



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: English Turn DGPS Site (814)
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Date: 12FEB2013

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 English Turn 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
Potomac Instruments 4100 Field Intensity Meter (FIM)

ENGLISH TURN DGPS SITE PARAMETERS:

Frequency	293 kHz
Forward Output Power	700 W
Transmission Rate	200 baud
Field Strength/Range	100 μ V/m (40 dB μ V/m) at 315 km

RESULTS:

Signal Strength:

A verification of the English Turn DGPS site coverage area was conducted from 20 km east of Port Arthur, TX, along Interstate 10 and Highway 98, along the Gulf Coast to approximately 50 km northwest of Panama City Beach, FL. Additionally, the signal for English Turn was verified along the Mississippi River from Venice, LA to 20 km north of the Port of Baton Rouge. The advertised coverage range is 315 km at 40 dB μ V/m. Figure 1 below displays adequate signal strength throughout the advertised coverage area. Green points represent areas of satisfactory signal strength, while red points represent unsatisfactory signal strength. Far-field (FF) signal readings were taken at western and eastern points along the range ring (see Tables 1 and 2 for more information).

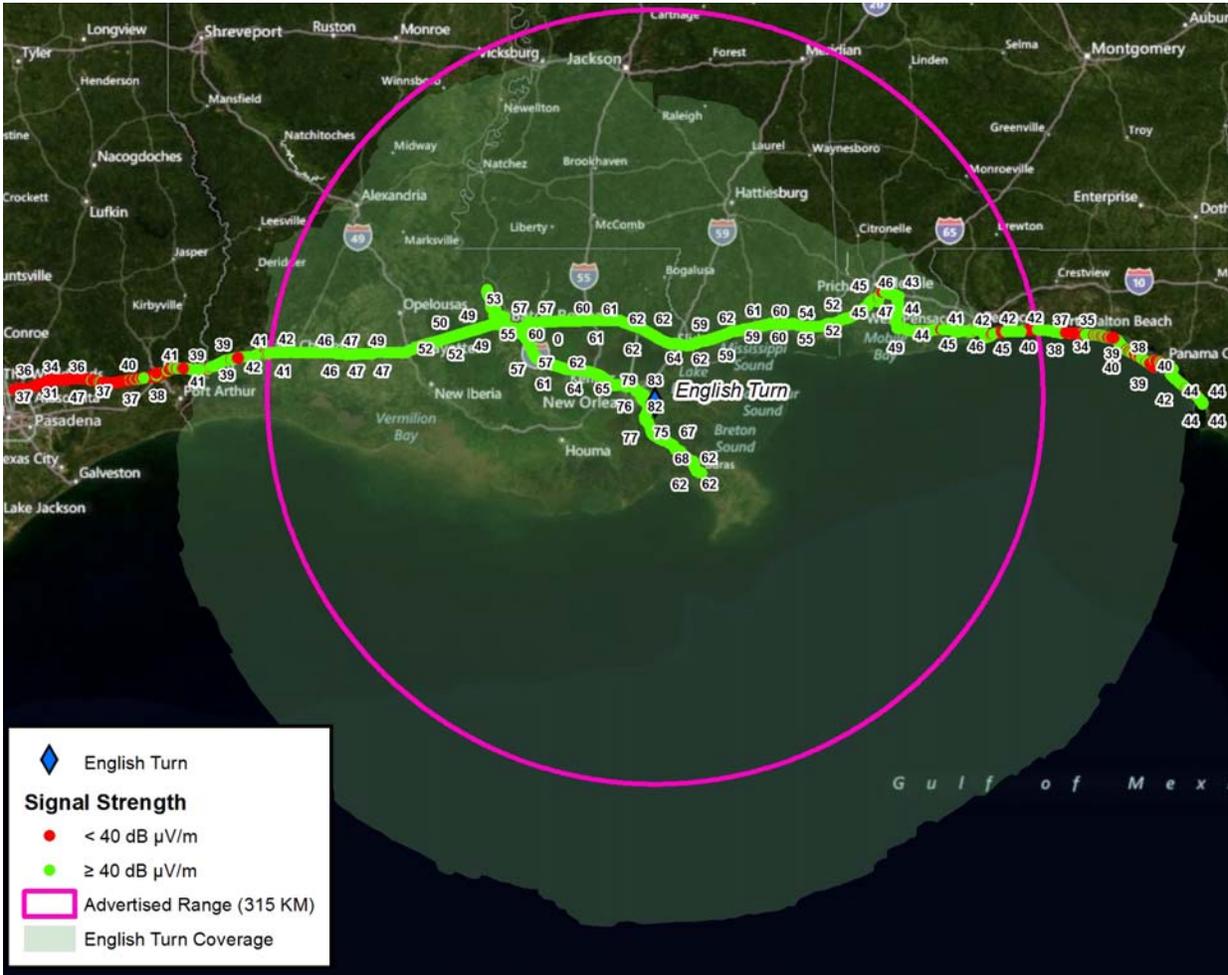


Figure 1: DNAV Signal Strength Results

	POSITION	Trimble SPS461	4100 FIM Meter
Side A SS	30.236104° N 093.189254° W	38 dB μV/m, 18 SNR	39.7 dB μV/m
Side B SS	30.236104° N 093.189254° W	38 dB μV/m, 18 SNR	39.8 dB μV/m

Table 1: West Far-Field Signal Strength Reading

	POSITION	Trimble SPS461	4100 FIM Meter
Side A SS	30.412136° N 086.727716° W	45 dB μV/m, 24 SNR	49.0 dB μV/m
Side B SS	30.412136° N 086.727716° W	45 dB μV/m, 23 SNR	49.3 dB μV/m

Table 2: East Far-Field Signal Strength Reading

RTCM Message Verification:

RTCM message scheduling, receipt, and content were checked on 01FEB2013 (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 A side Integrity Monitor computer. All message content was verified and is in accordance with Reference (4). While all Type 7 messages were scheduled and received on time, the content validation revealed only two sites were declared in the message. DGPS sites Eglin and Angleton are both declared.

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 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 5 and 6). Side A was 0.3541 meters, bearing 100.45°, away from the monument while Side B was 0.3563 meters, bearing 102.3°, 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 English Turn DGPS site and at the NGS monument location was conducted (Table 7) 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.

NGS Monument ID:	BBCD51
Monument LAT:	30° 40' 05.76330" N ±0.013 m
Monument LON:	087° 56' 10.37521" W ±0.002 m

Averaged LAT:	30.6682670° N
Averaged LON:	087.9362117° W
Distance from DGPS Site:	211.4 km
Antenna Distance from Monument:	0.3541 m (1.1617 ft)
Antenna Bearing from Monument:	100.45°

Table 5: Side A Accuracy Check Results

Averaged LAT:	30.6682669° N
Averaged LON:	087.9362117° W
Distance from DGPS Site:	211.4 km
Distance from Monument:	0.3563 m (1.1690 ft)
Bearing from Monument:	102.3°

Table 6: Side B Accuracy Check Results

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

Table 7: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the English Turn DGPS site revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. The eastern Far-Field signal strength readings were well within the required signal strength while the western Far-Field signal strength was slightly less than the requirement of 40 db μ V/m. The western FF measurement was taken on a bridge landing near an urban center; this location may have provided an obstruction to the reception of the DGPS signal. The signal strength numbers immediately rose to 41-42 db μ V/m upon departure of the location. All RTCM messages were verified and evaluated which is consistent with the requirements set forth by reference (2) and (3). Finally, accuracy measurements and analysis proved that at a distance of approximately 211.4 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).