



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Fort Stevens DGPS Site (886)
Inspector(s): CWO3 William Iozzino
Date: 24 SEP 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 Robinson Pt 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

ROBINSON PT DGPS SITE PARAMETERS:

Frequency	287 KHz
Forward Output Power	500 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 333 km

RESULTS:

Signal Strength:

A verification of the Fort Stevens DGPS coverage area was conducted from east range ring to Neah Bay then south along the coast to the southern range ring. The advertised service range is 333 km. Figure 1 below displays field strength readings to be consistent with the predicted coverage area. Green points represent areas of satisfactory signal strength. Red dots represent areas of unsatisfactory signal strength. Far-Field signal strength readings were taken at the east, north and south range rings (Table 1, 2 and 3). Of the three measurements taken only the southernmost point met the required 75 μ V/m signal strength.

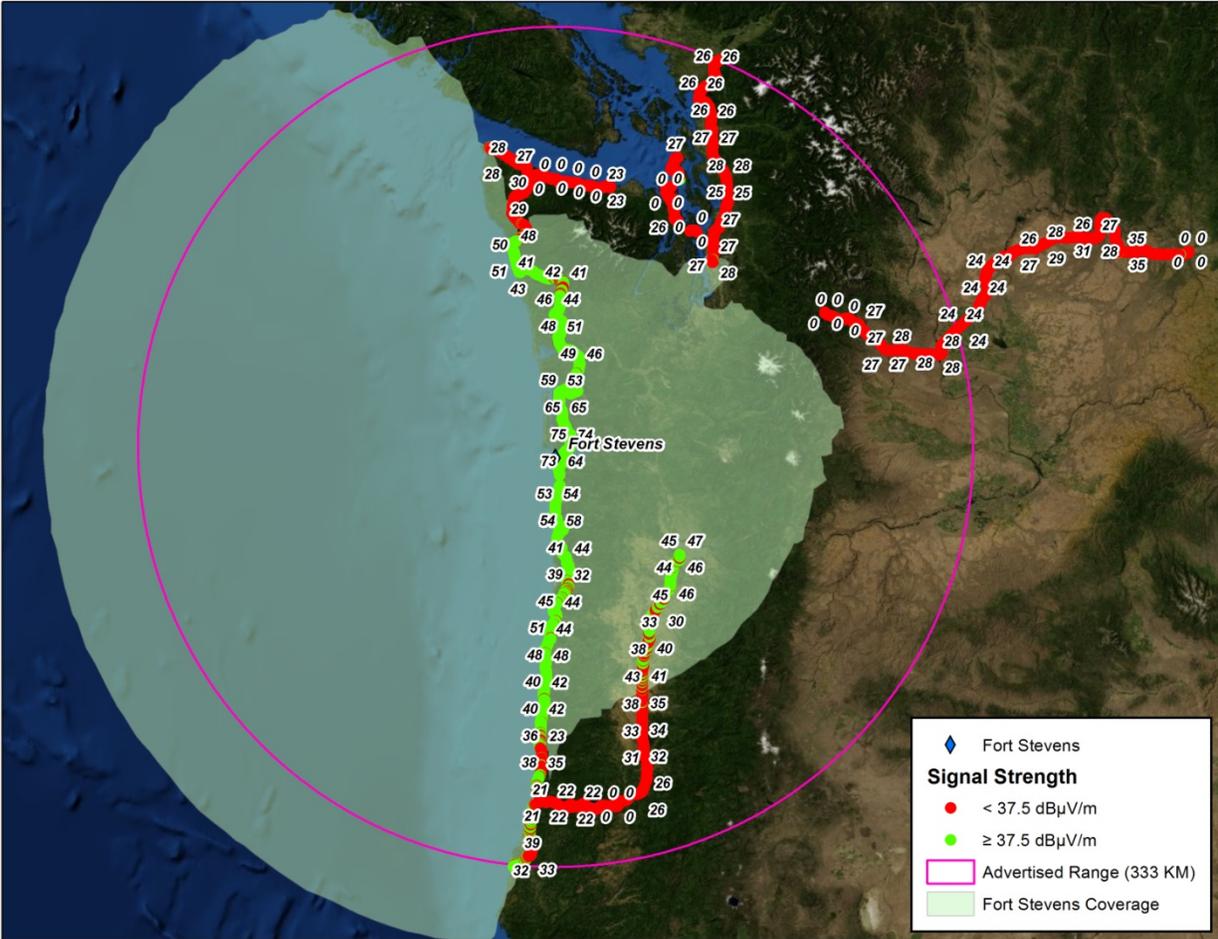


Figure 1: DNAV Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	27 dBµV/m	3 dBµV/m	47° 07.121969', -119° 48.38400'
B	26 dBµV/m	2 dBµV/m	

Table 1: East Far Field Signal Strength Readings measured w/ a Trimble SPS461)

Side	Signal Strength	Signal to Noise ratio	Position
A	26 dBµV/m	11 dBµV/m	48° 58.481626', -122° 16.299557'
B	26 dBµV/m	11 dBµV/m	

Table 2: North Far Field Signal Strength Readings measured w/ a Trimble SPS461)

Side	Signal Strength	Signal to Noise ratio	Position
A	42 dBµV/m	18 dBµV/m	43° 13.826438', -124° 22.850411'
B	42 dBµV/m	18 dBµV/m	

Table 3: South Far Field Signal Strength Readings measured w/ a Trimble SPS461)

RTCM Message Verification:

RTCM message scheduling, receipt and content were checked during the assessment (Table 4 and 5). RTCM message scheduling on both Side A and Side B was validated with the DGPS watch and is in accordance with 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 using the Side B Integrity Monitor. All message content was certified and is in accordance with reference (4) with the exception of the Appleton site location in the Type 7 message. **The position provided is .64 km to the south, which is .34 km greater than allowed.**

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

Table 4: 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	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 5: 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 6 and 7). Side A was 1.6870 m bearing 351.0° from the monument while Side B was 0.5425 m bearing 310.5°. As per reference (1) and (2), both distances are well within system accuracy requirements. A comparison between the GPS satellites in view at the Robinson Pt DGPS site and the NGS monument location was conducted (Table 8) to identify any differences in the GPS satellite geometry used at the two locations, any differences in the GPS satellite geometry could lead to accuracy discrepancies. In this case satellites being tracked by the RS and IM GPS receivers at the site were almost identical to those tracked at the NGS monument. A two dimensional radial review of the same time period was completed for the integrity monitors. Side A's average deviation was 0.10018 meters; Side B's average deviation was 0.08375 meters. Both findings are consistent with findings observed in the field and well with system parameters.

NGS Monument ID:	BBBG10
Monument LAT:	48° 1.361922'
Monument LON:	-122° 43.757946'
Distance from DGPS Site:	222.4 km

Averaged LAT:	48° 01.362821
Averaged LON:	-122° 43.758159
Antenna Distance from Monument:	1.687 m
Antenna Bearing from Monument:	351.0 °

Table 6: Side A Accuracy Check Results

Averaged LAT:	48° 1.362112
Averaged LON:	-122° 43.758279
Distance from Monument:	0.5425 m
Bearing from Monument:	310.5 °

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	1	4	8	9	12	15	17	24	26	28		
Integrity Monitor A	1	4	8	9	12	15	17	24	26	28		
Reference Station B	1	4	8	9	11	15	17	24	26	28		
Integrity Monitor B	3	7	8	9	11	13	17	19	26	28		
NGS Monument Location, Side A	1	4	8	9	15	17	24	26	28			
NGS Monument Location, Side B	1	4	8	9	15	17	24	26	28			

Table 8: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Fort Stevens DGPS site revealed that the provided coverage is consistent with the predicted cover plot but not the advertised range. The loss of coverage is believed to be caused by the surrounding mountain range. Far-Field signal strength readings taken from inland locations did not meet system requirements, while readings taken on the coast south of the site were satisfactory. Additionally, a review of the output and reflected power and the 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), with the exception of the Type 7 message as noted above. Finally the accuracy measurements and analysis proved that at a distance of 222.4 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by reference (1) and (2).