Navigation & Approaches and Pilot Decision Making

GPS Navigation and Approaches: Was It WAAS or WAAS It Not

Presented to: FAA Safety Seminar Attendees

By: W. J. Doyle, Jr., CFI A&I, AGI, IGI, FAAST Rep

Date: 09/01/2010 – 08/31/2011

Federal Aviation Administration

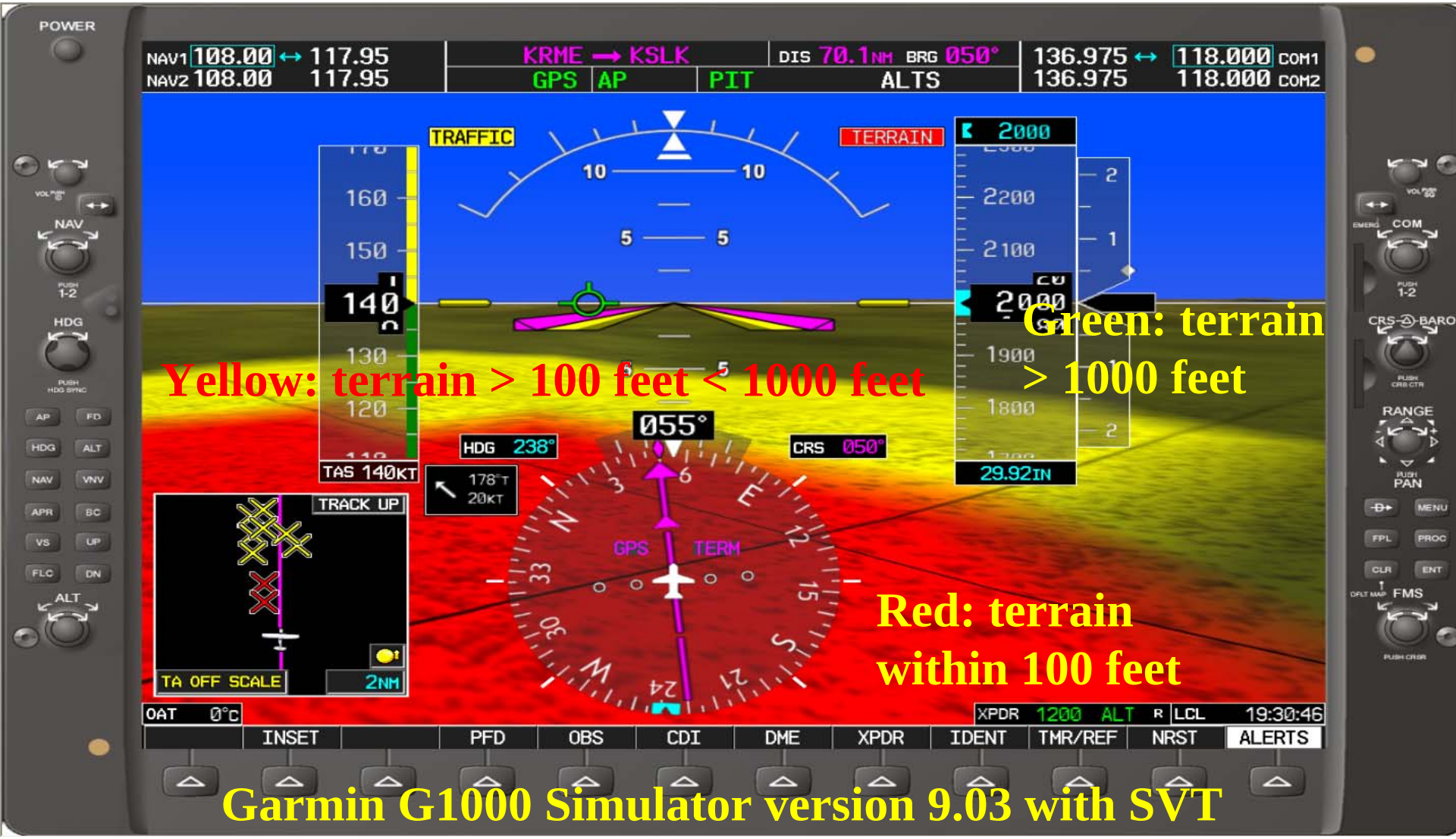
Setting the Stage – How Good Is Your En Route?

09/04/2004 En Route KMIV to KDYL in Cirrus SR20

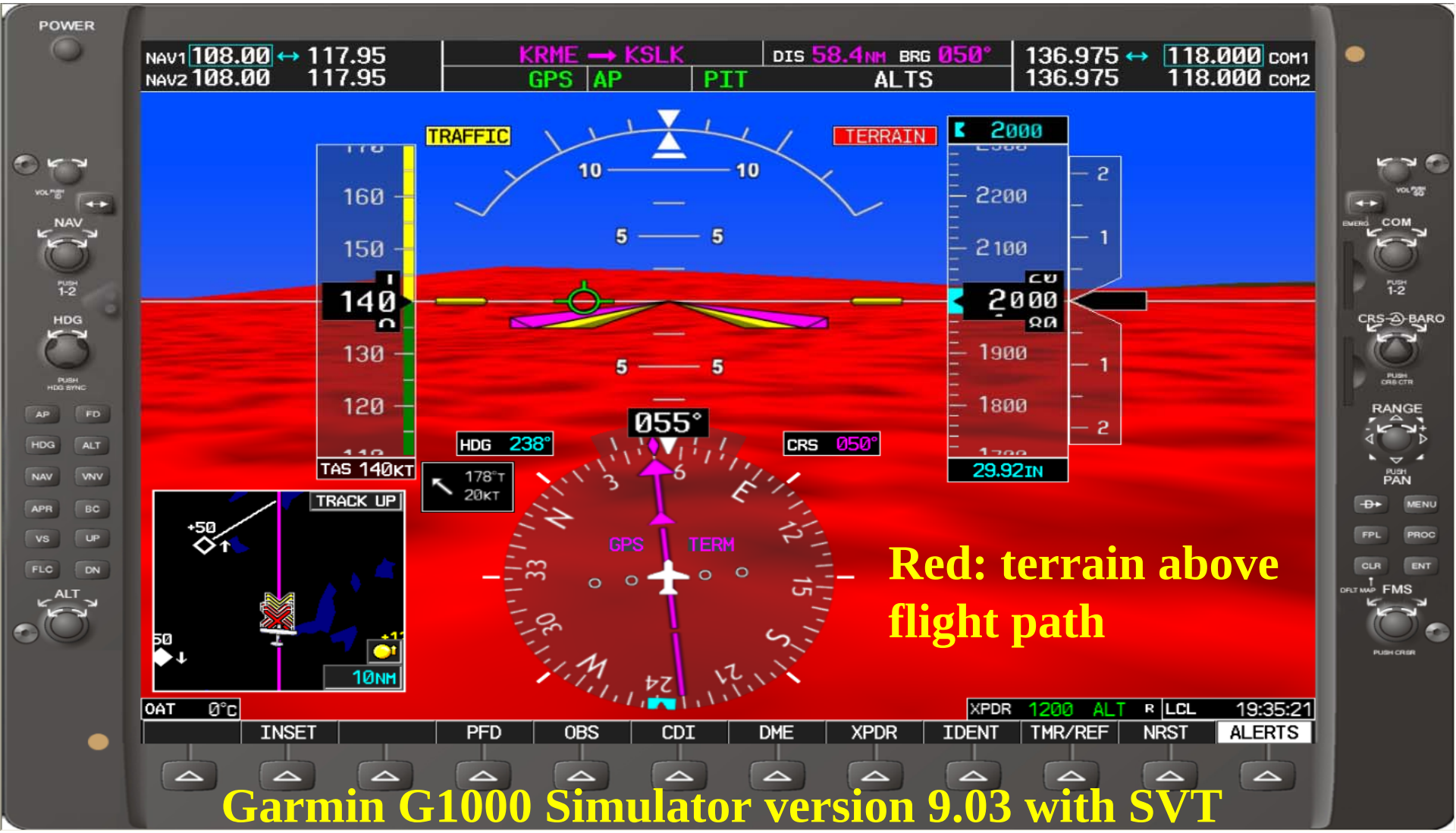
Setting the Stage – How Good Are Your Approaches?

Approach into Kai Tak Airport, Hong Kong

Anything Wrong With This Picture?



So What Do You Think? CFIT in the Making?



Garmin G1000 Simulator version 9.03 with SVT

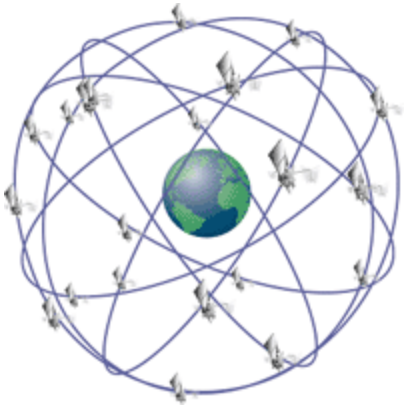
Presentation Agenda

- ***GPS – What is it?***
- ***Any GPS Preflight Tasks?***
- ***VOR to GPS Transition – What's it like?***
- ***Setting Up a GPS Flight Plan***
- ***WAAS – What is it?***
- ***Collection of GPS/WAAS Approaches for PA, NJ, and DE***
- ***Setting Up WAAS Approaches***
- ***What Are the Risks with Using GPS?***
- ***What Are Your Personal Minimums?***
- ***What are the NTSB Statistics on GPS?***
- ***AOPA Air Safety Foundation Statistics on TAA Accidents***
- ***How to Run NTSB Queries***

GPS
What is it?

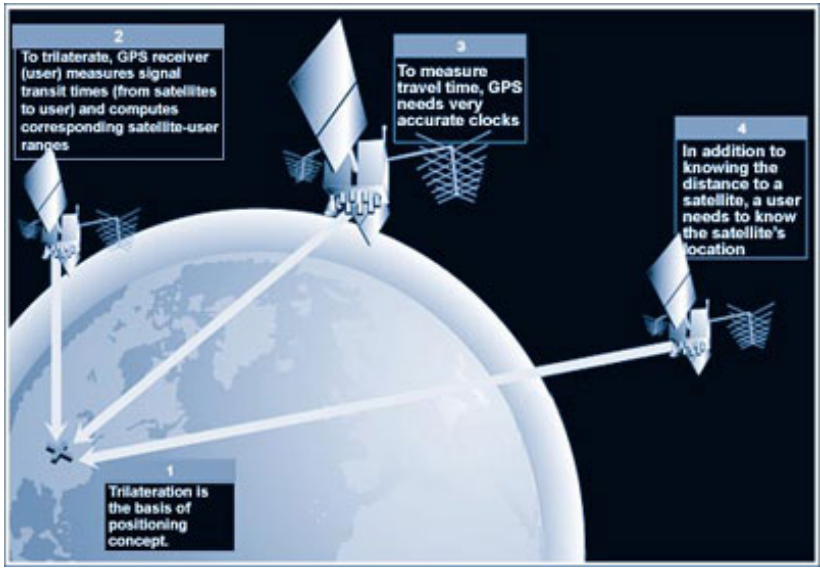
GPS – Global Positioning System

- **Space-based radio-navigation system consisting of**
  - Constellation of solar-powered satellites
  - Network of ground reference stations
- **Minimum of 24 GPS satellites**
  - Orbit the Earth
    - Altitude of ≈ 11,000 – 12,000 miles
    - Orbital velocity ≈ 7,000 mph
    - Two complete orbits every 24 hours
  - Provide accurate information on position, velocity, and time
    - Anywhere in the world
    - In all weather conditions
    - Non-WAAS receivers accurate to ≤ 15 meters
    - WAAS receivers accurate to ≤ 3 meters



GPS – Global Positioning System

- Worldwide aviation navigation
  - Arrival
  - Departure
  - Enroute
  - Landing
  - Surface and Oceanic
- Accurate, continuous, all-weather coverage
  - three dimensional coverage for GPS only
  - four dimensional coverage for GPS with augmentations
- Permits accurate aircraft position determination anywhere on or near the surface of the earth.



Any GPS Preflight Tasks?

FAR 91.103 – Preflight Action

– Each pilot in command shall, before beginning a flight, **become familiar with all available information concerning that flight.** This information **must include** –

a) For a flight under IFR or a flight not in the vicinity of an airport, **weather reports and forecasts, fuel requirements, alternatives** available if the planned flight cannot be completed, and **any known traffic delays** of which the pilot in command has been advised by ATC;

b) For any flight, **runway lengths at airports of intended use**, and the following takeoff and landing distance information:

1) For civil aircraft for which an approved Airplane or Rotorcraft Flight Manual containing takeoff and landing distance data is required, the **takeoff and landing distance data** contained therein; and

2) For civil aircraft other than those specified in paragraph (b)(1) of this section, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

Required Pre-Flight Activity – Database Check

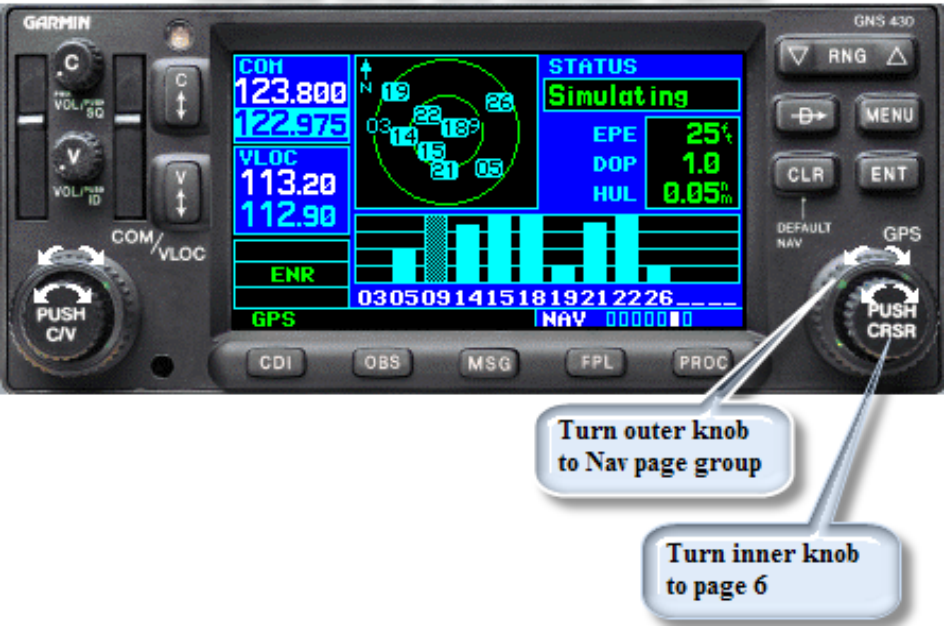
Garmin GNS 430 Database Currency Displays at Power Up

Garmin GNS 530 Database Currency Displays at Power Up

Required Pre-Flight Activity – Database Check

Required Pre-Flight Activity – Satellite Check

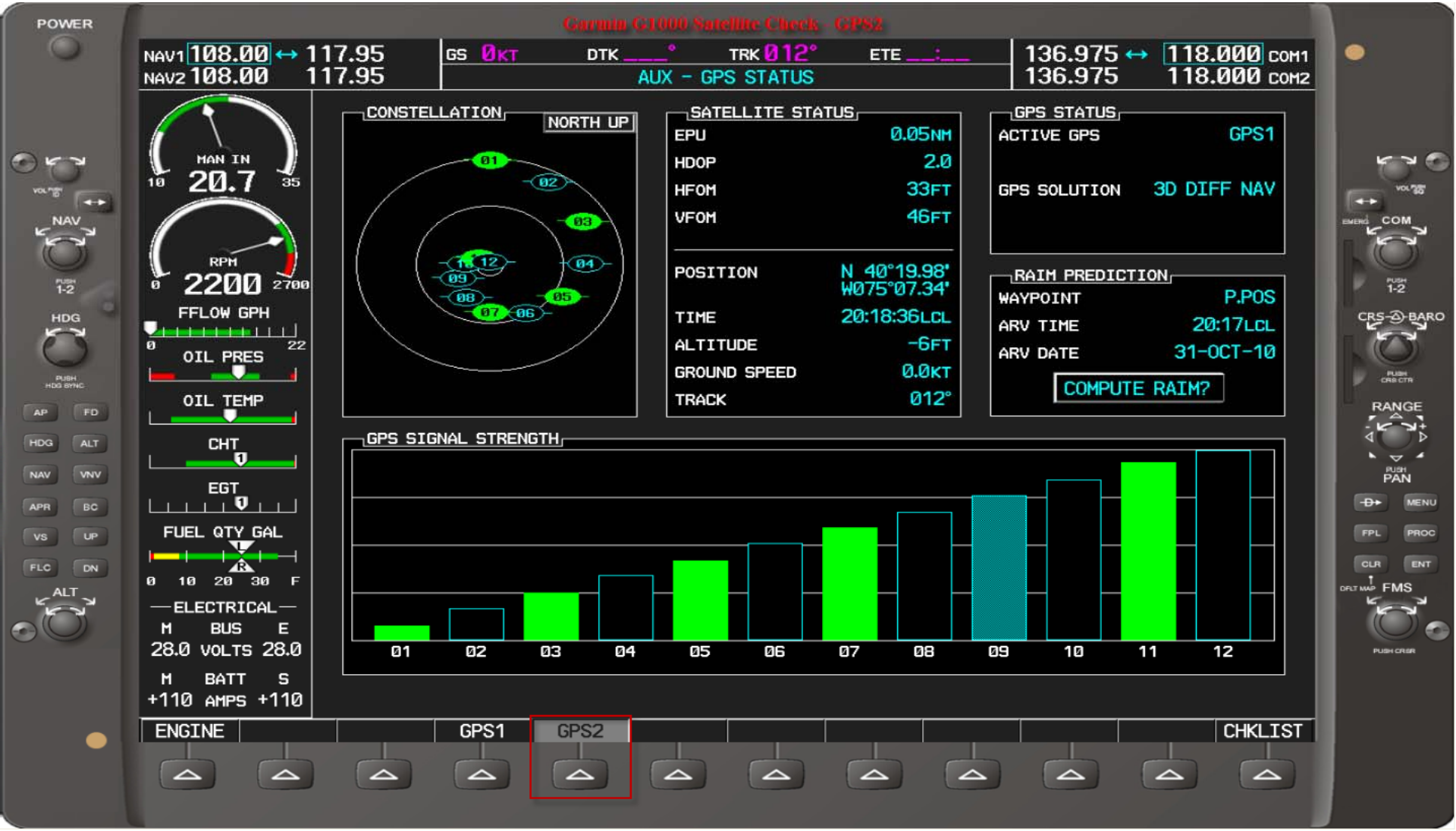
Garmin GNS 430 Satellite Check



Garmin GNS 530 Satellite Check

Required Pre-Flight Activity – Satellite Check

Required Pre-Flight Activity – Satellite Check



VOR to GPS Transition
What's it like?

En Route Information: VOR vs. GPS

- **VOR**
  - You need to keep the Course Deviation Indicator (CDI) centered
  - If CDI shifts left, you are right of course
    - Turn left, use a 30° intercept to reestablish
    - When CDI centers you are on course
  - If CDI shifts right, you are left of course
    - Turn right, use a 30° intercept to reestablish
    - When CDI centers you are on course
- **GPS**
  - You can see the airplane's course deviation on the Moving Map
  - Turn left or right to reestablish on the magenta course line

VOR Display of Course

- **Route: Doylestown Airport to Pottstown VOR**
  - KDYL to PTW on the 084° Radial
- **The VOR representation below shows**
  - Centered CDI on the 264° Bearing to the VOR
  - Tail of the arrow shows the radial
- **Need to set frequency in NAV radio**
  - 116.5

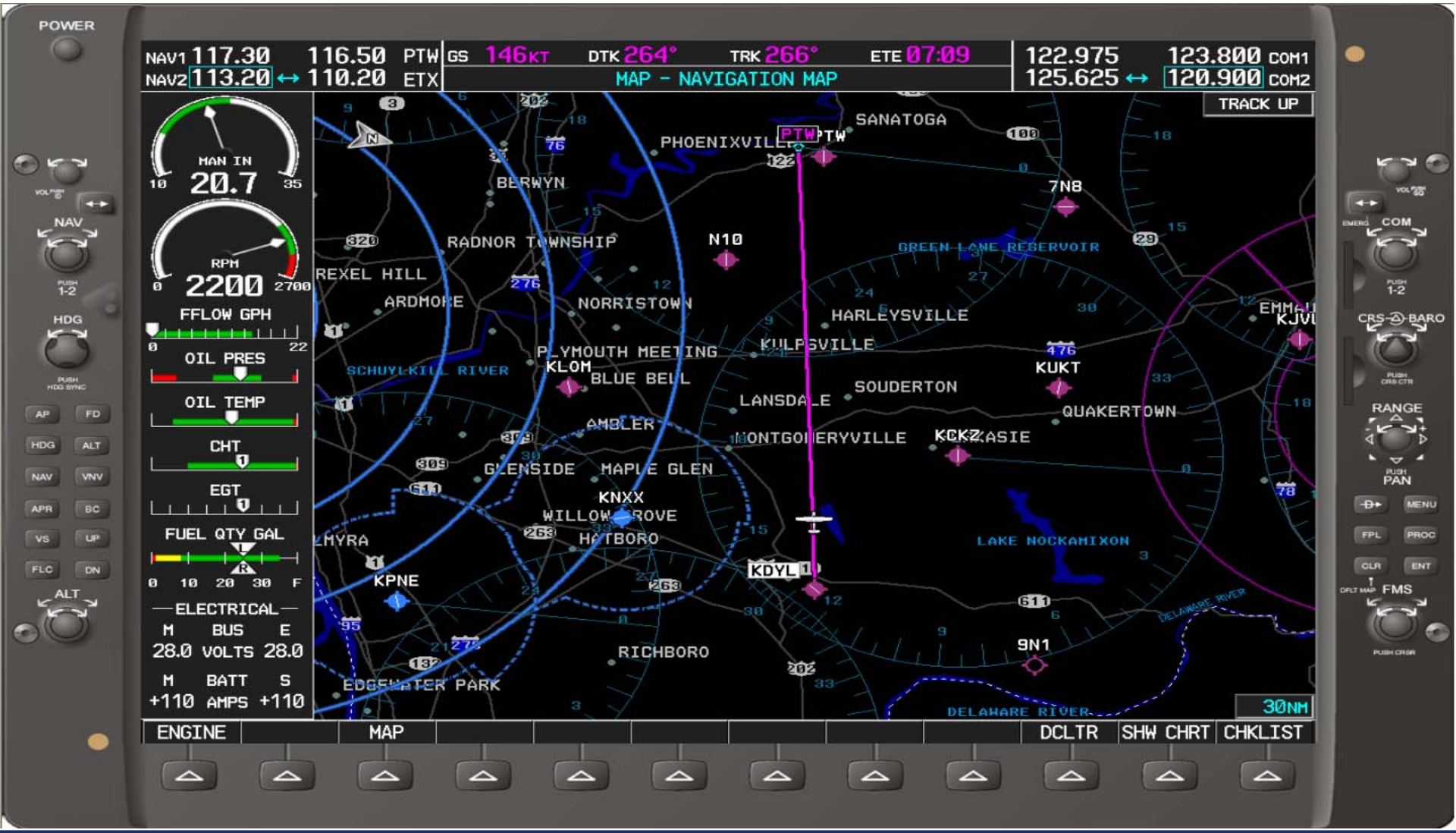
KDYL Direct to PTW VOR

GPS – En Route Course - Garmin 430 and Garmin 530

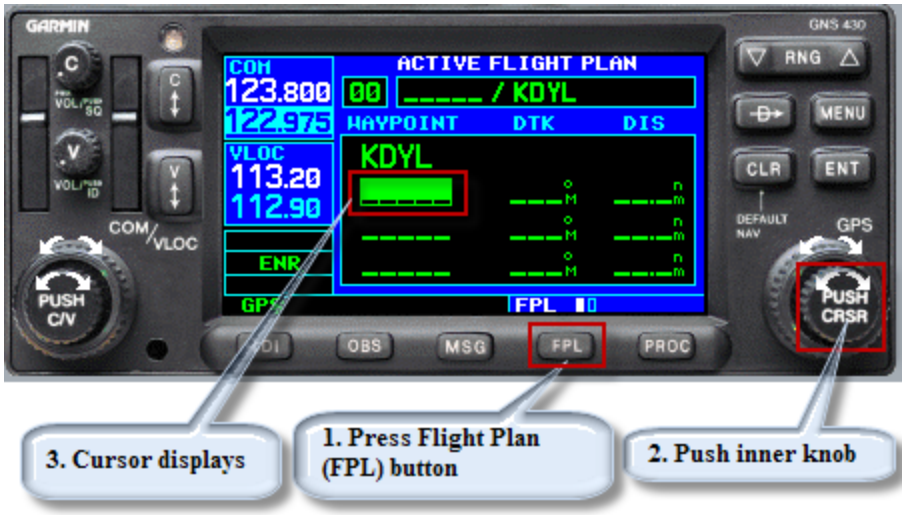
Garmin GNS 430 En Route KDYL to PTW

Garmin GNS 530 En Route KDYL to PTW

GPS – En Route – Garmin G1000 MFD



GPS – Setting Up Flight Plan - Garmin 430



GPS – Setting Up Flight Plan - Garmin 430

Intersections and Holds: VOR vs. GPS

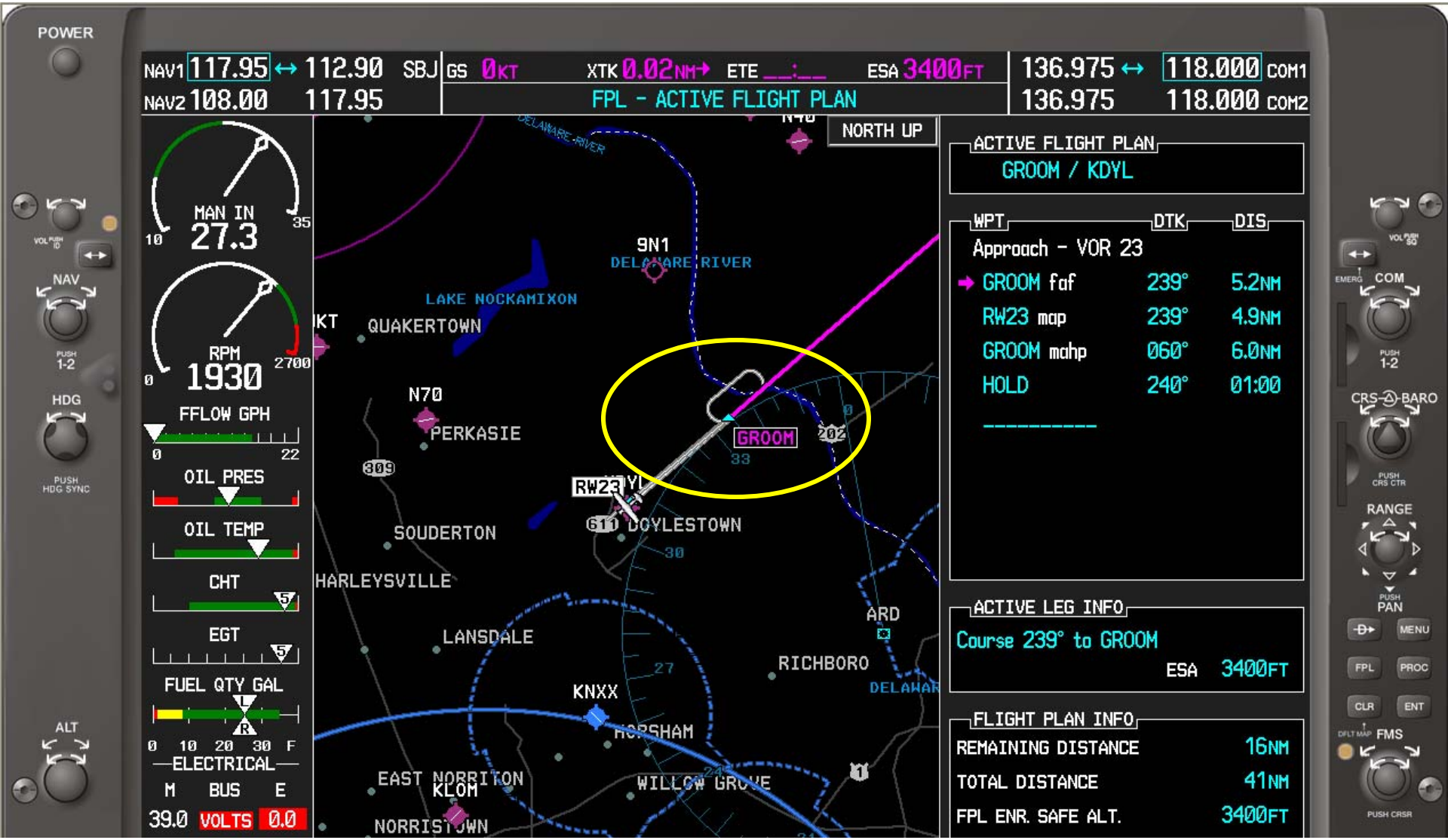
- **VOR**
  - You need to visualize the Intersection or Hold
  - Look at an en route chart
- **GPS**
  - You can see the Intersection or Hold on the Moving Map

VOR Display of Intersection

- **Visualize Intersection with two centered CDI needles**

GPS - Intersection and Hold - Garmin 530

GPS - Intersection and Hold – Garmin G1000 MFD



VOR vs. GPS for ILS Approach

VOR vs. GPS - ILS Instrument Approach

- **Route of Flight**
  - 3,000 feet MSL over Braden Airpark (N43), Easton, PA to Lehigh Valley International Airport (KABE), Allentown, PA for ILS 24
  - N43 ⇨ MUDRE (IAF, course reversal hold) ⇨ MUSYK (FAF) ⇨ KABE
- **VOR only**
  - Set Navigation radio frequencies
    - NAV1 radio to 108.55, identify IGUW localizer via Morse code
    - NAV2 radio to 112.9, identify SBJ VOR via Morse code
  - Set the OBS on VOR1 to 243° and VOR2 to 129 °
- **GPS**
  - Enter the flight plan in your Garmin 430, 530, or G1000
  - Select the instrument approach procedure in your Garmin 430, 530, or G1000
  - You can see the route on the MFD
  - For Garmin 430 and 530 – set OBS or VOR1 or H.S.I. to 243°, identify LOC
  - For Garmin G1000 – set up everything in PFD and MFD

VOR-Only ILS Approach

- **N43 to KABE Using VORs and Intersections**

Steam Gauge VOR Routing - N43 to KABE ILS24									
From	To	NAV1 Freq	VOR1 Name	VOR1 OBS	NAV2 Freq	VOR2 Name	VOR2 OBS	DME Distance	Comments
N43	MUDRE	110.2	ETX	249° To	112.9	SBJ	129° To	13.6	N/A
MUDRE	MUSYK	108.55	IGUW	243° To	110.2	ETX	Direct	6.0	ETX For
MUSYK	KABE	108.55	IGUW	243° To	110.2	ETX	Direct	7.6	Miss

Intercepting the Localizer

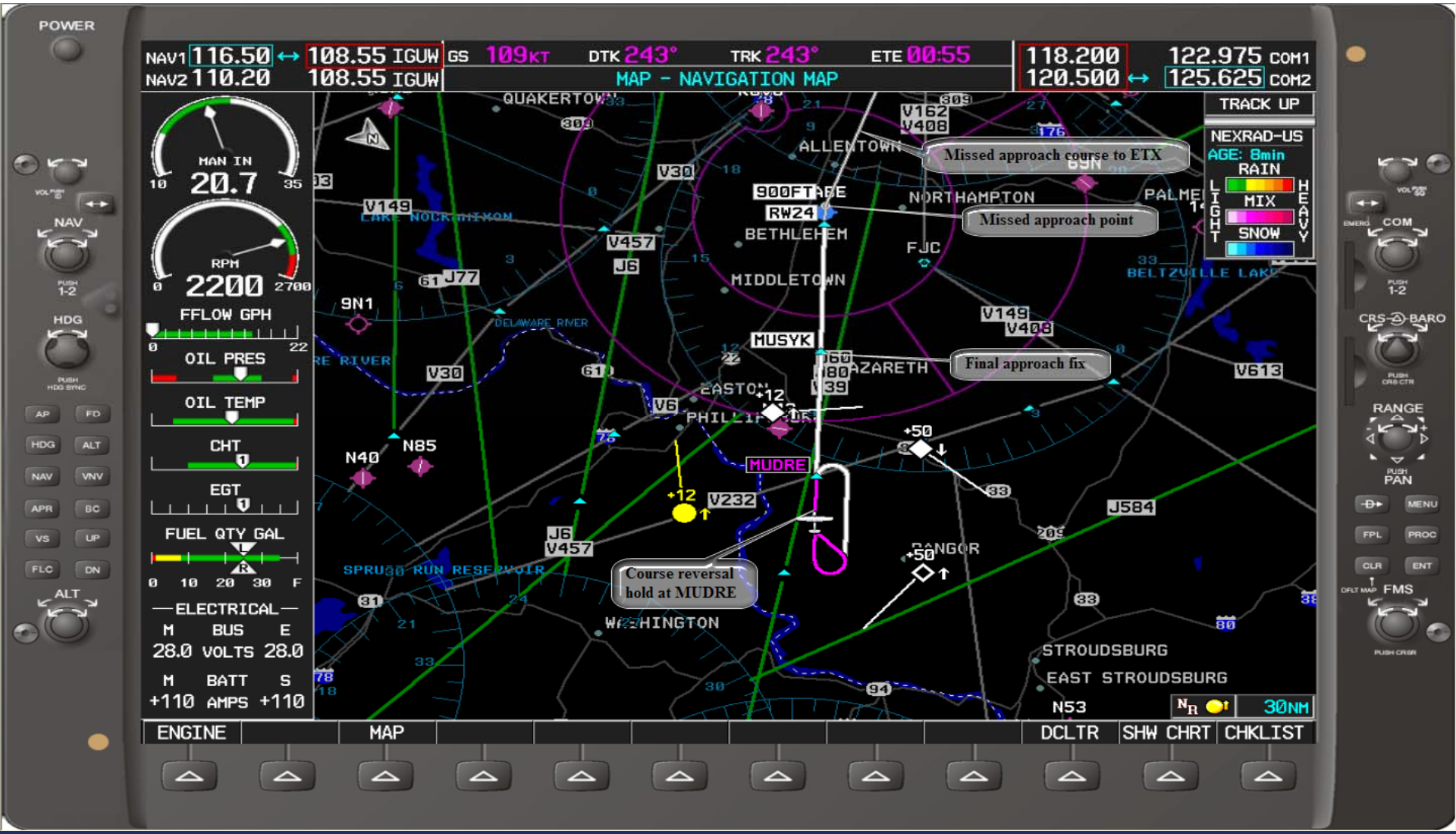
On Course On Glideslope

GPS ILS Approach – Garmin GNS 530

On Course
On Glideslope

GPS ILS Approach – Garmin G1000
PFD View in Reversionary Mode

GPS ILS Approach – Garmin G1000 – MFD View



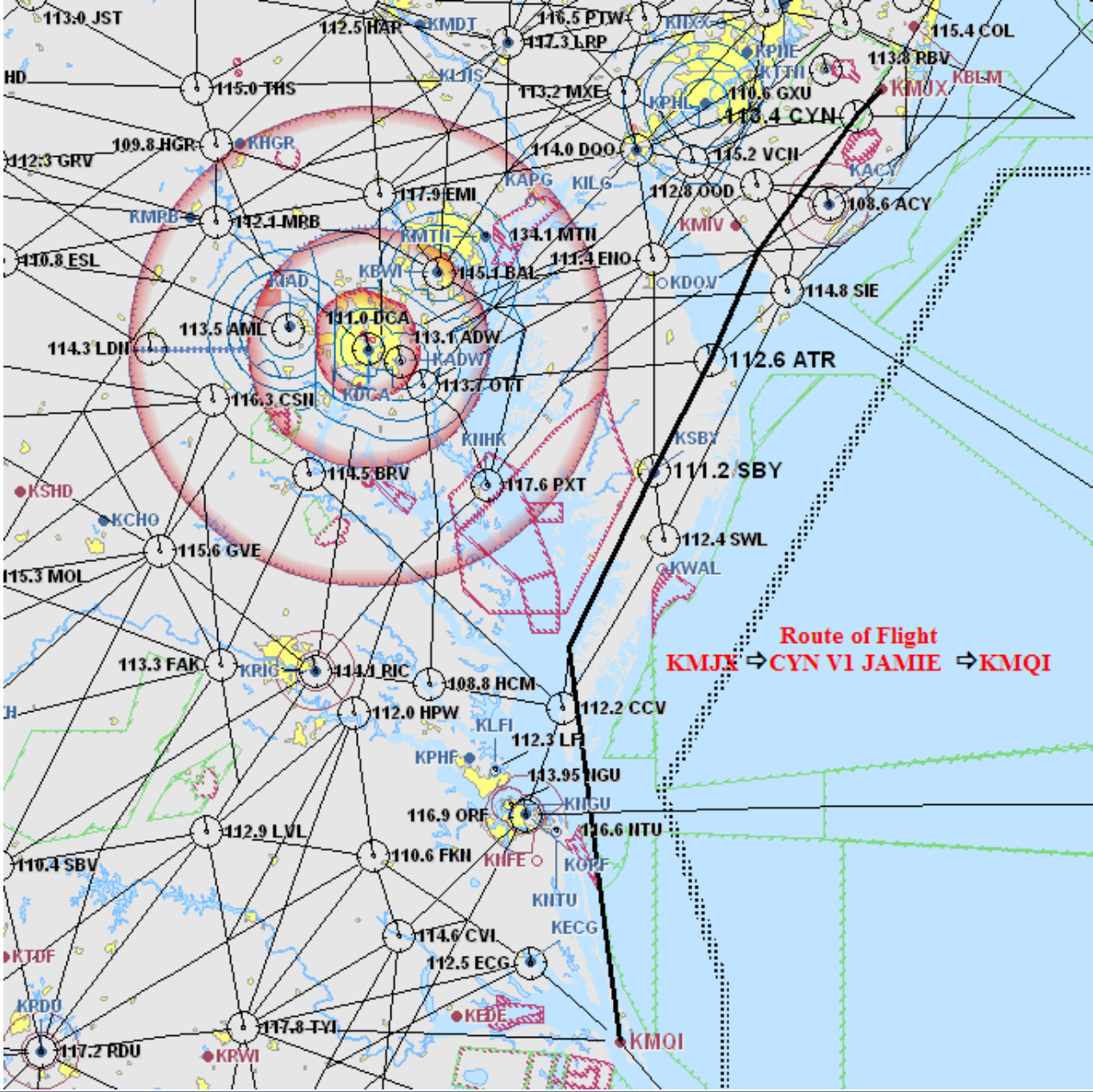
VOR vs. GPS for Cross Country Flight Planning

VOR vs. GPS
Cross Flight Planning

- **Route of Flight (using Victor Airways**
  - R. J. Miller Airpark (KMJX), Toms River, NJ to Dare County Regional Airport (KMQI), Manteo, NC
  - KMJX ⇨ CYN V1 JAMIE ⇨ KMQI
- **Steam Gauges**
  - You need to visually track the route on a low altitude enroute chart
  - Set and flip-flop NAV frequencies on NAV1 radio, maybe NAV2
  - Set the OBS on VOR1 and maybe VOR2
- **TAA**
  - You enter the flight in your Garmin 430, 530, or G1000
  - You can see the route on the MFD

Planned Route of Flight - Enroute Chart

From AOPA's Internet Flight Planner with permission



AOPA Internet Flight Planner

Powered by Jeppesen

NAVIGATION LOG

Route:	KMJX -> KMQI
Report Date:	January 26, 2011 20:25 Z
Departure:	January 26, 2011 22:21 Z
Aircraft:	Cessna Skylane 182
Tail #:	N584LQ

Filed Route
CYN V1 JAMIE

Waypoints Fixes	MEA / (MORA) FREQ	Route ALT	MC MH	Fuel (gal) LEG REM	Dist (Mi) LEG REM	GS (MPH) EST ACT	ETE TTE	ATE ATA	WIND OAT
KMJX MILLER N39° 55.650' W74° 17.543'				85	302				
CYN COYLE N39° 49.039' W74° 25.897'	(2200)		236	2	11	104	**00:06**		058@15
	113.40	5393	**235**	84	292		00:06		2°C
LEEAH N39° 15.654' W74° 57.183'	1800	V1	228	3	47	137	**00:21**		084@21
		6000	**221**	80	244		00:27		3°C
ATR WATERLOO N38° 48.589' W75° 12.679'	1800	V1	216	3	34	121	**00:17**		132@12
	112.60	6000	**211**	78	210		00:44		1°C
SBY SALISBURY N38° 20.700' W75° 30.635'	2000	V1	218	3	36	106	**00:20**		189@20
	111.20	6000	**216**	74	174		01:04		0°C
JAMIE N37° 36.343' W75° 57.813'	2000	V1	217	4	57	125	**00:27**		337@00
		6000	**217**	70	117		01:31		2°C
KMQI DARE CO REGL N35° 55.139' W75° 41.732'	(2200)		183	10	117	115	**01:01**		252@29
		13	**197**	60	0		02:32		
			ROUTE TOTALS	**25**	**302**		**02:32**		

From AOPA's Internet Flight Planner with permission

VOR Cross Country

- **KMJX to KMQI Using VORs and Intersections**

Steam Gauge VOR Routing - KMJX to KMQI								
From	To	NAV1 Freq	VOR1 Name	VOR1 OBS	NAV2 Freq	VOR2 Name	VOR2 OBS	Distance
KMJX	CYN	113.4	CYN	235° To	N/A	N/A	N/A	9
CYN	LEEAH	113.4	CYN	226° Fr	111.4	ENO	275° To	41
LEEAH	ATR	112.6	ATR	213° To	N/A	N/A	N/A	30
ATR	SBY	111.2	SBY	219° To	N/A	N/A	N/A	31
SBY	JAMIE	111.2	SBY	218° Fr	112.2	CCV	196° To	49
JAMIE	CCV	112.2	CCV	196° To	N/A	N/A	N/A	16
CCV	ORF	116.9	ORF	224° To	N/A	N/A	N/A	29
ORF	ECG	112.5	ECG	204° To	N/A	N/A	N/A	38
ECG	RBX	111.6	RBX	153° To	N/A	N/A	N/A	31
							Total	**274**

GPS Cross Country – Garmin GNS 530
Setting Up the Flight Plan

GPS Cross Country – Garmin GNS 530
Moving Map Display of Flight Plan

GPS Cross Country – Garmin G1000

Setting Up the Flight Plan

“Gotchas” with Garmin 530/430/420 Units

Cross-Filling Flight Plans with Dual Garmin GNS 530 - GNS 430 – GNC 420 GPS Units

- Good safety feature to cross-fill plans on the dual GPS units
- Press Menu button
  - Select Cross-fill from Page Menu
- Can cross-fill from
  - GPS1 to GPS2, or
  - GPS2 to GPS1
- Sending unit cannot cross-fill from NAV page 2 (Moving Map)
- Sending unit can be on
  - NAV 1, 3, 4, 5, or 6, or
  - Another Page Group

Common Errors Activating ILS Approach on Garmin GNS 430 GPS

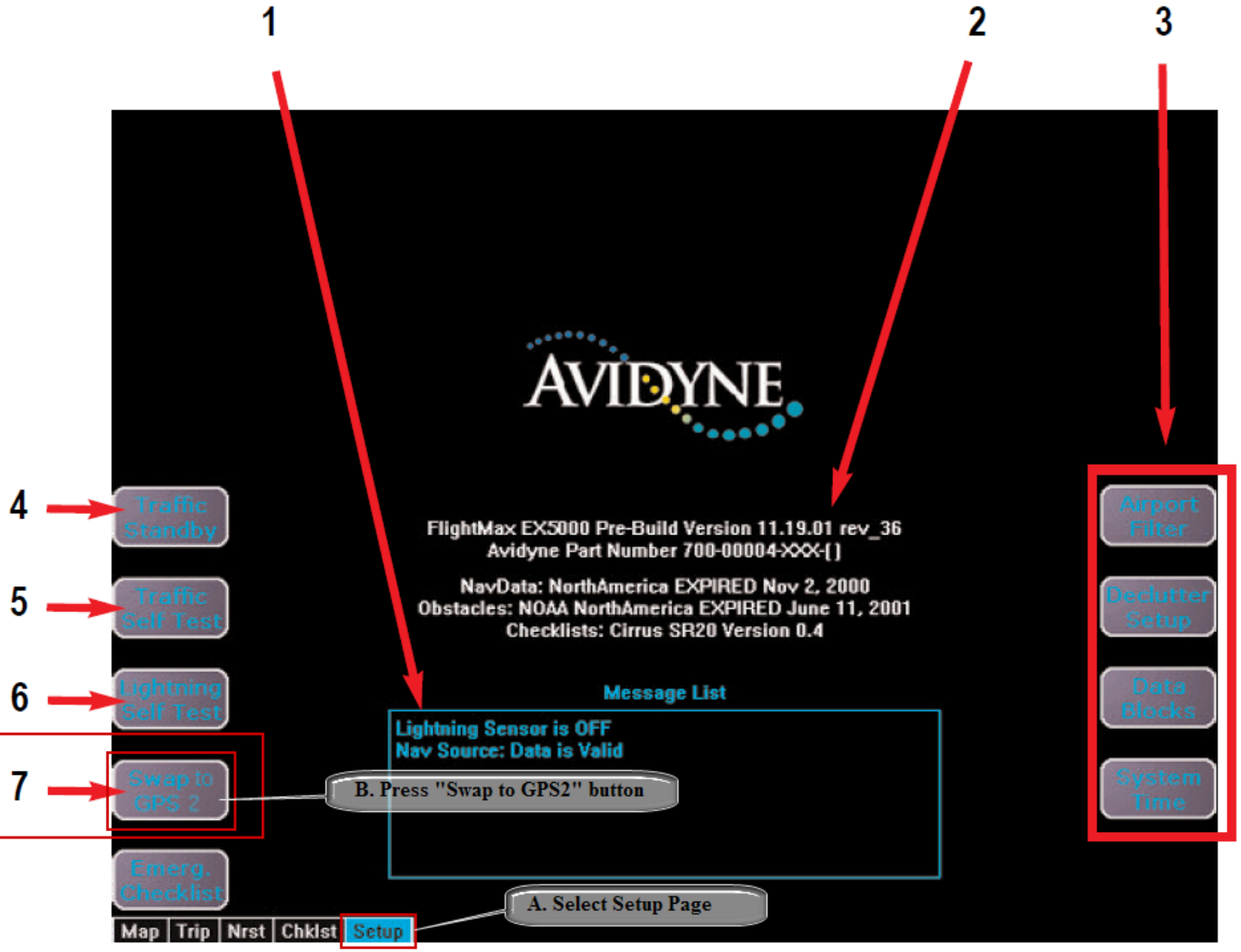
- Activating the approach from the Procedure Page does not automatically
  - Switch CDI from GPS to VLOC
  - Make LOC frequency active
- Pilots often forget this
- Press CDI button to
  - Switch from GPS to VLOC
- Press Navigation Frequency flip-flop button to
  - Switch LOC frequency from Standby to Active

Common Errors Activating ILS Approach on Garmin GNS 530 GPS

- Activating the approach from the Procedure Page does not automatically
  - Switch CDI from GPS to VLOC
  - Make LOC frequency active
- Pilots often forget this

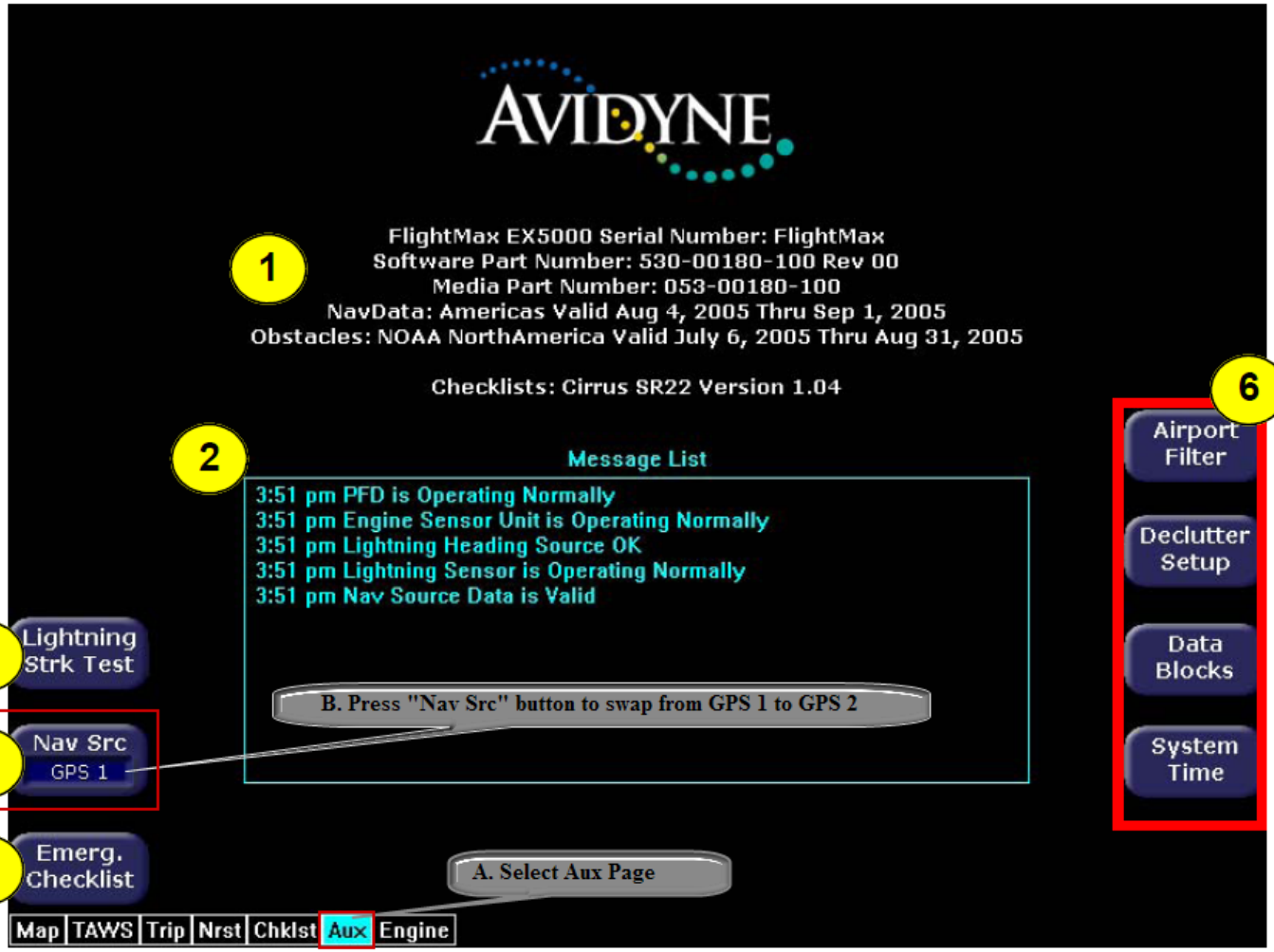
- Press CDI button to
  - Switch from GPS to VLOC
- Press Navigation Frequency flip-flop button to
  - Switch LOC frequency from Standby to Active

Switching GPS Source on Avidyne MFD When GPS1 Fails



- Avidyne MFD version on Cirrus SR20 v1
  - Select Setup Page
  - Press “Swap to GPS2” button
- May need to use Autopilot in Heading mode

Switching GPS Source on Avidyne MFD When GPS1 Fails

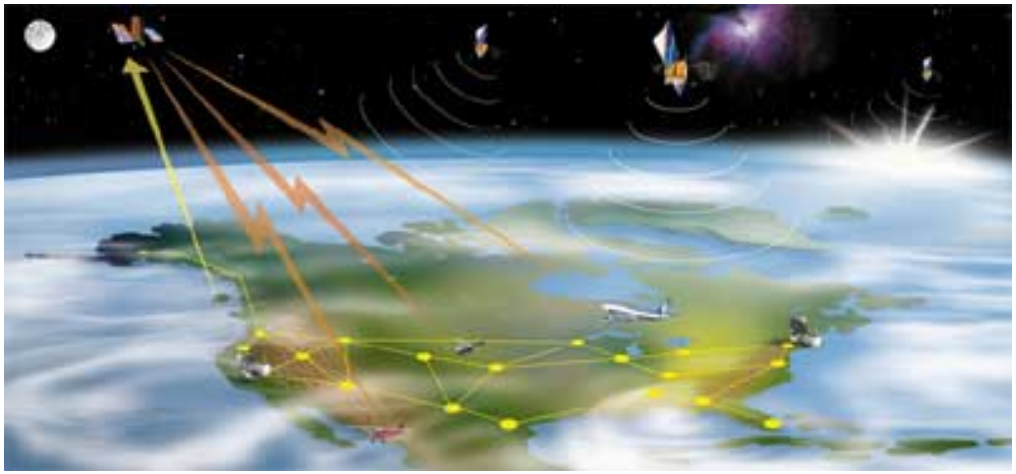


- Avidyne MFD version on Cirrus SR20 v2
  - Select Aux Page
  - Press “Nav Src” button to swap from GPS1 to GPS2
- May need to use Autopilot in Heading mode

WAAS
What is it?

WAAS – Wide-Area Augmentation System

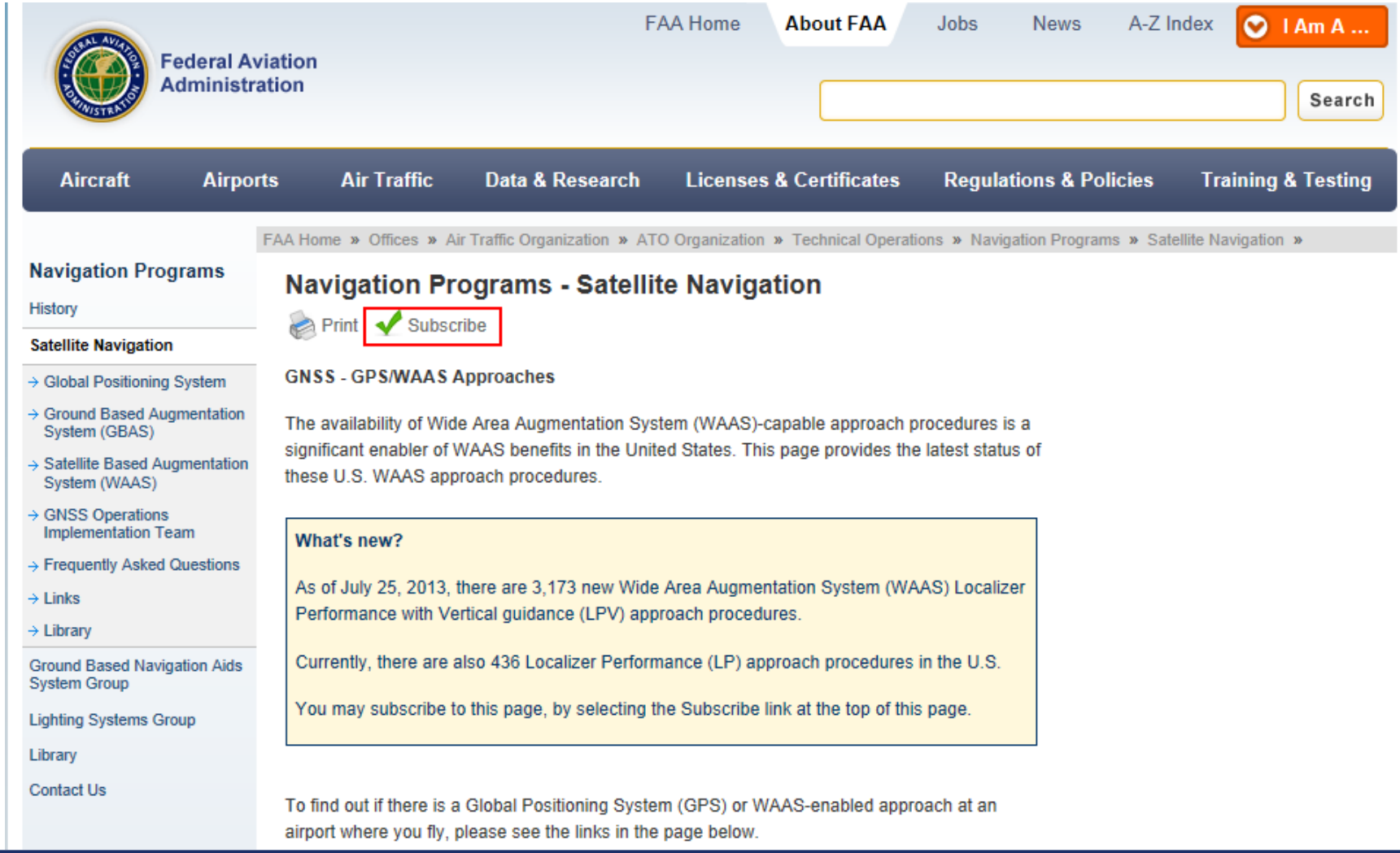
- WAAS provides service for all classes of aircraft in all phases of flight
  - en route navigation
  - airport departures
  - airport arrivals
  - vertically-guided landing approaches in IMC at all qualified locations throughout the National Air Space System (NAS)



Collection of GPS Approaches

National List of GPS Approaches

http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/



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WAAS-Capable Airports
(by Procedure Type/Airport Type)

	Part 139 Airports Served	Non-Part 139 Airports Served	Total Airports* (with WAAS-capable Procedures - GPS, LNAV, LNAV/VNAV, and/or LPV)
LNAV Procedures	530	2,086	2,616
LNAV/VNAV Procedures	458	1,030	1,488
LPV Procedures	470	1,113	1,583
LP Procedures	45	271	316
GPS Standalone Approaches	11	109	120

Update effective: July 25, 2013

Note: Number of GPS Stand-Alone Will Continue to Decrease As They Are Replaced By RNAV Procedures

***GPS** (MS Excel)*
***LNAV** (MS Excel)*
***LNAV/VNAV** (MS Excel)*
LP (MS Excel)
LPV (MS Excel)
***RNP** (MS Excel)*
ALL (MS Excel)

Update effective: July 25, 2013

National List of GPS Approaches

http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/

http://williamjdoylejr.net/G1000_2013/G1000_Pilot_IFR_Course/2013-09-22_FAA_GPS_Approach_Spreadsheet_for_NER.xlsx

shown in the screen shot below.

Standalone GPS Approaches – NJ

Stand Alone GPSs Published Effective 07/25/2013

Note: Data in this spreadsheet is derived from FAA Aeronautical Navigation Product Services Flight Information Publications. Data is for informational purposes only.
NOT to be used as official information in any capacity related to flight operations. For official information, please consult the current Flight Information Publications.

Area Svc Cntr	RGN	NPIAS	PART 139	FAA ID	AIRPORT NAME	LOCATION	ST	PROCEDURE NAME	MDA	VIS	HAT OR HAA	ILS to Rwy (Y/N)	ILS @ Arpt (Y/N)	ILS Arpt Cntr (Y/N)
ESC	AEA	Y	N139	LDJ	LINDEN	LINDEN	NJ	GPS-A	620	2 1/2	597		N	N
ESC	AEA	Y	N139	26N	OCEAN CITY MUNI	OCEAN CITY	NJ	GPS RWY 06	680	1	672	N	N	N

Note the procedure minima and other information

GPS | LNAVs | LPs | VNAVs | LPV | LP-LPVs Added This Cycle | GLSs | RNPs

Button indicates a drop-down filtering list

RNAV LNAV Approaches – NJ

RNAV LNAVs Published Effective 07/25/2013

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Area Svc Cntr	RGN	NPIAS	PART 139	FAA ID	AIRPORT NAME	LOCATION	ST	PROCEDURE NAME	MDA	VIS	HAT OR HAA	ILS to Rwy (Y/N)	ILS @ Arpt (Y/N)	ILS Arpt Cntr (Y/N)
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (GPS) Y RWY 13	520	2400	445	Y	Y	
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (GPS) Y RWY 31	440	1	377	Y	Y	
ESC	AEA	Y	N139	BLM	MONMOUTH EXECUTIVE	BELMAR-FARMINGDALE	NJ	RNAV (GPS) RWY 14	500	1	390	N	N	N
ESC	AEA	Y	N139	BLM	MONMOUTH EXECUTIVE	BELMAR-FARMINGDALE	NJ	RNAV (GPS) RWY 32	520	1	367	N	N	
ESC	AEA	Y	N139	19N	CAMDEN COUNTY	BERLIN	NJ	RNAV (GPS) RWY 05	740	1	590	N	N	N
ESC	AEA	Y	N139	19N	CAMDEN COUNTY	BERLIN	NJ	RNAV (GPS) RWY 23	840	1	698	N	N	
ESC	AEA	Y	N139	1N7	BLAIRSTOWN	BLAIRSTOWN	NJ	RNAV (GPS) RWY 07	1140	1	768	N	N	N
ESC	AEA	Y	N139	1N7	BLAIRSTOWN	BLAIRSTOWN	NJ	RNAV (GPS) RWY 25	1260	1 1/4	889	N	N	
ESC	AEA	Y	N139	CDW	ESSEX COUNTY	CALDWELL	NJ	RNAV (GPS) RWY 04	660	1	488	N	N	N
ESC	AEA	Y	N139	CDW	ESSEX COUNTY	CALDWELL	NJ	RNAV (GPS) RWY 10	740	1	571	N	N	
ESC	AEA	Y	N139	CDW	ESSEX COUNTY	CALDWELL	NJ	RNAV (GPS) RWY 22	740	1	568	N	N	
ESC	AEA	Y	N139	N81	HAMMONTON MUNI	HAMMONTON	NJ	RNAV (GPS) RWY 03	480	1	415	N	N	N
ESC	AEA	Y	N139	N12	LAKEWOOD	LAKEWOOD	NJ	RNAV (GPS) RWY 06	560	1	517	N	N	N
ESC	AEA	Y	N139	N12	LAKEWOOD	LAKEWOOD	NJ	RNAV (GPS) RWY 24	560	1	517	N	N	
ESC	AEA	Y	N139	N07	LINCOLN PARK	LINCOLN PARK	NJ	RNAV (GPS) RWY 01	1240	1 1/4	1058	N	N	N
ESC	AEA	Y	N139	N07	LINCOLN PARK	LINCOLN PARK	NJ	RNAV (GPS) RWY 19	1280	1 1/4	1098	N	N	
ESC	AEA	Y	N139	N14	FLYING W	LUMBERTON	NJ	RNAV (GPS) RWY 01	420	1	385	N	N	N
ESC	AEA	Y	N139	N14	FLYING W	LUMBERTON	NJ	RNAV (GPS) RWY 19	460	1	411	N	N	
ESC	AEA	Y	N139	47N	CENTRAL JERSEY RGNL	MANVILLE	NJ	RNAV (GPS) RWY 07	520	1	438	N	N	N
ESC	AEA	Y	N139	47N	CENTRAL JERSEY RGNL	MANVILLE	NJ	RNAV (GPS) RWY 25	520	1	455	N	N	
ESC	AEA	Y	N139	MIV	MILLVILLE MUNI	MILLVILLE	NJ	RNAV (GPS) RWY 10	460	1/2	386	Y	Y	
ESC	AEA	Y	N139	MIV	MILLVILLE MUNI	MILLVILLE	NJ	RNAV (GPS) RWY 14	480	1	399	N	Y	Y

GPS | LNAVs | LPs | VNAVs | LPV | LP-LPVs Added This Cycle | GLSs | RNPs

RNAV LP Approaches – NJ

RNAV LPs Published Effective 07/25/2013

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Area Svc Cntr	RGN	NPIAS	PART 139	FAA ID	AIRPORT NAME	LOCATION	ST	PROCEDURE NAME	MDA	VIS	HAT	ILS to Rwy (Y/N)	ILS @ Arpt (Y/N)	ILS Arpt Cntr (Y/N)	WAAS CHANNEL #	Initial Publication Date
ESC	AEA	Y	N139	CDW	ESSEX COUNTY	CALDWELL	NJ	RNAV (GPS) RWY 04	620	1	448	N	N	N	42622	15-Dec-11
ESC	AEA	Y	N139	CDW	ESSEX COUNTY	CALDWELL	NJ	RNAV (GPS) RWY 10	580	1	411	N	N		81922	15-Dec-11
ESC	AEA	Y	N139	47N	CENTRAL JERSEY RGNL	MANVILLE	NJ	RNAV (GPS) RWY 25	480	1	415	N	N	N	53424	25-Aug-11
ESC	AEA	Y	N139	VAY	SOUTH JERSEY RGNL	MOUNT HOLLY	NJ	RNAV (GPS) RWY 08	660	1	616	N	N	N	69324	25-Aug-11
ESC	AEA	Y	N139	VAY	SOUTH JERSEY RGNL	MOUNT HOLLY	NJ	RNAV (GPS) RWY 26	460	1	408	N	N		58323	25-Aug-11
ESC	AEA	Y	N139	N40	SKY MANOR	PITTSTOWN	NJ	RNAV (GPS) RWY 25	1080	1	522	N	N	N	50427	31-May-12
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (GPS) RWY 34	500	1	326	N	Y	Y	40230	20-Sep-12
ESC	AEA	Y	N139	4N1	GREENWOOD LAKE	WEST MILFORD	NJ	RNAV (GPS) RWY 06	1340	1	550	N	N	N	93821	9-Feb-12
ESC	AEA	Y	N139	4N1	GREENWOOD LAKE	WEST MILFORD	NJ	RNAV (GPS) RWY 24	1160	1	370	N	N		42525	9-Feb-12

GPS | LNAVs | LPs | VNAVs | LPV | LP-LPVs Added This Cycle | GLSs | RNPs

RNAV VNAV Approaches – NJ

RNAV VNAVs Published Effective 07/25/2013

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Area Svc Cntr	RGN	NPIAS	PART 139	FAA ID	AIRPORT NAME	LOCATION	ST	PROCEDURE NAME	WAAS NOTAM SYN OR WAAS THAT N/A	DA	VIS	HAT	GPA	TCH	ILS to Rwy (Y/N)	ILS @ ARPT (Y/N)	ILS Arpt Cntr (Y/N)	ILS CAT II or III
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (GPS) RWY 04		527	1 5/8	466	3.00	47	N	Y	Y	
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (GPS) RWY 22		355	7/8	288	3.00	51	N	Y		
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (GPS) Y RWY 13		475	4000	400	3.00	58	Y	Y		
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (GPS) Y RWY 31		421	6000	358	3.00	52	Y	Y		
ESC	AEA	Y	N139	CDW	ESSEX COUNTY	CALDWELL	NJ	RNAV (GPS) RWY 22		610	1	438	3.10	58	N	N	N	
ESC	AEA	Y	N139	N14	FLYING W	LUMBERTON	NJ	RNAV (GPS) RWY 19		353	1	304	3.00	45	N	N	N	
ESC	AEA	Y	N139	MIV	MILLVILLE MUNI	MILLVILLE	NJ	RNAV (GPS) RWY 10		460	1/2	386	3.00	52	Y	Y		
ESC	AEA	Y	N139	MIV	MILLVILLE MUNI	MILLVILLE	NJ	RNAV (GPS) RWY 14		550	1 3/4	469	3.00	45	N	Y	Y	
ESC	AEA	Y	N139	MIV	MILLVILLE MUNI	MILLVILLE	NJ	RNAV (GPS) RWY 28		405	1	320	3.00	45	N	Y		
ESC	AEA	Y	N139	MIV	MILLVILLE MUNI	MILLVILLE	NJ	RNAV (GPS) RWY 32		415	1	333	3.00	60	N	Y		
ESC	AEA	Y	N139	MMU	MORRISTOWN MUNI	MORRISTOWN	NJ	RNAV (GPS) RWY 05		894	2 1/4	712	3.50	59	N	Y	Y	
ESC	AEA	Y	N139	MMU	MORRISTOWN MUNI	MORRISTOWN	NJ	RNAV (GPS) Z RWY 23		784	1 5/8	601	3.00	55	Y	Y		
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (GPS) RWY 04L		441	5000	431	3.00	52	Y	Y	Y	2
ESC	AEA	Y	N139	39N	PRINCETON	PRINCETON/ROCKY HILL	NJ	RNAV (GPS) RWY 10		873	2 3/4	745	3.00	45	N	N	N	
ESC	AEA	Y	139	TEB	TETERBORO	TETERBORO	NJ	RNAV (GPS) X RWY 06		662	1 3/4	656	3.00	55	Y	Y	Y	
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (GPS) RWY 16		529	1	317	3.00	55	N	Y	Y	
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (GPS) Z RWY 06		585	7/8	425	3.00	60	Y	Y		
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (GPS) Z RWY 24		611	1 3/8	419	3.00	45	N	Y		

GPS | LNAVs | LPs | VNAVs | LPV | LP-LPVs Added This Cycle | GLSs | RNPs

RNAV LPV Approaches – NJ

RNAV LPVs Published Effective 07/25/2013

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Area Svc Cntr	RGN	NPIAS	PART 139	FAA ID	LOCATION	ST	PROCEDURE NAME	WAAS NOTAM SYN OR WAAS THAT N/A	DA	VIS	HAT	GPA	TCH	ILS to Rwy (Y/N)	ILS @ Arpt (Y/N)	ILS Arpt Cntr (Y/N)	ILS CAT II or III	WAAS CHANNEL #	Initial Publication Date
ESC	AEA	Y	139	ACY	ATLANTIC CITY	NJ	RNAV (GPS) RWY 04		311	1	250	3.00	47	N	Y	Y		78231	7-Mar-13
ESC	AEA	Y	139	ACY	ATLANTIC CITY	NJ	RNAV (GPS) RWY 22		363	1	196	3.00	51	N	Y			53631	7-Mar-13
ESC	AEA	Y	139	ACY	ATLANTIC CITY	NJ	RNAV (GPS) Y RWY 13		275	2400	200	3.00	58	Y	Y			45513	1-Sep-05
ESC	AEA	Y	139	ACY	ATLANTIC CITY	NJ	RNAV (GPS) Y RWY 31		263	4000	200	3.00	52	Y	Y			50113	1-Sep-05
ESC	AEA	Y	N139	CDW	CALDWELL	NJ	RNAV (GPS) RWY 22		491	1	287	3.10	58	N	N	N		58022	15-Dec-11
ESC	AEA	Y	N139	N14	LUMBERTON	NJ	RNAV (GPS) RWY 19		415	1 1/4	366	3.00	45	N	N	N		77828	26-Jul-12
ESC	AEA	Y	N139	MIV	MILLVILLE	NJ	RNAV (GPS) RWY 10		274	3/4	200	3.00	52	Y	Y			53723	28-Jul-11
ESC	AEA	Y	N139	MIV	MILLVILLE	NJ	RNAV (GPS) RWY 14		377	1	296	3.00	45	N	Y	Y		82000	8-Jun-06
ESC	AEA	Y	N139	MIV	MILLVILLE	NJ	RNAV (GPS) RWY 28		344	1	259	3.00	45	N	Y			42700	8-Jun-06
ESC	AEA	Y	N139	MIV	MILLVILLE	NJ	RNAV (GPS) RWY 32		381	1	299	3.00	60	N	Y			86900	8-Jun-06
ESC	AEA	Y	N139	MMU	MORRISTOWN	NJ	RNAV (GPS) RWY 05		816	1 7/8	634	3.50	59	N	Y	Y		97720	9-Feb-12
ESC	AEA	Y	N139	MMU	MORRISTOWN	NJ	RNAV (GPS) Z RWY 23		383	1/2	200	3.00	55	Y	Y			45621	30-Jun-11
ESC	AEA	Y	139	EWR	NEWARK	NJ	RNAV (GPS) RWY 04L		278	2400	268	3.00	52	Y	Y	Y		56224	19-Jan-06
ESC	AEA	Y	139	EWR	NEWARK	NJ	RNAV (GPS) RWY 22R		361	4000	351	3.00	48	Y	Y			77524	13-Apr-06
ESC	AEA	Y	139	EWR	NEWARK	NJ	RNAV (GPS) Y RWY 04R		357	4000	346	3.00	55	Y	Y			60924	19-Jan-06
ESC	AEA	Y	139	EWR	NEWARK	NJ	RNAV (GPS) Z RWY 22L		368	4000	358	3.00	50	Y	Y			70324	19-Jan-06
ESC	AEA	Y	N139	39N	PRINCETON/ROCKY HILL	NJ	RNAV (GPS) RWY 10		414	1	286	3.00	45	N	N	N		58216	11-Mar-10
ESC	AEA	Y	139	TEB	TETERBORO	NJ	RNAV (GPS) Y RWY 06		369	4000	363	3.00	53	Y	Y	Y		65707	5-Jun-08
ESC	AEA	Y	139	TTN	TRENTON	NJ	RNAV (GPS) RWY 16		462	1	250	3.00	55	N	Y	Y		99339	20-Sep-12
ESC	AEA	Y	139	TTN	TRENTON	NJ	RNAV (GPS) Z RWY 06		360	1/2	200	3.00	60	Y	Y			56430	20-Sep-12
ESC	AEA	Y	139	TTN	TRENTON	NJ	RNAV (GPS) Z RWY 24		462	7/8	270	3.00	45	N	Y			97530	20-Sep-12
ESC	AEA	Y	N139	WWD	WILDWOOD	NJ	RNAV (GPS) RWY 19		311	1	292	3.00	52	N	N	N		82400	8-Jun-06

GPS | LNAVs | LPs | VNAVs | **LPV** | LP-LPVs Added This Cycle | GLSs | RNPs

GLS Approaches – NJ

GLS's Published Effective 07/25/2013

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Area Svc Cntr	RGN	NPIAS	PART 139	FAA ID	AIRPORT NAME	LOCATION	ST	PROCEDURE NAME	DA	VIS	HAT	GPA	TCH	ILS to Rwy (Y/N)	ILS @ Arpt (Y/N)	ILS Arpt Cntr (Y/N)	ILS CAT II or III	LAAS CHANNEL #	Initial Publication Date
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	GLS RWY 04L	210	2400	200	3.00	55	Y	Y	Y	2	22727	29-Jul-10
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	GLS RWY 04R	261	4000	250	3.00	55	Y	Y		2,3	21083	29-Jul-10
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	GLS RWY 11	308	5000	290	3.00	53	Y	Y			21905	29-Jul-10
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	GLS RWY 22L	210	2400	200	3.00	43	Y	Y		2	21494	29-Jul-10
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	GLS RWY 22R	246	2400	236	3.00	48	Y	Y			20672	29-Jul-10

GPS | LNAVs | LPs | VNAVs | LPV | LP-LPVs Added This Cycle | GLSs | RNPs

RNAV RNP Approaches – NJ

RNAV RNPs Published Effective 06/27/2013

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Area Svc Cntr	RGN	NPIAS	PART 139	FAA ID	AIRPORT NAME	LOCATION	ST	PROCEDURE NAME	RNP	DA	VIS	HAT	GPA	TCH	ILS to Rwy (Y/N)	ILS @ Arpt (Y/N)	ILS Arpt Cntr (Y/N)	ILS CAT II or III	Initial Publication Date
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (RNP) Z RWY 13	0.30	437	4000	362	3.00	58	Y	Y	Y		23-Sep-10
ESC	AEA	Y	139	ACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	RNAV (RNP) Z RWY 31	0.30	401	6000	338	3.00	52	Y	Y			23-Sep-10
ESC	AEA	Y	N139	MMU	MORRISTOWN MUNI	MORRISTOWN	NJ	RNAV (RNP) Y RWY 23	0.11	553	3/4	370	3.00	55	Y	Y	Y		25-Aug-11
ESC	AEA	Y	N139	MMU	MORRISTOWN MUNI	MORRISTOWN	NJ	RNAV (RNP) Y RWY 23	0.30	788	1 5/8	605	3.00	55					25-Aug-11
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Y RWY 22L	0.30	482	6000	472	3.00	50	Y	Y	Y		13-Apr-06
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Y RWY 29	0.16	461	1 1/2	451	3.00	60	Y	Y			12-Mar-09
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Y RWY 29	*0.30	530	1 3/4	520	3.00	60					27-Aug-09
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Y RWY 29	0.30	573	1 7/8	563	3.00	60					12-Mar-09
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Z RWY 04R	*0.15	364	4000	353	3.00	55	Y	Y			13-Apr-06
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Z RWY 04R	0.30	490	6000	479	3.00	55					13-Apr-06
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Z RWY 29	0.16	466	1 1/2	456	3.00	60	Y	Y			12-Mar-09
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Z RWY 29	*0.30	485	1 1/2	475	3.00	60					12-Mar-09
ESC	AEA	Y	139	EWR	NEWARK LIBERTY INTL	NEWARK	NJ	RNAV (RNP) Z RWY 29	0.30	573	2	563	3.00	60					12-Mar-09
ESC	AEA	Y	139	TEB	TETERBORO	TETERBORO	NJ	RNAV (RNP) RWY 19	0.10	500	1 3/4	493	3.00	54	Y	Y	Y		24-Sep-09
ESC	AEA	Y	139	TEB	TETERBORO	TETERBORO	NJ	RNAV (RNP) Z RWY 06	0.30	679	2	673	3.00	53	Y	Y			24-Sep-09
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (RNP) Y RWY 06	0.10	484	1/2	324	3.00	60	Y	Y	Y		20-Sep-12
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (RNP) Y RWY 06	0.30	642	1 1/8	482	3.00	60					20-Sep-12
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (RNP) Y RWY 24	0.10	640	1 1/2	448	3.00	55	N	Y			7-Mar-13
ESC	AEA	Y	139	TTN	TRENTON MERCER	TRENTON	NJ	RNAV (RNP) Y RWY 24	0.30	740	1 5/8	548	3.00	55					7-Mar-13

GPS | LNAVs | LPs | VNAVs | LPV | LP-LPVs Added This Cycle | GLSs | RNPs

What Are WAAS Approaches?

RNAV Approaches – AIM References

- **AIM Chapter 5 – Air Traffic Procedures**
  - Section 5-4-5 – Instrument Approach Procedure Charts
  - LNAV – Lateral Navigation
    - Non-precision approach, descend at desired rate to MDA
  - LNAV+V – Lateral Navigation with Vertical Navigation
    - Non-precision approach, descend along WAAS Advisory Glide Path to MDA
  - LNAV/VNAV – Lateral Navigation with Vertical Navigation
    - Approach with Vertical Guidance (APV), descend along WAAS Glide Path to DA
  - LPV – Localizer Performance with Vertical Guidance.
    - Approach with Vertical Guidance (APV), descend along WAAS Glide Path to DA.
    - GLS – ICAO GNSS (Global Navigation Satellite System) Landing System. Referenced as LPV in United States

RNAV/GPS Approach Minima

- LPV DA (Decision Altitude): 300 ft AGL with 1 SM visibility
- LNAV/VNAV DA (Decision Altitude): 400 ft AGL with 1¼ SM visibility
- LNAV MDA (Minimum Descent Altitude): 500-600 ft AGL with ¾ SM visibility
- Circling: 600 ft AGL with 1 ¼ SM visibility

CATEGORY	A	B	C	D
LPV DA	630-1 250 (300-1)			
LNAV/ VNAV DA	755-1¼ 375 (400-1¼)			
LNAV MDA	940-1 560 (600-1)		940-1⅝ 560 (600-1⅝)	
CIRCLING	940-1 546 (600-1)		940-1⅝ 546 (600-1⅝)	980-2 586 (600-2)

40°39'N-75°26'W

ALLENTOWN / LEHIGH VALLEY INTL (ABE)
RNAV (GPS) RWY 31

LNAV (Lateral Navigation)

- Non-precision approach
- Descend at desired rate to MDA
- Fly level at MDA
  - Until runway environment in sight – then land, or
  - To MAP – then begin missed approach

CATEGORY	A	B	C	D
LNAV MDA	980-1 879 (900-1)	980-1¼ 879 (900-1¼)	NA	
CIRCLING	980-1¼	875 (900-1¼)	NA	

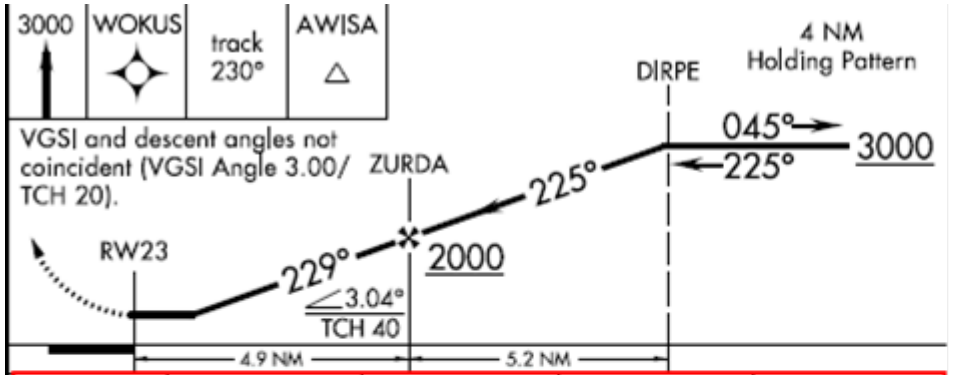
40°38'N - 74°40'W

SOMERVILLE / SOMERSET (SMQ)

RNAV (GPS) RWY 30

LNAV + V (Lateral Navigation plus Vertical Guidance)

- Non-precision approach
- Descend along *WAAS Advisory GP* to MDA
- Fly level at MDA
  - Until runway environment in sight – then land, or
  - To MAP – then begin missed approach procedure



CATEGORY	A	B	C	D
LNAV MDA	1040-1	646 (700-1)	NA	
CIRCLING	1040-1	646 (700-1)	NA	

DOYLESTOWN, PENNSYLVANIA
Amdt 1 08APR10

40°20'N - 75°07'W

DOYLESTOWN (DYL)
RNAV (GPS) RWY 23

LNAV / VNAV (Lateral Navigation / Vertical Navigation)

- **Non-precision approach**
- **Descend along *WAAS Advisory GP* to DA**
- **At DA – make a decision**
  - If runway environment in sight – land, **or**
  - If runway environment not in sight– then missed approach procedure

CATEGORY	A	B	C	D
LPV DA	326-¾ 250 (300-¾)			
LNAV/VNAV DA	400-¾ 324 (400-¾)			
LNAV MDA	520-¾ 444 (500-¾)		520-⅞ 444 (500-⅞)	
C CIRCLING	520-1 439 (500-1)	560-1 479 (500-1)	580-1½ 499 (500-1½)	700-2 619 (700-2)

TOMS RIVER, NEW JERSEY
Orig 22AUG13

39°56'N-74°18'W

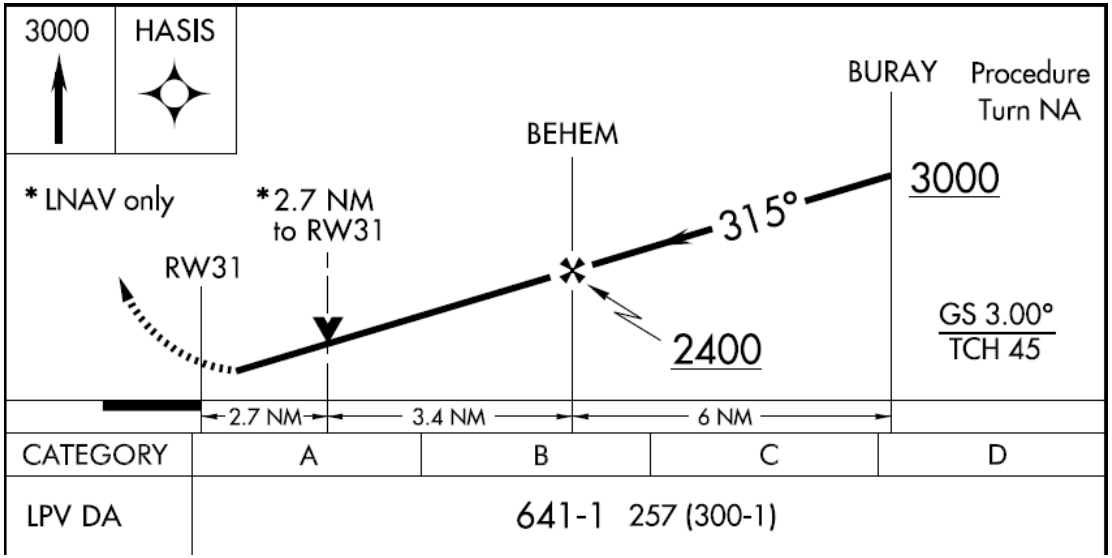
TOMS RIVER/ OCEAN COUNTY (MJX)
RNAV (GPS) RWY 6

LPV (Localizer Performance with Vertical Guidance)

- Approach with Vertical Guidance (APV)
- Descend along ***WAAS Advisory GP*** to DA
- At DA – make a decision
  - If runway environment in sight – land, **or**
  - If runway environment not in sight– then missed approach procedure

KABE

Allentown, PA



LPV (Localizer Performance with Vertical Guidance)

- Approach with Vertical Guidance (APV)
- Descend along *WAAS Advisory GP* to DA
- At DA – make a decision
  - If runway environment in sight – land, **or**
  - If runway environment not in sight– then missed approach procedure

CATEGORY	A	B	C	D
LPV DA	630-1 250 (300-1)			
LNAV/VNAV DA	755-1¼ 375 (400-1¼)			
LNAV MDA	940-1 560 (600-1)		940-1⅝ 560 (600-1⅝)	
CIRCLING	940-1 546 (600-1)		940-1⅝ 546 (600-1⅝)	980-2 586 (600-2)

40°39'N-75°26'W

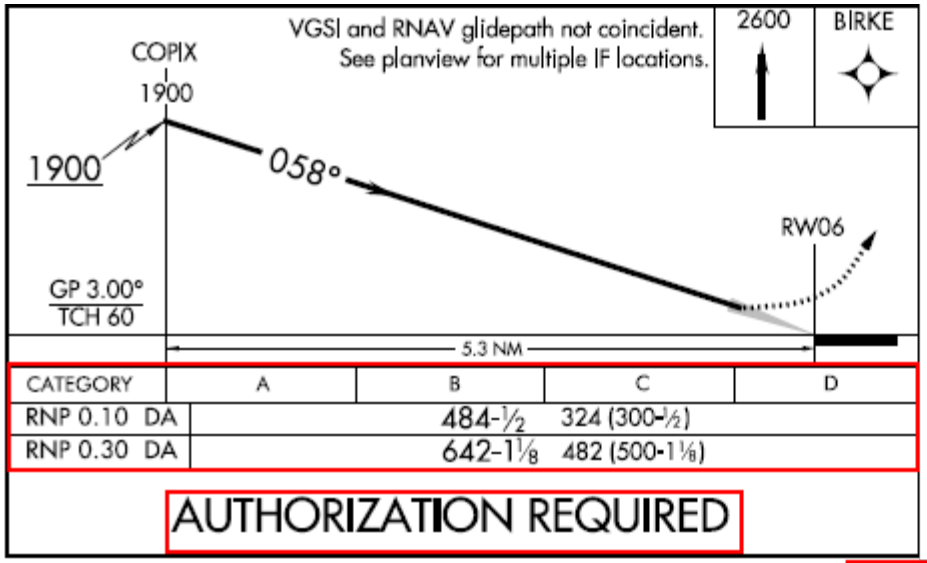
ALLENTOWN / LEHIGH VALLEY INTL (ABE)
RNAV (GPS) RWY 31

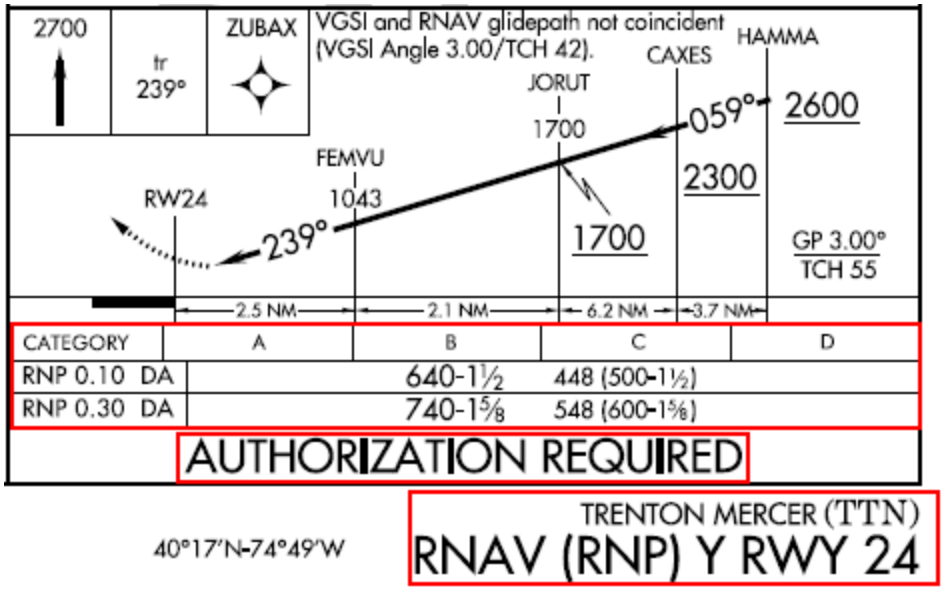
RNP (Required Navigation Performance)

- RNP-capable flight management system (FMS) utilizes enhanced software to monitor sensor inputs and compare real time navigation accuracy, also referred to as Actual Navigation Performance (ANP).
- Navigation performance for a particular RNP type is expressed numerically.
  - Depending on the capability of each aircraft's system, RNP values can be as low as 0.1 nautical miles.
  - A performance value of RNP 0.3, for instance, assures that the aircraft has the capability of remaining within 0.3 nautical miles to the right or left of the centerline 95% of the time and within a linear containment area of 0.6 nautical miles (twice the RNP value) 99.999% of the time.

RNP (Required Navigation Performance)

- RNP approaches for KTTN
  - Runway 6
  - Runway 24





RNAV/GPS Approach Minima - Glidepath

- No glidepath
  - **LNAV**
- WAAS-derived glidepath – loss of signal downgrades to LNAV
  - **LNAV + V**
  - **LNAV/VNAV**
  - **LPV**

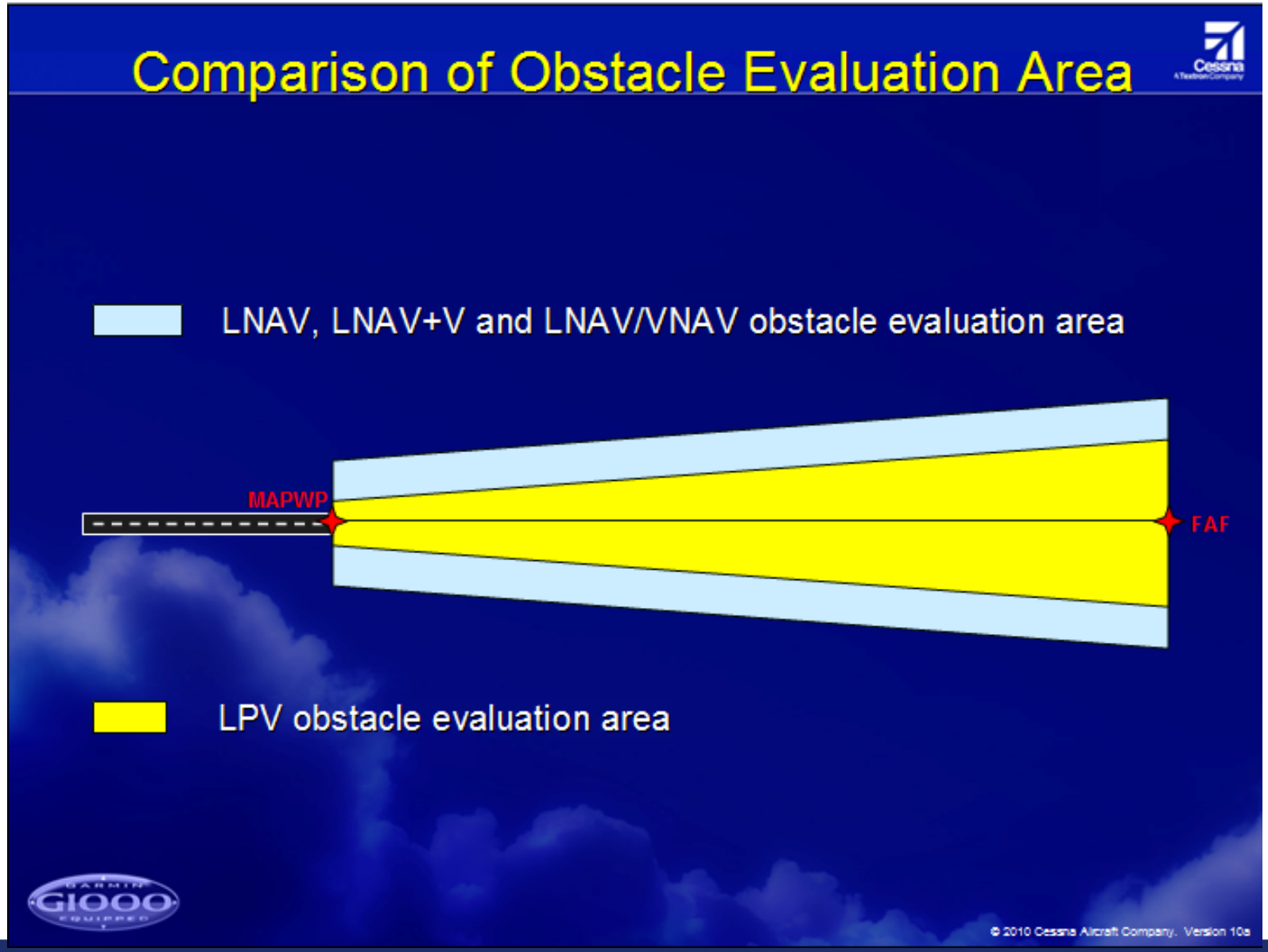
RNAV/GPS Approach Minima – Obstacle Evaluation Area

Wider Obstacle Evaluation Area

- **LNAV**
- **LNAV + V**
- **LNAV/VNAV**

- Narrower Obstacle Evaluation Area
  - **LPV**

RNAV/GPS Approach Minima – Obstacle Evaluation Area



What Are the Risks with Using GPS?

What Are the Risks with Using GPS?

- **Risk: Lack of Pilot Proficiency**
  - **Mitigation: Practice, practice, practice**
    - Get the simulator for whatever GPS you have
      - E.g.: Garmin GNS 430, Garmin GNS 530, Garmin G1000
    - Download training videos, manuals (PDF), flight planning lessons
    - Get some ground instruction and flight instruction from your CFI

What Are the Risks with Using GPS?

- **Risk: Head in the Cockpit Instead of Outside**
  - **Mitigation: Set up as much as possible on the ground**
    - Do your flight planning at home before coming to the airport
      - File an FAA flight plan (consider IFR even if VMC)
      - Print a navigation log (consider AOPA Internet Flight Planner)
    - Set up flight plan in GPS after preflight and engine start but before taxi
      - Contact Clearance Delivery on radio or cell phone
      - Set up clearance route in your GPS

What Are the Risks with Using GPS?

- **Risk: Single Pilot IFR**
  - **Mitigation: Take an experienced pilot or CFI**
    - Establish personal minimums, don't deviate from them
      - Consider establishing a risk management matrix
      - Refer to next section on personal minimums
    - Build experience
      - ***When appropriate***, revise your personal minimums

What Are the Risks with Using GPS?

- **Risk: Thunderstorm Penetration**
  - **Mitigation: Avoid thunderstorms**
    - Do ***not*** use NexRad or Strike Finder features to penetrate T-Storms
    - Use NexRad or Strike Finder features to avoid T-Storms
      - Preferably by putting the T-Storms at your six o'clock

What Are the Risks with Using GPS?

- **Other Things You Should Consider**
  - If possible, upgrade your GPS to WAAS
  - If possible, upgrade/subscribe to NexRad
    - Near real-time weather (6 minute lag)
    - Near real-time TFR (6 minute lag on published TFRs)
  - Keep your databases up to date
    - Subscriptions are available for downloads from the Internet

What Are the Risks with Using GPS?

- **Other Things You Should Consider**
  - Foster/practice continuing pilot education
    - Get an IPC every 6 – 12 months whether you need it or not
    - Engage in self-study
      - FAA Advanced Avionics Handbook
        - » http://www.faa.gov/library/manuals/aviation/media/FAA-H-8083-6.pdf
      - FAA Risk Management Handbook - See Appendix A for Personal Minimums
        - » http://www.faa.gov/library/manuals/aviation/media/FAA-H-8083-2.pdf
      - AOPA Air Safety Foundation - Technologically Advanced Aircraft Safety and Training
        - » http://www.aopa.org/asf/publications/topics/TAA2007.pdf

What are your Personal Minimums?

FAA Risk Management Handbook

http://www.faa.gov/library/manuals/aviation/media/FAA-H-8083-2.pdf

See Appendix A for Personal Minimums

What are your certificates, ratings, training, and experience?

Certification, Training, and Experience Summary	Self-Assessment Factors	Revised Self-Assessment
Certification/ratings (e.g., private, multi-engine; instrument)		
Highest certificate level 7 ratings (including complex aircraft)		
Training	Recency?	
Flight review (e.g., certificate, rating, Wings Program completion)	Annual WINGS?	
Instrument Proficiency Check	Recency?	
Time since checkout in aircraft #1:	Proficiency?	
Time since checkout in aircraft #2:	Proficiency?	
Time since checkout in aircraft #3:	Proficiency?	
Variation in equipment (GPS navigator), number of different panels	Proficiency? Recency?	
Experience	Recency?	
Total flying time in hours	Is 600 hours a lot of time?	
Number of years flying	Is it still a lot if it is spread over 25 years?	

What are your Personal Minimums for VFR?

Personal Minimums
VER Pilot

Cut and Fold	Cut and Fold	Cut and Fold
Condition	**Example: 100 Hour VFR Pilot**	**Your Personal Minimums**
Minimum visibility – day VFR	5 miles	
Minimum visibility – night VFR	7 miles	
Minimum ceiling – day VFR	3,000 feet	
Minimum ceiling – night VFR	5,000 feet	
Surface wind speed & gusts	15 knots 5 knot gust	
Maximum cross wind	7 knots	
Other VFR (e.g., mountain flying, over water beyond gliding distance)	Consult instructor/mentor	
Fuel reserves (day VFR)	1 hour	2 x FAA
Fuel reserves (night VFR)	1½ hour	2 x FAA

What are your Personal Minimums for IFR?

Personal Minimums
IFR Pilot

Cut and Fold	Cut and Fold	Cut and Fold
Condition	**Example: 300 Hour IFR Pilot**	**Your Personal Minimums**
Minimum visibility – day VFR	3 miles	
Minimum visibility – night VFR	5 miles	
Minimum ceiling – day VFR	2,000 feet	
Minimum ceiling – night VFR	3,000 feet	
Surface wind speed & gusts	15 knots 5 knot gust	
Maximum cross wind	7 knots	
IFR approach ceiling	Minimums + 500 feet	
IFR approach visibility (precision approaches)	Minimums + ½ mile	
IFR approach visibility (nonprecision approaches)	Minimums + 1 mile	
Other IFR (e.g., icing)	Consult instructor/mentor	
Fuel reserves (day VFR)	1 hour	2 x FAA
Fuel reserves (night or IFR) 1½ hour	1½ hour	2 x FAA

Statistics from the NTSB Database on GPS-involved Accidents

So Can You Get in Trouble with a GPS?

- Are there any NTSB statistics?

Summary of GPS-Involved Accidents 2000 - 2010				
State	Accidents	Non-Fatal	Fatal	Fatalities
PA	4	0	4	12
NJ	3	33	2	3
DE	0	0	0	0
Total	**7**	**33**	**6**	**15**

So Can You Get in Trouble with a GPS?

- Are there any NTSB statistics for New Jersey?

NTSB Database GPS-Invloved Accidents in New Jersey from 1/1/2000 to 11/17/2010							
Current Synopsis	PDF Report(s) (Published)	Event Date	Probable Cause Released	Location	Make / Model	N-Number	Event Severity
Probable Cause	Factual(6/4/2008) , Probable Cause(6/30/2008)	1/15/2007	6/30/2008	Wayne, NJ	Beech A36	N711SK	Fatal(1)
Probable Cause	Factual(10/3/2005) , Probable Cause(12/20/2005)	6/23/2005	12/20/2005	Vineland, NJ	Cessna T206H	N72806	Nonfatal
Probable Cause	Factual(1/12/2006) , Probable Cause(3/28/2006)	4/5/2005	3/28/2006	Green Creek, NJ	Piper PA-28R-201	N36725	Fatal(2)

So Can You Get in Trouble with a GPS?

- Are there any NTSB statistics Pennsylvania?

NTSB Database GPS-Invloved Accidents in Pennsylvania from 1/1/2000 to 11/17/2010							
Current Synopsis	PDF Report(s) (Published)	Event Date	Probable Cause Released	Location	Make / Model	N-Number	Event Severity
Probable Cause	Factual(8/13/2007) , Probable Cause(8/30/2007)	6/25/2006	8/30/2007	Tafton, PA	Piper PA-34-220T	N8371X	Fatal(3)
Probable Cause	Factual(2/7/2007) , Probable Cause(3/26/2007)	3/26/2005	3/26/2007	Bellefonte, PA	Pilatus PC-12/45	N770G	Fatal(6)
Probable Cause	Factual(6/28/2004) , Probable Cause(9/1/2004)	8/8/2003	9/1/2004	FACTORYVILLE, PA	Piper PA-32-300	N6373C	Fatal(2)
Probable Cause	Factual(5/3/2001) , Probable Cause(7/2/2001)	8/27/2000	7/2/2001	MILL CREEK, PA	Cessna 172L	N4344Q	Fatal(1)

Beech A36 – N711SK – 01/15/2007

- **Pilot Profile:**
  - ATP AMEL Center Line Thrust Only, COM ASEL AMEL RH IH
  - Total Time: 4,445 hours; Instrument Time: 565 hours
- **Flight from KCLT (Charlotte, NC) to KCDW (NJ)**
  - First take off of day 12 hours earlier
  - Night IMC, Conditions at KCDW: 1/8 sm in Fog
  - PIC crosses FAF 200 feet below MDA
- **NTSB Findings:**
  - PIC did not comply with IFR Approach Procedure
  - Pilot fatigue
  - (1) Fatality
- **What would you do?**

Cessna T206H – N72806 – 06/23/2005

- **Pilot Profile:**
  - PVT ASEL, Total Time: 600 hours; Make/Model Time: 450 hours
- **Flight from KMIV (NJ) to 25N (NJ)**
  - PIC diverted to 25N (Rudy's in Vineland) in Day VMC
  - PIC used Nearest function on GPS to choose 25N
  - Landed in sand, substantially damaged aircraft
- **NTSB Findings:**
  - Airport closed 3 months prior and properly NOTAM-ed
  - Inadequate preflight planning and preparation
- **Other Information**
  - T206H = Turbo Stationair
- **Anything come to mind?**

Piper PA28R-201 – N36725 – 04/05/2005

- **Pilot Profiles:**
  - PIC (Left Seat): PVT ASEL ASES IA,
    - Total Time: 334 hours;
    - Night Time: 14 hours;
    - Night in Last 90 Days: 1.7 hours
  - Pilot (Right Seat): PVT ASEL,
    - Total Time: 195 hours;
    - Night Time: 17 hours;
    - Instrument Time: 0.9 hours

Piper PA28R-201 – N36725 – 04/05/2005

- **Flight from KMIV (NJ) to WWD (NJ)**
  - First leg KVAY to KMIV on IFR flight plan with successful ILS 10 at MIV
  - PIC departed KMIV VFR for KWWD, no radio contact with ACY Approach
  - PIC attempted LOC 19 approach, flying through the final approach course
  - PIC did not correct heading to intercept LOC 19 course for another 30 seconds
  - PIC performed S-turns back and forth across the LOC 19 course throughout the approach
  - PIC crossed FAF at 1,200 ft, 300 ft below the minimum altitude for approach segment
  - PIC began a constant descent of about 850 feet per minute.
  - PIC crossed the localizer centerline at 100 feet, MDA for the final segment was 340 feet.

Piper PA28R-201 – N36725 – 04/05/2005

- **NTSB Findings:**
  - Flight crew failed to maintain terrain clearance while executing a practice published instrument approach in night visual meteorological conditions.
  - A factor in the accident was the dark night. (2 Fatalities)
- **What would you have done?**
  - Maintained radio contact with ACY approach?
  - Requested radar vectors for the approach?

Piper PA34-220T – N8371X – 06/25/2006

- **Pilot Profile:**
  - PIC: COM AMEL ASEL IA,
    - Total Time: 1,718 hrs;
    - Time in Make/Model: 27 hrs;
    - Time in Last 90 Days: 42 hrs

Piper PA34-220T – N8371X – 06/25/2006

- **Flight from Greensboro, NC to Sanford, ME**
  - PIC obtained updated weather briefing one hour before takeoff with information about thunderstorm activity along the route of the flight
  - PIC deviated around thunderstorm activity 2½ hours after takeoff, when airplane disappeared from radar
  - Witness heard engine "revving up and down," and seeing debris falling from sky
  - Examination of airplane revealed in-flight breakup; no evidence of mechanical malfunction identified
  - Weather radar images indicated airplane entered developing area of moderate to heavy intensity echoes consistent with a convective cell or thunderstorm
  - ***PIC advised ATC he was receiving weather information through a portable GPS with a weather subscription***
  - No published Convective SIGMETs, SIGMETs, or Center Weather Advisories for thunderstorms, current at time of accident
  - Except for 0.4 hours of simulated instrument time logged during multiengine rating check ride; PIC had not logged any additional instrument time in multiengine airplanes.

Piper PA34-220T – N8371X – 06/25/2006

- **NTSB Findings:**
  - PIC's inadvertent encounter with a thunderstorm, which resulted in a loss of aircraft control, and a subsequent in-flight breakup. (3 Fatalities)
- **What would you have done?**
  - Any symptoms of impending T-Storm on GPS?
  - Consider a course reversal?

Pilatus PC12/45 – N770G – 03/26/2005

- **Pilot Profile:**
  - PIC: PVT AMEL ASEL IA,
    - Total Time: 1,645 hours;
    - Time in Make/Model: 173 hours; Instrument Time: 385 hours

Pilatus PC12/45 – N770G – 03/26/2005

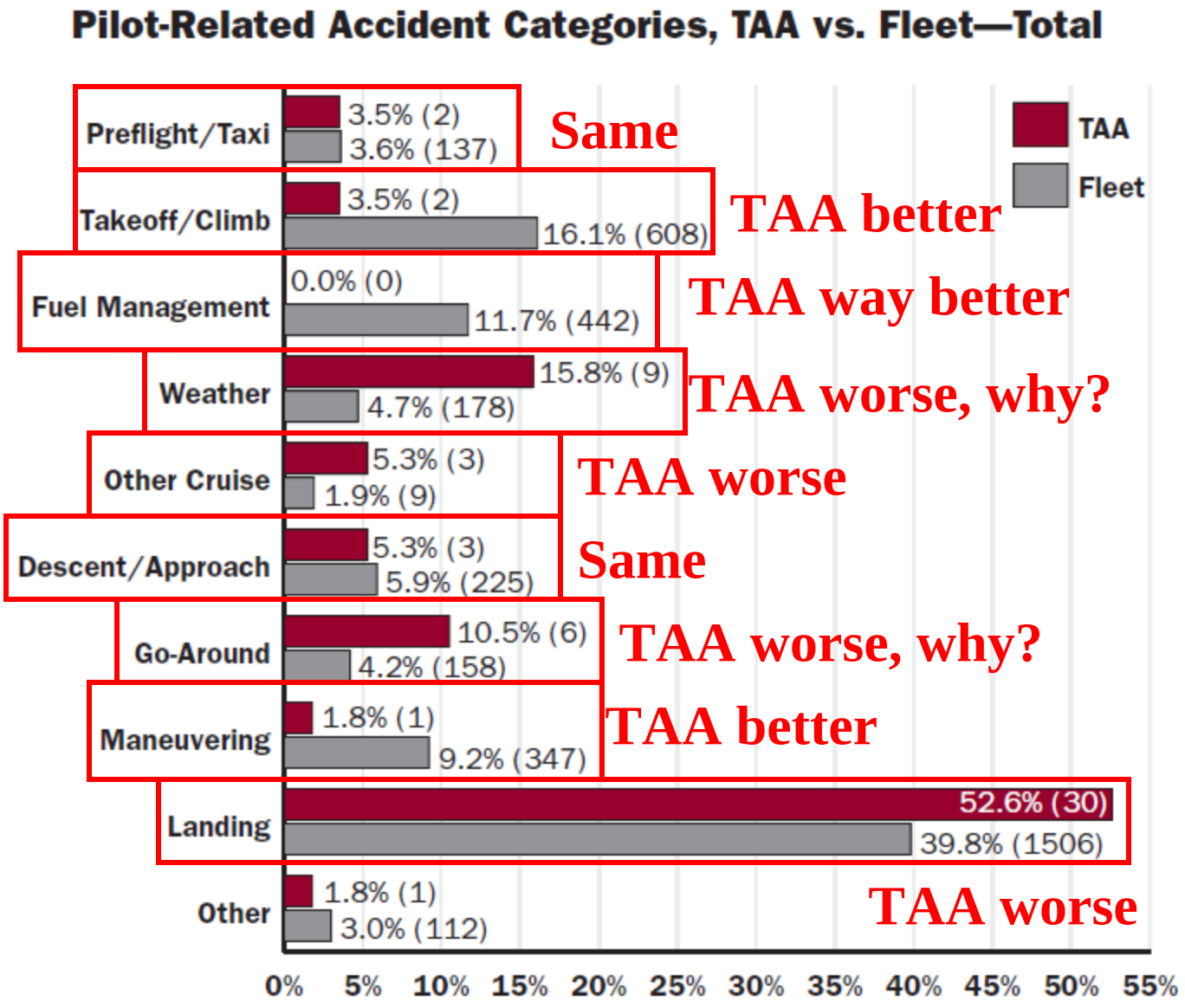
- **Flight from Naples, FL to State College, PA (KUNV)**
  - Airplane on ILS approach
  - Witnesses reported seeing airplane spinning in nose down, near vertical attitude before it collided with ground
  - Radar data disclosed that PIC had difficulty maintaining altitude and airspeed on final approach
    - Significant excursions above and below the glidepath
    - Large variations in airspeed.
  - Analysis of airplane's navigation system's light bulbs suggests PIC
    - Selected GPS mode for initial approach
    - Not switched to the proper instrument approach mode to allow the autopilot to lock onto the ILS.

Pilatus PC12/45 – N770G – 03/26/2005

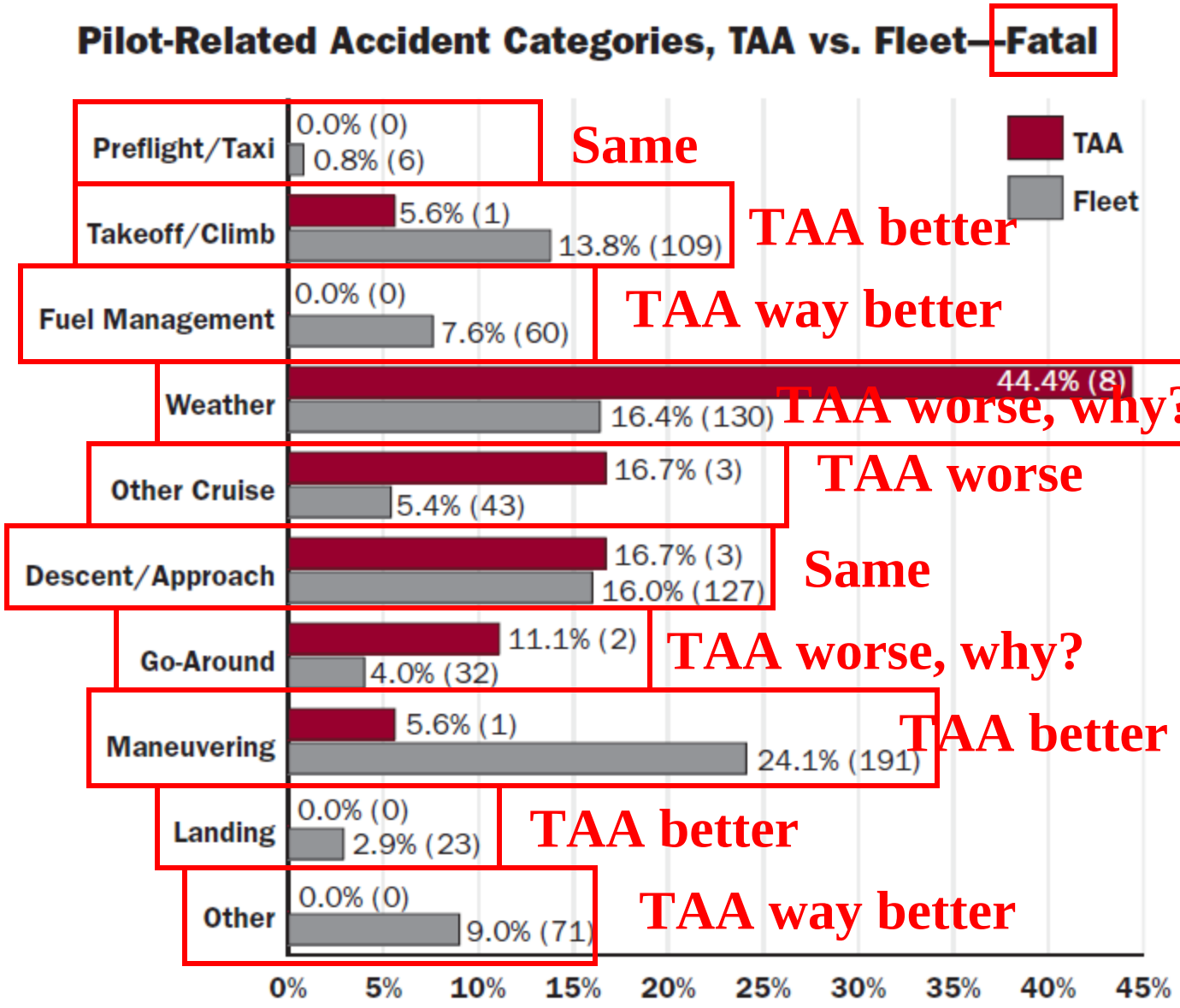
- **NTSB Findings:**
  - PIC failed to maintain sufficient airspeed to avoid stall during an instrument final approach, resulting in inadvertent stall/spin. (6 Fatalities)
  - Factors associated with accident are
    - Inadvertent stall/spin and
    - PIC's failure to follow procedures/directives
    - Clouds
- **What would you have done?**
  - Knowledge of GPS/ILS-autopilot procedures?
  - Who was really flying the airplane?

AOPA
Air Safety Foundation
Statistics
on
TAA Accidents

AOPA ASF Statistics on TAA Accidents - Any thoughts?



AOPA ASF Statistics on TAA Fatal Accidents - Any thoughts?



AOPA ASF Statistics on TAA Accidents

- **TAA fuel management accidents lower than GA fleet**
  - TAA MFDs may include a "range ring"
    - superimposes the aircraft's range with available fuel over the map display
  - TAA MFDs may show a digital readout of fuel remaining and range
    - calculated based on current fuel flow and groundspeed

AOPA ASF Statistics on TAA Accidents

- **TAA maneuvering accidents lower than GA fleet**
  - ASF speculates that higher levels of transportation use of these aircraft could be a factor
    - pilots are flying to some place
    - Pilots not spending so much time in the practice/local area or traffic pattern
      - where maneuvering accidents are prone to occur

AOPA ASF Statistics on TAA Accidents

- **TAA weather-related accidents higher than GA fleet**
  - TAAs have a higher percentage of use in transportation role, increasing exposure to adverse weather compared to those whose primary use is for training.
  - Pilots may have believed that access to near real-time weather improved their chances of dealing with adverse weather
    - Possible over-reliance on hardware
    - May have neglected to ask ATC about developing weather
    - May not understand TAF and METAR text format

AOPA ASF Statistics on TAA Accidents

- **TAA landing/go-around accidents higher than GA fleet**
  - New design TAAs with slick composite fuselages and wings can be difficult to slow to desired approach speed
    - May lead to porpoising during flare or long landings
  - While trying to correct the situation, or when initiating a go around,
    - torque from high-powered engine can lead to directional control problems

How to Query the NTSB Database

Accessing the NTSB Database

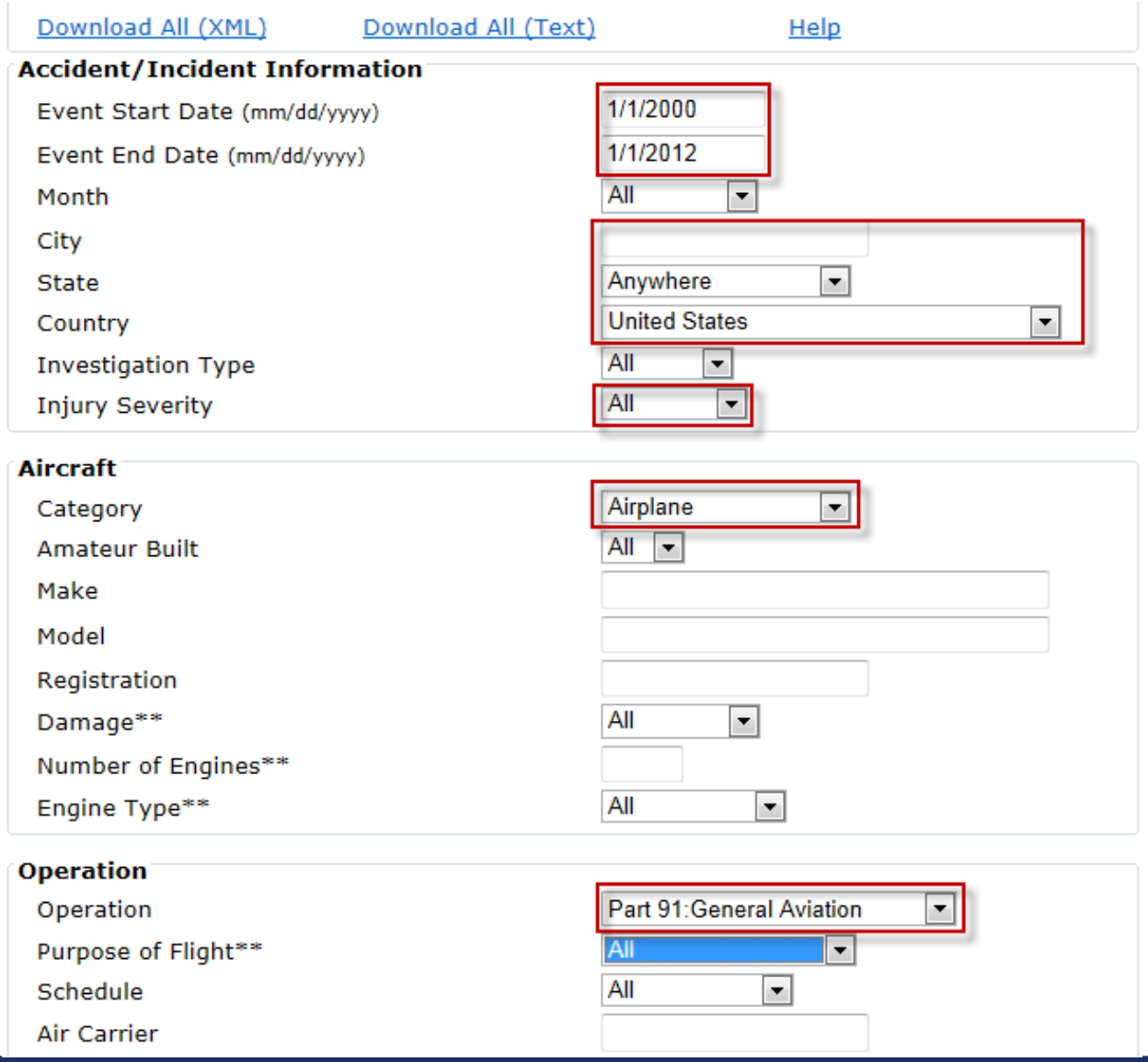
- Use your web browser to access the NTSB Database
  - http://www.ntsb.gov/aviationquery/index.aspx

The NTSB aviation accident database contains information from 1962 and later about civil aviation *accidents* and selected *incidents* within the United States, its territories and possessions, and in international waters. Generally, a **preliminary** report is available online within a few days of an accident. **Factual** information is added when available, and when the investigation is completed, the preliminary report is replaced with a **final** description of the accident and its probable cause. Full narrative descriptions may not be available for dates before 1993, cases under revision, or where NTSB did not have primary investigative responsibility.

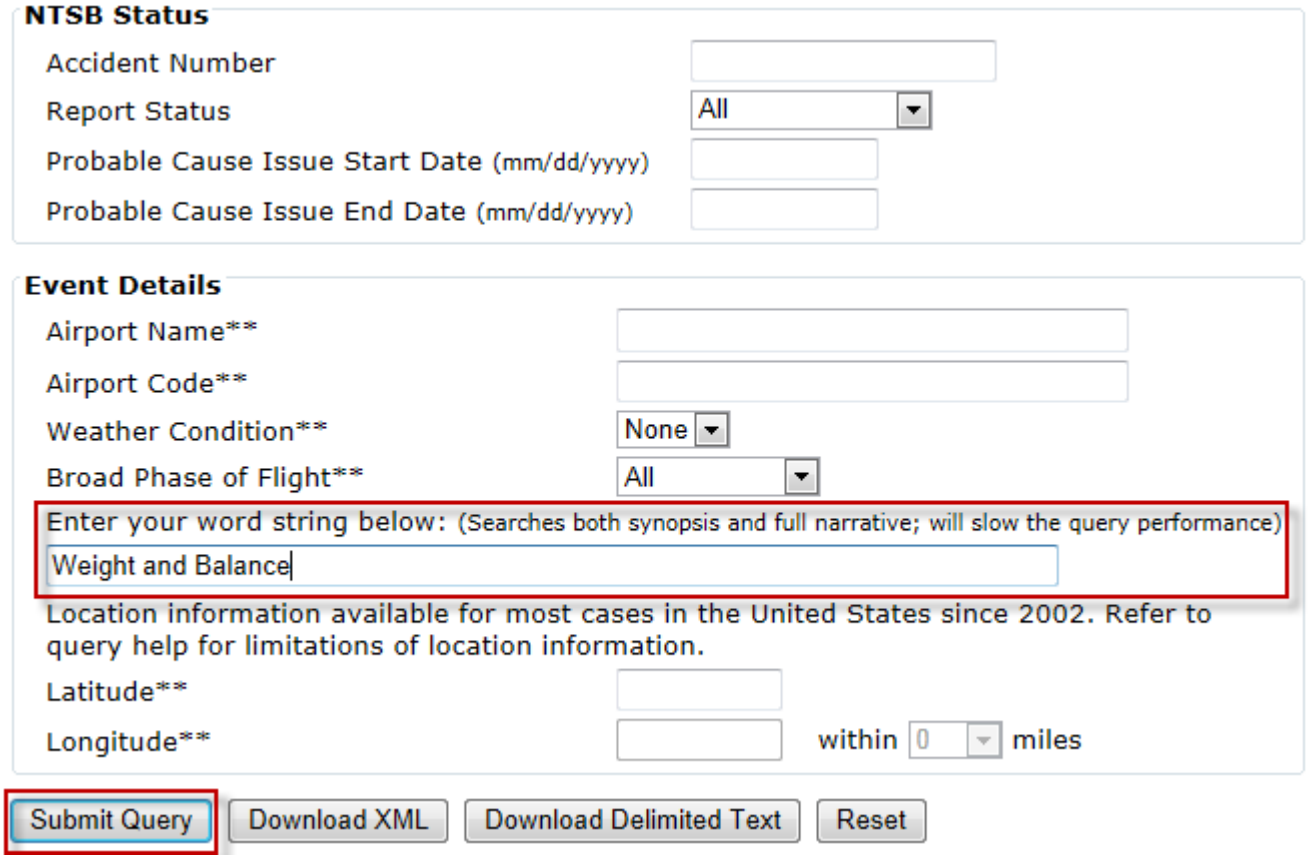
- Monthly lists - accidents sorted by date, updated daily.
- Investigations Nearing Completion - List of investigations with estimated dates of publishing probable cause.
- Downloadable datasets - one complete dataset for each year beginning from 1982, updated monthly in Microsoft Access 2000 MDB format; this site also provides weekly "change" updates and complete documentation.
- GILS record - complete description of the accident database, including definition of "accident" and "incident".
- FAA incident database - complete information about incidents, including those not investigated by NTSB, is provided by the Federal Aviation Administration.
- Data & Information Products - lists other sources of information about aviation accidents, including publications, dockets, and press releases

This interactive search capability for the NTSB database, updated daily; see the and **data dictionary** before using the form for the first time.

Accessing the NTSB Database



Creating an NTSB Database Query



For the word string you would use “GPS” instead of “Weight and Balance”

Parting Thoughts

The Three Most Useless Things to a Pilot

- **The runway behind you**
  - **Moral: know your aircraft's take-off minimums and cross-wind component, your airport's runway length, density altitude, any obstacles to be cleared**
- **The altitude above you**
  - **Moral: know your aircraft's power settings for climb, cruise, and descent**
- **The fuel on the ground below you**
  - **Moral: know your aircraft's fuel capacity, fuel system, GPH burn rate, and winds aloft for the route of flight.**
- **Utilize superior judgment to avoid needing to use superior skill**

Just a Real Nice Picture

Credits and Information

References and Information

- **FAA Aeronautical Information Manual**
  - http://www.faa.gov/air_traffic/publications/ATpubs/AIM/
- **FAA Advanced Avionics Handbook**
  - http://www.faa.gov/library/manuals/aviation/media/FAA-H-8083-6.pdf
- **FAA Risk Management Handbook**
  - http://www.faa.gov/library/manuals/aviation/media/FAA-H-8083-2.pdf
  - See Appendix A for Personal Minimums
- **FAA Navigation Services - GPS**
  - http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/gps/
- **FAA List of GNS-GPS/WAAS Approaches**

  http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/

  http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/media/Master-RNAVs_011311.full.xls

References and Information

- **Garmin**
  - What is GPS?
    - http://www8.garmin.com/aboutGPS/index.html
  - What is WAAS?
    - http://www8.garmin.com/aboutGPS/waas.html
  - GPS Glossary
    - http://www8.garmin.com/aboutGPS/glossary.html
- **AOPA Air Safety Foundation**
  - Technologically Advanced Aircraft Safety and Training
    - http://www.aopa.org/asf/publications/topics/TAA2007.pdf
- **Avidyne**
  - Cirrus SR20 and SR22 Multi-Function Display Pilot's Guide
    - http://www.avidyne.com/publications/cirrus/600-00108-000_EX5000C_MFD_REV07.pdf

References and Information

- **Author of Presentation**
  - William J. Doyle, Jr., CFI A&I, AGI, IGI, Cessna CFAI
    - FAA FAAST Team Representative, PHL FSDO
- **Downloading This Presentation**
  - http://williamjdoylejr.net/FAAST/gps.ppt
    - Uses PowerPoint 2003 and later
    - Password-protected, so click on the "Read Only" button
  - http://williamjdoylejr.net/FAAST/gps.pdf
    - Uses Adobe Acrobat Reader version
    - Recommended for use with iPads
  - http://williamjdoylejr.net/FAAST
    - Entire collection of FAAST presentations by W. J. Doyle, CFI A&I

Just a Real Nice Picture

FAASTeam
on
GPS Approaches:
To WAAS or Not to WAAS

Questions?

Comments?

Ideas?

This Completes

GPS Approaches:
To WAAS or Not to WAAS

Be sure to have your attendance record validated!

Appendix on Flying WAAS Approaches

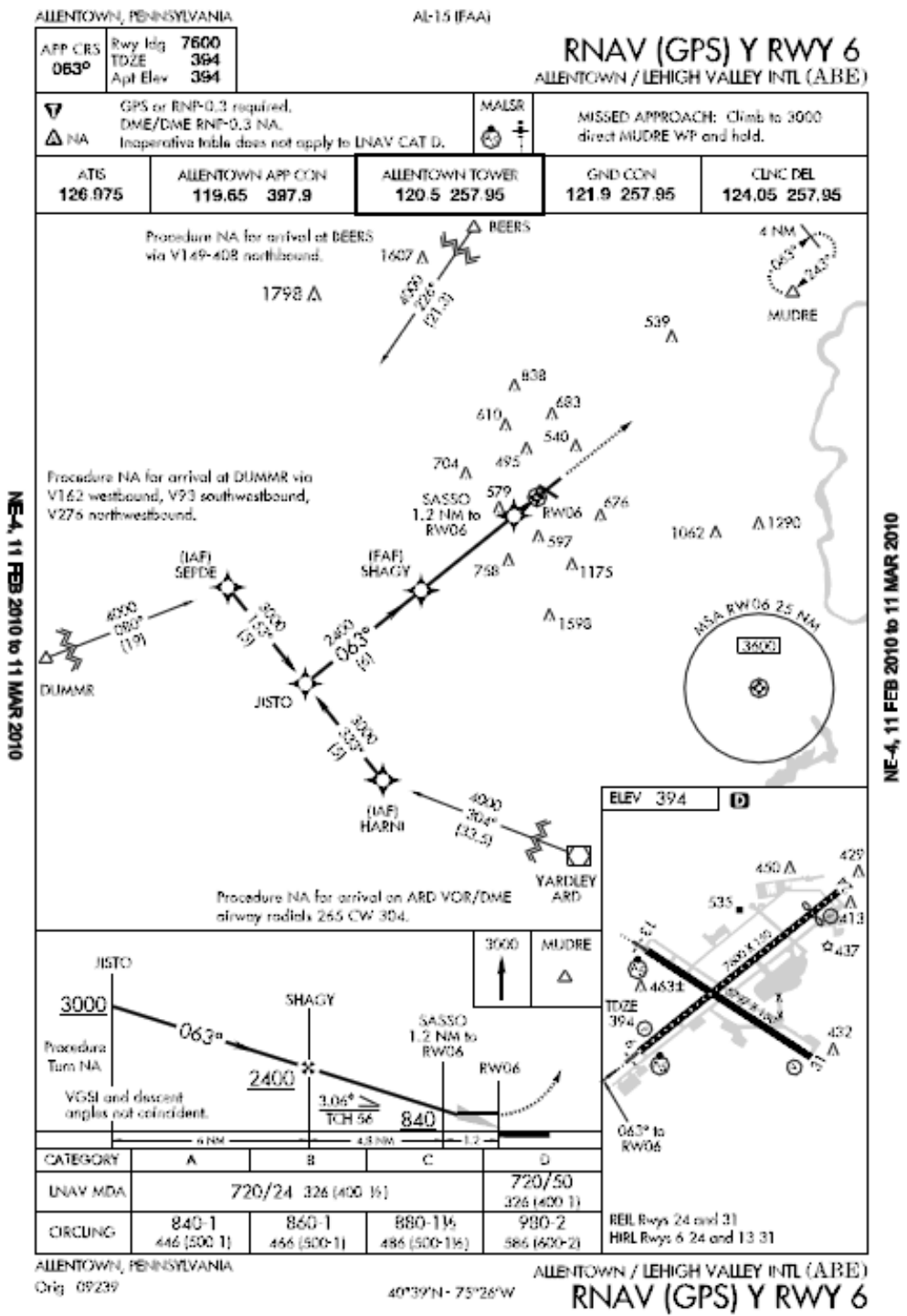
RNAV Approach Minima – ABE RNAV (GPS) Y RWY 6

CATEGORY	A	B	C	D
LNAV MDA	720/24 326 (400- ½)			720/50 326 (400-1)
CIRCLING	840-1 446 (500-1)	860-1 466 (500-1)	880-1½ 486 (500-1½)	980-2 586 (600-2)

ALLENTOWN / LEHIGH VALLEY INTL (ABE)

RNAV (GPS) Y RWY 6

RNAV Approach Plate ABE RNAV (GPS) Y RWY 6



ABE RNAV (GPS) Y RWY 6 LNAV

ARD (IAF) to HARNI (TOD)

ABE RNAV (GPS) Y RWY 6 LNAV

ARD (IAF) to HARNI (TOD) - TOD Advisory

ABE RNAV (GPS) Y RWY 6 LNAV

HARNI (TOD) to JISTO - Advisory Vertical Guidance and Altitude Armed

ABE RNAV (GPS) Y RWY 6 LNAV

JISTO to SHAGY- Advisory Vertical Guidance and Altitude Armed

ABE RNAV (GPS) Y RWY 6 LNAV

SHAGY to SASSO - Advisory Vertical Guidance Establishing

ABE RNAV (GPS) Y RWY 6 LNAV

SASSO to RW06 - Vertical Guidance and Descent Established

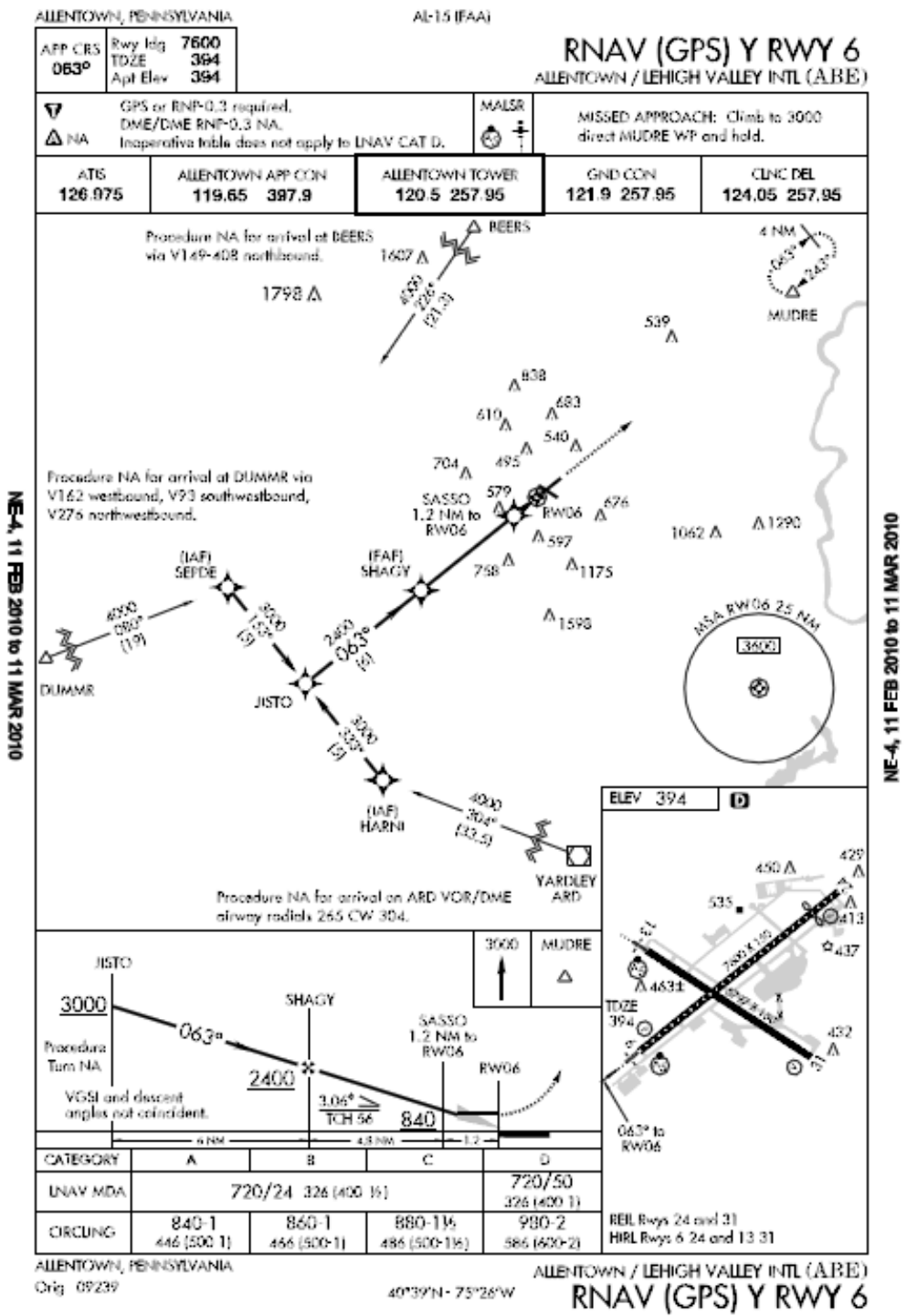
RNAV Approach Minima – ABE RNAV (GPS) Y RWY 6

CATEGORY	A	B	C	D
LNAV MDA	720/24 326 (400- ½)			720/50 326 (400-1)
CIRCLING	840-1 446 (500-1)	860-1 466 (500-1)	880-1½ 486 (500-1½)	980-2 586 (600-2)

ALLENTOWN / LEHIGH VALLEY INTL (ABE)

RNAV (GPS) Y RWY 6

RNAV Approach Plate ABE RNAV (GPS) Y RWY 6



ABE RNAV (GPS) Y RWY 6 LNAV+V

ARD (IAF) to HARNI (TOD)

ABE RNAV (GPS) Y RWY 6 LNAV+V

HARNI (TOD) to JISTO - Advisory Vertical Guidance Showing and Altitude Armed

ABE RNAV (GPS) Y RWY 6 LNAV+V

HARNI (TOD) to JISTO - Altitude and Advisory Vertical Guidance Armed

ABE RNAV (GPS) Y RWY 6 LNAV+V

SASSO to RW06 - Vertical Guidance and Descent Established

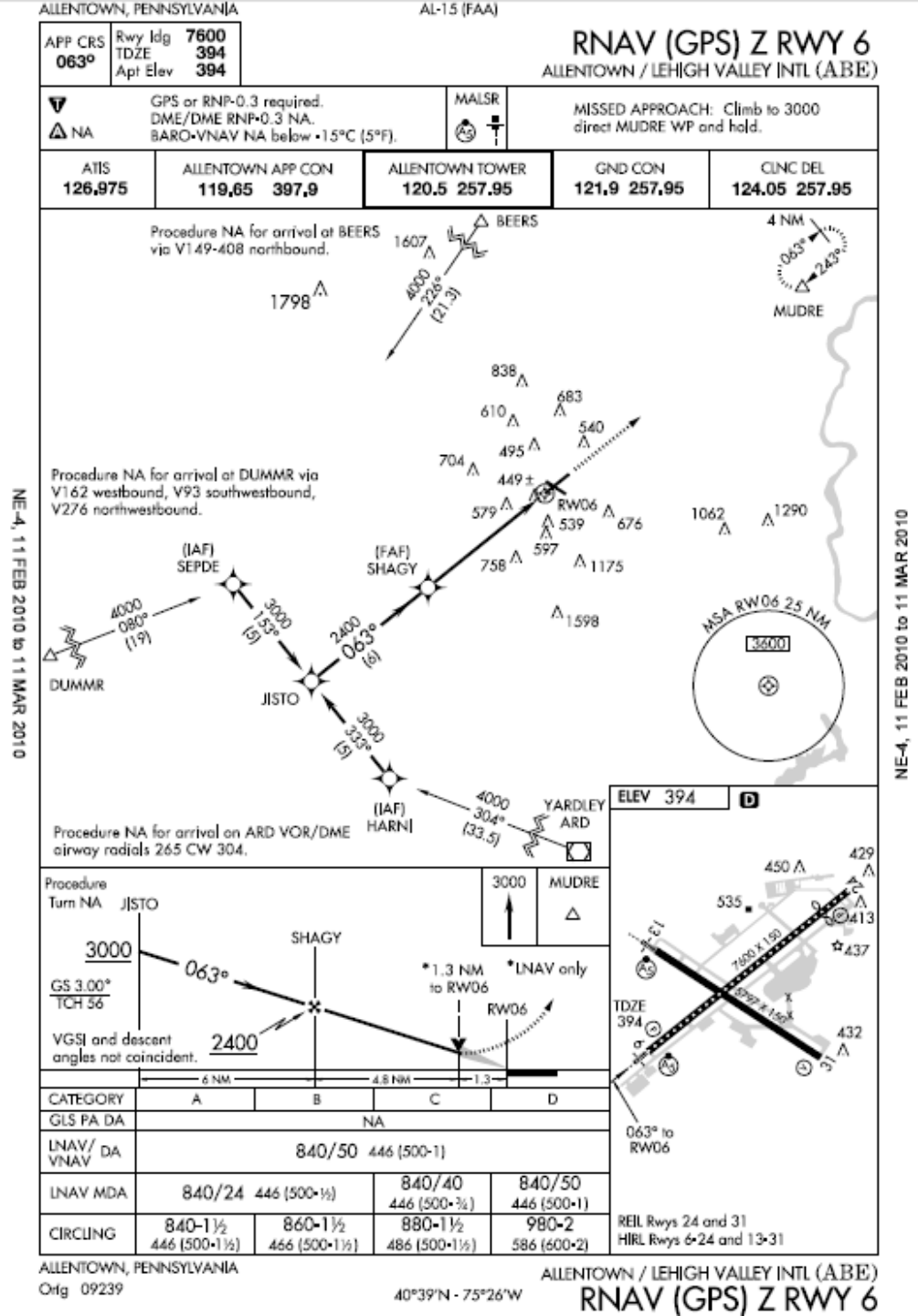
RNAV Approach Minima – ABE
RNAV (GPS) Z RWY 6

CATEGORY	A	B	C	D
GLS PA DA	NA			
LNAV/ VNAV DA	840/50 446 (500-1)			
LNAV MDA	840/24 446 (500-½)		840/40 446 (500-¾)	840/50 446 (500-1)
CIRCLING	840-1½ 446 (500-1½)	860-1½ 466 (500-1½)	880-1½ 486 (500-1½)	980-2 586 (600-2)

ALLENTOWN / LEHIGH VALLEY INTL (ABE)

RNAV (GPS) Z RWY 6

RNAV Approach Plate ABE RNAV (GPS) Z RWY 6



ABE RNAV (GPS) Z RWY 6 LNAV/VNAV

ARD (IAF) to HARNI (TOD)

ABE RNAV (GPS) Z RWY 6 LNAV/VNAV

HARNI (TOD) to JISTO -Vertical Path Guidance Armed

ABE RNAV (GPS) Z RWY 6 LNAV/VNAV

JISTO to SHAGY (FAF) - Altitude and Vertical Guidance Armed

ABE RNAV (GPS) Z RWY 6 LNAV/VNAV

SHAGY (FAF) to RW06 - Vertical Guidance & Descent Established

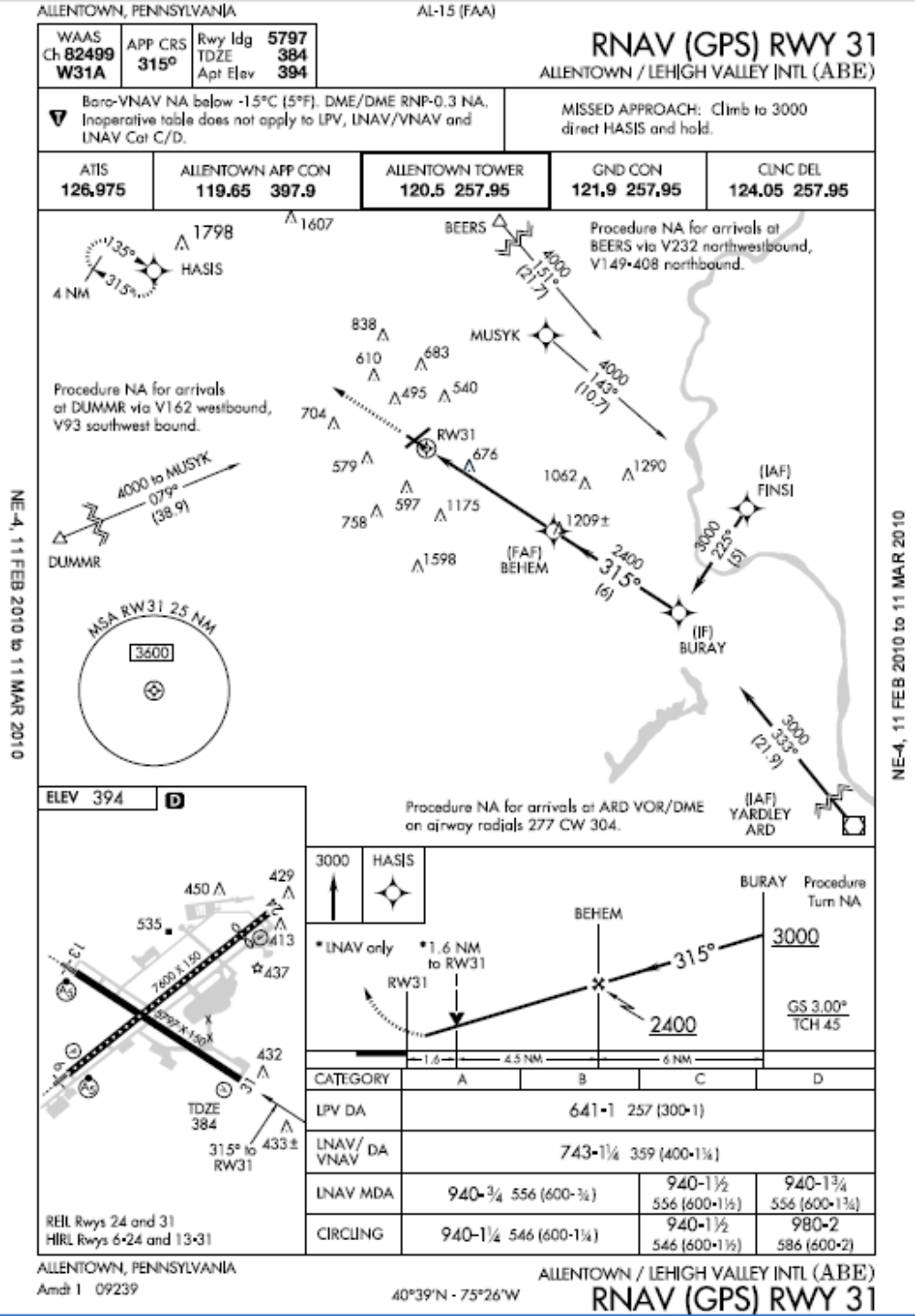
RNAV Approach Minima – ABE
RNAV (GPS) RNWY 31

CATEGORY	A	B	C	D
LPV DA	641-1 257 (300-1)			
LNAV/ VNAV DA	743-1¼ 359 (400-1¼)			
LNAV MDA	940-¾ 556 (600-¾)		940-1½ 556 (600-1½)	940-1¾ 556 (600-1¾)
CIRCLING	940-1¼ 546 (600-1¼)		940-1½ 546 (600-1½)	980-2 586 (600-2)

40°39′N - 75°26′W

ALLENTOWN / LEHIGH VALLEY INTL (ABE)
RNAV (GPS) RWY 31

RNAV Approach Plate ABE RNAV (GPS) RNWY 31



ABE RNAV 31GPS LPV

ARD (IAF) to BURAY (TOD)

ABE RNAV 31GPS LPV

BURAY (TOD) to BEHEM (FAF) - Glide Slope Armed

ABE RNAV 31GPS LPV

BEHEM (FAF) to RW31 MAP - Glide Slope Intercepted