SAJ-2004-12518 (SP-JCM)
St. John Marina

Exhibit 9, Attachment A

Survey Report - Geophysical Investigation and Bathymetric Survey

Survey Report
Geophysical Investigation and Bathymetric Survey
St. John Marina

Coral Harbor, Coral Bay
St John, USVI

September 2019

Prepared for:

SUMMER'S END
GROUP

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TABLE OF CONTENTS

INTRODUCTION

Sea Diversified, Inc. (SDI) was contracted by The Summer's End Group, LLC. (SEG) for analysis of their marina development project planned for Coral Harbor, located in Coral Bay, St. John, USVI. The project includes the construction of a fixed dock marina that can accommodate multiple vessels of varying sizes and type. Project plans and other documents provided to SDI indicate the marina will be constructed using pre-manufactured fixed frame dock systems supported by approximately 960 steel pipe piles filled with reinforced concrete. The project is currently under review by the U.S. Army Corps of Engineers (USACE) in consultation with the National Marine Fisheries Service (NMFS) and other federal agencies having jurisdiction to review and comment on the project.

One concern raised by the agencies is the potential impacts to sea turtles, marine mammals and other marine organisms caused by the extent and duration of noise resulting from the pile driving activities. Initial assumptions by project consultants indicate that impact hammers will likely be required for the pile installation. If this method is employed, assuming silty sand and clay conditions, consultants (Technomarine, February 23, 2018) estimated it could take approximately 300 strikes to install each pile to grade based on forty-five (45) foot piles with twenty-five (25) feet of pile embedment. Assuming 960 piles and six (6) piles driven per day there would be a total of 1800 pile strikes each day for a period of 160 days. These estimates were conditioned on actual sediment conditions with the understanding that rock, if encountered within the pile driving profile, could increase the number of required strikes per pile resulting in a longer duration of pile driving activities.

Noise levels developed from pile driving vary with type of pile, characteristics of sediments, water depth, extent of pile penetration and pile driving methodologies. Noise levels produced from piles driven with mechanical impact hammers will vary substantially from piles installed using vibratory hammers. Potential noise impacts have been discussed by the agencies, however it is apparent there was insufficient geophysical data to determine what means and methods of pile driving will ultimately be most practical for the project. Therefore, in order to determine the most practical pile driving techniques and subsequently validate initial estimates of pile driving duration, as relating to assessment of potential noise impacts, the USACE requested verification of the type of sub-surface materials within the footprint of the marina. A specific objective is to determine the presence or absence of hard material within the range of projected pile penetration that could affect overall pile driving methods and associated noise levels produced from the activity.

PROJECT APPROACH

Through coordination with the USACE, a geophysical study comprised of seismic or reflection profiling survey techniques was determined to be an effective means of evaluating sub-surface material conditions within the footprint of the proposed marina. Although there are inherent limitations in the ability to characterize sub-bottom material type through seismic profiling, the system can be very effective in detecting and mapping interfaces between various sedimentary layers beneath the seafloor including the interface between overburden and bedrock. This technology is commonly used to assess variations in sub-bottom material conditions over large areas and is used extensively to determine the location of apparent hardbottom or bedrock to assist in project planning and design initiatives.

SURVEY SCOPE

The geophysical survey was conducted on July 16, 2019 with the assistance of Sonographics, Inc., using a X-Star Full Spectrum Sonar system with Edgetech model SB 216S towfish. The system utilizes CHIRP technology, which enables the acquisition of seismic refection data over many frequency ranges, achieving

great resolution of sub-bottom material stratifications. The survey was conducted using a 50-foot fiberglass vessel, a local vessel of opportunity secured for the project by the client. A Trimble SPS-461 Real-Time Kinematic (RTK) Differential Global Positioning System (DGPS) for vessel positioning and heading. For vessel navigation and data collection / storage, the Coastal Oceanographics' (Xylem) "Hypack" system was utilized. Pre-planned survey transects were established for data collection based on a transect spacing of fifty (50) feet extending northeasterly from the west shoreline of the harbor. See **Figure 1.** However, the presence of numerous moored vessels, vacant mooring systems and other expected submerged obstructions required data collection along randomly spaced meandering lines to avoid collisions and other conflicts.

Figure 1: Planned Survey Lines

As part of the survey effort, SDI collected bathymetric data for purposes of translating or converting seismic reflector data to sub-surface profile elevations relative to the project vertical datum. The survey was conducted using a 35-foot fiberglass vessel equipped with SDI's automated hydrographic survey system. This encompassed an Odom Model CV100 echo-sounder operating at 200kHz with integrated TSS model DMS-05 3-axis motion sensor and a Trimble SPS-461 Real-Time Kinematic (RTK) Differential Global Positioning System (DGPS) for vessel positioning and heading. Data was collected along the same planned survey transects established for the geophysical survey. The sounder was calibrated via bar checks at the beginning of each survey day. Soundings were corrected for tidal fluctuations using an integrated Real-Time

Kinematic GPS. A tide gauge was also established and monitored in proximity to the project area as a redundant means of recording tides during the course of data collection.

SUMMARY OF SURVEY

Project Datum

Horizontal Data:	Feet, relative to WGS-84 ellipsoid, State Plane NAD-83, Zone PR-5200 PR & VI.
Vertical Datum:	Feet, relative to Virgin Island Vertical Datum (VIVD) based on benchmarks previously established on the island

Control

TBM 102	Northing:	844,129.40 (Feet, NAD 83, Zone PR-5200 PR & VI)
	Easting:	1,252,066.15
	Elevation:	4.20 (Feet, VIVD)
	Description:	PK Nail set in paint stripe at edge of road
1373A	Northing:	845,474.87 (Feet, NAD 83, Zone PR-5200 PR & VI)
	Easting:	1,253,190.85
	Elevation:	1.34 (Feet, VIVD)
	Description:	NOS B/D "1373A" 1983

Equipment (Geophysical Survey):

Survey Vessel:	50' Sea Ray, Vessel supplied by SEG
Sub-Bottom Profiler:	EdgeTech 3100-P Portable Sub-Bottom Profiling System w/ SB-216 towfish
Positioning:	Trimble SPS 461 Real Time Kinematic (RTK) Global Positioning System (GPS)
Navigation:	Coastal Oceanographics' (Xylem) "Hypack" software

Equipment (Bathymetric Survey):

Survey Vessel:	35' Intrepid, Vessel supplied by SEG
Sounder:	Odom Model CV100 echo-sounder operating at 200kHz
Motion Sensor:	Teledyne TSS Dynamic Motion Sensor (DMS-05)
Positioning:	Trimble SPS 461 Real Time Kinematic (RTK) Global Positioning System (GPS)
Navigation:	Coastal Oceanographics' (Xylem) "Hypack" software

DATA PROCESSING AND CHART PREPARATION

Upon completion of the sub-bottom profile data collection, seismogram records were reviewed and interpreted by Sonographics. Seismic reflectors, indicative of material changes, were mapped and extracted as ASCII X,Y,Z digital data files and imported into contouring software to produce isopachs of each reflector layer. The deepest reflector was assumed by the interpreter to be the location of bedrock and is considered to be of primary importance to the investigation. Isopach plots depicting the apparent location of bedrock within the proposed marina area are provided, herein as **Sheet SB-1**, **Appendix A**.

Upon completion of the bathymetric data collection activities, data was edited and reduced to the project datum and formatted as required for bathymetric modeling and chart preparation. Final data, reduced to an X,Y,Z, ASCII format was imported to a CADD environment and subsequently translated to Digital Terrain Model (DTM) for generating contour charts and profile plots. Bathymetric contour plots are provided, herein as **Sheet B-1**, **Appendix A**.

RESULTS

Results of the survey indicate that apparent bedrock varies extensively throughout the limits of the proposed marina footprint. This apparent bedrock layer, however was found to be consistently very deep with the shallowest areas mapped at approximately forty (40) feet (12m+/-) below the seafloor extending to as deep as one hundred fifty (150) feet (46m+/-) in certain areas where reflectors were ultimately lost and no longer discernable. Seismic reflectors indicative of varying sedimentary layers above bedrock were identified throughout the project area but were more random in nature. Representative seismogram clips are presented on **Figures 2 - 5**.

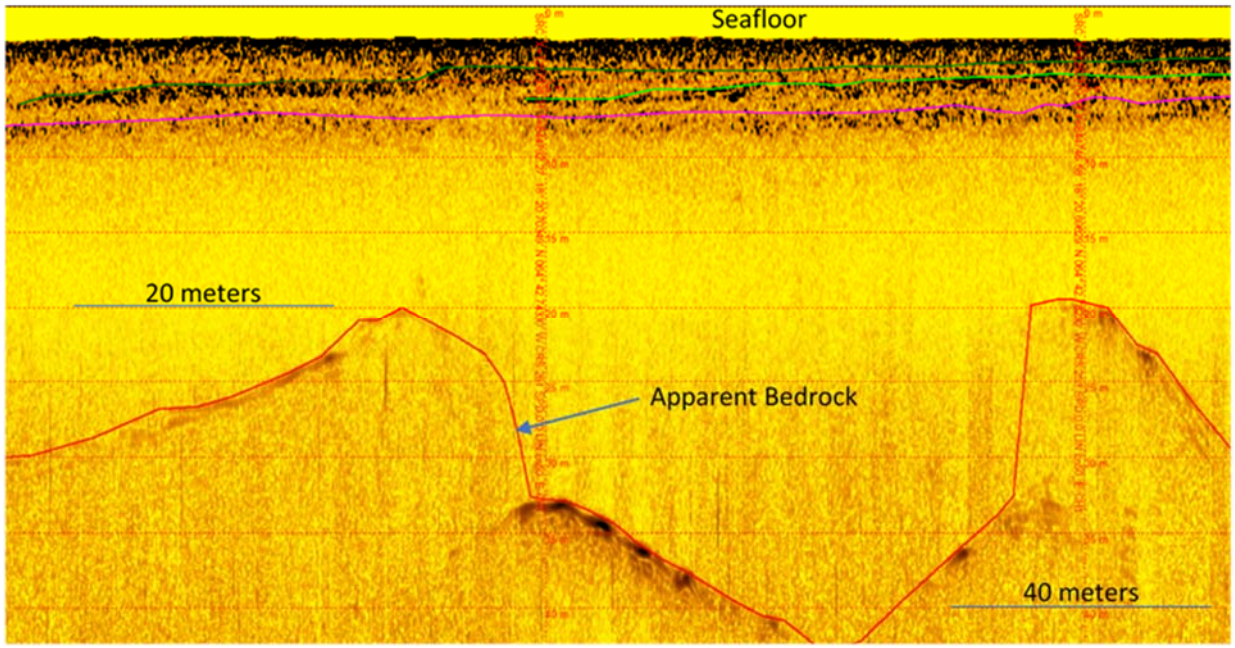


Figure 2: Typical Seismogram Clip

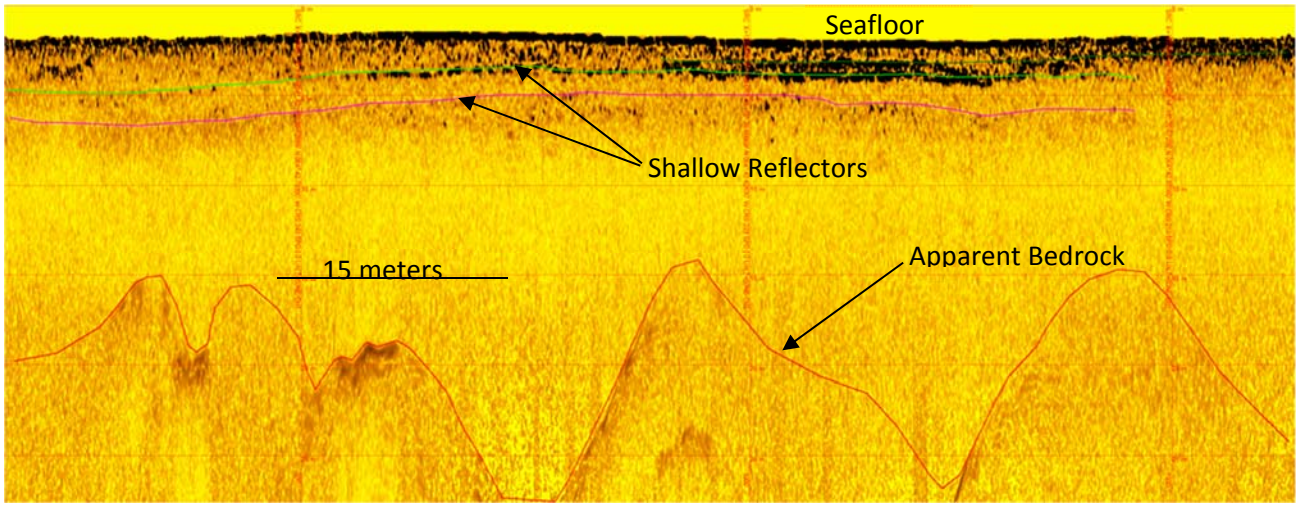


Figure 3: Typical Seismogram Clip

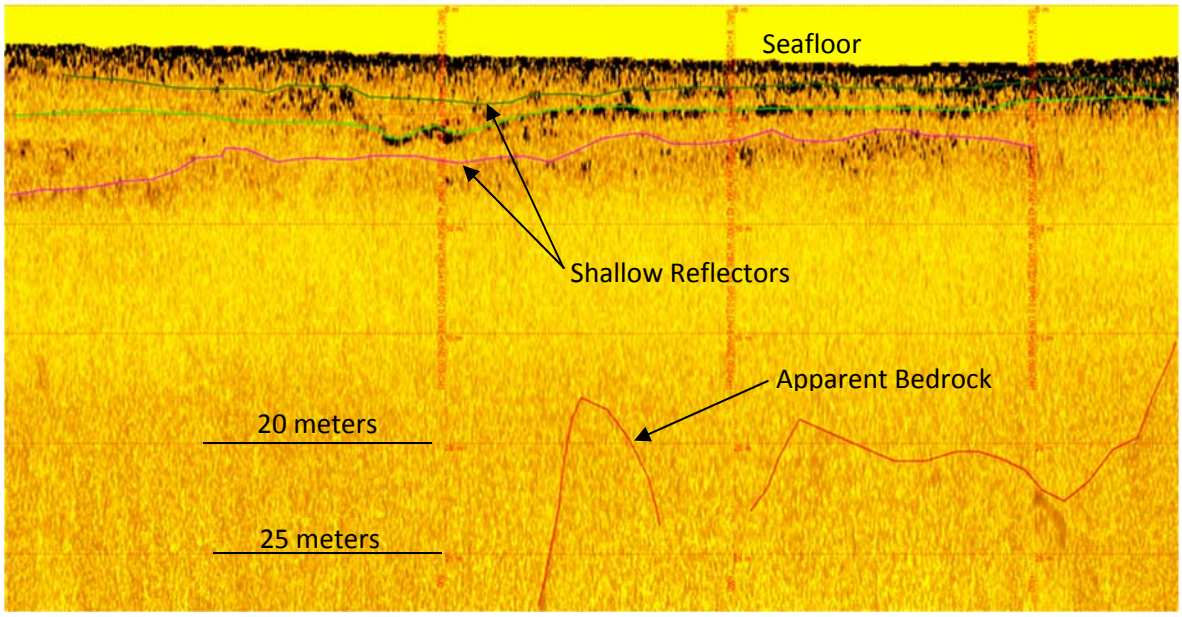


Figure 4: Typical Seismogram Clip

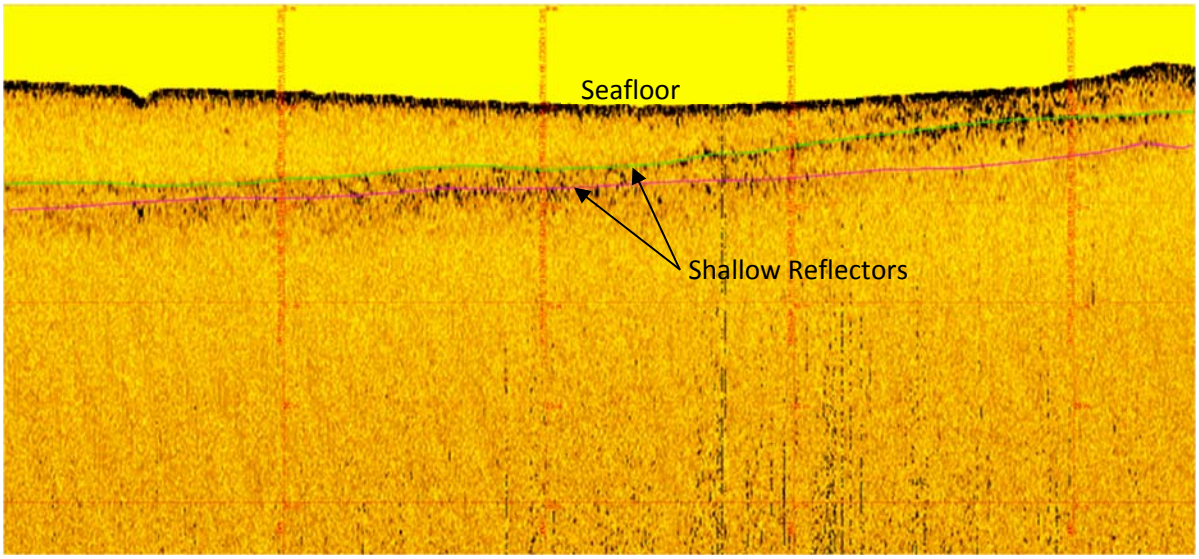


Figure 5: Typical Seismogram Clip

SUMMARY

Based on the results of the geophysical survey, it is apparent that marina piles would not extend to a deep bedrock layer. Therefore, with no evidence of hardbottom material within the projected limits of pile penetration, it is SDI's opinion based on experience with similar projects, that a no-impact, (high frequency / low resonance) vibratory hammer operating at very low noise levels could be used for the installation of steel piles. Project engineers concur and have updated their assumptions on pile driving methods, as well as their predictions on duration of pile driving activities (Technomarine, September 17, 2019 update). They now estimate, based on the new geophysical information, that eight (8) piles could be installed per day instead of their original estimate of six (6) piles per day due to an expected 33% greater efficiency of using vibratory hammers over impact hammers. This would result in 120 days to install 960 piles using a vibratory hammer, 40 days less than their original estimate of 160 days using standard mechanical pile driving techniques. This equates to a 25% reduction in overall time to install the piles from initial estimates.

The fact that a vibratory hammer can likely be used for the pile installation instead of an impact hammer, noise produced from this activity should be substantially minimized. Combined with the reduction in estimated timeframe to install the piles, agency concerns of potential impacts to sea turtles, marine mammals and other marine organisms from the overall pile driving component of the project, should be greatly reduced from what was originally assumed.

APPENDIX A:

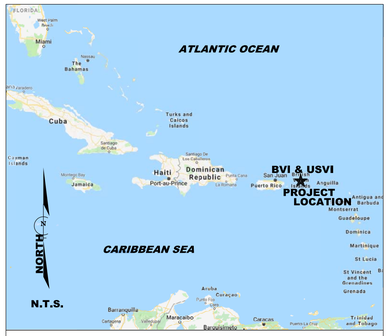
SURVEY MAP REDUCTIONS
Cover – Survey Notes
Bathymetric Survey Contours
Geophysical Isopachs

BATHYMETRIC SURVEY
INCLUDING GEOPHYSICAL INVESTIGATION
CORAL HARBOR, CORAL BAY
ST.JOHN, USVI

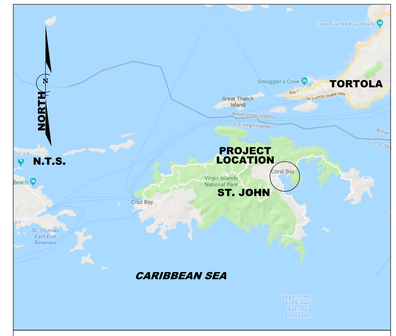
AUGUST 2019

PREPARED FOR:

SUMMER'S END GROUP

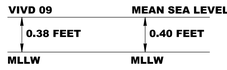


LOCATION MAP



VICINITY MAP

VERTICAL DATUM DIAGRAM



RELATIONSHIP BETWEEN VIVD 09, MLLW AND MSL.
SOURCE: TIDE STATION 9751381 AT LAMESHUR BAY, ST JOHN, VI.

SURVEY CONTROL

CONTROL	SPCS (FT) DATUM: NAD 83 NORTHING	SPCS (FT) DATUM: NAD 83 EASTING	ELEV. (FT) VIVD 09	DESCRIPTION
TBM 102	844,129.40	1,252,066.15	4.20	FND PK NAIL IN ROAD
SDI BASE	844,265.51	1,251.966.95	4.63	SET SPIKE
1373A	845,474.87	1,253,190.85	1.34	NOS B/D "1373A" 1983

AERIAL IMAGE

SHEET INDEX

ORDER	SHEET ID	DESCRIPTION
SHEET 1	C-1	COVER SHEET / SURVEY NOTES
SHEET 2	B-1	BATHYMETRIC CONTOURS
SHEET 3	SB-1	SUB-BOTTOM ISOPACH MAP
SHEET 4	SB-2	SUB-BOTTOM TOPOGRAPHY
SHEETS 5-8	XS-1 THRU XS-4	CROSS SECTIONS

ABBREVIATIONS

FT	FEET
BD	BRASS DISK
MSL	MEAN SEA LEVEL
MLLW	MEAN LOWER LOW WATER
NAD 83	NORTH AMERICAN DATUM OF 1983
VIVD 09	VIRGIN ISLAND VERTICAL DATUM OF 2009
NOS	NATIONAL OCEAN SERVICE
SPCS	STATE PLANE COORDINATE SYSTEM
FND	FOUND

SURVEY NOTES:

1. REFER TO SEA DIVERSIFIED PROJECT NUMBER 19.2768
2. THIS HYDROGRAPHIC SURVEY WAS PERFORMED AT THE REQUEST OF THE SUMMER'S END GROUP, LLC.
3. THIS SURVEY WAS CONDUCTED ON JULY 16 & 19, 2019.
4. THE INFORMATION DEPICTED HEREIN REPRESENTS THE RESULTS OF THE SURVEY ON THE DATE INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THE TIME.
5. HORIZONTAL DATA ARE IN UNITED STATES SURVEY FEET AN RELATIVE TO THE STATE PLANE COORDINATE SYSTEM BASED ON THE TRANSVERSE MERCATOR PROJECTION FOR PUERTO RICO & THE VIRGIN ISLANDS (5200), NORTH AMERICAN DATUM (NAD) OF 1983, 1990 ADJUSTMENT. VERTICAL DATA ARE IN FEET AND RELATIVE TO THE VIRGIN ISLANDS VERTICAL DATUM OF 2009 (VIVD 09).
6. GEOPHYSICAL SEISMIC DATA WAS COLLECTED USING A 50' SURVEY LAUNCH EQUIPPED WITH TRIMBLE DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS) FOR POSITIONING. DIFFERENTIAL CORRECTIONS WERE ACQUIRED FROM THE U.S. COAST GUARD NAVIGATION BEACON SYSTEM. HORIZONTAL POSITION ACCURACY WAS VERIFIED USING SURVEY CONTROL POINTS LISTED HEREIN. SEISMIC DATA COLLECTED USING AN EDGETECH 3100P PORTABLE SUB-BOTTOM PROFILER WITH AN EDGETECH TOWFISH MODEL SB 216S OPERATING FREQUENCY BETWEEN 2-16 kHz.
7. BATHYMETRIC DATA WAS COLLECTED USING A 35' SURVEY LAUNCH EQUIPPED WITH TRIMBLE REAL-TIME KINEMATIC (RTK) DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS) FOR POSITIONING AND AN ODOM CV100 SOUNDER USING A 200kHz NARROW BEAM TRANSDUCER. DIFFERENTIAL CORRECTIONS WERE ACQUIRED FROM THE U.S. COAST GUARD NAVIGATION BEACON SYSTEM. HORIZONTAL POSITION ACCURACY WAS VERIFIED USING SURVEY CONTROL POINTS LISTED HEREIN. THE SOUNDER WAS CALIBRATED PRIOR TO THE START OF THE SURVEY FOLLOWING MANUFACTURER RECOMMENDED PROCEDURES
8. AERIAL IMAGERY DATED FEBRUARY 2017, SOURCE GOOGLE EARTH.

DRAFT

REVISIONS:

NO.:	DATE:	DESCRIPTION:

PROJECT: BATHYMETRIC SURVEY INCLUDING GEOPHYSICAL INVESTIGATION CORAL HARBOR, CORAL BAY ST. JOHN, USVI AUGUST 2019

SHEET TITLE: COVER / SURVEY NOTES

PREPARED FOR: SUMMER'S END GROUP
5000 ESTATE ENIGHED #63
ST. JOHN, USVI 00830

PREPARED BY:
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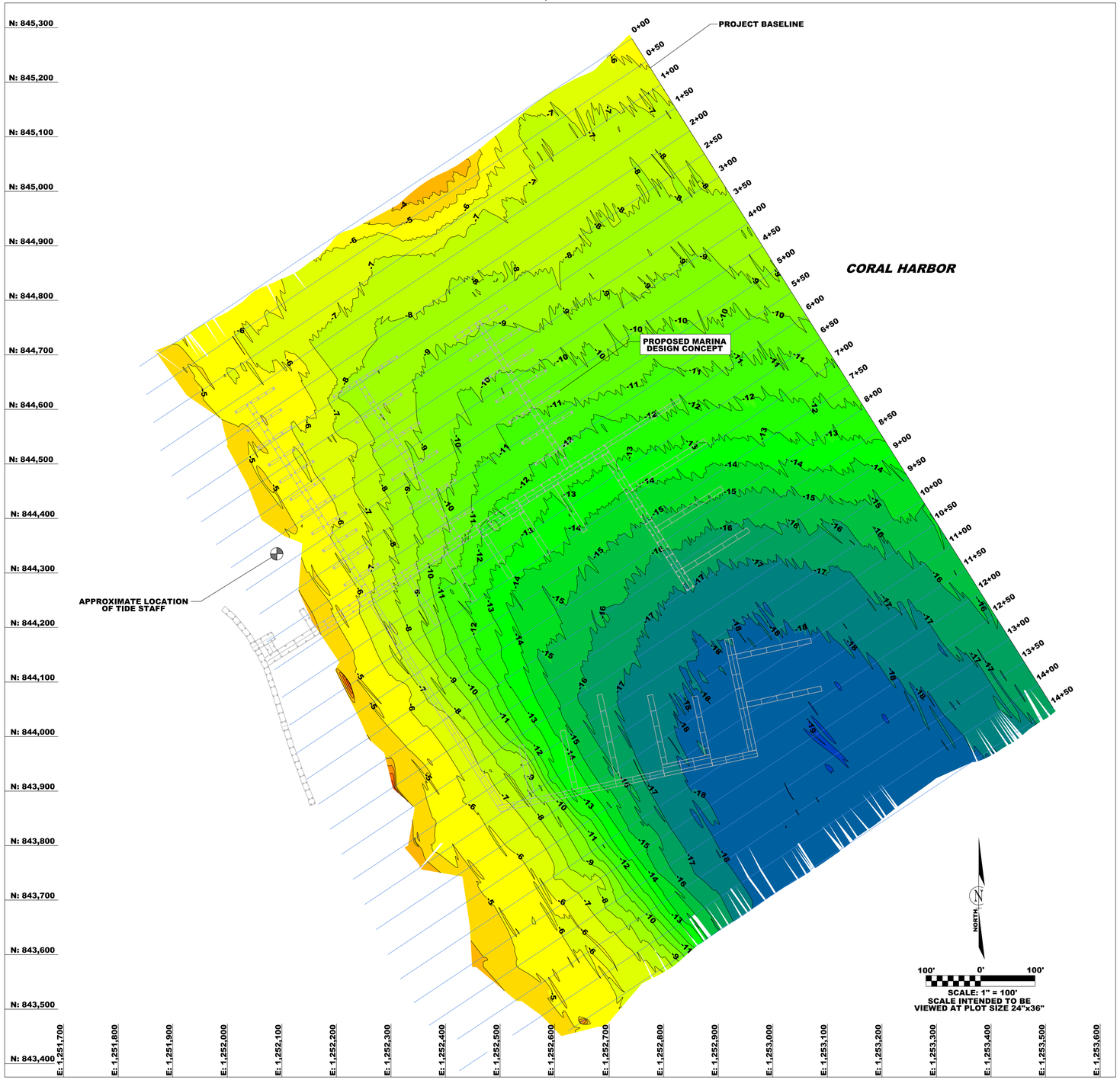
SEA DIVERSIFIED

DATE:	AUGUST 2019
DRAWN BY:	B.N.W.
CHECKED BY:	R.W.B.
SCALE:	AS SHOWN
SHEET:	C-1

CADD ID:
TOTAL NUMBER OF SHEETS: 7

SDI P.N. 19-2768

NOTE: CONTOURS ARE DEPICTED AT ONE-FOOT INTERVALS RELATIVE TO VIVD 2009, REFER TO COVER SHEET FOR SURVEY DETAILS.



COLOR BAR

(-)4.0' TO (-)5.0'
(-)5.0' TO (-)6.0'
(-)6.0' TO (-)7.0'
(-)7.0' TO (-)8.0'
(-)8.0' TO (-)9.0'
(-)9.0' TO (-)10.0'
(-)10.0' TO (-)11.0'
(-)11.0' TO (-)12.0'
(-)12.0' TO (-)13.0'
(-)13.0' TO (-)14.0'
(-)14.0' TO (-)15.0'
(-)15.0' TO (-)16.0'
(-)16.0' TO (-)17.0'
(-)17.0' TO (-)18.0'
(-)18.0' TO (-)19.0'
(-)19.0' TO (-)20.0'

DRAFT

REVISIONS:

NO.:	DATE:	DESCRIPTION:

PROJECT:
BATHYMETRIC SURVEY INCLUDING GEOPHYSICAL INVESTIGATION CORAL HARBOR, CORAL BAY ST. JOHN, USVI AUGUST 2019

SHEET TITLE:
BATHYMETRIC CONTOURS

PREPARED FOR:
SUMMER'S END GROUP
5000 ESTATE ENIGHED #63
ST. JOHN, USVI 00830

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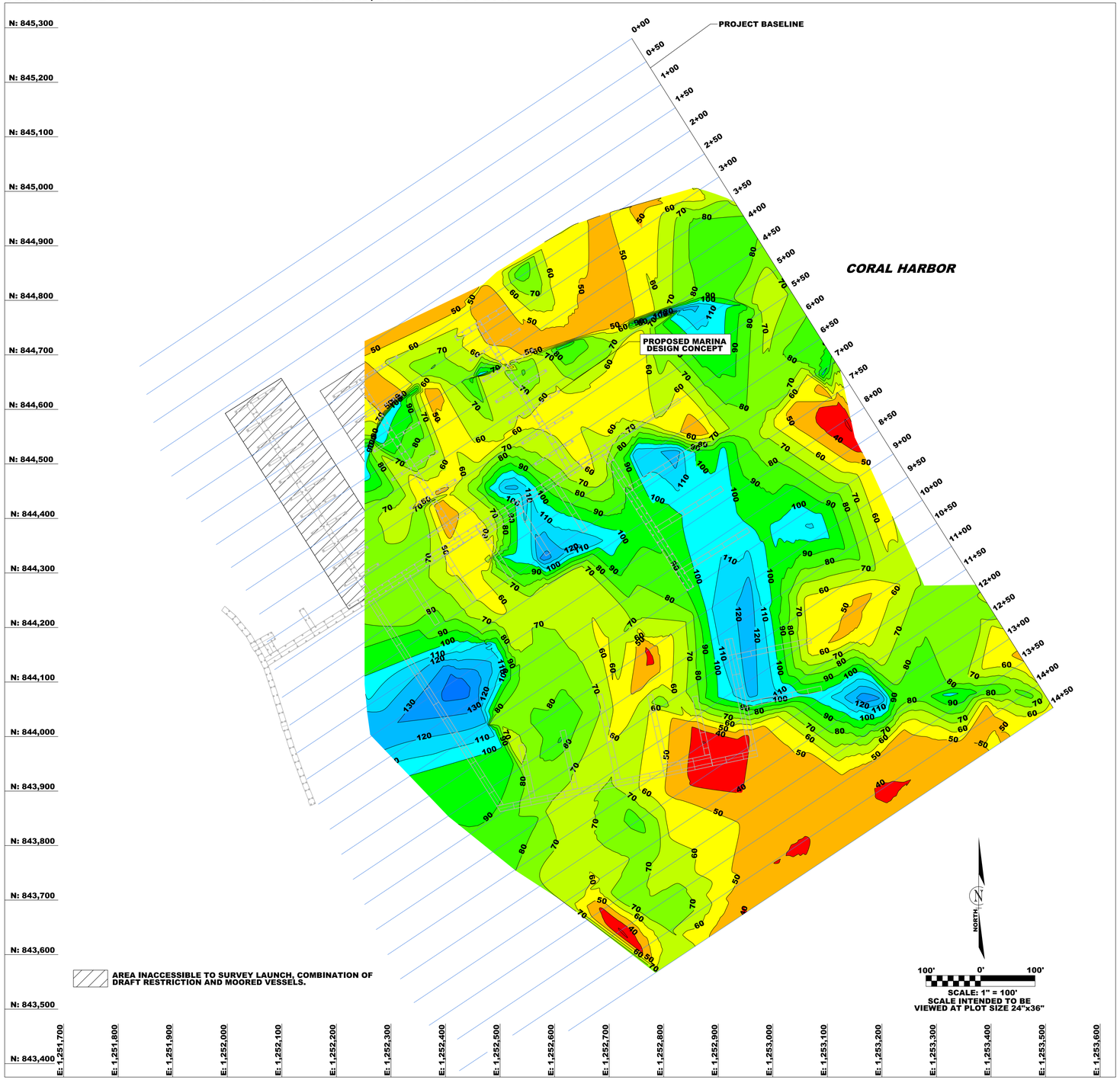
CADD ID:	
TOTAL NUMBER OF SHEETS:	

SDI P.N. 19-2768

NOTE: ISOPACH PLOT DEPICTS THE SEDIMENT THICKNESS BETWEEN SEAFLOOR AND THE DEEPEST SEISMIC REFLECTOR, WHICH IS ASSUMED TO BE BEDROCK. REFER TO GEOTECHNICAL REPORT PREPARED BY SEA DIVERSIFIED, DATED AUGUST 2019.



ISOPACH COLOR BAR

30.0' TO 40.0'
40.0' TO 50.0'
50.0' TO 60.0'
60.0' TO 70.0'
70.0' TO 80.0'
80.0' TO 90.0'
90.0' TO 100.0'
100.0' TO 110.0'
110.0' TO 120.0'
120.0' TO 130.0'
130.0' TO 140.0'
140.0' TO 150.0'

DRAFT

REVISIONS:

NO.:	DATE:	DESCRIPTION:

PROJECT:
BATHYMETRIC SURVEY INCLUDING GEOPHYSICAL INVESTIGATION CORAL HARBOR, CORAL BAY ST. JOHN, USVI AUGUST 2019

SHEET TITLE:
ISOPACH CONTOURS

PREPARED FOR:
SUMMER'S END GROUP
5090 ESTATE ENIGHED #63
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SCALE:	AS SHOWN

SHEET:
SB-1

CADD ID:
TOTAL NUMBER OF SHEETS:

SDI P.N. 19-2768