

*Incident Awareness &  
Assessment (IAA)  
Capabilities for  
Wildland Fire, All-  
Hazard and Natural  
Resource Management*

**Interagency  
Requester /  
End User  
Program  
Guide**

**March 2024**

# I. Introduction

## **Background**

For 50 years the wildland fire community has used infrared (IR) imaging to map wildland fires. Agency aircraft equipped with IR sensors under the US Forest Service's (USFS) National Infrared Operations (NIROPS) Program have been the mainstay collection platforms for over 40 of those years. In the last 10 years, additional fire imaging technology and capabilities have become available to the wildland fire community, much of it stemming from the US Government, both civil and defense, as well as private industry. The following is a brief timeline of IR capabilities used to support wildland fire operations:

- 1969 – the USFS began to use IR sensors on manned aircraft, which later became NIROPS
- Mid-1990's – National system collection platforms became available as surge capacity for NIROPS
- Early 2000's – NASA earth observation satellites Aqua and Terra became available with the Moderate Resolution Imaging Spectroradiometer (MODIS) active fire detection system
- 2003 – The USFS introduced the Firewatch Cobra Helicopter Program equipped with electrooptical (EO) and infrared (IR) sensors coupled with data transfer technology
- Mid-2000's – First attempts at using National Guard uncrewed aerial vehicle (UAV) on wildfires for information gathering
- 2012 – The Suomi National Polar-orbiting Partnership (NPP) and NOAA-20 satellites became available featuring the Visible Infrared Imaging Radiometer Suite (VIIRS)
- 2012 – The USFS introduced the Enterprise Geospatial Portal (EGP) as a dashboard display for fire information gathered from various data sources, including satellite collections
- 2013 – The USFS introduced the NightWatch program equipped with EO/IR sensors
- 2014 – The Colorado State's Division of Fire Prevention and Control (DFPC) introduced their Multi-Mission Aircraft (MMA) program equipped with EO/IR sensors along with data transmission capabilities
- 2015 – A Memorandum of Understanding between the USFS and Department of Defense (DOD) allowed use of Air National Guard Distributed Real Time Infrared (DRTI) aircraft with data streaming capabilities
- 2015 to 2017 – The USFS contracted with private sector vendors to provide aircraft equipped with MX15 and Wide-Area Motion Imagery EO/IR sensors for the Aerial Firefighting Use and Effectiveness Study
- 2018 – The Bureau of Land Management (BLM) hosted the first contracts for large Uncrewed Aircraft Systems (UAS) equipped with EO/IR and downlink capabilities
- 2019 – FireGuard began operating in support of wildfire detection and monitoring with includes two teams of Air Force and Army National Guard intelligence analysts
- 2019 – The USFS contracted additional aircraft with IR sensors to provide surge capacity for NIROPS
- 2020 and 2021 – The USFS continued expanding use of contract aircraft to provide IR imaging
- 2022 – USFS and interagency partners developed a new IAA hub with an AGOL ordering/status system-
- 2022 – USFS embarked on a drafting a Light Fixed-Wing (LFW) Multiple Award Task Order Contract (MATOC) for all enhanced IR capable platforms and un-enhanced aircraft for 10-year contracts.
- 2023 – USFS and interagency partners and cooperators (DOI-BIA, CAL FIRE, CO-DFPC, OR-ODF, and WA-DNR) worked to further standardize Incident Awareness & Assessment (IAA) ordering, product dissemination, training, terminology, and improved interagency cooperation of aerial assets and product dissemination.

The wildland fire community, with input from the USFS remote sensing program, other Federal and State agencies, and private industry, has been continuously evaluating how best to use airborne, ground-based

camera systems, and space-based platforms to gather intelligence and integrate IR data into fire operations. The end goal is to improve situational awareness and support strategic and tactical decision makers.

#### **A. Incident Awareness and Assessment (IAA) Defined:**

IAA is timely and usable information to all levels of command including local, State, Civil, and Federal leaders to save lives, reduce human suffering, and protect property. This information provides critical situational awareness for fireline personnel, Incident Management Teams (IMTs), fire managers, and Agency Administrators to both expedite initial attack and inform strategic and tactical decisions. IAA platforms include daytime airborne sensors on crewed and uncrewed aircraft, satellites, night-time infrared (NIROPS), and ground-based camera systems. Capabilities include but are not limited to electro-optical (EO-color) and infrared (IR) geo-referenced Tiff image files (snapshots) and full motion video (FMV) products, as well as near real-time perimeter maps available in various file formats.

IAA systems and platforms intended for wildland fire operations are evolving and currently range from small hand-held devices to sensors of various sizes on crewed and uncrewed aircraft and satellites. All Hazard Risk responders and Forest Health programs may also leverage these data collection systems for other incident/project missions.

Field-user imagery demands are increasing, especially as end-users realize the potential applications and integrate IAA data into operational planning cycles. However, this is evolving technology, and future innovation and fire-imaging use requires clearly defined operational objectives and requirements.

#### **B. Aerial Fire Imaging Technologies**

Aircraft equipped with IR systems can be loosely divided into three broad categories: Electro-Optical/Infrared (EO/IR) camera ball systems; EO/IR Line Scanner/Step-stare camera systems equipped with multi-spectral arrays including thermal bands; and EO/IR Wide-Area Motion Imagery (WAMI), which produce imagery from one or more-megapixel cameras and utilize an algorithm to stitch the geo-referenced images together into a complete picture.

##### **1. Electro-Optical/Infrared (EO/IR) Camera Ball Systems:**

Systems that incorporate a high resolution EO/IR camera array mounted in a steerable gimbal mounted turret are commonly used for IAA missions. The combination of EO and IR cameras allow the operator to switch back and forth between visual light and IR modes to identify and distinguish targets on the ground. Gimbal functions include pan, tilt, and zoom capabilities. EO/IR camera balls are typically mounted beneath the aircraft and can be aimed by the operator in any downward direction regardless of direction of flight and can retain focus on a specific point with cursor on target tools as the aircraft continues flight.

Capabilities of EO/IR camera systems vary by the manufacturer and model. Mid-wave IR (MWIR) and/or Long-wave IR (LWIR) are the most used bands for wildland fire operations to capture high-resolution thermal imagery; although, Short-wave, reflective IR (SWIR), can also be used and offers some advantages. Some camera systems may be cooled and can filter out extraneous heat signatures, which improve the imaging and detection capabilities. When EO/IR cameras are paired with mapping and navigation software, these systems can provide highly accurate map products showing location of active heat perimeters, spot fires, new starts, and sensor operators can generate KMZ, KML, and/or GIS shapefiles based on the end-users' needs.

EO/IR camera ball systems can be flown at varying altitudes ranging from low levels to 20,000+ feet above ground level (AGL). The acquisition altitude is typically governed by the need to avoid conflict with tactical aircraft operating in the incident's Fire Traffic Area (FTA), but it also a tradeoff between gaining a wider perspective and gaining better ground resolution/detection capabilities.

Due to higher resolutions, EO/IR camera ball systems are very effective tools for providing overwatch for specific areas of interest (AOIs) on a wildland fire, detecting spot fires or new fires, providing support for ground operations (e.g., ignition operations or line construction), monitoring impingement of trigger points, and identifying isolated heat along or near the fireline (residual heat during the monitoring or mop-up phases). Most cooled EO/IR camera systems have the sensitivity to detect body heat and can be used to spot individuals or animals on the ground. Aircraft with EO/IR camera ball systems can be used to map fires; however, due to the narrower field of view, it generally takes longer to map a fire than other systems, such as Line Scanner/Step-Stare camera system or WAMI (see below).

## **2. Electro-Optical/Infrared (EO/IR) Line Scanner / Step-Stare Camera Systems:**

Line scanners are downward looking camera systems that employ a step-stare technique, optimized to rapidly acquire imagery over a large area. Unlike a camera ball system that uses 'cursor-on-target' (COT) techniques, line scanners and step-stare systems capture imagery in a swath to either side of the aircraft, resulting in a wide field of view. After each pass, the software compiles an image mosaic showing areas of heat detection along the flight path. The combined imagery is then processed into map products showing a perimeter and classified areas including intense, scattered, and isolated heat, as well as burned (previously) and unburned areas.

Capabilities of these systems vary by the manufacturer and model used. Some systems consist of a multi-spectral array of EO, Short-Wave IR (SWIR), MWIR, LWIR, and Near IR (NIR) bands to generate an image mosaic. Other systems just use LWIR and NIR. Highly accurate map products may be constructed when combined with navigation and mapping software for use by fire managers.

USFS NIROPS aircraft line scanners use rotating mirrors to reflect thermal IR to the MWIR-LWIR scan head in a wide swath on either side of the flight path. The successive lines are compiled into high-resolution imagery showing heat detection, from which highly accurate map products are produced.

Aircraft equipped with these sensors typically fly a series of passes over the fire, like mowing a lawn. The field of view of each pass is dependent on the altitude, which in turn is determined by the sensitivity of the sensors and the capabilities of the host aircraft. For optimum coverage, aircraft equipped with step-stare or line scanners will typically conduct missions from 10,000 to 18,000 AGL, well above the Temporary Flight Restriction (TFR).

The advantage to these systems is their high scan volume (acres per hour), often up to 400,000 acres per hour, although this is dependent on the altitude and speed of the host aircraft. Even on the low end, these scan volumes are significantly higher than an aircraft equipped with an EO/IR camera ball. As a result, these systems are better suited for mapping large fires in a short amount of time. Depending on the speed and range of the host aircraft, they can map numerous large fires spread over one or more geographic area coordination centers (GACCs) in a single flight.

### **3. Electro-Optical/Infrared (EO/IR) Wide-Area Motion Imagery (WAMI):**

Wide-area motion imagery (WAMI) is an approach to intelligence-gathering that employs specialized software and a powerful camera system—usually airborne, and for extended periods of time—to detect activity over a large area, miles in diameter. A WAMI sensor images the entirety of its coverage area in real time. It also records and archives that imagery in a database for real-time and forensic analysis. WAMI operators can use this live and recorded imagery to spot activity otherwise missed by standard video cameras with narrower fields of view, analyze these activities in context, distinguish threats from normal patterns of behavior, and perform the work of a larger force. The WAMI sensors are fixed and mounted below an aircraft or on a wing. WAMI cameras are also known by other names such as Wide-Area Persistent Surveillance (WASP), Large-Volume Streaming Data (LVSD), Persistent Wide-Area Surveillance (PWAS), and others.

The typical WAMI sensor produces imagery at an update rate of 1 Hz or faster from one or more multiple megapixel cameras. The system then seamlessly stitches together the collected images and applies algorithms to geo-register them. This ensures the sensor picture represents ground truth. The update or refresh rate determines how disjointed the stream looks when viewed in real-time or near real-time. At a 1 Hz refresh rate, the stitched together imagery appears every second. The higher the refresh rate, the smoother the imagery transitions between stitched together images. As a comparison, nowadays, televisions have refresh rates of 60 to 120 Hz.

WAMI systems usually have a 0.5-meter ground sample distance (GSD)—enough to detect and track moving targets throughout the scene. All WAMI is geo-tagged with time, before being stored in an airborne or ground-based database. Users can remotely access this database, and like your home digital video recorder (DVR), they can fast forward or rewind imagery to find specific events or observations. Additionally, WAMI data users can pan, tilt, and zoom within the archived imagery for extremely detailed analysis.

There are currently no WAMI sensors operational in Interagency IAA use. However, WAMI sensors are expected to be integral to the future National Air Tactical Incident Awareness and Assessment (NAT-IAA) mission within the LFW MATOC. The WAMI sensors, identified in the MATOC, will produce 16-bit format imagery with refresh rates varying between 1 to 5 Hz or more and will be capable of identifying and characterizing active fire spread, aerial suppressant/retardant drop footprints, and drop/fire interactions during daytime environmental conditions associated with wildland fire activities. Future NAT-IAA aircraft, equipped with a WAMI, will be able to provide imagery coverage greater than five square miles or 3,200 acres per frame from an altitude of 12,500 ft AGL.

## II. Operational Needs

IR collection platforms available for wildland fire operations are increasing in number and capabilities. Real world operational experiences over the last few years have shown that not all platforms possess the same capabilities, products, or services. Actual practice has shown that certain combinations of platform and sensor(s) are better suited for one mission type, while other combinations may be better suited for another, although some overlap in capabilities exist.

The purpose of this guide is to identify the primary types of IR products and capabilities that are needed to support wildland fire operations, by identifying key differences in technologies, and to help Fire Imaging Program Managers select the best tool for the job, based on end-user requirements.

### **A. Discussion Points**

Demand for IR intelligence to support strategic and tactical operations is growing, as are the different types of IR systems that are becoming available. At current levels, the number of IR collection platforms is still limited. During higher preparedness levels (PL), requests for overhead imagery may exceed collection capacity resulting in the need for prioritization at the GACC and National levels.

Determining the end-user's product requirements should be the first step for fire managers. As the number of options for IR platforms increase, it is important to recognize that some platforms are better suited for a particular mission over others. As such, identifying what the end-user needs, how they intend to use the information, and how often it is needed will ultimately assist with selecting the best tool(s) for the job.

Polling of incident management personnel in late 2017 revealed a preference for GIS-ready map products as opposed to raw imagery, pictures, or full motion video (FMV). While pictures or FMV are useful for ground-tactical purposes, most responses indicated that map products such as KMZ, KML, and GIS shapefiles were in much higher demand and had much more long-term value. Video streaming in the IR spectrum has been successful in locating spot fires, monitoring burn out operations, providing situational awareness of fire activity when obscured by the smoke column or inversions, and has also been used to gauge fire behavior and calibrate fire spread models. However, monitoring live video streaming by ground personnel can be laborious and requires additional personnel and/or proprietary data link equipment, especially in areas of limited or no Wi-Fi or cellular connectivity.

During 2022, NTDP surveyed some IAA end-users, including a high percentage of dispatchers. Most users thought IAA products provided once per day sufficed and most that answered thought IAA products helped fight fire more effectively. Daytime perimeters were most useful, followed by detection location KMLs/KMZs/SHPs, isolated-heat locations, and narrated videos. isolated-heat images and real-time FMV were not listed quite as much, and snapshots were slightly less useful for management decisions. Furthermore, respondents felt that narrated videos were more helpful than unnarrated videos.

### **B. Infrared Missions to support Wildland Fire Operations, All-Risk, and Resource Management**

Program leaders have identified several types of missions/products where IR collection platforms play a key role. These missions/products provide support for wildland fire operations and decision making, all-risk damage inspection, search and rescue, and forest health remote sensing. These missions are described in Figure 1 below.

**Figure 1.** *Incident Awareness & Assessment (IAA) Capabilities for Wildland Fire, All-Hazard and Natural Resource Management Mission Types*

### C. How to order IAA resources to get your products.

The following decision tree can be useful to determine if you should order NIROPS or other IAA Products. If you have a fire, ask yourself these questions. Most answers will take you to IAA products as opposed to NIROPS.

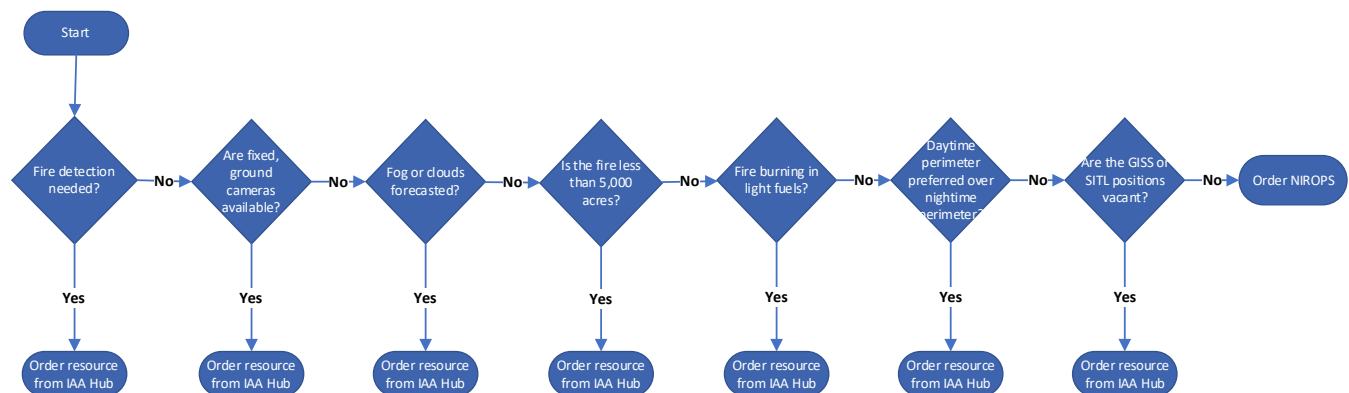
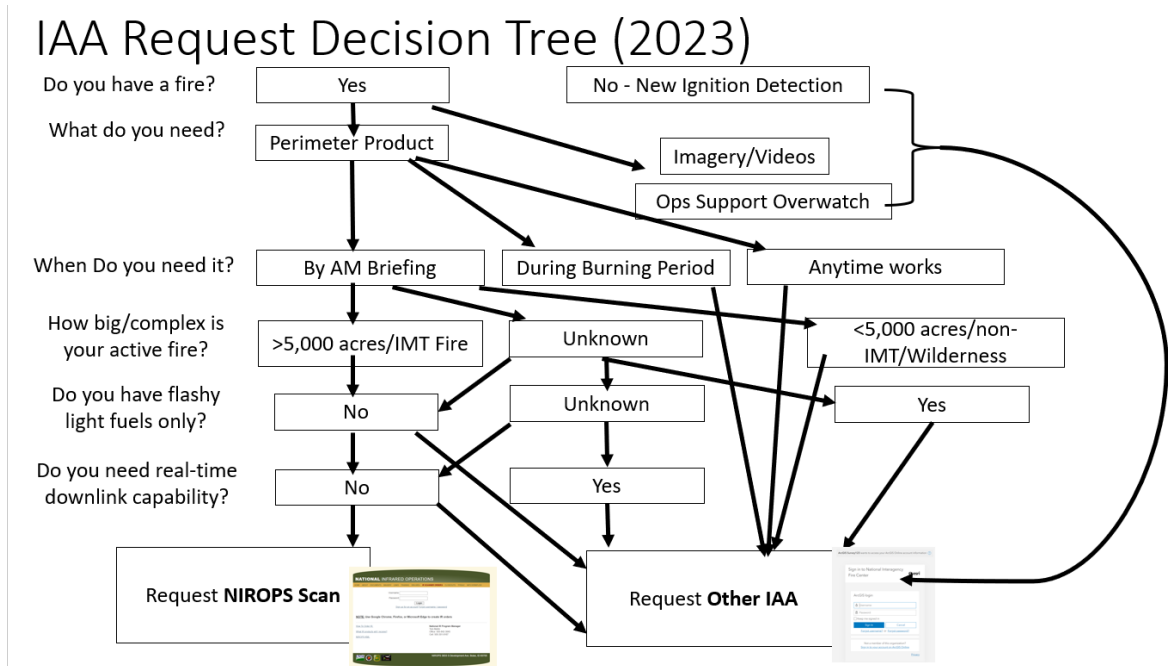


Figure 3. IAA Request Decision tree

To request IAA Support, visit the IAA hub at: <https://iaa-nifc.hub.arcgis.com/> Here you will see abundant IAA information and can select to complete an IAA Mission Request Form: <https://arcg.is/11jDqj0>

IAA Requestors need a [NIFC AGOL](#) account to submit requests to the IAA Hub. If you do not have an account, click on the link to request one. If you have an existing AGOL account other than a NIFC account, an AGOL map service page or bookmark may automatically log you in and your account will not support full IAA Hub functionality.



To make an IAA Hub request, sign in with your NIFC AGOL account on the [IAA Hub home page](#) and select **Request IAA Support**

#### **D. Where Products are Delivered/Viewed**

NIROPS products can be found in the NIFC file Transfer Protocol (FTP) site.

All other IAA products described above can be viewed in EGP and agency specific Common Operational Picture (COP) applications. EGP and most agency specific COPs are interconnected and display IAA data bidirectionally. These include:

- COWIMS (State of Colorado)
- CAL FIRE Tactical Analyst/Wildfire Analyst Enterprise
- NG Scout (CAL OES)
- SOFSA (Oregon Dept. of Forestry)
- Other Agency COPs

## III. Platform Capabilities

The following table summarizes the capabilities of the various Interagency IAA platforms working during 2023, with more detail provided in the appendices below.

**Figure 2.** Existing IR collection platforms comparison of capabilities

<i>Platform</i>	<i>Type of Sensor</i>	<i>IR Capability</i>	<i>Comms</i>	<i>Tactical Downlink</i>	<i>Day or Night</i>	<i>Standard Deliverable</i>	<i>Availability</i>	<i>Best Use</i>	<i>Ordering</i>
<b>FS NIOPS</b>	Line Scanner or Step-stare EO/IR systems	Dual Band IR (MWIR-LWIR), varies by platform	Satcom	No	Night	GIS Ready Shapefiles, KMZ, and PDFMap	National	Mapping multiple large fires across multiple Geo Areas	National Infrared Operations HUB page <a href="https://fsapps.nwcg.gov/nirops">https://fsapps.nwcg.gov/nirops</a>
<b>USFS EU/CWN &amp; Enhanced Platforms</b>	EO/IR Camera Ball	IR, EO, HD. Some Laser Capable	Satcom	Yes, ground resources required	Day or Night	Lat/Long of heat detection points	National	Detection and Operational Support	IAA HUB Page <a href="https://iaa-nifc.hub.arcgis.com/">https://iaa-nifc.hub.arcgis.com/</a>
<b>Federal BIA Enhanced Platforms</b>	EO/IR Camera Ball	IR, EO, HD, Laser	ATG Network /Flight Cell	Late 2023	Day or Night	Georec, Tiff, JPEG, PDF, metadata, video, ts, KMZ, Voice	National	Detection, Mapping, Operational Support, and ATGS	IAA HUB Page <a href="https://iaa-nifc.hub.arcgis.com/">https://iaa-nifc.hub.arcgis.com/</a>
<b>CAL FIRE</b>	EO/IR Camera Ball & Step-stare	HD IR and EO, Laser	Cellular	No	Day	GIS Ready Shapefiles, KMZ, and PDF Map	California	Detection, mapping, and Operational Support	IAA HUB Page <a href="https://iaa-nifc.hub.arcgis.com/">https://iaa-nifc.hub.arcgis.com/</a>
<b>CO-MMA</b>	EO/IR Camera Ball	HD MWIR, SWIR, EO, Laser Pointer	GoGo 3G	No	Day or Night	GIS Ready Shapefiles, KMZ, and PDF Map	Colorado, National Support on Request	Detection, Operational Support, Small Fire Mapping	Within CO - <a href="http://bit.ly/MMARequest">http://bit.ly/MMARequest</a> Outside CO – Call the DFPC Duty Officer @ 720.460.9367
<i>Platform</i>	<i>Type of Sensor</i>	<i>IR Capability</i>	<i>Comms</i>	<i>Tactical Downlink</i>	<i>Day or Night</i>	<i>Standard Deliverable</i>	<i>Availability</i>	<i>Best Use</i>	<i>Ordering</i>

<b>OR-MMA</b>	EO/IR, Camera Ball	EO/IR, SWIR, MWIR, NVG	Radio, Satcom	Starlink to internet	Night primary/Day secondary	KMZ, Geo TIFF, Georeferenc ed ARS Video, Livestream	Oregon- State Protection	Night detection, small-scale mapping/ hotspot detection, operational support	ODF Salem Coordination Center
<b>WA -MMA</b>	EO/IR Camera Ball	EO/IR, SWIR, MWIR	Cellular	Line-Of- Sight	Day	KMZ, Geo TIFF, Georeference d ARS Video	Washington	Detection, IAA, and mapping fires small fires or portions of large fires	TBD

## IV. Appendices IAA Systems

The following appendices identify IAA systems available for wildland fire, All-Risk incidents, and resource management support. The list is not inclusive of all available options, and there are several vendors on various contracts or agreements that may be available to provide similar IAA mission services and products. The IAA systems described in this guide primarily focus on wildland fire or cooperating-agency aircraft systems.

Appendix A: USFS National Infrared Operations (NIROPS)

Appendix B: USFS EU/CWN Enhanced Platforms

Appendix C: BIA EU/CWN Enhanced Platforms

Appendix D: CAL FIRE

Appendix E: Colorado MMA

Appendix F: Oregon MMA

Appendix G: Washington MMA

Appendix H: Ground-based Cameras

Appendix I: FireGuard/Satellites

## **Appendix A: National Infrared Operations (NIROPS) Program**



The National Infrared Operations (NIROPS) is operated by the USFS to provide IR mapping of wildfires across multiple geographic areas. NIROPS provides a once-per-24-hour update of the fire's heat, perimeter, and heat distribution, within the perimeter. NIROPS consists of Agency-owned aircraft, equipped with the Phoenix line-scanner system. Staffed with Agency pilots, IR Technicians, IR Interpreters (IRIN), and National Coordinators (IRCN), the NIROPS program has a workflow that has supported upwards of 49 fires spread across multiple geographic areas in a single night.

To respond to the increasing demand for NIROPS fire mapping service, the USFS is hosting contracts to provide additional surge capacity to the NIROPS program, using vendor-aircraft equipped with commercial IR sensors. Vendors deliver equivalent Agency NIROPS IR map services and products

Agency-aircraft have a scan volume of 300,000 acres per hour. Vendor-aircraft have a scan volume ranging from 100,000 to 400,000 acres per hour, depending on the aircraft/sensor.

### **Deliverables**

- Geo-rectified PDF map showing heat perimeter with areas of intense, scattered, and isolated heat
- KMZ or KML
- GIS ready shapefiles compatible with the GSTOP format
- IR Interpreter's Log
- All map products will be posted to the incident's IR folder on the NIFC-FTP by 0400 hours MDT.

### **Considerations**

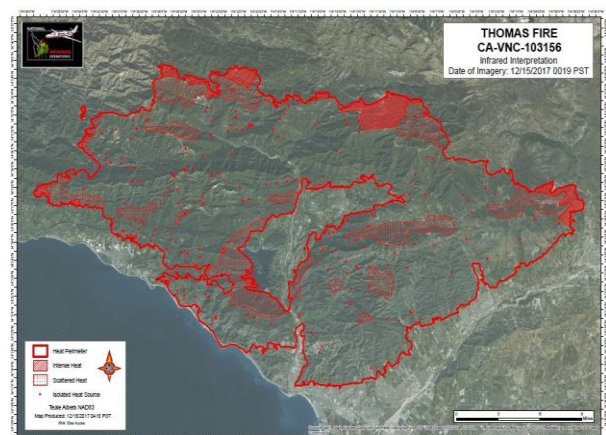
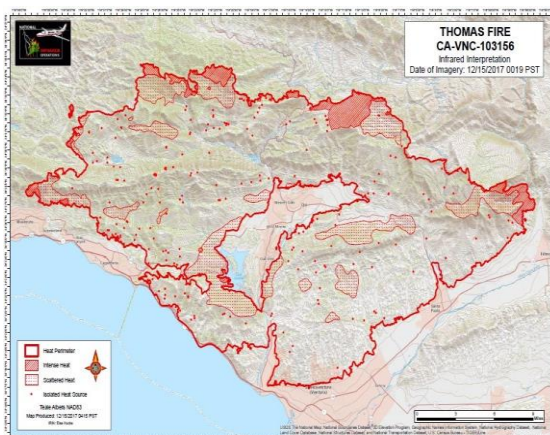
- Aircraft 3/Firehawk is a DoD asset that is available to provide support for incidents that may not be reachable by NIFC aircraft. Ordering and requesting AC3 support is done identically to regular NIROPS requests with the exception being that AC3 orders must be submitted by 0930MST to receive AC3

support that evening. The Firehawk/AC3 product is derived from multiple sources and very similar to regular NIROPS products. The delivered product is Arc shapefile format, WGS84, decimal degree, .pdf map, kmz and readme file. Zach put language about aircraft 3- and time cutoff

- NIROPS aircraft are typically flown at night when there is the greatest temperature contrast between the fire and the ground
- Agency-aircraft equipped with the Phoenix Line Scanner are optimized for nighttime operations
- Vendor-aircraft equipped with EO/IR sensors can provide pre-dusk coverage on a case-by case basis, provided earlier missions do not impede nighttime operations on other fires
- Daytime flights (early evening before sunset) may be more accurate for fires burning in light fuels to map 'cold black' perimeters
- IR sensors can only map the heat they detect. 'Cold black' perimeters (e.g., fires that burned in fine fuels) are difficult to detect and may require assistance from incident SITL or GISS to provide existing perimeter, or request the mission be conducted pre-dusk
- Cloud cover and fog (water vapor) inhibits infrared capability and accuracy
- Cost for IR mapping service varies by aircraft, fire size, and proximity to other fires
- NIROPS aircraft fly above the incident's Temporary Flight Restriction (TFR), at altitudes ranging from 6,000 to 18,000 feet AGL
- If additional IR missions are needed, consider ordering operational support IAA collection platforms for additional daytime products (see Consideration for Use Table in Section IV)

## Ordering

- Requests for NIROPS are to be submitted to the online IR scanner order website
  - (<https://fsapps.nwcg.gov/nirops>) prior to 1530 hours MDT
- Each day the National IR Coordinator will review the number and location of requests and assign the missions to an aircraft to be flown that evening
- During high demand periods, fires may be prioritized based on national and geographic area priorities
- An IR Interpreter (IRIN) will be assigned if the fire is flown by an agency or exclusive use contracted aircraft. Vendors under end product contract will provide interpretation and map products
- A Resource Order with an A-number will be generated in IROC
- Once the fire is assigned to an aircraft, the SITL or GISS will be contacted by the IRIN or vendor's interpreter to work out any additional details or refine the request



## Appendix B – USFS Exclusive Use/Call-When-Needed Platforms:



The Air Attack 51/ Nightwatch 51 platform is unique as it performs day and night missions and is always staffed with a qualified ATGS. This aircraft's capabilities are representative of other available CWN platforms within this category. These platforms are equipped to provide Satcom, detection, perimeter updates, near real-time Full Motion Video (FMV), narrated/unnarrated video, and operational support.

### Deliverables

#### Exclusive Use (EU)

##### Air Attack 51/Nightwatch 51

- Provide operational support to assist ground operations, detect spot fires, and night aerial supervision
- Provide perimeter mapping services for smaller fires, or provide updates for portions of larger fires
- GIS ready shapefiles and KMZ compatible with the GSTOP format
- Products are available in the EGP
- Products can be loaded to the incident's IR folder on the NIFC-FTP site or incident's FireNET drive
- Products, including FMV, can also be provided via thumb-drive
- Able to cover multiple fires within Southern California when not being used as a night Air Attack platform (primary role)

#### Other EU Aircraft



- Reserved

#### CWN Aircraft

- Provide operational support to assist ground operations, detect spot fires, and night aerial supervision
- Provide perimeter mapping services for smaller fires, or provide updates for portions of larger fires
- Available nationally for daytime missions
- GIS ready shapefiles, KMZ, FMV
- Products are available in the EGP
- Able to cover multiple fires within a GACC or nationally depending upon mission request prioritization

#### Near Real Time Awareness

##### Exclusive Use (EU)

##### Air Attack 51/Nightwatch 51

- Information captured by the platform is generally recorded and then processed after landing, which could take up to 3-hrs.
- Inflight tasking can be provided during missions through radio communications . Flight crew will monitor incident frequencies and provide information to ground personnel
- EO camera can take color photos of AOI(s) on the fire during the daylight. These can be recorded and processed in flight or after landing depending on aircraft
- Infrared camera can take snapshots (geo-Tiffs) of AOI(s) on the fire and be displayed the same as EO camera day or night
- Video can be taken from either the EO or IR camera to display continuous views of areas
  - These can be processed either in flight or after landing depending upon aircraft
  - The Air Attack 51/Nightwatch 51 video is narrated by the onboard ATGS

##### Other EU Aircraft

- Reserved

#### CWN Aircraft

- Inflight tasking can be provided during missions through radio communications, flight crew will be monitoring incident frequencies
- Platforms may have capabilities to process data in flight for timely product delivery
- EO camera can take color (EO) photos of AOIs of the fire during daylight operations. These can be recorded and processed in-flight or after landing depending on the aircraft
- IR camera can take snapshots (geo-Tiffs) of AOI(s) of the fire and be displayed in the same format as EO imagery during daytime missions
- Video can be taken from either the EO camera or the Infrared camera to display continuous view of areas
  - These can be processed either in flight or after landing depending upon aircraft
  - Video will be narrated by the qualified flight manager on board the aircraft

## Considerations

### Exclusive Use (EU)

#### Air Attack 51/Nightwatch 51

- Has the ability to fly both day and night. In 2023 the aircraft will be dual staffed for daytime and nighttime operations
- 5-hour flight time endurance
- Designated for use primarily in the Operations Southern California (OSC) GACC
- Typically operates within or above a Temporary Flight Restriction (TFR) and Fire Traffic Area (FTA)

#### Other EU Aircraft

- Reserved

#### CWN Aircraft

- CWN platforms have daytime availability
- 5-hour flight time endurance
- Available nationally depending on the GACC activity where the aircraft is located
- Typically operate above a TFR and FTA

## Ordering

### Exclusive Use (EU)

#### Air Attack 51/Nightwatch 51

- Needs approval of the OSC duty chief for use
  - Requests get sent to Angeles National Forest
- Request Fixed-Wing Air Attack with “Night Air Attack.” In special needs specify intel/aerial supervision or both

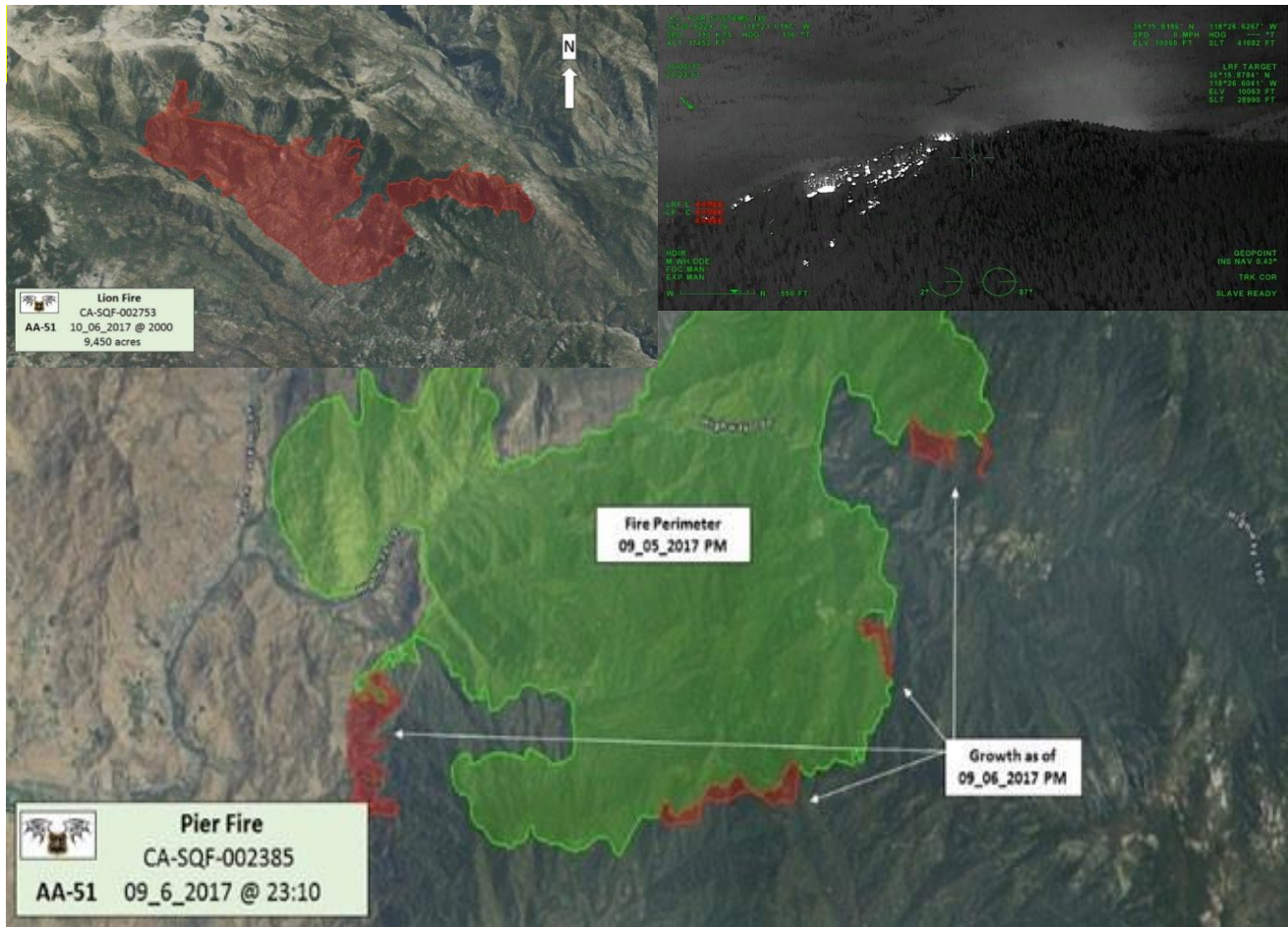
#### Other EU Aircraft

- Reserved

#### CWN Aircraft

- Requested through the IAA HUB website





## **Appendix C: Department of Interior, Bureau of Indian Affairs (BIA)**



The Bureau of Indian Affairs services 2 Enhanced Air Attack Platforms. Both are Pilatus PC-12. Each contract is 150-day Exclusive Use Period extendable to 365 and has 3 designated bases per aircraft at approximately 50 days per location. These aircraft will be capable of both IAA duties and Air Attack operations. While in an Air Attack profile the IAA features of the aircraft will be utilized when applicable. Both aircraft meet type 1 Air Attack radio packages and are trainee capable.

### **Deliverables**

- SWIR/MWIR Imagery
- Fire detection (GIS points) and size-up information
  - o Detection: Initial fire size up, KML/JPEG, exact location
  - o Mapping: Geo-rectified PDF, Shape files, Metadata infused Full motion video
- Operational Support: Ability to see through light smoke/fog, IR, Imagery, A/A and A/G communication, Narrated/Unnarrated Video, Geo Tiff
  - o Sensor Enhanced Air Attack: IR of fire perimeter, Aerial Supervision, ATGS trainer,

### **Near-Real Time Awareness**

- Ground Point of contact to the requester for further clarification.
- Complete GIS layers

- Direct communication with Air Attack onboard
- Ability to see through light smoke and communicate with ground operations

#### **Considerations**

- Can Operate without an Air Attack but will be limited to IAA operations (Rare Occurrence). Products are routed through data specialists which validate data. This process should take less than 60 minutes from data gathered to being available to the end user.

#### **Ordering**

- IAA Hub for mapping and data gathering missions Local Dispatch for Air Attack missions

#### **Additional Information**

- Aircraft Capabilities: 5 ½ hours of flight time with a cruise speed of 290 knots, and range of 750 knm.
- TK-8 capable with advanced notice.
- Dual Crew surge option with advanced notice
- Also capable of Law Enforcement tactical support, resource surveys, and all hazard emergency support.





#### **Appendix D: CAL FIRE Intel 641**

Operated by CAL FIRE is a Beechcraft A200 CT (Super King Air) with an Overwatch TK9 step-stare EO/IR camera and a FLIR 380 HDcX paired with an augmented reality mapping software that is capable of fire detection as well as perimeter mapping.

The missions that CAL FIRE Intel 641 can perform are:

- Perimeter mapping
- Isolated heat detection
- Damage assessment
- Full motion video products
- Fire Detection
- Imagery overlay
- Operational support with voice communication

CAL FIRE Intel 641 is an Agency owned aircraft staffed with Amentum pilots and agency personnel. Based out of Sacramento, CA (MCC), CAL FIRE Intel 641 can respond to incidents primarily within and threatening California. The aircraft is available during daylight hours. Nighttime operations are currently being evaluated for future mission requests.

### **Deliverables**

- Provide operational support to assist ground operations, detect spot fires
- KML/shapefiles of the fire perimeter as well as concentrations of heat or isolated hotspots in GeoOPs format
- GeoPDF of the incident on topo basemap
- High resolution, geo-referenced imagery of the fire
- Products are available in Technosylva's Tactical Analyst and Wildfire Analyst
- Products can be loaded to the incident's IR folder on the NIFC-FTP site or incident's FireNet drive

### **Near-Real Time Awareness**

- Information captured by the platform can be loaded to web service while in flight via cellular
- Inflight tasking can be provided during flight by cellular connection

### **Considerations**

- Can support a single incident or GACC with multiple incidents
- Can be tasked with wide area detection flight following lightning storm
- Can provide Air Attack role if ATGS qualified Mission Sensor Operator (MSO) is on board

### **Ordering**

- Should be ordered for missions via IAA Hub

## **Appendix E: Colorado Multi-Mission Aircraft**

Operated by the Colorado Department of Public Safety Division of Fire Prevention and Control (DFPC) the Colorado Multi-Mission Aircraft (CO-MMA) is a Pilatus PC-12 equipped with a FLIR 380HD EO/IR camera ball and paired with sophisticated mapping software that is capable of fire detection as well as perimeter mapping.

The CO-MMA was designed to perform three primary Incident Awareness and Assessment (IAA) missions:

- Fire Detection
- Tactical Decision Support on initial attack / emerging fires
- Operational Support on large fires



Based within Colorado, one of the PC-12s is often available to respond to fires in other geographic areas at the request from the NICC or on a state-to-state request. While not a direct replacement for NIROPS, the CO-MMA is capable of mapping fire perimeters at a lower acres/hour rate and provides shapefiles or KMLs of the fire perimeter.

### **Deliverables**

- GeoPDF map of the incident on a base map (topo)
- KML/shapefiles of the fire perimeter as well as concentrations of heat or isolated hotspots
- Ortho-imagery of the fire perimeter
- Identification and mapping of structures and other public safety points
- Video clips to provide situational awareness
- Fire detection (GIS points) and size-up information
- Can map entire perimeter of small fires, or provide perimeter updates of large fires
- Perimeter updates can be viewed near-real time in either the CO-WIMS or EGP websites

### **Near-Real Time Awareness**

- Information captured by the platform can be loaded to web service while in flight by 3G cellular connection
- Inflight tasking can be provided during flight by email or chat
- EO and IR cameras can take video and photos of areas of interest on the fire
- Provide over watch of areas of interest in support of ground operations, and provide voice updates by radio, data if recipient has cellular service for email

### **Considerations**

- Capable of flying day or night missions
- Can support a single incident or GACC with multiple incidents

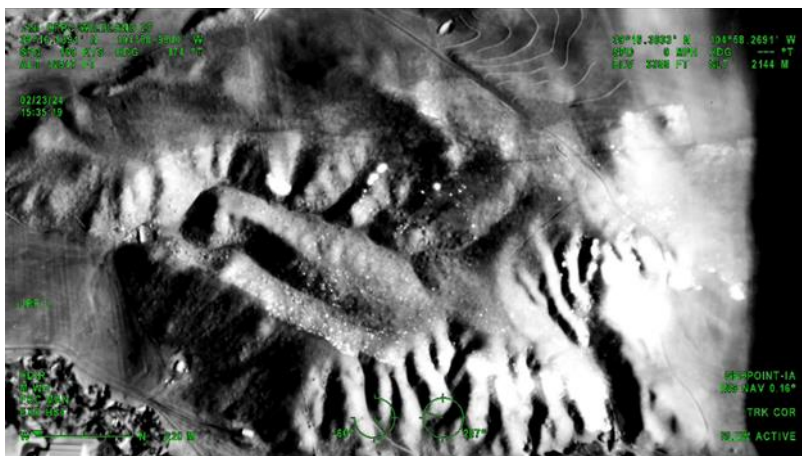
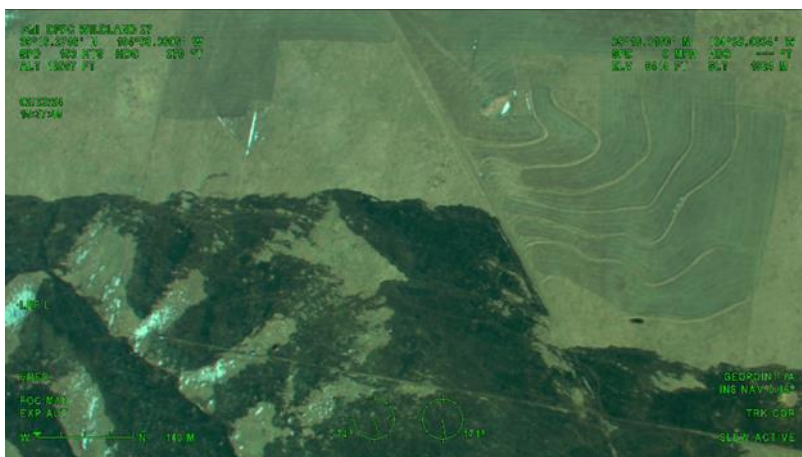
- Can be tasked with wide area detection flight following lightning storm
- Can provide periodic IAA support to multiple large wildfires, number of fires dependent on how far apart they are
- Can provide Air Attack role if ATGS qualified Mission Sensor Operator (MSO) is on board
- Fully carded for recon, air attack, and IR missions

### Ordering

- Contact GACC if incident is outside of the Rocky Mountain Area (RMA) GACC
- Order through IROC ordering system as "Fixed Wing -Infrared"
- Coordinate with the incident if assigned directly, or order recommend person to be supported out of the GACC

### Additional Information

- <https://www.colorado.gov/pacific/dfpc/multi-mission-aircraft-mma>



## Appendix F: Oregon MMA

Operated by the Oregon Department of Forestry (ODF) the ODF Multi-Mission Aircraft (OR-MMA) is a Partenavia P-68 Observer equipped with a FLIR 380 HDC EO/MWIR/SWIR camera ball paired with night-vision goggles (NVGs) and an NVG-compatible laser pointer. Sensor information is routed through a Churchill/Shotover augmented-reality system (ARS) to view spatial awareness and produce enhanced products. Product upload, streaming video, and communications via Starlink satcom.



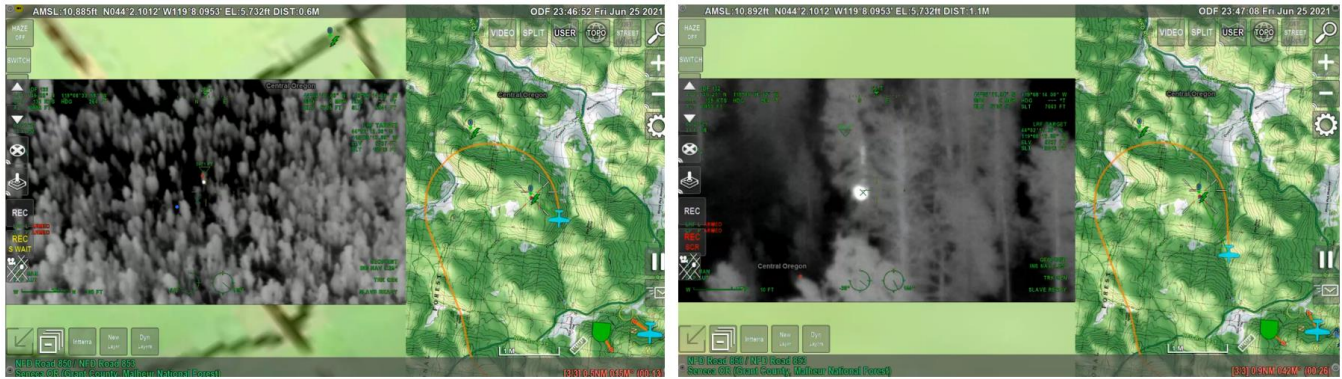
The OR-MMA excels at nocturnal fire-detection missions and is also capable of small-scale fire mapping and operational support missions.

The OR-MMA downloads lightning strike and other known fire data into ARS and can detect new fire starts as small as 3'x3' in ideal conditions. Operations are usually conducted at 10,000 – 11,000' MSL and can operate for 4-6 hours per night. New fire locations, fire size-up reports, updated fire perimeters, isolated heat sources, other vector data, georeferenced images, and full or split-screen ARS videos are uploaded in flight to the ODF SOFSA (Intterra) dashboard for viewing and downloading.

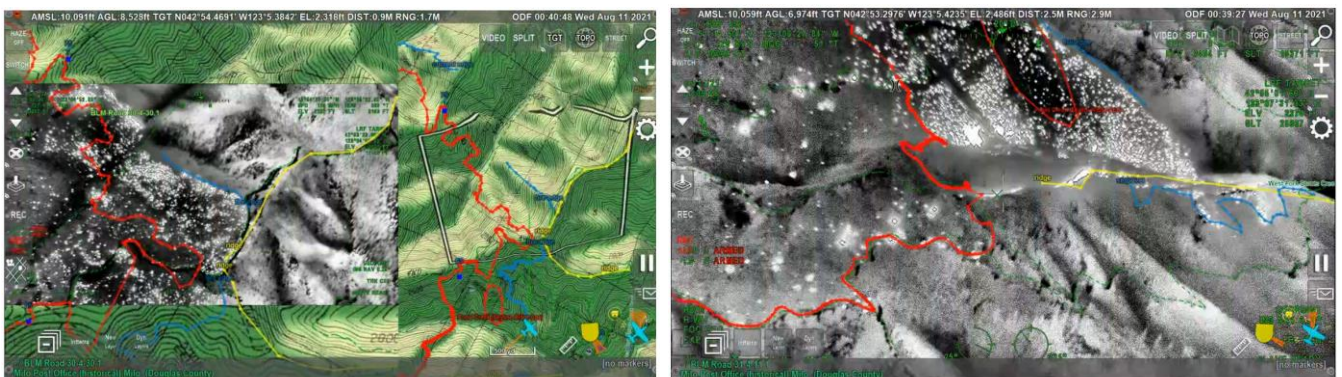
### Deliverables

- KMZ files of:
  - new fire locations,
  - perimeters,
  - flight paths, and
  - other vector data
- Georeferenced: videos (full or split-screen ARS), images, new fire size-up reports
- Images & videos available in EO (visible light), Mid-wave Infrared (heat), and/or Short-wave Infrared (super-visible light)
- Videos can show full or split-screen map and all ground features in ARS (perimeters, division breaks, drop points, roads, streams, lightning, etc.) for situational awareness





**Zoomed Out – Lightning fire up in a tree. – Zoomed In**



**Mapping updated fire perimeter & hot spots.**

**Operational mission: burnout support & mapping.**

### Considerations

- Staffed primarily for night missions but can fly day missions if available
- Currently available for ODF & possibly other state agency missions, depending on restrictions
- Products appear in OR SOFSA (Intterra) and IAA FS EGP
- May be limited by weather/terrain/TFR altitude requirements

### Ordering

- Order through local dispatch, generate TARO if existing incident
- Local dispatch coordinates with ODF Salem Coordination Center (SCC)
- Order through IROC as a “Service – Infrared Flight”
- Fill out the Mission Survey on AGOL
- Provide one point of contact in the Mission Survey for mission coordination

### Additional Information

- [Sarah.b.prout@odf.oregon.gov](mailto:Sarah.b.prout@odf.oregon.gov)
- [cole.c.lindsay@odf.oregon.gov](mailto:cole.c.lindsay@odf.oregon.gov)
- <https://www.youtube.com/watch?v=xkGhCIZZ6ys>

## Appendix G: Washington MMA



Washington Department of Natural Resources, Wildland Fire Management Division (WA DNR) operates two(2) Daher, Kodiak 100 Multi-Mission Aircraft (WA-MMA). Both aircraft are equipped to perform identical mission sets including detection/reconnaissance, fire mapping, operational decision-making support to ground fire fighters, and Enhanced Air Attack among others. Washington MMAs are equipped with the FLIR 380 HDc plus X upgrade on a retractable mount. The gimble is equipped with the following payloads: HDEO/HDLL/MWIR/SWIR along with a laser range finder and laser pointer. Sensor information is routed through the Shotover augmented-reality system (ARS) to view and produce a multitude of enhanced map products. WA-MMA has direct downlink capabilities via the Skylink Airborne Mini2 and additionally is able to send products using two different cell network cards within the system.

Additionally, WA-MMA has a 3 x 3 radio package (AM/FM), and aircraft WiFi bubble, allowing it to be used as an ATGS platform. Operations are usually conducted between 4000' and 11,000 MSL depending on mission set. Future upgrades include LiDAR, TK8 and Starlink capabilities.

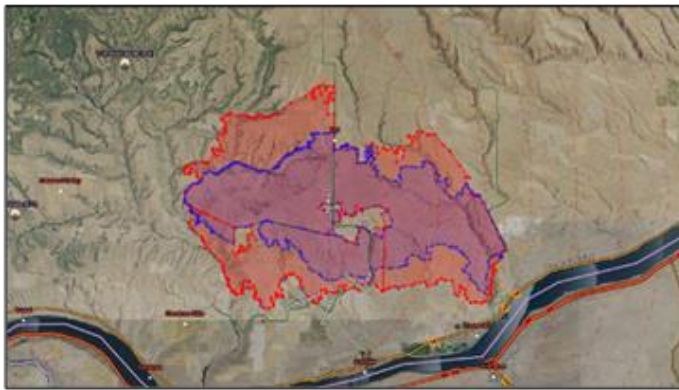


### Deliverables

- Geo-rectified PDF map of the incident on a base map
- KML/shapefiles of the fire perimeter as well as concentrations of heat or isolated hotspots
- Ortho-imagery of the fire perimeter
- Identification and mapping of structures and other public safety points
- Video clips to provide situational awareness (narration available if desired)
- Fire detection and size-up information
- Perimeter mapping and perimeter updates (new growth) of fires

### Example Products (not all inclusive)

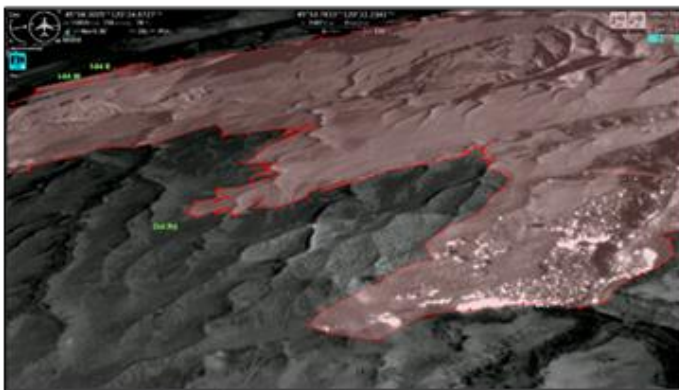




Fire Perimeter overlay with daily growth



Day HDEO video



Fire Perimeter overlayed on FLIR image



Hot Spot Detection

- Near-Real Time Awareness Products, images and video clips collected can be transferred in flight to Intterra or emailed to individuals through two (2) 4G cellular providers (if cellular connection is available)
- Realtime line-of-sight video can be provided to ground units via the Skylink Airborne Minilink2's direct link to provided mobile ground receive station (helibase kit/IMT) or MobilCMDR HD tablet (IC awareness).
- Inflight re-tasking can be provided during flight by dispatch, email or text
- Provide over watch of areas of interest in support of ground operations, and provide voice updates by radio, data if recipient has cellular service for email

### Considerations

- Current Federally Approved Cooperator letter
- Staffed during daylight hours. Night missions are available with 24-hour prior coordination and approval
- Currently available without restriction for Washington State and bordering states with reciprocal agreements.
- Products will populate to Intterra Air Intel tool and IAA FS EGP unless otherwise specified in request.

### Ordering

- Outside agencies order through normal IROC procedures through to WAWAC (Attention ADO)

- WA DNR order through local dispatch and generate TARO
- Direct coordination with Aircraft Duty Officer (ADO) for tasking available
- Order through IROC as a “Fixed Wing-Infrared”
- Provide one point of contact in the Mission Survey for mission coordination

#### **Additional Information**

- Ordering email:
  - [dnrdldispatchnrb@dnr.wa.gov](mailto:dnrdldispatchnrb@dnr.wa.gov)
  - [dnrrewdaviation@dnr.wa.gov](mailto:dnrrewdaviation@dnr.wa.gov)
- MMA info email:
  - [dave.ritchie@dnr.wa.gov](mailto:dave.ritchie@dnr.wa.gov)
  - [rich.knoth@dnr.wa.gov](mailto:rich.knoth@dnr.wa.gov)

#### **Appendix H: Ground-based Cameras**

Reserved

#### **Deliverable**

- Reserved

#### **Near-Real Time Awareness**

- Reserved

#### **Considerations**

- Reserved

### **Ordering**

- Reserved

### **Additional Information**

- Reserved

## **Appendix I: FireGuard/Satellites**

The FireGuard program provides 24/7 wildfire detection and monitoring for the entire US and is operated by the USFS National Interagency Fire Center (NIFC) and the National Guard. This program relies on a process called Firefly to provide FireGuard analysts with a set of wildfire monitoring capabilities from multiple data sources. CA and CO National Guard units and State and Federal analysts' staff and support the program. FireGuard Firefly data has three main use-cases, which include detection, verification, and clarification.

### **Deliverable**

- Additional fire data layer for fire managers and firefighters
- Provides additional capability for persistent monitoring and verification of new fire starts

- Analysts provide detection, emerging, and large fire updates via NIFC-managed ArcGIS Online Dashboard, Web App, and the Enterprise Geo-Spatial Portal (EGP)

### **Near-Real Time Awareness**

- FireGuard Firefly is a national capability that provides near real-time information from multiple sources on suspected wildfires to National Guard units. National Guard and State analysts assess the information and provide the location/shape of probable fires and hot areas to local and state wildfire agencies in coordination with regional GACCs
- For existing fires, FireGuard offers updates in approximately 10-minute intervals on areas of fire growth and activity (due to level of accuracy concerns, this should not be used for creating perimeters)

### **Considerations**

- FireGuard Firefly provides the location and general size of the fire but does not provide other products like detailed maps, imagery, video, or operational support
- FireGuard can be of great benefit for reporting on the most active portions of wildfires encroaching on or within the WUI, especially in the initial phases

### **Ordering**

- FireGuard products are ordered through the IAA Hub
  - <https://survey123.arcgis.com/share/b002660b503e47d59c7190c07d55a706>
- The data will be available on the NIFC org (<https://arcg.is/1PbfHT>) or through a Dashboard available on the NIFC Hub (<https://iaa-nifc.hub.arcgis.com/>) and EGP. The polygons associated with new detections are viewable on the Situation Analyst in the Intelligence and Resources (IR) view state

### **Additional Information**

- FireGuard Firefly does have limitations. There are risks of false positive reports and missed detections
- California and Colorado host teams that support FireGuard, based on their experience with programs within their states.
- The national effort complements and works cooperatively with these State programs. There may be differences in notifications and data dissemination between the two Guard state units, but the data (spatial polygons) being produced are the same across the country

