MEMORANDUM

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THRU: Renee Whitesell, PTP, Project Manager, DOWL

DATE: September 1, 2021

SUBJECT: Parks Highway Alternative Corridor Planning & Environmental Linkage (PEL) Study – Origin-Designation Methods

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1.0 INTRODUCTION AND PURPOSE

This memorandum provides the methodology and assumptions for conducting an Origin-Destination (O-D) study for the Parks Highway Alternative Corridor (PHAC) Planning and Environment Linkages (PEL) Study. The memo discusses the following:

- Project description (Section 2.0)
- Data collection methods (Section 3.0)
- Analytics methods (Section 4.0)
- Recommendations (Section 5.0)
- Format of the results (Section 6.0)

DOT&PF signed concurrence of the methodology is requested prior to initiating the O-D Study.

2.0 PROJECT AND TASK DESCRIPTION

The George Parks Highway (Parks Highway) is a two- to four-lane roadway that is the primary route between Anchorage and Wasilla and continues north to Denali National Park and Fairbanks. It connects with the Glenn Highway to the south, which then connects to Palmer and Anchorage. The Parks Highway serves approximately 40,000 vehicles per day through the City of Wasilla.

The Alaska Department of Transportation and Public Facilities (DOT&PF) is proposing to create a new National Highway System (NHS) controlled-access connection south of the existing Parks Highway near Wasilla in the project area shown in Figure 1. The new alignment has not yet been determined, but the project area generally extends from Hawk Lane on the west to Hyer Road on the east. Access along the new highway would be provided with interchanges at key north-south arterials (e.g. Knik-Goose Bay Road, Vine Road, and Clapp Road/Mack Drive).

Figure 1: Parks Highway Alternative Corridor Project Area

An O-D study will be performed to understand current travel patterns throughout the study area, which will be used to estimate the amount of traffic that is expected to use an alternative Parks Highway corridor and decide which cross streets are most important for access. In addition, the O-D study will help facilitate the development of traffic forecasts.

3.0 DATA COLLECTION METHODS

With multiple data collection methods available to the project team, important considerations for this project include how the data are collected and what type of sample size will be obtained from each method. Selecting a data source that meets the project needs as laid out in clear evaluation criteria is key to an accurate O-D study. This section discusses the following:

- Method evaluation metrics (Section 3.1)
- Description of methods (Section 3.2)
- Evaluation of methods (Section 3.3)

3.1 Method Evaluation Metrics

To recommend an optimal approach for this project, metrics were selected based on their ability to highlight the benefits and disadvantages of each data collection method. The three metrics used were the data sample quality, routing details, and vehicle type classification, as depicted in Figure 2.

The data sample quality should be sufficiently large and varied to represent the total trip population, and is a function of the following three components:

- Geographic coverage (where data are being collected)
- Temporal coverage (how long data are being collected)
- Vehicle count penetration rates (how many vehicles are being collected at a given location and time)

Routing details refer to how precisely the data collection method records the path vehicles take to get from their origin to their destination. Data on vehicle type classification can provide insights that distinguish between trips made by passenger cars or commercial vehicles.

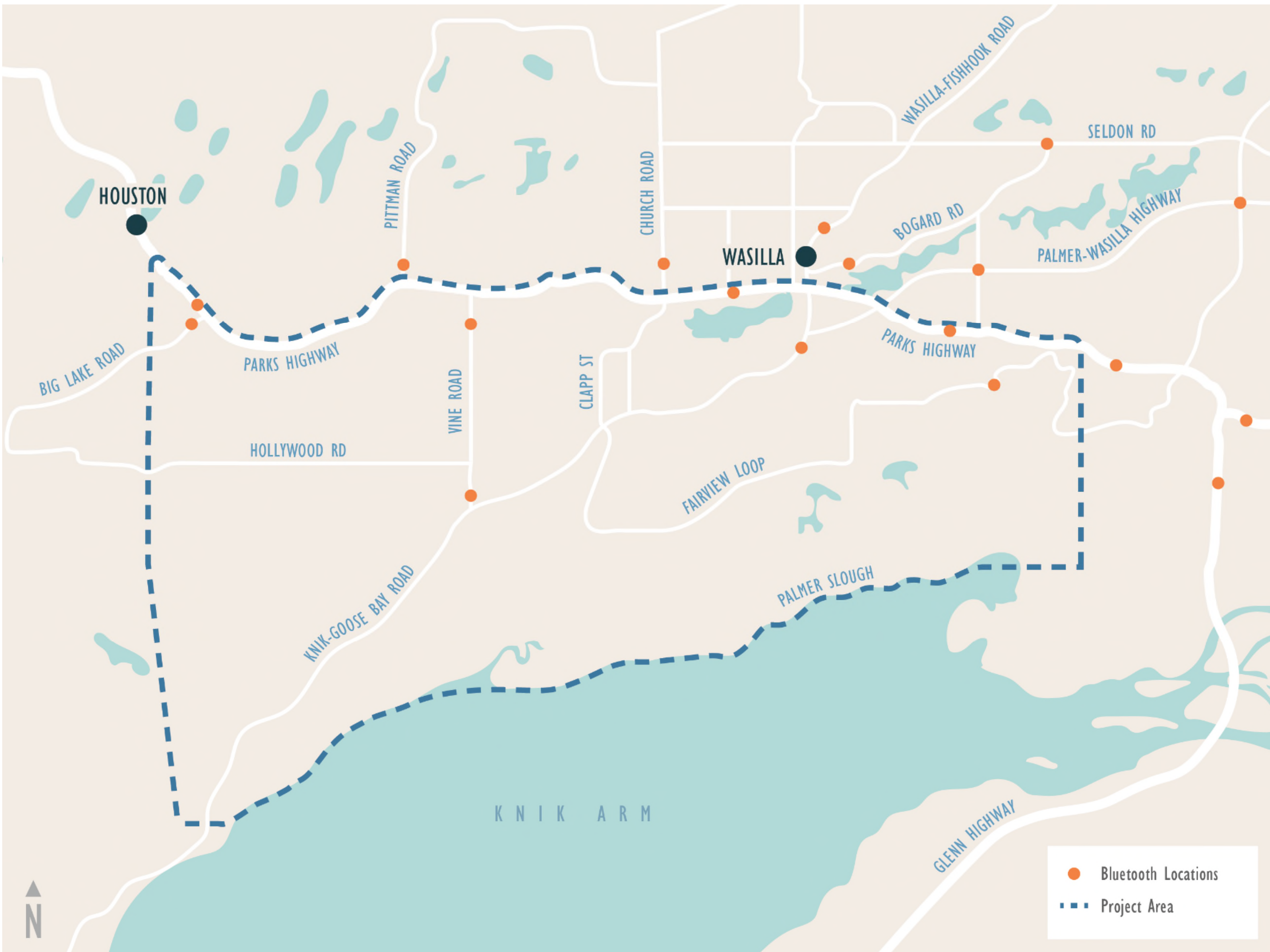
Figure 2: Data Collection Method Evaluation Metrics

3.2 Description of Methods

The O-D data collection methods considered for this project belong to two overall categories, namely, manual field data collection and probe data. Manual field collection methods considered include Bluetooth readers and automated license plate readers, while the probe data considered consist of “big data” aggregated and anonymized by vendors that originate from connected vehicle GPS data, location-based services (LBS), or a combination of the two. Each method is described below. Additional information on the data collection methods can be found on the Federal Highway Administration's website.[1]

3.2.1 Manual Field Data Collection

A key drawback of manual field data collection is the cost-prohibitive nature of covering every roadway. As a result, potential key locations for manual field data collection methods are shown in



[1] *Travel Time on Arterials and Rural Highways: State-of-the-Practice Synthesis on Rural Data Collection Technology – Data Source Summaries.* Federal Highway Administration. Accessed 2021. https://ops.fhwa.dot.gov/publications/fhwahop13029/ch2.htm

Figure 3. Locations were selected based on an understanding of the study area traffic network and the key routes used to travel to/from the area's neighborhoods as denoted in the most recent traffic count data available from DOT&PF.[2]

Bluetooth Readers
The Bluetooth reader method consists of deploying devices that read unique media access control (MAC) addresses of Bluetooth devices sending out signals in their vicinity. Whenever a Bluetooth device passes the Bluetooth sensor, the MAC address is recorded with a time stamp. When the same MAC address is recorded at a different location, the origin-destination and travel time can be determined by matching the addresses and comparing the timestamps. MAC addresses are not tied to sales records, and so cannot be used to identify the owners of specific Bluetooth devices. Data can be obtained for up to one week with this method and penetration rates range from 15 to 25 percent.

Automated License Plate Readers
Automated license plate readers involve setting up high-definition cameras that read the license plate of vehicles as they pass by the camera. By setting up multiple license plate readers at various locations, the origin and destination of each vehicle, as well as the travel time between each location, can be recorded and analyzed. Data collected using license plate readers would not be used for traffic enforcement purposes and would be limited to use for the O-D study. Data can be collected for two consecutive days with this method and penetration rates are nearly 100 percent.

[2] *Alaska Traffic Data.* Alaska Department of Transportation and Public Facilities. Accessed 2021. https://alaskatrafficdata.drakewell.com/publicmultinodemap.asp

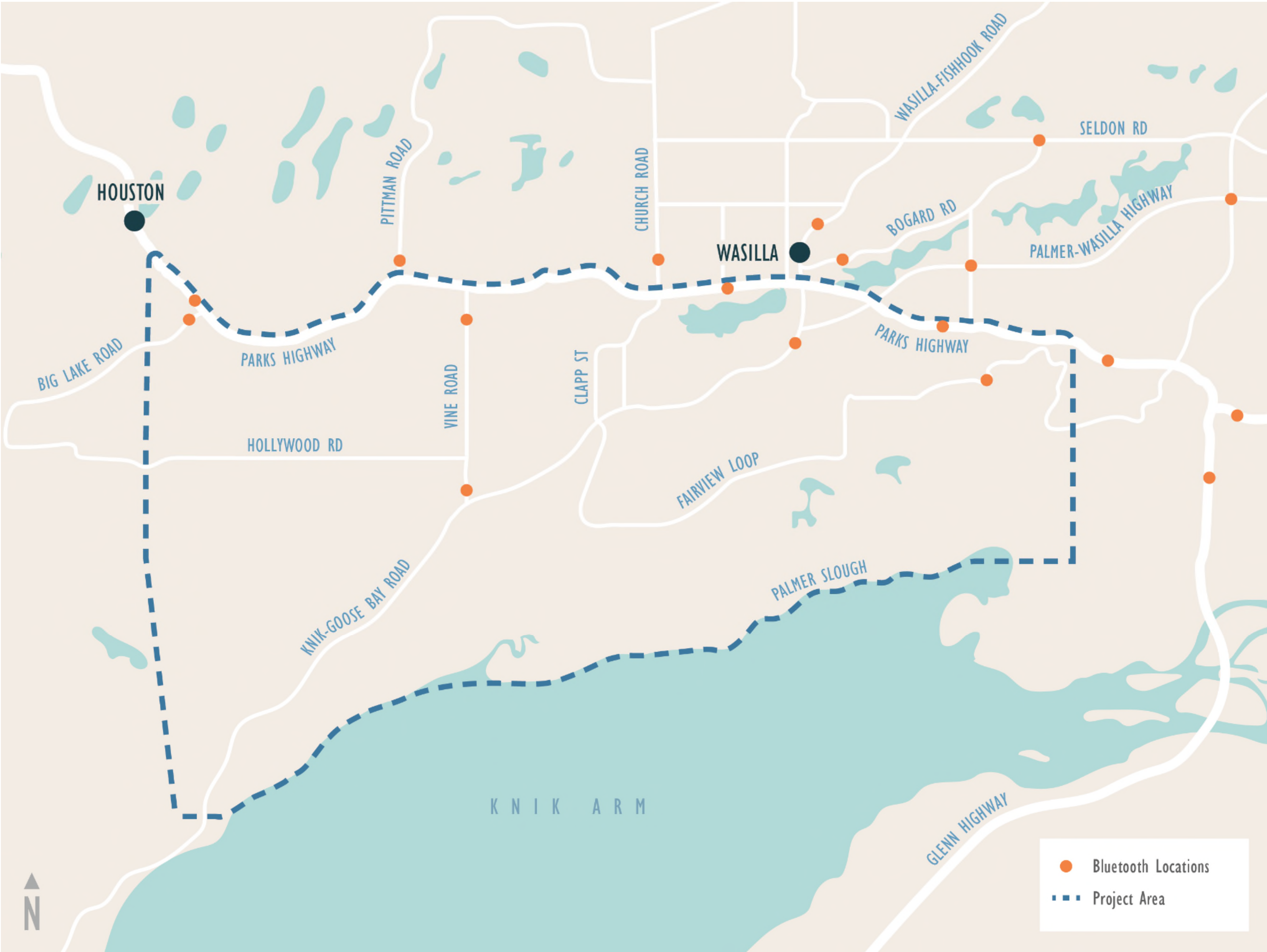


Figure 3: Potential Locations for Manual Field Data Collection Methods

3.2.2 Probe Data

Probe data refer to “big data” collected and aggregated by third-party vendors that originate from GPS devices in vehicles, mobile phones, and commercial fleets (Figure 4). These data can then be purchased by transportation agencies or engineering consultants for traffic-related analyses. Vendors run data quality and review processes, such as removing or refining anomaly or corrupted data, to increase the reliability of the raw data collected. Before delivering data to customers, vendors anonymize any data that could be used to identify drivers, and no personal information is included in the datasets.

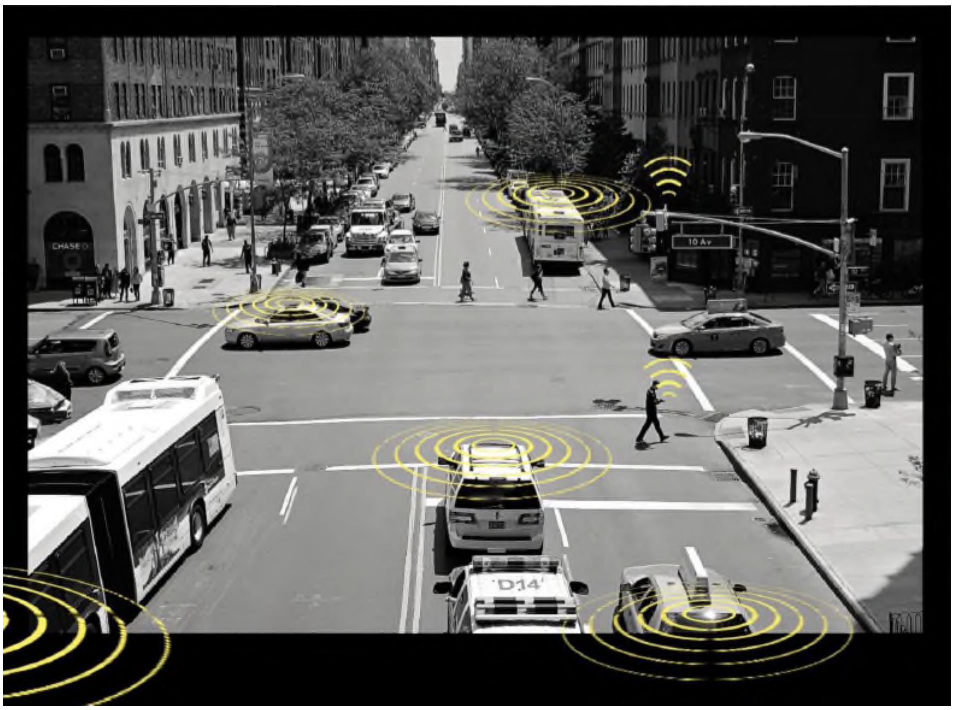


Figure 4: Probe Data Collected through Connected Vehicle GPS and LBS Data[3]

In terms of the data collection sample, there are no limits to geographic network coverage with the probe data methods, as vehicles are tracked regardless of location, and multiple months of continuously collected data can be obtained with relative ease. For this study, a sample of four months would control the data for seasonal variation and possible changes to travel patterns as a result of COVID-19.[4] Routing details are highly precise due to location data being reported multiple times each minute (Figure 5) and probe data include vehicle type classification.

[3] *Email correspondence with Moonshadow Mobile staff,* August 26, 2021

[4] While the Average Daily Traffic (ADT) along many arterials is approaching pre-pandemic levels, many roadways are still experiencing a shift in peaking behavior and trip purpose.

Figure 5: Example of Routing Details Provided by Probe Data[5]

Connected Vehicle GPS Data

Connected vehicle GPS data are collected through navigation-GPS devices built into personal vehicles. Vendors may collect this data for a wide range of vehicle manufacturers or may source their data from a single vehicle manufacturer. Penetration rates are typically lower for the connected vehicle GPS data, as only vehicles with GPS devices can be tracked, which are mostly vehicle models from 2015 and newer. Penetration rates in the project area range from three to five percent of all vehicles.

Location-based Services (LBS) Data with Connected Vehicle GPS Data

LBS data are collected through smartphone apps that record users' locations when operated in the foreground and may also collect location data in the background when the device is moving. None of the vendors contacted use LBS data exclusively but instead generate combined datasets that contain both LBS and connected vehicle GPS data. Penetration rates are typically higher for this method, ranging from seven to 15 percent, as many drivers carry a smartphone while driving and have apps that report location data.

3.3 Evaluation of Methods

Based on the metrics described in Section 3.1, each data collection method described in Section 3.2 was evaluated and the results are summarized in Table 1.

[5] *Email correspondence with INRIX staff,* August 17, 2021

The benefit of both manual data collection methods is their relatively high penetration rate, as most vehicles and smartphones have Bluetooth enabled and nearly every vehicle is recorded by automated license plate readers. However, the higher penetration rate is offset by limitations of geographic network coverage and temporal coverage. Because data cannot be recorded on every road in the study area, potential biases may exist in how locations are selected for data collection. Furthermore, the relatively short time period of data collection for both methods, from two days up to a week, may also produce a skewed dataset that does not account for seasonality or potential changes to travel patterns as a result of COVID-19. Both of these limitations may result in an analysis based on a data sample that is not reflective of the total vehicle trip population. Finally, because data can only be collected at 18 locations for each manual method, uncertainty would exist for the exact travel paths between the origins and destinations and certain routing detail assumptions would need to be made to conduct the analysis.

The benefits of LBS data with connected vehicle GPS data are the limitless geographic network coverage and high temporal coverage. This results in a sample that accounts for vehicle trips to and from lower volume rural locations and for variations in trip patterns that may be present from day to day, week to week, and month to month. Penetration rates for both methods are lower than rates obtained from manual field data collection methods, though the penetration rate is increased when using LBS and GPS data together. Finally, the provision of multiple waypoints per minute for both methods provides detailed data points on travel paths in between the origins and destinations.

Table 1: Evaluation of O-D Study Data Collection Methods

O-D Data Collection Method		Evaluation Metrics					Practical Application Considerations	
		Desired Geographic Coverage	Desired Temporal Coverage	Vehicle Count Penetration Rates (%)	Routing Details	Vehicle Type Classification	Cost	Schedule and Data Availability
Manual Field Data Collection	Bluetooth readers	18 point locations	One week	~15-25%	None	Unknown	$/location /hour	Scheduled dates only
	Automated license plate survey	18 point locations	9 hours (peak hours for two days)	~99%	None	Unknown	$/location /hour	Scheduled dates only
Probe Data	Connected vehicle GPS data only	Unlimited	4 months	~3-5%	Multiple waypoints per minute	Provided	$/month	2019 - present
	LBS data with connected vehicle GPS data	Unlimited	4 months	~7-15%	Multiple waypoints per minute	Provided	$/month	2019 - present

4.0 DATA ANALYTICS METHODS

Once the data have been collected, the preliminary setup and visualization of the data can occur through one of two options: (1) using a vendor-provided analytics platform, or (2) performing the preliminary data set up and visualization internally by the project team.

4.1 Vendor-Provided Analytics Platforms

Data gathered either from manual field data collection or from probe data can be stored, organized, and analyzed within vendor-provided analytics platforms. These platforms are web-based tools that eliminate the need to store and process large data files on personal computers, provide instant and automated visualizations and data summaries, and allow varied query capabilities based on geographic locations or other attributes of the data. Analytics platforms can automatically derive metrics such as travel times between origins and destinations, trip distances, and travel paths (if using probe data). Visualizations including tables, graphs, and maps can be quickly generated. Vendor-provided analytics platforms are particularly beneficial if using large probe datasets with many data columns that can be queried and analyzed.

While there are many analytics platforms to analyze and visualize traffic O-D data, some are more cost-prohibitive due to minimum subscription periods of up to a year. Some platforms are intended for agencies to use on a regular basis for many projects, as opposed to a single subscription for several months for a single study. A summary of analytics platforms is shown in Table 2.

Table 2: Vendor-Provided Analytics Platforms

Vendor Analytics Platform	Data Source	Platform Constraints	Approximate Cost	Website Link
Moonshadow Mobile DB4IoT	Probe or Manual Data	-	$4,500 + $950/mo[6]	http://db4iot.com/
SMATS iNode	Probe Data Only	-	$10,000 + $1,500/mo[7]	https://www.smatstraffic.com/inode-traffic-data-analytics/
Streetlight	Probe Data Only	Data not available for AK	$75,000+[8]	https://www.streetlightdata.com/
INRIX Trip Analytics	Probe Data Only	Requires 1 year minimum subscription	$100,000+ per year[9]	https://inrix.com/products/trip-analytics/

[6] *Email correspondence with Moonshadow staff,* August 19, 2021
[7] *Email correspondence with SMATS staff,* July 28, 2021
[8] *Email correspondence with Streetlight staff,* July 26, 2021
[9] *Email correspondence with INRIX staff, August 20, 2021*

4.2 Data Setup and Visualization Internally by Project Team

The second option is conducting the data setup and visualization internally by the project team. The data would be delivered as raw files from the vendor that contain attributes including vehicle location, the date and time the location was recorded, and a trip or vehicle identifier. The project team would use these data to geographically show and analyze travel paths, the number of trips on each travel path, and the time distribution of when travel paths occur. This would be achieved through a combination of database programs such as SQL Server or PostgreSQL, programming languages such as Python or R, geographic analysis software such as ArcGIS, and/or data visualization tools such as Power BI.

This approach requires the project team to allocate task hours to explore the structure of the dataset, perform quality control checks on the data, and develop and configure a project-specific analytics platform. This approach is expected to have a higher cost compared to using a vendor-provided platform, as the vendor platforms are pre-configured to run quality control checks in the background, automatically load in OD datasets, and create custom visualizations.

5.0 RECOMMENDATIONS

Given the findings and considerations for data collection methods, the project team recommends the use of a data collection method that combines LBS data with connected vehicle GPS data. This method has a substantially larger and more varied sample size due to the complete geographical coverage, high temporal coverage (4 months), and high penetration rate (7-15 percent), as well as provides routing details and vehicle type classification data.

For completion of the data analytics, the project team recommends the use of the Moonshadow DB4IoT analytics platform for data setup and visualization due to its ability to work seamlessly with the recommended connected vehicle GPS and LBS data and its overall cost-effectiveness. Using the DB4IoT platform is expected to increase the value and depth of the study due to analysis tools that can automatically create data visualizations and summaries consistent with those described subsequently in Section 6.0. If additional analysis is needed outside of the analytics platform, raw data can be exported and analyzed using other geospatial and analytics tools as mentioned in Section 4.2.

6.0 FORMAT OF THE RESULTS

The O-D study results will include high-level tabular, graphical, and/or geospatial summaries of vehicle trip sample sizes, trip distances, travel times, and temporal trends (i.e., trip trends by time of day, weekday, and/or month). The study will include an O-D matrix table showing the combinations of origins and destinations for vehicle trips and how many trips occurred for each combination. The results will also show a heat map geospatially displaying the O-D combinations with color scaling indicating the frequency of trips for each O-D combination. O-D matrices and heat maps will be generated for different times of day, weekday and weekend combinations, and months to show how travel patterns change temporally.

These results will be documented in an O-D study report, which will undergo both internal and agency reviews. This report will be used to inform the traffic forecasts, including estimates of the amount of traffic that would use an alternative corridor and its interchanges.

The signature below indicates concurrence with the methodology provided in this memorandum.

Kelly Summers 9/15/21

Kelly Summers, P.E.
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State of Alaska DOT&PF
Preliminary Design & Environmental

Date