



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Reedy Point, DE DGPS Site (870)
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REFERENCES

- (1) Differential Global Positioning System (DGPS) Concept of Operations, COMDTINST 16577.2 (AUG 1995).
- (2) 2012 Federal Radio Navigation Plan.
- (3) Broadcast Standard for the USCG DGPS Navigation Service, CIM 16577.1 (APR 1993).
- (4) Radio Technical Commission for Maritime Services (RTCM) Recommended Standards for Differential Global Navigation Satellite System (GNSS) Service, Version 2.3.

PURPOSE

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

EQUIPMENT

Trimble SPS461 Receiver
Trimble GA 530 Antenna
Dell PF4XRA00 Laptop

REEDY POINT DGPS SITE PARAMETERS

Frequency	309 KHz
Forward Output Power	800 W
Transmission Rate	200 baud
Field Strength/Range	100 μ V/m (40 dB μ V/m) at 113 km

SUMMARY

Operational Assessment of the site revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. The signal strength measurements, throughout the predicted coverage area within the advertised range, were satisfactory. All RTCM messages were verified, evaluated, and are consistent with the requirements set forth by reference (3) and (4). The accuracy check results of 1.35 meters for Side A and 1.55 meters for Side B were well within the 10 meter requirement.

RESULTS

Signal Strength

A verification of the Reedy Point DGPS coverage area was conducted from along the coast of Delaware, through eastern Pennsylvania, and New York. The advertised signal strength range is 113 km. Figure 1 displays adequate signal strength beyond the advertised range of 113 km from the site and throughout the predicted coverage area. Green points represent areas of satisfactory

signal strength, whereas areas of unsatisfactory signal strength are represented with red points. As seen in Table 1 and Table 2, far-field signal strength readings were taken at northern and southern points of the advertised range from both sides of the site. Both northern and southern far-field readings were well above the required 40 dB μ V/m signal strength on both sides.

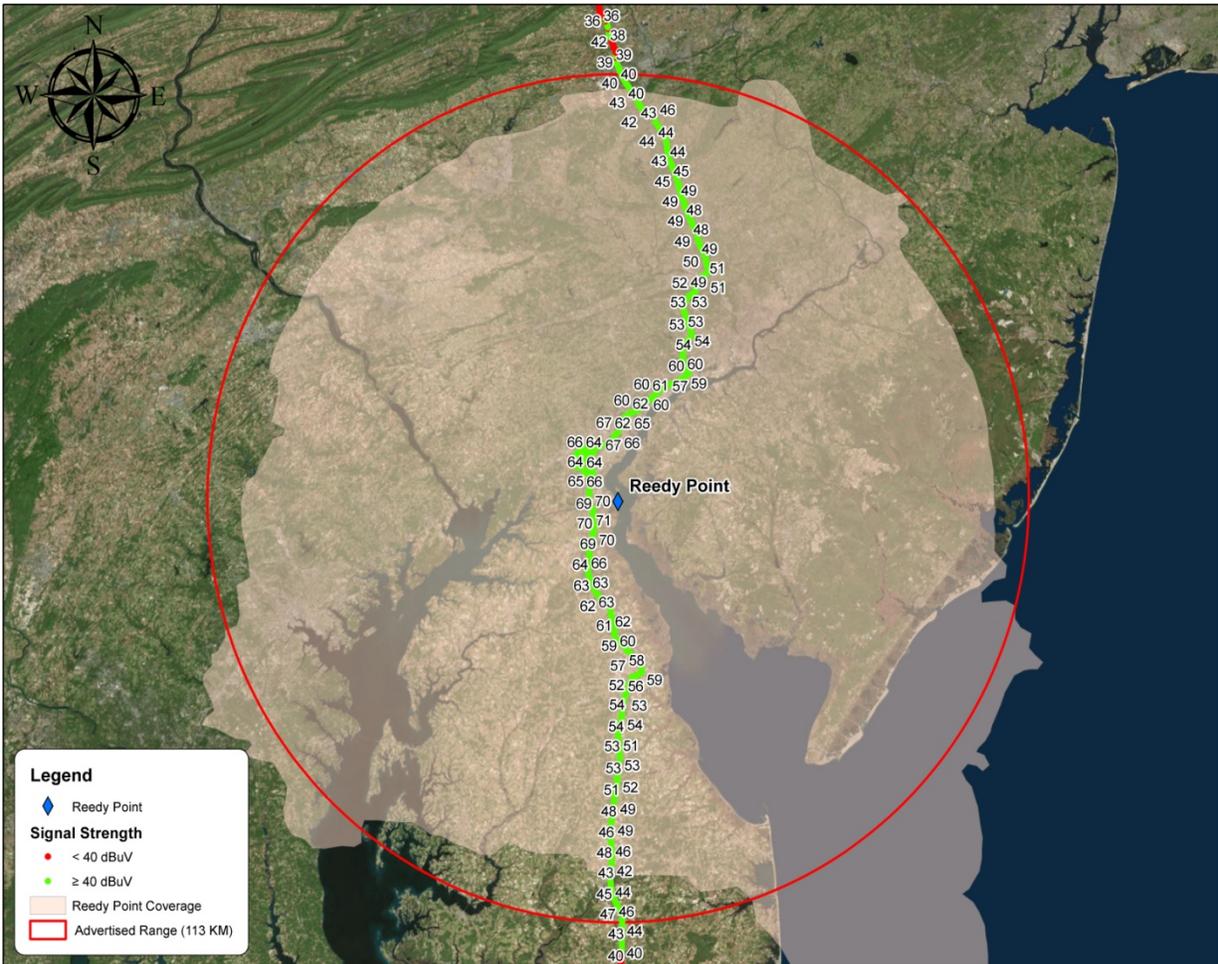


Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	45 dB μ V/m	13 dB μ V/m	38°29.2487'N, 75°33.4479'W
B	N/A	N/A	

Table 1: North Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	N/A	N/A	40°40.0123'N, 75°35.7349'W
B	43 dB μ V/m	3 dB μ V/m	

Table 2: South Far-Field Signal Strength Reading

RTCM Message Verification

Table 3 and Table 4 show RTCM message scheduling, receipt, and content collected during the assessment. RTCM message scheduling on both Side A and Side B was validated with the DGPS

watch and is in accordance with the Reference (3). 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 active and standby Integrity Monitor computers. All message content was verified and is in accordance with Reference (4) with the only exception of the Annapolis Beacon being off by 130 meters.

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 12 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 (See Table 6 and Table 7). Side A was 1.359 meters, bearing 190.53° from the monument, while Side B was 1.557 meters, bearing 360° from the monument. Per Reference (1) and (2), both respective distances were well within advertised accuracy requirements. As seen in Table 8, a comparison between the GPS satellites in view at the Reed Point DGPS site and those at the NGS monument location was conducted 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 Reference Station and Integrity Monitor GPS receivers at the site were almost identical to those tracked at the NGS monument location. A two dimension radial review of the same time period was completed for the integrity monitors. Side A’s average deviation was 1.359 meters; Side B’s average deviation was 1.557 meters. Both findings were consistent with the findings observed in the field and are well within system parameters. Furthermore, a comparison between the uncorrected GPS position and the NGS Monument was conducted to see how effective the DGPS corrections were. GPS accuracy was 1.458 meters away from the monument.

NGS Monument ID:	JU1672
Monument LAT:	39° 39' 1.62728" N
Monument LON:	075° 41' 51.35471" W
Distance from DGPS Site	14.8 km

Table 5: NGS Monument ID

Averaged LAT:	39° 39' 1.6302" N
Averaged LON:	075° 41' 51.3636" W
Antenna Distance from Monument:	1.359m (4.4586614ft)
Antenna Bearing from Monument:	190.53°

Table 6: Side A Accuracy Check Results

Averaged LAT:	39° 39' 1.623" N
Averaged LON:	075° 41' 51.3522" W
Distance from Monument:	1.557 m (5.1082677 ft)
Bearing from Monument:	360°

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>									
Reference Station A	5	7	13	15	18	21	22	24	27	29
Integrity Monitor A	5	13	15	18	21	24	29			
Reference Station B	14	16	20	23	25	29	30	31	32	
Integrity Monitor B	5	7	13	15	18	21	22	24	27	29
NGS Monument Location, Side A	5	13	15	18	21	24	29			
NGS Monument Location, Side B	13	15	18	21	22	24	27			

Table 8: GPS Satellite Comparison

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