WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #10

Reporting Period: July 1 to September 30, 2004

November 2004

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NSTB/WAAS T&E Team
Atlantic City International Airport, NJ 08405

Executive Summary

Since 1999 the WAAS Group at the William J. Hughes Technical Center has reported GPS performance as measured against the GPS Standard Positioning Service (SPS) Signal Specification. These quarterly reports are known as the PAN (Performance Analysis Network) Report. In addition to that report, the WAAS/NSTB Team reports on the performance of the Wide-Area Augmentation System (WAAS). This report is the tenth such WAAS quarterly report. This report covers WAAS performance during the period from July 1, 2004 to September 30, 2004. During this quarter the WAAS marked the first anniversary of system commissioning.

The following table shows observations for accuracy and availability made during the reporting period. See the body of the report for additional results in accuracy, availability, continuity, safety index, range accuracy, WAAS broadcast message rates and GEO ranging availability. Please note that the results in the below table are valid when the Localizer Approach with Vertical Guidance (LPV) service is available. LPV service is available when the calculated Horizontal Protection Level (HPL) is less than 40 meters and the Vertical Protection Level (VPL) is less than 50 meters.

Parameter	Site/Maximum	Site/Minimum
95% Horizontal Accuracy	Minneapolis 1.062 meters	Atlanta 0.610 meters
95% Vertical Accuracy	Minneapolis 1.790 meters	Oklahoma City 1.026 meters
LPV Instantaneous Availability (HPL < 40 meters & VPL < 50 meters)	Elko 99.97%	Boston 97.32%
95% HPL	Oakland 27.972 meters	Kansas City 15.639 meters
95% VPL	Boston 43.390 meters	Kansas City 25.445 meters

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1.0 INTRODUCTION

The FAA began monitoring GPS SPS performance in order to ensure the safe and effective use of the satellite navigation system in the National Airspace System (NAS). The Wide Area Augmentation System (WAAS) adds more timely integrity monitoring of GPS and improves position accuracy and availability of GPS within the WAAS coverage area.

Objectives of this report are:

a. To evaluate and monitor the ability of WAAS to augment GPS by characterizing important performance parameters.
b. To analyze the effects of GPS satellite operation and maintenance, and ionospheric activity on the WAAS performance.
c. To investigate any GPS and WAAS anomalies and determine their impact on potential users.
d. To archive performance of GPS and WAAS for future evaluations.

The WAAS data transmitted from GEO satellite PRN#122 (AORW) and PRN#134 (POR) were used in the evaluation. Table 1.1 and Table 1.2 list NSTB and WAAS reference station receivers used in Precision Approach (PA) and Non-Precision Approach (NPA) evaluation process, respectively. This report presents results from three months of data, collected from July 1, 2004 to September 30, 2004.

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Anderson	92	7923451
Atlantic City	89	7687028
Elko	27	2299412
Grand Forks	87	7510331
Great Falls	91	7874147
Greenwood	91	7850976
Oklahoma City	91	7858756
San Angelo	89	7690642
WAAS:		
Billings	92	7941810
Albuquerque	92	7943521
Chicago	92	7943487
Boston	92	7941668
Washington DC	92	7943907
Denver	92	7944088
Dallas	92	7934451
Houston	92	7940422
Jacksonville	92	7945678
Kansas City	92	7944273
Los Angeles	92	7944121
Salt Lake City	92	7938686
Miami	92	7942534
Memphis	92	7940487
Minneapolis	92	7940648
New York	92	7942238
Oakland	92	7939706
Cleveland	92	7941751
Seattle	92	7944312
Atlanta	92	7937113

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Bangor	92	7946870
Albuquerque	92	7944657
Anchorage	92	7944554
Atlanta	92	7938239
Bethel	82	7105792
Billings	92	7942640
Boston	92	7943632
Cleveland	92	7944669
Cold Bay	92	7911840
Fairbanks	86	7400035
Honolulu	92	7943590
Houston	92	7944523
Juneau	92	7932021
Kansas City	92	7944913
Kotzebue	92	7941230
Los Angeles	92	7945098
Mauna Loa	91	7860681
Miami	92	7944742
Minneapolis	92	7944438
Oakland	92	7942118
Puerto Rico	92	7939284
Salt Lake City	92	7942697
Seattle	92	7944822
Washington DC	92	7944034

The report is divided to seven performance categories listed below. This report also includes WAAS LPV Service Availability at Selected Airports, WAAS Deterministic Code Noise and Multipath (CNMP) Bounding Analysis, and WAAS Equipment Outage Report.

1. WAAS Position Accuracy
2. WAAS Operational Service Availability
3. Coverage
4. Continuity
5. Integrity
6. WAAS Range Domain Accuracy
7. GEO Ranging Performance

Table 1.3 lists the performance parameters evaluated for the WAAS in this report. Please note that these are the performance parameters associated with the WAAS IOC system. These requirements are extracted from the FAA Specification FAA-E-2892B Change 1. In future reports the performance parameters will be derived from FAA Specification FAA-E-2976, as applicable.

Table 1-3 WAAS Performance Parameters

Performance Parameter	Expected WAAS Performance
PA Accuracy Horizontal	≤ 7.6m error 95% of the time
PA Accuracy Vertical	≤ 7.6m error 95% of the time
NPA Accuracy Horizontal	≤ 100m error 95% of the time ≤ 556m error 99.999% of the time
Availability LPV*	Not Defined for Current WAAS phase
Availability LNAV/VNAV*	Not Defined for Current WAAS phase
Coverage LPV	Not Defined for Current WAAS phase For this report - 95% availability of 75% of CONUS
Coverage LNAV/VNAV	95% availability of 75% of CONUS
Coverage NPA	99.9% availability of 75% of service volume
NPA Continuity of Navigation	≥ 99.999% of the time
NPA Continuity of Fault Detection	≥ 99.999% of the time
PA Continuity of Function (LNAV/VNAV and LPV)	1-5.5 x 10^{-5} per approach
LPV Availability	≥ 95% of the time within the service volume
LNAV/VNAV Availability	≥ 95% of the time within the service volume
Integrity	≤ 4 X 10e-8 HMI's per approach

* Instantaneous availability (i.e. Availability is calculated every second.)

1.1 Event Summary

Table 1.4 lists test events that occurred during the reporting period that affected WAAS performance or the ability to determine the WAAS performance. These events include GPS or WAAS anomalies, relevant receiver malfunctions, and receiver maintenance conducted.

Table 1-4 Test Events

GPS Week	Date	Sites	Events
1278 day 1 to 1278 day 3	7/5/04 to 7/7/04	Grand Forks	Grand Forks outage.
1279 day 3	7/14/04	All	Abnormal AORW Switchover. 18 sec gap followed by 15 T0 msgs.
1280 day 3 to 1281 day 2	7/21/04 to 7/27/04	Atlantic City	Atlantic City SQM Receiver outage.
1280 day 3 to 1281 day 1	7/21/04 to 7/26/04	Elko	Elko outage.
1281 day 4	7/29/04	All AOR Non-Dual sites	23323 sec SIS outage on the AOR-W GEO. This was due to an inadvertent test signal transmitted by INMARSAT.
1281 day 6 to 1282 day 5	7/31/04 to 8/6/04	Dayton	Dayton outage.
1282 day 0 to present	8/1/04 to present	Elko	Elko outage.
1283 day 5 to present	8/13/04 to present	Prescott	Prescott outage.
1285 day 0	8/22/04	All AOR Non-Dual sites	7452 sec SIS outage on the AOR-W GEO.
1286 day 0	8/29/04	LA, Riverside, Oakland	IGP storm detector tripped. Lost availability at several western CONUS sites.
1287 day 2 to 1287 day 4	9/7/04 to 9/9/04	Atlantic City	Atlantic City outage.
1288 day 6	9/18/04	Billings	Billings Range errors underbounding, PRN 23. Caused by inaccurate SV h/w bias (T_{GD}) and uncorrected receiver h/w bias.
1290 day 3 to 1291 day 5	9/29/04 to 10/8/04	Grand Forks	Grand Forks outage.
1290 day 4 to 1291 day 5	9/30/04 to 10/8/04	Greenwood	Greenwood outage.

1.2 Report Overview

Section 2 provides the vertical and horizontal position accuracies from data collected, on a daily basis, at one-second intervals. The 95% accuracy index and the maximum accuracy for the reporting period are tabulated. The daily 95% accuracy index is plotted graphically for each receiver. Histograms of the vertical and horizontal error distribution are provided for three receivers within the WAAS service area.

Section 3 summarizes the WAAS instantaneous availability performance, at each receiver, for three operational service levels during the reporting period. Daily availability is also plotted for each receiver evaluated.

Section 4 provides the percent of coverage provided by WAAS on a daily basis. Monthly roll-up graphs presented indicate the portions of service volume covered, and the percentage of time that WAAS was available.

Section 5 provides the percentage of time continuity requirements were met during the reporting period for each receiver. Please note that these continuity requirements are from the WAAS Specification FAA-E-2892B Change 1. The definition for continuity is being evaluated from an operational perspective. The continuity analysis will be reported to reflect this new definition in future reports.

Section 6 summarizes the number of HMI's detected during the reporting period and presents a safety margin index for each receiver. The safety index reflects the amount of over bounding of position error by WAAS protection levels. This section also includes update rates of WAAS messages transmitted from AORW and POR.

Section 7 provides the UDRE and GIVE bounding percentage and the 95% index of the range and ionospheric accuracy for each satellite tracked by the WAAS receiver in Houston.

Section 8 provides the GEO ranging performance for AORW and POR.

Section 9 summarizes WAAS anomalies and problems identified during the reporting period, which adversely affect WAAS performance described in Table 1.3.

Section 10 provides WAAS LPV availability and outages at selected airports.

Section 11 provides the assessment of WAAS CNMP bounding for 75 WAAS receivers.

Section 12 summarizes WAAS equipment outages and GUS switchovers.

2.0 WAAS POSITION ACCURACY

Navigation error data, collected from WAAS and NSTB reference stations, was processed to determine position accuracy at each location. This was accomplished by utilizing the GPS/WAAS position solution tool to compute a MOPS-weighted least squares user navigation solution, and WAAS horizontal and vertical protection levels (HPL & VPL), once every second. The user position calculated for each receiver was compared to the surveyed position of the antenna to assess position error associated with the WAAS SIS over time. The position errors were analyzed and statistics were generated for two operational service levels: WAAS LPV, and WAAS LNAV/VNAV, as shown in Table 2.1. For this evaluation, the WAAS operational service level is considered available at a given time and location, if the computed WAAS HPL and VPL are within the horizontal and vertical alarm limits (HAL & VAL) specified in Table 2.1.

Table 2-1 Operational Service Levels

WAAS Operational Service Levels	Horizontal Alert Limit HAL (meters)	Vertical Alert Limit VAL (meters)
LPV (LOC/VNAV)	40	50
LNAV/VNAV	556	50

Table 2.2 shows PA horizontal and vertical position accuracy maintained for 95% of the time at LPV and LNAV/VNAV operational service levels for the quarter. The table also includes 95% SPS accuracy for certain locations. Figures 2.1 to 2.4 show the daily horizontal and vertical 95% accuracy for LNAV/VNAV operational service level for the period. Note that WAAS accuracy statistics presented are compiled only when all WAAS corrections (fast, long term, and ionospheric) for at least 4 satellites are available. This is referred to as PA navigation mode. The percentage of time that PA navigation mode was supported by WAAS at each receiver is also shown in Table 2.2. A user is considered to be in NPA navigation mode if only WAAS fast and long term corrections are available to a user (i.e. no ionospheric corrections). Table 2.3 shows NPA horizontal position accuracy for 95% and 99.999% of the time. This table also shows the maximum NPA horizontal position error for the quarter. Figures 2.5 shows the daily horizontal 95% accuracy for NPA.

During the evaluated period, the 95% horizontal and vertical accuracy at all evaluated sites were less than 7.6 meters for both WAAS operational service levels. The maximum 95% horizontal and vertical LPV errors are 1.062 meters and 1.790 meters respectively, both at the Minneapolis WAAS reference station. The minimum 95% horizontal and vertical LPV errors are 0.610 meters at Atlanta and 1.026 meters at Oklahoma City, respectively. The maximum 95% and 99.999% NPA horizontal errors are 4.578 meters and 15.531 meters both at Mauna Loa. The minimum 95% and 99.999% horizontal errors are 1.597 meters at Boston and 4.713 meters at Atlanta

Table 2.4 shows the maximum horizontal and vertical position errors while the calculated HPL and VPL met the LPV service levels. The column marked 'Horizontal (or Vertical) Error/HPL (or VPL)' is the ration of position error to protection level at the time the maximum error occurred. The column marked 'Horizontal (or Vertical) Maximum Ratio' is the maximum position error to protection level ratio for the quarter.

Figures 2.6 to 2.15 show the distributions of the vertical and horizontal errors in triangle charts and 2-D histogram plots for the quarter at three locations, Oklahoma City, Washington DC and Seattle. The triangle charts show the distributions of vertical position errors (VPE) versus vertical protection levels (VPL) and horizontal position errors (HPE) versus horizontal protection levels (HPL). The horizontal axis is the position error and the vertical axis is the WAAS protection levels. Lower protection levels equate to better availability. The diagonal line shows the point where error equals protection level. Above and to the left of the diagonal line in the chart, errors are bounded (WAAS is providing integrity in the position domain); below and to the right, errors are not bounded (HMI could be present). The horizontal lines at various protection levels represent the various operational service levels as defined in Table 2.1. The 2-D histogram plots contain four histograms showing the distributions of vertical and horizontal position errors and normalized position errors. The left top and bottom histograms show the distributions of the actual vertical and horizontal errors. The horizontal axis is the position errors and the vertical axis is the total count of data samples (log scale) in each 0.1-meter bin. The right top and bottom histograms show the distributions of the actual vertical and horizontal errors normalized by one-sigma value of the protection level; vertical - (VPL/5.33) and horizontal - (HPL/6.0). The horizontal axis is the standard units and vertical axis is the observed distribution of normalized errors data samples in each 0.1-sigma bin. Narrowness of the normalized error distributions shows very good observed safety performance.

Table 2-2 PA 95% Horizontal and Vertical Accuracy

Location	Horizontal GLS/APV2/LPV (HAL=40m) (Meters)	Horizontal APV-1(LNAV) (HAL=556m) (Meters)	Vertical LPV/VNAV (VAL=50m) (Meters)	Percentage in PA mode (%)	SPS Accuracy	
					95% Horizontal (Meters)	95% Vertical (Meters)
Anderson	0.801	0.813	1.481	99.72632	*	*
Atlantic City	0.809	0.823	1.440	99.71143	*	*
Elko	0.805	0.805	1.306	99.99947	*	*
Grand Forks	0.856	0.873	1.627	99.71119	*	*
Great Falls	0.880	0.887	1.461	99.80293	*	*
Greenwood	0.750	0.759	1.494	99.72432	*	*
Oklahoma City	0.797	0.804	1.026	99.73118	*	*
San Angelo	0.828	0.840	1.370	99.73805	*	*
Albuquerque	0.641	0.647	1.151	99.73327	3.472	5.808
Atlanta	0.610	0.618	1.259	99.72590	3.522	6.094
Billings	0.838	0.847	1.319	99.72620	3.249	5.406
Boston	0.753	0.764	1.401	99.72274	3.270	5.338
Chicago	0.665	0.676	1.218	99.72650	*	*
Cleveland	0.731	0.745	1.447	99.72676	3.342	5.662
Dallas	0.929	0.940	1.388	99.72627	*	*
Denver	0.738	0.746	1.650	99.72627	*	*
Houston	0.794	0.801	1.229	99.72635	3.813	6.051
Jacksonville	0.741	0.750	1.429	99.72526	*	*
Kansas City	0.636	0.645	1.170	99.72658	3.371	6.054
Los Angeles	0.972	0.973	1.592	99.99748	3.719	6.267
Memphis	0.674	0.684	1.321	99.72638	*	*
Miami	0.844	0.855	1.404	99.72417	4.084	6.304
Minneapolis	1.062	1.079	1.790	99.72746	3.292	5.735
New York	0.845	0.856	1.305	99.72067	*	*
Oakland	0.796	0.799	1.544	99.99747	3.547	6.024
Salt Lake City	0.706	0.707	1.231	99.99749	3.370	5.710
Seattle	0.900	0.901	1.149	99.99748	3.243	5.125
Washington DC	0.728	0.740	1.218	99.72166	3.313	5.782

* SPS accuracy not computed for this location.

Table 2-3 NPA 95% and 99.999% Horizontal Accuracy

Location	95% Horizontal (meters)	99.999% Horizontal (meters)	Percentage in NPA mode (%)	Maximum Horizontal Error
Albuquerque	2.421	5.660	99.727029	6.927
Anchorage	1.679	5.771	99.991351	9.906
Atlanta	2.133	4.713	99.727345	4.877
Bethel	2.864	8.010	99.991566	10.057
Billings	2.134	6.750	99.727136	6.956
Boston	1.597	7.417	99.727482	7.653
Cleveland	1.805	8.268	99.727273	8.467
Cold Bay	1.916	8.063	99.991292	8.615
Fairbanks	1.642	5.201	99.991918	5.943
Honolulu	4.458	12.818	99.977010	13.634
Houston	2.752	5.500	99.727529	5.790
Juneau	1.686	5.817	99.992949	6.101
Kansas City	2.109	5.704	99.727589	5.881
Kotzebue	2.484	6.378	99.991322	12.821
Los Angeles	2.739	7.523	99.997735	8.228
Mauna Loa	4.578	15.531	99.975353	16.702
Miami	2.596	5.378	99.726981	6.826
Minneapolis	2.573	8.275	99.727684	8.630
Oakland	2.434	6.803	99.997735	7.134
Puerto Rico	2.605	6.665	99.726772	11.987
Salt Lake City	2.200	6.250	99.997735	9.874
Seattle	2.048	7.442	99.997497	9.581
Washington DC	2.012	8.354	99.727613	8.514

Table 2-4 Maximum Position Errors and Position Error/Protection Level Ratio

Location	Horizontal Error (m)	Horizontal Error/HPL	Horizontal Maximum Ratio	Vertical Error (m)	Vertical Error/VPL	Vertical Maximum Ratio
Atlantic City	3.006	0.091	0.195	4.580	0.154	0.154
Anderson	2.746	0.224	0.232	5.807	0.117	0.199
Grand Forks	5.137	0.241	0.241	9.248	0.302	0.302
Great Falls	3.183	0.085	0.168	5.653	0.127	0.173
Greenwood	4.362	0.120	0.218	5.226	0.278	0.278
Oklahoma City	3.104	0.164	0.201	4.222	0.130	0.213
San Angelo	2.752	0.128	0.129	4.917	0.170	0.170
Albuquerque	2.583	0.066	0.161	3.286	0.071	0.136
Atlanta	2.534	0.145	0.192	4.452	0.142	0.156
Billings	3.534	0.111	0.157	6.947	0.166	0.195
Boston	3.059	0.092	0.150	6.510	0.164	0.167
Chicago	3.594	0.104	0.202	5.884	0.313	0.313
Cleveland	3.258	0.109	0.219	5.493	0.201	0.201
Dallas	4.304	0.184	0.225	8.722	0.199	0.201
Denver	3.420	0.089	0.155	6.519	0.186	0.200
Houston	2.433	0.169	0.169	4.267	0.127	0.142
Jacksonville	3.116	0.235	0.254	5.698	0.150	0.206
Kansas City	4.951	0.167	0.184	4.768	0.248	0.249
Los Angeles	3.549	0.123	0.161	5.166	0.121	0.159
Memphis	3.627	0.091	0.184	6.600	0.142	0.267
Miami	3.679	0.227	0.227	5.876	0.174	0.174
Minneapolis	7.887	0.225	0.242	7.376	0.229	0.229
New York	3.233	0.105	0.168	4.547	0.121	0.140
Oakland	3.871	0.111	0.119	5.368	0.108	0.162
Salt Lake City	2.788	0.083	0.162	4.819	0.121	0.187
Seattle	3.780	0.167	0.199	4.676	0.121	0.156
Washington DC	3.562	0.100	0.190	4.005	0.132	0.133

Figure 2-1 95% Horizontal Accuracy at LNAV/VNAV

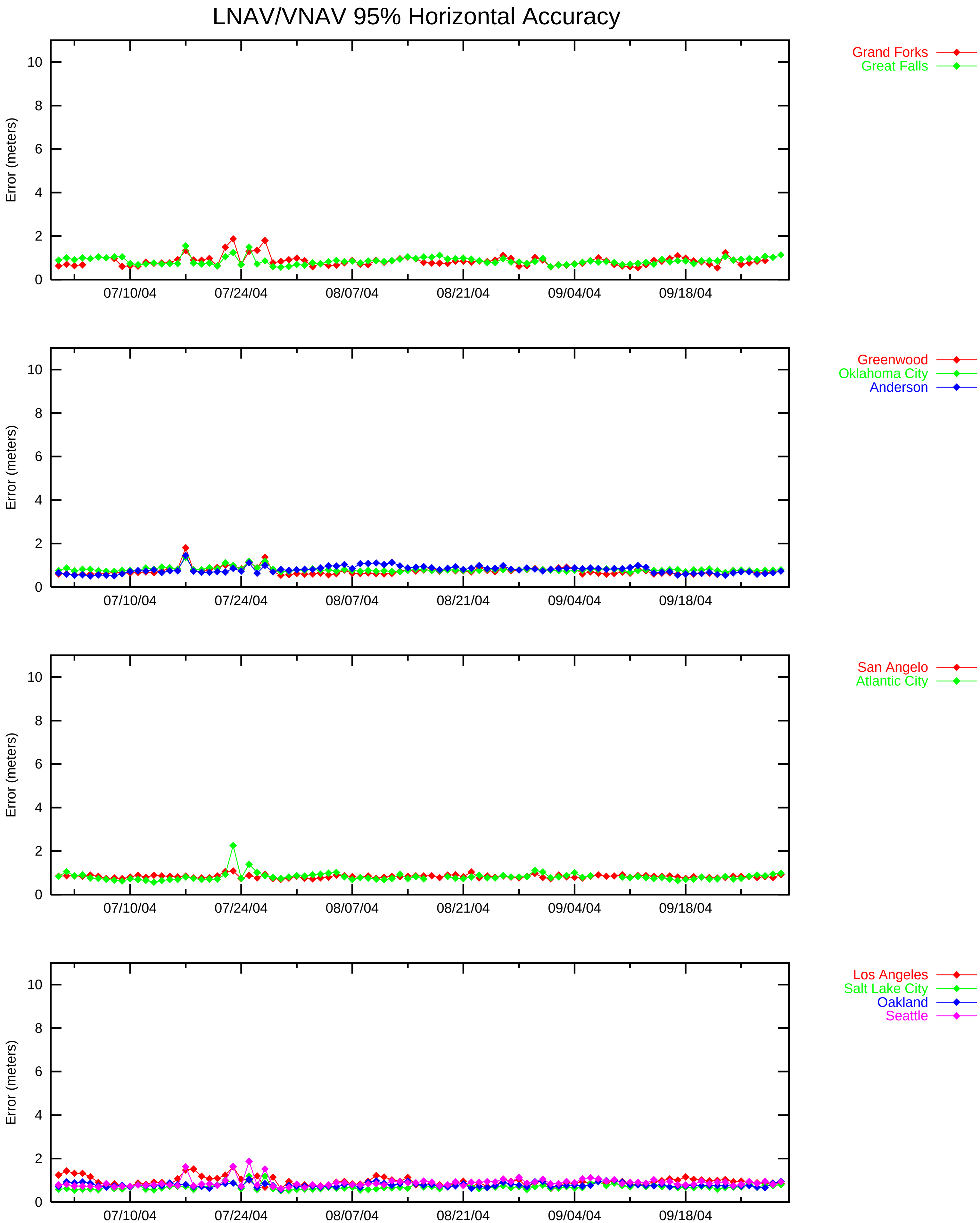


Figure 2-2 95% Horizontal Accuracy at LNAV/VNAV

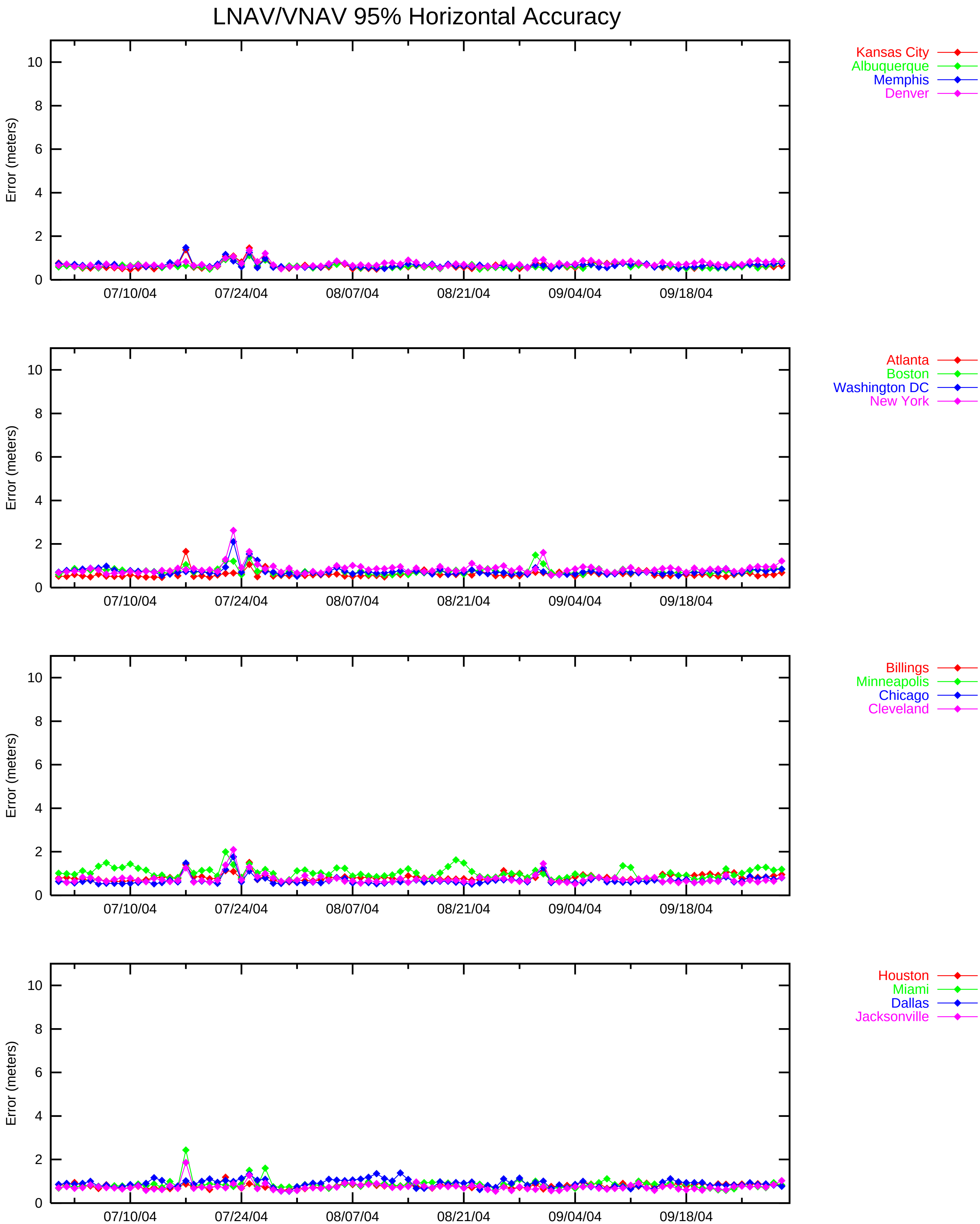


Figure 2-3 95% Vertical Accuracy at LNAV/VNAV

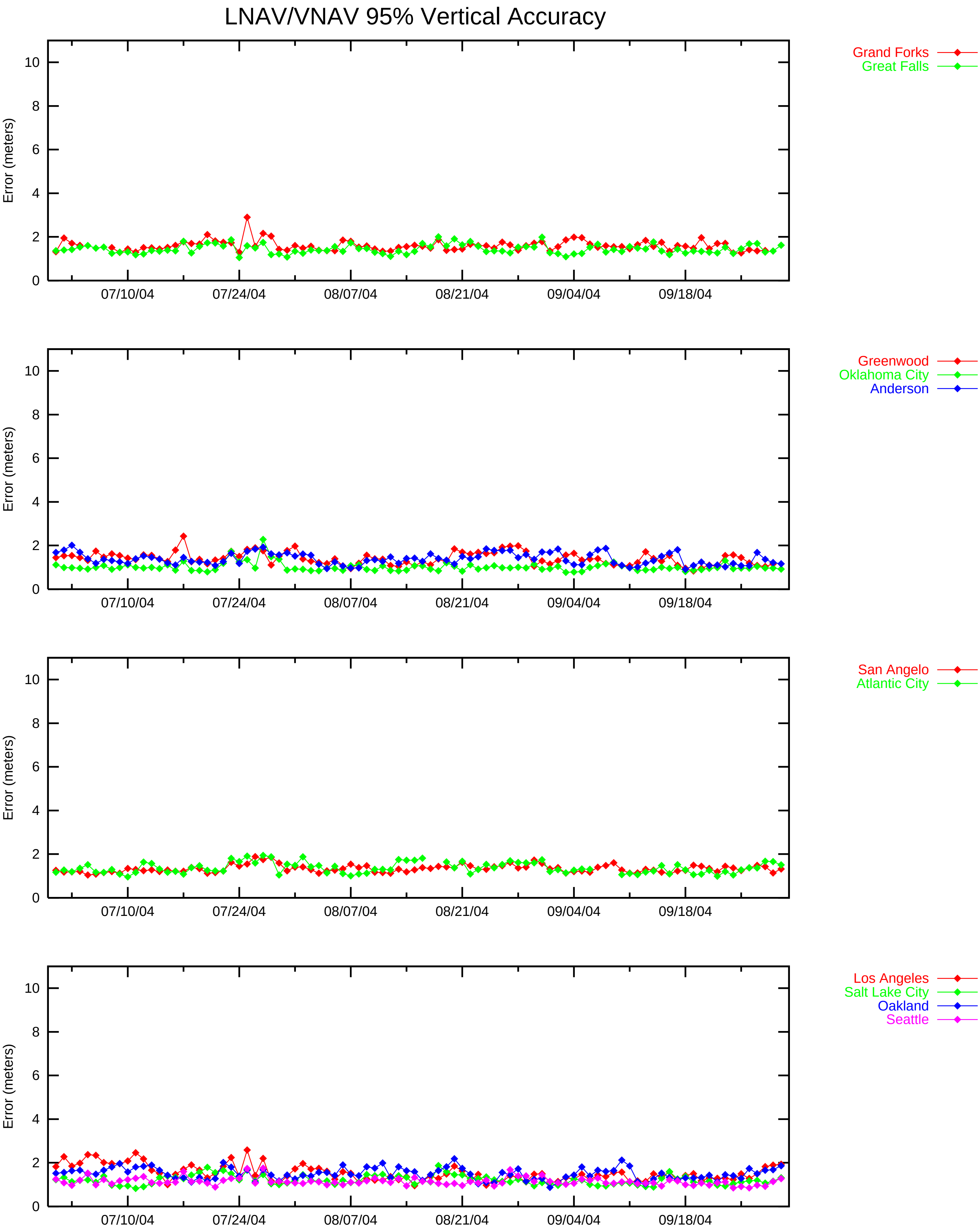


Figure 2-4 95% Vertical Accuracy at LNAV/VNAV

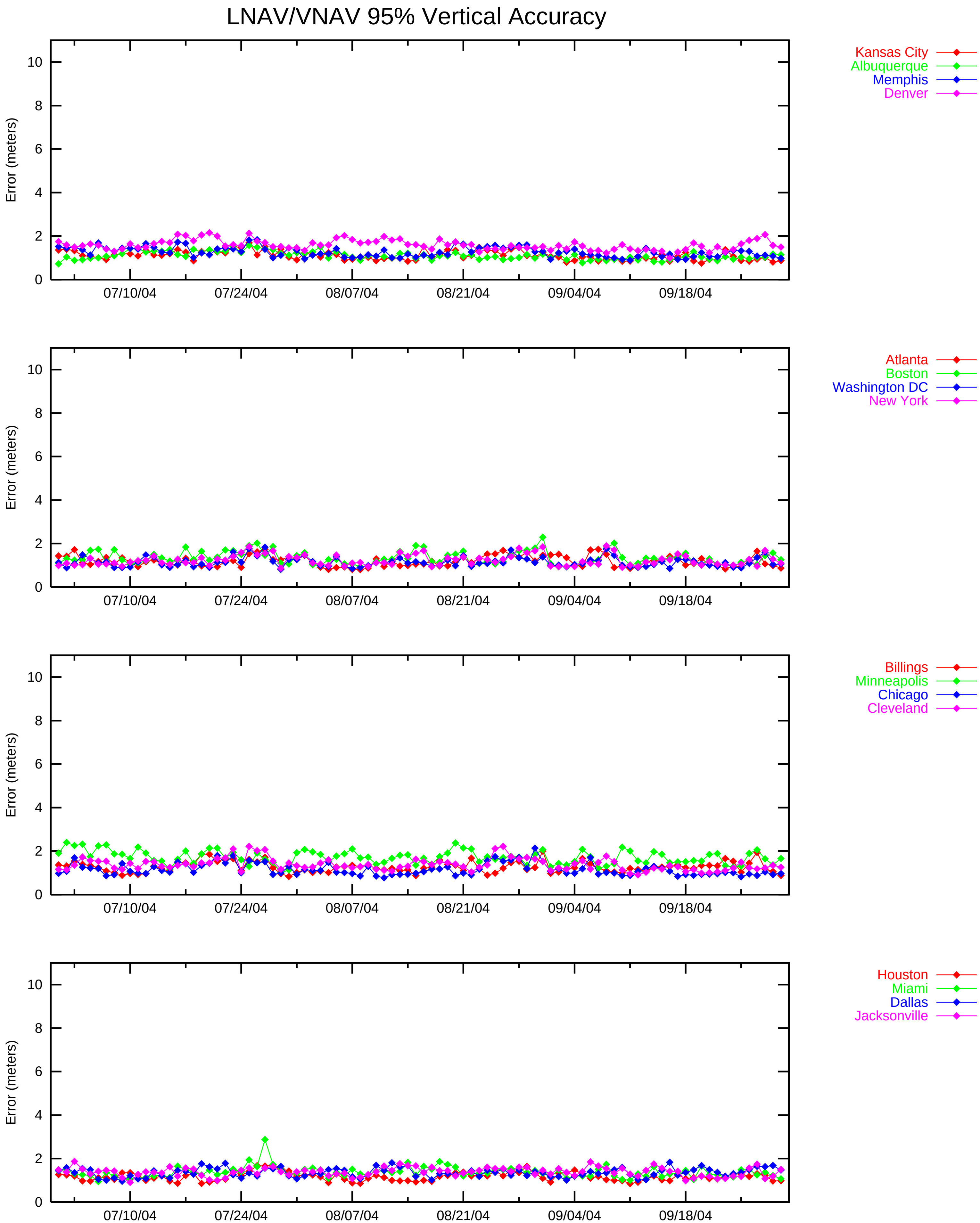
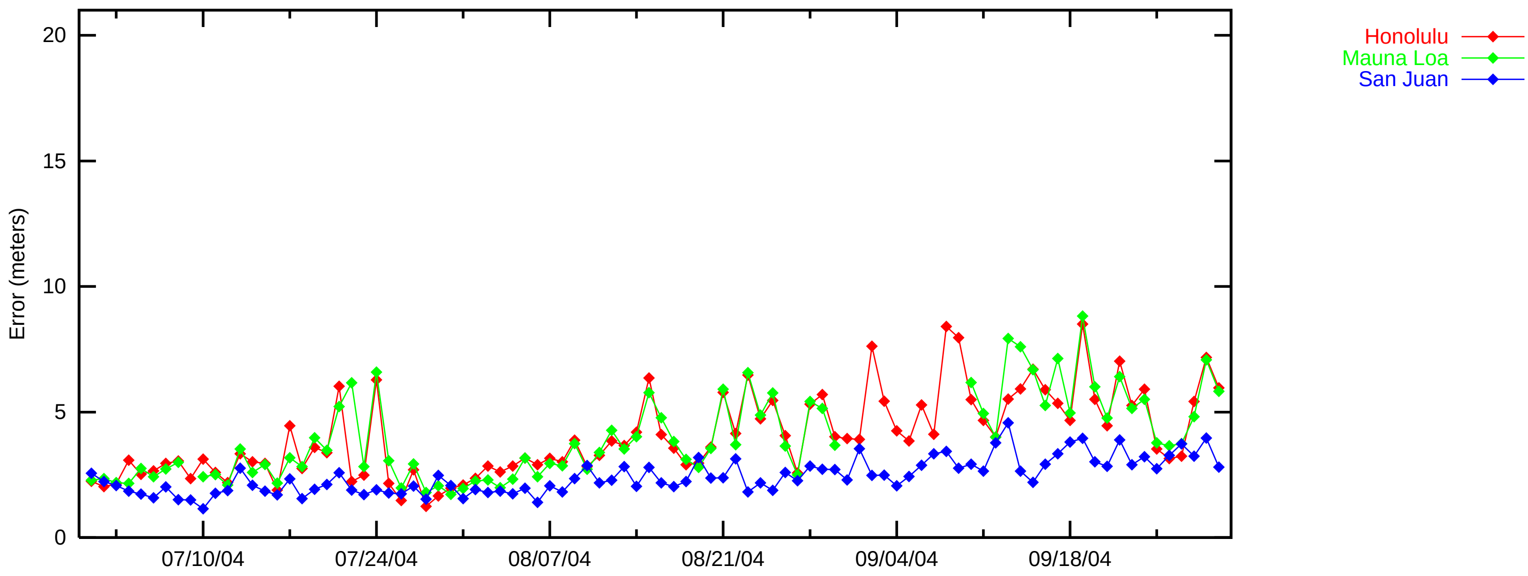
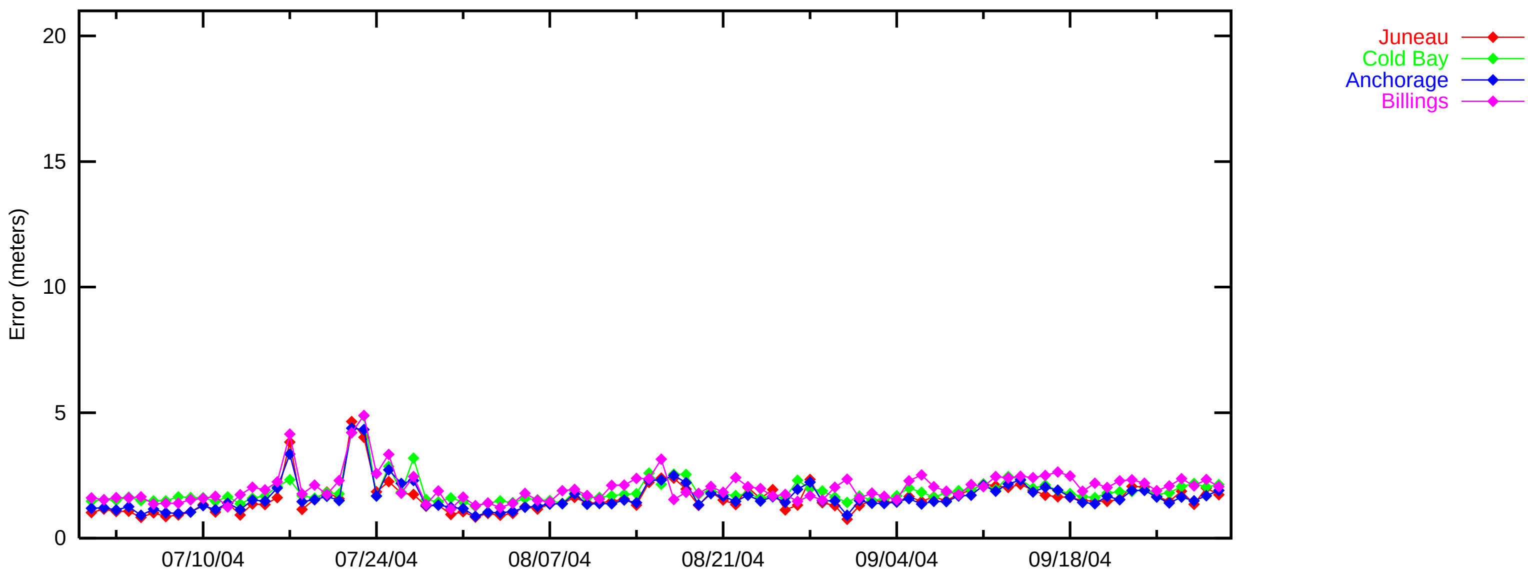


Figure 2-5 NPA 95% Horizontal Accuracy





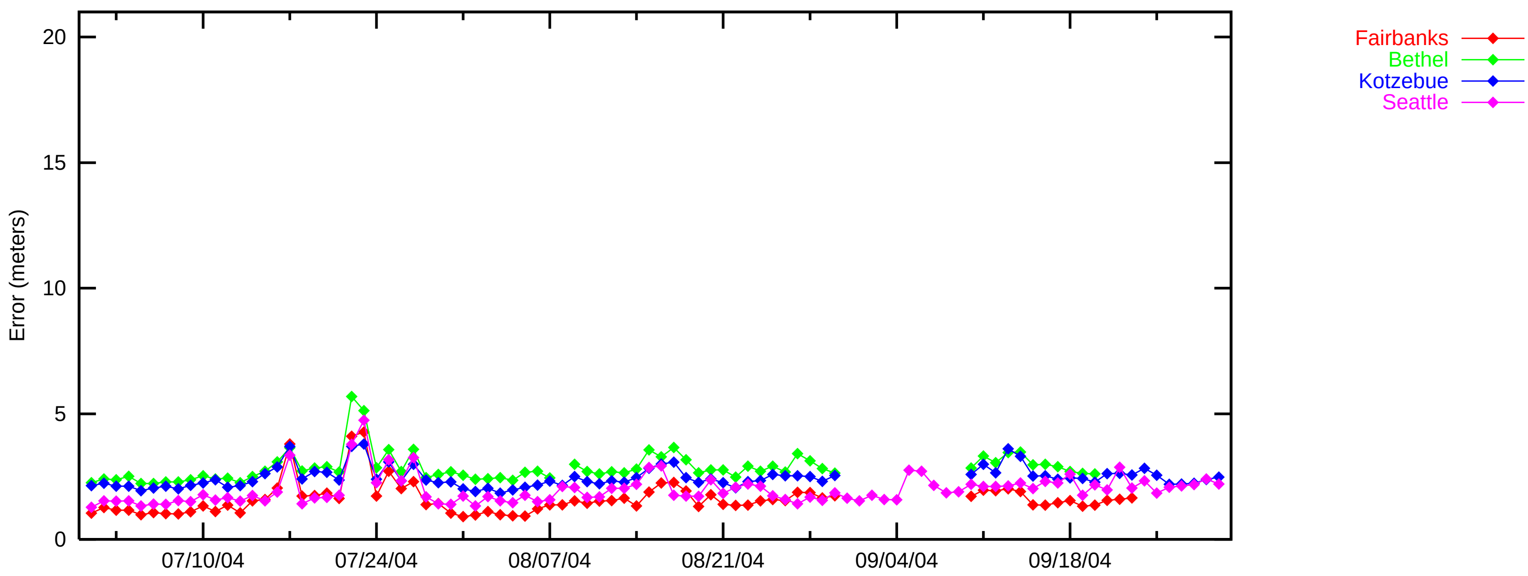
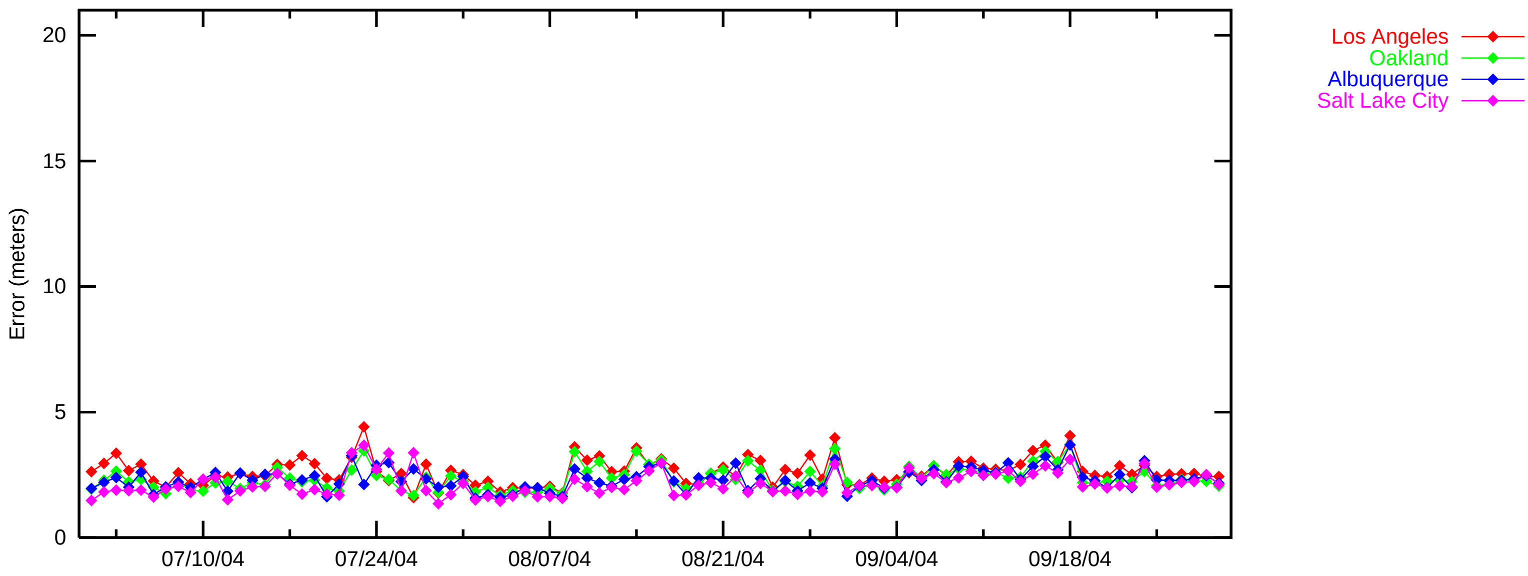
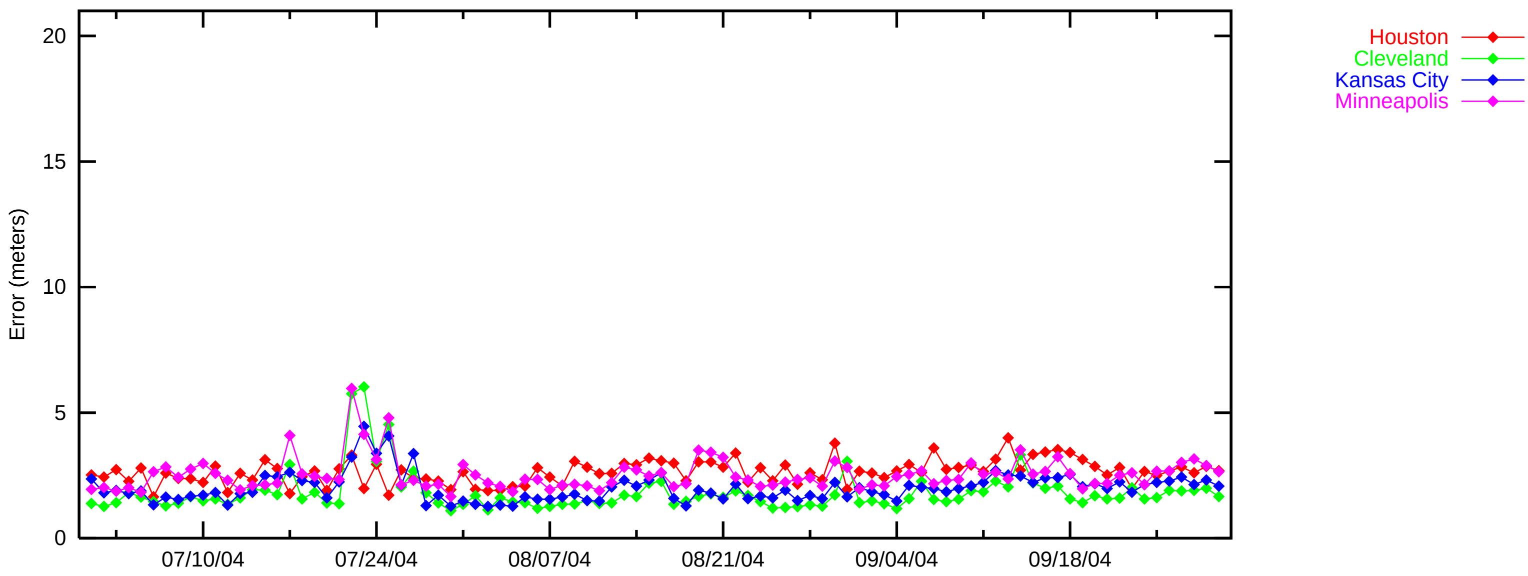


Figure 2-6 NPA 95% Horizontal Accuracy





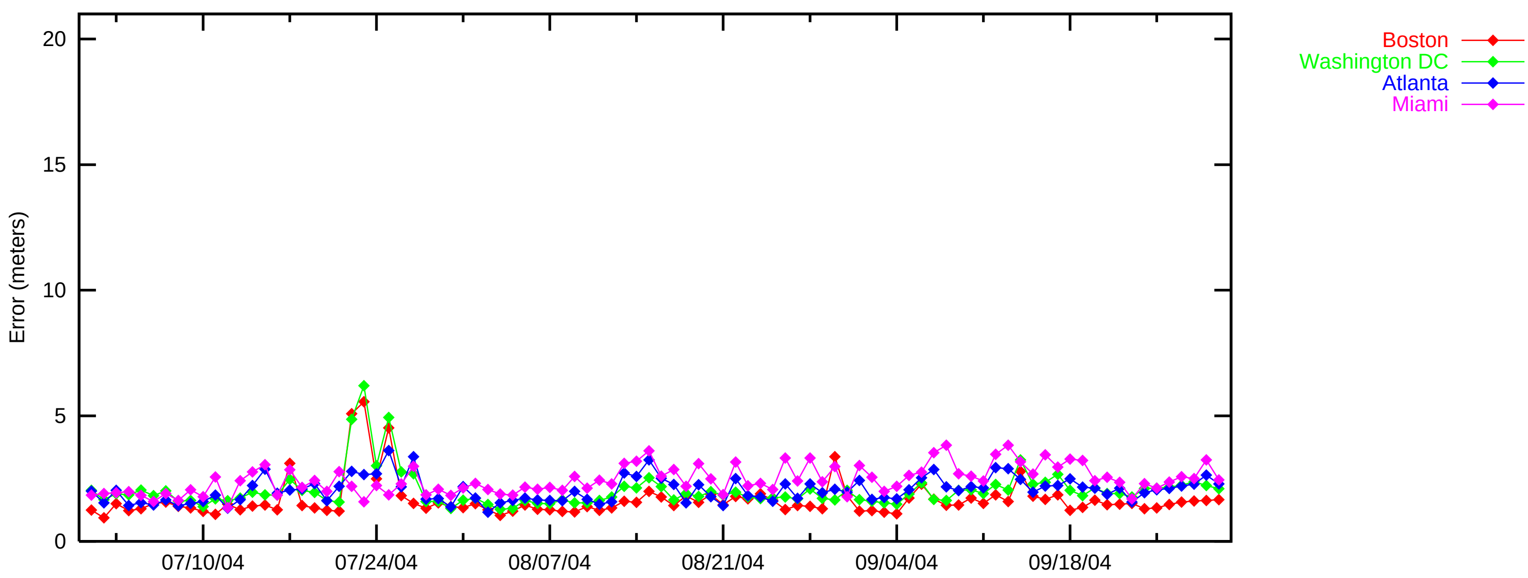


Figure 2-7 Horizontal Triangle Chart for Oklahoma City

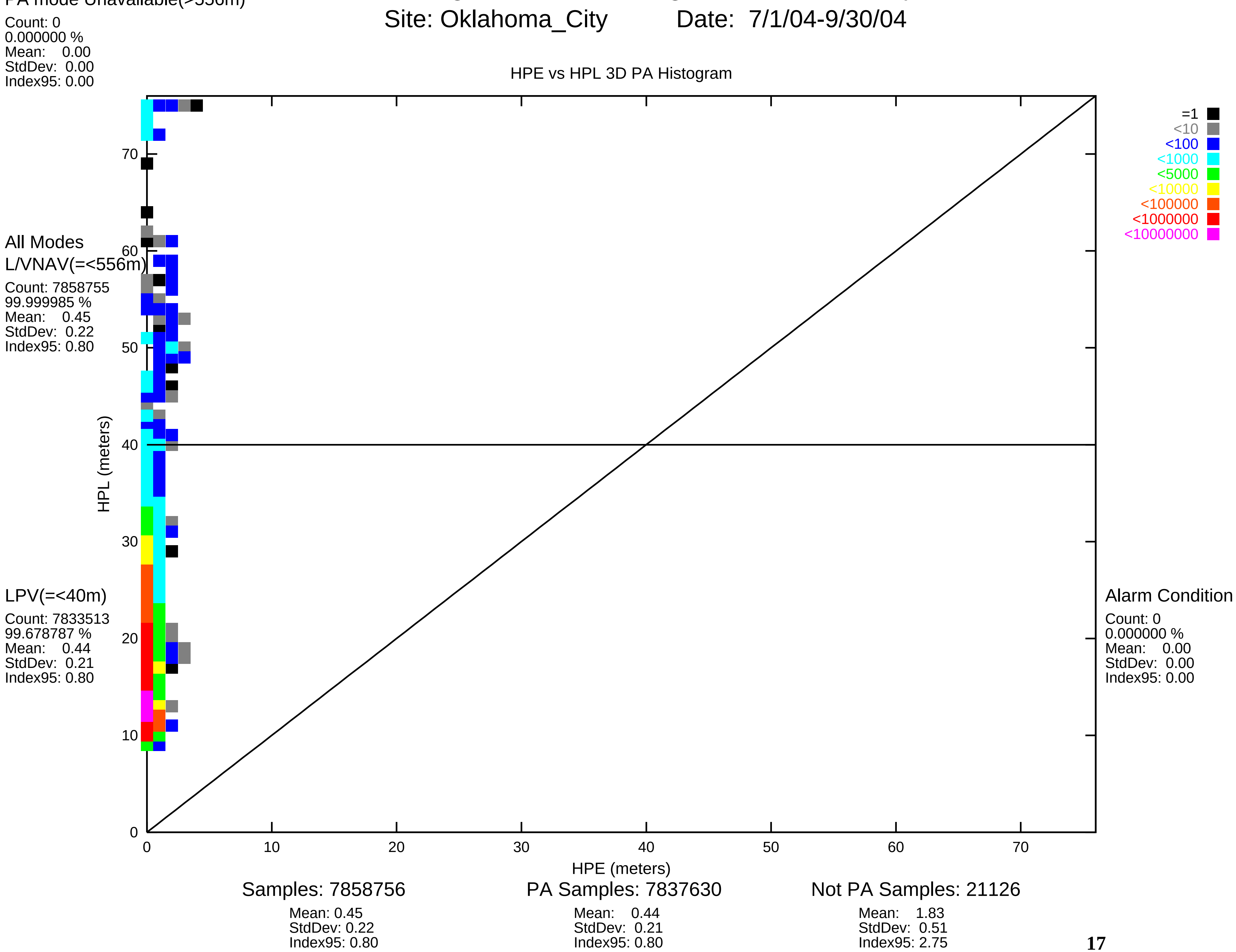


Figure 2-8 Vertical Triangle Chart for Oklahoma City

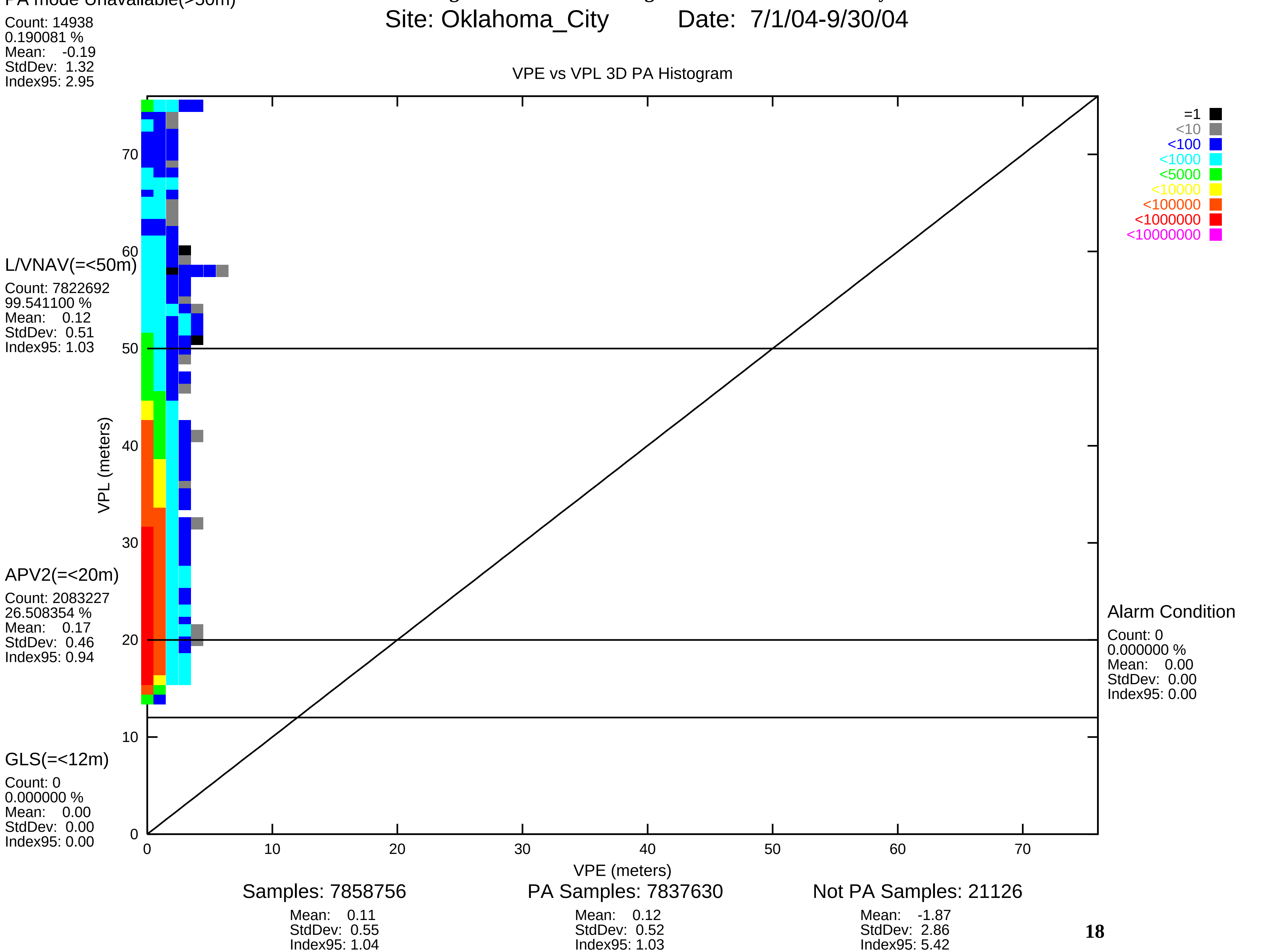


Figure 2-9 2-D Histogram for Oklahoma City

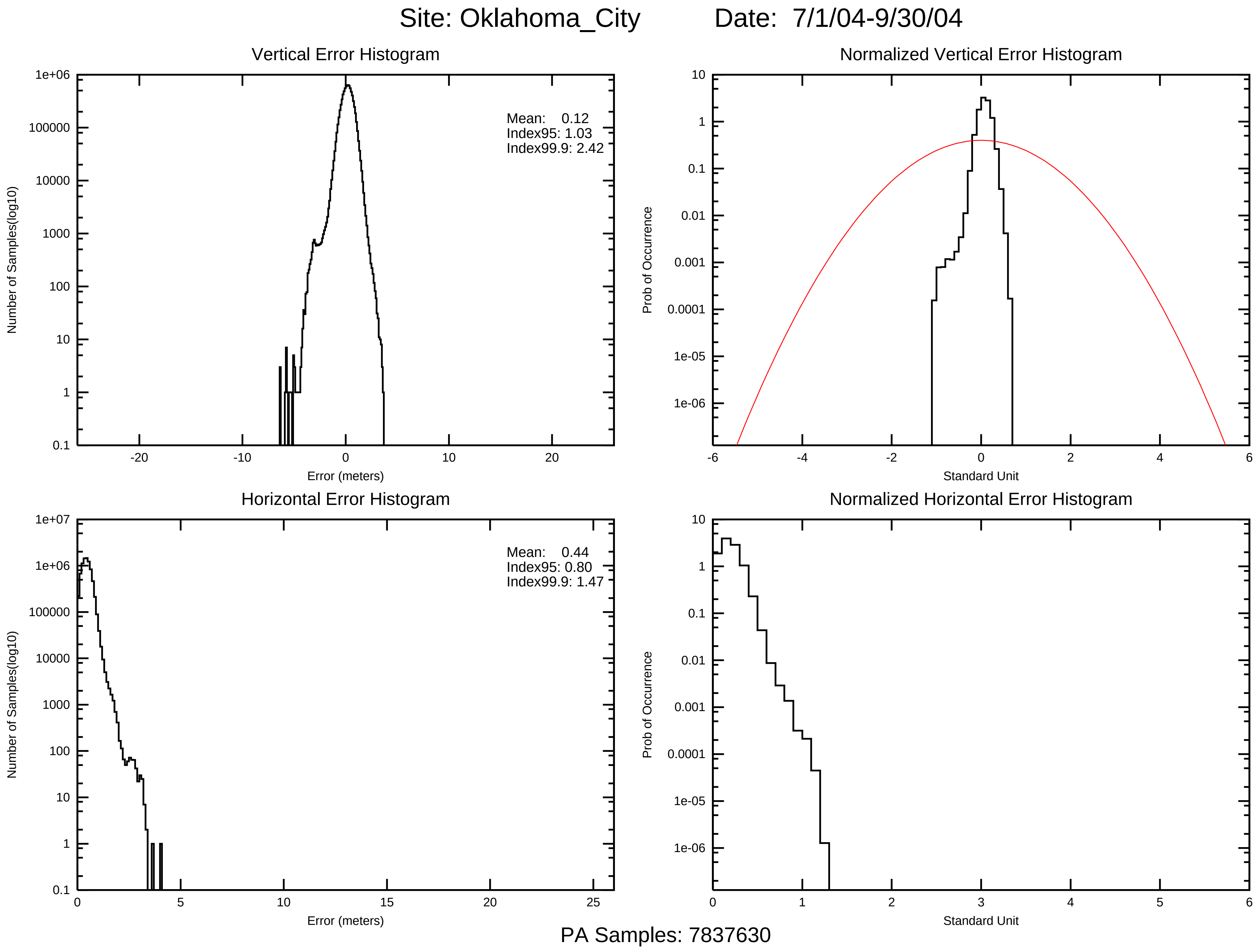


Figure 2-10 Horizontal Triangle Chart for Washington, DC

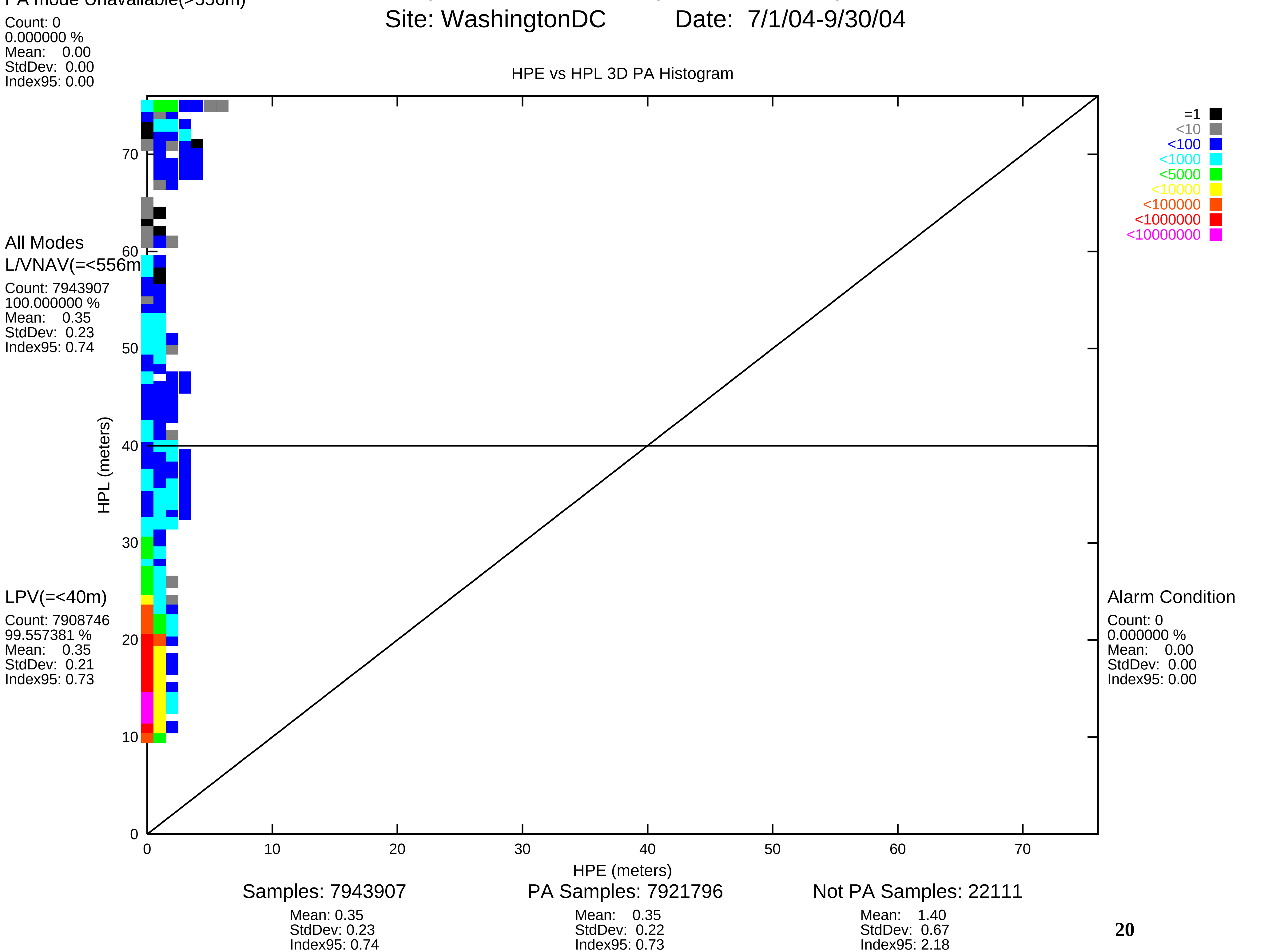


Figure 2-11 Vertical Triangle Chart for Washington, DC

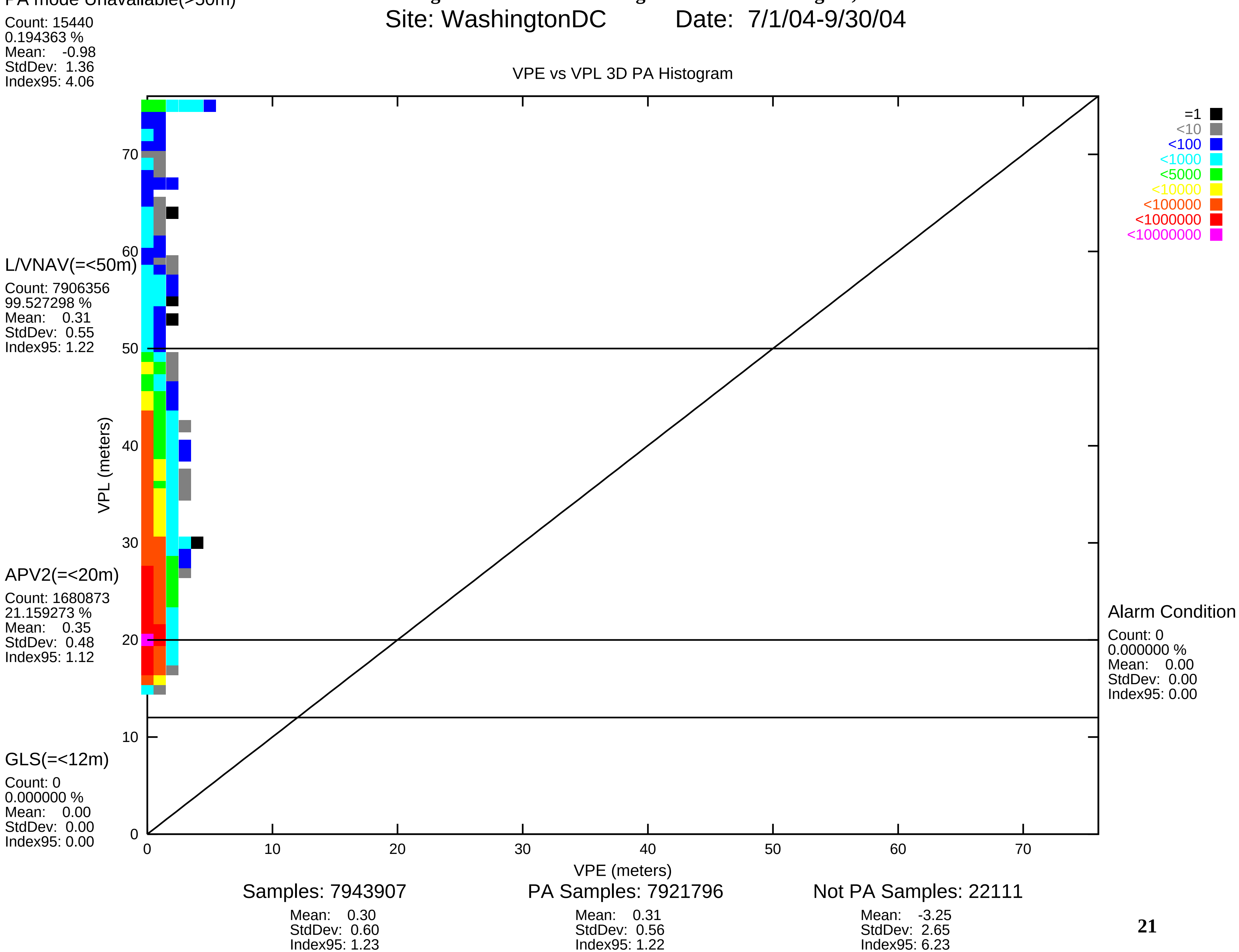


Figure 2-12 2-D Histogram for Washington, DC

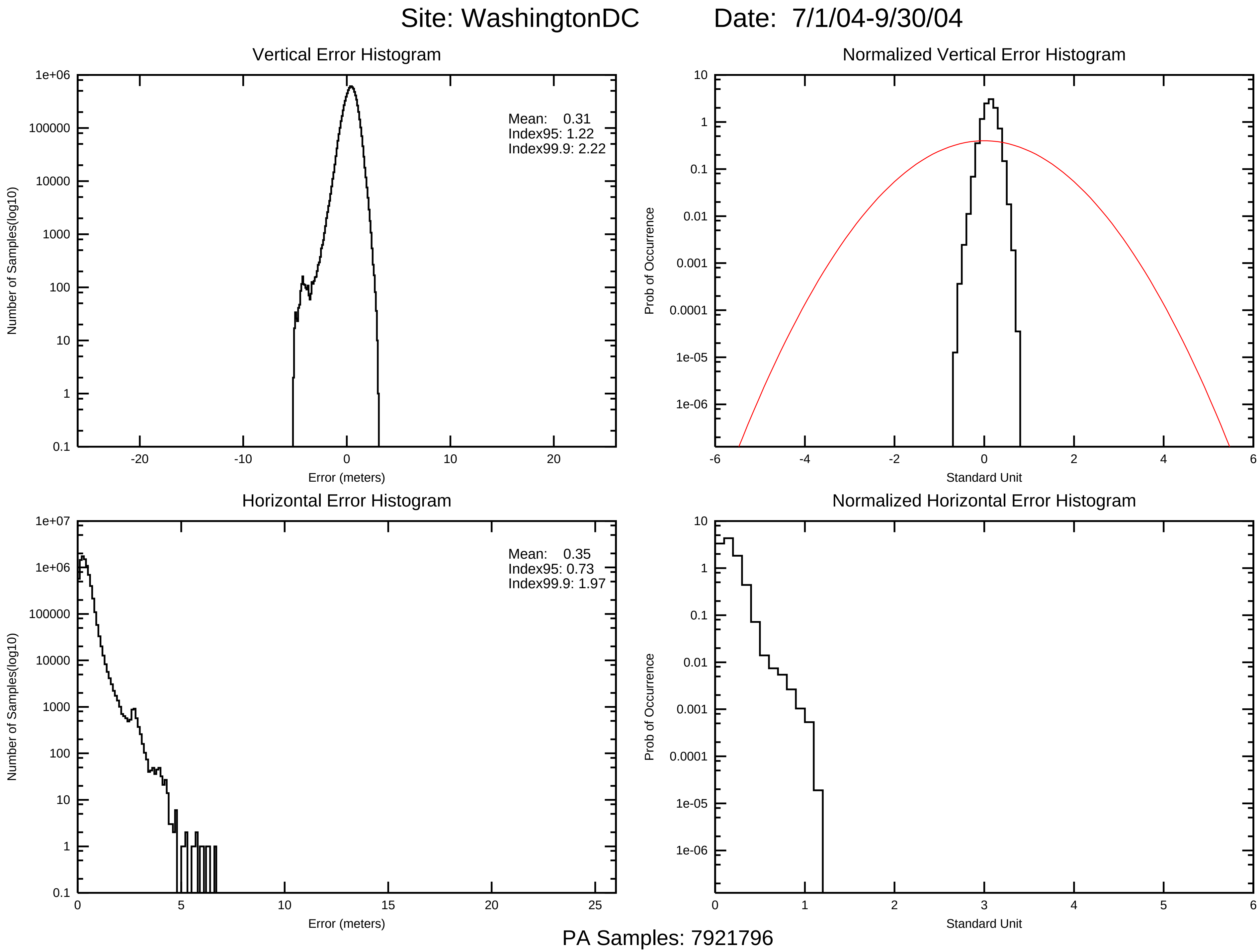


Figure 2-13 Horizontal Triangle Chart for Seattle

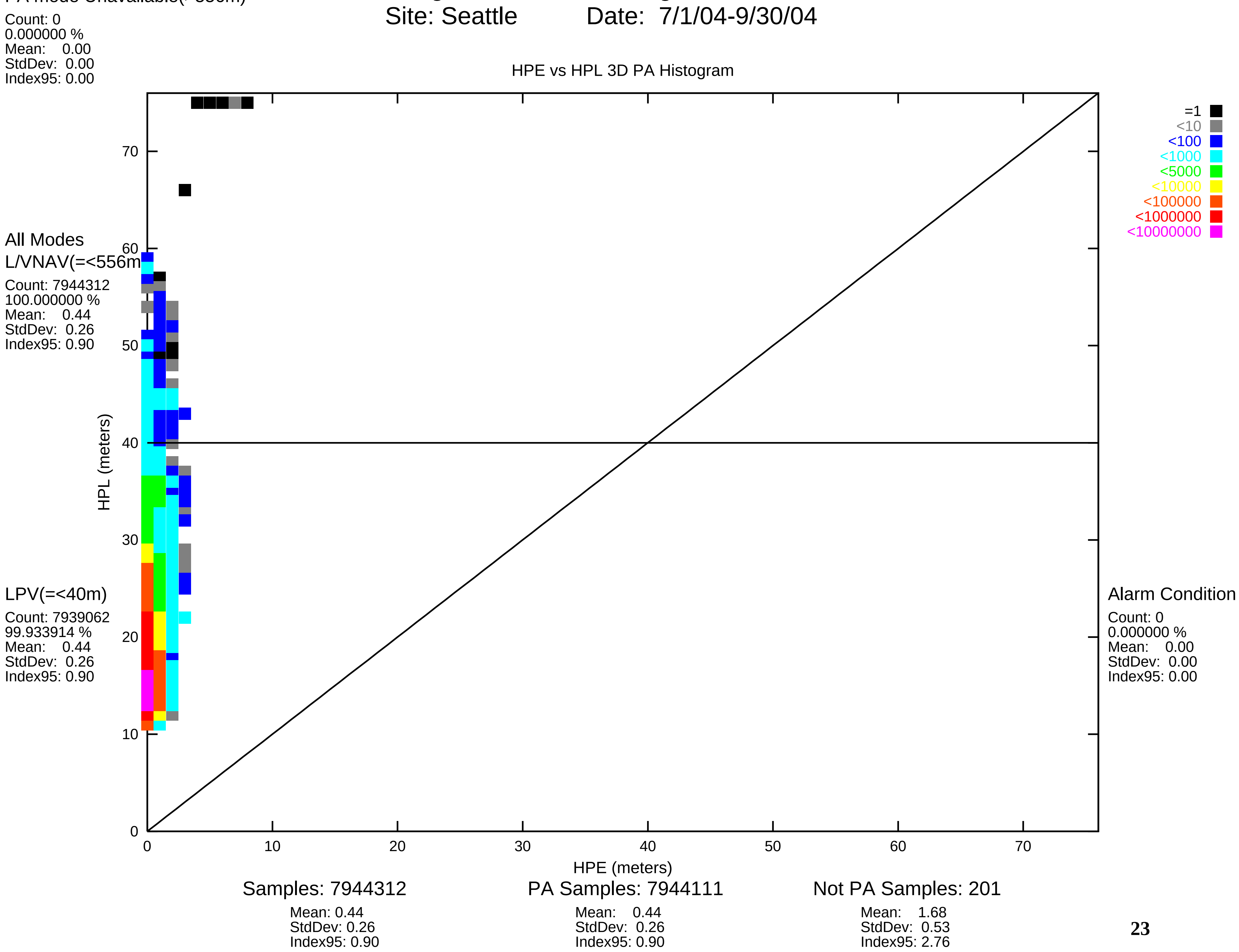


Figure 2-14 Vertical Triangle Chart for Seattle

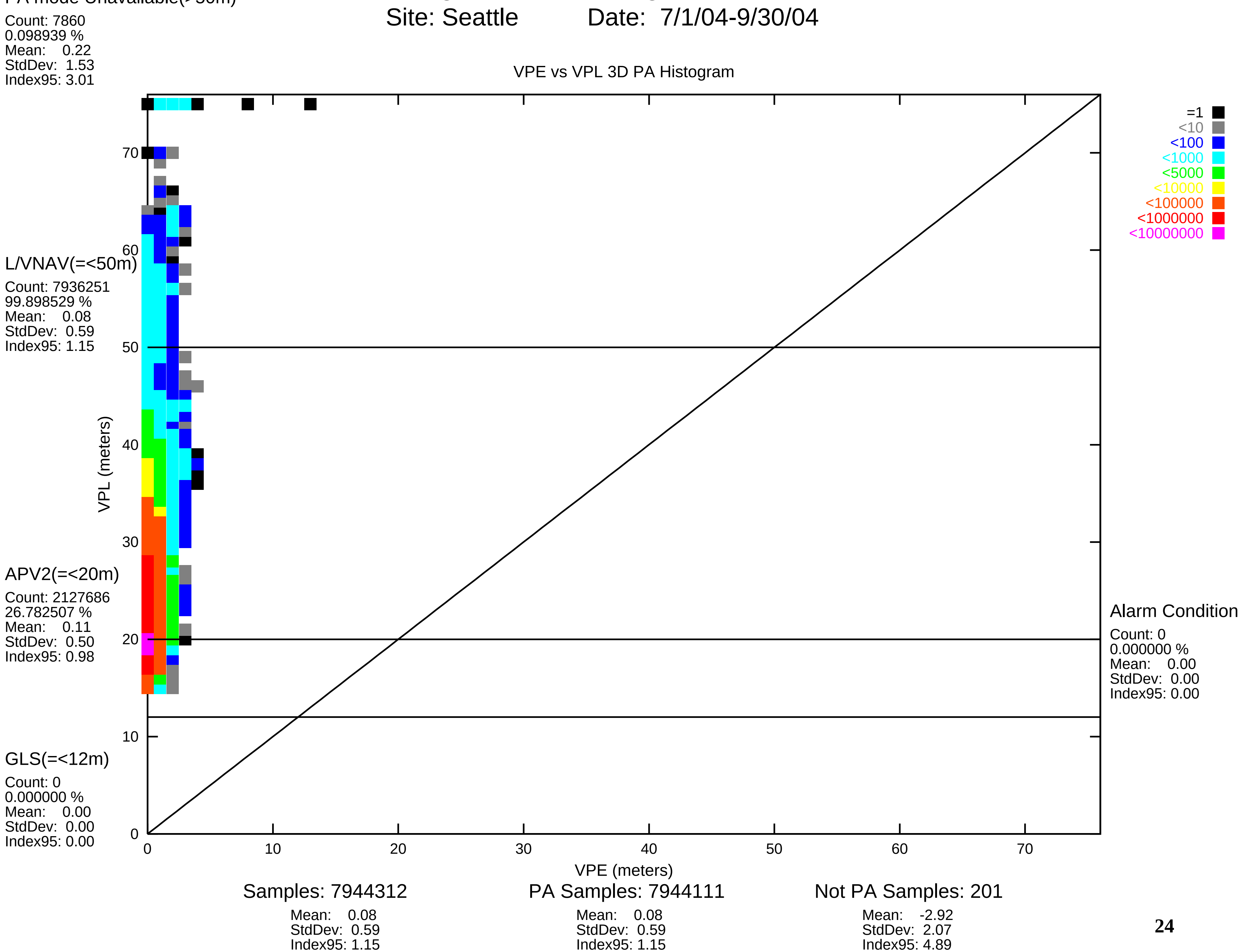
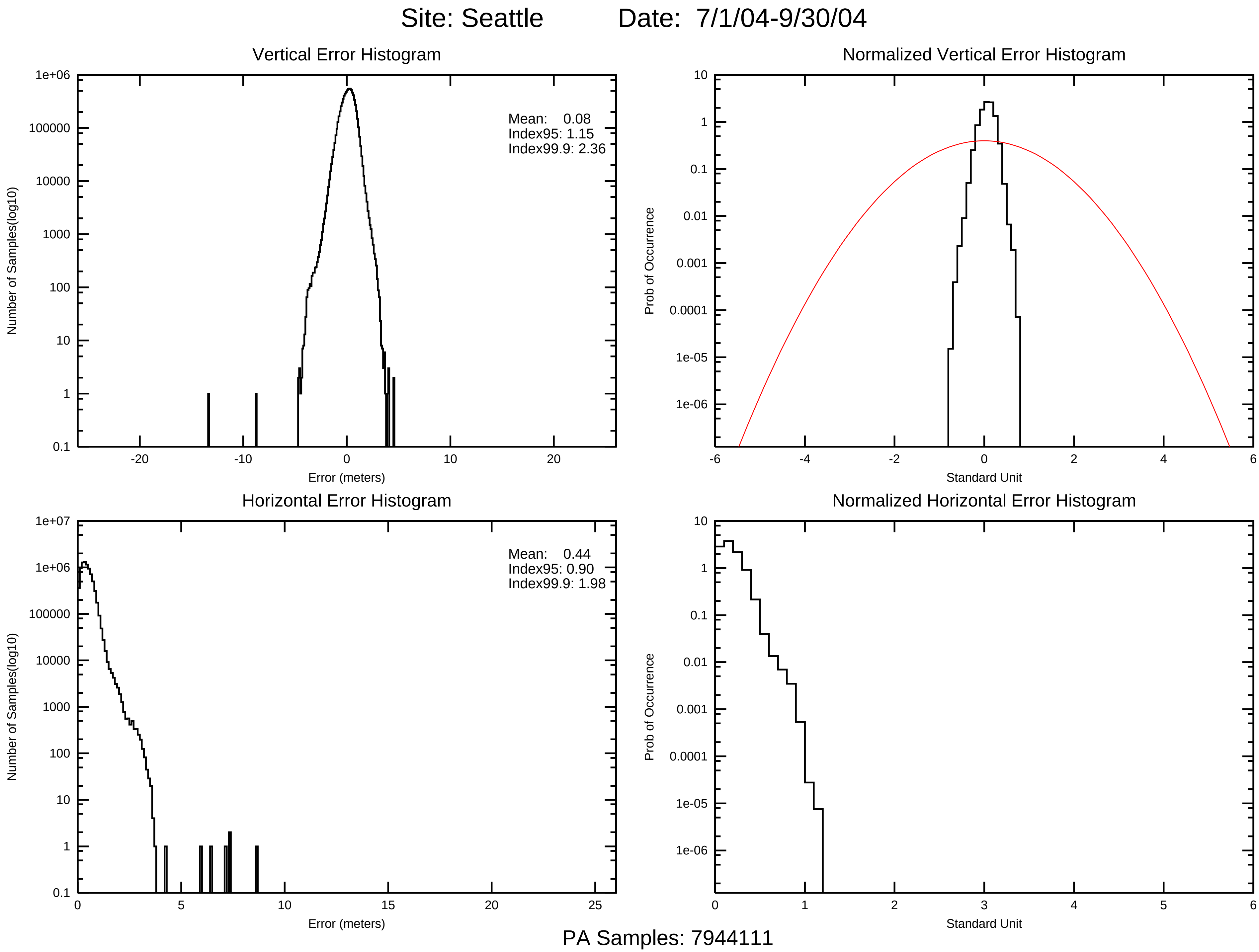


Figure 2-15 2-D Histogram for Seattle



3.0 AVAILABILITY

WAAS availability evaluation estimates the probability that the WAAS can provide service for the operational service levels (LPV and LNAV/VNAV) defined in Table 2.1. At each receiver, the WAAS message, along with the GPS/GEO satellites tracked, were used to produce WAAS protection levels in accordance with the WAAS MOPS. Table 3.1 shows the protection levels that were maintained for 95% of the time for each receiver location for the quarter. The table also included the percentage in PA mode as described in section 2.0. Table 3.2 presents the percentage of time that WAAS operational service levels were available at each receiver location. Figures 3.1 through 3.4 show the daily instantaneous availability of LNAV/VNAV and LPV service levels for the evaluated period.

The geographic location of each receiver evaluated is depicted in Figure 3.5 and 3.6, along with the 95% VPL value, the WAAS LPV and the LNAV/VNAV instantaneous availability percentage at each location for the quarter.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Anderson	17.195	28.750	99.726318
Atlantic City	21.790	37.501	99.711433
Elko	21.552	31.290	99.999474
Grand Forks	26.392	35.026	99.711189
Great Falls	24.571	34.763	99.802933
Greenwood	16.679	27.601	99.724319
Oklahoma City	20.712	34.083	99.731178
San Angelo	27.541	42.129	99.738052
Albuquerque	19.654	30.608	99.733269
Atlanta	16.442	28.023	99.725899
Billings	19.511	26.661	99.726196
Boston	26.437	43.390	99.722740
Chicago	16.188	26.682	99.726501
Cleveland	18.296	29.445	99.726761
Dallas	18.124	29.220	99.726273
Denver	17.504	26.356	99.726273
Houston	21.706	33.132	99.726349
Jacksonville	17.726	33.502	99.725258
Kansas City	15.639	25.445	99.726578
Los Angeles	26.860	39.613	99.997482
Memphis	15.988	27.541	99.726379
Miami	21.594	43.297	99.724167
Minneapolis	19.256	29.185	99.727463
New York	22.396	38.859	99.720673
Oakland	27.972	39.352	99.997467
Salt Lake City	18.973	27.769	99.997490
Seattle	21.783	29.044	99.997475
Washington DC	18.863	32.305	99.721657

Table 3-2 Average Quarterly Availability Statistics

Location	LPV (HAL = 40m VAL = 50m) Percentage of time	LNAV/VNAV (HAL= 556m VAL = 50m) Percentage of time
Anderson	0.99524415	0.99549222
Atlantic City	0.98823148	0.98844081
Elko	0.99975431	0.99983215
Grand Forks	0.99003893	0.99066579
Great Falls	0.99678469	0.99699497
Greenwood	0.99541485	0.99545979
Oklahoma City	0.99540383	0.99541098
San Angelo	0.98598504	0.98706716
Albuquerque	0.99726647	0.99726760
Atlanta	0.99540150	0.99579215
Billings	0.99562377	0.99570096
Boston	0.97329253	0.97351813
Chicago	0.99468279	0.99487376
Cleveland	0.99482721	0.99516290
Dallas	0.99662650	0.99666482
Denver	0.99599516	0.99599576
Houston	0.99348587	0.99350989
Jacksonville	0.99554652	0.99565691
Kansas City	0.99522775	0.99523282
Los Angeles	0.99154848	0.99212056
Memphis	0.99524212	0.99524486
Miami	0.98217481	0.98232943
Minneapolis	0.99443585	0.99495482
New York	0.98530579	0.98556995
Oakland	0.98859948	0.98941374
Salt Lake City	0.99963737	0.99965811
Seattle	0.99890071	0.99898529
Washington DC	0.99515480	0.99527299

During the evaluated period, the maximum 95% HPL and VPL are 27.972 meters at Oakland and 43.390 meters at Boston. The minimum 95% HPL and VPL are 15.639 meters and 25.445 meters, both at Kansas City. LNAV/VNAV instantaneous availability ranges between 97.3% and 100%. LPV instantaneous availability ranges between 97.3% and 99.9%.

Figure 3-1 LNAV/VNAV Instantaneous Availability

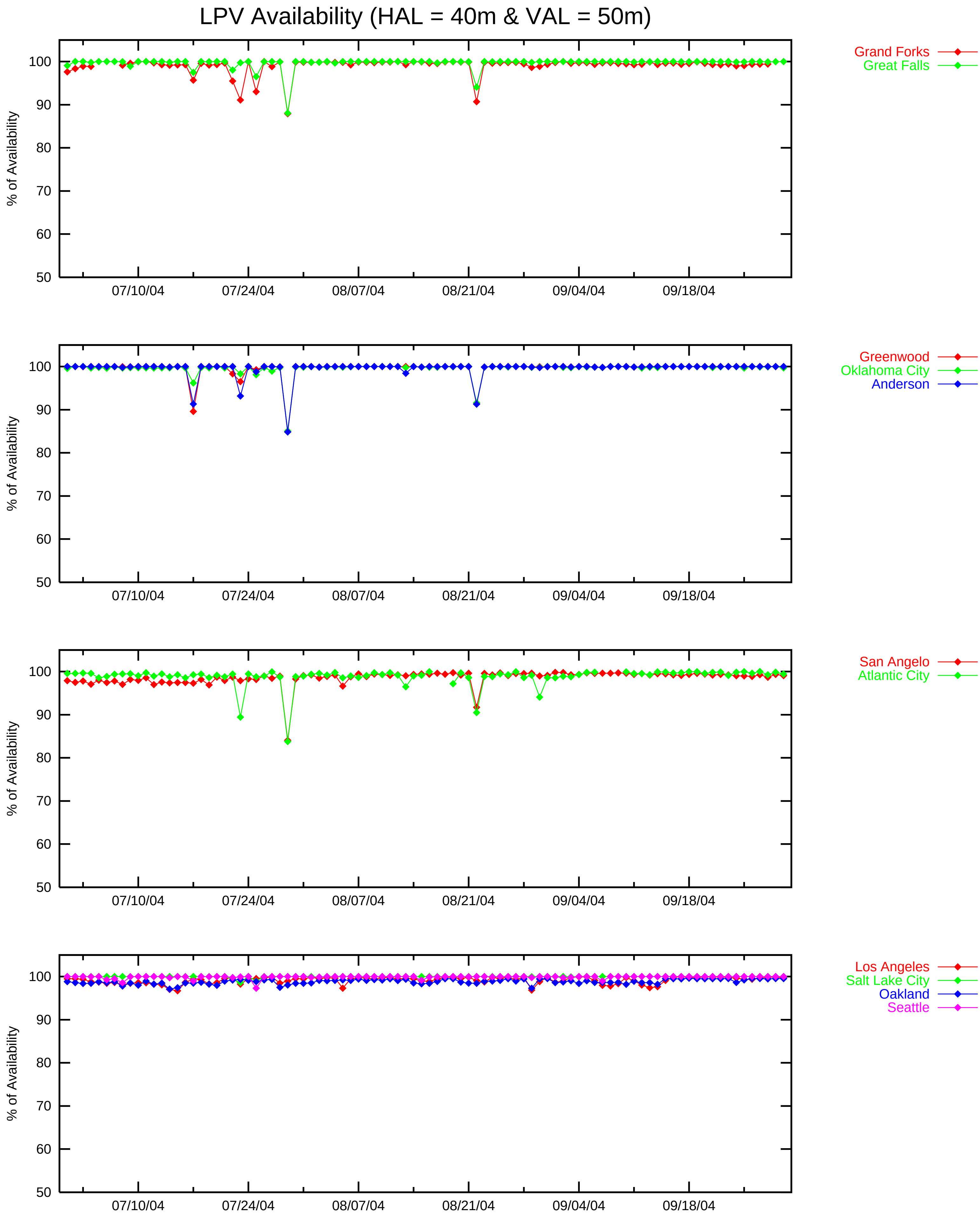


Figure 3-2 LNAV/VNAV Instantaneous Availability

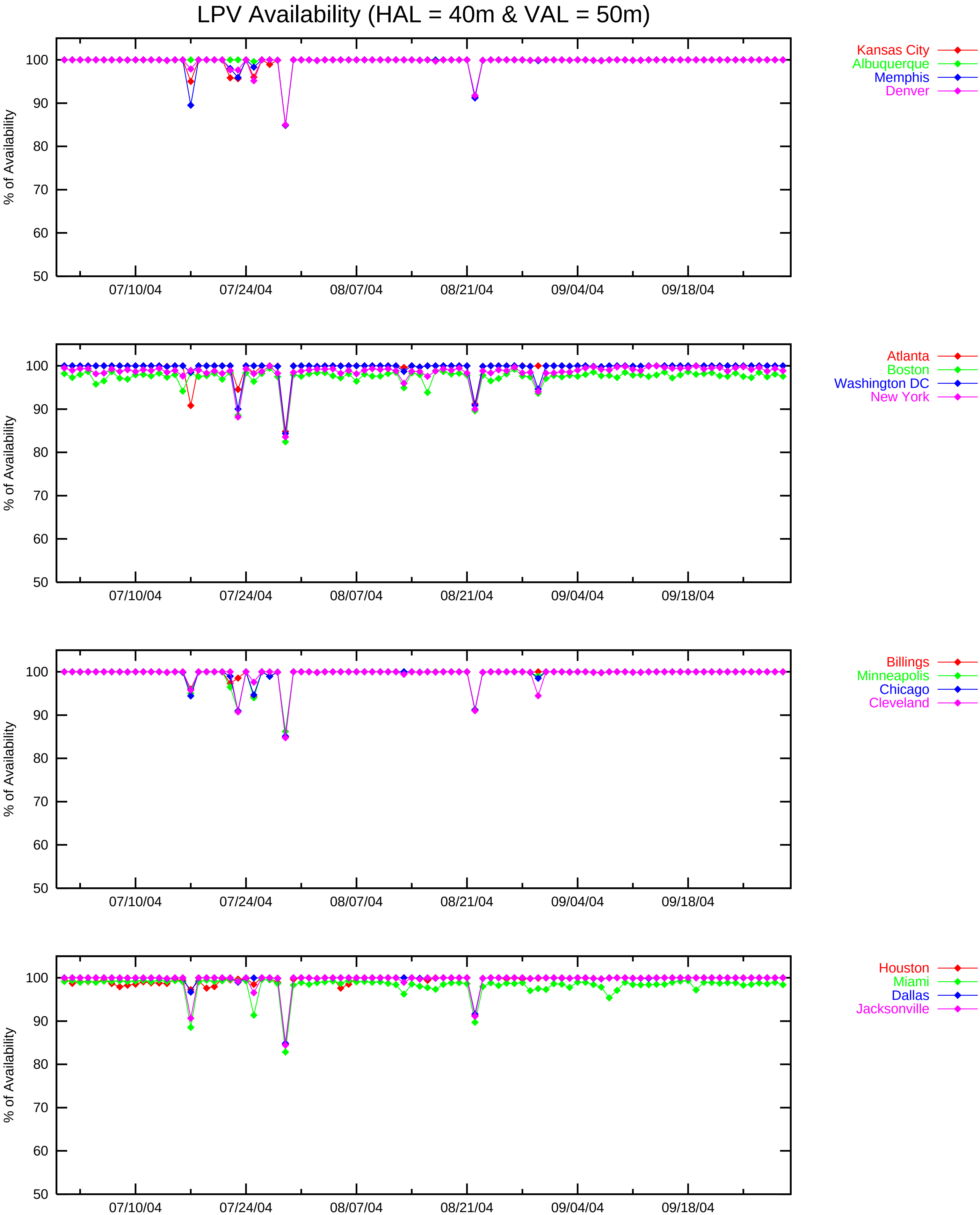


Figure 3-3 LPV Instantaneous Availability

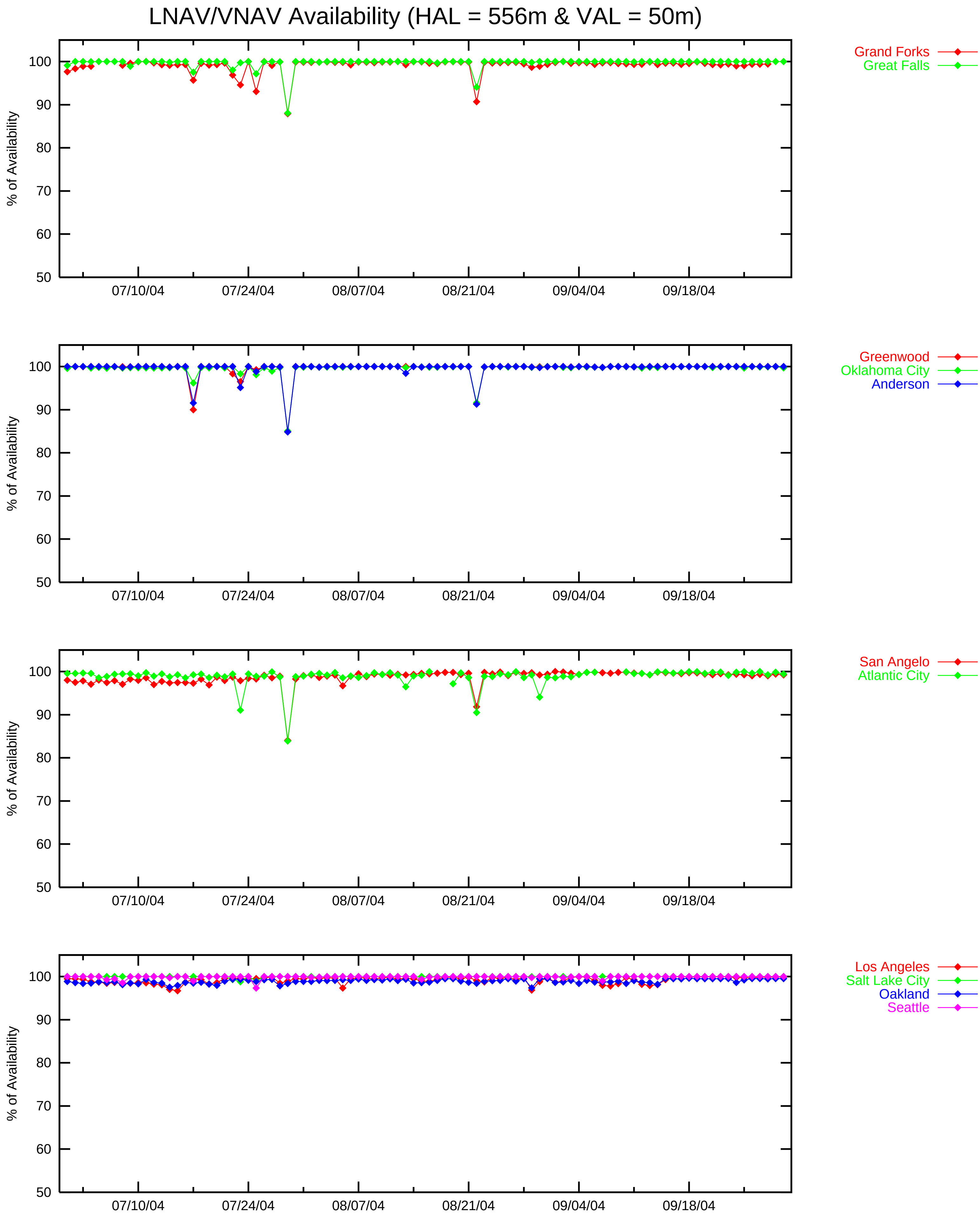


Figure 3-4 LPV Instantaneous Availability

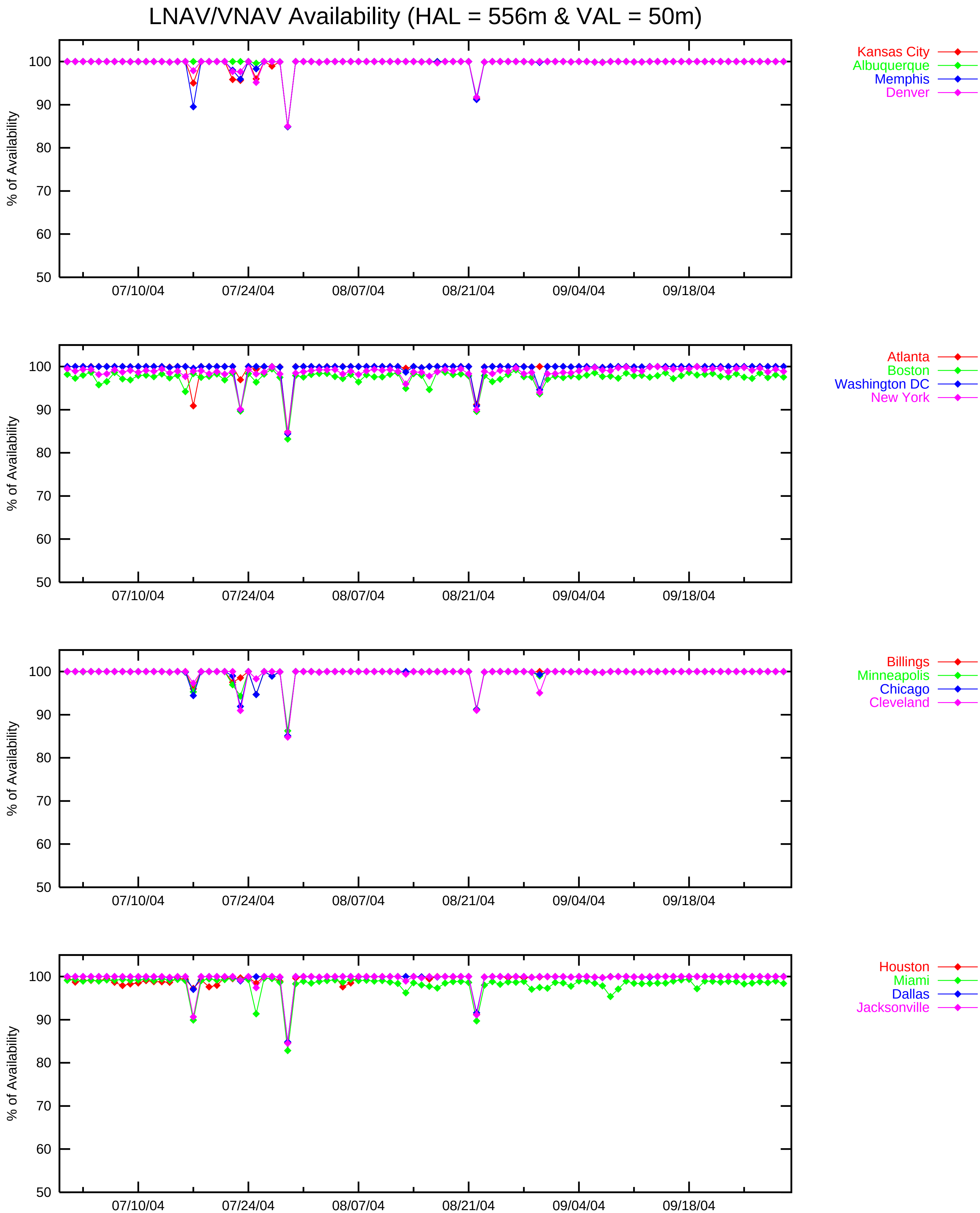


Figure 3-4 LPV Instantaneous Availability

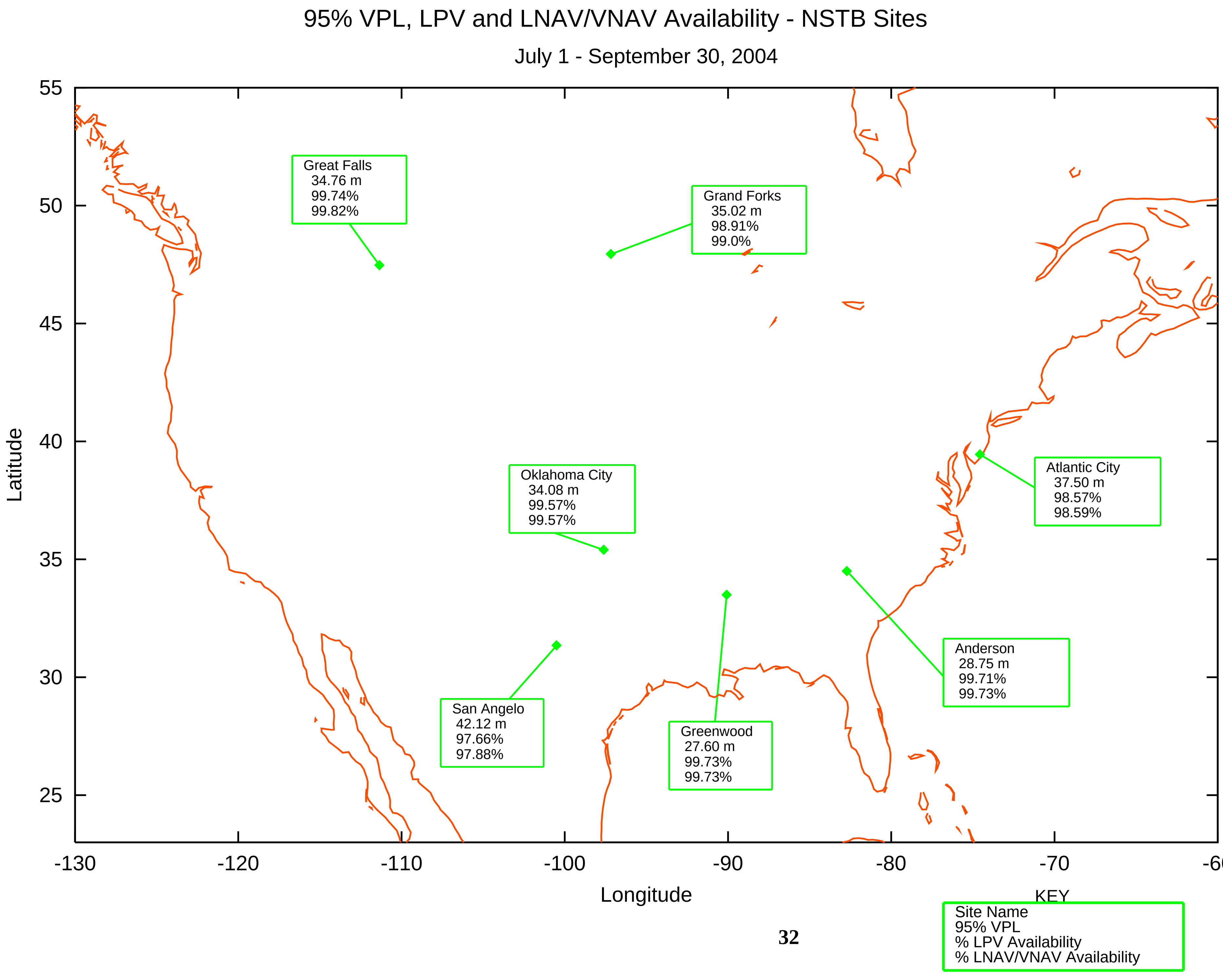
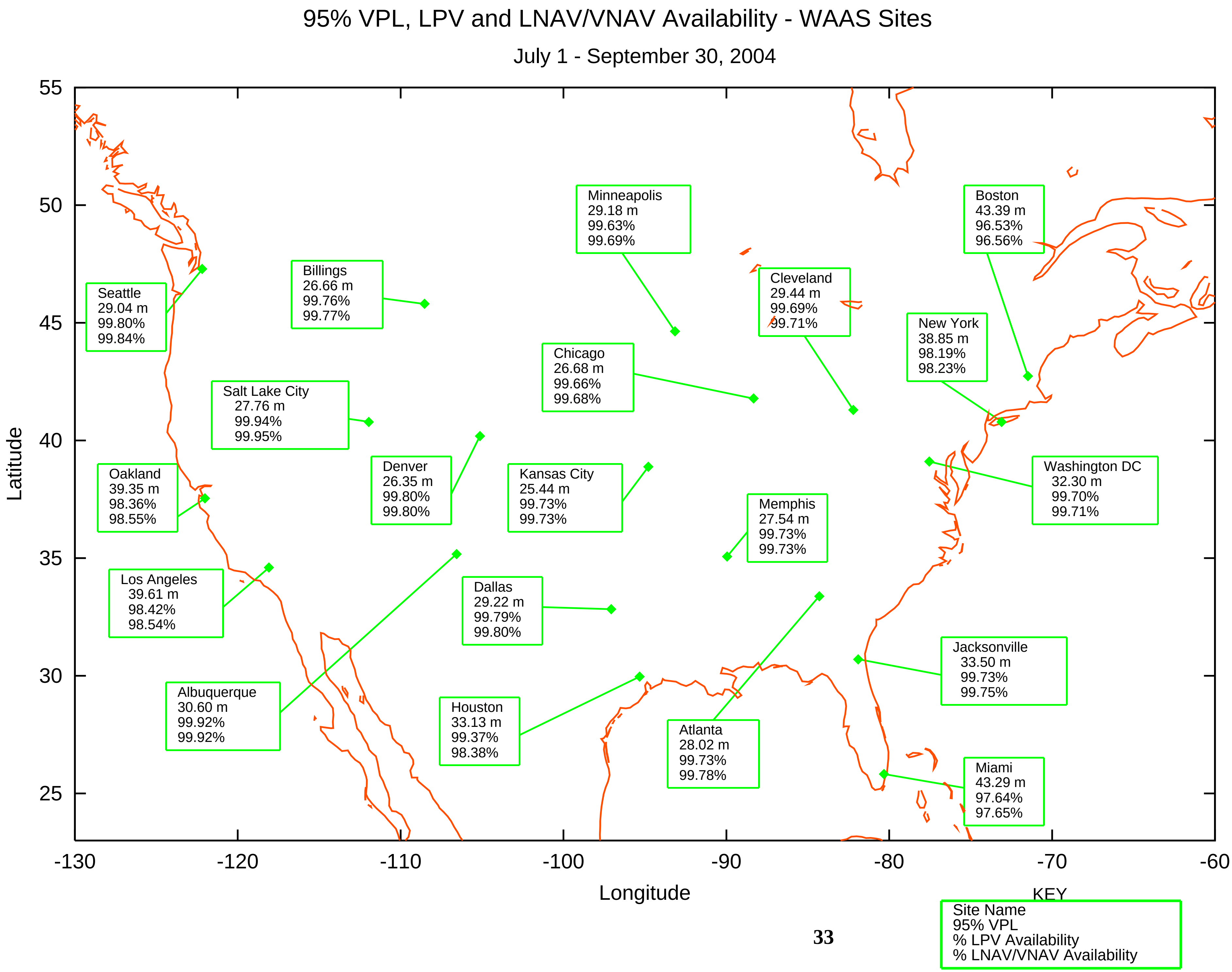


Figure 3-6 95% VPL , LPV and LNAV/VNAV Availability – WAAS sites



4.0 COVERAGE

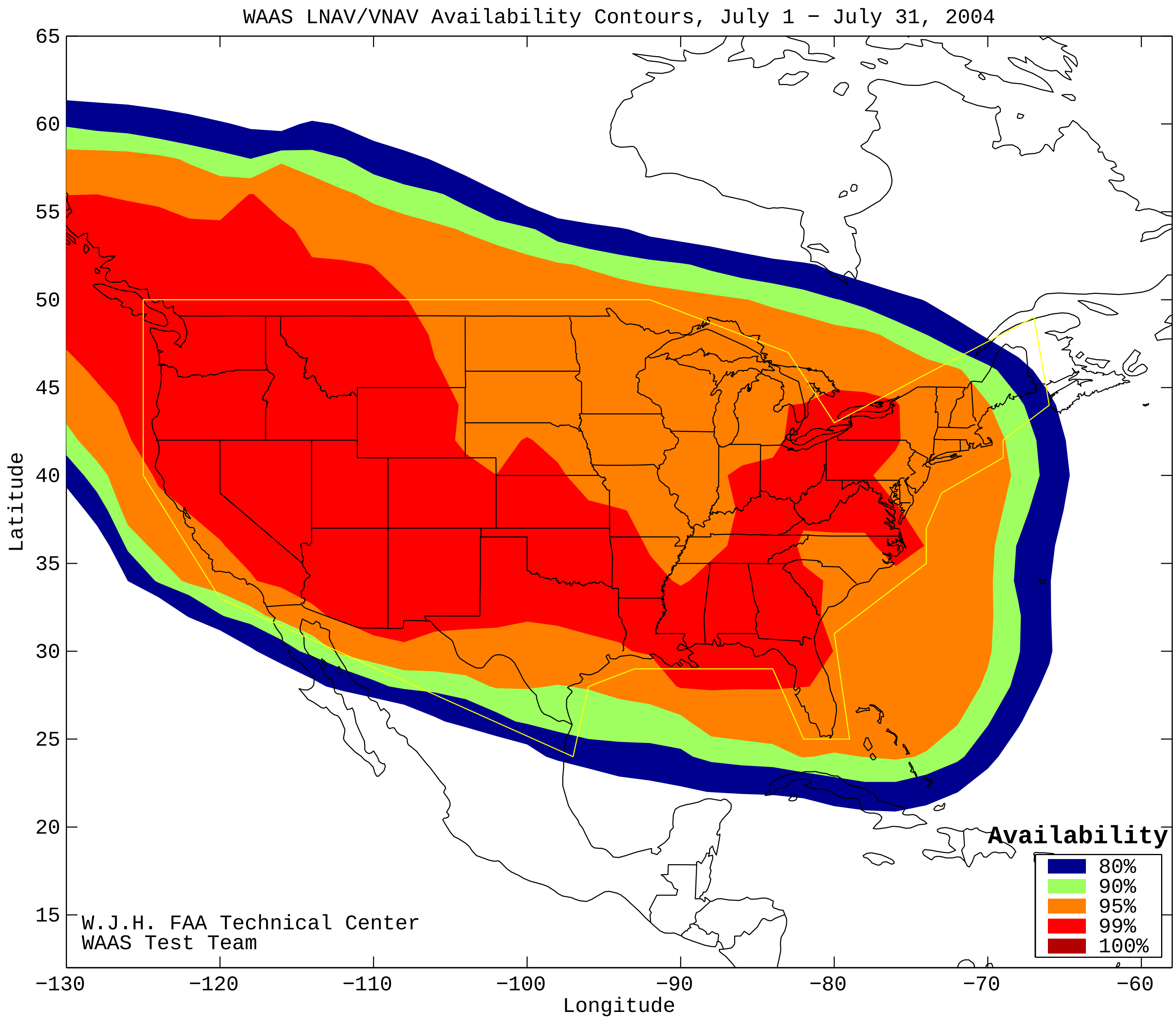
WAAS coverage area evaluation estimates the percent of service volume where WAAS is providing LPV, LNAV/VNAV and NPA services. The WAAS message and the GPS/GEO satellite status are used to determine WAAS availability across North America. For PA coverage, protection levels were calculated at two-minute intervals and at two degree spacing over the PA service volume, while NPA coverage was calculated at two-minute intervals and five degree spacing over the NPA service volume.

Daily analysis for PA was conducted for both LPV and LNAV/VNAV service levels. Figures 4.1 to 4.3 and 4.5 to 4.7 show the WAAS LNAV/VNAV and LPV coverage area for each month for this quarter, respectively. Figures 4.4 and 4.8 show the rollup WAAS LNAV/VNAV and LPV coverage for the quarter. The coverage plots also provide 100, 99, 95, 90 and 80% availability contours. Figure 4.13 shows the daily WAAS LNAV/VNAV and LPV coverage at 99% availability and ionosphere Kp index values for this quarter.

In Figure 4-14, the drops in NPA coverage are due to GUS switchovers. The switchovers cause a loss of WAAS service for a period of up to 5 minutes, for LNAV/VNAV and LPV users. For enroute/NPA users the time of lost service is shorter.

Figure 4.9 to 4.11 show the NPA coverage area of each month and Figure 4.12 shows the rollup NPA coverage for the quarter. Daily analysis for NPA was based on a 99.9% availability requirement. The NPA coverage plots also provide 100, 99.9 and 99% availability contours. Figure 4.14 shows the daily NPA coverage at 99.9% availability and ionosphere Kp index values for this quarter.

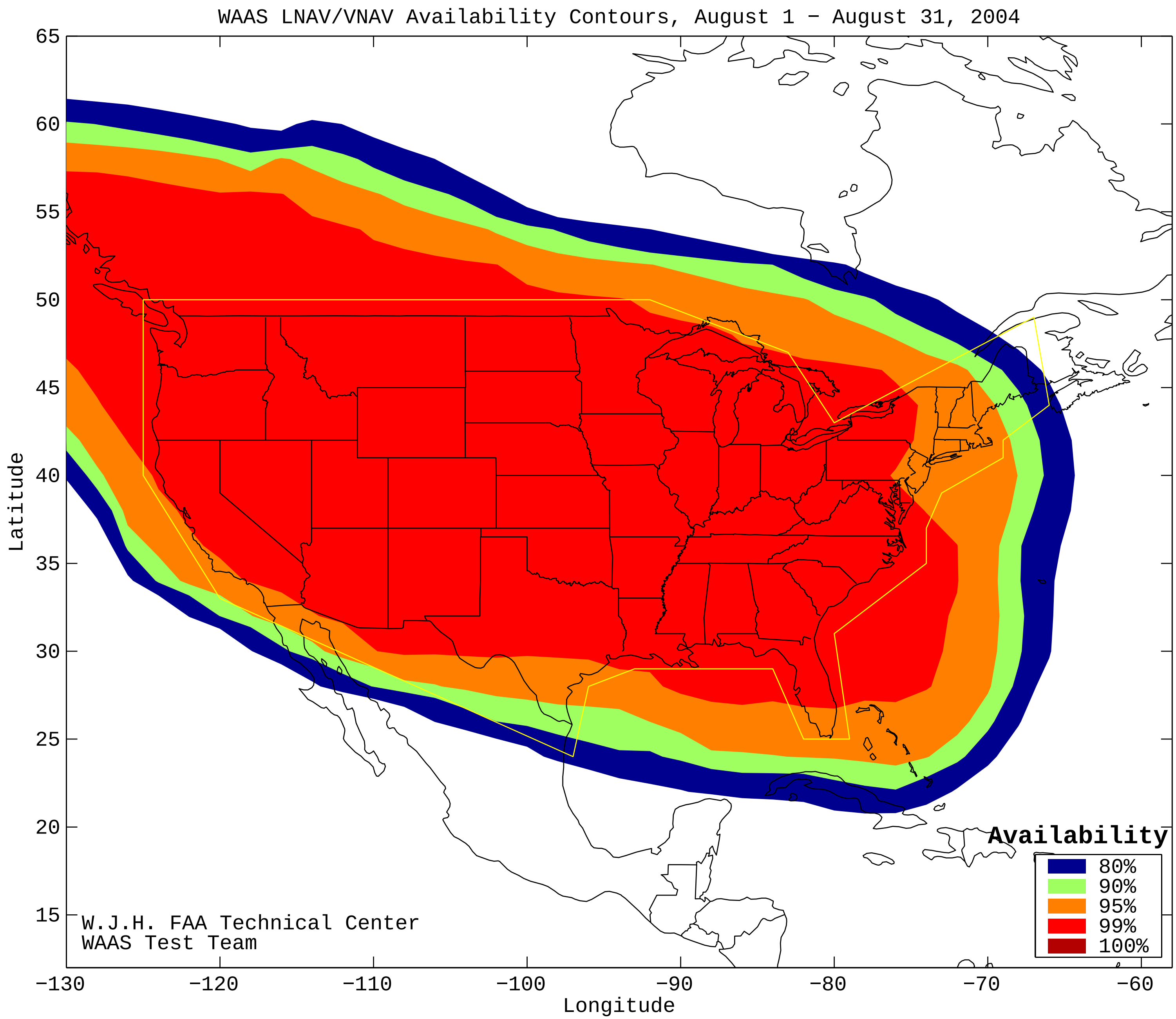
Figure 4-1 WAAS LNAV/VNAV Coverage - July



CONUS Coverage at 95% Availability = 95.95
CONUS Coverage at 99% Availability = 57.49
CONUS Coverage at 100% Availability = 0

SL = LNAV

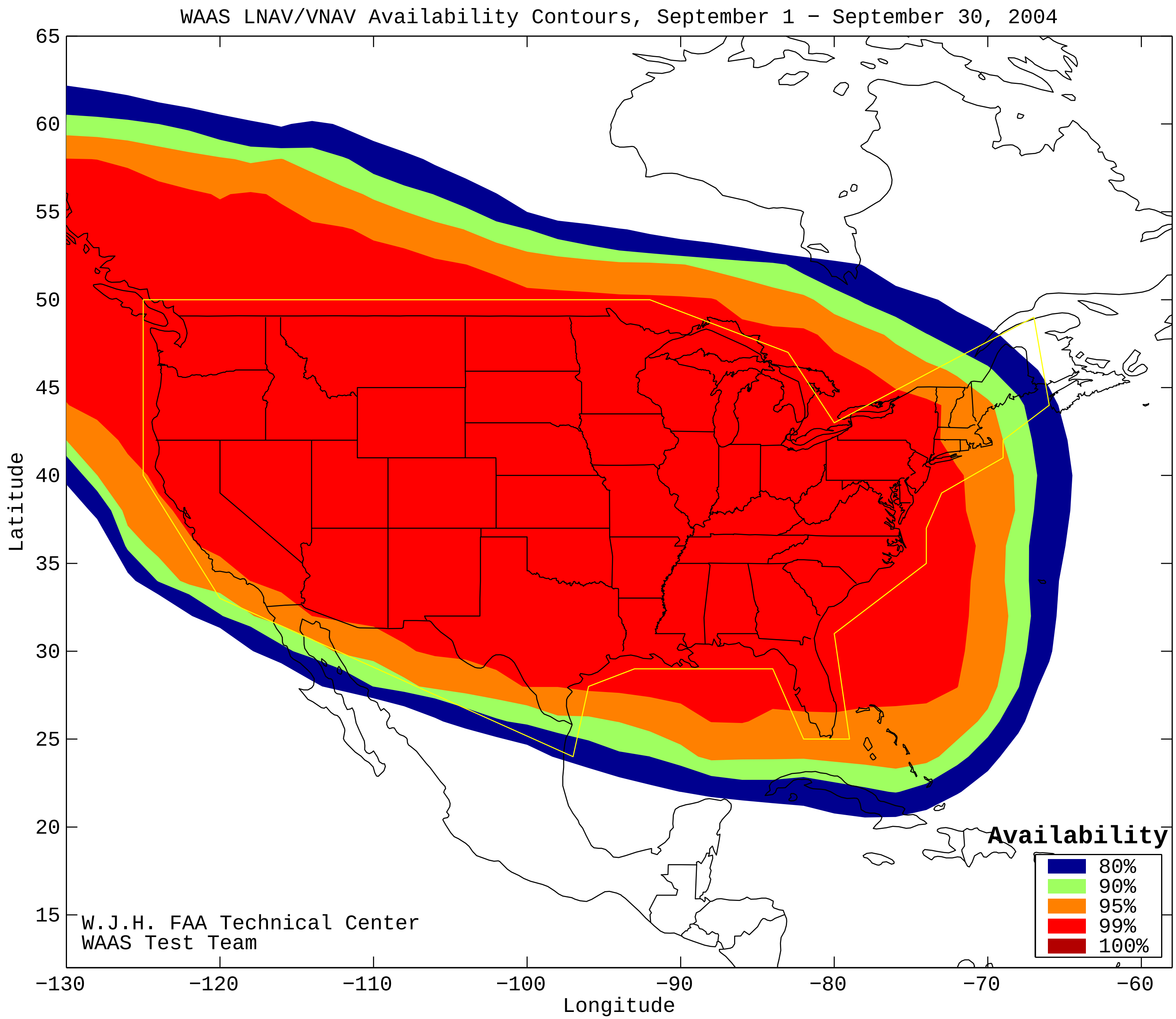
Figure 4-2 WAAS LNAV/VNAV Coverage - August



CONUS Coverage at 95% Availability = 96.76
CONUS Coverage at 99% Availability = 87.04
CONUS Coverage at 100% Availability = 0

SL = LNAV

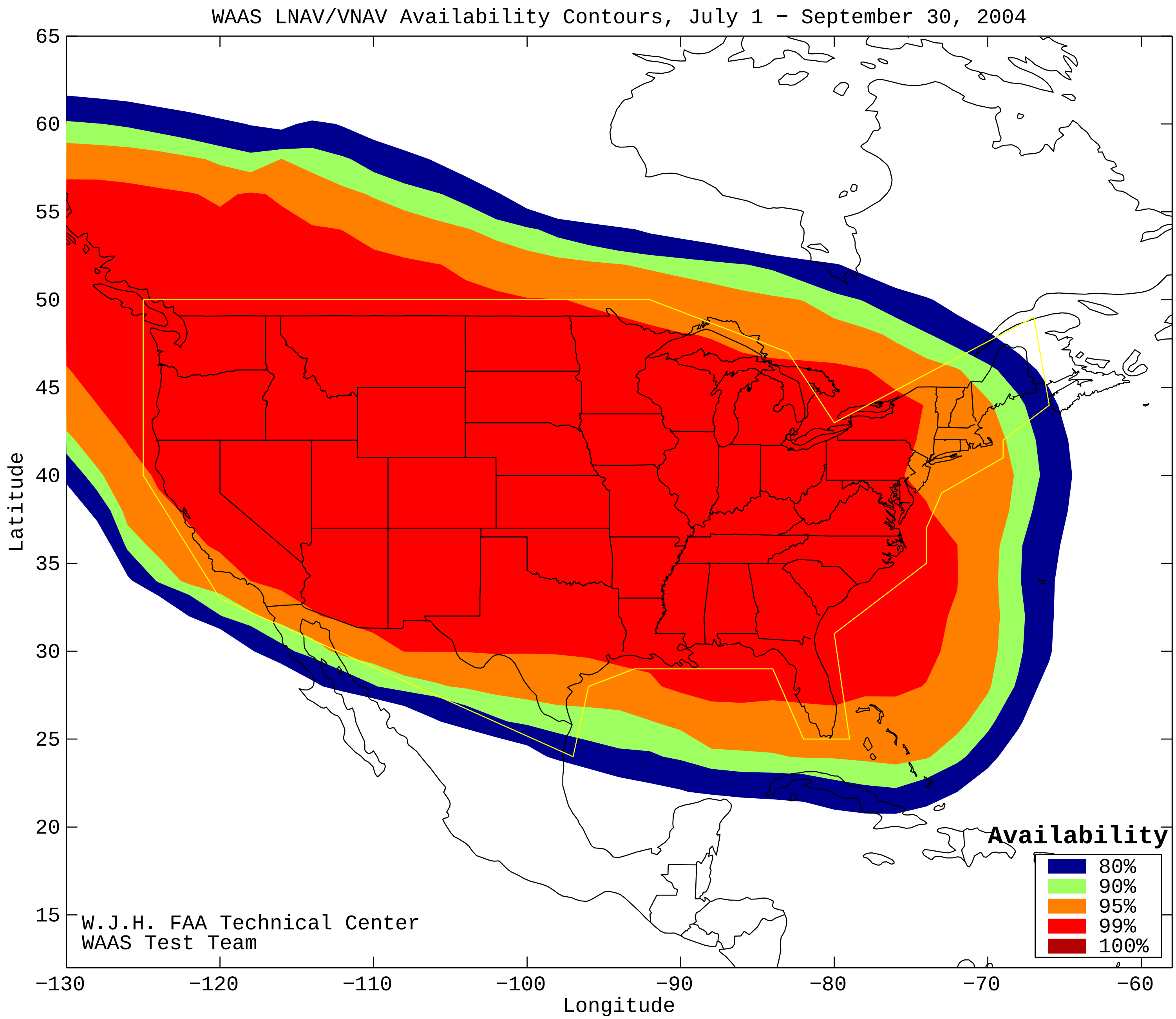
Figure 4-3 WAAS LNAV/VNAV Coverage – September



CONUS Coverage at 95% Availability = 96.76
CONUS Coverage at 99% Availability = 90.69
CONUS Coverage at 100% Availability = 0

SL = LNAV

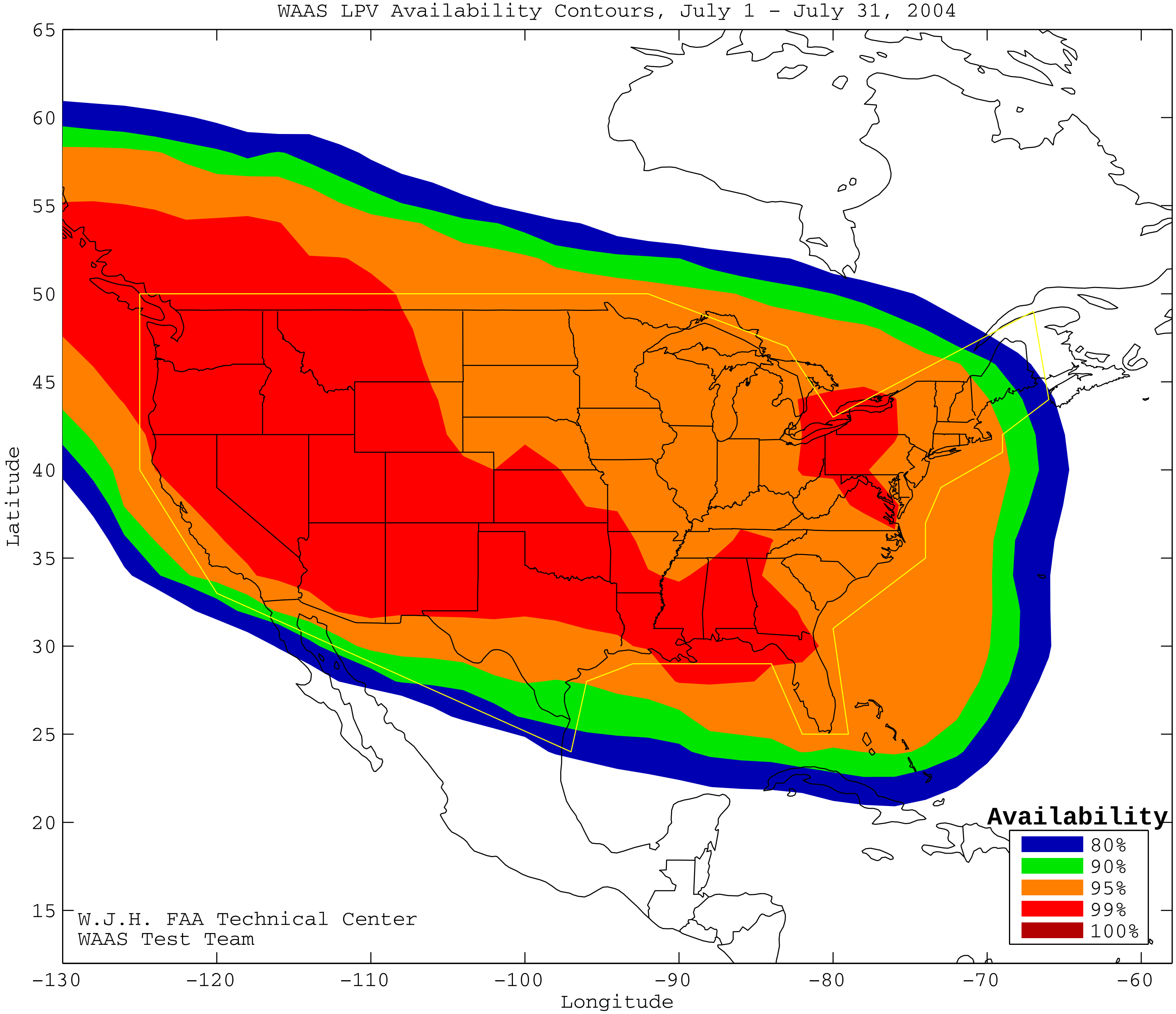
Figure 4-4 WAAS LNAV/VNAV Coverage for the Quarter



CONUS Coverage at 95% Availability = 96.76
CONUS Coverage at 99% Availability = 87.45
CONUS Coverage at 100% Availability = 0

SL = LNAV

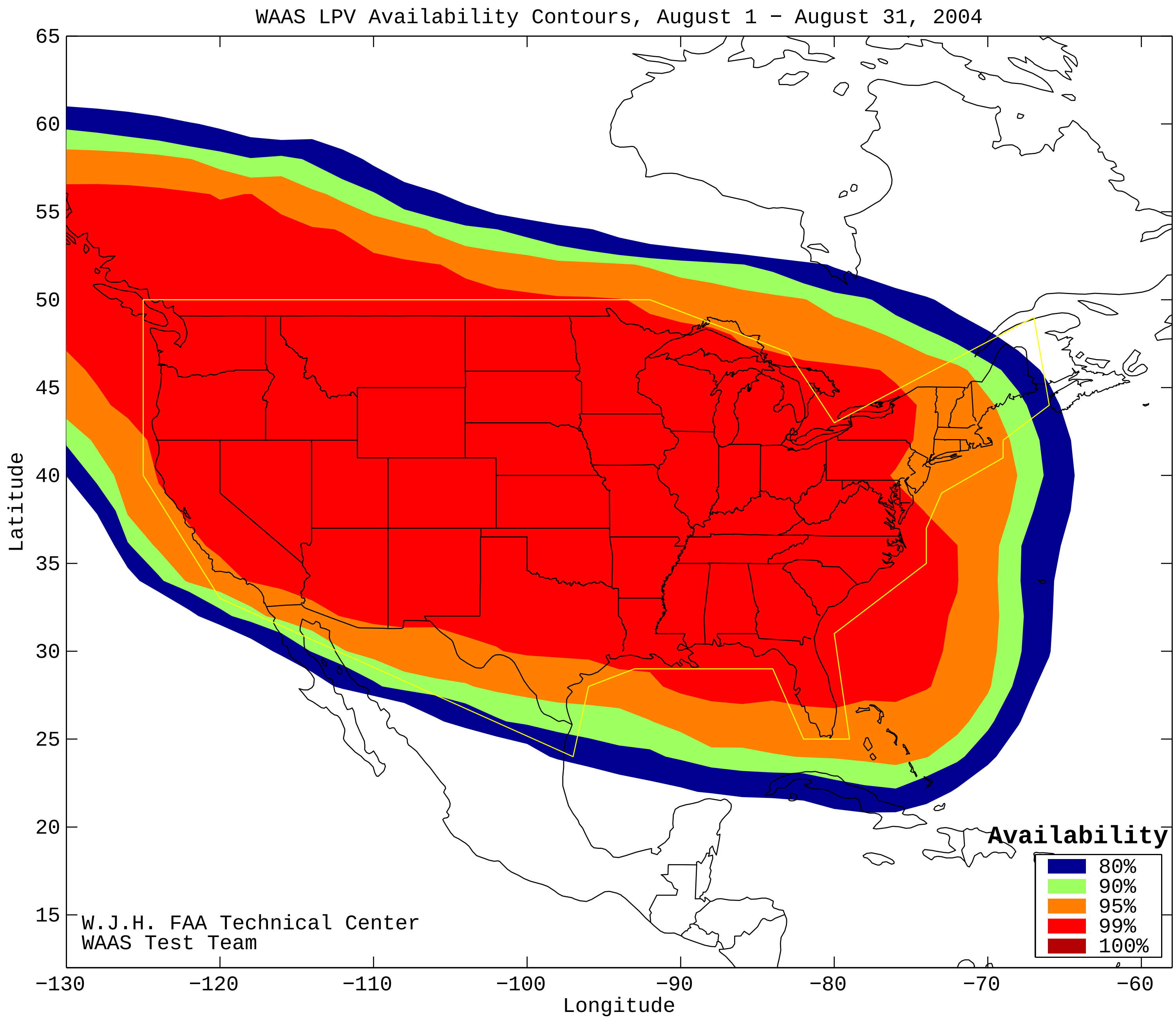
Figure 4-5 WAAS LPV Coverage - July



CONUS Coverage at 95% Availability = 95.14
CONUS Coverage at 99% Availability = 50.2
CONUS Coverage at 100% Availability = 0

SL = LPV

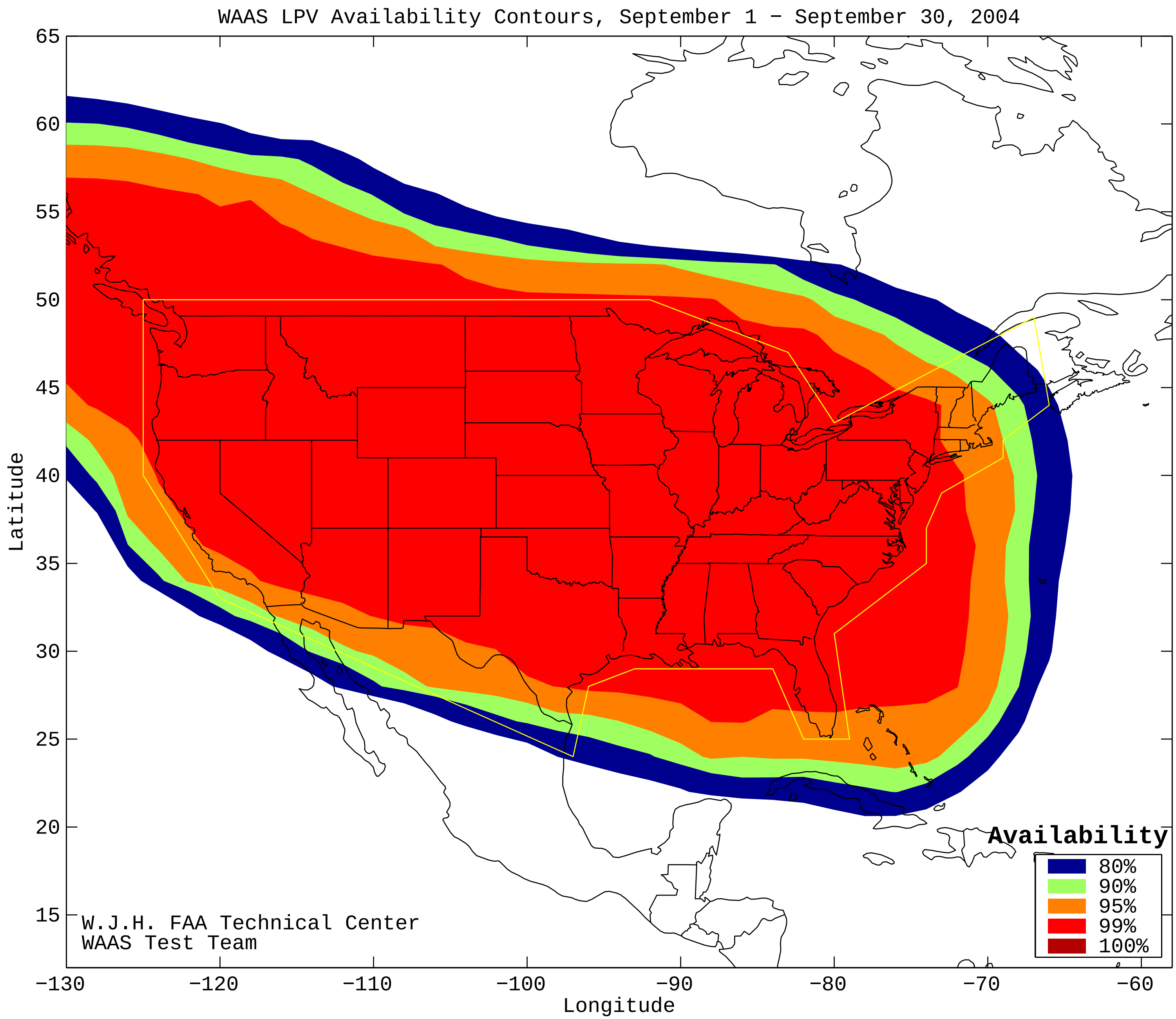
Figure 4-6 WAAS LPV Coverage - August



CONUS Coverage at 95% Availability = 95.95
CONUS Coverage at 99% Availability = 85.43
CONUS Coverage at 100% Availability = 0

SL = LPV

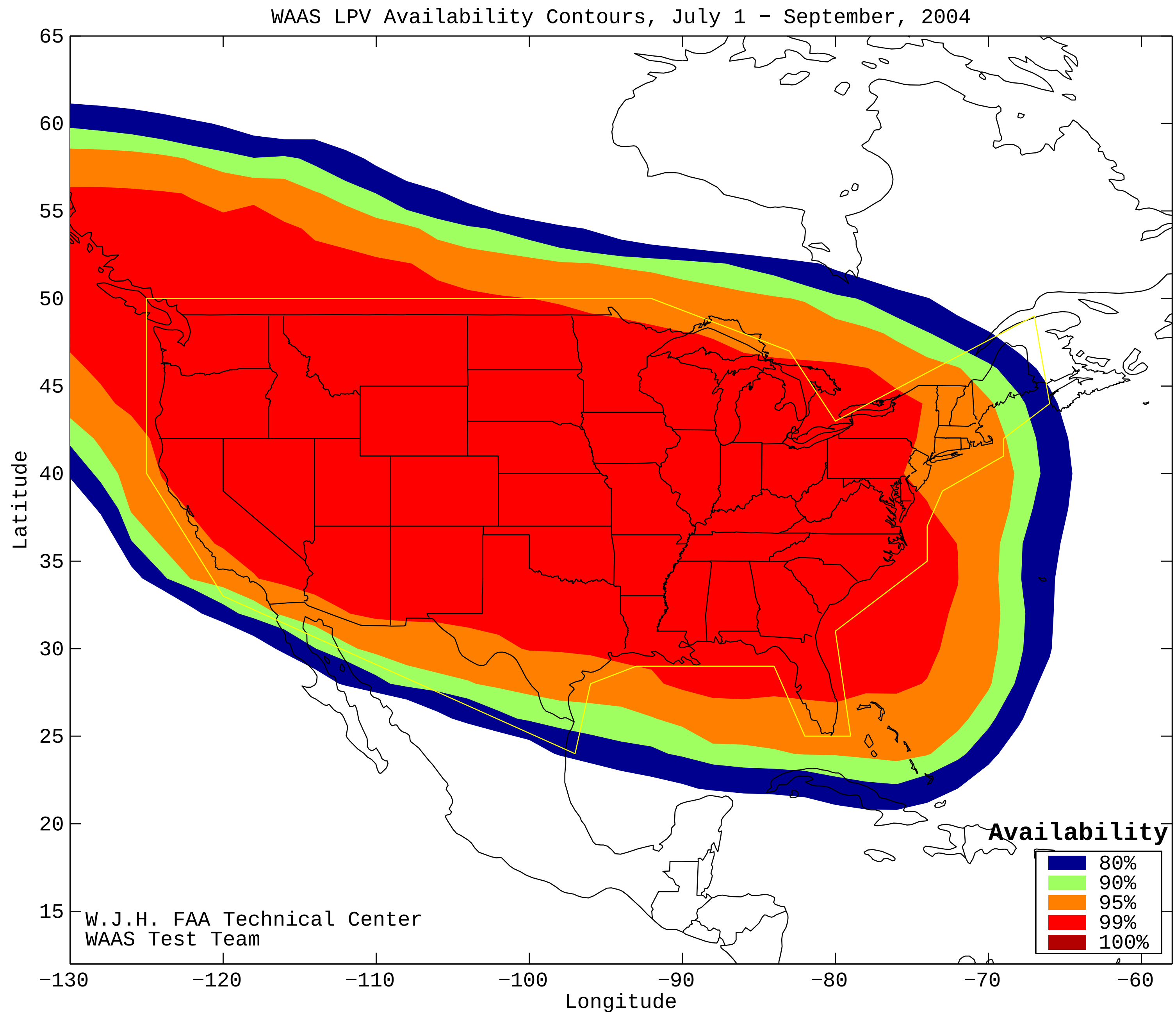
Figure 4-7 WAAS LPV Coverage - September



CONUS Coverage at 95% Availability = 96.36
CONUS Coverage at 99% Availability = 87.85
CONUS Coverage at 100% Availability = 0

SL = LPV

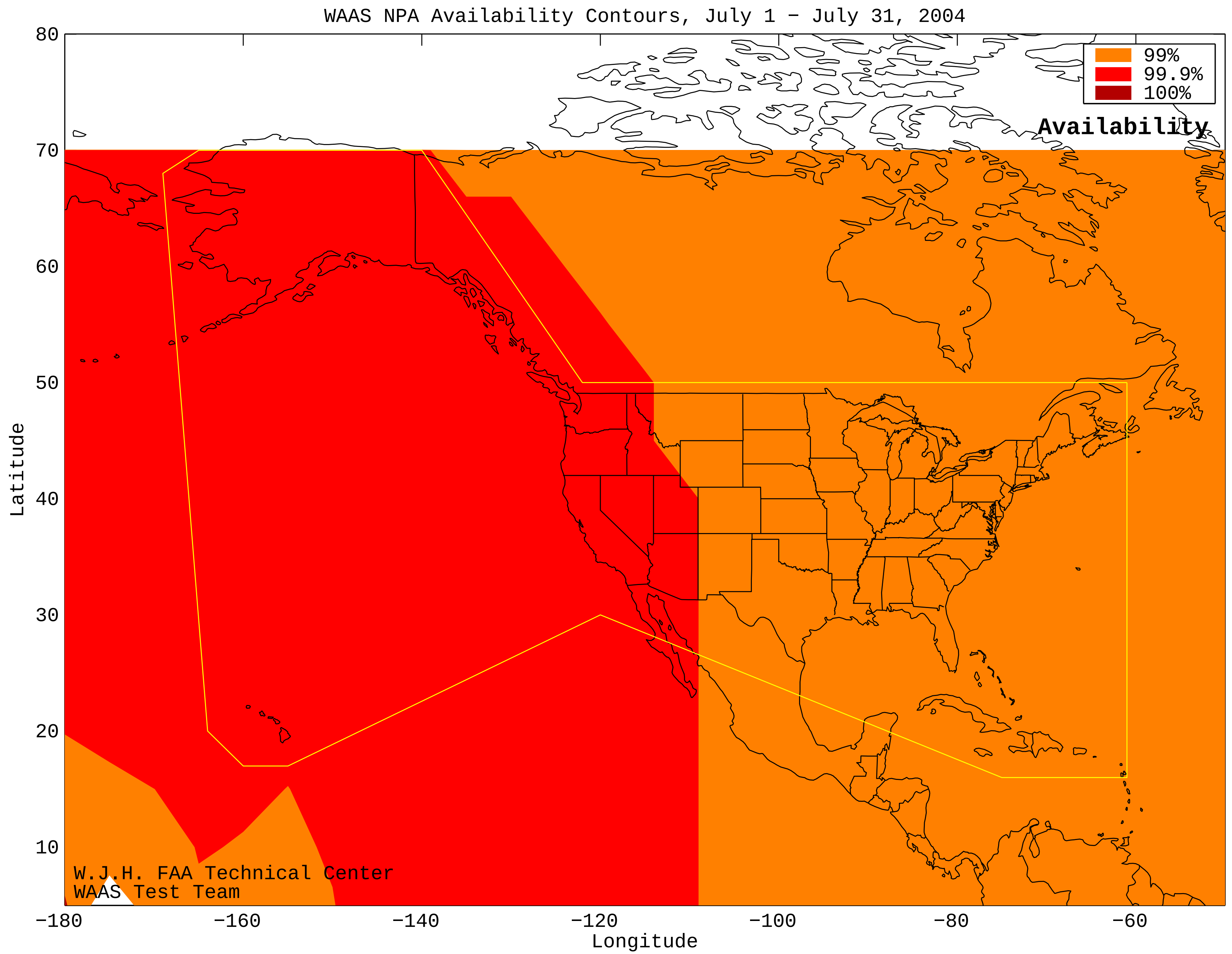
Figure 4-8 WAAS LPV Coverage for the Quarter



CONUS Coverage at 95% Availability = 95.95
CONUS Coverage at 99% Availability = 85.02
CONUS Coverage at 100% Availability = 0

SL = LPV

Figure 4-9 WAAS NPA Coverage - July



WAAS Coverage at 99% Availability = 100
WAAS Coverage at 99.9% Availability = 63.24
WAAS Coverage at 100% Availability = 0

SL = NPA

Figure 4-10 WAAS NPA Coverage – August

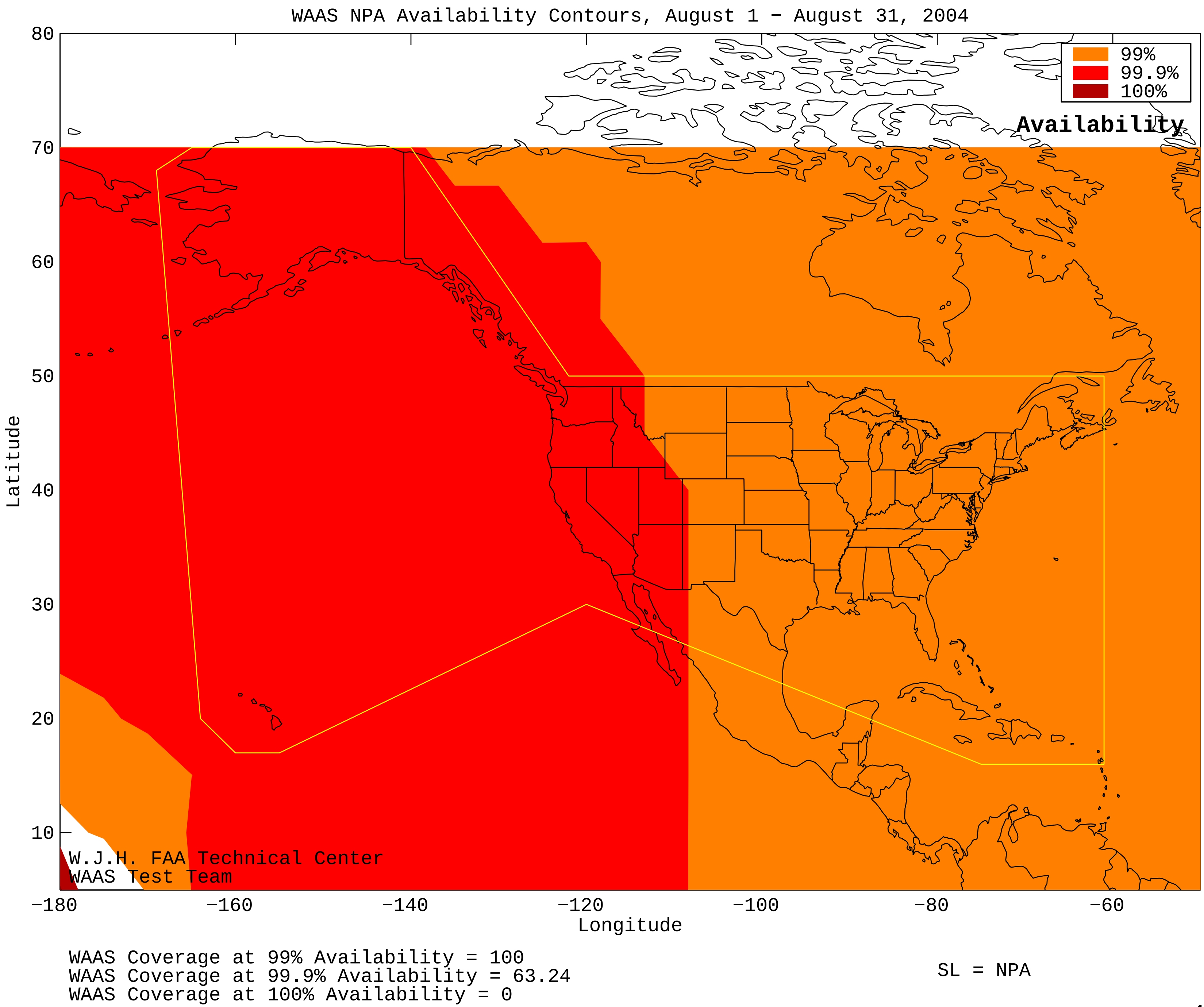
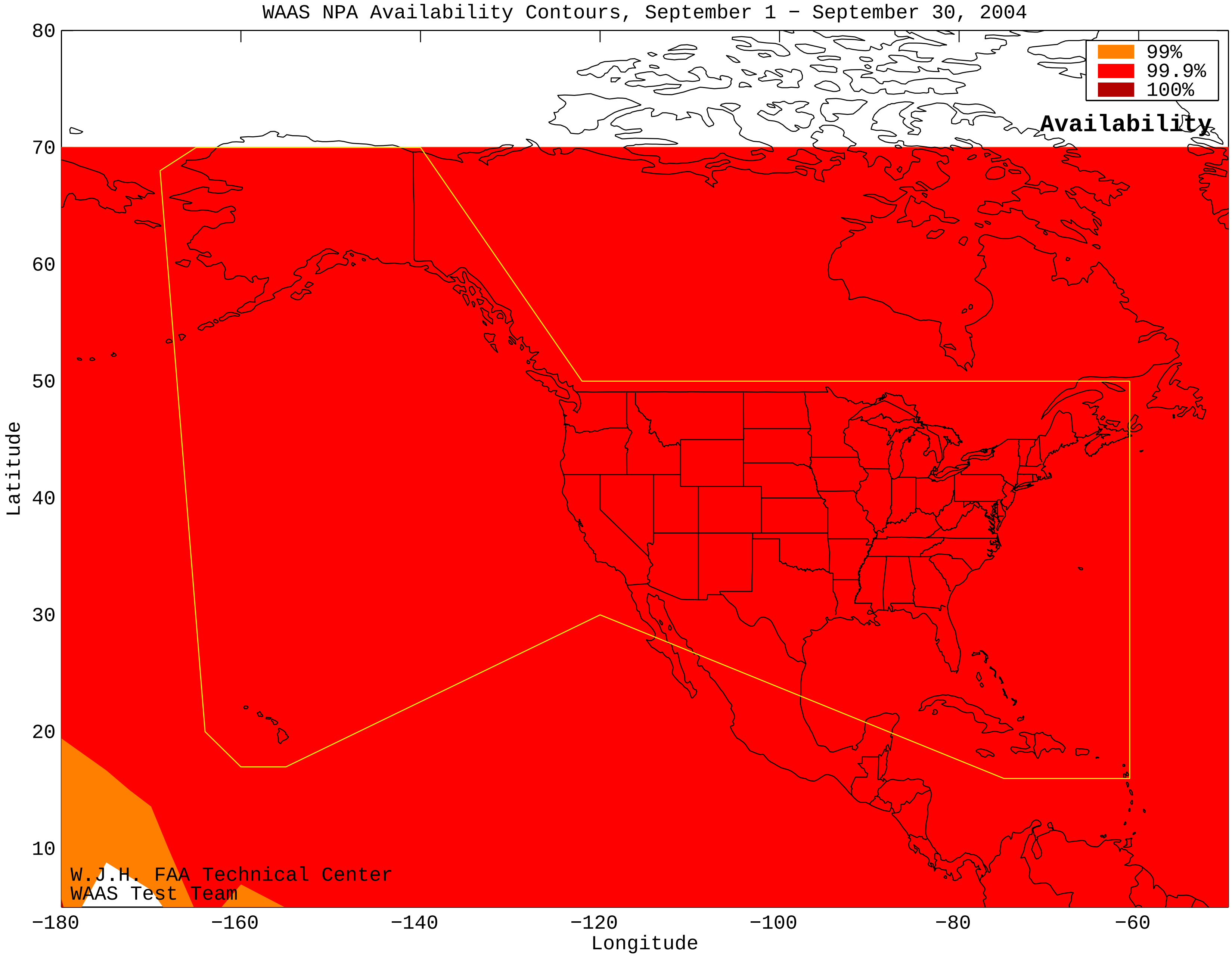


Figure 4-11 WAAS NPA Coverage - September



WAAS Coverage at 99% Availability = 100
WAAS Coverage at 99.9% Availability = 100
WAAS Coverage at 100% Availability = 0

SL = NPA

Figure 4-12 WAAS NPA Coverage for the Quarter

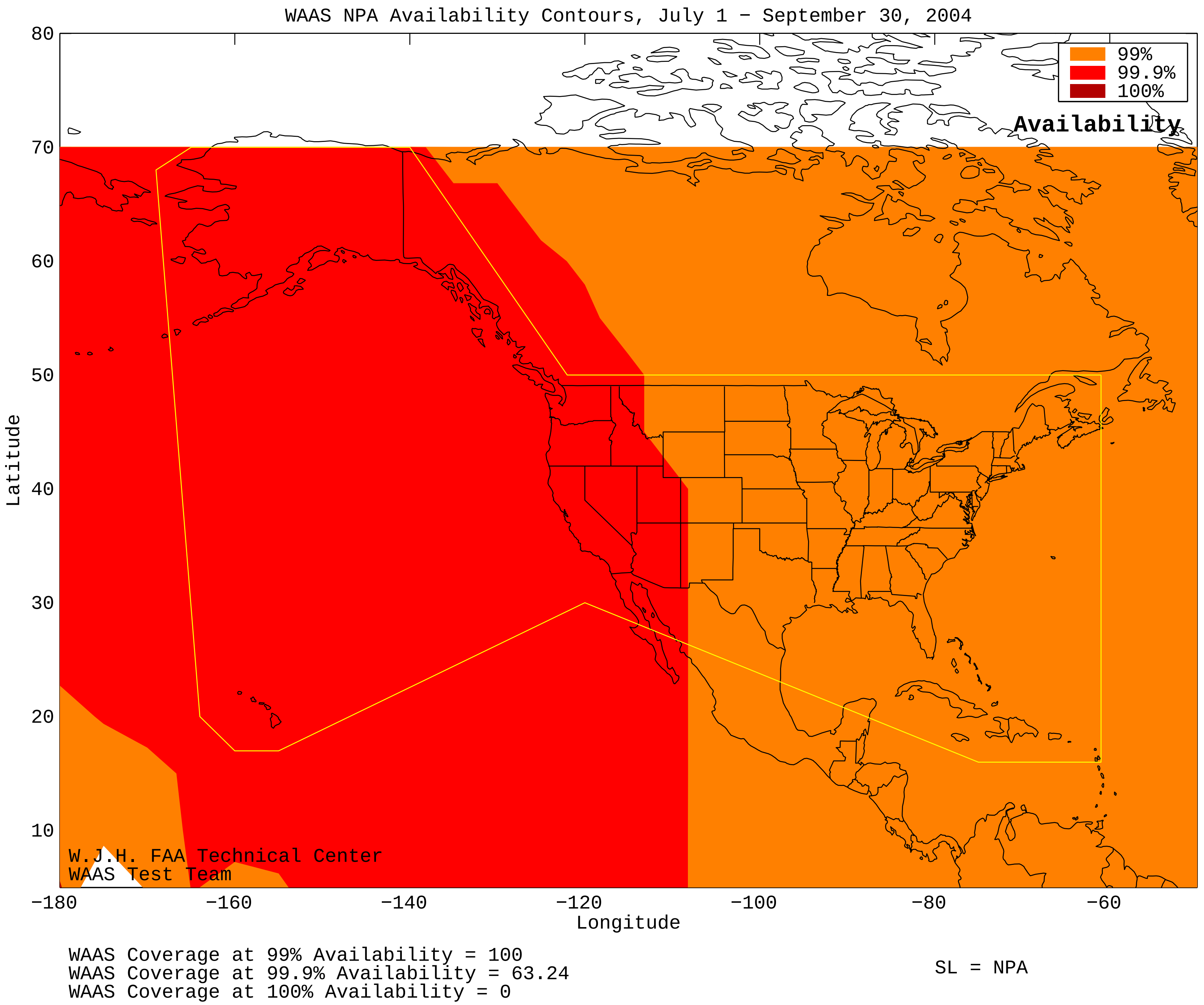


Figure 4-13 Daily WAAS LNAV/VNAV and LPV Coverage

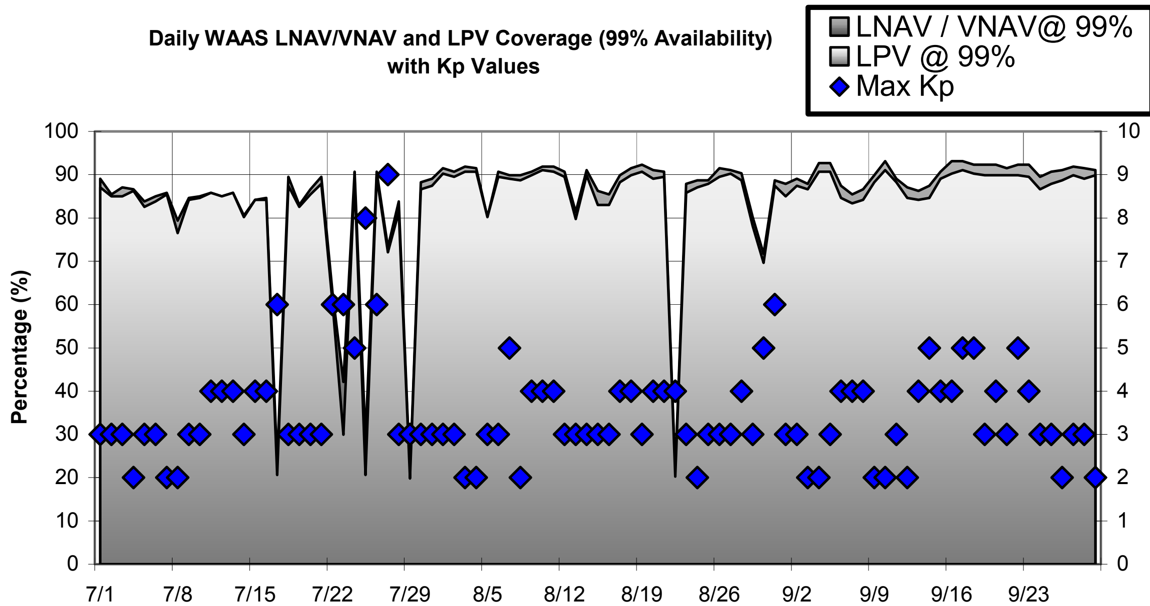
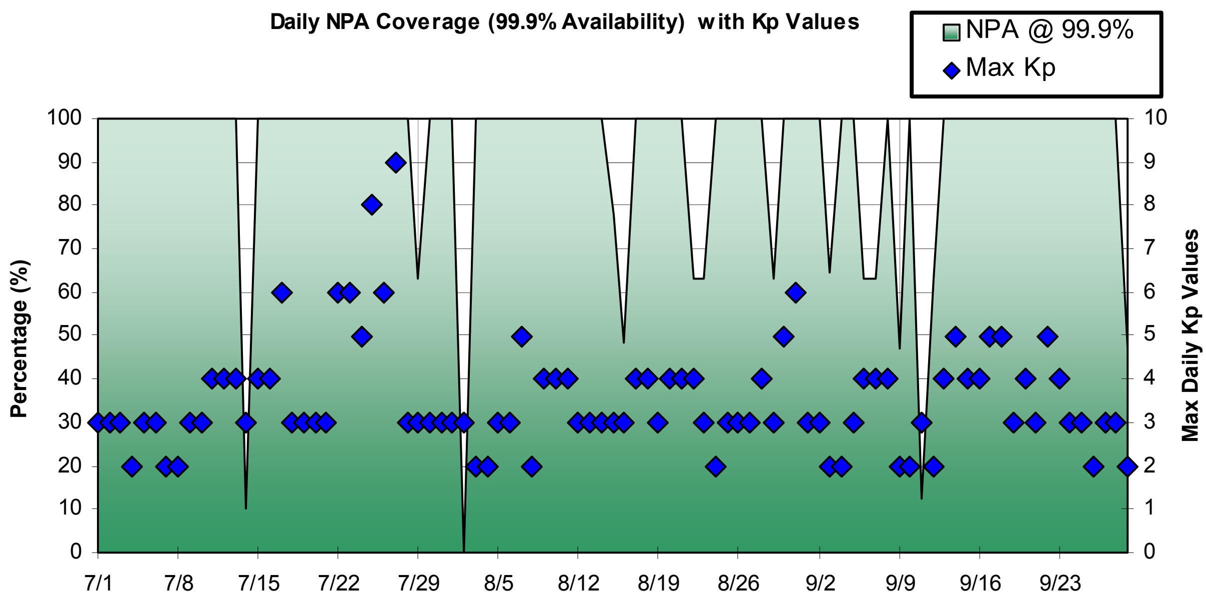


Figure 4-14 Daily NPA Coverage



5.0 CONTINUITY

The definition of PA and NPA continuity and availability definitions are based on the definition from the WAAS specification FAA-E-2892B Change 1. Future reports will use a different definition for continuity and availability to better reflect how these parameters affect operational performance of WAAS.

5.1 PA Continuity of Function

PA continuity of function was evaluated by monitoring the WAAS accuracy and integrity performance. Navigation error data for each reference site was divided into multiple bins consisting of 150 data samples. The position accuracy and integrity performance data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal and vertical position errors are less than 7.6 meter 95% of the time for each bin.
- No HMIs have occurred in the horizontal or vertical dimensions.
- User position tool maintains PA mode of operation as defined in Section 2.0.

If the above conditions are met, then the continuity flag is set to "1" to indicate the continuity of function is met for that particular flight segment. The continuity of function percentile statistic was computed for each site by summing the continuity flags of "1" together and dividing by the total number of test segments (bins) accumulated. Table 5.1 shows the PA Continuity of Function probability ranges from 0.999499 (Grand Forks) to 0.999924 (Salt Lake City).

Table 5-1 PA Continuity of Function

Location	PA Continuity of Function
Anderson	0.999544
Atlantic City	0.999589
Elko	0.999870
Grand Forks	0.999499
Great Falls	0.999618
Greenwood	0.999559
Oklahoma City	0.999560
San Angelo	0.999531
Billings	0.999545
Albuquerque	0.999546
Chicago	0.999546
Boston	0.999527
Washington DC	0.999546
Denver	0.999546
Dallas	0.999545
Houston	0.999545
Jacksonville	0.999527
Kansas City	0.999546
Los Angeles	0.999906
Salt Lake City	0.999924
Miami	0.999546
Memphis	0.999545
Minneapolis	0.999564
New York	0.999564
Oakland	0.999906
Cleveland	0.999545
Seattle	0.999906
Atlanta	0.999545

5.2 NPA Continuity of Navigation

NPA continuity of navigation was evaluated by monitoring the accuracy performance throughout each flight hour. Navigation error data for each site was divided into multiple bins consisting of 3600 data samples. The position accuracy data for each bin was analyzed and statistics were generated to evaluate the data. If the horizontal position error is less than 100 meters 95% of the time, then the continuity of navigation flag is set to "1" to indicate the continuity of navigation is met for that particular flight hour. The continuity of navigation percentile statistic was computed for each reference site by summing the continuity of navigation flags of "1" together and dividing by the total number of test hours (bins) accumulated. The NPA Continuity of Navigation column of Table 5.2 shows all evaluated sites passed the requirements with the maximum probability of 1.

5.3 NPA Continuity of Fault Detection

NPA continuity of fault detection was evaluated by monitoring the integrity performance throughout each flight hour. Navigation error data for each reference site was divided into multiple bins consisting of 3600 data samples. The horizontal and vertical position error data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- No HMIs have occurred in the horizontal dimension.
- User maintains NPA navigation mode of operation as defined in Section 2.0.

If the above conditions are met, then the continuity of fault detection flag is set to "1" to indicate the continuity of fault detection is met for that particular flight hour. The continuity of fault detection percentile statistic was computed for each reference site by summing the continuity of fault detection flags of "1" together and dividing by the total number of test hours (bins) accumulated. The NPA Continuity of Fault Detection column of Table 5.2 shows the probability ranges from 0.991835 (Grand Forks) to 0.998641 (Seattle). These statistics do not include Receiver Autonomous Integrity Monitoring (RAIM)/Fault Detection and Exclusion (FDE) integrity functions.

Table 5-2 NPA Continuity

Location	Continuity of Navigation	Continuity of Fault Detection (Excluding RAIM/FDE)
Anderson	1.000000	0.992255
Atlantic City	1.000000	0.993424
Elko	1.000000	0.998435
Grand Forks	1.000000	0.991835
Great Falls	1.000000	0.994500
Greenwood	1.000000	0.992184
Oklahoma City	1.000000	0.992650
San Angelo	1.000000	0.992495
Billings	1.000000	0.993188
Albuquerque	1.000000	0.993188
Chicago	1.000000	0.993188
Boston	1.000000	0.992734
Washington DC	1.000000	0.992276
Denver	1.000000	0.992276
Dallas	1.000000	0.992727
Houston	1.000000	0.992724
Jacksonville	1.000000	0.993191
Kansas City	1.000000	0.992269
Los Angeles	1.000000	0.998641
Salt Lake City	1.000000	0.998640
Miami	1.000000	0.993188
Memphis	1.000000	0.993185
Minneapolis	1.000000	0.992731
New York	1.000000	0.992734
Oakland	1.000000	0.998640
Cleveland	1.000000	0.993182
Seattle	1.000000	0.998641
Atlanta	1.000000	0.992724

5.4 LPV Availability

LPV availability was evaluated by monitoring the accuracy, integrity and availability performance throughout each flight segment. Navigation error data for each reference site was divided into multiple bins consisting of 150 data samples. The position accuracy, integrity and availability performance data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal and vertical position errors are less than 7.6 meter 95% of the time for each bin.
- No HMIs have occurred in the horizontal or vertical dimensions.
- User maintains PA mode of operation as defined in section 2.0.
- VPL is less than or equal to 50m and HPL is less than or equal to 40 m.

If the above conditions are met, then the continuity of function flag is set to "1" to indicate the LPV availability is met for that particular flight segment. The availability percentile statistic was computed for each reference site by summing the continuity of function flags of "1" together and dividing by the total number of test segments (bins) accumulated. LPV Availability column of Table 5.3 shows the probability for availability ranges from 96.5379% (Boston) to 99.9452% (Salt Lake City).

5.5 LNAV/VNAV Availability

LNAV/VNAV availability was evaluated by monitoring the accuracy, integrity and availability performance throughout each flight segment. Navigation error data for each reference site was divided into multiple bins consisting of 150 data samples. The position accuracy, integrity and availability performance data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal and vertical position errors are less than 7.6 meter 95% of the time for each bin.
- No HMIs have occurred in the horizontal or vertical dimensions.
- User maintains PA mode of operation as defined in section 2.0.
- VPL is less than or equal to 50m and HPL is less than or equal to 556 m.

If the above conditions are met, then the continuity of function flag is set to "1" to indicate the LNAV/VNAV availability is met for that particular flight segment. The availability percentile statistic was computed for each reference site by summing the continuity of function flags of "1" together and dividing by the total number of test segments (bins) accumulated. The LPV Availability column of Table 5.3 shows the availability ranges from 96.5606% (Boston) to 99.509% (Salt Lake City).

5.6 NPA Availability

NPA availability was evaluated by monitoring the accuracy, integrity and availability performance throughout each flight hour. Navigation error data for each reference site was divided into multiple bins consisting of 3600 data samples. The horizontal and vertical position error data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal position errors are less than 100 meters 95% of time for each bin
- No HMIs have occurred in the horizontal dimension.
- User maintains NPA navigation mode of operation as defined in Section 2.0.
- HPL is less than or equal to 556 meters.

If the above conditions are met, then the availability flag is set to "1" to indicate NPA availability is met for that particular flight hour. The NPA availability percentile statistic was computed for each reference site by summing the availability flags of "1" together and dividing by the total number of test hours (bins) accumulated.

The NPA Availability column of Table 5.4 shows the availability ranges from 99.2269% (Kansas City) to 99.8641% (Seattle). These statistics do not include RAIM/FDE integrity functions.

Table 5-3 LPV and LNAV/VNAV Availability

Location	LPV Availability	LNAV/VNAV Availability
Anderson	0.997133	0.997380
Atlantic City	0.985714	0.985949
Grand Forks	0.989164	0.990065
Great Falls	0.997442	0.998263
Greenwood	0.997375	0.997395
Oklahoma City	0.995732	0.995732
San Angelo	0.976671	0.978861
Albuquerque	0.999262	0.999262
Atlanta	0.997309	0.997802
Billings	0.997689	0.997784
Boston	0.965379	0.965606
Chicago	0.996648	0.996819
Cleveland	0.996932	0.997197
Dallas	0.997972	0.998048
Denver	0.998069	0.998069
Houston	0.993712	0.993882
Jacksonville	0.997350	0.997520
Kansas City	0.997368	0.997387
Los Angeles	0.984290	0.985461
Memphis	0.997310	0.997329
Miami	0.976461	0.976593
Minneapolis	0.996363	0.996913
New York	0.981989	0.982330
Oakland	0.983695	0.985528
Salt Lake City	0.999452	0.999509
Seattle	0.998055	0.998433
Washington DC	0.997065	0.997178

Table 5-4 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	0.993188
Anchorage	0.996828
Atlanta	0.992727
Bethel	0.996959
Billings	0.993188
Boston	0.992734
Cleveland	0.993188
Cold Bay	0.996815
Fairbanks	0.997082
Honolulu	0.995922
Houston	0.992724
Juneau	0.997275
Kansas City	0.992269
Kotzebue	0.996827
Los Angeles	0.998641
Mauna Loa	0.994505
Miami	0.993188
Minneapolis	0.992734
Oakland	0.998641
Puerto Rico	0.993185
Salt Lake City	0.998641
Seattle	0.998641
Washington DC	0.992276

6.0 INTEGRITY

6.1 HMI Analysis

Analysis of integrity includes the identification and evaluation of HMI (hazardously misleading information), as well as the generation of a safety index to illustrate the margin of safety that WAAS protection levels are providing. The safety margin index (shown in Table 6.1) is a metric that shows how well the protection levels are bounding the maximum observed error. The process for determining this index involves normalizing the largest error observed at a site. This is accomplished by dividing this maximum observed error by the WAAS estimated standard deviation of the error. The safety margin requirement, 5.33 standard units for vertical and 6 standard units for horizontal, is then divided by this maximum normalized error.

Table 6-1Safety Margin Index and HMI Statistics

Location	Safety Index		Number of HMIs
	Horizontal	Vertical	
Anderson	4.62	4.85	0
Atlantic City	5.45	6.66	0
Elko	5.45	4.10	0
Grand Forks	4.29	3.33	0
Great Falls	6.00	5.92	0
Greenwood	4.62	3.55	0
Oklahoma City	5.00	4.85	0
San Angelo	8.57	5.92	0
Albuquerque	6.67	7.61	0
Atlanta	5.45	6.66	0
Billings	6.67	5.33	0
Boston	6.67	5.92	0
Chicago	5.00	3.14	0
Cleveland	4.62	4.85	0
Dallas	4.62	4.85	0
Denver	6.67	4.85	0
Houston	6.00	6.66	0
Jacksonville	4.00	4.85	0
Kansas City	5.45	4.10	0
Los Angeles	6.67	6.66	0
Memphis	5.45	3.81	0
Miami	4.62	5.92	0
Minneapolis	4.29	4.44	0
New York	6.00	7.61	0
Oakland	8.57	5.92	0
Salt Lake City	6.67	5.33	0
Seattle	5.45	6.66	0
Washington DC	5.45	7.61	0

An observed safety margin index of greater than one indicates safe bounding of the greatest observed error, less than one indicates that the maximum error was not bounded, and a result equal to one means that the error was equal to the protection level. As evidenced by the statistics in the above table, the safety margin index never drops below 4.0 at any site. Also, Table 6.1 shows the number of HMIs that occurred during the quarter, of which there were none.

An HMI occurs if the position error exceeds the protection level in the vertical or horizontal dimensions at any time and 6.2 seconds or more passes before this event is corrected by WAAS.

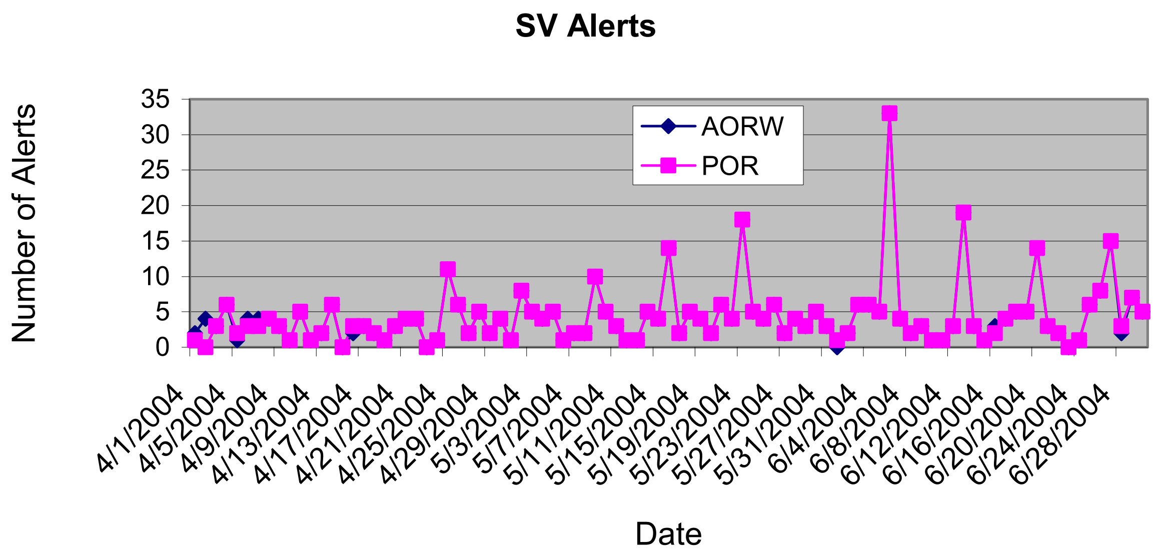
6.2 Broadcast Alerts

The WAAS transmits alert messages to protect the users from satellite degradation or severe ionospheric activity, both of which can cause unsafe conditions for a user. Space Vehicle (SV) alerts increase the User Differential Range Error (UDRE) of satellites, which can reduce the weighting of the satellite in the navigation solution, or completely exclude it from the navigation solution. Ionospheric Grid Point (IGP) alerts increase the Grid Ionospheric Vertical Error (GIVE) of IGP's, which can affect the usage of satellites whose pierce points are in the vicinity of the IGP. An increase in either UDRE's or GIVE's after an alert effectively increases the user protection levels (HPL and VPL), which affect the availability. Additionally, if an alert message sequence lasts for more than 12 seconds, WAAS fast corrections can time out, causing continuity of fault detection to not be met for that flight segment. Table 6.2 shows the total number of alerts and the average number of alerts per day. Figure 6.1 shows the number of SV alerts that occurred daily during the reporting period. Often the number of alerts on one GEO is the same as the number of alerts on the other GEO. Therefore, lines tend to overlap in most points on this plot. Also notice that there are many more alerts on Sundays than other days of the week. The cause for this trend is currently being investigated.

Table 6-2 WAAS SV Alert

	Number of Alerts		Average Alerts per Day	
Message Type	**AORW**	**POR**	**AORW**	**POR**
2	176	175	1.91	1.90
3	194	191	2.11	2.08
6	1	0	0.01	0
24	147	832	1.60	9.04
26	0	0	0	0
Total Alerts	518	1198	5.63	30.12

Figure 6-1 SV Daily Alert Trends



6.3 Availability of WAAS Messages (AORW & POR)

For an accurate and current user position to be calculated, the content of the WAAS message must be broadcast and received within precise time specifications. This aspect of the WAAS is critical to maintaining integrity requirements. Each message type in the WAAS SIS has a specific amount of time for which it must be received anew. Although the content of every message is relevant to the functionality of the system, the importance of different messages varies along with the frequency with which they must be received. Table 6.3 lists the maximum intervals at which each message must broadcast to meet system requirements.

GUS switchovers or broadcast WAAS alerts can interrupt the normal broadcast message stream. If these events occur at a time when the maximum interval of a specific message is approaching, that message may be delayed, resulting in its late transmittal.

All late messages statistics reported during the quarter were caused by GEO SIS outages, GUS switchovers and SV alerts except message type 7 and 10. Occasionally, message type 7 and 10 were late and they were not caused by GEO SIS outages, GUS switchovers or SV alerts. The lateness of type 7 and type 10 messages has little or no impact on user performance and safety. Tables 6.4 to 6.8 show fast correction, long correction, ephemeris covariance, ionosphere correction, and ionospheric mask message rates statistics broadcasted on AORW. The message rates statistics for POR are shown in table 6.9 to 6.13.

Table 6-3 Update Rates for WAAS Messages

Data	**Associated Message Types**	**Maximum Update Interval** (seconds)	**En Route, Terminal, NPA Timeout** (seconds)	**Precision Approach Timeout** (seconds)
WAAS in Test Mode	0	6	N/A	N/A
PRN Mask	1	60	None	None
UDREI	2-6, 24	6	18	12
Fast Corrections	2-5, 24	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C
Long Term Corrections	24, 25	120	360	240
GEO Nav. Data	9	120	360	240
Fast Correction Degradation	7	120	360	240
Weighting Factors	8	120	240	240
Degradation Parameters	10	120	360	240
Ionospheric Grid Mask	18	300	None	None
Ionospheric Corrections	26	300	600	600
UTC Timing Data	12	300	None	None
Almanac Data	17	300	None	None

Table 6-4 WAAS Fast Correction and Degradation Message Rates - AORW

Message Type	**On Time**	**Late**	**Max Late Length (seconds)**
1	141020	0	0
2	1321481	240	48
3	1321572	224	48
7	75239	144	146
9	92906	2	168
10	75205	147	217
17	29945	9	540
24	1321382	259	48

Table 6-5 WAAS Long Correction Message Rates (Type 24 and 25) - AORW

SV	On Time	Late	Max Late Length (seconds)
1	40275	0	0
3	46237	0	0
4	45622	1	169
5	46465	0	0
6	44486	3	179
7	44909	2	177
8	42980	3	174
9	46289	2	171
10	45529	2	179
11	47596	1	177
13	44372	3	166
14	45198	1	166
15	42843	0	0
16	46687	0	0
17	45085	2	170
18	43672	2	175
19	46202	2	177
20	46201	0	0
21	37083	1	173
22	39175	2	165
23	37720	1	173
24	46223	1	149
25	46440	1	179
26	44518	1	171
27	38936	1	171
28	38058	4	174
29	44762	1	179
30	46807	1	156
31	43930	3	177

Table 6-6 WAAS Ephemeris Covariance Message Rates (Type 28) - AORW

SV	On Time	Late	Max Late Length (seconds)
1	38412	1	161
3	43838	3	300
4	43243	2	181
5	44116	5	192
6	42325	1	180
7	42572	2	186
8	40429	2	174
9	43911	6	192
10	42852	3	187
11	45035	1	185
13	41752	3	192
14	42913	2	192
15	40322	0	0
16	43666	0	0
17	42057	3	194
18	40812	1	151
19	42352	2	192
20	42204	6	192
21	34305	1	195
22	35673	1	128
23	34415	3	192
24	42088	3	192
25	42154	0	0
26	40596	1	138
27	35845	1	192
28	35148	3	192
29	40925	0	0
30	42525	2	194
31	39841	2	192
122	83078	1	184
134	76158	5	193

Table 6-7 WAAS Ionospheric Correction Message Rates (Type 26) - AORW

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27557	6	576
1	0	27536	10	576
1	1	27541	7	578
1	2	27530	8	534
1	3	27538	7	528
1	4	27527	9	576
2	0	27534	13	576
2	1	27538	9	576
2	2	27526	7	529
2	3	27519	7	506
2	4	27534	9	523
2	5	27529	7	464
3	0	27549	4	457

Table 6-8 WAAS Ionospheric Mask Message Rates (Type 18) - AORW

Band	On Time	Late	Max Late Length (seconds)
0	68023	0	0
1	68062	0	0
2	68029	0	0
3	68032	0	0

Table 6-9 WAAS Fast Correction and Degradation Message Rates - POR

Message Type	On Time	Late	Max Late Length (seconds)
1	139695	1	125
2	1324348	557	32
3	1324436	546	29
7	74566	172	187
9	93150	0	0
10	74560	159	214
17	29906	14	466
24	1326890	246	26

Table 6-10 WAAS Long Correction Message Rates (Type 24 and 25) - POR

SV	On Time	Late	Max Late Length (seconds)
1	40403	0	0
3	46360	0	0
4	45673	0	0
5	46582	1	169
6	44471	1	169
7	45076	0	0
8	43120	1	171
9	46407	0	0
10	45642	0	0
11	47818	0	0
13	44464	0	0
14	45306	1	166
15	43013	0	0
16	46733	1	162
17	45117	0	0
18	43813	0	0
19	46419	0	0
20	46344	0	0
21	37151	0	0
22	39286	0	0
23	37833	0	0
24	46257	0	0
25	46525	1	172
26	44621	0	0
27	39102	0	0
28	38259	1	185
29	44895	0	0
30	46938	1	182
31	44163	0	0

Table 6-11 WAAS Ephemeris Covariance Message Rates (Type 28) – POR

SV	On Time	Late	Max Late Length (seconds)
1	38540	1	145
3	43984	0	0
4	43294	0	0
5	44236	1	133
6	42322	0	0
7	42757	2	184
8	40561	1	360
9	44030	1	136
10	42945	1	136
11	45243	0	0
13	41839	1	139
14	43021	1	158
15	40480	1	134
16	43714	1	137
17	42086	1	152
18	40956	0	0
19	42558	0	0
20	42327	1	128
21	34364	0	0
22	35774	2	240
23	34514	0	0
24	42117	0	0
25	42224	0	0
26	40716	1	139
27	35975	1	144
28	35319	0	0
29	41033	0	0
30	42594	2	162
31	40039	3	190
122	83091	2	184
134	76326	2	157

Table 6-12 WAAS Ionospheric Correction Message Rates (Type 26) – POR

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27633	10	496
0	1	27618	11	478
0	2	27606	12	480
1	0	27602	8	492
1	1	27623	12	384
1	2	27605	11	578
1	3	27617	11	578
1	4	27596	12	559
2	0	27587	13	545
2	1	27601	13	337
2	2	27605	9	348
2	3	27615	8	352

Table 6-13 WAAS Ionospheric Mask Message Rates (Type 18) - POR

Band	On Time	Late	Max Late Length (seconds)
0	67807	0	0
1	67832	0	0
2	67832	0	0

7.0 SV RANGE ACCURACY

Range accuracy evaluation computes the probability that the WAAS User Differential Range Error (UDRE) and Grid Ionospheric Vertical Error (GIVE) statistically bound 99.9% of the range residuals for each satellite tracked by the receiver. A UDRE is broadcast by the WAAS for each satellite that is monitored by the system and the 99.9% bound (3.29 sigma) of the residual error on a pseudorange after application of fast and long-term corrections is checked. The pseudorange residual error is determined by taking the difference between the raw pseudorange and a calculated reference range. The reference range is equal to the true range between the corrected satellite position and surveyed user antenna plus all corrections (WAAS Fast Clock, WAAS Long-Term Clock, WAAS Ionospheric delay, Tropospheric delay, Receiver Clock Bias, and Multipath). Since the true ionospheric delay and multipath error are not precisely known, the estimated variance in these error sources are added to the UDRE before the comparing it to the residual error.

GPS satellite range residual errors were calculated for seven WAAS receivers during the quarter. Table 7.1 and 7.2 show the range error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Last quarter 12 sites were evaluated but due processing issues the number of sites evaluated were reduced. During this period a new satellite, PRN 23, was launched. During this quarter the satellite hardware bias for this satellite was incorrect. The incorrect satellite hardware bias caused the ionospheric estimation that is used to determine the range to be incorrect.

A GIVE is broadcast by the WAAS for each IGP that is monitored by the system and the 99.9% (3.29 sigma) bound of the ionospheric error is checked. The WAAS broadcasts the ionospheric model using IGP's at predefined geographic locations. Each IGP contains the vertical ionospheric delay and the error in that delay in the form of the GIVE. The ionospheric error is determined by taking the difference between the WAAS ionospheric delay interpolated from the IGP's and GPS dual frequency measurement at that GPS satellite.

GPS satellite ionospheric errors were calculated for twelve WAAS receivers during the quarter. Table 7.3 and 7.4 show the ionospheric error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations.

Table 7.1 Range Error 95% index and 3.29 Sigma Bounding

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding
1	1.718	100	1.683	100	1.729	100	1.799	100	1.274	100	1.740	100
2	-	-	-	-	-	-	-	-	-	-	-	-
3	1.665	100	1.415	100	1.626	100	1.801	100	1.439	100	1.819	100
4	2.017	100	1.719	100	1.950	100	1.826	100	1.904	100	3.038	100
5	1.653	100	1.277	100	1.450	100	1.745	100	1.496	100	1.757	100
6	2.153	100	1.813	100	1.897	100	1.833	100	1.507	100	2.136	100
7	1.409	100	1.233	100	1.285	100	1.690	100	1.357	100	1.494	100
8	1.633	100	1.471	100	1.896	100	1.735	100	1.211	100	1.783	100
9	1.921	100	1.708	100	1.987	100	2.054	99.9954	2.100	100	1.803	100
10	1.561	100	1.712	100	1.248	100	1.993	100	1.282	100	1.283	100
11	1.584	100	1.448	100	1.355	100	2.414	99.9691	2.947	100	1.088	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.787	100	1.462	100	1.561	100	1.967	100	1.174	100	1.680	100
14	1.673	100	1.386	100	1.304	100	2.124	100	1.559	100	1.248	100
15	1.684	100	1.387	100	1.693	100	1.943	100	1.223	100	1.826	100
16	1.456	100	1.739	100	1.256	100	2.087	99.9623	1.293	100	1.398	100
17	1.657	100	1.739	100	1.708	100	1.559	100	1.529	100	1.666	100
18	1.602	100	1.440	100	1.292	100	1.947	100	1.635	100	0.903	100
19	2.962	99.9984	2.621	100	2.504	100	3.741	99.6767	3.213	100	2.198	100
20	1.528	100	1.423	99.9691	1.357	100	2.113	100	2.217	100	1.504	100
21	1.877	100	1.749	100	1.392	100	2.442	100	1.929	100	0.816	100
22	1.872	99.9997	1.300	100	1.335	100	2.216	100	1.687	100	1.027	100
23	4.880	88.9172	4.222	98.4626	4.495	99.9958	5.273	97.4810	5.365	84.9319	4.539	88.2146
24	2.174	100	1.675	100	2.176	100	1.897	100	3.500	100	2.210	100
25	1.597	100	1.624	100	1.697	100	1.565	100	1.855	100	2.063	100
26	2.046	100	1.947	100	2.356	100	2.008	100	2.258	100	2.001	100
27	1.826	100	1.664	100	1.738	100	1.929	100	1.110	100	1.498	100
28	1.515	100	1.062	100	1.404	100	2.128	100	1.497	100	0.960	100
29	1.821	100	2.265	100	2.093	100	2.084	100	1.604	100	1.862	100
30	2.305	100	1.739	100	2.101	100	2.278	100	1.776	100	2.367	100
31	1.432	100	0.999	100	1.456	100	1.862	100	1.931	100	1.314	100
122	4.184	100	2.632	100	3.151	100	2.594	100	2.441	100	2.749	100
134	-	-	-	-	-	-	-	-	-	-	-	-

Table 7.2 Range Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding
1	1.777	100	1.3700	100	1.371	100	2.261	99.7505	1.892	100	2.300	100
2	-	-	-	-	-	-	-	-	-	-	-	-
3	1.967	100	1.1890	100	1.185	100	1.775	99.9988	2.049	100	1.655	100
4	1.923	100	1.9770	100	1.591	100	2.289	100	2.183	100	2.305	100
5	1.887	100	1.6950	100	1.362	100	1.532	100	1.852	100	1.485	100
6	2.005	100	1.3680	100	1.960	100	2.917	99.9999	2.387	100	2.213	100
7	1.529	100	1.1420	100	1.254	100	2.070	100	1.485	100	1.494	100
8	1.517	100	1.0680	100	1.565	100	2.328	99.9999	1.985	100	1.678	100
9	2.530	100	1.4060	100	1.475	100	2.059	100	2.268	100	2.134	100
10	1.793	100	1.8060	100	1.381	100	1.335	100	1.407	100	1.335	100
11	1.672	100	1.4930	100	1.952	100	1.244	100	1.491	100	1.329	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.780	100	1.2310	100	1.419	100	1.916	100	1.758	100	1.831	100
14	1.544	100	1.2560	100	1.826	100	1.188	100	1.523	100	1.198	100
15	1.521	100	0.9750	100	1.517	100	1.257	100	2.095	100	1.337	100
16	1.629	100	1.2780	100	1.650	100	1.956	99.9163	1.566	100	1.344	100
17	1.629	100	1.2170	100	1.375	100	1.958	100	1.909	100	1.850	100
18	1.608	100	1.3970	100	1.959	100	1.188	100	1.469	100	1.295	100
19	2.737	100	2.4460	100	3.181	100	2.266	100	2.898	100	1.905	100
20	1.700	100	1.5650	100	1.982	100	1.656	99.9950	1.632	100	1.272	100
21	1.756	100	1.6170	100	1.705	100	1.194	100	1.546	100	1.311	100
22	1.862	100	1.4670	100	1.631	100	1.315	100	1.564	100	1.205	100
23	4.916	98.5419	4.8830	86.4888	5.051	96.4810	4.383	98.0519	5.274	83.8714	3.877	100
24	2.294	100	1.7530	100	1.981	100	2.754	99.9643	2.557	100	2.271	100
25	1.824	100	1.4180	100	1.339	100	2.049	99.6346	1.728	100	2.115	100
26	1.690	100	1.9330	100	1.503	100	2.520	100	2.468	100	2.248	100
27	1.506	100	1.3910	100	1.377	100	1.949	99.9494	2.031	99.9878	1.968	100
28	1.538	100	1.2050	100	1.369	100	1.442	100	1.408	100	1.179	100
29	1.987	100	1.3280	100	1.417	100	1.988	100	2.327	100	1.723	100
30	2.475	100	1.9480	100	1.590	100	1.978	100	2.304	99.9995	2.577	100
31	1.497	100	1.2840	100	1.882	100	1.849	100	1.499	100	1.602	100
122	4.047	100	4.3830	100	2.889	100	6.637	100	3.425	100	-	-
134	5.631	100	3.5730	100	-	-	-	-	-	-	2.382	100

Table 7.3 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding
1	0.822	100	0.709	100	0.921	100	1.195	100	0.789	100	0.800	100
2	-	-	-	-	-	-	-	-	-	-	-	-
3	0.693	100	0.694	100	0.739	100	0.889	100	0.788	100	0.880	100
4	1.055	100	0.987	100	1.085	100	1.239	100	1.113	100	1.768	100
5	0.728	100	0.512	100	0.858	100	0.974	100	0.855	100	0.774	100
6	0.857	100	0.831	100	1.095	100	0.958	100	0.614	100	1.389	100
7	0.870	100	0.610	100	0.750	100	1.466	100	0.829	100	0.719	100
8	0.862	100	0.715	100	1.006	100	1.077	100	0.818	100	1.035	100
9	0.786	100	0.748	100	0.866	100	1.007	100	0.905	100	0.863	100
10	1.014	100	0.973	100	0.750	100	1.527	100	0.943	100	0.667	100
11	0.780	100	0.730	100	0.567	100	1.227	100	1.698	100	0.553	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	0.797	100	0.611	100	0.864	100	1.150	100	0.613	100	0.863	100
14	1.082	100	0.855	100	0.721	100	1.959	100	1.272	100	0.619	100
15	0.598	100	0.610	100	0.727	100	1.329	100	0.571	100	0.925	100
16	0.744	100	0.887	100	0.576	100	1.428	100	1.058	100	0.796	100
17	0.874	100	0.922	100	0.891	100	1.080	100	0.864	100	0.936	100
18	1.027	100	0.962	100	0.821	100	1.567	100	1.338	100	0.565	100
19	1.917	100	1.759	100	1.541	100	2.409	100	2.317	100	1.527	100
20	0.842	100	0.754	100	0.710	100	1.225	100	1.214	100	0.616	100
21	1.344	100	1.086	100	1.070	100	1.802	100	1.405	100	0.530	100
22	1.310	100	0.996	100	0.926	100	2.057	100	1.420	100	0.690	100
23	3.877	99.1913	3.619	100	3.703	100	4.215	97.6283	4.609	93.2697	3.731	97.6873
24	1.301	100	0.962	100	1.447	100	1.202	100	2.204	100	1.521	100
25	0.880	100	0.752	100	0.928	100	1.236	100	1.094	100	1.084	100
26	0.923	100	0.939	100	1.159	100	0.914	100	1.045	100	1.258	100
27	1.065	100	0.888	100	1.041	100	1.324	100	0.658	100	0.881	100
28	1.033	100	0.620	100	0.878	100	1.759	100	1.222	100	0.544	100
29	0.748	100	1.063	100	0.951	100	1.022	100	0.682	100	1.066	100
30	1.035	100	0.814	100	1.080	100	0.999	100	0.630	100	1.061	100
31	0.993	100	0.385	100	0.841	100	1.391	100	1.171	100	0.679	100

Table 7.4 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding
1	0.760	100	0.543	100	0.689	100	0.603	100	1.093	100	0.983	100
2	-	-	-	-	-	-	-	-	-	-	-	-
3	0.721	100	0.504	100	0.608	100	0.703	100	1.114	100	0.900	100
4	1.024	100	1.107	100	0.888	100	1.131	100	1.293	100	1.232	100
5	0.478	100	0.809	100	0.799	100	0.607	100	0.876	100	0.618	100
6	1.075	100	0.732	100	0.930	100	1.198	100	1.334	100	1.131	100
7	1.033	100	0.486	100	0.566	100	0.775	100	0.923	100	0.652	100
8	0.777	100	0.547	100	0.710	100	1.013	100	1.103	100	0.993	100
9	0.852	100	0.582	100	0.509	100	0.856	100	1.080	100	0.937	100
10	1.054	100	0.835	100	0.676	100	0.571	100	0.878	100	0.587	100
11	0.588	100	0.654	100	0.896	100	0.698	100	0.840	100	0.609	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	0.698	100	0.448	100	0.688	100	0.667	100	1.052	100	1.009	100
14	0.533	100	0.747	100	1.194	100	0.805	100	1.316	100	0.653	100
15	0.539	100	0.402	100	0.566	100	0.601	100	1.040	100	0.596	100
16	0.658	100	0.519	100	0.828	100	0.545	100	0.998	100	0.647	100
17	0.933	100	0.694	100	0.651	100	0.945	100	1.180	100	0.981	100
18	0.625	100	0.858	100	1.324	100	0.872	100	1.144	100	0.863	100
19	1.536	100	1.653	100	1.853	100	1.618	100	1.852	100	1.516	100
20	0.634	100	0.636	100	1.207	100	0.898	100	1.075	100	0.667	100
21	0.774	100	0.995	100	1.355	100	1.082	100	1.271	100	1.052	100
22	0.770	100	0.943	100	1.220	100	1.130	100	1.388	100	0.896	100
23	3.927	100	4.057	99.8104	4.259	99.8634	4.014	99.9958	4.393	92.5124	3.619	100
24	1.600	100	1.066	100	1.280	100	1.516	100	1.718	100	1.337	100
25	0.637	100	0.653	100	0.716	100	0.567	100	1.038	100	0.999	100
26	0.840	100	0.900	100	0.612	100	1.104	100	1.252	100	1.158	100
27	0.803	100	0.820	100	0.673	100	0.687	100	1.244	100	1.083	100
28	0.649	100	0.653	100	0.969	100	0.927	100	1.048	100	0.707	100
29	0.819	100	0.625	100	0.583	100	0.816	100	1.201	100	0.900	100
30	1.074	100	0.896	100	0.677	100	0.845	100	1.148	100	1.150	100
31	0.769	100	0.583	100	1.011	100	0.656	100	0.910	100	0.660	100

Figure 7-1 95% Range Error (SV 1—SV 16) – Washington, DC

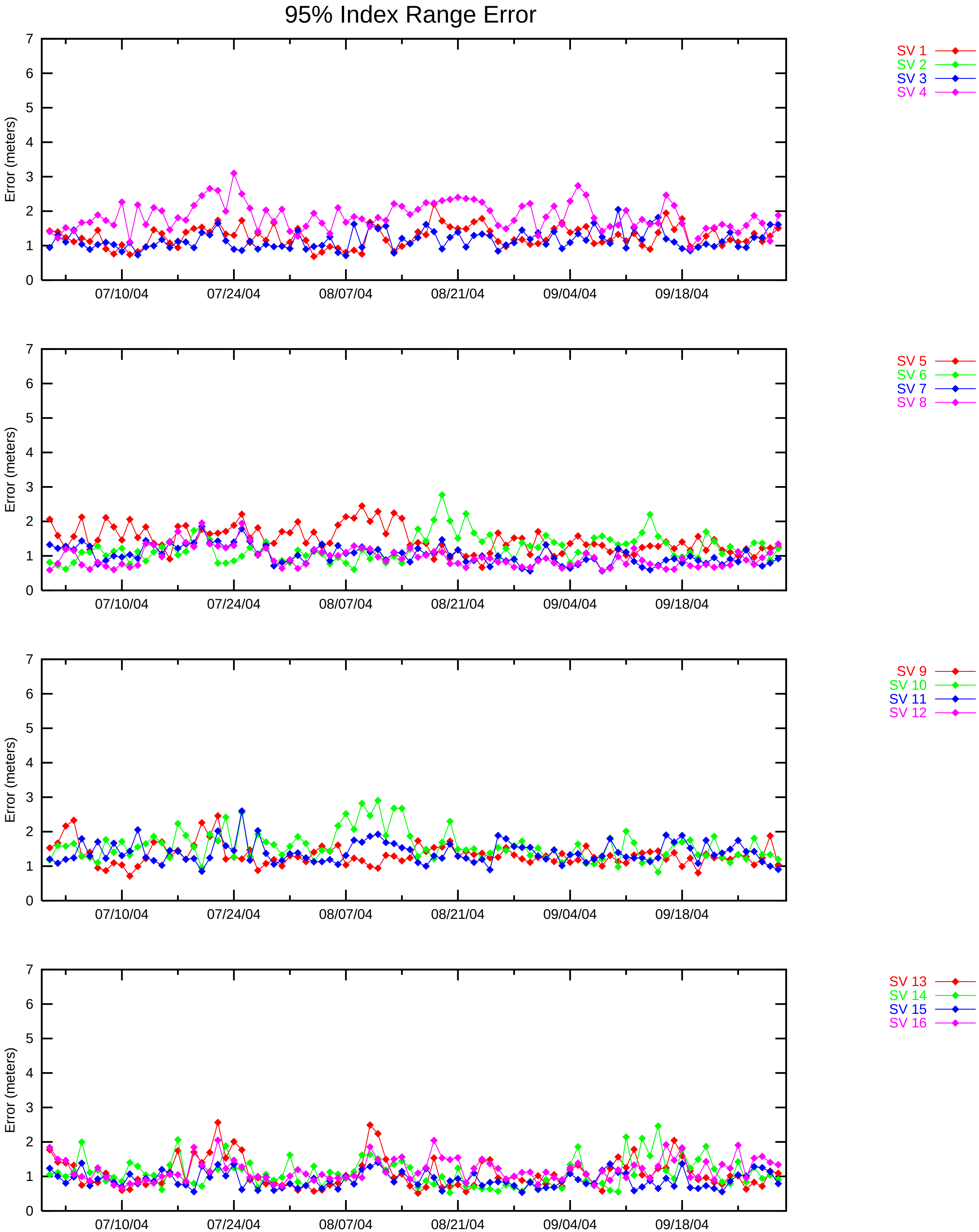


Figure 7-2 95% Range Error (SV 17—SV 31 and SV 122) – Washington, DC

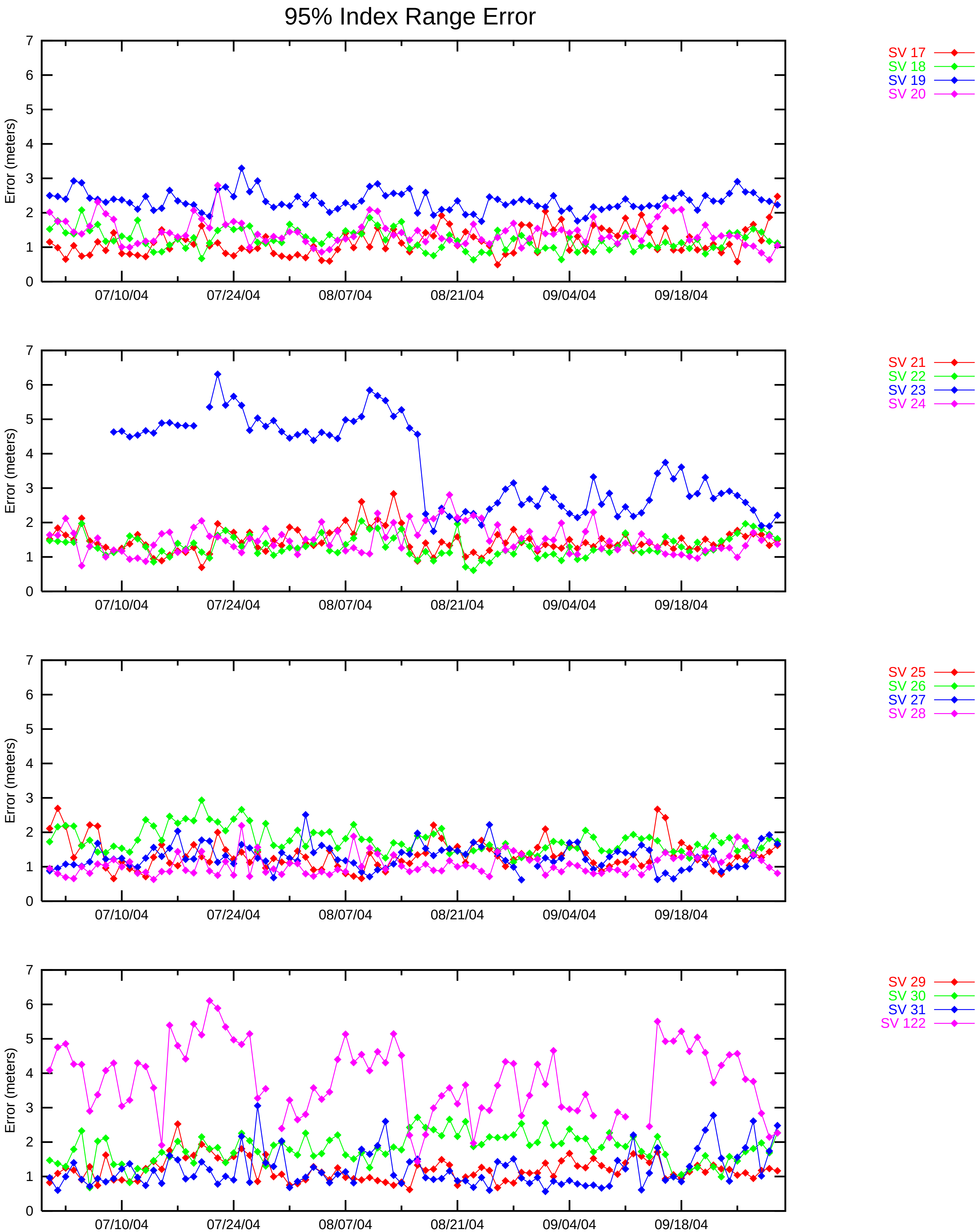


Figure 7-3 95% Ionospheric Error (SV 1—SV 16) – Washington, DC

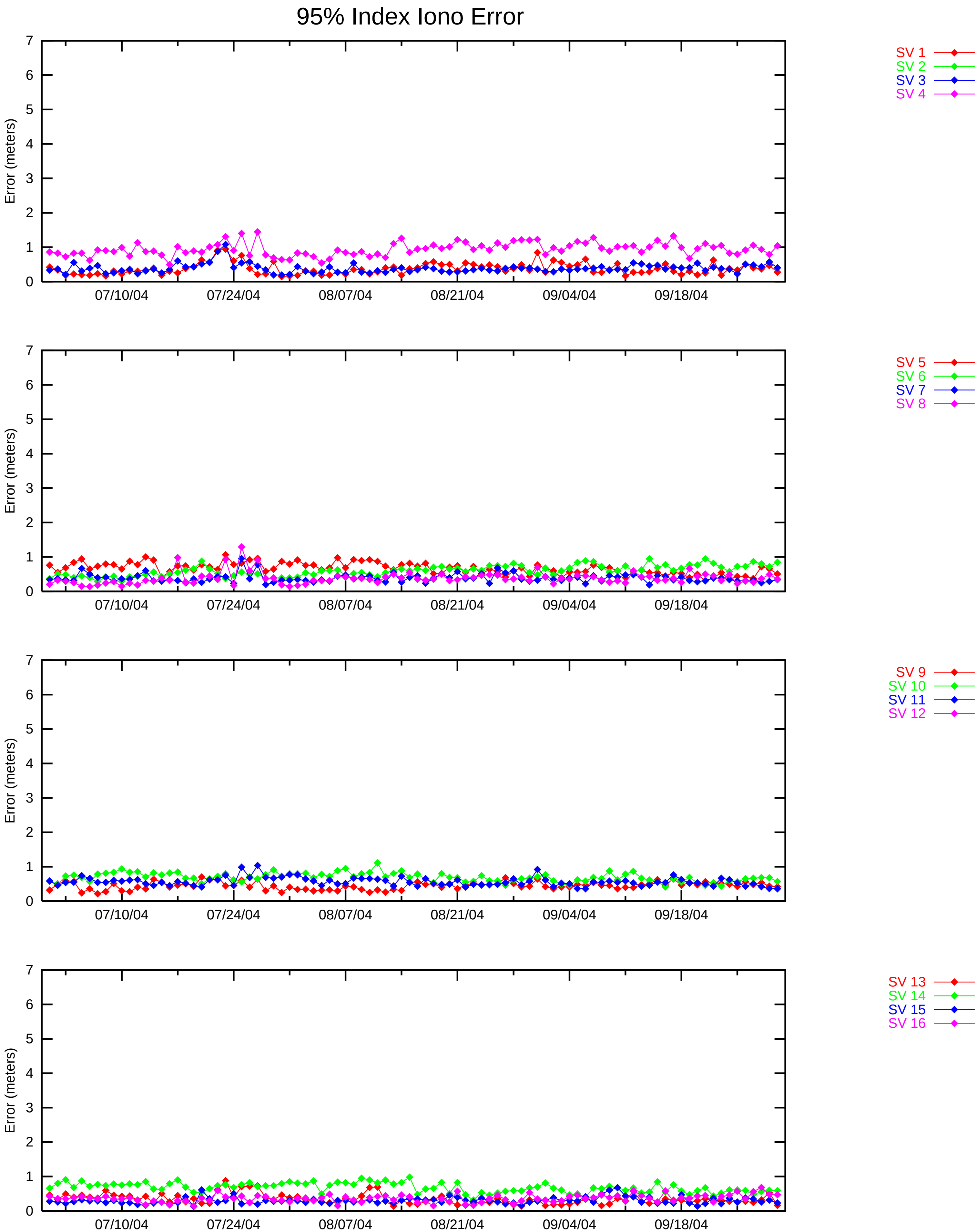


Figure 7-4 95% Ionospheric Error (SV 17—SV 31) – Washington, DC

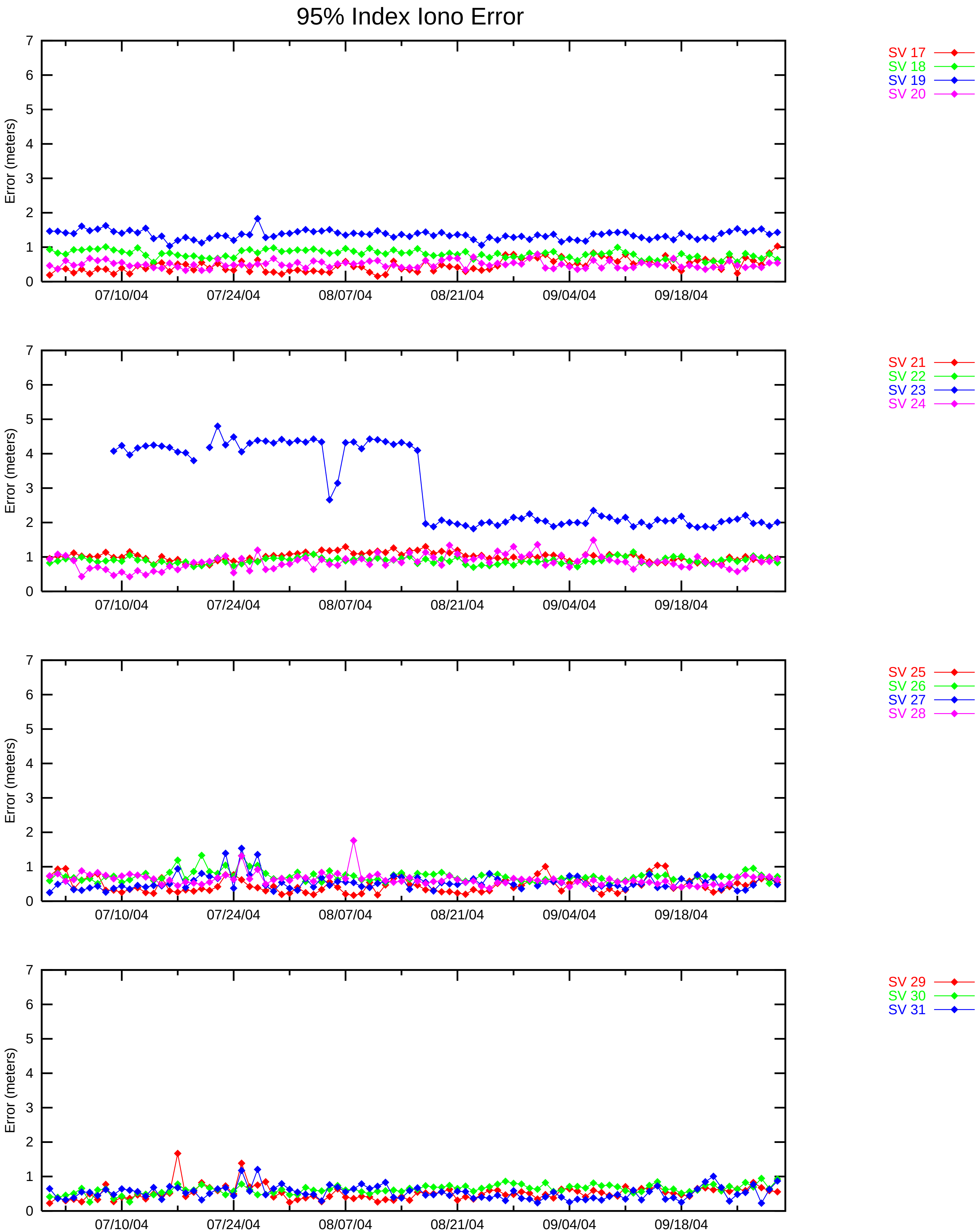
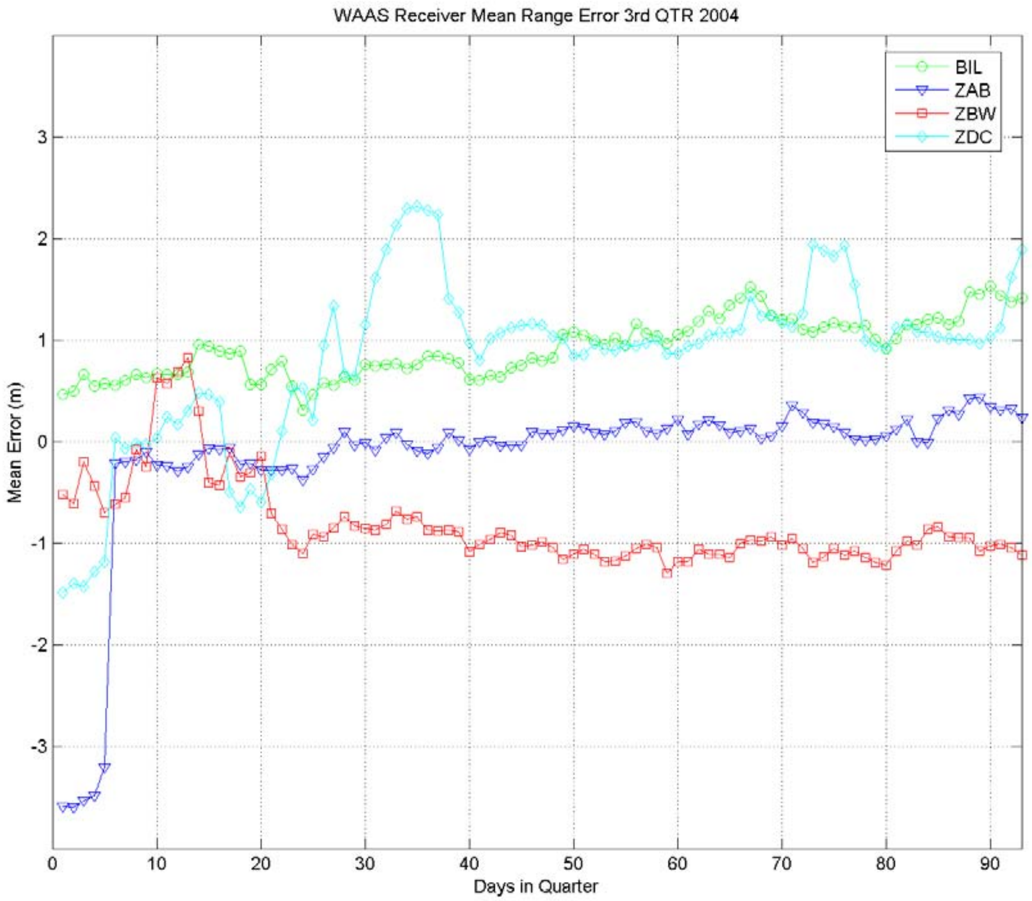


Figure 7-5 Receiver Mean Error Plot for Billings, Albuquerque, Boston, and Washington DC????



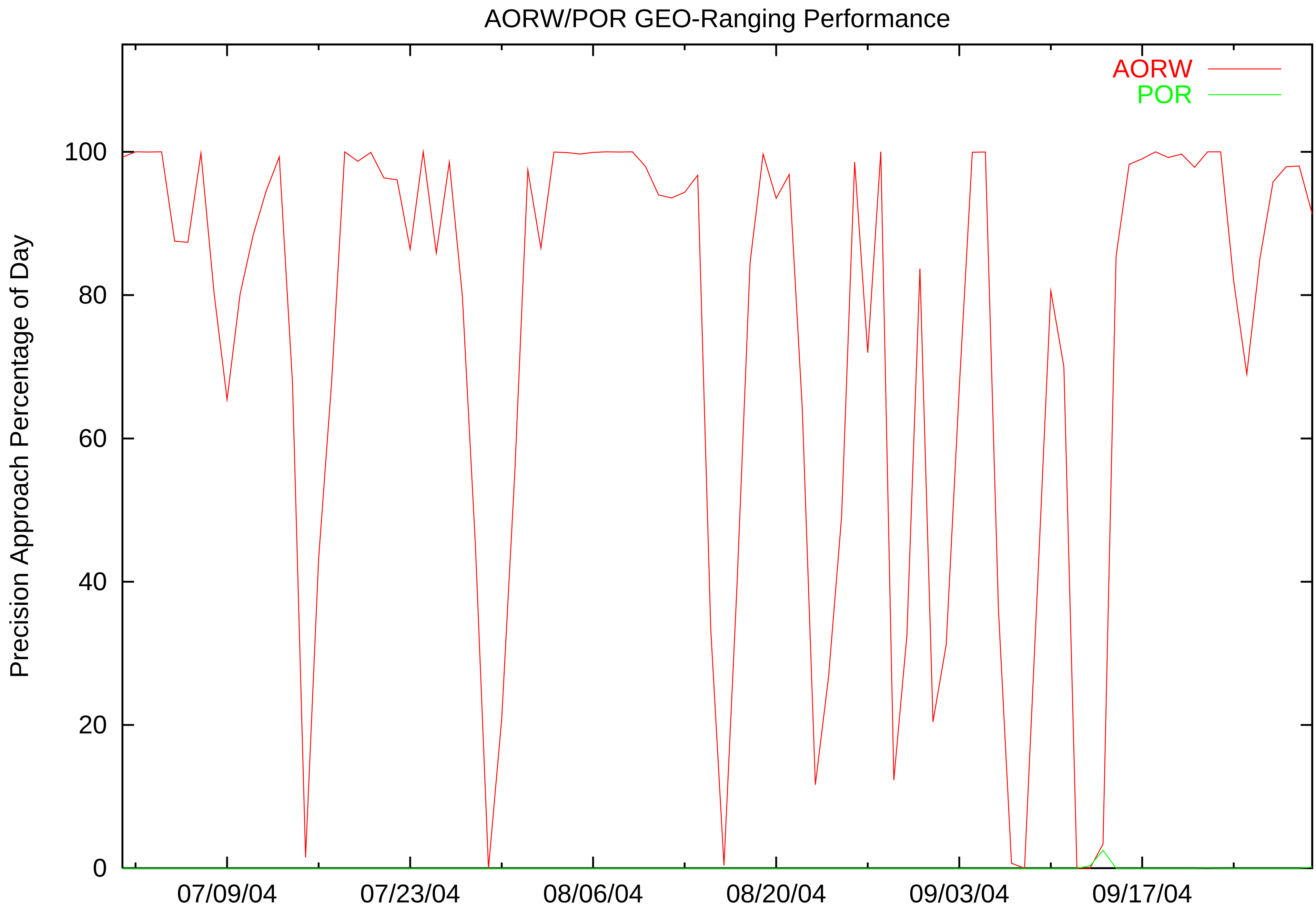
8.0 GEO RANGING PERFORMANCE

Table 8.1 shows the GEO-Ranging performance for AORW and POR satellites throughout the evaluated period. The percentage of PA ranging availability (i.e. the percentage of time a user receiver can use the GEO as a ranging source in a LNAV/VNAV or LPV position solution) for the AORW and POR is 74.26% and 0.032%, respectively. Figure 8.1 shows the trend of PA Ranging Availability for the AORW and POR satellite. The percentage of time the AOR-W GEO was available for PA ranging is lower this quarter than expected. The reason is thread switching by key WRSs and poor WRS receiver performance. The large drops in PA ranging availability for the AORW satellite is due to GUS switchovers. As in the past, the POR satellite as a ranging source has very low PA availability.

Table 8-1 GEO Ranging Availability

GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
AORW	74.26	23.68	0.312	1.487
POR	0.032	89.61	9.05	1.047

Figure 8-1 Daily PA GEO Ranging Availability Trend



9.0 WAAS PROBLEM SUMMARY

Title: Loss of AOR SIS

Description: This incident occurred twice during the quarter. Both times the cause was an inadvertent test signal transmitted by INMARSAT to the AOR-West GEO satellite. This test signal bled into the frequency used by the WAAS navigation transponder on the satellite. The GUS interpreted this signal as interference and correctly increased its transmit power to the satellite. For the first incident on July 29, 2004 after increasing the power to its maximum the GUS at Santa Paula faulted. The GUS at Clarksburg then went to primary mode but it faulted 8 seconds after the Santa Paula GUS faulted. The total outage lasted 23323 seconds (~6.5 hours). In the second AOR outage the same incident occurred. This outage lasted 7452 seconds, or a little more than 2 hours.

10.0 WAAS AIRPORT AVAILABILITY

The WAAS airport availability evaluation determines the number and length LVP service outages at selected airports from the transmitted WAAS navigation message. The navigation messages transmitted from both AORW and POR GEO satellites are processed simultaneously, and WAAS protection levels (VPL and HPL) are computed at each airport once a second in accordance with the WAAS MOPS. Once the protection levels have been produced at each airport an LPV service evaluation is conducted to identify outages in service (i.e. when protection levels exceed alert limits). WAAS LPV service is available for a user when the vertical protection level (VPL) is less than or equal to vertical alert limit (VAL) of 50 meters and the horizontal protection level (HPL) is less than or equal to horizontal alert limit (HAL) of 40 meters. If both conditions are met at a specified airport location then WAAS LPV service is available at that airport. If either one of the conditions are not met at a specified airport location then WAAS LPV service at that airport is unavailable and an outage in LPV service is recorded with its duration. When the LPV service becomes unavailable it is not considered available again until protection levels are below or equal to alert limits for at least 15 minutes. Although this will reduce LPV service availability minimally, it substantially reduces the number of service outages and prevents excessive switching in and out of service availability. When computing LPV service availability an extra two minutes of outage time was prefixed to each outage. The number of WAAS LPV service outages and the availability at selected airports for the period from 6/27/04 to 10/2/04 of WAAS operation is presented in Table 10.1. Figures 10.1 and 10.2 provide a graphical representation of WAAS LPV service availability and outage counts for the same period, respectively.

Table 10-1 WAAS LPV Outages and Availability

Airport ID	Airport Name	City	State	Outages	Availability
KBHM	BIRMINGHAM INTL	BIRMINGHAM	AL	25	0.9953617
KDHN	DOTHAN REGIONAL	DOTHAN	AL	31	0.99531335
EET	SHELBY COUNTY	ALABASTER	AL	25	0.99546844
79J	ANDALUSIA-OPP	ANDALUSIA/OP	AL	30	0.9952987
HSV	HUNTSVILLE INT'L- CARL T JONES FIELD	HUNTSVILLE	AL	24	0.9951082
MOB	MOBILE REGIONAL	MOBILE	AL	28	0.9954776
KARG	WALNUT RIDGE REGIONAL	WALNUT RIDGE	AR	26	0.9946406
KFSM	FORT SMITH RGNL	FORT SMITH	AR	26	0.9957925
KVBT	BENTONVILLE MUNI/LM THADDEN FLD	BENTONVILLE	AR	27	0.99547637
KXNA	NORTHWEST ARKANSAS RGNL	FAYETTEVILLE/SPRINGDALE/ROGERS	AR	27	0.99550647
CDH	HARRELL FIELD	CAMDEN	AR	25	0.99574643
LIT	ADAMS FIELD	LITTLE ROCK	AR	26	0.99507135
SRC	SEARCY MUNICIPAL	SEARCY	AR	25	0.99482816
ASG	SPRINGDALE MUNICIPAL	SPRINGDALE	AR	27	0.99548614
KGCN	GRAND CANYON NATL PARK	GRAND CANYON	AZ	18	0.9988897
KPHX	PHOENIX SKY HARBOR INTL	PHOENIX	AZ	60	0.9974438
KPRC	ERNEST A LOVE FIELD	PRESCOTT	AZ	22	0.99905694
KTUS	TUCSON INTL	TUCSON	AZ	137	0.989409
IFP	LAUGHLIN/BULLHEAD INTERNATIONAL	BULLHEAD CITY	AZ	30	0.9982918
RQE	WINDOW ROCK	WINDOW ROCK	AZ	19	0.99901015
KCRQ	MC CLELLAN-PALOMAR	CARLSBAD	CA	336	0.9662038
KDAG	BARSTOW-DAGGETT	DAGGETT	CA	122	0.99310994
KLAX	LOS ANGELES INTL	LOS ANGELES	CA	332	0.97255486
KMHR	SACRAMENTO MATHER	SACRAMENTO	CA	153	0.9918613
KOAK	METROPOLITAN OAKLAND INTL	OAKLAND	CA	210	0.98429763
KPMD	PALMDALE PROD FLT/TEST INSTLN	PALMDALE	CA	260	0.9833059

Airport ID	Airport Name	City	State	Outages	Availability
KSFO	SAN FRANCISCO INTL	SAN FRANCISCO	CA	217	0.9825173
KSMF	SACRAMENTO INTL	SACRAMENTO	CA	169	0.99094373
O60	CLOVERDALE MUNICIPAL	CLOVERDALE	CA	214	0.98330635
IYK	INYOKERN	INYOKERN	CA	120	0.9926759
ONT	ONTARIO INTERNATIONAL	ONTARIO	CA	232	0.9827208
SAN	SAN DIEGO INTERNATIONAL-LINDBERGH FIELD	SAN DIEGO	CA	415	0.9547455
SJC	SAN JOSE INTERNATIONAL	SAN JOSE	CA	214	0.9844809
SVE	SUSANVILLE MUNICIPAL	SUSANVILLE	CA	69	0.9979072
TNP	TWENTYNINE PALMS	TWENTYNINE PALMS	CA	123	0.99326736
KDEN	DENVER INTL	DENVER	CO	26	0.9951622
AKO	AKRON-COLORADO PLAINS REG'L	AKRON	CO	26	0.9949254
CEZ	CORTEZ MUNICIPAL	CORTEZ	CO	25	0.995937
HDN	YAMPA VALLEY	HAYDEN	CO	26	0.9955872
LHX	LA JUNTA MUNICIPAL	LA JUNTA	CO	27	0.9953013
LAA	LAMAR MUNICIPAL	LAMAR	CO	27	0.9953
2V2	VANCE BRAND	LONGMONT	CO	26	0.9951384
EEO	MEEKER	MEEKER	CO	26	0.9956397
TAD	PERRY STOKES	TRINIDAD	CO	29	0.99561703
2V5	WRAY	WRAY	CO	27	0.9948467
KBDL	BRADLEY INTL	WINDSOR LOCKS	CT	217	0.9705748
KDCA	RONALD REAGAN WASHINGTON INTL	WASHINGTON	DC	67	0.993431
KIAD	WASHINGTON DULLES INTL	WASHINGTON	DC	40	0.9944808
KAPF	NAPLES MUNI	NAPLES	FL	207	0.97806495
KFLL	FORT LAUDERDALE/HOLLYWOOD INTL	FORT LAUDERDALE	FL	188	0.978827
KGNV	GAINESVILLE RGNL	GAINESVILLE	FL	31	0.99483275
KJAX	JACKSONVILLE INTL	JACKSONVILLE	FL	30	0.9950058
KMCO	ORLANDO INTL	ORLANDO	FL	38	0.99411976
KMIA	MIAMI INTL	MIAMI	FL	219	0.97322774
KOCF	OCALA INTL-JIM TAYLOR FLD	OCALA	FL	30	0.9946633
KPBI	PALM BEACH INTL	WEST PALM BEACH	FL	116	0.98849523
KPFN	PANAMA CITY-BAY COUNTY INTL	PANAMA CITY	FL	32	0.9952934
KPIE	ST PETERSBURG-CLEARWATER INTL	ST PETERSBURG-CLEARWATER	FL	34	0.99411917
KPNS	PENSACOLA REGIONAL	PENSACOLA	FL	33	0.9951764
KRSW	SOUTHWEST FLORIDA INTL	FORT MYERS	FL	150	0.9867063
KTLH	TALLAHASSEE RGNL	TALLAHASSEE	FL	30	0.995118
KVRB	VERO BEACH MUNI	VERO BEACH	FL	51	0.9935025
SRQ	SARASOTA/BRADENTON INTERNATIONAL	SARASOTA/BRADENTON	FL	40	0.99378055
TPA	TAMPA INTERNATIONAL	TAMPA	FL	34	0.9942603
KACJ	SOUTHER FIELD	AMERICUS	GA	27	0.9951682
KATL	WILLIAM B HARTSFIELD ATLANTA INTL	ATLANTA	GA	28	0.9949095
KSAV	SAVANNAH INTL	SAVANNAH	GA	33	0.99476814
KTBR	STATESBORO-BULLOCH COUNTY	STATESBORO	GA	28	0.9947887

Airport ID	Airport Name	City	State	Outages	Availability
KIKV	ANKENY RGNL	ANKENY	IA	28	0.99453145
KMXO	MONTICELLO RGNL	MONTICELLO	IA	28	0.9944714
CID	THE EASTERN IOWA	CEDAR RAPIDS	IA	28	0.9941762
DSM	DES MOINES INTERNATIONAL	DES MOINES	IA	28	0.9945356
KBOI	BOISE AIR TERMINAL/GOWEN FLD	BOISE	ID	18	0.9988182
EUL	CALDWELL INDUSTRIAL	CALDWELL	ID	18	0.9987666
SUN	FRIEDMAN MEMORIAL	HAILEY	ID	17	0.99845076
SZT	SANDPOINT	SANDPOINT	ID	28	0.9981019
KARR	AURORA MUNI	CHICAGO/AURORA	IL	30	0.9943094
KENL	CENTRALIA MUNI	CENTRALIA	IL	28	0.9945058
KFOA	FLORA MUNI	FLORA	IL	27	0.99456173
KORD	CHICAGO-O'HARE INTL	CHICAGO	IL	31	0.9942608
KPIA	GREATER PEORIA RGNL	PEORIA	IL	28	0.99454886
KPPQ	PITTSFIELD PENSTONE MUNI	PITTSFIELD	IL	27	0.9943659
KRFD	GREATER ROCKFORD	ROCKFORD	IL	31	0.9942877
KSLO	SALEM-LECKRONE	SALEM	IL	28	0.9945524
KTIP	RANTOUL NATL AVN CTR/FRANK ELLIOT FLD	RANTOUL	IL	29	0.9945312
MDW	CHICAGO MIDWAY	CHICAGO	IL	31	0.99427885
MLI	QUAD-CITY	MOLINE	IL	30	0.9943261
KANQ	TRI-STATE STEUBEN COUNTY	ANGOLA	IN	27	0.9942158
KBMG	MONROE COUNTY	BLOOMINGTON	IN	26	0.99447656
KIND	INDIANAPOLIS INTL	INDIANAPOLIS	IN	28	0.99449855
0I2	BRAZIL CLAY COUNTY	BRAZIL	IN	27	0.99450004
FWA	FORT WAYNE INTERNATIONAL	FORT WAYNE	IN	27	0.99430186
SER	FREEMAN MUNICIPAL	SEYMOUR	IN	26	0.99444455
SBN	MICHIANA REG'L TRANSPORTATION CTR	SOUTH BEND	IN	29	0.99418306
KCBK	SHALTZ FIELD	COLBY	KS	27	0.99509925
KHYS	HAYS RGNL	HAYS	KS	28	0.99524933
KMHK	MANHATTAN RGNL	MANHATTAN	KS	27	0.99504465
KOJC	JOHNSON COUNTY EXECUTIVE	OLATHE	KS	26	0.99487764
KULS	ULYSSES	ULYSSES	KS	26	0.99562454
KWLD	STROTHER FIELD	WINFIELD/ARKANSAS CITY	KS	28	0.99579746
EHA	ELKHART-MORTON COUNTY	ELKHART	KS	26	0.9957415
TOP	PHILIP BILLARD MUNI	TOPEKA	KS	26	0.9949627
ICT	WICHITA MID-CONTINENT	WICHITA	KS	30	0.9956991
KCVG	CINCINNATI/NORTHERN KY INTL	COVINGTON/CINCINNATI	KY	25	0.994282
KK22	BIG SANDY RGNL	PRESTONBURG	KY	25	0.99438643
KLEX	BLUE GRASS	LEXINGTON	KY	25	0.9942934
SDF	LOUISVILLE INTERNATIONAL-STANDIFORD FLD	LOUISVILLE	KY	26	0.9943869
KAEX	ALEXANDRIA INTL	ALEXANDRIA	LA	27	0.9960808
L39	LEESVILLE	LEESVILLE	LA	37	0.995757
MSY	NEW ORLEANS INT'L/MOISANT FIELD	NEW ORLEANS	LA	32	0.9957356
SHV	SHREVEPORT REGIONAL	SHREVEPORT	LA	24	0.9962913
KBOS	GEN EDWARD LAWRENCE LOGAN INTL	BOSTON	MA	281	0.9565969
KPVC	PROVINCETOWN MUNI	PROVINCETOWN	MA	288	0.94947016

Airport ID	Airport Name	City	State	Outages	Availability
OWD	NORWOOD MEMORIAL	NORWOOD	MA	271	0.95811
KBWI	BALTIMORE-WASHINGTON INTL	BALTIMORE	MD	91	0.9907812
FDK	FREDERICK MUNICIPAL	FREDERICK	MD	50	0.9940641
GAI	MONTGOMERY COUNTY AIRPARK	GAITHERSBURG	MD	74	0.9931724
W00	FREEWAY	MITCHELLVILLE	MD	85	0.9918659
RJD	RIDGELY AIRPARK	RIDGELY	MD	100	0.9894111
DMW	CARROLL CNTY REG'L/JACK B. POAGE FLD	WESTMINSTER	MD	71	0.99273187
KPQI	N MAINE RGNL ARPT AT PRESQUE I	PRESQUE ISLE	ME	1041	0.7623452
PWM	PORTLAND INTERNATIONAL JETPORT	PORTLAND	ME	342	0.94324195
KARB	ANN ARBOR MUNI	ANN ARBOR	MI	28	0.9941671
KCMX	HOUGHTON COUNTY MEMORIAL	HANCOCK	MI	112	0.9881676
KDTW	DETROIT METROPOLITAN WAYNE CTY	DETROIT	MI	26	0.9943058
KFNT	BISHOP INTL	FLINT	MI	28	0.99412847
KGRR	GERALD R FORD INTL	GRAND RAPIDS	MI	29	0.9940535
KMBS	MBS INTL	SAGINAW	MI	30	0.9940022
KMKG	MUSKEGON COUNTY	MUSKEGON	MI	29	0.9940371
AMN	ALMA/GRATIOT COMMUNITY	ALMA	MI	28	0.9940269
Y15	CHEBOYGAN COUNTY	CHEBOYGAN	MI	70	0.9909646
BIV	TULIP CITY	HOLLAND	MI	30	0.99405265
HTL	ROSCOMMON COUNTY	HOUGHTON LAKE	MI	41	0.9934084
5D3	OWOSSO COMMUNITY	OWOSSO	MI	28	0.9940673
CIU	CHIPPEWA COUNTY INTERNATIONAL	SAULT STE. MARIE	MI	97	0.98985815
KAXN	CHANDLER FIELD	ALEXANDRIA	MN	31	0.9935635
KBDE	BAUDETTE INTL	BAUDETTE	MN	99	0.98858106
KBRD	BRAINERD-CROW WING CO RGNL	BRAINERD	MN	39	0.9929173
KDLH	DULUTH INTL	DULUTH	MN	60	0.9923923
KJYG	ST JAMES MUNI	ST JAMES	MN	28	0.9937311
KMSP	MINNEAPOLIS-ST PAUL INTL/WOLD CHAMBERLAIN	MINNEAPOLIS	MN	32	0.99369174
KRGK	RED WING RGNL	RED WING	MN	30	0.99414057
KRST	ROCHESTER INTL	ROCHESTER	MN	30	0.9942467
KDMO	SEDALIA MEMORIAL	SEDALIA	MO	24	0.99474573
KLBO	FLOYD W JONES LEBANON	LEBANON	MO	27	0.9947442
KMCI	KANSAS CITY INTL	KANSAS CITY	MO	26	0.9948319
KMO6	WASHINGTON MEMORIAL	WASHINGTON	MO	27	0.9946321
KSTL	LAMBERT-ST LOUIS INTL	ST LOUIS	MO	27	0.9944574
M05	CARUTHERSVILLE MEMORIAL	CARUTHERSVILLE	MO	26	0.9946399
LXT	LEE'S SUMMIT MUNICIPAL	LEE'S SUMMIT	MO	25	0.99485487
H41	MEXICO MEMORIAL	MEXICO	MO	24	0.99457186
SGF	SPRINGFIELD-BRANSON REGIONAL	SPRINGFIELD	MO	26	0.99483055
0M6	PANOLA COUNTY	BATESVILLE	MS	25	0.9950639
JAN	JACKSON INTERNATIONAL	JACKSON	MS	24	0.99545425

Airport ID	Airport Name	City	State	Outages	Availability
MPE	PHILADELPHIA MUNICIPAL	PHILADELPHIA	MS	23	0.995394
KBIL	BILLINGS LOGAN INTL	BILLINGS	MT	27	0.9948993
KHLN	HELENA RGNL	HELENA	MT	25	0.9964897
KLWT	LEWISTOWN MUNI	LEWISTOWN	MT	30	0.99489856
KMLS	FRANK WILEY FIELD	MILES CITY	MT	27	0.994523
6S5	RAVALLI COUNTY	HAMILTON	MT	19	0.9983759
KAVL	ASHEVILLE RGNL	ASHEVILLE	NC	26	0.9948761
KCLT	CHARLOTTE/DOUGLAS INTL	CHARLOTTE	NC	28	0.9947279
KEQY	MONROE	MONROE	NC	28	0.9945289
KFAY	FAYETTEVILLE RGNL/GRANNIS FIELD	FAYETTEVILLE	NC	34	0.99422604
KHBI	ASHEBORO MUNI	ASHEBORO	NC	33	0.99452496
KILM	WILMINGTON INTL	WILMINGTON	NC	40	0.99374664
KISO	KINSTON RGNL JETPORT AT STALLINGS FLD	KINSTON	NC	39	0.99402964
KRDU	RALEIGH-DURHAM INTL	RALEIGH/DURHAM	NC	33	0.9944098
KRUQ	ROWAN COUNTY	SALISBURY	NC	29	0.9945781
KTTA	SANFORD-LEE COUNTY RGNL	SANFORD	NC	34	0.99442255
MRH	MICHAEL J. SMITH FIELD	BEAUFORT	NC	48	0.9935194
ECG	ELIZABETH CITY CGAS	ELIZABETH CITY	NC	46	0.99388427
GSO	PIEDMONT TRIAD INTERNATIONAL	GREENSBORO	NC	32	0.99445283
PGV	PITT-GREENVILLE	GREENVILLE	NC	41	0.99397165
HSE	BILLY MITCHELL	HATTERAS	NC	50	0.99351066
HKY	HICKORY REGIONAL	HICKORY	NC	26	0.994765
MEB	LAURINBURG	MAXTON	NC	34	0.99426776
SUT	BRUNSWICK COUNTY	SOUTHPORT	NC	40	0.9938553
OCW	WARREN FIELD	WASHINGTON	NC	45	0.9938749
MCZ	MARTIN COUNTY	WILLIAMSTON	NC	44	0.9939265
W03	WILSON INDUSTRIAL AIR CENTER	WILSON	NC	35	0.99427825
KFAR	HECTOR INTL	FARGO	ND	34	0.99292696
MOT	MINOT INTL AIRPORT	MINOT	ND	42	0.99366
KANW	AINSWORTH MUNI	AINSWORTH	NE	29	0.99464035
KEAR	KEARNEY MUNI	KEARNEY	NE	28	0.9950338
KLBF	NORTH PLATTE RGNL LEE BIRD FLD	NORTH PLATTE	NE	30	0.99476355
AUH	AURORA MUNICIPAL	AURORA	NE	28	0.9948752
BIE	BEATRICE MUNICIPAL	BEATRICE	NE	27	0.99495244
CSB	CAMBRIDGE MUNICIPAL	CAMBRIDGE	NE	27	0.99503547
CEK	CRETE MUNICIPAL	CRETE	NE	28	0.9948336
GRN	GORDON MUNICIPAL	GORDON	NE	28	0.99449724
OMA	EPPLEY AIRFIELD	OMAHA	NE	26	0.9946438
OKS	GARDEN COUNTY	OSHKOSH	NE	27	0.9947431
SCB	SCRIBNER STATE	SCRIBNER	NE	26	0.99457175
SNY	SIDNEY MUNICIPAL	SIDNEY	NE	27	0.994756
VTN	MILLER FIELD	VALENTINE	NE	28	0.9946706
MHT	MANCHESTER	MANCHESTER	NH	260	0.9585974
K3NJ6	INDUCTOTHERM HELIPORT	RANCOCAS	NJ	124	0.98395914
KACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	126	0.9843065
KEWR	NEWARK INTL	NEWARK	NJ	144	0.9820764
KMMU	MORRISTOWN MUNI	MORRISTOWN	NJ	142	0.9823609

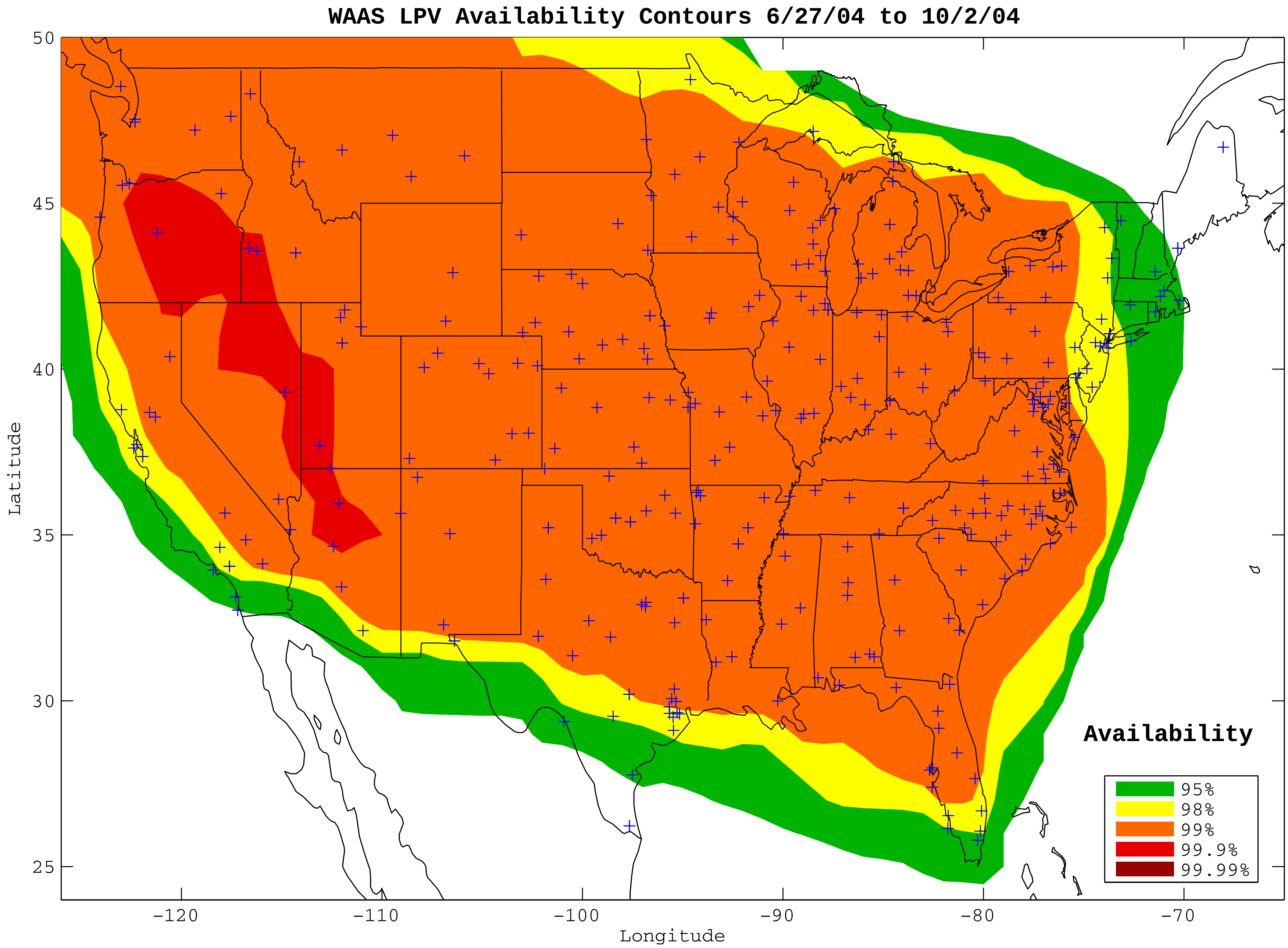
Airport ID	Airport Name	City	State	Outages	Availability
7N7	SPITFIRE AERODROM	PEDRICTOWN	NJ	113	0.98635346
KABQ	ALBUQUERQUE INTL SUNPORT	ALBUQUERQUE	NM	27	0.9965322
KFMN	FOUR CORNERS RGNL	FARMINGTON	NM	25	0.9959405
KLRU	LAS CRUCES INTL	LAS CRUCES	NM	51	0.9936926
KLAS	MC CARRAN INTL	LAS VEGAS	NV	34	0.99836063
ELY	ELY AIRPORT/YELLAND FELD	ELY	NV	17	0.99896204
KELM	ELMIRA/CORNING RGNL	ELMIRA	NY	32	0.99479914
KJFK	JOHN F KENNEDY INTL	NEW YORK	NY	150	0.9813158
KJHW	CHAUTAUQUA COUNTY/JAMESTOWN	JAMESTOWN	NY	26	0.9947804
KSWF	STEWART INTL	NEWBURGH	NY	160	0.9806918
KSYR	SYRACUSE HANCOCK INTL	SYRACUSE	NY	54	0.994191
ALB	ALBANY INTERNATIONAL	ALBANY	NY	192	0.9789478
BUF	BUFFALO NIAGARA INTERNATIONAL	BUFFALO	NY	27	0.9949373
LGA	LA GUARDIA	FLUSHING	NY	151	0.98127764
GFL	FLOYD BENNETT MEMORIAL	GLENS FALLS	NY	203	0.97481686
LKP	LAKE PLACID	LAKE PLACID	NY	223	0.9815932
ROC	GREATER ROCHESTER INTERNATIONAL	ROCHESTER	NY	30	0.99487704
B16	WHITFORDS	WEEDSPORT	NY	37	0.99467665
FOK	THE FRANCIS S. GABRESKI	WESTHAMPTON BEACH	NY	204	0.97719896
HPN	WESTCHESTER COUNTY	WHITE PLAINS	NY	160	0.9801479
PBG	PLATTSGURGH INTERNATIONAL	PLATTSGURGH	NY	273	0.9772565
KCLE	CLEVELAND-HOPKINS INTL	CLEVELAND	OH	26	0.9945975
KCMH	PORT COLUMBUS INTL	COLUMBUS	OH	26	0.9946022
KDAY	JAMES M COX DAYTON INTL	DAYTON	OH	26	0.9942739
KRZT	ROSS COUNTY	CHILLICOTHE	OH	25	0.9944472
KTOL	TOLEDO EXPRESS	TOLEDO	OH	27	0.99431276
1G5	MEDINA MUNICIPAL	MEDINA	OH	25	0.9946392
K2K4	SCOTT FIELD	MANGUM	OK	26	0.9961733
KAVK	ALVA RGNL	ALVA	OK	26	0.9959346
KCQB	CHANDLER MUNI	CHANDLER	OK	27	0.99592835
KHBR	HOBART MUNI	HOBART	OK	25	0.9961452
KMKO	DAVIS FIELD	MUSKOGEE	OK	25	0.9959784
KTUL	TULSA INTL	TULSA	OK	25	0.99591005
2O8	HINTON MUNICPAL	HINTON	OK	28	0.99595135
OKC	WILL ROGERS WORLD AIRPORT	OKLAHOMA CITY	OK	27	0.99590695
MDF	MORELAND MUNI	MORELAND	OK	28	0.9959055
KONP	NEWPORT MUNI	NEWPORT	OR	50	0.99785763
S07	BEND MUNICIPAL	BEND	OR	27	0.9990354
HIO	PORTLAND-HILLSBORO	HILLSBORO	OR	34	0.99859005
LGD	UNION COUNTY	LA GRANDE	OR	22	0.9986281
PDX	PORTLAND INTERNATIONAL	PORTLAND	OR	32	0.9986826
S47	TILLAMOOK	TILLAMOOK	OR	44	0.9981671
KAGC	ALLEGHENY COUNTY	PITTSBURGH	PA	25	0.99461925
KBFD	BRADFORD RGNL	BRADFORD	PA	26	0.9948929
KJST	JOHN MURTHA JOHNSTOWN-CAMBRIA COUNTY	JOHNSTOWN	PA	25	0.9945864
KPIT	PITTSBURGH INTL	PITTSBURGH	PA	25	0.9946254

Airport ID	Airport Name	City	State	Outages	Availability
ABE	LEHIGH VALLEY INTERNATIONAL	ALLENTOWN	PA	122	0.98596734
MDT	HARRISBURG INTERNATIONAL	HARRISBURG	PA	48	0.9942452
LHV	WILLIAM T. PIPER MEMORIAL	LOCK HAVEN	PA	27	0.9948893
PHL	PHILADELPHIA INTERNATIONAL	PHILADELPHIA	PA	118	0.98535955
PVD	THEODORE FRANCIS GREEN STATE	PROVIDENCE	RI	255	0.9611192
KCAE	COLUMBIA METROPOLITAN	COLUMBIA	SC	30	0.99456006
KCHS	CHARLESTON AFB/INTL	CHARLESTON	SC	34	0.9945264
KGSP	GREENVILLE-SPARTANBURG INTL	GREER	SC	25	0.9948057
KMYR	MYRTLE BEACH INTL	MYRTLE BEACH	SC	36	0.9940749
AND	ANDERSON REGIONAL	ANDERSON	SC	26	0.9949368
KHON	HURON REGIONAL	HURON	SD	27	0.99410725
KRAP	RAPID CITY REGIONAL	RAPID CITY	SD	28	0.9945258
1D1	MILBANK MUNICIPAL	MILBANK	SD	29	0.9938448
FSD	JOE FOSS FIELD	SIOUX FALLS	SD	27	0.99416345
KBNA	NASHVILLE INTL	NASHVILLE	TN	24	0.9950343
KMEM	MEMPHIS INTL	MEMPHIS	TN	26	0.9949126
CHA	LOVELL FIELD	CHATTANOOGA	TN	24	0.994831
TYS	MC GHEE TYSON	KNOXVILLE	TN	26	0.99489915
PHT	HENRY COUNTY	PARIS	TN	24	0.99463767
KABI	ABILENE REGIONAL	ABILENE	TX	50	0.9951492
KAXH	HOUSTON-SOUTHWEST	HOUSTON	TX	82	0.987671
KCXO	MONTGOMERY COUNTY	CONROE	TX	66	0.9935246
KDAL	DALLAS LOVE FIELD	DALLAS	TX	27	0.99618006
KDFW	DALLAS-FT WORTH INTL	DALLAS-FT WORTH	TX	27	0.9961761
KDRT	DEL RIO INTL	DEL RIO	TX	149	0.97482973
KDWH	DAVID WAYNE HOOKS MEMORIAL	HOUSTON	TX	70	0.99186933
KEFD	ELLINGTON FIELD	HOUSTON	TX	82	0.9890074
KHOU	WILLIAM P HOBBY	HOUSTON	TX	82	0.98906684
KHRL	VALLEY INTL	HARLINGEN	TX	381	0.91746366
KIAH	GEORGE BUSH INTERCONTINENTAL/HOUSTON	HOUSTON	TX	73	0.99144506
KIWS	WEST HOUSTON	HOUSTON	TX	77	0.9895987
KLBB	LUBBOCK INTL	LUBBOCK	TX	28	0.99628526
KLBX	BRAZORIA COUNTY	ANGLETON/LAKE JACKSON	TX	98	0.98441267
KSAT	SAN ANTONIO INTL	SAN ANTONIO	TX	112	0.9815104
KSGR	SUGAR LAND MUNI/HULL FLD	HOUSTON	TX	80	0.9881292
KSJT	SAN ANGELO RGNL/MATHIS FLD	SAN ANGELO	TX	76	0.99304944
KTYR	TYLER POUNDS RGNL	TYLER	TX	26	0.9963123
AMA	AMARILLO INTERNATIONAL	AMARILLO	TX	26	0.99607646
AUS	AUSTIN-BERGSTROM INTERNATIONAL	AUSTIN	TX	75	0.98988855
7F9	COMANCHE	COMANCHE	TX	53	0.9945621
CRP	CORPUS CHRISTI INTERNATIONAL	CORPUS CHRISTI	TX	265	0.9533251
ADS	ADDISON	DALLAS	TX	27	0.99618465
ELP	EL PASO INTERNATIONAL	EL PASO	TX	73	0.99105483

Airport ID	Airport Name	City	State	Outages	Availability
MAF	MIDLAND INTERNATIONAL	MIDLAND	TX	64	0.9938725
OSA	MOUNT PLEASANT MUNICIPAL	MOUNT PLEASANT	TX	25	0.9963149
KCDC	CEDAR CITY RGNL	CEDAR CITY	UT	16	0.9990015
KKNB	KANAB MUNI	KANAB	UT	17	0.9989997
BMC	BRIGHAM CITY	BRIGHAM CITY	UT	19	0.99845797
LGU	LOGAN-CACHE	LOGAN	UT	18	0.9982912
SLC	SALT LAKE CITY INTERNATIONAL	SALT LAKE CITY	UT	17	0.998728
KCHO	CHARLOTTESVILLE-ALBEMARLE	CHARLOTTESVILLE	VA	31	0.99416864
KORF	NORFOLK INTL	NORFOLK	VA	46	0.99401665
KPHF	NEWPORT NEWS/WILLIAMSBURG INTL	NEWPORT NEWS	VA	44	0.99396986
FKN	FRANKLIN MUNICIPAL-JOHN BEVERLY ROSE	FRANKLIN	VA	45	0.9940596
LVL	BRUNSWICK MUNICIPAL	LAWRENCEVILLE	VA	35	0.99424326
JYO	LEESBURG MUNICIPAL/GODFREY FIELD	LEESBURG	VA	36	0.9944992
HEF	MANASSAS REGIONAL/HARRY P. DAVIS FIELD	MANASSAS	VA	33	0.99464357
MTV	BLUE RIDGE	MARTINSVILLE	VA	30	0.9943928
RIC	RICHMOND INTERNATIONAL	RICHMOND	VA	36	0.9942188
AKQ	WAKEFIELD MUNICIPAL	WAKEFIELD	VA	41	0.99403304
WAL	WALLOPS FLIGHT FACILITY	WALLOPS ISLAND	VA	93	0.99085265
BTV	BURLINGTON INTERNATIONAL	BURLINGTON	VT	266	0.9729712
KGEG	SPOKANE INTL	SPOKANE	WA	25	0.9982442
KMWH	GRANT COUNTY INTL	MOSES LAKE	WA	29	0.9981888
KSEA	SEATTLE-TACOMA INTL	SEATTLE	WA	37	0.9976805
FHR	FRIDAY HARBOR	FRIDAY HARBOR	WA	55	0.99664074
BFI	BOEING FIELD/KING COUNTY INTERNATIONAL	SEATTLE	WA	37	0.99768895
KATW	OUTAGAMIE COUNTY RGNL	APPLETON	WI	33	0.9941141
KCWA	CENTRAL WISCONSIN	MOSINEE	WI	35	0.9938619
KGRB	AUTIN STRAUBEL INTL	GREEN BAY	WI	34	0.9939374
3T3	BOYCEVILLE MUNICIPAL	BOYCEVILLE	WI	34	0.9939257
FLD	FOND DU LAC COUNTY	FOND DU LAC	WI	32	0.994137
MSN	DANE COUNTY REGIONAL-TRUAX FIELD	MADISON	WI	31	0.99423975
MKE	GENERAL MITCHELL INTERNATIONAL	MILWAUKEE	WI	32	0.99419415
RHI	RHINELANDER-ONEIDA COUNTY	RHINELANDER	WI	44	0.9934666
SUE	DOOR COUNTY CHERRYLAND	STURGEON BAY	WI	40	0.99366194
RYV	WATERTOWN MUNICIPAL	WATERTOWN	WI	33	0.9941779
ETB	WEST BEND MUNICIPAL	WEST BEND	WI	33	0.9940857
KMGW	MORGANTOWN MUNI-WLB HART FLD	MORGANTOWN	WV	25	0.9944454
KPKB	WOOD CO-GILL ROBB WILSON FLD	PARKERSBURG	WV	25	0.9944064
KCPR	NATRONA COUNTY INTL	CASPER	WY	28	0.99489534
EVW	EVANSTON-UNITA CNTY-BURNS FLD	EVANSTON	WY	19	0.99843484

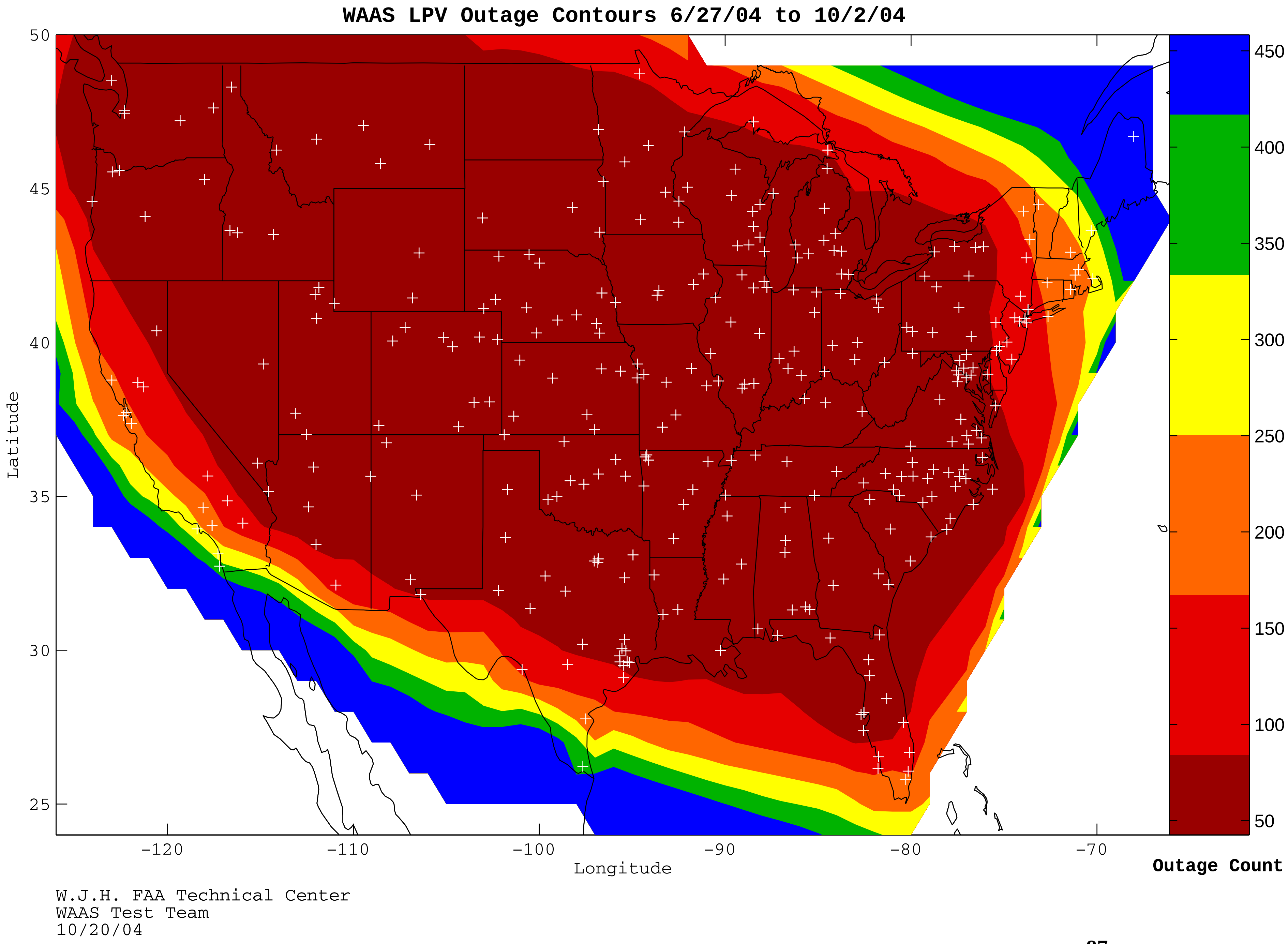
Airport ID	Airport Name	City	State	Outages	Availability
SAA	SHIVELY FIELD	SARATOGA	WY	26	0.9952653

Figure 10-1 WAAS LPV Availability



W.J.H. FAA Technical Center
WAAS Test Team
10/20/04

Figure 10-2 WAAS LPV Outage



11.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

WAAS utilizes a deterministic model to estimate the residual CNMP noise after the application of standard dual frequency carrier smoothing techniques to minimize the effects of multipath and code noise. This analysis performs an assessment of how well that deterministic model bounds the actual errors. This analysis is periodically performed as part of the WAAS Test Team's off-line monitoring to ensure that there are no drastic detrimental changes to the multipath environment at the WAAS Reference Stations (WRSs). This analysis also ensures that WAAS system is not indefinitely exposed to conspiring receiver failure symptoms that would invalidate the CNMP bounding estimate in a manner that would exceed the assumption that no more than one receiver is conspiring to deceive the WAAS monitors at any time by underestimating the residual measurement noise the safety monitors. Although some failures mechanisms that cause CNMP bounding issues are occasionally seen, no "conspiring" errors have ever been detected. That is, data has caused the safety monitors to trip unnecessarily versus missing a necessary trip.

The analysis post processes measurement data to estimate the pseudorange code to carrier ambiguity for each entire arc of measurements for each satellite pass. The ambiguity estimate is then used to level the carrier measurement. The leveled carrier is then used as a multipath free truth estimate. The WAAS real time deterministic CNMP smoothing algorithm is then applied to the original measurements. The difference between the smoothed measurements and the leveled truth measurements is compared to the deterministic noise estimates. Only arcs with continuous carrier phase greater in length than 7200 seconds are utilized for this analysis to minimize the impacts of non-zero mean multipath biasing the truth estimates. The WAAS dual frequency cycle slip detector algorithm is used to detect any discontinuities in the carrier phase.

Statistics are calculated on how well the 0.1 multiples of the deterministically estimated standard deviation bounds the difference between the leveled truth and the real time smoothed measurements. Those statistics are then compared to a theoretical gaussian distribution and an extensive set of plots are generated and manually reviewed. Table 11.1 recaps the results of that manual analysis.

Table 11-1 CNMP Bounding Statistics

WAAS Site	WRE	Oct 03	Nov 03	Dec 03	Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04
Albuquerque	A	green	blue	green	blue	blue	green	yellow	blue	blue	blue	blue	blue
	B	orange	green	blue	blue	blue	blue	yellow	blue	blue	blue	blue	blue
	C	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	blue
Anchorage	A	orange	orange	blue	green	green	yellow	blue	yellow	blue	blue	orange	green
	B	red	orange	green	blue	blue	blue	blue	blue	green	blue	green	blue
	C	green	orange	green	blue	blue	blue	blue	blue	blue	orange	blue	orange
Atlanta	A	blue	blue	blue	blue	blue	blue	blue	green	blue	blue	green	green
	B	green	green	blue	blue	blue	blue	yellow	blue	green	green	blue	blue
	C	orange	blue	blue	blue	blue	green	blue	blue	blue	blue	blue	blue
Billings	A	blue	green	blue	blue	blue	blue	blue	blue	blue	blue	blue	green
	B	blue	blue	blue	blue	blue	blue	yellow	blue	blue	blue	blue	blue
	C	green	blue	blue	blue	blue	blue	blue	blue	blue	green	blue	blue
Boston	A	green	blue	green	blue	green	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	green	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	green	orange	blue	blue
Chicago	A	blue	green	blue	orange	orange	blue	green	green	blue	blue	blue	blue
	B	blue	green	blue	blue	blue	blue	green	green	green	blue	blue	blue
	C	blue	blue	orange	blue	blue	yellow	yellow	yellow	blue	blue	green	orange
Cleveland	A	orange	orange	green	green	green	green	yellow	blue	yellow	blue	blue	green
	B	green	orange	green	blue	blue	yellow	green	green	blue	blue	blue	blue
	C	green	green	blue	green	blue	blue	green	blue	green	blue	blue	orange
Cold Bay	A	blue	blue	blue	blue	blue	red	blue	blue	blue	blue	blue	blue
	B	blue	orange	blue	green	blue	blue	green	blue	green	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	orange	blue
Dallas	A	green	green	green	blue	green	green	red	yellow	green	green	green	blue
	B	blue	blue	green	blue	blue	blue	blue	yellow	blue	blue	blue	green
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Denver	A	green	blue	green	green	blue	green	blue	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	blue	blue	yellow	blue	blue	blue	blue	green
	C	blue	blue	blue	blue	blue	blue	yellow	blue	blue	green	blue	blue
Honolulu	A	orange	green	orange	orange	orange	red	blue	green	red	orange	red	green
	B	blue	orange	blue	blue	blue	blue	blue	blue	blue	blue	blue	orange
	C	blue	green	blue	blue	green	blue	blue	blue	blue	blue	blue	blue
Houston	A	red	red	red	orange	red	red	red	yellow	yellow	red	yellow	red
	B	red	red	red	red	orange	red	red	red	red	red	red	orange
	C	red	orange	red	red	red	red	yellow	yellow	green	red	green	orange
Jacksonville	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	green	blue	blue
	B	blue	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	green
	C	blue	blue	green	blue	blue	blue	blue	red	blue	blue	blue	blue
Juneau	A	blue	blue	green	blue	blue	yellow	blue	blue	blue	blue	blue	blue
	B	blue	orange	orange	blue	blue	yellow	blue	yellow	green	green	orange	blue
	C	blue	blue	blue	blue	green	green	blue	blue	blue	green	blue	orange
Kansas City	A	green	orange	blue	blue	orange	yellow	yellow	blue	blue	green	blue	blue
	B	blue	green	blue	blue	orange	green	blue	blue	green	blue	blue	blue
	C	blue	red	green	blue	blue	green	green	blue	blue	blue	blue	blue
Los Angeles	A	blue	green	blue	blue	blue	blue	blue	blue	blue	green	blue	blue
	B	blue	orange	blue	blue	blue	blue	blue	blue	blue	blue	blue	green
	C	orange	green	blue	orange	blue	blue	yellow	green	green	blue	blue	green
Memphis	A	orange	blue	blue	blue	green	blue	blue	blue	blue	blue	orange	blue
	B	blue	orange	orange	blue	blue	blue	blue	blue	blue	blue	green	green
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Miami	A	orange	green	blue	green	green	green	yellow	blue	blue	blue	blue	blue
	B	orange	orange	green	green	green	green	blue	green	blue	blue	blue	green
	C	red	red	green	orange	orange	red	yellow	yellow	green	blue	blue	orange

WAAS Site	WRE	Oct 03	Nov 03	Dec 03	Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04
Minneapolis	A	blue	green	blue	blue	blue	yellow	blue	blue	blue	blue	blue	blue
	B	green	orange	orange	blue	green	blue	blue	green	yellow	green	blue	blue
	C	blue	orange	blue	blue	blue	blue	green	green	yellow	blue	blue	blue
New York	A	blue	blue	blue	blue	green	blue	blue	blue	blue	blue	green	blue
	B	green	blue	blue	blue	green	green	green	blue	blue	green	green	blue
	C	orange	green	green	green	green	green	green	blue	blue	blue	orange	blue
Oakland	A	green	blue	blue	blue	orange	blue	green	blue	green	orange	orange	blue
	B	red	orange	orange	blue	blue	blue	blue	yellow	blue	blue	blue	blue
	C	green	orange	red	blue	green	green	green	yellow	green	orange	orange	orange
Salt Lake City	A	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	green
	B	red	green	blue	green	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	green	blue
San Juan	A	green	green	blue	blue	blue	yellow	yellow	blue	blue	green	blue	blue
	B	orange	orange	blue	green	blue	yellow	green	blue	blue	blue	blue	yellow
	C	orange	green	orange	green	blue	blue	yellow	yellow	blue	green	blue	yellow
Seattle	A	blue	blue	blue	blue	blue	blue	blue	blue	red	blue	green	blue
	B	blue	orange	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	yellow	blue	green	blue	blue
Washington, DC	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	green	red	green	blue	blue	blue	blue	blue	red	blue

Δ (blue) **Excellent** - 3.29σ bounded 100%
Δ (green) **Good** - 4σ bounded 100%
Δ (orange) **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review)
Δ (red) **Poor** – Requires manual review

12.0 WAAS EQUIPMENT OUTAGE

To determine if outages of any WAAS assets affects the SIS performance, failures to WAAS equipment is tracked. Some events, such as a GUS switchover, definitely affect SIS performance. Other events, like multiple WRE outages at a single WRS, may or may not affect SIS performance. During this quarter, the WRS outages were a factor in degraded PA ranging availability for the AOR-W GEO.

Data was collected from all WAAS sites to determine if any failures occurred. This data is made available through the WAAS External Interface (WEI). WAAS Test Team developed software parses the data so it is available for analysis. Any equipment failures are confirmed with the WAAS operational community.

During this reporting period there were a total of sixteen GUS switchovers. The dates and times of the switchovers are shown in Table 12.1. The reasons for the switchovers include maintenance action, preventative maintenance, equipment failure, and operations policy. The operations policy refers to the policy that two GUSs cannot be in primary at the same site, in this case Santa Paula. To further explain, each GEO satellite for the WAAS has two uplink locations. The AORW satellite's uplinks are located at Clarksburg MD and Santa Paula CA. The POR satellite's uplinks are located at Brewster WA and Santa Paula CA (note that this uplink is physically independent from the AORW Santa Paula uplink, they are just located at the same facility). An uplink is normally in one of two modes: primary or backup. The primary uplink transmits the WAAS information to the respective GEO satellite. The backup uplink is a hot standby. When a switchover occurs there is a loss of the WAAS signal, for that particular GEO satellite, for approximately 10 seconds while the backup GUS locks in the GEO signal. The number of switchovers continues to be a concern due to the negative impact on WAAS users. The WAAS Operations organizations have been informed on the negative impacts of GUS switchovers. Policies have been implemented to help prevent the large number of switchovers that have occurred since WAAS commissioning.

There were also a large number of WRE outages during this quarter. Once again this quarter, the primary reasons for WRE outages were replacement of faulty receivers, the three-card reset and WRE Bias Monitor trips. Table 12.2 lists all the outages that affected reference stations.

There were three outages at the National Operations Command Center (NOCC) and Pacific Operations Command Center (POCC). None of these outages affected the WAAS SIS or WAAS operations. Table 12.3 lists all the outages at the NOCC and POCC for this reporting period.

There were five outages of the ZLA Corrections and Verification subsystem. Due to the redundant design of WAAS there was no interruption in the signal in space due to these outages.

There were two losses of signal in space for the AOR-W satellite during this quarter. The first time was due to a faulty test transmitter from INMARSAT. The test transmitter accidentally transmitted a carrier into the frequency band reserved for the WAAS transponder. This looked like interference to the WAAS GUS. Eventually both GUSs faulted due to this condition. The second outage was due to a similar incident.

NOTE: The tables below show dates and times according to GPS nomenclature. This quarter began on Week 1251, Day 4 (January 1, 2004) and ended Week 1264, Day 3 (March 31, 2004). Here is an explanation for the related column headings in all the following tables:

- *NSTB Week #: The GPS week begins 12:00:00 AM Sunday and ends 11:59:59 PM Saturday. The NSTB week is equal to the GPS week plus 1024.*
- *GPS Day: The first GPS day is Day 0 (Sunday) and Day 6 is Saturday.*
- *GPS Time: Number of seconds into the week since 12:00:00 AM Sunday.*

Table 12-1 WAAS GUS Switchovers from April 1, 2004 to June 30, 2004

NSTB Week Number	Day of Week	Site Type	Start Outage
1279	3	AOR-W	321605
1279	3	POR	337824
1281	3	AOR-W	315067
1281	**4**	AOR-W	**349473**
1281	**4**	AOR-W	**349481**
1284	0	AOR-W	29801
1284	1	POR	103289
1285	**0**	AOR-W	**55557**
1285	**0**	AOR-W	**55573**
1285	1	AOR-W	159676
1286	0	AOR-W	7588
1287	2	AOR-W	225635
1287	2	AOR-W	227399
1287	4	POR	379070
1287	6	POR	577859
1287	6	AOR-W	579284
1288	0	AOR-W	26752
1290	3	POR	268203

NOTE: The bolded entries indicate a complete loss of the WAAS Signal in Space for the AOR-W satellite. On Week 1281 Day 4 the duration of the outage was 23323 seconds. On Week 1285 Day 0 the duration of the outage was 7452 seconds.

Table 12-2 WRE Outages from April 1, 2004 to June 30, 2004

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1277	5	ZDC-C	WRS	453718	482518	28800
1277	6	ZFW-C	WRS	522989	526156	3167
1277	6	ZHU-C	WRS	586303	589255	2952
1278	0	ZDC-C	WRS	39983	147428	107445
1278	1	CDB-B	WRS	95408	98045	2637
1278	1	ZSU-C	WRS	106612	108860	2248
1278	1	ZNY-A	WRS	159516	163274	3758
1278	1	ZNY-B	WRS	159591	179280	19689
1278	2	ZHU-A	WRS	179487	182114	2627
1278	2	ZHU-B	WRS	179511	196218	16707
1278	2	CDB-A	WRS	191447	194984	3537
1278	2	ZMA-C	WRS	197482	203235	5753
1278	3	ZDC-C	WRS	273552	415919	142367
1278	3	ZME-A	WRS	326394	331486	5092
1278	4	ZAN-B	WRS	363427	366933	3506

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1278	4	ZNY-C	WRS	386037	390020	3983
1278	4	ZFW-A	WRS	404335	415525	11190
1278	4	ZMA-B	WRS	418966	423077	4111
1278	5	ZDC-C	WRS	438092	236464	1007972
1278	5	ZAU-C	WRS	492726	514563	21837
1278	6	ZOA-C	WRS	568813	571899	3086
1279	0	ZKC-A	WRS	72835	76731	3896
1279	1	ZDV-C	WRS	169615	174324	4709
1279	2	ZDV-A	WRS	193608	196915	3307
1279	2	HNL-A	WRS	227273	231109	3836
1279	3	ZKC-C	WRS	262566	268682	6116
1279	3	HNL-B	WRS	315174	318262	3088
1279	3	HNL-A	WRS	331521	335607	4086
1279	3	JNU-A	WRS	336529	344628	8099
1279	3	JNU-B	WRS	345525	353913	8388
1279	4	JNU-B	WRS	404620	409016	4396
1279	4	JNU-A	WRS	409785	415189	5404
1279	4	HNL-B	WRS	413297	420890	7593
1279	4	JNU-C	WRS	421655	429440	7785
1279	6	ZSU-C	WRS	601351	882	4331
1280	0	ZLC-A	WRS	21323	24609	3286
1280	0	ZSU-C	WRS	22160	25628	3468
1280	3	HNL-C	WRS	334347	338552	4205
1280	5	ZDV-B	WRS	487365	490912	3547
1280	6	ZAB-C	WRS	522301	526112	3811
1281	3	ZAN-A	WRS	322191	326509	4318
1281	3	ZFW-B	WRS	326406	331587	5181
1282	0	ZMP-B	WRS	34839	38483	3644
1282	0	ZSU-C	WRS	58346	62602	4256
1282	0	ZOB-A	WRS	74490	76944	2454
1282	1	CDB-C	WRS	138370	141362	2992
1282	1	JNU-C	WRS	153019	156613	3594
1282	2	ZAN-C	WRS	245544	248414	2870
1282	3	ZMP-A	WRS	273157	276847	3690
1282	3	ZOA-B	WRS	343988	347367	3379
1282	5	ZMP-C	WRS	488800	495878	7078
1283	0	ZSE-C	WRS	57714	60342	2628
1283	0	ZOA-A	WRS	63049	67605	4556
1283	0	ZLA-C	WRS	79876	82897	3021
1283	2	ZMA-C	WRS	221596	225815	4219
1283	2	ZFW-A	WRS	239579	242289	2710
1283	2	ZFW-B	WRS	239680	259940	20260
1283	2	ZSE-B	WRS	249325	252353	3028

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1283	5	ZAB-B	WRS	494791	497673	2882
1283	6	ZFW-A	WRS	524727	531288	6561
1283	6	ZFW-B	WRS	524743	543556	18813
1283	6	ZSU-C	WRS	580562	584148	3586
1284	2	ZSU-C	WRS	197272	201525	4253
1284	2	ZSU-B	WRS	205048	206010	962
1284	3	ZME-C	WRS	328859	334389	5530
1284	4	ZAU-B	WRS	369188	372355	3167
1284	5	BIL-C	WRS	432587	435903	3316
1284	6	ZSU-C	WRS	576067	579410	3343
1284	6	ZTL-B	WRS	588947	593359	4412
1285	0	ZSU-C	WRS	42107	46058	3951
1285	0	ZSU-C	WRS	60374	62494	2120
1285	0	ZTL-C	WRS	76153	80076	3923
1285	1	ZBW-B	WRS	157002	160054	3052
1285	1	ZTL-A	WRS	166616	174773	8157
1285	2	ZBW-A	WRS	181110	184837	3727
1285	2	ZBW-C	WRS	215466	218750	3284
1285	2	ZSU-C	WRS	216478	220342	3864
1285	3	ZSU-B	WRS	269452	272998	3546
1285	6	ZSU-C	WRS	532106	534787	2681
1286	3	ZME-C	WRS	316636	319877	3241
1287	2	ZHU-A	WRS	232312	235876	3564
1287	3	ZME-B	WRS	282699	286283	3584
1287	6	JNU-C	WRS	555645	558805	3160
1288	0	ZOB-A	WRS	5801	8037	2236
1288	0	ZOB-B	WRS	5831	21660	15829
1288	1	ZKC-C	WRS	88614	91141	2527
1288	1	BIL-A	WRS	153956	158948	4992
1288	4	ZME-A	WRS	375852	378883	3031
1288	4	ZMA-C	WRS	391044	403346	12302
1288	4	ZJX-C	WRS	400103	404539	4436
1289	2	ZLC-B	WRS	180787	183904	3117
1289	2	ZOB-C	WRS	256824	259854	3030
1289	3	ZLA-B	WRS	303093	306507	3414
1289	3	ZLC-C	WRS	341506	344686	3180
1289	4	ZKC-B	WRS	422383	426359	3976
1289	5	ZSE-A	WRS	462327	248101	390574
1289	5	ZMA-A	WRS	474293	477526	3233
1289	5	ZAU-C	WRS	483668	487255	3587
1290	0	BIL-B	WRS	57095	60123	3028
1290	1	ZAB-A	WRS	129464	132766	3302
1290	1	ZAU-A	WRS	152624	156365	3741

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1290	3	ZTL-A	WRS	324273	326909	2636
1290	3	ZSU-A	WRS	325864	327398	1534
1290	3	ZJX-B	WRS	333714	337763	4049
1290	4	ZTL-C	WRS	417159	419302	2143

Table 12-3 O&M Outages from April 1, 2004 to June 30, 2004

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1280	0	NOCC	O&M	20402	20428	26
1284	1	POCC	O&M	118112	118298	186
1285	0	POCC	O&M	71267	72401	1134

Table 12-4 CnV Outages from July 1, 2004 to September 30, 2004

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1280	1	ZLA-CP1	C&V	154057	239978	85921
1280	1	ZLA-CP2	C&V	154057	239979	85922
1281	3	ZLA-CP1	C&V	326083	331082	4999
1281	3	ZLA-CP2	C&V	326084	331083	4999
1282	1	ZLA-CP2	C&V	118584	126325	7741
1282	1	ZLA-CP1	C&V	120736	126324	5588
1287	2	ZLA-CP1	C&V	227674	233449	5775
1287	2	ZLA-CP2	C&V	227675	233450	5775
1287	5	ZLA-CP1	C&V	453776	462968	9192
1287	5	ZLA-CP2	C&V	453777	462969	9192

Appendix A: Glossary

General Terms and Definitions

Alert. An alert is an indication provided by the GPS/WAAS equipment to inform the user when the positioning performance achieved by the equipment does not meet the integrity requirements.

APV-ILNAV/VNAV. APV-I is a WAAS operational service level with an HAL equal to 556 meters and a VAL equal to 50 meters.

Availability. The availability of a navigation system is the ability of the system to provide the required function and performance at the initiation of the intended operation. Availability is an indication of the ability of the system to provide usable service within the specified coverage area.

AVP-II. APV-II is a WAAS operational service level with an HAL equal to 40 meters and a VAL equal to 20 meters.

CONUS. Continental United States.

Continuity. The continuity of a system is the ability of the total system (comprising all elements necessary to maintain aircraft position within the defined airspace) to perform its function without interruption during the intended operation. More specifically, continuity is the probability that the specified system performance will be maintained for the duration of a phase of operation, presuming that the system was available at the beginning of that phase of operation.

Coverage. The coverage provided by a radio navigation system is that surface area or space volume in which the signals are adequate to permit the user to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions, and other factors that affect signal availability.

Dilution of Precision (DOP). The magnifying effect on GPS position error induced by mapping GPS ranging errors into position through the position solution. The DOP may be represented in any user local coordinate desired. Examples are HDOP for local horizontal, VDOP for local vertical, PDOP for all three coordinates, and TDOP for time.

Fault Detection and Exclusion (FDE). Fault detection and exclusion is a receiver processing scheme that autonomously provides integrity monitoring for the position solution, using redundant range measurements. The FDE consists of two distinct parts: fault detection and fault exclusion. The fault detection part detects the presence of an unacceptably large position error for a given mode of flight. Upon the detection, fault exclusion follows and excludes the source of the unacceptably large position error, thereby allowing navigation to return to normal performance without an interruption in service.

GEO. Geostationary Satellite.

Global Positioning System (GPS). A space-based positioning, velocity, and time system composed of space, control, and user segments. The space segment, when fully operational, will be composed of 24 satellites in six orbital planes. The control segment consists of five monitor stations, three ground antennas, and a master control station. The user segment consists of antennas and receiver-processors that provide positioning, velocity, and precise timing to the user.

GLS. GLS is a WAAS operational service level with HAL equal to 40 meters and VAL equal to 12 meters.

Grid Ionospheric Vertical Error (GIVE). GIVEs indicate the accuracy of ionospheric vertical delay correction at a geographically defined ionospheric grid point (IGP). WAAS transmits one GIVE for each IGP in the mask.

Hazardous Misleading Information (HMI). Hazardous misleading information is any position data, that is output, that has an error larger than the current protection level (HPL/VPL), without any indication of the error (e.g., alert message sequence).

Horizontal Alert Limit (HAL). The Horizontal Alert Limit (HAL) is the radius of a circle in the horizontal plane (the local plane tangent to the WGS-84 ellipsoid), with its center being at the true position, which describes the region that is required to contain the indicated horizontal position with a probability of $1\text{-}10^{-7}$ per flight hour, for a particular navigation mode, assuming the probability of a GPS satellite integrity failure being included in the position solution is less than or equal to 10^{-4} per hour.

Horizontal Protection Level (HPL). The Horizontal Protection Level is the radius of a circle in the horizontal plane (the plane tangent to the WGS-84 ellipsoid), with its center being at the true position, which describes the region that is assured to contain the indicated horizontal position. It is based upon the error estimates provided by WAAS.

Ionospheric Grid Point (IGP). IGP is a geographically defined point for which the WAAS provides the vertical ionospheric delay.

LNAV. Lateral Navigation.

MOPS. Minimum Operational Performance Standards.

Navigation Message. Message structure designed to carry navigation data.

Non-Precision Approach (NPA) Navigation Mode. The Non-Precision Approach navigation mode refers to the navigation solution operating with a minimum of four satellites with fast and long term WAAS corrections (no WAAS ionospheric corrections) available.

Position Solution. The use of ranging signal measurements and navigation data from at least four satellites to solve for three position coordinates and a time offset.

Precision Approach (PA) Navigation Mode. The Precision Approach navigation mode refers to the navigation solution operating with a minimum of four satellites with all WAAS corrections (fast, long term, and ionospheric) available.

Selective Availability. Protection technique employed by the DOD to deny full system accuracy to unauthorized users.

Standard Positioning Service (SPS). Three-dimensional position and time determination capability provided to a user equipped with a minimum capability GPS SPS receiver in accordance with GPS national policy and the performance specifications.

SV. Satellite Vehicle.

User Differential Range Error (UDRE). UDRE's indicate the accuracy of combined fast and slow error corrections. WAAS transmits one UDRE for each satellite in the mask.

Vertical Alert Limit (VAL). The Vertical Alert Limit is half the length of a segment on the vertical axis (perpendicular to the horizontal plane of WGS-84 ellipsoid), with its center being at the true position, which describes the region that is required to contain the indicated vertical position with a probability of $1\text{-}10^{-7}$ per flight hour, for a particular navigation mode, assuming the probability of a GPS satellite integrity failure being included in the position solution is less than or equal to 10^{-4} per hour.

Vertical Protection Level (VPL). The Vertical Protection Level is half the length of a segment on the vertical axis (perpendicular to the horizontal plane of WGS-84 ellipsoid), with its center being at the true position, which describes the region that is assured to contain the indicated vertical position. It is based upon the error estimates provided by WAAS.

VNAV. Vertical Navigation.

Wide Area Augmentation System (WAAS). The WAAS is made up of an integrity reference monitoring network, processing facilities, geostationary satellites, and control facilities. Wide area reference stations and integrity monitors are widely dispersed data collection sites that contain GPS/WAAS ranging receivers that monitor all signals from the GPS, as well as the WAAS geostationary satellites. The reference stations collect measurements from the GPS and WAAS satellites so that differential corrections, ionospheric delay information, GPS/WAAS accuracy, WAAS network time, GPS time, and UTC can be determined. The wide area reference station and integrity monitor data are forwarded to the central data processing sites. These sites process the data in order to determine differential corrections, ionospheric delay information, and GPS/WAAS accuracy, as well as verify residual error bounds for each monitored satellite. The central data processing sites also generate navigation messages for the geostationary satellites and WAAS messages. This information is modulated on the GPS-like signal and broadcast to the users from geostationary satellites.