Hawaii National Marine Renewable Energy Center (HINMREC)

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Task 1: Management

Kāneʻohe Wave Energy Test Site: Dive Survey Report

Prepared by:
Sea Engineering, Inc.

Prepared for:
Hawaii Natural Energy Institute, University of Hawaii

December 2013

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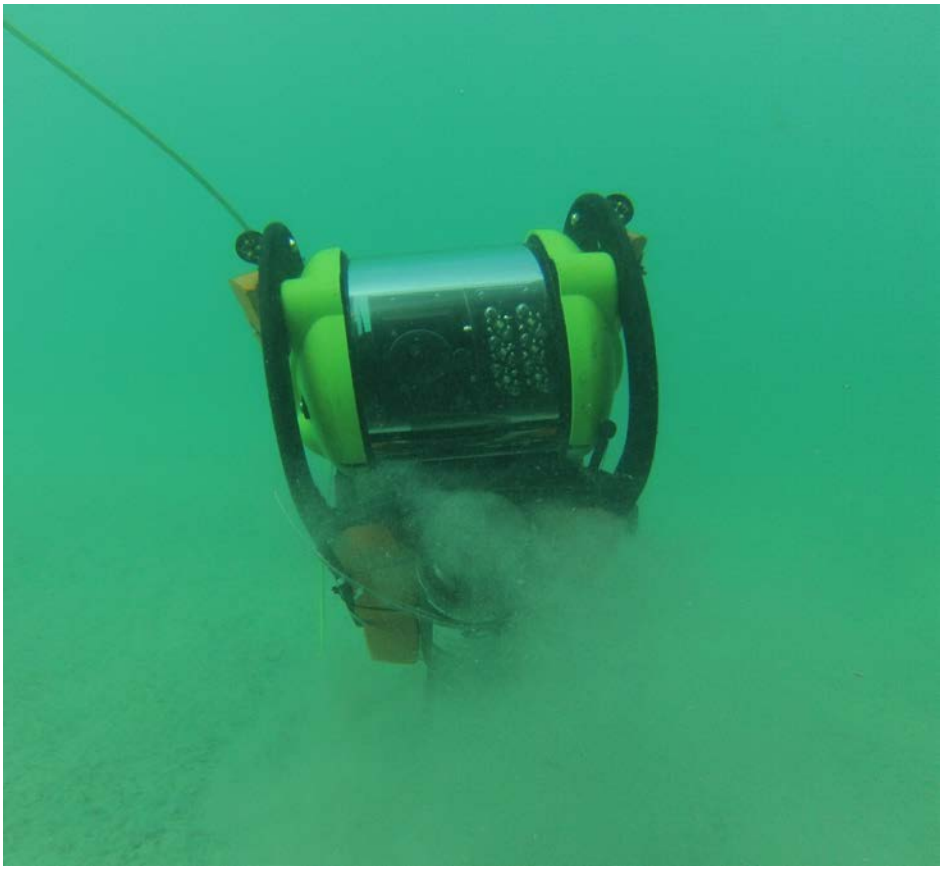
Hawaiʻi Natural Energy Institute
University of Hawaiʻi at Mānoa

KANEOHE WAVE ENERGY TEST SITE

DIVE SURVEY REPORT
OAHU, HI

December 2013



Prepared for:
Hawaii National Marine Renewable Energy Center
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

Prepared by:
Sea Engineering, Inc.
Makai Research Pier
Waimanalo, HI 96795

Job No. 25268

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1. INTRODUCTION

The area north of the Mokapu Peninsula, adjacent to Kaneohe Marine Corps Base Hawaii (MCBH), has been utilized by the U.S. Navy and Ocean Power Technologies, Inc. (OPT) for wave energy research since 2002. A prototype OPT PowerBuoy was retrieved from the 30 m water depth offshore of North Beach at the MCBH. The Hawaii National Marine Renewable Energy Center (HNMREC) at the University of Hawaii, under contract with Department of Energy, desires to expand the present test site to water depths of 100 m to allow for the testing of other wave energy devices.

Sea Engineering has been contracted by the HNMREC to conduct site investigations in support of the development of the expanded test site. This report presents the results of the Dive Survey of the deepwater cable routes, conducted by remotely operated vehicle (ROV). Remotely Operated Vehicles are camera equipped robotic vehicles controlled from the surface.

The project location is shown in Figure 1-1. Figure 2-1 presents the WETS existing cable route as well as proposed deepwater cable routes. The test site is 1600 to 2000 m wide and extends approximately 2600 m offshore from the 30 m depth contour to the approximate 100 m depth contour.

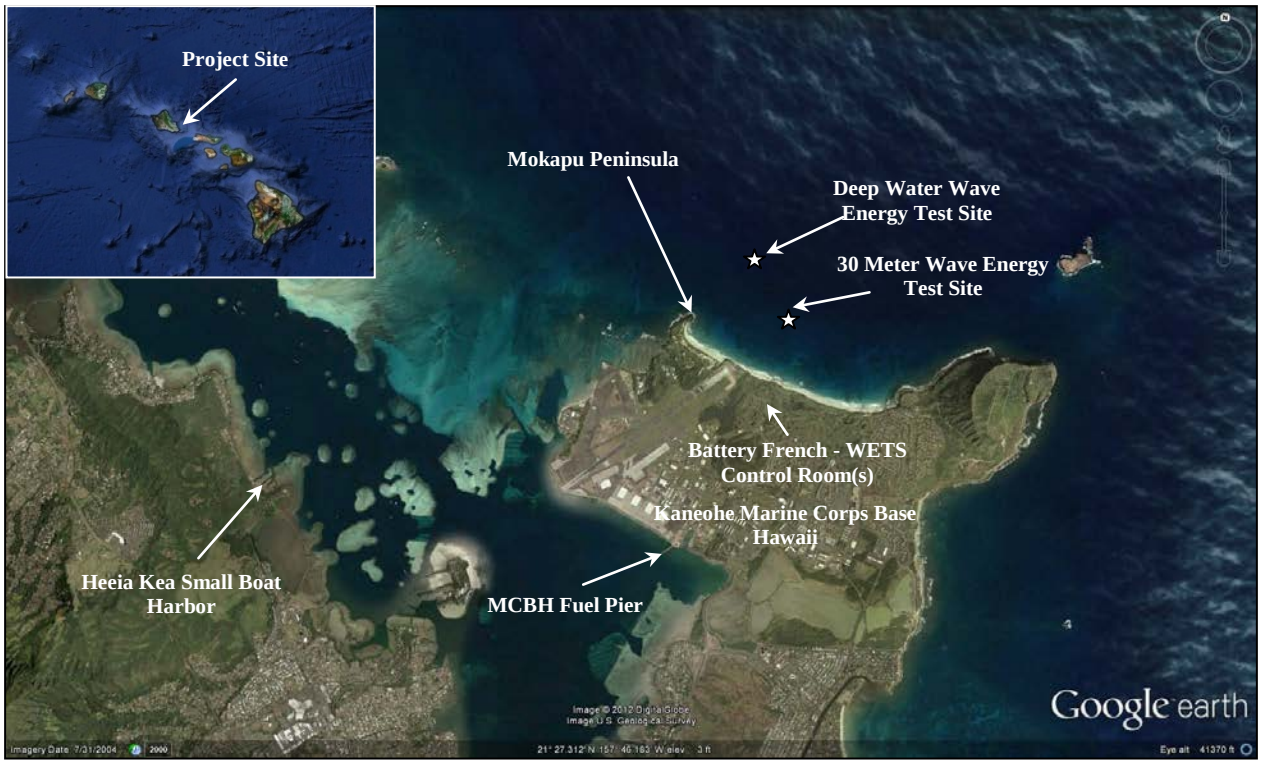


Figure 1-1: Kaneohe Marine Corps Base Hawaii – Wave Energy Test Site

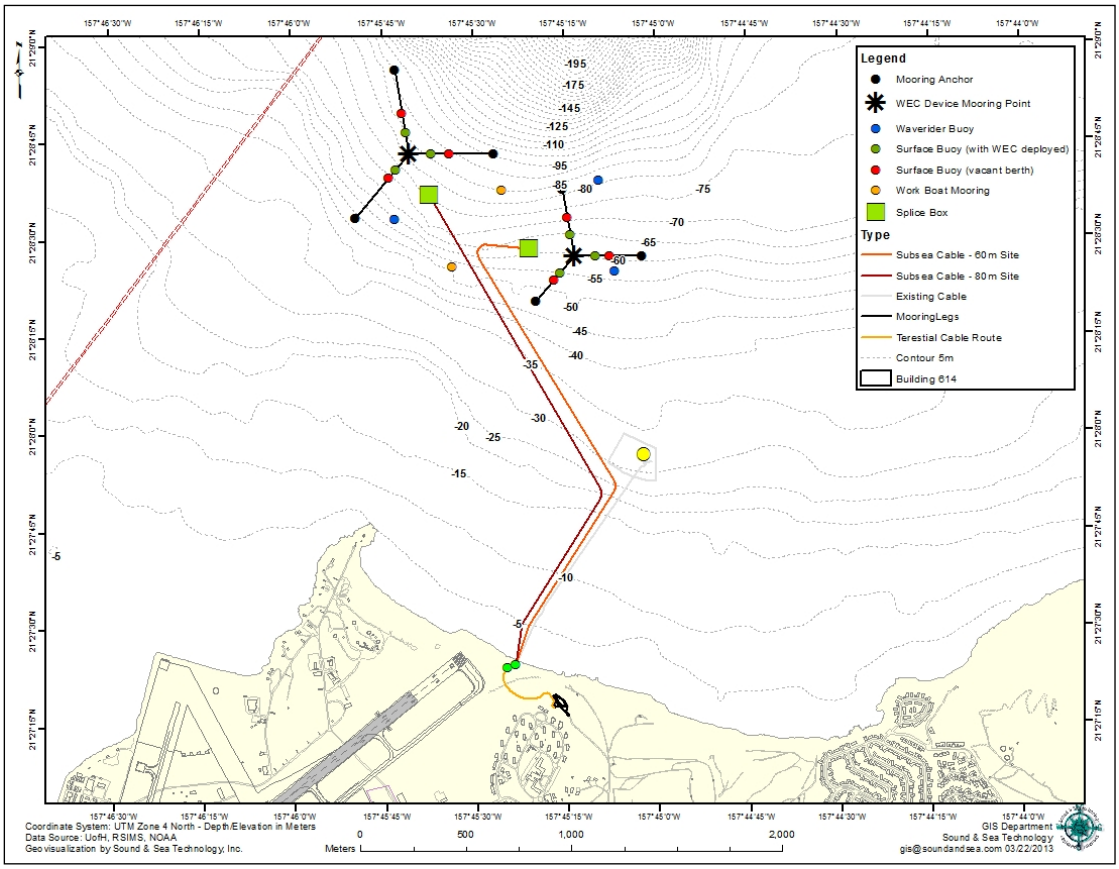


Figure 1-2: WETS Proposed Deepwater Cable Routes

2. METHODOLOGY

2.1 Survey Schedule

Sea Engineering conducted the ROV dive survey on October 15, 2013.

2.2 Units and Coordinate System

The project coordinate system is the Universal Transverse Mercator (UTM), Zone 4, meters.

2.3 Navigation and Positioning

A differential GPS (DGPS) receiver was used in conjunction with a USBL (Ultra Short BaseLine) acoustic positioning system for underwater horizontal positioning.

Hypack survey software was used for navigation of the survey vessel and to track and record the location of the ROV.

2.4 Remotely Operated Vehicle Methods

Remotely operated vehicles are camera and thruster equipped vehicles linked to a vessel with an umbilical control and electrical cable, and operated from the vessel to investigate the seafloor and underwater objects. They are used for a variety of underwater tasks ranging from underwater searches to plugging oil wells. They can be equipped with different equipment including manipulators, acoustic positioning systems, and multiple cameras.

For this survey, a SeaBotix LBV200L ROV was utilized. This ROV is equipped with a front facing color camera capable of 180° rotation, two LED lights and a GAPS Ixblue USBL transponder. The forward facing color camera was used to take video. ROV operational displays are overlaid over the video displaying compass direction, depth indicator (in meters), date, and time. Sample images from the ROV are shown in Figure 2-1 and Figure 2-2.

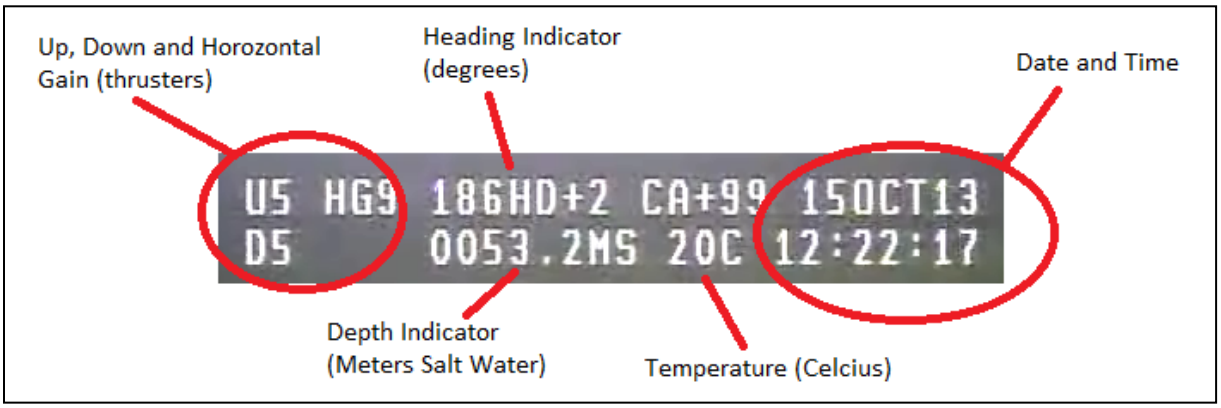


Figure 2-1: ROV Video Overlay Display

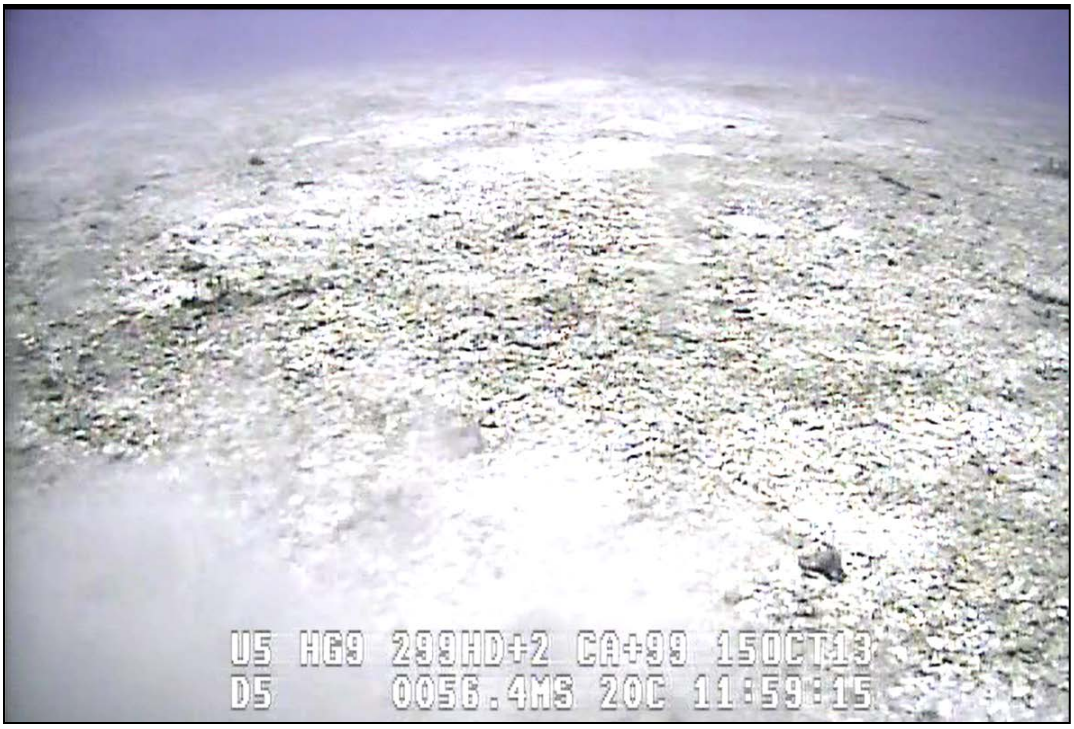


Figure 2-2: Sample Screen Shot of ROV Video

The ROV was piloted along the proposed high voltage cable routes, and anchor locations of interest. The USBL system provided real time positioning of the ROV allowing the pilot to follow a predetermined cable route with great accuracy. The ROV could also be towed short distances to survey a specific location on the bottom where unfavorable currents inhibited total pilot control.

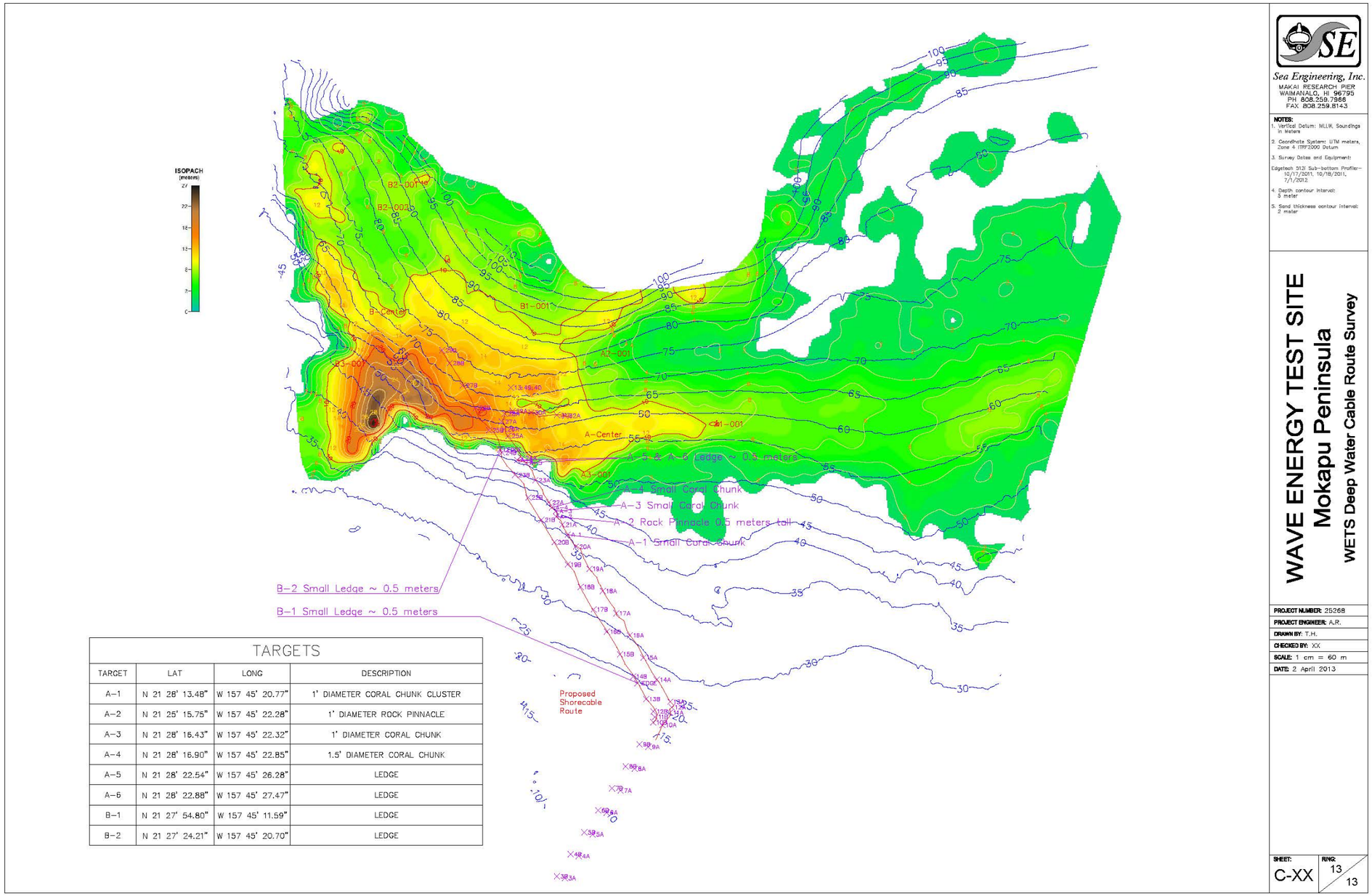
3. SURVEY RESULTS

Figure 3-1 and Figure 3-2 present the ROV survey track lines overlain on the bathymetry and sand thickness chart of the site. The exact position of the ROV can be determined by correlating the time on the ROV video with the list of time and position presented in Appendix A. Areas of interest or "Targets" are labeled, and their position is noted. Table 3-1 presents a summary of targets, position, and a brief description.

The video from the ROV was recorded and is distributed on DVD.

Table 3-1: Noted Areas of Interest from ROV Survey

TARGETS			
TARGET	LAT	LONG	DESCRIPTION
A-1	N 21 28' 13.48"	W 157 45' 20.77"	SMALL CORAL CHUNK
A-2	N 21 25' 15.75"	W 157 45' 22.28"	ROCK PINNACLE
A-3	N 21 28' 16.43"	W 157 45' 22.32"	SMALL CORAL CHUNK
A-4	N 21 28' 16.90"	W 157 45' 22.85"	SMALL CORAL CHUNK
A-5	N 21 28' 22.54"	W 157 45' 26.28"	LEDGE
A-6	N 21 28' 22.88"	W 157 45' 27.47"	LEDGE
B-1	N 21 27' 54.80"	W 157 45' 11.59"	LEDGE
B-2	N 21 27' 24.21"	W 157 45' 20.70"	LEDGE



TARGETS

TARGET	LAT	LONG	DESCRIPTION
A-1	N 21 28' 13.48"	W 157 45' 20.77"	1' DIAMETER CORAL CHUNK CLUSTER
A-2	N 21 28' 15.75"	W 157 45' 22.28"	1' DIAMETER ROCK PINNACLE
A-3	N 21 28' 16.43"	W 157 45' 22.32"	1' DIAMETER CORAL CHUNK
A-4	N 21 28' 16.90"	W 157 45' 22.85"	1.5' DIAMETER CORAL CHUNK
A-5	N 21 28' 22.54"	W 157 45' 26.28"	LEDGE
A-6	N 21 28' 22.88"	W 157 45' 27.47"	LEDGE
B-1	N 21 27' 54.80"	W 157 45' 11.59"	LEDGE
B-2	N 21 27' 24.21"	W 157 45' 20.70"	LEDGE

Figure 3-1: WETS Bathymetry and Sand Thickness Chart - ROV Survey Tracklines and Targets

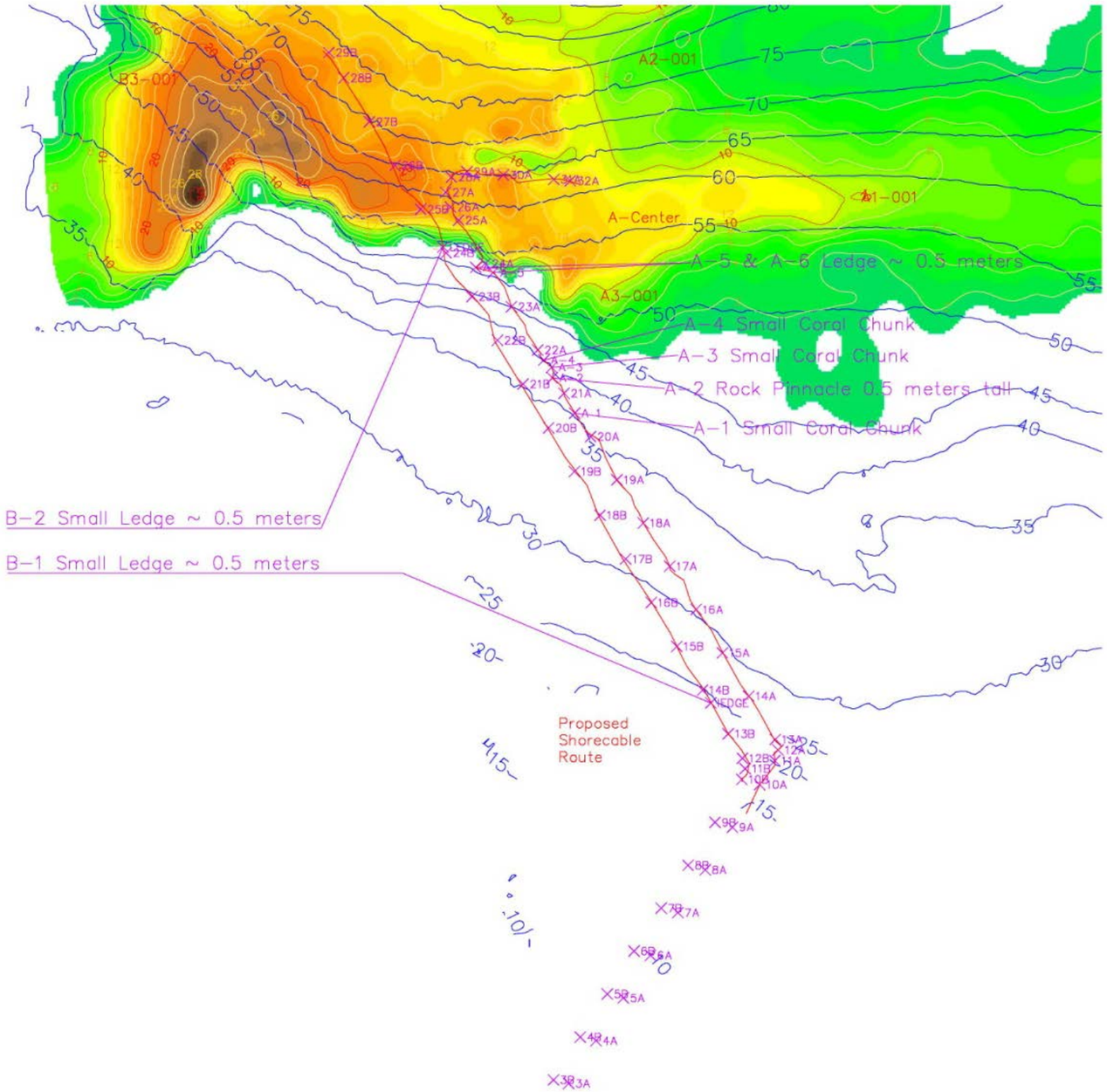


Figure 3-2: WETS Bathymetry and Sand Thickness Chart - ROV Survey Tracklines and Targets

3.1 ROV Dive Survey

3.1.1 Cable Route A

The dive along Cable Route A began at point 10A at a water depth of 10-15 meters and progressed seaward passing through points 10A-32A in numerical order (Figure 3-2). The dive along Route A terminated at point 32A at a water depth of 60-65 meters. Previous geophysical surveys conducted at the WETS site indicated that the seafloor in this area was hard bottom with irregular relief closer to shore, transitioning to a sand field near points 24A and 25A. The ROV survey confirmed these findings, and revealed hard bottom, with irregular relief and a spur and groove morphology on the inshore section. Sand was visible in the grooves while the spurs were barren, hard bottom with some algae. As the ROV survey progressed seaward, a 0.5 meter ledge was observed at targets A-5 and A-6 separating the inshore hard bottom from the broad sand field mapped in previous surveys (Figure 3-2, Figure 3-7, Figure 3-8). In addition to the ledge, three small coral heads and a rock pinnacle were discovered along Cable Route A (Figure 3-2, Figures 3-3 to 3-6). All coral heads were less than 30 cm in diameter, and the pinnacle was less than 0.5 meters tall with an estimated diameter of 20 centimeters.

Figure 3-3: Target A-1 Coral

Figure 3-4: Target A-2 Rock Pinnacle

Figure 3-5: Target A-3 Coral

Figure 3-6: Target A-4 Coral

Figure 3-7: Target A-5 Ledge

Figure 3-8 : Target A-6 Ledge

3.1.2 Cable Route B

The dive along Cable Route B began at point 10B at a water depth of 10-15 meters and progressed seaward passing through points 10B-29B in numerical order. The dive along Cable Route B terminated at point 29B at a water depth of 70-75 meters. The seafloor characteristics were similar to Route A, with a spur and groove morphology in the inshore section. Sand was visible in the grooves while the spurs were barren, hard bottom with some algae. As the ROV survey progressed seaward, a 0.5 meter ledge was observed at target B-2 separating the inshore hard bottom from the sand field (Figure 3-2, Figure 3-10). The ledge noted at target B-2 is likely the eastern continuation of the ledge noted at targets A-5 and A-6. In addition to the ledge at B-2, another 0.5 meter high ledge was observed at target B-1 at a water depth of 20-25 meters (Figure 3-2, Figure 3-9). No significant coral growth was discovered along Cable Route B.

Figure 3-9: Target B-1 Ledge

Figure 3-10: Target B-2 Ledge

3.1.3 Anchor Locations

The ROV was lowered and surveyed the ocean floor at anchor locations A1-001, A2-001 and A3-001 to provide a visual verification of bottom characteristics. The water depths at locations A1-001, A2-001 and A3-001 are 55-60 meters, 75-80 meters and 50-55 meters, respectively. Based on the previous geophysical surveys and vibracore data these locations are within the sand field with an estimated sand thickness of 5 meters or more. ROV video footage confirmed that the bottom was sandy with scattered patches of algae. Figures 3-11 through 3-13 depict general bottom conditions at the anchor locations. Figure 3-14 shows the anchor dive locations and targets along Cable Routes A and B.

Figure 3-11: Sand Bottom at Anchor Location A1-001

Figure 3-12: Sand Bottom at Anchor Location A2-001

Figure 3-13: Sand Bottom at Anchor Location A3-001

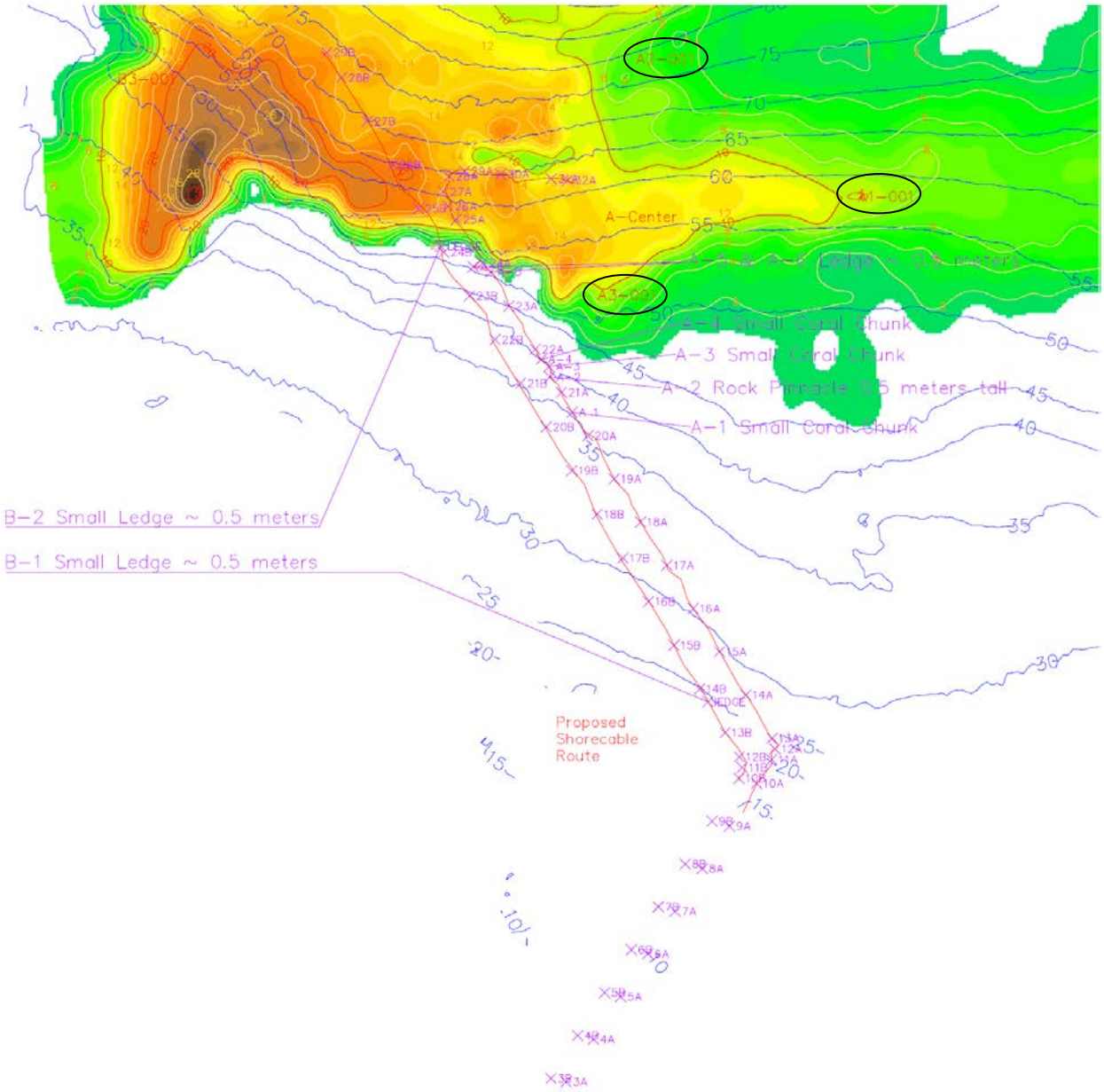


Figure 3-14: Anchor Dive Locations

3.2 Summary

The ROV dive survey of the Wave Energy Test Site area confirmed the previous interpretations of the side scan, sub-bottom, and bathymetric surveys. Reef limestone is present from the inshore area of the proposed cable routes to the approximate 50 meter contour, where a limestone ledge is present and marks the beginning of the sand field. The bottom is gently sloping for almost the entirety of the proposed cable routes, and no significant coral growth exists in the area. With the exception of the ledge noted at the approximate 50 meter depth contour, and at location B-1, there are no other major obstacles located along the proposed cable routes. The ROV video survey also confirmed that anchor locations A1-001, A2-001, and A3-001 are located in a sand field with no coral or hard bottom visibly present.

APPENDIX 1: VIDEO TIMESTAMP LOCATION REFERENCE

Cable Route A

Time	Easting	Northing	Time	Easting	Northing
9:38:37	629273.34	2373978.51	12:46:00	628749.66	2375172.25
9:39:00	629273.19	2373978.27	12:48:00	628749.78	2375172.40
9:40:00	629272.16	2373977.38	12:49:00	628739.00	2375151.17
9:41:00	629271.68	2373973.11	13:14:00	628797.87	2375166.91
9:42:00	629267.94	2373967.23	13:15:00	628802.27	2375163.05
9:44:00	629268.18	2373965.83	13:16:00	628806.10	2375160.35
9:45:00	629283.05	2373971.48	13:17:00	628809.02	2375165.73
9:46:00	629261.00	2373955.59	13:18:00	628808.50	2375165.70
9:47:00	629252.24	2373934.65	13:19:00	628809.12	2375168.35
10:00:00	629266.84	2374012.35	13:20:00	628808.39	2375168.84
10:03:00	629280.40	2374024.47	13:21:00	628808.78	2375169.14
12:21:00	628700.53	2375045.88	13:22:00	628808.97	2375169.01
12:24:00	628711.50	2375053.05	13:23:00	628808.73	2375169.54
12:25:00	628698.49	2375080.29	13:24:00	628808.71	2375169.45
12:26:00	628675.76	2375102.99	13:25:00	628784.02	2375190.84
12:27:00	628671.98	2375130.08	13:30:00	628787.19	2375176.14
12:28:00	628670.25	2375141.98	13:31:00	628791.38	2375175.44
12:29:00	628669.75	2375143.24	13:32:00	628795.80	2375177.10
12:30:00	628671.68	2375138.12	13:33:00	628794.53	2375178.21
12:31:00	628661.65	2375150.98	13:34:00	628795.86	2375178.78
12:32:00	628664.62	2375143.47	13:35:00	628795.14	2375179.60
12:33:00	628657.85	2375169.88	13:36:00	628781.29	2375182.00
12:34:00	628672.36	2375184.33	13:37:00	628771.41	2375184.32
12:35:00	628683.33	2375200.15	13:38:00	628772.23	2375185.16
12:36:00	628704.93	2375202.19	13:39:00	628773.28	2375185.35
12:37:00	628723.20	2375209.36	13:40:00	628773.44	2375185.48
12:38:00	628742.00	2375205.21	13:41:00	628775.46	2375186.75
12:39:00	628759.99	2375193.60	13:42:00	628743.96	2375178.94
12:40:00	628778.90	2375185.08	16:12:00	628718.19	2375200.21
12:41:00	628786.22	2375185.08	16:13:00	628728.59	2375189.13
12:42:00	628758.16	2375184.83	16:14:00	628765.08	2375176.50
12:43:00	628755.27	2375178.92	16:15:00	628805.34	2375178.80
12:44:00	628755.40	2375179.54	16:16:00	628845.73	2375185.13
12:45:00	628755.98	2375178.79	16:17:00	628884.89	2375184.26

Cable Route B

Time	Easting	Northing	Time	Easting	Northing
15:20:43	629240.13	2373995.39	15:40:00	628780.25	2374815.08
15:21:00	629238.98	2374000.91	15:41:00	628752.34	2374862.13
15:22:00	629252.92	2374038.17	15:42:00	628742.39	2374913.08
15:23:00	629230.76	2374066.48	15:43:00	628711.89	2374952.20
15:24:00	629199.69	2374109.26	15:44:00	628674.95	2374987.29
15:25:00	629174.96	2374157.46	15:45:00	628653.65	2375020.45
15:26:00	629145.91	2374206.21	15:46:00	628648.70	2375063.31
15:27:00	629111.05	2374252.65	15:47:00	628635.51	2375099.57
15:28:00	629093.39	2374303.93	15:48:00	628609.16	2375133.84
15:29:00	629065.10	2374343.06	15:50:00	628554.87	2375183.34
15:30:00	629044.23	2374381.06	15:51:00	628539.20	2375209.92
15:31:00	629014.72	2374418.57	15:52:00	628534.84	2375245.31
15:32:00	628995.85	2374461.98	15:53:00	628526.99	2375276.79
15:33:00	628971.11	2374499.94	15:54:00	628509.44	2375303.61
15:34:00	628946.33	2374548.73	15:55:00	628489.76	2375327.29
15:35:00	628924.21	2374594.46	15:56:00	628470.40	2375346.31
15:36:00	628890.45	2374636.54	15:57:00	628456.87	2375373.03
15:37:00	628865.41	2374681.91	15:58:00	628442.27	2375402.83
15:38:00	628833.77	2374727.83	15:59:00	628423.66	2375426.42
15:39:00	628814.17	2374775.22			

Anchor Drops

Time	Easting	Northing	Time	Easting	Northing
16:34:17	628938.80	2374933.91	17:09:00	629064.76	2375464.76
16:35:00	628931.25	2374931.17	17:10:00	629052.61	2375456.40
16:36:00	628936.80	2374929.30	17:11:00	629043.07	2375474.39
16:37:00	628936.48	2374929.41	17:12:00	629044.27	2375474.18
16:53:00	629447.85	2375128.34	17:13:00	629050.08	2375449.39
16:54:00	629449.86	2375157.05	17:14:00	629072.51	2375431.85
16:55:00	629439.45	2375150.51	17:15:00	629077.28	2375445.03
16:56:00	629432.02	2375148.90	17:16:00	629062.92	2375471.61
16:57:00	629427.11	2375146.75	17:19:00	629025.40	2375462.73