

# FY18 NDAA Section 1606 Complementary PNT Demonstration

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Demonstration Day  
NASA Langley Research Center  
13 Mar 2020



U.S. Department of Transportation

**Volpe Center**

*Advancing transportation innovation for the public good*

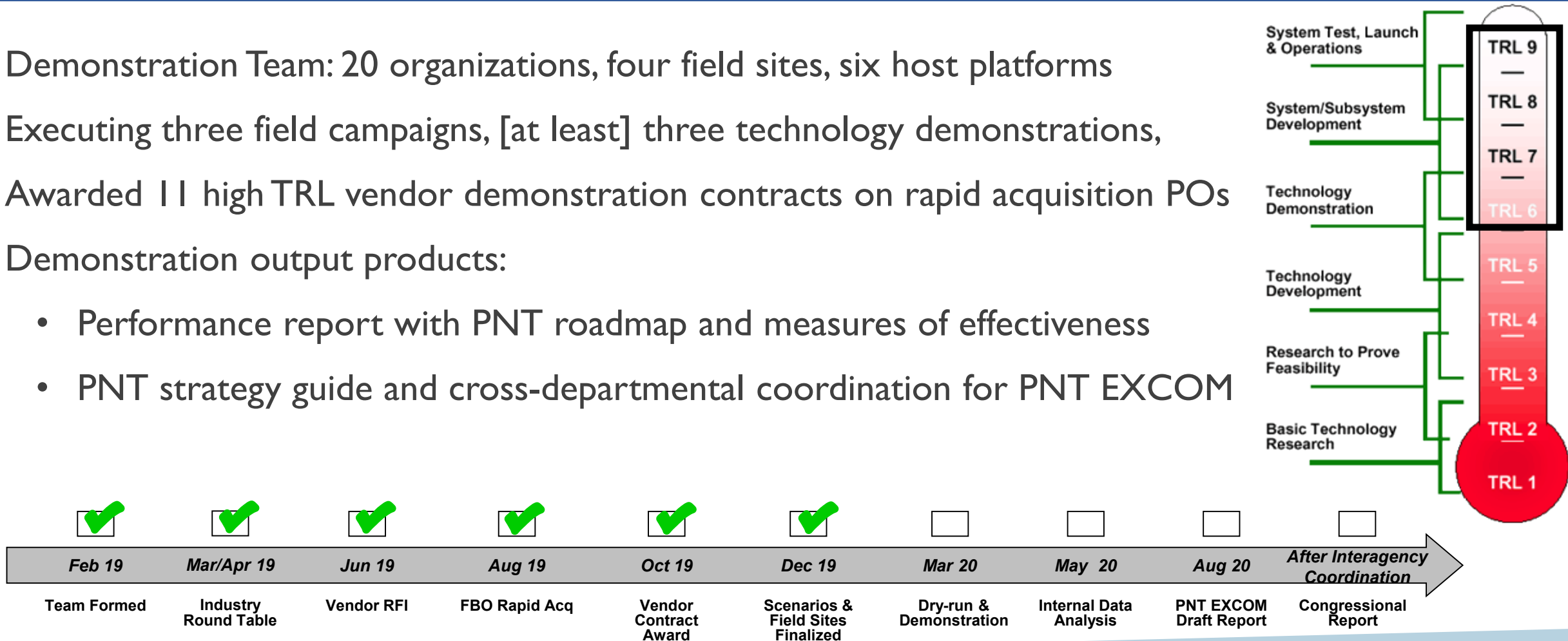
# GPS Backup Demonstration Overview

## High-level Demonstration Plan Developed Under FY18 NDAA

- Joint DOT/DHS/DOD Congressional briefing given Nov 2018
  - Coordination and planning efforts presented
  - DOT had yet to receive funds, transportation demonstration concept presented
  - FY20 NDAA extended period of performance to Dec 2020
- DHS Science and Technology conducted timing and positioning demonstration
  - Dec 2018 at NASA Langley/Insurance Institute for Highway Safety (IIHS) Ruckersville, VA
  - Technologies demonstrated: Locata, NextNav, Satelles (those already available at Langley)
  - Results and interim report in process
- DOT Volpe Center funded to execute demonstration Jan'19 - Dec '20

# NDAA GPS Backup Demonstration Status

- Demonstration Team: 20 organizations, four field sites, six host platforms
- Executing three field campaigns, [at least] three technology demonstrations,
- Awarded 11 high TRL vendor demonstration contracts on rapid acquisition POs
- Demonstration output products:
  - Performance report with PNT roadmap and measures of effectiveness
  - PNT strategy guide and cross-departmental coordination for PNT EXCOM

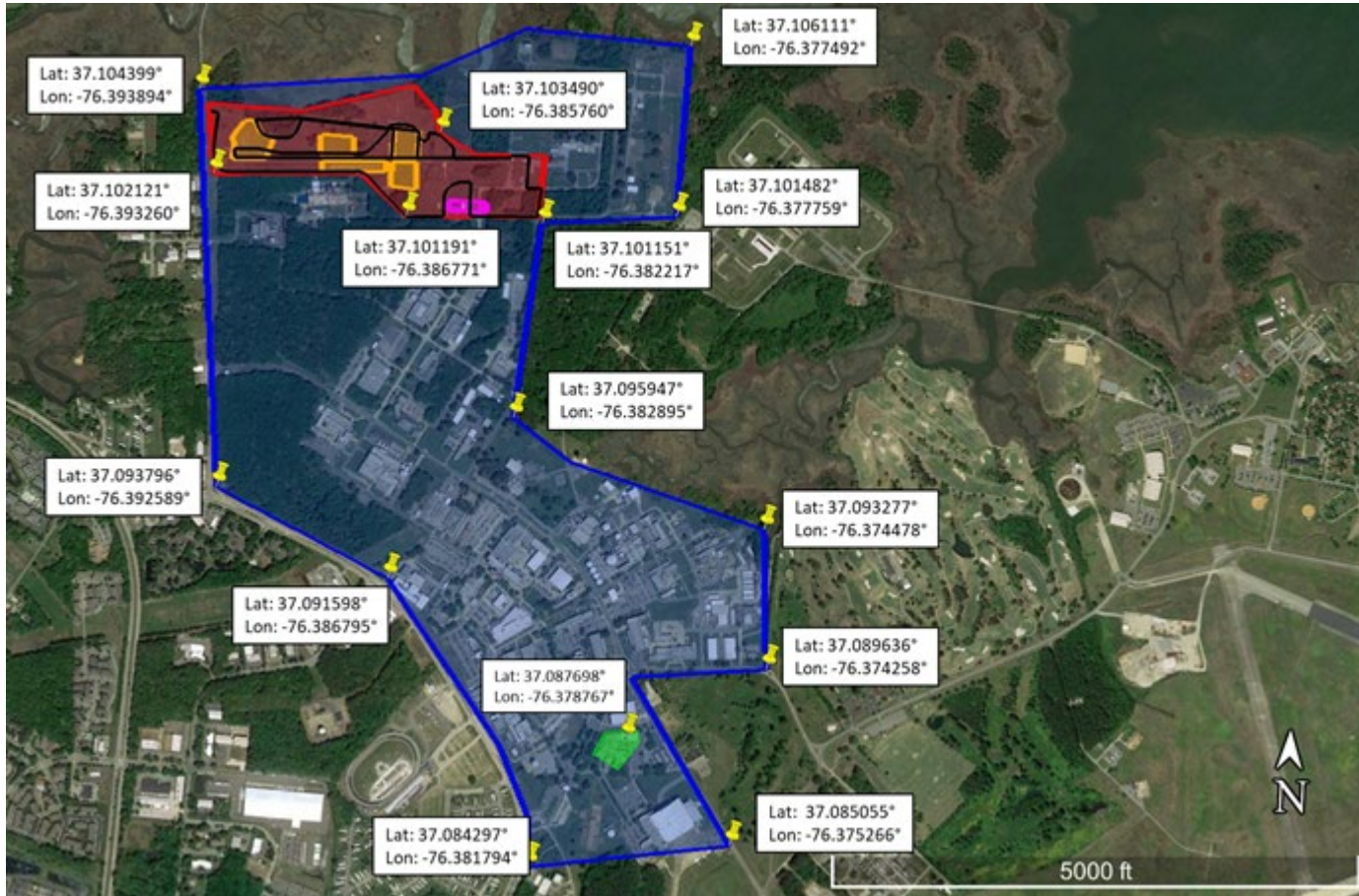


# Volpe Contracted PNT Vendors





# NASA Langley Research Center Field Facility



- Black track used for static timing, static positioning, and dynamic positioning scenarios
- Orange areas used for static timing, static positioning, and dynamic UAS/3D positioning scenarios
- Magenta area (hanger) used for indoor timing and positioning scenarios
- The green area (test building, Lat: 37.087698, Lon: -76.378767) used for fixed and underground/degraded timing scenarios

# Demonstration Plan

## NASA Langley Research Center (LaRC):

### Field Campaign

- 1 Week of Scenarios
- 6 Vendor Technologies
  - Echo Ridge
  - NextNav
  - OPNT
  - Seven Solutions
  - Skyhook
  - TRX Systems

Scenario	Monday	Tuesday	Wednesday	Thursday	Friday
72-Hour Bench Static Timing	72 Hours			As Needed	
Dynamic Outdoor Positioning w/Hold		Van - 4.0 Hours (PM)		Van -As Needed	
Static Outdoor Positioning	Non-van interfaced vendors	Van - 4.5 Hours (AM)	Non-van interfaced vendors		
Static Outdoor Timing			As Needed		
Static Indoor Positioning	Van - 2.0 Hours (PM)	Non-van interfaced vendors	Van - As Needed	Non-van interfaced vendors	
				As Needed	
Static Indoor Timing	Van - 4.5 Hours (AM)				
Static Basement Time				2 Hours (PM)	2 Hours (AM)
Southern Campus					2 Hours (AM)
3D Pos.	4 Hours	4 Hours	4 Hours	4 Hours	

Planned Day

Make-up Day

Only for participates not interfaced with the Van reference system (deconflicted with Van scenarios for safety)

# 2D Platform & Reference System (LaRC)

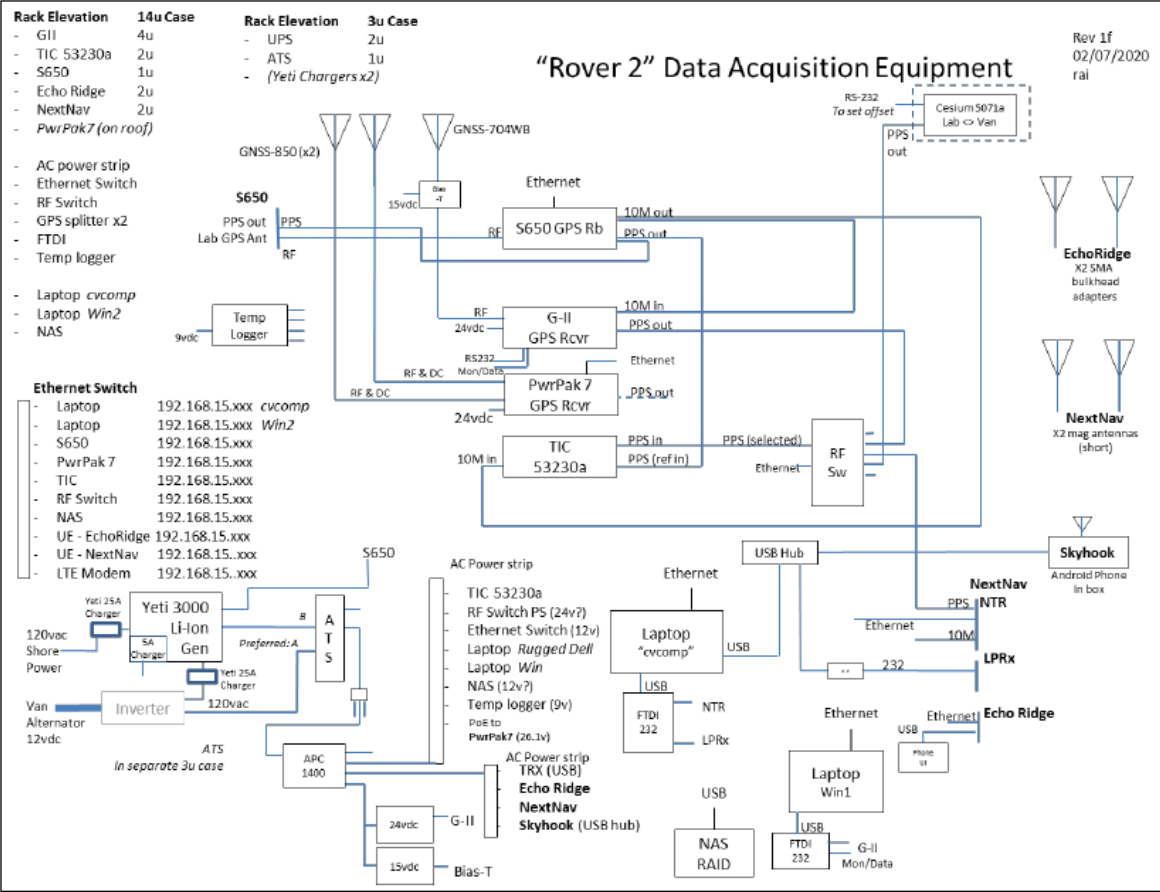


Figure 3: Rover Reference System Diagram LaRC “Rover 2”





# 3D Platform & Reference System (LaRC)

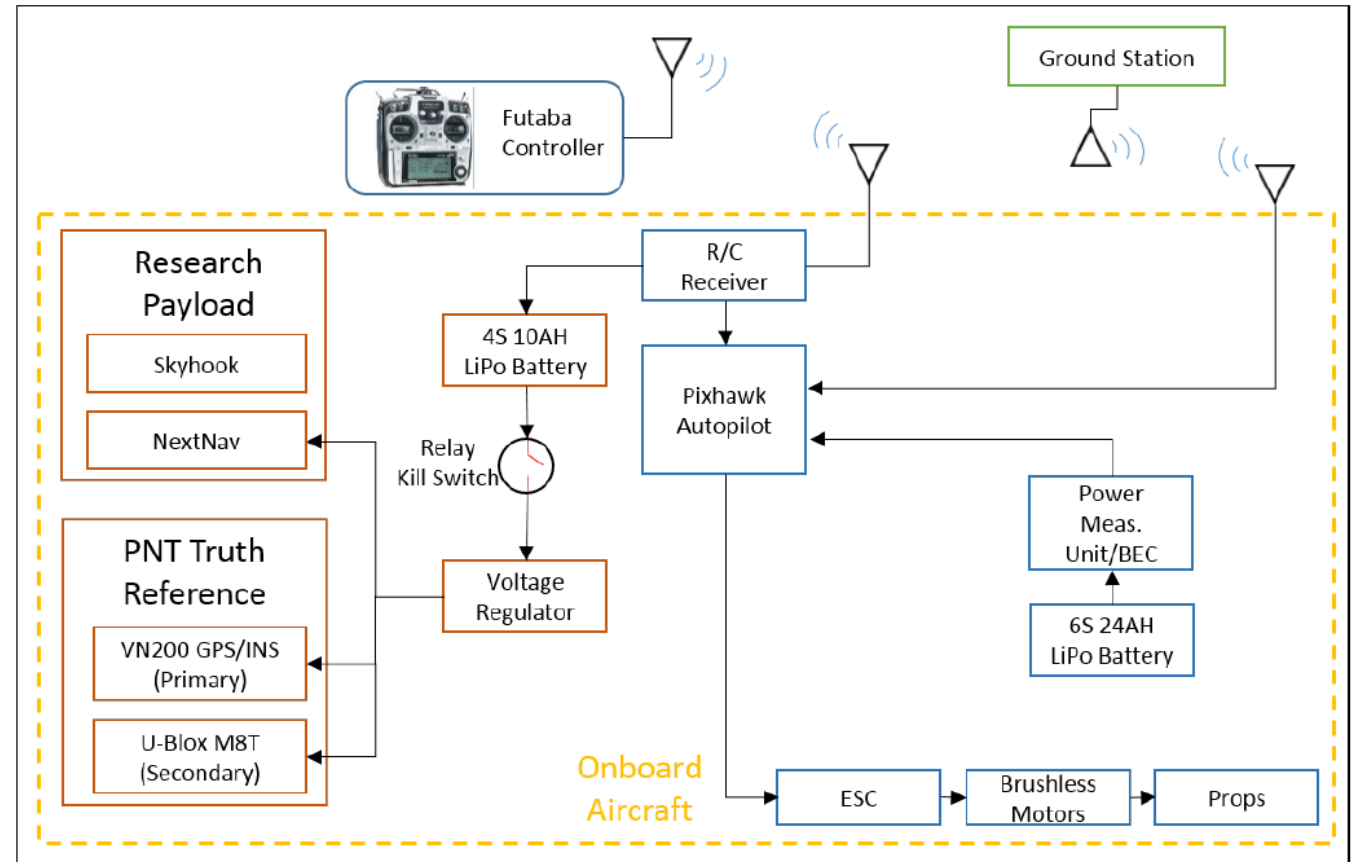


Figure 5: R3 Reference System Diagram LaRC

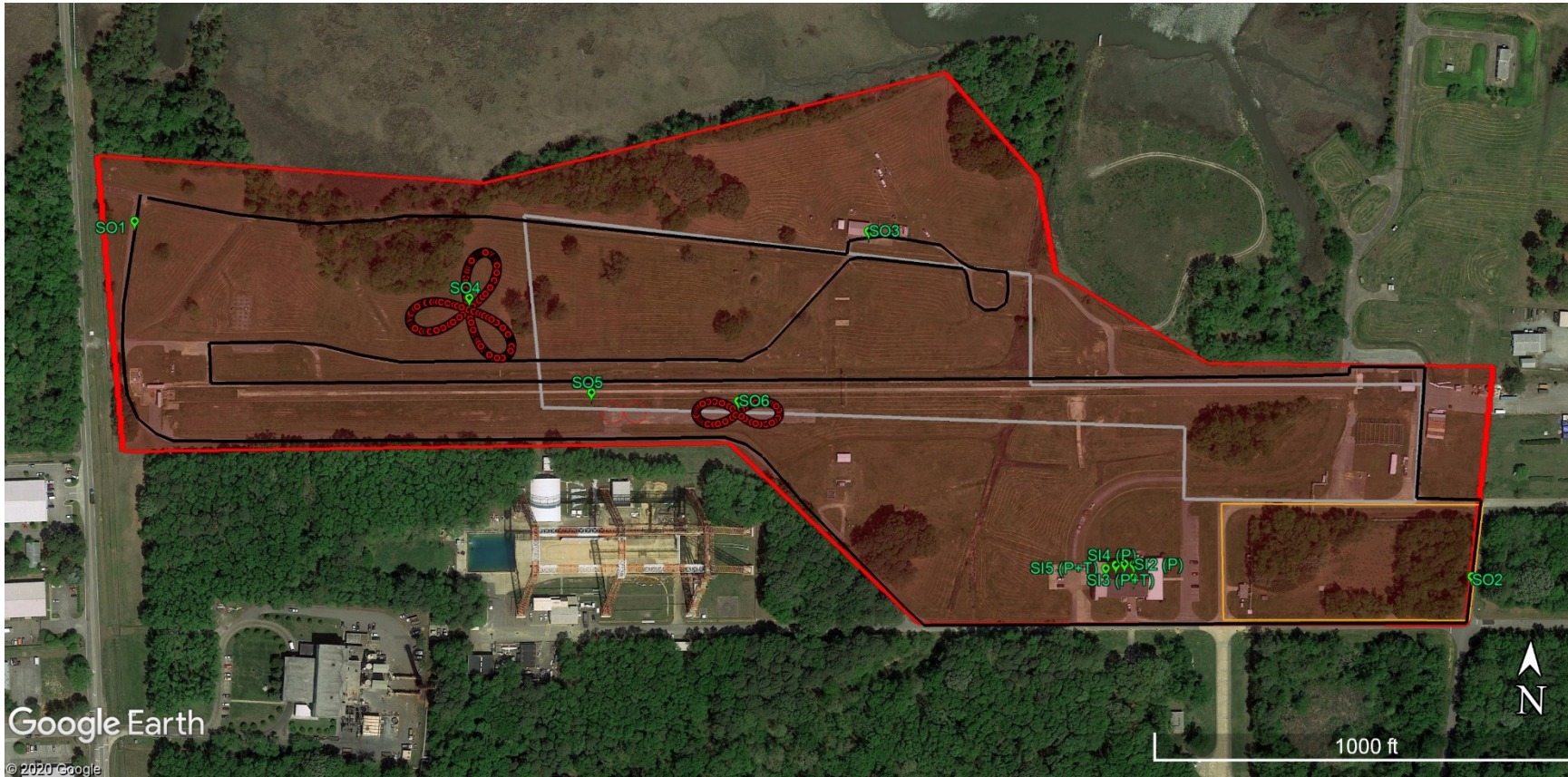


# Demonstration Vendor Scope and Schedule

VIP Demo	day	start	end	Technologies							Demo Platforms				
				In Situ	Terrestrial RF				Satellite	Fiber Optic	Fixed		Moving		
				Map Match	LF (Loran)	MF (R-mode)	VHF (passive)	WiFi (2.4 GHz)	L-Band (LEO)	PTP	Outdoor	Indoor	Static	2D (van)	3D (uas)
LaRC	13-Mar	9:00	16:00	x			x	x	x	x	x	x	x	x	x
JBCC	20-Mar	9:00	16:00		x	x		x	x		x	x	x	x	x
Vendors				TRX	Hellen Systems	Serco	NextNav	PhasorLab	Echo Ridge	OPNT					
					UrsaNav			Skyhook	Satelles	Seven Solutions					

	GPS Backup Demonstration: Vendor Travel and Deliverables Schedule - Through Demonstration																					
Weeks from Award	2019									2020												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Week Start Date	4-Nov	11-Nov	18-Nov	25-Nov	2-Dec	9-Dec	16-Dec	23-Dec	30-Dec	6-Jan	13-Jan	20-Jan	27-Jan	3-Feb	10-Feb	17-Feb	24-Feb	2-Mar	9-Mar	16-Mar	23-Mar
Demonstration Site Visits			*																			
Site Plan				★																		
UE Integration Verification				★ *																		
UE Hardware							★ *															
Vendor Technology Setup											*		★									
Dry Run															*		★					
Demonstration																			*		★	
*= Travel ★ = Deliverable	Date of Award = November 4, 2019																					

# Demonstration Outdoor Scenarios (2D LaRC)



- Red area – fully instrumented
- Black track – van routes
- Green points – static points
- Grey track – UAS routes
- Red track – UAS maneuvers
- Orange box – dismount area



# Demonstration Outdoor Scenarios (3D LaRC)

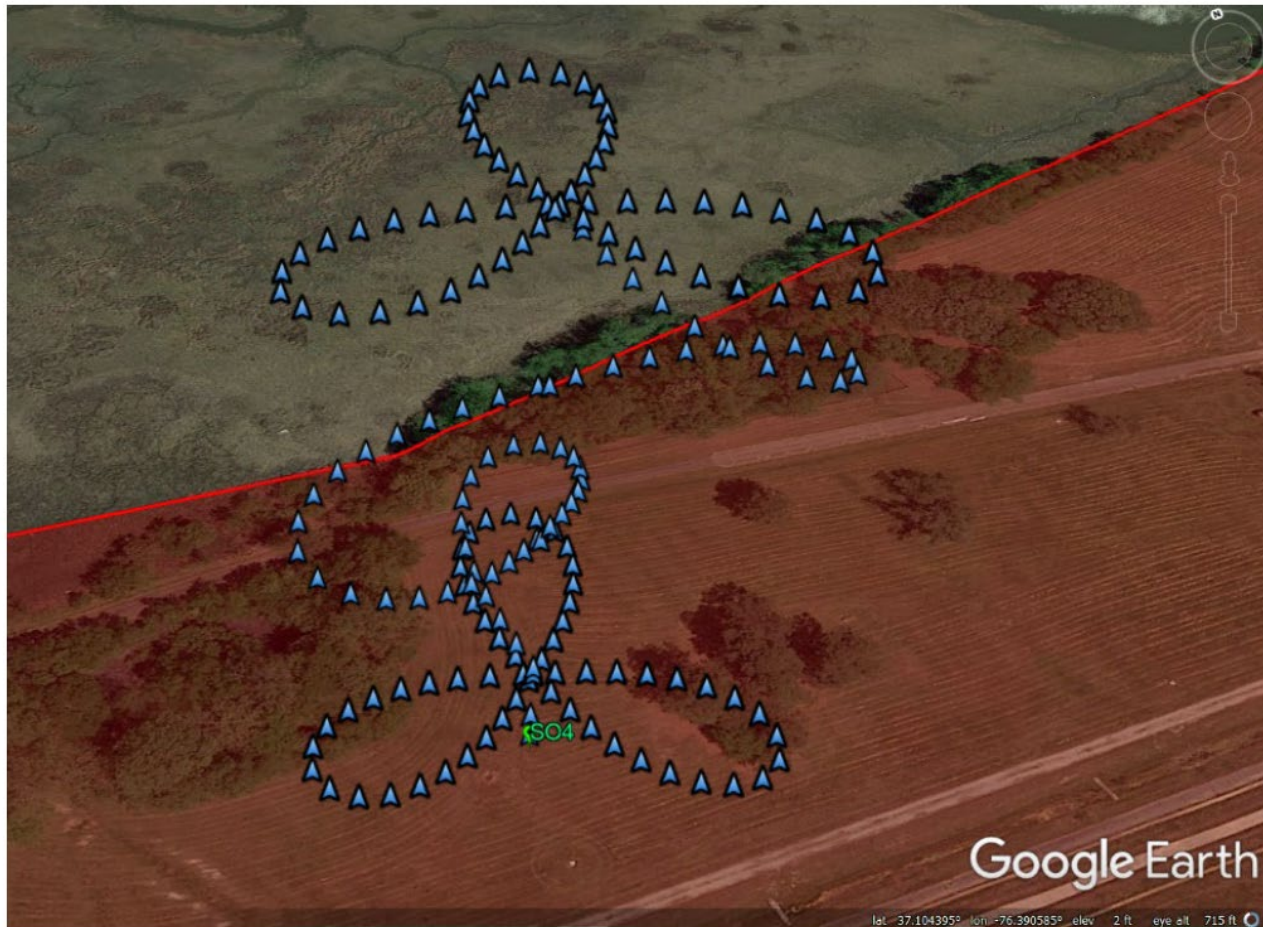


Figure 16: LaRC 3-Petal UAS Shape





# Demonstration Indoor Static Scenarios (LaRC)



Figure 11: LaRC Static Indoor Positioning and Timing Scenario