GNSS

SATELLITE NAVIGATION

FAA News
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FACT SHEET

Wide Area Augmentation System (WAAS)

WAAS Instrument Approaches Now Outnumber Instrument Landing System Approaches

In September 2008, the FAA passed a key milestone in its transition from a ground-based navigation infrastructure to an infrastructure based on satellites. The FAA has now published 1,333 Localizer Performance with Vertical guidance (LPV) approach procedures which are based on the Wide Area Augmentation System (WAAS), a space-based navigation system commissioned in 2003. This is significant as the number of approach procedures based on WAAS has now surpassed the number of approach procedures based on its ground-based predecessor, the Category-I Instrument Landing System (ILS). This is clearly a turning point for aviation and the way pilots navigate.

For the past 60 years, Category-I ILS has been used at airports throughout the National Airspace System (NAS) to guide aircraft to as low as 200 feet above the runway surface. WAAS, commissioned just five years ago, now provides this same capability, but at more runway ends. Today, WAAS LPVs can currently be found at 833 airports.

The number of WAAS LPVs will continue to grow. The FAA's goal is to produce 500 new WAAS procedures each year until every qualified runway in the NAS has one. Additionally, WAAS has enabled a new approach capability which will be introduced in 2009.

The WAAS signal is provided from space so there is no need for the FAA to install and maintain navigation equipment at an airport, such as that needed for an ILS. Additionally, safety is improved as more aircraft are provided with vertically-guided approaches and improved flight planning options enabled by WAAS.

Background

The Wide Area Augmentation System (WAAS) is a navigational system representing an enormous leap forward in air navigation. By virtue of its extensive coverage area, WAAS provides vertically-guided approach capability at thousands of airports and airstrips where this capability had previously not been affordable. It is a core element in transitioning to the satellite-based air traffic control system of the future.

Note: Quoted procedure and airport numbers current as of September 25, 2008 procedure publication date.

WAAS is designed to improve the accuracy and ensure the integrity of positioning and timing information from Global Positioning System (GPS) satellites.

- GPS alone does not meet FAA's navigation requirements for accuracy, integrity and availability for all operations; nor does GPS provide the necessary guarantees that its signal will be accurate, available, and safe to use at all times.
- WAAS corrects for the GPS satellite position errors, ionosphere delays, and other disturbances in the GPS signals, improving the accuracy and reliability of the users' position solution.
- More importantly, WAAS warns the pilot when the satellites are not functioning correctly and should not be used for navigation.

Although the WAAS was designed for aviation users, it supports a wide variety of non-aviation uses including agriculture, surveying, recreation, and surface transportation - just to name a few. The WAAS signal has been available for non safety-of-life applications since August 2000, and numerous manufacturers have developed WAAS-enabled GPS receivers for the consumer market. Today, there are millions of non-aviation WAAS-enabled GPS receivers in use.

WAAS was developed for the FAA by Raytheon Corporation.

How WAAS Works

WAAS uses a network of precisely-located ground reference stations that monitor GPS satellite signals. These stations are located throughout the continental U.S., Hawaii, Puerto Rico, Alaska, Canada and Mexico. The stations collect and process GPS information and send the information to WAAS master stations. The WAAS master stations develop a WAAS correction message that is sent to user receivers via navigation transponders on geostationary satellites. The WAAS message improves the accuracy, availability, and safety of GPS-derived position information. Using WAAS, GPS signal accuracy is improved from 20 meters to approximately 1.5 – 2 meters in both the horizontal and vertical dimensions. WAAS hardware consists of: 38 ground reference stations, 2 master stations, 2 geosynchronous satellites, 4 uplink stations, 2 operational control centers, and the WAAS terrestrial communications network.

Benefits

Two of the FAA's top goals are increased safety and greater capacity. WAAS provides for both, along with additional significant benefits:

- More vertically-guided approach procedures, which are proven to be safer than those without vertical-guidance.
- More flexible approach and departure routings, which will cut arrival times as well as enhance safety and noise abatement.
- More direct, fuel efficient and timely routings through the air traffic control system.
- Navigation source for Automatic Dependent Surveillance-Broadcast (ADS-B). Using WAAS, ADS-B can report a more accurate position to controllers and other aircraft flying in the area than can be provided by GPS alone.
- Navigation source for Terrain Avoidance Warning Systems, which warn pilots and controllers of proximity to the ground.
- Significant government cost savings due to the elimination of maintenance costs associated with older, more expensive ground-based navigation aids.

WAAS is a pioneering technology. Currently, no other navigation technologies exist to meet FAA requirements and user needs for the expansion of vertically-guided landing capabilities at thousands of additional airports.

Milestones

- ***July 2003*** - WAAS is commissioned by the FAA for instrument flight use supporting minimums as low as 250'.
- ***September 2003*** – The first WAAS LPVs are published.
- ***October 2004*** – FAA Administrator Marion C. Blakey announces that U.S. avionics manufacturers are building new WAAS receivers or upgrading existing GPS receivers to WAAS capability and urges aviation users to equip.
- ***December 2004*** - The FAA installs four additional WAAS reference stations in Barrow, Bethel, Fairbanks, and Kotzebue, AK as initial steps in a planned WAAS expansion.
- ***March 2005***- The FAA finalizes a Geostationary Satellite Communications Control Segment contract with Lockheed Martin for WAAS geostationary satellite leased services through 2016.
- ***June 2005*** - The first international WAAS reference station is installed in Canada.
- ***March 2006*** - Due to outstanding system performance, WAAS is approved to support lower minimums, as low as 200'.
- ***August 2006*** - WAAS service is expanded to cover all of Alaska.
- ***November 2006*** – A new WAAS GEO, the PanAmSat Galaxy XV, is integrated into WAAS, increasing WAAS availability throughout the U.S.
- ***July 2007*** – A second new WAAS GEO, the Telesat ANIK-F1R, is integrated into WAAS, completing the implementation of enhanced WAAS GEO coverage. Later in the same year, the original WAAS Inmarsat GEOs are phased out.
- ***September 2007*** – WAAS service is expanded to cover large portions of Canada and Mexico.
- ***June 2008*** – The number of WAAS LPV-capable avionics passes the 35,000 mark and continues to climb steadily each month.
- ***September 2008*** - The number of runways served by WAAS LPVs surpasses the numbers of runways served by ILS.

WAAS	APP CRS	Rwy Idg	9802
CH 56503	173°	TDZE	1286
W17A		Apt Elev	1295

RNAV (GPS) Z RWY 17L

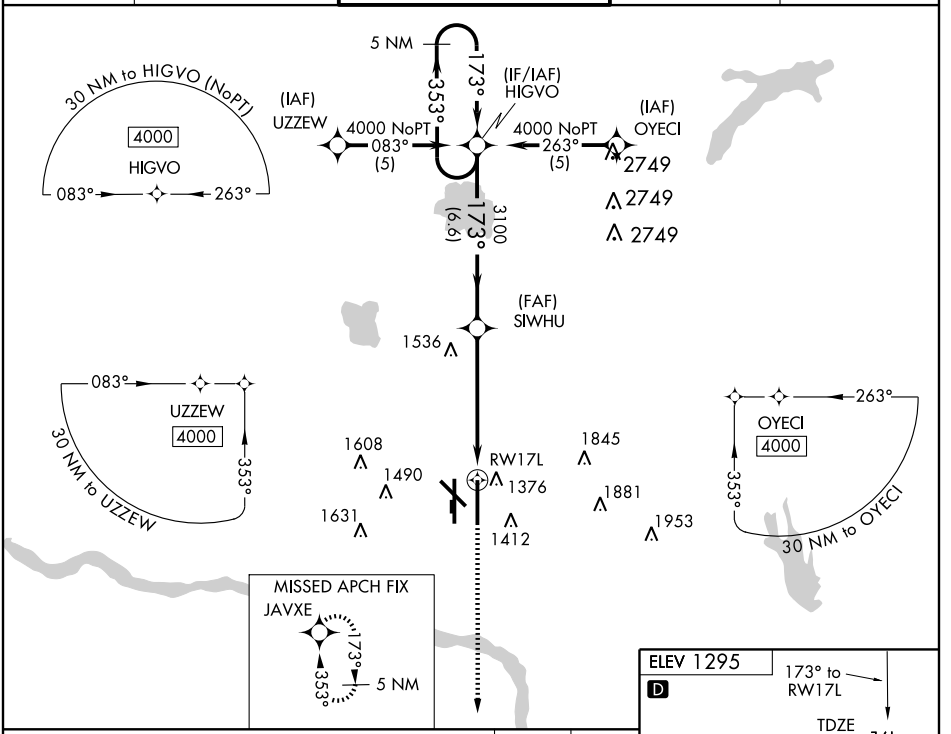
OKLAHOMA CITY/ WILL ROGERS WORLD (OKC)

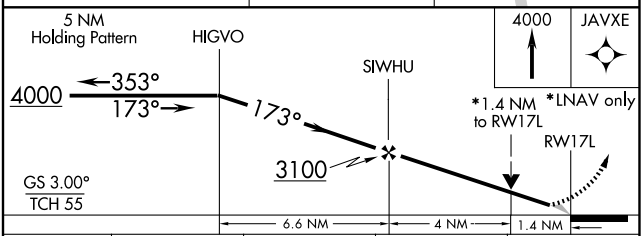
ASR — For inoperative MALSR, increase LNAV/VNAV Cat D visibility to RVR 5000. For uncompensated Baro-VNAV systems, LNAV/VNAV NA below -17°C (2°F) or above 46°C (114°F). DME/DME RNP-0.3 NA.

MALSR

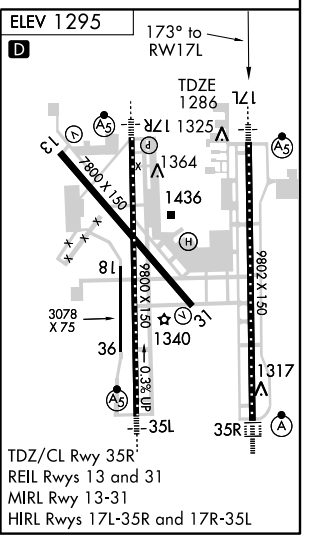
MISSED APPROACH: Climb to 4000 direct to JAVXE and hold.

ATIS	OKE CITY APP CON	ROGERS TOWER	GND CON	CLNC DEL
125.85	124.6 266.8	119.35 269.45	121.9 348.6	124.35





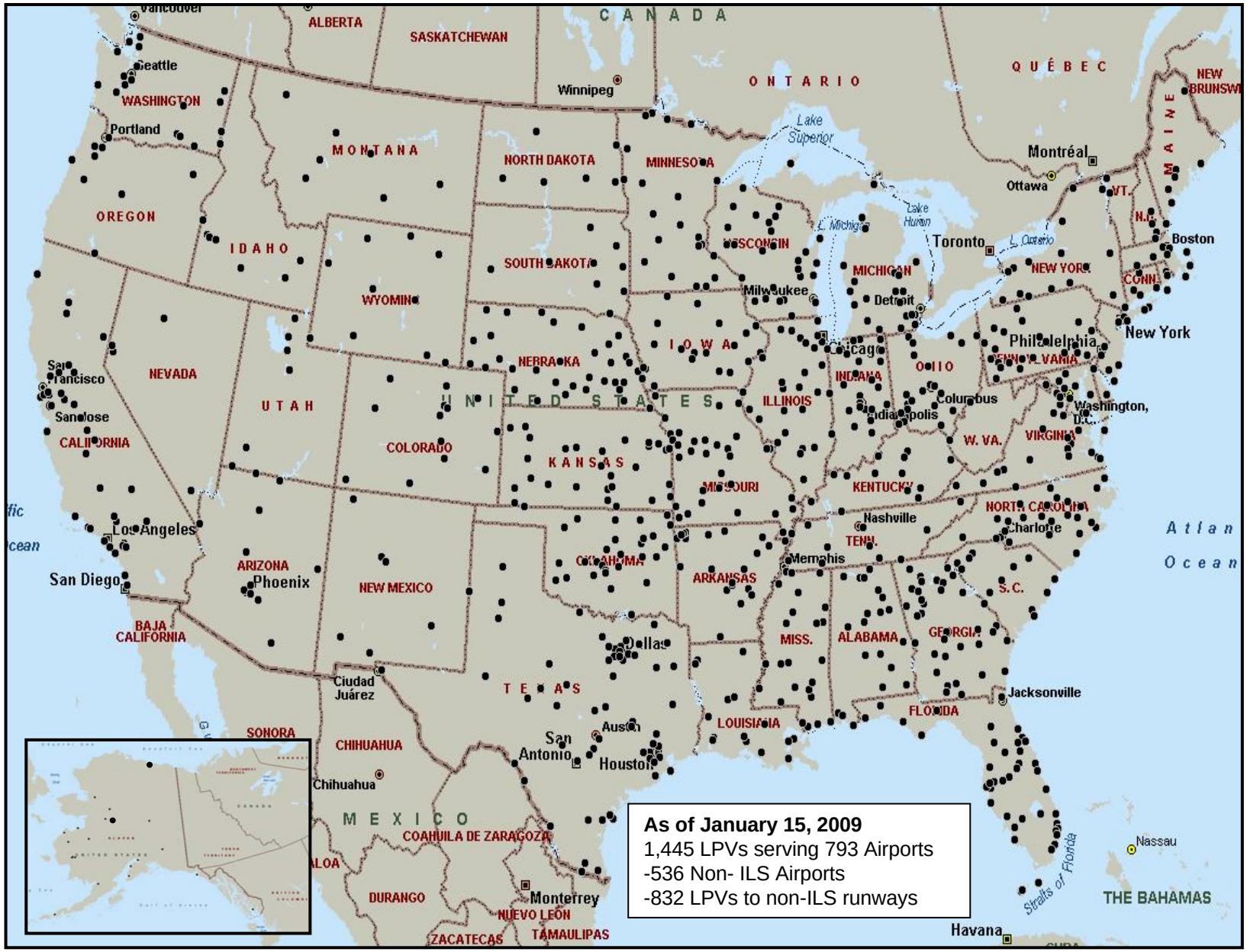
CATEGORY	A	B	C	D
LPV DA	1486/24 200 (200-½)			
LNAV/VNAV DA	1610/24 324 (400-½)			1610/40 324 (400-¾)
LNAV MDA	1800/24 514 (600-½)		1800/50 514 (600-1)	1800/60 514 (600-1¼)
CIRCLING	1800-1 505 (600-1)		1800-1½ 505 (600-1½)	1860-2 565 (600-2)



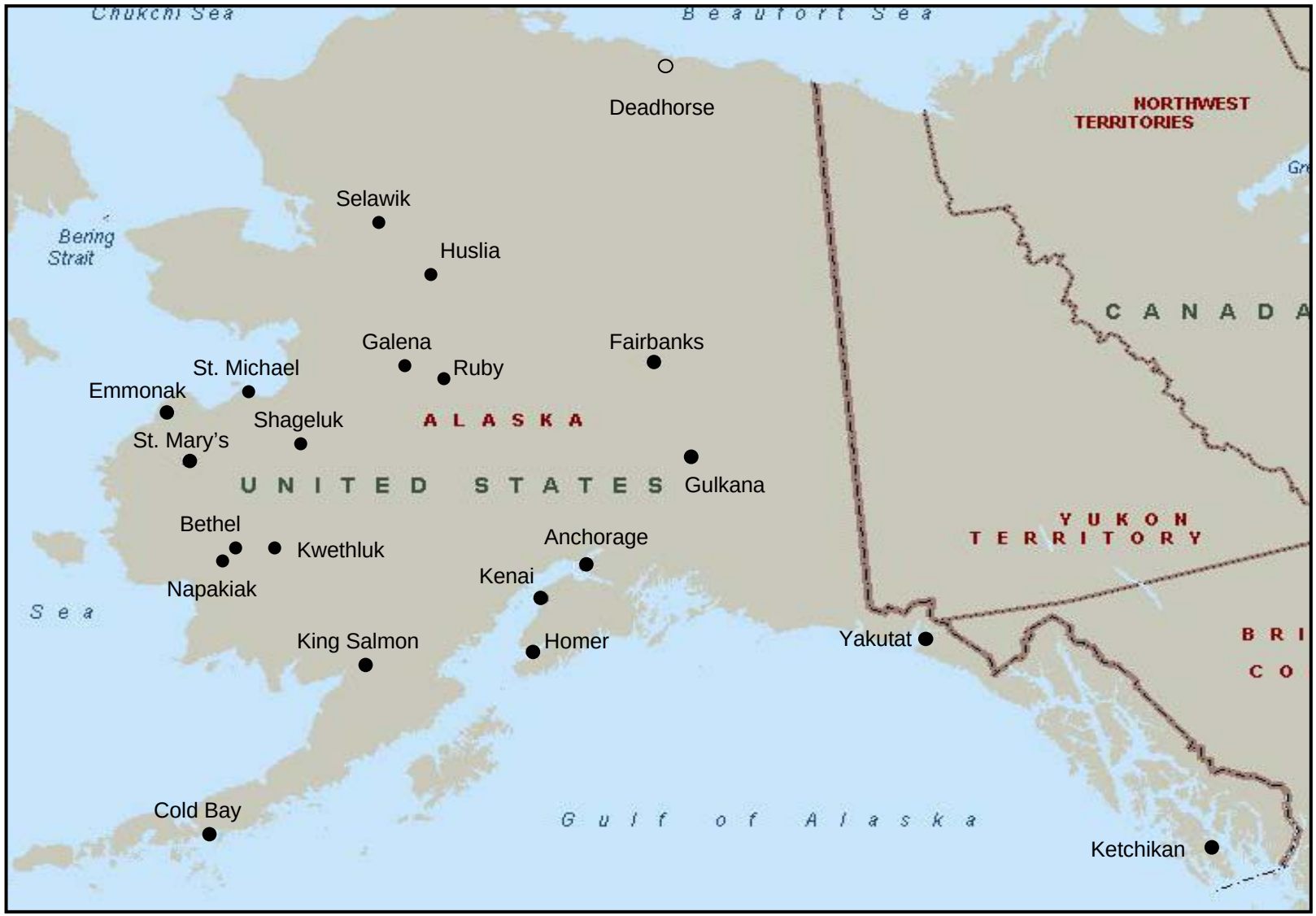
SC-1, 12 FEB 2009 to 12 MAR 2009
SC-1, 12 FEB 2009 to 12 MAR 2009


WAAS
Wide Area Augmentation System
GPS Satellites
Barrow
Kotzebue
Fairbanks
Bethel
Anchorage
Cold Bay
Juneau
Auburn
Billings
Salt Lake
Fremont
Palmdale
Longmont
Olathe
Aurora
Farmington
Winnipeg
Iqaluit
Goose Bay
Gander
Oberlin
Nashua
Ronkonkoma
Leesburg
Memphis
Hampton
Jacksonville
Miami
San Juan
Fort Worth
Albuquerque
Houston
Merida
San Jose Del Cabo
Puerto Vallarta
Mexico City
Tapachula
Honolulu
GEO Satellite
GEO Satellite
Wide-area Reference Station (WRS)
International WRS's
Wide-area Master Station (WMS)
Ground Uplink Station
as of 11/9/2007

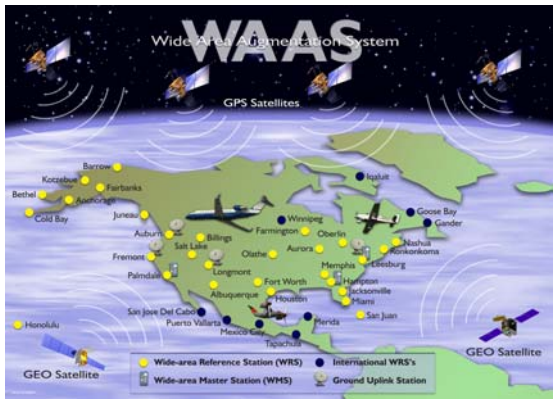
Airports with WAAS Supported Instrument Approaches with Vertical Guidance – Jan 15, 2009



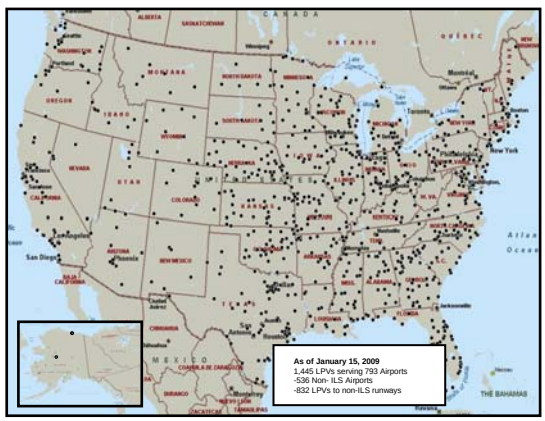
Alaska Airports with WAAS Supported Instrument Approaches with Vertical Guidance - Jan 15, 2009

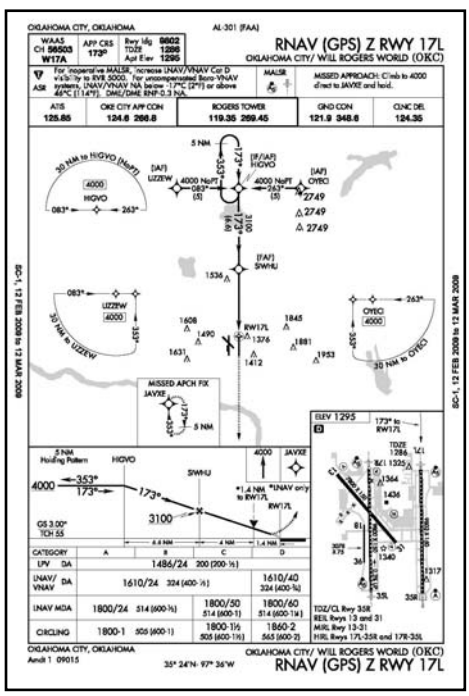


If you are interested in receiving an electronic version of these or any other graphics, please contact Tammy Jones or Paul Takemoto of the FAA Public Affairs Office at (202) 267-3883



Airports with WAAS Supported Instrument Approaches with Vertical Guidance





Federal Aviation Administration

WAAS: Quick Facts

Using WAAS, aircraft can access more than 1,300 runways in poor weather conditions with minimums as low as 200 feet. WAAS can even get you into places where ILS may not be available. In addition to its unprecedented benefits related to airport access, WAAS also offers a number of other benefits.

WAAS LPVs Provide Similar Level of Service to Category I ILS

- Vertical guidance
- Glide slope more stable than that of ILS
- Minimums as low as 200 feet
- Minimums lower than RNP and non-precision approaches

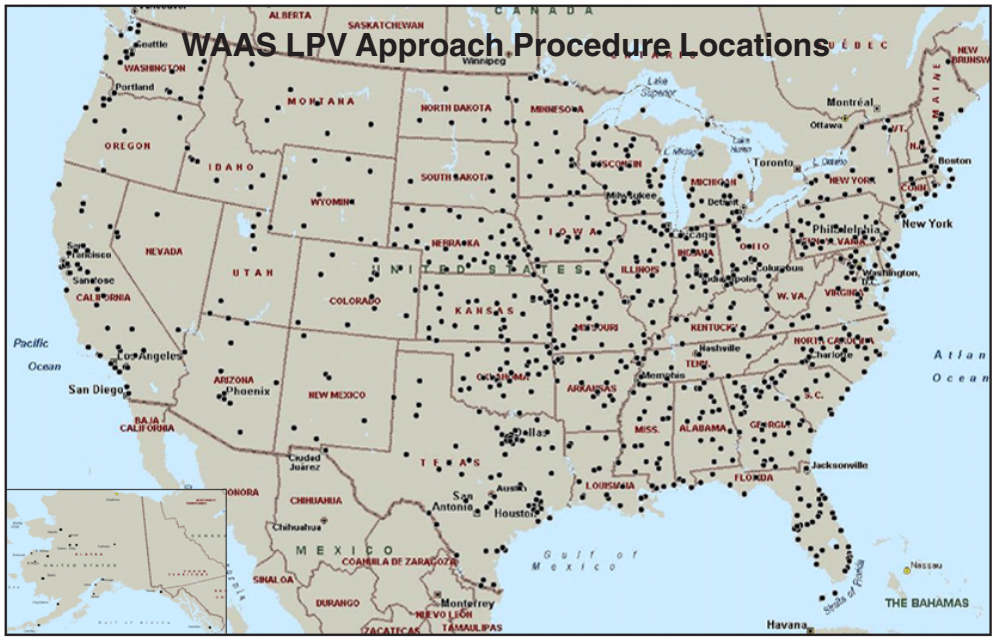
WAAS LPVs Outnumber Category I ILS Approaches Within the U.S.

As of September 25, 2008:

- 1,333 published LPVs
- Serving 833 airports
- Serving 386 non-ILS airports
- FAA is adding 500 new WAAS procedures each year

Benefits of WAAS compared with GPS for Flight Planning, Terminal and Enroute Operations

- Allows use of LNAV/VNAV minima without temperature restrictions
- Provides vertically-guided approach procedures capability at airports that do not have ground-based navigational aides *(Some infrastructure upgrades may be required to get the best possible minimums. More information is available in "Maximizing Airport Operations Using the Wide Area Augmentation System" available at http://gps.faa.gov.)*
- Is not affected by snow reflections that can impact ILS operations
- Allows RNAV (GPS) approaches to be used for alternate airport flight planning
- Increases number of alternate airport options which improves flight planning flexibiity
- Satisfies equipment requirements for 'T' and 'Q' routes (meets SFAR 97 in Alaska)
- Eliminates RAIM check requirement per AC 90-101A
- WAAS provides two additional ranging sources (from WAAS GEOs)
- Extension of terminal mode operations for both departure and arrival to beyond 30 miles from the airport reference point
- Increased accuracy and availability



For more information on exact locations, please visit http://gps.faa.gov and select button at bottom of page.

Talk to your Avionics Vendor about WAAS Today!

Who's Flying WAAS Today and in the Near Future?

Technical Details

GPS/WAAS Technical Standard Orders
TSO-C145c - "Airborne Navigation Sensors Using the GPS Augmented by the Satellite-Based Augmentation System"

TSO-C146c - "Stand-Alone Airborne Navigation Equipment Using the GPS System Augmented by the Satellite-Based Augmentation System"

WAAS Avionics

Garmin
- GNS 400W 500W series and GNS-480 (formerly Apollo CNX-80)
- Garmin 600, 900 and 1000 glass panel avionics

CMC Electronics
- 5024 sensor, 3024 sensor,
- CMA-4124 GNSSA OEM aviation GPS receiver

Rockwell Collins
- Proline 4/21
- GNLU-955 MMR in CL 604
- TSO Certification of GPS-4000S in FMC 6000
- TSO Certification of FMC 4200 w/GPS-4000S (CRJ-200 STC)

Bendex King
- KSN-770

Avidyne Smart Deck
- Smart Deck

Universal UNS-1EW series

Did we leave out your WAAS IFR receiver, sensor or STC? Or, If you are an avionics manufacturer and would like to be added to this list, contact Marty Heller representing the FAA's GNSS Operational Implementation Team at 703-841-2269 or martin.ctr.heller@faa.gov.

Talk to your Avionics Vendor about WAAS Today!