U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

# HORIZONTAL & VERTICAL CONTROL REPORT

| | |
|---|---|
| Type of Survey: | Hydrographic Survey |
| Project Number: | OPR-K354-KR-17 |
| Time Frame: | August - October 2017 |

**LOCALITY**

| | |
|---|---|
| State: | Louisiana |
| General Locality: | Gulf of Mexico |
| Sub-locality: | Louisiana Coast |

**2017**

CHIEF OF PARTY

George G. Reynolds

| NOAA FORM 77-28 (11-72) | U.S. DEPARTMENT OF COMMERCE<br>NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION | REGISTRY NUMBERS: |
|---|---|---|
| **HYDROGRAPHIC TITLE SHEET** | | H13040, H13041<br>H13042, H13043 |

| | |
|---|---|
| State: | **Louisiana** |
| General Locality: | **Gulf of Mexico** |
| Sub-Locality: | **Louisiana Coast** |
| Scale: | **1:40,000** |
| Date of Survey: | **August 3 to October 12, 2017** |
| Instructions Dated: | **June 21, 2017** |
| Project No.: | **OPR-K354-KR-17** |
| Vessels: | **R/V Ocean Explorer- Official Number 905425**<br>**R/V Osprey – CT Registration CT7934BC** |
| Chief of Party: | **George G. Reynolds** |
| Surveyed By: | **Ocean Surveys, Inc.** |
| Soundings by: | **Multibeam Echosounder** |
| Imagery by: | **Side Scan Sonar, Multibeam Echosounder Backscatter** |
| Verification by: | **Atlantic Hydrographic Branch** |
| Soundings Acquired in: | **Meters at MLLW** |
| H-Cell Compilation Units: | |

Remarks: The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products. All times are recorded in UTC. Data recorded and presented relative to UTM Zone 15 North.

Contractor: Ocean Surveys, Inc.
129 Mill Rock Rd E
Old Saybrook, CT 06475

THE INFORMATION PRESENTED IN THIS REPORT AND THE ACCOMPANYING BASE SURFACES REPRESENTS THE RESULTS OF SURVEYS PERFORMED BY OCEAN SURVEYS, INC. DURING THE PERIOD OF 3 AUGUST 2017 TO 12 OCTOBER 2017 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO OSI.

# TABLE OF CONTENTS

**Page**

# A. VERTICAL CONTROL

## A.1 Primary Tide Station

Tide/water levels for this project were provided exclusively by NOAA as verified data from NOAA Tide Station 876-4227, LAWMA, LA. The project is located within zones indicated by preliminary tidal zoning included in the project Statement of Work. Time and range corrections were applied to LAWMA, LA (876-4227) verified tide data according to Table 1.

**Table 1**
**Tide Zones Associated with Project OPR-K354-KR-17**

| Zone | Time Correction | Range Correction |
|---|---|---|
| 65 | -60 | 0.94 |
| 66 | -60 | 1.03 |
| 82 | -72 | 1.31 |
| 115 | -78 | 1.28 |
| 154 | -72 | 1.22 |
| 182 | -60 | 1.12 |
| 189 | -84 | 1.31 |
| 191 | -66 | 1.12 |
| 193 | -72 | 1.25 |
| 263 | -66 | 1.03 |

Based on the results of cross line analysis, it appears that the time and range factors as provided in the preliminary zoning scheme are adequate.

Coordinated Universal Time (UTC) was used to annotate the tide records and all other data obtained for this project.

Preliminary tide correctors were retrieved daily from the CO-OPS website. Verified tides were retrieved as they were made available by CO-OPS. Tide data were applied to processed soundings employing the CARIS “Import Tide to HIPS” function.

A slightly altered version of the CARIS-format zoning file, “K354KR2017rev.zdf” (provided by CO-OPS), was employed to facilitate the application of final tide zoning scheme factors. During data processing OSI discovered a minor flaw in the 6$^{th}$ vertex of CO-OPS-provided Zone #82; the vertex did not fall exactly on a nearby vertex of the adjacent zone which is the presumed intention of CO-OPS. The result was a long, narrow, triangular area with no zoning coverage. The non-coverage triangle had two legs roughly 11.6 kilometers long with the third leg being only about 4 meters long. OSI adjusted the Zone #82 vertex which resulted in elimination of the non-coverage area.

The 6th vertex as delivered by CO-OPS was 29.448176, -92.096407. OSI changed this vertex to 29.448128, -92.096409. In making the edit neither time nor magnitude multiplier changes were made to the preliminary zoning file. The OSI-edited zoning file, included with the project deliverables, uses the same name as noted above, i.e. the file name, as delivered by CO-OPS, was retained.

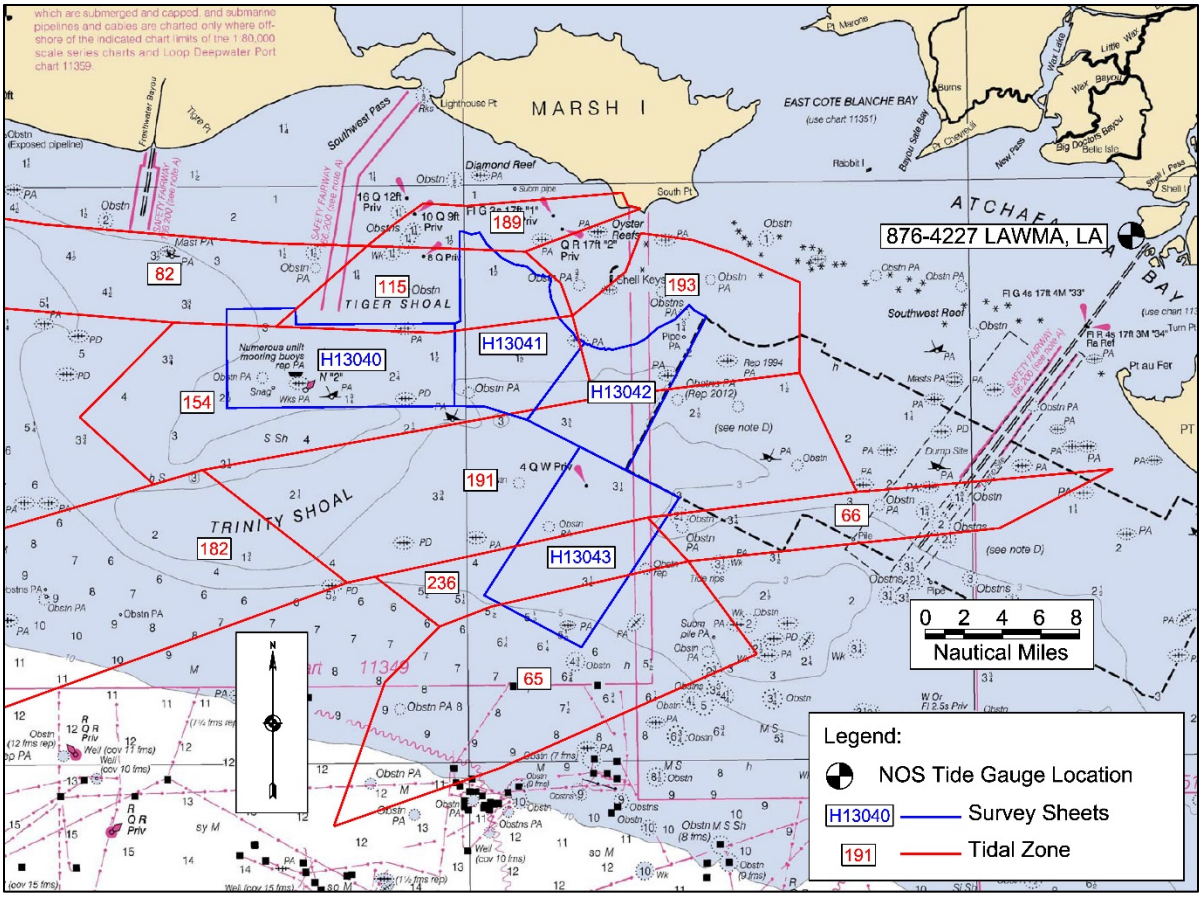


Figure 1. Project survey boundaries (blue lines), tidal zone boundaries (red lines), and the LAWMA, LA tide station location. In this figure the western end of Tide Zones 182 and 82 have been cropped for the sake of clarity of the 2017 project area.

## A.2 Unusual Tide Conditions

Specific information pertaining to individual surveys of Project OPR-K354-KR-17 will be documented, as applicable, in each survey's respective Descriptive Report.

As expected, there are moderate departures between predicted and verified tides due to wind setup. In general there was good agreement between mainscheme, cross line, and investigation MBES soundings. However, wind-induced tide offsets do in fact appear to affect agreement between mainscheme, cross line, and investigation MBES data when one or more of the

datasets were acquired during a windy period. Other mainscheme-cross line offsets were also noted to occur when one portion of the dataset was acquired with wind blowing a given direction, e.g. southwest and the overlapping dataset acquired with either slack wind or wind blowing in the opposite direction as during the first contributing dataset, e.g. northeast.

There was a nearly omnipresent offset between predicted and verified tides with verified tides being higher than predicted for much of the period of the survey. Accordingly there were just a few instances when the verified tide curve dipped below the predicted curve. The magnitude of the offset (verified higher than predicted) was 0.19 meters (average) with over 20% of peak offsets in excess of 0.3 meters. An example of the offset is shown in Figure 2. While the persistent offset might fall into the category of an "unusual tide condition" it was not cause for concern as pertains to reduction of project sounding data to MLLW datum.

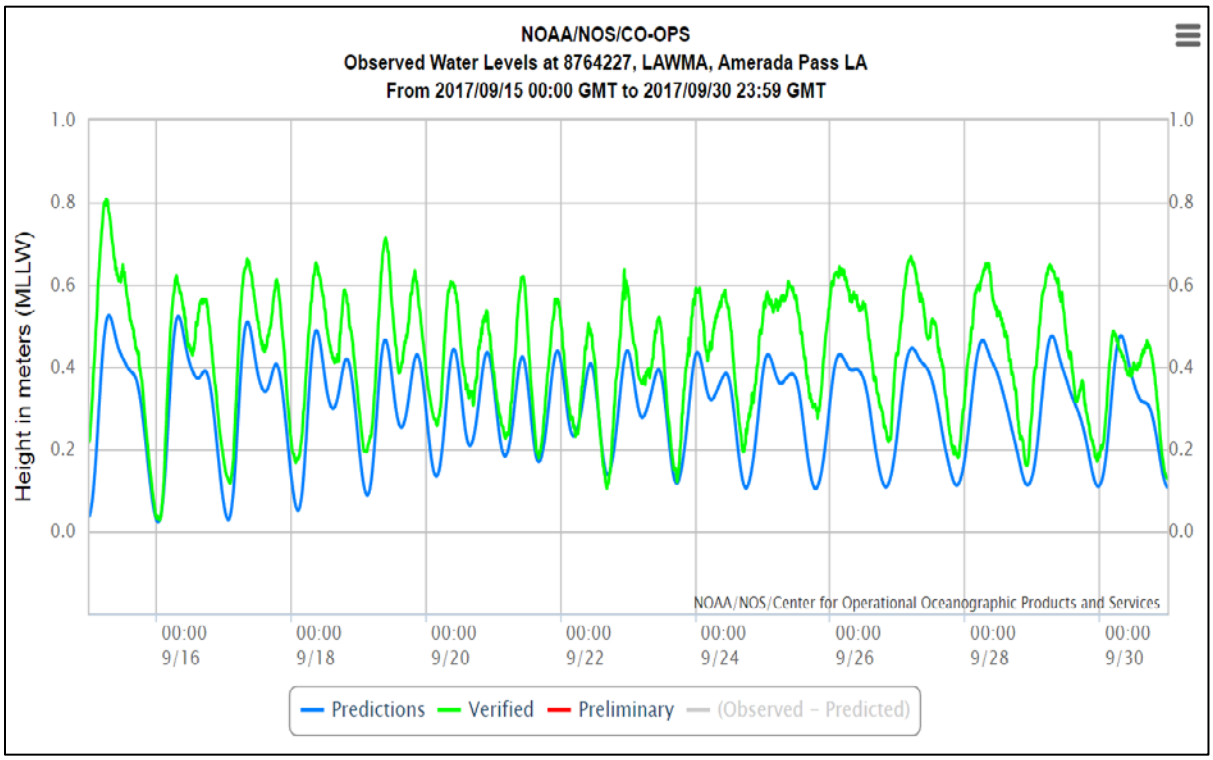


Figure 2. Example of persistent offset between predicted (blue) and verified (green) tide curves for the period September 15-30, 2017 (DN 258-273). This example is representative of the predicted/verified tide offset at the LAWMA station for nearly the entire period of the survey.

# B. HORIZONTAL CONTROL

## B.1 Horizontal Datum

The horizontal datum for this project is the North American Datum of 1983 (NAD83). Horizontal coordinates are referenced to Latitude/Longitude and Universal Transverse Mercator (UTM) Zone 15, in meters. The assigned project boundary falls entirely within UTM Zone 15.

## B.2 Horizontal Control

With the exception of certain calibrations, all survey tasks were executed employing Differential GPS (DGPS) positioning. English Turn, LA USCG DGPS beacon correctors were input to the primary navigation system (POS-MV). Infrequent outages to the English Turn, LA signal required that a second DGPS corrector source was used periodically (onboard the *R/V Ocean Explorer* only). The secondary DGPS corrector source for both vessels was the USCG Angleton, TX signal. Onboard the *R/V Ocean Explorer* navigation system positioning performance checks were performed while using both the English Turn, LA and the Angleton, TX signals (independently). Onboard the *R/V Osprey* only the English Turn, LA station was utilized by the primary navigating system. All navigation system positioning performance checks demonstrated that both of the aforementioned corrector source solutions were sufficiently accurate to control the survey.

On each vessel a secondary GPS solution provided input to the HYPACK SURVEY "positioning integrity alarm". This Trimble GPS was supplied with DGPS correctors from the Angleton, TX station (except in the case where the Angleton, TX signal was infrequently supplied directly to the *R/V Ocean Explorer's* POS MV).

OSI established a temporary X,Y navigation checkpoint along the waterfront of each vessel's base of operation. On the *R/V Ocean Explorer* positioning system confidence checks of the POS MV were accomplished at the start of survey and during provisioning stops in Intracoastal City, LA. On the *R/V Osprey* positioning system confidence checks were accomplished each morning prior to leaving the vessel's Cypremort Point, LA dock. In practice the distance between the respective vessel's reference point (RP) and the dockside horizontal control point, as computed by the navigation system, was compared to the tape-measured distance between the vessel RP and the horizontal control point. In all cases, dockside navigation system accuracy testing demonstrated that each vessel's POS MV, employing USCG correctors (from either source mentioned above), had an accuracy of better than 1.0 meter.

The temporary points were established August 1, 2017 (DN 212). The horizontal position of the temporary points (Figure 3 and Figure 4) were established by occupying the respective points with a Trimble 5700 GPS capable of recording dual-frequency GPS observables. Recorded data were submitted to the National Geodetic Survey's Online Users Positioning Service (OPUS) and solutions derived thus.

The position of the temporary X,Y points was established using a single OPUS observation (per location) with a duration of >2 hours each. The X,Y values for the observations are presented in Table 2. OPUS reports are appended at the end of the HVCR.

Vessel positions and distance measurements for each "nav check" were recorded in the respective acquisition log and are included herein (Table 3 and Table 4) as well as with Appendix III of the DAPR.


Figure 3. SMIC-01 NAIL is a pink flagged PK Nail in a Shell Morgan Landing dock piling shown here from three perspectives (antenna pole on point). This point was used exclusively by the *R/V Ocean Explorer*.

Figure 4. CP-01 NAIL is a pink flagged PK Nail adjacent to a Quintana Canal, Cypremort Point, LA dock piling shown here from three perspectives (antenna pole on point). This point was used exclusively by the *R/V Osprey*.

**Table 2**
**Navigation System Checkpoint**
**OPUS "Precise" Solution Coordinates**

| Nav. Check Point | Reference Easting UTM 15N, NAD83 (meters) | Reference Northing UTM 15N, NAD83 (meters) | Description of Position |
|---|---|---|---|
| SMIC-01 NAIL | 581,615.52 | 3,295,068.34 | PK nail in dock piling at Shell Morgan Landing, Intracoastal City, LA |
| CP-01 NAIL | 611,648.92 | 3,289,143.20 | PK nail adjacent to dock piling in Quintana Canal, Cypremort Point, LA |

**Table 3**
***R/V Ocean Explorer* - Tabulation of Navigation System Performance Checks**

| Date | Time UTC | Nav. Check-point | DGPS Beacon | Observed Easting UTM 15N, NAD83 (meters) | Observed Northing UTM 15N, NAD83 (meters) | Calculated Distance RP to Nav. Checkpoint (meters) | Tape Measure RP to Nav. Checkpoint (meters) | Difference Calculated vs. Tape Measured (meters) |
|---|---|---|---|---|---|---|---|---|
| 08/03/17 (DN 215) | 13:54 | SMIC Nail | English Turn, LA | 581,622.2 | 3,295,069.0 | 6.7 | 7.2 | 0.5 |
| 08/03/17 (DN 215) | 14:00 | SMIC Nail | Angleton TX | 581,623.3 | 3,295,070.1 | 7.9 | 7.2 | 0.7 |
| 08/04/17 (DN 216) | 5:45 | SMIC Nail | English Turn, LA | 581,624.9 | 3,295,069.9 | 9.5 | 8.9 | 0.6 |
| 08/10/17 (DN 222) | 5:22 | SMIC Nail | English Turn, LA | 581,623.1 | 3,295,068.1 | 7.6 | 8.5 | 0.9 |
| 08/16/17 (DN 228) | 8:12 | SMIC Nail | English Turn, LA | 581,625.0 | 3,295,067.1 | 9.5 | 9.1 | 0.5 |
| 08/22/17 (DN 234) | 10:22 | SMIC Nail | English Turn, LA | 581,624.1 | 3,295,066.6 | 8.7 | 8.8 | 0.1 |
| 09/01/17 (DN 244) | 0:44 | SMIC Nail | English Turn, LA | 581,622.4 | 3,295,068.2 | 6.9 | 7.8 | 0.9 |
| 09/11/17 (DN 254) | 21:11 | SMIC Nail | English Turn, LA | 581,623.9 | 3,295,066.9 | 8.4 | 8.9 | 0.5 |
| 09/25/17 (DN 268) | 2:56 | SMIC Nail | English Turn, LA | 581,624.3 | 3,295,065.5 | 9.3 | 9.7 | 0.4 |
| 10/10/17 (DN 283) | 9:46 | SMIC Nail | English Turn, LA | 581,624.0 | 3,295,066.5 | 8.7 | 9.3 | 0.7 |

**Table 4**
***R/V Osprey* - Tabulation of Navigation System Performance Checks**

| Date | Time UTC | Nav. Check-point | DGPS Beacon | Observed Easting UTM 15N, NAD83 (meters) | Observed Northing UTM 15N, NAD83 (meters) | Calculated Distance RP to Nav. Checkpoint (meters) | Tape Measure RP to Nav. Checkpoint (meters) | Difference Calculated vs. Tape Measured (meters) |
|---|---|---|---|---|---|---|---|---|
| 08/24/17 (DN 226) | 7:42 | CP Nail | English Turn, LA | 611647.3 | 3289135.4 | 8.0 | 6.8 | 1.2 |
| 08/24/17 (DN 236) | 23:16 | CP Nail | English Turn, LA | 611651.0 | 3289135.9 | 7.6 | 6.8 | 0.8 |
| 09/01/17 (DN 244) | 12:16 | CP Nail | English Turn, LA | 611647.6 | 3289135.8 | 7.5 | 6.8 | 0.7 |
| 09/02/17 (DN 245) | 11:57 | CP Nail | English Turn, LA | 611649.9 | 3289137.0 | 6.3 | 6.8 | 0.5 |
| 09/03/17 (DN 246) | 11:58 | CP Nail | English Turn, LA | 611649.4 | 3289136.3 | 6.9 | 6.8 | 0.1 |
| 09/04/17 (DN 247) | 12:03 | CP Nail | English Turn, LA | 611648.3 | 3289136.6 | 6.6 | 6.8 | 0.2 |
| 09/05/17 (DN 248) | 12:03 | CP Nail | English Turn, LA | 611648.5 | 3289135.9 | 7.3 | 6.8 | 0.5 |
| 09/06/17 (DN 249) | 12:08 | CP Nail | English Turn, LA | 611647.6 | 3289135.8 | 7.5 | 6.8 | 0.7 |
| 09/08/17 (DN 251) | 12:03 | CP Nail | English Turn, LA | 611646.3 | 3289137.4 | 6.4 | 6.8 | 0.4 |
| 09/09/17 (DN 252) | 12:05 | CP Nail | English Turn, LA | 611649.1 | 3289135.7 | 7.5 | 6.8 | 0.7 |
| 09/11/17 (DN 254) | 16:56 | CP Nail | English Turn, LA | 611650.5 | 3289136.0 | 7.4 | 6.8 | 0.6 |
| 09/12/17 (DN 255) | 12:03 | CP Nail | English Turn, LA | 611647.8 | 3289135.8 | 7.5 | 6.8 | 0.7 |
| 09/13/17 (DN 256) | 10:14 | CP Nail | English Turn, LA | 611648.2 | 3289136.6 | 6.6 | 6.8 | 0.2 |
| 09/14/17 (DN 257) | 12:08 | CP Nail | English Turn, LA | 611646.4 | 3289137.2 | 6.6 | 6.8 | 0.2 |
| 09/15/17 (DN 258) | 12:07 | CP Nail | English Turn, LA | 611647.7 | 3289136.1 | 7.3 | 6.8 | 0.5 |

| Date | Time UTC | Nav. Check-point | DGPS Beacon | Observed Easting UTM 15N, NAD83 (meters) | Observed Northing UTM 15N, NAD83 (meters) | Calculated Distance RP to Nav. Checkpoint (meters) | Tape Measure RP to Nav. Checkpoint (meters) | Difference Calculated vs. Tape Measured (meters) |
|---|---|---|---|---|---|---|---|---|
| 09/16/17 (DN 259) | 12:12 | CP Nail | English Turn, LA | 611648.4 | 3289136.9 | 6.3 | 6.8 | 0.5 |
| 09/17/17 (DN 260) | 12:08 | CP Nail | English Turn, LA | 611648.9 | 3289137.0 | 6.2 | 6.8 | 0.6 |
| 09/18/17 (DN 261) | 12:09 | CP Nail | English Turn, LA | 611650.2 | 3289136.6 | 6.7 | 6.8 | 0.1 |
| 09/19/17 (DN 262) | 12:12 | CP Nail | English Turn, LA | 611648.2 | 3289136.4 | 6.9 | 6.8 | 0.1 |
| 09/20/17 (DN 263) | 12:06 | CP Nail | English Turn, LA | 611648.3 | 3289136.9 | 6.4 | 6.8 | 0.4 |
| 09/21/17 (DN 264) | 12:03 | CP Nail | English Turn, LA | 611648.9 | 3289136.9 | 6.3 | 6.8 | 0.5 |
| 09/22/17 (DN 265) | 12:32 | CP Nail | English Turn, LA | 611647.3 | 3289136.9 | 6.6 | 6.8 | 0.2 |
| 09/23/17 (DN 266) | 12:22 | CP Nail | English Turn, LA | 611648.5 | 3289136.3 | 6.9 | 6.8 | 0.1 |
| 09/26/17 (DN 269) | 12:00 | CP Nail | English Turn, LA | 611649.0 | 3289136.3 | 6.9 | 6.8 | 0.1 |
| 09/27/17 (DN 270) | 12:05 | CP Nail | English Turn, LA | 611649.6 | 3289136.6 | 6.6 | 6.8 | 0.2 |
| 09/28/17 (DN 271) | 12:17 | CP Nail | English Turn, LA | 611648.8 | 3289136.8 | 6.4 | 6.8 | 0.4 |
| 09/29/17 (DN 272) | 12:12 | CP Nail | English Turn, LA | 611647.4 | 3289136.7 | 6.7 | 6.8 | 0.1 |
| 10/10/17 (DN 283) | 12:00 | CP Nail | English Turn, LA | 611649.0 | 3289136.3 | 6.9 | 6.8 | 0.1 |
| 10/11/17 (DN 284) | 12:05 | CP Nail | English Turn, LA | 611649.6 | 3289136.6 | 6.6 | 6.8 | 0.2 |
| 10/12/17 (DN 285) | 12:17 | CP Nail | English Turn, LA | 611648.8 | 3289136.8 | 6.4 | 6.8 | 0.4 |
| 10/12/17 (DN 285) | 12:12 | CP Nail | English Turn, LA | 611647.4 | 3289136.7 | 6.7 | 6.8 | 0.1 |

# OPUS Report for Navigation Checkpoint "SMIC-01 NAIL"

NGS OPUS SOLUTION REPORT
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All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: rmw@oceansurveys.com DATE: November 08, 2017
RINEX FILE: 2818213o.17o TIME: 15:38:28 UTC

SOFTWARE: page5 1603.24 master90.pl 160321 START: 2017/08/01 14:18:00
EPHEMERIS: igs19602.eph [precise] STOP: 2017/08/01 16:30:00
NAV FILE: brdc2130.17n OBS USED: 5082 / 5858 : 87%
ANT NAME: TRM41249.00 NONE # FIXED AMB: 35 / 38 : 92%
ARP HEIGHT: 1.2192 OVERALL RMS: 0.014(m)

| REF FRAME: | NAD_83(2011)(EPOCH:2010.0000) | IGS08 (EPOCH:2017.5826) |
|---|---|---|
| X: | -208389.121(m) 0.003(m) | -208389.928(m) 0.003(m) |
| Y: | -5536288.272(m) 0.035(m) | -5536286.783(m) 0.035(m) |
| Z: | 3149532.413(m) 0.011(m) | 3149532.223(m) 0.011(m) |
| LAT: | 29 46 59.74914 0.010(m) | 29 46 59.76732 0.010(m) |
| E LON: | 267 50 39.73589 0.004(m) | 267 50 39.70378 0.004(m) |
| W LON: | 92 9 20.26411 0.004(m) | 92 9 20.29622 0.004(m) |
| EL HGT: | -24.322(m) 0.035(m) | -25.681(m) 0.035(m) |
| ORTHO HGT: | 1.732(m) 0.060(m) [NAVD88 (Computed using GEOID12B)] | |

| | UTM COORDINATES<br>UTM (Zone 15) | STATE PLANE COORDINATES<br>SPC (1702 LA S) |
|---|---|---|
| Northing (Y) [meters] | 3295068.339 | 142528.052 |
| Easting (X) [meters] | 581615.525 | 920493.936 |
| Convergence [degrees] | 0.41943962 | -0.41115823 |
| Point Scale | 0.99968218 | 0.99993291 |
| Combined Factor | 0.99968600 | 0.99993673 |

US NATIONAL GRID DESIGNATOR: 15RWN8161595068(NAD 83)

BASE STATIONS USED

| PID | DESIGNATION | LATITUDE | LONGITUDE | DISTANCE(m) |
|---|---|---|---|---|
| DL9074 | FSHS FRANKLIN HIGH SCH CORS ARP | N294819.103 | W0913008.051 | 63219.7 |
| DP8058 | AMER AMERADA PASS CORS ARP | N292658.497 | W0912017.211 | 87392.1 |
| DL7622 | TONY ABDALLA HALL ULL CORS ARP | N301316.947 | W0920242.387 | 49722.3 |

NEAREST NGS PUBLISHED CONTROL POINT

| | | | | |
|---|---|---|---|---|
| AV0248 | 57 V 96 | N294704.175 | W0920924.366 | 175.3 |

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

# OPUS Report for Navigation Checkpoint "CP-01 NAIL"

NGS OPUS SOLUTION REPORT
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All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: rmw@oceansurveys.com DATE: November 08, 2017
RINEX FILE: 2818213t.17o TIME: 15:39:32 UTC

SOFTWARE: page5 1603.24 master96.pl 160321 START: 2017/08/01 19:16:00
EPHEMERIS: igs19602.eph [precise] STOP: 2017/08/01 21:21:00
NAV FILE: brdc2130.17n OBS USED: 3174 / 3303 : 96%
ANT NAME: TRM41249.00 NONE # FIXED AMB: 20 / 22 : 91%
ARP HEIGHT: 2.4384 OVERALL RMS: 0.015(m)

| REF FRAME: NAD_83(2011)(EPOCH:2010.0000) | | IGS08 (EPOCH:2017.5831) | |
|---|---|---|---|
| X: | -178525.224(m) 0.038(m) | -178526.031(m) | 0.038(m) |
| Y: | -5540403.144(m) 0.121(m) | -5540401.653(m) | 0.121(m) |
| Z: | 3144161.118(m) 0.069(m) | 3144160.928(m) | 0.069(m) |
| LAT: | 29 43 38.82569 0.001(m) | 29 43 38.84390 | 0.001(m) |
| E LON: | 268 9 15.94663 0.042(m) | 268 9 15.91481 | 0.042(m) |
| W LON: | 91 50 44.05337 0.042(m) | 91 50 44.08519 | 0.042(m) |
| EL HGT: | -25.005(m) 0.138(m) | -26.370(m) | 0.138(m) |

ORTHO HGT: 0.815(m) 0.235(m) [NAVD88 (Computed using GEOID12B)]

| | UTM COORDINATES UTM (Zone 15) | STATE PLANE COORDINATES SPC (1702 LA S) |
|---|---|---|
| Northing (Y) [meters] | 3289143.204 | 136167.270 |
| Easting (X) [meters] | 611648.922 | 950444.943 |
| Convergence [degrees] | 0.57251186 | -0.25612502 |
| Point Scale | 0.99975380 | 0.99993706 |
| Combined Factor | 0.99975773 | 0.99994099 |

US NATIONAL GRID DESIGNATOR: 15RXN1164889143(NAD 83)

BASE STATIONS USED

| PID | DESIGNATION | LATITUDE | LONGITUDE | DISTANCE(m) |
|---|---|---|---|---|
| DL7622 | TONY ABDALLA HALL ULL CORS ARP | N301316.947 | W0920242.387 | 58039.9 |
| DP8058 | AMER AMERADA PASS CORS ARP | N292658.497 | W0912017.211 | 58014.1 |
| DL9074 | FSHS FRANKLIN HIGH SCH CORS ARP | N294819.103 | W0913008.051 | 34307.4 |

NEAREST NGS PUBLISHED CONTROL POINT

| | | | | |
|---|---|---|---|---|
| AU3433 | L047A | N294357.146 | W0915043.059 | 564.8 |

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

## C. APPROVAL SHEET

# LETTER OF APPROVAL

# REGISTRY NOS.
# H13040, H13041, H13042, AND H13043

This report and the accompanying data are respectfully submitted.

Field operations contributing to the accomplishment of Surveys H13040, H13041, H13042, and H13043 were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and associated data have been closely reviewed and are considered complete and adequate as per the Statement of Work.

Digitally signed by George G. Reynolds
Date: 2018.01.19 10:36:22 -05'00'

George G. Reynolds
Ocean Surveys, Inc.
Chief of Party
January 19, 2018