
**Peer Exchange Attendees (Source: FHWA)**

# UAS Peer-to-Peer Exchange

## Lansing, Michigan

## August 20-21, 2024

U.S. Department of Transportation
**Federal Highway Administration**

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 3D | Three-dimensional |
| BVLOS | Beyond Visual Line of Sight |
| CFR | Code of Federal Regulations |
| FAA | Federal Aviation Administration |
| FHWA | Federal Highway Administration |
| IDOT | Illinois Department of Transportation |
| INDOT | Indiana Department of Transportation |
| Iowa DOT | Iowa Department of Transportation |
| KDOT | Kansas Department of Transportation |
| LiDAR | Light Detection and Ranging |
| MDOT | Michigan Department of Transportation |
| MoDOT | Missouri Department of Transportation |
| MnDOT | Minnesota Department of Transportation |
| NDDOT | North Dakota Department of Transportation |
| ODOT | Oklahoma Department of Transportation |
| PIC | Pilot in Charge |
| SMART | Strengthening Mobility and Revolutionizing Transportation |
| SOPs | Standard Operating Procedures |
| TxDOT | Texas Department of Transportation |
| UAS | Unmanned Aircraft Systems |
| USC | United States Code |
| WisDOT | Wisconsin Department of Transportation |

# INTRODUCTION

As part of the Federal Highway Administration's (FHWA) Support of Unmanned Aircraft Systems (UAS) Deployment Activities, the Michigan Department of Transportation (MDOT) hosted a peer exchange in Lansing, Michigan, on August 20-21, 2024. Representatives from State Departments of Transportation (DOTs) from Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, Minnesota, North Dakota, Oklahoma, Texas, and Wisconsin were among those in attendance. The goal of the peer exchange was to discuss the current state of play of UAS operations across the State DOTs in attendance and understand how each agency is working to further develop their respective UAS programs. Attending State DOTs shared successes and challenges throughout the peer exchange roundtable discussions, creating a collaborative environment and knowledge exchange. This report provides an overview and the findings from the various discussions from the peer exchange; the information was up to date at the time of the peer exchange.

# FEDERAL AVIATION ADMINISTRATION REGULATIONS

UAS operators in the public and private sectors must adhere to statutory and regulatory requirements. Public aircraft operations (including UAS operations) are governed under the statutory requirements for public aircraft established in 49 United States Code (USC) § 40102 and § 40125. Additionally, both public and civil UAS operators may operate under the regulations promulgated by the Federal Aviation Administration (FAA). The provisions of 14 Code of Federal Regulations (CFR) part 107 apply to most operations of UAS weighing less than 55 pounds. Operators of UAS weighing more than 55 pounds may request exemptions to the airworthiness requirements of 14 CFR part 91 pursuant to 49 USC § 44807. UAS operators should also be aware of the requirements of the airspace in which they wish to fly as well as the requirements for the remote identification of unmanned aircraft. The FAA provides extensive resources and information to help guide UAS operators in determining which laws, rules, and regulations apply to a particular UAS operation. For more information, please see https://www.faa.gov/uas/.

# UAS DEPLOYMENT ACTIVITIES MATURING

During the initial session of the peer exchange, representatives from the Michigan Division of FHWA welcomed participants to Lansing and noted the importance of continual knowledge sharing of the successes and failures with ever changing technology like UAS. Representatives from MDOT Division of Aeronautics also offered welcoming remarks and described the growth that MDOT has seen with its UAS program, from program infancy in 2016 to a team of five individuals dedicated to UAS in the Division of Aeronautics and many others throughout other divisions in MDOT actively using UAS.

FHWA has funded millions of dollars across numerous, diverse engagements to meet the goals of State DOTs as they have deployed UAS. Figure 1 summarizes the various UAS outreach activities, levels of engagement, and resources that are available to State DOTs.

Over **1,000** participants in UAS-focused webinars

Over **1,100** participants from **38** States and Territories at UAS local and regional workshops

Over **840** participants engaged through UAS Peer Exchanges

Over **20** UAS technical briefs and reports published

**16** free online NHI UAS courses on various applications

**Figure 1. FHWA UAS deployment engagement and resources (Source: FHWA).**

The 16 free online National Highway Institute UAS courses can be found by searching UAS in the "Find Course" search box at: https://fhwanhi.geniussis.com/RegistrationByCourse.aspx

Additionally, Federal funding that can assist State DOTs with UAS implementation can be accessed through various grant programs including:

- U.S. DOT Strengthening Mobility and Revolutionizing Transportation (SMART) Grant.
- FHWA Advanced Digital Construction Management Systems Grant.
- FHWA State Transportation Innovation Council Incentive Program.
- FHWA Accelerated Innovation Deployment Demonstration Program.

For more information and additional resources, visit the FHWA UAS website at: https://www.fhwa.dot.gov/uas/

As UAS technology continues to improve and become more affordable, State DOTs have increased their UAS applications; more than 40 UAS use cases have been identified at State DOTs (Hubbard and Hubbard, 2020).

# UAS STATE OF PLAY

MDOT led the roundtable discussion on the UAS current state of play and shared information about its UAS program. MDOT launched its UAS program in 2016, and the program now includes 35 certified pilots across 5 key groups: Aeronautics, Photography, Surveys, Operations, and Environmental. The MDOT Photography group pioneered using UAS within MDOT, procuring its first UAS in 2016. This group is responsible for capturing aerial photos and videos that are frequently featured on MDOT's website, showcasing the agency's ability to provide visual documentation for a range of projects.

MDOT Aeronautics is responsible for the management and oversight of the UAS program and is currently updating its UAS Operational Policy, originally written in 2019. MDOT representatives noted their interest in hearing how other States manage their UAS governance documents. MDOT also has a separate UAS Operations Manual that guides the day-to-day use of UAS across its various programs. In addition to managing the administrative aspects of the UAS program, MDOT Aeronautics uses UAS to assist with airport inspections, a use case that was expanded on in a later discussion.

The MDOT survey group has been at the forefront of using UAS for advanced data collection methods like Light Detection and Ranging (LiDAR). Recently the survey group developed a three-dimensional (3D) model for a repaving project and a retaining wall that proved to be beneficial to the larger project group. The survey group is also engaged in slope stabilization efforts along Lake Michigan, providing UAS services to the MDOT geotechnical team. The MDOT survey group has the largest number of UAS pilots within MDOT, having added 15 newly certified pilots in the past year. Additionally, the survey group has conducted extensive testing with various UAS sensors and is experimenting with ground control points, using a 40-acre test site featuring diverse vegetation and surface types to refine their capabilities.

Within MDOT Operations, the maintenance group has made significant strides in using UAS for herbicide spraying missions. Two people using UAS can cover large areas in just a few hours compared to traditional methods that required a crew of four and a full day to cover. This new method also minimizes damage to the environment because it avoids the challenges posed by using trucks in areas that are typically wet and muddy. The environmental group is actively using UAS to assist with inspecting mitigated water sites, conducting wetland analysis, and collaborating with academic institutions on UAS research projects.

After MDOT's presentation, each attending State DOT described its current state of play regarding UAS operations; these discussions are summarized below.

### ILLINOIS DEPARTMENT OF TRANSPORTATION

Illinois DOT (IDOT) started its UAS program in 2014, positioning itself as a public aircraft operator before the introduction of 14 CFR part 107 in 2016. While the UAS program saw steady growth following the implementation of part 107, IDOT reported that the program stagnated after the onset of the COVID-19 pandemic in 2020, and advancements in the UAS program were delayed. Due to these delays, IDOT noted the challenges associated with falling behind with the fast evolving nature of UAS technology. Despite these challenges, IDOT, through its Aeronautics division, is actively working to establish a robust operational model and better organization for the UAS program.

IDOT's survey groups have shown significant interest in the UAS program, with seven of nine districts participating in statewide procurement efforts for UAS. IDOT has approximately 50 certified pilots and 25 UAS that it is working to better utilize. IDOT is currently drafting a UAS operations manual to streamline UAS activities and ensure consistency across the State.

## INDIANA DEPARTMENT OF TRANSPORTATION

Indiana DOT (INDOT) began its UAS program around 2016, initially focusing on documenting disaster response and relief efforts. INDOT has developed a Concept of Operations that serves as an operations manual to guide pilots through essential preflight checklists, flight planning procedures, emergency response protocols, and other operational guidelines. The State DOT currently has five certified pilots and is working on diversifying its UAS fleet to continue to serve projects across all six districts.

The UAS program at INDOT is expanding as divisions within the agency integrate UAS into various workflows. Survey groups in the six districts are eager to integrate UAS into their operations, with INDOT aviation UAS pilots currently supporting these efforts. Three districts have initiated using UAS as a supplemental tool for bridge inspections, although this process has been temporarily paused to develop standard operating procedures (SOPs) specific to INDOT's bridge inspection program. INDOT noted it is also using UAS to supplement statewide traffic camera monitoring and conduct environmental surveys using multispectral imaging to identify invasive species. INDOT has also transitioned from using crewed aircraft for traditional aerial surveys to relying on UAS, recognizing the versatility and capabilities of various UAS platforms and sensors.

## IOWA DEPARTMENT OF TRANSPORTATION

Iowa DOT has about 15 certified pilots and is working on growing and diversifying its UAS fleet. Iowa DOT's UAS program is decentralized; each group or division is managing its use of UAS, procurement of UAS platforms, and the software needed for processing UAS-collected data. However, once an individual receives their FAA certification, they are all required to also complete a flight test with the Aviation Director or staff.

Iowa DOT has implemented UAS into various use cases such as design survey, airport inventories, natural disaster response, wetland mitigation, supplemental bridge inspection, among others. Additionally, the State DOT has utilized UAS from its fleet equipped with Real-Time Kinematics capabilities to capture data which is then processed into orthomosaics and combined with Computer-Aided Design linework and e-ticket data to create digital as-builts. Iowa DOT also has two tethered UAS in the Traffic Operations Bureau and is exploring the best route to integrate additional tethered UAS platforms.

## KANSAS DEPARTMENT OF TRANSPORTATION

Kansas DOT (KDOT) launched its UAS program in 2019, when the Division of Aviation began procuring UAS, drafting SOPs, and initiating UAS operations. The KDOT Division of Aviation then handed the UAS program off to the various divisions throughout KDOT, leaving it to each division to integrate the technology into its workflows. KDOT reported that this approach to integration has been challenging and noted that the agency is still working to fully incorporate

UAS into its operations. KDOT currently has 36 certified pilots and 50 visual observers and is working on diversifying its UAS fleet. KDOT is interested in exploring the use of LiDAR sensors and additional applications for LiDAR.

KDOT is currently exploring innovative uses for tethered UAS, such as bridge monitoring, traffic observation, and responses to bridge strikes. Additionally, the agency has started to explore using UAS as a tool to assist on bridge inspections, but there has been some resistance from seasoned employees unfamiliar with the technology and hesitancy from younger staff lacking UAS experience. Despite these challenges, KDOT is making progress in using UAS for various tasks, including quantity measurements on construction sites, culvert inspections, and slope analysis. The agency is also looking into cloud storage solutions to replace its internal servers for data management and is exploring pathways to use larger UAS for Beyond Visual Line of Sight (BVLOS) operations.

## MISSOURI DEPARTMENT OF TRANSPORTATION

Missouri DOT's (MoDOT) UAS program is housed within the Safety Management group, a decision that aligns with the MoDOT Director's strong focus on safety. MoDOT is following a three-phase approach to implement the program—Phase 1 began a year ago. During this initial phase, MoDOT procured five UAS platforms and involved three districts, prioritizing safety-focused use cases that reduced the need for personnel to work in roadways. One of the key initiatives includes equipping all four of MoDOT's bridge inspection snooper trucks with UAS to assist with initial inspections, thereby enhancing safety.

As the UAS implementation plan moves into Phase 2, MoDOT recently purchased four additional UAS and has engaged the survey teams. MoDOT's phased and centralized approach to starting its UAS program was informed by discussions with other States. MoDOT's plan emphasized starting small to build a solid foundation using the multiphase approach. The State DOT employs risk-based assessments using software that includes customized checklists and the ability to review and approve UAS operations. These risk-based evaluations prioritize safety throughout the UAS program's development.

## MINNESOTA DEPARTMENT OF TRANSPORTATION

The Aeronautics office at the Minnesota DOT (MnDOT) oversees UAS operations. The representative attending the peer exchange reported on the use of UAS by the Bridges and Structures group. MnDOT began its UAS program to assist with bridge inspections in 2015, initially as a series of research projects. By starting slowly and focusing on bridges and structures in rural areas, the group was able to gain management buy-in and approval, eventually expanding the program significantly. The MnDOT Bridge and Structures group has 33 certified pilots and more than 30 various UAS platforms, operating under the policies and procedures established by the MnDOT Aeronautics Office, which provides ongoing support and oversight. The program has benefited from Federal funding, including the FHWA State Transportation Innovation Council Incentive funding, which it used to acquire several UAS.

To manage the growing amount of data generated by UAS, MnDOT has opted to avoid cloud-based solutions for now, instead purchasing a separate server dedicated to bridge inspection UAS data. While this system can be cumbersome, particularly in managing permissions, it provides the State DOT with a secure and controlled space for its UAS-collected data. MnDOT noted it

meets semi-annually as a larger UAS committee that includes participants from FHWA, FAA, Minnesota Department of Natural Resources, and other stakeholders to discuss relevant topics and updates. Additionally, MnDOT has integrated a chapter on UAS use into its Bridge Inspection Manual, underscoring the role of UAS as a supplemental tool that enhances efficiency, addresses workforce challenges, and reduces the need for costly additional equipment.

## NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

North Dakota DOT (NDDOT) initiated its UAS program in 2017 by first developing a plan and policies to guide implementation. In 2018, the agency began procuring UAS and started exploring use cases in four of its eight districts. NDDOT was one of only three State DOTs that participated in the U.S. Department of Transportation's UAS Integrated Pilot Program. NDDOT's involvement in the pilot program tested the use of UAS over people and BVLOS, specifically inspecting power lines in urban areas where traditional methods like helicopter surveys would be cost-prohibitive.

As the UAS program matured and all eight districts began using UAS, NDDOT began purchasing larger UAS equipped with LiDAR sensors to expand its operational capacity. The NDDOT UAS program now consists of 33 aircraft and 52 pilots. The program is largely decentralized; each district has a designated lead Pilot in Command (PIC) who manages the day-to-day UAS operations within that district. If the district or PIC need additional resources or assistance, they can contact the UAS program manager in the NDDOT's Innovation and Technology group. This structure has enabled all eight districts, even those districts that were initially hesitant, to embrace UAS technology, as the positive impacts became clear.

As NDDOT continues to mature its UAS operations, the agency is exploring further diversification of its UAS fleet, including tethered systems for emergency operations like ice jam monitoring and river surveillance. Along the Interstate-29 corridor, NDDOT plans on using UAS to conduct BVLOS road assessments before sending out snowplows; this effort will help prioritize snow removal along the interstate. NDDOT also described its collaboration with the State fire marshal office regarding safe management and storage of its UAS equipment, specifically the batteries. The agency purchased fireproof equipment and the proper fire extinguishers to help ensure safe conditions for equipment storage.

## OKLAHOMA DEPARTMENT OF TRANSPORTATION

Oklahoma DOT (ODOT) has explored implementing a UAS program over the years but is currently primarily relying on consultants for UAS work rather than developing an in-house program. Efforts to introduce an in-house UAS program to senior leadership were made several years ago, but the proposal was declined. However, with the growing importance of digital delivery in transportation projects, ODOT representatives recognize there is now a greater need for UAS capabilities. The survey team is gathering insights from other States' successful UAS programs, which they plan to present to ODOT senior leadership as evidence to support the adoption and integration of UAS technology within the agency.

### TEXAS DEPARTMENT OF TRANSPORTATION

Over the last several years, Texas DOT (TxDOT) has been working to expand its UAS program to use UAS technology for a wide range of applications across the State. The UAS program is managed by the Flight Services group in the Aviation Division of TxDOT, and two UAS program managers oversee UAS platform and sensor procurement, training, and the development of policies and procedures. Because of the large size of Texas and the fact that TxDOT has 25 districts, there are currently 121 certified pilots, and the TxDOT training program trains around 60 new pilots every year. This approach helps ensure that each district is equipped with at least a few pilots, although even with the larger number of pilots, it has been challenging to meet the increasing demand. To address more complex UAS operations, TxDOT is building a core team of specialized pilots who can be used statewide on an as-needed basis.

The TxDOT Aviation Division procures UAS and provides each district with an initial UAS platform funded by the Aviation Division; the districts are responsible for purchasing additional UAS as needed. The program supports various applications, including environmental monitoring, bridge inspections, surveys, and mapping. To streamline UAS operations, TxDOT has implemented an internal web form to review and approve flight requests. Pilots attach a screenshot of the relevant airspace and complete the internal form, which is then reviewed by the UAS program managers for approval or further discussion, ensuring that all UAS activities are conducted safely and efficiently.

### WISCONSIN DEPARTMENT OF TRANSPORTATION

Wisconsin DOT (WisDOT) has a developed UAS program that actively supports its pilots by covering the cost of the FAA certification exam and requiring a WisDOT proficiency flight check every two years. Representatives from WisDOT noted that significant efforts were invested in demonstrating the value of UAS to the agency, for example, by demonstrating how UAS could be used to gather data in mapping projects without the need for lane closures or nighttime operations. However, convincing leadership of the necessity for specialized processing software and tools beyond the UAS platforms has been challenging. WisDOT aims to continue to advance its UAS program, including using UAS for quantity checks against contractor submissions as a quality assurance measure, further enhancing the State DOT's operational efficiency.

WisDOT is exploring the integration of UAS as a supplemental tool to traditional hands-on bridge inspections. The agency recognizes that while UAS cannot replace the expertise of a trained inspector, it can significantly enhance efficiency by helping inspectors focus on specific areas of concern on the structure. WisDOT has been exploring an approach that involves a two-person crew, with the bridge inspector working closely with the UAS pilot to maximize the effectiveness of inspections. By incorporating UAS into the regular inspection cycle, WisDOT is hoping to maximize the use of its inspectors' expertise and improve overall safety and precision in its bridge inspection and maintenance efforts.

## GETTING IT RIGHT DISCUSSION

In a roundtable discussion State DOTs reviewed challenges, lessons learned, and successes around their UAS programs within their respective organizations. MnDOT described the issues

arising from having the UAS program housed within Aeronautics, particularly the high turnover of UAS program managers. The lack of consistency in UAS program administration presents various challenges. A potential solution to the turnover of UAS program managers could be establish job specifications and dedicate a position solely to the UAS program, rather than continuing the current shared duty model. TxDOT shared it has two full-time, dedicated UAS Program Coordinators who handle UAS procurement, training, and implementation. WisDOT noted difficulty in convincing leadership of proposed full-time UAS positions, rather than as a supplemental tool.

The discussion also touched on managing the widespread enthusiasm from people about obtaining their UAS license and purchasing UAS because it will all be paid for by the agency but then the pilots and equipment are largely underutilized. MoDOT addressed this issue by centralizing its UAS program, ensuring that all procurement and pilot designations are managed by the UAS Program Manager. MoDOT has set an expectation, though not enforceable, that UAS pilots stay for at least three years. The agency is also focused on creating a positive workplace culture to make MoDOT an attractive place to work, particularly among State agencies. MoDOT emphasized the importance of careful selection, ensuring potential UAS pilots present high-use cases to justify their involvement in the UAS program. Similarly, TxDOT has centralized management of its UAS program, with strict approval processes in place for training and procurement.

A similar issue discussed was the difficulty in keeping trained pilots active and comfortable with flying, especially after the initial excitement of joining the UAS program wears off. KDOT noted that many employees were eager to join the program initially but became discouraged when they realized it added more duties without additional pay. WisDOT raised concerns about pilots losing confidence and abilities when they do not fly regularly. In response, MoDOT shared that it has implemented clear expectations, where pilots are informed that if they do not use the UAS equipment sufficiently, it may be recalled and placed with another division to leverage the asset more efficiently. Additionally, having a dedicated champion for UAS technology within the organization can help support new pilots, guiding them through initial use cases until they become comfortable and frequent users of the technology.

MDOT reflected on the growth of its UAS program. Initially, it was easy for the program to be centrally managed with one person overseeing it as an additional duty; however, as the program expanded, more oversight became necessary, and MDOT moved to a hybrid model between centralized and decentralized management. While the MDOT Division of Aeronautics has a team of people involved in the oversight of the UAS program, it has maintained a level of trust with the UAS pilots within other divisions of MDOT, trusting the pilots' training and abilities, allowing them to procure UAS and sensors as needed, and carry out their missions. MDOT Aeronautics assists with additional safety checks for more complex UAS operations through mission submissions and checklists.

# MICHIGAN DOT PROJECT-BASED PRESENTATION

As the host State for the peer exchange, representatives from Michigan DOT highlighted some of the UAS uses cases from across the State. Recently, MDOT Aeronautics had a rotational college intern with bridge experience who completed an introductory project with the bridge team. A bridge deck was closed for traditional checks for delamination and spalling using traditional

methods of a sounding hammer and dragging chains. The bridge deck was painted and marked using these traditional processes. While the bridge was still closed, UAS was used to capture aerial images of the painted bridge deck. These aerial images were later overlaid on the drawings from the traditional marking workflow to demonstrate the accuracy between the drawings and the actual painted markings as seen in Figure 2.

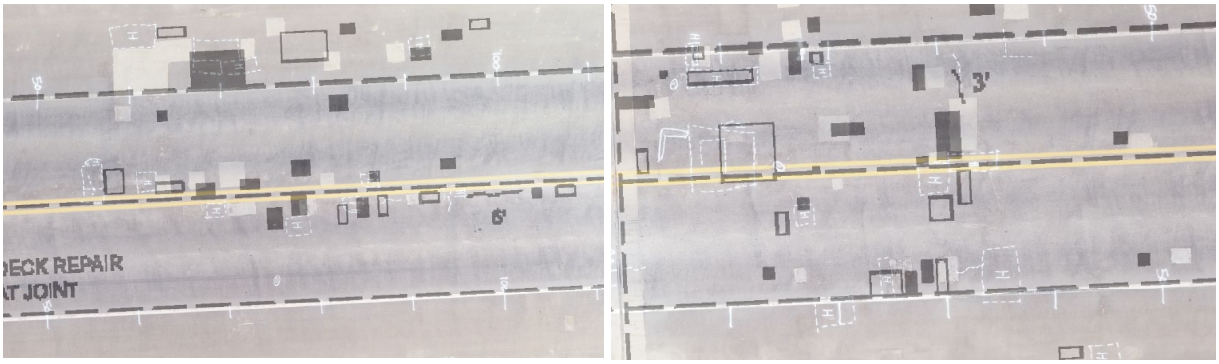


**Figure 2. Bridge deck aerial overlay (Source: MDOT).**

Another use case highlighted by MDOT was the use of UAS in environmental applications, specifically wetland management. MDOT reported that UAS technology can provide a comprehensive visual overview of wetland areas, enabling MDOT to more efficiently assess how much water is being retained and gain an overall perspective of the wetland's performance. This aerial perspective is particularly useful for wetland delineation, a process that involves identifying and mapping the location and size of wetlands. Traditionally, this task requires extensive fieldwork and data analysis, but MDOT shared how UAS has simplified the task by enabling quick and accurate area mapping.

One significant advantage of using UAS in wetland management is its efficiency in conducting tree mortality studies, particularly after harsh winters. Instead of spending a week walking through wetlands with a handheld Global Positioning System (GPS) unit, MDOT can now fly a UAS over the area to capture all necessary data in an hour or two for later processing in the office. This method not only saves time, but it also allows for the rapid and accurate measurement of wetland site size, providing essential information for the required environmental assessments.

MDOT is also using UAS to identify and manage invasive species within wetland areas. By flying a UAS over a wetland, specific invasive species can be detected and mapped using flight planning software (Figure 3). These data are then uploaded to a spray UAS (Figure 4) that precisely targets only the identified areas, leaving native species largely unharmed. This precision is a significant improvement over traditional spraying methods, which often damage desirable vegetation. Overall, MDOT's integration of UAS into wetland management has proven successful, offering more efficient, accurate, and environmentally friendly approaches to maintaining wetland health.

MDOT Aeronautics shared how it uses UAS to survey the approach surfaces for airport runways, as shown in Figure 5. This use allows for efficient and a more accurate understanding of whether trees or other objects are in the approach surfaces and require mitigation. Traditional methods of performing this job require individuals to stand near the end of runways using hand instruments in an effort to measure the height and location of trees. Using UAS to collect these data and then

process them into a 3D model enables a better visual understanding of which trees are encroaching into the protected approach surface (Figure 6). Similar methods could be used to determine vegetation encroachment into rights-of-way for highways.

**Figure 3. Mapping and identifying invasive species for mitigation (Source: MDOT).**

**Figure 4. MDOT's spray UAS (Source: MDOT).**

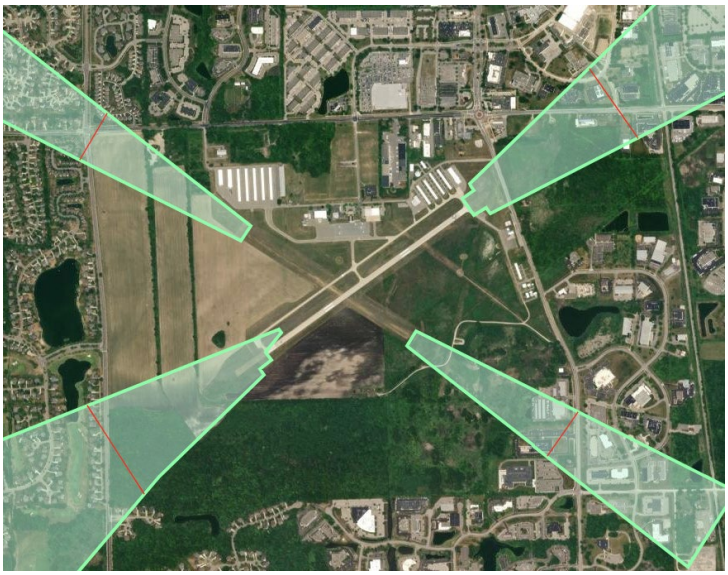

**Figure 5. Approach surfaces for runways (Source: MDOT).**

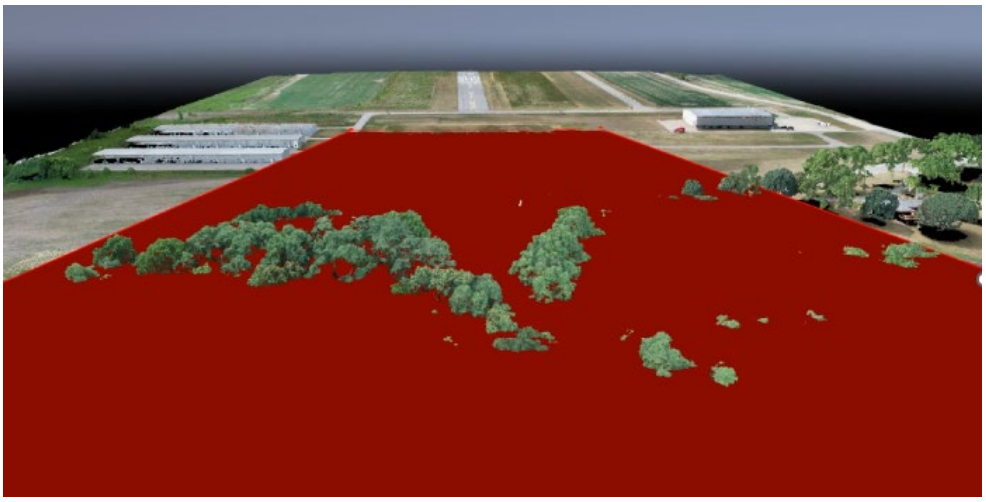

**Figure 6. Trees encroaching on protected runway approach surfaces (Source: MDOT).**

# DATA MANAGEMENT

State DOTs discussed common challenges in UAS data management, primarily around data storage, access, and processing capabilities. TxDOT highlighted issues with limited computing power on hardware, making it difficult for others to access and use large files on less powerful devices. Participants noted that although cloud processing solutions sometimes result in a slight loss of accuracy compared to desktop processing, cloud processing is the preferred solution. MnDOT's bridge group, however, successfully collaborated with its Information Technology department to secure dedicated servers, alleviating some data management challenges.

Sharing large UAS datasets, particularly complex point clouds, is another area where some State DOTs face difficulties. For instance, MoDOT noted that while it has been able set up a photo server accessible to all of its UAS pilots, sharing point cloud data remains a challenge due to software access issues.

Efforts are underway at many of the State DOTs to standardize workflows. For example, WisDOT is working on developing mission profiles outlining typical flight altitudes, ground sampling distances, and detailed workflow processes for specific use cases that can aid others in collecting and managing UAS data more effectively.

WisDOT also discussed its exploration of various approaches to naming conventions for UAS-collected data. ODOT shared that its innovation team is taking a lead role in managing data lifecycles and naming conventions. This includes aligning data management with the lifecycle of a project or asset, ensuring consistency and ease of access throughout the project's duration.

Privacy and data security principles were also explored in the data management roundtable discussion. MDOT shared it focuses on differentiating between best practices for internal versus external data sharing, noting there are differences depending on data set or asset ownership. Best practices for sharing data externally include redacting any sensitive or personal information. Retention policies vary, and many State DOTs are still deciding if they should retain both raw and processed UAS data or only retain processed data. Many of the State DOTs noted data management continues to be challenging.

# TAKEAWAYS AND NEXT STEPS

The concluding roundtable discussion was focused on the next steps and takeaways for each State DOT from the peer exchange. WisDOT highlighted the need to replace its UAS fleet and discussed the possibility of using the newly created grant program in the FAA Reauthorization Act to assist State and local transportation agencies with UAS fleet transitions. The peer exchange also provided insights into creating digital delivery, which WisDOT plans to explore further. Another takeaway WisDOT noted was the need for leadership buy-in and the value of return on investment examples and that data from other States can help support funding requests and program advancement. WisDOT also emphasized the value and importance of continuing UAS peer exchanges to facilitate ongoing learning and networking.

MoDOT discussed the challenges of the lack of UAS standardization and how it looks forward to the potential Pooled Fund Study on UAS standards. MoDOT also mentioned that UAS peer exchanges are a helpful way to learn from the experience of other State DOTs developing its program. IDOT, in turn, highlighted the benefits of making new contacts and learning about various UAS applications, such as data management, and expanding use cases into construction and bridge inspections. A next step for IDOT is working on securing a centralized organization for procurement and standardization within its UAS program.

KDOT appreciated the opportunity to compare its program with others and learn about overcoming common challenges, such as managing UAS operations across multiple divisions. KDOT found it particularly helpful to gain insights into grants and funding strategies and discussed the importance of organizing and managing UAS data, especially in the context of digital delivery. MnDOT echoed these sentiments, noting the value of not "reinventing the wheel" by learning from the experiences of other State DOTs. MnDOT also highlighted the importance of collaboration among State agencies through a UAS committee, which has been helpful in addressing common challenges.

ODOT noted it wants to grow its adoption of UAS and plans to engage senior leadership to demonstrate the potential benefits of UAS programs. ODOT shared that with the rise of digital delivery, the value of UAS as data collection tools is becoming more apparent, and the insights gained from other States during the peer exchange will help advocate for program expansion. Additionally, the importance of documenting successes for both leadership and public communication was underscored, with MnDOT sharing how it has prioritized public awareness of UAS initiatives from the start. Iowa DOT found the peer exchange useful for learning about safety improvements and new technologies like MDOT's spraying UAS, as well as for exploring funding strategies for fleet renewal. INDOT appreciated the insights on environmental applications and hearing about the collaboration between aeronautics and other teams.

TxDOT shared its plans of implementing remote UAS dock operations, particularly within large-scale projects like Interstate 35 in the Austin District. TxDOT is working on developing SOPs for these operations and is exploring other BVLOS operations. TxDOT continues to face challenges in sharing digital information and is engaging with its main software providers to find solutions. TxDOT also noted its exploration into implementing UAS lighting systems and furthering its UAS program development with insights gained from the peer exchange. MDOT wrapped up the discussion and noted that seeing how aeronautics divisions coordinate with other State DOT divisions or bureaus within other States may change its approach as a result. MDOT also highlighted the benefits of learning about other use cases.

# POOLED FUND STUDY – UAS STANDARDIZATION

As UAS deployment activities have matured across the country, State DOTs have recognized and identified the need for UAS standardization. As a result of this identified need, some State DOTs have collaborated to begin a transportation pooled fund study that Alaska Department of Transportation & Public Facilities is championing. The objective of the project is to create a comprehensive UAS standards and specifications guidebook that provides State DOTs with the needed UAS data collection standards and best practices. A standalone standards guidebook is envisioned for the following use cases:

- Survey
- Construction
- Bridge Inspections
- As-builts
- Incident Management
- Earth Movement

Additional details regarding the pooled fund study can be found at the following link: Transportation Pooled Fund – Solicitation Details – UAS Standardization.

# CONCLUSION

The peer exchange provided an environment for State DOTs to discuss and share challenges and successes related to growing their respective UAS programs. Each attending State DOT was able to report on its UAS state of play, while roundtable discussions covered key topics such as UAS pilot and equipment utilization, data management, and various use cases. Key takeaways from the peer exchange included:

- State DOTs are committed to using UAS as a tool and continuing to work on maturing UAS operations and applications.
- State DOTs experience similar challenges, for example, mitigating the low utilization rates of trained UAS pilots and purchased UAS equipment. A potential solution implemented by several attending State DOTs is to have centralized training and procurement guarded by robust approval processes with expectations established up front.
- Many State DOTs are actively working to replace existing UAS fleets and are seeking guidance on Federal funding opportunities to assist with these efforts.
- Data management continues to be a common challenge when collecting large amounts of data using UAS. These challenges include securing enough internal server space, permissions to the server, getting leadership approval for cloud solutions, and questions around retention best practices.
- An overarching theme in the concluding roundtable discussion was the value of the peer exchange itself, with most of the participants noting how helpful it was to hear about

other UAS programs, see the commonalities in challenges, and hear about different approaches to solving those challenges.

- The envisioned transportation pooled fund study for UAS standardization represents a significant step toward potentially creating unified UAS guidelines and best practices that can benefit all State DOTs.

# REFERENCES

Hubbard, S., and B. Hubbard. (2020). A Method for Selecting Strategic Deployment Opportunities for Unmanned Aircraft Systems (UAS) for Transportation Agencies. *Drones*, 4(3): 29. https://doi.org/10.3390/drones4030029