SUN Instrument Flight Procedure Assessment

Friedman Memorial Airport

August 6th, 2019

- **Reason for the Study:**
  How can Airport Flight Ops Access be improved during periods of inclement Weather?

What are these events?

- Low Clouds
- Low Visibility
- Precipitation (Rain / Snow)
- Smoke / Haze

Goals of the Feasibility Study

- Develop a new Performance Based Navigation (PBN) solution that’s compatible with today’s airline jet fleet operating at Hailey.
- Based on historical weather data, ensure the solution significantly reduces unnecessary diversions.
- Improve the passenger flying experience for the general public when utilizing the Friedman Memorial Airport.

How is this different than Past efforts?

SUN has performed considerable research in the past to explore and even implement solutions consisting of Microwave, Transponder, and traditional ILS based navigational aids.

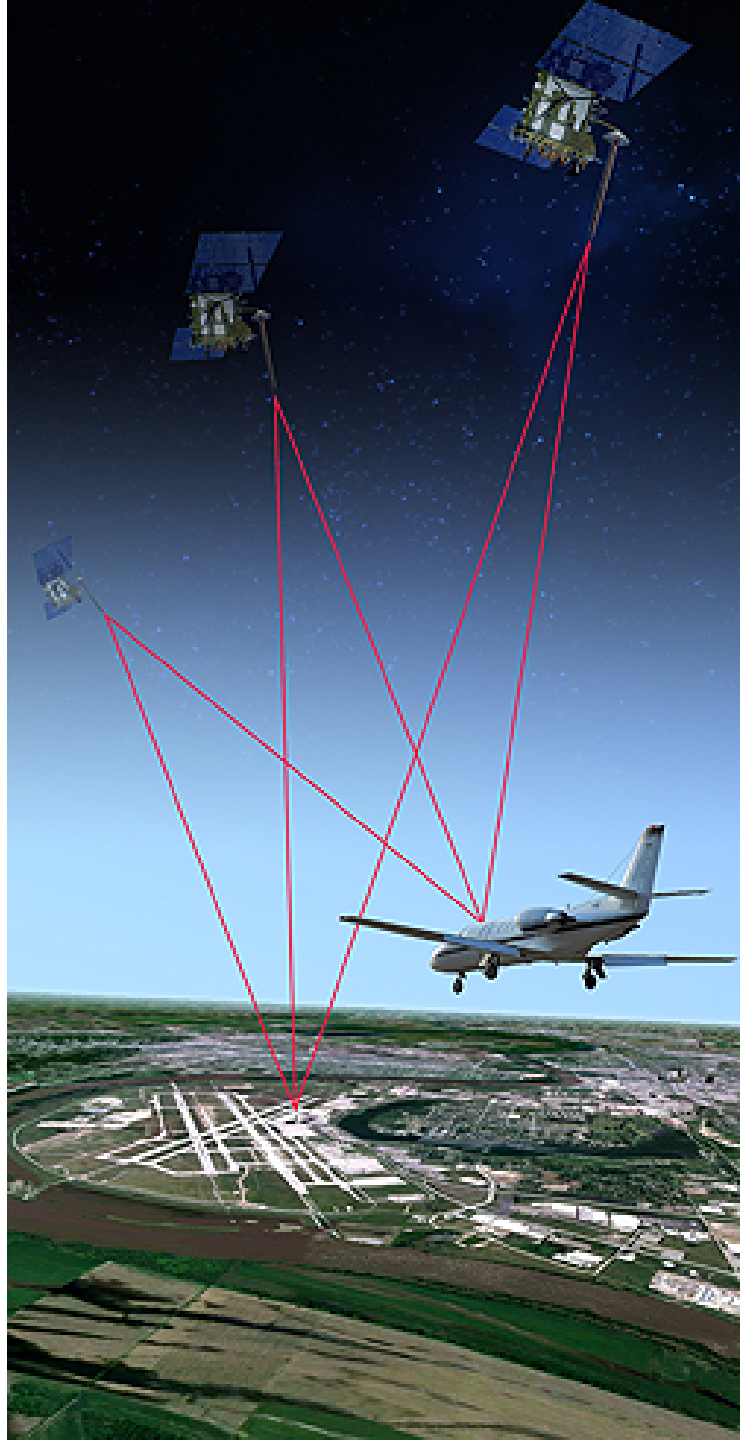
This study focused on advanced satellite-based technology, which is becoming more prevalent as the FAA moves away from traditional ground-based navigation infrastructure.

Accounts for the latest navigation system technology that is being installed on regional jet aircraft that are being delivered from the factory today.

Goes beyond just a report, instead delivering a validated approach concept that can be implemented by future aircraft operators.

Before we begin: Acronyms

- **IAP:** Instrument Approach Procedure – Guides aircraft safely from the enroute environment to ground for landing.
- **WAAS:** Wide Area Augmentation System augments the Global Positioning System (GPS), with the goal of improving its accuracy, integrity, and availability.
- **Minimums:** The cloud ceiling and visibility value which pilots can descend to on a approach before initiating a missed approach if they do not have the required visual references to continue descending and land on the runway.
- **PBN:** Performance Based Navigation (PBN). PBN is the basis for defining system performance requirements for navigation equipment and installation specifications.
- **RNAV:** Area Navigation (RNAV) enables aircraft to fly on any desired flight path rather than being constrained to an airway or ground based navaid.
- **RNP:** Required Navigation Performance is similar to Area Navigation (RNAV); but, RNP requires on-board navigation performance monitoring and alerting capability to ensure that the aircraft stays within a specific containment area.

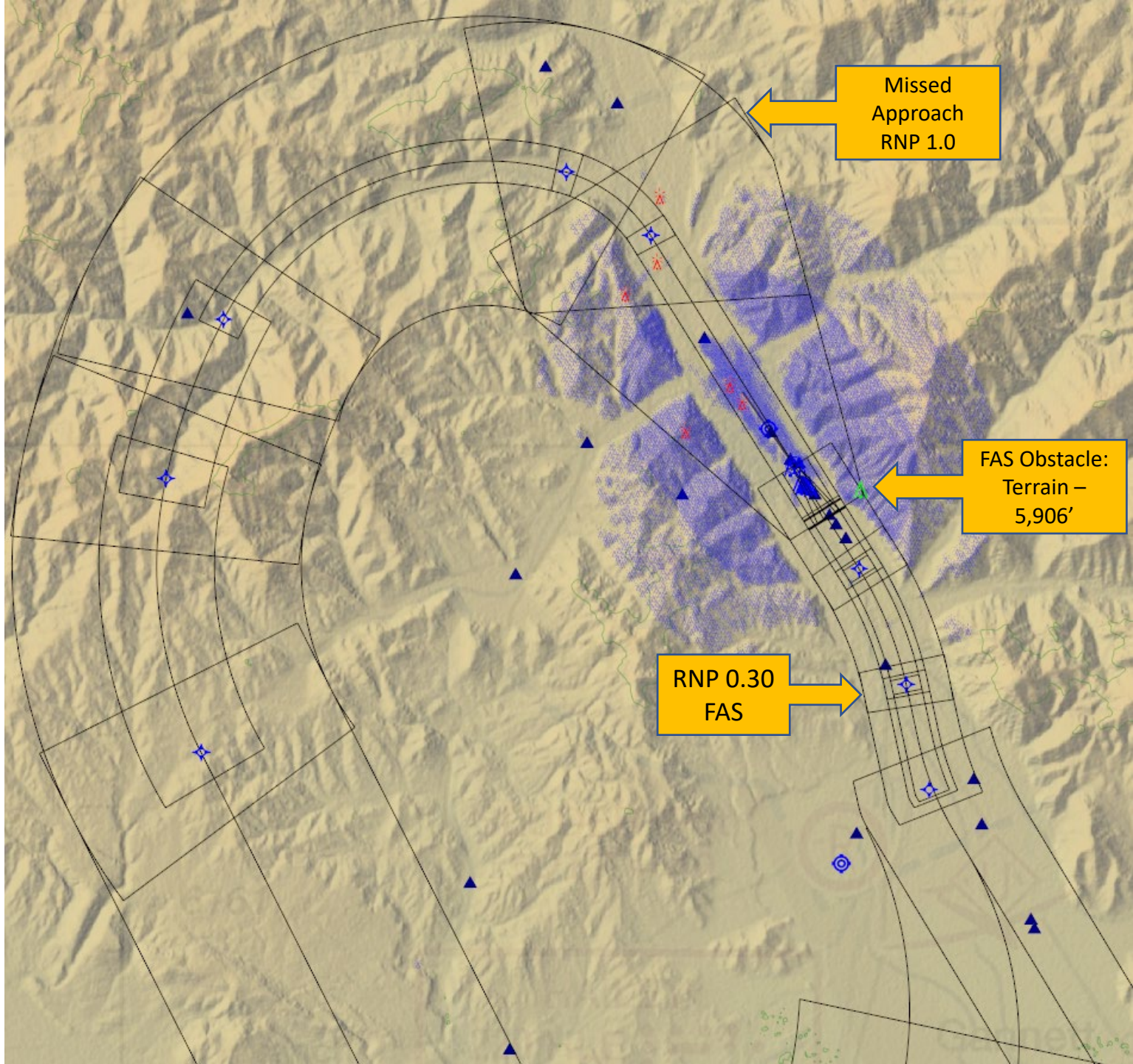


Approach Concepts Considered

- Based on stakeholder outreach, two different approach types were initially studied.
- The first is a specialization of Area Navigation (RNAV) called **RNP**. There are two levels of RNP called basic and low (such as what Horizon uses).
- The RNP level air carriers use depends on equipage, certification, and training.
- Both levels of RNP were initially examined.
- Second, an Area Navigation (RNAV) approach using **WAAS GPS** guidance to provide precise horizontal and vertical path guidance was also studied.
- This specialization provides ILS style guidance but uses the satellite equivalent called **LPV** (Localizer Performance w/ Vertical Guidance.

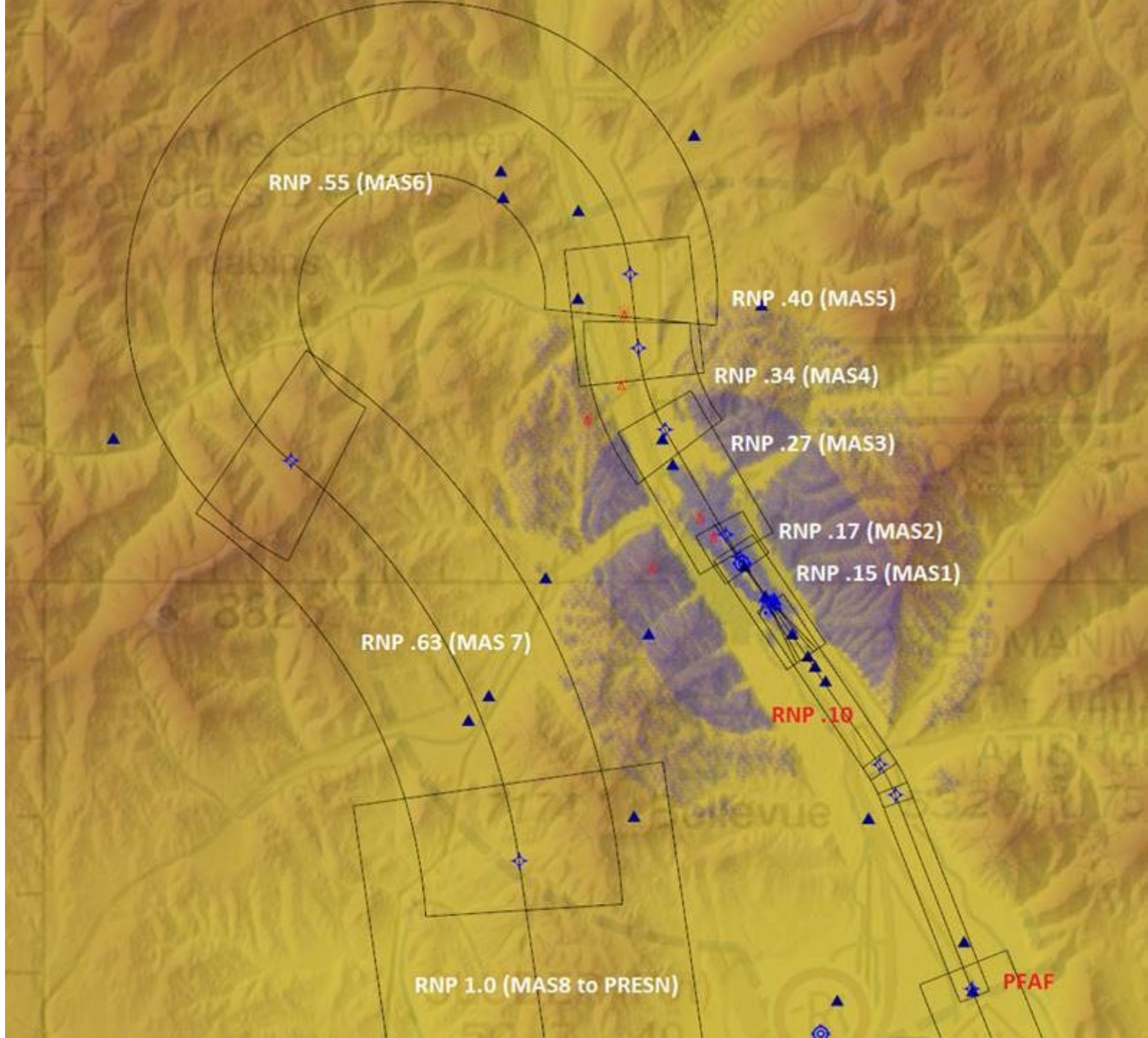
Basic RNP

- Commonly referred to as RNP .30.
- The .30 nm half width of the standard RNP Final segment picks up terrain in areas parallel to the runway. This raises cloud minimums above 1200’
- The missed approach uses a standard RNP 1.0 segment which drives excessive climb gradients due to rising terrain near the runway environment.
- The Climb Gradient can be mitigated by raising the cloud minimums to above 1,600’ AMSL, but this provides no benefit over existing public procedures.



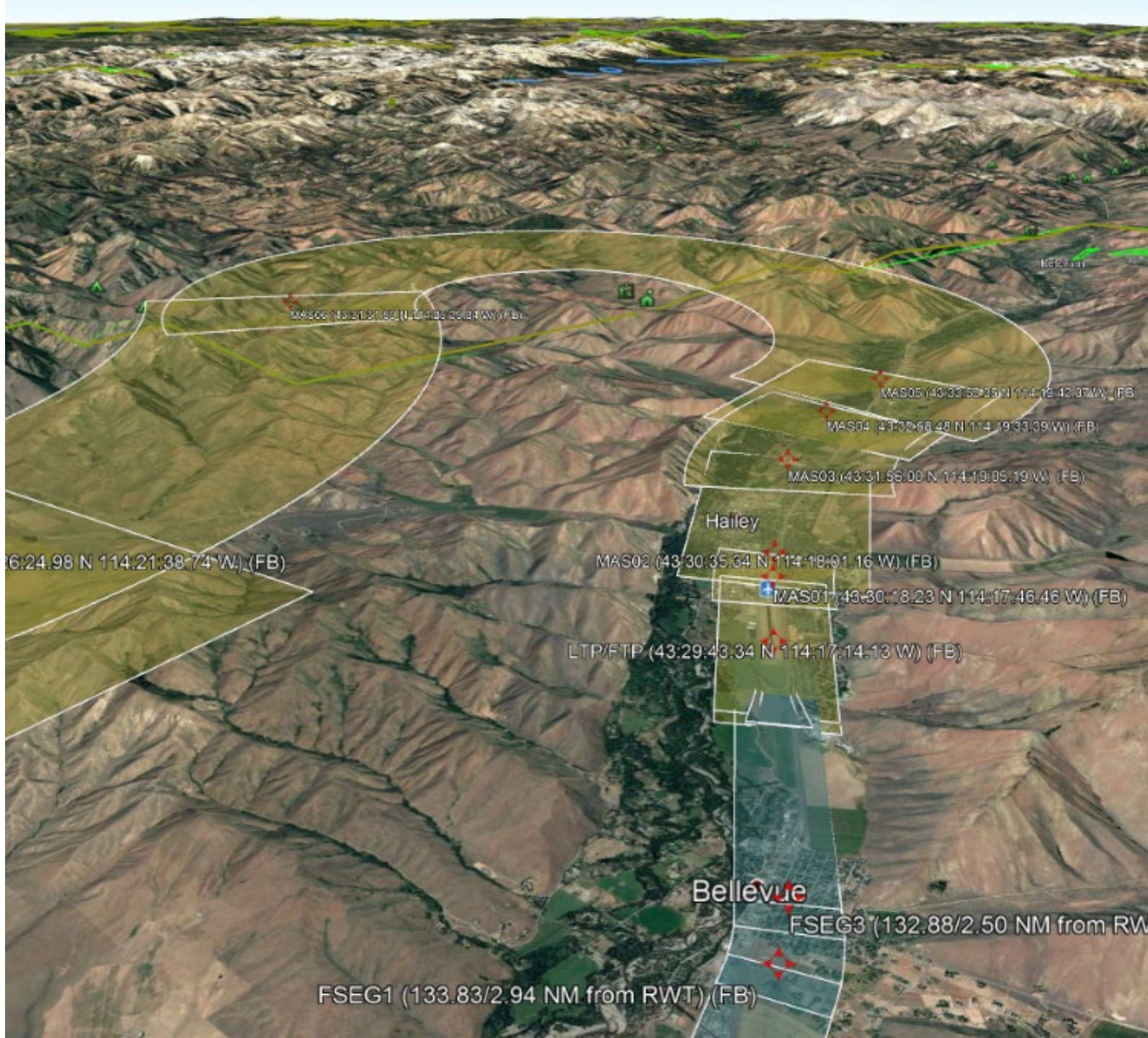
Low RNP

- When standard RNP design prevents the desired minimums from being achieved, an advanced level of RNP can be utilized commonly referred to as ‘Low RNP’.
- Low RNP levels are between 0.10 and 0.30 in the final approach segment and uses a telescoping missed approach segment that begins at RNP values below 1.0.
- These smaller obstacle accountability areas help avoid high terrain.
- The tradeoff though is that its harder for operators (GA & airline) to obtain FAA approval to fly Low RNP procedures without significant investment in avionics, aircraft certifications, and crew training.



Low RNP Minimums

- Approach Minimums of 286 ft above the runway (5,575’ AMSL) and 7/8 statute mile visibility are possible for a Low RNP approach.

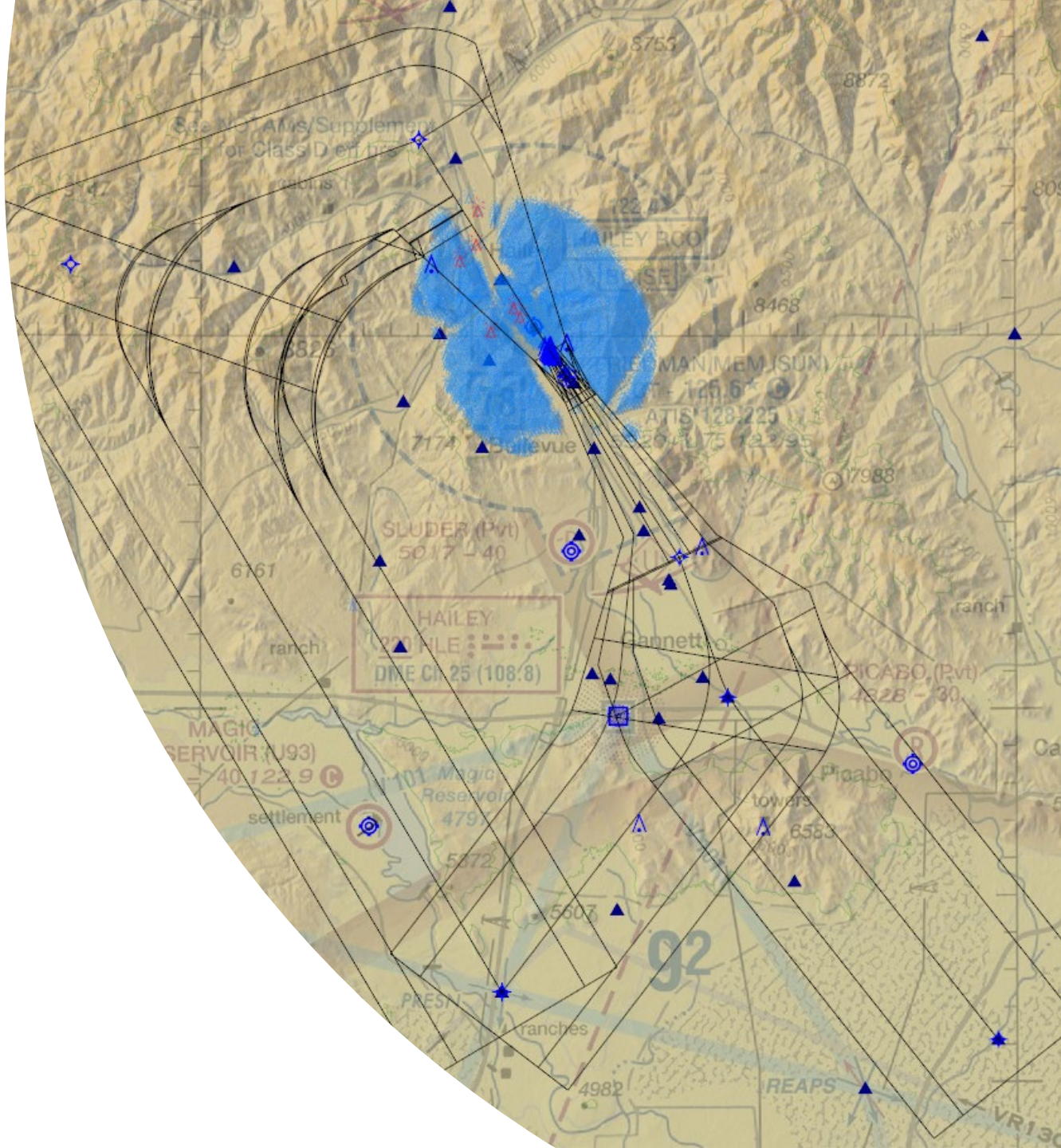


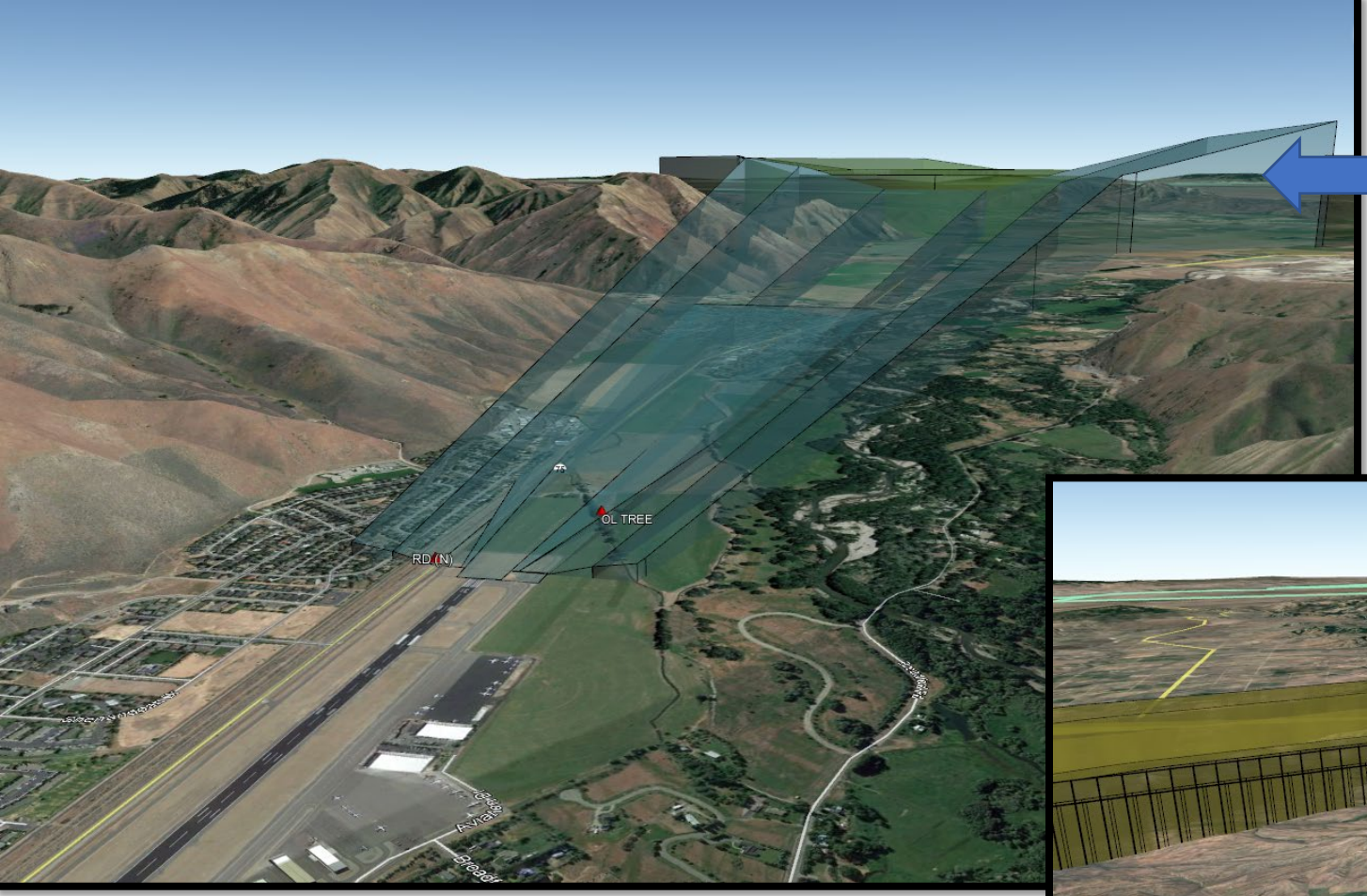
Option #2:
RNAV (GPS) - Localizer Performance with Vertical Guidance (LPV)

The second option studied was the development of a RNAV (GPS) Approach with an LPV line of minima. These wider surfaces are depicted in the image.

Highlights:

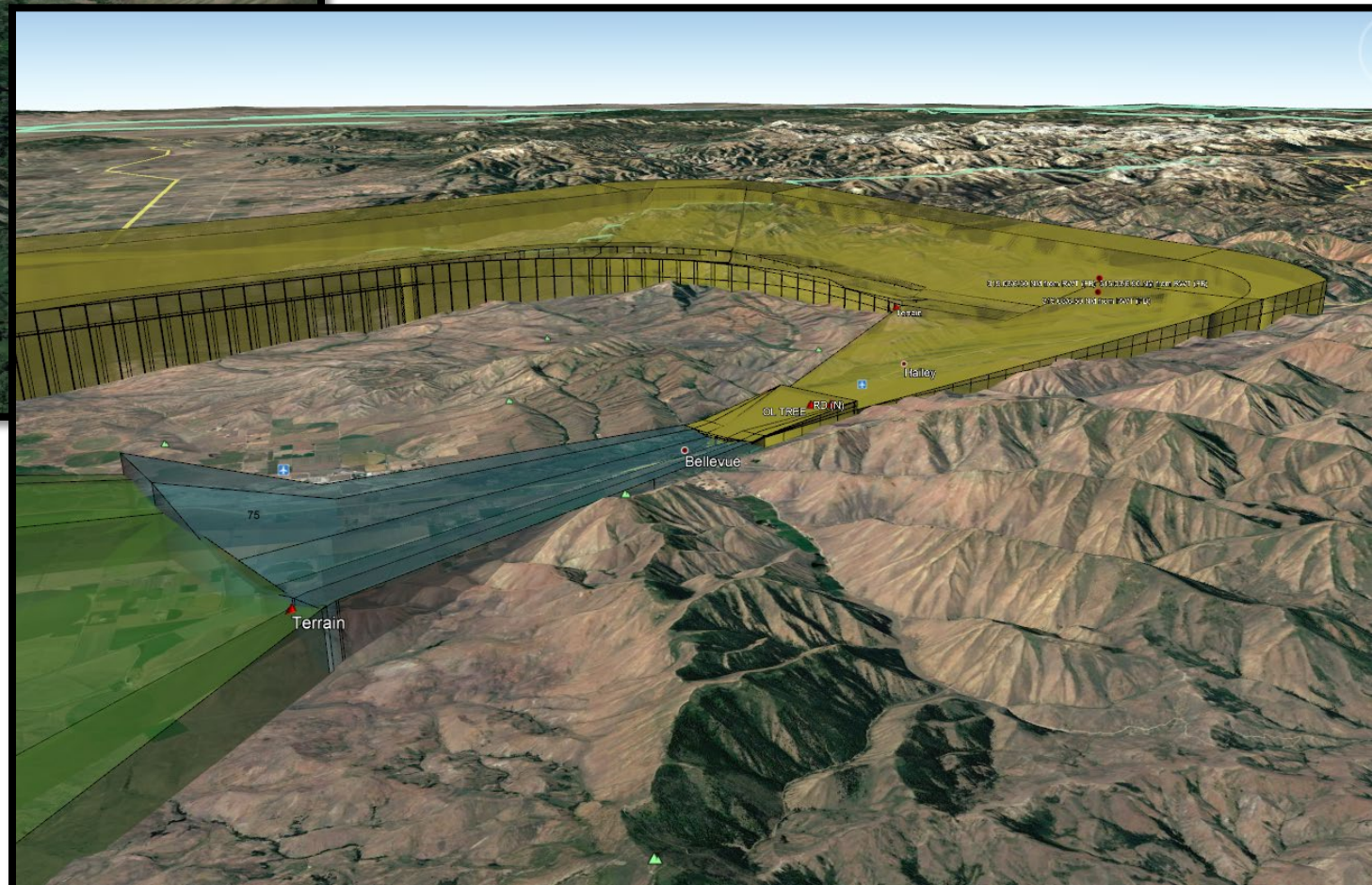
- This satellite-based approach utilizes WAAS Augmentation.
- Provides a Constant Descent Vertically Guided Approach
- Is similar to an ILS but without need for ground based navaids.
- Utilizes a Standard RNAV missed approach.
- Preferred by General Aviation and Business Jet Operators due to equipment compatibility.





Vertically Guided Final Approach Segment

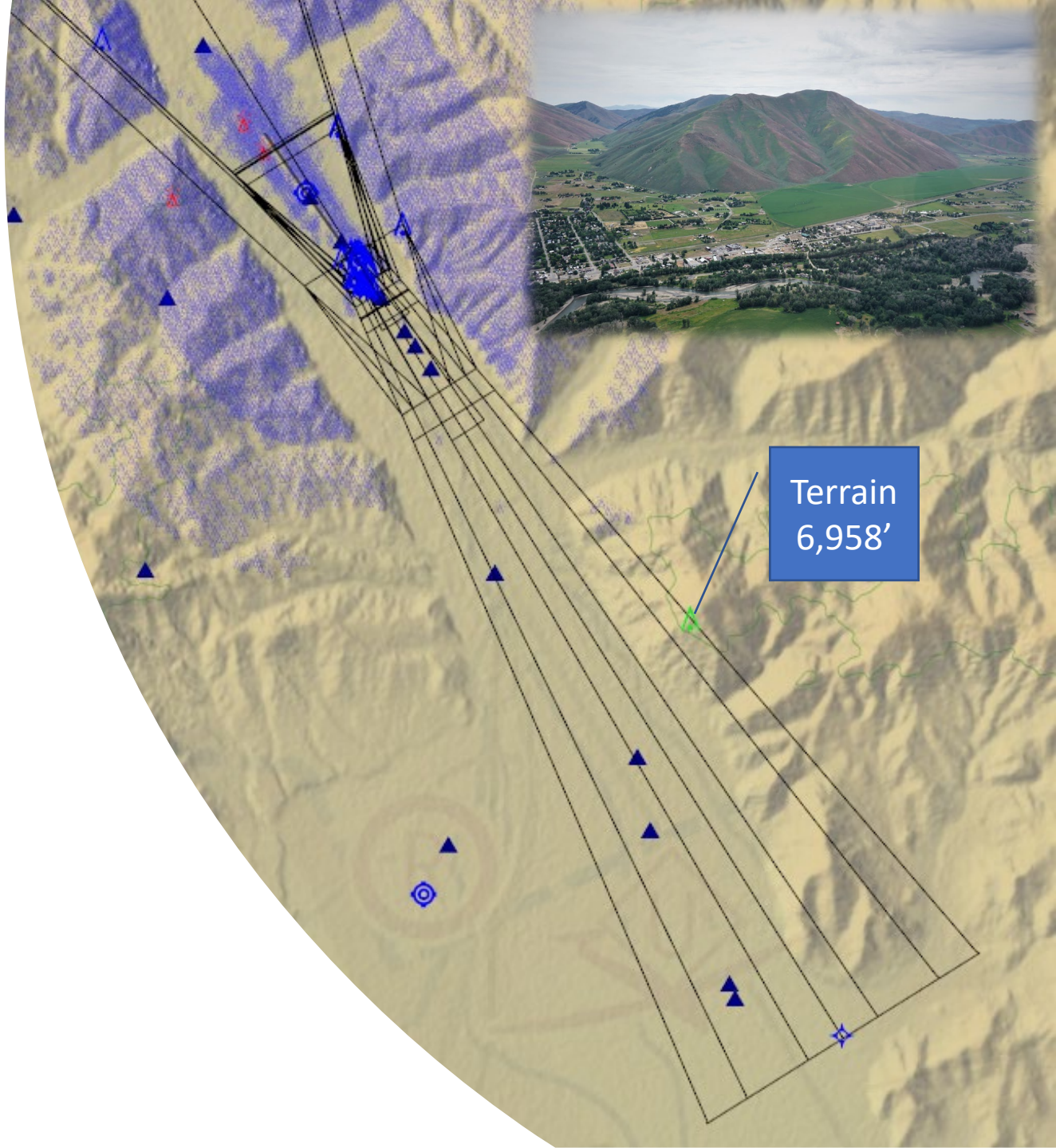
Option #2 Continued



LPV Missed Approach Path

Standard LPV Approach Assessment

- A couple issues were noted upon completion of the initial build and assessment.
- The Final Approach segment crossed a mountainous peak named Lookout Mountain
- This required an excessive descent gradient (above 4.0 degrees) or an offset in excess of 3.0 degrees in order to clear terrain.
- These necessary adjustments would cause the procedure design to fall outside of standard criteria and be unusable by airline jet fleets.

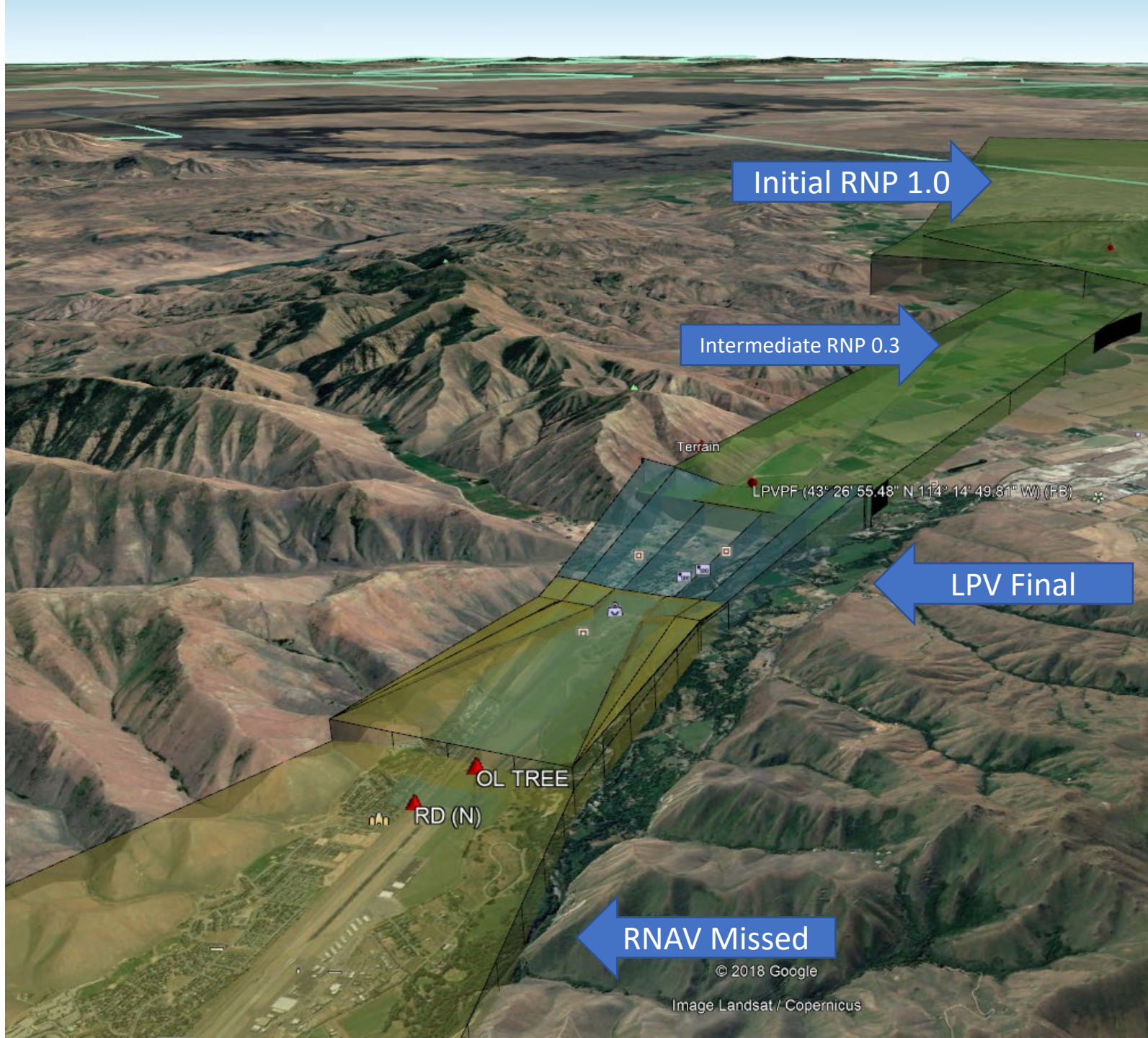


Next… Hybrid Assessment

- As a result of the obstacle issues at Lookout Mountain, it was determined that a standard RNAV (GPS) procedure with an LPV line of minima is not possible at SUN without excessive deviations.
- Research then began on an alternative approach utilizing basic RNP initial segments that connect to a LPV final.
- The FAA has recently published design rules allowing for this new hybrid approach concept.

Option #3: Hybrid Standard RNP to LPV Final

- Utilizes an RNP Initial (1.0) and Intermediate (0.3) segment to connect to a RNAV final segment with LPV line of minima.
- Initial & Intermediate segments avoid terrain features.
- Allows for a optimized alignment of the final approach course.
- Allows for reduced Vertical Descent Angle of 3.50 degrees.
- Does not require certification for Low RNP (i.e. below 0.3)
- Provides cloud ceiling minimums of 343 ft above the runway an 1 mile visibility.



Simulator Evaluation

- From the assessment, one approach concept was then chosen for Simulator testing to validate the procedure in the aircraft that will actually be flying the approach.
- Based on feedback from the lead air carrier, the Hybrid LPV procedure was chosen to test.
- The first evaluation was performed in the FMS Laboratory at Honeywell Aerospace in Phoenix.
- The second evaluation was completed in the full motion Embraer 170/175 simulator at Flight Safety International in Denver, CO.
- Both simulator evaluations proved successful and the feedback from the pilots was encouraging.

Reliability Improvements from a new Approach

A weather study previously performed by T-O Engineers identified how improved approach minimums benefited Airport Access.

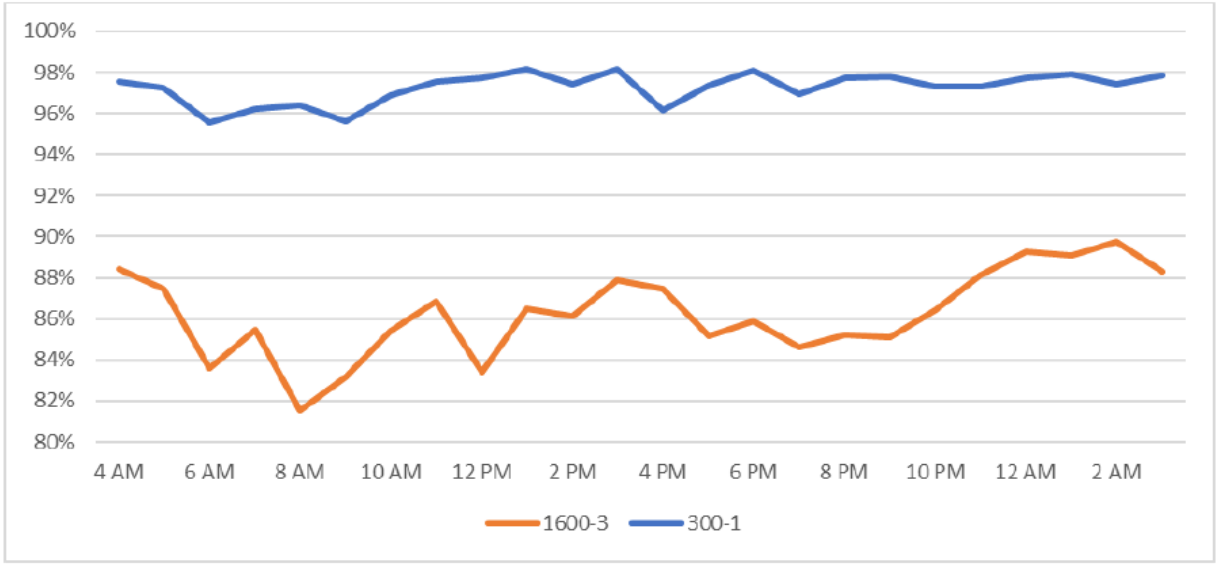
An approach with ceiling and visibility values between 300-400 ft and 1 mile visibility would result in an improvement of 78% over the existing public approach.

Table 2 – Percent Minima Met and Improvement from 1600' and 3 Miles

APPROACH	ANNUAL		NOV. - MAR.	
Ceiling and Visibility	Minima Met	Improvement	Minima Met	Improvement
1600-3	94.2%	-	87.7%	-
900-2.5	95.9%	29.6%	91.2%	28.1%
900-2	96.4%	38.1%	92.2%	36.2%
900-1	97.0%	48.0%	93.4%	46.5%
700-1	97.8%	62.0%	95.1%	60.3%
500-1	98.4%	71.7%	96.4%	70.5%
400-1	98.5%	75.0%	96.8%	74.1%
300-1	98.8%	79.3%	97.4%	78.4%

Source: T-O Engineers and SUN AWOS data

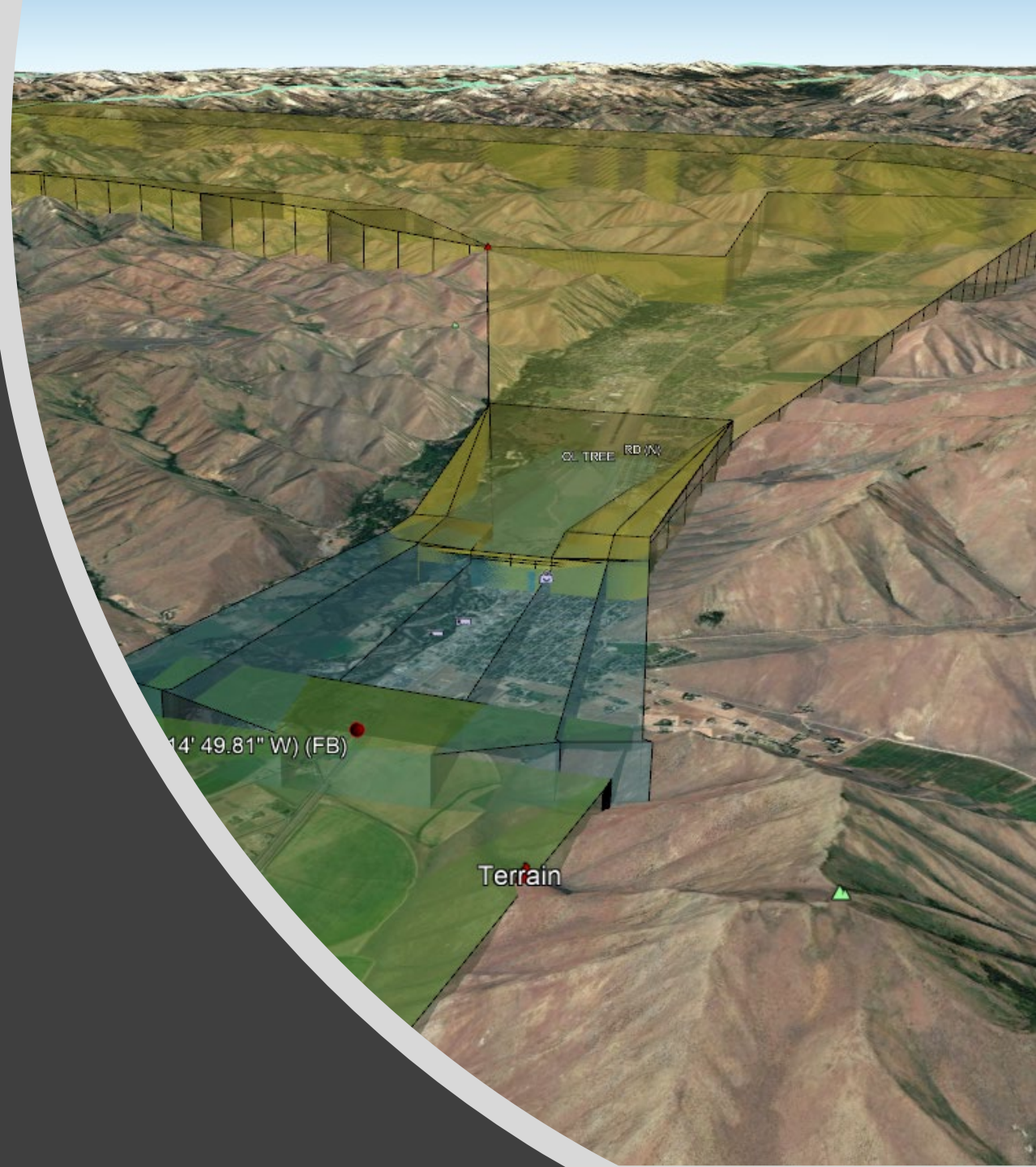
Figure 3 – Hourly Minima Trend on Percent Met Basis for 1600-3 and 300-1



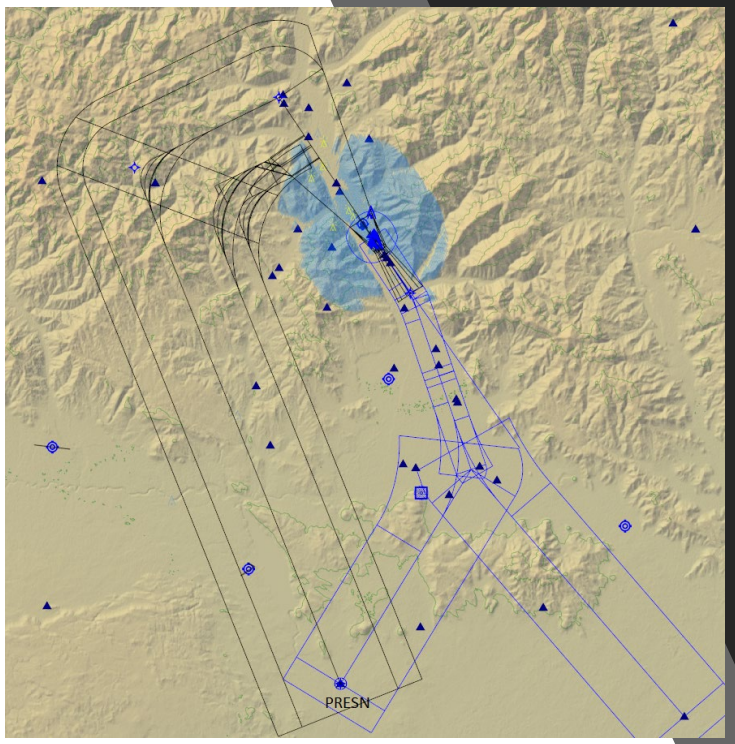
Source: T-O Engineers and SUN AWOS data

Implementation Tasks

- ✓Finalize RNP to LPV design concept
- ✓Formally introduce design package to the FAA Western Region office in SEA (with airport manager)
- ✓Meet with SLC Air Route Traffic Control Center to perform airspace coordination and receive approval.
- ✓Develop encoding and charting data.
- ✓Perform simulator evaluation with lead air carrier and FAA.
- ✓Perform Flight Validation & Airborne Obstacle Assessment with E-175
- ✓Submit approach to FAA Procedure Review Board
- ✓Aircraft Operator Onboarding of Special Procedure w/ FAA



Timelines & Cost of developing a special approach



✓ **7-10 month Timeline**– Which is variable due to FAA review process, government funding lapses, and lead aircraft navigation upgrades, etc.

Since the initial feasibility assessment has already been completed, the overall cost has been reduced.

From concept to implementation: $49,719

What factors in to the cost:

-A total of three people specializing in Approach design, Charting & FMS encoding, Quality Assurance, Flight Validation, and travel.

End of Presentation

FOR MORE EXAMPLES OR SPECIFIC QUESTIONS ABOUT A PREVIOUS OR ONGOING PROJECT, PLEASE CONTACT ALEC SEYBOLD (PRINCIPAL) AT FLIGHT TECH ENGINEERING.

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