City of Coral Gables Drone Use Cases

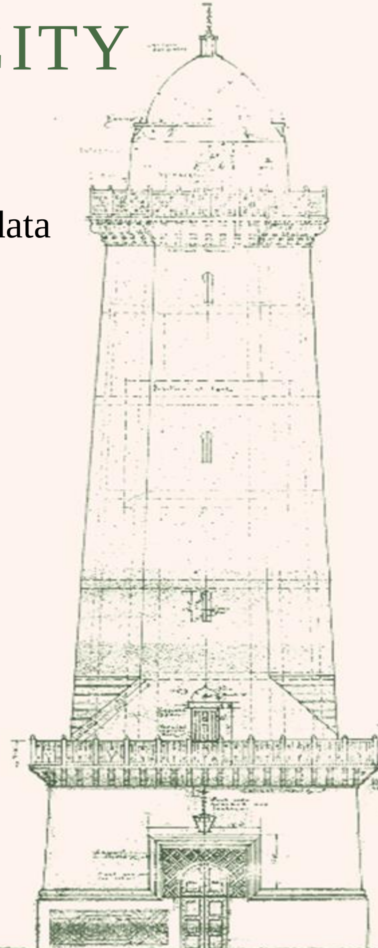
Public Safety,
Government Services, Research,
Smart City Programs

Raimundo Rodulfo, CIO
Alex Gamundi, Sr. IT Analyst

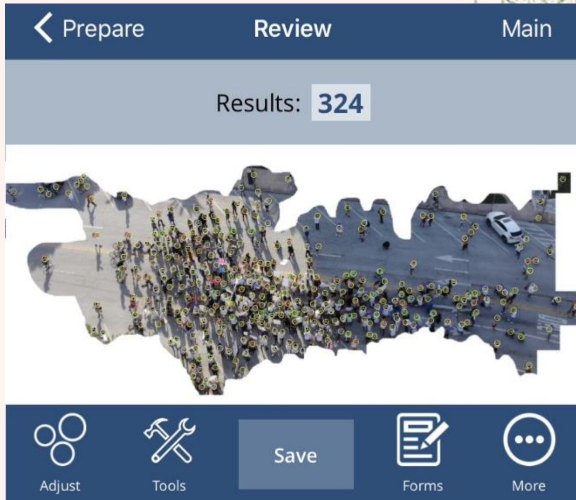
Coral Gables®
The City Beautiful

Coral Gables - Smart City
Drone Use Cases

1. Combined use case with crowd analysis, IoT, AI/ML, computer vision and data analytics.
2. Drone delivery.
3. Live video broadcasting; with autonomous routes; with cellular or satellite communications.
4. Public safety operations.
5. Fire accreditation.
6. Hurricane rescue recon.
7. Outdoor Covid-19 testing sites planning and monitoring.
8. Building rooftop water damage assessment.
9. Tower / antennae inspections.
10. LiDAR GIS 3D modeling in collaboration with universities and GIS / aerial photography.
11. Video analytics.
12. Our Communications / Public Affairs team also uses two drones with video for media production and creation.

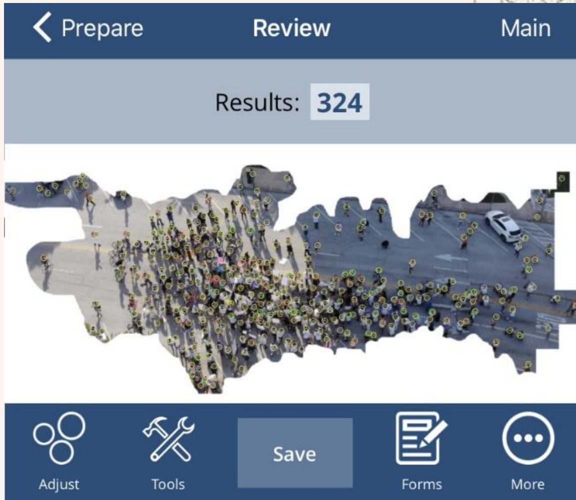


Smart city use case of drones, IoT, and A.I. in the ICP



- Crowd Analysis
- IoT Sensor Data
- Artificial Intelligence / Machine Learning
- Computer Vision
- Data Analytics

SMART CITY USE CASE OF DRONES, IoT, AND A.I. IN THE ICP

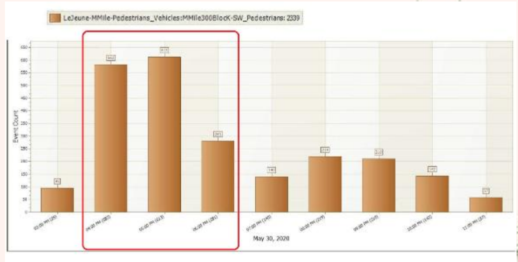


Crowd and Traffic Correlation Analysis:

- 1.1- Jacobs Method: produces a range of ~250-400 people (quick/approx.)
- 1.2- Computer vision AI analytics on drone footage: 324 ppl. Acc. of algorithm: ~ 90%
- 2.1- IOT traffic data analysis from the smart city hub CPS platform using optical sensors, edge analytics + cloud analytics
- 2.2- RF sensor behavioral data analytics from the smart Wi-Fi mesh network
- Correlation Analysis between 1.2, 2.1, 2.2 – Technology Sensing/Data Validation

SMART CITY USE CASE OF DRONES, IOT, AND A.I. IN THE ICP

2.1. IOT traffic data analysis:



- Using IOT traffic data from the smart city hub CPS platform (optical sensor + edge analytics + cloud analytics): it measured ~ 600 people avg. per hour during the event peak and ~350 during the last 90 minutes of the event.

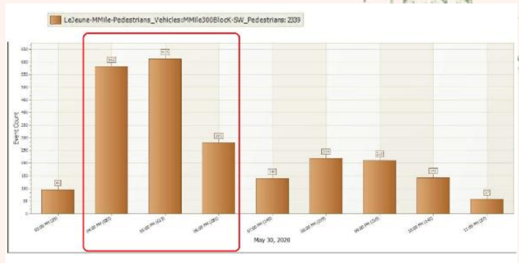
- Total ~1550 during the event. In a closed system, visitors are calculated as 1/2 of foot traffic, which would produce a visitor flow of ~ 290 people, ~ 310 people, ~140 and ~35 per the charts shown.

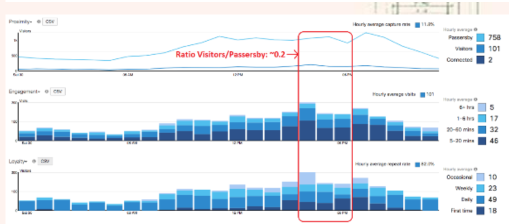
- In an open system with reentry, passersby and unaccounted residents, it is expected an even smaller ratio of visitors/passersby.

Smart city use case of drones, IoT, and A.I. in the ICP

2.2. IOT traffic data analysis:

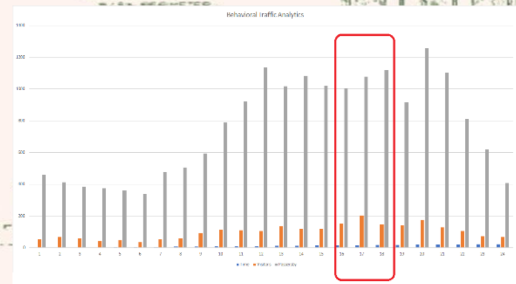
- Method 2 - Using RF sensor behavioral data analytics from the smart Wi-Fi system on Miracle Mile adjacent block: It measured a visitors / passersby ratio of approximately 0.2 (1/5) and ~150-200 visitors each hour between 4-7pm, which is consistent with the IOT sensor data





Correlation Results:

- Applying the behavioral ratio measured on Section 2.2 to the IOT foot traffic data from Section 2.1: 1550 * 0.2 = 310, very close to the 324 value measured before in 1.2.



Drone Delivery

- Currently testing payload & delivery mechanisms and loads / applications

- Handheld Radios
- SWAT / Hostage Response Equipment
- Small inflatable floatation devices
- Medications

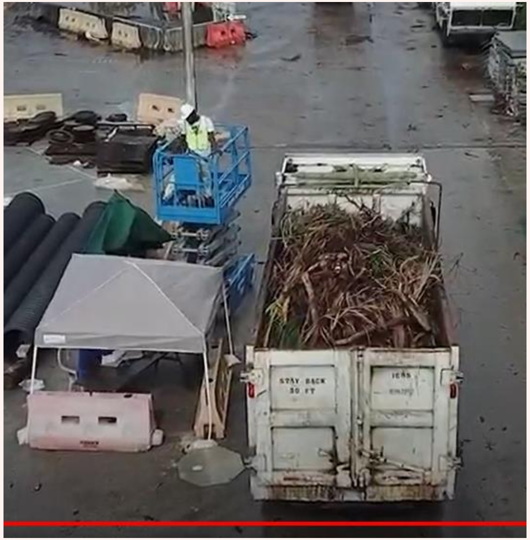
Live Video Feeds

- Drone feeds through RTMP servers
- Broadcast to any compatible HTTPS browser
- Increased situational awareness to Central Command Centers
- Real time feed back to Dispatch, Command, & active Law and Fire units on scene

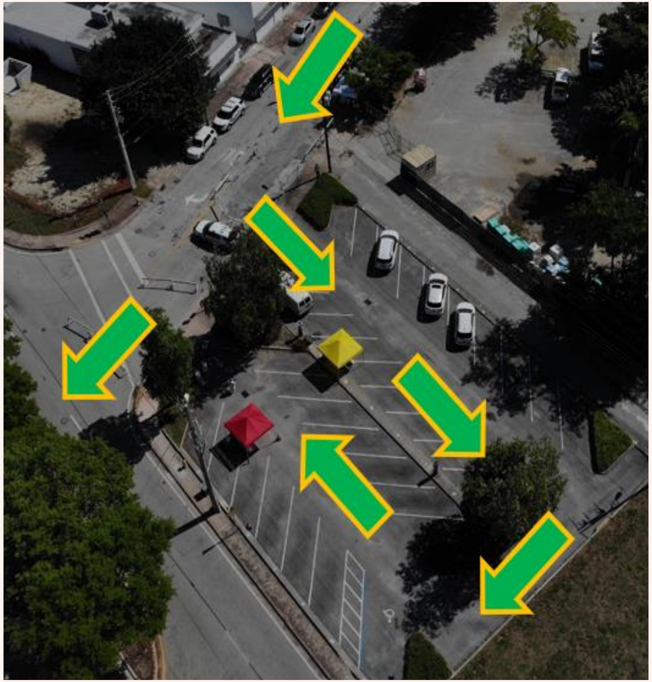
Fire Accreditation Support

CORAL GABLES
THE CITY BEAUTIFUL

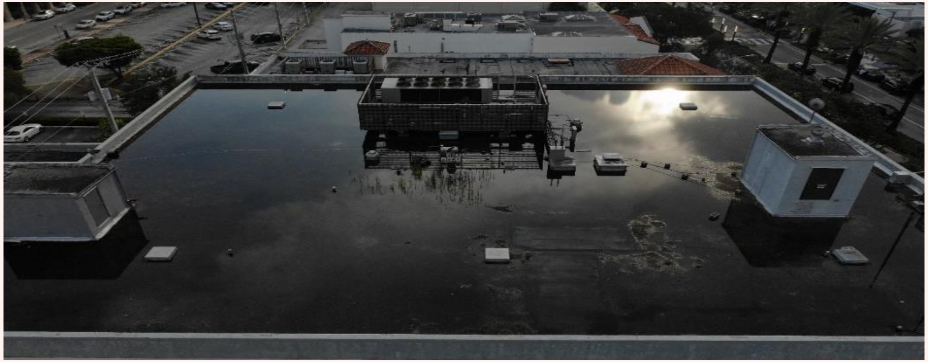
Hurricane Rescue Recon

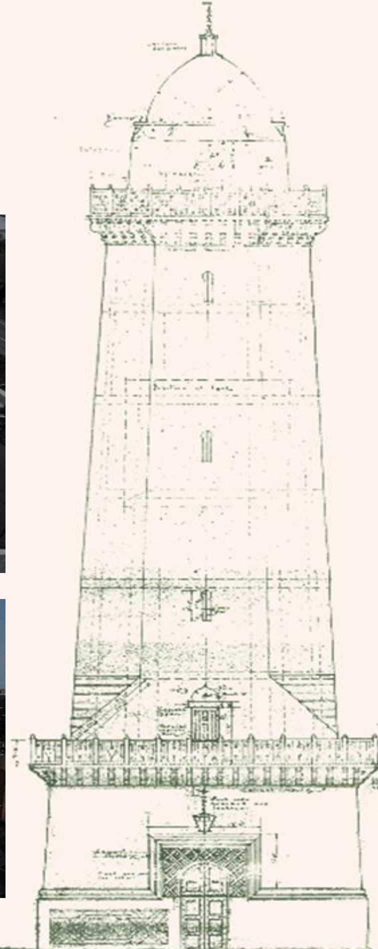


Covid Test Site Selection

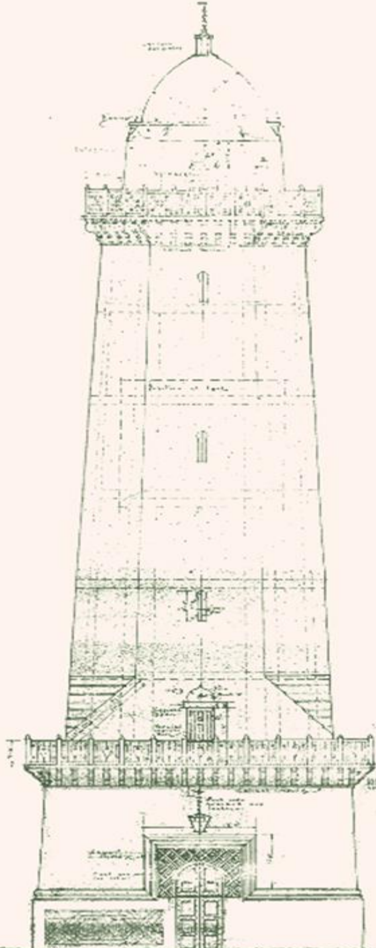


Rooftop Water Damage Assessments

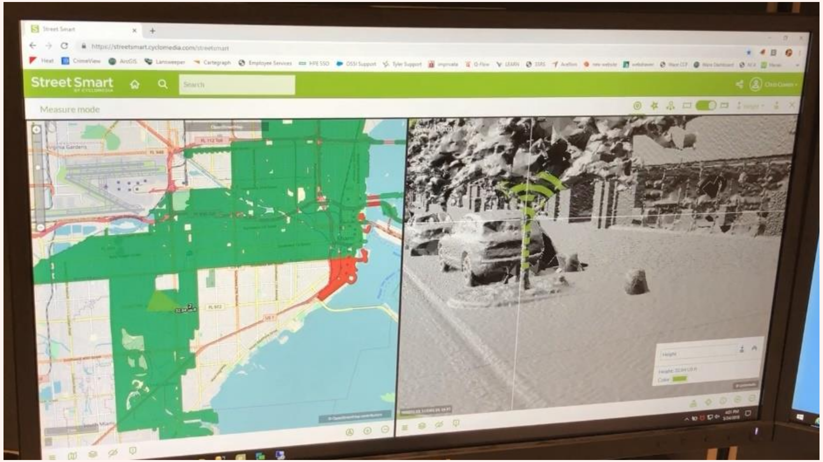


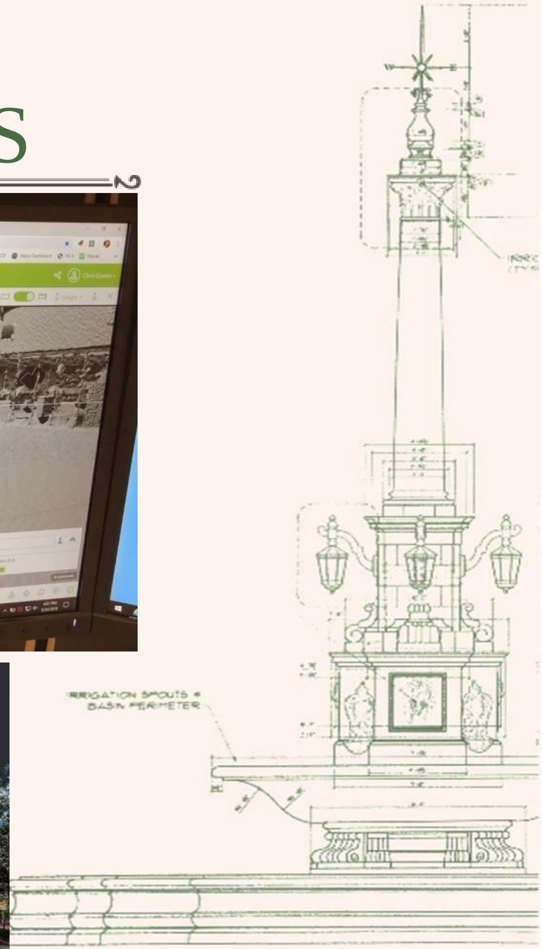


Tower Inspections



LiDAR, 3D GIS


Street Smart
Search
Measure mode


IRRIGATION SPOUTS + BASIN PERIMETER

- *Thank You for allowing us to share our story with you.*

- *More information can be found at www.coralgables.com/itdocs*

- *Contact information:*

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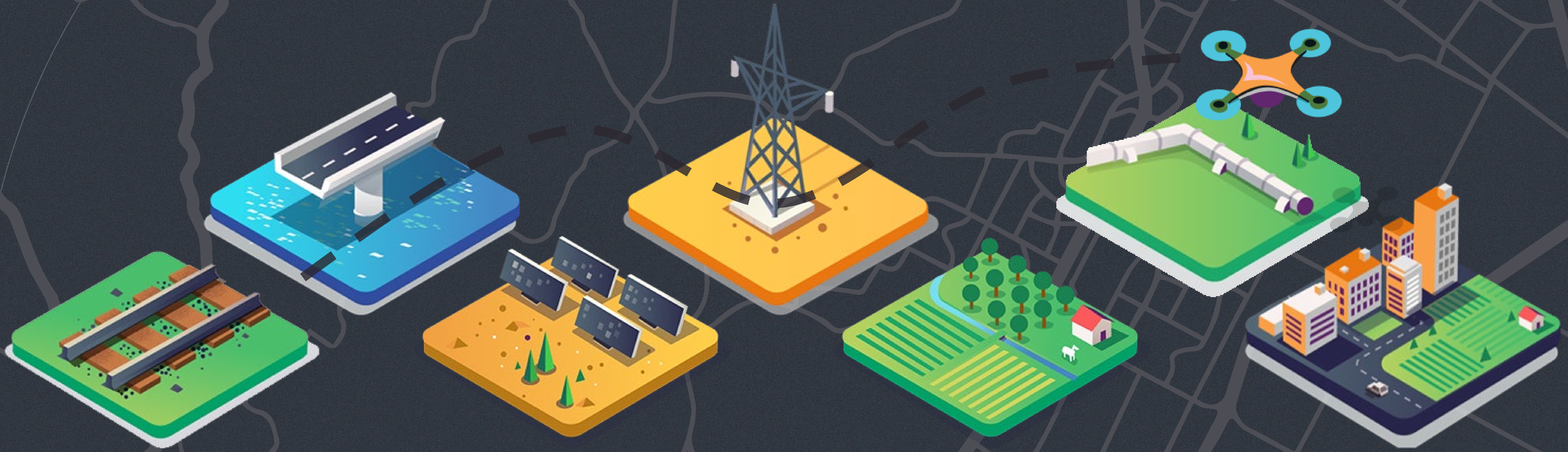
- *Alex Gamundi, IT Analyst* *agamundi@coralgables.com*

305-569-2448

airspacelink™
DIGITAL INFRASTRUCTURE FOR EVERY UAS OPERATION
DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA
FEDERAL AVIATION ADMINISTRATION
LAANC
CONNECTED

AIRHUB PLATFORM

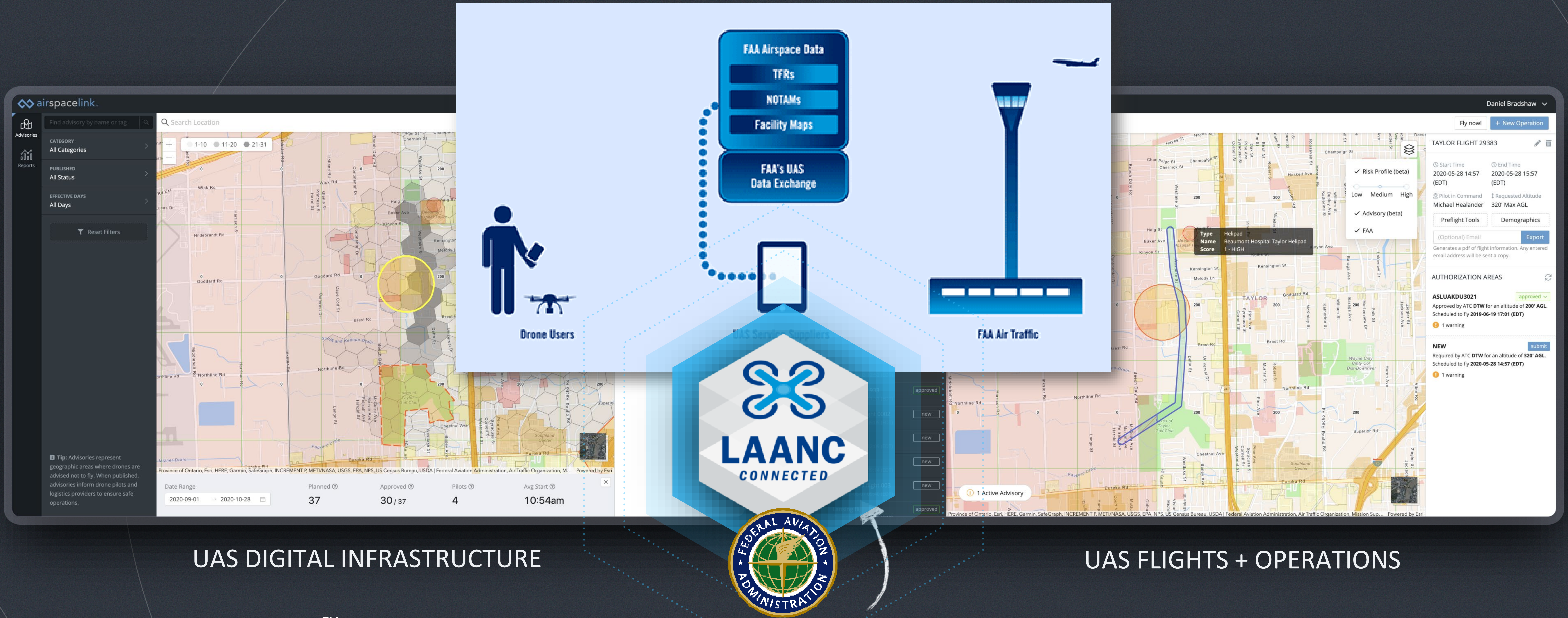
Enables communities to manage safe integration of UAS operations by providing ground risk insights



Building “Highways in the Sky” to support advanced UAS missions

AIRHUB | Platform

STRICTLY CONFIDENTIAL



UAS DIGITAL INFRASTRUCTURE

AirHub™ for Government

FAA APPROVED

Low Altitude Authorization & Notification Capabilities

(Only 1 of 5)

UAS FLIGHTS + OPERATIONS

AirHub™ for Pilots & Developers API

AIRHUB for Government: Data Onboarding

Hazard Data Integration From Multiple, Trusted Sources

Static data: Schools, hospitals, government buildings, helicopter pads, airports, stadiums, l rights-of-way, etc.

Policies: Special ordinances., land use, zoning

Dynamic data: advisories, weather, population movement patterns

Data Preparation

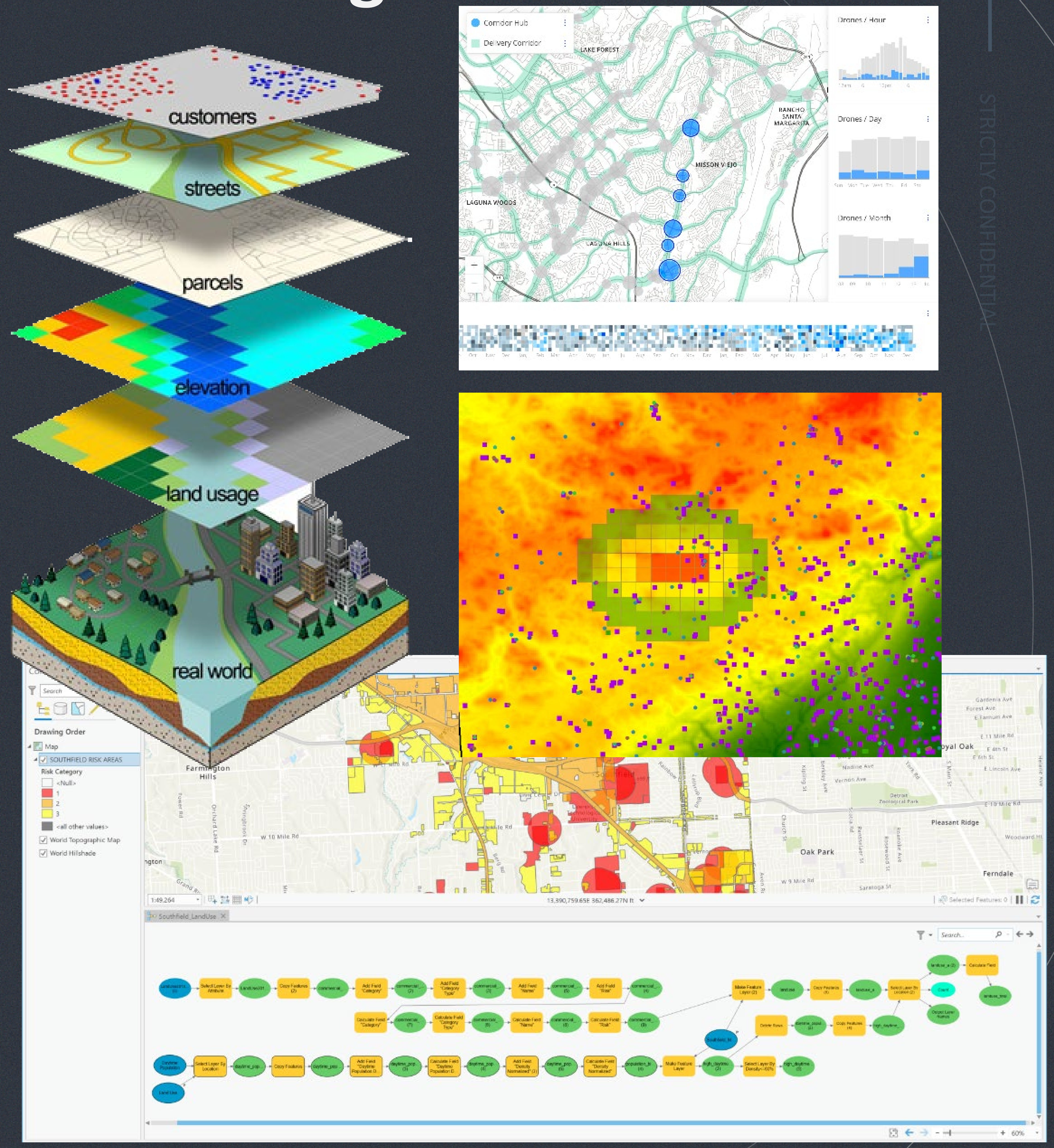
Corroborating and combining datasets into the UAS Spatial Data Model to facilitate processing and enable easier maintenance.

Model Processing

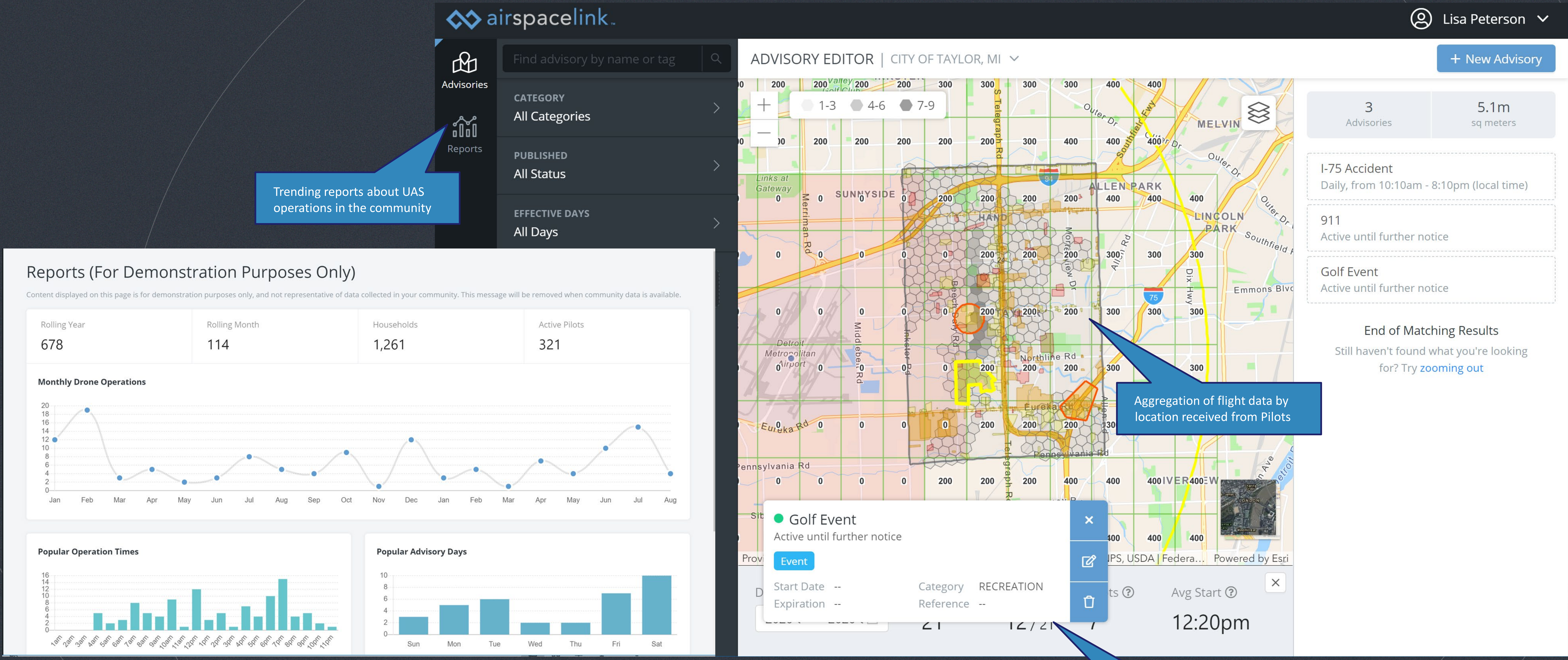
Applying the risk model based on UAS operator inputs, time and location risk attributes. Supports the underlying routing decision tree.

Deployment

Approval and deploy processed data to AirHub systems, enabling the state & local government the ability to publish advisories and risk data to UAS pilots.



AIRHUB for Government: Data Exchange With UAS Operators



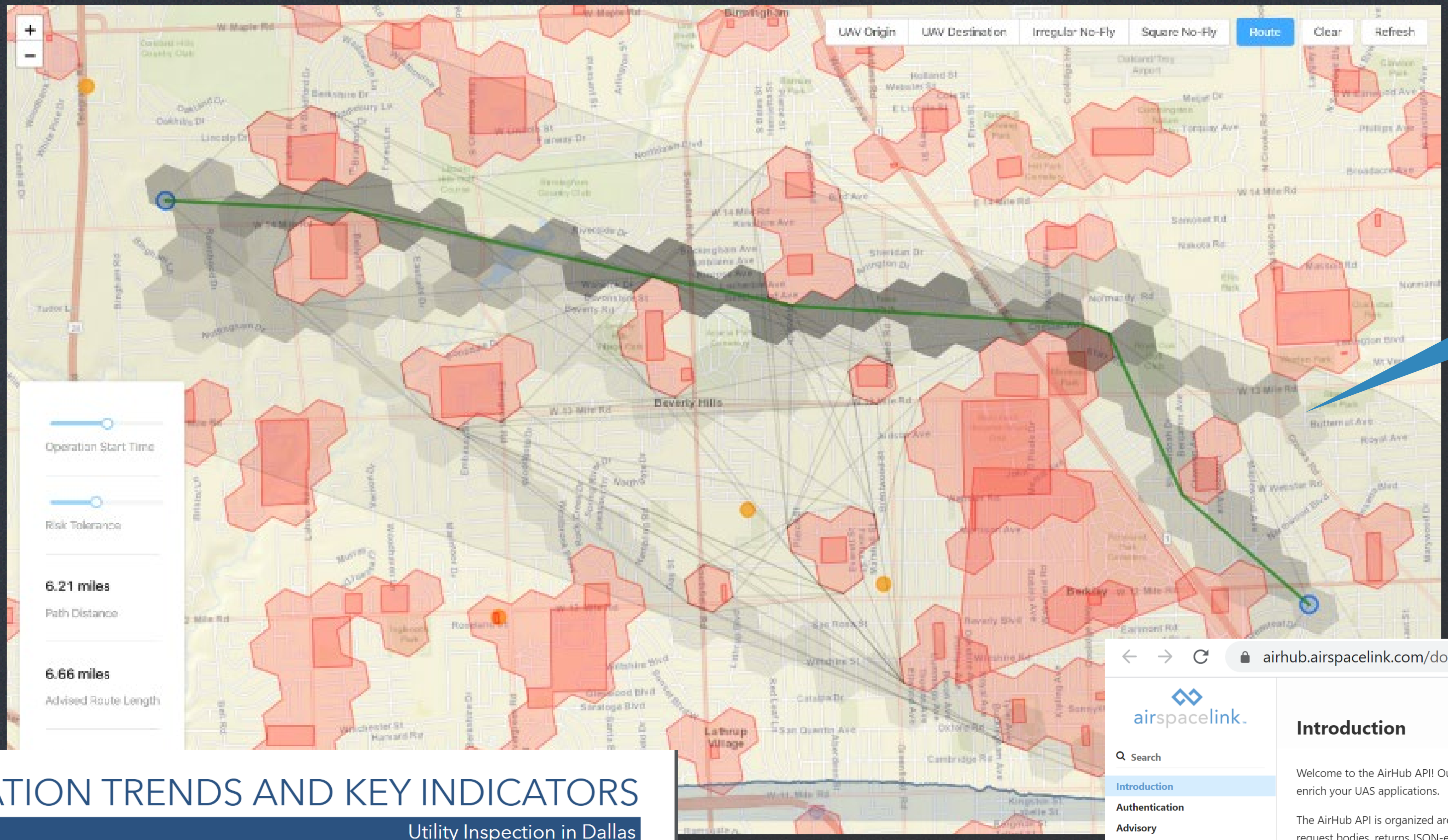
Event advisory information published to pilots

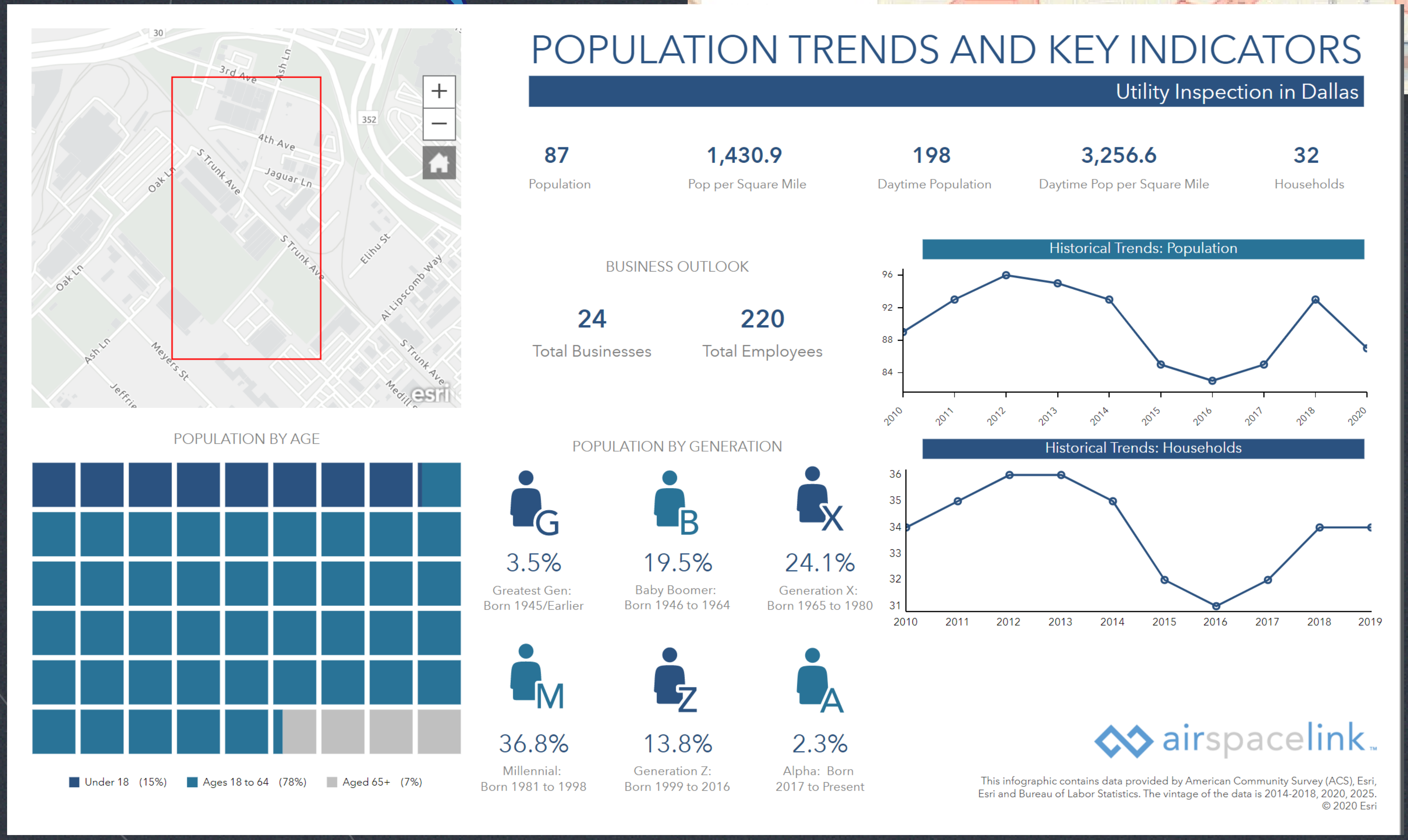
AIRHUB for Business and Developers

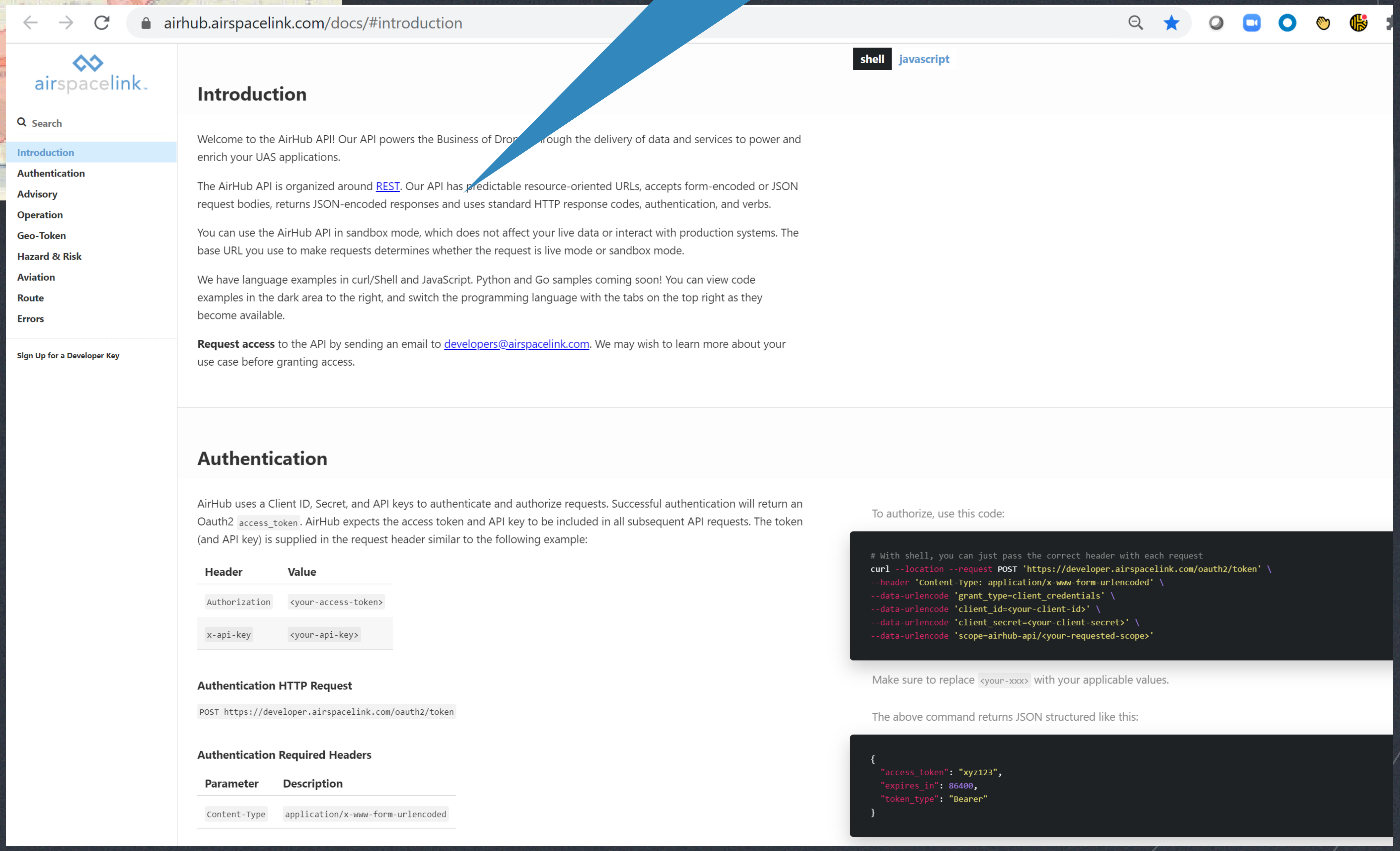
Safe route recommendations

Key data and services exposed through APIs

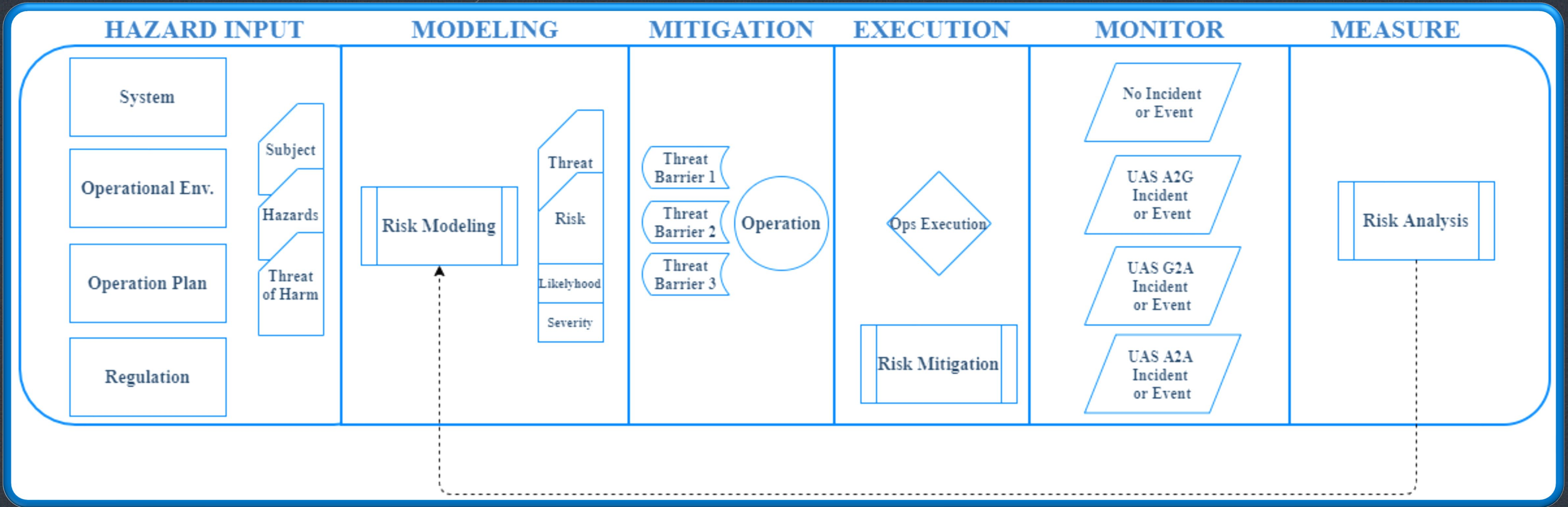
Flight Insights for Safety Case

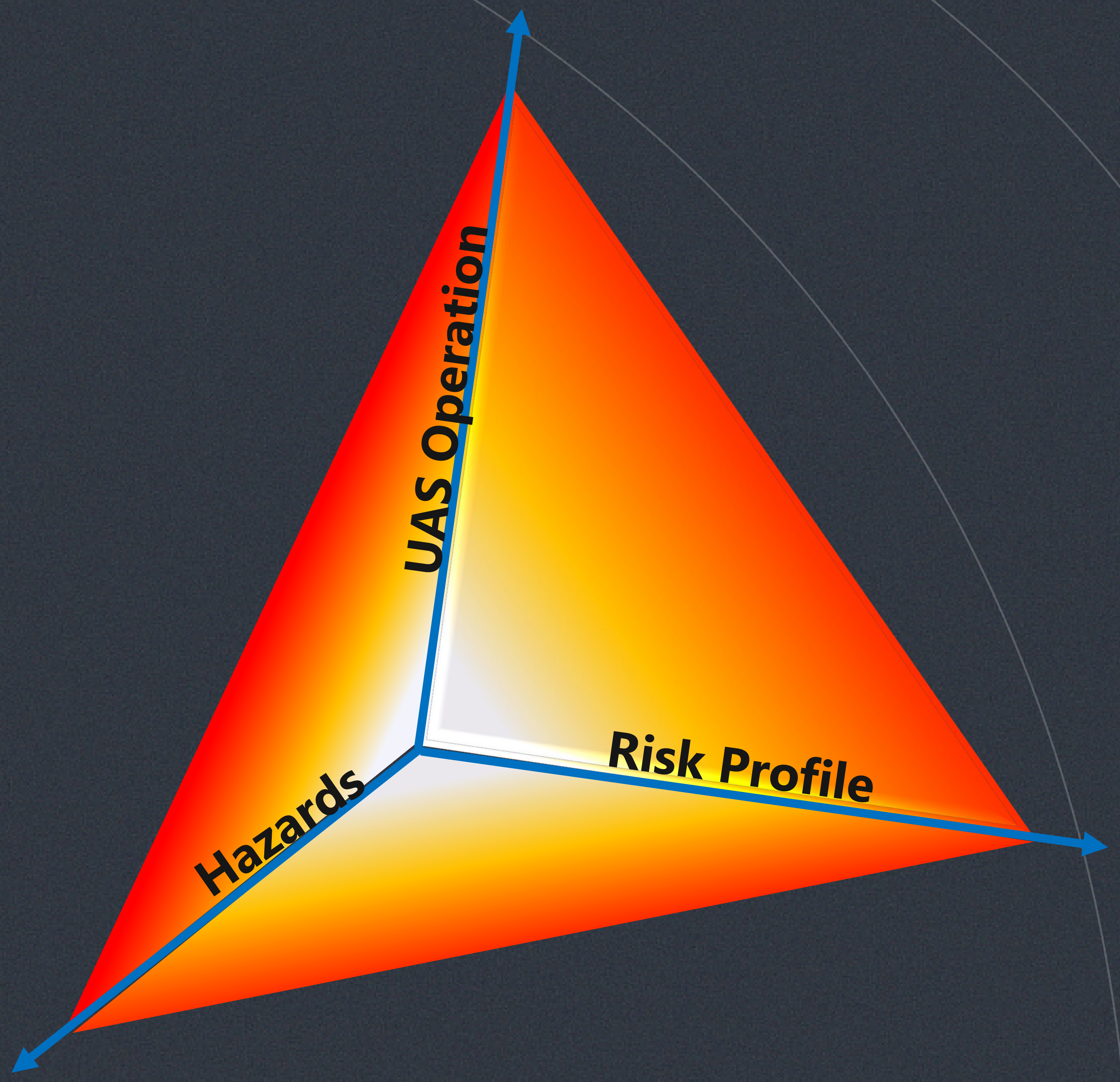


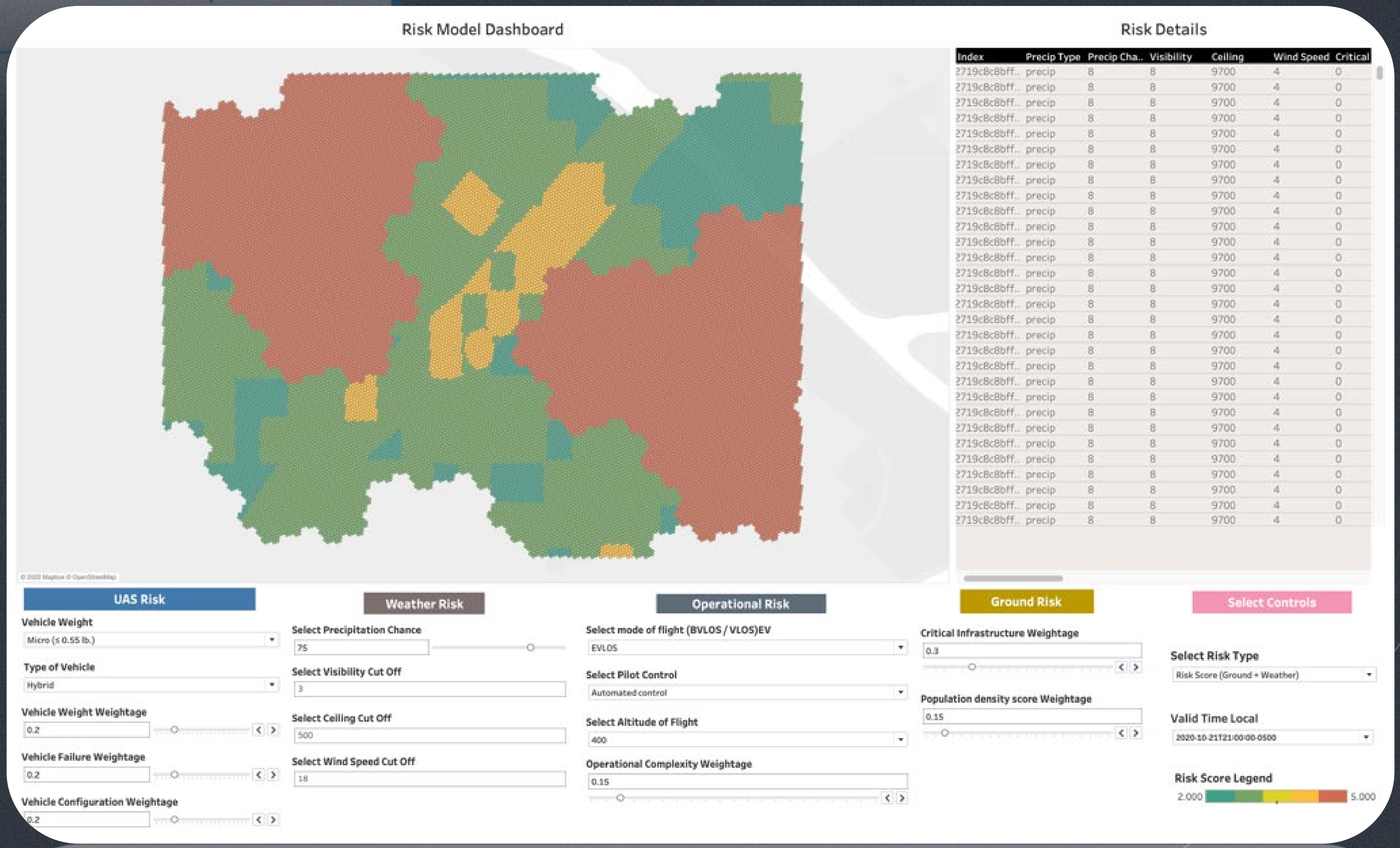




Applied Risk Model







CUSTOMER | Case Studies

Ontario, California, Is Using GIS to Look to the Sky

By Merlin Love, Airspace Link

The federal, state, and local laws surrounding the commercial use of drones, particularly for those outside the aviation industry, can feel like a complicated tapestry of regulations, rules, and red tape. While the sight of drones at recreational events has become ubiquitous, the commercial industry has led the charge in driving the drone business forward for the last three years. Drones have become an invaluable part of the everyday workflow for construction companies, mines, utilities, and engineering firms worldwide. While construction and engineering companies have been on the bleeding edge of adoption, state and local governments are poised to realize the full potential of what this technology has to offer.

Southern California is one of the most densely populated areas in the country. The six primary counties that make up the greater Los Angeles area account for 191 cities, 38,000 square miles, and some 19 million people. Tucked into the middle of the sprawl forty miles due east of Los Angeles is the city of Ontario. Home to Ontario International Airport, the eighth-busiest airport in California based on the number of passengers, and one of the busiest airports for outbound cargo, Ontario presents a difficult challenge, as most of the city lies within controlled airspace that prohibits drones from flying without a special waiver from either the Federal Aviation Administration (FAA) or the local air traffic control tower. These conditions, along with the web of commercial and recreational regulations, create a complex environment for understanding how and where drones can be legally flown.

Laying the Groundwork

Over the last 10 years, the FAA has been making progress in keeping pace with the regulatory requirements for an industry that has exploded in growth. As drones became safer and more reliable, the regulations changed to accommodate the differentiation and needs of the industry. From 2014 to 2016, drone pilots needed a 333 exemption, which was cumbersome to obtain because it required a commercial pilot's license. Recognizing that a more streamlined process was needed, in June of 2016, the FAA released the Part 107 certification. This new certification, earned by more than 120,000 drone pilots in the United States since its introduction, has been the accelerant needed for continued growth during the initial expansion phase of the industry.

Reacting again to the regulatory needs of a growing industry and the demands

ings, helicopter pads, airports, stadiums, utilities, transportation, land use, zoning, population density (at different times of the day), road rights-of-way, rules, regulations, and ordinances.

By Year Five, in a single U.S. metropolitan area, drone delivery could:

- Serve up to **53.9%** of the population;
- Recover up to **$582.5 million per year** in total time savings for consumers;
- Support the **3.6-6.6%** of metropolitan residents who lack access to a vehicle (as many as **66,000 people** in a single metropolitan area);
- Help **22,000 people** with mobility challenges to obtain their prescription medication;
- Generate up to **$284,000 per year** in new annual sales for a participating local business (up to **250%** additional sales compared to a scenario without drones);
- Avoid up to **294 million miles per year** in road use and up to **580 car crashes per year**;
- Reduce up to **113,900 tons per year** of CO_2 emissions, equivalent to **46,000 acres per year** of new forest.

Variations exist between cities based on a range of variables including size of the existing market, demographics, population density and urban environment. For example, in communities with greater distances between commercial centers and residences, consumers may benefit more from drone delivery through time saved – as much as **31-56 hours of time saved per person per year**, averaged across all residents. In denser communities with high costs of living, consumers may benefit more from the *value* of time saved – as much as **$323.5-582.5 million per year in total time savings**.

Lyon-Hill, S., Tilashalski, M., Ellis, K., & Tavis, E. (2020). *Measuring the Effects of Drone Delivery in the United States* (p. 6, Tech.). Blacksburg, VA: Virginia Tech.

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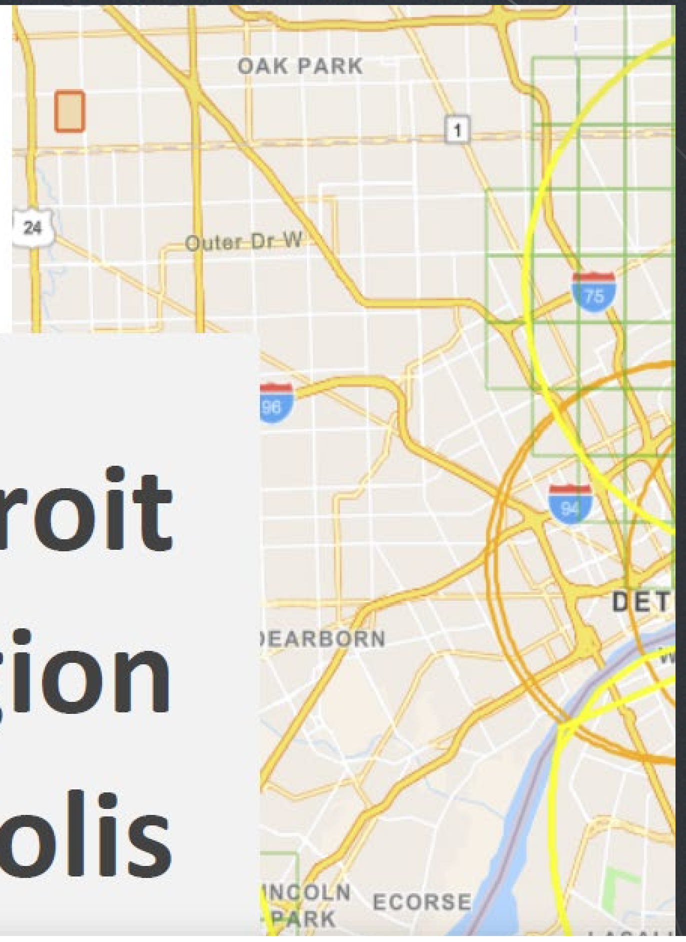


Detroit Region Aerotropolis

...g GIS to Build "Highways in the Skies" ...e City of Taylor, Michigan

...alander, Airspace Link

The Federal Aviation Administration (FAA) works hard to secure our national airspace, maintaining over 5.3 million square miles of domestic airspace for the United States. In Michigan alone, more than 2.7 million residents and 283 cities or townships live and operate under controlled airspace. One such community, the city of Taylor, is home to 62,000 residents and operates ...hin federally controlled airspace. ...east of the Detroit Metro Airport, 20 percent of ...r is blocked by the FAA from being able to fly ...mercial or recreational drone operation may ...e city without getting authorization by the FAA or ...irport Air Traffic Control (ATC). These types of ...ng with other standing FAA regulations, create ...oth residents and community officials to know ...e drone pilots may safely operate.

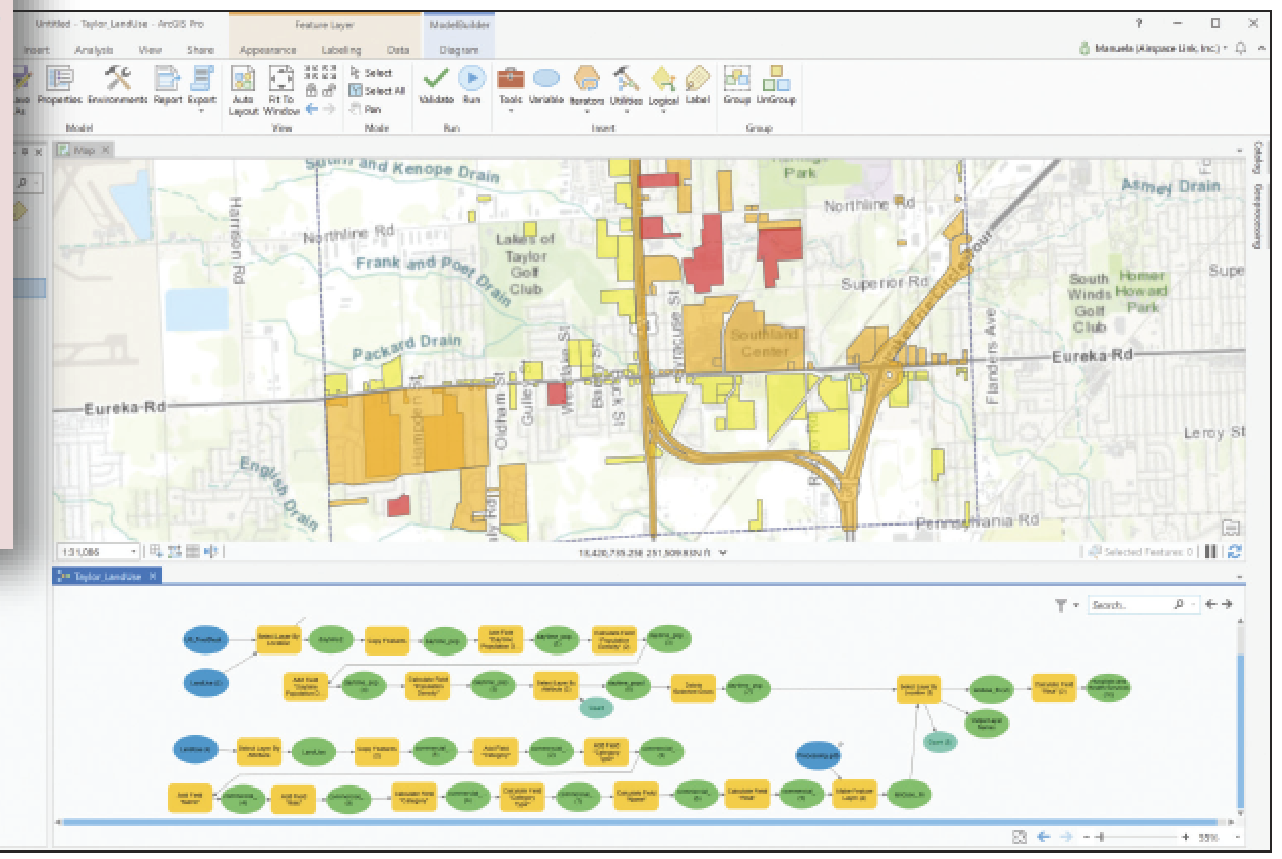
Challenge

To help meet the demands of drones in local airspace, the FAA has introduced the UAS Data Exchange, a partnership between government and Airspace Link facilitating the sharing of airspace data between the two parties. Under this umbrella of cooperation, the first program available to drone pilots today is known as the Low Altitude Authorization and Notification Capability (LAANC).

In the United States, the LAANC program is intended to directly support the integration of unmanned aircraft system (UAS) vehicles into national airspace. Regulators are interested in supporting technology innovation while still providing air traffic professionals with visibility into where and when drones are operating.

Local governments play an important role in supporting this industry and remain the strongest resource for the most up-to-date, on-the-ground information and enforcement of the use of drones within each community. The GIS data already

continued on page 6



↑ Existing GIS data layers are used to quantify and calculate ground-based risk. Data is gathered from a wide variety of datasets maintained by cities.

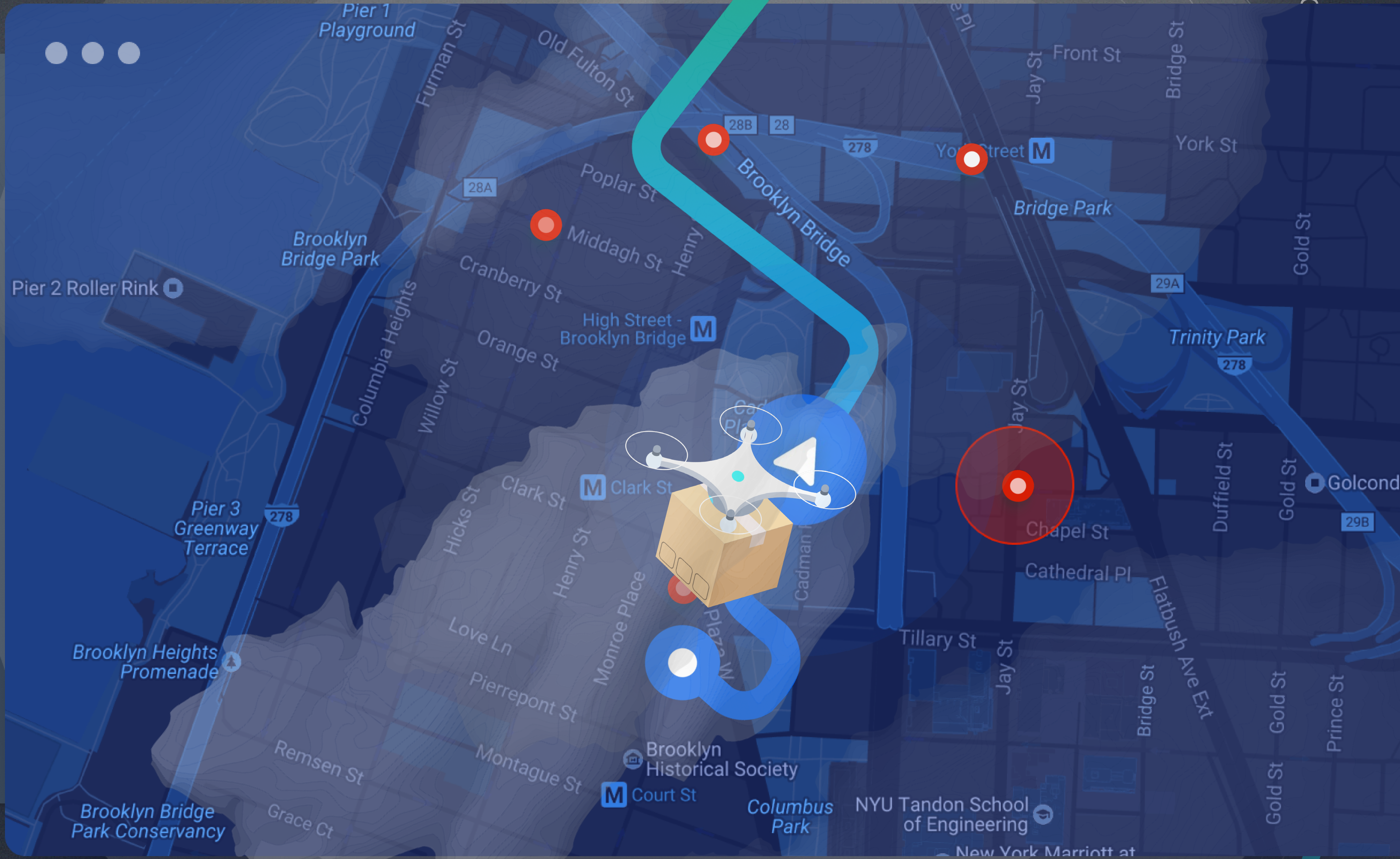
PRODUCT | DEMO

AIRHUB™ PLATFORM

TODAY
AirHub™ for Gov
AirHub™ for Pilots

BETA
AirHub™ for Developers
- OEM + Developers (Data, functions, API)

LAUNCH DEMOS



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AIRHUB for Government: Digital infrastructure for state and local governments to manage, risk, while engaging with and building their drone communities.

AIRHUB for Pilots: Flight planning, logging, and LAANC authorizations

AIRHUB for Business/Developers: Risk insights, safe routing and APIs

http://airspacelink.com

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Hidden Level

Safety Through Sensing

Prepared For: UAS Safety and Integration Task Force

James Licata
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Founders

Jeff Cole CEO

14^+ years in ATM, defense, CUAS

Kevin Nasman CTO

21^+ years in radar, control systems, CUAS

Gary Dominicos CFO

30^+ years in accounting and finance

Team Skill Sets

- ✓ Systems Engineering
- ✓ RF Engineering
- ✓ Embedded Software
- ✓ Board Design
- ✓ DSP Firmware
- ✓ Mechanical Design
- ✓ Wireless Comms

Our Team - **Headquartered in Syracuse, NY**

- Average team member experience: 12^+ years
  - 16 current employees
- Designed, developed, fielded advanced passive detection and radar tech for commercial and defense customers
- Industry experts active in standards groups (ASTM, RTCA)

Team Highlights

- US Army CUAS Program
- NASA UTM TCLs
- FAA Pathfinder Programs
  - BNSF Railway
  - Drone Detection For Airports (DFW)
- NY State UTM Corridor
- FAA Test Site Programs
  - Virginia Tech (MAAP)
  - Griffiss International Airport (NUAIR)

Drone Security

Drone Integration

Needs

- Scalable Solution
- Reduced Complexity
- High Performance
- Cost Effective
- Dual Use

Airspace Monitoring Service

The world’s first low altitude air traffic data service

Airspace Monitoring Service (AMS)

Safety Through Sensing™

+

=

One city-wide deployment, multiple applications

Foundational Partnerships

Uber

UAM / UTM

Supporting aerial ridesharing safety

C&S COMPANIES®

Infrastructure Deployment

Experienced telecom project management firm handling initial US based metropolitan deployments

LOCKHEED MARTIN

Government / Defense

Finding solutions for national security problems

LIVE EARTH

Facility SOC Integrated Solution

Bundled Hidden Level AMS + SOC management and visualization platform product offering

What AMS Is

Detection System
- Custom built passive, persistent, wide-area, low-altitude airspace monitoring

Infrastructure Built For Scale
- Coverage can be built out to cover an entire metro area

Actionable & Legal Airspace Data
- 24/7 accurate coverage over a large area gives more warning and traceability

Reduces Complexity
- Eliminates burden of owning and operating expensive/changing technology

What AMS Is Not

Mitigation System
- AMS enables mitigation to be used effectively and efficiently

Temporary or Single Point Installs
- The power of AMS lies in its long range, permanently installed, distributed sensors

Communications Link Interceptor
- AMS does not demodulate any transmitted non-broadcast signals or extract data fields

Require Dedicated Team or Tools
- AMS integrates into existing systems, without overhead or maintenance

Syracuse Testbed (Urban)

Footprint

- Up to 20 square miles
- Focused around south end of Onondaga Lake
- 2-3 Installation Sites
- 1-2 mobile sensor units

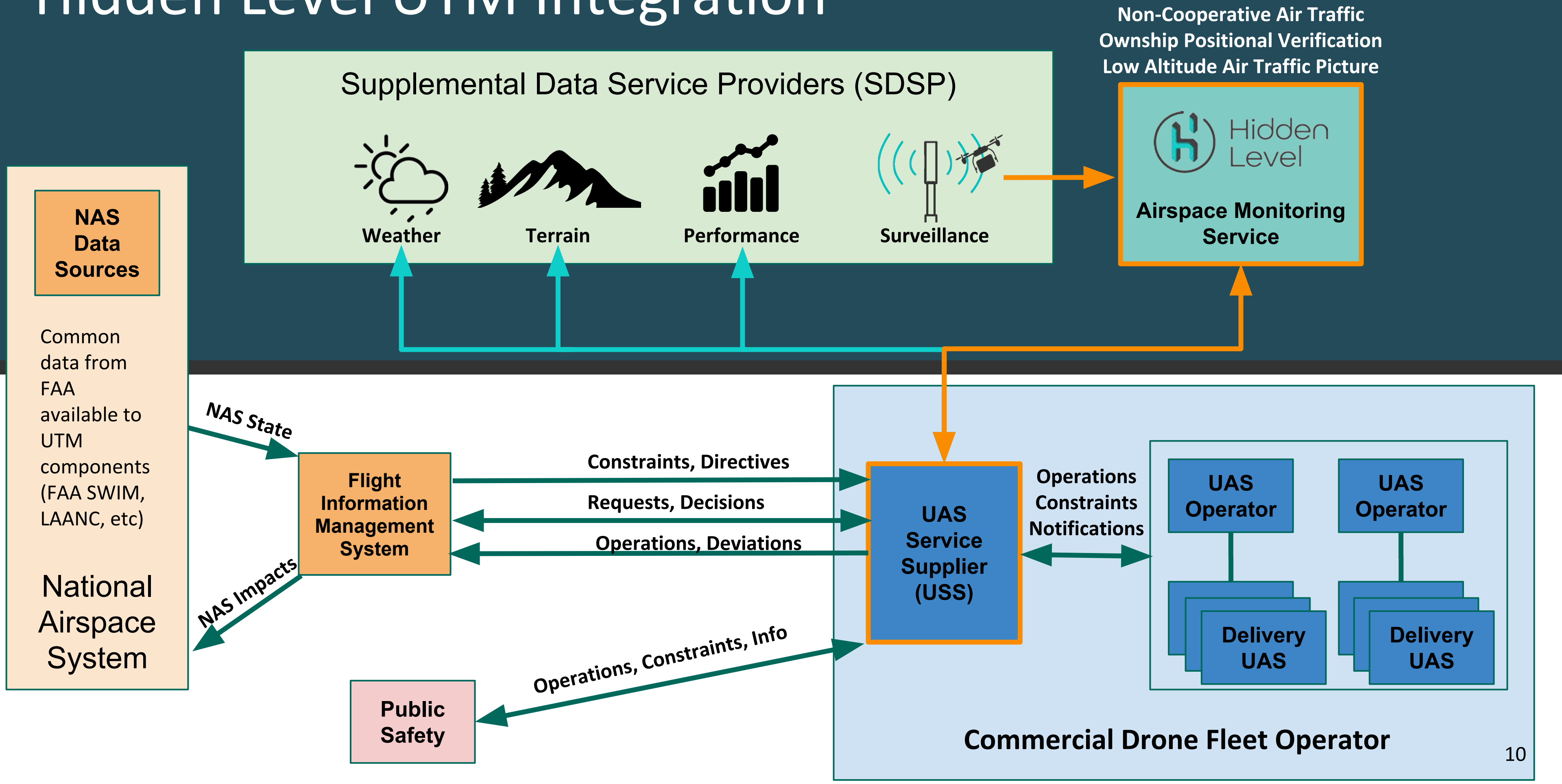
Syracuse Testbed (Rural)

Footprint

- Up to 20 square miles for low risk testing of complex test scenarios
- CNY Farmland
- Multiple Temporary Emplacement Sites
- 1-2 mobile sensor units

AMS For Integration

Hidden Level UTM Integration



Airspace Monitoring Service: UTM Benefits

LAANC CONNECTED

Detect/Validate 3D Position Low Altitude Air Traffic

No on-premise sensors required

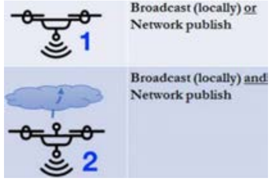
Subscribe only to data you need

<u>Realtime Airspace Data For USS</u>

- Report on cooperative and non-cooperative aircraft in low altitude airspace

<u>Enhanced Situational Awareness</u>

- Use historical data from AMS to develop more efficient flight routes, avoiding heavily trafficked areas



<u>Feed Existing GCS / Ops Center / UTM Platform</u>

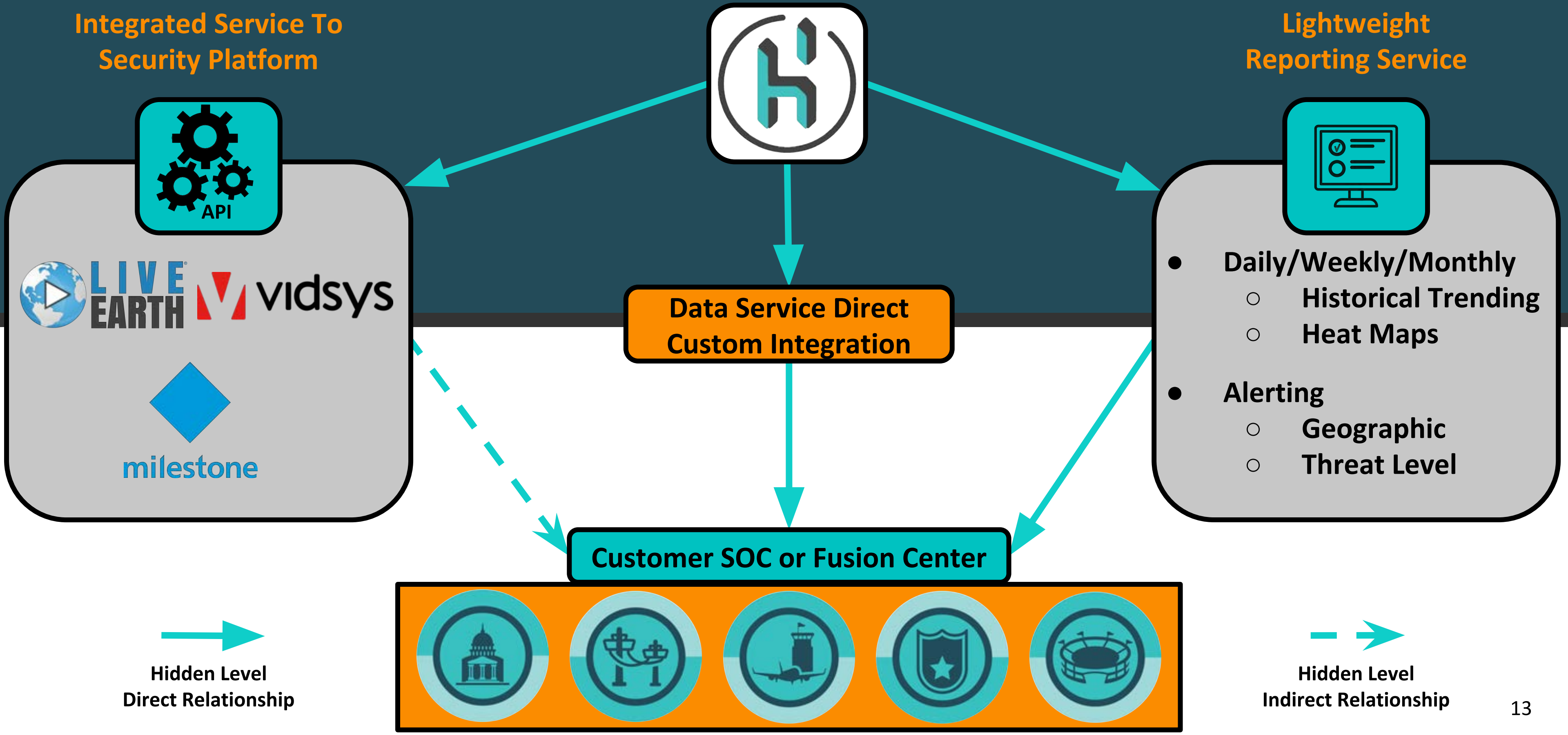
- Data integrates directly into existing systems
- Subscribe only to the data you need for operations

<u>Validate Remote ID / Telemetry Position</u>

- Independent verification of broadcast or networked reported position is essential to preventing mid-air collisions (both ownship and other self-reporting UAS)

AMS For Security

Airspace Monitoring Service For Security Customers



Airspace Monitoring Service: Security Benefits

Detect 3D Position of Intruder Drone or Operator

No on-premise sensors required

Subscribe only to data you need

<u>Generate Historical Data Report</u>
- Use historical data to identify likely launch/recovery spots
- Intel to feed CONOPS for patrols during events

<u>Fast and Efficient Response Times</u>
- Long range and accuracy of coverage gives security team more time to respond and confidence in system with low false alarm rates

<u>Feed Existing VMS or GSOC</u>
- Data integrates into existing systems
- Reduces venue security team burden for another screen, operator station, and training

<u>Cue Mitigation Systems</u>
- Work seamlessly with approved mitigation technology when authorized
- Reduces number of systems facility must accommodate for drone security purposes

Let’s Work Together

Bringing AMS To Your Area

Hidden Level

- ☑ Cost-effective, scalable, coverage for entire cities
- ☑ Service performance suitable for security and UAS Traffic Management
- ☑ Flexible capability to work across public and private sectors

- ☑ Provide AMS as an SDSP to UAS Service Suppliers
- ☑ Provide AMS data feed to your Security Operations Center
- ☑ Provide AMS data to support Smart City data fusion centers, Law Enforcement, Critical Infrastructure monitoring and municipal government services

Please reach out to discuss new projects and partnering initiatives!

Thanks!

James Licata
Business Development Manager
james.licata@hiddenlevel.com

Bell APT 70 System Integration and Operationalization (SIO)

NASA Systems Integration and Operationalization (SIO)

Furthering certification & BVLOS technology

Demonstrating Urban, Critical Medical Transport Mission

Flight demo Q3 2020

Engaging medical community support

Increasing BVLOS Tech TRL from 4 to 6

Detect & Avoid (DAA) with Xwing

Command & Control (C2), Internal

Pushing boundaries of Urban UAS Ops

Operating >55 lb UAS

Flying with GA & Heli traffic

Transiting in & out of DFW, Class B Airspace

Overcoming urban environment challenges

Building certification pathways for medium UAS

Capturing required approvals & process for air logistics missions

Contributing to standard committees on BVLOS tech

Navigating challenges with guidance and strong support from NASA

National and Local Stakeholders

Government, community and industry collaboration for furthering UAS routine UAS operations

Federal Aviation Administration (FAA)

North Central Texas Council of Government (NCTCOG)

Local Medical Community

Nation-wide Suppliers

Cities of Arlington & Fort Worth

NASA

SIO Sponsor

Bell

Vehicle, Datalink, Ground Station, System Integrator, Certification

Xwing

Detect and Avoid (DAA)

University of Massachusetts, Amherst's Center for Collaborative Adaptive Sensing of Atmosphere

Weather Avoidance Technology

Bell Autonomous Pod Transport (APT) 70

APT is an all-electric, tail sitting Vertical Take off and Landing (VTOL) unmanned aircraft, which uniquely transitions to fixed wing flight

Beyond Visual Line of Sight Technologies

Command and Control (C2)

2 RF Line of Sight (LOS) links on separate frequencies

Airborne Detect and Avoid (DAA) Sensor Fusion

ADS-B Transponder

Two aircraft radars

Visual DAA

Ground Control Station

Weather Avoidance / Monitoring

Integrated DAA Displays

Crawl, Walk, Run Approach

Component & System Testing

C2, DAA, GCS with DAA interface, and Weather Application testing in lab, simulation environments and component ground testing

C2 Mission environment Validation

Bell 407 test bed of subsystems and C2 system along flight path

EMI System Compatibility

Ground based, on vehicle testing of components

Airborne DAA Testing

DAA system testing on Bell 407 for tuning and flight encounters

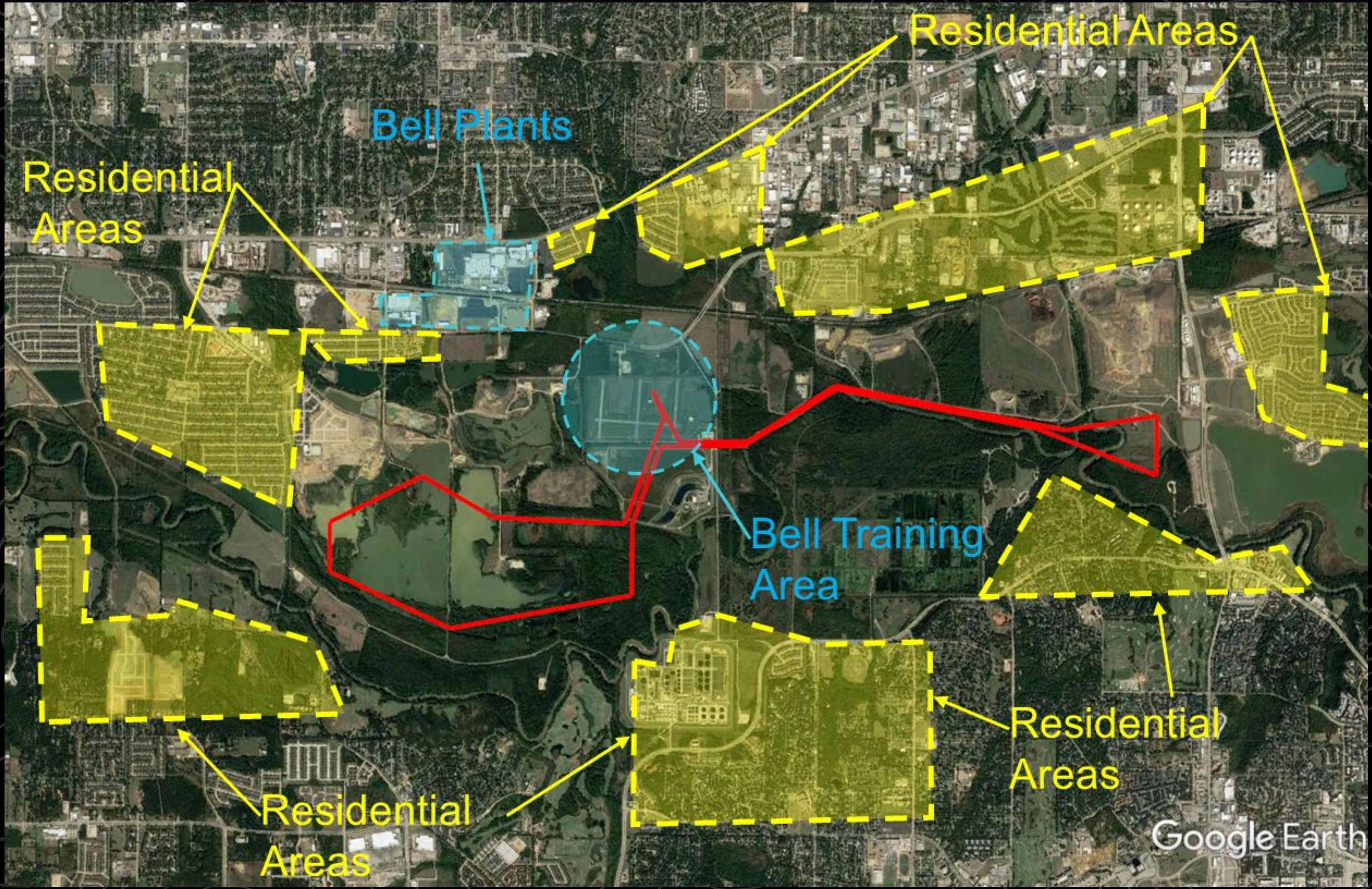
Spectral Survey of Operating Area

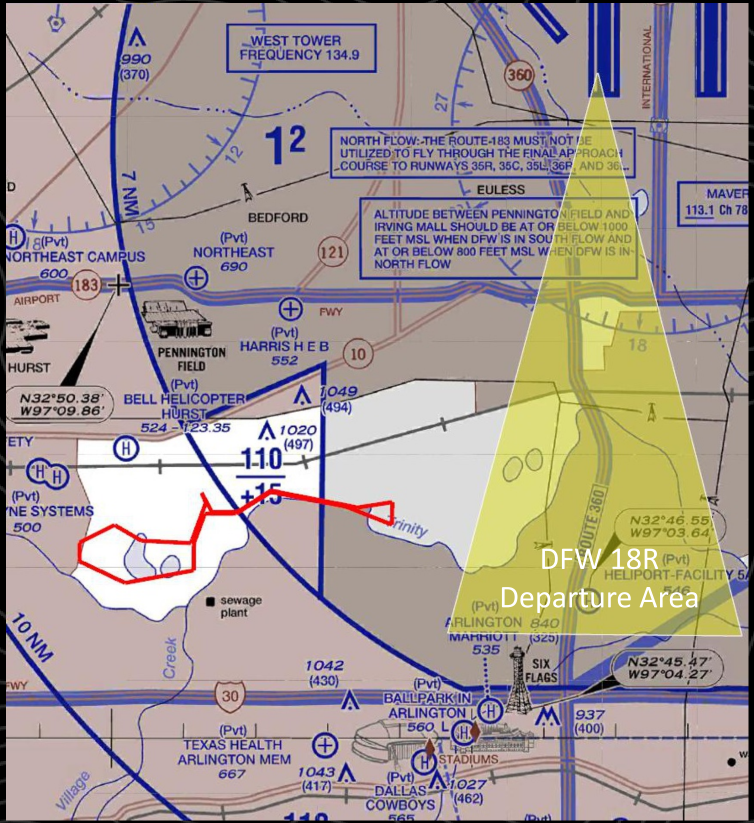
Airborne and Ground based testing

Bell APT 70 Flight Testing

Step-by-step remote site testing of integrated systems prior to demonstration

Mission Concept of Operations





9.4 nmi round trip
Flight altitudes: 500 to 1000 ft AGL

Mission Iteration

Safety is Primary

Focused on safety, Bell iterated with the FAA and NASA on mission operations and flight path over 10 months prior to submittal of paperwork for COA application.

FAA Organizations included

- Aircraft Certification Service (AIR)
- Air Traffic Organization (ATO)
- Spectrum Engineering (AJW-1C3)
- Flight Standards (AFS)
- Fort Worth MIDO, Fort Worth FSDO

Air Safety

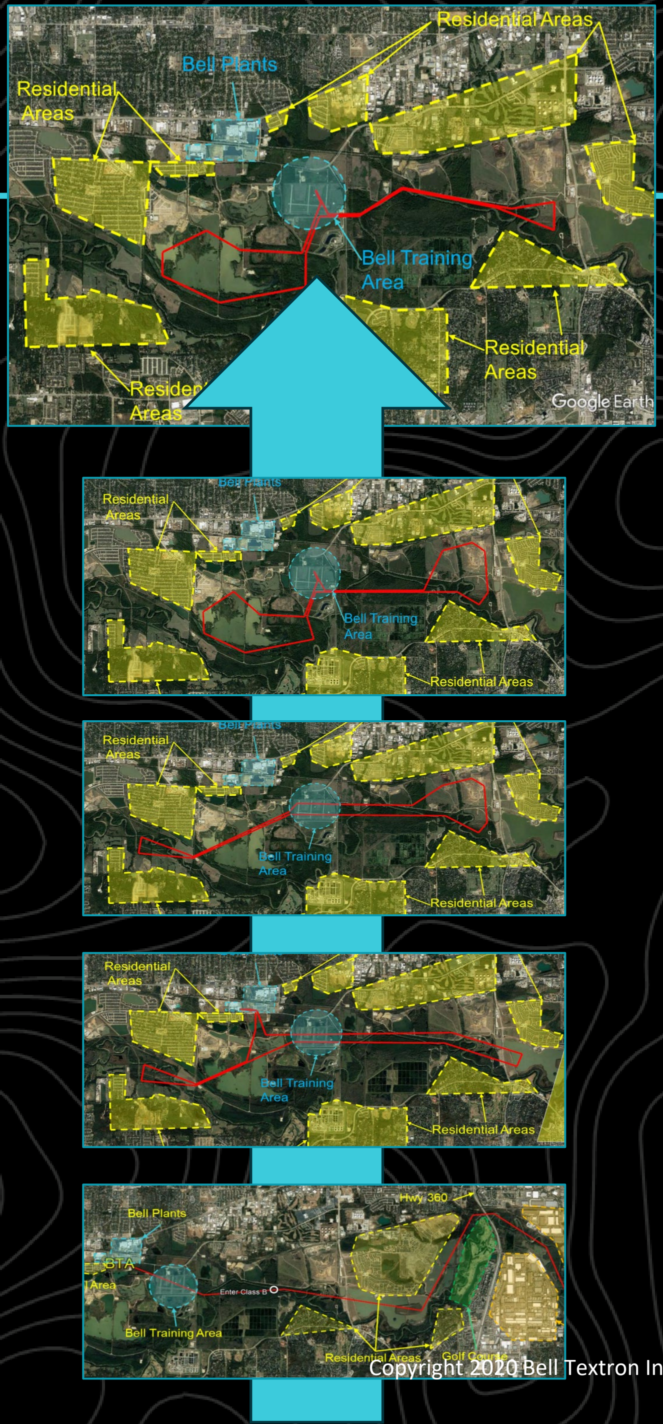
Proximity to DFW traffic, Non-cooperative traffic, BVLOS operations

Ground Safety

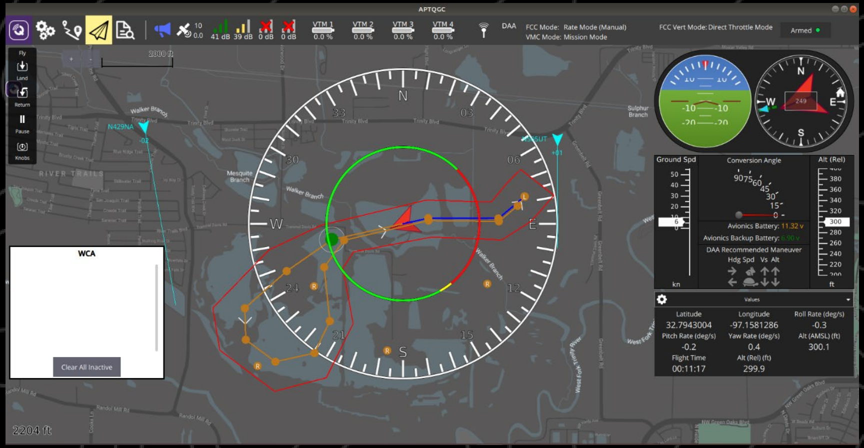
No flights over people, road crossing, land owner permissions, emergency landing zone evaluations

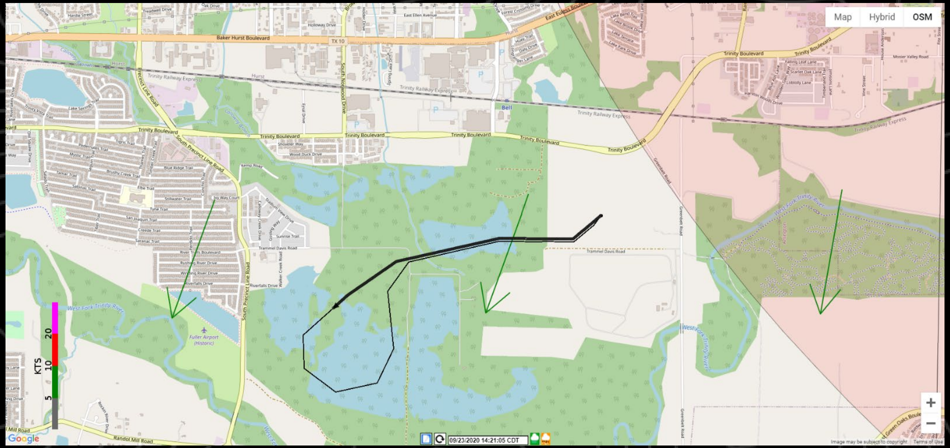
Mission Objectives

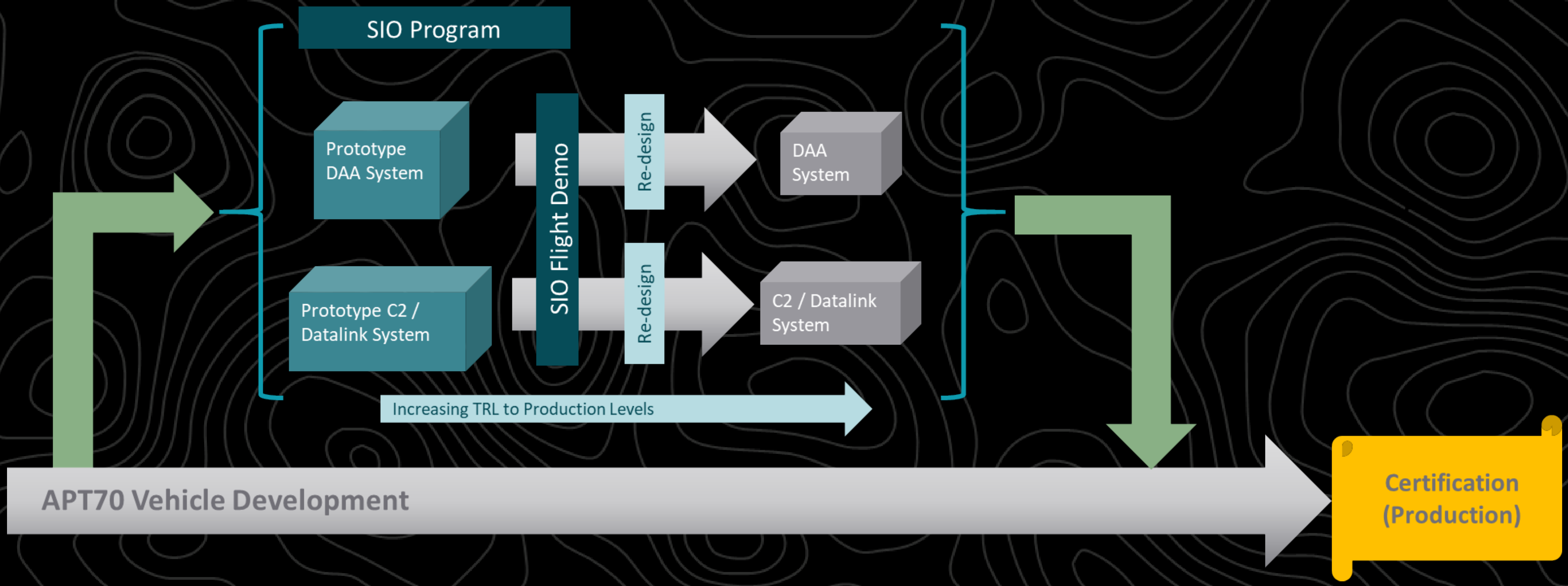
Controlled & Uncontrolled airspace, altitude 500 + ft AGL, representative of commercial operations



Bell APT70 SIO Flight Operations & Demonstration







Building the pathway for Medium UAS authorization & approvals

Capturing required approvals & processes for air logistics missions

Risk-based Safety Assessment

Mission Concept of Operations

Exemptions/Waiver applications

Navigating challenges with guidance and strong support from NASA & FAA

Controlled Airspace

Spectrum

Foundation for more robust and optimized (SWaP) solutions

Test Data & Analysis

Lessons Learned

Standards Requirements

Production design & airworthiness considerations

- BVLOS technologies
- Advanced automation / Autonomy
- Durability & reliability requirements
- Aviation-grade COTS approach
- Use of additive manufacturing
- Regulations & standards definition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