WAAS Technical Report
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DR# 99: WAAS LPV Service Outage at Boston WRE caused by L1 Radio Frequency Interference (RFI)
GPS Week/Day: Week 1606 Day 0 (10/17/2010)

Discussion:

On GPS Week 1606 Day 0, an unexpected WAAS LPV service outage at Boston WRE-A occurred for approximately 90 seconds. The number of satellites tracked by WAAS reference receiver WRE-A dropped suddenly and the vertical protection level (VPL) jumped in response from 16.5m to 114.2m at 56473 GPS time of week (15:41 GMT) as shown in figure 1. There were no GPS satellite or WAAS GEO satellite navigation signal problems that would affect the LPV service at this time. The receiver L1 frequency signal to noise ratios (C/No) for WAAS GEO satellites PRN135 and PRN138 were analyzed and the drop in the received signal levels were observed (see figure 2) to correlate with loss of receiver satellite tracking at 56471 GPS time of week.

Figure 1 WAAS WRE-A VPL and Satellites Tracked Wide View

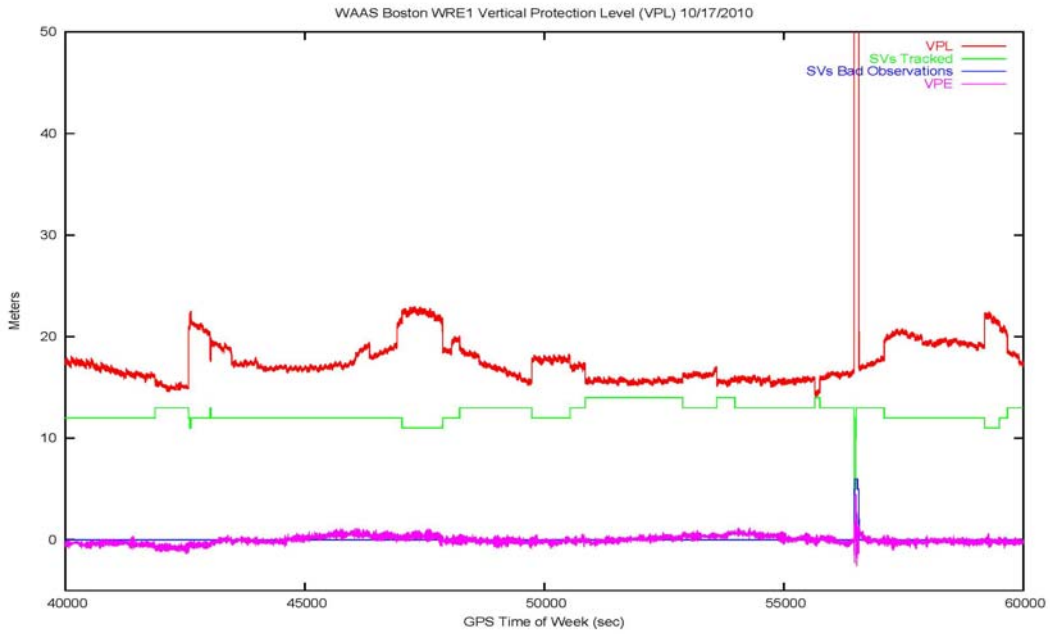
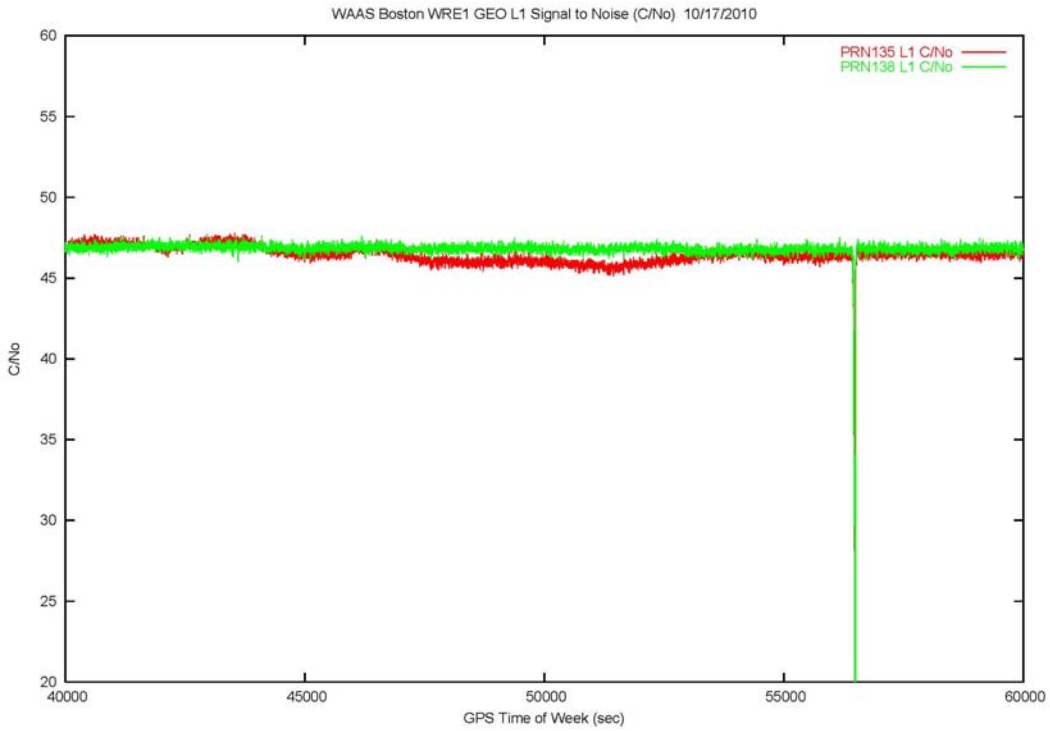


Figure 2 WAAS WRE-A GEO Satellites Signal to Noise Wide View



The WAAS reference site (WRS) has two additional receivers and the satellites tracked were also affected, with receiver 1 (WRE-A) dropping 8 satellites above 5 degrees from the track list shown in figure 3 and receivers 2 & 3 (WRE-B & WRE-C) also dropped 8 satellites above 5 degrees from the track list as shown in figure 4. Although the VPL increased after the loss of satellite tracking the vertical position error (magenta trace figure 3) remained less than 5 meters during the event.

Figure 3 WAAS WRE-A VPL and Satellites Tracked Zoom View

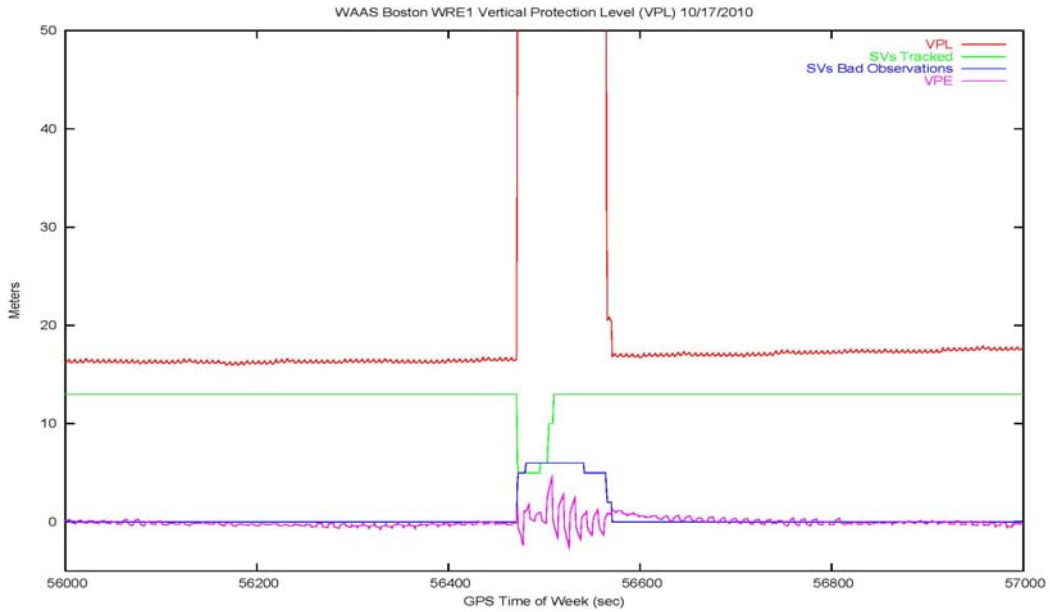
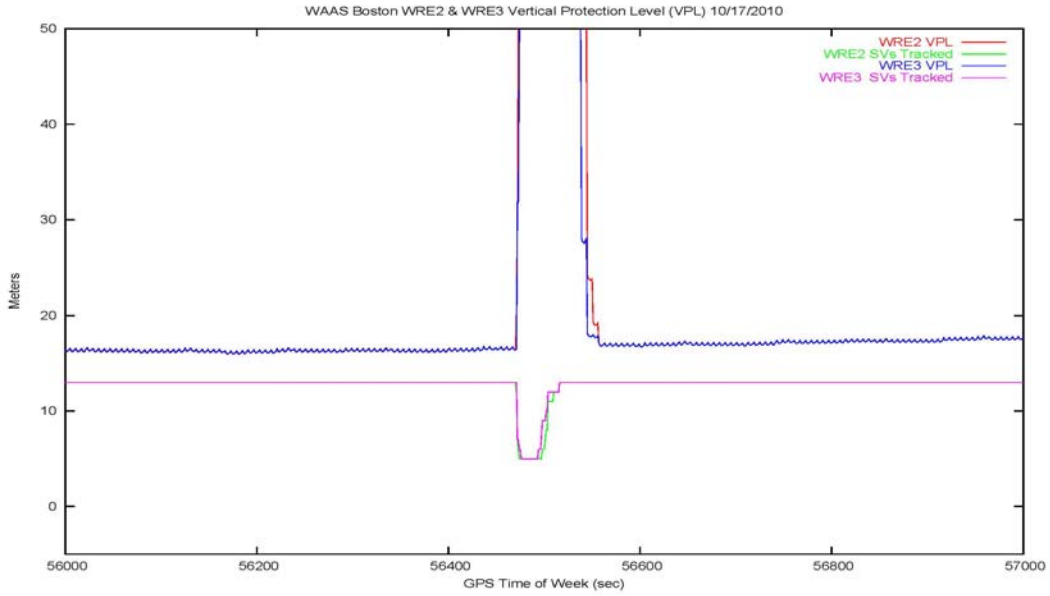


Figure 4 WAAS WRE-B & WRE-C VPL and Satellites Tracked Zoom View



The C/No for GEO's PRN135 & PRN138, during the time of the LPV outage for receiver 1 (WRE-A), in figure 5 shows a decreasing signal to noise from 47 db Hz until the receiver lost track over a period of 38 seconds as L1 radio frequency interference (RFI) increased in the local environment. Receiver WRE-A loss track GEO PRN 135 and 138 for 34 seconds during the peak time of RFI. The RFI reduced the L1 signal by 24 db Hz and appears to centered at the L1 frequency since GPS satellite signal level at L2 frequency remained at 45 db Hz during the RFI event (PRN8 green & PRN11 magenta trace figure 6) on two GPS satellites that the receiver 1 (WRE-A) was able to continue tracking.

Figure 5 WAAS WRE-A GEO Satellites Signal to Noise Zoom View

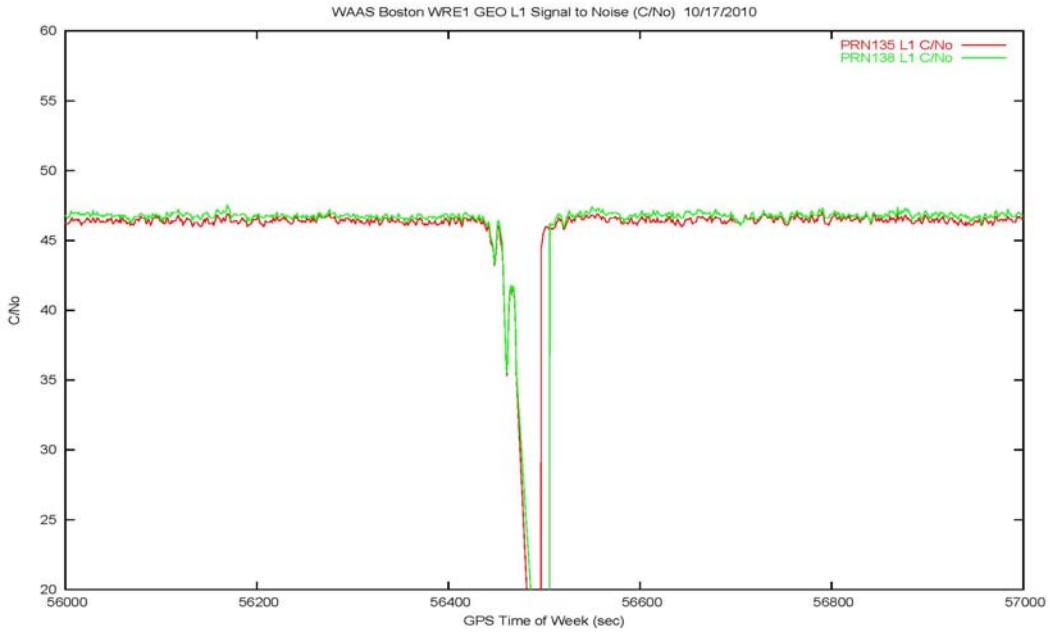
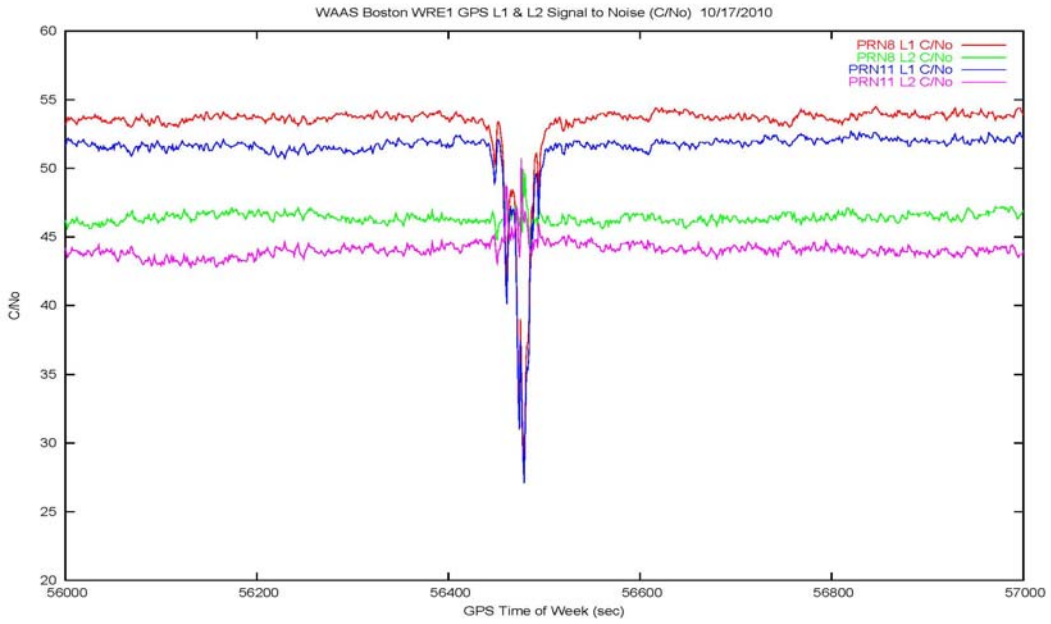
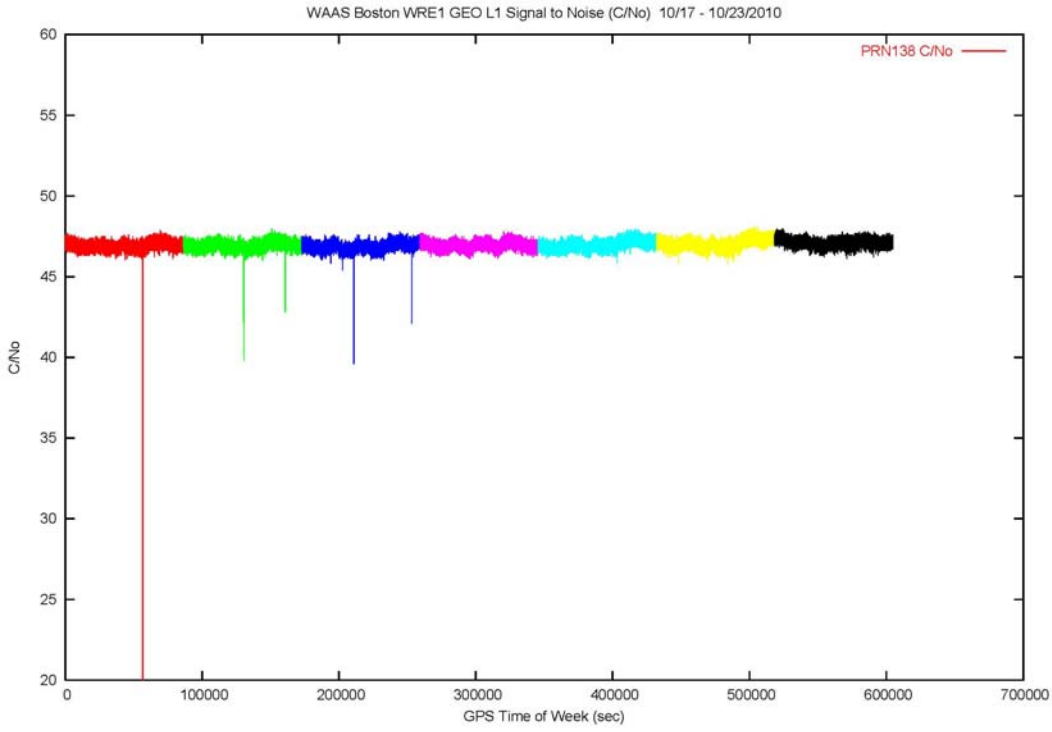


Figure 6 WAAS WRE-A GPS Satellites PRN8 & PRN11 Signal to Noise Zoom



The GEO signal level on receiver 1 (WRE-A) was analyzed for similarities during the week (10/17/2010 – 10/24/2010) and four other weaker RFI events were detected as shown in figure 7. There were no LPV service outages caused by these other events which degraded the L1 signal by 5 – 10 db Hz for duration of less than 30 seconds.

Figure 7 WAAS WRE-A GEO PRN138 Satellite Signal to Noise Week View



Conclusion:

The local L1 RFI in the vicinity of WAAS Boston WRS affected the receiver ability to maintain track of GEO and GPS satellites for 40 seconds causing the calculated VPL at receiver 1 (WRE-A) to exceed the LPV threshold of 50 meters. The amplitude of the L1 RFI changes over time and occurs for short periods reducing L1 C/No on tracked satellites by 10 – 24 db Hz .