



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Sandy Hook DGPS Site (804)
Inspector(s): CWO4 William Iozzino
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REFERENCES:

- (1) DGPS Concept of Operations, COMDTINST 16577.2 (AUG 1995)
- (2) 2010 Federal Radio Navigation Plan
- (3) Broadcast Standard for the USCG DGPS Navigation Service, CIM 16577.1 (APR 1993).
- (4) RTCM Recommend Standards for Differential GNSS Service, Version 2.3.

PURPOSE:

- Validate advertised DGPS coverage of the Sandy Hook DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

EQUIPMENT:

Trimble SPS 461 Receiver
Trimble GA 530 Antenna

SANDY HOOK DGPS SITE PARAMETERS:

Frequency	286 KHz
Forward Output Power	900 W
Transmission Rate	200 baud
Field Strength/Range	100 μ V/m (40.0 dB μ V/m) at 185 km

SUMMARY:

The Operational Assessment of the Sandy Hook DGPS site revealed that the provided coverage is consistent with the predicted coverage area with the exception of the areas near the range rings as noted below. Far-Field signal strength readings taken on the south range ring did not meet the required 100 μ V/m. FF readings taken on the North range ring exceeded system requirements. Additionally a review of the output/reflected power and near-field signal strength levels was conducted and found to be satisfactory. All RTCM messages were verified and evaluated and are consistent with the requirements set forth by reference (3) and (4) except as noted above for the Type-7 and 16 message. Finally, accuracy measurements taken at a range of 22.67 km from the DGPS site revealed 0.2472 to 0.3073 meter horizontal accuracy which exceeds accuracy requirements set forth by Reference (1) and (2).

RESULTS:

Signal Strength:

A verification of the Sandy Hook DGPS coverage area was conducted from Cape May New Jersey to Providence, RI and then from Piermont, NY south to Maryland. Figure 1 below shows that the DGPS coverage to the south is consistent with the predicted coverage plot and does not meet the advertised 185 km range but exceeds the predicted coverage along the Delaware River past the Delaware memorial bridge to the advertised range. To the north, intermittent coverage is shown beyond the predicted coverage area. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points. Far-Field (FF) signal strength measurements were taken at northern and southern points of the advertised range from both sides of the site (Table 1 and 2). The northern FF readings were well above the required $40 \text{ dB}\mu\text{V/m}$ while the southern readings taken did not meet system requirements.

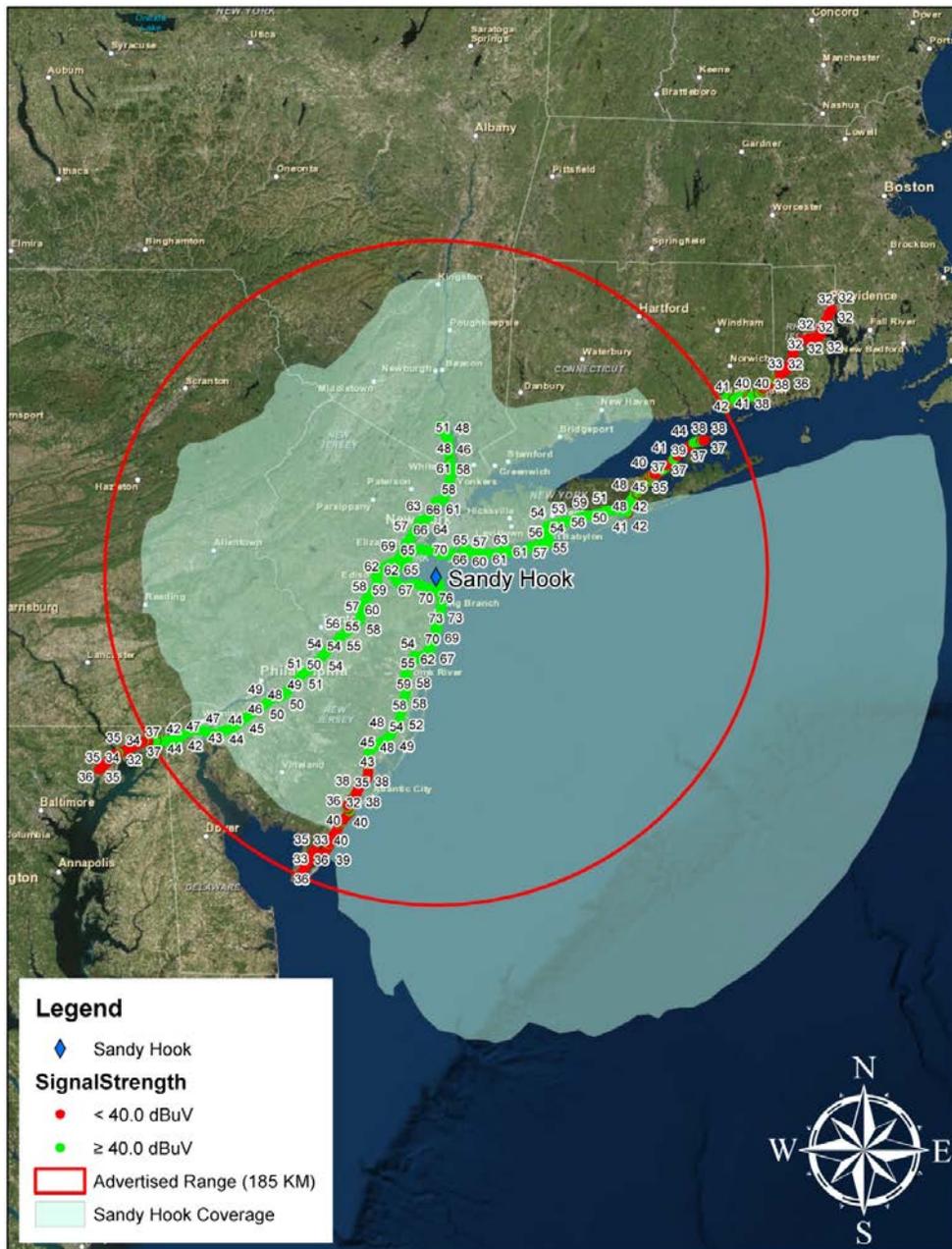


Figure 1: DNAV Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	32 dB μ V/m	13 dB μ V/m	38° 57.304066' N, 074° 53.527258' W
B	29 dB μ V/m	8 dB μ V/m	

Table 1: South. Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	45 dB μ V/m	23 dB μ V/m	41° 18.576370' N, 072° 06.661480' W
B	45 dB μ V/m	23 dB μ V/m	

Table 2: North East Far-Field Signal Strength

RTCM Message Verification:

RTCM message scheduling, receipt, and content were checked during the assessment (Table 3 and 4). Receipt of all RTCM messages was validated utilizing a Remote Desktop session whereby the assessment team witnessed the on-time receipt of all messages on the Sandy Hook side A Integrity Monitor. All message content was verified and is in accordance with Reference (4) with the exception of the location information provided in the Type-7 message for the Moriches DGPS site which places the site position 1.6 km to the north and 1.0 km to the west. Additionally the RTCM type 16 test messages were scheduled but not received on both sides. RTCM message scheduling on both Side A and Side B was validated with the DGPS watch and is in accordance with the Reference (3).

Message Type	Received	Scheduled	Content Verified/Accurate
<i>Type 3</i>	Y	Y	Y
<i>Type 5 (ensure message is not being transmitted)</i>	N	N	N/A
<i>Type 7</i>	Y	Y	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	N	N	N

Table 3: Side A RTCM Message Validation

Message Type	Received	Scheduled	Content Verified/Accurate
<i>Type 3</i>	Y	Y	Y
<i>Type 5 (ensure message is not being transmitted)</i>	N	N	N/A
<i>Type 7</i>	Y	Y	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	N	N	N

Table 4: Side B RTCM Message Validation

Accuracy Validation:

The OA team placed a Trimble GA 530 antennae atop of a National Geodetic Survey (NGS) marker and collected positional data for 10 minutes per side. Next, they post processed and compared the data to the published survey marker position in order to verify the horizontal accuracy of the broadcast correction (Table 5 and 6). Side A broadcasted a correction that was calculated to be 0.2472 meters away from the monument, bearing 321.2°. Side B's correction was calculated to be 0.3073 meters away from the monument, bearing 328.2°. As per Reference (1) and (2), both respective distances were well within advertised accuracy requirements.

A two dimension radial review of the same time period was completed for the integrity monitors. Side A's average deviation was 0.19497 meters; Side B's average deviation was 0.12996 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

NGS Monument ID:	BBDD33
Monument LAT:	40° 37.054' N
Monument LON:	073° 49.481685' W
Distance from DGPS Site	22.67 km

Averaged LAT:	40° 37.054332' N
Averaged LON:	073° 49.481795' W
Antenna Distance from Monument:	0.2472 meters (0.811 ft)
Antenna Bearing from Monument:	321.2°

Table 5: Side A Accuracy Check Results

Averaged LAT:	40° 37.054369' N
Averaged LON:	073° 49.481800' W
Distance from Monument:	0.3073 meters (1.01 ft)
Bearing from Monument:	328.2°

Table 6: Side B Accuracy Check Results