey) 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.

7. References

Adams, S.S., and Smith, R.B., (1981). *Geology and Recognition Criteria for Sandstone Uranium Deposits in Mixed Fluvial-Shallow Marine Sedimentary Sequences, South Texas,* National Uranium Resource Evaluation, prepared for U.S. Department of Energy, Grand Junction Office, Colorado, January.

AECOM (2014). *Dam Assessment Report for Escondido Creek Watershed Floodwater Retarding Structure No. 4,* Karnes County, Texas. June.

AECOM (2023). *Field Investigation and Testing Plan (FIP), Escondido Creek Watershed No. 4.* Karnes County, Texas. Prepared for TSSWCB. August.

Anders, R.B. (1962).Groundwater *Geology of Karnes County, Texas,* Geologic Survey Water Supply Paper 1539-G, United States Government Printing Office, Washington, D.C.

ASTM Standard D1586. (2018). *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.* ASTM International, West Conshohocken, Pennsylvania.

ASTM Standard D1587. (2015). *Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.* ASTM International, West Conshohocken, Pennsylvania.

Baker, E.T., (1979). *Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas*, Report 236, United States Geologic Survey, July.

Bodziak, R., Clemons, K., Stephens, A., and Meek, R., (2014). *The role of seismic attributes in understanding the hydraulically fracturable limits and reservoir performance in shale reservoirs: An example from the Eagle Ford Shale,* South Texas*,* AAPG Bulletin, v. 98, No. 11, November 2014, pp. 2217-2235.

Brown, T. E., Brewton, J. L., McGowen, J. H., Proctor, C. V., Aronow, S., and Barnes, V. E., 1975, Geologic Atlas of Texas, Beeville-Bay City Sheet: The University of Texas at Austin, Bureau of Economic Geology, Geologic Atlas Sheet, map scale 1:250,000.

Collins, E. W., Hovorka, S. D., and Laubach, S. E., (1992). *Fracture systems of the Austin Chalk North-Central Texas*, in Schmoker, J. W., Coalson, E. B., and Brown, C. A., eds., Geological studies relevant to horizontal drilling: examples from western North America: Rocky Mountain Association of Geologists, p. 129-142.

Ewing, T.E., and Lopez, R.F., compilers, (1991). Principal structural features, Gulf of Mexico basin, in Salvador, A., ed., The Gulf of Mexico basin: Boulder, Colorado, Geological Society of America, The Geology of North America, v. J, pl. 2.

GRL Engineers, Inc [GRL]. (2021). *Energy Measurement for Dynamic Penetrometers Standard Penetrometer Test (SPT), CME 75 (SN: 203187) and Diedrich D50 R (SN: 443) Drill Rigs, GRL Job Number 2155008-2*. Houston, Texas.

Hosman, R.L. (1996). *Regional Stratigraphy and Subsurface Geology of Cenozoic Deposits, Gulf Coastal Plan, South-Central United States, Regional Aquifer System Analysis-Gulf Coastal Plain.* U.S. Geological Survey Professional Paper, United States Government Printing Office, Washington, D.C.

McKeighan, C.A., (2022). *Understanding Anthropogenic Fault Rupture in the Eagle Ford Region, south-central Texas,* Thesis presented to the Universtiy of Texas at Austin, Austin, Texas, May.

Natural Resources Conservation Service [NRCS]. (2001). “Chapter 52: Field Procedures Guide for the Headcut Erodibility Index”. *National Engineering Handbook, Part 628 Dams*, United States Department of Agriculture, Washington, D.C., 1–33.

NRCS. (2011). “Appendix 52D: Erodibility Parameter Selection for Soil Material Horizons (Surface Detachment Coefficient and Headcut Erodibility Index)”. *National Engineering Handbook, Part 628 Dams, Draft Chapter 52*, Washington, D.C., D1-15.

NRCS. (2012a). “Chapter 2: Engineering Geologic Investigations”. *National Engineering Handbook, Part 631 Geology*, United States Department of Agriculture, Washington, D.C., 1–35.

NRCS. (2012b). “Chapter 4: Engineering Classification of Rock Materials”. *National Engineering Handbook, Part 631 Geology*, United States Department of Agriculture, Washington, D.C., 1–36.

NRCS. (2019a). *Technical Release 210-60: Earth Dams and Reservoirs*. United States Department of Agriculture, Washington, D.C., 1–63.

NRCS. (2019b). “Chapter 54: Articulated Concrete Block Armored Spillways”. *National Engineering Handbook, Part 628 Dams*, United States Department of Agriculture, Washington, D.C..

NRCS. 2022. *Dam Safety Inspection Report,* Escondido Creek Site 1, prepared for San Antonio River Authority, August.

Van Simaeys, S., Rendall, B., Lucia, F.J., Kerans, C., and Fullmer, S., (2017) *Facies-independent reservoir characterization of the micropore-dominated Word field (Edwards Formation),* Lavaca County, Texas, AAPG Bulletin, V. 1010, No. 1, January, pp. 73-94.

Soil Conservation Service (SCS). 1954. *Work Plan, Escondido Creek Watershed of the San Antonio River Watershed*, Karnes County. June.

SCS. 1956. *As-Built Plans, Floodwater Prevention Dam No. 4, Escondido Creek Watershed,* Karnes County, Texas. May.

SCS. 1961. *Embankment and Structure Repairs Drawing, Escondido Creek Watershed Site Nos. 1, 2, 3, 4, 8, and 12*, Karnes County, Texas.

SCS. 1968. *Dam Repair Details, Escondido Creek Watershed Site Nos. 4, 5, 6, 7, and 8*, Karnes County, Texas.

Woodruff, C.M., and McBride, M.W. (1979) *Regional Assessment of Geothermal Potential along the Balcones and Luling-Mexia-Talco Fault Zones, Central Texas, Final Report.* The University of Texas at Austin Bureau of Economic Geology, Austin, Texas. May.

University of Texas Institute of Geophysics [UTIG], Texas Division of Emergency Management [TDEM], and United States Department of Energy [USDOE]. (2013). “Complete List of Texas Earthquakes >M3 (1847-present).” *Texas Earthquakes*, <http://www-udc.ig.utexas.edu/external/TXEQ/> (Jan. 26, 2021).

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	321.56	13480965	2320954	25.0	NE [3]	--	NE [3]	Cement Bentonite Grout backfill
202-23	325.22	13481027	2321327	30.0	NE [3]	--	NE [3]	Cement Bentonite Grout backfill
203-23	324.69	13481325	2321039	40.0	NE [3]	--	NE [3]	Cement Bentonite Grout backfill
204-23	318.10	13481584	2321275	20.0	NE [3]	--	NE [3]	Cement Bentonite Grout backfill
205-23	318.99	13481900	2321531	20.5	NE [3]	--	NE [3]	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 North American Datum of 1983 (NAD83) using ArcGIS software.
(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	8	OL	--
“	2	4	ST-2	Shelby Tube	16	CL	CH
“	4	6	P-3	Push Tube	16.5	CL	--
“	6	7.5	SS-4	Split-Spoon	17	CL	--
“	8	10	P-5	Push Tube	16	CL	--
“	10	12	ST-6	Shelby Tube	22	CL	CH
“	12	13	ST-7	Shelby Tube	8	CL	CH
“	15	16.5	SS-8	Split-Spoon	18	CH	--
“	18.5	20	SS-9	Split-Spoon	18	CH	--
“	23.5	25	SS-10	Split-Spoon	18	CH	--
“	0	3	B-1	Bulk	--	Bulk	--
“	3	5	B-2	Bulk	--	Bulk	--
202-23	0	2	ST-1	Shelby Tube	22	CL	--
“	2	3.5	SS-2	Split-Spoon	14	CL	CH
“	4	6	P-3	Push Tube	14	CL	--
“	6	7.5	SS-4	Split-Spoon	14	SM	--
“	8	10	P-5	Push Tube	17	CH	--
“	10	11.5	SS-6	Split-Spoon	18	CH	--
“	12	14	ST-7	Shelby Tube	16.5	CH	CH
“	14	16	P-8	Push Tube	21.5	CH	--
“	18	20	ST-9	Shelby Tube	20.5	CH	CL
“	23.5	25	SS-10	Split-Spoon	15	CL	--
“	28.5	30	SS-11	Split-Spoon	18	CL	--
“	0	3	B-1	Bulk	--	Mixed	--
“	3	5	B-2	Bulk	--	Mixed	--
203-23	0	1.5	SS-1	Split-Spoon	12	ML	CL
“	2	4	P-2	Push Tube	14.5	ML	--
“	4	5.5	SS-3	Split-Spoon	8.5	ML	SM
“	6	8	P-4	Push Tube	11	SM	--
“	8	9.5	SS-5	Split-Spoon	14.5	SW	--
“	10	12	ST-6	Shelby Tube	15	CH	CH
“	12	14	P-7	Push Tube	22	CH	--
“	14	15.5	SS-8	Split-Spoon	17.5	SM	--
“	20	21.5	SS-9	Split-Spoon	18	SM	CL
“	23	24	ST-10	Shelby Tube	17	SP-SM	--
“	25	26	ST-11	Shelby Tube	10	CL	--
“	30	32	ST-12	Shelby Tube	15.5	CL	CH
“	33.5	35	SS-13	Split-Spoon	18	CL	--
“	38.5	40	SS-14	Split-Spoon	18	CL	CH
“	0.0	3.0	B-1	Bulk	--	Mixed	--

“	3.0	5.0	B-2	Bulk	--	Mixed	--
204-23	0.0	2.0	ST-1	Shelby Tube	21	SM	CL
“	2.0	3.5	SS-2	Split-Spoon	12.5	SW-SM	--
“	4.0	6.0	P-3	Push Tube	16	SW-SM	--
“	6.0	8.0	ST-4	Shelby Tube	16	CL	CH
	8.0	10.0	ST-5	Shelby Tube	17.5	CL	CL
	10.0	11.5	SS-6	Split-Spoon	18	CL	--
	13.0	15.0	P-7	Push Tube	18	CL	--
	18.5	20.0	SS-8	Split-Spoon	18	CL	--
“	0.0	3.0	B-1	Bulk	--	Mixed	--
“	3.0	5.0	B-2	Bulk	--	Mixed	--
205-23	0.0	2.0	ST-1	Shelby Tube	14.5	ML	SC
“	2.0	3.5	SS-2	Split-Spoon	9	ML	--
“	4.0	6.0	ST-3	Shelby Tube	17	SC	SC
“	6.0	8.0	P-4	Push Tube	14.5	SC	--
“	8.0	9.0	ST-5	Shelby Tube	9	SC	--
“	9.0	10.5	SS-6	Split-Spoon	13.5	SC	SC
“	13.5	15.0	SS-7	Split-Spoon	18	CL	--
“	18.0	19.0	ST-8	Shelby Tube	11.5	CL	CH
“	19.0	20.5	SS-9	Split-Spoon	18	CL	--
“	0.0	3.0	B-1	Bulk	--	Mixed	--
“	3.0	5.0	B-2	Bulk	--	Mixed	--

Table 3. Recommended Parameters for SITES Analysis of Existing Left (Inner) Bay of ASW

SITES inputs	Undifferentiated Clayey Fill/ Alluvium	Sandy Alluvium & Sand Lense	Residuum	Proposed Fill (ASW Borrow)
USCS - Soil Type (Predominant)	CL - Lean clay	SC – Clayey sand	CH - Fat clay	CL - Lean clay
PI	30	15	35	30
LL	45	30	55	40
Dry Density (lbs/ft3)	105	110	90	100
Kh	0.23	0.06	0.15	0.1
Clay %	30	30	30	30
D_{75} (mm)	0.2	0.3	0.1	0.1
D_{75} (in)	0.008	0.012	0.004	0.004
D_{50} (mm)	---	---	---	---
D_{50} (in)	---	---	---	---

Table 4. Recommended Parameters for SITES Analysis of Existing Right (Outer) Bay of ASW

SITES inputs	Undifferentiated Clayey Fill/ Alluvium	Sandy Alluvium & Sand Lense	Residuum	Proposed Fill (ASW Borrow)
USCS - Soil Type (Predominant)	CL - Lean clay	SC – Clayey sand	CH - Fat clay	CL - Lean clay
PI	20	15	30	30
LL	40	30	50	40
Dry Density (lbs/ft3)	105	110	90	100
Kh	0.23	0.06	0.15	0.1
Clay %	30	30	30	30
D_{75} (mm)	0.2	0.3	0.1	0.1
D_{75} (in)	0.008	0.0012	0.004	0.004
D_{50} (mm)	---	---	---	---
D_{50} (in)	---	---	---	---

FIGURES

Figure 1. Site Vicinity Map

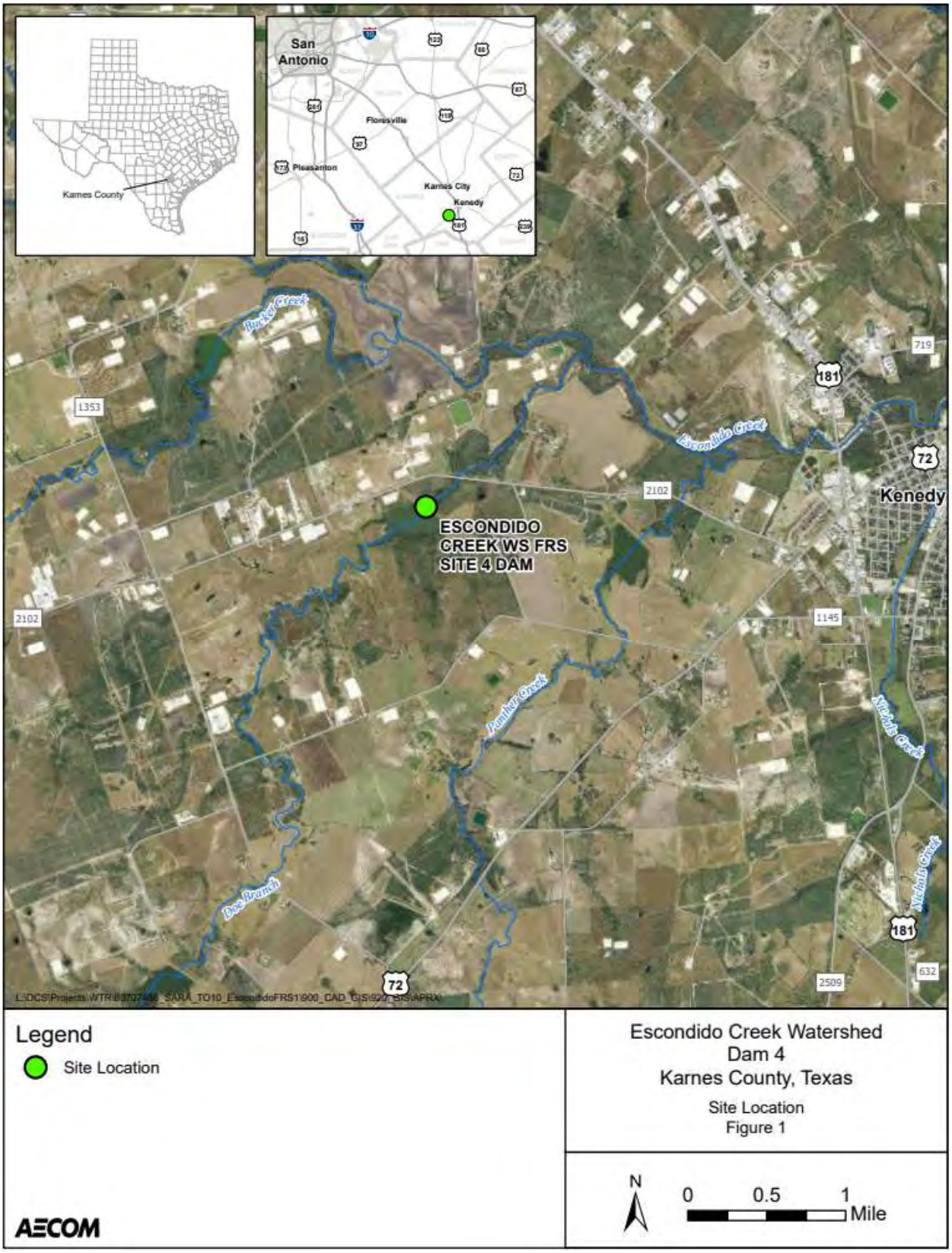


Figure 2. Geologic Map (Brown et al., 1975)

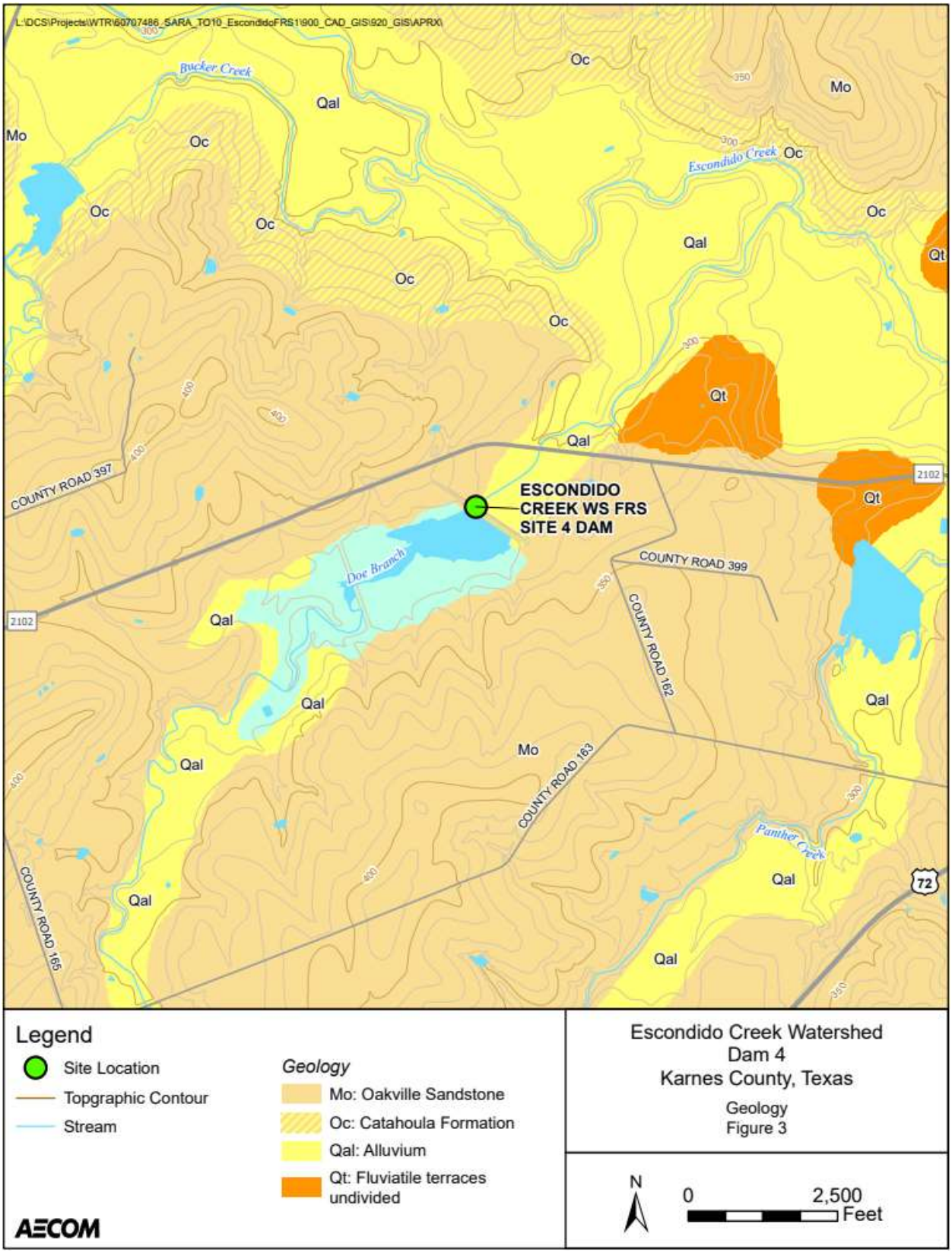
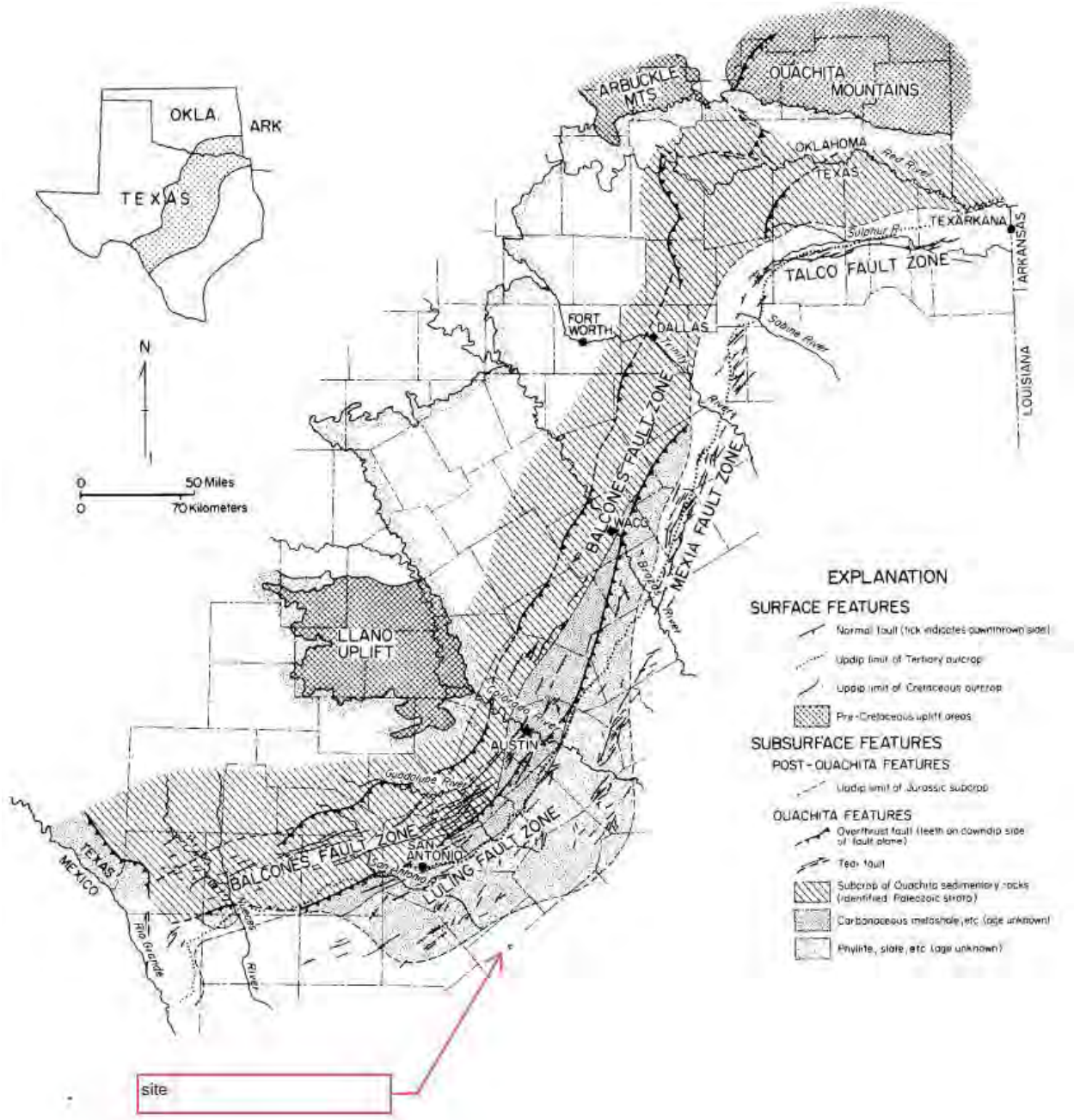


Figure 3. Regional Tectonic Features from Woodruff and McBride (1979)



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)

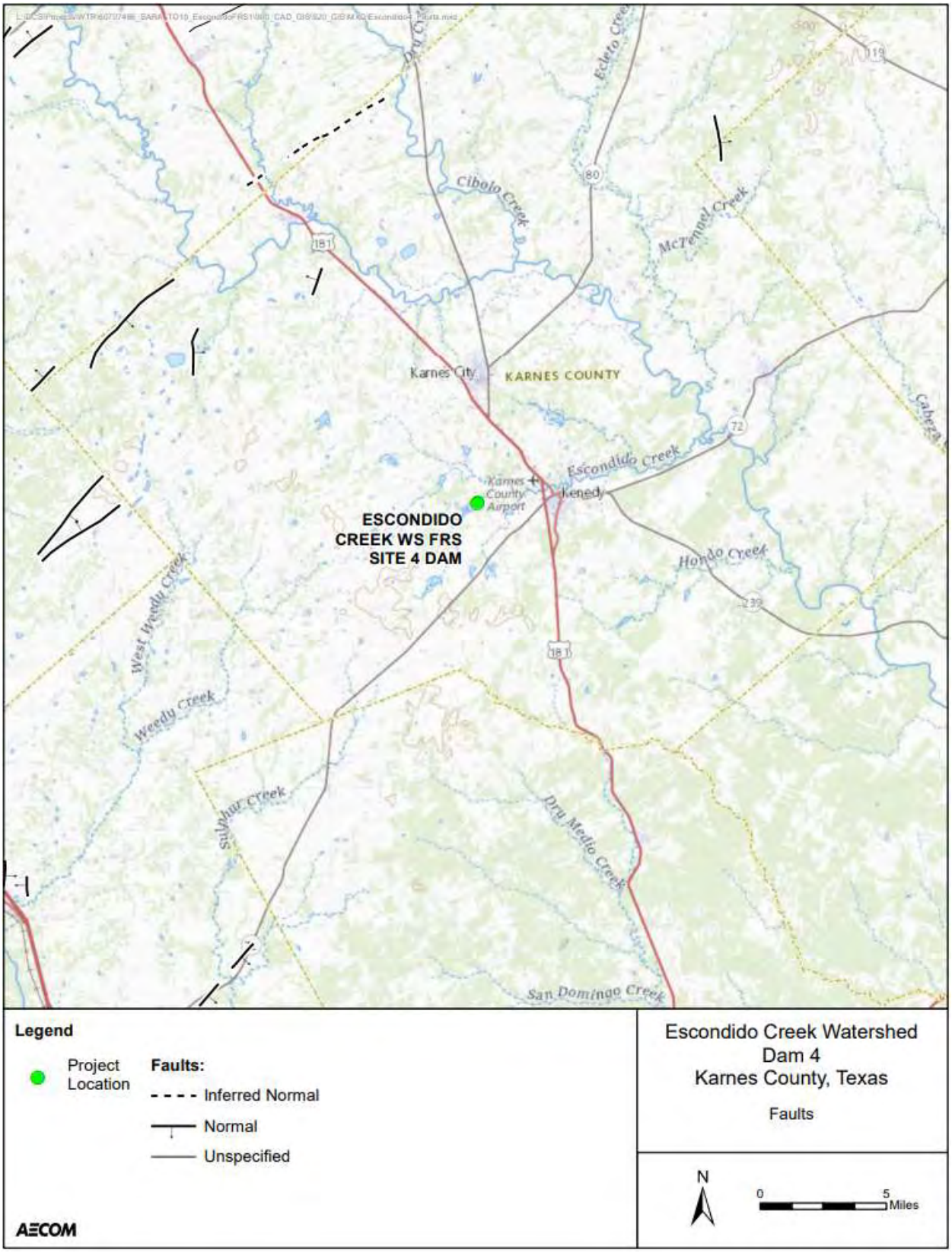


Figure 5. Regional Faults from McKeighan Thesis 2022

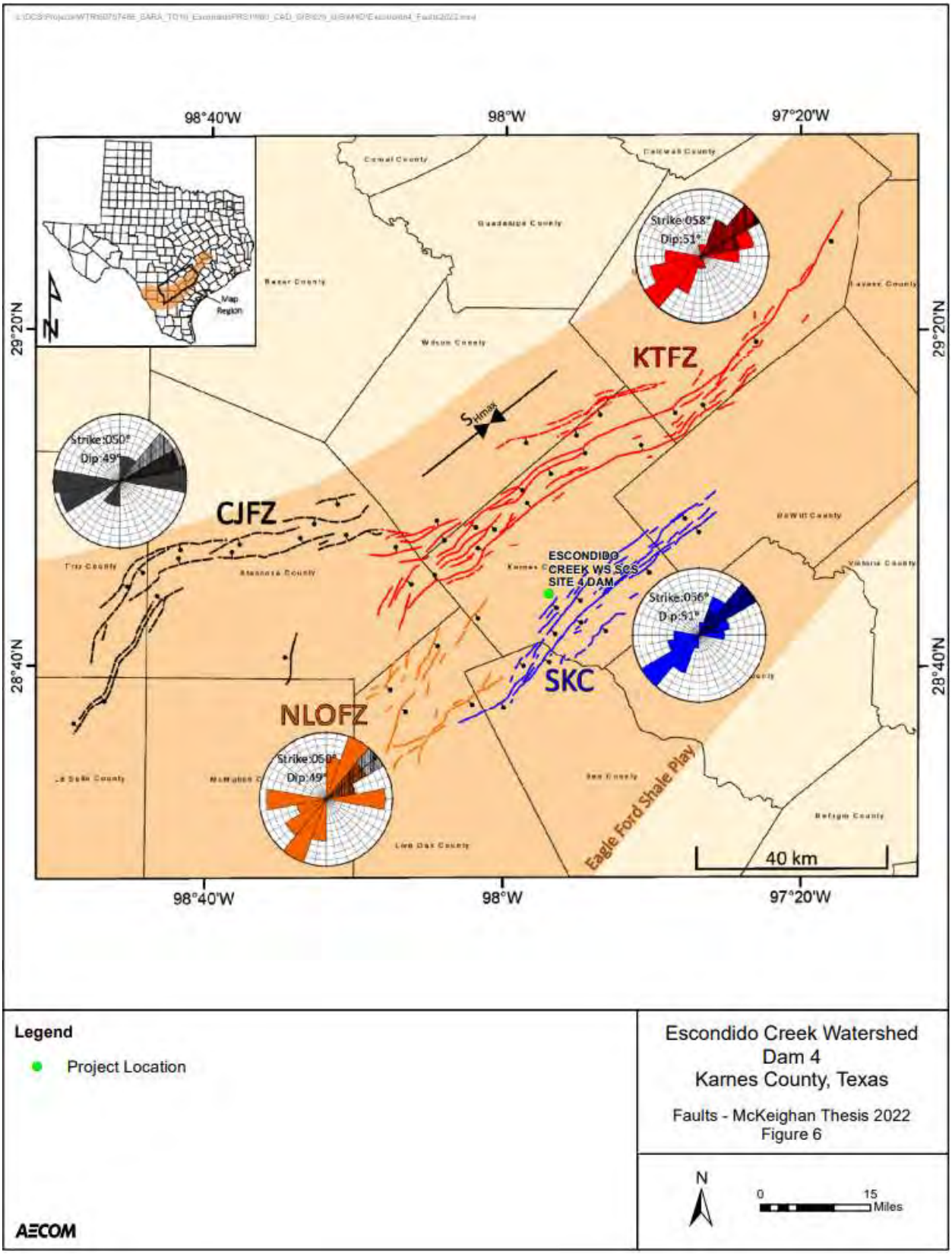


Figure 6. Recent and Historic Earthquakes

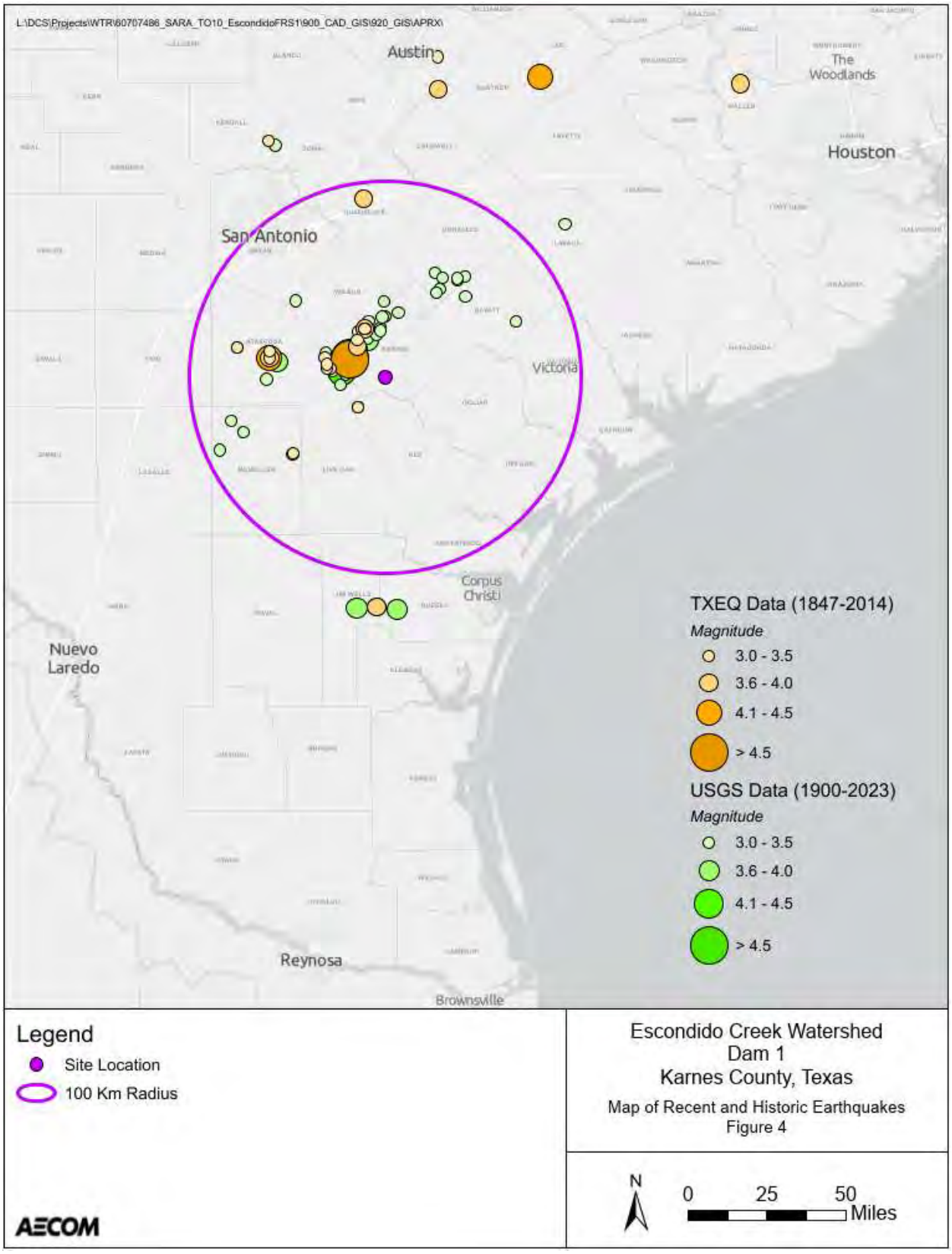
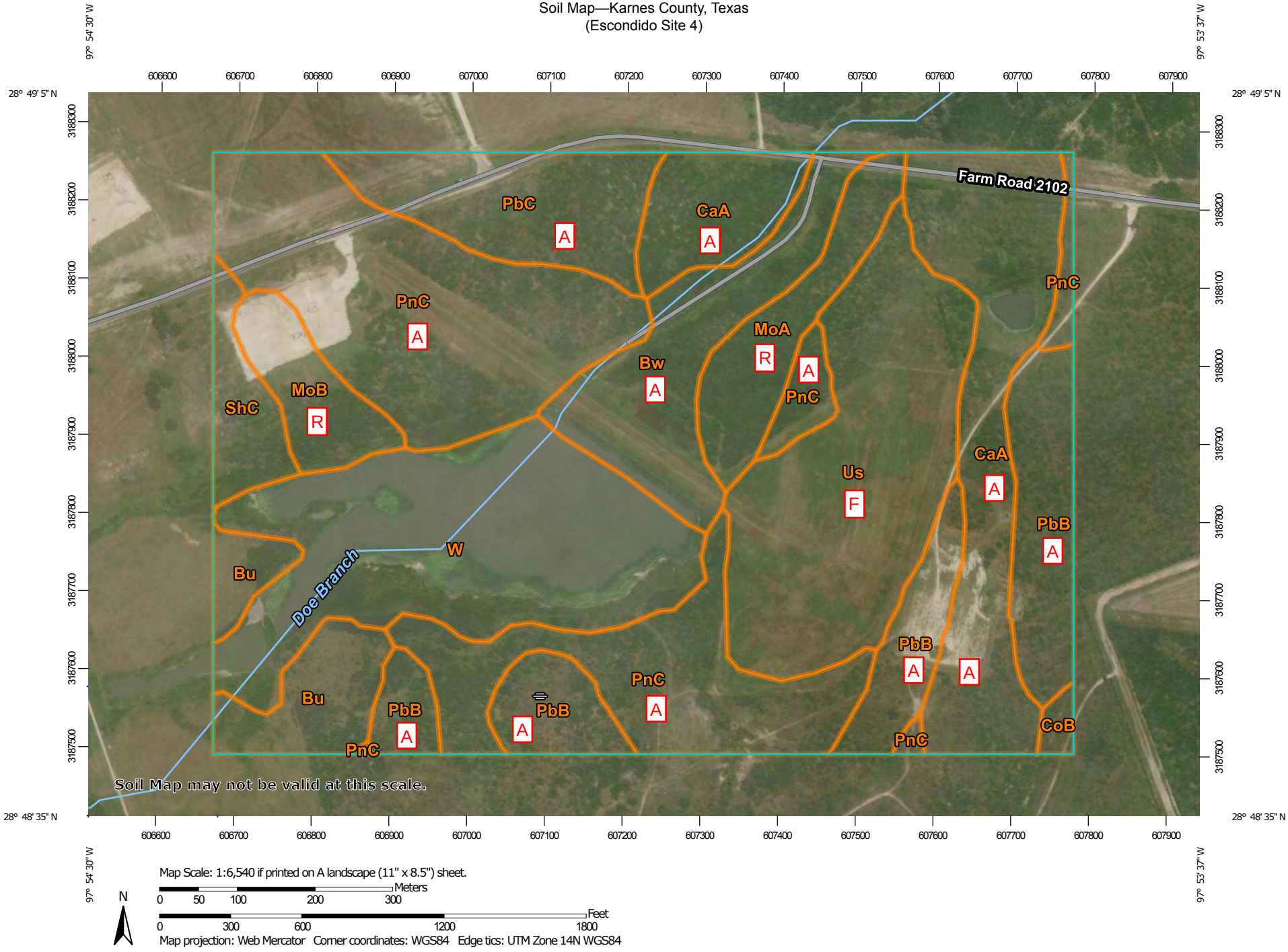


Figure 7. Plan of Borings



Appendix A NRCS Websoil Survey Data

Soil Map—Karnes County, Texas
(Escondido Site 4)



Map Scale: 1:6,540 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

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
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	8.5	4.0%
Bw	Buchel clay, 0 to 1 percent slopes, frequently flooded	14.1	6.7%
CaA	Clareville clay loam, 0 to 1 percent slopes	27.8	13.1%
CoB	Coy clay loam, 1 to 3 percent slopes	0.8	0.4%
MoA	Monteola clay, 0 to 1 percent slopes	8.2	3.9%
MoB	Monteola clay, 1 to 3 percent slopes	5.9	2.8%
PbB	Papalote fine sandy loam, 1 to 3 percent slopes	20.9	9.9%
PbC	Papalote fine sandy loam, 3 to 5 percent slopes	11.9	5.6%
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	48.8	23.1%
ShC	Schattel clay loam, 2 to 5 percent slopes	4.6	2.2%
Us	Ustarents, loamy	27.9	13.2%
W	Water	32.1	15.2%
Totals for Area of Interest		**211.6**	**100.0%**

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

MoA—Monteola clay, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t12q
Elevation: 120 to 570 feet
Mean annual precipitation: 27 to 37 inches
Mean annual air temperature: 70 to 72 degrees F
Frost-free period: 260 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Monteola and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monteola

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Microfeatures of landform position: Circular gilgai
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Calcareous clayey residuum weathered from sandstone and shale

Typical profile

A - 0 to 24 inches: clay
Bss - 24 to 40 inches: clay
Bkss - 40 to 54 inches: clay
BCky - 54 to 80 inches: clay

Properties and qualities

Slope: 0 to 1 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): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to moderately saline (0.5 to 10.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: D
Ecological site: R083BY017TX - Blackland
Hydric soil rating: No

Minor Components

Coy

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Runge

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083EY023TX - Sandy Loam
Hydric soil rating: No

Unnamed, hydric

Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

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

Karnes County, Texas

Bu—Buchel clay, 0 to 1 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: 2sf5c
Elevation: 40 to 450 feet
Mean annual precipitation: 25 to 32 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 275 to 290 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Buchel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buchel

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous clayey alluvium

Typical profile

A - 0 to 16 inches: clay
Bss1 - 16 to 42 inches: clay
Bss2 - 42 to 60 inches: clay
Bkss - 60 to 80 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: OccasionalNone
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to moderately saline (0.5 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: R083AY009TX - Clayey Bottomland
Hydric soil rating: No

Minor Components

Sinton
Percent of map unit: 7 percent
Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY013TX - Loamy Bottomland
Hydric soil rating: No

Odem
Percent of map unit: 5 percent
Landform: Natural levees
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R150AY534TX - Loamy Bottomland
Hydric soil rating: No

Meguin
Percent of map unit: 2 percent
Landform: Flood plains on river valleys
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY013TX - Loamy Bottomland
Hydric soil rating: No

Unnamed, hydric
Percent of map unit: 1 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R083AY009TX - Clayey Bottomland
Hydric soil rating: Yes

Data Source Information

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

Karnes County, Texas

Bw—Buchel clay, 0 to 1 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2sf5b
Elevation: 30 to 440 feet
Mean annual precipitation: 25 to 32 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 275 to 290 days
Farmland classification: Not prime farmland

Map Unit Composition

Buchel and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buchel

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Calcareous clayey alluvium

Typical profile

A - 0 to 22 inches: clay
Bss - 22 to 53 inches: clay
Bkss - 53 to 80 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: R083AY009TX - Clayey Bottomland
Hydric soil rating: No

Minor Components

Sinton
Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY013TX - Loamy Bottomland
Hydric soil rating: No

Unnamed, hydric
Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R083AY009TX - Clayey Bottomland
Hydric soil rating: Yes

Odem
Percent of map unit: 3 percent
Landform: Natural levees
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R150AY534TX - Loamy Bottomland
Hydric soil rating: No

Data Source Information

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

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

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

PbB—Papalote fine sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2wt0b
Elevation: 100 to 550 feet
Mean annual precipitation: 25 to 38 inches
Mean annual air temperature: 70 to 72 degrees F
Frost-free period: 270 to 305 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Papalote and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Papalote

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy and/or clayey alluvium

Typical profile

A - 0 to 9 inches: fine sandy loam
Bt - 9 to 40 inches: sandy clay
Btk - 40 to 48 inches: sandy clay loam
BCk - 48 to 80 inches: sandy clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
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: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 6.0
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: C
Ecological site: R083AY024TX - Tight Sandy Loam
Hydric soil rating: No

Minor Components

Runge
Percent of map unit: 6 percent
Landform: Knolls
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY023TX - Sandy Loam
Hydric soil rating: No

Clareville
Percent of map unit: 3 percent
Landform: Drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R083AY009TX - Clayey Bottomland
Hydric soil rating: No

Unnamed, hydric
Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

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

Karnes County, Texas

PbC—Papalote fine sandy loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: dcck
Elevation: 100 to 500 feet
Mean annual precipitation: 25 to 36 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 270 to 305 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Papalote and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Papalote

Setting

Landform: Stream terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy alluvium

Typical profile

H1 - 0 to 5 inches: fine sandy loam
H2 - 5 to 40 inches: sandy clay
H3 - 40 to 60 inches: sandy clay loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: High
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: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R083AY024TX - Tight Sandy 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

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

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

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*
Bu—Buchel clay, 0 to 1 percent slopes, occasionally flooded														
Buchel	85	D	0-16	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	93-97-100	92-96-100	80-95-100	75-90-100	52-66-82	26-38-44
			16-42	Silty clay, clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-95-95	55-69-83	30-40-48
			42-60	Clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-95-95	53-75-81	29-46-48
			60-80	Clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-93-95	54-69-79	29-41-48
Bw—Buchel clay, 0 to 1 percent slopes, frequently flooded														
Buchel	90	D	0-22	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-96-100	88-92-100	79-92-100	69-81-100	52-62-86	30-35-48
			22-53	Clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-96-100	88-92-100	75-92-100	64-81-98	51-68-82	32-39-48
			53-80	Clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-96-100	88-92-100	76-92-100	64-80-98	50-66-83	31-38-47

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*
MoA—Monteola clay, 0 to 1 percent slopes														
Monteola	90	D	0-24	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-100-100	93-100-100	85-99-100	70-82-90	55-59-62	36-38-40
			24-40	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	95-100-100	94-100-100	83-99-100	69-83-93	55-61-75	36-40-48
			40-54	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	97-99-100	94-98-100	83-97-100	69-81-93	50-59-73	27-38-48
			54-80	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	91-96-100	90-96-100	80-95-100	66-80-93	50-59-73	25-37-48
MoB—Monteola clay, 1 to 3 percent slopes														
Monteola	90	D	0-12	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-100-100	93-100-100	85-99-100	70-82-90	55-59-62	36-38-40
			12-26	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	95-100-100	94-100-100	83-99-100	69-83-93	55-61-75	36-40-48
			26-50	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	97-99-100	94-98-100	83-97-100	69-81-93	50-59-73	27-38-48
			50-80	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	91-96-100	90-96-100	80-95-100	66-80-93	50-59-73	25-37-48

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*
PbB—Papalote fine sandy loam, 1 to 3 percent slopes														
Papalote	90	C	0-9	Fine sandy loam	SC-SM, SC, SM	A-2-4, A-4	0- 0- 0	0- 0- 0	96-100-100	95-100-100	81-90-96	31-37-43	15-23-28	2-5 -9
			9-40	Sandy clay, clay, clay loam	CH, CL, SC	A-7-6	0- 0- 0	0- 0- 0	95-100-100	95-100-100	80-90-100	47-54-69	41-47-67	22-27-42
			40-48	Sandy clay loam, clay loam, sandy clay	CH, CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	91-99-100	90-98-100	84-94-100	46-52-66	33-45-55	17-27-36
			48-80	Sandy clay loam, clay loam, sandy clay	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	86-97-100	84-97-100	77-92-100	36-45-62	26-38-49	10-20-31
PbC—Papalote fine sandy loam, 3 to 5 percent slopes														
Papalote	85	C	0-5	Fine sandy loam	CL-ML, SC-SM, SC, SM	A-4	0- 0- 0	0- 0- 0	95-98-100	95-98-100	90-95-100	40-50-60	16-21-25	NP-4 -8
			5-40	Sandy clay, clay, clay loam	CH, CL, SC	A-7-6	0- 0- 0	0- 0- 0	95-98-100	90-95-100	85-93-100	43-57-70	41-51-61	21-29-36
			40-60	Sandy clay loam, clay loam, sandy clay	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	95-98-100	80-90-100	75-86-96	36-53-70	35-42-49	18-25-31

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

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

28.812336

Time Horizon

Return period in years

1000

Longitude

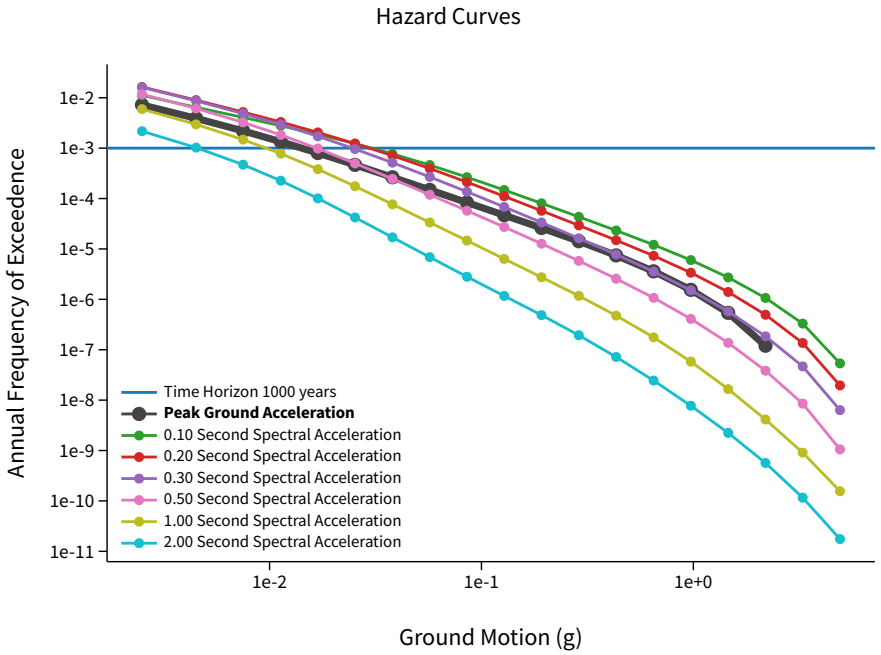
Decimal degrees, negative values for western longitudes

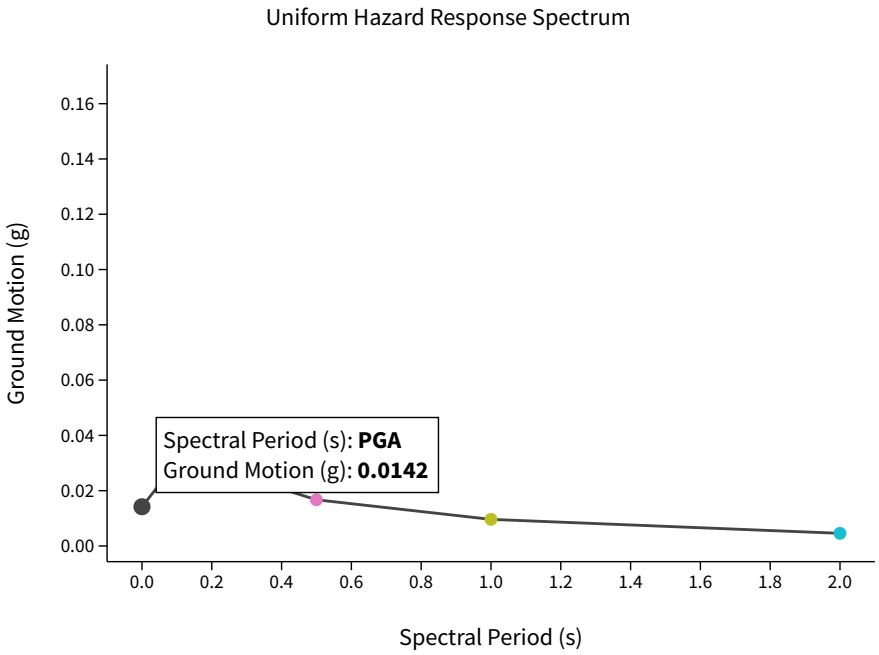
-97.899342

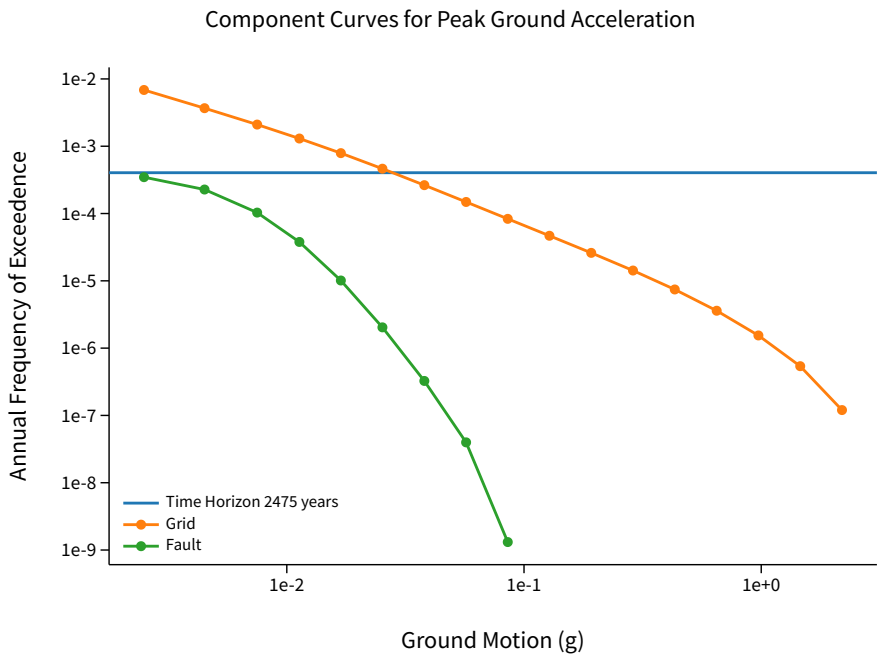
Site Class

760 m/s (B/C boundary)

Hazard Curve





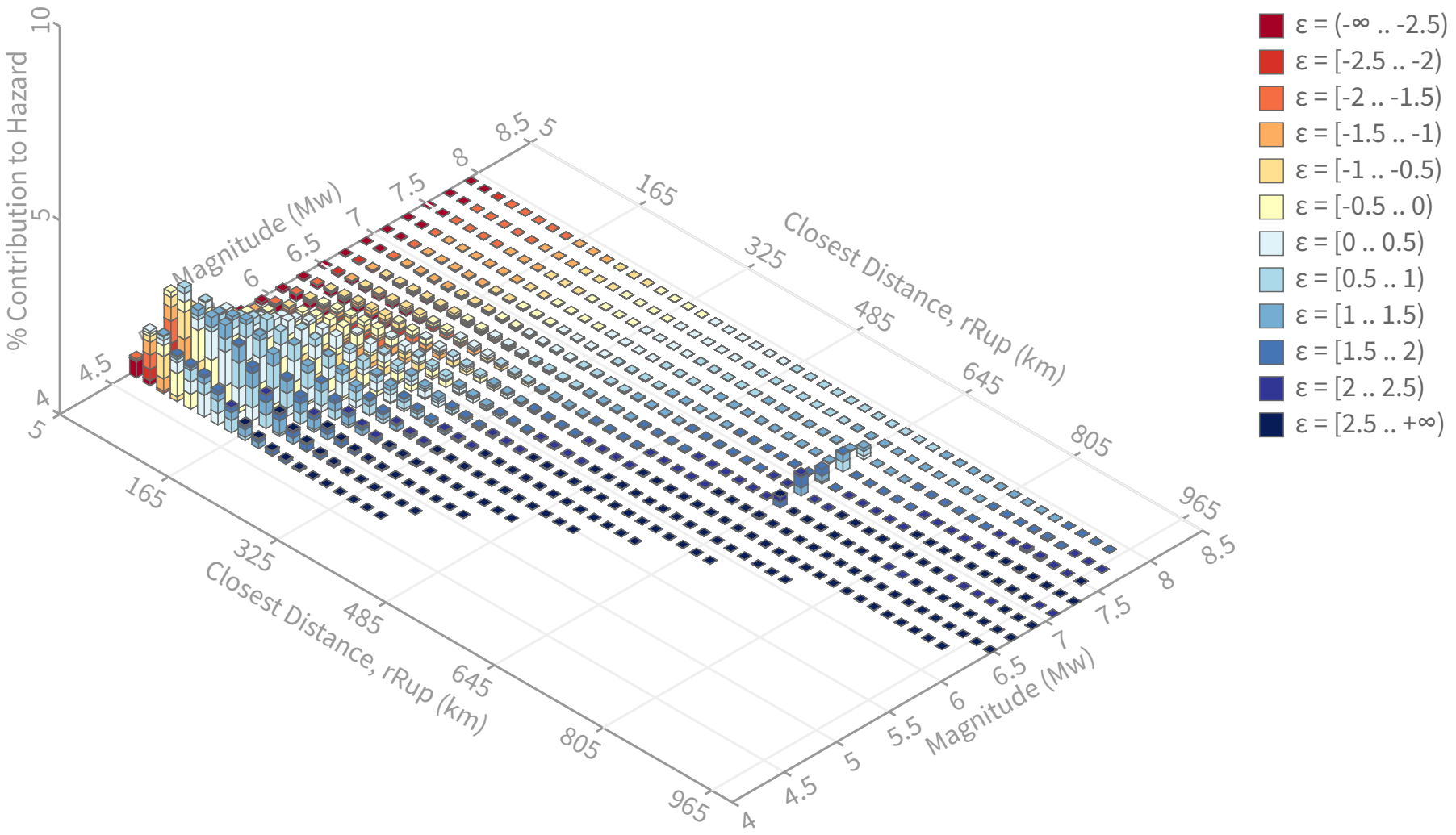


View Raw Data

Deaggregation

Component

Total


% Contribution to Hazard
10
5
4
Magnitude (Mw)
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Closest Distance, rRup (km)
5
165
325
485
645
805
965
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: 1000 yrs
Exceedance rate: 0.001 yr^{-1}
PGA ground motion: 0.014193051 g

Recovered targets

Return period: 996.91479 yrs
Exceedance rate: 0.0010030948 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 3.73 %

Mean (over all sources)

m: 5.52
r: 156.09 km
ε_0: -0.32 σ

Mode (largest m-r bin)

m: 4.9
r: 50.51 km
ε_0: -0.77 σ
Contribution: 2.4 %

Mode (largest m-r-ε_0 bin)

m: 4.9
r: 89.07 km
ε_0: -0.23 σ
Contribution: 0.89 %

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							25.46
SSCn Fixed Smoothing Zone 2 (opt)	Grid							25.34
USGS Adaptive Smoothing Zone 2 (opt)	Grid							17.06
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							16.96
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							3.04
USGS Adaptive Smoothing Zone 1 (opt)	Grid							2.98
SSCn Fixed Smoothing Zone 1 (opt)	Grid							2.93
USGS Fixed Smoothing Zone 1 (opt)	Grid							2.87
SSCn Meers Full Rupture	Fault							1.31
Meers CEUS - SSC		656.67	7.12	1.31	98.300°W	34.709°N	356.80	1.31

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

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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

28.812336

Time Horizon

Return period in years

2475

Longitude

Decimal degrees, negative values for western longitudes

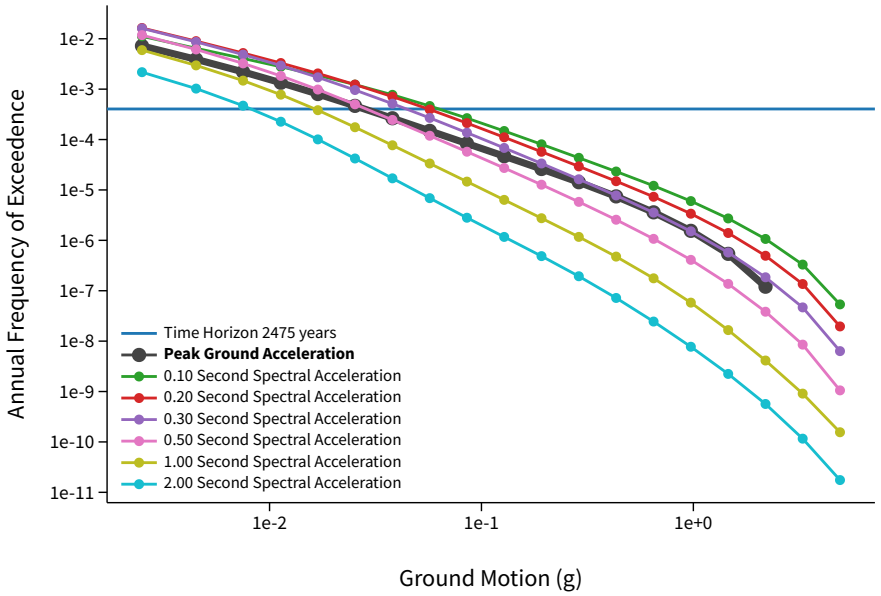
-97.899342

Site Class

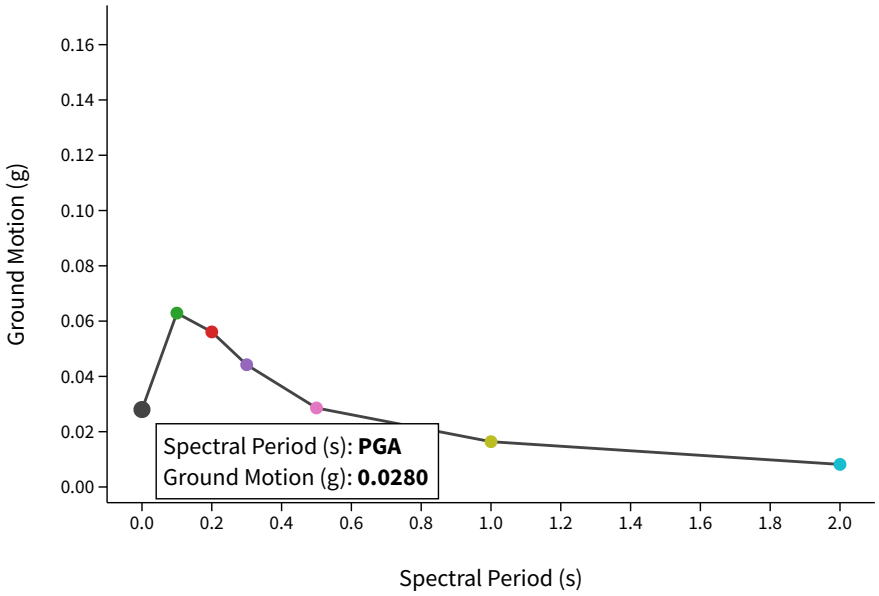
760 m/s (B/C boundary)

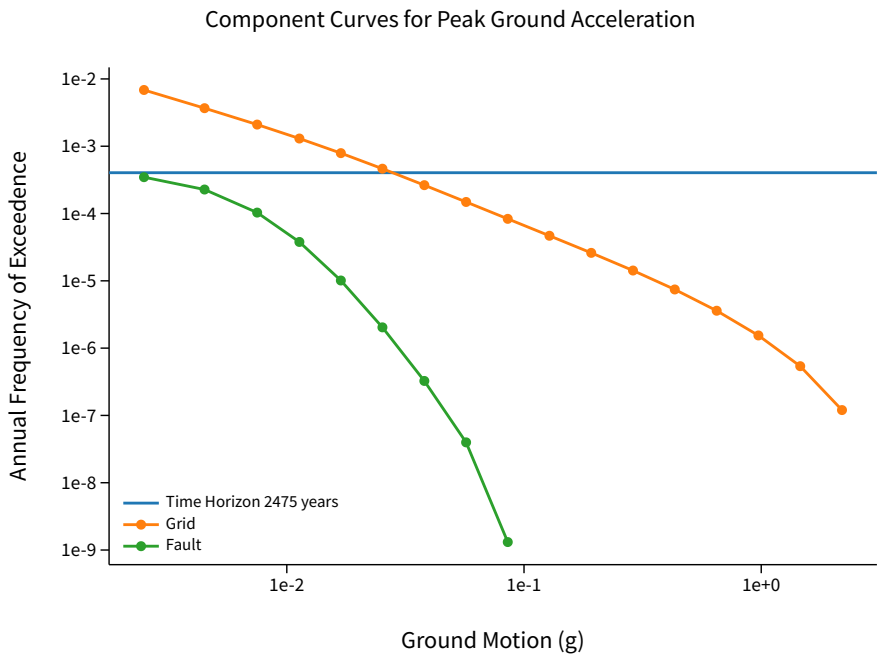
Hazard Curve

Hazard Curves



Uniform Hazard Response Spectrum



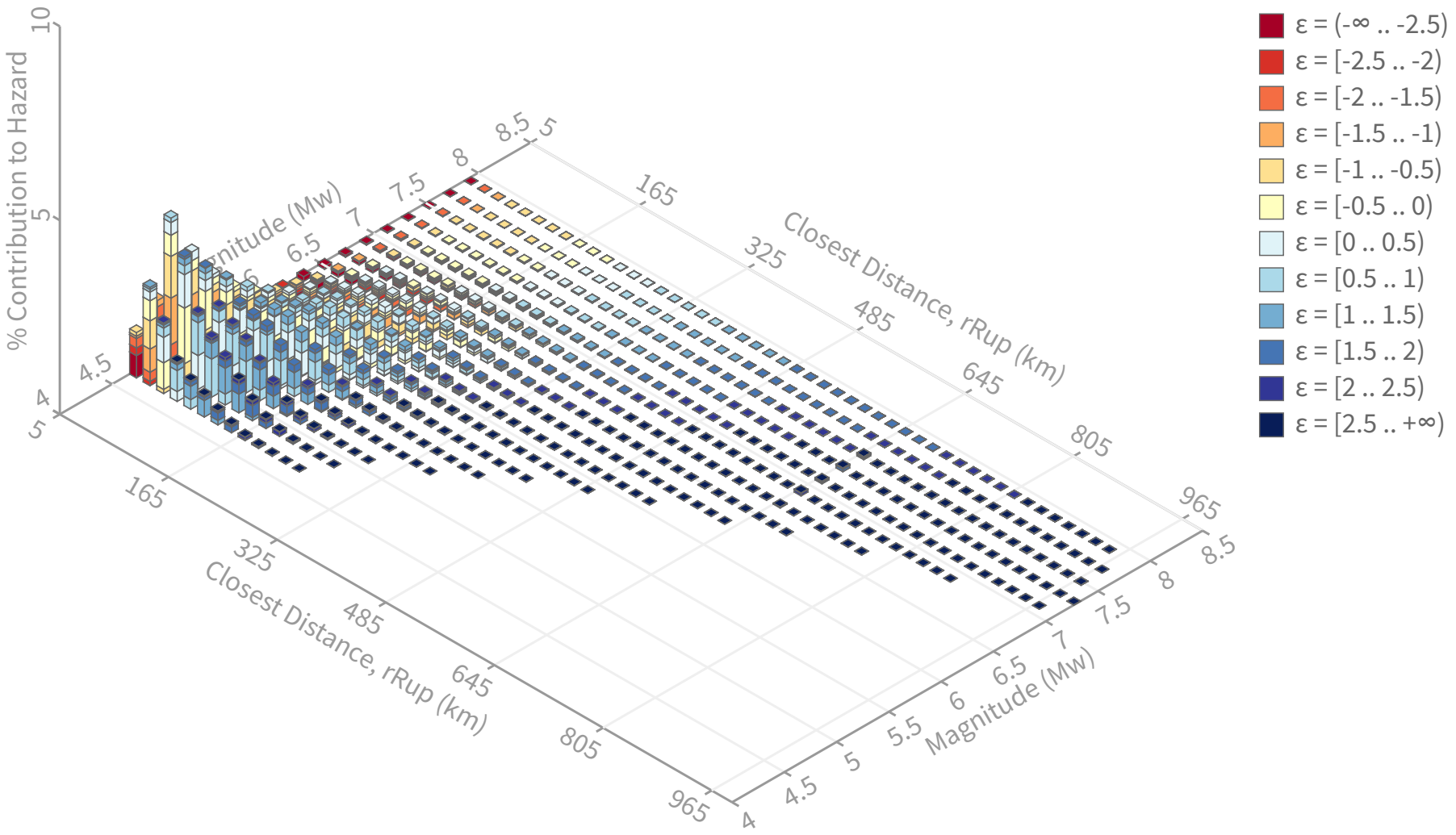


View Raw Data

Deaggregation

Component

Total


% Contribution to Hazard
10
5
4
5
4.5
6
6.5
7
7.5
8
8.5
Magnitude (Mw)
165
325
485
645
805
965
Closest Distance, rRup (km)
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: 0.028008273 g

Recovered targets

Return period: 2470.8309 yrs
Exceedance rate: 0.00040472216 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 2.67 %

Mean (over all sources)

m: 5.55
r: 104.22 km
ε_0: -0.21 σ

Mode (largest m-r bin)

m: 4.9
r: 30.68 km
ε_0: -0.93 σ
Contribution: 4 %

Mode (largest m-r-ε_0 bin)

m: 4.91
r: 49.31 km
ε_0: -0.23 σ
Contribution: 1.43 %

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							27.53
PointSourceFinite: -97.899, 29.150		37.51	5.22	-0.96	97.899°W	29.150°N	0.00	1.35
PointSourceFinite: -97.899, 29.240		47.34	5.27	-0.60	97.899°W	29.240°N	0.00	1.29
PointSourceFinite: -97.899, 29.105		32.60	5.19	-1.19	97.899°W	29.105°N	0.00	1.21
PointSourceFinite: -97.899, 29.015		22.83	5.15	-1.85	97.899°W	29.015°N	0.00	1.13
PointSourceFinite: -97.899, 29.329		57.17	5.33	-0.33	97.899°W	29.329°N	0.00	1.01
SSCn Fixed Smoothing Zone 2 (opt)	Grid							27.50
PointSourceFinite: -97.899, 29.150		37.51	5.22	-0.96	97.899°W	29.150°N	0.00	1.35
PointSourceFinite: -97.899, 29.240		47.34	5.27	-0.60	97.899°W	29.240°N	0.00	1.29
PointSourceFinite: -97.899, 29.105		32.60	5.19	-1.19	97.899°W	29.105°N	0.00	1.21
PointSourceFinite: -97.899, 29.015		22.83	5.15	-1.85	97.899°W	29.015°N	0.00	1.13
PointSourceFinite: -97.899, 29.329		57.17	5.33	-0.33	97.899°W	29.329°N	0.00	1.01
USGS Adaptive Smoothing Zone 2 (opt)	Grid							17.81
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							17.78
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							2.19
USGS Adaptive Smoothing Zone 1 (opt)	Grid							2.18
SSCn Fixed Smoothing Zone 1 (opt)	Grid							2.10
USGS Fixed Smoothing Zone 1 (opt)	Grid							2.09

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

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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

28.812336

Time Horizon

Return period in years

10000

Longitude

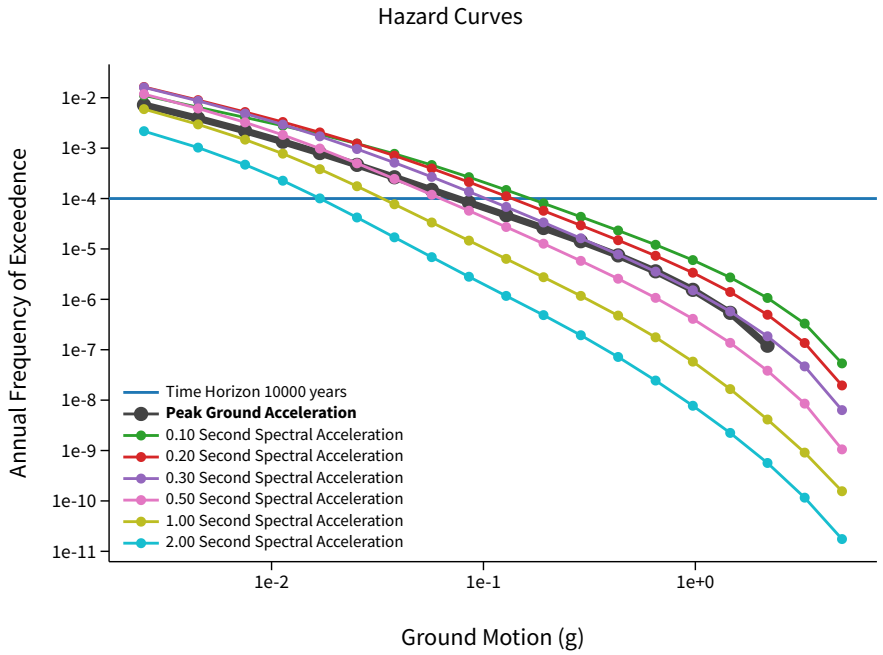
Decimal degrees, negative values for western longitudes

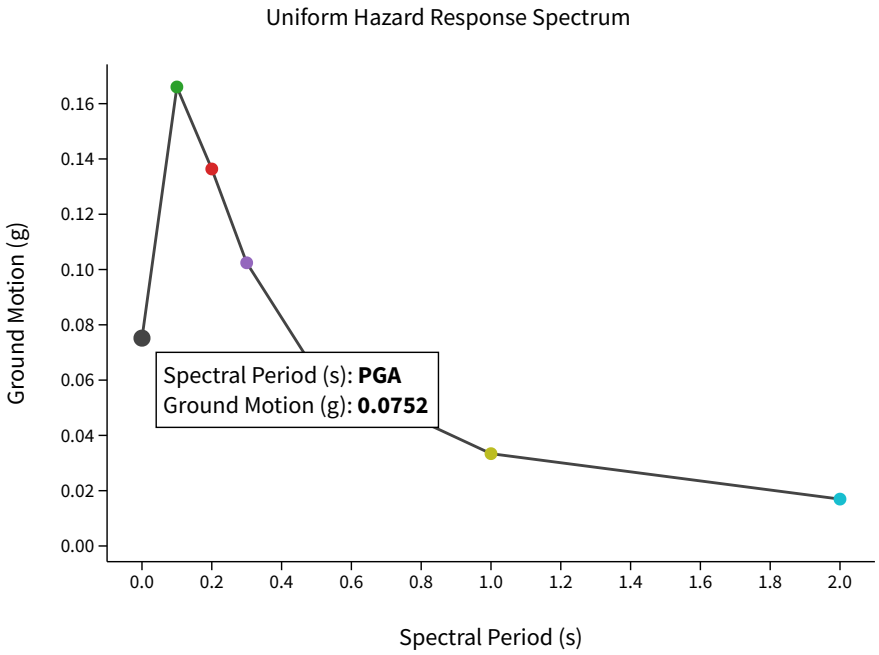
-97.899342

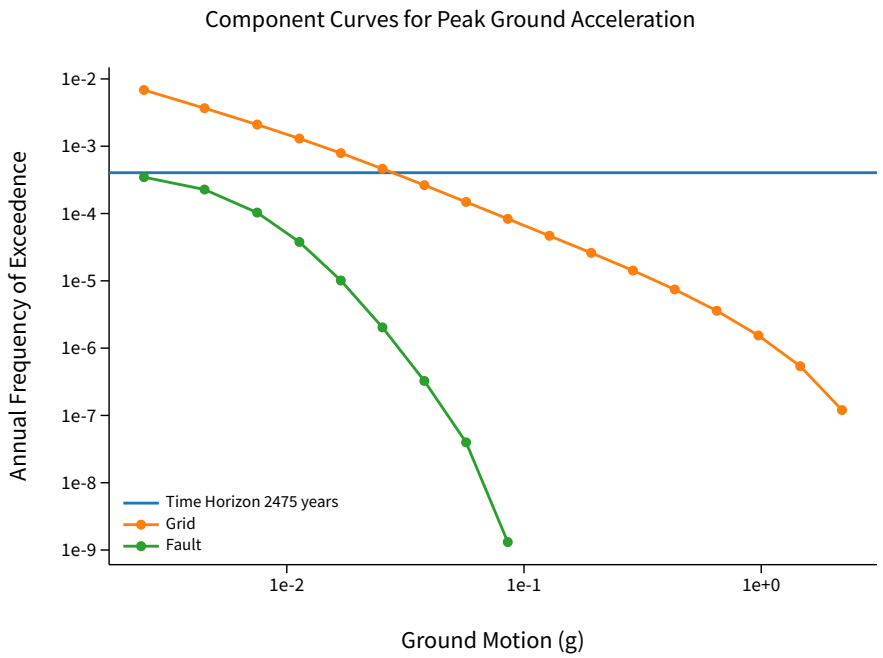
Site Class

760 m/s (B/C boundary)

Hazard Curve





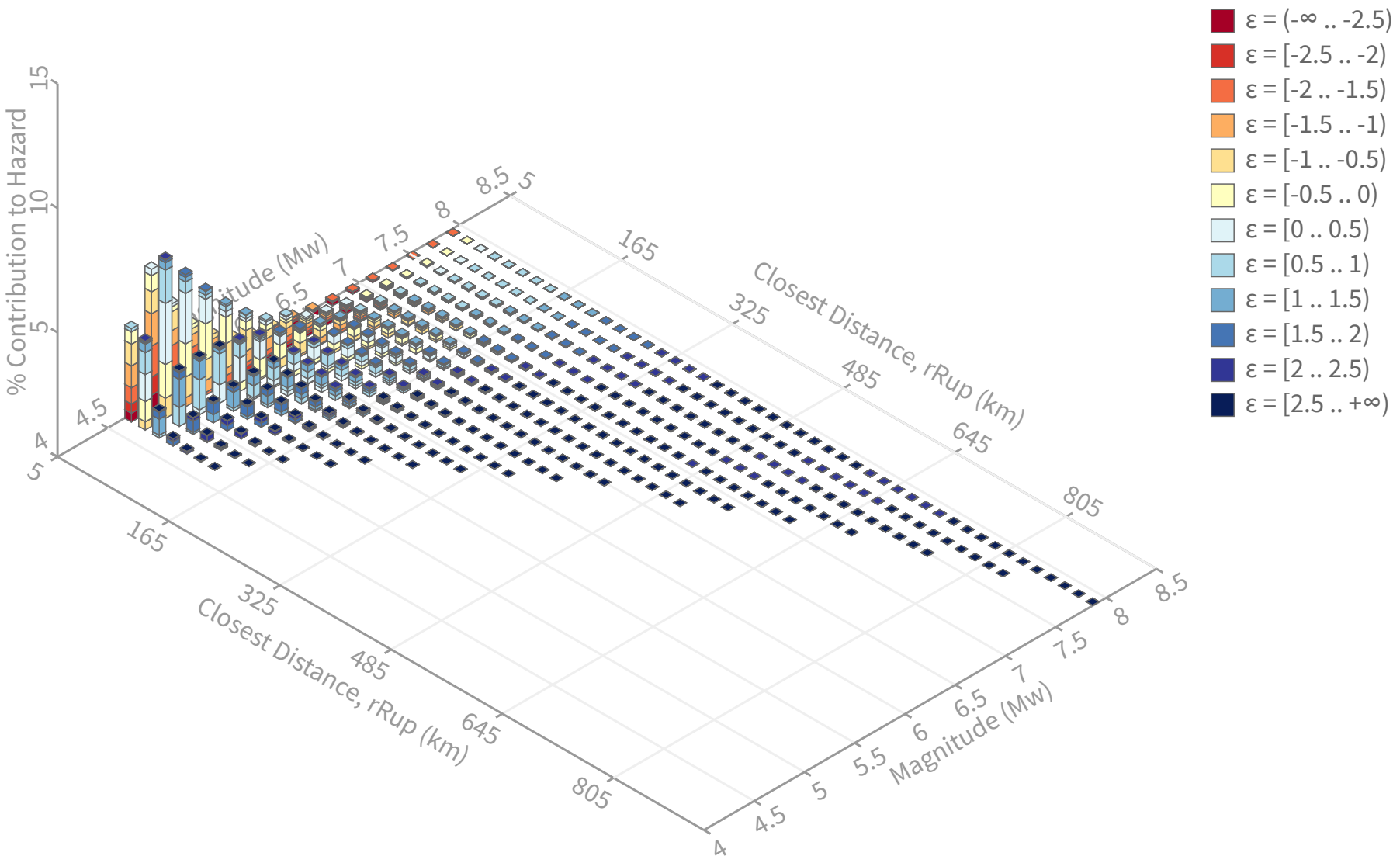


View Raw Data

Deaggregation

Component

Total


% Contribution to Hazard
15
10
5
4
5
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Magnitude (Mw)
165
325
485
645
805
Closest Distance, rRup (km)
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: 10000 yrs
Exceedance rate: 0.0001 yr^{-1}
PGA ground motion: 0.07518211 g

Recovered targets

Return period: 9999.2744 yrs
Exceedance rate: 0.00010000726 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 1.49 %

Mean (over all sources)

m: 5.59
r: 57.32 km
ε_0: -0.14 σ

Mode (largest m-r bin)

m: 4.9
r: 29.15 km
ε_0: 0.19 σ
Contribution: 6.38 %

Mode (largest m-r-ε_0 bin)

m: 4.91
r: 30.44 km
ε_0: 0.25 σ
Contribution: 2.45 %

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							29.10
PointSourceFinite: -97.899, 29.015		22.72	5.24	-0.68	97.899°W	29.015°N	0.00	2.89
PointSourceFinite: -97.899, 29.105		32.34	5.35	-0.17	97.899°W	29.105°N	0.00	2.21
PointSourceFinite: -97.899, 29.150		37.15	5.40	0.01	97.899°W	29.150°N	0.00	2.12
PointSourceFinite: -97.899, 28.970		17.95	5.19	-1.05	97.899°W	28.970°N	0.00	1.94
PointSourceFinite: -97.899, 28.880		8.91	5.14	-2.24	97.899°W	28.880°N	0.00	1.80
PointSourceFinite: -97.899, 29.060		27.52	5.29	-0.39	97.899°W	29.060°N	0.00	1.73
PointSourceFinite: -97.899, 28.925		13.28	5.16	-1.57	97.899°W	28.925°N	0.00	1.64
PointSourceFinite: -97.899, 29.240		46.74	5.53	0.27	97.899°W	29.240°N	0.00	1.58
PointSourceFinite: -97.899, 29.195		41.95	5.47	0.15	97.899°W	29.195°N	0.00	1.27
PointSourceFinite: -97.899, 29.284		51.52	5.59	0.37	97.899°W	29.284°N	0.00	1.06
SSCn Fixed Smoothing Zone 2 (opt)	Grid							29.10
PointSourceFinite: -97.899, 29.015		22.72	5.24	-0.68	97.899°W	29.015°N	0.00	2.89
PointSourceFinite: -97.899, 29.105		32.34	5.35	-0.17	97.899°W	29.105°N	0.00	2.21
PointSourceFinite: -97.899, 29.150		37.15	5.40	0.01	97.899°W	29.150°N	0.00	2.12
PointSourceFinite: -97.899, 28.970		17.95	5.19	-1.05	97.899°W	28.970°N	0.00	1.94
PointSourceFinite: -97.899, 28.880		8.91	5.14	-2.24	97.899°W	28.880°N	0.00	1.80
PointSourceFinite: -97.899, 29.060		27.52	5.29	-0.39	97.899°W	29.060°N	0.00	1.73
PointSourceFinite: -97.899, 28.925		13.28	5.16	-1.57	97.899°W	28.925°N	0.00	1.64
PointSourceFinite: -97.899, 29.240		46.74	5.53	0.27	97.899°W	29.240°N	0.00	1.58
PointSourceFinite: -97.899, 29.195		41.95	5.47	0.15	97.899°W	29.195°N	0.00	1.27
PointSourceFinite: -97.899, 29.284		51.52	5.59	0.37	97.899°W	29.284°N	0.00	1.06
USGS Adaptive Smoothing Zone 2 (opt)	Grid							18.80
PointSourceFinite: -97.899, 29.015		22.72	5.24	-0.68	97.899°W	29.015°N	0.00	1.99
PointSourceFinite: -97.899, 29.105		32.34	5.35	-0.17	97.899°W	29.105°N	0.00	1.45
PointSourceFinite: -97.899, 29.150		37.15	5.40	0.01	97.899°W	29.150°N	0.00	1.32
PointSourceFinite: -97.899, 28.970		17.95	5.19	-1.05	97.899°W	28.970°N	0.00	1.26
PointSourceFinite: -97.899, 28.880		8.91	5.14	-2.24	97.899°W	28.880°N	0.00	1.25
PointSourceFinite: -97.899, 29.060		27.52	5.29	-0.39	97.899°W	29.060°N	0.00	1.15
PointSourceFinite: -97.899, 28.925		13.28	5.16	-1.57	97.899°W	28.925°N	0.00	1.14
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							18.79
PointSourceFinite: -97.899, 29.015		22.72	5.24	-0.68	97.899°W	29.015°N	0.00	1.99

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
PointSourceFinite: -97.899, 29.105		32.34	5.35	-0.17	97.899°W	29.105°N	0.00	1.45
PointSourceFinite: -97.899, 29.150		37.15	5.40	0.01	97.899°W	29.150°N	0.00	1.32
PointSourceFinite: -97.899, 28.970		17.95	5.19	-1.05	97.899°W	28.970°N	0.00	1.26
PointSourceFinite: -97.899, 28.880		8.91	5.14	-2.24	97.899°W	28.880°N	0.00	1.25
PointSourceFinite: -97.899, 29.060		27.52	5.29	-0.39	97.899°W	29.060°N	0.00	1.15
PointSourceFinite: -97.899, 28.925		13.28	5.16	-1.57	97.899°W	28.925°N	0.00	1.14
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							1.06
USGS Adaptive Smoothing Zone 1 (opt)	Grid							1.06
SSCn Fixed Smoothing Zone 1 (opt)	Grid							1.01
USGS Fixed Smoothing Zone 1 (opt)	Grid							1.01

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

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

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.

$$N_{60} = N_m [E_m / (0.6E_r)] \quad (1)$$

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:

$$E(t) = {}_o\int^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

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

$$EF(t) = {}_o\int^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

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

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

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.

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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

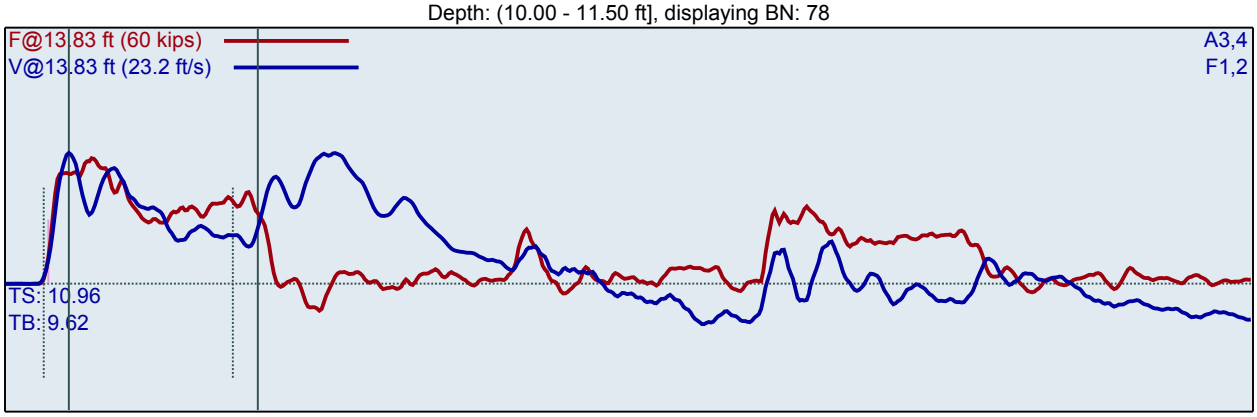
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

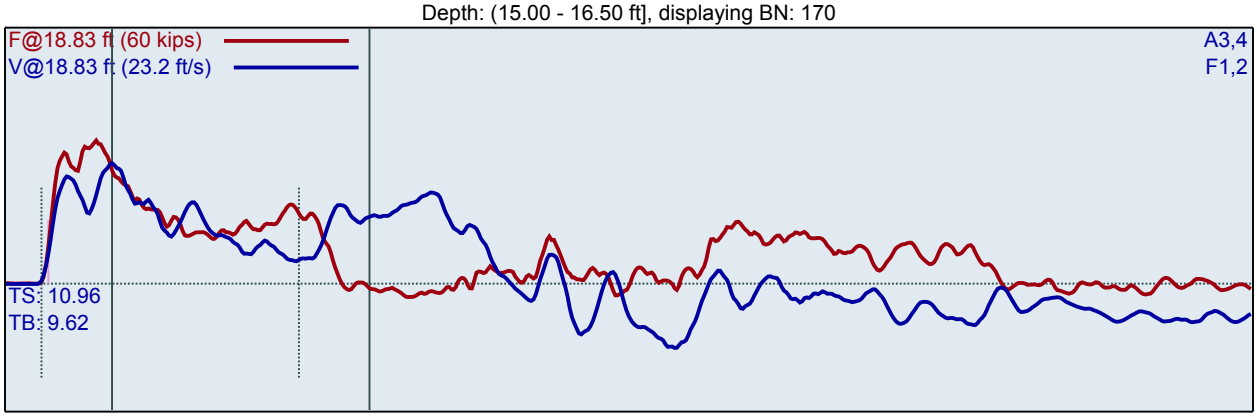
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
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: 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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

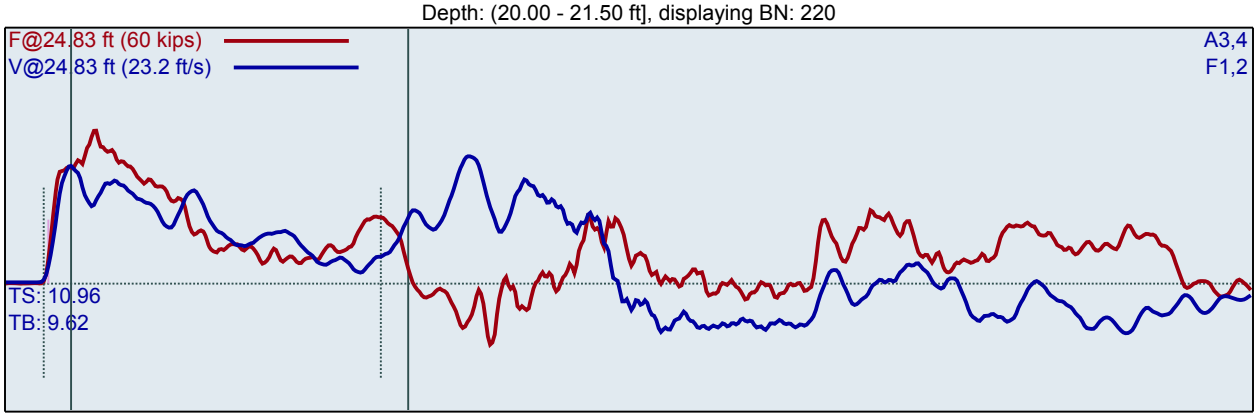
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

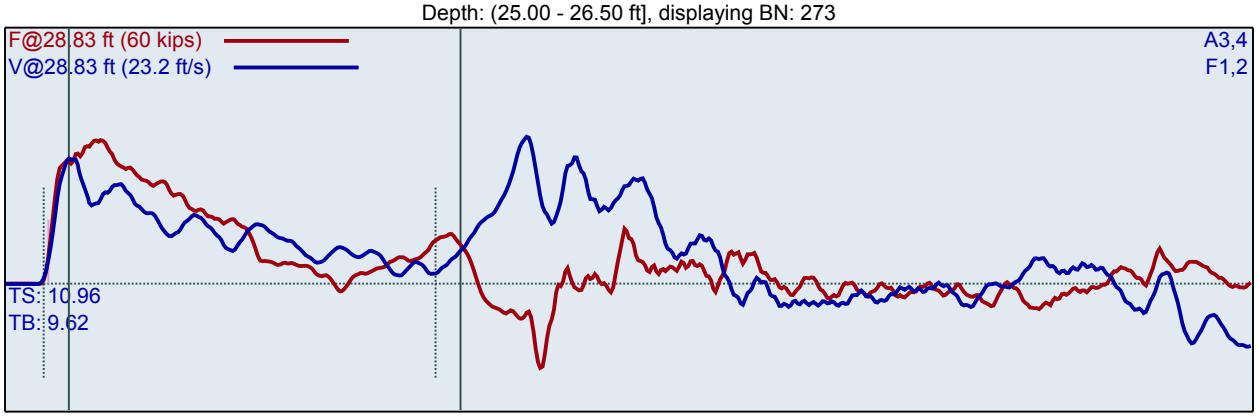
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

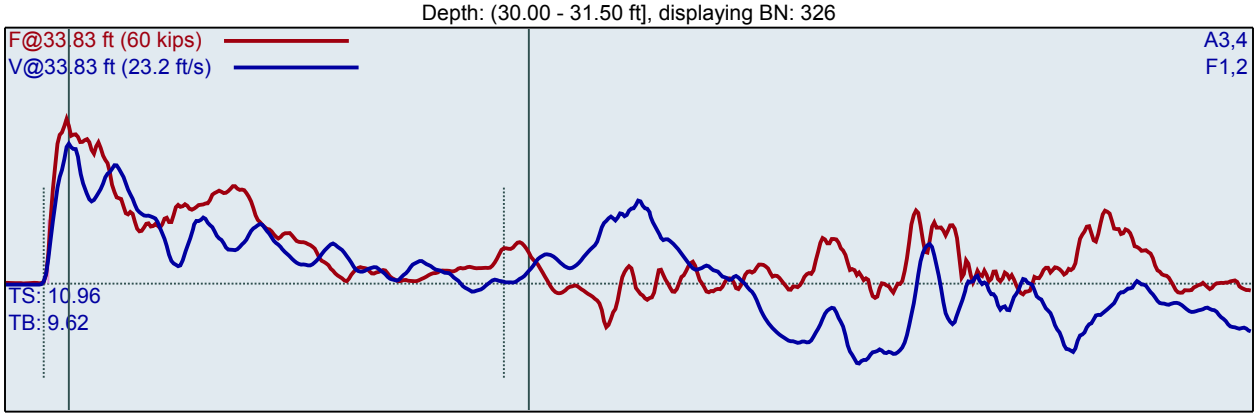
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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

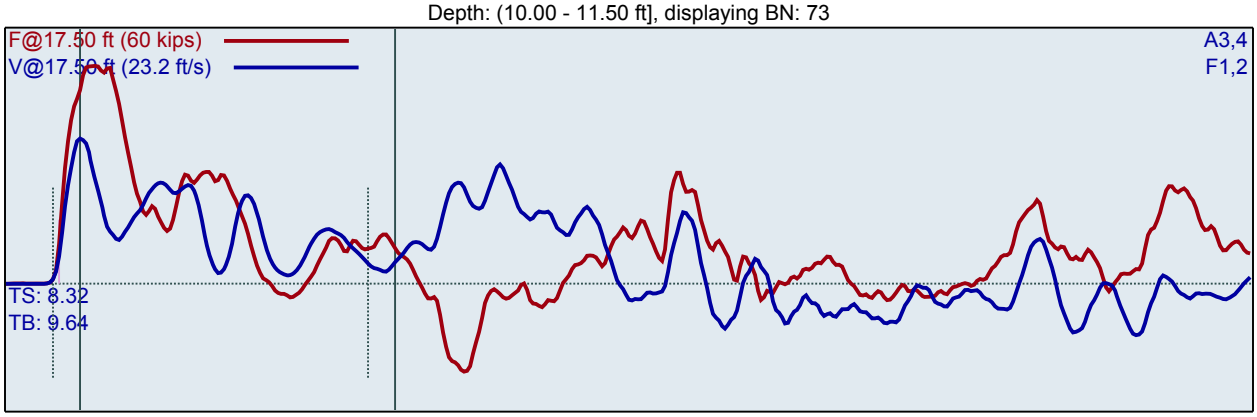
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

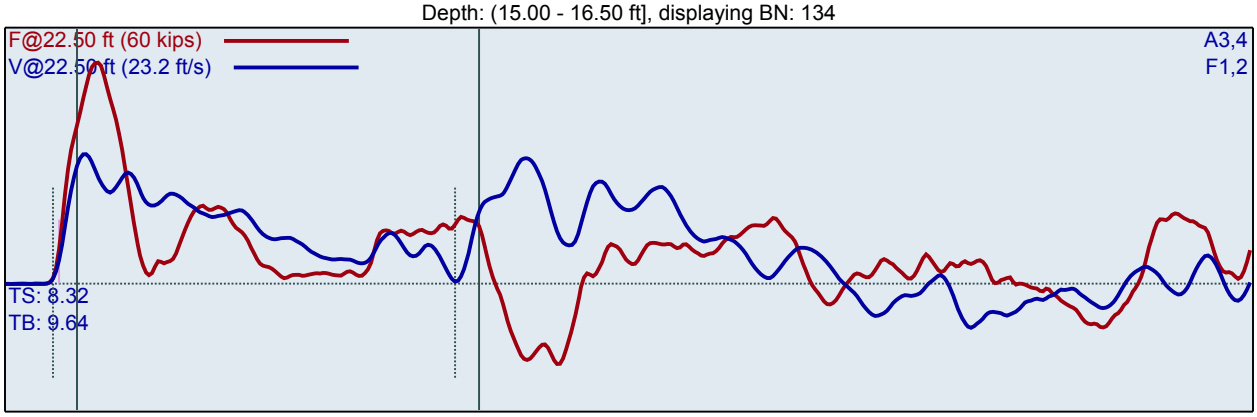
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

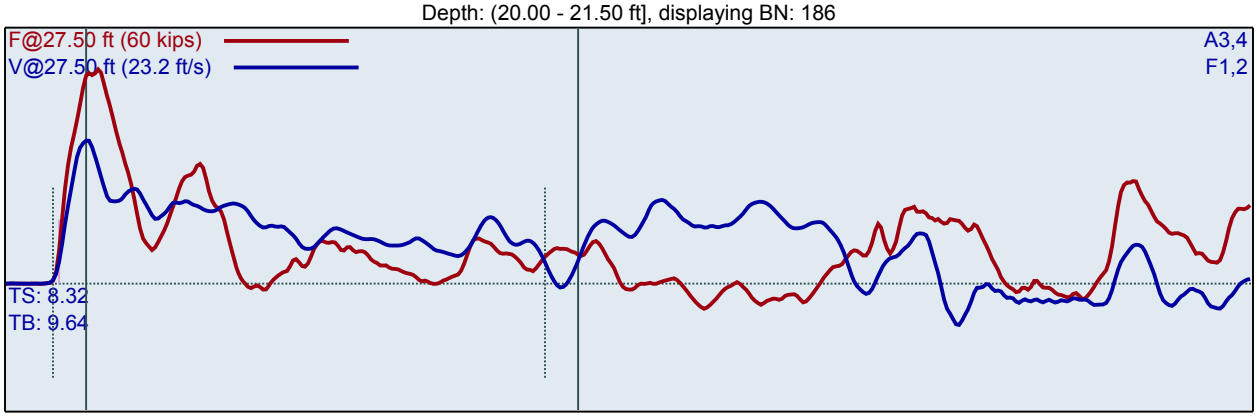
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 27.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

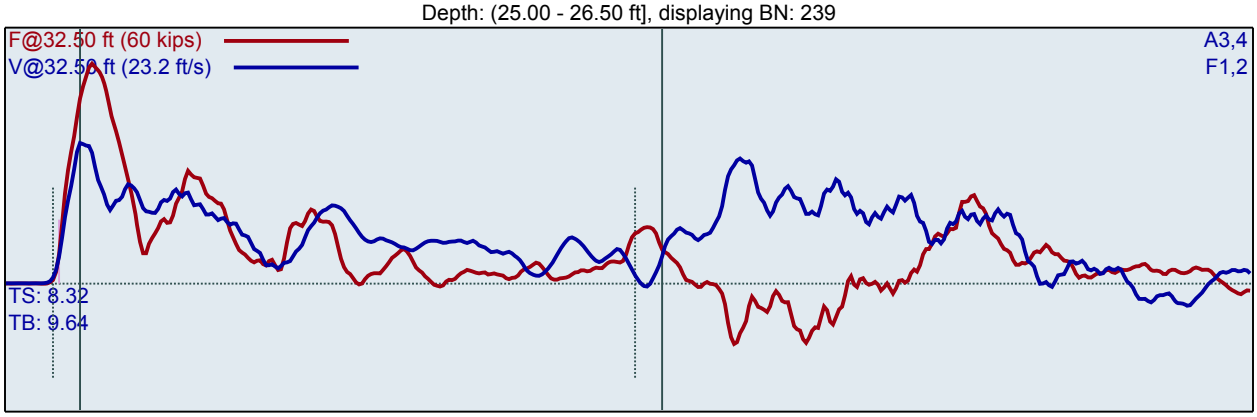
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

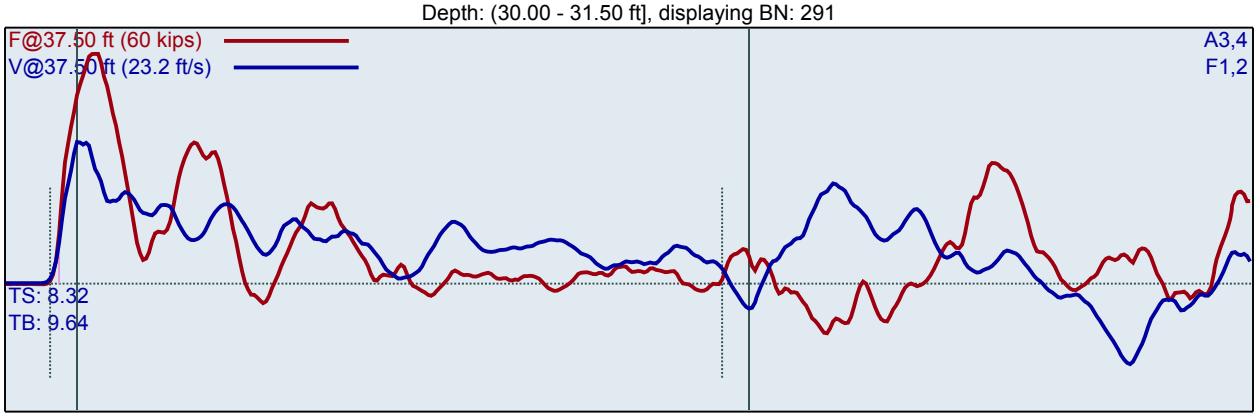
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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

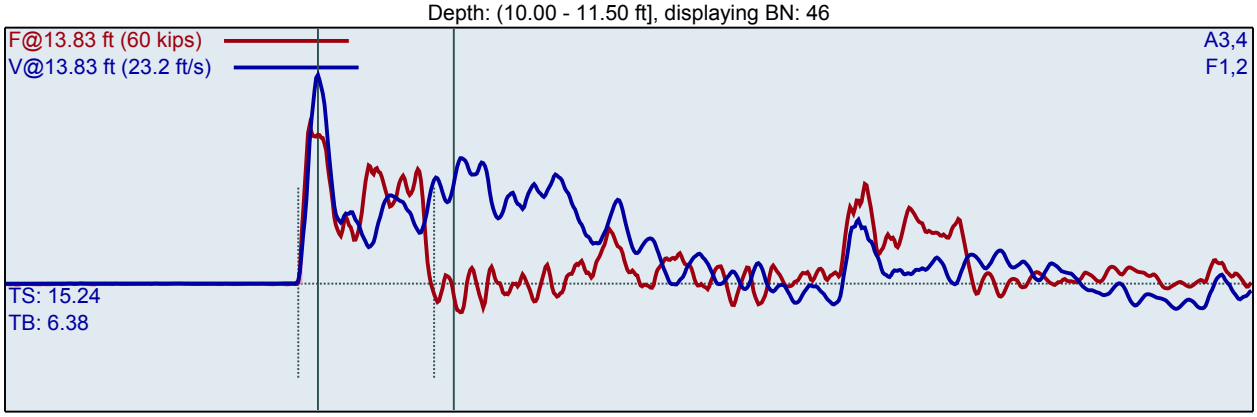
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
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: 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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

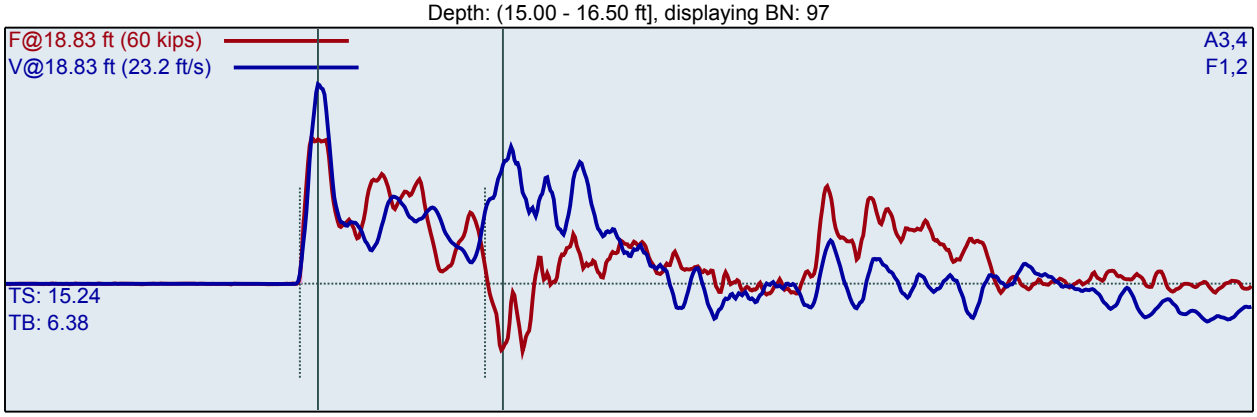
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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.

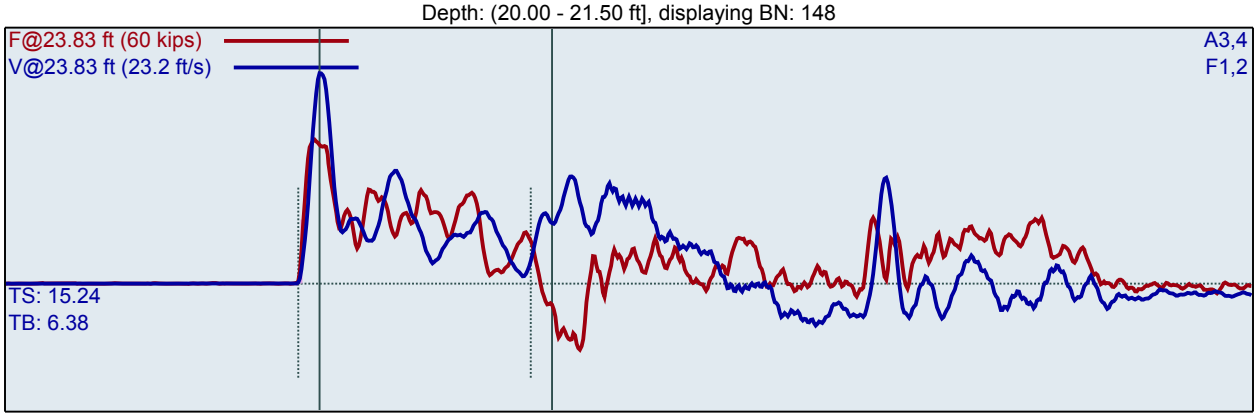
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

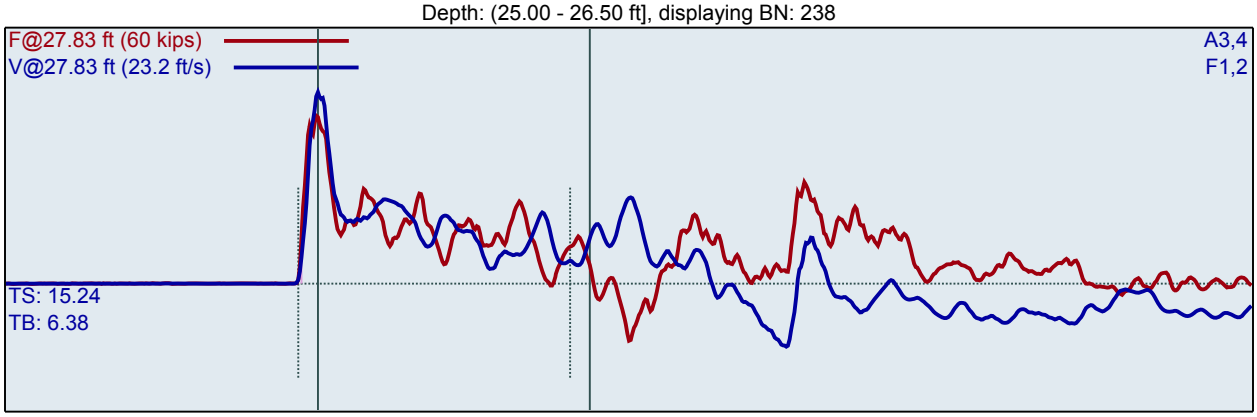
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

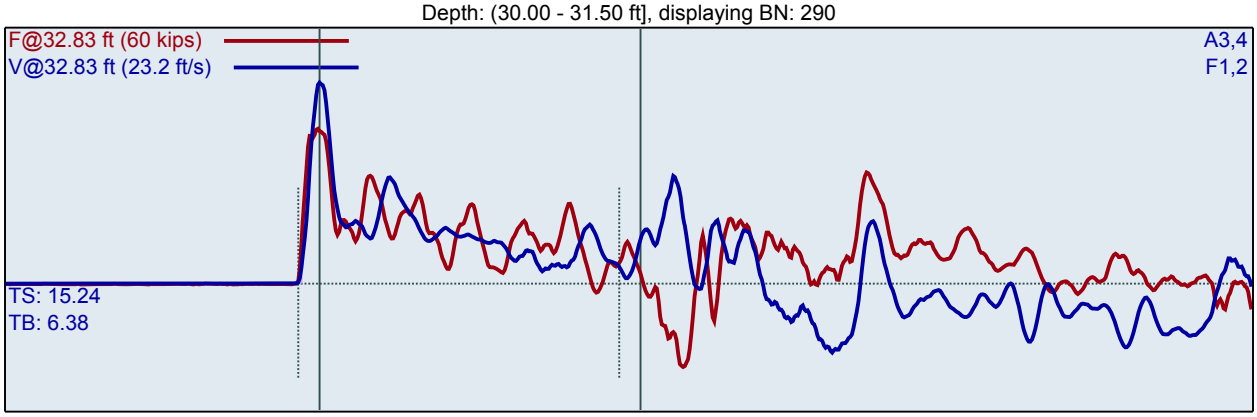
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 32.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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

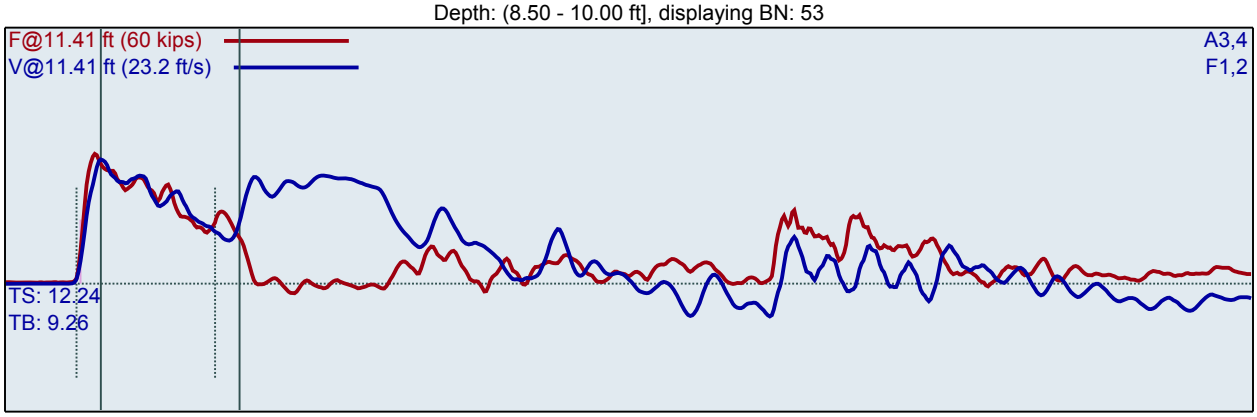
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

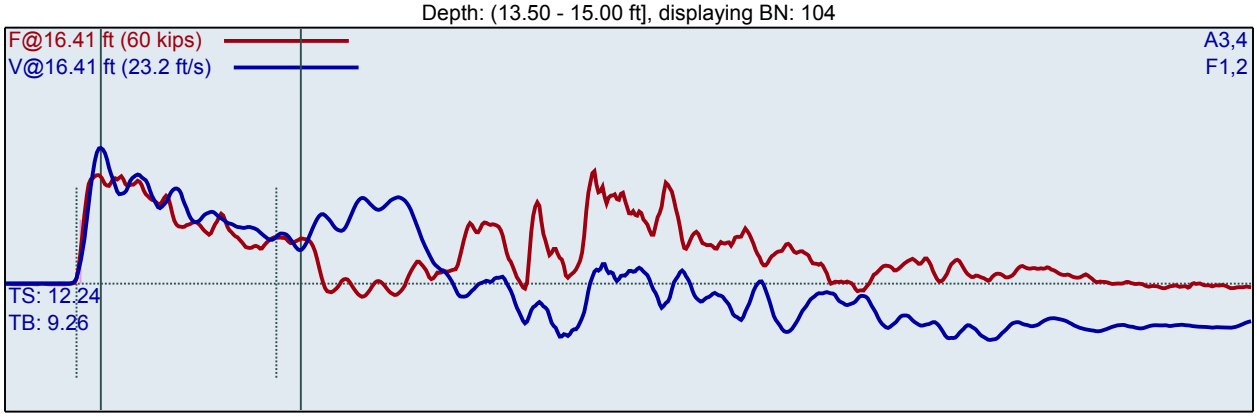
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

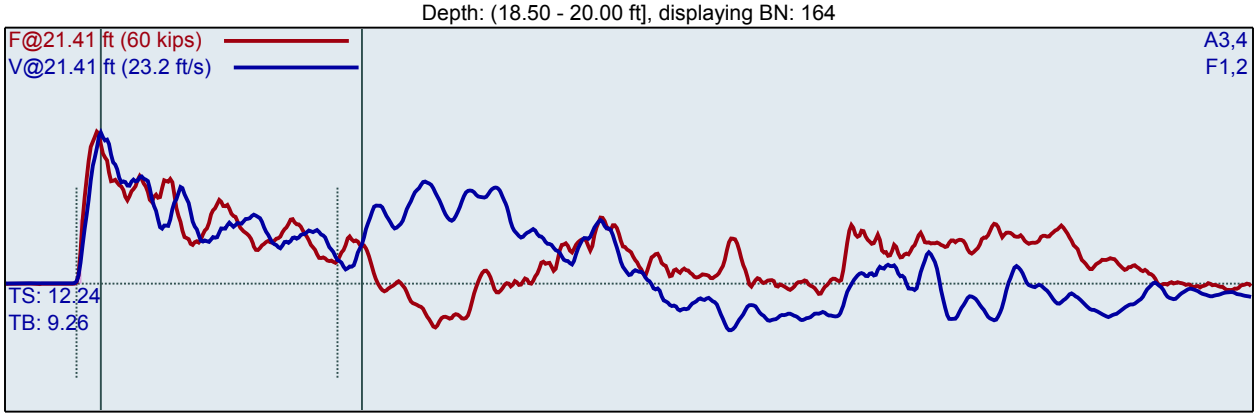
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

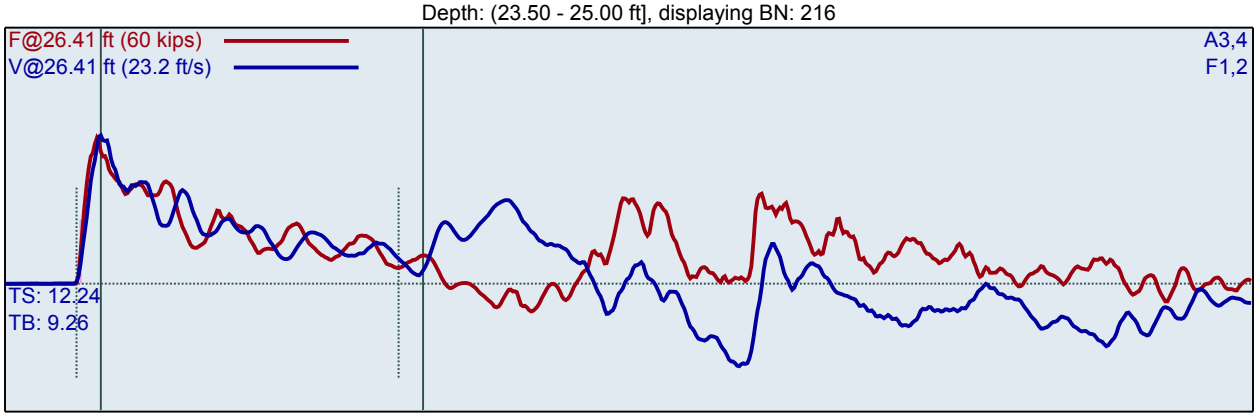
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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.

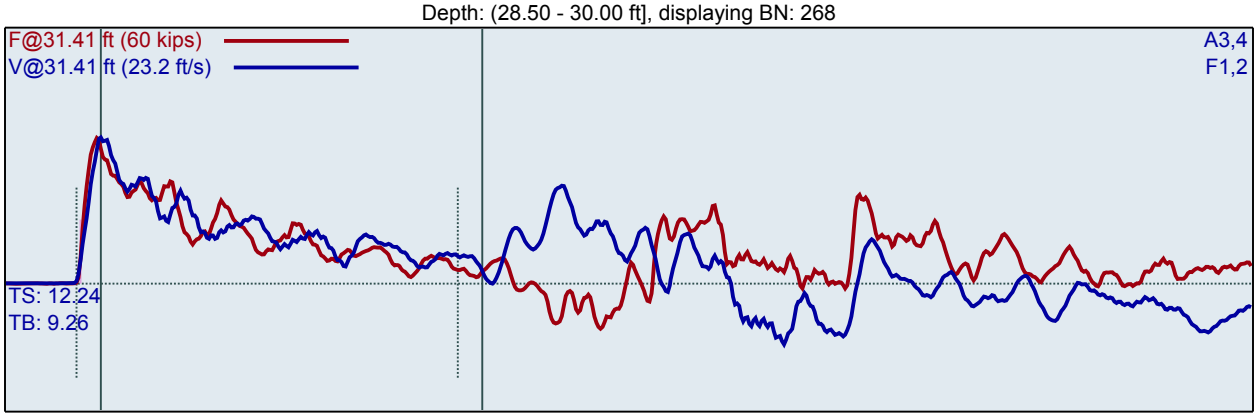
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

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 /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
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

PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/8/2023 - 8/9/2023	**TEST HOLE LEGEND**
PROJECT NO: 60707410	**NUMBER OF HOLES DRILLED:** 5	PAGE 1 OF 1
LOCATION: Kenedy, TX	**TOTAL LENGTH DRILLED (ft):** 135.5	

DEPTH (ft)	SOIL SAMPLES				STRATIGRAPHY	MATERIAL DESCRIPTION AND REMARKS	LITHOLOGY	ROCK CORE				
	SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (%)				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.

TYPICAL SOIL MATERIAL GRAPHIC SYMBOLS


High Plasticity Clay


Low Plasticity Clay


Clayey Sand


Silty clayey SAND


Poorly-graded Sand

TYPICAL ROCK MATERIAL GRAPHIC SYMBOLS

TYPICAL SAMPLER GRAPHIC SYMBOLS

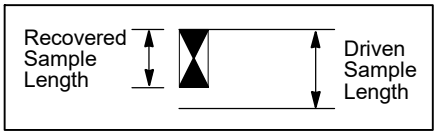

P: TX Push Tube


SS: Split Spoon


ST: Shelby Tube

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.

D.2 Boring Logs

PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/8/23 - 8/8/23	**LOG NO: 201-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 321.56	PAGE 1 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 25	

DRILL COMPANY / DRILLER: Texas Geobore / Eloy Ybarra	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Hollow Stem Auger	**AT END OF DRILLING** ---	**HOLE LOCATION:** Auxiliary Spillway
BIT SIZE/TYPE: 4.25" ID Hollow Stem Auger	**AFTER DRILLING** ---	**LATITUDE (deg)** 28.812336 (deg) **or NORTHING (ft):** 13480965.4(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg)** -97.899342 (deg) **or EASTING (ft):** 2320954(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	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 (%)
	0															
320			SS 1	6-6-8 (14)	4.5+	44	Hard, dry, dark gray, CLAY, low plasticity, blocky, with fines, 2 to 3% gravel up to 3 mm in diameter, trace roots, no HCl reaction, (Undifferentiated Clayey FILL/ALLUVIUM), (CL), (ALLUVIUM)		6		46	28				
			ST 2		4.5+	67	Hard, moist, sandy CLAY, high plasticity, with 5 to 8% calcareous inclusions up to 2 mm in diameter, (RESIDUUM), (CH), (RESIDUUM)		16	130	66	44	1	29	70	
	5		P 3		4.5+	69			17	126	61	40	0	21	79	41
315			SS 4	2-5-8 (13)	4.5+	94	Hard, moist, light brownish gray, CLAY, with sand, medium plasticity fines, 3 to 5% mafic minerals, trace iron oxide staining and calcareous inclusions, weak to strong HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		24							
			P 5		4.5+	67			28							
	10		ST 6		4.5+	92	Hard, moist, light gray, CLAY, with up to 25% fine to medium fine sand, medium plasticity fines, 2 to 3% mafic minerals, no HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		26	118	57	36	0	17	83	
310			ST 7		4.5+	67			24	119	53	36	0	15	85	
	15		SS 8	7-10-11 (21)	4.5+	100	Hard, moist, light gray, CLAY, with 10 to 15% fine to medium grained sand, 1 to 2% very coarse sand, high plasticity fines, trace iron oxide staining, no HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		22							
305																
	20		SS 9	8-9-12 (21)	4.25	100			17		34	19				

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AECOM-SMART-SOIL-LAB-ELEV_SOIL_PP+TV_GWR - URS_DENVER STD US LAB.GDT - 5/1/24 12:06 - \\NA.AECOMNET.COM\LFS\AMER\AUSTIN-USAUS2\DCS\PROJECTS\WTR\60707410_SARA_TO9_ESCONDIDOFRS4\400_TECHNICAL\440_FIELD_AND_LABORATC

PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/8/23 - 8/8/23	**LOG NO: 201-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 321.56	PAGE 2 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 25	

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 (%)
	20						Hard, moist, pale brown, CLAY, with 15 to 20% medium to fine grained sand, 1 to 2% very coarse sand, medium plasticity fines, trace iron oxide staining, no HCl reaction, (RESIDUUM), (CL), (RESIDUUM) *(continued)*									
300																
	25		SS 10	7-9-11 (20)	3.5	100	Hard, moist, light gray, CLAY, with 15 to 20% medium to fine sand, 1 to 2% very coarse sand, high plasticity fines, 3 to 5% mafic minerals, (RESIDUUM), (CH), (RESIDUUM)		20							

Bottom of hole at 25.0 feet.

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PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/9/23 - 8/9/23	**LOG NO: 202-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 325.22	PAGE 1 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 30	

DRILL COMPANY / DRILLER: Texas Geobore / Eloy Ybarra	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Hollow Stem Auger	**AT END OF DRILLING** ---	**HOLE LOCATION:** Auxiliary Spillway
BIT SIZE/TYPE: 4.25" ID Hollow Stem Auger	**AFTER DRILLING** ---	**LATITUDE (deg)** 28.812497 (deg) **or NORTHING (ft):** 13481027.3(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg)** -97.898177 (deg) **or EASTING (ft):** 2321326.6(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	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 (%)
325	0		ST 1			92	Hard, dry, pale brown, CLAY, with SAND, low plasticity, with trace roots, strong HCl reaction, (Undifferentiated Clayey FILL/ALLUVIUM), (CH), (ALLUVIUM)									
			SS 2	8-11-13 (24)	4.5+	78	2 to 5% medium grained sand, 2 to 3% mafic minerals, strong HCl reaction observed, (CH), (RESIDUUM)		9		59	43	0	14	86	
													0	21	79	40
320	5		P 3		4.5+	58	Very stiff, dry, pale brown, sandy CLAY, with SILT, low plasticity, calcareous inclusions up to 20 mm in diameter, fine to coarse grained sand stringers, strong HCl reaction, (RESIDUUM), (CL), (RESIDUUM)		8	129	32	17	0	46	54	22
			SS 4	7-8-10 (18)	4.5+	78			12				0	23	77	
			P 5		4.5+	71	Hard, dry, pale brown, CLAY, blocky, with medium to high plasticity fines, 3 to 5% fine to coarse sand, 2 to 3% mafic minerals, trace calcareous inclusions, weak HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		12	134						
315	10		SS 6	5-8-11 (19)	4.5+	100			18							
			ST 7		4.5+	69	Hard, dry, pale brown, CLAY, blocky, with 15 to 25% fine to coarse sand, medium to high plasticity fines, 2 to 3% mafic minerals, trace calcareous inclusions, weak HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		17	128	59	39	1	22	77	
310	15		P 8		4.5+	90	- 14 feet: Calcareous inclusions up to 10 mm in diameter and weak HCl reaction noted		29							
	20		ST 9		4.5+	85	Hard, moist, light brown, CLAY, calcareous, with 10 to 15% gravel, medium plasticity fines, 15 to 25% sand, 2 to 3% mafic minerals, no HCl reaction, (RESIDUUM), (CL), (RESIDUUM)		29	113	40	15	16	26	58	

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PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/9/23 - 8/9/23	**LOG NO: 202-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 325.22	PAGE 2 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 30	

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 (%)
305	20						Hard, moist, light brown, CLAY, calcareous, medium plasticity fines, 2 to 3% mafic minerals, no HCl reaction, (RESIDUUM), (CL), (RESIDUUM)									
			SS 10	17-19-20 (39)	4.5+	83	- 23.5 feet: Becoming pink, increase in calcium carbonate and mafic mineral contents, strong HCl reaction observed		17							
300	25															
			SS 11	9-12-15 (27)		100	Hard, moist, light brownish gray, CLAY, with high plasticity fines, 5 to 8% calcareous gravel up to 20 mm in diameter, trace roots, strong HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		26							
	30						Bottom of hole at 30.0 feet.									

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PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/9/23 - 8/9/23	**LOG NO: 203-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 324.69	PAGE 1 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 40	

DRILL COMPANY / DRILLER: Texas Geobore / Eloy Ybarra	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Hollow Stem Auger	**AT END OF DRILLING** ---	**HOLE LOCATION:** Auxiliary Spillway
BIT SIZE/TYPE: 4.25" ID Hollow Stem Auger	**AFTER DRILLING** ---	**LATITUDE (deg)** 28.813324 (deg) **or NORTHING (ft):** 13481325.2(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg)** -97.899067 (deg) **or EASTING (ft):** 2321038.7(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	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 (%)
	0															
		X	SS 1	5-7-7 (14)	4.0	67	Hard, dry, dark gray, sandy CLAY, low plasticity, blocky, with 2 to 3% medium grained calcareous sand, gravel, trace roots, calcareous inclusions up to 2 mm in diameter, weak HCl reaction, (Undifferentiated Clayey FILL/ALLUVIUM), (CL), (FILL)		7		45	28	0	43	57	
			P 2		4.5+	60	Medium dense, dry, grayish brown to brownish yellow, silty to clayey SAND, medium to coarse grained, calcareous, with low plasticity fines, strong HCl reaction, (SANDY ALLUVIUM), (SC/SM), (FILL)		8	124	47	29	16	48	36	
							- 2-3 feet: Lab USCS = Clayey SAND with gravel (SC)						0	52	48	21
320	5	X	SS 3	9-10-11 (21)	4.5+	47			7				0	55	45	
			P 4		4.5+	46	- 6 feet: Becomes pale brown		6		35	20				
315	10	X	SS 5	15-12-11 (23)		81	- 8 feet: Becomes loose to medium dense, very coarse to fine grained quartz sand		3				2	70	28	
			ST 6		4.5+	63	Hard, moist, pale brown, CLAY, with sand, 3 to 4% calcareous inclusions, trace iron oxidation staining, weak HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		18	126	65	44	2	13	85	
			P 7		4.5+	92	- 12 feet: Increase in iron oxide staining, calcareous inclusions up to 10 mm in diameter observed		12							
310	15	X	SS 8A/ 8B	8-10-13 (23)		97	Very stiff, moist, pale brown, sandy CLAY, medium coarse grained, with no reaction to HCl, (RESIDUUM), (CL), (RESIDUUM)		18 13		40	25	0	36	64	
305	20						Medium dense to dense, moist, pale brown, silty to clayey SAND, fine to coarse grained, with quartz particles, no HCl reaction, (RESIDUUM), (SC/SM), (RESIDUUM)									

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PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/9/23 - 8/9/23	**LOG NO: 203-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 324.69	PAGE 2 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 40	

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 (%)
	20		SS 9A/ 9B	8-11-22 (33)	3.0	100			16				0	67	33	
							Hard, moist, pale brown, sandy CLAY, with calcium carbonate filled veins, 2 to 3% calcareous inclusions, (RESIDUUM), (CH), (RESIDUUM)		26							
							- 23 feet: Weak HCl reaction noted		35	111	52	34	6	35	59	
300	25		ST 10		4.5+	71										
			ST 11		4.5+	83	Hard, moist, pale brown, CLAY, with sand, calcium carbonate filled veins, 2 to 3% calcareous inclusions, weak HCl reaction, (RESIDUUM), (CH), (RESIDUUM)									
295	30		ST 12		4.5+	65	- 30 feet: Becomes mottled, with 3 to 5% calcareous sand, 2 to 3% mafic minerals, and weak HCl reaction observed		35	113	57	35	2	20	78	
290	35		SS 13	12-19-21 (40)	4.5+	100	Hard, moist, grayish brown, CLAY, with medium to high plasticity fines, 2 to 3% mafic minerals, no HCl reaction, (RESIDUUM), (CH), (RESIDUUM)		27							
285	40		SS 14	18-23-25 (48)	4.5+	100	- 38.5 feet: Near vertical fracture planes, no HCl reaction observed		30		59	36				

Bottom of hole at 40.0 feet.

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PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/8/23 - 8/8/23	**LOG NO: 204-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 318.10	PAGE 1 OF 1 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 20	

DRILL COMPANY / DRILLER: Texas Geobore / Eloy Ybarra	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Hollow Stem Auger	**AT END OF DRILLING** ---	**HOLE LOCATION:** Auxiliary Spillway
BIT SIZE/TYPE: 4.25" ID Hollow Stem Auger	**AFTER DRILLING** ---	**LATITUDE (deg)** 28.81403 (deg) **or NORTHING (ft):** 13481584.1(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg)** -97.898322 (deg) **or EASTING (ft):** 2321274.8(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	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 (%)
	0		ST 1		4.5+	88	Very stiff to hard, dry, light brown to gray, sandy CLAY, with SILT, medium plasticity fines, medium to fine grained sand, weak to strong HCl reaction, (Undifferentiated Clayey FILL/ALLUVIUM), (CL)		9	120	40	28	0	39	61	
315			SS 2	10-8-7 (15)	3.5	69			5				0	50	50	
	5		P 3		4.5+	67	- 4.5 feet: Becomes blocky with calcium carbonate filled veins		29				0	34	66	31
310			ST 4		4.5+	67	Hard, moist, light brown, sandy CLAY, with medium to high plasticity fines, 2 to 3% calcareous inclusions, 30 to 45% fine grained sand, no HCl reaction, (Undifferentiated Clayey FILL/ALLUVIUM), (CH)		33		54	31	8	38	54	
	10		ST 5		4.5+	73	Hard, moist, light brown, CLAY, with SILT, 15 to 25% fine grained sand, 2 to 3% calcareous inclusions, medium plasticity fines, no HCl reaction, (RESIDUUM), (CL)		32	113	44	25	1	22	77	37
			SS 6	11-19-25 (44)	4.5	100	- 10 feet: Becomes less sandy, 5 to 8% mafic minerals, strong HCl reaction		22							
305																
	15		P 7		4.5+	75	- 13 feet: Becomes mottled, with trace iron oxide staining, 3 to 5% calcareous inclusions, weak HCl reaction		34	117						
300																
	20		SS 8	9-14-17 (31)	4.25	100	- 18.5 feet: Becomes moist with strong HCl reaction observed		27							

Bottom of hole at 20.0 feet.

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PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/8/23 - 8/8/23	**LOG NO: 205-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 318.99	PAGE 1 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 20.5	

DRILL COMPANY / DRILLER: Texas Geobore / Eloy Ybarra	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Hollow Stem Auger	**AT END OF DRILLING** ---	**HOLE LOCATION:** Auxiliary Spillway
BIT SIZE/TYPE: 4.25" ID Hollow Stem Auger	**AFTER DRILLING** ---	**LATITUDE (deg)** 28.814891 (deg) **or NORTHING (ft):** 13481899.9(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg)** -97.897513 (deg) **or EASTING (ft):** 2321531(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	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 (%)
	0		ST 1		4.5+	60	Medium dense, moist, dark grayish brown, clayey to silty SAND, with trace roots, no reaction to HCl, (SANDY ALLUVIUM), (SC/SM)		7	117	39	25	0	52	48	
			SS 2	8-10-11 (21)	4.5+	50	- 2 feet: Becomes blocky with 3 to 5% calcareous sand, shell fragments, weak HCl reaction		5				0	53	47	20
315																
	5		ST 3		4.5+	71	Dense, dry, pale brown, clayey SAND, with 2 to 5% calcareous inclusions, strong HCl reaction, (SANDY ALLUVIUM), (SC)		8		30	17	2	66	32	
			P 4		4.5+	60	- 6 feet: calcareous inclusions up to 4 mm in diameter observed		9				0	74	26	
310			ST 5		4.5+	75			6							
	10		SS 6	15-21-21 (42)	4.5+	75	- 9 feet: Trace roots, 5 to 10% calcareous inclusions, calcium carbonate filled veins, weak to strong HCl reaction		6		36	23	3	53	44	
							Medium dense, dry, pale brown, SAND, with medium grained sand, 2 to 3% calcareous inclusions, (RESIDUUM), (SP)									
305									26							
	15		SS 7	8-16-19 (35)	4.5+	100	Hard, moist, brown, CLAY, with medium plasticity fines, calcareous inclusions up to 15 mm in diameter, calcium carbonate filled veins, 3 to 5% mafic minerals, strong HCl reaction, (RESIDUUM), (CL)									
300			ST 8		4.5+	96	Hard, moist, brown, CLAY, with sand, high plasticity fines, calcareous inclusions up to 15 mm in diameter, calcium carbonate filled veins, 3 to 5% mafic minerals, no HCl reaction, (RESIDUUM), (CH)		34	112	50	22	2	28	70	
	20		SS 9	9-11-17	4.5+	100			31							

(Continued Next Page)

AECOM-SMART-SOIL-LAB-ELEV_SOIL_PP+TV_GWR - URS_DENVER STD US LAB.GDT - 5/1/24 12:06 - \\NA.AECOMNET.COM\LFS\AMER\AUSTIN-USAUS2\DCS\PROJECTS\WTR\60707410_SARA_TO9_ESCONDIDOFRS4\400_TECHNICAL\440_FIELD_AND_LABORATC

PROJECT NAME: Escondido FRS 4	**DATES DRILLED:** 8/8/23 - 8/8/23	**LOG NO: 205-23**
PROJECT NO: 60707410	**SURFACE ELEVATION (ft):** 318.99	PAGE 2 OF 2 AECOM
LOCATION: Kenedy, TX	**TOTAL DEPTH (ft):** 20.5	

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 (%)
	20	X		(28)	4.5+	100	- 20 feet: Weak HCl reaction observed		31							

Bottom of hole at 20.5 feet.

AECOM-SMART-SOIL-LAB-ELEV_SOIL_PP+TV_GWR - URS_DENVER STD US LAB.GDT - 5/1/24 12:06 - \\NA.AECOMNET.COM\LFS\AMER\AUSTIN-USAUS2\DCS\PROJECTS\WTR\60707410_SARA_TO9_ESCONDIDOFRS4\400_TECHNICAL\440_FIELD_AND_LABORATC

D.3 Geologic Field Reconnaissance

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
1	8/7/2023

Description:

Photo facing northwest along the downstream slope of the embankment.



Photo No.	Date:
2	8/7/2023

Description:

Photo facing northwest along the upstream slope of the embankment.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
3	8/7/2023

Description:

Photo facing northwest toward the right side groin.



Photo No.	Date:
4	8/7/2023

Description:

Photo facing northeast showing the principal spillway.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
5	8/7/2023

Description:
Close up of the principal spillway.



Photo No.	Date:
6	8/7/2023

Description:
Photo facing southeast along the embankment centerline.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
7	8/7/2023

Description:

Photo facing east showing the high-level inlet structure.



Photo No.	Date:
8	8/7/2023

Description:

Photo facing north along the splitter dike in the middle of the auxiliary spillway.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
9	10/30/2023

Description:

Photo facing north from the embankment showing standing water along the right side of the downstream toe.



Photo No.	Date:
10	10/30/2023

Description:

Photo facing northwest from the embankment towards the principal spillway.



Appendix E Sample Photographs

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
1	8/8/23

Description:

Boring: 201-23. SS-1.
Depths: 0-1.5 ft.



Photo No.	Date:
2	8/8/23

Description:

Boring: 201-23. ST-2.
Depths: 2-4 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
3	8/8/23

Description:

Boring: 201-23. P-3.
Depths: 4-6 ft.

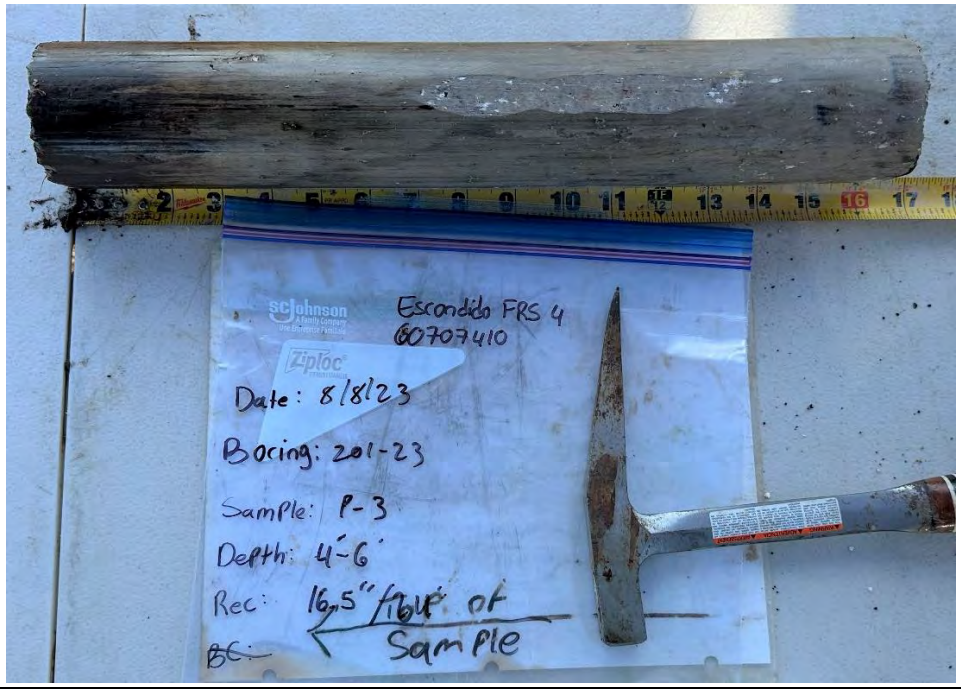


Photo No.	Date:
4	8/8/23

Description:

Boring 201-23. SS-4.
Depths: 6-7.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
5	8/8/23

Description:

Boring 201-23. P-5.
Depths: 8-10 ft.



Photo No.	Date:
6	8/8/23

Description:

Boring 201-23. ST-6.
Depths: 10-12 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
7	8/8/23

Description:

Boring 201-23. ST-7.
Depths: 12-14 ft.

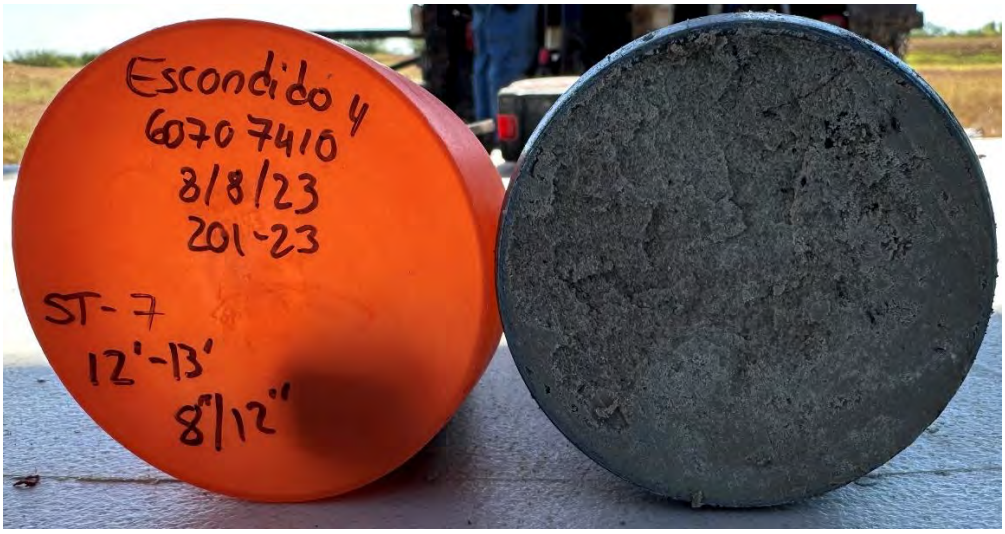


Photo No.	Date:
8	8/8/23

Description:

Boring 201-23. SS-8.
Depths: 15-16.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
9	8/8/23

Description:

Boring 201-23. SS-9.
Depths: 18.5-20 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
1	8/9/23

Description:

Boring: 202-23. ST-1.
Depths: 0-2 ft.



Photo No.	Date:
2	8/9/23

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. 4: Karnes County, TX	60707410

Photo No.	Date:
3	8/9/23

Description:

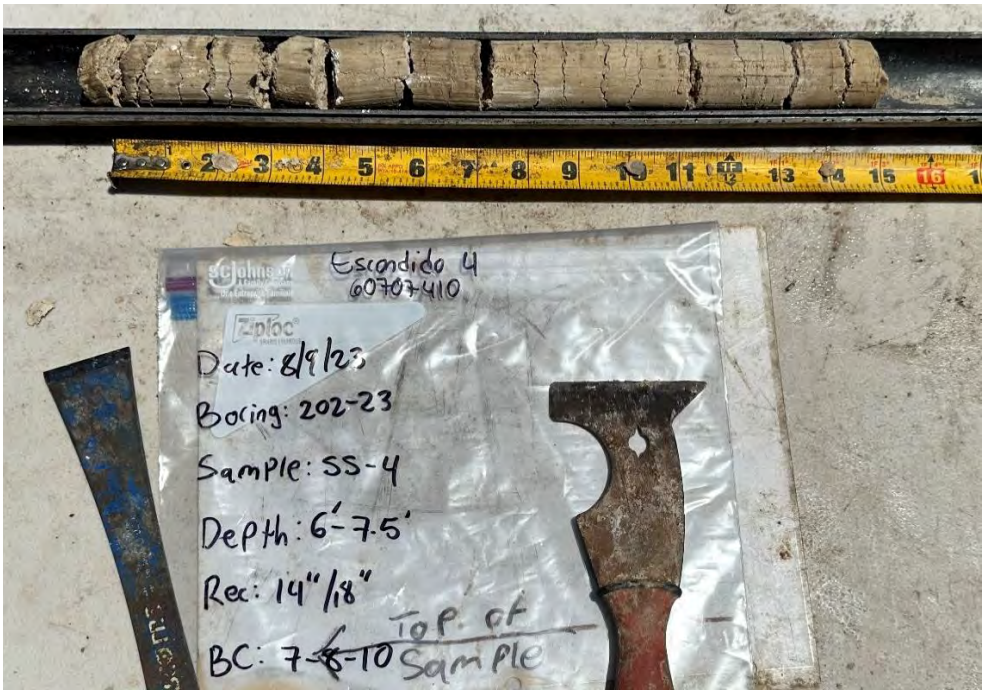
Boring: 202-23. P-3.
Depths: 4-6 ft.



Photo No.	Date:
4	8/9/23

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. 4: Karnes County, TX	60707410

Photo No.	Date:
5	8/9/23

Description:

Boring 202-23. P-5.
Depths: 8-10 ft.



Photo No.	Date:
6	8/9/23

Description:

Boring 202-23. SS-6.
Depths: 10-11.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
7	8/9/23

Description:

Boring 202-23. ST-7.
Depths: 12-14 ft.



Photo No.	Date:
8	8/9/23

Description:

Boring 202-23. P-8.
Depths: 14-15 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
9	8/9/23

Description:

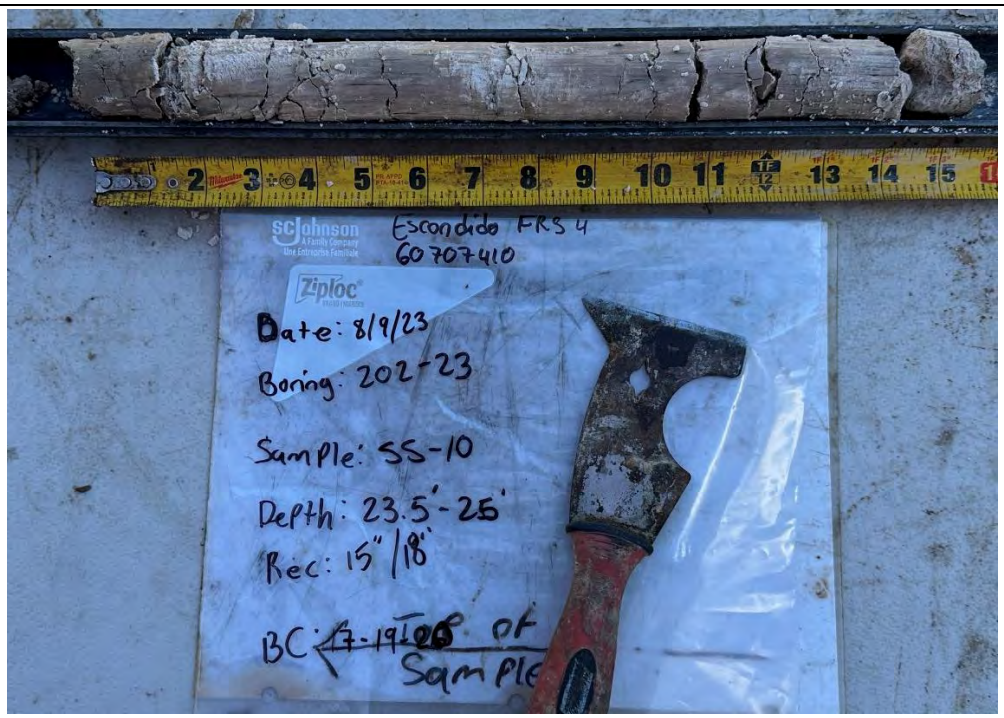
Boring 202-23. ST-9.
Depths: 18-20 ft.



Photo No.	Date:
10	8/9/23

Description:

Boring 202-23. SS-10.
Depths: 23.5-25 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
11	8/9/23

Description:

Boring 202-23. SS-11.
Depths: 28.5-30 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
1	8/9/23

Description:

Boring: 203-23. SS-1.
Depths: 0-1.5 ft.

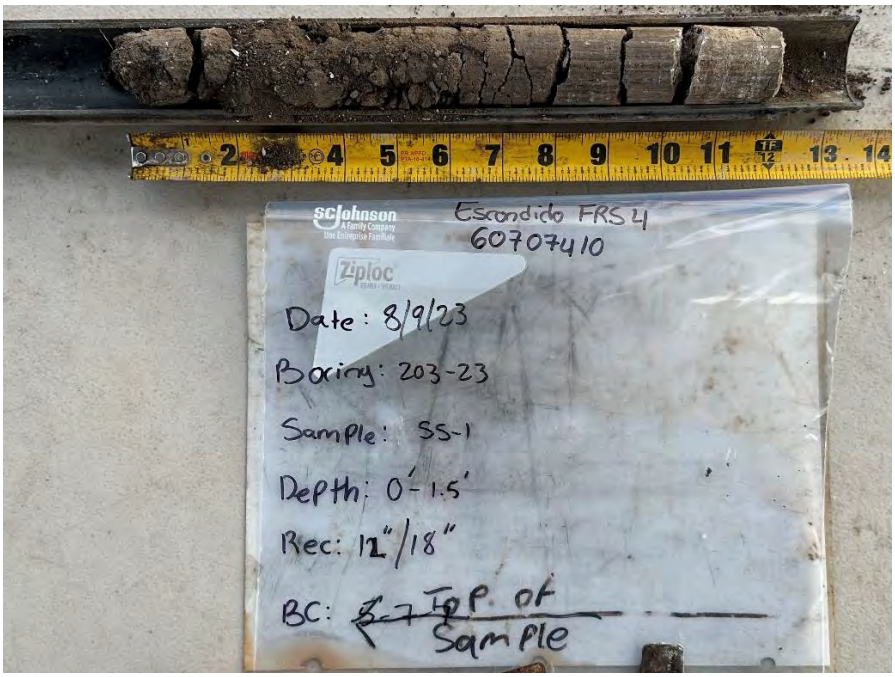


Photo No.	Date:
2	8/9/23

Description:

Boring: 203-23. P-2.
Depths: 2-4 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
3	8/9/23

Description:

Boring: 203-23. SS-3.
Depths: 4-5.5 ft.



Photo No.	Date:
4	8/9/23

Description:

Boring 203-23. P-4.
Depths: 6-8 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
5	8/9/23

Description:

Boring 203-23. SS-5.
Depths: 8-9.5 ft.

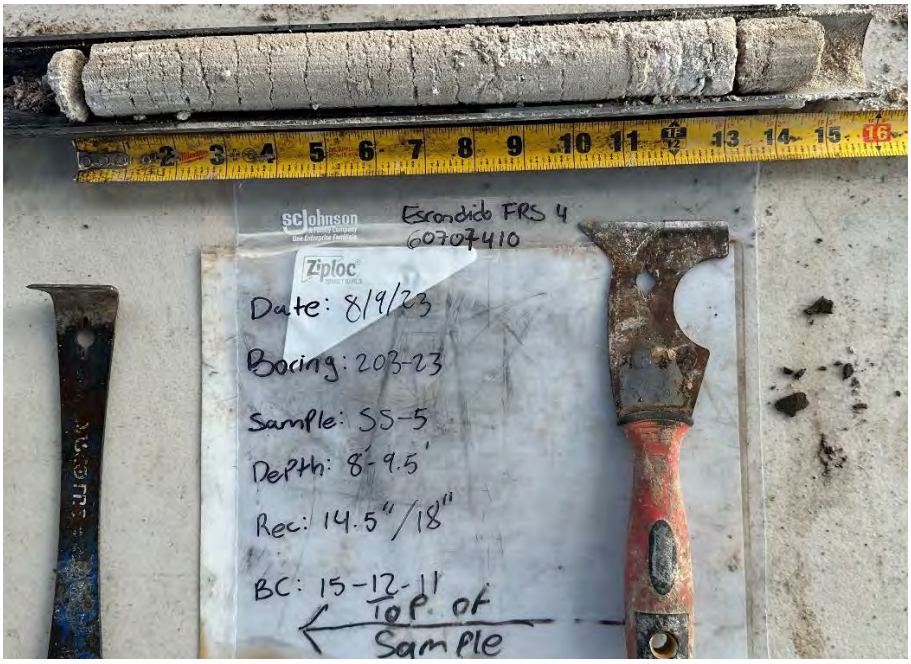


Photo No.	Date:
6	8/9/23

Description:

Boring 203-23. ST-6.
Depths: 10-12 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
7	8/9/23

Description:

Boring 203-23. P-7.
Depths: 12-14 ft.



Photo No.	Date:
8	8/9/23

Description:

Boring 203-23. SS-8.
Depths: 14-15.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
9	8/9/23

Description:

Boring 203-23. SS-9.
Depths: 20-21.5 ft.



Photo No.	Date:
10	8/9/23

Description:

Boring 203-23. ST-10.
Depths: 23-25 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
11	8/9/23

Description:

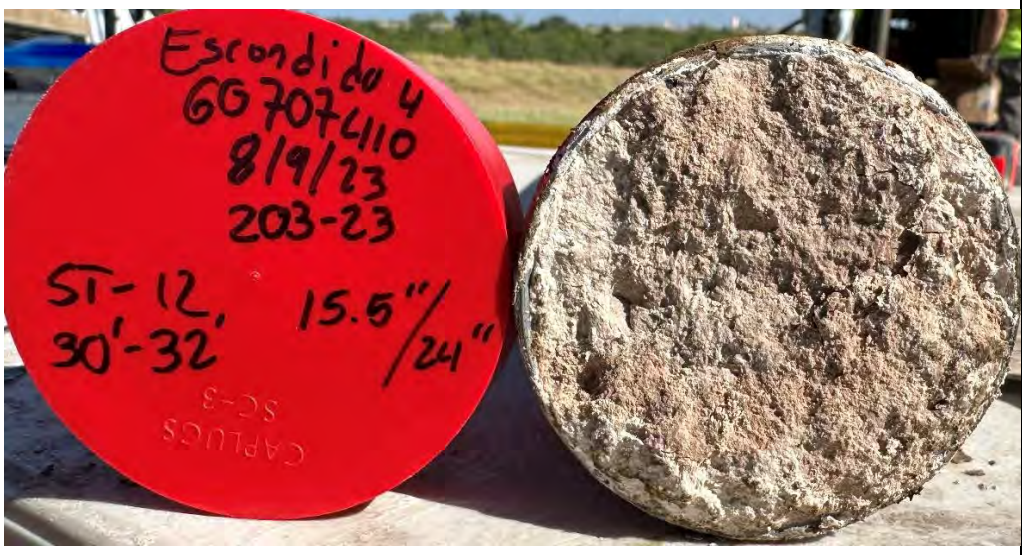
Boring 203-23. ST-11.
Depths: 25-26 ft.



Photo No.	Date:
12	8/9/23

Description:

Boring 203-23. ST-12.
Depths: 30-32 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
13	8/9/23

Description:

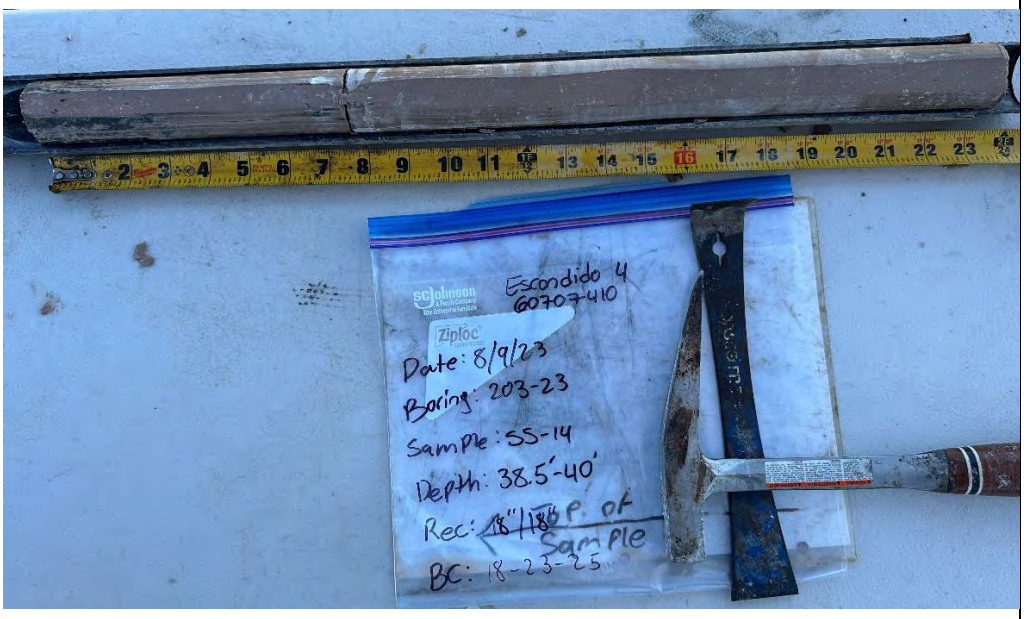
Boring 203-23. SS-13.
Depths: 33.5-35 ft.



Photo No.	Date:
14	8/9/23

Description:

Boring 203-23. SS-14.
Depths: 38.5-30 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
1	8/8/23

Description:

Boring: 204-23. ST-1.
Depths: 0-2 ft.

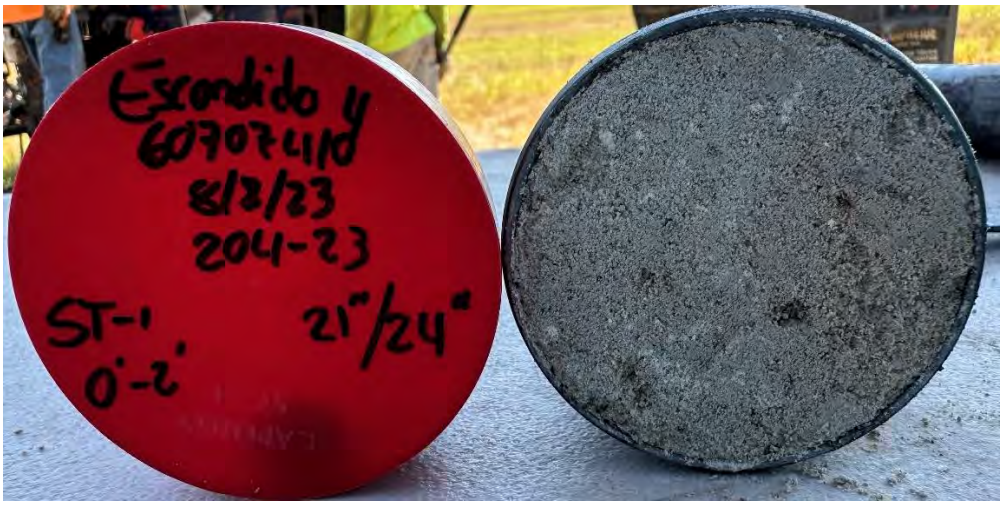
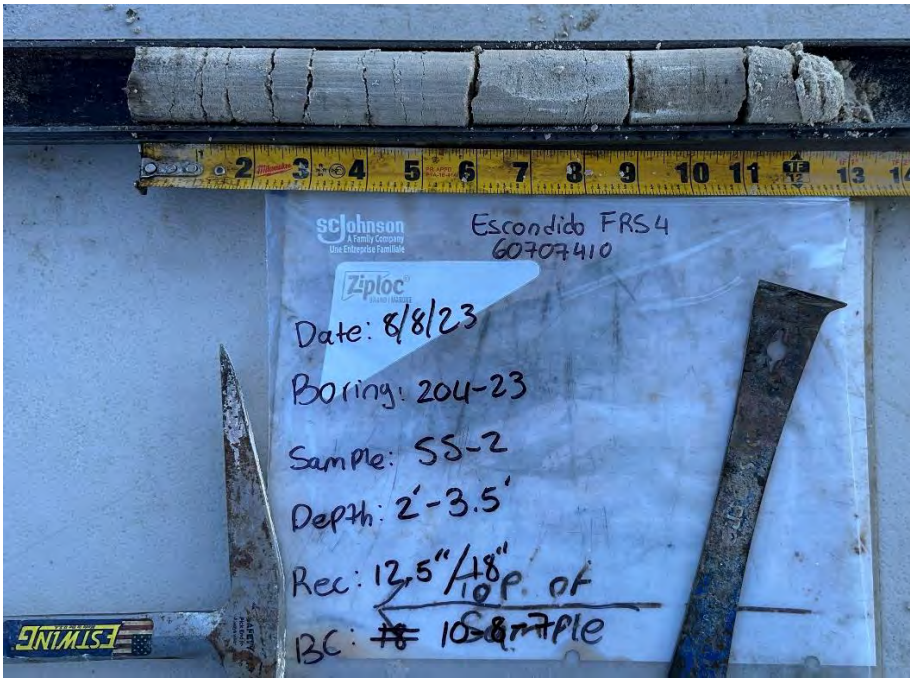


Photo No.	Date:
2	8/8/23

Description:

Boring: 204-23. SS-2.
Depths: 2-3.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
3	8/8/23

Description:

Boring: 204-23. P -3.
Depths: 4-6 ft.



Photo No.	Date:
4	8/8/23

Description:

Boring 204-23. ST-4.
Depths: 6-8 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
5	8/8/23

Description:

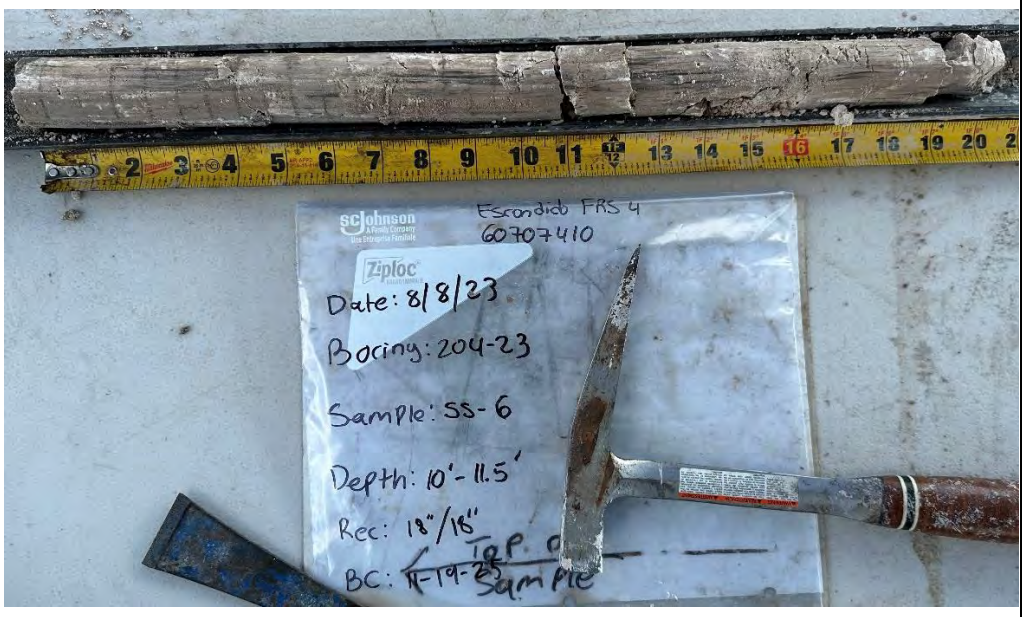
Boring 204-23. ST-5.
Depths: 8-10 ft.



Photo No.	Date:
6	8/8/23

Description:

Boring 204-23. SS-6.
Depths: 10-11.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
7	8/8/23

Description:

Boring 204-23. P-7.
Depths: 14-15 ft.



Photo No.	Date:
8	8/8/23

Description:

Boring 204-23. SS-8.
Depths: 18.5-20 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
1	8/8/23

Description:

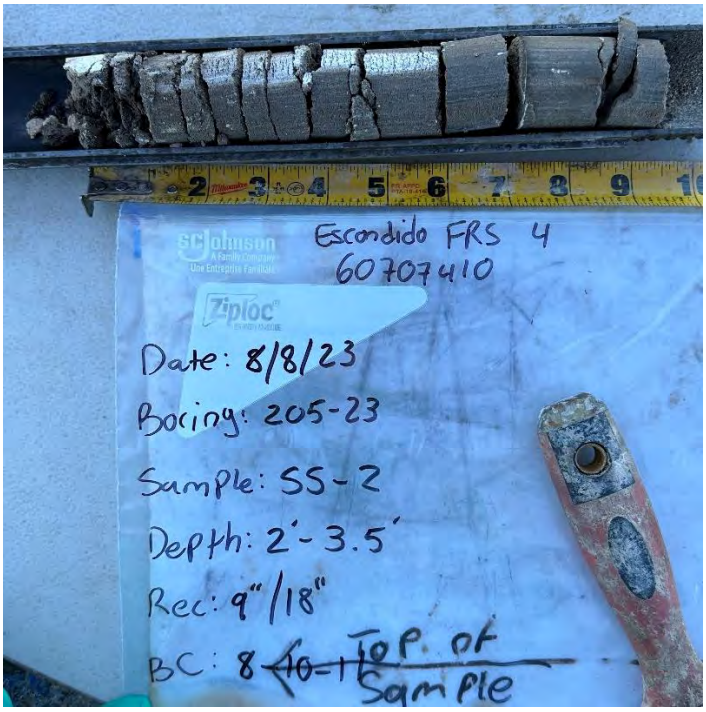
Boring: 205-23. ST-1.
Depths: 0-2 ft.



Photo No.	Date:
2	8/8/23

Description:

Boring: 205-23. SS-2.
Depths: 2-3.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
3	8/8/23

Description:

Boring: 205-23. ST-3.
Depths: 4-6 ft.



Photo No.	Date:
4	8/8/23

Description:

Boring 205-23. P-4.
Depths: 6-8 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
5	8/8/23

Description:

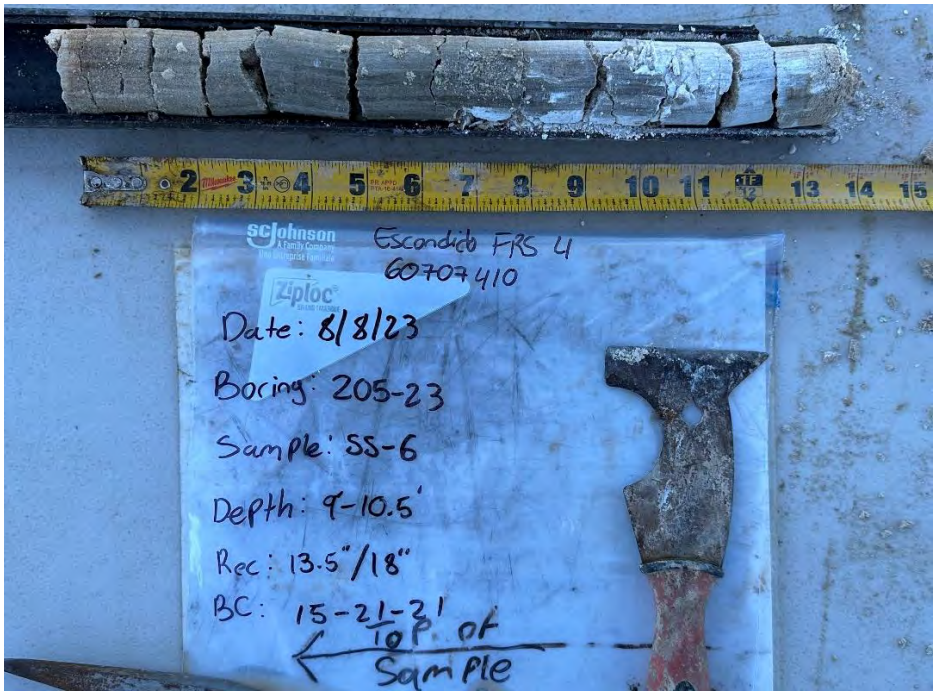
Boring 205-23. ST-5.
Depths: 8-9 ft.



Photo No.	Date:
6	8/8/23

Description:

Boring 205-23. SS-6.
Depths: 9-10.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

Photo No.	Date:
7	8/8/23

Description:

Boring 205-23. SS-7.
Depths: 13.5-15 ft.

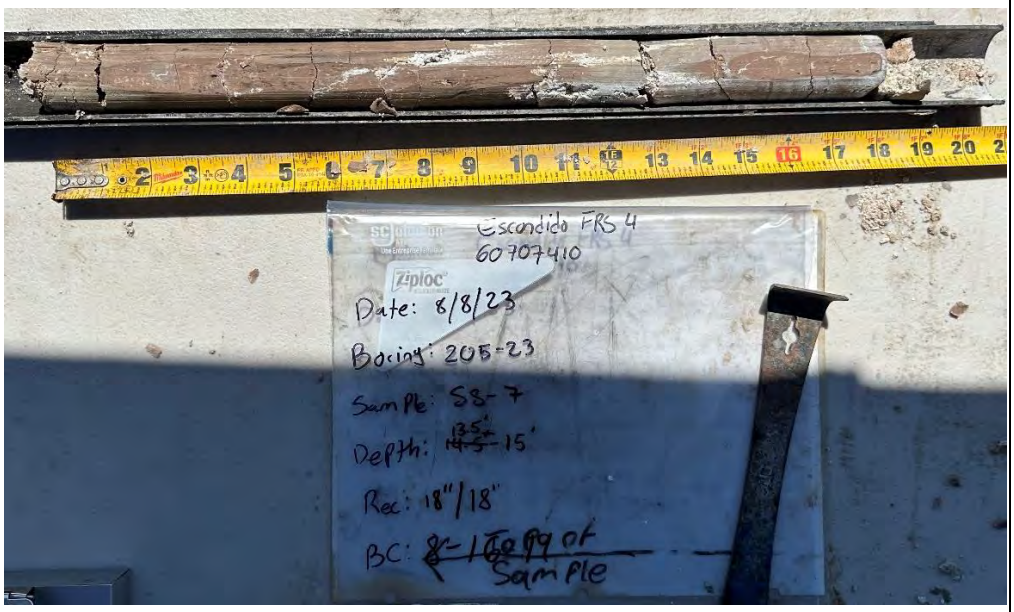


Photo No.	Date:
8	8/8/23

Description:

Boring 205-23. ST-8.
Depths: 18-19 ft.



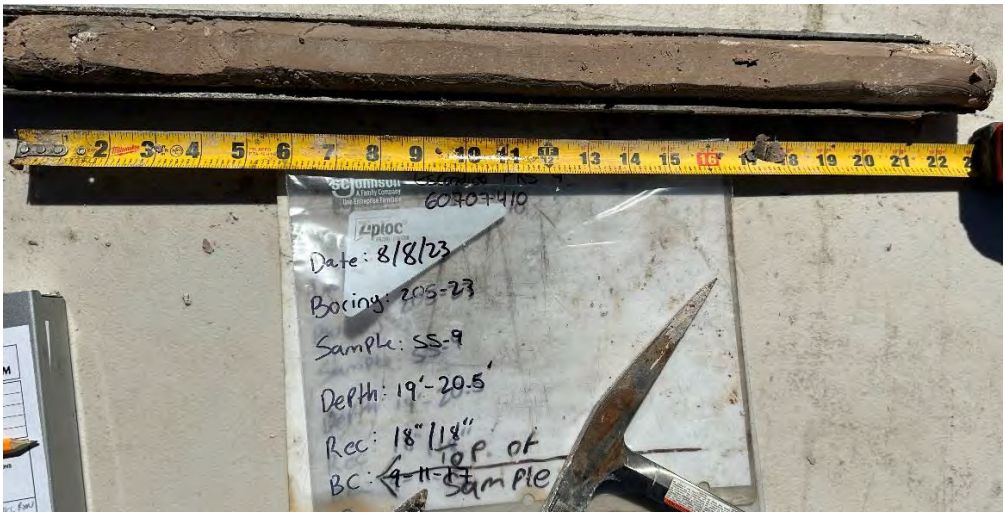
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 4: Karnes County, TX	60707410

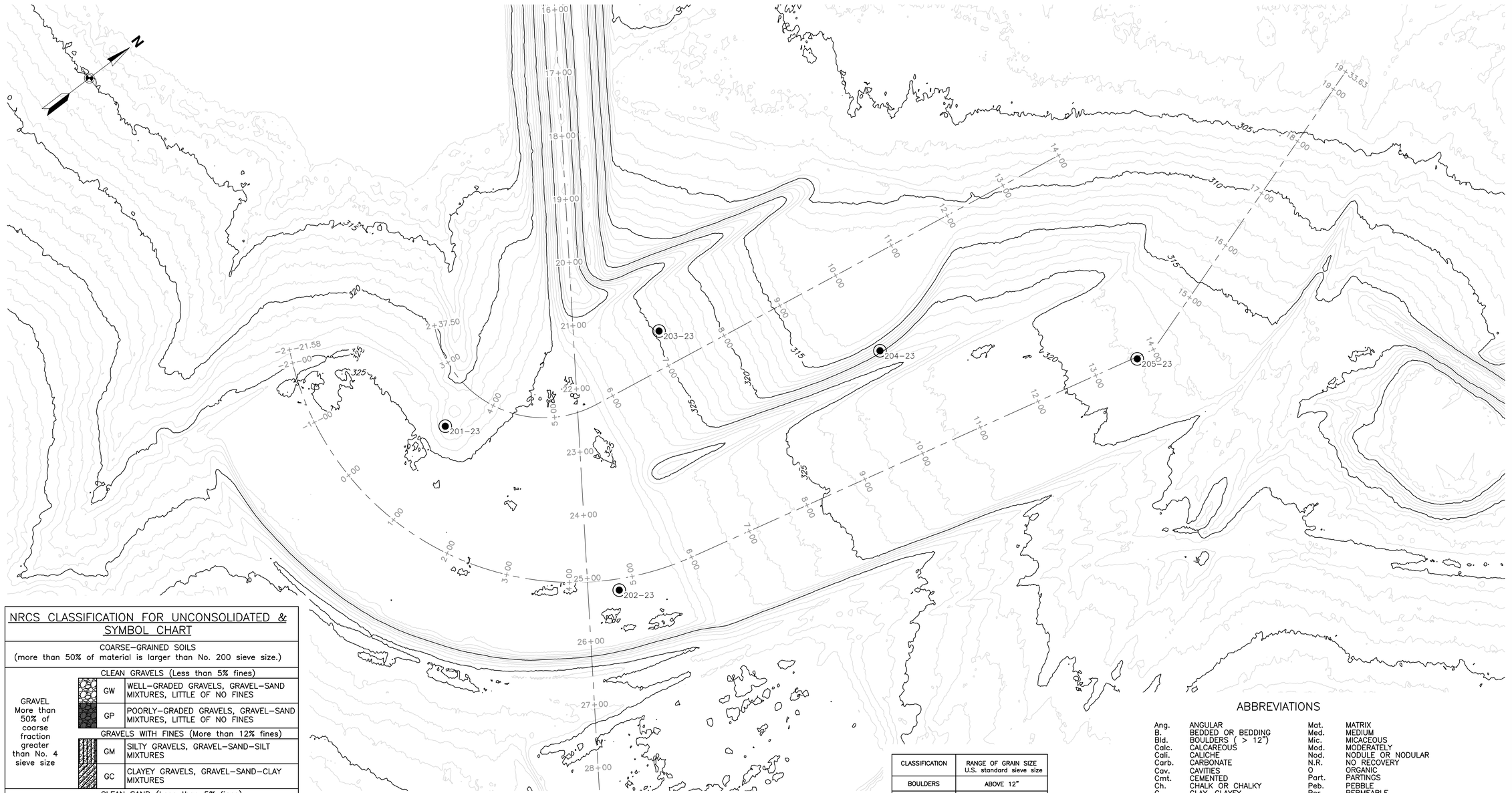
Photo No.	Date:
9	8/8/23

Description:

Boring 205-23. SS-9.
Depths: 19-20.5 ft.



Appendix F Geologic Profile



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
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Silty Clay (half silt, half clay)
- Clayey Sand with Silt
- Well Graded Sand

OTHER SYMBOLS

- HOLE LOGGED ONLY
- STRIKE AND DIP
- HOLE SAMPLED
- PIT OR TRENCH

PLAN

0 40 80 160

SCALE IN FEET

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 2/27/24

CHECKED MJ DATE 2/27/24

APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (INNER BAY)

FLOODWATER RETAINING STRUCTURE 4

ESCONDIDO CREEK WATERSHED

IN

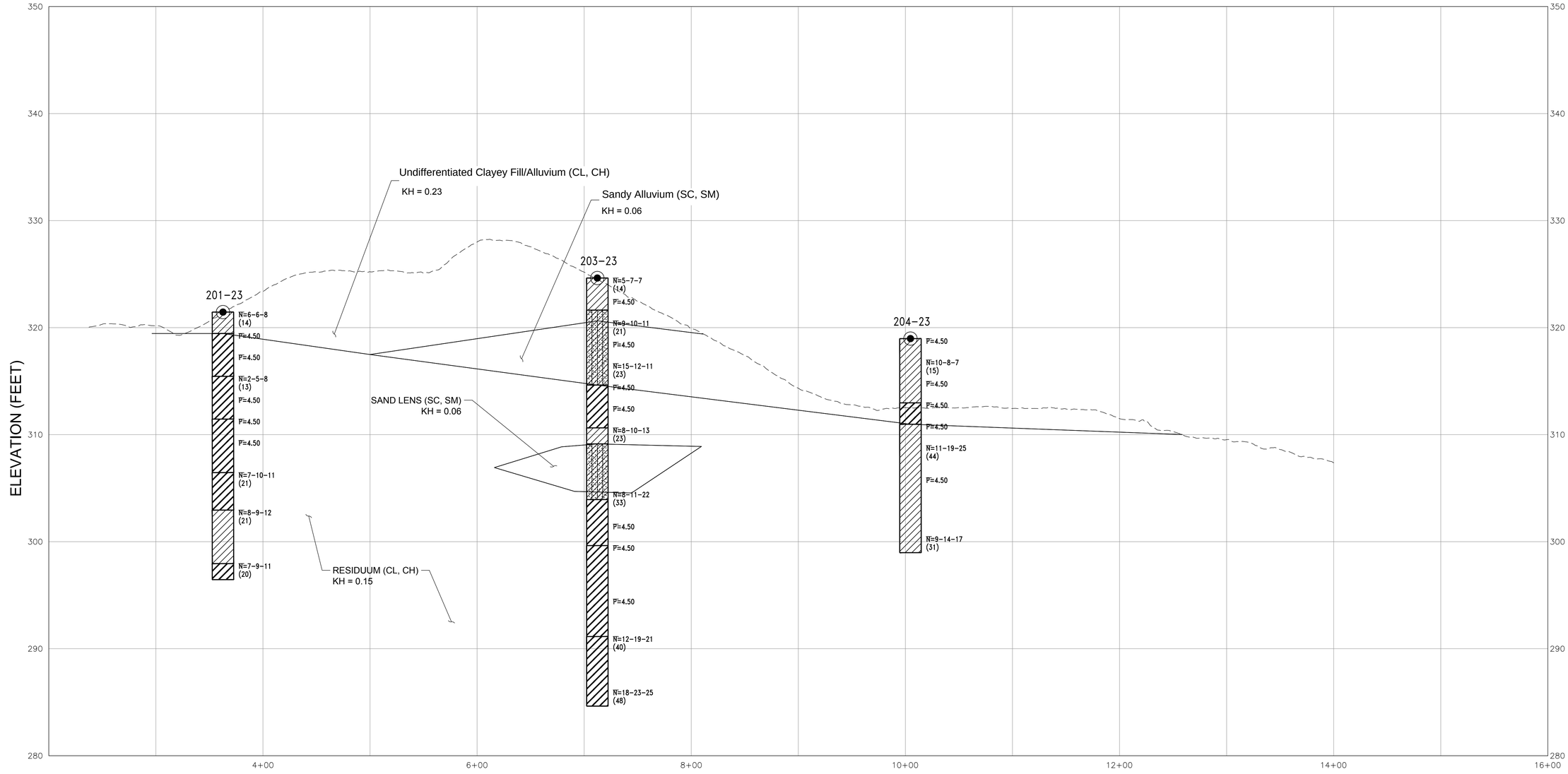
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 3

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LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Well Graded Sand
- Silty Clay (half silt, half clay)
- Clayey Sand with Silt

-- 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 2/27/24
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APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (INNER BAY)

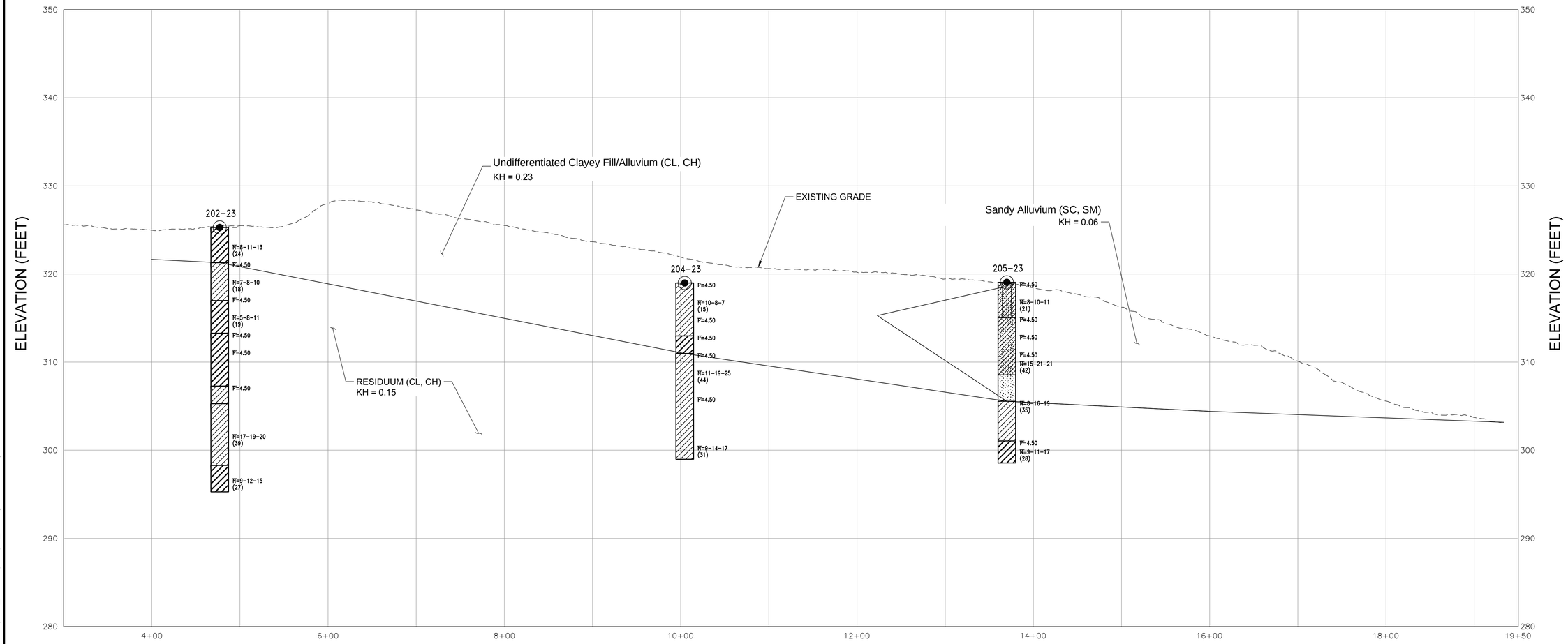
FLOODWATER RETAINING STRUCTURE 4
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 3

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LEGEND

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

-- 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 2/27/24
CHECKED MJ DATE 2/27/24
APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (OUTER BAY)

FLOODWATER RETAINING STRUCTURE 4
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME:
GEOLOGIC PROFILES.DWG

SHEET NO. 3 OF 3

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Appendix G Sites Memorandum

AECOM
13640 Briarwick Drive
Austin, TX 78729
aecom.com

Project name:
Escondido Creek FRS No. 4 SWP-EA,
Karnes County, TX

Project ref:
60707410

To:
Monica Wedo, PE (AECOM)

CC:

Sergio Teran, PG (AECOM)
Charlie Krolikowski, PE (AECOM)

From:
Mariana Jaimes, 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. 4 (Escondido 4) by AECOM. As a result of that study, the dam was reclassified as a high hazard dam. The existing dam does not meet current National Resources Conservation Service (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 rehabilitation of the dam. 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 Supplemental Watershed Plan No. III - Environmental Assessment (SWP-EA) which was submitted to the River Authority under separate cover.

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 the 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 the 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 channels using SITES software for this project.

2. Site Description

Escondido 4 is located on Doe Branch, a tributary of Escondido Creek, and a tributary to the San Antonio River, approximately 3.2 miles west of downtown Kenedy, Texas and 60 miles southeast of San Antonio, Texas. Global positioning system (GPS) coordinates for the site are near latitude 28.813794° and longitude -97.902410°.

Site access is available via an unimproved road off FM 2102, approximately 2.0 miles northwest of the intersection of FM 2102 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 4 was designed and constructed as a low hazard dam in 1956. The dam has an estimated drainage area of approximately 3,992 acres and a total reservoir capacity estimated at 2,229 acre-feet (floodwater and sediment storage). Escondido 4was recently reclassified as a high hazard structure, and does not meet the current dam design and safety requirements.

According to the as-built drawings, the dam is approximately 29-feet-tall at the maximum section and is approximately 2,900 feet long. The crest was built to maximum elevation (El). 334.5 feet in the central portion of the creek valley (including over-build to compensate for post-construction settlement), and tapered to El. 333.1 and El. 333.4 at the left and right abutments, respectively. The upstream slopes of the embankment were constructed at an inclination of 3H:1V (horizontal:vertical), and the downstream slopes were constructed at 2H:1V. A 10-foot-wide wave protection berm was constructed on the upstream slope at approximately El. 311.7[*] feet according to the North American Vertical Datum of 1988 (NAVD88). The width of the embankment crest is approximately 14 feet. The dam was constructed with an internal drainage system consisting of a toe drain trench filled with single-stage aggregate filter with a 6-inch-diameter perforated corrugated metal drain pipe (galvanized steel with bituminous coating). The specified gradation of the aggregate filter shown in the as-builts suggests a predominantly coarse- to medium-grained sand with about 5 to 25% fine gravel and less than 10% fines was used.

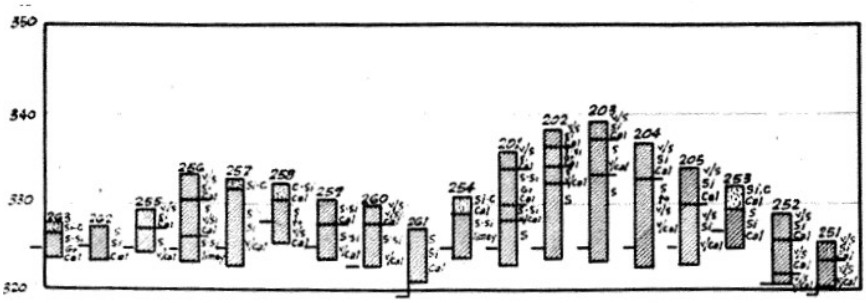
As-built drawings indicate at least two repair projects were made at Escondido Creek 4. The first repair project was completed in 1961 and included repair of slope failures on the downstream slope of the embankment. Slope repair included excavating beyond the slide surface to a uniform slope, and then reconstructing the downstream slope. The repair maintained the original 2H:1V slope angle in the upper part of the reconstructed downstream slope, but added a stability berm with top El. 321.6 in the lower half of the downstream slope. The stability berm had 12-foot-wide crest with back-sloped “gutter” to direct surface flow away from the slopes, and was constructed with a flatter downstream slope of 2.5H:1V. The second repair project was completed in 1968, and included repair gully erosion on the embankment between Station (STA.) 0+00 to 5+00. The gully repair consisted of excavating beyond the eroded surface and shaping gully banks to uniform slope, and backfilling with earthfill to the pre-erosion ground surface. The drawings do not specify the properties of the earthfill material or placement/compaction criteria used in the gully repairs.

The dam features a two-bay vegetated ASW with a splitter dike at the right abutment, and a principal spillway near the original creek alignment. The PSW consists of a drop inlet, two upstream low-level ports separate from the inlet riser, a conduit under the dam, and an unlined downstream plunge pool. Four (4) anti-seep collars spaced at 24 feet on center are also present.

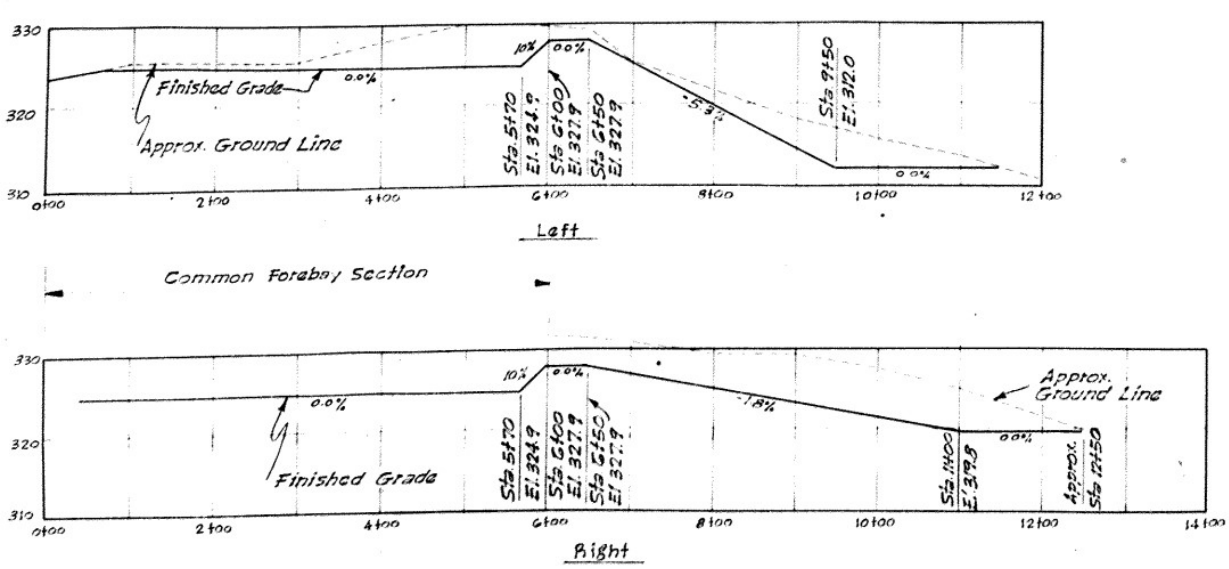
The ASW bays are designated as “left” and “right” in the as-built drawings. Each of the ASW bays has a 250 foot long channel. The left and right bays share a common 50-foot-long crest section set at El. 328.0 feet. The entrance channel slope, common to both ASW bays, was excavated nearly flat (0% per the as-built drawings) to about El. 325.0 at maximum depths of about 5 feet below pre-construction ground surface along the spillway centerline. The as-built drawings (see **Attachment 1**) indicate the ASW crest was excavated primarily into layers of native

[*] Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29), and were converted to NAVD88 for the purposes of this report. Conversion from NGVD29 to NAVD88 is +0.12 feet.

calcareous clay interbedded with sand and silt. Similarly, the exit channels were excavated out of the native calcareous clay and very silty to sandy layers. The exit channels of the two ASW bays were designed to vary in terms of length and slope angle to accommodate the pre-construction site topography while maintaining the same alignment. The left bay exit channel was originally built at a 5.3% grade over a 300-foot length, with excavation depths ranging from 0 to 5 feet. Excavation depths on the left bay increased between the crest and the ASW outlet. The right bay was built at a 1.8% grade over a 450-foot length, and the excavation depths varied from 0 to 6 feet. Excavation depths remained relatively constant throughout the right bay. For reference, the as-built spillway profiles of the ASW left and right bays are shown in the images below as well as the stick logs provided in the as-built drawings for the auxiliary spillways.



LOG OF SPILLWAY BORINGS
SEE PLAN OF EMBANKMENT AND SPILLWAY



PROFILE ON ℄ OF SPILLWAYS

2.2 Spillway Historical Performance

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2017, 2021, and 2022 annual inspections (San Antonio River Authority, 2017 and 2021; TCEQ for San Antonio River Authority, 2022) reported that the spillways were in good condition. The most recent dam safety inspection (TCEQ, 2022) noted adequate vegetative cover throughout the ASW with the exception of areas where harvester ant beds and hog related damage were observed. Hog damage was particularly of concern on the right half of the left bay and near the splitter dike on the right bay. Harvester ant beds were noted on the control section of the spillways. Furthermore, a 2-foot-deep burrow was noted at the left bay near the splitter dike toe and hay bales were also observed throughout both bays.

2.3 Proposed Improvements

The prior dam assessment (AECOM, 2014) performed at Escondido Creek 4 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 proposed improvements as part of the rehabilitation option from the 2014 Dam Assessment of Escondido 4, with elevations correct to NAVD88, included:

- Raising the crest elevation of the dam embankment by approximately 4.0 feet from elevation (El.) 333.0 feet to El. 337.0 feet,
- Flattening the downstream embankment slope from 2H:1V to a 3H:1V ratio (horizontal: vertical) ratio,
- Raising the auxiliary spillway crest approximately 1.1 feet from elevation (El.) 327.9 feet to El. 329.0 feet,
- Replacing the existing 28-inch principal spillway (PSW) conduit with a 42-inch-diameter conduit, and
- Replacing the PSW inlet/outlet structures.

The purpose of the SWP-EA (AECOM, 2024) was to further evaluate alternatives, including an alternative for watershed structure rehabilitation of Escondido Creek 4. As a result of this work, the proposed improvements recommended for the high hazard rehabilitation of the dam have been modified to include the following:

- Remove the existing principal spillway system;
- Install a new principal spillway system consisting of a standard inlet tower with crest at elevation 317.2 feet, two 10-inch by 10-inch low level ports at elevation 312.7 feet, and a 42-inch RCP conduit discharging into an impact basin;
- Install a 150-feet wide, five-cycle labyrinth weir structural spillway over the existing embankment with crest set above the 50-year PSH elevation at 328.7 feet and concrete chute discharging into a concrete stilling basin;
- Regrade inlet and outlet channel of the existing vegetated auxiliary spillway and raise left bay and right bay crests to the 100-year PSH elevation of 329.2 feet (1.18 feet raise from as-built);
- Flatten downstream embankment slope to 3H:1V;
- Abandon existing trench drain and install new toe drain at downstream toe;
- Install upstream dam embankment slope riprap; and
- Raise top of dam elevation to 335.3 feet (2.18 feet raise) and extend the cutoff trench below the 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; Baker, 1979). Per the geologic map (Brown et. al, 1975), 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; Baker, 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is montmorillonite with variable amounts of kaolinite and subordinate illite.

Alluvium (Qal) of the Holocene Epoch is mapped downstream of the principal spillway and along the banks of Doe Branch. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Alluvium deposits in Central Texas are typically organized as point bars, natural levees, stream channels, or backswamps.

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 either Alluvium, Residuum (resulting from in-place weathering of the parent bedrock), of Fill. Alluvium makes up the majority of the near-surface soils mapped at the dam site, and is identified along most of the dam embankment and upstream (south and southwest) of it. Residuum is mapped in two smaller zones located northwest of the auxiliary spillway and upstream of the dam embankment (north of the reservoir). Fill material is mapped within the auxiliary spillway channel, likely generalized to account for the fill berms/splitter dike. Note that the ASW bays were excavated approximately 5 to 7 feet below pre-construction grade along the centerline for over 800 feet of the ASW channel profile.

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 Creek 4 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 eleven dam sites in the watershed as part of the work plan. No standalone site-specific investigation was prepared for Escondido 4.

The 1954 Escondido Creek Watershed Work Plan (SCS, 1954) describes the foundation of the Escondido Creek Watershed dams (including Escondido 4) 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 4 provided subsurface profiles of the site with boring "stick" logs from the pre-construction investigation with generalized soil types. The investigation consisted of the consisted of the following:

- 16 borings along the dam centerline (Hole numbers not legible/provided on the as-built drawings)
- 10 borings along the shared auxiliary spillway forebay (Hole Nos. 201 through 205, 254 through 257, and 263);
- 7 borings along the right auxiliary spillway (Hole Nos. 251 through 253 and 258 through 261);
- 1 boring along the left auxiliary spillway (Hole No. 262);
- 24 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 174).

The complete investigation report containing the Escondido 4 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1956 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 Creek 4. Based on this documentation, the existing dam embankment is primarily underlain by clay and sand with some gravelly and silty zones. Clay was encountered in 15 of the 16 original dam embankment borings drilled and was described as hard, friable, moist to wet, silty to

sandy, and calcareous with calcium carbonate and trace limestone inclusions. Sand was encountered in 11 of the original embankment borings drilled and was described as silty to clayey sand with gravel.

Similarly, review of the available geologic stick logs of borings indicates the auxiliary spillway channel at Escondido Creek 4 was excavated up to about 7 feet below original grade, exposing sandy to silty calcareous clays in the upper half of the spillway channel. The second half of the channel does not appear to have been reached in the borings drilled during the original investigation. Groundwater was recorded in 6 of the borings drilled all of which were located between original centerline Sta. 10+00 and Sta. 18+00, near the original valley channel.

The as-built drawings indicate that the materials in the spillway excavations were suitable for use in forming the single-zoned homogeneous embankment. Additional borrow material was available in a borrow area located in the present-day reservoir; however, stick logs for the reservoir borrow area were not included in the as-built drawings and were not available to AECOM for review.

3.3.2 NRCS – 2022 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on February 23, 2022, by the NRCS part of the routine dam safety inspections for the River Authority (NRCS, 2022). The inspection identified several 1 to 4 feet deep animal burrows along the dam embankment and near the upstream and downstream toes. In addition, the inspection noted hog rooting at the embankment crest, upstream slope, auxiliary spillways, and downstream berm and indicated that poor vegetative cover was observed on the upstream slope, near the right abutment. Standing water was observed at the downstream berm toe in an area described as a natural low. While this area of standing water was not more distinctively identified in the 2022 inspection report, review of the as-built drawings (SCS, 1956) appears to suggest the presence of a remnant of the original stream channel between centerline Sta. 14+00 and Sta. 16+00. In addition, an area of ponded water at the downstream toe of the dam near Sta. 16+00 is visible through aerial images available on Google Earth which leads AECOM to the interpretation that the area of accumulated water reported in the 2022 inspection report is likely located in the vicinity of Sta. 14+00 to Sta. 16+00.

Several hay bales and harvester ant beds were noted along the ASW channel. Woody brush and a tree were noted in the vicinity of the PSW and the plunge pool was enlarged, causing discharge water to backup into the PSW conduit. Several repairs were recommended for the auxiliary and principal spillways. The ASW was noted as being in good dimensional condition, while the PSW was deemed to be in adequate condition.

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

The 2022 inspection concluded that Escondido 4 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 August of 2023 in general accordance with the approved Field Investigation and Testing Plan submitted to the River Authority prior to field mobilization. Geologic investigation of the existing ASW was performed to develop recommended geologic input parameters for SITES erodibility analysis. The investigation of the ASW bays included five (5) geotechnical test borings in the existing channel designated as 201-23 through 205-23. Boring locations are shown in **Figure 1**. 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 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. The generalized stratigraphy included undifferentiated clayey Alluvium/Fill and sandy Alluvium overlying a cohesive Residuum layer with sand lenses. Borings terminated in the Residuum layers and no bedrock layers were encountered.

The NRCS soil survey mapping shows fill material within the ASW channels, and alluvium and residuum materials upstream and downstream of the ASW channel. The 1954 as-built drawings (SCS) indicate that the left bay had fill placed on the inner half of the channel. Per the typical spillway sections, the remaining portion of the left bay and the entirety of the right ASW bay were excavated from in-situ materials. The approximate upper 1/4 to 1/3 of the splitter dike separating the left and right ASW bays and portion of the exterior training berms were also constructed of fill. The discrepancy between the as-built drawings location of fill and the NRCS soil survey mapping could partially be due to the resolution of the NRCS soil survey mapping influenced by the presence of the fill berms/dike. While an attempt was made to distinguish between the fill and alluvium during the AECOM field investigation, the scope of this study did not provide enough additional information to confirm the difference; as a result, no distinction was made between the fill and alluvium. However, the geologic description of the alluvium as consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter is consistent with the materials encountered. The residuum is consistent with the work plan description of the silty clays and sandy clays that make up the valley slopes (SCS, 1954a).

Subsurface profiles cut along the existing ASW left and right bay centerlines are presented in **Figure 2** and **Figure 3**, respectively. The profile includes abridged boring “stick” logs indicating field USCS classification, pocket penetrometer values, and SPT N-values. For the purposes of spillway erodibility analysis, the following generalized subsurface stratigraphy was assigned for the ASW channel:

1. Undifferentiated Clayey Fill/Alluvium
2. Sandy Alluvium
3. Residuum

The Undifferentiated Clayey Fill/Alluvium stratum was described as lean clay to sandy lean clays with trace roots and trace gravel and were generally very stiff to hard, dry, light brown to dark gray, and no to strong reactions to hydrochloric acid (HCl). Sandy Alluvium was encountered below and downstream from the Clayey Alluvium/Fill materials in borings 203-23 and 205-23 and were described as clayey sand (SC) and silty sand (SM) with calcareous inclusions. The Sandy Alluvium soils were generally medium dense to dense, dry, dark grayish brown to pale brown, fine to medium grained sand, and weak to strong HCl reactions. It should be noted that the Sandy Alluvium was identified directly at the surface in boring 205-23.

Residuum was encountered below the Fill/Alluvium strata. The Residuum was described as lean to fat clay with sand to sandy lean to fat clay (CL to CH). The unit was calcareous with calcium carbonate veins and trace iron oxide staining. The Residuum was generally stiff to hard, moist to dry, grayish brown to predominately light brown to brown, medium plasticity, and had weak to strong HCl reactions.

A sand lense within the Residuum was encountered in boring 203-23 on the left bay of the ASW, , approximately between elevations 300 feet and 310 feet (15.5 feet to 20.5 feet below the ground surface [bgs]). The lense was described as a medium dense to dense, moist, pale brown, clayey sand (SC) with no HCl reaction.

The borings generally encountered clayey soils from surface to a depth of approximately 30 feet, except borings 203-23 and 205-23 which encountered one or more intervals of sandy soils ranging from about 5 to 10 feet thick. A limited number of SPT tests was completed in the Clayey Fill/Alluvium and little variation was observed in the SPT N-values recorded which averaged approximately 14 blows/foot (bpf). In the Sandy Alluvium, SPT N-values

ranged from 21 to 41 bpf which generally increased with depth (average of 27 bpf). In the Residuum, N-values ranged from 13 to 48 bpf (average of 28 bpf). A single SPT test was performed in the sand lense observed with N-value of 33 bpf. Pocket penetrometer readings were generally greater than 4.5 tsf with only two recorded reading of 3.5 tsf, measured on a shallow split-spoon sample recovered from boring 204-23 and on a deeper sample (more than 20 feet bgs) obtained from boring 201-23. Bedrock, defined as SPT and/or Shelby Tube refusal or visual determination, was not encountered in the borings completed.

3.4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were not added to the borings as rock coring was not performed. 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 Clayey Fill/Alluvium and Residuum, assuming each of the parameters except Ms are held constant and equal to 1.0. Kh

estimations for the Sandy Alluvium followed the general procedure for cohesionless soils. Due to similarity of between Sandy Alluvium and the Sand Lense within the Residuum, a separate analysis was not performed for the Sand Lense and the same values developed for the Sandy Alluvium were adopted.

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) Undifferentiated Clayey Fill/ Alluvium,
2) Sandy Alluvium,
3) Residuum (of the Oakville Sandstone Formation),
4) Sand lense within Residuum in boring 203-23, and
5) Proposed Fill (ASW excavation 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, 2024). 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 Penetrometer readings, 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 Undifferentiated Clayey Fill/Alluvium and Residuum were considered "cohesive" soil for the purposes of estimating the Ms parameter, whereas the Sandy Alluvium (and Sand Lense) was conservatively treated as "cohesionless" soil in analyses although the PI was generally greater than 10. The material designated as Proposed Fill was obtained from samples collected in the upper 5 feet of the borings drilled which primarily classified as lean clays (CL), and thus was also considered as "cohesive" soil. While the Proposed Fill would have similar gradation and plasticity as the in-situ soils, 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 as a separate layer.

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 Residuum exceeded 30 bpf, the laboratory UCS values indicate the material is borderline and should still be considered soil like in analysis. Similarly, blow counts greater than 30 bpf were recorded in the Sandy Alluvium, which was also treated as a soil-like material. One unconfined compression test was completed in the Sandy Alluvium that indicated the material was soil-like (UCS=11,280 psf) 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 1.0 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.

Undifferentiated Clayey Fill/ Alluvium and Residuum

SITES parameters for this unit were estimated using several methods including the results of 19 field standard penetration tests correlated to an estimated Su value, correlations from liquidity indices (LI) to estimated Su, and 11 unconfined compression (UC) tests. Greater weight was given to the UC tests and LI correlation methods. The liquidity indices were 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.

Sandy Alluvium

SITES parameters for the Sandy Alluvium were estimated primarily based on the results of 5 standard penetration tests and 1 UC strength test.

Proposed Fill (ASW Borrow)

The Ms value for Proposed Fill materials is typically estimated by performing laboratory UC 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 as determined by ASTM D698). As such, the range of Ms values were estimated based on results of 3 UC tests on representative composite samples remolded from auger cuttings collected near the surface for each of the borings drilled.

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 Undifferentiated Clayey Fill/ Alluvium and Residuum layers and Proposed Fill are considered as "massive, unjointed cohesive" soil materials, and the Sandy Alluvium 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 clayey layers and proposed fill materials are considered as "cohesive" materials, while the Sandy Alluvium 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 Undifferentiated Clayey Fill/ Alluvium layer had PL values ranging from 12 to 23 (average 18). The Residuum layer had PL values ranging from 15 to 28 (average 20) with two samples (each recovered at 18 feet bgs in borings 202-23 and 205-23) with PL ≥ 25. Fissures were noted in the upper depths of all borings drilled, within the Undifferentiated Clayey Fill/ Alluvium stratum, except for 205-23. As such, the blocky soil reduction factor was applied to the Kh values for the Undifferentiated Clayey Fill/ Alluvium soils. In contrast, due to the lack of observed fissures and estimated PL values below the recommended threshold, the blocky soil reduction factor was not applied to the Kh values for the Residuum 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:

<u>Left Bay of ASW</u>

- Undifferentiated Clayey Fill/ Alluvium: Kh = 0.23

- Sandy Alluvium: Kh = 0.06
- Residuum: Kh = 0.15
- Proposed Fill (ASW Excavation Borrow): Kh = 0.10

Right Bay of ASW

- Undifferentiated Clayey Fill/ Alluvium: Kh = 0.23
- Sandy Alluvium: Kh = 0.06
- Residuum: Kh = 0.15
- Proposed Fill (ASW Excavation Borrow): Kh = 0.10

The recommended values for the cohesive soil-like materials are generally in agreement with those recommended for stiff to 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

AECOM. 2014. *Dam Assessment Report,* Escondido Creek Watershed Floodwater Retarding Structure No. 4. Karnes County, Texas, June.

AECOM. 2024a. *Preliminary Geologic Investigation Report, Escondido Creek Floodwater Retarding Structure No. 4,* Karnes County, TX prepared for San Antonio River Authority, October.

AECOM. 2024b. *Preliminary Soil Mechanics Report, Escondido Creek Floodwater Retarding Structure No. 4,* Karnes County, TX prepared for San Antonio River Authority, October.

Adams, S.S. and Smith, R.B., 1981. *Geology and Recognition Criteria for Sandstone Uranium Deposits in Mixed Fluvial-Shallow Marine Sedimentary Sequences, South Texas,* National Uranium Resource Evaluation, prepared for U.S. Department of Energy, Grand Junction Office, Colorado, January.

Anders, R.B. 1962.Groundwater *Geology of Karnes County, Texas,* Geologic Survey Water Supply Paper 1539-G, United States Government Printing Office, Washington, D.C.

Baker, E.T., 1979. *Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas*, Report 236, United States Geologic Survey, July.

Brown, T. E., Brewton, J. L., McGowen, J. H., Proctor, C. V., Aronow, S., and Barnes, V. E., 1975, Geologic Atlas of Texas, Beeville-Bay City Sheet: The University of Texas at Austin, Bureau of Economic Geology, Geologic Atlas Sheet, map scale 1:250,000.

McCook, D.K. 2005. *Guidance on the Selection of the Soil Erodibility Index, Kh for the NRCS/ARS Auxiliary Spillway Erosion Model (SITES)*.

Natural Resources Conservation Service (NRCS). 2001. *National Engineering Handbook (NEH) Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index*, March.

NRCS. 2011. *National Engineering Handbook (NEH) Part 628, DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons (Surface Detachment Coefficient and Headcut Erodibility Index)*. October.

NRCS. 2022. *Dam Safety Inspection Report,* Escondido Creek Site 4 (TX02035), prepared for San Antonio River Authority, February.

Soil Conservation Service (SCS). (1954a). *Work Plan, Escondido Creek Watershed of the San Antonio River Watershed*, Karnes County, June.

SCS. 1956. *As-Built Plans, Flood Prevention Dam No. 4, Escondido Creek Watershed,* Karnes County, Texas, May.

7. Attachments

Table 1. Summary of Laboratory Test Results by Stratum for ASW Borings
Table 2. Recommended SITES Parameters for Existing Left (Inner Bay) ASW
Table 3. Recommended SITES Parameters for Existing Right (Outer Bay) ASW

Figure 1. Site Map and Plan of Geologic Investigations
Figure 2. Geologic Profile of Auxiliary Spillway (Inner Bay)
Figure 3. Geologic Profile of Auxiliary Spillway (Outer Bay)

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
Undifferentiated Clayey Fill/ Alluvium	2-8	CL	19-20 (19)	3.5 - 4.5+ (4.3)	9,660	19,320	110	40 - 54 (46)	28 - 31 (29)	-0.43 to +0.32 (-0.14)	50 - 86 (60)	---[3]	0.18 – 0.30 (0.24)	1
Sandy Alluvium	8-13	SC, SM (partially cemented)	28-56 (36)	4.5 - 4.5+ (4.5)	5,640	11,280	109 - 115	30 - 47 (37)	17 - 29 (23)	-0.45 to-0.28 (-0.34)	26 - 48 (39)	20	0.20 - 0.45 (0.26)	1
Residuum	7 – 25+	CH	17-64 (38)	3.5 - 4.5+ (4.5)	520 - 12,400 (3,141)	1,040 - 24,800 (6,282)	83 - 120 (98)	32 - 66 (53)	15 - 44 (32)	-0.41 to +0.52 (+0.11)	58 - 85 (74)	22 - 41 (33)	0.05 - 0.48 (0.20)	1 - 4 (2)
Proposed Fill (ASW Borrow)	TBD	CL	---[3]	---[3]	---[3]	---[3]	98 - 113 (104)	35 - 57 (48)	20 - 37 (30)	-0.20 to -0.09 (-0.04)	36 - 82 (58)	21 - 40 (31)	---[3]	1 - 1 (1)

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.

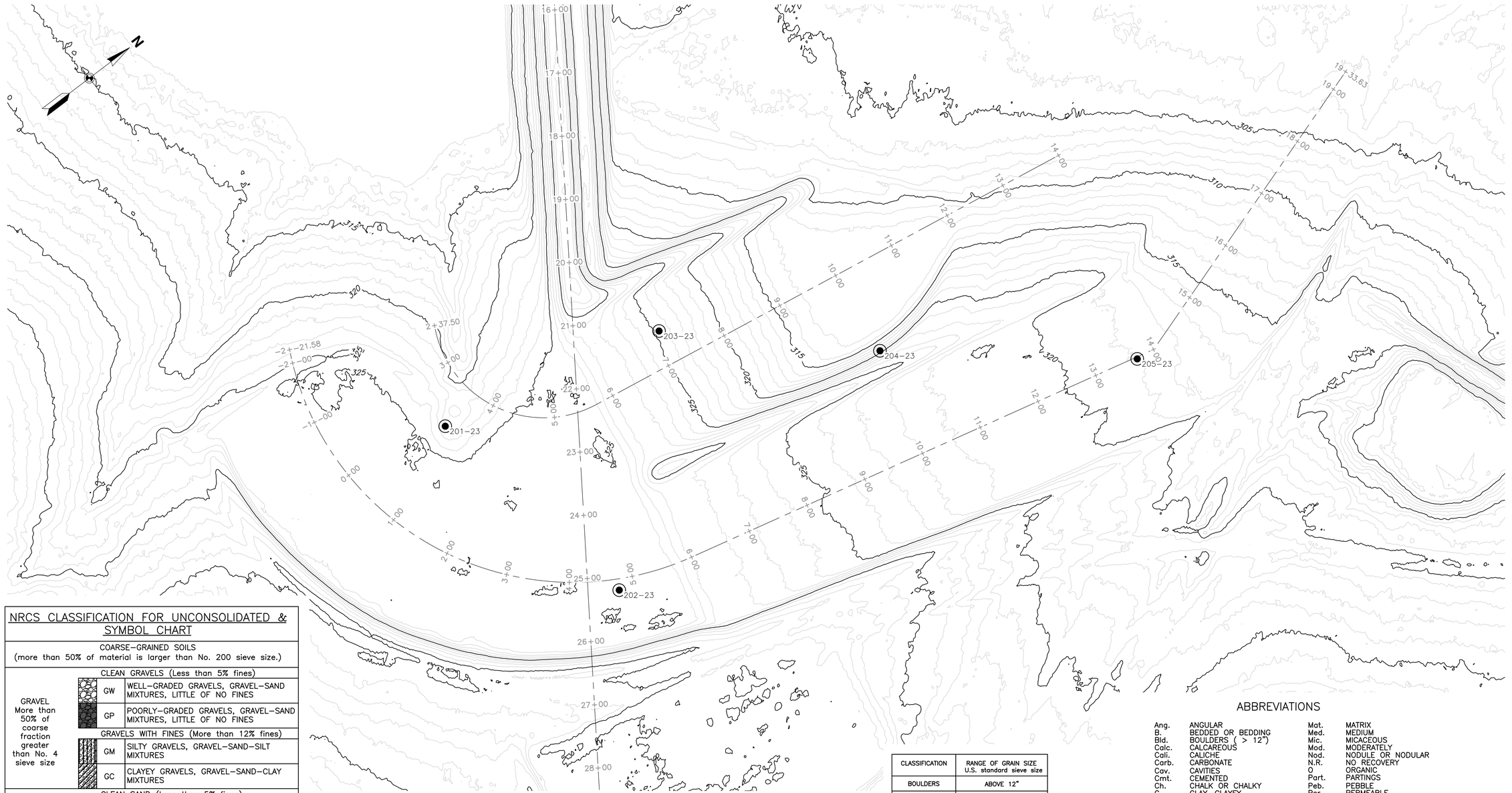
Table 2. Recommended Material Parameters for SITES Analysis of Existing Left (Inner) Bay of ASW

SITES inputs	Undifferentiated Clayey Fill / Alluvium	Sandy Alluvium & Sand Lense	Residuum	Proposed Fill (ASW Borrow)
USCS - Soil Type (Predominant)	CL - Lean clay	SC – Clayey sand	CH - Fat clay	CL - Lean clay
PI – Representative	30	15	35	30
LL – Representative	45	30	55	40
Dry Density (lbs/ft3) – Representative	105	110	90	100
Kh – Representative	0.23	0.06	0.15	0.1
Clay % – Representative	30	30	30	30
Rep. Diam. D_{75} (mm) – Representative	0.2	0.3	0.1	0.1
Rep. Diam. D_{75} (in) – Representative	0.008	0.012	0.004	0.004
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---

Table 3. Recommended Material Parameters for SITES Analysis of Existing Right (Outer) Bay of ASW

SITES inputs	Undifferentiated Clayey Fill/ Alluvium	Sandy Alluvium & Sand Lense	Residuum	Proposed Fill (ASW Borrow)
USCS - Soil Type (Predominant)	CL - Lean clay	SC – Clayey sand	CH - Fat clay	CL - Lean clay
PI – Representative	20	15	30	30
LL – Representative	40	30	50	40
Dry Density (lbs/ft3) – Representative	105	110	90	100
Kh – Representative	0.23	0.06	0.15	0.1
Clay % – Representative	30	30	30	30
Rep. Diam. D_{75} (mm) – Representative	0.2	0.3	0.1	0.1
Rep. Diam. D_{75} (in) – Representative	0.008	0.012	0.004	0.004
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---

FIGURES



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
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Silty Clay (half silt, half clay)
- Clayey Sand with Silt
- Well Graded Sand

OTHER SYMBOLS

- HOLE LOGGED ONLY
- STRIKE AND DIP
- HOLE SAMPLED
- PIT OR TRENCH

PLAN

0 40 80 160

SCALE IN FEET

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 2/27/24

CHECKED MJ DATE 2/27/24

APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (INNER BAY)

FLOODWATER RETAINING STRUCTURE 4

ESCONDIDO CREEK WATERSHED

IN

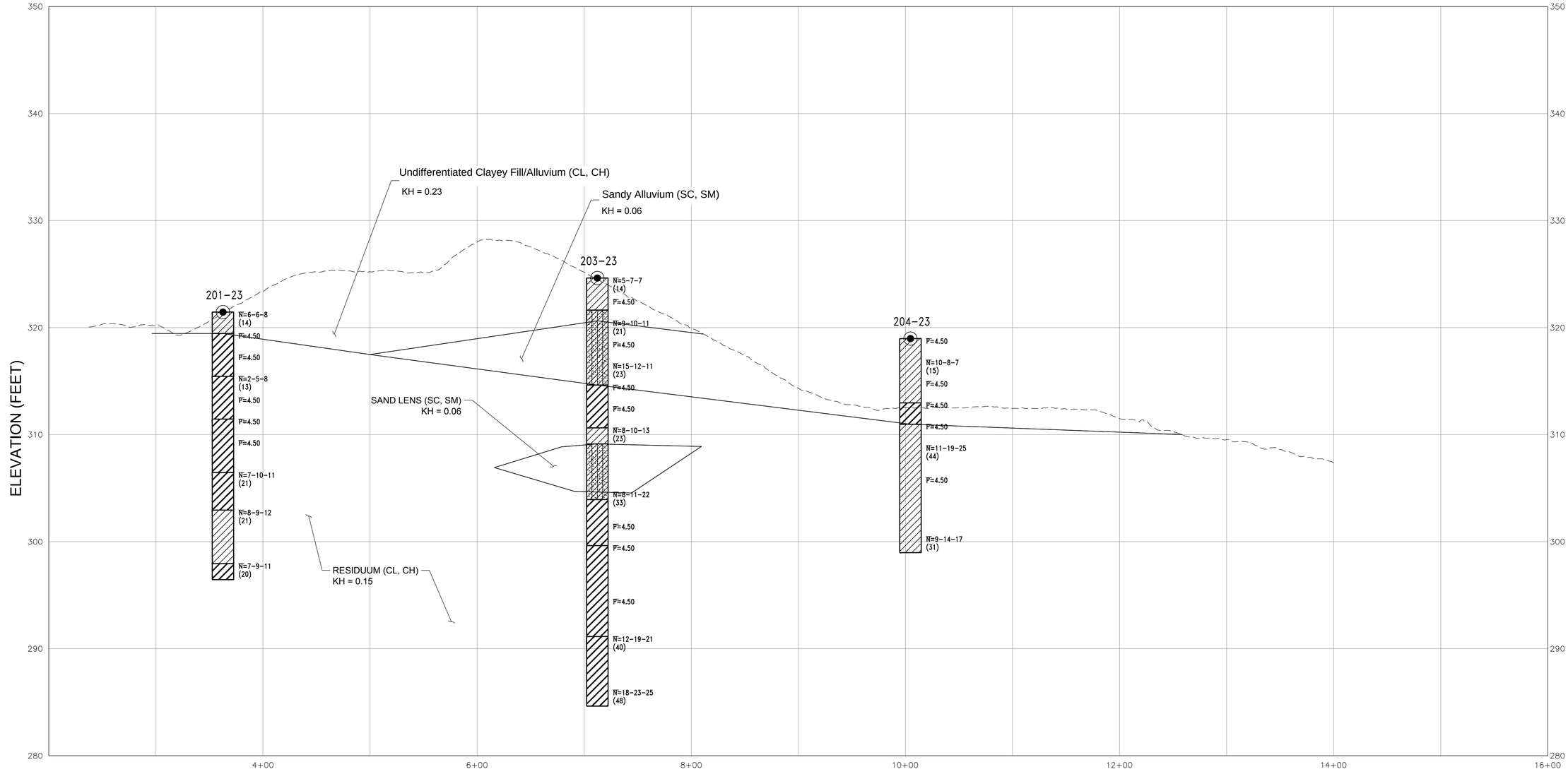
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 3

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LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Sandstone
- Clayey Sand
- Well Graded Sand
- Silty Clay (half silt, half clay)
- Clayey Sand with Silt

-- 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 2/27/24
CHECKED MJ DATE 2/27/24
APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (INNER BAY)

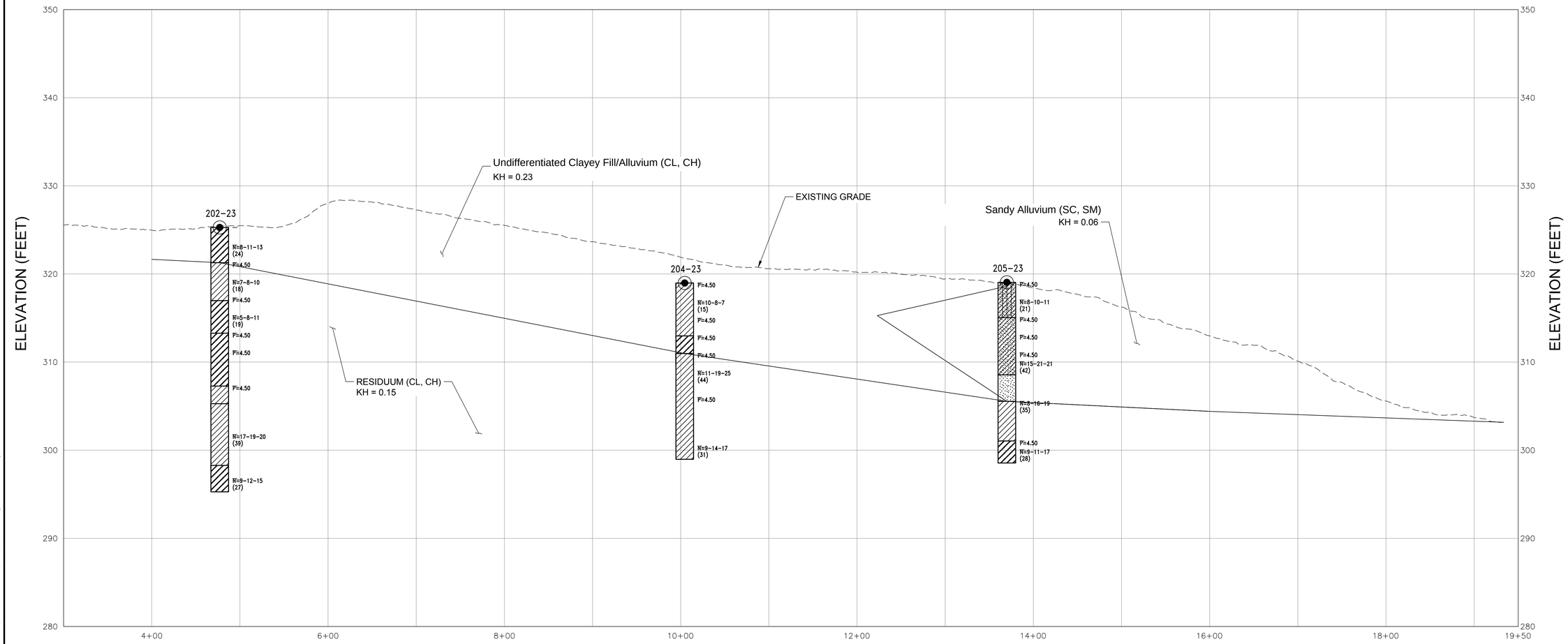
FLOODWATER RETAINING STRUCTURE 4
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 3

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LEGEND

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

-- 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 2/27/24
CHECKED MJ DATE 2/27/24
APPROVED LF DATE 2/27/24

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY (OUTER BAY)

FLOODWATER RETAINING STRUCTURE 4
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME:
GEOLOGIC PROFILES.DWG

SHEET NO. 3 OF 3

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ATTACHMENT 1.

AS-BUILT DRAWINGS

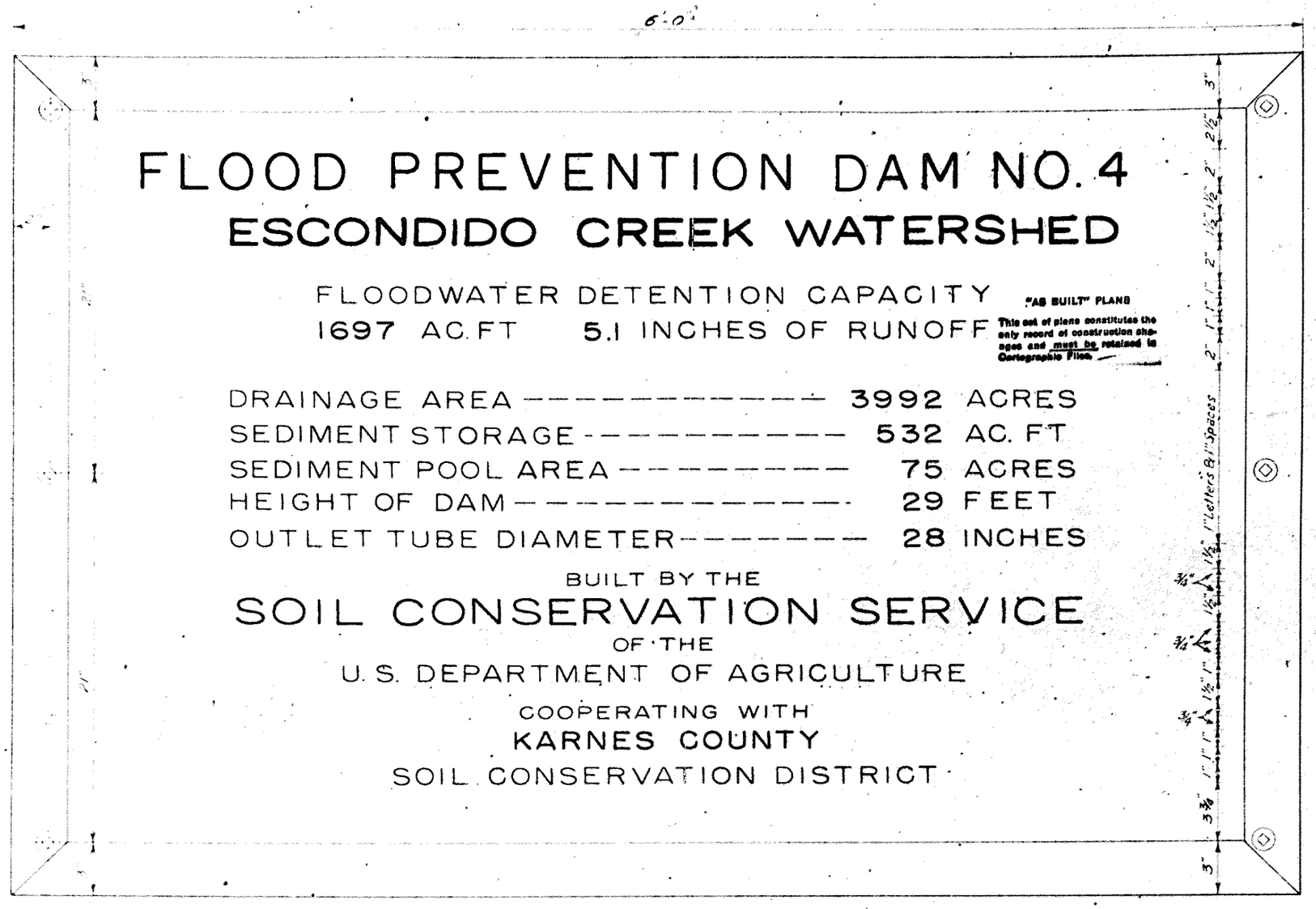
FLOOD PREVENTION DAM NO. 4
ESCONDIDO CREEK WATERSHED

FLOODWATER DETENTION CAPACITY
1697 AC. FT 5.1 INCHES OF RUNOFF

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

DRAINAGE AREA	3992 ACRES
SEDIMENT STORAGE	532 AC. FT
SEDIMENT POOL AREA	75 ACRES
HEIGHT OF DAM	29 FEET
OUTLET TUBE DIAMETER	28 INCHES

BUILT BY THE
SOIL CONSERVATION SERVICE
OF THE
U. S. DEPARTMENT OF AGRICULTURE
COOPERATING WITH
KARNES COUNTY
SOIL CONSERVATION DISTRICT

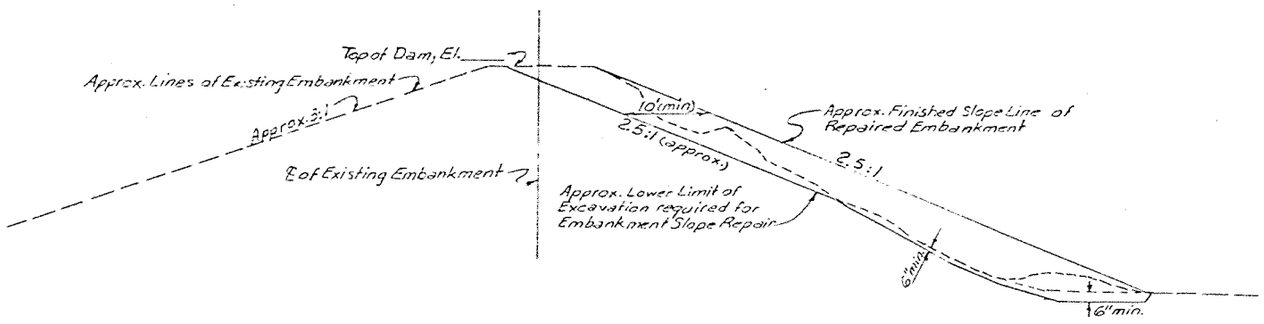


CONSTRUCTION DRAWINGS APPROVED

Howard Matson Con. 5/15/56
B. M. Price 5/15/56
TEMPLE TEXAS

Completed- November 17, 1956
Accepted- January 24, 1957

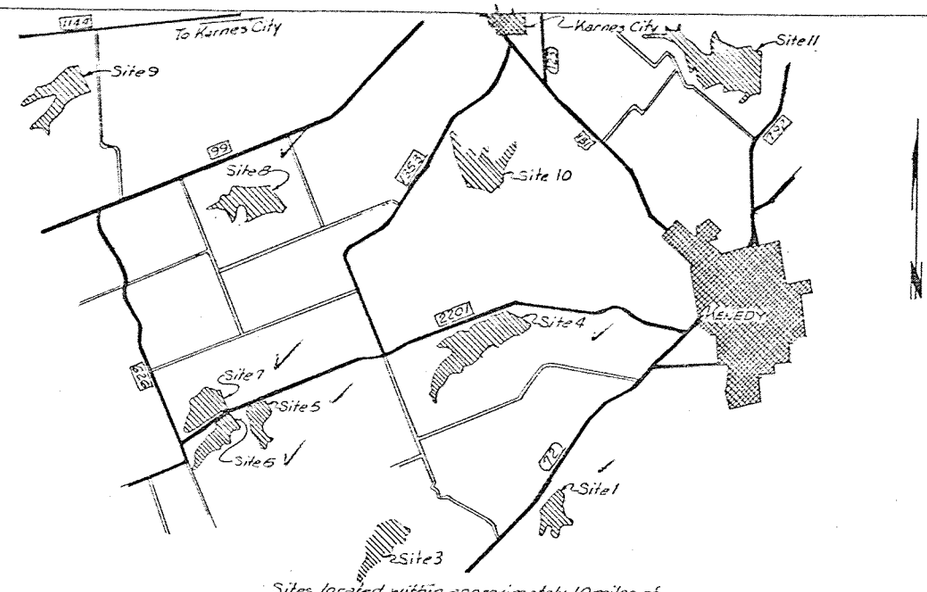
Dwg No. 4-E-10,440
Sheet No. 1 of 8
Revised



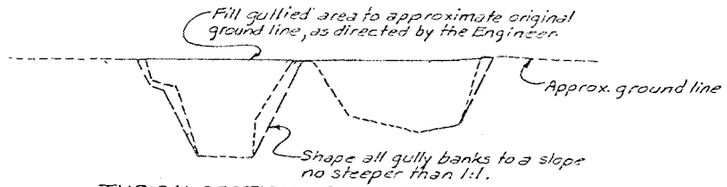
TYPICAL SECTION - EMBANKMENT SLOPE REPAIR
(Site Nos. 5, 6, 7 and 8)

NOTES:
1. Removal or stripping of soil materials for the slope repair shall include topsoil, displaced or low density embankment materials (if any) and such other materials as may be necessary to provide suitable working area for the operation of the construction equipment. The estimated limits of removal are shown; however, the final limits of removal will be determined by the Engineer based on his inspection of the materials exposed by the removal and on the minimum area (approx. 10 ft horizontal) required for operation of the construction equipment.
2. The slope repair shall consist of the removal of materials as specified above and of the construction of the 2.5:1 downstream slope as shown on the drawings.
3. Additional materials required for the completion of the slope repair shall be obtained from a borrow area or borrow areas designated at each site. The location and lateral limits of each borrow area shall be as directed by the Engineer. Borrow excavations are not included in the quantity estimates.

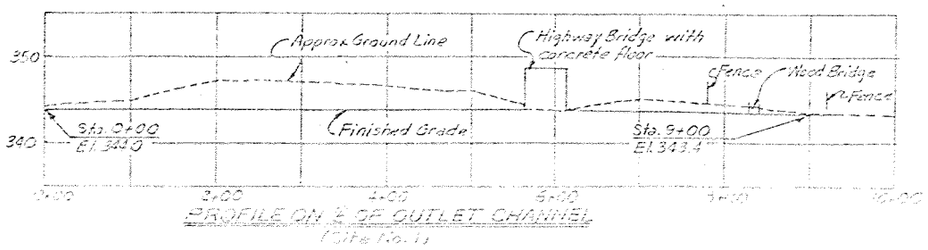
SITE No.	LIMITS OF REPAIR		ESTIMATED QUANTITIES	
	From	To	Excavation	Earth Fill
1	Sta 0+00	Sta. 9+00	1,010 cu.yds.	
4	Sta. 0+00	Sta. 5+00		2,980 cu.yds.
5	Sta. 5+00	Sta 20+00	4,240 cu.yds.	9,960 cu.yds.
6	Sta. 7+00	Sta. 26+00	7,150 cu.yds.	16,130 cu.yds.
7	Sta. 3+70	Sta. 19+00	6,530 cu.yds.	15,750 cu.yds.
8	Sta. 4+00	Sta. 22+00	5,910 cu.yds.	15,062 cu.yds.



These repairs were made in 1968. As-built plans were not prepared. However, this work was accomplished. This drawing documents changes in these structures.



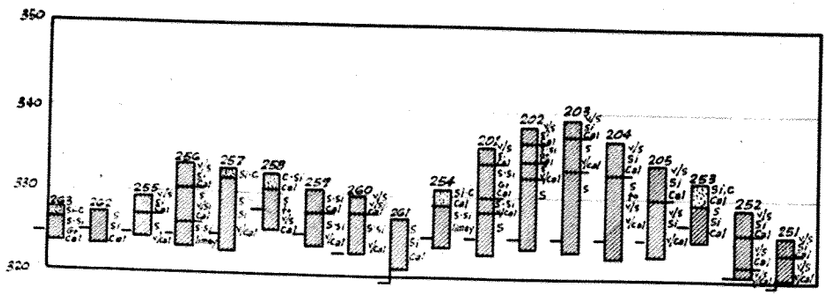
TYPICAL SECTION - GULLY FILL
(Site No. 4)



PROFILE ON ℄ OF OUTLET CHANNEL
(Site No. 1)

Note
1. The outlet channel below Site No. 1 shall have 12 ft. bottom width and 3:1 side slopes. Grade from Sta. 0+00 to Sta. 9+00 shall be as staked by the Engineer.

REPAIR DETAILS
FLOODWATER RETARDING STRUCTURES
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed M.D.K. 1-68
Drawn M.D.K. 1-68
Traced
Checked
Approved
Temple, Texas
Sheet 1 of 4 Sheets No.
4-E-25,837



Note: Bar at left of boring is at spillway grade.

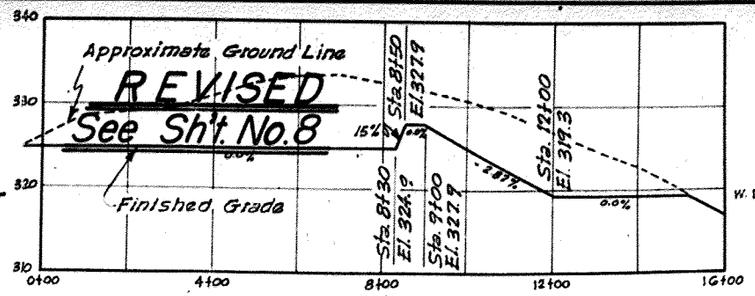
LOG OF SPILLWAY BORINGS

SEE PLAN OF EMBANKMENT AND SPILLWAY

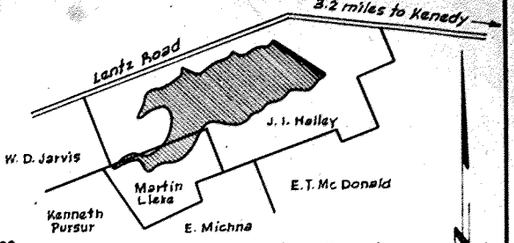
All material in spillway excavation is suitable for use in forming the embankment.

"AS BUILT" PLANS

This set of plans constitutes the only record of construction changes and must be retained in Contractor's files.



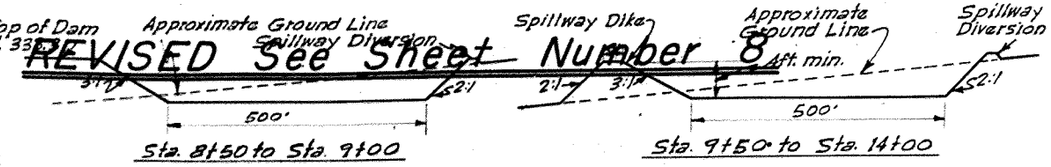
PROFILE ON ℄ OF SPILLWAY



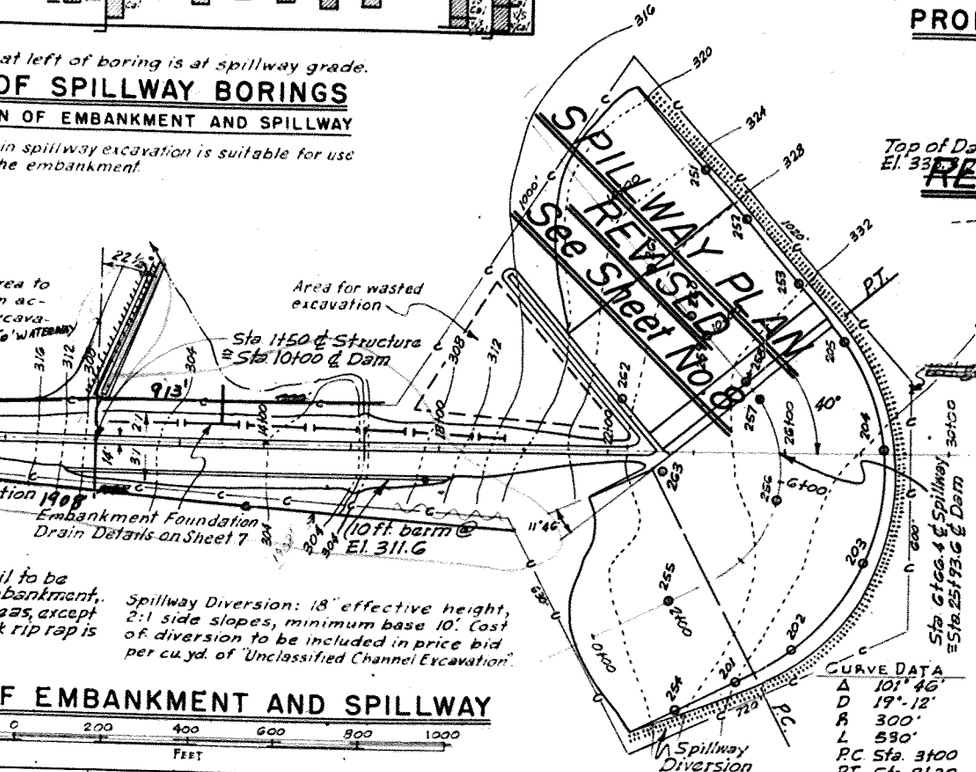
Located 3.2 miles west of Kenedy, Kerres County, Texas.

VICINITY MAP





TYPICAL SPILLWAY SECTIONS

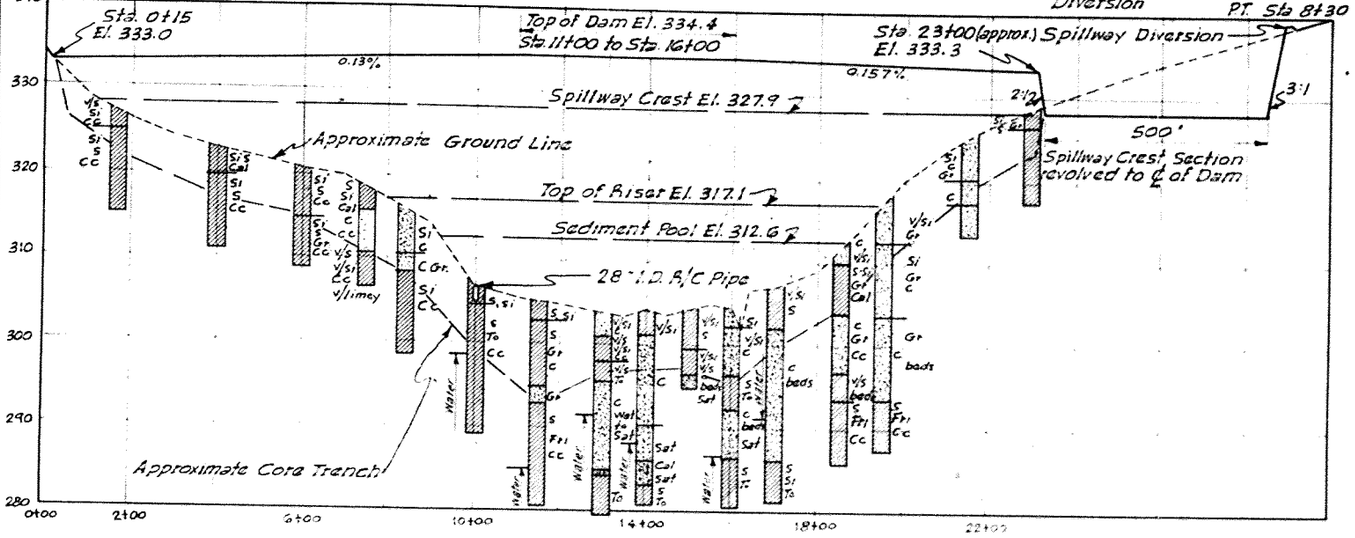


A minimum of 6 inches of topsoil to be placed in Spillway and on all Embankment, dike, spillway slopes and waste areas, except where rock is encountered or rock rip rap is placed. Refer to specifications.

Spillway Diversion: 18" effective height, 2:1 side slopes, minimum base 10'. Cost of diversion to be included in price bid per cu. yd. of "Unclassified Channel Excavation".

PLAN OF EMBANKMENT AND SPILLWAY



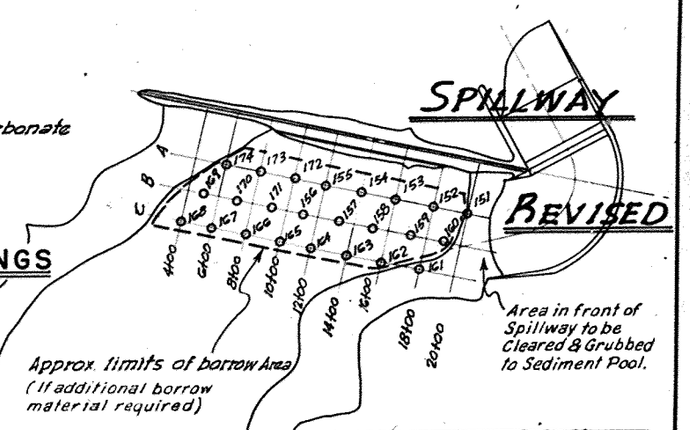


PROFILE ON ℄ OF DAM

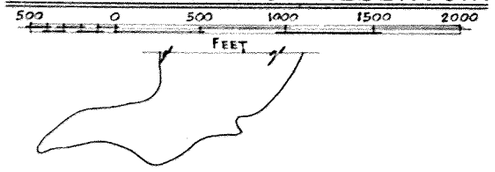
Sand, Clay, Gravel

C Clay
S Sand
Si Silt
Gr Gravel
Cal Calcareous
Cc Calcium Carbonate
Sat Saturated
V/ Very
To Tough
Fri Friable

LEGEND OF BORINGS



GENERAL PLAN OF RESERVOIR



Elevation	Surface Acres	Storage Acre Ft.	Storage Inches
312.6	51.5	200.0	0.60
315.0	75.3	352.2	1.06
317.1	95.9	532.0	1.60
319.0	109.2	721.2	2.17
323.0	151.7	1243.0	3.74
327.9	250.7	2229.0	6.70
331.0	300.8	3060.0	9.20

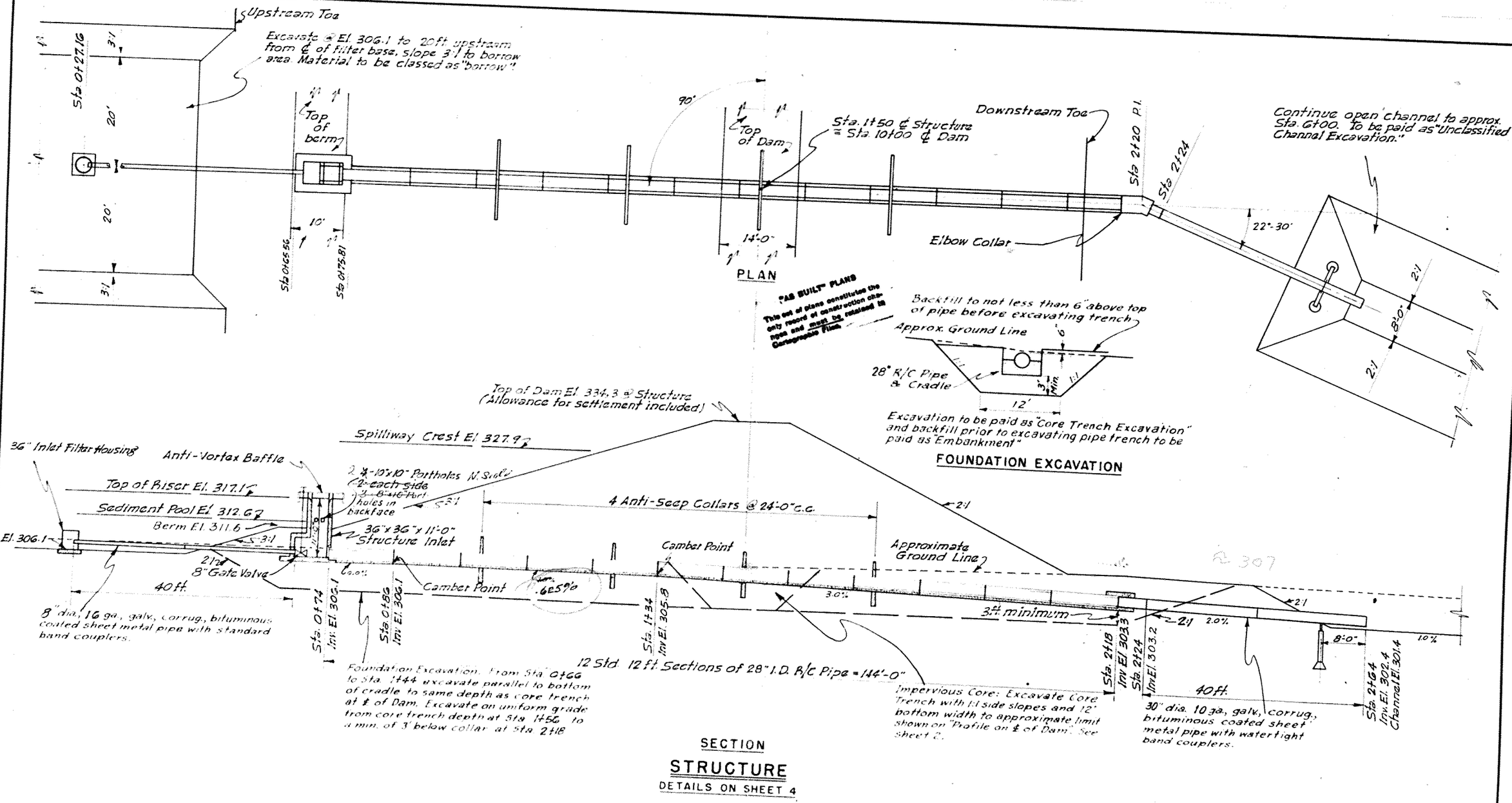
Top of Dam (Effective) Elev.	333.0
Spillway Crest Elev.	327.9
Top of Riser Elev.	317.1
Sediment Pool Elev.	312.6
Drainage Area, Acres	3992
Sediment Storage, Ac. Ft.	532
Floodwater Storage, Ac. Ft.	1697

Spillway Revised 5/56

GENERAL PLAN AND PROFILE
FLOODWATER RETARDING STRUCTURE SITE No. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED – TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed C.E.C.	Date 4/56	Approved by	
Drawn C.E.C. & D.S.	4/56		
Traced D.S.	4/56	Sheet No. 2 of 8	Drawing No. 4-E-10,440
Checked C.E.C.	4/56		



Spillway Revised 5/56

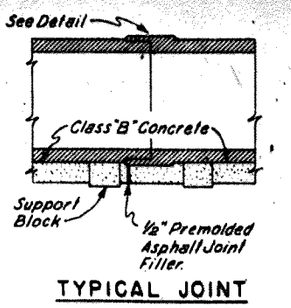
STRUCTURE — PLAN AND SECTION
FLOODWATER RETARDING STRUCTURE SITE No. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED — TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

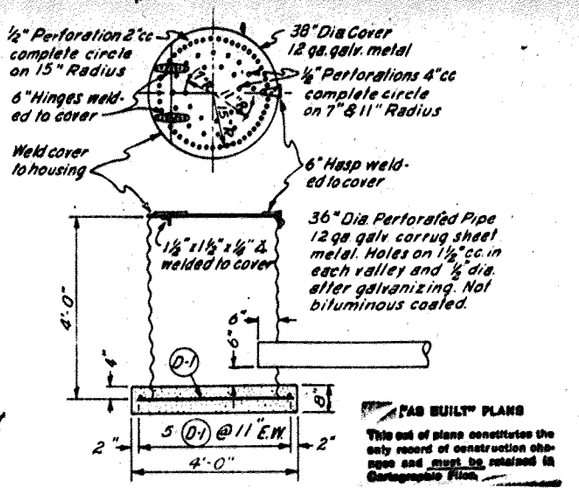
Designed C.E.C.	Date 4/56	Approved by	
Drawn C.E.C. & D.S.	4/56	AREA ENGINEERING & WATERSHED PLANNING UNIT, POST WORTH, TEXAS	
Traced D.S.	4/56	STATE CONSERVATION ENGINEER, TEMPLE, TEXAS	
Checked C.E.C.	4/56	Sheet No. 3	Drawing No.

FOR TYPICAL BAR TYPES REFER TO A.C.I. STANDARD 315-48

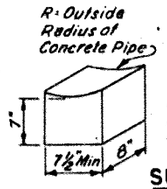
Bar No	Location	Qty.	Lgth	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
A-1	Anti-Seep Collar	6	16-2	97-0	4	Str										
A-2	" " "	12	9-2	110-0	4	"										
A-3	" " "	6	2-8	16-0	4	"										
A-4	" " "	4	5-6	22-0	4	"										
A-5	" " "	2	6-6	13-0	4	"										
A-6	" " "	2	4-0	8-0	4	"										
A-7	" " "	2	7-0	14-0	4	"										
A-8	" " "	2	3-0	6-0	4	"										
	Total Steel in One Anti-Seep Collar (Size 4) = 284'-0" = 189.7 lbs.															
	Class "A" Concrete in One Anti-Seep Collar = 3.12 cu. yds															
B-1	Outfall Pipe Support	8	8-6	68-0	4	1	0-9	7-9							0-6	
B-2	" " "	1	9-6	9-6	4	4	0-9	1-6	0-11	3-2	0-11	1-6	0-9	0-8		7-6
B-3	" " "	2	9-6	19-0	4	4	0-9	1-0	0-11	4-2	0-11	1-0	0-9	0-8		7-6
B-4	" " "	2	5-6	11-0	4	Str.										
	Total Steel in Outfall Pipe Support (Size 4) = 107'-6" = 71.81 lbs															
	Class "A" Concrete in Outfall Pipe Support = 0.68 lbs.															
C-1	Elbow Collar	8	5-9	46-0	4	14	4-2	1-7						0-7		
C-2	" "	2	5-3	10-6	4	14	3-11	1-4						0-7		
C-3	" "	4	5-0	20-0	4	14	3-9	1-3						0-6		
C-4	" "	2	4-9	9-6	4	14	3-7	1-2						0-5		
C-5	" "	8	4-6	36-0	4	14	3-6	1-0						0-4		
C-6	" "	10	9-3	92-6	4	2	2-7	4-1	2-7							
C-7	" "	10	7-9	77-6	4	2	2-3	3-3	2-3							
	Total Steel in Collar (Size 4) = 292'-0" = 195.1 lbs															
	Total Class "A" Concrete in Collar = 2.96 cu. yds															
	Class "A" Concrete in Pipe Cradle = 0.202 cu. yd per lin. ft.															
D-1	Inlet Filter Base	10	3-8	36-8	4	Str.										
	Total Steel in Inlet Filter Base (Size 4) = 36' 8" = 24.5 lbs.															
	Total Class "A" Concrete in Inlet Filter Base = 0.4 cu. yds.															



TYPICAL JOINT

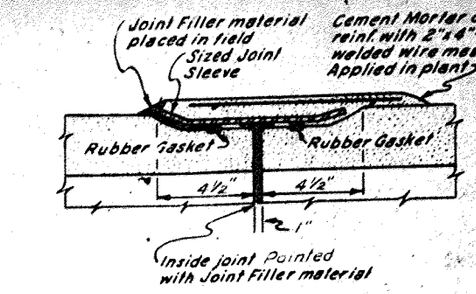


INLET FILTER HOUSING

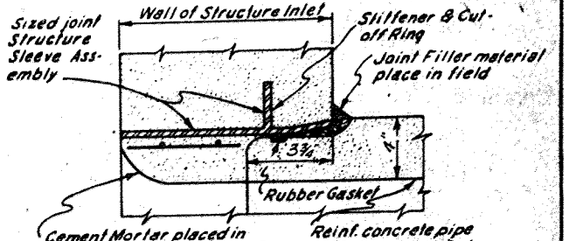


Precast Concrete Support Blocks may be set up to 24" from end of pipe joint. Use 2 blocks per joint of pipe.

SUPPORT BLOCK

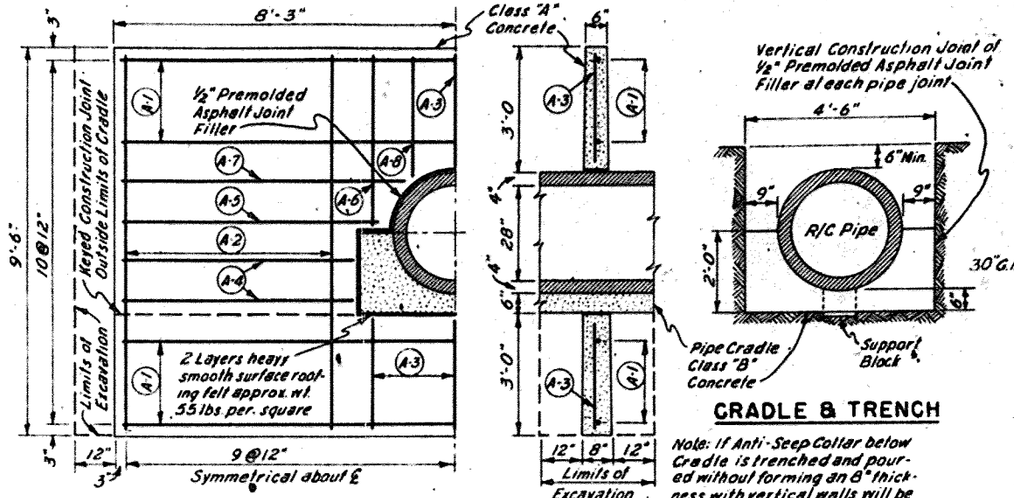


PIPE JOINT



STRUCTURE CONNECTION

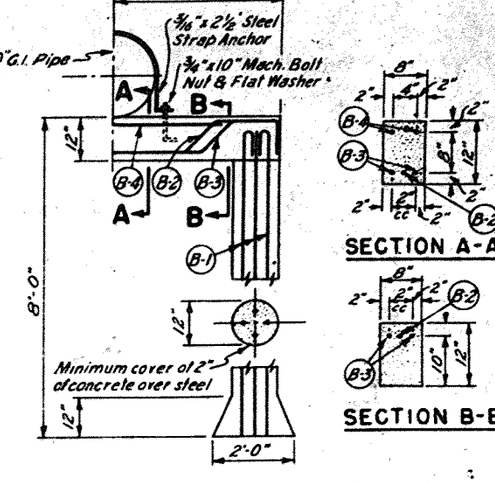
PIPE JOINT DETAILS



ANTI-SEEP COLLAR

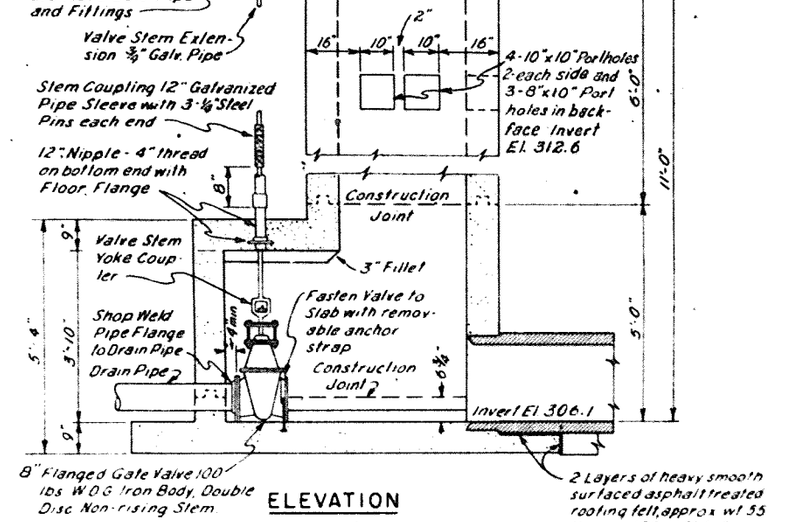
CRADLE & TRENCH

Note: If Anti-Seep Collar below Cradle is trenched and poured without forming an 8" thickness with vertical walls will be permitted, below Cradle

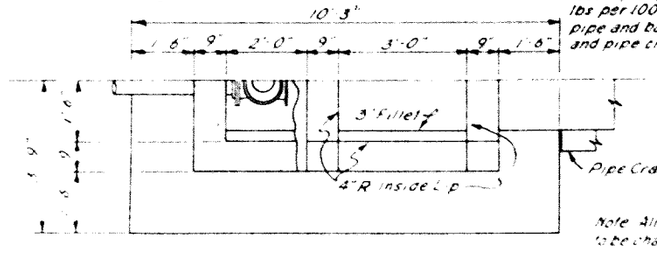


OUTFALL PIPE SUPPORT

Note Holes for supporting piers to be drilled or hand dug in natural ground



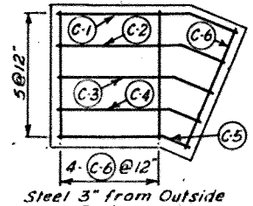
ELEVATION



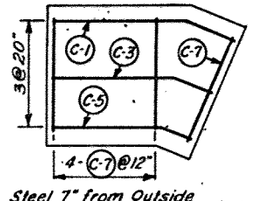
HALF PLAN

STRUCTURE INLET

Last joint of concrete pipe to have sized joint sleeve on both ends. Pack with Oakum between corrug. metal pipe and sized joint sleeve.

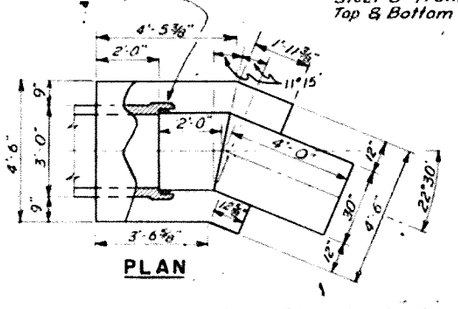


Steel 3" from Outside Top & Bottom

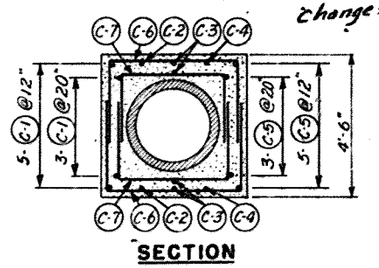


Steel 7" from Outside Top & Bottom

No Construction changes



PLAN



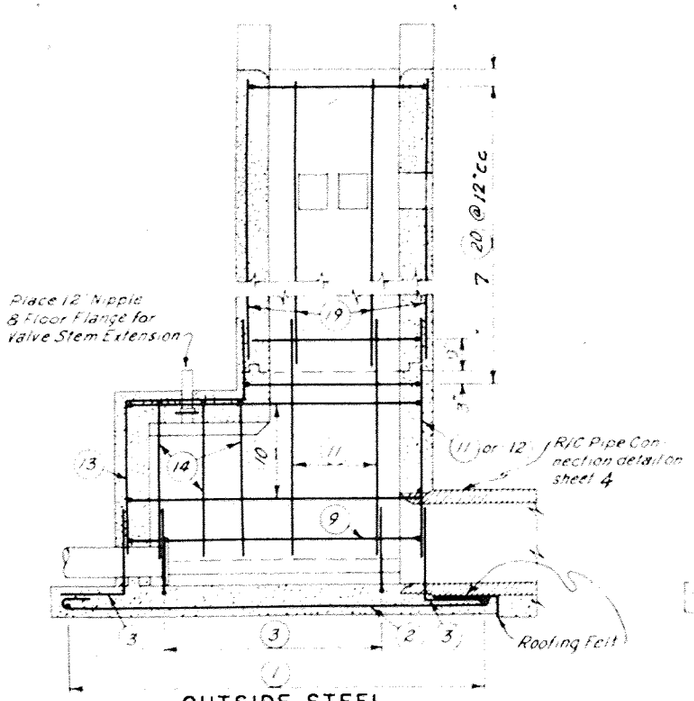
SECTION

ELBOW AND COLLAR DETAILS

Spillway Revised 5/56

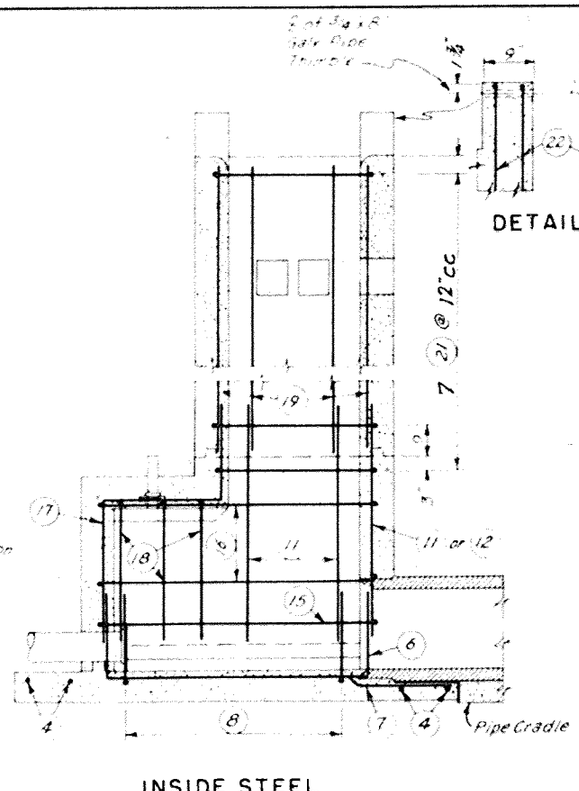
STRUCTURE DETAIL	
FLOODWATER RETARDING STRUCTURE SITE NO. 4	
ESCONDIDO CREEK WATERSHED	
OF THE	
SAN ANTONIO RIVER WATERSHED - TEXAS	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed C.E.C. date 4/56	Approved by
Drawn C.E.C. & R.D.B. date 4/56	
Traced R.D.B. date 4/56	
Checked C.E.C. date 5/56	Dwg. No. 4-E-10,440
	Sheet No. 4 of 8

le Valve & 48" Inlet Filter 28" R/C 4-E-10,081

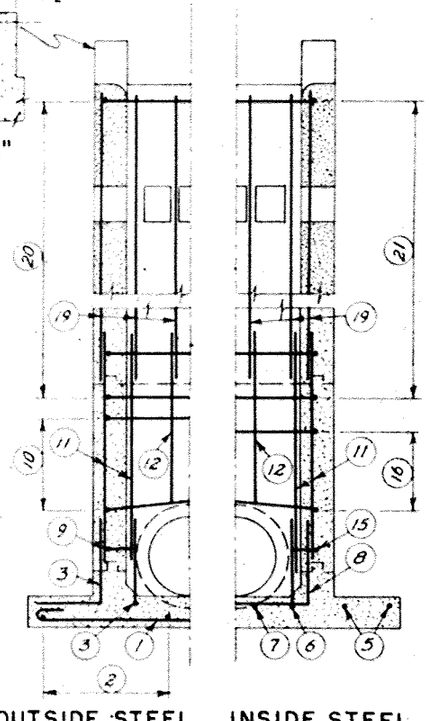


OUTSIDE STEEL

SECTION A-A



INSIDE STEEL



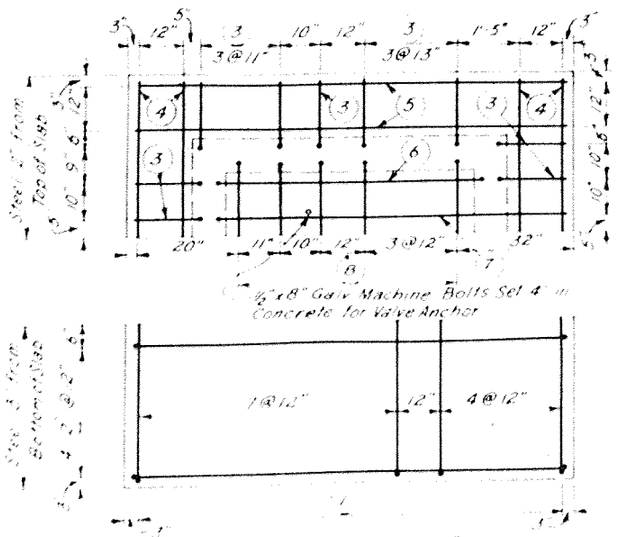
OUTSIDE STEEL INSIDE STEEL

SECTION B-B

FOR TYPICAL BAR TYPES REFER TO A.C.I. STANDARD 315-48														
Bar No.	Qty	Length	Total Length	Size	Type	A	B	C	D	E	G	H	J	O
1	11	8'-0	88'-0	4	1	0'-6	7'-0				0'-6		0'-4	
2	8	10'-9	86'-0	4	1	0'-6	9'-9				0'-6		0'-4	
3	22	3'-6	77'-0	4	2	1'-6	2'-0							
4	4	7'-0	28'-0	4	Str.									
5	4	9'-9	39'-0	4	Str.									
6	2	10'-1	20'-2	4	2	2'-0	6'-1				2'-0			
7	2	10'-0	20'-0	4	2	2'-0	8'-0							
8	6	7'-4	44'-0	4	2	2'-0	3'-4				2'-0			
9	2	10'-2	20'-4	4	2	2'-9	6'-10				0'-7			
10	6	12'-4	74'-0	4	2	2'-9	6'-10				2'-9			
11	18	5'-9	103'-6	4	Str.									
12	4	4'-0	16'-0	4	Str.									
13	6	8'-4	50'-0	4	8	3'-9	2'-9				1'-10			
14	3	11'-10	35'-6	4	2	3'-10	4'-2				3'-10			
15	2	9'-0	18'-0	4	2	2'-4	6'-1				0'-7			
16	6	10'-9	64'-6	4	2	2'-4	6'-1				2'-4			
17	4	8'-5	33'-8	4	8	3'-5	2'-9				2'-3			
18	3	10'-2	30'-6	4	2	3'-5	3'-4				3'-5			
19	32	5'-9	184'-0	4	Str.									
20	7	17'-10	124'-10	4	T2	0'-7	4'-2	4'-2	4'-2	4'-2	0'-7			
21	7	14'-6	101'-6	4	T2	0'-7	3'-4	3'-4	3'-4	3'-4	0'-7			
22	8	4'-3	34'-0	3	1	2'-0	2'-0						0'-3	
23	6	2'-8	16'-0	4	2	0'-10	1'-0				0'-10			

Total Size No 3 Steel in Inlet Structure = 36'-0" = 13.50 lbs.
" " - 4 " " " " = 1274'-6" = 851.37 lbs.
Total Steel = 864.87 lbs.
Class "A" Concrete in Inlet Structure = 7.47 cu. yds.
4-3/4" x 9" Galvanized Steel Pipe Thimbles

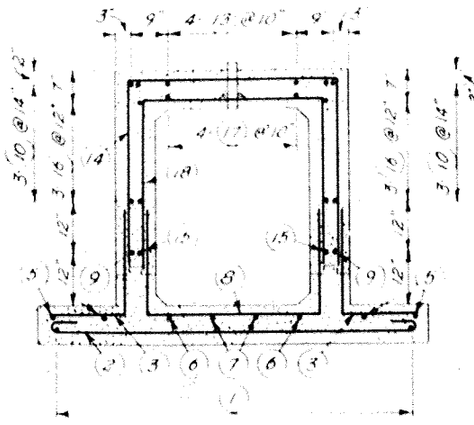
See Detail "A" for Bar No 22



SECTION C-C

SECTION E-E

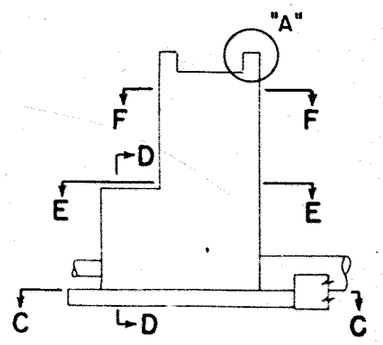
SECTION F-F



SECTION D-D

"AS BUILT" PLANS

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



No changes in construction

KEY TO SECTIONS
36" x 36" RISER

Spillway Revised 5/56

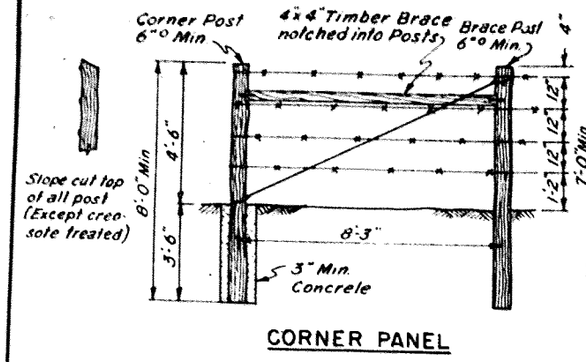
STRUCTURE INLET - STEEL PLACEMENT
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

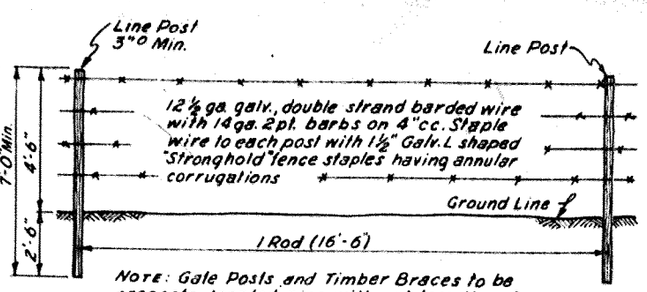
Designed	C.E.C.	date 4/56	Approved by W. M.
Drawn	C.E.C. & B.D.B.	date 4/56	HEAD, ENGINEERING WATERSHED PLANNING UNIT
Traced	B.D.B.	date 4/56	STATE CONSERVATION ENGINEER A. & M. COLLEGE, TEXAS
Checked	C.E.C.	date 5/56	Dwg. No. 4-E-10,440
			Sheet No. 5 of 8

Steel Placement, 36 x 36 Structure Inlet W/Valve Box.

Supp. 4-E-9741
3-1955

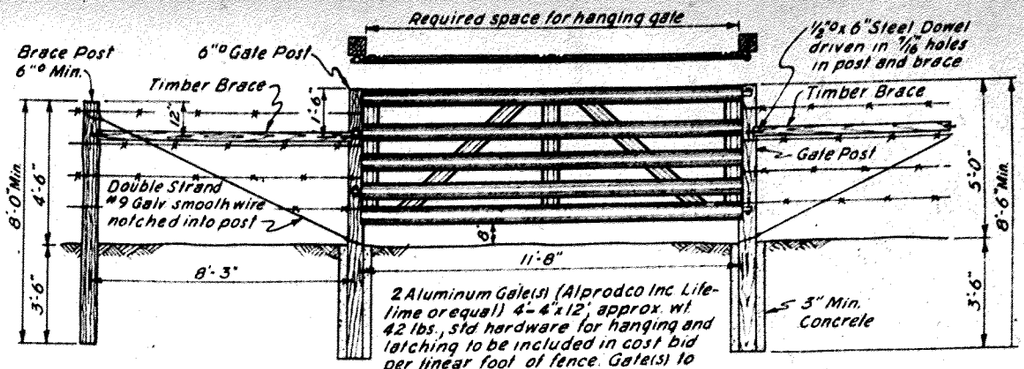


CORNER PANEL



Note: Gate Posts and Timber Braces to be creosote treated pine with not less than 8 lbs. retention per cu. ft. Preservative shall meet requirements of Federal Specifications TT-W-566a. See Specifications For Fence Post Material.

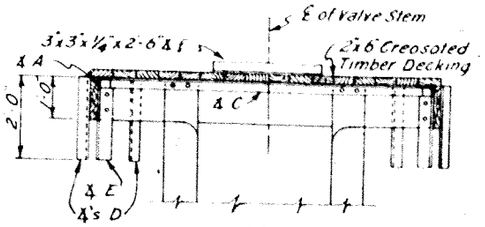
LINE PANEL



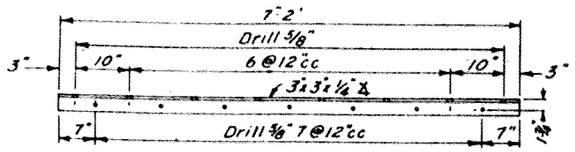
2 Aluminum Gate(s) (Alprodco Inc Lifetime or equal) 4'-4"x12', approx. wt. 42 lbs., std hardware for hanging and latching to be included in cost bid per linear foot of fence. Gate(s) to be DOUBLE LATCHED

GATE PANEL

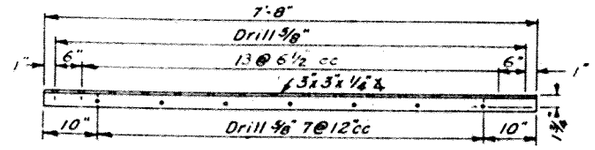
FENCE DETAILS



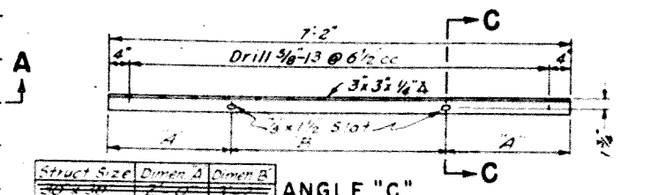
SECTION A-A



ANGLE "A"

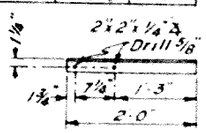


ANGLE "B"

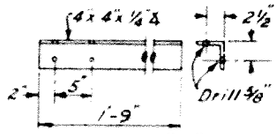


Struct Size	Dimen A	Dimen B
30" x 30"	2'-6"	3'-3"
36" x 36"	3'-0½"	3'-9"

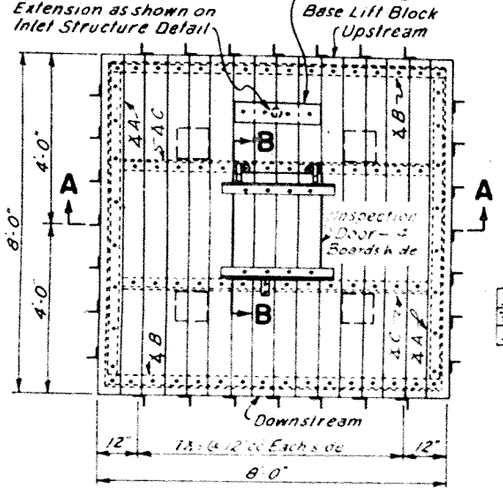
ANGLE "C"



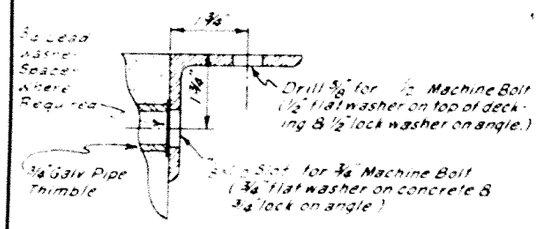
ANGLE "D"



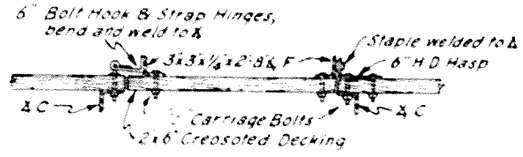
ANGLE "E"



PLAN



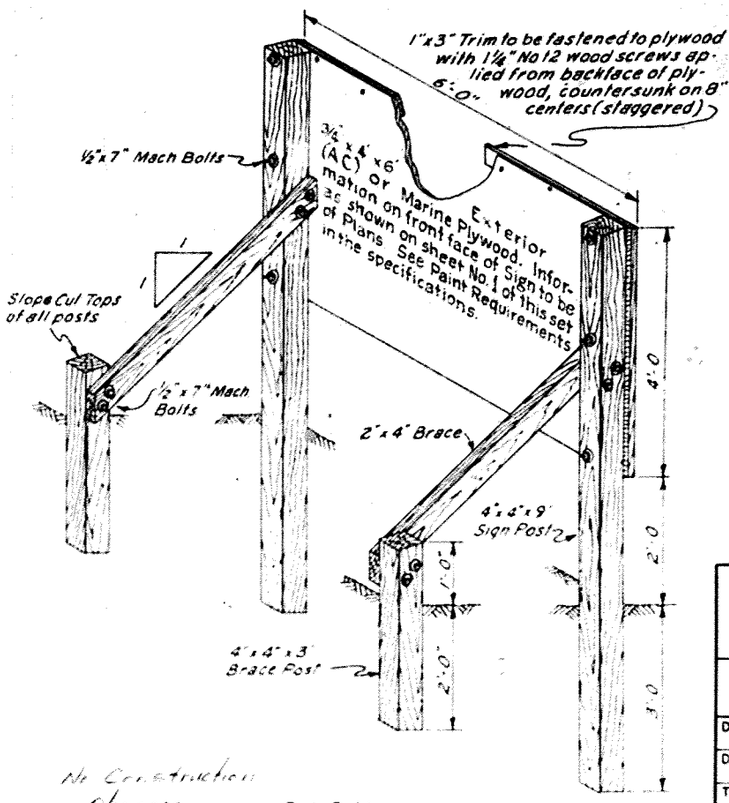
SECTION C-C



SECTION B-B

ANTI-VORTEX BAFFLE

"AS BUILT" PLANS
This set of plans constitutes the only record of construction changes and must be retained in Cartographic Files



SIGN

	Quan.	Item
Anti-Vortex Baffle	2	3"x3"x¼"x7'-2" ∠ A
	2	3"x3"x¼"x7'-8" ∠ B
	2	3"x3"x¼"x7'-2" ∠ C
	28	2"x2"x¼"x2'-0" ∠ D
	4	4"x4"x¼"x1'-9" ∠ E
	2	3"x3"x¼"x2'-8" ∠ F
	1	6" Heavy Duty Hinge Hasp
	1pr	6" Bolt Hook & Strap Hinge
	4	¾"x10½" Machine Bolts (Galvanized)
	4	¾" Flat Washers (Galvanized)
	4	¾" Lock Washers (Galvanized)
	141	½"x 4" Machine Bolts (Galvanized)
	10	½"x 4" Carriage Bolts (Galvanized)
	157	½" Flat Washers (Galvanized)
	155	½" Lock Washers (Galvanized)
	2	½"x5" Machine Bolts (Galvanized) *
	2	½"x6" Machine Bolts (Galvanized) *
	1	2"x6"x2'-0" No. 1 Rough Pine (Treated) *
	2	2"x12"x8'-0" No. 1 Rough Pine (Treated)
	2	2"x12"x7'-6" No. 1 Rough Pine (Treated)
	15	2"x6"x8'-0" No. 1 Rough Pine (Treated)
	4	¾" Lead Washers
Sign	2	4"x4"x9'-0" No. 1 Rough Pine (Treated)
	2	4"x4"x3'-0" No. 1 Rough Pine (Treated)
	2	2"x4"x6'-0" No. 1 Rough Pine (Treated)
	1	¾"x4'x6' Marine Plywood
	2	1"x3"x6'-0" No. 1 Pine S4S
	2	1"x3"x4'-0" No. 1 Pine S4S
	14	½"x 7" Machine Bolts (Galvanized
	28	½" Flat Washers (Galvanized)
	14	½" Lock Washers (Galvanized)
	38	1¼" No. 12 Wood Screws (Galvanized)

* Required only when Sluice Gate is used.

All angles to be shop painted with one coat of red lead. One field coat of red lead, and one coat of aluminum paint to be applied after baffle is assembled.

All treated wood material to be creosote with not less than 8 lbs retention per cu. ft. Preserative shall meet Federal Specifications TT-W-566-A

Where bearing is on wood, all bolt heads and nuts to be backed with flat washers. Use lock washer under each nut.

No changes in Construction

ANTI-VORTEX BAFFLE AND FENCE DETAIL
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

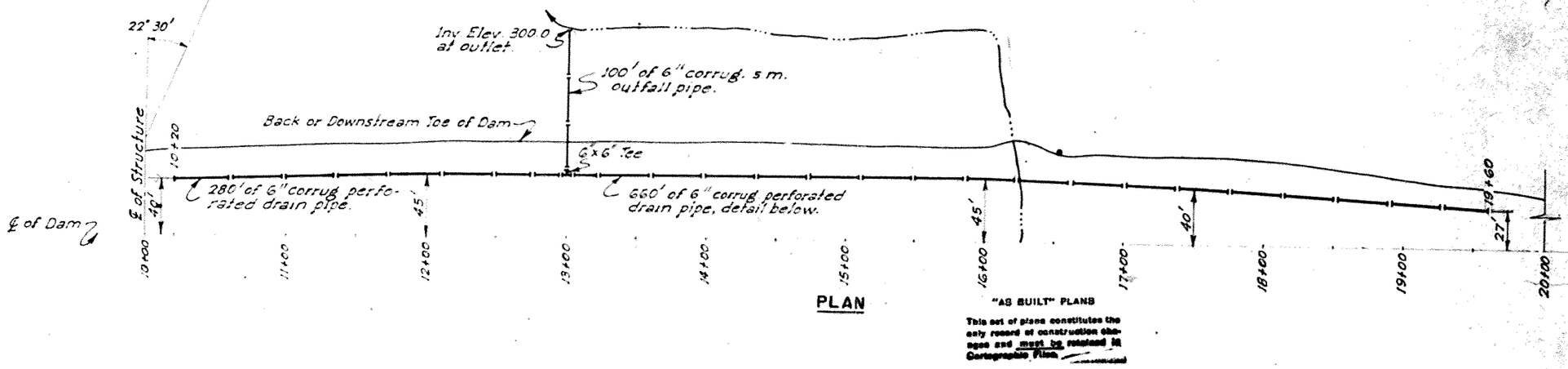
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	C.E.C.	date 4/56	Approved by W. M. HEAD, ENGINEERING & WATERSHED PLANNING UNIT
Drawn	C.E.C. & R.D.B.	date 4/56	
Traced	R.D.B.	date 4/56	STATE CONSERVATION ENGINEER, S.C.S. TEMPLE, TEXAS
Checked	C.E.C.	date 5/56	Dwg. No. 4-E-10,440
			Sheet No 6 of 8

No Construction Changes

Spillway Revised 5/56
(Revised 5-23-54)

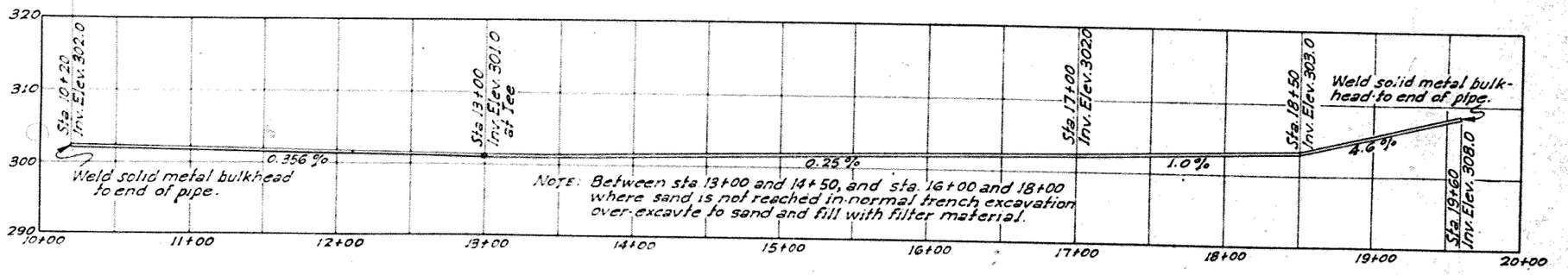
Anti-Vortex Baffle and Fence Detail Base 4-E-9672



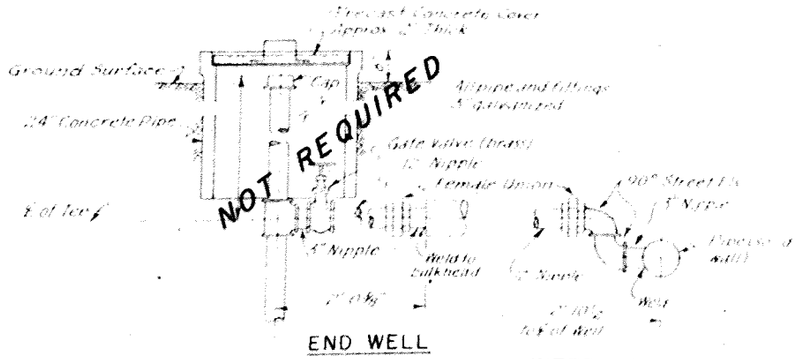
PLAN

"AS BUILT" PLANS

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



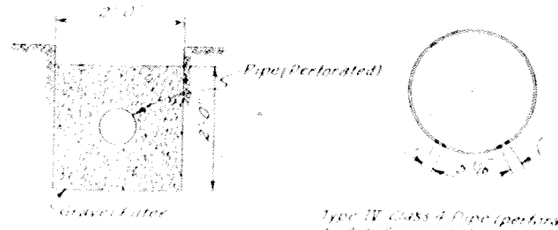
PROFILE



END WELL

INTERMEDIATE WELL

RELIEF WELL



TRENCH FOR PERFORATED PIPE

Gradation of Filter Material.

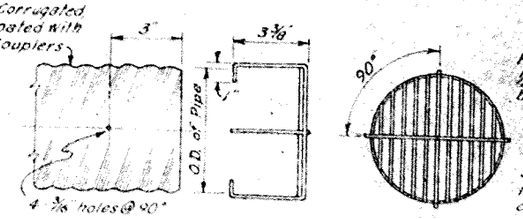
Screen Size	% Passing
1"	100
1/2"	95-100
No. 4	75-95
" 16	20-70
" 50	5-25
" 100	0-15
" 200	< 10

Type M Class 4 Pipe (perforated), 16 Ga. Galv. Corrugated S.M. Bituminous Coated with Standard Band Couplers. Perforations in valley to be No. after coating with not less than 4 holes per lineal ft. of pipe and beginning 4" from each end of each section.

PERFORATED PIPE

Cover perforations in pipe with not less than a 10" strip of #10 mesh copper screen. Wrap with wire at intervals close enough to assure complete coverage of all perforations.

Type 1, Class 4 Pipe (solid wall), 16 Ga., Galv. Corrugated S.M. Bituminous Coated with Standard Band Couplers



Fabricate of ½" ø on ½" cc (install with bars vertical)

Note: Adjust dimensions as necessary if circumferentially corrug. pipe is used.

OUTFALL PIPE (COLLECTOR LINE)

No Changes in Construction

RODENT GUARD

(1 REQUIRED EACH OUTFALL LINE)

No Construction Changes Spillway Revised 5/56

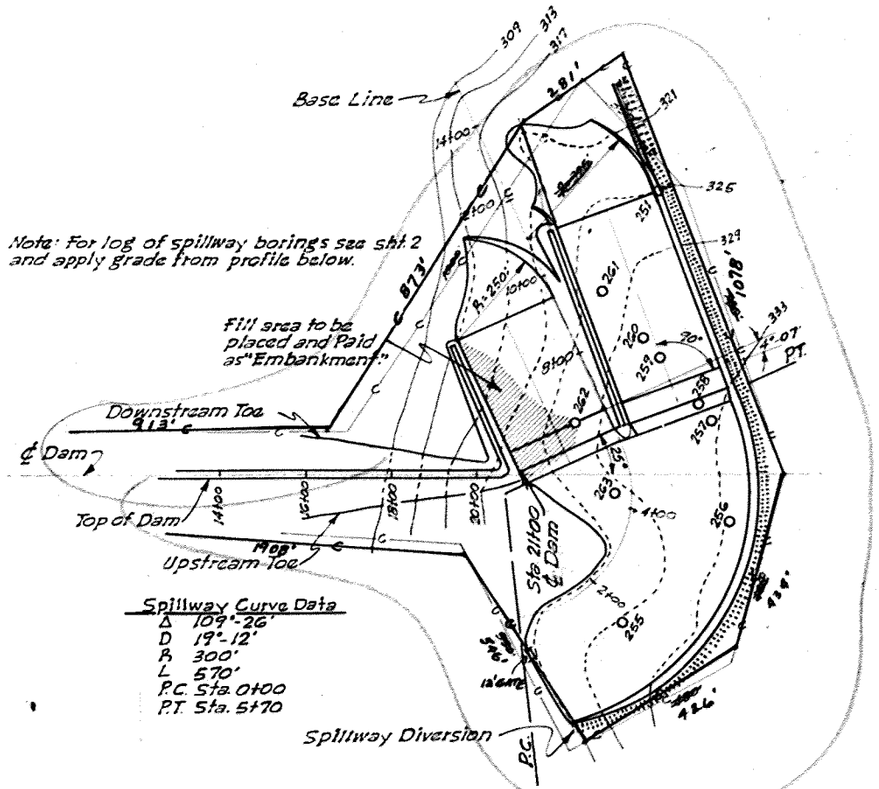
FOUNDATION DRAINAGE
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	C.E.C.	date 5-11-56	Approved by
Drawn	C.E.C.	date 5-11-56	
Traced	H.S.W.	date 5-14-56	
Checked	C.E.C.	date 5-56	Dwg. No. T-E-10,440
			Sheet No. 7 of 8

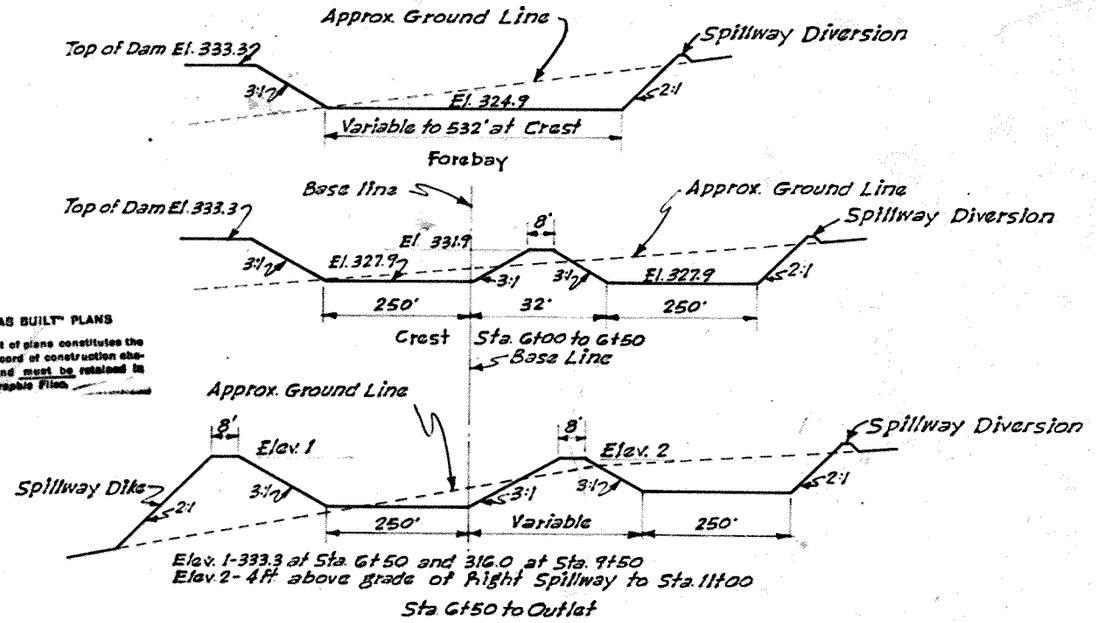
RELIEF WELL AND DRAIN PIPE DETAIL

Relief Well and Drain Pipe Detail

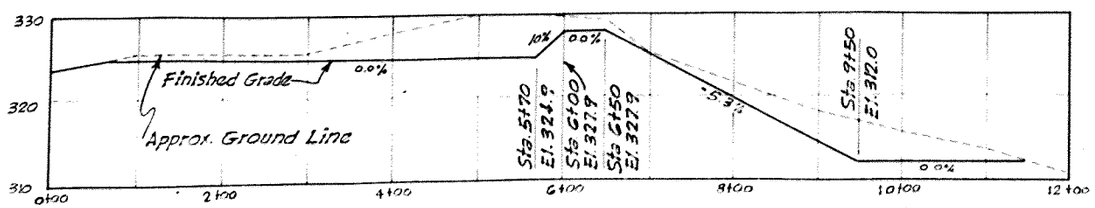


PLAN OF SPILLWAY

200 0 200 400 600
Feet

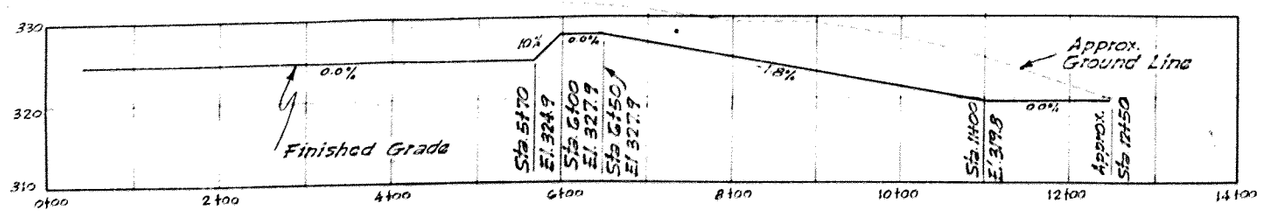


TYPICAL SPILLWAY SECTIONS



Left

Common Forebay Section



Right

PROFILE ON ℄ OF SPILLWAYS

REVISED SPILLWAY
FLOODWATER RETARDING STRUCTURE SITE No. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	C.E.C.	5/56
Drawn	C.E.C. & D.S.	5/56
Traced	D.S.	5/56
Checked	C.E.C.	5/56

Approved by [illegible] Regional Conservation Engineer, Fort Worth, Texas
State Conservation Engineer, Temple, Texas

Sheet No. 8 of 8
Drawing No. 4-E-10,440

Plan Of Proposed Outfall Channel & Pipe

Profile Of Proposed Outfall Channel & Pipe

Typical Diversion Cross Section

Typical Cross Section Of Proposed Outfall Channel & Dyke

Profile Of Stilling Basin

Typical Cross Section of Stilling Basin

Earthwork Revisions by SCS completed on 9-2-59
Fencing " " " " No Change
" " Harnes SCD " " 9-15-59

PROPOSED OUTFALL PIPE EXTENSION & CHANNEL
AND
EMBANKMENT FOUNDATION DRAIN
FLOODWATER RETARDING STRUCTURE SITE NO. 4
ESCONDIDO CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED - TEXAS

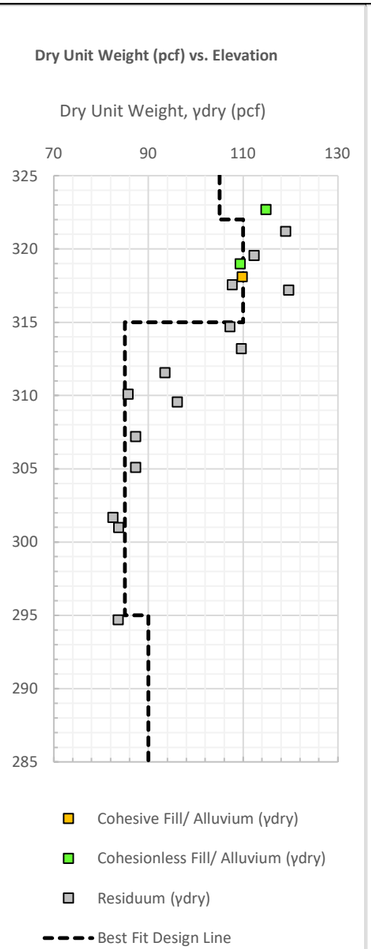
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

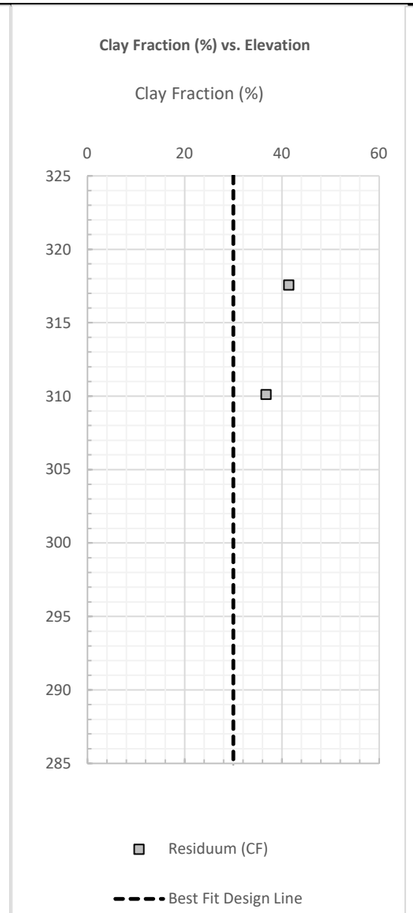
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Checked
Date
Approved by
Title
Title
Sheet
Drawing No.
No.
of
4-F-10440

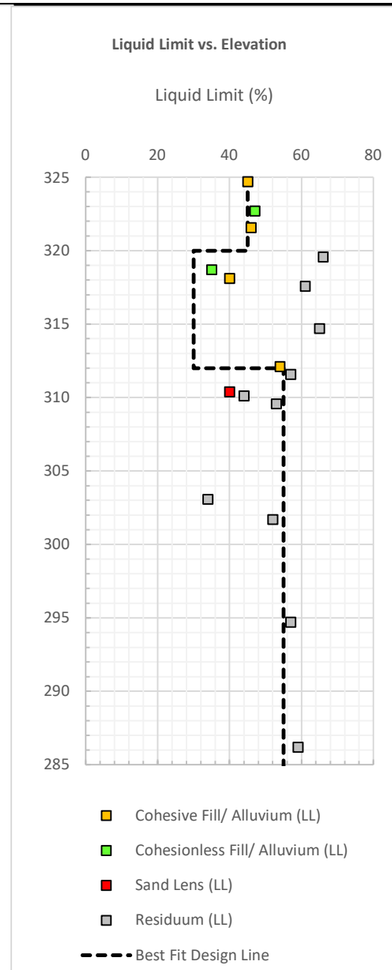
Appendix Sheet No. 2-A

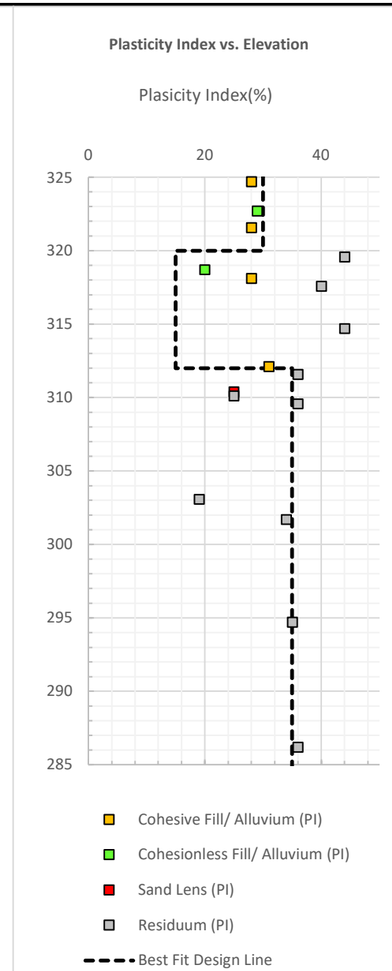
ATTACHMENT 2.

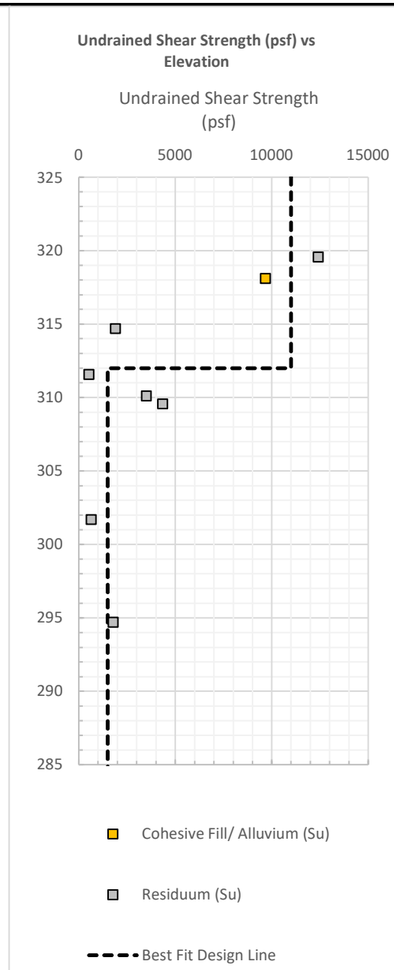
LABORATORY TEST DATA PLOTS FOR ASW BORINGS

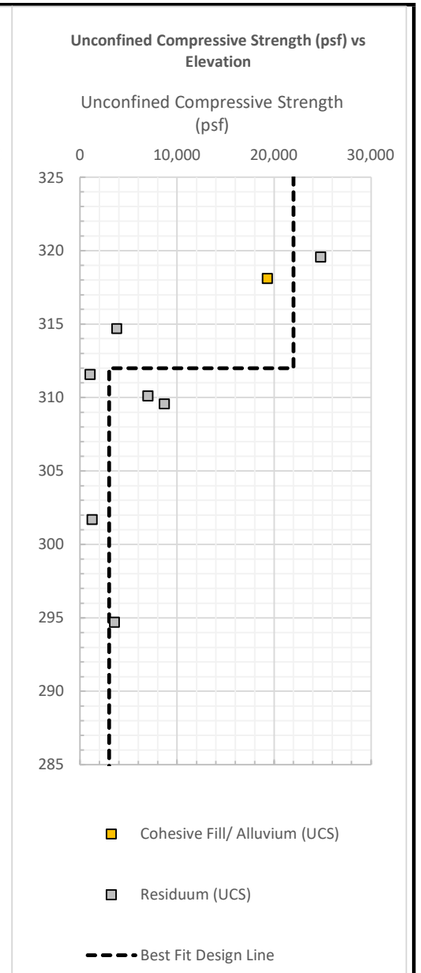




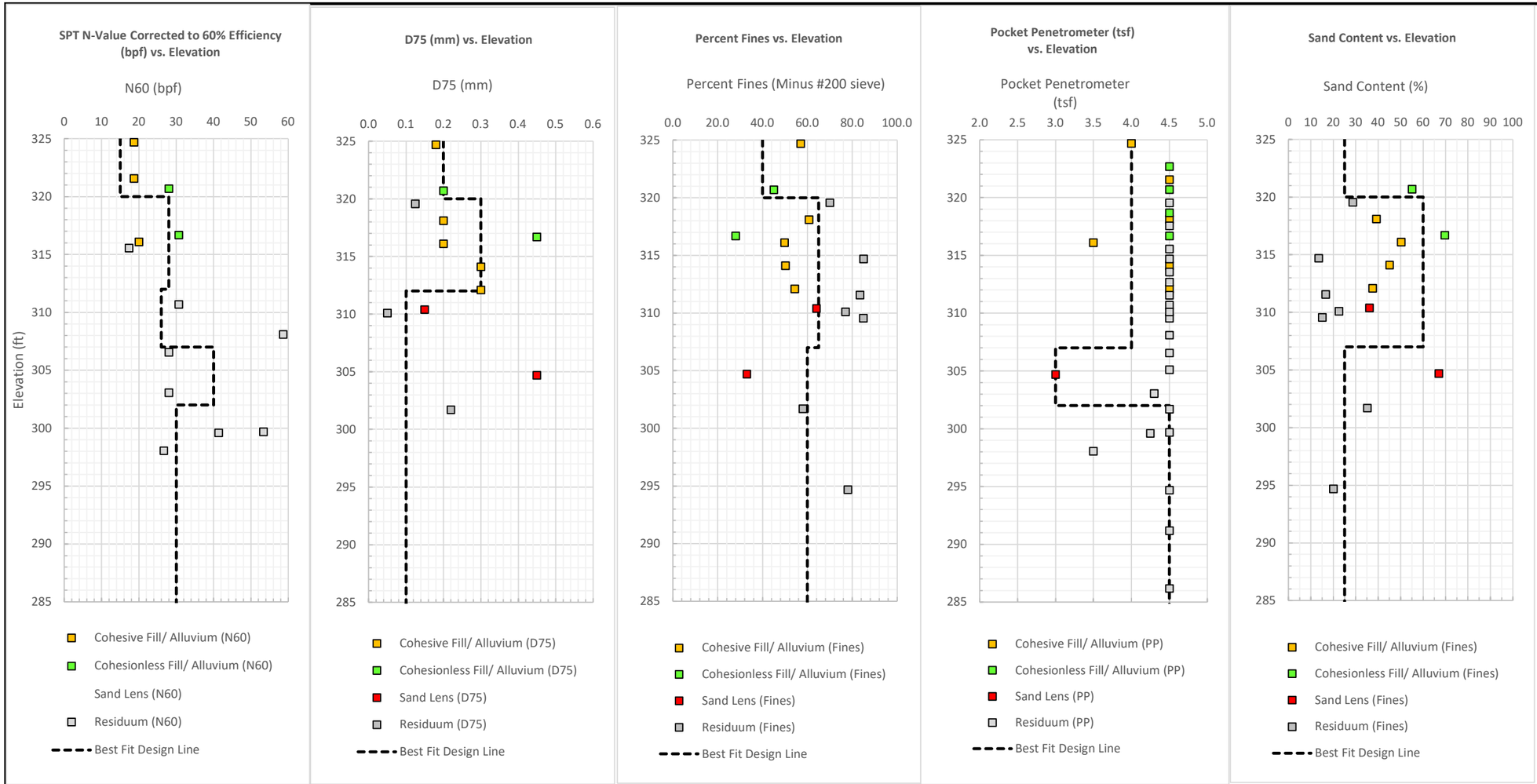




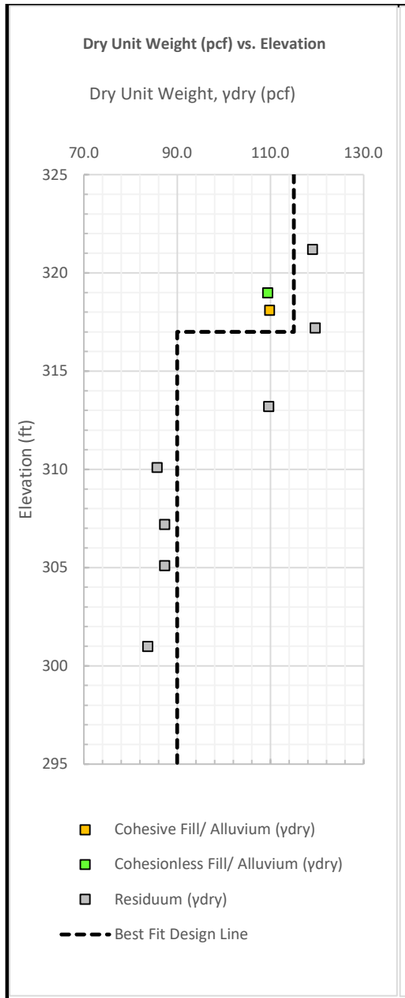


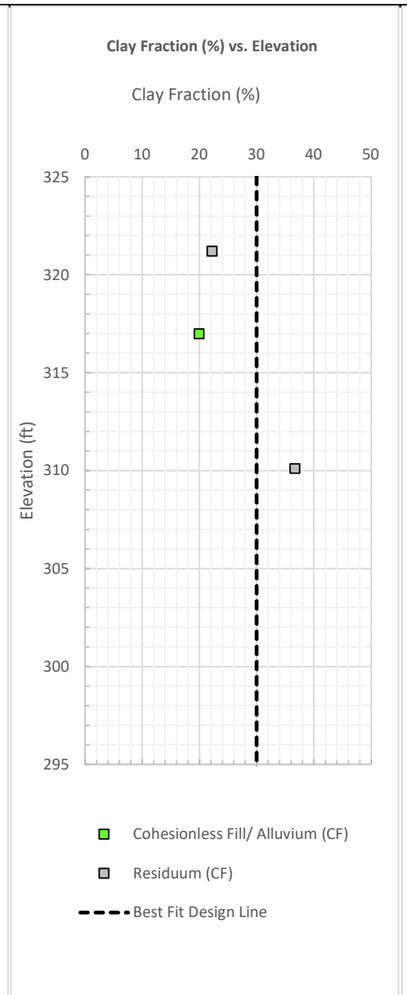


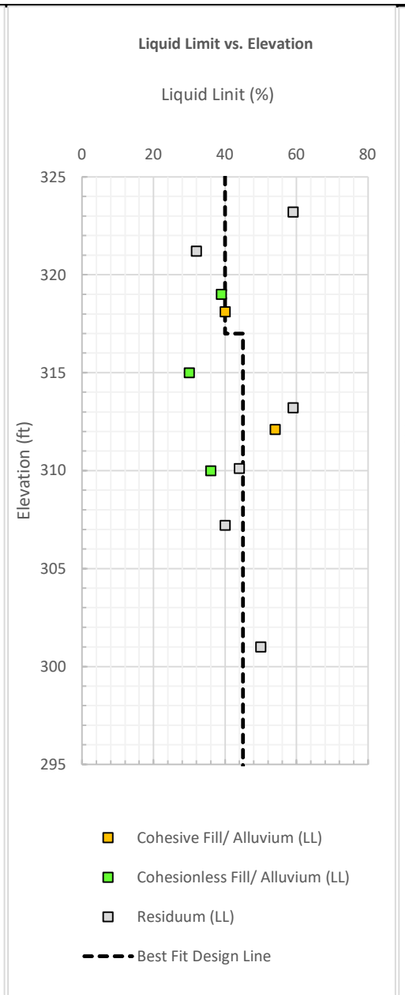
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Left ASW)	
AECOM	March 2024 / Attachment No. 1

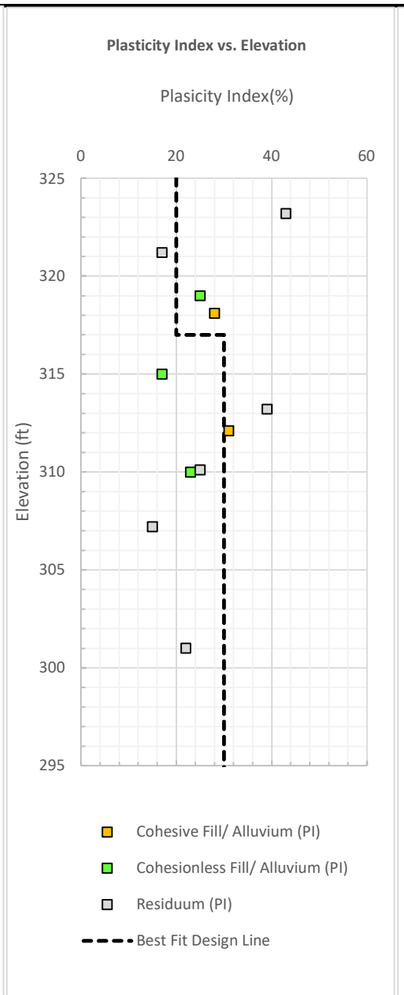


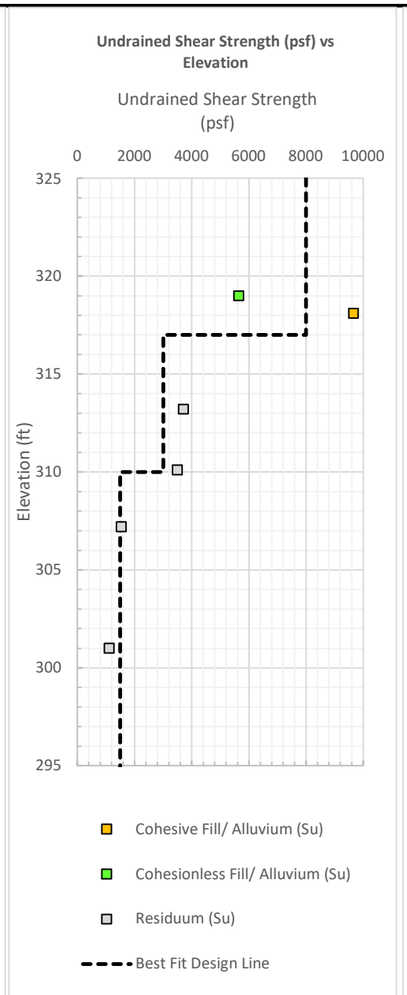
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Left ASW)	
AECOM	March 2024 / Attachment No. 2

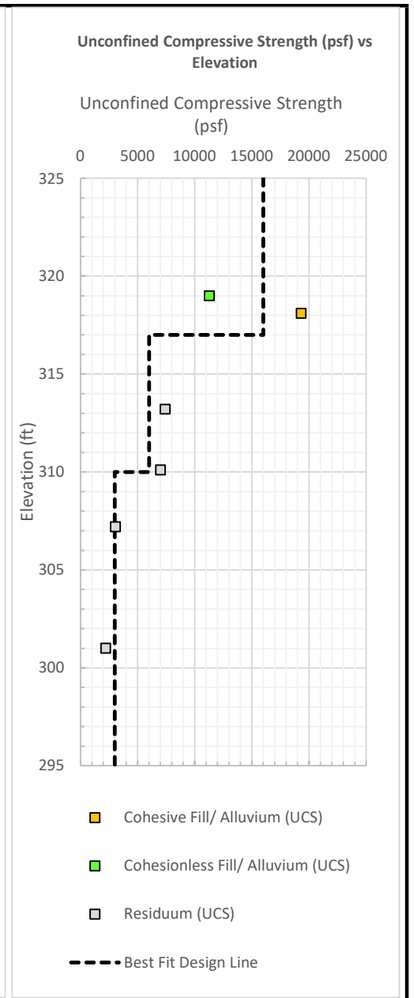




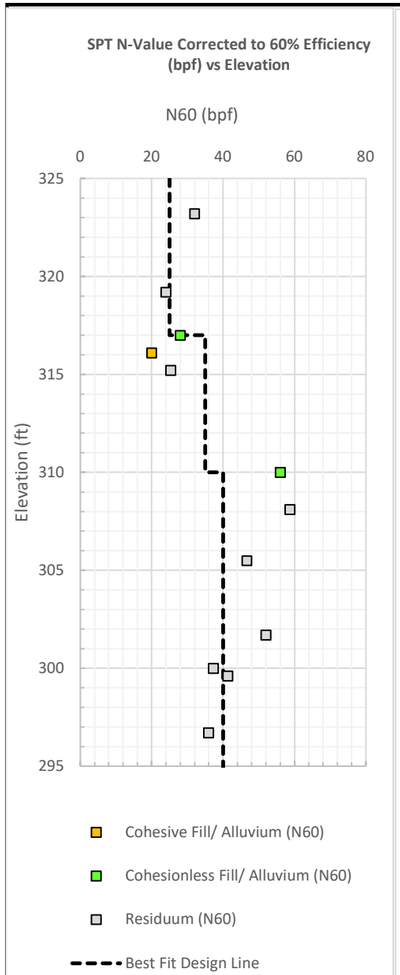


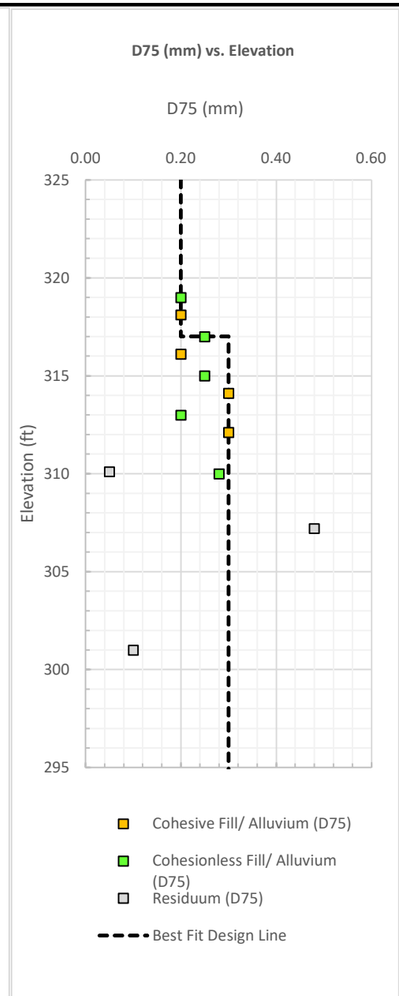


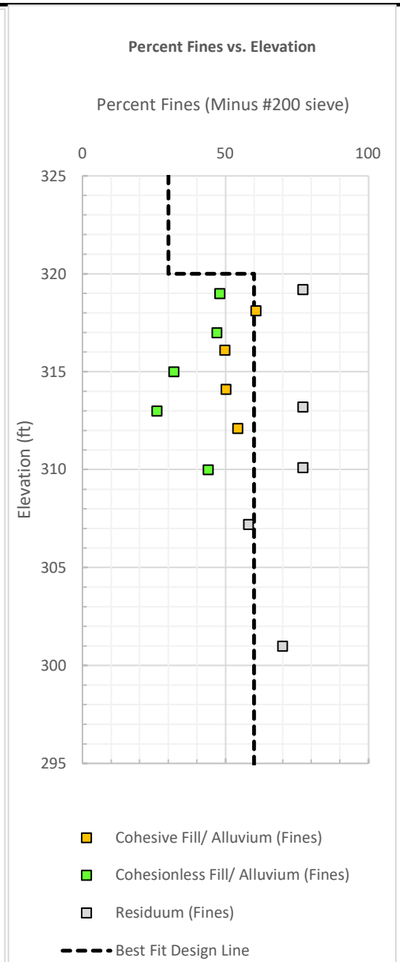


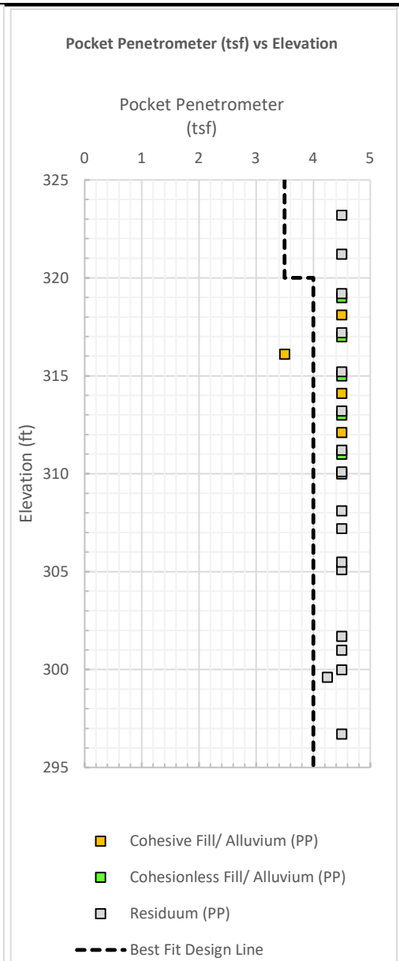


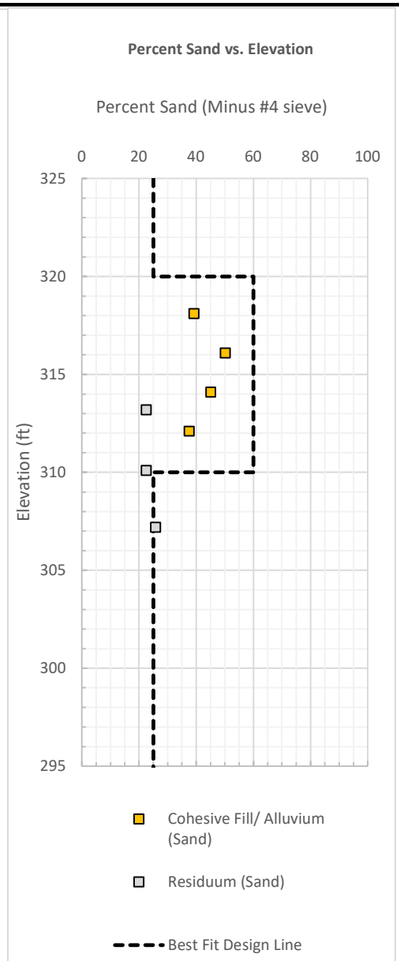
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Right ASW)	
AECOM	March 2024 / Attachment No. 2







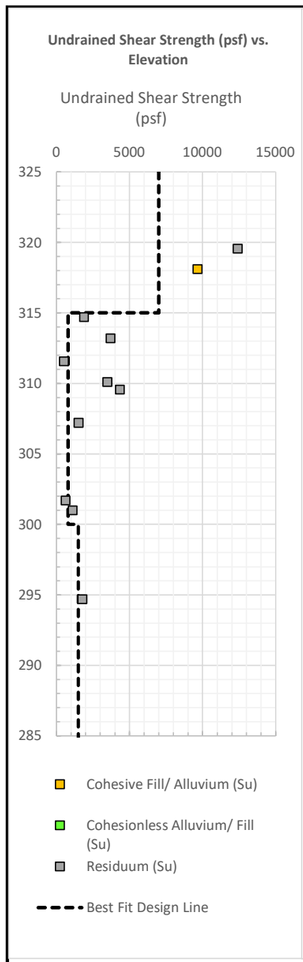


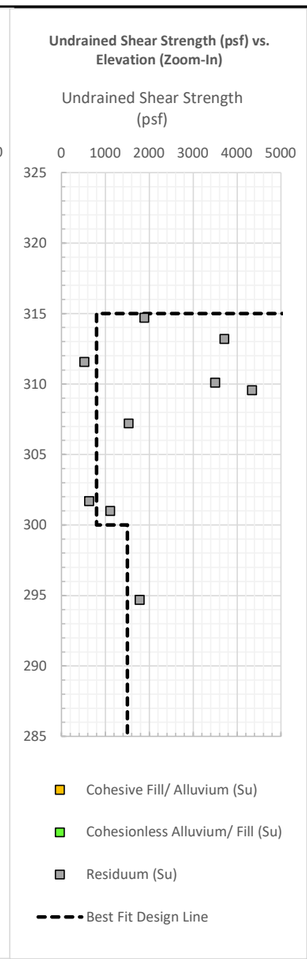


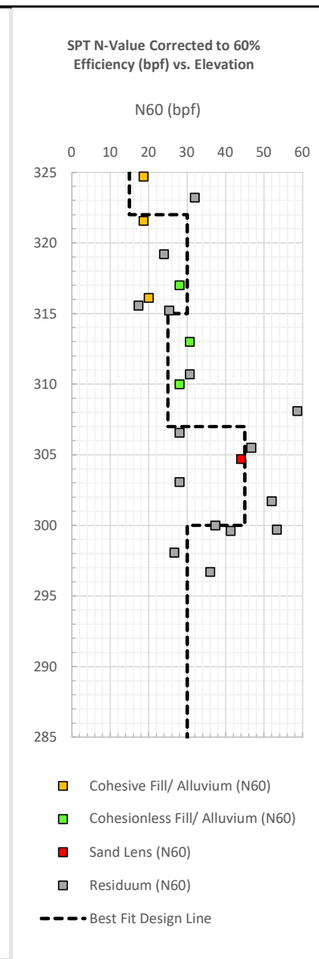
San Antonio River Authority Escondido FRS No. 4 SWP-EA		Project No. 60707410
Geotechnical Laboratory Testing Summary Plots (Right ASW)		
AECOM	March 2024	Attachment No. 2

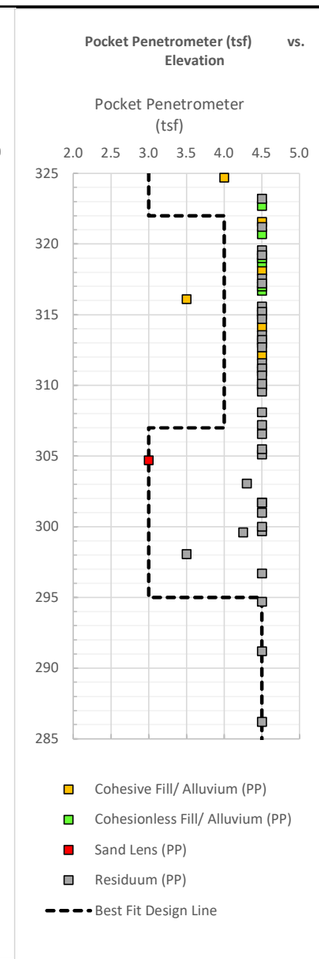
ATTACHMENT 3.

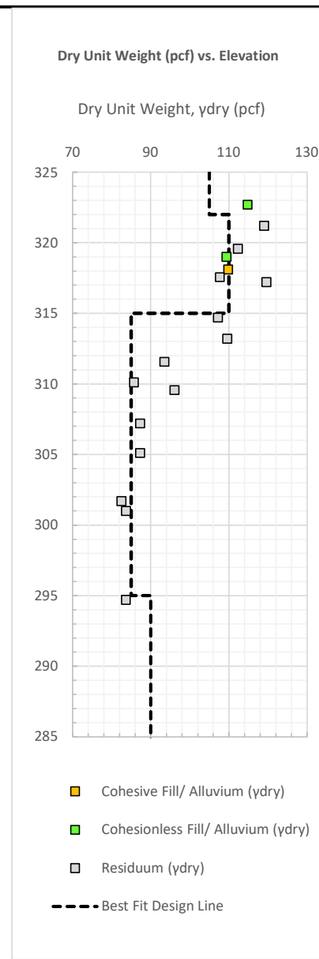
HEADCUT ERODIBILITY INDEX (Kh) CALCULATIONS











Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	LL	PI	% Passing No. 200 Sieve	UC (natural moisture)		
					WCn (%)	DDn (pcf)	Su (psf)
201-23	2	66	44	70	16	112	12400
201-23	10	57	36	83	26	94	520
203-23	10	65	44	85	18	107	1890
204-23	0	40	28	61	9	110	9660
204-23	8	44	25	77	32	86	3500
205-23	0	39	25	48	7	109	5640
Average		52	34	71	18	103	5602

Best Fit Design Lines

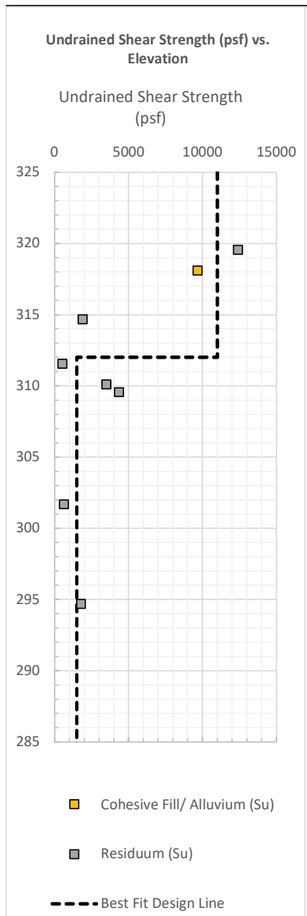
Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
0	7000	15	3	105
3	7000	15	3	105
3	7000	30	4	110
10	7000	30	4	110
10	800	25	4	85
18	800	25	4	85
18	800	45	3	85
25	800	45	3	85
25	1500	30	3	85
30	1500	30	3	85
30	1500	30	4.5	90
30	1500	30	4.5	90
40	1500	30	4.5	90
45	1500	30	4.5	90

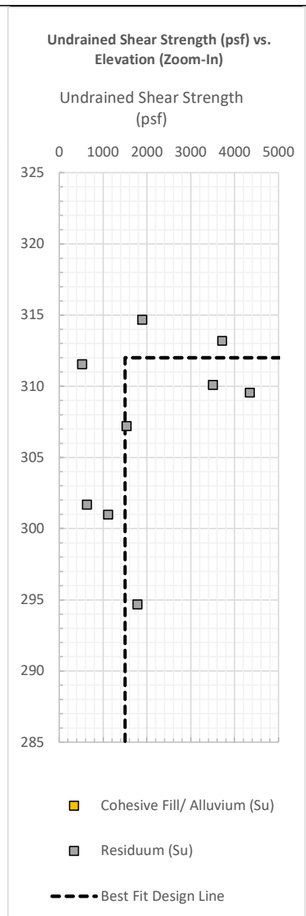
Estimated Kh Values

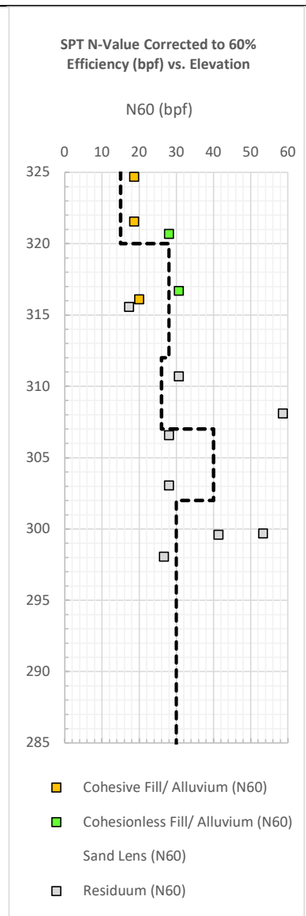
Depth(ft)	From Su1[(1)]	From Su2[(2)]	From N60[(3)]	From N60[(4)]	From PP1[(1)]	From PP1[(2)]	Avg
0	0.69	0.50	0.22	---	0.29	0.20	0.38
3	0.69	0.50	0.22	---	0.29	0.20	0.38
3	---	---	---	0.11	---	---	0.11
10	---	---	---	0.11	---	---	0.11
10	0.07	0.05	0.36	---	0.39	0.27	0.23
18	0.07	0.05	0.36	---	0.39	0.27	0.23
18	0.07	0.05	0.65	---	0.29	0.20	0.25
25	0.07	0.05	0.65	---	0.29	0.20	0.25
25	0.14	0.09	0.44	---	0.29	0.20	0.23
30	0.14	0.09	0.44	---	0.29	0.20	0.23
30	0.14	0.09	0.44	---	0.44	0.31	0.28
30	0.14	0.09	0.44	---	0.44	0.31	0.28
40	0.14	0.09	0.44	---	0.44	0.31	0.28
45	0.14	0.09	0.44	---	0.44	0.31	0.28

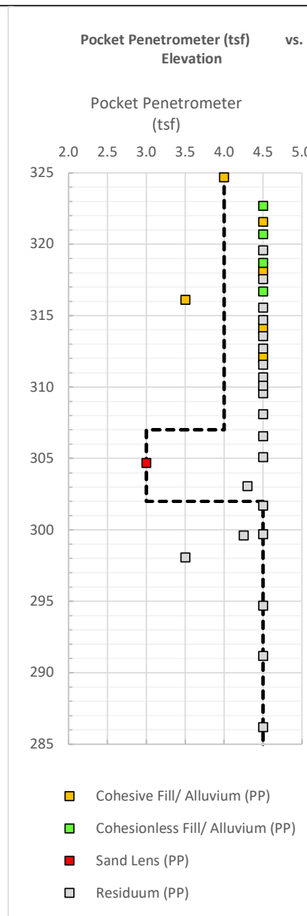
(1) Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4
(2) Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3
(3) Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3 (cohesive)
(4) Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2 (cohesionless)

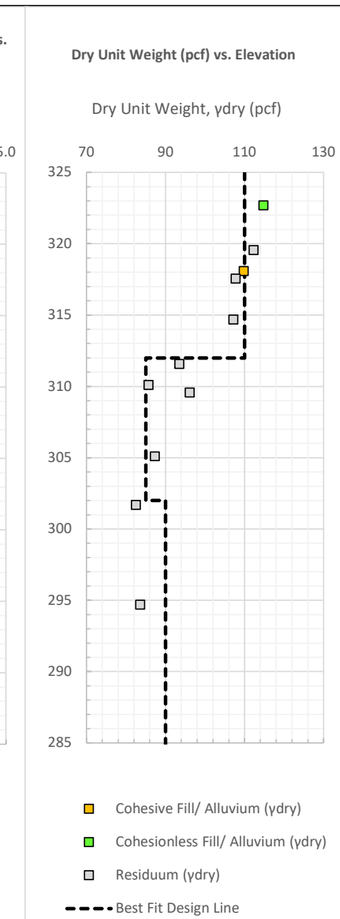
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Parameters for Kh Development (Depth)	
AECOM	March 2024
	Attachment No. 3











Best Fit Design Lines

Elevation(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
325	11000	15	4	110
320	11000	15	4	110
320	11000	28	4	110
312	11000	28	4	110
312	1500	26	4	85
307	1500	26	4	85
307	1500	40	3	85
302	1500	40	3	85
302	1500	30	4.5	90
295	1500	30	4.5	90
295	1500	30	4.5	90
295	1500	30	4.5	90
285	1500	30	4.5	90
280	1500	30	4.5	90

Estimated Kh Values

Elevation (ft)	From Su1[(1)]	From Su2[(2)]	From N60[(3)]	From N60[(4)]	From PP1[(1)]	From PP1[(2)]	Avg
325	1.09	0.83	0.22	---	0.39	0.27	0.56
320	1.09	0.83	0.22	---	0.39	0.27	0.56
320	---	---	---	0.10	---	---	0.10
312	---	---	---	0.10	---	---	0.10
312	0.14	0.09	0.38	---	0.39	0.27	0.26
307	0.14	0.09	0.38	---	0.39	0.27	0.26
307	---	---	---	0.15	---	---	0.15
302	---	---	---	0.15	---	---	0.15
302	0.14	0.09	0.44	---	0.44	0.31	0.28
295	0.14	0.09	0.44	---	0.44	0.31	0.28
295	0.14	0.09	0.44	---	0.44	0.31	0.28
295	0.14	0.09	0.44	---	0.44	0.31	0.28
285	0.14	0.09	0.44	---	0.44	0.31	0.28
280	0.14	0.09	0.44	---	0.44	0.31	0.28

Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	UC (natural moisture)		
		WCn (%)	DDn (pcf)	Su (psf)
201-23	2	16	112.3	12,400
201-23	10	26	93.5	520
203-23	10	18	107.2	1,890
204-23	0	9	109.8	9,660
204-23	8	32	85.7	3,500
	Average	20	102	5594

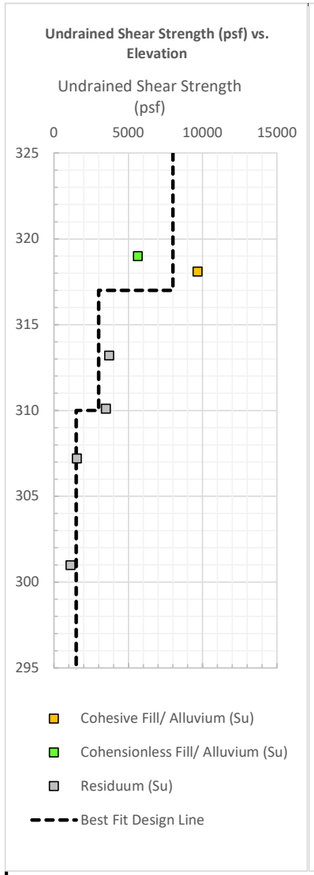
[(1)] Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4

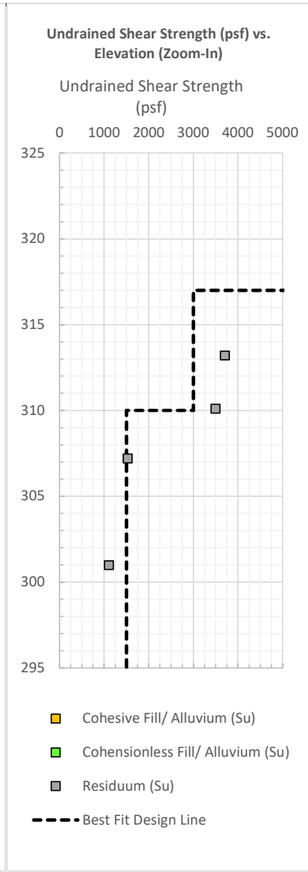
[(2)] Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3

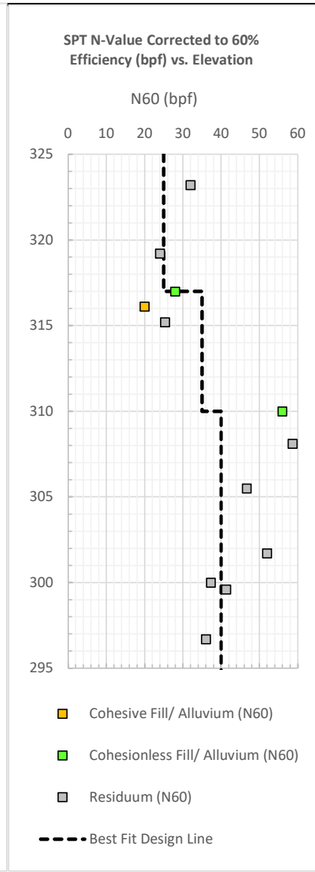
[(3)] Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3 (cohesive)

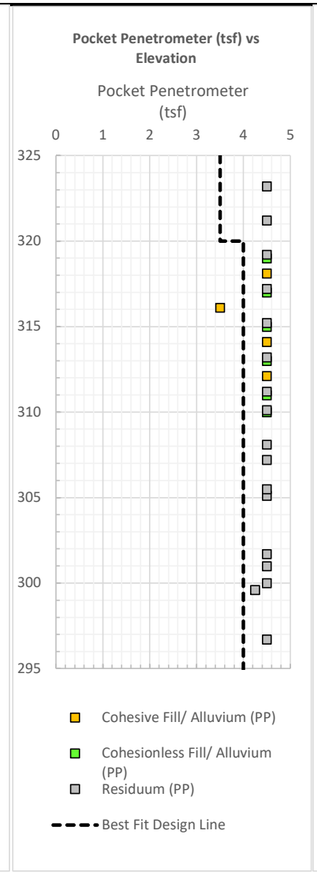
[(4)] Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2 (cohesionless)

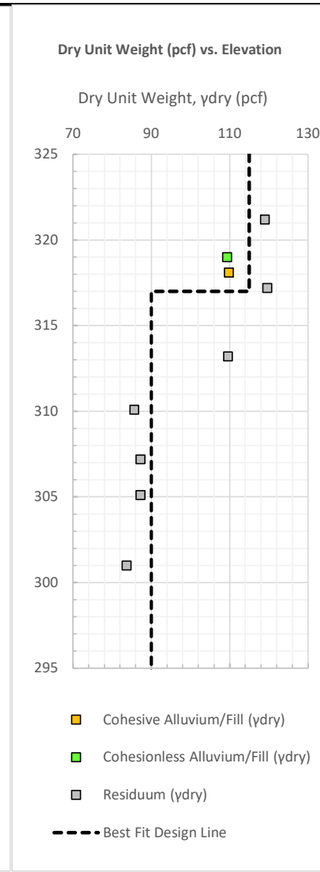
San Antonio River Authority Escondido FRS No. 4 SWP-EA	Project No. 60707410
Parameters for Kh Development (Left ASW)	
AECOM	March 2024
	Attachment No. 3











Best Fit Design Lines

Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
325	8000	25	3.5	115
320	8000	25	3.5	115
320	8000	25	4	115
317	8000	25	4	115
317	3000	35	4	90
310	3000	35	4	90
310	1500	40	4	90
290	1500	40	4	90
290	1500	40	4	90
290	1500	40	4	90

Estimated Kh Values

Depth(ft)	From Su1[(1)]	From Su2[(2)]	From N60[(3)]	From N60[(4)]	From PP1[(1)]	From PP1[(2)]	Avg
325	0.79	0.58	0.36	---	0.34	0.24	0.46
320	0.79	0.58	0.36	---	0.34	0.24	0.46
320	0.79	0.58	0.36	0.09	0.39	0.27	0.41
317	0.79	0.58	0.36	0.09	0.39	0.27	0.41
317	---	---	---	0.13	---	---	0.13
310	---	---	---	0.13	---	---	0.13
310	0.14	0.09	0.58	---	0.39	0.27	0.30
290	0.14	0.09	0.58	---	0.39	0.27	0.30
290	0.14	0.09	0.58	---	0.39	0.27	0.30
290	0.14	0.09	0.58	---	0.39	0.27	0.30

[(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 (cohesive)
[(4)] Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2 (cohesionless)

Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	UC (natural moisture)		
		WCn (%)	DDn (pcf)	Su (psf)
204-23	0	9.0	109.8	9,660
204-23	8	32.0	85.7	3,500
205-23	0	7.0	109.4	5,640
	Average	16.0	101.6	6266.7

San Antonio River Authority Escondido FRS No. 4 SWP-EA		Project No. 60707410
Parameters for Kh Development (Right ASW)		
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Attachment 3
Estimation of Erodibility Coefficient Index (Kh)
Escondido Creek FRS No. 4, 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)	Ground Surface El. (ft)	Top Elevation (ft)	Sample ID	Stratum	Field USCS	Lab USCS	w-n (%)	DD (pcf)	Ground Surface El. (ft)	Sample El. (ft)	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 (%)	Ll-n	Ll-sat	Su-sat (psf)	Kh	Kh-adj
201-23	0.0	1.5	321.6	321.6	SS-1	Cohesive Fill/ Alluvium	OL		6.0		321.6	321.6						46.0	18.0	28.0	2.62				YES	-	-	-	-	-	-	-0.43	-	-	0.45	0.23
201-23	2.0	4.0	321.6	319.6	ST-2	Residuum	CL	CH	16.0	**112.3**	**321.6**	319.6	130.0	1.3	28.7	70.0		66.0	22.0	44.0	2.62	UC	2.31	12400	YES	24,800	1,187	1.19	0.94	0.47	17.4	-0.14	-0.10	4,000	0.45	0.23
201-23	4.0	6.0	321.6	317.6	P-3	Residuum	CL		17.0	**107.7**	**321.6**	317.6	126.0				41.4	61.0	21.0	40.0	2.62				NO	-	-	-	-	-	19.8	-0.10	-0.03	4,000	0.45	0.45
201-23	6.0	7.5	321.6	315.6	SS-4	Residuum	CL		**24.0**		321.6	315.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	8.0	10.0	321.6	313.6	P-5	Residuum	CL		28.0		321.6	313.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	10.0	12.0	321.6	311.6	ST-6	Residuum	CL	CH	26.0	**93.5**	**321.6**	311.6	118.0	0.0	16.6	83.4		57.0	21.0	36.0	2.62	UC	0.61	520	NO	1,040	50	0.05	0.03	0.03	28.6	0.14	0.21	1,930	0.26	0.26
201-23	12.0	13.0	321.6	309.6	ST-7	Residuum	CL	CH	**24.0**	96.1	321.6	309.6	119.0	0.0	15.1	84.9		53.0	17.0	36.0	2.62	UC	1.0	4340	NO	8,680	416	0.42	0.30	0.30	26.8	0.19	0.27	1,562	0.21	0.21
201-23	15.0	16.5	321.6	306.6	SS-8	Residuum	CH		22.0		321.6	306.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	18.5	20.0	321.6	303.1	SS-9	Residuum	CH		17.0		321.6	303.1						34.0	15.0	19.0	2.62				NO	-	-	-	-	-	-	0.11	-	-	0.29	0.29
201-23	23.5	25.0	321.6	298.1	SS-10	Residuum	CH		20.0		321.6	298.1									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	0.0	3.0	322.6	322.6	G-1	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
201-23	3.0	5.0	323.6	320.6	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	0.0	2.0	325.2	325.2	ST-1	Cohesive Fill/ Alluvium	CL				325.2	325.2		0.2	13.5	86.0					2.62				YES	-	-	-	-	-	-	-	-	-	-	-
202-23	2.0	3.5	325.2	323.2	SS-2	Residuum	CL	CH	9		325.2	323.2						59	16	43	2.62				YES	-	-	-	-	-	-	-0.16	-	-	0.45	0.23
202-23	4.0	6.0	325.2	321.2	P-3	Residuum	CL		**8**	119.0	325.2	321.2	128.5			77.0	22.2	32	15	17	2.62				YES	-	-	-	-	-	14.3	-0.41	-0.04	4,000	0.45	0.23
202-23	6.0	7.5	325.2	319.2	SS-4	Residuum	SM		12		325.2	319.2									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	8.0	10.0	325.2	317.2	P-5	Residuum	CH		12	119.6	325.2	317.2	134.0								2.62				NO	-	-	-	-	-	14.0	-	-	-	-	-
202-23	10.0	11.5	325.2	315.2	SS-6	Residuum	CH		18		325.2	315.2		0.8	22.5	77.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	12.0	14.0	325.2	313.2	ST-7	Residuum	CH	CH	17	109.6	325.2	313.2	128.2					59	20	39	2.62	UC	1.43	3710	NO	7,420	355	0.36	0.25	0.25	18.8	-0.08	-0.03	4,000	0.45	0.45
202-23	14.0	16.0	325.2	311.2	P-8	Residuum	CH		29		325.2	311.2		15.8	25.8	58.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	18.0	20.0	325.2	307.2	ST-9	Residuum	CH	CL	29	87.3	325.2	307.2	112.6					40	25	15	2.62	UC	1.1	1530	NO	3,060	147	0.15	0.10	0.10	33.3	0.27	0.55	586	0.16	0.16
202-23	23.5	25.0	325.2	301.7	SS-10	Residuum	CL		17		325.2	301.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	28.5	30.0	325.2	296.7	SS-11	Residuum	CL		26.0		325.2	296.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	0.0	3.0	325.2	325.2	G-1	Remolded	Bulk										40.4				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	3.0	5.0	325.2	322.2	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	0.0	1.5	324.7	324.7	SS-1	Cohesive Fill/ Alluvium	ML	CL	7		324.7	324.7				57.0		45	17	28	2.62				YES	-	-	-	-	-	-	-0.36	-	-	0.45	0.23
203-23	2.0	4.0	324.7	322.7	P-2	Cohesionless Fill/ Alluvium	ML		8	114.8	324.7	322.7	124.0					47	18	29	2.62				YES	-	-	-	-	-	16.2	-0.34	-0.06	4,000	0.45	0.23
203-23	4.0	5.5	324.7	320.7	SS-3	Cohesionless Fill/ Alluvium	ML		7		324.7	320.7		0.0	55.1	45.0					2.62				YES	-	-	-	-	-	-	-	-	-	-	-
203-23	6.0	7.5	324.7	318.7	P-4	Cohesionless Fill/ Alluvium	SM		6		324.7	318.7						35	15	20	2.62				NO	-	-	-	-	-	-	-0.45	-	-	0.45	0.45
203-23	8.0	9.5	324.7	316.7	SS-5	Cohesionless Fill/ Alluvium	SW		3		324.7	316.7		2.1	69.6	28.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	10.0	11.0	324.7	314.7	ST-6	Residuum	CH	CH	18	107.2	324.7	314.7	126.5	1.5	13.5	85.0		65	21	44	2.62	UC	1.62	1890	NO	3,780	181	0.18	0.12	0.12	20.0	-0.07	-0.02	4,000	0.45	0.45
203-23	12.0	14.0	324.7	312.7	P-7	Residuum	CH		12		324.7	312.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	14.0	14.3	324.7	310.7	SS-8A	Residuum	SM		18		324.7	310.7									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	14.3	15.5	324.7	310.4	SS-8B	Sand/ Gravel Lens	SM	CL	13		324.7	310.4		0.0	36.1	64.0		40	15	25	2.62				NO	-	-	-	-	-	-	-0.08	-	-	0.45	0.45
203-23	20.0	20.7	324.7	304.7	SS-9A	Sand/ Gravel Lens	SM		16		324.7	304.7		0.0	67.0	33.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	20.7	21.5	324.7	304.0	SS-9B	Residuum	SP-SM		26		324.7	304.0									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	23.0	25.0	324.7	301.7	ST-10	Residuum	CL	CH	35	82.5	324.7	301.7	111.4	6.4	35.1	58.0		52	18	34	2.62	UC	1.31	630	NO	1,260	60	0.06	0.04	0.04	37.5	0.50	0.57	550	0.07	0.07
203-23	25.0	26.0	324.7	299.7	ST-11	Residuum	CL				324.7	299.7									2.62	UC	0.86	1780	NO	3,560	170	0.17	0.11	0.11	-	-	-	-	-	-
203-23	30.0	32.0	324.7	294.7	ST-12	Residuum	CL	CH	35	83.6	324.7	294.7	112.9	1.7	20.0	78.0		57	22	35	2.62				NO	-	-	-	-	-	36.5	0.37	0.41	954	0.11	0.11
203-23	33.5	35.0	324.7	291.2	SS-13	Residuum	CH		27		324.7	291.2									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	38.5	40.0	324.7	286.2	SS-14	Residuum	CH		30		324.7	286.2						59	23	36	2.62				NO	-	-	-	-	-	-	0.19	-	-	0.21	0.21
203-23	0.0	3.0	324.7	324.7	G-1	Remolded	Bulk									36.0	21.3				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
203-23	3.0	5.0	324.7	321.7	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	0.0	2.0	318.1	318.1	ST-1	Cohesive Fill/ Alluvium	SM	CL	9	109.8	318.1	318.1	119.7		39.2	60.7		40	12	28	2.62	UC	1.51	9660	YES	19,320	925	0.93	0.72	0.36	18.7	-0.11	0.24	1,753	0.45	0.23
204-23	2.0	3.5	318.1	316.1	SS-2	Cohesive Fill/ Alluvium	SW-SM		5		318.1	316.1			50.2	49.8					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	4.0	6.0	318.1	314.1	P-3	Cohesive Fill/ Alluvium	SW-SM		**29**		318.1	314.1		2.7	45.1	50.2					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	6.0	8.0	318.1	312.1	ST-4	Cohesive Fill/ Alluvium	CL	CH	33		318.1	312.1		8.2	37.5	54.3		54	23	31	2.62				NO	-	-	-	-	-	-	0.32	-	-	0.13	0.13
204-23	8.0	10.0	318.1	310.1	ST-5	Residuum	CL	CL	32	85.7	318.1	310.1	113.1	0.7	22.5	77.0	36.700	44	19	25	2.62	UC	1.3	3500	NO	7,000	335	0.34	0.24	0.24	34.6	0.52	0.63	457	0.07	0.07
204-23	10.0	11.5	318.1	308.1	SS-6	Residuum	CL		22		318.1	308.1									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	13.0	15.0	318.1	305.1	P-7	Residuum	CL		34	87.3	318.1	305.1	116.982								2.62				NO	-	-	-	-	-	33.3	-	-	-	-	-
204-23	18.5	20.0	318.1	299.6	SS-8	Residuum	CL		27		318.1	299.6									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	0.0	3.0	318.1	318.1	G-1	Remolded	Bulk				318.1	318.1					31.3				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
204-23	3.0	5.0	318.1	315.1	G-2	Remolded	Bulk				318.1	315.1									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	0.0	2.0	319.0	319.0	ST-1	Cohesionless Fill/ Alluvium	ML	SC	7	109.4	319.0	319.0	117.058			48		39	14	25	2.62	UC	1.12	5640	NO	11,280	540	0.54	0.40	0.40	18.9	-0.28	0.19	2,036	0.45	0.45
205-23	2.0	3.5	319.0	317.0	SS-2	Cohesionless Fill/ Alluvium	ML		5		319.0	317.0				47	19.9				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	4.0	6.0	319.0	315.0	ST-3	Cohesionless Fill/ Alluvium	SC	SC	8		319.0	315.0				32		30	13	17	2.62				NO	-	-	-	-	-	-	-0.29	-	-	0.45	0.45
205-23	6.0	8.0	319.0	313.0	P-4	Cohesionless Fill/ Alluvium	SC		9		319.0	313.0				26					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	8.0	9.0	319.0	311.0	ST-5	Cohesionless Fill/ Alluvium	SC		6		319.0	311.0									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	9.0	10.5	319.0	310.0	SS-6	Cohesionless Fill/ Alluvium	SC	SC	6		319.0	310.0				44		36	13	23	2.62				NO	-	-	-	-	-	-	-0.30	-	-	0.45	0.45
205-23	13.5	15.0	319.0	305.5	SS-7	Residuum	CL		26		319.0	305.5									2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	18.0	19.0	319.0	301.0	ST-8	Residuum	CL	CH	34	83.7	319.0	301.0	112.158			70		50	28	22	2.62				NO	-	-	-	-	-	36.4	0.27	0.38	1,068	0.15	0.15
205-23	19.0	20.5	319.0	300.0	SS-9	Residuum	CL		31		319.0	300.0									2.62	UC	1.12	1110	NO	2,220	106	0.11	0.07	0.07	-	-	-	-	-	-
205-23	0.0	3.0	319.0	319.0	G-1	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
205-23	3.0	5.0	319.0	316.0	G-2	Remolded	Bulk														2.62				NO	-	-	-	-	-	-	-	-	-	-	-
																								MIN	520				MIN	0.03				
																								MAX	12,400				MAX	0.47				
																								AVG	3,893				AVG	0.21				

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Preliminary Soil Mechanics Report

Escondido Creek Floodwater Retarding Structure (FRS) No. 4 SWP-EA, Karnes County, TX

This Preliminary Soil Mechanics Report (SMR) provides a summary of geotechnical laboratory testing results on samples recovered during the field geologic investigation for Escondido Creek FRS No. 4 (Escondido Creek 4). The field geologic investigation is documented in the Preliminary Geologic Investigation Report (GIR) (AECOM, 2024) under separate cover.

The purpose of this Preliminary SMR is to present and discuss the results of the laboratory testing. Geotechnical engineering analyses of the dam embankment or ancillary structures or engineering recommendations for dam rehabilitation are beyond the scope of this Preliminary SMR and will need to be addressed during final design under separate authorization.

This report was prepared by AECOM for the San Antonio River Authority (River Authority) in accordance with the Project Scope of Work for the SWP-EA for Escondido Creek 4, Karnes County, Texas which was authorized as part of Task Order No. 9 (C230133) on April 12, 2023, and performed under the terms and conditions of IDIQ Contract No. C210002 effective August 3, 2020.

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)
- Crumb test (ASTM D6572)
- Double hydrometer (ASTM D4221)
- Standard Proctor moisture-density (ASTM D698)

The preliminary GIR characterized the subsurface conditions according to the generalized stratigraphy listed below (descending order relative to depth). The discussion of results and referenced laboratory summary tables presented in the following paragraphs of this report denote the interpreted stratum to which each sample belongs. Note that the NRCS soil survey mapping shows fill within the ASW channel; however, the as-built drawings indicate that only the left bay had fill placed on the inner half. Thickness of the fill ranged

decreasing in thickness downstream in the channel. Only boring 203-23 is anticipated to be located in the fill. The discrepancy between the as-built drawings location of fill and the NRCS soil survey mapping could partially be due to the resolution of the NRCS soil survey mapping. While an attempt was made to distinguish between the fill and alluvium, the scope of this study did not provide enough additional information to confirm the difference; as a result, no distinction was made between the clayey fill and alluvium.

- Undifferentiated Clayey Fill/ Alluvium (CL, CH)
- Sandy Alluvium (SC, SM)
- Residuum (CL, CH) of the Oakville Sandstone Formation
- Sand Lense (SC/SM) within the Residuum in boring 203-23

Index Testing

The results of index tests are summarized for each stratum in **Table 1**. The results indicate the following:

1. The Undifferentiated Undifferentiated Clayey Fill / Alluvium generally classifies as lean to fat clays (CL, CH) with an average liquid limit (LL) of 46 and average plasticity index (PI) of 29.

2. The Sandy Alluvium classifies as clayey and silty sands (SC, SM) with average LL of 37 and average PI of 23.

3. The Residuum classifies as lean to fat clays (CL, CH) with average LL of 53 and average PI of 32.

4. A sand lense within the Residuum identified in the left bay of the auxiliary spillway (ASW) between approximately elevations (El.) 300 and 310 feet classifies primarily as clayey to silty sands (SC/SM) on the basis of limited laboratory gradation testing supplemented by field visual-manual classification of samples recovered.

Published geologic mapping indicates the Oakville Sandstone Formation underlies Escondido Creek 4, and is described as being composed of interbedded sand and clay layers. The encountered sand lense within the Residuum (derived from in-place weathering of the Oakville Sandstone) is consistent with those descriptions.

Strength Testing

A summary of the strength test results is provided in **Table 2**. Strength testing included 12 unconfined compression (UC) tests on relativey undisturbed Shelby tube samples to estimate the strength of in-situ materials, and 3 UC tests on remolded samples of the proposed borrow source materials to estimate the strength of Proposed Fill. The remolded samples were compacted to approximately 95% of maximum dry density at a +2% of optimum moisture content relative to Standard Proctor results for each tested sample to simulate typical compaction specifications for earthfill.

The resulting undrained shear strengths (Su) on relatively undisturbed samples generally ranged from 1,110 to 12,400 psf (average 4,555 psf), which are consistent with stiff to hard cohesive soils. The exceptions are two tests with unexpectedly low Su values of 520 and 630 psf (i.e., medium stiff cohesive soils) performed on samples of Residuum obtained from depths of 10 and 23 feet bgs, respectively. The two low results were performed on samples which had pocket penetrometer readings of 4.5+ tsf (i.e., hard cohesive soil), which suggests possible sample defects (e.g., crack, fissure, etc.) may have contributed the relatively lower UC strengths. Post-test photographs of the samples were not available from the testing laboratory to confirm the presence of suspected sample defects. Note that only one of the UC tests was performed on samples of the Sandy Alluvium, and the other 11 tests were performed on samples of Residuum.

The Su values on remolded samples of the proposed borrow material ranged from 1,530 to 1,930 psf (average 1,730 psf), consistent with stiff cohesive soils. Note that one of the remolded samples classified as clayey sand (SC) with fines content of 45%, but the measured Su of 1,730 psf indicates shear behavior is controlled by the plastic fines fraction of the sample rather than the sand fraction.

Moisture-Density Testing (Standard Proctor)

The results of Standard Proctor testing on three composite samples composed of bulk samples recovered from the top 5 feet of the spillway channels 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 (e.g., include spillway channel grading).

Dispersion Testing

The dispersion test results summary is provided in **Table 4**, and includes comparison of results from crumb and double-hydrometeter test methods where available. No pinhole tests were performed.

Four samples in the Residuum classified as dispersive to highly dispersive based on the crumb test (Grades 3 and 4). Confirmatory double-hydrometer tests were performed on these sample – one sample was non-dispersive, two were intermediate, and one was dispersive indicating dispersive pcokets of residuum material. However, each of these samples were recovered from depths greater than 5 feet, and thus would not be directly exposed to surface water flow resulting from precipitation and/or auxiliary spillway flows. Results of 5 other crumb tests in the Residuum classified it as non-dispersive to intermediate (Grade 1 and 2). Two double-hydrometer tests were performed on samples of Residuum within the top 5 feet which had crumb tests indicating intermediate dispersion (Grade 2); less than 30% dispersion was reported in both of the double-hydrometer tests and thus confirmed the non-dispersive classification of the crumb test in those instances.

Each of the other 3 crumb tests performed in the Undifferentiated Clayey Fill / Alluvium and Sandy Alluvium, (plus 3 of the Residuum crumb tests representative of the Proposed Earthfill borrow material) resulted in Grade 1 (non-dispersive). Three additional double-hydrometer tests completed in the composite samples representative of the Proposed Earthfill (Residuum source) each resulted in less than 10% dispersion (i.e., non-dispersive).

Corrosivity Testing

Corrosivity testing was completed on the three composite bulk samples representative of the borrow material under consideration for use in a potential dam rehabilitation. Testing included the test methods listed below, and results are reported as minimum – maximum (average). Published thresholds for aggressive (corrosive) soil generally include pH values less than 5 or greater than 9, 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): 7.6 – 7.9 (7.7)
- Electrical resistivity (ASTM G187): 1,830 – 5,020 (3,557) ohm-cm
- Soluble Sulfates (ASTM C1580): 160 – 1,480 (607) ppm
- Soluble Chlorides (ASTM D512): 280 – 460 (353) ppm

Borrow Assessment

Based on the test results presented above, excavations in the ASWs are likely to produce a suitable borrow source of earthfill for an embankment raise and/or spillway grading. However, the presence of some higher plasticity clays may 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 (i.e., generally less than 3,000 ppm). Note that the corrosivity test results (specifically sulfate content and chloride content) indicates the proposed fill could be corrosive to buried metal and concrete, and corrosion protection measures may need to be considered for such elements in final design for dam rehabilitation.

Note that additional on-site borrow sources may be needed to provide a sufficient volume of required earthfill for proposed dam rehabilitation alternatives. Sampling and testing of other candidate borrow areas were not performed as part of this scope.

Conclusions and Recommendations

Several crumb test results on samples of Residuum indicated potentially dispersive soils. Final design investigations for dam rehabilitation should perform additional sampling and confirmatory testing using pinhole or double-hydrometer methods to further evaluate the potential for dispersive soils at the site. Dispersive soils are highly erodible when subjected to surface water flows (e.g. auxiliary spillway), and present an elevated risk of internal erosion ("piping") when subjected to seepage flows.

Samples of existing embankment or foundation materials were not collected during the geologic investigation, and thus no testing of these materials were conducted. Sampling and testing of these materials should be performed as part of final design investigations for dam rehabilitation.

Additional on-site borrow sources may need to be identified, sampled, and tested as part of final dseign investigations to provide a sufficient volume of earthfill required for dam rehabilitation alternatives.

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 Mariana Jaimes or Lance Finnefrock.

Yours Sincerely,



Mariana Jaimes, P.E.
Geotechnical Engineer
AECOM
M: 703.474.6778
E: mariana.sa@aecom.com

Lance Finnefrock, P.E., G.E.
Senior Geotechnical Engineer
AECOM
M: 512.413.7269
E: lance.finnefrock@aecom.com

Tables and Attachments:

Table 1	Index Test Results Summary
Table 2	Soil Strength Test Results Summary
Table 3	Proposed Fill Strength Test Results Summary
Table 4	Dispersion Test Results Summary
Attachment 1	Geotechnical Laboratory Testing Results

Table 1 – Index Test Results Summary[1]

Stratum Description	Thickness (ft)	USCS	Dry Unit Weight (pcf)	LL	PI	LI	Fines Content (%)	CF (%)
Undifferentiated Clayey Fill/ Alluvium	2 - 10	CL, CH	110	40 - 54 (46)	28 - 31 (29)	-0.43 to +0.32 (-0.14)	50 - 86 (60)	--- [2]
Sandy Alluvium	2 - 15	SC, SM	109 - 115	30 - 47 (37)	17 - 29 (23)	-0.45 to -0.28 (-0.34)	26 - 48 (39)	20
Residuum	7 – 25+	CL, CH	83 - 120 (98)	32 - 66 (53)	15 - 44 (32)	-0.41 to +0.52 (+0.11)	58 - 85 (74)	37
Sand Lense within Residuum	5 - 7	SC-SM	--- [2]	40	25	-0.08	33	--- [2]
Proposed Fill (ASW Borrow) [3]	TBD	CH	98 - 113 (104) [4]	35 - 57 (48)	20 - 37 (30)	-0.20 to +0.09 (+0.04)	36 - 82 (58)	31

Notes:

(1) Format of reported values is Minimum – Maximum (Average). Average value not reported when two or fewer results are available.
(2) No tests performed.
(3) Proposed Fill materials collected from the upper 5± feet of the ASW channel.
(4) Reported results reflect the maximum dry density from Standard Proctor testing.

Table 2 – Soil Strength Test Results Summary

Boring ID	Depth		Field USCS	Lab USCS	Stratum	LL	PI	FC (%)	UC Test (undisturbed sample at natural moisture)			
	Top	Bottom							WCn (%)	DDn (pcf)	TD (pcf)	Su (psf)
201-23	2	4	CL	CH	Residuum	66	44	70	16	112	130	12,400
201-23	10	12	CL	CH	Residuum	57	36	83	26	94	118	520
201-23	12	13	CL	CH	Residuum	53	36	85	24	96	119	4,340
202-23	12	14	CH	CH	Residuum	59	39	77	17	110	128	3,710
202-23	18	20	CH	CL	Residuum	40	15	58	29	87	113	1,530
203-23	10	11	CH	CH	Residuum	65	44	85	18	107	127	1,890
203-23	23	25	CL	CH	Residuum	52	34	58	35	83	111	630
203-23	30	32	CL	CH	Residuum	57	35	78	35	84	113	1,780
204-23	0	2	SM	CL	Residuum	40	28	61	9	110	120	9,660
204-23	8	10	CL	CL	Residuum	44	25	77	32	86	113	3,500
205-23	0	2	ML	SC	Sandy Alluvium	39	25	48	7	109	117	5,640
205-23	18	19	CL	CH	Residuum	50	22	70	34	84	112	1,110
Comp A	0	5	Bulk	CH	Proposed Fill (Remolded)	57	37	82	19*	98*	117*	1,930
Comp B*	0	5	Bulk	CH	Proposed Fill (Remolded)	51	32	63	22*	102*	124*	1,530
Comp C*	0	5	Bulk	SC	Proposed Fill (Remolded)	35	20	45	11*	113*	126*	1,730
Average						**51**	**31**	**69**	**22**	**98**	**119**	**3460**

Notes:

Abbreviations: FC = Fines content (percent passing #200 sieve); Wcn = Natural water content; DDn = Natural dry density; TD = Total Density and Su = Undrained shear strength

* WC, DD, and TD are from the remolded UC samples

Table 3 –Standard Proctor Test Results Summary

Composite Sample ID	Borings	Sample IDs	Depth (ft bgs)	Stratum (Borrow Source)	USCS	LL	PI	FC (%)	Standard Proctor	
									Opt. WC (%)	Max. DD (pcf)
COMP-A	201-23	G-2	3 – 5	Proposed Fill (Residuum)	CH	57	37	82	16.5	106.0
	202-23	G-1 & G-2	0 – 5							
COMP-B	203-23	G-1 & G-2	0 – 5	Proposed Fill (Residuum)	CH	51	32	63	17.2	104.3
	205-23	G-1 & G-2	0 – 5							
COMP-C	204-23	G-1 & G-2	0 - 5	Proposed Fill (Residuum)	SC	35	20	45	16.3	106.4
Average						**52**	**33**	**63**	**16.7**	**105.7**

Table 4 – Dispersion Test Results Summary

Boring / Sample ID	Depth (ft bgs)	Stratum	Field USCS	Lab USCS	Dispersion	
					Crumb Test Grade	Double Hydrometer (%)
201-23	0	Undifferentiated Clayey Fill/ Alluvium	OL	-	1	-
201-23	4	Residuum	CL	-	2	9.7
201-23	18.5	Residuum	CH	-	4	72.5
202-23	4	Residuum	CL	-	2	27.6
202-23	8	Residuum	CH	-	3	32.6
202-23	12	Residuum	CH	CH	2	-
203-23	2	Sandy Alluvium	ML	-	1	-
203-23	23	Residuum	CL	CH	4	43.7
204-23	8	Residuum	CL	CL	3	23.2
204-23	13	Residuum	CL	-	1	-
205-23	2	Sandy Alluvium	ML	-	1	-
205-23	13.5	Residuum	CL	-	1	-
COMP-A	0-5	Proposed Fill (Residuum)	CH	-	1	7.1
COMP-B	0-5	Proposed Fill (Residuum)	CH	-	1	6.7
COMP-C	0-5	Proposed Fill (Residuum)	SC	-	1	6.4

Attachment 1 – Laboratory Test Results

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

September 19, 2024
Arias Job No. 2023-135

Via Email: Charles.Krolikowski@aecom.com

Mr. Charlie Krolikowski, P.E.
AECOM
13640 Briarwick Drive, Suite 200
Austin, TX 78729

RE: Geotechnical Data Report
Escondido Creek Watershed FRS No. 4
Karnes County, TX

Project Information

We understand that AECOM is assisting SARA with the Improvement of an 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 for Dam 4 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

Five (5) 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.

The 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 the final data report. The following tests were performed in general 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 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)

The summary of the results is appended with this letter.

Sincerely,

9/19/2024

ARIAS & Associates, Inc.
TBPE Registration No: F-32

Sandeep K. Malla, P.E
Geotechnical Engineer



Mark J. O'Connor, P.E.
Senior Geotechnical Engineer

LABORATORY TEST SUMMARY

PROJECT: Escondido FRS No. 4
PROJECT LOCATION: Southwest of Karnes City, Texas
AECOM / JOB NO.: 60707401
PROJECT MANAGER: L. Finnefrock

Provided by AECOM				D4318			D1140	D2216	D7263	D6913	D854	D6913 & D7928	D2974	D2166	D4767	D6572	D4221	G51	G200	D152	C1580	G187	D698	
BORING No.	SAMPLE No.	DEPTH (feet)		INDEX TESTS										SOIL STRENGTH TESTS		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**	CU TRIAXIAL	CRUMB TEST**	DISP. OF CLAY BY DOUBLE HYDRO.**	pH	REDOX	CHLORIDE	SULFATE	RESISTIVITY	Maximum Dry Density**	Optimum Moisture Content**
				LL	PL	PI	%	%	pcf				%	tsf		Grade	% Dispersion		milivolts	mg/kg	ppm	ohms-cm	lb/ft^3	%
201-23	SS-1	0.0	1.5	46	18	28		6					4.2			1								
	ST-2	2.0	4.0	66	22	44	70	16	112.3					12.4	--									
	P-3	4.0	6.0	61	21	40		17	107.7							2	9.7							
	SS-4	6.0	7.5					24																
	P-5	8.0	10.0					28																
	ST-6	10.0	12.0	57	21	36	83	26	93.5					0.52										
	ST-7	12.0	13.0	53	17	36	85	24	96.1					4.34										
	SS-8	15.0	16.5					22																
	SS-9	18.5	20.0	34	15	19		17								4	72.5							
	SS-10	23.5	25.0					20																
	G-1	0.0	3.0																					
	G-2	3.0	5.0																					
202-23	ST-1	0.0	2.0	*	*	*									--									
	SS-2	2.0	3.5	59	16	43	86	9																
	P-3	4.0	6.0	32	15	17		8	119							2	27.6							
	SS-4	6.0	7.5				77	12		**														
	P-5	8.0	10.0					12	119.6							3	32.6							
	SS-6	10.0	11.5					18																
	ST-7	12.0	14.0	59	20	39	77	17	109.6					3.71		2								
	P-8	14.0	16.0					29																
	ST-9	18.0	20.0	40	25	15	58	29	87.3					1.53										
	SS-10	23.5	25.0					17																
	SS-11	28.5	30.0					26																
	G-1	0.0	3.0																					
	G-2	3.0	5.0																					

LABORATORY TEST SUMMARY

PROJECT: Escondido FRS No. 4
PROJECT LOCATION: Southwest of Karnes City, Texas
AECOM / JOB NO.: 60707401
PROJECT MANAGER: L. Finnefrock

Provided by AECOM				D4318			D1140	D2216	D7263	D6913	D854	D6913 & D7928	D2974	D2166	D4767	D6572	D4221	G51	G200	D152	C1580	G187	D698	
BORING No.	SAMPLE No.	DEPTH (feet)		INDEX TESTS										SOIL STRENGTH TESTS		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**	CU TRIAXIAL	CRUMB TEST**	DISP. OF CLAY BY DOUBLE HYDRO.**	pH	REDOX	CHLORIDE	SULFATE	RESISTIVITY	Maximum Dry Density**	Optimum Moisture Content**
				LL	PL	PI	%	%	pcf				%	tsf		Grade	% Dispersion		milivolts	mg/kg	ppm	ohms-cm	lb/ft^3	%
203-23	SS-1	0.0	1.5	45	17	28	57	7																
	P-2	2.0	4.0	47	18	29		8	114.8							1								
	SS-3	4.0	5.5				45	7																
	P-4	6.0	7.5	35	15	20		6		*														
	SS-5	8.0	9.5				28	3		**														
	ST-6	10.0	11.0	65	21	44	85	18	107.2					1.89	--									
	P-7	12.0	14.0					12																
	SS-8A	14.0	14.3					18																
	SS-8B	14.3	15.5	40	15	25	64	13		**														
	SS-9A	20.0	20.7				33	16		**														
	SS-9B	20.7	21.5					26																
	ST-10	23.0	25.0	52	18	34	58	35	82.5					0.63		4	43.7							
	ST-11	25.0	26.0																					
	ST-12	30.0	32.0	57	22	35	78	35	83.6					1.78										
	SS-13	33.5	35.0					27																
	SS-14	38.5	40.0	59	23	36		30																
	G-1	0.0	3.0				36																	
	G-2	3.0	5.0																					
204-23	ST-1	0.0	2.0	40	12	28	61	9	109.8	**				9.66										
	SS-2	2.0	3.5				50	5																
	P-3	4.0	6.0				50	29		**														
	ST-4	6.0	8.0	54	23	31	54	33							--									
	ST-5	8.0	10.0	44	19	25	77	32	85.7			**		3.5		3	23.2							
	SS-6	10.0	11.5					22																
	P-7	13.0	15.0					34	87.3							1								
	SS-8	18.5	20.0					27																
	G-1	0.0	3.0																					
	G-2	3.0	5.0																					

LABORATORY TEST SUMMARY

PROJECT: Escondido FRS No. 4
PROJECT LOCATION: Southwest of Karnes City, Texas
AECOM / JOB NO.: 60707401
PROJECT MANAGER: L. Finnefrock

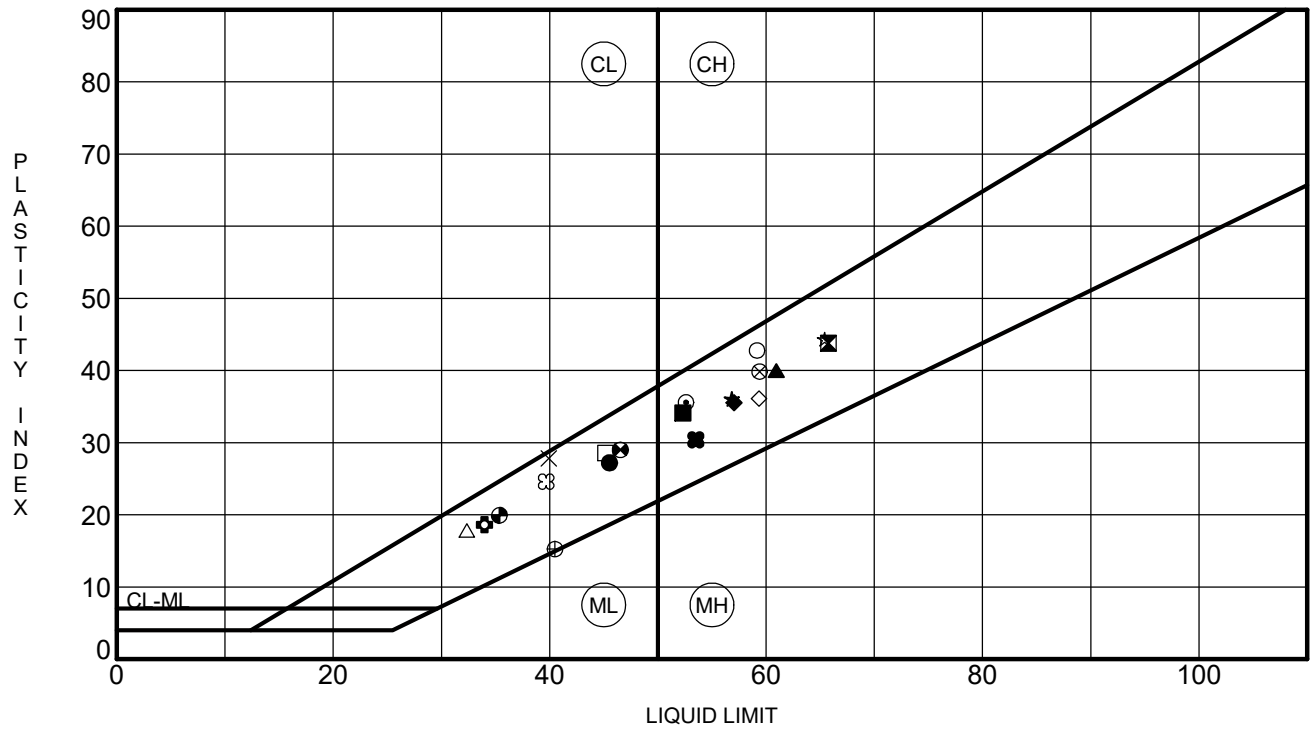
Provided by AECOM				D4318			D1140	D2216	D7263	D6913	D854	D6913 & D7928	D2974	D2166	D4767	D6572	D4221	G51	G200	D152	C1580	G187	D698	
BORING No.	SAMPLE No.	DEPTH (feet)		INDEX TESTS										SOIL STRENGTH TESTS		DISPERSION**		CORROSIVITY SUITE					BULK TESTS (STANDARD PROCTOR)**	
		Top	Bottom	ATTERBERG LIMITS (3 pt)**			Wash #200 SIEVE**	MOISTURE CONTENT	DRY UNIT WEIGHT	SIEVE THROUGH #200	SPECIFIC GRAVITY	SIEVE + HYDROMETER	ORGANIC CONTENT	UNCONFINED COMPRESSION**	CU TRIAXIAL	CRUMB TEST**	DISP. OF CLAY BY DOUBLE HYDRO.**	pH	REDOX	CHLORIDE	SULFATE	RESISTIVITY	Maximum Dry Density**	Optimum Moisture Content**
				LL	PL	PI	%	%	pcf				%	tsf		Grade	% Dispersion		milivolts	mg/kg	ppm	ohms-cm	lb/ft^3	%
205-23	ST-1	0.0	2.0	39	14	25	48	7	109.4					5.64										
	SS-2	2.0	3.5				47	5				**				1								
	ST-3	4.0	6.0	30	13	17	32	8																
	P-4	6.0	8.0				26	9		**														
	ST-5	8.0	9.0					6																
	SS-6	9.0	10.5	36	13	23	44	6		**														
	SS-7	13.5	15.0					26								1								
	ST-8	18.0	19.0	50	28	22	70	34	83.7					1.11										
	SS-9	19.0	20.5					31																
	G-1	0.0	3.0																					
	G-2	3.0	5.0																					
COMP A	201-23 (G-2) and 202-23 (G-1 & G-2)			57	20	37	82	19	97.9		2.615			1.93		1	7.1	7.58	4.8	320	180	5020	106	16.5
COMP B	203-23 (G-1 & G-2) and 205-23 (G-1 & G-2)			51	19	32	63	22	101.9		2.634			1.53		1	6.7	7.79	5.2	280	1480	3820	104.3	17.2
COMP C	204-23 (G-1 & G-2)			35	15	20	45	11	113.1		2.62			1.73		1	6.4	7.87	4.9	460	160	1830	106.4	16.3

* Not Sufficient Material

** See Attached Graph

-- Broken samples recovered during extraction/ Sample just enough to run one test

ATTERBERG LIMIT RESULTS



Boring		Depth	LL	PL	PI	Fines	Classification
●	201-23	0.0	46	18	28		
⊠	201-23	2.0	66	22	44	70	SANDY FAT CLAY (CH)
▲	201-23	4.0	61	21	40		
★	201-23	10.0	57	21	36	83	FAT CLAY with SAND (CH)
⊙	201-23	12.0	53	17	36	85	FAT CLAY with SAND (CH)
✿	201-23	18.5	34	15	19		
○	202-23	2.0	59	16	43	86	FAT CLAY (CH)
△	202-23	4.0	32	15	17		
⊗	202-23	12.0	59	20	39	77	FAT CLAY with SAND (CH)
⊕	202-23	18.0	40	25	15	58	SANDY LEAN CLAY with GRAVEL (CL)
□	203-23	0.0	45	17	28	57	SANDY LEAN CLAY (CL)
❁	203-23	2.0	47	18	29		
◕	203-23	6.0	35	15	20		
☆	203-23	10.0	65	21	44	85	FAT CLAY (CH)
⊠	203-23	14.3	40	15	25	64	SANDY LEAN CLAY (CL)
■	203-23	23.0	52	18	34	58	SANDY FAT CLAY (CH)
◆	203-23	30.0	57	22	35	78	FAT CLAY with SAND (CH)
◇	203-23	38.5	59	23	36		
×	204-23	0.0	40	12	28	61	SANDY LEAN CLAY (CL)
✖	204-23	6.0	54	23	31	54	SANDY FAT CLAY (CH)

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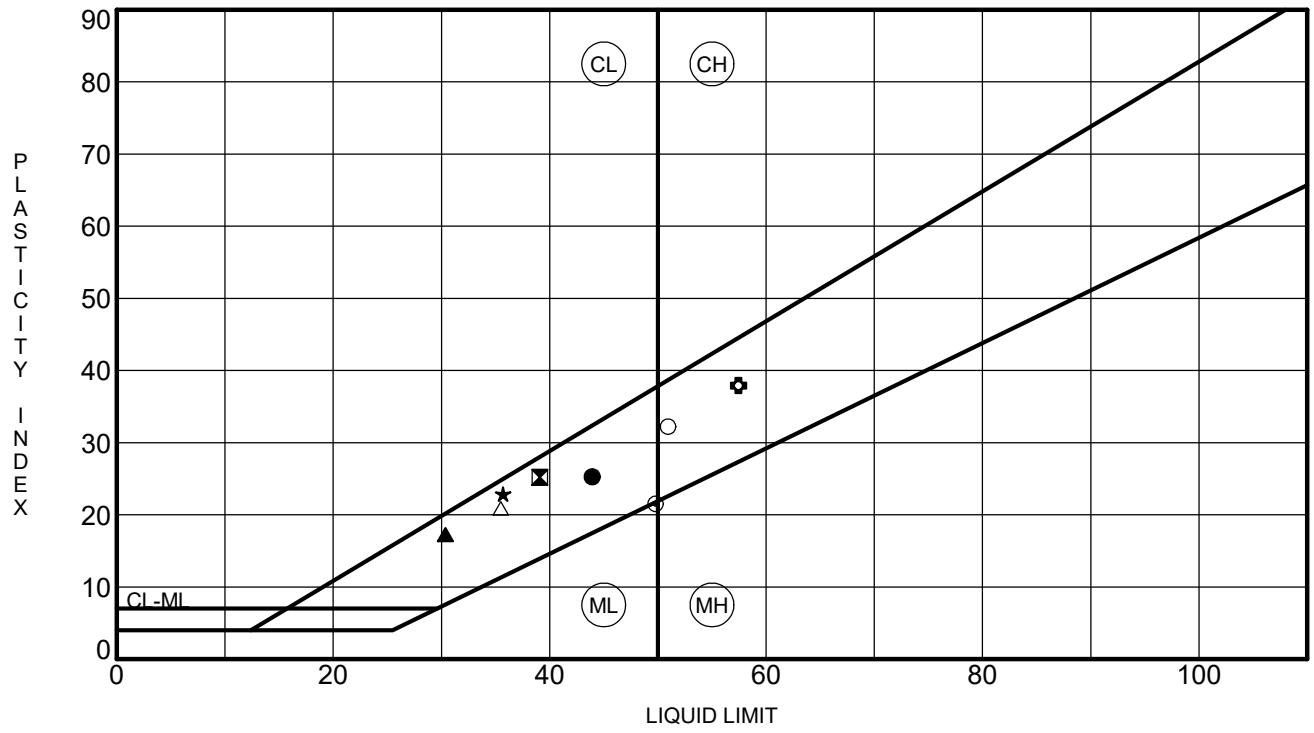
ATTERBERG LIMITS RESULTS

Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/25/23 (ATTERBERG LIMITS SUMMARY GRAPH,US_LAB.GDT,LIBRARY2023.GLB)



Boring		Depth	LL	PL	PI	Fines	Classification
●	**204-23**	**8.0**	**44**	**19**	**25**	**77**	**LEAN CLAY with SAND (CL)**
⊠	**205-23**	**0.0**	**39**	**14**	**25**	**48**	**CLAYEY SAND (SC)**
▲	**205-23**	**4.0**	**30**	**13**	**17**	**32**	**CLAYEY SAND (SC)**
★	**205-23**	**9.0**	**36**	**13**	**23**	**44**	**CLAYEY SAND (SC)**
⊙	**205-23**	**18.0**	**50**	**28**	**22**	**70**	**FAT CLAY with SAND (CH)**
✿	**COMP A**	**0.0**	**57**	**20**	**37**	**82**	**FAT CLAY with SAND (CH)**
○	**COMP B**	**0.0**	**51**	**19**	**32**	**63**	**SANDY FAT CLAY (CH)**
△	**COMP C**	**0.0**	**35**	**15**	**20**	**45**	**CLAYEY SAND (SC)**

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ATTERBERG LIMITS RESULTS

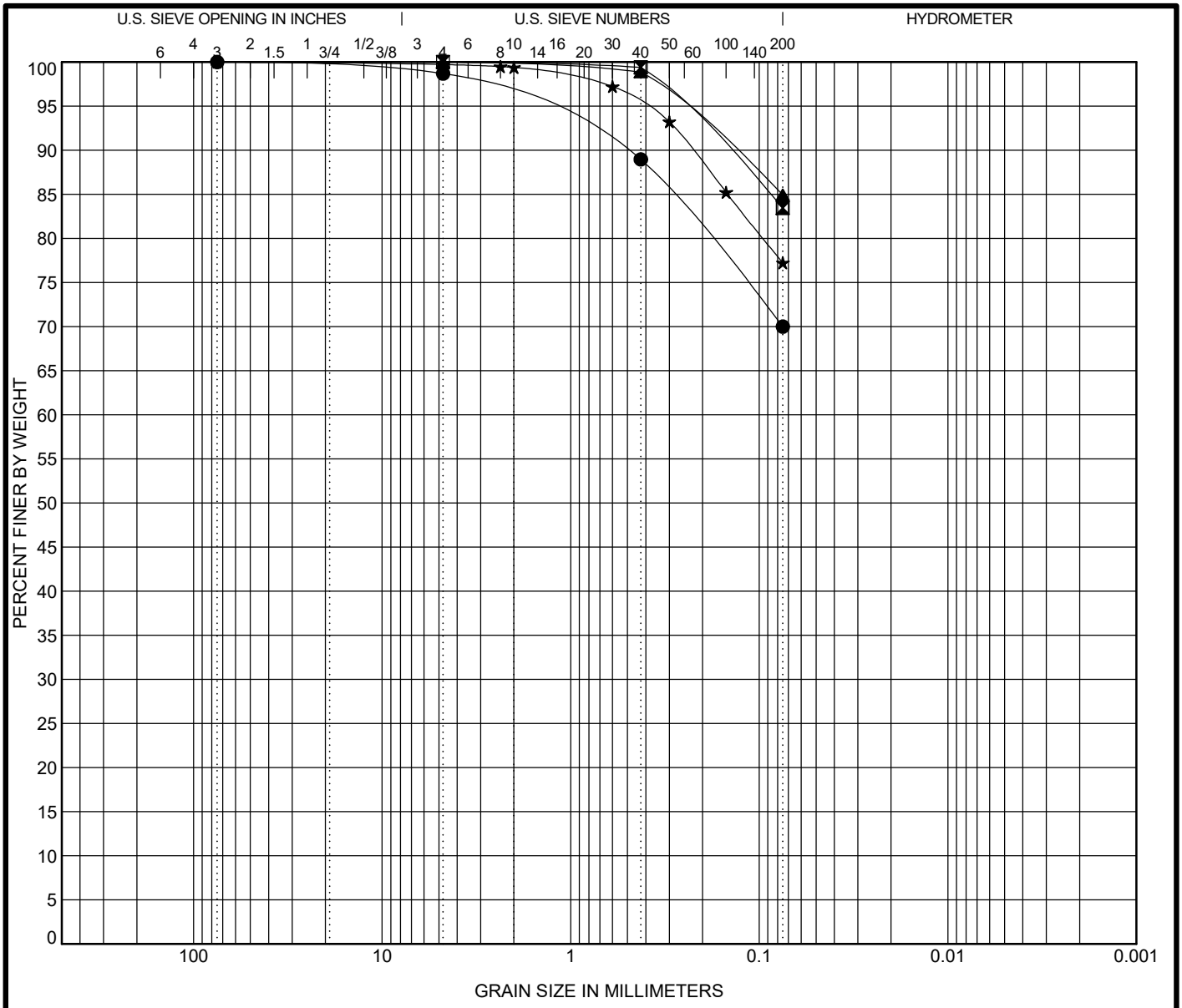
Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/25/23 (ATTERBERG LIMITS SUMMARY GRAPH.US_LAB.GDT.LIBRARY2023.GLB)

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		2.0	SANDY FAT CLAY (CH)	66	22	44		
⊠	201-23		10.0	FAT CLAY with SAND (CH)	57	21	36		
▲	201-23		12.0	FAT CLAY with SAND (CH)	53	17	36		
★	202-23		6.0						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	201-23	2.0	75				1.3	28.7	70.0	
⊠	201-23	10.0	4.75				0.0	16.6	83.4	
▲	201-23	12.0	4.75				0.0	15.1	84.9	
★	202-23	6.0	75				0.3	22.5	77.2	

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

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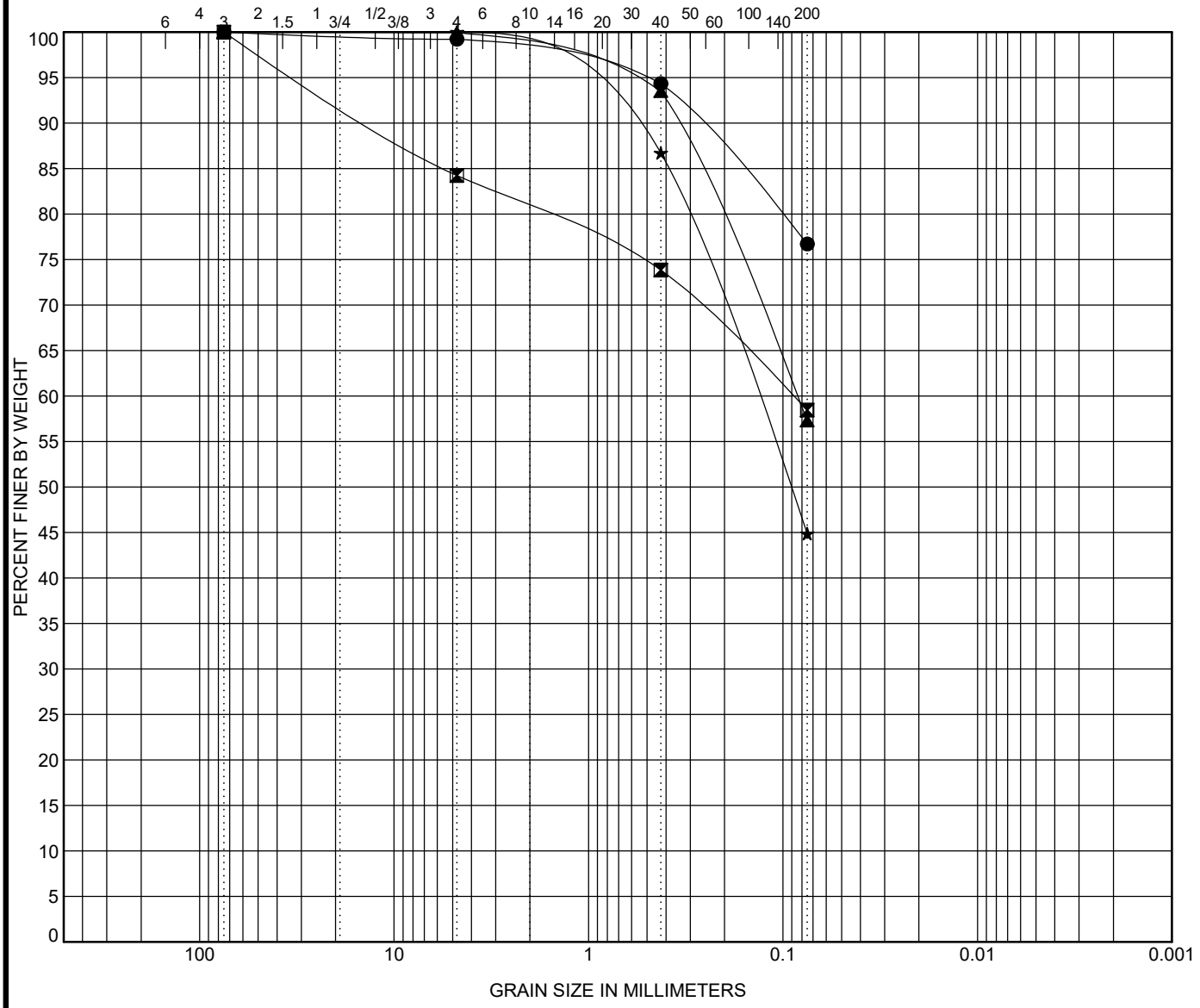
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/12/23 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**202-23**		**12.0**	**FAT CLAY with SAND (CH)**	**59**	**20**	**39**		
⊠	**202-23**		**18.0**	**SANDY LEAN CLAY with GRAVEL (CL)**	**40**	**25**	**15**		
▲	**203-23**		**0.0**	**SANDY LEAN CLAY (CL)**	**45**	**17**	**28**		
★	**203-23**		**4.0**						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**202-23**	**12.0**	**75**				**0.8**	**22.5**	**76.7**	
⊠	**202-23**	**18.0**	**75**	**0.089**			**15.8**	**25.8**	**58.5**	
▲	**203-23**	**0.0**	**75**	**0.086**			**0.0**	**42.7**	**57.3**	
★	**203-23**	**4.0**	**4.75**	**0.14**			**0.0**	**55.1**	**44.9**	

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

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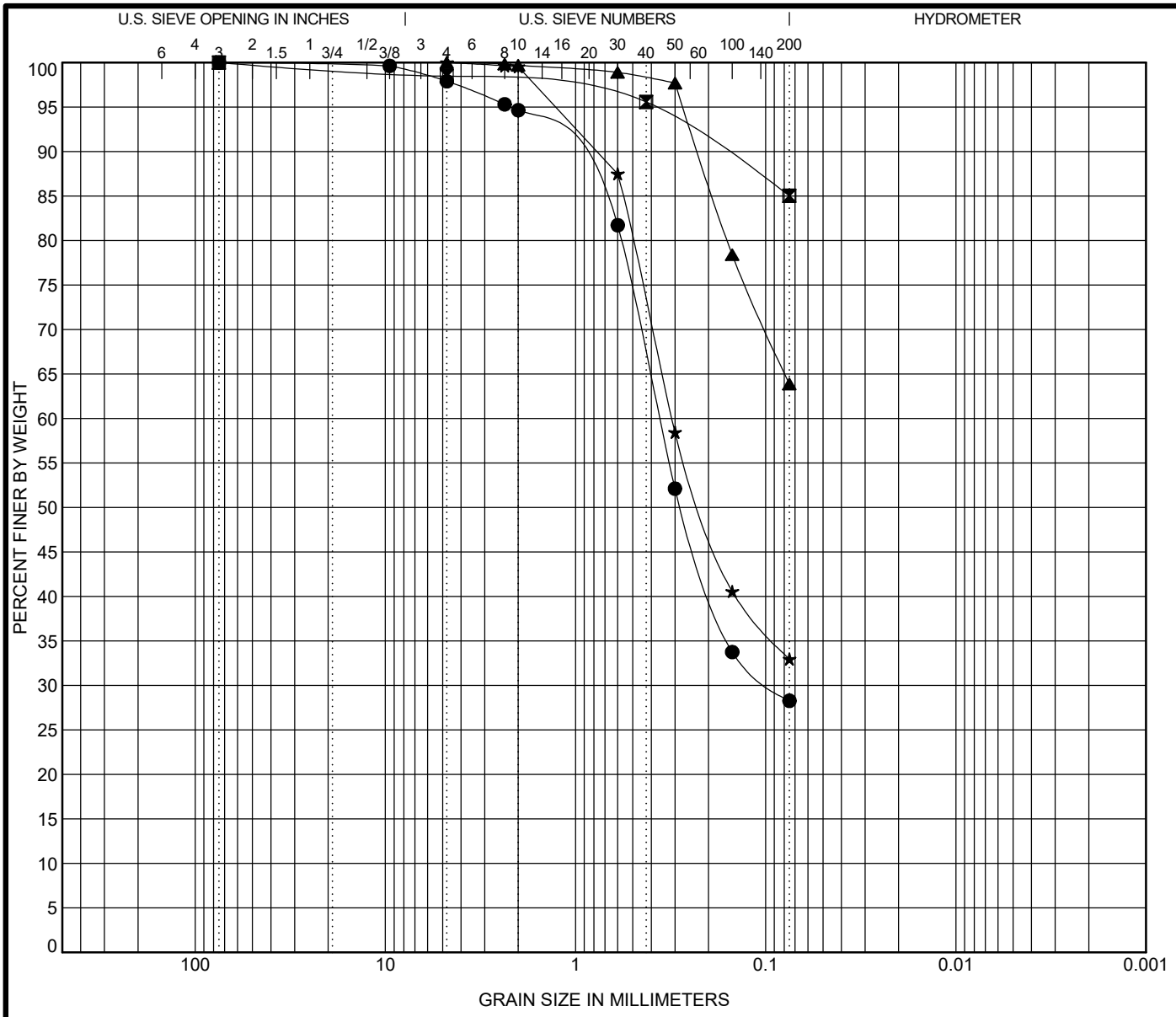
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/12/23 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	203-23		8.0						
⊠	203-23		10.0	FAT CLAY (CH)	65	21	44		
▲	203-23		14.3	SANDY LEAN CLAY (CL)	40	15	25		
★	203-23		20.0						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	203-23	8.0	75	0.361	0.093		2.1	69.6	28.3	
⊠	203-23	10.0	75				1.5	13.5	85.0	
▲	203-23	14.3	4.75				0.0	36.1	63.9	
★	203-23	20.0	4.75	0.311			0.0	67.0	33.0	

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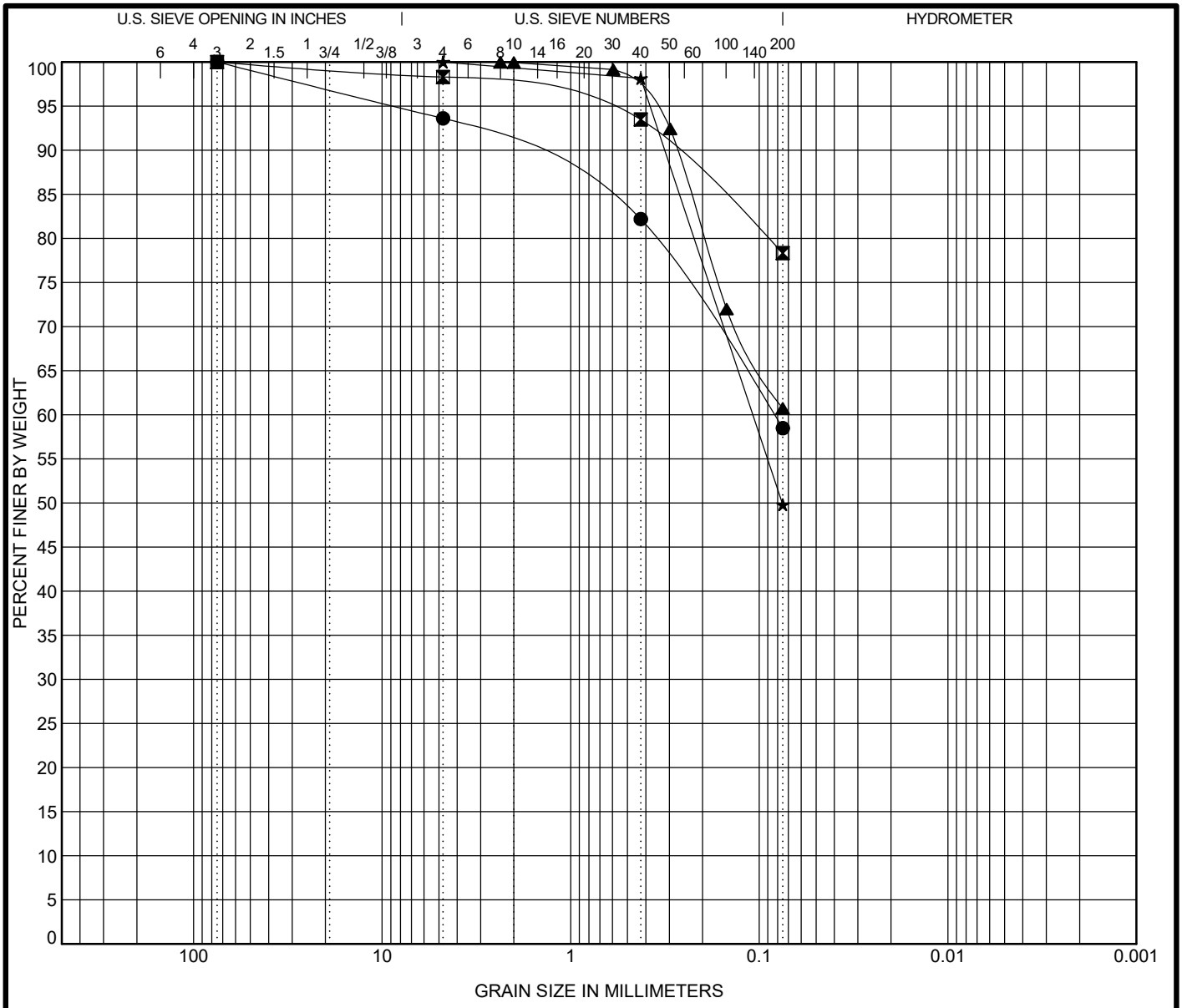
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/12/23 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	203-23		23.0	SANDY FAT CLAY (CH)	52	18	34		
⊠	203-23		30.0	FAT CLAY with SAND (CH)	57	22	35		
▲	204-23		0.0	SANDY LEAN CLAY (CL)	40	12	28		
★	204-23		2.0						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	203-23	23.0	75	0.084			6.4	35.1	58.5	
⊠	203-23	30.0	75				1.7	20.0	78.3	
▲	204-23	0.0	2.36					39.2	60.7	
★	204-23	2.0	4.75	0.108			0.0	50.2	49.8	

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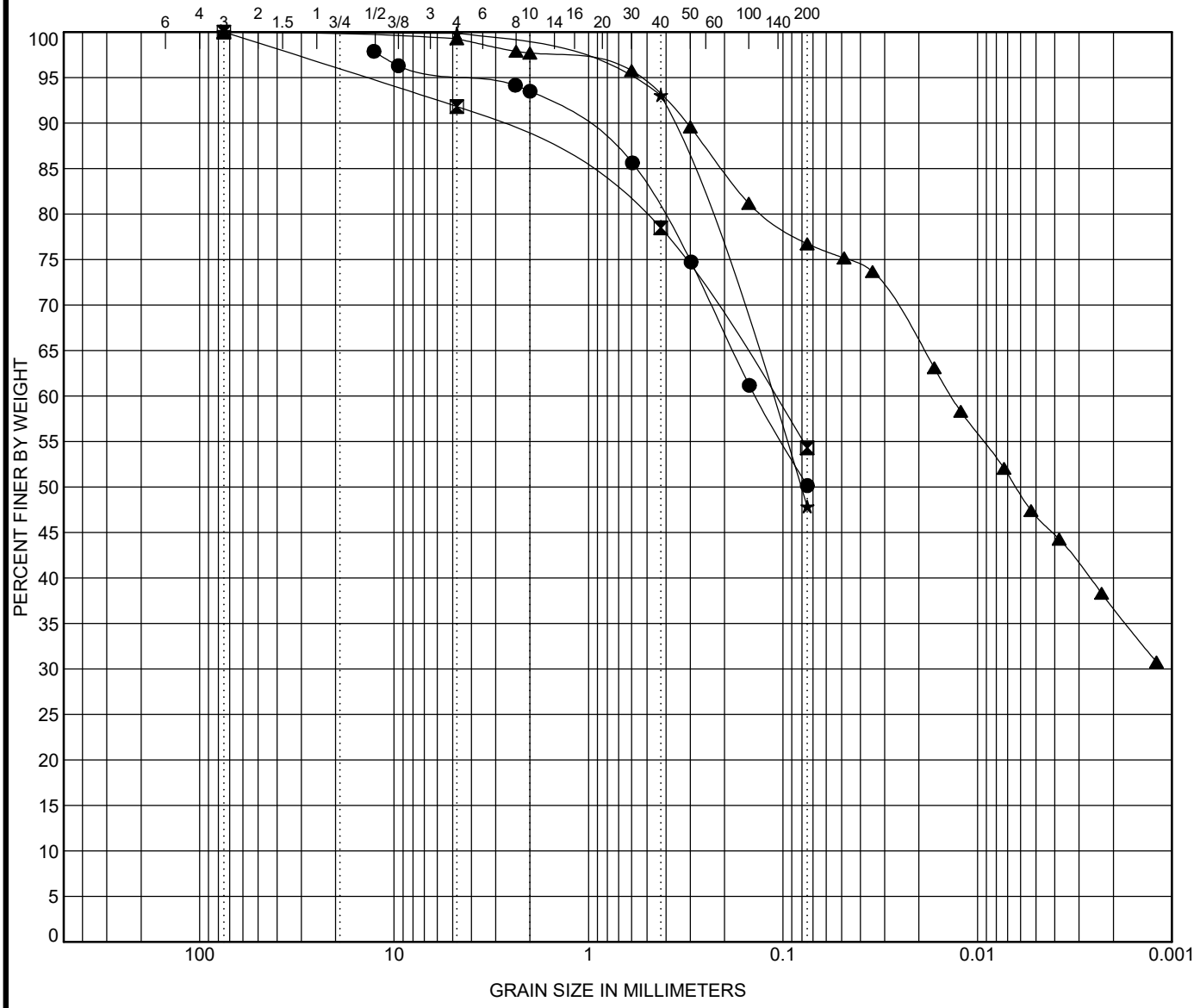
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/12/23 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	204-23		4.0						
⊠	204-23		6.0	SANDY ELASTIC SILT (MH)	52	31	21		
▲	204-23		8.0	ELASTIC SILT with SAND (MH)	57	33	24		
★	205-23		0.0	CLAYEY SAND (SC)	39	14	25		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	204-23	4.0	12.7	0.139			2.7	45.1	50.2	
⊠	204-23	6.0	75	0.113			8.2	37.5	54.3	
▲	204-23	8.0	75	0.014			0.7	22.5	40.0	36.7
★	205-23	0.0	75	0.12			0.1	52.0	47.9	

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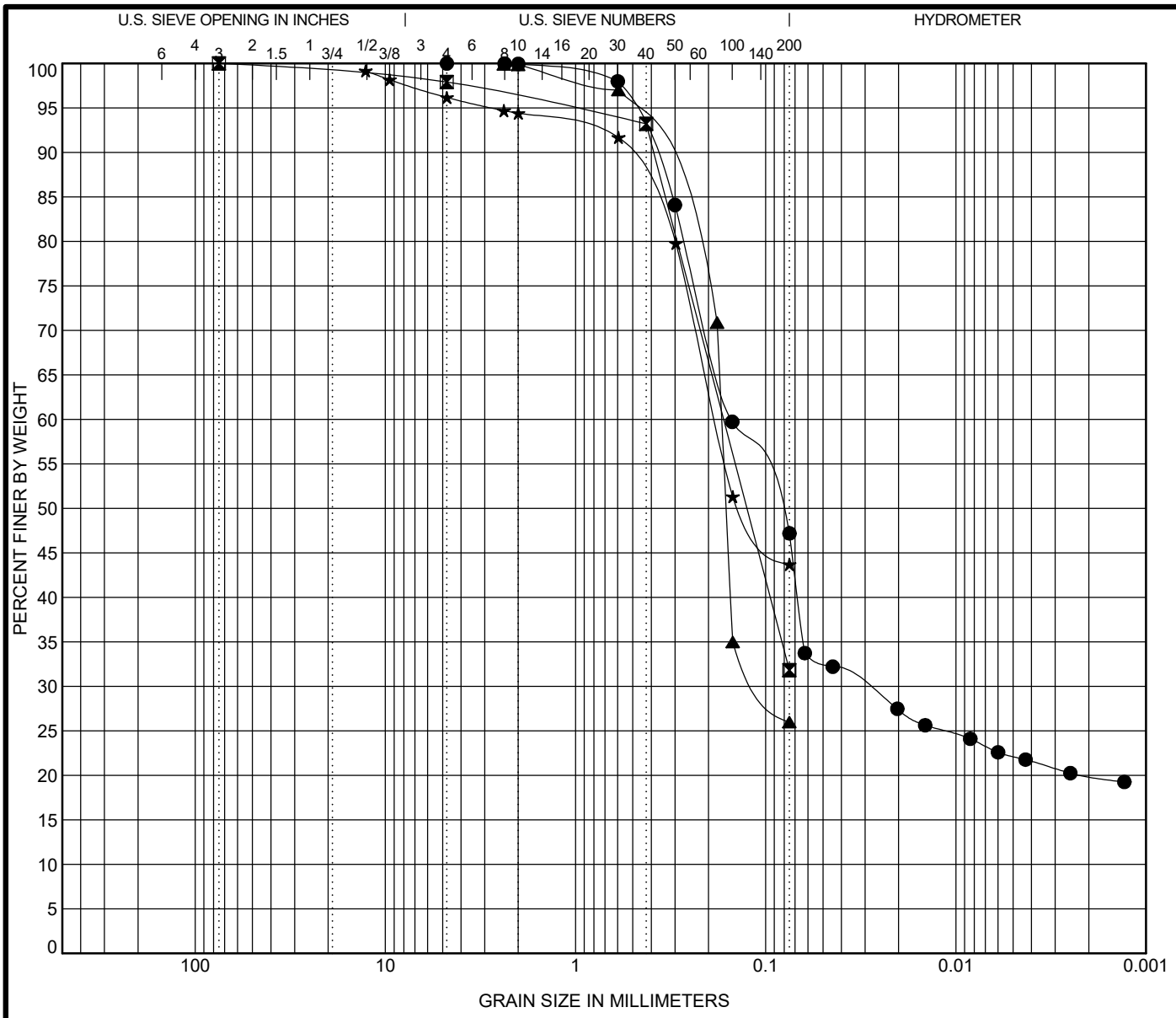
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/12/23 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY 2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	205-23		2.0						
⊠	205-23		4.0	CLAYEY SAND (SC)	30	13	17		
▲	205-23		6.0						
★	205-23		9.0	CLAYEY SAND (SC)	36	13	23		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	205-23	2.0	4.75	0.151	0.031		0.0	52.8	27.3	19.9
⊠	205-23	4.0	75	0.166			2.1	66.1	31.8	
▲	205-23	6.0	2.38	0.17	0.102			73.9	26.0	
★	205-23	9.0	12.7	0.184			3.0	52.5	43.7	

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

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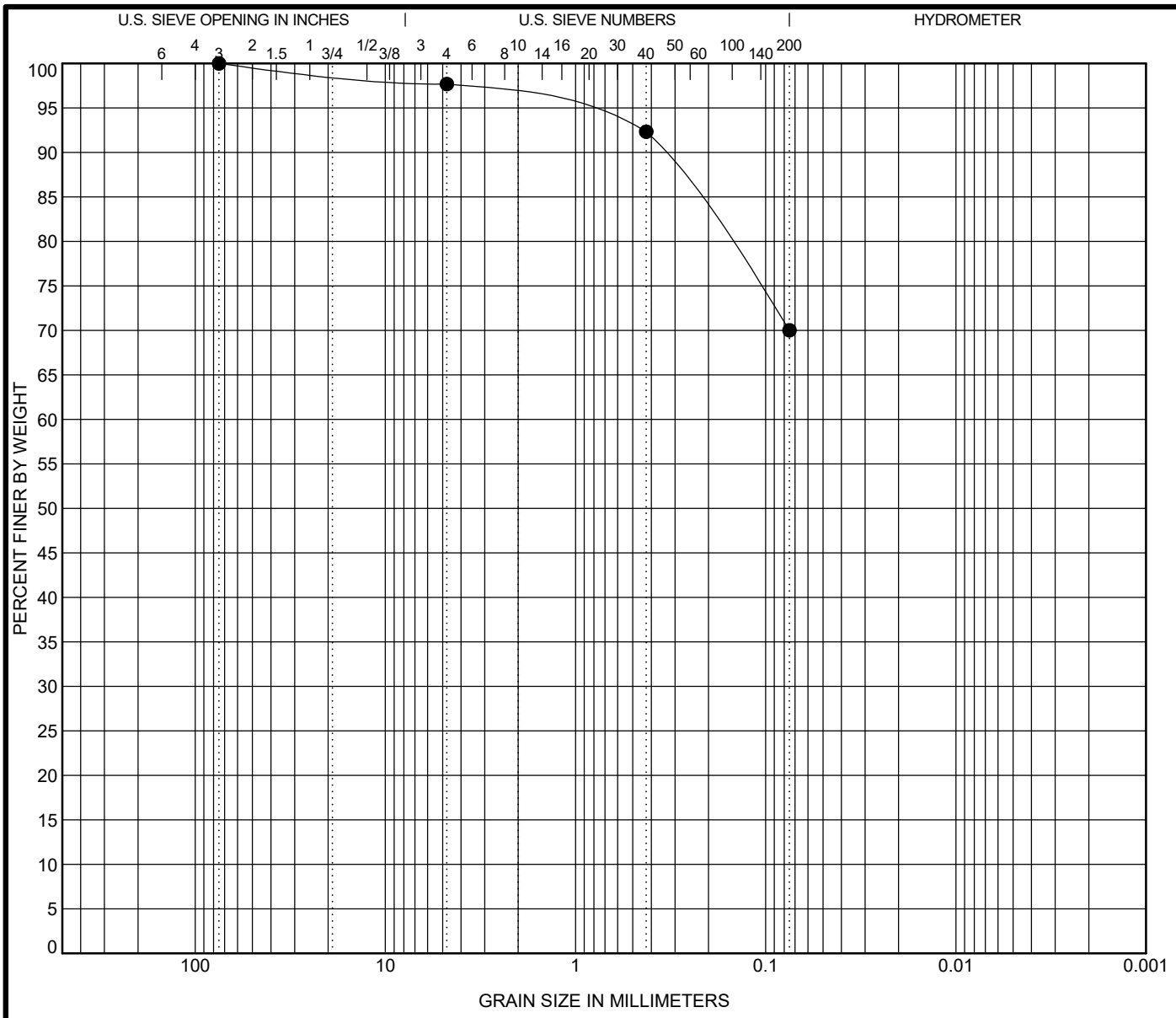
GRAIN SIZE DISTRIBUTION

Project: Escondido FRS 4

Location: See Boring Location Plan

Job No.: 2023-135

GINT.GPJ 10/12/23 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY 2023.GLB)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**205-23**		**18.0**	**FAT CLAY with SAND (CH)**	**50**	**28**	**22**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**205-23**	**18.0**	**75**				**2.3**	**27.7**	**70.0**	

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 4

Location: See Boring Location Plan

Job No.: 2023-135

UNCONFINED COMPRESSION TEST RESULTS

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Unconfined Compressive Strength Test
ASTM D2166

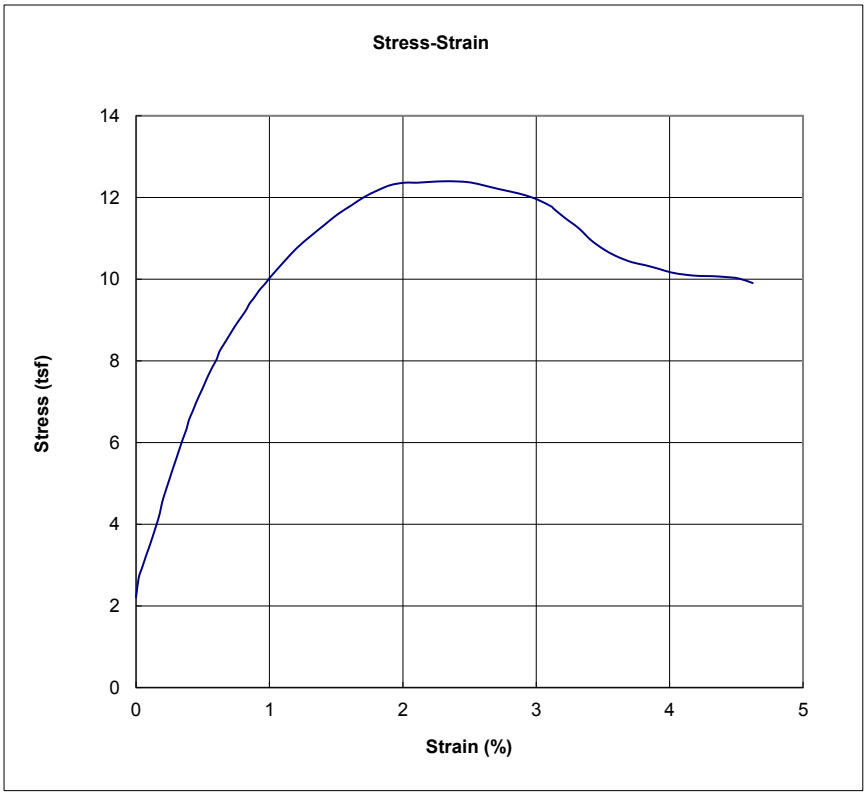
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		201-23
Depth (ft)		2 - 4
Sample Date		8/8/2023
Soil Type		SANDY FAT CLAY (CH)
Specimen Height	inch	5.54
Specimen Diameter	inch	2.77
Moisture Content	%	16.3
Dry Density	pcf	112.3
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	2.31
Failure Stress	tsf	12.4



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Unconfined Compressive Strength Test
ASTM D2166

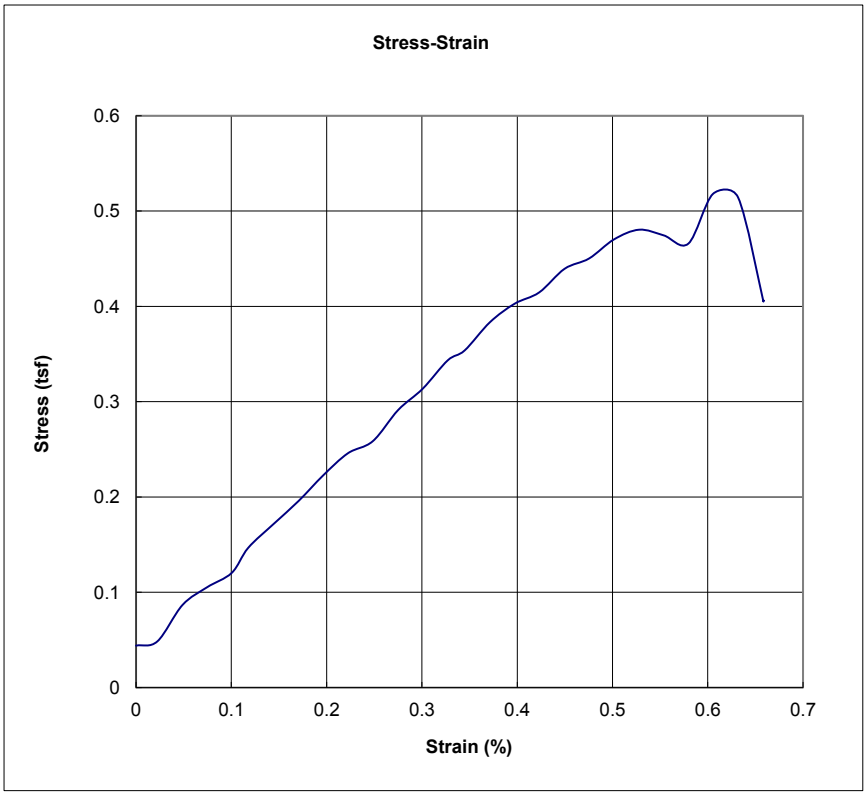
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		201-23
Depth (ft)		10 - 12
Sample Date		8/8/2023
Soil Type		FAT CLAY with Sand (CH)
Specimen Height	inch	5.79
Specimen Diameter	inch	2.77
Moisture Content	%	26.2
Dry Density	pcf	93.46
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	0.61
Failure Stress	tsf	0.52



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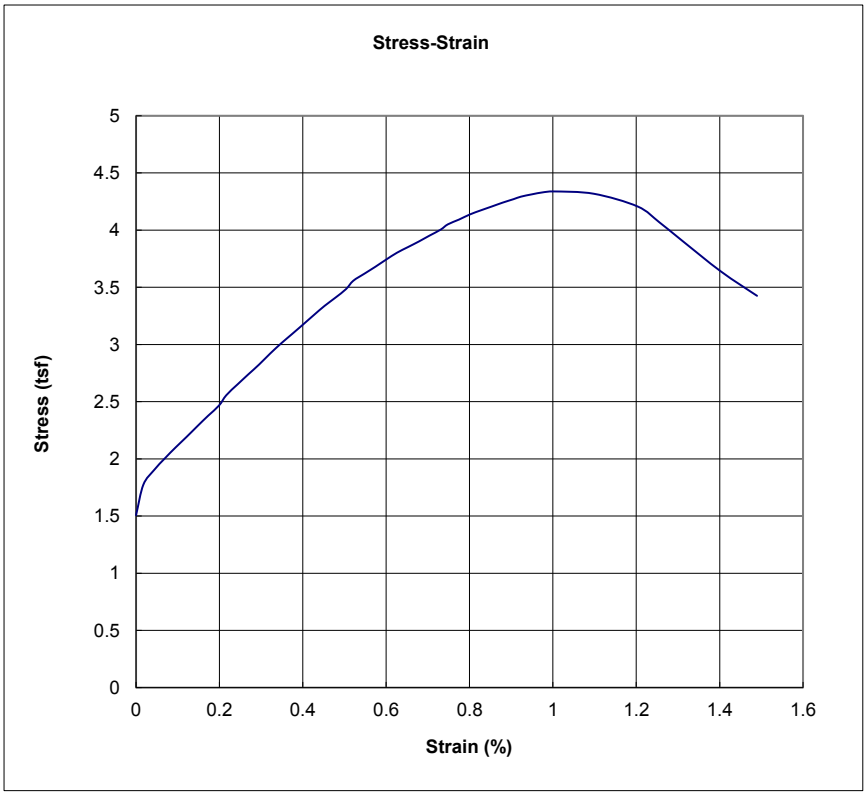
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Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		201-23
Depth (ft)		12 - 13
Sample Date		8/8/2023
Soil Type		FAT CLAY with SAND (CH)
Specimen Height	inch	5.58
Specimen Diameter	inch	2.78
Moisture Content	%	23.5
Dry Density	pcf	96.05
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.00
Failure Stress	tsf	4.34



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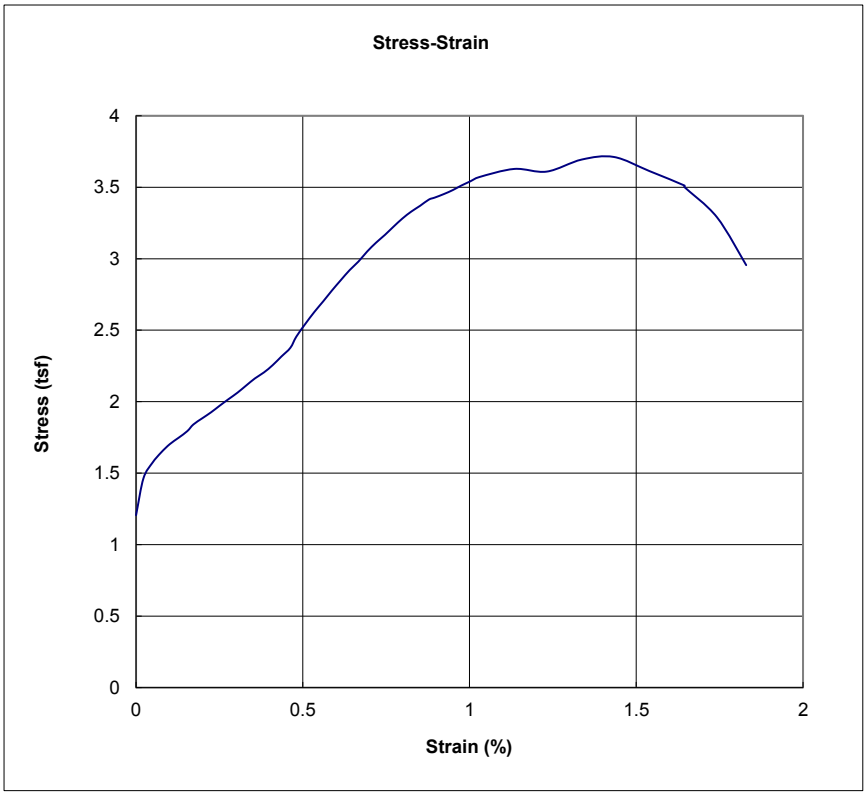
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Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		202-23
Depth (ft)		12 - 14
Sample Date		8/8/2023
Soil Type		FAT CLAY with SAND (CH)
Specimen Height	inch	5.72
Specimen Diameter	inch	2.77
Moisture Content	%	16.8
Dry Density	pcf	109.6
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.43
Failure Stress	tsf	3.71



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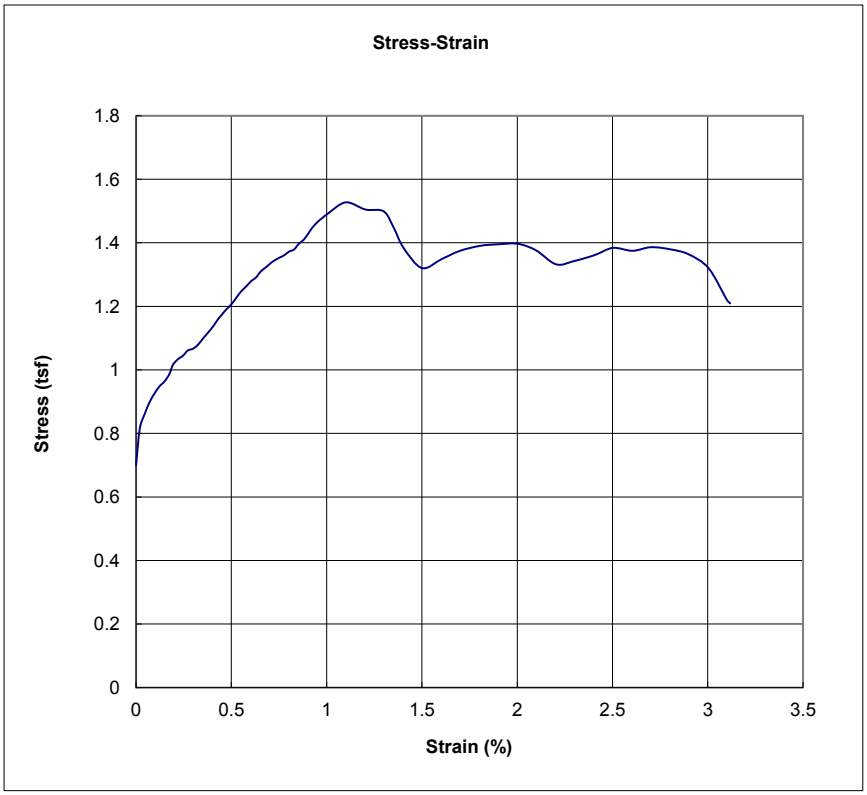
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Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		202-23
Depth (ft)		18 - 20
Sample Date		8/8/2023
Soil Type		SANDY LEAN CLAY with GRAVEL (CL)
Specimen Height	inch	5.67
Specimen Diameter	inch	2.77
Moisture Content	%	28.6
Dry Density	pcf	87.3
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.10
Failure Stress	tsf	1.53



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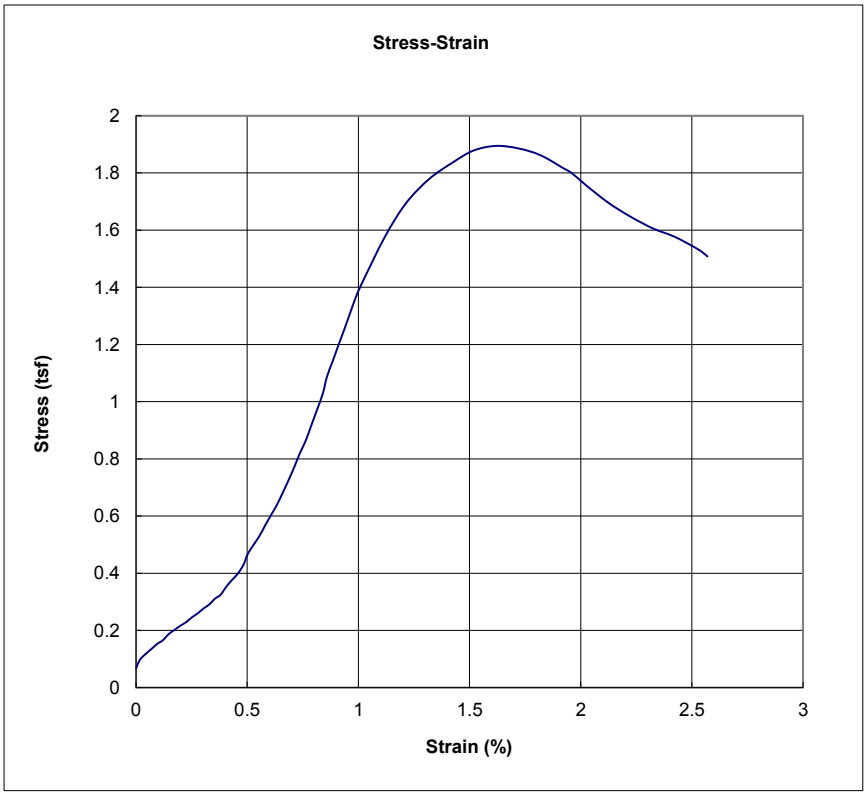
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Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		203-23
Depth (ft)		10 - 11
Sample Date		8/8/2023
Soil Type		FAT CLAY (CH)
Specimen Height	inch	5.59
Specimen Diameter	inch	2.75
Moisture Content	%	18.2
Dry Density	pcf	107.2
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.62
Failure Stress	tsf	1.89



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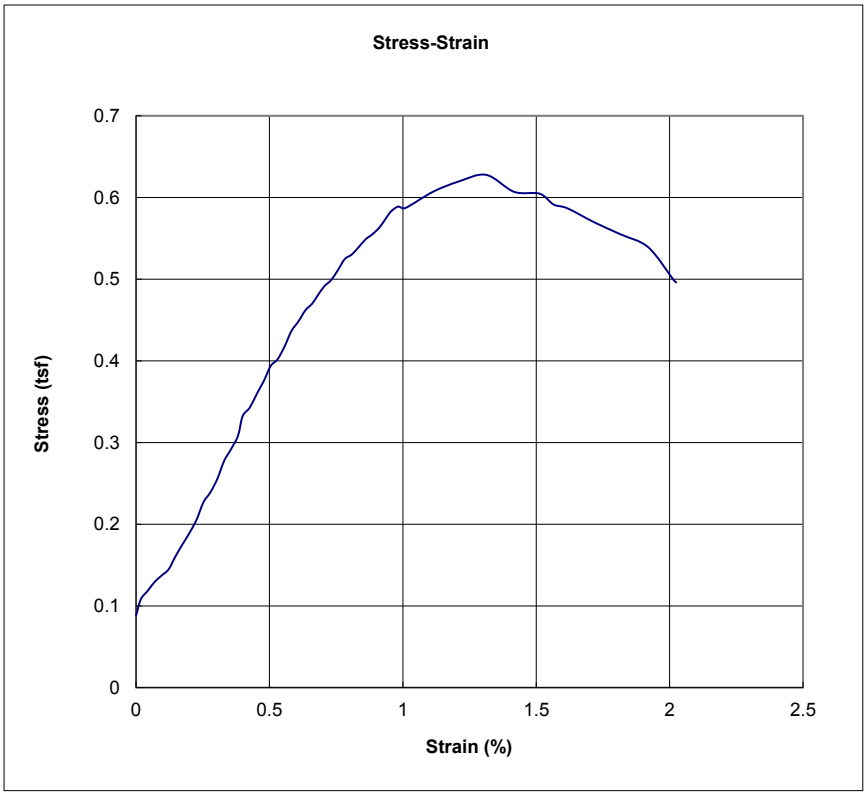
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Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		203-23
Depth (ft)		23 - 25
Sample Date		8/8/2023
Soil Type		SANDY FAT CLAY (CH)
Specimen Height	inch	5.49
Specimen Diameter	inch	2.74
Moisture Content	%	35.1
Dry Density	pcf	82.5
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.31
Failure Stress	tsf	0.63



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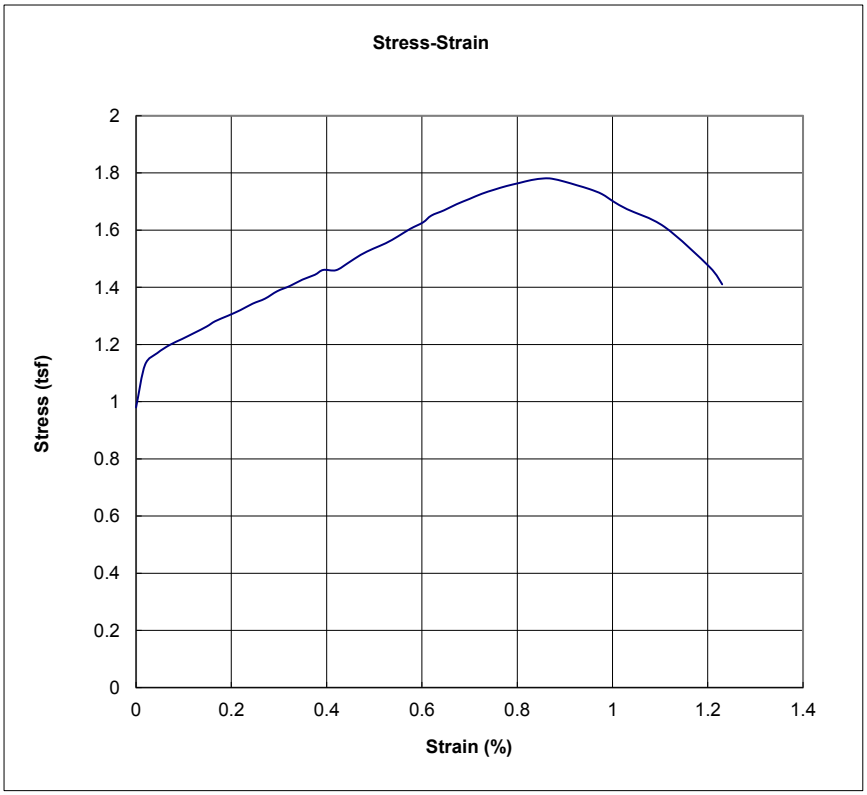
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Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		203-23
Depth (ft)		30 - 32
Sample Date		8/8/2023
Soil Type		FAT CLAY with SAND (CH)
Specimen Height	inch	5.59
Specimen Diameter	inch	2.78
Moisture Content	%	35.5
Dry Density	pcf	83.6
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	0.86
Failure Stress	tsf	1.78



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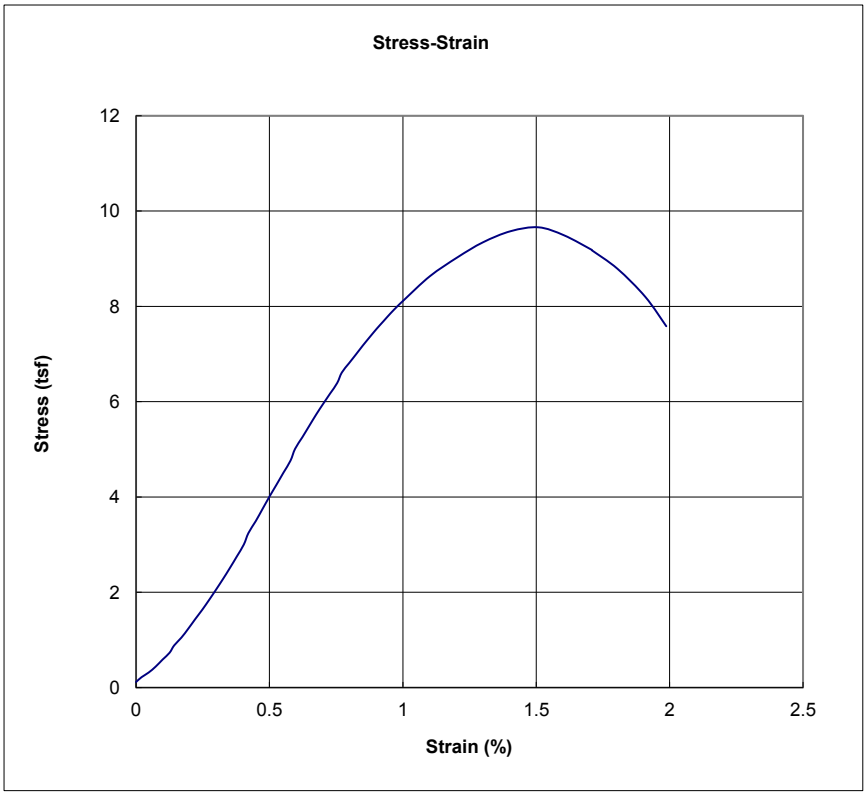
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Specimen and Testing Details

Borehole		204-23
Depth (ft)		0 - 2
Sample Date		8/8/2023
Soil Type		SANDY LEAN CLAY (CL)
Specimen Height	inch	5.56
Specimen Diameter	inch	2.75
Moisture Content	%	9.2
Dry Density	pcf	109.8
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.51
Failure Stress	tsf	9.66



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Unconfined Compressive Strength Test
ASTM D2166

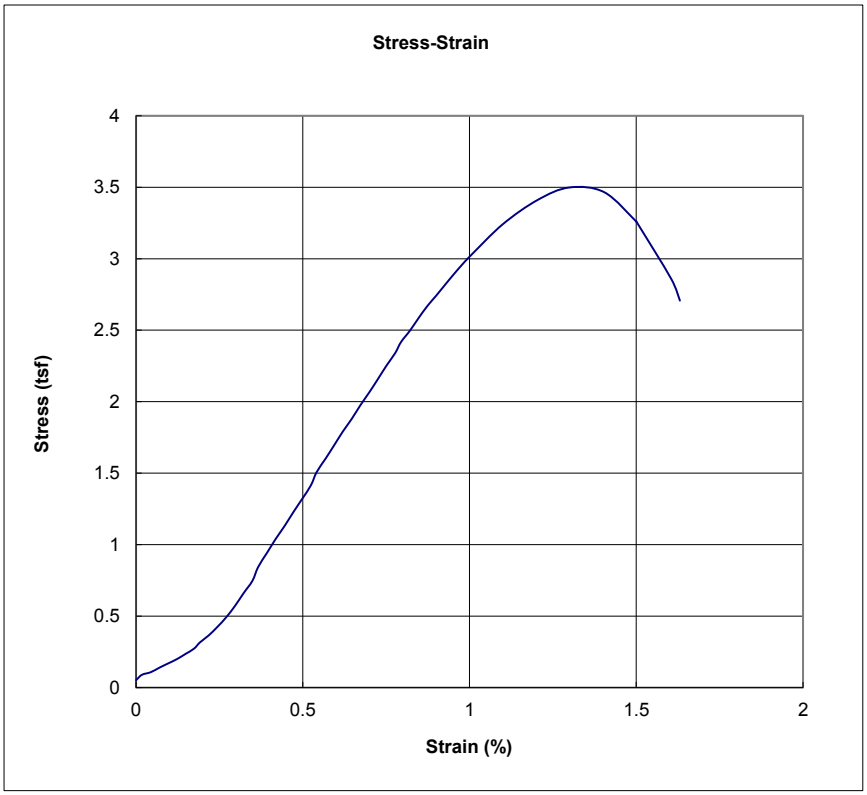
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		204-23
Depth (ft)		8 - 10
Sample Date		8/8/2023
Soil Type		ELASTIC SILT with SAND (MH)
Specimen Height	inch	5.54
Specimen Diameter	inch	2.77
Moisture Content	%	31.7
Dry Density	pcf	85.7
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.30
Failure Stress	tsf	3.5



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Unconfined Compressive Strength Test
ASTM D2166

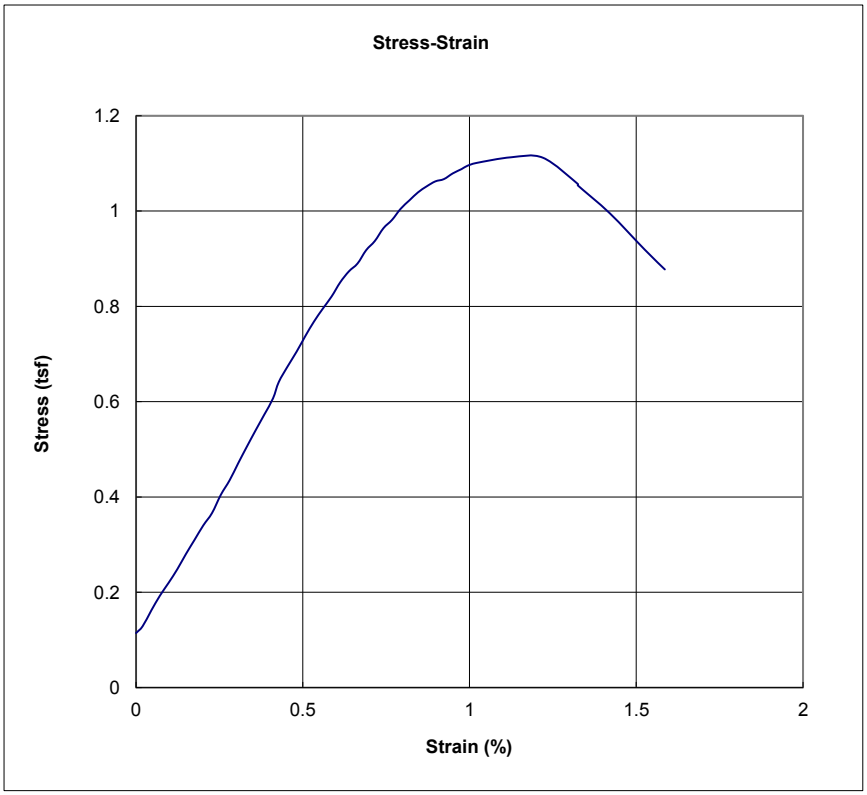
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		205-23
Depth (ft)		18 - 19
Sample Date		8/8/2023
Soil Type		FAT CLAY with Sand (CH)
Specimen Height	inch	5.49
Specimen Diameter	inch	2.76
Moisture Content	%	33.6
Dry Density	pcf	83.71
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.12
Failure Stress	tsf	1.11



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Unconfined Compressive Strength Test
ASTM D2166

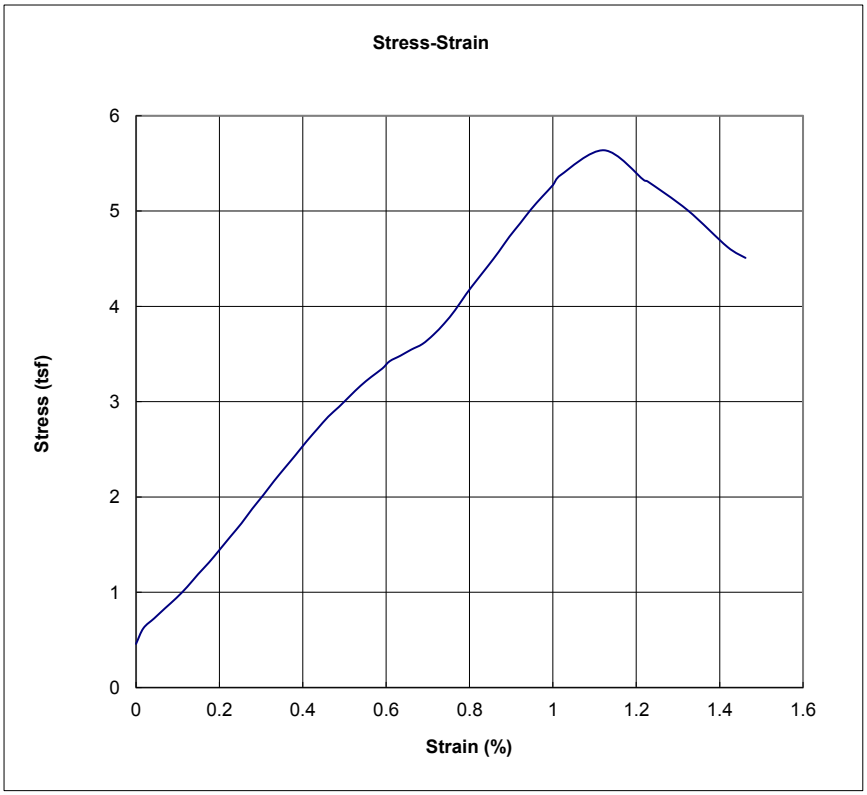
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		205-23
Depth (ft)		0 - 2
Sample Date		8/8/2023
Soil Type		CLAYEY SAND (SC)
Specimen Height	inch	5.54
Specimen Diameter	inch	2.78
Moisture Content	%	7
Dry Density	pcf	109.4
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.12
Failure Stress	tsf	5.64



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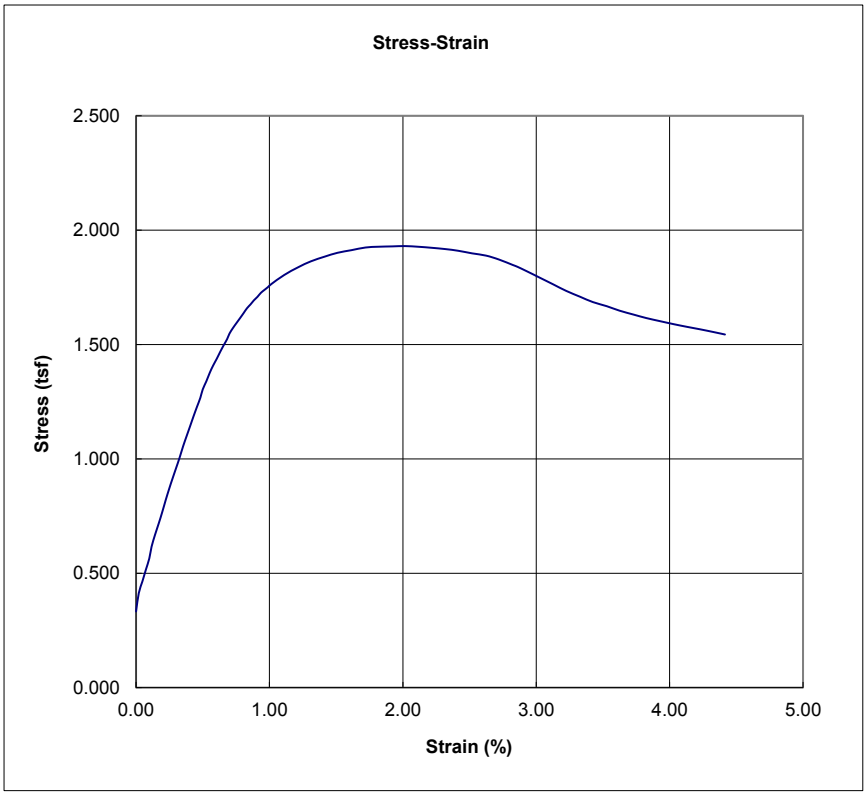
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		COMP A
Depth (ft)		0 - 5
Sample Date		8/8/2023
Soil Type		FAT CLAY (CH)
Specimen Height	inch	4.57
Specimen Diameter	inch	3.98
Moisture Content	%	19.5
Dry Density	pcf	97.9
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	2.02
Failure Stress	tsf	1.93



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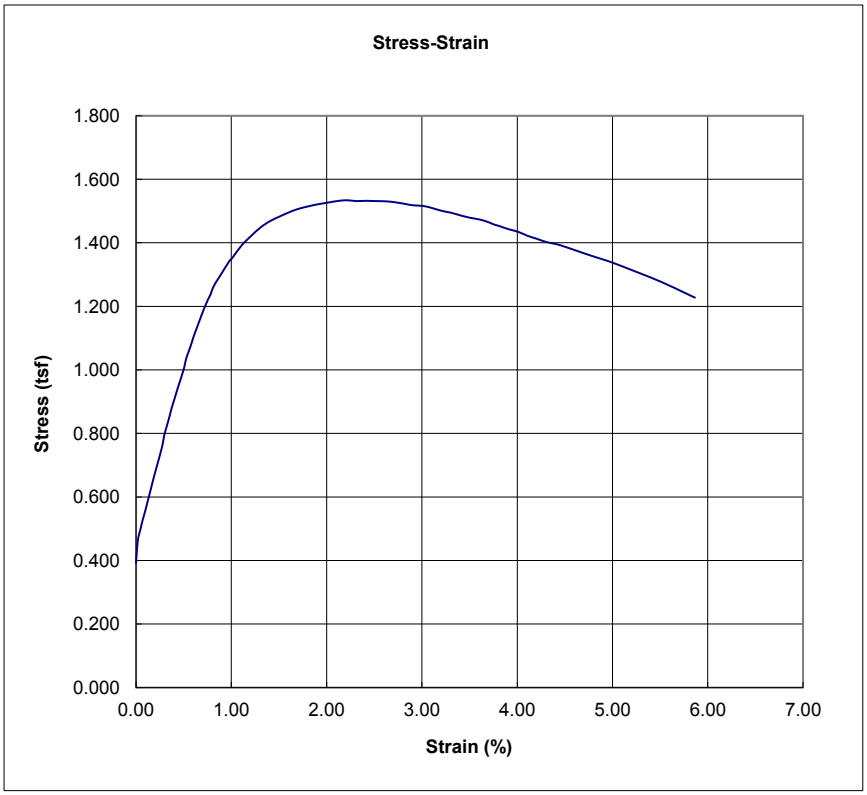
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		COMP B
Depth (ft)		0 - 5
Sample Date		8/8/2023
Soil Type		FAT CLAY (CH)
Specimen Height	inch	4.54
Specimen Diameter	inch	3.98
Moisture Content	%	22.2
Dry Density	pcf	101.9
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	2.21
Failure Stress	tsf	1.53



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Unconfined Compressive Strength Test
ASTM D2166

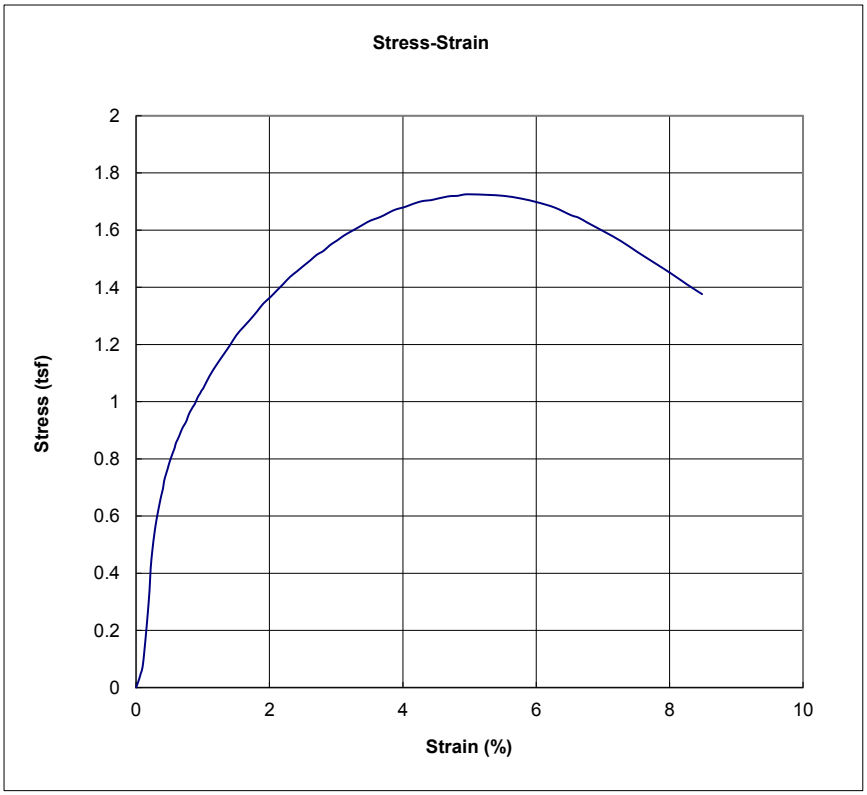
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 4
Kenedy, TX

Project Number: 2023-135
Date of Test:

Specimen and Testing Details

Borehole		COMP C
Depth (ft)		0 - 5
Sample Date		8/8/2023
Soil Type		CLAYEY SAND (SC)
Specimen Height	inch	4.56
Specimen Diameter	inch	3.99
Moisture Content	%	11.2
Dry Density	pcf	113.05
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	5.02
Failure Stress	tsf	1.73



CRUMB TEST RESULTS

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Tel: (512) 387-1287

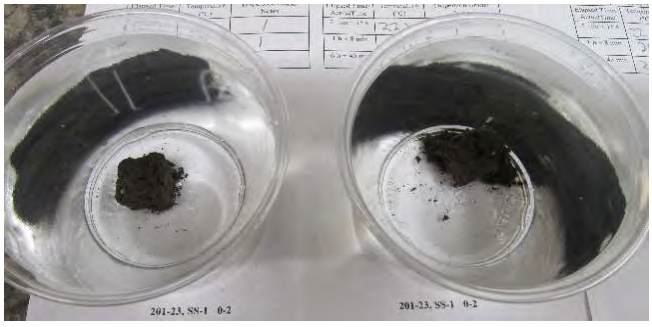
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method B)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

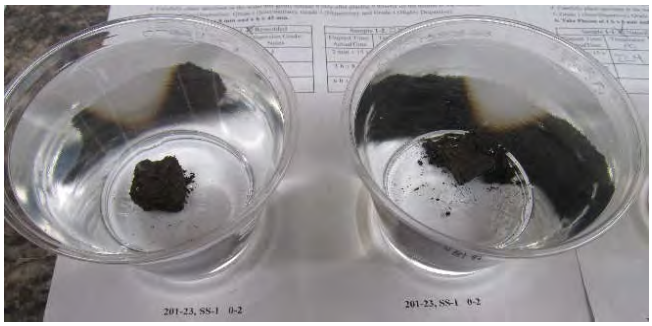
Alpine Project No.: 2309348
Test Date: 10/05/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, SS-1 (0-2 ft)	2 minutes	22.1	1	Non-dispersive
	1 hour	21.4	1	Non-dispersive
	6 hours	20.7	1	Non-dispersive

*Remolded soil crumbs (Method B) 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. 10/10/23

Reviewed By / Date

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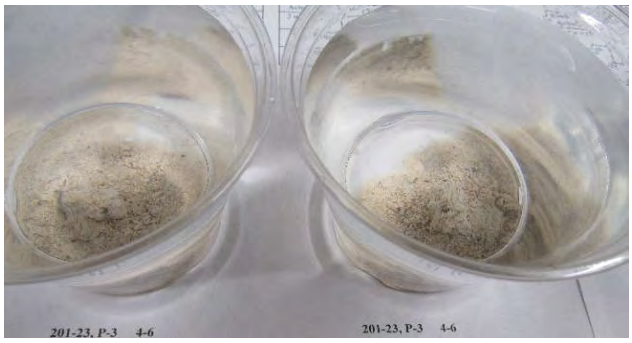
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

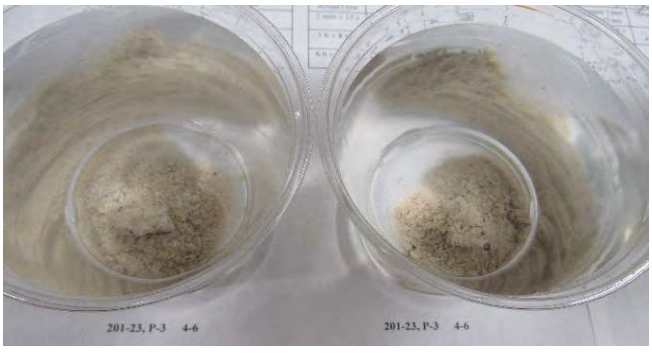
Alpine Project No.: 2309348
Test Date: 10/05/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, P-3 (4-6 ft)	2 minutes	22.4	1	Non-dispersive
	1 hour	21.4	1	Non-dispersive
	6 hours	20.5	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. 10/10/23

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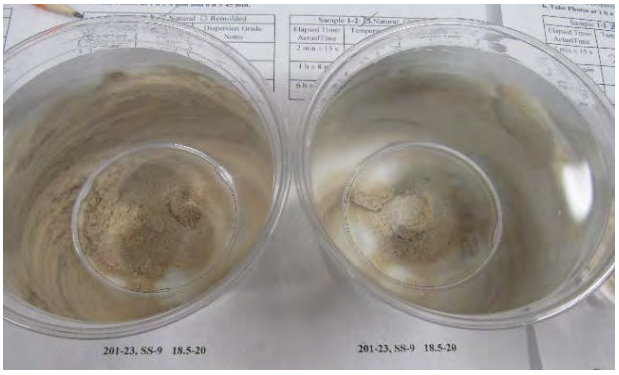
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

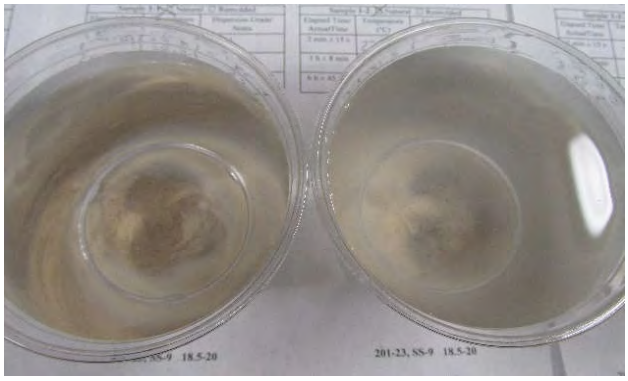
Alpine Project No.: 2309348
Test Date: 10/05/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, SS-9 (18.5-20 ft)	2 minutes	22.3	1	Non-dispersive
	1 hour	21.4	2	Intermediate
	6 hours	20.5	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. 10/10/23

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Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method B)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

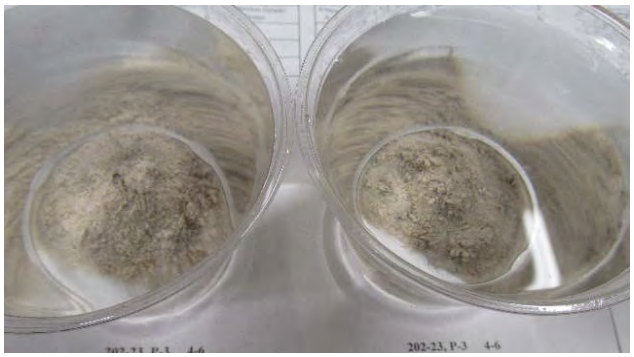
Alpine Project No.: 2309348
Test Date: 10/05/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, P-3 (4-6 ft)	2 minutes	22.4	2	Intermediate
	1 hour	21.4	2	Intermediate
	6 hours	20.3	2	Intermediate

*Remolded soil crumbs (Method B) 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. 10/10/23

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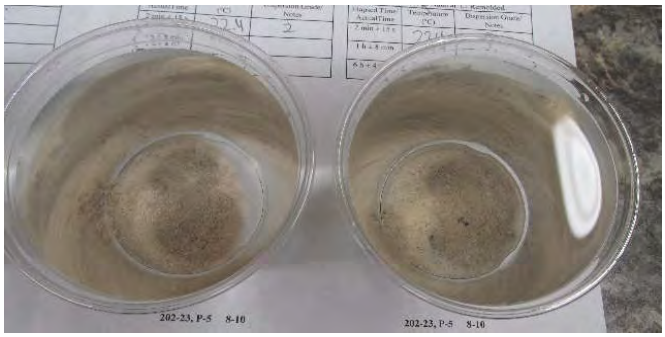
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

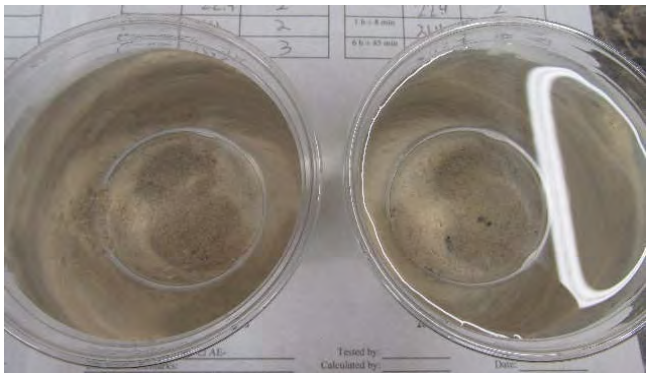
Alpine Project No.: 2309348
Test Date: 10/05/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, P-5 (8-10 ft)	2 minutes	22.4	2	Intermediate
	1 hour	21.4	2	Intermediate
	6 hours	20.3	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

Cheng-Wei Chen, Ph.D. 10/10/23

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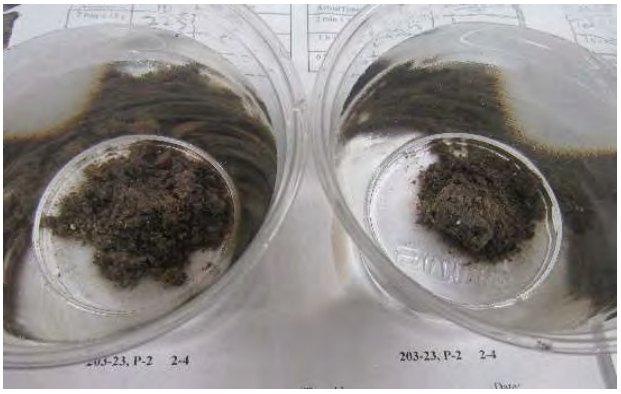
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

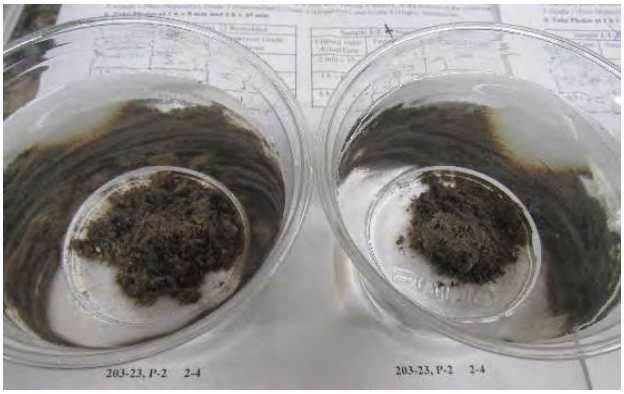
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, P-2 (2-4 ft)	2 minutes	22.3	1	Non-dispersive
	1 hour	21.0	1	Non-dispersive
	6 hours	20.1	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. 10/10/23

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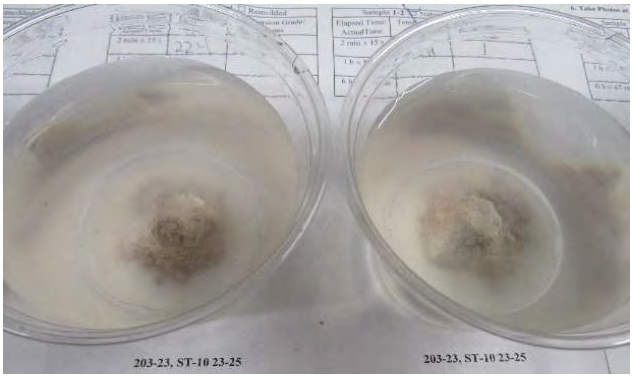
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

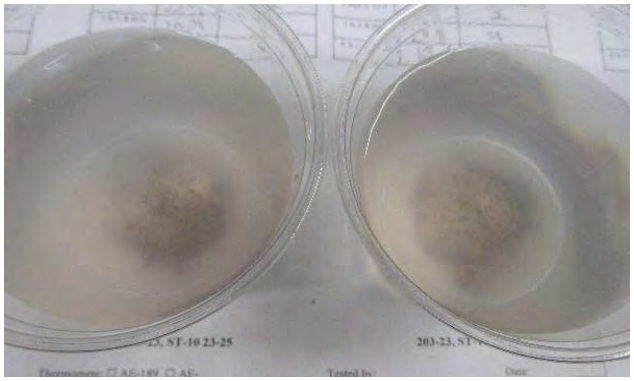
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, ST-10 (23-25 ft)	2 minutes	22.4	2	Intermediate
	1 hour	20.9	4	Highly Dispersive
	6 hours	19.9	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. 10/10/23

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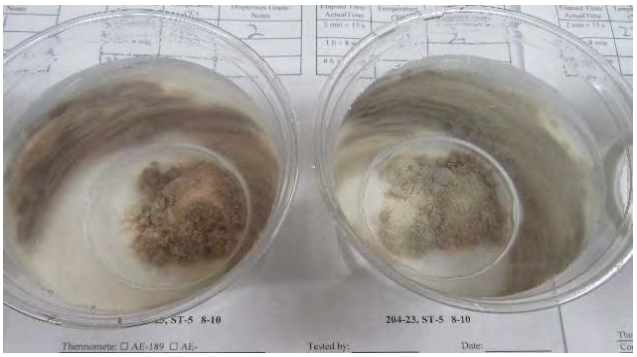
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

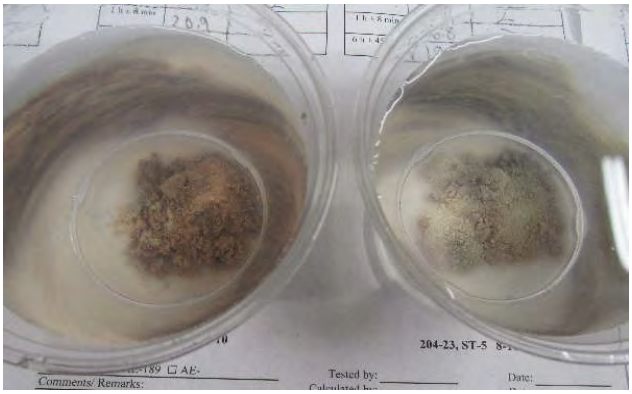
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, ST-5 (8-10 ft)	2 minutes	22.4	2	Intermediate
	1 hour	20.9	3	Dispersive
	6 hours	19.9	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

Cheng-Wei Chen, Ph.D. 10/10/23

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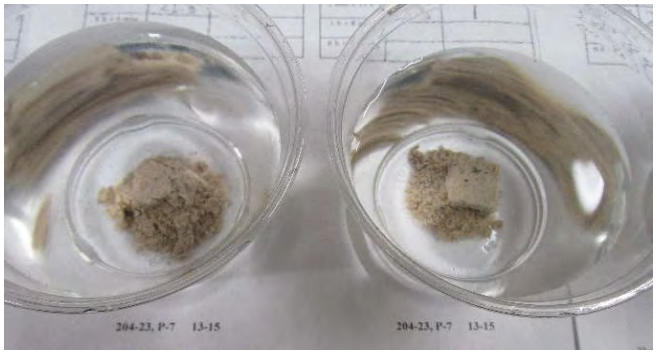
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

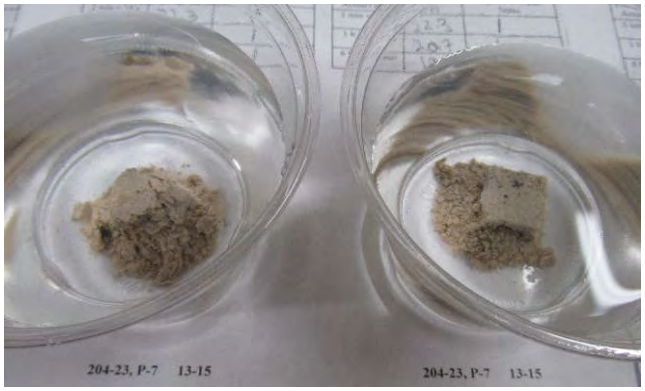
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, P-7 (13-15 ft)	2 minutes	22.3	1	Non-dispersive
	1 hour	20.8	1	Non-dispersive
	6 hours	19.7	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. 10/10/23

Reviewed By / Date

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Tel: (512) 387-1287

Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method B)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
205-23, SS-2 (2-3.5 ft)	2 minutes	22.4	1	Non-dispersive
	1 hour	20.7	1	Non-dispersive
	6 hours	19.6	1	Non-dispersive

*Remolded soil crumbs (Method B) 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. 10/10/23

Reviewed By / Date

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Tel: (512) 387-1287

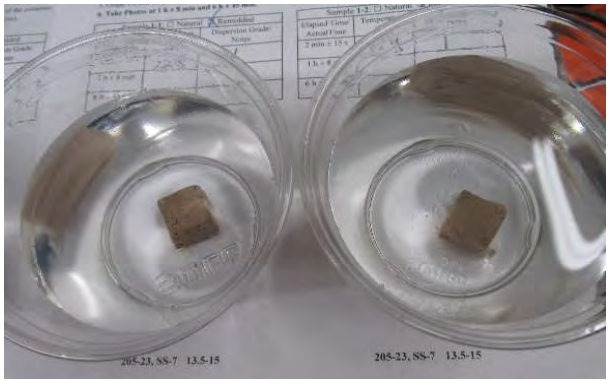
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method B)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

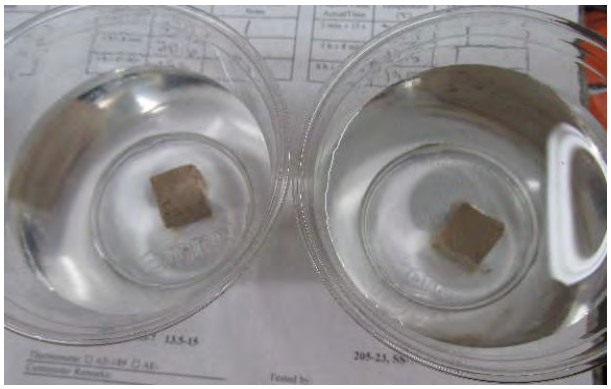
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
205-23, SS-7 (13.5-15 ft)	2 minutes	22.5	1	Non-dispersive
	1 hour	20.6	1	Non-dispersive
	6 hours	19.5	1	Non-dispersive

*Remolded soil crumbs (Method B) 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. 10/10/23

Reviewed By / Date

The testing was performed in accordance with applicable industry standard. The results provided in this report do not constitute a professional opinion by Alpine Engineering Service, LLC (Alpine). This report may be used only by the Client and the registered design professional in charge.

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

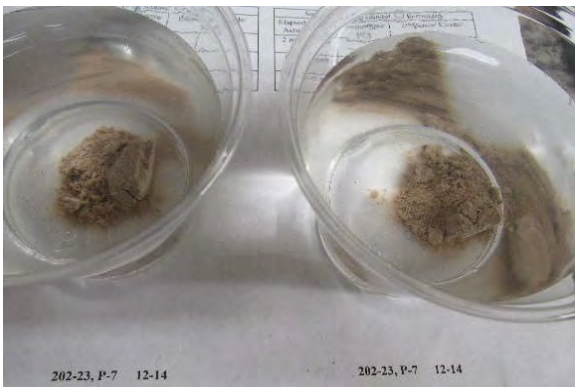
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, P-7 (12-14 ft)	2 minutes	22.8	1	Non-dispersive
	1 hour	22.0	2	Intermediate
	6 hours	21.3	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. 10/10/23

Reviewed By / Date

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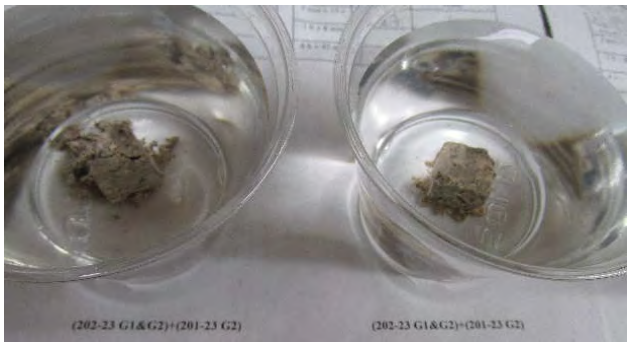
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method B)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

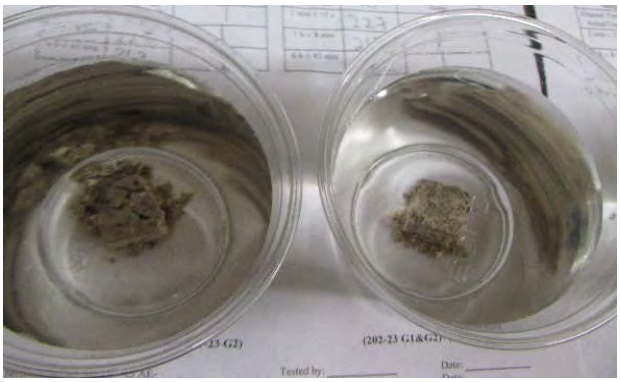
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, G1 & G2 + 201-23 G2	2 minutes	22.7	1	Non-dispersive
	1 hour	22.0	1	Non-dispersive
	6 hours	21.2	1	Non-dispersive

*Remolded soil crumbs (Method B) 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. 10/10/23

Reviewed By / Date

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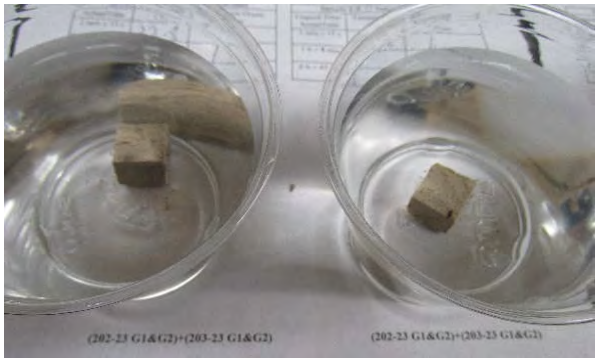
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method B)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

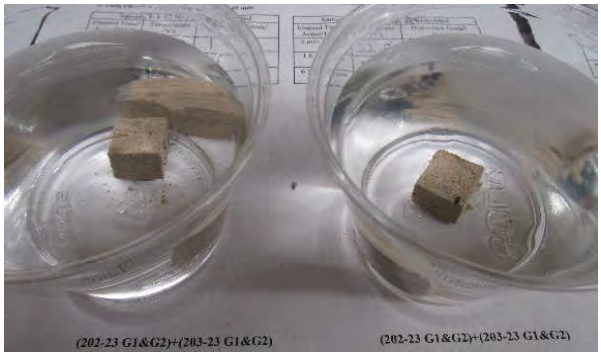
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, G1 & G2 + 205-23, G1 & G2	2 minutes	22.8	1	Non-dispersive
	1 hour	21.9	1	Non-dispersive
	6 hours	21.2	1	Non-dispersive

*Remolded soil crumbs (Method B) 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. 10/10/23

Reviewed By / Date

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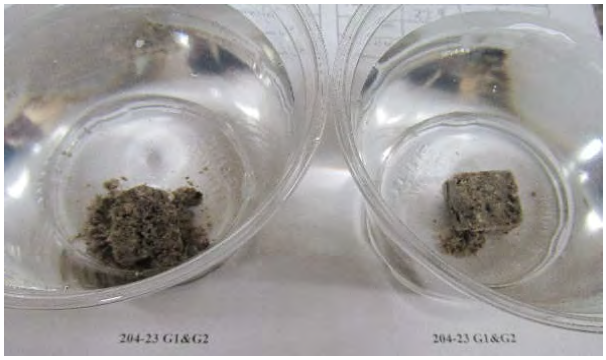
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method B)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)

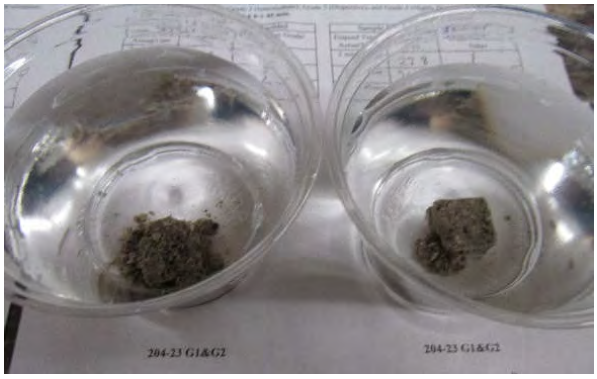
Alpine Project No.: 2309348
Test Date: 10/06/23
Tested By: O.V.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, G1 & G2	2 minutes	22.8	1	Non-dispersive
	1 hour	21.9	1	Non-dispersive
	6 hours	21.1	1	Non-dispersive

*Remolded soil crumbs (Method B) 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. 10/10/23

Reviewed By / Date

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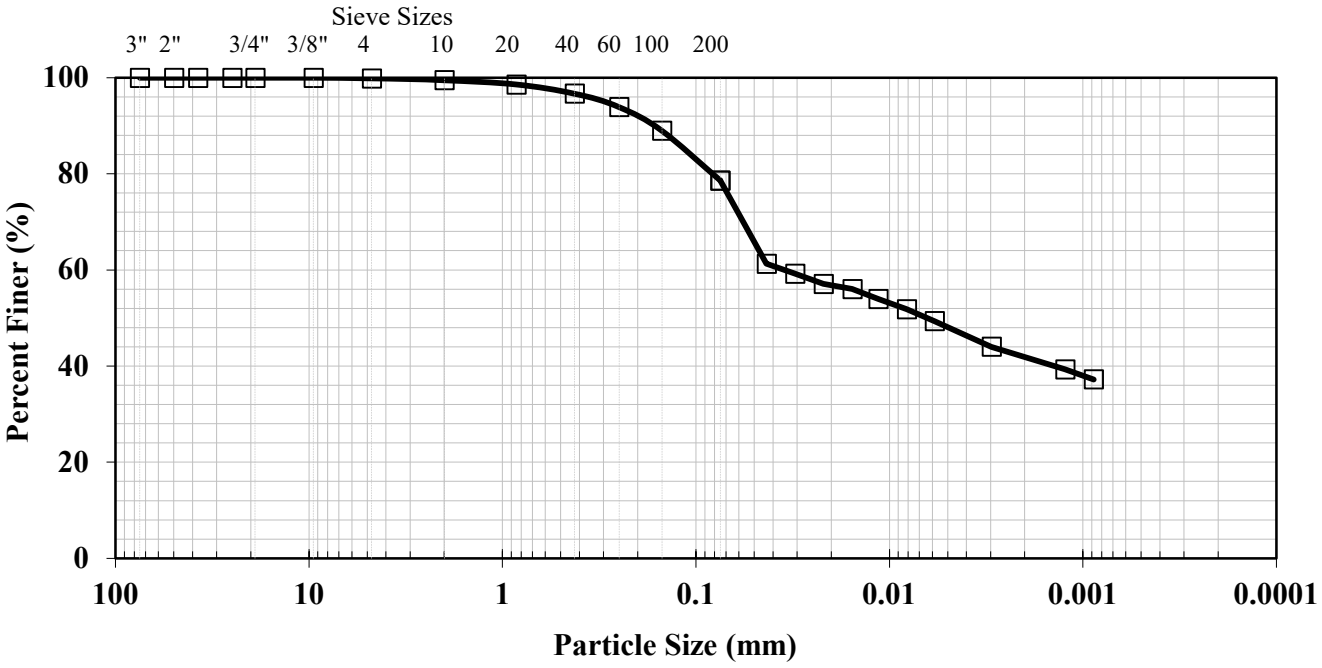
DOUBLE HYDROMETER RESULTS

Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: 201-23, P-3 (4-6 ft)

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	99.9
No. 10 (2.0 mm)	99.5
No. 20 (850 µm)	98.6
No. 40 (425 µm)	96.7
No. 60 (250 µm)	93.9
No. 100 (150 µm)	89.0
No. 200 (75 µm)	78.6

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0433 mm	61.3
0.0308 mm	59.2
0.0220 mm	57.1
0.0156 mm	56.1
0.0115 mm	54.0
0.0082 mm	51.9
0.0058 mm	49.3
0.0030 mm	44.0
0.0012 mm	39.3
0.0009 mm	37.2

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 41.4

D60 (mm)	0.035
D30 (mm)	- -
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

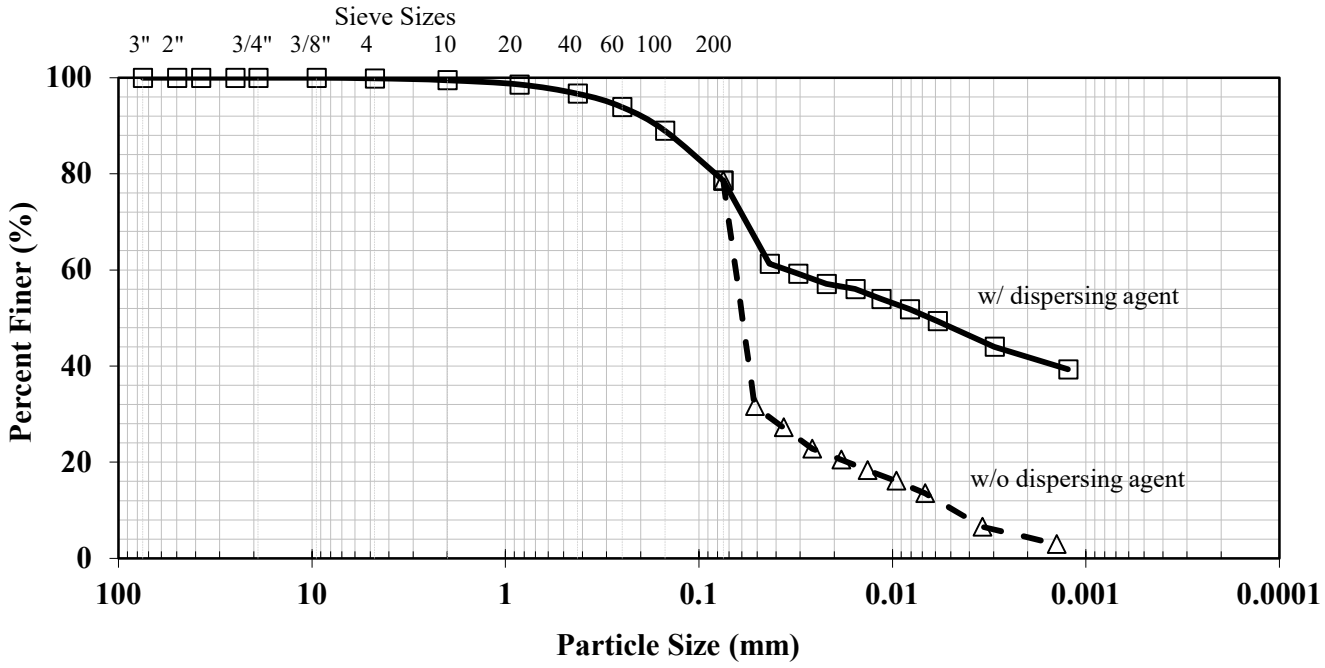
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: 201-23, P-3 (4-6 ft)

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	99.9
No. 10 (2.0 mm)	99.5
No. 20 (850 µm)	98.6
No. 40 (425 µm)	96.7
No. 60 (250 µm)	93.9
No. 100 (150 µm)	89.0
No. 200 (75 µm)	78.6

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0515 mm	31.7
0.0366 mm	27.2
0.0260 mm	22.8
0.0184 mm	20.6
0.0135 mm	18.3
0.0096 mm	16.1
0.0068 mm	13.6
0.0034 mm	6.5
0.0014 mm	3.0

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 4.0

% Dispersion = 9.7

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

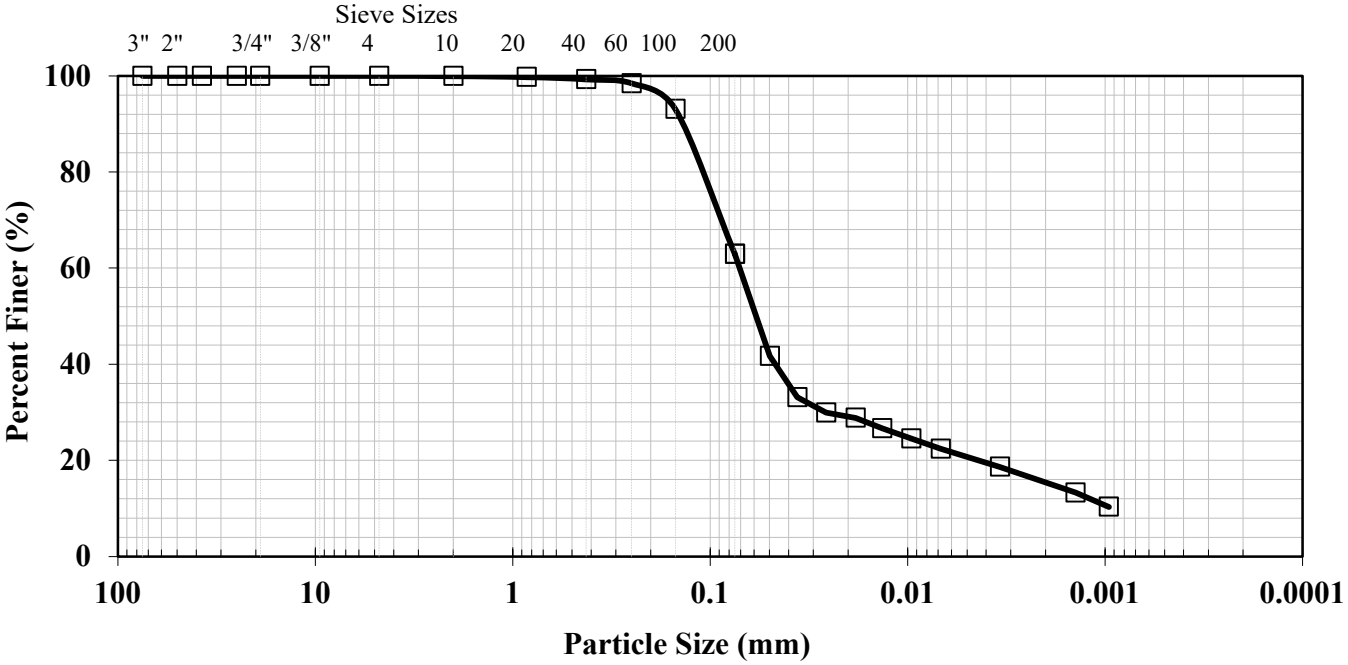
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Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 201-23/SS-9 (18.5-20 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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)	99.8
No. 40 (450 µm)	99.3
No. 60 (250 µm)	98.5
No. 100 (150 µm)	93.1
No. 200 (75 µm)	62.9

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0499 mm	41.7
0.0362 mm	33.1
0.0258 mm	29.9
0.0183 mm	28.8
0.0135 mm	26.7
0.0096 mm	24.5
0.0068 mm	22.4
0.0034 mm	18.7
0.0014 mm	13.3
0.0010 mm	10.3

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 14.9

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

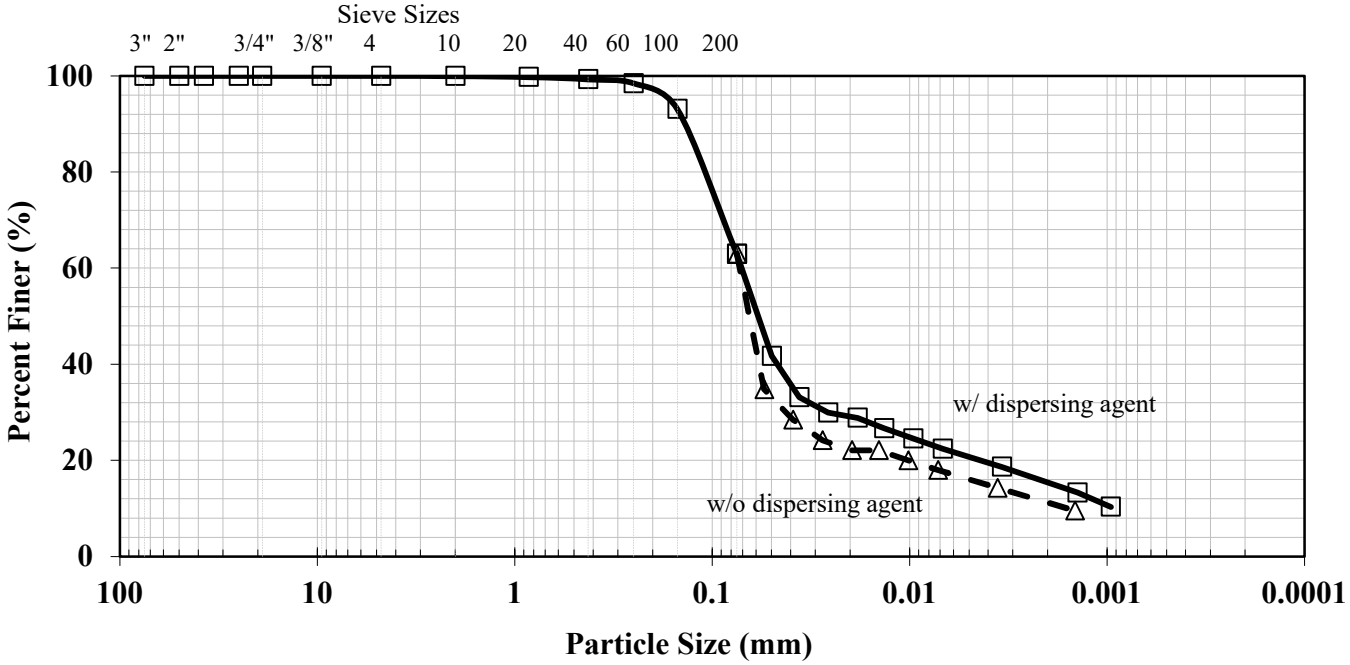
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

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

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 201-23/SS-9 (18.5-20 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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)	99.8
No. 40 (450 µm)	99.3
No. 60 (250 µm)	98.5
No. 100 (150 µm)	93.1
No. 200 (75 µm)	62.9

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0546 mm	34.8
0.0389 mm	28.4
0.0277 mm	24.2
0.0196 mm	22.1
0.0143 mm	22.1
0.0102 mm	20.0
0.0072 mm	18.0
0.0036 mm	14.3
0.0015 mm	9.6

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 10.8

% Dispersion = 72.5

Note 2: The % dispersion is greater 50 % - The soil is probably dispersive.

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

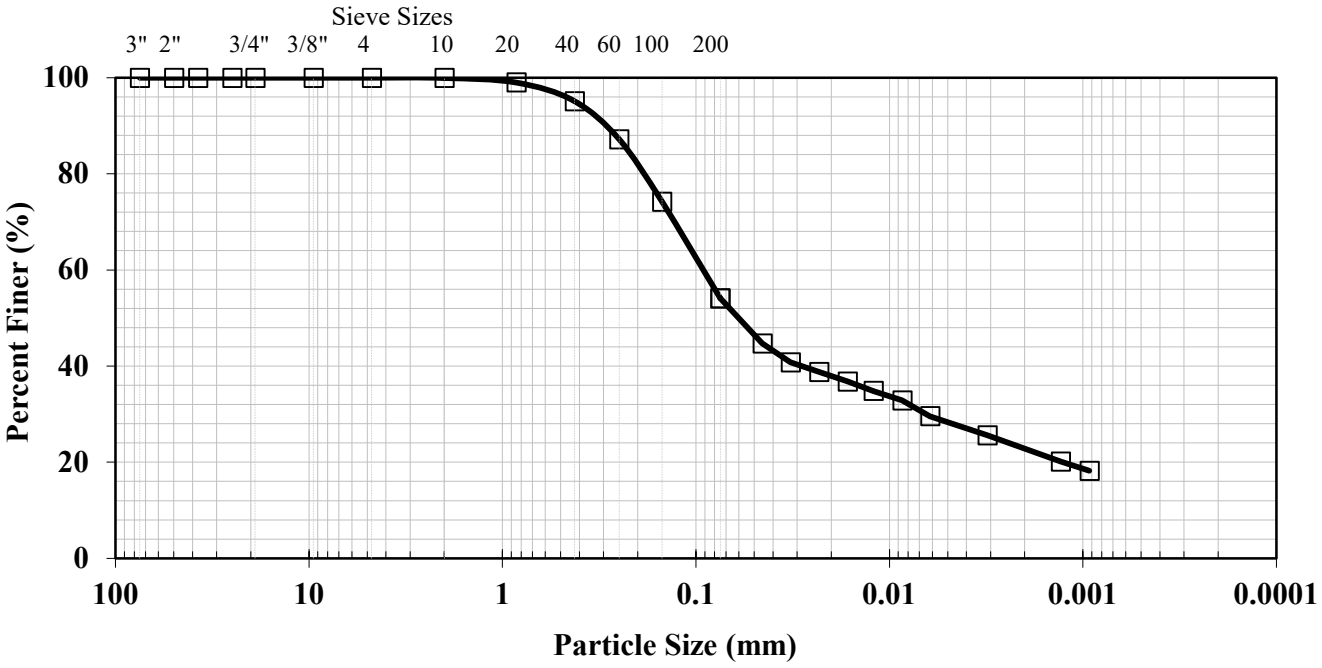
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Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: 202-23, P-3 (4-6 ft)

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	99.0
No. 40 (425 µm)	95.1
No. 60 (250 µm)	87.2
No. 100 (150 µm)	74.2
No. 200 (75 µm)	54.1

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0454 mm	44.7
0.0325 mm	40.8
0.0231 mm	38.8
0.0165 mm	36.8
0.0121 mm	34.8
0.0086 mm	32.8
0.0062 mm	29.6
0.0031 mm	25.6
0.0013 mm	20.1
0.0009 mm	18.2

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 22.2

D60 (mm)	0.097
D30 (mm)	0.006
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

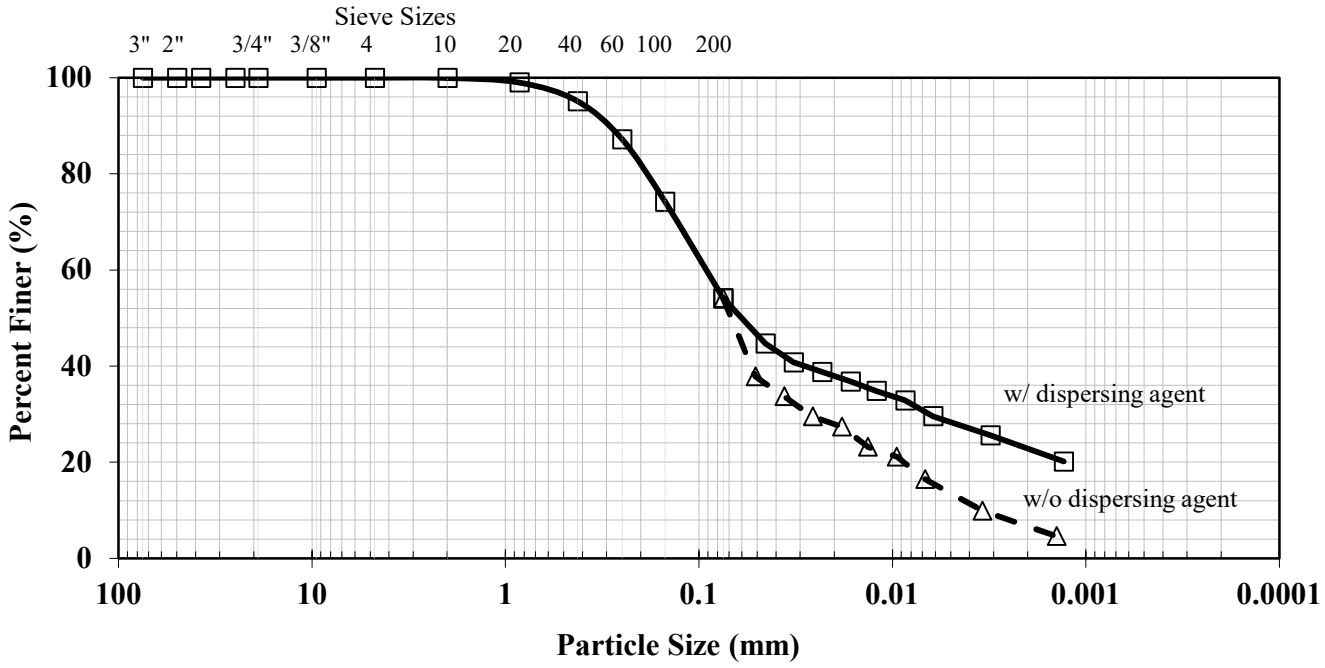
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: 202-23, P-3 (4-6 ft)

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	99.0
No. 40 (425 µm)	95.1
No. 60 (250 µm)	87.2
No. 100 (150 µm)	74.2
No. 200 (75 µm)	54.1

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0511 mm	37.9
0.0363 mm	33.7
0.0258 mm	29.5
0.0183 mm	27.4
0.0134 mm	23.2
0.0095 mm	21.1
0.0068 mm	16.5
0.0034 mm	9.9
0.0014 mm	4.6

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 6.1

% Dispersion = 27.6

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

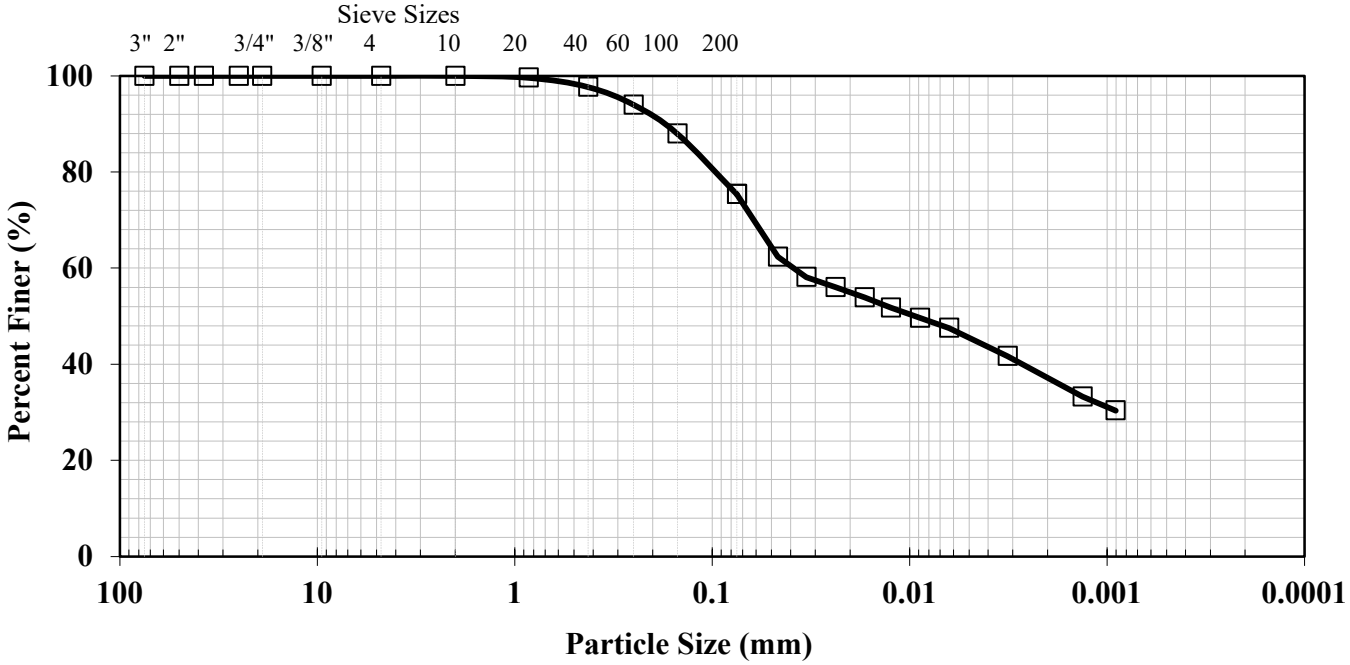
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Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 202-23/P-5 (8-10 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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)	99.6
No. 40 (450 µm)	97.7
No. 60 (250 µm)	94.0
No. 100 (150 µm)	88.0
No. 200 (75 µm)	75.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0464 mm	62.4
0.0333 mm	58.1
0.0237 mm	56.0
0.0169 mm	53.9
0.0124 mm	51.8
0.0089 mm	49.7
0.0063 mm	47.5
0.0032 mm	41.7
0.0013 mm	33.3
0.0009 mm	30.4

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 36.3

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

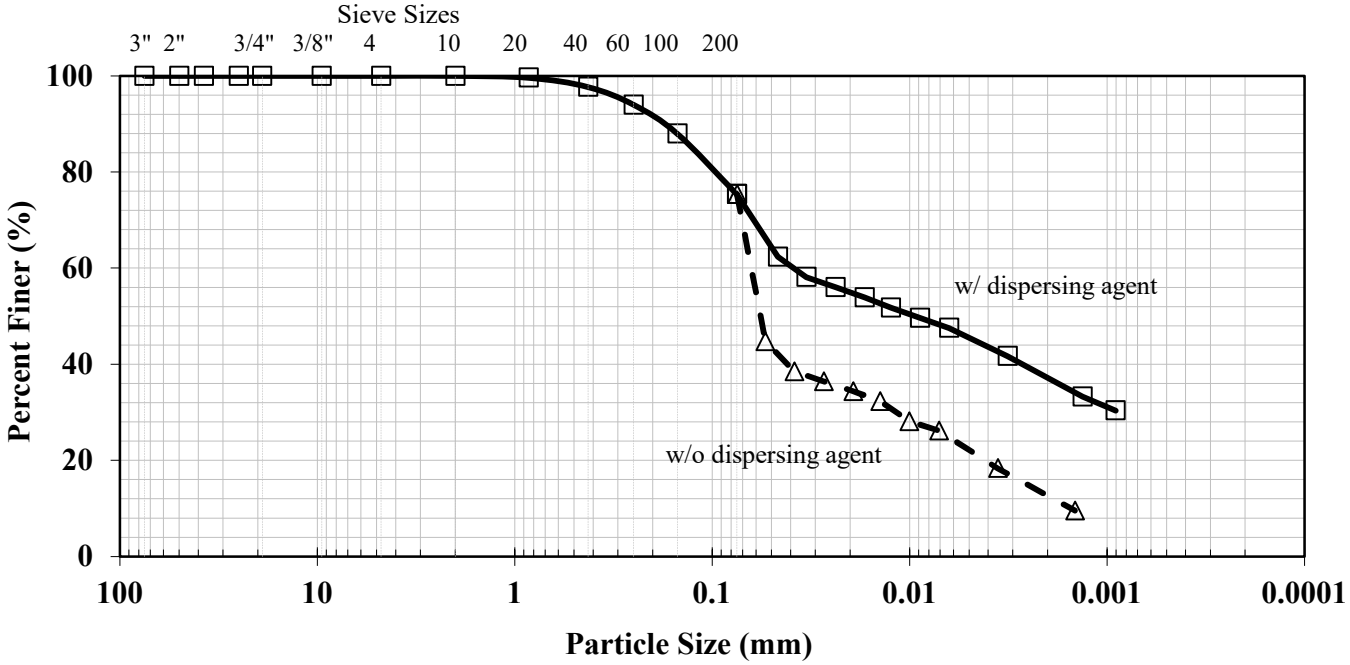
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Alpine Engineering Services, LLC
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Hutto, TX 78634
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 202-23/P-5 (8-10 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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)	99.6
No. 40 (450 µm)	97.7
No. 60 (250 µm)	94.0
No. 100 (150 µm)	88.0
No. 200 (75 µm)	75.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0538 mm	44.8
0.0384 mm	38.6
0.0272 mm	36.5
0.0193 mm	34.4
0.0141 mm	32.3
0.0100 mm	28.1
0.0071 mm	26.2
0.0036 mm	18.4
0.0015 mm	9.6

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\ 2\ \mu m,\ nd}$ (%) = 11.8

% Dispersion = 32.6

Note 2: The % dispersion is between 30 to 50 % - The soil is probably intermediate dispersiveness.

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

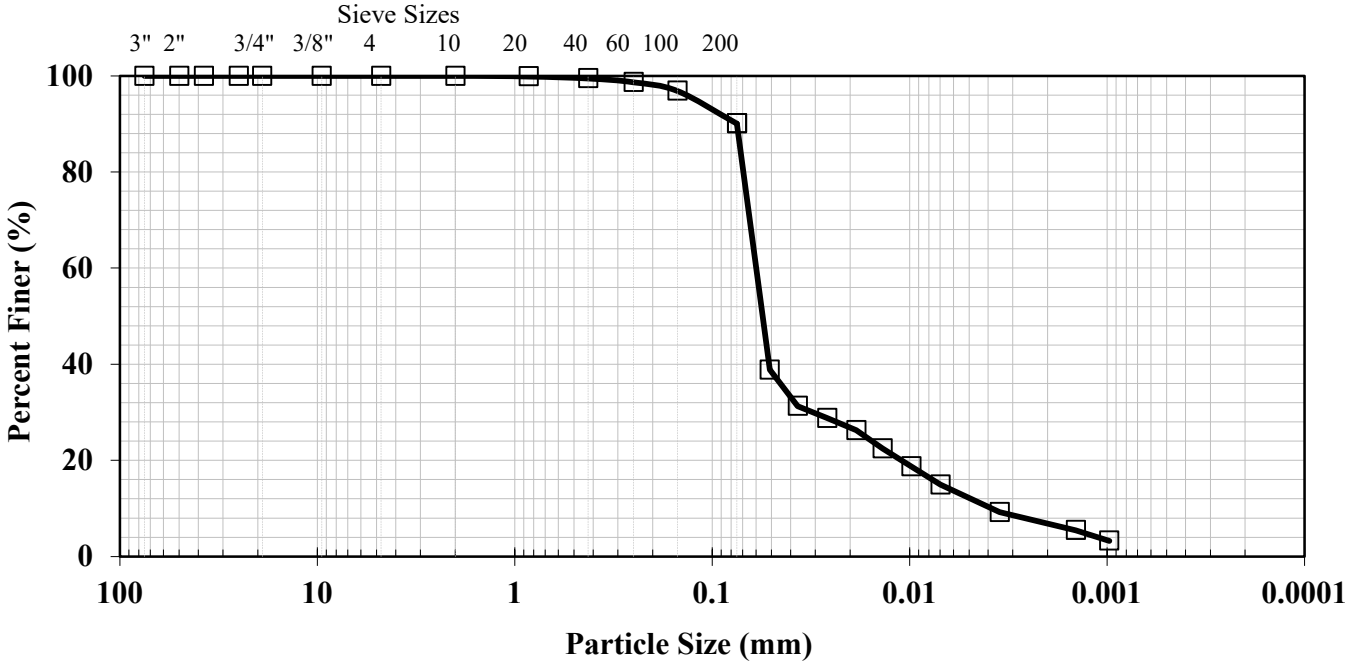
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Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 203-23/ST-10 (23-25 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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 (450 µm)	99.5
No. 60 (250 µm)	98.7
No. 100 (150 µm)	96.9
No. 200 (75 µm)	90.1

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0511 mm	38.8
0.0368 mm	31.3
0.0262 mm	28.8
0.0186 mm	26.3
0.0137 mm	22.5
0.0098 mm	18.7
0.0070 mm	14.9
0.0035 mm	9.2
0.0014 mm	5.5
0.0010 mm	3.3

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 6.5

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

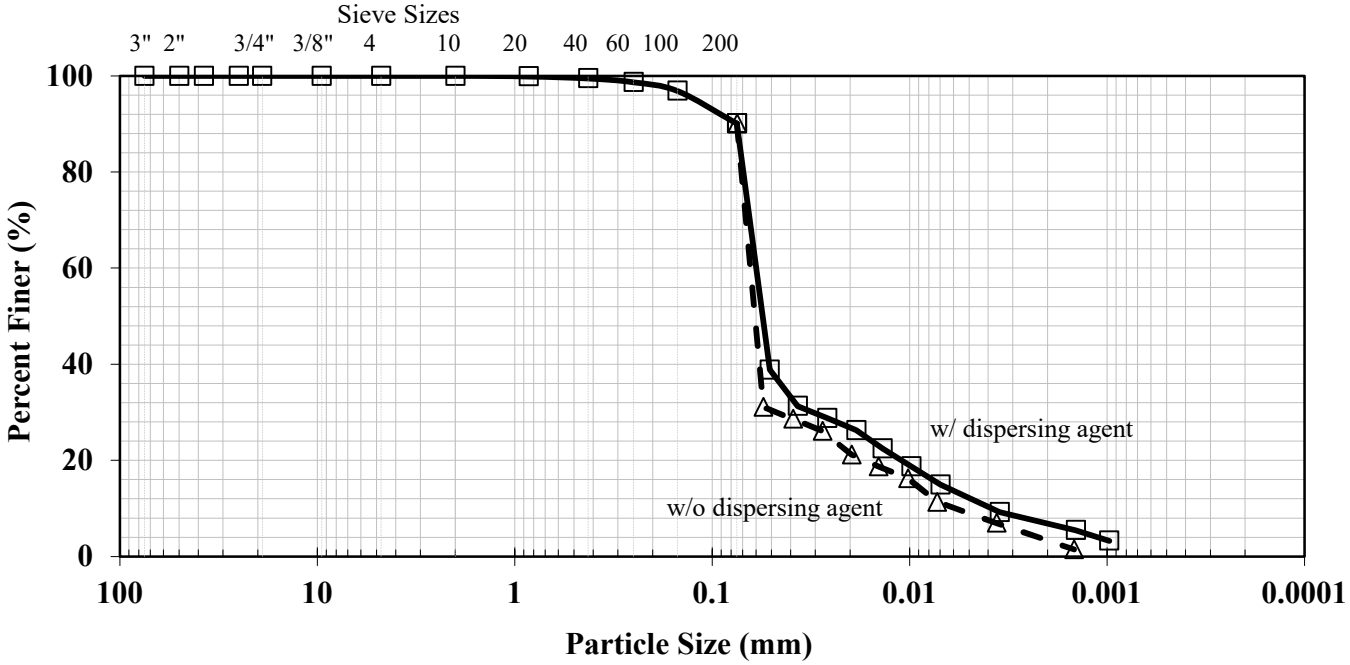
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

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

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 203-23/ST-10 (23-25 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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 (450 µm)	99.5
No. 60 (250 µm)	98.7
No. 100 (150 µm)	96.9
No. 200 (75 µm)	90.1

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0551 mm	31.1
0.0390 mm	28.6
0.0277 mm	26.2
0.0197 mm	21.2
0.0144 mm	18.7
0.0102 mm	16.3
0.0073 mm	11.3
0.0036 mm	7.0
0.0015 mm	1.5

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\ 2\ \mu m,\ nd}$ (%) = 2.8

% Dispersion = 43.7

Note 2: The % dispersion is between 30 to 50 % - The soil is probably intermediate dispersiveness.

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

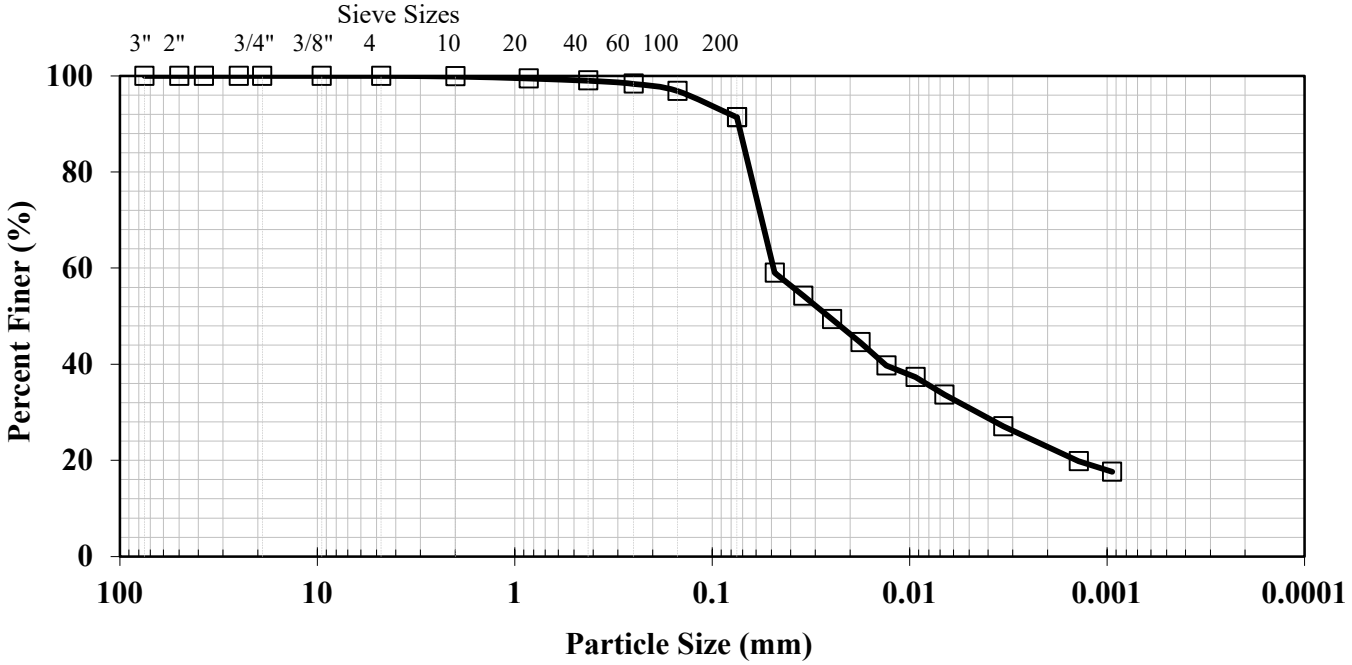
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Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 204-23/ST-5 (8-10 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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)	99.5
No. 40 (450 µm)	99.0
No. 60 (250 µm)	98.4
No. 100 (150 µm)	96.9
No. 200 (75 µm)	91.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0482 mm	59.0
0.0345 mm	54.2
0.0247 mm	49.4
0.0177 mm	44.5
0.0131 mm	39.7
0.0093 mm	37.3
0.0067 mm	33.7
0.0034 mm	27.1
0.0014 mm	19.8
0.0009 mm	17.6

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 22.1

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

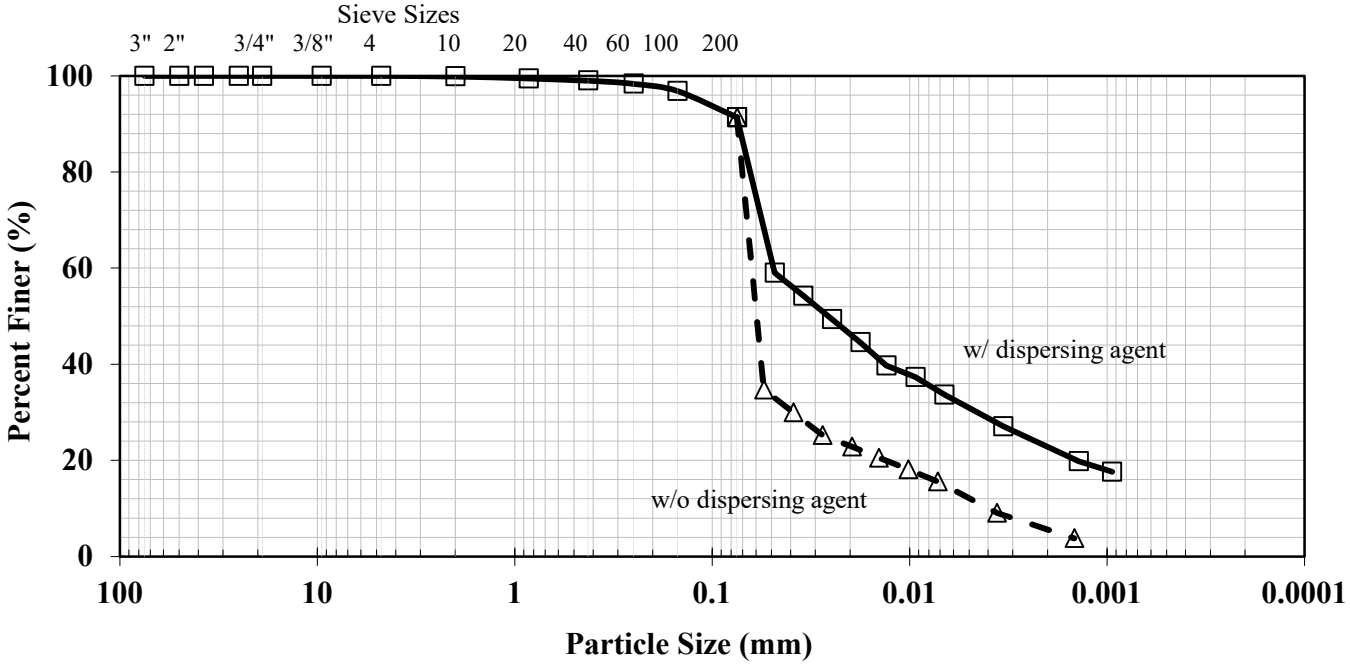
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Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Kenedy Dam 4 (PN: 2023-135)
Sample ID: 204-23/ST-5 (8-10 ft)

Alpine Project No.: 2402041
Test Date: 02/12/24
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)	99.5
No. 40 (450 µm)	99.0
No. 60 (250 µm)	98.4
No. 100 (150 µm)	96.9
No. 200 (75 µm)	91.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0547 mm	34.8
0.0389 mm	30.0
0.0276 mm	25.3
0.0196 mm	22.9
0.0144 mm	20.5
0.0102 mm	18.1
0.0072 mm	15.6
0.0036 mm	9.1
0.0015 mm	3.8

Note 1: Specific gravity was assumed to be 2.65, sample was prepared moist.

$N_{m,\ 2\ \mu m,\ nd}$ (%) = 5.1

% Dispersion = 23.2

Note 2: The % dispersion is less than 30 % - The soil is probably nondispersive.

Cheng-Wei Chen, Ph.D. 02/19/24
Reviewed By / Date

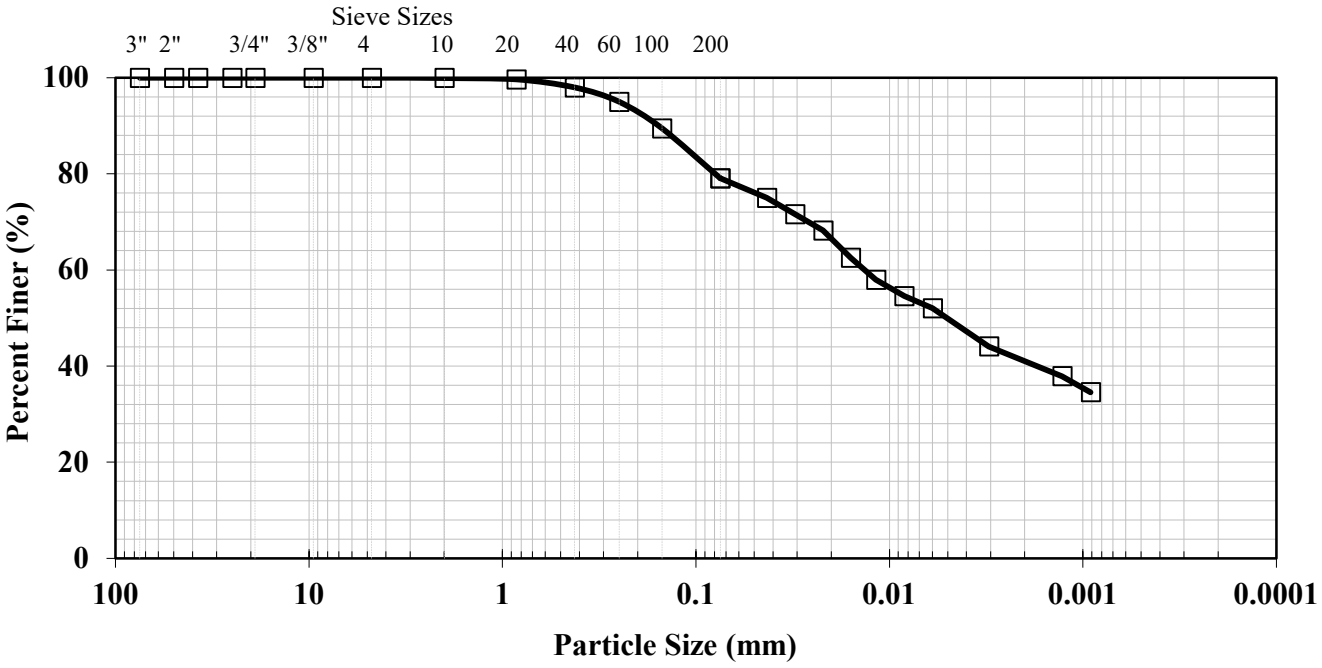
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Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: (202-23, G1&G2) + (201-23, G2) COMP A

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	98.0
No. 60 (250 µm)	95.0
No. 100 (150 µm)	89.5
No. 200 (75 µm)	79.1

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0430 mm	75.0
0.0308 mm	71.6
0.0220 mm	68.2
0.0159 mm	62.5
0.0117 mm	58.0
0.0084 mm	54.6
0.0060 mm	52.0
0.0031 mm	44.1
0.0013 mm	37.9
0.0009 mm	34.6

Note 1: Specific gravity was measured to be 2.615, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 40.4

D60 (mm)	0.014
D30 (mm)	- -
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

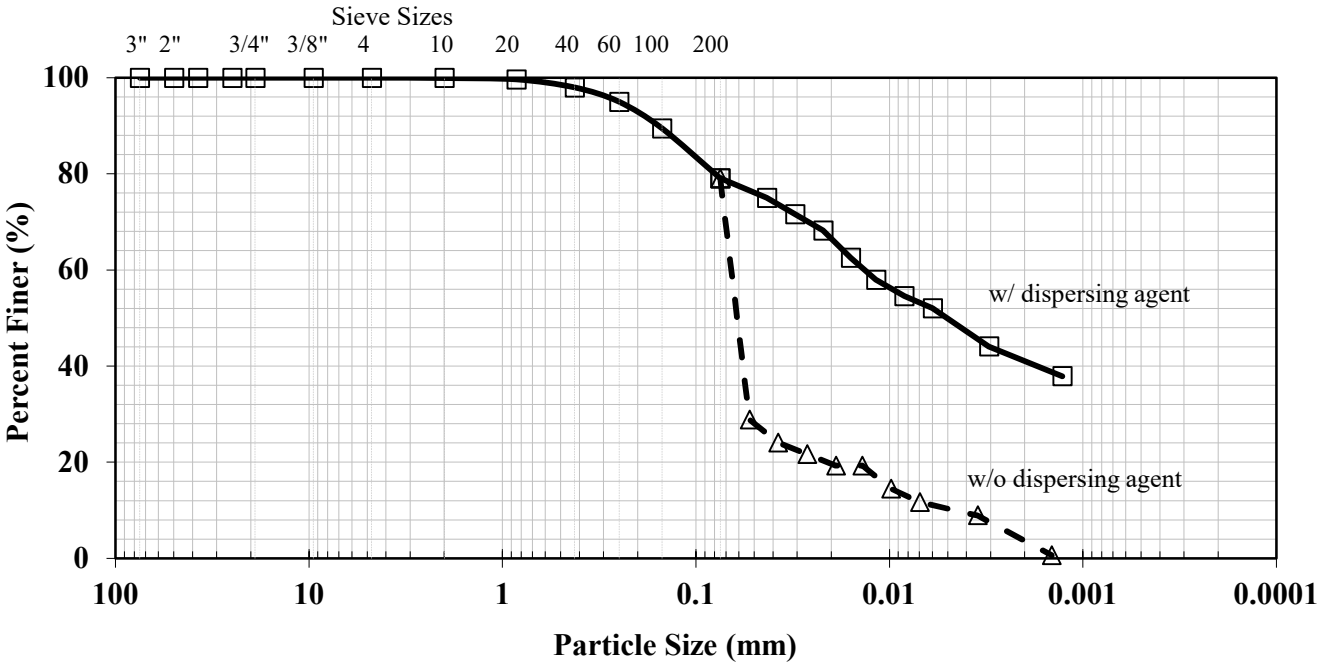
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: (202-23, G1&G2) + (201-23, G2) COMP A

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	98.0
No. 60 (250 µm)	95.0
No. 100 (150 µm)	89.5
No. 200 (75 µm)	79.1

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0530 mm	28.9
0.0376 mm	24.1
0.0267 mm	21.7
0.0189 mm	19.3
0.0138 mm	19.3
0.0098 mm	14.5
0.0070 mm	11.7
0.0035 mm	8.9
0.0015 mm	0.7

Note 1: Specific gravity was measured to be 2.615, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 2.9

% Dispersion = 7.1

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

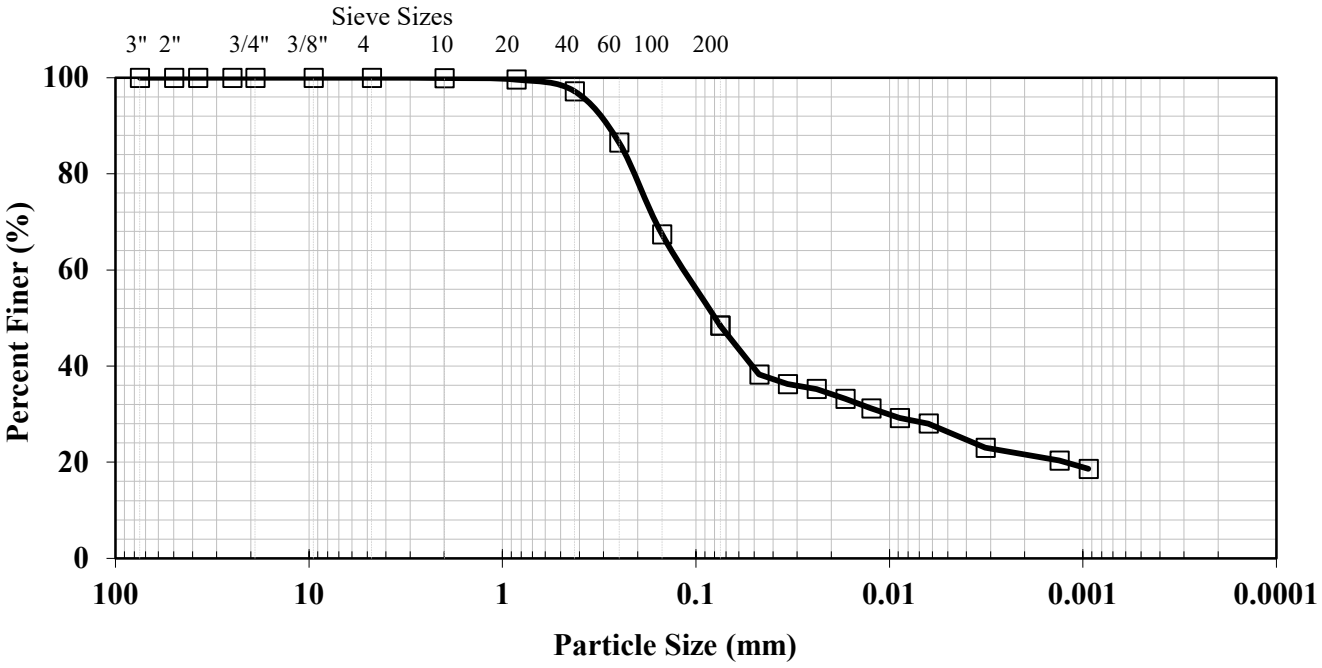
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Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: (203-23, G1&G2) + (205-23, G1&G2) COMP B

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	97.2
No. 60 (250 µm)	86.5
No. 100 (150 µm)	67.4
No. 200 (75 µm)	48.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0472 mm	38.3
0.0336 mm	36.2
0.0238 mm	35.2
0.0170 mm	33.2
0.0125 mm	31.2
0.0089 mm	29.2
0.0063 mm	28.0
0.0032 mm	23.0
0.0013 mm	20.3
0.0009 mm	18.6

Note 1: Specific gravity was measured to be 2.634, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 21.3

D60 (mm)	0.121
D30 (mm)	0.010
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

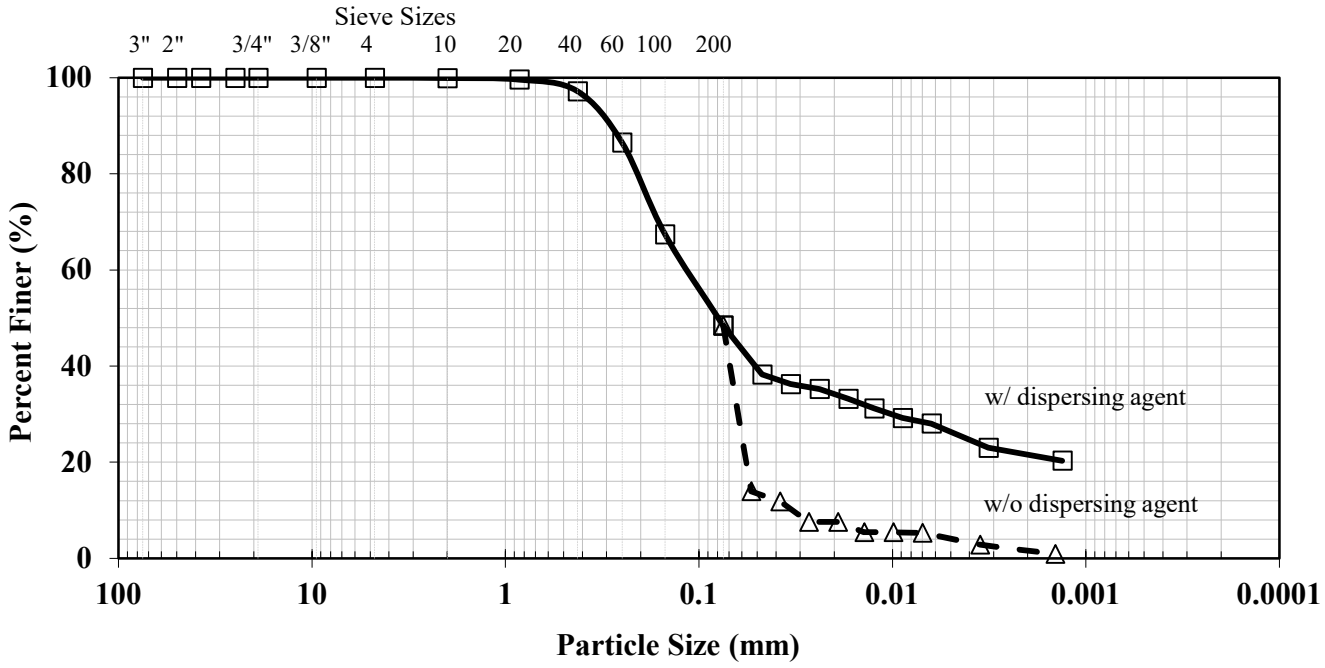
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Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: (203-23, G1&G2) + (205-23, G1&G2) COMP B

Alpine Project No.: 2309348
Test Date: 10/03/23
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)	97.2
No. 60 (250 µm)	86.5
No. 100 (150 µm)	67.4
No. 200 (75 µm)	48.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0537 mm	14.0
0.0381 mm	11.8
0.0271 mm	7.6
0.0191 mm	7.6
0.0140 mm	5.5
0.0099 mm	5.5
0.0070 mm	5.3
0.0035 mm	2.9
0.0014 mm	0.9

Note 1: Specific gravity was measured to be 2.634, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 1.4

% Dispersion = 6.7

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

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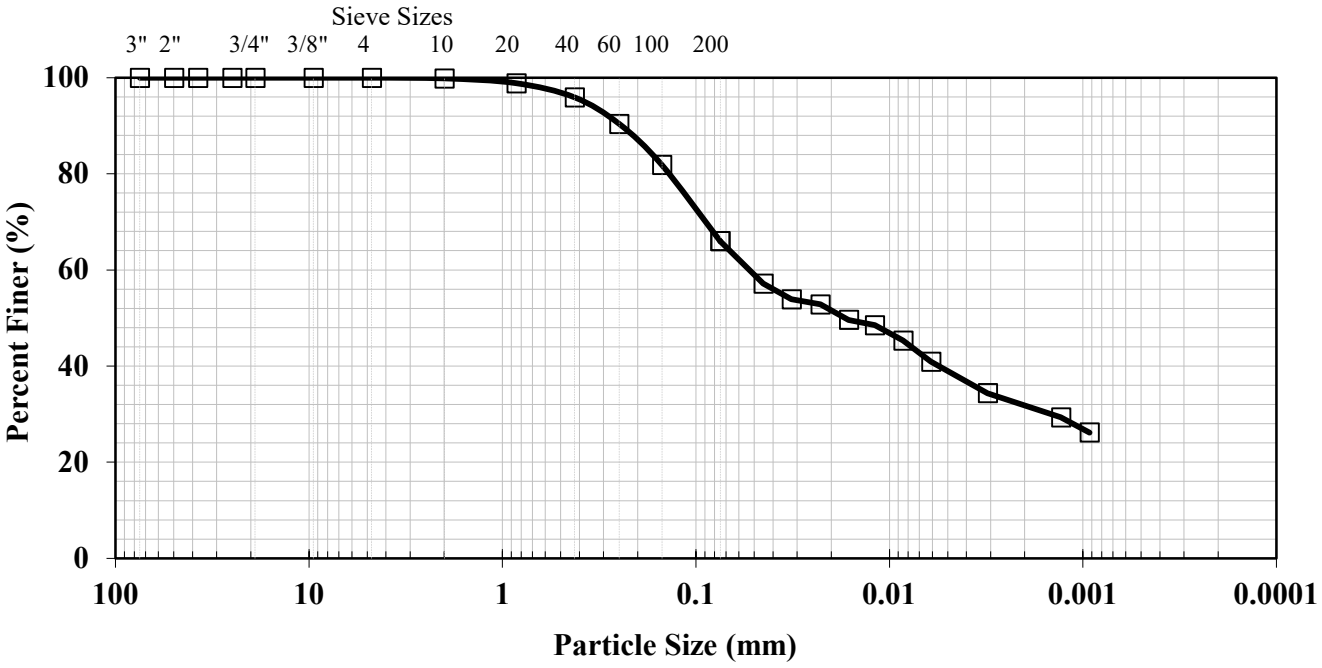
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4 (PN: 2023-135)
Sample ID: 204-23, G1&G2

Alpine Project No.: 2309348
Test Date: 10/03/23
Tested By: T.D.

COMP C



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)	98.9
No. 40 (425 µm)	95.9
No. 60 (250 µm)	90.4
No. 100 (150 µm)	81.9
No. 200 (75 µm)	66.0

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0449 mm	57.2
0.0321 mm	53.9
0.0228 mm	52.8
0.0163 mm	49.6
0.0119 mm	48.5
0.0085 mm	45.3
0.0061 mm	40.9
0.0031 mm	34.4
0.0013 mm	29.3
0.0009 mm	26.2

Note 1: Specific gravity was measured to be 2.634, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 31.3

D60 (mm)	0.055
D30 (mm)	0.002
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

The testing was performed in accordance with applicable industry standard. The results provided in this report do not constitute a professional opinion by Alpine Engineering Services, LLC (Alpine). This report may be used only by the Client and the registered design professional in charge.

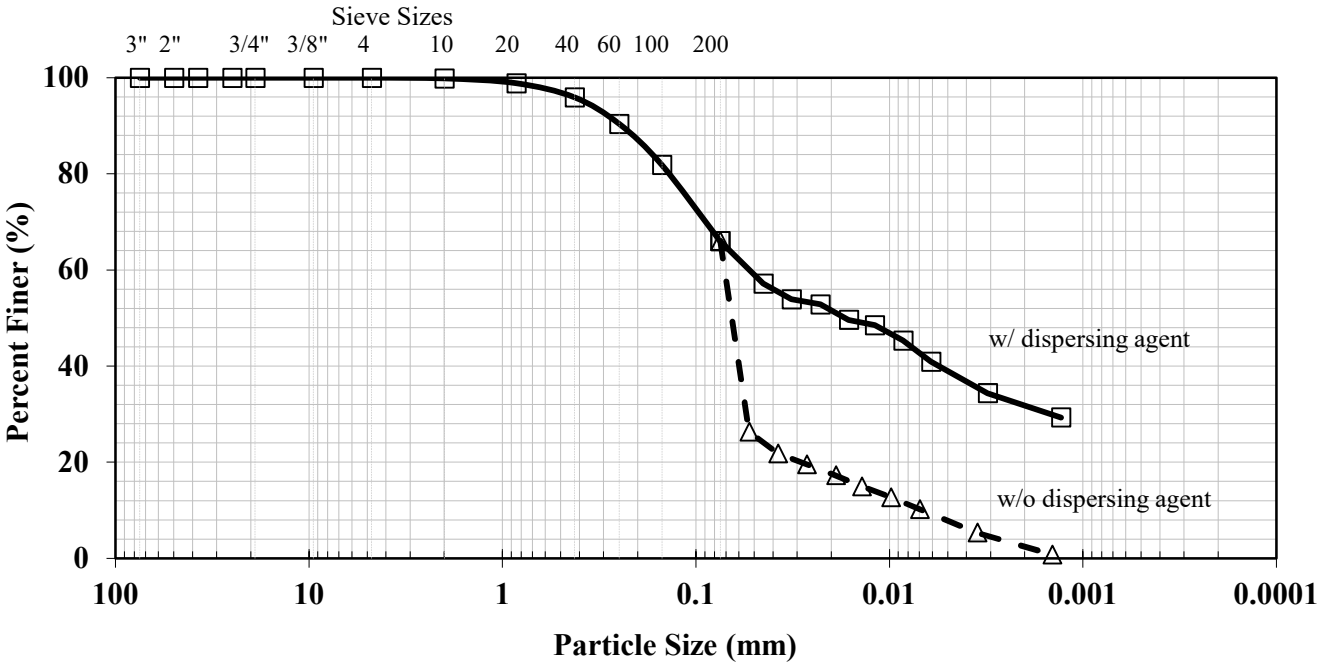
Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

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

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.4
(PN: 2023-135)
Sample ID: 204-23, G1&G2

Alpine Project No.: 2309348
Test Date: 10/03/23
Tested By: T.D.

COMP C



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)	98.9
No. 40 (425 µm)	95.9
No. 60 (250 µm)	90.4
No. 100 (150 µm)	81.9
No. 200 (75 µm)	66.0

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0530 mm	26.4
0.0377 mm	21.8
0.0267 mm	19.5
0.0189 mm	17.2
0.0139 mm	15.0
0.0098 mm	12.7
0.0070 mm	10.2
0.0035 mm	5.3
0.0014 mm	0.8

Note 1: Specific gravity was measured to be 2.634, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 2.0

% Dispersion = 6.4

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/09/23
Reviewed By / Date

The testing was performed in accordance with applicable industry standard. The results provided in this report do not constitute a professional opinion by Alpine Engineering Services, LLC (Alpine). This report may be used only by the Client and the registered design professional in charge.

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 FRS No. 4

Report Date: September 26, 2023 **Arias Report No.:** 2023-135

Soil Description: Lean Clay (CL) with Sand

Material Origin: 201-23 3-5, 202-23, 0-5

Date Sampled: August 11, 2023

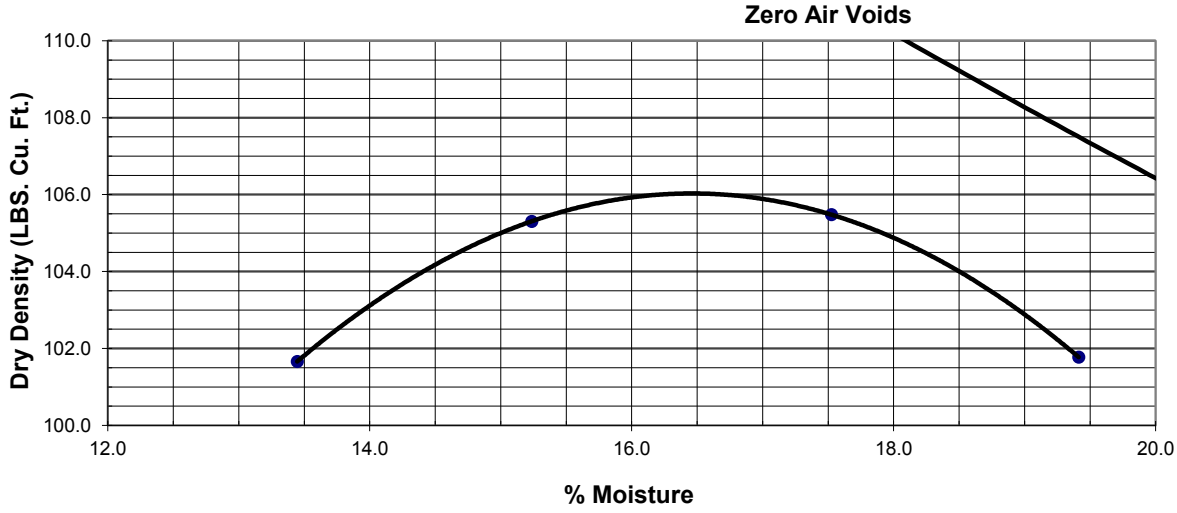
Sampled By: H. Bowman

Test Method: ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool, ASTM D1140 Method B

Application:

Comments:

Test results for sample I.D.:	23-1133
Maximum Dry Density(lb/ft3):	106.0
Optimum Moisture Content (%):	16.5
Liquid Limit:	38
Plasticity Index:	25
(%) Passing No. 200 Sieve:	82
(Estimated) Specific Gravity:	2.6



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

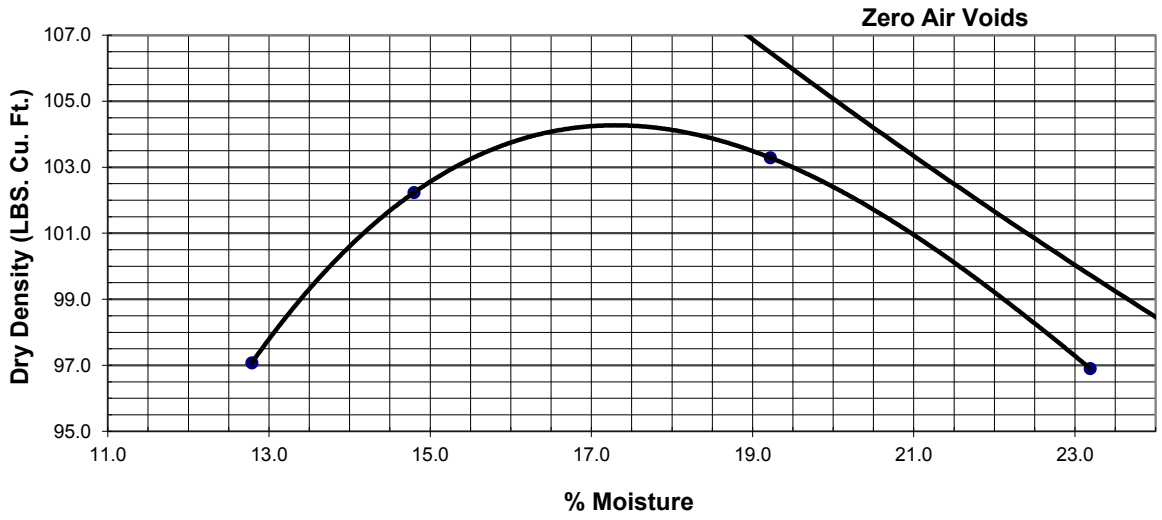
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Kenedy Dam 4

Report Date: October 6, 2023 **Arias Report No.:** 2023-135

Soil Description:	Clay, Gray and brown
Material Origin:	203-23 0-5, 205-23 0-5
Date Sampled:	August 8, 2023
Sampled By:	Larry Arizola
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.:	23-1095
Maximum Dry Density(lb/ft3):	104.3
Optimum Moisture Content (%):	17.2
Liquid Limit:	49
Plasticity Index:	17
(Estimated) Specific Gravity:	2.6



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

Name
Name
XXX/xx

cc:

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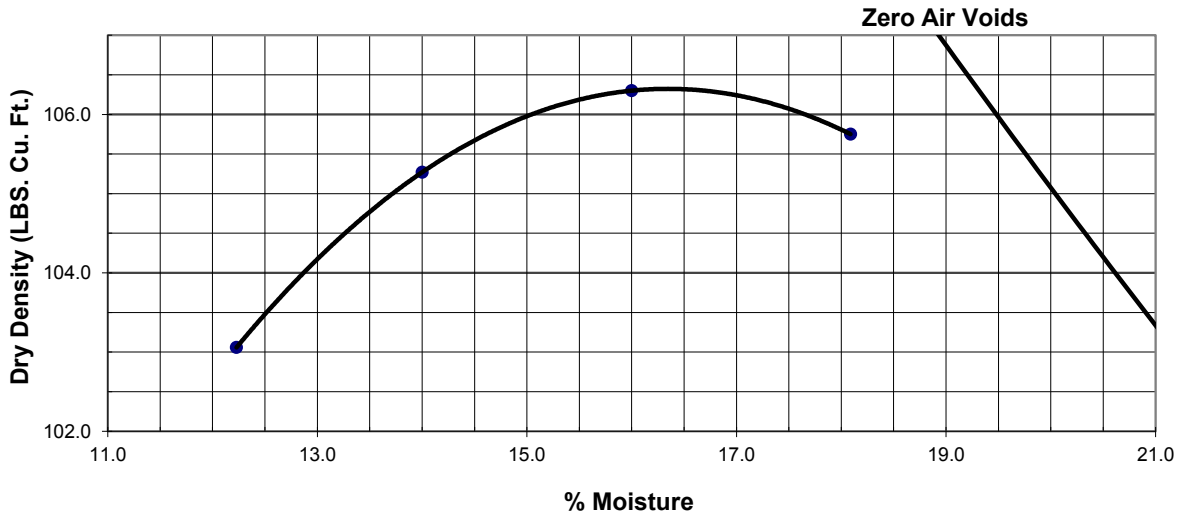
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Kenedy Dam 4

Report Date: October 6, 2023 **Arias Report No.:** 2023-135

Soil Description:	Clay, dark brown
Material Origin:	204-23 3-5, B-2 0-3
Date Sampled:	August 8, 2023
Sampled By:	Larry Arizola
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.:	23-1276
Maximum Dry Density(lb/ft3):	106.4
Optimum Moisture Content (%):	16.3
Liquid Limit:	36
Plasticity Index:	20
(Estimated) Specific Gravity:	2.6



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

Name
Name
XXX/xx

cc: