



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Driver DGPS Site (806)
Inspector(s): CWO2 Marin Kaczmar, CWO3 William Iozzino
Date: 22 July 2013

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 Driver DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

EQUIPMENT:

Raven INVICTA Receiver
MBA-2 Receive Antenna
Trimble SPS461 Receiver
Trimble GA 530 Antenna

Driver DGPS SITE PARAMETERS:

Frequency	289 KHz
Forward Output Power	900 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 241 km

RESULTS:

Signal Strength:

A verification of the Driver DGPS coverage area was conducted starting at NAVCEN, East to Maryland, South across the Chesapeake Bay bridge, North to Richmond VA then South to Wilmington NC. The advertised signal strength range is 241 km. Figure 1 below displays adequate signal strength, within the advertised range of 241 km from the site and throughout 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 readings were taken at northern and southern points of the advertised range from both sides of the site (Table 1 and Table 2). Both northern and southern FF readings were above the required 37.5 dB μ V/m signal strength on both sides

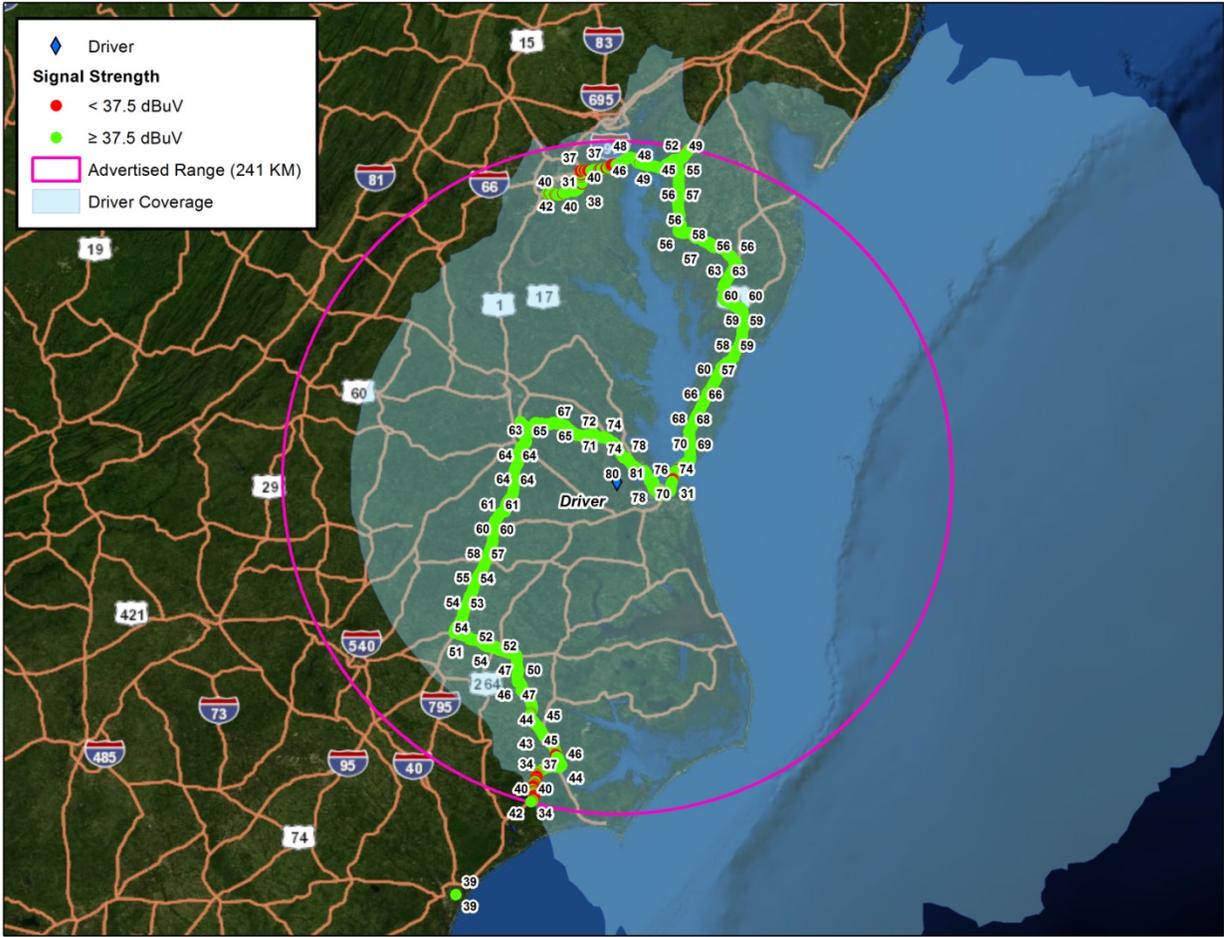


Figure 1: DNAV Signal Strength Results

	POSITION	Trimble SPS461
Side A SS 922	39° 04' 43.581'N 75° 58' 45.723''W	49 dB μ V/m, 29 SNR
Side B SS 922	39° 04' 43.581'N 75° 58' 45.723''W	49 dB μ V/m, 29 SNR

Table 1: North Far-Field Signal Strength Reading

	POSITION	Trimble SPS461
Side A SS 922	34° 52' 03.505'N 77° 58' 45.723''W	40 dB μ V/m, 15 SNR
Side B SS 922	34° 52' 03.505'N 77° 58' 45.723''W	41 dB μ V/m, 14 SNR

Table 2: South Far-Field Signal Strength Reading

RTCM Message Verification:

RTCM message scheduling, receipt, and content were checked during the assessment (Table 3 and 4). RTCM message scheduling on both Side A and Side B was validated in the field and is in accordance with Reference (3). All message content was verified and an error with one of the advertised positions of a neighboring site was found to be out of tolerance in accordance with Reference (4).

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	Y
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

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	Y
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 4: Side B RTCM Message Validation

Accuracy Validation:

Positional data was collected for 10 minutes per side using the Trimble SPS461. The data was then post processed and compared to a National Geodetic Survey (NGS) marker to verify the horizontal accuracy of the broadcast correction (Table 5 and 6). Side A was 0.1851 meters, bearing 303°, away from the monument while Side B was 0.4216 meters, bearing 345°, away from the monument. As per Reference (1) and (2), both respective distances were well within advertised accuracy requirements. A comparison between the GPS satellites in view at the Driver DGPS site and at the NGS monument location was conducted (Table 7) to identify any differences in the GPS satellite geometry used at the respective locations. Any differences in geometry could lead to accuracy discrepancies. In this case, the satellites being tracked by the RS and IM GPS receivers at the site were almost identical to those tracked at the NGS monument location.

NGS Monument ID:	BBCB81
Monument LAT:	37° 18' 43.66811" N
Monument LON:	077° 13' 20.18434" W

Averaged LAT:	37° 18' 43.674102" N
Averaged LON:	077° 13' 20.185781" W
Distance from DGPS Site:	70.89 km
Antenna Distance from Monument:	0.1851 m (0.607282 ft)
Antenna Bearing from Monument:	303°

Table 5: Side A Accuracy Check Results

Averaged LAT:	37° 18' 43.681309" N
Averaged LON:	077° 13' 20.188718" W
Distance from DGPS Site:	70.89 km
Distance from Monument:	0.4216 m (1.383199 ft)
Bearing from Monument:	345°

Table 6: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A	1	7	8	9	11	17	19	20	26	28	
Integrity Monitor A	1	7	8	9	11	17	26	28			
Reference Station B	1	7	8	9	11	17	26	28			
Integrity Monitor B	1	7	8	9	11	17	19	20	26	28	
NGS Monument Location, Side A	1	7	8	9	11	17	20	26	28		
NGS Monument Location, Side B	1	7	8	9	11	17	20	26	28	32	

Table 7: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Driver DGPS site revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. Both northern and southern Far-Field signal strength readings were well within the required signal strength. The signal strength measurements throughout the predicted coverage area within the advertised range, were satisfactory. 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. An error of advertised position of a neighboring site was found not consistent with the requirements set forth by reference (3) and (4). Finally, accuracy measurements and analysis proved that at a distance of approximately 71 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).