Chapter 4 – Unmanned Aircraft Systems Evaluation

This chapter was prepared by the Pendleton UAS Range.

Introduction

Pendleton UAS Range

The Pendleton UAS Range (PUR) is part of the Pan-Pacific UAS Test Range Complex (PPUTRC), led by the University of Alaska. The PPUTRC is one of six official FAA UAS test sites in the United States. The test ranges are chartered to manage and support a variety of UAS activities to include: Range Support/Management, Engineering, and Flight Test efforts with the goal of integrating UAS into the National Airspace System (NAS).

The PUR is based at the Eastern Oregon Regional Airport (KPDT) and encompasses 14,000 square miles of airspace in northeastern Oregon. The PUR is dedicated to supporting UAS manufacturers and operators in developing safe, effective processes and procedures that have all necessary approvals for UAS operations in the NAS. The PUR Range Management office at KPDT manages all UAS operations on the PUR in support of research, regulatory development, and commercialization projects.

The strategic vision of the PUR is to develop a diverse, high-tech UAS industry base at KPDT, providing a variety of UAS services to Original Equipment Manufacturers (OEM's) including FAA type-certification.

FIGURE 4-1: UAS GROUPS

DoD Unmanned Aircraft Systems (As of 1 JULY 2011)

General Groupings	Depiction	Name	(Vehicles/GCS)	Capability/Mission	Command Level
Group 5 • > 1320 lbs • > FL180		•USAF/USN RQ-4A **Global Hawk/BAMS-D** Block 10 •USAF RQ-4B **Global Hawk** Block 20/30 •USAF RQ-4B **Global Hawk** Block 40	•9/3 •20/6 •5/2	•ISR/MDA (USN) •ISR •ISR/BMC	•JFACC/AOC-Theater •JFACC/AOC-Theater •JFACC/AOC-Theater
		•USAF MQ-9 **Reaper**	•73/85* *MQ-1/MQ-9 same GCS	•ISR/RSTA/EW/ STRIKE/FP	•JFACC/AOC- Support Corps, Div, Brig, SOF
Group 4 • > 1320 lbs • < FL180		•USAF MQ-1B **Predator**	•165/85*	•ISR/RSTA/STRIKE/FP	•JFACC/AOC-Support Corps, Div, Brig
		•USA MQ-1 **Warrior**/MQ-1C **Gray Eagle**	•31/11	•(MQ-1C Only-C3/LG)	•NA
		•USN **UCAS**- CVN Demo	•2/0	•Demonstration Only	•NA
		•USN MQ-8B **Fire Scout** VTUAV	•14/8	•ISR/RSTA/ASW/ ASUW/MIW/OMCM/ EOD/FP	•Fleet/Ship
		•SOCOM/DARPA/USA/USMC A160T **Hummingbird**	•8/3	•Demonstration Only	•NA
Group 3 • < 1320 lbs • < FL180 • < 250 knots		•USA MQ-5 **Hunter**	•45/21	•ISR/RSTA/BDA	•Corps, Div, Brig
		•USA/USMC/SOCOM RQ-7 **Shadow**	•368/265	•ISR/RSTA/BDA	•Brigade Combat Team
		•USN/USMC **STUAS**	•0/0	•Demonstration	•Small Unit
Group 2 • 21-55 lbs • < 3500 AGL • < 250 knots		•USN/SOCOM/USMC RQ-21A **ScanEagle**	•122/13	•ISR/RSTA/FORCE PROT	•Small Unit/Ship
Group 1 • 0-20 lbs • < 1200 AGL • < 100 knots		•USA / USN / USMC / SOCOM RQ-11 **Raven**	•5628/3752	•ISR/RSTA	•Small Unit
		•USMC/ SOCOM **Wasp**	•540/270	•ISR/RSTA	•Small Unit
		•SOCOM SUAS AECV **Puma**	•372/124	•ISR/RSTA	•Small Unit
		•USA **gMAV** / USN **T-Hawk**	•270/135	•ISR/RSTA/EOD	•Small Unit

UAS Airside and Landside Activities

The Unmanned Aircraft Systems (UAS) industry is a rapidly expanding market. The domestic regulatory environment is dynamic as the FAA continues to work through the challenges of integration between manned and unmanned aviation in the National Airspace System. UAS technology is also evolving rapidly and the PUR is working to integrate infrastructure and airspace plans into future development and accommodate the wide range of needs across both UAS and manned platforms in support of the PUR strategic vision.

UAS needs vary greatly between the many different types, sizes and functions of platforms, and associated support equipment. Although not totally inclusive, **Figure 4-1** generally describes the different types and categories of UAS platforms, organized into basic groups. Commercial industry generally falls into these categories as well. Group 2 & 3 are dominating the commercial market, mostly driven by current FAA restrictions and cost; while the Department of Defense (DoD) and other government agencies are operating UAS platforms across the full spectrum of size and capability. Due to the recent FAA Part 107 ruling easing

restrictions on non-commercial use of small UAS (<55 lbs.) by hobbyists, the number of Group 1 UAS in the NAS has increased dramatically. The general infrastructure and support requirements for each of group are laid out in this section.

UAS Airside Facility Requirements

Group 1 Infrastructure Requirements:

RUNWAY REQUIREMENTS

None. Hand launched / recovered.

AIRFIELD SUPPORT SERVICES

General Services

Group 1 vehicles are small, mobile and likely will not require operations into, or out of the airport. Support requirements may include a Mobile Operations Center (MOC), radio communications equipment, crew shelter, data-processing space, training room and secure storage locations.

Facilities

None.

Office / Administrative Space

Customers utilizing Group 1 platforms will likely utilize office space for data-processing, training and secure equipment storage. Current space at Eastern Oregon Regional Airport (EORA) include:

- Office: Single office available in terminal
- Training / Storage Room: Single training / storage area available in terminal, adjacent to office space (old baggage claim area).

The current office and training / storage area may be sufficient to support one customer at a time. However, additional MOC storage areas will be required (approx. 20' x 40'). Customer demand will generate the need for additional office and storage locations at the EORA.

Group 2 & 3 Infrastructure Requirements:

RUNWAY REQUIREMENTS

There are a wide range of requirements for Unmanned Aircraft platforms and associated launch, recovery and control mechanisms ranging from pneumatic launchers, skyhook recovery, to runway and net system recovery. The infrastructure plans for PUR at the EORA include accommodations for these varying requirements. Typical equipment support and footprints for Group 2 & 3 platforms are described below. **Figure 4-2** shows an example of a UAS launch. **Figure 4-3** shows an example of a portable UAS capture system.

FIGURE 4-2: INSITU SCAN EAGLE LAUNCH

FIGURE 4-3: ARCTURUS T-20 PORTABLE CAPTURE SYSTEM

Launch / Recovery

- Pneumatic Launch and Skyhook recovery
- Bungee or hand launch, hard packed surface recovery
- Pneumatic launch and runway recovery

Typical Footprint:

Launch:

- Stowed
  - Length: 17.83 ft.
  - Width: 7.25 ft.
  - Height: 6.42 ft.
- Deployed
  - Length: 22 ft.
  - Width: 7.25 ft.
  - Height: 8 ft.

Transport:

- Typically hitch-mounted, or trailer transport
- Weight: Ranging between 200 - 4,200 lbs.

Recovery:

Runway:

- Condition:
  - Hard-packed, paved, gravel or dirt
  - Less than 1000 ft.

Net Capture:

- Typically off airport

Sky Hook:

- Stowed:
  - Length: 19 ft.
  - Width: 7.2 ft.
  - Height: 6.25 ft.
- Deployed:
  - Length: 28.75 ft.
  - Width: 17.5 ft.
  - Height: 58 ft.

Fuel Storage, Handling & Limitations

Typical Fuel Requirements:

- JP-5 or JP-8 fuel
- Hybrid Power System Propane/Rechargeable Battery
- Fuel cell
- Battery operated

AIRFIELD SUPPORT SERVICES

General Services

Group 2 & 3 systems will require airfield services such as fuel, UAS pad maintenance, utility support (internet, power, trash, sewer, etc.), transportation, security and labor associated with safety, compliance, and administration support. Memorandums of Agreement (MOA) will be required with the Air Traffic Control Tower (ATCT) for airfield movement and airspace coordination / approval.

Facilities

Fifteen UAS pads are located on the airport, adjacent to taxiways Foxtrot and Golf. Each UAS pad is equipped with 115/208V single-phase, 60 Hz AC electrical power, water, and fiber internet access. These UAS pads are able to accommodate a wide range of trailers or other support equipment to meet the needs of current and future UAS customers. A typical Mobile Operations Center (MOC) as shown in **Figure 4-4 and Figure 4-5**: Many Group 2 systems utilize an MOC to support operations in the field.

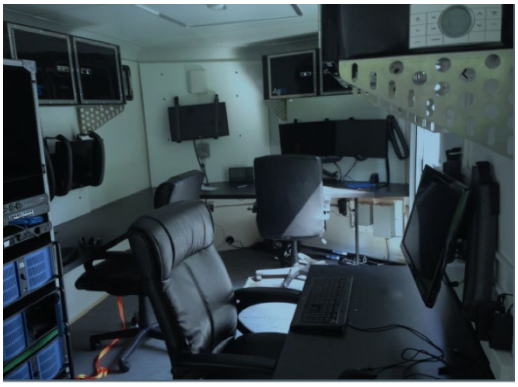
The PUR MOC is available to range users and includes:

- Length: 25 ft.
- Width: 8 ft.
- Computer Workstations: 4
- VHF Voice Radio
- Pan and Zoom Camera
- Video Matrix Switch
- Four, 55" inch LED Screens
- Two, ADS-B Receivers and IPad Displays
- Two Cellular WiFi Hotspots, Printer
- Rack Mounted General-Purpose Computer

- Rack Mounted 900 MHz- 8 GHz Spectrum Analyzer
- Back-up power (24VDCbattery)
- Generator for normal power/Able to connect to shore power
- Heat/AC/Shower/Toilet
- External lighting
- Dodge Ram 2500 Mega Cab tow vehicle

FIGURE 4-4: MOC TRAILER(TYPICAL)

FIGURE 4-5: MOC TRAILER INTERIOR



Office / Administrative Space:

Similar to Group 1, Group 2 & 3, UAS customers will require office space for data-processing, administration support, training, and secure storage.

The current office / storage space located in the EORA terminal would likely meet the needs for one customer at a time (accommodating approximately 3-5 personnel per operation), but additional customer demand will generate the need for increased office and storage space at the EORA.

A 9,600 square-foot, two-bay, multipurpose hangar with an open floorplan is under construction to meet immediate and future needs of both manned and unmanned aviation (north of TWY Delta). This hangar is outfitted with restrooms, HVAC, 480V three-phase, 60 Hz AC power, and office space. By designing the hangar to be dual-purpose (large enough to fit a King Air type aircraft), it will allow the highest level of flexibility while the UAS industry evolves. This new construction will be ready for occupancy in 1Q2017.

Group 4 & 5 General Infrastructure Requirements:

RUNWAY REQUIREMENTS

As a general rule, Group 4 & 5 UAS operate very similarly to manned aviation and require very similar infrastructure and equipment support.

AIRFIELD SUPPORT SERVICES

General Services

Large UAS will require airfield services such as towing, refueling / de-fueling, deicing, power, security, hangar space, etc. MOA's will be required with the ATCT for airfield movement and airspace coordination / approval.

Fuel Storage, Handling & Limitations

Typical Fuel Requirements:

– Primary - MIL-T-83133, JP-8, or JP-8+100.

– Alternate - MIL-T-5624, JP-5, or additivized TS-1

Facilities

Hangars

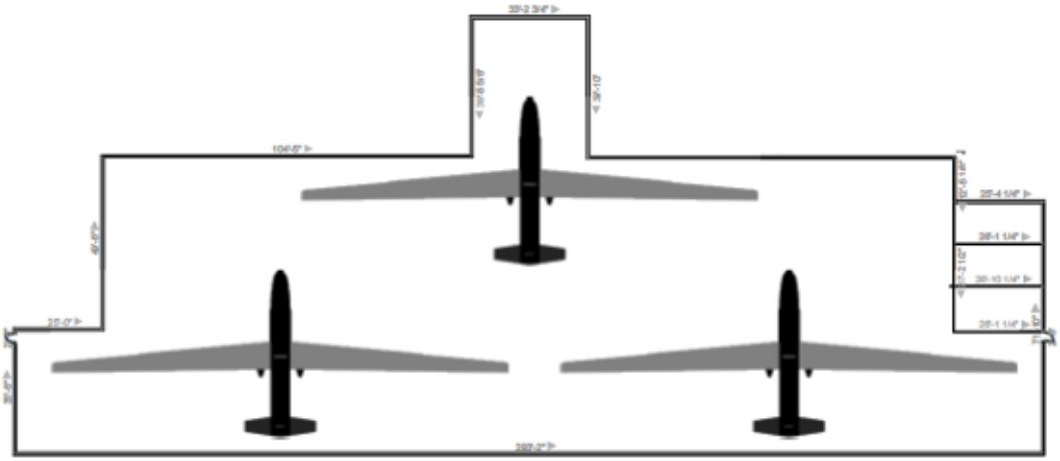
For scaling purposes, we utilized a Global Hawk platform as an example of infrastructure requirements for a large, Group 5 UAS platform.[1] **Figure 4-6** shows typical Large UAS dimensions. **Figure 4-7** shows an example of a UAS hangar layout.

FIGURE 4-6: GLOBAL HAWK DIMENSIONS

	RQ-4A	RQ-4B
Wing Span (ft)	116.2	130.9
Length (ft)	44.4	47.6
Height (ft)	15.2	15.4
Verticle Clearance (in)	19.5	20.65
Tread (ft)	10.6	21.1

[1] Technical Manual 1Q-4(R) A-2-DB-1, 22 April 2008, Version 07.12.001

FIGURE 4-7: EXAMPLE HANGAR PLAN



Office / Administrative Space

The administrative footprints for large platforms are significant with personnel office space ranging from 10-20 offices with a conference room, break-room, and bathrooms. Space located above a large hangar or a small-detached building would meet the needs of required administrative personnel.

Building-based Operations Center

Depending on the owner / operator, Group 4 & 5 UAS platforms utilize command and control stations that may be building-based, or housed within mobile ground stations. The DoD developed mobile ground stations to support overseas locations and separated the Mission Control Element (MCE) and Launch and Recovery Element (LRE) functions. These stations are typically housed in commercially available trailers outfitted with UHF and VHF radio links, a C-band line of sight data link, and KU-band satellite data links. Other users, such as National Aeronautics and Space Administration (NASA), utilize a building-based operations center where ground, support, and communications equipment are permanently installed. **Figure 4-8** shows a typical UAS operations center.[2]

[2] Northrop Grumman Corporation, Pake Chin, Sep 2013

FIGURE 4-8: OPERATIONS CENTER

Summary:

As identified in this section, there is a wide variation of infrastructure, equipment and support service requirements across the various types and sizes of Unmanned Aircraft Systems. Current infrastructure at the EORA will support the immediate needs of customers flying at the PUR. Based on current and forecasted UAS operations tempo (OpsTempo), we believe the Phase I infrastructure and new hangars will support a number of potential flight operations for the next two to five years. The additional hangar construction and office / storage space would be highly attractive to both the UAS and manned aviation industries; both as an immediate and future need at the airport. Phase I & II of the PUR infrastructure execution will likely be driven by customer demand. The evolving FAA regulatory environment has a direct impact on customer demand at the PUR, and thus OpsTempo.

Current and Future UAS Airspace Approvals / Requirements

Approval for operation in KPDT Class Delta airspace currently include Shadow (RQ-7) operations from the Oregon Army National Guard; Arcturus T-20, Tigershark, RMAX and FAZER operations from the north end of Taxiway Golf or the UAS pads. A copy of the Army Letter of Agreement (LOA) and Certificate of Authorizations (COA), and approved PUR COA for UAS within KPDT Class Delta airspace is included in **Appendix C**. Additional approvals are in-place to allow for day and night operations for large and small UAS operating in Class Echo and Golf airspace, from surface to 9,999 Ft MSL. All UAS operations require that the vehicle remain in visual contact by an observer. If the UAS mission plan will take the vehicle beyond the line-of-sight of the observer, daisy-chaining of observers is allowed, or a chase aircraft must follow the UAS and maintain direct radio contact with the UAS Pilot-in-Command.

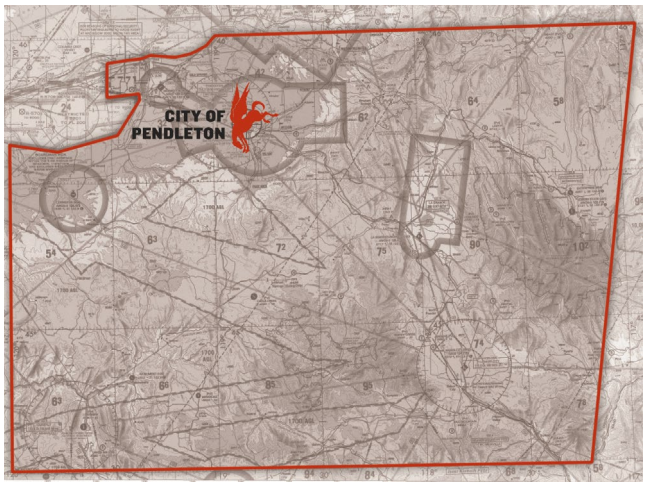
Currently, UAS operations in the class Delta airspace do not have an impact on arriving and/or departing VFR and/or IFR traffic. Segregation by ATCT, and management of the range schedule are the current risk mitigation approach used for traffic confliction between manned and unmanned platforms. Additionally, lost-link contingency routes are planned for all UAS activity on the range; these routes define what the UAS will do in the event the command and control data link is lost and are designed such that a UAS in a lost-link situation will not over-fly approach or departure route, population centers, etc. as it returns to base. These contingency plans are briefed to ATCT personnel prior to every UAS mission in class Delta airspace.

If the air traffic control tower were to close, UAS operations are permitted in Class E airspace with proper approval from the FAA, either through a certificate of authorization, Section 333 Exemption, and as of August 2016, small UAS operations for commercial use are authorized under CFR Part 107. Section 333 Exemption of the FAA Modernization and Reform Act of 2012 (FMRA), grants the Secretary of Transportation the authority to determine whether an airworthiness certificate is required for UAS to operate safely in the National Airspace System (NAS). The Section 333 Exemption process provides operators who wish to pursue safe and legal entry into the NAS a competitive advantage in the UAS marketplace, thus discouraging illegal operations and improving safety.[3] CFR Part 107 allows operators of small, commercial UAS to obtain a 'Remote Pilot Certificate' (RPC) by taking a written Aeronautical Knowledge test, similar to a private pilot written test. Once a commercial operator has obtained an RPC, the may operate a small UAS in the NAS; if operations will be in controlled airspace, the operator must coordinate with local ATC before commencing operations. ATC's primary responsibility is to separate air traffic near an airport. The smaller the aircraft is, the harder it is for pilots to see-and-avoid other aircraft. The importance of having and maintaining an active air traffic control tower is critical for the safety of both manned and unmanned aircraft.

Figure 4-9 shows the UAS operations area surrounding Pendleton.

[3] Federal Aviation Administration; Section 333 ‹https://www.faa.gov/uas/legislative_programs/section_333/›

FIGURE 4-9: PUR OPERATIONS AREA

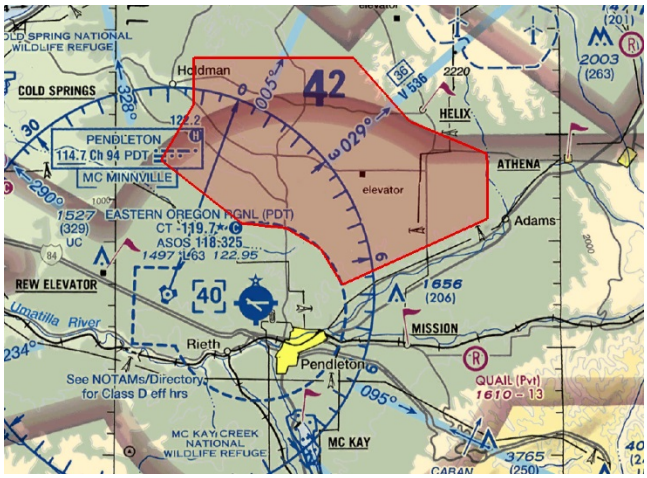


UAS operations are approved as outlined below:

1. Inside KPDT Class Delta airspace:
    a. Altitude: at or below 4,000ft MSL (as assigned by KPDT ATCT)
    b. UAS operations allowed with clearance from PDT ATCT
        - KPDT ATCT personnel attend Flight Readiness Reviews/Preflight briefings before any UAS operations in KPDT Class Delta
    c. NW, NE, and SW Holding Points (as depicted in the LOA) are established and used as directed by KPDT ATCT. UAS operators will comply with all ATC instructions while operating in KPDT Class Delta.
    d. NOTAM's will be submitted for UAS operations being conducted in KPDT Class Delta.
2. Operations in North OPAREA outside Class Delta airspace:
    a. Altitude: at or below 4,000 ft. MSL (as assigned by Pasco TRACON)
    b. Communications will be with PDT ATCT
3. Operations between KPDT Class D and R-5701 (Army National Guard):
    a. Altitude: at or below 4,000 ft. MSL (as assigned by Pasco TRACON)
    b. Communications will be with KPDT ATCT.
4. Operations between KPDT and PUR airspace:
    a. The PUR includes 14,000 square miles of airspace ranging from surface to 18,000.
5. The mixing of manned and unmanned traffic within Class D airspace during launch and recovery operations is approved.

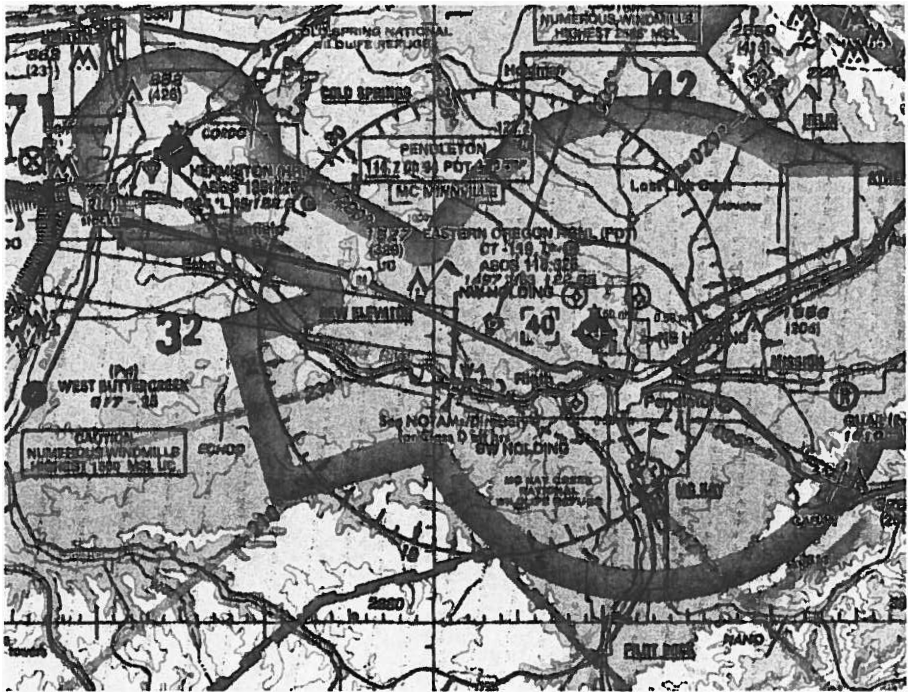
Figure 4-10 shows the North Operations Area

FIGURE 4-10: NORTH OPERATIONS AREA (OPAREA)



AIRSPACE MANAGEMENT:

FIGURE 4-11 SHOWS KPDT ON A SECTIONAL CHART.FIGURE 4-11: KPDT



Future airspace management between manned and unmanned aircraft is part of the FAA's NextGen program, including Automatic Dependent Surveillance-Broadcast (ADS-B) technology.

Automatic Dependent Surveillance–Broadcast (ADS-B) is a precise satellite-based surveillance system. ADS-B Out uses GPS technology to determine an aircraft's location, airspeed and other data, and broadcasts that information to a network of ground stations, which relays the data to air traffic control displays and to nearby aircraft equipped to receive the data via ADS-B In. Operators of aircraft equipped with ADS-B In can receive weather and traffic position information delivered directly to the cockpit. Range operations are governed by current ATCT LOA restrictions (very similar to the Guard LOA).[4]

ADS-B will be mandated for all aircraft starting in 2020 and available in the size of a business card (today), accommodating the minimal payload capacity on small manned and/or unmanned aircraft. This technology will serve as a tool for both manned aviators in the sky and controllers on the ground to all detect-and-avoid each other.

We do not anticipate the UAS operational tempo driving a need for change to airport air traffic flow for the foreseeable future (next 5-10 years). The procedures described above will accommodate current and future UAS testing at the PUR, and Army ANG training operations. Assumptions include no significant increase to Army training requirements and no large (Group 4 & 5) UAS vehicles as a tenant to KPDT. Large group 4 and 5 fixed-wing UAS vehicles, as well as manned, flying test bed aircraft require a large runway (5,000-7,500 feet in length) for takeoff and landing and associated support infrastructure / equipment. Large group 4 and 5 rotary-wing, vertical take-off and landing (VTOL) UAS and manned, rotary-wing flying test bed aircraft can operate from existing ramp and apron areas. The PUR is expecting that group 4 fixed wing UAS operations will commence in February 2017, and group 5 rotary-wing UAS operations will commence in KPDT class Delta in the summer of 2017. Additionally, the PUR has been in discussion with clients interested in flying manned test-bed aircraft (CRJ700 and similar) in support of development work for UAS applications.

Group 2 & 3 UAS platforms can utilize unused portions of KPDT runways and taxiways; taking advantage of current air traffic separation / segregation techniques currently employed by the ATCT.

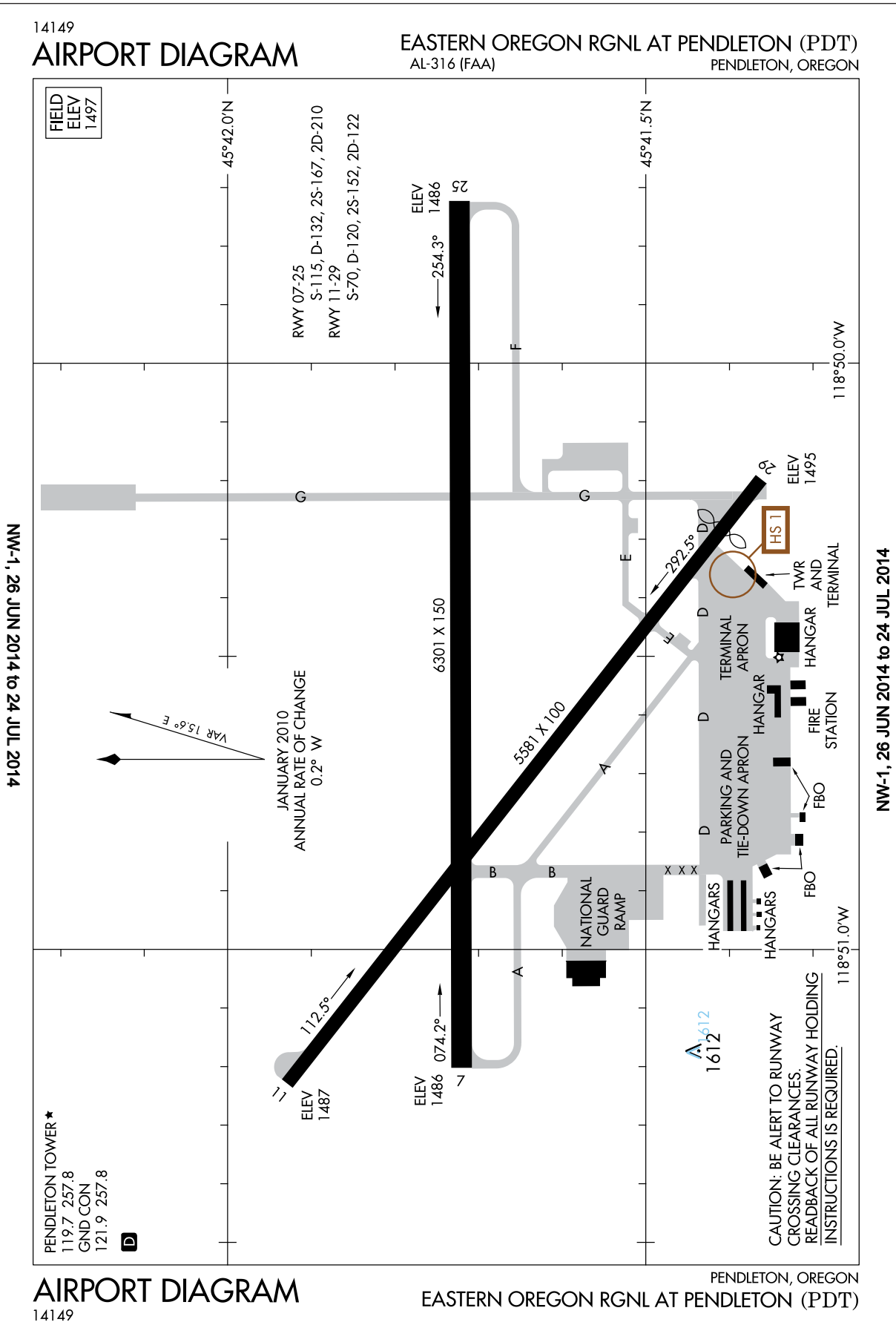
[4] https://www.faa.gov/nextgen/programs/adsb/

UAS Landside Facility Requirements

Current and future UAS infrastructure support requirements are captured in the EORA's Phase I, II, and III plans for the Pendleton UAS Range. Phase I is complete, while Phase II and III development will be implemented upon customer demand. The UAS industry is still an evolving market so plans include maximum flexibility, accommodating both manned and unmanned aviation industries until the UAS market becomes more established and self-sustaining.

Infrastructure:

The available EORA paved surfaces include: UAS Strip 16/34 (currently Taxiway Golf): 60' x 4,300', Runway 7/25 (Main): 150' x 6,301', and Runway 11/29: 11' x 5,581'. The Class Delta airspace is managed by a UAS experienced ATCT that coordinates closely with both PUR and the established Army National Guard UAS unit operating the Shadow (RQ-7) safely and routinely. The experienced range management team onsite at the PUR is led by a team of expert industry professionals across manned, unmanned, and FAA backgrounds that ensure operations are conducted in a safe and cost-effective manner. **Figure 4-12** shows the airport diagram at Eastern Oregon Regional Airport.



KPDT AIRPORT DIAGRAM
FIGURE 4.12

EASTERN OREGON REGIONAL AIRPORT
AIRPORT MASTER PLAN

CENTURY WEST ENGINEERING

Phase I:

The airport provides a 2,800-foot UAS dedicated strip and a full-service UAS operating area with available fiber connections. The EORA maintains a dedicated UAS Operations Area with 15, 50'x50' work areas (UAS Pads) adjacent to the dedicated, paved UAS strip. These customer work areas were designed to accommodate UAS trailers, MOCs, crew operations, etc. and wired for 240v, 50amp and 120v, 30amp electrical outlets as well a water hookups. Secure Fiber Gigabit hardline access with 100mbps standard speed is also provided. This can be upgraded to full Gigabit speeds that tie into one of the fastest data pipelines in the State of Oregon, allowing for real-time cloud-based data uploads and computing.

Phase I build out in support of the Pendleton UAS Range includes some infrastructure and equipment specific to the needs of unmanned aircraft (i.e. UAs launch/recover pads), but the majority of plans accommodate the needs of both manned and unmanned aircraft. This will maximize infrastructure support at the airport while the UAS market continues to evolve (growth dependent heavily on FAA regulation development).

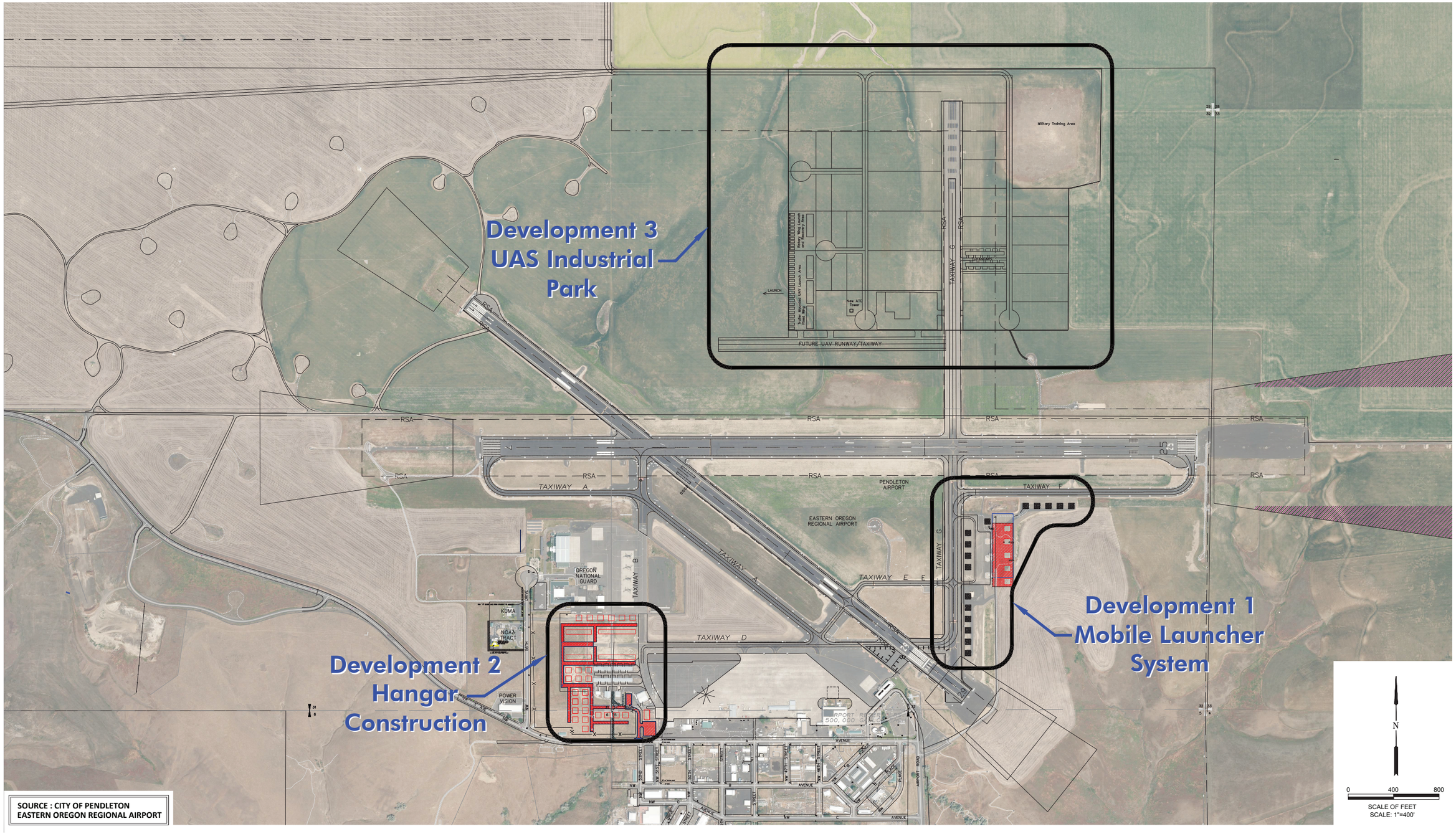
Phase II:

Phase II includes hangar construction on the southwest corner of the airfield, near the existing T-hangars. This hangar is nearing completion and is scheduled to be occupied by a group 5 UAS starting in 2Q2017.

Phase III:

Phase III addresses long-term development needs for UAS facilities. This includes an industrial park area with vehicle access from the west; adequate space for construction of a new UAS hangars and buildings; and construction of a new UAS launch and recovery runway.

Figure 4-13 is the Pendleton UAS Range Phase I, II, and III.



SOURCE : CITY OF PENDLETON
EASTERN OREGON REGIONAL AIRPORT

UAS DEVELOPMENT PHASES
FIGURE 4.13

EASTERN OREGON REGIONAL AIRPORT
AIRPORT MASTER PLAN

CENTURY WEST ENGINEERING