DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Kenai DGPS Site (896)
Inspector(s): LT Michael Brashier, CWO3 Louie Baytan
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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 Kenai DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

EQUIPMENT:

Hemisphere VS330 Receiver
Hemisphere R330 Receiver
Hemisphere R110 Receiver
Hemisphere A43 Antenna
Hemisphere A42 Antenna
MBA-2 Receive Antenna

KENAI DGPS SITE PARAMETERS:

Frequency	310 KHz
Forward Output Power	500 Watts
Transmission Rate	100 baud
Field Strength/Range	75µV/m (37.5 dBµV/m) at 260 km

SUMMARY:

The Operational Assessment of the Kenai DGPS site revealed that the provided coverage is ***not*** consistent with the predicted coverage plot and advertised range. A large portion of coverage areas inland and within Prince William Sound has inadequate signal strength. 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 74 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 Kenai DGPS coverage area was conducted from M/V Kennicott as she transited Prince William Sound and the Gulf of Alaska and via a land route from Homer to

Denali National Park. The advertised signal strength range is 260km. Figure 1 below displays adequate signal strength through large portions of the coverage area however there is significant evidence of terrestrial masking in the western portion of Prince William Sound east of Kenai, north of Talkeetna, and east of Palmer, AK. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points. Far-field (FF) signal strength readings were taken at northern and southern points of the advertised range of the site (Table 1 and Table 2). The northern FF reading was below the required 37.5 dBµV/m signal strength while the southern FF reading was well above the required 37.5 dBµV/m.

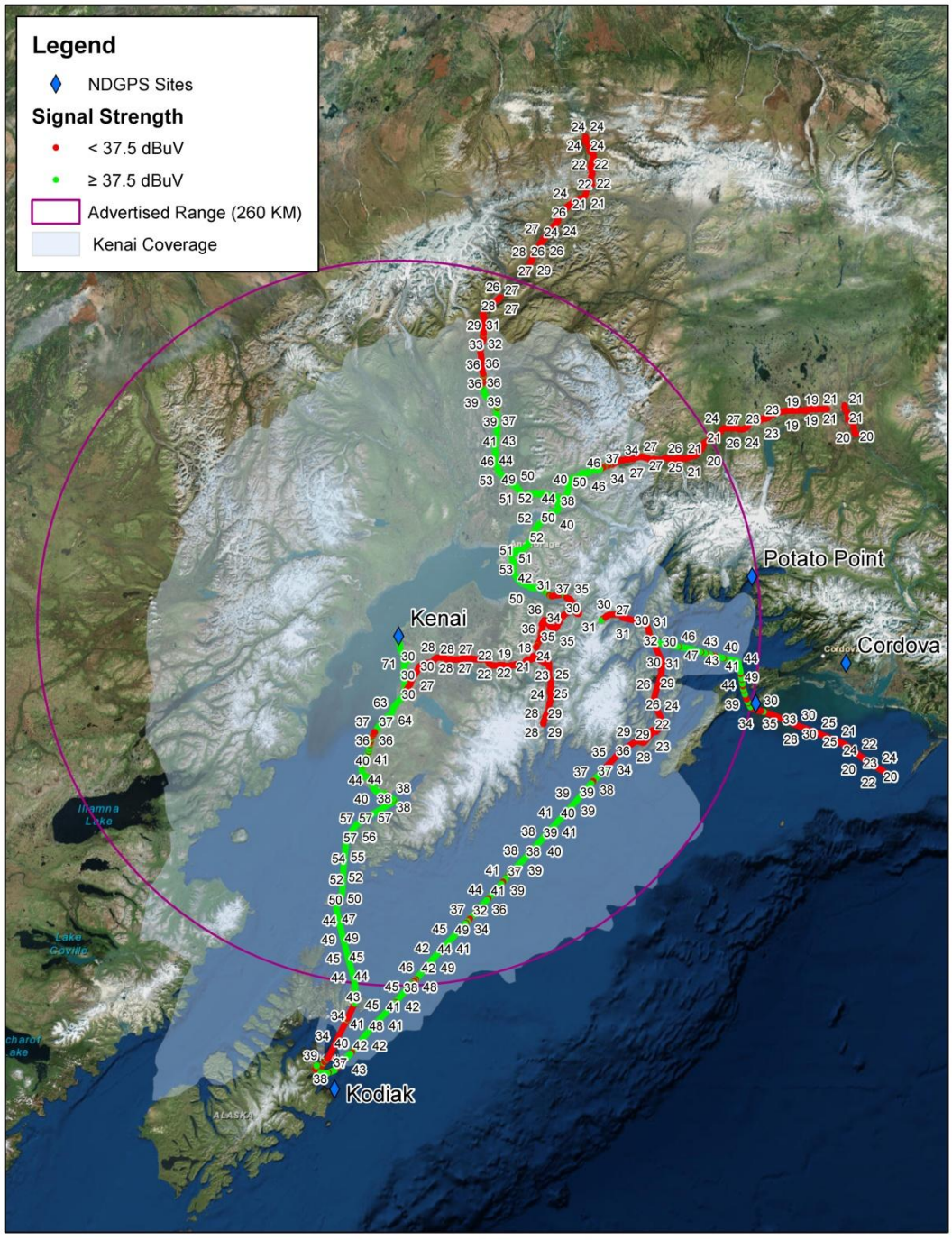

Figure 1: DNAV Signal Strength Results

Signal Strength	Signal to Noise ratio	Position
28 dBµV/m	11 dBµV/m	62° 52' 30.013", -149° 50' 2.405"

Table 1: North Far-Field Signal Strength Reading

Signal Strength	Signal to Noise ratio	Position
42 dBµV/m	11 dBµV/m	58° 21' 5.952", -151° 10' 57.977"

Table 2: South 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 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 per side using the Hemisphere R110. 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 0.279 meters away from the monument bearing 202º while Side B was 1.5689 meters away bearing 187 º. 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 Kenai 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 0.11607meters; Side B's average deviation was 0.2098 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

NGS Monument ID:	**BBCM32**
Monument LAT:	60° 3' 5.24806"
Monument LON:	151° 40' 8.10584"W
Distance from DGPS Site	71.4 km

Table 5: Monument ID

Averaged LAT:	60º 03' 05.239692" N
Averaged LON:	151º 40' 08.11272" W
Antenna Distance from Monument:	0.279 m (0.91667 ft)
Antenna Bearing from Monument:	202.3158º

Table 6: Side A Accuracy Check Results

Averaged LAT:	60º 03' 05.229792" N
Averaged LON:	151º 40' 08.11056" W
Distance from Monument:	0.5689 m (1.8665 ft)
Bearing from Monument:	187.3497º

Table 7: Side B Accuracy Check Results

Antenna Location	***GPS Satellites Tracked (PRN)***											
Reference Station A	2	3	5	6	7	8	10	13	23	28		
Integrity Monitor A	2	4	12	14	17	20	24	25	32			
Reference Station B	2	4	12	14	17	20	24	25	32			
Integrity Monitor B	2	4	12	14	17	20	24	25	32			
NGS Monument Location, Side A	2	4	12	14	17	24	25	32				
NGS Monument Location, Side B	2	4	12	14	17	24	25	32				

Table 8: GPS Satellite Comparison