WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #21

Reporting Period: April 1 to June 30, 2007

July 2007

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NSTB/WAAS T&E Team
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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 twenty-first such WAAS quarterly report. This report covers WAAS performance during the period from April 1, 2007 to June 30 2007.

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, 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	CONUS Site/Maximum	CONUS Site/Minimum	All Sites Site/Maximum	All Sites Site/Minimum
95% Horizontal Accuracy	Seattle 0.844 meters	Memphis 0.514 meters	Seattle .844 meters	Memphis 0.514 meters
95% Vertical Accuracy	Miami 1.231 meters	Seattle 0.754 meters	Barrow 1.830 meters	Seattle 0.754 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Greenwood 99.997%	Boston 97.27%	Greenwood 99.997%	Barrow 66.687%
95% HPL	Boston 27.749 meters	Memphis 15.801 meters	Barrow 49.978 meters	Memphis 15.801 meters
95% VPL	Boston 42.449 meters	Kansas City 24.701 meters	Barrow 82.815 meters	Kansas City 24.701 meters

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX

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), PRN#134 (POR), and PRN#135 (CRW) were used in the evaluation. Currently the CRW GEO provides only the data link capability, i.e. there is no ranging service available from this GEO.

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 April 1, 2007 to June 30, 2007

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Atlantic City	89	7685075
Greenwood	75	6440210
WAAS:		
Albuquerque	91	7821384
Anchorage	90	7815764
Atlanta	90	7813351
Barrow	88	7630598
Bethel	89	7696888
Billings	90	7811276
Boston	91	7819461
Chicago	90	7813448
Cleveland	90	7797975
Cold Bay	90	7737192
Dallas	90	7772887
Denver	90	7802541
Fairbanks	89	7716027
Houston	91	7822563
Jacksonville	90	7819153
Juneau	88	7624741
Kansas City	90	7736846
Kotzebue	86	7473193
Los Angeles	88	7617784
Memphis	90	7818705
Miami	90	7806200
Minneapolis	90	7816944
New York	90	7799005
Oakland	90	7794363
Salt Lake City	91	7824364
Seattle	90	7796557
Washington DC	91	7828146

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	90.53	7821952
Anchorage	90.48	7817404
Atlanta	90.44	7814025
Bethel	89.17	7704264
Billings	90.51	7820452
Boston	90.51	7820033
Cleveland	90.26	7798822
Cold Bay	89.79	7757839
Fairbanks	89.39	7723292
Honolulu	90.09	7783874
Houston	90.54	7822895
Juneau	89.95	7771402
Kansas City	89.87	7764908
Kotzebue	88.22	7622226
Los Angeles	88.50	7646359
Miami	90.36	7807485
Minneapolis	90.50	7818790
Oakland	90.24	7796657
Salt Lake City	90.57	7825554
San Juan	90.08	7782957
Seattle	90.26	7798066
Washington DC	90.61	7828349

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

1. WAAS Position Accuracy
2. WAAS Operational Service Availability
3. Coverage
4. Integrity
5. WAAS Range Domain Accuracy
6. 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 1and 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
LPV and LNAV/VNAV Outages and outage rate	Not Defined for Current WAAS phase
LNAV Outages and outage rates	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
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. Detailed analyses of particular events are documented in the Discrepancy Reports (DR). The DRs are posted on the website http://www.nstb.tc.faa.gov under 'WAAS Technical Reports' and can also be accessed via hyperlink from Table 1.4 below.

Table 1-4 Test Events

GPS Week	Date	Sites	Events
1421 day 0	4/1/07	None	See DR# 54, "POR SV alert did not change UDREI's."
1421 day 1	4/2/07	Kotzebue	See DR# 62 "Ionospheric scintillation that caused high errors and alarm condition."
1421 day 4 to 1425 day 5	4/5/07 to 5/4/07	Southwest CONUS sites	See DR# 56, "Loss of 100% WAAS availability in southwest CONUS region."
1422 day 2 to 1422 day 3	4/10/07 to 4/11/07	Several sites	See DR# 55, "GPS satellite PRN 18 anomaly affecting SPS performance."
1422 day 4 to 1422 day 5	4/12/07 to	Atlantic City	Atlantic City outage.

GPS Week	Date	Sites	Events
	4/13/07		
1422 day 6 to 1423 day 0	4/14/07 to 4/15/07	Southwest CONUS sites	PRN 14 outage.
1423 day 1 to 1424 day 1	4/16/07 to 4/23/07	CRW-only sites	CRW GEO in test mode.
1423 day 2	4/17/07	All WAAS sites	WEI outage resulting in the loss of AOR messages.
1423 day 5	4/20/07	All WAAS sites	WEI outages.
1424 day 0 to 1425 day 2	4/22/07 to 5/1/07	LA	ZLA WRE-A low C/N_0 caused poor performance.
1424 day 1 to 1424 day 2	4/23/07 to 4/24/07	LA	LA outage.
1424 day 2	4/24/07	Denver, Dallas, KC, LA, Oakland, Seattle, Cold Bay	ZLA TCS communications node outage – common 8 second data gap.
1424 day 3	4/25/07	All WAAS sites	WEI outage.
1424 day 4	4/26/07	Non-G2 WAAS sites	See DR# 57, "Inconsistent satellite tracking of PRN 25 at non-G2 WAAS receivers following NANU 2007060"
1425 day 3	5/2/07	LA	LA WRS antenna and receiver firmware upgrades.
1425 day 4	5/3/07	All WAAS sites	WEI outages.
1426 day 3	5/9/07	CRW-only sites	See DR# 58, "Communication fault caused selected C&V source switch on CRW GUST's"
1426 day 5	5/11/07	Anchorage	Anchorage WRS antenna upgrade.
1426 day 5	5/11/07	NY	NY WRS antenna and receiver firmware upgrades.
1427 day 4	5/17/07	Barrow	Ionospheric scintillation. See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."
1427 day 4	5/17/07	Seattle	Seattle WRS antenna upgrade.
1427 day 5	5/18/07	Fairbanks	Ionospheric scintillation. See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."
1427 day 5	5/18/07	SLC	SLC WRS antenna upgrade.
1427 day 5	5/18/07	Chicago	Chicago WRS antenna upgrade.
1428 day 3	5/23/07	Kotzebue	Ionospheric scintillation. See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."
1428 day 4	5/24/07	Central and west CONUS sites	PRN 4 outage.
1428 day 6	5/26/07	Kotzebue	Ionospheric scintillation. See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."
1430 day 6	6/9/07	None	See DR# 59, "POR GEO pointing error caused SIS degradation and SIS outage."
1431 day 4	6/14/07	Fairbanks	Ionospheric scintillation. See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."
1431 day 6 to 1433 day 6	6/16/07 to 6/30/07	Greenwood	Greenwood outage.
1432 day 4	6/21/07	All sites	See DR# 60, "ZDC C&V faulted, followed by GEO initialization."
1433 day 4	6/28/07	All WAAS sites	Scheduled WAAS router firmware upgrades caused WEI outage, ZLA TCS communications node outage, and other network outages.
1433 day 5	6/29/07	All sites	See DR# 61, "ZDC C&V faulted, followed by GEO initialization."
1433 day 6	6/30/07	All WAAS sites	Release 5.2 router upgrades caused router outages.

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. The number of outages and outage rate for each site is reported.

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 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, POR and CRW.

Section 6 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 7 provides the GEO ranging performance for AORW, POR and CRW.

Section 8 summarizes WAAS anomalies and problems identified during the reporting period, which adversely affect WAAS performance described in Table 1.3.

Section 9 provides WAAS LPV availability and outages at selected airports.

Section 10 provides the assessment of WAAS CNMP bounding for 75 WAAS receivers.

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 2 meters for both WAAS operational service levels. The maximum 95% horizontal and vertical LPV errors are .844 meters at Seattle and 1.807 at Barrow, respectively. The minimum 95% horizontal and vertical LPV errors are 0.514 meters at Memphis and 0.754 meters at Seattle, respectively. The maximum 95% and 99.999% NPA horizontal errors are 2.407 meters and 6.766 meters at Honolulu, respectively. The minimum 95% and 99.999% horizontal errors are 1.074 meters at Albuquerque and 2.244 meters at Washington DC.

The AOR-W GEO is no longer available for PA ranging. Currently the CRW GEO provides only the data link capability, i.e. there is no ranging service available from this GEO.

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 ratio 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.

During this evaluated period, the unusual high vertical and horizontal errors, observed at Fairbanks and Kotzebue, are due to ionospheric scintillation.

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, Kansas 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)
Atlantic City	0.692	0.692	1.208	99.99335	*	*
Greenwood	0.648	0.648	1.096	100	*	*
Albuquerque	0.555	0.555	0.795	99.99612	2.171	4.114
Anchorage	0.592	0.592	1.049	99.99596	*	*
Atlanta	0.549	0.549	0.970	99.99396	2.390	4.809
Barrow	0.651	0.766	1.830	99.95087	*	*
Bethel	0.519	0.520	0.924	99.99625	2.079	3.971
Billings	0.677	0.677	0.871	99.99560	2.132	4.003
Boston	0.661	0.661	1.133	99.99513	2.375	4.549
Chicago	0.581	0.581	0.997	99.99424	*	*
Cleveland	0.697	0.697	1.021	99.99394	2.409	4.677
Cold Bay	0.815	0.839	1.043	99.99619	*	*
Dallas	0.597	0.597	1.028	99.99522	*	*
Denver	0.540	0.541	0.880	99.99610	*	*
Fairbanks	0.578	0.579	1.000	99.99590	1.985	4.113
Houston	0.614	0.615	1.069	99.99526	2.392	4.439
Jacksonville	0.546	0.546	1.006	99.99395	*	*
Juneau	0.624	0.624	1.065	99.99680	*	*
Kansas City	0.662	0.662	1.011	99.99434	2.286	4.411
Kotzebue	0.684	0.700	1.183	99.99166	2.009	4.180
Los Angeles	0.690	0.690	1.181	99.99625	2.309	4.325
Memphis	0.514	0.514	0.966	99.99441	*	*
Miami	0.699	0.699	1.231	99.99394	2.561	4.842
Minneapolis	0.640	0.640	1.119	99.99442	2.235	4.266
New York	0.628	0.629	1.009	99.99509	*	*
Oakland	0.663	0.663	1.051	99.99653	2.212	4.677
Salt Lake City	0.622	0.623	0.796	99.99612	2.171	4.537
Seattle	0.844	0.844	0.754	99.99651	2.226	4.289
Washington DC	0.579	0.579	0.999	99.99379	2.422	4.914

* 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	1.074	3.354	99.999	3.520
Anchorage	1.467	3.736	99.999	3.958
Atlanta	1.185	2.414	99.998	3.797
Bethel	1.484	3.766	99.999	3.759
Billings	1.432	3.961	99.999	4.502
Boston	1.200	2.811	99.999	3.221
Cleveland	1.242	3.515	99.998	4.416
Cold Bay	1.426	2.969	99.999	3.534
Fairbanks	1.468	3.186	99.998	4.323
Honolulu	2.407	6.766	99.997	6.945
Houston	1.492	3.647	99.999	6.066
Juneau	1.522	4.697	99.999	5.094
Kansas City	1.200	2.449	99.998	5.359
Kotzebue	1.596	3.186	99.999	7.375
Los Angeles	1.374	4.945	99.999	3.534
Miami	1.484	3.727	99.998	3.874
Minneapolis	1.162	4.001	99.998	6.227
Oakland	1.207	2.747	99.999	2.964
Salt Lake City	1.158	2.283	99.998	3.865
San Juan	1.689	4.402	92.240	4.525
Seattle	1.278	2.789	99.998	3.228
Washington DC	1.119	2.244	99.998	2.612

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	2.218	0.088	0.143	4.227	0.119	0.160
Greenwood	2.045	0.091	0.139	3.220	0.110	0.128
Albuquerque	1.968	0.053	0.098	3.153	0.096	0.108
Anchorage	3.208	0.100	0.126	4.567	0.100	0.134
Atlanta	2.541	0.077	0.109	2.692	0.065	0.130
Barrow	4.173	0.160	0.160	6.525	0.159	0.159
Bethel	2.536	0.067	0.087	3.440	0.113	0.113
Billings	2.399	0.154	0.200	3.856	0.078	0.121
Boston	1.814	0.050	0.085	2.706	0.068	0.104
Chicago	1.794	0.067	0.118	2.711	0.102	0.120
Cleveland	2.781	0.176	0.190	4.948	0.250	0.250
Cold Bay	3.688	0.115	0.176	6.507	0.132	0.145
Dallas	1.708	0.075	0.114	5.064	0.193	0.193
Denver	2.076	0.088	0.106	2.919	0.107	0.109
Fairbanks	9.742	0.513	0.513	13.298	0.556	0.556
Houston	1.781	0.056	0.105	3.010	0.099	0.122
Jacksonville	1.550	0.066	0.111	2.926	0.130	0.149
Juneau	1.765	0.063	0.098	3.822	0.169	0.169
Kansas City	1.580	0.111	0.118	2.625	0.061	0.115
Kotzebue	8.812	0.524	0.525	37.308	0.935	0.935
Los Angeles	1.692	0.056	0.104	3.142	0.068	0.105
Memphis	1.525	0.122	0.123	2.721	0.100	0.111
Miami	2.307	0.121	0.134	5.160	0.137	0.183
Minneapolis	2.988	0.128	0.175	4.554	0.154	0.154
New York	1.691	0.066	0.098	3.254	0.073	0.111
Oakland	2.573	0.111	0.111	3.469	0.092	0.095
Salt Lake City	1.731	0.067	0.107	3.702	0.131	0.131
Seattle	2.937	0.142	0.157	3.825	0.086	0.148
Washington DC	1.777	0.073	0.092	3.571	0.088	0.109

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

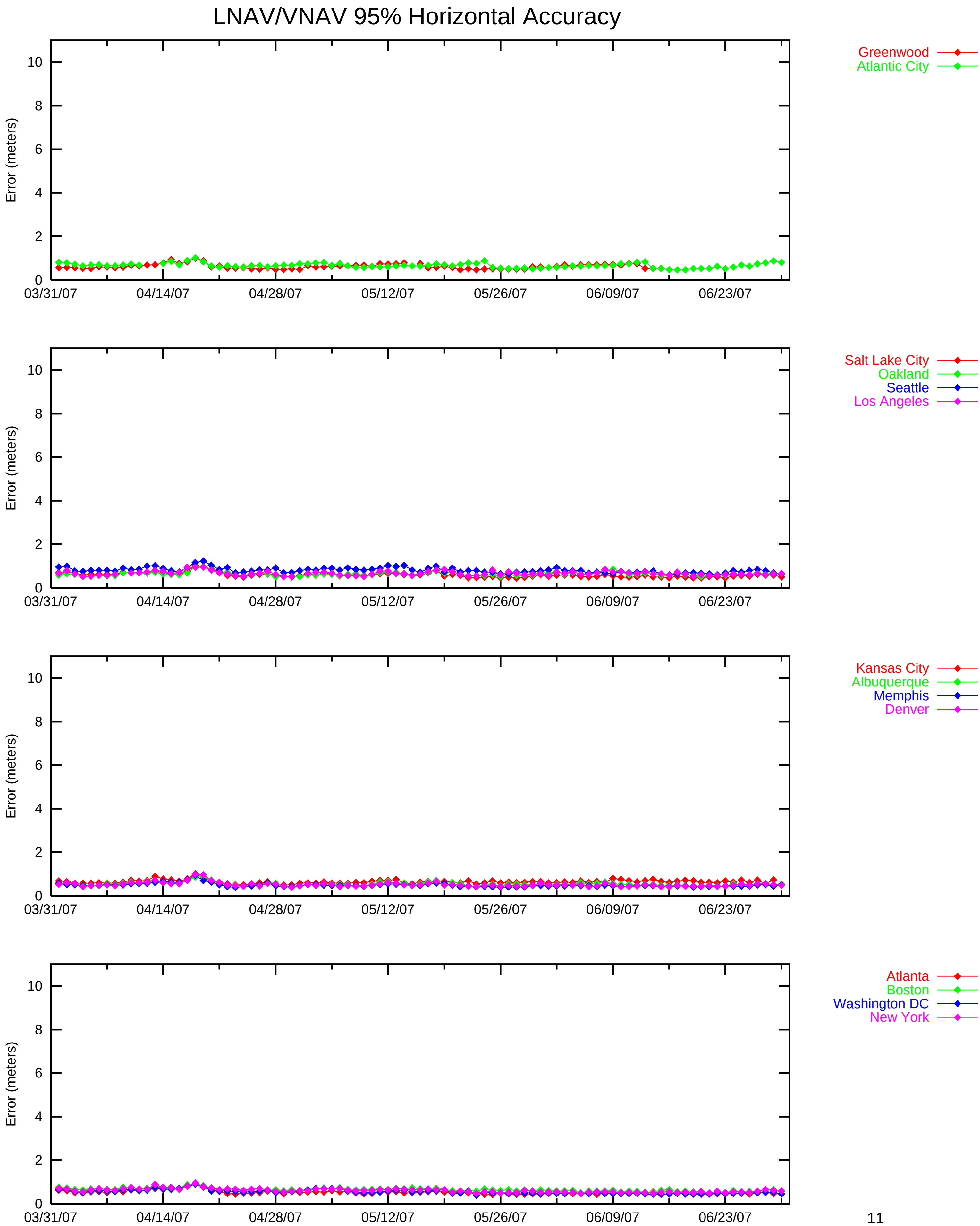


Figure 2-2 95% Horizontal Accuracy at LNAV/VNAV

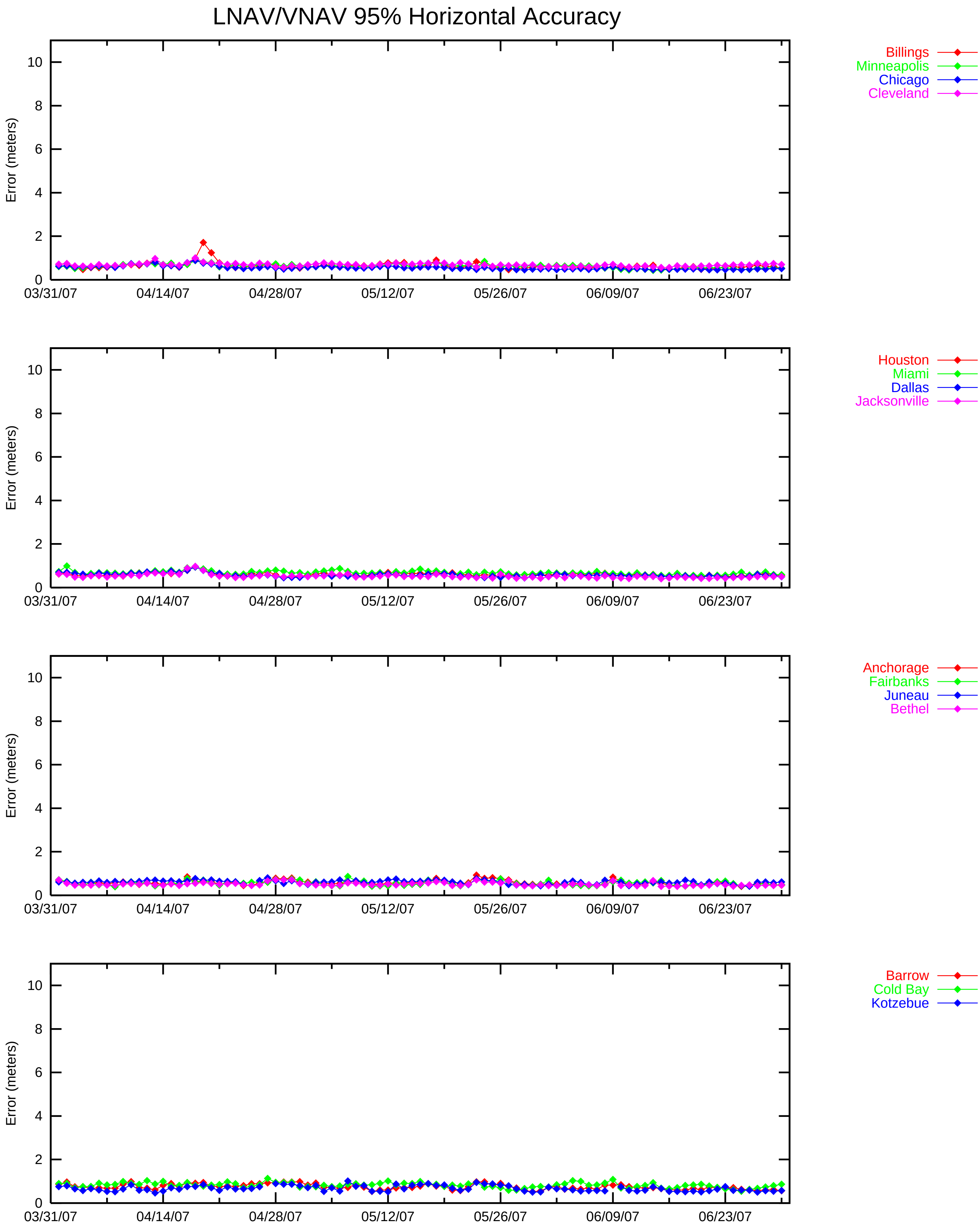


Figure 2-3 95% Vertical Accuracy at LNAV/VNAV

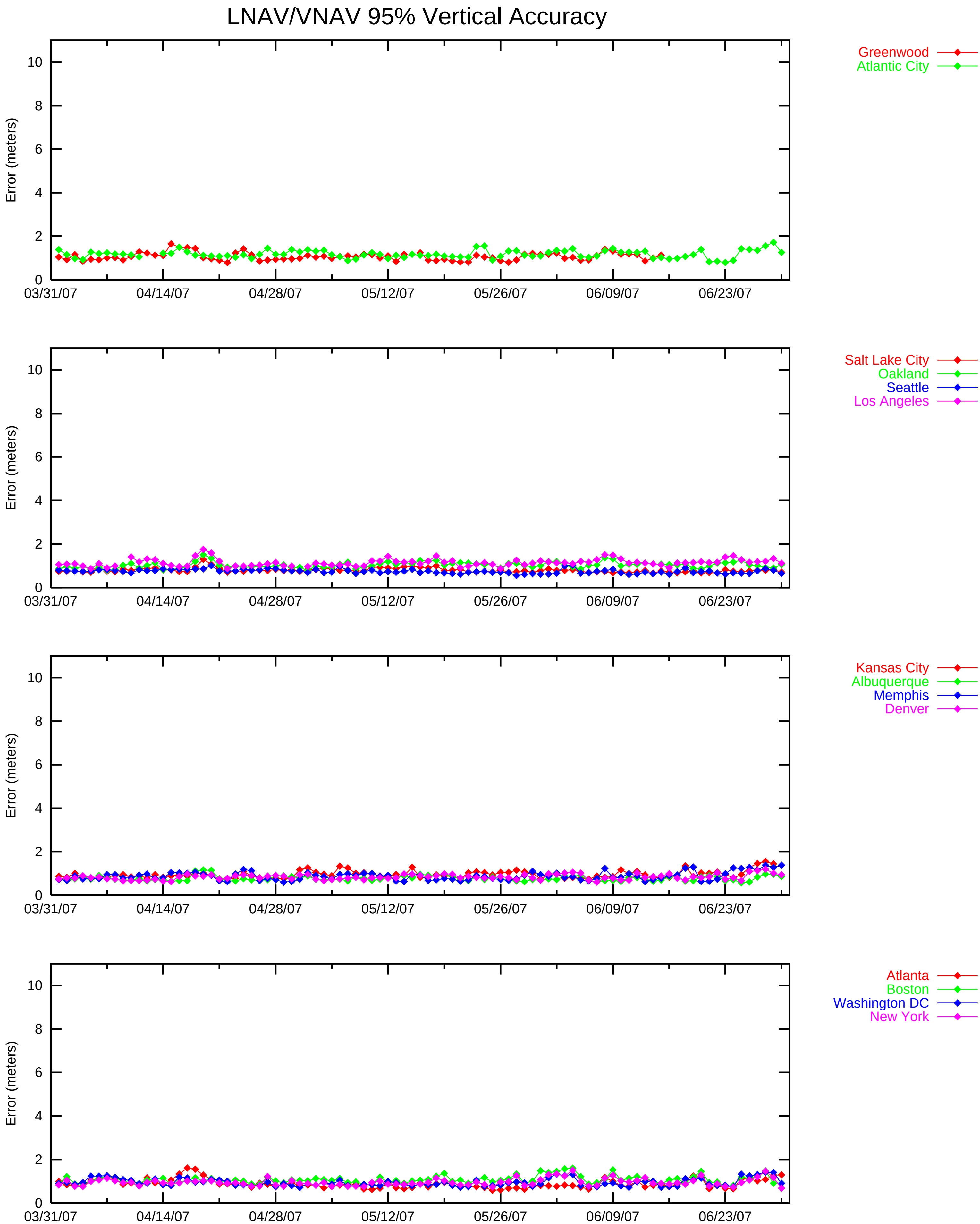


Figure 2-4 95% Vertical Accuracy at LNAV/VNAV

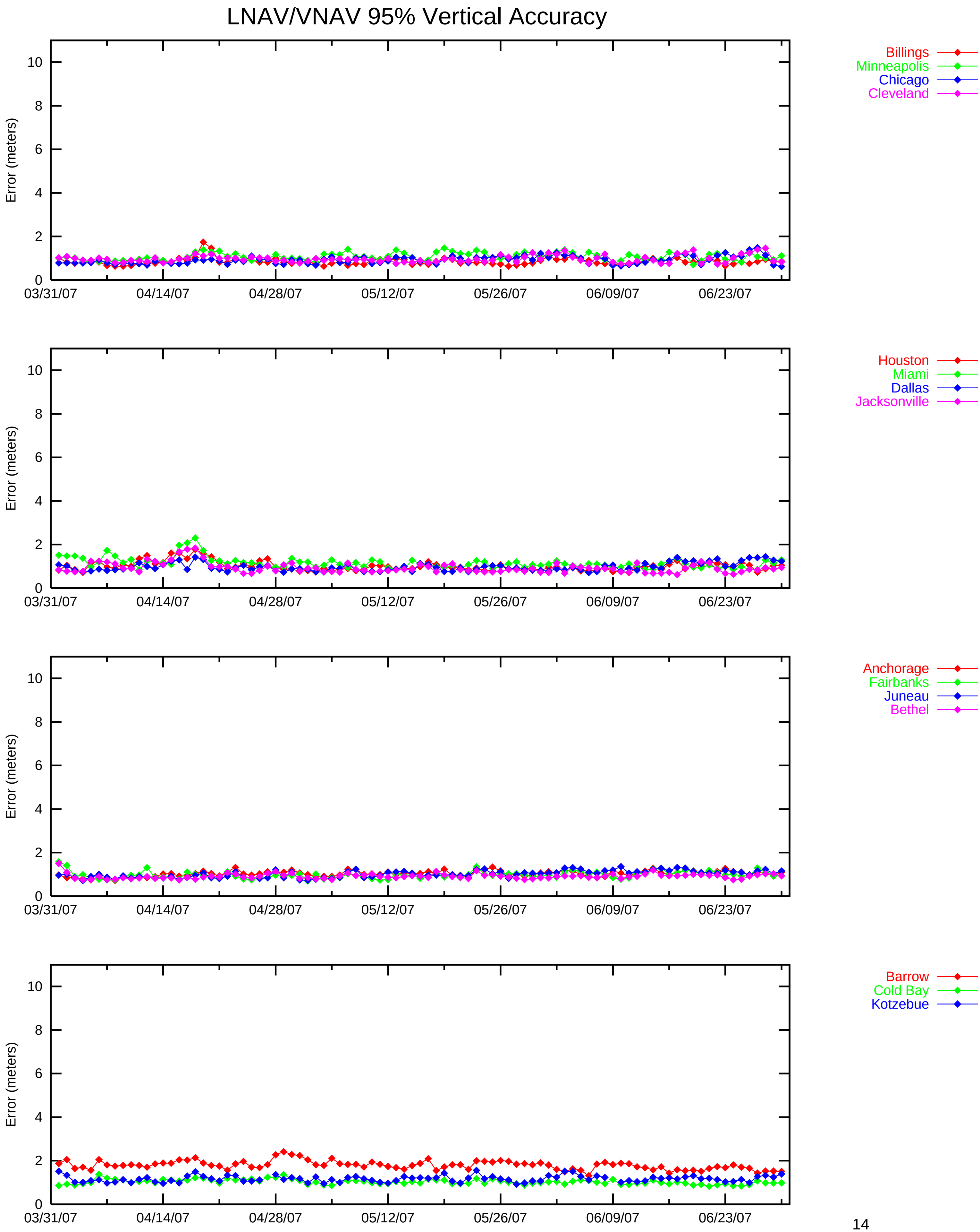


Figure 2-5 NPA 95% Horizontal Accuracy

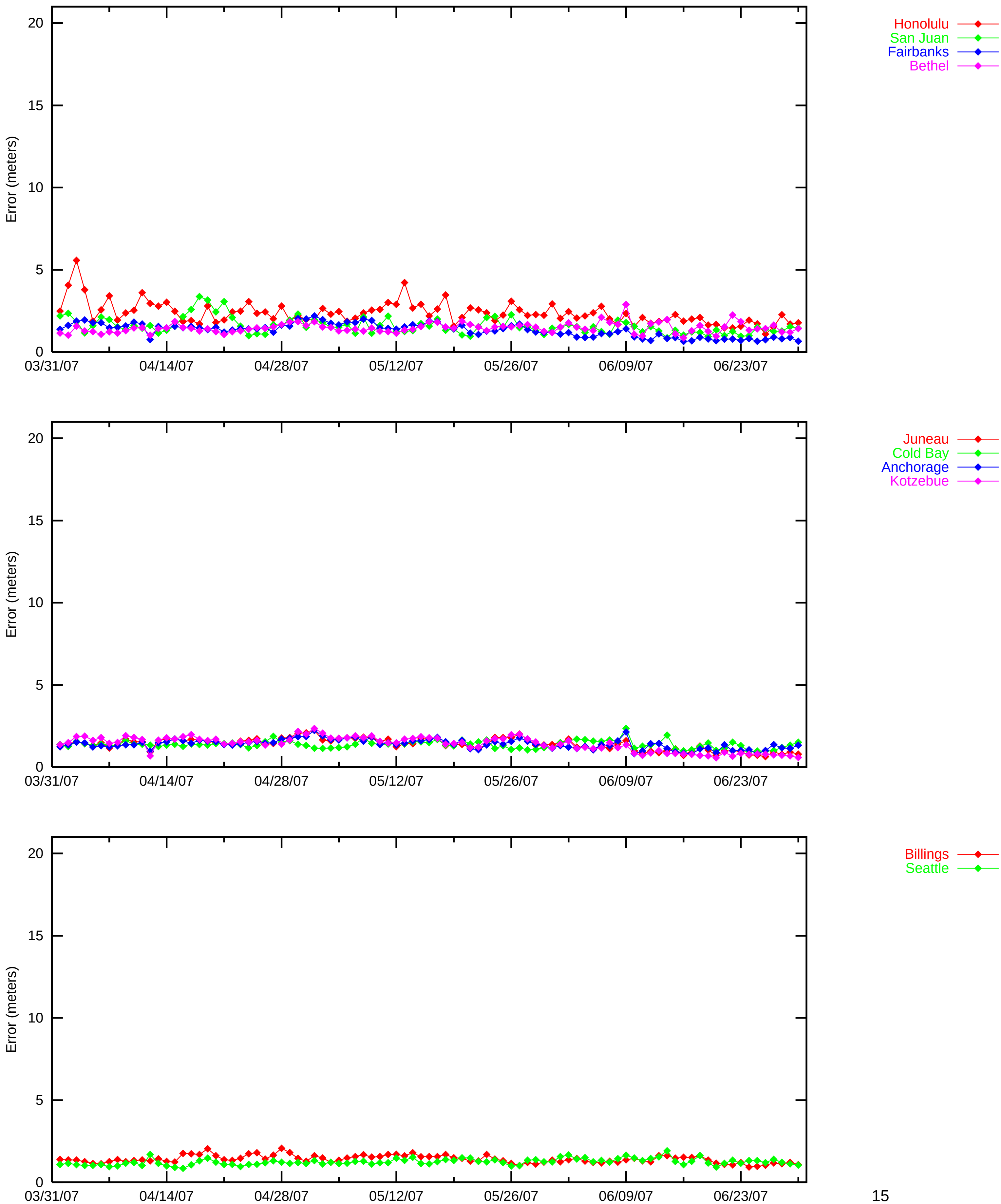


Figure 2-6 NPA 95% Horizontal Accuracy

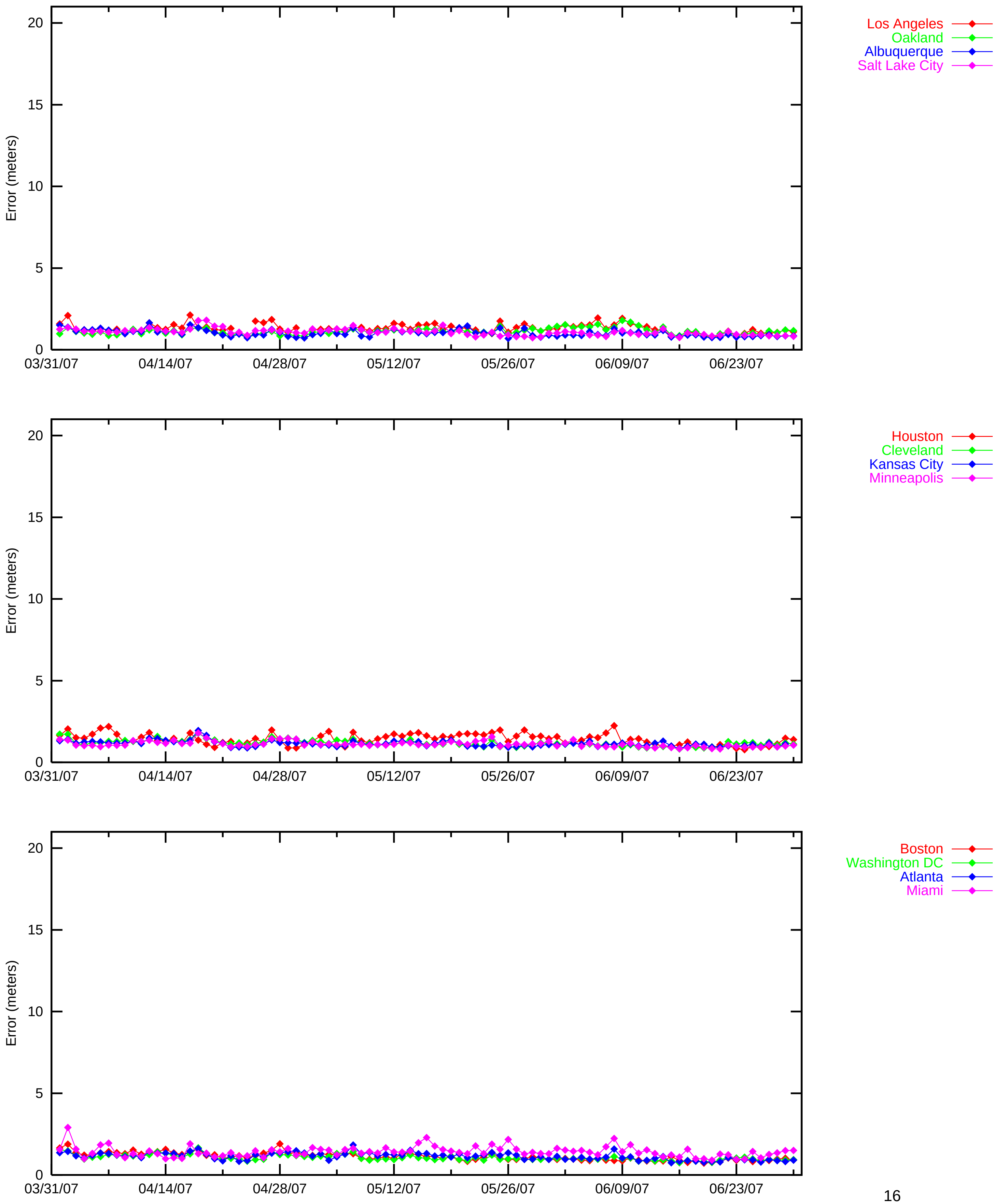


Figure 2-7 Horizontal Triangle Chart forKansas City

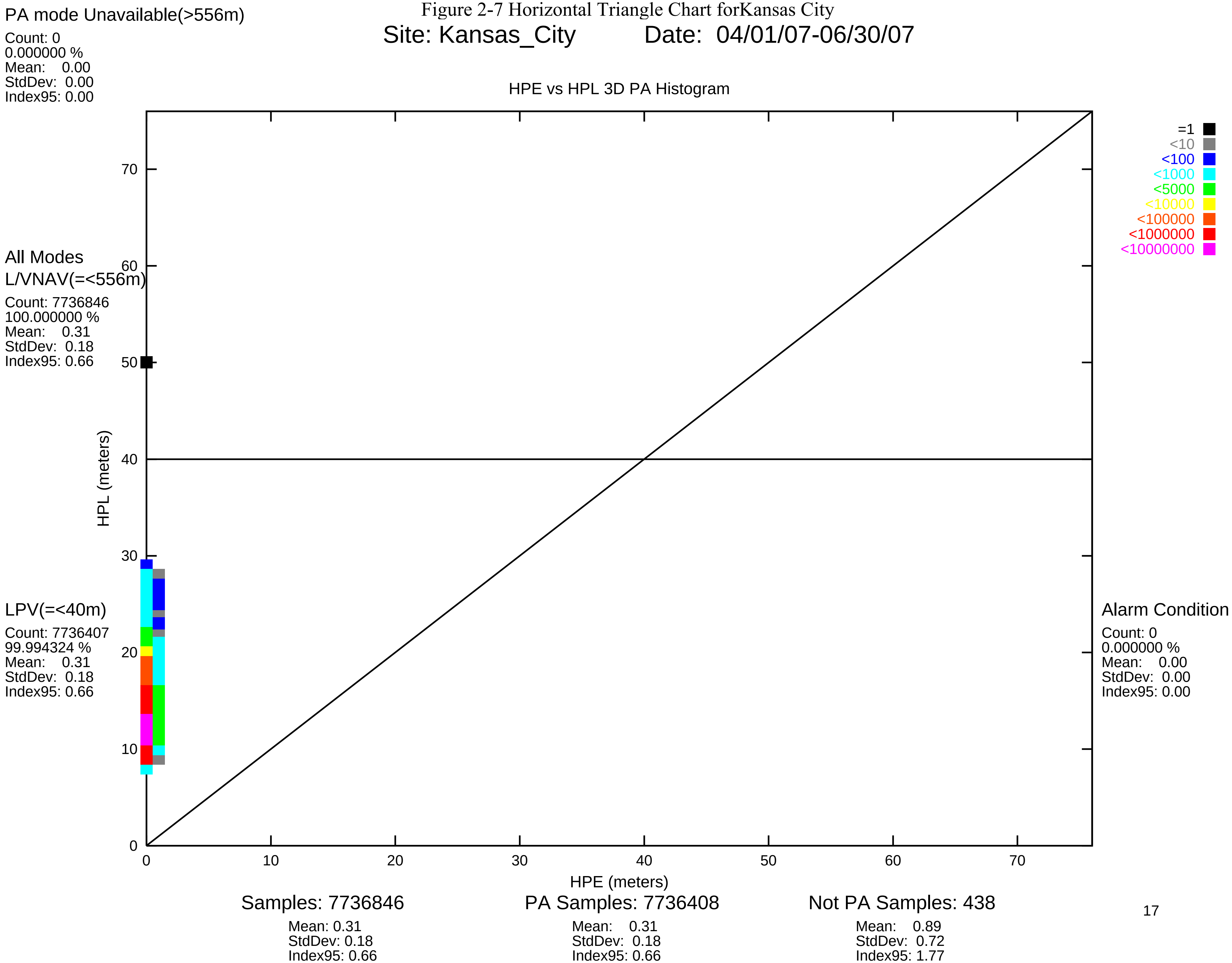


Figure 2-8 Vertical Triangle Chart for Kansas City

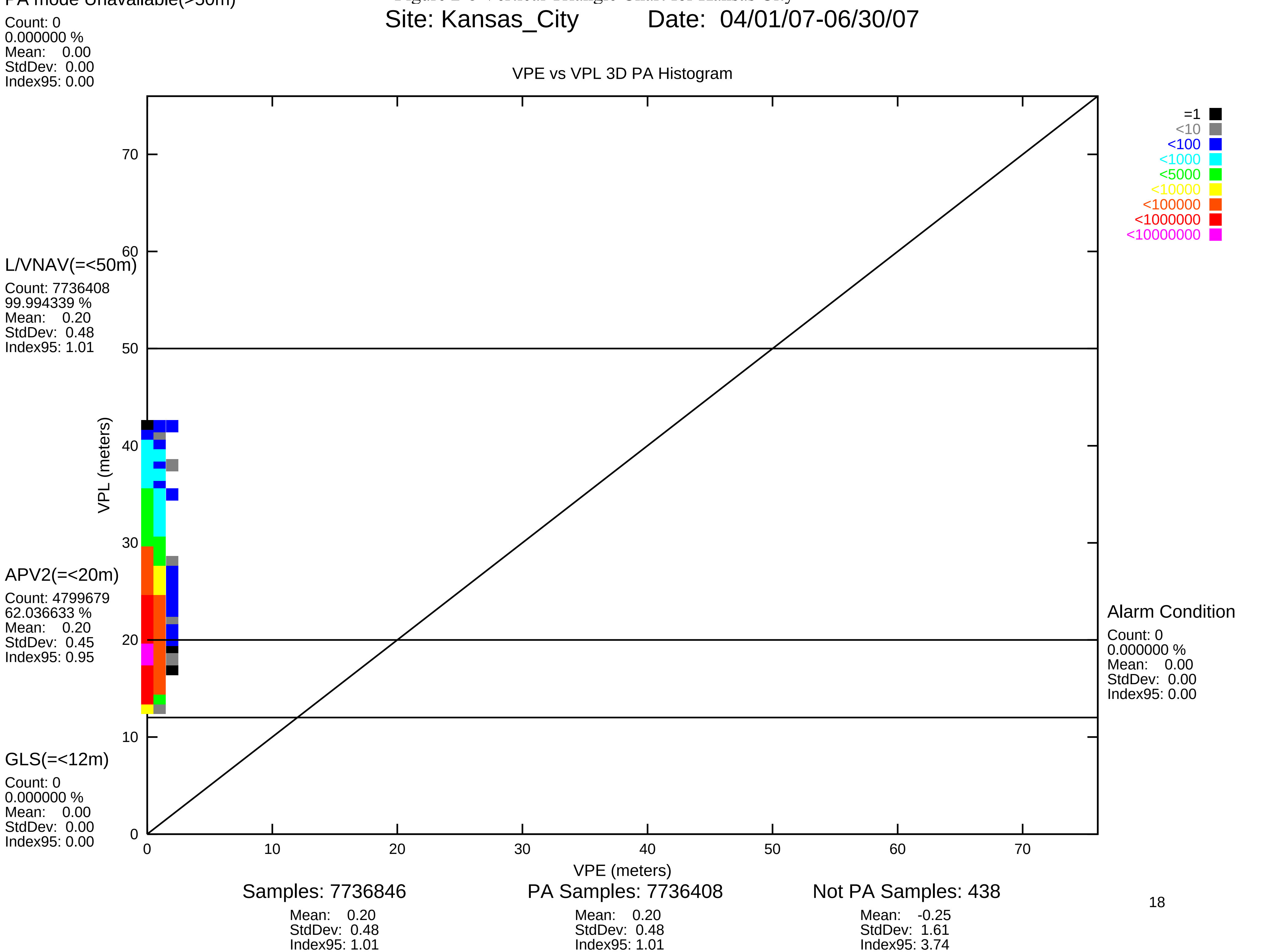
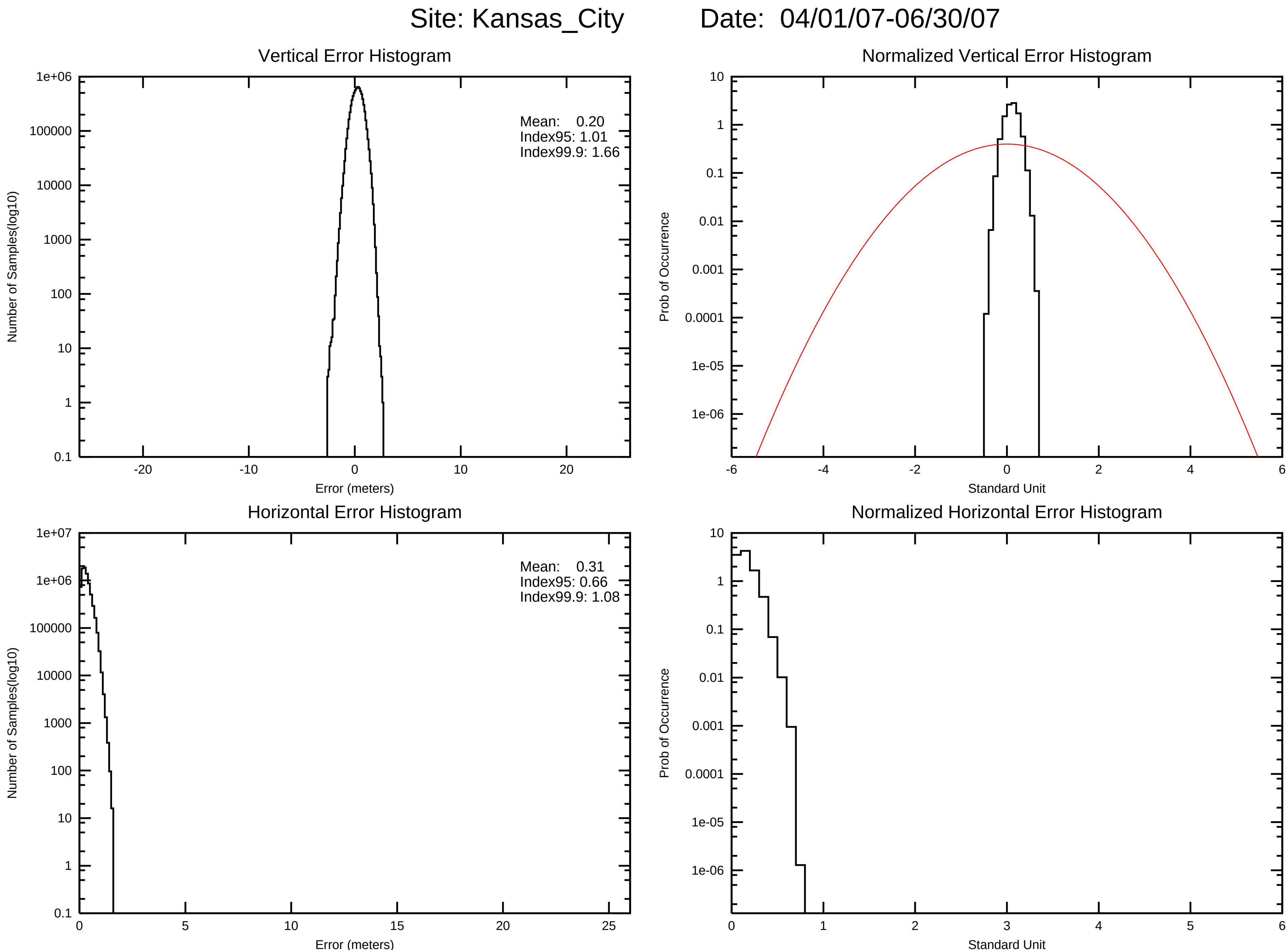


Figure 2-9 2-D Histogram for Kansas City



PA Samples: 7736408

Figure 2-10 Horizontal Triangle Chart for Washington, DC

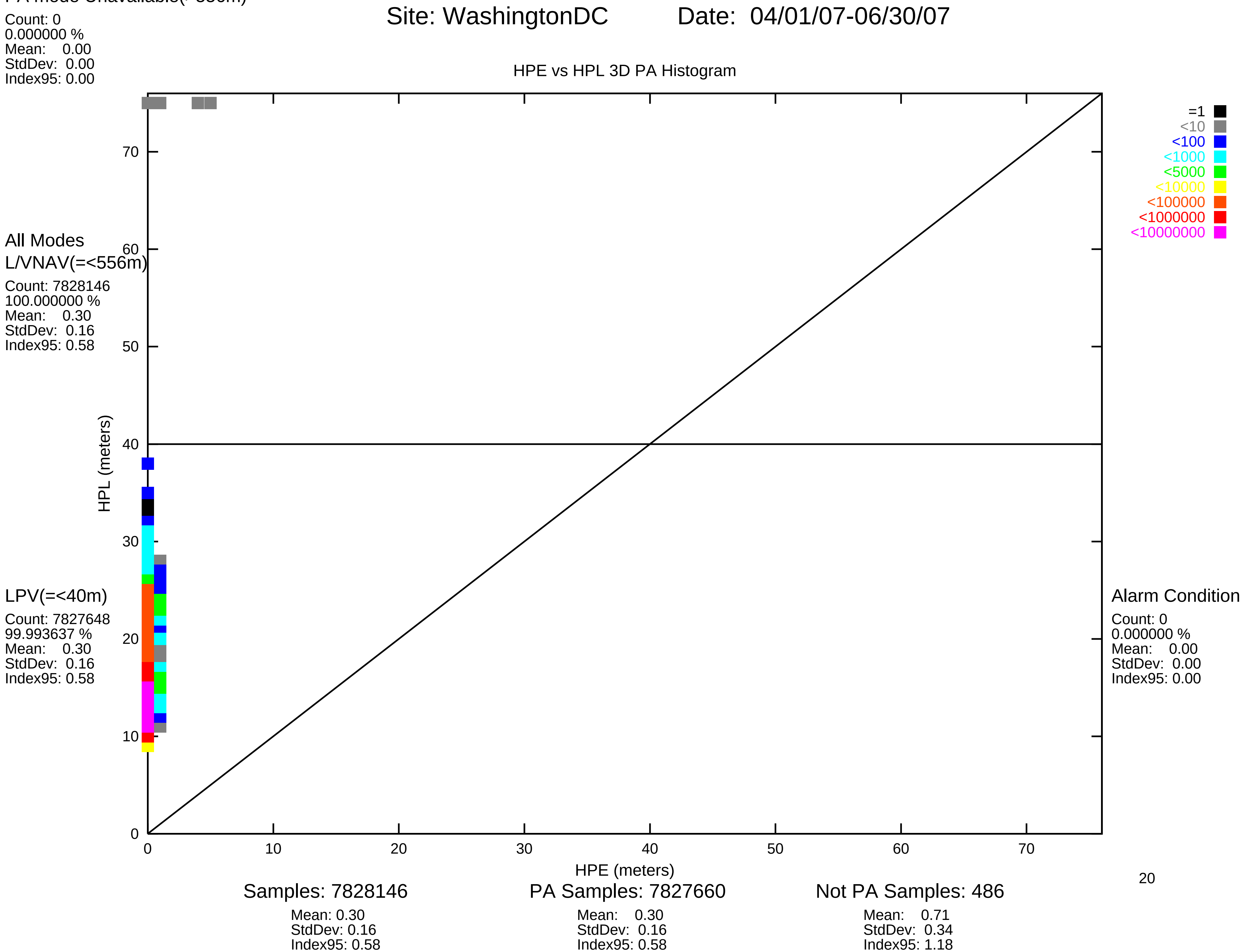


Figure 2-11 Vertical Triangle Chart for Washington, DC

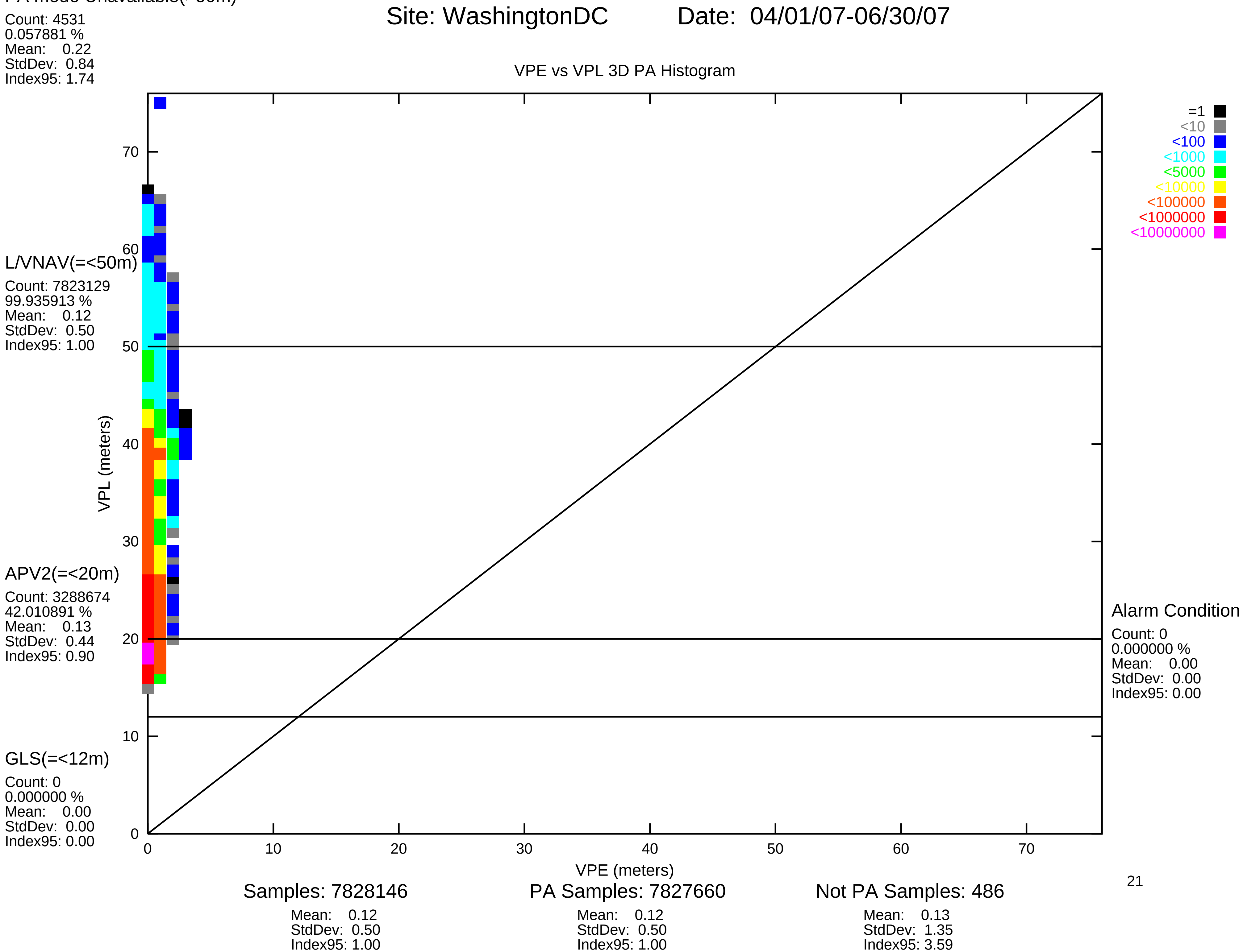


Figure 2-12 2-D Histogram for Washington, DC

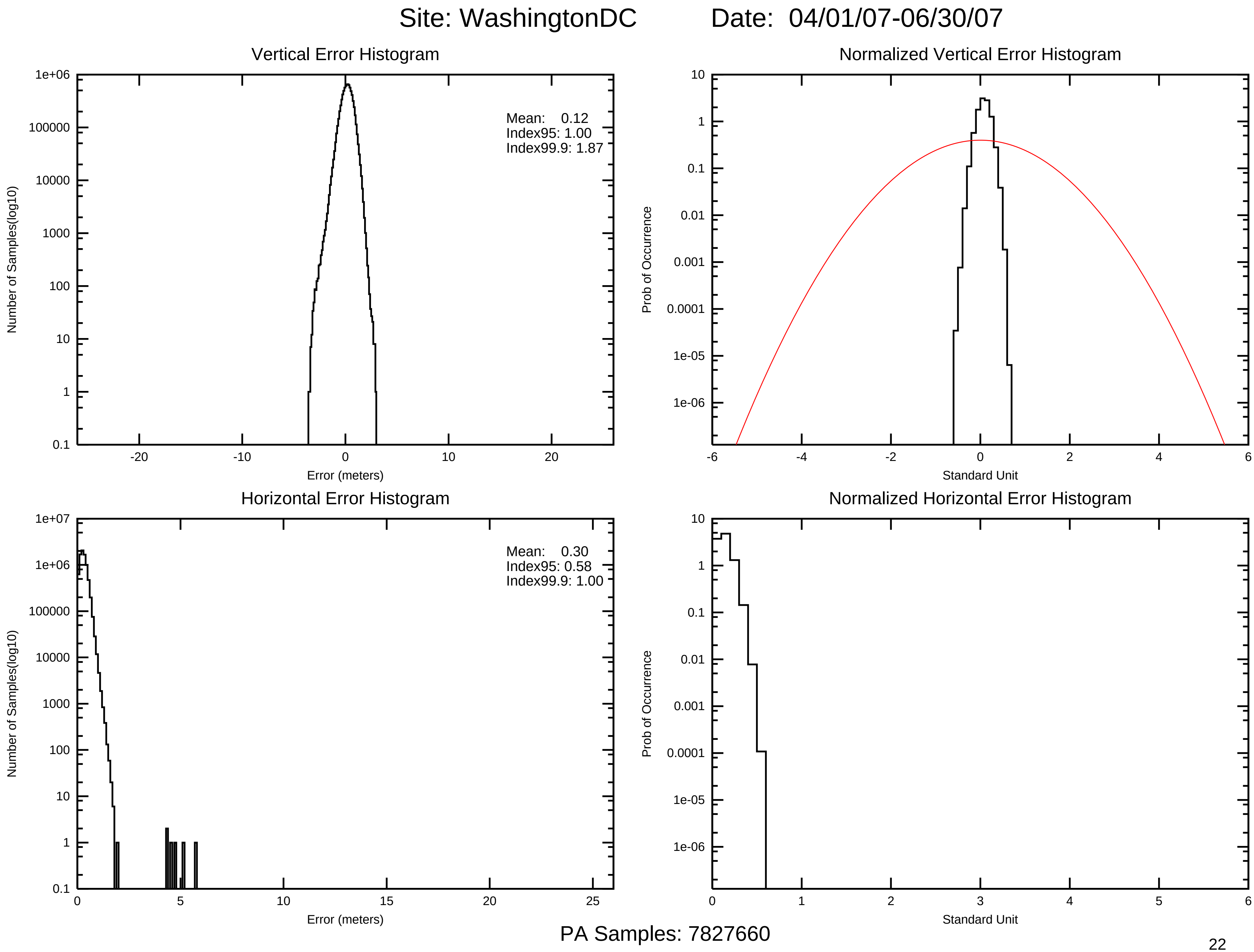


Figure 2-13 Horizontal Triangle Chart for Seattle

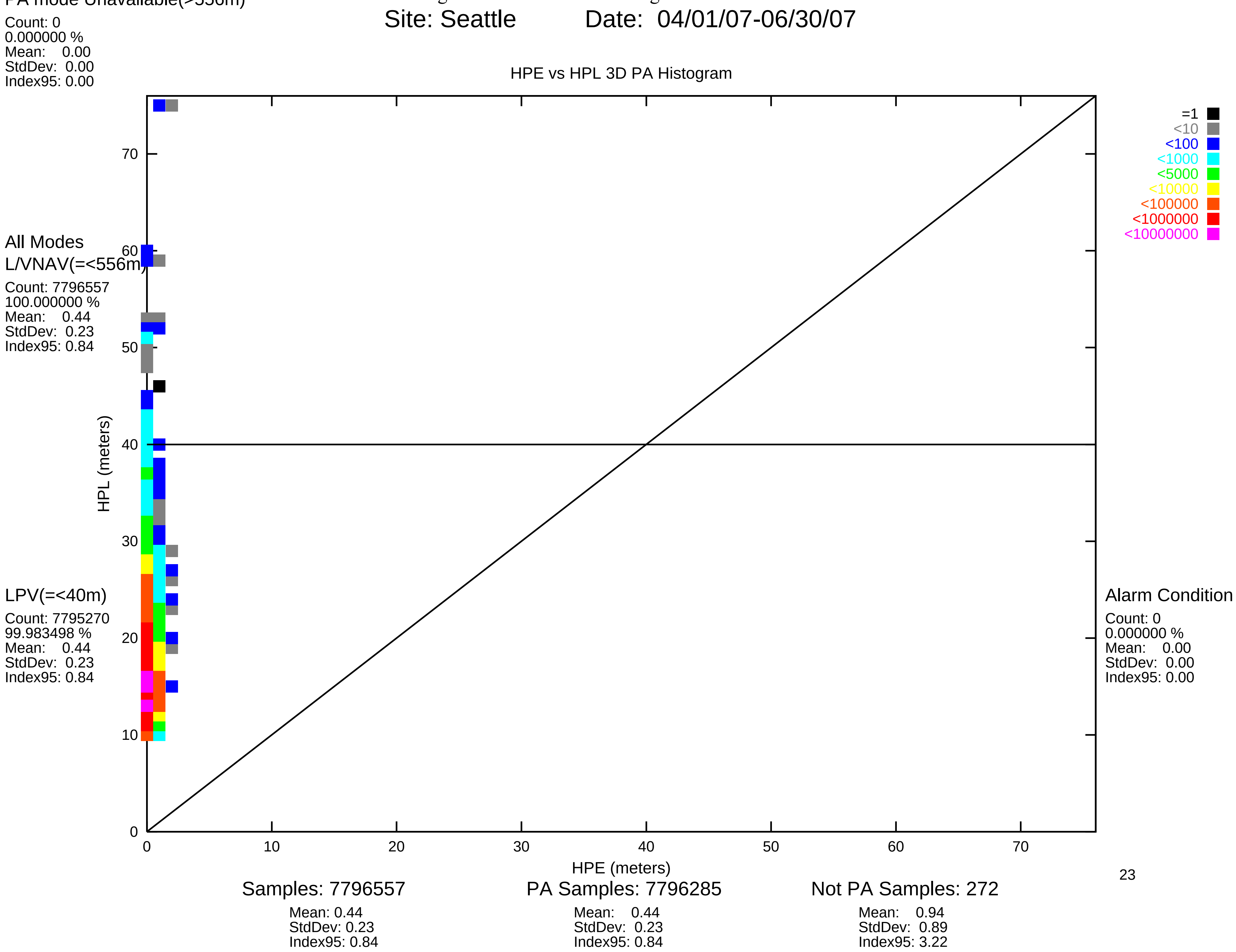
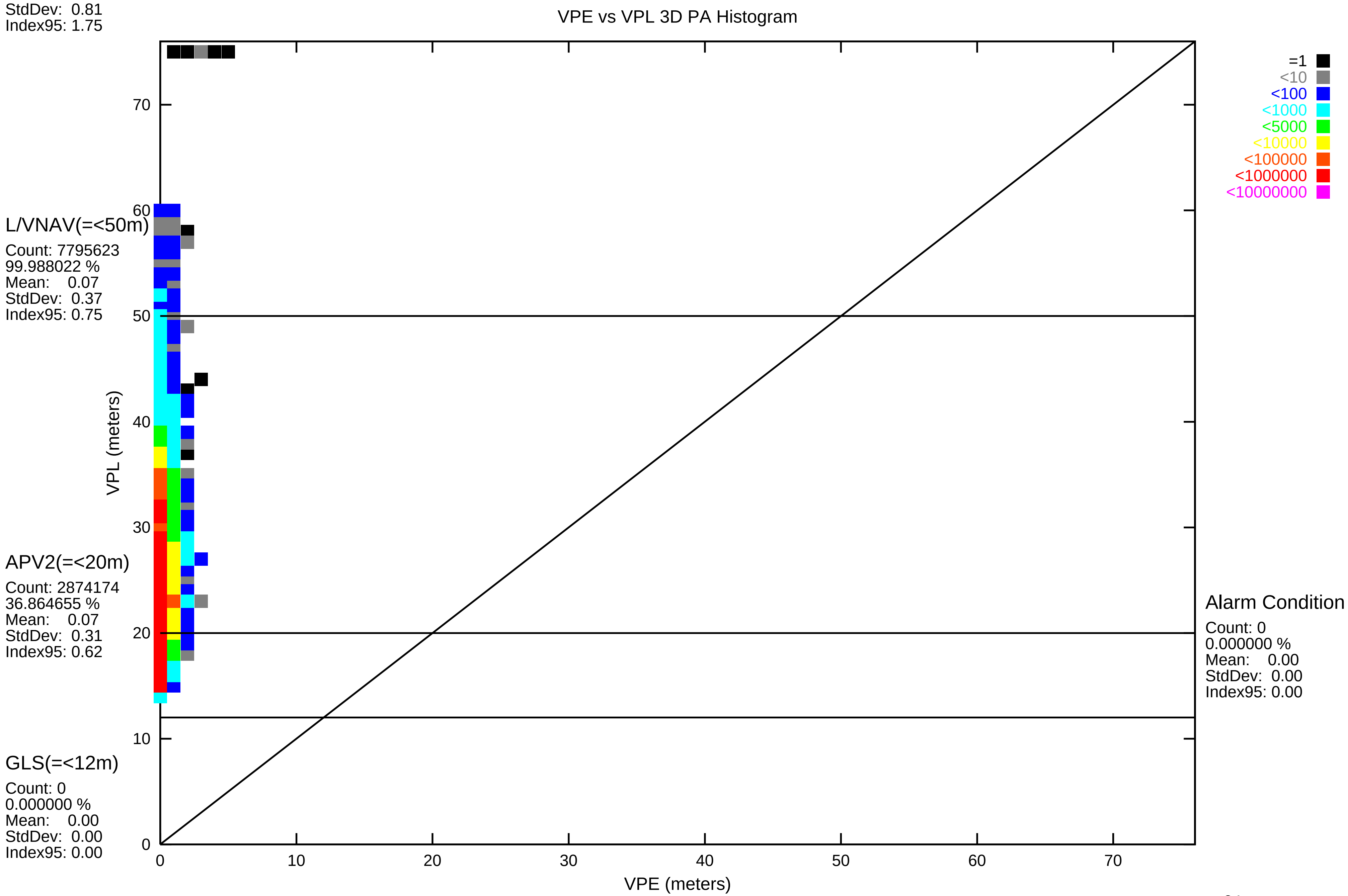


Figure 2-14 Vertical Triangle Chart for Seattle

Site: Seattle Date: 04/01/07-06/30/07

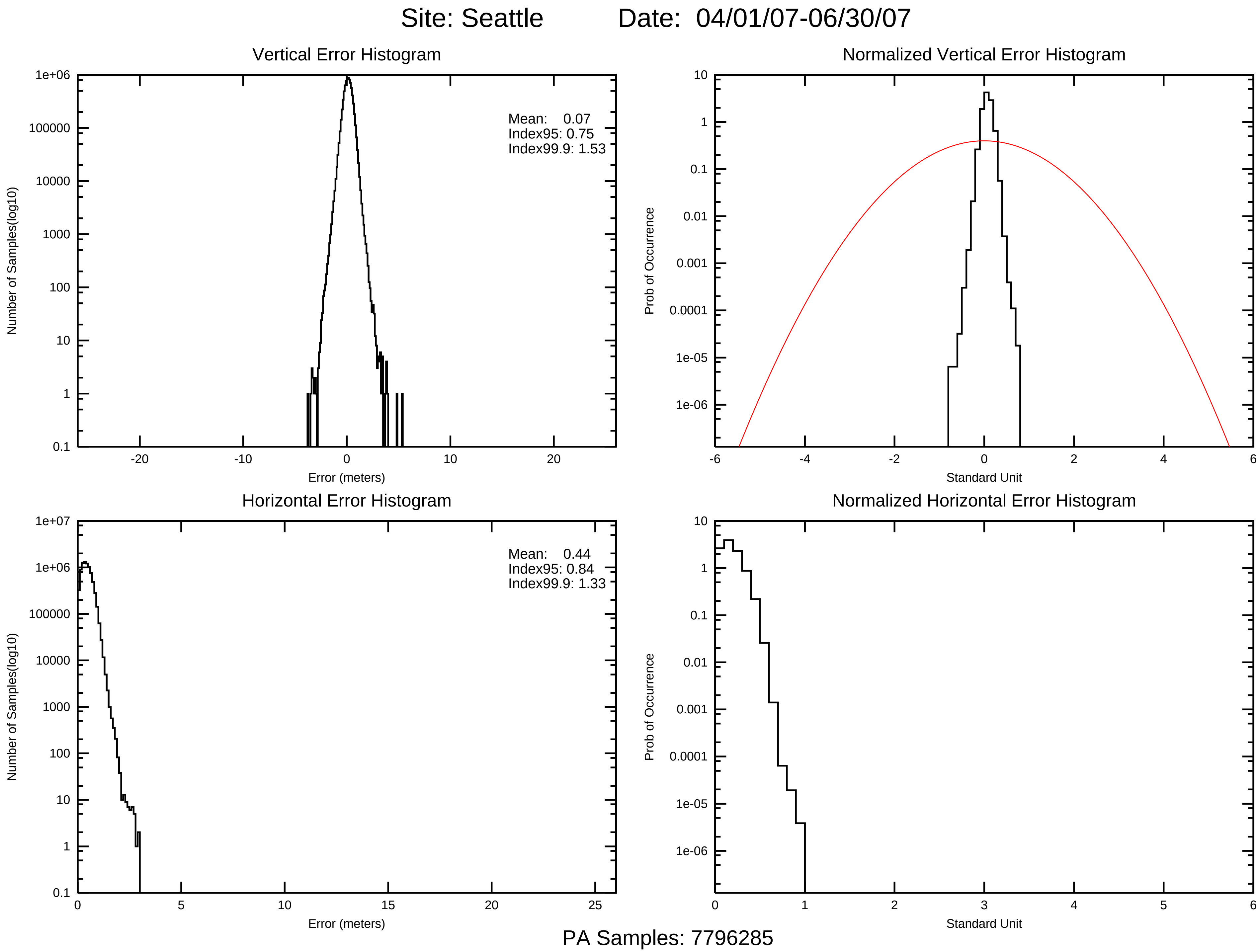


Samples: 7796557
Mean: 0.07
StdDev: 0.37
Index95: 0.75

PA Samples: 7796285
Mean: 0.07
StdDev: 0.37
Index95: 0.75

Not PA Samples: 272
Mean: 1.42
StdDev: 1.40
Index95: 3.76

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. The first two columns of Table 3.2 presents the average portion of time that WAAS operational service levels are available at each receiver location.

Availability of LPV and LNVA/VNAV service is evaluated by monitoring the WAAS protection levels at receiver locations throughout the test period. If both the vertical and horizontal protection levels are not greater than their respective alert limits (VAL and HAL) then the service is available. If either of the protection levels exceeds the required alert level then the operational service at that location is considered unavailable and an outage in service is recorded with its duration. The operational service is not considered available again until the protection levels are both within the alert limits for at least 15 minutes. Although this will reduce operational service availability minimally, it substantially reduces the number of service outages and prevents excessive switching in and out of service availability. The percent of time that LPV and LNVA/VNAV service is available using the fifteen-minute window criteria is presented in the last two columns in Table 3.2. The LPV and LNVA/VNAV service outages and associated outage rate for the test period is presented in Table 3.4. The outage rate is the percent of approaches that theoretically would be interrupted by a loss of operational service once the approach had started. Figures 3.1 through 3.4 show the daily availability of LNAV/VNAV and LPV service levels for the evaluated period. Figures 3.5 through 3.8 show the daily interruptions of LNAV/VNAV and LPV service levels for the evaluated period.

The following table shows the maximum and minimum 95% HPL and VPL observed for this evaluated period.

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	All Sites Site/Maximum	All Sites Site/Minimum
95% HPL	Boston 27.749 meters	Memphis 15.801 meters	Barrow 49.978 meters	Memphis 15.801 meters
95% VPL	Boston 42.449 meters	Kansas City 24.701 meters	Barrow 82.815 meters	Kansas City 24.701 meters

Availability of NPA service is evaluated by monitoring the WAAS horizontal protection level at receiver locations throughout the test period. If the horizontal protection level is not greater than the horizontal alert limit (HAL = 556m) then the service is available. If the horizontal protection level exceeds the required alert level or if WAAS navigation message is not received then the NPA service at that location is considered unavailable and an outage in service is recorded with its duration. The NPA service is not considered available again until the horizontal protection level is within the alert limit for at least 15 minutes. The percent of time that NPA service is available using the fifteen-minute window criteria is presented in Table 3.3. The NPA service outages and associated outage rate for this period is presented in Table 3.5. The outage rate is the percent of NPA approaches that theoretically would be interrupted by a loss of operational service once the approach had started.

During this evaluated period, there were three short SIS outages that caused a lower NPA availability for all sites. Two events due to C&V faulted and one event due to AOR SIS outage.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Atlantic City	22.403	36.515	99.99335
Greenwood	17.198	26.597	100
Albuquerque	19.282	30.720	99.99612
Anchorage	21.787	36.911	99.99596
Atlanta	16.067	26.794	99.99396
Barrow	49.978	82.815	99.95087
Bethel	26.359	47.329	99.99625
Billings	18.934	28.261	99.99560
Boston	27.749	42.449	99.99513
Chicago	16.486	25.854	99.99424
Cleveland	17.640	27.326	99.99394
Cold Bay	43.537	62.758	99.99619
Dallas	18.466	28.691	99.99522
Denver	17.246	27.279	99.99610
Fairbanks	21.517	42.323	99.99590
Houston	22.039	32.726	99.99526
Jacksonville	18.278	30.958	99.99395
Juneau	20.932	32.868	99.99680
Kansas City	15.909	24.701	99.99434
Kotzebue	29.883	59.247	99.99166
Los Angeles	26.646	41.290	99.99625
Memphis	15.801	25.073	99.99441
Miami	22.848	37.391	99.99394
Minneapolis	19.540	27.632	99.99442
New York	24.233	38.754	99.99509
Oakland	27.362	42.157	99.99653
Salt Lake City	18.131	29.398	99.99612
Seattle	20.719	31.176	99.99651
Washington DC	17.729	31.449	99.99379

Table 3-2 Quarterly Availability Statistics

Location	LPV *Average Availability Percentage of time*	LNAV/VNAV *Average Availability Percentage of time*	LPV 200 WAAS *With 15 minute window*	LPV WAAS *With 15 minute window*	LNAV/VNAV *With 15 minute window*
Atlantic City	0.99672729	0.99673182	0.92563166	0.99625429	0.99625885
Greenwood	0.99997407	0.99998850	0.99808207	0.99997204	0.99998851
Albuquerque	0.99814522	0.99814522	0.98503490	0.99789480	0.99789480
Anchorage	0.99827218	0.99827361	0.91827780	0.99689763	0.99689878
Atlanta	0.99988389	0.99988389	0.99573626	0.99988337	0.99988337
Barrow	0.66687185	0.69289929	0.21701300	0.62222880	0.65139975
Bethel	0.96477085	0.96488476	0.72627464	0.95763796	0.95778339
Billings	0.99990398	0.99990398	0.99342815	0.99990037	0.99990037
Boston	0.97278059	0.97292948	0.83111485	0.96703028	0.96718213
Chicago	0.99993753	0.99993765	0.99917758	0.99993381	0.99993394
Cleveland	0.99989921	0.99989921	0.98245345	0.99989905	0.99989905
Cold Bay	0.81989461	0.85619992	0.28953196	0.77981868	0.82485361
Dallas	0.99985963	0.99985963	0.99702877	0.99985754	0.99985754
Denver	0.99983752	0.99983752	0.99139418	0.99960565	0.99960565
Fairbanks	0.98459464	0.98459619	0.86520016	0.98113867	0.98114022
Houston	0.99974346	0.99976629	0.97673665	0.99968185	0.99972725
Jacksonville	0.99978614	0.99978614	0.97258214	0.99981462	0.99981462
Juneau	0.99878854	0.99880743	0.96528544	0.99794419	0.99797703
Kansas City	0.99994326	0.99994338	0.99918108	0.99994324	0.99994337
Kotzebue	0.87623549	0.88078028	0.52603706	0.85165241	0.85553295
Los Angeles	0.99746478	0.99760705	0.80981832	0.99750156	0.99768495
Memphis	0.99993616	0.99994272	0.99949721	0.99993616	0.99994268
Miami	0.99842536	0.99863827	0.91599618	0.99719686	0.99735410
Minneapolis	0.99992591	0.99993384	0.99194276	0.99992181	0.99992975
New York	0.99286228	0.99290359	0.91546108	0.99167893	0.99172601
Oakland	0.98979646	0.98985022	0.79296997	0.98820572	0.98829954
Salt Lake City	0.99985391	0.99985391	0.98639082	0.99979877	0.99979877
Seattle	0.99975282	0.99988019	0.99037810	0.99966154	0.99983552
Washington DC	0.99935913	0.99935913	0.96531764	0.99917169	0.99917169

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	0.99999450
Anchorage	0.99999360
Atlanta	0.99999462
Bethel	0.99999363
Billings	0.99999437
Boston	0.99999399
Cleveland	0.99999384
Cold Bay	0.99999368
Fairbanks	0.99999365
Honolulu	0.99998210
Houston	0.99999463
Juneau	0.99999395
Kansas City	0.99999433
Kotzebue	0.99999383
Los Angeles	0.99999164
Miami	0.99999462
Minneapolis	0.99999437
Oakland	0.99999436
Puerto Rico	0.99569108
Salt Lake City	0.99999425
Seattle	0.99999423
Washington DC	0.99999400

Table 3-4 LPV and LNAV/VNAV Outage Rate

Location	LPV 200 Outages	LPV 200 Outage Rates	LPV Outages	LPV Outage Rates	LNAV/VNAV Outages	LNAV/VNAV Outage Rates
Atlantic City	382	0.008058	91	0.001784	91	0.001784
Greenwood	35	0.000817	2	0.000047	1	0.000023
Albuquerque	173	0.003369	34	0.000654	34	0.000654
Anchorage	588	0.012293	77	0.001483	77	0.001483
Atlanta	95	0.001832	4	0.000077	4	0.000077
Barrow	775	0.070257	1057	0.033419	1125	0.033976
Bethel	1052	0.028237	403	0.008204	402	0.008182
Billings	117	0.002262	4	0.000077	4	0.000077
Boston	939	0.021681	213	0.004227	212	0.004206
Chicago	24	0.000461	4	0.000077	3	0.000058
Cleveland	155	0.003036	3	0.000058	3	0.000058
Cold Bay	1045	0.070033	1062	0.026425	767	0.018043
Dallas	44	0.000852	5	0.000097	5	0.000097
Denver	94	0.001823	15	0.000289	15	0.000289
Fairbanks	774	0.017395	293	0.005807	292	0.005787
Houston	355	0.006971	9	0.000173	7	0.000134
Jacksonville	194	0.003828	5	0.000096	5	0.000096
Juneau	407	0.008242	52	0.001019	50	0.000979
Kansas City	26	0.000505	3	0.000058	2	0.000039
Kotzebue	1294	0.049399	891	0.021009	888	0.020844
Los Angeles	57	0.002616	412	0.024204	54	0.002554
Memphis	18	0.000346	3	0.000058	2	0.000038
Miami	500	0.010493	69	0.001330	67	0.001291
Minneapolis	95	0.001838	6	0.000115	4	0.000077
New York	382	0.008029	107	0.002076	104	0.002018
Oakland	850	0.020635	123	0.002396	120	0.002337
Salt Lake City	197	0.003830	6	0.000115	6	0.000115
Seattle	175	0.003401	10	0.000193	5	0.000096
Washington DC	261	0.005183	32	0.000614	32	0.000614

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	2	0.00003836
Anchorage	2	0.00003839
Atlanta	1	0.00001920
Bethel	1	0.00001949
Billings	1	0.00001919
Boston	1	0.00001919
Cleveland	2	0.00003848
Cold Bay	2	0.00003871
Fairbanks	1	0.00001944
Honolulu	3	0.00005796
Houston	1	0.00001918
Juneau	1	0.00001932
Kansas City	1	0.00001932
Kotzebue	1	0.00001971
Los Angeles	1	0.00002914
Miami	1	0.00001922
Minneapolis	1	0.00001919
Oakland	1	0.00001924
Puerto Rico	9	0.00018819
Salt Lake City	2	0.00003835
Seattle	2	0.00003848
Washington DC	1	0.00001917

Figure 3-1 LPV Instantaneous Availability

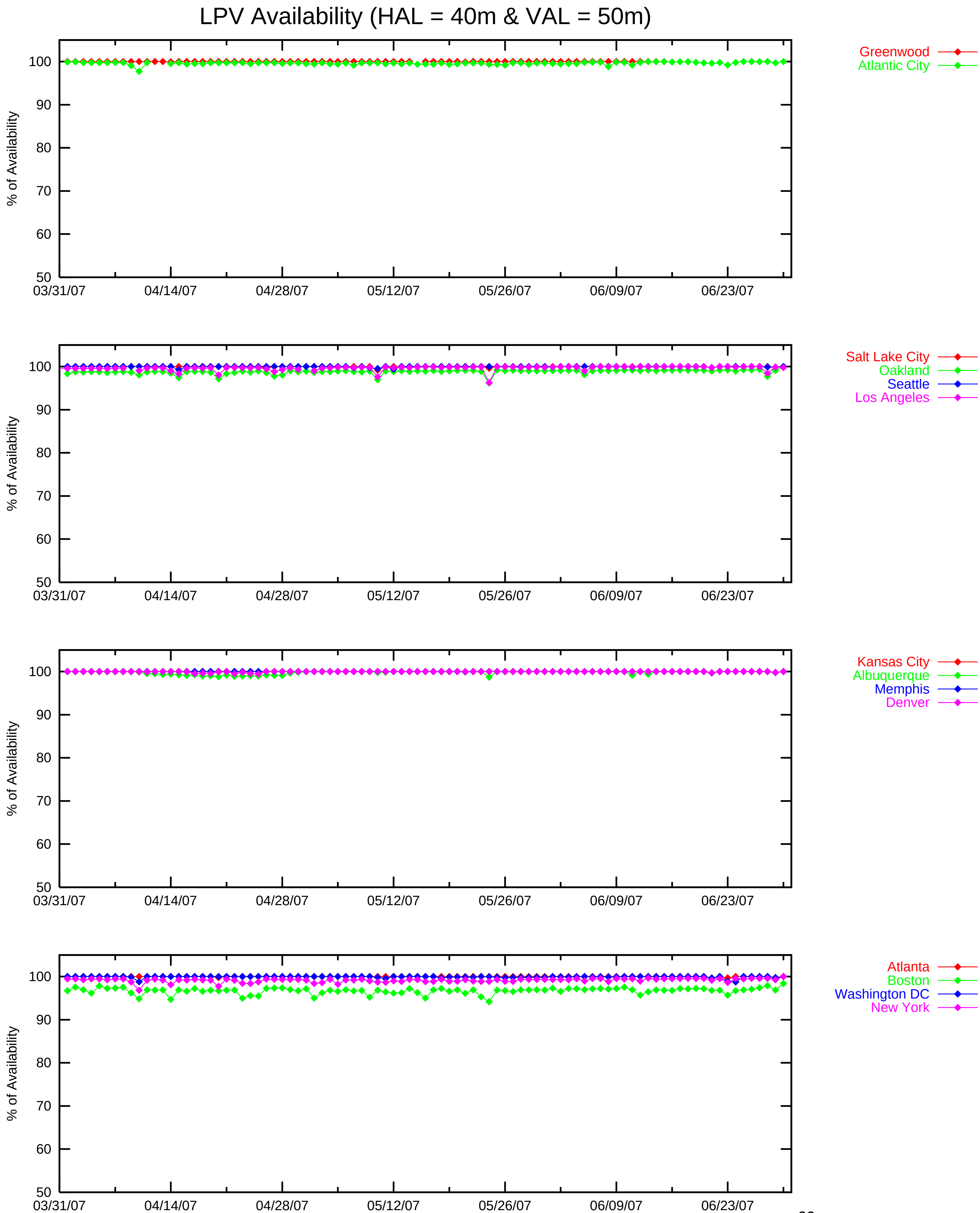


Figure 3-2 LPV Instantaneous Availability

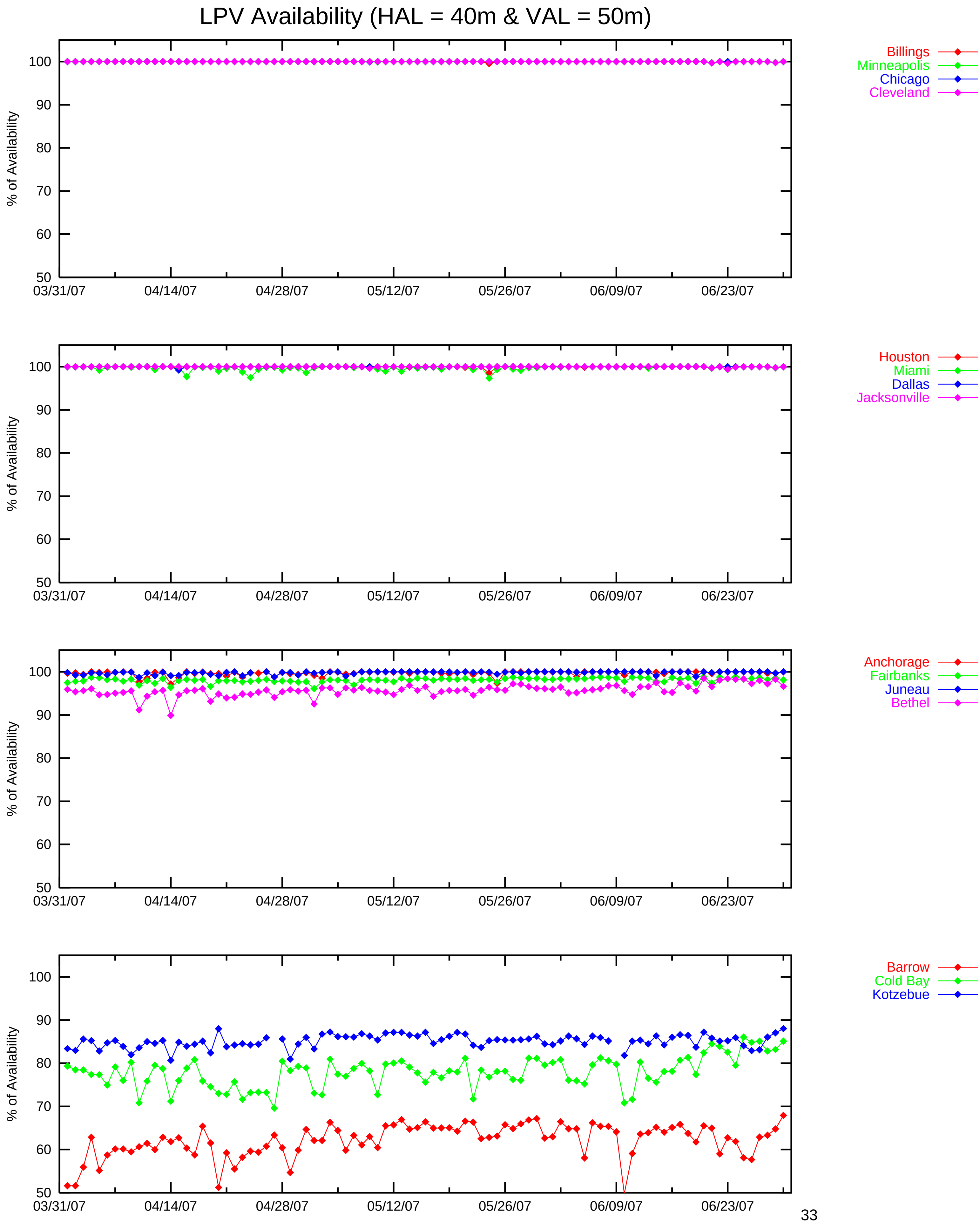


Figure 3-3 LNAV/VNAV Instantaneous Availability

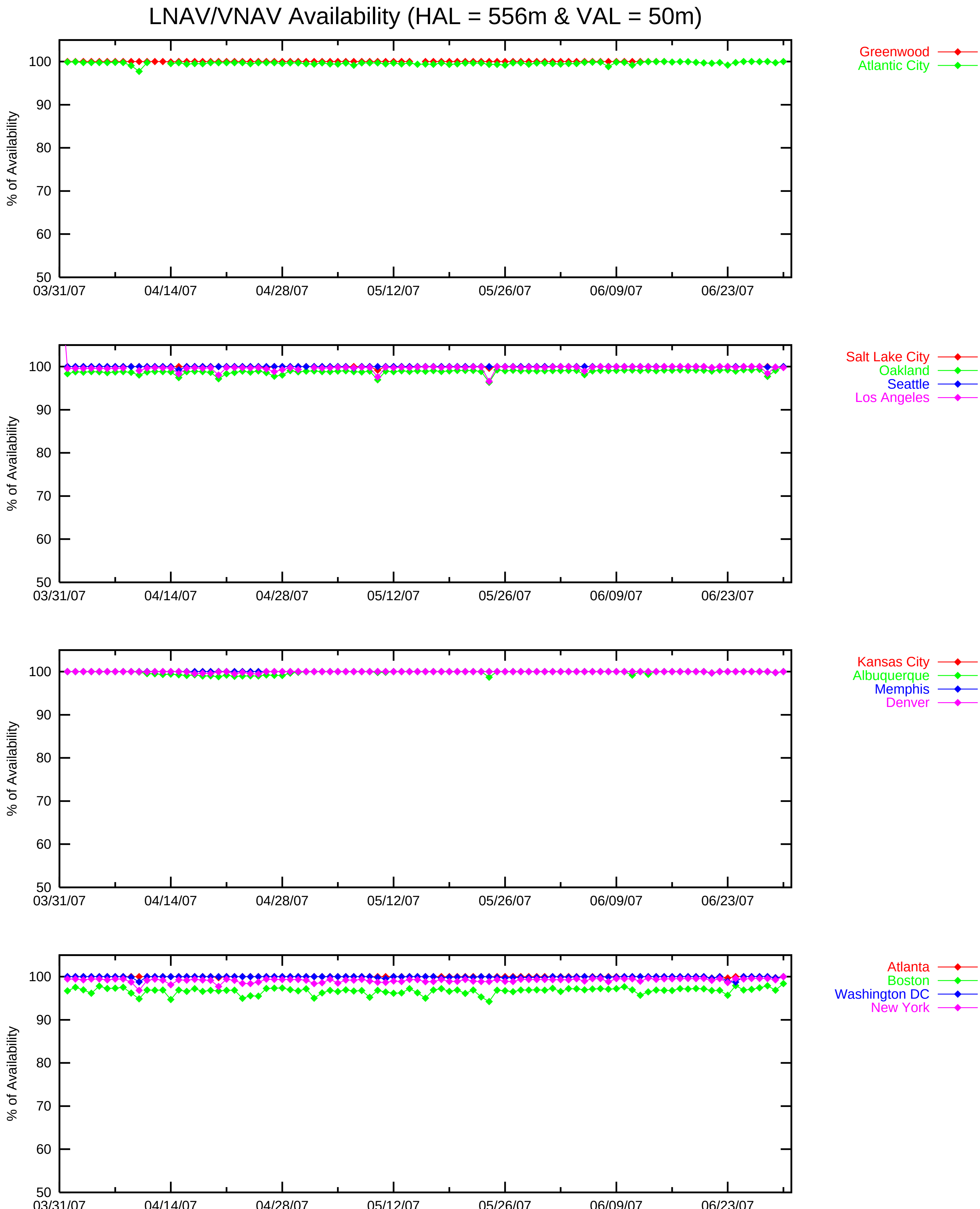


Figure 3-4 LNAV/VNAV Instantaneous Availability

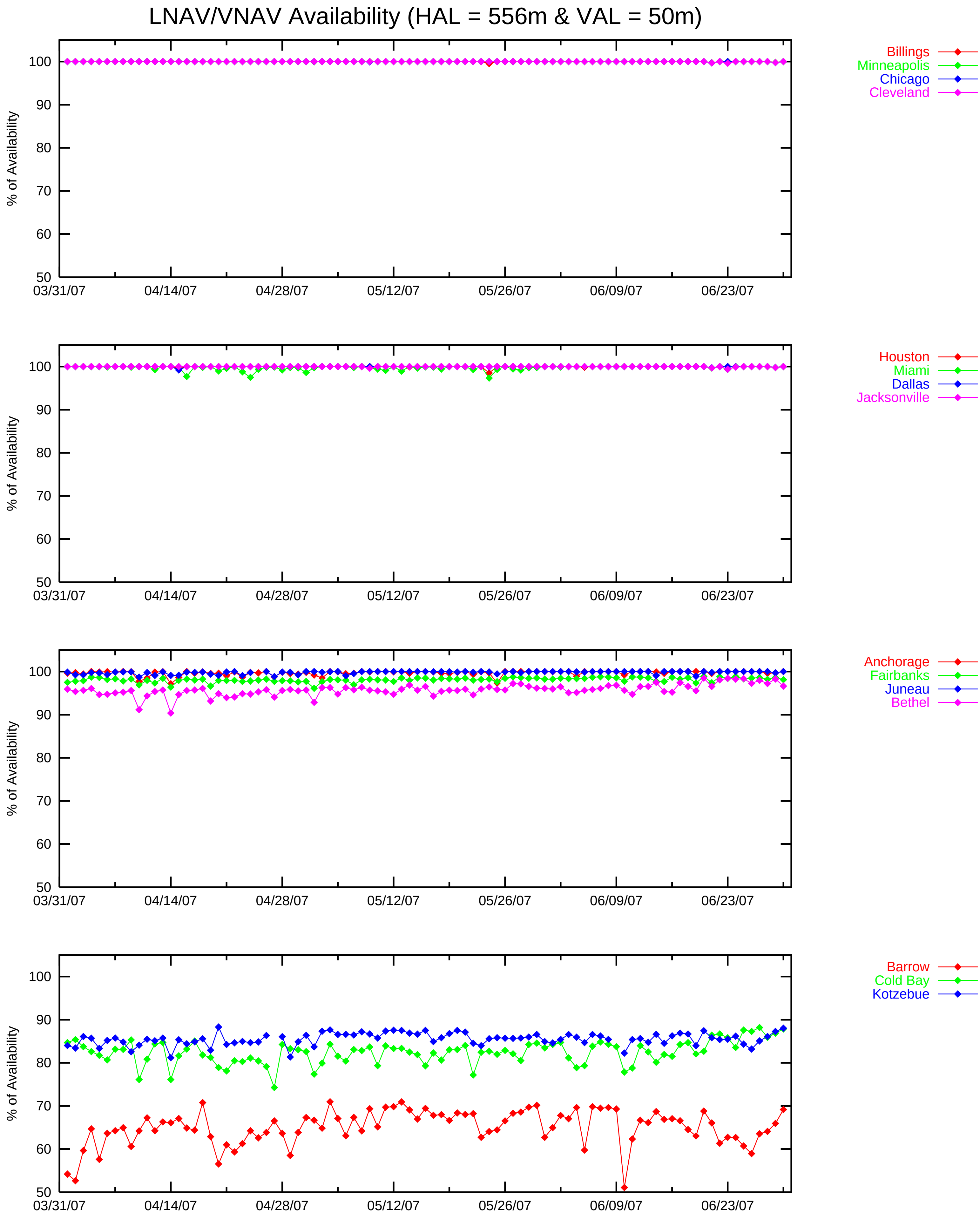


Figure 3-5 LPV Outages

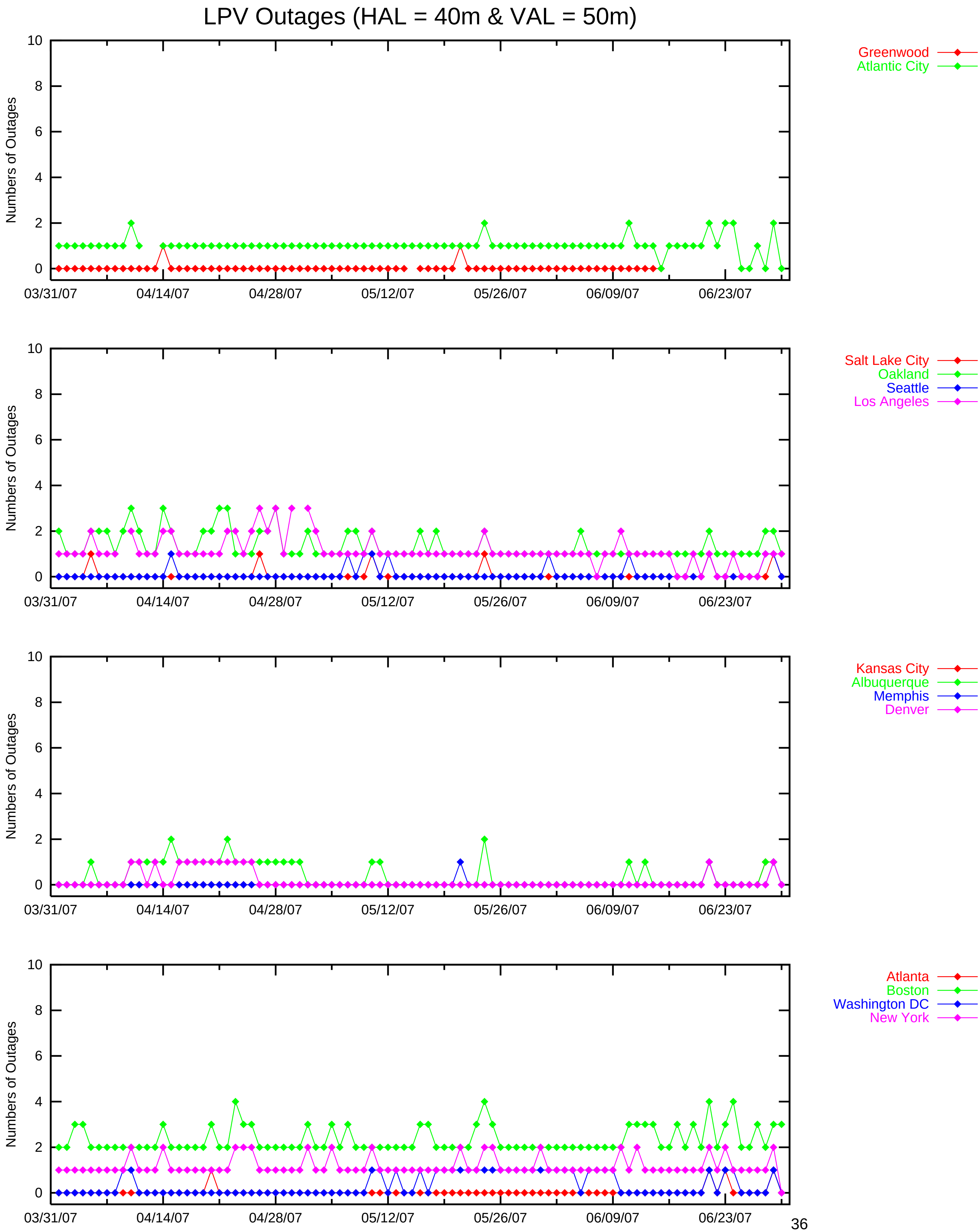


Figure 3-6 LPV Outages

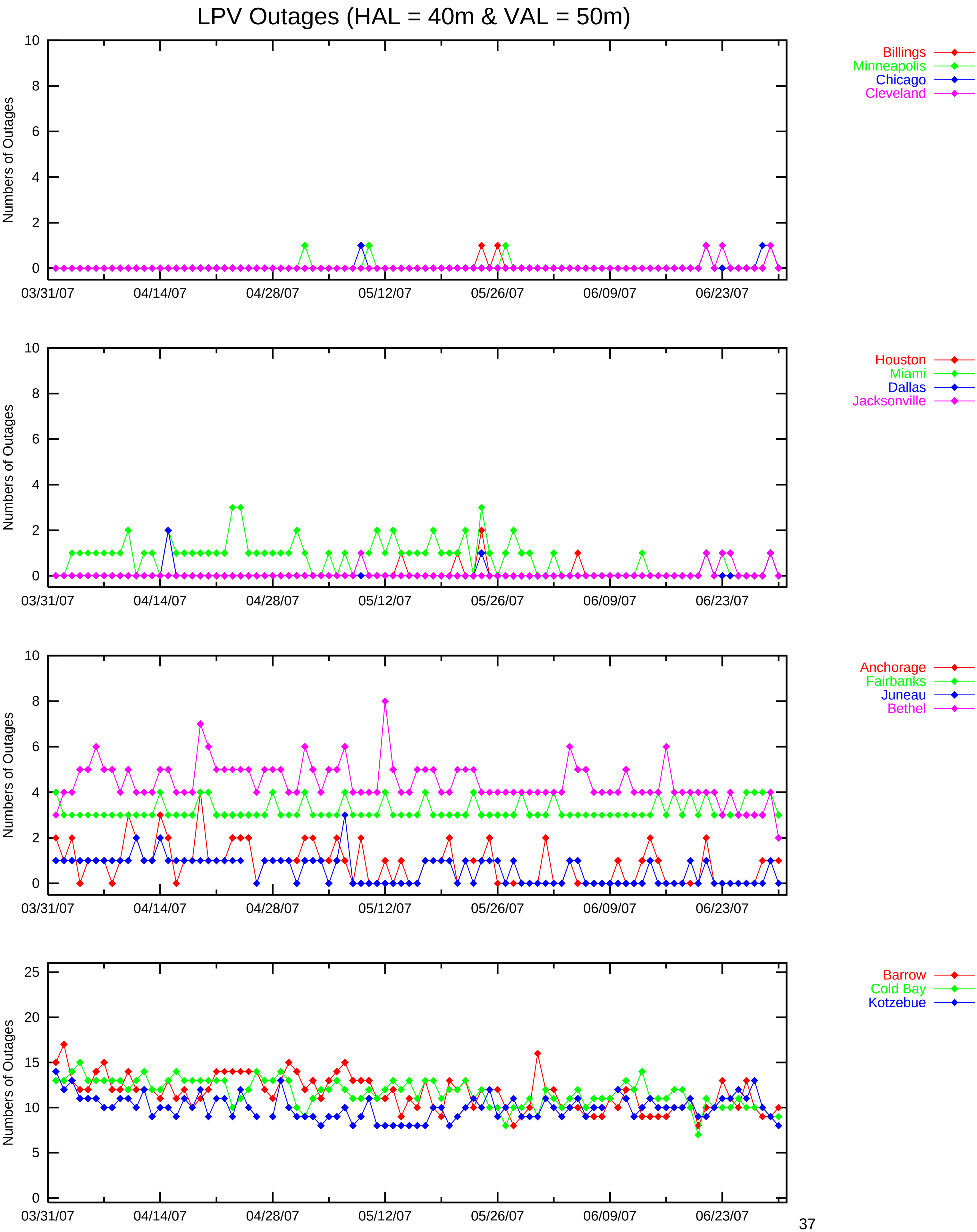


Figure 3-7 LNAV/VNAV Outages

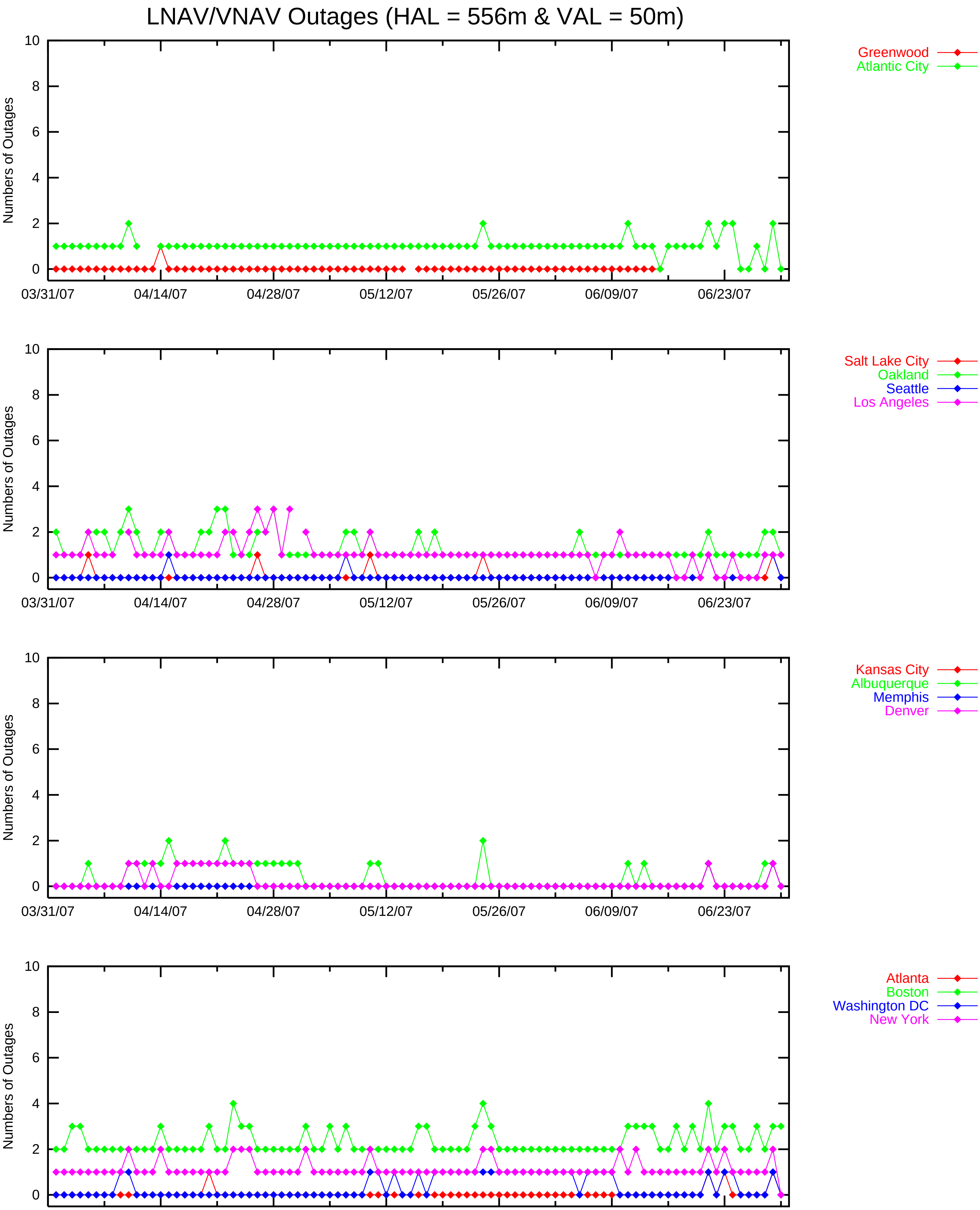
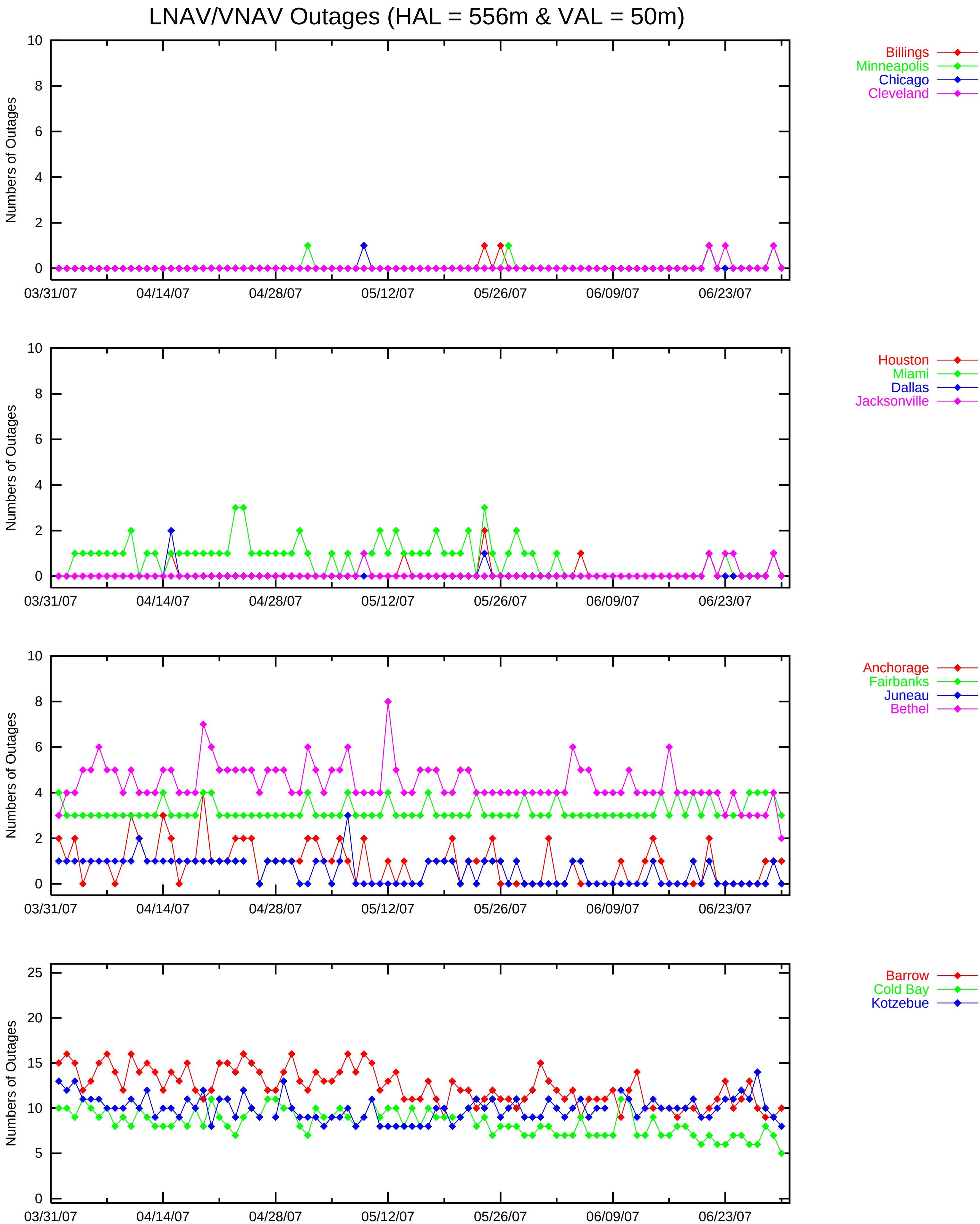


Figure 3-8 LNAV/VNAV Outages



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.

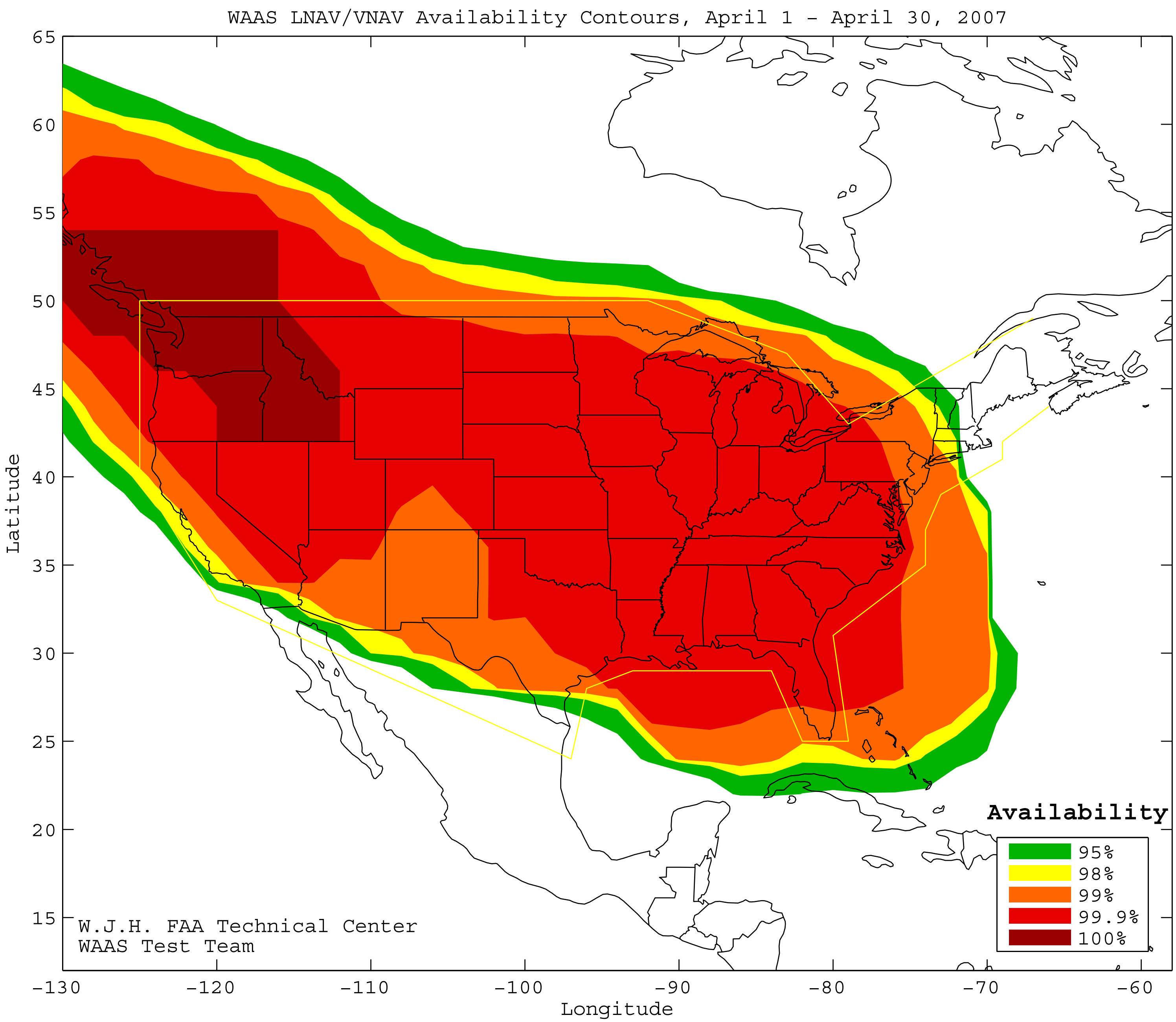
Daily analysis for PA was conducted for LPV, LPV200, and LNAV/VNAV service levels. The coverage plots provide 100, 99, 95, 90 and 80% availability contours. Figures 4.1 to 4.3 show the LNAV/VNAV CONUS coverage, Figure 4.5 to 4.7 show the LPV CONUS coverage, Figure 4.9 to 4.11 show the LPV200 CONUS coverage, and Figure 4.23 to 4.25 show the LPV Alaska coverage for each month for this quarter. Figure 4.4, 4.8, and 4.12 show the rollup LNAV/VNAV, LPV, and LPV200 for the quarter. Figure 4.17 shows the daily LNAV/VNAV and LPV CONUS coverage, and Figure 4.27 shows the daily LPV Alaska coverage at 99% availability and ionosphere KP index values for this quarter.

Daily analysis for NPA was based on a 99.9% availability requirement. The NPA coverage plots provide 100, 99.9 and 99% availability contours. Figure 4.13 to 4.15 show the NPA coverage area of each month and Figure 4.16 shows the rollup NPA coverage for the quarter. Figure 4.18 shows the daily NPA coverage at 99.9% availability and ionosphere Kp index values for this quarter.

During this evaluated period, the lower than normal LNAV/VNAV and LPV coverage on 4/15/2007 and 5/24/2007 are due to satellite out for service.

Figures 4.19 to 4.21 show the rollup of LNAV/VNAV, LPV and NPA CONUS coverage since WAAS commissioning (July 2003). Figure 4.22 shows the rollup of LPV 200 CONUS, and Figure 4.28 shows the rollup of LPV Alaska coverage since added to the WAAS (Oct 2006).

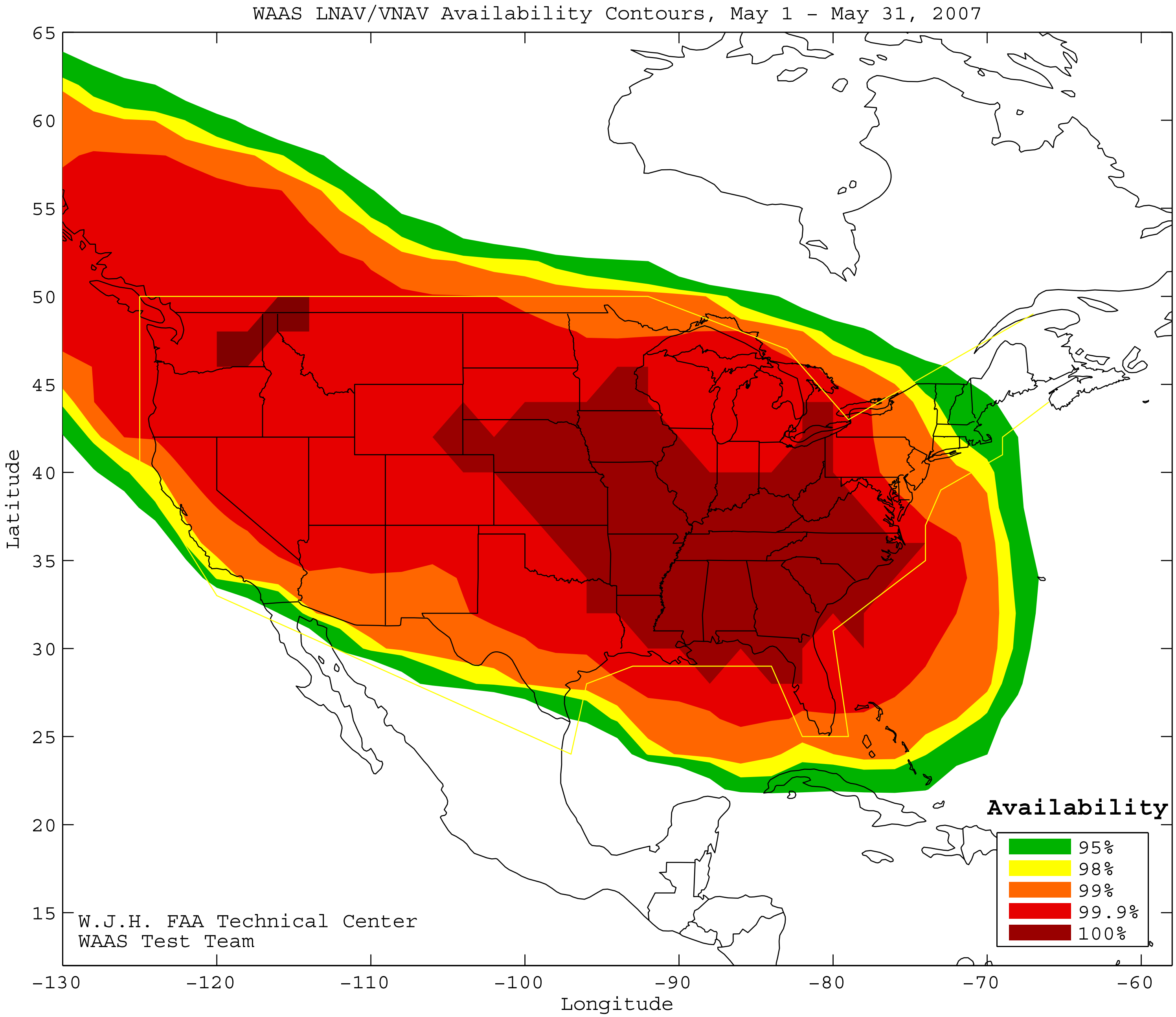
Figure 4-1 WAAS LNAV/VNAV Coverage - April



CONUS Coverage at 95% Availability = 95.14%
CONUS Coverage at 99% Availability = 90.69%
CONUS Coverage at 100% Availability = 9.312%

SL = LNAV/VNAV

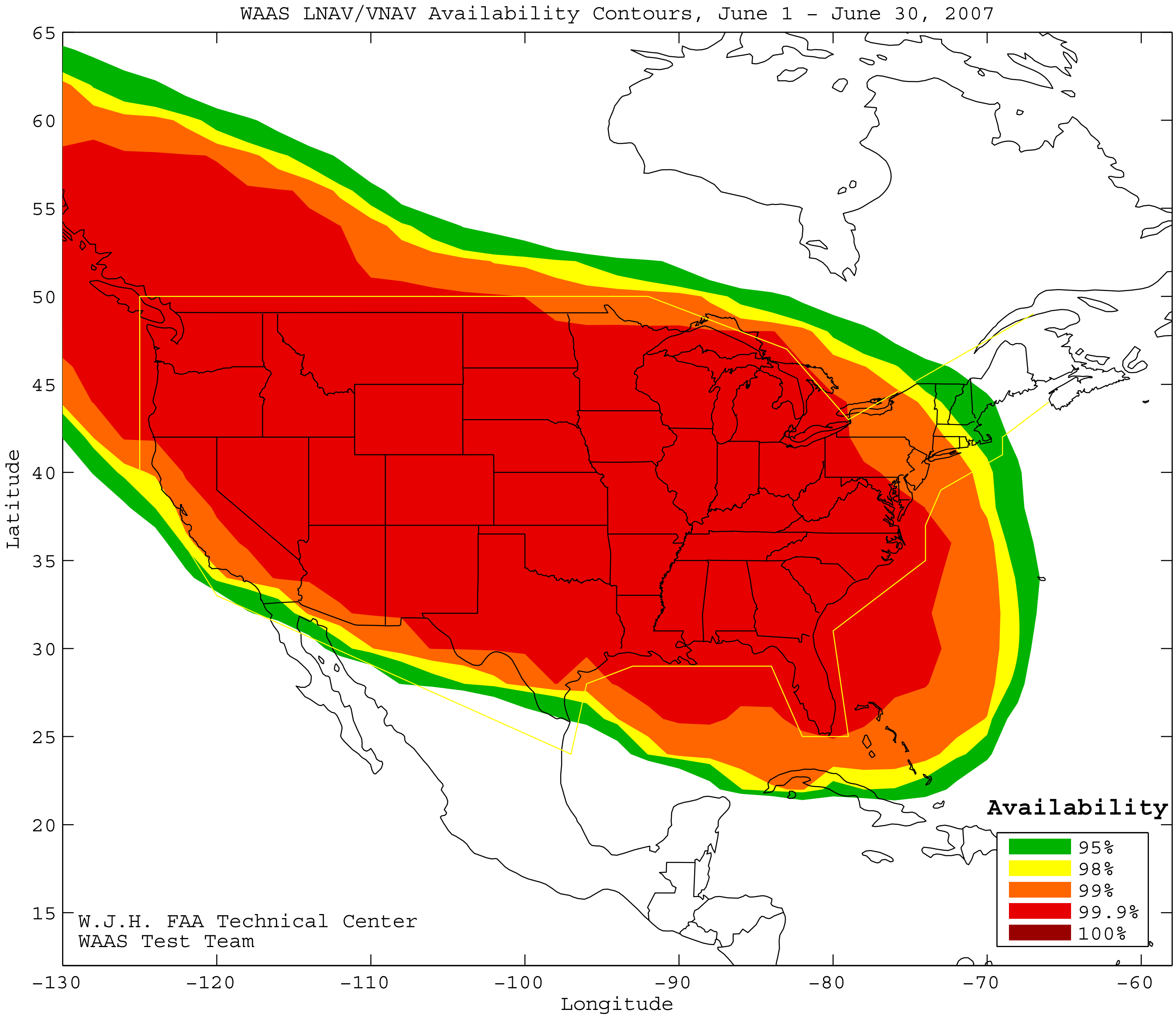
Figure 4-2 WAAS LNAV/VNAV Coverage - May



CONUS Coverage at 95% Availability = 96.36%
CONUS Coverage at 99% Availability = 90.69%
CONUS Coverage at 100% Availability = 36.44%

SL = LNAV/VNAV

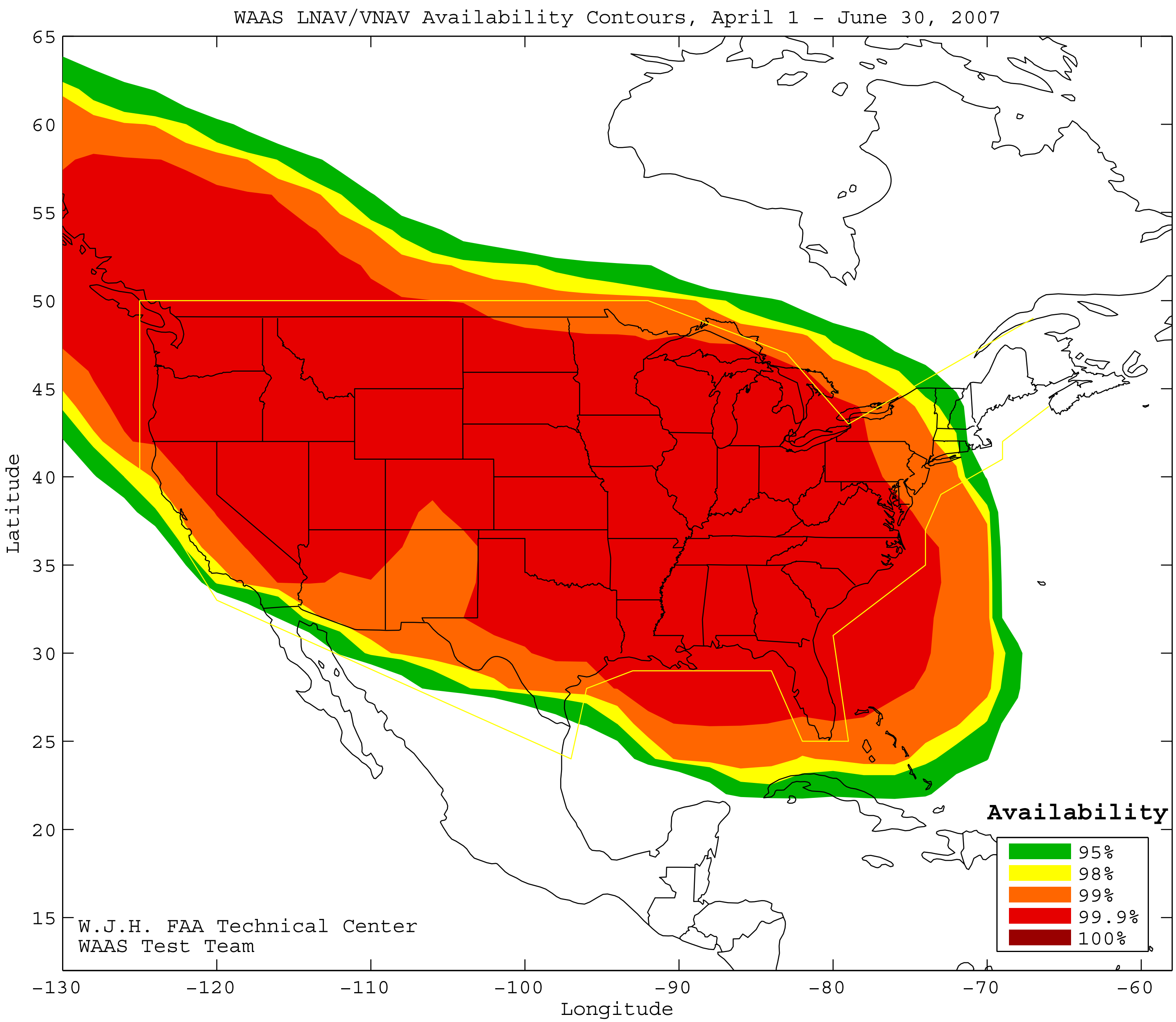
Figure 4-3 WAAS LNAV/VNAV Coverage - June



CONUS Coverage at 95% Availability = 96.76%
CONUS Coverage at 99% Availability = 91.5%
CONUS Coverage at 100% Availability = 0%

SL = LNAV/VNAV

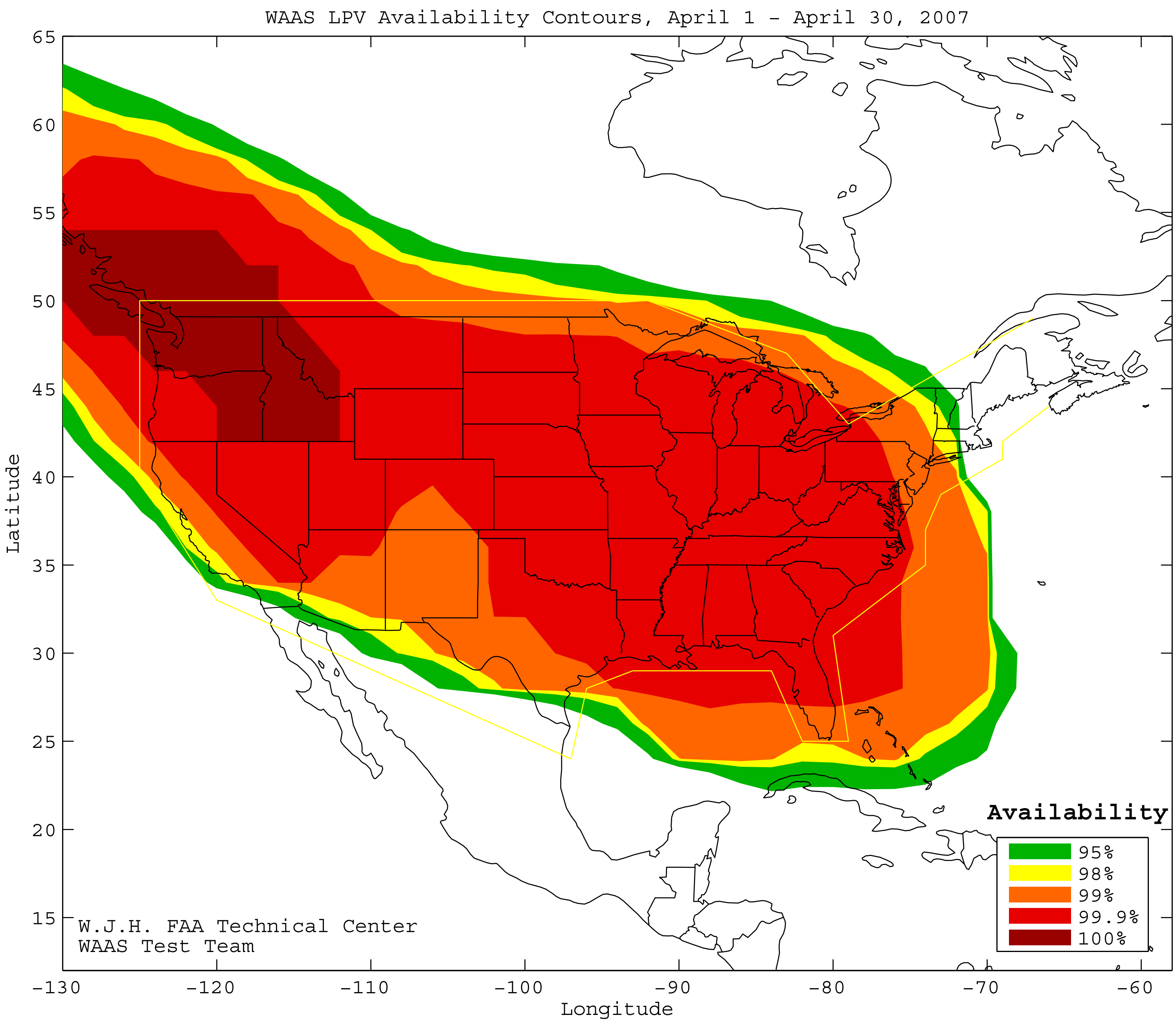
Figure 4-4 WAAS LNAV/VNAV Coverage for the Quarter



CONUS Coverage at 95% Availability = 95.95%
CONUS Coverage at 99% Availability = 91.09%
CONUS Coverage at 100% Availability = 0%

SL = LNAV/VNAV

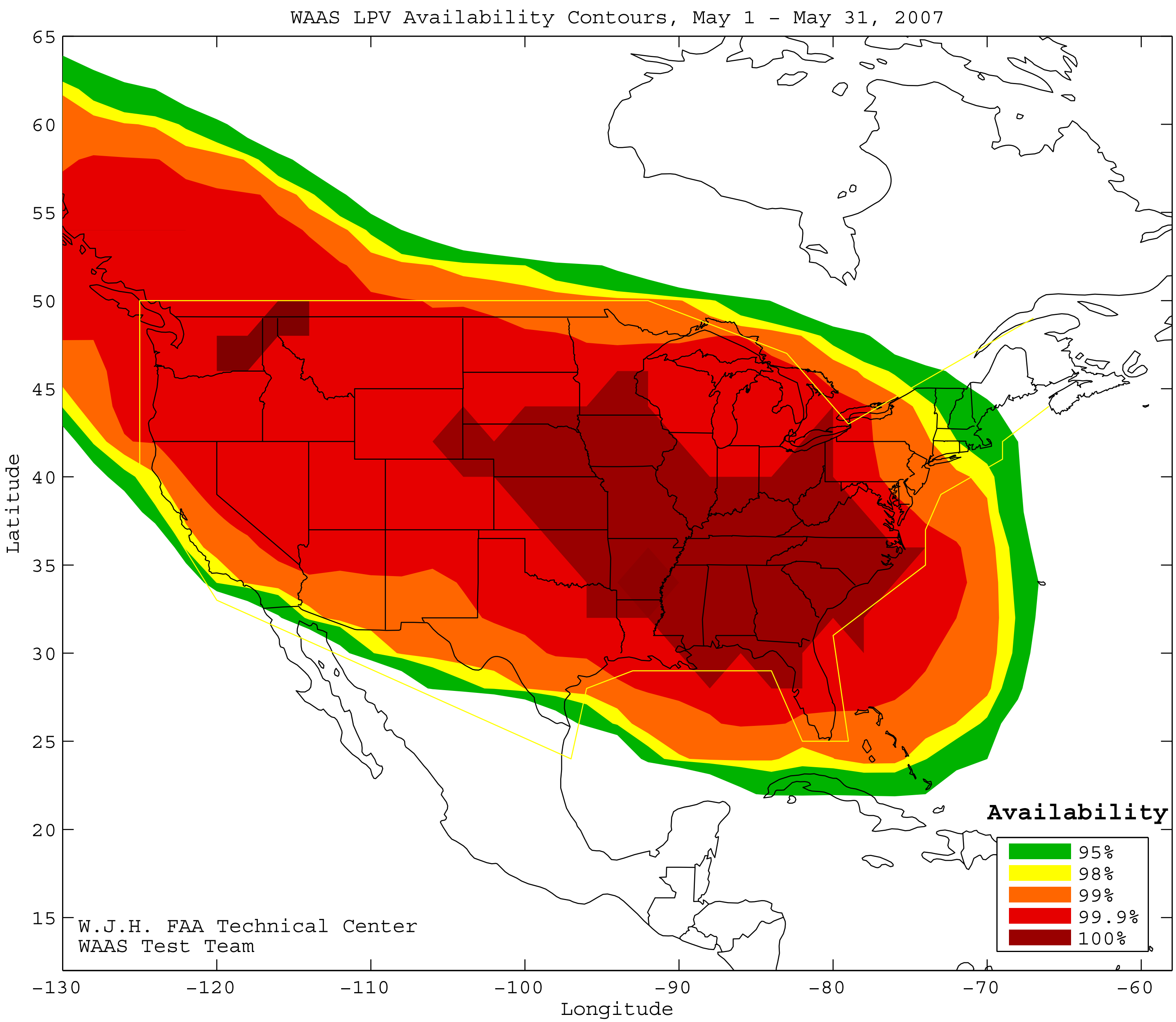
Figure 4-5 WAAS LPV Coverage - April



CONUS Coverage at 95% Availability = 94.74%
CONUS Coverage at 99% Availability = 89.47%
CONUS Coverage at 100% Availability = 9.312%

SL = LPV

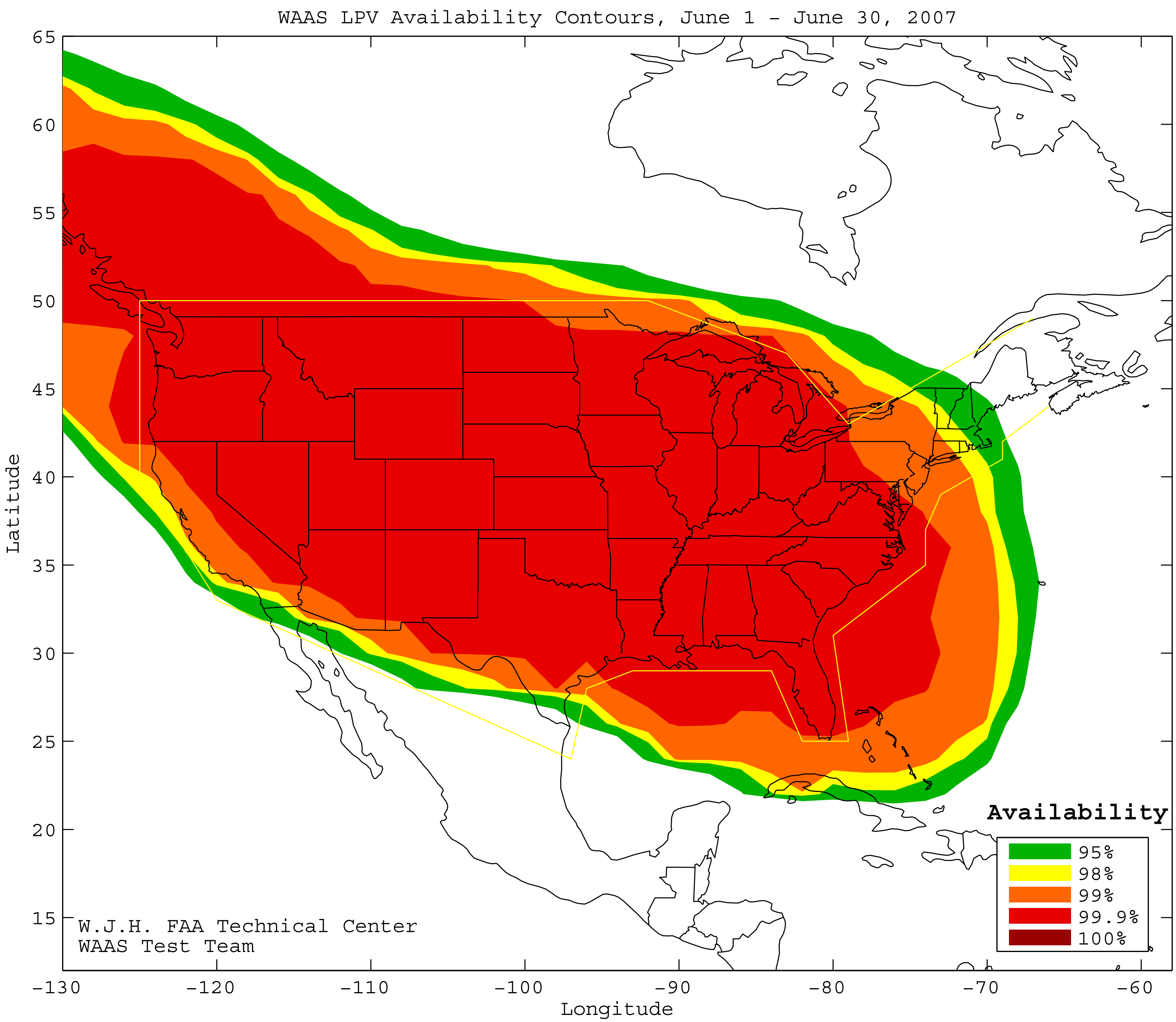
Figure 4-6 WAAS LPV Coverage - May



CONUS Coverage at 95% Availability = 95.95%
CONUS Coverage at 99% Availability = 90.69%
CONUS Coverage at 100% Availability = 35.22%

SL = LPV

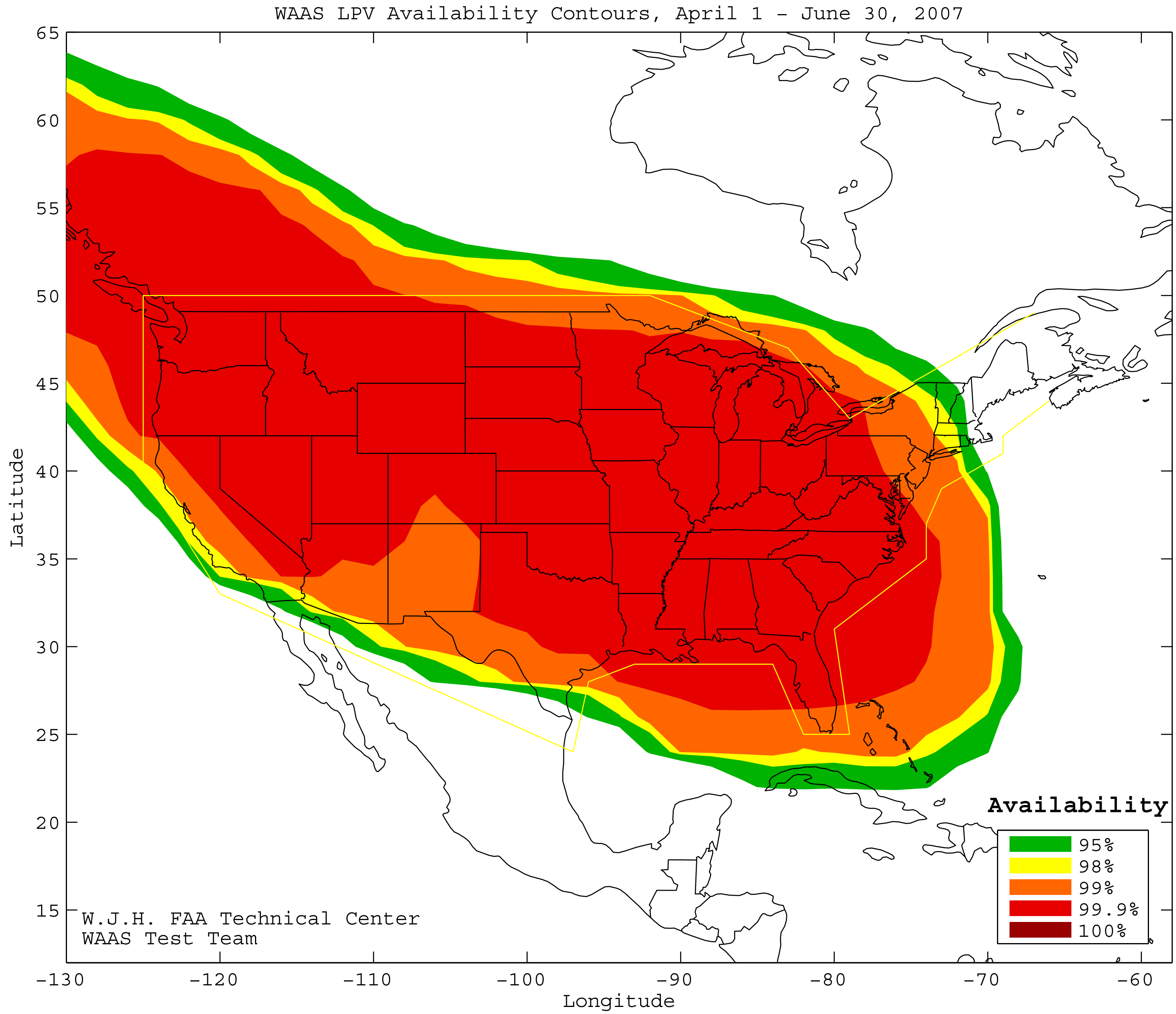
Figure 4-7 WAAS LPV Coverage - June



CONUS Coverage at 95% Availability = 96.36%
CONUS Coverage at 99% Availability = 91.5%
CONUS Coverage at 100% Availability = 0%

SL = LPV

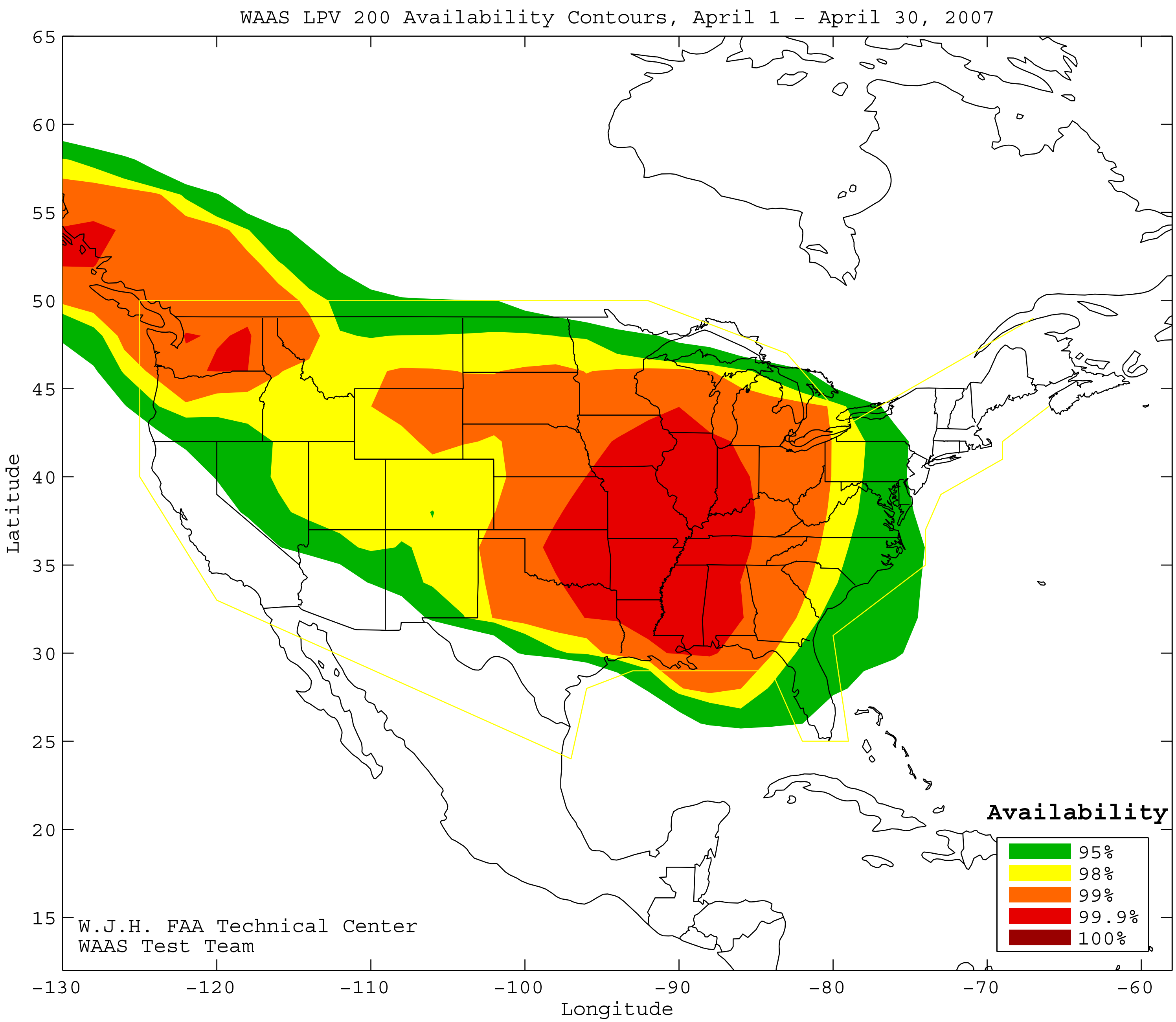
Figure 4-8 WAAS LPV Coverage for the Quarter



CONUS Coverage at 95% Availability = 95.14%
CONUS Coverage at 99% Availability = 90.69%
CONUS Coverage at 100% Availability = 0%

SL = LPV

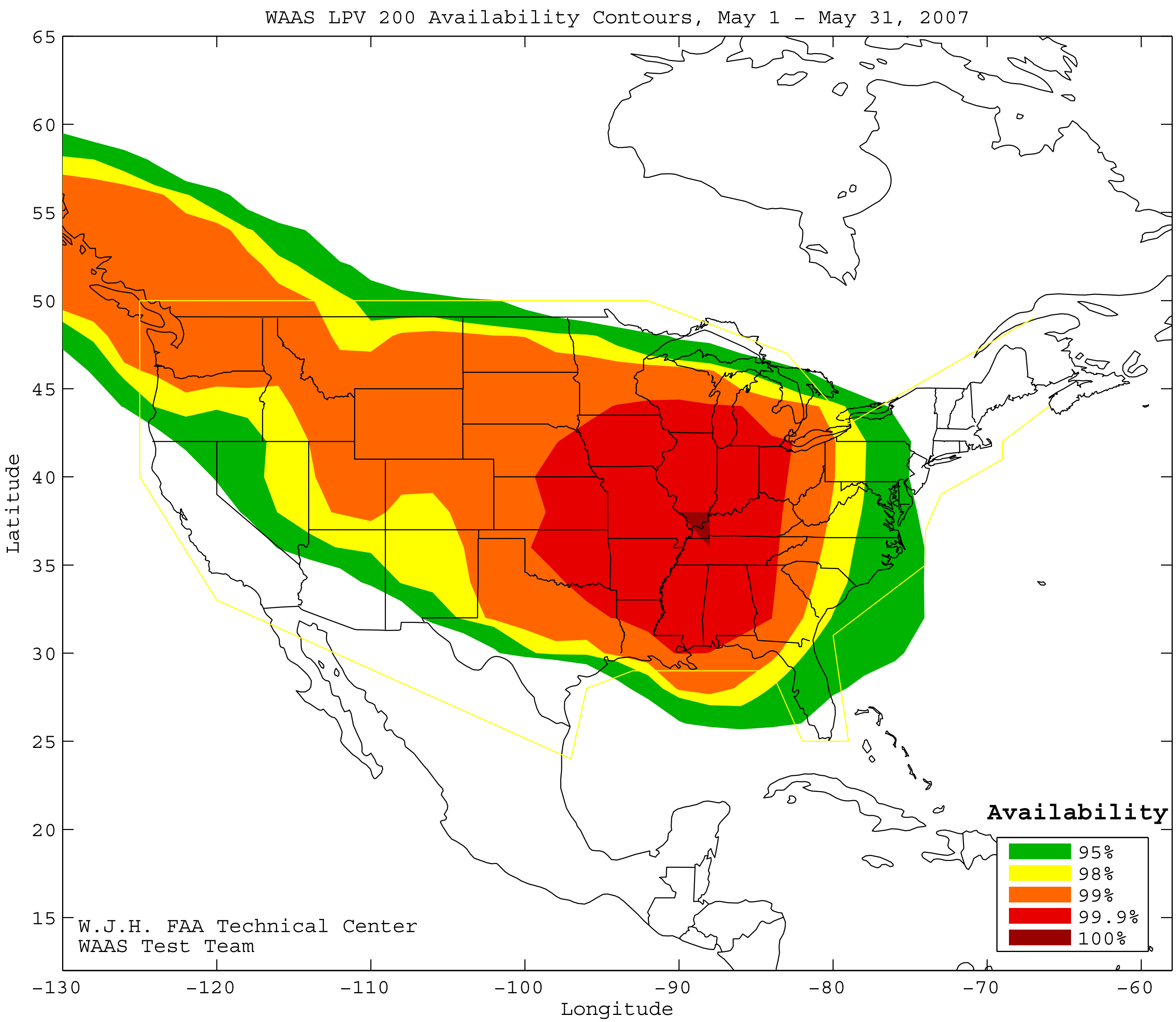
Figure 4-9 WAAS LPV 200 CONUS Coverage - April



CONUS Coverage at 95% Availability = 78.95%
CONUS Coverage at 99% Availability = 41.7%
CONUS Coverage at 100% Availability = 0%

SL = LPV 200

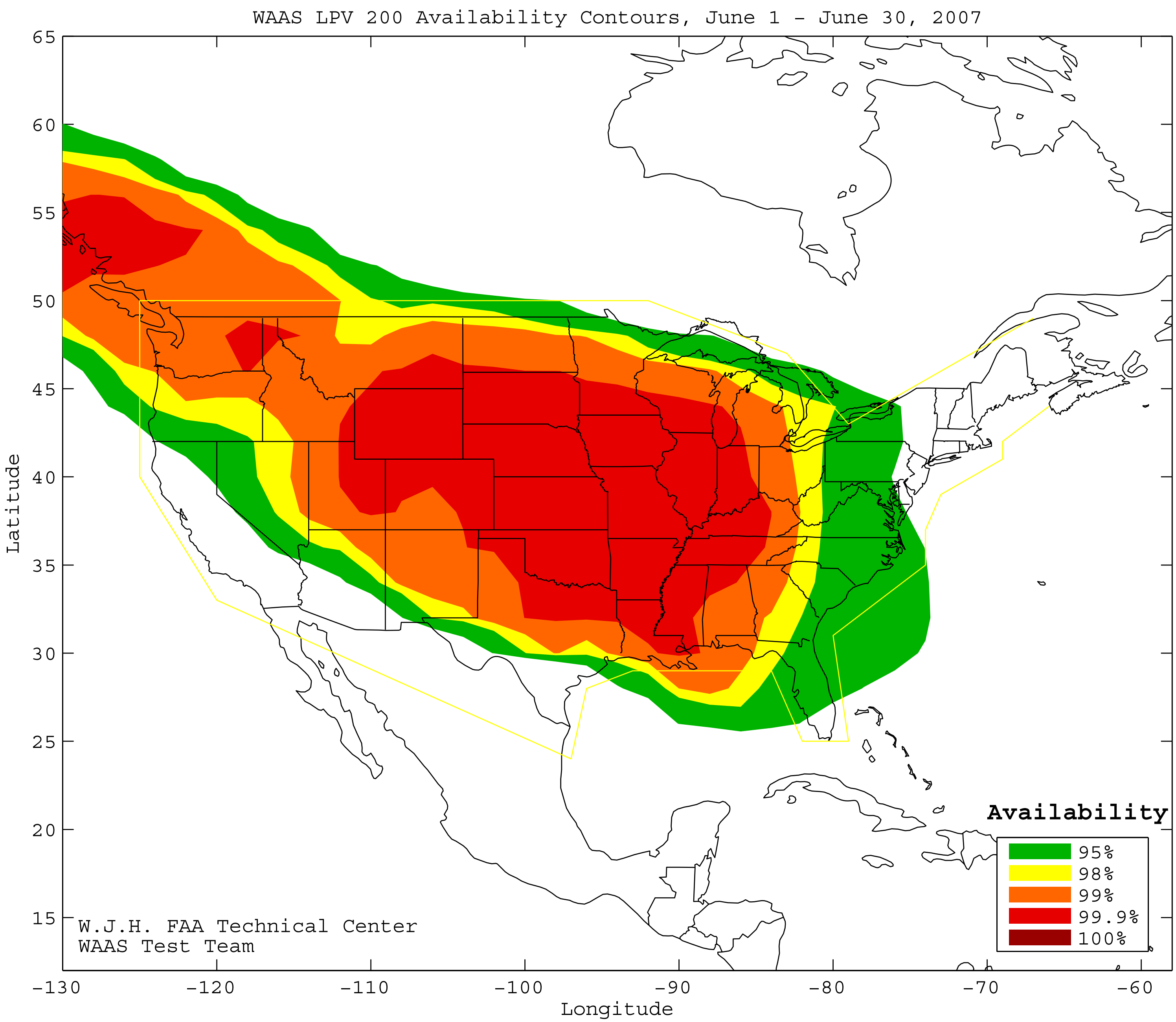
Figure 4-10 WAAS LPV 200 CONUS Coverage - May



CONUS Coverage at 95% Availability = 78.95%
CONUS Coverage at 99% Availability = 54.25%
CONUS Coverage at 100% Availability = 1.619%

SL = LPV 200

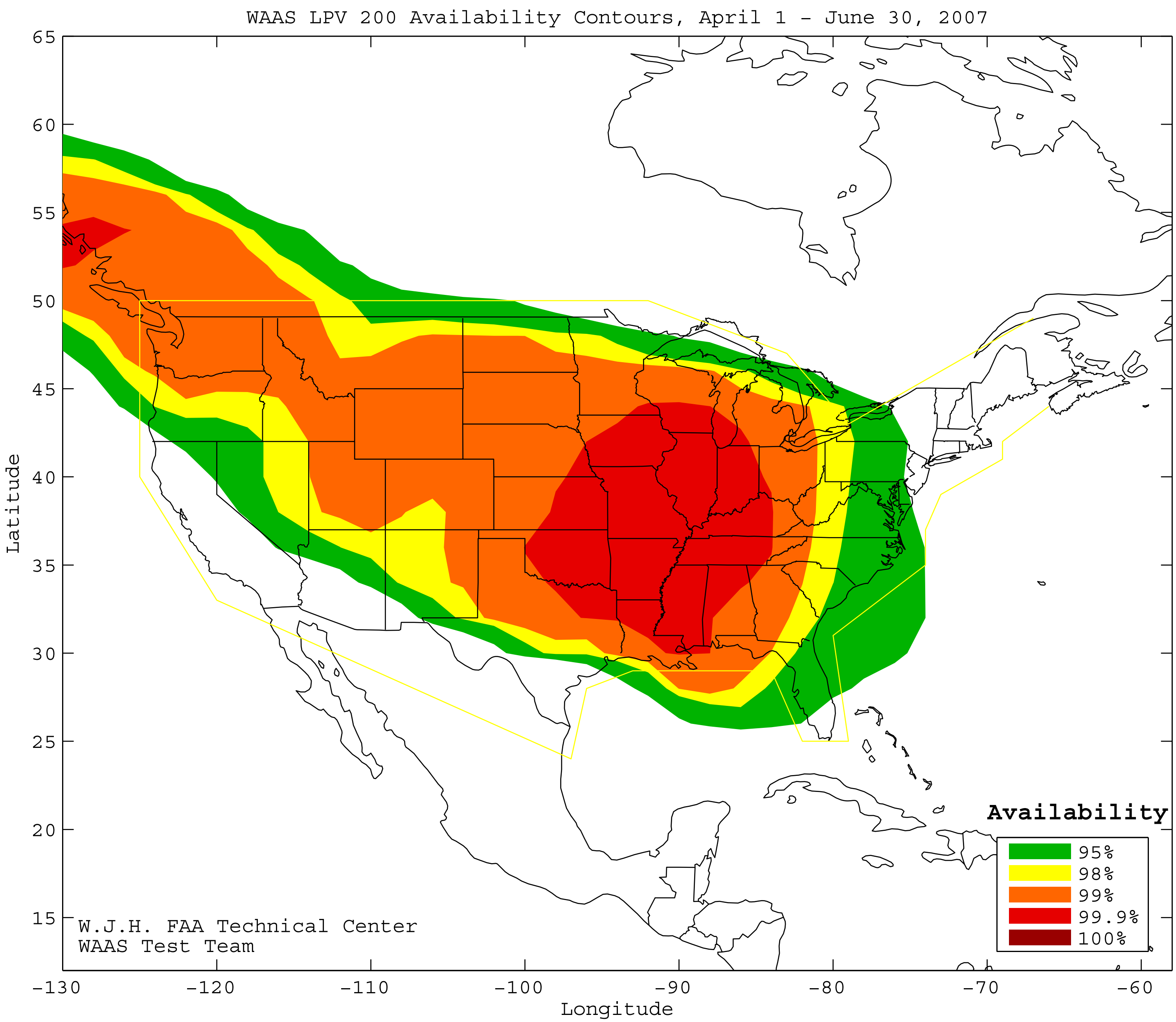
Figure 4-11 WAAS LPV 200 CONUS Coverage - June



CONUS Coverage at 95% Availability = 80.16%
CONUS Coverage at 99% Availability = 55.87%
CONUS Coverage at 100% Availability = 0%

SL = LPV 200

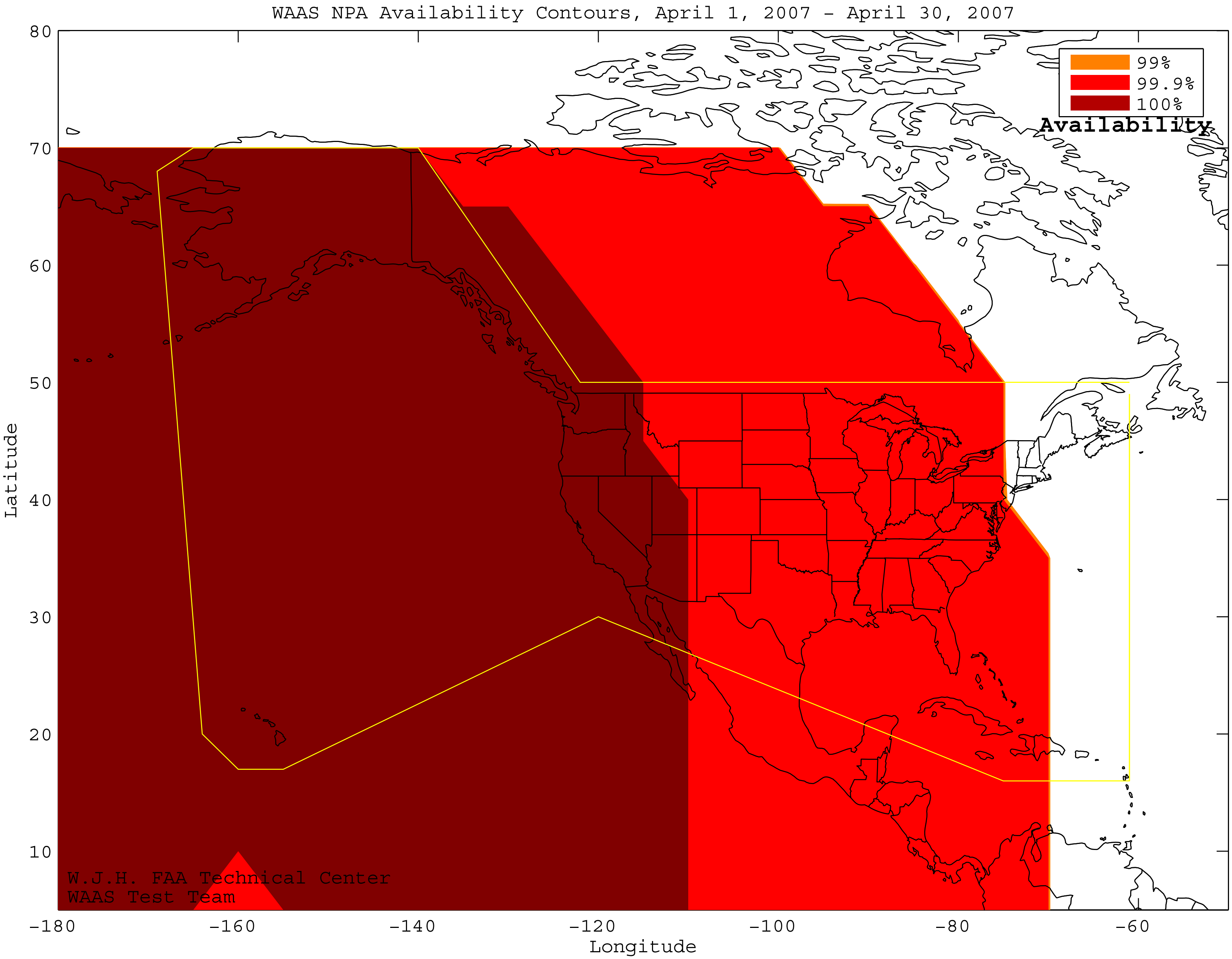
Figure 4-12 WAAS LPV 200 CONUS Coverage - Quarter



CONUS Coverage at 95% Availability = 78.95%
CONUS Coverage at 99% Availability = 53.44%
CONUS Coverage at 100% Availability = 0%

SL = LPV 200

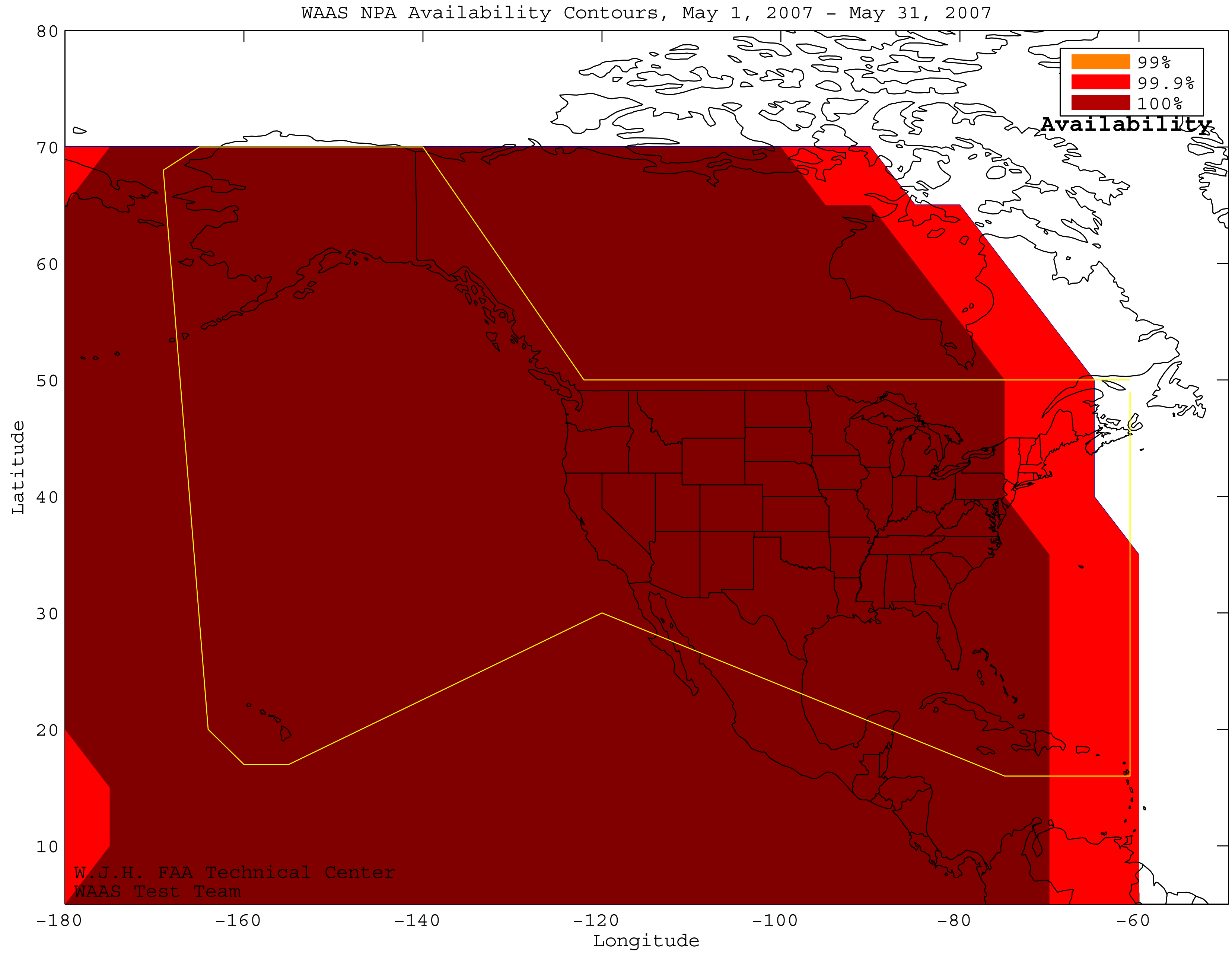
Figure 4-13 WAAS NPA Coverage - April



WAAS Coverage at 99% Availability = 94.12%
WAAS Coverage at 99.9% Availability = 94.12%
WAAS Coverage at 100% Availability = 63.24%

SL = NPA

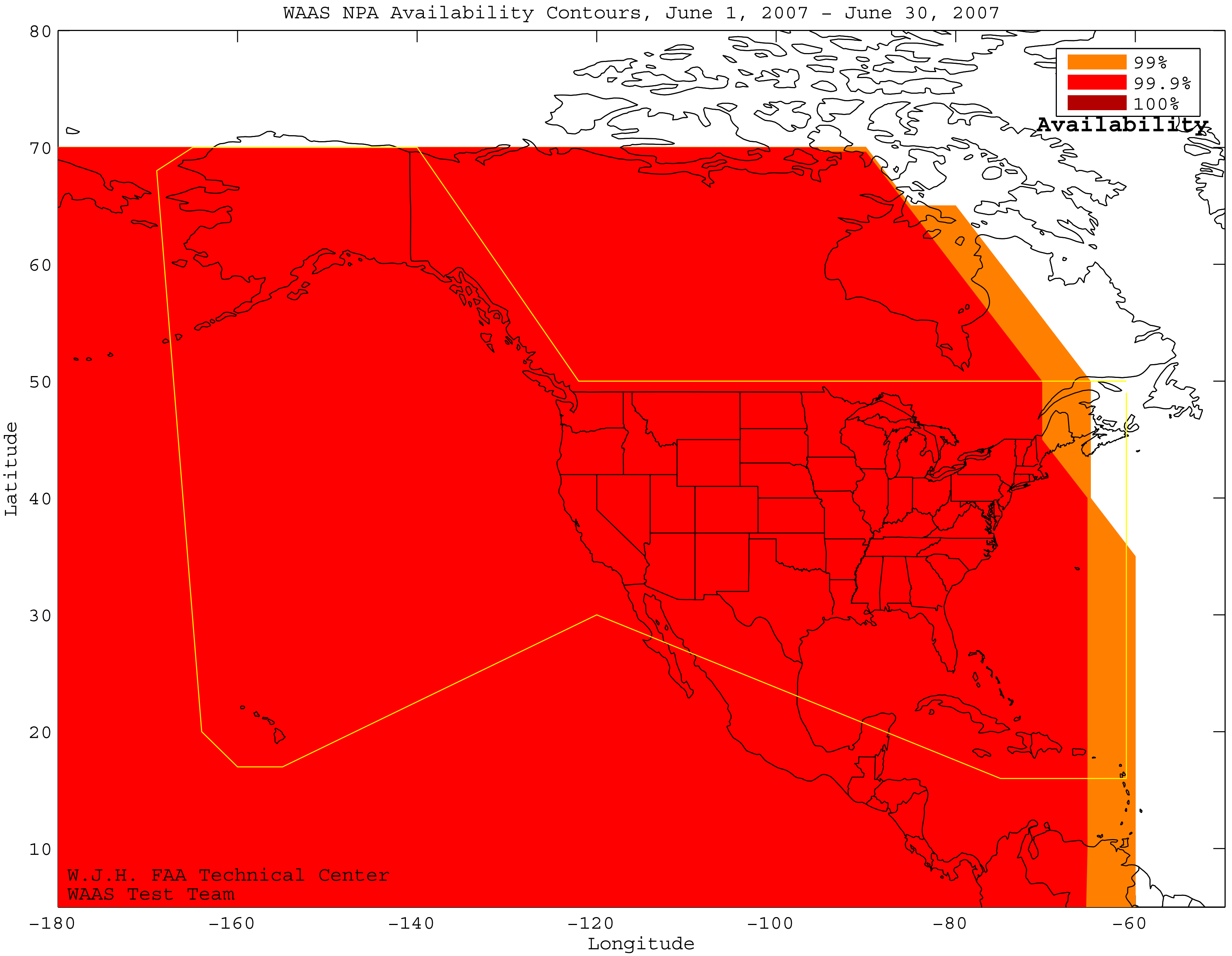
Figure 4-14 WAAS NPA Coverage - May



WAAS Coverage at 99% Availability = 100%
WAAS Coverage at 99.9% Availability = 100%
WAAS Coverage at 100% Availability = 94.12%

SL = NPA

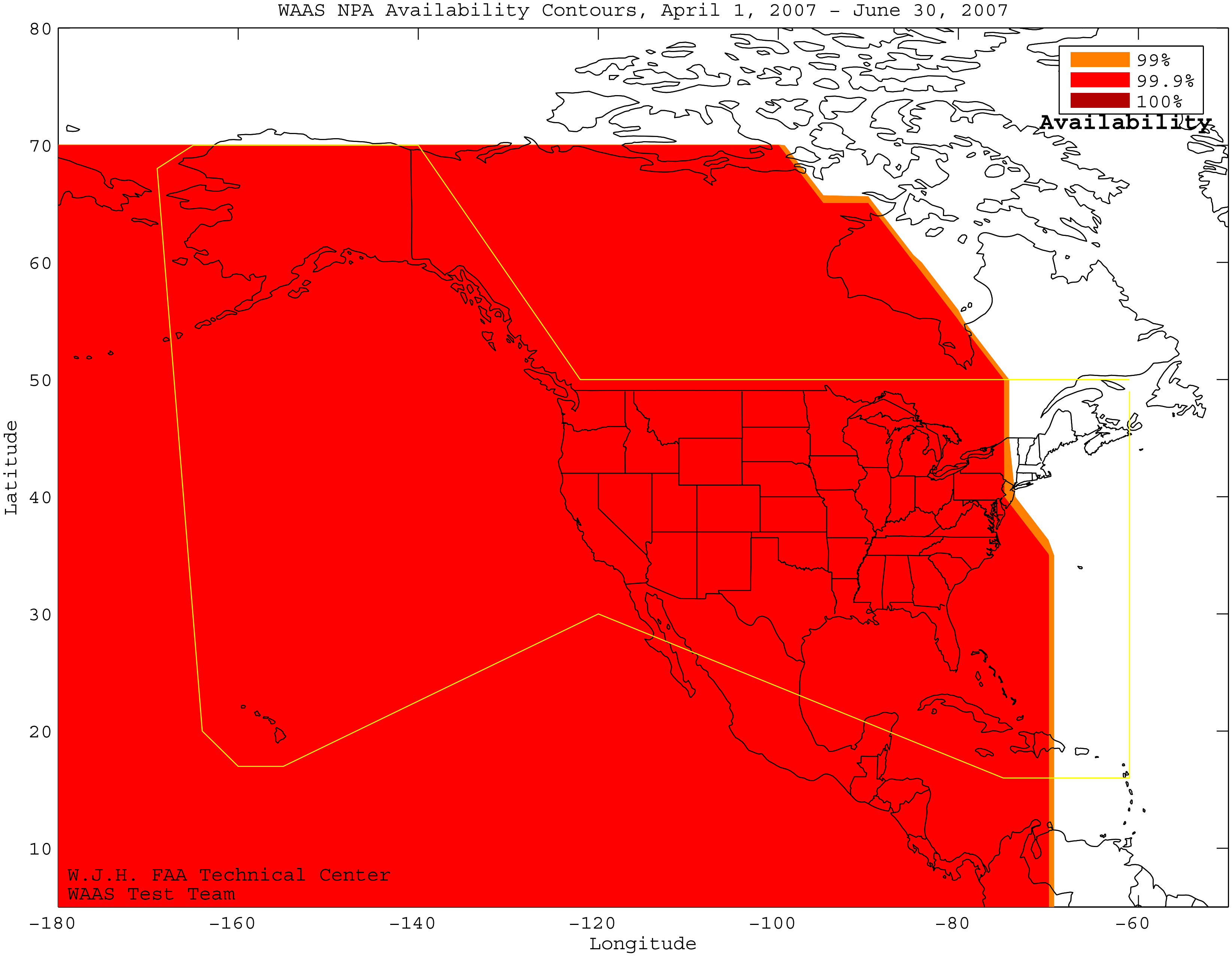
Figure 4-15 WAAS NPA Coverage - June



WAAS Coverage at 99% Availability = 100%
WAAS Coverage at 99.9% Availability = 94.85%
WAAS Coverage at 100% Availability = 0%

SL = NPA

Figure 4-16 WAAS NPA Coverage for the Quarter



WAAS Coverage at 99% Availability = 94.12%
WAAS Coverage at 99.9% Availability = 94.12%
WAAS Coverage at 100% Availability = 0%

SL = NPA

Figure 4-17 Daily LNAV/VNAV and LPV Coverage

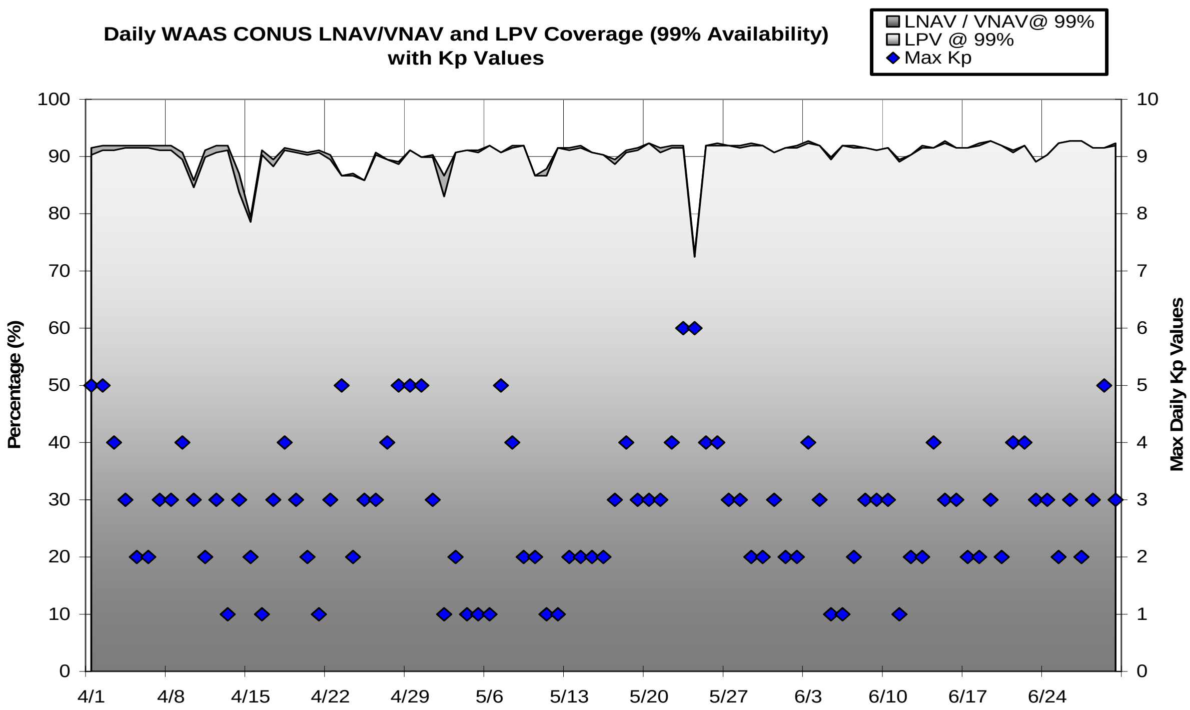


Figure 4-18 Daily NPA Coverage

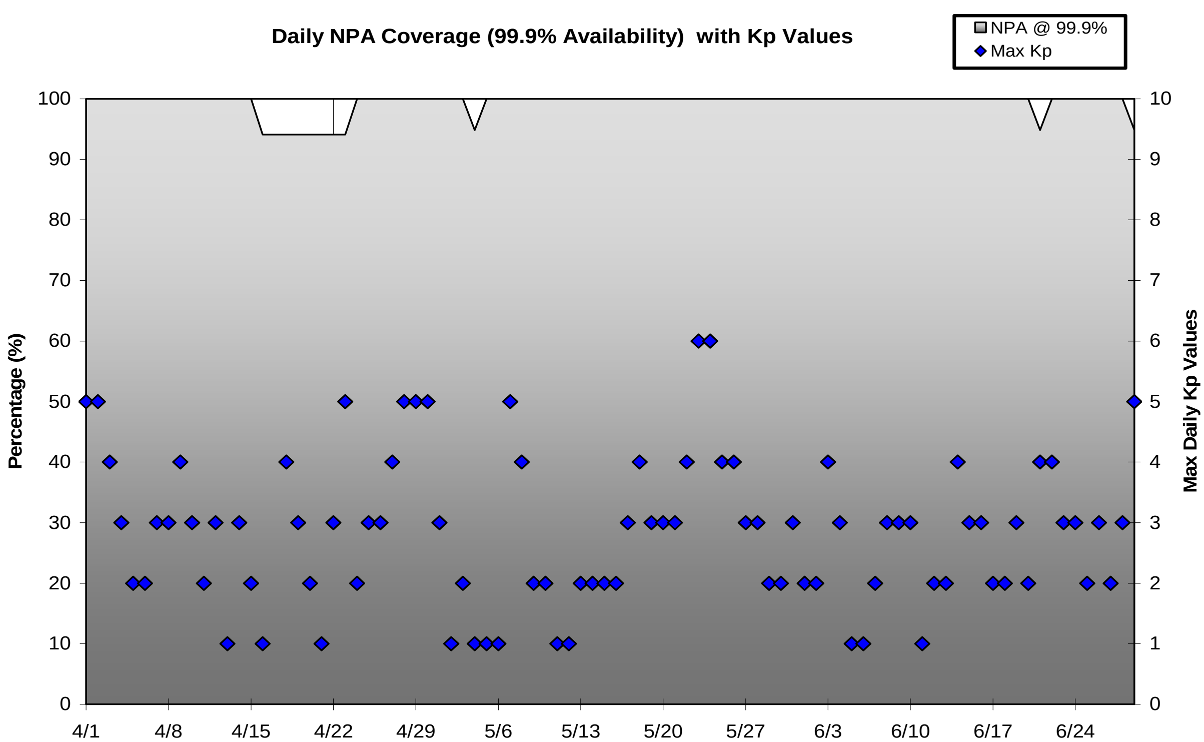
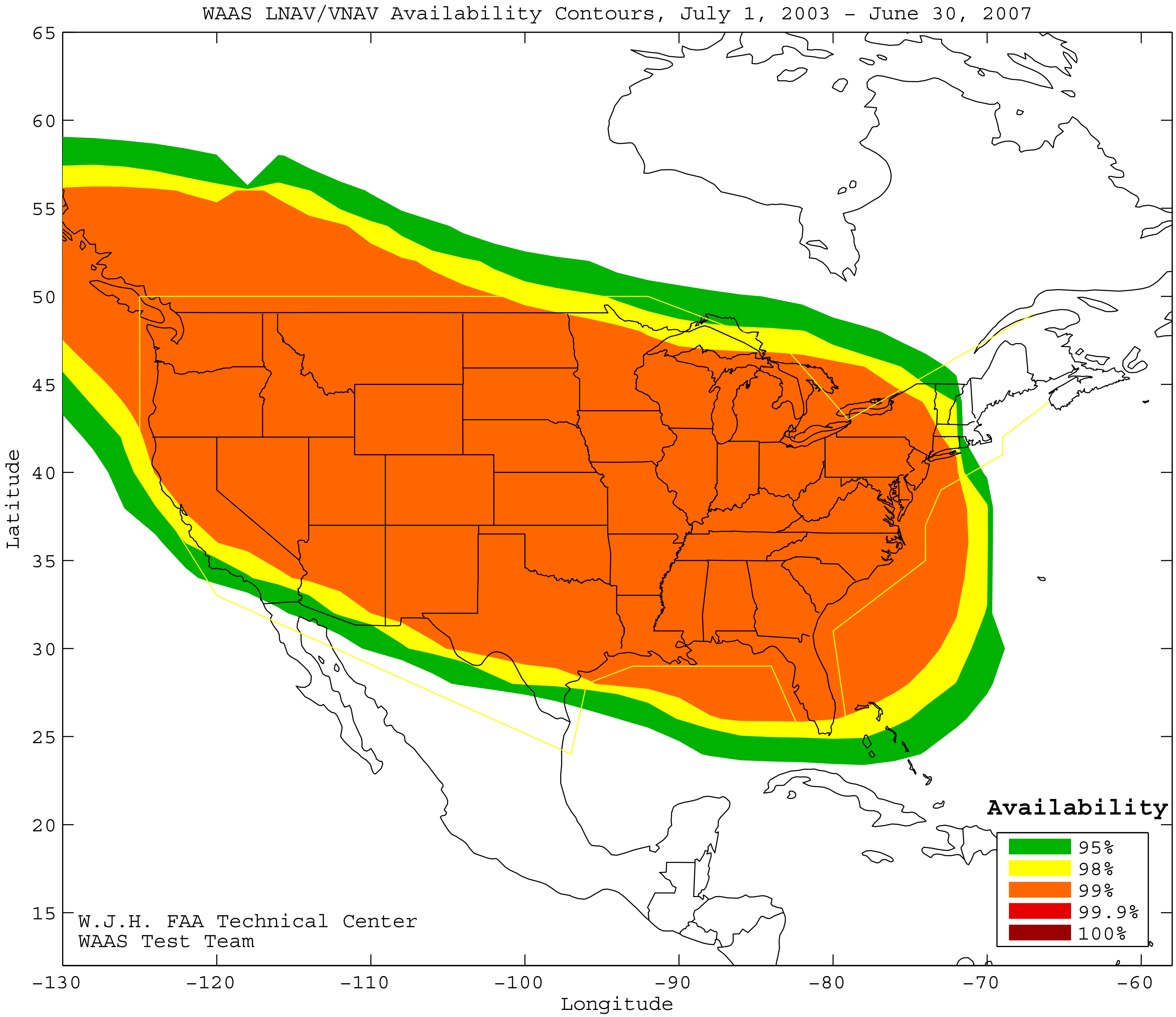


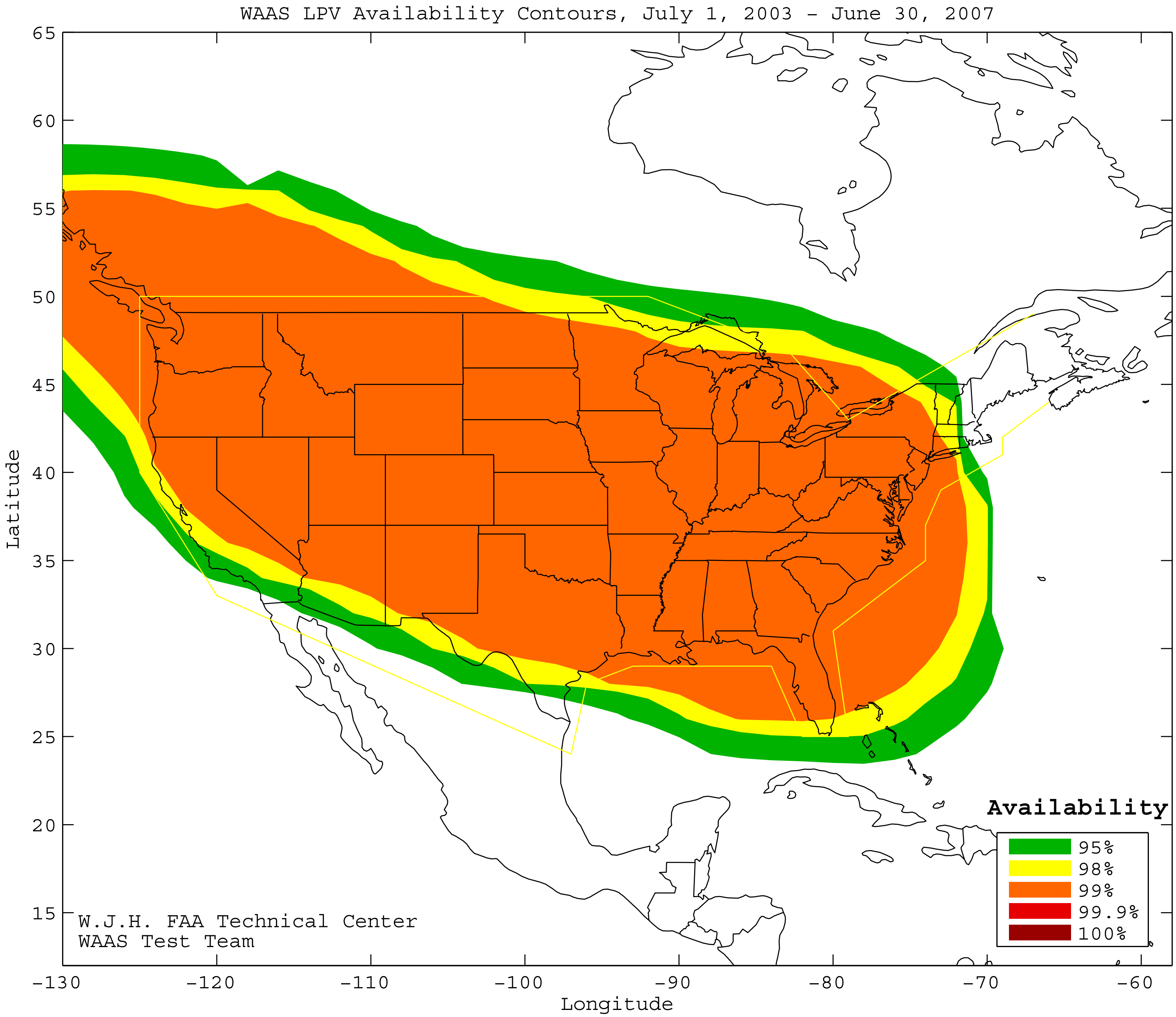
Figure 4-19 WAAS LNAV/VNAV CONUS Coverage Since Commissioning



CONUS Coverage at 95% Availability = 94.74%
CONUS Coverage at 99% Availability = 86.23%
CONUS Coverage at 100% Availability = 0%

SL = LNAV/VNAV

Figure 4-20 WAAS LPV CONUS Coverage Since Commissioning



CONUS Coverage at 95% Availability = 94.33%
CONUS Coverage at 99% Availability = 84.62%
CONUS Coverage at 100% Availability = 0%

SL = LPV

Figure 4-21 WAAS NPA CONUS Coverage Since Commissioning

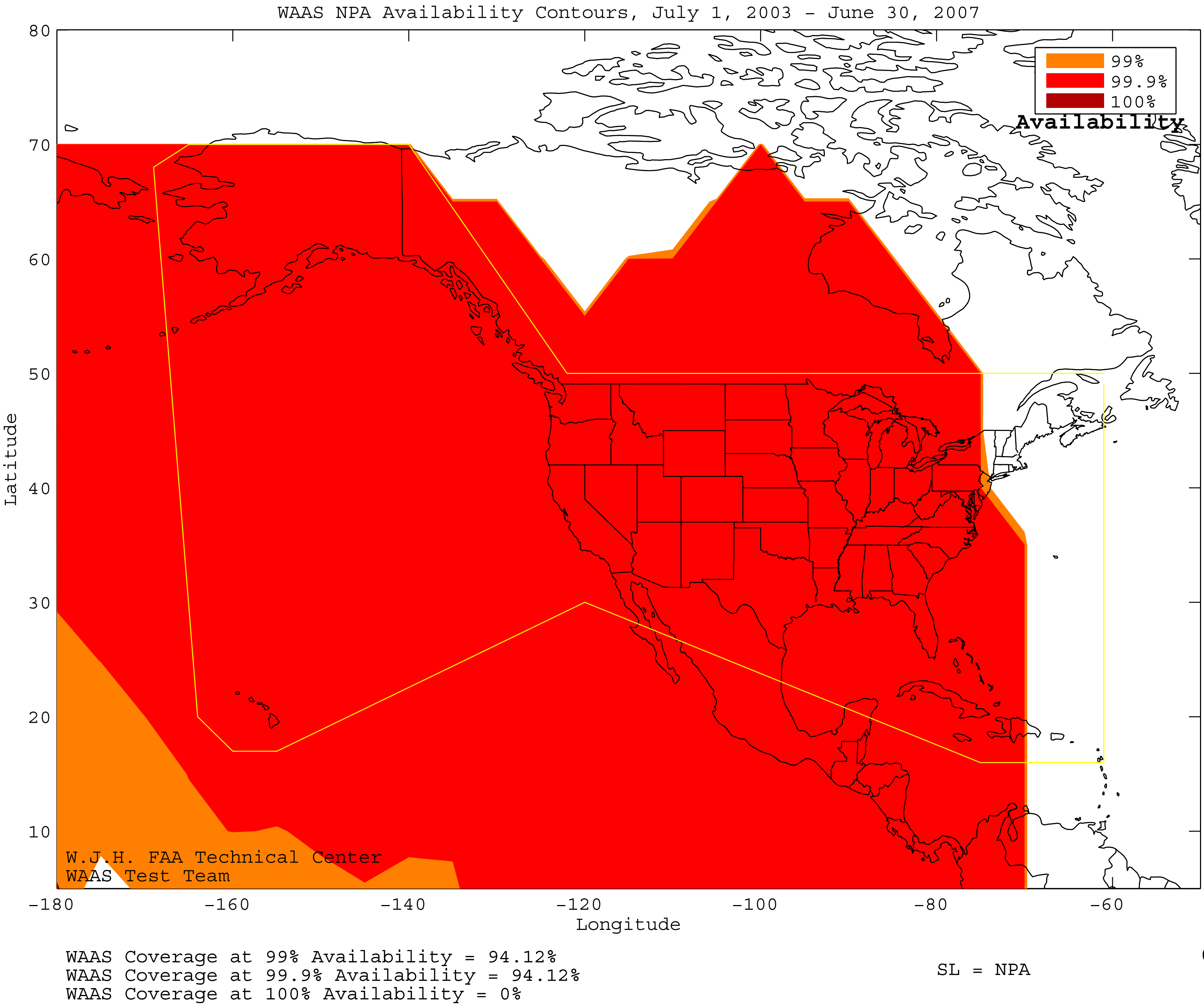
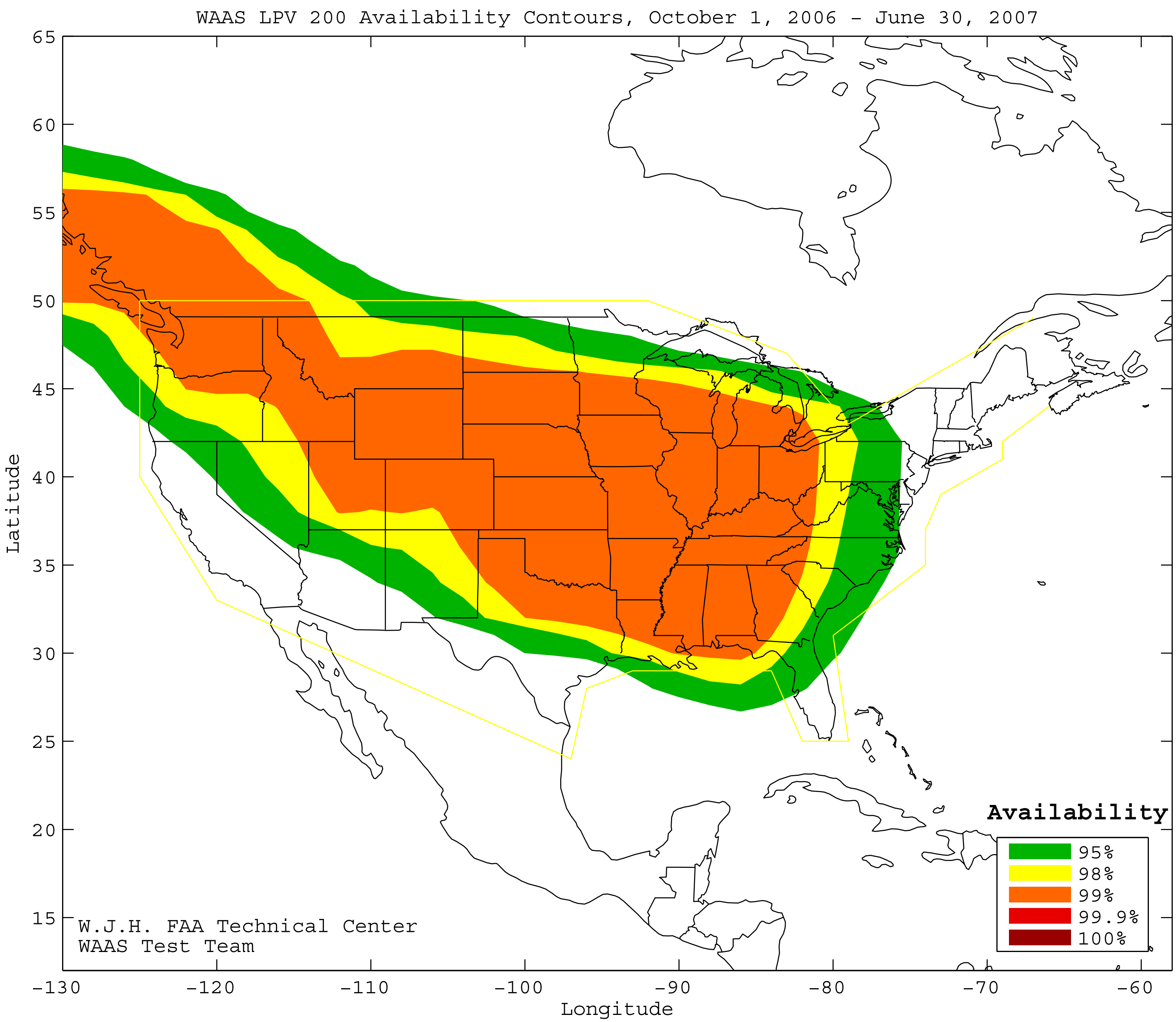


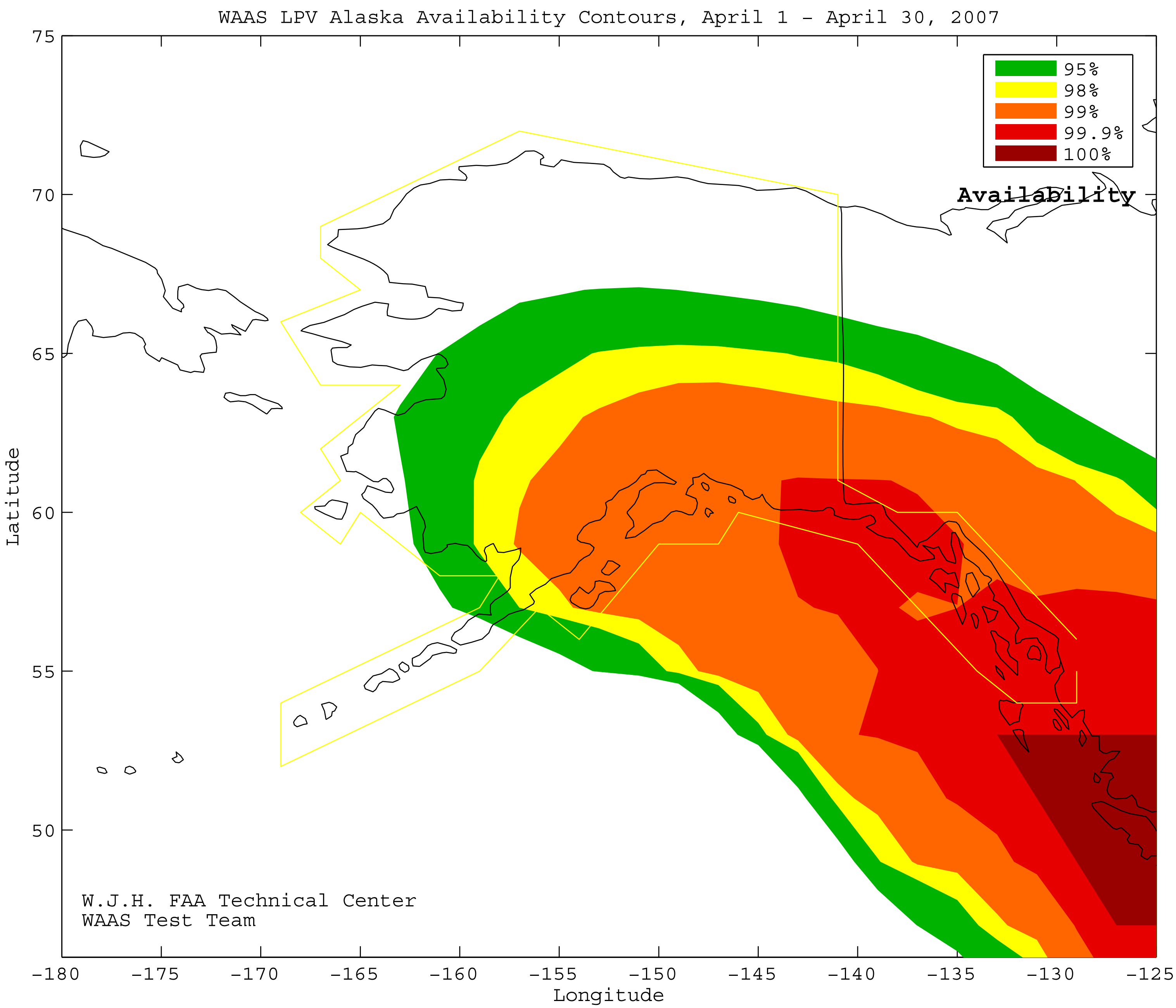
Figure 4-22 WAAS LPV 200 CONUS Coverage Since Commissioning



CONUS Coverage at 95% Availability = 76.52%
CONUS Coverage at 99% Availability = 46.96%
CONUS Coverage at 100% Availability = 0%

SL = LPV 200

Figure 4-23 LPV Alaska Coverage - April



Alaska Coverage at 95% Availability = 57.61%
Alaska Coverage at 99% Availability = 31.52%
Alaska Coverage at 100% Availability = 0%

SL = LPV

Figure 4-24 LPV Alaska Coverage - May

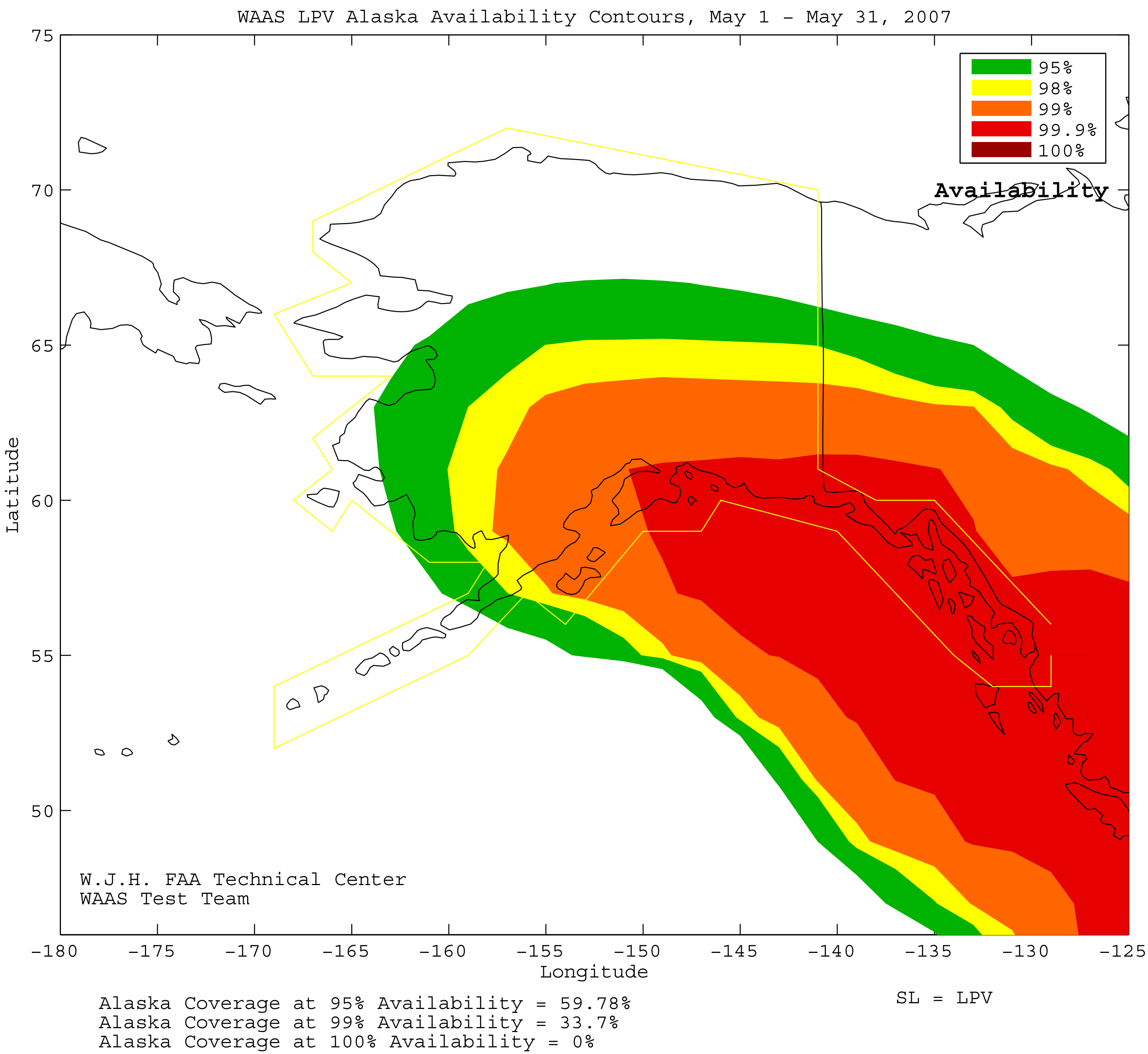
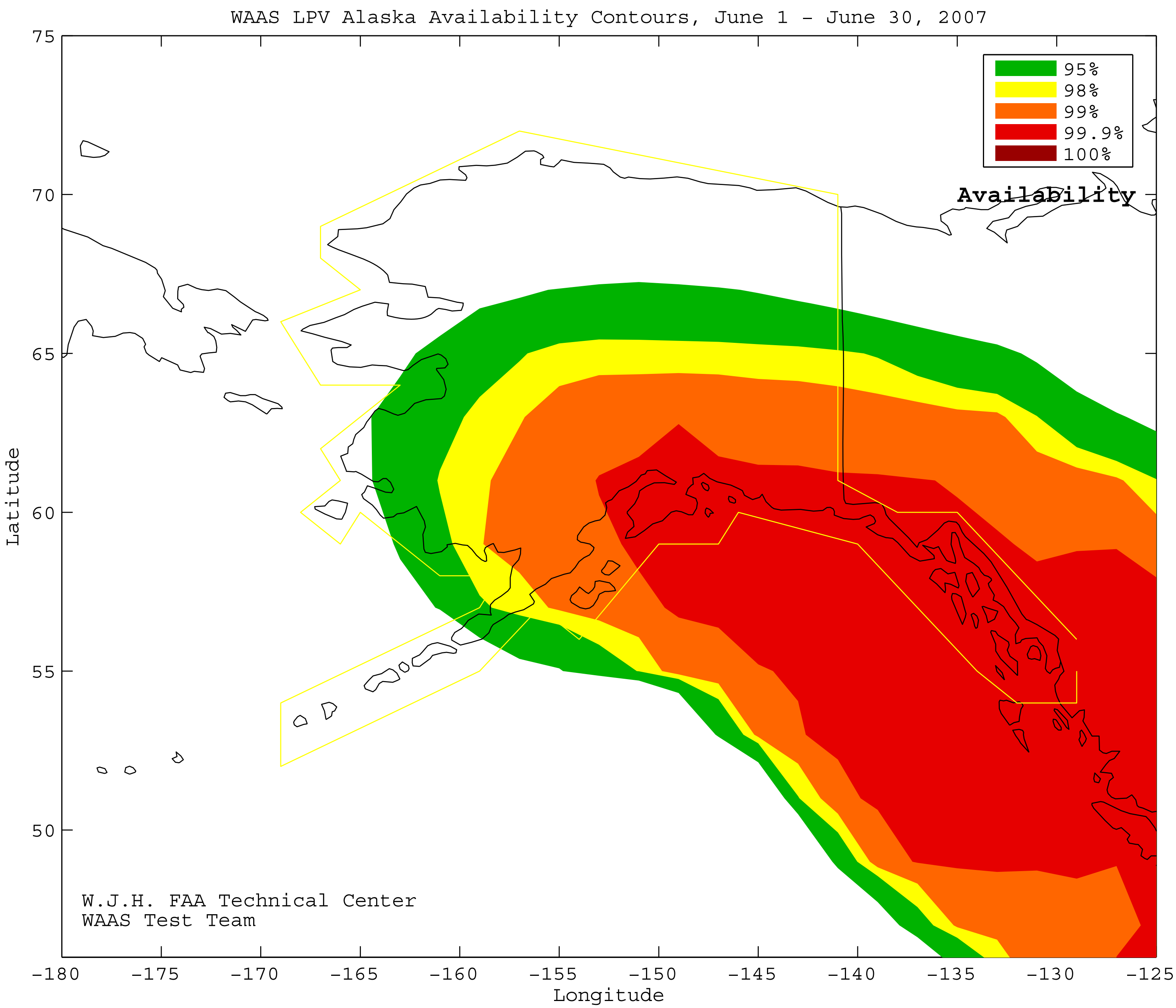
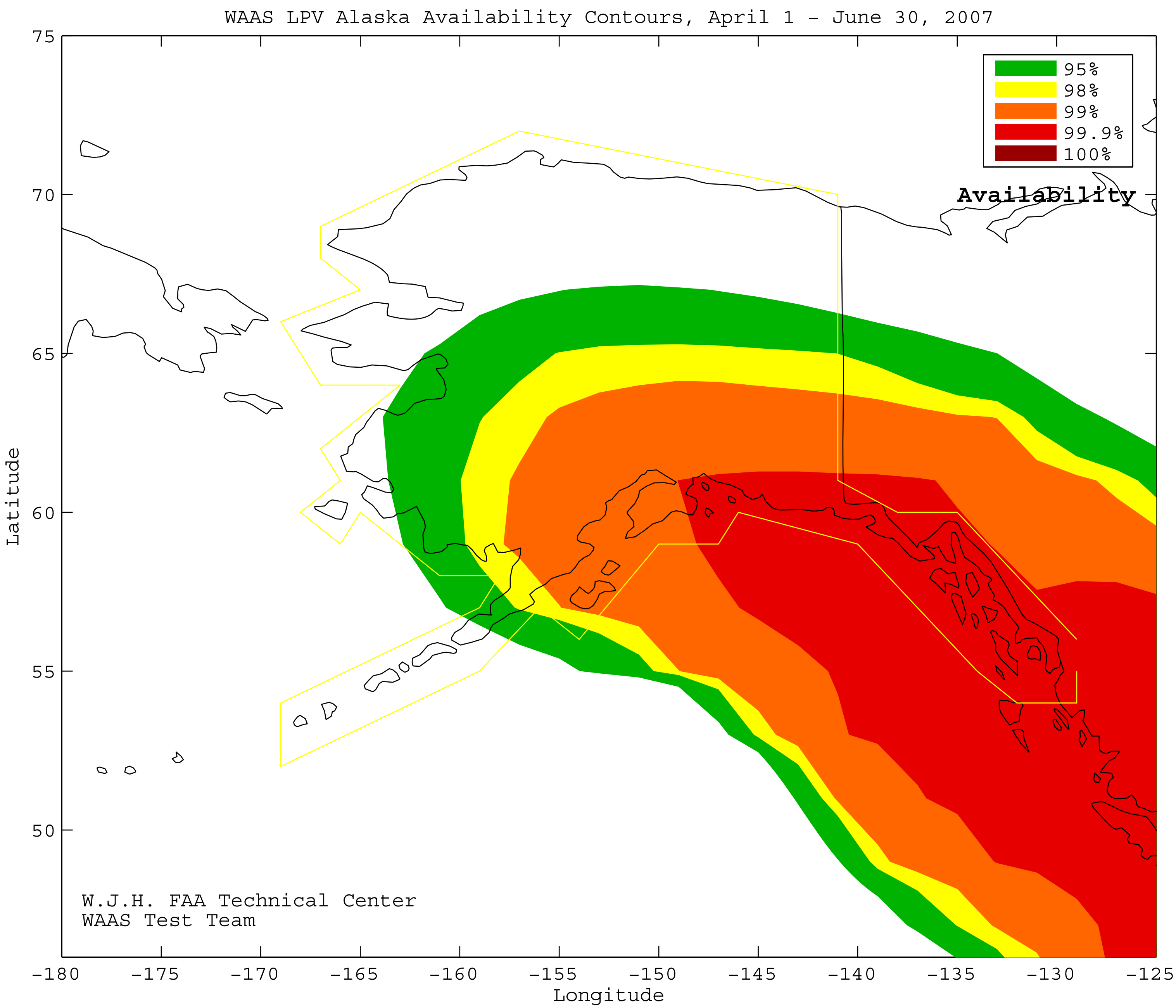


Figure 4-25 LPV Alaska Coverage - June



Alaska Coverage at 95% Availability = 63.04%
Alaska Coverage at 99% Availability = 34.78%
Alaska Coverage at 100% Availability = 0%

Figure 4-26 LPV Alaska Coverage for the Quarter



Alaska Coverage at 95% Availability = 59.78%
Alaska Coverage at 99% Availability = 33.7%
Alaska Coverage at 100% Availability = 0%

SL = LPV

Figure 4-27 Daily LPV Alaska Coverage

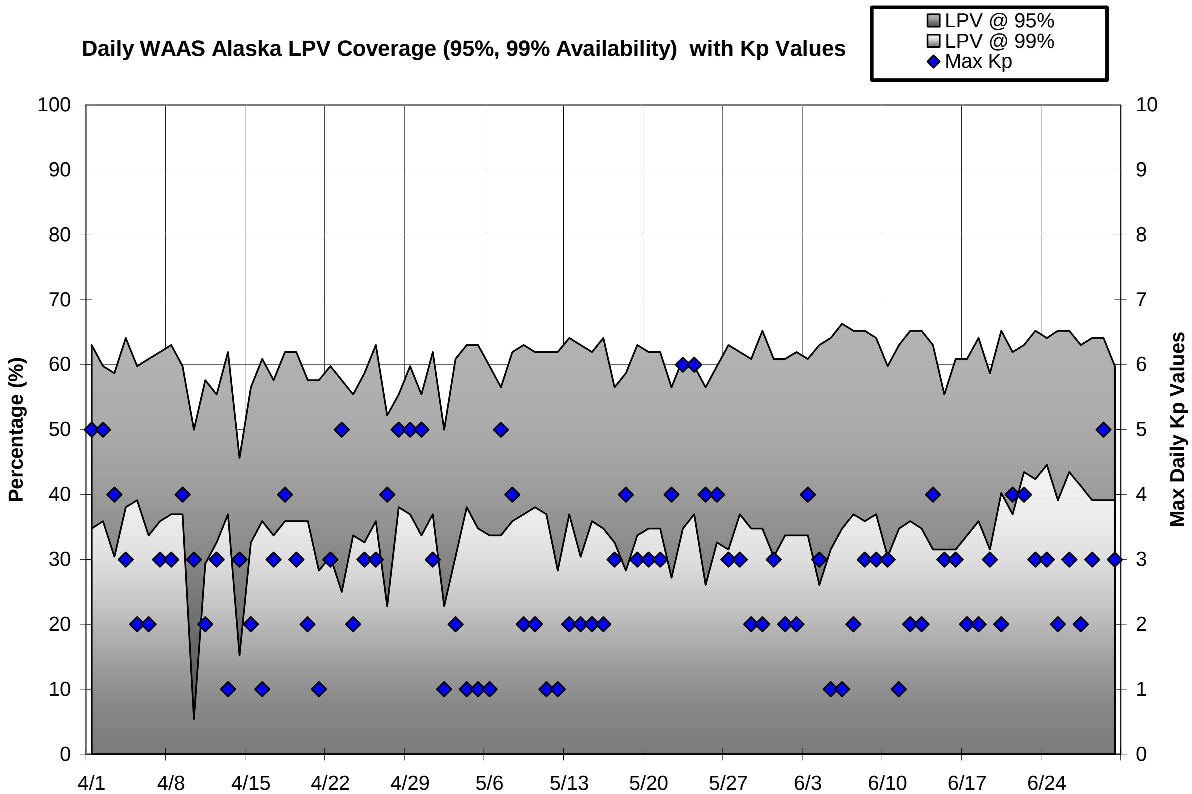
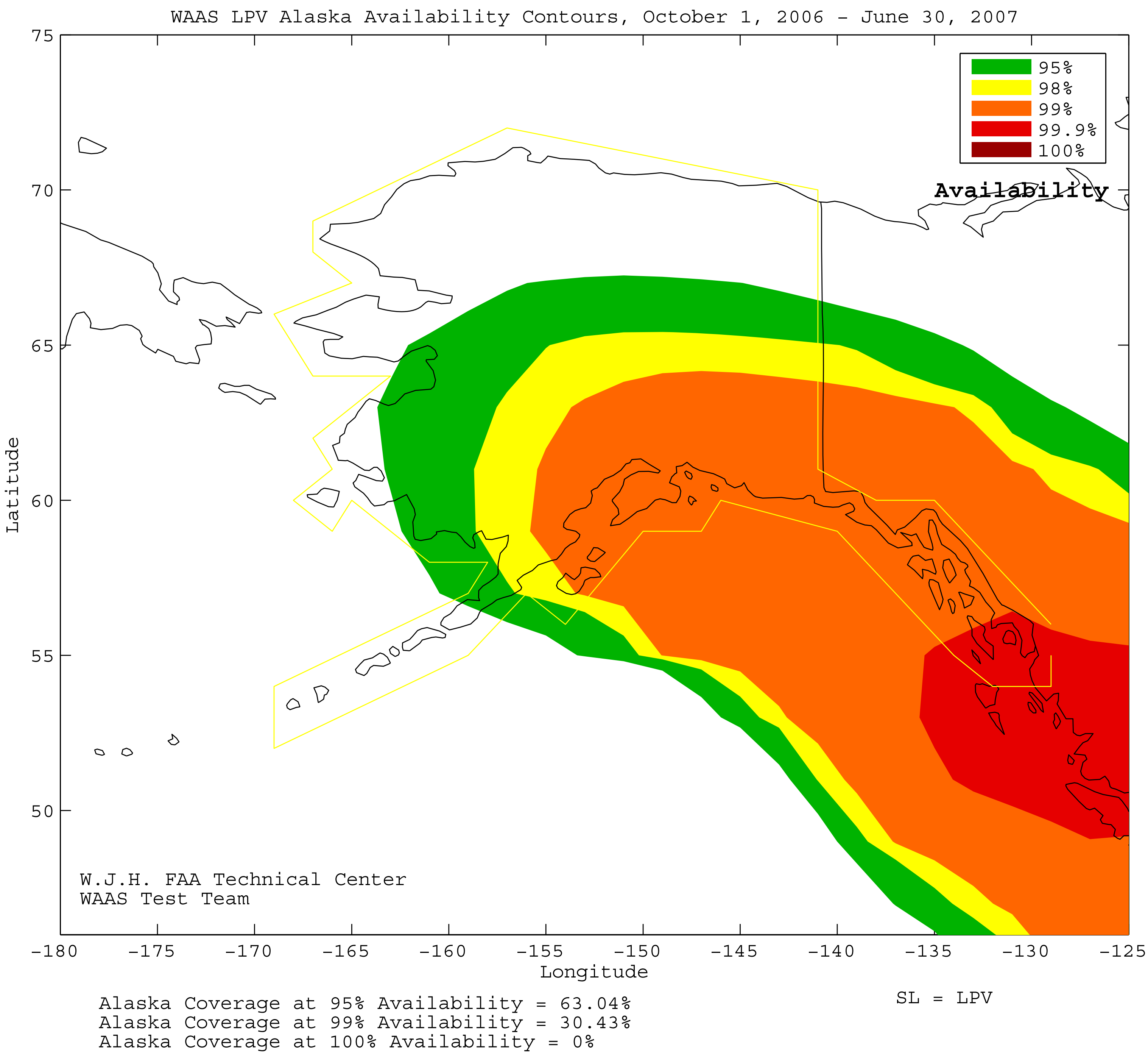


Figure 4-28 LPV Alaska Coverage Since Added to WAAS (Oct 2006)



5.0 INTEGRITY

5.1 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 5.1) 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 5-1 Safety Margin Index and HMI Statistics

Location	Safety Index		Number of HMIs
	Horizontal	Vertical	
Atlantic City	7.50	5.92	0
Greenwood	7.50	7.61	0
Albuquerque	12.00	8.88	0
Anchorage	8.57	7.61	0
Atlanta	10.00	7.61	0
Barrow	2.14	5.33	0
Bethel	12.00	8.88	0
Billings	5.45	8.88	0
Boston	12.00	8.88	0
Chicago	8.57	8.88	0
Cleveland	5.45	4.10	0
Cold Bay	6.00	5.33	0
Dallas	10.00	5.33	0
Denver	10.00	8.88	0
Fairbanks	2.00	1.78	0
Houston	10.00	7.61	0
Jacksonville	10.00	6.66	0
Juneau	12.00	5.92	0
Kansas City	8.57	8.88	0
Kotzebue	1.82	1.07	0
Los Angeles	10.00	8.88	0
Memphis	8.57	8.88	0
Miami	7.50	5.33	0
Minneapolis	6.00	6.66	0
New York	12.00	8.88	0
Oakland	10.00	10.66	0
Salt Lake City	10.00	7.61	0
Seattle	6.67	6.66	0
Washington DC	12.00	8.88	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 lowest safety margin index is 1.07 at Kotzebue. High error caused by ionopsheric scinitilation was observed at Kotzebue but did not exceed protection limit. Table 5.1 also 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. Since WAAS was made available to the public in August 2000 there has not been an HMI event. Note that the FAA commissioned WAAS for safety of life services in July 2003.

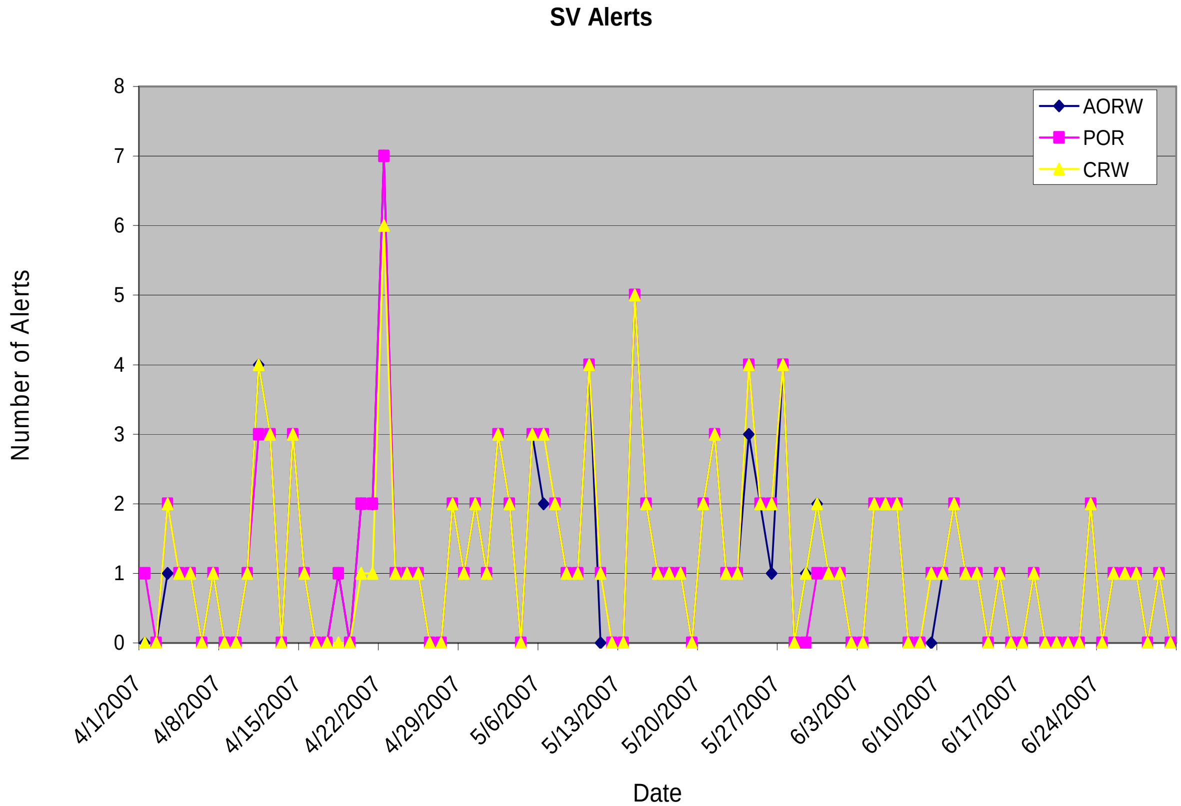
5.2 Broadcast Alerts

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. An increase in UDRE'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 a loss of continuity. Table 5.2 shows the total number of alerts and the average number of alerts per day. Figure 5.1 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.

Table 5-2 WAAS SV Alert

	Number of Alerts			Average Alerts Per Day		
Message Type	**AORW**	**POR**	**CRW**	**AORW**	**POR**	**CRW**
2	17	17	13	0.1868	0.1868	0.1428
3	57	57	57	0.6263	0.6263	0.6263
4	32	36	38	0.3516	0.3956	0.4175
5	0	0	0	0	0	0
6	0	0	0	0	0	0
24	0	0	0	0	0	0
26	0	0	0	0	0	0
Total Alerts	106	110	108	1.1648	1.2087	1.1868

Figure 5-1 SV Daily Alert Trends



5.3 Availability of WAAS Messages (AOR-W, POR and CRW)

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 5.3 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 5.4 to 5.8 show fast correction, long correction, ephemeris covariance, ionosphere correction, and ionospheric mask message rates statistics broadcasted on AORW. Table 5.9 to 5.13 show message rates statistics broadcasted on POR. Table 5.14 to 5.18 show messages rates statistics broadcasted on CRW.

Table 5-3 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 5-4 WAAS Fast Correction and Degradation Message Rates – AORW

Message Type	On Time	Late	Max Late Length (seconds)
1	98119	4	139
2	1310151	109	30
3	1310330	73	25
4	1310256	81	28
7	90415	10	178
9	92123	2	177
10	90429	4	128
17	30617	2	448

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

SV	On Time	Late	Max Late Length (seconds)
1	46545	1	176
2	47461	2	187
3	48376	0	0
4	47830	2	175
5	48472	0	0
6	47708	0	0
7	48380	5	180
8	46255	1	187
9	47708	0	0
10	48010	0	0
11	49154	1	173
12	48786	3	247
13	47543	5	180
14	47042	0	0
16	48756	1	176
17	47763	1	170
18	46371	0	0
19	48595	0	0
20	48440	0	0
21	44016	0	0
22	45396	2	176
23	47154	4	187
24	45584	1	167
25	43906	0	0
26	46826	1	173
27	44745	2	178
28	45975	1	166
29	47904	1	157
30	48587	1	175
31	48620	2	170

Table 5-6 WAAS Ephemeris Covariance Message Rates (Type 28) – AORW

SV	On Time	Late	Max Late Length (seconds)
1	43463	1	193
2	44316	0	0
3	45311	5	192
4	44709	1	192
5	45295	1	170
6	44572	1	173
7	45258	1	180
8	43275	2	192
9	44703	0	0
10	44833	2	192
11	45977	2	175
12	45538	0	0
13	44276	3	183
14	43670	0	0
16	44953	3	194
17	44146	1	149
18	43374	1	192
19	44441	4	192
20	43838	4	192
21	39959	0	0
22	40890	0	0
23	42549	1	192
24	41072	1	192
25	39499	0	0
26	42023	0	0
27	40232	0	0
28	41461	0	0
29	43122	0	0
30	43881	0	0
31	43863	0	0
122	82909	6	193
134	81216	2	128

Table 5-7 WAAS Ionospheric Correction Message Rates (Type 26) - AORW

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27306	7	496
1	0	27337	8	369
1	1	27303	12	576
1	2	27284	13	576
1	3	27310	12	416
1	4	27299	12	399
2	0	27294	10	400
2	1	27291	16	576
2	2	27313	10	576
2	3	27313	14	514
2	4	27293	17	578
2	5	27313	13	576
3	0	27309	10	486

Table 5-8 WAAS Ionospheric Mask Message Rates (Type 18) - AORW

Band	On Time	Late	Max Late Length (seconds)
0	72714	0	0
1	72742	0	0
2	72672	0	0
3	72763	0	0

Table 5-9 WAAS Fast Correction and Degradation Message Rates - POR

Message Type	On Time	Late	Max Late Length (seconds)
1	95385	4	153
2	1308979	88	33
3	1309206	71	48
4	1309064	75	28
7	87844	5	130
9	92040	1	174
10	87873	7	153
17	30325	1	325

Table 5-10 WAAS Long Correction Message Rates (Type 24 and 25) - POR

SV	On Time	Late	Max Late Length (seconds)
1	46454	0	0
2	47473	1	176
3	48291	0	0
4	47830	0	0
5	48393	0	0
6	47721	0	0
7	48384	0	0
8	46266	0	0
9	47627	1	166
10	48011	3	170
11	49072	0	0
12	48706	1	172
13	47554	0	0
14	46957	0	0
16	48753	0	0
17	47732	0	0
18	46290	0	0
19	48510	1	166
20	48408	0	0
21	43931	0	0
22	45316	0	0
23	47178	2	166
24	45552	0	0
25	43899	2	170
26	46806	1	166
27	44751	1	172
28	45884	0	0
29	47902	0	0
30	48510	1	169
31	48544	1	182

Table 5-11 WAAS Ephemeris Covariance Message Rates (Type 28) – POR

SV	On Time	Late	Max Late Length (seconds)
1	43374	2	185
2	44325	0	0
3	45242	0	0
4	44718	0	0
5	45211	0	0
6	44579	2	183
7	45264	0	0
8	43282	1	176
9	44622	0	0
10	44844	2	167
11	45892	0	0
12	45459	0	0
13	44283	2	187
14	43588	0	0
16	44962	0	0
17	44116	0	0
18	43295	0	0
19	44382	0	0
20	43802	1	149
21	39888	0	0
22	40812	0	0
23	42555	0	0
24	41045	1	193
25	39497	0	0
26	42009	1	192
27	40238	0	0
28	41372	1	166
29	43129	0	0
30	43814	0	0
31	43820	0	0
122	82833	4	194
134	81222	2	174

Table 5-12 WAAS Ionospheric Correction Message Rates (Type 26) – POR

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27288	5	424
0	1	27293	7	414
0	2	27281	14	418
1	0	27280	15	576
1	1	27282	6	418
1	2	27314	11	560
1	3	27298	9	552
1	4	27271	9	540
2	0	27269	6	465
2	1	27287	11	500
2	2	27275	10	538
2	3	27303	11	455

Table 5-13 WAAS Ionospheric Mask Message Rates (Type 18) - POR

Band	On Time	Late	Max Late Length (seconds)
0	70044	0	0
1	70044	0	0
2	70015	0	0

Table 5-14 WAAS Fast Correction and Degradation Message Rates – CRW

Message Type	On Time	Late	Max Late Length (seconds)
1	98609	7	157
2	1295873	55	30
3	1295850	62	26
4	1295890	55	26
7	90894	8	140
9	91117	0	0
10	90958	10	176
17	30407	4	404

Table 5-15 WAAS Long Correction Message Rates (Type 24 and 25) – CRW

SV	On Time	Late	Max Late Length (seconds)
1	46179	1	167
2	46574	0	0
3	43297	0	0
4	47292	0	0
5	45787	0	0
6	46688	0	0
7	47264	1	182
8	46167	1	182
9	47279	0	0
10	47186	0	0
11	48307	0	0
12	24025	0	0
13	46835	1	164
14	46975	0	0
16	47479	1	167
17	46916	0	0
18	45186	0	0
19	47689	0	0
20	48028	0	0
21	43346	0	0
22	44957	0	0
23	46362	0	0
24	45407	0	0
25	47361	0	0
26	46052	0	0
27	44365	0	0
28	45140	0	0

29	41150	1	164
30	48275	1	172
31	47942	1	182

Table 5-16 WAAS Ephemeris Covariance Message Rates (Type 28) – CRW

SV	On Time	Late	Max Late Length (seconds)
1	46179	1	167
2	46574	0	0
3	43297	0	0
4	47292	0	0
5	45787	0	0
6	46688	0	0
7	47264	1	182
8	46167	1	182
9	47279	0	0
10	47186	0	0
11	48307	0	0
12	24025	0	0
13	46835	1	164
14	46975	0	0
16	47479	1	167
17	46916	0	0
18	45186	0	0
19	47689	0	0
20	48028	0	0
21	43346	0	0
22	44957	0	0
23	46362	0	0
24	45407	0	0
25	47361	0	0
26	46052	0	0
27	44365	0	0
28	45140	0	0
29	41150	1	164
30	48275	1	172
31	47942	1	182

Table 5-17 WAAS Ionospheric Correction Message Rates (Type 26) – CRW

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27010	6	504
0	1	26991	16	488
0	2	27007	9	311
1	0	27004	12	331
1	1	26996	11	550
1	2	26992	14	576
1	3	27006	10	319
1	4	26996	12	576
2	0	27005	11	576

2	1	27005	11	533
2	2	27000	12	409
2	3	26985	12	410
2	4	27013	16	392
2	5	26998	10	380
3	0	26987	17	398

Table 5-18 WAAS Ionospheric Mask Message Rates (Type 18) - CRW

Band	On Time	Late	Max Late Length (seconds)
0	72945	0	0
1	72923	0	0
2	72930	0	0
3	72963	0	0

6.0 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 twelve WAAS receivers during the quarter. Table 6.1 and 6.2 show the range error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Figures 6.1 and 6.2 show the range error for each SV as measured by the WAAS receivers at the Washington DC reference station.

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 vertical 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 6.3 and 6.4 show the ionospheric error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Figures 6.3 and 6.4 show the ionospheric error for each SV as measured by the WAAS receiver at the Washington DC reference station.

During this evaluated period, the receiver at Salt Lake City could not be used to conduct range and iono analysis due to hardware bias fluctuation.

Table 6-1 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	0.533	100.00	1.634	100.00	1.196	100.00	1.017	100.00	1.241	100.00	1.202	100.00
2	1.067	100.00	1.495	100.00	1.429	100.00	1.530	100.00	1.698	100.00	1.546	100.00
3	0.616	100.00	1.442	100.00	1.439	100.00	1.452	100.00	1.316	100.00	1.335	100.00
4	1.120	100.00	2.077	100.00	1.594	100.00	1.398	100.00	1.770	100.00	1.574	100.00
5	0.473	100.00	1.257	100.00	1.206	100.00	0.902	100.00	1.107	100.00	1.271	100.00
6	1.040	100.00	1.855	100.00	2.279	100.00	1.534	100.00	1.369	100.00	1.963	100.00
7	0.591	100.00	1.446	100.00	1.090	100.00	1.352	100.00	1.086	100.00	1.572	100.00
8	0.700	100.00	1.323	100.00	1.302	100.00	1.412	100.00	1.070	100.00	1.264	100.00
9	0.648	100.00	1.731	100.00	1.559	100.00	1.185	100.00	1.349	100.00	1.091	100.00
10	0.363	100.00	1.266	100.00	0.874	100.00	0.863	100.00	1.158	100.00	2.193	100.00
11	0.518	100.00	1.134	100.00	1.086	100.00	1.600	100.00	1.607	100.00	1.183	100.00
12	0.578	100.00	1.846	100.00	1.436	100.00	1.000	100.00	1.120	100.00	1.623	100.00
13	0.752	100.00	1.531	100.00	1.298	100.00	1.082	100.00	1.676	100.00	1.382	100.00
14	0.773	100.00	1.062	100.00	1.346	100.00	0.992	100.00	1.292	100.00	0.845	100.00
15	-	-	-	-	-	-	-	-	-	-	-	
16	0.410	100.00	1.181	100.00	0.902	100.00	1.094	100.00	1.231	100.00	1.193	100.00
17	0.543	100.00	1.702	100.00	1.645	100.00	1.203	100.00	1.331	100.00	1.113	100.00
18	0.819	100.00	1.107	100.00	1.204	100.00	1.659	100.00	1.193	100.00	1.283	100.00
19	1.404	100.00	1.984	100.00	2.234	100.00	2.162	100.00	1.986	100.00	2.782	100.00
20	0.512	100.00	1.531	100.00	1.132	100.00	1.040	100.00	1.299	100.00	1.322	100.00
21	0.899	100.00	1.144	100.00	1.156	100.00	1.613	100.00	1.427	100.00	1.262	100.00
22	0.915	100.00	0.921	100.00	1.409	100.00	1.440	100.00	1.099	100.00	1.198	100.00
23	1.697	100.00	1.556	100.00	1.834	100.00	1.972	100.00	1.882	100.00	2.163	100.00
24	1.065	100.00	1.930	100.00	1.816	100.00	1.883	100.00	1.467	100.00	1.851	100.00
25	0.688	100.00	1.500	100.00	1.527	100.00	1.230	100.00	1.194	100.00	1.234	100.00
26	0.872	100.00	1.957	100.00	1.666	100.00	1.610	100.00	1.456	100.00	1.634	100.00
27	0.653	100.00	1.436	100.00	1.242	100.00	1.288	100.00	1.045	100.00	1.377	100.00
28	0.662	100.00	0.959	100.00	0.884	100.00	1.155	100.00	1.130	100.00	0.947	100.00
29	0.715	100.00	1.963	100.00	1.602	100.00	1.444	100.00	1.647	100.00	1.710	100.00
30	0.841	100.00	2.161	100.00	1.569	100.00	1.507	100.00	1.948	100.00	1.665	100.00
31	0.536	100.00	1.408	100.00	1.072	100.00	1.052	100.00	1.479	100.00	2.125	100.00
122	-	-	-	-	-	-	-	-	-	-	-	-
134	-	-	-	-	-	-	-	-	-	-	-	-

Table 6-2 Range Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		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
1	1.120	100.00	1.259	100.00	1.231	100.00	0.978	100.00	1.607	100.00
2	2.193	100.00	2.187	100.00	1.643	100.00	1.394	100.00	1.082	100.00
3	1.227	100.00	1.272	100.00	1.517	100.00	1.109	100.00	1.214	100.00
4	1.420	100.00	2.267	100.00	1.828	100.00	1.727	100.00	1.659	100.00
5	1.284	100.00	1.184	100.00	1.441	100.00	0.987	100.00	1.289	100.00
6	1.072	100.00	1.890	100.00	2.126	100.00	1.494	100.00	1.484	100.00
7	1.170	100.00	1.638	100.00	1.470	100.00	1.029	100.00	1.354	100.00
8	1.075	100.00	1.238	100.00	1.567	100.00	1.057	100.00	1.292	100.00
9	1.465	100.00	1.368	100.00	1.718	100.00	1.378	100.00	1.842	100.00
10	1.657	100.00	1.246	100.00	0.903	100.00	0.864	100.00	0.778	100.00
11	1.585	100.00	2.963	100.00	1.237	100.00	1.043	100.00	0.969	100.00
12	1.566	100.00	1.631	100.00	1.324	100.00	1.496	100.00	1.503	100.00
13	1.150	100.00	1.705	100.00	1.478	100.00	1.398	100.00	1.510	100.00
14	1.645	100.00	1.888	100.00	1.600	100.00	0.836	100.00	0.815	100.00
15	-	-	-	-	-	-	-	-	-	-
16	1.690	100.00	1.879	100.00	1.094	100.00	1.047	100.00	0.769	100.00
17	1.282	100.00	1.392	100.00	1.194	100.00	1.080	100.00	1.378	100.00
18	1.785	100.00	1.693	100.00	1.418	100.00	1.245	100.00	1.008	100.00
19	3.156	100.00	2.628	100.00	2.165	100.00	2.413	100.00	1.846	100.00
20	1.766	100.00	1.490	100.00	1.198	100.00	1.021	100.00	0.872	100.00
21	2.130	100.00	2.008	100.00	1.237	100.00	1.203	100.00	0.961	100.00
22	2.184	100.00	2.201	100.00	1.371	100.00	1.306	100.00	0.852	100.00
23	2.271	100.00	2.614	100.00	2.374	100.00	1.698	100.00	1.312	100.00
24	1.104	100.00	1.590	100.00	2.078	100.00	1.452	100.00	1.865	100.00
25	1.130	100.00	1.960	100.00	1.392	100.00	1.021	100.00	1.546	100.00
26	1.166	100.00	1.702	100.00	1.980	100.00	1.737	100.00	1.724	100.00
27	1.104	100.00	1.141	100.00	1.526	100.00	1.029	100.00	1.410	100.00
28	1.694	100.00	2.099	100.00	1.097	100.00	1.012	100.00	0.778	100.00
29	1.260	100.00	1.552	100.00	1.745	100.00	1.341	100.00	1.269	100.00
30	1.307	100.00	1.799	100.00	1.700	100.00	1.600	100.00	1.811	100.00
31	1.439	100.00	1.687	100.00	1.119	100.00	1.161	100.00	1.164	100.00
122	-	-	-	-	-	-	-	-	-	-
134	-	-	-	-	-	-	-	-	-	-

Table 6-3 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	0.840	100.00	1.013	100.00	0.621	100.00	0.559	100.00	0.545	100.00	0.487	100.00
2	0.955	100.00	1.045	100.00	0.993	100.00	1.123	100.00	0.920	100.00	1.016	100.00
3	0.571	100.00	0.696	100.00	0.526	100.00	0.585	100.00	0.656	100.00	0.573	100.00
4	1.218	100.00	1.514	100.00	1.061	100.00	1.060	100.00	1.455	100.00	1.077	100.00
5	0.507	100.00	0.649	100.00	0.569	100.00	0.293	100.00	0.495	100.00	0.343	100.00
6	1.093	100.00	1.126	100.00	0.957	100.00	0.777	100.00	0.791	100.00	0.890	100.00
7	0.749	100.00	0.856	100.00	0.478	100.00	0.613	100.00	0.433	100.00	0.557	100.00
8	0.709	100.00	0.864	100.00	0.559	100.00	0.611	100.00	0.593	100.00	0.590	100.00
9	0.755	100.00	0.938	100.00	0.627	100.00	0.481	100.00	0.553	100.00	0.503	100.00
10	0.451	100.00	0.687	100.00	0.291	100.00	0.480	100.00	0.565	100.00	1.064	100.00
11	0.457	100.00	0.639	100.00	0.377	100.00	0.677	100.00	0.864	100.00	0.608	100.00
12	0.759	100.00	0.998	100.00	0.611	100.00	0.422	100.00	0.507	100.00	0.765	100.00
13	0.907	100.00	0.955	100.00	0.576	100.00	0.461	100.00	0.852	100.00	0.557	100.00
14	0.770	100.00	0.542	100.00	0.481	100.00	0.375	100.00	0.647	100.00	0.400	100.00
15	-	-	-	-	-	-	-	-	-	-	-	-
16	0.380	100.00	0.581	100.00	0.309	100.00	0.508	100.00	0.665	100.00	0.448	100.00
17	1.748	100.00	1.171	100.00	0.912	100.00	0.663	100.00	0.815	100.00	0.598	100.00
18	0.530	100.00	0.825	100.00	0.729	100.00	0.852	100.00	0.646	100.00	0.785	100.00
19	1.367	100.00	1.313	100.00	1.415	100.00	1.512	100.00	1.433	100.00	1.763	100.00
20	0.354	100.00	0.698	100.00	0.610	100.00	0.503	100.00	0.562	100.00	0.530	100.00
21	0.612	100.00	0.852	100.00	0.752	100.00	0.951	100.00	0.851	100.00	0.792	100.00
22	0.424	100.00	0.691	100.00	0.962	100.00	0.859	100.00	0.643	100.00	0.787	100.00
23	0.851	100.00	1.208	100.00	1.166	100.00	1.377	100.00	1.318	100.00	1.475	100.00
24	1.066	100.00	1.330	100.00	0.880	100.00	1.044	100.00	0.924	100.00	0.889	100.00
25	1.110	100.00	1.070	100.00	0.708	100.00	0.552	100.00	0.675	100.00	0.574	100.00
26	0.949	100.00	1.182	100.00	0.645	100.00	0.745	100.00	0.845	100.00	0.788	100.00
27	0.607	100.00	1.024	100.00	0.602	100.00	0.601	100.00	0.635	100.00	0.662	100.00
28	0.525	100.00	0.571	100.00	0.430	100.00	0.538	100.00	0.556	100.00	0.442	100.00
29	0.905	100.00	1.011	100.00	0.680	100.00	0.606	100.00	0.839	100.00	0.724	100.00
30	0.965	100.00	1.103	100.00	0.789	100.00	0.675	100.00	0.808	100.00	0.664	100.00
31	1.758	100.00	0.920	100.00	0.527	100.00	0.683	100.00	0.941	100.00	0.951	100.00

Table 6-4 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		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
1	0.650	100.00	0.760	100.00	0.533	100.00	0.524	100.00	0.852	100.00
2	1.320	100.00	1.643	100.00	1.067	100.00	0.855	100.00	0.805	100.00
3	0.573	100.00	0.742	100.00	0.616	100.00	0.484	100.00	0.546	100.00
4	0.784	100.00	1.483	100.00	1.120	100.00	1.109	100.00	0.951	100.00
5	0.484	100.00	0.691	100.00	0.473	100.00	0.329	100.00	0.465	100.00
6	0.570	100.00	1.090	100.00	1.040	100.00	0.678	100.00	0.774	100.00
7	0.454	100.00	0.960	100.00	0.591	100.00	0.389	100.00	0.605	100.00
8	0.448	100.00	0.970	100.00	0.700	100.00	0.544	100.00	0.622	100.00
9	0.573	100.00	0.680	100.00	0.648	100.00	0.546	100.00	0.888	100.00
10	1.006	100.00	0.885	100.00	0.363	100.00	0.284	100.00	0.386	100.00
11	0.855	100.00	1.284	100.00	0.518	100.00	0.534	100.00	0.519	100.00
12	0.807	100.00	0.945	100.00	0.578	100.00	0.663	100.00	0.718	100.00
13	0.586	100.00	1.104	100.00	0.752	100.00	0.649	100.00	0.695	100.00
14	0.795	100.00	1.300	100.00	0.773	100.00	0.326	100.00	0.606	100.00
15	-	-	-	-	-	-	-	-	-	-
16	0.944	100.00	1.035	100.00	0.410	100.00	0.342	100.00	0.370	100.00
17	0.895	100.00	1.070	100.00	0.543	100.00	0.635	100.00	0.703	100.00
18	1.058	100.00	1.404	100.00	0.819	100.00	0.769	100.00	0.815	100.00
19	1.857	100.00	1.547	100.00	1.404	100.00	1.426	100.00	1.390	100.00
20	0.897	100.00	0.872	100.00	0.512	100.00	0.450	100.00	0.409	100.00
21	1.290	100.00	1.655	100.00	0.899	100.00	0.768	100.00	0.746	100.00
22	1.145	100.00	1.632	100.00	0.915	100.00	0.786	100.00	0.659	100.00
23	1.533	100.00	1.881	100.00	1.697	100.00	1.318	100.00	0.933	100.00
24	0.816	100.00	1.038	100.00	1.065	100.00	0.840	100.00	1.275	100.00
25	0.590	100.00	1.236	100.00	0.688	100.00	0.539	100.00	0.784	100.00
26	0.646	100.00	0.985	100.00	0.872	100.00	0.859	100.00	0.966	100.00
27	0.508	100.00	0.983	100.00	0.653	100.00	0.544	100.00	0.766	100.00
28	0.817	100.00	1.383	100.00	0.662	100.00	0.452	100.00	0.541	100.00
29	0.690	100.00	0.782	100.00	0.715	100.00	0.592	100.00	0.673	100.00
30	0.723	100.00	0.968	100.00	0.841	100.00	0.755	100.00	0.904	100.00
31	0.729	100.00	0.915	100.00	0.536	100.00	0.712	100.00	0.529	100.00

Figure 6-1 95% Range Error (SV 1 --SV 16) - Washington, DC

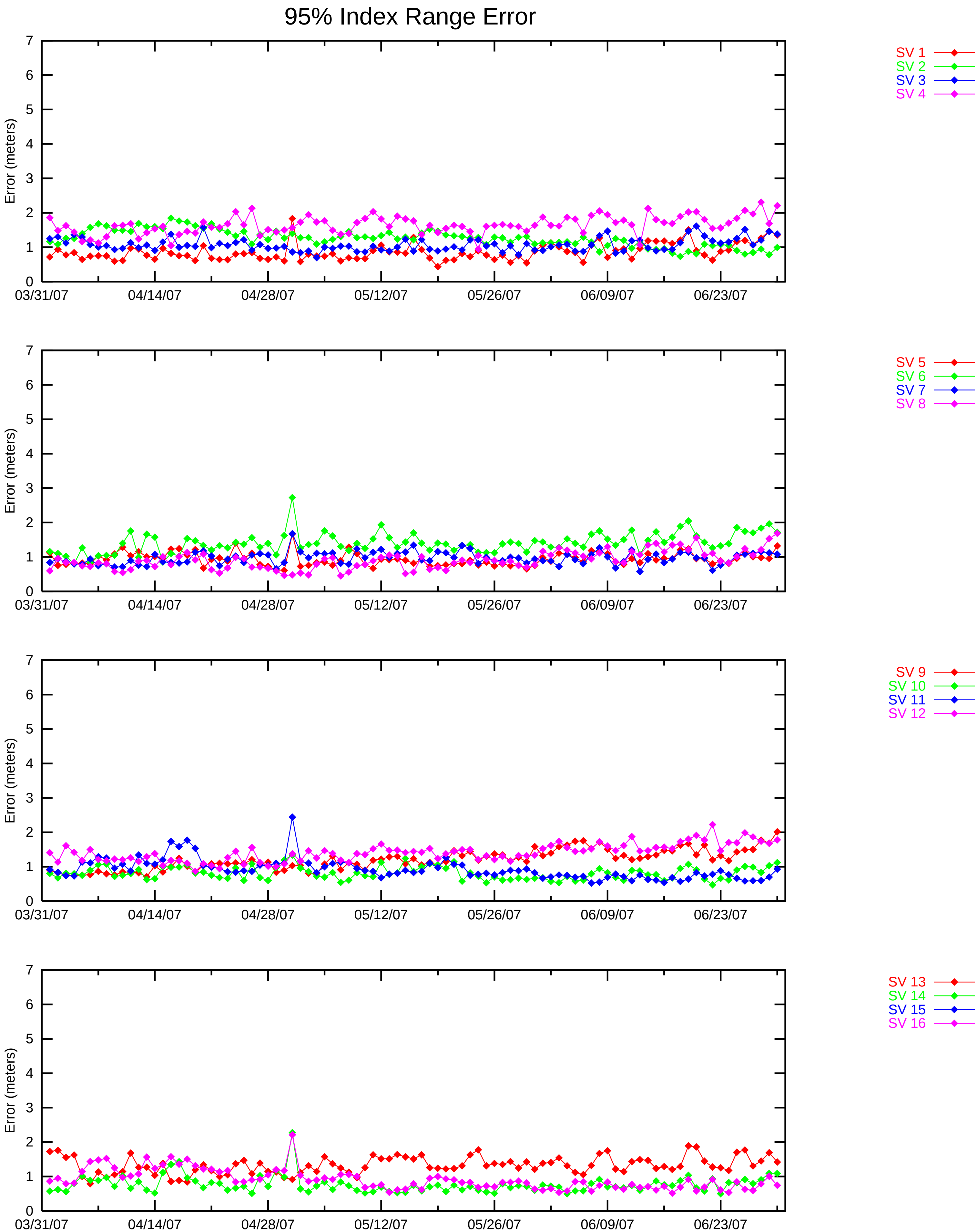


Figure 6-2 95% Range Error (SV 17 --SV 31 and SV 122) - Washington, DC

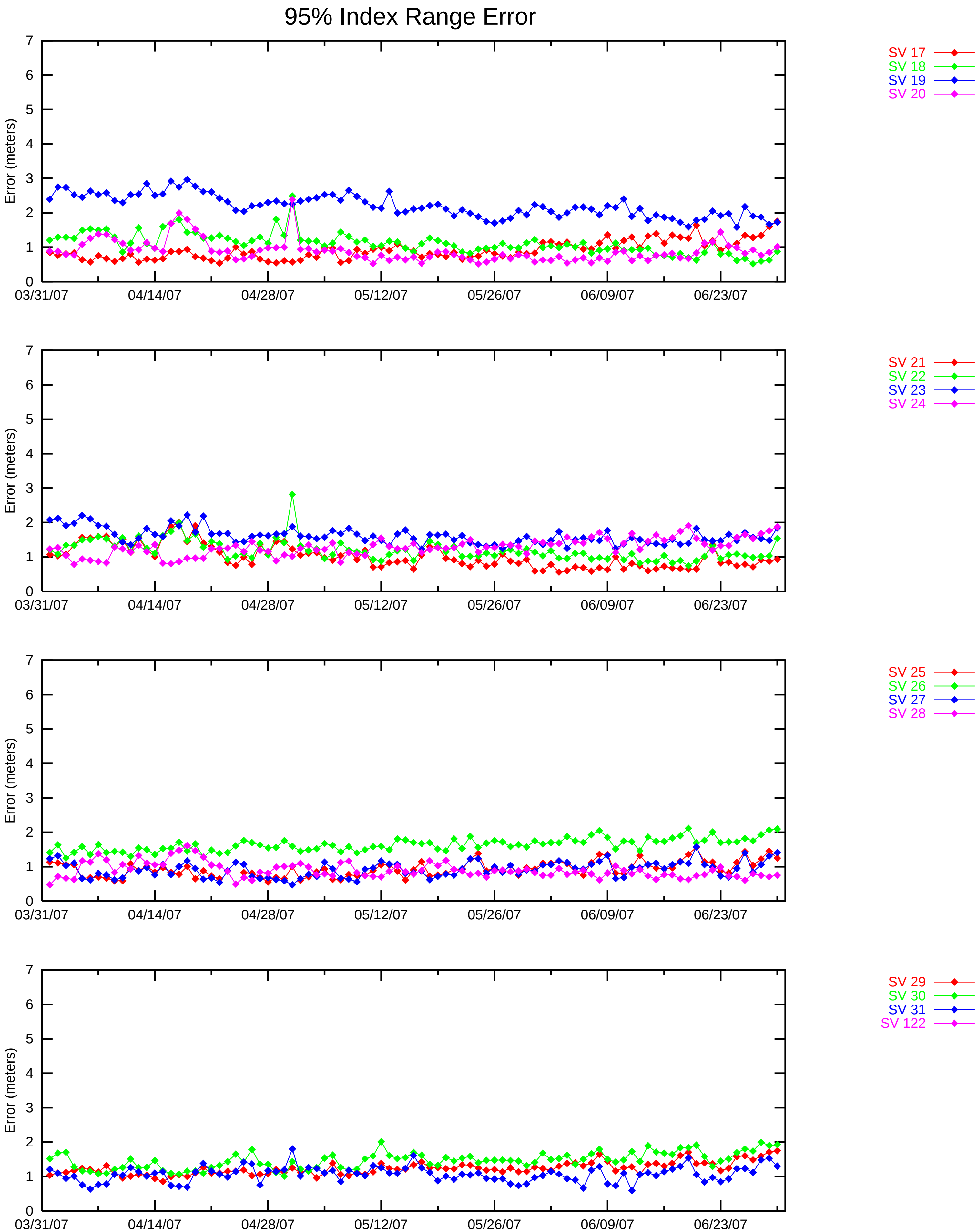


Figure 6-3 95% Ionospheric Error (SV 1 --SV 16) - Washington, DC

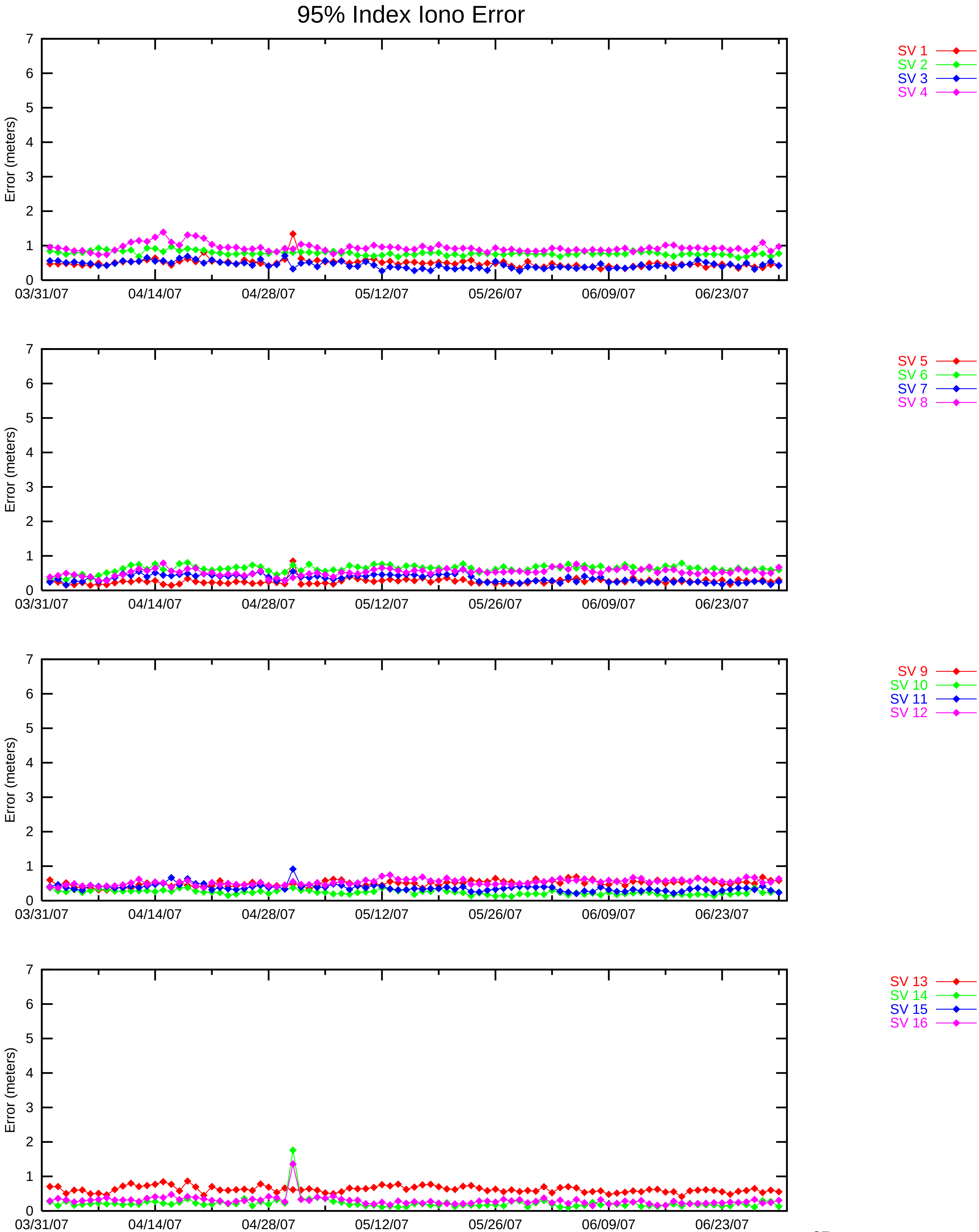
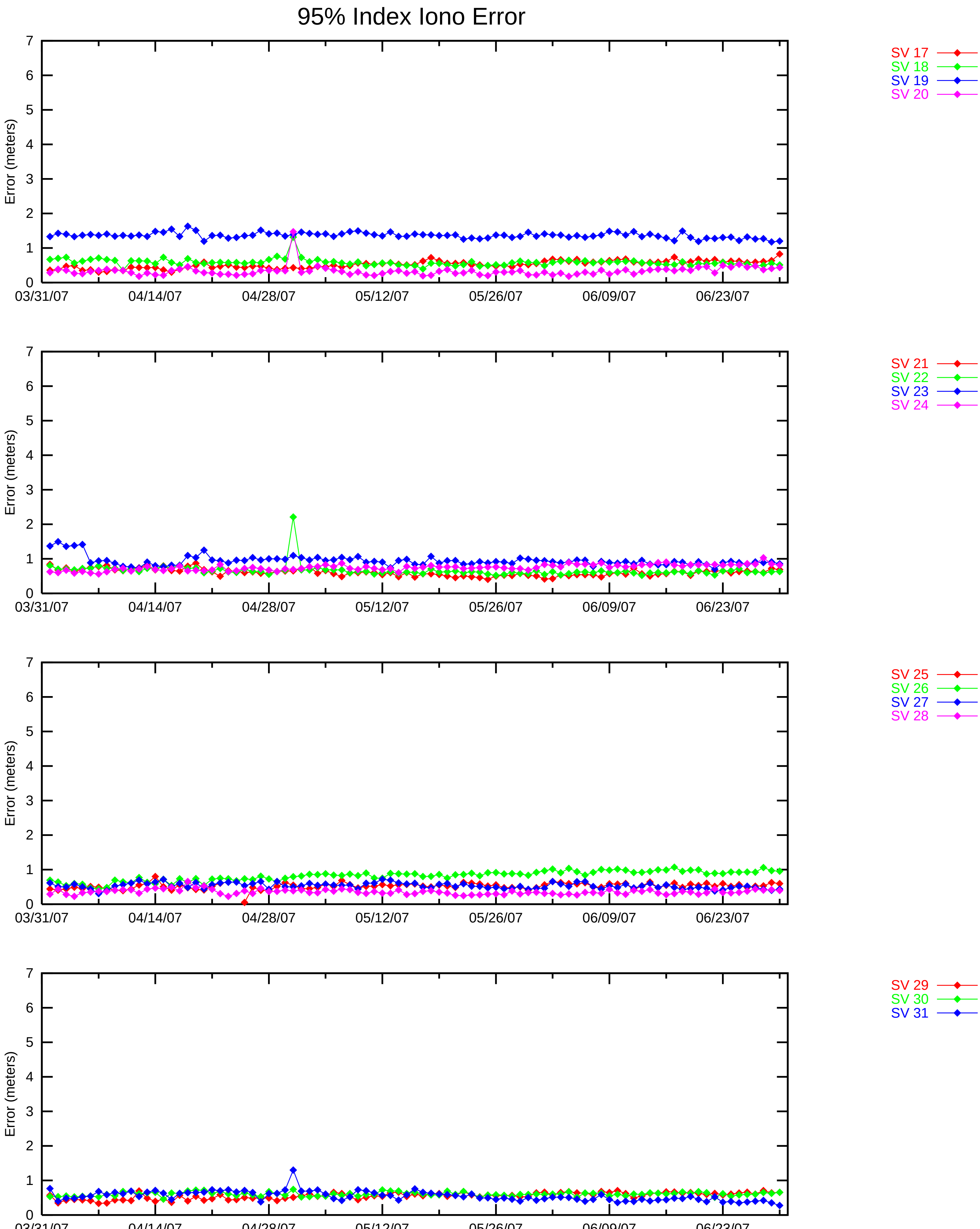


Figure 6-4 95% Ionospheric Error (SV 17 --SV 31) - Washington, DC



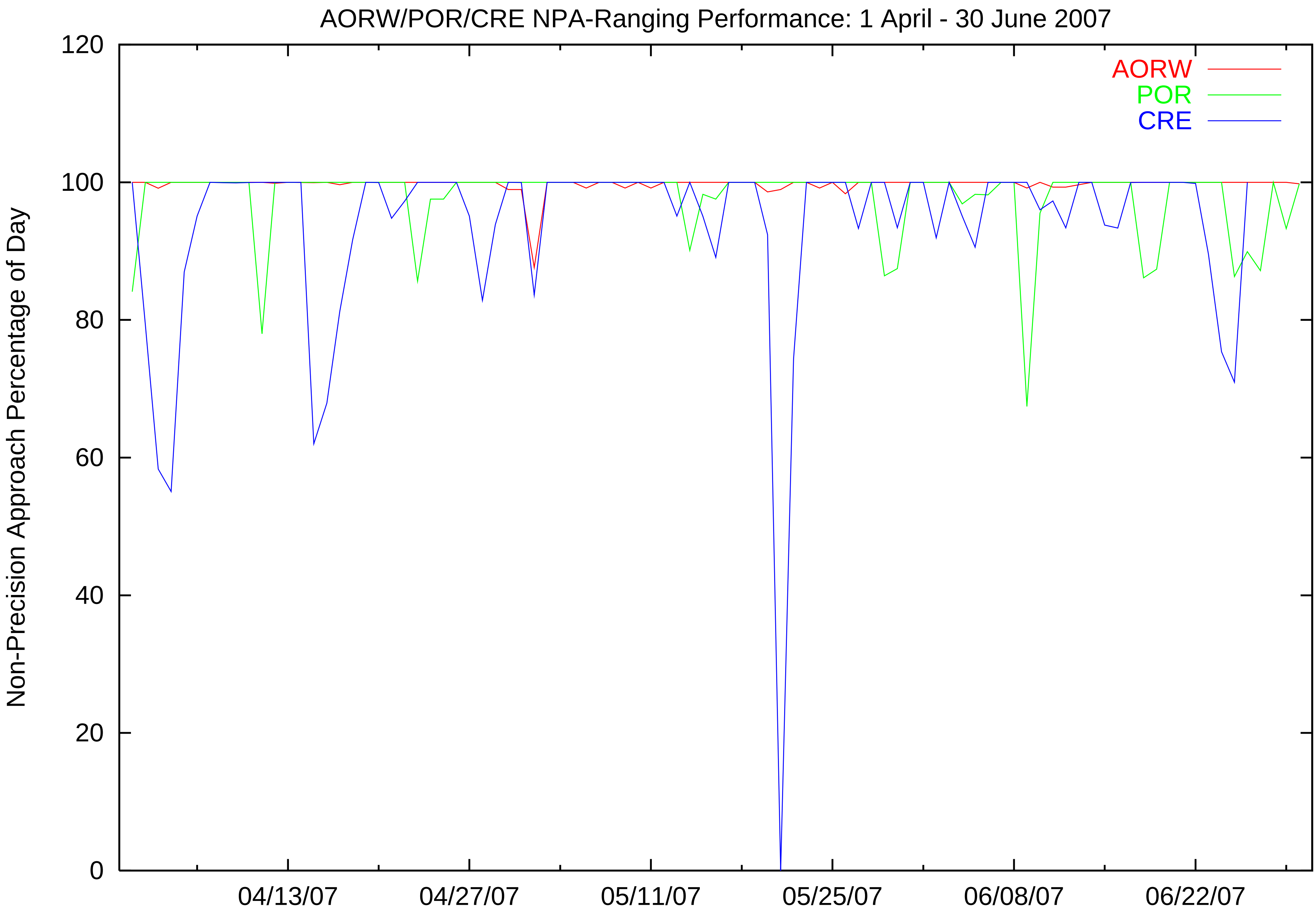
7.0 GEO RANGING PERFORMANCE

For the evaluated period, AOR-W GEO no longer provides PA ranging capability. Currently, the CRW GEO provides only the data link capability, i.e. there is no ranging service available from this GEO. As in the past, the POR satellite as a ranging source has very low PA availability. Table 7.1 shows the GEO-Ranging performance for AORW, POR, and CRW satellites throughout the evaluated period. Figure 7.1 shows the trend of NPA Ranging Availability for the AORW and POR satellite.

Table 7-1 GEO Ranging Availability

GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
AORW	0	99.578	0.108	0.304
POR	0	98.134	1.647	0.209
CRW	0	0	99.909	0.081

Figure 7-1 Daily NPA GEO Ranging Availability Trend



8.0 WAAS PROBLEM SUMMARY

Events that adversely affected the WAAS service for this evaluated period are listed in Table 8.1. These events include any WAAS anomalies and problems that affected the WAAS performance. Details of each of the events are documented in the WAAS Dscrepancy Report (DR). The DRs are available on the website http://www.nstb.tc.faa.gov under 'WAAS Technical Reports', and can also be accessed via hyperlink below.

Table 8-1 WAAS Problem Summary

Date	Events
4/2/07	See DR# 62 "Ionospheric scintillation that caused high errors and alarm condition."
4/5/07 to 5/4/07	See DR# 56, "Loss of 100% WAAS availability in southwest CONUS region."
4/10/07 to 4/11/07	See DR# 55, "GPS satellite PRN 18 anomaly affecting SPS performance."
4/26/07	See DR# 57, "Inconsistent satellite tracking of PRN 25 at non-G2 WAAS receivers following NANU 2007060"
5/9/07	See DR# 58, "Communication fault caused selected C&V source switch on CRW GUST's"
5/17/07 5/18/07 5/23/07 5/26/07 6/14/07	Ionospheric scintillation caused high errors but did not exceed the protection limit. See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."
6/9/07	See DR# 59, "POR GEO pointing error caused SIS degradation and SIS outage."
6/21/07	See DR# 60, "ZDC C&V faulted, followed by GEO initialization."
6/29/07	See DR# 61, "ZDC C&V faulted, followed by GEO initialization."

9.0 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 this evaluated period of WAAS operation is presented in Table 9.1. Figures 9.1 and 9.2 provide a graphical representation of WAAS LPV service availability and outage counts for the same period, respectively.

Table 9-1 WAAS LPV Outages and Availability

Airport Id	Airport Name	State	Outages	Availability
79J	ANDALUSIA-OPP	AL	6	0.99970050
BHM	BIRMINGHAM INTL	AL	2	0.99995220
DHN	DOTHAN REGIONAL	AL	7	0.99959720
HSV	HUNTSVILLE INTL-CARL T JONES F	AL	2	0.99995230
JKA	JACK EDWARDS	AL	6	0.99956477
MDQ	MADISON COUNTY EXECUTIVE	AL	2	0.99995230
BFM	MOBILE DOWNTOWN	AL	6	0.99972160
MOB	MOBILE REGIONAL	AL	6	0.99975556
MGM	MONTGOMERY REGIONAL (DANNELLY FIELD)	AL	4	0.99984354
MSL	NORTHWEST ALABAMA REGIONAL	AL	2	0.99995220
DCU	PRYOR FIELD REGIONAL	AL	2	0.99995230
LIT	ADAMS FIELD	AR	2	0.99993020
M73	ALMYRA MUNICIPAL	AR	2	0.99993020
BYH	ARKANSAS INTL	AR	3	0.99991935
VBT	BENTONVILLE MUNICIPAL/LOUISE M THAD	AR	2	0.99993120
HRO	BOONE COUNTY	AR	2	0.99993120
FSM	FORT SMITH REGIONAL	AR	2	0.99993120
PBF	GRIDER FIELD	AR	2	0.99993020
XNA	NORTHWEST ARKANSAS REGIONAL	AR	2	0.99993120
BPK	OZARK REGIONAL	AR	2	0.99993020
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	2	0.99993120
SRC	SEARCY MUNICIPAL	AR	2	0.99993020
ELD	SOUTH ARKANSAS REGIONAL	AR	2	0.99993020
ASG	SPRINGDALE MUNICIPAL	AR	2	0.99993120
SGT	STUTTGART MUNICIPAL	AR	2	0.99993020
ARG	WALNUT RIDGE REGIONAL	AR	3	0.99991786
PRC	ERNEST A. LOVE FIELD	AZ	63	0.99545850
GCN	GRAND CANYON NATIONAL PARK	AZ	5	0.99976140

IFP	LAUGHLIN/BULLHEAD INTL	AZ	22	0.99802120
DVT	PHOENIX DEER VALLEY	AZ	88	0.99255040
PHX	PHOENIX SKY HARBOR INTL	AZ	107	0.99111870
TUS	TUCSON INTL	AZ	201	0.97991323
APV	APPLE VALLEY	CA	113	0.99102160
ACV	ARCATA	CA	107	0.98950636
DAG	BARSTOW-DAGGETT	CA	88	0.99348545
C83	BYRON	CA	129	0.98356840
CNO	CHINO	CA	222	0.97832800
FAT	FRESNO YOSEMITE INTL	CA	93	0.98895310
WJF	GENERAL WM J FOX AIRFIELD	CA	162	0.98637730
HAF	HALF MOON BAY	CA	194	0.97376920
LGB	LONG BEACH /DAUGHERTY FIELD/	CA	297	0.96263236
LAX	LOS ANGELES INTL	CA	294	0.96358580
CRQ	MC CLELLAN-PALOMAR	CA	320	0.94801220
BFL	MEADOWS FIELD	CA	138	0.98556125
OAK	METROPOLITAN OAKLAND INTL	CA	142	0.97884345
MRY	MONTEREY PENINSULA	CA	228	0.97137374
APC	NAPA COUNTY	CA	132	0.98161906
O02	NERVINO	CA	28	0.99830640
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	158	0.97843660
VCB	NUT TREE	CA	127	0.98448694
ONT	ONTARIO INTL	CA	209	0.98125520
PSP	PALM SPRINGS INTL	CA	171	0.98418990
PMD	PALMDALE REGIONAL/USAF PLANT 4	CA	167	0.98637605
RAL	RIVERSIDE MUNICIPAL	CA	210	0.97936416
MHR	SACRAMENTO MATHER	CA	78	0.99163526
SFO	SAN FRANCISCO INTL	CA	168	0.97651350
TCY	TRACY MUNICIPAL	CA	124	0.98382470
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	3	0.99991363
AKO	COLORADO PLAINS REGIONAL	CO	2	0.99993426
CEZ	CORTEZ MUNICIPAL	CO	2	0.99993630
DEN	DENVER INTL	CO	2	0.99993426
GXY	GREELEY-WELD COUNTY	CO	2	0.99993426
ITR	KIT CARSON COUNTY	CO	2	0.99993426
LAA	LAMAR MUNICIPAL	CO	2	0.99993426
ALS	SAN LUIS VALLEY REGIONAL/BERGM	CO	2	0.99993630
HDN	YAMPA VALLEY	CO	2	0.99993630
BDL	BRADLEY INTL	CT	217	0.96689594
GON	GROTON-NEW LONDON	CT	217	0.96679260
HVN	TWEED-NEW HAVEN	CT	193	0.98430570
DCA	RONALD REAGAN WASHINGTON NATIONAL	DC	7	0.99928220
GED	SUSSEX COUNTY	DE	16	0.99849564
CEW	BOB SIKES	FL	6	0.99960650
BCT	BOCA RATON	FL	38	0.99653006
DAB	DAYTONA BEACH INTL	FL	13	0.99876320
DED	DELAND MUNI-SIDNEY H TAYLOR FIELD	FL	12	0.99875190
FLL	FORT LAUDERDALE/HOLLYWOOD INTL	FL	66	0.99477804
GNV	GAINESVILLE REGIONAL	FL	13	0.99890440
JAX	JACKSONVILLE INTL	FL	12	0.99904263
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	109	0.99238133
EYW	KEY WEST INTL	FL	227	0.97462910
ISM	KISSIMMEE GATEWAY	FL	14	0.99849296

MLB	MELBOURNE INTL	FL	14	0.99839020
COI	MERRITT ISLAND	FL	14	0.99847937
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	14	0.99877630
MCO	ORLANDO INTL	FL	14	0.99853490
PBI	PALM BEACH INTL	FL	25	0.99724233
PFN	PANAMA CITY-BAY CO INTL	FL	7	0.99952585
PNS	PENSACOLA REGIONAL	FL	6	0.99954313
PMP	POMPANO BEACH AIRPARK	FL	49	0.99588650
SRQ	SARASOTA/BRADENTON INTL	FL	20	0.99793680
RSW	SOUTHWEST FLORIDA INTL	FL	30	0.99713993
PIE	ST PETERSBURG-CLEARWATER INTL	FL	16	0.99823260
TLH	TALLAHASSEE REGIONAL	FL	8	0.99956300
TPA	TAMPA INTL	FL	15	0.99826133
VDF	VANDENBERG	FL	15	0.99820960
AGS	AUGUSTA RGNL AT BUSH FIELD	GA	5	0.99980070
BQK	BRUNSWICK GOLDEN ISLES	GA	9	0.99918990
CSG	COLUMBUS METROPOLITAN	GA	7	0.99969400
ATL	HARTSFIELD - JACKSON ATLANTA INTL	GA	7	0.99976190
MCN	MIDDLE GEORGIA REGIONAL	GA	7	0.99974570
CCO	NEWNAN COWETA COUNTY	GA	6	0.99976510
SAV	SAVANNAH/HILTON HEAD INTL	GA	8	0.99947244
ACJ	SOUTHER FIELD	GA	8	0.99964240
TBR	STATESBORO-BULLOCH COUNTY	GA	5	0.99976760
AYS	WAYCROSS-WARE COUNTY	GA	10	0.99965260
CTJ	WEST GEORGIA REGIONAL - O V GRAY F	GA	6	0.99976560
IKV	ANKENY REGIONAL	IA	2	0.99993120
DVN	DAVENPORT MUNICIPAL	IA	2	0.99995220
DSM	DES MOINES INTL	IA	2	0.99993120
DBQ	DUBUQUE REGIONAL	IA	2	0.99995220
EOK	KEOKUK MUNICIPAL	IA	2	0.99994930
MCW	MASON CITY MUNICIPAL	IA	2	0.99993120
MXO	MONTICELLO REGIONAL	IA	2	0.99994930
MUT	MUSCATINE MUNICIPAL	IA	2	0.99994930
OTM	OTTUMWA INDUSTRIAL	IA	2	0.99994930
SDA	SHENANDOAH MUNICIPAL	IA	2	0.99993120
SLB	STORM LAKE MUNICIPAL	IA	2	0.99993120
CID	THE EASTERN IOWA	IA	2	0.99994930
ALO	WATERLOO REGIONAL	IA	2	0.99993120
BOI	BOISE AIR TERMINAL/GOWEN FIELD	ID	5	0.99979330
IDA	IDAHO FALLS REGIONAL	ID	4	0.99984090
LWS	LEWISTON-NEZ PERCE COUNTY	ID	4	0.99963960
PIH	POCATELLO REGIONAL	ID	4	0.99983543
SPI	ABRAHAM LINCOLN CAPITAL	IL	2	0.99995220
ARR	AURORA MUNICIPAL	IL	4	0.99989110
BMI	CENTRAL IL REGIONAL ARPT	IL	3	0.99991655
ENL	CENTRALIA MUNICIPAL	IL	3	0.99987510
MDW	CHICAGO MIDWAY INTL	IL	4	0.99983120
ORD	CHICAGO O'HARE INTL	IL	4	0.99984443
RFD	CHICAGO/ROCKFORD INTL	IL	3	0.99992750
DEC	DECATUR	IL	3	0.99988780
FOA	FLORA MUNICIPAL	IL	3	0.99987674
PIA	GREATER PEORIA REGIONAL	IL	2	0.99995220
PPQ	PITTSFIELD PENSTONE MUNICIPAL	IL	2	0.99995220

MLI	QUAD CITY INTL	IL	2	0.99995220
TIP	RANTOUL NATL AVN CNTR-FRANK EL	IL	3	0.99992620
SLO	SALEM-LECKRONE	IL	3	0.99987245
ALN	ST LOUIS REGIONAL	IL	2	0.99995220
UGN	WAUKEGAN REGIONAL	IL	5	0.99981110
BAK	COLUMBUS MUNICIPAL	IN	3	0.99991950
GWB	DE KALB COUNTY	IN	4	0.99980550
EKM	ELKHART MUNICIPAL	IN	4	0.99977297
FWA	FORT WAYNE INTL	IN	4	0.99981785
IND	INDIANAPOLIS INTL	IN	3	0.99990550
MZZ	MARION MUNICIPAL	IN	4	0.99983174
CEV	METTEL FIELD	IN	4	0.99989770
BMG	MONROE COUNTY	IN	3	0.99990624
SBN	SOUTH BEND REGIONAL	IN	4	0.99976850
ANQ	TRI-STATE STEUBEN COUNTY	IN	4	0.99978644
PTS	ATKINSON MUNICIPAL	KS	2	0.99993120
AAO	COLONEL JAMES JABARA	KS	2	0.99993120
DDC	DODGE CITY REGIONAL	KS	2	0.99993120
FOE	FORBES FIELD	KS	2	0.99993120
HYS	HAYS REGIONAL	KS	2	0.99993120
OJC	JOHNSON COUNTY EXECUTIVE	KS	2	0.99993120
LWC	LAWRENCE MUNICIPAL	KS	2	0.99993120
MHK	MANHATTAN REGIONAL	KS	2	0.99993120
IXD	NEW CENTURY AIRCENTER	KS	2	0.99993120
EWK	NEWTON-CITY-COUNTY	KS	2	0.99993120
OEL	OAKLEY MUNICIPAL	KS	2	0.99993120
TOP	PHILIP BILLARD MUNICIPAL	KS	2	0.99993120
GLD	RENNER FLD /GOODLAND MUNICIPAL	KS	2	0.99993120
SLN	SALINA MUNICIPAL	KS	2	0.99993120
TQK	SCOTT CITY MUNICIPAL	KS	2	0.99993120
CBK	SHALZ FIELD	KS	2	0.99993120
WLD	STROTHER FIELD	KS	2	0.99993120
ULS	ULYSSES	KS	2	0.99993426
ICT	WICHITA MID-CONTINENT	KS	2	0.99993120
EKX	ADDINGTON FIELD	KY	2	0.99995230
PAH	BARKLEY REGIONAL	KY	6	0.99985450
K22	BIG SANDY REGIONAL	KY	5	0.99979140
LEX	BLUE GRASS	KY	2	0.99995230
FFT	CAPITAL CITY	KY	3	0.99993540
CVG	CINCINNATI/NORTHERN KENTUCKY INTL	KY	3	0.99992764
LOZ	LONDON-CORBIN ARPT-MAGEE FIELD	KY	5	0.99987686
SDF	LOUISVILLE INTL-STANDIFORD FIELD	KY	2	0.99995230
OWB	OWENSBORO-DAVIESS COUNTY	KY	3	0.99993370
ARA	ACADIANA REGIONAL	LA	7	0.99928190
AEX	ALEXANDRIA INTL	LA	4	0.99989680
BTR	BATON ROUGE METROPOLITAN RYAN	LA	7	0.99965584
DRI	BEAUREGARD REGIONAL	LA	7	0.99969566
CWF	CHENNAULT INTL	LA	7	0.99929476
PTN	HARRY P WILLIAMS MEMORIAL	LA	8	0.99918190
LCH	LAKE CHARLES REGIONAL	LA	7	0.99923600
MSY	LOUIS ARMSTRONG NEW ORLEANS IN	LA	9	0.99932283
DTN	SHREVEPORT DOWNTOWN	LA	2	0.99993020
SHV	SHREVEPORT REGIONAL	LA	2	0.99993170

TVR	VICKSBURG TALLULAH REGIONAL	LA	2	0.99993020
HYA	BARNSTABLE MUNICIPAL - BOARDMAN/POLAN	MA	335	0.94020295
OWD	NORWOOD MEMORIAL	MA	286	0.94867426
ORH	WORCESTER REGIONAL	MA	251	0.95482380
BWI	BALTIMORE/WASHINGTON INTL THUR	MD	9	0.99920930
DMW	CARROLL COUNTY REGIONAL/JACK B	MD	8	0.99921600
FDK	FREDERICK MUNICIPAL	MD	9	0.99937830
GAI	MONTGOMERY COUNTY AIRPARK	MD	7	0.99928490
LEW	AUBURN/LEWISTON MUNICIPAL	ME	511	0.91249484
AUG	AUGUSTA STATE	ME	610	0.89257830
BHB	HANCOCK COUNTY-BAR HARBOR	ME	796	0.82850915
PWM	PORTLAND INTL JETPORT	ME	464	0.91809076
ARB	ANN ARBOR MUNICIPAL	MI	5	0.99973280
ACB	ANTRIM COUNTY	MI	9	0.99929667
FNT	BISHOP INTL	MI	5	0.99966764
DTW	DETROIT METROPOLITAN WAYNE COUNTY	MI	5	0.99973810
GRR	GERALD R. FORD INTL	MI	5	0.99965876
CMX	HOUGHTON COUNTY MEMORIAL	MI	44	0.99555707
OZW	LIVINGSTON COUNTY SPENCER J. H	MI	5	0.99968980
MBS	MBS INTL	MI	6	0.99958520
MKG	MUSKEGON COUNTY	MI	5	0.99965954
HYX	SAGINAW COUNTY H.W. BROWNE	MI	6	0.99960390
BIV	TULIP CITY	MI	5	0.99967176
YIP	WILLOW RUN	MI	5	0.99973200
BRD	BRAINERD LAKES REGIONAL	MN	9	0.99919110
AXN	CHANDLER FIELD	MN	8	0.99955880
HIB	CHISHOLM-HIBBING	MN	23	0.99798065
DLH	DULUTH INTL	MN	14	0.99882060
MSP	MINNEAPOLIS-ST PAUL INTL	MN	5	0.99981135
RGK	RED WING REGIONAL	MN	4	0.99983275
RST	ROCHESTER INTL	MN	4	0.99986720
STC	ST CLOUD REGIONAL	MN	8	0.99967750
JYG	ST JAMES MUNICIPAL	MN	3	0.99989890
STP	ST PAUL DOWNTOWN HOLMAN FIELD	MN	5	0.99980720
CGI	CAPE GIRARDEAU REGIONAL	MO	6	0.99983150
MKC	CHARLES B. WHEELER DOWNTOWN	MO	2	0.99993120
GPH	CLAY COUNTY REGIONAL	MO	2	0.99993120
COU	COLUMBIA REGIONAL	MO	2	0.99994930
LBO	FLOYD W. JONES LEBANON	MO	2	0.99993145
HIG	HIGGINSVILLE INDUSTRIAL MUNICIPAL	MO	2	0.99993120
JLN	JOPLIN REGIONAL	MO	2	0.99993120
MCI	KANSAS CITY INTL	MO	2	0.99993120
TKX	KENNETT MEMORIAL	MO	3	0.99991477
IRK	KIRKSVILLE REGIONAL	MO	2	0.99994930
STL	LAMBERT-ST LOUIS INTL	MO	2	0.99995220
AIZ	LEE C FINE MEMORIAL	MO	2	0.99994930
6M6	LEWIS COUNTY REGIONAL	MO	2	0.99994930
MYJ	MEXICO MEMORIAL	MO	2	0.99994930
STJ	ROSECRANS MEMORIAL	MO	2	0.99993120
DMO	SEDALIA MEMORIAL	MO	2	0.99993134
SIK	SIKESTON MEML MUNICIPAL	MO	4	0.99988693
SGF	SPRINGFIELD-BRANSON NATIONAL	MO	2	0.99993120
TBN	WAYNESVILLE REGIONAL ARPT	MO	2	0.99994930

UNO	WEST PLAINS MUNICIPAL	MO	2	0.99994930
GWO	GREENWOOD-LEFLORE	MS	2	0.99993020
GNF	GRENADA MUNICIPAL	MS	2	0.99994930
GPT	GULFPORT-BILOXI INTL	MS	9	0.99959654
JAN	JACKSON-EVERS INTL	MS	2	0.99993020
MEI	KEY FIELD	MS	2	0.99994930
OLV	OLIVE BRANCH	MS	2	0.99994930
CRX	ROSCOE TURNER	MS	2	0.99994930
UTA	TUNICA MUNICIPAL	MS	2	0.99994930
BTM	BERT MOONEY	MT	5	0.99970317
BIL	BILLINGS LOGAN INTL	MT	4	0.99980235
MLS	FRANK WILEY FIELD	MT	4	0.99979640
GPI	GLACIER PARK INTL	MT	10	0.99919784
HLN	HELENA REGIONAL	MT	6	0.99963090
LWT	LEWISTOWN MUNICIPAL	MT	5	0.99974020
HBI	ASHEBORO REGIONAL	NC	6	0.99968370
AVL	ASHEVILLE REGIONAL	NC	5	0.99979216
CLT	CHARLOTTE/DOUGLAS INTL	NC	6	0.99976340
JQF	CONCORD REGIONAL	NC	6	0.99975490
FAY	FAYETTEVILLE REGIONAL/GRANNIS	NC	7	0.99951440
LHZ	FRANKLIN COUNTY	NC	7	0.99950117
GWW	GOLDSBORO-WAYNE MUNICIPAL	NC	11	0.99901380
ISO	KINSTON REGIONAL JETPORT	NC	11	0.99887960
EQY	MONROE REGIONAL	NC	6	0.99976087
GSO	PIEDMONT TRIAD INTL	NC	6	0.99965507
PGV	PITT-GREENVILLE	NC	11	0.99887590
RDU	RALEIGH-DURHAM INTL	NC	8	0.99952840
RWI	ROCKY MOUNT-WILSON REGIONAL	NC	11	0.99917510
RUQ	ROWAN COUNTY	NC	6	0.99969130
TTA	SANFORD-LEE COUNTY REGIONAL	NC	8	0.99956500
SVH	STATESVILLE REGIONAL	NC	6	0.99970330
ILM	WILMINGTON INTL	NC	11	0.99892765
BIS	BISMARCK MUNICIPAL	ND	8	0.99946620
DIK	DICKINSON - THEODORE ROOSEVELT	ND	9	0.99959630
GFK	GRAND FORKS INTL	ND	14	0.99876270
FAR	HECTOR INTL	ND	10	0.99911720
MOT	MINOT INTL	ND	15	0.99855960
ANW	AINSWORTH MUNICIPAL	NE	2	0.99993120
BIE	BEATRICE MUNICIPAL	NE	2	0.99993120
FNB	BRENNER FIELD	NE	2	0.99993120
GRI	CENTRAL NEBRASKA REGIONAL	NE	3	0.99990726
CDR	CHADRON MUNICIPAL	NE	3	0.99991226
OLU	COLUMBUS MUNICIPAL	NE	2	0.99993120
OMA	EPPLEY AIRFIELD	NE	2	0.99993120
HSI	HASTINGS MUNICIPAL	NE	3	0.99990666
OFK	KARL STEFAN MEMORIAL	NE	2	0.99993120
EAR	KEARNEY MUNICIPAL	NE	3	0.99989600
LNK	LINCOLN	NE	2	0.99993120
MCK	MC COOK REGIONAL	NE	2	0.99993120
VTN	MILLER FIELD	NE	2	0.99993120
LBF	NORTH PLATTE RGNL AIRPORT LEE	NE	2	0.99993120
PMV	PLATTSMOUTH MUNICIPAL	NE	2	0.99993120
SCB	SCRIBNER STATE	NE	2	0.99993120

LCG	WAYNE MUNICIPAL	NE	2	0.99993120
BFF	WESTERN NEB. REGIONAL/WILLIAM B. H	NE	2	0.99993120
JYR	YORK MUNICIPAL	NE	2	0.99993120
CON	CONCORD MUNICIPAL	NH	315	0.94634193
ACY	ATLANTIC CITY INTL	NJ	30	0.99801904
WWD	CAPE MAY COUNTY	NJ	18	0.99827087
MIV	MILLVILLE MUNICIPAL	NJ	19	0.99843967
EWR	NEWARK LIBERTY INTL	NJ	75	0.99569390
ABQ	ALBUQUERQUE INTL SUNPORT	NM	3	0.99991250
CVN	CLOVIS MUNICIPAL	NM	3	0.99983734
AEG	DOUBLE EAGLE II	NM	3	0.99990994
FMN	FOUR CORNERS REGIONAL	NM	2	0.99993630
SVC	GRANT COUNTY	NM	41	0.99721150
LRU	LAS CRUCES INTL	NM	52	0.99660534
ROW	ROSWELL INTL AIR CENT	NM	8	0.99972630
LAS	MC CARRAN INTL	NV	27	0.99865013
4SD	RENO/STEAD	NV	20	0.99874884
WMC	WINNEMUCCA MUNICIPAL	NV	8	0.99941660
9G3	AKRON	NY	13	0.99916230
BUF	BUFFALO NIAGARA INTL	NY	13	0.99920330
OLE	CATTARAUGUS COUNTY-OLEAN	NY	11	0.99928635
JHW	CHAUTAUQUA COUNTY/JAMESTOWN	NY	9	0.99942500
ELM	ELMIRA/CORNING REGIONAL	NY	19	0.99878880
FOK	FRANCIS S GABRESKI	NY	165	0.98771720
BGM	GREATER BINGHAMTON	NY	36	0.99776226
ROC	GREATER ROCHESTER INTL	NY	15	0.99886715
JFK	JOHN F KENNEDY INTL	NY	92	0.99471050
LGA	LA GUARDIA	NY	92	0.99463230
MSS	MASSENA INTL-RICHARDS FIELD	NY	255	0.96717894
PBG	PLATTSBURGH INTL	NY	321	0.94940627
SWF	STEWART INTL	NY	111	0.99325055
SYR	SYRACUSE HANCOCK INTL	NY	59	0.99658996
HPN	WESTCHESTER COUNTY	NY	117	0.99321020
CXY	CAPITAL CITY	OH	10	0.99916510
CLE	CLEVELAND-HOPKINS INTL	OH	9	0.99976190
MGY	DAYTON-WRIGHT BROTHERS	OH	3	0.99992190
FDY	FINDLAY	OH	4	0.99985090
DAY	JAMES M COX DAYTON INTL	OH	4	0.99989736
1G3	KENT STATE UNIVERSITY	OH	8	0.99974310
I68	LEBANON-WARREN COUNTY	OH	3	0.99992340
OSU	OHIO STATE UNIVERSITY	OH	3	0.99991786
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	4	0.99982830
CMH	PORT COLUMBUS INTL	OH	4	0.99990030
RZT	ROSS COUNTY	OH	5	0.99988200
TOL	TOLEDO EXPRESS	OH	5	0.99979040
AVK	ALVA REGIONAL	OK	2	0.99993120
CQB	CHANDLER REGIONAL	OK	2	0.99993120
CHK	CHICKASHA MUNICIPAL	OK	3	0.99991316
GCM	CLAREMORE REGIONAL	OK	2	0.99993120
F29	CLARENCE E PAGE MUNICIPAL	OK	3	0.99991566
1K4	DAVID JAY PERRY	OK	3	0.99991680
MKO	DAVIS FIELD	OK	2	0.99993120
DUA	EAKER FIELD	OK	2	0.99993426

2O8	HINTON MUNICIPAL	OK	2	0.99993426
HBR	HOBART MUNICIPAL	OK	4	0.99989610
MLC	MC ALESTER REGIONAL	OK	2	0.99993120
MIO	MIAMI MUNICIPAL	OK	2	0.99993120
MDF	MOORELAND MUNICIPAL	OK	2	0.99993180
OKM	OKMULGEE REGIONAL	OK	2	0.99993120
PVJ	PAULS VALLEY MUNICIPAL	OK	3	0.99991730
PNC	PONCA CITY REGIONAL	OK	3	0.99991580
RVS	RICHARD LLOYD JONES JR	OK	2	0.99993120
2K4	SCOTT FIELD	OK	4	0.99989110
SNL	SHAWNEE REGIONAL	OK	2	0.99993120
SWO	STILLWATER REGIONAL	OK	2	0.99993120
TQH	TAHLEQUAH MUNICIPAL	OK	2	0.99993120
TUL	TULSA INTL	OK	2	0.99993120
OKC	WILL ROGERS WORLD	OK	3	0.99991506
UAO	AURORA STATE	OR	14	0.99892706
LMT	KLAMATH FALLS	OR	21	0.99873490
LGD	LA GRANDE/UNION COUNTY	OR	4	0.99971700
EUG	MAHLON SWEET FIELD	OR	16	0.99838740
SLE	MCNARY FLD	OR	14	0.99877036
ONP	NEWPORT MUNICIPAL	OR	18	0.99834200
PDX	PORTLAND INTL	OR	13	0.99912610
AGC	ALLEGHENY COUNTY	PA	9	0.99961360
AOO	ALTOONA-BLAIR COUNTY	PA	9	0.99945500
HZL	HAZLETON MUNICIPAL	PA	19	0.99882310
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA	PA	9	0.99950780
LNS	LANCASTER	PA	13	0.99907243
ABE	LEHIGH VALLEY INTL	PA	22	0.99842820
PNE	NORTHEAST PHILADELPHIA	PA	26	0.99832326
PHL	PHILADELPHIA INTL	PA	22	0.99856824
PIT	PITTSBURGH INTL	PA	8	0.99965190
FWQ	ROSTRAVER	PA	8	0.99962140
OYM	ST MARYS MUNICIPAL	PA	9	0.99941120
UNV	UNIVERSITY PARK	PA	9	0.99925540
FKL	VENANGO REGIONAL	PA	9	0.99955076
PVD	THEODORE FRANCIS GREEN STATE	RI	263	0.95440660
AIK	AIKEN MUNICIPAL	SC	5	0.99979230
AND	ANDERSON REGIONAL	SC	5	0.99979980
CHS	CHARLESTON AFB/INTL	SC	10	0.99913514
CAE	COLUMBIA METROPOLITAN	SC	5	0.99977410
GSP	GREENVILLE SPARTANBURG INTL	SC	5	0.99977905
MYR	MYRTLE BEACH INTL	SC	11	0.99901783
ABR	ABERDEEN REGIONAL	SD	6	0.99970263
BKX	BROOKINGS REGIONAL	SD	4	0.99988085
HON	HURON REGIONAL	SD	5	0.99983150
FSD	JOE FOSS FIELD	SD	2	0.99993120
PIR	PIERRE REGIONAL	SD	6	0.99982560
RAP	RAPID CITY REGIONAL	SD	3	0.99989230
PVE	BEECH RIVER REGIONAL	TN	2	0.99995220
UCY	EVERETT-STEWART	TN	3	0.99993220
CHA	LOVELL FIELD	TN	4	0.99991390
TYS	MC GHEE TYSON	TN	8	0.99981034
MEM	MEMPHIS INTL	TN	2	0.99994930

NQA	MILLINGTON REGIONAL JETPORT	TN	3	0.99993044
BNA	NASHVILLE INTL	TN	2	0.99995220
TRI	TRI-CITIES REGIONAL TN/VA	TN	5	0.99976330
ABI	ABILENE REGIONAL	TX	6	0.99964410
ADS	ADDISON	TX	5	0.99983220
ALI	ALICE INTL	TX	143	0.97753200
LFK	ANGELINA COUNTY	TX	7	0.99951990
GKY	ARLINGTON MUNICIPAL	TX	5	0.99974155
AUS	AUSTIN-BERGSTROM INTL	TX	11	0.99899370
LBX	BRAZORIA COUNTY	TX	27	0.99727780
BWD	BROWNWOOD REGIONAL	TX	6	0.99959180
E30	BRUCE FIELD	TX	9	0.99945440
TKI	COLLIN COUNTY REGIONAL AT MC K	TX	5	0.99987510
CRP	CORPUS CHRISTI INTL	TX	147	0.97807896
RBD	DALLAS EXECUTIVE	TX	5	0.99976060
DAL	DALLAS LOVE FIELD	TX	5	0.99979370
DFW	DALLAS/FORT WORTH INTL	TX	5	0.99978620
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	9	0.99892414
DRT	DEL RIO INTL	TX	43	0.99602294
TPL	DRAUGHON-MILLER CENTRAL TEXAS	TX	5	0.99950624
CLL	EASTERWOOD FIELD	TX	6	0.99935570
EBG	EDINBURG INTL	TX	538	0.90096617
ELP	EL PASO INTL	TX	59	0.99558710
AFW	FORT WORTH ALLIANCE	TX	5	0.99978083
FWS	FORT WORTH SPINKS	TX	6	0.99971270
IAH	GEORGE BUSH INTERCONTINENTAL	TX	9	0.99887186
PVW	HALE COUNTY	TX	6	0.99981153
AXH	HOUSTON-SOUTHWEST	TX	21	0.99806356
ERV	KERRVILLE MUNI/LOUIS SCHREINER	TX	12	0.99888760
LNC	LANCASTER	TX	5	0.99976060
LRD	LAREDO INTL	TX	196	0.97555950
CXO	LONE STAR EXECUTIVE	TX	7	0.99915120
LBB	LUBBOCK PRESTON SMITH INTL	TX	7	0.99976915
GVT	MAJORS	TX	2	0.99993426
MFE	MC ALLEN MILLER INTL	TX	632	0.87605630
HQZ	MESQUITE METRO	TX	5	0.99980070
MAF	MIDLAND INTL	TX	15	0.99903923
OSA	MOUNT PLEASANT REGIONAL	TX	2	0.99993426
RAS	MUSTANG BEACH	TX	147	0.98095036
BAZ	NEW BRAUNFELS MUNICIPAL	TX	24	0.99829160
AMA	RICK HUSBAND AMARILLO INTL	TX	3	0.99985236
SJT	SAN ANGELO REGIONAL/MATHIS FIELD	TX	10	0.99929905
SAT	SAN ANTONIO INTL	TX	24	0.99821050
GLS	SCHOLES INTL AT GALVESTON	TX	24	0.99797110
SPS	SHEPPARD AFB/WICHITA FALLS	TX	5	0.99983150
SGR	SUGAR LAND REGIONAL	TX	21	0.99816720
T43	T P MC CAMPBELL	TX	138	0.98213380
TRL	TERRELL MUNICIPAL	TX	5	0.99985460
TYR	TYLER POUNDS REGIONAL	TX	3	0.99990890
IWS	WEST HOUSTON	TX	21	0.99848150
HOU	WILLIAM P HOBBY	TX	21	0.99834680
CDC	CEDAR CITY REGIONAL	UT	6	0.99972606
KNB	KANAB MUNICIPAL	UT	4	0.99983275

LGU	LOGAN-CACHE	UT	3	0.99987596
OGD	OGDEN-HINCKLEY	UT	3	0.99988410
PVU	PROVO MUNICIPAL	UT	3	0.99990195
SLC	SALT LAKE CITY INTL	UT	3	0.99989086
SGU	ST GEORGE MUNICIPAL	UT	6	0.99963397
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	7	0.99954000
FCI	CHESTERFIELD COUNTY	VA	7	0.99942610
JYO	LEESBURG EXECUTIVE	VA	8	0.99942344
HEF	MANASSAS REGIONAL	VA	7	0.99942523
PSK	NEW RIVER VALLEY	VA	6	0.99965470
PHF	NEWPORT NEWS/WILLIAMSBURG INTL	VA	10	0.99891550
ORF	NORFOLK INTL	VA	12	0.99864876
RIC	RICHMOND INTL	VA	7	0.99940896
RMN	STAFFORD REGIONAL	VA	7	0.99944150
BCB	VIRGINIATECH/MONTGOMERY EXECUT	VA	6	0.99964260
IAD	WASHINGTON DULLES INTL	VA	8	0.99941190
FSO	FRANKLIN COUNTY STATE	VT	352	0.94134800
BLI	BELLINGHAM INTL	WA	15	0.99914515
FHR	FRIDAY HARBOR	WA	15	0.99911770
MWH	GRANT CO INTL	WA	9	0.99937016
PUW	PULLMAN/MOSCOW REGIONAL	WA	5	0.99953080
RLD	RICHLAND	WA	4	0.99964790
SEA	SEATTLE-TACOMA INTL	WA	12	0.99934600
BVS	SKAGIT REGIONAL	WA	14	0.99917465
PAE	SNOHOMISH COUNTY (PAINE FIELD)	WA	10	0.99941290
GEG	SPOKANE INTL	WA	10	0.99925560
ALW	WALLA WALLA REGIONAL	WA	4	0.99964490
GRB	AUSTIN STRAUBEL INTL	WI	9	0.99954367
CWA	CENTRAL WISCONSIN	WI	6	0.99964530
MSN	DANE COUNTY REGIONAL-TRUAX FIELD	WI	4	0.99986100
EGV	EAGLE RIVER UNION	WI	11	0.99920714
FLD	FOND DU LAC COUNTY	WI	5	0.99978215
MKE	GENERAL MITCHELL INTL	WI	6	0.99978260
MTW	MANITOWOC COUNTY	WI	7	0.99956375
MFI	MARSHFIELD MUNICIPAL	WI	5	0.99974030
ATW	OUTAGAMIE COUNTY REGIONAL	WI	7	0.99959797
RHI	RHINELANDER-ONEIDA COUNTY	WI	11	0.99932986
RPD	RICE LAKE REGIONAL	WI	7	0.99961257
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	6	0.99971970
OSH	WITTMAN REGIONAL	WI	5	0.99976970
PKB	MID-OHIO VALLEY REGIONAL	WV	5	0.99975604
MGW	MORGANTOWN MUNICIPAL -WALTER L. BILL	WV	6	0.99966350
HTS	TRI-STATE/MILTON J. FERGUSON	WV	5	0.99980503
CYS	CHEYENNE REGIONAL/JERRY OLSON	WY	2	0.99993426
GCC	GILLETTE-CAMPBELL COUNTY	WY	3	0.99987775
JAC	JACKSON HOLE	WY	3	0.99986530
LAR	LARAMIE REGIONAL	WY	2	0.99993616
CPR	NATRONA COUNTY INTL	WY	3	0.99989724
RIW	RIVERTON REGIONAL	WY	3	0.99988010
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	3	0.99989960
COD	YELLOWSTONE REGIONAL	WY	3	0.99986520

Figure 9-1 WAAS LPV Availability

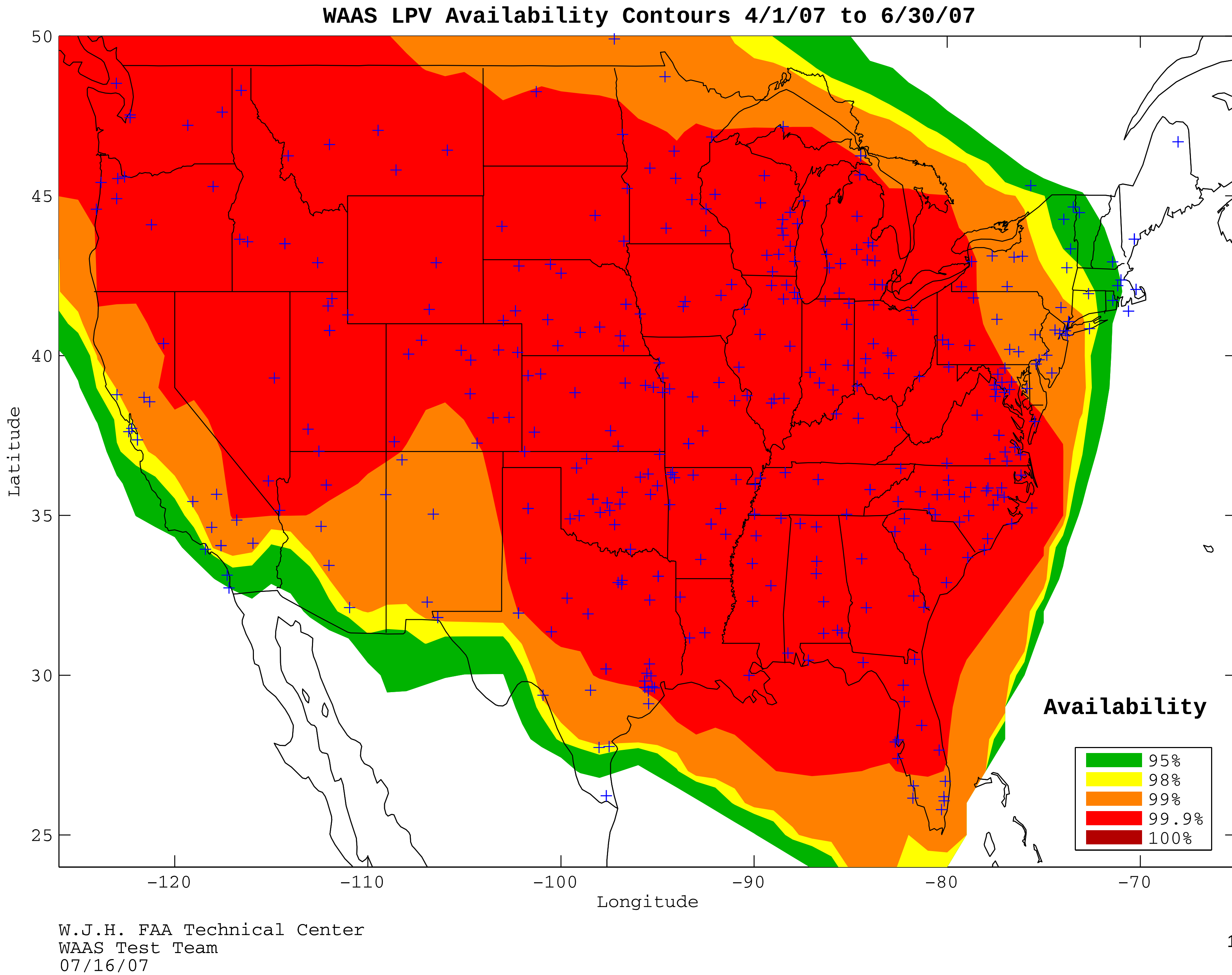
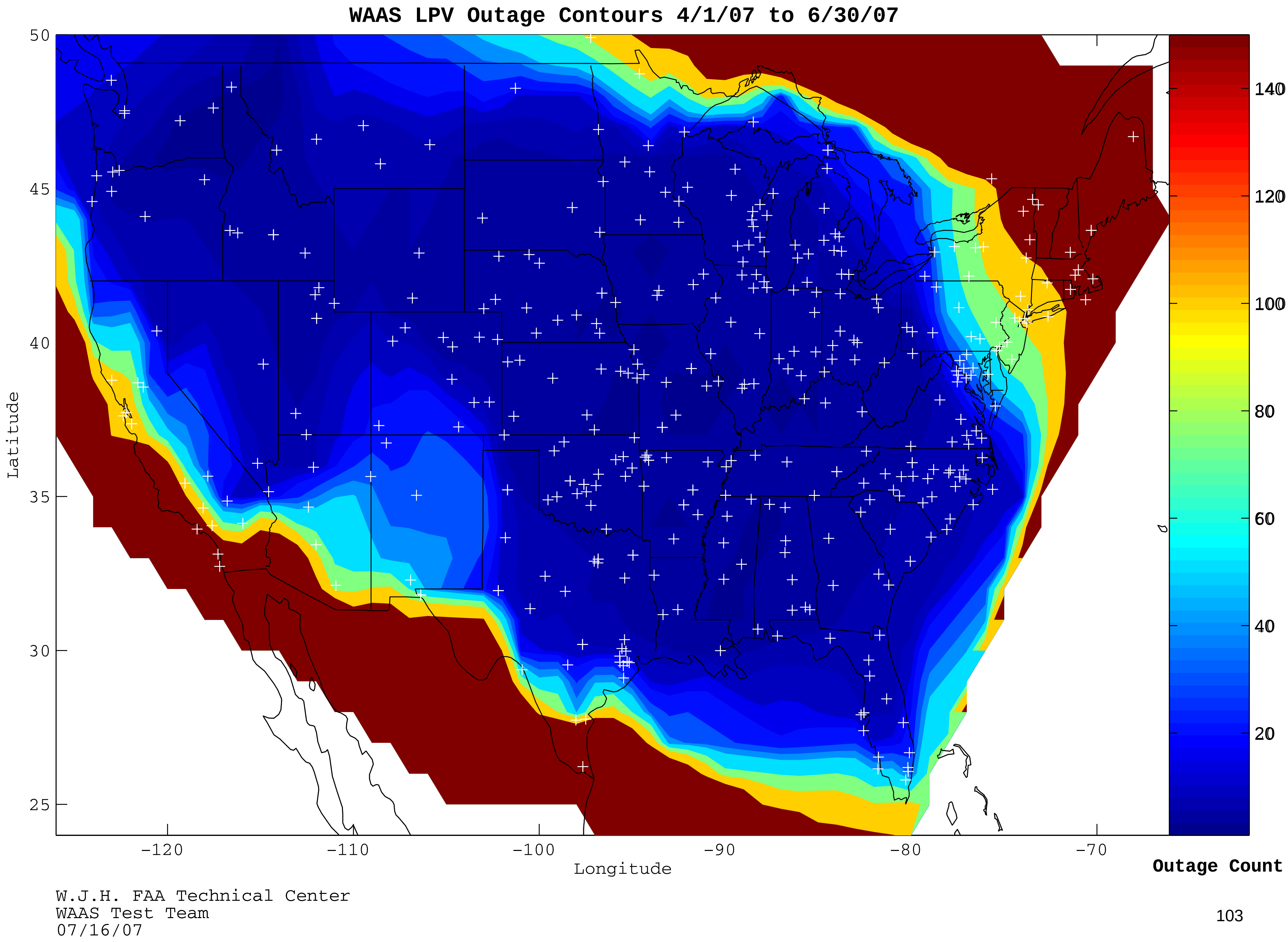


Figure 9-2 WAAS LPV Outage



10.0 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 10.1 recaps the results of that manual analysis.

Table 10-1 CNMP Bounding Statistics

WAAS Site	WRE	Jul 06	Aug 06	Sep 06	Oct 06	Nov 06	Dec 06	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07
Albuquerque	A	red	green	yellow	blue	green	green	blue	blue	blue	blue	blue	blue
	B	red	green	blue	blue	green	blue	blue	green	blue	blue	yellow	blue
	C	blue	yellow	red	blue	blue	blue	blue	yellow	blue	blue	blue	yellow
Anchorage	A	green	red	red	red	green	green	red	green	yellow	red	green	green
	B	red	red	red	yellow	red	red	green	green	red	red	yellow	yellow
	C	red	yellow	red	red	red	yellow	red	red	red	green	green	green
Atlanta	A	yellow	blue	blue	green	green	blue	blue	blue	blue	blue	blue	blue
	B	yellow	blue	blue	yellow	blue	blue	blue	blue	blue	blue	blue	blue
	C	green	yellow	blue	yellow	blue	blue	blue	blue	blue	blue	blue	blue
Billings	A	red	green	blue	blue	blue	blue	green	blue	green	blue	yellow	blue
	B	yellow	green	blue	blue	blue	green	green	blue	blue	blue	blue	blue
	C	green	blue	blue	blue	blue	blue	green	blue	green	blue	blue	yellow
Boston	A	yellow	blue	blue	blue	blue	green	blue	blue	blue	blue	green	blue
	B	blue	blue	yellow	green	green	yellow	blue	yellow	yellow	yellow	green	blue
	C	blue	yellow	blue	blue	green	blue	blue	blue	blue	blue	yellow	yellow
Chicago	A	green	yellow	blue	green	blue	blue	green	blue	green	blue	blue	blue
	B	blue	green	blue	blue	blue	yellow	green	blue	blue	blue	blue	blue
	C	blue	blue	red	blue	green	blue	blue	yellow	blue	blue	yellow	yellow
Cleveland	A	yellow	blue	blue	blue	green	yellow	green	green	yellow	green	yellow	blue
	B	blue	blue	green	green	blue	blue	blue	green	red	yellow	green	blue
	C	blue	green	yellow	green	yellow	yellow	green	blue	yellow	green	yellow	blue
Cold Bay	A	yellow	yellow	red	red	yellow	green	green	yellow	red	yellow	yellow	red
	B	red	red	yellow	yellow	red	red	red	red	red	yellow	red	red
	C	yellow	yellow	red	yellow	red	yellow	red	yellow	green	blue	green	red
Dallas	A	yellow	yellow	red	red	yellow	red	red	red	red	green	red	red
	B	red	red	red	red	red	red	yellow	red	red	red	yellow	red
	C	red	red	red	yellow	red	red	red	red	red	red	blue	blue
Denver	A	blue	blue	blue	yellow	green	blue	blue	yellow	yellow	yellow	blue	blue
	B	blue	blue	green	blue	blue	blue	blue	blue	yellow	blue	blue	blue
	C	yellow	yellow	green	blue	blue	yellow	blue	blue	green	green	blue	blue
Honolulu	A	blue	blue	yellow	green	red	green	yellow	green	green	green	green	yellow
	B	blue	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	green	blue	red	green	yellow	green	green	blue	red	green
Houston	A	green	green	yellow	yellow	red	green	green	yellow	yellow	yellow	green	green
	B	yellow	green	green	yellow	yellow	yellow	red	green	yellow	blue	green	red
	C	blue	green	yellow	yellow	yellow	red	green	red	red	yellow	yellow	green
Jacksonville	A	blue	yellow	blue	blue	green	blue	green	blue	blue	blue	blue	blue
	B	blue	green	blue	green	blue	green	green	green	blue	blue	blue	blue
	C	blue	blue	blue	green	blue	blue	green	blue	blue	blue	blue	blue
Juneau	A	yellow	green	blue	red	green	green	yellow	yellow	red	red	green	green
	B	blue	green	green	blue	blue	blue	blue	blue	yellow	red	blue	blue
	C	yellow	green	green	blue	green	blue	blue	blue	yellow	yellow	blue	blue
Kansas City	A	yellow	yellow	red	red	red	red	red	red	red	red	red	yellow
	B	red	red	red	red	yellow	green	yellow	red	red	blue	blue	yellow
	C	green	green	blue	red	red	red	green	blue	yellow	blue	blue	blue
Los Angeles	A	blue	green	yellow	green	blue	green	blue	blue	yellow	blue	yellow	red
	B	green	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow
	C	yellow	blue	yellow	blue	blue	blue	blue	blue	green	blue	blue	blue
Memphis	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	green	blue	blue	blue	blue
Miami	A	green	green	yellow	yellow	red	yellow	yellow	yellow	yellow	red	blue	green
	B	blue	blue	red	blue	blue	blue	green	green	blue	blue	blue	green
	C	yellow	yellow	red	green	blue	blue	yellow	blue	blue	red	blue	yellow
Minneapolis	A	red	red	red	red	red	red	green	yellow	red	red	red	red
	B	red	red	red	yellow	red	red	yellow	red	green	red	red	yellow
	C	yellow	yellow	green	blue	yellow	yellow	red	red	yellow	green	red	red
New York	A	yellow	yellow	blue	blue	blue	green	blue	blue	blue	green	blue	blue
	B	blue	blue	blue	blue	blue	yellow	yellow	green	blue	yellow	blue	blue
	C	red	red	green	blue	blue	red	red	red	red	red	green	green
Oakland	A	yellow	red	yellow	red	red	green	yellow	red	red	yellow	yellow	blue
	B	red	red	red	red	red	red	red	red	red	blue	green	blue
	C	red	yellow	red	red	red	red	red	green	red	yellow	red	red
Salt Lake City	A	yellow	red	red	green	yellow	yellow	red	red	red	red	blue	blue
	B	yellow	blue	red	yellow	green	yellow	green	yellow	yellow	green	red	yellow
	C	yellow	red	red	yellow	green	yellow	red	yellow	green	yellow	blue	yellow
San Juan	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	blue	yellow	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue
	C	blue	blue	blue	blue	blue	blue	blue	green	blue	blue	blue	blue

Seattle	A	red	red	red	red	green	red	green	green	red	yellow	blue	blue
	B	red	green	red	yellow	red	yellow	red	red	blue	red	blue	green
	C	red	green	green	blue	yellow	blue	blue	red	green	yellow	yellow	blue
Washington, DC	A	green	red	red	blue	blue	green	blue	green	yellow	yellow	blue	yellow
	B	red	yellow	blue	yellow	yellow	blue	yellow	yellow	blue	blue	blue	blue
	C	red	yellow	blue	yellow	red	yellow	green	green	yellow	blue	blue	blue

- **Excellent** - 3.29σ bounded 100%
- **Good** - 4σ bounded 100%
- **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review if symptoms repeat from month to month)
- **Poor** – Requires manual review

Shaded receivers represent legacy receivers (non-G2). These receivers are predominantly the trouble receivers, with over 95% of their failures occurring on the L2 frequency.

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.

DR. Discrepancy Report

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.