Preliminary Results of the 2015 Reconnaissance Phase of Bureau of Ocean Energy Management’s Atlantic Sand Assessment Project

29th Annual National Conference on Beach Preservation Technology
Florida Shore and Beach Preservation Association
Thursday, February 4, 2016
8:55 am

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Sterling, Virginia

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CB&I (NYSE: CBI) has designed, permitted, implemented, and monitored over 75 coastal restoration projects, more than any other firm in the US, having identified billions of cubic yards of sand resources on the Inner and OCS.

CB&I is the most complete energy infrastructure focused company in the world. With 125 years of experience and the expertise of approximately 54,000 employees, CB&I provides reliable solutions while maintaining a relentless focus on safety and an uncompromising standard of quality.

National Safety Council “Green Cross for Safety” 2015 Recipient
1) Project Description
2) Project Schedule and Milestones
3) 2015 Reconnaissance Survey Equipment
4) 2015 Reconnaissance Survey Preliminary Results
5) 2016 Design Level Survey Plan
$342 Million Allocated to DOI for Hurricane Sandy Recovery

$13.6 Million to BOEM
- $5 million for Atlantic Sand Assessment Project (ASAP)
- $3 million for initial round of State Cooperative Agreements
- $1.5 million for second round of State Cooperative Agreements (in 2016)
- $3.1 million to Division of Environmental Assessment
  - Environmental Assessment and monitoring
Project Scope:

- Collection of a minimum of 5,600 km of geophysical data on the OCS
  - Between 3-8 nm (4.8-12.9 km) from the shoreline
  - To a depth of approximately 90 ft (27.5 m)
  - Geophysical data will not be processed and interpreted (except for QA/QC subset)

- Collection of 350 geotechnical samples
  - 250 vibracores
    - Cores will be split, logged, sampled/analyzed, and photographed
  - 100 grab samples
  - Division of vibracore vs. grab samples to be determined upon geophysical survey results
The geophysical and geotechnical survey will be conducted under two (2) phases totaling 5,600 km of data and 350 geotechnical samples

- **Reconnaissance level (2015):** Approximately 4,200 km of geophysical data and 260 geotechnical samples (160 vibracores, 100 surface grab samples)

- **Design level (2016):** Approximately 1,400 km of geophysical data and 90 geotechnical vibracore samples
Breakdown of Reconnaissance Geophysical and Geotechnical Data

<table>
<thead>
<tr>
<th>State</th>
<th>Geophysical</th>
<th>Geotechnical</th>
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<tbody>
<tr>
<td></td>
<td>km</td>
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<td>MA</td>
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<tr>
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<tr>
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<td>MD</td>
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<tr>
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<tr>
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<tr>
<td>FL</td>
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<td>12%</td>
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Design-Level Data Acquisition will be allocated to:

- Develop potential borrow areas offshore New York and New Jersey to maintain 40% effort contract requirement
- Potentially develop one additional potential borrow area offshore a different state based on reconnaissance geophysical data analysis and BOEM direction
Project Timeline

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<td>August</td>
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- Quarterly Updates
- Task 1: Literature/Data Search, State Agency Coordination
- Task 2: Develop Data Acquisition Plan
- Task 3a: Mobilization
- Task 3b: Reconnaissance Geophysical Data Acquisition
- Task 3c: Reconnaissance Geotechnical Data Acquisition
- Task 3d: Design Geophysical Data Acquisition
- Task 4: Design Geotechnical Data Acquisition
- Geotechnical Data Analysis and Final Report of Findings

A World of Solutions
### Geophysical

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### Geologic

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<th>Surface Samples</th>
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<td><strong>Totals</strong></td>
<td><strong>160</strong></td>
<td><strong>100</strong></td>
<td><strong>260</strong></td>
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**What's Been Done?**

A World of **Solutions**
2015 Reconnaissance Survey Milestones

- Project Kickoff: **November 19, 2014**
- State/Stakeholder Meetings: **January/February 2015**
- Final Data Acquisition Plan: **March 24, 2015**
- 2015 Reconnaissance Geophysical Survey (Complete)
  - Complete Geophysical Mobilization: **April 16, 2015**
  - Equipment Calibrations: **April 17-18, 2015**
  - Data Collection Begins Offshore FL: **April 19, 2015**
  - Complete Geophysical Survey Offshore MA: **July 26, 2015**
  - Complete Demobilization: **July 30, 2015**
- 2015 Reconnaissance Geologic Sampling Cruise (Complete)
  - First Sample Collected Offshore FL: **July 29, 2015**
  - Complete Geophysical Survey Offshore MA: **December 13, 2015**
  - Complete Demobilization: **December 14, 2015**
- Augmented differential global navigation satellite system (DGNSS)
- Dual frequency satellite corrections
- Integrated into Hypack Navigation station
- Data is logged for post processing with Continually Operating Reference Stations (CORS)
- Motion reference unit mounted to the survey vessel
- Attitude, heading, heave, position and velocity
- Combining GPS with inertial measurements

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<td><strong>Horizontal</strong></td>
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<td><strong>Vertical</strong></td>
<td>+/- (15 mm + 1 ppm x baseline length)</td>
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<td><strong>Pitch and Roll</strong></td>
<td>0.01° (up to 0.008° with post processing)</td>
</tr>
<tr>
<td><strong>Heave</strong></td>
<td>5 cm or 5% (TrueHeave of 3 cm or 2%).</td>
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</table>
Pole mounted bathymetry and backscatter acquisition
- Chirp pulse modulation
- Integrate different data sources
  - Sound velocity
  - Altimeter
  - Motion reference unit
- .jsf - backscatter
- X/Y/Z - processed bathymetry

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<tr>
<th></th>
<th>Bathymetry</th>
<th>Sidescan sonar</th>
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<tr>
<td><strong>Power</strong></td>
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<td>550 kHz</td>
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<td></td>
<td>1600 kHz</td>
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<td><strong>Swath</strong></td>
<td>350 m</td>
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<td></td>
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<td>250 m</td>
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<td></td>
<td>70 m</td>
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<td><strong>Range</strong></td>
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<tr>
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<td>1 cm</td>
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<td></td>
<td>0.6 cm</td>
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EdgeTech 3200 Sub-Bottom Profiler with 512i Towfish

- High-resolution sub-bottom profile data
- Frequency Modulated pulse
- Full spectrum of frequency range
- Resolution: 0.06 to 0.10 m
- .jsf file format

EdgeTech 3200 data examples from the Atlantic Outer Continental Shelf offshore NC (top) and VA (bottom)
EdgeTech 4200-HFL Sidescan Sonar

- Dual acquisition system
- 300/600 kHz
- Controlled by a topside box running Discover software
- .jsf file format

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<th>Resolution</th>
<th>300kHz</th>
<th>600kHz</th>
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<tr>
<td>Along Track</td>
<td>1.3 m at 150 m</td>
<td>0.45 m at 100 m</td>
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<tr>
<td>Across Track</td>
<td>3 cm</td>
<td>1.5 cm</td>
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</table>

Image of the EdgeTech 4200 Sidescan Sonar towfish (left) and data example depicting a shipwreck and adjacent seafloor from the northern Gulf of Mexico, offshore Louisiana in approximately 35 ft of water depth (right).
Geometrics G-882 Cesium Marine Magnetometer

- Used to identify magnetic anomalies within the study area
  - Potential hazards and cultural resources
- Necessary for geotechnical sample collection site clearance by a qualified archaeologist
- Hypack .raw file format

Geometrics G882 magnetometer (top) and magnetometer data examples (bottom) from the Maryland Outer Continental Shelf in approximately 20 m of water depth. Examples show a small magnitude multicomponent target (left) and a small magnitude dipolar target (right).
- Air-driven vibratory hammer, aluminum H-beam and drilling bit with a cutting edge
- Core sample: 6.09 m (20 ft) in length, 10.16 cm (4 inches) in diameter
- gINT file format
Florida Regional As-Collected Data

A World of Solutions
Florida Area 2

Legend:
- As-Built Geological Samples
- Surface Grab Sample
- Vibrocore
- As-Run Tracklines
- NOAA AWOIS
- Artificial Reefs
- 5 Nautical Miles
- Federal/State Boundary
- Authorized Borrow Areas
- USACE/EPA Offshore Dredge Material Disposal Sites
- ROSS Potential Sand Resources

Depth (m):
- -15
- -24
- -28
- < -30

Geographic coordinates:
- Florida
- Gulf of Mexico
- Atlantic Ocean
- Georgia
### Granulometric Report

<table>
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<tr>
<th>Sieve Size (mm)</th>
<th>Sieve Size (Micrometers)</th>
<th>% Weight Retained</th>
<th>Granules Retained</th>
<th>C. % Weight Retained</th>
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**Statistics**
- Mean Phi: 3.27
- Mean mm: 2.67
- Sorting: 1.10
- Skewness: 0.20
- Kurtosis: 0.56

**Phases**
- Phi 5
- Phi 16
- Phi 25
- Phi 50
- Phi 75
- Phi 84
- Phi 95

**Values**
- 3.27
- 2.67
- 2.73
- 2.36
- 2.02
- 1.78
- 1.30
Florida Area 3

INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC10
8.0’-10.0’

INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC10
10.0’-12.0’

INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC10
12.0’-14.0’

INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC10
14.0’-16.0’
INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC10
16.0’ - 18.0’

INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC10
18.0’ - 19.7’
### Granulometric Report

<table>
<thead>
<tr>
<th>Slope Number</th>
<th>Sieve Size (Ppi)</th>
<th>Sieve Size (Millimeters)</th>
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<td>Phi 84</td>
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</tbody>
</table>

**Statistics**

- Mean Phi: 2.0
- Mean mm: 0.25
- Moment: 0.88
- Skewness: -0.24
- Kurtosis: 10.29
**Florida Area 4**

**DRAFT**

**Boring Designation:** FL-BEM-2015-VG15

**DRILLING LOG**

<table>
<thead>
<tr>
<th>DIVISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBI</td>
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</tbody>
</table>

**TOTAL DEPTH OF BORING:** 20.6 Ft.

### CLASSIFICATION OF MATERIALS

<table>
<thead>
<tr>
<th>Class</th>
<th>Depth (Ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHELL</td>
<td>0.0</td>
<td>Mustard</td>
</tr>
<tr>
<td>SHELL SAND</td>
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<td>Shell sand</td>
</tr>
<tr>
<td>SAND</td>
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<td>Sandy sand</td>
</tr>
<tr>
<td>SAND</td>
<td>6.1</td>
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<td>7.7</td>
<td>Sandy sand</td>
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<tr>
<td>SAND</td>
<td>11.6</td>
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<tr>
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</tr>
<tr>
<td>SAND</td>
<td>20.0</td>
<td>Sandy sand</td>
</tr>
</tbody>
</table>

**End of Boring**

---

**Granulometric Report**

- **Granulometric Analysis**:
  - **Dry Weight (g)**: 92.96
  - **Wet Weight (g)**: 91.90
  - **Percent Retained**: 0.02
- **Sieve Number**: 3/4
- **% Weight Retained**: 0.00
- **Cum. Grams Retained**: 0.00
- **C. % Weight Retained**: 0.00

---

**Statistics**:

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean Phi</th>
<th>Mean mm</th>
<th>Sorting</th>
<th>Skewness</th>
<th>Kurtosis</th>
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</thead>
<tbody>
<tr>
<td>Phi</td>
<td>16</td>
<td>25</td>
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<td>Moment</td>
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<tr>
<td>Statistics</td>
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<td>0.24</td>
<td>0.77</td>
<td>-1.78</td>
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</table>
Florida Area 5

INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC04
16.0'-18.0'

INVENTORY OF POTENTIAL SAND RESOURCES ON THE ATLANTIC OCS
FL-BOEM-2015-VC04
18.0'-19.6'
DRAFT

Boring Designation: FL-BOEM-2015 VC01

1. PROJECT
Inventory of Potential Beach Nourishment and Coastal Restoration Sand Sources on the Atlantic OCS

2. BORING DESIGNATION
FL-BOEM-2015 VC01

3. DRILLING AGENCY
American Vortexa Services, Inc.

4. NAME OF DRILLER
Brian McCard

5. DIRECTION OF DRILLING
CO-ORDINATE SYSTEM

6. DEPTH TO SUBSURFACE MEDIUM
- 6.0 Ft.
- 0.0 Ft.

7. DEPTH DRILLED INTO ROCK
160.0 Ft.

8. TOTAL DEPTH OF BORING

9. CLASSIFICATION OF MATERIALS

10. REMARKS

11. SAMPLE #1, Depth = 0.0
Mean (mm): 0.16, Phi Sorting: 1.24
Fines (223): 0.78% (5W-SM)
Fines (225): 3.00% (5W-SM)
Fines (225): 3.00% (5W-SM)
Fines (225): 3.00% (5W-SM)

12. SAMPLE #2, Depth = 0.0
Mean (mm): 0.40, Phi Sorting: 1.51
Fines (225): 3.00% (5W-SM)

13. SAMPLE #3, Depth = 0.0
Mean (mm): 0.13, Phi Sorting: 0.78
Fines (225): 4.01% (5W-SM)

14. SAMPLE #4, Depth = 0.0
Mean (mm): 0.11, Phi Sorting: 0.73
Fines (225): 0.63% (SM)

15. SAMPLE #5, Depth = 0.0
Mean (mm): 0.11, Phi Sorting: 0.69
Fines (225): 2.16% (SM)

16. SAMPLE #6, Depth = 0.0
Mean (mm): 0.41, Phi Sorting: 0.68
Fines (225): 10.16% (SW-SM)

17. TOTAL RECOVERY FOR BORING
15.0 Ft.

18. SIGNATURE AND TITLE OF INSPECTOR

Granulometric Report

- Dry weight (kg) 193.03
- Moisture (%): 9.93
- Sieve Size (mm): 0.51
- Sieve Retained: 0.02
- % Weight Retained: 0.00
- Coarse (%): 0.00
- Fine (%): 0.00
- Clay (%): 0.00
- Calcareous (%): 0.00
- Residual (%): 0.00

<table>
<thead>
<tr>
<th>Sieve Number</th>
<th>Sieve Size (mm)</th>
<th>Sieve Retained (mm)</th>
<th>Sieve Retained (%)</th>
<th>% Weight Retained</th>
<th>Cumulative Retained (kg)</th>
<th>C % Weight Retained</th>
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</thead>
<tbody>
<tr>
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<td>7.0</td>
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<td>0.00</td>
<td>0.00</td>
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<tr>
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<td>0.00</td>
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</tr>
</tbody>
</table>

Florida Area 6
### Geophysical Survey

- Total contracted survey effort (**5,600 km’s**) less 2015 planned reconnaissance effort (**4,262 km’s**) allows planned 2016 design level effort (**1,338 km’s**)  
- 2016 planned design level effort (**1,338 km’s**) plus Maine’s allocation (**50 km’s**) totals adjusted 2016 design level effort (**1,388 km’s**)  
- **1,388 km’s** of geophysical data
  - **554 km’s** to NY & NJ to satisfy 40% total effort stipulation  
  - **834 km’s** remaining to allocate

### Geologic Sampling

- **350 total samples** less **260 reconnaissance samples** allows **90 samples** for design level geologic sampling effort
  - **Approx. 39 samples** to NY/NJ to satisfy 40% total effort stipulation  
  - **Approx. 51 samples** remaining to allocate to other states based on geophysical data