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Research & Development Center

Report No. CG-D-01-19

Environmentally Friendly Buoy Mooring System Deployment

Interim Report

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August 2018

Homeland Security

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16. Abstract (MAXIMUM 200 WORDS)

The USCG Research and Development Center (RDC) is conducting the Environmentally Friendly Buoy Mooring System project to evaluate if alternative mooring system technologies have the potential to minimize impact on the sea bottom. The RDC acquired buoy mooring systems from four vendors for evaluation:

- Supflex Pontoon Mooring Systems, Inc. – Superflex SB18020
- Sealite USA LLC - Synthetic Mooring Solutions
- American Underwater Contractors Inc. (AUC) – StormSoft Elastic Mooring
- Hazelett Marine - Conservation Elastic Mooring System

The RDC also acquired helix anchor systems from AUC and Hubbell Power Systems.

This report provides the results of the deployment of the buoy mooring systems and anchors. In actuality, because of component discrepancies, the project deployed the following system/combinations on buoys marking the main ship channel into Tampa Bay:

- Superflex SB18020 to concrete sinker
- Hazelett Marine to concrete sinker
- Two StormSoft to concrete sinkers
- StormSoft to AUC helix anchor

The report also provides the results of the initial inspection of the buoy mooring systems post-deployment. The results are the baseline to compare subsequent quarterly inspection results systems during 2018 and 2019 to assess mooring system condition and ability to safely keep the buoys moored for another quarter.

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ABSG	ABSG Consulting, Inc.
AP	Assigned Position
AUC	American Underwater Contractors, Inc.
CG	Coast Guard
EFBMS	Environmentally Friendly Buoy Mooring System
ft	feet
hp	horsepower
in	inch
kt	knot
lb	pound
m	meter
mm	millimeter
RCSS	Round corner square shaft
RDC	Research and Development Center (USCG)
UHMWPE	Ultra-High-Molecular-Weight Polyethylene
USCG	United States Coast Guard
WLM	Coastal Buoy Tender

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1 INTRODUCTION

For more than 20 years, the Coast Guard (CG) has sought to develop adequate buoy mooring systems that have minimal impacts on the ocean floor, especially in coral reef areas. The CG Research and Development Center (RDC) contracted with ABSG Consulting, Inc. (ABSG) to assist with the Environmentally Friendly Buoy Mooring System (EFBMS) project. The project deployed five buoy mooring systems along the entrance channel to Tampa Bay, Florida to evaluate if the mooring systems have the potential to minimize impact on the sea bottom.

2 LOCATION

The buoy locations selected by the CG for the environmentally friendly buoy mooring systems demonstration mark the main ship channel into Tampa Bay as listed in Table 1 and shown in Figure 1. The table identifies the *intended* mooring system, buoy size, anchor type, water depth, bottom type and assigned position.

Table 1. Environmentally friendly buoy planned mooring types and locations.

Buoy Locations	Mooring System	Buoy Size	Anchor	Water Depth (ft)	Bottom Type	Latitude	Longitude
Egmont Channel R "4"	StormSoft	8X22LFR	Helix	45	Sand	27.59361	-82.9531
Egmont Channel G "5"	Sealite	8X22LFR	Concrete	48	Sand	27.59833	-82.9261
Egmont Channel R "6"	Supflex	8X22LFR	Concrete	46	Sand	27.59639	-82.9261
Mullet Key Channel Buoy G "25"	StormSoft	6X16LFR	Helix	46	Sand	27.61361	-82.6756
Mullet Key Channel Buoy R "26"	Hazelett Marine	6X16LFR	Concrete	38	Sand	27.6125	-82.6708

As this guide will explain, Table 2 lists the actual mooring systems and anchors.

Table 2. Environmentally friendly buoy **actual** mooring types and locations.

Buoy Locations	Mooring System	Buoy Size	Anchor	Water Depth (ft)	Bottom Type	Latitude	Longitude
Egmont Channel R"4"	StormSoft	8X22LFR	**Concrete**	**49**	Sand	27.59361	-82.9531
Egmont Channel G"5"	**StormSoft**	8X22LFR	Concrete	**49**	Sand	27.59833	-82.9261
Egmont Channel R"6"	Supflex	8X22LFR	Concrete	**50**	Sand	27.59639	-82.9261
Mullet Key Channel Buoy G"25"	StormSoft	6X16LFR	Helix	**41**	Sand	27.61361	-82.6756
Mullet Key Channel Buoy G"23"	Hazelett Marine	6X16LFR	Concrete	**38**	Sand	27.61092	-82.6952

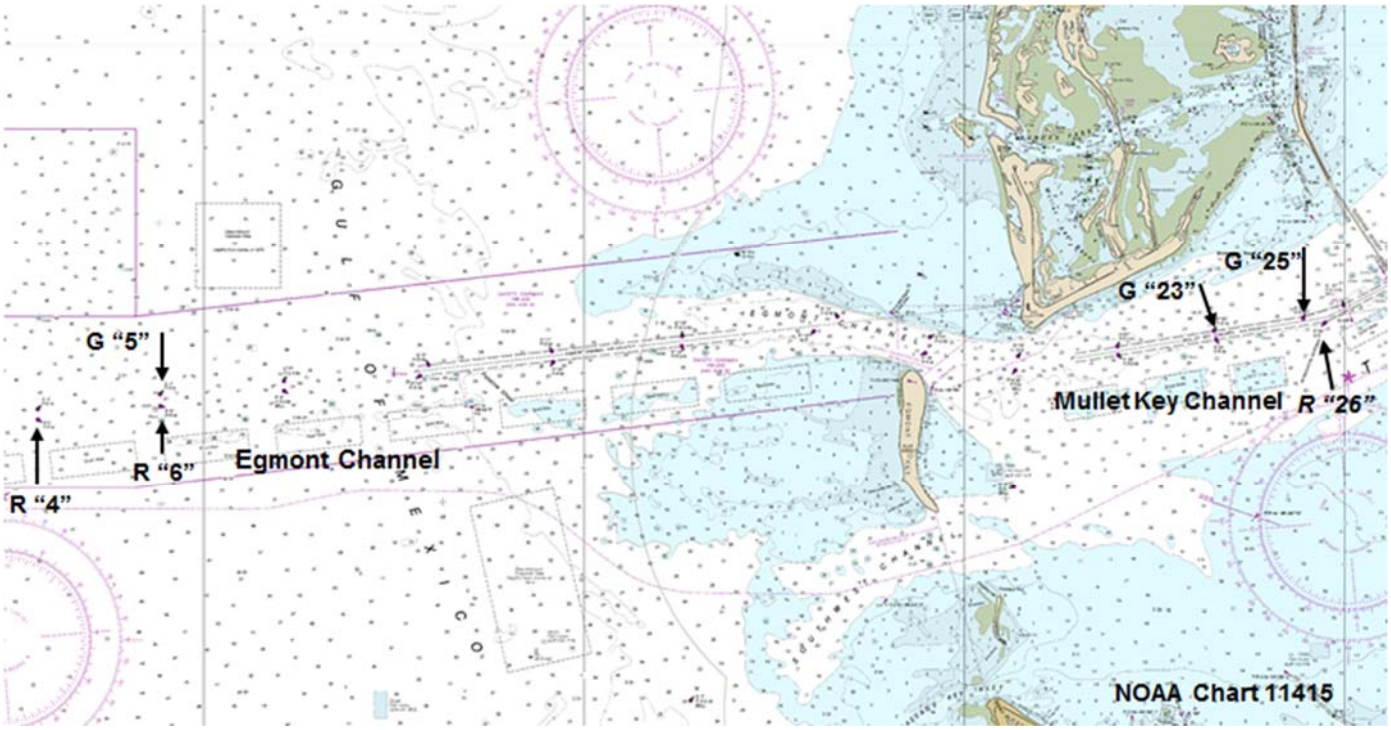
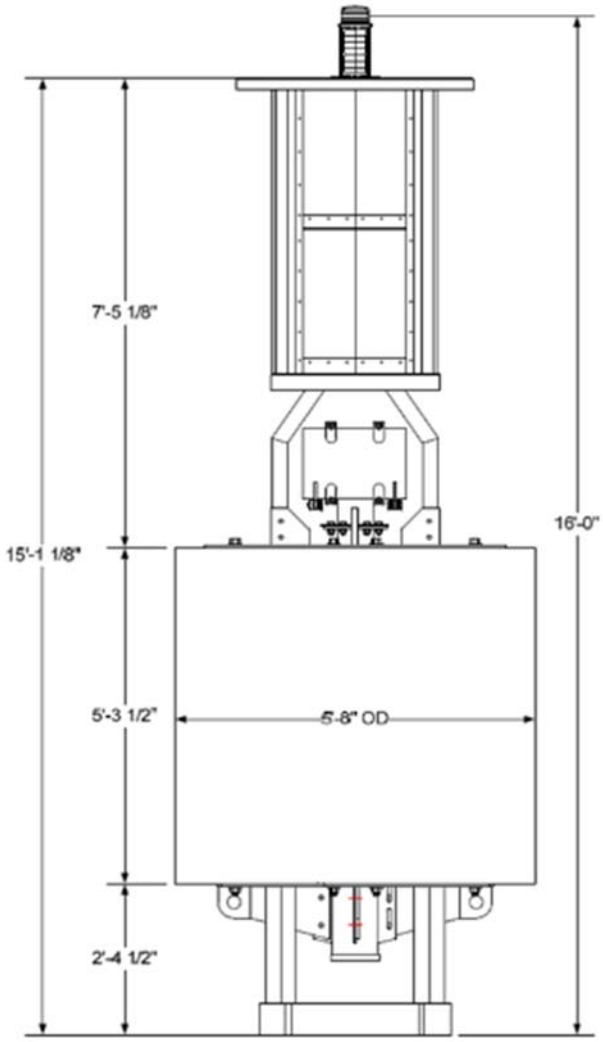


Figure 1. Tampa Bay Main Ship Channel showing actual and ***intended*** mooring systems locations.

3 BUOYS

Two foam 6X16LFR buoys replace steel 6X20LR buoys in Mullet Key Channel as part of the experiment. Figure 2 shows the general arrangement of the 6X16LFR buoy.

a. Standard Buoy Arrangement. 2007 6X16LFR.



Physical Characteristics. (no moorings)

Buoy Weight	3,640 lbs.
Buoy Draft	5 ft. 0 in.
Focal Height of Light	11 ft. 0 in.
Freeboard	2 ft. 8 in.
Minimum Freeboard	1 ft. 1 in.
Pounds per inch Immersion	134

Related Equipment.

Mooring Bridle	1 in. x 12 ft.
Sinker (concrete)	5,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.5 nm
Radar Range	3.0 nm
Mooring Depth (min.)	18 ft.

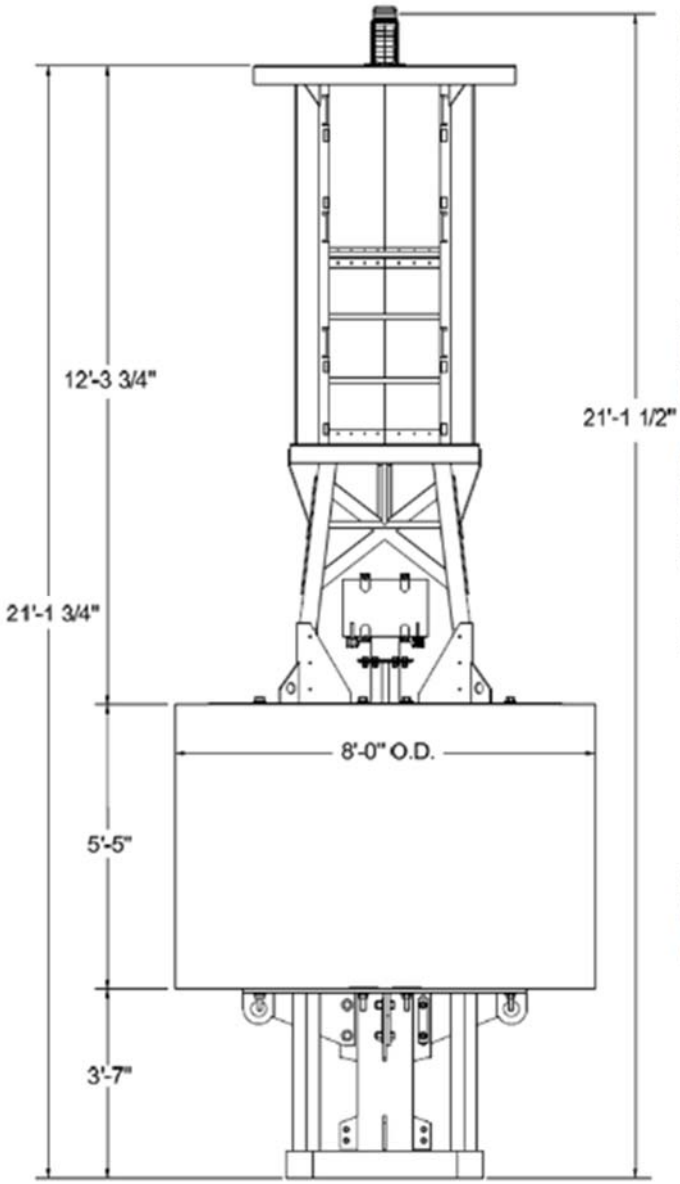
Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	78 ft.
1-1/4"	110 ft.
1-1/8"	138 ft.
1"	174 ft.

Reference Documents. (use latest rev.)
G-SEC Drawing No. 121184
G-SEC Specification No. 450

Figure 2. General arrangements 6X16LFR.

Three foam 8X22LFR buoys replace steel 8X26LR buoys in Egmont Channel. Figure 3 shows the general arrangement of the 8X22LFR buoy.



Physical Characteristics. (no moorings)

Buoy Weight	7,000 lbs.
Buoy Draft	5 ft. 10 in.
Focal Height of Light	15 ft 3-1/2 in.
Freeboard	3 ft 2 in.
Minimum Freeboard	1 ft 3 in.
Pounds per inch Immersion	264

Related Equipment.

Mooring Bridle	1-1/4" x 15 ft.
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.4 nm
Radar Range	3.9 nm
Mooring Depth (min.)	18 ft.

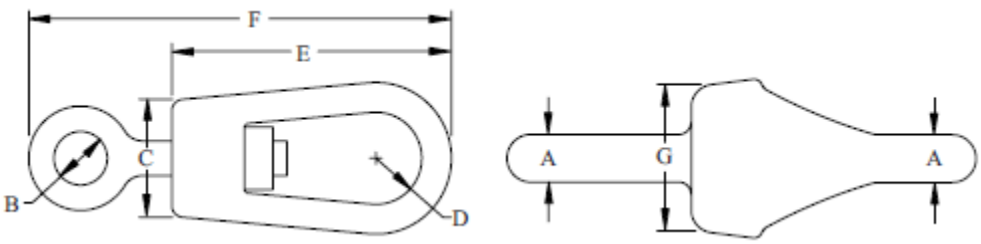
Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	175 ft.
1-1/4"	257 ft

Reference Documents. (use latest rev.)
G-SEC Drawing No. 121185
G-SEC Specification No. 450

Figure 3. General arrangements 8X22LFR.

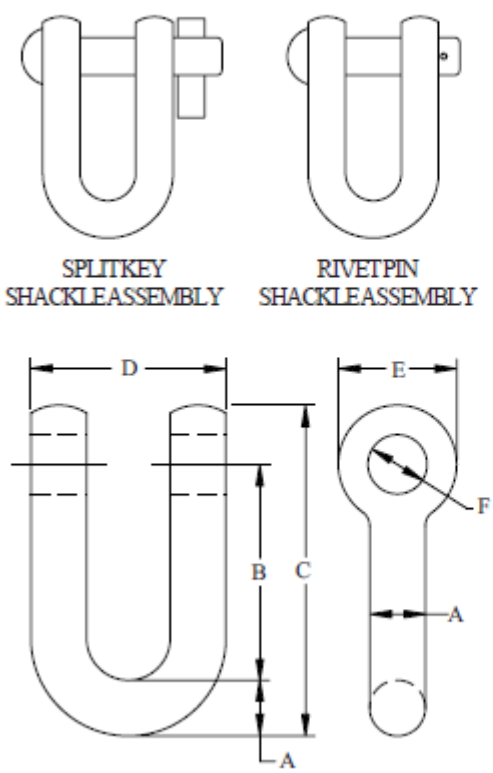
The CG supplied swivels and shackles of various sizes to make connections to the buoy bridle and concrete anchors. Excerpts from the *Aids to Navigation Manual, Technical* COMDTINST M16500.3A provide details on the swivels and shackles in Figures 4 through 6. Tables 3 through 7 describe the components of each EFBMS. The tables include components from the manufacturer's equipment list and the CG provided components used to complete the EFBMS (identified with **bold** text).



	DIMENSIONS (INCHES)							PROOF	BREAK	WEIGHT
CLASS	A	B	C	D	E	F	G	LOAD	LOAD	(LBS)
1ST	2	3	6	2-1/4	12	19-3/4	6-3/4	82,000	164,000	78
2nd	1-3/4	2-3/4	5	1-7/8	10-3/4	17-3/4	5-3/4	60,000	120,000	52
3rd	1-1/2	2-1/2	4-1/2	1-5/8	9-1/2	15-3/4	5	45,000	90,000	39
4th	1-1/4	2-1/4	4	1-1/2	7-3/4	13	4-1/2	30,000	60,000	19

Figure 4. CG swivel specifications (Data Sheet 2.M.4. Swivels).

2.M.3

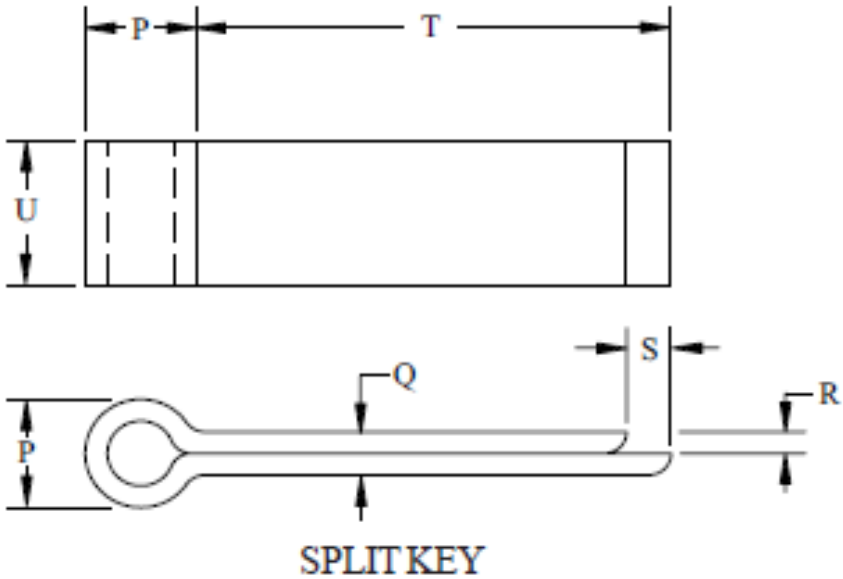


CLASS	PROOF LOAD	BREAKING LOAD	WEIGHT (APPROX.) DRY	WET
1st	115,000	230,000	40	35
2nd	90,000	180,000	27	23
3rd	65,000	130,000	16	14
4th	30,000	60,000	6	5
SPECIAL*	180,000	360,000	75	65

*SPLITKEYPINTYPEONLY

CLASS	A	B	C	D	E	F
1st	2	7-3/4	11-7/8	7	4-1/4	2-1/8
2nd	1-3/4	6-7/8	10-1/2	6-1/4	3-3/4	1-7/8
3rd	1-1/2	5-1/4	8-1/2	5-1/4	3-1/4	1-5/8
4th	1	4-1/8	6-1/2	4-1/4	2-1/2	1-1/8
SPECIAL	2-1/2	9	14-1/4	11	5-1/2	2-5/8
TOLERANCES	±1/16	±1/4	REF.	+3/16 -1/8	+1/4 -1/8	±1/32

Figure 5. CG shackle specifications (Data Sheet 2.M.3. Shackles).



CLASS	P	Q	R	S	T	U
1st, 2nd 3rd	15/16	3/8	3/16	3/8	4	1-1/4
4th	13/16	1/4	1/8	3/8	4	7/8
SPECIAL	1-1/16	3/8	3/16	3/8	5	1-1/4
TOLERANCES	±1/16	±1/32	±1/64	±1/16	±1/16	±1/32

Figure 6. CG shackle specifications (Data Sheet 2.M.3. Shackles (Cont'd.)).

4 MOORING SYSTEMS AND VENDORS

The RDC is evaluating buoy mooring systems from four different vendors:

- Supflex Pontoon Mooring Systems, Inc. - Superflex SB18020.
- Sealite USA LLC - Synthetic Mooring Solutions.
- American Underwater Contractors (AUC), Inc. – StormSoft Elastic Moorings.
- Hazelett Marine - Conservation Elastic Mooring System.

The RDC is also evaluating a helix mooring anchor as an alternative to the standard concrete anchor for Mullet Key Channel G "25" buoy.

4.1 Supflex Pontoon Mooring Systems, Inc. – Superflex SB18020

The Superflex mooring line is synthetic rubber mixed with Kevlar and ultra-high-molecular-weight polyethylene (UHMWPE). The Superflex 18020 shock absorber contains 18 strands of mooring line 25 millimeters in diameter and 2 meters in length with a stainless steel top and bottom cap with eyes to connect to other system components. According to the *Superflex® Installation Instruction,* construction of the rubber rope part includes ARAMID (Kevlar or Technora) UHMWPE fiber, and carbon fiber, combined with high quality complex component rubbers, which also includes some nano-chemical materials. Additional components of the mooring systems include:

- (5) 2-in. steel shackles (Grade 3).
- (1) 1.5-in. steel (Grade 3) Swivel, End Links and Large Links.
- 2m of 1.5-in. steel chain (Grade 3).
- Kentor Shackle (Pear link)(Grade 2).
- 45 feet of UHMWPE with Polyester mix line with thimbles.

Figure 7 shows an example of the Superflex SB 18020 shock absorber.

Figure 7. Superflex SB18020 shock absorber.

Figure 8 shows the designed Superflex SB18020 mooring system arrangement.

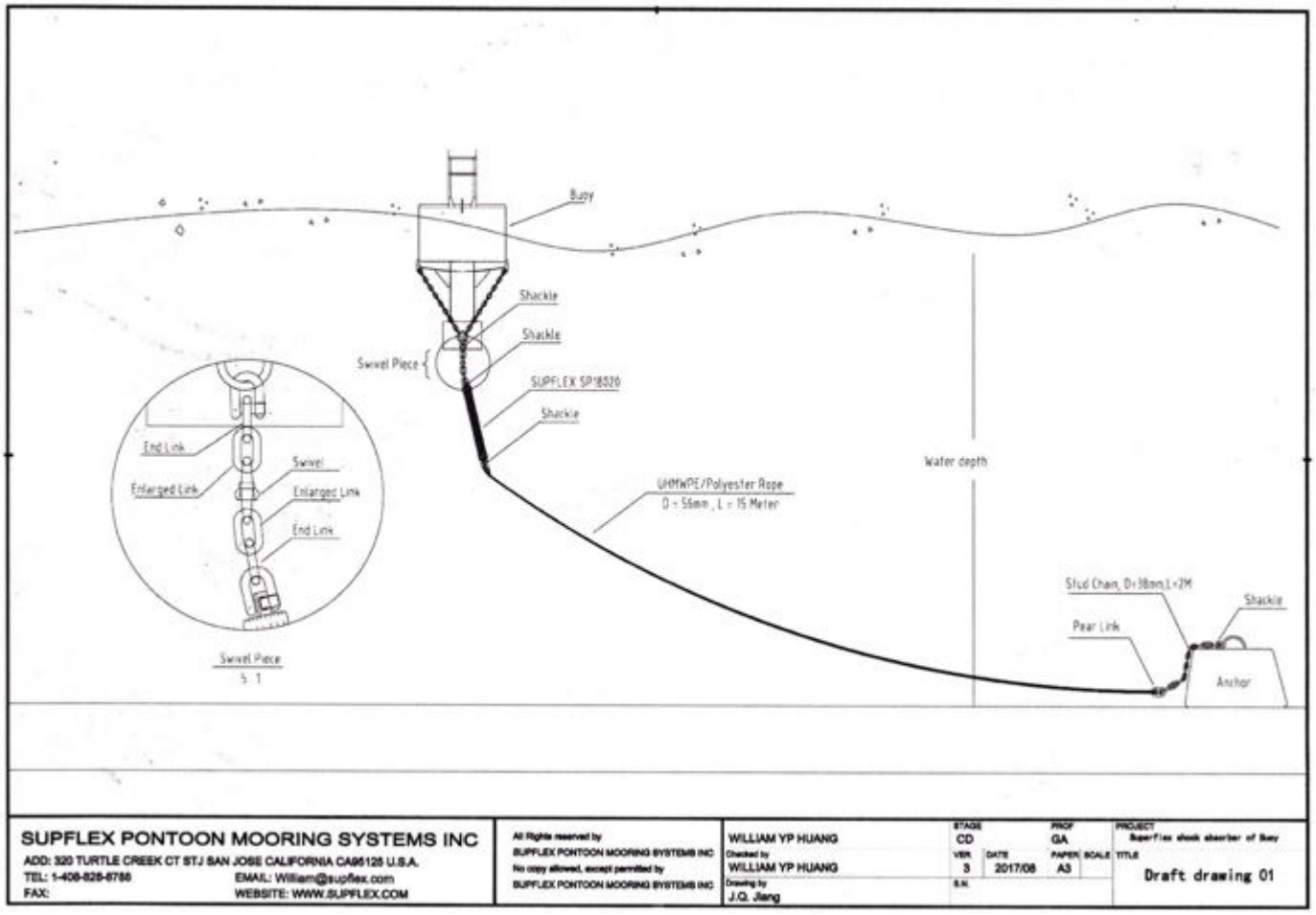


Figure 8. Superflex SB18020 mooring system arrangement.

4.2 Sealite USA LLC - Synthetic Mooring Solutions

The Sealite mooring line has a high-strength nylon inner core, encapsulated by a sheath of abrasive resistant rubber, with thimble eyelets embedded into the rubber casing. Sealite is a single strand mooring line 47 meters in length made from three individual sections spliced together – two 20 meter and one seven meter. A sheath of abrasive resistant rubber covers the line and also encapsulates each joining coupler. The mooring line is 3 inches in diameter. Figure 9 provides an example of the Sealite mooring system.

Figure 9. Sealite mooring system.

Note: Sealite provided a 47 meter-long mooring cable to the Coast Guard. On multiple occasions, the RDC project manager and team questioned the length, especially as the team had concerns that the scope provided would float on the surface at slack-water conditions. As this report will point out below, the project did not use the Sealite mooring.

4.3 American Underwater Contractors, Inc. – StormSoft Elastic Moorings

The standard StormSoft elastic mooring system is 1.25 inch diameter by 10 feet long, containing a 5-foot shock absorbing segment with an attached float to keep the line off the anchor or bottom. It has a 100% braided polyester core, surrounded by multi-strand, industrial rubber cords ("shock absorbers") that allow limited stretch for shock loads, and has a 100% polyester outer shell. The mooring system is spliced to Miami Cordage PYB1 Polyester Double Braid rope one inch in diameter which attaches to the buoy bridle. Figure 10 provides an example of the StormSoft system.

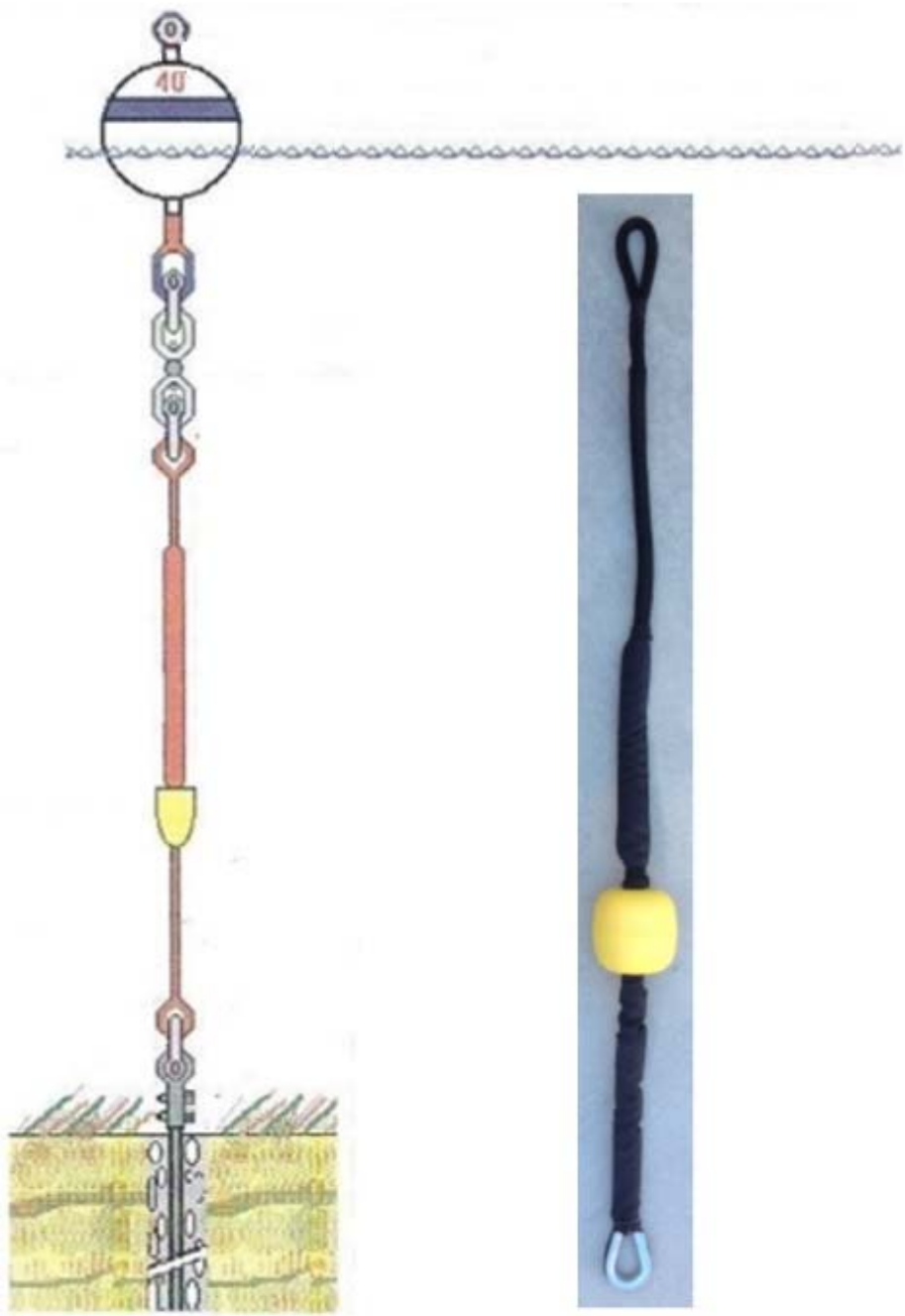


Figure 10. StormSoft elastic mooring system.

4.4 Hazelett Marine - Conservation Elastic Mooring System

The Hazelett Marine Conservation Elastic Mooring System is a single point mooring system consisting of two, polyurethane rodes 10 feet in length by 1.75 inch diameter, and two hard trawl floats which keep the mooring components off the anchor or bottom. Thirty-feet of 5/8-inch Yale Cordage Uniline attaches the mooring system to the buoy bridle. Figure 11 shows the Hazelett mooring system.

Figure 11. Hazelett Marine mooring system.

4.5 Helix Anchor

The project is also evaluating a helix anchor as an alternative to the standard concrete sinker for buoy mooring systems. The helix anchor system has three components:

- Lead section – 7 ft x 1.75-in. hot dip galvanized steel round corner square shaft (RCSS) containing three helical plates of 8/10/12 inches in diameter.
- Extensions – (3) 5 ft x 1.75-in. hot dip galvanized steel RCSS and (1) 3.5 ft x 1.75 in. heavy duty galvanized steel RCSS.
- Hot dip galvanized steel mooring termination head for 1.75 in. RCSS anchor.

A 7/8-inch hot dip galvanized steel bolts connect the sections. The helix anchor screws into the seabed using a hydraulic installation tool operated from a barge (shallow water) or by divers. The RDC used divers to install the helix anchors mooring system due to buoy-location water depth. Figures 12 through 14 are helix-system detailed drawings.

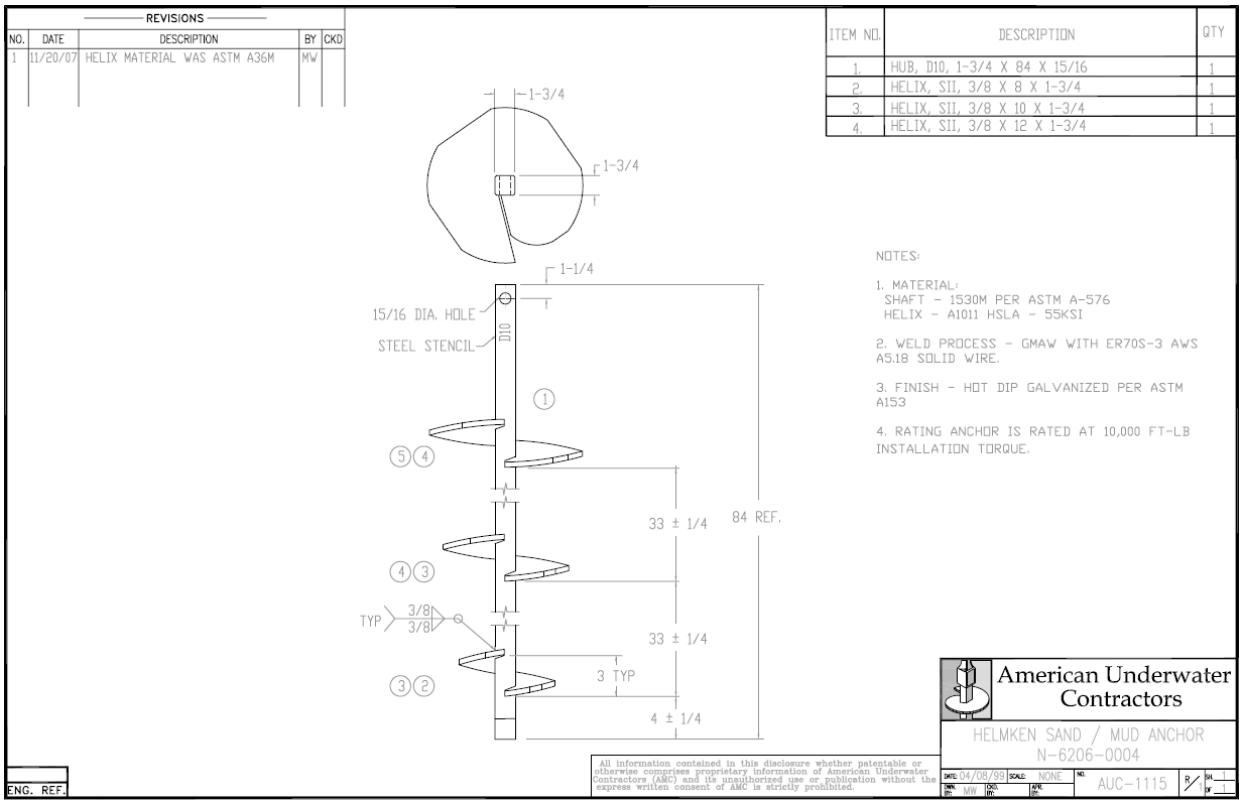


Figure 12. Helix anchor lead section drawing.

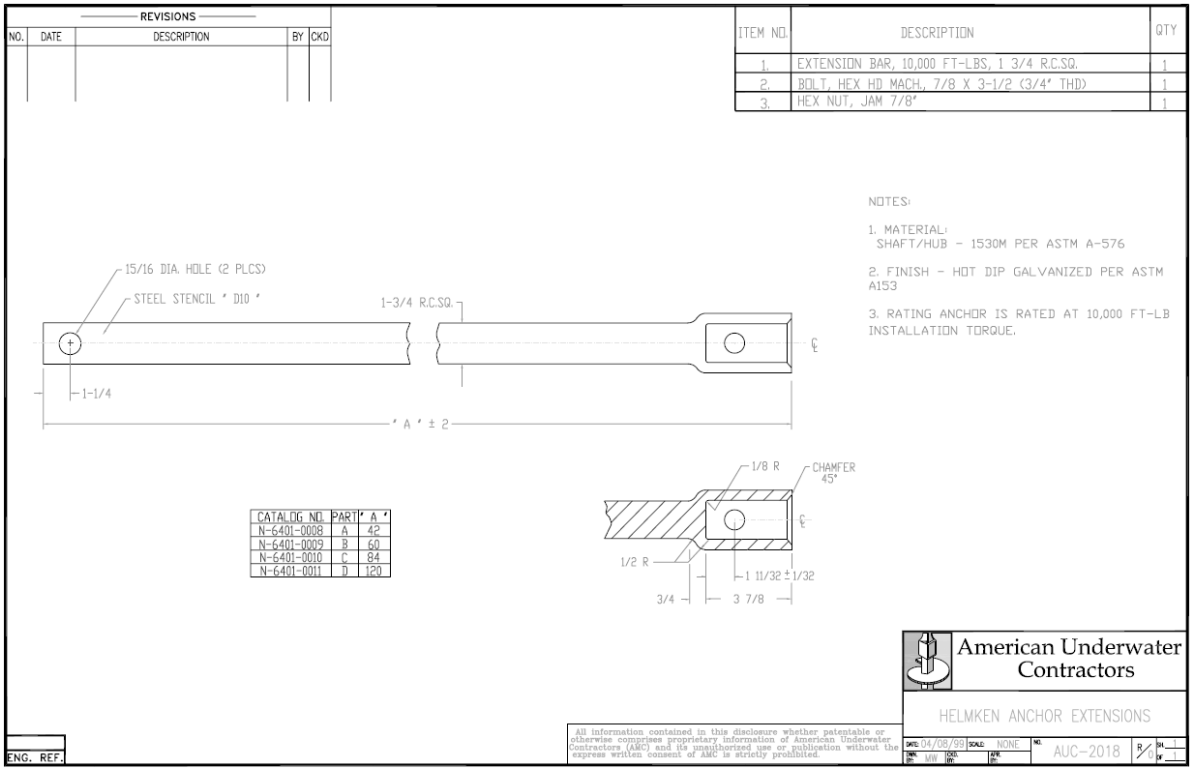


Figure 13. Helix anchor extension drawing.

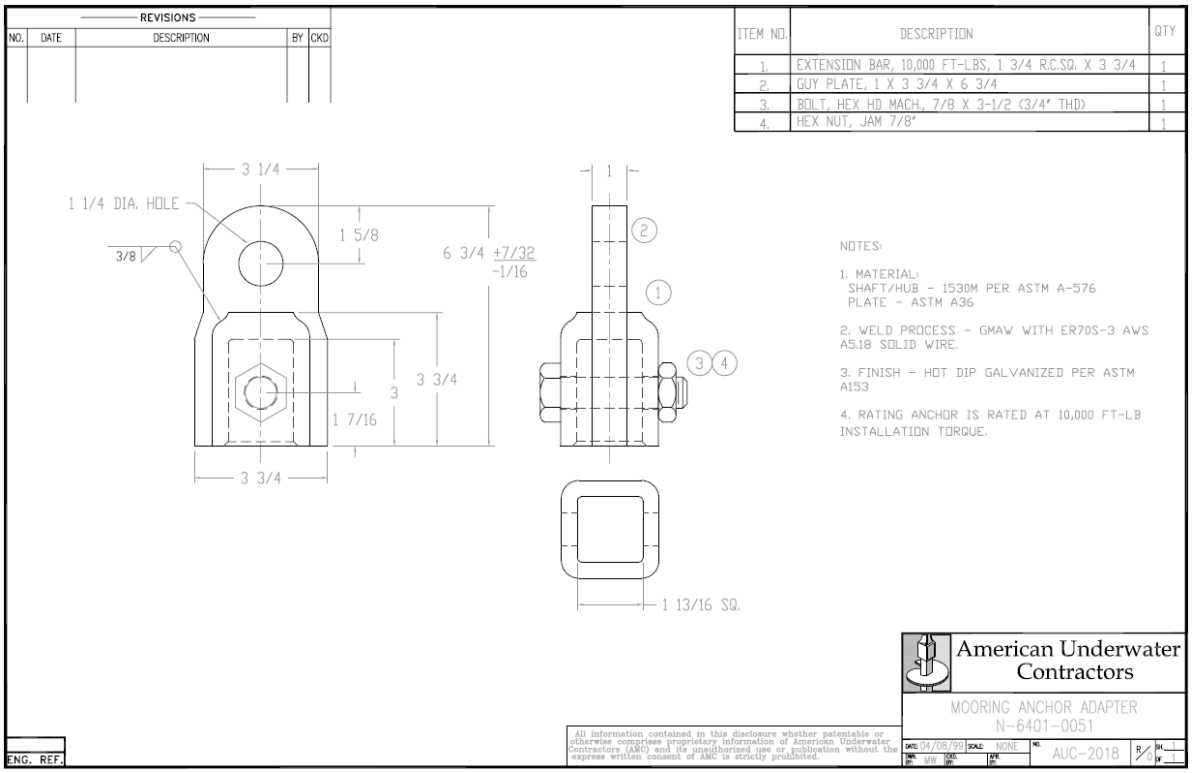


Figure 14. Helix anchor mooring termination head drawing.

5 EFBMS DEPLOYMENT

This section contains deployment inspection procedures from the *Environmentally Friendly Mooring System Inspection Guide* developed by the RDC, the results from the initial inspection, and results from deployment. Appendix A contains completed data collection sheets detailing the inspection and deployment of each EFBMS.

5.1 Inspection Procedures

Conduct and document (with photos and written records) a baseline mooring inspection of all components prior to deployment. For dimensional measurements of 2 in. (51mm) or less, use an accurate caliper with precision of 1/64 in. (0.5mm). Take photos for reference.

Mooring leg:

If multiple components make up the mooring leg, measure each component as follows:

Chain: If chain makes up any section of the mooring, inspect for wear by measuring, if possible, the smallest parts of the most worn links.

(1) End links – if of a different size than common links, inspect end links at both contact-surfaces and other location(s) if wear is present, and estimate amount of wear.
(2) Common links –
a. If end links used are of a different size, inspect contact surface at last common link before end link. If wear is present, estimate amount.
b. If end link is of same size as common link, inspect at contact surface of connecting hardware. If wear is present, estimate amount.
c. If overall length of common chain exceeds 6 feet, perform cursory inspection of entire length, and if wear is detected, estimate amount and location.

Elastic component/composite material:

(1) Inspect sheathing to see if there is any swelling, shrinkage, material cracks, abrasion and best describe the nature of the damage.
(2) If there is any damage to sheathing, best estimate whether component fibers are damaged or broken.
(3) Examine cable terminations and determine if there is any cracking or separation of sheathing to fitting, whether any fibers show, and if any fibers are broken. If fibers are broken, estimate amount.

Bridle

Bridle chain

(1) Inspect for and estimate wear along chain at contact surfaces. Specifically note wear at end links.
(2) Inspect links for any deformation, stretching, bending, or twisting.

Buoy and connecting hardware

(1) Examine buoy mooring bails, bridle shackles, and bridle ring for wear. Estimate amount of wear on contact surfaces.

Anchor and Bottom

Helix anchor:

(1) Measure vertical distance from bottom surface (at shank) to center of bail-eye or shackle pin.
(2) Measure horizontal distance from reference stake at bottom surface to center of shank at bottom surface.
(3) Estimate percent of anchor-bail wear or corrosion on contact surface at attachment point.
(4) Note any bend or distortion in shank.

Standard concrete sinker

(1) Measure distance from reference stake at bottom surface to center of attachment bail.
(2) Estimate percent of bail wear or corrosion at bail's contact surface.

Connecting hardware

(1) Inspect all contact surfaces and estimate amount of wear or corrosion.
(2) For swivels, where contact surface may not be visible (e.g., Miller swivels), measure total length of swivel under tension.
(3) For shackles, jaws, or other similar hardware, determine whether shackle or jaw, and shackle pins or clevis pins, are bent or distorted.

5.2 Initial Inspection Results

Personnel from the RDC, CG-NAV-1, Seventh Coast Guard District, Waterways Operation Product Line, buoy tender, divers and ABSG performed the initial EFBMS and helix anchor inspection on 26 March 2018, pier side, adjacent to the coastal buoy tender (WLM) USCGC JOSHUA APPLEBY, WLM-566. A representative from American Underwater Contractors, Inc., the StormSoft systems provider, was also present. The results of the initial inspection follow below. Appendix A contains the completed data collection sheets.

5.2.1 Supflex Pontoon Mooring Systems, Inc. – Superflex SB18020

Supflex shipped the Superflex SB18020 mooring system with all components connected except the pear link to the CG in a 2 ft x 3 ft x 5 ft steel box which included installation instructions and a component list. According to the installation instructions provided by Supflex the weight of the mooring system is 928 pounds. Due to the weight of the mooring system the buoy tender crew used a fork lift to remove the system from the steel box to lay out on the pier for inspection as shown in Figure 15 and Figure 16. Figure 17 shows the eye splices on either end of the mooring rope are loose around the thimbles.

The inspection team decided to use three WLM-provided 2nd Class split-key shackles to connect the mooring system to the buoy bridle and concrete sinker instead of the pear link. The ship's crew used the buoy tender crane to load the mooring system to the buoy deck. The mooring system used about 30 square feet of buoy deck space (Figure 18). The crew loaded the mooring system and installed the shackles in less than twenty minutes.

Figure 15. Superflex SB18020 mooring system.

Figure 16. Superflex SB18020 mooring system ends.

Figure 17. Mooring rope eye splices and thimbles.

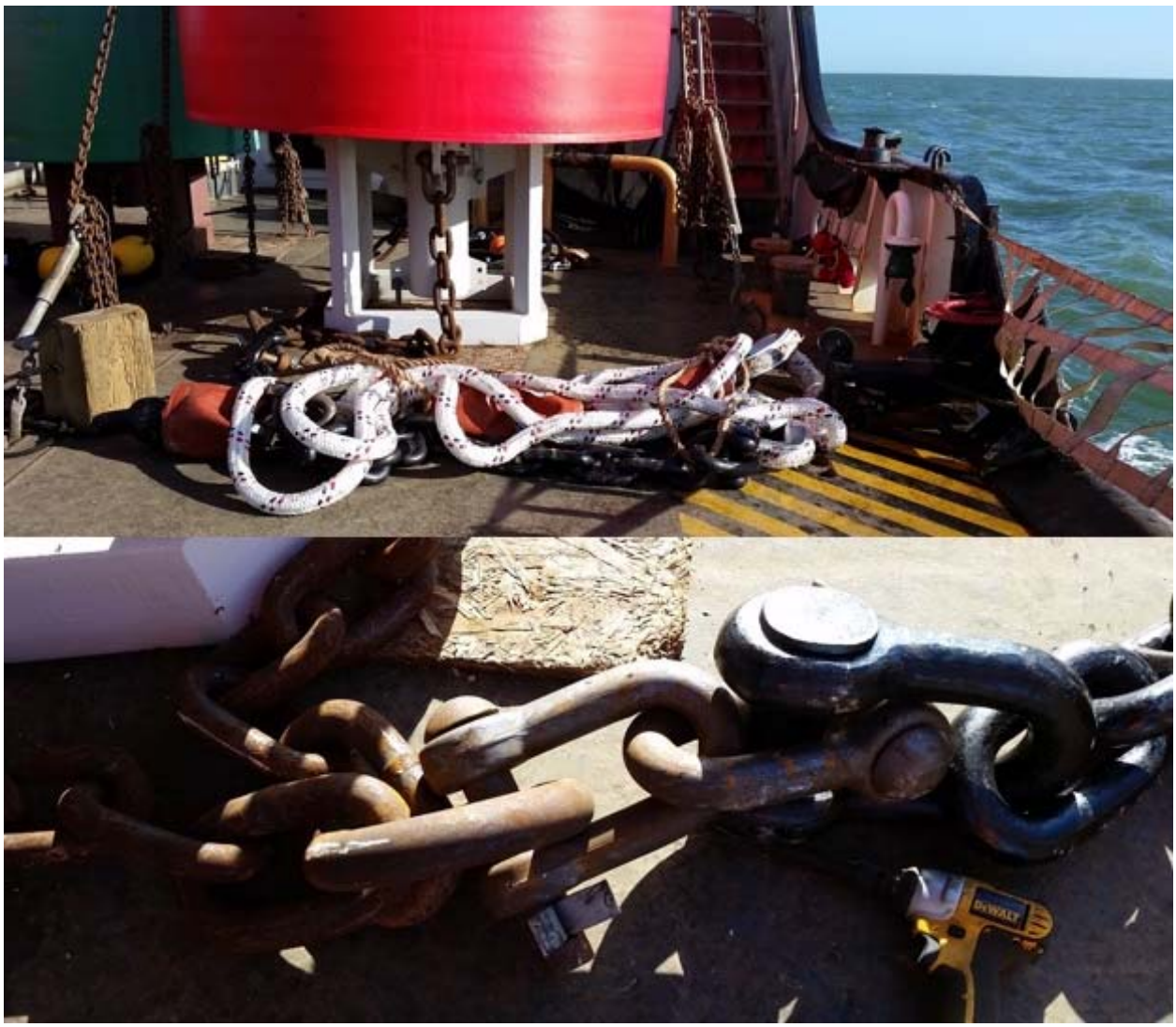


Figure 18. Superflex mooring system connected to buoy stowed on buoy deck.

Table 3 provides the components that make up the Egmont Channel R "6" buoy mooring system using the Superflex SB 18020 shock absorber (additional CG-provided components in **bold)**. The table also contains the approximate length of components and overall length.

Table 3. Egmont Channel R "6" EFBMS components Superflex SB18020.

Egmont Channel R "6" buoy mooring system components	Length (ft, in)
8X22LFR Buoy (depth)	3, 0
Bridle	8, 0
2nd Class shackle	0, 6
2nd Class shackle	0, 6
38 mm swivel and two end links	4, 0
2 m x 25 mm, 18 strand shock absorber with two 2 in. shackles	8, 0
UHMWPE rope	51, 0
2 m x 38 mm (1.5 in.) Anchor Chain with two 2 in. shackles	8, 0
2nd Class shackle	0, 6
Total Length	83, 6

5.2.2 Sealite USA LLC - Synthetic Mooring Solutions

Sealite USA LLC shipped the Sealite mooring line to the CG on a wooden pallet. The system consists of a mooring line with eye splice and thimble on each end, and two 2.5-in. shackles. A forklift was required to move the mooring line on the pallet due to its weight but it was still light enough for several personnel to uncoil for measurement on the pier. The length of the mooring line measured 151 ft (47 m) by 3 in. diameter.

Figure 19. Sealite mooring line.

After assessing the length, the project team, stakeholders, and the USCGC JOSHUA APPLEBY command decided not to deploy the Sealite mooring system. The concurrent thought held that at slack water, in calm conditions, and the 48-foot depth at Egmont Channel G "5," approximately 100 feet of mooring line would float near the surface and become a navigation hazard. (The team decided to use one of the StormSoft mooring systems for Egmont Channel G "5," instead).

5.2.3 American Underwater Contractors Inc. – StormSoft Elastic Moorings

AUC, Inc. provided three StormSoft elastic mooring systems of different lengths. Each system came in a separate 27-gallon plastic container and was handled by one person. AUC delivered the StormSoft elastic mooring line and the Miami Cordage mooring line to the CG already connected and encased in a protective polyester shell. No installation instructions were included in the containers. An AUC representative was present and confirmed the components and proper installation.

The mooring systems were complete except for end shackles (not fully tightened) and the stainless steel cotter pins (not bent and covered with heat shrink). FiberFix tape covers the wear areas on the shackles and swivels. CG Headquarters and Seventh District representatives expressed concern about the small size of the 1-inch swivels provided with the StormSoft systems not providing enough "free rotation" under tension, so the WLM crew added a 3rd Class swivel and shackle to attach to the buoy bridle for each of the three systems. The crew added another 3rd Class shackle to two of the StormSoft mooring systems in order to attach the mooring system to the concrete sinker. An AUC technician secured the CG-provided shackles and swivels to the end shackles by tightening the shackle bolts, splitting cotter pins, and applying heat shrink using a propane torch. This was accomplished pier side before the system was loaded on the buoy tender. Figures 20-25 show the StormSoft componentry. The CG buoy tender crew carried the mooring systems aboard the buoy tender and secured them on the buoy deck. Each system takes less than 10 square feet of deck space.

Figure 20. Storage boxes containing StormSoft mooring lines.

Figure 21. StormSoft mooring lines.

5.2.3.1 StormSoft mooring system #1

Table 4 provides the components that make up the Egmont Channel G "5" buoy mooring system using the StormSoft EFBMS. Due the overall length of the StormSoft mooring system (~43 ft) being too short for the depth of the water at the buoy location the WLM crew planned to leave 9 feet of chain from the existing mooring chain to increase the scope of the mooring system (i.e. the top 9 feet attached to the buoy bridle by the existing shackle and swivel). The StormSoft EFBMS will connect to the chain using a 3rd Class swivel and shackle. The table also contains the approximate length of components and overall length.

Table 4. Egmont Channel G "5" EFBMS components StormSoft #1.

Egmont Channel G "5" buoy mooring system components	Length (ft, in)
8X22LFR Buoy (depth)	3, 0
Bridle	8, 0
3rd Class Shackle	**0, 5**
3rd Class Swivel	**1, 0**
3rd Class Shackle	**0, 5**
Chain 1.5"	**9, 0**
3rd Class Shackle	**0, 5**
3rd Class Swivel	**1, 0**
1" Shackle	0, 3
1" Swivel	1, 0
1" Shackle	0, 3
StormSoft/Miami Cordage line	41, 0
1" Shackle	0, 3
1" Shackle	0, 3
3rd Class Shackle	**0, 5**
Total Length	66, 8

Figure 22. StormSoft mooring system #1 with CG swivel and shackle.

Figure 23. StormSoft mooring system #1 on buoy deck.

5.2.3.2 StormSoft mooring system #2

Table 5 provides the components that make up the Egmont Channel R "4" buoy mooring system using StormSoft. The table also contains the approximate length of components and overall length.

Table 5. Egmont Channel R "4" EFBMS components StormSoft #2.

Egmont Channel R "4" buoy mooring system components	Length (ft, in)
8X22LFR Buoy (depth)	3, 0
Bridle	8, 0
3rd Class Shackle	**0, 5**
3rd Class Swivel	**1, 0**
1" Shackle	0, 3
1" Swivel	1, 0
1" Shackle	0, 3
StormSoft/Miami Cordage line	47, 0
1" Shackle	0, 3
1" Shackle	0, 3
3rd Class Shackle	**0, 5**
Total Length	61, 10

Figure 24. StormSoft mooring system #2 connected to buoy on buoy deck with CG swivel and shackles.

5.2.3.3 StormSoft mooring system #3

Table 6 provides the components that make up the Mullet Key Channel G "25" buoy mooring system using StormSoft. The table also contains the approximate length of components and overall length.

Table 6. Mullet Key Channel G "25" EFBMS components StormSoft #3.

Mullet Key Channel G "25" buoy mooring system components	Length (ft, in)
6X16LFR Buoy (depth)	3, 0
Bridle	8, 0
3rd Class Shackle	**0, 5**
3rd Class Swivel	**1, 0**
1" Shackle	0, 3
1" Swivel	1, 0
1" Shackle	0, 3
StormSoft/Miami Cordage line	47, 0
1" Shackle	0, 3
1" Shackle	0, 3
Total Length	60, 5

Figure 25. StormSoft mooring system #3 connected to buoy on buoy deck with helix anchor mooring termination head.

5.2.4 Hazelett Marine - Conservation Elastic Mooring System

Hazelett Marine delivered the conservation elastic mooring system to the CG in a cardboard box with approximate dimensions of 2 ft x 1.5 ft x 15 ft, as a fully assembled system except for the shackle from the Uniline rope to the elastic rodes. No packing list or installation instructions were included. Hazelett Marine provided a component list and installation diagram in emails to the RDC. All components were in good condition. Figure 26-27 show the Hazelett Marine componentry.

Figure 26. Hazelett Marine conservation elastic mooring system.

The buoy tender crew installed the sling shackle to connect the Uniline to the elastic rodes with standard wrenches. There is concern about the small size of the 1-in. swivel provided with the Hazelett Marine mooring system, therefore the swivel and 1-in. shackle were removed and a Coast Guard-provided 3rd Class swivel and 4th Class shackle were used to attach the Uniline rope to the buoy bridle. The WLM crew also added a 4th Class shackle at the bottom end of the elastic rode attaching the sling shackle to the sinker bail (to keep the elastic rode off the sinker bail).

The WLM crew carried the mooring system aboard the buoy tender and secured it on the buoy deck. The system takes less than 10 square feet of deck space.

Figure 27. Hazelett Marine mooring system on buoy deck.

Table 7 provides the components that make up the Mullet Key Channel G "25" buoy mooring system using the Hazelett Marine Conservation Elastic Mooring System. The table also contains the approximate length of components and overall length.

Table 7. Mullet Key Channel G "23" EFBMS components Hazelett Marine.

Mullet Key Channel G "23" buoy mooring system components	Length (ft, in)
6X16LFR Buoy (depth)	3, 0
Bridle	8, 0
4th Class Shackle	**0, 4**
3rd Class Swivel	**1, 0**
4th Class Shackle	**0, 4**
Uniline	34, 0
1" CM Alloy Web Sling Shackle	0, 4
Elastic Rodes	10, 0
1" CM Alloy Web Sling Shackle	0, 4
4th Class Shackle	**0, 4**
Total Length	57, 2

5.2.5 Helix Anchor

The RDC acquired three helix anchor systems, one from AUC and two from Hubbell Power Systems. The anchor systems are identical except for the location of the holes to bolt the sections of the anchor together. The anchor supplied by AUC as shown in Figure 28 includes:

- One lead section – 7 ft x 1.75-in. hot dip galvanized steel round corner square shaft (RCSS) containing three helical plates of 8/10/12 inches in diameter.
- Three 5 ft x 1.75-in. RCSS extensions.
- One 3.5 ft x 1.75-in. RCSS extension.
- One 6.75-in. mooring termination head for 1.75-in. RCSS.

Figure 28. Helix anchor provided by AUC.

The helix anchor systems provided by Hubbell Power Systems shown in Figure 29 include:

- Two lead sections –5 ft x 1.75-in. hot dip galvanized steel RCSS containing three helical plates of 8/10/12 inches in diameter.
- Two 5 ft x 1.75-in. RCSS extensions.
- Two 3.5 ft x 1.75-in. RCSS extensions.
- Two 3. 5ft x 1.75-in. RCSS mooring terminations.
- Two 1.5 in x 1.5-in. mooring termination heads (not shown).

Figure 29. Helix anchors provided by Hubbell Power Systems.

Hubbell Power Systems provided two different type of mooring terminations. The 3.5 ft x 1.75-in mooring terminations were not the correct design for the project (the shackle for the mooring line attaches around the anchor shaft instead of an eye and the top of the shaft) and the other mooring termination heads provided fit the 1.5-in RCSS anchors and do not fit the 1.75-in RCSS anchors. The proper size mooring termination heads were not readily available. Therefore the two anchors were not used.

5.3 Deployment

Based on the results of the initial inspection, the project team and WLM crew made the following modifications to the deployment plan:

- Deploy helix anchor for Mullet Key Channel Buoy G"25". Use concrete sinkers for the other four buoys.
- Replace Sealite mooring system with modified StormSoft mooring system for Egmont Channel G"5".
- Deploy the Hazelett Marine mooring system at Mullet Key Channel Buoy G”23” due to the difference in Mullet Key Channel Buoy R”26”buoy-hull type.

The deployment was initially scheduled for the last week in March 2018. The diving contractors used a 24-foot “Carolina Skiff” as the main equipment vessel and a 20-foot runabout as the secondary vessel. On 27 March, 17 kt winds, 2-ft waves, and approx. 1.2 kt current conditions precluded diving operations, so RDC, the dive contractor and the WLM crew agreed to reschedule the deployment to the first week in April. The project deployed the EFBMSs in Mullet Key Channel on 3 April 2018 and in Egmont Channel on 4 April 2018. Table 8 and Figure 30 show the revisions to the deployment plan (in bold). The table displays the updated water depth from USCGC JOSHUA APPLEBY aid positioning records during the EFMBS deployment. The aid positioning records are included in Appendix B.

Table 8. Revised environmentally friendly buoy mooring locations.

Buoy Locations	Mooring System	Buoy Size	Anchor	Water Depth (ft)	Bottom Type	Latitude	Longitude
Egmont Channel R"4"	StormSoft	8X22LFR	**Concrete**	**49**	Sand	27.59361	-82.9531
Egmont Channel G"5"	**StormSoft**	8X22LFR	Concrete	**49**	Sand	27.59833	-82.9261
Egmont Channel R"6"	Supflex	8X22LFR	Concrete	**50**	Sand	27.59639	-82.9261
Mullet Key Channel Buoy G"25"	StormSoft	6X16LFR	Helix	**41**	Sand	27.61361	-82.6756
Mullet Key Channel Buoy G”23”	Hazelett Marine	6X16LFR	Concrete	**38**	Sand	27.61092	-82.6952

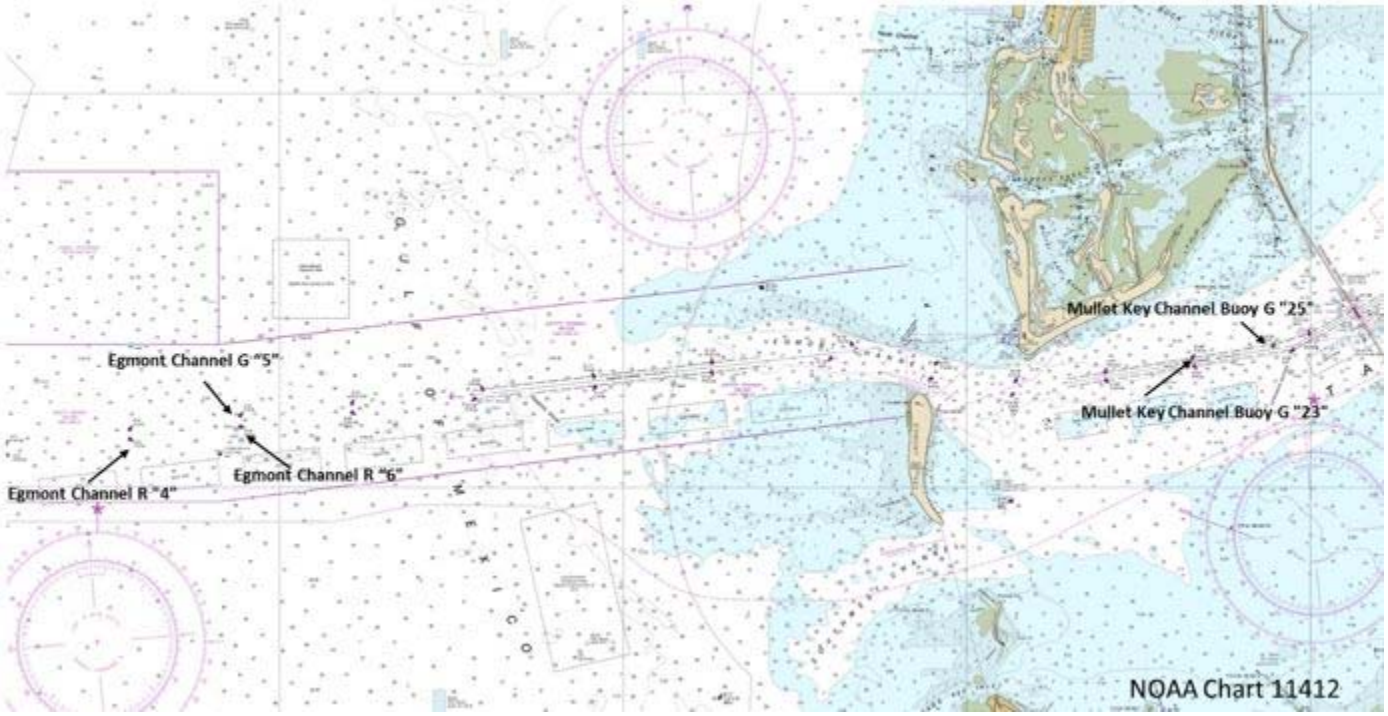


Figure 30. Revised mooring locations.

5.3.1 Mullet Key Channel Buoy G "25"

USCGC JOSHUA APPLEBY (the WLM) arrived on scene Mullet Key Channel Buoy G"25" at approximately 0800 (all times local time) retrieved the 6X16LFR buoy at 0830 to allow StormSoft attachment to the bridle while on deck, and placed a 5th Class, foam can buoy with 3/4-inch chain and 200-pound pyramid anchor to mark the assigned buoy position. On scene conditions were: wind 12 kt SW, <1-foot chop, current approximately 1 kt ENE.

After the WLM moved 100 yards from buoy location, the dive boats set up a four-point anchor system to stabilize position. The divers first entered the water at 0918, and used the pyramid anchor as a guide to determine the helix anchor position. The diver jet probed the sand bottom to insure adequate depth for the helix below the bottom to the limestone ledge (about 10 ft below the sand bottom). The divers installed the seven-foot lead section (helix) using a hydraulic installation tool with a stabilizing bar secured to the bottom. The installation tool drive-head (torque motor) required a 16 hp gas engine on the dive boat driving a 2000-2500 PSI, 8-9 GPM hydraulic pump, with 100 ft of hydraulic hose (1/2 in.) for power shown in Figure 31.

The divers then added a five-foot extension to the lead section with the lead section driven six feet into the bottom, leaving about one foot above the bottom to make the connection. Next, they connected the two parts with the 7/8-inch bolt using standard wrenches. They continued to drill the five-foot extension into the bottom leaving about six inches of the anchor shaft above the bottom.

After the divers set the helix anchor, the WLM set the 6X16LFR buoy in the water, with attached StormSoft system and helix anchor termination head. The divers then towed the buoy to the anchor location and

attached the mooring termination head to the anchor shaft with the bolt provided, using standard wrenches. Figure 32 shows the mooring termination head to the helix anchor.

Figure 31. Helix anchor installation tool.

Figure 32. Mullet Key Channel G "25" helix mooring termination head with StormSoft EFBMS.

The divers inspected the StormSoft EFBMS starting at the buoy, then the buoy bridle connection, swivels, floats and helix anchor termination. The only part of the mooring system in contact with the sand bottom is the mooring termination with the remainder of the mooring system floating in the water column. Dive operations completed at 1220.

5.3.2 Mullet Key Channel Buoy G "23"

The WLM arrived on scene Mullet Key Channel Buoy G "23" at 1230 on 3 April. On scene conditions were: wind 12 kt SSW, 1-foot chop, current approx. 1.2 kt ENE. By 1240, the WLM had the buoy on deck (Figure 33) and the WLM crew began to replace the chain mooring leg at the bridle with the Hazelett Marine EFBMS. During this time, the WLM also reset the concrete sinker at assigned position. (Note: Buoy "23" is a new 6X16LCFR buoy RDC bought, specifically for this test, but the WLM previously deployed it in late March so it could swap the steel hull with another, damaged steel hull.).

At 1300, the WLM lowered the existing chain to the bottom and used a 5th Class can buoy to mark the sinker and chain, then stood off at approximately 75 yards upwind. At 1315, the divers then went to the assigned position and set up a line from a small float to the sinker so as to provide a guideline and downhaul less subject to the effects of current and wind. The divers also requested the WLM to repositionin order to create more of a lee. At 1355, the WLM put the buoy in the water and the dive boat towed the buoy to the assigned position, and then used the downhaul to pull the mooring system down to the concrete sinker. Because of the Hazelett Marine mooring's lack of space between the shackle bail and the synthetic eye, the divers used a CG-provided 4th Class split key shackle as shown in Figure 34.

Note: for all buoy deployments that used the concrete sinker as the anchor, the WLM left the standard chain attached to the sinker bail. Should the EFBMS fail or show premature deterioration, the WLM would then use a diver to float the chain so the WLM could reattach the standard chain to the buoy bridle.

The divers inspected the Hazelett Marine EFBMS starting at the concrete sinker, then the connections to the elastic rodes, floats, Uniline mooring rope, wire rope clips, CG 3rd Class swivel, shackles and buoy bridle. The two floats keep the mooring system above the sinker bail with no bottom contact. The divers completed operations at 1445 and the WLM retrieved the disconnected, unlighted can at 1500.

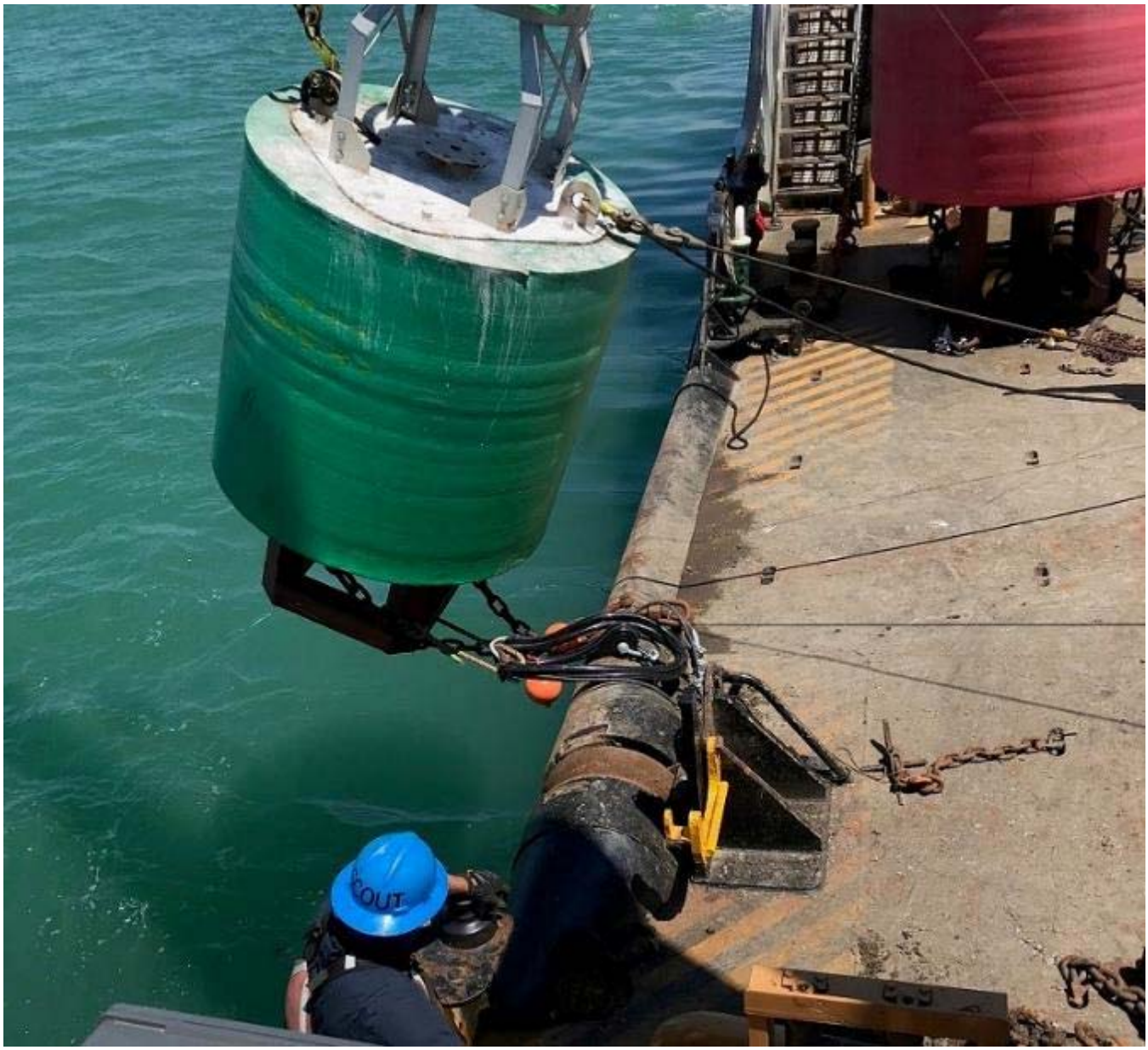


Figure 33. RDC-provided 6X16LFR buoy with Hazelett Marine mooring.

Figure 34. Mullet Key Channel G "23" Hazelett Marine EFBMS connection to concrete sinker.

Figure 35. Hazelett Marine EFBMS Uniline connection to CG 3rd Class swivel at buoy bridle.

5.3.3 Egmont Channel R "4"

The WLM arrived on scene Egmont Channel R “4” at 0840, 4 April. On Scene conditions were: winds calm, seas calm, current estimated at 0.3 kt N. The WLM relieved the 8x26 LR steel hull and attached a 5th Class nun and chain to the existing chain and lowered it to the bottom. The WLM then set the RDC-provided 8X22LFR with StormSoft EFBMS attached (Figure 36), in the water. After the divers set up their downhaul, at 0940, the dive boat towed the new buoy and mooring to the assigned position and connected the StormSoft mooring system to the existing concrete sinker at its assigned position. The divers used a CG provided 3rd Class split key shackle to attach the mooring system to the concrete sinker as shown in Figure 37. As with Mullet Key Channel G “23”the mooring chain remains attached to the concrete sinker.

The divers inspected the StormSoft EFBMS starting at the concrete sinker, inspecting the connections to the mooring system at the sinker, swivel, CG 3rd Class swivel (Figure 38) and shackle, and buoy bridle and completed temporary buoy disconnect at 1015. The dive boat started to tow the unlighted nun towards the Egmont Channel G”5” location, but did not make too much progress because of the chain, so they left the buoy drifting for later retrieval by the WLM.

Figure 36. StormSoft EFBMS attached to 8X22LFR Egmont Channel R “4” on buoy deck.

Figure 37. Egmont Channel R "4" StormSoft EFBMS connection to concrete sinker (diver tagline present).

Figure 38. StormSoft EFBMS connection to CG 3rd Class swivel at buoy bridle.

5.3.4 Egmont Channel G "5"

The WLM retrieved the Egmont Channel G “5” 8X22LFR hull at 1000 on 4 April and attached a 5th Class can to the chain, preparing for the next deployment. On scene conditions were: winds 3 kt SSW, seas calm, current negligible. After diverting to retrieve the temporary nun from the R”4” deployment, the WLM arrived back at Egmont Channel G “5” at 1114. During the time between retrieval and deployment, the WLM crew attached nine feet of 1.5-inch chain between the StormSoft EFBMS and the buoy bridle (Figure 39). The WLM added the chain because the length of this StormSoft mooring was shorter than the water depth at assigned position (AP), and the extra chain would allow attachment of the mooring in a no-strain condition. The WLM deployed the hull at 1126 and the divers towed the hull to AP to connect the mooring and anchor with a 3rd Class swivel and split key shackle.

The divers inspected the StormSoft EFBMS starting at the concrete sinker (Figure 40), then the connections to the mooring system at the sinker, swivel, CG 3rd Class swivels and shackles, and chain and buoy bridle (Figure 41). The divers confirmed that the mooring system did not contact the sand bottom.

Figure 39. Egmont Channel G “5” with nine feet of 1.5-inch chain connecting the StormSoft EFBMS with the bridle.

Figure 40. Egmont Channel G "5" StormSoft EFBMS connection to concrete sinker.

Figure 41. StormSoft EFBMS connection to CG 3rd Class swivel, shackle and chain.

5.3.5 Egmont Channel R "6"

The WLM arrived Egmont Channel R “6” buoy at 1130. On scene conditions were: winds SSW 5 kt, seas 1/2-foot, current negligible. The WLM relieved the 8X26 LR steel hull, maneuvered slightly to AP and attached a 5th Class nun and chain to the existing chain and lowered it to the bottom. The WLM then set the RDC-provided 8X22LFR with the Superflex EFBMS attached in the water (see Figure 42). At 1256 the divers towed the buoy with the Superflex EFBMS to the location of the concrete sinker and secured the buoy to the sinker with a rope. Three divers used a 200-lb lift bag to maneuver the two-meter long chain (part of the Superflex mooring) over to and up onto the concrete sinker. They used a 2nd Class split key shackle to attach the mooring chain to the concrete sinker as shown in Figure 43.

The divers inspected the Superflex EFBMS starting at the concrete sinker, then the connections to the mooring system at the sinker, chain, mooring rope thimbles, Superflex SB18020 shock absorber, swivel, 2nd Class shackles, and buoy bridle. Though the synthetic parts of the mooring (shock absorber and UHMWPE rope) hang above the bottom, approximately one meter of the Superflex-provided chain is on the bottom, with another meter draped from the sinker bail (and 2nd Class shackle) over the side of the concrete sinker (Figure 43). Figures 44 and 45 show the two shackles connecting the bridle to the Superflex system while Figure 46 shows the mooring rope between the shock absorber and the bottom chain. The mooring rope thimble makes contact with the bottom as shown in Figure 47. As noted previously, the eye splices over the mooring rope thimbles are not tight and may result in chafing at the thimbles during mooring-system movement. Also, since this is the only mooring that contacts the sinker itself, the 1.5-inch chain may cause additional wear on the sinker.

Figure 42. Superflex EFBMS attached to 8X22LFR Egmont Channel R “6” before deployment.

Figure 43. Egmont Channel R "6" Superflex EFBMS connection to concrete sinker.

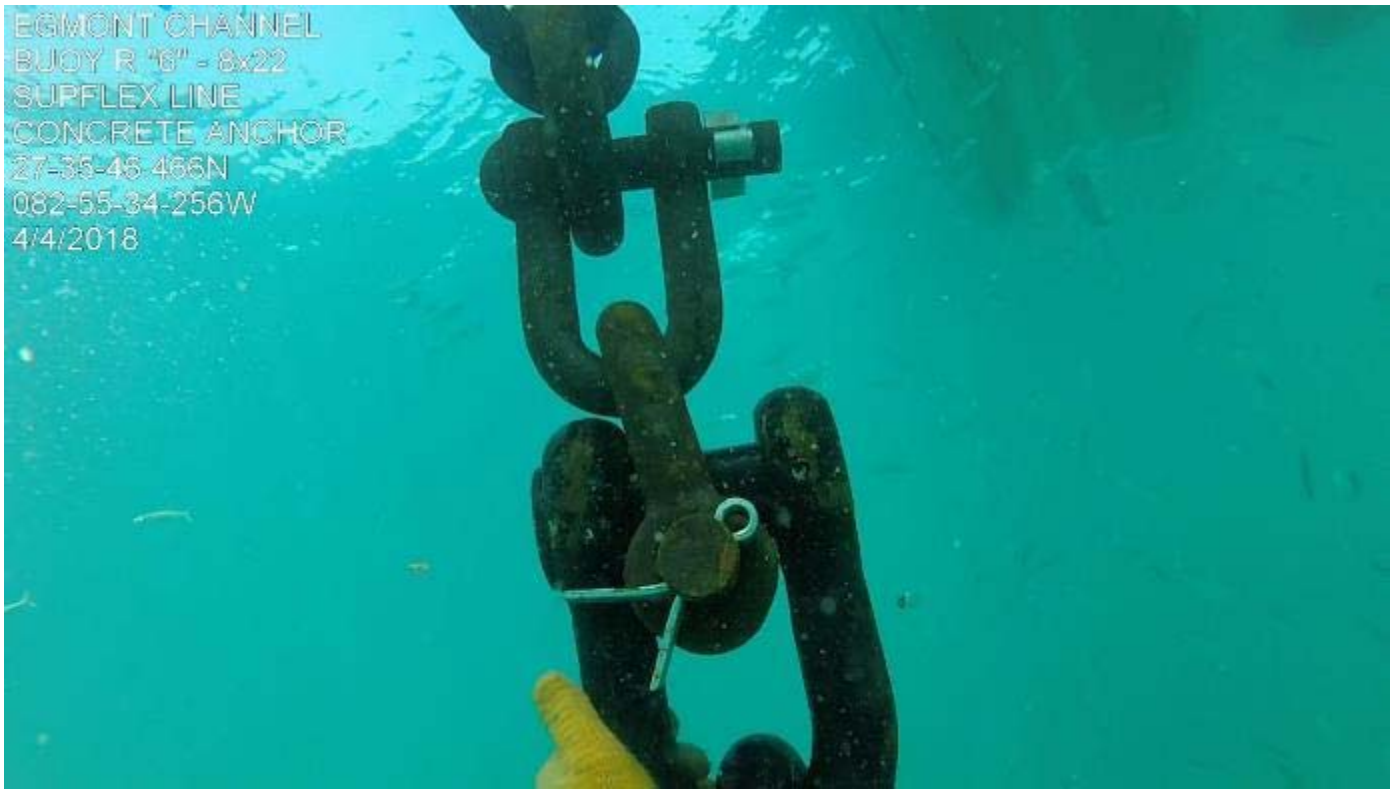


Figure 44. Superflex EFBMS connection to 2nd Class swivel, shackle and chain.

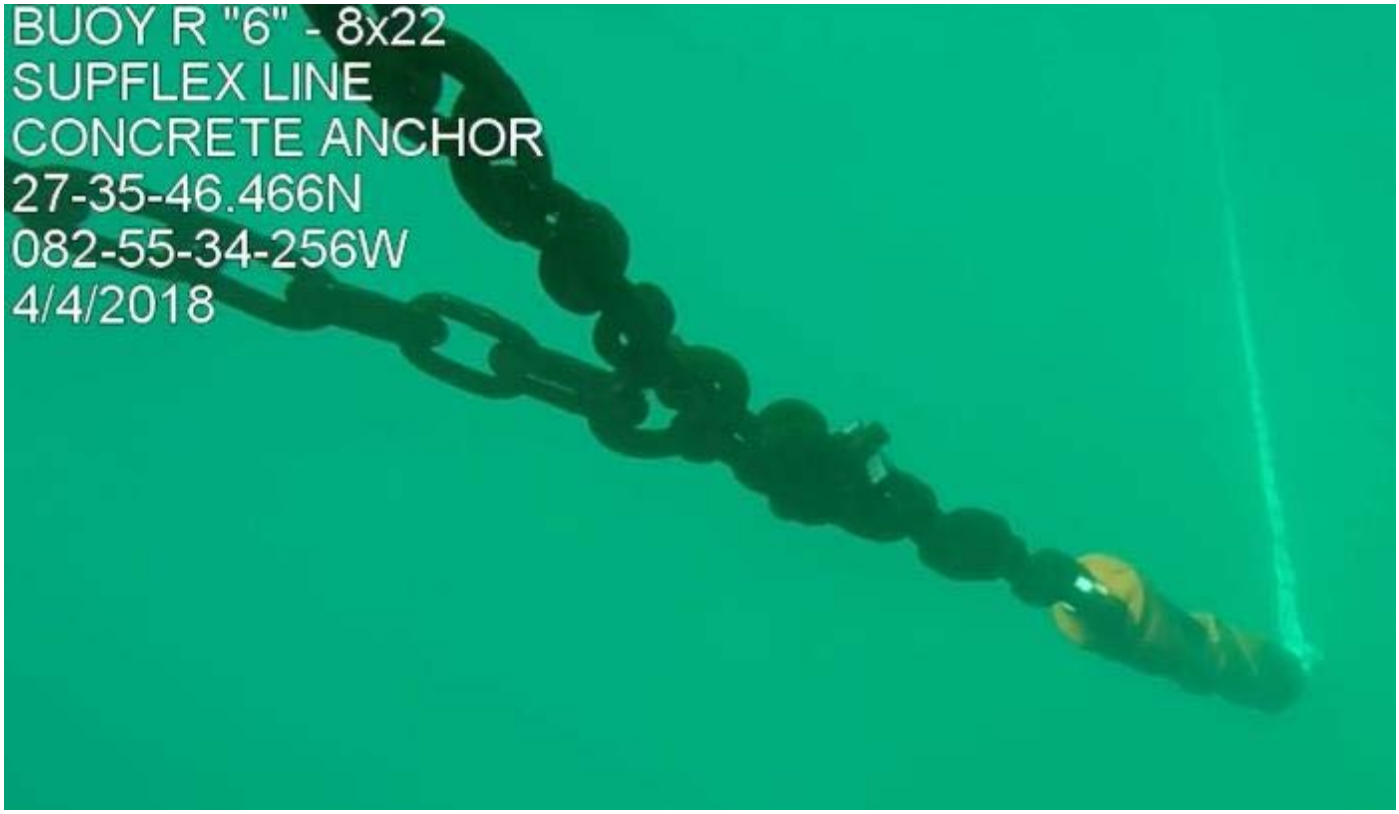


Figure 45. Superflex EFBMS SB18020 shock absorber and buoy bridle.

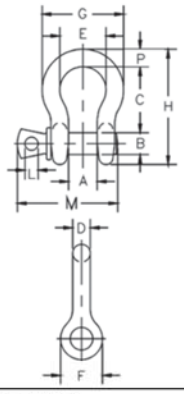
Figure 46. Superflex EFBMS chain/mooring line connection on bottom.

Figure 47. Superflex EFBMS mooring rope loose eye splices around thimbles.

APPENDIX A. EFBMS DEPLOYMENT DATA COLLECTION SHEETS

A.1 StormSoft Elastic Mooring System Egmont Channel Buoy R"4"

StormSoft Elastic Mooring System (#2) Egmont Channel Buoy R"4"			
Mooring Component	Component Location	Thickness	Length
10' x 1.25" StormSoft elastic mooring line & Miami Cordage PYB1 polyester double braid rope	Buoy bridle to to concrete anchor		47'
Thimble (Nylon)	StormSoft top end	1.5"	8"L x 5W"
Thimble (Nylon)	StormSoft bottom end	1.5"	8"L x 5W"
1"CM Forged eye and eye swivel - Dixie	Swivel to mooring line	1"	12"
3rd Class swivel	Bridle to StormSoft	1.5"	12"



Mooring Component	Component Location	Dimensions (in.)				
		A	C	B	D	P
		1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	CG swivel to swivel	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	Swivel to mooring rope	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	Mooring rope to StormSoft mooring line	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	StormSoft mooring line to CG shackle	1.69	3.75	1.13	1.00	1.00
3rd Class shackle	Buoy bridle to CG swivel	2.25	4.50	1.50	1.50	1.50
3rd Class shackle	1" shackle to anchor	2.25	4.50	1.50	1.50	1.50

Discrepancies / Comments

The 1.25" StormSoft elastic mooring line and the Miami Cordage 1" mooring line was delivered to the Coast Guard already connected and encased in a protective polyester shell.

Shackles and swivels provided with the StormSoft have been wrapped in FiberFix tape on all the wear points.

The length of the combined mooring line is 47'. The shackles and swivel provided adds ~2'. The WLM crew added a 3rd class swivel and two 3rd class split key shackles that adds ~2' (12" for swivel and 5" for each shackle). The depth of the buoy (~3') and length of the bridle (8') adds 11'. The total length of all components is about 62'.

Egmont Channel R "4", StormSoft, concrete sinker	Length (ft, in)
8x22LFR Buoy depth	3, 0
Bridle	8, 0
3rd Class shackle	**0, 5**
3rd Class swivel	**1, 0**
1" Shackle	0, 3
1" Swivel	1, 0
1" Shackle	0, 3
StormSoft line	47, 0
1" Shackle	0, 3
1" Shackle	0, 3
3rd Class shackle	**0, 5**
Total Length	61, 10

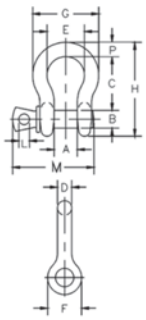
RDC EFBMS Deployment Data Collection Checklist	
Buoy Name	**Egmont Channel R "4"**
Buoy Location	27-35-37.112N. 082-57-10.915W
Buoy Type	8X22LFR
Mooring System	**StormSoft**
Anchor	**Concrete**
Bottom Type	Sand
Pre-deploy - loading	
How are mooring systems packaged? Take pictures of packaged systems.	Mooring system is small enough to fit in a 27 gallon plastic tote.
Make copies of bill of lading, packing lists, etc.	No packing list in container. Component list provided by email.
Inventory mooring system components.	All components are connected and accounted for. Documented mooring systems components with pictures.
Are all components included?	
Note condition of components.	
List any missing components.	
Take pictures of components.	
Are installation instructions and diagrams provided? Make copies of installation documents	No installation instructions provided. StormSoft rep was present and confirmed the components and proper installation. Attachment points were marked on thimbles.
Is mooring system completely "made up" and ready for attachment to buoy bridle and anchor? (yes/no)	The mooring systems were complete except for end shackles (not fully tightened) and the stainless steel cotter pins (not bent and covered with heat shrink). This was accomplished pier side before the system was loaded on the buoy tender. The buoy tender crew added shackles to each end and a swivel on the buoy bridle end.
If buoy systems are not "made up", are instructions provided to build the system?	No instructions provided.
Are instructions adequate?	
Do installation instructions include a list of required tools to completely build the mooring system?	No instructions provided. AUC technician used standard wrenches to tighten the shackles pliers to bend the cotter pins, and heat shrink applied using a propane torch. CG uses split key shackles that only require hammers to install the split key.
Record list of required tools to build system.	
Record the amount of time it takes to build the mooring system.	The mooring systems were complete except for end shackles (not fully tightened) and the stainless steel cotter pins (not bent and covered with heat shrink). The additional shackles and swivels added by the CG took less than five minutes. One person can perform this and system is light weight and only requires one person to lift and load onto the buoy tender.
Record the number of personnel required to build the mooring system.	
Take pictures of complete mooring systems	Documented mooring systems components with pictures.

RDC EFBMS Deployment Data Collection Checklist	
Can crew load mooring to deck w/o any additional or abnormal equipment?	No forklift of crane is required to load the mooring system onto the buoy deck from the pier. Mooring system is light weight and one person can carry.
Record if forklift or crane used to load mooring system.	
Record time to load and the number of personnel required each mooring system.	On person to load and less than 5 minutes to load.
Do mooring components provide attachment points as necessary?	Yes.
Record the deck space required for the mooring system.	Less than 10 square feet of buoy deck space is required for the mooring system.
Do mooring components unnecessarily foul working deck?	No.
Can existing pad eye arrangement on buoy deck hold components securely for transit?	Yes.
Does storage interfere or unnecessarily complicate normal buoy deck transit load?	No.
Pre-deploy transit	
Do components remain in place without rolling, shifting, sliding?	Yes.
Can vessel work other buoys with mooring on deck?	Yes. Buoy tender worked #4 with relieved 8X26 steel hull, 8X22 foam hull, 2 additional moorings, and 5th class can all on buoy deck
Environmental Conditions at Deployment Location	
Record wave height and direction	Calm
Record wind speed and direction	Est. wind 080T, 2kt
Record current	200T, 0.5kt
Record weather	Fair, calm
Deployment	
Concrete Anchor System	
Record position of concrete anchor (latitude, longitude)	27-35-37.119N, 082-57-10.899W
Mooring System Installation	
Does vessel need equipment beyond existing ship's outfit to install mooring system?	No extra equipment. Divers and dive gear are required to connect the mooring system to the concrete sinker.
What tools / special equipment are required for installation?	

RDC EFBMS Deployment Data Collection Checklist	
Does vessel need personnel beyond existing ship's complement?	The regular buoy tender crew connected the buoy mooring system to the buoy bridle. Divers connected the mooring system to the concrete sinker.
List required personnel to install mooring system.	
Record time of mooring system installation commencement.	0840 4 Apr 2018 – “4” Alongside
Record time of mooring system installation completion.	1011 4 Apr 2018 – Dive boat disconnected Temp Buoy
If divers are required, record time when divers commence installation.	0920 4 Apr 2018 – Dive boat approach after WLM set Temp Buoy
If divers are required, record time when divers complete installation.	1011 4 Apr 2018 - Dive boat disconnected Temp Buoy
Does placing mooring result in any visible disturbance of the bottom?	No
Does deployment technique hazard any deck crew?	No
Record position of buoy (latitude, longitude)	27-35-37.119N, 082-57-10.899W
Post deployment	
Does buoy appear to remain on station?	Yes
Does deployment give any indication that mooring is fouled?	No
Does deployment give any indication that mooring is not upset?	No

A.2 StormSoft Elastic Mooring System Egmont Channel Buoy G"5"

StormSoft Elastic Mooring System (#2) Egmont Channel Buoy R"4"			
Mooring Component	Component Location	Thickness	Length
10' x 1.25" StormSoft elastic mooring line & Miami Cordage PYB1 polyester double braid rope	Buoy bridle to to concrete anchor	1.25"	41'
Thimble (Nylon)	StormSoft top end	1.5"	8"L x 5W"
Thimble (Nylon)	StormSoft bottom end	1.5"	8"L x 5W"
1"CM Forged eye and eye swivel - Dixie	Swivel to mooring line	1"	12"
3rd Class shackle	Bridle to chain	1.5"	12"
3rd Class shackle	Chain to StormSoft	1.5"	12"



Mooring Component	Component Location	Dimensions (in.)				
		A	C	B	D	P
		1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	CG swivel to swivel	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	Swivel to mooring rope	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	Mooring rope to StormSoft mooring line	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	StormSoft mooring line to CG shackle	1.69	3.75	1.13	1.00	1.00
3rd Class shackle	Buoy bridle to CG swivel	2.25	4.50	1.50	1.50	1.50
3rd Class shackle	CG swivel to chain	2.25	4.50	1.50	1.50	1.50
3rd Class shackle	Chain to CG swivel	2.25	4.50	1.50	1.50	1.50
3rd Class shackle	1" shackle to anchor	2.25	4.50	1.50	1.50	1.50

Discrepancies / Comments

The 1.25" StormSoft elastic mooring line and the Miami Cordage 1" mooring line was delivered to the Coast Guard already connected and encased in a protective polyester shell. Shackles and swivels provided with the StormSoft have been wrapped in FiberFix tape on all the wear points.

The length of the combined mooring line is 41'. The shackles and swivel provided adds 2'. The buoy tender crew added a 3rd class swivel and two 3rd class split key shackles that adds approximately ~2' (12" for swivel and 5" for each shackle). The depth of the buoy (~3') and length of the bridle (8') adds 11'. During deployment the buoy tender crew cut the chain to the buoy leaving the buoy bridle, shackles, swivel and 9' of chain to attach to the StormSoft mooring line. The total length of all components is about 67'.

Egmont Channel G "5", StormSoft, concrete sinker	Length (ft, in)
8X22LFR Buoy depth	3, 0
Bridle	8, 0
3rd Class shackle	**0, 5**
3rd Class swivel	**1, 0**
3rd Class shackle	**0, 5**
Coast Guard Chain 1.5"	**9, 0**
3rd Class shackle	**0, 5**
3rd Class swivel	**1, 0**
1" Shackle	0, 3
1" Swivel	1, 0
1" Shackle	0, 3
StormSoft line	41, 0
1" Shackle	0, 3
1" Shackle	0, 4
3rd Class shackle	**0, 5**
Total Length	66, 8

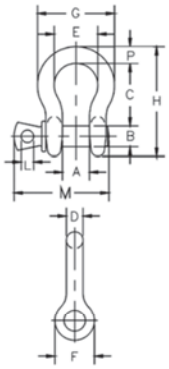
RDC EFMS Deployment Data Collection Checklist	
Buoy Name	Egmont Channel G “5”
Buoy Location	27-35-53.907N, 082-55-34.241W
Buoy Type	8X22LCFR
Mooring System	**StormSoft**
Anchor	**Concrete**
Bottom Type	Sand
Pre-deploy - loading	
How are mooring systems packaged? Take pictures of packaged systems.	Mooring system is small enough to fit in a 27 gallon plastic tote.
Make copies of bill of lading, packing lists, etc.	No packing list in container. Component list provided by email.
Inventory mooring system components.	All components are connected and accounted for. Documented mooring systems components with pictures.
Are all components included?	
Note condition of components.	
List any missing components.	
Take pictures of components.	
Are installation instructions and diagrams provided? Make copies of installation documents	No installation instruction provided. StormSoft rep was present and confirmed the components and proper installation. Attachment points were marked on thimbles.
Is mooring system completely “made up” and ready for attachment to buoy bridle and anchor? (yes/no)	The mooring systems were complete except for end shackles (not fully tightened) and the stainless steel cotter pins (not bent and covered with heat shrink). This was accomplished pier side before the system was loaded on the buoy tender. The buoy tender crew added shackles to each end and a swivel on the buoy bridle end.
If buoy systems are not “made up”, are instructions provided to build the system?	No instructions provided.
Are instructions adequate?	
Do installation instructions include a list of required tools to completely build the mooring system?	No instructions provided. AUC technician used standard wrenches to tighten the shackles pliers to bend the cotter pins, and heat shrink applied using a propane torch. CG uses split key shackles that only require hammers to install the split key.
Record list of required tools to build system.	
Record the amount of time it takes to build the mooring system.	The mooring systems were complete except for end shackles (not fully tightened) and the stainless steel cotter pins (not bent and covered with heat shrink). The additional shackles and swivels added by the CG took less than five minutes. One person can perform this and system is light weight and only requires one person to lift and load onto the buoy tender.
Record the number of personnel required to build the mooring system.	
Take pictures of complete mooring systems	Documented mooring systems components with pictures.

RDC EFMS Deployment Data Collection Checklist	
Can crew load mooring to deck w/o any additional or abnormal equipment?	No forklift of crane is required to load the mooring system onto the buoy deck from the pier. Mooring system is light weight and one person can carry.
Record if forklift or crane is used to load mooring system.	
Record time to load and the number of personnel required each mooring system.	One person to load and less than 5 minutes to load.
Do mooring components provide attachment points as necessary?	Yes.
Record the deck space required for the mooring system.	Less than 10 square feet of buoy deck space is required for the mooring system.
Do mooring components unnecessarily foul working deck?	No.
Can existing pad eye arrangement on buoy deck hold components securely for transit?	Yes.
Does storage interfere or unnecessarily complicate normal buoy deck transit load?	No.
Pre-deploy transit	
Do components remain in place without rolling, shifting, sliding?	Yes.
Can vessel work other buoys with mooring on deck?	Yes. Buoy tender worked # 5 with relieved 8x26 steel hull, 8x22 foam hull, 2 additional moorings, and 5th class can all on buoy deck
Environmental Conditions at Deployment Location	
Record wave height and direction	Calm
Record wind speed and direction	Est. wind 074T, 2kt
Record current	200T, 0.5kt
Record weather	Fair, calm
Deployment	
Concrete Anchor System	
Record position of concrete anchor (latitude, longitude)	27-35-53.909N, 082-55-34.270W
Mooring System Installation	
Does vessel need equipment beyond existing ship's outfit to install mooring system?	No extra equipment. Divers and dive gear are required to connect the mooring system to the concrete sinker.
What tools / special equipment are required for installation?	

RDC EFMS Deployment Data Collection Checklist	
Does vessel need personnel beyond existing ship's complement?	The regular buoy tender crew connected the buoy mooring system to the buoy bridle. Divers connected the mooring system to the concrete sinker.
List required personnel to install mooring system.	
Record time of mooring system installation commencement.	1000 - #5 alongside, 1005 - # 5 on deck, 1011- Temp buoy in water
Record time of mooring system installation completion.	1200
If divers are required, record time when divers commence installation.	Est 1100
If divers are required, record time when divers complete installation.	Est 1200
Does placing mooring result in any visible disturbance of the bottom?	No
Does deployment technique hazard any deck crew?	No
Record position of buoy (latitude, longitude)	27-35-53.909N, 082-55-34.270W
Post deployment	
Does buoy appear to remain on station?	Yes
Does deployment give any indication that mooring is fouled?	No
Does deployment give any indication that mooring is not upset?	No

A.3 Supflex Superflex Mooring System (1) Egmont Channel Buoy R"6"

Supflex Superflex Mooring System Egmont Channel Buoy R"6"			
Mooring Component	Component Location	Thickness	Length
38mm swivel and two end links (Grade 3a)	Buoy bridle to shock absorbor	1.5"	4'
2m x 25mm, 18 strand shock absorber	Swivel to mooring line	1"	8'
45ft (56mm) Ultra-High-Molecular-Weight Polyethylene and Polyester mix mooring line (Jiuli Rope Co.,Ltd.)	Shock absorber to anchor chain	2.5"	51'
2m x 38mm Anchor Chain	Mooring line to anchor	8' (with shackles)	



Mooring Component	Component Location	Dimensions (in.)				
		A	C	B	D	P
2" (Grade 3) Shackle	Buoy bridle to end link and swivel		7.00	3.375	2.00	2.00
2" (Grade 3) Shackle	End link to top of Superflex		7.00	3.375	2.00	2.00
2" (Grade 3) Shackle	Bottom of Superflex to mooring line		7.00	3.375	2.00	2.00
2" (Grade 3) Shackle	Mooring line to anchor chain		7.00	3.375	2.00	2.00
2" (Grade 3) Shackle	Connect chain to anchor		7.00	3.375	2.00	2.00
(2) 2nd Class shackles	Buoy bridle to CG swivel	2.75	6.00	1.75	1.75	1.75
2nd Class shackle	CG swivel to chain	2.75	6.00	1.75	1.75	1.75

Discrepancies / Comments

The combined length of the Superflex SB18020, chain, end links & swivel, mooring rope and shackles is 71'. The buoy tender crew added two class 2 shackles (~1') to connect the mooring system to the bridle and with another 2nd class shackle (6") to connect the mooring chain to the concrete anchor (instead of using the pear link provided by Supflex). The depth of the buoy (~3') and length of the bridle (8') adds 11'. The total length of all components is about 84'.

Egmont Channel R "6" buoy mooring system components	Length (ft, in)
8X22LFR Buoy depth	3, 0
Bridle	8, 0
2nd Class shackle	0, 6
2nd Class shackle	0, 6
38mm swivel and two end links	4, 0
2m x 25mm, 18 strand shock absorber with two 2in shackles	8, 0
UHMWPE rope	51, 0
2m x 38mm Anchor Chain with two 2in shackles	8, 0
2nd Class shackle	0, 6
Total Length	83, 6

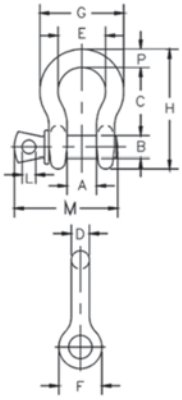
RDC EFMS Deployment Data Collection Checklist	
Buoy Name	Egmont Channel R “6”
Buoy Location	27-35-46.466N, 082-55-34.256W
Buoy Type	8X22LFR
Mooring System	**Supflex**
Anchor	**Concrete**
Bottom Type	Sand
Pre-deploy - loading	
How are mooring systems packaged? Take pictures of packaged systems.	Mooring system came in an approximate 2'x3'x5' steel box and weighs several hundred pounds.
Make copies of bill of lading, packing lists, etc.	Steel box contained list of components and instructions.
Inventory mooring system components.	All components are connected and accounted for. Documented mooring systems components with pictures.
Are all components included?	
Note condition of components.	
List any missing components.	
Take pictures of components.	
Are installation instructions and diagrams provided? Make copies of installation documents	Instructions provided and adequate. Suplex provided electronic copies of the instructions.
Is mooring system completely “made up” and ready for attachment to buoy bridle and anchor? (yes/no)	The mooring system was complete. The eye splices on either end of the mooring rope were loose around the thimbles.
If buoy systems are not “made up”, are instructions provided to build the system?	Instructions provided and adequate. A CG provided split key shackle replaced the pear link for connection to the concrete sinker.
Are instructions adequate?	
Do installation instructions include a list of required tools to completely build the mooring system?	Instructions provided and adequate. A CG provided split key shackle replaced the pear link for connection to the concrete sinker.
Record list of required tools to build system.	
Record the amount of time it takes to build the mooring system.	The mooring system was complete. A CG provided split key shackle replaced the pear link for connection to the concrete sinker. The additional shackles added by the CG took less than 10 minutes. One person can perform.
Record the number of personnel required to build the mooring system.	
Take pictures of complete mooring systems	Documented mooring systems components with pictures.

RDC EFMS Deployment Data Collection Checklist	
Can crew load mooring to deck w/o any additional or abnormal equipment?	The buoy tender crew used forklift to move the mooring system around pier side and required the crane to load onto the buoy deck.
Record if forklift or crane is used to load mooring system.	
Record time to load and the number of personnel required each mooring system.	About 10 minutes to load and requires a crane operator, and at least two crew on the buoy deck to load the mooring system
Do mooring components provide attachment points as necessary?	Yes.
Record the deck space required for the mooring system.	About 30 square feet of buoy deck space is required for the mooring system.
Do mooring components unnecessarily foul working deck?	No. WLM crew attached the mooring system to the buoy and placed on the deck adjacent and under the buoy.
Can existing pad eye arrangement on buoy deck hold components securely for transit?	Yes.
Does storage interfere or unnecessarily complicate normal buoy deck transit load?	No.
Pre-deploy transit	
Do components remain in place without rolling, shifting, sliding?	Yes.
Can vessel work other buoys with mooring on deck?	Yes. Buoy tender worked #6 with 2 8x26 steel hulls, 1 5th class can and mooring hardware on the buoy deck with no need to move them.
Environmental Conditions at Deployment Location	
Record wave height and direction	Calm
Record wind speed and direction	Est. wind 222T, 2kt
Record current	200T, 0.5kt
Record weather	Fair, calm
Deployment	
Concrete Anchor System	
Record position of concrete anchor (latitude, longitude)	27-35-46.458N, 082-55-34.246W
Mooring System Installation	
Does vessel need equipment beyond existing ship's outfit to install mooring system?	No extra equipment. Divers and dive gear are required to connect the mooring system to the concrete sinker.
What tools / special equipment are required for installation?	

RDC EFMS Deployment Data Collection Checklist	
Does vessel need personnel beyond existing ship's complement?	No extra equipment. Divers and dive gear are required to connect the mooring system to the concrete sinker.
List required personnel to install mooring system.	
Record time of mooring system installation commencement.	1132 – relieve 8x26 steel hull, 1200 Temp buoy set
Record time of mooring system installation completion.	1335 – mooring set
If divers are required, record time when divers commence installation.	1200 – mooring set
If divers are required, record time when divers complete installation.	1400 – divers took extra video
Does placing mooring result in any visible disturbance of the bottom?	No
Does deployment technique hazard any deck crew?	No
Record position of buoy (latitude, longitude)	27-35-46.458N, 082-55-34.246W
Post deployment	
Does buoy appear to remain on station?	Yes
Does deployment give any indication that mooring is fouled?	No
Does deployment give any indication that mooring is not upset?	No

A.4 StormSoft Elastic Mooring System (2) Mullet Key Channel Buoy G"25"

StormSoft Elastic Mooring System (#3) Mullet Key Channel Buoy G"25"			
Mooring Component	Component Location	Thickness	Length
10' x 1.25" StormSoft elastic mooring line & Miami Cordage PYB1 polyester double braid rope	Buoy bridle to to concrete anchor		48'
Thimble (Nylon)	StormSoft top end	1.5	8"L x 5W"
Thimble (Nylon)	StormSoft bottom end	1.5	8"L x 5W"
1"CM Forged eye and eye swivel - Dixie	Swivel to mooring line	1"	12"
3rd Class swivel	Bridle to StormSoft	1.5"	12"



		Dimensions (in.)				
		A	C	B	D	P
Mooring Component	Component Location	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	Buoy bridle to swivel	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	Swivel to mooring rope	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	Mooring rope to StormSoft mooring line	1.69	3.75	1.13	1.00	1.00
1" safety bolt shackle	StormSoft mooring line to anchor	1.69	3.75	1.13	1.00	1.00
3rd Class shackle	Buoy bridle to CG swivel	2.25	4.50	1.50	1.50	1.50

Discrepancies / Comments

The 1.25" StormSoft elastic mooring line and the Miami Cordage 1" mooring line was delivered to the Coast Guard already connected and encased in a protective polyester shell.

Shackles and swivels provided with the StormSoft have been wrapped in FiberFix tape on all the wear points.

The length of the combined mooring line is 48'. The shackles and swivel provided adds 2'. The buoy tender crew added a 3rd class swivel and shackle that adds approximately 1' (12" for swivel and 5" for shackle). The depth of the buoy (~3') and length of the bridle (6') adds 9'. The total length of all components is about 60'.

Mullet Key Channel G "25" buoy mooring system components	Length (ft, in)
6X16LFR Buoy depth	3, 0
Bridle	8, 0
3rd Class shackle	0, 5
3rd Class swivel	1, 0
1" Shackle	0, 3
1" Swivel	1, 0
1" Shackle	0, 3
StormSoft line	47, 0
1" Shackle	0, 3
1" Shackle	0, 3
Total Length	60, 5

Helix Anchor System	
Installation Location	**Mullet Key Channel Buoy G"25"**
Latitude (assigned position)	27-36-48.848N
Longitude (assigned position)	082-40-32.320W
Latitude (actual)	27-36-48.984N
Longitude (actual)	082-40-32.916W
Position verified (GPS, other)	GPS MX 420

Mooring Component	Part #	Thickness	Length
Helmken mooring anchor adaptor	**N-6401-0051**	**1.75" x1.75"**	**7.5"**
Helmken/M.P. helical mooring anchor, heavy duty galvanized 1.75"RCSS x 7' 8/10/12	**N-6206-0004**	**1.75" x1.75"**	**7'**
5' Helmken anchor extension, heavy duty galvanized 1.75" RCSS		**1.75" x1.75"**	**59"**
5' Helmken anchor extension, heavy duty galvanized 1.75" RCSS	Not used.	1.75" x1.75"	59"
5' Helmken anchor extension, heavy duty galvanized 1.75" RCSS	Not used.	1.75" x1.75"	59"
3.5' Helmken anchor extension, heavy duty galvanized 1.75" RCSS	Not used.	1.75" x1.75"	3.5'

<u>Discrepancies / Comments</u>

Measurements match the drawings provided.

The Mullet Key Channel Buoy G"25" location had a sand bottom with ledge hit at ~10' below the bottom. The divers installed a 7' lead section, a 5' extension and the mooring anchor adaptor. The top of the mooring adapter is about 6" above the bottom.

RDC EFMS Deployment Data Collection Checklist	
Buoy Name	Mullet Key Channel G “25”
Buoy Location	27-36-48.848N, 082-40-32.320W
Buoy Type	6X16LFR Can
Mooring System	**StormSoft**
Anchor	**Helix**
Bottom Type	Sand
Pre-deploy - loading	
How are mooring systems packaged? Take pictures of packaged systems.	Mooring system is small enough to fit in a 27 gallon plastic tote.
Make copies of bill of lading, packing lists, etc.	No packing list in container. Component list provided by email.
Inventory mooring system components.	All components are connected and accounted for. Documented mooring systems components with pictures.
Are all components included?	
Note condition of components.	
List any missing components.	
Take pictures of components.	
Are installation instructions and diagrams provided? Make copies of installation documents	No installation instruction provided. StormSoft rep was present and confirmed the components and proper installation. Attachment points were marked on thimbles.
Is mooring system completely “made up” and ready for attachment to buoy bridle and anchor? (yes/no)	The mooring systems were complete except for end shackles (not fully tightened) and the stainless steel cotter pins (not bent and covered with heat shrink). This was accomplished pier side before the system was loaded on the buoy tender. The buoy tender crew added a shackle and a swivel to the buoy bridle end.
If buoy systems are not “made up”, are instructions provided to build the system?	No instructions provided.
Are instructions adequate?	
Do installation instructions include a list of required tools to completely build the mooring system?	No instructions provided. AUC technician used standard wrenches to tighten the shackles pliers to bend the cotter pins, and heat shrink applied using a propane torch. CG uses split key shackles that only require hammers to install the split key.
Record list of required tools to build system.	
Record the amount of time it takes to build the mooring system.	The mooring systems were complete except for end shackles (not fully tightened) and the stainless steel cotter pins (not bent and covered with heat shrink). The additional shackles and swivels added by the CG took less than five minutes. One person can perform this and system is light weight and only requires one person to lift and load onto the buoy tender.
Record the number of personnel required to build the mooring system.	
Take pictures of complete mooring systems	Documented mooring systems components with pictures.

RDC EFMS Deployment Data Collection Checklist	
Can crew load mooring to deck w/o any additional or abnormal equipment?	No forklift of crane is required to load the mooring system onto the buoy deck from the pier. Mooring system is light weight and one person can carry.
Record if forklift or crane is used to load mooring system.	
Record time to load and the number of personnel required each mooring system.	One person to load and less than 5 minutes to load.
Do mooring components provide attachment points as necessary?	Yes.
Record the deck space required for the mooring system.	Less than 10 square feet of buoy deck space is required for the mooring system.
Do mooring components unnecessarily foul working deck?	No.
Can existing pad eye arrangement on buoy deck hold components securely for transit?	Yes.
Does storage interfere or unnecessarily complicate normal buoy deck transit load?	No.
Pre-deploy transit	
Do components remain in place without rolling, shifting, sliding?	Yes.
Can vessel work other buoys with mooring on deck?	Yes. Buoy tender worked other buoys with all 5 mooring systems on the buoy deck with no need to move them. Two 8x22 and two 6x16 buoys were on deck at the time.
Environmental Conditions at Deployment Location	
Record wave height and direction	1 ft chop
Record wind speed and direction	12 kt SW
Record current	1 kt ESE
Record weather	Fair
Deployment	
Helix Anchor System	
Does vessel need equipment beyond existing ship's outfit to install Helix anchor?	The divers used a jet probe to check for bedrock under the sand bottom. A diver hydraulic installation tool (drill) with a stabilizing bar secured to the seafloor installs the helix anchor. A power pack consisting of hydraulic pump driven by a 16hp gas engine located on the dive boat powers the drill. Documented the installation equipment with pictures.
What tools / special equipment are required for Helix anchor installation?	
List tools / special equipment (name, model, etc.).	

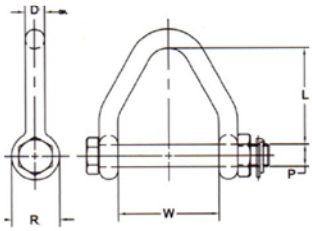
RDC EFMS Deployment Data Collection Checklist	
Take pictures of special equipment required for Helix anchor installation.	
Does vessel need personnel beyond existing ship's complement?	Two divers are required to install the helix anchor.
List required personnel to install Helix anchor.	
Record time when divers enter water to commence installation of Helix anchor.	Divers began at 0918, helix anchors over the side 1016
How is Helix anchor lowered to the sea floor?	By rope individual sections
How is Helix anchor position determined on the sea floor?	The buoy tender placed a small buoy with a pyramid anchor in the correct position using the buoy tenders positioning equipment. Divers installed the helix anchor in close proximity to the pyramid anchor. Divers installed a 7' lead section and a 5' extension. Divers attached the mooring termination head, previously attached to the mooring line and buoy to the helix anchor using the bolt provided.
What equipment is used to determine correct position?	
How is position communicated to divers performing installation?	
How was Helix anchor installation position verified?	
Record Start time of Helix anchor drilling into sea floor.	Unknown
Record End time of Helix anchor drilling into sea floor.	Unknown
Record completion time of Helix anchor installation.	1104
Record position of Helix anchor (latitude, longitude)	27-36-48.868N, 082-40-32.414W
Mooring System Installation	
Does vessel need equipment beyond existing ship's outfit to install mooring system?	No extra equipment. Divers and dive gear are required to connect the mooring system to the helix anchor.
What tools / special equipment are required for installation?	
Does vessel need personnel beyond existing ship's complement?	The regular buoy tender crew connected the buoy mooring system to the buoy bridle. Divers connected the mooring system to the helix anchor.
List required personnel to install mooring system.	
Record time of mooring system installation commencement.	1152
Record time of mooring system installation completion.	1217

RDC EFMS Deployment Data Collection Checklist	
If divers are required, record time when divers commence installation.	0918
If divers are required, record time when divers complete installation.	1217
Does placing mooring result in any visible disturbance of the bottom?	Installation of the helix anchor disturbs the bottom around the location of the anchor where the divers stand on the bottom and where the end of the hydraulic drill head support attaches to the bottom.
Does deployment technique hazard any deck crew?	No
Record position of buoy (latitude, longitude)	27-36-48.868N, 082-40-32.414W
Post deployment	
Does buoy appear to remain on station?	Yes
Does deployment give any indication that mooring is fouled?	No
Does deployment give any indication that mooring is not upset?	No

A.5 Hazelett Marine Mooring System Mullet Key Channel Buoy G"23"

Hazelett Marine Mooring System Mullet Key Channel Buoy G"23"			
Mooring Component	Component Location	Thickness	Length
30ft 5/8" Uniline rope (Yale Cordage)	Buoy bridle to rodes	0.625"	34'
10' x 1.75" Elastic rode	Uniline to anchor	1.75"	10'
10' x 1.75" Elastic rode	Uniline to anchor	1.75"	10'
Trawl Float	Elastic rodes	Installed per plan	
Trawl Float	Elastic rodes		
0.75" Thimble heavy duty hot	Buoy bridle (Uniline)	0.75"	N/A
0.75" Thimble heavy duty hot	Elastic rodes (Uniline)	0.75"	N/A
5/8" Wire rope clip	Uniline	Wire rope clips have been installed properly	
5/8" Wire rope clip	Uniline		
5/8" Wire rope clip	Uniline		
5/8" Wire rope clip	Uniline		
5/8" Wire rope clip	Uniline		
5/8" Wire rope clip	Uniline		
Coast Guard Class 3 swivel	Bridle to Uniline	1.5"	12"

Mooring Component	Component Location	Dimensions (in.) D	P	L	W
1" CM Alloy Web Sling Shackle	Top of elastic rode	1.00	1.00	4.25	5.00
1" CM Alloy Web Sling Shackle	Bottom of elastic rode to anchor	1.00	1.00	4.25	5.00
4th Class shackle	Buoy bridle to CG swivel	2.25	1.00	3.63	2.25
4th Class shackle	1" shackle to anchor	2.25	1.00	3.63	2.25
4th Class shackle	1" shackle to anchor	2.25	1.00	3.63	2.25



Discrepancies / Comments

The combined length of the elastic rodes (10') and Uniline rope (34') is 44'. The 1" swivel and shackles were removed. A Class 3 swivel (12") and two Class 4 shackles (~4") were connected to the thimble on the Uniline and a 4th class shackle (~4") was connected to the sling shackle to connect to the sinker adds 2'. The depth of the buoy (~3') and length of the bridle (6') adds 9'. The total length of all components is about 57'.

Mullet Key Channel G "23" buoy mooring system components	Length (ft, in)
6X16LFR Buoy depth	3, 0
Bridle	8, 0
4th Class shackle	0, 4
3rd Class shackle	1, 0
4th Class shackle	0, 4
Uniline	34, 0
1" CM Alloy Web Sling Shackle	0, 4
Elastic Rodes	10, 0
1" CM Alloy Web Sling Shackle	0, 4
4th Class shackle	0, 4
Total Length	57, 2

RDC EFMS Deployment Data Collection Checklist	
Buoy Name	Mullet Key Channel G “23”
Buoy Location	27-36-39.300N, 082-41-42.738W
Buoy Type	6X16LCFR
Mooring System	**Hazelett Marine**
Anchor	**Concrete**
Bottom Type	Sand
Pre-deploy - loading	
How are mooring systems packaged? Take pictures of packaged systems.	Mooring system is small enough to fit in a 27 gallon plastic tote.
Make copies of bill of lading, packing lists, etc.	No packing list in container. Component list provided by email.
Inventory mooring system components.	All components accounted for and fully assembled except for the shackle from the Uniline rope to the elastic rodes. All were in good condition. Documented mooring systems components with pictures.
Are all components included?	
Note condition of components.	
List any missing components.	
Take pictures of components.	
Are installation instructions and diagrams provided? Make copies of installation documents	No installation instruction provided. Hazelett Marine representative provided information on proper installation with the float end of the elastic rodes going to the anchor.
Is mooring system completely “made up” and ready for attachment to buoy bridle and anchor? (yes/no)	The mooring system was complete except for the shackles were loose and the sling shackle from the Uniline to the elastic rodes required installation.
If buoy systems are not “made up”, are instructions provided to build the system?	No instructions provided.
Are instructions adequate?	
Do installation instructions include a list of required tools to completely build the mooring system?	No instructions provided. WLM crew used standard wrenches to tighten the shackles. CG uses split key shackles that only require hammers to install the split key.
Record list of required tools to build system.	
Record the amount of time it takes to build the mooring system.	The mooring system was complete except for installing the sling shackle, tightening the shackle bolts and securing the safety clips which took less than 10 minutes. A decision to remove the 1" shackles and swivel and use a CG provided swivel and shackles due to concern about the small size of the swivel. The additional shackles and swivels added by the CG took less than 10 minutes. One person can perform this and system is light weight and only requires one person to lift and load onto the buoy tender.
Record the number of personnel required to build the mooring system.	

RDC EFMS Deployment Data Collection Checklist	
Take pictures of complete mooring systems	Documented mooring systems components with pictures.
Can crew load mooring to deck w/o any additional or abnormal equipment?	No forklift of crane is required to load the mooring system onto the buoy deck from the pier. Mooring system is light weight and one person can carry.
Record if forklift or crane is used to load mooring system.	
Record time to load and the number of personnel required each mooring system.	One person to load and less than 5 minutes to load.
Do mooring components provide attachment points as necessary?	Yes.
Record the deck space required for the mooring system.	Less than 10 square feet of buoy deck space is required for the mooring system.
Do mooring components unnecessarily foul working deck?	No.
Can existing pad eye arrangement on buoy deck hold components securely for transit?	Yes.
Does storage interfere or unnecessarily complicate normal buoy deck transit load?	No.
Pre-deploy transit	
Do components remain in place without rolling, shifting, sliding?	Yes.
Can vessel work other buoys with mooring on deck?	Yes. Buoy tender worked other buoys with all 5 mooring systems on the buoy deck with no need to move them. Two 8X22 and two 6X16 buoys were on deck at the time.
Environmental Conditions at Deployment Location	
Record wave height and direction	1 ft chop
Record wind speed and direction	Est. wind 160T, 7kt variable to 12kt SSW
Record current	260T, 1kt
Record weather	fair
Deployment	
Concrete Anchor System	
Record position of concrete anchor (latitude, longitude)	27-36-39.277N, 082-41-42.609W
Mooring System Installation	
Does vessel need equipment beyond existing ship's outfit to install mooring system?	No extra equipment. Divers and dive gear are required to connect the mooring system to the concrete sinker.

RDC EFMS Deployment Data Collection Checklist	
What tools / special equipment are required for installation?	
Does vessel need personnel beyond existing ship's complement?	The regular buoy tender crew connected the buoy mooring system to the buoy bridle. Divers connected the mooring system to the concrete sinker.
List required personnel to install mooring system.	
Record time of mooring system installation commencement.	1300
Record time of mooring system installation completion.	1500
If divers are required, record time when divers commence installation.	1315
If divers are required, record time when divers complete installation.	1448
Does placing mooring result in any visible disturbance of the bottom?	No
Does deployment technique hazard any deck crew?	No
Record position of buoy (latitude, longitude)	27-36-39.277N, 082-41-42.609W
Post deployment	
Does buoy appear to remain on station?	Yes
Does deployment give any indication that mooring is fouled?	No
Does deployment give any indication that mooring is not upset?	No

A.6 Divers Interview Questions

Question	Response
What tools did you use to install the helix anchor?	Hydraulic Power Pack (2000-2500PSI, 8-9 GPM), with 100FT of hydraulic hose (1/2in ID) and Torque Motor.
Where the tools difficult to use?	No.
Did you have any issues with the tools?	No.
What communication equipment did you use, if any?	N/A
Where there any issues with the communications?	N/A
Describe the seabed conditions e.g. bottom type (mud, sand, or rock) general health of the seabed, scouring, current)	Most sites were sand/gravel, last site (6) was hard gravel/rock-video will show these conditions
How did you determine the correct position to install the helix anchor on the sea bottom?	Used a Jet Pump 2in necked down to 3/4in pipe (10ft long)
Did have any issues assembling the parts of the helix anchor?	No
Did you have any issues performing the installation?	No.
How much time did it take to install the helix anchor?	Once the site was selected, equipment lowered – 30 minutes **This does not include USCG buoy removal, deployment of small buoy, setting 3PT anchor system, jetting, and removal of equipment, p/u new buoy, towing into position and securing buoy/line assembly.
Did you have any issues connecting the Superflex buoy mooring system to the concrete anchor?	Used a 200 lb lift bag to assist in lifting the anchor chain onto the concrete sinker to make the connection to the sinker.
Did you have any issues connecting the StormSoft buoy mooring system to the helix anchor?	No.
Did you have any issues connecting the Hazelett Marine buoy mooring system to the concrete anchor?	No, though you need a strong person to stretch this to connect to anchor
Any other issues or thoughts on the installation process?	SEE Shoreline report “USCG Notes”

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APPENDIX B. AID POSITIONING RECORDS

This appendix contains the Aid Positioning Records from the USCGC JOSHUA APPLEBY WLM-566 for deployment of the EFBMS at the following buoys:

- Mullet Key Channel G “23”
- Mullet Key Channel G “25”
- Egmont Channel R “4”
- Egmont Channel R “6”
- Egmont Channel G “5”

DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	**Mullet Key Channel Lighted Buoy 23**	AID NUMBER	**200100021003**
LATITUDE	**27-36-39.300N**	LLNR	**22375**
LONGITUDE	**082-41-42.738W**	AID SUB TYPE	**Floating**
CHART NUMBER	**11416**	CHART EDITION	**13**
		CHART PANEL	**CHART**

FOUND GPS MEASUREMENTS - ANTENNA POSITION [27-36-39.450N, 082-41-42.036W]

```
$GPGGA,164725.00,2736.6575,N,08241.7006,W,2,10,00.8,20.7,M,-27.3,M,05.0,0245*4E
$GPGRS,164725.00,1,00.0,01.0,00.0,01.0,00.0,00.0,00.0,00.0,00.0,00.0,,*4D
$GPGSA,A,3,03,08,09,14,16,22,23,26,27,31,,,01.6,00.8,01.3*0D
$GPGST,164725.00,000.5,000.3,000.2,065.1,000.3,000.3,000.6*54
$GPVHW,226.3,T,232.2,M,00.00,N,00.00,K*46
$GPVTG,164.0,T,169.9,M,00.12,N,00.22,K,D*21
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
```

SET GPS MEASUREMENTS - ANTENNA POSITION [27-36-39.480N, 082-41-42.126W]

```
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$GPGRS,165121.00,1,00.0,00.0,00.0,,00.0,00.0,00.0,00.0,00.0,00.0,,*50
$GPGSA,A,3,03,08,09,,16,22,23,26,27,31,,,01.7,00.9,01.4*0F
$GPGST,165120.00,000.3,000.2,000.2,067.2,000.2,000.2,000.4*52
$GPVHW,227.8,T,233.7,M,00.00,N,00.00,K*48
$GPVTG,171.3,T,177.2,M,00.32,N,00.59,K,D*2C
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
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	FOUND DATA USING GPS		**SET DATA USING GPS**
DATE/TIME	**4/3/2018 12:47:26 PM**	DATE/TIME	**4/3/2018 12:51:21 PM**
UNIT	**CGC JOSHUA APPLEBY**	UNIT	**CGC JOSHUA APPLEBY**
VESSEL	**175' WLM/556**	VESSEL	**175' WLM/556**
GPS TYPE	**MX420**	GPS TYPE	**MX420**
GPS SERIAL	**00805846**	GPS SERIAL	**00805846**
GPS DATUM	**W84**	GPS DATUM	**W84**
MEASURED DEPTH	**30ft**	MEASURED DEPTH	**30ft**
TIDE CORRECTION	**0ft**	TIDE CORRECTION	**0ft**
DRAFT	**8ft**	DRAFT	**8ft**
DATUM	**38ft**	DATUM	**38ft**
EST. WIND	**160T 7kt**	EST. WIND	**160T 7kt**
EST. CURRENT	**260T 1kt**	EST. CURRENT	**260T 1kt**
HEADING	**226T**	HEADING	**228T**
BUOY PORT	**FWD STBD**	BUOY PORT	**FWD STBD**
SHORT STAY	**Y**	SHORT STAY	**Y**
EXCURSION	**000T 0yds**	EXCURSION	**000T 0yds**
MPP LATITUDE	**27-36-39.277N**	MPP LATITUDE	**27-36-39.321N**
MPP LONGITUDE	**082-41-42.609W**	MPP LONGITUDE	**082-41-42.704W**
AP TO MPP	**101T 3.9yds**	AP TO MPP	**056T 1.2yds**
2DRMS	**0.85yds**	2DRMS	**0.57yds**
POS. TOLERANCE	**15yds**	POS. TOLERANCE	**15yds**
FOUND STATION	**ON**	SET STATION	**ON**

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	**Mullet Key Channel Lighted Buoy 23**	AID NUMBER	**200100021003**
LATITUDE	**27-36-39.300N**	LLNR	**22375**
LONGITUDE	**082-41-42.738W**	AID SUB TYPE	**Floating**
CHART NUMBER	**11416**	CHART EDITION	**13**
		CHART PANEL	**CHART**

REMARKS

03APR18: RFV PROTOTYPE MOORING INSTALL. AID FWP. ATTACHED PROTOTYPE HULL NR 6X16 LCFR 12-02-GC WITH 46 FEET OF HAZELETT MARINE MOORING SYSTEM TO EXISTING CONCRETE SINKER, ON AP. 100 FEET OF 1 1/4 INCH CHAIN REMAIN ON THE BOTTOM OF THE SEA FLOOR, ATTACHED TO CONCRETE SINKER. VERIFIED CARMANAH 850 BATT NR 07-023754. ADJUSTED AID INSPECTION AND MOORING SIF TO 24 MOS TO REFLECT PROJECT TIMELINE PARAMETERS. REQUEST UPDATE TO USAIMS, VERIFIED LL, CP AND CHARTS. LWP.

PREPARED BY (SIGNATURE) _____ DATE _____

CO/OINC (SIGNATURE) _____ DATE _____

DISTRICT REVIEW (SIGNATURE) _____ DATE _____

COMMENTS

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	**Mullet Key Channel Lighted Buoy 25**	AID NUMBER	**200100021007**
LATITUDE	**27-36-48.848N**	LLNR	**22390**
LONGITUDE	**082-40-32.320W**	AID SUB TYPE	**Floating**
CHART NUMBER	**11415**	CHART EDITION	**12**
		CHART PANEL	**CHART**

FOUND GPS MEASUREMENTS - ANTENNA POSITION [27-36-49.002N, 082-40-33.000W]

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$GPGRS,124753.00,1,00.0,00.0,,00.0,00.0,00.0,,,00.0,00.0,00.0,00.0*56
$GPGSA,A,3,01,10,,12,14,18,,,25,26,31,32,01.5,00.9,01.2*03
$GPGST,124753.00,000.3,000.2,000.2,035.4,000.2,000.2,000.4*54
$GPVHW,079.4,T,085.3,M,00.00,N,00.00,K*46
$GPVTG,336.7,T,342.6,M,00.07,N,00.13,K,D*21
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
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SET GPS MEASUREMENTS - ANTENNA POSITION [27-36-48.984N, 082-40-32.916W]

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$GPGRS,125439.00,1,,00.0,,00.0,00.0,00.0,00.0,00.0,00.0,00.0,00.0,*58
$GPGSA,A,3,,10,,12,14,18,22,25,26,31,32,,01.5,00.9,01.2*02
$GPGST,125438.00,000.5,000.3,000.3,035.8,000.3,000.3,000.5*50
$GPVHW,080.0,T,085.9,M,00.00,N,00.00,K*4E
$GPVTG,014.9,T,020.8,M,00.07,N,00.14,K,D*22
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
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	FOUND DATA USING GPS		SET DATA USING GPS
DATE/TIME	**4/3/2018 8:47:54 AM**	DATE/TIME	**4/3/2018 8:54:39 AM**
UNIT	**CGC JOSHUA APPLEBY**	UNIT	**CGC JOSHUA APPLEBY**
VESSEL	**175' WLM/556**	VESSEL	**175' WLM/556**
GPS TYPE	**MX420**	GPS TYPE	**MX420**
GPS SERIAL	**00805846**	GPS SERIAL	**00805846**
GPS DATUM	**W84**	GPS DATUM	**W84**
MEASURED DEPTH	**33ft**	MEASURED DEPTH	**33ft**
TIDE CORRECTION	**0ft**	TIDE CORRECTION	**0ft**
DRAFT	**8ft**	DRAFT	**8ft**
DATUM	**41ft**	DATUM	**41ft**
EST. WIND	**000T 0kt**	EST. WIND	**000T 0kt**
EST. CURRENT	**000T 0kt**	EST. CURRENT	**000T 0kt**
HEADING	**079T**	HEADING	**080T**
BUOY PORT	**FWD STBD**	BUOY PORT	**FWD STBD**
SHORT STAY	**Y**	SHORT STAY	**Y**
EXCURSION	**000T 0yds**	EXCURSION	**000T 0yds**
MPP LATITUDE	**27-36-48.868N**	MPP LATITUDE	**27-36-48.845N**
MPP LONGITUDE	**082-40-32.414W**	MPP LONGITUDE	**082-40-32.332W**
AP TO MPP	**283T 2.9yds**	AP TO MPP	**251T 0.4yds**
2DRMS	**0.57yds**	2DRMS	**0.85yds**
POS. TOLERANCE	**15yds**	POS. TOLERANCE	**15yds**
FOUND STATION	**ON**	SET STATION	**ON**

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	**Mullet Key Channel Lighted Buoy 25**	AID NUMBER	**200100021007**
LATITUDE	**27-36-48.848N**	LLNR	**22390**
LONGITUDE	**082-40-32.320W**	AID SUB TYPE	**Floating**
CHART NUMBER	**11415**	CHART EDITION	**12**
		CHART PANEL	**CHART**

REMARKS

03APR2018: RFV PROTOTYPE MOORING INSTALL. AID FWP. VERIFIED NEW PROTOTYPE HULL NR 06X16LFR 12-01-GC. VERIFIED CARMANAH M850 BATT NR 07-023494. RECOVERED CHAIN AND CONCRETE SINKER MOORING. SET HELIX ANCHOR SYSTEM ALONG WITH 51 FEET OF STORMSOFT MOORING ON AP. ADJUSTED AID INSPECTION AND MOORING SIF TO 24 MOS TO REFLECT PROJECT TIMELINE PARAMETERS. REQUEST UPDATE TO USAIMS, VERIFIED CHARTS, LL, AND CP.

PREPARED BY (SIGNATURE) _____ DATE _____

CO/OINC (SIGNATURE) _____ DATE _____

DISTRICT REVIEW (SIGNATURE) _____ DATE _____

COMMENTS

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	**Egmont Channel Lighted Buoy 4**	AID NUMBER	**200100021105**
LATITUDE	**27-35-37.112N**	LLNR	**22245**
LONGITUDE	**082-57-10.915W**	AID SUB TYPE	**Floating**
CHART NUMBER	**11415**	CHART EDITION	**12**
		CHART PANEL	**CHART**

FOUND GPS MEASUREMENTS - ANTENNA POSITION [27-35-37.482N, 082-57-10.452W]

```
$GPGGA,130453.00,2735.6247,N,08257.1742,W,2,09,00.9,19.9,M,-27.1,M,06.0,0245*42
$GPGRS,130453.00,1,00.0,00.0,,00.0,00.0,00.0,,00.0,00.0,00.0,00.0,*50
$GPGSA,A,3,01,10,,12,14,18,,25,26,31,32,,01.6,00.9,01.3*01
$GPGST,130452.00,000.3,000.2,000.2,026.7,000.2,000.2,000.4*52
$GPVHW,202.7,T,208.4,M,00.00,N,00.00,K*4B
$GPVTG,241.0,T,246.7,M,00.09,N,00.17,K,D*29
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
```

SET GPS MEASUREMENTS - ANTENNA POSITION [27-35-36.600N, 082-57-11.184W]

```
$GPGGA,203006.00,2735.6100,N,08257.1864,W,2,08,01.2,18.6,M,-27.1,M,05.0,0244*49
$GPGRS,203005.00,1,00.0,00.0,,00.0,00.0,00.0,00.0,00.0,,,00.0,*4A
$GPGSA,A,3,02,05,,13,15,18,20,21,,,29,,02.0,01.2,01.5*05
$GPGST,203005.00,000.3,000.3,000.2,002.2,000.3,000.2,000.5*55
$GPVHW,000.1,T,005.6,M,00.00,N,00.00,K*40
$GPVTG,207.7,T,213.2,M,00.35,N,00.65,K,D*23
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
```

	FOUND DATA USING GPS		**SET DATA USING GPS**
DATE/TIME	**4/4/2018 9:04:53 AM**	DATE/TIME	**9/15/2017 4:30:05 PM**
UNIT	**CGC JOSHUA APPLEBY**	UNIT	**CGC JOSHUA APPLEBY**
VESSEL	**175' WLM/556**	VESSEL	**175' WLM/556**
GPS TYPE	**MX420**	GPS TYPE	**MX420**
GPS SERIAL	**00805846**	GPS SERIAL	**00805846**
GPS DATUM	**W84**	GPS DATUM	**W84**
MEASURED DEPTH	**40ft**	MEASURED DEPTH	**36.6ft**
TIDE CORRECTION	**-1ft**	TIDE CORRECTION	**1ft**
DRAFT	**8ft**	DRAFT	**8ft**
DATUM	**49ft**	DATUM	**43.6ft**
EST. WIND	**080T 2kt**	EST. WIND	**082T 2kt**
EST. CURRENT	**200T 0.5kt**	EST. CURRENT	**100T 0.3kt**
HEADING	**203T**	HEADING	**000T**
BUOY PORT	**FWD STBD**	BUOY PORT	**FWD STBD**
SHORT STAY	**Y**	SHORT STAY	**Y**
EXCURSION	**000T 0yds**	EXCURSION	**000T 0yds**
MPP LATITUDE	**27-35-37.119N**	MPP LATITUDE	**27-35-37.088N**
MPP LONGITUDE	**082-57-10.899W**	MPP LONGITUDE	**082-57-10.927W**
AP TO MPP	**062T 0.5yds**	AP TO MPP	**205T 0.9yds**
2DRMS	**0.57yds**	2DRMS	**0.72yds**
POS. TOLERANCE	**15yds**	POS. TOLERANCE	**15yds**
FOUND STATION	**ON**	SET STATION	**ON**

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME **Egmont Channel Lighted Buoy 4**
LATITUDE **27-35-37.112N**
LONGITUDE **082-57-10.915W**
CHART NUMBER **11415**

AID NUMBER **200100021105**
LLNR **22245**
AID SUB TYPE **Floating**
CHART EDITION **12**
CHART PANEL **CHART**

REMARKS

04APR18: RFV PROTOTYPE MOORING INSTALL. AID FWP. ATTACHED PROTOTYPE HULL NR 8X22LNFR-12-04-GC WITH 51 FEET OF STORMSOFT MOORING SYSTEM TO EXISTING CONCRETE SINKER, ON AP. 115 FEET OF 1 1/2 INCH CHAIN REMAIN ON THE BOTTOM OF THE SEA FLOOR, ATTACHED TO CONCRETE SINKER. VERIFIED AND RECOVERED VEGA VLB-67 BATT NR 07-021041. INSTALLED NEW CARMANAH M860 BATT NR 07-026423. ADJUSTED AID INSPECTION AND MOORING SIF TO 24 MOS TO REFLECT PROJECT TIMELINE PARAMETERS. REQUEST UPDATE TO USAIMS, VERIFIED LL, CP AND CHARTS. LWP.

PREPARED BY (SIGNATURE) _____ DATE _____

CO/OINC (SIGNATURE) _____ DATE _____

DISTRICT REVIEW (SIGNATURE) _____ DATE _____

COMMENTS

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	**Egmont Channel Lighted Buoy 5**	AID NUMBER	**200100021108**
LATITUDE	**27-35-53.907N**	LLNR	**22250**
LONGITUDE	**082-55-34.241W**	AID SUB TYPE	**Floating**
CHART NUMBER	**11415**	CHART EDITION	**12**
		CHART PANEL	**CHART**

FOUND GPS MEASUREMENTS - ANTENNA POSITION [27-35-54.324N, 082-55-34.656W]

```
$GPGGA,141722.00,2735.9054,N,08255.5776,W,2,10,00.9,19.9,M,-27.1,M,08.0,0245*49
$GPGRS,141722.00,1,00.0,00.0,00.0,00.0,,00.0,00.0,00.0,00.0,,00.0,00.0*4D
$GPGSA,A,3,01,03,10,14,,18,22,25,26,,31,32,01.8,00.9,01.6*0A
$GPGST,141722.00,000.3,000.2,000.2,047.8,000.2,000.2,000.5*59
$GPVHW,115.3,T,121.0,M,00.00,N,00.00,K*46
$GPVTG,041.7,T,047.4,M,00.04,N,00.08,K,D*2F
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
```

SET GPS MEASUREMENTS - ANTENNA POSITION [27-35-53.712N, 082-55-34.848W]

```
$GPGGA,155220.00,2735.8952,N,08255.5808,W,2,09,01.0,19.6,M,-27.1,M,06.0,0244*43
$GPGRS,155220.00,1,00.0,00.0,,03.0,00.0,00.0,00.0,00.0,00.0,,00.0,00.0*4C
$GPGSA,A,3,02,05,,12,13,15,18,20,21,,25,29,01.6,01.0,01.3*00
$GPGST,155220.00,000.4,000.3,000.3,031.8,000.3,000.3,000.6*5E
$GPVHW,047.7,T,053.3,M,00.00,N,00.00,K*43
$GPVTG,342.8,T,348.3,M,00.16,N,00.31,K,D*22
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
```

	FOUND DATA USING GPS		**SET DATA USING GPS**
DATE/TIME	**4/4/2018 10:17:23 AM**	DATE/TIME	**11/17/2017 10:52:21 AM**
UNIT	**CGC JOSHUA APPLEBY**	UNIT	**CGC JOSHUA APPLEBY**
VESSEL	**175' WLM/556**	VESSEL	**175' WLM/556**
GPS TYPE	**MX420**	GPS TYPE	**MX420**
GPS SERIAL	**00805846**	GPS SERIAL	**00805846**
GPS DATUM	**W84**	GPS DATUM	**W84**
MEASURED DEPTH	**40ft**	MEASURED DEPTH	**42ft**
TIDE CORRECTION	**-1ft**	TIDE CORRECTION	**0ft**
DRAFT	**8ft**	DRAFT	**8ft**
DATUM	**49ft**	DATUM	**50ft**
EST. WIND	**074T 2kt**	EST. WIND	**040T 15kt**
EST. CURRENT	**200T 0.5kt**	EST. CURRENT	**000T 0kt**
HEADING	**115T**	HEADING	**048T**
BUOY PORT	**FWD STBD**	BUOY PORT	**FWD STBD**
SHORT STAY	**Y**	SHORT STAY	**Y**
EXCURSION	**000T 0yds**	EXCURSION	**000T 0yds**
MPP LATITUDE	**27-35-53.909N**	MPP LATITUDE	**27-35-53.872N**
MPP LONGITUDE	**082-55-34.270W**	MPP LONGITUDE	**082-55-34.270W**
AP TO MPP	**275T 0.9yds**	AP TO MPP	**217T 1.5yds**
2DRMS	**0.57yds**	2DRMS	**0.85yds**
POS. TOLERANCE	**15yds**	POS. TOLERANCE	**15yds**
FOUND STATION	**ON**	SET STATION	**ON**

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	**Egmont Channel Lighted Buoy 5**	AID NUMBER	**200100021108**
LATITUDE	**27-35-53.907N**	LLNR	**22250**
LONGITUDE	**082-55-34.241W**	AID SUB TYPE	**Floating**
CHART NUMBER	**11415**	CHART EDITION	**12**
		CHART PANEL	**CHART**

REMARKS

04APR18: RFV PROTOTYPE MOORING INSTALL. AID FWP. ATTACHED PROTOTYPE HULL NR 8X22LCFR-12-01-GC WITH 45 FEET OF STORMSOFT MOORING SYSTEM TO EXISTING CONCRETE SINKER WITH ADDITIONAL 9FT OF CHAIN BELOW THE BRIDLE, ON AP. 101 FEET OF 1 1/2 INCH CHAIN REMAIN ON THE BOTTOM OF THE SEA FLOOR, ATTACHED TO CONCRETE SINKER. VERIFIED CARMANAH M850 BATT NR 07-023491. ADJUSTED AID INSPECTION AND MOORING SIF TO 24 MOS TO REFLECT PROJECT TIMELINE PARAMETERS. REQUEST UPDATE TO USAIMS, VERIFIED LL, CP AND CHARTS. LWP.

PREPARED BY (SIGNATURE) _____ DATE _____

CO/OINC (SIGNATURE) _____ DATE _____

DISTRICT REVIEW (SIGNATURE) _____ DATE _____

COMMENTS

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME	Egmont Channel Lighted Buoy 6	AID NUMBER	200100021111
LATITUDE	27-35-46.466N	LLNR	22255
LONGITUDE	082-55-34.256W	AID SUB TYPE	Floating
CHART NUMBER	11415	CHART EDITION	12
		CHART PANEL	CHART

FOUND GPS MEASUREMENTS - ANTENNA POSITION [27-35-46.872N, 082-55-33.858W]

```
$GPGGA,154638.00,2735.7812,N,08255.5643,W,2,09,01.0,20.2,M,-27.1,M,06.0,0245*4B
$GPGRS,154637.00,1,00.0,00.0,00.0,00.0,,00.0,00.0,00.0,00.0,00.0,,*52
$GPGSA,A,3,03,14,16,22,,26,27,29,31,32,,,01.7,01.0,01.4*08
$GPGST,154637.00,000.4,000.2,000.2,024.2,000.2,000.2,000.5*50
$GPVHW,194.9,T,200.6,M,00.00,N,00.00,K*43
$GPVTG,078.9,T,084.6,M,00.18,N,00.34,K,D*24
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
```

SET GPS MEASUREMENTS - ANTENNA POSITION [27-35-46.896N, 082-55-33.882W]

```
$GPGGA,154658.00,2735.7816,N,08255.5647,W,2,09,01.0,20.3,M,-27.1,M,05.0,0245*4F
$GPGRS,154657.00,1,00.0,00.0,00.0,00.0,,00.0,00.0,00.0,00.0,00.0,,*54
$GPGSA,A,3,03,14,16,22,,26,27,29,31,32,,,01.7,01.0,01.4*08
$GPGST,154657.00,000.4,000.3,000.2,313.9,000.3,000.3,000.5*5B
$GPVHW,194.6,T,200.3,M,00.00,N,00.00,K*49
$GPVTG,051.3,T,057.0,M,00.05,N,00.09,K,D*2F
$GPDTM,W84,,0000.0000,N,00000.0000,E,,W84*71
```

	FOUND DATA USING GPS		SET DATA USING GPS
DATE/TIME	4/4/2018 11:46:38 AM	DATE/TIME	4/4/2018 11:46:58 AM
UNIT	CGC JOSHUA APPLEBY	UNIT	CGC JOSHUA APPLEBY
VESSEL	175' WLM/556	VESSEL	175' WLM/556
GPS TYPE	MX420	GPS TYPE	MX420
GPS SERIAL	00805846	GPS SERIAL	00805846
GPS DATUM	W84	GPS DATUM	W84
MEASURED DEPTH	41ft	MEASURED DEPTH	41ft
TIDE CORRECTION	-1ft	TIDE CORRECTION	-1ft
DRAFT	8ft	DRAFT	8ft
DATUM	50ft	DATUM	50ft
EST. WIND	222T 2kt	EST. WIND	222T 2kt
EST. CURRENT	200T 0.5kt	EST. CURRENT	200T 0.5kt
HEADING	195T	HEADING	195T
BUOY PORT	FWD STBD	BUOY PORT	FWD STBD
SHORT STAY	Y	SHORT STAY	Y
EXCURSION	000T 0yds	EXCURSION	000T 0yds
MPP LATITUDE	27-35-46.458N	MPP LATITUDE	27-35-46.481N
MPP LONGITUDE	082-55-34.246W	MPP LONGITUDE	082-55-34.268W
AP TO MPP	130T 0.4yds	AP TO MPP	325T 0.6yds
2DRMS	0.57yds	2DRMS	0.85yds
POS. TOLERANCE	15yds	POS. TOLERANCE	15yds
FOUND STATION	ON	SET STATION	ON

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DEPARTMENT OF HOMELAND SECURITY
U.S. COAST GUARD

AID POSITIONING RECORD

AID NAME **Egmont Channel Lighted Buoy 6**
LATITUDE **27-35-46.466N**
LONGITUDE **082-55-34.256W**
CHART NUMBER **11415**

AID NUMBER **200100021111**
LLNR **22255**
AID SUB TYPE **Floating**
CHART EDITION **12**
CHART PANEL **CHART**

REMARKS

RFV PROTOTYPE MOORING INSTALL. AID FWP. RECOVERED 8X26LR 8-97-11-UM. ATTACHED PROTOTYPE HULL NR 8X22LNFR-17-01-GC WITH 74 FEET OF SUPFLEX MOORING SYSTEM TO EXISTING CONCRETE SINKER, ON AP. 120 FEET OF 1 1/2 INCH CHAIN REMAIN ON THE BOTTOM OF THE SEA FLOOR, ATTACHED TO CONCRETE SINKER. VERIFIED AND TRANSFERRED CARMANAH M850 BATT NR 07-026401 TO NEW HULL. ADJUSTED AID INSPECTION AND MOORING SIF TO 24 MOS TO REFLECT PROJECT TIMELINE PARAMETERS. REQUEST UPDATE TO USAIMS, VERIFIED LL, CP AND CHARTS. LWP.

PREPARED BY (SIGNATURE) _____ DATE _____

CO/OINC (SIGNATURE) _____ DATE _____

DISTRICT REVIEW (SIGNATURE) _____ DATE _____

COMMENTS

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