WILLIAMS PIPELINE COORDINATION CASE STUDY

Beau Suthard, P.G. – APTIM
Chelsea Rice – Williams
WILLIAMS PIPELINES

**PSN 12579**
- Length: 72,525 feet (13.73 miles)
- Location: HI 199 – HI 110
- Per email dated 1/11/2018, BSEE requested amended application reflecting that 47,957 feet (9.08 miles) be removed
- Upon review of the Vibracore Study, BOEM has recommended Williams abandon 25,027 ft in-place and remove 23,725.84 ft
- Reviewed by following Agencies:
  > BOEM Marine Minerals Group
  > BSEE Pipeline Section
  > LA Coastal Zone Management

**PSN 7199**
- Length: 62,310 feet (11.80 miles)
- Location: HI A6 – HI 137
- Per email dated 7/9/2018, BSEE requested amended application reflecting that 48,796 feet (9.24 miles) be removed
- Upon review of the Vibracore Study, BOEM has recommended that PSN 7199 be abandoned in-place in its entirety
- Reviewed by following Agencies:
  > BOEM Marine Minerals Group
  > BSEE Pipeline Section
  > LA Coastal Zone Management
  > Texas General Land Office
  > National Oceanic and Atmospheric Administration (NOAA)
SCOPE OF WORK

► Total of 16377 pipelines in the GOM
  > 55 belong to Williams
► Total of 588 Significant Sediment Resource Areas (SSRA) in GOM (2018)
  > 87 crossed by Williams assets
► BOEM determining removal needs for abandoned/inactive pipelines
► Williams assess removal needs for portions of assets crossing SSRA
  - Phase I: Conduct desktop study for pipelines
  - Phase II: Collect geophysical and geotechnical data along asset
    - PSN7199 and PSN12579
  > Determine if sections of assets can be abandoned in place
PIPELINES IN GOM AND SSRA BLOCKS IN GOM
WILLIAMS PIPELINES IN SSRA BLOCKS IN GOM
PHASE I: DESKTOP STUDY

- Assess the geologic baseline near pipelines PSN7199, PSN12579
  - Delineate areas of sand (shoals)
    - Boundary of Heald Bank
  - Incised paleochannels and buried paleochannels
    - Cultural Resource
    - Sand resource

- Geologic framework of Heald Bank and paleochannels
  - Formed by sea level fluctuations during sea level rise/fall in Quaternary
PHASE I: GEOLOGIC SETTING

► Along the Trinity/Sabine Incised River Valley System
  > Transgression (16 ka to 4 ka): 100m sea level rise (melting ice sheets)
    - Transgressive depositional systems
    - Formation of banks near Trinity-Sabine incised valley
      • Submerged paleoshorelines
      • Sabine Bank, Heald Bank, Shepard Bank, Thomas Bank
    - Over Pleistocene Beaumont Clay Formation
PHASE I: HISTORIC HEALD BANK CHARACTERISTICS

► Facies A: Interbedded shell hash and sand unit
  > 2 - 3 m thick

► Facies B: 2 - 3 m thick
  > <10% mud-bioturbated sand
  > 2.5 - 2.0 phi (0.17/0.25 mm)
  > Subcrops on bank shelf/flank

► Facies C: intercalated layers of sand and silt

► Bank Sand Quality
  > Good sand (not evenly spread)
  > Upper 2 m = 95% sand
  > Potential volume of sand (shelly and muddy) = 585 million m$^3$
  > Shelly sand: 458 million m$^3$, 2.5 m thick
PHASE II: GEOPHYSICAL DATA COLLECTION

► Geophysical survey operations: May 13 and May 15, 2018
  > Seismic Sub-bottom: EdgeTech 3200 512i
  > Sidescan Sonar: EdgeTech 4200 (300/600 kHz)
  > Magnetometer: Geometrics 882
  > Single Beam: Teledyne Hydrotrac II

► Main line 50 ft off pipeline
► Additional Lines 1,000 ft either side
► PSN7199: 38 nm
► PSN12579: 34 nm
► Vibracore locations picked in real time
► Cultural Resource Clearance
PHASE II: GEOPHYSICAL DATA PROCESSING

► Seismic Sub-bottom
  > Digitization of sand shoals, paleochannels, geohazards
  > Sand thickness (isopach)

► Sidescan sonar
  > Delineation of surface features, types, characteristics and surface hazards/debris

► Magnetometer
  > Identify magnetic anomalies

► Single Beam
  > Bathymetric surface along pipeline
PHASE II: GEOTECHNICAL DATA COLLECTION

► Geotechnical survey operations July 3 though July 8, 2018
► VC-700 Vibracore System
  > Electric vibracore
  > 20 ft sediment sample
  > 600-2200 rpm
► Collection of 12 vibracores
PHASE II: GEOTECHNICAL DATA PROCESSING

► APTIM’s credited laboratory
► Vibracores were split, photographed, logged and sampled
  > Layer thickness, color, texture, composition and grain size (clay, sit, sand, gravel, shells)
► Entered into gINT
  > Mean, median grain size, sorting, silt/clay content (moment method)
► Vibracores color coded based on grain size (Facies)
  > Plotted on seismic sub-bottom data

<table>
<thead>
<tr>
<th>Sieve Number</th>
<th>Size (phi)</th>
<th>Size (mm)</th>
<th>Wentworth Scale</th>
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</thead>
<tbody>
<tr>
<td>3/4</td>
<td>4.25</td>
<td>19.00</td>
<td>Pebble</td>
</tr>
<tr>
<td>5/8</td>
<td>4.00</td>
<td>16.00</td>
<td>Gravel</td>
</tr>
<tr>
<td>7/16</td>
<td>3.50</td>
<td>11.20</td>
<td>Very Coarse Sand</td>
</tr>
<tr>
<td>3/16</td>
<td>3.00</td>
<td>8.00</td>
<td>Coarse Sand</td>
</tr>
<tr>
<td>4</td>
<td>2.25</td>
<td>4.75</td>
<td>Medium Sand</td>
</tr>
<tr>
<td>5</td>
<td>2.00</td>
<td>4.00</td>
<td>Fine Sand</td>
</tr>
<tr>
<td>7</td>
<td>1.50</td>
<td>2.80</td>
<td>Very Fine Sand</td>
</tr>
<tr>
<td>10</td>
<td>1.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>-0.50</td>
<td>1.40</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>0.00</td>
<td>1.00</td>
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<td>0.50</td>
<td>0.71</td>
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<td>35</td>
<td>1.00</td>
<td>0.50</td>
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<td>45</td>
<td>1.50</td>
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<td>60</td>
<td>2.00</td>
<td>0.25</td>
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<tr>
<td>80</td>
<td>2.50</td>
<td>0.18</td>
<td>Fine Sand</td>
</tr>
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<td>120</td>
<td>3.00</td>
<td>0.13</td>
<td>Sand</td>
</tr>
<tr>
<td>170</td>
<td>3.50</td>
<td>0.09</td>
<td>Very Fine Sand</td>
</tr>
<tr>
<td>200</td>
<td>3.75</td>
<td>0.08</td>
<td></td>
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<tr>
<td>230</td>
<td>4.00</td>
<td>0.06</td>
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PSN7199 LINE 103
PSN7199 VC03
PSN7199 VC03

Drilling Log

1. PROJECT
Williams Field Investigation
Field Site

2. BORING DESIGNATION
WL-2018-7199-VC03

3. DRILLING DEPTH
15.0' - 16.0'

4. SOIL OR MATERIAL
CLAY, very soft, trace shell, fish, shell base

5. CLASSIFICATION OF MATERIAL
CLAY, very soft, trace shell, fish, shell base

6. REQUIRED
Sample #1, Depth = 14.2'
Ave. Field Value (3x): 9.21
# Drilling Log

**Boring Designation:** WL-2018-7199-VC03

**Date:** December 18, 2018

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification of Material</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>CLAY, very soft, trace shell, shell base</td>
<td>Sample #1, Depth = 1.0' Ave. Field Value (wet) 9.05</td>
</tr>
<tr>
<td>6.8</td>
<td>CLAY, very soft, shale, over clay, indicator in position 10 to 11 (4.0&quot; x 4.0&quot;)</td>
<td>Sample #2, Depth = 7.0' Ave. Field Value (wet) 15.06</td>
</tr>
<tr>
<td>12.5</td>
<td>CLAY, very soft, little organic, organic distributed in bottom, (2.0&quot; x 3.0&quot;), (CL)</td>
<td>Sample #3, Depth = 14.2' Ave. Field Value (wet) 9.23</td>
</tr>
<tr>
<td>17.0</td>
<td>CLAY, very soft, Still Sample from 17.1 to 17.2, clay gray (H=0), (CL)</td>
<td>Sample #4, Depth = 17.7' Ave. Field Value (wet) 6.10</td>
</tr>
<tr>
<td>19.5</td>
<td>No Recovery</td>
<td>End of Boring</td>
</tr>
</tbody>
</table>

**Classification of Material:**
- CLAY: very soft, trace shell, shell base, indicator in position 10 to 11 (4.0" x 4.0")
- CLAY: very soft, shale, over clay
- CLAY, very soft, indicator in position 10 to 11 (4.0" x 4.0")
- CLAY, very soft, little organic, organic distributed in bottom
- CLAY, very soft, Still Sample from 17.1 to 17.2, clay gray

**Remarks:**
- Sample #1, Depth = 1.0', Ave. Field Value (wet) 9.05
- Sample #2, Depth = 7.0', Ave. Field Value (wet) 15.06
- Sample #3, Depth = 14.2', Ave. Field Value (wet) 9.23
- Sample #4, Depth = 17.7', Ave. Field Value (wet) 6.10
PSN7199 LINE 103
### DRILLING LOG

<table>
<thead>
<tr>
<th>Layer</th>
<th>Depth</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>58.1</td>
<td>2.7</td>
<td>SAND, fine-grained, quartz, some silt; trace clay, trace soil; clay distributed in pockets up to 0.9’ (0.27’-0.27’) thick; clay pockets @ 2.5’, dark gray (2.5Y 4/1), (TS)</td>
</tr>
<tr>
<td>54.8</td>
<td>0.6</td>
<td>CLAY, very soft, 2.1’ (0.67’) thick; hard pockets @ 2.5’ and 3.5’, very hard pockets from 0.5’ to 0.7’ (1.5’-1.7’) thick; hard pocket @ 3.5’, dark brownish gray (3.5Y 4/1), (CL)</td>
</tr>
<tr>
<td>49.5</td>
<td>0.2</td>
<td>CLAY, firm, color is modified (2.5Y 5/2) and, dark greenish gray (7.5Y 4/1), (CL)</td>
</tr>
<tr>
<td>49.5</td>
<td>16.3</td>
<td>CLAY, soft, trace sand, sand distributed in layer and pockets up to 1.5’. (3. Sample from 15.8 to 16.3’, color is modified (2.5Y 5/2), 3.5Y 5/2) and, dark greenish gray (7.5Y 4/1), (CL)</td>
</tr>
</tbody>
</table>

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**End of Boring**
RESULTS - PSN7199

► Not on Heald Bank
  > No sand shoal delineated in seismic
  > Facies B and Facies C
► Near-surface paleochannels not sand infilled
  > Soft clays
► Surface sections silty sands (Facies B)
► Within the Trinity/Sabine Incised River Valley
  > Significant overburden
  > Adjacent to large Sand Shoal
Drilling Log

Boring Designation  WL-2018-12579-VC04

1. PROJECT  
Williams Field Investigation  
Texas South Central  

2. LOCATION  
Lat: 30°46′4.22″  
Lon: -94°2′34″  

3. DRILLING METHOD  
Auger  

4. MATERIALS REMOVED  
SAND, fine gravel, quartz, silt, oolitic, clayey, shell fragments, oolitic, shell hash, trace silt, trace whole shell, trace silt, and shell fragments up to 1″, dark gray (5YR 4/1), (5Y)

5. TOTAL RECOVERY  
No Recovery

SAND, fine gravel, quartz, silt, oolitic, clayey, shell fragments, oolitic, shell hash, trace silt, trace whole shell, trace silt, and shell fragments up to 1″, dark gray (5YR 4/1), (5Y)

SAND, fine gravel, quartz, silt, oolitic, clayey, shell fragments, oolitic, shell hash, trace silt, trace whole shell, trace silt, and shell fragments up to 1″, dark gray (5YR 4/1), (5Y)

No Recovery  

End of Boring  

Sample 3: Depth = 6.0'  
Moist (mo): 12.7%, P.S. Content: 0.65  
Fine (200): 17.5%, (5Y)

No Recovery  

End of Boring  

Sample 4: Depth = 9.0'  
Moist (mo): 12.7%, P.S. Content: 0.65  
Fine (200): 8.5%, (5Y)
PSN12579 LINE 103 AND 205
PSN12579 VC10

WILLIAMS FIELD INVESTIGATION
PSN12579
WL-2018-12579-VC10
0.0’ - 2.0’

WILLIAMS FIELD INVESTIGATION
PSN12579
WL-2018-12579-VC10
2.0’ - 4.0’

WILLIAMS FIELD INVESTIGATION
PSN12579
WL-2018-12579-VC10
4.0’ - 6.0’

WILLIAMS FIELD INVESTIGATION
PSN12579
WL-2018-12579-VC10
6.0’ - 8.0’
# Boring Designation: WL-2018-12579-VC10

<table>
<thead>
<tr>
<th>Depth</th>
<th>Material/Formation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-2.0</td>
<td>Sand</td>
<td>fine-grained, quartz, some silt, trace clay, trace shell fragments, trace shell (?), clay (dissolution pockets to 1.2&quot;) and shell fragments up to 0.5&quot;, (1.5&quot;) x (0.5&quot;) whole shell</td>
</tr>
<tr>
<td>2.0-7.0</td>
<td>Clay</td>
<td>very soft, fine sand, trace clay, sand discordant in laminar and nodular to pebble, 1.5&quot;, (2&quot;) x (1&quot;) shell lath oriented to pebble, 1.0&quot;, (2&quot;) x (1&quot;) shell lath oriented to pebble, sample 16&quot; x 16&quot; (?)</td>
</tr>
<tr>
<td>7.0-11.0</td>
<td>Sand</td>
<td>fine-grained, quartz, some silt, trace clay, trace shell fragments, trace shell (?), clay (dissolution pockets to 1.2&quot;) and shell fragments up to 0.5&quot;, (1.5&quot;) x (0.5&quot;) whole shell</td>
</tr>
</tbody>
</table>

- **SAND**: fine-grained, quartz, some silt, trace clay, trace shell fragments, trace shell (?), clay (dissolution pockets to 1.2") and shell fragments up to 0.5", (1.5") x (0.5") whole shell in medium gravel (10YR 2/1), (SM)
- **CLAY**: very soft, fine sand, trace clay, sand discordant in laminar and nodular to pebble, 1.5", (2") x (1") shell lath oriented to pebble, 1.0", (2") x (1") shell lath oriented to pebble, sample 16" x 16" (?) in medium gravel (10YR 2/1), (CLAY)
PSN12579 VC10


Drill Core Log:

Drilling Log

<table>
<thead>
<tr>
<th>Depth</th>
<th>Classification</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #1, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
</tr>
<tr>
<td>-45.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #2, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
</tr>
<tr>
<td>-40.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #3, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
</tr>
<tr>
<td>-35.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #4, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
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<tr>
<td>-30.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #5, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
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<tr>
<td>-25.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #6, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
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<tr>
<td>-20.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #7, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
</tr>
<tr>
<td>-15.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #8, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
</tr>
<tr>
<td>-10.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #9, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
</tr>
<tr>
<td>-5.0</td>
<td>Clay, very soft, loose sand, sandy clayey silt, shell fragments, clays, silts, sands, cobbles to pebbles, some fine gravel</td>
<td>Sample #10, Depth = 15.0' Ave. Field Vane (MF) 9.25</td>
</tr>
</tbody>
</table>

Note: All samples were collected using a Shelby core barrel.
PSN12579 LINE 103 AND 205 (TIE)
RESULTS- PSN12579

- Portions on the slope of Heald Bank
  - Exposed sections of Facies B (sandy mud)
- Sand (Facies A) localized to south and central portion of asset
- Within the Sabine-Trinity Paleovalley
  - North section
  - Significant overburden
  - Adjacent to large Sand Shoal
PROJECT CONCLUSIONS

► PSN7199
  > Not on sand deposit of Heald Bank
  > <2 ft of sand, mostly silty sands and clay (Facies B and C)
  > Little impact on sand extraction of Heald Bank
  > 48,796.18 ft abandoned in place

► PSN12579
  > Partially within Heald Bank, 3-13 ft of sand (Facies A)
  > Determine abandonment of sections off Heald Bank, Facies B and Facies C
  > Pipeline Abandonment
    - 25,026.99 ft abandoned in place
    - 23,725.84 ft removed
QUESTIONS?

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