blyncsy™
MOVEMENT DATA INTELLIGENCE

Plano
City of Excellence

BLYNCSY CASE STUDY

THE CITY OF PLANO, TEXAS

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1. Executive Summary

Road maintenance can save lives, reduce costs, and extend the useful life of our roadway assets. However, the cost of road surveys can be prohibitive, subject to the surveyor's perspective, and time consuming. Blyncsy by Blyncsy uses Artificial Intelligence (AI) Vision and crowdsourced dash camera footage to automate the surveying process in a standardized way, at a fraction of the cost and time associated with previous manual surveying methods.

The City of Plano, Texas conducted an "apples to apples" comparison of their traditional manual method of surveying four centerline miles of roadway to Blyncsy's Blyncsy product analyzing the same four miles of roadway. This case study seeks to highlight the results of that comparison.

Both Blyncsy and Plano surveyed 11 different asset types within these four miles of roadway. The outcomes demonstrated in this case study highlight the high level of detail and insight that Blyncsy can deliver to cities, ensuring results equal to and at times better than those of manual surveys. Additionally, Blyncsy costs 90% less than surveying the traditional way. This case study also highlights the need for manual surveys to provide engineering judgment and identify issues that Blyncsy may not automatically detect.

"Blyncsy's ability to quantify and inventory traffic elements can be a very powerful tool that could save lots of man-hours and help maintain and stay informed about the condition of city infrastructure."
-Chad Ostrander, Senior Traffic Engineer, City of Plano Transportation Engineering

2. Introduction

2.1 About Blyncsy

Blyncsy has been in business since 2016 assisting public agencies, communities, and Departments of Transportation (DOTs) by gathering data on their roadways. Blyncsy has developed the tools needed to process and analyze dashcam footage, and have lowered the bar for Departments of Transportation to make use of them. With cutting-edge techniques such as machine learning, image processing, and data science, Blyncsy's products help innovate the way we think about road maintenance.

Roadway management is a significant logistical and financial challenge for agencies, with safety and financial implications for everyday motorists and the cities that serve them. Promoting preventative maintenance strategies for road maintenance is vital in preserving the life span of resources. Fortunately Blyncsy, a new software solution, allows for up to date street-level imagery and data-driven insights to guide decision making for roadway management.

2.1 About Blyncsy Cont.

Blyncsy by Blyncsy is a technology for processing dashcam footage from hundreds of thousands of vehicles already on the roads, in many cases processing images within 60 seconds from the time of collection. Blyncsy can provide an up-to-date view of roadways from around the country without ever scheduling someone to drive the roads. Blyncsy can detect anything the eye can see, whether it's fading paint lines or streetlight outages.

Blyncsy can reduce or eliminate the need to manually survey roads, and the raw imagery that Blyncsy collects is automatically stored in the cloud for historical review. Additionally, the street-level imagery that is collected by Blyncsy can be used for a wide range of applications, like debris detection, paintline quality, road sign quality, etc. This can lower the cost of data collection even further by sharing it across departments and neighboring communities.

2.2 About Plano, Texas

The City of Plano, Texas is a city located in the north of the Dallas-Fort Worth metroplex. It has a population of over 270,000 people, making it the ninth most populous city in Texas. Plano is known for its affluent neighborhoods, excellent schools, and strong economy, with major employers including Toyota, Liberty Mutual, and JCPenney.

Plano is also significant in the transportation sector, thanks to its location at the intersection of several major roadways. The city has a major highway on each side: Dallas North Tollway (DNT) on the west, President George Bush Turnpike (PGBT) on the south, U.S. Highway 75 on the east, and State Highway 121/Sam Rayburn Tollyway (SRT) on the north. These roads provide easy access to nearby cities such as Dallas and Frisco, as well as to other major Texas cities and beyond. These highways are also crucial for the movement of goods and services.

Plano is served by two major airports, the Dallas/Fort Worth International Airport and the Dallas Love Field Airport, which provide domestic and international air travel options.

Additionally, Plano is home to the headquarters of several major transportation companies, including J.C. Penney Transportation Center and FedEx Office, further highlighting its importance in the transportation industry.

Overall, Plano's transportation infrastructure plays a vital role in supporting the city's economy and connecting it to other parts of the region and the world.

2.3 Purpose of the Project

Road maintenance is a costly and labor-intensive task that requires significant investment from state and federal agencies. According to the American Society of Civil Engineers, there is a $2.6 trillion investment gap in America's infrastructure. This is due in part to the high cost of manual labor required for road maintenance, which can account for up to 50% of the cost of road repairs.

Manual surveys are often used to assess the condition of roads and are extremely time-consuming, while requiring significant resources. This boots on the ground approach to fixing roads also increases the carbon footprint of road maintenance operations. Additionally, road maintenance comes with significant risk of liability for agencies, as sending out employees to analyze roadways puts both drivers and employees at risk.

The City of Plano Transportation Engineering Division (Plano) received complaints and requests from multiple citizens about safety concerns and speeding along the Los Rios Boulevard corridor from 14th Street to Parker Road. As a result, Plano conducted a traffic safety audit to investigate and identify traffic safety issues as well as develop solutions.

In addition to Plano's manual survey, the city wanted to analyze what can be done automatically with Blyncsy versus what requires an engineer to go into the field and apply their professional engineering skills to evaluate specific problems on their roadways.

Alongside Plano's manual survey of this four mile roadway, Blyncsy conducted its own survey utilizing crowdsourced dashcam imagery and artificial intelligence. Through Blyncsy's various partnerships with dashcam providers, Blyncsy is able to crowdsource imagery from over 400,000 vehicles nationwide. Using this imagery, Blyncsy applies machine learning algorithms to automatically detect the quality of various roadway assets

The purpose of this project was to compare the results of a four mile road survey conducted by Blyncsy and by a manual road survey. This case study highlights the amount of time and money that the City of Plano saved by using Blyncsy compared to manual surveys; and highlights the level of detail that Blyncsy provides. The study also highlights the need for an engineer’s evaluation to provide engineering judgment and decision-making by performing a manual survey.

3. Project

The City of Plano requested an “apples to apples” comparison of Blyncsy's data and the data collected by manual surveys.

The Plano division was divided into five pairs of two engineers each to do a manual survey by driving the roughly four centerline miles of roadway and recording their findings. The city's manual survey was strictly visual. The division then shared their findings for internal discussion and created work orders to fix the identified issues. The City of Plano noted that each pair of engineers had to drive back and forth along the four mile stretch several times in order to survey the entire road properly.

Plano’s primary goal of the traffic safety audit was to ensure the corridor was operating in a safe and efficient manner as well as complying to codes and standards, such as the Manual on Uniform Traffic Control Devices (MUTCD). The manual survey included numerous drives back and forth along the corridor, a curve ball bank speed study, and photo and video recordings to enhance visual detection. In addition to identifying missing or incorrect traffic control, crash data and citizen requests' history were also reviewed and analyzed as part of Plano’s study.

Alongside Plano's manual survey, Blyncsy collected crowdsourced dashcam imagery along four centerline miles of roadway. Blyncsy analyzed the imagery collected using machine learning algorithms. By segmenting imagery with artificial intelligence, Blyncsy allows Plano to see their roads through the lens of machine vision. Blyncsy surveyed 4 miles of roadway for 11 different asset types discussed in detail in Figure 1 below. All of this data was uploaded to the Blyncsy platform for Plano employees to view.

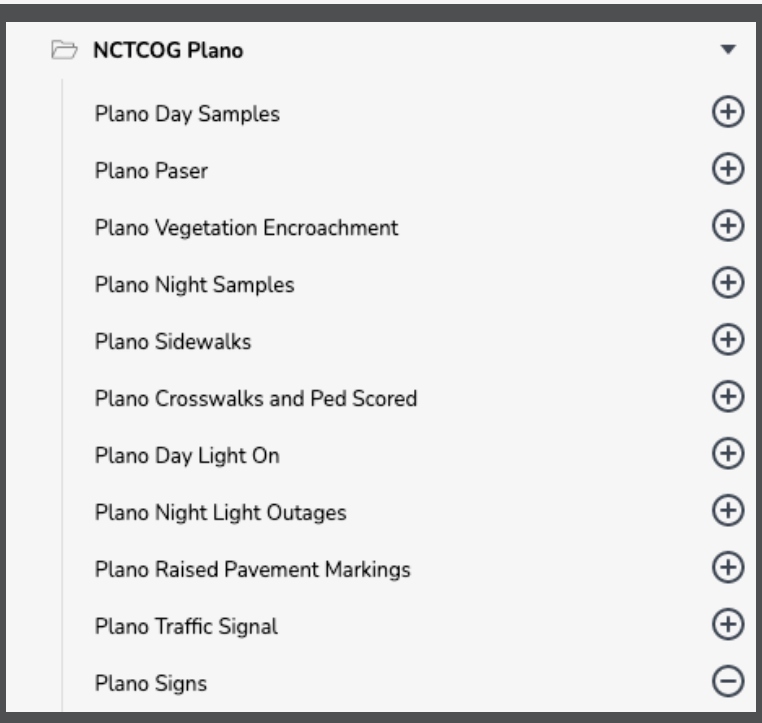

Figure 1. This image highlights the 11 different asset types Blyncsy analyzed for Plano, Texas

4. Plano's Findings

4.1 Issues Identified

Similar to the 11 different asset types that Blyncsy analyzed, Plano identified issues in the following categories in their manual survey:

- Missing or incorrect signs
- Condition of signs
- Condition of crosswalks
- Condition of pavement
- Condition of pavement markings
- Lane line extensions
- Access management
- Median access
- Lighting
- Signal operations
- Improperly designed lane drop
- Crash data analysis
- Curve speed study
- 85th percentile speed study
- Fix It Plano requests history

In Plano's report of their manual visual survey, they identified approximately 38 issues on the four mile stretch of roadway between the five pairs of engineers. Blyncsy identified seven of the same maintenance issues. However, the other 31 issues were out of scope for Blyncsy's survey. It is important to note that Blyncsy is capable of identifying many of these issues through computer vision. The issues identified by Plano are listed below along with some figures for specific examples:

Angelina Street sign is faded and/or not reflective
"STOP" sign and Street Name sign are leaning/crooked
"ONE WAY" sign height is too low near PEHS
Inconsistent/missing Lane Assignment Signs @ Los Rios Boulevard & Park Boulevard
NB Los Rios Boulevard @ 14th Street: Insufficient/incorrect signage and pavement marking for lane drop
Crosswalk markings are not aligned with pedestrian ramps @ Parker Road & Los Rios Boulevard
Missing advance warning signs at school zone south of Merriman Drive, e.g. "SCHOOL ZONE AHEAD"
Inconsistent/missing Lane Assignment Signs @ Los Rios Boulevard & Parker Road
Missing "PEDESTRIAN CROSSING AHEAD" signs near school zone
Bike Route signs for Route 97 missing
SB Los Rios Boulevard @ Kite Landing Lane: missing dedicated left-turn lane for residential street access
Bridge over Rowlett Creek: Barrier missing end treatment and/or OM3-L/R sign
Graffiti stickers on service cabinet
SB Los Rios Boulevard @ Parker Road: Multiple signs staggered back to back
Inconsistent/missing Left Turn Arrow pavement markings in left-turn bays
NB & SB Los Rios Boulevard RT @ 14th Street: Missing "RIGHT TURN ONLY" signs
NB Los Rios Boulevard @ Parker Road: NBLT puppy tracks are misaligned
EB Parker Road @ Los Rios Boulevard LT lane is closed: verify split phasing
Object markers recommended to be installed at left-side extra pavement sections
SB Los Rios Boulevard north of 18th Street: Missing signage for additional lane
Reflective buttoning/markings recommended to be installed at median noses
Conduct curve study for roadway geometry between Bent Ridge Drive and Primavera Drive
Access Management around Plano East High School is poor and needs addressing
Full median reconstructon for Plano East High School parking lot access
SB Los Rios Boulevard near PEHS: confusing staggered lane drops at median openings
NB Los Rios Boulevard @ Tree Shadow & Trail Walker: back to back left-turn lanes spacing is too close

Figure 2. Issues that Plano identified through their survey and were out of scope for Blyncsy's survey

4.2 Plano's Crosswalk Scoring

Figure 3. Los Rios Boulevard and Parker Road- The City of Plano Transportation Division identified crosswalk pavement markings that were not aligned with the pedestrian ramp in the northwest corner.

Figure 4. Northbound on Los Rios Boulevard at Merriman Drive– The City of Plano Transportation Division identified that pedestrian ramps were present at all four corners of the intersection, but crosswalk pavement markings were missing at all four approaches.

4.3 Plano's Sign Inventory and Sign Condition

Figure 5. Northbound on Los Rios Boulevard at Merriman Drive– The City of Plano Transportation Division identified missing advanced warning Stop Ahead (W3-1) signs at all four approaches. Per MUTCD Table 2C-4 for a 35 mph condition, the Stop Ahead (W3-1) sign shall be placed 100 feet in advance of the Stop (R1-1) sign.

Figure: 6. Los Rios Boulevard and 14th Street- The City of Plano Transportation Division identified missing mandatory movement lane control signs, i.e. Right Lane Must Turn Right (R3-7) and Right Turn Only (R3-5) signs.

4.4 Plano's Taper/ Lane Drop Findings

Figure 7. Northbound Los Rios Boulevard at 14th Street- The City of Plano Transportation Division identified insufficient and incorrect use of signs and pavement markings in order for drivers to taper and merge properly for the inside lane drop traveling northbound on Los Rios Boulevard north of 14th Street.

Figure 8. Abrupt lane drop traveling northbound on Los Rios Boulevard at 14th Street

5. Plano's Findings VS. Blyncsy

Plano compiled their findings from the five different pairs of engineers into a cohesive report. The identified issues are stated in the above section. Through comparing Plano's report with Blyncsy's findings, Blyncsy was able to identify seven of the same maintenance issues.

It is important to note that Plano was surveying for more roadway assets than Blyncsy through their manual survey. For example, using engineering judgment, Plano identified missing signs that had not been installed previously and also identified signs that should be added at specific locations to enhance safety.

Blyncsy is able to detect missing signs if given historical data of signs that have been previously installed. Blyncsy can also notify Plano of any changes in sign condition over time.

Issues Plano Identified	Did Blyncsy Detect This?	Part of Blyncsy's survey?
"35 MPH SPEED LIMIT" signs are either only in the median or only in the parkway area	✓	✓
Uneven road conditions near railroad tracks between Plano Parkway and 14th Street	✓	✓
Crosswalk markings are faded @ Camino Dr/Dottie Dr & Los Rios Boulevard	✓	✓
Lighting is missing or needs replacement; dual arm luminaire recommended at six locations	✓	✓
Lighting is inconsistent, e.g. LED vs incandescent, spacing between light poles needs evaluating	✓	✓
Uneven road conditions near bridge over Rowlett Creek	✓	✓
Signs are obscured by trees	✓	✓

6. Blyncsy's Findings

6.1 Blyncsy's Pavement Markings- Daytime Condition

Visible pavement markings on roads are essential for promoting road safety. Studies show that well-defined and visible markings can reduce the risk of accidents and improve driver awareness, particularly when it comes to lane departures. According to the National Highway Traffic Safety Administration, 11% of fatal crashes in 2019 involved lane departures. Proper pavement markings can help prevent lane departures by providing a clear boundary between lanes. Furthermore, with the rise of autonomous vehicles, visible markings are even more crucial as self-driving cars rely on them to navigate the roads safely.

For this project, Blyncsy analyzed the visibility of pavement markings in 54,036 image samples on four centerline miles of roadway. The City of Plano uses raised pavement markings for the majority of their roadways along with painted markings for items like turn arrows. Blyncsy scored the presence and overall visibility of both raised pavement markings and painted pavement markings.

Of these images, 31,788 were day-time images. An image was taken every five feet throughout the four centerline miles of roadway. Blyncsy scores pavement markings according to a color-coded scale from "Worst" to "Best" and displays these color coordinated points on either a GIS map or in a CSV format. This scale is also completely customizable.

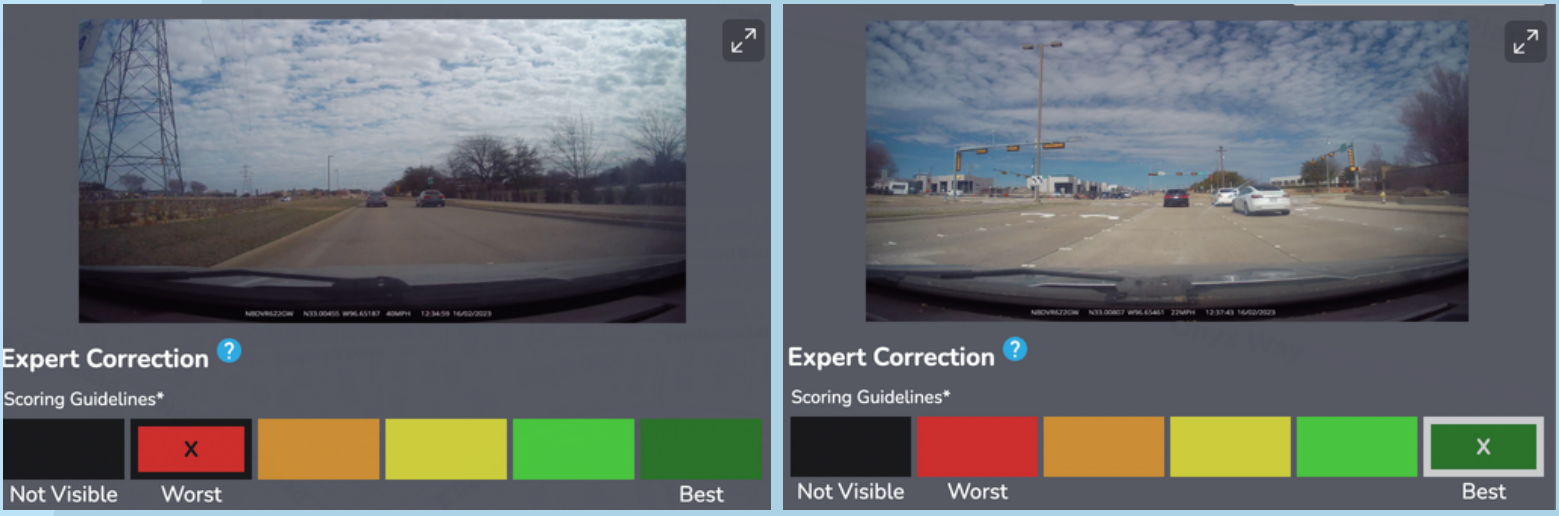

Figure 9. This image shows sample images with pavement markings scored "Worst" on the left and "Best" on the right

6.1 Cont

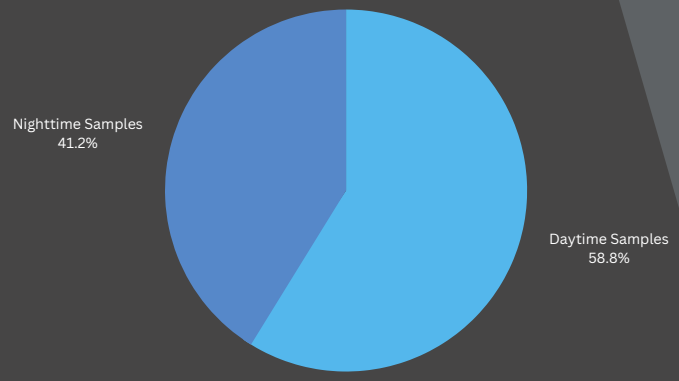

Figure 10. Daytime samples made up 58% of total samples analyzed for pavement marking quality

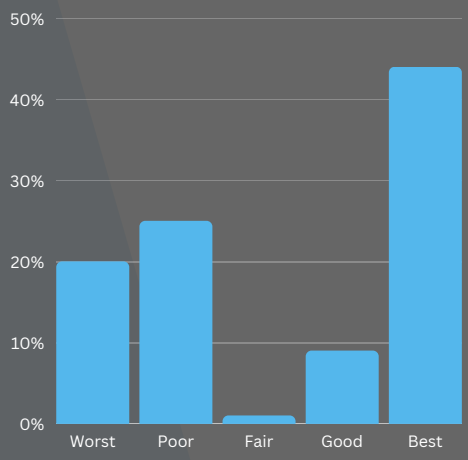

Figure 11. Percentage of scored pavement marking samples associated with each score

6.2 Blyncsy's Pavement Markings- Nighttime Condition

The importance of visible pavement markings on roads is even more crucial at night when visibility is reduced, and the risk of accidents is higher. According to the National Highway Traffic Safety Administration, 54% of fatal crashes occur at night. Well-maintained and reflective markings can help reduce this risk by providing clear guidance for drivers and improving their awareness of the road's layout. In fact, a study by the Federal Highway Administration (FHWA) found that reflective pavement markings can reduce nighttime accidents by up to 30%.

The City of Plano did not perform a retro-reflectivity analysis. Since the city uses raised pavement markings (RPM's), they know that if there are enough to see them in the day, they will be visible at night. As stated above, Blyncsy analyzed 54,036 samples on four centerline miles of roadway. Of those samples, 22,248 were nighttime images. In Blyncsy's reflectivity survey, it surveyed the presence and overall visibility of both raised pavement markers and painted pavement markings. Using nighttime images allows Blyncsy to calculate a correlated reflectivity score that is comparable to an overall reflectivity score.

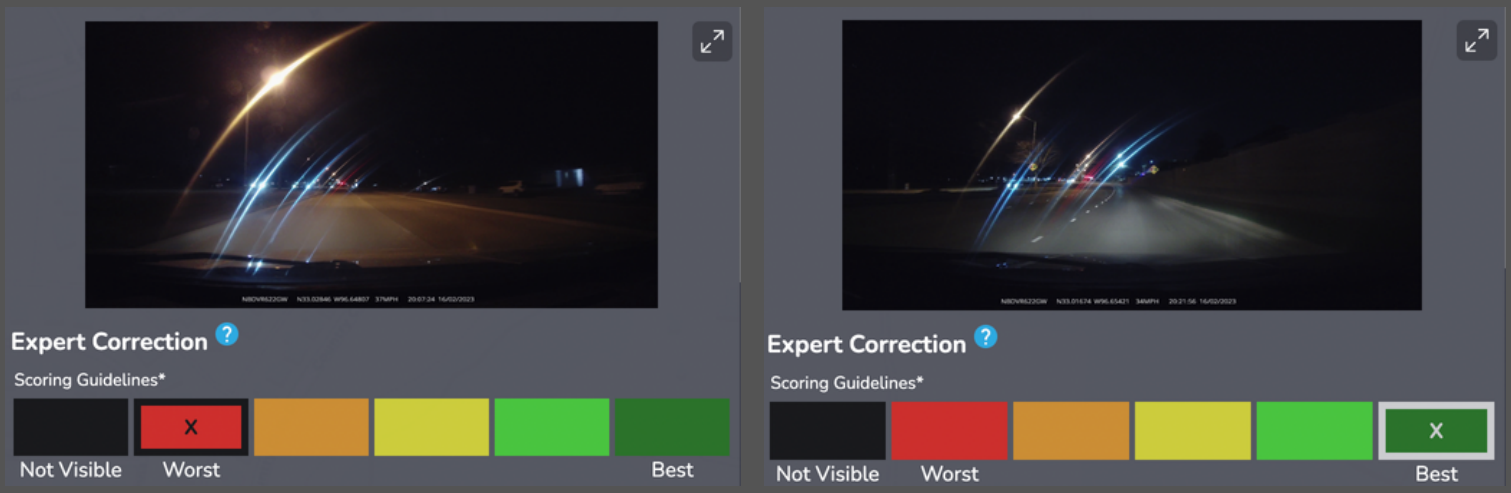

Figure 12. "Worst" reflectivity is shown in the image on the left and "Best" reflectivity is shown on the right

6.3 Blyncsy's Raised Pavement Markings

Raised pavement markings (RPM's) a re an effective safety measure used on roadways to improve visibility and reduce accidents. These markers are raised above the road surface and can be made of various materials, including thermoplastic, epoxy, or ceramic. They are often used to mark pedestrian crossings, bike lanes, and stop lines at intersections. According to the FHWA, raised pavement markings can reduce nighttime crashes by up to 40%. Additionally, the FHWA found that using raised pavement markers on centerlines can reduce head-on collisions by up to 50%. Moreover, raised pavement markings are more durable than traditional painted markings and can withstand heavy traffic and adverse weather conditions.

Ensuring that RPM's are in proper condition is vital. However, surveying raised pavement markings is difficult and oftentimes dangerous. In many states, RPM inspection can involve a manual process of inspecting each roadway marker with a hammer. The process is risky and labor-intensive.

Blyncsy automates this process using visual imagery and AI.

Throughout this project, Blyncsy detected a total of 9,539 raised pavement markings and detected 242 missing pavement markings. These missing pavement markings were located within groupings of 5, which means that the line lane is still considered in good condition.

Figure 13. This figure shows show two different examples of missing raised pavement markings

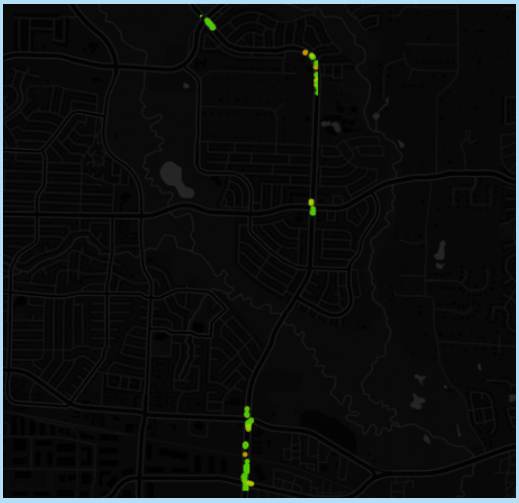

Figure 14. Blyncsy created 100 meter segments and calculated number of RPM's that were present and the number that were missing in order to determine a score of "good, fair, or poor."

6.4 Blyncsy's Pavement Surface Evaluation and Rating (PASER)

Using public funds to maintain safe roads requires balancing budgets and priorities. There are three especially useful steps in managing local roads (PASER Manual, Transportation Information Center, University of Wisconsin-Madison):

1. Inventory all local roads and streets.
2. Periodically evaluate the condition of all pavements.
3. Use the condition evaluations to set priorities for projects and select alternative treatments.

Blyncsy's remote Pavement Surface Evaluation and Rating (PASER) system is part of the Blyncsy product, and enables cities to perform all three steps without ever leaving the office.
Blyncsy conducts its PASER analysis by analyzing the frequency and severity of cracks in each image and combining the images in each segment to determine an overall score for the segment of roadway. The PASER system scores segments on a scale of 1 to 10 where a rating of 1 is a road in failed condition and rating of 10 is a road in excellent condition.

For this project, Blyncsy analyzed 291 different segments, each 50 meters long. By using a smaller segment, Blyncsy was able to create more precise and accurate segment scores.

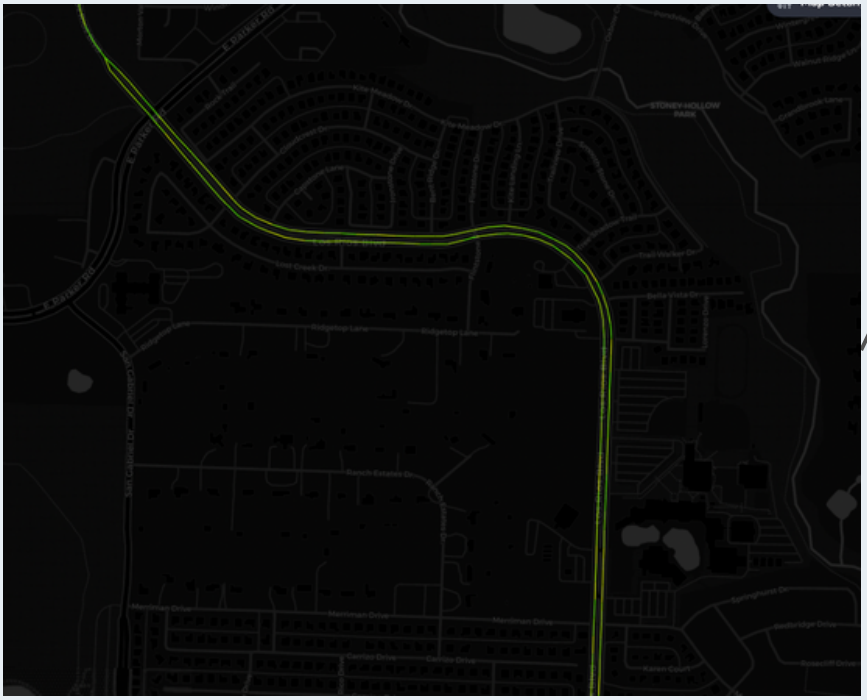

Figure 15. This image shows a portion of the four mile roadway that consisted of 291 different segments, which were scored according to the PASER system

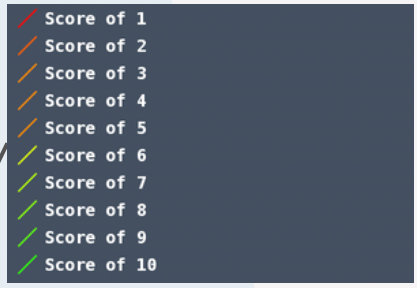

Figure 16. Blyncsy's PASER system scores on a scale of 1-10. This scale as well as the segments can be customized

6.4 Cont.

Figure 17. A segment with a score of 6 is shown on the left and a segment with a score of 9 is shown on the right

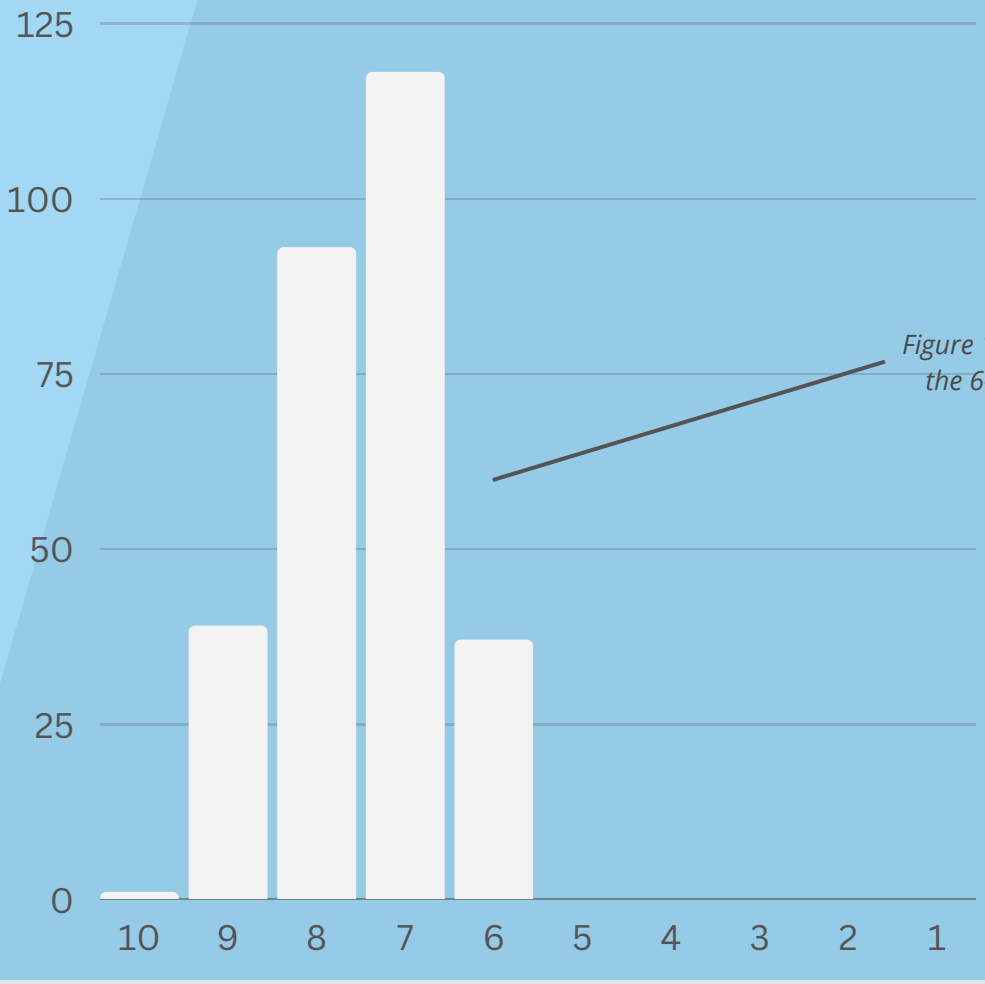

Figure 18. All segments were scored in the 6-10 range on the PASER scale

6.5 Blyncsy's Vegetation Encroachment Insights

Vegetation encroachment on roadways refers to the growth of plants, trees, and bushes along the sides of roads or medians. When vegetation encroaches on roadways, it can cause several problems, such as reduced visibility, damage to road signs and barriers, and increased risk of accidents. Additionally, the roots of the plants can penetrate and damage the pavement, and fallen leaves and debris can clog stormwater drains, leading to water buildup and erosion. According to the American Association of State Highway and Transportation Officials (AASHTO), vegetation encroachment causes more than 160 fatalities and 6,500 injuries annually in the United States. Furthermore, the cost of maintaining roadway vegetation is estimated to be approximately $6 billion per year.

In the City of Plano, vegetation is not a significant issue. Because the city was not overly concerned about these issues, they did not include it in their manual survey. However, using computer vision, Blyncsy can automatically detect vegetation encroachment and detected six incidents of vegetation encroachment on these four centerline miles.

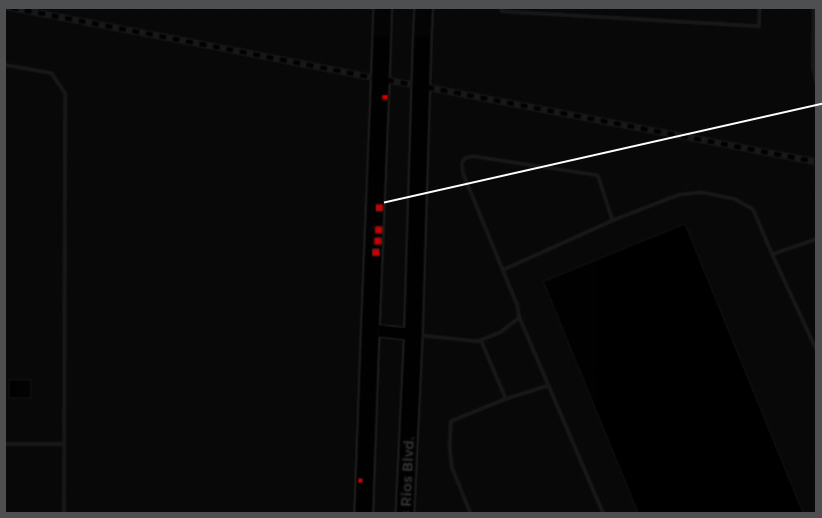

Figure 19. This figure shows the images with vegetation encroachment were located relatively close to each other

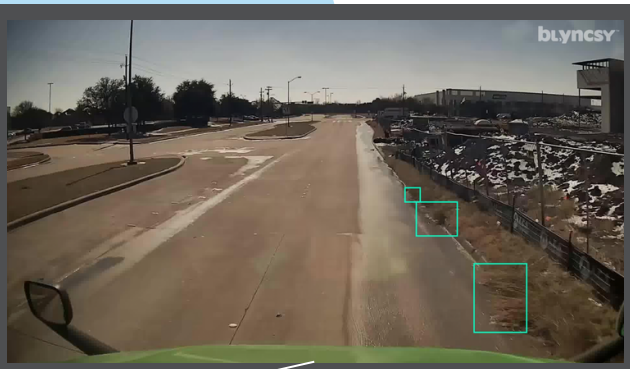

Figure 20. Example of vegetation encroaching onto the roadway

6.6 Blyncsy's Sidewalk Insights

Knowing where sidewalks are located is essential for pedestrian safety, as sidewalks provide a safe and accessible space for people to walk, jog, or ride a bike away from vehicular traffic. According to the National Highway Traffic Safety Administration (NHTSA), in 2019, over 6,200 pedestrians were killed in traffic crashes in the United States, and an additional 82,000 were injured.

Using computer vision, Blyncsy can automatically detect sidewalks and their position relative to the roadway. Aside from detecting sidewalks, Blyncsy can detect standing water, debris, and other safety critical issues for pedestrian safety. In Blyncsy's automated survey, there were 110 image samples containing sidewalks. All sidewalks surveyed were in good condition.

Using this data, agencies can view the location and see the condition of sidewalks in order to prioritize pedestrian safety. The City of Plano did not directly analyze sidewalk condition, but did take into account crosswalks and curb side analysis for access management.

Figure 22. Blyncsy automatically detects sidewalks and includes an image from a driver's perspective.

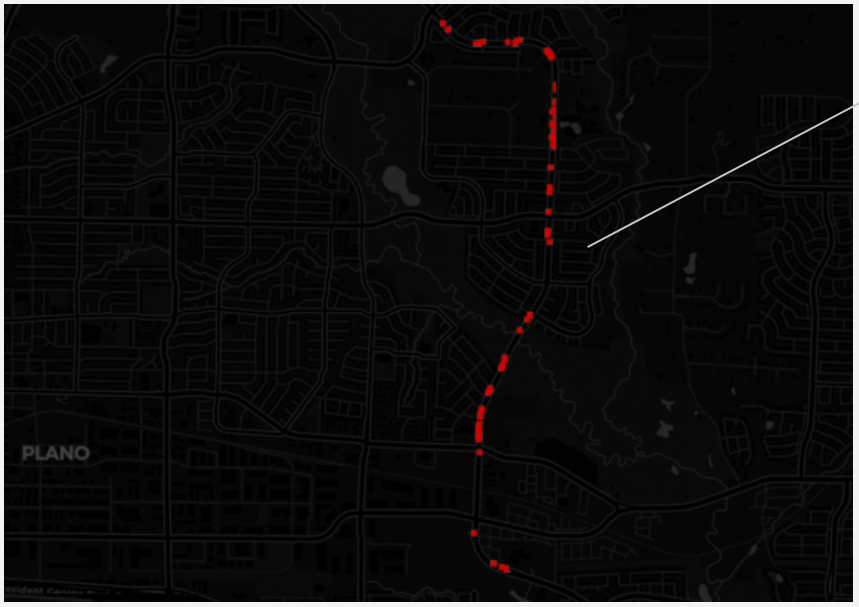

Figure 21. Blyncsy displays samples containing sidewalks on a GIS map

6.7 Crosswalk Quality Scoring

Knowing where crosswalks are located is crucial for pedestrian safety, as crosswalks provide a designated area for pedestrians to safely cross the street. According to the National Highway Traffic Safety Administration (NHTSA), in 2019, nearly 20% of all pedestrian fatalities occurred at intersections. Properly marked crosswalks with clear signage and visibility aids such as flashing beacons and overhead lighting can help reduce the risk of pedestrian accidents.

While the City of Plano looked at the condition of pavement markings, as well as what signs were in place at each crosswalk and in advance of each crosswalk and what type of traffic control should be used at each crosswalk; Blyncsy only surveyed the quality of the crosswalk pavement markings. However, it's important to note that Blyncsy can detect pedestrian signs and traffic signals as well.

Through Blyncsy's survey, 50 images contained crosswalks and pedestrian crossings. Blyncsy scores the visibility of crosswalks in each image. Through this data, cities not only understand where their crosswalks are, but can see which crosswalks are in need of repainting. This score can be validated with an image taken from the driver's perspective. Blyncsy scores crosswalks on a scale of zero to four where 0 is the best and 4 is the worst.

Figure 23. Blyncsy scores the condition of the crosswalks present in each image and display this data on a GIS map

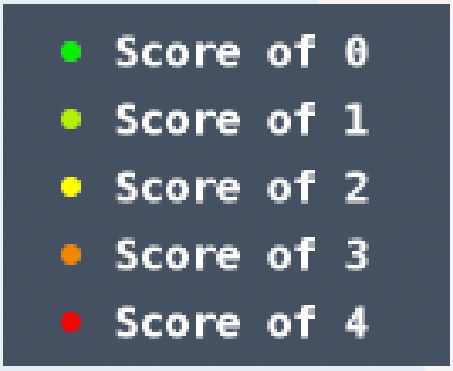

Figure 24. Blyncsy scores crosswalks on a 0-4 scale (0 is best, 4 is worst)

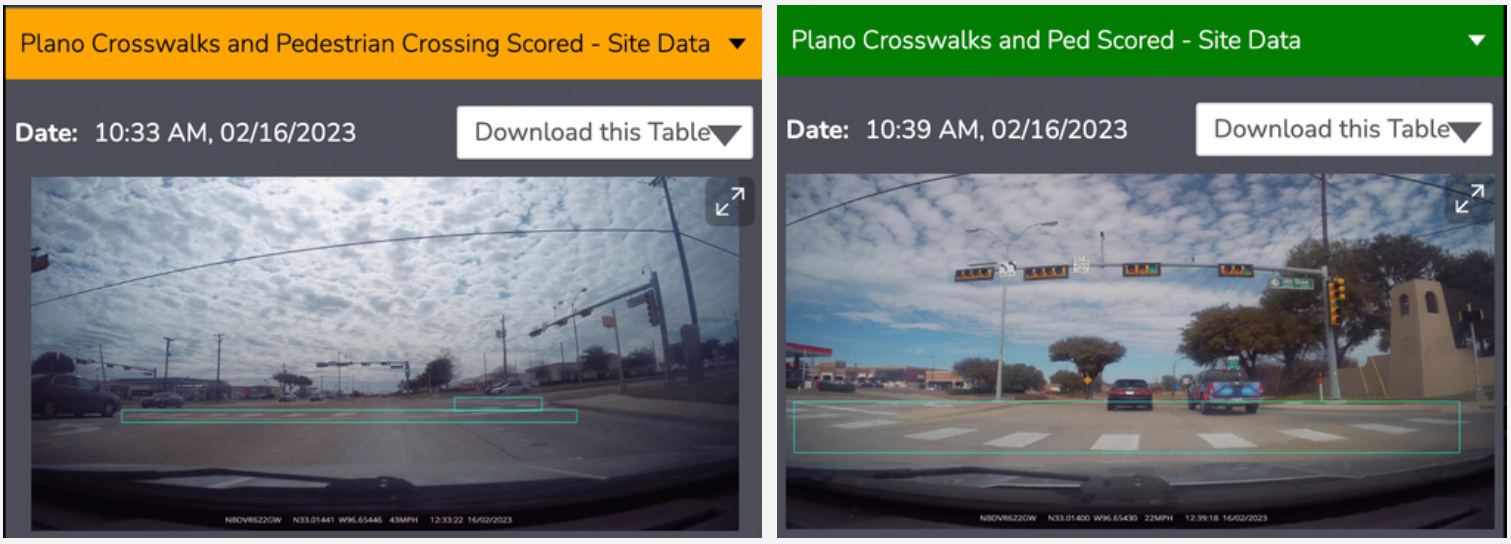

Figure 25. A fading crosswalk scored as 3 is shown to the left and a visible crosswalk scored as a 0 is shown to the right

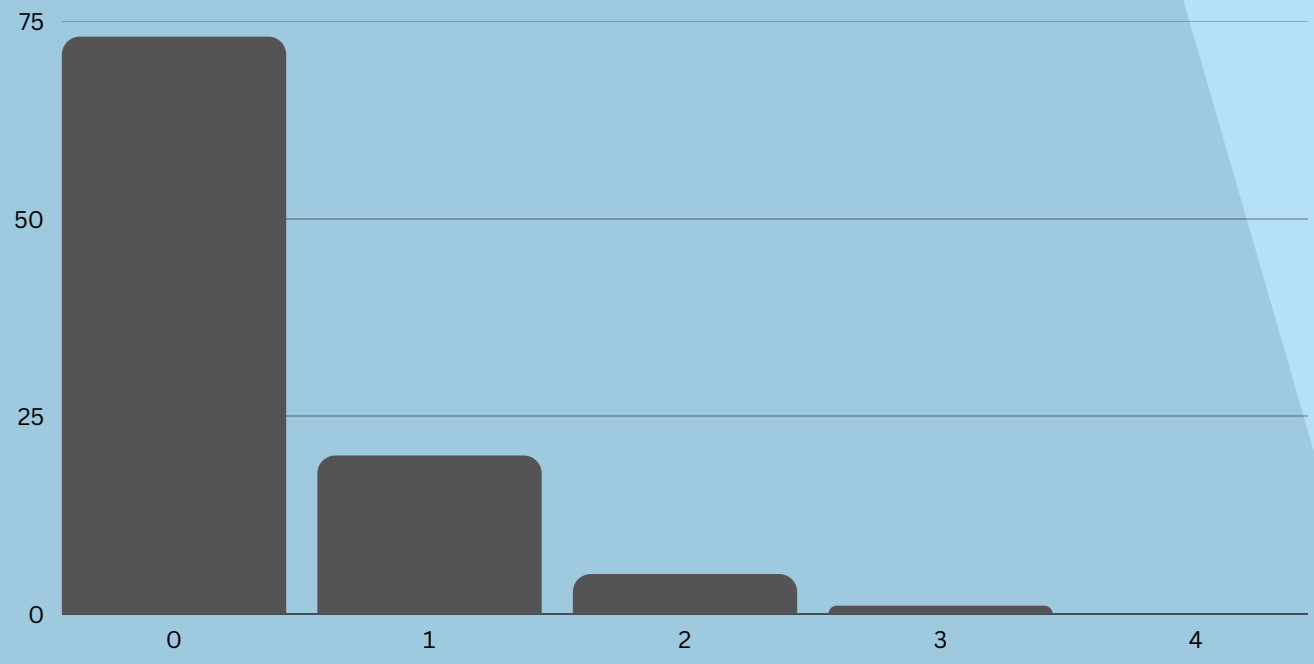

Figure 26. Most crosswalks were in fair to best condition

6.8 Street Lights- Off at Night

Streetlights and well-lit streets play a critical role in ensuring safety and security in our communities. Adequate lighting in public spaces such as roads, sidewalks, and parking lots can prevent accidents, reduce crime, and improve overall visibility. Studies show that street lighting reduces the likelihood of pedestrian accidents by 30%, and vehicle accidents by up to 50%. Additionally, well-lit streets create a sense of safety and deter criminal activity, making it easier for law enforcement to monitor public areas. Streetlights also promote social and economic activity by increasing foot traffic and enhancing the attractiveness of public spaces. Therefore, it is crucial for municipalities to invest in street lighting to create a safer and more vibrant community.

Through Blyncsy's automated survey in Plano, it detected 3 different streetlights that were out at night. For these three different streetlights, Blyncsy collected 18 images from different angles. With this data, agencies can easily pinpoint areas of weakness in order to increase safety for pedestrians and drivers.

Plano also found this issue through their manual survey and notified their streetlight management company using their streetlight outage system.

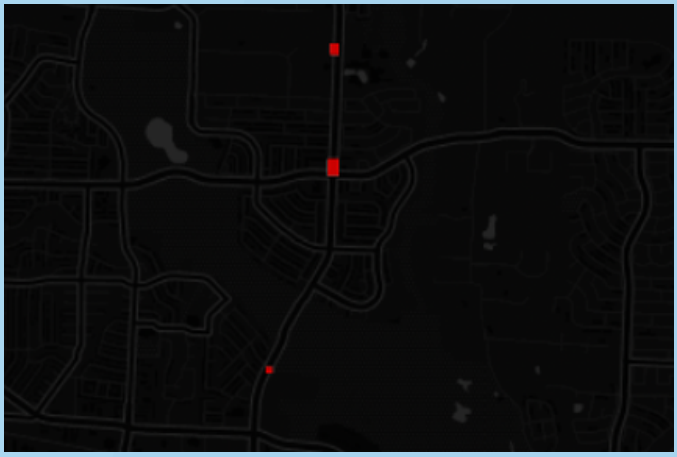

Figure 27.hows streetlight outages on a GIS map so Plano and other agencies can easily pinpoint their outages.

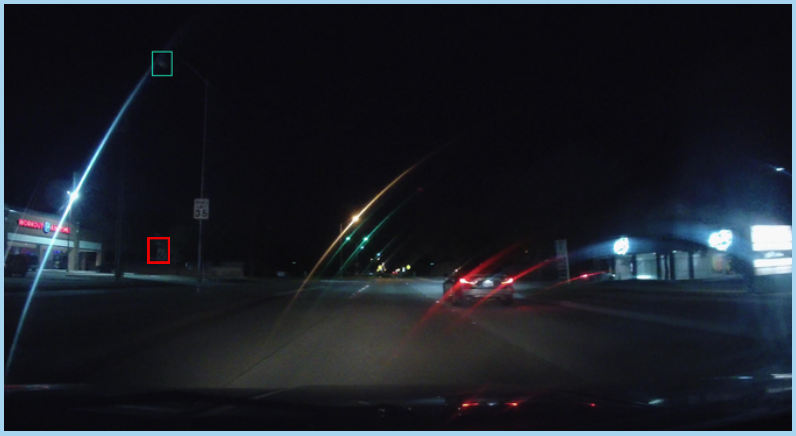

Figure 28. An example of a streetlight outage detected in Plano

6.9 Street Lights- On During Day

The average street light costs an average of 145 watts of power per hour, costing $2 per hour - equating to nearly $200 per week. Street lights that remain powered on during the day lead to increased power cost, decreased life expectancy, and increased labor costs for replacement.

In Blyncsy's four mile survey, it detected one streetlight that was on during the day located near the intersection of Los Rios Boulevard and Plano Parkway. Blyncsy detected 18 different images of this individual streetlight from different angles and approaches.

The City of Plano did not evaluate this condition in their manual survey. Since Plano does not maintain the city's streetlights, this is not a major concern for the city. However, using Blyncsy's data, they were able to notify their streetlight management company using their streetlight outage system.

Figure 29. Blyncsy detected this streetlight that was on during the day

Figure 30. Blyncsy displays images of this erroneous streetlight on a GIS map in order to easily pin point areas that need maintenance

6.10 Traffic Signals

Understanding where traffic signals are and knowing when there are outages is essential for cities to promote safety and swiftly repair traffic lights that need maintenance. Traffic signals are designed to regulate traffic flow and improve safety by preventing accidents and reducing traffic congestion. However, traffic signals can malfunction due to power outages, equipment failures, or weather events, which can cause confusion and increase the risk of accidents. By knowing where traffic signals are and being aware of outages, municipalities can help prevent accidents and promote safe navigation on roadways.

During this project, Blyncsy detected traffic signals at four different intersections. Through Blyncsy's automated survey, it did not detect any outages. There are multiple images of each traffic signal, so Plano can see all approaches for each intersection that dash cameras drove through.

Aside from location of traffic signals, Blyncsy can also detect signal outages as well as crosswalk signals and the presence of safety focused signage. The City of Plano communicated a desire for future signal analysis, combining sign inventory and crosswalk scoring to detect "safe crossing zones" with Blyncsy.

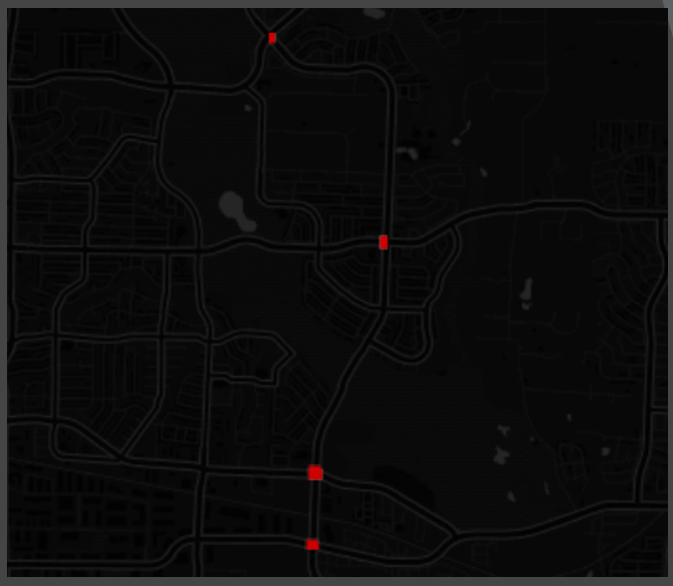

Figure 31. This image shows the locations of four different intersections with traffic signals

Figure 32. An example of traffic signals that Blyncsy detected and provided image validation for

6.11 Sign Inventory and Sign Condition

Road signs are a critical aspect of road safety and play a vital role in reducing accidents, injuries, and fatalities on the roadways. According to the World Health Organization, poor signage is a significant contributing factor to roadway accidents. Studies show that well-placed and well-maintained road signs can improve driver awareness and reduce accidents by up to 30%. Furthermore, road signs are becoming even more critical as autonomous vehicles become more prevalent. Self-driving cars rely on accurate and up-to-date road signs to navigate the roads.

Using AI and crowdsourced imagery, Blyncsy can conduct a full sign inventory, classify each sign according to MUTCD guidelines, and determine the quality of each sign. If given historical data, Blyncsy can also detect missing signs as well as any other changes of sign quality. For this project, Blyncsy did not have historical data and therefore only surveyed the location and overall condition of road signs. Furthermore, Blyncsy's algorithms can detect if signs are missing, damaged, or not visible at night. This helps cities quickly catalog and inventory their signs.

In Plano's survey, trucks were required to drive the road several times in order to get accurate results for sign inventory. In addition to looking for faded or obstructed signs, Plano looked for incorrect or insufficient signs as well. Blyncsy can also detect these issues, however since Blyncsy was not provided historical data, so this was out of scope for Blyncsy's automated survey.

Blyncsy automatically detected 143 MUTCD signs on the four mile roadway segment in Plano. For some signs, Blyncsy captured multiple images from different angles and approaches.

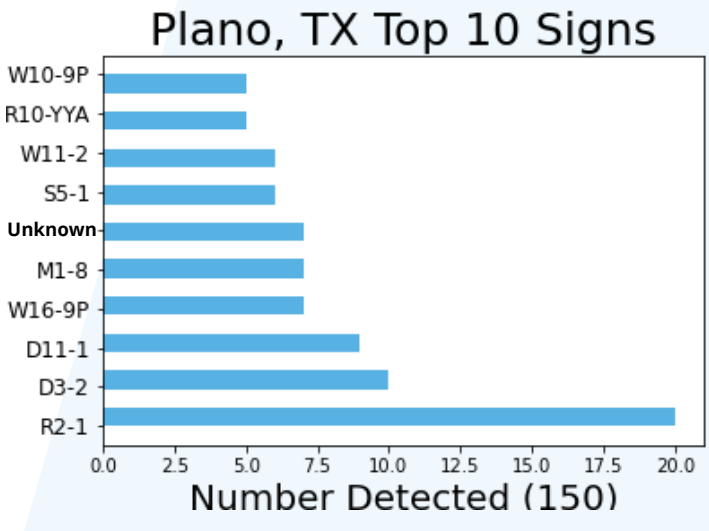

Figure 33. Top 10 signs detected in Plano, TX including seven unknown signs local to Plano

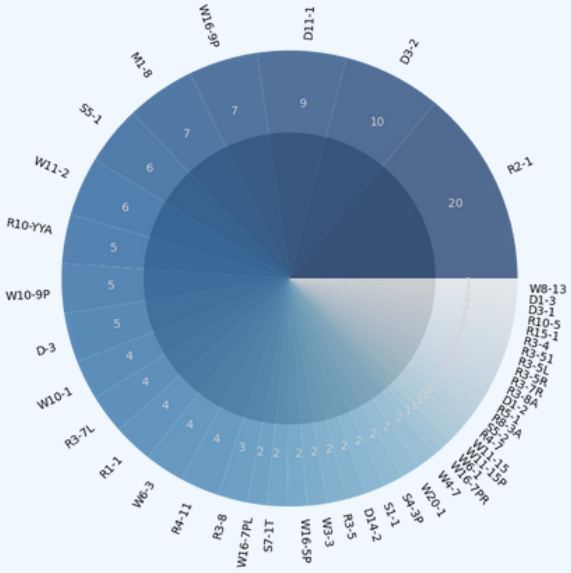

Figure 34. Proportion of each sign detected in Plano, Texas

6.11 Cont.

Blyncsy automatically detects the quality of all signs detected. The machine learning algorithms take into account the following attributes:

- Readability - Fading, peeling, graffiti
- Damage - Leaning and falling signs
- Nighttime Reflectivity - Whether signs are visible at night
- Change detection - Missing signs or quality degradation

Figure 35. Blyncsy scores signs according to good, fair, and poor

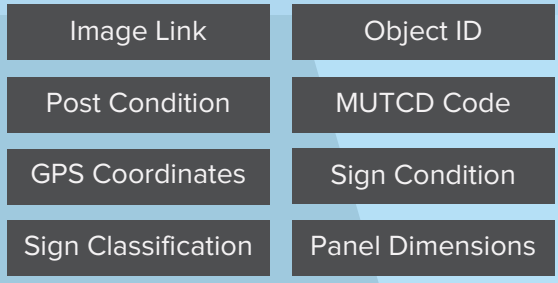

Figure 36. Blyncsy delivers the above assets for sign inventory and condition

Of the 143 signs that Blyncsy detected, only eight were in fair condition and zero were in poor condition

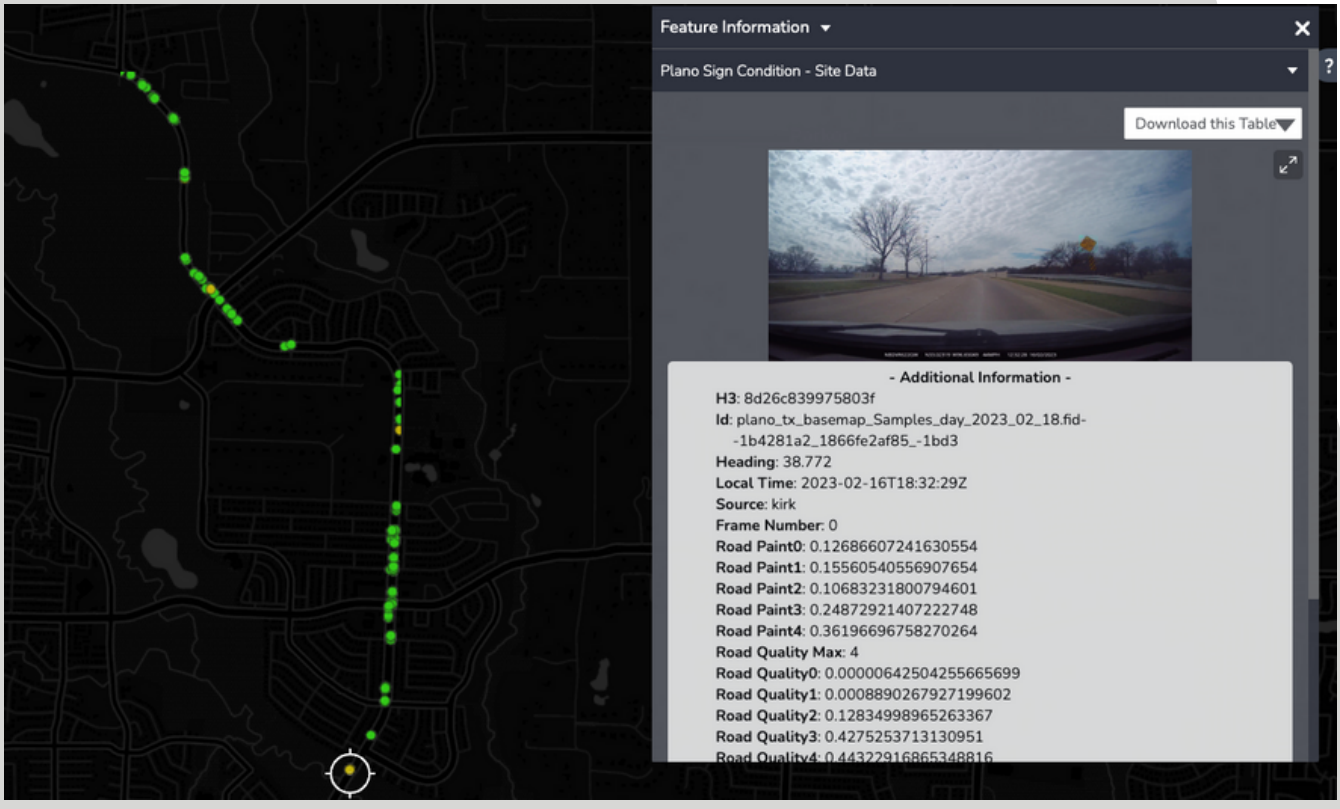

Figure 37. Blyncsy color codes signs based on their condition and displays this data on a GIS map

7. Manual Surveys

Manual road surveys involve physically measuring and evaluating various aspects of a roadway, such as pavement condition, signage, and visibility. While these surveys can provide valuable information for transportation agencies, they also come with significant drawbacks. First, manual surveys are time-consuming and labor-intensive, which can increase liability for cities/agencies if they do not have enough staff to perform them efficiently. Second, these surveys often require vehicles to traverse the roadway multiple times, which can produce emissions and contribute to air pollution. Third, manual surveys can be subjective and may vary depending on the surveyor's experience and interpretation of the data, which can lead to inconsistencies and inaccuracies in the results. Overall, while manual road surveys can provide important insights for transportation agencies, they also come with significant drawbacks that should be considered when deciding on survey methods.

Plano conducted manual surveys on the same roadway that Blyncsy analyzed in order to conduct an "apples to apples" comparison of the data collected by both inspection techniques.

Plano's process required two traffic engineers to survey the roadway. This four mile manual survey took a total of 20 man hours, 10 employees, and five work vehicles.

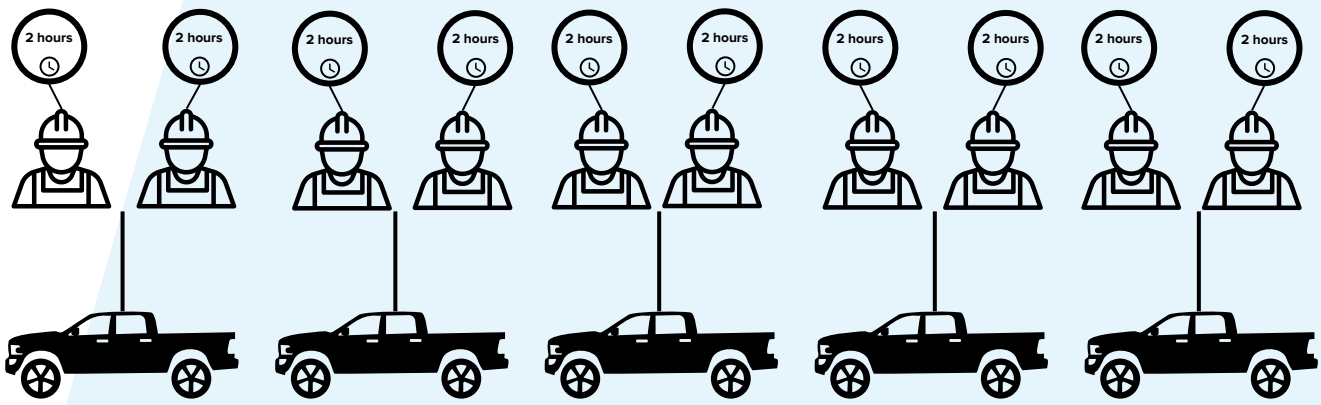

Figure 38. For Plano to survey four miles of roadway, it required five trucks, 10 engineers, and 20 total hours

Blyncsy's machine vision technology conducted a survey on the same 4 miles of roadway, collecting data on the same 11 assets in near real-time, using imagery from cameras that already exist on the roadway. This process is completely automated and passive, requiring no manual labor, hardware, or other resources.

8. Blyncsy's Coverage

Blyncsy has a network of over 400,000 dash cameras already on roadways through partnerships with dash cam distributors. Blyncsy provides equitable coverage across all communities. For this project, Blyncsy was able to provide imagery on every five feet of the roadway surveyed. These images are stored in the Blyncsy workspace and in the cloud for historical use.

8.1 Equitable Infrastructure

Blyncsy aims to remove bias from public complaints and manual inspections. Whereas one person may regard a sign as visible, another may not. Blyncsy takes the bias and subjectivity out and standardizes the process. With expansive coverage, cities can prioritize the most severe maintenance issues, not the ones with the loudest voices behind them.

Benefits of machine vision insights:

- Objective
- Expansive coverage
- Easy to visualize
- Detections to keep all types of road users safe: drivers, pedestrians, and cyclists

8.2 Climate Resilience

Transportation is the largest contributor to Co2 emissions than any other industry. Blyncsy aims to improve the way we monitor roadway maintenance, thus reducing traffic and minimizing transportation's environmental impact. Blyncsy aims to provide real-time roadway data in order to equip our infrastructure for the autonomous driving future that is quickly approaching.

Blyncsy reduces emissions by allowing drivers to get from point A to point B quickly and safely, thus reducing emissions. Blyncsy relies on dashcam images from drivers already out on the roads to gain real-time and accurate insights. Blyncsy also greatly reduces the need to manually survey, saving agencies up to 23,286 pounds of carbon emissions per work vehicle per year.

Blyncsy's machine vision technology reduces boots on the ground in order to create more resilient and efficient roadways.

9. Estimated Savings

Manually surveying four miles of roadway took Plano 20 total hours, 10 engineers, and five work vehicles. The average salary for a Traffic Engineer in Plano, TX is $91,229 as of 2023. Assuming that a typical work week for a traffic engineer is 40 hours per week, a Plano traffic engineer makes an average $1,754.40 per week. Factoring in an additional 38% for benefit costs, one week of a full time traffic engineer costs an average of $2,421.07 per week. For this project, a manual survey for 11 different assets on 4 miles of roadway required 10 engineers who each contributed 2 hours. Manually surveying this roadway cost the City of Plano $1,210.50 and 20 total man hours. By eliminating the need to survey, engineers can focus on prioritizing repair and other issues.

Aside from time and money saved, Blyncsy also reduces emissions. By reducing the amount of manual surveys, Blyncsy can help reduce agencies' carbon footprint. A common work vehicle such as a 2018 Ford F-150 using just 20 gallons of gas per week will produce 23,286 pounds of carbon emissions per year. Using a conservative estimate that Blyncsy will reduce just 50% of physical surveying, that translates to a 11,931 pounds reduction in that vehicle's annual carbon emissions. Agencies also save on the price of gas as well. Using a conservative estimate that each work vehicle cost Plano $30 in fuel and overall costs, Plano saved a total of $150 total.

For the same four mile footprint, Blyncsy's automated survey costed $12 per lane mile, equating a total of $53.

By automating this 4 mile manual survey on 11 different assets, Blyncsy saved an average of 450 pounds of carbon emissions, 20 man hours, and a total of $1,307. If Blyncsy were to survey all 2,900 lane miles of Plano, the savings potential would be $475,238.

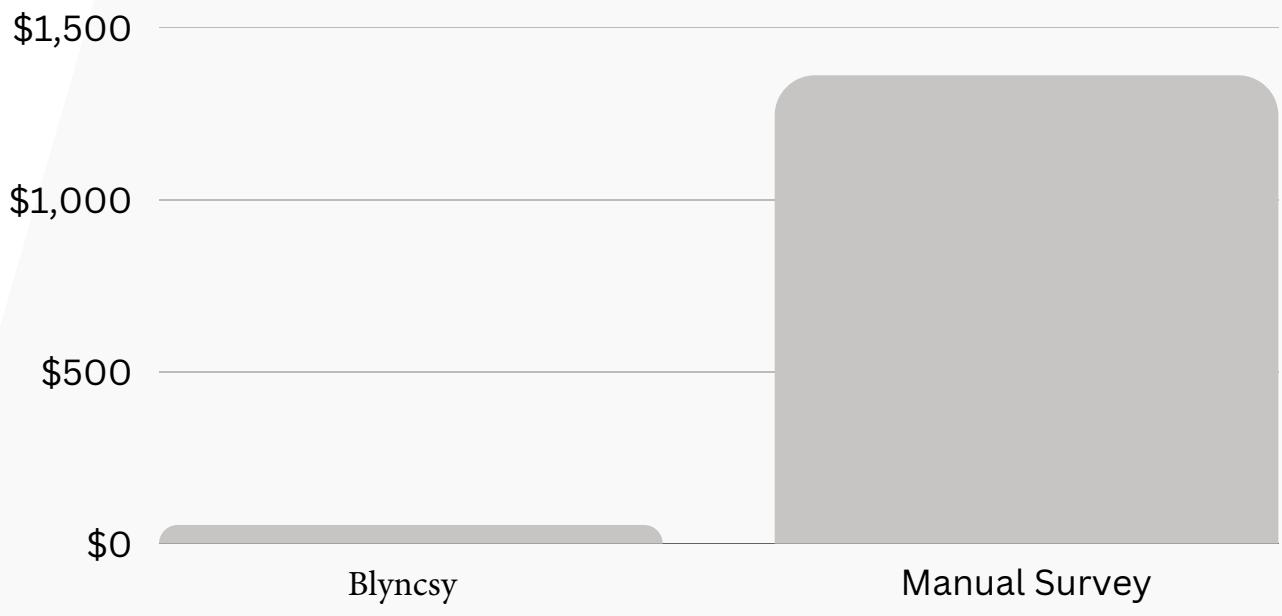

Figure 39. Cost comparison of Blyncsy and manual road survey on four miles of roadway

10. Conclusion and Findings

Both Blyncsy and Plano surveyed 11 different asset types within four miles of roadway. Blyncsy ended up saving Plano time, money, and resources. In this comparison, Blyncsy saved Plano an average of 20 man hours, $1,307, and 450 pounds of carbon emissions in just four miles. In addition to hard costs, there's also great increases in safety to drivers, pedestrians, and bicyclists by improved lighting, better crosswalks, etc. Poorer neighborhoods are also served equally by using Blyncsy in part by the excellent coverage.

While Blyncsy has the ability to quickly identify and record inventory, it will never fully replace the need for a manual survey. There are some issues that Blyncsy cannot easily identify and also some issues that Plano cannot easily identify. From this "apples-to-apples" comparison, this case study shows how Blyncsy can reduce the number of manual surveys required by more than 90%, which saves considerable time and money. At the same time, it highlights how manual surveys are still needed in order to provide engineering judgment, make decisions, and develop solutions.

*"Blyncsy's inventory and detection capabilities have the potential to be really **powerful when used on a wide scale to identify issues like streetlight outages and other potential safety concerns."***
- Chad Ostrander, Senior Traffic Engineer, City of Plano Transportation Engineering

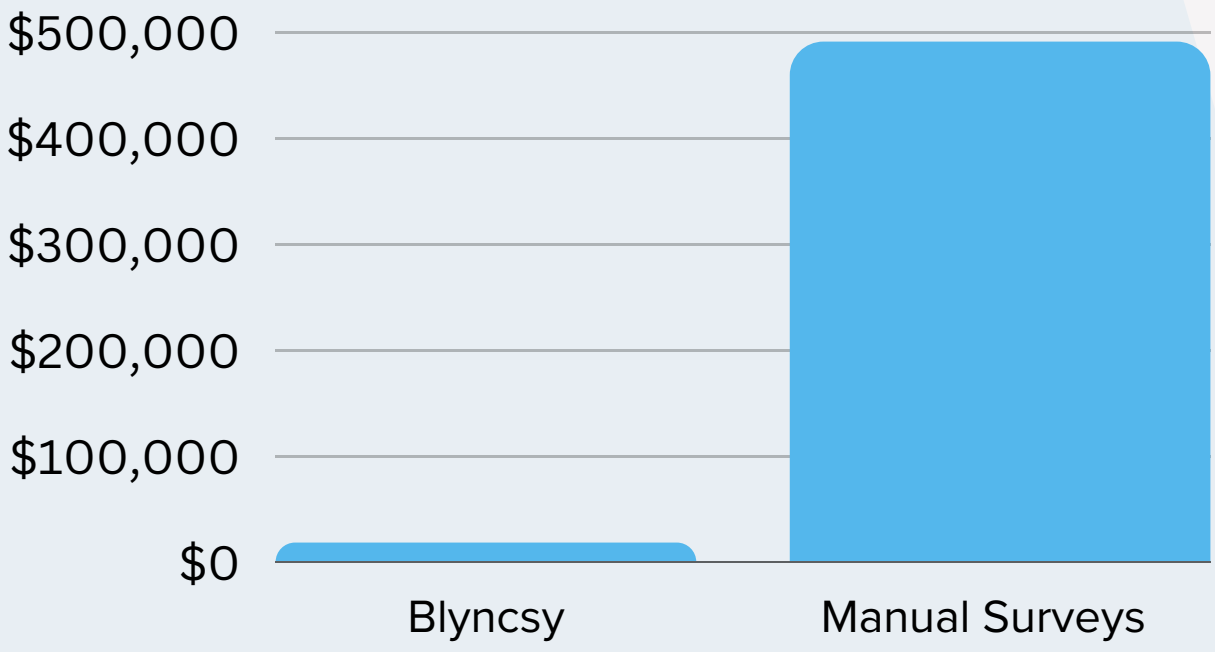

Figure 40. Cost comparison of Blyncsy and a manual road survey to survey 2,900 lane miles in the City of Plano