Assessment of Drilled Shaft Capacity and QA/QC from Measuring While Drilling BED31-977-09

#### **GRIP Meeting**

FDOT Project Manager: Dino Jameson, P.E.

UF Project Investigator: Michael Rodgers, Ph.D., P.E.

> Graduate Researcher: Wyatt Kelch, M.E.

> > August 15, 2024

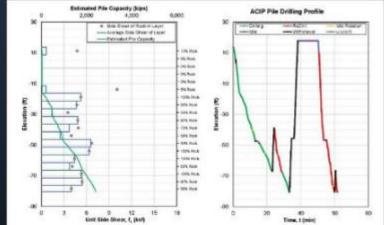




#### Project Background

- FDOT investigated the use of MWD for Auger Cast Piles (ACP) to provide QA/QC during pile installations in Miami-Dade
  - BDV31-977-125
- A new analysis tool was developed
  - Transformed time-referenced data collected from AME to depth-referenced data that is compatible for MWD strength assessment
- For ACPs, a time-referenced data format collected from AME is most commonly used in Florida, and the ACP analysis tool was developed specifically to accommodate the data format

	FD	TO	
	FD		
	ACIP Pile - MWD	) Summary Report	
Project	Location	Engineer	Pile ID
>395	Marri, Florida	Rodgers, Michley, Kelch	916
Diation	Offeet (R)	Drill flig	(ni) tatematic SB (lin)
100-03.01	10.00	Dvill Rig D	.00
Top of Pile Elevation (*)	Bottom of Pile Elevation (ff)	Depth inerconent Analyzed dom)	IDO-MWD Assessment
13.55	-80.54	1	Class 1
Specific Energy Ale	ove Threshold, e (psl)	ACIP Pile Capa	wity QAUGC
to Emergy Tronatedo (pai)	\$,250	This Langes (It)	54:08
Constant and the	7,849	Total Rock Socker Length (ft)	55-W
n	2,300	Average File Side Sheer, f, (cel)	3.27
ed Deviation	2,394	Unfactored Pile Capecity (kips)	2.418
cient of Variation (Cv)	0.04	Factored Pile Capacity (spec	1,401
with	49,098	Partnered Design Load (Kpail	0,070
uin .	1,212	CID Rule for LRFD 0 + 0.0	1.30
er of Data Paints	1,764	Design Regulation of Inspectan	Passed
Inconfined Compressive Stre	ength Above Threshold, q, (ski)	Pie Installation	n Dummery
eshold (ps)	58	Drifting Time (min)	26.7
	100	Diachter Cenergiane	10.4
n	197	Edit Relation Time erring	2.6
att Deviation	116	de Time invani	14.0
clent of Variation (CV)	0.62	Withdrawal Time-(min)	67
A/143	1,897	Perchatian we Ratation Time Incom	0.6
Later	60	Total Time: (mm)	81.6
er of Data Paints	1,704	Drilling Difference (%)	42%



#### **Project Background**

- For drilled shaft MWD...
  - Time-referenced data
  - Depth-referenced data
  - Both data formats
- A new analysis tool needed to be developed to accommodate the possible variations in raw data recording and reporting
- Provide the FDOT with a reliable method of drilled shaft QA/QC analysis, regardless of the monitoring system used
- Contractors can utilize a variety of MWD systems
  - System does not have to produce depthreferenced data
  - Current constraint for full drilled shaft MWD implementation
- On-site and remote monitoring should be explored to improve the quality control portion of the of the QA/QC tool
  - Providing real time strength assessments that can be viewed by all stakeholders

#### **Project Objectives**

- 1. Using FDOT MWD criteria (FM 5-625), develop a versatile data analysis tool that will be used to provide drilled shaft MWD QA/QC
- 2. Conduct a feasibility study to identify the requirements of providing on-site and remote monitoring capabilities to enhance the QA/QC method
- 3. Monitor at least one load tested shaft and three production shafts at three independent sites to develop correlations for QA/QC purposes
- 4. Provide a QA/QC report for all shafts monitored during the research
- 5. Compare test results with previously derived correlations

#### **Tasks and Deliverables**

- Deliverable 1 Establish drilled shaft MWD data reduction criteria and procedures (Task 1)
- Deliverable 2 On-site and remote monitoring implementation feasibility study (Task 2)
- Deliverable 3 MWD specific energy vs. drilled shaft side shear correlation (Task 3)
- Deliverable 4 MWD correlation validation for drilled shaft QA/QC (Task 4)
- Deliverable 5a Draft Final (Task 5)
- Deliverable 5b Closeout Meeting (Task 5)
- Deliverable 6 Final Report (Task 6)



Task 1 – Establish Drilled Shaft MWD Data Reduction Criteria and Procedures for QA

- Task 1 has two subtasks
  - (1a) Developing specification language
  - (1b) Developing a new versatile data analysis tool for drilled shaft QA/QC purposes (Beta Version)
  - Purchase of new MWD system (LIM)
- Provides the FDOT...
  - Necessary spec language to convey proper MWD requirements to the contractor during bidding, or prior to construction
  - Necessary data analysis tool to process and evaluate the raw MWD data received from the contractor to provide quality assurance (QA)



#### Task 1a – Development of Specification Language

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- Identify MWD systems currently available
  - On-board, in-house, and commercially available systems
- Develop spec language that includes data recording and data formatting requirements
- Specification language will detail construction requirements for the contractor
  - Ensures each drill rig has the appropriate monitoring equipment installed and calibrated
  - Data logging capabilities to supply the FDOT with the necessary electronic records for drilled shaft MWD QA.

### Task 1a – Development of Specification Language

- On-board MWD Systems
  - Bauer's B-tronic System
  - Liebehrr's Litronic System
  - Soilmec's Drilling Mate System (DMS)
- Commercially Available MWD Systems
  - Jean Lutz' DIALOG MX System
  - LiM's PocketLIM System
  - Gamperl & Hatlapa's DaVis Systems
  - Pile Dynamics' Pile Installation Recorder (PIR) System
- In-house MWD Systems
  - Keller's Pile Installation Monitoring System (PIMS)
- Every system can produce time-referenced data at 1Hz
  - FM 5-625 requirement for FDOT Bored Pile Class 1



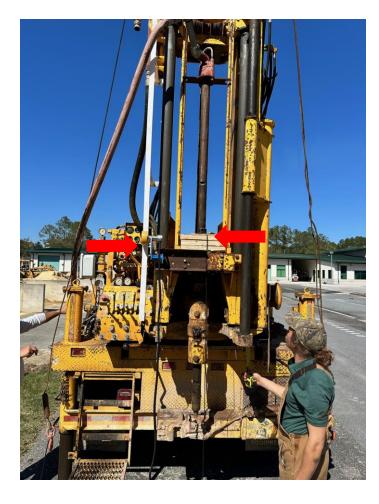
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## Task 1a – Development of Specification Language

- UF Researchers submitted draft spec language for Drilled Shaft MWD:
- FDOT Standard Specifications for Road and Bridge Construction – Section 455
  - Section 455-15.1.2 Drilled Shaft Installation Plan (DSIP)
  - Section 455-15.1.3.1 Measuring While Drilling (MWD)
  - Section 455-15.10.5 MWD Equipment
  - Section 455-15.10.6 MWD Measurements
- Florida Method of Test (FM 5-625)
  - Section 3.6.1 Minimum Accuracy of Measured Values

#### Task 1b - New MWD System - LiM's PocketLiM







#### Task 1b – Development of the Data Analysis Tool – Beta Version

- The monitoring systems onboard the drilled shaft drill rigs, and the format in which the drilling parameters may be recorded and reported were unknown
- New raw data processing criteria and procedures needed to be developed to accommodate the data, regardless of the format
  - Data layout
  - File type
    - e.g., .xlsx, .csv, .txt, .guh, etc.
- The research team considered:
  - Prior MWD data collected in various formats
  - Obtained sample drilling data from commercial vendors
  - Simulated large data sets (1 million rows of data)
    - 16 hrs of drilling at 20 Hz
  - Investigated multiple file types for reported data
- Allowed UF to develop initial processing criteria and a preliminary analysis tool (Beta Version)
  - 5<sup>th</sup> iteration of Beta version in use in S. Florida for ACPs

#### **Raw Data Variations Based on MWD System**

Time (s)	Depth (feet)	Penetration Rate (ft/min)	RPM (rev/min)	Torque pressure (psi)	Crowd pressure (psi)	Crowd Force (Tf)	Bottom Grout (psi)	Top Grout pressure (psi)	Grout Flow (yd3/h)	Grout Volume yd3
0.00	0.000	0.00	0.00	116.03	406.10	0.183	45.122	3.881091138	0	
0.00	0.000	0.00	0.00	111.20	402.48	0.176	45.097	4.39633378	0	C
2.37	0.082	0.54	0.00	111.33	408.06	1.826	45.133	4.606430907	0	C
2.56	0.157	20.85	0.00	116.03	406.10	4.572	45.017	4.608424711	0	C
2.75	0.236	23.92	0.00	116.03	410.94	4.978	45.058	4.654531436	0	C
3.01	0.312	16.72	0.00	116.03	413.36	4.807	45.049	4.624562065	0	C
3.14	0.397	28.84	0.00	116.03	406.10	4.725	45.001	4.583066013	0	C
3.39	0.479	14.80	0.00	112.40	416.98	4.816	45.045	4.704096164	0	C
3.59	0.551	20.33	0.00	101.53	406.10	6.433	45.040	4.377891091	0	C
3.78	0.627	22.90	0.00	140.20	406.10	5.865	44.924	3.953709229	0	C
3.97	0.696	22.90	0.00	328.75	454.45	6.040	44.934	3.958319901	0	C
4.23	0.771	15.19	0.00	681.67	732.44	6.009	44.966	3.94679322	0	C
4.42	0.840	18.97	0.00	1005.59	1256.99	6.020	45.035	3.87993847	0	C
4.61	0.909	21.53	0.00	841.21	1165.13	5.836	45.058	4.290288315	0	C
4.80	0.988	22.56	1.10	836.38	1131.29	5.892	44.994	4.66375278	0	C
5.06	1.056	16.34	3.30	997.13	1334.34	5.862	44.987	4.648768095	0	C
5.25	1.132	18.63	3.30	1213.48	1580.90	5.850	44.984	4.580760677	0	C
5.38	1.201	27.94	3.30	1319.84	1791.21	5.849	44.987	4.659142108	0	C
5.83	1.316	11.75	3.30	1429.65	1808.82	5.844	44.980	4.613694051	0	C

Time	Duration (min)	Gear Box RPM	Penetration Rate (ft/min)	Penetration Rate Dept	h (ft)	Gear Box Pres Torque (ft-lbs	)	Crowd Pressu	Thrust (lb
6/10/2020 7:29:31 AM	0	-81.89	-46.9488204	3.048	0	639.0361062	0	221.0374548	3426.96
6/10/2020 7:29:32 AM	0.02	-82.5	-49.1469832	3.048	0	66.2822289	0	201.8924784	3130.14
6/10/2020 7:29:33 AM	0.03	-84.45	-51.2467208	3.048	0.0656168	0	0	44.8166493	694.837
6/10/2020 7:29:34 AM	0.05	-88.47	-53.0183744	3.048	0.0656168	664.9978545	0	213.0603813	3303.29
6/10/2020 7:29:35 AM	0.07	-80.52	-48.4908152	3.048	0.0656168	589.4332128	0	224.2282842	3476.44
6/10/2020 7:29:36 AM	0.08	11.97	1.0498688	0.9525	0.0984252	584.0668179	0	213.4954944	3310.03
6/10/2020 7:29:37 AM	0.1	12.45	1.6076116	0.622040816	0.164042	620.9063937	0	248.3045424	3849.71
6/10/2020 7:29:38 AM	0.12	14.51	1.8372704	0.544285714	0.1968504	691.1046405	0	253.2358242	3926.17
6/10/2020 7:29:39 AM	0.13	18.86	1.804462	0.554181818	0.2624672	653.5398762	0	256.4266536	3975.64
6/10/2020 7:29:40 AM	0.15	21.26	2.3950132	0.417534247	0.2952756	661.5169497	0	250.915221	3890.19
6/10/2020 7:29:41 AM	0.17	22.16	2.8543308	0.350344828	0.328084	652.66965	0	273.5411022	4240.98
6/10/2020 7:29:42 AM	0.18	22.64	2.8543308	0.350344828	0.3937008	653.1047631	0	280.3578741	4346.67
6/10/2020 7:29:43 AM	0.2	23.07	2.952756	0.338666667	0.4593176	691.9748667	0	259.1823699	4018.36
6/10/2020 7:29:44 AM	0.22	23.33	3.0183728	0.331304348	0.492126	686.8985472	0	258.6022191	4009.37
6/10/2020 7:29:45 AM	0.23	23.55	2.9855644	0.334945055	0.5577428	710.1045792	0	252.6556734	3917.17
6/10/2020 7:29:46 AM	0.25	23.7	2.952756	0.338666667	0.5905512	732.2953473	0	269.1899712	4173.52
6/10/2020 7:29:47 AM	0.27	24.06	2.9855644	0.334945055	0.6233596	678.776436	0	255.4113897	3959.9
6/10/2020 7:29:48 AM	0.28	24.24	2.8871392	0.346363636	0.6889764	694.5855453	0	254.8312389	3950.9
6/10/2020 7:29:49 AM	0.3	24.38	2.8543308	0.350344828	0.7217848	679.3565868	0	252.8007111	3919.42

#### [PARAMETER]

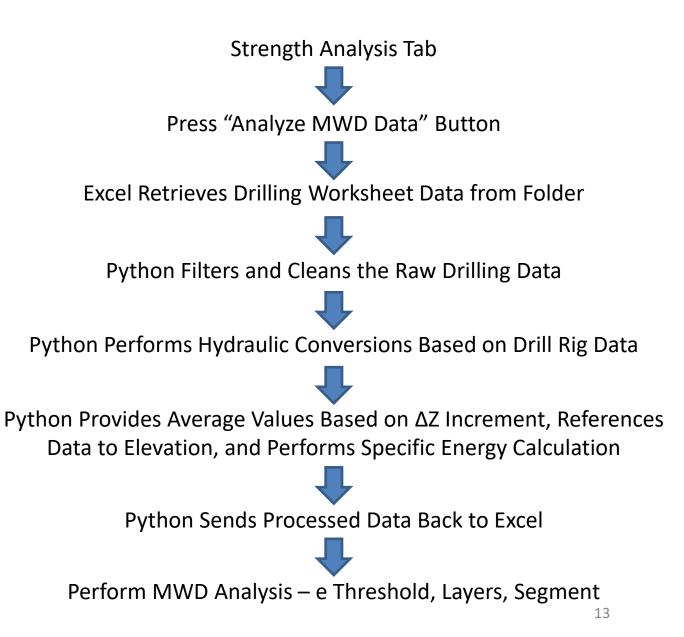
Date;Depth;P-Grout;P-Rotary Head;P-Crowd;Rotation;Torque;Speed;X-Axis;Y-Axis;Grout 0;m;bar;bar;bar;RPM;kNm;cm/min;°;°;1/min;L;%;-;-;~;%;1/min

#### [DATA]

12.10.2022 10:52:3;0;-10;0;27;0;0;0;0;0.1;0;0;0;1;0;0;30;0.1 12.10.2022 10:52:4;0;-10;0;25;0;0;0;0;0;0.1;0;0;0;1;0;0;30;0.1 12.10.2022 10:52:5;0;-10;0;27;0;0;0;0;0;1;0;0;1;0;0;28;0.08 12.10.2022 10:52:6;0;-10;2;27;6;1;0;0;0.1;0;0;0;1;0;0;75;0.23 12.10.2022 10:52:7;0;-10;97;27;22;55;0;0;0.1;0;0;0;1;0;0;46;0.67 12.10.2022 10:52:8;0;-10;62;27;24;35;0;-0.1;0;0;0;0;1;0;0;34;0.48 12.10.2022 10:52:9;0;-10;60;27;26;34;0;0;0;0;0;0;0;1;0;0;33;0.47 12.10.2022 10:52:10;0;-10;55;27;25;31;0;-0.1;-0.1;0;0;0;1;0;0;33;0.5 12.10.2022 10:52:11;0;-10;57;27;25;32;0;0;0;0;0;0;0;1;0;0;33;0.45 12.10.2022 10:52:12;0;-10;55;27;25;31;0;0.1;0;0;0;0;0;1;0;0;33;0.45 12.10.2022 10:52:13;0;-10;52;27;25;29;0;0;0;0;0;0;0;1;0;0;33;0.47 12.10.2022 10:52:14;0;-10;52;27;25;29;0;0.1;0;0;0;0;1;0;0;34;0.47 12.10.2022 10:52:15;0;-10;52;27;25;29;0;0;-0.1;0;0;0;1;0;0;34;0.52 12.10.2022 10:52:16;0;-10;55;27;25;31;0;0;0;0;0;0;0;1;0;0;34;0.47 12.10.2022 10:52:17;0;-10;52;27;25;29;0;0;-0.2;0;0;0;1;0;0;33;0.52 12.10.2022 10:52:18;0;-10;52;27;25;29;0;0;0;0;0;0;0;1;0;0;34;0.47 12.10.2022 10:52:19;0;-10;52;27;25;29;0;0;0;0;0;0;0;0;34;0.47 12.10.2022 10:52:20;0;-10;52;27;25;29;0;0.1;0;0;0;0;1;0;0;33;0.47 12.10.2022 10:52:21; -0.01; -10; 57; 112; 24; 32; 0; -0.1; 0.1; 0; 0; 0; 1; 0; 0; 35; 0.47 12.10.2022 10:52:22; -0.02; -10.1; 57; 100; 25; 32; 0; 0.1; 0.1; 0; 0; 0; 1; 0; 0; 34; 0.53 12.10.2022 10:52:23; -0.05; -10.1;62; 100; 22; 35; 0; 0.1; 0; 0; 0; 0; 1; 0; 0; 35; 0.48 12.10.2022 10:52:24; -0.12; -10.1;85;97;23;48;114;0.1;0;0;0;0;0;1;0;0;39;0.55 12.10.2022 10:52:25;-0.21;-10.2;87;97;23;49;114;0;0.5;0;0;0;1;0;0;40;0.62 12.10.2022 10:52:26;-0.29;-10.2;95;95;23;54;114;-0.1;-0.1;0;0;0;1;0;0;41;0.58 12.10.2022 10:52:27; -0.38; -10.2; 92; 92; 52; 52; 114; 0.1; 0.2; 0; 0; 0; 1; 0; 0; 41; 0.63 12.10.2022 10:52:28; -0.47; -10.1;82;92;26;46;114;0.1;0.2;0;0;0;1;0;0;40;0.55 12.10.2022 10:52:29; -0.56; -10; 105; 92; 25; 59; 523.2; 0; 0.1; 0; 0; 0; 1; 0; 0; 42; 0.6 12.10.2022 10:52:30; -0.64; -10; 112; 92; 23; 63; 523.2; -0.1; 0.5; 0; 0; 0; 2; 0; 0; 42; 0.6 12.10.2022 10:52:31;-0.72;-10;120;92;22;68;523.2;-0.1;0.2;0;0;0;2;0;0;44;0.62 12.10.2022 10:52:32;-0.79;-10;135;92;23;76;523.2;0;0.4;0;0;0;2;0;0;45;0.65 12.10.2022 10:52:33; -0.87; -10;147;87;22;83;523.2; -0.1;0.3;0;0;0;2;0;0;46;0.67 12.10.2022 10:52:34;-0.93;-10;162;87;21;92;458.4;0;0.4;0;0;0;2;0;0;48;0.77 12.10.2022 10:52:35;-1;-10;177;87;21;100;458.4;-0.1;0.4;0;0;0;2;0;0;50;0.73 12.10.2022 10:52:36; -1.06; -10; 177; 87; 20; 100; 458.4; -0.1; 0.5; 0; 0; 0; 2; 0; 0; 50; 0.73 12.10.2022 10:52:37; -1.12; -10; 190; 87; 20; 107; 458.4; 0; 0.4; 0; 0; 0; 2; 0; 0; 50; 0.73 12.10.2022 10:52:38; -1.19; -10; 180; 85; 23; 102; 458.4; -0.2; 0.3; 0; 0; 0; 0; 0; 0; 0; 51; 0.77 12.10.2022 10:52:39; -1.25; -10; 212; 87; 18; 120; 388.8; -0.1; 0.4; 0; 0; 0; 3; 0; 0; 52; 0.75 12.10.2022 10:52:40; -1.31; -10; 185; 87; 18; 105; 388.8; -0.3; 0.3; 0; 0; 0; 3; 0; 0; 51; 0.73 12.10.2022 10:52:41; -1.38; -10; 205; 87; 19; 116; 388.8; -0.2; 0.5; 0; 0; 0; 3; 0; 0; 53; 0.78 12.10.2022 10:52:42;-1.44;-10;205;87;18;116;388.8;-0.1;0.5;0;0;0;3;0;0;51;0.83 12.10.2022 10:52:43; -1.49; -9.9; 215; 87; 19; 122; 388.8; -0.1; 0.4; 0; 0; 0; 3; 0; 0; 53; 0.8 12.10.2022 10:52:44; -1.55; -9.9; 227; 87; 16; 128; 357.6; -0.1; 0.5; 0; 0; 0; 3; 0; 0; 54; 0.8 12.10.2022 10:52:45; -1.61; -9.9; 222; 87; 16; 126; 357.6; -0.2; 0.4; 0; 0; 0; 3; 0; 0; 53; 0.78 12.10.2022 10:52:46; -1.66; -9.8; 217; 87; 17; 123; 357.6; -0.1; 0.4; 0; 0; 0; 3; 0; 0; 54; 0.82 12.10.2022 10:52:47; -1.71; -9.8; 220; 87; 17; 124; 357.6; -0.1; 0.4; 0; 0; 3; 0; 0; 55; 0.82

### FLMWD Analysis Tool Workflow

- New MWD analysis tool utilizes python to perform the background calculations
  - No longer have to copy and paste data or files into analysis tool
    - Imports all data and files from folders
    - Never have to open a single drilling file to analyze your MWD data
  - Much smaller file sizes
    - > 3MB compared to 40 to 50 MB
  - Easier to track changes during upgrades and modifications
- Provides a similar user interface (UI) to ACIP analysis tool
  - Specific energy threshold and layers can be adjusted without triggering the program to reanalyze the data



### Agreement

I agree that I obtained this spreadsheet from the Florida Department of Transportation (FDOT) and have been granted authorization by the FDOT to use it. I also agree that I will not modify, copy, or distribute this spreadsheet, its contents, or accompanying packages to anyone.

If you agree with these statements, please check the box below indicating you agree.

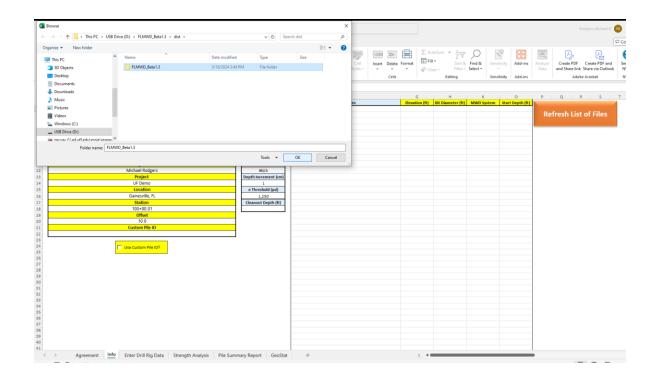
I Agree

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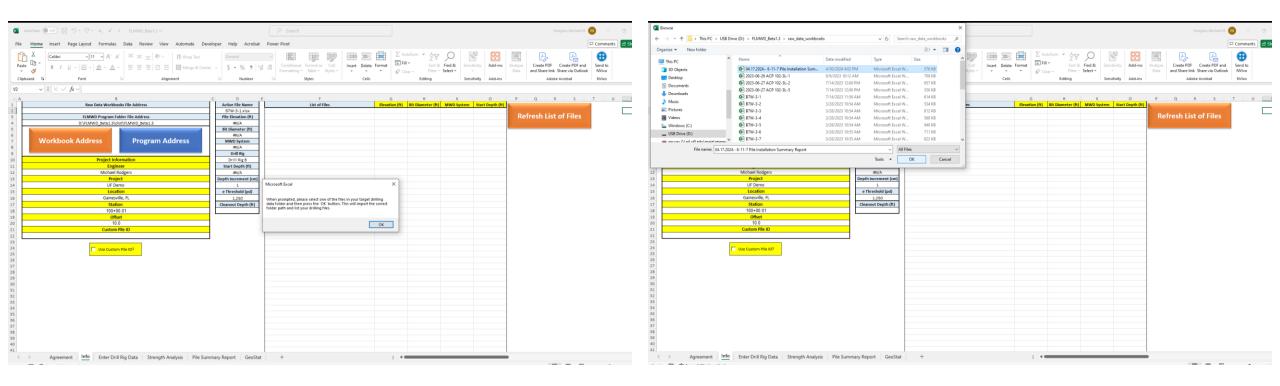
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7       #VA	
5       #1/A       #1/A <t< td=""><td></td></t<>	
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Bottom       #VA       -10148       #VA	
Agreement     Info     Strength     Analysis     Pile Summary Report     GeoStat     G       Scrult to the right for additional analysis     Info     Strength     Analysis     Pile Summary Report     GeoStat     G       Scrult to the right for additional analysis     Info     Strength     Analysis     Pile Summary Report     GeoStat     G       MUX0 accessments to for     Strength     Analysis     Pile Summary Report     GeoStat     G     C       Serverh     MWD Bored Pile GA/OC Analysis     File Summary Report     GeoStat     File Summary Report     GeoStat     G       Serverh     Serverh     MWD Bored Pile GA/OC Analysis     MWD Bored Pile GA/OC Analysis     MMD Bored Pile GA/OC Analysis     MUX0 Accessments at 1 cm Openet Analysis     MMD Bored Pile GA/OC Analysis       Segment Bored Developer     File Sum Segment Analysis     Segment Bored Pile GA/OC Analysis     MUX0 Bored Pile GA/OC Analysis       MWD accessments at 1 cm Openet Accessment (ont)     Segment Bored Pile GA/OC Analysis     MMD Bored Pile GA/OC Analysis     MMD Bored Pile GA/OC Analysis       Segment Bored Developer     File Segment Bored Pile GA/OC Analysis     Segment Bored Pile GA/OC Analysis     MUX0 Bored Pile GA/OC Analysis       Segment Bored Developer     File Segment Bored Pile GA/OC Analysis     Segment Bored Pile GA/OC Analysis     Segment GeoB       Signent Bored Developer <td></td>	
Agreement info Enter Drill Rig Data     Scredit to the right for additional analysis      Agreement info     Enter Drill Rig Data     Strength Analysis     Ne	
Agreement     Info     Info     Info     Info     Info     Info       Scroll to the right for additional analysis     Info     Info     Info     Info     Info       Scroll to the right for additional analysis     Info     Info     Info     Info     Info       Agreement     Mod     Enter Drill Rig Data     Strength Analysis     File Summary Report     GeoStat     Info     Info       Info     Info     Info     Info     Info     Info     Info     Info     Info       Info     Info     Info     Info     Info     Info     Info     Info     Info     Info       Info     Info     Info     Info     Info     Info     Info     Info     Info     Info     In	
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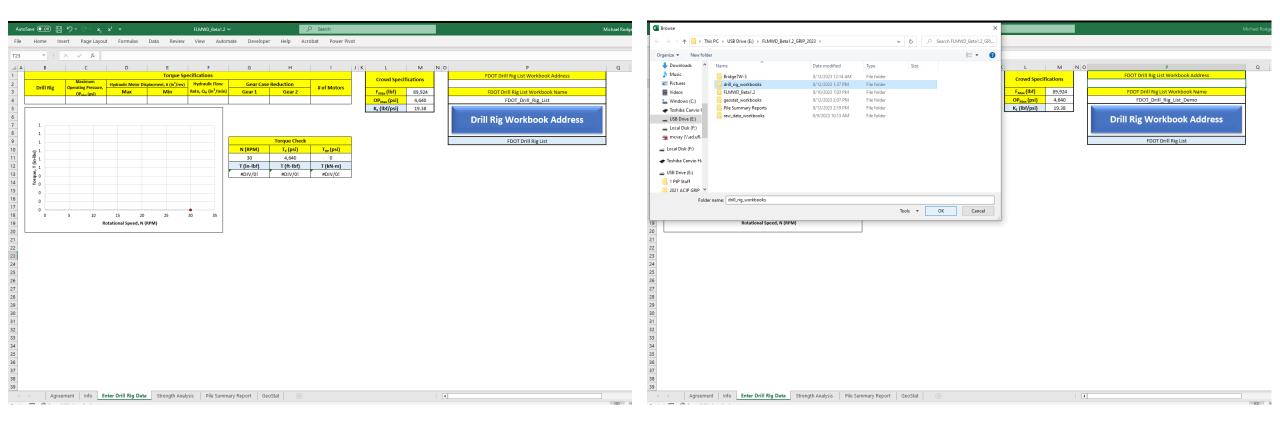
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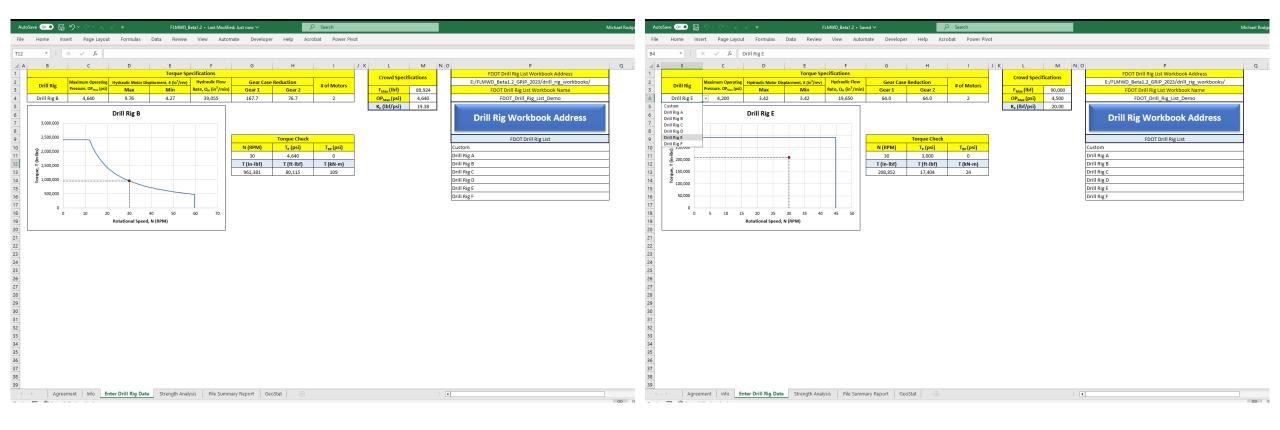
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Project         Depth Increment (cm)         B7W-3-2.xlsx         1.85         2.5         PIMS         0           1         e Threshold (psi)         1.         B7W-3-3.xlsx         1.3.50         2.5         PIMS         0           0.0cation         0.0         B7W-3-4.xlsx         1.3.50         2.5         PIMS         0           0.0         Station         1.250         0.0         0.0         2.5         PIMS         0           0.0         0.0         0.0         1.250         0.0         0.0         2.5         PIMS         0           0.0         0.0         0.0         0.5         2.5         PIMS         0		0														
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Image: Gainesville, FL       1,250       1,2		0										Threshold (noi)				
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1395_B26_Demo.xlsx       34.02       0.0       PIMS       0         1395_B26_Test_PiPie_1-1.xlsx       35.70       0.0       PIMS       0         1395_B26_Test_PiPie_1.xlsx       33.20       0.0       PIMS       0         1395_B26_Test_PiPie_1.xlsx       33.20       0.0       PIMS       0         1395_B26_Test_PiPie_1.xlsx       33.20       0.0       PIMS       0         1395_B26_Test_PiPie_1.xlsx       10.70       3.5       Jean Lutz       15.28         wyat_book.xlsm       10.70       3.5       Jean Lutz       15.28         Wyat_book.xlsm       10.70       3.5       Jean Lutz       15.28         ZP2_2024-02-27T15+35+39.xlsx       0       0.5       Jean Lutz       15.28		0								set Example.guh						
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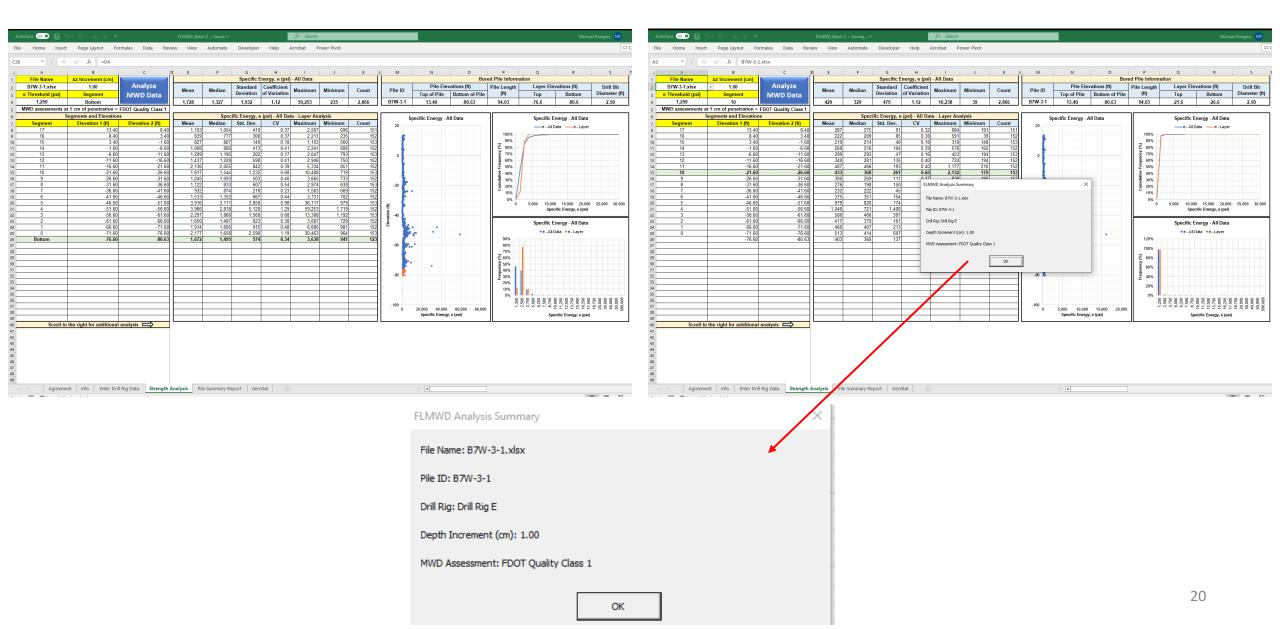
#### Enter Drill Rig Data



#### Enter Drill Rig Data



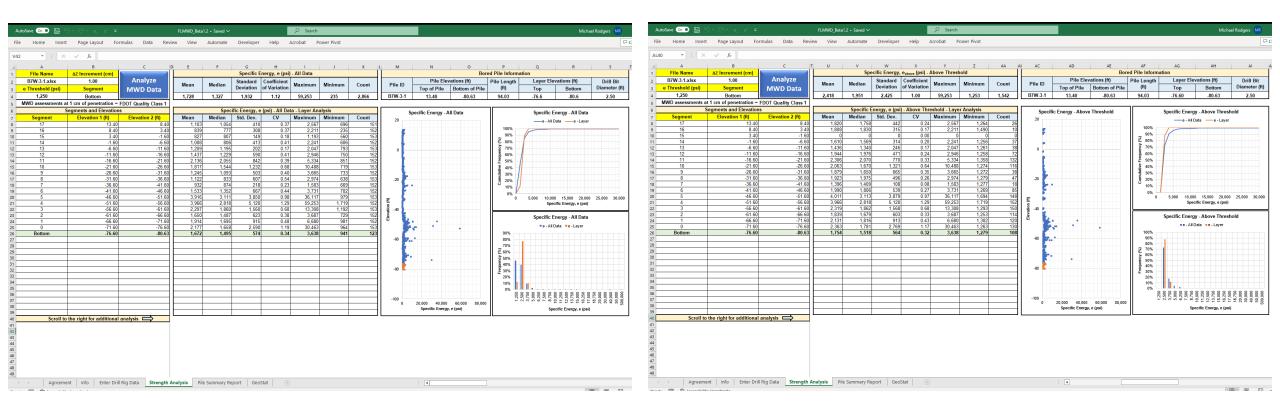
#### Strength Analysis



### Strength Analysis – Specific Energy Threshold

#### All Specific Energy Data

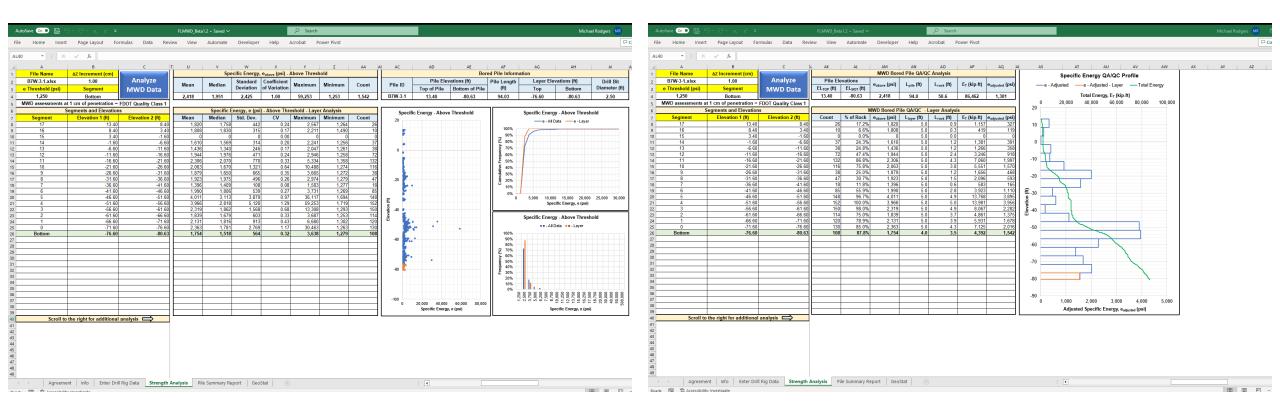
#### Only Specific Energy Data Above Threshold



### Strength Analysis – Specific Energy Threshold

#### Only Specific Energy Data Above Threshold

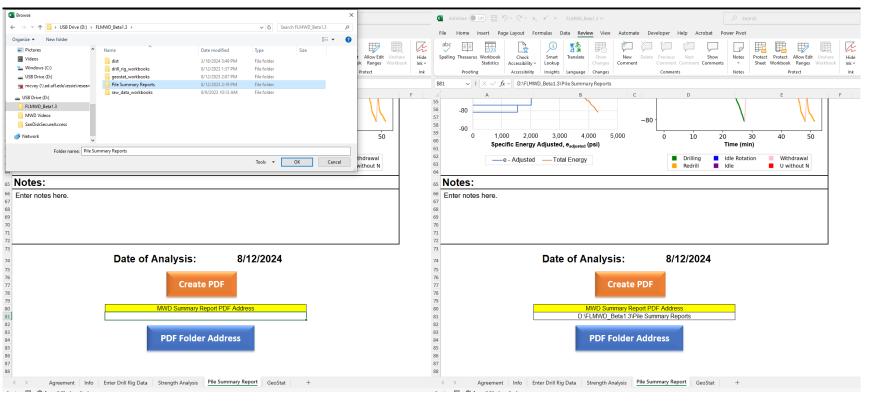
#### Bored Pile QA/QC Analysis





		nmary Report	B III B L F L
Engineer Michael Redgers	Pile ID 7W-3-1	Drill Rig Drill Rig B	Drill Bit Diameter (in) 30
Michael Rodgers			
Project	Location	Top of Pile Elevation (ft)	Bottom of Pile Elevation (ft)
UF Demo	Gainesville, FL	13.40 Depth Increment Analyzed (cm)	-80.63 MWD Assessment
Station 100+00.01	0ffset (ft) 10.00	1.00	FDOT Quality Class 1
100+00.01	10.00	1.00	1 DOT Quality class 1
Specific Energy, e	(psi) - All Data	ACIP Pile QA/QC - Ro	ck Socket Assessment
lean	1,728	Pile Length (ft)	94.03
ledian	1,327	Total Rock Socket Length (ft)	50.59
tandard Deviation	1,932	Pile Pecentage of Rock (%)	54%
coefficient of Variation (CV)	1.12	Specific Energy Threshold (psi)	1,250
laximum linimum	59,253 235	Specific Energy, e <sub>above</sub> (psi)	2,418 1,301
lumber of Data Points	2,866	Specific Energy, e <sub>adjusted</sub> (psi) Total Energy, E <sub>T</sub> (kip-ft)	86,469
amber of Data 1 onto	2,000	Total Energy, ET (Kip-it)	00,403
Specific Energy, e <sub>above</sub> (ps	i) - Above Threshold	Bored Pile Installation	n Summary - Time (min)
lean	2,418	Drilling	23.33
ledian	1,951	Redrill	11.43
tandard Deviation	2,425	Idle Rotation	1.55
coefficient of Variation (CV)	1.00	ldle	9.10
Maximum Minimum	59,253 1,253	Withdraw Penetration without Rotation	5.33 0.52
lumber of Data Points	1,542	Total	51.27
10		$\lambda$	
0		0 -	
-10			
-20		$\hat{a}^{-20}$	
£ -30		Elevation (#)	
(±) -30 totation (±) -30 (±) -30 (±) (±) -30 (±) (±) -30 (±) (±) -30 (±) (±) -30 (±) (±) (±) -30 (±) (±) (±) (		i li	
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-80			
-80		-80 -	V VX
-90		-80 -	
0 1,000 2,000	3,000 4,000 5,000 djusted, e <sub>adjusted</sub> (psi)		30 40 50 ne (min)
	-Total Energy		Rotation Withdrawal
Notes:			
Enter notes here.			
Enter notes here.			

### **Pile Summary Report**





#### FDOT

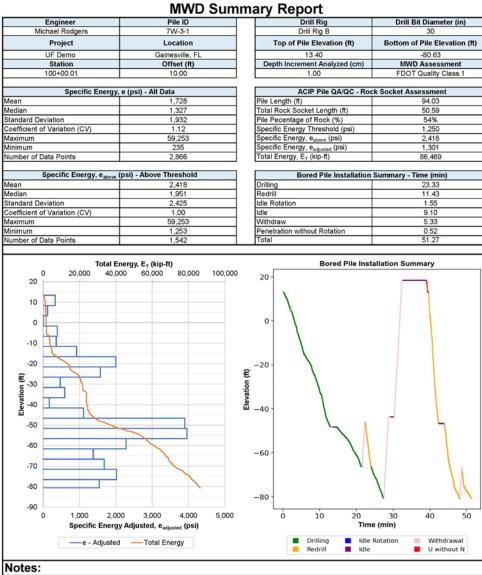
### Pile Summary Report

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0	PDF saved to: D:\FLMWD_Beta1.3\Pile Summary Reports\7W-3-1.pdf	
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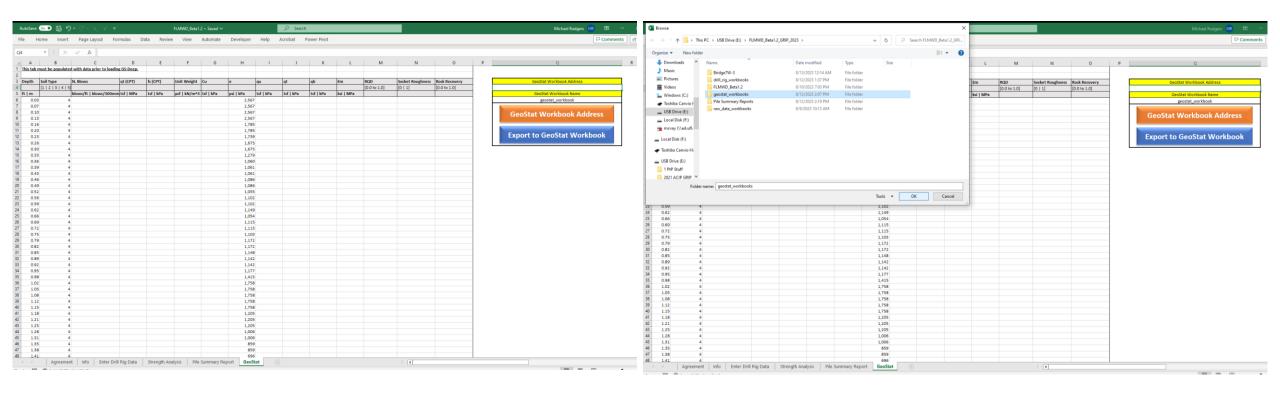
Name A 7W-3-1 A 7W-3-6 A 7W-3-8

Date modified
8/12/2024 2:43 PM
4/25/2024 12:47 PM
4/30/2024 11:59 AM



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#### GeoStat



#### GeoStat

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2															
3	Depth	Soil Type	N. Blows	qt (CPT)	fs (CPT)	Unit Weig	Cu	e	qu	qt	qb	Em	RQD	Socket Ro	Rock Reco
4		[1   2   3											[0.0 to 1.0	[0   1]	[0.0 to 1.0]
5	ft   m		blows/ft	tsf   MPa	tsf   kPa	pcf   kN/r	tsf   kPa	psi   kPa	tsf   kPa	tsf   kPa	tsf   kPa	ksi   MPa	1		
6		4	L .					2,567							
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8		4	l .					2,567							
9	0.13	4	L .					2,567							
10		4						1,785							
11	-	4						1,785							
12		4						1,739							
13		4						1,675							
14		4						1,675							
15	-	4						1,279							
16		4						1,060							
17		4						1,061							
18	-	4						1,061							
19	-	4						1,086							
20		4						1,086							
21	-	4						1,055							
22	-	4						1,102							
23		4						1,102							
24		4						1,149							
25	-	4						1,054							
26	-	4						1,115							
27		4						1,115							
28		4						1,103							
29		4						1,172							
30	-	4						1,172							
31		4						1,148							
32	-	4						1,142							
33		4						1,142							
34		4						1,177							
35		4						1,415		-					
36	-	4						1,758							
37	-	4				-		1,758		-					
38		4						1,758							
39	-	4						1,758		-					
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41								1,205							
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poth	Soil Type	N. Blows	at (	(CPT)	fs (CPT)	Unit Weigh	Cu	e	qu	qt	qb	Em	RQD	Socket Roughness	Rock Recovery	i - 6	GeoStat Workbook Address
pui	[1   2   3   4   5		444	(0) 1/	in (cr. i)				40	4.	40		[0.0 to 1.0]	[0   1]	[0.0 to 1.0]		E:/FLMWD_Beta1.2_GRIP_2023/geostat_workbooks/
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0.72								1,115									
0.79								1,172									
0.82	4	1						1,172									
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0.89								1,142								-	
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0.95								1,177								1	
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1.05								1,758									
1.08								1,758								-	
1.12		1						1,758								-	
1.15								1,758									
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1.28								1,006									
1.31								1,006								-	
1.35								859								-	
1.58								696								-	
		nt Info Ente	er Drill Rig	Data	Strength Ani	horis Di	e Summary Rev							1.4			

#### Task 2 – Real Time, On-site and Remote QC Monitoring Implementation Feasibility Study

- The new data analysis tool will greatly improve drilled shaft QA/QC as the quality and lengths of rock sockets can be verified through specific energy obtained from MWD
- When MWD-load test correlations can be established for a site or region, the QA portion of the procedure is improved by allowing the shaft's axial capacity to be estimated to ensure it meets design criteria, directly
- However, the quality control (QC) portion of the procedure could be further improved by providing real-time measurements of specific energy, total energy, and side shear axial shaft capacity during the drilling process

# Task 2 – Real Time, On-site and Remote QC Monitoring Implementation Feasibility Study

- Can currently view drilling parameters live
- Need to develop a robust method that can transmit MWD data that is applicable to all monitoring systems
  - Likely through CAN bus integration
  - Will be tested during BED31-977-03 in a controlled setting
  - SBC module can transmit actual data on-site and to remote locations via CAN and Modem hats added in
- Moving in the direction of remote monitoring being demonstrated during this project
  - Live data is sent to a satellite server that can be accessed via the FLMWD Excel UI, filtered, cleaned, and analyzed in the office
    - Creates a viable path forward for remote monitoring and live analysis in the office
    - Will be tested with the Jean Lutz system very soon



### **Remaining Tasks**

- Deliverable 1 Establish drilled shaft MWD data reduction criteria and procedures (Task 1)
- Deliverable 2 On-site and remote monitoring implementation feasibility study (Task 2)
- Deliverable 3 MWD specific energy vs. drilled shaft side shear correlation (Task 3)
- Deliverable 4 MWD correlation validation for drilled shaft QA/QC (Task 4)
- Deliverable 5a Draft Final (Task 5)
- Deliverable 5b Closeout Meeting (Task 5)
- Deliverable 6 Final Report (Task 6)

#### Questions?



