Hawaii National Marine Renewable Energy Center (HINMREC)

U.S. Department of Energy Award Number: DE-FG36-08GO18180

Task 4: Environmental Impact Monitoring at WETS

Sediment Transport Analysis Reports, 3A-3D

Prepared by:
Sea Engineering, Inc.

Prepared for:
Hawaii Natural Energy Institute, University of Hawaii

2014 - 2017

HNEI
Hawai'i Natural Energy Institute
University of Hawai'i at Mānoa

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalanianaole Hwy.
Waimanalo, Hawaii 96795-1820
Ph: (808) 259-7966 Fax: (808) 259-8143
Email: sei@seaengineering.com
Website: www.seaengineering.com

FIELD REPORT

DATE:	December 1, 2014	
TO:	Luis Vega	
FROM:	Tor Harris	
SUBJECT:	WETS Task 3A Sediment Transport Analysis	

Date: October 29, 2014

Locations & Activity: 80 meter and 60 meter anchor location sediment transport deployment

Crew: Tor Harris, Andrew Rocheleau, Patrick Anderson, Ryan Wagner, Kyle Myers

Sediment Staff Configuration:
The sediment staffs consist of a fiberglass grate base 2 x 2 ft in dimensions, supporting a raised aluminum cross bar extending 2 feet to either side of the grate, with 4 thin aluminum rods welded vertically downward from the cross bar. The rods are located at the end of the cross bar (2 feet outside of the grate base), and 1 foot inside of the end of the cross bar (1 foot outside of the grate base). The end rods extend 3 inches below the grate base, and thus, when the grate is initially placed on the seafloor, the rods penetrate 3 inches into the sediment, allowing measurement of any variation in sediment level. The inner rods extend level with the grate base, and thus, when the grate is initially placed on the seafloor, the tips of the inner rods should be approximately at sediment level. The rods are marked in centimeter graduations. Figure 1 illustrates a sediment staff grate. Two sediment staff grates have been fabricated.

Two scour measurement cylinders have been also been fabricated. These consist of thin walled sheet metal cylinders approximately 12" in diameter, and 16" high. The cylinders are partially filled with concrete from 4" to 10" from the bottom of the cylinder. When placed on the seafloor, the cylinders will sink into the sediment to the level of the concrete, and will allow observation of scour. The cylinder is marked in centimeter graduations. Figure 2 is a photograph of the scour cylinder prior to deployment.

Deployment
SEI deployed the sediment staff grates and scour cylinders on October 29, 2014. One grate and cylinder were deployed just east of anchor base A. The coordinates for the location of the sediment transport equipment was: 281569.16 E, 2375053.87 N (UTM Zone 4, meters). The second grate and cylinder were deployed just east of anchor base B. The coordinates for the location of the sediment transport equipment was: 280816.19 E, 2375531.32 N (UTM Zone 4, meters). Figures 3 - 6 present ROV video frame grab images of the grates and cylinders resting on the seafloor following deployment.

Measurement

As the sediment transport will be monitored by ROV video feed, the operators will need to count the graduated markings on all instruments by counting downward from the top. This is due to the fact that the staffs or scour piles will be partially buried in the sand, so the bottom will not be visible. Markings were made every one centimeter with a highlight above every fifth centimeter.

Sediment Staffs (Outside Staffs): On the outside two sediment staffs, from the top down, the first black line represents the 0cm mark, and has seven highlights: between 4-5cm, 9-10cm, 14-15cm, 19-20cm, 24-25cm, 29-30cm 34-35cm, and an additional half highlight from 39-39.5cm. The total length of the outside staffs is 39.5cm.

Sediment Staffs (Inside Staffs): On the inside two sediment staffs, from the top down, the first black line represents the 0cm mark, and has six highlights: between 4-5cm, 9-10cm, 14-15cm, 19-20cm, 24-25cm, and 29-30cm. The total length of the inside staffs are 30.5cm.

Scour Cylinders: Both scour cylinders are marked every centimeter with a black line, have a highlight every 5cm and have a total height of approximately 44.5cm.

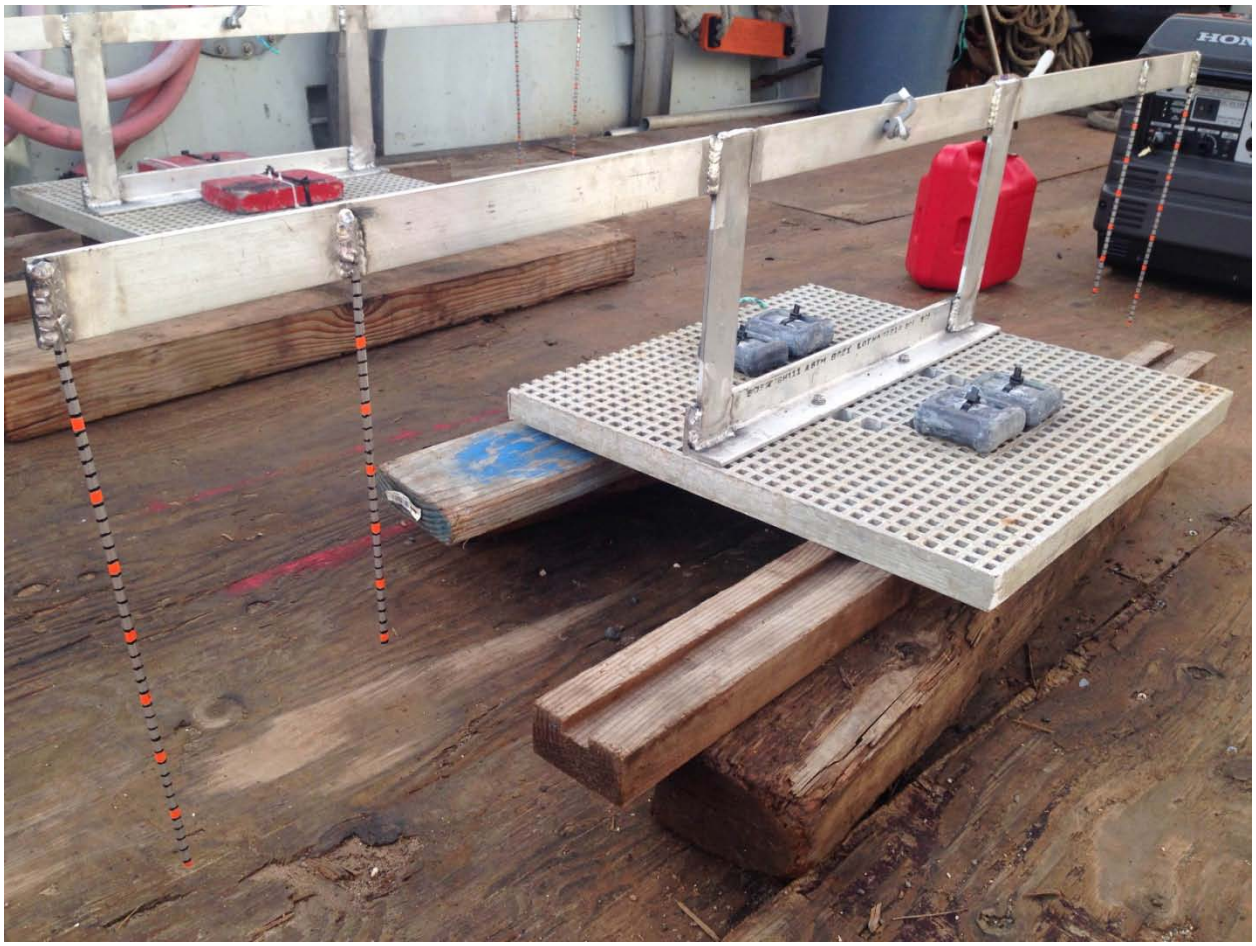

Figure 1. Sediment staff grate

Figure 2. Scour cylinder

Figure 3. Scour pile deployed at anchor base B

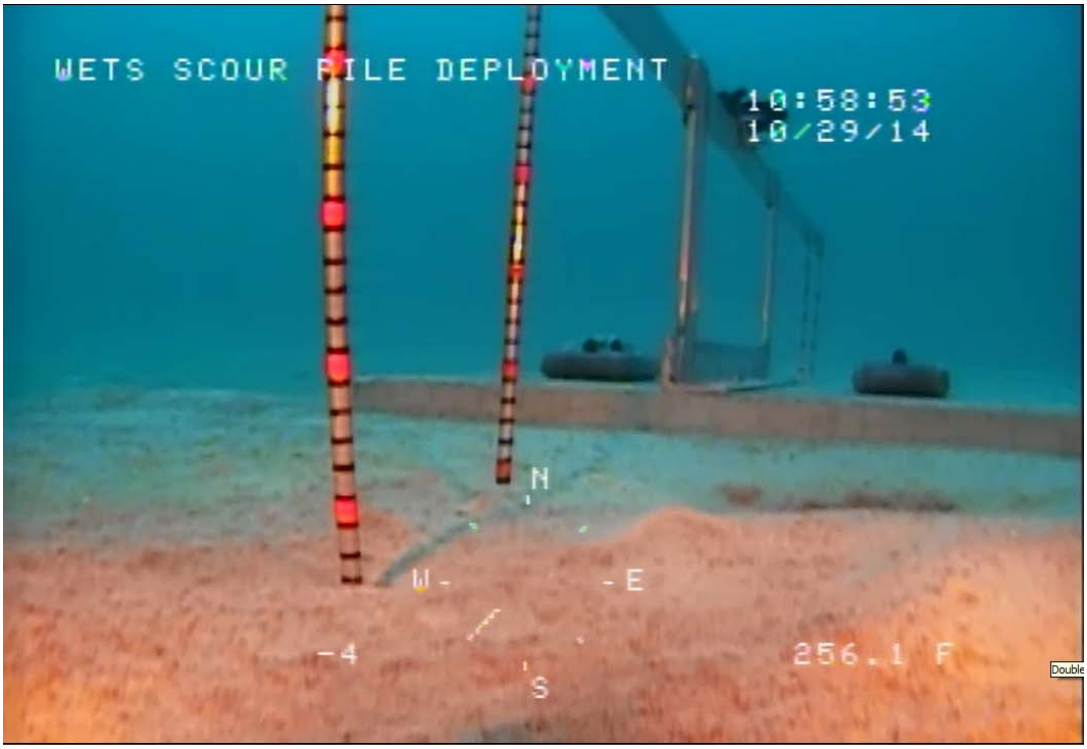

Figure 4. Sediment staffs deployed at anchor base B

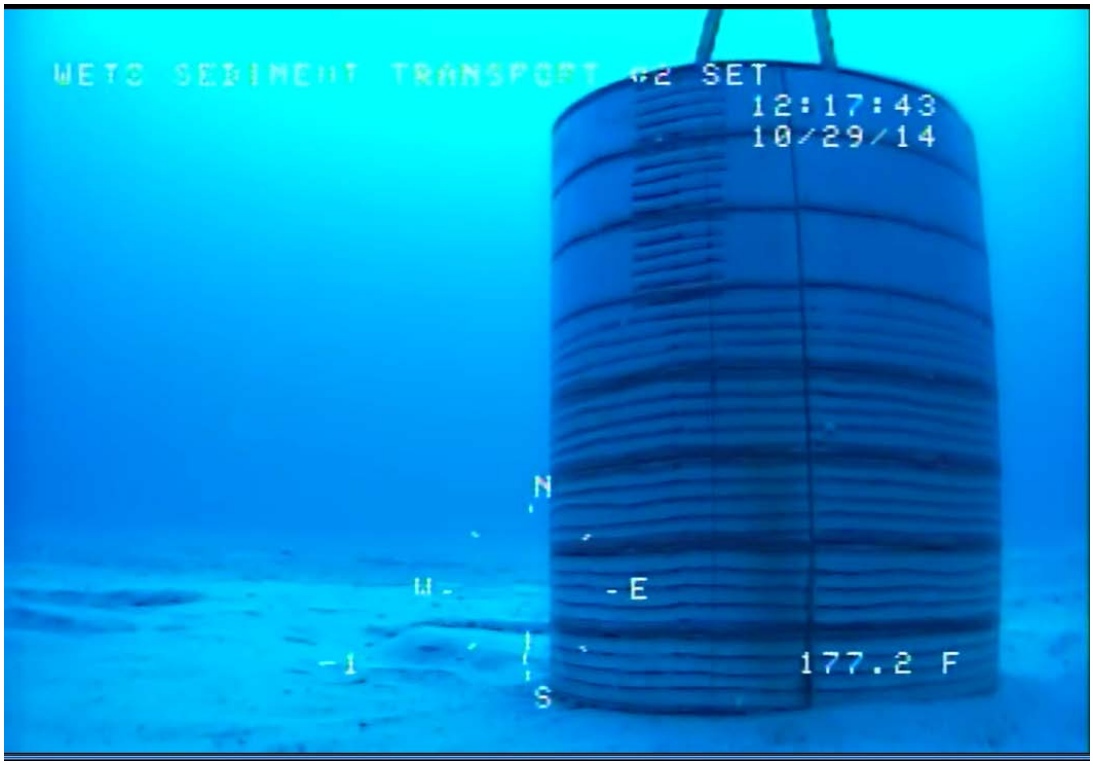

Figure 5. Scour cylinder deployed at anchor base A

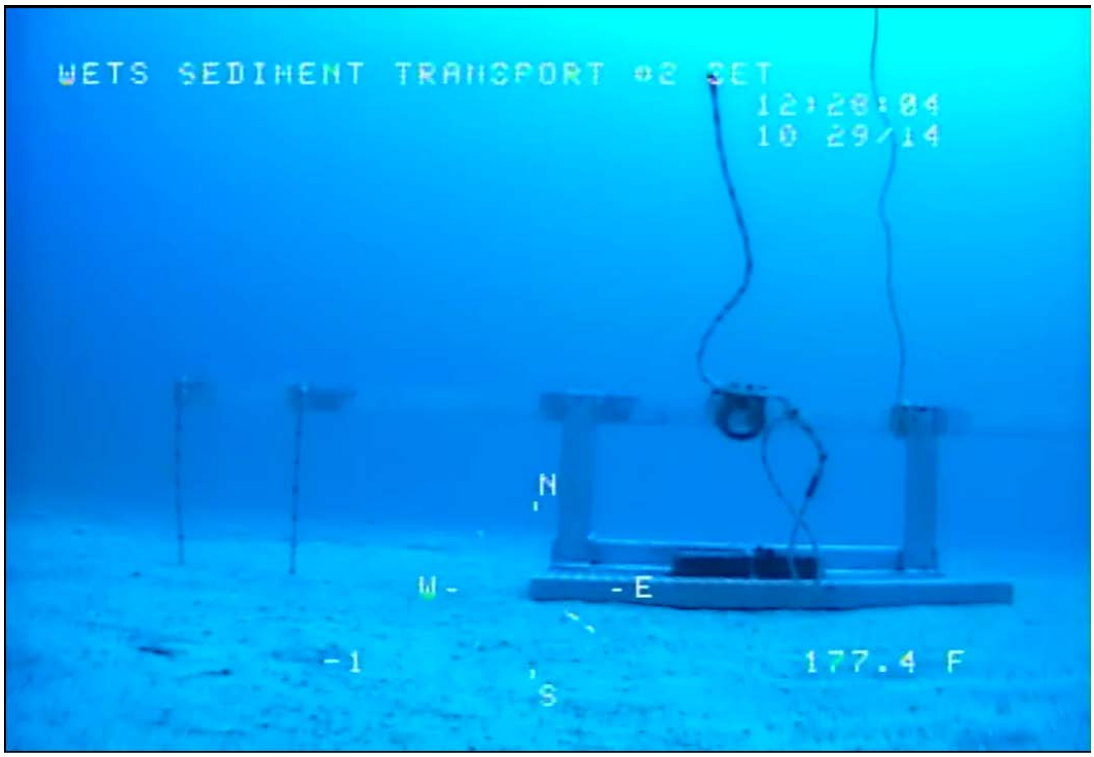

Figure 6. Sediment staffs deployed at anchor base A

Sea Engineering, Inc.
Makai Research Pier
41-305 Kalanianaole Hwy.
Waimanalo, Hawaii 96795-1820
Ph: (808) 259-7966 Fax: (808) 259-8143
Email: sei@seaengineering.com
Website: www.seaengineering.com

FIELD REPORT

DATE:	July 1, 2015	
TO:	Luis Vega	
FROM:	Patrick Anderson, Tor Harris	
SUBJECT:	WETS Task 3B Sediment Transport Analysis	

Date: May 22, 2015

Location: 80 meter and 60 meter Mooring Locations

Activity: ROV Survey of Sediment Staffs and Scour Cylinders

Crew: Tor Harris, Patrick Anderson, and Kyle Myers

Vessel: BobR

Sediment Staff Configuration
The sediment staffs consist of a fiberglass grate base 60.96 x 60.96 cm [2 x2 ft] supporting a raised aluminum cross bar extending 60.96 cm [2 ft] to either side of the grate, with 4 thin aluminum rods welded vertically downward from the cross bar. The rods are located at the end of the cross bar (60.96 cm [2 ft] outside of the grate base), and 30.48 cm [1 ft] inside of the end of the cross bar (30.48 cm [1 ft] outside of the grate base). The outside rods extend 3 inches below the grate base, and thus, when the grate is initially placed on the seafloor, the rods penetrate 7.62 cm [3 in] into the sediment, allowing measurement of any variation in sediment level. The inner rods extend level with the grate base, and thus, when the grate is initially placed on the seafloor, the tips of the inner rods should be approximately at sediment level. The rods are marked in centimeter graduations. Figure 1 illustrates a sediment staff grate prior to deployment. Two sediment staff grates were fabricated one for each of the deep water mooring locations.

Scour Cylinder Configuration
Two scour measurement cylinders, were also been fabricated. These consist of thin walled sheet metal cylinders approximately 30.48 cm [12 in] diameter, and 40.64 cm [16 in] high. The cylinders are partially filled with concrete from 10.16 cm [4 in] to 25.4 cm [10 in] from the bottom of the cylinder. When placed on the seafloor, the cylinders will sink into the sediment to the level of the concrete, and will allow observation of scour. The scour cylinder is marked in centimeter graduations. Figure 2 is a photograph of a scour cylinder prior to deployment.

SEI deployed the sediment staff grates and scour cylinders on October 29, 2014. One grate and scour cylinder were deployed just east of the moorings for the 60 m and 80 m site. The coordinates of the each of the sediment transport measurement devices is shown in Table 1 below.

Table 1. Sediment Staff and Scour Cylinder Locations

Site	Latitude	Longitude	Depth
Sediment Staff & Scour Cylinder - B Mooring	21° 28' 39.8883" N	157° 45' 37.6917" W	53.56 m [175.7 ft]
Sediment Staffs & Scour Cylinder - A Mooring	21° 28' 24.1677" N	157° 45' 11.6637" W	77.28 m [253.5 ft]

Measurement

Both the staffs and cylinders are marked in centimeters increments with highlights every five centimeters. The total length of the outside staffs and inside staffs is of the sediment staffs is 39.5 cm and 30.5 cm respectively. The total height of the scour cylinders is approximately 44.5cm. Measurements are made by measuring down from the top of the staff and cylinders to the seafloor.

Results

The following tables show the measurements of the sediment staffs on May 22, 2015 compared with observations on the day of deployment. Heights in the tables are given as cm of staff above the ocean floor. Figure 4 and Figure 6 show the sediment staffs for Mooring A and Mooring B respectively.

Table 2. Sediment Staff Mooring A

Arm	Staff	Staff Length - Top to Seabed		Sedimentation (+) or Scour (-)
		10/29/2015	5/22/2015	
NE	Outer	30.5 cm	30.5 cm	0 cm
	Inner	30.5 cm	30.5 cm	0 cm
SW	Outer	30.5 cm	30.5 cm	0 cm
	Inner	30.5 cm	30.5 cm	0 cm

Table 3. Sediment Staff Mooring B

Arm	Staff	Staff Length - Top to Seabed		Sedimentation (+) or Scour (-)
		10/29/2015	5/22/2015	
NE	Outer	32 cm	32 cm	0 cm
	Inner	30.5 + cm	30.5 + cm	0 cm
SW	Outer	28 cm	29.5 cm	1.5 cm
	Inner	28 cm	29 cm	-1.0 cm

The seafloor around the scour cylinder located near Mooring A had observable scour in a semicircle around the West-Southwest side of the scour cylinder. The diameter of the scour was approximately 82 cm, and was roughly 4 cm deep. The cylinder was also leaning in the West-

Southwest direction. Due to the fact that the cylinder was leaning or tilting, a range of heights were observed from 44 cm to 36 cm.

The seafloor around the scour cylinder located near Mooring B had observable scour in a full circle around the cylinder. The diameter of the scour was approximately 77 cm, and was roughly 12 cm deep. The scour cylinder had an observed height of approximately 44 cm. Photographs of the scour cylinders for Mooring A and Mooring B are shown in Figure 3 and Figure 5.

Discussion

The May 22, 2015 observations indicate that there was little, nature sediment transport in the area. The seafloor at the Mooring A staff was unchanged, and scoured 1 to 1.5 on the southwest arm of the Mooring B. Given the time between deployment and observation, and the fact that only one arm of the sediment staffs observed a notable change, this scour quantity is insignificant, and within the range of error.

The May 22, 2015 observations on the cylinders indicate there was scour at both locations. The scour appears to be more significant at the Mooring B location, displaying a deeper and complete scour around all sides of the scour cylinder. The scour observed around the scour cylinder located at Mooring A is more shallow, and only encompasses one side of the cylinder, suggesting a predominant current direction towards the West-Southwest.

Marine growth is starting to obscure the reading of the markings on the staffs and scour cylinders. All the measurements reported in this report were reference to the markings on the staffs and scour cylinders. In the future when the markings are no longer visible due to buildup of marine growth, the measurements will be taken by scaling known dimensions in the images to the staff and scour cylinders.

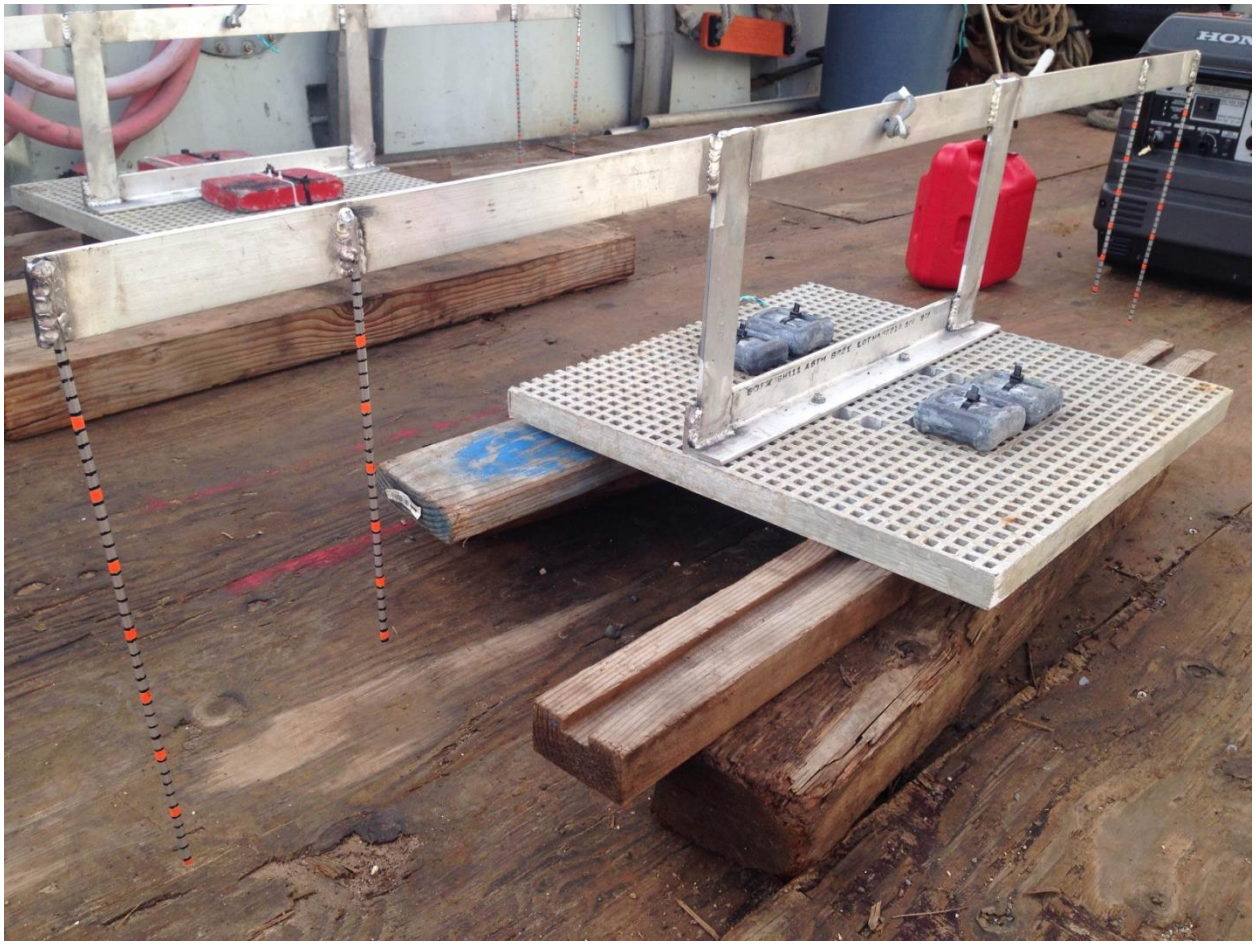

Figure 1. Sediment staff grate

Figure 2. Scour cylinder

Figure 3. Scour cylinder deployed at anchor base A

Figure 4. Sediment staffs deployed at anchor base A

Figure 5. Scour cylinder deployed at anchor base B

Figure 6. Sediment staffs deployed at anchor base B

Sea Engineering, Inc.
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Waimanalo, Hawaii 96795-1820
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Website: www.seaengineering.com

FIELD REPORT

DATE:	October 1st , 2015	
TO:	Luis Vega	
FROM:	Patrick Anderson, Tor Harris	
SUBJECT:	WETS Task 3C Sediment Transport Analysis	

Date: August 11th, 2015

Location: 80 meter and 60 meter Mooring Locations

Activity: ROV Survey of Sediment Staffs and Scour Cylinders

Crew: Tor Harris, Patrick Anderson, and Kyle Myers

Vessel: BobR

Sediment Staff Configuration
The sediment staffs consist of a fiberglass grate base 60.96 x 60.96 cm [2 x2 ft] supporting a raised aluminum cross bar extending 60.96 cm [2 ft] to either side of the grate, with 4 thin aluminum rods welded vertically downward from the cross bar. The rods are located at the end of the cross bar (60.96 cm [2 ft] outside of the grate base), and 30.48 cm [1 ft] inside of the end of the cross bar (30.48 cm [1 ft] outside of the grate base). The outside rods extend 3 inches below the grate base, and thus, when the grate is initially placed on the seafloor, the rods penetrate 7.62 cm [3 in] into the sediment, allowing measurement of any variation in sediment level. The inner rods extend level with the grate base, and thus, when the grate is initially placed on the seafloor, the tips of the inner rods should be approximately at sediment level. The rods are marked in centimeter graduations. Figure 1 illustrates a sediment staff grate prior to deployment. Two sediment staff grates were fabricated, one for each of the deep water mooring locations.

Scour Cylinder Configuration
Two scour measurement cylinders, were also fabricated. These consist of thin walled sheet metal cylinders approximately 30.48 cm [12 in] diameter, and 40.64 cm [16 in] high. The cylinders are partially filled with concrete from 10.16 cm [4 in] to 25.4 cm [10 in] from the bottom of the cylinder. When placed on the seafloor, the cylinders will sink into the sediment to the level of the concrete, and will allow observation of scour. The scour cylinder is marked in centimeter graduations. Figure 2 is a photograph of a scour cylinder prior to deployment.

SEI deployed the sediment staff grates and scour cylinders on October 29, 2014. One grate and scour cylinder were deployed just east of the moorings for the 60 m and 80 m site. The coordinates of the each of the sediment transport measurement devices is shown in Table 1 below.

Table 1. Sediment Staff and Scour Cylinder Locations

Site	Latitude	Longitude	Depth
Sediment Staff & Scour Cylinder - B Mooring	21° 28' 39.8883" N	157° 45' 37.6917" W	53.56 m [175.7 ft]
Sediment Staffs & Scour Cylinder - A Mooring	21° 28' 24.1677" N	157° 45' 11.6637" W	77.28 m [253.5 ft]

Measurement

Both the staffs and cylinders are marked in centimeters increments with highlights every five centimeters. The total length of the outer and inner staffs is 39.5 cm and 30.5 cm respectively. The total height of the scour cylinders is approximately 44.5cm. Measurements are made by measuring down from the top of the staff and cylinders to the seafloor.

Results

Both the sediment staffs and scour cylinders had significant marine growth. The markings on the staffs were not visible. The measurements for this observation of the staffs were obtained using scaling of know dimensions of the sediment staffs. This method is considerably less accurate. The following tables show the current and previous measurements of each sediment staff. Heights in the tables are given as cm of staff above the ocean floor. Figure 4 and Figure 6 show the sediment staffs for Mooring A and Mooring B respectively.

Table 2. Sediment Staff Mooring A (77m depth)

Arm	Staff	Staff Length - Top to Seabed			Sedimentation (+) or Scour (-)
		10/29/2014	5/22/2015	8/11/2015	
NE	Outer	30.5 cm	30.5 cm	25.7 cm[1]	4.8 cm[1]
	Inner	30.5 cm	30.5 cm	26.6 cm[1]	3.9 cm[1]
SW	Outer	30.5 cm	30.5 cm	24.8 cm[1]	5.7 cm[1]
	Inner	30.5 cm	30.5 cm	21.9 cm[1]	8.6 cm[1]

Table 3. Sediment Staff Mooring B (53 m depth)

Arm	Staff	Staff Length - Top to Seabed			Sedimentation (+) or Scour (-)
		10/29/2014	5/22/2015	8/11/2015	
NE	Outer	32 cm	32 cm	26.0 cm[1]	6 cm[1]
	Inner	30.5 + cm	30.5 + cm	27.7 cm[1]	2.8 cm[1]
SW	Outer	28 cm	29.5 cm	30.5 cm[1]	-2.5 cm[1]
	Inner	28 cm	29 cm	29.7 cm[1]	-1.7 cm[1]

[1] These represent inaccuracies of the scaling measurement technique and the settling of the base of the sediment staffs and not actual sediment transport processes.

The August 11th ROV observations indicate that the base of the staff at the 80m site (Mooring A) is undermined. The loss of sediment s likely due to marine animals. This undermining appears to have caused the base to shift or tilt and thus the measurements have lost their reference. Furthermore, seagrass is growing in the voids created by the undermining. Also burrow holes are evident around both the northeast staffs. These holes do not seem to be formed by any sedimentation process but by marine animal activity. Measurement of the staffs indicate 3.9 to 8.6cm of sedimentation. However, the differences are likely due to the base settling into the undermined void and also due to the inaccuracies of the scaling used rather than actual sediment transport processes

The scour cylinder located at the 80m site (Mooring A) also had extensive marine growth. The markings were still visible and measurements were possible. The seafloor around the cylinder has scoured all around all sides of the cylinder. Again the most defined observable scour is on the West-Southwest side of the scour cylinder. The diameter of the scour area has enlarged from approximately 82 cm to 89 cm. The scour depth has also increased from roughly 4 cm deep to 10 cm. The cylinder was still leaning in the West-Southwest direction. Due to the fact that the cylinder was leaning or tilting, a range of heights were observed from 45 cm to 38 cm.

The sediment staffs at the 60m site (Mooring B) also have substantial growth that has obscured the markings. However, there was no evidence of burrowing or scouring around the base of the staffs. The measurements are shown in Table 3. The larger variation in the measurements for the August 11th readings is due to the inaccuracies of scaling a known dimension and not any sediment transport process.

The scour cylinder located near Mooring B has toppled over. There appears to be a shallow scour depression (about 3-4cm) around the North side of the overturned cylinder. Seagrass has started to grow in the void at the top of the cylinder. Photographs of the scour cylinders for Mooring A and Mooring B are shown in Figure 3 and Figure 5. Table 4 shows the sediment scour cylinder measurements for both Mooring A and Mooring B.

Table 4. Sediment Scour Cylinder Measurements

Sediment Cylinder measurements		10/29/2015	5/22/2015	8/11/2015
Mooring A (80 m site)	High	40 cm	44 cm[1]	45 cm [1]
	Low	39 cm	36 cm [1]	38 cm [1]
	Scour Diameter	n/a	82cm	89cm
	Scour Depth	n/a	4 cm	10 cm
	Current Direction	n/a	West - Southwest	West - Southwest
Mooring B (60 m site)	High	37 cm	44 cm	n/a [2]
	Low	35 cm	44 cm	n/a [2]
	Scour Diameter	n/a	77 cm	none [2]
	Scour Depth	n/a	12 cm	none [2]
	Current Direction	n/a	West - Southwest	n/a [2]

[1] Cylinder was leaning thus the variation of the measurements.

[2] The cylinder at Mooring B topple over.

Discussion

The May 22, 2015 observations of the sediment staffs indicate that there was little, natural sediment transport in the area. The seafloor at the Mooring A staff was unchanged, and scoured 1 to 1.5 cm on the southwest arm of the Mooring B. The scour was determined to be insignificant, and within the range of error.

The August 11, 2015 survey of the sediment staffs revealed significant influence of marine biological activity. The staffs have marine growth on them that has obscured the marking increments. The base of the staffs at the 80m site has been undermined by marine biological activity and there is a depression surrounding the northeast staffs. The extensive marine growth at both locations, and the undermining of the base at Mooring A, render further measurements based on the sediment staffs invalid.

The May 22, 2015 observations on the cylinders indicated there was scour at both locations. The scour appeared to be more significant at the Mooring B location, which displayed deeper and complete scour around all sides of the scour cylinder. The scour observed around the scour cylinder located at Mooring A was more shallow, and only encompassed one side of the cylinder, suggesting a predominant current direction towards the West-Southwest.

The August 11, 2015 observations of the cylinders show increased scour at both mooring sites. Likely the cylinder at the B mooring site toppled over due to excessive scour since it had the greatest scour in the previous observation.

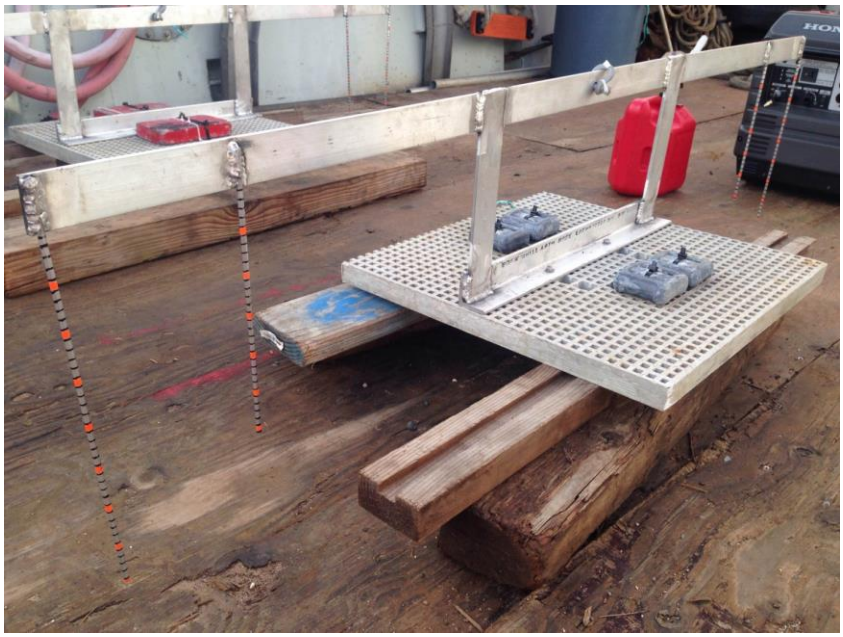

Figure 1. Sediment staff grate

Figure 2. Scour cylinder

Figure 3. Scour cylinder deployed at anchor base A

Figure 4. Sediment staffs deployed at anchor base A

Figure 5. Scour cylinder deployed at anchor base B

Figure 6. Sediment staffs deployed at anchor base B

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Waimanalo, Hawaii 96795-1820
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Email: sei@seaengineering.com
Website: www.seaengineering.com

FIELD REPORT

DATE:	April 25, 2017	
TO:	Luis Vega	
FROM:	Patrick Anderson, Tor Harris	
SUBJECT:	WETS Task 3D Sediment Transport Analysis Field Report	

WETS Task 3D was conducted on January 14, 2016. Additionally, images from WETS Task 7C and 7D have been incorporated into the report. The table below shows the vessel and crew information.

Table 1 Dates, Vessel, and Crew Summary

Location	80-meter and 60-meter Mooring Locations		
Date	January 14, 2016	March 5, 2016	January 11, 2017
Vessel	Huki Pono	Bob R	Huki Pono
Crew	Patrick Anderson, Kyle Myers, Adam Commons	Patrick Anderson, Kyle Myers, Adam Commons, Mike Zadra (Sound and Sea Technologies)	Patrick Anderson, Ken Kohnfelder, Mike Napali

Sediment Transport

WETS Task 3 initially involved measurements and observations of sediment staffs and scour cylinders specifically placed on the sandy seafloor at the WETS site. Thick marine growth rapidly obscured measurement marks on the staffs and cylinders, and extensive burrowing by marine animals undermined and caused movement, tiling, or toppling the staffs and cylinders. Since these measuring methods were compromised observations of the seafloor around objects on site such as chain moorings, sinkers and anchors were substituted to assess sediment transport and sediment disturbance.

Measurement

Sedimentation or scour around the objects is estimated based on the known dimensions of the existing objects. The concrete cubic sinker is 1192 mm wide as shown in Figure 1. The chains installed at WETS for the deep water berths are 2.75-in ABS Grade 3 stud link chain that have a length of 16.5 inches and width of 9.875inches.

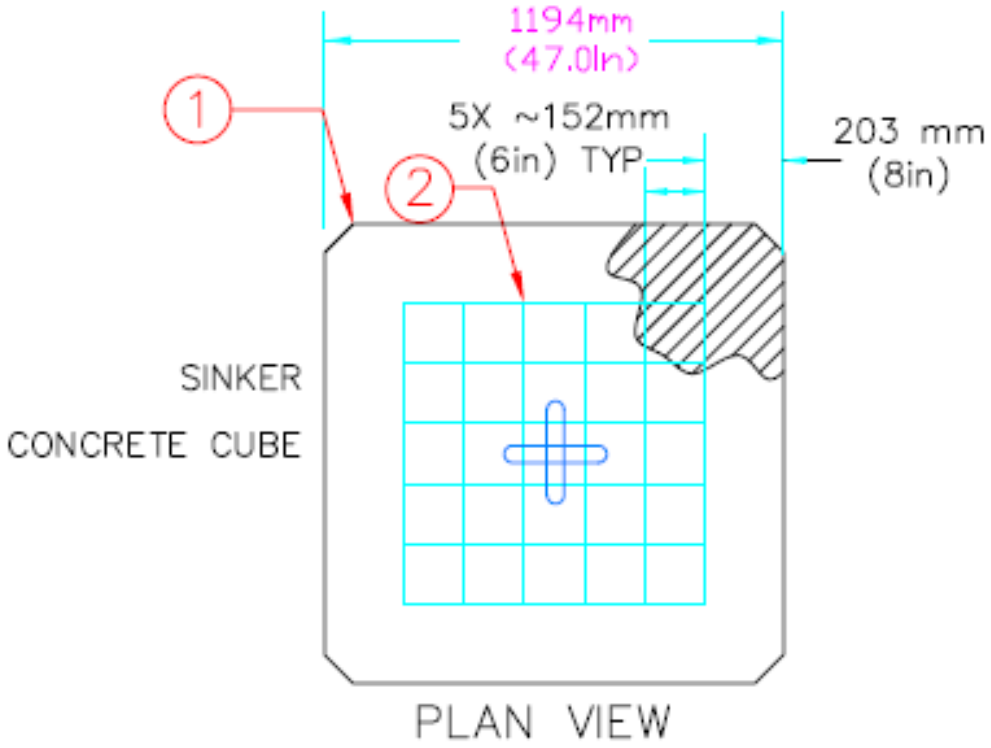

Figure 1 Concrete sinker dimensions

Observations

The images used to assess the sediment transport and changes were taken from the ROV surveys on January 14, 2016, March 5, 2016, and January 11, 2017. The objects on moorings A (60 m water depth) and B (80 m water depth) were analyzed to determent if sediment deposition, scour erosion or any other notable sediment changes had occurred effects on the local sediment dynamics. Each mooring leg was surveyed. The first sinker block on each mooring leg is unique because it is moved by the motion of the surface float. The mooring chain on each leg impacts the seafloor and the first sinker weight thus disturbing the sediment.

A Mooring Legs

- Figure 2 shows mooring leg A1 recorded on March 5, 2016. There is no noticeable scour or sediment accumulation around the sinkers; however, there is considerable rounding of the top corners of the sinker weight and no marine growth. This was attributed to the motion of the chain and first sinker weight. The studs in the chain links that are impacting the seafloor (and piling up on the chain below) had been displaced or were completely missing. The first sinker weight on the A2 mooring leg had disconnected from the mooring leg.
- Scour erosion around the fifth sinker (1194 mm wide) can be seen in Figure 3 on mooring leg A2 recorded on March 5, 2016. The radius of the scour is estimated to be 1590 mm and the depth 240 mm. Erosion is more intense on the right (west) side of the structure indicating that the current flows towards the west.
- Figure 4, recorded on March 5, 2016, shows the sediment being suspended by the up and down movement of the chain on mooring leg A3. The constant up and down motion is caused by the mooring buoy A3 rising and falling with the swell and the chain

subsequently following. This continuous rising and dropping of the chain is the suspected reason for the formation of a large depression around the first sinker of the A3 mooring leg, as seen in Figure 5.

- The anchor of mooring leg A3 has significant sediment accumulation on its left (east) side, as shown Figure 6, recorded on March 5, 2016, and Figure 7, recorded November 13, 2015. This indicates that current flow and sediment transport is from east to west. Sand deposited on the on top of the cross bracing of the anchor is also shown in Figure 6.

Figure 2 First Concrete Block Sinker on Mooring Leg A1, March 5, 2016

Figure 3 Scour Erosion around Fifth Sinker on Mooring Leg A2, March 5, 2016

Figure 4 Sediment Lifted by the Heave Movement of Mooring Leg A3, March 5, 2016

Figure 5 Depression around a Sinker on Mooring Leg A2, March 5, 2016

Figure 6 Anchor on Mooring Leg A3, March 5, 2016

Figure 7 Anchor on Mooring A3, November 13, 2015

B Mooring Legs

Analyses of the ROV video surveys on March 5, 2016 and November 13, 2015, resulted in the following observations regarding sediment transport, scour, or displacement at the B moorings.

- Figure 8 recorded on March 5, 2016, shows the B3 mooring leg chain and that there is no significant deposition or erosion on the chain.
- Figure 9 recorded on March 5, 2016, on mooring leg B2 there is no significant scour erosion, although some sediment deposition can be seen on the chains near the sinker.
- Figure 10 recorded on March 5, 2016, shows scour erosion around a sinker which on mooring leg B3. The radius of the scour is estimated to be 1600 mm and the depth 350 mm. The shape and dimensions of the scour erosion on mooring B are very similar to the ones observed on mooring A. Scour appears to be on the East side suggesting a west to east flow opposite of which is different with that noted at mooring A.
- Figure 11 recorded on March 5, 2016, shows more intense scour erosion on the right (west) side of the sinker, causing differential settlement of the block.
- It is possible to see deposition of sediment on the front left (east) side of the sinker in Figure 12. The height of the sand accumulation is estimated to be 398 mm, covering around one third of the block. Again, the sediment transport seems to be in the east-west direction.
- The Fred Olsen Lifesaver was installed on March 25, 2016. When installed the hawsers pulled the mooring legs towards the center of the mooring arrangement. The mooring legs then had larger dip section of chain in intermittent contact with the seafloor. This larger dip section resulted in sediment displacement in the form of trenches in the seafloor sediments that centered on the dip section of each leg. This can be seen in Figure 13, Figure 14, and Figure 15.

Figure 8: Moring 3B chain, March 5, 2016

Figure 9 Sinker on mooring leg B2, November 13, 2015

Figure 10 Scour erosion around sinker on mooring leg B3

Figure 11 Sinker with differential settlement due to scour erosion

Figure 12 Sediment deposition at sinker on mooring 3B

Figure 13 A1 Dip Section of Chain

Figure 14 A2 Dip Section of Chain

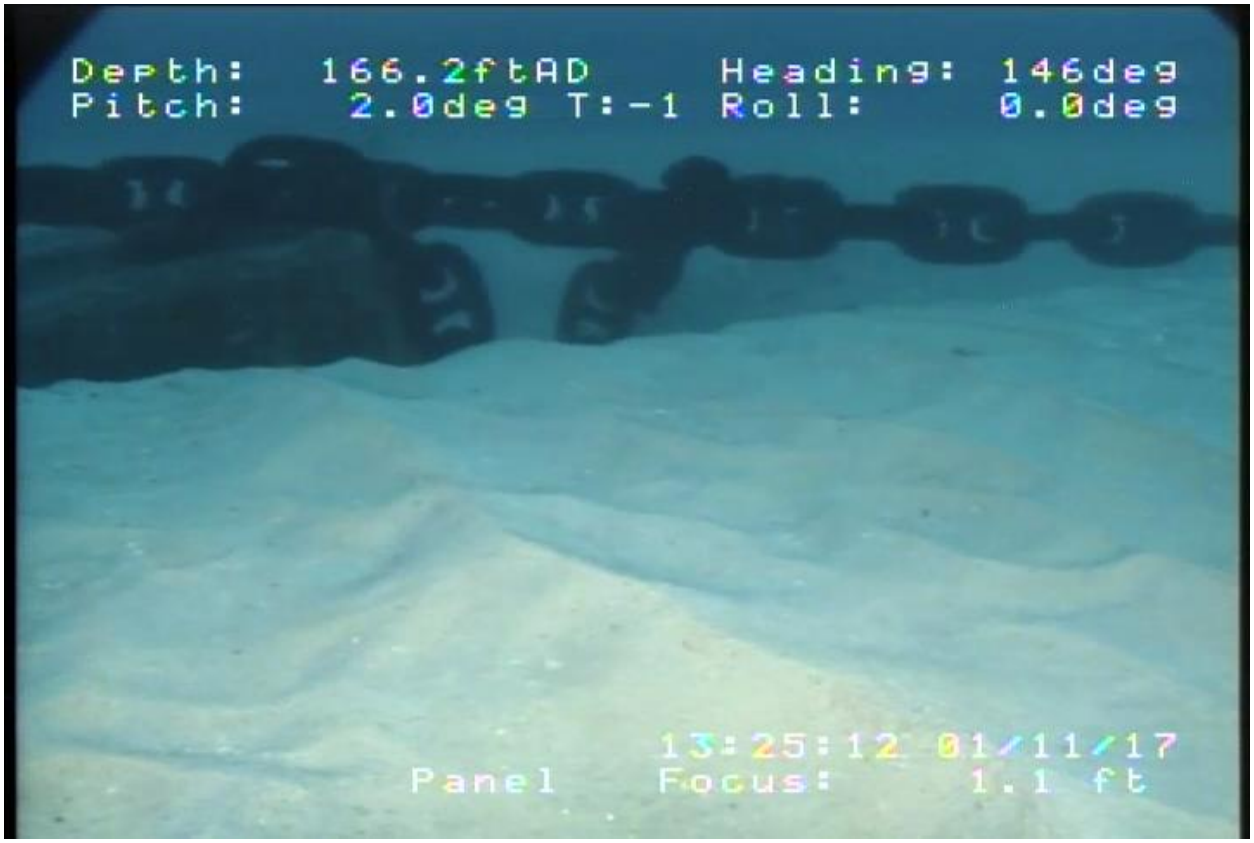

Figure 15 A3 Dip Section of Chain (third sinker weight in trench)

Conclusions

Sediment was displaced by the motion of the mooring chain and first sinker weight each of the mooring leg. The displaced sediment formed a circular depression in the seafloor at the vacant B moorings. A trench was formed in the seafloor at the A moorings hosting the Lifesaver.

The sediment accumulation or erosion at the wave energy test site is much more visible around the structures of moorings A and B then the chains. The scour around the sinkers are about one third of the sinker depth and four thirds of the sinker radius. Sediment deposition on the east side, and scour on the west side of the structures indicate that the sediment transport and current direction is from east to west for both moorings A and B; however, some observations contradict this generalization (Figure 10).

A summary of the Task 3 surveys is shown in Table 2.

Table 2 Task 3 Schedule

	TASK 3: Sediment Transport (60m and 80m Berths)	**Date Completed**
3A	Field Report: Installation of Four (4) Measurement Staffs	10/29/2014
3B	Field Report: ROV Monitoring of Four Staffs (1st Quarter/1st Year)	5/22/2015
3C	Field Report: ROV Monitoring of Four Staffs (2nd Quarter/1st Year)	8/11/2015
3D	Field Report: ROV Monitoring of Four Staffs (3rd Quarter/1st Year)	1/14/2016