



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Hackleburg DGPS Site (825)
Inspector(s): ENS Scott McIntire, CWO4 William Iozzino
Date: 03 JUN 14

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 Hackleburg 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

HACKLEBURG DGPS SITE PARAMETERS:

Frequency	307 KHz
Forward Output Power	700 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 200 km

RESULTS:

Signal Strength:

A verification of the Hackleburg DGPS coverage area was conducted from Millers Ferry, AL, to Carlisle, AR. The advertised signal strength range is 200 km. Figure 1 below displays inadequate signal strength, throughout the advertised and 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 taken at points on the western and southern advertised range ring (Table 1 and Table 2) did not meet the required 37.5 dB μ V/m signal strength on both side A and B.

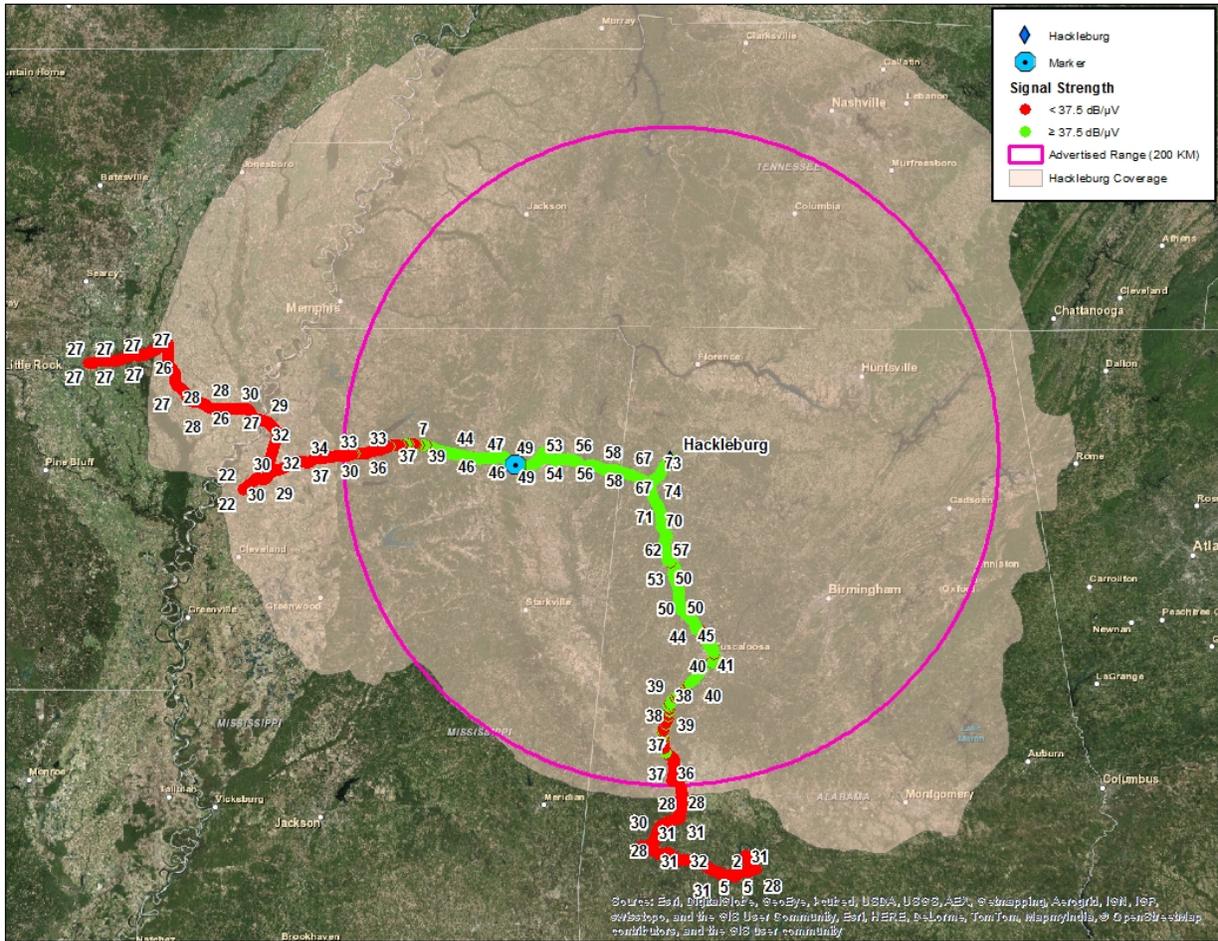


Figure 1: DNAV Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	33 dBµ V/m	04 dBµ V/m	32° 29.051098' N, 087° 48.065579' W
B	32 dBµ V/m	04 dBµ V/m	

Table 1: South Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	28 dBµ V/m	03 dBµ V/m	34° 17.749182' N, 090° 01.873416' W
B	36 dBµ V/m	03 dBµ V/m	

Table 2: West 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 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 Side B Integrity Monitor. 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 15 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 6 and 7). Side A was 0.5703 meters, bearing 230.4°, away from the monument while Side B was 0.4762 meters, bearing 243.2°, 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 Hackleburg DGPS site and at the NGS monument location was conducted (Table 8) 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.

A two dimension radial review of the same time period was completed for the integrity monitors. Side A’s average deviation was 0.06196 meters; Side B’s average deviation was 0.05890 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

NGS Monument ID:	BBBW05
Monument LAT:	34° 15.288271' N
Monument LON:	-088° 53.325333' W
Distance from DGPS Site	94.90 km

Table 5: Monument ID

Averaged LAT:	34° 15.288075'
Averaged LON:	-088° 53.325620'
Antenna Distance from Monument:	0.5703 meters (1.8710 feet)
Antenna Bearing from Monument:	230.4°

Table 6: Side A Accuracy Check Results

Averaged LAT:	34° 15.288156'
Averaged LON:	-088° 53.325611'
Distance from Monument:	0.4762 meters (1.5623 feet)
Bearing from Monument:	243.2°

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	1	3	7	8	11	13	17	19	26	28	30	
Integrity Monitor A	1	3	7	8	11	17	19	26	28	30		
Reference Station B	1	3	7	8	11	13	17	19	26	28	30	
Integrity Monitor B	1	3	7	8	9	11	13	19	23	26	27	
NGS Monument Location, Side A	1	3	7	8	11	17	19	26	28	30		
NGS Monument Location, Side B	1	3	7	8	11	13	17	19	26	28	30	

Table 8: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Hackleburg DGPS site revealed that **the provided coverage does not meet the predicted or the advertised range**. Both northern and southern Far-Field signal strength readings taken were lower than requirements set forth in reference (3). 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). Finally, accuracy measurements and analysis proved that at a distance of approximately 94.9 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).