

**WAAS Technical Report**  
**William J. Hughes Technical Center**  
**Pomona, New Jersey**  
**1/27/09**

*Author(s): Noah Rosen*

***DR#77: CRW Downlink Frequency Spikes Caused Reduced PA Ranging Availability***  
***GPS Week/Day: Week 1503 Day 3, Week 1505 Day 4, Week 1507 Day 2, Week 1508***  
***Day 3, Week 1508 Day 5, Week 1509 Day 0***

**Discussion:**

Sudden changes in the downlink carrier frequency from the CRW geosynchronous satellite have caused reduced PA Ranging Availability on several days from October to December 2008. The downlink spikes have a frequency change of approximately 2-7 Hz over about one second. The frequency changes are only observed on the downlink path. The frequency spikes have been observed at multiple downlink stations.

Table 1 lists the PA Ranging Availability for each day where downlink spikes caused the UDREi to change on the CRW geosynchronous satellite. There were two days where frequency spikes had a small effect on PA ranging availability. On four other days, PA ranging availability was reduced.

**Table 1: CRW PA Ranging Availability**

Date	GPS Week/Day	CRW PA Ranging Availability(% of day)
10/29/08	Week 1503 Day 3	99
11/13/08	Week 1505 Day 4	84
11/25/08	Week 1507 Day 2	99
12/03/08	Week 1508 Day 3	90
12/05/08	Week 1508 Day 5	75
12/07/08	Week 1509 Day 0	71

Table 2 shows how downlink frequency spikes affected the CRW ranging mode. On two occasions, CRW went from PA quality ranging to “Not Monitored.” CRW changed from PA quality ranging to NPA quality ranging five times.

**Table 2: CRW UDREi**

Date	Message Type	Previous UDREi	Current UDREi	Previous Time (UTC)	Current Time (UTC)	Duration	Trigger
10/29/08	4	10	14	10:03:38	10:03:44	6	PA → NM
11/13/08	4	11	12	15:04:18	15:04:24	6	PA → NPA
11/13/08	4	11	12	20:13:00	20:13:06	6	PA → NPA
11/25/08	4	10	12	18:45:36	18:45:42	6	PA → NPA
11/25/08	4	10	14	21:38:51	21:38:57	6	PA → NM
12/05/08	4	10	12	10:21:18	10:21:23	5	PA → NPA
12/07/08	4	10	14	00:45:40	00:45:46	6	PA → NM

Following the UDREi changes on CRW, the amount of time before PA quality ranging was restored to the geosynchronous satellite varied significantly. Table 3 shows the amount of time it took for PA Ranging Availability to be restored following a downlink frequency spike.

**Table 3: Time to Restore PA Ranging Availability on CRW**

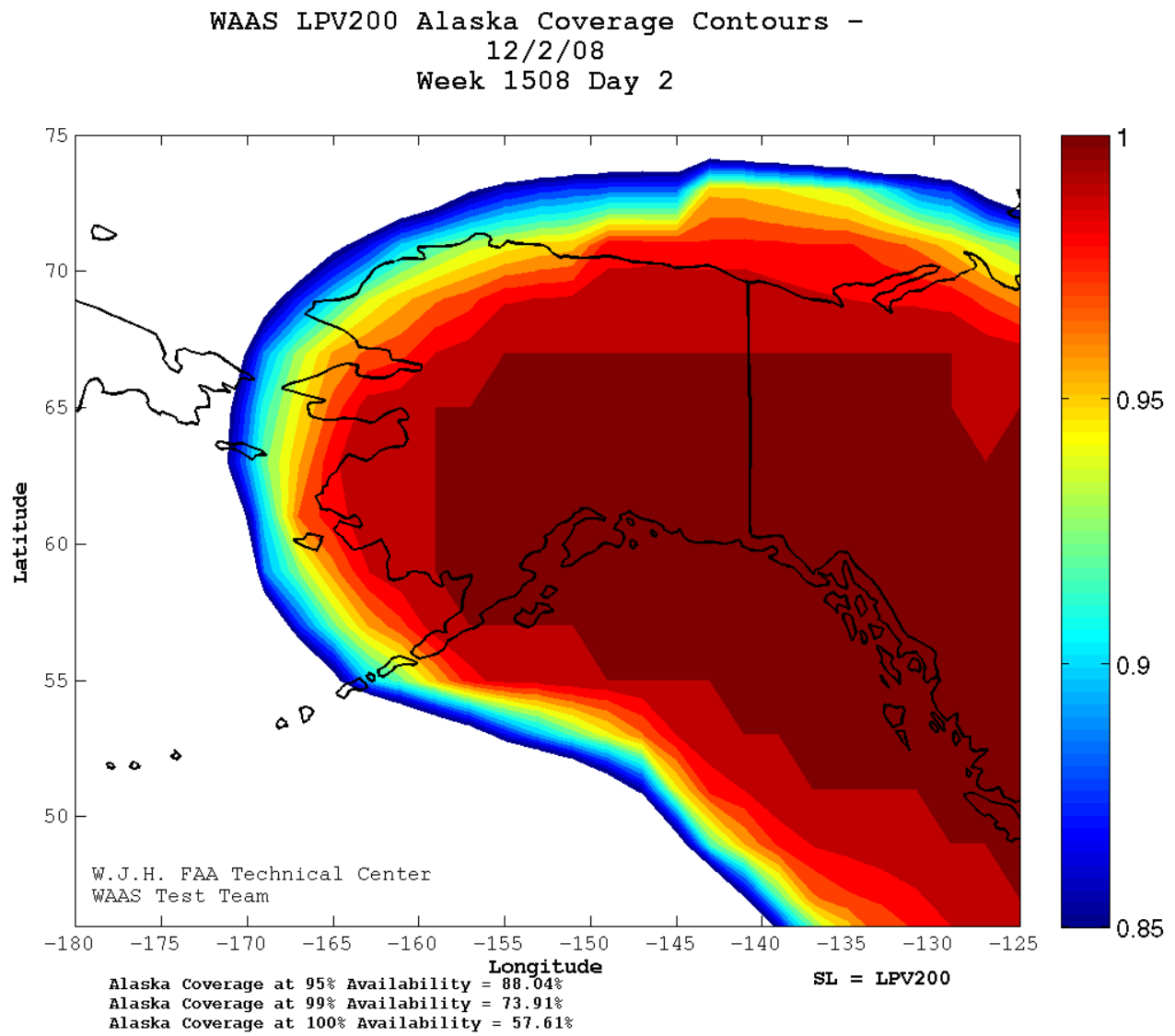
Date	PA Ranging Outage Start Time	PA Ranging Outage Stop Time	Time to Restore PA Ranging Availability
10/29/08	10:03:44	10:12:38	00:08:54
11/13/08	15:04:24	15:04:30	00:00:06
11/13/08	20:13:06	01:00:04	04:46:57
11/25/08	18:45:42	18:45:48	00:00:06
11/25/08	21:38:51	04:19:30	06:40:38
12/05/08	10:21:23	16:08:58	05:47:40
12/07/09	00:45:46	07:35:16	06:49:30

Because CRW was unavailable as a PA ranging source, the WAAS satellite constellation was weakened. On 12/7/08, the day when CRW had the lowest PA ranging availability between October and December, 2008, CONUS LPV200 coverage at 100% availability was five percent below optimal availability.

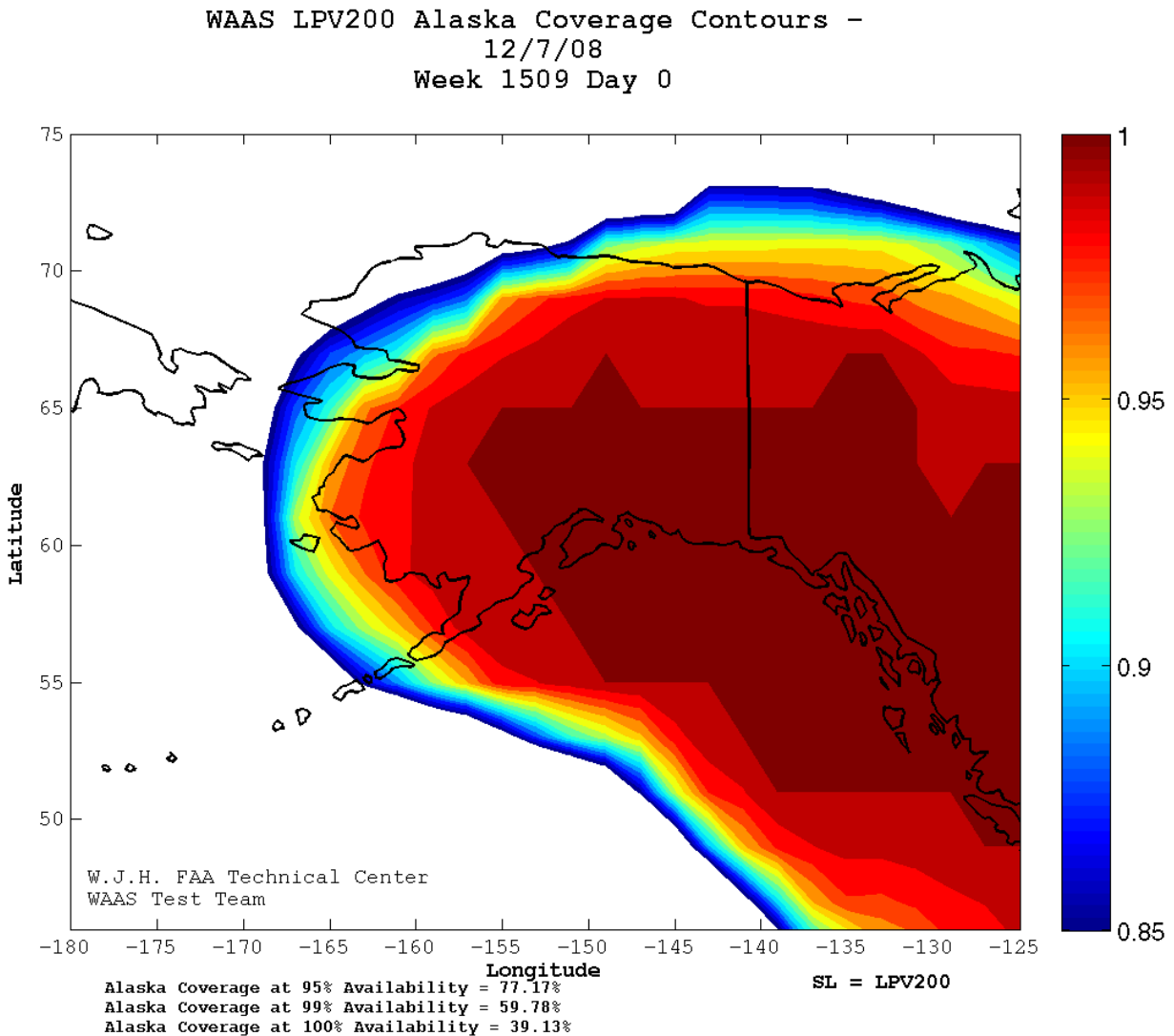
There was a more significant impact to LPV200 service in the Alaska region on 12/7/08. LPV200 coverage was reduced by approximately 14% at the 99% availability contour and approximately 19% at the 100% availability contour. LPV service in both the CONUS and Alaska region was unaffected by the loss of CRW as a ranging source.

Figure 1 shows LPV200 availability in the Alaska region on 12/2/2008, when no satellite maintenance was performed and CRW was available the entire day for PA quality ranging. Figure 2 shows LPV200 availability in the Alaska region on 12/7/08, when CRW was unavailable as a PA ranging source for nearly seven hours.

**Figure 1: WAAS Alaska LPV200 Coverage on 12/2/08**



**Figure 2: WAAS Alaska LPV200 Coverage on 12/7/08**



**Conclusion:**

Between October and December 2008, sudden changes in the downlink carrier frequency from the CRW geosynchronous satellite caused the UDREi to change. The ranging quality on CRW changed from Precision Approach to Non-Precision Approach or Not Monitored states. This caused the loss of CRW as a PA quality ranging source. Alaska LPV200 coverage was most affected by the change in satellite constellation.