Announcement M13AS00014: Hurricane Sandy Coastal Recovery and Resiliency – Resource Identification, Delineation and Management Practices

Agreement M14AC00002: NJGWS Post Hurricane Sandy Offshore New Jersey Sand Resources Investigation

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Cooperative Agreement Project Deliverables:

Deliverable D

Preliminary Data Synthesis and Assessment of

Northern Atlantic County Offshore Sand Resource Areas

U.S. Dept. of the Interior

Bureau of Ocean Energy Management

Cooperative Agreement Number M14AC00002

Submitted by Katie Diaz

New Jersey Geological and Water Survey

New Jersey Dept. of Environmental Protection

April 2018

New Jersey Geological and Water Survey (NJGWS) conducted an analysis of seismic data acquired by NJGWS in 1997 and 2003 to locate, describe, and identify potential sand resources in offshore Northern Atlantic County, New Jersey. Lithologic data from 49 vibracores collected by NJGWS and the U.S. Army Corps of Engineers (USACE) in 1997, 2001, 2003, 2004, and 2011 were used to correlate features traced by reflectors in the seismic data.

The lithologic data within the NJGWS and USACE vibracores were categorized into groups of favorable and unfavorable material for beach replenishment. Factors used to determine a suitable sand resource include grain size, color, amount of shells, features present on corresponding seismic lines, and abundance of sand within the core. Available data used to categorize these cores includes grain size analysis, lithologic descriptions, and pictures taken of the cores.

SonarWiz™6 software was used to analyze seismic data. Sand shoals were delineated by tracing reflectors in the seismic profile and correlated with available vibracore data. If the vibracore data was favorable within the traced shoal feature, the shoal was identified, and a thickness was calculated. The thickness of the sand shoal was calculated in SonarWizTM6 by converting the two-way travel time from the traced seafloor to the base of the sand shoal reflector using an acoustic velocity of 1750 meters per second. The data was exported into Surfer™12 software to create contour maps and calculate volumetric data. Volumes were calculated at base of sand (Z = 0), leaving a 5-foot thickness of sand behind (Z = 5), and leaving a 10-foot thickness of sand behind (Z = 10). The contour maps were overlain with seismic lines, vibracore locations, and previous sand resource borrow areas to create a comprehensive map (Figure 1).

Within the Northern Atlantic County study area, three potential sand resource areas (Figure 2) have been identified containing an estimated 108,700,000 cubic yards of sand (Table 1).

1. Northern Shoal – located parallel to Brigantine Inlet, this shoal feature is in the northern portion of the study area (Figures 3 and 4).

2. Central Shoal – located in the central section of the study area, this shoal feature has the largest surface area of all three shoals (Figures 5 and 6).

3. Southern Shoal – this shoal feature consists of two notable sand resource potential areas with a high percentage of material located 13 to 25 feet above the ocean floor. To note, part of this feature falls within a previously noted sand resource borrow area (Figures 7 and 8).

After analyzing the seismic lines in the Northern Atlantic County study area, there are several lines that have potential shoal features but no supporting vibracore data. Table 2 presents preliminary suggestions for new vibracore locations along with their positioning, associated lines, and commentary regarding their importance. Corresponding reconnaissance level Chirp data collected by CB&I in 2015 were excluded from this assessment due to an abundance of poor unusable data. Further discussion on quality of CB&I Chirp data is discussed in Deliverable F. The lines and features were untraceable due to noise, static, and a high number of multiples. There were indications of features in some locations, but they never extended far enough to be utilized. For example, USACE vibracore NJV-020 (located at the intersection of lines 45 and 54) indicated 15 feet of medium to coarse quartz sand suitable for nourishment, but any attempt to trace this feature beyond the intersection was futile due the poor data.

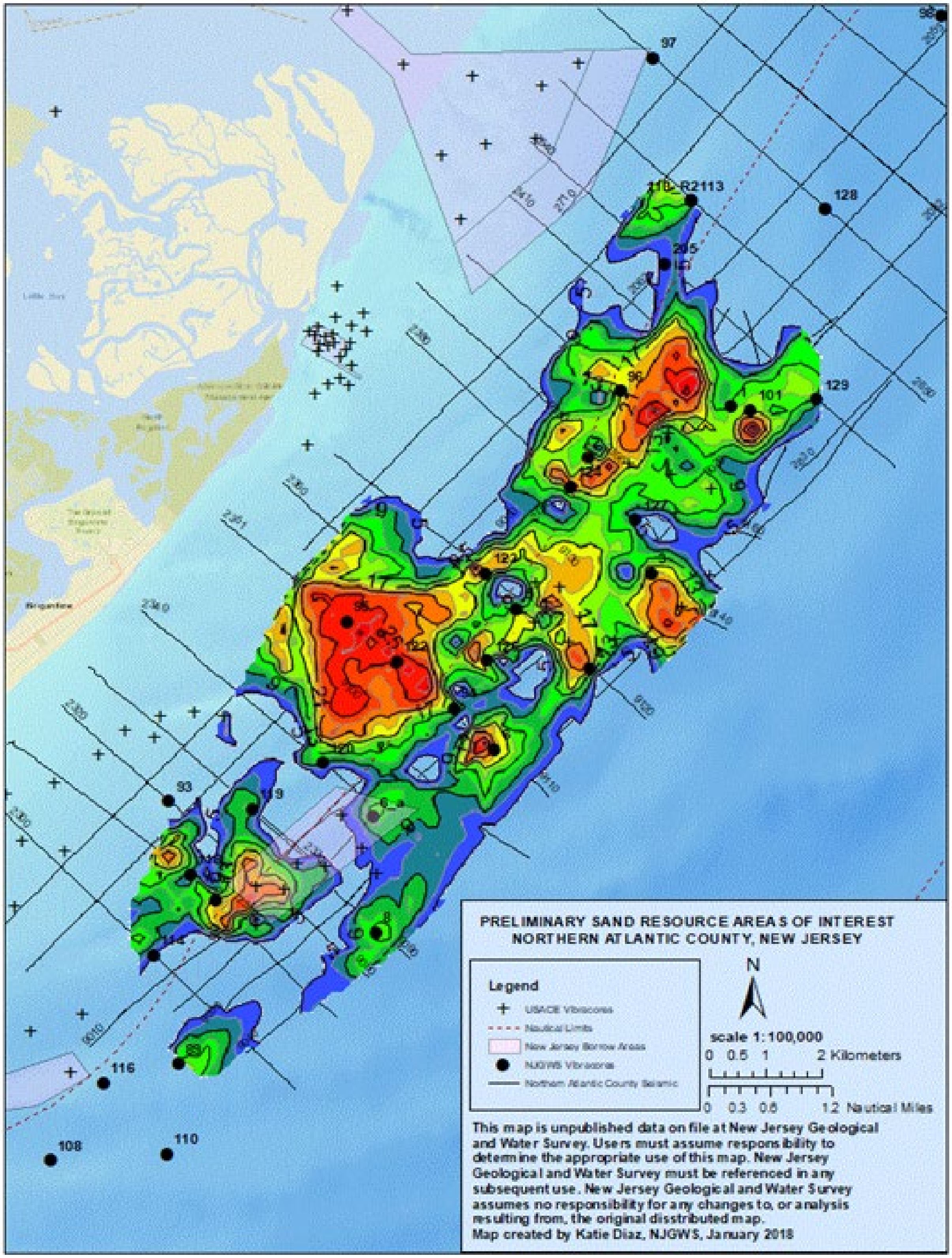

Figure 1. Northern Atlantic County Study Area overlain with vibracores (NJGWS and USACE), seismic lines, shoal features, and previous borrow areas.

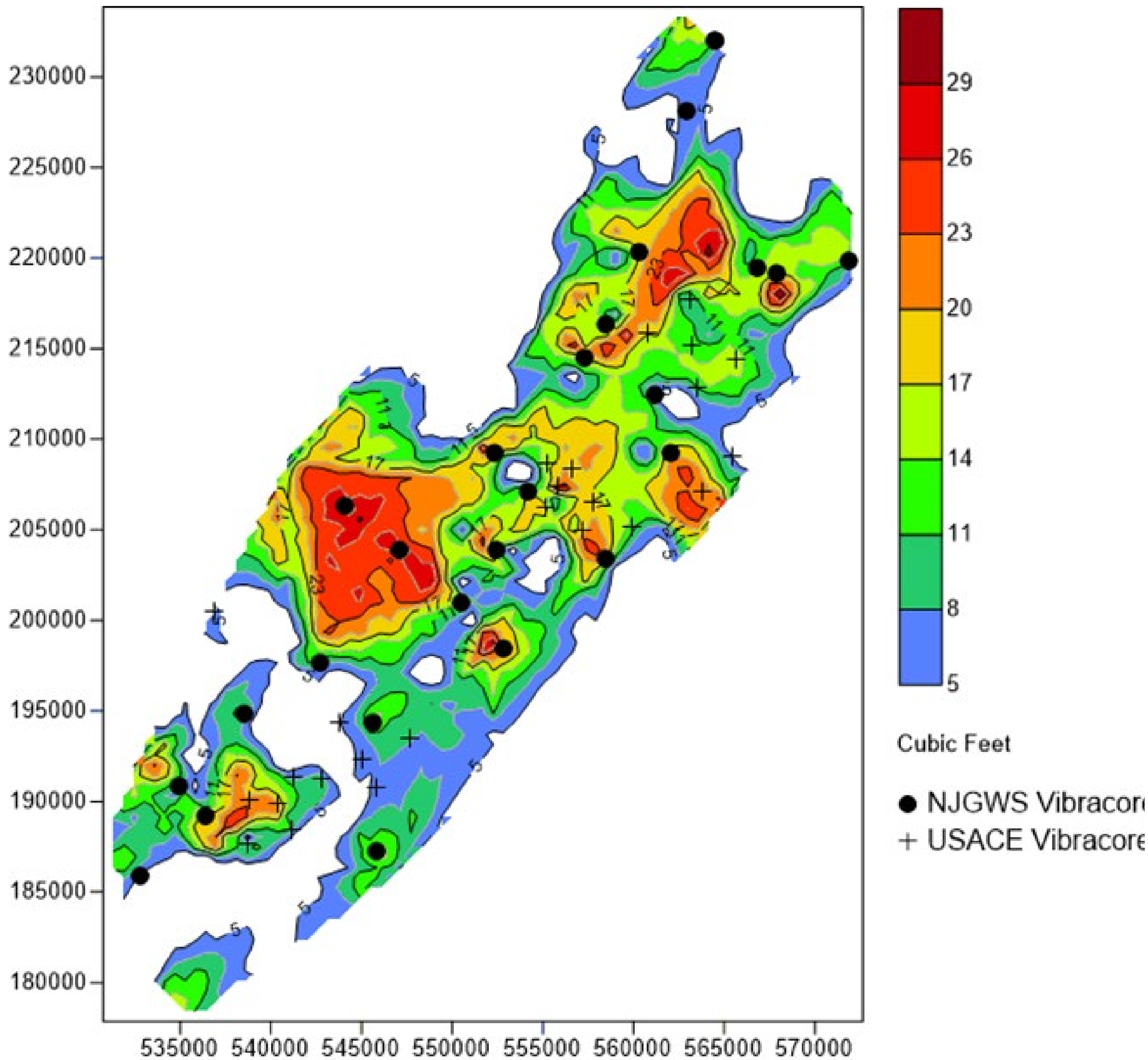

Figure 2. Northern Atlantic County Study Area showing contours beginning at 5ft thickness.

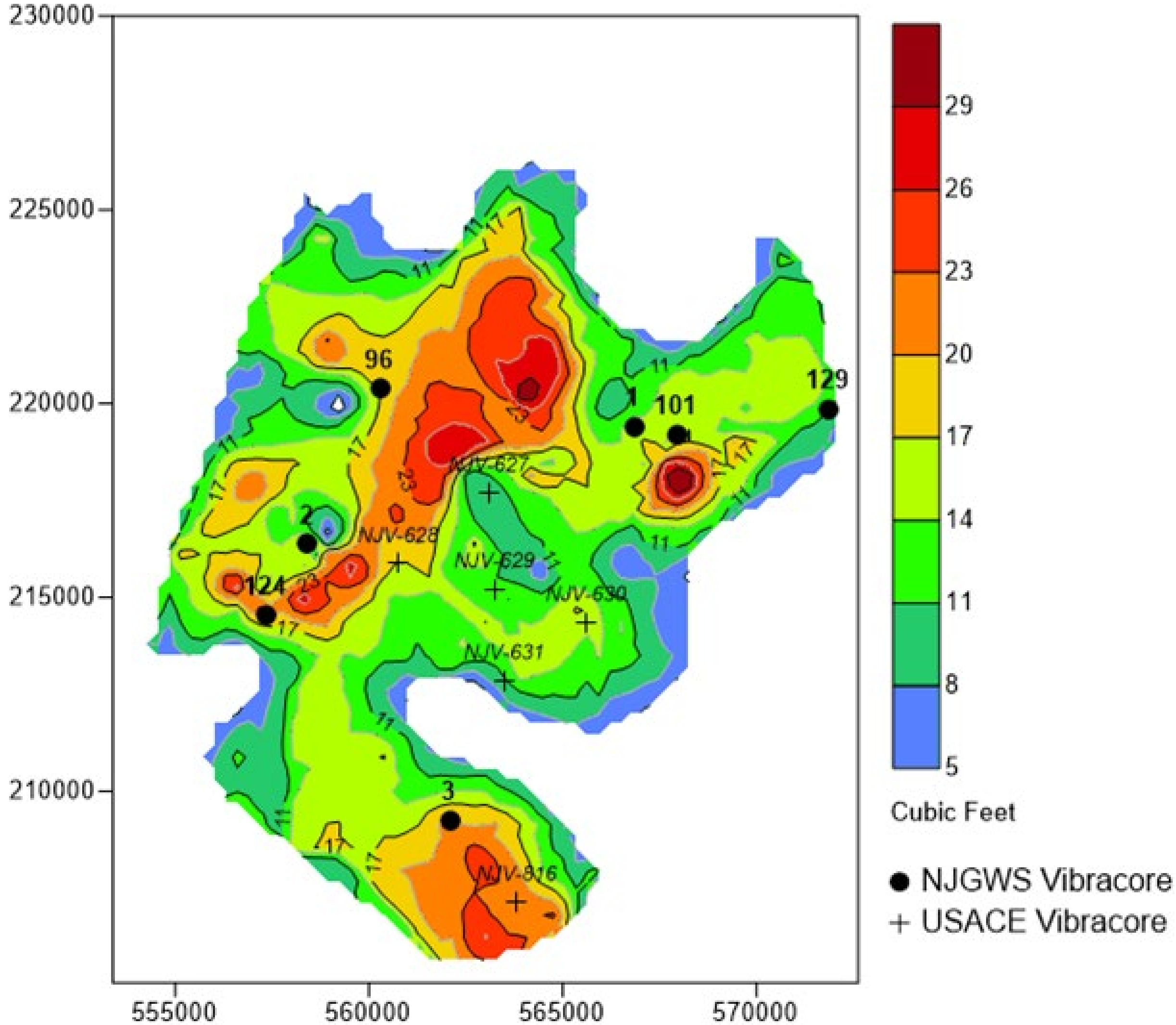

Figure 3. Northern Shoal showing contours beginning at 5ft thickness.

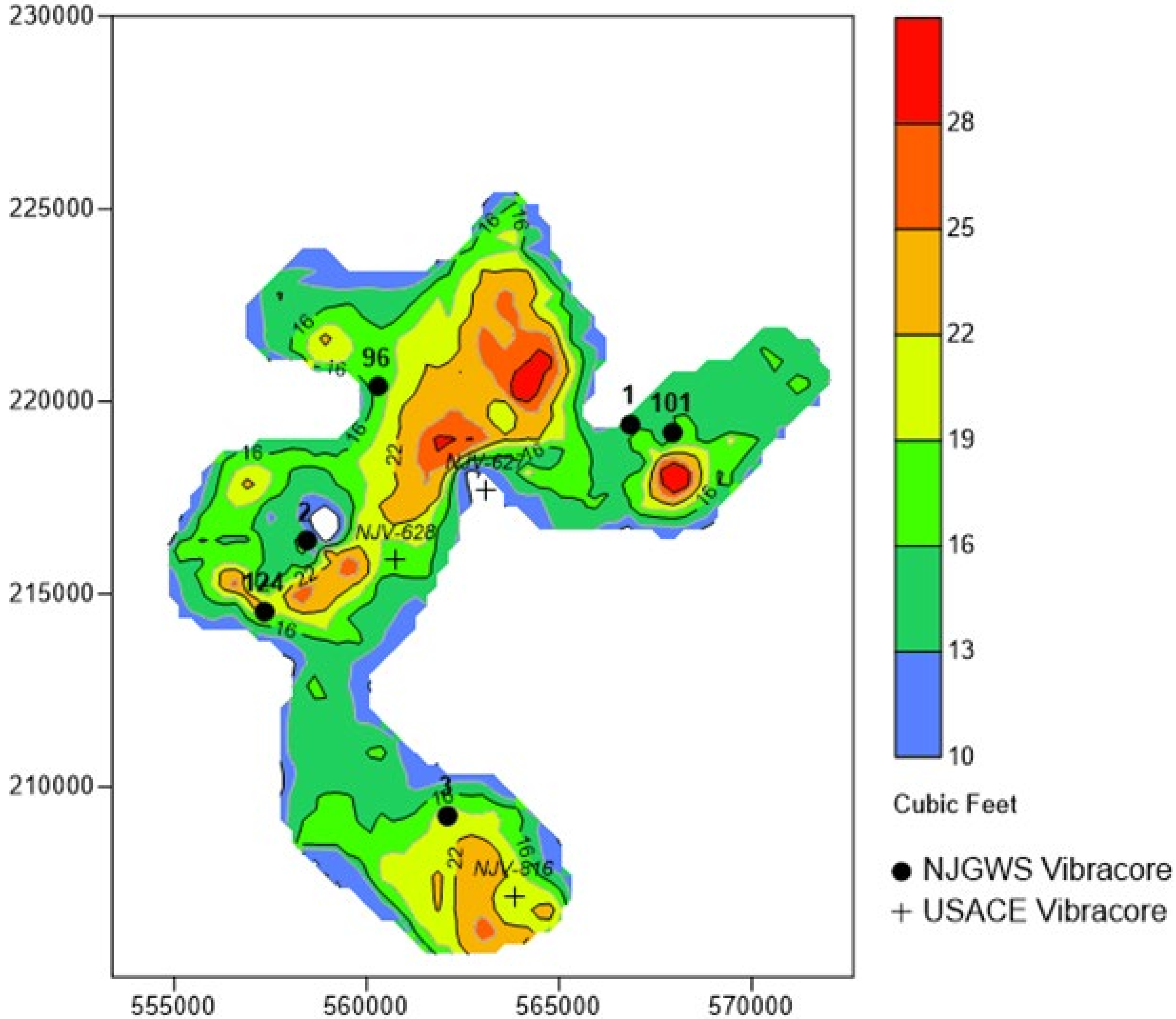

Figure 4. Northern Shoal showing contours starting at 10ft thickness.

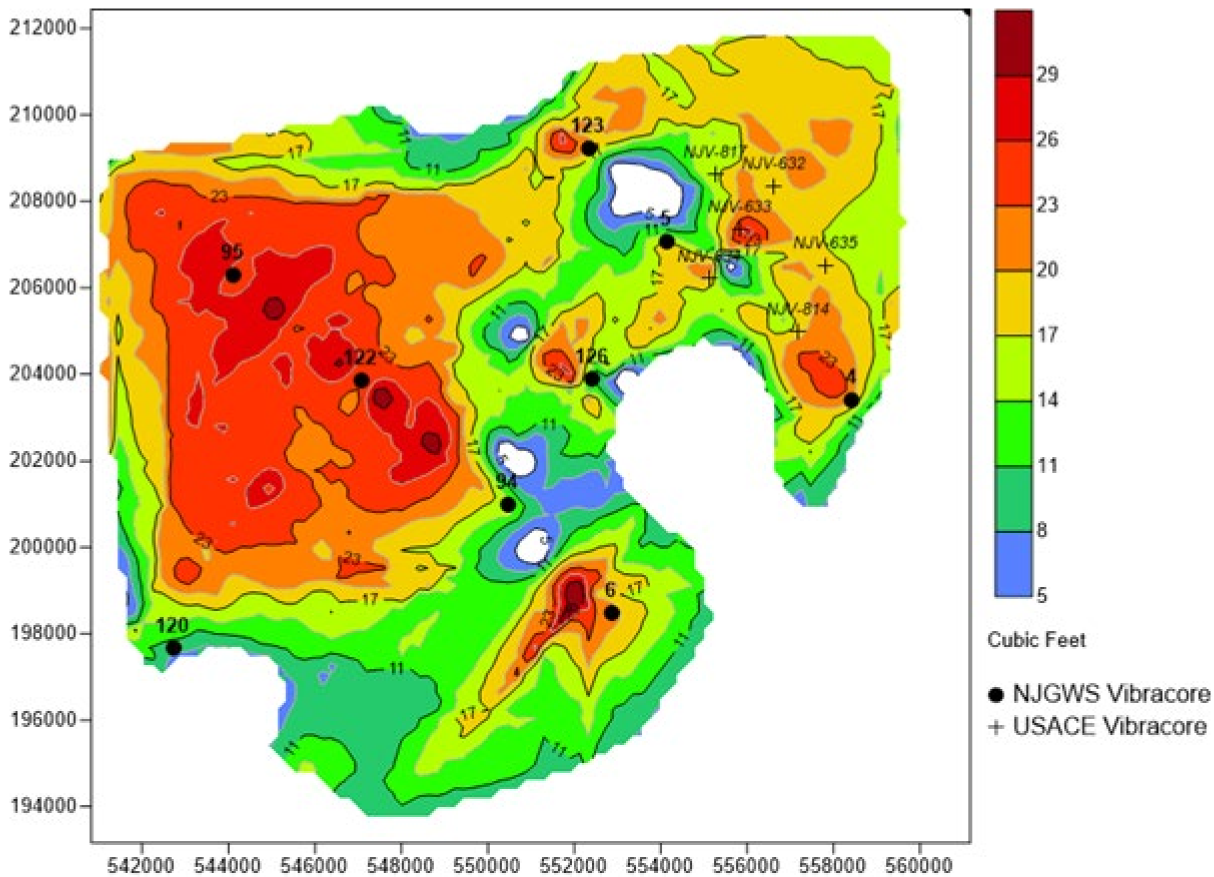

Figure 5. Central Shoal showing contours beginning at 5ft thickness.

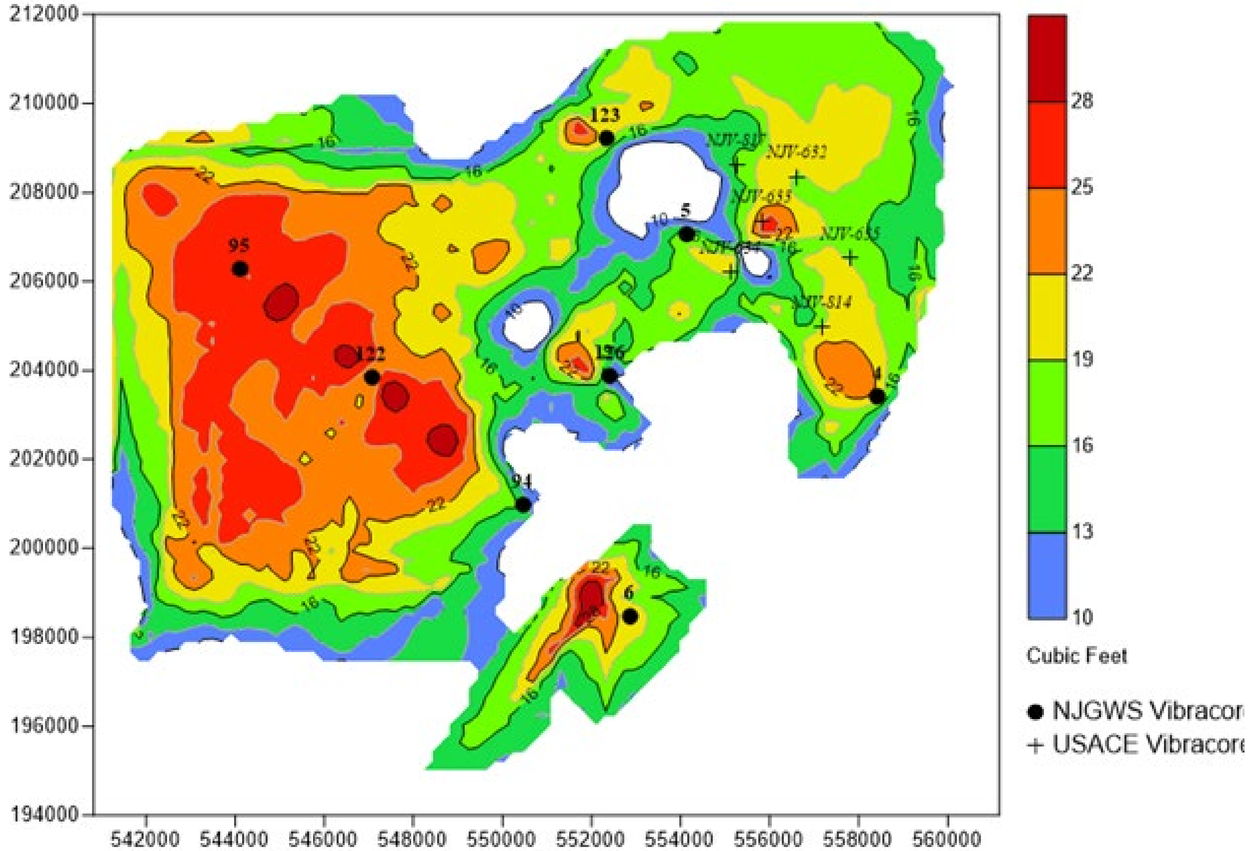

Figure 6. Central Shoal showing contours beginning at 10ft thickness.

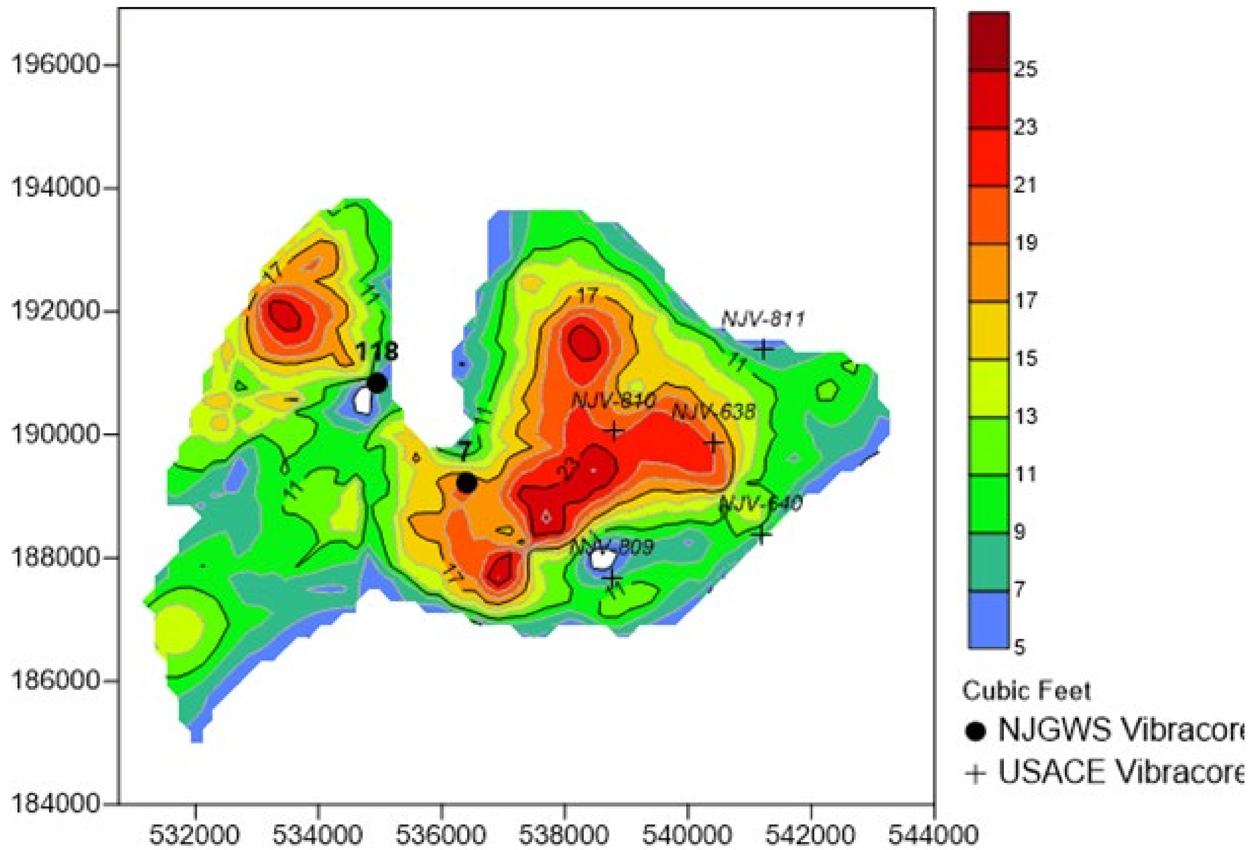

Figure 7. Southern Shoal showing contours beginning at 5ft thickness.

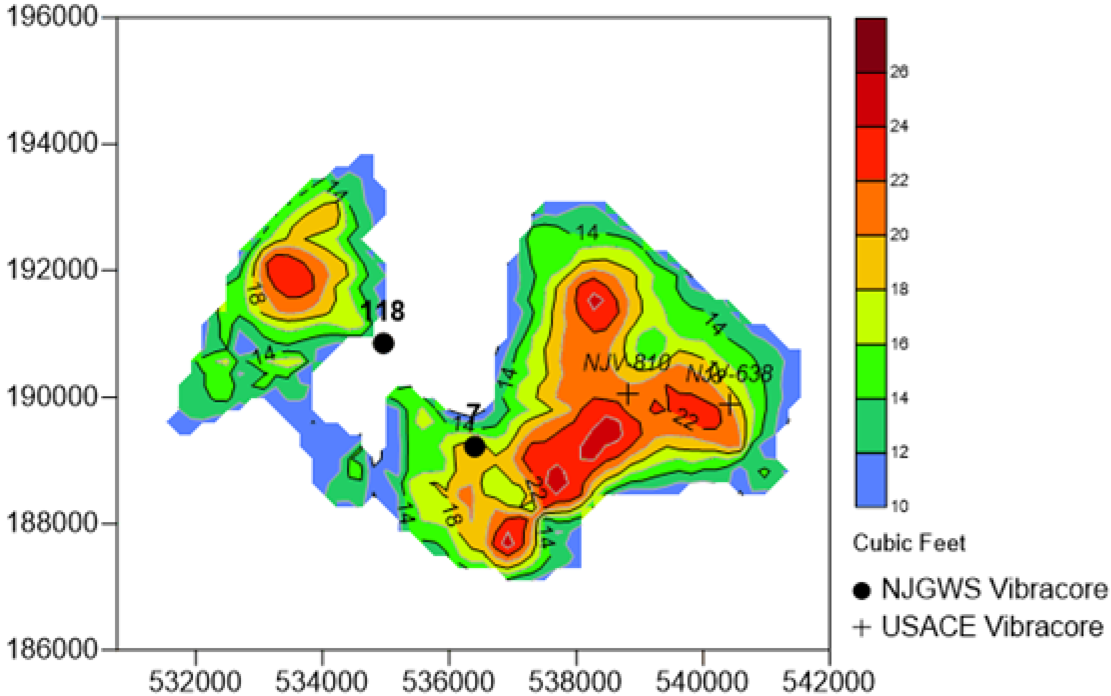

Figure 8. Southern Shoal showing contours beginning at 10ft thickness.

Shoal Name	Seismic Lines	Vibracores	Z = 0 (*cubic yards*)	Z = 5 (*cubic yards*)	Z = 10 (*cubic yards*)
Northern Shoal	9020, 9040, 9050, 9140, 9150, 9160, 9170, 2032, 2400, 2640, 2650, 2750	1, 2, 3, 13, 96, 101, 124, 129, NJV-628, NJV-631	118,308,355	77,894,771	37,481,187
Central Shoal	9010, 9020, 9110, 9120, 2032, 2041, 2340, 2351, 2370, 2360	4, 5, 5 Trace, 6, 6a, 94, 95, 120, 122, 123 Trace, 126, NJV-632, NJV-633, NJV-634 Trace, NJV-635	152,795,262	108,727,263	64,659,263
Southern Shoal	9010, 9020, 9070, 9080, 9090, 2300, 2310, 2330, 2280	7, 8, 89, 114, 118, 118 Trace, 119, NJV-638, NJV-640	29,360,567	17,956,122	6,551,677

Table 1. Shoals in Northern Atlantic County with corresponding seismic lines, vibracores (NJGWS and USACE), and volumetric data.

North Atlantic County Vibracore Location Picks				
Core Number	Northing	Easting	Associated Lines	Explanation
1	186432.35	526625.66	2280, 2050, 2053	Feature seen on 3 intersecting lines, within 3-mile range
2	192712.65	540958.74	2330, 9010, 2032	Potential shoal seen on 3 lines, outside of 3-mile range
3	178927.02	538616.05	2011, 2300	Pinching out edge of shoal, outside of 3-mile range
4	216453.67	555401.61	2380, 2053	Edge of possible shoal, close to 3-mile range
5	214281.22	557751.37	2380, 9050	Other edge of possible shoal, connected to 5, close to 3-mile range
6	221475.44	565538.09	2410, 2750	Interesting feat. Getting end of shoal, near 3-mile range
7	225133.86	555077.36	2400, 2072	No cores nearby, within 3-mile range, could be useful
8	209728.23	539978.42	2351, 2071	No cores nearby, within 3-mile range, potential shoal feature

Table 2. Preliminary suggestions of additional offshore coring sites within the Northern Atlantic County area.

Deliverable E

F1 Technical Report

An Evaluation of Optimal Seismic Line Spacing and Placement for Delineating Design Level Offshore Sand Resource Areas

U.S. Dept. of the Interior

Bureau of Ocean Energy Management

Cooperative Agreement Number M14AC00002

Submitted by Michael Castelli, Senior Geologist

New Jersey Geological and Water Survey

New Jersey Dept. of Environmental Protection

April 2018

Introduction

The goal of this study was to characterize the sand resource within the F1 area based on the new seismic and core data collected by CB&I and detail the efficacy of the design level survey completed by CB&I. Area F1 is located approximately 6.3 nautical miles offshore of Toms River Township, Ocean County New Jersey. This project conducted an analysis of both the reconnaissance data collected in 2015 and the design level data collected in 2016 by Chicago Bridge and Iron (CB&I) for the Bureau of Ocean Energy Management (BOEM) as part the Atlantic Sand Assessment Project. There were six reconnaissance level CHIRP sub-bottom seismic lines and two reconnaissance level vibracores collected in F1. The design level survey of F1 consisted of 97 CHIRP sub-bottom seismic lines collected in a northwest- southeast orientation at approximately 30-meter spacing. Geologic data was collected from 31 locations in the form of 20-foot vibracores.

The New Jersey Geological and Water Survey (NJGWS) had previously conducted a preliminary analysis of sand resource areas in northern Ocean County that included a volumetric calculation for area F1 (Kuhn et. al., 2016). This assessment was completed during a cooperative agreement with BOEM, number M14AC00002. The assessment analyzed 10 seismic lines and 5 vibracores for the F1 area, all of which were collected by the NJGWS. The assessment calculated a 5-foot volumetric of 19,770,726 cubic yards of sand in area F1 (Kuhn et. al., 2016). This study compared our initial sand resource evaluation with a newly created one using the design level data and makes recommendations about whether the tight grid spacing of seismic lines and vibracores was necessary.

Methods

The CHIRP data analyzed in this study was collected by CB&I using an EdgeTech™ SB-0512i 3200 High Penetration Sub-Bottom Profiler. SoanrWiz™7 software was used to analyze the seismic and vibracore data. Sand reflectors were traced where the base of the sand reflector is evident in the seismic profile. The sand reflectors were traced by only one person to maintain consistency. Vibracore data was analyzed and plotted onto the seismic profiles to ground-truth the reflector that delineates the base of sand. The thickness of the sand in each seismic line was calculated in SonarWiz™7 by converting the two-way travel time from the seafloor to the base of the sand assuming an acoustic velocity of 1750 meters per second. The result was exported as an XYZ text file where Z represented sand thickness in feet. The data was then imported into Surfer™12 software to create sand thickness isopach maps and calculate sand volumes. The isopach maps created in Surfer™ 12 were blanked at the 5-foot thickness contour to only provide a volume for the shoal areas that were at least five feet thick. The sand volumes calculated in Surfer™12 are in cubic feet and converted to cubic yards for use by client agencies.

To determine the most efficient line spacing for a design level survey a center fix point in the shoal was chosen. Seismic line NJ_DL_331 was chosen as the center fix point as it was located directly in the center of all the data collected over area F1. In consultation with BOEM and a NJDEP statistician we originally chose to calculate volumes for differing line spacings outward from the center fix point until a 10% variation from the original calculated volume was reached. This variation was reached in tighter line spacings than expected so calculations were continued for increased line spacings. A trend in the data showed that line spacing was not the only factor affecting the variation. Line placement and the data coverage of both the flanks and center of the shoal also affected the amount of variation in the sand volume calculations.

The 60-meter line spacing was attained by choosing every other line and using those lines to determine a volume of sand (figure 3 and figure 4). For the next calculation, 90-meter spacing, every third line was chosen (figure 5) and used to calculate the volume of sand. This process was repeated for every 4th line form the center point (120-meter spacing), 5th line (150-meter spacing), etc. Due to each line being spaced 30 meters apart, each new iteration would increase the line spacing by 30 meters. This was completed for line spacing out to 480 meters. Beyond this line spacing volume calculations were only conducted for line spacings that had full flank and center coverage of the shoal, due to the noticed trends in the data showing the importance line placement has on the volume calculation. 720 and 960 meters volume calculations had very low percent variations so additional calculations for line spacings between 480 meter and 960 meter spacing was deemed to be unnecessary. Line spacing of 960 meters only used 4 seismic lines so the only other possible increase in line spacing was 1440 meters, which used 3 seismic lines. No calculations beyond this line spacing were computed because there would not have been enough data used to define the shoal.

The volumes calculated using the selected lines of a certain spacing were compared to the volume calculated at 30-meter spacing. This original volume was calculated using all 97 seismic lines and was considered the control for the experiment. A comparison of the original calculated volume to a volume calculated using only vibracore data and no seismic data was also conducted. The location of each vibracore and the thickness of sand was imported into Surfer12 as an XYZ text file.

Results

The sand volume calculated using all 97-design level seismic lines and 31 vibracores was 15,286,148 cubic yards. This volume was calculated using all the available data in this study so it is the most accurate representation of the real-life sand volume of F1 and will be referred to throughout this study as the original calculated volume. As shown in table 1, calculations using seismic lines spaced at 60, 90 and 120 meters resulted in minimal variation from the original calculated volume. Greater amounts of variation were seen in line spacings of 150 meters and 210 meters but the variation did not surpass 10% which was set as the variation limit. Line spacing of 270 meters gave a variation of 11.8% from the original calculated volume, surpassing the limit of 10% variation. As stated in the methods, calculations were continued for even greater line spacings. Table 1 shows that for some line spacings greater than 270

Data Used	Volume Cu/Ft	Volume Cu/Yds	% of Original Volume	Variation from Original Volume	# of Lines Used	# of Cores on Lines	Approx. Line Spacing (meter)	Approx. Line Spacing (mi)	Approx. Line Spacing (nm)
All Lines	412,726,420	15,286,148	100.0%	0.0%	97	31	30	0.02	0.02
2nd	403,745,214	14,953,511	97.8%	2.2%	49	14	60	0.04	0.03
3rd	408,720,053	15,137,765	99.0%	1.0%	33	9	90	0.06	0.05
4th	407,584,142	15,095,694	98.8%	1.2%	25	11	120	0.07	0.06
5th	383,661,066	14,209,655	93.0%	7.0%	19	9	150	0.09	0.08
6th	415,322,695	15,382,307	100.6%	0.6%	17	3	180	0.11	0.10
7th	371,257,167	13,750,252	90.0%	10.0%	13	3	210	0.13	0.11
8th	399,970,398	14,813,704	96.9%	3.1%	13	1	240	0.15	0.13
9th	363,911,395	13,478,186	88.2%	11.8%	11	3	270	0.17	0.15
10th	363,044,788	13,446,090	88.0%	12.0%	9	5	300	0.19	0.16
11th	373,105,558	13,818,711	90.4%	9.6%	9	2	330	0.21	0.18
12th	413,349,275	15,309,217	100.2%	0.2%	9	2	360	0.22	0.19
13th	338,969,732	12,554,422	82.1%	17.9%	7	2	390	0.24	0.21
14th	364,918,542	13,515,488	88.4%	11.6%	7	1	420	0.26	0.23
15th	391,169,500	14,487,745	94.8%	5.2%	7	1	450	0.28	0.24
16th	405,395,623	15,014,638	98.2%	1.8%	7	0	480	0.30	0.26
24th	414,004,104	15,333,470	100.3%	0.3%	5	0	720	0.45	0.39
32nd	414,163,631	15,339,378	100.3%	0.3%	4	0	960	0.60	0.52
48th	465,567,397	17,243,220	112.8%	12.8%	3	0	1440	0.89	0.78
Recon	354,101,794	13,114,868	85.8%	14.2%	5	2			
Cores	341,365,143	12,643,141	82.7%	17.3%	0	31			

Table 3. F1 sand volume comparisons computed in Surfer 12^{TM} for different distances between seismic lines.

meters, the percent variation from the original calculated volume fell below 1%. Such findings suggest that another factor besides line spacing was influencing the calculation. This factor was found to be the placement of the lines. The line spacings that resulted in incomplete coverage of the shoal, particularly the flanks, were found to be the instances that gave the larger amounts of variation from the original calculated volume. Line spacings of 360, 480, 720 and 960 meters used seismic lines that covered the full extent of the shoal and all yielded minimal amounts of variation from the original calculated volume. Line spacings of 270, 300, 390 and 420 meters did not have full coverage of the flanks of the shoal and were shown to have the greatest amount of variation from the original calculated volume. Line spacings of 330 and 450 meters consisted of seismic lines that somewhat covered the outskirts of the shoal, resulting in 5-10%. This trend shows that as seismic lines used in the calculations were located closer to the flanks of the shoal there was less variation in the volume calculation. This change in shoal coverage can be seen in Figure 19, Figure 21 and Figure 23. Figure 19 represents minimal flank coverage, figure 21 shows seismic lines located closer to the flanks, and figure 23 shows full seismic coverage of the shoal.

The data shows that at a line spacing of 720 meters, using only 5 of the 97 available seismic lines, the calculated volume was within 0.3% of the original calculated volume. To maintain full coverage of the shoal the next line spacing variation possible was 960 meters. To obtain this line spacing the center fix point could not be used (Figure 35) but the calculated volume still only varied 0.3% from the original calculated volume. The shortcoming of this line spacing was in the isopach map created in Surfer™12. Due to the omission of the center fix point the isopach map did not accurately represent the thickest portion of the shoal and only showed a maximum thickness of 16 feet, while the isopach map created using 30-meter spacing showed a maximum thickness of 20 feet. Even though this line spacing can accurately calculate the volume of sand and depict the general shape of the shoal but was unable to accurately map the areas of the shoal with the greatest thicknesses. To maintain full coverage of the shoal, the next possible line spacing was 1440 meters. This line spacing yielded a 12.8% variation from the original calculated volume, indicating that 1440-meter line spacing was too large to meet our desired accuracy.

Reconnaissance level lines yielded a variation of 14.2% from the original calculated volume. The line spacing in the northwest-southeast oriented reconnaissance level lines was approximately 1000 meters and the two northeast-southwest lines were spaced approximately 600 meters apart (Figure 39). The 14.2% variation in volume calculated using the reconnaissance level data may be a result of data quality issues. This issue will be expanded on more in the conclusions below.

Using only vibracore data a volume of 12,643,141 cubic yards of sand was calculated. This sand volume varied 17.3% from the original calculated volume.

Conclusions

A sand volume of 15,286,148 cubic yards was calculated for area F1 using all the available data in this study. The preliminary sand resource assessment for northern Ocean County calculated a volume of 19,770,726 cubic yards (Kuhn et. al., 2016). These two analyses had a difference of approximately 4.5 million cubic yards. This discrepancy could have occurred due to factors such as differences in data quality affecting which reflector was traced as the base of sand, differences in the amount of vibracore and seismic data used for each assessment and differences in the type of seismic data that was collected and analyzed for each study. Both assessments show a very similar shoal shape and display realistic shoal features such as a steep southern shoal face and a more gradual sloping north face. They differ in that the preliminary analysis conducted by Kuhn et. al. shows larger thicknesses in the easterly portion of the shoal (figure 43).

This project was completed using the data provided to the New Jersey Geological and Water Survey (NJGWS) by CB&I. The quality of this data was fair to poor. Quality assurance/ quality control was conducted by the NJGWS as deliverable F of this grant and showed that 0% of the reconnaissance data was classified as "good". Approximately 85% of the reconnaissance data was classified as "fair" and approximately 14% of reconnaissance data for area F1 was classified as "poor". For explanations on these classifications please reference Deliverable F. An example of the reconnaissance level data that was classified as poor quality can be seen in Figure 45. The quality of the reconnaissance data is a potential source of error in the sand volume calculated with that data and likely affected the amount of variation from the original calculated volume. The data quality did not affect the line spacing comparisons because the analyzed sand thicknesses for each line remained the same for every calculation to ensure consistency.

Using the same criteria to categorize the data quality, 41% of the F1 design level data was classified as "good", 56% was classified as "fair" and 3% was classified as "poor" (figure 48). Figure 45 shows an example of the CB&I design level data classified as fair. NJGWS collected a seismic line in the exact same location as CB&I line 335 shown in Figure 46 for data comparison purposes. The line collected by NJGWS can be seen in Figure 47 and shows higher resolution in the shallow subsurface and more features below the base of sand are visible than in the data collected by CB&I.

The NJGWS has several recommendations about how to more efficiently collect seismic and geologic data while still producing accurate sand volume calculations. The data from this study shows that design level line spacing 720 meters can accurately estimate the sand volume of a shoal and will produce a reasonably accurate isopach map. NJGWS recommends to not solely collect seismic lines that are parallel to one another. There should be multiple tie lines, along the axis of the shoal, collected in a perpendicular orientation from the other seismic lines collected. Collecting seismic lines in multiple orientations helps to pull the data together and creates a more accurate representation of the shape and volume of the shoal in Surfer™12 . The intersections of these tie lines are also very beneficial locations to obtain core data, especially on the outskirts of the shoal where the core can show the exact depth of the base of sand. If a survey were to be conducted using these recommendations NJGWS believes that line spacing greater than 720 meters can be used while still maintaining accurate volume calculations. As shown by the 960-meter spacing, accurate sand volume estimates can be calculated at line spacings greater than 720 meters, however line placement plays a key role in isopach map accuracy. Using only vibracore data did not produce an accurate volume estimate; however, it does need to be recognized that the seismic data collected covers a larger area than the cores alone do. The isopach map that was created (figure 42) did not accurately depict the shape and size of the shoal.

Based on the findings of this study, NJGWS makes a conservative recommendation for design level seismic line spacing of 720 meters (0.39 nautical mile) contingent on 1) seismic coverage of full extent of the shoal, 2) a grid of perpendicular tie lines collected throughout the study area, and 3) vibracores located on intersections of the seismic lines and on the flanks of the shoal. Greater accuracy of sand volume calculations can be achieved with closer line spacings, however the line spacing of 30 meters collected by CB&I was found to be excessive and unnecessary.

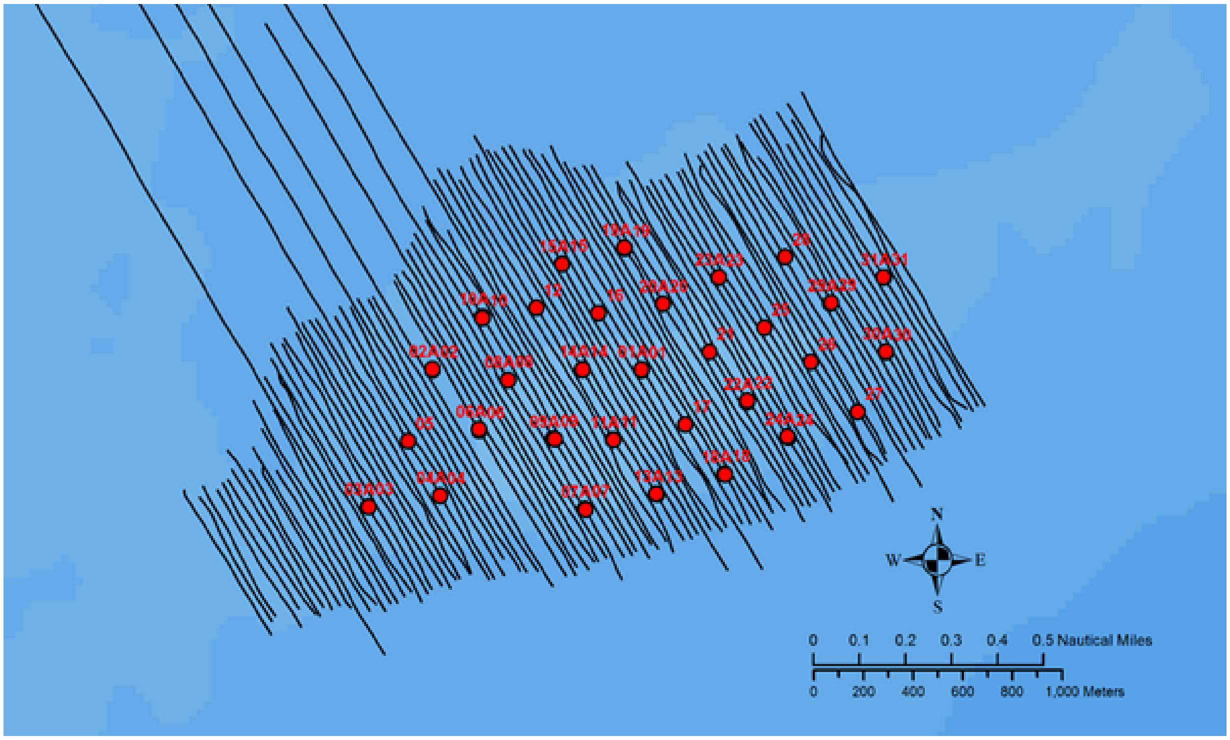

Figure 9. Locations of all 97 seismic lines collected at 30-meter spacing and the 31 vibracores locations.

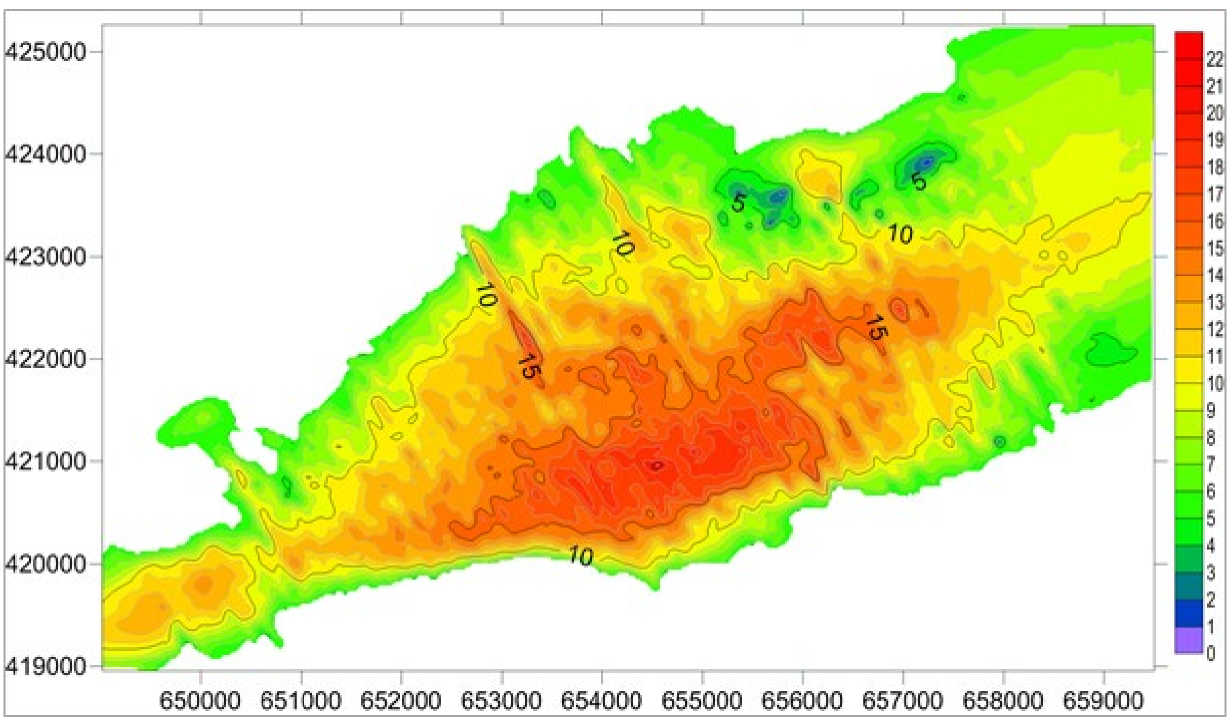

Figure 10. Isopach map created in Surfer™12 using data from all 97 seismic lines collected at 30-meter spacing. Isopach was blanked at 5-foot contour.

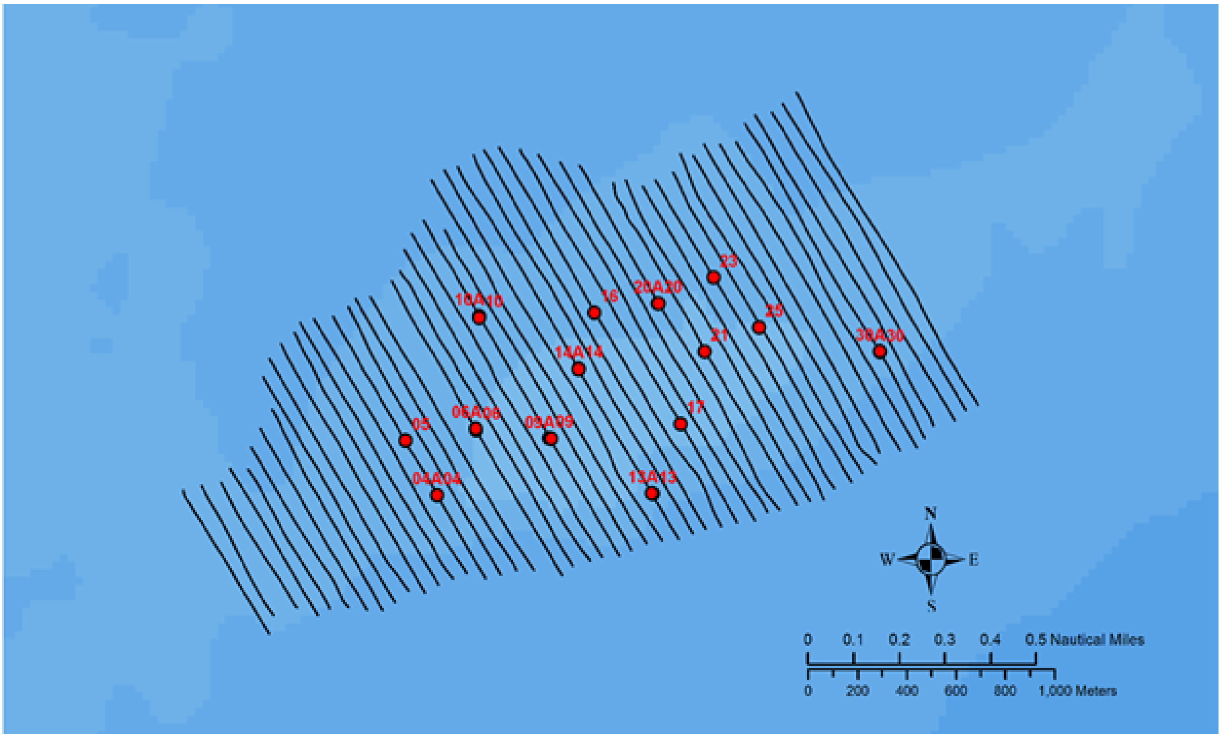

Figure 11. Locations of seismic lines at 60-meter spacing and the 14 vibracores located on those lines.

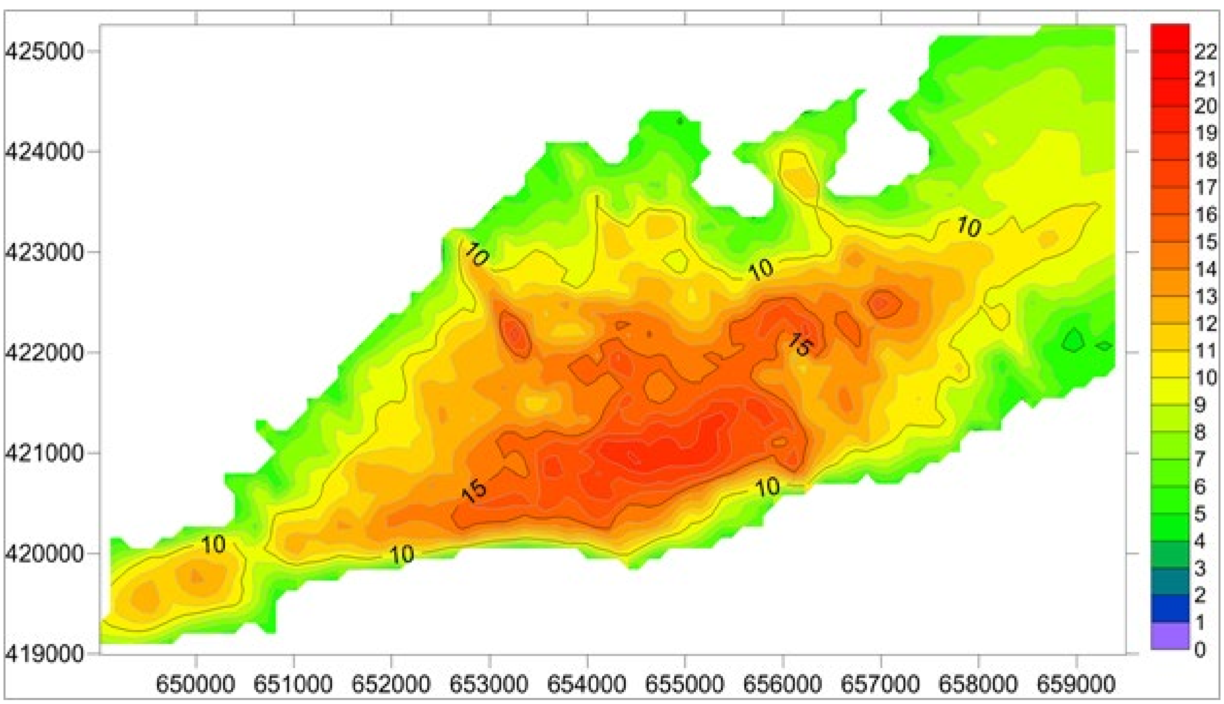

Figure 12. Isopach map created in Surfer™12 using data from seismic lines at 60-meter spacing.

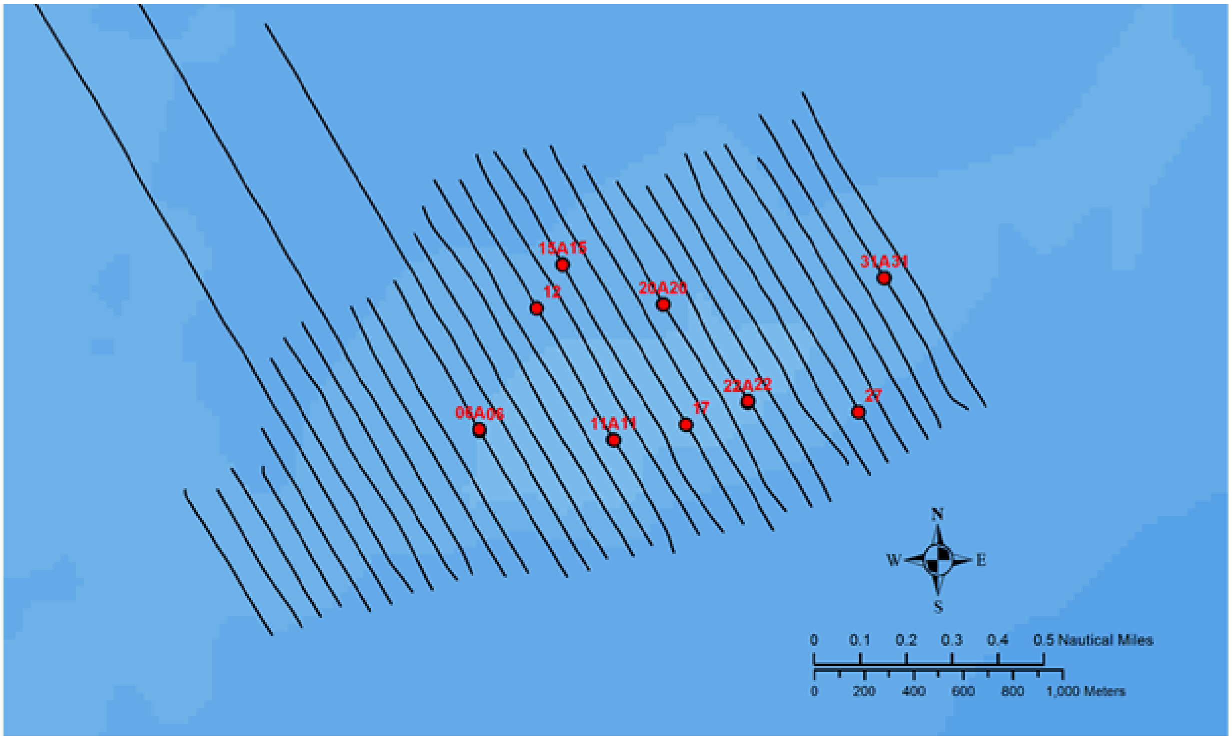

Figure 13. Locations of seismic lines at 90-meter spacing and the 9 vibracores located on those lines.

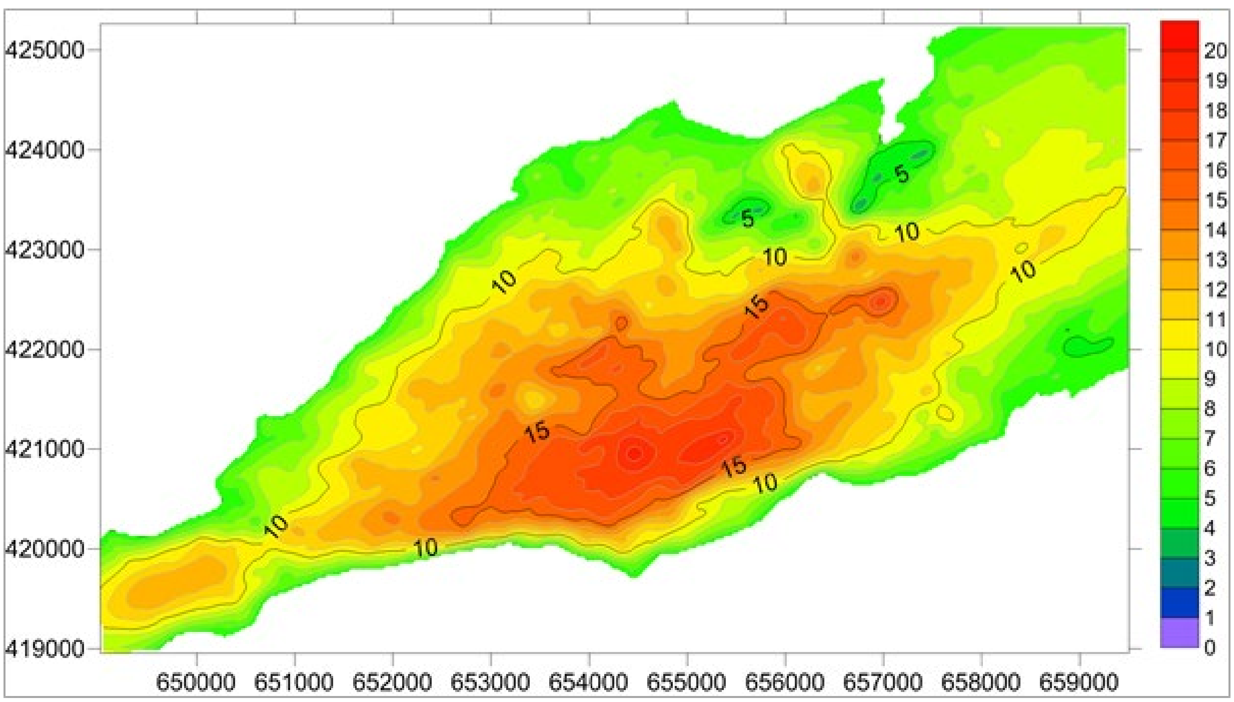

Figure 14. Isopach map created in Surfer™12 using data from seismic lines at 90-meter spacing.

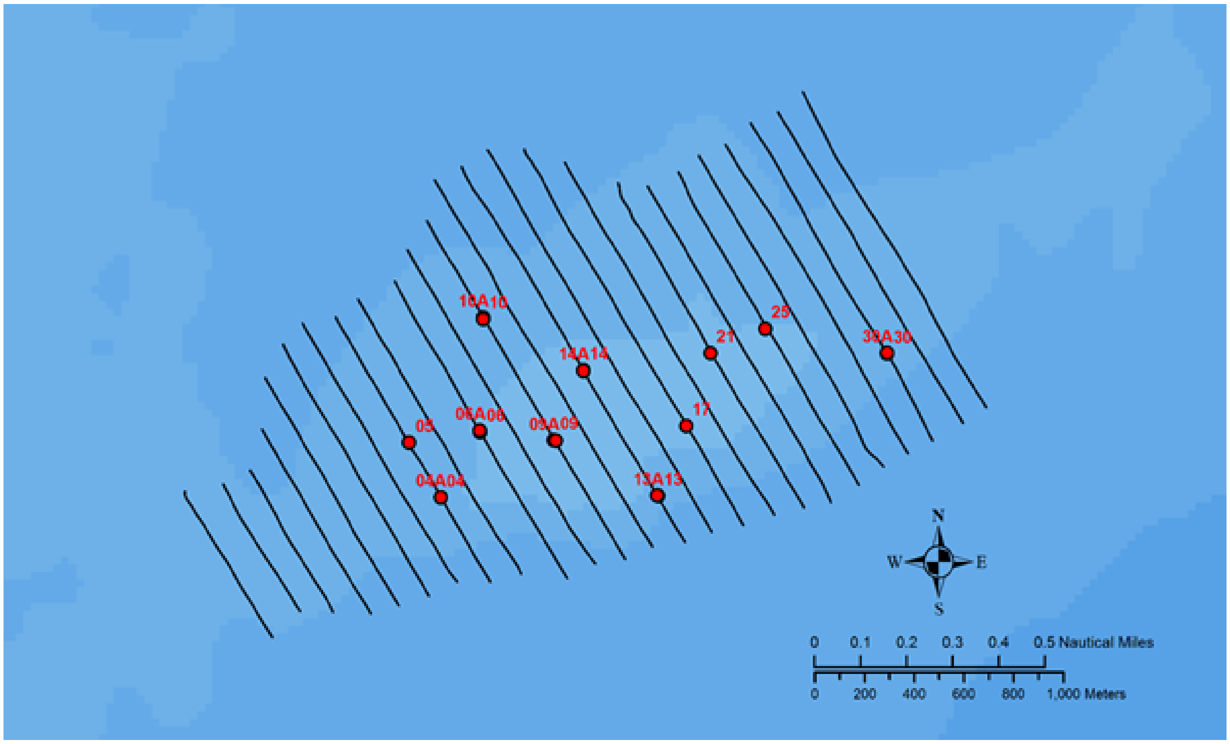

Figure 15. Locations of seismic lines at 120-meter spacing and the 11 vibracores located on those lines.

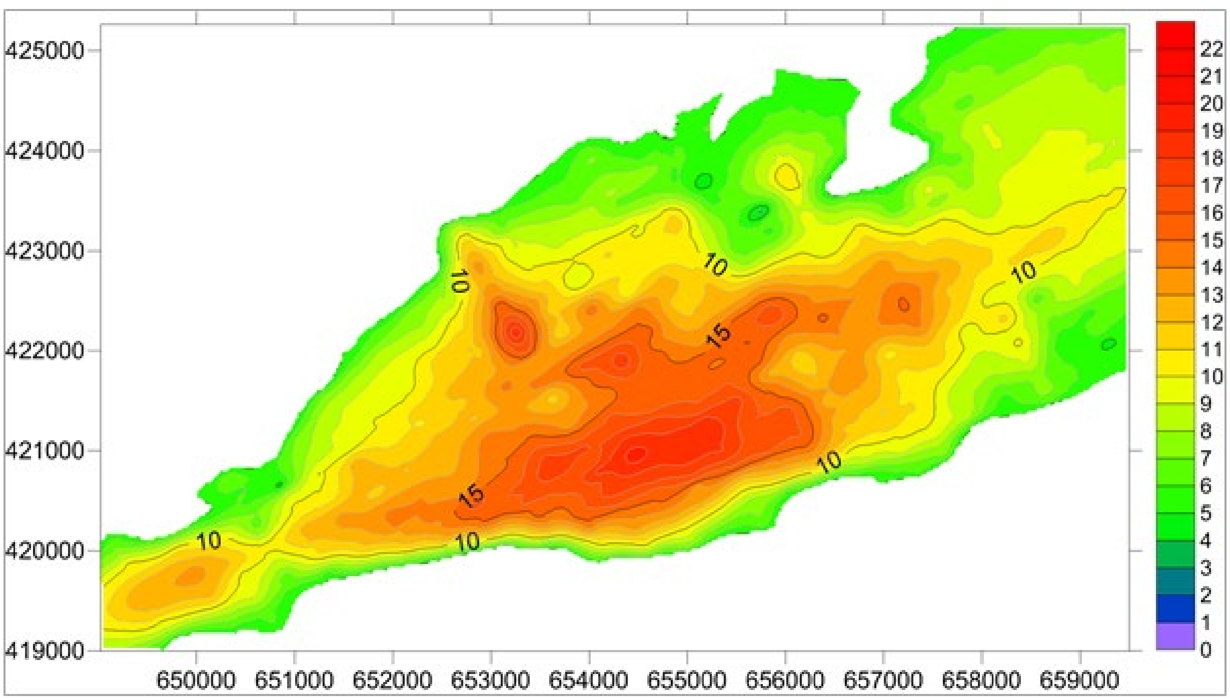

Figure 16. Isopach map created in Surfer™12 using data from seismic lines at 120-meter spacing.

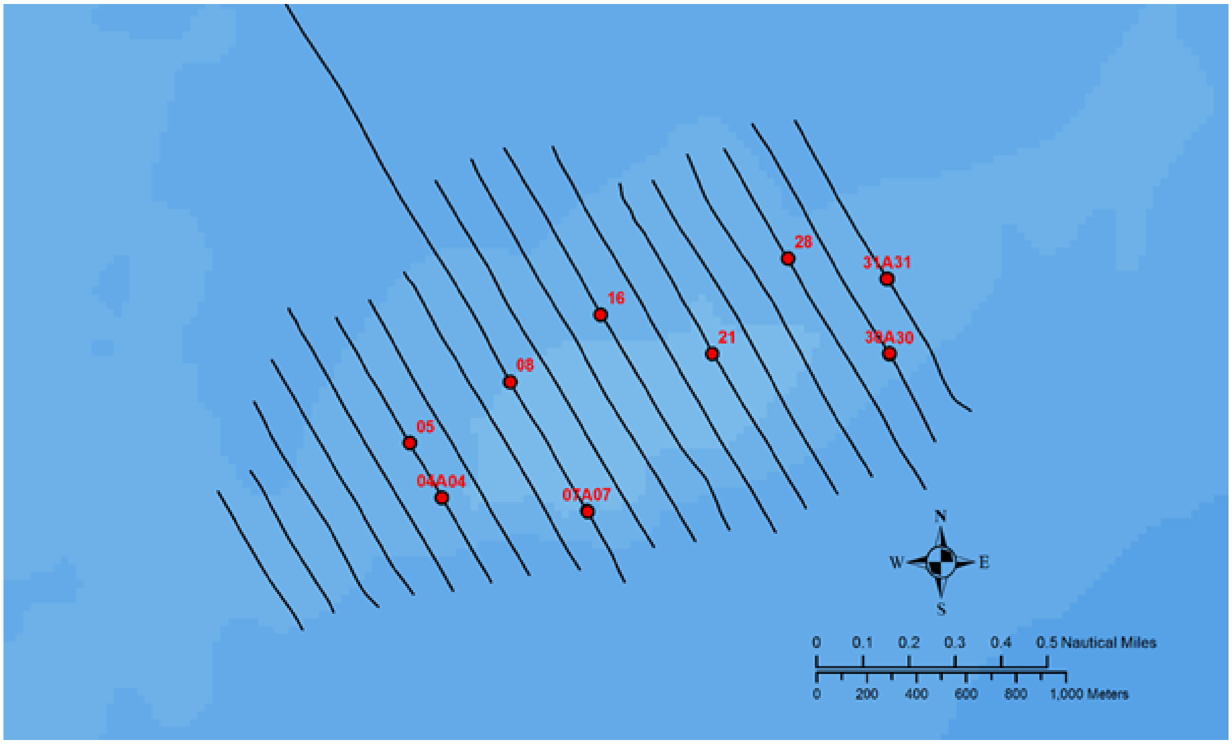

Figure 17. Locations of seismic lines at 150-meter spacing and the 9 vibracores located on those lines.

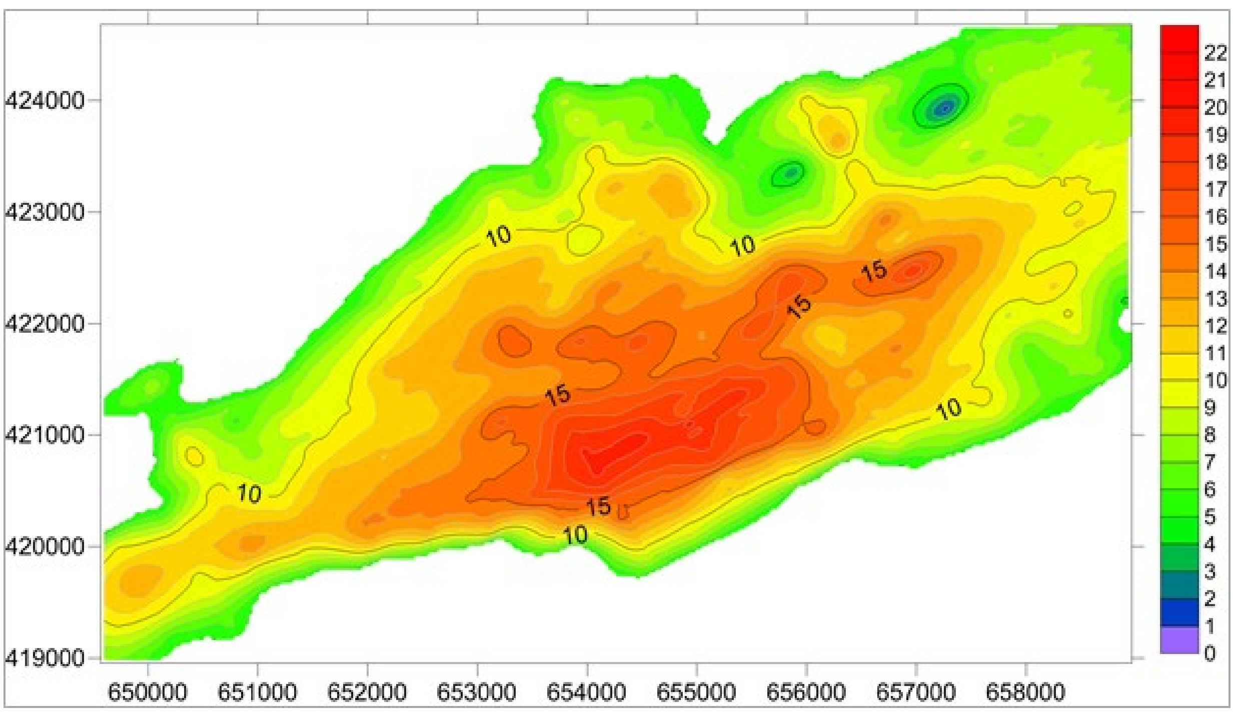

Figure 18. Isopach map created in Surfer™12 using data from seismic lines at 150-meter spacing.

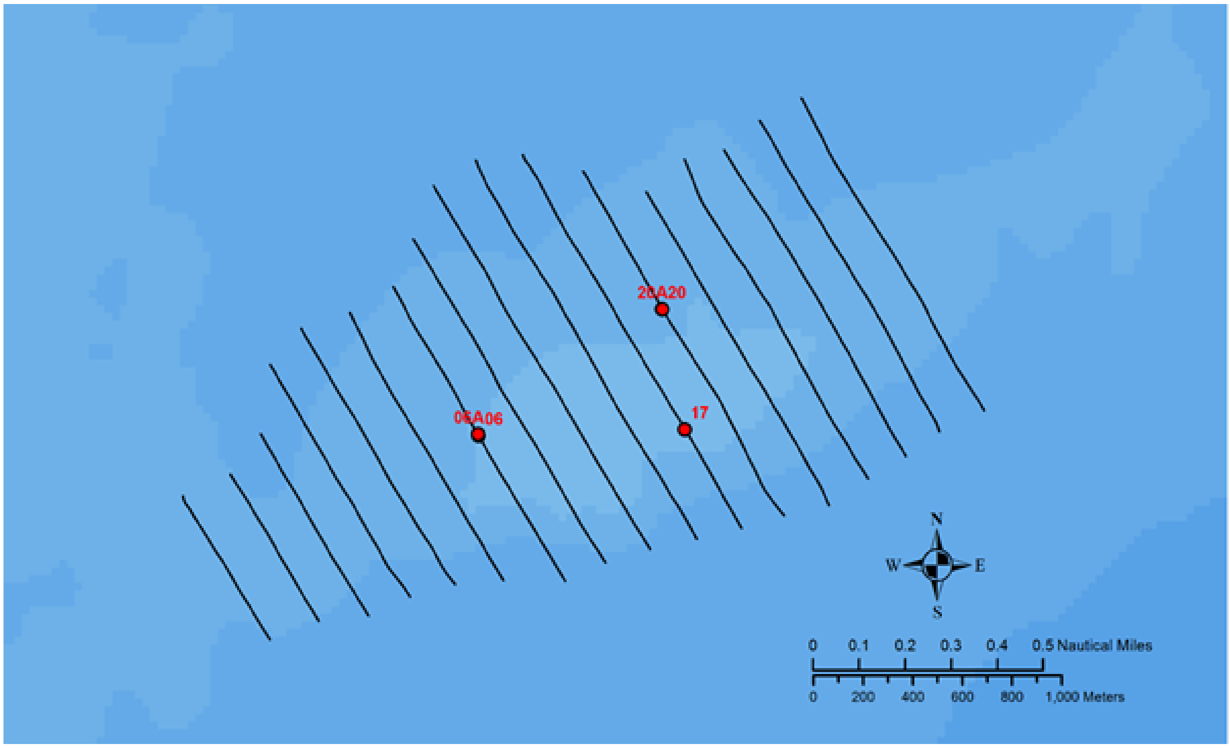

Figure 19. Locations of seismic lines at 180-meter spacing and the 3 vibracores located on those lines.

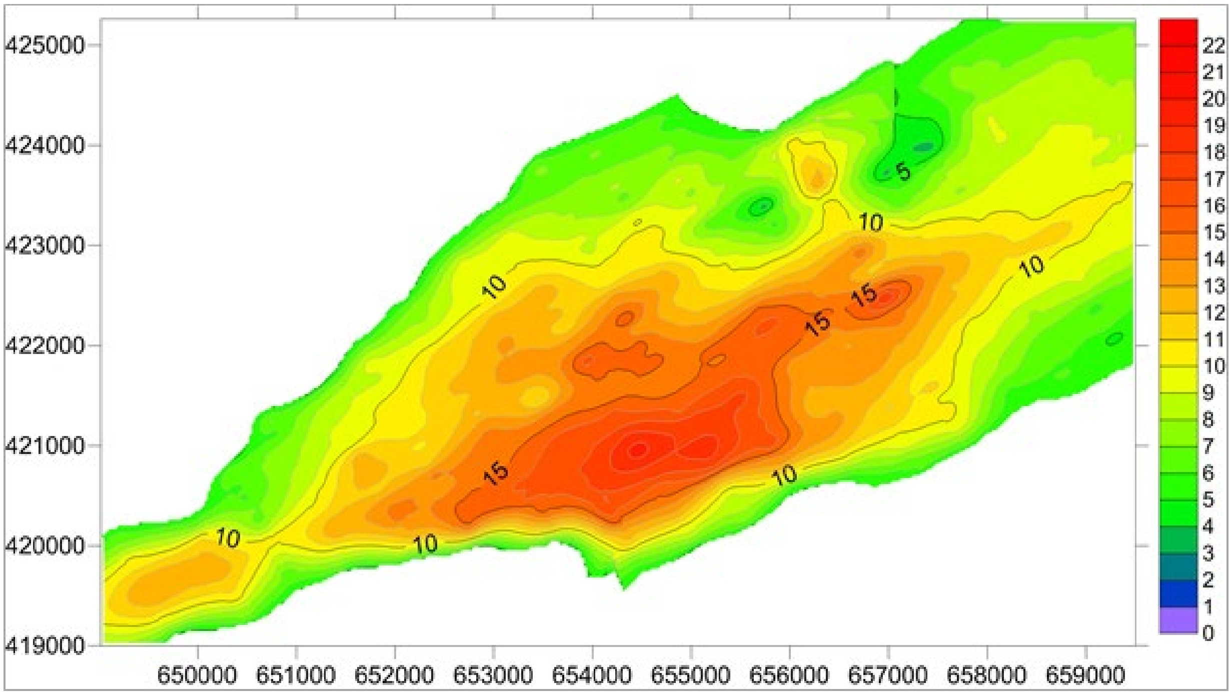

Figure 20. Isopach map created in Surfer™12 using data from seismic lines at 180-meter spacing.

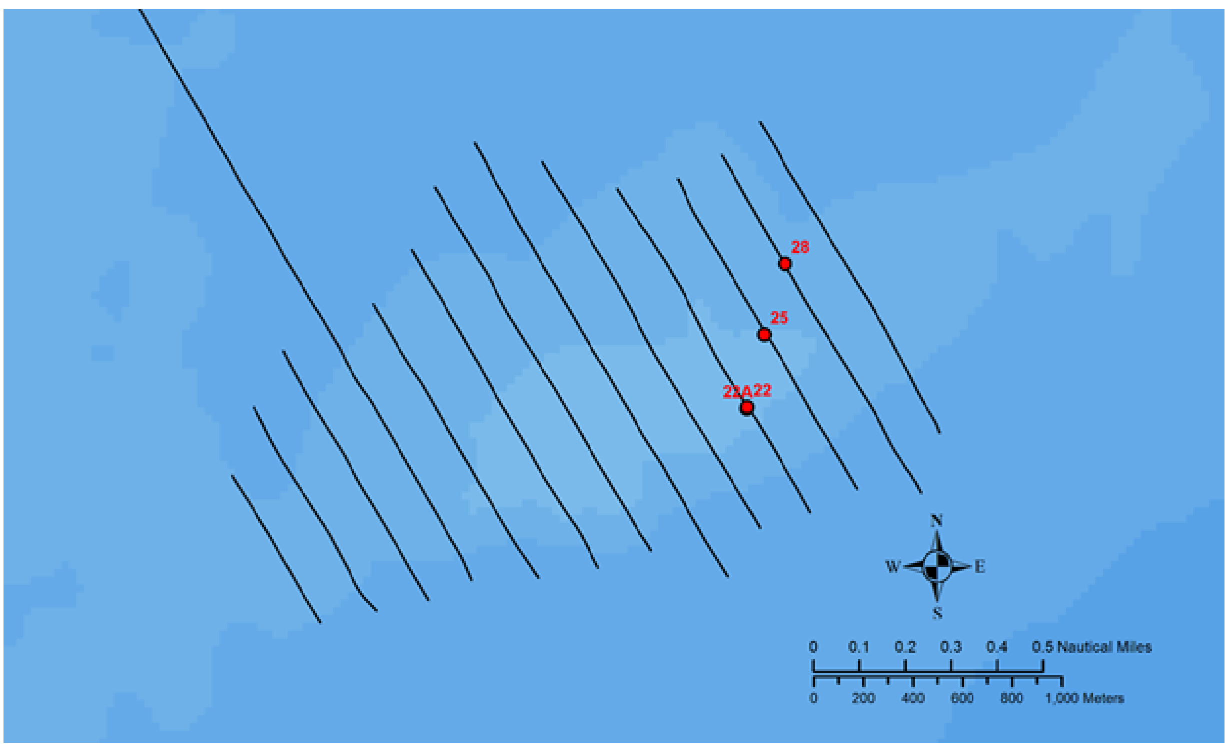

Figure 21. Locations of seismic lines at 210-meter spacing and the 3 vibracores located on those lines.

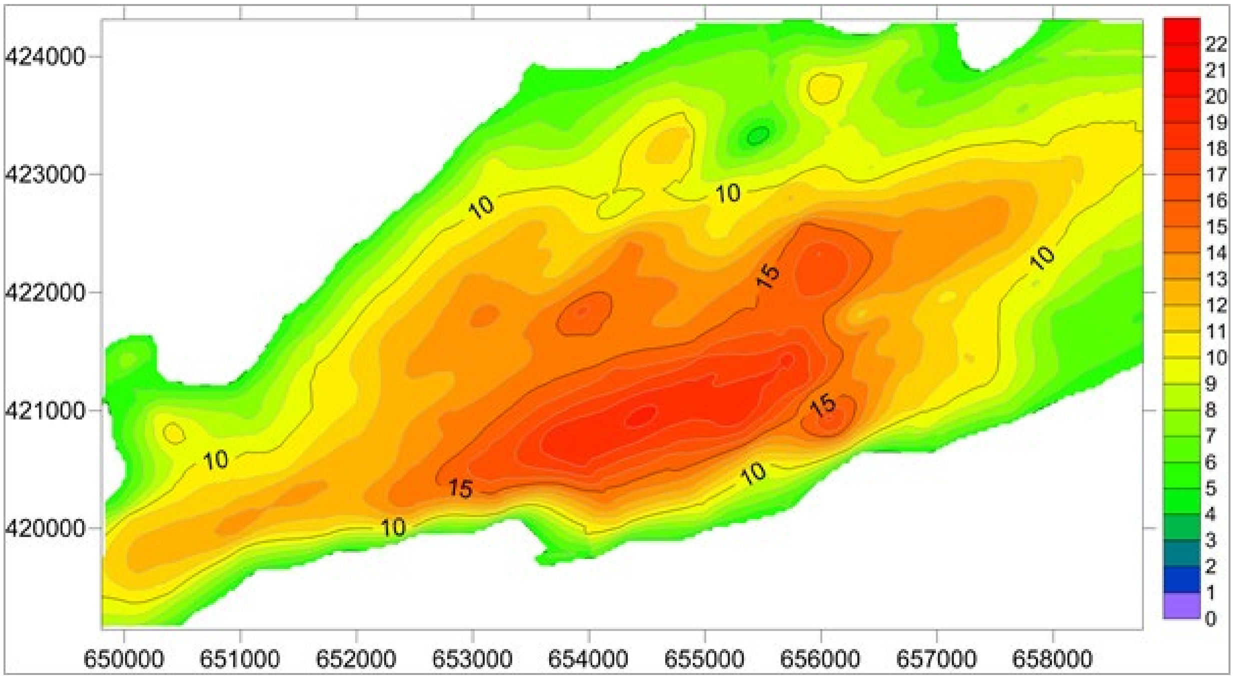

Figure 22. Isopach map created in Surfer™12 using data from seismic lines at 210-meter spacing.

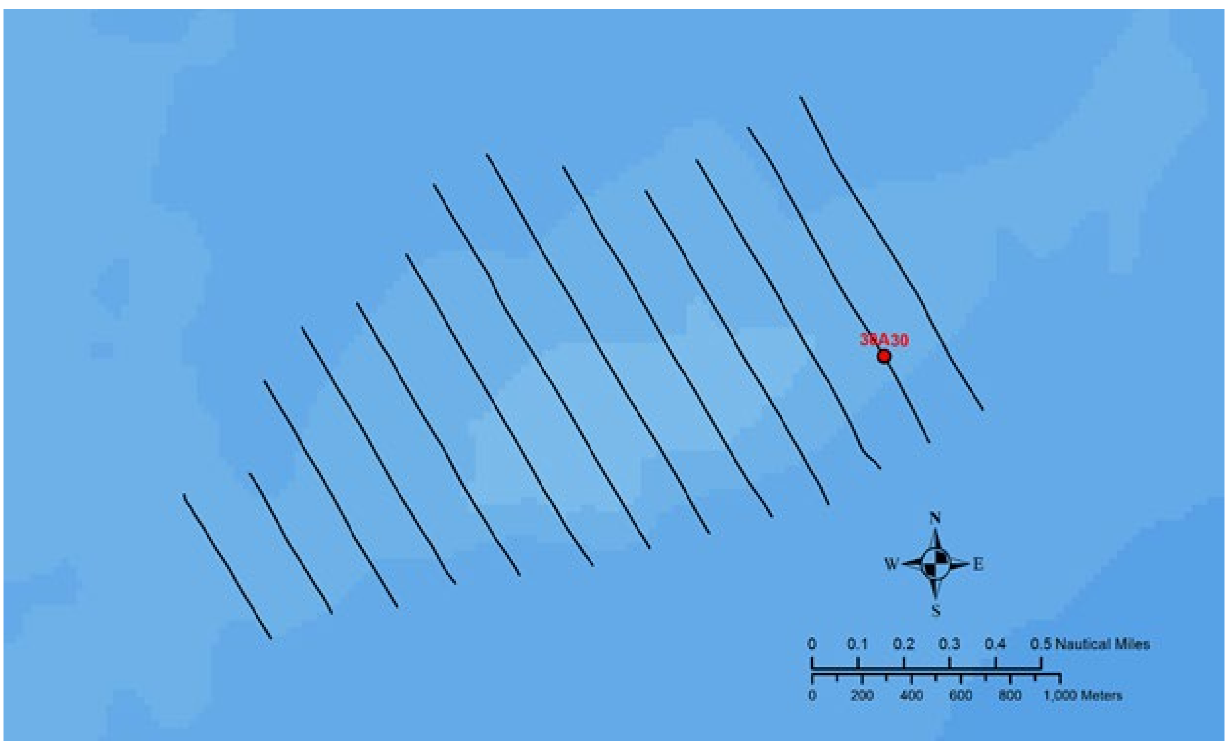

Figure 23. Locations of seismic lines at 240-meter spacing and the 1 vibracore located on those lines.

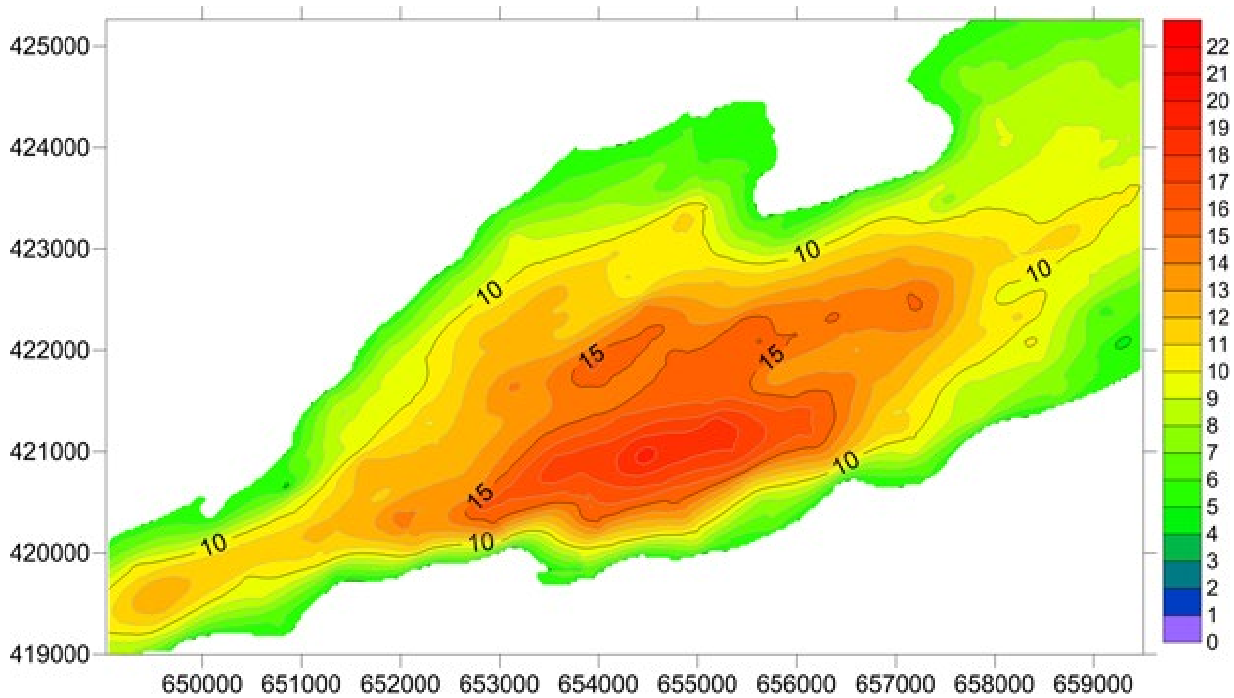

Figure 24. Isopach map created in Surfer™12 using data from seismic lines at 240-meter spacing.

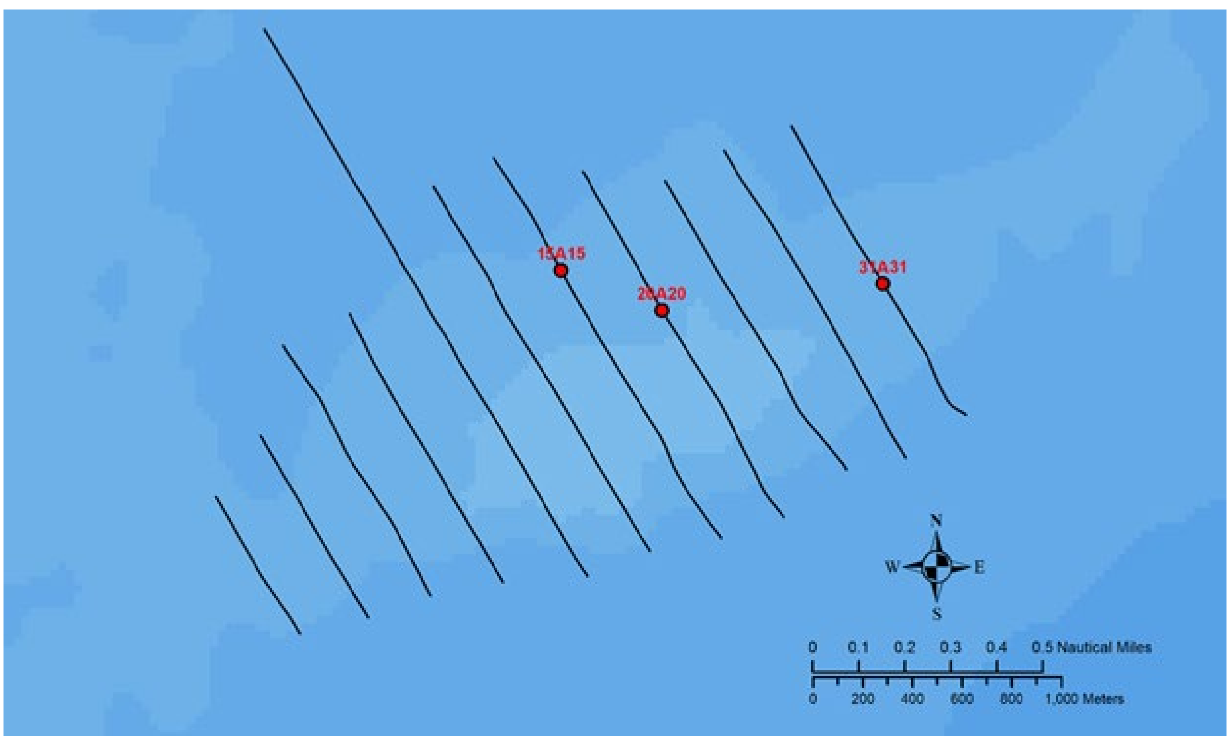

Figure 25. Locations of seismic lines at 270-meter spacing and the 3 vibracores located on those lines.

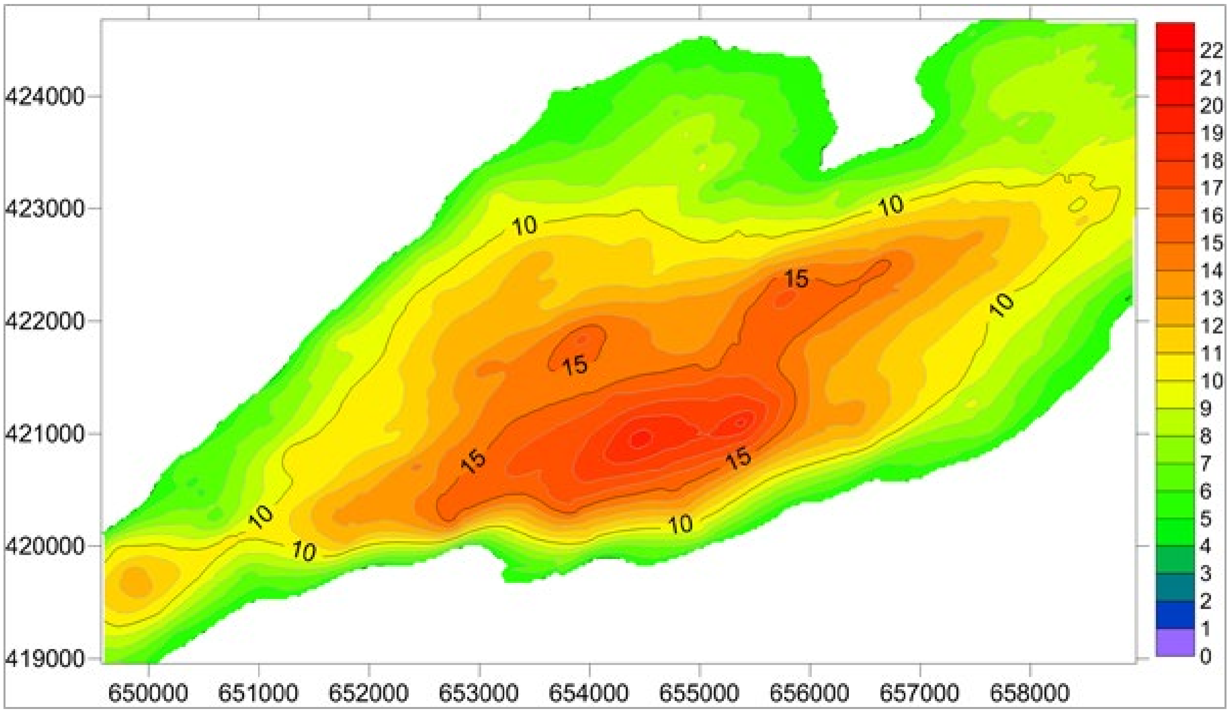

Figure 26. Isopach map created in Surfer™12 using data from seismic lines at 270-meter spacing.

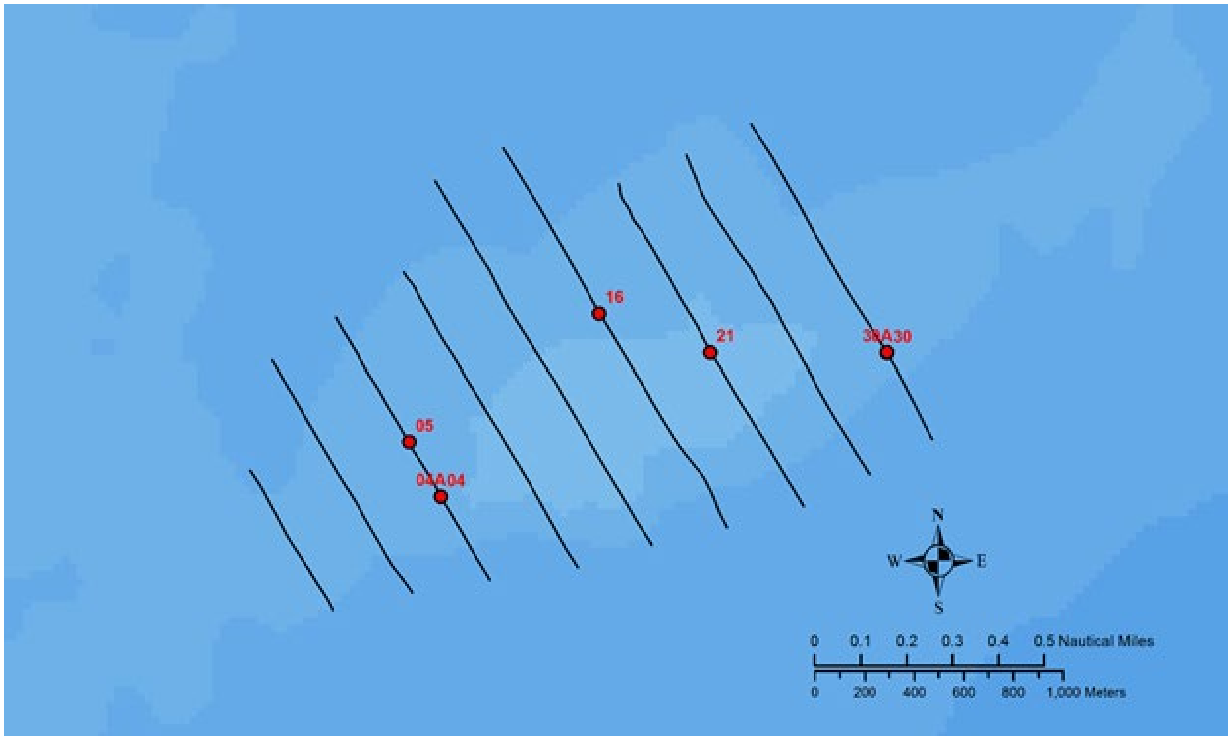

Figure 27. Locations of seismic lines at 300-meter spacing and the 5 vibracores located on those lines.

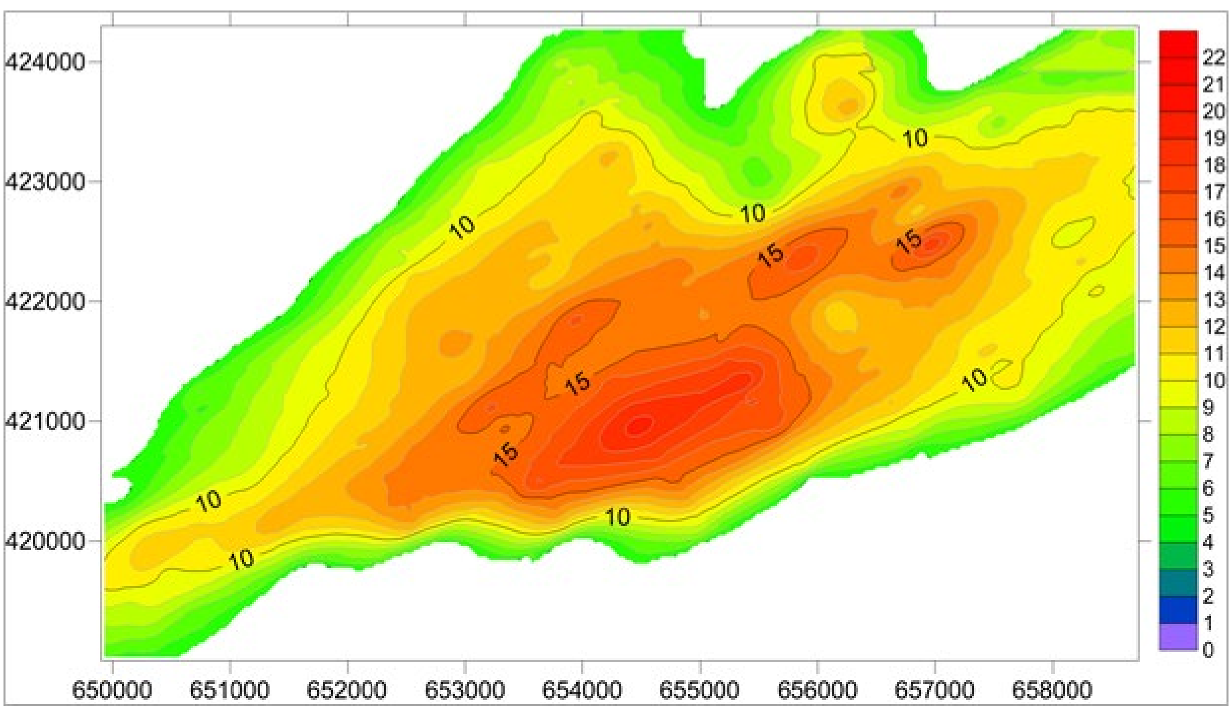

Figure. Isopach map created in Surfer™12 using data from seismic lines at 300-meter spacing.

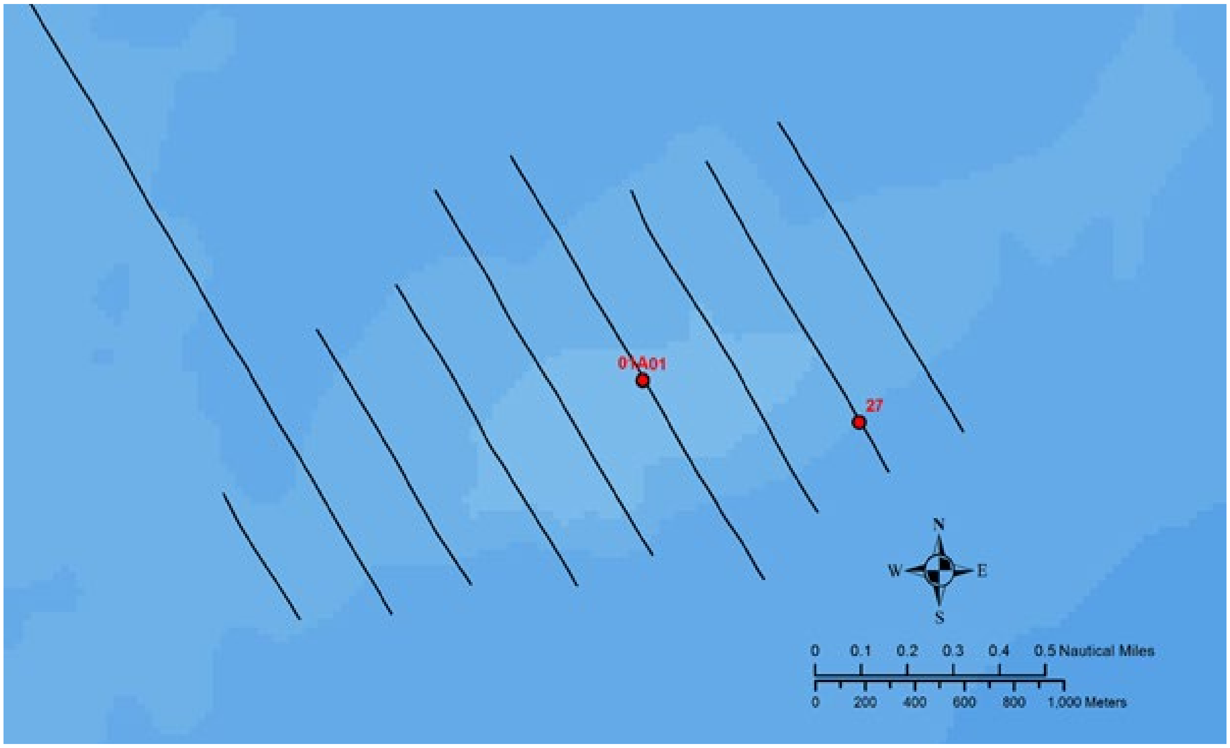

Figure 28. Locations of seismic lines at 330-meter spacing and the 2 vibracores located on those lines.

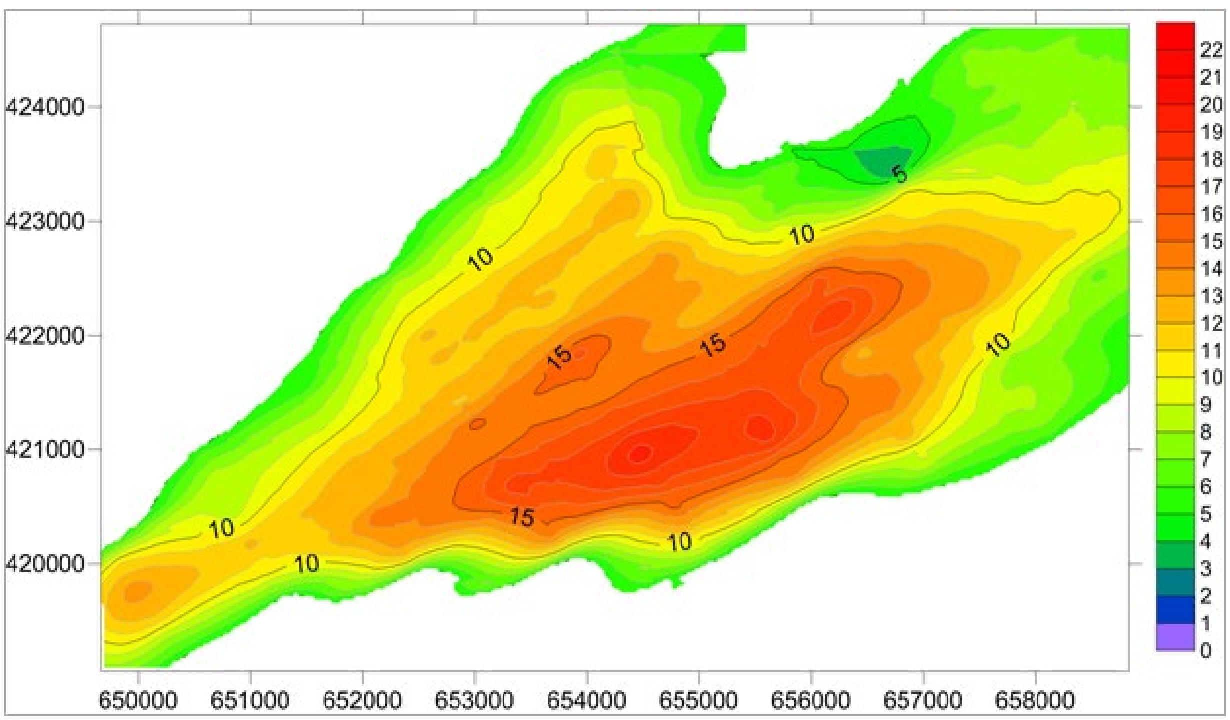

Figure 29. Isopach map created in Surfer™12 using data from seismic lines at 330-meter spacing.

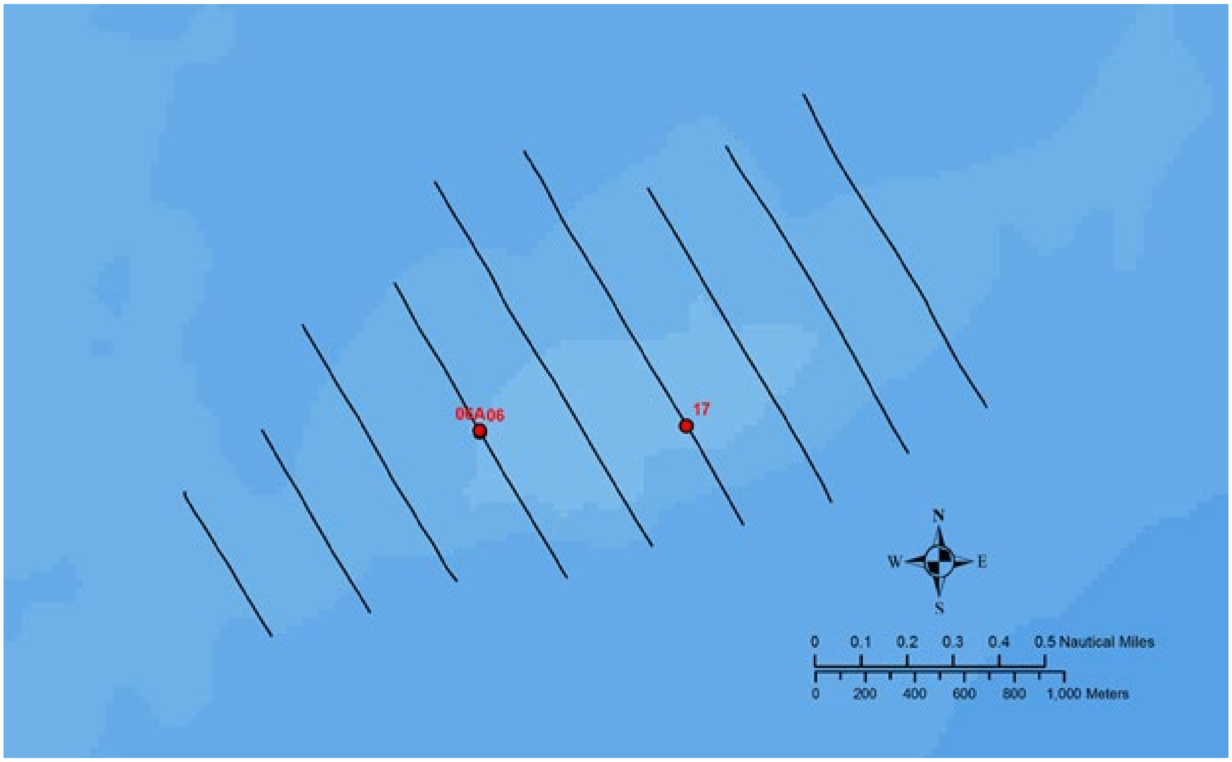

Figure 30. Locations of seismic lines at 360-meter spacing and the 2 vibracores located on those lines.

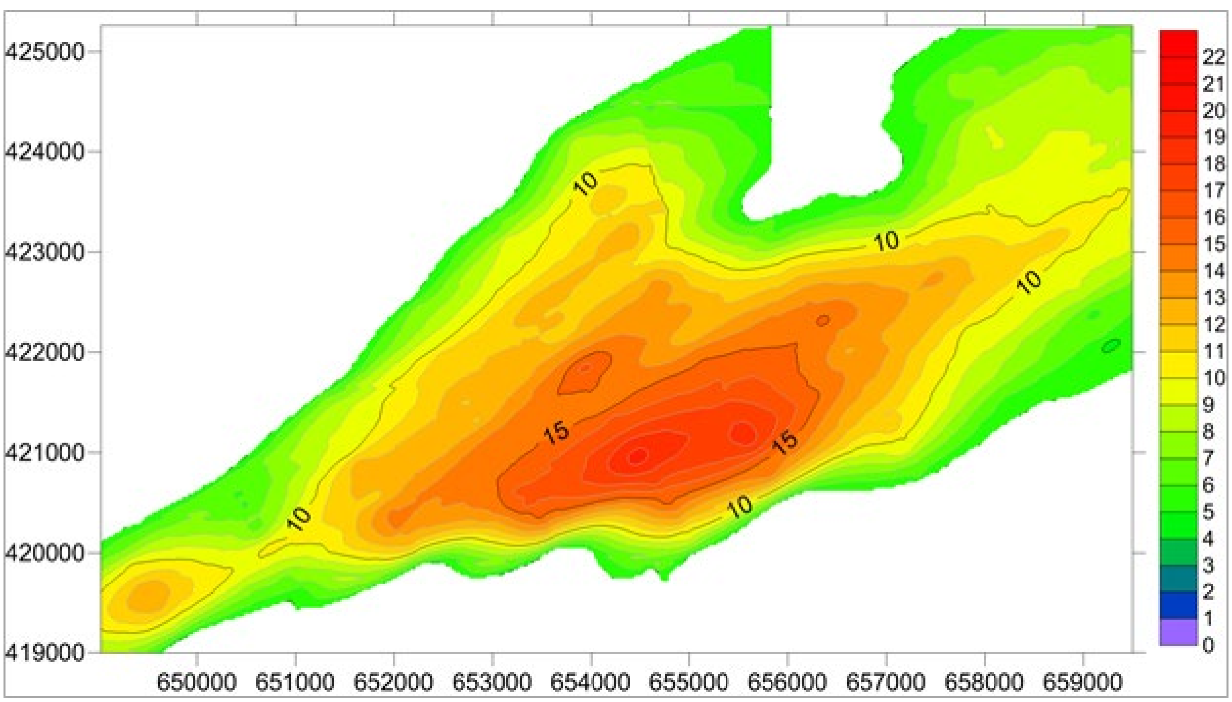

Figure 31. Isopach map created in Surfer™12 using data from seismic lines at 360-meter spacing.

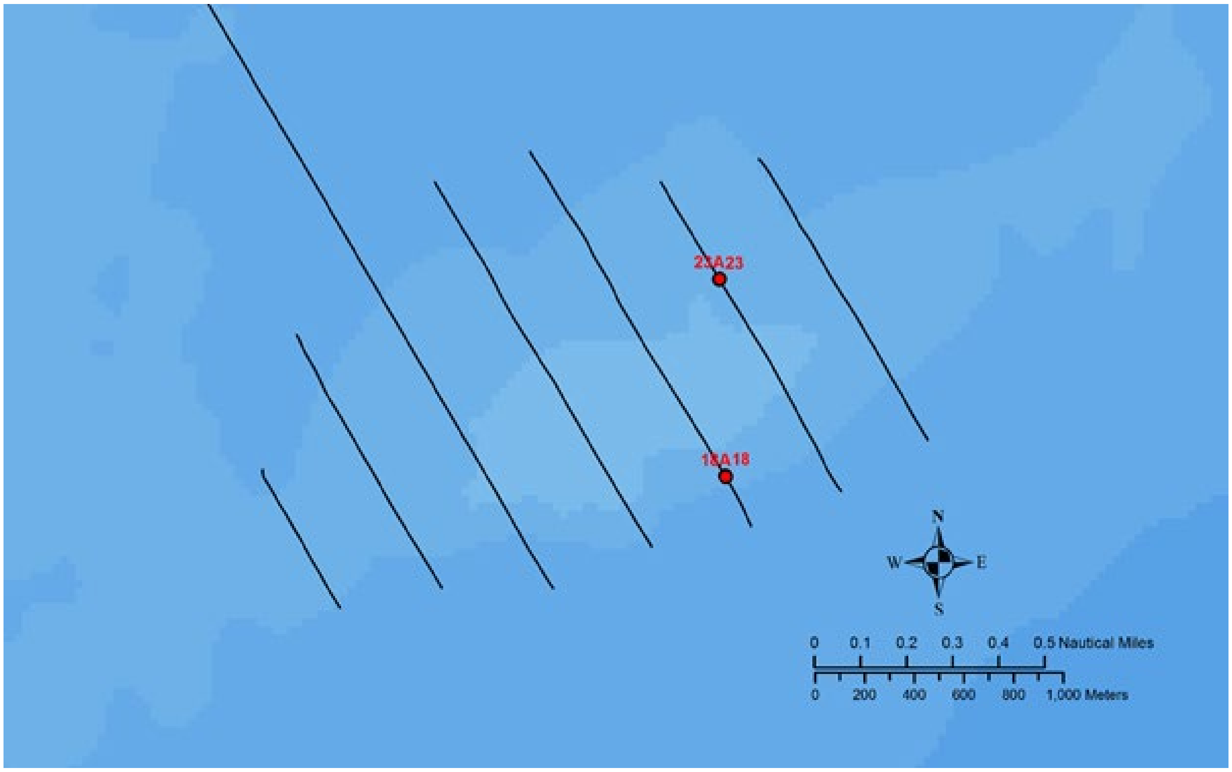

Figure 32. Locations of seismic lines at 390-meter spacing and the 2 vibracores located on those lines.

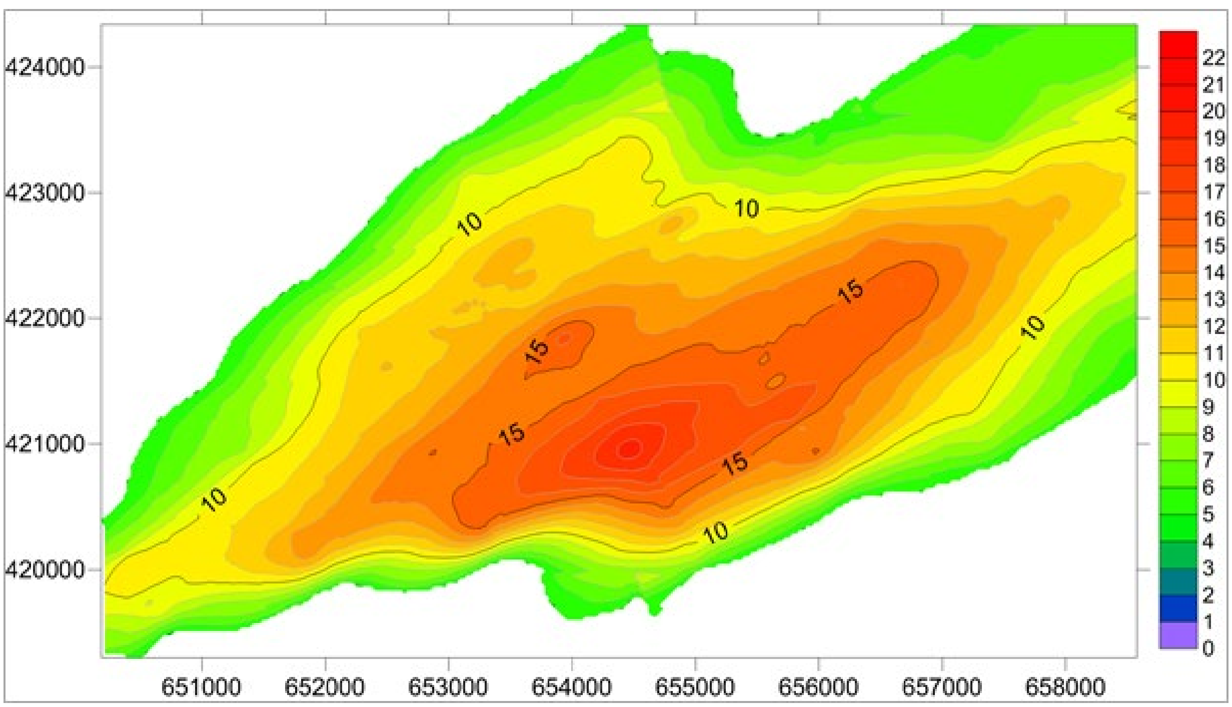

Figure 33. Isopach map created in Surfer™12 using data from seismic lines at 390-meter spacing

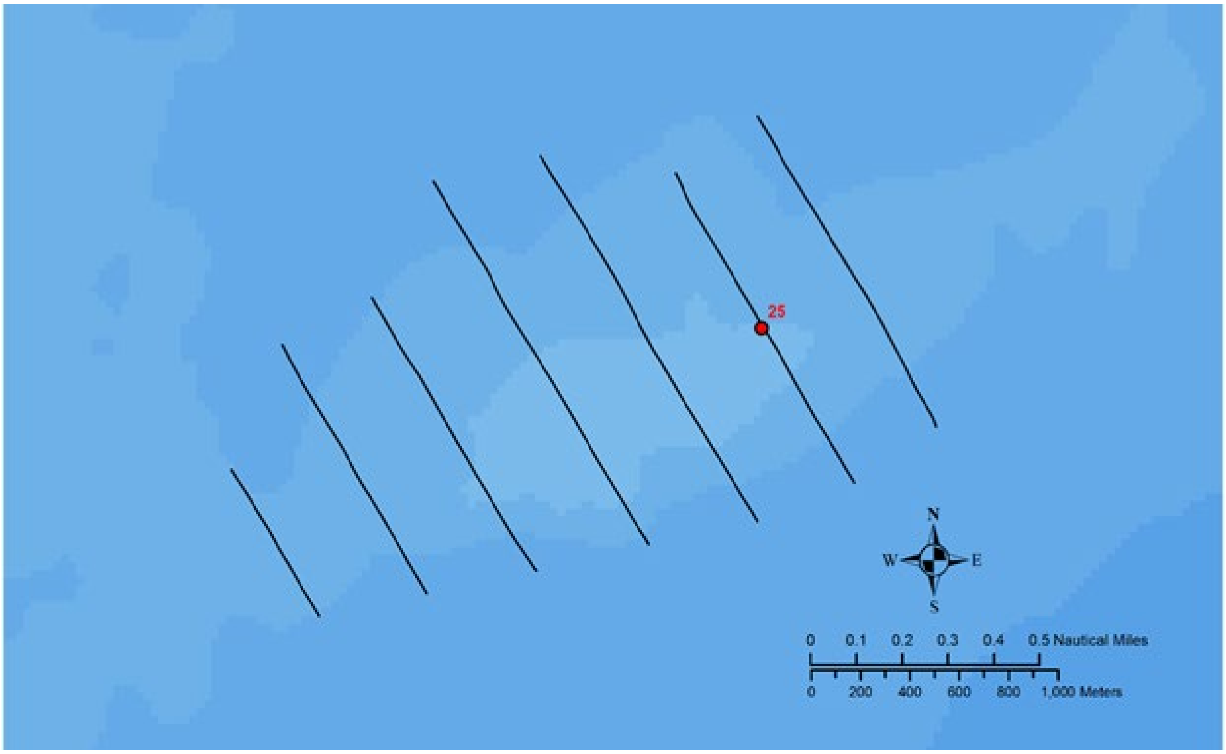

Figure 34. Locations of seismic lines at 420-meter spacing and the 1 vibracore located on those lines.

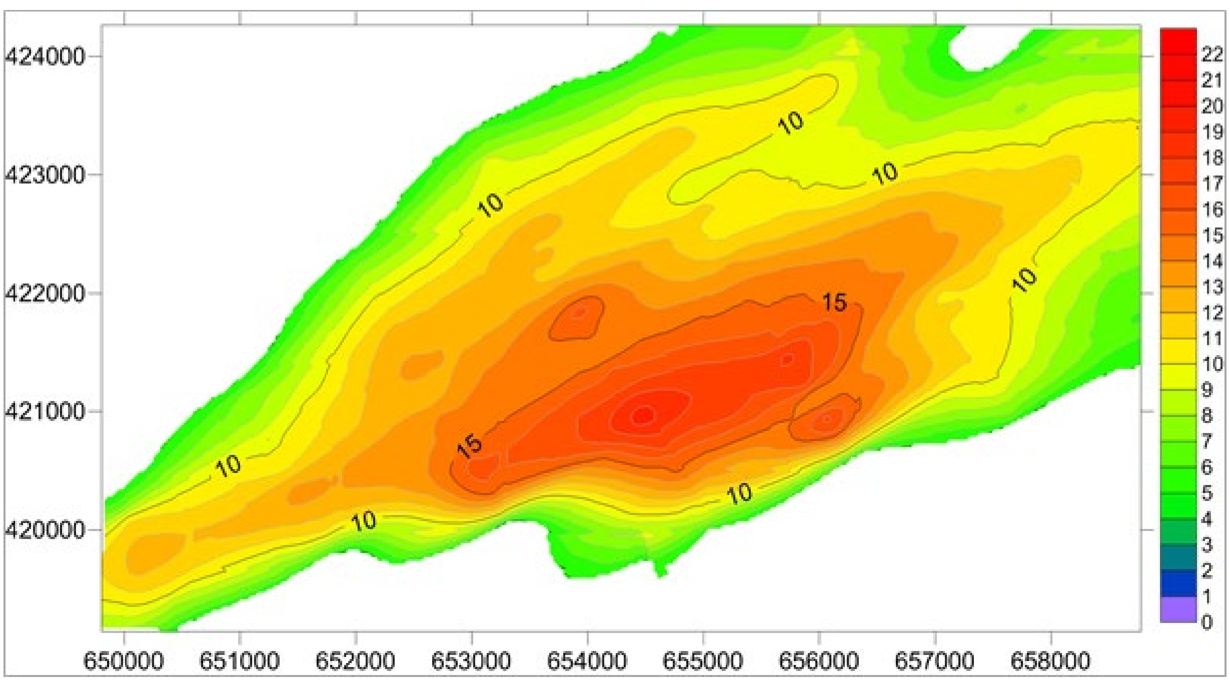

Figure 35. Isopach map created in Surfer™12 using data from seismic lines at 420-meter spacing.

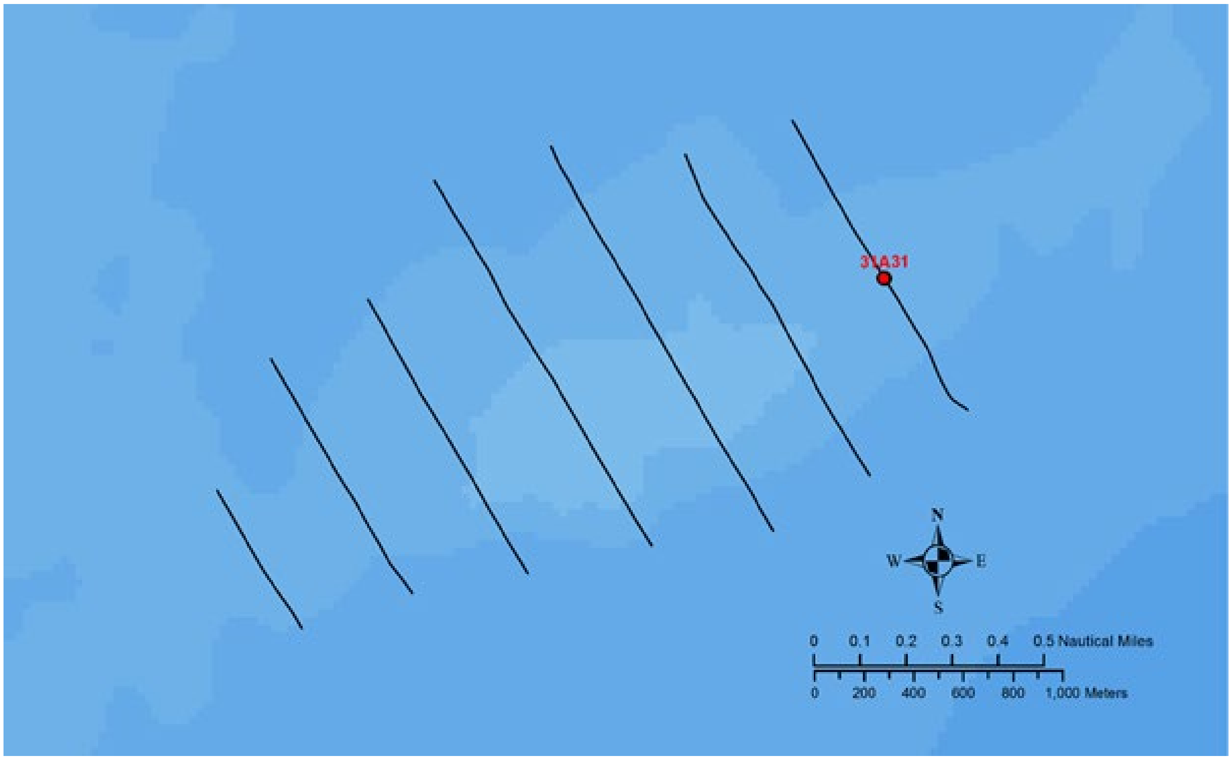

Figure 36. Locations of seismic lines at 450-meter spacing and the 1 vibracore located on those lines.

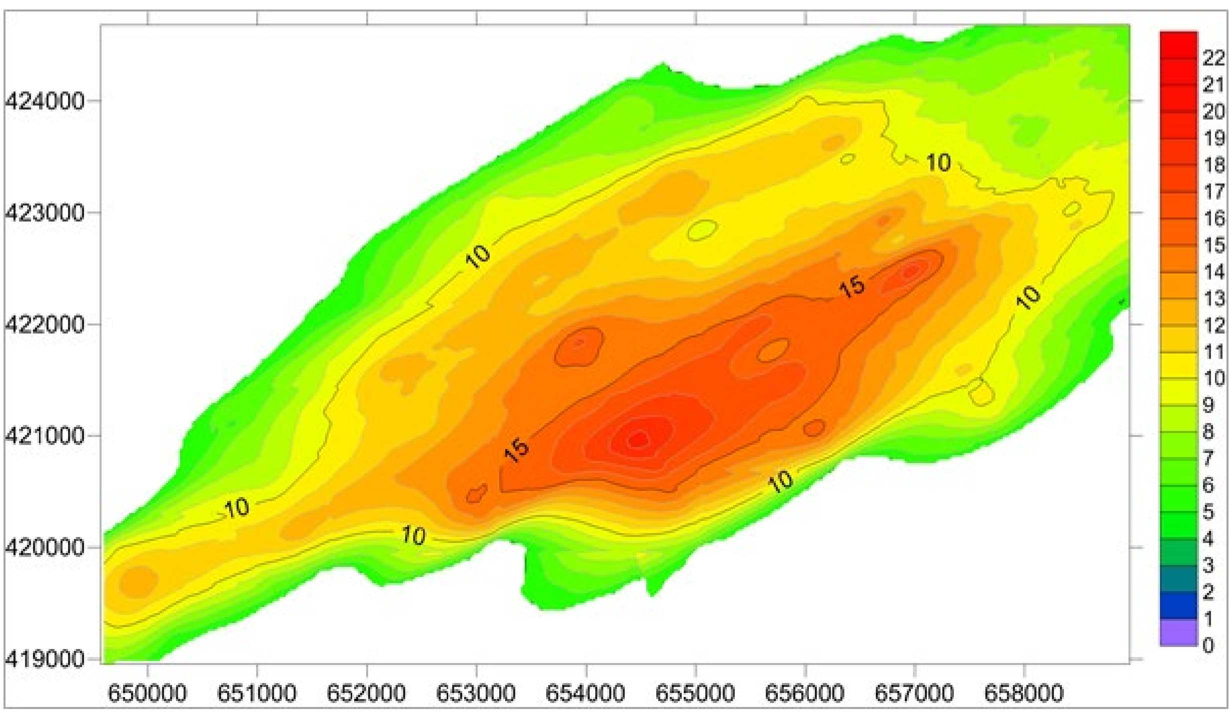

Figure 37. Isopach map created in Surfer™12 using data from seismic lines at 450-meter spacing.

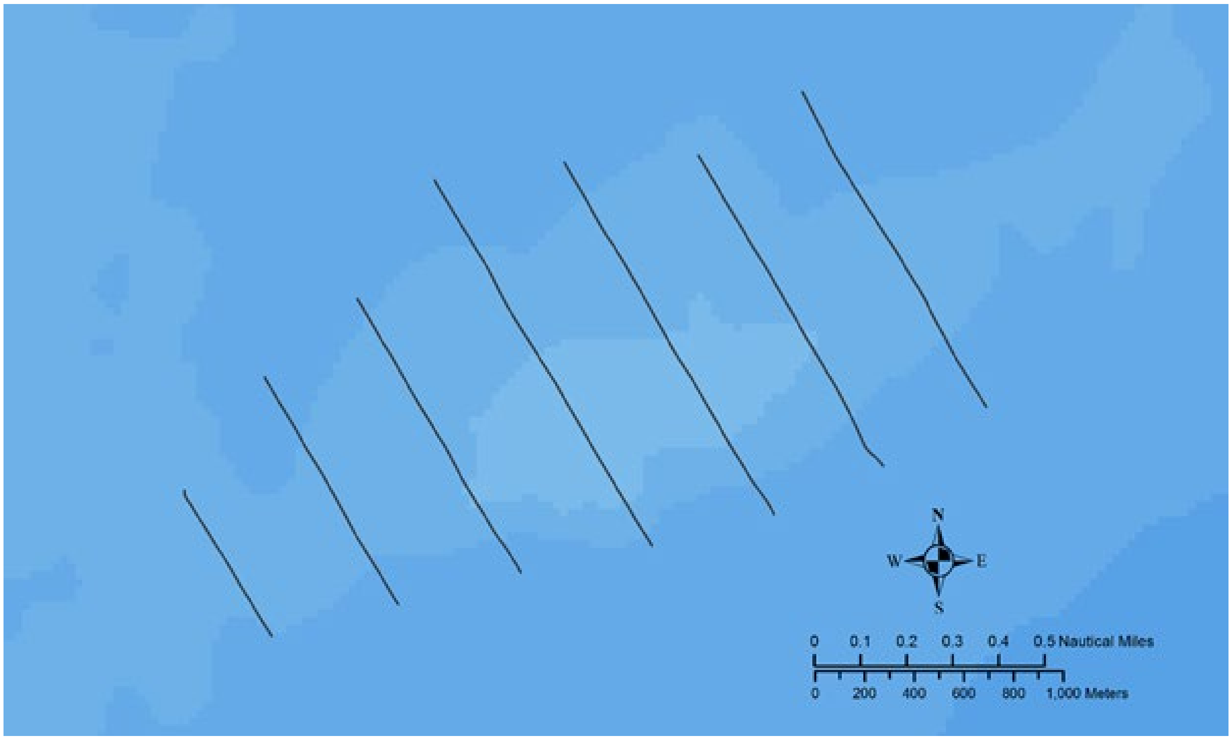

Figure 38. Locations of seismic lines at 480-meter spacing. No vibracores were located on these lines.

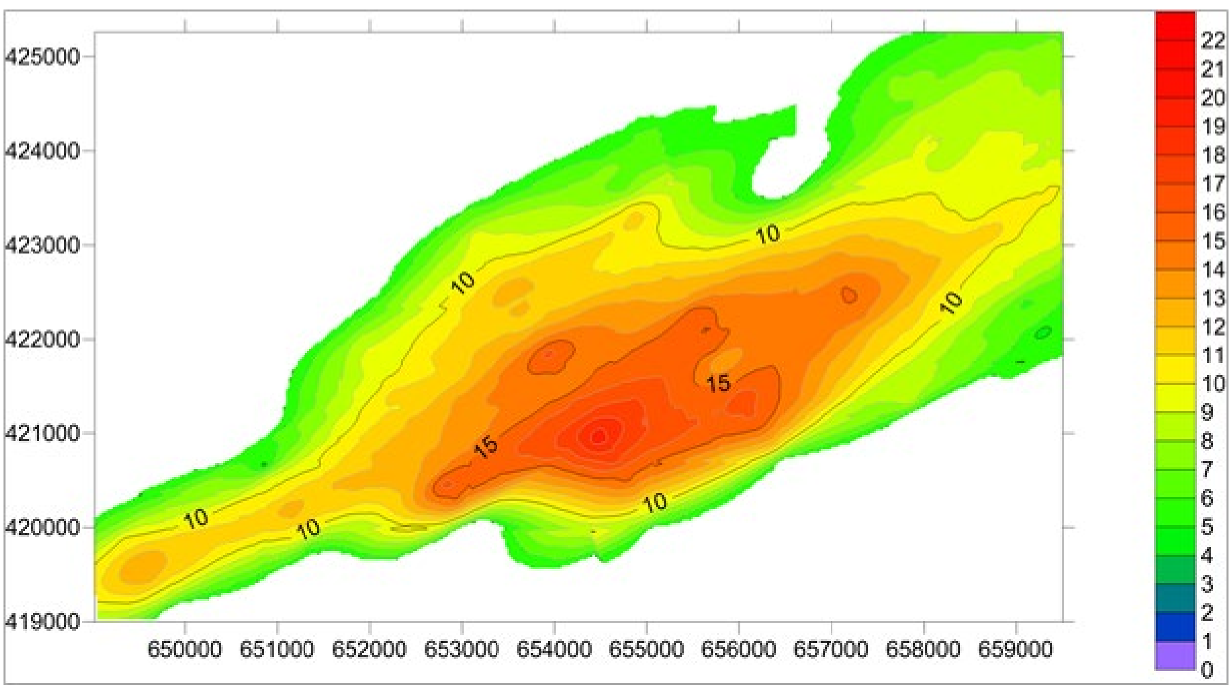

Figure 39. Isopach map created in Surfer™12 using data from seismic lines at 480-meter spacing.

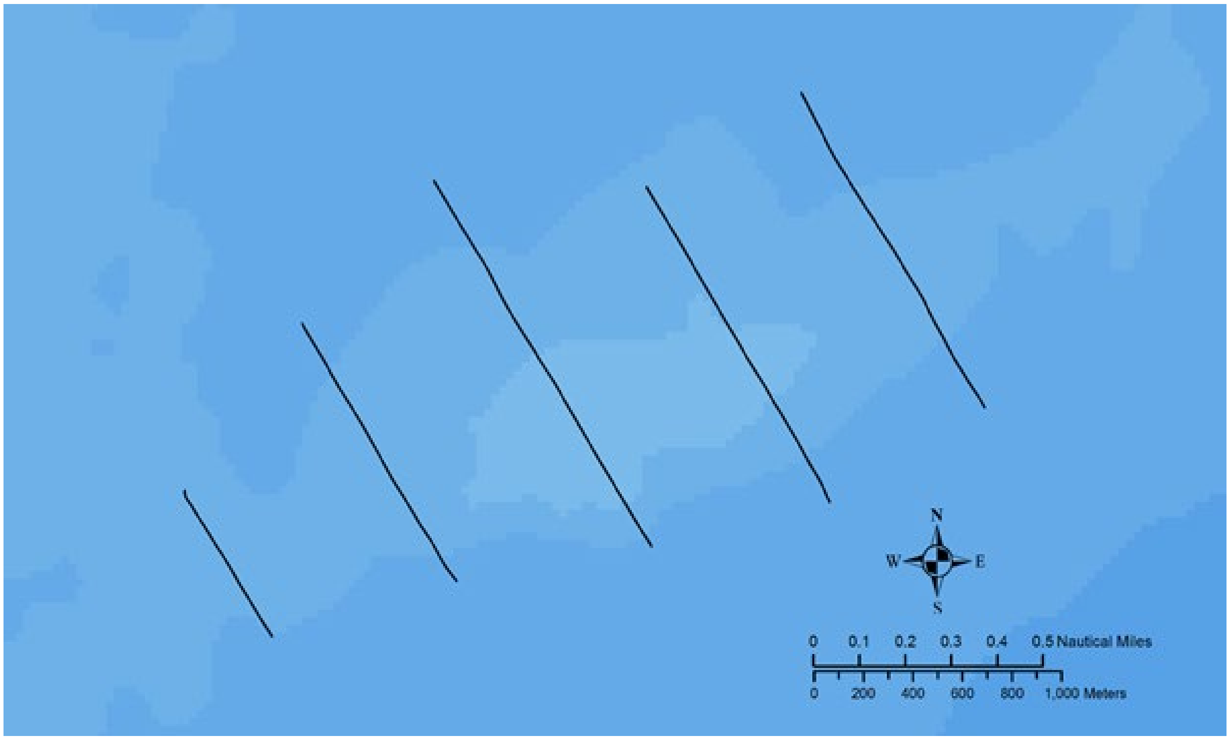

Figure 40. Locations of seismic lines at 720-meter spacing. No vibracores were located on these lines.

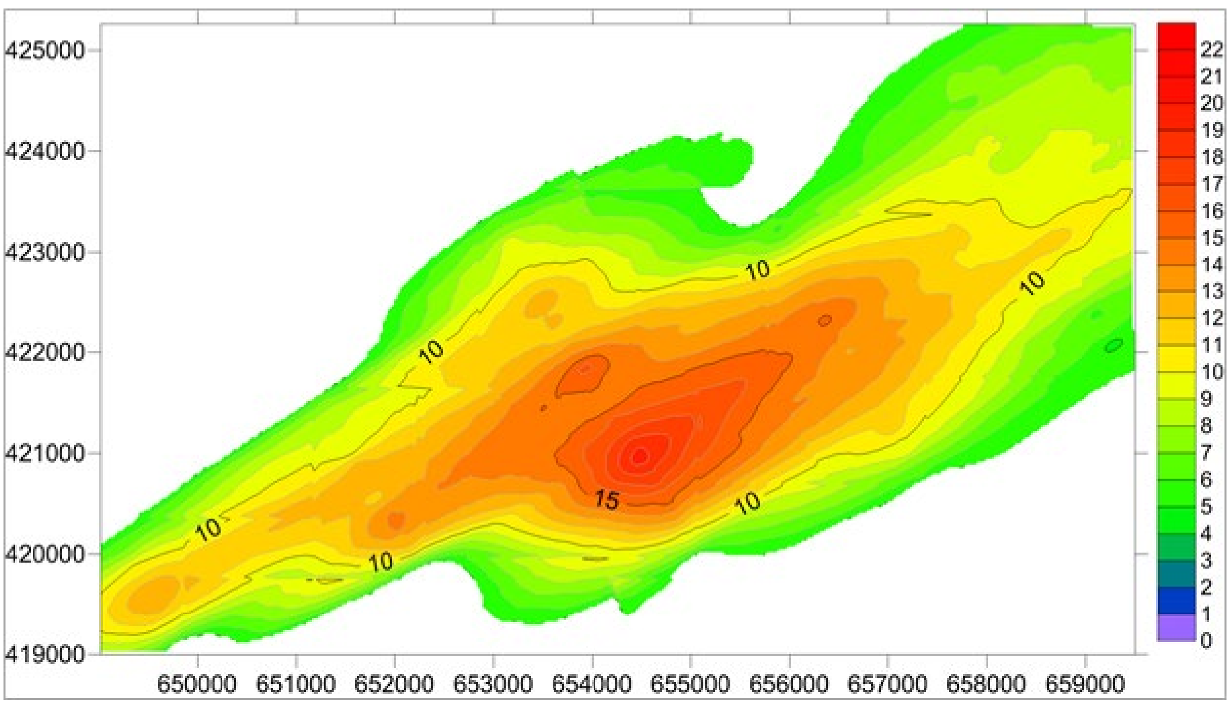

Figure 41. Isopach map created in Surfer™12 using data from seismic lines at 720-meter spacing.

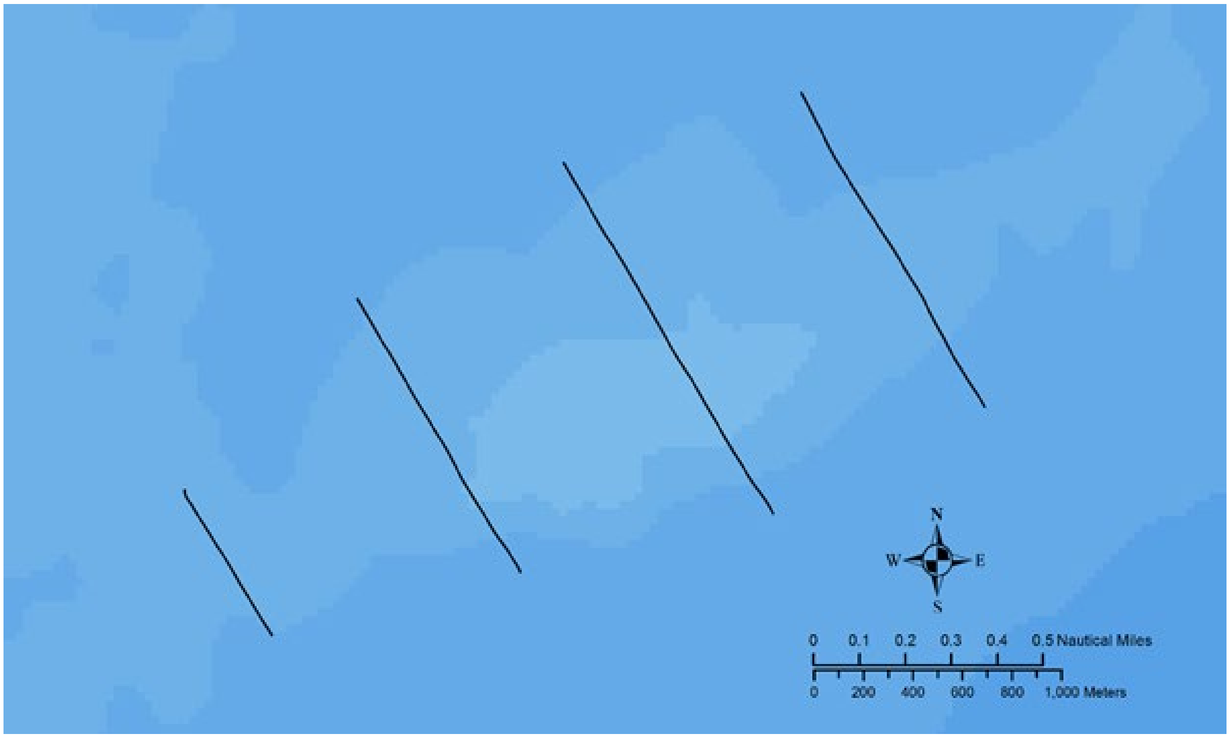

Figure 42. Locations of seismic lines at 960-meter spacing. No vibracores were located on these lines.

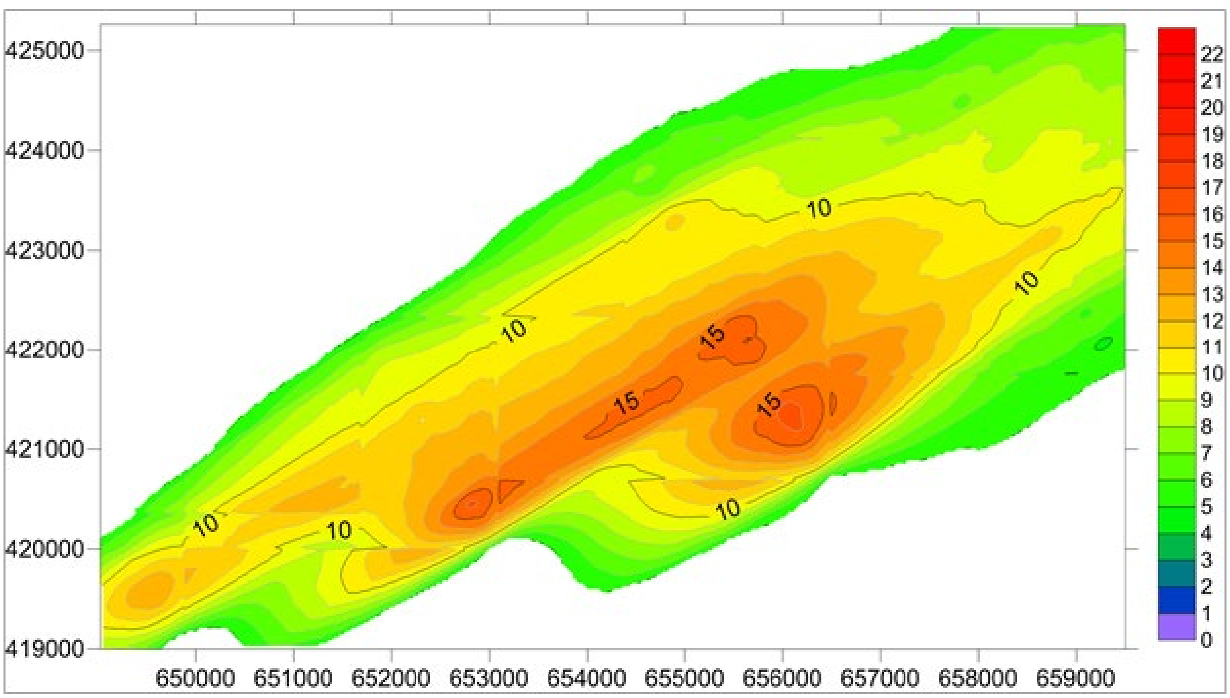

Figure 43. Isopach map created in Surfer™12 using data from seismic lines at 960-meter spacing.

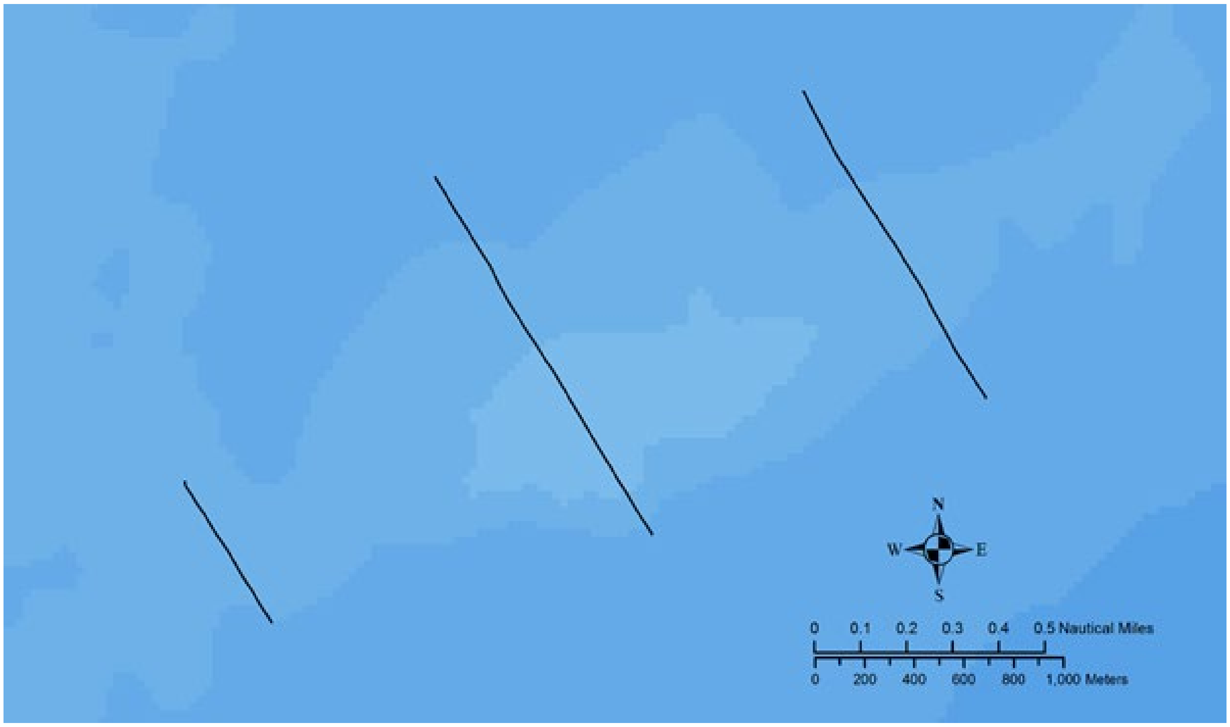

Figure 44. Locations of seismic lines at 1440-meter spacing. No vibracores were located on these lines.

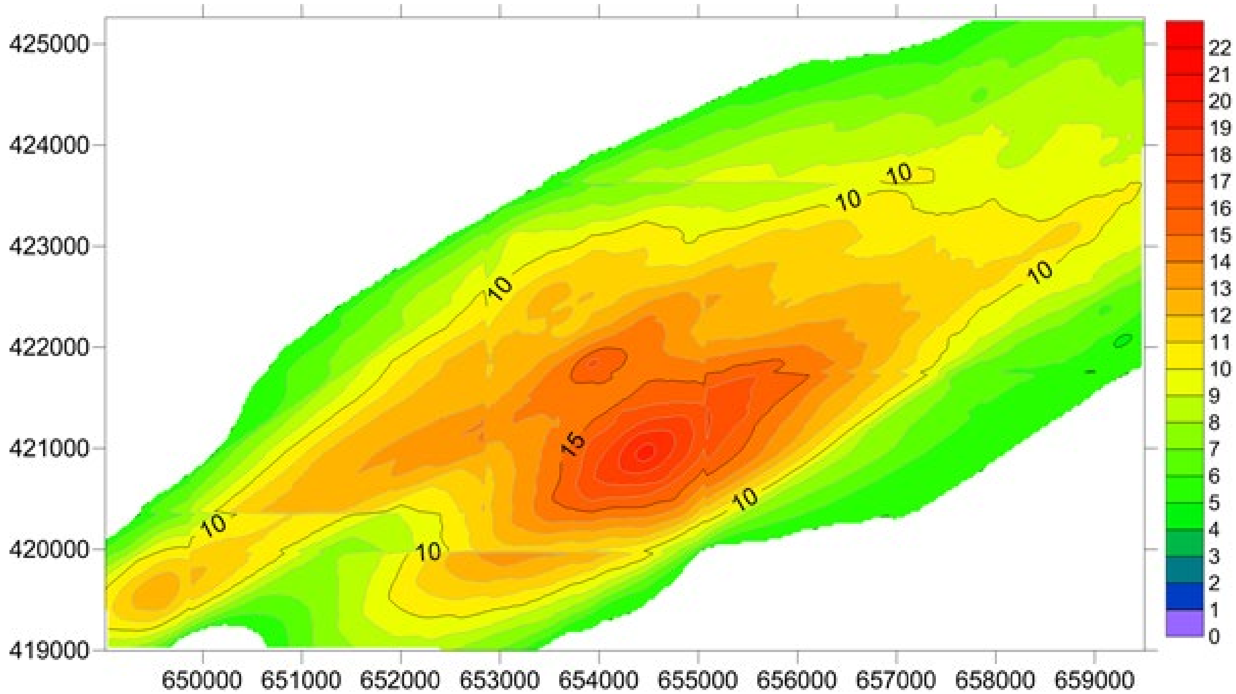

Figure 45. Isopach map created in Surfer™12 using data from seismic lines at 1440-meter spacing.

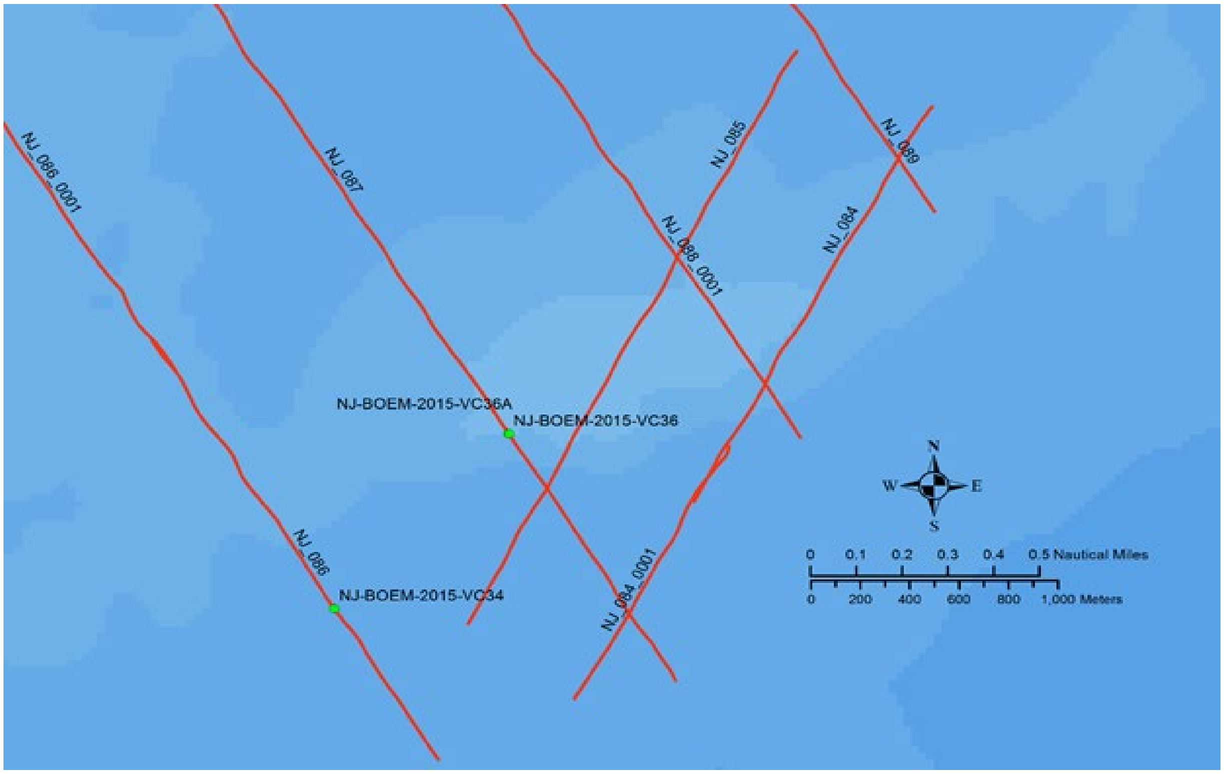

Figure 46. Locations of reconnaissance level seismic lines and the two reconnaissance level vibracores.

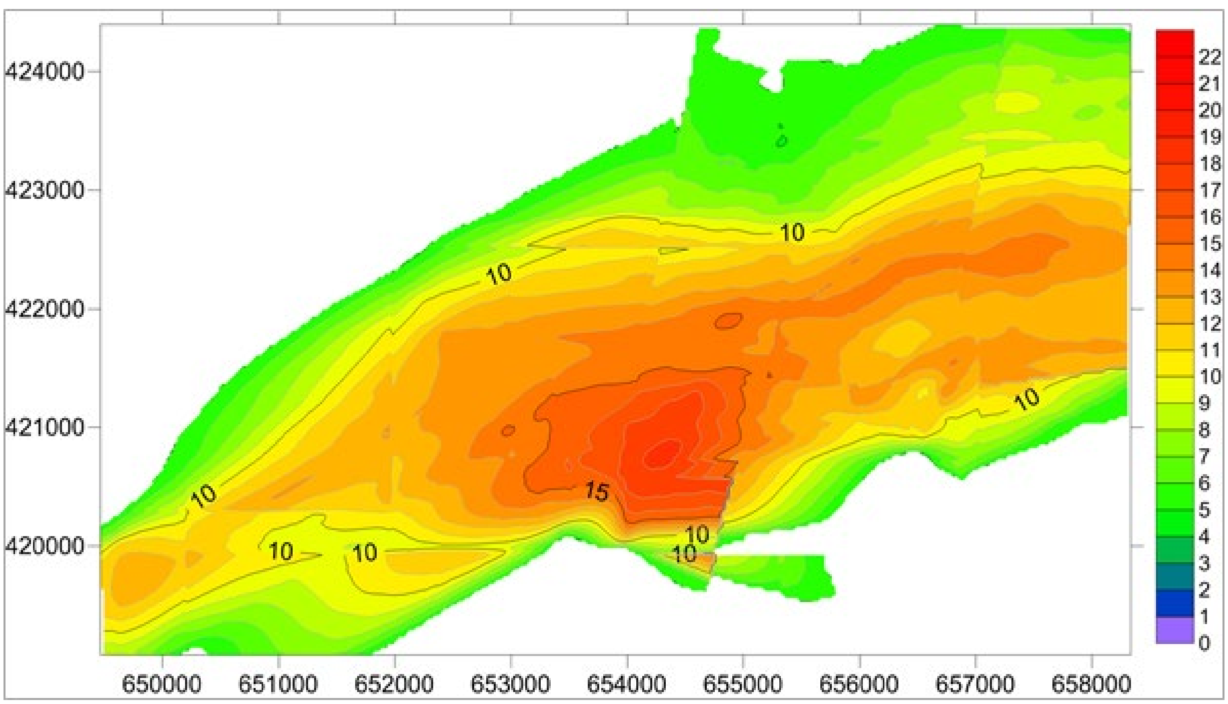

Figure 47. Isopach map created in Surfer™12 using data from reconnaissance level seismic lines.

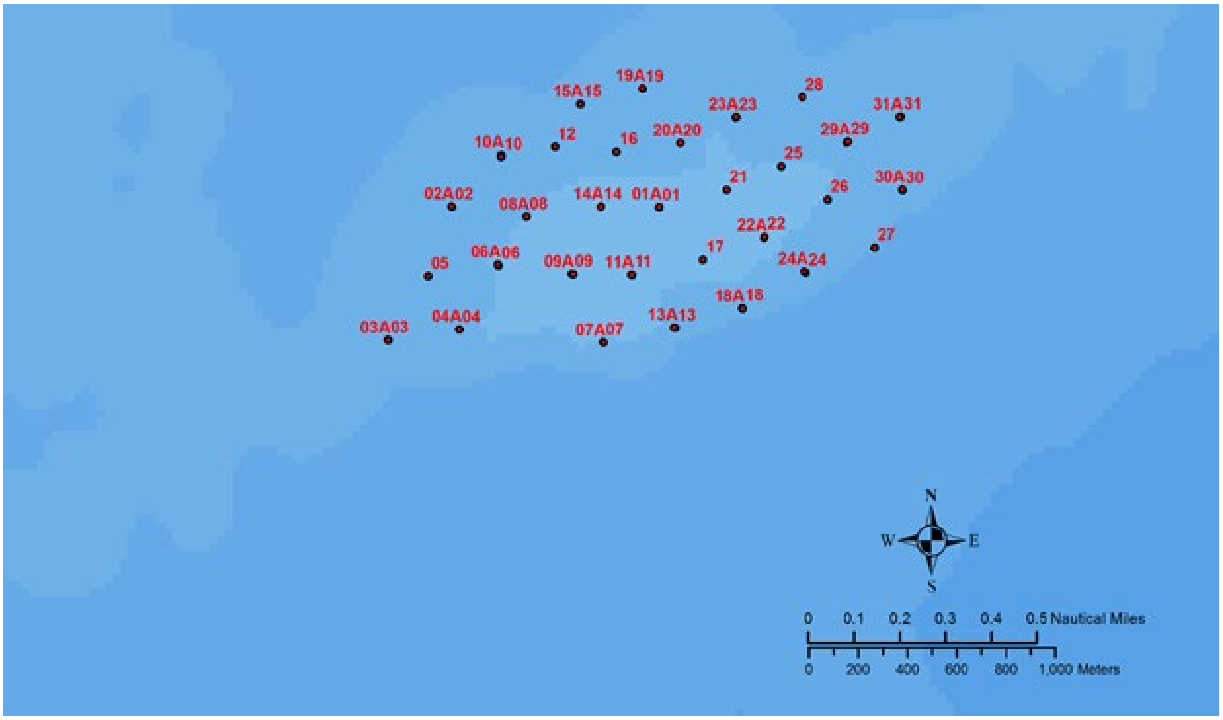

Figure 48. Locations of all design level vibracores.

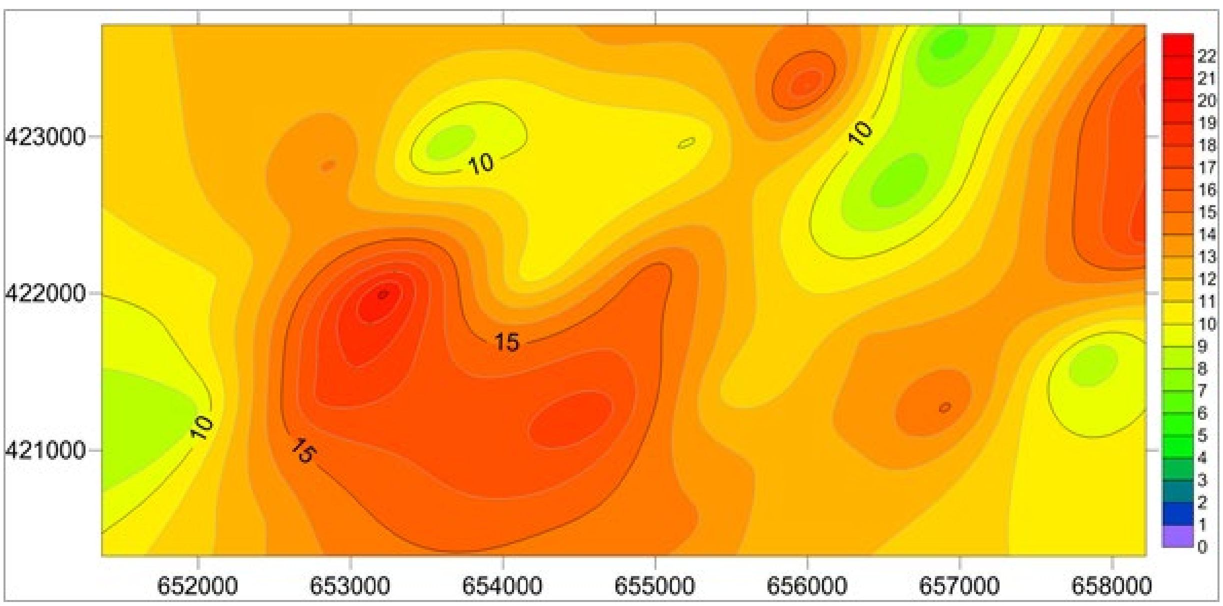

Figure 49. Isopach map created in Surfer™12 using data from design level vibracores.

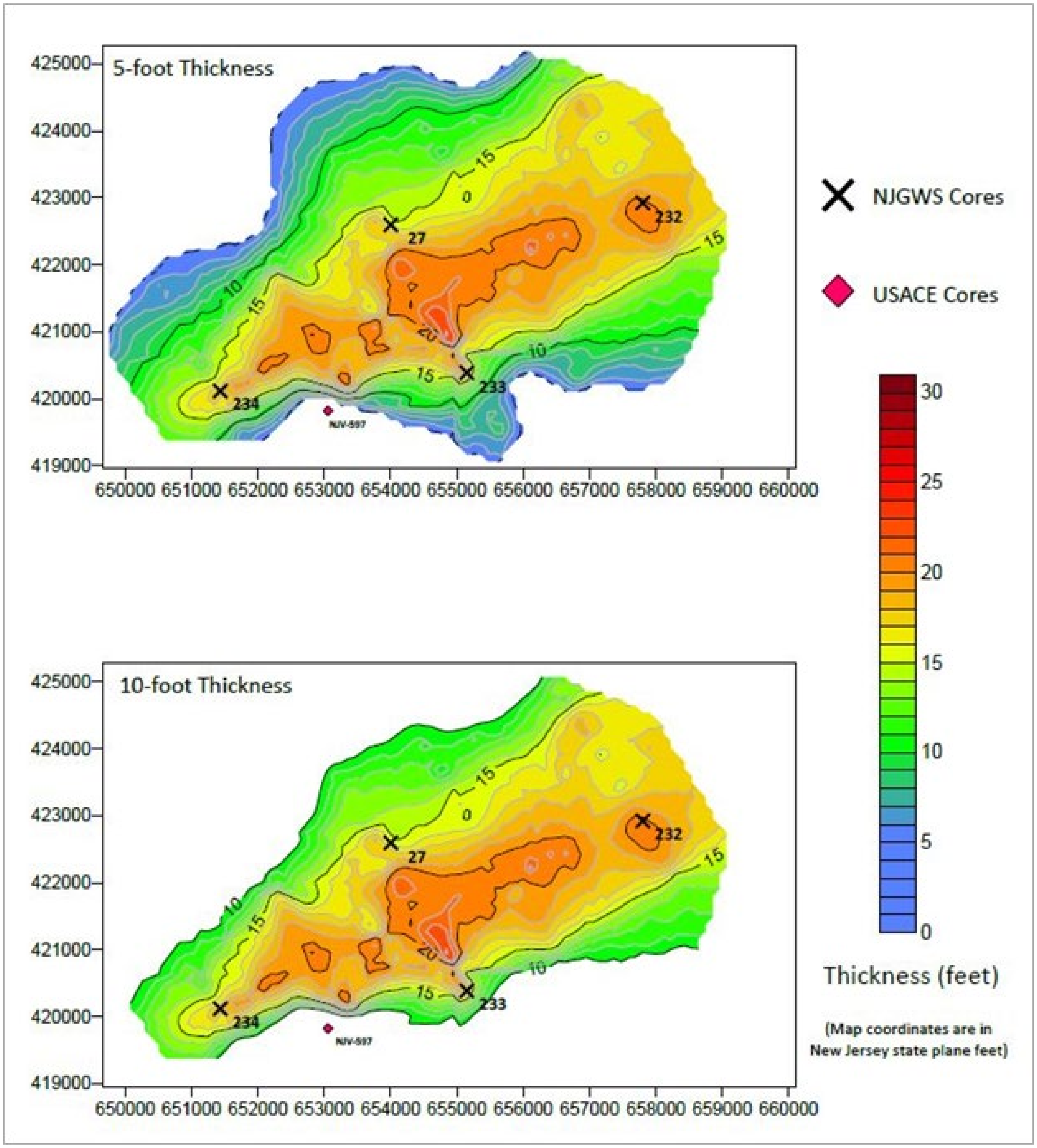

Figure 50. Figure taken from Kuhn et. al., 2016 showing the Isopach maps of area F1 created in Surfer™12 for the preliminary analysis of northern ocean county sand resource areas.

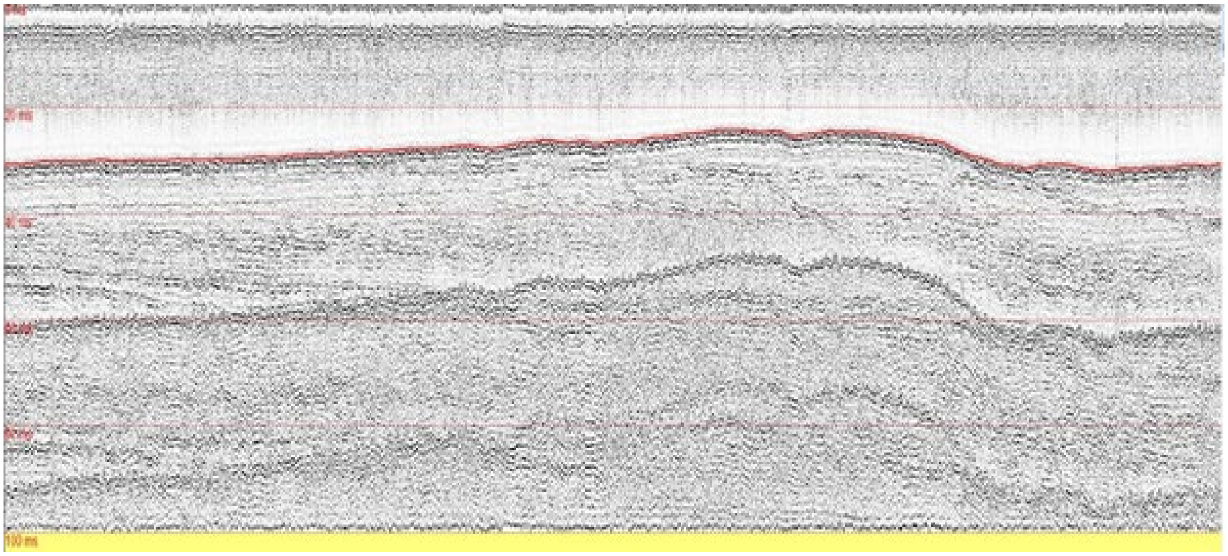

Figure 51. NJGWS line 645. This is an example of the data used by Kuhn et. al., 2016.

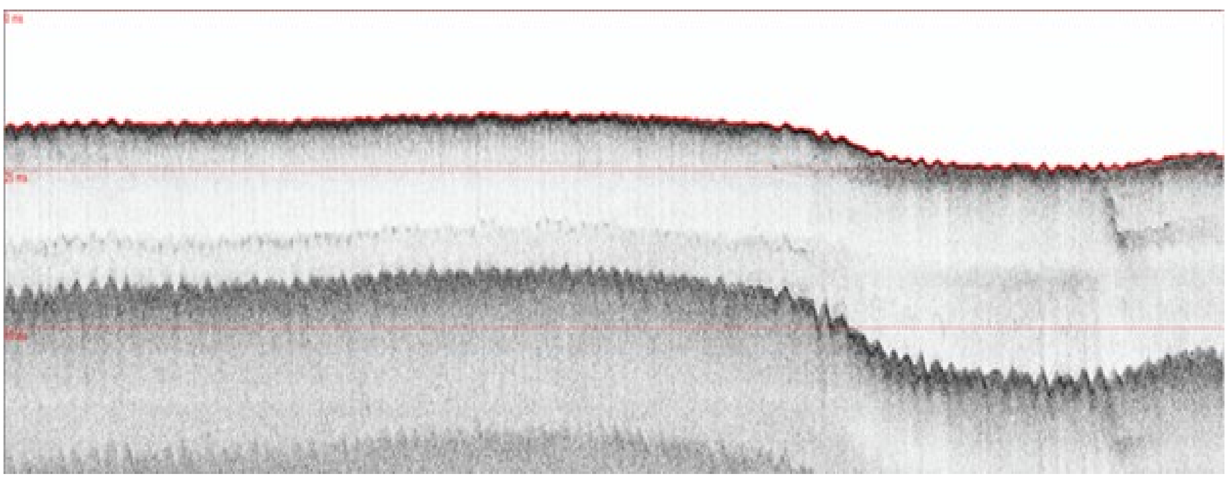

Figure 52. CB&I Reconnaissance line NJ_085

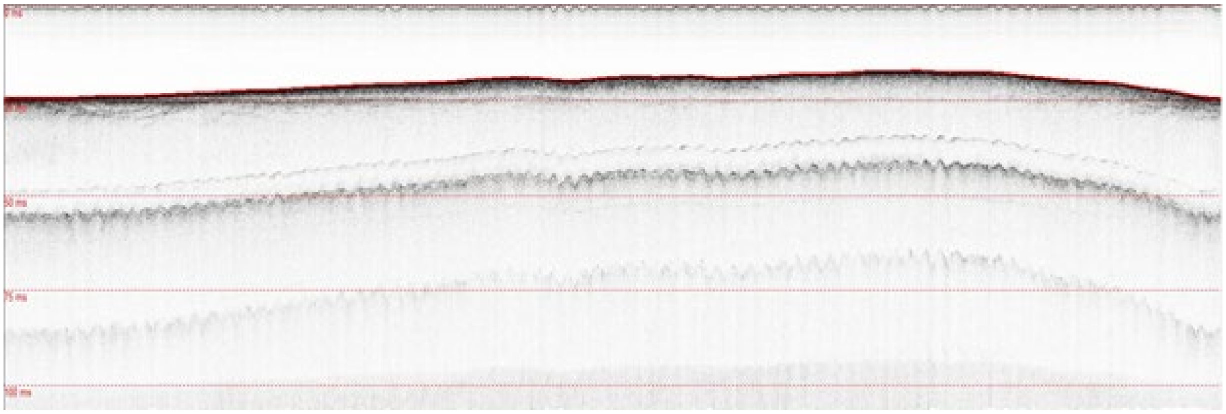

Figure 53. CB&I Design Level line 335

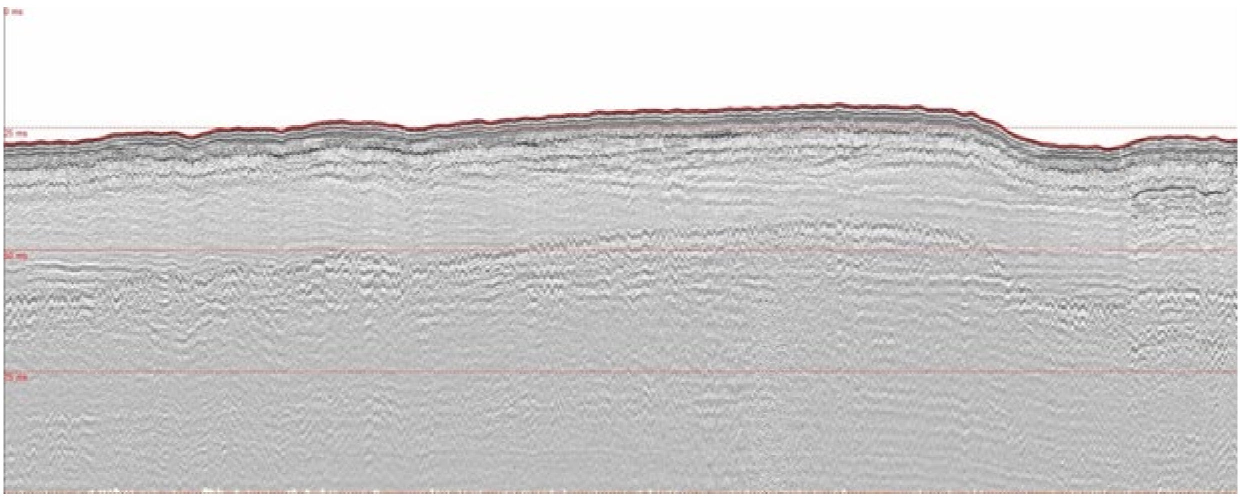

Figure 54. NJGWS Seismic line 733 collected in 2017. This line was collected in the exact same location as CB&I Reconnaissance line NJ_085.

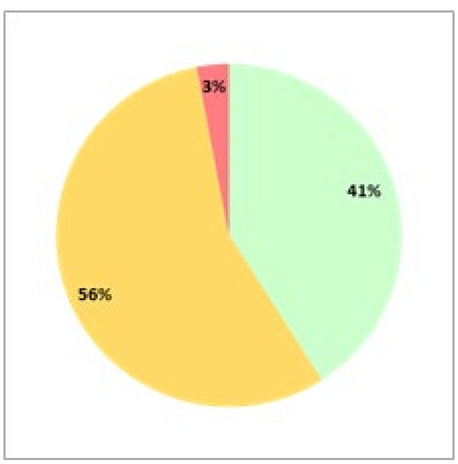

Figure 55. Pie chart from Deliverable F showing percentages of design level data quality. Green represents good data, yellow represents fair data and red represents poor data.

References

Kuhn, M.E., Gagliano, M.P., Castelli, M.V., Uptegrove, J, 2016, Northern Ocean County offshore Sand Resource Area Synthesis and Assessment: “Sand-Resource Areas in Northern Ocean County, New Jersey”.

Deliverable F

Technical Report Detailing the Quality of the BOEM ASAP Data

U.S. Dept. of the Interior

Bureau of Ocean Energy Management

Cooperative Agreement Number M14AC00002

New Jersey Geological and Water Survey

New Jersey Dept. of Environmental Protection

April 2018

As part of Cooperative Agreement M14AC00002, the Bureau of Ocean Energy Management (BOEM) contracted Chicago Bridge and Iron (CB&I) to collect offshore geophysical and vibracore data along the east coast of the United States as part of its Atlantic Sand Assessment Project.

In review of the geophysical data collected offshore New Jersey, the New Jersey Geological & Water Survey (NJGWS) created a simple grading scale to categorize the quality of the data. The grading scale has three categories: good, fair and poor. Data was considered good if the reflector representing the base of sand is visible and can be followed throughout the entire extent of the shoal. There was little to no ringing or distortion of the data directly below the seafloor surface and features such as paleochannels typically present deeper than the base of sand reflector was visible with the multiple not cutting through or masking these features (Figure 1). Data was considered fair if the reflector representing the base of sand was traceable and visible throughout most of the shoal. Some distortion of the data directly below the seafloor and features below the base of sand were considered acceptable (Figure 2). Data categorized as poor does not have any visible base of sand, almost all the data below the seafloor is distorted and no features are visible in any portion of the record (Figure 3).

Tables 1-4 show the grading of reconnaissance level data by county collected by CB&I during 2015. Overall, 7% of the data was good, 50% of the data was fair, and 43% of the data was poor.

Figures 4 and 5 show the grading results of the design level data collected by CB&I. As there was over 400 design level lines, the table was omitted, but all the data can be found in the included "NJ_QAQC.xlsx" spreadsheet. Overall the design level data was considerably better than the reconnaissance data, with the majority of the data being good or fair.

Reasons for the poor data quality on the reconnaissance level data may be too fast collection speed, poor sea state or weather conditions, and improper settings on the collection equipment. We recommend future surveys be collected regionally so local expertise may be applied. Also cancelling or delaying survey days would be preferable to get quality data rather than collecting through poor weather conditions. NJGWS also recommends the use of a Boomer system rather than Chirp. NJGWS has been using a Boomer since the beginning of its Offshore

Research Exploration program and have found that they are easy to deploy and operate and collect high quality data with good depth penetration and resolution.

In review of the vibracore data collected offshore New Jersey, the NJGWS created a Microsoft Access table to categorize the data. The table contains all pertinent information including phi size, if there were shells in the vibracore, if it was located on or near a potential sand resource, which geophysical line it was located on, the length of the vibracore, and any other comments. Figure 6 shows an example of the vibracore data, and the full data set can be found in the included “NJ_Vibracore_QAQC.accdb” database.

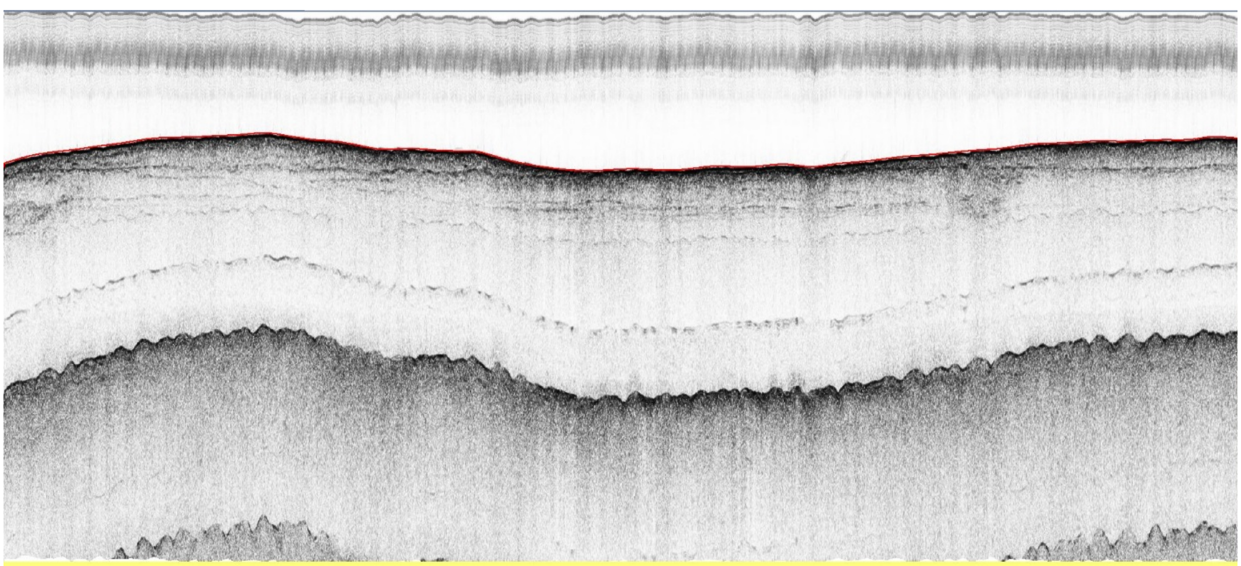

Figure 56. Example of a Chirp line collected by CB&I that is considered Good-quality data.

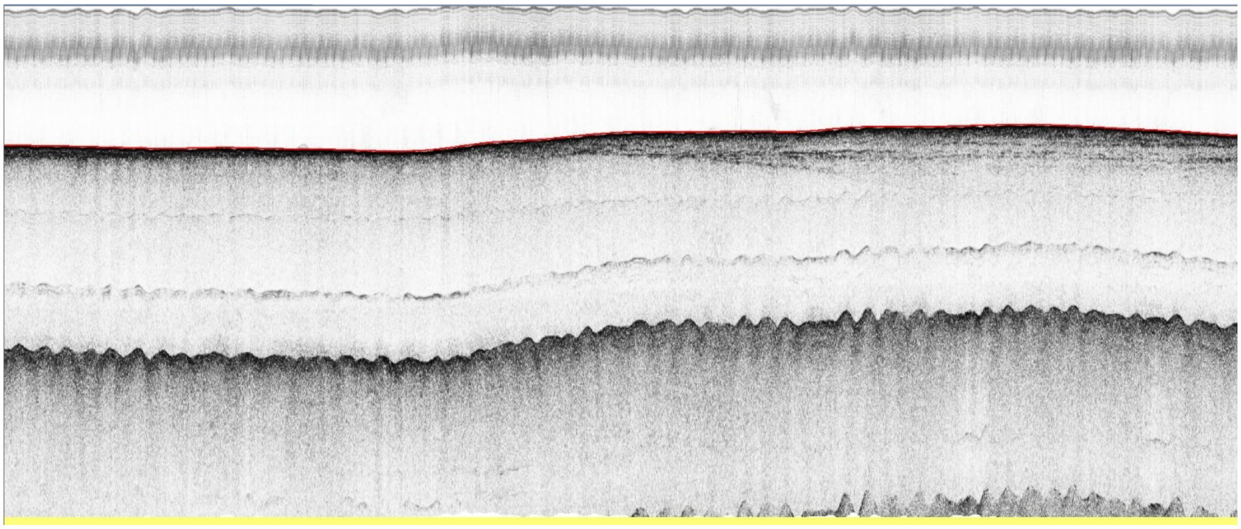
Figure 57. Example of a Chirp line collected by CB&I that is considered Fair-quality data.

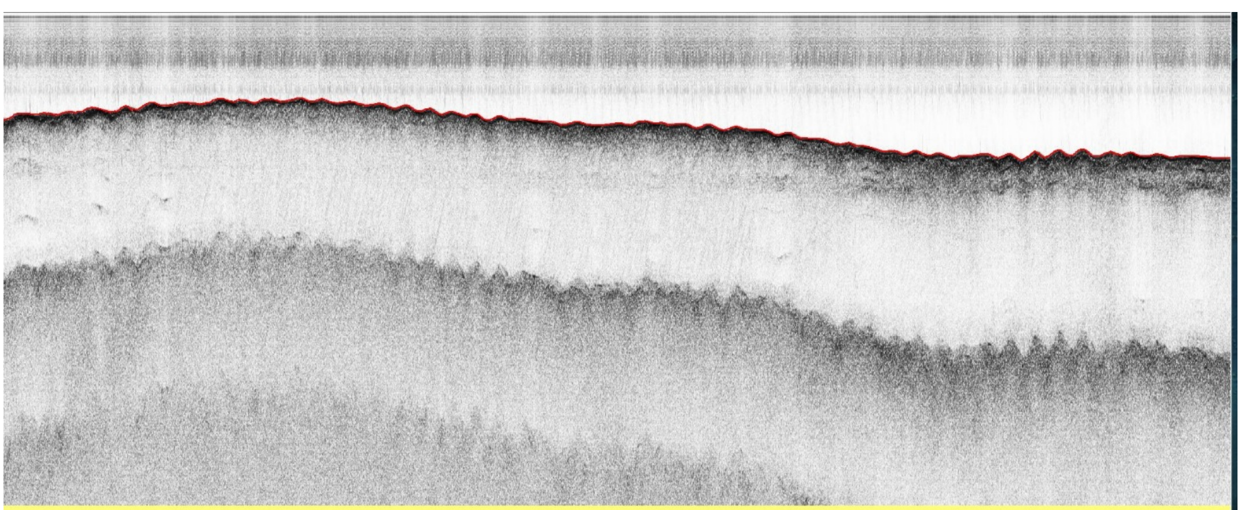
Figure 58. Example of a Chirp line collected by CB&I that is considered Poor-quality data.

ATLANTIC COUNTY			
Recon Level	Geophysics		
Line Number	Good	Fair	Bad
NJ_043		1	
NJ_044			1
NJ_045			1
NJ_046		1	
NJ_047			1
NJ_048		1	
NJ_049			1
NJ_050		1	
NJ_051			1
NJ_052			1
NJ_053			1
NJ_054		1	
NJ_055		1	
NJ_056		1	
NJ_057		1	
NJ_058		1	
NJ_059	1		
NJ_060		1	
Total	1	10	7
%	5%	56%	39%

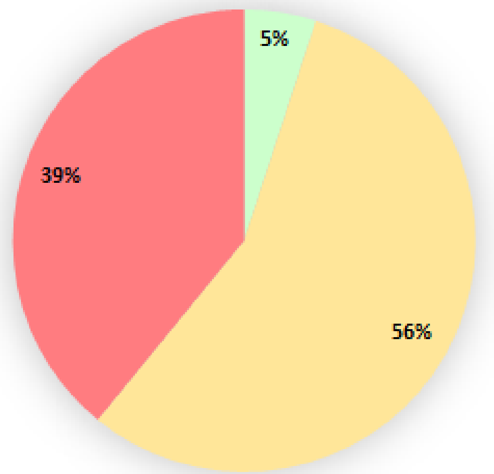

Table 4. Reconnaissance level geophysical data quality for Atlantic County, NJ.

CAPE MAY COUNTY			
Recon Level	Geophysics		
Line Number	Good	Fair	Bad
NJ_001			1
NJ_002		1	
NJ_003			1
NJ_003_1		1	
NJ_003_1.001		1	
NJ_004		1	
NJ_004_1		1	
NJ_005			1
NJ_006			1
NJ_007		1	
NJ_008		1	
NJ_009			1
NJ_010		1	
NJ_011			1
NJ_012			1
NJ_013			1
NJ_014		1	
NJ_015			1
NJ_016		1	
NJ_017			1
NJ_018_1			1
NJ_018			1
NJ_019		1	
NJ_020			1
NJ_021			1
NJ_022			1
NJ_023			1
NJ_024		1	
NJ_024.001		1	
NJ_025		1	
NJ_026		1	
NJ_026.001		1	
NJ_027	1		
NJ_027_1	1		
NJ_028		1	
NJ_029		1	
NJ_030		1	
NJ_031		1	
NJ_032		1	
NJ_033			1
NJ_034	1		
NJ_34_1		1	
NJ_035		1	
NJ_036		1	
NJ_037		1	
NJ_038		1	
NJ_039			1
NJ_040		1	
NJ_041		1	
NJ_042		1	
Total	3	29	18
%	6%	58%	36%

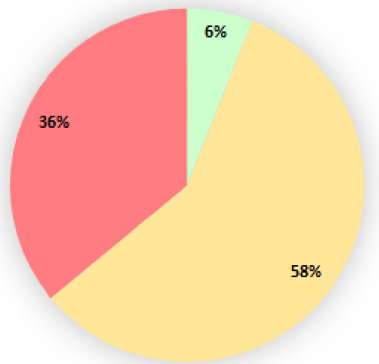

Table 5. Reconnaissance level geophysical data quality for Cape May County, NJ.

MONMOUTH COUNTY			
Recon Level	Geophysics		
Line Number	Good	Fair	Bad
NJ_090			1
NJ_091			1
NJ_092			1
NJ_093			1
NJ_094		1	
NJ_095			1
NJ_096		1	
NJ_097		1	
NJ_098			1
NJ_099			1
NJ_100	1		
NJ_101			1
NJ_102			1
NJ_103		1	
NJ_104		1	
NJ_105			1
Total	1	5	10
%	6%	31%	63%

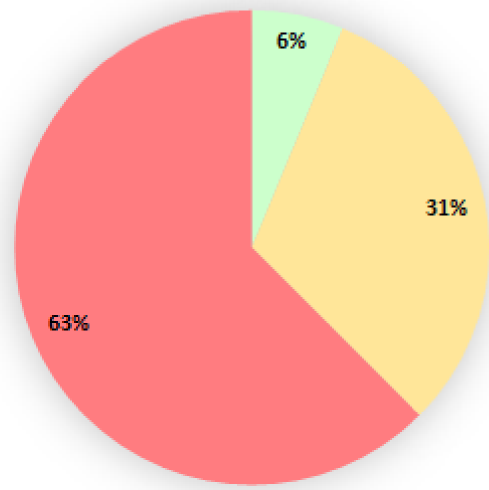

Table 6. Reconnaissance level geophysical data quality for Monmouth County, NJ.

OCEAN COUNTY			
Recon Level	Geophysics		
Line Number	Good	Fair	Bad
NJ_061		1	
NJ_062		1	
NJ_063			1
NJ_064		1	
NJ_065		1	
NJ_066		1	
NJ_067	1		
NJ_068	1		
NJ_069	1		
NJ_069.001		1	
NJ_070			1
NJ_070.001			1
NJ_071			1
NJ_071.001			1
NJ_072		1	
NJ_073		1	
NJ_073.001			1
NJ_074			1
NJ_075			1
NJ_076			1
NJ_077		1	
NJ_078			1
NJ_079		1	
NJ_079.001			1
NJ_080			1
NJ_081			1
NJ_082			1
NJ_083		1	
NJ_084		1	
NJ_084.001		1	
NJ_085		1	
NJ_086			1
NJ_086.001			1
NJ_086.002			1
NJ_087		1	
NJ_088			1
NJ_088.001		1	
NJ_089		1	
Total	3	17	18
%	8%	45%	47%

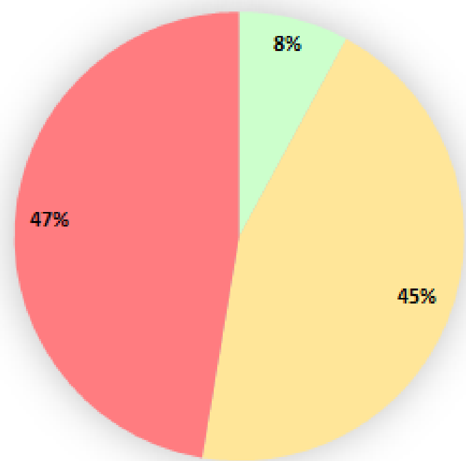

Table 7. Reconnaissance level geophysical data quality for Ocean County, NJ.

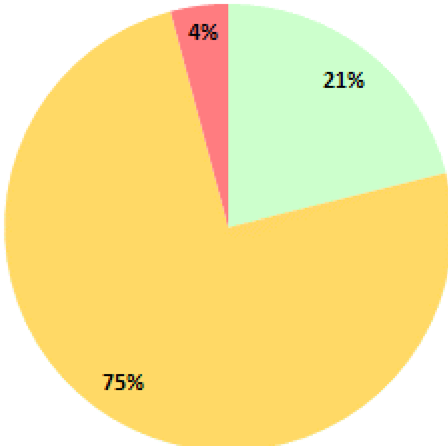

Figure 59. Design level geophysical data quality for Monmouth County, NJ.

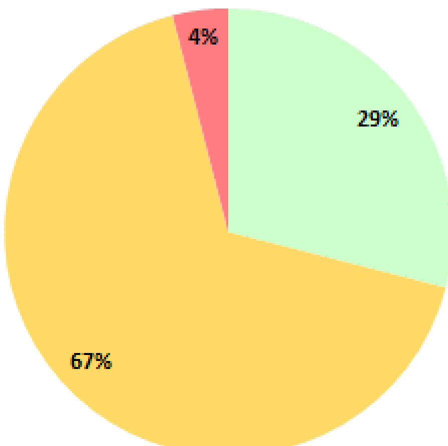

Figure 60. Design level geophysical data quality for Area F, Ocean County, NJ.

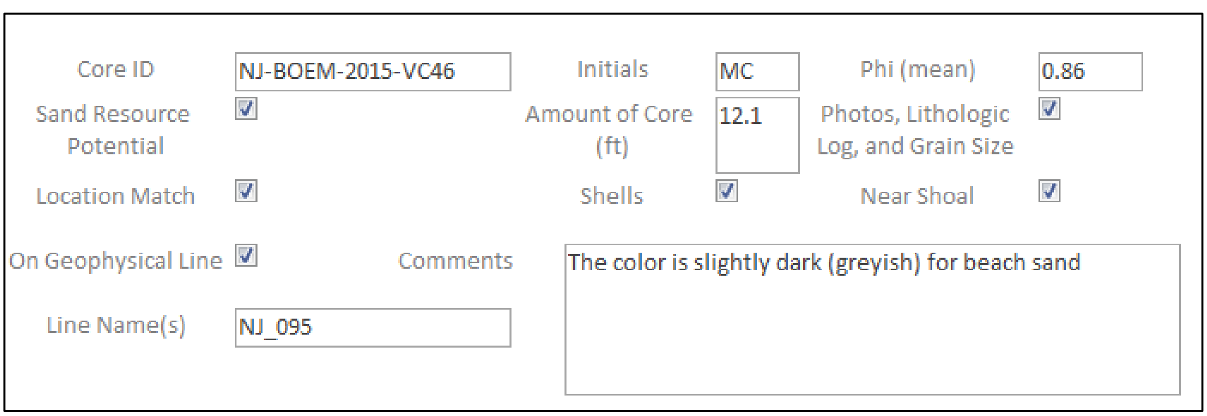

Figure 61. Vibracore database example.

Deliverable G
GIS Coverage delineating Areas for Future Geophysical and Geological Surveys to Fill Existing Data Gaps

U.S. Dept. of the Interior

Bureau of Ocean Energy Management

Cooperative Agreement Number M14AC00002

New Jersey Geological and Water Survey

New Jersey Dept. of Environmental Protection

April 2018

As part of Cooperative Agreement M14AC00002, the New Jersey Geological & Water Survey (NJGWS) were tasked with delineating any areas in Federal waters off the coast of New Jersey that need more data collection. NJGWS staff identified 8 potential resource areas missing seismic data (Figure 1). These areas were based on existing gaps, bathymetry, and the needs of the US Army Corp of Engineers (USACE). Please note that the area off Atlantic County was completed as part of the Atlantic Sand Assessment Project, however the data collected there was poor and unusable, and we request that it be redone as it is an area that USACE will need replenishment sand from in the future. Figure 2 includes locations and orientations of the seismic lines that the NJGWS believes would be required for sufficient data analysis of the areas.

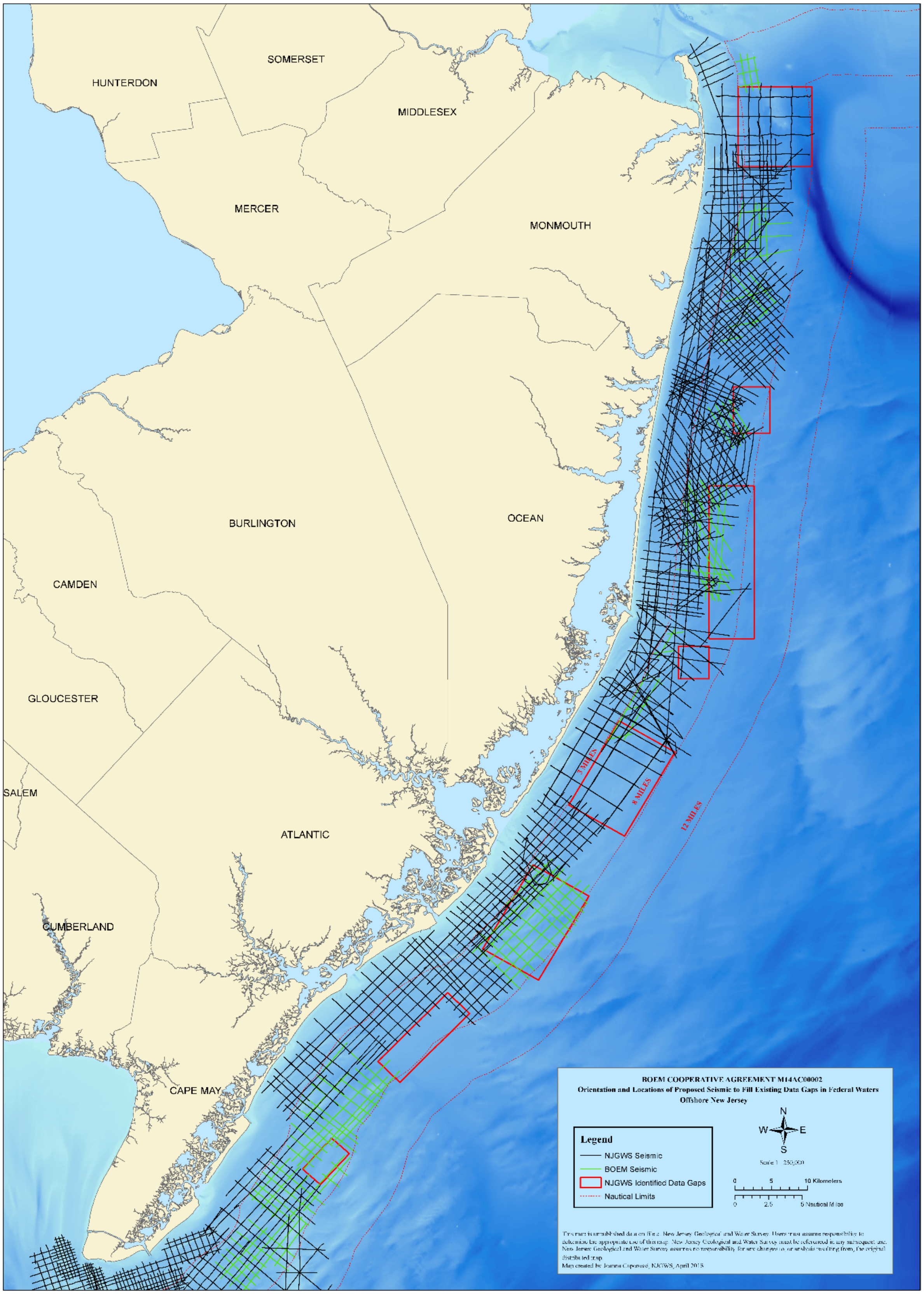

Figure 62. NJGWS identified data gaps.

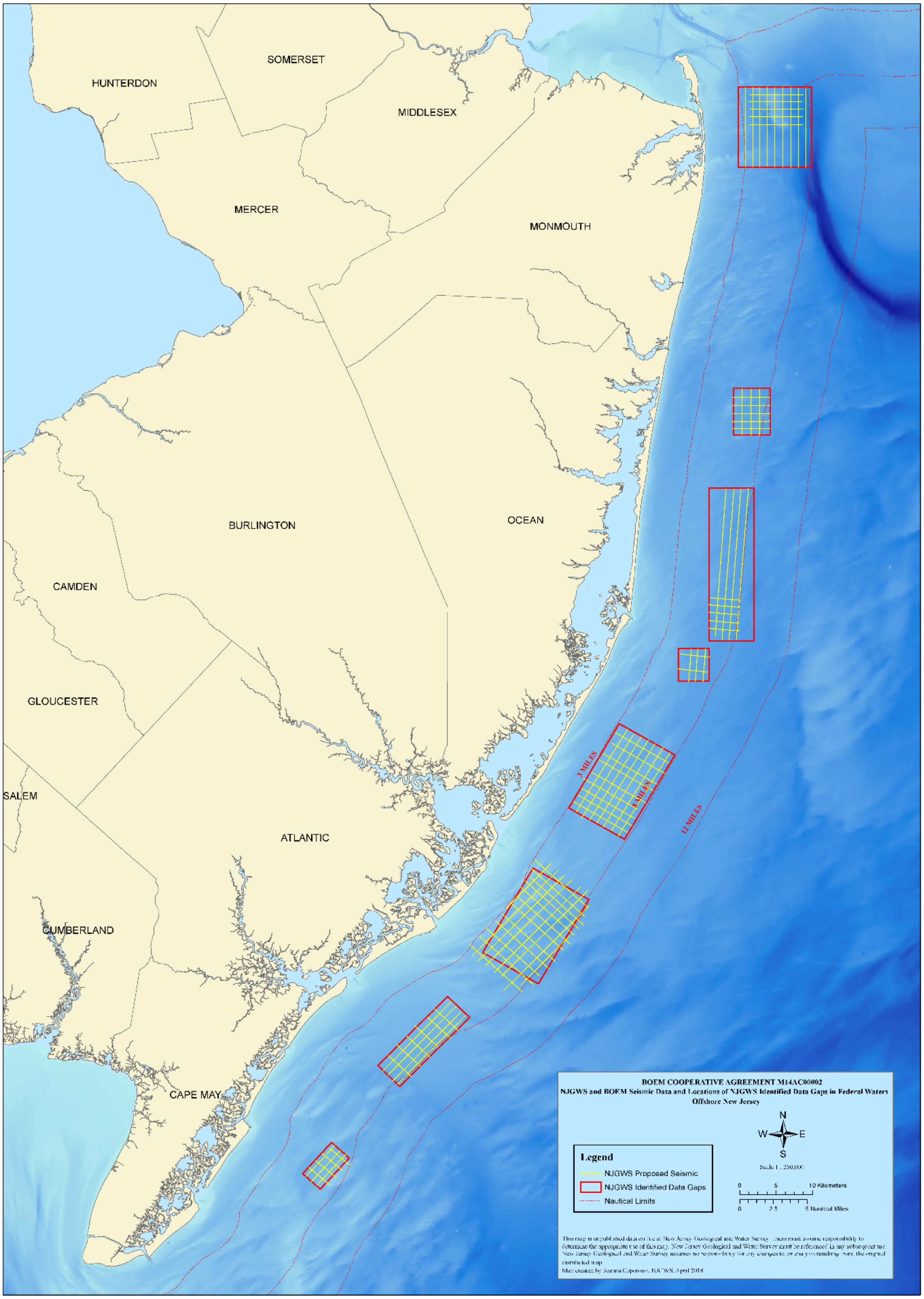

Figure 63. NJGWS proposed seismic.