



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Hawk Run, PA DGPS Site (788)
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Date: 16 Mar 2015

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 Hawk Run 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

HAWK RUN DGPS SITE PARAMETERS

Frequency	291 KHz
Forward Output Power	1000 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 300 km

SUMMARY

The Operational Assessment of the Hawk Run DGPS site revealed that the provided coverage is inconsistent with the predicted coverage plot and advertised range. All RTCM messages were verified and evaluated and are consistent with the requirements set forth by reference (3) and (4). The signal strength measurements, throughout the predicted coverage area within the advertised range, were not satisfactory. The Department of Transportation (DOT) will be notified. The accuracy check results of .20 meters for Side A and .38 meters for Side B were well within the 10 meter requirement.

RESULTS

Signal Strength

A verification of the Hawk Run DGPS coverage area was conducted through central New York and central Pennsylvania. The advertised signal strength range is 300 km. Figure 1 displays adequate signal strength within the advertised range of 300 km from the site and throughout the

predicted coverage area. However, the coverage was inconsistent with areas in the northeast and southeast sectors of the predicted coverage area having insufficient signal strength. Green points on Figure 1 represent areas of satisfactory signal strength, where as 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 predicted coverage area from both sides of the site. Neither the northern or southern far-field readings met the required 37.5 dB μ V/m signal strength on either side. Because of the limited range from the site, readings were taken closer to the transmitter than is usual.

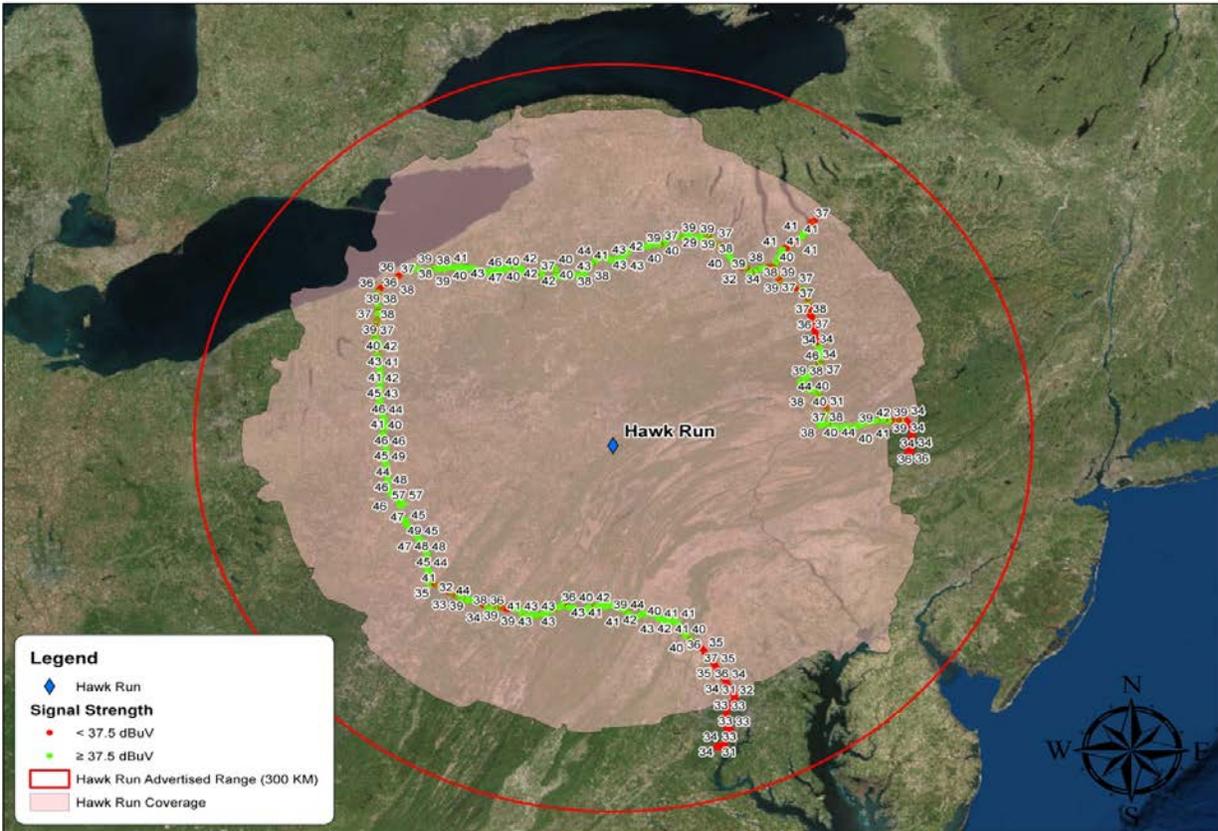


Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	40 dB μ V/m	3 dB μ V/m	42°29.2285' N, 76° 28.0388' 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	39°18.9836' N, 77° 21.1397' W
B	38 dB μ V/m	18 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).

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 0.2094 meters, bearing 214.1808° from the monument, while Side B was 0.3846 meters, bearing 270.5646° 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 Hawk Run 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. 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 0.297 meters away from the monument.

NGS Monument ID:	BBDK58
Monument LAT:	41° 13' 57.25040" N
Monument LON:	076° 25' 25.25952" W
Distance from DGPS Site	154.49 km

Table 5: NGS Monument ID

Averaged LAT:	41° 13' 57.2448" N
Averaged LON:	076° 25' 24.2646" W
Antenna Distance from Monument:	0.2094 m (0.687008 ft)
Antenna Bearing from Monument:	214.1808°

Table 6: Side A Accuracy Check Results

Averaged LAT:	41° 13' 57.2628" N
Averaged LON:	076° 25' 24.258" W
Distance from Monument:	0.3846 m (1.26181 ft)
Bearing from Monument:	270.5646°

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	1	4	8	11	12	14	18	22	25	31	32	
Integrity Monitor A	1	4	8	12	14	18	22	25	31	32		
Reference Station B	1	4	8	12	14	18	22	25	31	32		
Integrity Monitor B	1	4	8	12	14	18	22	25	31	32		
NGS Monument Location, Side A	1	4	12	14	18	22	25	31	32			
NGS Monument Location, Side B	1	4	12	14	18	22	25	31	32			

Table 8: GPS Satellite Comparison

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