



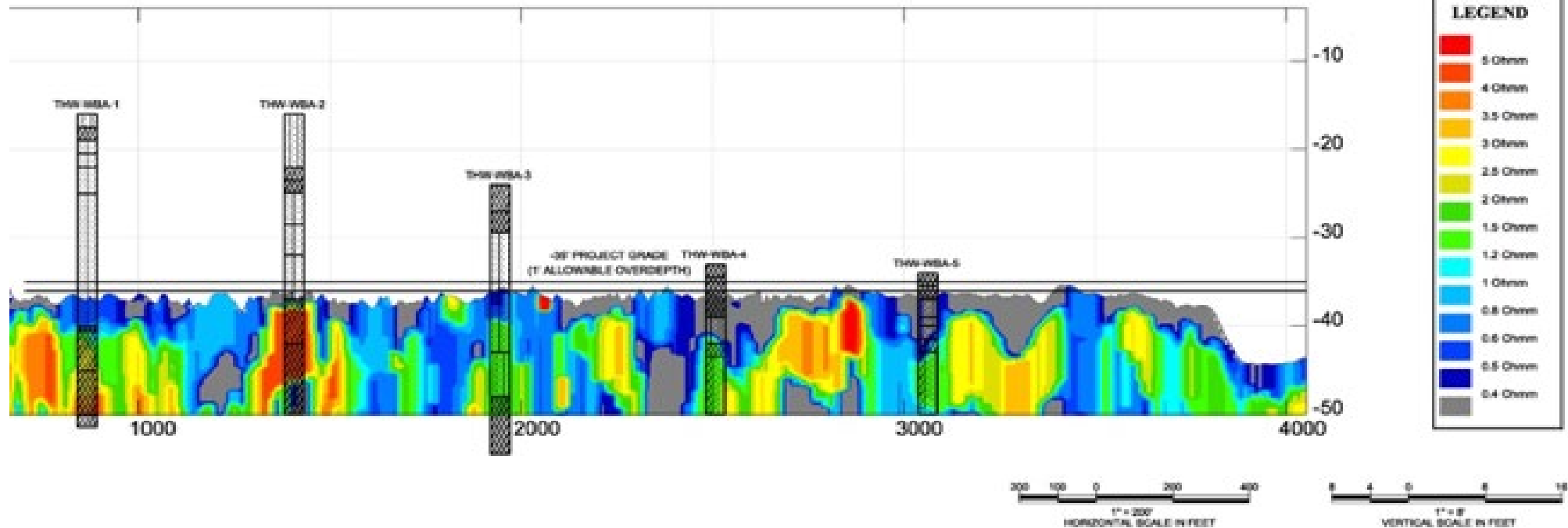
Advanced Subsurface Technology

Reducing Dredging Costs & Improving Production

Providing a Clear Understanding of the Subsurface

BILLING LOG	DATE	LOCATION	DEPTH
1. PROJECT NAME	2. DATE	3. LOCATION	4. DEPTH
5. CLIENT	6. PROJECT NO.	7. DRAWING NO.	8. SHEET NO.
9. PROJECT DESCRIPTION	10. PROJECT STATUS	11. PROJECT START DATE	12. PROJECT END DATE
13. PROJECT LOCATION	14. PROJECT COORDINATES	15. PROJECT ELEVATION	16. PROJECT DURATION
17. PROJECT BUDGET	18. PROJECT COST	19. PROJECT PROFIT	20. PROJECT RISK
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RESISTIVITY VERTICAL PROFILE "P2"



Join the Group



- ❖ **Quonset, RI**
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Rock Location Pre-Dredging
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Channel & Harbor Deepening
- ❖ **Jacksonville, FL**
Drydock Excavation
- ❖ **Rockledge, FL**
Sediment Remediation
- ❖ **Bayou Chico, FL**
Sediment Remediation
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- ❖ **Freeport Harbour, Bahamas**
Sheet Pile to Top of Rock
- ❖ **San Juan, PR**
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- ❖ **Kissimmee, FL**
Contaminated Lake Sediments
- ❖ **Mobile, AL**
Channel Deepening & Widening
- ❖ **Brunswick, GA**
Pre-bid Investigation

Rockledge Florida
Contaminated Sediment Location Survey
How the System Works

- Rockledge Video



Quonset, Rhode Island Channel Deepening & Widening



“On several occasions Foth has worked with ARC to develop geophysical data for marine projects. The results of the Aquares survey have provided valuable information that helped move our projects forward. We have found good correlation with other methodologies and were particularly excited about the coverage the system attained. Arc was forthright in explaining the benefits and limitations of the system and helped guide us through the analysis and use of the data produced by the system. The use of the Aquares system improved our overall site analysis.”

Regards,

Mike Campagnone, P.E.

Senior Technology Manager – Geophysical Surveys

Licensed in MA, RI, NY



Foth Infrastructure & Environment, LLC

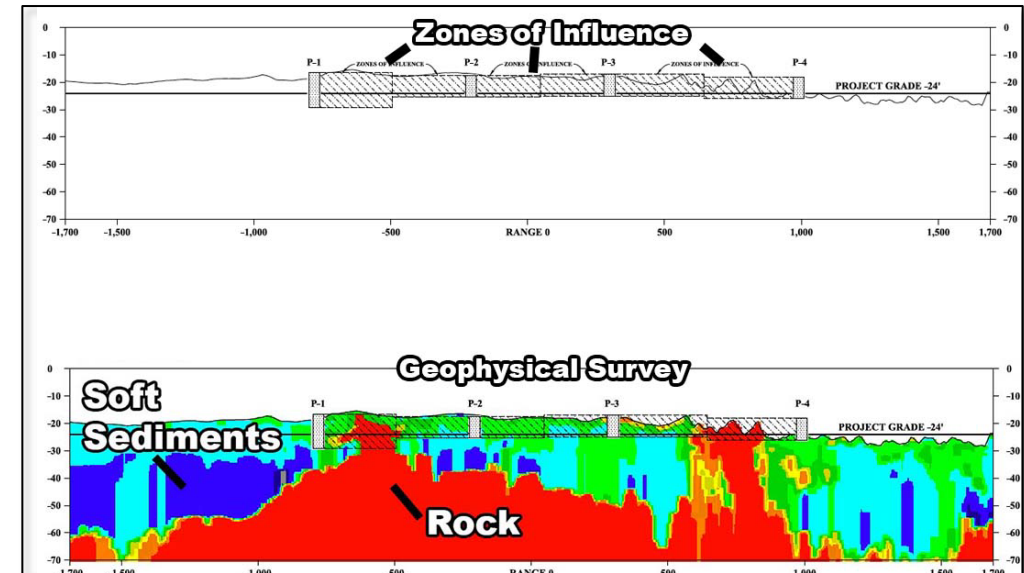
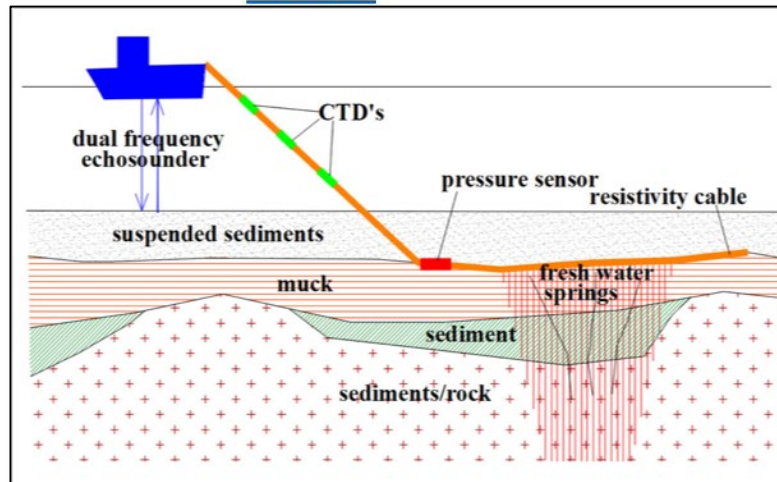
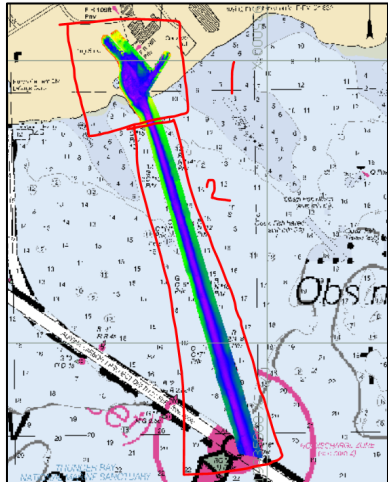
15 Creek Road

Marion, MA 02738

Direct: (508) 748-0937

Cell: (401) 663-5782

foth.com





San Juan Harbor, Puerto Rico Deepening & Widening Survey



Curtin Maritime specializes in clamshell dredging, tackling large scale capital projects with difficult geotechnical conditions. We carry many different sized buckets in our fleet to tackle varying strata of material and it's important that we are able to select the correct tool for the job each and every day. The industry standard for project owners is to provide typically outdated boring logs taken sporadically through the dredge areas to provide an idea of what the geological composition of the in-situ dredge material is. While a trusted and true method, it requires a lot of interpolation and can lead to many inaccuracies, which then leads to poor planning for project bucket utilization. Swapping between different buckets frequently can cause lengthy downtime delays and increased costs and schedule for stakeholders.

A more concise method is to perform a geophysical survey to create visual and digital understanding of the of the dredge template, like the method that Arc Surveying & Mapping is leading in the US.

We recently hired Arc to conduct a geophysical survey for our deepening and widening project in San Juan, Puerto Rico: a project slated to be our company's most complicated bucket strategy yet due to varying resistance values in the material. Arc was able to create a 3D model mapping our dig areas with different useful visuals depending on how we needed to plan. *The data from the survey has lined up better than any boring log ever has based on material we've removed to date*, and we at Curtin can recommend that federal agencies, ports, and harbors should consider this service as a valuable investment tool for any capital dredging project that's guaranteed to save on cost and schedule.



Kyle Herrick
cell: 386-847-4692
email: kherrick@curtinmaritime.com





Lakeland, Florida Contaminated Sediment Survey



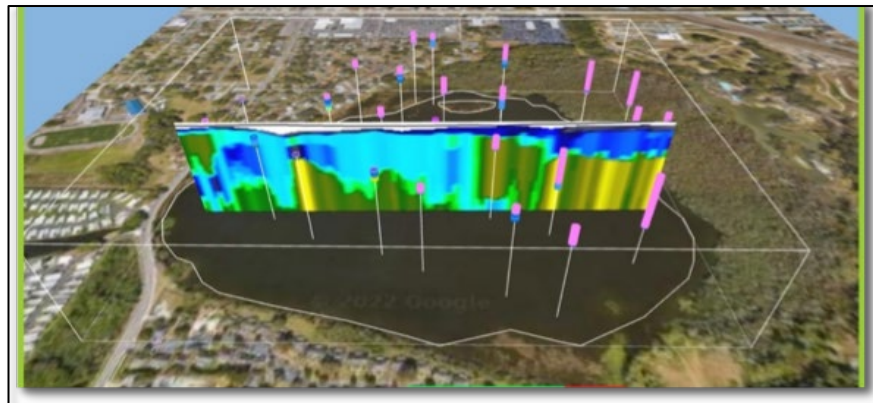
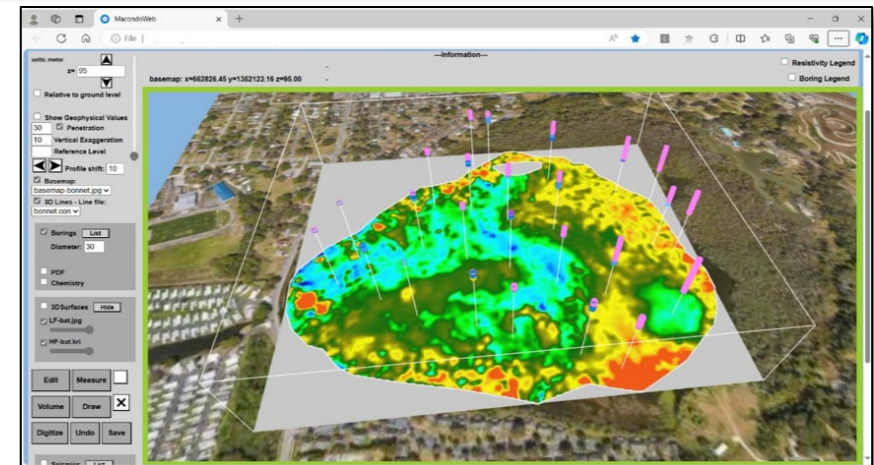
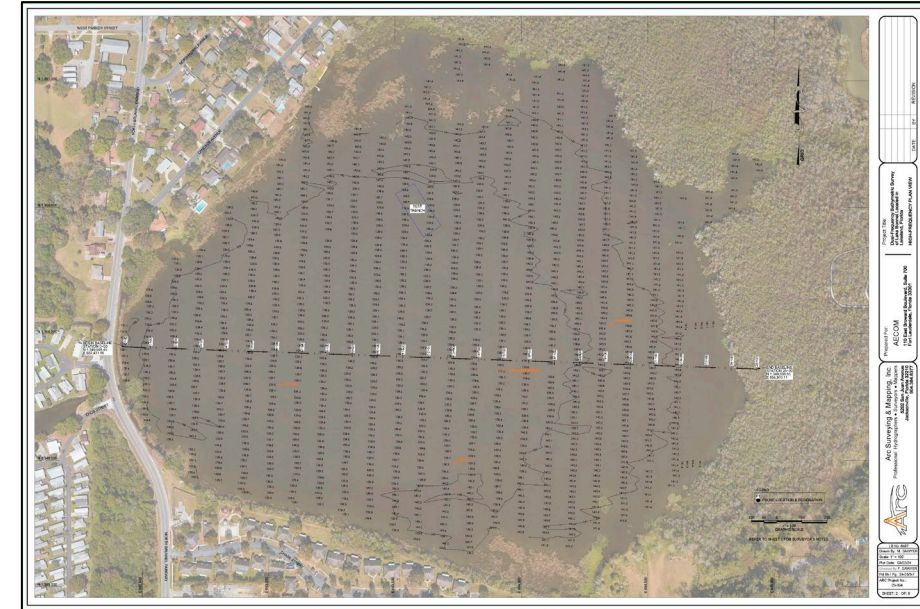
On behalf of AECOM, I would like to commend Arc Surveying and Mapping for their outstanding effort in completing the electrical resistivity surveying and subsurface profiling of Lake Bonnet in Lakeland, FL. This high-profile project, which has received over \$42 million in grant funding to reduce flooding, required a comprehensive subsurface profile of the lake's sediments to evaluate the best alternatives. Your team's technical expertise and extensive knowledge of the dredging industry have been invaluable in helping us visualize the subsurface sediments in an accurate and manageable manner.

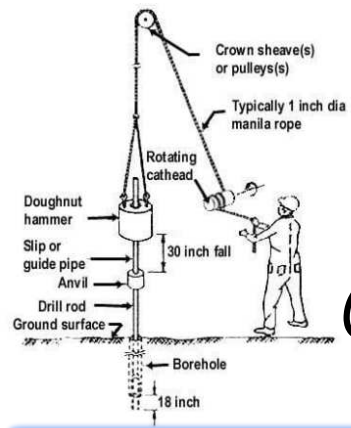
I have relied on Arc Surveying and Mapping's expertise for over 20 years and consider them to be one of the best bathymetric and geophysical surveyors in the business. Their commitment to excellence and consistent delivery of high-quality results make them a trusted partner for any surveying and mapping needs.

Dan

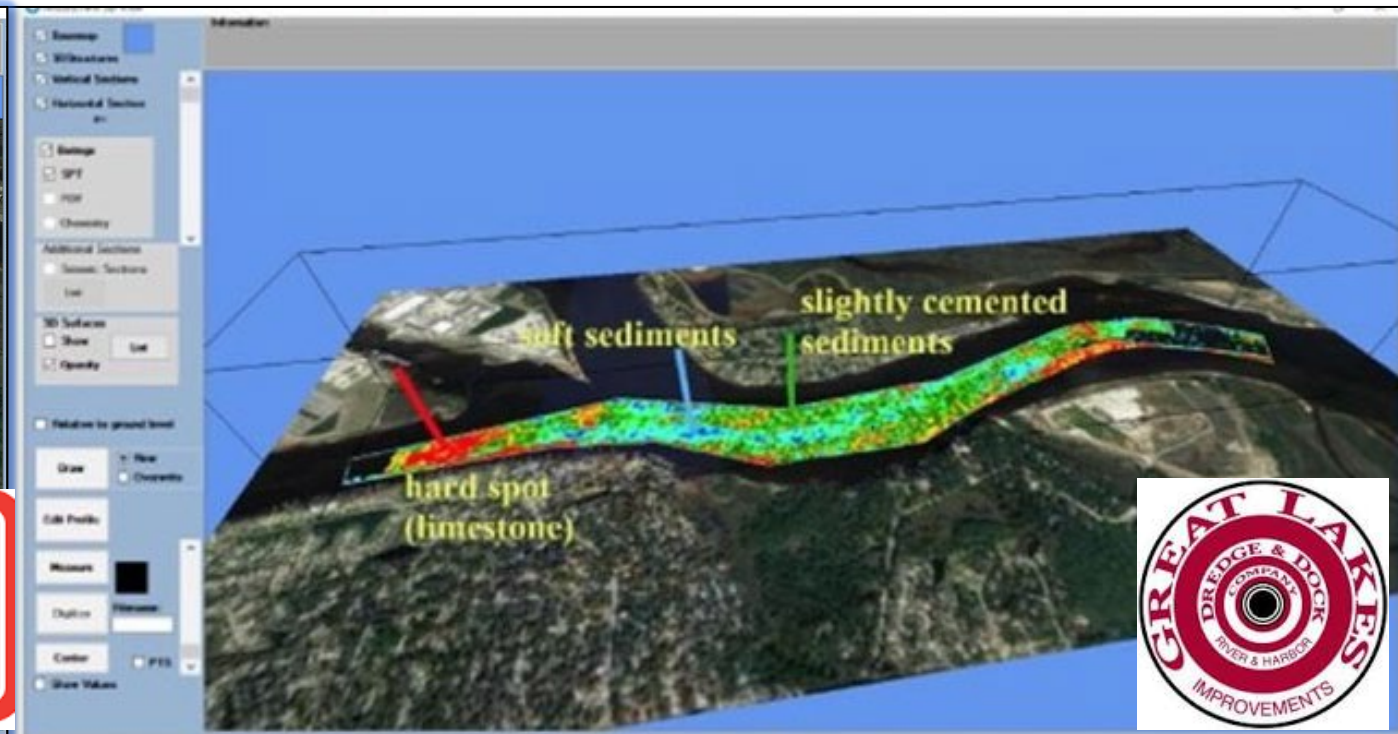
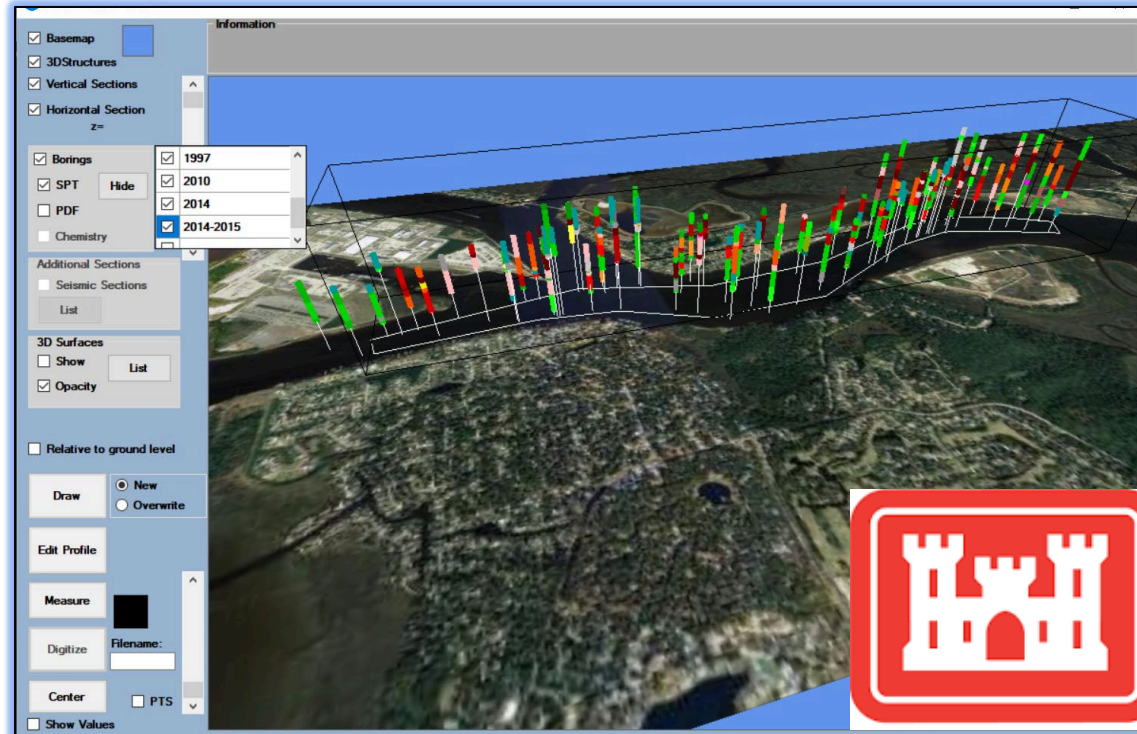
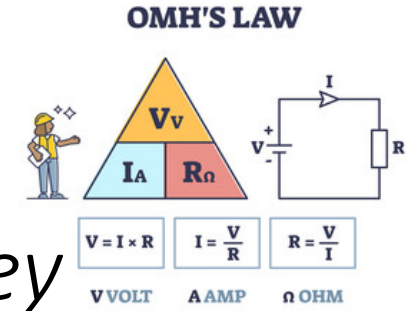
Daniel J. Levy, P.G.
Vice President, Environment
National Director / Founder – Algae Practice
M 305.519.1194
dan.levy@aecom.com

AECOM
110 East Broward Blvd
Suite 700
Fort Lauderdale, FL 33317, Country
T 305.519.1194





Jacksonville Florida Deepening and Widening Project Core Borings Versus Aquares Geophysical Survey



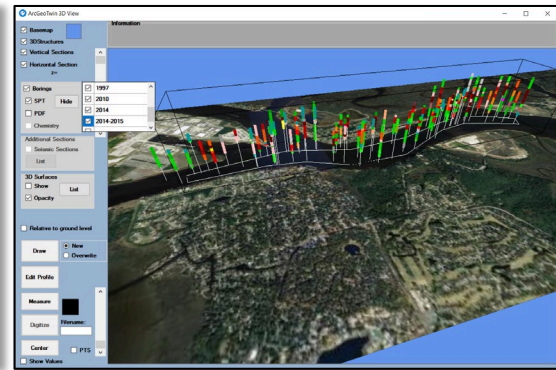
Over 80 core borings required by the ACOE to describe the Jacksonville Harbor Deepening subsurface.

An Arc Aquares Geophysical Survey described the entire Jacksonville Harbor subsurface requiring minimal core boring to describe the geotechnical characteristics.

Identify the Entire Subsurface Reduce the Number of Borings Substantially Reduce Subsurface Investigative Costs

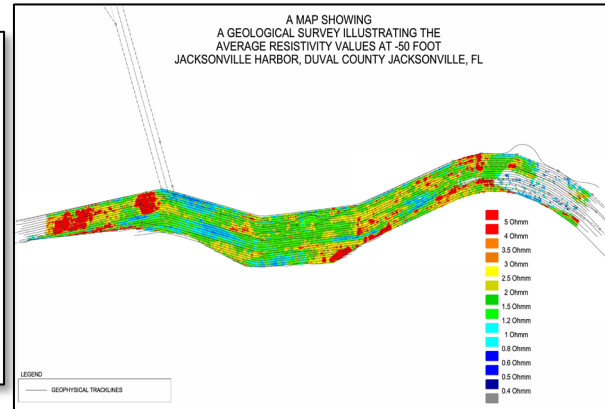
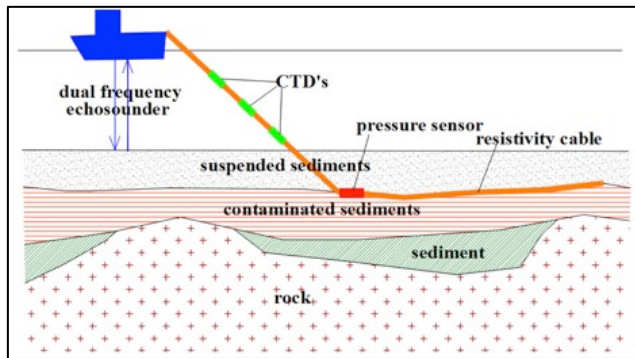
Core borings are necessary to describe subsurface material strengths and types.

Core borings require a Jackup barge to acquire subsurface samples due to existing channel depths which are usually in excess of 30 feet deep. Boring locations are often dependent on ship traffic and sometimes not acquired in heavy ship traffic channels. Many days are required to mobilize and acquire core samples.



Resistivity surveys are necessary to describe 100% of subsurface geological structures.

An electrical resistivity survey is accomplished in two or three days and describes the entire subsurface to a depth of 40 feet below existing bottom. A 3D Integrated digital geologic model is provided identifying changes in subsurface geology and a scientific method of choosing core boring locations.

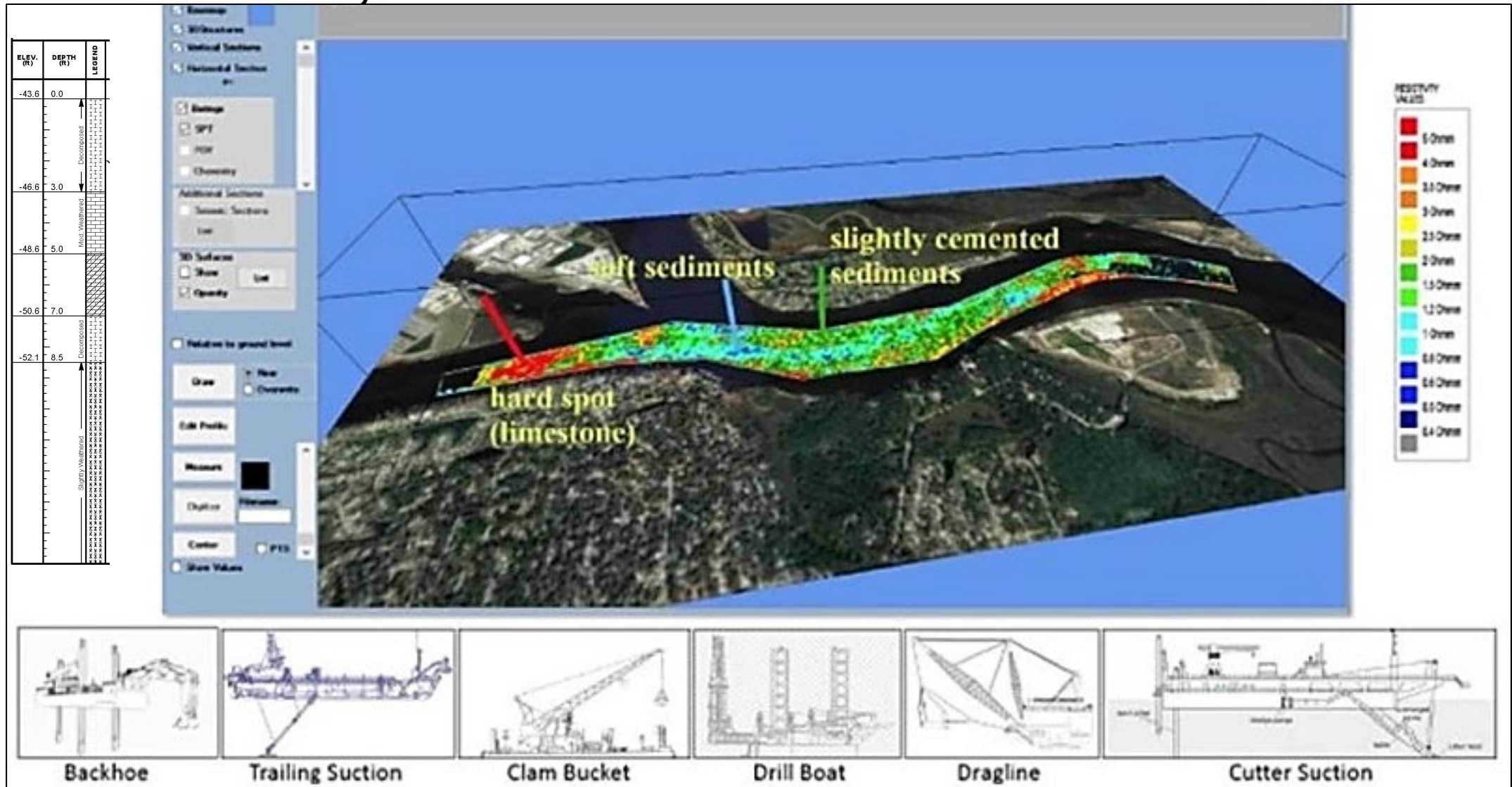


In most cases, the cost of an Arc Aquares geophysical survey is less than the mobilization cost of a Jackup barge.

Reduce the number of borings necessary to describe subsurface strengths and material types by performing a geophysical survey.

Choose Equipment Types Scientifically

Understand the electrical resistivity and mechanical strengths of the materials to be excavated



Understand the Subsurface in Clear Detail Permitting Selection of Different Buckets & Cutters for Different Material Types



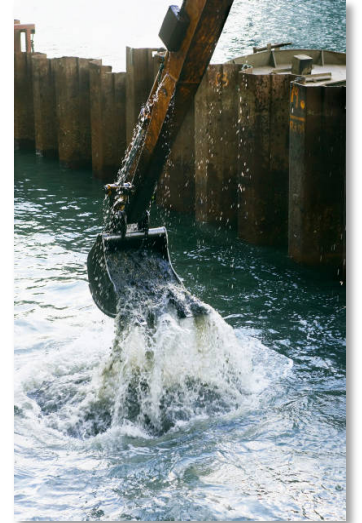
72 cy Bucket



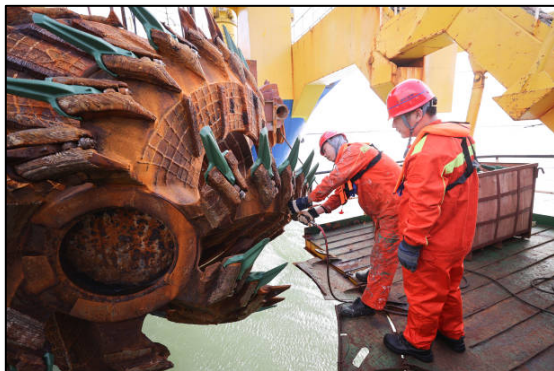
Hard Material Backhoe



Rock Grapple



Medium Backhoe



Rock Hydraulic Cutter



Backhoe Clam



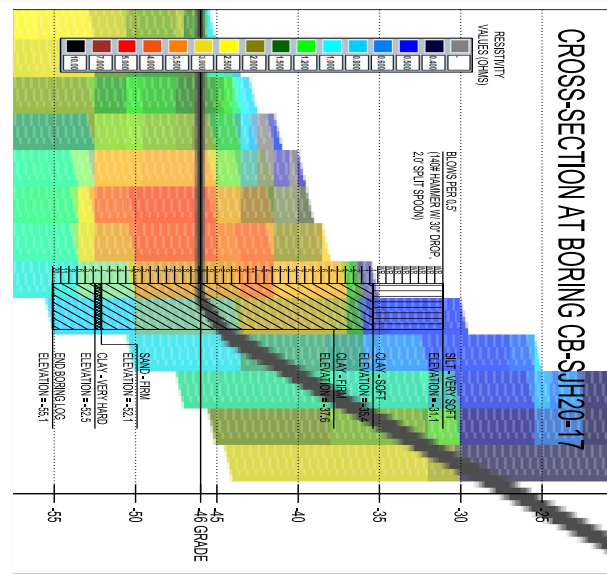
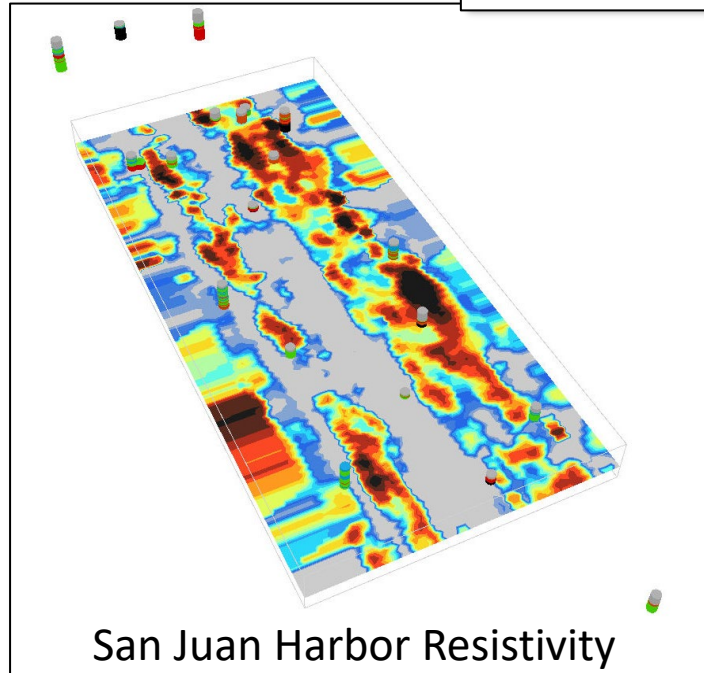
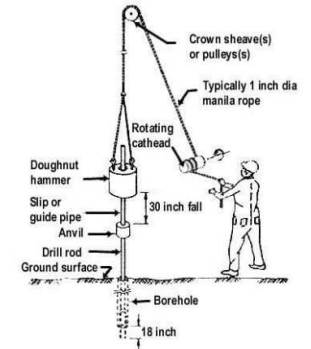
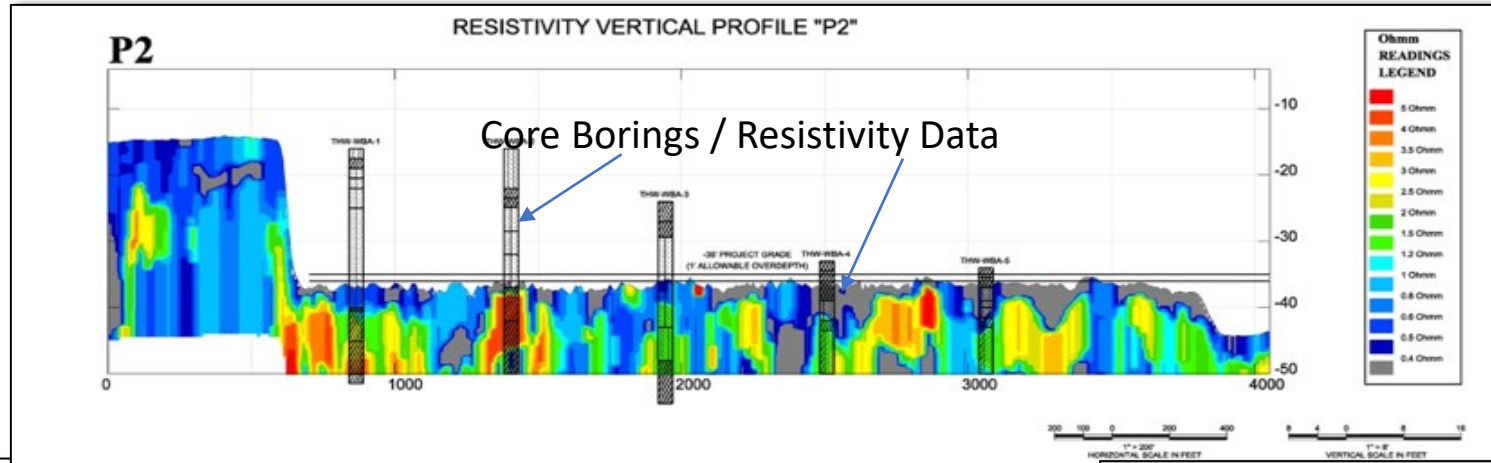
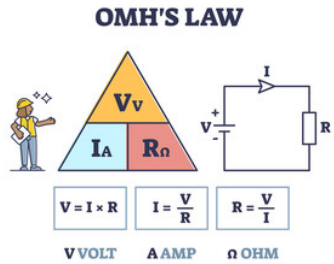
Medium Material Clam



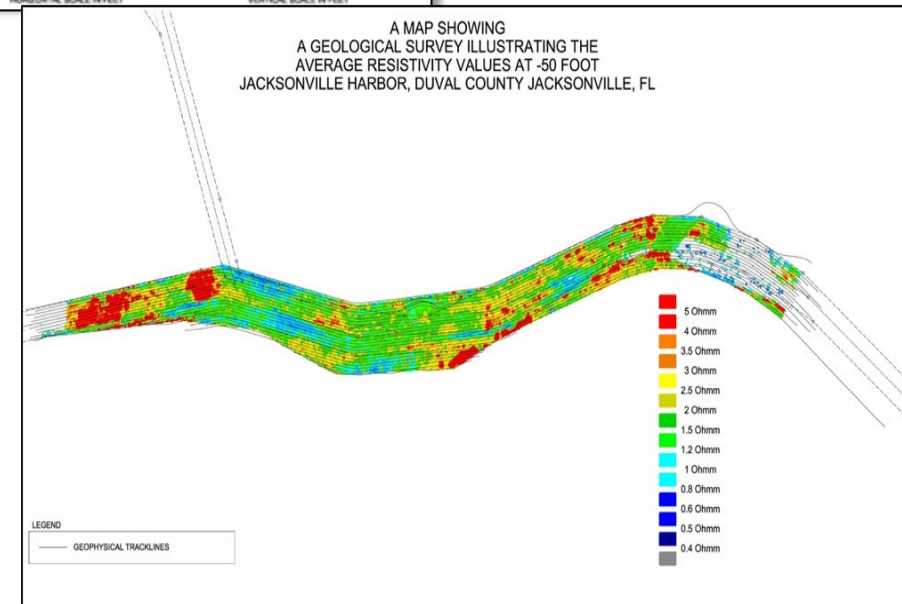
Trailing Suction

Quality Control

Comparing Bathymetry / Core Borings and Aquares Data

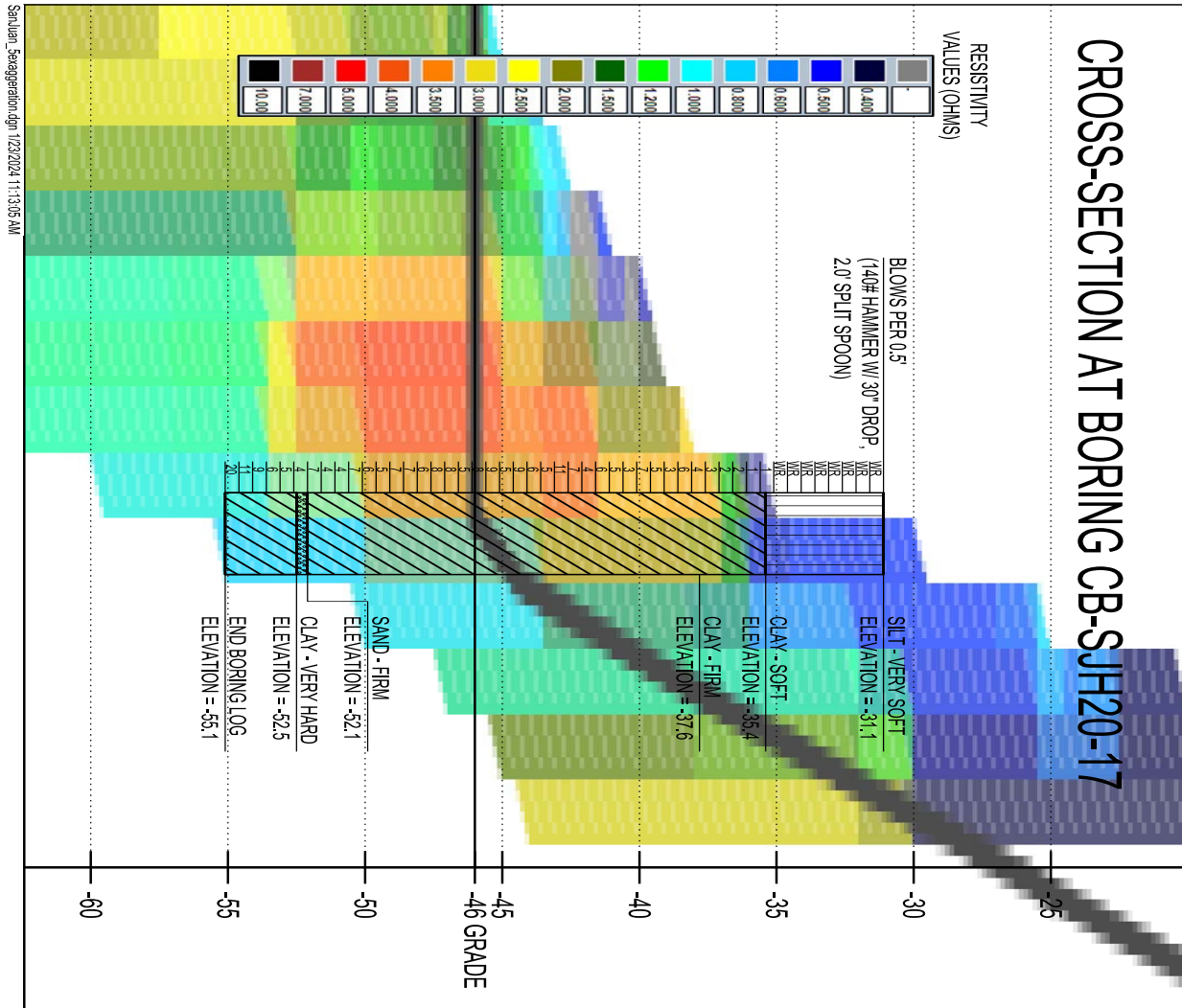


Combined Boring & Resistivity



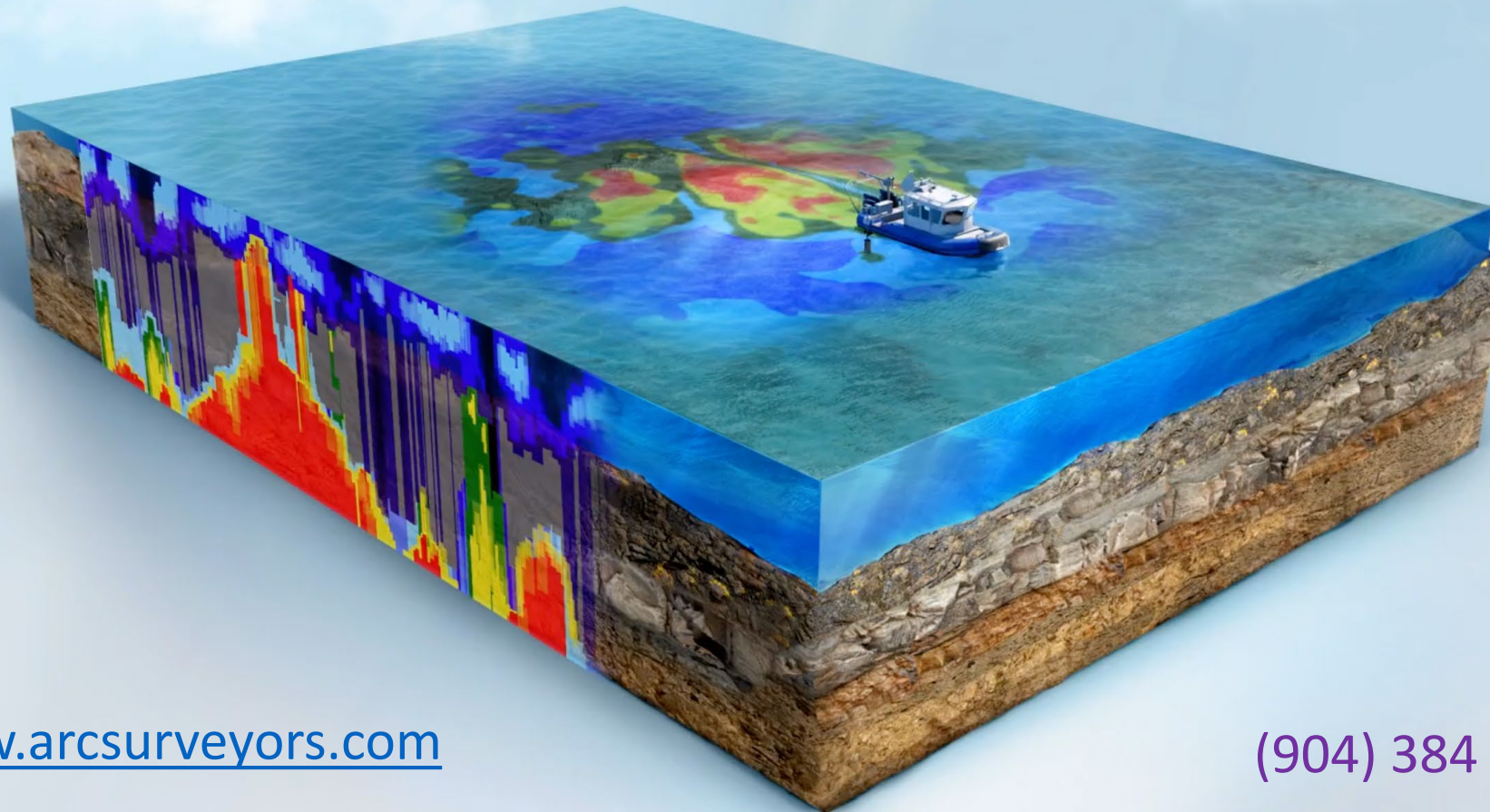
Jacksonville Harbor Resistivity

Comparison of SPT Material Strength to Resistivity Data



DRILLING LOG		INSTALLATION		SHEET 1 OF 2 SHEETS	
PROJECT: San Juan Harbor Navigation Improvements		LOCATION: Jacksonville District			
BORING DESIGNATION: CB-SJH20-17		DATE AND TYPE OF SOIL: See Remarks			
LOCATION COORDINATES: X = 755,044 Y = 875,051		COORDINATE SYSTEM/DATUM: NAD83		VERTICAL: MLLW	
DRILLING METHOD: Suction, PSC		MANUFACTURER'S DESIGNATION OF SOIL: Acker AC-2		AUTO HAMMER: <input type="checkbox"/> MANUAL HAMMER: <input checked="" type="checkbox"/>	
NAME OF DRILLER: Reader Analytics		TOTAL SAMPLES: 18		UNUSABLE(S) (SU): 0	
DIRECTION OF BORING: <input type="checkbox"/> VERTICAL <input type="checkbox"/> HELIXED		TOTAL NUMBER CORE BOXES: 0			
THICKNESS OF OVERBURDEN: N/A		ELEVATION ABOVE PLATE: N/A			
DEPTH DRILLED INTO ROCK: N/A		DATE BORING: STARTED: 07-26-20 COMPLETED: 07-26-20			
TOTAL DEPTH OF BORING: 24.0 FT		ELEVATION TOP OF BORING: -31.1 FT			
		TOTAL RECOVERY FOR BORING: 93 %			
		SIGNATURE AND TITLE OF INSPECTOR: Artha Reddy, Geotechnical Engineer			
BLK. NO.	DEPTH (FT)	CLASSIFICATION OF MATERIALS	REMARKS	SPT VALUE	REMARKS
	-31.1 0.0	SI, marginal, nonplastic, very soft, mostly silty, few subrounded fine-grained sand-sized grains; no reaction with HCl, wet, 50-52 green green (ML)		0	WR
	73 S-1		SPT Sampler	1	WR
	100 S-2		SPT Sampler	1	WR
	100 S-3a		SPT Sampler	1	WR
	-31.1 4.3	VIH EI -35.2 FT, little angular fine-grained coarse-grained shell		3	1
	47 S-4	CLAY, silty, high plasticity, soft, mostly clay, some silt, few subrounded, fine-grained sand-sized grains; tips and edges to medium-grained sand-sized shell; weak reaction with HCl, wet, 50-52 pale green (CH)		4	2
	100 S-5	VIH EI -37.6 FT, high plasticity, firm, mostly clay, little inorganic clay subangular fine-grained sand-sized rock fragments; no reaction with HCl, wet, rock-structure, NKRH 60 yellow		4	3
	100 S-6		SPT Sampler	3	3
	100 S-7		SPT Sampler	5	5
	93 S-8	From EI -41.6 to -47.6 FT, trace organic matter		4	4
	100 S-9		SPT Sampler	5	5
	100 S-10		SPT Sampler	5	5
	100 S-11		SPT Sampler	5	5
	73 S-12		SPT Sampler	7	7
	100 S-13		SPT Sampler	5	5
	100 S-14		SPT Sampler	4	4
	-51.1 21.0	VIH EI -51.5 FT, little angular to subangular fine to coarse-grained sand-sized shell		7	7
	100 S-15	CLAY, silty, mostly subrounded fine-grained sand-sized quartz, few subrounded fine-grained sand-sized shell; no reaction with HCl, wet, iron staining, 2-3% HCl large orange (CC)		5	5
	100 S-16	CLAY, lean, medium plasticity, very hard, mostly clay, little subrounded fine-grained sand-sized quartz, few angular subangular fine-grained sand-sized rock fragments; no reaction with HCl, wet, rock-structure, 0		9	9
	100 S-17		SPT Sampler	11	11
	-51.1 24.0	VR (S4 Light) (Yellow/Red) (CL)		20	20
NOTES:					
1. USAGE appropriate is the outlier for these crystal lines.					
2. Soils were field visually classified in accordance with the Unified Soils Classification System.					
3. Depth to Mudline: 32'					
4. Tidal Elevation: 0.7'					
5. Laboratory Testing Results					
SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION			
S-2	1.5/24.0	CH*			
S-7	8.0/24.0	CH			
*Lab visual classification based on gradation curve					
SAMPLE DEPTH	LABORATORY SOIL TESTING	RESULT	UNIT		
1.5	Water Content	112	%		
1.5	Unit Weight	7	pcf		
8.0	Atterberg (PI)	63	%		
8.0	Water Content	38	%		
8.0	Unit Weight	7	pcf		

Arc Surveying & Mapping, Inc.
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