



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Medora DGPS Site (851)
Inspector(s): CWO2 Marin Kaczmar, ETC Jeremiah Brown
Date: 23 OCT 2014

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 Medora 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

MEDORA DGPS SITE PARAMETERS:

Frequency	325 KHz
Forward Output Power	600 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 325 km

SUMMARY:

The Operational Assessment of the Medora DGPS site has revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. The eastern far-field (FF) signal strength readings were well within the required signal strength beyond the predicted coverage area. 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 306 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).

RESULTS:

Signal Strength:

A verification of the Medora DGPS coverage area was conducted along I-94 to Dickinson ND, and south to Rapid City SD on Hwy 85. Figure 1 below displays adequate signal strength throughout the predicted coverage, and exceeds 325 km to the east of the site. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points. Signal strength readings were taken 306 km east of the site (Table 1). Eastern signal strength readings were well above the required 37.5 dB μ V/m signal strength on side B. Side A data was unobtainable due to a temporary site casualty.

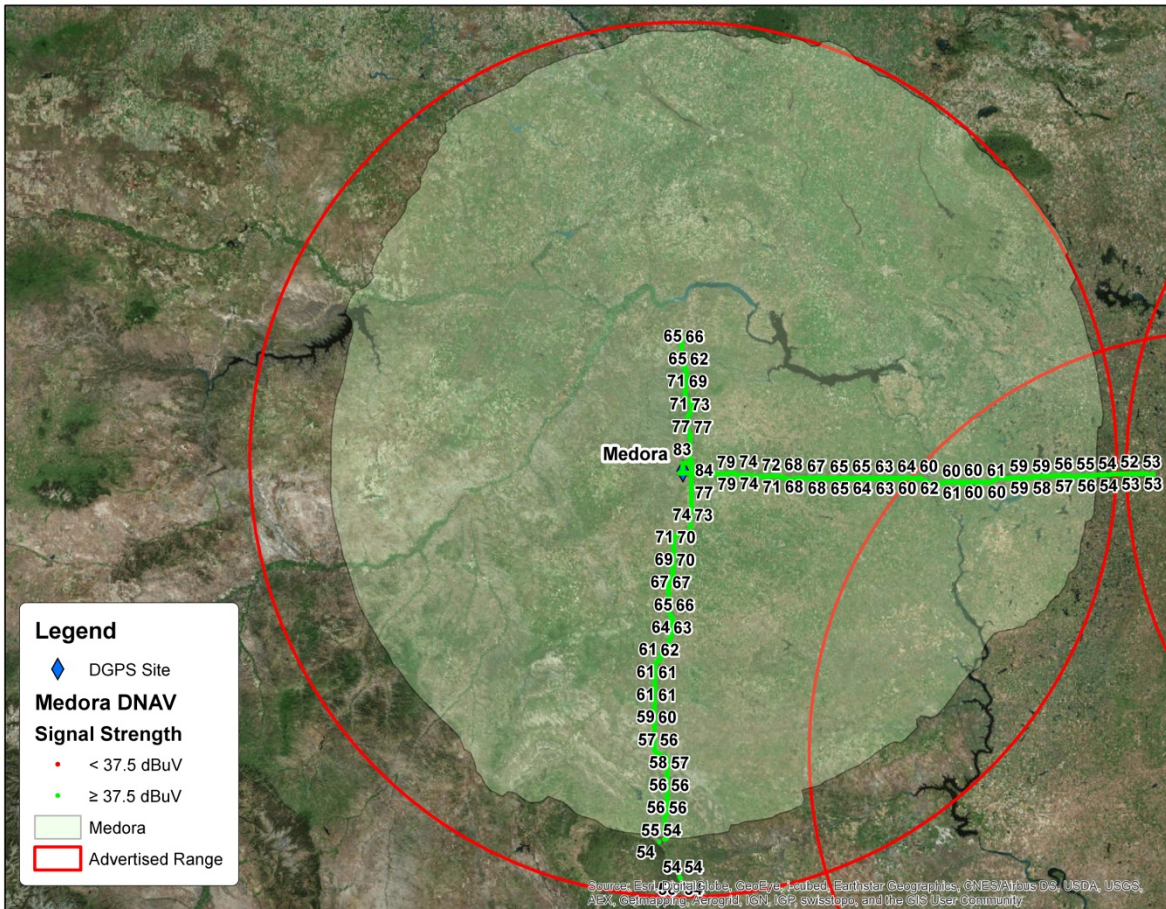


Figure 1: DNAV Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
B	53 dB μ V/m	34 dB μ V/m	46° 53' 00.609612 N, 99° 14' 42.466812 W

Table 1: East FF 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 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
Type 3	Y	Y	Y
Type 5 (ensure message is not being transmitted)	N	N	N/A
Type 7	Y	Y	Y
Type 9	Y	Y	Y
Type 16	Y	Y	Y

Table 3: Side A RTCM Message Validation

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

Table 4: Side B RTCM Message Validation

Accuracy Validation:

Positional data was collected for 10 minutes on side B only, 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). Side B was 0.8108 meters from the monument bearing 67.5694°. The respective distance was well within advertised accuracy requirements as per Reference (1) and (2). A comparison between the GPS satellites in view at the Medora 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 0.48809 meters; Side B's average deviation was 0.48437 meters. Both findings were consistent with the findings observed in the field and are well within the system parameters.

NGS Monument ID:	RR0664
Monument LAT:	46° 49' 21.48628" N
Monument LON:	100° 32' 28.54554" W
Distance from DGPS Site	208.1 km

Table 5 Monument ID

Averaged LAT:	46° 49' 21.496296" N
Averaged LON:	100° 32' 28.510080" W
Antenna Distance from Monument:	0.8108 m (2.660100ft)
Antenna Bearing from Monument:	67.5694°

Table 6: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A											
Integrity Monitor A											
Reference Station B	3	6	7	10	13	16	20	23	30	31	32
Integrity Monitor B	5	6	9	15	16	18	21	22	26	29	
NGS Monument Location, Side A											
NGS Monument Location, Side B	3	5	7	8	11	13	16	19	23	27	28

Table 8: GPS Satellite Comparison