PND ENGINEERS, INC.

MEMORANDUM

Date: December 30, 2019 **PND No.** 184094

To: Aaron Claiborne, PMP

From: Chris Fornace, P.E.; Colin Kuester, P.E.; Jon Keiser, P.E.

Subject: Dave Ullin Open Water Marina – Buoy Installation

The purpose of this technical memorandum is to summarize the inspection and testing of the 16 buoys for the City of Bainbridge Island's (COBI) Dave Ullin Open Water Marina (DUOWM), and provide PND's recommendation of acceptance of the installed work.

The sixteen mooring buoys were installed in November and December, 2019 by Norwest Marine LLC (Norwest). Load testing was performed between the dates of December 11 and December 14.

Per the specifications, the helical anchors were to be proof loaded with 10,500 pounds vertical static load for 1 minute minimum. Norwest tested the anchors with inflatable salvage bags (3 total) rated for 11,000 pounds. A passed test is defined as a test that exhibits no vertical movement or slippage during the entirety of the load test. Video of the load tests were recorded by Norwest showing proper attachment to the anchor, fully inflated salvage bags, and minimum test duration performed. Testing locations were verified above water by COBI. PND has reviewed the submitted videos for conformance with the design drawings. Norwest's submitted videos show that the load tests have been performed in accordance with the design drawings; PND takes no exceptions to the helical anchor proof load tests.

The specifications also required an installation torque of 5,000 ft-lb. Torque is not directly measured during installation, but rather pneumatic pressure to the motor is recorded, which is correlated to torque using tables supplied by the motor manufacturer. Norwest certified that the line pressure was taken to 1,800 psi for each anchor, corresponding to 3,000 ft-lb of torque (see attached log). This torque is less than specified, but Norwest noted to PND that their helical anchor supplier, Pile King, believed that the design torque would cause undue risk to the integrity of the anchors. Pile King subsequently provided a letter (attached) certifying that they would recommend a torque of only 1,250 ft-lb provided that the load test requirements were met. PND accepted this change to the specification and takes no exception to the installed torques.

To verify installation of mooring line components, Norwest provided videos showing the line between each anchor/buoy pair. These videos were viewed by PND and no exception was taken to the mooring line installations. The following changes were made and accepted by PND: 1. Spongex CP-7 mid-line floats were not available and Retex RX-10 floats were supplied by Norwest as in-kind replacements. 2. Norwest noted that the bottom rope thimble did not fit around the shackle when the shackle was looped around the top of the anchor. Concurrently, COBI noted that each mooring line assembly (including chain) was supplied approximately 1 foot shorter than specified. PND proposed adding an extra swivel and shackle at the anchor to create a shackle-swivel-shackle assembly. Norwest accepted this proposal and installed with this change. Note that they sourced the extra shackles at the anchor by removing one of two designed at the rope-chain attachment, where only one was required to ensure performance as intended in the design. Note that Norwest also secured the threaded shackle pins with baling wire to ensure that the pins don't back out.

PND has also recorded as-built locations of the buoys by handheld Garmin GPS. Considering typical error margins for such GPS units, PND can confirm that the buoys, and vessels moored to them as specified in the design drawings, will not interfere with each other in design wind and current conditions. An as-built site plan is attached showing the recorded buoy locations and swing circles.

In summary, PND has verified the load capacity, installation torque, components, and installation location of each of the 16 DUOWM buoys. We consider this portion of the work by Norwest to be complete and acceptable for public use.

Lastly, PND understands that COBI plans annual maintenance of the buoys and lines to remove marine growth. We recommend that a full dive inspection be included as part of this annual maintenance to observe the chains, lines, and anchors for signs of damage, wear, or, in the case of the anchors, slippage from their embedment. Additionally, inspections should be conducted after major storm events or if there is damage noted at any time.

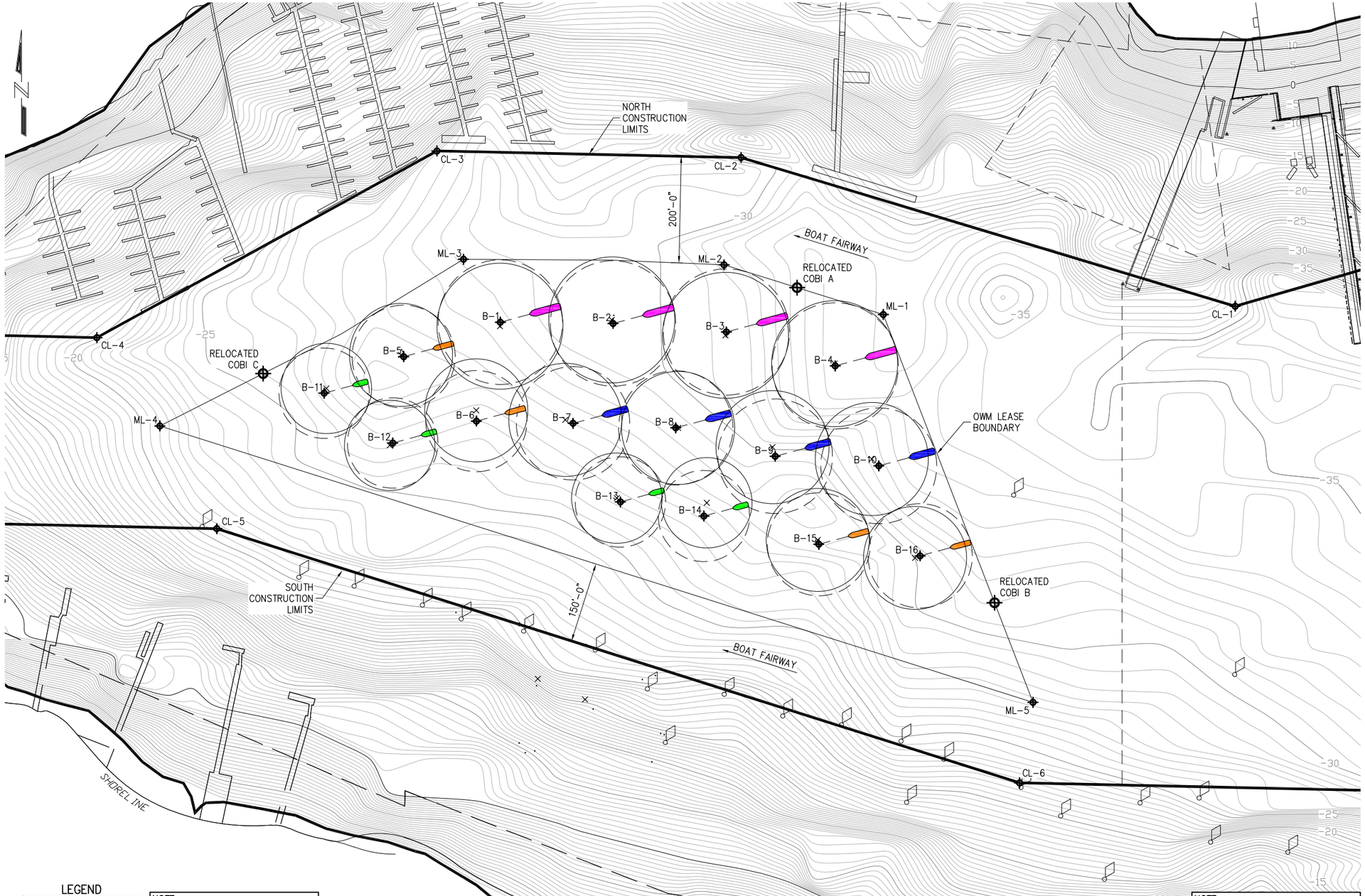
Attachments:

As-Built Buoy Locations

Norwest Anchor Installation Record

Pile King Torque Recommendation Letter

Load Test and Mooring Line Dive Videos (separate)



MOORING LIMIT

POINT No.	NORTHING	EASTING	LATITUDE	LONGITUDE
ML-1	230686.31	1225110.84	N047°37'11.85"	W122°31'02.82"
ML-2	230778.32	1224815.12	N047°37'12.69"	W122°31'07.17"
ML-3	230788.71	1224331.36	N047°37'12.69"	W122°31'14.23"
ML-4	230479.30	1223767.82	N047°37'09.52"	W122°31'22.36"
ML-5	229965.79	1225388.60	N047°37'04.80"	W122°30'58.54"

CONSTRUCTION LIMIT

POINT No.	NORTHING	EASTING	LATITUDE	LONGITUDE
CL-1	230701.56	1225763.90	N047°37'12.14"	W122°30'53.30"
CL-2	230977.69	1224846.67	N047°37'14.67"	W122°31'06.77"
CL-3	230989.82	1224282.08	N047°37'14.67"	W122°31'15.02"
CL-4	230643.29	1223650.95	N047°37'11.11"	W122°31'24.12"
CL-5	230288.43	1223873.61	N047°37'07.66"	W122°31'20.75"
CL-6	229816.29	1225363.84	N047°37'03.32"	W122°30'58.85"

NAVIGATION BUOYS

POINT No.	NORTHING	EASTING	LATITUDE	LONGITUDE
COBI A	230736.01	1224950.82	N047°37'12.31"	W122°31'05.18"
COBI B	230150.90	1225317.24	N047°37'06.61"	W122°30'59.64"
COBI C	230576.55	1223959.60	N047°37'10.52"	W122°31'19.59"

MOORING SCHEDULE

POINT No.	NORTHING	EASTING	LATITUDE	LONGITUDE
B-1	230671.97	1224399.82	N047°37'11.55"	W122°31'13.20"
B-2	230669.55	1224609.02	N047°37'11.58"	W122°31'10.14"
B-3	230653.72	1224819.51	N047°37'11.47"	W122°31'07.07"
B-4	230590.72	1225021.42	N047°37'10.89"	W122°31'04.10"
B-5	230607.92	1224220.32	N047°37'10.88"	W122°31'15.79"
B-6	230488.22	1224355.35	N047°37'09.73"	W122°31'13.79"
B-7	230484.12	1224534.79	N047°37'09.73"	W122°31'11.17"
B-8	230475.74	1224725.52	N047°37'09.69"	W122°31'08.38"
B-9	230422.87	1224910.05	N047°37'09.21"	W122°31'05.67"
B-10	230405.15	1225102.38	N047°37'09.07"	W122°31'02.86"
B-11	230540.11	1224072.75	N047°37'10.18"	W122°31'17.93"
B-12	230447.58	1224199.95	N047°37'09.30"	W122°31'16.04"
B-13	230338.13	1224622.61	N047°37'08.31"	W122°31'09.84"
B-14	230311.89	1224777.76	N047°37'08.08"	W122°31'07.57"
B-15	230259.47	1224991.05	N047°37'07.61"	W122°31'04.44"
B-16	230238.02	1225179.18	N047°37'07.44"	W122°31'01.68"

LEGEND
- 30' VESSEL (4)
- 40' VESSEL (4)
- 50' VESSEL (4)
- 60' VESSEL (4)

NOTE:
ALL EXISTING PIERS ALONG THE SOUTH SHORELINE ARE NOT INCLUDED IN CITY PROVIDED SURVEY. CONTRACTOR SHALL FIELD VERIFY EXISTING SITE CONDITIONS.

PLAN

0 50 100 200 300 FT.

× GPS-RECORDED AS-BUILT ANCHOR LOCATION
SOLID CIRCLES SHOW SWING RADIUS

NOTE:
LATITUDE AND LONGITUDE ARE APPROXIMATE AND PROVIDED FOR REFERENCE ONLY. BUOYS ARE TO BE LOCATED BASED ON CITY PROVIDED SURVEY COORDINATES.

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JONATHAN BRUCE KELSER — STATE OF WASHINGTON — 32789 — REGISTERED PROFESSIONAL ENGINEER

REVISIONS		
REV	DATE	DESCRIPTION

PROJECT:
BAINBRIDGE ISLAND DAVE ULLIN OPEN WATER MARINA

TITLE:
BUOY LAYOUT WITH AS-BUILT LOCATIONS

DESIGNED BY:	CF	PROJECT NO:	184094
DRAWN BY:	GRD	DATE:	MARCH 2019
CHECKED BY:		SCALE:	NOTED

SHEET NO: 2 OF 3

12/6/19 - C:\USERS\...\2018 PROJECT FILES\184094 - BAINBRIDGE ISLAND DAVE ULLIN OPEN WATER MARINA\D. ENGINEER DRAWINGS\CK AS BUILT\184094-02-03.DWG

McDowell NW Pile King, Inc.
HELICAL PILE INSTALLATION RECORD

Customer:		C.O.B.I.					Soils Engineer:				
Job Name:		DUOWM BUOY REMOVAL & INSTALL					Helical Pile Capacity:		5,000 lbs ft-lbs TORQUE		
Date Completed:							Drill Motor Model:		ESKRIDGE	4K5	
Piles installed by:		NORWEST MARINE LLC									
Anchor #	Lead Shaft Diameter	Helix Config.	Extension Shaft Diameter	Lead + Extension Lengths	Overall Length	Length Less Cut Off	PSI Pin - Pout	Torque (ft-lbs) Approx.	Degree of Inclination	Remarks	
B 1	1.75	10/12/14	1.75	7'+5'	27'		1,800	3000			
B 2	1.75	10/12/14	1.75	7'+5'	27'		1,800	3000			
B 3	1.75	10/12/14	1.75	7'+5'	27'		1,800	3000			
B 4	1.75	10/12/14	1.75	7'+5'	37'		1,800	3000			
B 5	1.75	10/12/14	1.75	7'+5'	27'		1,800	3000			
B 6	1.75	10/12/14	1.75	7'+5'	27'		1,800	3000			
B 7	1.75	10/12/14	1.75	7'+5'	27'		1,800	3000			
B 8	1.75	10/12/14	1.75	7'+5'	37'		1,800	3000			
B 9	1.75	10/12/14	1.75	7'+5'	37'		1,800	3000			
B 10	1.75	10/12/14	1.75	7'+5'	37'		1,800	3000			
B 11	1.75	10/12/14	1.75	7'+5'	27'		1,800	3000			
B 12	1.75	10/12/14	1.75	7'+5'	37' 27'		1,800	3000			
B 13	1.75	10/12/14	1.75	7'+5'	37' 32'		1,800	3000			
B 14	1.75	10/12/14	1.75	7'+5'	37'		1,800	3000			
B 15	1.75	10/12/14	1.75	7'+5'	37'		1,800	3000			
B 16	1.75	10/12/14	1.75	7'+5'	37'		1,800	3000			
023 17	1.75	10/12/14	1.75	7'+5'	17'		1,800	3000			
18								0			
19								0			
20								0			
21								0			
22								0			
23								0			
24								0			
25								0			

Subtotal: Pile Footage Installed This Page 561 0 LF

PILE KING

McDowell NW Pile King, Inc.

Memo

Date: 27 December 2019

Re: City of Bainbridge Island Buoy Removal & Install

To Whom It May Concern:

McDowell Pile King is the distributor of record for MacLean Dixie helical anchors for WA & OR. Pile King is authorized and trained in the installation of helical anchors by helical manufacturer MacLean Dixie, and as such, has also been certified as a trainer of installers of MacLean Dixie helical anchors.
We understand the required anchor capacity is 5,250lbs design load (DL), 10,500lbs ultimate capacity. We recommend the anchors be installed to a minimum 2-time DL capacity. Since the ultimate capacity of the anchors is 10,500lbs and anchors have been successfully tested, we recommend a minimum installation torque of 1,050ft/lbs. be required.

Regards,

John McDowell

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