Flight Planning

Objective

Safely plan a VFR cross-country flight, use various types of navigation to get there, and use a navigation log to compute expected distances, times, and fuel requirements. Also use ForeFlight to plan a flight and interpret its output.

Motivation

Flying to another airport requires additional planning and multiple forms of navigation. A pilot needs to understand the information needed to accurately plan a flight and have the skills to execute that flight plan.

Overview

- Picking Destinations
- Picking Waypoints
- VFR Cruising Altitudes (91.159)
- Cruising Altitudes
- Dead Reckoning
- Navigation Log
    - Steps to manually complete a navlog
- Flight Planning with ForeFlight
- Preflight Information Requirements (91.103)
- Weather Briefings
- Flight Plans
- UTC Time Conversion
- Flying our Flight Plan
- VOR and DME navigation
- GPS Navigation
- Lost Procedures
- Diverting to an Alternate

Picking a Destination

What airport do we want to go to?

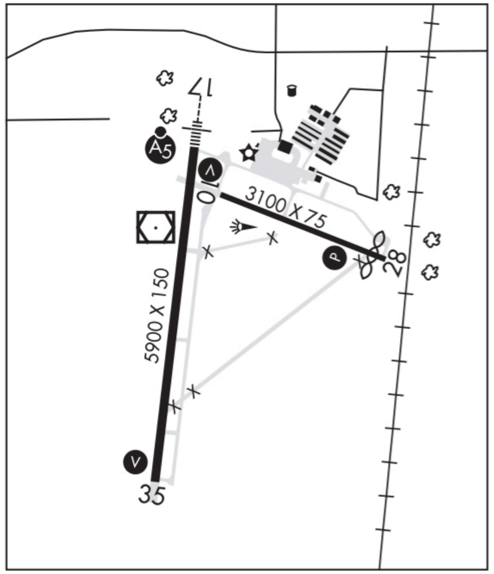
- Someplace we want to go!
- How far can we make it in 1 hour of flying time?
- Airport
  - Elevation: Aircraft performance
  - Runway lengths, within our personal minimums?
  - Night flight: Lighting, VASI or PAPI?
- Services
  - Is there an FBO (Fixed-base operator)?
  - Self-serve fuel?
  - Crew cars?
- Weather

Going to Corvalis

- We hear Corvallis has a good restaurant, where should we land?
- Considering KCVO
  - At least 5900' runway
  - Airport is lighted
  - Airport has a beacon
  - Airport has fuel
  - Has an AWOS - Automated weather
  - Fuel available - tick marks

More Information: Chart Supplement

CORVALLIS MUNI (CVO)(KCVO) 4 SW UTC–8(–7DT) N44°29.81´ W123°17.37´ **KLAMATH FALLS**
250 B TPA—1050(800) NOTAM FILE CVO **H–1B, L–1B**
RWY 17–35: H5900X150 (ASPH) S–35, D–73, 2S–127, 2D–100 HIRL **IAP**
RWY 17: MALSR. VASI(V4L)—GA 3.0° TCH 45´.
RWY 35: REIL. VASI(V4L)—GA 3.0° TCH 51´.
RWY 10–28: H3100X75 (ASPH) S–51, D–65, 2D–100 MIRL
RWY 28: PAPI(P4L)—GA 3.0° TCH 25´. Thld dsplcd 228´. Railroad.



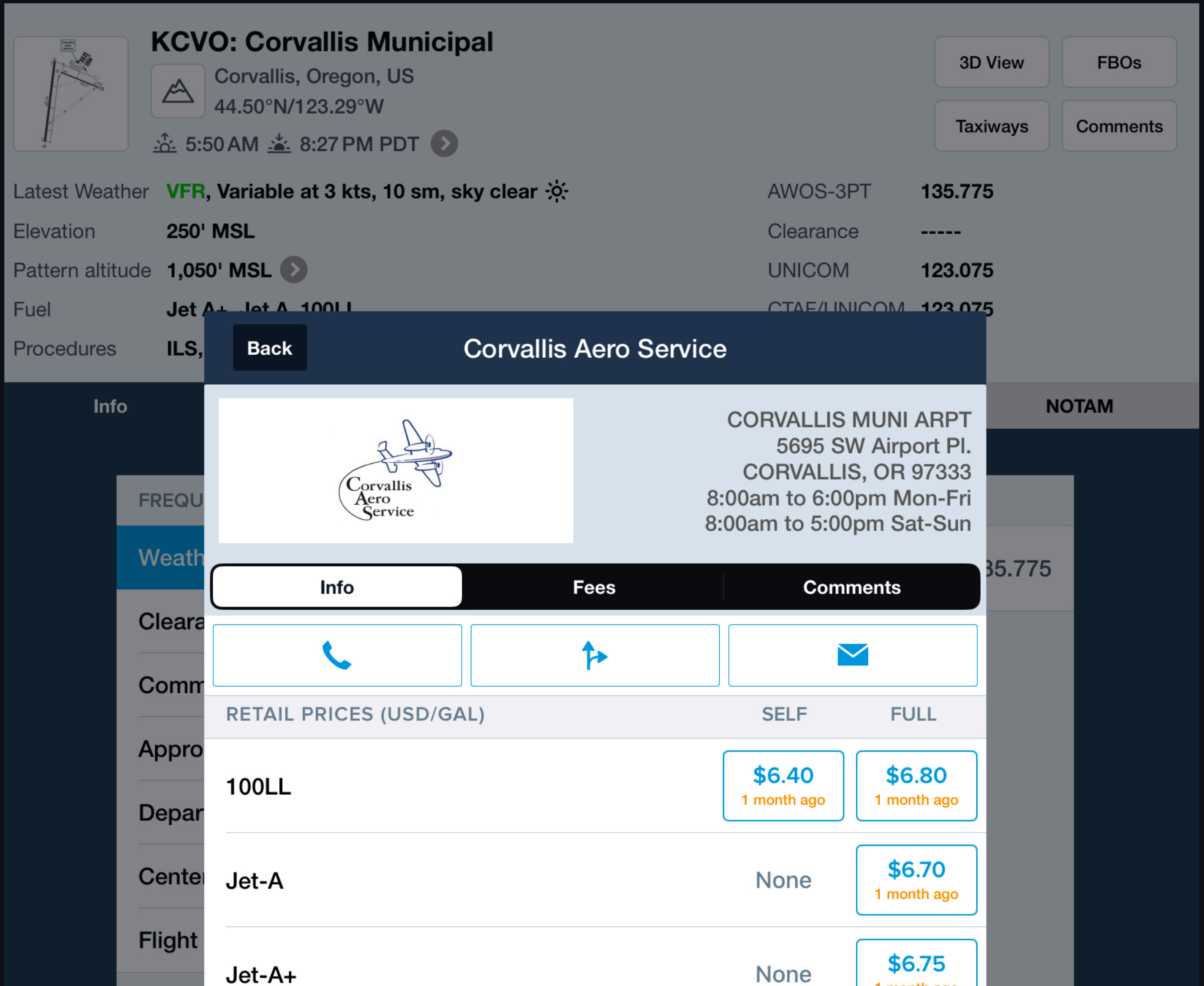
RUNWAY DECLARED DISTANCE INFORMATION

RWY 10:	TORA–3100	TODA–3100	ASDA–3100	LDA–3100
RWY 17:	TORA–5900	TODA–5900	ASDA–5900	LDA–5900
RWY 28:	TORA–3100	TODA–3100	ASDA–3100	LDA–2872
RWY 35:	TORA–5900	TODA–5900	ASDA–5900	LDA–5900

SERVICE: S4 **FUEL** 100LL, JET A **OX** 1, 2, 3 **LGT** ACTVT MALSR Rwy 17, REIL Rwy 35; PAPI Rwy 28; VASI Rwy 17 and Rwy 35; HIRL Rwy 17–35 and MIRL Rwy 10–28—CTAF.
AIRPORT REMARKS: Attended 1600Z‡–dusk. Migratory waterfowl and other birds on and invof arpt. Rwy 10–28 has white side stripes. Surf cond not reported daily 0100–1600Z‡ and all times Saturdays and Sundays.
AIRPORT MANAGER: (541) 766-6783
WEATHER DATA SOURCES: AWOS–3PT 135.775 (541) 754–0081.
COMMUNICATIONS: CTAF/UNICOM 123.075
Ⓡ **CASCADE APP/DEP CON** 127.5 (1400–0730Z‡)
Ⓡ **SEATTLE CENTER APP/DEP CON** 125.8 (0730–1400Z‡)
CLEARANCE DELIVERY PHONE: For CD ctc Cascade Apch at 541-607-4674/4675, when Apch clsd ctc Seattle ARTCC at 253-351-3694.
RADIO AIDS TO NAVIGATION: NOTAM FILE CVO.
(VH) (DH) VORW/DME 115.4 CVO Chan 101 N44°29.97´ W123°17.62´ at fld. 242/18E.
VOR unusable:
061°–073° byd 40 NM
097°–129° byd 40 NM
151°–334° byd 40 NM
335°–345° byd 40 NM blo 28,000´

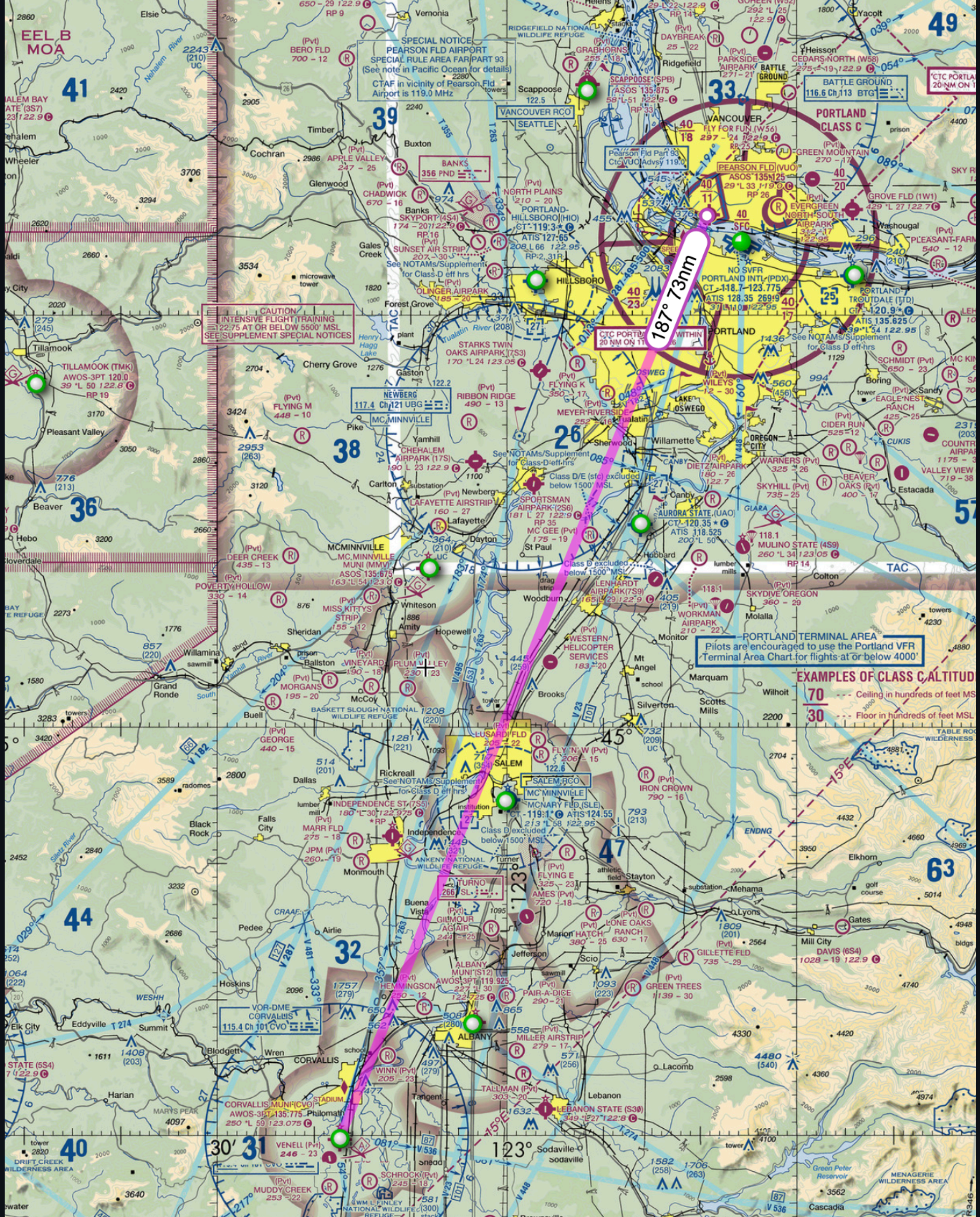
- 2 runways: 5900' and 3100'
- 4 mi SW of city of Corvallis
- 100LL available
- Has a VOR on the field

More Information: Services



- FBO: Fixed-based operator
- Self-serve fuel
- Rental cars
- Attended 8-6pm M-F

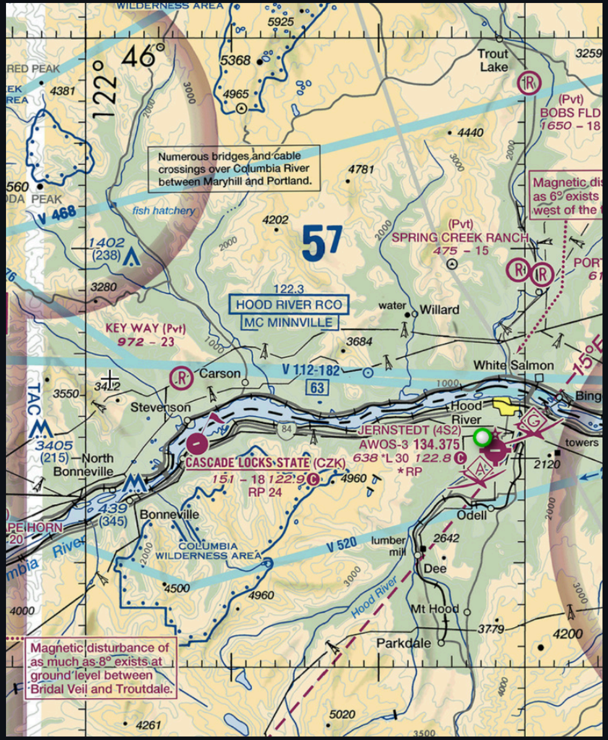
Routing to our Destination

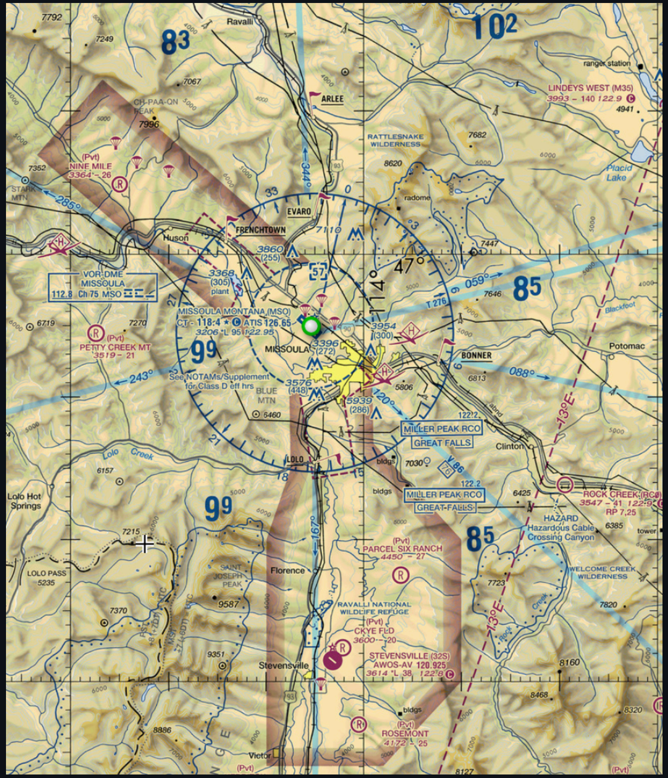


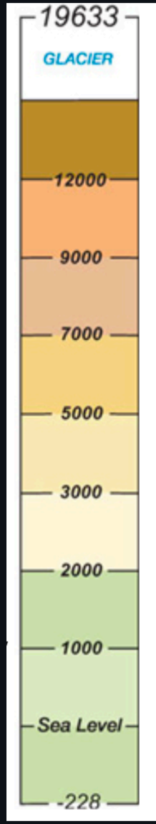
Direct Route

- What's the terrain like?
- Airspace:
  - B/C/D airspace
  - Restricted or prohibited areas
  - MOAs
- Where would we go in an emergency?
- Diversion options

Terrain Shading

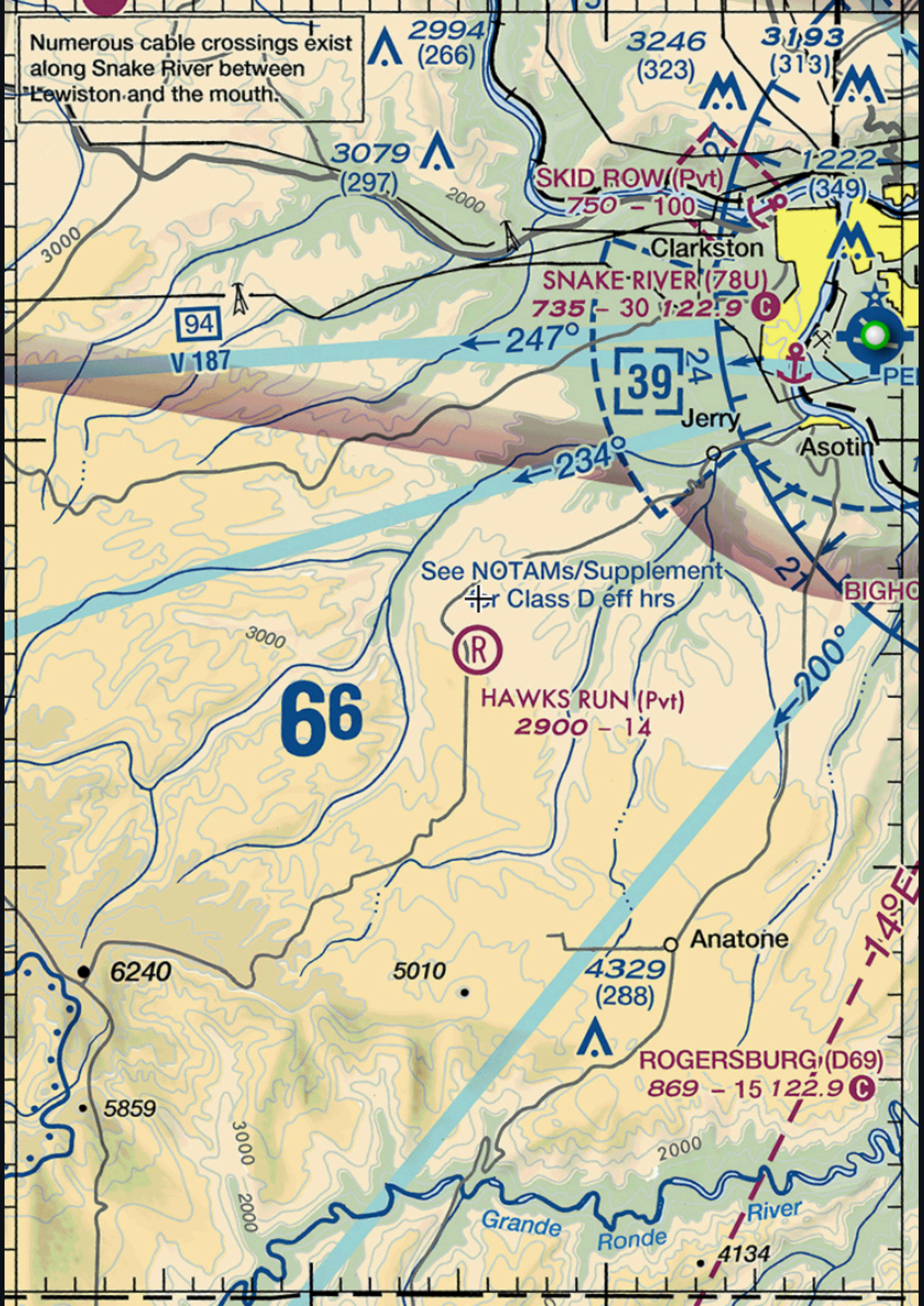






Maximum Elevation Figures (MEF)

- Height of the highest terrain or obstacle in MSL
- +100 foot buffer
- Rounded up to near 100' level
- With a MEF of 6600, where would we want to cruise at?

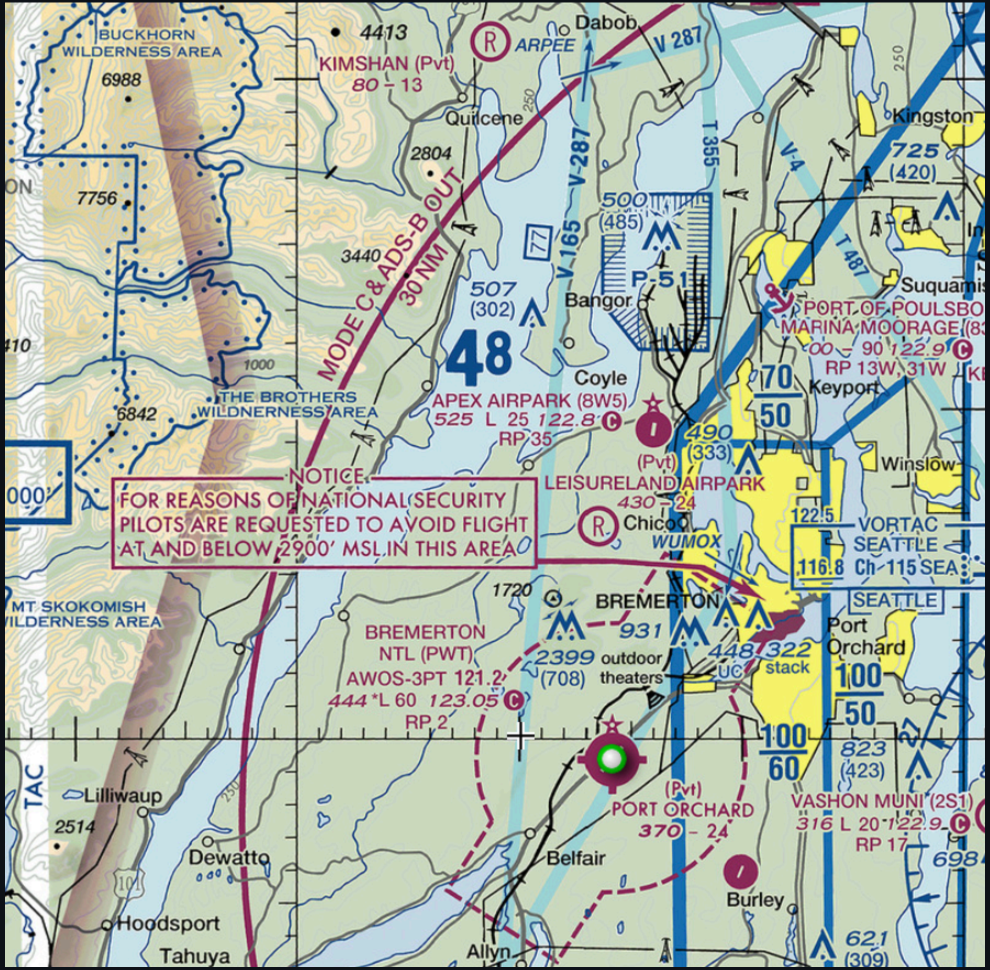


Obstacles

- Top number: MSL altitude
- Bottom number: AGL altitude
- Some are lighted

Airspace

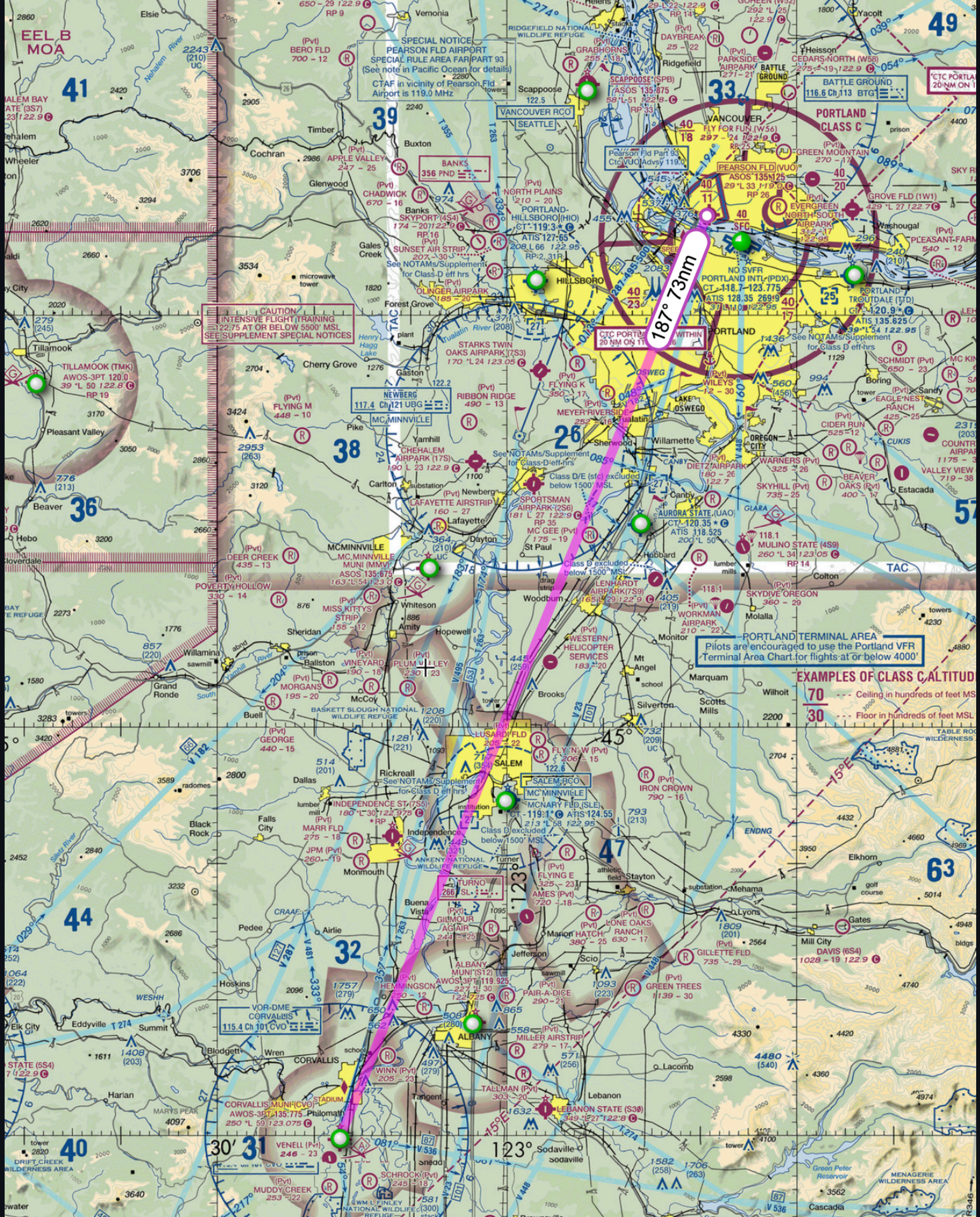
Seaside
Tillamook Head
SADDLE MOUNTAIN
OREGON ISLANDS
NATIONAL WILDLIFE REFUGE
945
(318)
124
Jewell
15°30'E
Cannon
Beach
2860
Elsie
EEL B
MOA
Arch
Cape
3076
2243
(210)
UC
Nehalem River
OREGON ISLANDS
NATIONAL WILDLIFE REFUGE
41
2420
Cape Falcon
NEHALEM BAY
STATE (3S7)
30 – 23 122.9
NOTICE TO PILOTS
he Islands, Rocks and Reefs along the Pacific
oastline from 42°00'N to 46°00'N are National
ildlife Refuges. Low flights may disturb wildlife
sulting in a violation of Federal law.
Manzanita
Nehalem
Wheeler
Brighton
1079
(210)
3706
3294
W-570C
Rockaway
Beach
OREGON ISLANDS
NATIONAL WILDLIFE REFUGE
794
(268)
2620
1740
Garibaldi
2660
Bay City
CAPE MEARES
NATIONAL WILDLIFE REFUGE
2020
279
(245)
1420
towers
Oceanside
Tillamook
THREE ARCH ROCKS
NATIONAL WILDLIFE REFUGE
Netarts
TILLAMOOK (TMK)
AWOS-3PT 120.0



BUCKHORN
WILDERNESS AREA
4413
KIMSHAN (Pvt)
80 – 13
ARPEE
Dabob
V 287
6988
Quilcene
Kingston
2804
725
(420)
7756
V-287
T 355
500
(485)
3440
MODE C & ADS-B OUT
30 NM
P-51
507
(302)
Bangor
Suquamish
PORT OF POULSBO
MARINA MOORAGE
RP 13W, 31W
48
Coyle
70
50
Keyport
6842
THE BROTHERS
WILDERNESS AREA
APEX AIRPARK (8W5)
525 L 25 122.8
RP 35
490
(333)
Winslow
NOTICE
FOR REASONS OF NATIONAL SECURITY
PILOTS ARE REQUESTED TO AVOID FLIGHT
AT AND BELOW 2900' MSL IN THIS AREA
LEISURELAND AIRPARK
430 – 24
Chico
WUMOX
VORTAC
SEATTLE
116.8 Ch 115 SEA
SEATTLE
MT SKOKOMISH
WILDERNESS AREA
1720
BREMERTON
931
BREMERTON
NTL (PWT)
AWOS-3PT 121.2
444 *L 60 123.05
RP 2
2399
(708)
outdoor
theaters
448
UC
322
stack
Port
Orchard
100
50
100
60
823
(423)
Lilliwaup
2514
PORT ORCHARD
370 – 24
VASHON MUNI (2S1)
316 L 20 122.9
RP 17
698
Dewatto
Belfair
Burley
Hoodsport
Tahuya
Allyn
621
(309)

Emergencies

- Where would go if our engine quits?
  - Airports
  - Type of terrain
  - Roads
  - Civilization

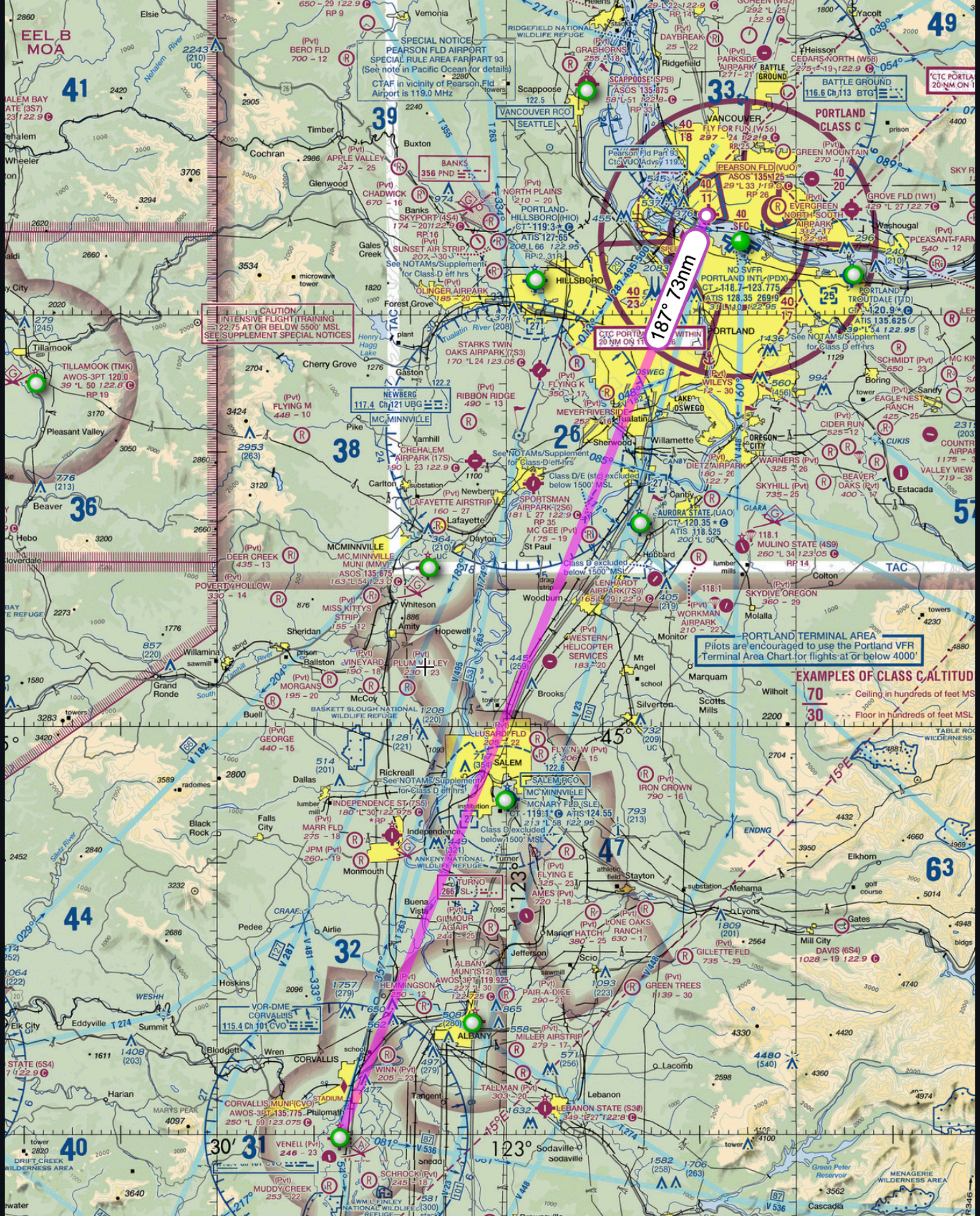


Our Corvallis Flight

Terrain?

Airspace?

Emergencies?

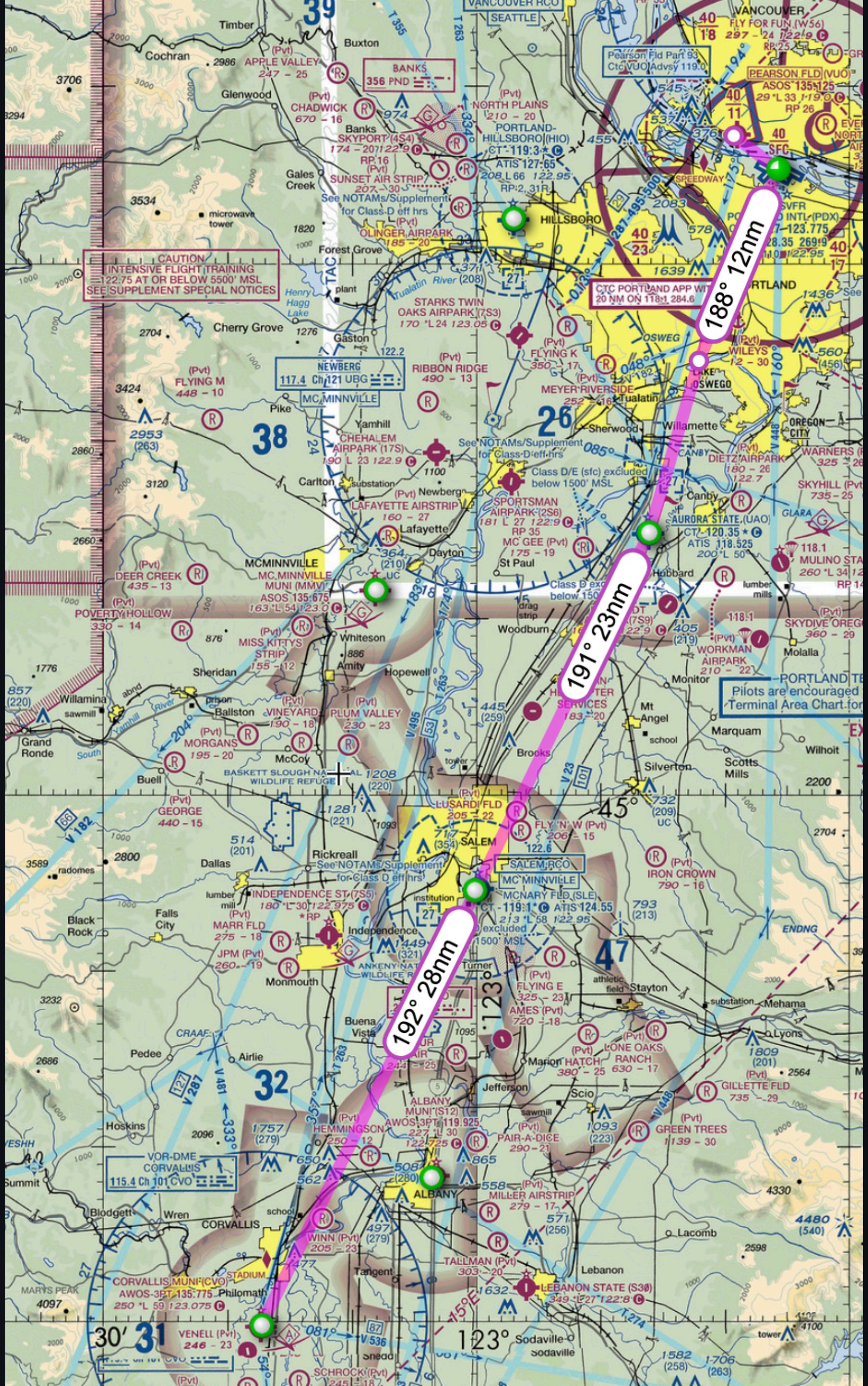


Our Corvallis Flight

- Terrain
  - MEFs: 3,200, 4,700, 2,600
- Airspace
  - Class C transition over PDX (up to 4000')
  - Aurora Class D (2700')
  - Salem Class D (2700')
- Emergencies
  - Lots of valley fields
  - Several towns
  - I-5

Picking Waypoints

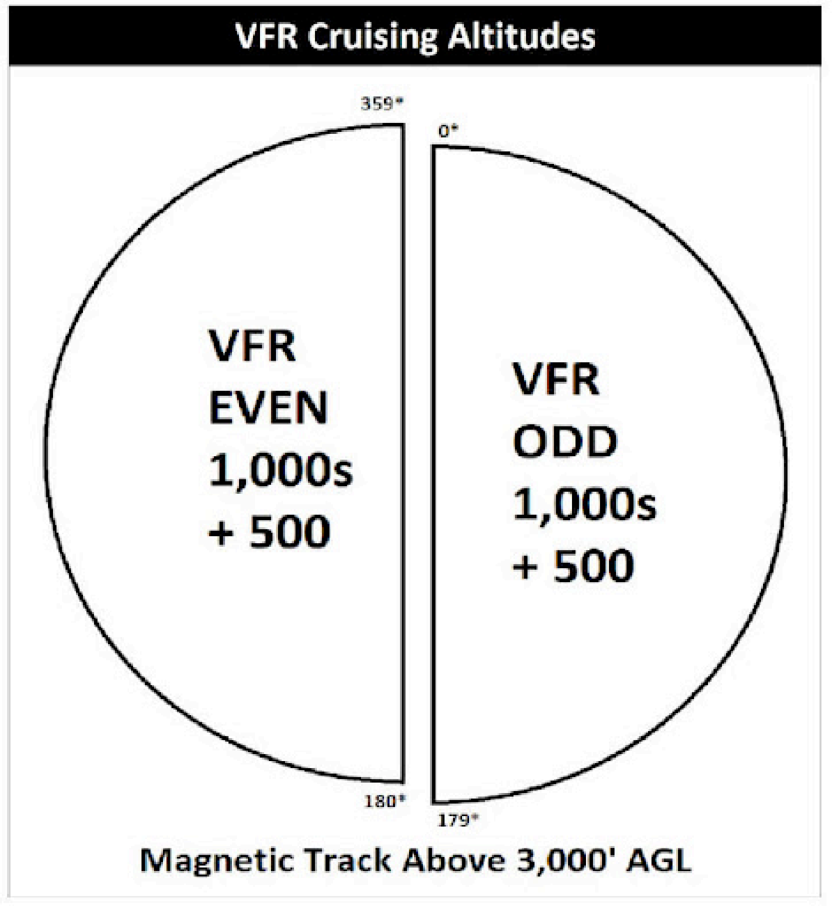
- Use waypoints to route along a path that works best
- Picking good waypoints: Something you can see easily from the air
  - Rivers, lakes, mountains
  - Towns, roads
  - VFR waypoints
  - Airports: Can be great
    - Small grass strips can be hard to see
    - Difficult to see at night



Corvallis Flight Waypoints

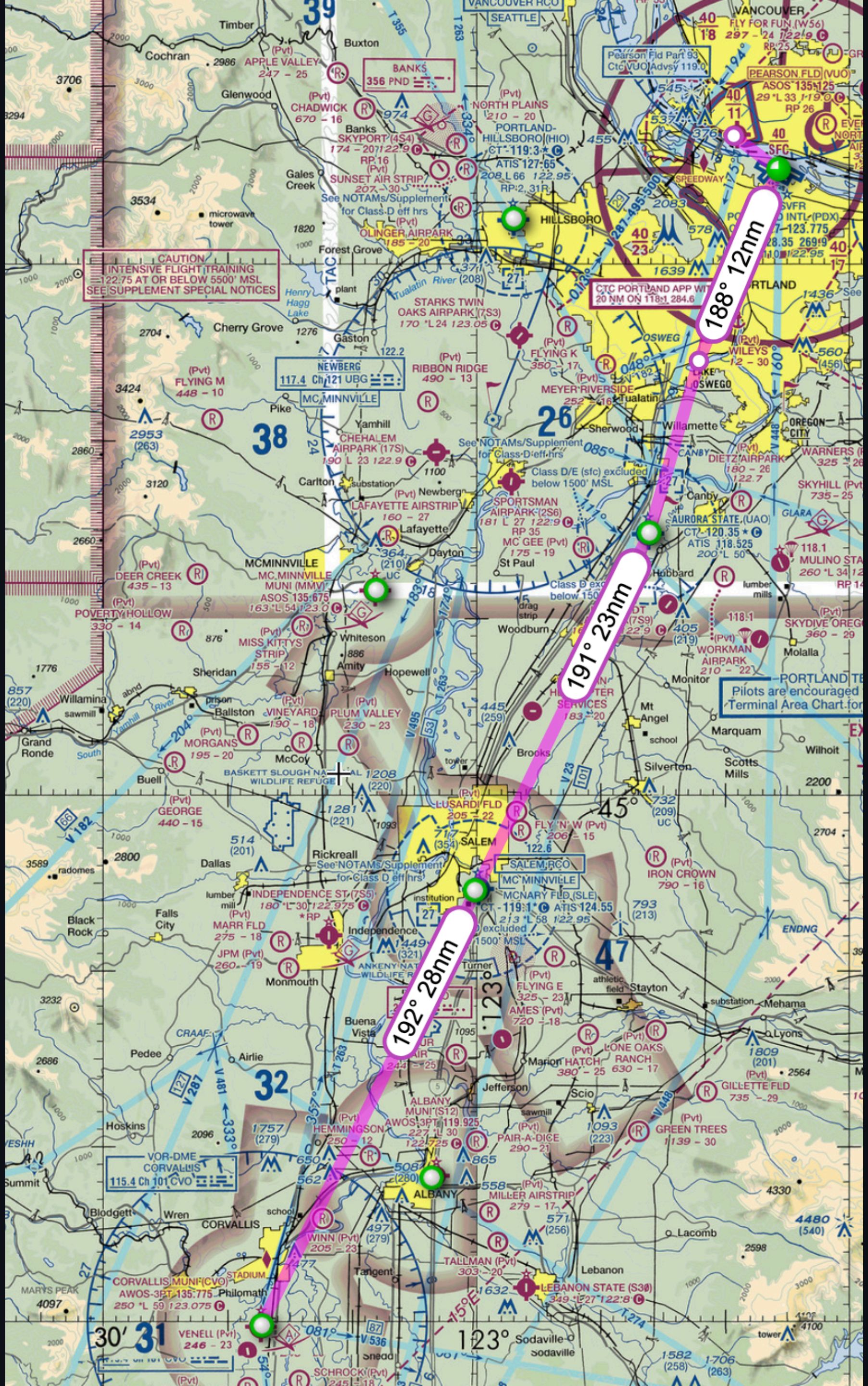
- KVUO
- KPDX
- Lake Oswego
- KUAO - Aurora
- KSLE - Salem
- KCVO

VFR Cruising Altitudes (91.159)



Above 3000' AGL, VFR traffic in level cruising flight shall fly:

- On **eastbound** headings (0 thru 179° magnetic)
  - Odd thousands + 500'
  - E.g. 3500', 5500', 7500'
- On **westbound** headings (180 thru 359° magnetic)
  - Even thousands + 500'
  - E.g. 4500', 6500', 8500'



Cruising Altitudes

- Select based on:
  - Terrain
  - Performance
  - Emergency considerations
- Our Corvallis flight
  - Highest terrain 3000'
  - Class D up to 2700'
  - Let's pick **6500** ft

Simple Altitude Planning - Climb

CONDITIONS:
Flaps Up
2400 RPM
31 Inches Hg
Mixture Full Rich
Cowl Flaps Open

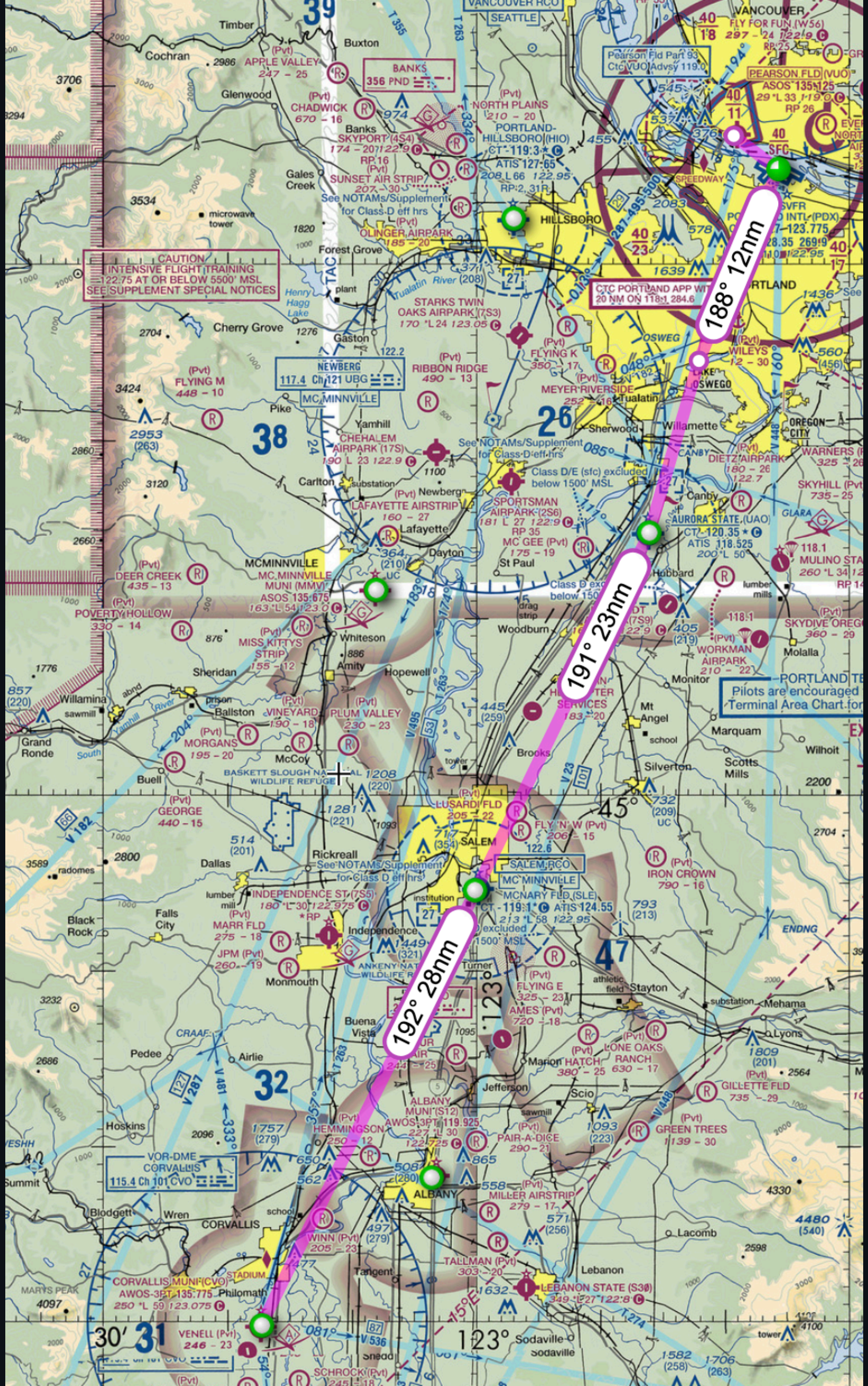
WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
			-20°C	0°C	20°C	40°C
3100	S.L.	87	1175	1055	935	815
	4000	86	1085	965	840	715
	8000	86	970	845	720	595
	12,000	85	825	700	580	- - -
	16,000	85	670	550	435	- - -
	20,000	84	505	390	- - -	- - -

Figure 5-6. Maximum Rate of Climb

- Takeoff from Pearson
- Start climbing to our cruising altitude
  - Let's say 1000 ft/min. climb
  - Climb from S.L. to 6,500 ft.
  - **6.5 minutes**
- Cruise at 6,500'

Simple Altitude Planning - Descent

- Takeoff from Pearson
- When do we want to descend?
  - Let's use 500 fpm down
  - Decent from 6,500 to KCVO pattern altitude (1250')
  - 6500 - 1500 = 5000'
  - **10 minutes** before arrival
    - Plus some extra to enter traffic pattern

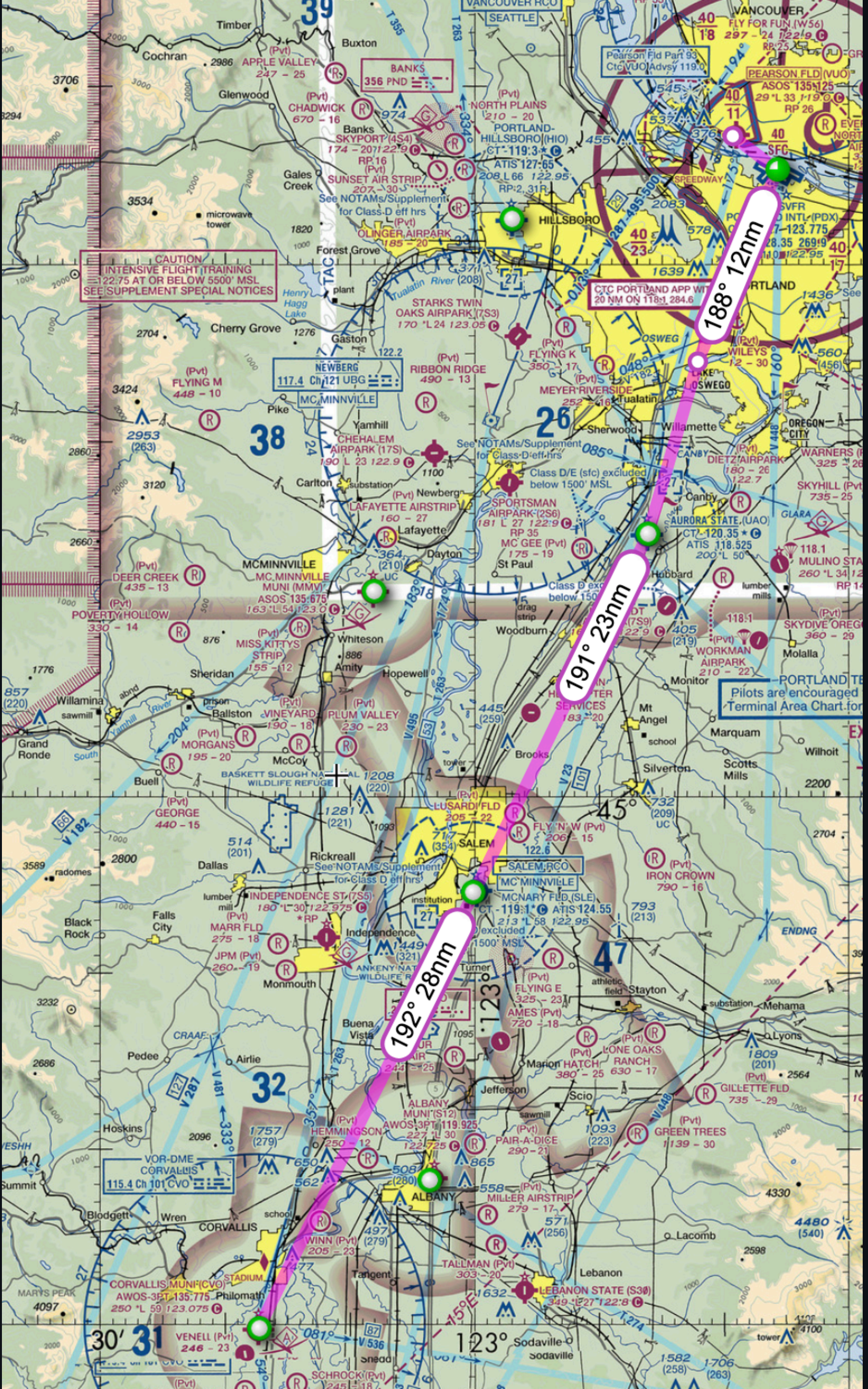


Final Plan

- KVUO
- KPDX
- Top-of-climb (TOC) - 6,500' MSL
- Lake Oswego
- KUAO - Aurora
- KSLE - Salem
- Top-of-decent (TOD)
- KCVO

Preflight Information Requirements (91.103)

- "NWKRAFT"
  - **N**OTAMs
  - **W**eather
  - **K**nown ATC delays: For bigger airports
  - **R**unway lengths: For our intended airports
  - **A**lternates available: Other airports we can go to
  - **F**uel requirements
  - **T**akeoff and landing distances: Performance charts



How are we going to get there?

- Pilotage: Look out the window
  - See our waypoints
  - (and everything in between)
- Dead reckoning:
  - Speed * Time = Distance
- Radio navigation:
  - Newberg VOR
  - Corvallis VOR
- GPS

Dead Reckoning

How much time will it take to take to fly from waypoint A to waypoint B?

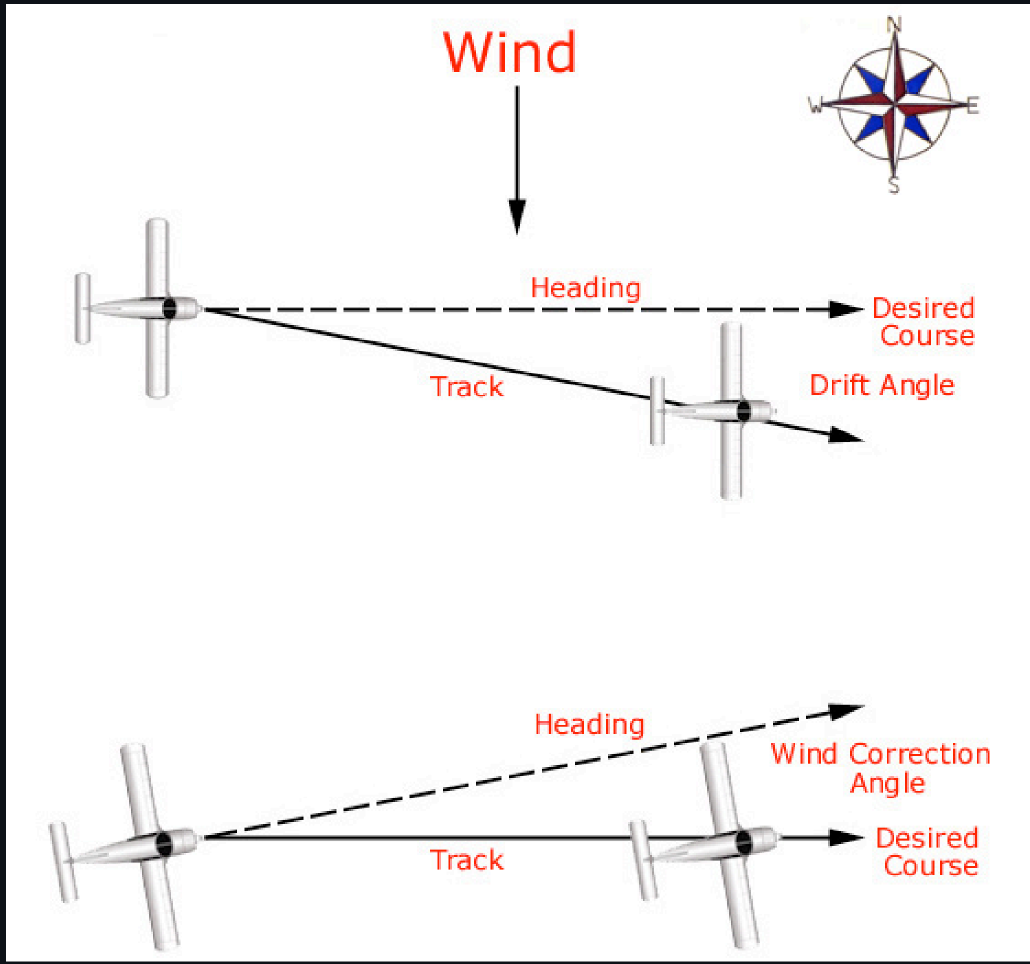
Time = Distance / Speed

We need to know our speed over the ground (groundspeed)

Dead Reckoning - Ground Speed

How do we find our speed over the ground?

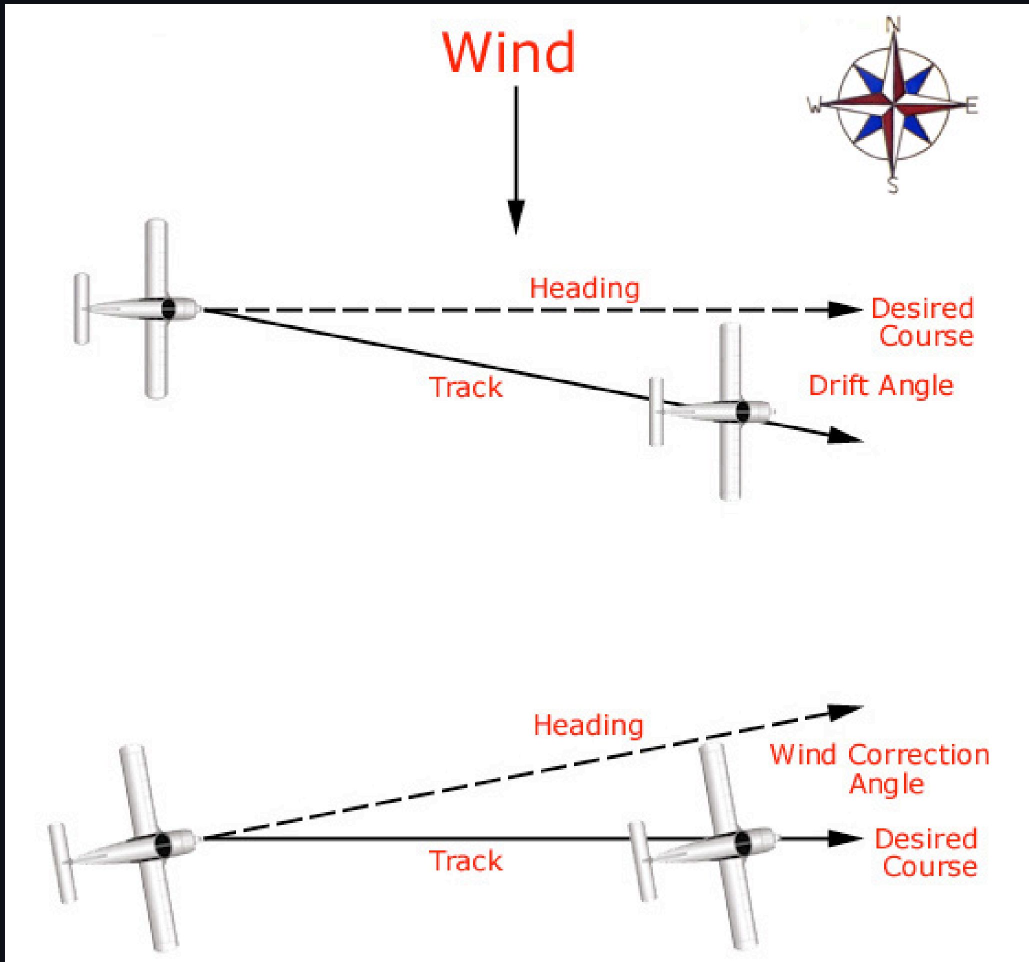
1. Start with our expected airspeed from performance
2. Account for atmospheric conditions (pressure, temperature)
3. Use forecasted winds to account for wind drift

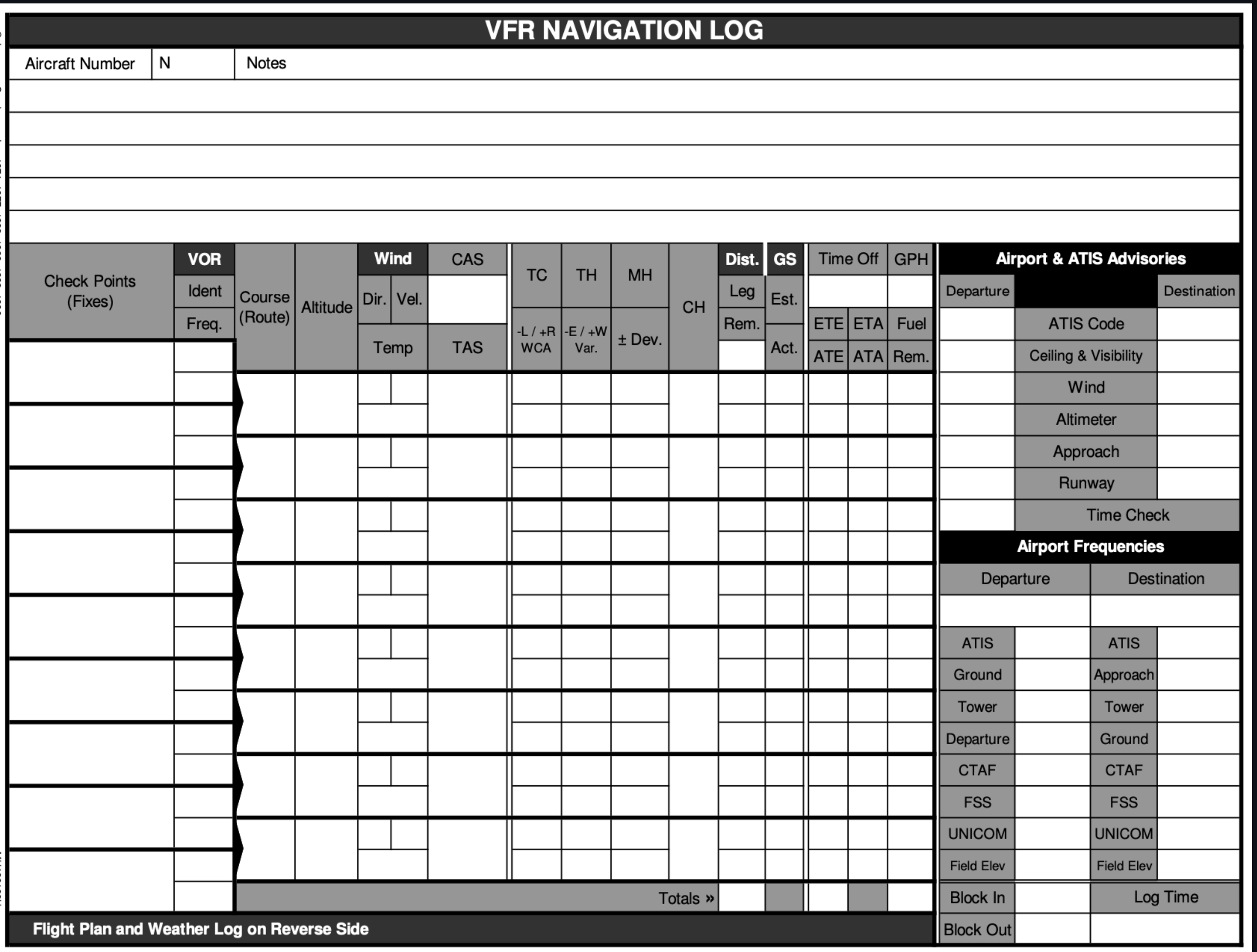


Dead Reckoning - Wind Correction

What heading do we need to fly to get to waypoint B?

- We need to turn to correct for the direction the wind is blowing us
- We call this the **wind correction angle**
- It depends on wind speed and wind direction




VFR NAVIGATION LOG
Aircraft Number | N | Notes
Check Points (Fixes) | VOR: Ident, Freq. | Course (Route) | Altitude | Wind: Dir., Vel., Temp | CAS, TAS | TC, -L / +R WCA | TH, -E / +W Var. | MH, ± Dev. | CH | Dist.: Leg, Rem. | GS: Est., Act. | Time Off: ETE, ATE, ETA, ATA | GPH: Fuel, Rem.
Totals »
Flight Plan and Weather Log on Reverse Side
Airport & ATIS Advisories
Departure | Destination
ATIS Code
Ceiling & Visibility
Wind
Altimeter
Approach
Runway
Time Check
Airport Frequencies
Departure | Destination
ATIS | ATIS
Ground | Approach
Tower | Tower
Departure | Ground
CTAF | CTAF
FSS | FSS
UNICOM | UNICOM
Field Elev | Field Elev
Block In | Log Time
Block Out

Navigation Log

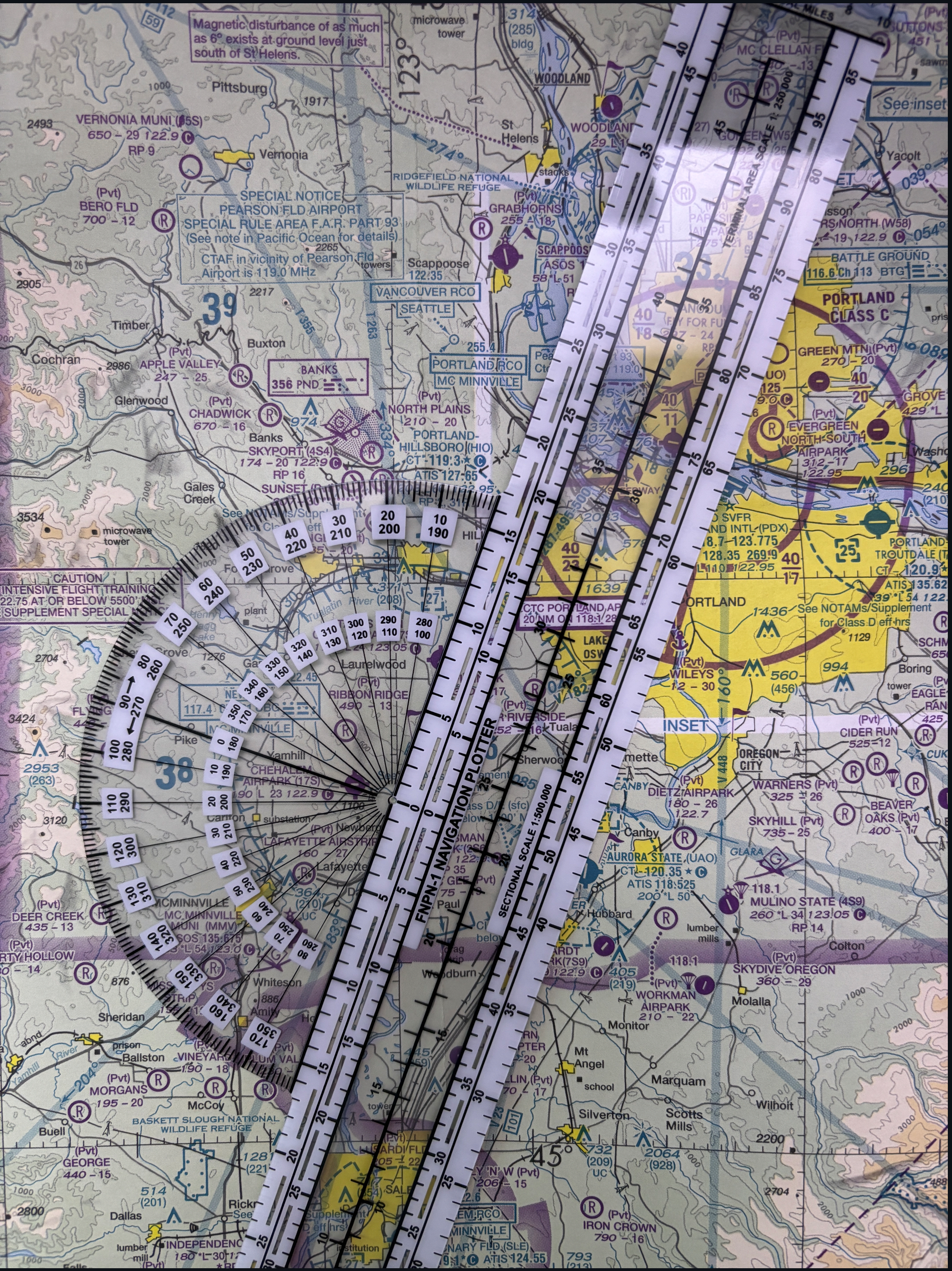
- Includes preplanned fields
  - Start with distance and true course
  - Compute heading to fly
  - Compute time
  - Compute fuel burn
- Fill out left to right

Navlog - Step 1: Enter our Waypoints

Check Points (Fixes)	VOR Ident	VOR Freq.
KVUO		
KPDX		
(TOC)		
LAKE OSWEGO		
KUAO		
KSLE		
KCVO		

Flight Plan and Weather Log

- List our fixes
- List our top-of-climb (TOC) after PDX
- Add any VOR identifiers with their frequencies / morse identifiers



Navlog - Step 2: Determine true courses

- Use a plotter
- Use SkyVector.com

Navlog - Step 2: Determine true courses

Aircraft Number	N	Notes

Check Points (Fixes)	VOR Ident	VOR Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	Temp
KVUO			127				
KPDX			203	6500			
(TOC)			203	6500			
LAKE OSWEGO			196	6500			
KUAO			206	6500			
KSLE			206				
KCVO							

- True course for each leg
- Note (TOC) leg has same course as next leg
- Also added our altitudes

Navlog - Step 3: Determine distances

- Use a plotter and a paper chart
- Use an SkyVector.com

Navlog - Step 4: Compute Climb

WEIGHT LBS	PRESSURE ALTITUDE FT	TEMP °C	CLIMB SPEED KIAS	RATE OF CLIMB FPM	FROM SEA LEVEL		
					TIME MIN	FUEL USED GALLONS	DISTANCE NM
3100	S.L.	15	87	965	0	0	0
	2000	11	87	945	2	0.9	3
	4000	7	86	920	4	1.7	6
	6000	3	86	885	6	2.6	10

- From S.L. to 6000'
  - Time = 6 - 0 = 6 minutes
  - 10 - 0 = 10nm
  - 2.6 - 0 = 2.6 gallons
  - 6 / 60 = 0.1 hours
- Compute rates:
  - 10nm / 0.1 hours = **100 knots** groundspeed (no wind)
  - 2.6 gallons / 0.1 hour = **26 gallons per hour**
- Use this as our TAS for the climb

Navlog - Step 4: Compute Climb

Check Points (Fixes)	VOR Ident	VOR Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	Temp	CAS	TAS
KVUO									
			127					100	
KPDX									
			203	6500				100	
(TOC)									
			203	6500					

Navlog - Step 5: Determine Cruise, Winds

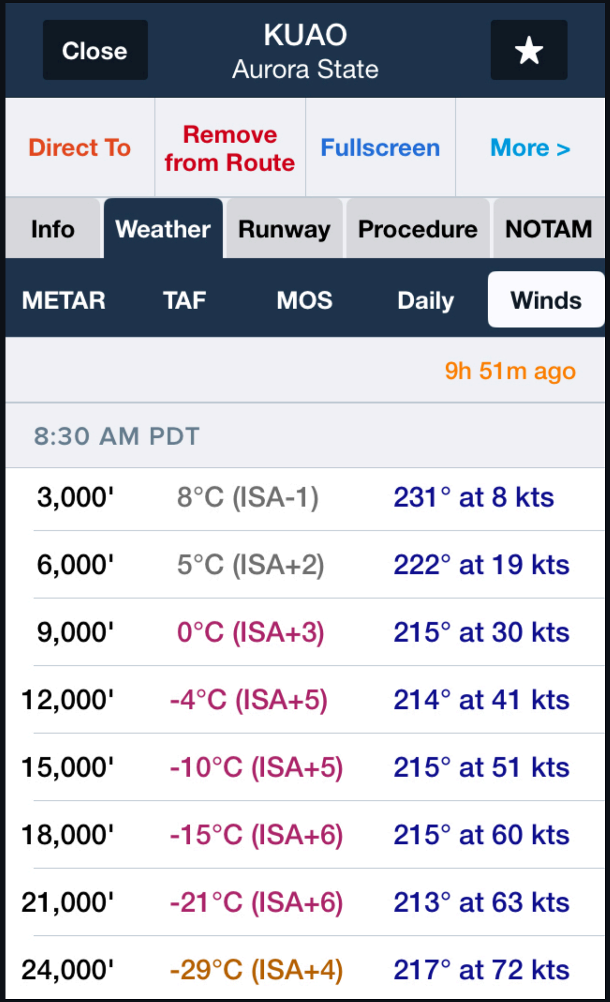
Winds Aloft forecast from aviationweather.gov

```
(Extracted from FBUS31 KWNO 101358)
FD1US1
DATA BASED ON 101200Z
VALID 101800Z   FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT  3000    6000    9000   12000   18000   24000  30000  34000  39000
PDX 2306 2318+05 2229+00 2242-06 2164-17 2177-28 218843 218852 228861
```

- Climb: 230° true @ 6 knots
- Cruise: 6000 ft: 230° true @ 18 knots, 5° C

ForeFlight Winds



- We can also get winds over an airport using ForeFlight
- Uses weather model to predict winds

Navlog - Step 5: Determine Cruise, Airspeed

		20°C BELOW STANDARD TEMP -17°C			STANDARD TEMPERATURE 3°C			20°C ABOVE STANDARD TEMP 23°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	25	- - -	- - -	- - -	79	143	15.0	75	142	14.2
	23	75	137	14.3	72	137	13.6	68	136	12.9
	21	67	131	12.8	64	130	12.2	61	129	11.6
	19	60	123	11.4	57	123	10.9	54	121	10.4
2300	25	80	140	15.1	76	140	14.4	72	140	13.6
	23	72	135	13.7	68	134	13.0	65	133	12.4
	21	64	128	12.2	61	127	11.7	58	126	11.1
	19	57	120	10.9	54	119	10.4	51	118	10.0
2200	25	76	138	14.5	72	138	13.7	69	137	13.0
	23	69	132	13.1	65	131	12.4	62	130	11.8
	21	61	125	11.7	58	124	11.2	55	123	10.7
	19	54	117	10.4	51	116	10.0	49	115	9.5
2100	25	73	135	13.8	69	135	13.1	66	134	12.5
	23	65	129	12.5	62	128	11.9	59	127	11.3
	21	58	122	11.2	55	121	10.7	53	120	10.2
	19	51	114	9.9	49	113	9.5	46	111	9.1
	17	44	105	8.7	42	102	8.4	40	99	8.0

Pressure altitude, 6000' chart

- Use standard temperature (3° vs 5° C)
- 61% BHP
- 127 knots true airspeed (TAS)
- 11.7 gph fuel burn, with proper leaning

Airspeed Calibration

FLAPS UP													
KIAS	50	60	70	80	90	100	110	120	130	140	150	160	170
KCAS	61	65	72	80	89	99	109	118	128	138	147	157	167

- 127 knots indicated airspeed (IAS)
- ~125 knots calibrated airspeed (CAS)

Navlog - Step 5: Determine Cruise, Airspeed

Check Points (Fixes)	VOR Ident	VOR Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	Wind Temp	CAS 125 / TAS
KVUO								
			127					100
KPDX								
			203	6500				100
(TOC)								
			203	6500				127
LAKE OSWEGO								
			196	6500				127
KUAO								
			206	6500				127
KSLE								
			206					127
KCVO								

Navlog - Step 5: Determine Cruise, Add Winds

Check Points (Fixes)	VOR Ident	VOR Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	Temp	CAS 125 / TAS
KVUO								
			127		230	6		100
KPDX								
			203	6500	230	6		100
(TOC)								
			203	6500	230	18	+5 C	127
LAKE OSWEGO								
			196	6500	230	18	+5 C	127
KUAO								
			206	6500	230	18	+5 C	127
KSLE								
			206		230	18	+5 C	127
KCVO								

Navlog - Step 6: Course and Headings

- We need to convert the true course we got from the chart into a heading we can follow in the airplane
- We need to correct for
  - Wind
  - Magnetic variation (magnetic vs true heading)
  - Compass deviation (interference with our airplane's compass)

Navlog - Step 6: Course and Headings

1. Compute true heading (TH) = True course (TC) + wind correction angle (WCA)
2. Compute magnetic heading (MH) = True heading + magnetic variation
3. Compute compass heading (CH) = Magnetic heading (MH) + compass deviation

Navlog - Step 6: Course and Headings, True Heading

Check Points (Fixes)	VOR Ident / Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	Temp	CAS	TAS	TC	-L / +R WCA	TH	-E / +W Var.	MH	± Dev.	CH
KVUO		127					125	100	127						
KPDX															

Using an E6B, compute heading/groundspeed:

- Climb leg winds (3000'): 230° true @ 6 knots
- Course: 127 ° True
- True airspeed: 100 knots

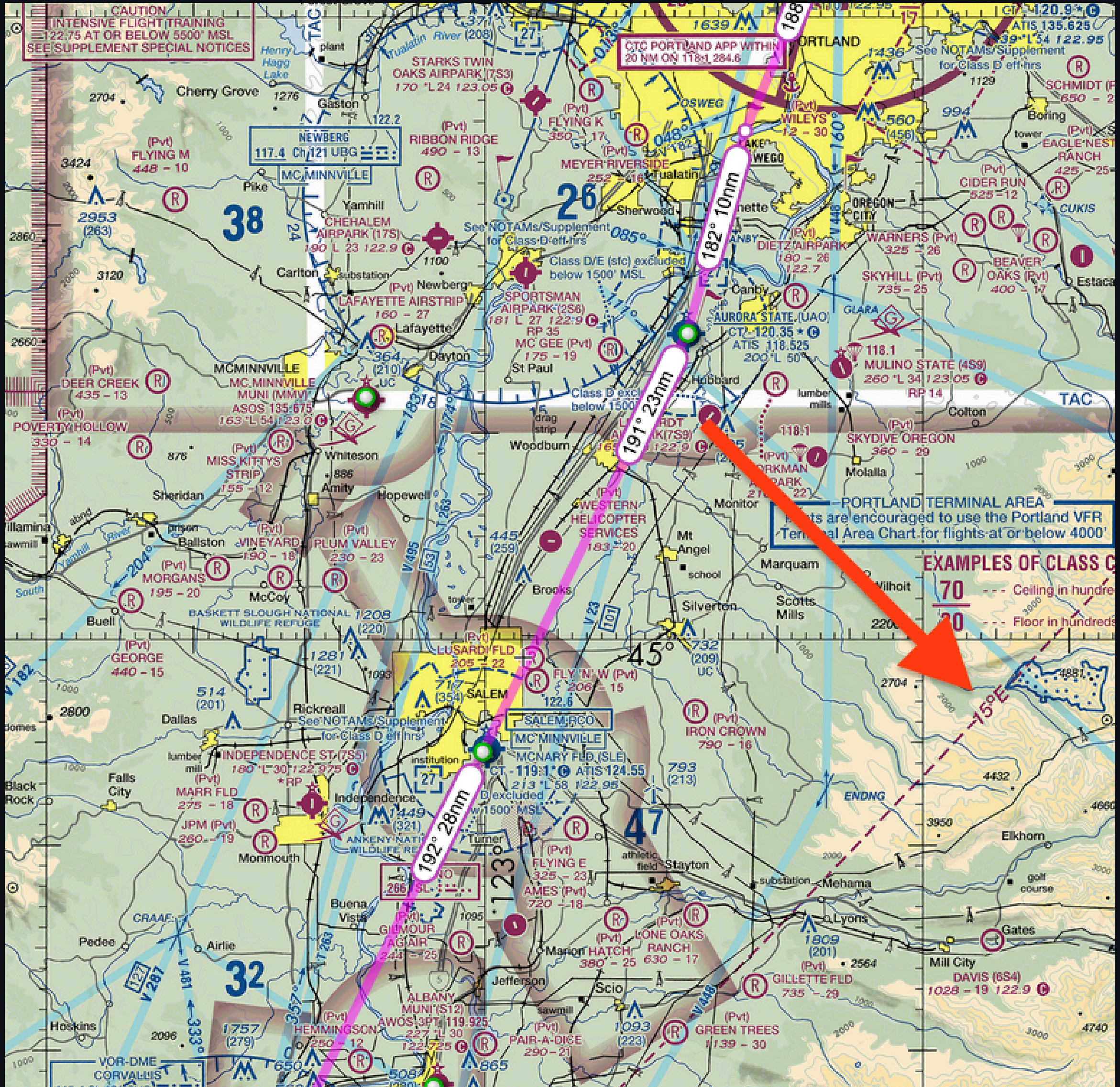
Result: Heading **130 ° True**, Wind correction angle (WCA): **+3°**, Groundspeed: **101 knots**

Navlog - Step 6: Course and Headings, True Heading

Check Points (Fixes)	VOR Ident. / Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	CAS / TAS	TC / -L / +R WCA	TH / -E / +W Var.	MH / ± Dev.	CH	Dist. Leg / Rem.	GS Est. / Act.
				Temp		CAS 125						
KVUO		127		230	6	TAS 100	127 / +3	130			3.2	101
KPDX												

Result: Heading **130 ° True**, Wind correction angle (WCA): **+3°**, Groundspeed: **101 knots**

Navlog - Step 6: Course and Headings, Magnetic Heading



- On the section find an "isogonic line"
- "East is least"
  - Subtract easterly variation
  - Add westerly variation
- We have 15° E, so we'll subtract 15°

Navlog - Step 6: Course and Headings, Magnetic Heading

Check Points (Fixes)	VOR Ident	VOR Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	CAS	TC	TH	MH	CH	Dist. Leg	GS Est.
					Temp		TAS	-L / +R WCA	-E / +W Var.	± Dev.		Rem.	Act.
							125						
KVUO			127		230	6	100	127	130	115		3.2	101
								+3	-15				
KPDX													

Navlog - Step 6: Course and Headings, Compass Heading

For	N	30	60	E	120	150
Steer	0	27	56	85	116	148
For	S	210	240	W	300	330
Steer	181	214	244	274	303	332

- Compasses installed in airplanes are subject to magnetic interference due to
  - Skin and surface of the aircraft
  - Electrical components in the airplane
- This error is called **compass deviation**
  - A compass deviation card will be in your airplane
  - This card shows corrections for this error

Navlog - Step 6: Course and Headings, Compass Heading

For	N	30	60	E	120	150
Steer	0	27	56	85	116	148
For	S	210	240	W	300	330
Steer	181	214	244	274	303	332

- For our magnetic heading of 115°
  - Use the 120°. Error is -1°
- 115° - 4 = 111 ° Magnetic
- This is our **compass heading**

Navlog - Step 6: Course and Headings, EFIS Heading

Note that an airplane with an EFIS (like the Garmin G5), are calibrated for deviation error during installation

- We will fly **magnetic heading** when navigating with the G5
- We will fly with **compass heading** when navigating with our magnetic compass

Navlog - Step 6: Course and Headings, Compass Heading

Check Points (Fixes)	VOR	Course (Route)	Altitude	Wind		CAS	TC	TH	MH	CH	Dist.	GS	Time Off		GPH
	Ident			Dir.	Vel.	125					Leg	Est.			
	Freq.			Temp		TAS	-L / +R WCA	-E / +W Var.	± Dev.		Rem.	Act.	ETE	ETA	Fuel
													ATE	ATA	Rem.
KVUO		127		230	6	100	127	130	115	111	3.2	101			
							+3	-15	-4						
KPDX															

Navlog - Step 6: Course and Headings, Compass Heading

Check Points (Fixes)	VOR Ident / Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	Temp	CAS 125 / TAS	TC	-L / +R WCA	TH	-E / +W Var.	MH	± Dev.	CH	Dist. Leg / Rem.	GS Est. / Act.	Time Off: ETE / ATE	ETA / ATA	GPH: Fuel / Rem.
KVUO																			
		127		230	6		100	127	+3	130	-15	115	-4	111	3.2	101	2		1
KPDX																			
		203	6500	230	6		100	203	+1	204	-15	189	+4	193		128			
(TOC)																			
		203	6500	230	18	+5 C	127	203	+4	204	-15	192	+4	196		111			
LAKE OSWEGO																			
		196	6500	230	18	+5 C	127	196	+5	201	-15	186	+4	190	10.1	112			
KUAO																			
		206	6500	230	18	+5 C	127	206	+3	209	-15	194	+4	198	22.5	110			
KSLE																			
		206		230	18	+5 C	127	206	+3	209	-15	194	+4	198	27.6	110			

Navlog - Step 7: Computing Top of Climb

- Compute climb distance
  - 6 minutes = 0.1 hours
  - 3.2nm / 101 knots * 60 = 2 minutes
- Second leg
  - 6 - 2 minutes = 4 minutes
  - (4 / 60) * 128 knots = **8.5nm**
- Computing leg distances
  - PDX to Lake Oswego: 12nm
  - Third leg: (TOC) to Lake Oswego: 12 - 8.5nm = **3.5nm**

Navlog - Step 7: Computing Top of Climb

Check Points (Fixes)	VOR Ident	VOR Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	Temp	CAS 125 / TAS	TC	-L / +R WCA	TH	-E / +W Var.	MH	± Dev.	CH	Dist. Leg	Dist. Rem. 75	GS Est.	GS Act.
KVUO																			
			127		230	6		100	127	+3	130	-15	115	-4	111	3.2		101	
KPDX																			
			203	6500	230	6		100	203	+1	204	-15	189	+4	193	8.5		128	
(TOC)																			
			203	6500	230	18	+5 C	127	203	+4	204	-15	192	+4	196	3.5		111	
LAKE OSWEGO																			
			196	6500	230	18	+5 C	127	196	+5	201	-15	186	+4	190	10.1		112	
KUAO																			

Navlog - Step 8: ETE and Fuel

Now that we know our groundspeed we can compute:

- Estimated time enroute (ETE): Time between waypoints
  - 3.2nm / 101 knots GS = **2 minutes**
  - Climb fuel: 26 gallons / hour * (2 minutes) = **0.9 gallons**
- Estimate fuel burn: How much fuel we will burn each leg

Navlog - Step 8: ETE and Fuel

Check Points (Fixes)	VOR	Course (Route)	Altitude	Wind		CAS	TC	TH	MH	CH	Dist.	GS	Time Off		GPH
	Ident			Dir.	Vel.	125					Leg	Est.			
	Freq.			Temp		TAS	-L / +R WCA	-E / +W Var.	± Dev.		Rem.	Act.	ETE	ETA	Fuel
													ATE	ATA	Rem.
KVUO		127		230	6	100	127	130	115	111	3.2	101	2		1
							+3	-15	-4						
KPDX															

Navlog - Final Navlog

Check Points (Fixes)	VOR Ident / Freq.	Course (Route)	Altitude	Wind Dir.	Wind Vel.	CAS 125 / TAS	TC / -L / +R WCA	TH / -E / +W Var.	MH / ± Dev.	CH	Dist. Leg / Rem. 75.4	GS Est. / Act.	Time Off: ETE / ATE	ETA / ATA	GPH 12: Fuel / Rem.
KVUO															
		127		230	6	100	127	130	115	111	3.2	101	2		1
							+3	-15	-4		71.8				49
KPDX															
		203	6500	230	6	100	203	204	189	193	8.5	128	4		2
							+1	-15	+4		63.3				47.5
(TOC)															
		203	6500	230	18	127	203	204	192	196	3.5	111	2		.5
				+5 C			+4	-15	+4		59.8				47
LAKE OSWEGO															
		196	6500	230	18	127	196	201	186	190	10.1	112	6		1
				+5 C			+5	-15	+4		50.1				46
KUAO															
		206	6500	230	18	127	206	209	194	198	22.5	110	12		2.5
				+5 C			+3	-15	+4		27.6				43.5
KSLE															
		206	6500	230	18	127	206	209	194	198	27.6	110	15		3
				+5 C			+3	-15	+4						40.5
KCVO															
										Totals »	75.4		41		10

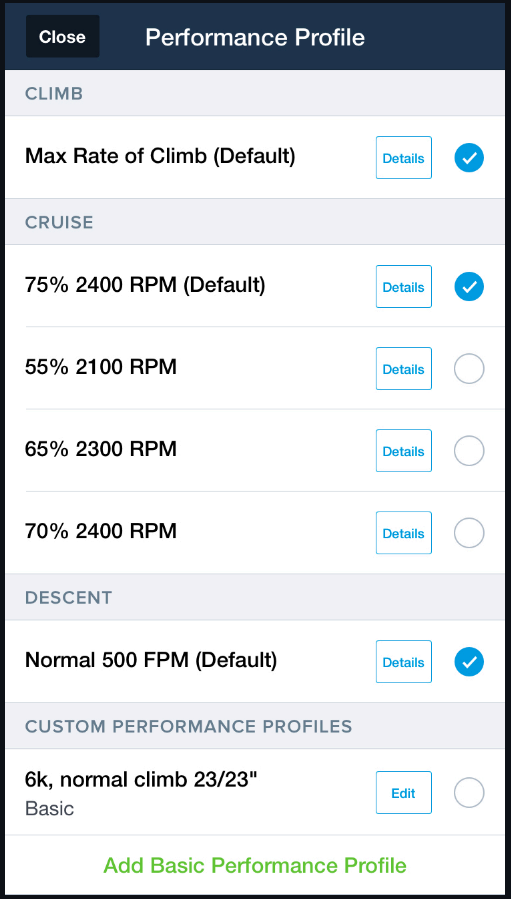
Flight Plan and Weather Log on Reverse Side

Flight Planning with ForeFlight

Entering a Flight Plan

ForeFlight Profiles

"Advanced Profiles": ForeFlight-made



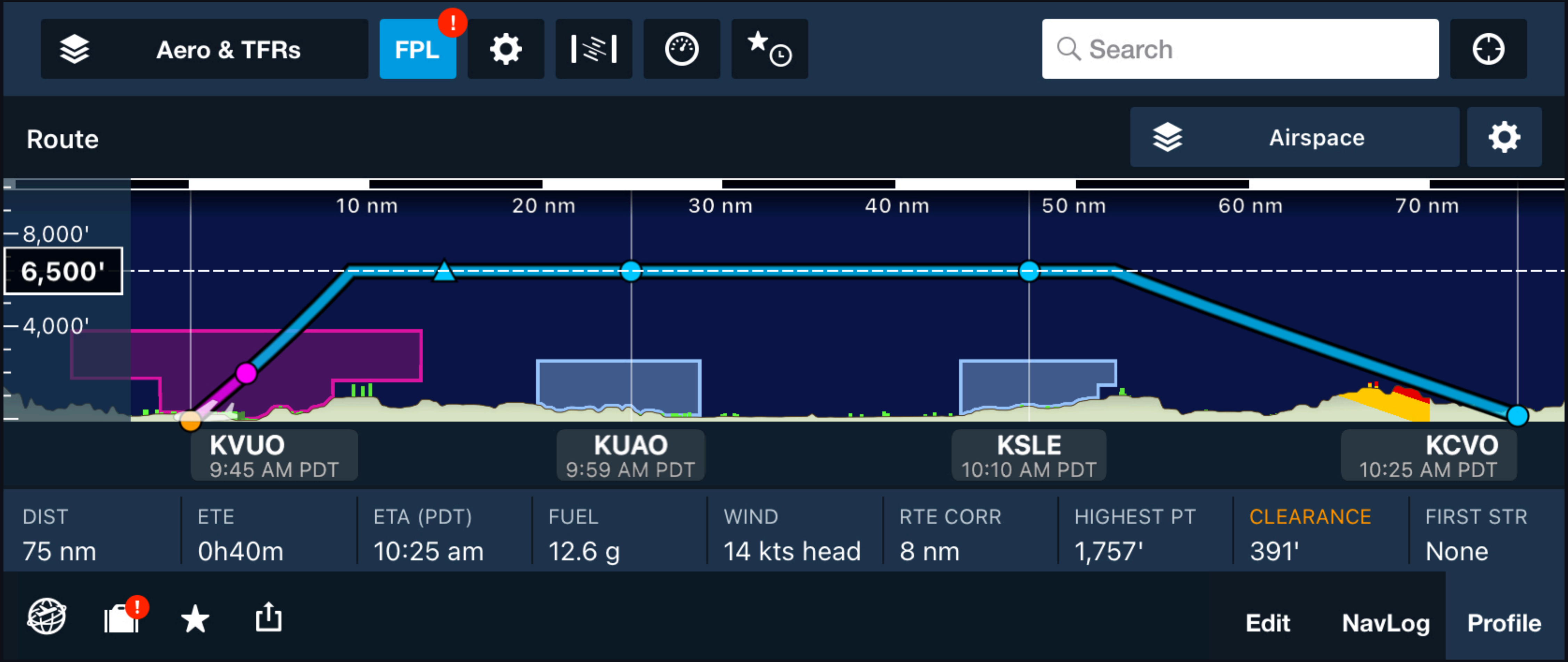
Basic profiles: User-entered

Aero & TFRs | FPL | Search

FROM	TO	HDG	TOTALS			LEG			REMAINING		ETA
KVUO	KPDX	114°M	3 nm	2.8 g	2m03s	3 nm	0.8 g	2m03s	------	------	--:-- --
KPDX	LAKE OSWEGO	187°M	14 nm	5.2 g	9m01s	11 nm	2.4 g	6m58s	------	------	--:-- --
LAKE OSWEGO	KUAO	188°M	25 nm	6.5 g	0h14m	11 nm	1.2 g	5m11s	------	------	--:-- --
KUAO	KSLE	194°M	47 nm	9.1 g	0h25m	23 nm	2.7 g	0h11m	------	------	--:-- --
KSLE	KCVO	194°M	75 nm	12.6 g	0h40m	28 nm	3.5 g	0h15m	------	------	--:-- --

DIST	ETE	ETA (PDT)	FUEL	WIND	RTE CORR
75 nm	0h40m	10:26 am	12.6 g	14 kts head	8 nm

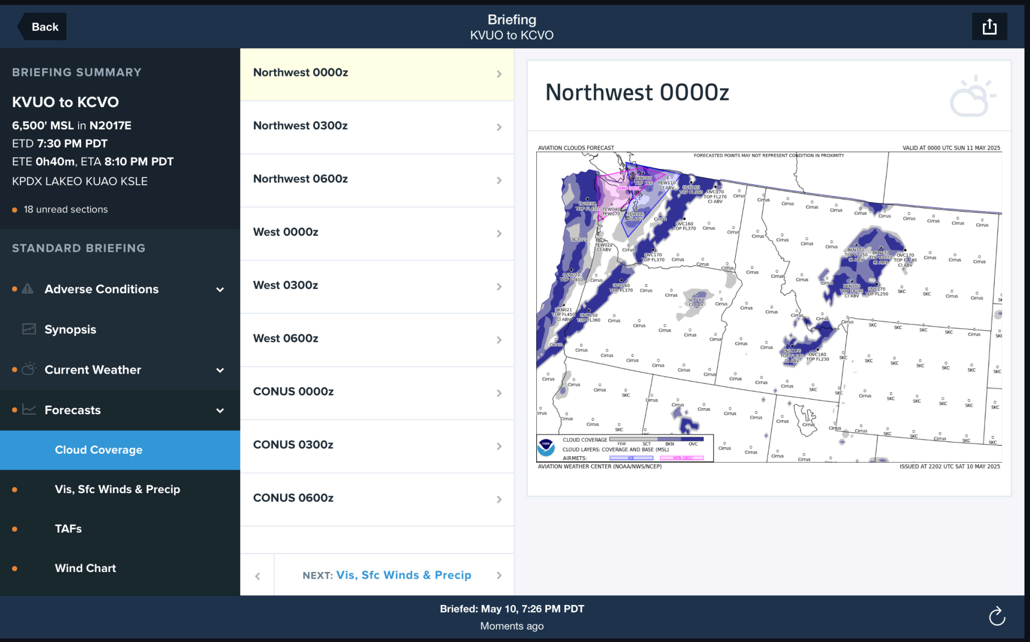
Edit | NavLog | Profile


Aero & TFRs
FPL
Search
Route
Airspace
10 nm
20 nm
30 nm
40 nm
50 nm
60 nm
70 nm
8,000'
6,500'
4,000'
KVUO
9:45 AM PDT
KUAO
9:59 AM PDT
KSLE
10:10 AM PDT
KCVO
10:25 AM PDT
DIST
75 nm
ETE
0h40m
ETA (PDT)
10:25 am
FUEL
12.6 g
WIND
14 kts head
RTE CORR
8 nm
HIGHEST PT
1,757'
CLEARANCE
391'
FIRST STR
None
Edit
NavLog
Profile

Manual Navlog vs ForeFlight

- Why are they different?
  - ForeFlight can compute changing winds as the route progresses
  - ForeFlight can calculate winds as we climb
  - ForeFlight performance
  - Rounding on manual navlog
- Sanity-check any ForeFlight output

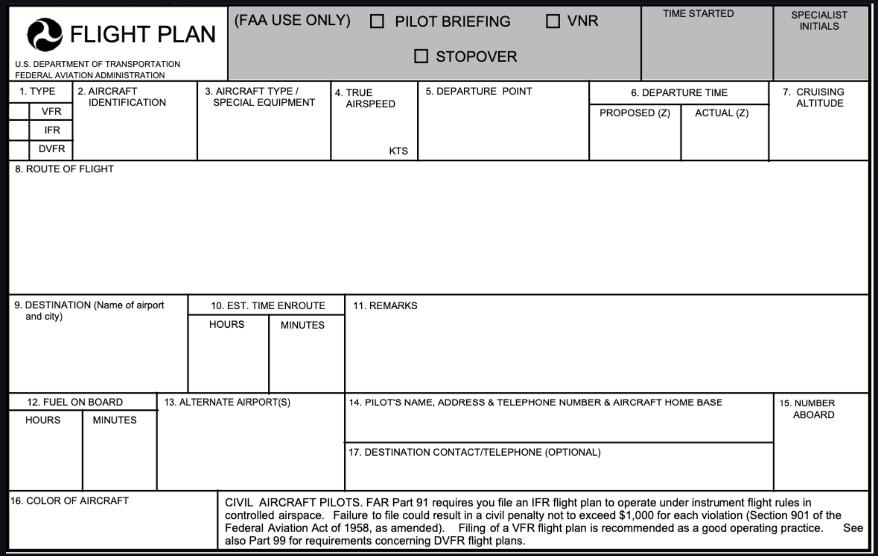
Flying our Flight Plan



Getting A Weather Briefing

- What is a weather briefing?
    - Includes NOTAMs, METARs, TAFs, AIRMETS/SIGMETs for a route of flight
- Where can we get one?
    - ForeFlight
    - 1800wxbrief.com
    - Calling 1800-WX-BRIEF or a Flight Service Station
- A record of the briefing is kept

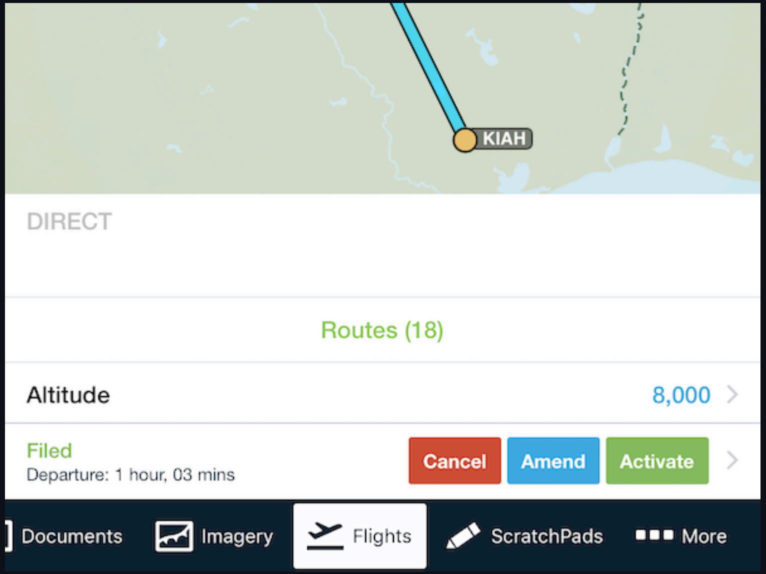
Filing a Flight Plan



FLIGHT PLAN
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
(FAA USE ONLY) ☐ PILOT BRIEFING ☐ VNR
☐ STOPOVER
TIME STARTED
SPECIALIST INITIALS
1. TYPE
VFR
IFR
DVFR
2. AIRCRAFT IDENTIFICATION
3. AIRCRAFT TYPE / SPECIAL EQUIPMENT
4. TRUE AIRSPEED
KTS
5. DEPARTURE POINT
6. DEPARTURE TIME
PROPOSED (Z)
ACTUAL (Z)
7. CRUISING ALTITUDE
8. ROUTE OF FLIGHT
9. DESTINATION (Name of airport and city)
10. EST. TIME ENROUTE
HOURS
MINUTES
11. REMARKS
12. FUEL ON BOARD
HOURS
MINUTES
13. ALTERNATE AIRPORT(S)
14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE
15. NUMBER ABOARD
17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)
16. COLOR OF AIRCRAFT
CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.

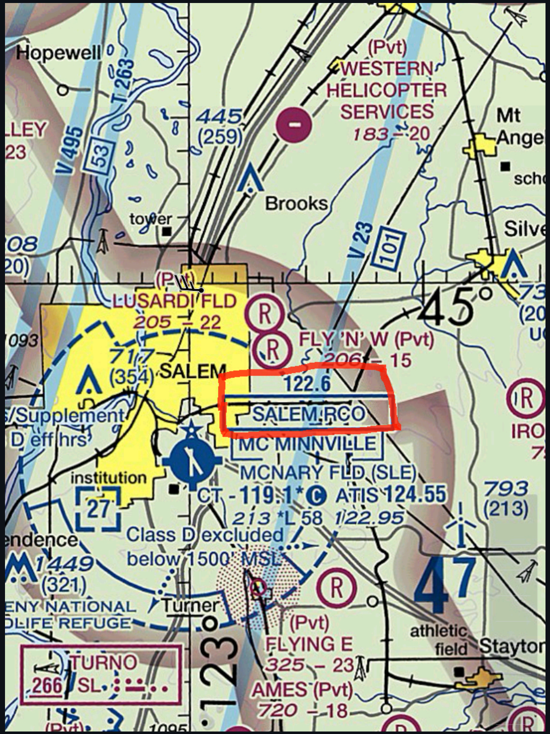
- What is a flight plan?
  - Details about your flight that you file with flight service
  - Includes your route, ETD, ETA, passengers
  - A flight plan that has not been closed 30 minutes after the ETA will initiate search and rescue
- Why use a flight plan?
  - It's not required, but it's a good idea
  - We want someone looking for us

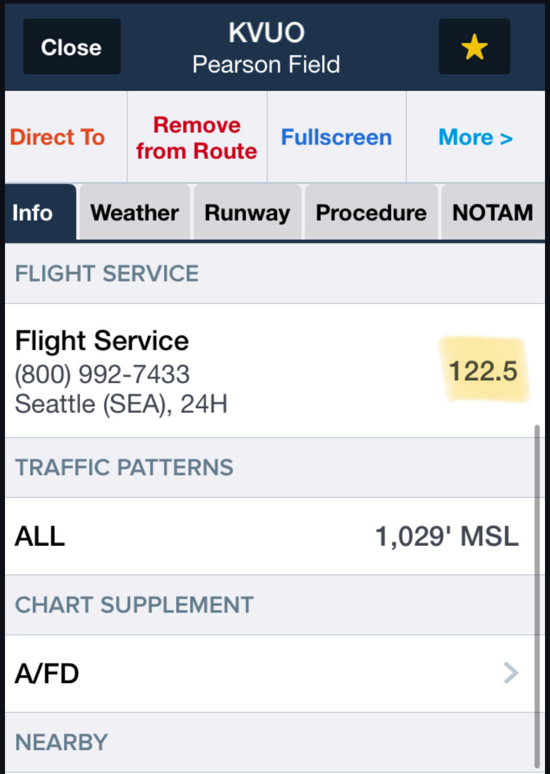
Flight Plan: Activating



- Before takeoff, file your flight plan, use your best estimate for ETD and ETE
- Shortly before or after departure, open the flight plan
- If your ETA is going to change significantly, contact FSS or amend your flight plan
- After landing, close your flight plan
- Ways to activate or close a flight plan
  - Via ForeFlight
  - Calling an FSS: 1800-WX-BRIEF
  - Contacting FSS in the air

Flight Service Stations (FSS)





- FSS frequencies
  - List on the sectional chart above airport datablock
  - Also listed in ForeFlight
- Example radio call
  - `"McMinnville radio, Cessna 2017E on 122.6"`
  - `"McMinnville radio, Cessna 2017, I'd like to open my VFR flight plan to Renton, K-R-N-T"`

UTC Time Conversion

Pacific Daylight Time (Summer) [UTC -7]

Zulu Time	Local Time	Zulu Time	Local Time
0:00Z	17:00 Local	12:00Z	5:00 Local
1:00Z	18:00 Local	13:00Z	6:00 Local
2:00Z	19:00 Local	14:00Z	7:00 Local
3:00Z	20:00 Local	15:00Z	8:00 Local
4:00Z	21:00 Local	16:00Z	9:00 Local
5:00Z	22:00 Local	17:00Z	10:00 Local
6:00Z	23:00 Local	18:00Z	11:00 Local
7:00Z	0:00 Local	19:00Z	12:00 Local
8:00Z	1:00 Local	20:00Z	13:00 Local
9:00Z	2:00 Local	21:00Z	14:00 Local
10:00Z	3:00 Local	22:00Z	15:00 Local
11:00Z	4:00 Local	23:00Z	16:00 Local

Pacific Standard Time (Winter) [UTC -8]

Zulu Time	Local Time	Zulu Time	Local Time
0:00Z	16:00 Local	12:00Z	4:00 Local
1:00Z	17:00 Local	13:00Z	5:00 Local
2:00Z	18:00 Local	14:00Z	6:00 Local
3:00Z	19:00 Local	15:00Z	7:00 Local
4:00Z	20:00 Local	16:00Z	8:00 Local
5:00Z	21:00 Local	17:00Z	9:00 Local
6:00Z	22:00 Local	18:00Z	10:00 Local
7:00Z	23:00 Local	19:00Z	11:00 Local
8:00Z	0:00 Local	20:00Z	12:00 Local
9:00Z	1:00 Local	21:00Z	13:00 Local
10:00Z	2:00 Local	22:00Z	14:00 Local
11:00Z	3:00 Local	23:00Z	15:00 Local

Flying our Flight Plan

Going to use all the tools at our disposal:

- Pilotage: Look out the window
- Dead reckoning:
  - Using our navlog, flying headings
  - Note the time of each waypoint
- Radio navigation
- GPS navigation
- VFR flight following

VOR and DME navigation

- Limited by line-of-sight, works better the higher you go
- Flying to a VOR:
    i. Ensure CDI is in VLOC mode (not GPS mode)
    ii. Tune the station
    iii. Identify the station: Listen for morse code
        - No morse code means station is out of service
    iv. Center the CDI with a TO indication
    v. Turn to the course shown, bracketing for wind

GPS Navigation

- Ensure CDI is in GPS mode
- Guidance towards the purple line on the map
- Direct-To: Course from your current position to another waypoint

Lost Procedures

4 C's

- **C**limb
  - Better see landmarks, get
  - Get adequate radio or nav signal reception
- **C**ommunicate:
  - Talk to ATC
  - Ask for vector to a know location (airport, VFR point)
- **C**onfess
  - Say that you're lost
- **C**omply
  - Follow what ATC says

Diverting to an Alternate: Picking an Alternate

- Use information available in the cockpit to decide on a good alternate
    - GPS Navigators
    - FIS-B Weather
    - ATC

Diverting to an Alternate: Navigating to an Alternate

- Use pilotage
- Use a GPS direct
- Use radio navigation
- Apply rule-of-thumb calculations:
  - ~60 knots of groundspeed: 1nm per minute
  - ~90 knots of groundspeed: 1.5nm per minute
  - ~120 knots of groundspeed: 2nm per minute

Summary

- Picking Destinations
- Picking Waypoints
- VFR Cruising Altitudes (91.159)
- Cruising Altitudes
- Dead Reckoning
- Navigation Log
  - Steps to manually complete a navlog
- Flight Planning with ForeFlight
- Preflight Information Requirements (91.103)
- Weather Briefings
- Flight Plans
- UTC Time Conversion
- Flying our Flight Plan
- VOR and DME navigation
- GPS Navigation
- Lost Procedures
- Diverting to an Alternate

Knowledge Check

How do you convert calibrated airspeed into indicated airspeed?

Knowledge Check

You're traveling at 120 knots grounds speed and you have 50nm left to your destination. If we maintain our speed, how long will us take you get there?

Knowledge Check

You're traveling at 120 knots grounds speed and you have 50nm left to your destination. If we maintain our speed, how long will us take you get there?

```
50 / 2nm / minute = 25 minutes
```

Knowledge Check

We're planning to divert to an airport with an elevation of 3500'. We're currently cruising at 8500' and our ground speed is approximately 120 knots.

When should we start to descending to enter the traffic pattern 3nm from the airport?

Knowledge Check

We're planning to divert to an airport with an elevation of 3500'. We're currently cruising at 8500' and our ground speed is approximately 120 knots.

```
8500 - 4500 = 4000'
5000' / 500 fpm = 8 minutes
8 minutes * 2 nm / min = 16nm
16nm - 3nm = 13nm
```