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November 17, 2017

Tim Blankenship, PE  
Moffatt & Nichol  
2937 SW 27th Avenue, Suite 101A  
Coconut Grove, Florida 33133

Sub: Monitoring of helical anchor installation at the Dinner Key north mooring field

Ref: City of Miami RFP 15-16-011, Misc. Marine and Coastal Engineering Services  
M&N Job # 9450-02, Task Work order # 2  
HPCI Project No.: CE-M&N-CityMia-17-01

Dear Mr. Blankenship:

Attached is the final report on our monitoring services for the helical anchors installation at the Dinner Key north mooring field.

We greatly appreciate the opportunity to work on this phase of the project and are looking forward to assisting you on the subsequent phases and other forthcoming projects.

Sincerely,

A.S. Kumbhojkar, Ph.D., P.E., F. ASCE  
President and Principal Engineer  
Florida PE # 41067

# CONSTRUCTION MONITORING AT THE DINNER KEY MARINA MOORING FIELD

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# CONSTRUCTION MONITORING AT THE DINNER KEY MARINA MOORING FIELD

## 1.0 INTRODUCTION

HP Consultants Inc. (HPCI) is submitting this report on our services for the project, *Monitoring of helical anchor installation<sup>1</sup> at the Dinner Key North mooring field<sup>2</sup>* (the “Project”). We provided these services for Moffatt & Nichol’s (M&N) assignment under its agreement with the City of Miami, FL for the *RFP 15-16-011, Miscellaneous Marine & Coastal Engineering Services*. HPCI executed this work under its subconsultant agreement with M&N. Mr. Tim Blankenship, PE, M&N issued the task work order, served as the Project Manager and authorized us to begin the work on 8/18/17. Ms. Nicole Pauly, PE served as the Project Coordinator.

### 1.1 Project information and data

M&N sent us a copy of the aerial view of the Project area. It is included in Appendix-A as Figure A-1. We were to monitor installation of helical anchors in the offshore seabed for collecting data on the subsurface conditions in the Project area as an input to the design of the proposed moorings. M&N also forwarded us a copy of the contractor’s report on the jet probing. It is attached to this report. The anchors were to be drilled by the American Underwater Contractors, Inc. (AUC), a specialty contractor.

### 1.2 Scope of our work

The scope of our work (the “scope”) included the following tasks:

1. Project planning including site visit upon the arrival of the barge at the Dinner Key Marina
2. Providing services of a driller/inspector for monitoring the helical anchor installation
3. Preparation of a report on our monitoring, and
4. Project Management and coordination

We have completed the above tasks.

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<sup>1</sup> The term installation is used throughout this report only for the drilling/augering of the anchor.

<sup>2</sup> Formerly known as *Construction monitoring at the Dinner Key Marina mooring field*; the title of our proposal CE-M&N-CityMia-17-01.

## 2.0 FIELD MONITORING

### 2.1 Project location

The helical anchor installation site was offshore across the Dinner Key Marina office at 3400 Pan American Drive, Miami, FL 33133.

### 2.2 Project planning and coordination

Upon authorization, we coordinated our activities with Ms. Nicole Pauly, PE. Dr. Kumbhojkar, HPCI's Project Manager visited the site on 8/22/2017 along with HPCI's driller/inspector. They met Mr. David L. Foster, President, AUC on the barge docked at the Dinner Key marina to develop the outline of the proposed installation and monitoring.

### 2.3 Site conditions

The site was a portion of the offshore area in the vicinity of the marina. It was navigable and accessible to the barge (Figure A-2 in Appendix-A).

### 2.4 Anchor installation monitoring

Anchors were drilled in the north mooring field on 8/23/2017 at various locations using the anchor installation equipment on the barge. Recording the torque and the anchor installation equipment were key components of our monitoring work. Appendix-B includes the copies of our record of anchor installation. Also included is a table showing the correlation between the recorded and the psi for the Pro Dig Model X5K5 that was used in this project.

### 2.5 Jet probes

We monitored the jet probes performed by AUC. Probes assessed the refusal depth. The relevant portion of the AUC report on these borings is attached in the Appendix-B. As stated in this report, the depth of the refusal was between 1' and 6'-3".

### 2.6 Comments on the field observations

Although no samples were collected, it is our assessment that the jet probe refusal was caused by, and the anchors were drilled in, Miami Limestone, also known as the Miami Oolite (See the subsurface profile below the Biscayne Bay in Figure B-1, Appendix-B). We understand that the managed anchor fields were constructed using helical anchors at the nearby Coconut Grove Sailing Club and Dinner key Managed Mooring Field using barge-based equipment and appropriate techniques.

## Appendix A Project location



Figure A-1: General area for anchor installation off the Dinner Key Marina



Figure A-2: Anchor installation barge at the Dinner Key Marina

## Appendix B Monitoring records



Project:		Date: 8/23/17	Sheet # 1
Location:	ANCHOR 1	Site: DINNER Key Marina	
GPS:	25.72857°N, 080.23095°W	Recorded by: Luis	

Anchor Sand/Rock	Time	Depth	Torque	Comments
Rock Bit		8'		Starting w/ 6" Rock Bit
	8:50	1'		
	8:50	2'		
	8:51	3'	2217	1200 PSI, Rubble, Light Rock
	8:52	4'	2587	1400 PSI, Rubble, Light Rock
	8:57			Extracted the 6" Rock Bit
Rock	9:05	1'	—	Pushed Through
	9:05	2'		" "
	9:05	3'		" "
	9:06	4'	<del>2402</del> 2217	Light Rock
	9:06	5'	2402	Light Rock
	9:06	6'	2402	Light Rock
	9:07	7'	2402	Light Rock
	9:07	8'	2402	Light Rock
	9:07	9'	2402	Light Rock
	9:08	10'	2402	Light Rock, Stayed consistent from 4'-10'
	9:12	11'	2217	1200 PSI
	9:13	12'	2402	1300 PSI
	9:14	13'	2402	1300 PSI
	9:15	14'	2402	1300 PSI

Project:		Date: 8/23/17	Sheet # 1
Location:	ANCHOR #2	Site: Dinner Key Marina	
GPS:	25.72986°N, 080.22915°W	Recorded by: Luis	

Anchor Sand/Rock	Time	Depth	Torque	Comments
Starting		5' 8"		Starting
Rock		1'	—	6' Rock Helix, Pushed through
		2'	—	
	10:32	3'	—	800 psi, Light Rock
	10:32	4'	—	800 PSI, " "
	10:33	5'	—	800 PSI, " "
	10:33	6'	—	800 PSI, " "
	10:34	7'	2402	Light Rock
	10:34	8'	2402	" "
	10:35	9'	2217	" "
	10:35	10'	2402	" "
	10:35	11'	2217	" "
	10:36	12'	2402	" "
	10:36	13'	2402	" "
Rock	10:36	14'	2402	Light Rock, Very Consistent

Project:		Date: 8/23/17	Sheet # 1
Location:	ANCHOR 3	Site: Dinner Key Marina	
GPS:	25.72786 N, 080.22869	Recorded by: Lois	

Anchor Sand/Rock	Time	Depth	Torque	Comments
		7'4"		Starting with 6" Rock Helix
Rock	10:58	1'	—	600 PSI, Rubble Sand
	10:58	2'	—	" " "
	10:58	3'	—	" " "
	10:58	4'	—	750 PSI, Sand
	10:59	5'	—	700 PSI, Rubble Sand
	10:59	6'	—	600 PSI, " "
	10:59	7'	—	800 PSI, Rubble Sand, <del>stay</del>
	10:59	8'	—	800 PSI, Sand
	11:00am	9'	—	800 PSI, Sand
	11:01	10'	1848	1000 PSI, Sand
	11:01	11'	—	800 PSI, Sand
	11:02	12'	—	800 PSI, Sand
	11:02	13'	—	800 PSI, Sand
		<del>14'</del>		
Rock		7'4"	Starting	8'8'10'12" Rock Anchor
	11:12	1'	—	600 PSI, Rubble, Sand
	11:12	2'	—	600 PSI, " "
	11:12	3'	—	700 PSI, " "
	11:12	4'	—	700 PSI, " "
	11:13	5'	—	700 PSI, Rubble, Sand
	11:13	6'	1848	1000 PSI, " "
	11:14	7'	1848	1000 PSI, " "
	11:14	8'	1848	1000 PSI, " "
	11:14	9'	2033	1100 PSI, Rubble, Sand
	11:14	10'	2217	1200 PSI, " "
	11:14	11'	2402	1300 PSI, " "
	11:17	12'	2217	1200 PSI, Added Extension
	11:17	13'	2033	1100 PSI, Rubble, Sand
	11:18	14'	2402	1300 PSI, " "
	11:18	14'6"	2402	1300 Rock Layer

PRO DIG MODEL X5K5  
SN. 100721

psi	torque	
900	1663	*
1000	1848	
1100	2033	
1200	2217	
1300	2402	
1400	2587	
1500	2771	*
1600	2956	
1700	3141	
1800	3326	
1900	3510	
2000	3695	*
2100	3880	
2200	4065	
2300	4250	
2400	4435	
2500	4619	
2600	4804	
2700	4989	
2800	5174	
2900	5359	
3000	5543	*

\*Factory supplied torque values

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August 29, 2017

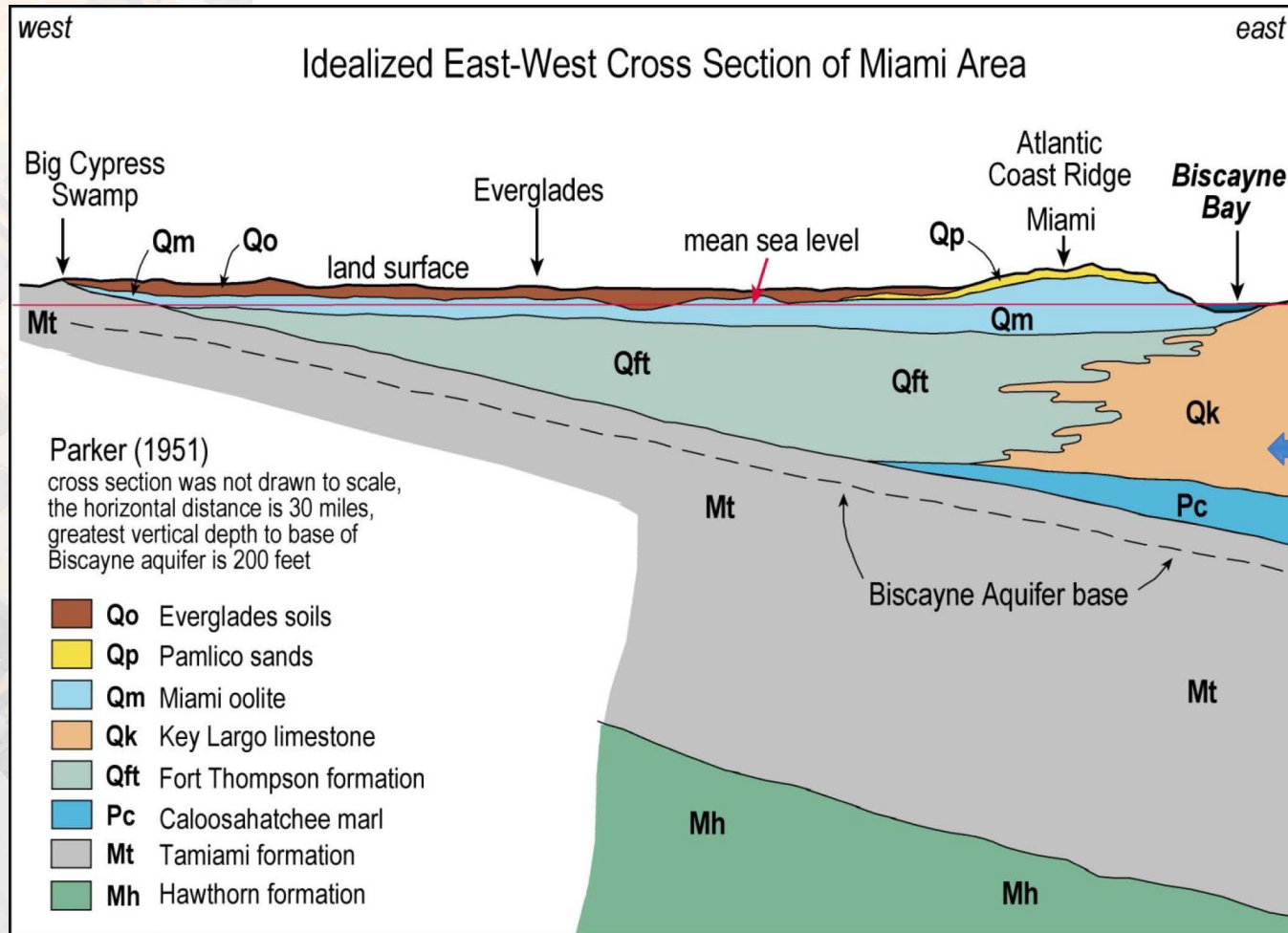
### Jet Probe Report

Jet probes were conducted to refusal at the following locations:

Dinner Key Mooring Field				
Position #	GPS Coordinates		Water Depth	Probe to Refusal
1	25° 43.695	80° 13.769	6' water	6' 3"
2	25° 43.669	80° 13.792	5.5' water	5' 6"
3	25° 43.686	80° 13.814	5' water	4'
4	25° 43.735	80° 13.781	9' 6" water	1'
5	25° 43.786	80° 13.768	7' 6" water	6'
6	25° 43.796	80° 13.795	8' 10" water	2' 2"
7	25° 43.790	80° 13.820	9' 7" water	4' 2"
8	25° 43.748	80° 13.835	10' 4" water	2' 3"
9	25° 43.737	80° 13.858	8' 1" water	1' 1"
10	25° 43.725	80° 13.880	7' 7" water	2' 10"
11	25° 43.750	80° 13.887	8' water	2' 2"



# Key Largo Limestone in the Miami – Biscayne Bay Region



Interfingering beneath Biscayne Bay known since the 1950's

Figure B-1: Miami limestone below Biscayne Bay

Slide credit, Dr. Donald F. McNeill, Ph.D., PG