Mandeville, La. Small Craft Channel: An Example of Bottom Contrasting™

(with Quantitative Acoustic Backscattering capable of being used to calculate Sediment Bulk Density, Porosity, Bottom Loss and Reflection Coefficient)

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Survey Area

The Mandeville (Louisiana) small craft navigation channel extends from the Mandeville harbor into northern Lake Pontchartrain. The area selected to survey includes both inshore and lake water bottom areas. The area exhibits great diversity in surficial sediment types making it ideal for demonstrating Bottom Contrasting ™. The entire survey area is geopositioned using GPS; however, to eliminate clutter, the GPS grid is not shown on the attached charts.

Equipment Used & Methodology

Unabara's portable Hydro-2F™ Multi-Frequency Synthetic Beam Bathymetric & Sea Floor Sonar was installed aboard a shallow draft survey launch. Other equipment used included a Windows Notebook PC and RTK GPS system. 20 hertz was used as the echo sounding rate to insure maximum spatial definition of the water bottom. Acoustic bottom losses, for both frequencies, were recorded in XYZ format and also plotted using Hydromagic ™ PC mapping software; to display distribution of sediments as differentiated by backscattering and bottom loss values. Bottom losses were used to compute Reflection Coefficients, and then the resulting Porosities and Bulk Densities. These parameters were then used to estimate bottom sediment types; ground truthing was then done on a limited basis to confirm.

Observations

CHART A, overlayed with a scaled satellite photograph to provide an augmented reality map, is the survey area bathymetry based upon 230 Khz. (high acoustic channel) echo sounding. Echoes upon which depths are based are from the initial "surficial" sediment layer of the bottom.

CHART B is the bathymetry of the same area but based upon 12 Khz. (low acoustic channel) sounding. The depths are based upon echo returns from a hard "consolidated" bottom layer beneath the "soft" surficial sediment layer.

CHART C shows the difference in depths between the two bottom layers and thus the surficial layer thickness.

To the layman, the surficial sediments in this area seem to be pretty much homogenous visually. However, as shown on **CHART D**, Bottom Losses vary widely indicating many different sediment types (by composition and grain size); organics from local run-off further effect sediment characteristics. As

shown on **CHART D**, the majority of the water bottom lies in areas of "mud" (of some degree of clay, silt and organics). *All bottom losses on **CHART D** represent those losses in the surficial sediment as measured by the Hydro-2F's high frequency channel (230 Khz.).*

Below the bottom of the surficial sediment (whose thickness is shown on CHART C) is a much more consolidated ("hard") sediment layer; see **CHART E** for the bottom losses for this consolidated layer. This layer was defined using the highly directive low frequency signal of the Hydro-2F™ operating at 12 Khz.. (The user may also field select other low frequencies such as 10, 18, 24, 28, & 30 Khz.).

CHART F provides predictions of wet Bulk Density (in grams/cubic centimeter of sediment) for the surficial sediment layer. **CHART G** provides the wet Bulk Density for the consolidated sediment layer. If one compares these two charts/maps, it will be observed the surficial layer is much more "soft and loose" than the consolidated layer.

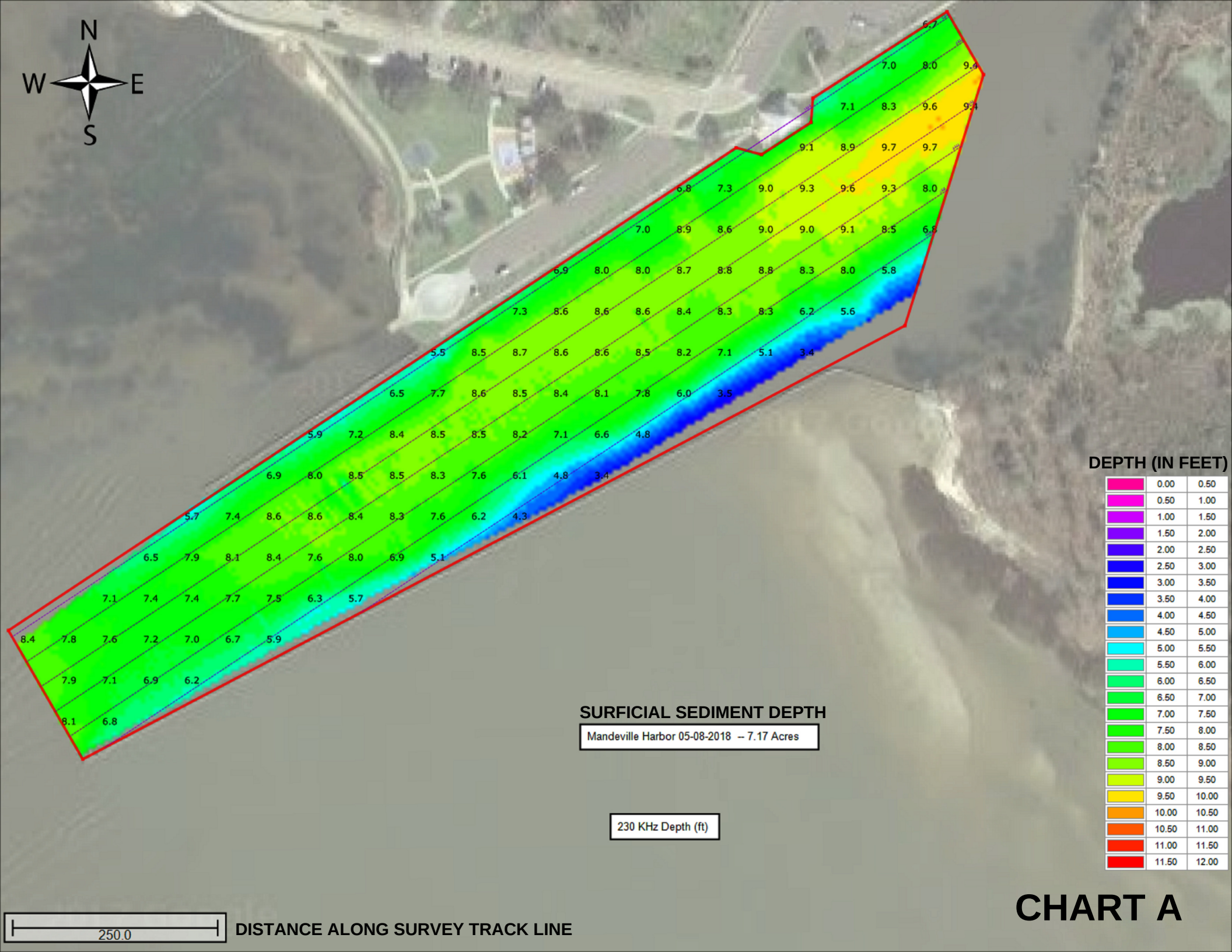
Shellfish fishery managers would be well served to study CHARTS F & G in concert with CHART C. If an existing reef is to be evaluated or managed, or if a new artificial reef will be created, here are examples of questions which this type of chart/map data (wherever the survey area is located) will answer for the researcher/manager: 1) Is the surficial sediment layer of significant density ("hardness") to support a bed of shellfish ?; 2) Same question for the consolidated sediment layer; 3) If the answer to question 1 is no, but the answer to question 2 is yes, how much reef material (thickness wise) will be needed to be added to compensate for the "soft" layer whose thickness can be found on CHART C ? Further, for existing Shellfish beds, the amount of siltation, for example after a dredging operation or storm can be estimated.

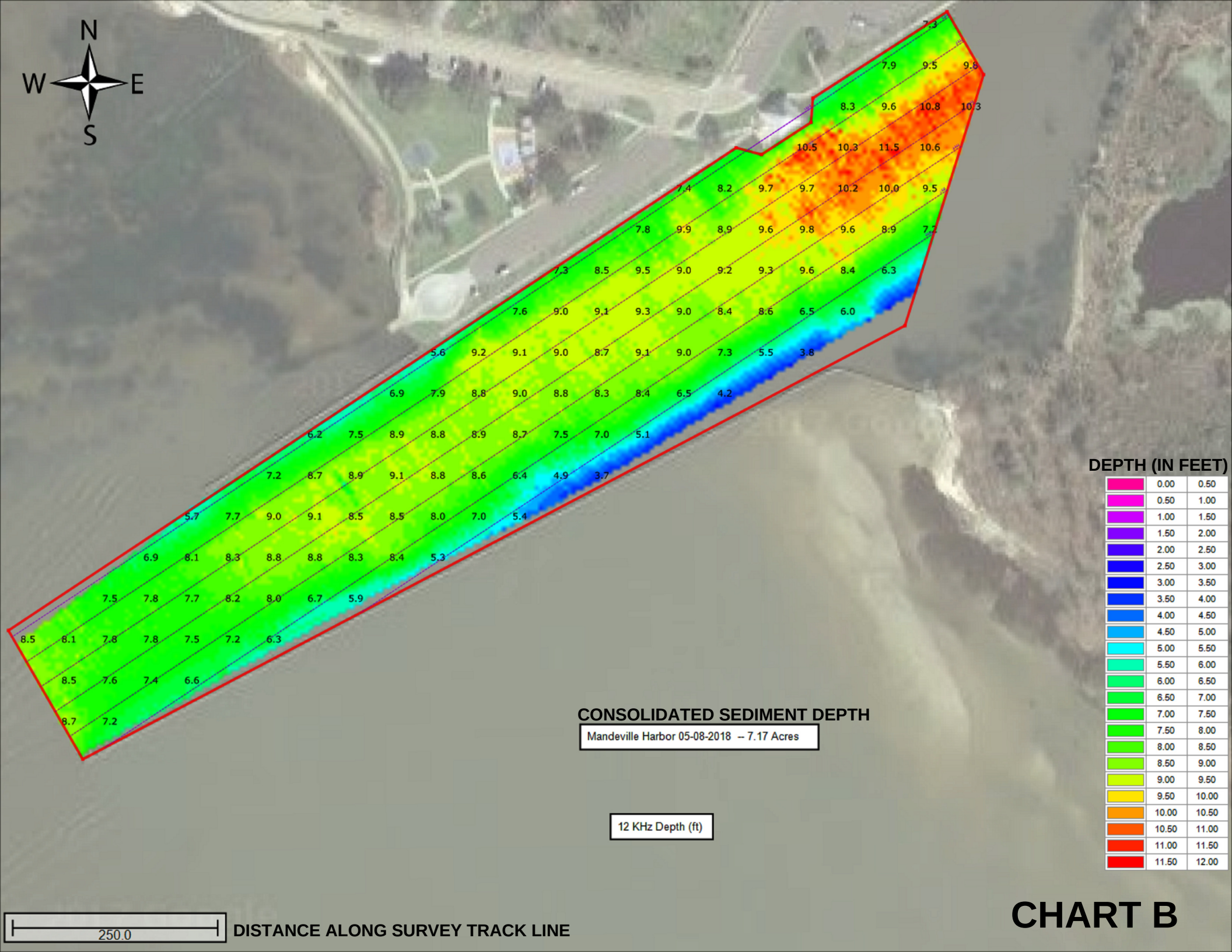
For those users who want to further quantify geotechnical parameters, Porosity of surficial and consolidated sediments can be displayed as shown on **CHART H and CHART I.**

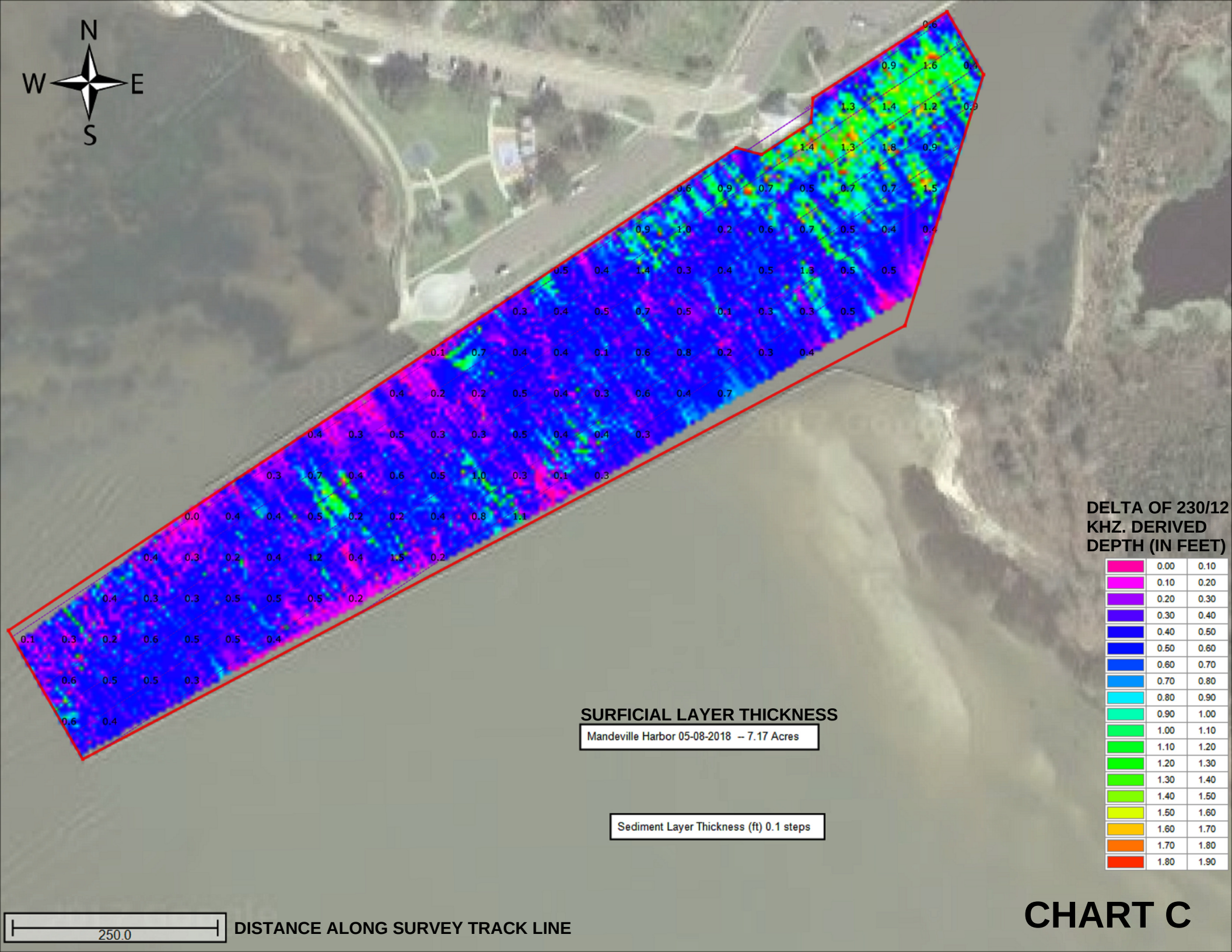
Implications

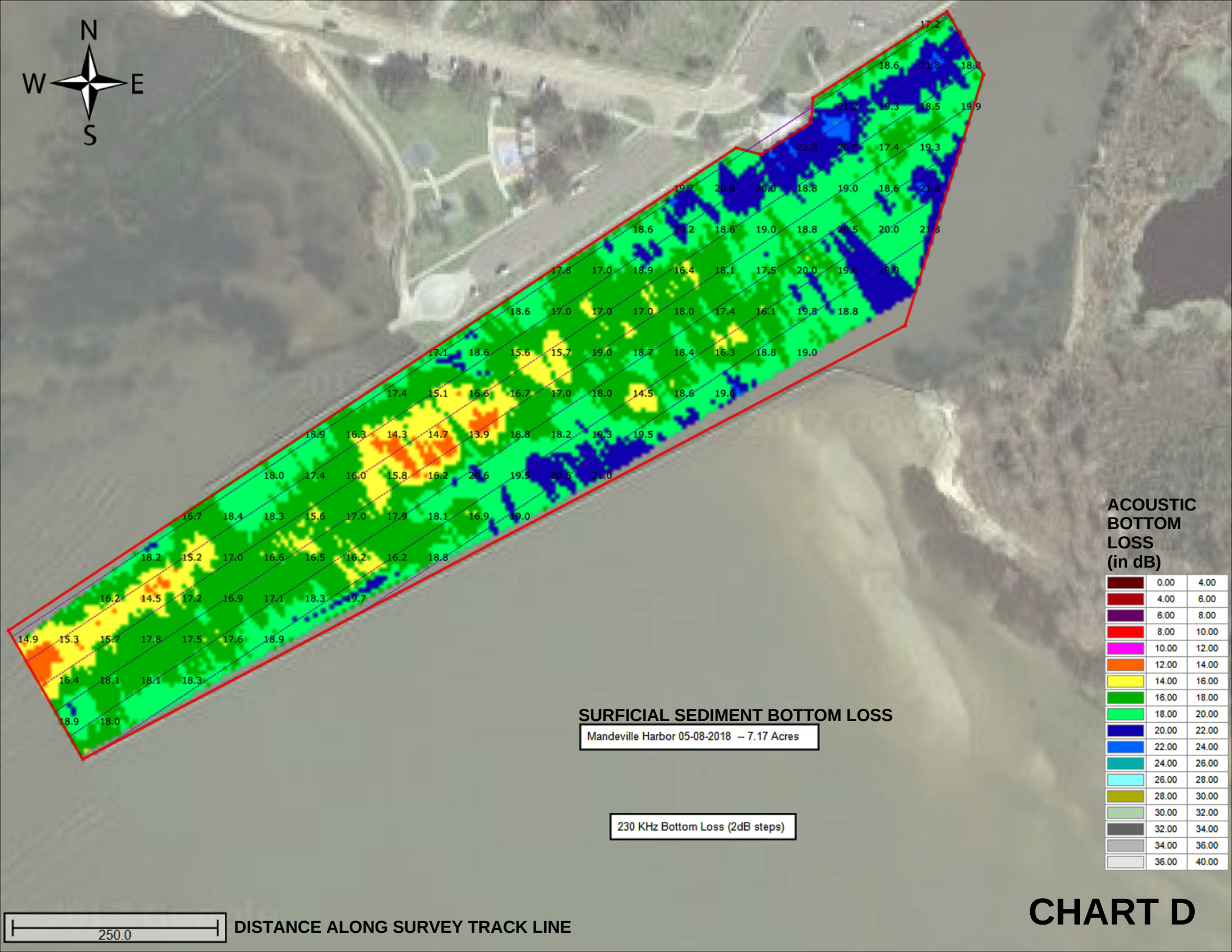
Bottom Contrasting™, and its use in sediment type prediction has a wide range of uses. In shellfish areas, oyster and clam beds are easily located and defined by boundary. In cases where land/beach replenishment projects need to find a submerged "borrow pit", the Hydro-2F™ can verify the type of material being collected for use. In bridge scour events, where the scour hole has already been "backfilled" with softer/lighter material, the scour hole can be located and its size and depth determined. Builders of artificial reefs have been able to verify location and sea floor coverage using the Hydro-2F™. Prior to building artificial habitats, marine biologists can review the sediment characteristics of the planned habitat to determine if the surficial sediment is a suitable substrate.

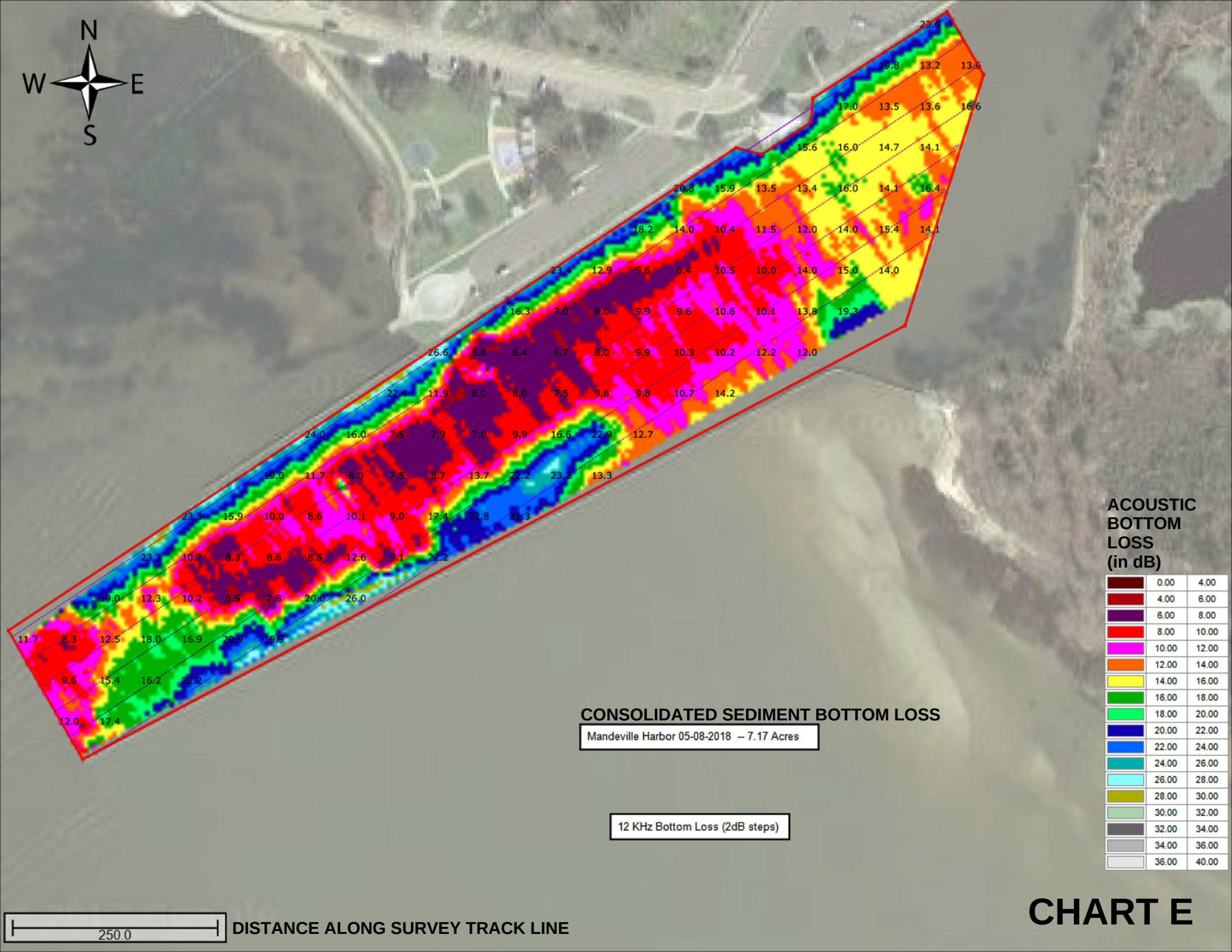
CHARTS A thru I

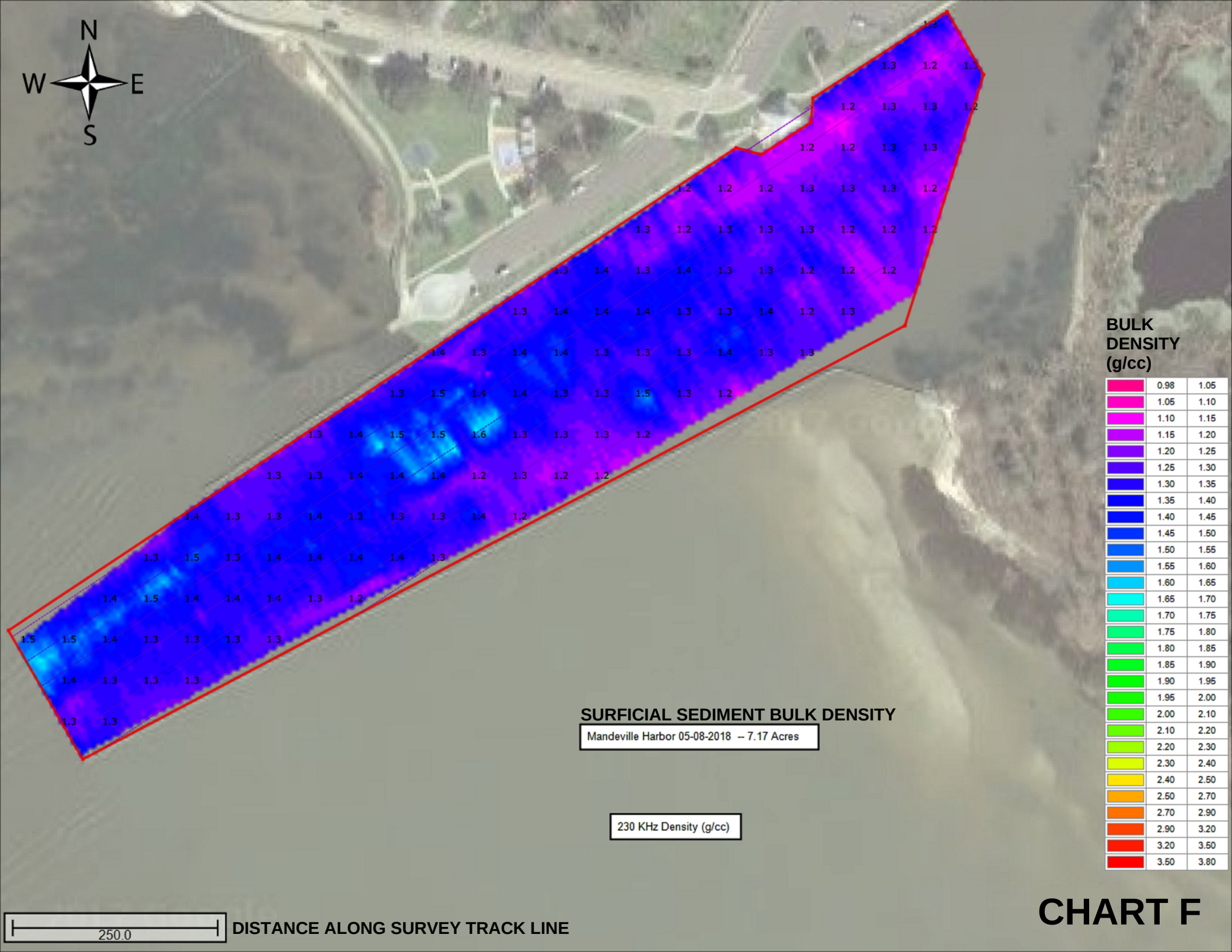

N
W
E
S
DEPTH (IN FEET)
0.00 0.50
0.50 1.00
1.00 1.50
1.50 2.00
2.00 2.50
2.50 3.00
3.00 3.50
3.50 4.00
4.00 4.50
4.50 5.00
5.00 5.50
5.50 6.00
6.00 6.50
6.50 7.00
7.00 7.50
7.50 8.00
8.00 8.50
8.50 9.00
9.00 9.50
9.50 10.00
10.00 10.50
10.50 11.00
11.00 11.50
11.50 12.00
SURFICIAL SEDIMENT DEPTH
Mandeville Harbor 05-08-2018 -- 7.17 Acres
230 KHz Depth (ft)
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART A

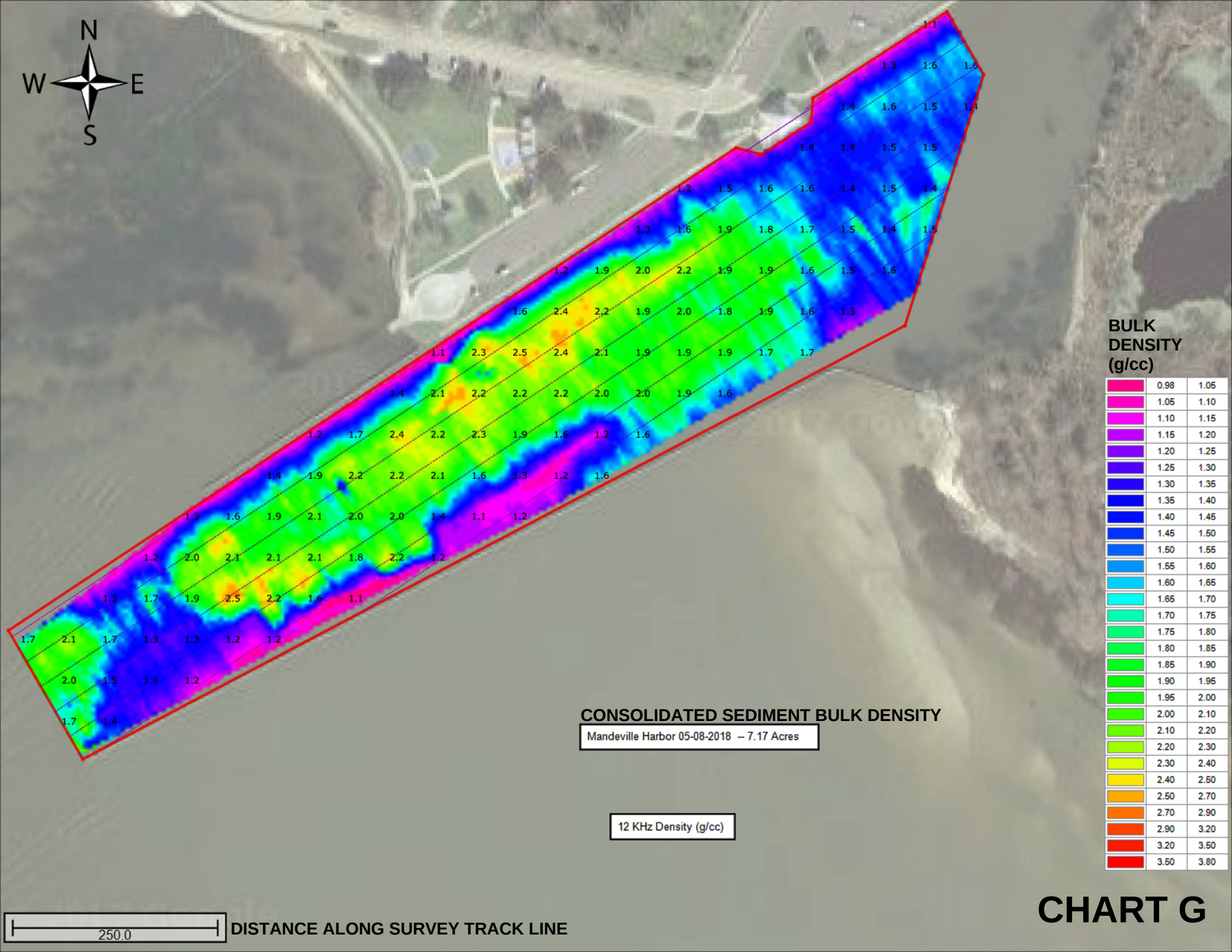

N
W
E
S
7.3
7.9 9.5 9.8
8.3 9.6 10.8 10.3
10.5 10.3 11.5 10.6
7.4 8.2 9.7 9.7 10.2 10.0 9.5
7.8 9.9 8.9 9.6 9.8 9.6 8.9 7.2
7.3 8.5 9.5 9.0 9.2 9.3 9.6 8.4 6.3
7.6 9.0 9.1 9.3 9.0 8.4 8.6 6.5 6.0
5.6 9.2 9.1 9.0 8.7 9.1 9.0 7.3 5.5 3.8
6.9 7.9 8.8 9.0 8.8 8.3 8.4 6.5 4.2
6.2 7.5 8.9 8.8 8.9 8.7 7.5 7.0 5.1
7.2 8.7 8.9 9.1 8.8 8.6 6.4 4.9 3.7
5.7 7.7 9.0 9.1 8.5 8.5 8.0 7.0 5.4
6.9 8.1 8.3 8.8 8.8 8.3 8.4 5.3
7.5 7.8 7.7 8.2 8.0 6.7 5.9
8.5 8.1 7.8 7.8 7.5 7.2 6.3
8.5 7.6 7.4 6.6
8.7 7.2
DEPTH (IN FEET)
0.00 0.50
0.50 1.00
1.00 1.50
1.50 2.00
2.00 2.50
2.50 3.00
3.00 3.50
3.50 4.00
4.00 4.50
4.50 5.00
5.00 5.50
5.50 6.00
6.00 6.50
6.50 7.00
7.00 7.50
7.50 8.00
8.00 8.50
8.50 9.00
9.00 9.50
9.50 10.00
10.00 10.50
10.50 11.00
11.00 11.50
11.50 12.00
CONSOLIDATED SEDIMENT DEPTH
Mandeville Harbor 05-08-2018 -- 7.17 Acres
12 KHz Depth (ft)
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART B

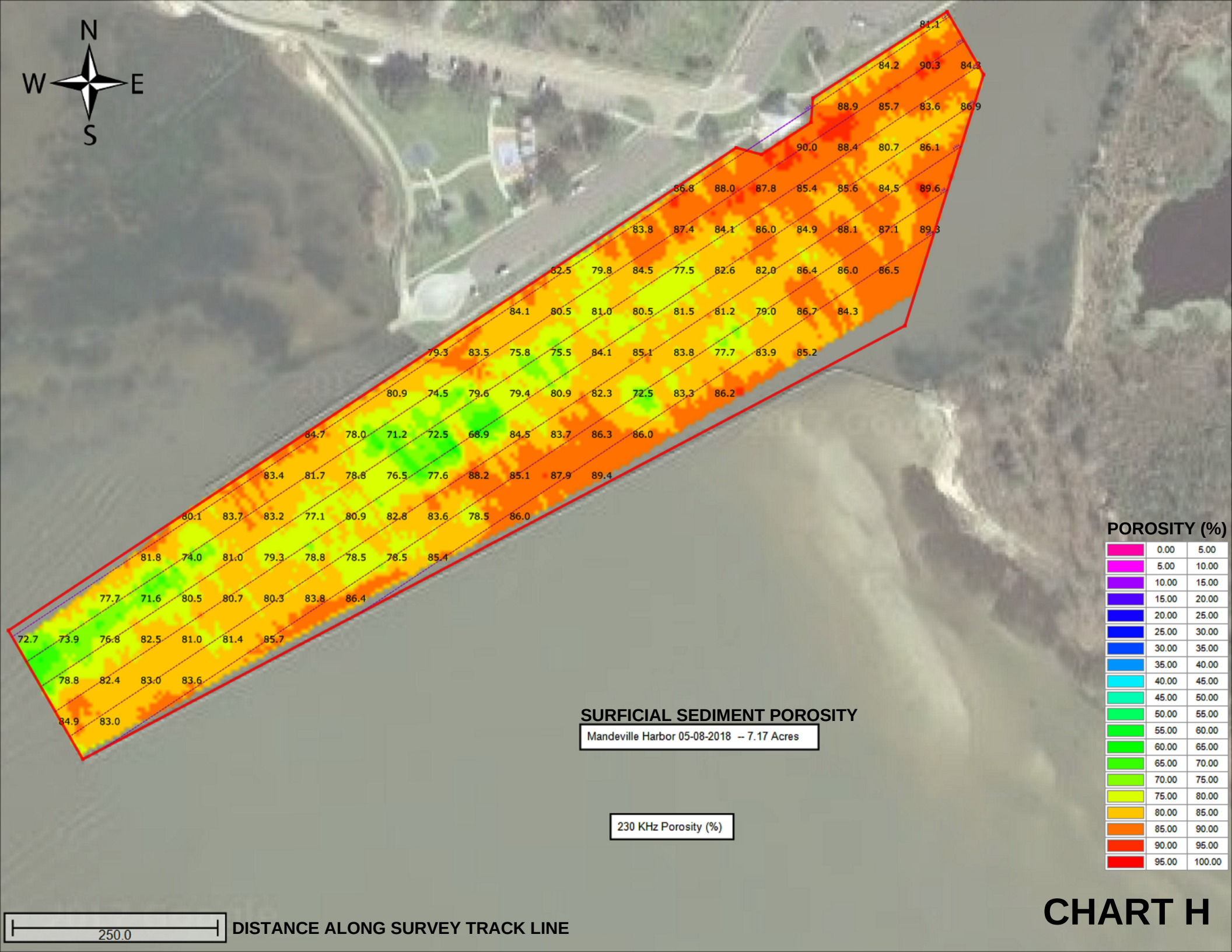

N
W
E
S
DELTA OF 230/12 KHZ. DERIVED DEPTH (IN FEET)
0.00 0.10
0.10 0.20
0.20 0.30
0.30 0.40
0.40 0.50
0.50 0.60
0.60 0.70
0.70 0.80
0.80 0.90
0.90 1.00
1.00 1.10
1.10 1.20
1.20 1.30
1.30 1.40
1.40 1.50
1.50 1.60
1.60 1.70
1.70 1.80
1.80 1.90
SURFICIAL LAYER THICKNESS
Mandeville Harbor 05-08-2018 -- 7.17 Acres
Sediment Layer Thickness (ft) 0.1 steps
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART C

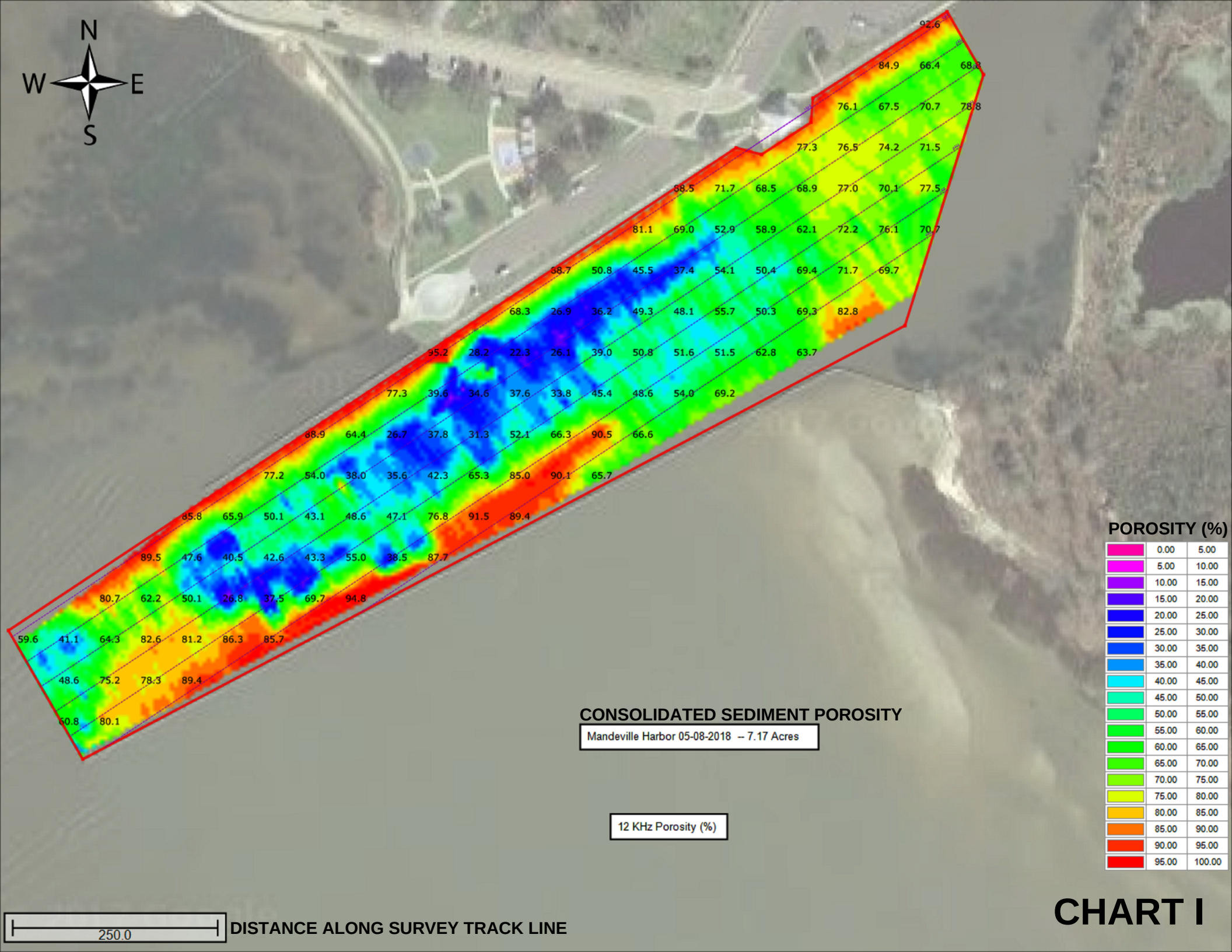

N
W
E
S
17.2
18.6 21.8 18.8
21.2 19.3 18.5 19.9
22.0 20.8 17.4 19.3
19.7 20.8 20.0 18.8 19.0 18.6 21.8
18.6 20.2 18.6 19.0 18.8 20.5 20.0 21.8
17.8 17.0 18.9 16.4 18.1 17.5 20.0 19.6 19.9
18.6 17.0 17.0 17.0 18.0 17.4 16.1 19.8 18.8
17.1 18.6 15.6 15.7 19.0 18.7 18.4 16.3 18.8 19.0
17.4 15.1 16.6 16.7 17.0 18.0 14.5 18.6 19.6
18.9 16.3 14.3 14.7 13.9 18.8 18.2 19.3 19.5
18.0 17.4 16.0 15.8 16.2 20.6 19.5 20.5 21.0
16.7 18.4 18.3 15.6 17.0 17.9 18.1 16.9 19.0
18.2 15.2 17.0 16.6 16.5 16.2 16.2 18.8
16.2 14.5 17.2 16.9 17.1 18.3 19.7
14.9 15.3 15.7 17.8 17.5 17.6 18.9
16.4 18.1 18.1 18.3
18.9 18.0
SURFICIAL SEDIMENT BOTTOM LOSS
Mandeville Harbor 05-08-2018 -- 7.17 Acres
230 KHz Bottom Loss (2dB steps)
ACOUSTIC BOTTOM LOSS (in dB)
0.00 4.00
4.00 6.00
6.00 8.00
8.00 10.00
10.00 12.00
12.00 14.00
14.00 16.00
16.00 18.00
18.00 20.00
20.00 22.00
22.00 24.00
24.00 26.00
26.00 28.00
28.00 30.00
30.00 32.00
32.00 34.00
34.00 36.00
36.00 40.00
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART D


N
W
E
S
ACOUSTIC BOTTOM LOSS (in dB)
0.00 4.00
4.00 6.00
6.00 8.00
8.00 10.00
10.00 12.00
12.00 14.00
14.00 16.00
16.00 18.00
18.00 20.00
20.00 22.00
22.00 24.00
24.00 26.00
26.00 28.00
28.00 30.00
30.00 32.00
32.00 34.00
34.00 36.00
36.00 40.00
CONSOLIDATED SEDIMENT BOTTOM LOSS
Mandeville Harbor 05-08-2018 -- 7.17 Acres
12 KHz Bottom Loss (2dB steps)
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART E


N
W
E
S
BULK DENSITY (g/cc)
0.98 1.05
1.05 1.10
1.10 1.15
1.15 1.20
1.20 1.25
1.25 1.30
1.30 1.35
1.35 1.40
1.40 1.45
1.45 1.50
1.50 1.55
1.55 1.60
1.60 1.65
1.65 1.70
1.70 1.75
1.75 1.80
1.80 1.85
1.85 1.90
1.90 1.95
1.95 2.00
2.00 2.10
2.10 2.20
2.20 2.30
2.30 2.40
2.40 2.50
2.50 2.70
2.70 2.90
2.90 3.20
3.20 3.50
3.50 3.80
SURFICIAL SEDIMENT BULK DENSITY
Mandeville Harbor 05-08-2018 -- 7.17 Acres
230 KHz Density (g/cc)
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART F


N
W
E
S
BULK DENSITY (g/cc)
0.98 1.05
1.05 1.10
1.10 1.15
1.15 1.20
1.20 1.25
1.25 1.30
1.30 1.35
1.35 1.40
1.40 1.45
1.45 1.50
1.50 1.55
1.55 1.60
1.60 1.65
1.65 1.70
1.70 1.75
1.75 1.80
1.80 1.85
1.85 1.90
1.90 1.95
1.95 2.00
2.00 2.10
2.10 2.20
2.20 2.30
2.30 2.40
2.40 2.50
2.50 2.70
2.70 2.90
2.90 3.20
3.20 3.50
3.50 3.80
CONSOLIDATED SEDIMENT BULK DENSITY
Mandeville Harbor 05-08-2018 -- 7.17 Acres
12 KHz Density (g/cc)
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART G


N
W
E
S
81.1
84.2 90.3 84.3
88.9 85.7 83.6 86.9
90.0 88.4 80.7 86.1
86.8 88.0 87.8 85.4 85.6 84.5 89.6
83.8 87.4 84.1 86.0 84.9 88.1 87.1 89.3
82.5 79.8 84.5 77.5 82.6 82.0 86.4 86.0 86.5
84.1 80.5 81.0 80.5 81.5 81.2 79.0 86.7 84.3
79.3 83.5 75.8 75.5 84.1 85.1 83.8 77.7 83.9 85.2
80.9 74.5 79.6 79.4 80.9 82.3 72.5 83.3 86.2
84.7 78.0 71.2 72.5 68.9 84.5 83.7 86.3 86.0
83.4 81.7 78.8 76.5 77.6 88.2 85.1 87.9 89.4
80.1 83.7 83.2 77.1 80.9 82.8 83.6 78.5 86.0
81.8 74.0 81.0 79.3 78.8 78.5 78.5 85.4
77.7 71.6 80.5 80.7 80.3 83.8 86.4
72.7 73.9 76.8 82.5 81.0 81.4 85.7
78.8 82.4 83.0 83.6
84.9 83.0
POROSITY (%)
0.00 5.00
5.00 10.00
10.00 15.00
15.00 20.00
20.00 25.00
25.00 30.00
30.00 35.00
35.00 40.00
40.00 45.00
45.00 50.00
50.00 55.00
55.00 60.00
60.00 65.00
65.00 70.00
70.00 75.00
75.00 80.00
80.00 85.00
85.00 90.00
90.00 95.00
95.00 100.00
SURFICIAL SEDIMENT POROSITY
Mandeville Harbor 05-08-2018 -- 7.17 Acres
230 KHz Porosity (%)
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART H


N
W
E
S
92.6
84.9 66.4 68.8
76.1 67.5 70.7 78.8
77.3 76.5 74.2 71.5
88.5 71.7 68.5 68.9 77.0 70.1 77.5
81.1 69.0 52.9 58.9 62.1 72.2 76.1 70.7
88.7 50.8 45.5 37.4 54.1 50.4 69.4 71.7 69.7
68.3 26.9 36.2 49.3 48.1 55.7 50.3 69.3 82.8
95.2 28.2 22.3 26.1 39.0 50.8 51.6 51.5 62.8 63.7
77.3 39.6 34.6 37.6 33.8 45.4 48.6 54.0 69.2
88.9 64.4 26.7 37.8 31.3 52.1 66.3 90.5 66.6
77.2 54.0 38.0 35.6 42.3 65.3 85.0 90.1 65.7
85.8 65.9 50.1 43.1 48.6 47.1 76.8 91.5 89.4
89.5 47.6 40.5 42.6 43.3 55.0 38.5 87.7
80.7 62.2 50.1 26.8 37.5 69.7 94.8
59.6 41.1 64.3 82.6 81.2 86.3 85.7
48.6 75.2 78.3 89.4
60.8 80.1
POROSITY (%)
0.00 5.00
5.00 10.00
10.00 15.00
15.00 20.00
20.00 25.00
25.00 30.00
30.00 35.00
35.00 40.00
40.00 45.00
45.00 50.00
50.00 55.00
55.00 60.00
60.00 65.00
65.00 70.00
70.00 75.00
75.00 80.00
80.00 85.00
85.00 90.00
90.00 95.00
95.00 100.00
CONSOLIDATED SEDIMENT POROSITY
Mandeville Harbor 05-08-2018 -- 7.17 Acres
12 KHz Porosity (%)
250.0
DISTANCE ALONG SURVEY TRACK LINE
CHART I