Geotechnical Baseline Report for the Big Fill Landslide

M.P. 12.8 Wyoming Highway 22

ND32401

Wilson – Idaho State Line

August 2024

Compiled by Seth Wittke

Geology Program

Wyoming Department of Transportation

5300 Bishop Blvd.

Cheyenne, Wyoming 82009

PROFESSIONAL GEOLOGIST
SETH J. WITTKE
PG-3790
WYOMING

8-23-2024

Contents

Introduction

During the night of June 7th, 2024, a 200 foot section of WY-22, and associated fill, failed at what is known locally as the Big Fill (MP 12.8). Road distress on June 6th predated the failure and was evident in the form of roadway cracks and deformed guard rail. Roughly 70 feet of fill, a variable depth of native ground, and both lanes of WY-22 were involved in the landslide. The failure closed the road until a detour could be established to the south, inside the original road alignment curve.

Geologic Setting

Local geologic information, derived from mapping published by Pampeyan (1967), Schroeder (1972), and work done by Zeller (1982), shows a complicated network of thrust faulting and rock of varying lithologies and ages. The area immediately surrounding the Big Fill contains rocks of Cambrian, Ordovician, Mississippian, Triassic, and Cretaceous age thrust in multiple directions and tilted at various angles, in some places near vertical (Fig. 1).

Directly under the Big Fill, Schroeder maps a unit he names “Ku - Sedimentary Rocks, undifferentiated” and describes as “Mainly black shale and brownish-gray-weathering fine-grained ‘salt and pepper’ sandstone.” Although undifferentiated in this specific area, Pampeyan (1967) and Schroeder (1969) map similar units to the west and south respectively as the Aspen Shale and Bear River Formation. It is difficult to determine if the Ku unit is the Aspen Shale or Bear River Formation, or a combination of the two, due to the complicated structure. In addition, Zeller (1982) maps the unit as the Cretaceous-aged Frontier Formation. Regardless of the actual formation present, all potential Cretaceous units in the area are known to include shale and clay.

Schroeder (1972) maps the Cache Creek Fault just north and the Jackson Fault just south of the Big Fill (Fig. 1). The Cache Creek Fault is thrust to the south, placing Triassic Chugwater (siltstone and shale) and Dinwoody formations (siltstone) on top of the Cretaceous undifferentiated rocks. The northward-thrusted Jackson Fault placed

Mississippian Mission Canyon Limestone, Ordovician Bighorn Dolomite, and Cambrian Gallatin Formation (dolomite, limestone, and shale) over the same Cretaceous unit (Fig. 1).

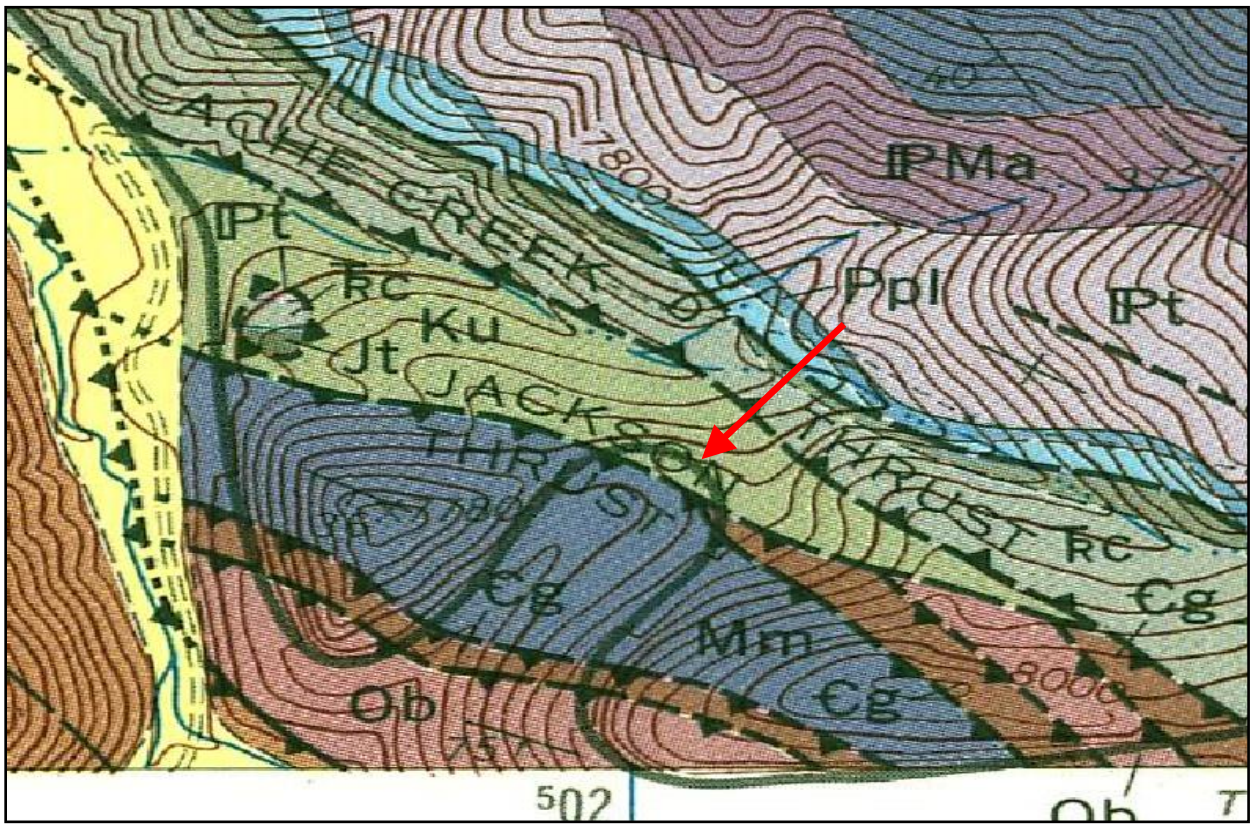


Figure 1. Map taken from Schroeder, 1972. Geologic units are as follows: Gallatin Formation (Cg), Bighorn Dolomite (Ob), Mission Canyon Limestone (Mm), Chugwater Formation (Trc), Darby Formation (Trd), and Sedimentary Undifferentiated (Ku). Big Fill noted by red arrow.

Original Design/Construction

Wyoming Highway 22 was built in the 1960s. The road section known as the “Big Fill” was constructed with an average grade of 10.5%. Based on available plans (Fig 2), the fill is generally 70-75 feet tall to the north, and 40-45 feet to the south. Plans also show the original ground surface under the fill is uneven. It is likely that fill thickness varies appreciably across the Big Fill. Additional construction plans for the fill have proven difficult to locate. However, based on fill exposed by the headscarp of the landslide the material was locally sourced. Likely from the nearby outcropping Mission Creek Limestone, Bighorn Dolomite, and other competent lithologies.

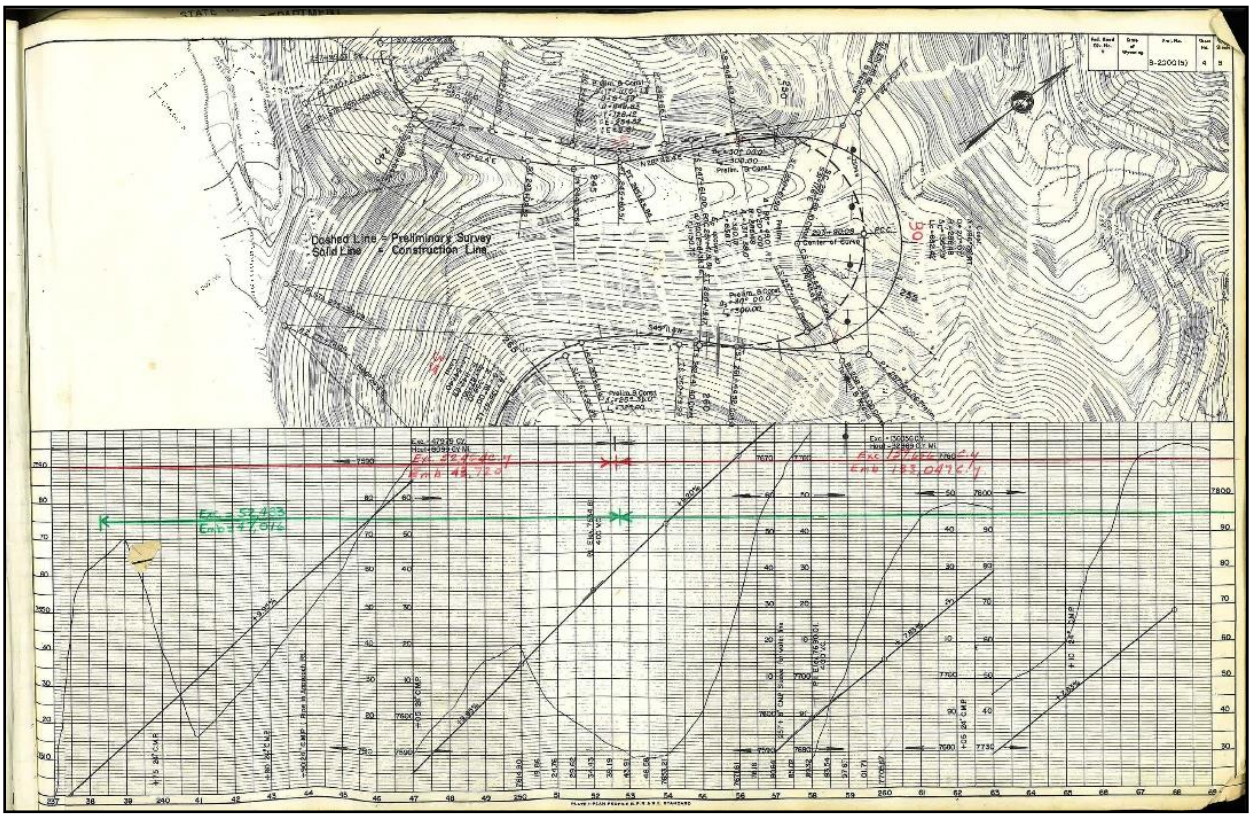


Figure 2. Original plans sheet dated 1964 showing design of the Big Fill

Event Description

Based on conversations with District 3 staff, primarily from the Jackson office, the roadway on the Big Fill has required occasional maintenance for several years. In 2022,

cracks developed in the roadway. In response, WYDOT geologists drilled and logged a borehole on the Big Fill in September of 2022 (SL22-1). The log record shows dense silty sand to a depth of ~50 feet and dense clayey sand with rock (possibly bedrock) to a total borehole depth of 79.5 feet Most recently, a portion of the roadway on the Big Fill was resurfaced in 2023, resulting in ~18 inches of pavement to correct the super elevation and improve ride and plowing conditions. Shortly after resurfacing was complete, WYDOT geologists, with the help of Salisbury Associates, installed an inclinometer tube (TBF-01) just north of the guardrail (SL23-1), near SL22-1 in August of 2023. The inclinometer log shows the borehole passed through the existing fill (~85 feet) into an olive-gray to gray fine grained sandstone. Readings of the inclinometer on May 24th, 2024 showed ~0.10 inches of movement had occurred since instillation (Fig. 3).

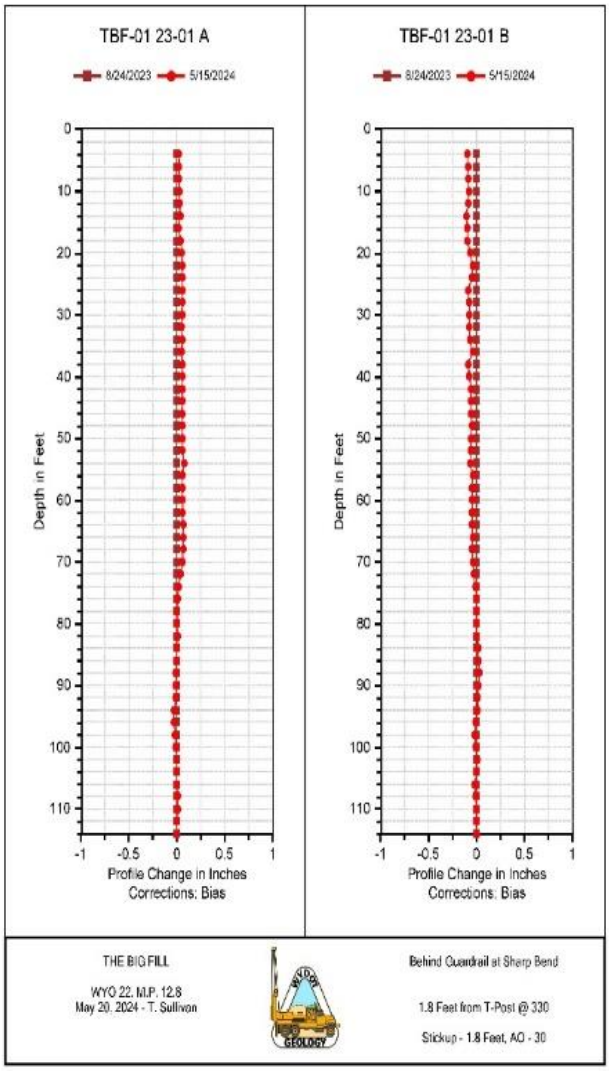


Figure 3. Inclinometer plot showing 0.1" of movement between 08/24/2023 and 05/15/2024.

A significant weather system moved into the area of Teton Pass a week prior to the failure. On June 3rd a U.S. Department of Agriculture SNOTEL site located on Phillips Bench (3

miles east of the Big Fill) recorded a daily rainfall total of 1.2 inches. The same SNOTEL site, and a Bridger-Teton Avalanche Center weather station (MP 12, WY-22) showed a significant increase in temperatures after the precipitation event which continued up to and past the failure event. Perhaps more significantly, the stations show minimum temperatures no longer dropping below freezing after May 30th, a week prior to failure (Fig. 4).

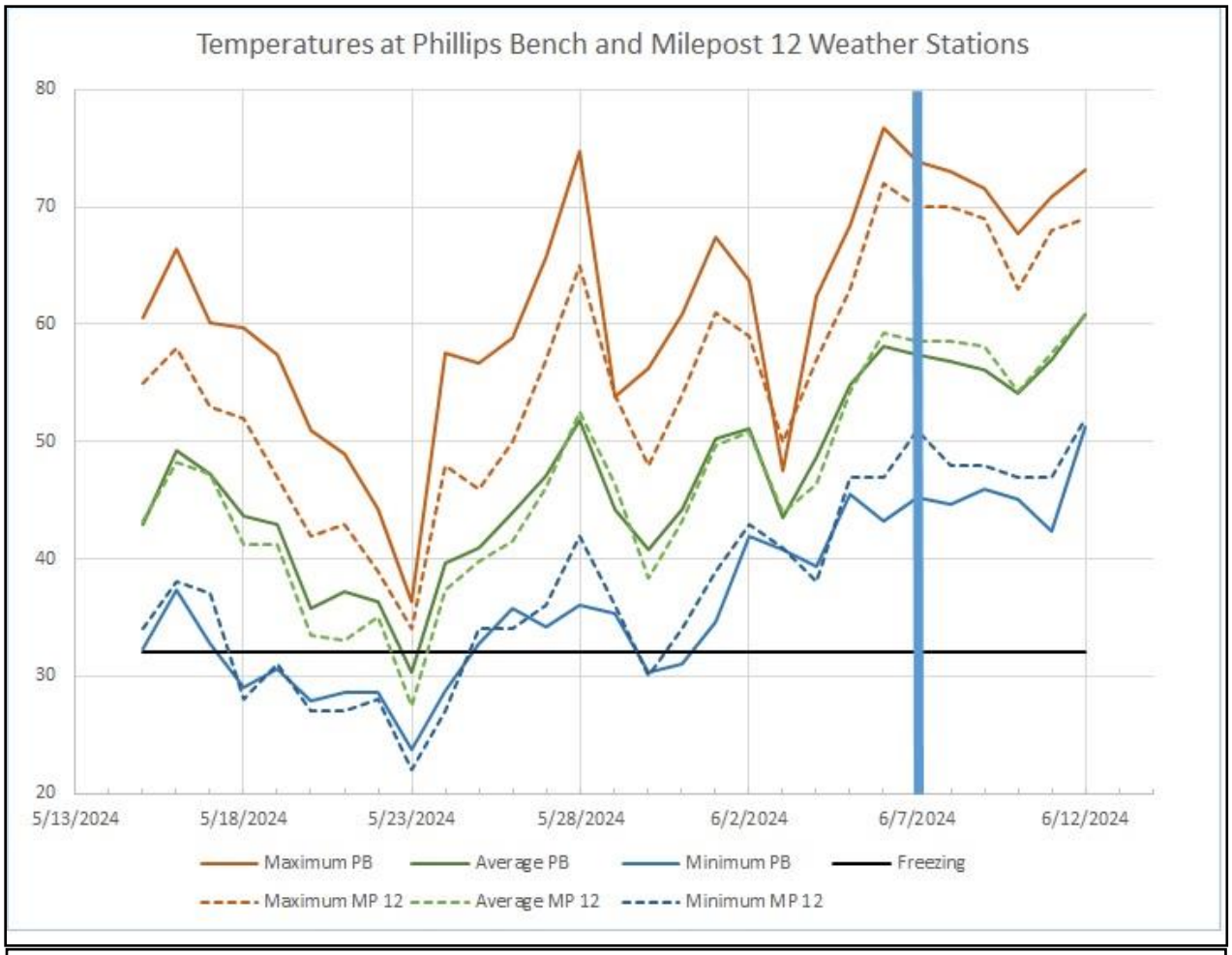


Figure 4. Graph showing maximum, minimum, and average temperatures (F°) at the Phillips Bench (PB) and Milepost 12 (MP 12) weather stations. Black horizontal line denotes 32° F. Blue vertical line denotes June 7th, 2024.

On June 6th a motorcyclist lost control after hitting a bump in the roadway at about MP 12.8. Wyoming Highway Patrol responded and contacted the Jackson regional office to investigate the roadway. Additional road deformation, including sharp bumps and arcuate cracks, was identified. The cracks were marked to monitor potential movement and

sealed by District Maintenance. WY-22 was closed temporarily while the road was being looked at until the determination to reopen the roadway was made. Construction cones were placed around road damage to direct traffic and the road was reopened the afternoon of June 6th. During their investigation staff from the Jackson regional office noted tension cracks in the fill which extended from the arcuate cracks in the roadway north to the base of the fill. Staff also noted a spring, roughly 45 feet below the road surface. The spring was emitting orange mud and water (Fig 5), flows were approximated at less than 1 cfs.

WYDOT geologists mobilized on June 6th, reaching the site on June 7th. Over the night of June 6th, a mudslide overtopped WY-22 at MP 15, closing the road. A forthcoming baseline geotechnical written by T. Sullivan will detail that event. Geologists and Jackson office personnel observed the cracks, filled on the 6th, were noticeably wider, up to 2 inches, and had offset vertically. Paint was used to remark the cracks and lathe was placed and marked for continued measurement purposes. Inclinometer TBF-01, located just north of the westbound guardrail on the fill, was measured and was sheared at 70 feet. Tension cracks in the fill, more prevalent than the day before, were walked by geologists down the fill slope to the north and into the native ground. Cracks were primarily oriented north-to-south, however a few cracks were found in a west-to-east orientation about 50 feet to the north of the fill/native ground transition. The spring continued to emit similar material, however staff noted the flow seemed to have slightly increased from the day before. Returning to the road surface, staff noted that the cracks in the roadway had widened and offset vertically further. Measurements of lathe showed additional vertical displacement of 3 inches over the course of an hour (Fig 5).

Due to the additional movement, it was decided by WYDOT staff to attempt to remove the driving force from the instability by stripping the pavement from the failure. An emergency contract was entered into with Evans Construction (Jackson, WY) to begin removing pavement and guard rail the afternoon of June 7th (Fig. 5). The roadway continued to move as work began on the roadway, reaching up to 6 inches per hour by 6:00 p.m. on June 7th. Work continued until 10:00pm when darkness and crew safety necessitated stoppage.

Overnight on June 7th, a 200 foot length of WY-22 and associated fill failed in a northward direction. The failure plane continued from the shoulder of the eastbound lane, through the fill, and continued into a variable thickness of native ground (Fig. 5). WY-22 had remained closed since the mudflow earlier on June 7th. Instability in the failure continued for roughly 12 hours at which point ground conditions stabilized, excluding an occasional minor rock fall.

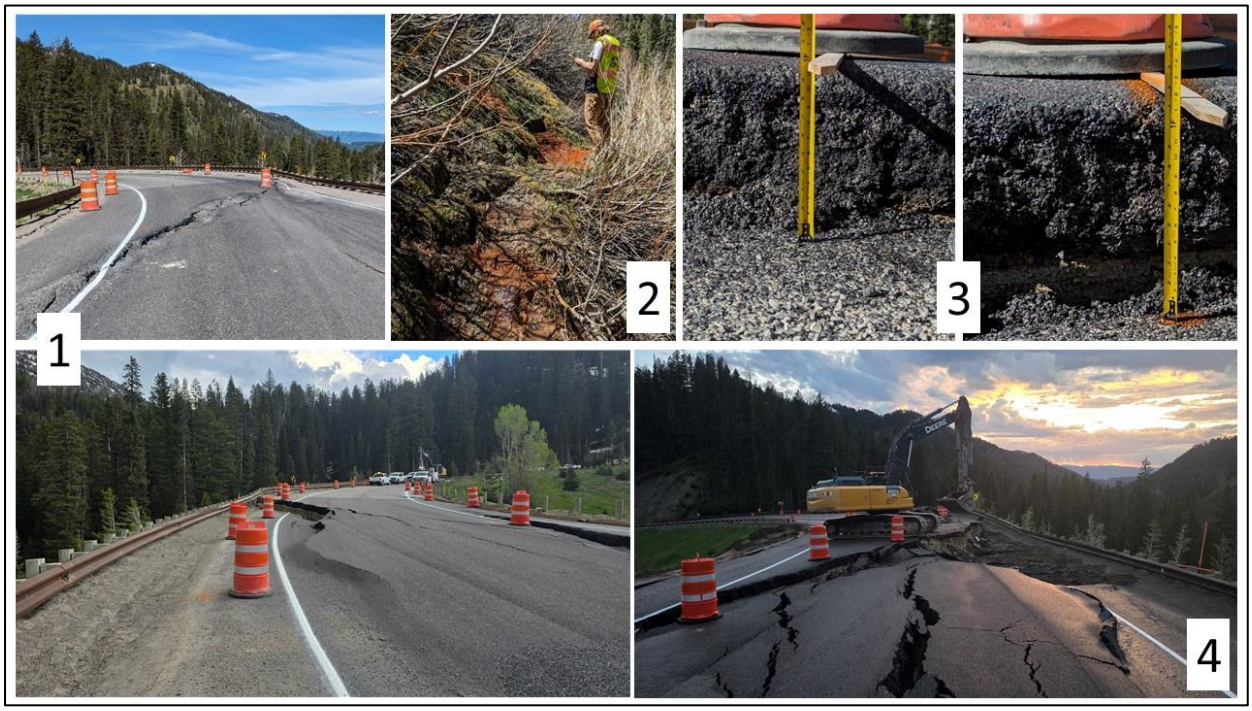


Figure 5. Images taken on June 6th and 7th, prior for failure, showing: 1) Cracking of the roadway, top photo looking west, bottom photo looking east, 2) Spring near base of fill slope with flowing water and orange mud, 3) Observed vertical movement over the course of an hour on June 7th, and 4) Removing pavement to decrease driving forces on the evening of June 7th.

Geotechnical Investigation/Results

Post Event Field Observations

After the failure, a site investigation noted groundwater was seen seeping out of the headscarp at roughly 20 feet below the top of remaining fill (Fig. 6). A second “spring” was encountered at the base of the headscarp (Fig 6). The lower spring is considered to be at, or near, the contact with native ground. The landslide itself is roughly 70,000 square feet in total with a maximum headscarp height of ~70 feet. The free face of the headscarp shows only fill material, native ground is not exposed.

Landslide debris extends downslope, to the north, where it dammed a small creek. Water in the creek had pooled behind the toe of the landslide to a three foot depth, however water was moving under the slide mass, exiting the mass to the west. The slide body is made up of mixed material with no discernable blocks of bedrock. Numerous springs were observed within the body of the slide as well.

Geologists investigated the steep and heavily treed area surrounding the landslide. The perimeter of the landslide was traversed, including hillsides south, east and west of the slide. For the most part the local geology is consistent with Schroeder’s mapping. The small knoll to the west of the Big Fill is made up of Mission Canyon Limestone and the ridge to the east is composed of competent rocks of the Mission Canyon, Bighorn Dolomite and Gallatin Formation. Lower slopes, north of the ridges, are hummocky and contain moist areas (Fig 6).

At the time of site investigation, surface water was flowing towards the Big Fill from the ridge to the east. Water was collecting in a ditch roughly 200 feet up the slope from the roadway borrow (Fig 6) and in the borrow ditch itself. In both cases water was infiltrating into the ground and not continuing at the surface down-drainage. A spring was discharging water at the base of the fill downhill from the ditches but east of the landslide (Fig 6). No apparent surface water was flowing eastward from the knoll, suggesting the majority of the water in the fill embankment originated from the east.

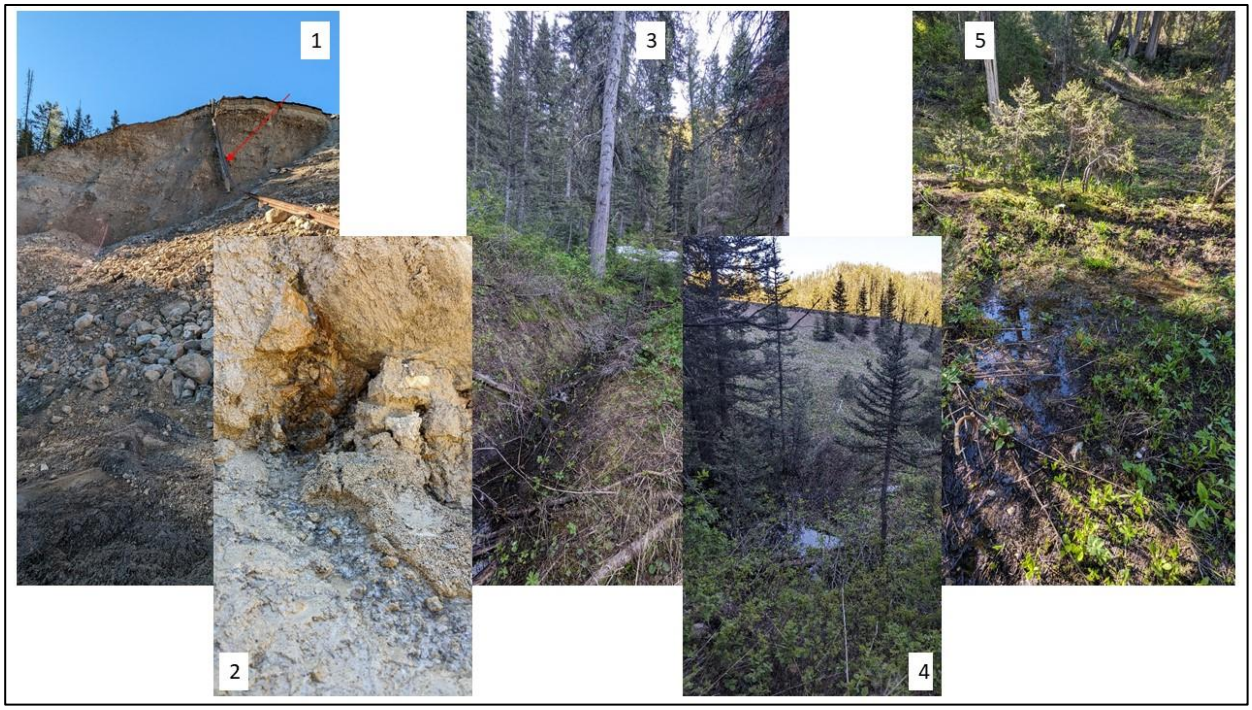


Figure 6. Field images showing: 1) Seep in head scarp (red arrow), 2) Spring at base of head scarp, 3) Man made ditch in forest east of the Big Fill, 4) Spring downhill from ditch, east of the Big Fill, and 5) Hummocky and wet ground west of the Big Fill.

Geotechnical Investigation

In total, 14 boreholes have been drilled in the immediate area of the Big Fill. Prior to the failure, two boreholes, SL22-1 and SL23-1 were completed. Post failure, 12 borehole sites; nine test holes (24-01 – 24-08, 24-11), one water monitoring well (24-10), and two inclinometer tubes (24-09 and 24-12) were drilled (Fig. 7). Full borehole logs with select cross sections and laboratory results for all sites can be found in Appendix A and B respectively.

SL22-1 was drilled in October of 2022 to assess the fill and underlying native ground with rig 823 (CM-75). The borehole reached a depth of 79.5 feet. Although not definitive, native ground was likely encountered at about 50 feet. 10 Standard Penetration Tests (SPTs) were completed in the fill and native ground.

Borehole SL23-1 was drilled to a depth of 115 feet by Salisbury Associates in August of 2023 to install an inclinometer (TBF-01) in response to road distress. An olive-gray to

gray sandstone was encountered at 85 feet and is considered to be the contact between fill and native ground at this site. Two SPTs were completed and samples were submitting for classification to the Foundation Laboratory. A memorandum, written by T. Sullivan, regarding SL23-1 can be found in Appendix C.

Beginning on June 10th, 2024 and continuing for the next three weeks, WYDOT Geology completed 12 boreholes with rig 4001. A split spoon sampler was used to collect 69 samples during Standard Penetration Testing. Of the samples collected, 37 were submitted to the Foundation Lab for characterization. Seven grab samples were also collected, five from existing fill (BF S#1-S#5), one from outcrop east of the landslide (OS-01) and one at site 24-02 for an Alkali Test (Fig. 7). Lab results for samples can be located in Appendix B.

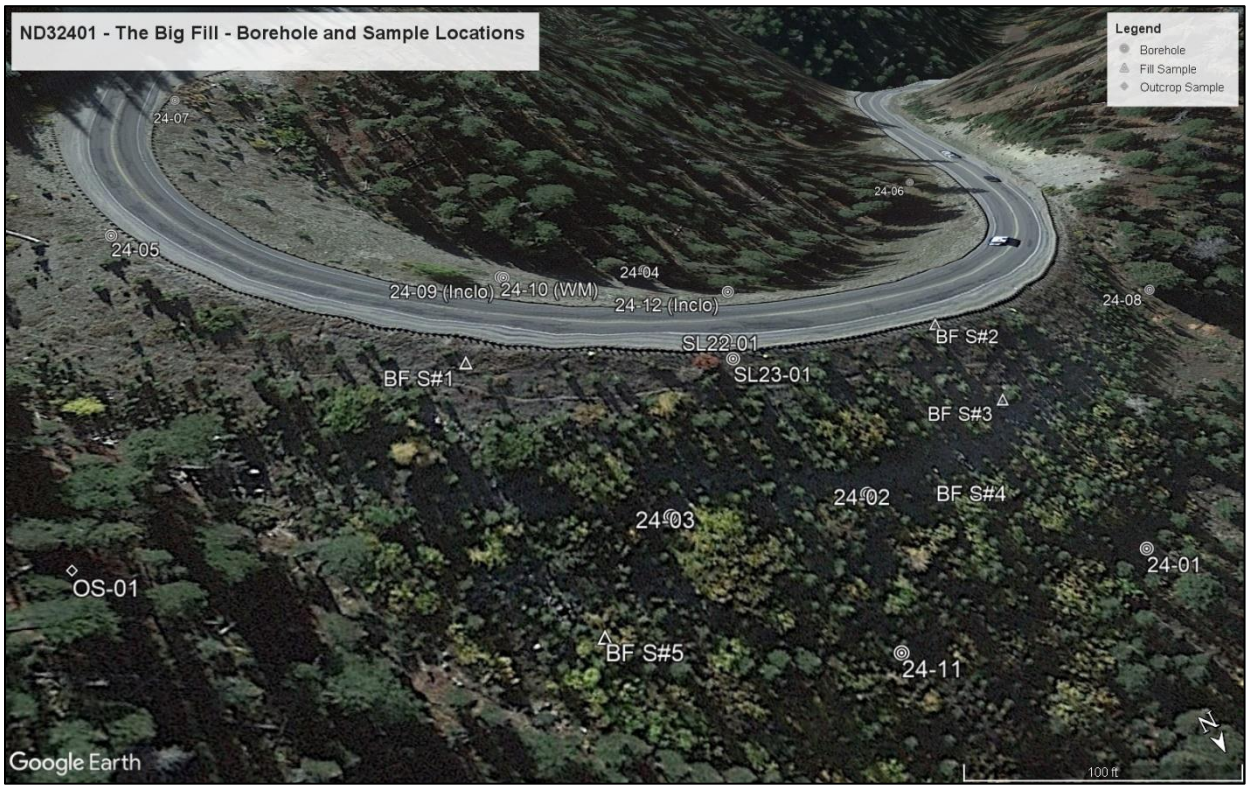


Figure 7. Map showing borehole, fill, and outcrop sample locations at the Big Fill.

Geotechnical Results and Discussion

Classification of samples taken in the fill at sites SL22-01 and SL23-01 show variable percentages of fines passing a #200 sieve. Values range from 9 to 45% depending on the depth of sample (Table 1.) AASHTO classification are primarily group A-1 for fill

samples, however borehole SL22-1 shows an A-4 at a depth of 68feet (7589 feet.) At the time of sampling, moisture content was less than 10%, except for the A-4 sample which shows a slightly higher moisture content of 13.5. Uncorrected N-Values primarily ranged from 13-30, while a higher blow count of 47 was recorded at 58 feet.

SPT tests taken in native ground largely show A-6 classification. The moisture content of the A-6 samples varies from 8 to 21% with an average of 13.5%. Many of the samples taken in the native ground are made up of weathered to un-weathered shale, although there are sandy intervals encountered on occasion. Uncorrected N values range from 10 to refusal depending on depth of sample (Table 1).

Samples from boreholes 24-01, 24-02, 24-08, and a sample collected from an outcrop east of the landslide rated as A-7 (Fat Clay). The fat clay samples obtained from sites 24-01 and 24-02 are comprised of white to gray homogenous clay with moisture contents higher than the A-6 samples (28-33%). Samples 12 and 13, taken from 24-02, were remolded and tested for direct sheer. Results showed a peak ϕ angle of 15 degrees and a residual of 10. Clays sampled at 24-08 and at outcrop are gray-maroon clays with moisture contents of 34 and 17% respectively (Table 1). The elevation of the fat clay layer in boreholes 24-01 and 24-02 is 7536 feet and 7541 feet respectively, thicknesses of the fat clay varies from 16 feet at borehole 24-02 to 6 feet and 22-01. Stratigraphic tops or thicknesses were not obtained at 24-08 or outcrop.

Table 1. Classification results for selected SPT samples

Test Hole	Sample Number	Sample Depth	Lithology	Uncorrected N-Value	AASHTO	< #200	M%
SL22-1							
	1	8.0' - 9.5'	silty gravel with sand	48	A-1-b	18.9	3.8
	2	18.0' - 19.5'	clayey gravel with sand	13	A-2-6(0)	25.3	7.2
	3	28.0' - 29.5'	silty gravel with sand	15	A-1-b	19.4	4.6
	4	38.0' - 39.5'	well-graded gravel with clay and sand	30	A-2-4(0)	8.9	1.8
	5	48.0' - 49.5'	silty clayey gravel with sand	22	A-1-b	19.4	4.8
	6	58.0' - 59.5'	silty gravel with sand	47	A-1-b	23.4	5.3
	7	68.0' - 69.5'	silty gravel with sand	21	A-4(0)	45.3	13.5
	8	78.0' - 79.5'	silty gravel with sand	29	A-1-b	19.5	8.1
SL23-1							
	1	10.5' - 11.5'	silty gravel with sand	21	A-1-a	13.7	1.6

	2	20.5' - 21.5'	poorly graded gravel with silt and sand	12	A-1-a	11.2	5.5
SL 24-1							
	3	18.0' - 19.5'	gravelly lean clay	49	A-6(6)	63.8	10.6
	6	33.5' - 34.5'	fat clay	13	A-7-6(30)	85.6	28.8
	8	43.0' - 43.8'	lean clay with sand	100/0.25'	A-6(7)	84.8	13.9
SL 24-2							
	12	38.5' - 39.5'	Remold with #13	15	NA	NA	NA
	13	43.5' - 44.5'	Remold with #12	27	NA	NA	NA
	14	48.5' - 49.5'	fat clay	18	A-7-6(53)	98.8	33.3
	16	58.5' - 59.5'	lean clay with sand	80	A-6(7)	79.8	8.7
SL 24-3							
	20	32.5' - 33.5'	sandy lean clay	42	A-6(8)	57.8	16.0
	21	37.5' - 38.5'	lean clay	54	A-6(10)	98.1	14.4
	22	42.0' - 43.1'	sandy lean clay	100/1'	A-6(4)	66.9	9.9
SL 24-4							
	24	18.0' - 19.0'	sandy lean clay with gravel	NA	A-6(4)	52.8	16.0
	25	29.5' - 30.5'	silty clay with sand	25	A-4(3)	80.0	15.0
	27	49.5' - 50.5'	lean clay	52	A-6(17)	89.7	14.6
SL 24-5							
	31	29.5' - 30.5'	lean clay with sand	20	A-6(10)	78.4	19.8
	32	39.5' - 40.5'	lean clay with sand	24	A-6(15)	74.3	20.1
	33	49.5' - 50.5'	gravelly lean clay with sand	21	A-6(6)	51.1	13.2
	34	59.5' - 60.5'	sandy lean clay	31	A-6(7)	70.4	21.1
	35	69.0' - 70.2'	lean clay with sand	100/0.7'	A-6(7)	80.0	15.0
SL 24-6							
	36	13.0' - 14.5'	sandy lean clay with gravel	10	A-4(3)	62.7	11.5
SL 24-7							
	43	18.0' - 19.5'	lean clay	16	A-6(14)	92.0	15.8
	49	68.0' - 69.5'	lean clay	56	A-6(21)	89.7	9.5
SL 24-8							
	52	24.0' - 25.5'	fat clay	13	A-7-6(101)	95.0	34.2
	55A	54.0' - 55.0'	silt with sand	98	A-4(0)	71.2	11.9
	55B	55.0' - 55.5'	lean clay	NA	A-4(4)	86.0	8.3
OS-01							
	60	0.0'	sandy lean clay with gravel	NA	A-7-6(9)	56.8	15.2
SL 24-11							
	64 and 65	32.0' - 33.5'	clayey gravel with sand	18	A-6(3)	40.6	9.0
	66	42.0' - 43.5'	clayey gravel with sand	36	A-2-6(2)	30.5	8.1

Based on borehole logs and cross sections (Appendix A), it is expected that bedrock (shale) will be encountered at decreasing elevations to the north in the Big Fill area (Fig. 8). Bedrock can be found at a higher elevation to the south which is consistent with elevation trends shown in the original road plans. The fat clay encountered in 24-01 and

24-02 should be expected at ~7540 feet and higher near borehole 24-08 (7582 feet). Based on the complexity of local geology it is difficult to project any specific lithology or strata between boreholes with confidence. Numerous SPT samples suggest vertical framework within the shales as collected, suggesting steeply dipping geologic units. The logs and cross sections also hint at a complex substructure with varying lithologies which is consistent with the geologic interpretations of Schroeder and Zeller.

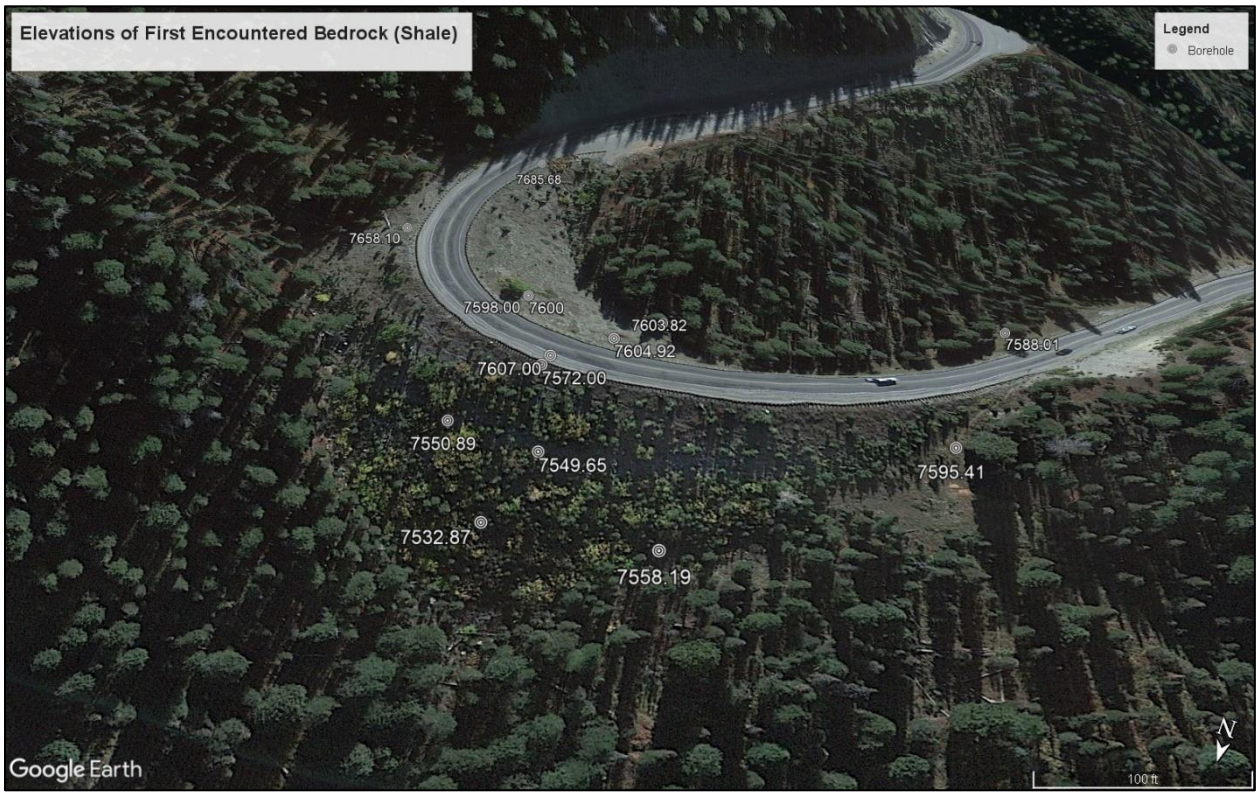


Figure 8. Map showing elevations of first encountered bedrock (shale).

Modeling and Results

WYDOT contracted with RJ Engineering and Consulting, Evergreen, CO, to model the slope failure using internally collected geotechnical information and calculate a Factor of Safety for the post-failure slope and expected detour. Found in Appendix D, the report also makes monitoring recommendations.

References

Pampeyan, E.H., Schroeder, M.L., Schell, E.M., and Cressman, E.R., 1967, Geologic map of the Driggs quadrangle, Bonneville and Teton Counties, Idaho, and Teton County, Wyoming, U.S. Geological Survey, Mineral Investigations Field Studies Map MF-300, 1:31,680.

Schroeder, M.L., 1972, Geologic map of the Rendezvous Peak quadrangle, Teton County, Wyoming, U.S. Geological Survey, Geologic Quadrangle Map GQ-980, 1:24,000.

Zeller, C.G., 1982, Structural Geology Along Teton Pass, Wyoming, Rocky Mountain Association of Geologists Geologic Studies of the Cordilleran Thrust Belt, pg. 831-842, Vol II, 1982

APPENDIX A – BOREHOLE LOGS AND ASSOCIATED CROSS SECTIONS

Borehole logs and cross sections contained in Appendix A were created using BoreDM™ software. Soil and rock descriptions are generalized for display and organization purposes. Laboratory results displayed on logs and cross sections are also found in Appendix B – Borehole and Sample Results, please refer to Appendix B for detailed information.

ND32401 - The Big Fill - Borehole and Cross Section Plan View

Cross section lines are approximate. Lines CS-01, 02, 03, and 04 run West to East. CS-05, 06, and 07 run South to North.

Legend

- Borehole
- Cross Section 01
- Cross Section 02
- Cross Section 03
- Cross Section 04
- Cross Section 05
- Cross Section 06
- Cross Section 07

24-11
24-01
CS-01
24-02
24-03
SL23-01
SL22-01
CS-05
CS-06
CS-07
CS-02
24-12 (Inclo)
24-09 (Inclo)
24-10 (WM)
24-08
CS-03
24-05
24-04
24-06
CS-04
24-07

Google Earth

100 ft

N

WYOMING DEPARTMENT OF TRANSPORTATION

LOG OF BORING

BORING NO. **SL22-1**

PAGE 1 OF 3

PROJECT B229066 (Statewide Slide monitoring) | STATION | NORTHING | LATITUDE 43.503675

LOCATION Wilson-Idaho State Line | OFFSET | EASTING | LONGITUDE -110.975851

DATE STARTED 10/11/2022 | DATE COMPLETED 10/12/2022 | SURFACE ELEVATION 7657 | TYPE SL | TOTAL DEPTH 79.5 ft

DRILLER G. Olson | GEOLOGIST B. Smith | ▽ AT TIME OF DRILLING NATD

DRILL RIG 823-CME 75 | ALKALI SAMPLES | ▼ AFTER N/A

DRILLING METHOD	DRIVE POINT/ DRILL RATE (min/ft)	DEPTH (ft)	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY (ft)	CORE REC % (RQD %)	BLOW COUNTS (N VALUE)	VANE SHEAR (ksf)	USCS	AASHTO CLASSIFICATION	UNCONFINED (ksf)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING #200 (%)	GRAPHIC LOG	MATERIAL DESCRIPTION (Unified (Visual) Classification System for Soil; Graphic Log based on Unified (Visual) Classification; (Consistency, Color, Soil Type, Degree Saturation))	ELEVATION (ft)
8" HSA	D	0														PMP/Patch	1.3
	56															Crushed base	2.5
	106															Dense Silty Sand Dry	
	82																
	56	5															
	30																
	33																
	28																
	38		1	1	0%	08-28-20 (48)		GM	A-1-b		3.8	NV	NP	18.9			
	25	10															10.0
	14															M. Dense silty Sand & Gravel, Dry.	
	22																
	32																
	20																14.0
	40	15														M. Dense silty Sand & Gravel, Dry.	
	37																
	29																
	43																18.0
	95		2	1.5	0%	07-7-6 (13)		GC	A-2-6(0)		7.2	27.8	10.8	25.3		M. Dense clayey sand with small rock (1/4"), moist	
	114	20															22.0
	35																
	40																
	52															M. Dense Clayey Sand & Gravel, Slightly moist	
	33																
	30	25															
	32																
	38																
	53																
	38		3	1	0%	08-8-7 (15)		GM	A-1-b		4.6	NV	NP	19.4			
	31	30															
	82																
	90																
	180																
	160																
	219	35															35.0

BORING LOG W/ LAB DATA W/ DRIVE POINT - WORKING DATA TEMPLATE.GDT - 6/6/24 13:26 - J:\LANDSLIDES\TETON PASS\THE BIG_FILL_WY22_MP12.8\GEIDRAFT\BORINGS.GPJ

(Continued Next Page)

WYOMING DEPARTMENT OF TRANSPORTATION

LOG OF BORING

BORING NO. **SL22-1**

PAGE **2** OF **3**

PROJECT B229066 (Statewide Slide monitoring) | STATION | NORTHING | LATITUDE 43.503675

LOCATION Wilson-Idaho State Line | OFFSET | EASTING | LONGITUDE -110.975851

DATE STARTED 10/11/2022 | DATE COMPLETED 10/12/2022 | SURFACE ELEVATION | TYPE SL | TOTAL DEPTH 79.5 ft

DRILLER G. Olson | GEOLOGIST B. Smith | ▽ AT TIME OF DRILLING NATD

DRILL RIG 823-CME 75 | ALKALI SAMPLES | ▼ AFTER N/A

DRILLING METHOD	DRIVE POINT/ DRILL RATE (min/ft)	DEPTH (ft)	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY (ft)	CORE REC % (RQD %)	BLOW COUNTS (N VALUE)	VANE SHEAR (ksf)	USCS	AASHTO CLASSIFICATION	UNCONFINED (ksf)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING #200 (%)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft)
	204	35														Dense silty Sand & Gravel, Dry.	
	152																
	97																
	160		4	0.9	0%	018-10-20 (30)		GW-GC	A-2-4(0)		1.8	21.5	7.4	8.9			
	180	40															
	88																
	400-6"																
		45															
			5	0.5	0%	08-10-12 (22)		GC-GM	A-1-b		4.8	18.5	5.2	19.4			
		50														50.0	
																Dense clayey sand with rock, possibly Bedrock	
		55															
			6	0.5	0%	014-32-15 (47)		GM	A-1-b		5.3	NV	NP	23.4			
		60															
		65															
			7	1.5	0%	08-6-15 (21)		GM	A-4(0)		13.5	30.8	5.9	45.3			
		70															

Unified (Visual) Classification System for Soil
Graphic Log based on Unified (Visual) Classification
(Consistency, Color, Soil Type, Degree Saturation)

BORING LOG W/ LAB DATA W/ DRIVE POINT - WORKING DATA TEMPLATE.GDT - 6/6/24 13:26 - J:\LANDSLIDES\TETON PASS\THE BIG_FILL_WY22_MP12.8\GEIDRAFT\BORINGS.GPJ

(Continued Next Page)

WYOMING DEPARTMENT OF TRANSPORTATION

LOG OF BORING

BORING NO. **SL22-1**

PAGE **3** OF **3**

PROJECT B229066 (Statewide Slide monitoring) **STATION** _____ **NORTHING** _____ **LATITUDE** 43.503675

LOCATION Wilson-Idaho State Line **OFFSET** _____ **EASTING** _____ **LONGITUDE** -110.975851

DATE STARTED 10/11/2022 **DATE COMPLETED** 10/12/2022 **SURFACE ELEVATION** _____ **TYPE** SL **TOTAL DEPTH** 79.5 ft

DRILLER G. Olson **GEOLOGIST** B. Smith ▽ **AT TIME OF DRILLING** NATD

DRILL RIG 823-CME 75 **ALKALI SAMPLES** _____ ▼ **AFTER** N/A

DRILLING METHOD	DRIVE POINT/ DRILL RATE (min/ft)	DEPTH (ft)	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY (ft)	CORE REC % (RQD %)	BLOW COUNTS (N VALUE)	VANE SHEAR (ksf)	USCS	AASHTO CLASSIFICATION	UNCONFINED (ksf)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING #200 (%)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft)
		70														Unified (Visual) Classification System for Soil Graphic Log based on Unified (Visual) Classification (Consistency, Color, Soil Type, Degree Saturation)	
		75	8	1.5	0%	015-13-16 (29)		GM	A-1-b		8.1	NV	NP	19.5		Dense clayey sand with rock, possibly Bedrock *(continued)* 79.5	

Bottom of borehole at 79.5 feet.

BORING LOG W/ LAB DATA W/ DRIVE POINT - WORKING DATA TEMPLATE.GDT - 6/6/24 13:26 - J:\LANDSLIDES\TETON PASS\THE BIG_FILL_WY22_MP12.8\GE\DRAFT\BORINGS.GPJ

WYOMING DEPARTMENT OF TRANSPORTATION

LOG OF BORING

BORING NO. **SL23-01**

PAGE **1** OF **4**

PROJECT B229066 (Statewide Slide monitoring) **STATION** _____ **NORTHING** _____ **LATITUDE** 43.503704

LOCATION Wilson-Idaho State Line **OFFSET** _____ **EASTING** _____ **LONGITUDE** -110.97584

DATE STARTED 08/01/2023 **DATE COMPLETED** 08/04/2023 **SURFACE ELEVATION** _____ **TYPE** SL **TOTAL DEPTH** 115 ft

DRILLER Caleb Zemmer **GEOLOGIST** T. Sullivan ▽ **AT TIME OF DRILLING** NATD

DRILL RIG LF70 **ALKALI SAMPLES** _____ ▼ **AFTER** N/A

DRILLING METHOD	DRIVE POINT/ DRILL RATE (min/ft)	DEPTH (ft)	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY (ft)	CORE REC % (RQD %)	BLOW COUNTS (N VALUE)	VANE SHEAR (ksf)	USCS	AASHTO CLASSIFICATION	UNCONFINED (ksf)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING #200 (%)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft)
2 3/8" CORE BARREL		0														Unified (Visual) Classification System for Soil Graphic Log based on Unified (Visual) Classification (Consistency, Color, Soil Type, Degree Saturation)	
		5														Sand, gravelly, loose, light tan *Mostly plow sand - <1/2"* 6.5	
		10	1	0.7	0%	05-6-15 (21)										Boulder/cobbles, limestone, gray, hard 10.0	
		15														Gravel, sandy with random Cobbles and Boulders, dense *Isolated clayey zones - lots of washout*	
		20	2	0.5	0%	04-5-7 (12)											
		25															
		30															
		35															

BORING LOG W/ LAB DATA W/ DRIVE POINT - WORKING DATA TEMPLATE.GDT - 6/6/24 13:26 - J:\LANDSLIDES\TETON PASS\THE BIG_FILL_WY22_MP12.8\GEI\DRAFT\BORINGS.GPJ

(Continued Next Page)

WYOMING DEPARTMENT OF TRANSPORTATION

LOG OF BORING

BORING NO. **SL23-01**

PAGE **2** OF **4**

PROJECT B229066 (Statewide Slide monitoring) | STATION | NORTHING | LATITUDE 43.503704

LOCATION Wilson-Idaho State Line | OFFSET | EASTING | LONGITUDE -110.97584

DATE STARTED 08/01/2023 | DATE COMPLETED 08/04/2023 | SURFACE ELEVATION | TYPE SL | TOTAL DEPTH 115 ft

DRILLER Caleb Zemmer | GEOLOGIST T. Sullivan | ▽ AT TIME OF DRILLING NATD

DRILL RIG LF70 | ALKALI SAMPLES | ▼ AFTER N/A

DRILLING METHOD	DRIVE POINT/ DRILL RATE (min/ft)	DEPTH (ft)	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY (ft)	CORE REC % (RQD %)	BLOW COUNTS (N VALUE)	VANE SHEAR (ksf)	USCS	AASHTO CLASSIFICATION	UNCONFINED (ksf)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING #200 (%)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft)
		35														Gravel, sandy with random Cobbles and Boulders, dense *(continued)*	
		40															
		45															
		50															
		55															
		60															
		65															
		70															

Unified (Visual) Classification System for Soil
Graphic Log based on Unified (Visual) Classification
(Consistency, Color, Soil Type, Degree Saturation)

BORING LOG W/ LAB DATA W/ DRIVE POINT - WORKING DATA TEMPLATE.GDT - 6/6/24 13:26 - J:\LANDSLIDES\TETON PASS\THE BIG_FILL_WY22_MP12.8\GEI\DRAFT\BORINGS.GPJ

(Continued Next Page)

WYOMING DEPARTMENT OF TRANSPORTATION

LOG OF BORING

BORING NO. SL23-01

PAGE 3 OF 4

PROJECT B229066 (Statewide Slide monitoring) STATION _____ NORTHING _____ LATITUDE 43.503704

LOCATION Wilson-Idaho State Line OFFSET _____ EASTING _____ LONGITUDE -110.97584

DATE STARTED 08/01/2023 DATE COMPLETED 08/04/2023 SURFACE ELEVATION _____ TYPE SL TOTAL DEPTH 115 ft

DRILLER Caleb Zemmer GEOLOGIST T. Sullivan ▽ AT TIME OF DRILLING NATD

DRILL RIG LF70 ALKALI SAMPLES _____ ▼ AFTER N/A

DRILLING METHOD	DRIVE POINT/ DRILL RATE (min/ft)	DEPTH (ft)	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY (ft)	CORE REC % (RQD %)	BLOW COUNTS (N VALUE)	VANE SHEAR (ksf)	USCS	AASHTO CLASSIFICATION	UNCONFINED (ksf)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING #200 (%)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft)
		70														Unified (Visual) Classification System for Soil Graphic Log based on Unified (Visual) Classification (Consistency, Color, Soil Type, Degree Saturation)	
																Gravel, sandy with random Cobbles and Boulders, dense *(continued)*	
		75															
		80															
		84.8															
		85														Sandstone, olive-gray to gray, hard, fine-grained, fractured *Predominantly 45 to 65 degree fractures. Sandstone is slightly weaker and weathered below 104 feet.*	
		90															
		95															
		100															
		105															

BORING LOG W/ LAB DATA W/ DRIVE POINT - WORKING DATA TEMPLATE.GDT - 6/6/24 13:26 - J:\LANDSLIDES\TETON PASS\THE BIG_FILL_WY22_MP128\GEI\DRAFT\BORINGS.GPJ

(Continued Next Page)

WYOMING DEPARTMENT OF TRANSPORTATION

LOG OF BORING

BORING NO. **SL23-01**

PAGE **4** OF **4**

PROJECT B229066 (Statewide Slide monitoring) **STATION** _____ **NORTHING** _____ **LATITUDE** 43.503704

LOCATION Wilson-Idaho State Line **OFFSET** _____ **EASTING** _____ **LONGITUDE** -110.97584

DATE STARTED 08/01/2023 **DATE COMPLETED** 08/04/2023 **SURFACE ELEVATION** _____ **TYPE** SL **TOTAL DEPTH** 115 ft

DRILLER Caleb Zemmer **GEOLOGIST** T. Sullivan ▽ **AT TIME OF DRILLING** NATD

DRILL RIG LF70 **ALKALI SAMPLES** _____ ▼ **AFTER** N/A

DRILLING METHOD	DRIVE POINT/ DRILL RATE (min/ft)	DEPTH (ft)	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY (ft)	CORE REC % (RQD %)	BLOW COUNTS (N VALUE)	VANE SHEAR (ksf)	USCS	AASHTO CLASSIFICATION	UNCONFINED (ksf)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING #200 (%)	GRAPHIC LOG	MATERIAL DESCRIPTION Unified (Visual) Classification System for Soil Graphic Log based on Unified (Visual) Classification (Consistency, Color, Soil Type, Degree Saturation)	ELEVATION (ft)
		105														Sandstone, olive-gray to gray, hard, fine-grained, fractured *(continued)*	
		110															
		115														115.0	

Bottom of borehole at 115.0 feet.

BORING LOG W/ LAB DATA W/ DRIVE POINT - WORKING DATA TEMPLATE.GDT - 6/6/24 13:26 - J:\LANDSLIDES\TETON PASS\THE BIG_FILL_WY22_MP12.8\GEI\DRAFT\BORINGS.GPJ

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.504025/-110.976332 SOIL BORING: 24-01

Project Number:	ND32401	Drilling Date:	06/11/2024	Drilling Completed:	06/11/2024
Driller:	Craig Walker	Logger:	Todd Sullivan	Method:	Auger
Surface Elevation:	7571.69'	Lat / long:	43.504025, -110.976332	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Brown, moist, **Lean Clay**		7570
	5												7565
		8 ft	1		2-7-9 (16)	1.5							
	10												7560
		13 ft	2		15-27-19 (46)	1.5					13.5		
	15										Siltstone, dark gray, Hard, very fractured with clay infilling. Fault gouge in lower unit.		7555
		18 ft	3		13-25-24 (49)	1.5	240187	31-17-14	10.6		18.8		
	20										Weathered shale, tan to gray, silty, weathered		7550
		23 ft	4		20-48-52 (100/11.5"')	0.9					23.5		
											Shale, black		

▽ After Drilling (AD)	Weathered Shale
After Drilling (AD)	Shale
Lean Clay	SPT - Standard Penetration Test
Siltstone	-

Depth	Comment
3.5	Water encountered 3.5 hours after drilling @ 3.5' on 06/11
0	Water encountered 6.0 hours after drilling @ 0' on 06/11

24

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.504025/-110.976332 SOIL BORING: 24-01

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Sample Number	Sample Graphic	Blow Counts (N/Refusal)	Recovery Length (ft)	Lab: Lab Sample ID	Atterberg Limits (LL-PL-PI)	Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Shale, black		7545
		28 ft											
			5		10-15-12 (27)	1.5							
	30												7540
											32.0		
		33 ft									Light gray to white gray, slightly moist to moist, **Fat Clay** (CH), Stiff, uniform		
			6		4-4-9 (13)	1.5	240188	51-16-35	28.8				
	35												7535
		38 ft											
			7		5-16-57 (73)	1.5							
											38.8		
											Siltstone, black		
	40										41.0		7530
											Shale, gray, laminated with horizontal partings		
		43 ft											
			8		66-100 (100/3"')	0.5	240189	27-16-11	13.9				
											43.8		
	45												7525

Shale	Siltstone
CH	SPT

Depth	Comment
3.5	Water encountered 3.5 hours after drilling @ 3.5' on 06/11
0	Water encountered 6.0 hours after drilling @ 0' on 06/11

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503883/-110.975928 SOIL BORING: 24-02

Project Number:	ND32401	Drilling Date:	06/11/2024	Drilling Completed:	06/11/2024
Driller:	Craig Walker	Logger:	Todd Sullivan	Method:	Auger
Surface Elevation:	7585.65'	Lat / long:	43.503883, -110.975928	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
	5										**Cobbles and Boulders**		7585
											5.0		
											Gravel		7580
		8 ft	9		1-3-3 (6)	0.2							
	10												7575
	15												7570
		18 ft	10		3-8-10 (18)	1							
	20										20.0		
											Mixed Material		7565

Cobbles and Boulders		Mixed Material	
Gravel		SPT - Standard Penetration Te	

Depth	Comment
-	-
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503883/-110.975928

SOIL BORING: 24-02

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Mixed Material		7560
		28 ft											
			11		27-13-23 (36)	1.5							
	30												7555
	35												7550
											36.0		
											Fat Clay (CH), light gray to blueish white, stiff, slightly moist to moist, very uniform		
		38 ft											
			12		3-5-10 (15)	1.5	240190						
	40												7545
		43 ft											
			13		5-12-15 (27)	1.5	240191						
	45												7540
		48 ft											
			14		4-7-11 (18)	1.5	240192	67-20-47	33				

Mixed Material	SPT
CH	-

Depth	Comment
-	-
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503883/-110.975928 SOIL BORING: 24-02

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Fat Clay (CH), light gray to blueish white, stiff, slightly moist to moist, very uniform		7535
											52.0		
		53 ft									Shale, Gray, Very Stiff to Very Hard, Dry to Wet above 55 feet		
			15		6-12-18 (30)	0							
	55												7530
		58 ft											
			16		12-20-60 (80)	0.7	240193	26-14-12	9				
	60												7525
		63 ft											
			17		x-100 (100/2"')						63.2		
	65												7520
	70												7515

CH	SPT - Standard Penetration Tes
Shale	-

Depth	Comment
-	-
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503836/-110.975625 **SOIL BORING: 24-03**

Project Number:	ND32401	Drilling Date:	06/12/2024	Drilling Completed:	06/12/2024
Driller:	Craig Walker	Logger:	Todd Sullivan	Method:	Auger
Surface Elevation:	7576.89'	Lat / long:	43.503836, -110.975625	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
X											**Cobbles and Boulders**, Pockets of slightly moist clayey Sand.		7575
8													
5													
7													
10													
10	5												7570
13													
16													
19													
46													
32	10												
21													
▼		12 ft											7565
20			18		4-8-11 (19)	0.5							
▽ 34													
20													
17	15												
35													7560
30													
70													
53													
26	20												
36													
		22 ft											7555
45			19		7-13-87 (100)	0.5							
44													
38													

▽	At Time of Drilling (ATD)		Cobbles and Boulders
▼	After Drilling (AD)		SPT

Depth	Comment
13	Water encountered 1 hours after drilling @ 13' on 06/11 ▽
12	Water encountered 24 hours after drilling @ 12' on 06/12 ▼

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503836/-110.975625 SOIL BORING: 24-03

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Sample Number	Sample Graphic	Blow Counts (N/Refusal)	Recovery Length (ft)	Lab: Lab Sample ID	Atterberg Limits (LL-PL-PI)	Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
35											**Cobbles and Boulders**, Pockets of slightly moist clayey Sand.		
26											26.0		
28											Weathered shale, gray, hard, dry to wet. WeatheredThin shear zones with fine siltstone fragments in clay matrix		7550
22													
15													
15	30												
18		32 ft											7545
27			20		13-18-24 (42)	0.5	240194	32-13-19	16.0				
33													
47													
66	35												
86											36.0		
100/8"		37 ft									Shale, looks undisturbed		7540
			21		13-22-32 (54)	1.5	240195	30-19-10	14.4				
	40												
		42 ft											7535
			22		26-50-50 (100/1')	1	240196	24-13-11	9.9				
	45												
											46.0		
		47 ft									Sandstone, Shaley, gray, very hard, saturated		7530
			23		x-100 (100/.75"')	0.01					47.1		

Cobbles and Boulders		Sandstone	
Weathered Shale		SPT	
Shale		-	

Depth	Comment
13	Water encountered 1 hours after drilling @ 13' on 06/11
12	Water encountered 24 hours after drilling @ 12' on 06/12

30

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503253/-110.976015 **SOIL BORING: 24-04**

Project Number:	ND32401	Drilling Date:	06/12/2024	Drilling Completed:	06/12/2024
Driller:	Craig Walker	Logger:	Todd Sullivan	Method:	Auger
Surface Elevation:	7615.82'	Lat / long:	43.503253, -110.976015	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
	0										**FILL**, slightly moist, **Well-graded Fill** with **Clay**, Placed recently		7615
	5												7610
	10												7605
	15	18 ft	24				240197	29-16-13	16		12.0 Soft to medium stiff, moist to wet, **Lean Clay** (CL), with fine grained Gravel		7600
	20										22.0 **Silty Clay** (CL-ML), Clay, silty with isolated fine Gravel, tan, very stiff, sl. moist, intact and undisturbed		7595

At Time of Drilling (ATD)	CL-ML
Well-graded Fill	Grab - Grab Sample
CL	-

Depth	Comment
15	Water encountered .2 hours after drilling @ 15' on 06/12
-	-

31

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503253/-110.976015 SOIL BORING: 24-04

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Silty Clay (CL-ML), Clay, silty with isolated fine Gravel, tan, very stiff, sl. moist, intact and undisturbed		7590
		29 ft											
	30		25		11-11-14 (25)	1.2	240198	24-17-7	15				7585
	35										35.5		7580
											Shale, hard, gray with wet zones. Fine siltstone fragments		
		39 ft											
	40		26		28-50-50 (100/1')	1							7575
	45												7570
		49 ft											
			27		10-18-34 (52)	1	240199	36-16-20	14.6				

CL-ML	SPT
Shale	-

Depth	Comment
15	Water encountered .2 hours after drilling @ 15' on 06/12
-	-

32

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503253/-110.976015 SOIL BORING: 24-04

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
		50 ft	27		10-18-34 (52)	1	240199	36-16-20	14.6		Shale, hard, gray with wet zones. Fine siltstone fragments		7565
											53.0		
		54 ft									Siltstone, shaley, dry, Shaley, pulverized, dry		
			28		x-100 (100/2"')	0.1					54.2		
	55												7560
	60												7555
	65												7550
	70												7545

Depth	Comment
15	Water encountered .2 hours after drilling @ 15' on 06/12
-	-

Shale	SPT - Standard Penetration Test
Siltstone, shaley, dry	-

33

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503167/-110.975008 SOIL BORING: 24-05

Project Number:	ND32401	Drilling Date:	06/13/2024	Drilling Completed:	06/13/2024
Driller:	Craig Walker	Logger:	Todd Sullivan	Method:	Auger
Surface Elevation:	7681.10'	Lat / long:	43.503167, -110.975008	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
	0										**Fill**, Pad Fill: Gravel, sandy with Cobbles, dry, angular		7680
	5										5.0 **Fill**, Embankment Fill: Sand, gravelly with Clay and Cobbles, medium dense, sl. moist to moist, tan, limestone clasts		7675
		7 ft	29		8-6-5 (11)	1.2							
	10												7670
	15												7665
		19 ft	30		6-7-10 (17)	0.8							
	20												7660
											23.0 **Lean Clay** (CL), Clay, olive brown, medium to very stiff, sl. moist, minor carbonaceous layers and fine gravel 25.0		

Fill		SPT	
CL		-	

Depth	Comment
30.5	Water encountered .2 hours after drilling @ 30.5' on 06/13
30.5	Water encountered 3 hours after drilling @ 30.5' on 06/13

34

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503167/-110.975008 SOIL BORING: 24-05

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
		29 ft									**Lean Clay** (CL), Clay, olive brown, medium to very stiff, sl. moist, minor carbonaceous layers and fine gravel		7655
	30		31		10-10-10 (20)	1.1		30-14-16	19.8				7650
	35	39 ft	32		6-11-13 (24)	1.4		37-14-23	20.1				7645
	40												7640
	45	49 ft	33		6-10-11 (21)	1		32-12-20	13.2				7635

At Time of Drilling (ATD)	CL		
After Drilling (AD)	SPT		

Depth	Comment
30.5	Water encountered .2 hours after drilling @ 30.5' on 06/13
30.5	Water encountered 3 hours after drilling @ 30.5' on 06/13

35

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503167/-110.975008 SOIL BORING: 24-05

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
		50 ft	33		6-10-11 (21)	1		32-12-20	13.2		**Lean Clay** (CL), Clay, olive brown, medium to very stiff, sl. moist, minor carbonaceous layers and fine gravel		7630
	55												7625
		59 ft	34		9-18-13 (31)	0.6		27-13-14	21.1				
	60												7620
	65										64.0 Shale, mottled gray and dark gray, very hard, dry to sl. moist, mixed with abundant very fine siltstone fragments within the claystone moist zones		7615
		69 ft	35		17-62-38 (100/9"')	0.7		28-17-11	15		69.8		
	70												7610

CL	SPT
Shale	-

Depth	Comment
30.5	Water encountered .2 hours after drilling @ 30.5' on 06/13
30.5	Water encountered 3 hours after drilling @ 30.5' on 06/13

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50296/-110.97709 SOIL BORING: 24-06

Project Number:	ND32401	Drilling Date:	06/17/2024	Drilling Completed:	06/17/2024
Driller:	Craig Walker	Logger:	Lief Swanbom	Method:	Auger
Surface Elevation:	~7599.51'	Lat / long:	43.50296, -110.97709	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
3											**Fill**, Logging Road Pad: Silt. sand, limetone cobbles and boulders.		
4											2.0		
5											**Soil**, Light to dark brown, organic rich clay, and silt with roots (topsoil)		
10											3.0		
13											**Clayey Silt**, Medium dense, light brown moist clayey silt and silt with minor clay, sand and small angular to rounded gravel		7595
16	5												
19													
18													
		8 ft											
18			35		5-4-7 (11)	1							
18													7590
13	10												
14											11.5		
18											**Clay with Sand**, Stiff to loose, gold to orange, moist, clay and sand, silt; all of limestone origin.		
		13 ft											
35			36		2-4-6 (10)	1.4	240205	23-14-8	11.5				
43													7585
43	15												
42											16.0		
61											Siltstone, Very hard, very dense, white to gray, light brown hematite stained clayey, limy silt and small siltstone fragments and slight weathered shale - unit appeared "chewed up"		
		18 ft											
56			37		41-46-54 (100)	1.5							
60													7580
125	20												
165													
		23 ft											
			38		22-29-50 (79/1')	1.5							
													7575

Fill		Clay with Sand	
Soil		Siltstone	
Clayey Silt		SPT - Standard Penetration Test	

Depth	Comment
-	-
-	-

37

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50296/-110.97709 SOIL BORING: 24-06

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Siltstone, Very hard, very dense, white to gray, light brown hematite stained clayey, limy silt and small siltstone fragments and slight weathered shale - unit appeared "chewed up"		
											29.0		
	30										Shale, Very hard, gray brown, fractured weathered to unweathered shale - very reactive with HCL, hematite stained.		7570
		33 ft	39		x-100 (100)	0							
	35												7565
											38.0		
	40										Siltstone, Very dense, yellow to orange, siltstone with thin clay layers - very fine sandstone, dry. Limy' clay layers are hematite stained.		7560
		43 ft	40		90-100 (100)	0.75							
													7555
	45												
													7550

Siltstone	SPT - Standard Penetration Tes
Shale	-

Depth	Comment
-	-
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50296/-110.97709

SOIL BORING: 24-06

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
		53 ft	41		82-100 (100)	0.75					Siltstone, Very dense, yellow to orange, siltstone with thin clay layers - very fine sandstone, dry. Limy' clay layers are hematite stained.		7545
	55										54.5		7540
	60												7535
	65												7530
	70												7525

Siltstone

SPT - Standard Penetration Te

Depth	Comment
-	-
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50264/-110.97524 SOIL BORING: 24-07

Project Number:	ND32401	Drilling Date:	06/18/2024	Drilling Completed:	06/18/2024
Driller:	Craig Walker	Logger:	Lief Swanbom	Method:	Auger
Surface Elevation:	~7697.68'	Lat / long:	43.50264, -110.97524	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
	5	8 ft	42		6-8-9 (17)	0.75					**Fill**, Fill - Medium dense/very stiff, Silt, sand, gravel, cobbles, boulders up to 1.5 feet; angular to rounded. Minor clay., ashy white to brown. Calcium carbonate rich (limestone origin)		7695
	10												7690
	15	18 ft	43		5-6-10 (16)	1.2	240206	33-16-15	15.8		12.0 **Silty Clay** (CL), Stiff, dark brown, dry, silty clay with roots, coal fragments.		7685 7680
	20										24.5 Weathered shale, Weathered		7675

Fill	Weathered shale
CL	SPT - Standard Penetration Te

Depth	Comment
-	-
-	-

40

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50264/-110.97524 SOIL BORING: 24-07

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Weathered shale, Weathered shale 26.0		
		28 ft	44		4-11-10 (21)	1.3					Shale, Very stiff to dense/hard, blue green to blue-gray to white to black, silty to argillaceous shale with carbonaceous and coal lenses, silty very fine grain speckled sandstone, with calcium carbonate cement - poorly cemented. Shale and sandstone are interbedded. Dry to slightly moist. Sulfuric odor emitted from test hole while drilling at approximately 50 feet.		7670
	30												7665
	35	38 ft	45		16-24-23 (47)	1.4							7660
	40												7655
	45	48 ft	46		21-31-26 (57)	1.25							7650

Weathered shale	SPT - Standard Penetration Tes
Shale	-

Depth	Comment
-	-
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50264/-110.97524 SOIL BORING: 24-07

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
	55	54 ft	48								Shale, Very stiff to dense/hard, blue green to blue-gray to white to black, silty to argillaceous shale with carbonaceous and coal lenses, silty very fine grain speckled sandstone, with calcium carbonate cement - poorly cemented. Shale and sandstone are interbedded. Dry to slightly moist. Sulfuric odor emitted from test hole while drilling at approximately 50 feet.		7645
		58 ft	47		20-23-26 (49)	1.3							7640
	60												
													7635
	65												
		68 ft	49		18-25-31 (56)	1.3	240207	38-14-24	9.5				7630
	70										69.5		
													7625

Shale	SPT - Standard Penetration Tes
Grab - Grab Sample	-

Depth	Comment
-	-
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50367/-110.97697 SOIL BORING: 24-08

Project Number:	ND32401	Drilling Date:	06/18/2024	Drilling Completed:	06/18/2024
Driller:	Craig Walker	Logger:	Lief Swanbom	Method:	Auger
Surface Elevation:	~7606.41'	Lat / long:	43.50367, -110.97697	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
											Topsoil, Organic rich topsoil		7605
											3.0		
		4 ft									**Silty Clay**, Medium stiff, brown, moist, silty clay with grave siltstone fragments. Caliche present.		
			50		3-2-5 (7)	0.8							
	5												7600
	10										11.0		7595
											Weathered sandstone, Medium dense, yellow brown, dry to slightly moist, lower fine grain sand. and clay - weathered sandstone and shale. Hematite staining, minor clay.		
		14 ft											
			51		6-7-8 (15)	0.9							
	15												7590
	20										21.0		7585
											Shale, Stiff to very stiff, dark gray to gray - maroon, shale. Argillaceous. Plastic.		
		24 ft											
			52		4-5-8 (13)	1.4	240208	117-25-92	34.2				

At Time of Drilling (ATD)	Weathered Sandstone
After Drilling (AD)	Shale
Topsoil	SPT - Standard Penetration Test
Silty Clay	-

Depth	Comment
11.5	Water encountered 0.5 hours after drilling @ 11.5' on 06/18 at 4:05PM
12.2	Water encountered 24.5 hours after drilling @ 12.2' on 06/20 at 4:00PM

43

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50367/-110.97697 SOIL BORING: 24-08

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Sample Number	Sample Graphic	Blow Counts (N/Refusal)	Recovery Length (ft)	Lab: Lab Sample ID	Atterberg Limits (LL-PL-PI)	Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
		25 ft	52		4-5-8 (13)	1.4	240208	117-25-92	34.2		Shale, Stiff to very stiff, dark gray to gray - maroon, shale. Argillaceous. Plastic.		7580
	30												7575
		34 ft	53		18-17-20 (37)	1.5							
	35												7570
	40												7565
		44 ft	54		8-12-19 (31)	1.5							
	45										46.0 Siltstone, Very hard, white, clayey siltsone and gray to green shale, shilty shale. Dry to slightly moist.		7560

Shale		SPT - Standard Penetration Te	
Siltstone		-	

Depth	Comment
11.5	Water encountered 0.5 hours after drilling @ 11.5' on 06/18 at 4:05PM
12.2	Water encountered 24.5 hours after drilling @ 12.2' on 06/20 at 4:00PM

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.50367/-110.97697 SOIL BORING: 24-08

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
		54 ft	55		38-37-61 (98)	1.4	240209	NP	11.9		Siltstone, Very hard, white, clayey siltsone and gray to green shale, shilty shale. Dry to slightly moist.		7555
	55						240210	19-10-9	8.3				7550
		59 ft	56		51-95-5/0.03' (100)						60.5		7545
	60												
	65												7540
	70												7535

Depth	Comment
11.5	Water encountered 0.5 hours after drilling @ 11.5' on 06/18 at 4:05PM
12.2	Water encountered 24.5 hours after drilling @ 12.2' on 06/20 at 4:00PM

Siltstone | SPT - Standard Penetration Te

45

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503398/-110.975619 SOIL BORING: 24-09

Project Number:	ND32401	Drilling Date:	06/25/2024	Drilling Completed:	06/25/2024
Driller:	Craig Walker	Logger:	Michael Killion	Method:	Auger
Surface Elevation:	7665.38'	Lat / long:	43.503398, -110.975619	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	5		Tan, slightly moist, **Loose to Medium Dense Fill**, 1/2" to 6" limestone subrounded to angular rock		7660
			5.0 Tan, slightly moist to moist, **Medium to Stiff Fill**, 1/2" to 2" subrounded gray limestone gravel		
	10				7655
	15				7650
	20				7645

Depth	Comment
82	Water encountered @ 82'
-	-

Loose to medium dense Fill	-

46

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503398/-110.975619

SOIL BORING: 24-09

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	30		Tan, slightly moist to moist, **Medium to Stiff Fill**, 1/2" to 2" subrounded gray limestone gravel		7635
	35				7630
	40				7625
	45				7620

Depth	Comment
82	Water encountered @ 82'
-	-

Medium to stiff FIll	-

47

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503398/-110.975619

SOIL BORING: 24-09

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	55		Tan, slightly moist to moist, **Medium to Stiff Fill**, 1/2" to 2" subrounded gray limestone gravel		7610
	60				7605
	65		65.0 Gray, saturated, **Medium Sandy Silt**, Native Material 67.0		7600
	70		Shale, extremely weak , silty clayey Shale		7595

Depth	Comment
82	Water encountered @ 82' ▽
-	-

Medium to stiff FIll	Shale
Medium Sandy Silt	-

48

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503398/-110.975619

SOIL BORING: 24-09

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	80		Shale, extremely weak , silty clayey Shale		7585
	85				7580
	90				7575
	95				7570

Depth	Comment
82	Water encountered @ 82'
-	-

At Time of Drilling (ATD)

Shale

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503398/-110.975619

SOIL BORING: 24-09

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
			Shale, extremely weak , silty clayey Shale		
	105				7560
	110				7555
			111.7 Shale, extremely weak , 800 psi down pressure,silty clayey Shale		
	115				7550
	120				7545

Depth	Comment
82	Water encountered @ 82'
-	-

Shale | -

50

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503398/-110.975619

SOIL BORING: 24-09

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
			Shale, extremely weak , 1000 psi down pressure,silty clayey Shale		
			127.7		
	130				7535
	135				7530
	140				7525
	145				7520

Depth	Comment
82	Water encountered @ 82' ▽
-	-

Shale	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503394/-110.975616 SOIL BORING: 24-10

Project Number:	ND32401	Drilling Date:	06/26/2024	Drilling Completed:	06/26/2024
Driller:	Craig Walker	Logger:	Nathan Willis	Method:	Auger
Surface Elevation:	~7665.38'	Lat / long:	43.503394, -110.975616	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	5		**FILL**, loose, light brown to brown, dry to slightly moist, subangular, **Silty Sand Fill**, gravel, limestone gravel up to 4"		7660
	10				7655
	15				7650
	18.0				
	20		**FILL**, loose, brown, slightly moist, **Silty Sand Fill**, gravel, limestone gravel up to 1/2"		7645
	23.0		**FILL**, loose, brown, moist, **Silty Sand Fill**, gravel and clay, less gravel than above material		

Depth	Comment
49.6	Water encountered 22 hours after drilling @ 49.6'
-	-

Silty sand Fill	-

52

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503394/-110.975616

SOIL BORING: 24-10

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	30		**FILL**, loose, brown, moist, **Silty Sand Fill**, gravel and clay, less gravel than above material		7635
	35				7630
	40				7625
	45				7620
			46.0 **FILL**, loose, brown, very moist to wet, **Silty Sand Fill**, Gravel and clay		

▽ At Time of Drilling (ATD)

Silty sand Fill

Depth	Comment
49.6	Water encountered 22 hours after drilling @ 49.6'
-	-

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503394/-110.975616

SOIL BORING: 24-10

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	55		**FILL**, loose, brown, wet to saturated, **Silty Sand Fill**, Gravel and clay		7610
	60				7605
	65				7600
			67.0		
			Shale, dark gray to black		
	70		69.9		7595

Depth	Comment
49.6	Water encountered 22 hours after drilling @ 49.6'
-	-

Silty sand Fill

Shale

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.504026/-110.975844 SOIL BORING: 24-11

Project Number:	ND32401	Drilling Date:	06/26/2024	Drilling Completed:	06/26/2024
Driller:	Craig Walker	Logger:	Michael Killion	Method:	Auger
Surface Elevation:	7577.87'	Lat / long:	43.504026, -110.975844	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
2 9 12 10 19 13 10 10 5 10	5	7 ft									Slide debris, tan, slightly moist to moist, **Slide Debris**, 1/4" to 4" angular gray limestone gravel,Loose to medium dense, sandy silt to silty sand		7575
10 5 6 9 12 8 8 8 10 7	10		61		5-2-3 (5)	0.6							7570
9 9 9 13 10 13 16 11	15	17 ft	62		7-12-7 (19)	0.7							7565
	20												7560
													7555

Depth	Comment
-	No free water encountered on 06/26
52.8	Water encountered 20 hours after drilling @ 52.8' on 02/07

Slide Debris | SPT - Standard Penetration Te

55

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.504026/-110.975844 SOIL BORING: 24-11

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Sample Number	Sample Graphic	Blow Counts (N/Refusal)	Recovery Length (ft)	Lab: Lab Sample ID	Atterberg Limits (LL-PL-PI)	Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
13											Slide debris, tan, slightly moist to moist, **Slide Debris**, 1/4" to 4" angular gray limestone gravel,Loose to medium dense, sandy silt to silty sand		
16		27 ft											
13			63		11-10-6 (16)	1							7550
13													
15													
27	30										30.0		
27											Brown, moist, **Mixed Material**, 1/16 to 1/4" limestone gravel,stiff to very stiff, silty clay		
27		32 ft											
24			64		6-6-11 (17)	0.3	240238						7545
15													
27													
43	35												
56													
65		37 ft											
59			65		8-8-10 (18)	0.15	240239	33-15-18	9				7540
56													
41	40												
32													
35		42 ft									42.0		
3			66		9-14-22 (36)	0.8	240240	32-12-20	8.1		Gray, slightly moist, **Mixed Material**, black very weak shale, dense, clayey, angular fine grained sand		7535
44													
57	45										45.0		
52											Weathered shale, brown/black, extremely weak, moderately weathered		
60		47 ft											
79			67		22-41-59 (100/11.4"')	1.5							7530
84													

Slide Debris	SPT - Standard Penetration Tes
Weathered Shale	-

Depth	Comment
-	No free water encountered on 06/26
52.8	Water encountered 20 hours after drilling @ 52.8' on 02/07

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.504026/-110.975844 SOIL BORING: 24-11

Dynamic Cone Penetrometer	Depth (ft)	Samples: Depth of Sample (ft)	Samples: Sample Number	Samples: Sample Graphic	Samples: Blow Counts (N/Refusal)	Samples: Recovery Length (ft)	Lab: Lab Sample ID	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Graphic Log	Materials Description	Well	Elevation (ft)
100-9"		52 ft	68		18-26-74 (100/10.8"')	1.5					Weathered shale, brown/black, extremely weak, moderately weathered		7525
	55	57 ft	69		18-28-51 (79)	1.5					57.0 Shale, gray, extremely weak fresh 58.5		7520
	60												7515
	65												7510
	70												7505

After Drilling (AD)		Shale	
Weathered Shale		SPT - Standard Penetration Te	

Depth	Comment
-	No free water encountered on 06/26
52.8	Water encountered 20 hours after drilling @ 52.8' on 02/07

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503535/-110.975978 SOIL BORING: 24-12

Project Number:	ND32401	Drilling Date:	06/27/2024	Drilling Completed:	06/27/2024
Driller:	Craig Walker	Logger:	Nathan Willis	Method:	Auger
Surface Elevation:	~7644.92'	Lat / long:	43.503535, -110.975978	Drill Rig:	4001 CME-1050

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	5		**FILL**, loose, brown, dry to slightly moist, **Silty Sand Fill** with **Gravel**		7640
	10				7635
			13.0		
	15		**FILL**, brown, slightly moist to moist, **Sandy Silt Fill** with **Gravel and Clay**, limestone gravel up to 1/4"		7630
			18.0		
	20		**FILL**, loose, brown, slightly moist to moist, subangular, **Gravel and Sand Fill** with **Silt and Clay**, limestone gravel up to 1/2"		7625
					7620

Depth	Comment
53	Water encountered @ 53' ▽
-	-

Silty sand Fill	-

58

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503535/-110.975978

SOIL BORING: 24-12

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
	30		**FILL**, loose, brown, slightly moist to moist, subangular, **Gravel and Sand Fill** with **Silt and Clay**, limestone gravel up to 1/2"		7615
	35				7610
	40		40.0 Weathered shale, moderately weathered, minor gravel found in cuttings (from up-hole?)		7605
	45				7600
					7595

Depth	Comment
53	Water encountered @ 53' ▽
-	-

Gravel and sand Fill

Weathered Shale

59

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503535/-110.975978

SOIL BORING: 24-12

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
			Weathered shale, moderately weathered, minor gravel found in cuttings (from up-hole?)		
	55				7590
	60				7585
	65				7580
	70				7575
					7570

Depth	Comment
53	Water encountered @ 53'
-	-

▽ At Time of Drilling (ATD)

Weathered Shale

60

5300 Bishop Boulevard
Office: (307) 777-4475

The Big Fill Landslide

Lat/Lon: 43.503535/-110.975978

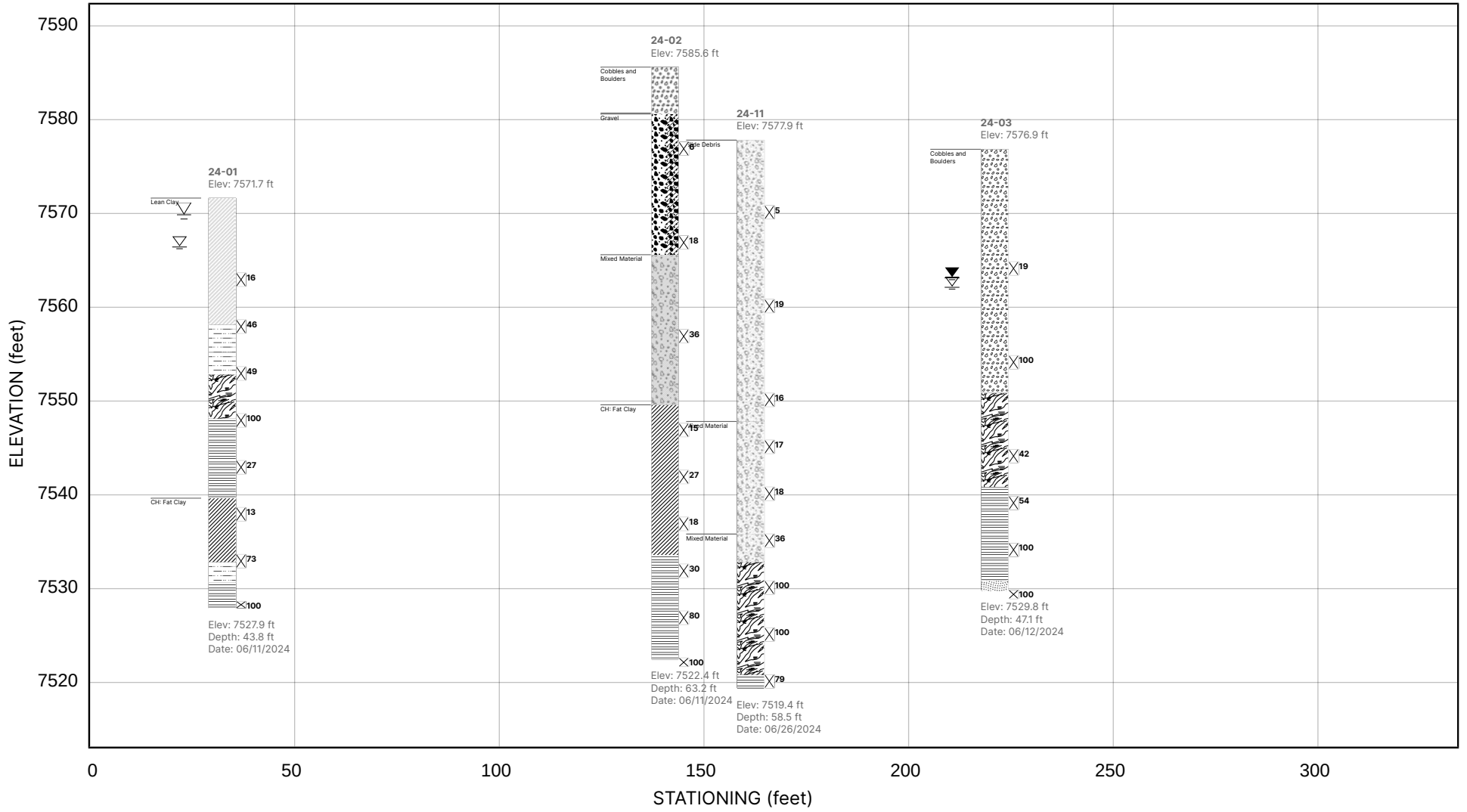
SOIL BORING: 24-12

Dynamic Cone Penetrometer	Depth (ft)	Graphic Log	Materials Description	Well	Elevation (ft)
			Weathered shale, moderately weathered, minor gravel found in cuttings (from up-hole?)		
			78.0		
	80				7565
	85				7560
	90				7555
	95				7550
					7545

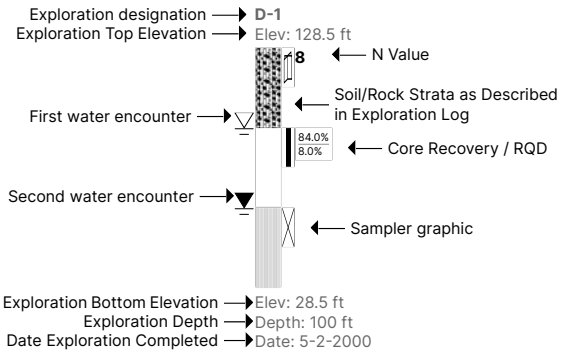
Depth	Comment
53	Water encountered @ 53'
-	-

Weathered Shale	-

61



EXPLORATION LOG LEGEND

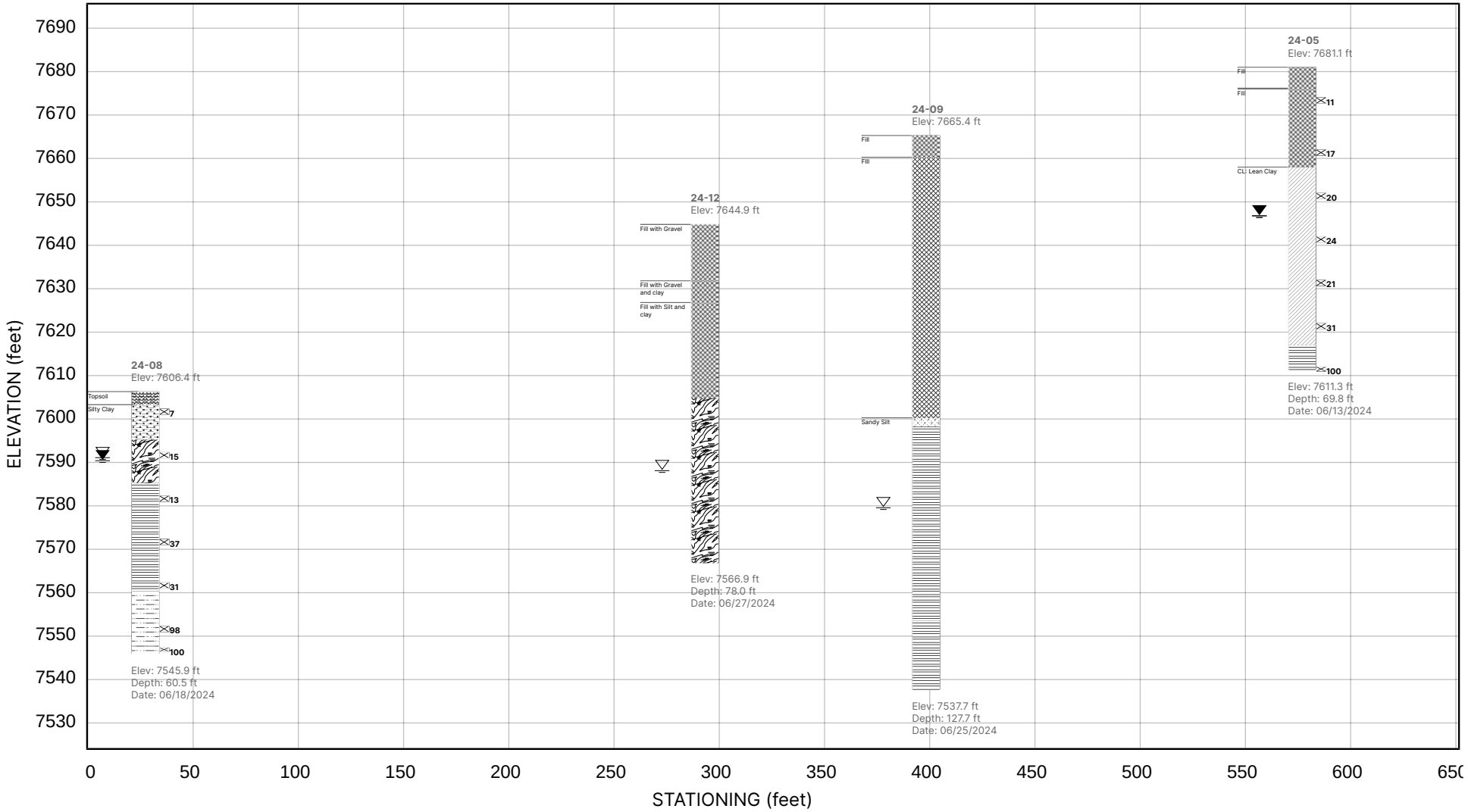


LEGEND KEY

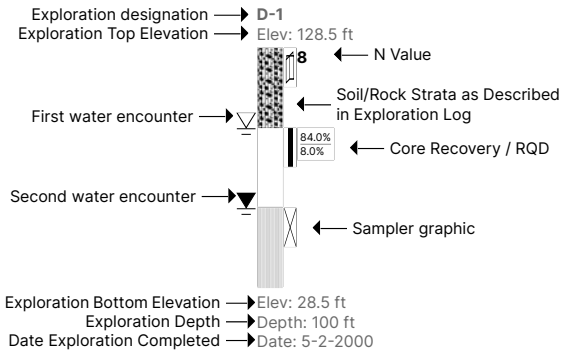
- Shale
- Sandstone
- Weathered Shale
- Siltstone
- Slide Debris
- CH
- Weathered Shale
- Mixed Material
- Lean Clay
- Cobbles and Boulders
- Gravel

The Big Fill Landslide
43.5033160362482,
-110.97584284710703

CROSS SECTION REPORT 01 (CS-01)



EXPLORATION LOG LEGEND

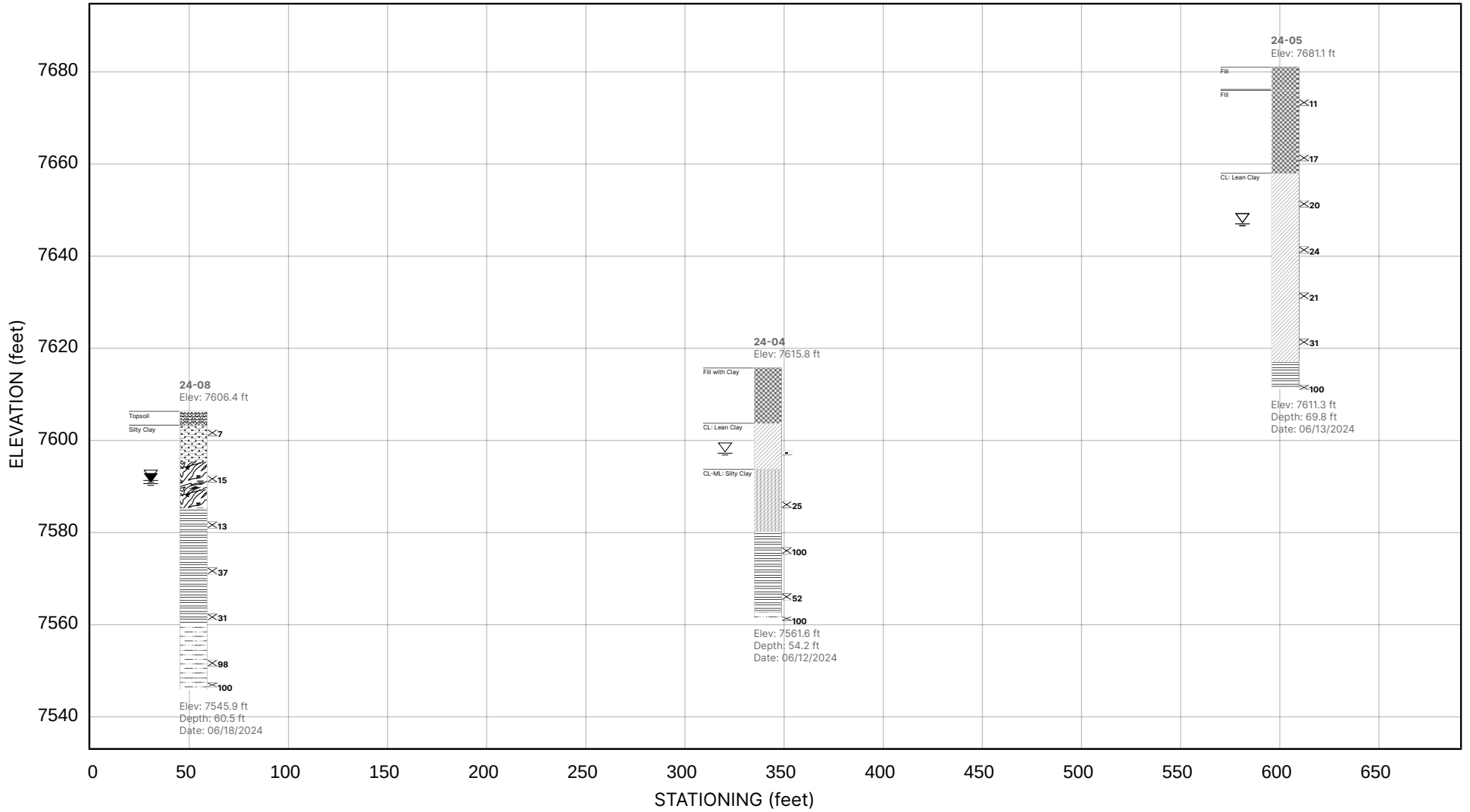


LEGEND KEY

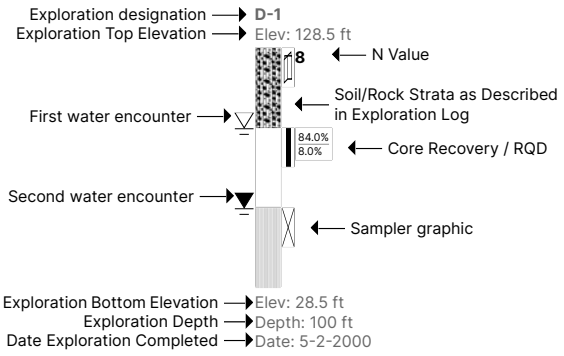
- Shale
- Siltstone
- Weathered Shale
- Medium Sandy Silt
- Silty Clay
- Topsoil
- Fill
- CL

The Big Fill Landslide
43.50331609362482,
-110.97584284710703

CROSS SECTION REPORT 02 (CS-02)



EXPLORATION LOG LEGEND

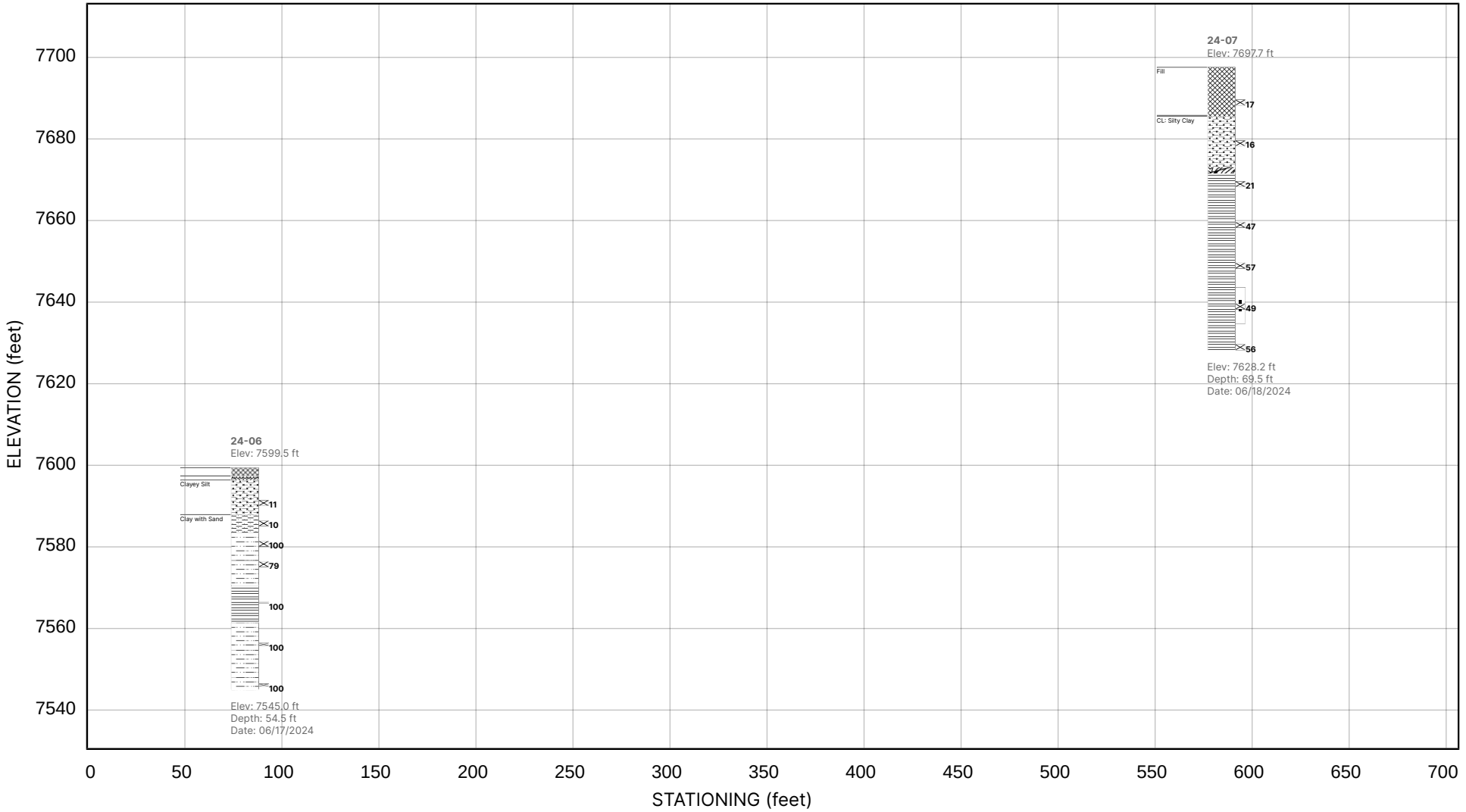


LEGEND KEY

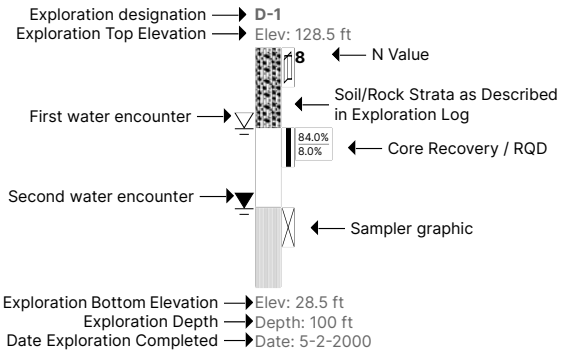
- Siltstone, shaley, dry
- Shale
- CL-ML
- Weathered Sandstone
- Silty Clay
- CL
- Topsoil
- Fill

The Big Fill Landslide
43.50331609362482,
-110.97584284710703

CROSS SECTION REPORT 03 (CS-03)



EXPLORATION LOG LEGEND

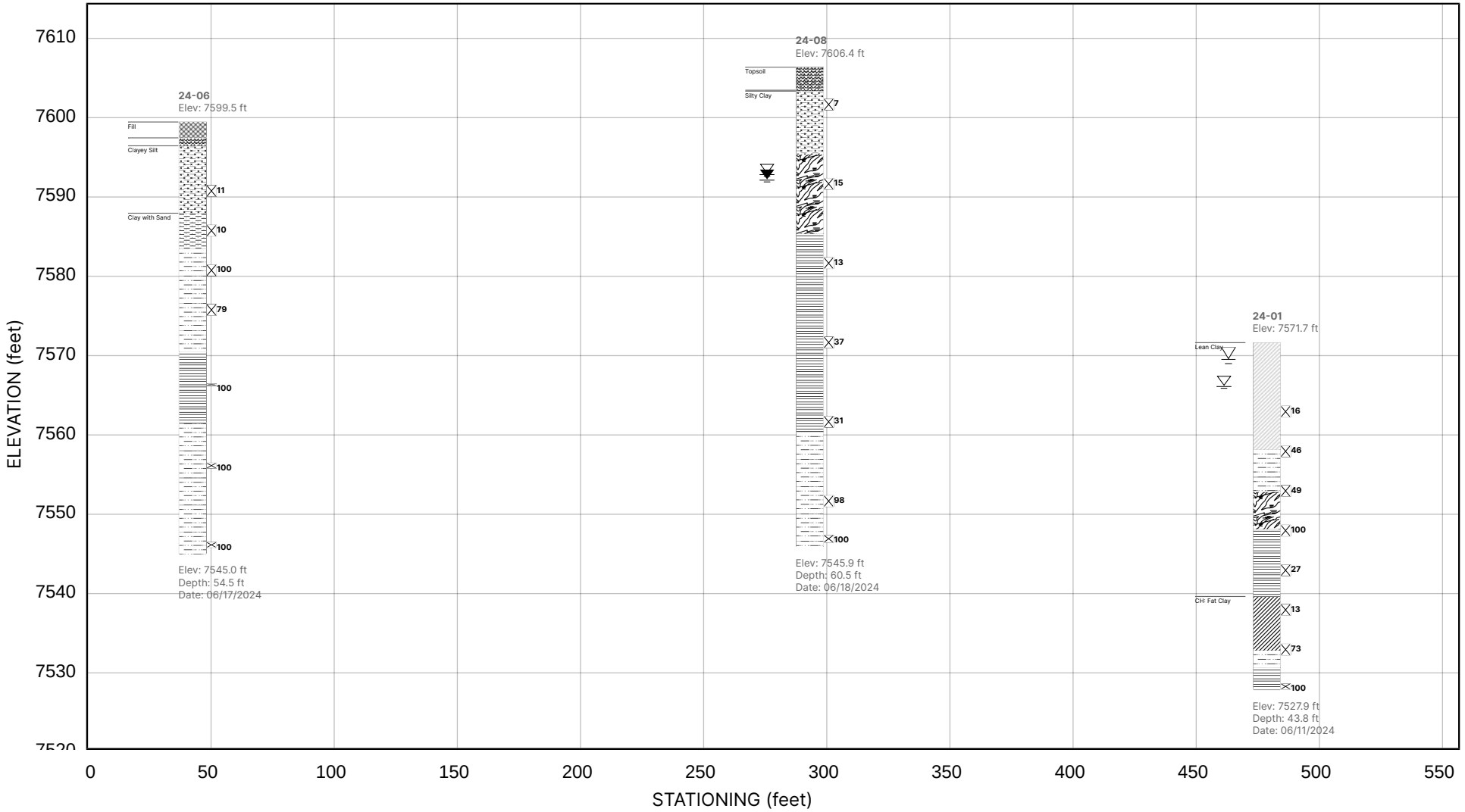


LEGEND KEY

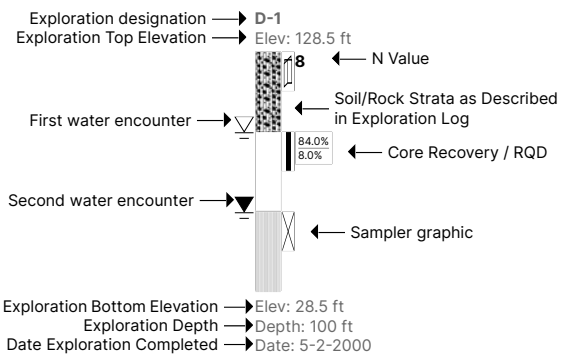
- Siltstone
- Shale
- Clay with Sand
- CL
- Soil
- Fill
- Weathered shale

The Big Fill Landslide
43.50331609362482,
-110.97584284710703

CROSS SECTION REPORT 04 (CS-04)



EXPLORATION LOG LEGEND

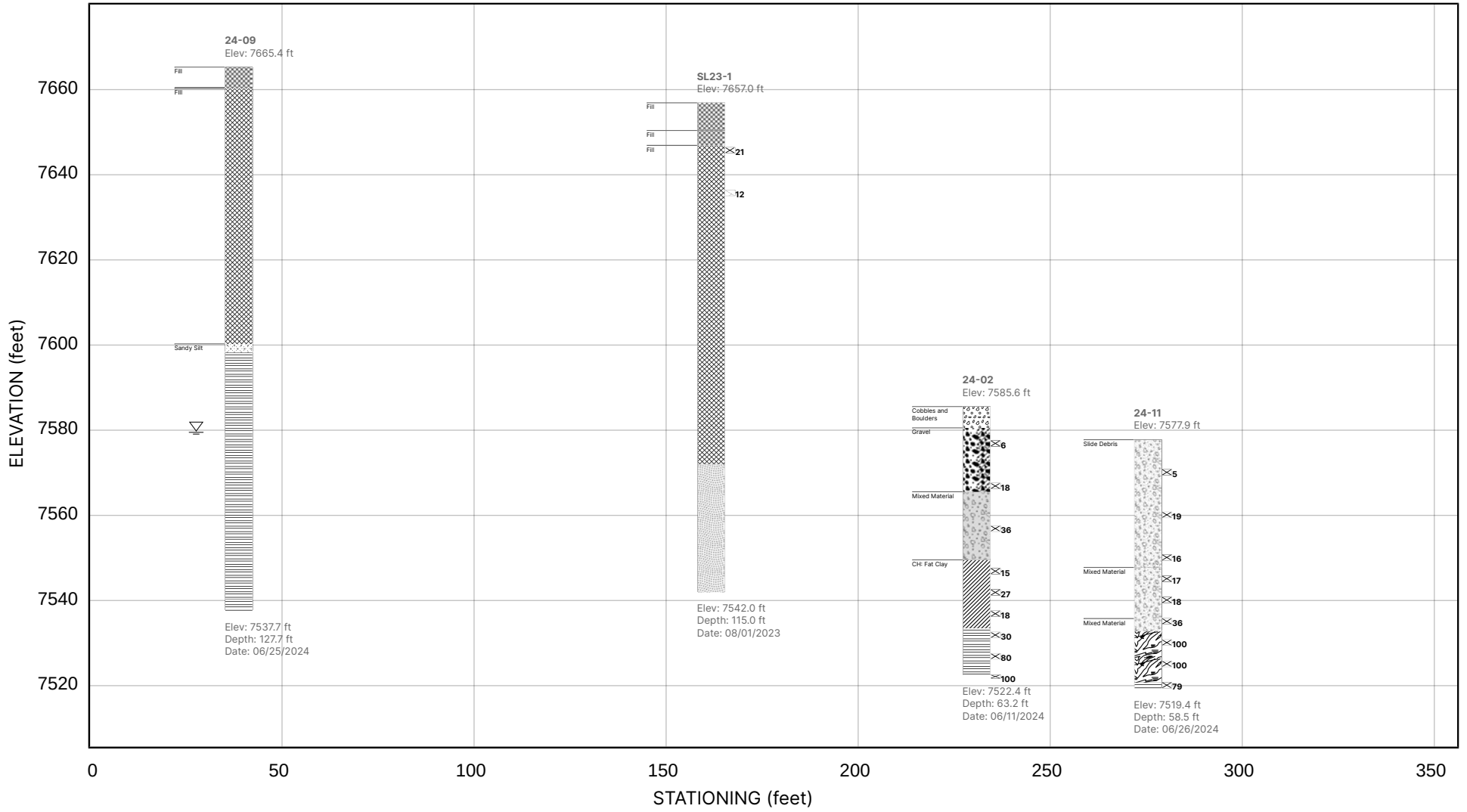


LEGEND KEY

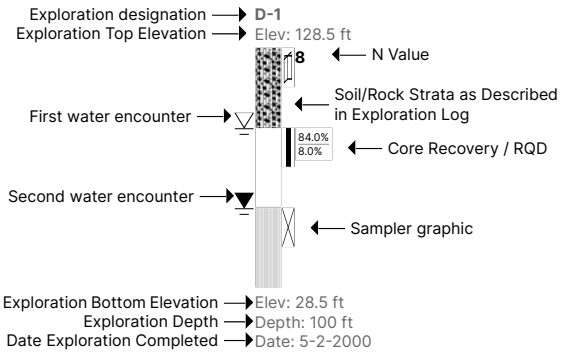
- Shale
- Siltstone
- CH
- Weathered Sandstone
- Lean Clay
- Clay with Sand
- Silty Clay
- Topsoil
- Fill

The Big Fill Landslide
43.50331609362482,
-110.97584284710703

CROSS SECTION REPORT 05 (CS-05)



EXPLORATION LOG LEGEND

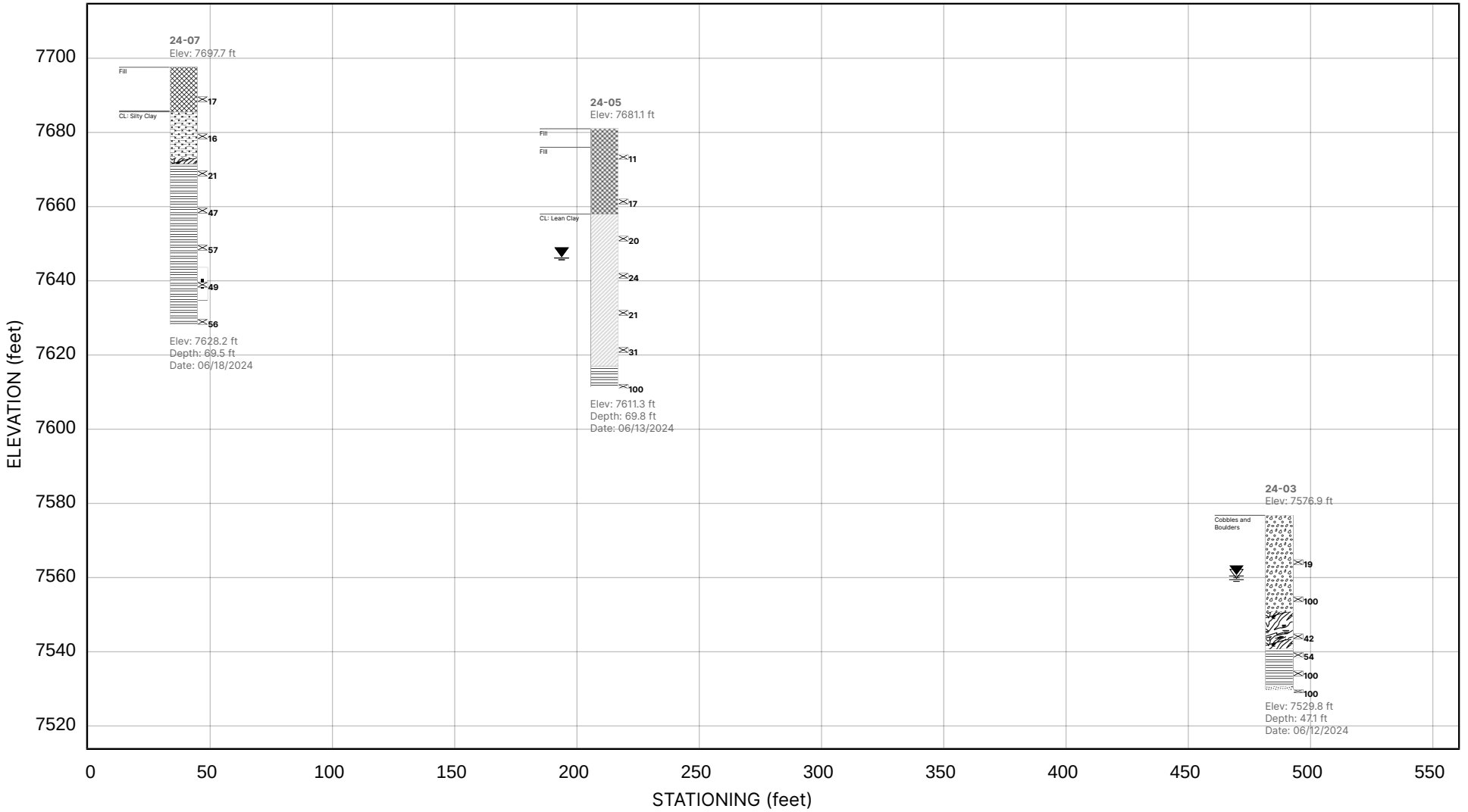


LEGEND KEY

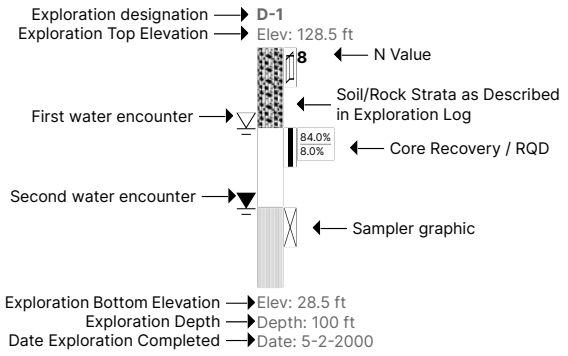
- Shale
- Weathered Shale
- Slide Debris
- CH
- Mixed Material
- Sandstone
- Gravel
- Cobbles and Boulders
- Medium Sandy Silt
- Loose to medium dense Fill

The Big Fill Landslide
43.50331609362482,
-110.97584284710703

CROSS SECTION REPORT 06 (CS-06)



EXPLORATION LOG LEGEND



LEGEND KEY

- Sandstone
- Shale
- Weathered shale
- Cobbles and Boulders
- CL
- Fill
- CL

The Big Fill Landslide
43.50331609362482,
-110.97584284710703

CROSS SECTION REPORT 07 (CS-07)

APPENDIX B – BOREHOLE AND SAMPLE RESULTS

								Percent Passthrough										
Test Hole	Lab Number	Sample Number	Sample Depth	Lithology	Uncorrected N-Value	USCS	AASHTO	1"	3/4"	3/8"	#4	#10	#40	#200	LL	PL	PI	M%
SL22-1																		
	220609	1	8.0' - 9.5'	silty gravel with sand	48	GM	A-1-b	85.6	79.3	66.5	53.9	39.5	27.0	18.9	NV	NP	NP	3.8
	220610	2	18.0' - 19.5'	clayey gravel with sand	13	GC	A-2-6(0)	100.0	93.4	75.0	59.1	45.1	32.6	25.3	27.8	17.0	10.8	7.2
	220611	3	28.0' - 29.5'	silty gravel with sand	15	GM	A-1-b	82.3	82.3	71.5	54.9	40.3	26.8	19.4	NV	NP	NP	4.6
	220612	4	38.0' - 39.5'	well-graded gravel with clay and sand	30	GW-GC	A-2-4(0)	69.8	66.1	53.4	45.2	33.5	16.1	8.9	21.5	14.1	7.4	1.8
	220613	5	48.0' - 49.5'	silty clayey gravel with sand	22	GC-GM	A-1-b	100.0	86.5	69.2	54.7	41.2	27.6	19.4	18.5	13.3	5.2	4.8
	220614	6	58.0' - 59.5'	silty gravel with sand	47	GM	A-1-b	100.0	87.6	74.1	58.4	43.8	30.7	23.4	NV	NP	NP	5.3
	220615	7	68.0' - 69.5'	silty gravel with sand	21	GM	A-4(0)	95.0	95.0	82.1	70.2	61.7	53.5	45.3	30.8	24.9	5.9	13.5
	220616	8	78.0' - 79.5'	silty gravel with sand	29	GM	A-1-b	87.3	68.3	60.9	55.5	51.0	43.8	19.5	NV	NP	NP	8.1
SL23-1																		
	230466	1	10.5' - 11.5'	silty gravel with sand	21	GM	A-1-a	89.4	80.5	58.8	47.3	33.3	20.9	13.7	NV	NP	NP	1.6
	230467	2	20.5' - 21.5'	poorly graded gravel with silt and sand	12	GP-GM	A-1-a	66.9	50.6	31.2	26.8	22.0	15.1	11.2	NV	NP	NP	5.5
SL 24-1																		
	240187	3	18.0' - 19.5'	gravelly lean clay	49	CL	A-6(6)	100.0	100.0	92.0	76.6	70.4	66.7	63.8	31.2	17.2	14.0	10.6
	240188	6	33.5' - 34.5'	fat clay	13	CH	A-7-6(30)	100.0	100.0	100.0	100.0	98.5	96.2	85.6	50.5	15.8	34.7	28.8
	240189	8	43.0' - 43.8'	lean clay with sand	100/0.25'	CL	A-6(7)	100.0	100.0	98.8	96.1	95.6	94.4	84.8	27.1	16.2	10.9	13.9
SL 24-2																		
	240190	12	38.5' - 39.5'	Remold with #13	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	240191	13	43.5' - 44.5'	Remold with #12	27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	240192	14	48.5' - 49.5'	fat clay	18	CH	A-7-6(53)	100.0	100.0	100.0	100.0	100.0	100.0	98.8	67.2	19.5	47.7	33.3
	240193	16	58.5' - 59.5'	lean clay with sand	80	CL	A-6(7)	100.0	100.0	100.0	97.2	93.8	87.1	79.8	26.0	14.1	11.9	8.7
SL 24-3																		
	240194	20	32.5' - 33.5'	sandy lean clay	42	CL	A-6(8)	100.0	100.0	93.3	85.7	77.7	69.9	57.8	31.7	12.8	18.9	16.0
	240195	21	37.5' - 38.5'	lean clay	54	CL	A-6(10)	100.0	100.0	99.4	99.4	99.2	99.1	98.1	29.5	19.1	10.4	14.4
	240196	22	42.0' - 43.1'	sandy lean clay	100/1'	CL	A-6(4)	100.0	100.0	100.0	100.0	99.1	97.3	66.9	23.8	12.8	11.0	9.9
SL 24-4																		
	240197	24	18.0' - 19.0'	sandy lean clay with gravel	NA	CL	A-6(4)	100.0	100.0	91.4	82.5	73.3	64.4	52.8	28.7	15.6	13.1	16.0
	240198	25	29.5' - 30.5'	silty clay with sand	25	CL-ML	A-4(3)	100.0	100.0	100.0	96.1	91.6	86.7	80.0	24.0	17.0	7.0	15.0
	240199	27	49.5' - 50.5'	lean clay	52	CL	A-6(17)	100.0	100.0	99.8	98.2	95.6	92.1	89.7	35.6	16.0	19.6	14.6
SL 24-5																		
	240200	31	29.5' - 30.5'	lean clay with sand	20	CL	A-6(10)	100.0	100.0	94.9	94.1	91.8	87.6	78.4	29.9	13.9	16.0	19.8
	240201	32	39.5' - 40.5'	lean clay with sand	24	CL	A-6(15)	100.0	100.0	97.2	93.2	87.6	81.9	74.3	36.9	13.9	23.0	20.1
	240202	33	49.5' - 50.5'	gravelly lean clay with sand	21	CL	A-6(6)	100.0	86.2	74.4	69.2	65.1	61.1	51.1	32.1	11.7	20.4	13.2
	240203	34	59.5' - 60.5'	sandy lean clay	31	CL	A-6(7)	100.0	100.0	98.5	94.9	88.5	77.6	70.4	26.7	13.2	13.5	21.1
	240204	35	69.0' - 70.2'	lean clay with sand	100/0.7'	CL	A-6(7)	100.0	100.0	99.6	97.7	94.4	84.6	80.0	27.5	16.7	10.8	15.0
SL 24-6																		
	240205	36	13.0' - 14.5'	sandy lean clay with gravel	10	CL	A-4(3)	100.0	92.6	88.3	83.9	77.8	68.0	62.7	22.6	14.4	8.2	11.5
SL 24-7																		
	240206	43	18.0' - 19.5'	lean clay	16	CL	A-6(14)	100.0	100.0	99.5	98.3	97.1	94.5	92.0	32.5	16.2	16.3	15.8
	240207	49	68.0' - 69.5'	lean clay	56	CL	A-6(21)	95.4	95.4	95.4	95.1	94.8	93.5	89.7	38.2	14.3	23.9	9.5
SL 24-8																		
	240208	52	24.0' - 25.5'	fat clay	13	CH	A-7-6(101)	100.0	100.0	100.0	98.9	98.0	96.5	95.0	117.2	25.0	92.2	34.2
	240209	55A	54.0' - 55.0'	silt with sand	98	ML	A-4(0)	100.0	100.0	100.0	100.0	99.6	98.1	71.2	NV	NP	NP	11.9
	240210	55B	55.0' - 55.5'	lean clay	NA	CL	A-4(4)	100.0	100.0	100.0	98.7	96.4	92.3	86.0	18.7	9.5	9.2	8.3
OS-01																		
	240237	60	0.0'	sandy lean clay with gravel	NA	CL	A-7-6(9)	100.0	100.0	95.6	81.1	70.4	63.1	56.8	42.6	23.3	19.3	15.2
SL 24-11																		
	240238 and 239	64 and 65	32.0' - 33.5'	clayey gravel with sand	18	GC	A-6(3)	72.5	72.5	65.4	62.0	56.6	49.0	40.6	32.6	15.4	17.2	9.0
	240240	66	42.0' - 43.5'	clayey gravel with sand	36	GC	A-2-6(2)	90.6	79.1	68.1	58.2	50.8	43.6	30.5	32.2	12.2	20.0	8.1

Table A.1 WYDOT Geology Foundation Lab results for ND32401 select borehole samples

Form T-123
Rev. 9-11-01

FD (scan): W. Bybee

WYOMING DEPARTMENT OF TRANSPORTATION
Materials Program

REPORT OF TESTS ON ALKALI

Laboratory No's: As Listed Below
Submitted by: Hammond
Identification Marks: As Listed Below
Source or Brand: Big Fill Slide
Location: WY 22

Date : 16-Jul-24
At:
Date Sampled: 10-Jul-24
Date Rec'd: 12-Jul-24
Date Tested: 16-Jul-24
Project: ND32401

LAB. NO.	FIELD NO.	LOCATION (Station and MilePost)	VERTICAL LIMITS	SOIL CHARACTERISTICS				CORROSION ANALYSIS		
								Material Type		
								METALLIC	NON-METALLIC	
				pH	Minimum Resistivity (ohm-cm)	Soluble Salts (%)	Sulfates, SO_4 (%)	CR Classification (See Remarks below)		Concrete Requirements
24-059		MP 12.8	0-2'	8.20	1300			CR1	CR1	Type II or 1L(MS) Cement

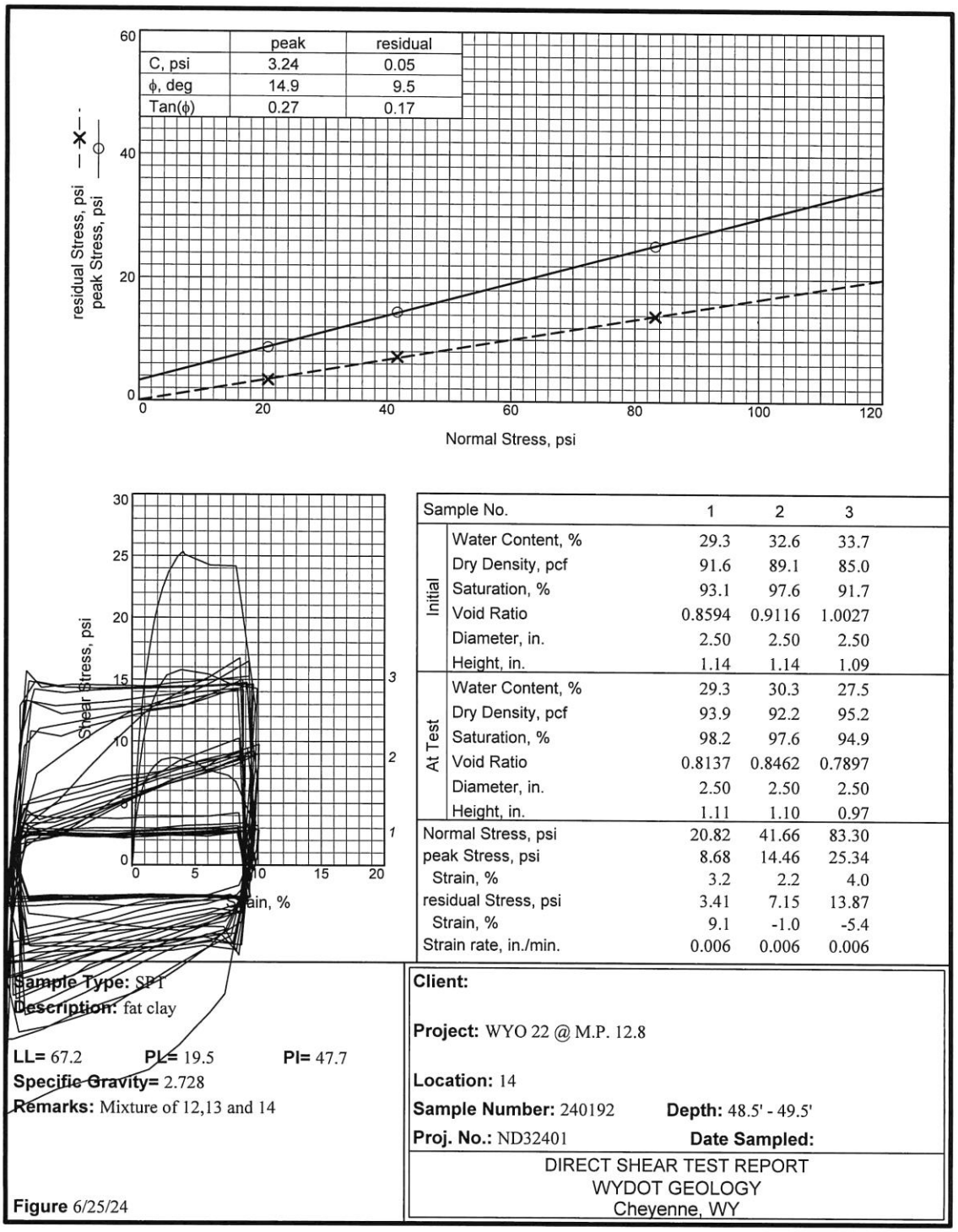
Remarks:

CR Number	APPLICATION						
	NEW Installation or REPLACEMENT of Existing						EXTEND Existing
	Metallic & Non-Metallic	Structural Plate (required modifications)					
		No Modifications	Bituminous Coating Both Sides	Decrease Gage by 2	Use Granular Backfill	Perform Additional Analysis	ALL Material Types (Including Structural Plate, etc.)
1	Use acceptable material per WYDOT Standard Specifications and Concrete requirements as shown above	X					If pipe or structure condition is *SATISFACTORY*, use existing type, size, and backfill. Otherwise, modify existing system.
2			X				
3			X	X			
4			X	X			
5			X	X	X		
6						X	
7						X	

APPROVED BY: Ethan Crockett, P.E.
Materials Staff Engineer

TESTED BY: SN, SB, JPW

Table A.2 WYDOT Materials Lab result for ND32401 alkali sample



Sample No.		1	2	3
Initial	Water Content, %	29.3	32.6	33.7
	Dry Density, pcf	91.6	89.1	85.0
	Saturation, %	93.1	97.6	91.7
	Void Ratio	0.8594	0.9116	1.0027
	Diameter, in.	2.50	2.50	2.50
	Height, in.	1.14	1.14	1.09
At Test	Water Content, %	29.3	30.3	27.5
	Dry Density, pcf	93.9	92.2	95.2
	Saturation, %	98.2	97.6	94.9
	Void Ratio	0.8137	0.8462	0.7897
	Diameter, in.	2.50	2.50	2.50
	Height, in.	1.11	1.10	0.97
Normal Stress, psi		20.82	41.66	83.30
peak Stress, psi		8.68	14.46	25.34
Strain, %		3.2	2.2	4.0
residual Stress, psi		3.41	7.15	13.87
Strain, %		9.1	-1.0	-5.4
Strain rate, in./min.		0.006	0.006	0.006

Tested By: DC

Table A.3 WYDOT Geology Foundation Lab results for ND32401 Direct Shear Test. Samples 12 and 13, from 24-02, were remolded for the test.

WYOMING DEPARTMENT OF TRANSPORTATION

T-166

MATERIALS TESTING LABORATORY

(Rev. 11-21)

AGGREGATE ANALYSIS

PROJECT NO(S).: ND32401WP1
ENGINEER: Bob Hammond RE
SAMPLE I.D.:
PIT OR QUARRY: Backfill Samples from Slide Site
QUANTITY: N/A
DATE RECEIVED: 8/7/2024

TEST NUMBER: BF_Sample1
PROJECT NAME: Teton Pass Slide - mm12.8
TOWN: Wilson
SAMPLED BY: Todd w/ WYDOT Geology
COUNTY: Teton
FOR USE AS: Test Sample
DATE TESTED: 8/7/2024

	WEIGHT (lbs or kg)	
	COARSE AGG.	FINE AGG.
Sample	10078.8 = (E)	507.2 = (F)
After Wash		461.9
Pass No. 200 [75µm]		45.3
Pass No. 200 [75 µm], Pan		12.8
Total Pass No. 200 [75µm]		58.1

	Weight Retained (lbs or kg)	% Retained = (A or B / D) x 100
RETAINED No. 4 [4.75 mm] = (A)	2602.70	25.8 = (H)
PASS No. 4 [4.75 mm]= (B)	7475.00	74.2 = (I)
TOTAL , A + B = (D)	10077.70	

SIEVE SIZE	WT RET =K	% RET = K X 100 / E =L	WT RET =P	% RET = P x 100 / F =R	% RET R x I / 100 =S	COMBINED AGGREGATE % PASSING 100 - S (Z) =Z	% PASSING to 0.1 %	% PASSING to 1 %	SPEC % PASSING
1 1/2" [37.5 mm]							100.0	100	
1" [25mm]	115.40	1.1				1.1	98.9	99	
3/4" [19 mm]	98.70	1.0				1.0	97.9	98	
1/2" [12.5 mm]	374.90	3.7				3.7	94.2	94	
3/8" [9.5 mm]	215.40	2.1				2.1	92.1	92	
No. 4 [4.75 mm]	1798.30	17.8				17.8	74.3	74	
No. 8 [2.36 mm]			132.0	26.0	19.3	19.3	55.0	55	
No. 16 [1.18 mm]			115.0	22.7	16.8	16.8	38.2	38	
No. 30 [600 µm]			70.0	13.8	10.2	10.2	28.0	28	
No. 40 425 [µm]									
No. 50 [300 µm]			48.9	9.6	7.1	7.1	20.9	21	
No. 100 [150 µm]			45.1	8.9	6.6	6.6	14.3	14	
No. 200 [75 µm]			37.6	7.4	5.5	5.5	8.8	8.8	
Pass No. 200 [75 µm], Pan	7475.00	74.2	58.1	11.5	8.5				
TOTAL PASSING	#####	99.9	506.7	99.9					
SHAKER LOSS %	0.0%		0.1%						
FRACTURED FACES %	One or more		SHAKER LOSS FORMULA						
FLAT & ELONGATED %	1:5 Ratio		([E or F] - TOTAL PASSING) / [E or F] * 100						
☐ FINENESS MODULUS: see M.T.M., Sect. 816.0:									

	WET WT (lb or kg)	22.3
	DRY WT (lb or kg)	22.2
	WET - DRY = MOISTURE	0.1
	% MOIST.=(MOIST./ DRY WT)x100	0.3

BLOWS =	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	Corr. Factor	LL*Corr. Factor	PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)										
PLASTIC LIMIT (PL)										

REMARKS Deleterious Material in Sample. Bits of Aspalt were in this Sample.

TESTED BY Mark Schon

CERTIFICATION NO. 9864

Table A.4.a WYDOT Materials Lab results for ND32401 Fill Gradation Testing

WYOMING DEPARTMENT OF TRANSPORTATION

MATERIALS TESTING LABORATORY

T-166 (Rev. 11-21)

AGGREGATE ANALYSIS

PROJECT NO(S).: ND32401WP1
ENGINEER: Bob Hammond RE
SAMPLE I.D.:
PIT OR QUARRY: Backfill Samples from Slide Site
QUANTITY: N/A
DATE RECEIVED: 8/7/2024

TEST NUMBER: BF_Sample2
PROJECT NAME: Teton Pass Slide - mm12.8
TOWN: Wilson
SAMPLED BY: Todd w/ WYDOT Geology
COUNTY: Teton
FOR USE AS: Test Sample
DATE TESTED: 8/7/2024

	WEIGHT (lbs or kg)	
	COARSE AGG.	FINE AGG.
Sample	8953.9 = (E)	466.9 = (F)
After Wash		407.5
Pass No. 200 [75µm]		59.4
Pass No. 200 [75 µm], Pan		21.1
Total Pass No. 200 [75µm]		80.5

	Weight Retained (lbs or kg)	% Retained = (A or B / D) x 100
RETAINED No. 4 [4.75 mm] = (A)	3554.40	39.7 = (H)
PASS No. 4 [4.75 mm]= (B)	5395.00	60.3 = (I)
TOTAL , A + B = (D)	8949.40	

SIEVE SIZE	WT RET =K	% RET = K X 100 / E =L	WT RET =P	% RET = P x 100 / F =R	% RET R x I / 100 =S	COMBINED AGGREGATE =Z	% PASSING 100 - S (Z) to 0.1 %	% PASSING 100 - S (Z) to 1 %	SPEC % PASSING
1 1/2" [37.5 mm]							100.0	100	
1" [25mm]	235.70	2.6				2.6	97.4	97	
3/4" [19 mm]	582.40	6.5				6.5	90.9	91	
1/2" [12.5 mm]	835.30	9.3				9.3	81.6	82	
3/8" [9.5 mm]	568.90	6.4				6.4	75.2	75	
No. 4 [4.75 mm]	1332.10	14.9				14.9	60.3	60	
No. 8 [2.36 mm]			112.6	24.1	14.5	14.5	45.8	46	
No. 16 [1.18 mm]			85.9	18.4	11.1	11.1	34.7	35	
No. 30 [600 µm]			59.4	12.7	7.7	7.7	27.0	27	
No. 40 425 [µm]									
No. 50 [300 µm]			50.9	10.9	6.6	6.6	20.4	20	
No. 100 [150 µm]			42.6	9.1	5.5	5.5	14.9	15	
No. 200 [75 µm]			35.0	7.5	4.5	4.5	10.4	10	
Pass No. 200 [75 µm], Pan	5395.00	60.3	80.5	17.2	10.4				
TOTAL PASSING	8949.40	100.0	466.9	99.9					
SHAKER LOSS %	0.1%								
FRACTURED FACES %	One or more		SHAKER LOSS FORMULA						
FLAT & ELONGATED %	1:5 Ratio		([E or F] - TOTAL PASSING) / [E or F] * 100						
☐ FINENESS MODULUS: see M.T.M., Sect. 816.0:									

	WET WT (lb or kg)	
	DRY WT (lb or kg)	
	WET - DRY = MOISTURE	
	% MOIST.=(MOIST./ DRY WT)x100	

BLOWS =	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	Corr. Factor	LL*Corr. Factor	PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)										
PLASTIC LIMIT (PL)										

REMARKS Deleterious Material in Sample.

TESTED BY Mark Schon
CERTIFICATION NO. 9864

Table A.4.b WYDOT Materials Lab results for ND32401 Fill Gradation Testing

WYOMING DEPARTMENT OF TRANSPORTATION

MATERIALS TESTING LABORATORY

T-166 (Rev. 11-21)

AGGREGATE ANALYSIS

PROJECT NO(S).: ND32401WP1
ENGINEER: Bob Hammond RE
SAMPLE I.D.:
PIT OR QUARRY: Backfill Samples from Slide Site
QUANTITY: N/A
DATE RECEIVED: 8/7/2024

TEST NUMBER: BF_Sample3
PROJECT NAME: Teton Pass Slide - mm12.8
TOWN: Wilson
SAMPLED BY: Todd w/ WYDOT Geology
COUNTY: Teton
FOR USE AS: Test Sample
DATE TESTED: 8/7/2024

	WEIGHT (lbs or kg)	
	COARSE AGG.	FINE AGG.
Sample	10650.4 = (E)	380.1 = (F)
After Wash		356
Pass No. 200 [75µm]		24.1
Pass No. 200 [75 µm], Pan		14.2
Total Pass No. 200 [75µm]		38.3

	Weight Retained (lbs or kg)	% Retained = (A or B / D) x 100
RETAINED No. 4 [4.75 mm] = (A)	2783.40	26.2 = (H)
PASS No. 4 [4.75 mm]= (B)	7860.00	73.8 = (I)
TOTAL , A + B = (D)	10643.40	

SIEVE SIZE	WT RET =K	% RET = K X 100 / E =L	WT RET =P	% RET = P x 100 / F =R	% RET R x I / 100 =S	COMBINED AGGREGATE % PASSING 100 - S (Z) =Z	to 0.1 %	to 1 %	SPEC % PASSING
1 1/2" [37.5 mm]							100.0	100	
1" [25mm]	17.50	0.2				0.2	99.8	100	
3/4" [19 mm]	344.30	3.2				3.2	96.6	97	
1/2" [12.5 mm]	512.30	4.8				4.8	91.8	92	
3/8" [9.5 mm]	324.60	3.0				3.0	88.8	89	
No. 4 [4.75 mm]	1584.70	14.9				14.9	73.9	74	
No. 8 [2.36 mm]			86.4	22.7	16.8	16.8	57.1	57	
No. 16 [1.18 mm]			85.8	22.6	16.7	16.7	40.4	40	
No. 30 [600 µm]			63.0	16.6	12.3	12.3	28.1	28	
No. 40 425 [µm]									
No. 50 [300 µm]			39.8	10.5	7.8	7.8	20.3	20	
No. 100 [150 µm]			33.9	8.9	6.6	6.6	13.7	14	
No. 200 [75 µm]			32.9	8.7	6.4	6.4	7.3	7.3	
Pass No. 200 [75 µm], Pan	7860.00	73.8	38.3	10.1	7.5				
TOTAL PASSING	#####	99.9	380.1	100.1					
SHAKER LOSS %	0.1%								
FRACTURED FACES %	One or more		SHAKER LOSS FORMULA						
FLAT & ELONGATED %	1:5 Ratio		([E or F] - TOTAL PASSING) / [E or F] * 100						
☐ FINENESS MODULUS: see M.T.M., Sect. 816.0:									

	WET WT (lb or kg)	
	DRY WT (lb or kg)	
	WET - DRY = MOISTURE	
	% MOIST.=(MOIST./ DRY WT)x100	

BLOWS =	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	Corr. Factor	LL*Corr. Factor	PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)										
PLASTIC LIMIT (PL)										

REMARKS Deleterious Material in Sample.

TESTED BY Mark Schon
CERTIFICATION NO. 9864

Table A.4.c WYDOT Materials Lab results for ND32401 Fill Gradation Testing

WYOMING DEPARTMENT OF TRANSPORTATION

MATERIALS TESTING LABORATORY

T-166 (Rev. 11-21)

AGGREGATE ANALYSIS

PROJECT NO(S).: ND32401WP1
ENGINEER: Bob Hammond RE
SAMPLE I.D.:
PIT OR QUARRY: Backfill Samples from Slide Site
QUANTITY: N/A
DATE RECEIVED: 8/7/2024

TEST NUMBER: BF_Sample4
PROJECT NAME: Teton Pass Slide - mm12.8
TOWN: Wilson
SAMPLED BY: Todd w/ WYDOT Geology
COUNTY: Teton
FOR USE AS: Test Sample
DATE TESTED: 8/7/2024

	WEIGHT (lbs or kg)	
	COARSE AGG.	FINE AGG.
Sample	11847.8 = (E)	418.9 = (F)
After Wash		301.2
Pass No. 200 [75µm]		117.7
Pass No. 200 [75 µm], Pan		45
Total Pass No. 200 [75µm]		162.7

	Weight Retained (lbs or kg)	% Retained = (A or B / D) x 100
RETAINED No. 4 [4.75 mm] = (A)	4574.30	38.6 = (H)
PASS No. 4 [4.75 mm]= (B)	7268.00	61.4 = (I)
TOTAL , A + B = (D)	11842.30	

SIEVE SIZE	WT RET =K	% RET = K X 100 / E =L	WT RET =P	% RET = P x 100 / F =R	% RET R x I / 100 =S	COMBINED AGGREGATE =Z	% PASSING 100 - S (Z) to 0.1 %	% PASSING 100 - S (Z) to 1 %	SPEC % PASSING
1 1/2" [37.5 mm]	133.90	1.1				1.1	98.9	99	
1" [25mm]	223.60	1.9				1.9	97.0	97	
3/4" [19 mm]	471.90	4.0				4.0	93.0	93	
1/2" [12.5 mm]	1172.10	9.9				9.9	83.1	83	
3/8" [9.5 mm]	673.50	5.7				5.7	77.4	77	
No. 4 [4.75 mm]	1899.30	16.0				16.0	61.4	61	
No. 8 [2.36 mm]			36.3	8.7	5.3	5.3	56.1	56	
No. 16 [1.18 mm]			50.2	12.0	7.4	7.4	48.7	49	
No. 30 [600 µm]			50.9	12.2	7.5	7.5	41.2	41	
No. 40 425 [µm]									
No. 50 [300 µm]			46.5	11.1	6.8	6.8	34.4	34	
No. 100 [150 µm]			36.0	8.6	5.3	5.3	29.1	29	
No. 200 [75 µm]			35.5	8.5	5.2	5.2	23.9	24	
Pass No. 200 [75 µm], Pan	7268.00	61.3	162.7	38.8	23.8				
TOTAL PASSING	#####	99.9	418.1	99.9					

SHAKER LOSS %	0.0% / 0.2%
FRACTURED FACES %	One or more
FLAT & ELONGATED %	1:5 Ratio
☐ FINENESS MODULUS: see M.T.M., Sect. 816.0:	

SHAKER LOSS FORMULA
([E or F] - TOTAL PASSING) / [E or F] * 100

WET WT (lb or kg)	
DRY WT (lb or kg)	
WET - DRY = MOISTURE	
% MOIST.=(MOIST./ DRY WT)x100	

BLOWS =	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE
LIQUID LIMIT (LL)						
PLASTIC LIMIT (PL)						

% MOISTURE (DD / EE) x 100	Corr. Factor	LL*Corr. Factor	PLASTIC INDEX (PI) =LL - PL

REMARKS Deleterious Material in Sample.

TESTED BY Mark Schon
CERTIFICATION NO. 9864

Table A.4.d WYDOT Materials Lab results for ND32401 Fill Gradation Testing

WYOMING DEPARTMENT OF TRANSPORTATION

MATERIALS TESTING LABORATORY

T-166 (Rev. 11-21)

AGGREGATE ANALYSIS

PROJECT NO(S).: ND32401WP1
ENGINEER: Bob Hammond RE
SAMPLE I.D.:
PIT OR QUARRY: Backfill Samples from Slide Site
QUANTITY: N/A
DATE RECEIVED: 8/7/2024

TEST NUMBER: BF_Sample5
PROJECT NAME: Teton Pass Slide - mm12.8
TOWN: Wilson
SAMPLED BY: Todd w/ WYDOT Geology
COUNTY: Teton
FOR USE AS: Test Sample
DATE TESTED: 8/7/2024

	WEIGHT (lbs or kg) COARSE AGG.		WEIGHT (lbs or kg) FINE AGG.		
Sample	9734.1 = (E)		523.6 = (F)		
After Wash			395.6		
Pass No. 200 [75µm]			128		
Pass No. 200 [75 µm], Pan			43.3		
Total Pass No. 200 [75µm]			171.3		

	Weight Retained (lbs or kg)	% Retained = (A or B / D) x 100
RETAINED No. 4 [4.75 mm] = (A)	3999.30	41.1 = (H)
PASS No. 4 [4.75 mm]= (B)	5736.40	58.9 = (I)
TOTAL , A + B = (D)	9735.70	

SIEVE SIZE	WT RET =K	% RET = K X 100 / E =L	WT RET =P	% RET = P x 100 / F =R	% RET R x I / 100 =S	COMBINED AGGREGATE % PASSING 100 - S (Z) =Z	to 0.1 %	to 1 %	SPEC % PASSING
1 1/2" [37.5 mm]	110.20	1.1				1.1	98.9	99	
1" [25mm]	281.40	2.9				2.9	96.0	96	
3/4" [19 mm]	459.80	4.7				4.7	91.3	91	
1/2" [12.5 mm]	1023.80	10.5				10.5	80.8	81	
3/8" [9.5 mm]	563.80	5.8				5.8	75.0	75	
No. 4 [4.75 mm]	1560.30	16.0				16.0	59.0	59	
No. 8 [2.36 mm]			89.2	17.0	10.0	10.0	49.0	49	
No. 16 [1.18 mm]			82.4	15.7	9.3	9.3	39.7	40	
No. 30 [600 µm]			54.8	10.5	6.2	6.2	33.5	34	
No. 40 425 [µm]									
No. 50 [300 µm]			38.1	7.3	4.3	4.3	29.2	29	
No. 100 [150 µm]			41.6	7.9	4.7	4.7	24.5	25	
No. 200 [75 µm]			46.2	8.8	5.2	5.2	19.3	19	
Pass No. 200 [75 µm], Pan	5736.40	58.9	171.3	32.7	19.3				
TOTAL PASSING	9735.70	99.9	523.6	99.9					
SHAKER LOSS %	0.0%								
FRACTURED FACES %	One or more		SHAKER LOSS FORMULA						
FLAT & ELONGATED %	1:5 Ratio		([E or F] - TOTAL PASSING) / [E or F] * 100						
☐ FINENESS MODULUS: see M.T.M., Sect. 816.0:									

	WET WT (lb or kg)	
	DRY WT (lb or kg)	
	WET - DRY = MOISTURE	
	% MOIST.=(MOIST./ DRY WT)x100	

BLOWS =	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	Corr. Factor	LL*Corr. Factor	PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)										
PLASTIC LIMIT (PL)										

REMARKS Deleterious Material in Sample.

TESTED BY Mark Schon
CERTIFICATION NO. 9864

Table A.4.e WYDOT Materials Lab results for ND32401 Fill Gradation Testing

APPENDIX C – MEMORANDUM B249066

Mark Gordon
Governor

WYOMING Department of Transportation
"Providing a safe, high quality, and efficient transportation system"
5300 Bishop Boulevard, Cheyenne, Wyoming 82009-3340

Darin J. Westby, P.E.
Director

October 20, 2023

PROFESSIONAL GEOLOGIST
TODD A. SULLIVAN
PG-2555
10/20/23
WYOMING

MEMORANDUM

TO: John Eddins, P.E., District Engineer, Rock Springs

FROM: Todd Sullivan, P.G., Engineering Geologist, Cheyenne

SUBJECT: Inclinometer Installation, 'The Big Fill', WYO 22, MP 12.8

PROJECT: B249066, Wilson-Idaho State Line, Teton County

An inclinometer was installed at the above-referenced location August 2-3, 2023, utilizing a contract portable drill operated by Salisbury & Associates from Spokane, Washington. The drill was set a few feet over the guard rail on sloped terrain (Figure 1) with a truck-mounted crane. The inclinometer location is shown on the Site Location Map (Figure 2). The inclinometer will be used to monitor slide movement or embankment instability in 'The Big Fill' and/or the underlying bedrock, as pavement distress and possible 'slumping' has been occurring at this location since 2004. Bedrock was encountered at a depth of eighty-five feet, and 2.75-inch SI casing was installed to a depth of 115 feet. Groundwater was not encountered. Water was used as the circulation medium during drilling, which rendered poor core recovery due to the flushing or 'washing out' of the fines, leaving gravel and cobble-sized fragments for recovery. Water was supplied by a WYDOT water truck, which was filled up at the Public Works Department in Victor, Idaho.

Figure 1: Drill location on embankment slope past the guard rail

Figure 2: Site Location Map

DISCUSSION

TBF-01 (IN 23-01): Materials consisted of 6.5 feet of loose, gravelly sand over 3.5 feet of dense, boulders and cobbles, overlying 75 feet of medium dense, sandy gravel with cobbles and random boulders. Hard, fine-grained Upper Cretaceous sandstone bedrock with high-angle fractures was encountered at 85 feet. There were mineralized deposits on many of the fracture faces and there was a clayey zone just above the bedrock contact from 84.5 to 84.8 feet. The embankment is situated between two east-west trending faults; the Jackson Thrust Fault to the south and the Cache Creek Thrust Fault to the north.

Inclinometer casing was installed to a depth of 115 feet with 1.8 feet of stick-up and an A_0 direction of 30 degrees. Approximately 80 gallons of grout were used to fill the annular space, using six 47.5 pound bags of Portland cement and one 47.5 pound bag of quick gel. The inclinometer was initialized on August 24, 2023 and no movement was detected as of October 9, 2023 during the first sequential reading, shown on the inclinometer plot in Figure 3. The inclinometer will be monitored on a six month schedule to identify slide planes or displacement which shows up as deviations from the straight line plots. New pavement was placed in the area prior to the October reading, as the pronounced dip and pavement distress had been repaired and there was no additional distress observed. Heavy snow normally gets cast over the guardrail onto the slope each winter season. Maintenance personnel should be aware of the presence of the inclinometer and try to avoid damaging it during any maintenance activities.

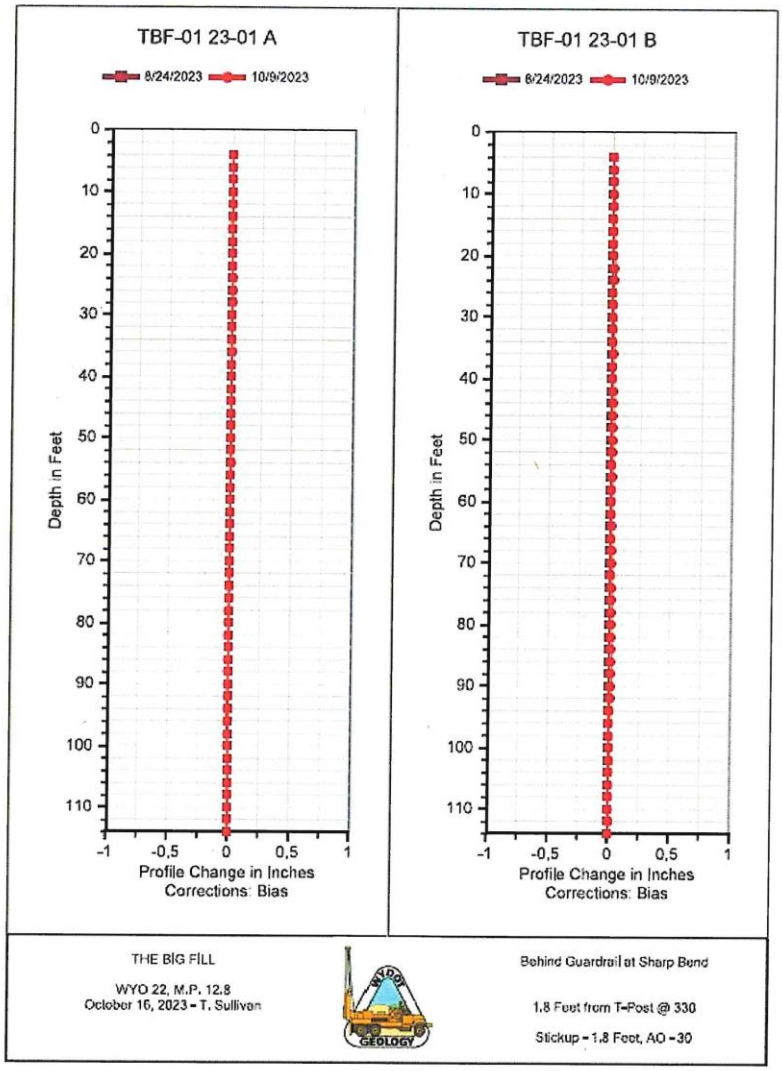


Figure 3: The Big Fill Inclinometer Plot

Reviewed By: David Vandeveer
Principal Geologist

Approved By: _____
Chief Engineering Geologist

Attachments: None

cc: Peter Stinchcomb, P.E., District Construction Engineer, Rock Springs
Tory Thomas, P.E., District Maintenance Engineer, Rock Springs
Bob Hammond, P.E., Resident Engineer, Jackson
Michael Jerup, Maintenance Supervisor, Jackson
Geology (3)

RJ Engineering & Consulting, Inc.

June 28, 2024, Project No. 24-014B-C1

Mr. James Dahill, PG
WYDOT-Geology
Program 5300 Bishop
Blvd.
Cheyenne, WY. 82009-3340

Subject: State Highway 22 Teton Pass Big Fill Detour - Global Stability Evaluation.

Dear Mr. Dahill,

RJ Engineering & Consulting, Inc. (RJ) was requested to provide an evaluation of the global stability of the detour constructed to open the corridor to the traveling public between Victor, Idaho and Jackson, Wyoming. The detour was constructed as an emergency measure after the existing embankment failed.

DISCUSSION / OBSERVATIONS

A bypass was constructed inside of the Big Fill Failure. WYDOT requested RJ provide an evaluation and analysis of the global stability of the detour roadway template.

RJ personnel visited the site on June 14, 24, and 25, 2024. Various observations regarding the slide were conducted for an evaluation process. Based on our

observations and requests from WYDOT for the slope evaluation, we requested the following:

- Use of the services of Chinook Landscape Architecture which uses drone mapping for detailed tools for use in site analysis.
- Additional inclinometers to be placed between the detour and the failed slope. The inclinometers should utilize a shape array system that can provide a subsurface movement warning system.
- A piezometer be placed near the inclinometer to monitor ground water levels within the embankment.
- Use of a radar slope scanning system to monitor slope movements of the embankment.
- An additional boring at the base of the existing head-scarp.

SITE ASSUPTIONS

Due to the emergency nature of the work, RJ is working with WYDOT in a teamwork fashion and has developed and reviewed various cross sections and subsurface conditions throughout the detour construction process.

RJ has made the following general assumptions regarding the site and stability analysis:

- Soil parameters were mutually agreed upon with the design team for the stability analysis.
- Elevated surface and ground water was a significant contributor to the failure of the embankment.
- The embankment was likely nearly saturated in the lower half just prior to failure.
- The embankment materials exposed consist of blocks (cobble and boulder sized material) in a fine-grained matrix.
- The embankment soils have significant cohesion. The current head scarp slope faces are standing at 60 degrees or steeper in places.
- Groundwater levels within the current embankment have dropped but are still present.

STABILITY ANALYSIS

RJ has evaluated two cross sections:

- Alignment along the general slide path to the northwest.
- Approximately perpendicular to the roadway alignment to the northeast.

Figure 1 depicts the location of the two (2) cross sections evaluated.

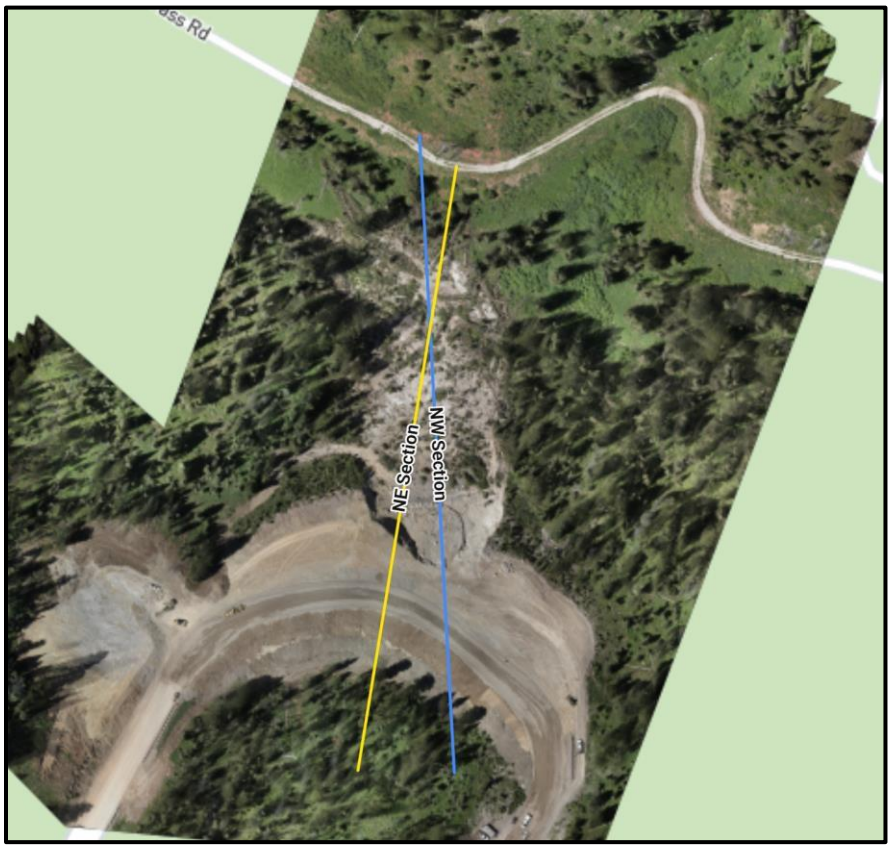
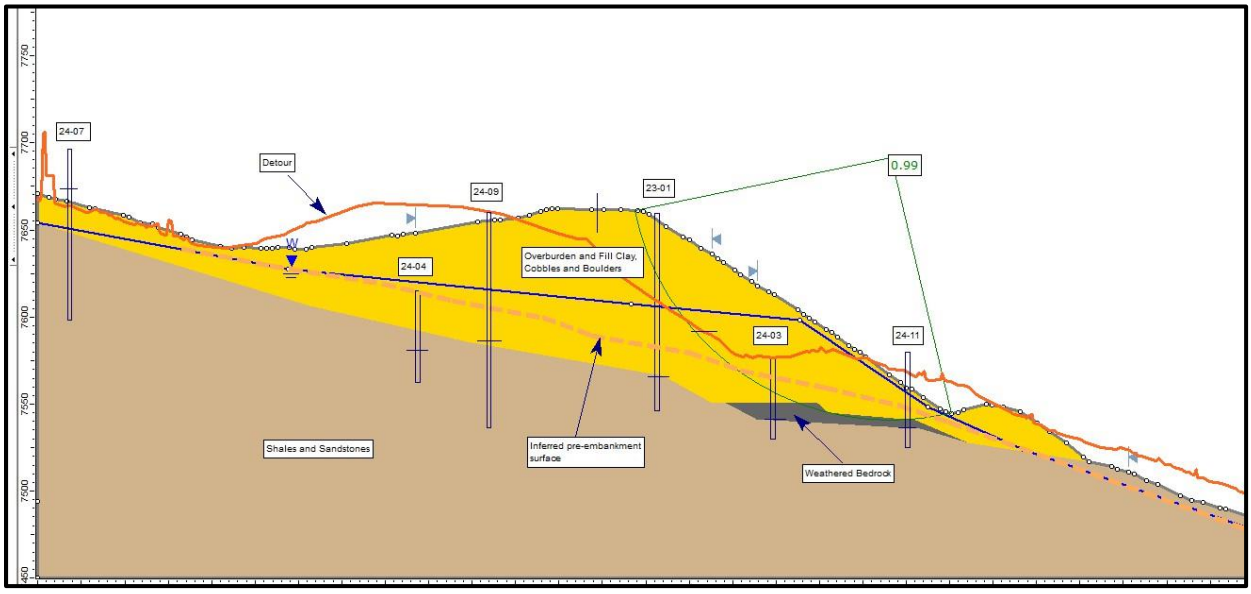


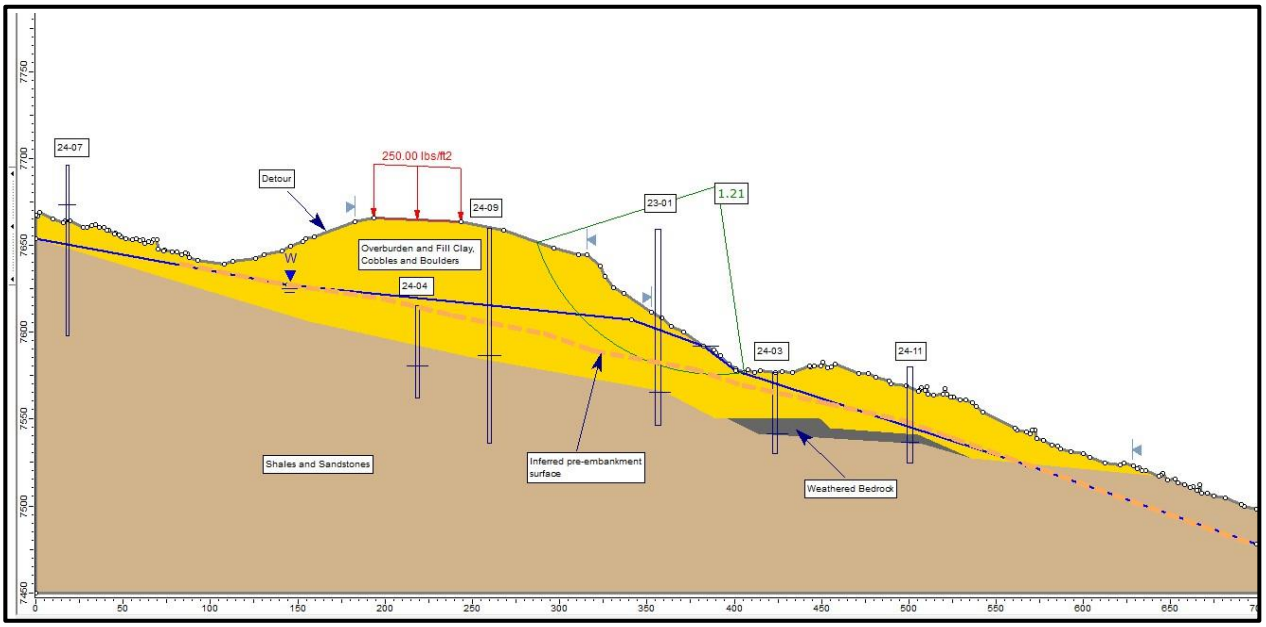
Figure 1. Plan View of Cross Sections Evaluated.

NW Cross Section

Pre-Failure Stability Analysis Model

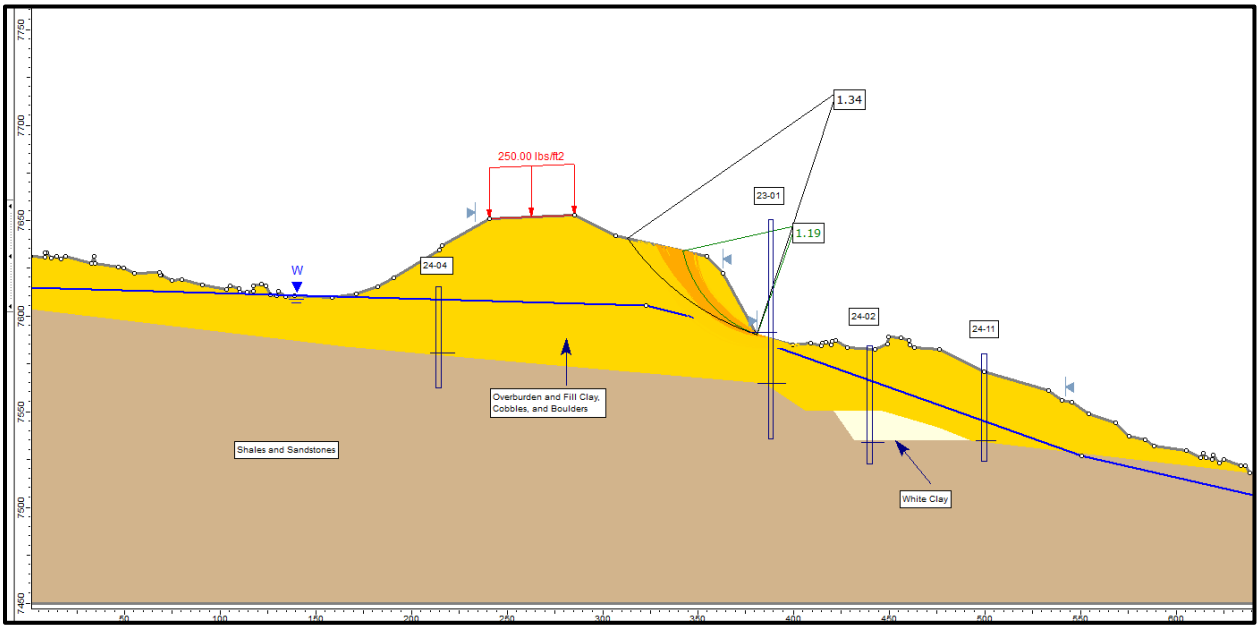


Post Failure Stability Analysis Model

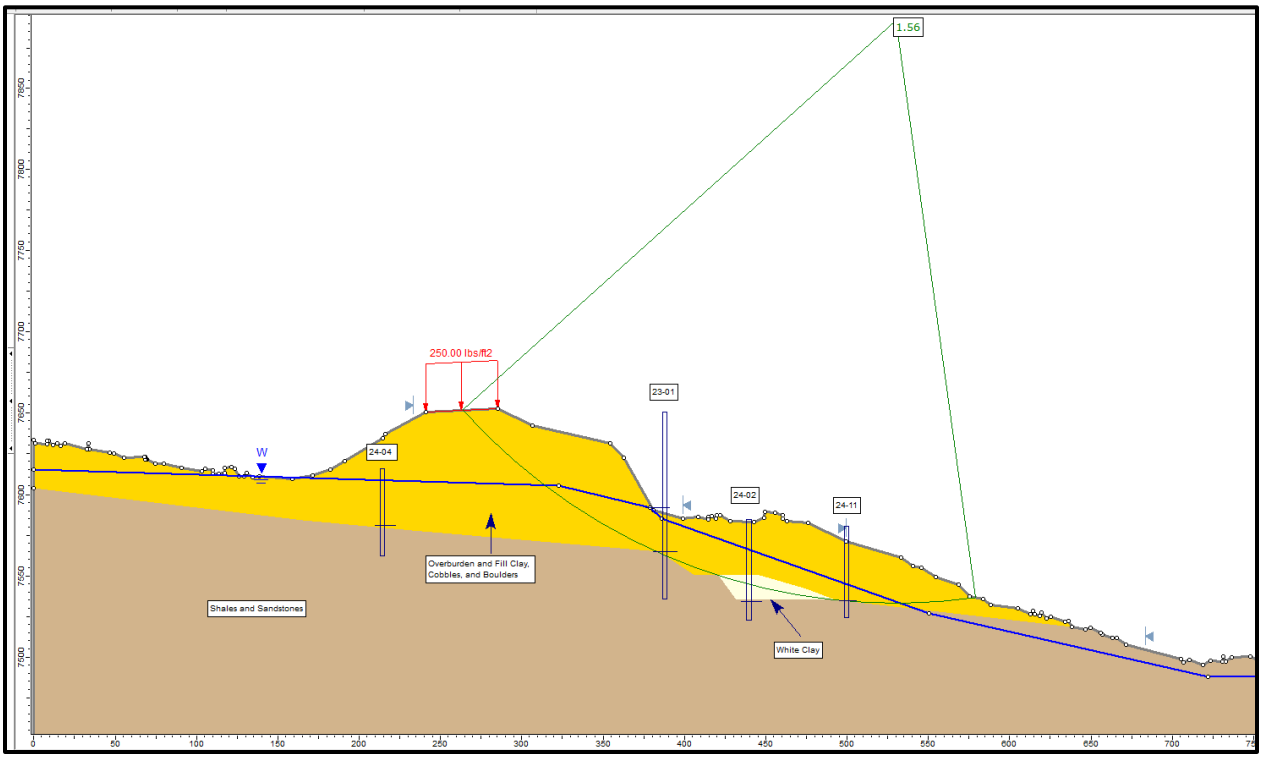


NE Cross Section

Present Stability Analysis Model – Localized Limits



Present Stability Analysis Model – Extended Limits


1.56
250.00 lbs/ft2
23-01
24-04
24-02
24-11
W
Overburden and Fill Clay, Cobbles, and Boulders
Shales and Sandstones
White Clay

OPINIONS

Based on our understanding of the project, data provided to us, and the current estimated groundwater levels, we offer the following:

- RJ has provided what we consider are the two critical analyzed sections.
- The detour template is at a Factor of Safety (FS) of greater than 1.20 for the current slope and water conditions.
- Head-scarp slopes faces may be at a FS of less than 1.20, but the FS between the slope face and the current detour roadway is greater than 1.20.
- Monitoring systems such as shape arrays, piezometers, and radar slope scanning are suggested to be installed and will be utilized to refine stability models. The monitoring systems will provide a layered early warning system in the event the slope moves, so action can be taken to reassess the slope and groundwater conditions.

LIMITATIONS

This study has been conducted in accordance with generally accepted geological and geotechnical engineering practices in this area for use by the client. The suggestions submitted in this report are based upon the data obtained from the ongoing evaluation of the site.
Geologic conditions and ground water levels will also change over time, so the results of the analyses and recommendations will also change over time and may need to be reassessed.

The report was prepared in substantial accordance with the generally accepted standards of practice for geotechnical engineering as exist in the site area at the time of our investigation. No warranties, express or implied, are intended or made.

Sincerely,

RJ Engineering & Consulting, Inc.

Ben Arndt, PE

Principal

Reviewed by:

Richard D. Johnson,

PE Principal